THE SOURLAND MOUNTAIN WATERSHED PROTECTION PLAN


Rock Brook, 2007

Prepared For:

New Jersey Department of Environmental Protection 319 (h) Grant

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Executive Summary

One of the benefits of a regional Watershed Protection Plan is the ability to identify stream impacts and identify their potential upstream causes, regardless of their municipal jurisdiction. Based upon the field studies, modeling, and data analysis the Sourland Watershed Protection Plan identified that the conditions of the Sourland streams are some of the best in a rapidly developing central New Jersey. While, most of central New Jersey experienced exponential growth rates, the local Sourland Mountain communities initiated planning strategies since the 1980s to minimize the impacts from development and preserve the watersheds, forests and farms that they value and which characterize the Sourland Mountains and their communities. Because of this mindful and limited development the streams remain in good condition as described in the following paragraphs.

- Modestly undeveloped, intact riparian corridors exist in the *upper* segments of the Back Brook, Furmans Brook, Stony Brook, Beden Brook and Rock Brook watershed, with intact streambanks, good water quality and non-impaired biological communities. These headwaters support and maintain a diverse community of organisms with optimal habitat, good water quality, and good biological integrity, and should be protected and maintained to support these important ecological qualities.
- The headwaters of the Sourland Streams support state threatened species and vernal pools. In addition, the downstream portions of the Stony Brook support freshwater mussel, and these watersheds should be protected from measurable changes in water quality.
- The upper segments of Rock Brook and the *lower* segments of each of the Sourland streams including Back Brook, Furmans Brook, Stony Brook, and Beden Brook demonstrate degraded water quality by pathogens, reduced diversity of macroinvertebrate communities, degraded riparian corridors, slightly elevated nutrient levels, and segments of eroded streambanks. Except for Rock Brook, the detected concentrations of fecal coliform (pathogens) were slightly elevated above the NJ Standard of 200 MPN/100 ml.
- Water quality impairments occur from fecal coliform and slightly elevated nutrient levels occur in the watershed, and may be attributed to aging septic systems (>20 years) built in floodplain areas, and livestock management.
- Eroded streambanks are visible in the lower segments of the watershed streams which may have been caused by naturally erodible soils and steep slopes. Historic logging in the 1900s, more than a century of farming in the area, and limited stormwater controls for the villages of Ringoes and Hopewell Borough and from major roadways, are contributing to the erosion of streambanks.
- The field survey observations and pollutant loading analyses indicate that the majority of impacts are related to erosion, bank instability and sediment loading. The secondary effects attributable to reduced biological diversity and nutrient enrichment may also be related to sediment loadings.

- Residential areas maintain segments of riparian corridors as mowed lawn areas with limited shade trees, likely increasing water temperatures and eroding stream banks.
- Public awareness and sense of stewardship for the watershed streams and wildlife habitat can be improved.

The results of this Sourland Watershed Protection Plan identified various Best Management Practices (BMPs) for stormwater and land use practices within the Sourland Mountain watershed including measures to raise public awareness, improve water and land stewardship practices on private lands and farms, better septic management, and measures to protect and enhance critical habitats. These BMPs also include more detailed studies to evaluate the causes and impacts of stream bank erosion, the implementation of rain gardens at public lands, a wetland enhancement project at Amwell Lake and several stream restorations**.** The findings of this report should be presented to the public at a final public meeting. (Appendix A)

The implementation of these actions and success of this plan is greatly dependent upon the continue commitment the commitment and coordination of a variety of stakeholders including federal, state, county and municipal officials and agencies, environmental organizations and private land owners. Implementation will also be highly affected by the availability of funding, public access, consent or willingness to place lands in conservation easements, ecological benefits, and costs. A brief summary of the recommended BMPs and Watershed Protection Strategies are identified in order of priority in the Appendix A Tables and Figures. In addition, details of these strategies and stream restorations are presented in Appendix A Tables including the length, height or extent of the restoration to facilitate a review of the magnitude of the problem and cost estimates. The proposed stream bank restorations would improve the riparian buffers, aquatic habitat and reduce sediment loadings; however, the reduction of pathogens in the Sourland Watershed streams is best addressed by more rigorous septic education and management, livestock management and riparian corridor protections.

It should also be noted that based upon a review of the 1930's aerials of this watershed, significant acreage has been converted from farmland to forest cover, and approximately 39% of the watershed remains forested today. Specifically, the aerials for the Stony Brook and Rock Brook subwatershed appear much more forested today than 70 years ago. The eroded streambanks that are observed in the Sourland watershed today, may actually be a historic artifact caused by extensive logging and over a century of widespread farming. Riparian corridors were likely less vegetated in the past, than under the current forested land cover and with the current regulatory oversight.

Additional upgrades to the existing stormwater infrastructure and controls may be possible and should be evaluated by the township engineers to improve stormwater runoff quality. Upgrades may include modifying existing stormwater catch basins with the installation of water quality inlets or manufactured treatment devices, and street tree trenches to intercept street runoff. This should be considered for all public improvement projects, especially those undertaken by the County and NJDOT, since the existing stormwater controls are very limited.

1.0 INTRODUCTION / DESCRIPTION OF THE STUDY AREA

The Sourland Mountain is a unique and special natural feature spanning southern portions of Hunterdon and Somerset Counties and northwest Mercer County. The Sourland Mountain watershed area includes sensitive natural resources and provides critical habitats for a variety of species designated as threatened and endangered by the New Jersey Department of Environmental Protection (NJDEP), based on data provided by NJDEP in the Landscape Project database. (NJDEP, 2002 and the Sourland Regional Plan) However, the headwater streams and watershed lands in this region do not receive any special protections under existing NJDEP regulations. Specifically, they are designated as FW2-NT or Freshwater Non-Trout waters. In order to protect these streams and resources, the NJDEP agreed to fund the preparation of a Regional Stormwater Management Plan (RSWMP) for the Sourland Mountain watershed area. However, this report was later revised as the Sourland Watershed Protection Plan (SWPP). This plan will characterize and assess the conditions of these streams and to provide a comprehensive approach to maintain or enhance their water quality and to ensure their protection. This approach was also recommended in the NJDCA, Smart Growth Planning and Management Plan for the Sourland Mountain to create a voluntary municipal alliance modeled on the Ten Towns Great Swamp Watershed Management Committee approach. This model relies on municipal cooperation towards planning initiatives, regulations, public education, and land steward incentives.

The study area for the Sourland Watershed Protection Plan encompasses portions of the Townships of East Amwell, Hillsborough, Montgomery, West Amwell, Raritan, Hopewell and the Borough of Hopewell. This SWPP is focused on the first-order and second-order headwater streams that originate on the Sourland Mountain and drain to the Neshanic River, Stony Brook, and Millstone River, some of the most important streams and waterways of west-central New Jersey. Specifically this SWPP includes the subwatershed areas that drain to the Back Brook, Furmans Brook, Rock Brook, Beden Brook, and Stony Brook (Appendix B, Map 1). Based on the sensitivity and importance of the headwaters streams of the Sourland Mountain, the decision was made to focus this SWPP on the lands surrounding these streams (approximately 30,293 acres or 47.3 square miles), rather than the entire Sourland Mountain region. The northern boundary of the watershed was also extended to assess conditions of the headwaters of the Neshanic River that receive drainage from the Sourland Mountain ridgeline.

The Sourland WPP area spans both Watershed Management Area (WMA) 8 and WMA 10, and encompasses the hydrologic units (HUC14) including: 020301050300600, 2030105030050, 02030105110060, 02030105090010, 02030105090020 and 02030105110040.

With the exception of Amwell Lake, these streams are not designated as Special Water Resources and they have not been elevated to a Category 1, non-degradation status. In addition, the gradient of portions of these streams, as they transition from the Sourland Mountain ridgeline to the Amwell and Hopewell valleys, tends to be too steep to support a significant trout community, and limits the designation of significant floodplain areas associated with these streams. Furthermore, because portions of these streams are hydrologically intermittent (tend to be dry in the summer), they are not associated with extensive wetland areas. Therefore, the riparian areas are not afforded the protections of current NJ wetlands or floodplain regulations due to the lack of substantial riparian transitional areas located adjacent to the streams. In summary, these headwater streams are not afforded significant *state* regulatory protections related to water quality.

The headwater streams and waterbodies to which they drain show some evidence of both hydrologic and water quality stress and degradation, and it is clear that without proper management and protection these headwaters and streams are at peril. *Impacts include alteration of baseflow, scour and sedimentation, impaired water quality, endangerments to biota, and ecosystem degradation.* Jurisdiction over land use practices on these watershed lands rest with seven communities and three counties, precluding the consistent protection of these streams. The SWPP for the headwater streams will provide the opportunity for a comprehensive approach to prevent further degradation of these streams as well as the Neshanic River, and the lower reaches of the Stony Brook and Millstone River, to which they drain.

It is also important to note that based on the Build-Out Analysis conducted as part of the Characterization and Assessment Plan, approximately 17,440 acres in the Sourland Mountain watershed, or *58% of the total watershed area, are available for future development*. The remaining 12,660 acres were considered "not available for development," either because it is part of a permanently protected open space or farmland preservation parcel, or because steep slopes, wetlands or other unsuitable conditions preclude development.

1.1 Regional Importance of the Sourland Mountain Watersheds

The Sourlands study area contains approximately 11,000 acres of forest, 4,600 acres of wetlands and 8,700 acres of agricultural land (NJDEP, 2002). Groundwater recharge and the headwater streams in the Sourlands supply the Delaware & Raritan Canal, which provides water to about one million New Jersey residents. The Sourlands region's forests and wetlands are the largest contiguous habitat areas in central New Jersey and provide habitat to threatened and endangered animal species including the barred owl, bobcat, Cooper's hawk, grasshopper sparrow, savannah sparrow, and wood turtle. In addition, the Sourlands serves as a stopover area for neo-tropical migratory birds such as the scarlet tanagers that travel between South and Central America and the Arctic, as well as forest birds migrating between Washington, D.C., and Boston (NJDEP, 2004). (Map 2, Appendix B)

"The Sourlands are important to our water supply, and over 100 species of tropical migratory birds breed or nest there. Except for the Pine Barrens, this is the largest wilderness area between New York City and Philadelphia."
Bill Rawlyk, D&R Greenway Land Trust, December 2006.

Potential Benefits of Regional Planning, presented by Christopher Obropta, Rutgers University Cooperative Extension Service, 2006

- Allows more stringent regulations to be required of developers in environmentally sensitive areas;
- Focuses on flooding and water quality issues for the entire watershed and how each municipalities' actions impact other communities;
- Provides specific solutions to defined watershed problems;
- Promotes cooperation among the various entities to address water resource issues; and the
- Regional Stormwater Management Plans (RSWMP) can provide information that the municipalities can incorporate into the individual municipal SWMP, saving money

1.2 Sourland Watershed Protection Plan Committee and Project History

Municipalities are empowered to regulate land use activities that affect stormwater impacts by the authority of the NJ Stormwater regulations N.J.A.C. 7:8 and 7:14 (effective February 2004) and the municipal land use codes or ordinances. However, in the spring 2004, the NJDEP awarded a federal grant under the Clean Water Act Section 319h to East Amwell Township for the preparation of a Regional Stormwater Management Plan (RSWMP). Subchapter 3 of the stormwater rules describes the process and strategies for developing a regional stormwater management plan, including: plan elements; planning process; characterization; development of drainage area-specific objectives and standards; selection of stormwater management measures; strategy for implementing the measures and evaluating the effectiveness of the regional stormwater management plan; plan review, adoption, amendment or revision; and provisions for implementation and periodic evaluation of the plan (N.J.A.C. 7:8-3.1).

In February 2005, the NJDEP officially recognized the Sourland Mountain RSWMP Committee pursuant to the New Jersey stormwater regulations (N.J.A.C. 7:8-3.2), and the NJDEP approved East Amwell Township as the Lead Planning Agency of the RSWMP Committee, which was formed from local and regional watershed stakeholders. In August 2004, Letters of Invitation to participate on the project and committee were mailed to forty-nine (49) separate government offices, agencies and interested groups, and eleven offices/organizations have been actively participating in this project. The active partners include: the Townships of East Amwell, West Amwell, and Montgomery Township, the Counties of Hunterdon, Somerset and Mercer, the Sourland Planning Council, the Stony Brook-Millstone Watershed Association, the NJ Water Supply Authority, the Regional Planning Partnership, and the NJDEP. The local communities of Raritan, Hillsborough, Hopewell Township and Hopewell Borough, which are located within the study area did not actively participate in the project, but information has been sent to them throughout the process. A list of the participating organizations and their contact information is provided in Appendix C. On October 16, 2007, the NJDEP agreed to allow the RSWMP to be modified as the Sourland Watershed Protection Plan.

Sampling of the streams was conducted from the spring to the winter of 2005, and the Sourland Watershed Characterization and Assessment report was submitted to the NJDEP in March 2006 summarizing the results of the field work and pollutant modeling. In March 2007, the NJDEP approved the Sourland Characterization and Assessment Report and work resumed to identify potential pollutant sources and prepare recommendations for stream restorations and pollutant reduction measures that are outlined in this SWPP.

1.3 Authority of Regional Stormwater Management Plan (RSWMP)

In accordance with the stormwater regulations (N.J.A.C. 7:8-3.4 to 3.6) a Regional Stormwater Management Plan would assess the subwatershed study area and prepare drainage area specific objectives and performance standards for water quality, groundwater recharge and water quantity. The RSWMP would also select stormwater management measures and strategies for their implementation, identify schedules, responsible partners, cost estimates and methods to evaluate the effectiveness of the RSWMP strategies (N.J.A.C. 7:8-3.7 and 3.8). Once a RSWMP is approved by the NJDEP and adopted as an amendment to the area wide Water Quality Management Plan Rules (N.J.A.C. 7:15), the Department would rely upon the adopted RSWMP for reviewing stormwater management aspects of development projects or activities, in accordance with N.J.A.C. 7:8-3.9 and 3.10. Specifically, the Department would use the RSWMP for the stormwater review in the following programs: Coastal permitting, freshwater wetlands, CAFRA, stream encroachment, NJPDES, and Dam Safety. The Residential Site Improvement Standards (N.J.A.C. 5:21-7) also acknowledge that all future residential developments must conform to a RSWMP approved by the Department.

Guidance concerning the WQMP amendment procedure as it applies to a regional stormwater management plans is discussed in Section 9.0 and outline within N.J.A.C. 7:15-3.4 and 7:15-3.4(b)5i-iv. Upon approval by the NJDEP, each municipality within the regional stormwater management study area would be required to amend their stormwater management plans and ordinances to incorporate the applicable provisions from the RSWMP. In May 2007 the Department proposed amendments to the WQMP rules with recommendations that each County assume the role of WQMP Designated Planning Agency (DPA). This may require that three separate Water Quality Management Plans would need to be amended in order to adopt the a RSWMP for the Sourland communities. In addition, several local communities did not actively participate in the three year development of a RSWMP for the Sourland Mountain region, and therefore, it is unclear whether these communities would support or oppose its adoption.

However, on October 16, 2007, the NJDEP representatives approved the request from East Amwell Township, as the designated Lead Planning Agency (LPA), to modify the RSWMP to a Sourland Watershed Protection Plan. The main effects from this decision include:

- Recommendations and Design Performance Standards outlined in a RSWMP would have been legally mandatory, and would supersede the Municipal Stormwater Management Plans and Ordinances that have recently been adopted by the seven Sourland communities. It was determined that it would be difficult to gain consensus and obtain endorsements from seven municipalities and three counties for these legal mandates in a RSWMP. In addition it would be a very lengthy endeavor to complete the official adoption process that may have required the amendment of three County Water Quality Management Plans (WQMPs).

- A Watershed Protection Plan can be more comprehensive because the recommendations are voluntary measures that communities can consider implementing at their own pace.
- A Watershed Protection Plan can more readily address concerns from existing development, while a RSMWP would focus on new construction.
- Implementation of these recommendations and access to funding opportunities under a Watershed Protection Plan may be significantly quicker than through the protracted RSWMP adoption process.

1.4 Other Relevant Regulatory Programs

During the preparation of the Sourland Watershed Protection Plan, each municipality was required to also comply with the NJDEP stormwater regulations and develop and submit individual Municipal Stormwater Management Plans and Ordinances in accordance with N.J.A.C. 7:8. A discussion of the status of the municipal stormwater management planning efforts and their compliance with the NJ Stormwater Regulations is provided in section 7.0. In addition, the Department adopted or proposed significant changes to various regulatory programs in order to protect and enhance water resources. For example, the NJDEP proposed amendments to the *Water Quality Management Plans N.J.A.C. 7:15 and the Water Quality Standards for Category One stream designations NJAC 7:9B,, and adopted amendments to the Flood Hazard regulations N.J.A.C. 7:13.* These regulations and proposed amendments have been reviewed and incorporated as appropriate within the Sourland Watershed Protection Plan recommendations to address water resources concerns and better manage the Sourland subwatersheds.

In addition, each municipality within the regional study area has been actively involved in updating their Master Plans, ordinances and zoning amendments; pursued open space and farmland preservation; and has engaged in the efforts by the NJ Department of Community Affairs (DCA) and the Sourland Smart Growth Initiative – Phase I and II. Some of these plans and ordinances provide recommendations and strategies beyond the NJDEP stormwater basic requirements and guidance for best management practices. These actions have also been reviewed and incorporated as appropriate within the SWPP recommendations to address water resources concerns in the Sourland subwatersheds.

1.5 Data Sources

The project municipalities have an extensive GIS database that has been used in the past to support a wide array of planning and environmental initiatives, including the preparation of the municipal Environmental Resource Inventories (ERI), Municipal Stormwater Management Plans, and amendments to municipal Master Plans. The information presented and synthesized herein is largely based on information acquired through the review of the municipal databases; GIS data layers coverage and information obtained through the State, Somerset County, Mercer County and Hunterdon County; and other data sources and reference materials as noted herein. The information used to prepare this SWPP also reflects zoning, development and related planning information for each of the stakeholder municipalities; including up-to-date and RSWMPC-rectified land use and land cover data. In addition, water quality measurements and analyses and biological survey data were collected during the course of this SWPP. The site-specific stream and water quality data were further supplemented with data and information available through the US Geological Survey (USGS) (stream flow), NJDEP (threatened and endangered species and water quality), NJDEP's Ambient Biomonitoring Network (AMNET) and the Index of Biotic Integrity (IBI).

2.0 HYDRIC CYCLE AND STORMWATER DISCUSSION

Surface water, wetland and groundwater resources are all hydrologically linked, and the proper management of these resources requires a concerted, integrated approach. The Sourland Watershed Protection Plan Committee (SWPPC) recognizes the inter-connected nature of these resources and the importance of managing the overall ecosystems of the Sourland Mountain using, in part, a hydrology-defined approach to make recommendations for resource conservation, protection, mitigation and restoration.

Development and land disturbance has the capacity to significantly alter the properties of local ecosystems. From a hydrologic perspective, the most obvious impact is flooding and it's associated human consequences and impacts. From an ecological perspective, the most obvious impact is often degradation of water quality, and changes in the basic hydrology of the affected ecosystem, whether stream, pond, lake, wetland or riparian community. Even nominal changes in watershed development can alter regional hydrologic conditions and pollutant loadings. For example, Schueler (1987) reports that streams begin to display impairment with as little as 10% impervious cover. The challenge for this SWPP is identifying, managing or mitigating these impacts. In order to understand the value and benefits of watershed management planning, it is important to understand the relationship of the hydric cyclic and how land use practices can affect water quality and quantity, groundwater recharge, and stream health and integrity. The following information has been provided by the NJDEP to address these concerns.

2.1 Impacts to Water Quantity

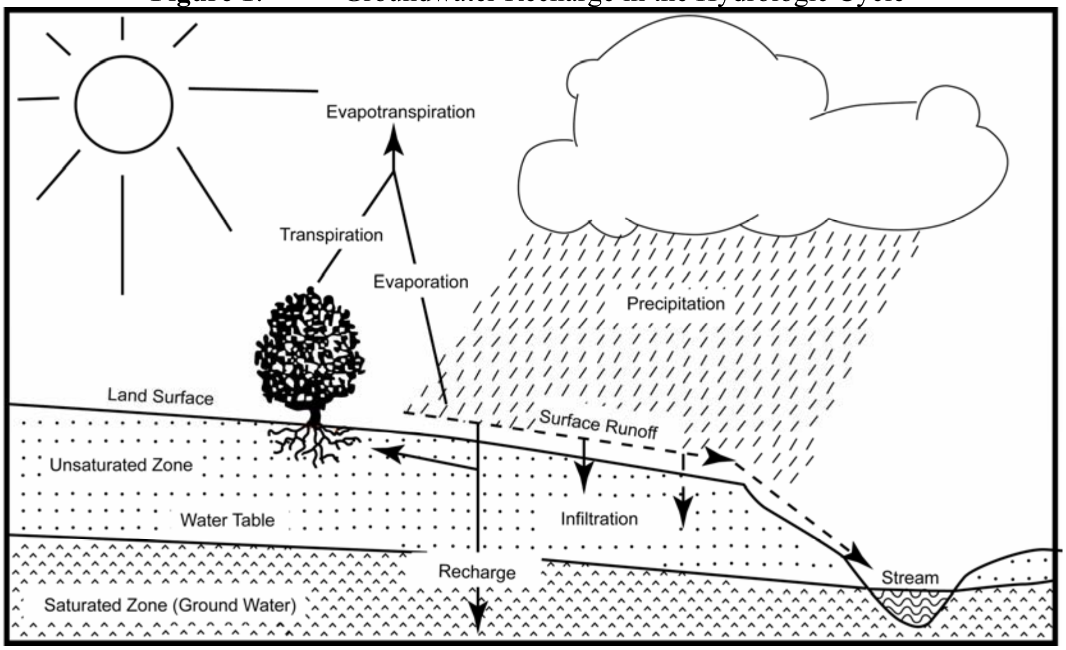
Land development can dramatically alter the hydrologic cycle of a site and, ultimately, an entire watershed (Figure 1). Lands that are undeveloped provide native vegetation that can either directly intercept precipitation or draw water that has infiltrated into the ground and return it to the atmosphere through evapo-transpiration. Development can remove this beneficial vegetation and replace it with lawn or other impervious cover, reducing the site's potential for evapo-transpiration and infiltration rates. Clearing and grading a site can remove depressions that store rainfall. Construction activities may also compact the soil and diminish its infiltration ability, resulting in increased volumes and rates of stormwater runoff from the site. Impervious areas such as rooftops, parking lots and roadways that are connected by gutters, channels, and storm sewers can transport runoff to streams more quickly than natural areas. This shortening of the transport or travel time quickens the rainfall-runoff response of the drainage area, causing flow in downstream waterways to peak faster and higher than natural conditions. These increases can create new and aggravate existing downstream flooding and erosion problems and increase the quantity of sediment in the channel. Filtration of runoff and removal of pollutants by surface and channel vegetation is eliminated by storm sewers that discharge runoff directly into a stream. Increases in impervious area also decrease opportunities for infiltration which, in turn, reduces stream base flow and groundwater recharge. Reduced groundwater base flows and increased runoff peak flows produce greater fluctuations between normal and storm flow rates, which can increase channel erosion. Reduced ground water base flows to streams can also negatively impact the hydrology of seeps, springs, wetlands and the health of biological communities that depend on these wetlands and streams. Finally, excessive erosion and sedimentation can destroy these aquatic habitats. (NJDEP, Municipal SWMP, 2005)

2.2 Impacts to Water Quality

In addition to increases in runoff peaks and volumes, and the loss of groundwater recharge, land development can also result in the accumulation of pollutants on the land surface that stormwater runoff can mobilize and transport to streams. New impervious surfaces and cleared areas created by development can accumulate a variety of pollutants from the atmosphere, fertilizers, animal wastes, and leakage and wear from vehicles. Pollutants can include bacteria or pathogens, nutrients, sediments, hydrocarbons, pesticides, and metals. This is referred to as Nonpoint source pollution (NPS), as it enters streams from a variety of sources. Nonpoint sources of pollution are responsible for many of the stream impairments listed by the NJDEP on the New Jersey Integrated Water Quality Monitoring and Assessment Report.

Nutrients and organic waste can lead to algal blooms and excessive plant growth which ultimately deplete oxygen supplies for fish and some other aquatic life. Sediment can fill lakes and streams and cover habitat for plants and animals, as well as clog fish gills and smother fish eggs. Metals and organic chemicals can contaminate fish and shellfish. (NJDEP, Municipal SWMP, 2005)

Figure 1: Groundwater Recharge in the Hydrologic Cycle



Source: New Jersey Geological Survey Report GSR-32.

2.3 Impacts to Wildlife and Habitats

Land development can also adversely affect water quality and stream biota in more subtle ways. For example, as development and impervious cover approach 10% of a subwatershed, the volume of stormwater increases and accelerates stormwater runoff flow which can adversely affect stream characteristics and aquatic ecosystems (Schueller, 1989). Increased runoff can erode stream bed and banks, increase the sediment load in the stream and ultimately bury the natural stream substrate. In addition, stormwater falling on impervious surfaces or stored in detention or retention basins can become heated and raise the temperature of the downstream waterway, adversely affecting cold water fish species such as trout. Development can remove trees along stream banks that normally provide shading, stabilization, and leaf litter that falls into streams and becomes food for the aquatic community. (NJDEP, Municipal SWMP, 2005)

2.4 Statewide Water Quality Key Findings:

Based on an ongoing comprehensive assessment of the State of New Jersey's waters, the 2006 NJDEP Integrated Report highlighted the key findings listed below. Based on this data, continued efforts and funding are needed to improve water recourses throughout the state (NJDEP, 2006).

- Approximately 25% of the State's HUC-14 subwatersheds could be fully assessed for all applicable designated uses (except fish consumption), and only ten percent (10%) of the assessed subwatersheds attained all applicable designated uses (i.e., full attainment).

- All freshwaters of the State are designated for drinking water supply use. Over 70% of assessed subwatersheds attained the drinking water supply use. (Note: this is not directly related to the safety of finished potable water supplies).
- Less than 20% of the State's waters attain the general aquatic life use; less than 20% of rivers and streams classified for trout production/trout maintenance attain this aquatic life use.
- Fish consumption advisories for mercury and PCBs resulted in the highest number of impairments. Wherever the fish consumption use was assessed, it was found to be non-attained.
- The Department has identified 688 (71%) HUC-14 subwatersheds and 161 (34%) lakes as impaired for one or more designated uses. The top five pollutants (mercury, pathogens, phosphorus, pH, and PCBs) are responsible for over 50% of the listings.
- Phosphorus caused the third most frequent number of impairments.
- Of all the 940 subwatersheds designated for primary contact recreational use, 18 % attained the use, 39% did not attain the use, and 43% were not assessed.

3.0 SOURLAND WATERSHED PROTECTION PLAN GOALS AND OBJECTIVES

A Regional Stormwater Management Plan is required under section N.J.A.C. 7:8-3.5, to identify "drainage area-specific water quality, groundwater recharge and water quantity objectives", and these goals and objectives were also incorporated into the Sourland Watershed Protection Plan. The SWPP is viewed primar*y* as a proactive means of protecting sensitive surface water resources and critical wildlife habitats, and the project's objectives reference quantifiable enhancements to the streams where the NJDEP has identified stream impairments and approved Total Maximum Daily Loads (TMDLs) to address these impairments. As such, the seven goals of the project are to:

1. Protect the encompassed headwater streams from improper farming and development activities.

2. Provide a concerted, uniform tool by which the affected municipal governments can protect and *manage* the headwater and 2nd order streams, their wetlands, riparian corridors and floodplains.

3. Provide protections from loss of baseflow, minimize stream damages caused by excessive peak flows, and promote stream recharge.

4. Restore riparian habitat along the corridors of the affected streams, especially those associated with the 2nd order streams that occur at the foot of the Sourland Mountains.

5. Enable the NJDEP to use the results of this project as a model for the protection of other headwater streams, not only in WMA 8 and 10, but elsewhere throughout the State.

6. Create defensible and watershed specific standards and performance measures for the headwater streams of Sourland Mountains, for later inclusion in Master Plan amendments, zoning and local land use regulations and initiatives.

7. Use the data generated through this effort and the resulting RSWMP to amend the Water Quality Management Plan (WQMP).

3.1 Sourland Drainage Area Specific Objectives for Water Quality, Quantity, and Recharge

The objectives for the SWPP include the nine objectives identified in the NJDEP guidance for municipal stormwater management plans, and additional items identified in local community plans and highlighted by the SWPP committee members. The objectives set forth in this Watershed Protection Plan are as follows:

1. **Reduce flood damage**, including damage to life, property, and natural resources such as streams and their riparian areas, floodplains, and the fragile ecosystem of the Sourland Mountain region and downstream waterways through maintenance of large contiguous tracts of forest.

2. **Minimize any increase in stormwater runoff from development**, by limiting impervious surfaces and by promoting infiltration and recharge on site, thus sustaining aquifer levels.

3. **Reduce sediment loading to streams and soil erosion from development** or construction projects through soil conservation and the conservation of natural vegetation and/ or the establishment of vegetation, particularly native species.

4. **Avoid exceeding the capacity of existing and proposed stormwater infrastructure**, such as culverts and bridges, other in-stream structures, by inhibiting increases in stormwater runoff volume and velocity and by avoiding flooding from development.

5. **Maintain groundwater recharge and baseflow to local streams by promoting groundwater infiltration** and natural vegetative cover, including the maintenance of large contiguous tracts of forest and woodland understory.

6. **Prevent an increase in nonpoint source pollution from land disturbance activities** associated with development by requiring conservation of land and natural vegetation through Low Impact Development, or conservation-based development design, including the maintenance of large, contiguous tracts of forest with an intact and diverse woodland understory and healthy, stable soils.

7. **Maintain the integrity of stream channels**, including headwaters, for their biological functions as well as for the transport of flows, through the protection and restoration of riparian areas for habitat along stream corridors, headwaters, wetlands, vernal pools, and lakes.

8. **Minimize pollutants in stormwater runoff and improve water quality from new and existing development and land uses; and maintain or improve water quality of the headwaters and waterbodies within the Sourland Watershed area.**
    a. To restore, enhance, and maintain the chemical, physical, and biological integrity of the waters of the State, to protect public health, to safeguard fish and aquatic life,
    b. To preserve and protect scenic and ecological values, to enhance the domestic, municipal, recreational, commercial, and other uses of water,
    c. To conserve the natural landscape for habitat, and to maintain large contiguous tracts of forest and their understory in order to reduce pollution to streams and their associated ecosystems.

9. **Protect public safety through the proper design, operation and maintenance of stormwater systems and outlets.**

10. **Provide for the proper long term management of the Sourland Mountain subwatersheds.**

11. **Improve the aesthetics of Sourland watershed area to restore, create or enhance recreational uses**

12. **Educate the public about watershed and non-point source pollution, and improved land stewardship practices.**

The intent of the SWPP is to more effectively reduce the influx of pollutants, control sedimentation, protect riparian corridors and habitats, promote recharge, and minimize stream channel erosion. These goals and objectives for the Sourland Watershed Protection Plan are consistent with the goals of stormwater management planning as outlined in N.J.A.C. 7:8-2.2 and 7:8-3.5. The objectives for the SWPP have also considered factors concerning environmental, social, and economic concerns for the Sourland Mountain watersheds. In addition, the application of N.J.A.C. 7:8-5, Design and Performance Standards for Stormwater Management Measures, have been consulted and used for guidance for the objectives for major developments. The SWPP will also be consistent with the past and current conservation and preservation efforts of the regional Sourland Mountain stakeholders to protect the surface and groundwater resources of the Sourland Mountain, preserve habitat for threatened and endangered species, better manage development within the watershed, prevent loss of baseflow and reduce stormwater pollutant loading, and preserve the rural and agricultural nature of the watershed.

4.0 NJDEP WATER RESOURCE DESIGNATIONS

4.1 Water Use Designations

The NJDEP has established a hierarchy of water use designations pursuant to the State Water Quality Standards (SWQS) NJAC 7:9B. In accordance with this hierarchy, streams are classified as providing such uses as drinking water, recreational, and or possibly trout production. The streams identified in the Sourland Watershed study area including Back Brook, Furmans Brook, Stony Brook, Rock Brook, and Beden Brook are all identified as Freshwater–Non-trout waters that provide recreational uses (FW2-NT). The designated uses for FW2 waters include:

1. Maintenance, migration and propagation of the natural and established aquatic biota;
2. Primary and secondary contact recreation (swimming and boating);
3. Industrial and agricultural water supply;
4. Public potable water supply after conventional filtration treatment; and
5. Any other reasonable uses.

Amwell Lake, located within the Stony Brook subwatershed, is designated as a freshwater Category One waterbody (C1), primarily because it is located and protected within the Amwell Wildlife Management Area, which is owned and managed by the State. The NJDEP defines Category One streams as:

> "those waters designated in the tables at N.J.A.C. 7:9B-1.15(c) through (h), for the purposes of implementing the anti-degradation policies set forth at N.J.A.C. 7:9B-1.5(d), for protection from measurable changes in water quality characteristics because of their clarity, color, scenic setting, other characteristics of aesthetic value, exceptional ecological significance, exceptional recreational significance, exceptional water supply significance or exceptional fisheries resource(s) (N.J.A.C. 7:9B-1.4). These waters may include, but are not limited to:
>
> 1. Waters originating wholly within Federal, interstate, State, county or municipal parks, forests, fish and wildlife lands, and other special holdings that have not been designated FW1 at N.J.A.C. 7:9B-1.15(h) Table 6;
> 2. Waters classified at N.J.A.C. 7:9B-1.15(c) through (g) as FW2 trout production waters and their tributaries;
> 3. Surface waters classified in this subchapter as FW2 trout maintenance or FW2 non-trout that are upstream of waters classified in this subchapter as FW2 trout production;
> 4. Shellfish waters of exceptional resource value; or
> 5. Other waters and their tributaries that flow through, or border Federal, State, county or municipal parks, forests, fish and wildlife lands, and other special holdings."

4.2 Water Quality Designations

The NJDEP also has established a hierarchy of water quality designations based on whether the streams are attaining the appropriate State Water Quality Standards (SWQS) (N.J.A.C. 7:9B1.14). In accordance with this hierarchy, streams can be classified as impaired or non-impaired, based on the biological diversity of the macro-invertebrates (insects and crustaceans) documented in the streams. In addition, streams can be classified as attaining or not attaining the specified State Water Quality Standards based on sampling and chemical analysis. If the NJDEP has determined that certain stream segments routinely or chronically do not attain certain State Water Quality Standards, the NJDEP establishes a Total Maximum Daily Load (TMDL) pursuant to N.J.A.C. 7:15 for these stream segments, which sets goals to reduce the particular pollutant.

The USEPA defines a Total Maximum Daily Load as is the amount of a particular pollutant that a particular stream, lake, estuary or other waterbody can 'handle' without violating state water quality standards. Once a TMDL is established, responsibility for reducing pollution among both point sources (pipes) and diffuse sources is assigned. Diffuse "sources" include, but are not limited to run-off (urban, agricultural, forestry, etc.), leaking underground storage tanks, unconfined aquifers, septic systems, stream channel alteration, and damage to a riparian area.

4.3 Stream Designations in the Sourland Watershed

The Sourland Mountain Watershed is divided into seven subwatersheds which are depicted on Map 3, Appendix B along with the "blueline" streams mapped by the USGS. The *only* stream in the Sourland Watershed *not* listed as impaired for either the NJDEP biological or chemical criteria is Furmans Brook. However, this stream segment may not have been sampled by the NJDEP. Three streams in the Sourland Watershed are designated on the NJDEP Sublist 5 list of Impaired Waterways (Clean Water Act, Section 303(d)) for impairments to aquatic life including Back Brook, Bedens Brook and segments of Stony Brook. Therefore, the SWPP objectives address measures to reduce impairments to aquatic life. Rock Brook is designated by the NJDEP on the Sublist 4A list of Impaired Waterways for not attaining the NJDEP Standard for pathogens (fecal coliform or E coli bacteria), and the NJDEP has established a Total Maximum Daily Load to reduce pathogens by 97% in Rock Brook (NJDEP, 2006). (Map 4, Appendix B)

In segments of water bodies downstream from the Sourland Watershed area the NJDEP also established TMDLs to reduce pollutants. The NJDEP has established a TMDL to reduce pathogens in Bedens Brook, Stony Brook, the Neshanic River and Millstone River. The lower segments of Stony Brook also have a TMDL for reducing Total Suspended Solids (TSS), and TMDLs have also been established to reduce phosphorus in the Neshanic River, Bedens Brook, Stony Brook and Millstone River. Because the Sourland headwaters can impact these downstream water bodies, reducing pathogens, phosphorous and sediment are important objectives of the Sourland Watershed Protection Plan (NJDEP, 2006). Table 1 provides a description of the status of the water quality designations in the study area, based on the 2004 and 2006 NJ Integrated Water Quality Monitoring and Assessment Reports (NJDEP, 2004, 2006). http://www.state.nj.us/dep/watershedmgt/tmdl.htm and http://www.state.nj.us/dep/wms/bwqsa/

Downstream portions of the Stony Brook are also included on the NJDEP 2006 303(d) list of impaired waters related to arsenic, mercury, pH, and temperature and total suspended solids. As such, the SWPP drainage area objectives generally address the reduction of all non-point source pollutants that threaten and impair the water quality of the watershed (NJDEP 2006). In order to evaluate and characterize pathogen loadings in waterbodies and thus propose proper management responses, the NJDEP recommends that source assessments are warranted**.** Source assessments include identifying the types of sources and their relative contributions to pathogen loadings; identifying potential seasonal changes; and identifying or targeting the potential contributing locations. This is discussed in more detail in SWPP recommendations, section 8.0 and 9.0.

Table 1. NJDEP Reported Surface Water Quality Impairments in the Sourland Mountain Watershed.*

Headwaters Stream Assessment ID	Drains to	Identified Impairments <u>Within Study Area</u> (NJDEP, 2006)	Identified Impairments <u>Downstream from Study</u> Area (NJDEP, 2006)
Back Brook 02030105030050-01	Neshanic River	Aquatic Life Pollutant unknown – low priority (at Rt. 609 in East Amwell)	Neshanic River Pathogens – TMDL Phosphorous – TMDL High priority Aquatic Life Pollutant unknown – low priority
Furmans Brook	Neshanic River	None	Neshanic River See notes above
Bedens Brook Above Province Line Rd 02030105110040-01	Millstone River	Aquatic Life Pollutant unknown – low priority	Phosphorus – high priority, Arsenic – med priority, Lead (Beden Brook near Rocky Hill)
Rock Brook (and Cat Tail Brook) Above Camp Meeting Rd 02030105110060-01	Beden Brook and Millstone River	Pathogens- TMDL High Priority	Millstone River Pathogens- TMDL high priority Temperature, pH, Phosphorous – high priority, Arsenic – med priority, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Selenium, Zinc
Stony Brook 02030105090010-01	Stony Brook and Millstone River	Aquatic Life Pollutant unknown – low priority (at Stony Brook Road)	Pathogen – TMDL Aquatic Life Pollutant unknown – low priority Mercury, Arsenic, Cadmium (at Stony Brook Rd and Mine Road in Hopewell)
			Pathogen, Phosphorous, TSS – TMDLs Aquatic Life Mercury, Arsenic, Cadmium, (at Princeton)

5.0 FINDINGS OF THE CHARACTERIZATION AND ASSESSMENT OF THE SOURLAND SUBWATERSHEDS

In March 2007, the NJDEP approved the Characterization and Assessment Report submitted on behalf of the Sourland Watershed Protection Plan. Excerpts are summarized here to briefly describe the watershed in relation to the SWPP recommendations. The Characterization and Assessment Report should be reviewed in order to fully appreciate details of watershed's demographics, land use, wetland and groundwater resources, critical wildlife habitats, water quality details, and potential stormwater pollutant loadings.

The signature aspect of the Sourland Watershed is its composition by various headwater streams. Headwater streams are classified by the USGS as a first order stream if they do not have tributaries and normally originate from springs and/or seeps. Second order stream begin at the confluence of two first order streams, and so on. First and second order streams, account for most of the total stream miles within any watershed and cumulatively provide much of the habitat for aquatic organisms. Ephemeral or intermittent headwater streams may not be included on the USGS maps, but are identified on the County Soil Survey maps. Intermittent and small perennial streams play an important role in spawning and nursery habitat by fish, and in transporting invertebrates, detritus, and other organic matter that fuel downstream food webs.
http://www.streamcontinuity.org/ecological_concerns/import_sm_streams/index.htm

5.1 Demographics of the Sourland Watershed

The SWPP area boundary encompasses portions or all of seven municipalities in three counties: East Amwell Township, Hillsborough Township, Hopewell Township, Hopewell Borough, Montgomery Township, Raritan Township and West Amwell Township. The majority of the watershed area (approximately 14,057 acres or 46%) lies within East Amwell Township. Another significant portion of the SWPP area (8,878 acres or 29% of the total watershed) lies within Hopewell Township. Raritan Township comprises the smallest portion (less than 1%) of the watershed, with just 3 acres within the SWPP area boundary. Table 2 describes the breakdown of the Sourland Mountain Watershed by municipality.

Table 2. Municipality Acreage Within the Sourland Watershed.

Municipality	County	Acres within the Sourland Mountain Watershed	Percentage of total watershed area
East Amwell Township	Hunterdon	14,0567	46.4%
Hopewell Township	Mercer	8,876.4	29.3%
Hillsborough Township	Somerset	2,607.3	8.6%
Montgomery Township	Somerset	2,423.9	8.0%

West Amwell Township	Hunterdon	1,874.5	6.2%
Hopewell Borough	Mercer	449.1	1.5%
Raritan Township	Hunterdon	3.2	0.01%
TOTAL WATERSHED	**--**	**30,291.4**	**100%**

As noted in the Characterization and Assessment Report each of the Sourland Mountain Watershed's seven municipalities has experienced significant growth over the past decade. Montgomery Township, which comprises only 8% of the study area has undergone the most dramatic rise in population of any of the watershed municipalities, with an increase of 12,675 residents—132% between 1990 and 2004. Hopewell Township's population increased by 5,992 residents or 52%, during the same time period, and Hopewell Township comprises 29% of the study area. However, East Amwell Township which comprises 46% of the watershed grew by only 5% since 1990, with an increase of 232 persons (US Census Bureau, 2004). Although these population estimates reflect the total population of each municipality, rather than the population within the SWPP area, the numbers illustrate the powerful development pressures that continue to be felt throughout this region. They also underscore the urgency of mitigating the associated water quality impacts on the watershed's sensitive water resources.

To address the development pressures and to help preserve local natural resources, the Sourland communities have updated their Master Plans, conducted Environmental Resource Inventories, adopted various environmental ordinances, adopted low density zoning, and are currently beginning Phase II of the Sourland Regional Planning Initiative under a Smart Growth Grant from the NJ Department of Community Affairs (DCA).

5.2 Land Use and Land Cover (LU/LC)

The New Jersey Development and Redevelopment Plan (the State Plan) designates the Sourland watershed as predominately environmentally sensitive areas, where critical habitats exist, infrastructure is limited, riparian areas are generally intact, and future low density development is envisioned. (Map 5, Attachment A) Despite continued development pressures, the Sourland Mountain Watershed remains largely undeveloped, with large swaths of forest and working farmland. An analysis of the NJDEP Land Use/Land Cover (LU/LC) data from 2002 in comparison to the 1995/97 data for the watershed reveals minor changes in land use in this watershed area. In 2002 farmland and forest remain the dominant land covers for approximately 68% of the watershed, including 29% agriculture and 39% forest. Residential and commercial development grew slowly from approximately 14.5% to 15.7%. Wetlands also comprise a large portion of the watershed, with 15.3% of the total watershed area. Barren land and water comprise the remaining 1% of the region. The largest land use change since 1995 was the development of approximately 400 acres of farmland into residential properties, throughout the entire watershed.

Table 3A: Sourlands Land Use Land Cover, NJDEP 2002 Data		
LU/LC	Acreage	Percentage
AGRICULTURE	8,794.5025	29.03%
BARREN LAND	201.4211	0.66%
FOREST	11,761.4430	38.83%
URBAN	4,771.3657	15.75%
WATER	127.0045	0.42%
WETLANDS	4,636.9418	15.31%

Table 3B: Sourlands Land Use Land Cover, NJDEP 1995/97 Data		
LU/LC	Acreage	Percentage
AGRICULTURE	9,244.1690	30.52%
BARREN LAND	44.5179	0.15%
FOREST	11,812.3813	38.99%
URBAN	4,403.0010	14.53%
WATER	116.5638	0.38%
WETLANDS	4,672.0456	15.42%

Table 3C: Sourlands Land Use Land Cover, Change 1995 - 2002		
LU/LC	Acreage	Percentage
AGRICULTURE	-449.6665	-1.48%
BARREN LAND	156.9032	0.52%
FOREST	-50.9383	-0.17%
URBAN	368.3647	1.22%
WATER	10.4407	0.03%
WETLANDS	-35.1038	-0.12%

The zoning recently enacted by the local municipalities requires large lots, characterized as low-density residential uses, ranging from 5, 10, to 15 acres per dwelling unit, with limited commercial zones along Route 31, 179, and 202. Medium-density residential development with a commercial/ business district exist within both the Village of Ringoes and Hopewell Borough, and overall the impervious cover within the watershed is minimal. A generalized zoning map was created for area-wide characterization purposes only, and recognizes that within the areas designated as low-density residential, the allowable development intensity may vary. For example, within East Amwell Township, minimum lot size in the Amwell Valley Agricultural District is 10 acres, but existing residential units on smaller 1-3 acre parcels are also located within the study area. In summary, the conversion from farm and forest to residential land use is the most significant land use change that can occur within the RSWMP area. These land use changes affect total disturbance, impervious cover, and pollutant loading analysis. In addition, the potential development can disturb and fragment critical habitat areas. The land use cover data and aerial mapping identified that the majority of this watershed has intact forested riparian corridors or farmed corridors. (Map 5, Appendix B) Based on the existing land use regulations and a build out analysis, approximately 58% of the study area can be developed, and this can potentially impact pollutant loadings. This is discussed in more detail in section 6.0.

5.3 Preserved and Protected Lands

Open Space may be defined as any parcel of land or water that is essentially unimproved and set aside, dedicated, designated or reserved for public or private use. Preserved open space protects water supply and water quality, preserves sensitive habitats for endangered and threatened species, and minimizes or mitigates the effects of suburban sprawl. Farmland preservation goals are similar to other open space preservation efforts which seek to limit development, preserve scenic views, promote agricultural land uses, maintain hydrologic functions and preserve specialized ecosystem habitats. Preserving open space in the Sourland Mountain region is also among the top priorities in the NJDEP office of Green Acres. From 2000 until 2005, the Green Acres Program has protected over 2,000 acres in the Sourlands region. The Green Acres Program also provided funding to local municipal and land trust partners to protect over 6,000 acres in the Sourlands.

Each of the municipalities and counties in the Sourland Mountain region has been actively involved in the acquisition and preservation of open space and the preservation of farmland. Each has used funding available through local open space taxes, NJ Green Acres and Farmland Preservation grants; environmental, conservation and drainage easements obtained through development approvals; environmental buffer ordinances; and regulatory requirements. An overview of the open space lands designated as either Public Open Space or Preserved Farmland within the project boundaries is provided on Map 6, Appendix B. A review of that map demonstrates that much of the preserved land is in the agricultural valley sections of the study area, with a few sizable tracts within the forested ridgeline, including the 273-acre Hunterdon County Sourland Mountain Preserve.

The Delaware & Raritan Greenway Land Trust has worked with municipalities and private owners on preserving lands within this study area, and as of December 2006, the D&R Greenway has helped preserved close to 4,000 acres in the Sourlands. D&R Greenway Land Trust maintains two preserves within the Sourland greenway: the Northern Stony Brook Preserve and Cedar Ridge, with a concept for a 20-mile greenway trail traversing the Sourland ridge. (www.njtrails.org).

5.4 Geology and Soils

The unique hydrologic properties of the Sourland Mountain are detailed in the report prepared by Mulhall and Demicco in 2004 as part of the Sourland Smart Growth Project. The major geologic units of the Sourland Mountain region consists of the Stockton Formation, the Lockatong Formation, the Passaic Formation (and its subunit the Passaic Formation gray bed), and diabase. Of these, the diabase is of particular interest, as these dense and weathered resistant rocks occur most commonly on the highest topographic features within the Sourland Mountain region. This rock tends to have low porosity for transmitting water, and groundwater storage and transmission are largely dependent on the existence of faults, joints or changes in bedding planes (Mulhall and Demicco, 2004).

Only 3.1 percent of the soils within the Sourland Mountain region are mapped as having slight to few operational limitations for septic systems. Approximately 32.5 percent of the soils are mapped as having moderate limitations and an additional 64.4 percent would likely have severe limitations for septic system operations. These moderate and/or severe limitations for septic suitability are typically associated with shallow depths to groundwater, bedrock or shallow water tables and are depicted on Map 7, Appendix B (Mulhall and Demicco, 2004).

The soils that predominate along the side slopes the Sourland Mountain include Neshaminy and Mount Lucas soil series. The Mount Lucas soils have a very shallow depth to seasonal high water (0.5 to 2.5 ft), with severe restrictions for the construction and operation of on-site wastewater systems, moderate restrictions for the excavation of basements, and moderate erosion potential (Jablonski, 1988). The Neshaminy soils tend to be clustered along the East Amwell/Montgomery Township borders, have very severe to moderately severe erosion potential, severe restrictions for the construction and operation of on-site wastewater systems, and moderate restrictions for the excavation of basements. The predominant soils occurring along the transition area from the ridgeline to the valley areas are the Chalfont soils, which are also characterized by very shallow depth to groundwater (0.5 to 1.5 ft), severe septic restrictions and severe restrictions relative to the construction of basements (Jablonski, 1988). However, these soils have only a slight erosion potential. The depth to bedrock for these soils tends to be at least 3.5 feet. (Hunterdon County Soil Survey) (Map 8, Appendix B)

Approximately 0.1 percent of the region is underlain by soils with low surface water runoff rates and high infiltration rates, and therefore, have an A hydrologic soil group code. Soils beneath approximately 16.9 percent of the region have moderate infiltration and surface-water runoff rates, and therefore, have a B hydrologic soil group code. However, soils beneath approximately 83 percent of the region have low to very low infiltration rates and high to very high surface-water runoff rates, and therefore, have C and D hydrologic soil group codes (Mulhall and Demicco, 2004). The natural soil characteristics and geology limit the ability to infiltrate stormwater in this region.

5.5 Groundwater Recharge and Stream Hydrology

The Mulhall and Demicco report recognizes the relationship between groundwater and surface water. The report explains that in the Sourland region, land alterations, disturbances, and development has the potential to directly impact stream flow especially during dry periods when the majority of stream flow originates from groundwater. Thus, any impact that depletes groundwater depletes stream baseflow. The Mulhall and Demicco report estimated recharge rates associated with the various formations. The study shows that the Passaic/Stockton formations have normal recharge and drought recharge rates of 8.2 inches/year and 5.5 inches/year, respectively. In contrast, the Lockatong formation along with the diabase and hornfels, have normal and drought recharge rates of 3.15 and 2.1 inches/year. This data highlights the sensitivity of the Sourland Mountain to factors that impact stormwater infiltration, groundwater recharge, transitivity, and nitrate dilution in groundwater (Mulhall and Demicco, 2004).

Groundwater recharge information prepared by NJDEP and the New Jersey Geological Survey (NJGS) is presented on Map 9, Appendix B. The recharge mapping was computed using the NJ Geological Survey Report (GSR-32), which represents the anticipated recharge (inches per year), based on the permeability rates of prevailing soils, with adjustments for slope. The groundwater recharge map shows that areas of highest recharge occur along the ridgeline of the Sourland Mountain. The least amount of recharge is predicted along the slope areas extending from the ridgeline into the valley areas. The soils and areas most conducive to the infiltration of rainwater exist below the Sourland Ridgeline, providing for infiltration of 9-11 inches per year. Within the Sourland watershed, the shallow depth to the bedrock and steep slopes cause the majority of the annual precipitation of 47.5 inches of rainwater to runoff to streams. These conditions result in flashy storm surges, and limited infiltration of rain to recharge groundwater supplies and baseflow for streams. With the limited availability of baseflow, these headwater streams are prone to be dry during the summer months.

The GSR-32 recharge data reflects areas where the lateral movement of groundwater from soil storage reservoirs, into streams and wetlands is likely to be maximal. As such, it is possible that an area designated as having high soil recharge capability can at the same time have poor well yields. It is well recognized that potable well water yields on the Sourland Mountain tend to be very low, due to the prevailing geology and the presence of argillite and diabase formations that have very poor water storage and water yield characteristics.

5.5.1 Hydrologic Modeling Results

Details of the Hydrologic Modeling results, prepared by Princeton Hydro, were reported in the Characterization and Assessment and indicate that:

- Based on 30 years of climate data, the total precipitation on the Sourland Mountain study area is 148,000,000 cubic meters.

- The Rational Method calculations indicate that up to 119,000,000 cubic meters of total precipitation are discharged as surface runoff or 80% of the total precipitation.
- Groundwater recharge was estimated using the GSR-32 model at approximately 28,000,000 cubic meters or 18.9%.
- The Posten Method was used to calculate groundwater baseflow to streams, and estimated a total interflow of 35,000,000 cubic meters. The result is greater than groundwater recharge, which may indicate poor aquifer recharge throughout the region.

The TOPMODEL program was initially proposed to calculate overland and subsurface flow components and estimate depth to water table in the watershed. However, this model was not completed because substantial data is available from the Mulhall and Demicco reports.

Limited stream flow data was evaluated from the US Geological Service (USGS) gauge installed on a tributary to Back Brook, near the intersection of Wertsville Road and Rocktown Road. Based on a decade of data from 1977 to 1988, stream flow in Back Brook can vary from 8-9 cubic feet per second (cfs) in the winter months, to 6 cfs in the spring, to less than 4 cfs in the winter, and less than 2 cfs in the summer. Stream flow in June is typically the lowest month with a mean monthly average flow of 0.96 cubic feet per second, indicting the stream has dry conditions in the summer months.

Table 4: USGS Stream Flow Back Brook 01398045– Mean Monthly Discharge cfs (Calculated on data from 1977 to 1988)											
Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
8.2	9.9	6.5	6.1	3.8	0.96	2.0	1.6	2.4	2.4	3.6	5.2

5.6 Floodplains and Stormwater Infrastructure

The majority of the land use in the watershed is forest and farming with some large lot residential development, and there is limited stormwater management infrastructure in watershed. A few stormwater basins are associated with more recent commercial developments. The watershed is crossed by Highway 202, Routes 31, 179 and 518, and runoff from these highways is generally directed by drainage ditches and swales and piped outfalls to the streams, without any detention or retention. GPS mapping of stormwater outfalls is currently underway in all seven communities, and use of the NJDEP outfall reporting form would be beneficial to highlight concerns with aging infrastructure, erosion sites and potential illicit discharges to the stormwater sewer lines. http://www.state.nj.us/dep/stormwater/

Localized flooding occurs infrequently after major storm events, and flooding primarily affects the downstream segments of the watershed streams, as reported by local county and municipal officials. Major storm events such as Hurricane Floyd in 1999, a 100-year plus storm, caused the Neshanic River and Back Brook to over flow their banks, and forced evacuations of several homes along Welisewitz Road for several days. Floodwaters occasionally inundate roadways including sections of Wertsville Road, and the intersection of Manners Road and Welisewitz Road, Aunt Molly Road and Hollow Road. These flood events can cause high stream flow velocities, stream bank and stream bottom scouring sedimentation of the stream and erosion which is evident on Back Brook, Furmans Brook, Beden Brook and Rock Brook. Streams and floodplains need to operate as a connected system in order to relieve the erosive force of flood discharges by reducing the velocity of the water. But in certain stream segments the 4 foot high streambanks limits flow access to the floodplains, and results in additional erosion. Additional information on stream bank erosion sites is discussed in section 9.0 and in Appendix A.

The lower segments of Back Brook, Stony Brook, Beden Brook and Rock Brook are mapped as 100 year floodplains, in accordance with the 1981 Federal Emergency Management Agency (FEMA) National Flood Insurance Program Q3 Flood Data, which are depicted on Map 10, Appendix B. Fortunately much of the floodplains include intact forests or farmlands, with limited homes affected by flooding. Montgomery Township also undertook measures to remap the 100 year floodplain boundaries in the lowland areas of their Township.

Flooding and bank full flows can also have ecological benefits, when these events scour out pools, clean coarser substrates (gravel, cobbles, and boulders) of fine sediment, and redistribute or introduce woody debris. Aquatic ecosystems can benefit from occasional flooding events and minor changes to their physical structure such as trees fallen into the channel, roots extending into the flow, pools and riffles, overhanging vegetation, and a variety of bottom materials. This complexity enhances habitat for organisms and also restores hydrologic properties.

Another important consideration regarding water quality is the location of older homes and septic systems within the designated floodplain areas. The septic systems located within the floodplains are generally subject to shallow water tables, and become inundated during flooding events. These older septic systems are likely significant sources of pathogen contamination throughout the watershed, but especially along Back Brook, Rock Brook and Stony Brook.

5.7 Critical Environmental Areas

5.7.1 Steep Slopes

Much of this farming region is characterized by the “rolling hill” topography, with steeper grades in the forested areas. As illustrated on Map 11, Appendix B, the steepest lands within the study area occur along the transition areas immediately north and south of the Sourland Mountain ridgeline with some slopes greater than 25% along Rock Brook and Beden Brook. Limited areas of slopes greater than 15% also exist along Back Brook and Furmans brook, and Stony Brook. In some cases, streams flow through these steep slope areas, resulting in significantly eroded stream banks, such as segments on Rock Brook. The Water Quality Management Plan (WQMP) rules proposed by NJDEP in May 2007 suggest that development should be restricted on slopes greater than 20%. Generally, the communities in the watershed have adopted ordinances that restrict development from slopes varying from 15 to 20%.

5.7.2 Wetlands

The NJDEP GIS mapping identified that 15.3% of the study area are comprised of wetlands, located mainly along the Sourland Mountain ridgeline and along the Stony Brook and Beden Brook (Map 12, Appendix B). Also notable is the scarcity of mapped wetlands located along Back Brook and Rock Brook. In accordance with the NJDEP land use cover data the watershed has lost a modest 35 acres of wetland since 1995 (Table 3C). Vernal pools, which are critical springtime breeding pools for frogs and salamanders are also depicted on the map. It is likely that additional undocumented vernal pools exist within the forested areas of the watershed and further investigation and data collection is needed to verify their presence.

The NJDEP wetland regulations restrict disturbances to wetlands and 50 foot transition area or buffer. However, if rare, threatened and endangered species are present, the NJDEP can designate the wetlands as an "exceptional resource value" and increase the buffer to 150 feet. Much of the Sourlands forested areas provide habitat for threatened and endangered species and wetlands in these areas are likely to be designated by NJDEP as "exceptional". In addition to these state regulations, Montgomery Township has enacted a critical areas ordinance that restricts the construction of septic systems within wetlands and their transition buffers.

Certified vernal pool habitats are also protected by a 50 foot buffer under the Freshwater Wetlands Rules(N.J.A.C. 7:7A unless threatened and endangered (T&E) species are identified, then the Wetland Rules classify these as "exceptional wetlands" and provide for a 150-foot transition area. To be protected these vernal pools must be identified and certified by the NJDEP.

In November 2007, the New Jersey Highlands Water Protection and Planning Council (Highlands Council) determined that these protective areas do not provide adequate habitat protection for species dependent upon ephemeral vernal pools. Based on studies conducted by Semlitsch (1998), Semlitsch and Bodie (2003), the Metropolitan Conservation Alliance (Calhoun and Klemens, 2002), and literature review, the Highlands Council has proposed to restrict disturbance within 1,000 feet of certified Vernal Pools. These studies identified that the terrestrial habitat of amphibians and frogs can extend beyond 1,000 feet from their breeding vernal pool, and that significant declines in populations have been documented when disturbances occur within 500 feet of the vernal pool habitats. This recommendation is outlined in the Highland Regional Master Plan and would apply to major development projects within the Highland region that disturb an acre of land or increase impervious cover by a quarter acre.

The NJDEP Division of Fish & Wildlife defines "Endangered Species" as "those whose prospects for survival in NJ are in immediate danger because of a loss or change in habitat, over-exploitation, predation, competition, disease, disturbance or contamination." Assistance is needed to prevent future extinction in the state. "Threatened Species" are "those who may become endangered if conditions surrounding them begin to or continue to deteriorate." The term "Species of Special Concern" applies to those that "warrant special attention because of some evidence of decline, inherent vulnerability to environmental deterioration, or habitat modification that would result in their becoming a Threatened species. See www.nj.gov/dep/fgw/spclspp.htm. "Priority species" are non-game wildlife considered by NJDEP to be species of special concern as determined by a panel of experts (Niles et al., 2004).

5.8 Landscape Project Mapping (Threatened & Endangered Habitat)

The East Amwell Township Natural Resource Inventory describes the Sourland Watershed as having a very rich diversity of plants and animals, including sixteen plant species that are either endangered or of "special concern" in New Jersey. The area provides important "stopover" habitat for migrating birds. The presence of wetlands and vernal pools also provides important breeding habitats for various reptiles and amphibians, such as wood frogs and salamanders (East Amwell Township NRI, 2004).

The NJDEP Natural Heritage Program documents the state's most significant natural areas through a comprehensive inventory of rare plant and animal species and representative natural communities, and these ecological communities and habitats are mapped under the GIS program known as the Landscape Project. Specifically, the Natural Heritage Database compiles information on the distribution, biology, status, and preservation needs of identified species and communities, and this data is presented in Table 5. The Landscape Project has identified the vast majority of the Sourland Mountain Watershed—almost 99% (a total of approximately 29,872 acres) as critical wildlife habitat, with over 90% of the area providing documented habitat for species identified by NJDEP as either threatened or endangered species. The majority of this area, approximately 15,488 acres, is critical forested habitat, which may support state threatened species such as wood turtle, Cooper's hawk, and barred owls. The Landscape Project has identified areas of wood turtle habitat as concentrated in two major patches in the central and southeastern parts of the study area in East Amwell Township and Hopewell Township, respectively. There is also suitable habitat for the Eastern Box Turtle, Fowler's Toad and Spotted Turtle which are designated by NJDEP as species of special concern. Additionally, over 8,400 acres are designated as critical habitat for grassland birds, including the state threatened species such as grasshopper sparrow and bobolinks. Table 5 provides a listing of the critical habitat areas and rankings identified in the Sourland Mountain Watershed and their respective acreages. Maps 13, 14 and 15 provided in Appendix B depict the details of the forested, grassland and wetland habitat areas in the watershed. (NJDEP, Landscape Project Data, 2002)

Table 5. Critical Habitat Areas in the Sourland Mountain Watershed.

Critical Habitat Area	Rank	Acreage within the Sourland Mountain Watershed	Percentage of total watershed area
Emergent Wetland	1	307.70	1.02%
Forested	1	259.50	0.86%
Forested	2	2,728.70	9.01%
Forested	3	11,991.60	39.59%
Forested	4	508.20	1.68%
Forested Wetlands	1	796.40	2.63%

Forested Wetlands	2	1,421.30	4.69%
Forested Wetlands	3	2,017.30	6.66%
Grassland	1	1,548.30	5.11%
Grassland	2	2,953.30	9.75%
Grassland	3	519.10	1.71%
Grassland	4	3,406.20	11.25%
Wood Turtle	3	1,414.10	4.67%
Total Critical Habitat Area	**--**	**29,871.70**	**98.62%**
TOTAL WATERSHED AREA	**--**	**30,290.38**	**100.00%**
Rank 5 – one or more occurrences of at least one Federal Endangered or Threatened wildlife species. Rank 4 – one or more occurrences of at least one State Endangered wildlife species. Rank 3 – one or more occurrences of at least one State Threatened species. Rank 2 – one or more occurrences of at least one non-listed State priority species. Rank 1 – meets habitat-specific suitability requirements such as minimum size criteria for endangered, threatened or priority wildlife species, but does not intersect with any confirmed occurrences of such species. (Niles et al., 2004)			

As mentioned previously, the forested areas in this study area is of regional importance to central New Jersey, and is second in size only to the Pinelands forests. In general, the NJDEP Landscape Project reports that, "older forests with larger, fewer trees and well developed canopy, sub-canopy, shrub and herbaceous layers with a well-developed component of dead biomass support the highest diversity of species". While each species has its own threshold tolerance for habitat loss and fragmentation, forest-interior birds prefer breeding within the forest core greater than 90 meters from the forest edge with a the minimum forested core habitat of 10 hectares (20 acres). The fragmentation of these forested habitats or creation of "edge habitat" tend to result in low reproductive success for interior forests birds because of greater competition for foraging and nesting sites, high nest depredation, brood parasitism, fewer nest sites, poor prey availability, the spread of invasive species, or a combination of these factors. Generally small, isolated forest patches tend to have a greater proportion of forest edge which diminishes their ability to support viable populations of sensitive species. For example, blue-gray gnatcatchers, eastern towhees, ovenbirds, scarlet tanagers, and wood thrushes, found in the Sourlands have a low tolerance for forest disturbances. Therefore, it is critical to preserve large contiguous forested tracts and connect suitable forested areas with suitable habitat corridors. NJDEP references studies by Hodge and Krementz (1996), and Keller, et al (1993) who recommends that riparian corridors or greenways be a minimum 100 meters in order to serve as effective wildlife corridors. (NJDEP, Landscape Project Data 2002)

5.8.1 Freshwater Mussels

In 2003, the NJDEP updated the designated New Jersey list of threatened and endangered species to include freshwater mussels, and these rare freshwater mussels have been documented

in segments of the Stony Brook downstream from the study area. The NJDEP reported that within the state, the Paulins Kill and Stony Brook had the highest diversities of freshwater mussels, with five species each, including the State Endangered Brook Floater, the State Threatened Triangle Floater and the Eastern Pondmussel. In addition, the Stony Brook is the location of the last known sighting of the State Endangered Green Floater mussel. These species require clean, well oxygenated water, and are susceptible to periods of low flow. Therefore, in May 2007, the Department proposed a Category One designation for the Stony Brook from the Pennington-Hopewell Road to the Delaware and Raritan Canal, in accordance with recommendations from the NJ Wildlife Action Plan.
http://www.nj.gov/dep/fgw/tandespp.htm and http://www.nj.gov/dep/fgw/ensp/waphome.htm

The NJDEP reports that freshwater mussels, dragonflies and damselflies, and stream-associated herptiles are excellent indicators of water quality. Freshwater mussels, which spend their entire lives in the aquatic environment, have a low tolerance for water-borne pollutants and may be useful as water quality indicators and overall stream health. Freshwater mussel extinctions and declines can be attributed to habitat degradation, construction of dams, and expansion of exotic species. There are 12 native freshwater mussel species in the state, nine of which are listed as Endangered, Threatened or Special Concern. http://www.state.nj.us/dep/fgw/ensp/ibaa03.htm

Stream dragonflies and damselflies (Odonata) have also been severely impacted by water quality degradation due to fertilizer and pesticide runoff, sewage and organic wastes, sediment, and dams. There are 172 Odonata species found in New Jersey, with 43 considered rare, including the River Jewelwing, Sparkling Jewelwing, Scarlet Bluet, Spine-crowned Clubtail, Banner Clubtail, Main Snaketail, Russet-tipped Clubtail, Arrow Spiketail and Allegheny River Cruiser. http://www.state.nj.us/dep/fgw/ensp/ibaa03.htm The NJ Wildlife Action Plan identifies several conservation and protection strategies for the wildlife and habitat areas of the Sourland Watershed and this is discussed in more detail in Section 7.0.
http://www.nj.gov/dep/fgw/ensp/waphome.htm

6.0 WATERSHED PROBLEM IDENTIFICATION AND ANALYSIS

6.1 Water Quality Monitoring – Biological Analysis

The New Jersey Department of Environmental Protection (NJDEP) has established the Ambient Biomonitoring Network (AMNET) to document the health of the state's waterways, by sampling for benthic macroinvertebrates. Utilizing the NJDEP Rapid Bioassessment Protocol, the macroinvertebrate data is evaluated to generate a New Jersey Impairment Score (NJIS), which helps classify streams as non-impaired, moderately impaired, or severely impaired based on the dynamics of the benthic macroinvertebrate communities found.

Macroinvertebrate samples were collected in 2005 from the Sourland Watershed, and the detailed results of this monitoring program are depicted in tables in Appendix D. The results of this biological monitoring program are visually portrayed on Map 15, Appendix B, along with the NJDEP Amnet results. Based on the NJDEP Rapid Bioassessment Protocol, Princeton Hydro determined that sample locations in four streams were Non-Impaired for benthic macroinvertebrates, including: Furmans Brook, Rock Brook, Cattail Brook and the Stony Brook samples. However, the sample results from locations in Back Brook and Beden Brook were identified as Moderately Impaired.

6.2 Water Quality Monitoring – Chemical Analysis

The major pollutants found in many waterways include oxygen depleting substances, such as sediments, manure, ammonia, and organic wastes; the nutrients nitrogen and phosphorus; acids from mining or industrial activities; and toxic materials, such as pesticides and salts or metals contained in runoff. The New Jersey Integrated Water Quality Monitoring and Assessment Report is required by the federal Clean Water Act (Section 305(b) and 303(d)) to be prepared biennially, with the most recent reports published in 2004 and 2006. This report presents data and identifies waterways that are attaining water quality standards and waters that are impaired. Sublist 5 of the Integrated List constitutes the list of waters impaired or threatened by pollutants, and Sublist 4A identifies stream segments that are routinely impaired and a Total Maximum Daily Load (TMDL) has been established by the NJDEP. This NJDEP data was evaluated together with monitoring data collected from the study area in 2005 for pathogens (fecal coliform), nutrients and total suspended solids. Details of this data are presented in Table 3, reported in the March 2006 Characterization and Assessment Report, and this data is visually portrayed on Map 16, Appendix B. http://www.state.nj.us/dep/wms/bwqsa/

6.2.1 Pathogens

Elevated levels of pathogens (fecal coliform) significantly above the State Water Quality Standard (SWQS of 200 CFU/100ml) were observed during fifty percent of the sampling events at sample Stations #1, 4, 9 and 10 for Back Brook, Beden Brook, Rock Brook and Stony Brook. This data substantiates the NJDEP findings and the establishments of TMDLs for pathogen reduction, and identifies that these headwaters are also sources of pathogens. The data confirms the need to reduce pathogen levels in the headwaters in order to improve water quality conditions downstream.

Assessment of Potential Sources

Nonpoint sources of fecal coliform can be attributed to a number of potential sources including human, domestic or livestock animals, agricultural practices, and wildlife. Fecal coliform from these sources can reach waterbodies directly, through overland runoff, groundwater baseflow, or through sewage or stormwater conveyance facilities. Nonpoint sources also include inputs from failing sewage conveyance systems, and failing or inappropriately located septic systems. Development of effective management strategies depends on an accurate assessment of the sources, identifying responsible entities, and aligning available funding for implementation.

It should be noted that the Sourlands watershed streams were sampled only during baseflow events and yet elevated levels of pathogens and phosphorous were detected. This could indicate that failing septic systems could be a significant source of the pollutant, rather than stormwater runoff. The Characterization and Assessment Report noted that the area experienced drought conditions in August and September 2005, with only 0.79 inches of precipitation reported in September. Flows in these headwater streams were therefore, dependent upon groundwater baseflow contributions. Upon review of the bacteria data and the ratio of Fecal coliform to Fecal Strep (FC: FS) the majority of the results suggest that the bacteria was not from human sources; however, this is not a definitive test procedure. Pathogens can also be present in stream sediments from previous storm events.

There are no public wastewater treatment plants with point sources of pathogens in the Sourland Watershed study area. The NJDEP reports that wastewater treatment plants, whether municipal or industrial, are required to disinfect effluent prior to discharge and to meet the surface water quality criteria for pathogens. NJDEP reports that sewage treatment plants routinely achieve essentially complete disinfection (less than 20 CFU/100ml significantly less than the applicable criteria for fecal coliform. Consequently, the NJDEP pathogen TMDLs do not impose any change in current practices for affected wastewater treatment plants (NJDEP TMDLs, 2006). However, it should be noted that wastewater treatment plants located downstream from the Sourland Study area do occasionally experience sanitary systems overflow (SSO) conditions during significant storm events, and improperly treated effluent can be discharged to the Bedens Brook, Stony Brook, and the Millstone River downstream from this study area. Within the study area, sanitary collection lines are often located in low lying areas and along stream corridors, and these lines, specifically within Hopewell Borough, should be inspected and evaluated to determine if leaks could also be contributing to the pathogen levels in Beden Brook.

Rock Brook (Station #7), Montgomery Township, September 8, 2005 experiencing drought conditions

6.2.2 Nutrients

The in-stream concentrations of total phosphorous (TP) were generally below the State standard of 0.1 mg/L at stations #1, 2, 4, 7, 10 and 11, and exceeded the TP standard in late October at Stations #1 for Back Brook. While these observed levels were in compliance with the state standards, elevated levels of phosphorous of 0.05 mg/l can still contribute towards excessive growth of algal blooms and eutrophic conditions in a pond or stream, and the TP standard for lakes is 0.05 mg/l in New Jersey. The soluble reactive phosphorus (SRP) component was also relatively high, in most samples accounting for as much as 50% of the measured TP. SRP is easily assimilated by algae, phytoplankton and periphyton, and contributes to excessive algal and plant growth. In the Sourland Mountain study streams, SRP concentrations were typically in the range of 0.02 mg/L, with concentrations as great as 0.43 mg/L measured at station #1, on Back Brook. Most of the stream samples were generally at or near 0.05 mg/l for TP indicating a slightly elevated nutrient level. This data substantiates the NJDEP findings and the establishments of TMDLs for phosphorous in downstream water bodies, and confirms the need to reduce phosphorous levels in the headwaters in order to improve water quality conditions downstream. Additional information is available on the USEPA website regarding nutrients and pathogens. http://epa.gov/waterscience/criteria/nutrient/index.htm

The NJDEP SWQS for nitrates is set at 10 mg/L, which may be related to a health concern for elevated nitrates in groundwater wells. The USGS and the USEPA report that the typical background concentration of nitrates in *streams* is at or below 1.0 mg/l. In the Sourland streams, concentrations of nitrates were generally below 1.0 mg/l and certainly in compliance with the SWQS of 10 mg/L for nitrates. However, elevated levels of nitrates above 2 mg/l were reported in Back Brook and Beden Brook at stations #1, 2 and 4, and algal blooms were also observed. These concentrations can contribute towards eutrophic conditions with excessive growth of algal blooms and low dissolved oxygen concentrations conditions that affect aquatic life. This data substantiates the USEPA findings.

6.2.3 Total Suspended Solids

All data for Total Suspended Solids (TSS) were collected during baseflow conditions and were reported generally below 10 mg/L, well below the SWQS of 40mg/L for TSS. These observed levels were in compliance with the state standards for TSS, but were not indicative of stormwater runoff conditions. Eroded stream banks are noted throughout the watershed, and elevated levels of TSS are likely to occur during significant storm events. The need to improve stormwater management and reduce TSS levels in the headwaters is necessary to improve water quality conditions downstream.

As evidenced in the field surveys, soil erosion and sediment transport is a water quality problem in the watershed. The impacts associated with sediments can include loss of habitat, occlusion (smothering) of benthic organisms and even fish kills. The influx of excessive sediment into the waters of the State is in violation of N.J.A.C. 7:9 and N.J.A.C. 7:8, and the local communities have developed ordinances pertaining to steep slope disturbance and soil erosion control to prevent these types of impacts from occurring. However, agricultural activities and stormwater runoff can also lead to erosion concerns and outreach to land owners could be effective. Correction measures or mitigation of infrastructure and drainage swales to improve the design, retrofit or upgrade of the stormwater collection and/or treatment system could also be effective.

No monitoring was performed to assess arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, and zinc that were affecting downstream waterbodies.

6.3 Ecological ***Integrity of the Sourland Streams***

In May 2007 the NJDEP proposed to amend the State Water Quality Standards to include certain measurable criteria as tools to evaluate the *Ecological Integrity* of streams. The NJDEP would consider these Ecological Integrity criteria to assist in determining whether a stream should be upgraded to a Category One designation. Using these NJDEP criteria the headwater streams in the Sourland Watershed were evaluated and the results are highlighted below in Table 6.

The summary of the watershed data demonstrates a modestly undeveloped watershed with intact riparian corridor in the upper segments of the subwatershed areas, with good water quality and non-impaired biological communities. The upper segments of the headwaters generally support and maintain a diverse community of organisms with optimal habitat, good water quality, and good biological integrity, and should be protected and maintained because of these qualities. The lower segments of each of the watershed streams do demonstrate degraded water quality by pathogens and nutrients; reduced diversity of macroinvertebrate communities; degraded riparian corridors, and segments of eroded streambanks. The headwaters and watershed areas support state threatened species and vernal pools, and downstream portions of the Stony Brook support freshwater mussels that should be protected from measurable changes in water quality.

This SWPP recommends that additional investigations be conducted on these streams to document the possible additional habitats for vernal pools, wood turtle, freshwater mussels, and evaluate fish diversity, especially those related to freshwater mussel breeding, such as darters.

Table 6: Sourland Streams Evaluation using the NJDEP Proposed Ecological Integrity Criteria for Potential Category One Streams

Stream	Benthic Macroinvertebrate Data[1]	Instream Habitat[2]	Fish Community[3]	State Water Quality Criteria (SWQC)[1]	Habitat for Aquatic-Dependent Endangered And Threatened Species[4]	Impervious Surface
Back Brook	Impaired	Suboptimal / marginal	No fish Biotic data – Neshanic River fair upstream / good downstream from Back Brook	Exceeds pathogen criteria Elevated phosphorous levels	Not documented	Low impervious cover Med Imp cover in Ringoes
Furmans Brook	Non Impaired	Suboptimal	No fish Biotic data – Neshanic River fair upstream / good downstream from Furmans Brook	Elevated pathogens and phosphorous levels	Not documented	Low impervious cover
Stony Brook	Most headwaters are Non Impaired, except one location was Impaired.	Suboptimal	Good fish biotic data upstream and downstream of Pennington	Exceeds pathogen criteria at one location	▪ Freshwater mussels / wood turtle habitat in headwaters ▪ State threatened species in forested wetlands ▪ Certified vernal pools	Low impervious cover
Beden Brook	Headwaters Non Impaired and Impaired below the Borough	Suboptimal	Good fish biotic data downstream of Hopewell Borough	Exceeds pathogen criteria below Borough	▪ Wood turtle habitat in headwaters and below Hopewell Borough ▪ State threatened species in forested wetlands ▪ Certified vernal pools	Med- high impervious cover in the Borough
Rock Brook	Non Impaired throughout waterway	Optimal	No fish biotic data for Rock Brook	Exceeds pathogen criteria in headwaters and downstream	▪ State threatened species in forested wetlands ▪ Certified vernal pools	Low impervious cover

1. The water quality biological and chemical data includes both NJDEP data and results from the RSWMP Characterization and Assessment sampling.
2. The Instream Habitat determination is based on data collected by the NJDEP at their Amnet Biological Sampling Stations, which were generally collected in the lower segments of these headwater streams.
3. The fish biotic diversity is based on limited data from the NJDEP.
4. Presence of T&E species is based on NJDEP Landscape Project data.

6.4 Pollutant Loading Analysis

The Sourland Watershed Characterization and Assessment Report of March 2006 provides details of pollutant loads computed using the ArcView Generalized Watershed Loading Functions (AVGWLF) model, to generate a Unit Areal Loading (UAL) analysis based on the 1995 NJDEP land use land cover data and pollutant loading coefficients for total phosphorous (TP), total nitrate (TN), and total suspended solids (TSS). The AVGWLF model is recommended by the USEPA and the NJDEP. Tables 7, 8 and 9, which are replicated below from the Characterization and Assessment Report, present the results of the pollutant modeling based the existing subwatershed conditions and future built-out scenarios for TP, TN and TSS. It should be noted that Table 9 was slightly revised to report the data more accurately.

Existing Land Use

Summarizing the results of the modeling effort for existing land uses, the watershed-wide total estimated for three primary pollutants loads are TN: 55,316 lbs/yr, TP: 2,911 lbs /year and TSS: 6,111,382 lbs /year. The tables indicates that the largest pollutant loadings within the study area are attributed to Subwatershed A (Back Brook) which includes 25% of the total landmass and contributes 31% TN, 33% TP, and 34% TSS. Subwatershed E (Hopewell Borough and Beden Brook) which includes 16% of the landmass contributes 17.6% TN, 18.7% TP, and 18% TSS. Subwatershed C (Stony Brook 2) includes 20% of the landmass and contributes 17.4% TN, 14.8% TP, and 15.6% TSS. The role of agriculture, road runoff and stream scour will need to be examined more closely with respect to determining specific pollutant sources and developing management recommendations for these streams.

Projected Future Land Use (Build out)

Future pollutant loadings are also provided based on build out projections that incorporate GIS mapping and the restrictions and requirements of current municipal zoning regulations (i.e., minimum lot size, maximum percent impervious coverage, development type). For example, the GIS database for the watershed was queried to identify any lands with characteristics, such as steep slopes (≥15%), wetlands, FEMA floodplain areas, mines and quarries, and permanently preserved parcels (i.e., county, municipal and Green Acres open space parcels and lands preserved under the NJ Department of Agriculture – State Agriculture Development Committee's Farmland Preservation program), that render that land unsuitable and/or unavailable for development. In contrast, lands without development constraints were considered "developable," and were reclassified according to the land uses each would have if built out fully to the most intensive state possible under current zoning. Based on this methodology, 12,659.88 acres are considered un-developable in the future, and a total of 17,439.92 acres in the Sourland Mountain watershed, or 58% of the total watershed area, is available for development. A breakdown of this data is provided in the Characterization and Assessment Report.

A comparison was made between estimated current pollutant loading and pollutant loading under future development conditions, given the assumptions described above. The results of this comparison are provided in Tables 7, 8 and 9, below. Considering the study area as a whole, TP loading is expected to increase by almost 14% (approximately 404 lbs/year); however, the Subwatershed F, Rock Brook is projected to experience the largest total increase of 53% TP (from 234 to 359 lbs/year). Subwatershed C, Stony Brook 1, is projected to experience the second largest increase in TP loads, from 430 to 532 lbs/year. In both situations, the future build out envisions primarily forested lands being converted to low-density residential development.

Total nitrogen (TN) and total suspended solids (TSS) pollutant loads are expected to decrease by 8% or 4,378 lbs/yr of TN, and 7% or 394,381 lbs/yr of TSS, under future development conditions for the watershed region. This is based on an anticipated transition of primarily agricultural lands and pasture to low-density residential development. The model assumes that the intensive use of high-nitrogen fertilizers and soil erosion due to agricultural activities (including grazing animals), will decrease, resulting in lower or comparable TN and TSS concentrations under build-out conditions. However, it should also be noted that Subwatershed F (Rock Brook) is projected to be converted from forested areas to residential, and this conversion will likely increase TN loadings by 37% or 1,538 lbs/yr and increase TSS by 49% or 207,979 lbs/yr in the Rock Brook subwatershed. Overall the water quality of the Rock Brook subwatershed is projected to decline substantially, due to the projected loss of forest cover. Ordinances to minimize tree clearing would be especially important to this subwatershed.

Table 7. Change in Estimated TP Loading from Current to Future Development Conditions.

Sub-watershed	Total Acreage	Current Estimated TP Load (lbs/year)	Projected Future TP Load (lbs/year)	Change from current to future estimated TP load (lbs/year)	Percent Change
A	7,474.19	960.83	995.65	**+34.82**	**+3.62%**
B	3,561.35	372.70	399.12	**+26.42**	**+7.09%**
C	6,174.22	429.64	531.70	**+102.06**	**+23.75%**
D	3,135.55	242.65	284.95	**+42.30**	**+17.43%**
E	5,035.13	544.31	611.45	**+67.14**	**+12.33%**
F	3,875.72	233.54	358.52	**+124.98**	**+53.52%**
G	1,034.23	127.57	133.60	**+6.03**	**+4.73%**
TOTAL WATERSHED	**30,290.38**	**2,911.25**	**3,315.00**	**+403.75**	**+13.87%**

Table 8. Change in Estimated TN Loading from Current to Future Development Conditions.

Sub-watershed	Total Acreage	Current Estimated TN Load (lbs/year)	Projected Future TN Load (lbs/year)	Change from current to future estimated TN load (lbs/year)	Percent Change
A	7,474.19	17,273.27	14,574.26	**-2,699.01**	**-15.63%**
B	3,561.35	6,768.50	6,180.87	**-587.63**	**-8.68%**
C	6,174.22	9,617.45	9,029.35	**-588.10**	**-6.11%**
D	3,135.55	5,672.46	5,083.07	**-589.39**	**-10.39%**
E	5,035.13	9,758.02	8,500.47	**-1,257.55**	**-12.89%**
F	3,875.72	4,105.90	5,644.53	**+1,538.63**	**37.47%**
G	1,034.23	2,120.50	1,925.12	**-195.38**	**-9.21%**
TOTAL WATERSHED	**30,290.38**	**55,316.11**	**50,937.67**	**-4,378.43**	**-7.92%**

Table 9. Change in Estimated TSS Loading from Current to Future Development Conditions.

Sub-watershed	Total Acreage	Current Estimated TSS Load (lbs/year)	Projected Future TSS Load (lbs/year)	Change from current to future estimated TSS load (lbs/year)	Percent Change
A	7,474.19	2,075,194.69	1,710,397.51	**-364,797.18**	**-17.58%**
B	3,561.35	693,461.03	663,738.06	**-29,722.97**	**-4.29%**
C	6,174.22	955,880.73	926,278.79	**-29,601.94**	**-3.10%**
D	3,135.55	591,096.68	556,161.17	**-34,935.51**	**-5.91%**
E	5,035.13	1,108,245.11	984,284.88	**-123,960.23**	**-11.19%**
F	3,875.72	422,965.43	630,944.63	**207,979.20**	**49.17%**
G	1,034.23	264,538.45	245,195.53	**-19,342.92**	**-7.31%**
TOTAL WATERSHED	**30,290.38**	**6,111,382.12**	**5,717,000.58**	**-394,381.54**	**-6.45%**

These scenarios underscore the importance of improved management and treatment of stormwater-based NPS pollution in the subwatersheds currently experiencing the greatest impacts to water quality, and to mitigate or address the anticipated increased pollutant loads. In addition, a desire on the part of the watershed municipalities to maintain the rural/agricultural landscape that largely defines the community may stimulate efforts to protect additional agricultural lands through farmland preservation programs. To reduce the nutrient and TSS loads that go hand-in-hand with agricultural operations, opportunities to implement and fund agricultural BMPs, such as riparian buffer creation/maintenance, manure management programs and soil-conserving tilling practices should be pursued. To protect and reduce loadings when forested areas are lost to development, municipalities may consider ordinances to restrict tree clearing, and to encourage the construction of residential rain gardens.

6.5 Subwatershed Assessment

6.5.1 Back Brook and Furmans Brook – Subwatershed Area A and D

Located predominately in East Amwell Township, and the majority of this subwatershed is in agricultural use and designated by the NJDEP Landscape Project as providing habitat for grassland birds designated as threatened and endangered species. The majority of these privately owned farms are managed for horses and livestock, and a high percentage is enrolled in the State Farmland Preservation program. The watershed concerns observed in these subwatershed areas include:

- Land use is predominately agricultural (many preserved farmlands) in this subwatershed with older residential development on smaller 2-3 acre lots along the streams and roads. Excessive levels of fecal coliform were detected at sampling stations # 1 (Manners Road) and #2 (Welisewitz Rd Bridge), and a potential source may be the septic systems that are located in the floodplain along Back Brook and Furmans Brook along Welisewitz Rd.
- Horse farms in the area and local riding trails along Back Brook may also contribute to the pathogen levels found in the streams. Sample Location #3 by Linvale Road showed signs of biological impairment, but was not sampled for pathogens.
- Eroded stream banks exist along Back Brook near Back Brook Road, near the bridge at Manner Rd, Wertsville and Welisewitz Road.
- Approximately 2,000 feet of eroded streambank (3-4 feet in height) exists along Welisewitz Road, from Wertsville Road to Cider Mill Road Bridge. However, much of this area is just outside of the study area and is considered the Neshanic River watershed. In long stretches of Furman's Brook the high four foot streambanks prevent storm flows from accessing the agricultural floodplains. In addition, wetlands are noticeable absent or very limited in this subwatershed area.
- Regrading and restoring the stream banks with crib walls or gabion walls is possible, but local and state officials should also consider addressing storm flows by providing access to the floodplains, and creating wetlands, infiltration basins, or wet ponds possibly within farmlands or possibly within the publicly owned lands of Welisewitz Road Park.
- The Village of Ringoes located in this subwatershed is a historic area dating back to 1800's. Ringoes includes tightly clustered homes and businesses that are served by aging septic systems and private wells, which could contribute to fecal contamination

observed in the stream. Some businesses and residents may be discharging sump water and laundry to storm sewers. In recent years, some failing septic systems have been replaced by mounded systems and peat systems. Gasoline stations may be contributing hydrocarbons via stormwater runoff and nurseries in the area may be contributing pesticide and nutrients in their runoff.

- Highways Route 31 and Route 202 cross the headwaters of this subwatershed and stormwater runoff from these highways may be increasing the stream bank erosion along Melbourne Lane and reducing water quality.
- Limited stormwater facilities are present in the subwatershed.

6.5.2 Stony Brook – Subwatersheds B& C

Located in three municipalities including East Amwell, West Amwell and Hopewell Township, approximately 50% of this subwatershed is forested and designated by the NJDEP Landscape Project as providing habitat for threatened and endangered species, including the wood turtle. The riparian corridors are predominately intact, benthic macroinvertebrate populations identified by Princeton Hydro were diverse and not impaired, and water quality in these subwatersheds was some of the best in the study area, with the exception of elevated fecal coliform at station #10.

The watershed problems observed in these subwatersheds include:

- Excessive levels of fecal coliform were detected at sampling stations # 10; and a likely source may be older septic systems located within the floodplain, and the septic system at the Rambling Pines Camp, horses and wildlife. Geese at Amwell Lake and some farm ponds can be a source of pathogens; however, sample location # 11 just downstream from Amwell Lake did not report elevated pathogen levels.
- Amwell Lake is designated as a Category One waterbody, and the land use draining to the Lake is predominately agricultural, forest and wetlands. Some residential and commercial development exists in the subwatershed, and there is limited stormwater controls for the drainage to this lake.
- Highways Route 31 and Route 518 cross this subwatershed and stormwater runoff from these highways may be increasing the stream bank erosion and reducing water quality.
- Two sedimentation basins were installed in the 1950s to help control runoff and sedimentation to Stony Brook, including Amwell Lake and a sedimentation basin just west of Rte 31, south of Rte 518. Recent studies indicated that the basins have been effective. However, ownership and the long term management and maintenance of these basins and dams are under discussion between NJDEP, Mercer County, and the Stony Brook Millstone Watershed Association. Sediment dredging from these basins may be necessary, particularly Amwell Lake.

6.5.3 Beden Brook - Subwatershed Area E

Located predominately in Hopewell Township and Hopewell Borough, the headwater areas include forested areas with habitat for threatened and endangered species, as well as grassland bird habitats. Hopewell Borough is a historic community dating back to 1800s. The Borough includes tightly cluster homes and businesses that are predominately served by sewered areas and public water lines, with limited areas relying on aging septic systems and private wells.

The watershed problems observed in this subwatershed include:

- Eroded stream banks, especially along Aunt Molly's Road;
- Excessive levels of fecal coliform were detected at sampling stations # 4; and a likely source may be septic systems, illicit stormwater connections, aging and leaking sanitary system infrastructure, livestock farms, and pet waste from the Borough Park.
- Stormwater sewers exist in the Borough but there is limited stormwater retention.
- Potential illicit discharges to the stormwater sewers and leaking sanitary lines should be investigated further.

6.5.4 Rock Brook – Subwatershed F & G

Located in Hillsborough and Montgomery Townships, approximately 90% of this subwatershed is forested and designated by the NJDEP Landscape Project as providing habitat for threatened and endangered species. The subwatershed riparian corridors are in fairly intact forested condition, but shallow bedrock and steep slopes cause high stormwater flows and eroded streambanks. The shallow bedrock may also contribute to failing septic systems.

The watershed problems observed in these subwatersheds include:

- Severely eroded stream banks are present near Camp Meeting Road, but the restoration may be difficult because of the surface bedrock, steep slopes, high banks, and flashy runoff conditions.
- Excessive levels of fecal coliform were detected at sampling stations # 8 and 9; and a likely source may be failing septic systems, older cesspools, or wildlife.
- The Meszaros junk yard in East Amwell has two locations along Lindbergh Road,, and discharges and runoff from these sites could be impacting both the Rock Brook and Beden Brook Watersheds (Subwatershed E). East Amwell is actively engaged with the NJDEP in the investigation and cleanup at the Meszaros junkyard, including the removal of tires in 2006 and significant funding has been obtained for soil testing to determine the extent of areas of contamination. Additional remediation of the property may be needed.

7.0 ONGOING PLANNING AND MANAGEMENT STRATEGIES

This section provides a general overview of planning and management strategies underway or recently completed by the various local communities. Some of these efforts will positively affect the goals and objectives outlined in the Sourland Watershed Protection Plan.

7.1 Stormwater Management Plans and Ordinances

During the preparation of this Watershed Protection Plan, each municipality was required to comply with the NJDEP stormwater regulatory deadlines and develop and submit individual Municipal Stormwater Management Plans and Ordinances in accordance with N.J.A.C. 7:8.

Some of these plans and ordinances are quite detailed, with recommendations and strategies beyond the NJDEP basic requirements, best management practices, guidance and proposed examples. Hunterdon County also created a Model Stormwater Ordinance that approximately 50% of its communities adopted. The County Planning offices have reviewed and approved these municipal plans and ordinances.
http://www.co.hunterdon.nj.us/pdf/stormwater/HCETModelOrdinanceFINALNov05.pdf

East Amwell Township and Hopewell Borough are designated by NJDEP as Tier B communities, and as such must comply with the Tier B Stormwater State Basic Requirements. The following requirements are *not* mandated for Tier B communities, but are recommended in order to improve water quality conditions. The NJDEP has provided various models to assist towns in these efforts.

- creating a Stormwater Pollution Prevention Plan,
- performing routine maintenance at public maintenance yards, SOPs for vehicle fueling, employee training
- providing covered salt storage facilities,
- mapping, monitoring and maintaining stormwater inlets and outfalls
- detecting and correcting illicit discharges to storm sewers
- adopting ordinances that address pet waste, litter, wildlife feeding, illicit connections, and improper waste disposal.

In the summer of 2007, the Montgomery Township completed their Stormwater Ordinance and it offers significant details on groundwater recharge and infiltration, LID BMPs, and maintenance issues. The Montgomery Township Stormwater Ordinance has been included as Appendix E, as a Model Stormwater Ordinance that other Sourland Communities can consider adopting, and several sections are highlighted in section 8.0.

7.2 Educational and Outreach Programs

Numerous public education and outreach efforts have been provided by each of the communities on stormwater management, smart growth, water conservations, septic management and open space preservation. In addition, the environmental organizations such as the Stony Brook-Millstone Watershed Association, the Delaware & Raritan Greenway Land Trust, the Sourland Planning Council, and the NRCS have all offered educational brochures and workshops on similar topics, as well as land stewardship programs.

Several Sourland communities provide educational information to residents annually with the tax bills, on the town website, and in the town newsletters. Welcome Wagon packages for new local residents address these issues in East Amwell. The local newspapers also routinely report on environmental topics. The East Amwell Committee members recommended that mailings on environmental topics be included with the tax bills, as these were most likely to be read and reach the target audience. Specific efforts to promote septic pumping during the fall season could be organized when East Amwell also promotes well testing. Educational information could identify the potential impacts from septic systems to wells, and provide additional information how these systems may also be leaching and impairing surface water quality. Examples of educational brochures, including stormwater NPS concerns are provided in Appendix F.

The annual *Hunterdon Horse Expo* is held each spring and the *Hunterdon County 4-H Fair* is held each August in East Amwell, and these events can provide opportunities to promote conservation programs and best management practices for residents and farmers. In August 2007, the various Sourland stakeholders promoted information from the Sourland Watershed Characterization and Assessment Report, specific to nutrient and pathogen impairments in the Sourland streams and the critical habitats in the watershed. In addition, the North Jersey Resource Conservation and Development Council (NJRC&D) also promoted the *River Friendly Farm* program and NRCS grant programs for landowners. Copies of these educational brochures and exhibits are presented in Appendix F.

7.3 Resource Protection Planning Initiatives

Several of the Sourland communities have been on the forefront of proactive watershed management and the environmental stewardship of the resources in their towns. The following initiatives and measures highlight a few of the actions undertaken by the Townships to protect the groundwater, surface water and natural resources of the Sourland Mountain:

- The Sourland communities have worked with the NJ Department of Community Affairs (DCA) to designated the entire Sourland Mountain study area as Planning Areas 4 (rural), 4B (rural/environmental sensitive) and PA5 (environmentally sensitive) pursuant to the State Development and Redevelopment Plan (State Plan). These designations limited the potential extensions of infrastructure into these areas, and thereby limit excessive growth. These communities have also worked to identify historic landmarks and designate historic districts. (Appendix B, Figure 1)
- The Sourland communities have completed a detailed hydrological review and analysis of ground water resources, water supply, wastewater management, nitrate-dilution, and aquifer recharge modeling conducted by Peter Demicco, P.G. and Matthew Mulhall in 2004
- The Sourlands communities completed the DCA Smart Growth report on the *Planning Strategies for Conservation and Resource Protection on the Sourland Mountain* (Banisch Associates, 2002).
- Based on the findings from the Phase I Sourland Smart Growth studies and the NJDEP Landscape Project data, Hunterdon County supported the nomination of the Sourland Mountain region as a Special Resource Area to the NJ State Planning Commission during the County Cross Acceptance Process for the State Plan. (This action is similar to the initial steps for the Highlands Special Resource Area). The State Planning Commission

would decide on this issue and invite local stakeholders to develop policies and planning implementation strategies. (Hunterdon County, July 2007, Cross Acceptance Report)

- Phase II of the Smart Growth Initiative began in the fall 2007 to support regional research and planning for the Sourland Mountain, and the Sourland Planning Council (SPC) is the lead agency for this Initiative. SPC is a non-profit, membership organization dedicated to protecting the Sourland Mountain and has organized a Task Force representing each Sourland municipality. The organization's board of trustees also includes residents from each of the Sourland municipalities and members from throughout the region.

7.4 Environmental Protective Ordinances and Initiatives

Each of the Sourland Communities has completed a Municipal Assessment Review coordinated by the Stony Brook-Millstone Watershed Association (SBMWA) from 2000-2004. This Assessment evaluated the environmental conservation goals of each community and provided recommendations to achieve these objectives. Some of the common recommendations identified from this Assessment are listed below and have been implemented in some of these communities.

- Increasing public education and participation on planning issues,
- Encouraging more training and site visits for local officials
- Adopting BMPs for wellhead protection and aquifer protection areas
- Preserving the rural character and historic features of the communities through education efforts, and ordinances for zoning, historic districts, and view sheds.
- Improving the management of septic systems
- Adopting and enforcing stream corridors protection ordinances
- Identifying and protecting critical habitats through education efforts, and ordinances for woodlands and steep slopes.

- Each community has completed an Environmental Resource Inventory and mapping of sensitive species habitat. Hunterdon County and the Sourland Watershed communities have developed model ordinances for the protection of slopes, woodlands, streams corridors, critical environmental settings, and aquifer recharge. As such, at the local level there are varied regulations in place to deter further physical disturbance of the stream and its riparian areas. These ordinances are highlighted in Table 10, Municipal Environmental Ordinances Chart which was originally published in the Sourlands Smart Growth Planning Project (2002).

- A detailed Environmental Inventory has been completed for the Sourland Region which could serve as a basis for a regional woodland protection plan, and the basis for woodland protection ordinances.

- The Sourland communities participated with Hunterdon County on the development of the Environmental Ordinance Toolbox that provided models to address: Wellhead Protection Ordinance, Woodland Protection Ordinance, Viewshed Ordinance, Riparian Buffer

Protection Ordinance, Site Design Standards, Steep Slopes, Conservation Design, Transfer Development Rights, Agricultural Zoning, etc. These Model Ordinances can be viewed at:

Hunterdon County Environmental Toolbox
http://www.co.hunterdon.nj.us/planning/toolbox.htm

EPA Model Ordinances
http://www.epa.gov/owow/nps/ordinance/osm1.htm

DVRPC Natural Resource Protection Information
http://www.dvrpc.org/planning/protectiontools.htm
Model Ordinances
http://www.dvrpc.org/planning/Protection%20Tools/ordinances.htm

- The following environmental resource protection tools are designed to support and improve existing environmental protection efforts, local zoning and land development regulations, based upon findings contained in this study, and are also recommended:

  - Agricultural Easement Provisions
  - Aquifer Testing Requirements
  - Buffer Size and Landscaping Requirements
  - Bulk Storage Restrictions
  - Conservation Easement Requirements
  - Deed Restriction Requirements (Open Space & Agricultural Preservation)
  - Density Standards Development
  - Environmental Impact Statement Requirements
  - Erosion and Sedimentation Control
  - Establishment of Protective Zoning Districts (AR, RR, SSR)
  - Floodway, Flood fringe, Floodplain, and Flood Hazard Restrictions
  - Height Restrictions
  - Maximum Impervious Surface Restrictions
  - Minimum Contiguous Land Requirements
  - Noise Restrictions
  - Odor Restrictions
  - Open Space Requirements (Less floodplains, wetlands, and steep slopes) & Listed Conservation
  - Percolation Test Requirements
  - Proof of Drinking Water and Available Wastewater Treatment
  - Residential Cluster and Planned Development Provisions
  - Set back Requirements
  - Sign Regulations
  - Steep Slope (Critical Area) Regulations
  - Stormwater Treatment Requirements
  - Stream Corridor Protection Regulations
  - Top Soil Removal Restrictions
  - Truck Traffic Regulations
  - Tree Protection Regulations (SSR Zone)
  - Waste Disposal & Storage Restrictions
  - Wetland (Critical Area) Regulations
  - Woodland Protection

Table 10. Summary of Relevant Land Use Ordinances

Regulatory Measure	Municipal Action
Drinking Water (Aquifers and Reservoirs) Protection	▪ Wellhead protection ordinances are geared towards public well fields and may be suitable for the communities of Hopewell Township and Hopewell Borough
Wetlands/ Riparian Buffer Protection	▪ The Townships of West Amwell, Hopewell, Montgomery, and Hillsborough have local ordinances that protect riparian buffers. Hopewell Borough and East Amwell do not have riparian ordinances.
Erosion and Sediment Control/Steep slopes	▪ Erosion and sediment control is mainly managed by the county Soil Conservation Districts ▪ Several communities have enacted ordinances protecting steep slope
Stormwater Management	▪ All municipalities in the Watershed adopted a stormwater ordinance.
Woodland Conservation and Replacement	▪ Several communities restrict tree clearing in riparian buffers, but additional measures for woodland protection and tree clearing in uplands should be considered.
Litter/ Refuse Management	▪ All municipalities in the Watershed adopted provisions for refuse management, but more prominent signage in public places and enforcement can be improved.
Site Design	▪ All municipalities in the Watershed have helpful provisions for appropriate site design recommendations, and checklists for environmental reviews. However, the DCA Smart Growth Plan will likely have additional recommendations. ▪ Many of the open space requirements relate only to cluster developments or higher density developments and not to all of the subdivisions.

7.5 Zoning to Preserve Water Supplies and Natural Resources

In response to evidence indicating the potential for groundwater contamination and impact to the sustainable supply of potable water from septic systems, several towns increased the minimum residential lot in the Sourland Mountain District to 5-15 acres. This effort will also protect habitats and decrease the occurrence of forest fragmentation impacts.

7.6 Septic Management

- Montgomery Township has adopted a "Septic System Management Ordinance", which is one of only eight that exist statewide. Using this ordinance, the Township's Board of Health works to monitor and enforce maintenance of septic systems to ensure that ground water and drinking water remain healthy.

- **Septic Educational information** is already provided to residents annually with the tax bills, on the town websites, in the town newsletters regarding the appropriate measures for septic management, such as septic pumping every three years. Several communities have hosted programs to informed homeowners on the appropriate measures for septic management and Welcome Wagon packages for new local residents also already address these issues. The local paper, the *Hunterdon Democrat*, occasional reports on environmental topics.
  - The Sourland stakeholders suggested that mailings with the tax bills were most likely to be read and reach the target audience.
  - East Amwell currently works with the South Branch Watershed to assist residents to test their wells annually during the fall season, and this timeframe could also be targeted to promote both well testing and septic pumping.

- **Septic System Upgrades** - The East Amwell Township Health Code contains provisions that are more strict than the State Code for new Individual Subsurface Sewage Disposal Systems (ISSDS) (N.J.A.C. 7:9A) in order to protect ground and surface water quality in the Sourland region. Some of these requirements include:
  - increased separation distances between wells and septic systems,
  - increased distances between septic systems and streams, and
  - a requirement that a new septic system be located outside of the flood hazard areas and wetland transition areas.
  - Other Sourland communities could consider adopting similar requirements to protect water quality of the Sourland streams, and to require that improvements be provided when homes or septic system located within flood prone areas are proposed to be expanded.

- Communities including Montgomery, East Amwell and Hopewell Township have recently updated their Wastewater Management Plans (WMP).
- Communities have also developed Board of Health regulations concerning aquifer stress tests and specifications for wells and septics which address the special characteristics of the Sourland Mountain's hydrogeology.

7.6.1 Water Quality Management Plan Rules, Proposed by NJDEP in May 2007

As noted previously some of the objectives of the Sourland Watershed Protection Plan include maintaining and enhancing the quality of ground water and surface water resources; reducing potential pollutants; maintaining sufficient recharge and baseflow; and protecting and preserving stream corridors or riparian zones. Many of these objectives are also outlined in the regulatory amendments for Water Quality Management Plans (WQMP-NJAC 7:15), proposed by the NJDEP in May 2007. These proposed WQMP amendments identify requirements for communities and developers regarding issues that are also germane to this SWPP, such as: a nitrate groundwater criteria, build out analysis, wastewater management, septic systems, NPS pollutants, TMDLs, riparian zones, and water supply. Planning and zoning in the Sourland communities may be affected by a variety of the proposed amendments if these WQMP rules become effective. The most significant concerns related to the SWPP are listed below. http://www.nj.gov/dep/rules/notices/052107a.htm

- **Nitrate Criteria** - The most significant change is the newly proposed nitrate criteria and its affect on build out and zoning. The NJDEP has proposed at N.J.A.C. 7:15-5.25(e)1 that the density of septic systems in undeveloped and underdeveloped areas shall not cause exceedance of the nitrate planning standard of 2.0 mg/L of nitrate, on a HUC 11 basis, in order to provide sufficient groundwater recharge and nitrate dilution necessary to protect water quality and public health. HUC 11 regions are large, approximately 50 square miles, overlapping municipal boundaries and including several communities. The Sourland Study Area includes ***portions*** of three different HUC 11 regions that drain to the Stony Brook, Millstone River or the Neshanic River. In the Sourlands Mountain region, the current zoning requirements of 5-15 acres per residential dwelling unit were based on a nitrate dilution criterion of 5.2 mg/L per the previous NJDEP guidance. Land use density calculations based on the nitrate criteria of 2 mg/L may not significantly affect the zoning density if it is applied on the large HUC 11 watershed area.

    - *Accordingly, proposed section N.J.A.C. 7:15-5.25(e)1v provides that municipalities should determine, and allocate through zoning, the types and intensity of development at their discretion and in ways that will satisfy local objectives, provided the overall level of development on a HUC 11 basis assures protection of ground water quality.*

    - *Under the proposed WQMP rules (N.J.A.C. 7:15-5.25(e)1ii) communities are to determine the number of undeveloped and underdeveloped acres outside of sewer service areas and apply the required number of acres per single family residential dwelling unit determined in N.J.A.C. 7:15-5.25(e)1i in order to calculate the total number of additional single family residential dwelling units allowable in the HUC 11.*

- **Maintenance Requirement** - Currently section N.J.A.C. 7:9A-3.14 requires health departments to notify homeowners with septic systems every three years with advice on long-term operation and maintenance practices. *The Department is now proposing under N.J.A.C. 7:15-5.25(e)3 that a mandatory maintenance program be established at the local level.* The Department is not specifying the form of the program, but is proposing to require periodic tank pump outs and repair of malfunctioning parts as needed. Depending on the size and type of septic system, pump outs should occur between every three to seven years (Rutgers, 2005). Various levels of regulation and administrative oversight are possible, including:

- a simple voucher program, where a homeowner is required to periodically submit evidence that the system had been pumped out, to
- a program that includes licensing of inspectors and renewable permits for septic systems.

- **Water Supply Analysis** - As part of a Municipal Wastewater Management Plan (WMP) or update, the NJDEP has proposed under N.J.A.C. 7:15-5.25(f) to require an analysis of sufficient water supply availability to meet needs and address impacts from cumulative water supply demands. This information will also assess the cumulative impact of the depletive and consumptive losses on stream baseflow and water quality.

7.7 Open Space Preservation

- Each community has an open space tax, active committee and open space plan. And these groups meet routinely through the County sponsored Open Space Green Table Programs to coordinate their efforts.
- The Open Space Map (Figure 6) identifies that nearly 8,000 acres in the Sourland Watershed have been preserved or protected as either preserved farmlands (3,326 acres), open space acquisitions (2,783 acres) or through conservation easements (1,822 acres). Acquisition of over 6,000 acres of land for open space and preserved farmland using a combination of Township open space tax funds in conjunction with state Green Acres funding, and private donations has occurred.
- The creation and implementation of Stewardship Plans for these preserved lands and Monitoring of Conservation Easements is an important next step for these municipalities and land trust organizations to ensure the proper long term stewardship of these lands. Controlling invasive plant species is important to prevent the loss of native plant communities on public lands and conservation easements. Managing deer populations on these lands may also need review.
- Training and volunteer opportunities to remove invasive species should be encouraged by each municipality, county and land trust organization, including the training of public works staff. The D&R Greenway offers advice on invasive species controls (http://www.drgreenway.org/stewardship.html).

7.8 Streambank Restoration

- Limited streambank restorations have occurred in these communities working with the municipalities, SBMWA, volunteers and 319(h) grants from the NJDEP, but most of these actions were not within this watershed study area.

- Additional streambank restorations are recommended in Section 8.0 and the SBMWA and the Sourland communities could work together to document the past efforts, monitor their progress, and prioritize future work.

7.9 Farm and Livestock Management

- NRCS recommends that a Conservation Plan is needed before a landowner may be eligible for grant funding. These Conservation Plans typically require an inventory of local resources, such as critical habitats and areas of stream impairments. This information has been summarized from the Sourland Characterization and Assessment Report and outlined in a brochure that was provided for the August 2007 Agriculture Fair. It can also be provided on township websites, NRCS and other organizations in order to assist local farmers apply for NRCS funding opportunities.
- In addition to the NRCS programs and grants, the North Jersey Resource Conservation and Development Council (NJRC&D) is promoting the River Friendly Farm Program throughout the Raritan Basin. Representatives from both these groups are available to make presentations and meet with landowners, and it may be practical for the community Agricultural Advisory Committee to host these programs. Visit the websites for additional information at

  River Friendly Farm Program
  http://www.raritanbasin.org/RaritanAg/RF_Farm/about.htm

  NRCS – Comprehensive Nutrient Management Plan
  http://www.nj.nrcs.usda.gov/programs/eqip/guidance2005.html#1.%20Nutrient%20and%20Pest%20Management%20System

Some watershed farming management alternatives suggested by the NRCS include:

Contour strips
Conservation tillage
Construction site erosion control
Filter or buffer strips
Terraces
Nutrient management
Pest management
Tree plantings
Irrigation water conservation
Home water conservation
Septic system maintenance
Alternative livestock watering sources
Roadside erosion control
Enterprise zones
Prime farmland protection
Private/rural road maintenance
Storm water management
Streambank stabilization
Constructed wetlands
Rotational grazing
Riparian zone management

7.10 Riparian Conservation Buffer Ordinances

The NRCS reports that a healthy riparian vegetation zone is one of the most important elements for a healthy stream ecosystem. Riparian areas perform a wide range of functions with respect to stream health, wildlife uses, and the economic and social values of people. The quality of the riparian zone increases with the width and the complexity of the woody vegetation within it. (NRCS SVAP, 1998) Functions and benefits of riparian areas include, but are not limited to the following (NJSWA Raritan Basin, 2000):

- Maintaining habitat for fish and other aquatic organisms by shading and moderating water temperatures, providing woody debris, habitat cover and detritus material;
- Storing flood waters, and dissipates energy during flood events thereby decreasing damage to property;
- Stabilizing stream banks and reducing channel erosion;
- Trapping/removing sediments, nutrients such as phosphorus and nitrogen, and other pollutants such as pesticides from runoff that can negatively affect aquatic ecosystems;
- Offering recreational and educational opportunities;
- Providing habitat for terrestrial organisms;
- Improving the aesthetics of stream corridors (which can increase property values);

7.10.1 Riparian Areas - State Regulations

In November 2007, the NJDEP adopted amendments to the Flood Hazard Control Rules (N.J.A.C. 7:13) that restricts disturbances within a 50 foot riparian corridor for freshwater-non-trout streams. This restriction was increased from 25 feet. The Amendments also increase the restriction to 150 foot wide riparian buffer for trout production and trout maintenance streams in rural areas, outside of the Pinelands or Highlands Planning areas. In addition, pursuant to the stormwater regulations (N.J.A.C. 7:8-5.5h) the NJDEP restricts disturbances within a 300 foot riparian buffer for streams designated as Category One streams, and the tributaries to these streams within the HUC 14 subwatershed area.

7.10.2 Category One Streams

Within the Sourland Watershed the state Category One 300 foot buffer restrictions currently apply only to Amwell Lake. In May 2007, the NJDEP proposed to designate portions of the Stony Brook as a Category One stream due to the presence of freshwater mussels; however, this segment is downstream from the Sourland Study area. The upper reaches of the Stony Brook encompass approximately 32% of the Sourland Watershed area, and several of the RSWMP partners submitted letters of support for the Category One designation to also include the upper reaches of the Stony Brook (Map 17, Appendix B). Copies of these letters of support are enclosed as Appendix G.

7.10.3 Delaware & Raritan Canal Commission

The state Delaware & Raritan Canal Commission (DRCC) also regulates riparian corridors along streams that are tributaries to the Delaware & Raritan Canal, and restricts disturbances within the a 100 foot buffer from the 100-year floodplain delineation. Within the Sourland Watershed this restriction applies to the Stony Brook in Hopewell, East Amwell and West Amwell Townships.

7.10.4 WQMP Riparian Conservation Buffer zone

Under N.J.A.C. 7:15-5.25(g)2, the Department is proposing to establish the minimum widths of riparian zones based on stream classification and other characteristics. These widths are also consistent with existing protections afforded in the Stormwater Management rules, N.J.A.C. 7:8 and the Flood Hazard Area Control Act Rules, N.J.A.C. 7:13.

- *Given the many important ecological functions that a healthy riparian zone provides, adequately preserving such areas is essential to protecting New Jersey's natural resources and water supply. The loss of soil and plant life that occurs adjacent to surface waters not only threatens public and private property, but directly impacts water quality and the health of fish and wildlife. Therefore the Department is requiring protection of additional riparian zones as follows:*
    - *150 feet along all trout production waters, and upstream tributaries to trout production waters, trout maintenance waters and tributaries within one mile upstream, waters flowing through areas that support certain threatened or endangered species and tributaries within one mile upstream; and*
    - *150 feet along all waters that flow through areas that contain acid producing soils.*
    - *a 50 feet riparian zone is required to provide a minimum level of protection for all regulated waters that are not Category one waters.*
    - *The Department proposes that compliance with the riparian zone standard be demonstrated by providing evidence of an ordinance adopted by the municipalities within a wastewater management planning area which prevent, with few exceptions, new disturbance for projects or activities (proposed at N.J.A.C. 7:15-5.25(g)3), Exceptions include redevelopment within the limits of existing impervious surfaces and new development necessary to 1) protect public health, safety or welfare, such as to clean up a contaminated site; 2) to provide an environmental benefit, such as a stream bank stabilization project; or 3) to prevent extraordinary hardship.*

7.10.5 Municipal Stream Corridor Ordinances

The Hunterdon County Growth Management Plan, completed in September 2007, reported that seventy-four percent(74%) of residents surveyed supported a 100 foot buffer along streams or rivers for water quality protection.

In addition to these state regulations, the local communities within the Sourland Watershed have also adopted municipal ordinances to protect stream corridors and water resources. In Montgomery Township, the stream corridors for Rock Brook and Cat Tail Brook are protected by the Critical Areas Ordinance and a restriction on a 100-foot buffer from the 100-year floodplain. In Hopewell Township the Stony Brook and Bedens Brook are protected by a 150 foot buffer from the center of the stream. West Amwell Township also protects portions of the Stony Brook with a municipal riparian buffer that restricts encroachments in the floodplain and protects buffers ranging from 75 feet to 150 feet depending on the lot size. Much of the riparian corridors in Hopewell Borough have been disturbed by housing or lawns, and the Borough does not have a riparian ordinance. East Amwell Township requires that a municipal permit be obtained if soil is being disturbed within 150 feet of a stream, such as Back Brook and Furmans Brook. This provides the municipality the opportunity to oversee the activity, but the ordinance does not truly preclude development, restrict disturbances, or require mitigation, as do the other municipal ordinances. Model ordinances to protect riparian corridors are provided on the websites for the Hunterdon County Toolbox and the Stony Brook-Millstone Watershed Association.

In summary, within the Sourland Watershed the streams vulnerable to existing and potential stream encroachments are Beden Brook (Hopewell Borough), Back Brook and Furmans Brook. The NJDEP 50 foot buffer identified in the regulatory amendments for the Flood Hazard and WQMP rules may not be sufficient to protect sensitive headwater streams and their critical habitats. Therefore, if communities do not adopt more stringent stream corridor ordinances, they can consider creating and adopting a voluntary *Sourland Watershed Greenway Plan*, described in the next section.

7.11 A Sourland Watershed Greenway Plan

"Greenways differ in their location and function, but overall, a greenway will protect natural, cultural, and scenic resources, provide recreational benefits, enhance natural beauty and quality of life in neighborhoods and communities, and stimulate economic development opportunities. Greenways enhance the sense of place in a community or region, and accentuate the scenic beauty and majesty of our state, and are a core component of strategies to foster health and wellness for all ages."

Pennsylvania Greenways: An Action Plan for Creating Connections,
Pennsylvania Department of Transportation, 2001
http://www.dcnr.state.pa.us/brc/gwplan.pdf
http://www.dcnr.state.pa.us/brc/publications/

"Greenways provide numerous direct and indirect ecological benefits to the communities in which they are located. Primarily, they function as protectors and preservers of our natural resources by:

- Preserving vital habitat corridors,

- Promoting plant and animal species diversity,
- Absorbing the contaminants from surface runoff,
- Cleansing and replenishing the air through trees and shrubs,
- Buffering the negative effects of development,
- Mitigating noise, water, thermal and air pollution, and
- Controlling property damage due to flooding."

Benefits of Greenways: A Pennsylvania Study
Pennsylvania Greenways Partnership Commission, 2002

In 1990 East Amwell reported that 450 acres were permanently preserved as farmland, and 450 additional acres were enrolled in the 8 year farmland preservation program. In 1999, preserved farmland had increased to over 3,093 acres or 17% of East Amwell Township. In 2004 the Municipal Assessment performed by SBMWA for East Amwell reported that the Township had successfully helped preserve approximately 30% or 6,000 acres as preserved farmlands. Many of these preserved farms also include stream corridors, wetlands, forested and grassland habitats, and this accomplishment has worked to protect and link environmentally sensitive lands in accordance with the goals of the Greenway Plan. Hillsborough Township is also implementing a Greenway Plan to preserve lands along the Neshanic River and Rock Brook.

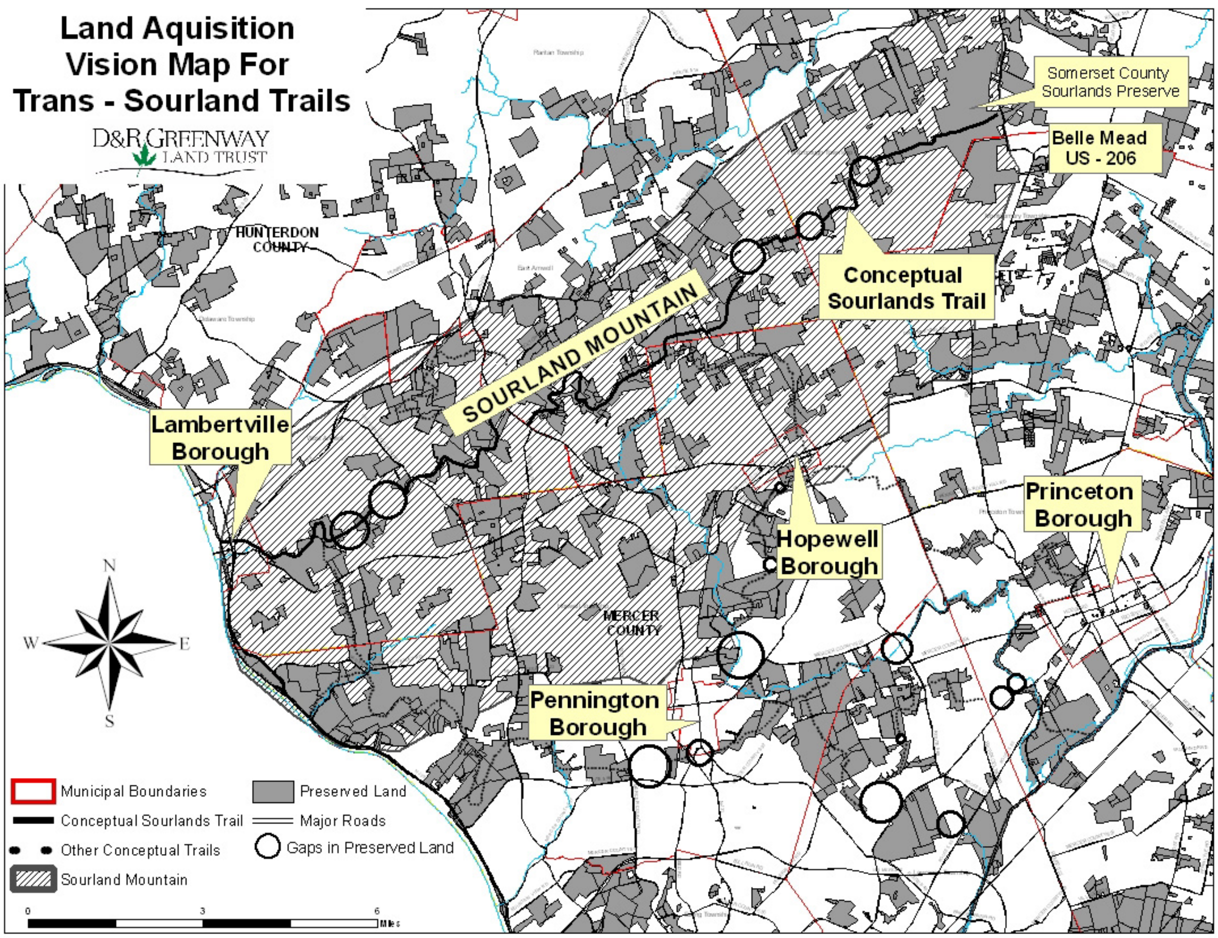
In October 1990, East Amwell Township adopted a Conservation Plan Amendment to their Master Plan which outlined a proposed East Amwell Greenway Plan. An updated Greenway and Open Space Element of the East Amwell Township Master Plan was completed in December 1999. The principal focus of the Greenway Plan is the protection and preservation of water resources, environmentally sensitive and significant natural areas, including wetlands, floodplains, stream corridors, woodlands, and steep slopes. The Greenway Plan is intended to serve as a guide for a network of preserved open space and greenway corridors to link natural areas and protect important water resources and their buffers.

The D& R Greenway Land Trust has made great strides towards acquiring lands to connect the proposed *Trans–Sourland Greenway Trail* across the Sourland ridgeline, as depicted in the map below. However, the Sourland communities should consider adopting a *Sourland Watershed Greenway Plan* with goals similar to East Amwell Township that would add greater emphasis on greenway connections along riparian corridors to preserve buffers, critical habitats and protect water quality. The Sourland Watershed Greenway Plan can identify and map priority habitat areas, historical and cultural features such as view sheds, and identify potential greenway connecting corridors along the waterways. (Appendix A, Figure I)

By promoting the stewardship of the Greenway buffer, landowners may come to understand that their property is part of a larger habitat area that needs preservation, and they may be encouraged to maintain the greenway buffer in a forested condition. By promoting the Greenway buffer, stewardship practices may be positively affected in order to obtain the desired compliance with local ordinances.

Specific to the Sourland Watershed Protection Plan this Greenway Plan approach can be identified as a strategic mitigation measure to reduce NPS loading and flooding hazards in the Sourland subwatersheds. This approach can cross municipal and county boundaries to satisfy local and regional goals. By officially adopting a Greenway Plan, organizing an advisory committee, and establishing monitoring criteria, the Sourland communities sanction these *regional preservation goals* and can reduce the disturbance of greenway corridors. This approach will also encourage developers and landowners to voluntarily preserve or donate lands along the greenway corridor, possibly 100-300 feet from local streams via a Conservation Easement. This Greenway Plan will encourage farmers to commit to Conservation Plans for lands identified in the greenway.

D& R Greenway – Sourland Trail Map



7.12 NJ Wildlife Action Plan for Freshwater Riparian and Aquatic Species – Freshwater mussels and Odonata

The NJDEP Bureau of Freshwater Fisheries are currently working on stream classifications through an integrated biotic index that may include freshwater mussels, non-game fishes and Odonata (dragonflies and damselflies) as obligate aquatic species ("that breed exclusively in aquatic habitat and occur in New Jersey's rivers, streams, lakes and ponds"). Water quality degradation, habitat loss and/or alteration and loss of essential riparian areas threaten species within these groups. The NJDEP reports that the next phase of the Landscape Project is the ***Riparian Landscape Project***, which will address these species. (NJDEP Wildlife Action Plan, 2007 - http://www.nj.gov/dep/fgw/ensp/waphome.htm)

Freshwater Mussels - The NJ Wildlife Action Plan recommends that additional investigations should be conducted to protect these rare freshwater mussels, such as: (NJDEP, 2007)

- long-term monitoring of their populations,
- public education and outreach,
- work with private landowners, government agencies and non-government organizations (NGOs) and conservation organizations to protect riparian areas through stream bank restoration efforts and land management practices.
- develop management plans that would include stream bank restoration, and increased water quality protection, and
- recommend stream classification upgrades to Category One designations to provide 300 foot stream buffers and anti-degradation protections for water quality.

Odonata (Dragonflies and Damselflies)- In regard to Odonata, the NJ Wildlife Action Plan also recommends that additional funding is needed for baseline Odonata surveys, with a focus on rare species within this taxonomic group. In addition, the NJDEP may begin mapping stream segments with endangered or threatened Odonata species present and seek Category One upgrades for these segments. Long term monitoring is necessary to evaluate trends of the Odonata population abundance, productivity and distribution of priority species.

8.0 EVALUATION OF TARGETED STRATEGIES FOR THE SOURLAND WATERSHED

8.1 Common Municipal Stormwater Compliance Issues

In July 2007, the USEPA reported the results of a stormwater management audit undertaken nationally to identify potential compliance issues among the 140 municipalities surveyed by the USEPA contractor Tetra Tech. Listed below are five of the common findings from this stormwater audit that should be addressed during the implementation of the Sourland Watershed

Protection Plan, and these items are included in the Targeted Stormwater Actions outlined in Section 8.5. (EPA Stormwater Audit, 2007)

1) Inadequate maintenance yard best management practices (BMPs). The USEPA identified this as the most prevalent program deficiency nationally, and identified **u**nprotected storm drains, lack of containment for potentially polluting materials, lack of spill-control measures, and generally poor housekeeping as important matters to address. The Sourland municipalities should use the NJDEP SWPPP checklist to inspect and maintain their maintenance yards. (www.njstormwater.org)

2) No Stormwater Pollution Prevention Plans (SWPPPs) developed for maintenance yards: NJDEP requires the Tier A Stormwater communities to develop a SWPPP to address potential pollutant sources from auto-maintenance shops, chemical-storage areas, truck-washing facilities, refueling stations, and other maintenance facilities and activities that can pose a threat to water quality. All of the Sourland communities should use the NJDEP Model SWPPP to identify potentially polluting concerns and activities, specific BMPs for each, and outline spill-control and response measures for their public works facilities. (www.njstormwater.org)

3) Inadequate inspections: Many municipalities in the national study had insufficient inspectors dedicated to inspecting and enforcing their construction or stormwater ordinance(s). The Sourland communities should ensure the implementation of construction BMPs and ensure that compliance-related activities are properly documented and tracked. These BMPs and inspections should also apply to public projects that may be exempt from the municipal oversight. The funding and training needed for these efforts is discussed in section 9.0.

4) Lack of training for personnel: Each municipality should ensure that their engineers or inspectors have been properly trained on stormwater related issues such as:

- identifying potential pollutant sources and appropriate spill response measures,
- identifying construction runoff including sediment, concrete washouts or fuel and appropriate response measures
- stormwater pretreatment,
- the NJDEP point system for LID measures,
- identify problems with individual BMPs, such as design flaws or poor maintenance
- fire safety, and
- train health department inspectors and/or public works staff to identify illicit discharges and stormwater violations

5) Not assessing measurable goals: Measurable goals are required by the USEPA for municipal stormwater programs. Since 2004, municipal progress on stormwater management has been measured by the completing the NJDEP Annual Stormwater Compliance Report to monitor their progress completing the State Basic Requirements. The Annual Compliance Report also provides an opportunity to audit the SWMP and identify ways to improve its implementation. In addition, this Watershed Protection Plan outlines measurable goals specific to the Sourland Watershed in section 9.0 that can be adopted by the stakeholders.

8.2 Stormwater Regulatory Design Criteria and Performance Standards

1. Residential Site Improvement Standards for Stormwater NJAC 5:21-7

It should be noted that while a Municipal Stormwater Ordinance regulates stormwater management for non-residential development, there are some questions regarding the authority of a Municipal Stormwater Ordinances over new residential developments versus the authority of the Residential Site Improvement Standards (RSIS) N.J.A.C. 5:21.7 adopted by the Department of Community Affairs (DCA) in June 2007 for stormwater management.

The NJDEP regulations N.J.A.C. 7:14A-25.6.iv(3)(A) states that municipalities shall:

- Adopt and implement a municipal stormwater control ordinance or ordinances in accordance with N.J.A.C. 7:8. The ordinance(s) shall control stormwater from non-residential development and redevelopment projects. Where necessary to implement the municipal stormwater management plan, the ordinance(s) shall also: (A) *Control aspects of residential development and redevelopment projects that are not preempted by the Residential Site Improvement Standards*.

Therefore, items that are not fully addressed by the RSIS *may* be addressed in a Municipal Stormwater Ordinance. This issue should be fully evaluated by the municipal land use planner and/or attorney. Some items that may not be fully addressed by the RSIS include: redevelopment concerns, reduction of Total Suspended Solids (TSS), soil suitability testing, impervious cover, and maintenance issues.

In addition, Section N.J.A.C. 7:14A-25.6(a) and (i) provide that at the permittee's discretion [the municipality], and to the extent allowable under law, the [municipal] stormwater program may also include Optional Measures (OMs), that prevent or reduce the pollution of waters of the State. Examples of BMPs that permittees may identify as OMs include BMPs for retrofitted stormwater treatment, road deicing, wildlife management, and fertilizer and pesticide management ordinances.

However, in order to ensure that the Municipal Stormwater Ordinance can apply to residential developments the Sourland communities can also consider applying to the DCA Site Improvement Advisory Board for a "*Special Area Standards*" in accordance with the procedures outlined pursuant to N.J.A.C. 5:21-3.5. These RSIS rules explain that the DCA recognizes the need for preservation and/or enhancement of community character in New Jersey municipalities, and therefore outlines the procedure whereby a municipality may develop supplemental or alternative standards in the form of municipal ordinances that would be reviewed and approved by the Site Improvement Advisory Board.

A *Special Area Standard* designation may be applied by a municipal ordinance to an area that exhibits a distinctive character or environmental feature that the municipality or regional municipalities have identified and expressed a desire to preserve and enhance. The following examples of a special area outlined in N.J.A.C. 5:21-3.5 would readily apply to the Sourland communities:

- Areas where environmental systems such as watersheds may require special environmental controls;
- Designated scenic corridors,
- Rural preservation areas including but not limited to designated Agricultural Development Areas, pursuant to N.J.S.A. 4:1C, and in support of the rural preservation policies of the State Development and Redevelopment Plan.

Obtaining approval from the DCA Site Improvement Advisory Board requires the submittal of 1) the municipal ordinance, 2) the rational for the deviations, 3) a municipal resolution, 4) a map of the special area, 5) a notice in the New Jersey Register, and 6) a public hearing with the Site Improvement Board. The information summarized in Section 9.0 of this Watershed Protection Plan should be sufficient to address item #2 rational for deviations, along with a map of the Sourland Mountain area.

2. Stormwater Design Criteria and Performance Standards

Based on the sensitive environmental conditions of the Sourland Watershed variations of the Stormwater Design Criteria and Performance Standards may be considered by the Sourland Communities in order to reduce pathogens, phosphorus and total suspended solids in these sensitive headwater streams to assist in the achievement of the established TMDLs for Rock Brook, and the stream segments they drain to including: Stony Brook, Beden Brook, and the Neshanic River. This section outlines examples of Design Criteria and Performance Standards that the Sourland Watershed communities can review and consider incorporating into their Municipal Stormwater Management Plans and Ordinances.

A. Applicability of the Stormwater Ordinance:

- The Stormwater regulations adopted by the NJDEP and the Department of Community Affairs Residential Site Improvement Standards (DCA – RSIS) apply to new development proposed after February 2004. Some communities have opted to require that all development, including redevelopment projects must comply with the municipal ordinances.
- East Amwell Township requires that all new site disturbances that are greater than one quarter acre shall trigger compliance with the stormwater ordinance.
- Stormwater regulations within the NJ Highlands Region require that any non-residential development shall comply with the stormwater regulation, regardless of the acreage disturbed.
- The NJ Highlands Rules also specify that residential redevelopment that will require environmental land use or water permits from the NJDEP shall comply with the stormwater regulations, including freshwater wetlands permits, stream encroachment permits, transition area waivers, etc.

B. Impervious Cover

- Gravel surfaces may be described as "impervious cover" based on test results in accordance with the Montgomery Township Stormwater Ordinance.

  "Impervious surface" means a surface that has been covered with a layer of material so that it is highly resistant to infiltration by water and has a CN value equal or greater than 76 for hydrologic soil group A, equal or greater than 85 for hydrologic soil group B, equal or greater than 89 for hydrologic soil group C and equal or greater than 91 for hydrologic group D.
- East Amwell Township defines gravel areas as impervious cover due to the resulting compaction over time.
- Reducing impervious cover for new and redevelopment projects is a beneficial low impact development strategy. Princeton Township adopted an ordinance that caps the amount of impervious cover allowed on a parcel on a sliding scale based on the size of the parcel and its existing impervious cover.

Note: The Montgomery Township Stormwater Ordinance is enclosed as Appendix E.

C. NPS Pollutant Reduction Rates

- The NJDEP stormwater regulations require that BMPs be implemented to reduce phosphorus loading as much as practical. Many of the BMPs specified by the NJDEP manual can achieve a 40% Phosphorus Reduction rate, and communities could consider adding this as a numerical standard.
- The NJDEP stormwater regulations require that BMPs be implemented to reduce Total Suspended Solids (TSS) pollutant loading by 80% in freshwater-non-trout streams (FW2-NT); and 95% TSS removal is required for Category 1 streams. Readington Township requires stormwater BMPs to achieve a 90% TSS reduction.

D. Stormwater LID Management Review

- The NJDEP has published a point system guidance document for developers to follow in order to demonstrate that their proposed stormwater management measures will satisfy the requirements for Low Impact Development (LID). The Montgomery Township stormwater ordinance requires the submittal of the NJDEP LID/Point System Forms rather than relying on voluntary compliance.

E. Permeability Testing

- The NJDEP stormwater regulations encourage stormwater management measures that infiltrate stormwater. The Montgomery Township Stormwater Ordinance offers significant details on groundwater recharge, soil testing and infiltration to ensure that stormwater infiltration is successful. The NJ American Water Resources Association (NJ-AWRA) Groundwater Subcommittee is currently working with NJDEP-DWM on standards for soil testing and groundwater mounding and this information is included in the Montgomery Township Ordinance. The NJDEP guidance document is expected to be released in the fall 2007.

F. Stormwater Maintenance

- The Montgomery Township Stormwater Ordinance emphasizes long term maintenance and requires that Homeowners Associations (HOA) will maintain ownership of stormwater facilities and perform routine maintenance, and a financial assurance is required (establishment of an escrow account) if it becomes necessary for the Township to assume the maintenance responsibility
- The East Amwell ordinance requires a non-binding agreement for long term maintenance and requires that records be filed annually with the township and allows for the dedication of the stormwater facility to the Township (An escrow account for maintenance is recommended).
- The Mulhockaway Creek Watershed Plan is currently being reviewed by the NJDEP and this report provides recommendations that could be considered by the Sourland communities, including:
    1. Required Maintenance Plans for existing stormwater basins
    2. Allow existing Stormwater basins in residential developments to be donated to the municipality, along with funding to provide for its long term maintenance and any needed repairs.
    3. Allow for the municipality to assess a tax to cover the costs for any repairs, mitigation, or long term maintenance of any Stormwater basin deeded to the Municipality or mitigation to any downstream drainage feature.

G. Mitigation Measures

- Several of the Sourland Municipal Stormwater Ordinances require that if stormwater mitigation is required, than the developer shall provide the stormwater management mitigation within the same HUC-14 watershed for which the subject project is proposed. Alternatively, the mitigation may:

  (1) Provide for funding toward an offsite or regional stormwater control project, if available and practicable, or

  (2) Fund an analysis to determine a more appropriate mitigation method to be presented to the Land Use Board for approval,

  (3) Provide for equivalent stormwater treatment at an alternate location,

  (4) Provide some other equivalent water quality benefit, if an on-site method is not proposed, provided the results required herein are achieved,

  (5) Provide additional groundwater recharge benefits,

  (6) Provide for protection from stormwater runoff quantity and quality impacts from previously developed properties that do not currently meet the performance standards,

  (7) Provide funding for long term maintenance of any mitigation measure.

  (8) Provide funding for environmental enhancement or purchase of environmental sensitive lands identified in the Township's open space plan.

H. Equine Operations

- The New Jersey Conservation Foundation (NJCF) recommends that the County Agriculture Development Boards and municipalities should be permitted to adopt more stringent standards for regulating equine operations**.** Section N.J.A.C. 2:76-2B.3 Eligibility of equine activities for right to farm protections, (c)3.i. states that "It shall be the responsibility of each county agriculture development board (CADB) to determine the permissible percentage of total usable area occupied by equine-related infrastructure based on the level of, or proximity of the farm to, non-agricultural development." The New Jersey Conservation Foundation (*NJCF) recommends that preserved farmland be limited to 5% impervious cover*.

- Section NJAC 2:76-21.10 Agricultural management practice for equine activities on commercial farms (d)3 requires a 100-foot buffer between manure storage and composting facilities and waters of the State. NJCF recommends that a 300-foot buffer be required, so that manure storage and composting facilities, and dumpsters storing manure, be located at least 300 feet away from waters of the State in order to safeguard water resources.

I. No Mow Riparian Zones

- During the field reconnaissance it was noted that existing residential, commercial and farming land owners mow their lawns to the top of the stream bank or drainage swales. While some local stream corridor ordinances restrict the clearing of vegetation (presumably woody vegetation), the ordinances do not specifically restrict lawn mowing. If a "25 or 50 foot no mow zone" was established or encouraged, these stream and drainage buffers would naturally revert to a landscaped cover over several years without any costs to the landowner or community. The native woody vegetation would filter and infiltrate stormwater runoff, resulting in better water quality and baseflow. If mowing along stream corridors continues, the streambanks may continue to erode, affecting water quality and water temperatures. The removal of invasive species such as multi floral rose, purple loosestrife, phragmites and autumn olive, that invade these riparian buffers, should be encouraged and is permitted activities within most stream corridor protection ordinances. It should be noted that the NJDEP draft fertilizer ordinance also identifies a 50 ft buffer as a preferred to limit fertilizer applications.

8.3 Potential Structural BMPs to Address Pollutants in the Watershed

Many of the observed problems with the watershed streams are associated with existing land uses and development, and the limited stormwater control systems and controls. Correction or mitigation of these impacts may involve the redesign, retrofit or upgrade of existing stormwater systems and controls to decrease sediment, nutrient and pollutant loadings. Potential structural stormwater strategies are highlighted in the Table 11, which were extracted from the 2005

USEPA Handbook for Watershed Restoration. This USEPA matrix rates bioretention basins, infiltration trenches, stormwater wetlands or wet ponds with a good or a high capability to reduce fecal bacteria and nutrients, which are a concern in this watershed. These methods would also help to infiltrate, recharge and/or retain stormwater in the subwatershed areas, which are also priority objectives identified for this Watershed Plan. For example, creating stormwater wetlands could reduce stormwater runoff, improve water quality, and positively affect downstream drainage channels. Conventional dry detention or extended dry detention would not satisfy the current NJDEP requirements for 80% TSS reduction or satisfy the NJDEP recharge requirements. Bioretention, infiltration trenches, and wet ponds should be evaluated as appropriate structural strategies that can be selected for site specific areas within the Sourland Watershed. Land availability and costs are critical considerations for these BMP strategies.

Table 11: Best Management Practice Screening Matrix (EPA 2005).

Structural Management Practice	Hydrologic Factor				Pollutant Factor				
	Interception	Infiltration	Evaporation	Reduced Peak Flow	Total Suspended Solids	Nutrients	Fecal Coliform Bacteria	Metals	Temperature
Bioretention	●	θ	θ	θ	●	●	●	●	●
Conventional dry detention	○	○	θ	●	○	○	●	θ	θ
Extended dry detention	○	○	θ	●	θ	θ	●	θ	○
Grass swale	θ	θ	○	○	θ	○	○	●	θ
Green roof	●	○	●	θ	○	○	○	○	●
Infiltration trench	○	●	○	θ	●	●	●	●	●
Parking lot underground storage	θ	θ	○	●	●	●	θ	●	●
Permeable pavement	θ	θ	θ	θ	θ	○	θ	○	θ
Sand filter	○	○	○	○	●	●	θ	●	●
Stormwater wetland	●	○	θ	●	●	●	●	●	θ
Vegetated filter strip with level spreader	θ	θ	○	○	θ	θ	○	θ	θ
Water quality swale	θ	θ	θ	θ	●	●	○	●	●
Wet pond	○	○	●	●	●	●	●	●	○

○ Poor, Low or No Influence
θ Moderate Influence
● Good, High Influence[1]

Standard catch basins were designed to transport storm water to receiving waterbodies as quickly as possible to avoid localized flooding, and they offer little positive impact on storm water quality. In contrast, water quality inlets along with manufactured treatment devices can convey stormwater yet provide some degree of pollutant reduction. And these measures should be considered for the Sourland watershed study area to decrease pollutant loadings to the Sourland streams. Water quality inlets are catch basins with an outlet invert pipe rise approximately 0.6 m

[1] The recommendations in Table 11 were based primarily on the following references: USEPA National Management Measures to Control Nonpoint Source Pollution from Urban Areas, NJDEP Stormwater BMP Manual, NYDEC Stormwater Manual on Structural BMPs, and the Connecticut Stormwater Manual.

(2 ft) from the bottom. By raising the outlet pipe, a retention volume is created within the basin. This sump helps to trap sediments by slowing storm surges and reducing the velocity of the inflowing runoff. Slowing stormwater flow allows for the settling of coarse and medium-sized sediment particles.

In addition to trapping sediments, water quality inlets may have the added effect of removing other pollutants such as heavy metals, petroleum hydrocarbons and, to a lesser extent, nutrients. These pollutants are removed because of their affinity towards binding with sediment particles. Removal of the sediments results in the removal of the adsorbed pollutants. The installation of an elbow hood or baffle to the sump basin further aids in oil and grease separation and the trapping and containment of floatables (paper, leaves and trash). This modification also minimizes the re-suspension of settled sediment particles trapped within the basin. Water quality inlets are unobtrusive and are compatible with standard storm drain networks. They can be easily accessed for maintenance and are capable of reducing pollutant loading from vehicular traffic, especially petroleum hydrocarbons. Disadvantages of water quality inlets include their limited stormwater and pollutant removal capabilities and the need for the frequent clean-out of accumulated sediments. The normal cleaning is done at least twice a year; once in the late autumn after leaf fall, and following the spring thaw once all deicing/snow clearing activities have ceased. Proper maintenance enhances pollutant removal and helps prevent re-suspension of trapped sediment particles

Manufactured treatment devices can be used with, or as a supplement to, an existing stormwater collection system. These devices are particularly well suited for the retrofit and/or upgrade of stormwater collection systems from impervious areas. The pollutant removal capabilities of these structures are limited largely to the removal of total suspended solids and floatables, and to some extent, particulate pollutants, including particulate phosphorus and the heavy metals and petroleum hydrocarbons that adhere to sediments. There is a variety of manufactured stormwater treatment devices recognized and approved by the NJDEP.

8.4 Septic Education and Management

In the Sourlands Study area, the soils are designated as either severely or most severely constrained for septic use, due to shallow bedrock, shallow water table, soil permeability or steep slopes. Housing and septic systems which were previously installed within floodplain areas or riparian corridors can also increase the risk to polluting either groundwater or surface waters. High-intensity land use activities that generate pollutants can include: aged and failing septic systems that are greater than 20 years old; leaking underground storage tanks; illicit connections to storm sewers, leaking sewer lines or malfunctioning pump stations; and livestock or inappropriate manure storage.

To help identify the housing density and locations, floodplain areas, and the results of the monitoring program for the Sourland communities aerial maps of each subwatershed were created (Appendix A, Figures III-VII). Based on this data and maps, subwatershed B for the

Stony Brook is the only area where pathogen contamination was not detected in surface waters. These maps may help local officials consider ways to improve educational outreach and management of these high risk septic areas as a cost-effective way to prevent or remediate the pollution problems identified in the streams, as well as minimize risks to potable groundwater wells.

Hunterdon County published a Growth Management Plan in September 2007 which recommended that, "Municipalities that rely predominantly on septic systems and wells should consider instituting septic management programs designed to encourage, if not mandate, routine, proper septic system maintenance and pumping by individual property owners. Aggressive educational outreach is essential to advance the importance of septic system maintenance and the impact of pollutants from septic systems on wells and surface water ecology."

In order to advance the goals of Hunterdon County and to address the potential septic leaching to the Sourland streams the following actions are suggested:

- Information relative to the age of housing, repair records, and pump-out frequency would also assist in understanding and reducing the risk of pathogen contamination in the streams. The NRCS Septic A-Syst Program offers a detailed survey program that municipalities and health officials can provide to their residents. Princeton Hydro modified this NRCS information into a concise 2 page survey that offers an opportunity for residents and officials to educate and better understand how maintenance practices can reduce their risk of contaminating water resources. This Septic System Survey Brochure could be mailed to residents and is included in Appendix H. (www.nrcs)

- The proposed amendments to the WQMP rules may require towns to update their wastewater management plans and increase the oversight and management of septic maintenance. Communities may encourage annual well testing, pump out requirements every 3 years, and encourage the replacement of failing systems where the depth to water table is marginal (less than two feet).

- **Septic Pump Out Voucher Program** – The Sourland communities could consider initiating a Septic Pump Out Voucher Program. Determine if State funding under the 319h or 604 b programs would be available to fund a local initiative to mail a $20 voucher program to all residents to assist and encourage homeowners to pump out their septic tanks. This would start as a "state model and a one time offer" and based on its success (monitoring the use of the vouchers) the NJDEP would consider annual programs in priority communities where water supplies are impacted by faulty septic systems. Note: Some local septic pumping firms already offer a $10 voucher for this $250 service and the NJDEP could partner with these firms. Another option is to partner with firms to obtain reduced group rates to pump their septic tanks.

- **NJ State Infrastructure Trust Financing** – The county or local health departments could consider securing state funding from the NJ Infrastructure Trust Fund to assist local businesses or residents to upgrade their aging septic systems by providing smaller low interest loans. Initially, the local officials could work with the NJDEP and NJ State Infrastructure Trust to host a forum and gauge local interest in obtaining these low interest loans. This forum could be hosted for all seven communities in the Sourlands, and financial planning would depend on the outcome of the forum.

8.5 Impacts from Fertilizer Use, Lawn Care and Livestock

Nutrient loading to surface water and groundwater resources are also be impacted from excessive fertilizer use and lawn care. The Table 12 reproduced from the *Wastewater Planning Handbook*, prepared by the University of Rhode Island Cooperative Extension identifies that a one-acre residential property can generate approximately 6.8 mg/l of nitrates from use of a septic system, lawn care and pets. However, if pet waste is managed and fertilizers are not used, this nitrate loading can be reduced in half to 3 mg/L, minimizing impacts to groundwater and surface water resources. Therefore, communities may want to consider adopting ordinances that restrict the use of fertilizers within areas of steep slopes, riparian corridors, floodplains, and stormwater basins; encourage soil testing before fertilizers are applies; and encourages the use of fertilizers that do not contain phosphorous. A NJDEP draft ordinance that restricts fertilizer use is available at the NJDEP website at:
http://www.state.nj.us/dep/watershedmgt/DOCS/TMDL/Fertilizer%20Application%20Model%20Ordinance.pdf

Farmers can play an important role in improving water quality in streams. The Hunterdon County Growth Management Plan, September 2007 reported that by 1999, some 14,000 acres in New Jersey were using best management practices on their lands through programs sponsored by the North Jersey RC&D, in partnership with the Natural Resources Conservation Service, Rutgers Cooperative Extension, and County Soil Conservation Districts, and the NJ Department of Agriculture. Additional outreach efforts and better stewardship practices can be achieved through these programs by assisting the NJRC&D promote the River Friendly Farm program which each municipality through their Agricultural Advisory Committees. In addition, farmers, land trusts and landowners should be encouraged to utilize available assistance programs through the Landowners Incentive Program (LIP) sponsored by the NJ Endangered and Nongame Species program (ENSP) and the various NRCS grants provided under the Farm Bill such as: http://www.nj.nrcs.usda.gov/programs/index.html

- Conservation Reserve Enhancement Program (CREP)
- Conservation Reserve Program (CRP)
- Environmental Quality Incentives Program (EQIP)
- Farm and Ranch Land Protection Program (FRPP)
- Grassland Reserve Program (GRP)
- Wetlands Reserve Program (WRP)

- Wildlife Habitat Incentives Program (WHIP)

In addition, the NJDEP should encourage the USDA-NRCS to monitor and provide statistics for these grant programs on a County basis in order to determine potential impacts to local watersheds and natural resources and the success of local efforts.

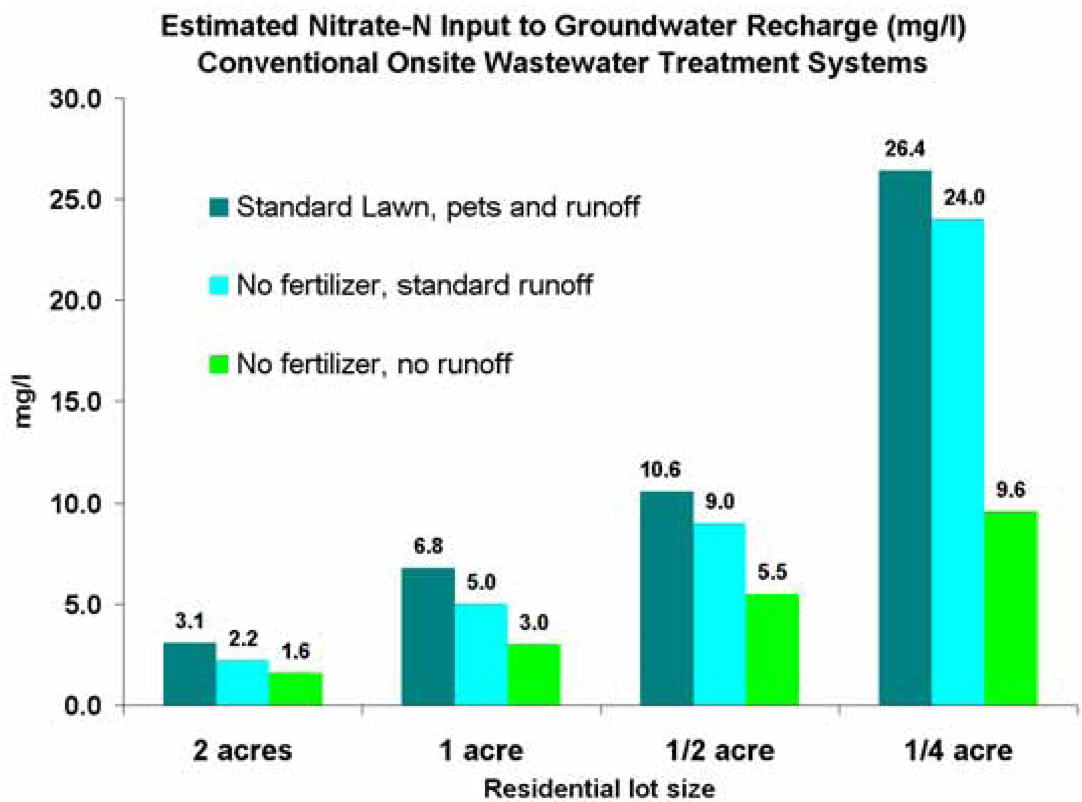


Table 12
Nitrate-Nitrogen Loading Estimates for Different Lot Size Densities Subject to Different Fertilizer and Runoff Management Options – from the Rhode Island

8.6 Screening of Management Alternatives

This section highlights appropriate recommendations for land use practices, regulatory measures, mitigation actions, stormwater BMPs, stream restoration measures, stormwater management technologies, and public outreach measures to address the targeted stormwater and watershed concerns. These target recommendations focus on the improvement of priority problem areas identified in the watershed related to the overall goals of: fishable and swimmable waters, improved water quality, maintenance of baseflow conditions, and the restoration of aquatic and riparian habitat. The recommended actions are summarized under three main watershed targets:

- TARGET A: Improved Stormwater Management
- TARGET B: Improved Water Quality and Aesthetics
- TARGET C: Improved Healthy Ecosystems and Resources

Within each targeted objective, there are possible five management strategies that can be implemented to meet the goals for the Sourland watershed RSWMP. These strategies include targeting the following types of opportunities and recommended actions:

1. **Planning and Policy/Agency coordination:** Participating in both regional (Phase II of the Sourland DCA Grant) and local planning initiatives to implement measure to preserve and protect natural resources, use ecological design principles, ensure partner coordination, and community input.
2. **Regulatory – Non-structural BMP Activities (ordinances):** Ensuring that state regulations and local land use and stormwater ordinances are adopted, implemented, and adhered to by the appropriate audiences of developers, and landowners.
3. **Restoration, Mitigation Projects and Maintenance:** Ensure that local officials and staff are properly trained to identify and address stormwater concerns and maintenance issues. Identify large and small-scale restoration activities that restore the stream corridors, streambanks, stormwater infrastructure and the surrounding landscape to improve the health of the watershed, and obtain the necessary funding to implement these measures. Ensure that a maintenance schedule is developed and implemented with appropriate funding
4. **Monitoring and Research:** Engage in the continued monitoring and research of ecological parameters and agreed upon milestones to ensure that water and natural resources of the Sourland watershed are maintained or improve.
5. **Education, Outreach and Stewardship:** Facilitate community education and involvement in all matters affecting the health of the watershed, and coordinate these actions with the various partners of the Sourland Watershed RSWMP.

By defining clear and achievable objectives and targets, the alternatives and implementation plan will have a higher likelihood of success. The recommended alternatives have been listed to address each of these targeted objectives to better identify their purpose and to ease their implementation. This approach is being successfully implemented pursuant to the Watershed Plan for Tookany Creek in Philadelphia PA. This list of targeted actions can also be used to identify milestones that have been addressed or completed.

8.7 Targeted Stormwater Actions

Target A : Stormwater Management

Regulatory Actions

AR1 *Upgrade the municipal ordinances to include the recommendations highlighted in Section 8.2 as Stormwater Design Criteria and Standard Performances.*

AR2 *Require that Stormwater Mitigation projects be implemented primarily within the same HUC 14 subwatershed or next closest area in order to reduce flood damage*

AR3 *Requiring Better Site Design and Review Procedures for Redevelopment Projects, and consider incentives to encourage native landscaping, stormwater management for all redevelopment*

AR4 *Adopt a municipal ordinance that address Impervious Cover restrictions, such as the sliding scale used in the Princeton Township Ordinance.*

- *Review municipal codes for any minimum size requirements for impervious surfaces, such as road and sidewalk widths.*
- *Limit the impervious cover connected directly to drainage systems by "Reducing Impervious Cover through Conservation Site Design" . Developers are free to choose a combination of methods to meet the required reduction in impervious cover, directing runoff onto depressed landscaped areas, tree credits, and structural BMPs.*
- *For redevelopment projects consider tying structural stormwater controls to the impervious area calculations as an incentive to reduce impervious area. (It may be more cost effective than installing structural stormwater BMPs.)*

AR5 *Promote LID measures to minimize soil disturbance and maintain large contiguous tracts of forest with an intact and diverse woodland understory*

AR6 *Ensure that new development and redevelopment along the Route 31 commercial corridor that drain to Amwell Lake, a Category One waterway, satisfy the regulations to maintain 300 foot buffers and provide for 95% TSS removal for stormwater management.*

AR7 *Encourage Porous Pavement, infiltration and or Subsurface Storage for all development or redevelopment, including on government owned properties*

AR8 *Encourage Green Rooftops in village centers such as Ringoes and Hopewell Borough*

AR9 *Encourage/ restrict a 25-50 foot no mow zone within the riparian corridor*

Municipal Restoration and Maintenance Measures

AM1 *Ensure that local officials and staff are properly trained to identify and address stormwater concerns, structural deficiencies and maintenance issues. Provide training to assist in the prioritization or ranking of these of structural deficiencies, and ensure that a maintenance and restoration schedule is developed and appropriate funding is available to ensure implementation of the needed repairs.*

AM2 *Assess the capacity of existing and proposed stormwater infrastructure, such as culverts and bridges, other in-stream structures and avoid exceeding the capacity*

AM3 Map infrastructure and outfalls and ensure proper functions. Perform Sewer and outfall inspections, cleaning and prioritize necessary rehabilitation
AM4 Perform catch basin and storm inlet maintenance
AM5 Perform Illicit Discharge, Detection, and Elimination (IDD&E)
AM6 Perform street sweeping and responsible bridge and roadway maintenance
AM7 Ensure all municipal Mitigation Lists encourage the repair of roadside swales, stormwater basin retrofits, streambank stabilization, aquatic habitat improvements, stormwater outfall and inlet restorations or retrofits
AM8 Perform stream cleanup and maintenance and consider implementing the streambank restoration projects outlined in section 8.6.
AM9 Enhance stream corridor recreational and cultural resources by responsible landscaping practices on public lands, such as the conservation of natural vegetation and/ or the establishment of vegetation, particularly native species
AM10 Maintain/Retrofit existing stormwater structures with plantings or bioretention
AM11 Complete monitoring, reporting, and identify needs for further study annually
AM12 Provide training for municipal staff on: roadway deicing, minimize use of salt/ and alternatives, and proper storage.
AM13 Provide training for municipal staff on the creation and maintenance of wet ponds, bioretention systems, vegetated swales, other stormwater BMP technologies.
AM14 Provide training for municipal staff on

- *identifying potential pollutant sources and appropriate spill response measures,*
- *identifying construction runoff including sediment, concrete washouts or fuel and appropriate response measures*
- *stormwater pretreatment,*
- *the NJDEP point system for LID measures,*
- *identify problems with individual BMPs, such as design flaws or poor maintenance*
- *fire safety, or*
- *train health department inspectors and public works staff to identify illicit discharges and stormwater violations*

AM15 Use the NJDEP Guidance to develop a SWPPP for all municipal maintenance yards to identify unprotected storm drains, contain potentially polluting materials, and address spill-control measures and housekeeping measures.
AM16 Ensure that implementation of construction BMPs and inspection procedures occur at public, capital improvement projects and satisfies state requirements. Ensure that compliance-related activities are properly documented and tracked to demonstrate that such activities were performed.

Public Educational Outreach

AE1 Encourage Residential, rain gardens and rain barrels, and possibly the use of dry wells in Ringoes and Hopewell Borough via educational brochures, workshops, and plans
AE2 Encourage the installation of rain barrels, rain gardens, porous pavement, native species herbaceous plantings in storm swales and basins, and other stormwater BMP

demonstration projects on public land, school sites, town hall, fire houses, public works yards, and within community parks

- *Include funding for these projects in upcoming budgets*

AE3 Provide educational materials to promote better stewardship of riparian areas by private landowners.

- *Promote existing educational brochures created by SBMWA on stream buffers, wetlands, vernal pools, rain gardens, and grassland birds.*
- *Provide website links and provide materials at community events regarding pathogen and nutrient pollution and measures to improve septic management and lawn care alternatives.*
- *Provide signage in community parks regarding the importance of riparian corridors, floodplains, stormwater management, wetlands, vernal pools, etc.*
- *Include funding for these projects in upcoming budgets*

Target B : Water Quality and Aesthetics

Planning and Policy Initiatives

BP1 Ensure that municipal officials and local Department of Health officials are aware of the TMDLs established by the NJDEP to reduce pathogens in local waterways, especially Rock Brook, Back Brook, Beden Brook and Stony Brook. Ensure that the TMDL reductions and recommendations are incorporated into the municipal stormwater ordinances.

BP2 Ensure that municipal officials are aware of the impairments reported by the NJDEP to water quality reported for phosphorous, Total Suspended Solids (TSS), and impairments to aquatic life (macro-invertebrates), especially in Back Brook, Beden Brook and Stony Brook.

BP3 Ensure that all development applications include measures that prevent and reduce pathogens, TSS and nutrients in these waterbodies, as well as prevent and/or work to improve the impairments to aquatic life.

BP3 Work with NJDOT and the County's to require modification and retrofit of existing highway stormwater management system if improvements are proposed for major roadways such as Rte 31, 518, 202, and 179, to address areas where streams banks have become eroded and or streams are impaired by road runoff.

BP4 Work with the NJDEP to develop a geese management plan for Amwell Lake and other ponds or areas where resident geese are a nuisance

- *Publish educational materials*
- *Install signage on public lands to enhance education on the importance of riparian buffers, septic management, land use practices, and geese management.*

BP5 Initiate studies and garner community support to enhance stream corridor recreational and cultural resources

BP6 Work with the NJDEP, NJ Geological Service (NJGS), local communities and the Stony Brook Millstone Watershed Association (SBMWA) to collect and document periods of *extreme low stream flow or no flow drought conditions, to improve documentation of base flow conditions in the headwater streams.*

BP7 *Continue participation in both regional (Phase II of the Sourland DCA Grant) and local planning initiatives to implement measure to preserve and protect natural resources, use ecological design principles, ensure partner coordination, and community input.*

BP8 *Maintain the continuity, commitment and coordination among the Sourland community partners by hosting annual meetings, joint training sessions, joint educational programs, etc*

BP9 *Encourage Hopewell Borough and East Amwell to adopt municipal stream corridor protection ordinance, and encourage the implementation of a Greenway Plan through the voluntary dedication of a Conservation Easement along a 100-300 foot buffer for streams in the Sourland communities. This is similar to the West Windsor Township Greenway Plan that has been successfully implemented for over twenty years.*

BP10 *Form and empower a municipal tree commission to:*

- *Advise community leaders and planners on enhancements to street trees, public lands and riparian areas and the review of landscaping plans for development projects*
- *Work with the municipal Agriculture Committee, NRCS and others on woodland management plans for farmland assessments*
- *Stimulate and organize tree plantings and maintenance*
- *Develop and implement a Community Woodland Plan that includes an inventory of public lands, community parks, riparian areas, and rights of way; stewardship plans; and ordinances*
- *Lessen liability by arranging to remove hazardous trees and repair damage caused by trees*

BP11 *Engage in the continued monitoring and research of ecological parameters and agreed upon milestones to ensure that water and natural resources of the Sourland watershed are maintained or improve.*

Regulatory Approaches

BR1 *Identify Floodplain Management Concerns to protect floodplain functions and prevent flood damage by enhancing safety management for residents, and restricting septic location and design*

BR2 *Recommend that all municipalities (East Amwell and Hopewell Borough) adopt a Stream Corridor Protection Ordinance in accordance with the Model developed by the Stony Brook Millstone Watershed Association (Appendix XX) or Passaic River model*

BR3 *Evaluate municipal ordinances to improve management of junk yards and illicit dumping*

BR4 *Improve On-Site Septic Disposal (Septic System) Management through education and or oversight*

BR5 *Create and implement a Municipal Illicit Discharge Detection Management Plan and test sewer infrastructure and streams for illicit discharges and non-point sources of bacteria.*

BR6 Recommend that all municipalities include wetlands, stream corridors and steep slopes in their definition of "critical areas" and that these critical areas be preserved from development and disturbances
BR7 Recommend that all municipalities consider adopting a low phosphorus fertilizer ordinance
BR8 Ensure that the technical review of applications for new or redevelopment projects completed by municipal officials should be paid for through developer or applicant fees.

Public Education, Outreach and Volunteer Programs

BE1 Share information from this Sourland Watershed report to ensure that municipal officials and local Department of Health officials are aware of the TMDLs established by the NJDEP to reduce pathogens in local waterways, especially Rock Brook, Back Brook, Beden brook and Stony Brook.
BE2 Increase Participation in Volunteer Opportunities (modifying behavior may be best achieved by involving residents in activities and volunteering rather than lectures).
BE3 Provide demonstration plots or projects on public lands and community parks, such as rain gardens to improve stormwater management and water quality
BE4 Improve On-Site Septic Disposal (Septic System) Management through education and or oversight

- *Provide educational brochures, signage, website information, and educational forums, community sponsored events*
- *Work with land owners to enhance water quality and reduce pathogens by 97% and meet water quality standards for pathogens as specified in the TMDLs established by NJDEP for Rock Brook.*
- *Work with land owners to enhance water quality to reduce pathogens to meet water quality standards for pathogens as specified in the TMDLs established by NJDEP for the Neshanic River, Stony Brook (96%), and Millstone River (97%).*
- *Improve septic education and septic management; and consider securing 604(b) funding to enhance these programs.*

BE5 Improve Farm and Livestock Management through education

- *Share this report and work with NRCS, North Jersey Resource Conservation and Development Council (NJRCD), and local Agricultural Committees to promote farming Conservation Plans, NRCS Grant opportunities, and the River Friendly Farming Certification Program to improve manure management practices and reduce nutrients in local waterways.*
- *Provide educational brochures, signage, website information, and educational forums, community sponsored events*
- *Work with land owners to enhance water quality to reduce pathogens to meet water quality standards for pathogens as specified in the TMDLs established by NJDEP for Rock Brook, the Neshanic River, Stony Brook, and Millstone River.*

BE6 Work with land owners to enhance water quality to reduce phosphorous and other nutrients that are impairing the Neshanic River, Beden Brook, Stony Brook and the Millstone River

- *Through public education encourage the use of low phosphorus fertilizer by landowners; and provide information on an "approved list of organic landscapers"*
- *Through public education and work with the NRCS, NJRCS, Agriculture Committees encourage improved livestock and manure management.*

BE7 Reduce debris and floatables in waterways through education concerning Ordinances for Improper Disposal of Waste, dumping, pet waste, and litter

- *Install additional signage in public areas to encourage compliance with litter laws.*
- *Provide community service opportunities for stream cleanups and watershed stewardship*

BE8 Assist in the development of a geese management plan for Amwell Lake and other ponds or areas where resident geese are a nuisance

- *Publish educational materials*
- *Install signage on public lands to enhance education on the importance of riparian buffers, septic management, and land use practices.*

Target C : Healthy Ecosystems and Resources

Planning and Policy Initiatives

CP1 Ensure that municipal and county Master Plans, Environmental Resource Inventories, Conservation Plans, and Open Space Plans incorporate the most up to date data from the NJDEP Landscape Project, including the recent updates on the potential occurrence of threatened and endangered species such as grassland birds, wood turtle, freshwater mussels, and Odanota (dragon flies and damselflies) species. Update municipal ordinances as necessary to reflect and protect these critical habitats.

CP2 Target Open Space Preservation to:

- *Protect streams and fragile ecosystems through the preservation of riparian corridors and large contiguous tracts of forest.*
- *Prioritize the preservation of lands and habitats of threatened and endangered species, identified by the NJDEP Landscape Project data layers and mapping.*
- *Work to create long term stewardship plans created specifically for each open space parcel preserved in the community*
- *Coordinate open space preservation and acquisitions on a regional level within the Sourland watershed through the County Green Table meeting programs.*

CP3 Complete Community Forest Plans to identify critical habitat areas. Detailed environmental inventories have been completed on the County parkland by the Washington Crossing Audubon Society. Invite them or similar organizations to complete additional inventories on lands acquired by the municipality, local land trusts, or lands preserved with Conservation Easements

CP4 Work with the NJDEP to restore vegetated buffers around Amwell Lake in the headwaters of Stony Brook

CP5 Increase Tree Canopy in streets and along streams, and include as potential Stormwater Mitigation Measure
CP6 Engage in the continued monitoring and research of ecological parameters and agreed upon milestones to ensure that water and natural resources of the Sourland watershed are maintained or improve.
CP7 Work with NJDEP, SBMWA, landowners and volunteers each spring to identify, assess, map and certify additional vernal pools within the Sourland Watershed

Channel Stability and Aquatic Habitat Restoration Actions
CR1 Perform Bank Stabilization and Habitat Restoration as outlined in Appendix XX
CR2 Ensure stormwater mitigation lists include the stream bank stabilization and restoration, stream buffer re-vegetation, re-forestation, or stormwater retrofits as outlined in Section 9.
CR3 Correct erosion sites, conduct stream stabilization projects and focus on the implementation of bioengineered solutions
CR4 Work with local Open Space Committees to identify areas where Invasive Species Management would be appropriate. Prioritize these locations and provide volunteer opportunities to control invasive species in the watershed.

Public Education and Outreach
CE1 Provide educational information related to the NJ Wildlife Action Plan to residents by:
- *Sharing this report and providing website links to the NJDEP report*
- *Providing educational material of rare species in the watershed at community events, through website links, promote existing brochures created by the SBMWA, and others.*
- *Encourage community contests for paintings or photos of these rare species and their habitats*

CE2 Provide volunteer opportunities related to NJ Wildlife Action Plan, such as biological surveying
CE3 Promote "no mowing practices until after July 15th" for large parcel landowners to improve the survival of nesting and fledgling grassland birds that are important in this watershed.
CE4 Encourage private landowners to allow the NJ Audubon and other groups to perform wildlife surveys to enhance the NJDEP Landscape Project database and the Raritan Piedmont Grassland Bird Project.
CE5 Encourage better coordination with the NJ Dept of Forestry on the development of forest management plans for landowners seeking farmland assessments, to ensure that critical habitats, wetlands and water resources are identified and protected
CE6 Maximize landowner involvement in programs that educate and reduce pathogens, nutrients in waterways, provide guidance on riparian corridors, manure and livestock management, and lawn care, such as the NRCS and NJRCD programs and grants.

9.0 CONCLUSIONS FOR THE SOURLAND WATERSHED RSMWP

9.1 Summary of Sourland Mountain Watershed Status and Problem Identification

Based upon the field studies, modeling, and data analysis, some of the priority issues and concerns identified in the Sourland Watershed include:

- Modestly undeveloped, intact riparian corridors exist in the *upper* segments of the Back Brook, Furmans Brook, Stony Brook, Beden Brook and Rock Brook watershed, with intact streambanks, good water quality and non-impaired biological communities. These headwaters support and maintain a diverse community of organisms with optimal habitat, good water quality, and good biological integrity, and should be protected and maintained to support these important ecological qualities.
- The headwaters of the Sourland Streams support state threatened species and vernal pools. In addition, the downstream portions of the Stony Brook support freshwater mussel, and these watersheds should be protected from measurable changes in water quality.
- The upper segments of Rock Brook and the *lower* segments of each of the Sourland streams including Back Brook, Furmans Brook, Stony Brook, and Beden Brook demonstrate degraded water quality by pathogens, reduced diversity of macroinvertebrate communities, degraded riparian corridors, slightly elevated nutrient levels, and segments of eroded streambanks. Except for Rock Brook, the detected concentrations of fecal coliform (pathogens) were slightly elevated above the NJ Standard of 200 MPN/100 ml.
- Water quality impairments occur from fecal coliform and slightly elevated nutrient levels occur in the watershed, and may be attributed to aging septic systems (>20 years) built in floodplain areas, and livestock management.
- Possible illicit discharges from sump pumps, laundry, and sinks are connected to storm sewers in the town centers of Ringoes and Hopewell Borough.
- Little stormwater management infrastructure actually exists within the Sourland watersheds, and the majority of the infrastructure that is present is not designed to manage runoff, but rather to route runoff into the stream as quickly as possible. Flooding events occur infrequently near residential homes and roadways built in the floodplains. Stormwater discharges from the villages of Ringoes and Hopewell Borough and major highways and roadways are likely contributing to the erosion of streambanks.
- Eroded streambanks are visible in the lower segments of the watershed streams which may have been caused by naturally erodible soils and steep slopes. Historic logging in the early 1900s, more than a century of farming in the area, and limited stormwater controls are also likely contributing to the erosion of streambanks.
- The field survey observations and pollutant loading analyses indicate that the majority of impacts are related to erosion and sediment loading. This is likely caused by historic logging and farming, and improper stormwater management and stream

corridor encroachment, resulting in bank erosion, sediment deposition, and bank instability. The secondary effects attributable to reduced biological diversity and nutrient enrichment may also be related to sediment loadings.

- Residential areas maintain segments of riparian corridors as mowed lawn areas with limited shade trees, likely increasing water temperatures and eroding stream banks.
- Public awareness and sense of stewardship for the watershed streams and wildlife habitat can be improved.

9.2 Recommended BMPs and Watershed Protection Strategies

One of the benefits of a regional Watershed Management Plan is the ability to identify the causes and impact from stormwater on downstream waterways that may be located in a different jurisdiction. The results of this Sourland Watershed Protection Plan identified various Best Management Practices (BMPs) for stormwater and land use practices within the Sourland Mountain watershed to raise public awareness, improve water and land stewardship practices, improve water quality, protect and enhance critical habitats. This entails the continued coordination of a variety of stakeholders including federal, state, county and municipal officials and agencies, environmental organizations and private land owners. The implementation of these actions and success of this plan is greatly dependent upon the continue commitment of these stakeholders and appropriate funding. Implementation will also be highly affected by ownership, public access, consent or willingness to place lands in conservation easements, availability of funding, ecological benefits, and costs.

A brief summary of the recommended BMPs and Watershed Protection Strategies are identified in order of priority and within the Appendix A summary tables and figures. In addition, several potential stream bank restoration projects have been identified. Details of these strategies are presented in Appendix A, including the length, height or extent of the restoration to facilitate a review of the magnitude of the problem and cost estimates. The proposed stream bank restorations would improve the riparian buffers, aquatic habitat and reduce sediment loadings; however, the reduction of pathogens in the Sourland Watershed streams is best addressed by more rigorous septic education and management, livestock management and riparian corridor protections.

It should also be noted that based upon a review of the 1930's aerials of this watershed, significant acreage has been converted from farmland to forest cover, and approximately 39% of the watershed remains forested today. Specifically the aerials for the Stony Brook and Rock Brook subwatershed appear much more forested today than 70 years ago, although actual acreage is unavailable. The eroded streambanks that are observed in the Sourland watershed today, may actually be a historic artifact caused by extensive logging that occurred at the turn of the century, and a century of widespread farming. Riparian corridors were likely less vegetated in the past, than under the current forested land cover and with the current regulatory oversight. Comparative aerial mapping from the NJDEP for 2002 and the 1930s is provided for each subwatershed area in Appendix J.

Runoff from the highways and roadways Rt. 202, Rte 31 or Rte 518 convey pollutants and storm surges, both of which impact the quality and condition of the streams immediately down gradient of these roadways. Structural BMP projects to manage storm runoff from the Rt. 202, Rte 31 or Rte 518 corridors are possible, similar to the stormwater improvements recently constructed at the intersection of Rte 31 and Rte 518. However, to design size and construct such a BMP will require a significant amount of funding, and could also involve a lengthy permitting and approval process. The first step would be a detailed hydrologic and hydraulic study of the storm flows generated by these roadways.

Additional upgrades to the existing stormwater infrastructure and controls may be possible and should be evaluated by the township engineers to improve stormwater runoff quality. Upgrades may include the modifying existing stormwater catch basins with the installation of water quality inlets or manufactured treatment devices. This should be considered for all public improvement projects, especially by the County and NJDOT, since the existing stormwater controls are very limited.

9.3 Prioritizing Tasks

The lists of management options described in the previous section were developed to meet each of the goals and objectives established for the Sourland Watershed. The implementation of these alternatives can be prioritized based on the following criteria adopted from the *Pennsylvania Growing Greener Watershed Assessments program:*

- Measurable Stream Improvement/Restoration (TMDL Strategies)
- Ecological benefit
- Community Support
- Land Owner Access and Cooperation
- Upstream to downstream Prioritization
- Permitting Requirements
- Site Constraints (topography, groundwater, wetland/stream encroachments, etc.)
- Anticipated Costs, Funding Means and Expected Time Frame
- Identify Project Partners for Implementation, Monitoring and Updating Progress

9.4 Funding and Financial Resources

Planning-level costs have been developed for some of the stormwater options being recommended; however, these costs are highly dependent on site specific conditions and size of the restoration areas. (Appendix A). Estimated costs have been provided in Table 13 for planning purposes only, in order to compare the implementation costs for the various strategies and to evaluate the magnitude of funding needs. The exact mix of BMPs and Restoration measures implemented in each subwatershed will likely be determined by each municipality and the availability of funding.

Probable funding sources include the NJDEP CWA 319(h) grant funds are available for implementation projects on public lands or lands under a Conservation Easement restriction. This funding limitation may help prioritize demonstration projects on municipal, county or state owned lands such as town hall, school sites, and parklands. This funding is available to assist municipalities in meeting the Phase II Stormwater requirements. In addition, The New Jersey Environmental Infrastructure Financing Program, which includes New Jersey's State Revolving Fund, provides low interest loans to assist in correction of water quality problems related to stormwater and wastewater management. Grant funding is also available from the NRCS for restoration projects for public and private landowners.

9.5 Public Education and Outreach

The continued protection and preservation of the Sourland Watershed region is contingent upon an educated audience of county and municipal leaders, residents, farmers and land owners, and the business community regarding various matters affecting the health of the watershed and its critical habitat areas, including:

- Improve communication, training and coordination among local, county, state governments, local committees, and environmental organizations for watershed related activities.
- Improve public education and raise awareness to promote stewardship of watershed resources, improve water quality, and reduce non-point source pollutants.
- Improve environmental and land conservation efforts by preserving open space, sensitive environmental areas and habitats by promoting such concepts as riparian buffer stream bank preservation and restoration, reforestation, floodplain preservation,
- Enhance the existing volunteer stream monitoring and restoration programs in this watershed offered by SBMWA, SPC, D&R Greenway Trust and the municipal committees.
- Celebrate successes to recognize noteworthy efforts, encourage participation, and continue the implementation of the Sourland Watershed Protection Plan
- Prepare and disseminate the Sourland Watershed information via:
    - Educational Displays and Brochures for community events
    - Demonstration projects
    - Watershed tours or hikes
    - Workshops and staff training seminars
    - Volunteer opportunities for cleanups, plantings, monitoring or stenciling storm drains
    - Local planning or ordinances efforts

The implementation of these actions and success of this plan is greatly dependent upon the continue commitment and coordination among the municipal partners and stakeholders of the Sourland Watershed Protection Plan. These groups can share the costs of these outreach efforts and work to ensure that a specific audience is reached with a targeted message. For example, NJRC&D can continue to work with the municipal Agriculture Advisory Committees and local farmers, while SBMWA, the Sourland Planning Council or the D& R Greenway Land Trust can work with volunteers and Environmental Committees on cleanups, invasive removals, plantings, rain gardens or sampling. Semi-annual meetings should be hosted to monitor the implementation progress and local community events should be targeted to disseminate general educational information, update the community on the implementation of specific projects, and to recognize or honor volunteers or stakeholders working on completed project tasks, possibly at an Annual Sourland Mountain Picnic or festival.

Several educational outreach examples are provided in Appendix E, including a Septic Management Survey, Farm Conservation Plans, River Friendly Farms, and Vernal Pools.

In 2005, Hunterdon County conducted surveys on the needs and use of recreational facilities, and through this work the County identified the outreach options most preferred by residents. As listed in Table 14, the most effective outreach modes were mailing newsletters, newspaper ads or articles, and internet emails and websites. These options could be employed as outreach mechanisms for the information in this Watershed Protection Plan. It should also be noted that members of the Sourland Stakeholders identified that mailing to residents with their annual tax bills was deemed as the most read and most effective communication tool.

Table 13: Hunterdon County Opinion Survey on Recreation, December 2005

	Effective	**Not Effective**	**Not Sure**
Mailing Newsletters	81%	7%	12%
Newspaper Ads	69%	15%	16%
Internet email, and website publishing	56%	21%	23%
Brochures, flyers or posters at public facilities	41%	31%	28%
Flyers sent home from school	40%	49%	11%
TV and Radio media	32%	39%	29%

9.6 Long Term Monitoring Plans

To measure the success of this Watershed Protection Plan a variety of milestones and measurable criteria have been suggested that are related to five basic strategies: Planning and Agency Coordination, Regulatory Activities, Mitigation Projects, Monitoring, and Education. It is recommended that communities can track their progress on implementing the various aspects of this Watershed Protection Plan by summarizing their activities in the Annual Reports to NJDEP for Municipal Stormwater Plans and in any updates to municipal master plan documents.

1. **Planning and Policy/Agency Coordination:**
   - Assess participation in both regional (Phase II of the Sourland DCA Grant) and local planning initiatives to implement measure to preserve and protect natural resources, use ecological design principles, ensure partner coordination, and community input.

- Assess the implementation of the measures recommended in the 2002 Planning Strategies for Conservation and Resource Protection on the Sourland Mountain (Banisch Associates), Hunterdon County Toolbox and the Phase II of the DCA Smart Growth grant.
- Assess acres of preserved open space and farmland compared with the remarkable 6,000 acres already preserved in the watershed.
- Assess NJDEP land use and land cover data to determine loss of forest, farms, and wetlands over time
- Assess the creation of Tree Commissions, Community Forest Plans, Woodland Protection Ordinance and the development of stewardship plans for public lands.
- Assess the current zoning relative to maintaining the NJDEP proposed groundwater nitrate level of 2 mg/L.

2. **Regulatory – Non-structural BMP Activities (ordinances):**
   - Assess the adoption of local land use and stormwater ordinances related to stormwater infiltration, impervious cover limits, redevelopment projects, septic management, etc.
   - Assess actions from the local Dept of Health regarding improved septic management or septic replacements, wells testing data and mapping to identify areas of potential water supply concerns.
   - Ensure that Master Plans and other municipal documents are updated every six years to incorporate all the recommendations provided in the Sourland Watershed Protection Plan.
   - Increase protection of vernal pools in the Sourland Mountain region, which are currently protected by the NJDEP Wetland Rules with a 50 or 150 foot buffer. This limited protection could potentially subject these salamander and frog populations to degradation from future development. The Sourland communities should consider the following options:
     - Petition the NJDEP to amend the Freshwater Rules and extend the protective buffer to 1,000 feet for all vernal pools, regardless of its location or presence of threatened and endangered species, as recommended by the Highlands Council.
     - Adopt local ordinances for the protection of vernal pools with a 1,000 foot buffer.
     - Adopt an objective in the Municipal Conservation Plan that encourages private land owners to identify vernal pools, obtain NJDEP certification of these vernal pools and voluntarily restrict disturbances within a 1,000 foot buffer.

3. **Mitigation, Restoration, Projects and Maintenance:**
   - Assess the obligation of funding and implementation of large and small-scale stormwater demonstration projects; restoration activities that restore the stream corridors, streambanks, stormwater infrastructure and the surrounding landscape to improve the health of the watershed.
   - Assess the obligation of funding and timely implementation of stormwater maintenance projects.

4. **Monitoring and Research:**
    - Routinely assess and compare baseline data for water quality parameters for pathogens, nutrients, and TSS.
    - Assess populations and diversity of macroinvertebrates, Odonata, freshwater mussels, and fish species
    - Assess populations and diversity of other rare species important to this watershed including wood turtle, salamanders, frogs, grassland birds, and other interior forest birds.
    - Increase the number of vernal pools that become identified and certified.

5. **Education, Outreach and Stewardship:**
    - Assess the training provided to local officials and staff related to stormwater and other watershed concerns.
    - Assess the number and public participation in community sponsored workshops, events, and volunteer stewardship opportunities
    - Assess the dissemination of the educational materials to municipalities, environmental organizations and landowners regarding smart growth initiatives, water conservations, stormwater management, riparian corridor protection, septic management and open space preservation.
    - Assess the number of landowners and farms that adopt NRCS Conservation Plans, obtain NRCS grants and/or become River Friendly Certified by NJRC&D. Request that NRCS and NJRC&D share this information routinely with local Agriculture Committees.

9.7. Consistency with Other Plans and Regulations

This Draft Sourland Watershed Protection Plan is consistent with the NJDEP regulations for stormwater management (N.J.A.C. 7:8), Regional Stormwater Plans, Residential Site Improvement Standards (RSIS) N.J.A.C. 5:21, NJDEP established TMDLs, State Plan, NJ Wildlife Action Plan (Feb 2007), Municipal Land Use Laws (MLUL), Municipal Stormwater Management Plans and Ordinances, local Master Plans, the Raritan Basin Watershed Plan, and the DCA Smart Growth Initiative. In addition this Watershed Protection Plan has considered and included provisions in the recently adopted Flood Hazard Mitigation Rules, (N.J.A.C. 7;13) and the Water Quality Management Plan Rules (WQMP) N.J.A.C. 7:15. The Draft Sourland Watershed Protection Plan will also be consistent with the past and current conservation and preservation efforts of the regional Sourland Mountain stakeholders to protect the surface and groundwater resources, preserve habitat for threatened and endangered species, better manage development within the watershed, prevent loss of baseflow and reduce stormwater pollutant loading, and preserve the rural and agricultural nature of the watershed.

9.8 Watershed Plan Adoption Process

As mentioned previously, while forty-nine (49) governmental offices and organizations were invited to participate in the creation of the Sourland Regional Stormwater Management Plan (RSWMP), only eleven groups routinely participated in the meetings and review process. Therefore, full endorsement of a RSMWP was considered unlikely, and the report received approval from the NJDEP in October 2007 to be modified as the Sourland Mountain Watershed Protection Plan. Based on the findings and recommendations in this report, each municipality is requested to modify their stormwater plans or ordinances as suggested in the Watershed Protection Plan.

East Amwell Township, as the designated Lead Planning Agency, will work in concert with the NJDEP and to host a public hearing to present the findings and recommendation of the Sourland Watershed Protection Plan, and provide for a minimum 30-day public comment period. Following the pubic hearing and comment period, the plan will be officially adopted by the NJDEP. Each municipality within the Sourland Watershed Study area will be informed and invited to attend the meeting and provide comments. Upon adoption of the Watershed Plan, the NJDEP could highlight it on the NJDEP Watershed Management website, and NJDEP may provide notice in the New Jersey Register; however, this action may not be required for Watershed Protection Plan.

It was also noted that while the County Planning and/or Engineering offices participated in the Watershed plan and RSWMP proceedings, the County Soil Conservation Districts did not. In the future, better coordination with the County Soil Conservation Districts, the NRCS, and the NJRC&D should be encouraged.

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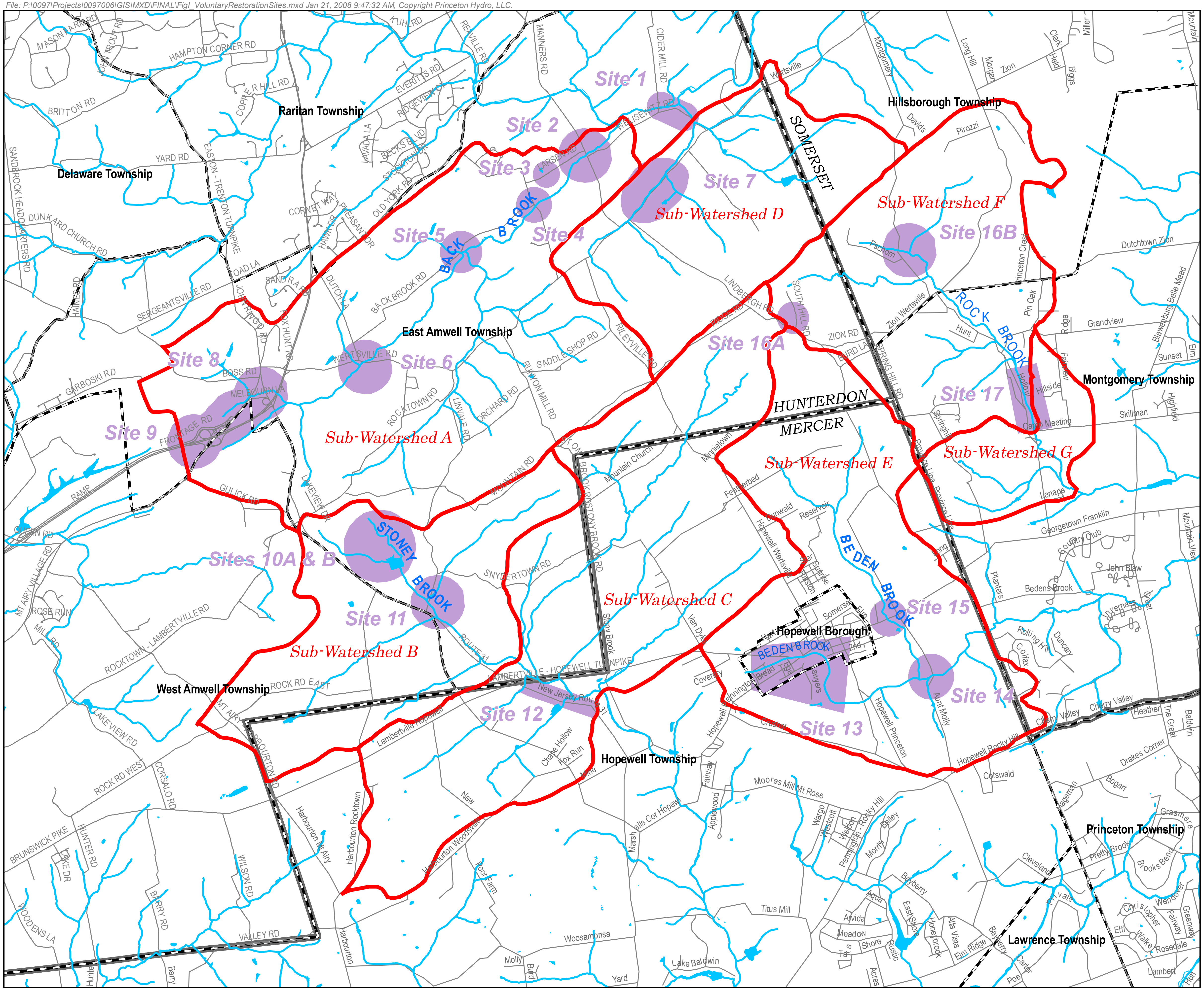
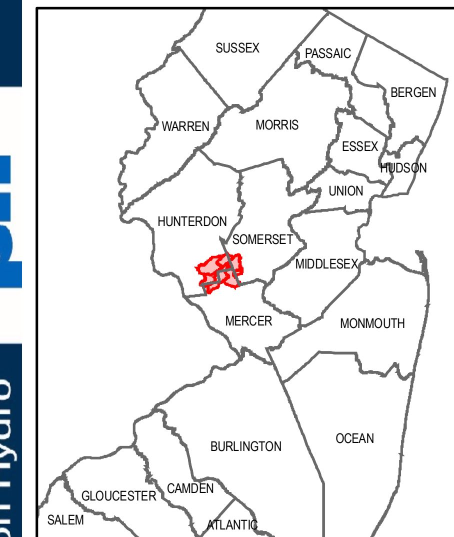


Princeton Hydro

NEW JERSEY COUNTY MAP



PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551

N

0 2,500 5,000 Feet

1 inch equals 5,000 feet

SOURCES:

1. Roads are the Tiger/Line Files, US Census Bureau except for Hunterdon County, which data was obtained from the Hunterdon County GIS webpage

FIGURE I: VOLUNTARY RESTORATION AND MITIGATION SITES

SOURLAND MOUNTAIN WATERSHED PROTECTION PLAN

Legend

- Project Area
- Potential Restoration Sites
- Lakes
- Streams
- Roads
- Municipal Boundaries
- County Boundaries

Sourland Watershed Protection Plan
Table A-1: Recommendations, Delegation, Schedule and Costs

BMP Action	Tasks	Responsible Party	Timeframe	Costs / Funding Sources
1. Sourland Watershed Protection Plan	Present the findings of the Watershed Plan at a public meeting and solicit public comment.	NJDEP/ County / WQMP Designated Agency/ Sourland Municipalities	3 months	Not applicable
2. Education and Outreach	• Develop Sourland Watershed displays for local events • Lawn care demonstrations • Demonstrations in parks or public lands	Each Municipality And Local Environmental Organizations	3mths -2 yrs Dependent on funding.	$3,000 Grant funding should be pursued and shared on the regional basis.
3. Stormwater Ordinances	Update Stormwater Plans and Ordinances as suggested below. • Address all development, including redevelopment • Address proper soil testing to ensure success of infiltration systems • Update Mitigation Plans to include stormwater improvements on public lands, streambank restorations, and drainage improvements on local roads. • Require maintenance plans for existing stormwater basins and controls • Allow for basins to be donated to the municipality, along with a source of funding for long term maintenance. • Request a Special Area Standard designation from the DCA- Site Improvement Advisory Bd to allow for more stringent SW regulations.	Each Municipality/ County and NJDEP Review	6 months – two years	$5,000 per municipality for Attorney and Planners fees
4. Land Use Ordinances	Update Municipal Master Plans and Land Use Ordinances to: • Minimize tree clearing and address woodland protection by adopting community woodland plans, and more restrictive wood clearing ordinances.	Each Municipality	6 months – two years	$5,000/ municipality Attorney and Planners fees
5. Septic Management	Improve septic management by: • Provide $20 septic pump out vouchers • Mail septic survey to garner information voluntarily on age, condition of septic systems and management practices. • Consider adopting DOH management options • Perform bacteria monitoring (MST)	Each Municipality/ County and NJDEP	6 months – two years	$70,500 for East Amwell Twp model septic voucher program, outreach and MST monitoring.

Sourland Watershed Protection Plan
Table A-1: Recommendations, Delegation, Schedule and Costs

BMP Action	Tasks	Responsible Party	Timeframe	Costs / Funding Sources
6. Adopt Greenway Plan	• Organize and develop a Greenway Plan to promote buffer stewardship	Each Municipality County And Local Environmental Organizations	6 months – four years	$30,000 for Watershed wide program for plan, mapping, adoption, and outreach promotion
7. Promote Agriculture Land Stewardship	• Create Conservation Plans for 20 farms as a model for others.	Each Municipality/ County NRCS NJRC& D NJDEP	6 months – four years	$32,000 for Watershed wide program
8. Demonstration Rain Gardens	• Improve stormwater management on public lands • Demonstration rain gardens in parks or public lands – *e.g. Schools, Town Hall, South County Park* • Involve youth and civic groups in community events	Each Municipality County And Local Environmental Organizations	2-5 years Depending on funding availability.	$55,500 for rain gardens and SW controls
9. Stream Bank Erosion Study	• Oversee volunteers measuring streambank erosion over a one year period using rebar stakes, especially for Rock Brook, Beden Brook and Furmans Brook. • Conduct limited hydraulic studies and field surveying • Install bank plantings	Each Municipality County And Local Environmental Organizations	1-2 years	$46,000 for studies, surveys, volunteer mgmt, installation of limited plantings, permits and monitoring
10. Streambank Restorations and Infrastructure Repairs	Major Restoration Projects • Welisewitz Park –Back Brook • Amwell Lake – Stony Brook • Aunt Molly Rd - Beden Brook • Camp Meeting Rd - Rock Brook • Van Lieus Bridge – Back Brook • Wertsville Rd – Back Brook	Each Municipality And Local Environmental Organizations	> 2-5 years Depending on funding availability.	$145,500 -Welisewitz Park $ 95,500 - Amwell Lake $ 56,500 -Beden Brook, $105,000 - Rock Brook $69,500- Van Lieus Bridge, $36,500 -Wertsville Rd

Project Name: Sourland Septic Management Back Brook, Furmans Brook and Stony Brook Watersheds **Priority: 1**	**Ownership:** Public/ Private / Conservation Easement Address/ Block & Lot : Jurisdictions: East Amwell

1. Project Description:

Elevated levels of pathogens have been detected in these three watersheds, and TMDLs to reduce pathogens have been approved by NJDEP for downstream portions of Stony Brook and the Neshanic River. Promote routine septic pumping by providing $20 discounts or vouchers for these services. Partner with the NJDEP to obtain funding and local septic firms to promote pump out vouchers.

2. Recommendations:

- **Septic Pump Out Voucher Program** –East Amwell is willing to work with the NJDEP on a septic voucher program to obtain funding to mail a $20 voucher program to all residents to assist and encourage homeowners to pump out their septic tanks. This would start as a "state model and a one time offer" and based on its success (monitoring the use of the vouchers) the NJDEP would consider annual programs in priority communities where water supplies are impacted by faulty septic systems. Note: Some local septic pumping firms already offer a $10 voucher for this $250 service and the NJDEP could partner with these firms.
- **Microbial Source Tracking (MST)** – A second phase of this effort will include additional stream sampling in Back Brook, Furmans Brook, Stony Brook and Rock Brook to better identify the levels and sources of the pathogens. The NJDEP has approved TMDLs for the reduction of pathogens in downstream segments of these water bodies. Better documentation of the pathogen sources, will increase the success of their reduction to satisfy the TMDLs. For example, elevated pathogen levels at station #10 on the Stony Brook may be caused by faulty septic systems, a summer camp or local horse farms**.**
    - Quantitative Polymerase Chain Reaction (qPCR) is a new technology that uses a "thermal light cycler" to measure the quantity of Deoxyribonucleic acid (DNA) present in a given sample that is unique to an organism. This procedure serves to detect and count *Enterococci* bacteria in water, which serves as an indicator of the presence of other more harmful fecal related bacteria. Samples will be analyzed for E coli and qPCR, as well as water quality parameters and nutrients.

3. Anticipated Benefits:

- Routine septic pumping would be encouraged and can be monitored.
- Based on the success (monitoring the use of the vouchers) the NJDEP could use this model program in priority communities where water supplies are impacted by faulty septic systems.
- The MST sampling will help identify and eliminate pathogen sources and work to satisfy TMDL reductions. The results of this work will also be a model for other watersheds.

4. Implementation Concerns:

- The pump voucher program would require professionally designed promotional mailings, accompanied by news articles.
- The qPCR methodologies are very new and the appropriate partners and labs must be coordinated.

5. Task Descriptions	**Implementation Costs**
a. Professional Designed mailings and vouchers	$ 5,000.00
b. Mailing cost to 1,000 residents	$ 500.00
c. $20 voucher for 1,000 residents	$20,000.00
d. MST sampling using qPCR technologies at 10 stations for four events.	$45,000.00
Total	**$ 70, 500.00**

Project Name: Sourland Greenway Plan **Priority: 2** Map ID: 8	**Ownership:** Public/ Private / Conservation Easement Jurisdiction: Sourland Communities

1. Project Description:
Seek funding towards the creation of a *Sourland Mountain Watershed Greenway Plan* that would emphasize greenway connections along riparian corridors in order to preserve buffers, critical habitats and protect water quality.

2. Recommendations:
- Partner with communities, D&R Greenway Land Trust, SPC, SBMWA and others to create an inventory and baseline GIS mapping that identifies existing open space, riparian corridors, priority habitat areas, historical and cultural features such as view sheds, and identify potential greenway connecting corridors with residential areas.
- This Greenway partnership would also create goals and objectives for the greenway plan, address monitoring easements, and stewardship concerns. This Greenway buffer could include a 100 foot width or more.
- By adopting and promoting a Greenway Plan along stream corridors, the effort can educate property owners about the potential impacts to water quality and benefits of preserving stream corridors. By promoting the stewardship of a Greenway Buffer may help landowners realize that their property is part of a larger habitat area, and encourage them to maintain the stream corridors in a forested condition. In other words, maintaining a regional Greenway Buffer may appeal to landowners more than being required to comply with restrictions under a municipal stream corridor ordinance. This effort may positively affect the behavior and stewardship practices of the landowner, and obtain compliance.

3. Anticipated Benefits:
- By officially adopting a greenway plan, organizing an advisory committee, and establishing monitoring criteria, the Sourland communities sanction these *regional preservation goals* and can reduce the disturbance within the greenway corridors. This approach may also encourage developers and landowners to voluntarily preserve or donate lands along the greenway corridor, via a Conservation Easement. This Greenway Plan may encourage farmers to commit to Conservation Plans for lands identified in the greenway.
- Specific to the Sourland Watershed Protection Plan this greenway plan approach can serve as a strategic mitigation measure to reduce NPS loading and flooding hazards in the Sourland subwatersheds. This approach can cross municipal and county boundaries to satisfy local and regional goals.
- Maintaining forested buffers will stabilize stream banks, reduce erosion and sedimentation, which is likely the current cause of the impaired macroinvertebrate diversity. Forested buffers will also reduce runoff and potential pathogens from horse farms.
- Stream cleanups, stream bank plantings, easement monitoring, stream sampling may be easier to organize and promote in order to protect the Greenway Buffer.

5. Implementation Concerns:
- Each community has different stream corridor restrictions and the Greenway partnership will need to determine the appropriate width of the Greenway Buffer, which could extend from 100 feet, or more. This buffer could also have different widths for different stream segments.
- Each municipality would be encouraged to adopt the Greenway Plan as part of their Open Space Plan. Compliance by landowners would be sought primarily through educational outreach. Enforcement would be managed by the individual municipalities and through site plan reviews. Easements would be recorded with each municipality.

5. Task Descriptions	**Implementation Costs**
a. Inventory and create GIS maps of all the existing open space and *conservation easements* in the region. Township wide.	$ 8,000.00
b. Categorize habitats or environs that they encompass or are intended to protect.	$ 3,000.00
c. Develop a checklist and conduct baseline field assessments the buffers and each conservation easement. Identify critical habitat areas, and stewardship concerns such as erosion, invasive species, or disturbances. Photograph and prepare a baseline report for the Greenway Plan.	$ 10,000.00
d. Develop recommendations for a long term monitoring and stewardship program that could be conducted with volunteers and local public works staff. Include some field work and oversight by ecological professionals to ensure the appropriate care of critical habitats.	$ 4,000.00
e. Create a Greenway Plan brochure for distribution to landowners that have easements on their properties, this would be given out with building permits and could be distributed periodically with tax bills, and made available at the Municipal building and website.	$ 3,000.00
f. Prepare a check list for use by the building inspector or zoning officer, if they need to inspect a property within the Greenway Buffer, or with a conservation easement.	$ 2,000.00
Total	**$30, 000.00**

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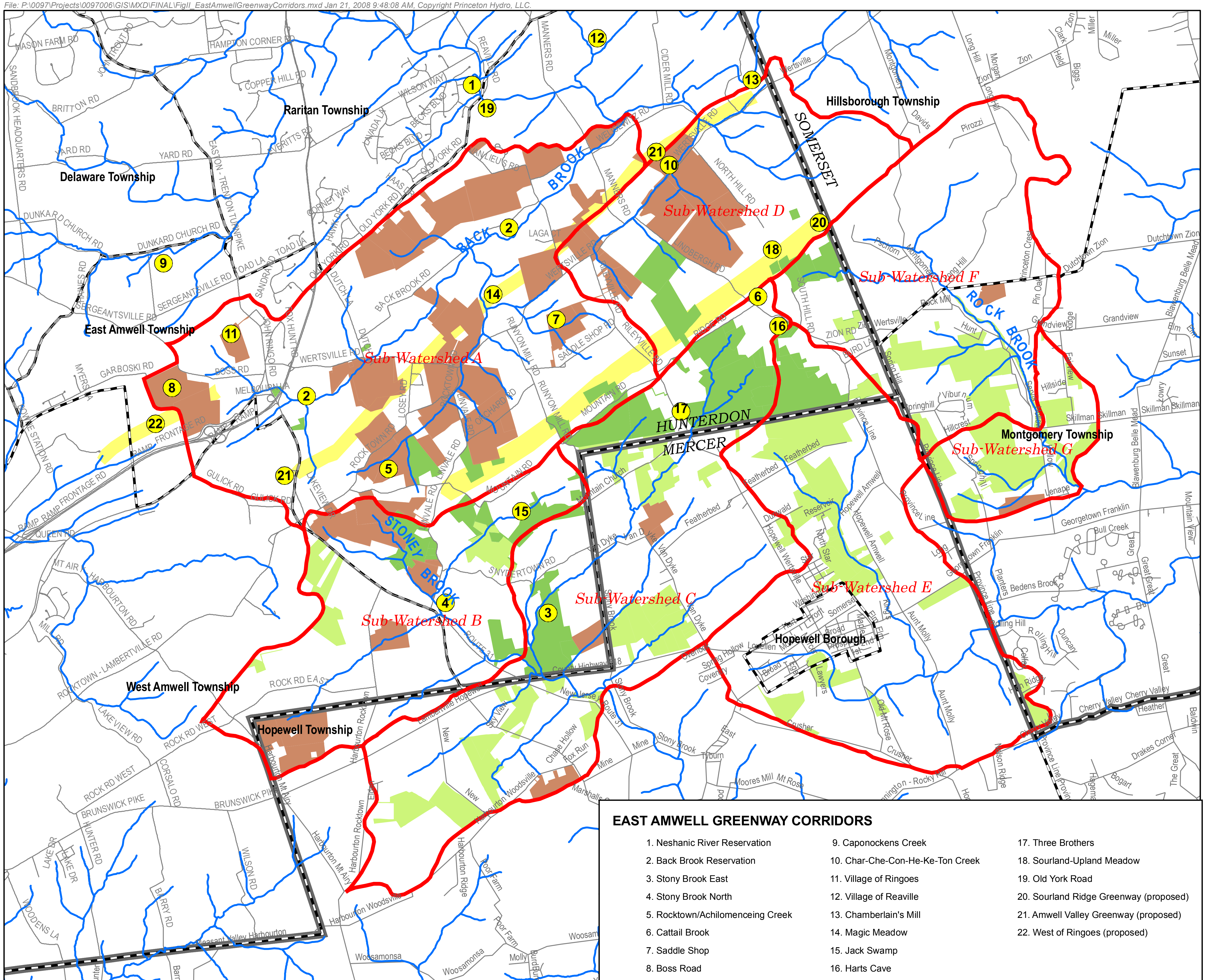
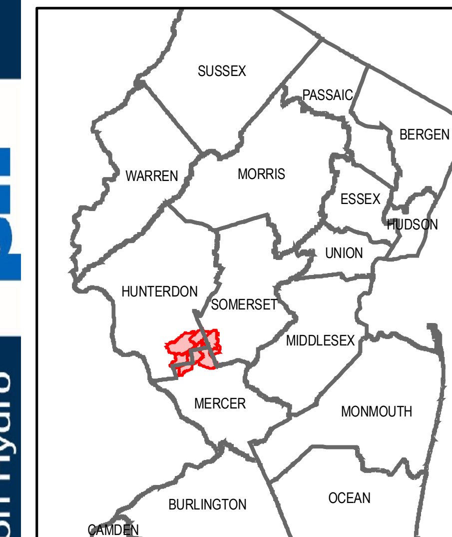


NEW JERSEY COUNTY MAP



Princeton Hydro

PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551

0 2,500 5,000 Feet

1 inch equals 5,000 feet

SOURCES:

1. Roads are the Tiger/Line Files, US Census Bureau except for Hunterdon County, which road data was obtained from the Hunterdon County GIS website

2. Open Space: Data obtained from the NJDEP Green Acres Program, Hunterdon Co. GIS Dept., East Amwell Twp, and Mercer Co.

3. Farmland Preservation: Data obtained from the Dept. of Agriculture,Hunterdon Co. GIS Dept., East Amwell Twp and Mercer County

4. Greenway Corridor locations as identified in the Greenways and Open Space Element of the East Amwell

FIGURE II: SOURLAND MOUNTAIN GREENWAY PLAN

SOURLAND MOUNTAIN WATERSHED PROTECTION PLAN

Legend

- Project Area
- Streams
- Municipal Boundaries
- County Boundaries
- Roads
- Conservation Easement
- Farmland Preservation
- Open Space Preservation
- Greenway Corridor Locations
- Potential Greenway Corridors

Project Name: Farming Conservation Plans Sourland Watersheds **Priority:** 3	**Ownership:** Private / Preserved Farmlands Jurisdiction: Sourland Communities

1. Project Description:
Stream bank erosion, pathogens, nutrients and impaired macroinvertebrate diversity exist in the Sourland Watersheds. Funding should be sought to work with approximately 20 farmers and the NRCS and NJRC&D to develop individual Conservation Plans to reduce the NPS runoff to these streams.

2. Recommendations:
- Mail flyers and host workshops through the local agricultural advisory boards to promote the granted funded Conservation Plans and the utilization of NRCS funding to implement these Conservation Plans.
- Conducted meetings and field visits with 20 farmers and create Conservation Plans.
- Identify BMPs such as use of no mow buffers, contour tilling, fencing, reforestation, and appropriate manure storage.
- Reward farmers with a River Friendly Farm certification for implementing these BMPs.

3. Anticipated Benefits:
- Over 30% of the Sourland Mountain Watershed region includes farmlands, and therefore, increased use of BMP practices could reduce NPS loadings and have a significant positive impact on water quality.

6. Implementation Concerns:
- Changing traditional farm practices and land stewardship will take time.

5. Task Descriptions	Implementation Costs
a. Create flyers, mailers, news articles and host workshops	$ 5,000.00
b. Create 20 Farmland Conservation Plans	$22,000.00
c. Three year monitoring plan	$ 5,000.00
Total	**$ 32, 000.00**

Project Name: Ringoes Village - Rain Garden Demonstrations, Back Brook **Priority: 4** Map ID: 7	**Ownership:** Public /Private / Conservation Easement Address/ Block & Lot : Jurisdiction: East Amwell Township

1. Project Description:

Stream bank erosion, elevated pathogens, nutrients and impaired macroinvertebrate diversity exists in Back Brook, and limited stormwater management exists in this older village community. Seek funding to install demonstration rain gardens at the East Amwell town hall and elementary school, at the South County Park, and implement a streambank restoration along Melbourne Lane.

In regard to South County Park the location of utility pipelines may limit the possible location of stormwater drainage facilities on the parcel. However, additional stormwater management could be provided by directing the down spouts from the four covered sheds/barns to dry wells for infiltration, and a bioretention basin or rain garden may be installed along the parking area and existing drainage outfall.

2. Recommendations:

- Conduct limited field surveys to document baseline erosion conditions.
- Conduct limited hydraulic studies of this segment of Back Brook to better understand the hydraulic flows for various storm events and the outfall conditions. Provide engineering evaluation as necessary to ensure that plantings are a viable option for the streambank restorations
- Install rain garden plantings at the East Amwell town hall and school, and at the South County Park.
- Install stream bank plantings and live stakes along stream bank to stabilize bank. Determine whether additional engineering measures are needed to reduce bank erosion
- Encourage no mow along stream, contour tilling and runoff infiltration measures on lands upstream of Back Brook.
- Direct down spouts and install dry wells at sixteen locations from the four barns.

3. Anticipated Benefits:

- Plantings will stabilize stream bank and reduce erosion and sedimentation, which is likely the current cause of the impaired macroinvertebrate diversity. Plantings will also reduce runoff and potential NPS pollutants.
- Working with the Township, SBMWA and SPC to recruit volunteers for plantings, will also promote NPS educational opportunities.

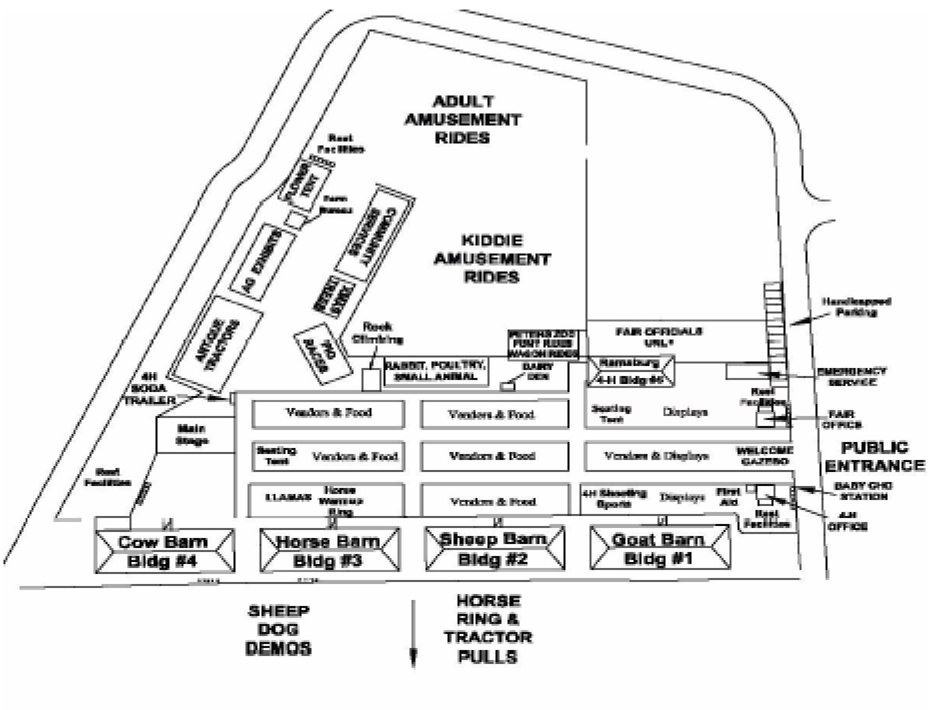
7. Implementation Concerns:

- Plantings may not be sufficient to fully stabilize the stream banks and additional hydraulic studies and engineering should be conducted to determine if outfall modifications are needed.

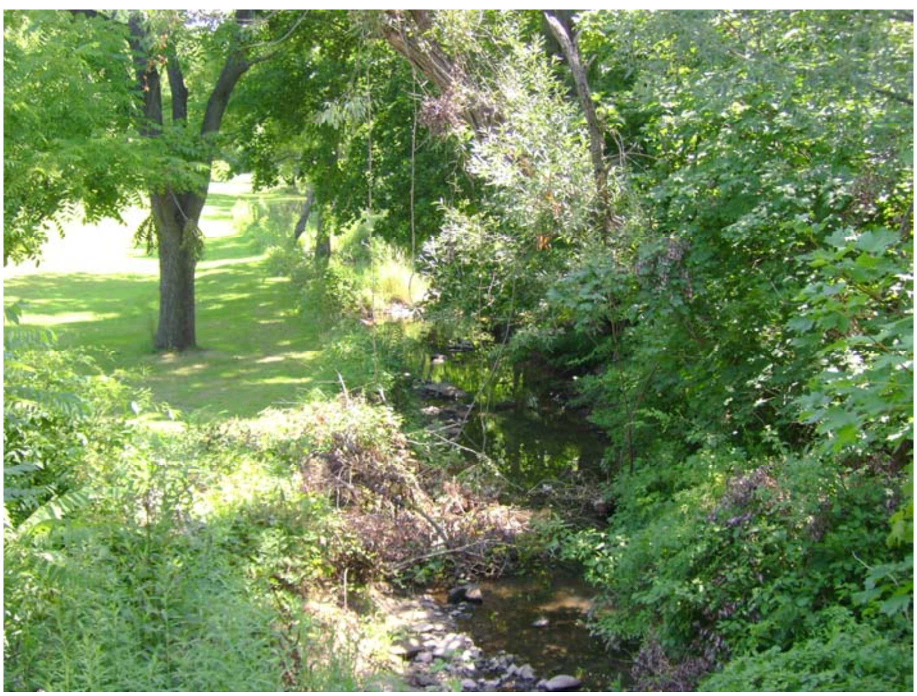
5. Task Descriptions	**Implementation Costs**
a. Hydraulic Studies	$ 10,000.00
b. Engineering Surveys	$ 10,000.00
c. Stream bank restoration plan and permit application	$ 8,000.00
d. Installation of 300 live stakes and 200 stream bank plantings.	$ 2,000.00
e. Construct a rain garden and install plantings at	

the East Amwell town hall, school and the South County Park.	$ 8,000.00
f. Direct down spouts to dry wells at sixteen locations.	$22,000.00
g. Management of plantings and volunteers.	$ 2,000.00
h. Three year monitoring plan	$ 4,500.00
Total	**$ 55, 500.00**

South County Park – no existing stormwater controls



Project Name: Ringoes Village - Rain Garden Installations and Stream Bank Restoration
Back Brook
Priority: 4



<table>
<tr><td>Project Name: Sourland Streams Bank Erosion Studies- Rock Brook, Back Brook, Furmans Brook, and Beden Brook, and the Stony Brook,
Priority: 5
Map ID #17</td><td>Ownership:
Jurisdiction : Montgomery Township –
Address/ Block & Lot :</td></tr>
<tr><td colspan="2">1. Project Description:
Stream bank erosion of over 8 ft in height exists in the lower segments of Rock Brook near Camp Meeting Road, for length greater than 1,000 ft. The stream is very rocky, steep slopes and experiences high flashy storm events. Today the surrounding watershed is a young (30 year forest), but the Sourland region had been entirely logged by the turn of the century and had been farmed for nearly a century. The 1930 aerials identified the entire watershed as farmed. The severe erosion may have been initiated by the previous logging and farming, and significant erosion and soil loss continue today from eroding of the streambanks and channel enlargement.

Funding should be sought to study and measure the streambank erosion, channel enlargement, and the effects of varying storm events of these streams. This data will help to evaluate future watershed strategies to minimize upland sediment erosion, quantify and address erosion of stream channels, and address storage of sediment on floodplains. This data can be used as a model for other watershed studies in New Jersey.</td></tr>
<tr><td colspan="2">2. Recommendations:
Conduct five field surveys in each of the subwatersheds (Rock Brook, Back Brook, Furmans Brook, and Beden Brook, and the Stony Brook) to document current channel width, channel depth and erosion conditions in the first order, second order and third order streams.
Evaluate historic aerials, FEMA flood hazard mapping, and historic parcel data to determine historic land uses, impervious cover, channel width, and channel depth as best as possible.
Evaluate existing hydraulic data and conduct hydraulic studies on these subwatersheds to better understand the hydraulic flows for various storm events.
Install rebar into the stream banks at various locations and heights. Recruit volunteers thru the SBMWA and EC members to routinely monitor storms, photograph streams, record impacts to stream banks, and evaluate soil loss by measuring the exposed lengths of the rebar during the course of one year. Record data and prepare a report based on one year of records.
Install stream gauges to record stream height during storms and base flow conditions.
Determine whether additional engineering measures are appropriate or needed to reduce bank erosion and ensure.
Install stream bank plantings and live stakes along stream bank to stabilize bank.
Encourage riparian preservation and contour tilling and runoff infiltration measures on farms/lands upstream of these channels.
</td></tr>
<tr><td colspan="2">3. Anticipated Benefits:
Plantings will stabilize stream bank and reduce erosion and sedimentation, which is likely the current cause of the impaired macroinvertebrate diversity.
The proposed mitigation site is floodplain and publicly owned by East Amwell, and was donated to the town for open space.
Working with the Township, SBMWA and SPC to recruit volunteers for plantings, will also promote NPS educational opportunities.
</td></tr>
<tr><td colspan="2">4. Implementation Concerns:
Plantings may not be sufficient to fully stabilize the stream banks and additional
</td></tr>
</table>

hydraulic studies and engineering would be needed to consider regrading and use of crib walls or gabion structures to reduce erosion by the bridge.

- Stream plantings will likely enhance the project site and water quality downstream from the study area. Stream plantings will not reduce pathogens.

5. Task Descriptions	**Implementation Costs**
a. Hydraulic Studies – routine measurements of rebar stakes.	$12,000.00
b. Engineering Surveys	$ 8,000.00
c. Stream bank restoration plan and permit application	$10,000.00
d. Installation of 2000 live stakes and 500 stream bank plantings along Furmans Brook, Back Brook and Rock Brook.	$3,000.00
e. Management of plantings and volunteers.	$ 8,000.00
f. Three year monitoring plan	$ 5,000.00
Total	**$ 46, 000.00**

Rock Brook by Camp Meeting Rd

Beden Brook by Aunt Molly Rd

Project Name: Welisewitz Park Furmans & Back Brook Bridge crossing on Welisewitz and Wertsville Rd **Priority: 6**	**Ownership:** East Amwell Township – Welisewitz Park Address/ Block & Lot :
1. Project Description: Restore areas of stream bank erosion by installing live stakes into the stream banks. Erosion of approximately 4 ft height occurs by the bridge crossing on Welisewitz Rd. Bank erosion is greater than a 2,000 foot length. The area also experiences flooding at times. East Amwell owns this land (Welisewitz Park) as a conservation area and has no recreational plans for the property.	
2. Recommendations: • Conduct field surveys to document baseline erosion conditions. • Conduct hydraulic studies of this area on Furmans Brook, Back Brook and the Neshanic River to better understand the hydraulic flows for various storm events at this confluence area. Provide engineering evaluation as necessary to ensure that plantings are a viable option. • Determine whether additional engineering measures are needed to reduce bank erosion and ensure the bridge integrity. • Install stream bank plantings and live stakes along stream bank to stabilize bank. • Encourage riparian preservation, contour tilling and runoff infiltration measures on farms upstream of stream.	
3. Anticipated Benefits: • Plantings will stabilize stream bank and reduce erosion and sedimentation, which is likely the current cause of the impaired macroinvertebrate diversity. • The proposed mitigation site is floodplain and publicly owned by East Amwell, and was donated to the town for open space. • Working with the Township, SBMWA and SPC to recruit volunteers for plantings, will also promote NPS educational opportunities.	
5. Implementation Concerns: • Plantings may not be sufficient to fully stabilize the stream banks and additional hydraulic studies and engineering would be needed to consider regrading and use of crib walls or gabion structures to reduce erosion by the bridge. • Stream plantings will likely enhance the project site and water quality downstream from the study area. Stream plantings will not reduce pathogens.	
5. Task Descriptions	**Implementation Costs**
a. Hydraulic Studies	$110,000.00
b. Engineering Surveys	$ 8,000.00
c. Stream bank restoration plan and permit application	$ 10,000.00
d. Installation of 2000 live stakes and 500 stream bank plantings.	$ 5,000.00
e. Management of plantings and volunteers.	$ 8,000.00
f. Three year monitoring plan	$ 4,500.00
* Permit fees are not included and may be substantial **Total**	**$ 145, 500.00**

#6 Priority Restoration Site
Welisewitz Park – Owned by East Amwell Township
Bridge crossing on Welisewitz and Wertsville Rd
Located within floodplain of Furmans Brook, Back Brook & Neshanic River

Project Name: Amwell Lake Wildlife Refuge, Sediment Removal & Wetland Enhancement Route 31, East Amwell NJ Stony Brook Watershed area **Priority: 7 Map ID 10A**	**Ownership:** New Jersey Parks & Forestry Address/ Block & Lot : Jurisdiction: East Amwell

1. Project Description:

Amwell Lake is a state owned Wildlife Management Center that was originally constructed in the 1950s by the USDA-NRCS under PL-566 as a regional stormwater basin to control and reduce sediment loading to the Stony Brook from the rural agricultural area. The basin has successfully retained sediments for decades and has become fairly filled with sediments, and is in need of being dredged. The water column in the Lake is shallow, water temperatures are high, dissolved oxygen levels are low, algal growth is high, and trees and shrub are minimal along the shoreline. Perform bathymetry studies and hydrology studies and design plans to improve the water quality, sediment controls and continued uses for fishing and birding.

Funding under the 319 program may be available to perform the necessary engineering and designs, while 319 and NRCS funding may be available to implement the plantings on public lands. Funding for dredging may be available from the NJ Corporate Tax for water improvement projects.

2. Recommendations:

- Conduct bathymetry surveys to document depth of water column and sediment in the lake.
- Conduct hydraulic studies of inflow to Amwell Lake and outflow to Stony Brook to better understand the hydraulic flows for various storm events.
- Dredge sediment from lake, and use sediments to create and enhance a wetland shelf along the shoreline near the depositional areas.
- Create a sump area to facilitate future sediment collection, and ensure lake integrity to enhance water quality and recreational fishing.
- Install trees, shrubs and herbaceous plantings to stabilize shoreline, provide shaded habitat areas, enhance the wetlands and fish habitat, and to reduce geese access along 1,000 ft of the lake shore.
- Initiate a plan to deter resident geese nesting.
- Encourage contour tilling and runoff infiltration measures on farms upstream of stream.

3. Anticipated Benefits:

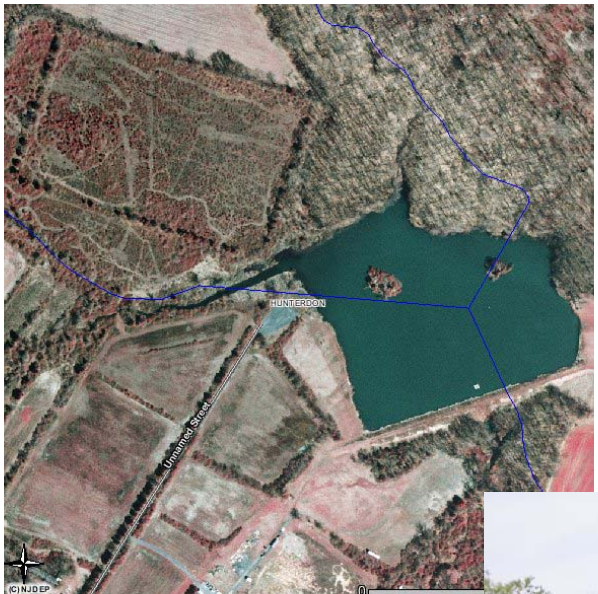
- Dredging sediments will increase water column, increase water quality, increase wetland and fish habitat, and increase recreational values.
- Plantings will stabilize shoreline, reduce erosion, shade habitat areas to increase water quality, habitats and recreational values. The plantings may discourage geese nesting and reduce pathogens in Stony Brook.
- Working with the Township, SBMWA and SPC to recruit volunteers for the plantings and possible geese control will also promote NPS educational opportunities.
- The project is on publicly owned lands and would be eligible for funding.

4. Implementation Concerns:

- The project is on publicly owned lands and wetland creation should be eligible for funding. But there may be delays obtaining funding and permits for dredging.

5. Task Descriptions	**Implementation Costs**
a. Hydraulic Studies	$25,000.00
b. Bathymetry and Engineering Surveys	$20,000.00
c. Wetland creation plan, dredging plan, plantings design, and permit applications.	$30,000.00
d. Installation of 2000 trees and plantings.	$7,000.00
e. Management of plantings and volunteers.	$8,000.00
f. Three year monitoring plan	$ 5,000.00
g. Implementation of dredging and creating wetlands are separate construction costs. Dredging 1.5 feet from a 10 acre lake can cost approximately $850,000.	
Total	**$ 95, 000.00**

Priority # 7
Project Name: Amwell Lake Wildlife Refuge, Route 31, East Amwell NJ
Stony Brook Watershed area



Project Name: Aunt Molly Rd Beden Brook **Priority: 8** Map ID: 4	**Ownership:** Private / Conservation Easement Address/ Block & Lot : Jurisdiction: Hopewell Borough /Twp

1. Project Description:

Restore stream bank erosion along Beden Brook of greater than 4 ft height is occurring near Aunt Molly Rd. Bank erosion is greater than a 500 foot length and could affect the integrity of the road and bridge. Oxbow formation is occurring, whereby excessive stream flows have advanced erosion to such a degree that the stream channel flows nearly perpendicular towards Aunt Molly Road and then turns at a right angle back to the channel. Soil regrading will be necessary to facilitate stream flow, and reduce impact to the roadway. The streambank may be located on private lands.

It would also be beneficial to consider infrastructure modifications within Hopewell Borough to reduce runoff such as encouraging rain gardens, street tree trenches, or bioretention measures to intercept / infiltrate runoff.

2. Recommendations:

- Conduct field surveys to document baseline erosion conditions.
- Conduct hydraulic studies of this segment of Beden Brook to better understand the hydraulic flows for various storm events and the outfall conditions. Provide engineering evaluation as necessary to ensure that regarding and restorations are viable options.
- Evaluate alternative engineering measures needed to reduce bank erosion and stabilize the Aunt Molly road and bridge.
- Install stream bank plantings and live stakes along stream bank to stabilize bank.
- Encourage no mow along stream, contour tilling and runoff infiltration measures on farms upstream of stream.

3. Anticipated Benefits:

- Reduce erosion and minimize the undercutting of Aunt Molly's Rd and the bridge.
- Plantings and stabilizing the stream channel will reduce erosion and sedimentation, which is likely the current cause of the impaired macroinvertebrate diversity.
- Working with the Borough, SBMWA and SPC to recruit volunteers for plantings, will also promote NPS educational opportunities.

8. Implementation Concerns:

- Plantings may not be sufficient to fully stabilize the stream banks and additional hydraulic studies and engineering should be conducted to identify measures to stabilize the bridge integrity.
- The site may include private lands and a conservation easement would be needed.

5. Task Descriptions	**Implementation Costs**
a. Hydraulic Studies	$27,000.00
b. Engineering Surveys	$ 8,000.00
c. Stream bank restoration plan and permit application	$10,000.00
d. Installation of 1,000 live stakes and 200 stream bank plantings.	$3,000.00
e. Management of plantings and volunteers.	$4,000.00
f. Three year monitoring plan	
Total	$4,500.00
	$ 56, 500.00

Priority: 8 Map ID: 4
Project Name: Beden Brook, Aunt Molly Rd, Hopewell Borough/ Hopewell Township

Project Name: Hollow Rd & Camp Meeting Rd Rock Brook **Priority: 9** Map ID: 4	**Ownership:** Private / Conservation Easement Address/ Block & Lot : Jurisdiction: Hopewell Borough /Twp

1. Project Description:
Restore stream bank erosion along Rock Brook of greater than 8 ft height is occurring near Hollow Rd & Camp Meeting Rd. Bank erosion is greater than a 1,000 foot length The streambank may be located on private lands.

2. Recommendations:
- Conduct field surveys to document baseline erosion conditions.
- Conduct hydraulic studies of this segment of Rock Brook to better understand the hydraulic flows for various storm events and the outfall conditions.
- Evaluate engineering alternatives as necessary to ensure that streams restorations are viable options including use of, rock cross vain, j hooks, crib walls, etc

3. Anticipated Benefits:
- Reduce erosion and minimize the undercutting along Rock Brook.
- Plantings and stabilizing the stream channel will reduce erosion and sedimentation, which is likely the current cause of the impaired macroinvertebrate diversity.
- Working with the Borough, SBMWA and SPC to recruit volunteers for plantings, will also promote NPS educational opportunities.

9. Implementation Concerns:
- Plantings may not be sufficient to fully stabilize the stream banks and additional hydraulic studies and engineering should be conducted to identify measures to stabilize the bridge integrity.
- The site may include private lands and a conservation easement would be needed.

5. Task Descriptions	Implementation Costs
a. Hydraulic Studies	$55,000.00
b. Engineering Surveys	$20,000.00
c. Stream bank restoration plan and permit application	$30,000.00
Total	**$ 105, 000.00**

Rock Brook

Project Name: Bridge at Van Lieus Rd Back Brook **Priority: 10** Map ID: 4	**Ownership:** Private / Conservation Easement Address/ Block & Lot : Jurisdiction: East Amwell Township

1. Project Description:
Stream bank erosion exists in Back Brook of approximately 2-4 ft height occurring along Back Brook Road by the Van Lieus Bridge. Bank erosion is greater than a 1,000 foot length. The streambank is located on private lands with some preserved farm lands.

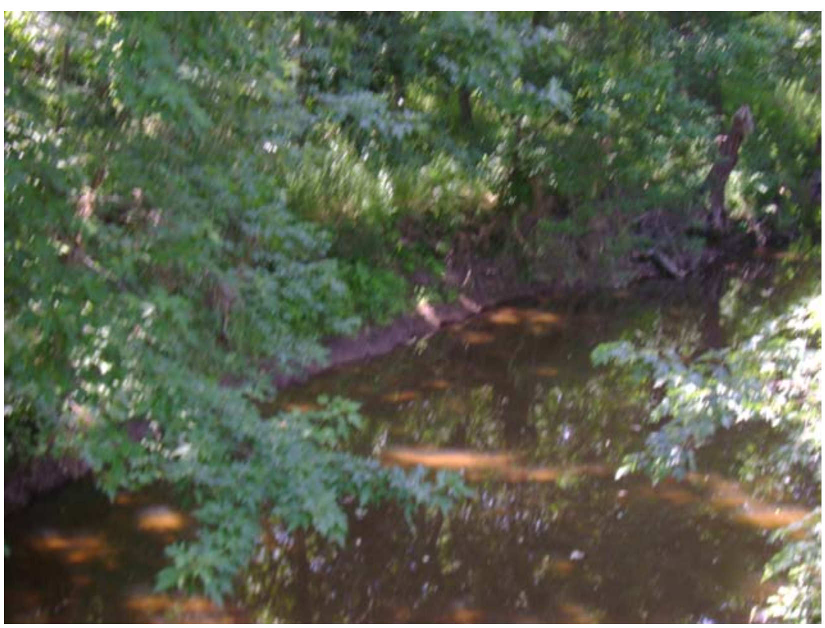
2. Recommendations:
- Conduct field surveys to document baseline erosion conditions.
- Conduct limited hydraulic studies of this segment of Back Brook to better understand the hydraulic flows for various storm events.
- Evaluate engineering alternatives as necessary to ensure that streams restorations are viable options.
- Determine whether additional engineering measures are needed to reduce bank erosion and stabilize the bridge.
- Install stream bank plantings and live stakes along stream bank to stabilize bank.
- Encourage no mow along stream, contour tilling and runoff infiltration measures on farms upstream of stream.

3. Anticipated Benefits:
- Plantings will stabilize stream bank and reduce erosion and sedimentation, which is likely the current cause of the impaired macroinvertebrate diversity. Plantings will also reduce runoff and potential pathogens from horse farms.
- Working with the Township, SBMWA and SPC to recruit volunteers for plantings, will also promote NPS educational opportunities.

10. Implementation Concerns:
- Plantings may not be sufficient to fully stabilize the stream banks and additional hydraulic studies and engineering should be conducted to identify measures to stabilize the bridge integrity.
- The site may include private lands and a conservation easement would be needed.

5. Task Descriptions	**Implementation Costs**
d. Hydraulic Studies	$40,000.00
e. Engineering Surveys	$ 8,000.00
f. Stream bank restoration plan and permit application	$10,000.00
g. Installation of 1,000 live stakes and 200 stream bank plantings.	$3,000.00
h. Management of plantings and volunteers.	$4,000.00
i. Three year monitoring plan	
Total	$4,500.00
	$ 69, 500.00

Priority: **10** Map ID: 4
Project Name: Bridge at Van Lieus Rd, Back Brook, East Amwell Township



Project Name: Wertsville Rd Furmans Brook Outfall and stream erosion along Wertsville Rd **Priority: 11** Map ID: 7	**Ownership:** Private / Conservation Easement Address/ Block & Lot : Jurisdiction: East Amwell Township

1. Project Description:
Stream bank erosion exists in Furmans Brook of approximately 2-4 ft height occurring along by Wertsville Rd. Bank erosion is greater than a 500 foot length. The area also experiences flooding at times. The streambank is located on a private, but preserved horse farm. Some rip rap has been installed to reduce erosion from storm outfall.

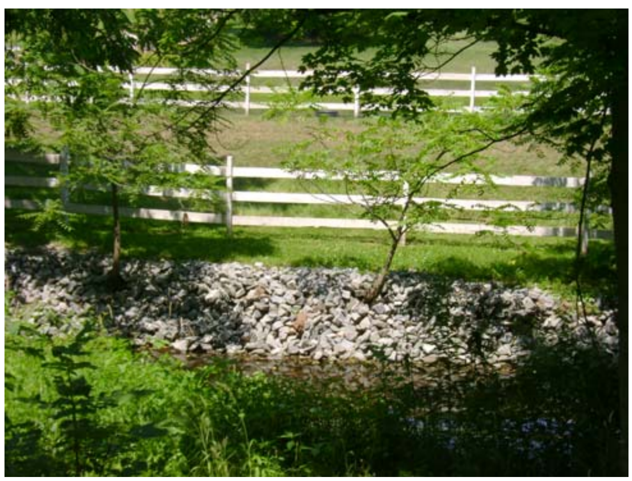
2. Recommendations:
- Conducted limited field surveys to document baseline erosion conditions.
- Conduct limited hydraulic studies of this segment of Furmans Brook to better understand the hydraulic flows for various storm events and the outfall conditions. Provide engineering evaluation as necessary to ensure that plantings are a viable option.
- Determine whether additional engineering measures are needed to reduce bank erosion.
- Install stream bank plantings and live stakes along stream bank to stabilize bank.
- Encourage no mow along stream, contour tilling and runoff infiltration measures on farms upstream of stream.

3. Anticipated Benefits:
- Plantings will stabilize stream bank and reduce erosion and sedimentation, which is likely the current cause of the impaired macroinvertebrate diversity. Plantings will also reduce runoff and potential pathogens from horse farm.
- Working with the Township, SBMWA and SPC to recruit volunteers for plantings, will also promote NPS educational opportunities.

11. Implementation Concerns:
- Plantings may not be sufficient to fully stabilize the stream banks and additional hydraulic studies and engineering should be conducted to determine if outfall modifications are needed.
- Stream plantings will likely enhance the project site and water quality downstream from the study area. Stream plantings will not reduce pathogens.

5. Task Descriptions	**Implementation Costs**
i. Hydraulic Studies	$12,000.00
j. Engineering Surveys	$ 5,000.00
k. Stream bank restoration plan and permit application	$ 9,000.00
l. Installation of 500 live stakes and 200 stream bank plantings.	$2,000.00
m. Management of plantings and volunteers.	$4,000.00
n. Three year monitoring plan	
Total	$4,500.00
	$ 36, 500.00

Priority: 11 Map ID: 7
Project Name: Wertsville Rd
Furmans Brook
Outfall and stream erosion along Wertsville Rd



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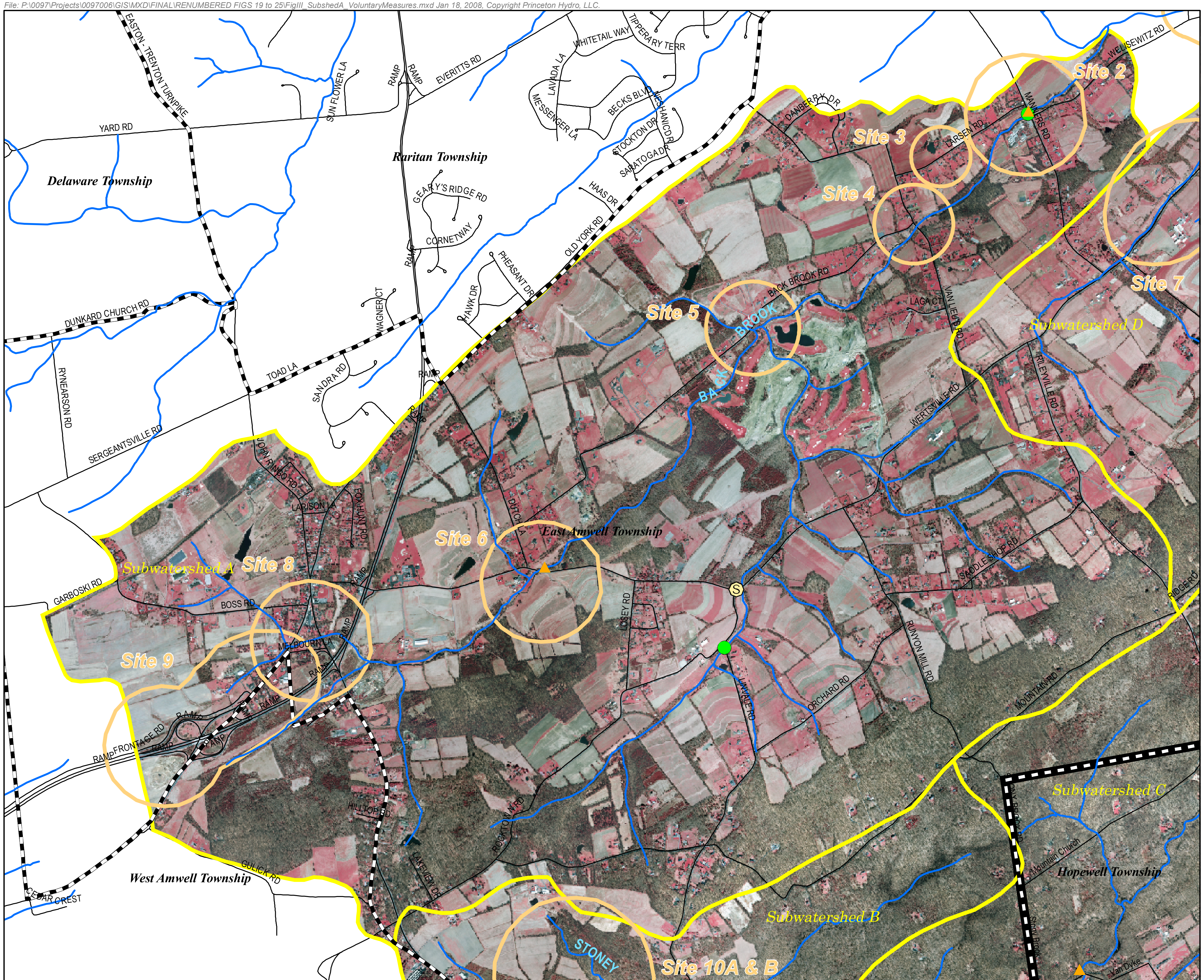
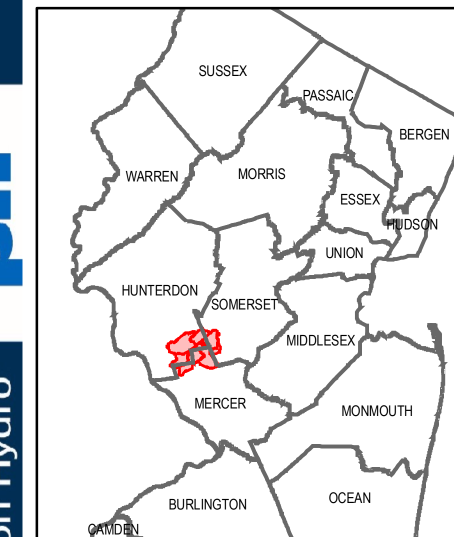


NEW JERSEY COUNTY MAP



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PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551

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SOURCES:
1. Roads are the Tiger/Line Files, US Census Bureau except for Hunterdon County, which data was obtained from the Hunterdon County GIS website
2. 2002 Aerial Photographs obtained from the NJ Image Warehouse web site
3. County and Municipal Boundaries obtained from the NJ DEP GIS website.

FIGURE III: SUBWATERSHED A POTENTIAL RESTORATION SITES

SOURLAND MOUNTAIN WATERSHED PROTECTION PLAN

Legend
- Revised HUC14 /Project Area
- AMNET Monitoring Stations
- RSWMP Sampling Points
- USGS Stream Flow Gages
- Potential Restoration Sites
- Streams
- Roads
- Municipal Boundaries
- County Boundaries

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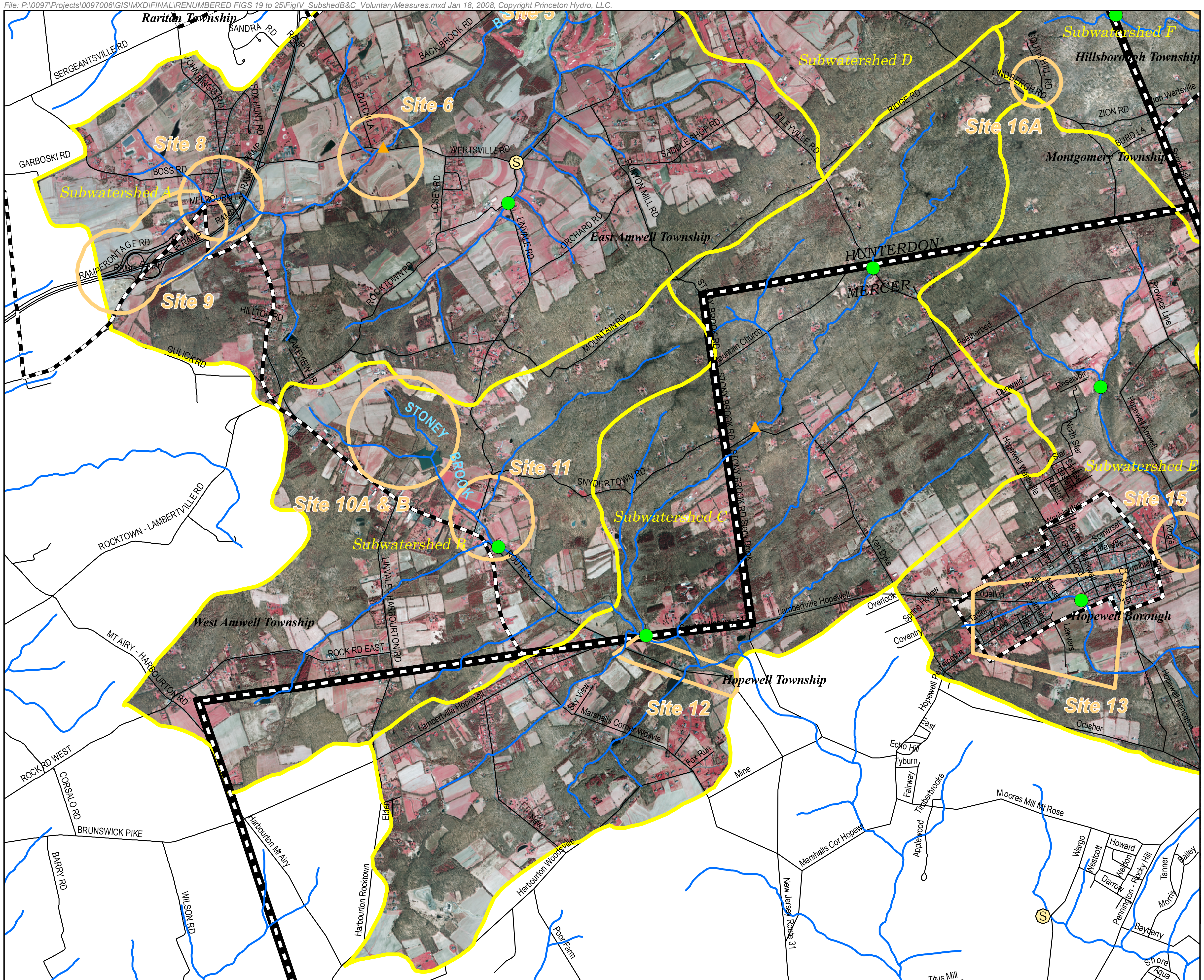

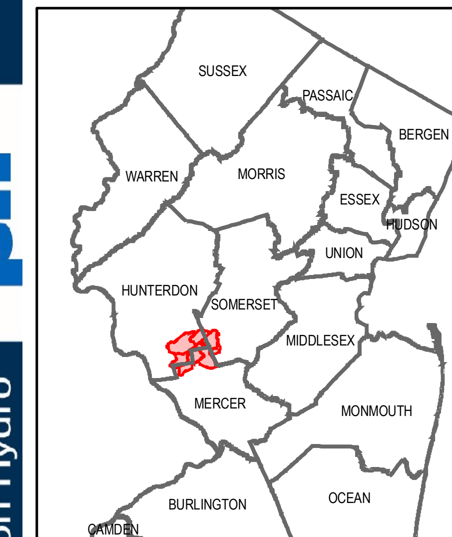

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RINGOES, NJ 08551

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3. County and Municipal Boundaries obtained from the NJ DEP GIS website.

FIGURE IV: SUBWATERSHEDS B&C POTENTIAL RESTORATION SITES

SOURLAND MOUNTAIN WATERSHED PROTECTION PLAN

Legend
- Revised HUC14 /Project Area
- AMNET Monitoring Stations
- RSWMP Sampling Points
- USGS Stream Flow Gages
- Potential Restoration Sites
- Streams
- Roads
- Municipal Boundaries
- County Boundaries

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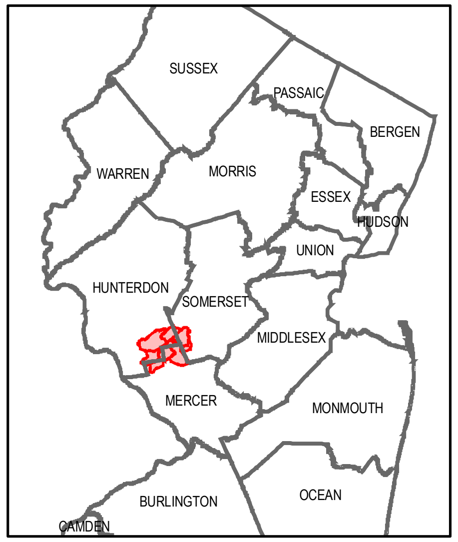
NEW JERSEY COUNTY MAP



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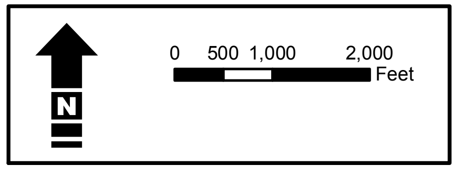

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3. County and Municipal Boundaries obtained from the NJ DEP GIS website.

FIGURE V: SUBWATERSHED D POTENTIAL RESTORATION SITES

SOURLAND MOUNTAIN WATERSHED PROTECTION PLAN

Legend

- AMNET Monitoring Stations
- RSWMP Sampling Points
- USGS Stream Flow Gages
- Streams
- Potential Restoration Sites
- Municipal Boundaries
- Revised HUC14 /Project Area
- County Boundaries
- Roads

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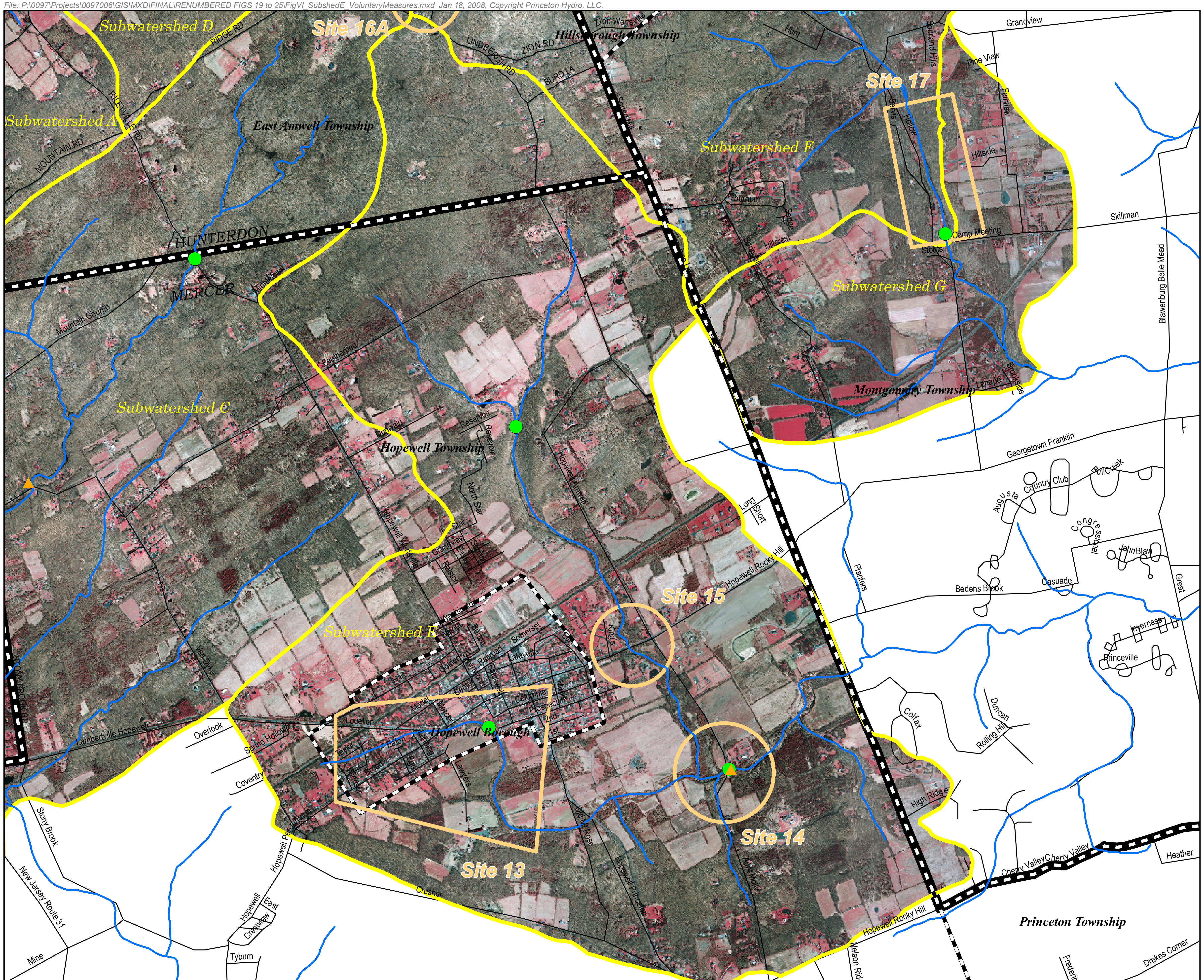

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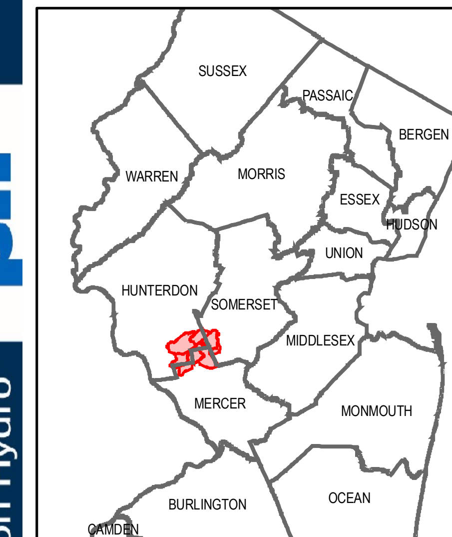
NEW JERSEY COUNTY MAP



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3. County and Municipal Boundaries obtained from the NJ DEP GIS website.

FIGURE VI: SUBWATERSHED E POTENTIAL RESTORATION SITES

SOURLAND MOUNTAIN WATERSHED PROTECTION PLAN

Legend

- Revised HUC14 /Project Area
- AMNET Monitoring Stations
- RSWMP Sampling Points
- USGS Stream Flow Gages
- Potential Restoration Sites
- Streams
- Roads
- Municipal Boundaries
- County Boundaries

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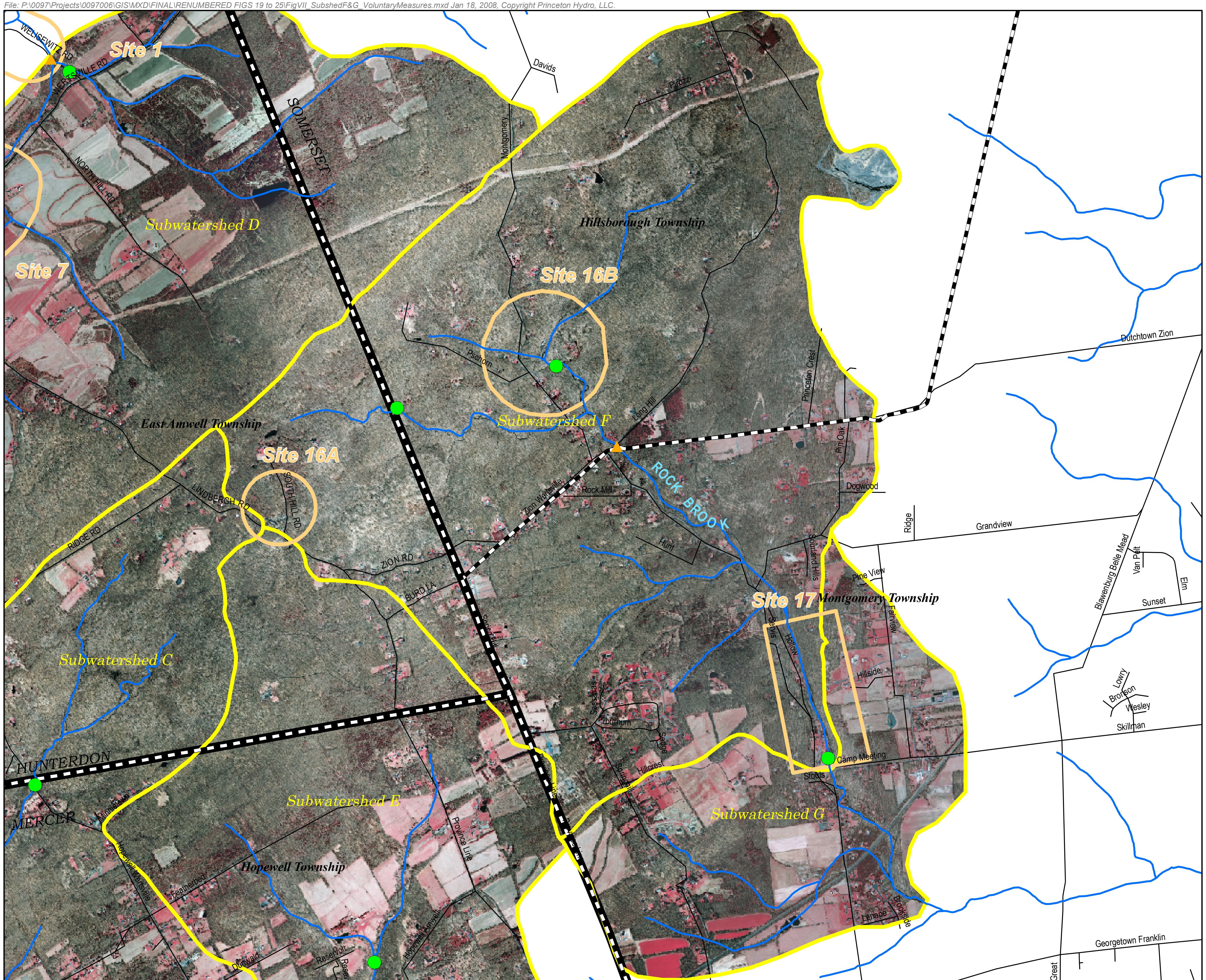
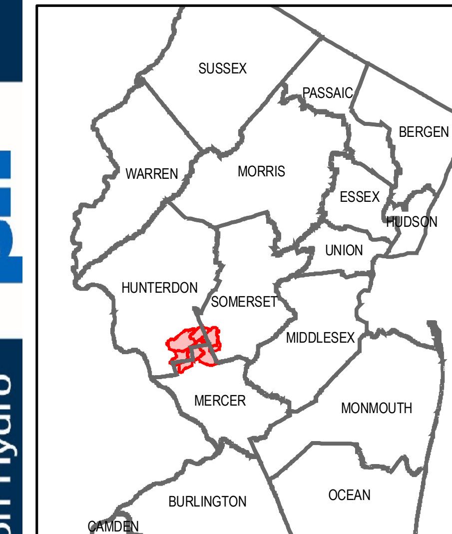


NEW JERSEY COUNTY MAP



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3. County and Municipal Boundaries obtained from the NJ DEP GIS website.

FIGURE VII: SUBWATERSHEDS F&G POTENTIAL RESTORATION SITES

SOURLAND MOUNTAIN WATERSHED PROTECTION PLAN

Legend

- Revised HUC14 /Project Area
- AMNET Monitoring Stations
- RSWMP Sampling Points
- USGS Stream Flow Gages
- Potential Restoration Sites
- Streams
- Roads
- Municipal Boundaries
- County Boundaries

APPENDIX A -Table A-3
Stormwater Best Management Practices Summary Tables and Cost Estimates

1. Stormwater BMPs that Best Address Bacterial Removal					
Type	**Brief Summary**	**Advantages**	**Pollutant Removal Efficiency (if known)**	**Costs (if known)**	**Design Criteria**
Infiltration Structures	Infiltration structures are basins or trenches constructed within highly permeable soils (min. rate of 0.5 in/hour) that provide temporary storage of stormwater runoff. Normally, outflow from these structures infiltrates through the surrounding soil into the groundwater, rather than being conveyed through a structural outlet to a downstream waterbody or storm sewer system. When designed and maintained properly, infiltration basins can recharge the groundwater and remove pollutants as runoff is filtered through the soil. (NJDEP 2004)	● Cost-effective; typically consumes about 2-3% of the drainage area ● Relatively high pollutant removal rate as compared to other BMPs (NJDEP 2004)	TSS reduction in postconstruction runoff: 80% TP: 60% TN: 50% (NJDEP 2004) Bacteria: 70% (NYSDEC 2003)	EPA estimates cost – effective on smaller sites, and construction cost moderate, but rehabilitation costs can be high. One study estimated the total construction cost for a ¼-acre infiltration basin at $2/ft3 of stormwater treated, and the cost for infiltration trenches at $5/ft3 of stormwater treated (SWRPC 1991 in EPA 2002). However, since long-term maintenance is critical to basin effectiveness, those annual costs (estimated at 5 to 10% of construction costs, or $0.10 to $0.20/ft3) must also be considered.	● Limited to soils in hydrologic groups A and B with the required permeability rates. ● Useful only for small drainage areas (max. 10 acres). ● Not appropriate where there is risk of basement flooding, surface flooding of groundwater or interference with subsurface sewage disposal systems and other subsurface structures (NJDEP 2004)
Extended Detention Basins	Extended detention basins provide temporary storage of stormwater runoff, detaining it for a prescribed period of time (typically 24 hours) and then releasing it slowly through an appropriately-sized outlet to a downstream system. They address stormwater quantity by slowing runoff and infiltrating some of it, and improve stormwater quality by allowing sediment particles and associated pollutants to settle out into the basin. (The longer the detention time, the greater the pollutant removal efficiency.) They are effective on sites of 10 acres or more. (NJDEP 2004)	● Considered by EPA to be one of the least expensive stormwater BMPs (cost per unit area treated). ● Can accept runoff from "hot spots" (areas that generate highly contaminated runoff) provided there is adequate separation from seasonal high water table (min. 1 foot). ● Useful retrofit: existing basins can be modified to function as extended detention; new extended detention basins can be constructed to capture runoff from existing development. (NJDEP 2004)	TSS reduction in postconstruction runoff: 40% TP: 20% TN: 20% (NJDEP 2004) Bacteria: 70% (NYSDEC 2003)	Based on a recent study (Brown and Schueler 1997), EPA estimates the cost of extended detention basins with the equation C = 12.4V0.760, where: C = construction, design and permitting cost and V = volume needed to control the 10-year storm (ft3). Using this equation, typical construction costs are $41,600 for a 1 acre-foot basin, $239,000 for a 10 acre-foot basin and $1.38 million for a 100 acre-foot basin. EPA estimates lowest costs alternative in size range.	■ Flexibility: can be used at residential, commercial, and industrial development sites; can be used with almost all soils and geology; can be used on sites with slopes up to about 15%. (NJDEP 2004)

1. Stormwater BMPs that Best Address Bacterial Removal					
Type	**Brief Summary**	**Advantages**	**Pollutant Removal Efficiency (if known)**	**Costs (if known)**	**Design Criteria**
Constructed Wetlands	Constructed stormwater wetlands are designed to temporarily store stormwater runoff in shallow, vegetated pools. Similar to bioretention systems, they mimic natural systems by using wetland plants to filter runoff, remove pollutants and provide erosion and flood control. They usually have three zones: 1) Pool (pond, micropond or forebay): 2 to 6 ft deep, supports submerged and floating vegetation, provides most particulate settling 2) Marsh (high or low, depending on standing water depth): 6 to 18 in. deep, mainly emergent wetland vegetation 3) Semi-wet: located above pool and marsh zones, inundated only during storm events, supports both wetland and upland plants (NJDEP 2004)	● Can remove sediment and pollutants adhering to sediment particles (e.g., phosphorus, metals and bacteria) ● Wetland plants and ponds can improve the aesthetic value of a site and provide wildlife habitat. ● Water is generally flushed through the wetlands within a week, reducing opportunities for mosquito breeding. (NJDEP 2004)	TSS reduction in postconstruction runoff: 90% TP: 50% TN: 30% (NJDEP 2004) Bacteria: 70% (NYSDEC 2003)	EPA estimates costs moderate to higher than conventional detention facilities. EPA modified the following equation developed by Brown and Schueler (1997) to estimate the cost of storm water wetlands: C = 30.6V0.705 (where C = construction, design, and permitting cost and V = wetland volume needed to control the 10-year storm (ft3)). Using this equation, EPA estimates typical construction costs as $57,100 for a 1 acre-foot facility, $289,000 for a 10 acre-foot facility and $1.47 million for a 100 acre-foot facility.	● Limited to areas where sufficient water is available to sustain aquatic vegetation between rainfall/runoff events. ● Design criteria depends on site and type of wetland (shallow, pocket, etc.) (American Rivers 2004)

1. Stormwater BMPs that Best Address Bacterial Removal					
Type	**Brief Summary**	**Advantages**	**Pollutant Removal Efficiency (if known)**	**Costs (if known)**	**Design Criteria**
Wet Ponds	Wet ponds (sometimes called retention basins) typically have two main components: a forebay and a permanent pool. As stormwater enters the forebay, its rate is slowed and sediment and pollutants are allowed to "settle out"; this process continues in the permanent pool, where biological activity helps to remove additional pollutants. In general, the larger the pool, the higher the pollutant removal capability. Pollutant removal can be further increased by using an extended detention basin above the wet pond to detain stormwater runoff and provide additional settling, and/or by using multiple wet ponds in a series as part of a "treatment train." (NJDEP 2004)	● Relatively long lifespan (up to 20 years). ● If properly landscaped, can provide habitat and aesthetic values. ● Can provide cost-effective water supply for fire protection and/or irrigation (e.g., golf courses). ● Can accept runoff from "hot spots" (areas that generate highly contaminated runoff) provided there is adequate separation from seasonal high water table (min. 1 foot). ● Wide applicability; few limits on soils or geology. ● Useful retrofit: existing flood control detention ponds can be modified to include a permanent wet pool for water quality control and a smaller outlet structure for channel protection. (NJDEP 2004)	TSS reduction in postconstruction runoff: 50% TP: 50% TN: 30% (NJDEP 2004) Bacteria: 70% (NYSDEC 2003)	EPA recommends that only pocket ponds are practical in urban settings. EPA uses the following equation developed by Brown and Schueler (1997) to estimate the cost of wet ponds: C = 24.5 V=0.705, where C = construction, design and permitting cost and V = volume needed to control the 10-year storm (ft^3). Using this equation, typical construction costs are \$45,700 for a 1 acre-foot pond, \$232,000 for a 10 acre-foot pond and \$1.17 million for a 100 acre-foot pond. Annual maintenance is about 3 to 5% of construction costs; sediment removal (every 5 to 10 yrs) may be 20 to 40% of initial costs.	■ Useful on sites with upstream slopes up to 15%. (NJDEP 2004)
Bioretention Systems	Bioretention systems mimic the functions of a natural forest ecosystem, treating stormwater runoff by filtering it through vegetation soil and sand and then infiltrating it through the soil and into the groundwater. A portion may also be conveyed through pipes to a storm sewer system or waterbody The systems have three main components: 1) a soil bed planted with native vegetation 2) a sand layer 3) an underground gravel layer (with or without perforated drainage pipes) (NJDEP 2004)	● Can provide groundwater recharge and reduce volume of water discharging into receiving streams. ● Can remove a variety of pollutants including solids, nutrients, metals, hydrocarbons and bacteria. ● Can reduce peak runoff rates and increase stormwater infiltration. ● Native vegetation used in these systems can remove some nutrients and other stormwater pollutants, improve the aesthetic value of the site, and provide wildlife habitat and shade. Root systems and soil can also break down some pollutants. (NJDEP 2004)	TSS: 90% TP: 60% TN: 30% (NJDEP 2004) Bacteria: 70% (NYSDEC 2003)	Costs for bioretention systems include land acquisition, excavating and grading the site, adding soils and planting wetland vegetation. (NJDEP 2004)	● Flexibility: can be designed in a variety of sizes and installed in lawns, median strips, parking lot islands, unused lot areas and certain easements. ● Should only be used on smaller sites (max. 5 acres) because of tendency to clog when used for larger drainage areas (NJDEP 2004)

2. Green BMP Alternatives for Stormwater Management					
Type	**Brief Description**	**Advantages**	**Pollutant Removal Efficiency (if known)**	**Costs (if known)**	**Design Criteria**
Permeable Pavement	Pervious paving systems are paved areas that infiltrate rain or runoff either through a permeable layer of pavement or through the spaces between individual pavers, reducing runoff from a site and filtering pollutants. Three types: 1.Porous paving: porous asphalt or concrete 2.Permeable pavers w/ storage bed 3. Permeable pavers w/o storage bed (NJDEP 2004)	● Can reduce stormwater volume and allow for infiltration (NJDEP 2004)	TSS: Porous paving 80% Permeable w/storage bed 80% Permeable w/o storage N/A TP: 60% TN: 50% (NJDEP 2004)	EPA estimates the cost of a pervious paving system at \$2 to \$3 per ft_2 (CWP 1998 and Schueler 1987 in EPA 2002), which is equivalent to \$87,120 to \$130,680 per impervious acre treated. Associated vacuum sweeping costs may also be substantial.	● Flexibility: can be used in intensely developed residential and commercial areas and on small urban sites such as driveways, streets and commercial parking areas ● Appropriate for gentle slopes and soils that have field-verified permeability rates of at least 0.5 in./hour (NJDEP 2004)
Downspout Disconnection	Disconnecting residential roof downspouts may be an important way to reduce water pollution caused by CSOs. By allowing the relatively clean rain water to flow from the roof to the ground, the total amount of water flowing into the sewer system will be reduced. This has the added benefit of reducing flooding potential since the flow of water will be stretched over a longer period of time. (City of Portland 2007)	● Flexibility: can be used in intensely developed residential and commercial areas on small urban sites. ● A relatively easy project for homeowners, good outlet for public participation ● Can reduce stormwater volume and allow for infiltration (City of Portland 2007)	N/A	Costs depend on scale of project.	● The slope of the downspout extension and yard must drain water away from the building and not into a poorly drained area ● Downspouts should extend at least 6ft away from a basement or crawl space ● Avoid directing downspout near retaining walls, oil tanks or walkways and driveways (City of Portland 2007)

2. Green BMP Alternatives for Stormwater Management					
Type	**Brief Description**	**Advantages**	**Pollutant Removal Efficiency (if known)**	**Costs (if known)**	**Design Criteria**
Rainwater Collection	The benefit of harvesting rainwater is that it conserves water: instead of turning on the hose to water gardens or wash cars, rainwater can be re-used for these tasks. This is another simple project for a homeowner and a good outlet for public participation. By re-using rainwater in the garden, water has the chance to infiltrate back into the ground. (Harvest H2O 2004)	● Reduces amount of stormwater volume ● A relatively easy project for homeowners, good outlet for public participation and education	N/A	Costs depend on size and material of rainwater collection basin (cistern). Accessories will increase costs.	● Cisterns should be connected to roof ● Rainwater may become contaminated by dirt, debris, and other materials from the roof surface. The best strategy is to filter and screen out the contaminants before they enter the cistern ● The storage tank (cistern) must be sized properly to ensure that the rainwater potential is optimized and the material should be watertight and durable. ● Any roofing material may be used if it is for non-drinking use only. Asbestos materials should not be part of a system to provide drinking water. Asphalt shingles can contribute grit to the system. Lead materials in any form should not be used in the system (i.e. lead flashing) (Harvest H2O 2004)
Green Roofs	A green roof consists of: 1. an insulation layer, 2. a waterproof membrane to protect the building from leaks, 3. a root barrier to prevent roots from penetrating the waterproof membrane, 4. a drainage layer. Green roofs improve air quality, conserve energy, reduce stormwater runoff and help reduce the urban heat island effect. The plants reflect heat, provide shade and help cool the surrounding air through evapotranspiration. Plants also filter the air, which improves air quality by using excess CO_2 to produce oxygen. There are 2 basic types of green roofs: intensive and extensive (American Rivers 2004)	● Decreases building's energy expenses for heat and cooling ● Decreases amount of stormwater that flows to rivers ● Estimated to last up to twice as long as conventional roofs, resulting in decreased maintenance and savings in replacement costs ● Aesthetically pleasing (NRDC 2007)	Research and modeling is being developed	Costs vary by landscape design, roof dimensions, type of roof and site constraints.	● Three main concerns in design: weight or load constraints, drainage and roof slope. ● Plant choice depends on intensive or extensive roof type. ● Design also depends on regional climatic conditions (American Rivers 2004)

3. Bioengineered BMP Alternatives Appropriate for Urban Land Use					
Type	**Brief Description**	**Advantages**	**Pollutant Removal Efficiency (if known)**	**Costs (if known)**	**Design Criteria**
Vegetated Filters	Vegetated filters are designed to remove suspended solids and other pollutants from stormwater runoff flowing through them. They may be composed of planted and/ or naturally occurring grasses and herbaceous and woody vegetation. (NJDEP 2004)	● Effective in reducing sediment and other solids and particulates, as well as associated pollutants such as hydrocarbons, heavy metals, and nutrients. ● Can provide wildlife habitat. ● Can create shade along waterbodies, lowering aquatic temperatures. (NJDEP 2004)	TSS: - turf grass – 60% - native grasses, meadow, planted woods - indigenous woods – 80% TP: 30% TN: 30% (NJDEP 2004) Bacteria 35-70% (NYSDEC 2003)	EPA uses the cost of seed ($0.30/ft2) and sod ($0.70/ft2) to calculate a range of $13,000 to $30,000/acre of vegetative filter area or impervious area treated (EPA 2002). Typical maintenance costs are about $350/acre/year (EPA 2002) and may overlap with regular landscape maintenance costs. EPA estimates grass swales cheaper than curb and gutters.	● In order to maintain pollutant removal, all runoff to a vegetated filter must both enter and flow through as sheet flow – making it useful for parking and driveway areas on residential and commercial sites. ● The required length of the vegetative filter is based in part upon the type of soils within its drainage area. ● Only effective on gentle slopes (<2%) and/or areas that slow down, pond and/or disperse runoff over the entire filter width. ● Only useful for small areas (<1 acre); maximum drainage area is 100 feet long for impervious surfaces and 150 feet long for pervious surfaces. (NJDEP 2004)
Sand Filters	Sand filters can be used to remove relatively large amounts of sediments, metals, hydrocarbons and floatables from stormwater runoff, but they do not provide groundwater recharge. There are three types of sand filter: 1) surface 2) subsurface 3) perimeter (NJDEP 2004)	● Can be used as pretreatment for infiltration BMPs (NJDEP 2004)	TSS reduction in post construction runoff: 80% TP: 50% TN: 35% (NJDEP 2004) Bacteria: 35-70% (NYSDEC 2003) Bacteria 55% (Schueler 1997)	EPA cites a study by Brown and Schueler (1997) that found a range of installation costs from $2.50 to $7.50/ft^3 of stormwater treated, with an average cost of $5/ft^3 (EPA 2002). Estimates for cost per impervious acre treated range from $10,000 to $50,000, depending on the region and size of the perimeter filter (EPA 2002).	● Can be used on sites with slopes up to 6% ● Can be used on almost any type of soil ● Can be used in areas with limited surface space. (NJDEP 2004)

Media Filters	Media filters are an evolution of fixed bed sand filtration technology. Media filter cartridges are typically enclosed in underground concrete vaults where stormwater passes through the media and traps particulates and/or soluble pollutants. Various materials may be used as filter media including pleated fabric, activated charcoal, perlite, amended sand and perlite mixes, and zeolite. ▪ Most filtration techniques require a forebay or clarifier to remove larger particles in runoff from clogging the filter media. ▪ Pretreatment prior to the filter media is typically necessary for stormwater with high total suspended solids, hydrocarbon, and debris loadings that may cause clogging and premature filter failure. ▪ Maintenance requirements for filter media include sediment removal and replacement of media cartridges. 2002. USEPA National Menu of Best Management Practices http://www.epa.gov/npdes/menuofbmps/menu.htm	▪ Selection of filter media is a function of the pollutants targeted for removal. ▪ Media filters should primarily be used in an off-line configuration as a secondary treatment practice. ▪ Pretreatment in a stormwater treatment train with other management practices.	Limited peer review data available. Significant reductions can occur using media for targeted pollutants. 2004, Connecticut Stormwater Quality Manual	Estimated costs are based on the size and number of filter cartridges needed, which is based upon the anticipated loading rate and design water quality flow.	▪ Applicable for industrial sites with specific pollutants (i.e., organics, heavy metals, pathogens, and soluble nutrients). ▪ Retrofits of existing stormwater drainage systems, particularly in highly developed areas where conventional treatment practices are not feasible. ▪ Polluted water or sediment removed from these devices should be properly disposed in accordance regulations. Analyses should be performed.

4. Structural BMPs Stormwater Management Appropriate for Urban Land Uses					
Type	**Brief Description**	**Advantages**	**Pollutant Removal Efficiency (if known)**	**Costs (if known)**	**Design Criteria**
Manufactured Treatment Device (MTD)	Manufactured treatment devices are intended to capture sediments, metals, hydrocarbons, floatables, and/or other pollutants in stormwater runoff before being conveyed to a storm sewer system, additional stormwater quality treatment measure or waterbody. (NJDEP 2004)	● MTDs are appropriate for small drainage areas with high impervious cover likely to contribute high hydrocarbon and sediment loads (e.g., small parking lots, gas stations) ● MTDs can trap oil, debris and floatables. ● Useful retrofit: designed to modify existing or new stormwater infrastructure (catch basins). (NJDEP 2004)	Estimates are provided by manufacturers. (NJDEP 2004)	Costs vary depending on manufacturer.	Varies by manufacturer, typically used at urban, impervious sites.

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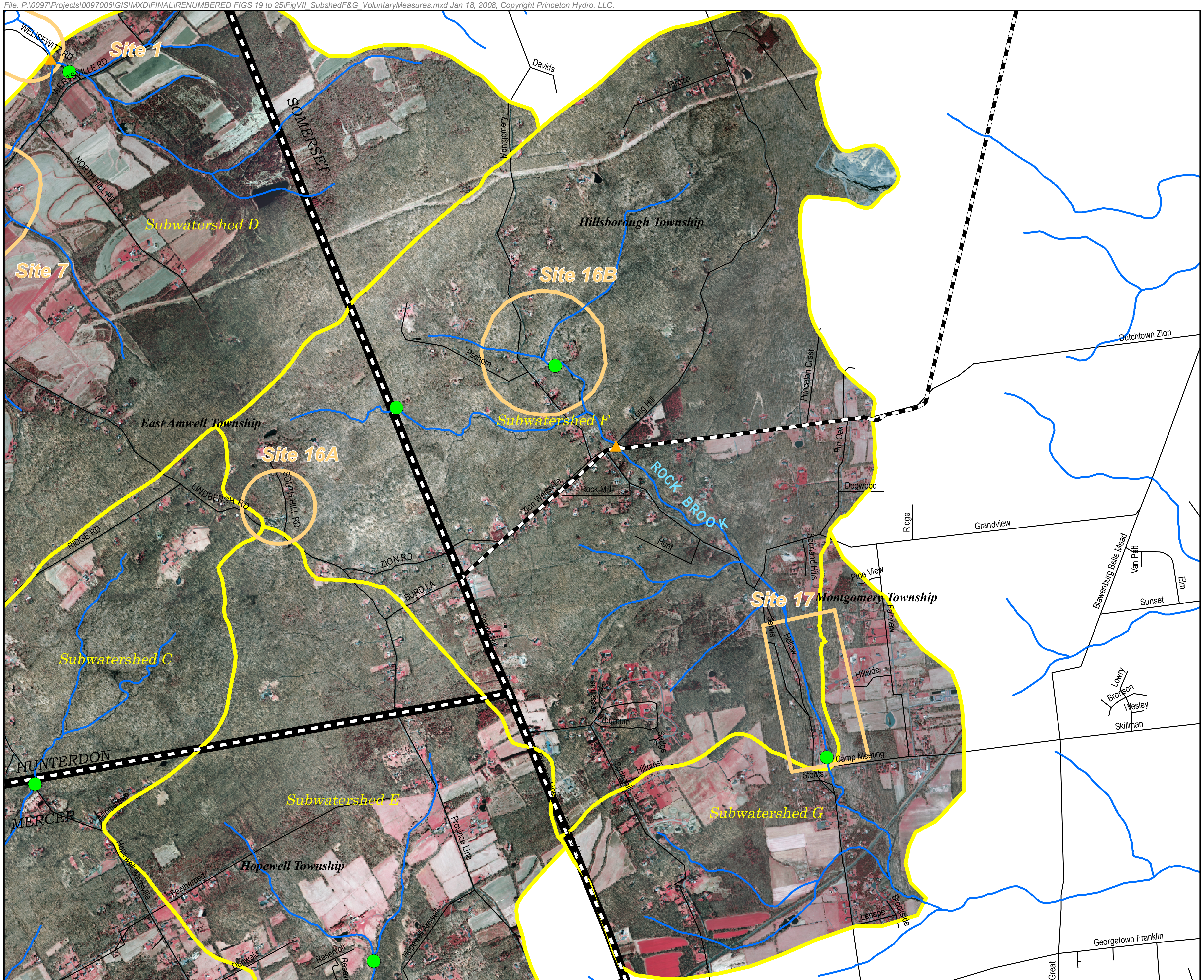
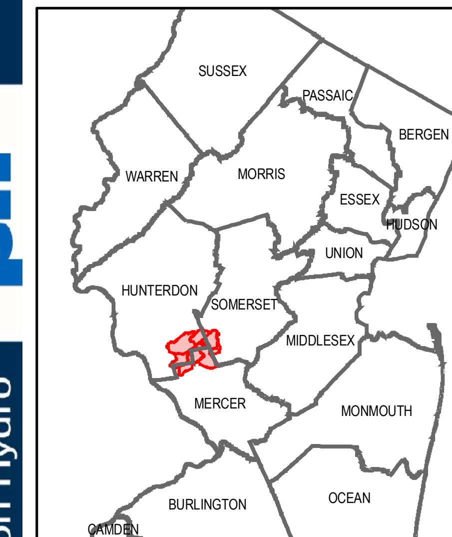


NEW JERSEY COUNTY MAP



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1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551

N

0 500 1,000 2,000 Feet

SOURCES:
1. Roads are the Tiger/Line Files, US Census Bureau except for Hunterdon County, which data was obtained from the Hunterdon County GIS website
2. 2002 Aerial Photographs obtained from the NJ Image Warehouse web site
3. County and Municipal Boundaries obtained from the NJ DEP GIS website.

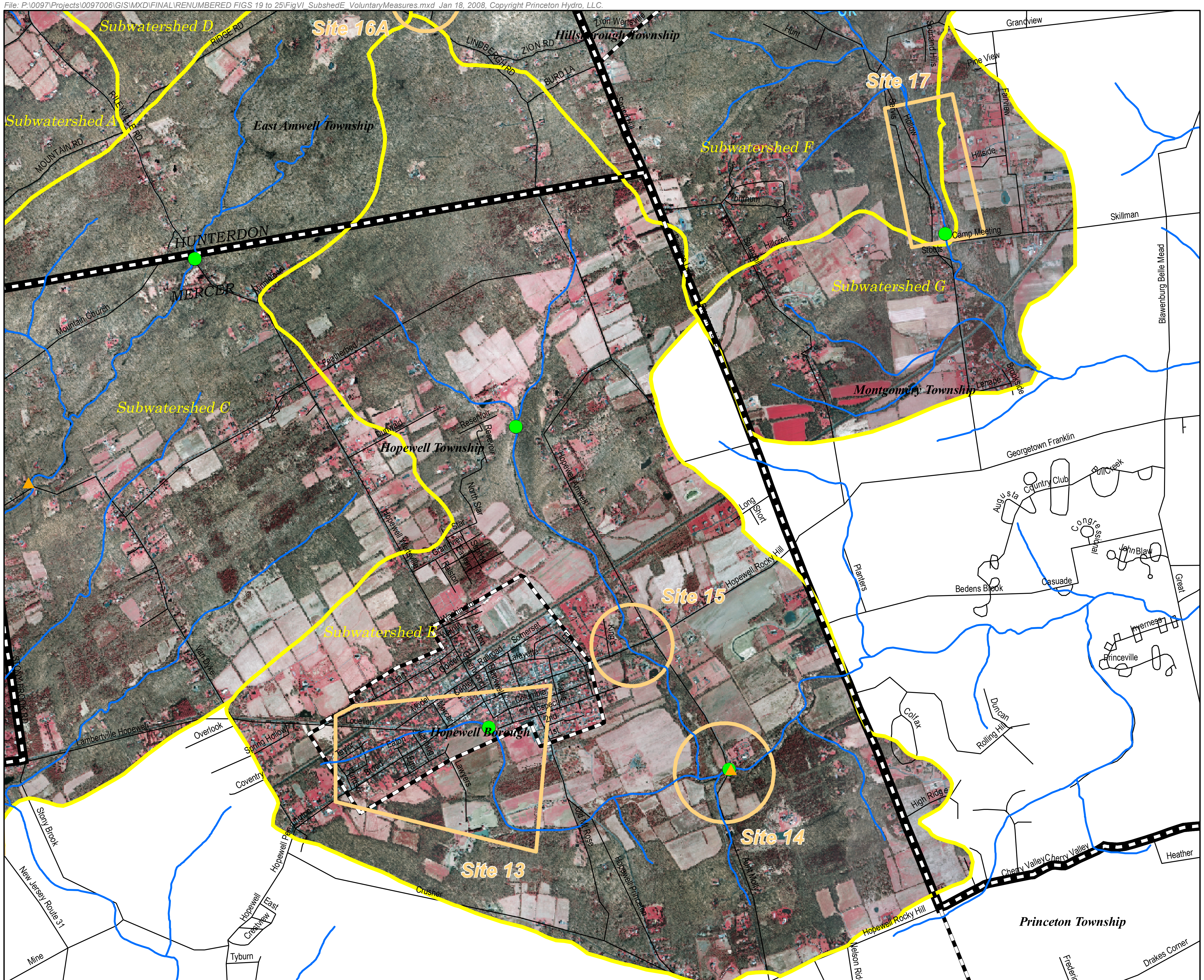
FIGURE VII: SUBWATERSHEDS F&G POTENTIAL RESTORATION SITES

SOURLAND MOUNTAIN WATERSHED PROTECTION PLAN

Legend

- Revised HUC14 /Project Area
- AMNET Monitoring Stations
- RSWMP Sampling Points
- USGS Stream Flow Gages
- Potential Restoration Sites
- Streams
- Roads
- Municipal Boundaries
- County Boundaries

File: P:\0097\Projects\0097006\GIS\MXD\FINAL\RENUMBERED FIGS 19 to 25\FigVI_SubshedE_VoluntaryMeasures.mxd Jan 18, 2008, Copyright Princeton Hydro, LLC.



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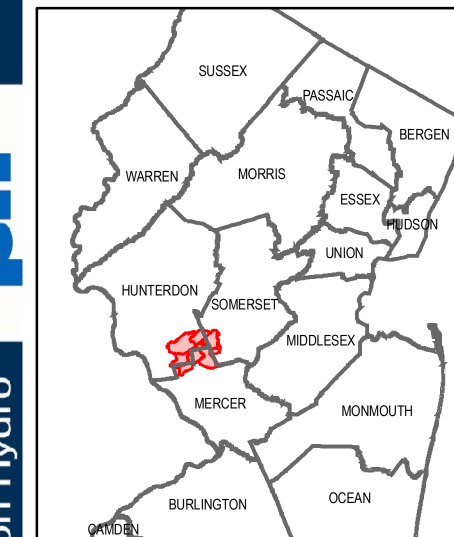
NEW JERSEY COUNTY MAP



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N

0 500 1,000 2,000 Feet

SOURCES:
1. Roads are the Tiger/Line Files, US Census Bureau except for Hunterdon County, which data was obtained from the Hunterdon County GIS website
2. 2002 Aerial Photographs obtained from the NJ Image Warehouse web site
3. County and Municipal Boundaries obtained from the NJ DEP GIS website.

FIGURE VI: SUBWATERSHED E POTENTIAL RESTORATION SITES

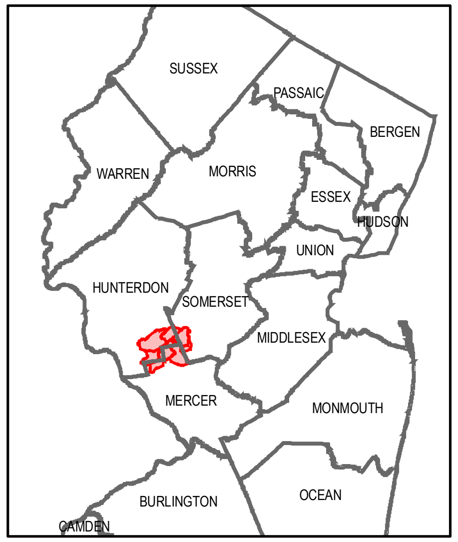
SOURLAND MOUNTAIN WATERSHED PROTECTION PLAN

Legend

- Revised HUC14 /Project Area
- AMNET Monitoring Stations
- RSWMP Sampling Points
- USGS Stream Flow Gages
- Potential Restoration Sites
- Streams
- Roads
- Municipal Boundaries
- County Boundaries

File: P:\0097\Projects\0097006\GIS\MXD\FINAL\RENUMBERED FIGS 19 to 25\FigV_SubshedD_VoluntaryMeasures.mxd Jan 18, 2008, Copyright Princeton Hydro, LLC.

NEW JERSEY COUNTY MAP



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P.O. BOX 720
RINGOES, NJ 08551

N

0 500 1,000 2,000 Feet

SOURCES:
1. Roads are the Tiger/Line Files, US Census Bureau except for Hunterdon County, which data was obtained from the Hunterdon County GIS website
2. 2002 Aerial Photographs obtained from the NJ Image Warehouse web site
3. County and Municipal Boundaries obtained from the NJ DEP GIS website.

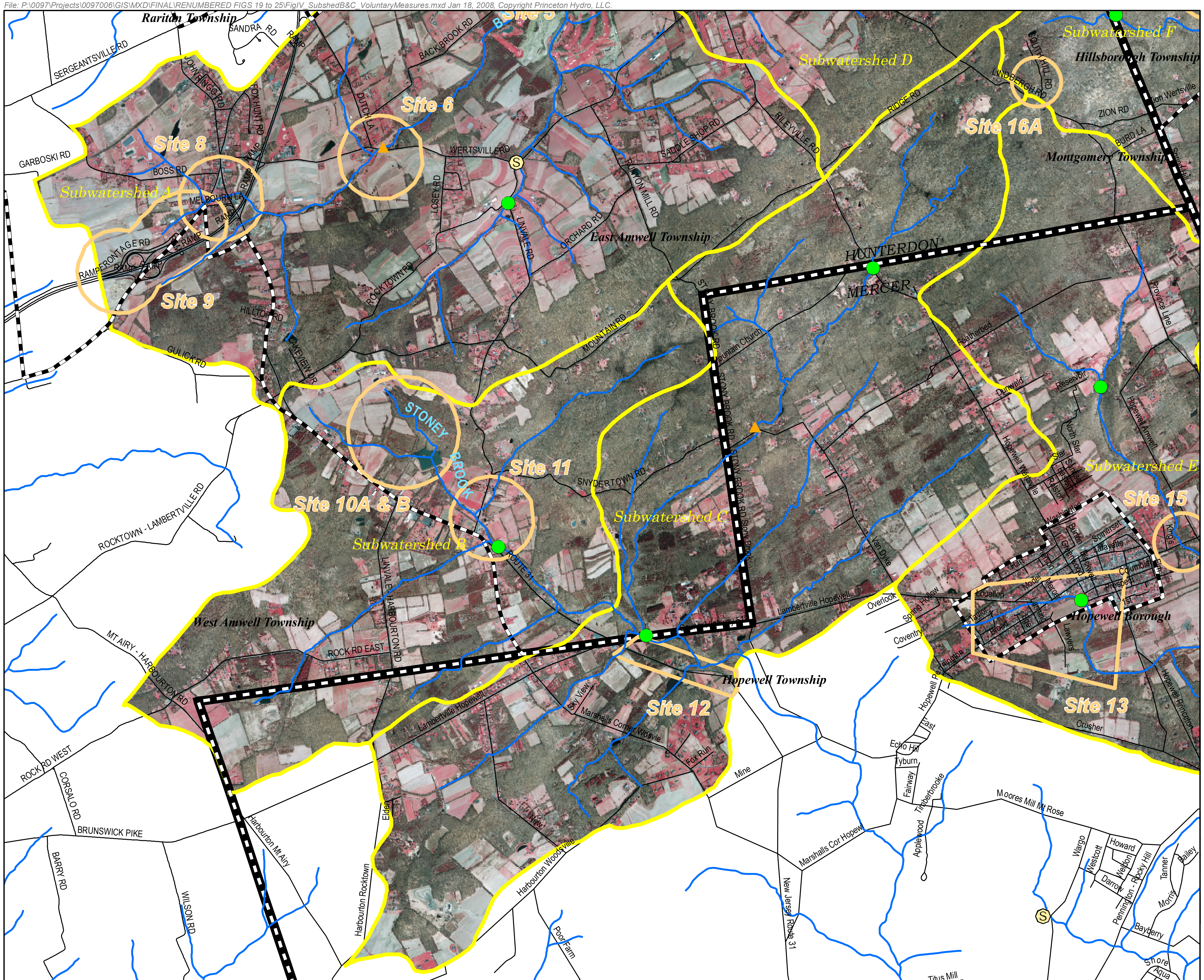
FIGURE V: SUBWATERSHED D POTENTIAL RESTORATION SITES

SOURLAND MOUNTAIN WATERSHED PROTECTION PLAN

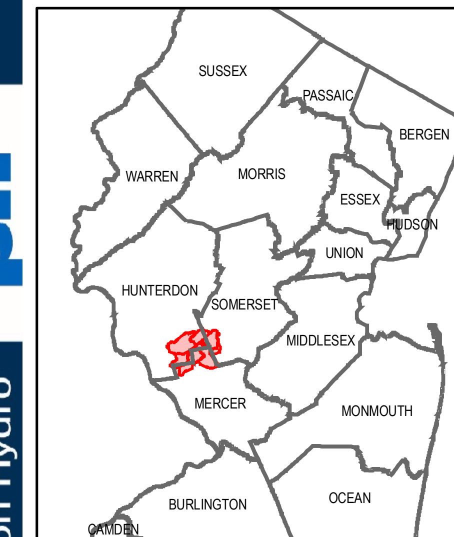
Legend

- AMNET Monitoring Stations
- RSWMP Sampling Points
- USGS Stream Flow Gages
- Streams
- Potential Restoration Sites
- Municipal Boundaries
- Revised HUC14 /Project Area
- County Boundaries
- Roads

File: P:\0097\Projects\0097006\GIS\MXD\FINAL\RENUMBERED FIGS 19 to 25\FigIV_SubshedB&C_VoluntaryMeasures.mxd Jan 18, 2008, Copyright Princeton Hydro, LLC.



NEW JERSEY COUNTY MAP



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1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551

N

0 1,000 2,000 4,000 Feet

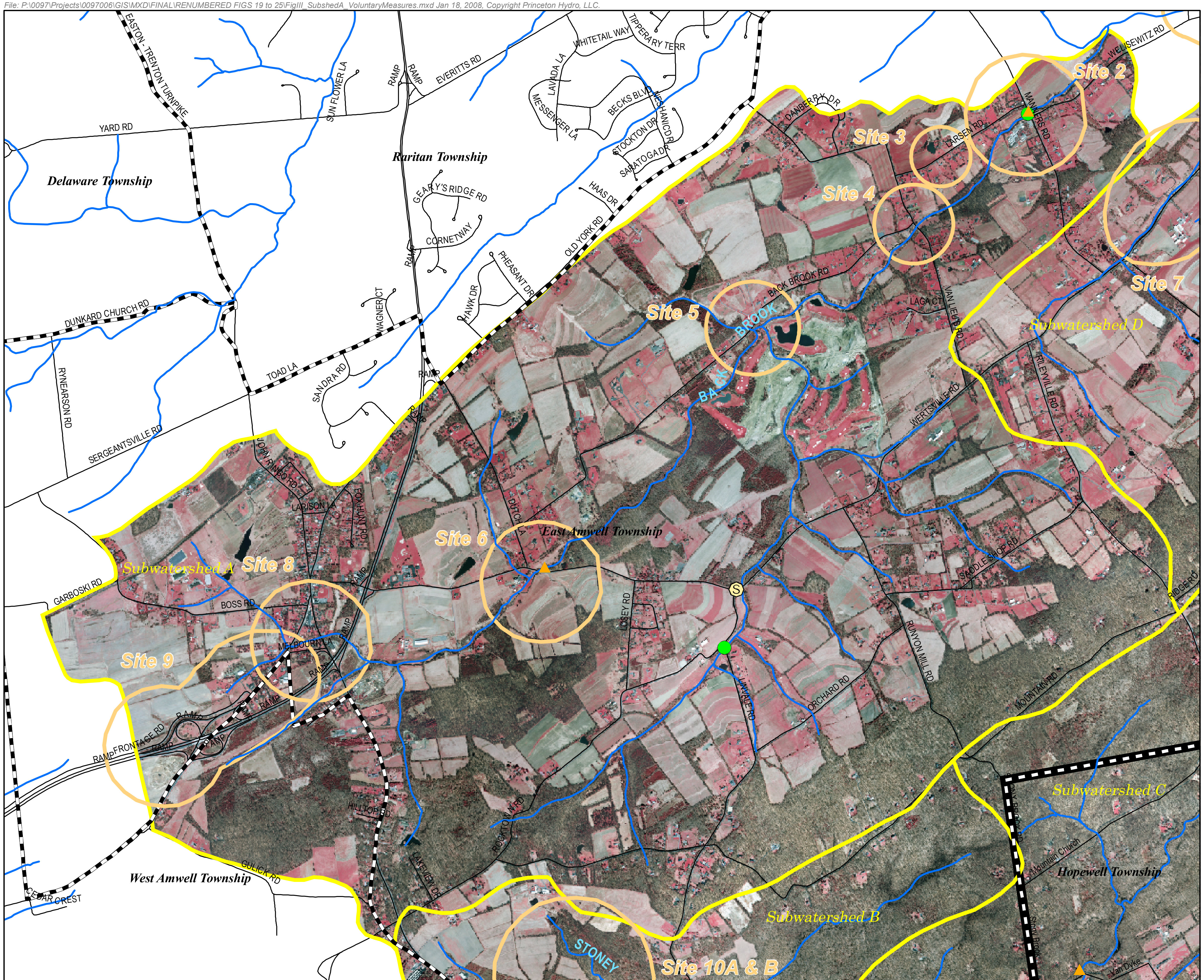
SOURCES:
1. Roads are the Tiger/Line Files, US Census Bureau except for Hunterdon County, which data was obtained from the Hunterdon County GIS website
2. 2002 Aerial Photographs obtained from the NJ Image Warehouse web site
3. County and Municipal Boundaries obtained from the NJ DEP GIS website.

FIGURE IV: SUBWATERSHEDS B&C POTENTIAL RESTORATION SITES

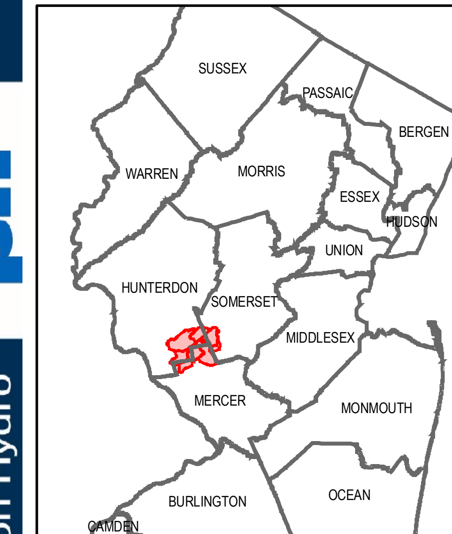
SOURLAND MOUNTAIN WATERSHED PROTECTION PLAN

Legend

- Revised HUC14 /Project Area
- AMNET Monitoring Stations
- RSWMP Sampling Points
- USGS Stream Flow Gages
- Potential Restoration Sites
- Streams
- Roads
- Municipal Boundaries
- County Boundaries



NEW JERSEY COUNTY MAP



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P.O. BOX 720
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N

0 500 1,000 2,000
Feet

SOURCES:
1. Roads are the Tiger/Line Files, US Census Bureau except for Hunterdon County, which data was obtained from the Hunterdon County GIS website
2. 2002 Aerial Photographs obtained from the NJ Image Warehouse web site
3. County and Municipal Boundaries obtained from the NJ DEP GIS website.

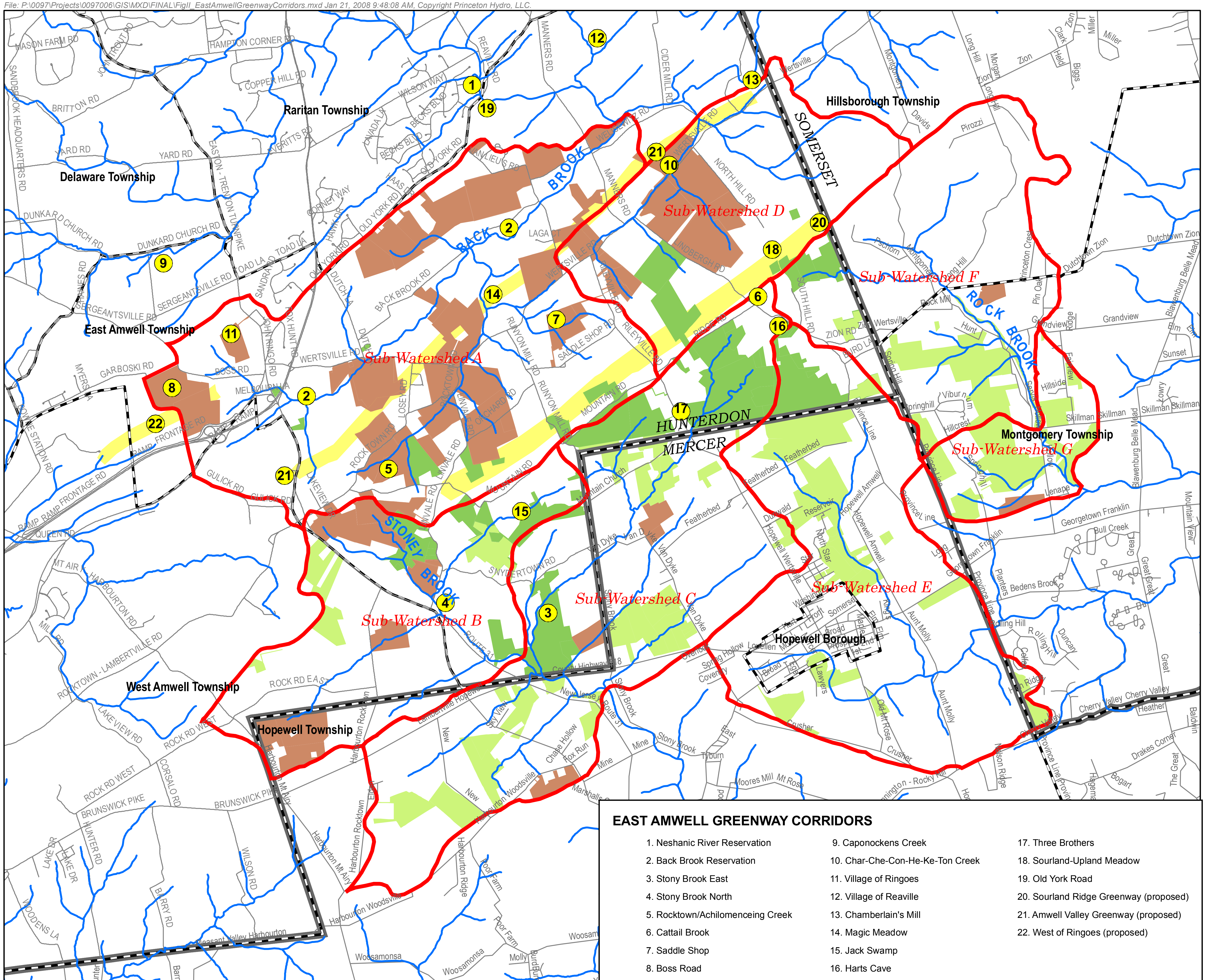
FIGURE III: SUBWATERSHED A POTENTIAL RESTORATION SITES

SOURLAND MOUNTAIN WATERSHED PROTECTION PLAN

Legend

- Revised HUC14 /Project Area
- AMNET Monitoring Stations
- RSWMP Sampling Points
- USGS Stream Flow Gages
- Potential Restoration Sites
- Streams
- Roads
- Municipal Boundaries
- County Boundaries

File: P:\0097\Projects\0097006\GIS\MXD\FINAL\FigII_EastAmwellGreenwayCorridors.mxd Jan 21, 2008 9:48:08 AM, Copyright Princeton Hydro, LLC.



EAST AMWELL GREENWAY CORRIDORS

1. Neshanic River Reservation
2. Back Brook Reservation
3. Stony Brook East
4. Stony Brook North
5. Rocktown/Achilomenceing Creek
6. Cattail Brook
7. Saddle Shop
8. Boss Road
9. Caponockens Creek
10. Char-Che-Con-He-Ke-Ton Creek
11. Village of Ringoes
12. Village of Reaville
13. Chamberlain's Mill
14. Magic Meadow
15. Jack Swamp
16. Harts Cave
17. Three Brothers
18. Sourland-Upland Meadow
19. Old York Road
20. Sourland Ridge Greenway (proposed)
21. Amwell Valley Greenway (proposed)
22. West of Ringoes (proposed)

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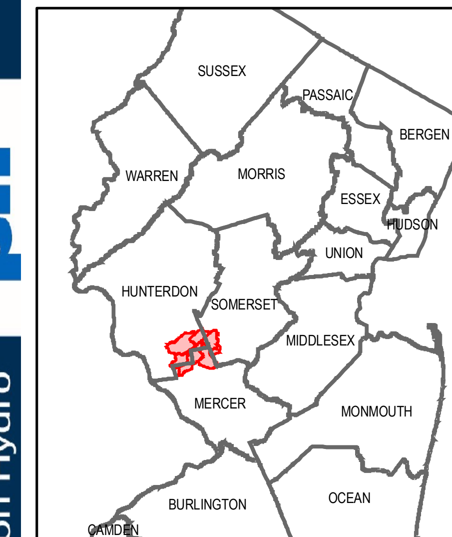
NEW JERSEY COUNTY MAP



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RINGOES, NJ 08551

N

0 2,500 5,000 Feet

1 inch equals 5,000 feet

SOURCES:

1. Roads are the Tiger/Line Files, US Census Bureau except for Hunterdon County, which road data was obtained from the Hunterdon County GIS website

2. Open Space: Data obtained from the NJDEP Green Acres Program, Hunterdon Co. GIS Dept., East Amwell Twp, and Mercer Co.

3. Farmland Preservation: Data obtained from the Dept. of Agriculture,Hunterdon Co. GIS Dept., East Amwell Twp and Mercer County

4. Greenway Corridor locations as identified in the Greenways and Open Space Element of the East Amwell

FIGURE II: SOURLAND MOUNTAIN GREENWAY PLAN

SOURLAND MOUNTAIN WATERSHED PROTECTION PLAN

Legend

- Project Area
- Streams
- Municipal Boundaries
- County Boundaries
- Roads
- Conservation Easement
- Farmland Preservation
- Open Space Preservation
- Greenway Corridor Locations
- Potential Greenway Corridors

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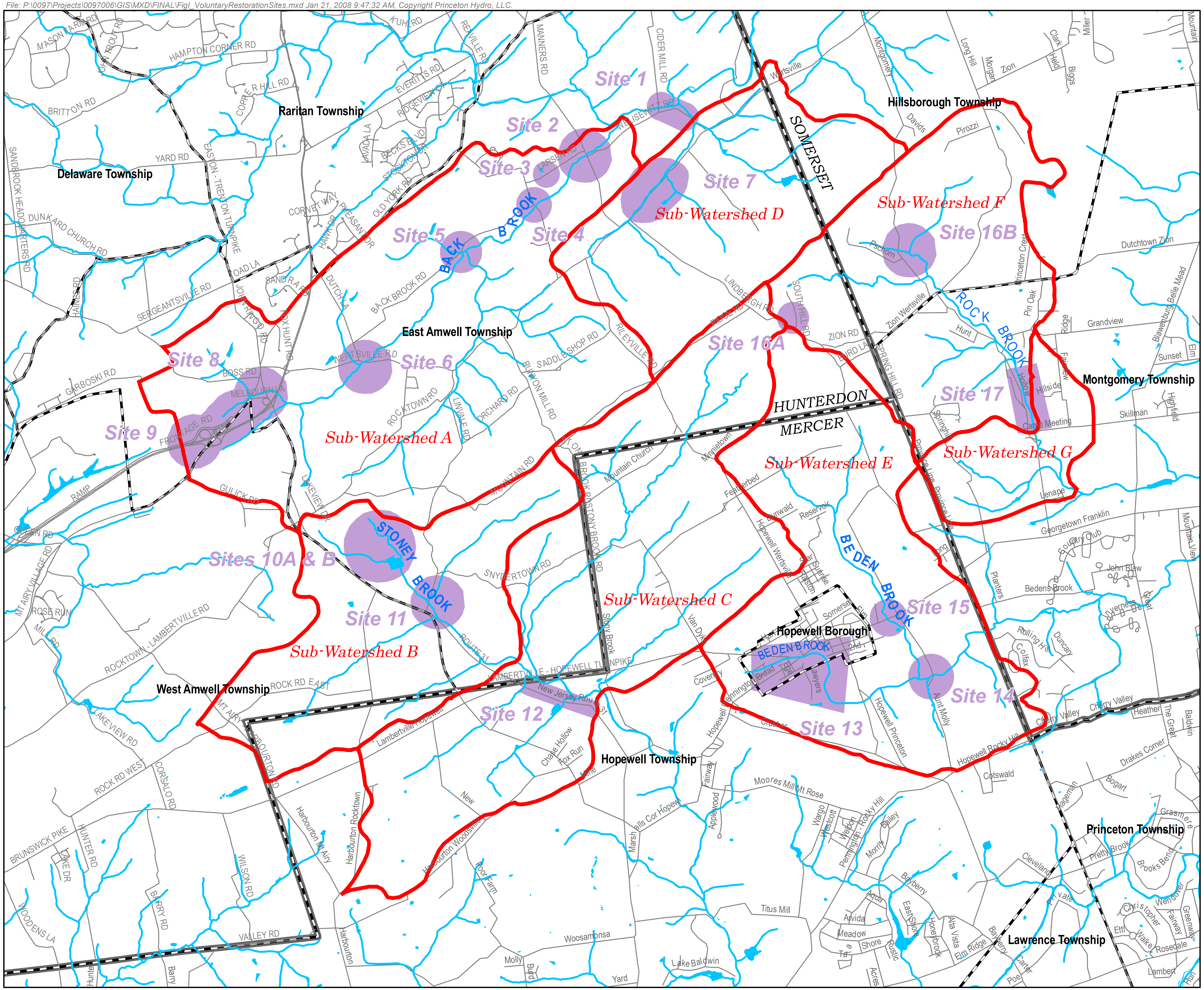

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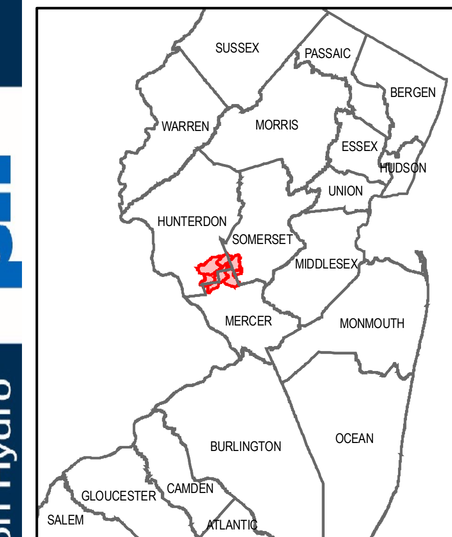
NEW JERSEY COUNTY MAP



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N

0 2,500 5,000 Feet

1 inch equals 5,000 feet

SOURCES:

1. Roads are the Tiger/Line Files, US Census Bureau except for Hunterdon County, which data was obtained from the Hunterdon County GIS webpage

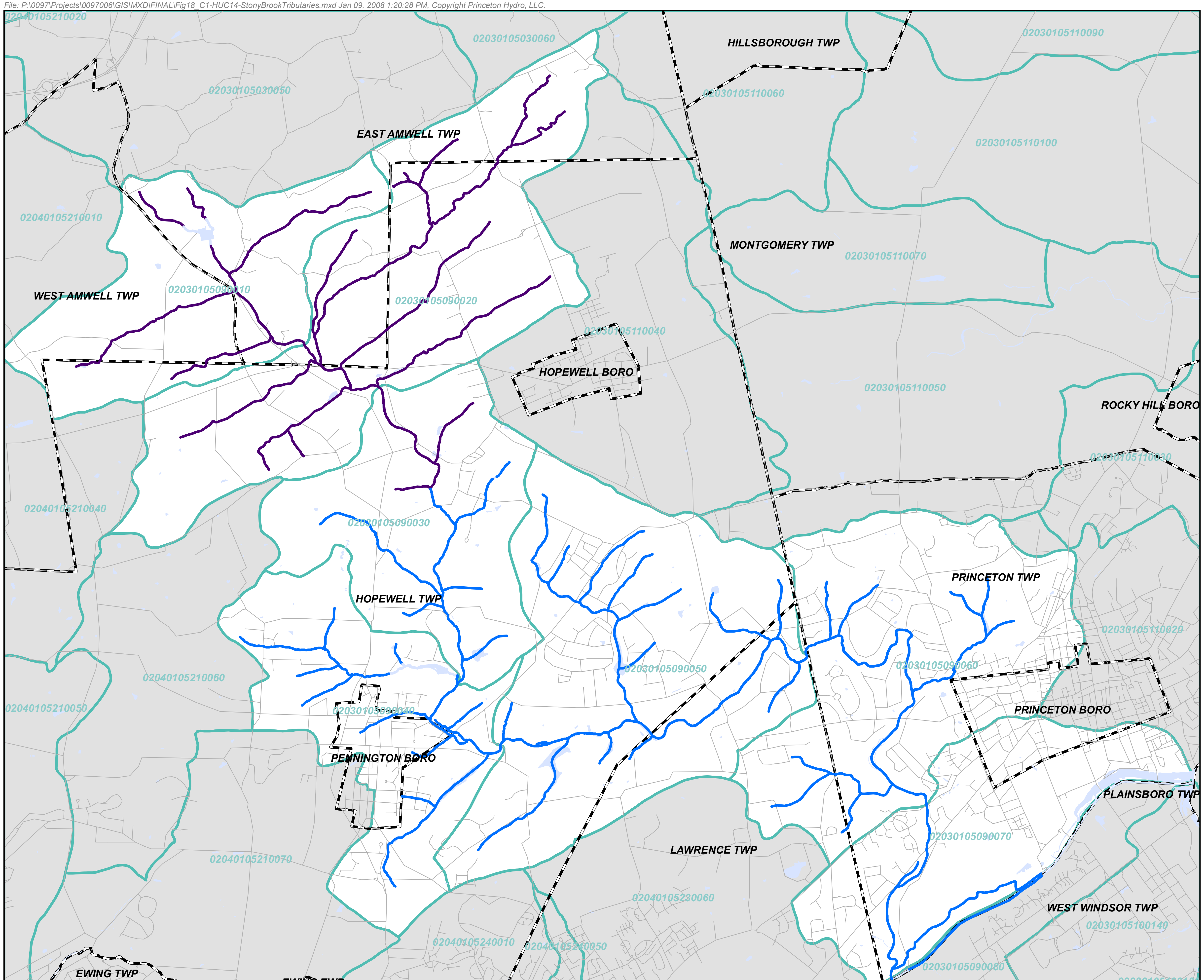
FIGURE I: VOLUNTARY RESTORATION AND MITIGATION SITES

SOURLAND MOUNTAIN WATERSHED PROTECTION PLAN

Legend

- Project Area
- Potential Restoration Sites
- Lakes
- Streams
- Roads
- Municipal Boundaries
- County Boundaries

File: P:\0097\Projects\0097006\GIS\MXD\FINAL\Fig18_C1-HUC14-StonyBrookTributaries.mxd Jan 09, 2008 1:20:28 PM, Copyright Princeton Hydro, LLC.



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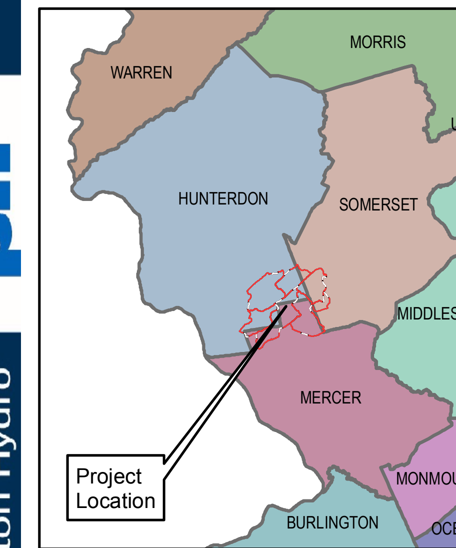
NEW JERSEY COUNTY MAP



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Miles
0 0.25 0.5 1
1 inch equals 1 miles

SOURCES:

1. Roads, streams, lakes, municipal and county boundaries as obtained from the NJDEP GIS website.

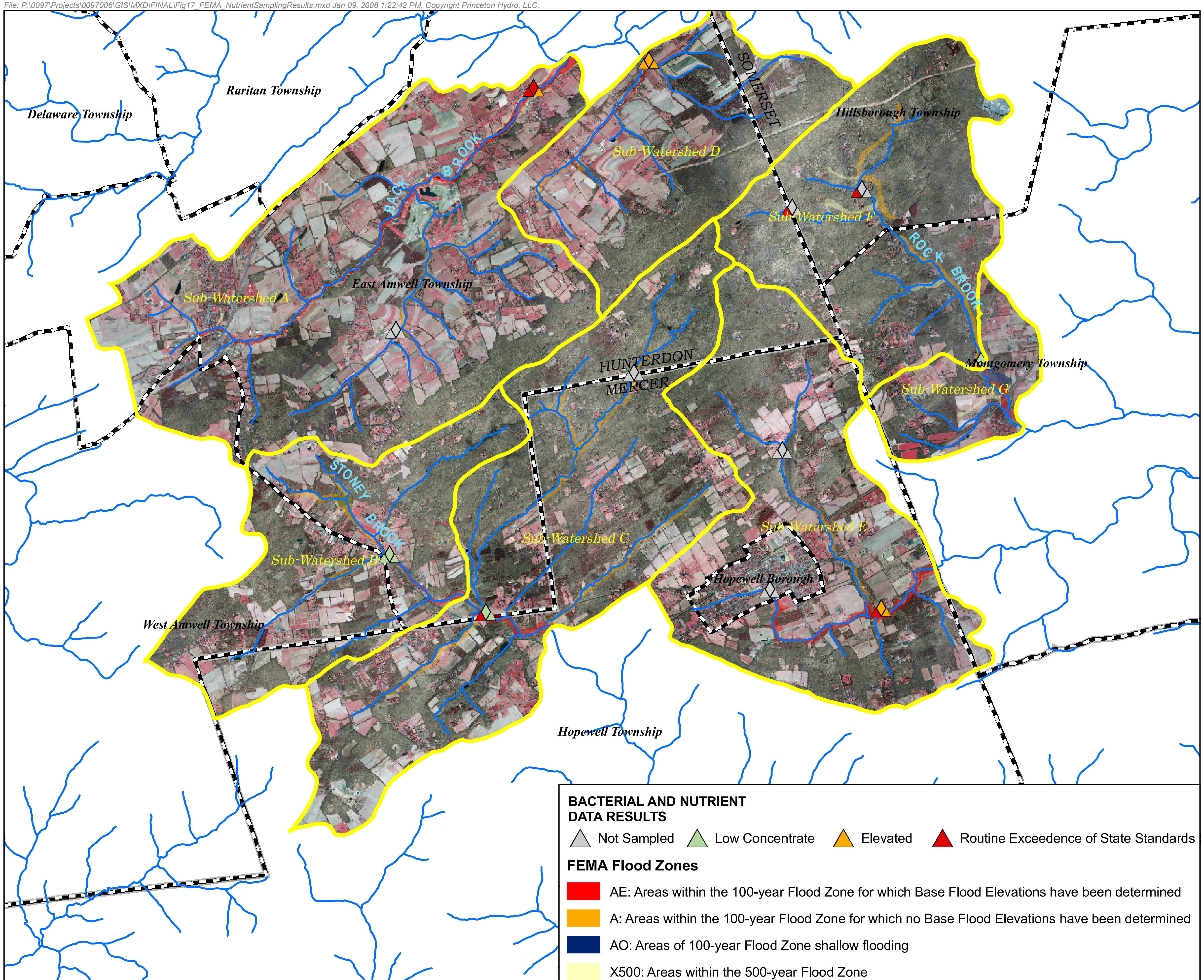
FIGURE 18: C1 STREAM NOMINATIONS

SOURLAND MOUNTAIN WATERSHED PROTECTION PLAN

Legend

- Existing C1 Stream
- C1 Nomination
- Should be included in C1 Nomination
- Lakes
- Roads
- HUC 14 Boundaries

File: P:\0097\Projects\0097006\GIS\MXD\FINAL\Fig17_FEMA_NutrientSamplingResults.mxd Jan 09, 2008 1:22:42 PM, Copyright Princeton Hydro, LLC.



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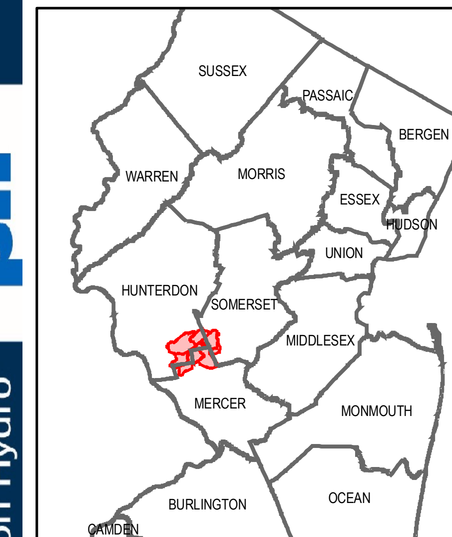
NEW JERSEY COUNTY MAP



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P.O. BOX 720
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N

0 2,500 5,000 Feet

1 inch equals 5,000 feet

SOURCES:
1. Roads are the Tiger/Line Files, US Census Bureau except for Hunterdon County, which data was obtained from the Hunterdon County GIS website

2. 2002 Aerial Photographs obtained from the NJ Image Warehouse website

3. County and Municipal Boundaries obtained from the NJ DEP GIS website.

4. FEMA floodplain data as obtained from the Federal Emergency Management Agency National Flood Insurance Program Q3 Flood Data (Disc 18 New Jersey)

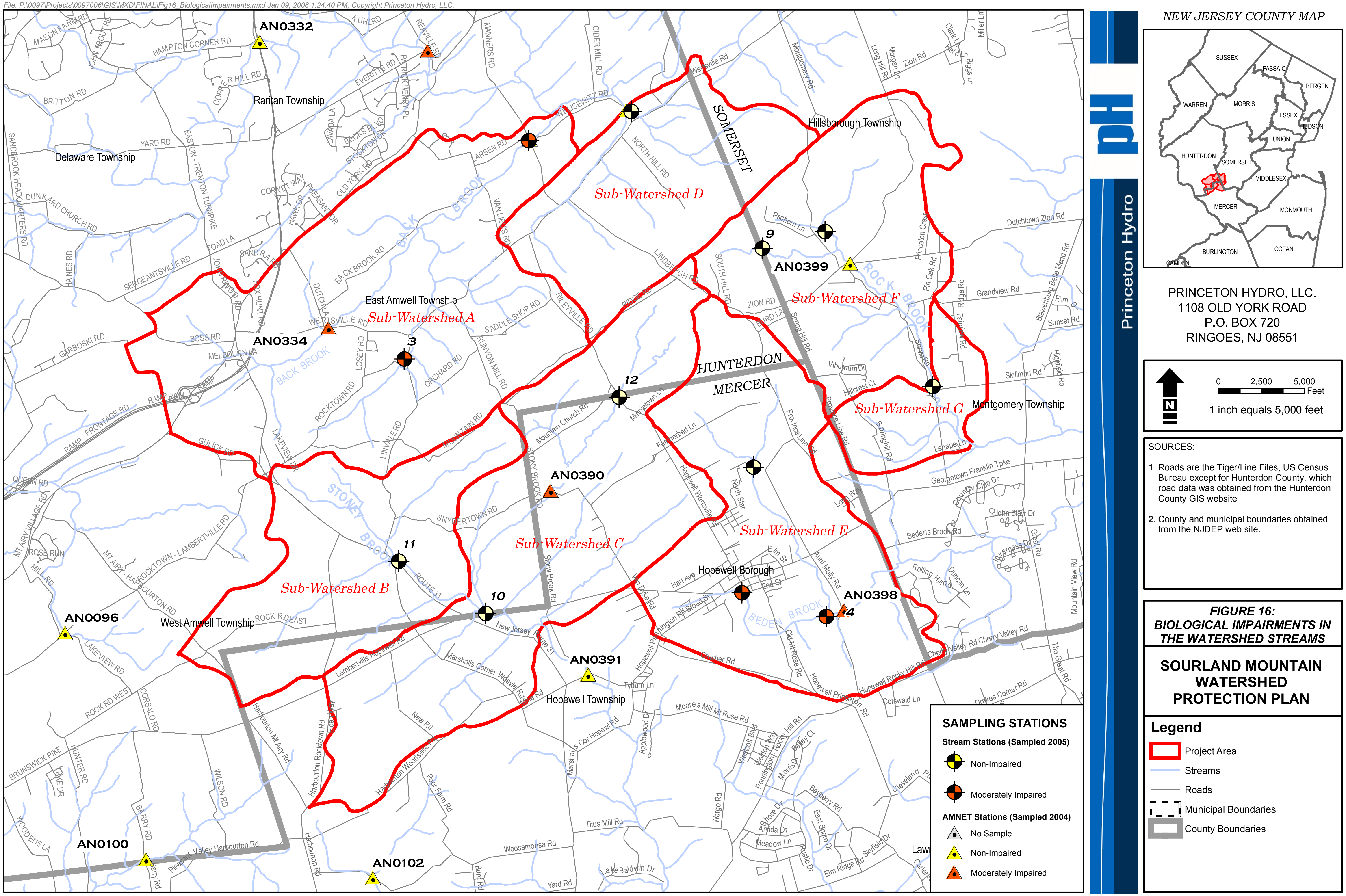
FIGURE 17: FEMA FLOODPLAINS & NUTRIENT SAMPLING RESULTS

SOURLAND MOUNTAIN WATERSHED PROTECTION PLAN

Legend

Revised HUC14 /Project Area
Streams
County Boundaries

B = Bacterial
TP = Total Phosphorous
N = Nitrate


File: P:\0097\Projects\0097006\GIS\MXD\FINAL\Fig16_BiologicalImpairments.mxd Jan 09, 2008 1:24:40 PM, Copyright Princeton Hydro, LLC.
Raritan Township
Delaware Township
East Amwell Township
West Amwell Township
Hillsborough Township
Montgomery Township
Hopewell Township
Hopewell Borough
SOMERSET
HUNTERDON
MERCER
Sub-Watershed A
Sub-Watershed B
Sub-Watershed C
Sub-Watershed D
Sub-Watershed E
Sub-Watershed F
Sub-Watershed G
AN0332
AN0334
AN0390
AN0391
AN0399
AN0398
AN0096
AN0100
AN0102
3
4
9
10
11
12
BACK BROOK
STONEY BROOK
ROCK BROOK
BEDEN BROOK
NEW JERSEY COUNTY MAP
SUSSEX
PASSAIC
BERGEN
WARREN
MORRIS
ESSEX
HUDSON
UNION
HUNTERDON
SOMERSET
MIDDLESEX
MERCER
MONMOUTH
BURLINGTON
OCEAN
CAMDEN
Princeton Hydro
PRINCETON HYDRO, LLC.
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P.O. BOX 720
RINGOES, NJ 08551
N
0 2,500 5,000 Feet
1 inch equals 5,000 feet
SOURCES:
1. Roads are the Tiger/Line Files, US Census Bureau except for Hunterdon County, which road data was obtained from the Hunterdon County GIS website
2. County and municipal boundaries obtained from the NJDEP web site.
FIGURE 16:
BIOLOGICAL IMPAIRMENTS IN THE WATERSHED STREAMS
SOURLAND MOUNTAIN WATERSHED PROTECTION PLAN
Legend
Project Area
Streams
Roads
Municipal Boundaries
County Boundaries
SAMPLING STATIONS
Stream Stations (Sampled 2005)
Non-Impaired
Moderately Impaired
AMNET Stations (Sampled 2004)
No Sample
Non-Impaired
Moderately Impaired

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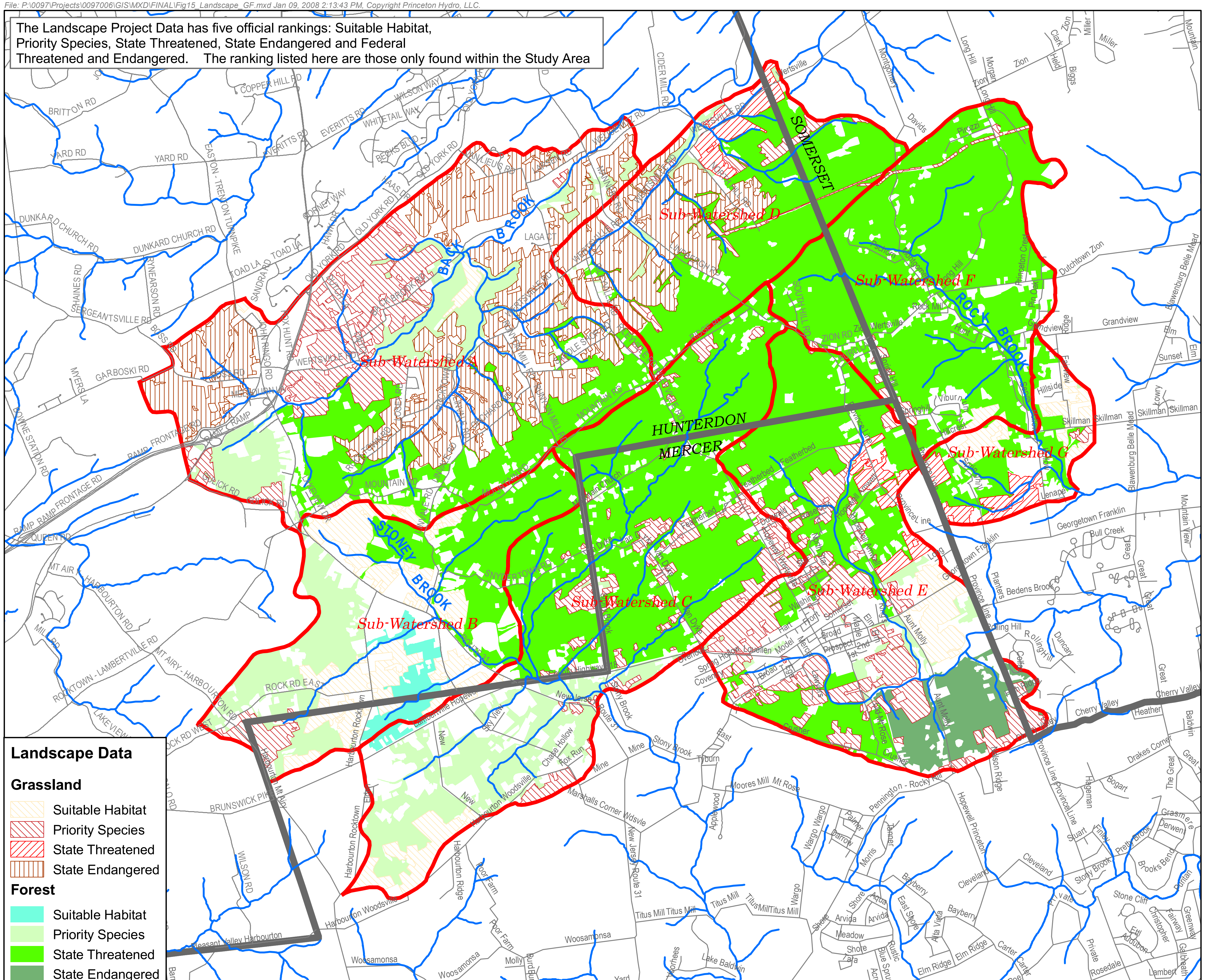

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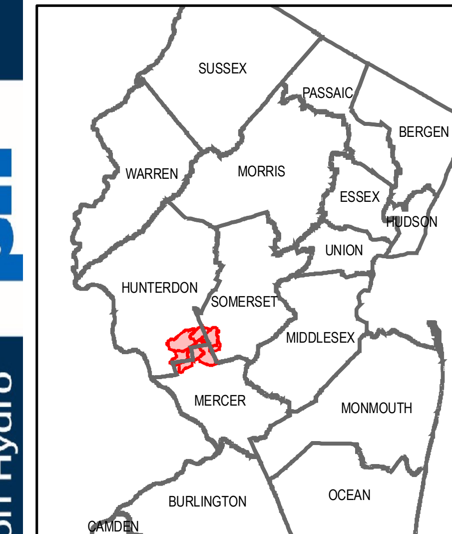
NEW JERSEY COUNTY MAP



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P.O. BOX 720
RINGOES, NJ 08551

N

0 2,500 5,000 Feet

1 inch equals 5,000 feet

SOURCES:

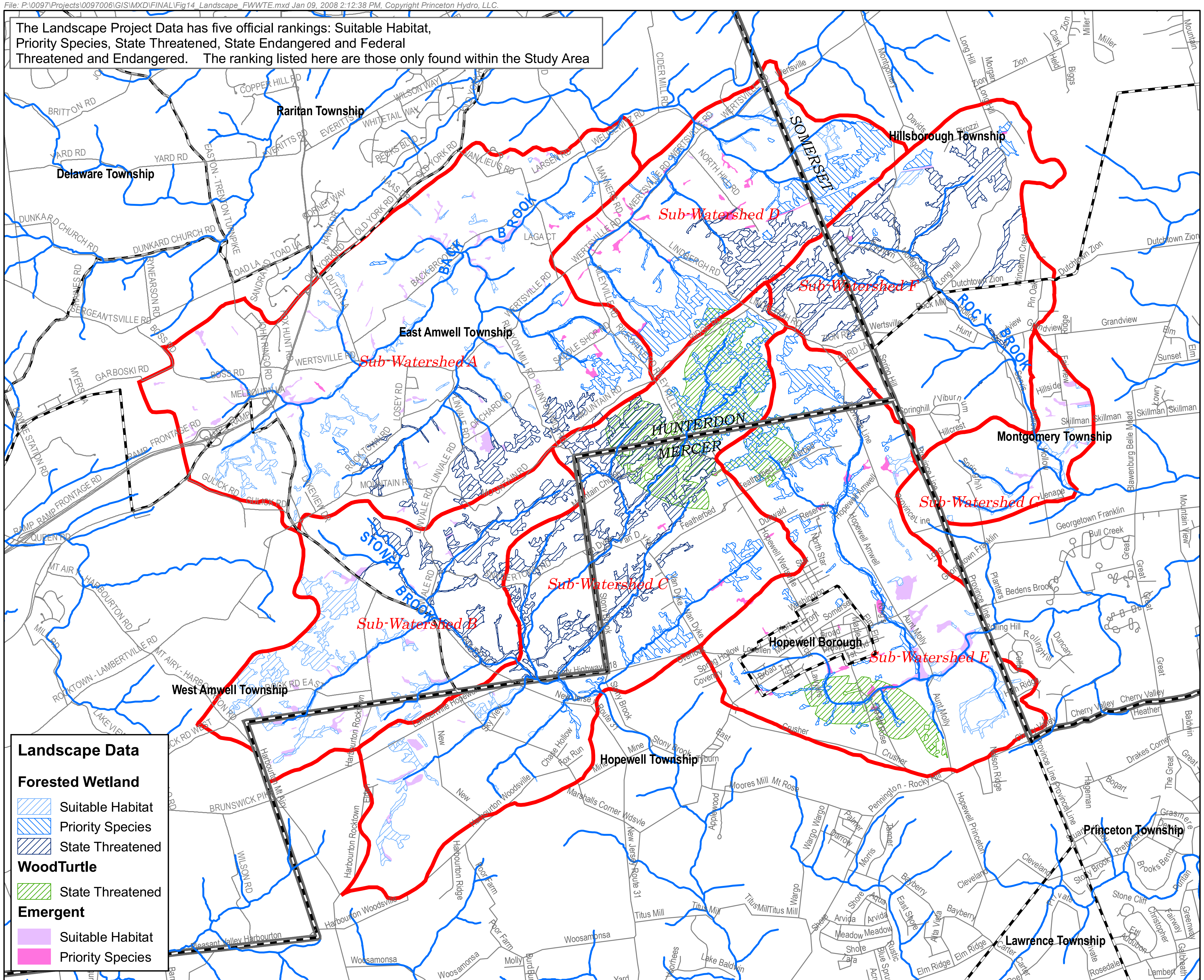
1. Roads are the Tiger/Line Files, US Census except for Hunterdon County, which road data was obtained from the Hunterdon County GIS website
2. Landscape Project (Version 2) data obtained from the NJDEP, Division of Fish and Wildlife, Endangered and Nongame Species Program
3. County and Municipal Boundaries obtained from the NJ DEP's GIS web site.

FIGURE 15: LANDSCAPE PROJECT MAPPING OF GRASSLAND HABITATS, 2002

SOURLAND MOUNTAIN WATERSHED PROTECTION PLAN

Legend

- Roads
- Municipal Boundaries
- County Boundaries
- Project Area



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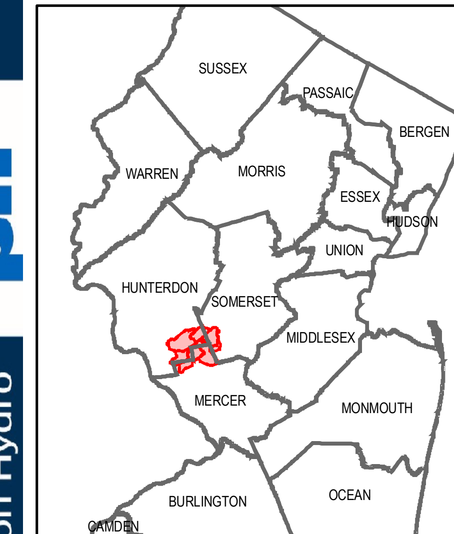
NEW JERSEY COUNTY MAP



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P.O. BOX 720
RINGOES, NJ 08551

N

0 2,500 5,000 Feet

1 inch equals 5,000 feet

SOURCES:
1. Roads are the Tiger/Line Files, US Census except for Hunterdon County, which road data was obtained from the Hunterdon County GIS website
2. Landscape Project (Version 2) data obtained from the NJDEP, Division of Fish and Wildlife, Endangered and Nongame Species Program
3. County and Municipal Boundaries obtained from the NJ DEP's GIS web site.

FIGURE 14: LANDSCAPE PROJECT MAPPING OF FOREST AND WETLAND HABITATS 2002

SOURLAND MOUNTAIN WATERSHED PROTECTION PLAN

Legend

- Roads
- Municipal Boundaries
- County Boundaries
- Project Area
- Streams

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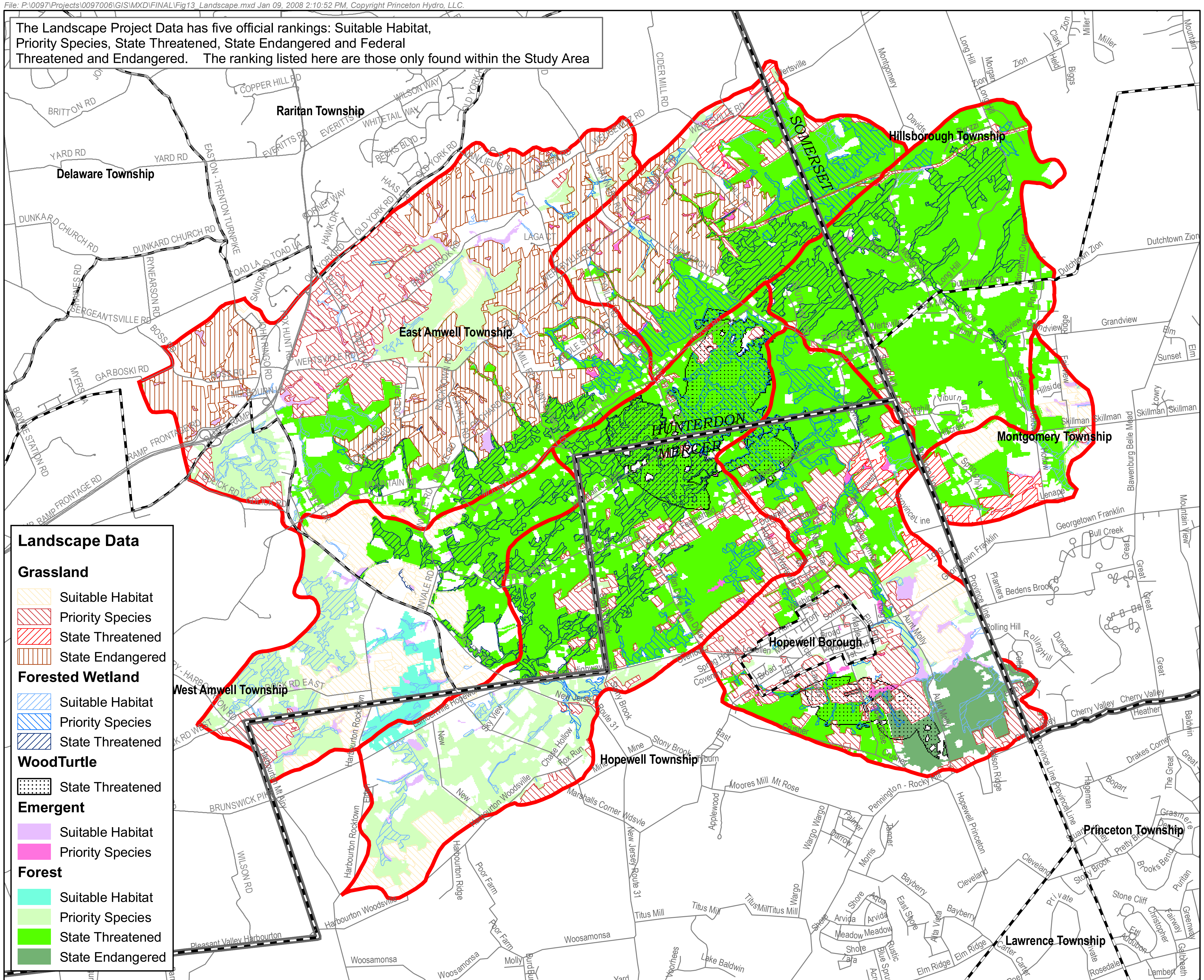

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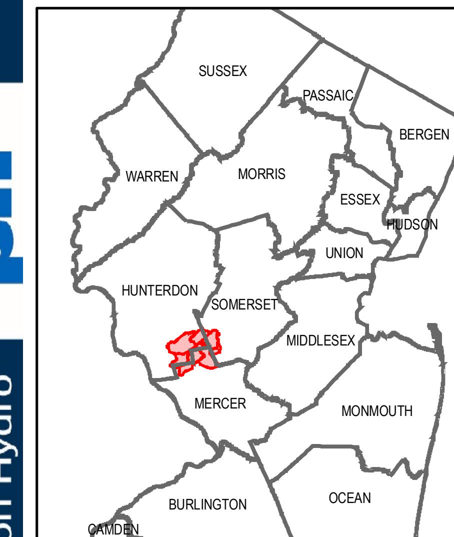
NEW JERSEY COUNTY MAP



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P.O. BOX 720
RINGOES, NJ 08551

N

0 2,500 5,000 Feet

1 inch equals 5,000 feet

SOURCES:
1. Roads are the Tiger Line Files except for Hunterdon County, which road data was obtained from the Hunterdon County GIS website

2. Landscape Project (Version 2) data obtained from the NJDEP, Division of and Wildlife, Endangered and Nongame Species Program

3. County and Municipal Boundaries obtained from the NJ DEP's GIS web site.

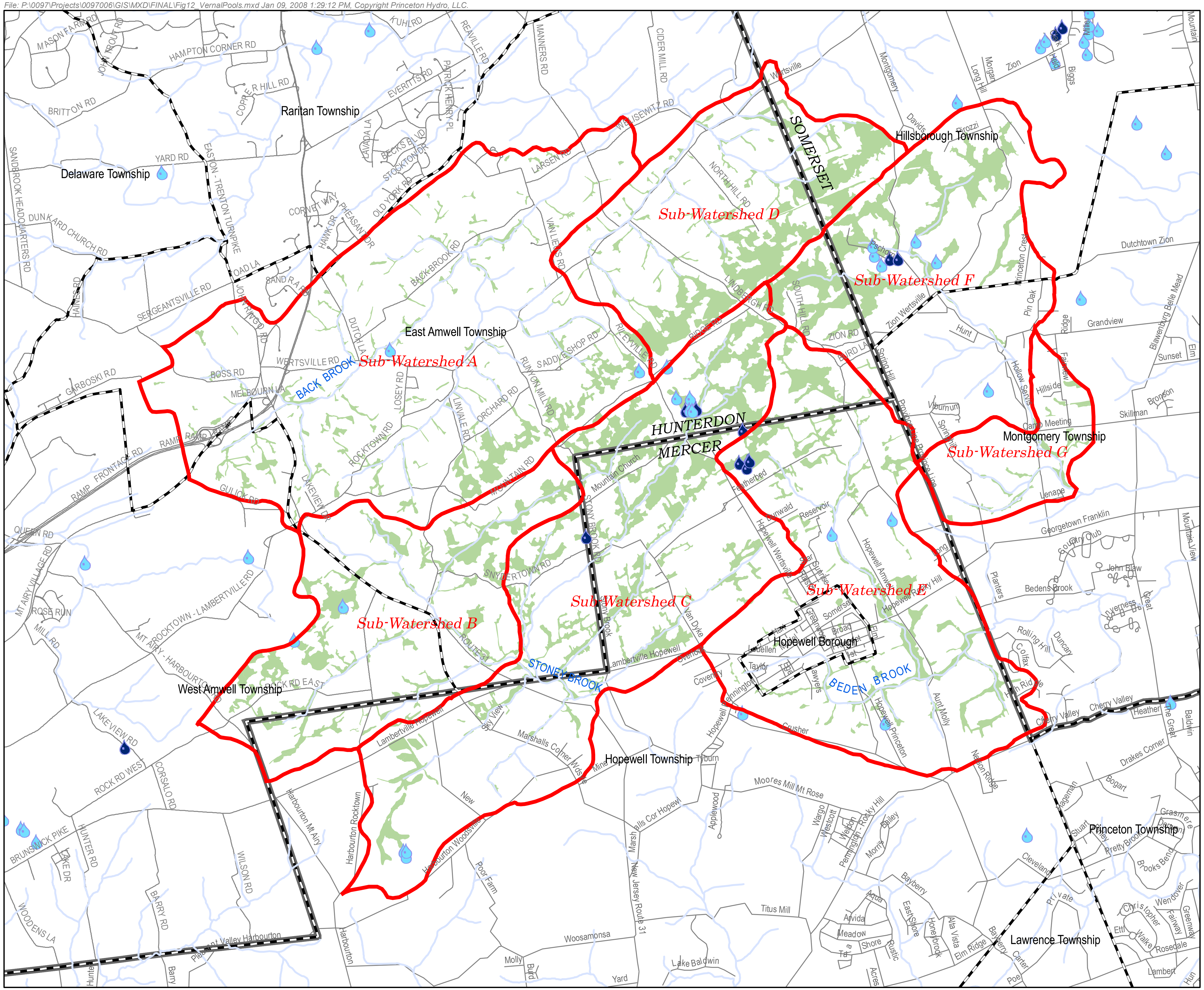
FIGURE 13: LANDSCAPE PROJECT MAPPING OF CRITICAL HABITATS, 2002

SOURLAND MOUNTAIN WATERSHED PROTECTION PLAN

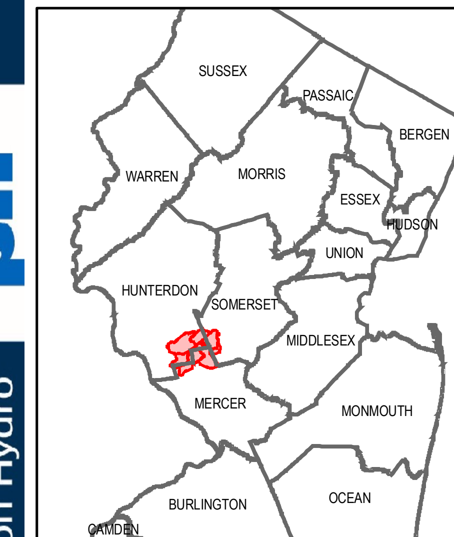
Legend

Roads
Municipal Boundaries
County Boundaries
Project Area

File: P:\0097\Projects\0097006\GIS\MXD\FINAL\Fig12_VernalPools.mxd Jan 09, 2008 1:29:12 PM, Copyright Princeton Hydro, LLC.



NEW JERSEY COUNTY MAP



PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551

N

0 2,500 5,000 Feet

1 inch equals 5,000 feet

SOURCES:

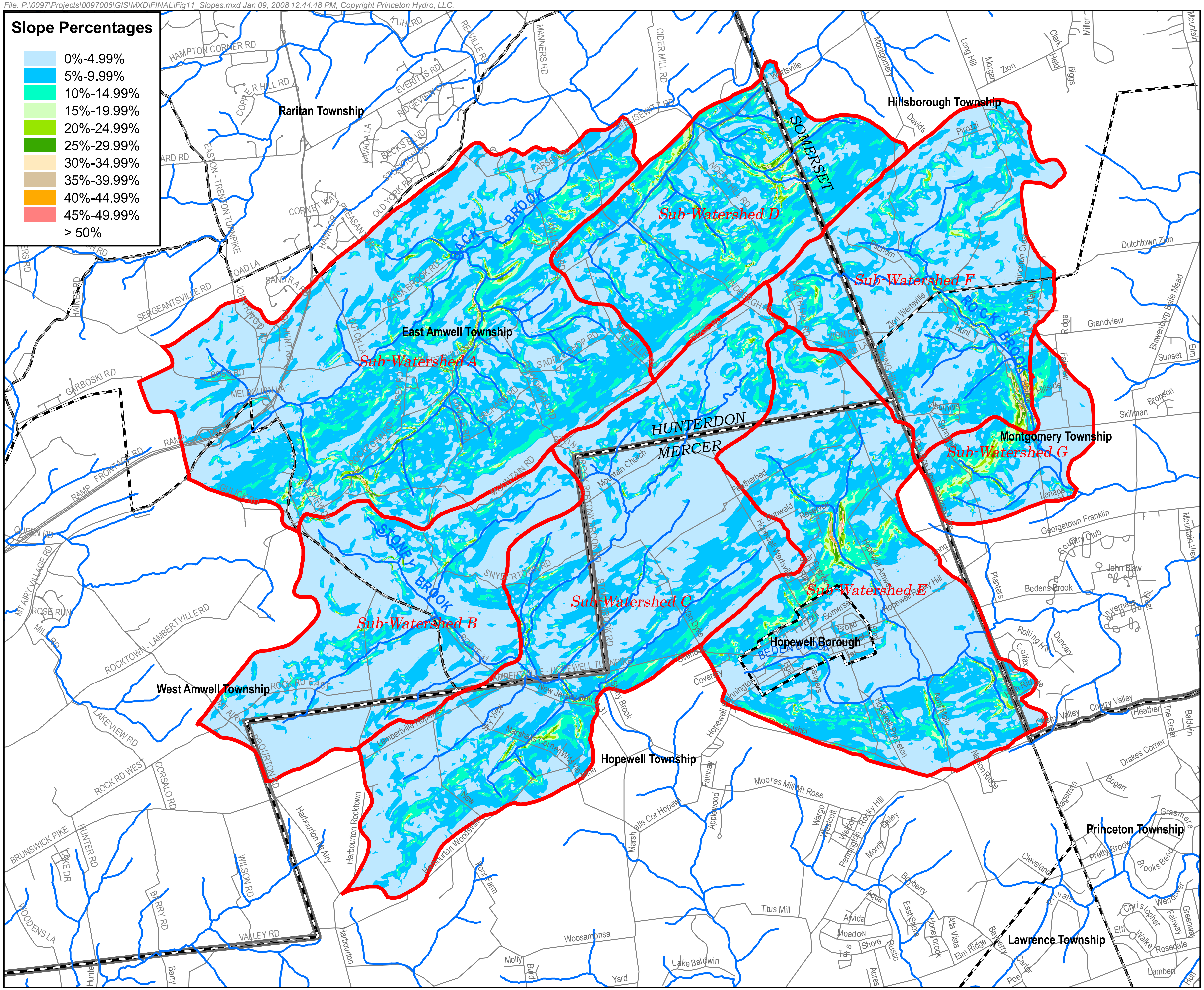
1. Roads are the Tiger/Line Files, US Census Bureau except for Hunterdon County, which road data was obtained from the Hunterdon County GIS website
2. County and Municipal Boundaries obtained from the NJDEP GIS website.
3. NJ DEP Wetlands are a sub-set of DEP's 1995/97 Land Use/Land Cover GIS data set.
4. Vernal pools obtained from Rutgers University.

FIGURE 12: WETLANDS AND VERNAL POOLS

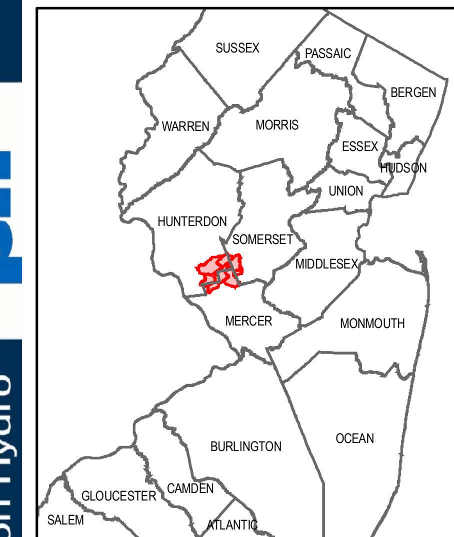
SOURLAND MOUNTAIN WATERSHED PROTECTION PLAN

Legend

- Project Area
- Certified Vernal Pool
- Potential Vernal Pool
- Streams
- Municipal Boundaries
- County Boundaries
- Roads
- NJ DEP Wetlands



NEW JERSEY COUNTY MAP



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PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551

N

0 2,500 5,000 Feet

1 inch equals 5,000 feet

SOURCES:

1. Roads are the Tiger/Line Files, US Census Bureau except for Hunterdon County, which road data was obtained from the Hunterdon County GIS webpage

2. Slopes data derived from 10 meter Digital Elevation Models (DEM) that were obtained from the NJ DEP's GIS website. Slopes percentages calculated with ESRI GIS software

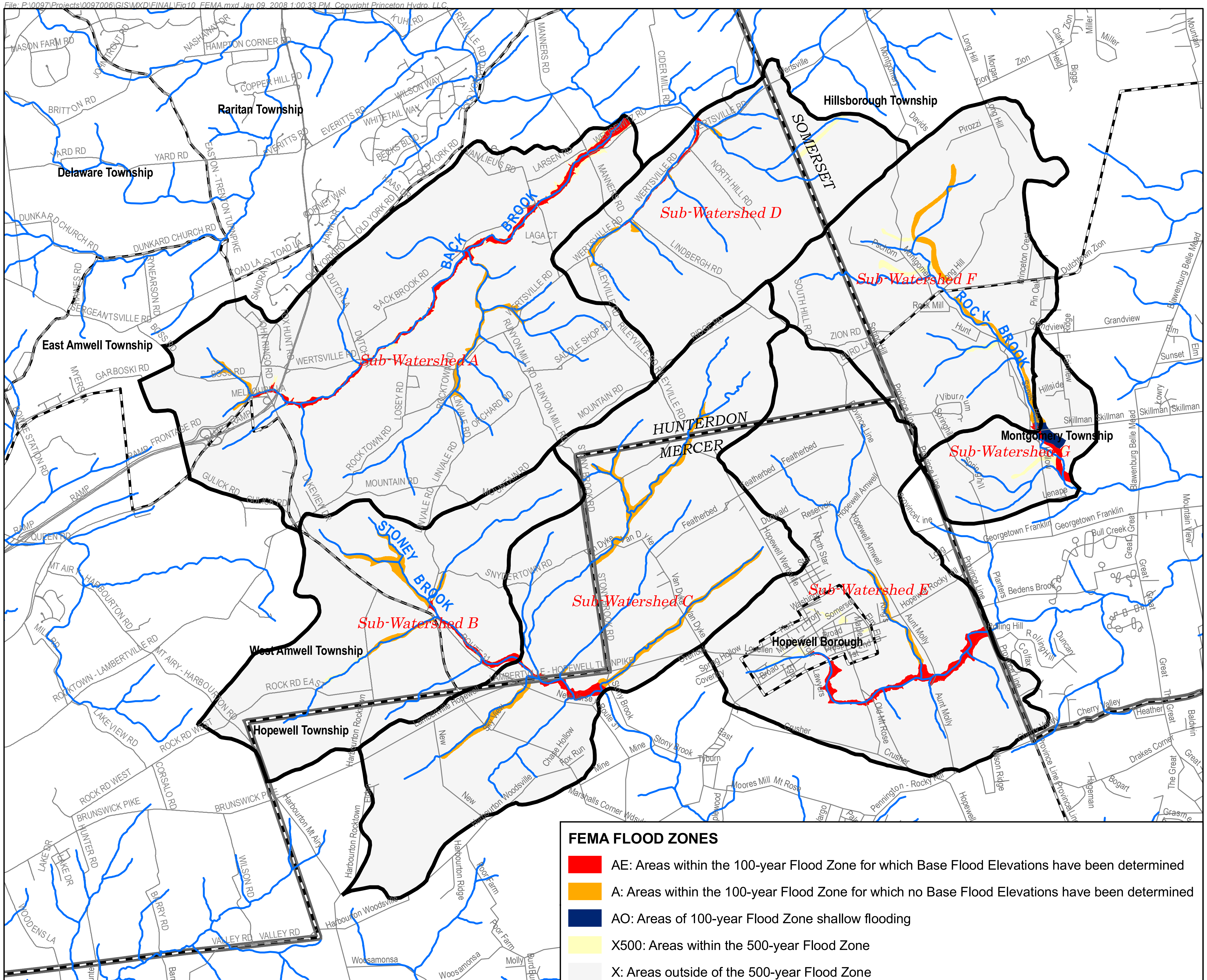
FIGURE 11: SLOPE ANALYSIS

SOURLAND MOUNTAIN WATERSHED PROTECTION PLAN

Legend

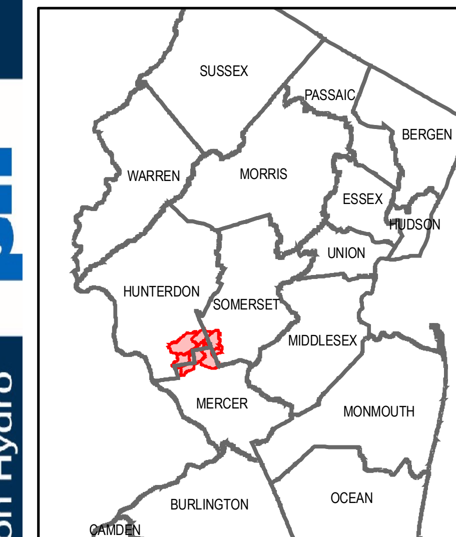
- Project Area
- Streams
- Roads
- Municipal Boundaries
- County Boundaries

File: P:\0097\Projects\0097006\GIS\MXD\FINAL\Fig10_FEMA.mxd Jan 09, 2008 1:00:33 PM Copyright Princeton Hydro, LLC



Princeton Hydro

NEW JERSEY COUNTY MAP



PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551

N

0 2,500 5,000 Feet

1 inch equals 5,000 feet

SOURCES:

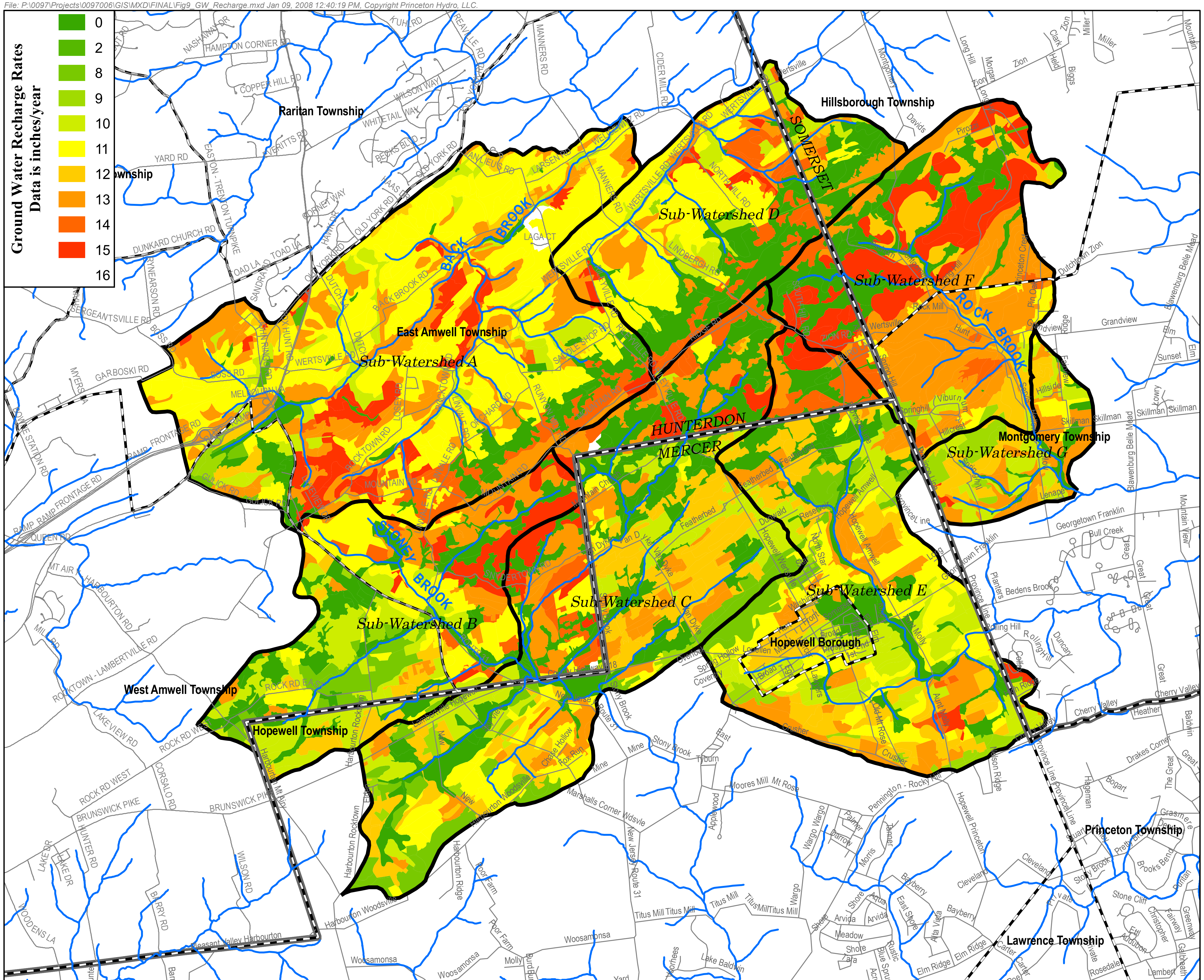
1. Roads are the Tiger/Line Files, US Census Bureau except for Hunterdon County, which road data was obtained from the Hunterdon County GIS website
2. FEMA floodplain data as obtained from the Federal Emergency Management Agency National Flood Insurance Program Q3 Flood Data (Disc 18 New Jersey)

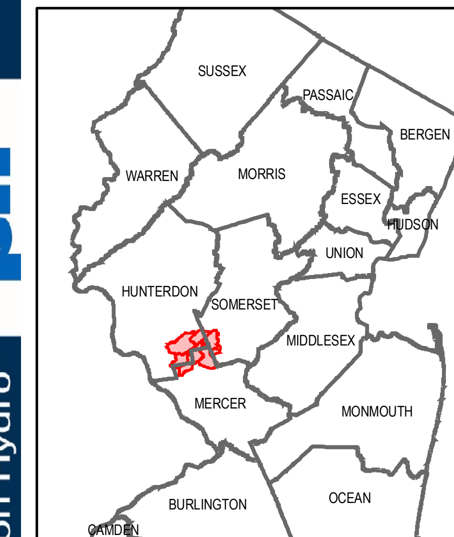
FIGURE 10: FEMA Q3 FLOOD PLAINS

SOURLAND MOUNTAIN WATERSHED PROTECTION PLAN

Legend

- Project Area
- Streams
- Roads
- Municipal Boundaries
- County Boundaries





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PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551

N
0 2,500 5,000 Feet
1 inch equals 5,000 feet

SOURCES:

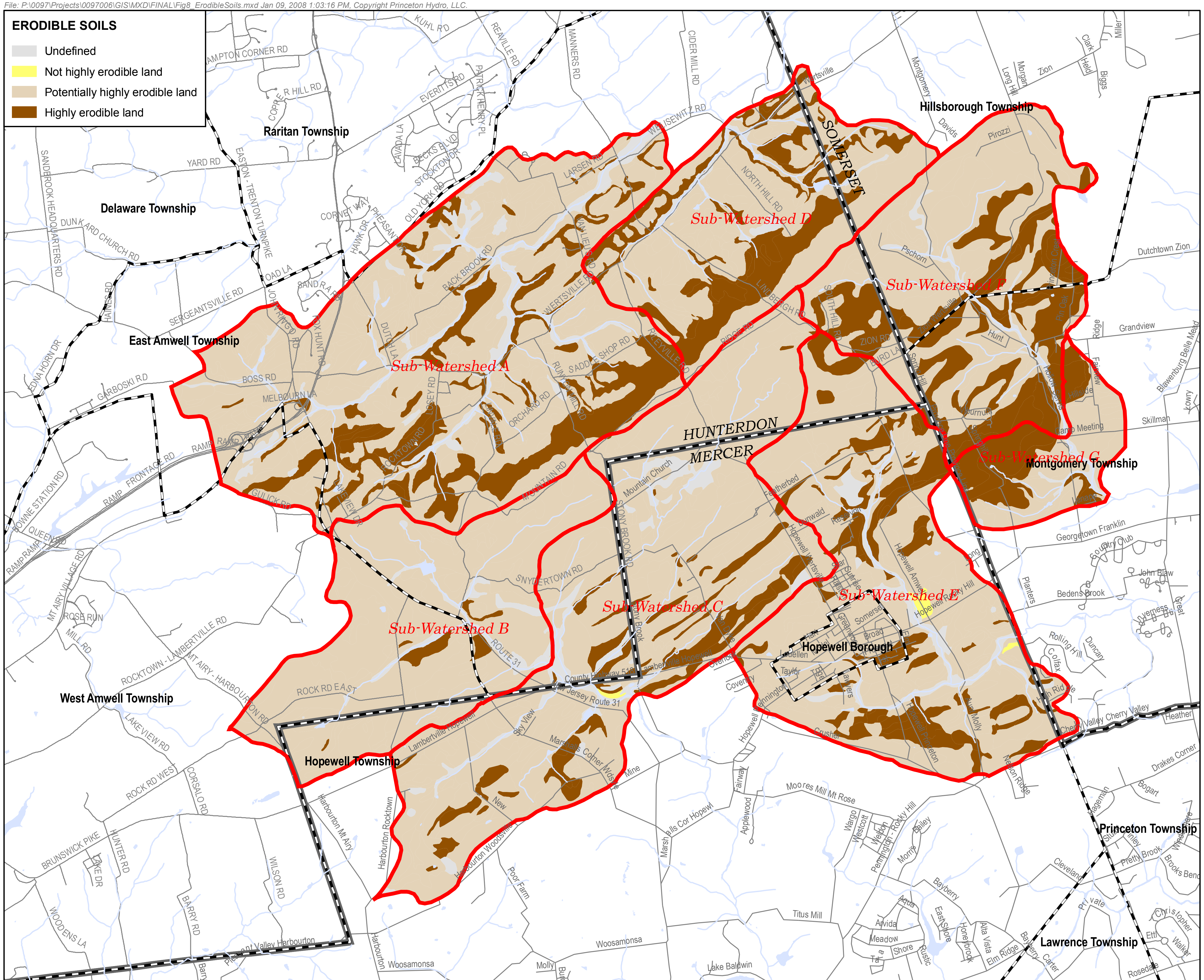
1. Roads are the Tiger/ Line Files , US Census Bureau except for Hunterdon County, which road data was obtained from the Hunterdon Co. GIS website
2. Groundwater Recharge areas/rates obtained from NJ Geological Sruvey. Recharge rates/areas calculated using methodology from NJGS's GSR-32 report. Data displayed here reflects the County recharge ranking ("RANK")

FIGURE 9: GROUNDWATER RECHARGE

SOURLAND MOUNTAIN WATERSHED PROTECTION PLAN

Legend

- Project Area
- Streams
- Roads
- Municipal Boundaries
- County Boundaries



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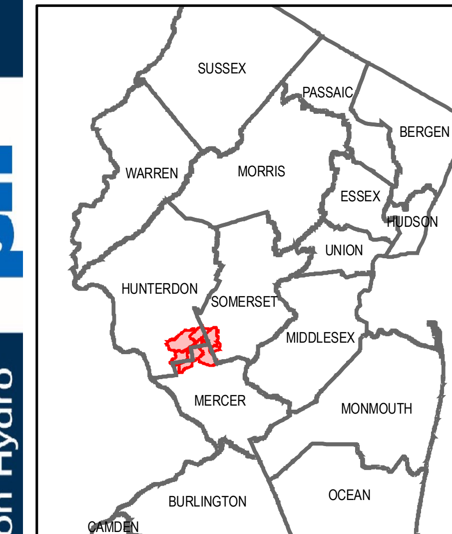
NEW JERSEY COUNTY MAP



PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551

N

0 2,500 5,000 Feet

1 inch equals 5,000 feet

SOURCES:

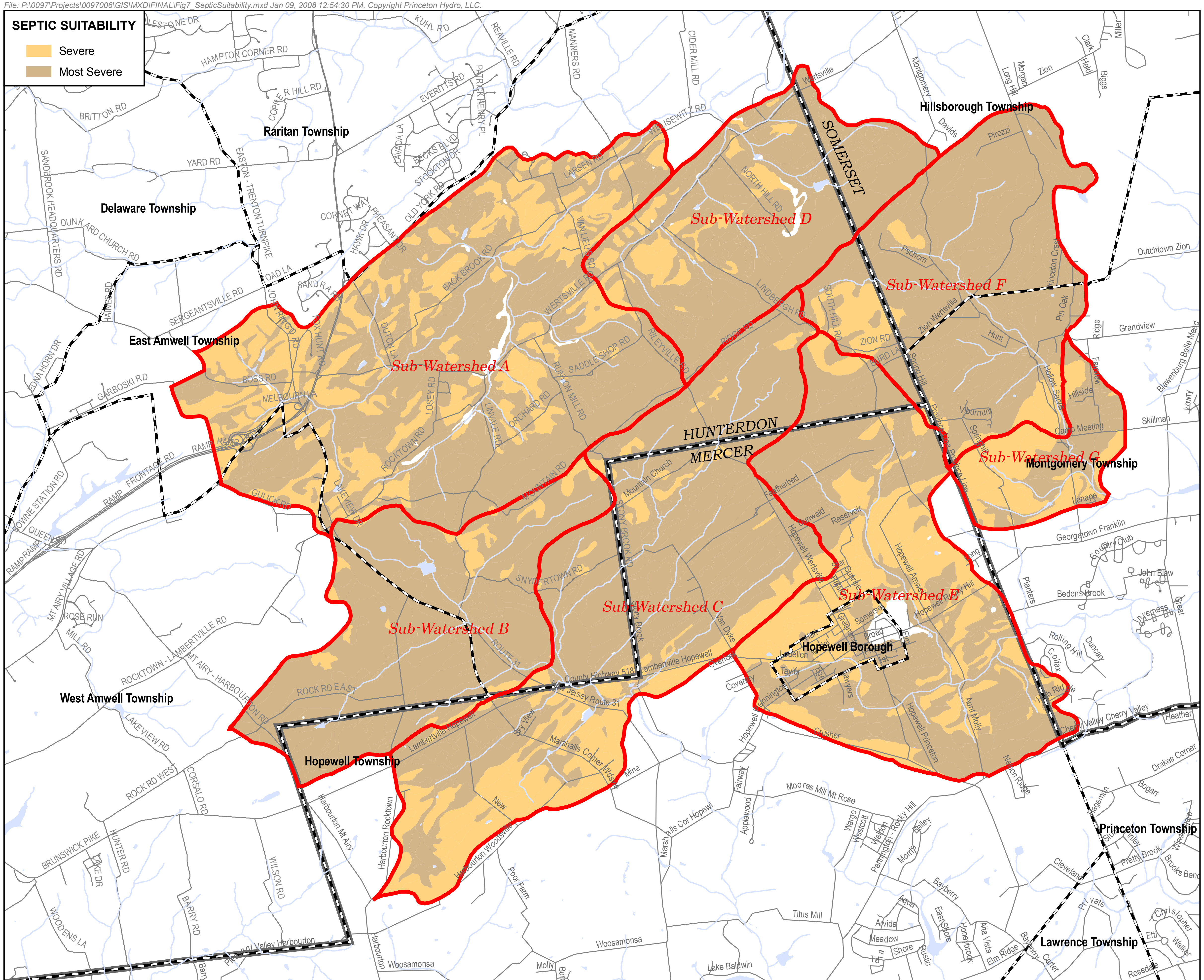
1. Roads are the Tiger/Line Files, US Census Bureau except for Hunterdon County, which road data was obtained from the Hunterdon County GIS website
2. Erodible soils derived from SSURGO soils data obtained from Natural Resources Conservation Service.

FIGURE 8: ERODIBLE SOILS

SOURLAND MOUNTAIN WATERSHED PROTECTION PLAN

Legend

- Project Area
- Municipal Boundaries
- County Boundaries
- Roads



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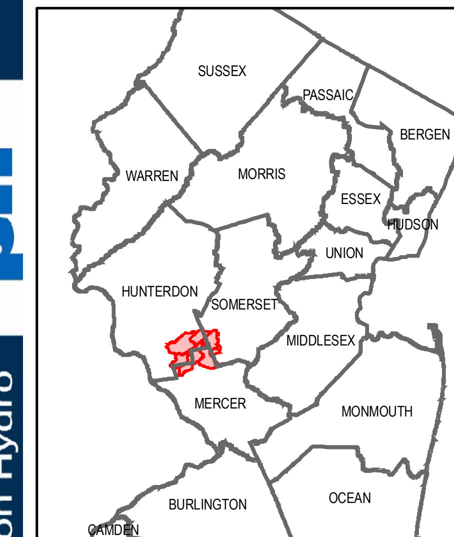
NEW JERSEY COUNTY MAP



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1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551

N

0 2,500 5,000 Feet

1 inch equals 5,000 feet

SOURCES:

1. Roads are the Tiger/Line Files, US Census Bureau except for Hunterdon County, which road data was obtained from the Hunterdon County GIS website

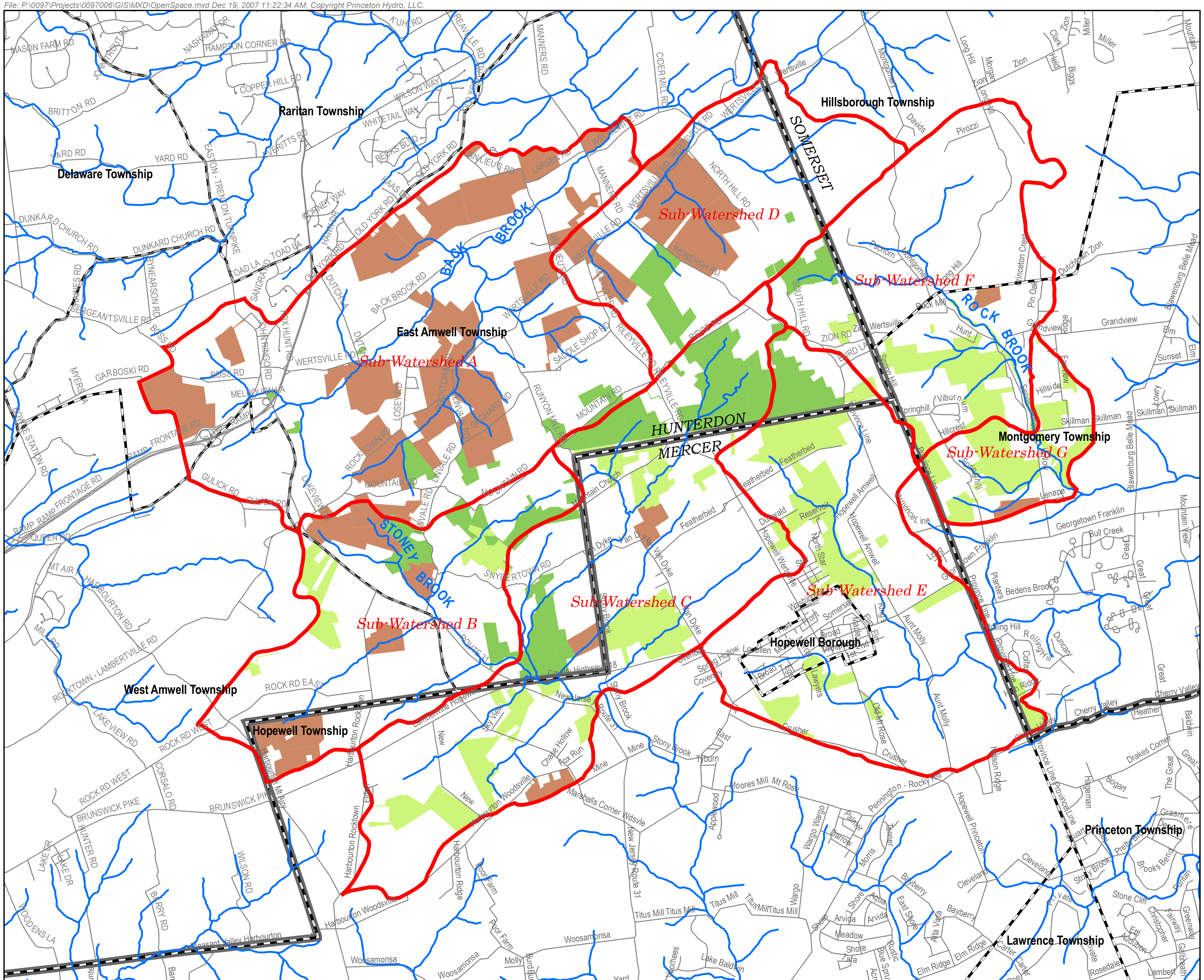
2. Septic suitability derived from SSURGO soils data obtained from Natural Resources Conservation Service and classified by the soil suitability classification of NJ from the New Jersey Administrative Code NJAC Chapter 7:9A, Appendix D.

FIGURE 7: SEPTIC SUITABILITY

SOURLAND MOUNTAIN WATERSHED PROTECTION PLAN

Legend

- Project Area
- Municipal Boundaries
- County Boundaries
- Roads



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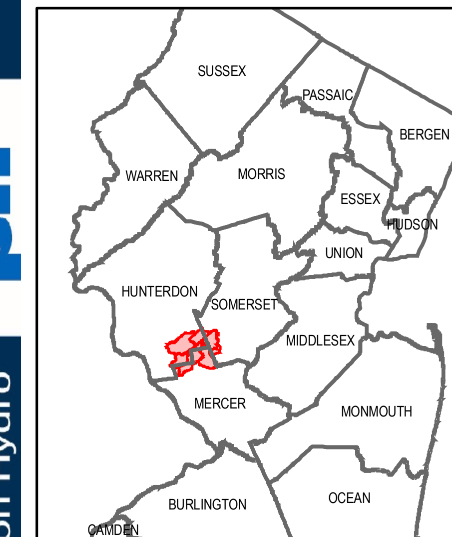
NEW JERSEY COUNTY MAP



PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551

0 2,500 5,000 Feet

1 inch equals 5,000 feet

SOURCES:
1. Roads are the Tiger/Line Files, US Census Bureau except for Hunterdon County, which road data was obtained from the Hunterdon County GIS website
2. Open Space: Data obtained from the NJ DEP Green Acres Program, Hunterdon Co. GIS Dept., East Amwell Twp, and Mercer Co.
3. Farmland Preservation: Data obtained from the Dept. of Agriculture, Hunterdon Co. GIS Dept., East Amwell Twp and Mercer County

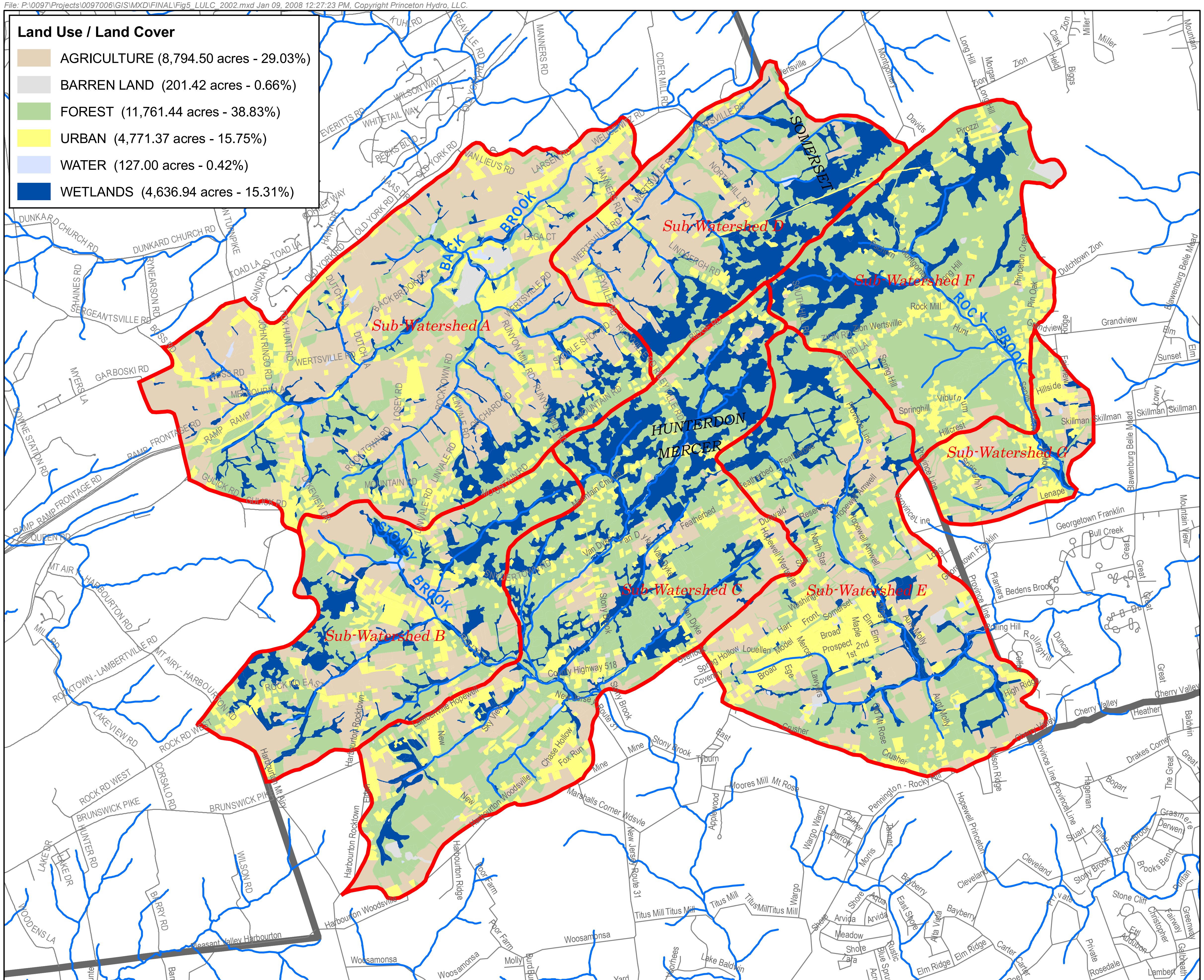
FIGURE 6: OPEN SPACE / PRESERVED FARMS

SOURLAND MOUNTAIN WATERSHED PROTECTION PLAN

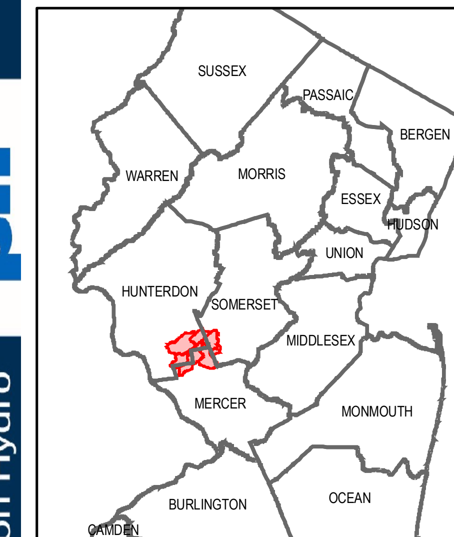
Legend

- Project Area
- Streams
- Municipal Boundaries
- County Boundaries
- Roads
- Conservation Easement
- Farmland Preservation
- Open Space Preservation

File: P:\0097\Projects\0097006\GIS\MXD\FINAL\Fig5_LULC_2002.mxd Jan 09, 2008 12:27:23 PM, Copyright Princeton Hydro, LLC.



NEW JERSEY COUNTY MAP



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PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551

N

0 2,500 5,000 Feet

1 inch equals 5,000 feet

SOURCES:

1. Roads are the Tiger/Line Files, US Census Bureau except for Hunterdon County, which road data was obtained from the Hunterdon County GIS website

2. LULC for 2002 as obtained from the NJDEP GIS website.

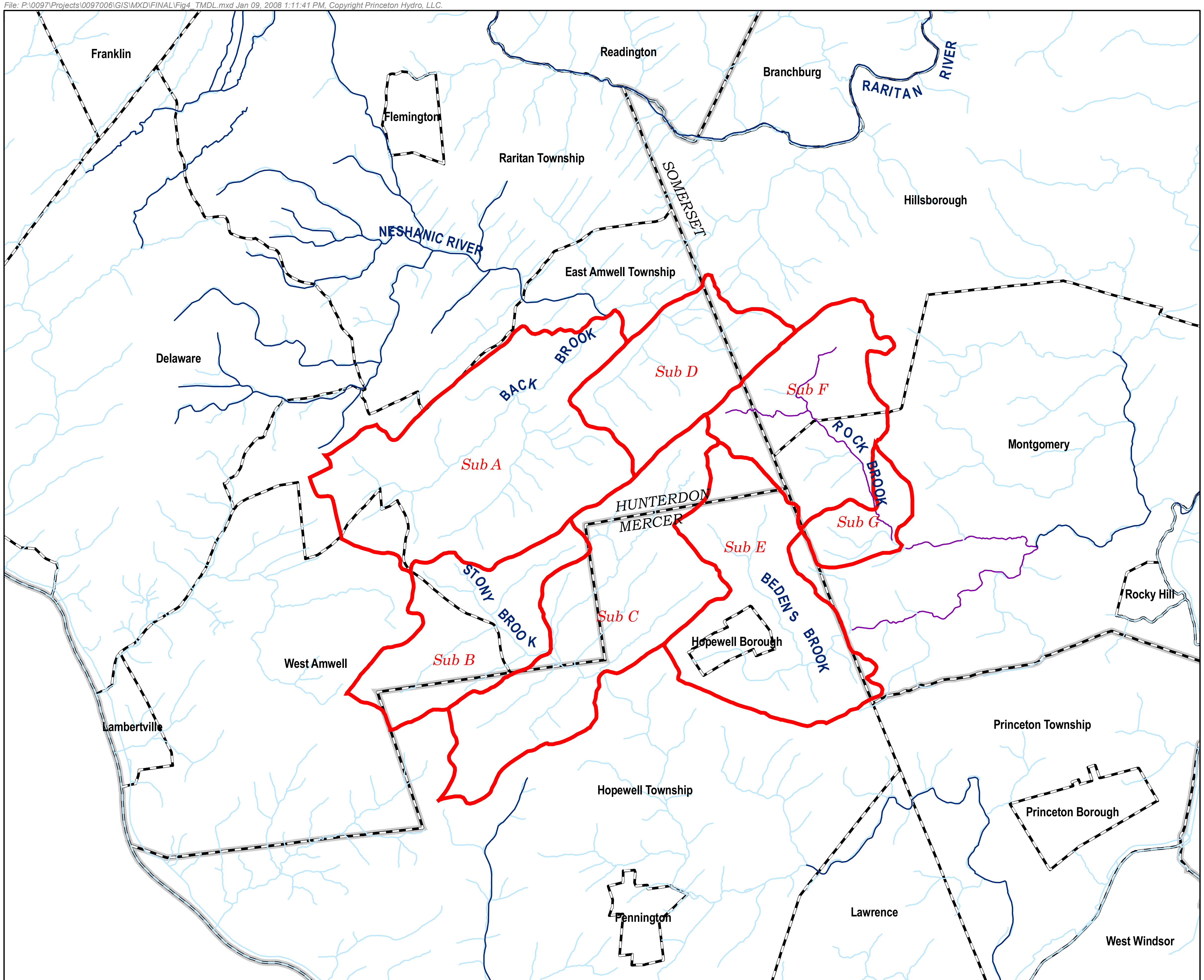
FIGURE 5: NJDEP LAND USE LAND COVER, 2002

SOURLAND MOUNTAIN WATERSHED PROTECTION PLAN

Legend

- Project Area
- Streams
- Municipal Boundaries
- County Boundaries
- Roads

File: P:\0097\Projects\0097006\GIS\MXD\FINAL\Fig4_TMDL.mxd Jan 09, 2008 1:11:41 PM, Copyright Princeton Hydro, LLC.



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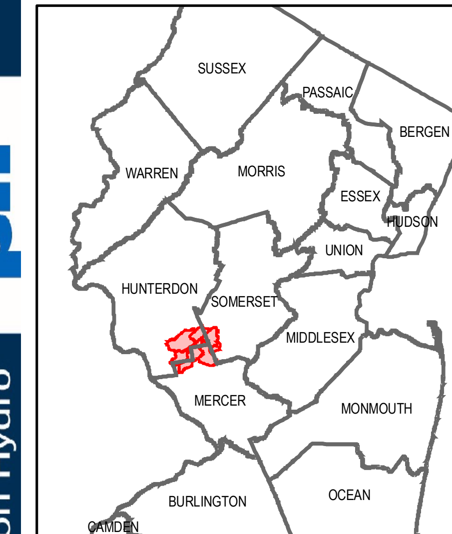
NEW JERSEY COUNTY MAP



PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551

N

0 2,500 5,000 10,000 Feet

1 inch equals 8,000 feet

SOURCES:

1. TMDL (2003) and SWQS streams, and county and municipal boundaries as obtained from the NJDEP GIS website.

2. TMDL (2006) streams as derived from the NJDEP Integrated Report.

FIGURE 4: WATER QUALITY DESIGNATIONS AND ESTABLISHED TMDLS

SOURLAND MOUNTAIN WATERSHED PROTECTION PLAN

Legend

- Project Area
- TMDL Streams (2003)
- TMDL Streams (2006)
- Streams Meeting SWQS
- Municipal Boundaries
- County Boundaries

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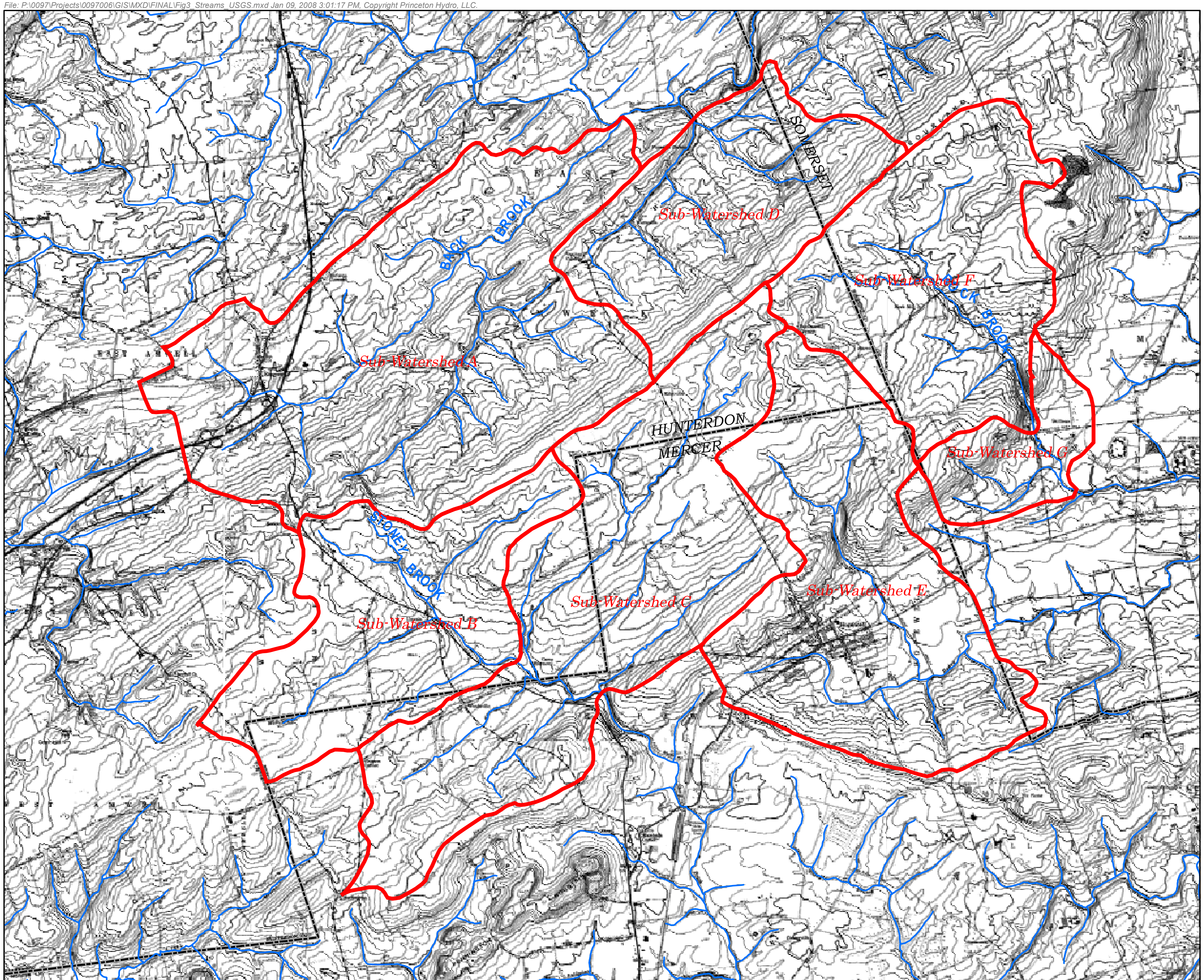

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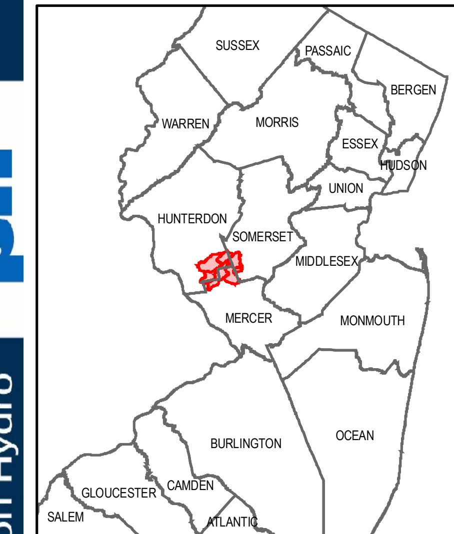
NEW JERSEY COUNTY MAP



PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551

N

0 2,500 5,000 Feet

1 inch equals 5,000 feet

SOURCES:

1. Roads are the Tiger/Line Files, US Census Bureau except for Hunterdon County, which road data was obtained from the Hunterdon County GIS webpage
2. County and Municipal Boundaries obtained from the NJ DEP GIS web site.
3. USGS 7.5 Minute Quadrangles of Stockton Hopewell, Rocky Hill, Lambertville, Pennington and Princeton, New Jersey

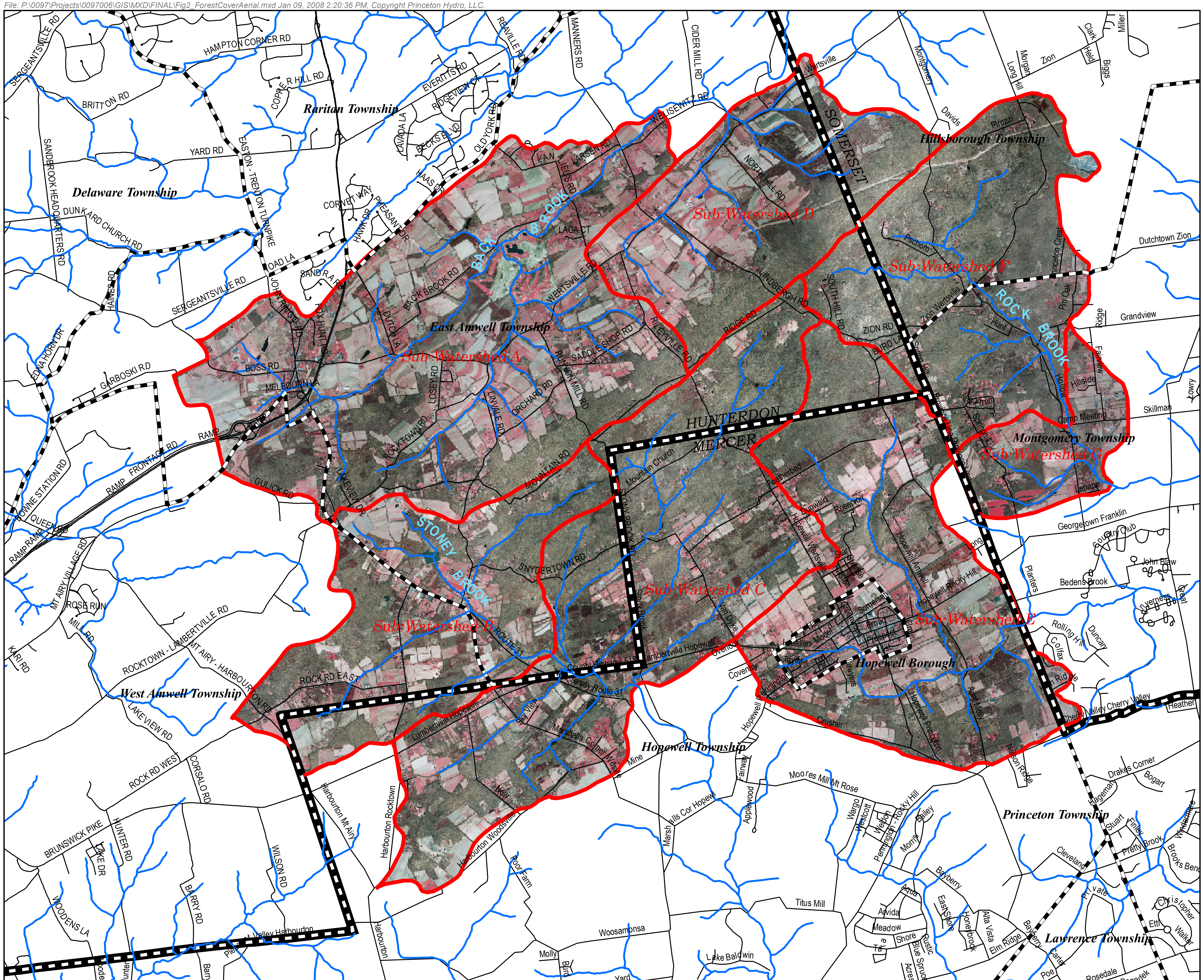
FIGURE 3: STREAMS AND USGS TOPOGRAPHIC MAP

SOURLAND MOUNTAIN WATERSHED PROTECTION PLAN

Legend

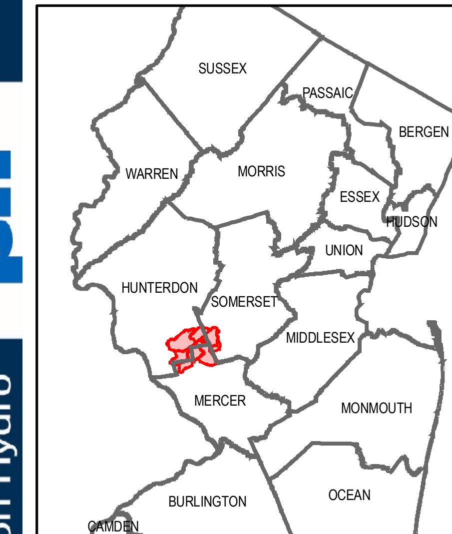
- Project Area
- Streams
- County Boundaries
- Municipal Boundaries

File: P:\0097\Projects\0097006\GIS\MXD\FINAL\Fig2_ForestCoverAerial.mxd Jan 09, 2008 2:20:36 PM, Copyright Princeton Hydro, LLC.



Princeton Hydro

NEW JERSEY COUNTY MAP



PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551

N

0 2,500 5,000 Feet

1 inch equals 5,000 feet

SOURCES:
1. Roads are the Tiger/Line Files, US Census Bureau except for Hunterdon County, which data was obtained from the Hunterdon County GIS website
2. 2002 Aerial Photographs obtained from the NJ Image Warehouse web site
3. County and Municipal Boundaries obtained from the NJ DEP GIS website.

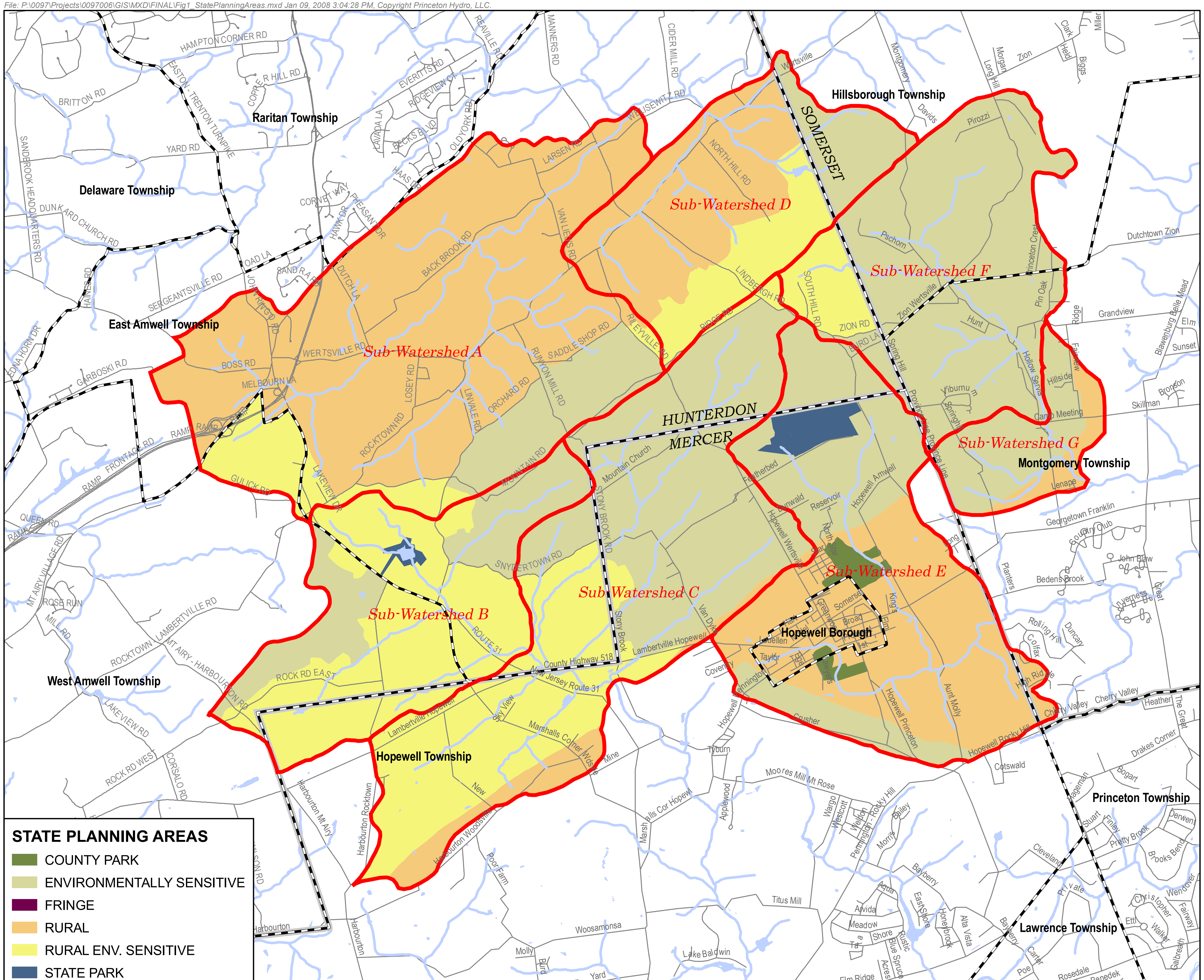
FIGURE 2:
FOREST COVER AERIAL FOR CENTRAL NEW JERSEY

SOURLAND MOUNTAIN WATERSHED PROTECTION PLAN

Legend

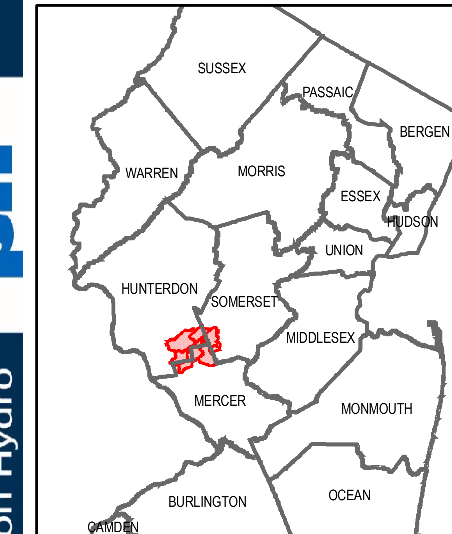
- Revised HUC14 /Project Area
- Roads
- County Boundaries
- Streams

File: P:\0097\Projects\0097006\GIS\MXD\FINAL\Fig1_StatePlanningAreas.mxd Jan 09, 2008 3:04:28 PM, Copyright Princeton Hydro, LLC.



Princeton Hydro

NEW JERSEY COUNTY MAP



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1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551

N

0 2,500 5,000 Feet

1 inch equals 5,000 feet

SOURCES:

1. Roads are the Tiger/Line Files, US Census Bureau except for Hunterdon County, which road data was obtained from the Hunterdon County GIS website

2. Lakes, streams and state planning areas as obtained in digital format from NJDEP.

FIGURE 1: RSWMP PLANNING AREA AND JURISDICTIONAL BOUNDARIES

SOURLAND MOUNTAIN WATERSHED PROTECTION PLAN

Legend

- Project Area
- Municipal Boundaries
- County Boundaries
- Streams
- Lakes
- Roads

Ms. Kathy Machnik
East Amwell Township
1070 Route 202/31
Ringoes NJ 08551

Ms. Andrea Bonette
East Amwell Township
PO Box 72
Hopewell NJ 08525

Ms. Tracy Carluccio
East Amwell Township
81 North Hill Road
Ringoes, NJ 08551

Mayor David Nettles
Hopewell Borough
4 Columbia Avenue
PO Box 128
Hopewell Borough, NJ 08525

Mr. Paul Pogorzelski
Hopewell Township Engineer
Van Cleef Engineering
2345 Route 33
Robbinsville, NJ 08691

Mayor Vanessa Sandom
Hopewell Township
207 Washington Crossing-Pennington Rd
Titusville, NJ 08560

Mayor Ron Shapella
West Amwell Township
150 Rocktown-Lambertville Road
Lambertville, NJ 08530

Ms. Catherine Urbanski
West Amwell Township Environmental Commission
150 Rocktown-Lambertville Road
Lambertville, NJ 08530

Mayor Anthony Ferrera
Hillsborough Township
379 South Branch Road
Hillsborough, NJ 08844

Mr. Steve Sacks Wilner
Montgomery Township Planning Bd.
2261 Route 206
Belle Mead, NJ 08502

Deputy Mayor Louise Wilson
Montgomery Township
2261 Route 206
Belle Mead, NJ 08502

Mr. Chris Testa
Hunterdon County Soil Conservation District
687 Pittstown Road, Suite 1
Frenchtown, NJ 08825

Mr. Ernest Thurlow
Somerset- Union Soil Conservation District
308 Milltown Road
Bridgewater, NJ 08807

Mr. Gregory Sandusky
Mercer County Engineer
640 South Broad Street
PO Box 8068
Trenton, NJ 08650

Mr. Ary Farajollahi
Mercer County Mosquito Control Program
300 Scotch Road
West Trenton, NJ 08628

Ms. Donna Lewis
Mercer County Planning Division and Agricultural Development Board
640 South Broad Street
PO Box 8068
Trenton, NJ 08650

Mr. William Brash, Jr.
Mercer County Soil Conservation District
508 Hughes Drive
Hamilton Square, NJ 08690

Mr. Paul McCall
Somerset County Mosquito Control Program
20 Grove Street
Somerville, NJ 08876

Mr. Robert P. Bzik, Director
Somerset County Planning and Engineering
PO Box 3000
Somerville, NJ 08876

Ms. Susan Charkes
Stony Brook-Millstone Watershed Association
31 Titus Mill Road
Pennington NJ 08534

Mr. Jerry Haimowitz
Sourland Planning Council
88 East Somerset Street
Raritan NJ 08869

Mr. Bill Kibler
South Branch Watershed Association
41 Lilac Drive
Flemington NJ 08822

Ms. Noelle Reeve
The Regional Planning Partnership
118 West State Street
Trenton NJ 08608

Ms. Amy Shallcross
NJ Water Supply Authority
74 East Main Street
Somerville NJ 08876

Nick Zripko
NJDEP-Div. of Watershed Mgmt
PO Box 418
Trenton NJ 08625

Ms. Sue Dziamara
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PO Box 2900
Flemington NJ 08822

Mr. James Martin
Hunterdon County Engineering Dept.
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Flemington NJ 08822

Mr. Tadgh Rainey
Hunterdon County Dept. of Health
PO Box 2900
Flemington NJ 08822

Mr. Andy Reid
Amwell Valley Business Association
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Ringoes NJ 08851

Mr. John Kantorek
Stony Brook Regional Sewerage Authority
290 River Road
Princeton NJ 08540

Ms. Maria Wieczorek
Mercer County Planning Division
640 South Broad Street
PO Box 8068
Trenton, NJ 08650

APPENDIX C:
2005 WATER QUALITY MONITORING
QUALITY ASSURANCE PROJECT PLAN

QUALITY ASSURANCE PROJECT PLAN (QAPP)

Sourland Mountain Watershed
Back Brook, Bedens Brook, Rock Brook, Stony Brook and Furmans Brook
East Amwell Township, Hunterdon County, New Jersey

319(h) Contract RPF # 04-084

Prepared by: ______________________ Date: 5/11/2005
Stephen J. Souza, Ph.D., Project Manager
Princeton Hydro, LLC

Reviewed by: ______________________ Date: 5/11/05
Fred S. Lubnow, Ph.D., QA/QC Officer
Princeton Hydro, LLC

Reviewed by: Teresa Stahl Date: May 11, 2005
Teresa Stahl, RMC, Municipal Clerk
319(h) Grantee and Lead Planning Agency
East Amwell Township

Reviewed by: ______________________ Date: 6-1-05
Nick Zripko, 319(h) Project Manager
Bureau of Watershed Planning

Reviewed by: ______________________ Date: 05/23/05
Helen Rancan, Statewide NPS Coordinator
Bureau of Watershed Planning

Approved by: ______________________ Date: 06/2/05
Marc Ferko, Quality Assurance Officer
Office of Quality Assurance

QUALITY ASSURANCE PROJECT PLAN

SOURLAND MOUNTAIN WATERSHED
(BACK BROOK, BEDENS BROOK, ROCK BROOK, STONY BROOK AND FURMANS BROOK)
EAST AMWELL TOWNSHIP
HUNTERDON COUNTY, NEW JERSEY

Submitted for the Section 319H NPS
Pollution Control and Management Implementation Grant:
Sourland Mountain Watershed Regional Stormwater Management Plan

Grant # RP04-084

Submitted to:

New Jersey Department of Environmental Protection
Division of Watershed Management
P.O. Box 418
Trenton, New Jersey 08625-0418

Prepared by:

Princeton Hydro, LLC
P.O. Box 720
1108 Old York Road, Suite 1
Ringoes, New Jersey 08551

October 2004
Revision #1 - March 2005
Revision #2 - May 2005

Project Name:	Development of the Sourland Mountain Watershed Regional Stormwater Management Plan
Project Requested By:	Township of East Amwell
Date Project Initiated:	May 2004 (As per receipt of NJDEP executed grant agreement)
Project Officer Name:	Stephen J. Souza, Ph.D.
Address:	Princeton Hydro, LLC P.O. Box 720 1108 Old York Road, Suite 1 Ringoes, New Jersey 08551
Phone:	(908) 237-5660
QA/QC Officer Name:	Fred Lubnow, Ph.D.
Address:	Princeton Hydro, LLC P.O. Box 720 1108 Old York Road, Suite 1 Ringoes, New Jersey 08551
Phone:	(908) 237-5660

Project Description

A. Objective and Scope Statement

The Sourland Mountain is a unique and special natural feature spanning Southern Hunterdon, Southwestern Somerset and Northwestern Mercer counties. The Sourland Mountain serves as the headwater for three important regional waterbodies: the upper reaches of the Neshanic River, the Stony Brook and the Millstone River, including two of its major tributaries, Rock Brook and Bedens Brook. Although the Sourland Mountain is recognized as an important and sensitive natural resource, the headwater streams that originate on the Mountain, specifically those within the proposed project area are not protected in any particular manner by existing New Jersey Department of Environmental Protection (NJDEP) regulations. That is, none have been elevated to Category 1 status. Furthermore, because many of these streams are intermittent, due to groundwater being their primary source of base flow, they tend not to be associated with extensive or significant wetlands. As such, they are not protected by current wetland regulations because of the lack of any substantial riparian transitional area adjacent to the streams. Finally, the gradient of these streams tends to be too steep to support a significant fish community. As such, they are designated only as FW2-NT waters. With this designation, many fail to understand the sensitivity of these streams and their aquatic, non-fish, communities, thereby further subjecting these streams to risk and disturbance. Based on data compiled over the past 15 years by East Amwell and Montgomery Townships alone, it is clear that without proper management and protection these streams are at peril. Furthermore, the streams to which these headwater streams drain, specifically Bedens Brook, Back Brook, and Rock Brook, show evidence of both hydrologic and water quality stress and degradation.

The lack of a concerted, well-designed Regional Stormwater Management Plan for the headwater streams simply magnifies the opportunity for the continued degradation of these streams as well as the Neshanic River and Millstone River, to which they drain. The Township, as a result of the active work of the Planning Board, Environmental Commission and Township Committee, has worked hard over the past 20 years to properly manage land use activities in the Township and preserve its rural and agricultural nature. Representative of these efforts are the Township's commitment to open space and farmland acquisition, the development of advanced stormwater management regulations, the protection of groundwater recharge areas, and guidance concerning silvaculture and other land disturbance activities on steeper sloped, fragile areas of the Sourland Mountain.

With the development of a comprehensive Regional Stormwater Management Plan (RSWMP), it will be possible to more effectively reduce the influx of pollutants, control sedimentation, protect riparian habitats, promote recharge and minimize stream channel erosion of the headwater streams on the Sourland Mountain and first and second order streams of the adjoining valley areas. The development of a RSWMP is consistent with the past efforts of East Amwell with respect to the management of the Sourland Mountain and its associated resources. Specifically, it is reflective of the efforts of East Amwell, working independently and in concert with other local and regional stakeholders, to protect surface and groundwater resources of the Sourland Mountain, preserve habitat for threatened and endangered species, better manage development within the watershed, prevent loss of baseflow and reduce stormwater pollutant loading.

B. Data Usage

The data collected during this study will be utilized to develop a Regional Stormwater Management Plan for the Sourland Mountain Watershed.

C. Sampling Procedures

Note: All sampling activity will occur downstream first, then move upstream to eliminate contamination of samples.

Water Quality Monitoring Procedures

All sampling procedures shall be in conformance with standard practices and procedures listed in *Standard Methods for the Analysis of Water and Wastewater, 18th Edition* (American Public Health Association 1992), State protocol (NJDEPE 1992, NJDEP 2003) and any applicable USEPA guidance documents (e.g., USEPA 1997, USEPA 2001, USEPA 2002). Instrumentation used for the collection of field data (dissolved oxygen, temperature, pH and conductivity) shall be properly calibrated in conformance with manufacturer's instructions. It should be noted that Princeton Hydro is a state-certified lab (State ID # 10006) for the use of in situ monitoring equipment to measure dissolved oxygen, temperature, pH and conductivity. Please note that Princeton Hydro received its full certification on June 25, 2004. A copy of Princeton Hydro's Laboratory Certificate and Annual Certified Parameter List is included in this QAPP. This certification covers the four in situ water quality parameters that will be monitored for this project (pH, temperature, dissolved oxygen, conductivity). In collecting such data, Princeton Hydro will follow all procedures required under that certification. All sampling sites were chosen to be representative sites and are subject to the approval of the NJDEP. All sampling sites will be identified, then mapped using GPS technology. Once the sites have been recorded using GPS, the data will be downloaded utilizing GIS technology, and maps will be produced.

A single discrete (i.e., grab) sample will also be collected at each chemical sampling station during each water quality sampling event. Specifically, during each sampling event, a lab-cleaned sample bottle provided by our State-certified laboratory will be used. The bottle will be inverted as it is placed in the water, and then turned over to fill the bottle with water from the central portion of the water column. Samples will be placed in a cooler with wet ice to maintain their temperature at 4ºC and transported to a NJ State-certified analytical lab for analysis of total phosphorus, **soluble reactive phosphorus (SRP),** total suspended solids and nitrate-nitrogen.

Fecal coliform **and fecal streptococcus** samples will also be collected at **selected stations (# 1, 2, 4, 7, 8, 9 and 10) during eight (8) additional water quality sampling events.** Fecal coliform **and fecal streptococcus** sample collection will follow established procedures as outlined in the NJDEP Field Sampling Procedures Manual, 1992. Pre-labeled, sterile bacteriological sample containers will be used to collect a single grab sample from the middle of the stream at each chemical sampling station. Samples will be placed in a cooler with wet ice to maintain their temperature at 4ºC and transported to a NJ State-certified analytical lab for analysis. Arrangements will be made with the lab to ensure that samples are analyzed for fecal coliform **and fecal streptococcus** within six (6) hours of collection.

The results of all chemical and pathogen analyses will be discussed with the Regional Stormwater Planning Committee (RSWMPC) and provided to NJDEP. It is anticipated that the results of the pathogen analyses will provide useful information not only for the development of the RSWMP, but also for the refinement of the proposed fecal coliform TMDL for the Rock Brook and the assessment of progress toward achieving the goals of that TMDL.

<u>Biological Monitoring Procedures</u>

Benthic macroinvertebrates will be sampled at each sampling station a single time during the **May** 2005 sampling survey in accordance with USEPA Rapid Bioassessment Protocols (Plafkin et al. 1989, Barbour et al. 1999), NJDEP Ambient Biomonitoring Network (AMNET) guidelines (NJDEP 2003), and Mid-Atlantic Coastal Streams Workgroup guidelines (USEPA 1997). A single composite sample will be collected from each sampling station from the best available hard-substrate habitat at that site. Each composite sample will be composed of 10 unit-area samplings from different locations at each site. At each location, all invertebrates on the selected hard substrate will be disturbed and washed into a 500 µm D-frame net. Material from all 10 locations will then be pooled and preserved using 95% ethanol.

Invertebrate samples will be returned to and processed at Princeton Hydro's in-house biological laboratory. Following NJDEP's standard protocols (NJDEP 2003), 100 organism sub-samples will be obtained by sorting all invertebrates from randomly selected grids in a gridded tray until a minimum of 100 organisms are found. Invertebrates will then be identified to family level using the best available taxonomic references (e.g., Pennak 1989, Merritt and Cummins 1996). From these data, a number of ecological metrics will be calculated for each site, and a single AMNET bioassessment rating will be calculated for each site and compared to statewide biological impairment tables to determine the level of impairment of each study site.

Invertebrate identification will be made by Dr. Erik Silldorff. Dr. Erik Silldorff has over 12 years of experience and training as an aquatic invertebrate ecologist and taxonomist for projects throughout the United States. His experience includes extensive work in the northeastern states while at Cornell University, the Academy of Natural Sciences of Philadelphia, and Princeton Hydro. He specializes in the identification of all freshwater macroinvertebrates, with particular strength in the aquatic insect groups. In addition, Dr. Silldorff provides QA/QC services for the Stony Brook Millstone Watershed Association as part of their various stream characterization projects. Princeton Hydro will send 10% of the samples to EcoAnalysts in Moscow, Idaho, for a QA/QC check on the invertebrate identifications. EcoAnalysts is the laboratory currently used by the New Jersey AMNET program (as well as other state programs) for such QA/QC checks.

Notification will be provided by phone and email by Princeton Hydro to Marc Ferko, NJDEP Office of Quality Assurance, at least one week prior to scheduled sampling activities. However, in order to maintain consistency with the project workplan and NJDEP's AMNET sampling schedule, the macroinvertebrate sampling event **was intended to be conducted** in April 2005. **Due to the time spent reviewing and revising the QAPP, the macroinvertebrate sampling event was conducted on May 12 and 13, 2005 with the approval of the NJDEP Project Manager. Notice was also provided to Marc Ferko.** Due to the weather-dependent nature of the monitoring program, it must be recognized that the sampling schedule is subject to change with less than one week's notice of any individual sampling event. Princeton Hydro will make every attempt to notify NJDEP promptly in the event of any sampling schedule changes.

D. Water Quality Monitoring Parameters and Frequency

1. Back Brook, Bedens Brook, Rock Brook, Stony Brook and Furmans Brook will be monitored for in situ and discrete water chemistry a total of eight (8) times through the course of the 2005 growing season under baseflow conditions. Specifically, monitoring events will be conducted from **May** through October. Baseflow is defined as a condition

of 72 continuous hours where less than 0.05 inches of rain has fallen. Baseflow conditions will be determined by reference to precipitation data collected at the National Weather Service station located at Wertsville (Cooperative Network ID #289363). The sampling events will intentionally span different seasons and a variety of baseflow conditions in order to document and quantify the variability in water quality condition at baseflow. As a result, there will be no restrictions on either flow or dissolved oxygen prior to sampling. The single exception to this will be a re-scheduling of a sampling event for a given site if that site contains no surface water at the time of sampling (i.e., intermittent streams).

2. Sampling stations will be located on each stream near the headwater limit of its respective HUC-14. Based on discussions with the RSWMP Committee and the Lead Planning Agency, East Amwell Township, at the January 2005 RSWMP Committee meeting, the study area boundaries were refined to more accurately delineate the Sourland Mountain drainage area. The refined project boundary is depicted on the attached map. Specifically, the northern boundary of the watershed was extended to include a portion of HUC14 02030105030060 in East Amwell Township. This will allow us to assess conditions of the headwaters of the Neshanic River that receive drainage from the Sourland Mountain ridgeline. (When the proposal for this project was initially developed, this entire HUC14 was considered for inclusion in the study area. However, based on consultation with NJDEP, due to this HUC 14's extensive area (which includes significant acreage beyond the Sourland Mountain ridgeline), it was recommended that it not be included. However, after reviewing the initial maps of the watershed, the RSWMP Committee and Lead Planning Agency requested that the portion of this HUC 14 exhibiting characteristic Sourland Mountain topography be included as a logical part of the stormwater planning area. Specifically, Furmans Brook has a relatively large watershed which lies entirely within the Sourlands area, including a number of headwater tributaries. As a result, the omission of a monitoring station on this stream was determined to be an important gap in the existing study design.) Therefore, in consultation with the RSWMP Committee and the Lead Planning Agency, a sampling station has been proposed to coincide with AMNET station AN0336 (Furmans Brook at Welisewitz Road in East Amwell) and is identified on the enclosed chart and map as Station #2. This proposed sampling site will be used to collect both physical/chemical and biological water quality data to assess conditions in the portion of the Sourland Mountain watershed draining to the headwaters of the Neshanic River.

   On Back Brook, the station will be located where Manners Rd. crosses the stream in East Amwell Township **(Station #1)**. For Bedens Brook, the sampling will occur at Aunt Molly Road where it crosses the stream in Hopewell Twp. **(Station #4)**. Rock Brook will be sampled in Montgomery Township at Camp Meeting Ave. where it crosses Rock Brook **(Station # 7)**. Sampling for Stony Brook will occur where Lambertville-Hopewell Turnpike crosses the stream at the border of East Amwell and Hopewell Townships **(Station # 10)**. Finally, sampling for Furmans Brook (a tributary of the Neshanic River) will be conducted at the current AMNET station sampling site at Welisewitz Road in East Amwell Township **(Station # 2)**.

All of these proposed sampling station locations are being submitted to the NJDEP for review and approval. The location of each will be recorded using GPS technology, and subsequently plotted on a map using GIS technology. A map is included to display these sampling station locations as well as the locations of the six (6) existing AMNET stations within the study area. A chart identifying each sampling location and parameter to be sampled is also enclosed.

The proposed sampling sites were initially identified by reviewing topographic and other maps in consultation with representatives of East Amwell Township, the Lead Planning Agency. Based on their input, sites were chosen specifically to ensure not only that they would be representative of water quality conditions for each stream within the study area, but also that each site could be accessed safely. Where this could not be determined by map review alone, Princeton Hydro staff conducted a brief site visit to visually confirm site accessibility. Furthermore, Princeton Hydro staff have conducted water quality monitoring at some of the proposed locations, or in close proximity to them, as part of past work efforts conducted for East Amwell and Montgomery Townships. The RSWMP Committee was also given the opportunity to review and provide input on the proposed site locations and found them to be appropriate.

3. At each sampling station, a calibrated Eureka Manta multi-probe will be used to monitor the in situ parameters dissolved oxygen (DO), temperature, pH and conductivity. During sampling events, discrete water quality samples will be collected at each sampling station also. These samples will be collected and delivered to a State-certified laboratory for the analysis of total phosphorus, **soluble reactive phosphorus (SRP),** total suspended solids **and** nitrate-nitrogen.

4. **During eight (8) additional sampling events, samples will also be collected at seven (7) sampling stations and delivered within the required six (6) hour maximum holding time to another State-certified laboratory for the analysis of pathogens (fecal coliform and fecal streptococcus). Fecal coliform and fecal streptococcus samples will be collected at chemical stations # 1, 2, 4, 7 and 10 and biological stations # 8 and 9 (described below in Section E).**

5. A field duplicate and rinse blank will also be collected during each sampling event. Field duplicates will be collected for a different water quality parameter during each individual sampling event.

6. **Two methods of flow estimation will be used to cross-validate discharge estimates for each water quality sampling location. First, discharge measurements from the USGS station on Pike Run at Belle Mead (Station ID 01401650) will be obtained from the USGS for the dates and times of sample collection. This station is the only continuous recording station draining the Sourlands region with a relatively small watershed area (5.36 mi^2) and thus serves as the only plausible extrapolation point for other headwater streams draining the Sourlands. Discharge measurements**

from Pike Run at Belle Mead will be obtained for each sampling date and time from the USGS, and estimates of flow at the project sampling stations will be obtained by area-weighting the discharge measurements at this station with the watershed areas for each sampling station. These empirical discharge estimates will then be cross-validated with modeled discharges for each stream based on land cover, soils group, slope, and precipitation history for the upstream catchment of each sampling station. Specifically, the Modified Rational model will be used in combination with precipitation data from the National Weather Service station located at Wertsville (Cooperative Network ID #289363) to model the expected discharge at each sampling station at the time of sampling. The two discharge values for each station will then be compared, with a final discharge calculated as a weighted average of the two flow estimates.

E. Biological Monitoring Parameters and Frequency

1. In addition to the water quality parameters, biological assessment of the stream invertebrate community will be conducted at 12 stations throughout the watershed, with a single sampling event in April 2005 for each station. Five of the stations will correspond to the water quality stations above, and the remaining 7 stations will be distributed in the primary headwater streams of each of the 4 watersheds. A chart identifying each sampling location and parameter to be sampled is enclosed. Field and laboratory methods will conform to the NJDEP and USEPA standards for macroinvertebrate assessments (see Section C above for detailed protocols).

2. The seven (7) additional biological monitoring stations will be located at the following sites: in the Back Brook watershed, the headwaters of the major unnamed tributary to Back Brook will be monitored where Linvale Road crosses the stream just south of Rocktown Road (both in East Amwell Township) **(Station # 3)**. In the Bedens Brook watershed, the headwaters of Bedens Brook will be monitored in Hopewell Borough Park **(Station # 5)**, and the large unnamed tributary to Bedens Brook east of Hopewell Borough will be monitored near its headwater forks along Hopewell-Amwell Road in Hopewell Township **(Station # 6)**. The headwaters of Rock Brook will be sampled along Montgomery Rd. near Pschorn Lane in Hillsborough Township **(Station # 8)**, while Cat Tail Brook (the major headwater tributary to Rock Brook) will be sampled south of Pschorn Lane near the boundary between East Amwell and Hillsborough Townships **(Station # 9)**. Finally, Stony Brook's headwaters will be sampled adjacent to Rt. 31 north of the Route 518 junction in East Amwell Township **(Station # 11)**, and on the large unnamed headwater tributary to Stony Brook where this tributary crosses Hopewell-Wertsville Road in Hopewell Township **(Station # 12)**.

3. Through the AMNET program, the NJDEP sampled the stream invertebrate community at six (6) locations in these watersheds in April 1994 and April 1999. To maximize the utility of the existing data, the biological assessments for this RSWMP **were intended to occur** in April at all stations. **As described above, the QAPP review and revision time necessitated rescheduling this sampling in early May. It is anticipated that this**

change in the sampling date will still permit direct comparisons among the data sets because of the comparable sampling seasons and the comparable methods, thus providing a broader picture of the watershed and the ecological conditions of these streams.

F. Parameter Table

Summaries of all water quality parameters to be measured and analytical methods to be used are shown in Table 1. This table was developed in coordination with the independent analytical laboratories, Environmental Compliance Monitoring, Inc. (ECM) and New Jersey Laboratories (fecal coliform **and fecal streptococcus** analysis), who will follow the methods and protocols listed in Table 1. ECM will be responsible for all laboratory analyses except for macroinvertebrates, which will be identified and enumerated by Princeton Hydro, and **pathogens (**fecal coliform **and fecal streptococcus)**, which will be analyzed by New Jersey Laboratories. Princeton Hydro will also conduct all in situ water quality monitoring.

Information on project detection limits, levels of interest, precision and accuracy for parameters of interest is listed in Table 2. This table was developed in conjunction with Mr. Thomas Grenci of ECM and indicates the data quality that is expected for this study. In addition, Mr. John Jaglowski, Microbiology laboratory manager for New Jersey Laboratories, provided similar data for fecal coliform **and fecal streptococcus** analyses.

Data Comparability: Analytical data comparability will be achieved by following the analytical methodology, preservation practices and holding times described in Table 1. Each parameter will be analyzed using the referenced methodology and changes in analytical procedures will not take place from sample to sample. The same holds true for sample preservation, holding times and QA/QC practices. The methods used are standard analytical methods that will also allow comparisons with data from the earlier projects.

Data Completeness: Data will be considered complete and usable for decision making when all results have been completed and submitted to the NJDEP in accordance with the sampling and analytical methodology and the required QA/QC practices listed in this project plan. However, it is recognized that some data loss may occur as a result of factors such as sampling equipment malfunction, losses during sample handling, or analysis outside of laboratory acceptance limits. Samples will be re-analyzed if results are outside of laboratory acceptance limits, providing that sufficient sample volume is available and that holding times for the affected parameter(s) have not been exceeded.

Table 1 – Parameters for the Sourland Mountain Watershed Regional Stormwater Management Plan Water Quality Monitoring Program

Parameter	Analytical Method Reference* (Standard Methods)	Sample Container and Preservation Method	Holding Time (Maximum)
Fecal Coliform	9221B and 9221D	Sterile with $Na_2S_2O_3$ added, cool to 4°C	6 hours
Fecal Streptococcus	**9230A and 9230B**	**Sterile with $Na_2S_2O_3$ added, cool to 4°C**	**6 hours**
Total Phosphorus	4500-P B-5 and 4500-P E	1 pint plastic, H_2SO_4 added to sample to pH <2, cool to 4°C	28 days
Soluble Reactive Phosphorus (SRP)	**4500-P E**	**250 mL plastic, no preservative**	**48 hours**
Total Suspended Solids	2540 D	1 pint plastic, cool to 4°C	7 days
Nitrate-nitrogen	352.1 (EPA)	1 pint plastic, cool to 4°C	48 hours
Conductivity Profile	2510 B	in situ	N/A
pH Profile	4500-H^+ B	in situ	N/A
Dissolved Oxygen Profile	4500-O G	in situ	N/A
Temperature Profile	2550 B	in situ	N/A

* As per Standard Methods (American Public Health Association 1992).

Table 2 - Information on Detection Limits, Precision and Accuracy for Water Quality Parameters

Parameter	Sample Matrix	Detection Limit	Level of Interest	Relative Percent Difference*	Percent Recovery*
Fecal Coliform	Water	1 cfu/100 mls	**1 cfu/100 mls**	N/A	N/A
Fecal Streptococcus	**Water**	**1.8 cfu/100 mls**	**1.8 cfu/100 mls**	**N/A**	**N/A**
Total Phosphorus	Water	0.02 mg/L	0.02 mg/L	-18.9 to 18.9	67 to 121
Soluble Reactive Phosphorus	**Water**	**0.003 mg/L**	**0.007 mg/L**	**-17 to 17**	**75 to 121**
Nitrate-N	Water	0.02 mg/L	0.05 mg/L	-13.8 to 13.8	8 to 188
Total Suspended Solids	Water	3.0 mg/L	5.0 mg/L	-76 to 76	N/A

* As supplied by Environmental Compliance Monitoring, Inc. and New Jersey Laboratories (fecal coliform **and fecal streptococcus**).

Table 2 - Information on Detection Limits, Precision and Accuracy for Water Quality Parameters (continued)

Parameter	Sample Matrix	Detection Limit	Level of Interest	Relative Percent Difference*	Percent Recovery*
Conductivity Profile	Water	1 µmhos/cm	1 µmhos/cm	N/A	N/A
pH Profile	Water	0.1 Standard Unit	0.1 Standard Unit	N/A	N/A
Dissolved Oxygen Profile	Water	0.1 mg/L	0.1 mg/L	N/A	N/A
Temperature Profile	Water	0.1° Celsius	0.5° Celsius	N/A	N/A

* As supplied by Princeton Hydro, LLC

Project Schedule, Organization and Responsibility

Table 3 displays the sampling schedule for all field-related activities associated with the development of the Regional Stormwater Management Plan. The sampling schedule shown in Table 3 was developed to comply with East Amwell Township's schedule for completing the Regional Stormwater Management Plan by June 30, 2006.

Princeton Hydro, LLC, under the direction of Dr. Stephen J. Souza, will serve as the project manager. As project manager, responsibilities will include overall project coordination, data management, and the preparation of project reports, documents and deliverables. Dr. Fred S. Lubnow, Director of Princeton Hydro's Aquatics Program, will be responsible for QA/QC for the project. The review and approval of this QAPP will be under the direction of the representatives appointed by the NJDEP: Nick Zripko, 319(h) Project Manager, Bureau of Watershed Planning; Helen Rancan, Statewide NPS Coordinator, Bureau of Watershed Planning; and Marc Ferko, Quality Assurance Officer, Office of Quality Assurance. East Amwell Township, as grantee and Lead Planning Agency (LPA), will serve as the Project Manager for the project and will be responsible for ensuring that all identified tasks are conducted and completed in an acceptable manner.

Fiscal management and administration of the project will also be the responsibility of East Amwell Township. Additional project support will be provided by members of the Regional Stormwater Management Plan Committee.

The key individuals who will be responsible for various project tasks are listed in Table 4. Dr. Erik Silldorff of Princeton Hydro, LLC will also be responsible for stream sampling operations and macroinvertebrate identification. ECM Inc., of Neshanic Station, NJ, will perform the chemical analyses for the project under the direction of Mr. Thomas Grenci. New Jersey Labs of New Brunswick, NJ, will perform the fecal coliform **and fecal streptococcus** analyses under the direction of Mr. John Jaglowski.

Table 3

Proposed Schedule of Field Activities for the Development of the Regional Stormwater Management Plan for the Sourland Mountain Watershed

Year 2005[1]

Task	A	M	J	J	A	S	O
Water Quality Monitoring [2] Back Brook, Bedens Brook Rock Brook, Stony Brook and Furmans Brook							
Macroinvertebrate Survey of Back Brook, Bedens Brook Rock Brook, Stony Brook and Furmans Brook							

1. Sampling will be conducted on eight (8) sampling dates between **May** and October 2005. Sampling will be influenced by stream flow conditions under baseflow. As such, sampling will occur only during those times within the bracketed timeframe when stream conditions are appropriate and conducive.

2. Water quality monitoring includes in situ monitoring and the collection of discrete samples for chemical analyses.

Table 4 - Project Responsibility

Area of Responsibility	Name	Affiliation
State-Based Project Management	Nick Zripko, Project Manager, Bureau of Watershed Planning	New Jersey Department of Environmental Protection
Project Management	Stephen J. Souza, Ph.D.	Princeton Hydro, LLC
Laboratory Analysis	Thomas Grenci	Environmental Compliance Monitoring, Inc.
	Mr. John Jaglowski	New Jersey Laboratories
Laboratory QC	Suzanne Armbruster	Environmental Compliance Monitoring, Inc.
Macroinvertebrate Analyses	Erik Silldorff, Ph.D.	Princeton Hydro, LLC
Data Processing	Christine Krupka	Princeton Hydro, LLC
Data Processing QA/QC Officer	Christopher Mikolajczyk	Princeton Hydro, LLC
Data Quality Review	Fred Lubnow, Ph.D.	Princeton Hydro, LLC
Performance Auditing	Teresa Stahl, RMC	East Amwell Township
Systems Auditing	Marc Ferko, Quality Assurance Officer	New Jersey Department of Environmental Protection
Overall QA	Fred S. Lubnow, Ph.D.	Princeton Hydro, LLC
Overall Coordination	Stephen J. Souza, Ph.D.	Princeton Hydro, LLC

Chain of Custody Procedures

Chain of Custody (COC) procedures will be utilized once the samples are collected and transported to the laboratory for analysis. Personnel responsible for sampling operations will inform the analytical laboratory at least twenty-four (24) hours in advance of the date that stream monitoring samples will be delivered. A copy of the ECM COC form is included with this QAPP.

The sample collector will be required to record the following information on the sampling container and field data sheet: sample number and/or station, date and time of collection, source, preservation technique and collector's name. The sample collector will also record pertinent field data, field observations and the analyses required on the field data sheets. A COC form will be completed to identify the analyses requested and will be submitted to the laboratory at the time of sample delivery.

Following collection, samples will be placed on ice in an insulated container for transport to the laboratory. The sample collector or Princeton Hydro, LLC will deliver the samples to the laboratory, where laboratory personnel will visually inspect all sample containers to confirm the method of transportation, date of collection and preservation technique. Samples will not be accepted and fresh samples will be requested if for any reason the holding time was exceeded, proper preservation techniques were not followed or transportation conditions were unsuitable.

Calibration Procedures and Preventive Maintenance

Field equipment will be calibrated on each sampling date in accordance with the manufacturer's instructions. Any problems will be corrected before samples are collected.

A Eureka Manta multi-probe will be used to monitor temperature, dissolved oxygen, pH and conductivity. Prior to each sampling event, the Manta multi-probe will be calibrated for these water quality parameters. The calibration standards will bracket the expected range for the monitoring. All of the calibration information will be documented. Calibration information will include, but will not be limited to, dates of calibration, name of person performing calibration, any problems and, if so, how they were corrected. Princeton Hydro is a State-certified laboratory (#10006) in these analyze immediately parameters.

ECM, Inc. is a State-certified Laboratory (#18630) that maintains an active Quality Assurance/Quality Control (QA/QC) program to ensure that the collected data will meet all project requirements and that laboratory instruments are properly calibrated. Standards will be analyzed with each batch of samples to ensure that instruments are operating properly. These procedures are in accordance with all applicable State and Federal regulations.

New Jersey Laboratories is a State-certified Laboratory (#12128) that maintains an active Quality Assurance/Quality Control (QA/QC) program to ensure that the collected data will meet all project requirements and that laboratory instruments are properly calibrated. Controls will be analyzed with each batch of samples to ensure that instruments are operating properly. These procedures are in accordance with all applicable State and Federal regulations.

Documentation, Data Reduction, and Reporting

All data will be included in the final RSWMP reports and will be kept on file by Princeton Hydro, LLC for a minimum of five years, as per the Regulations Governing the Certification of Laboratories and Environmental Measurements (NJAC 7:18-8.5(a)), the NJ Pollutant Discharge Elimination System rules (NJAC 7:14A-6), USEPA's "Guidance for Quality Assurance Project Plans" (December 2002), and USEPA's "Requirements for Quality Assurance Project Plans" (March 2001).

Data Validation

Data validation will be performed by Princeton Hydro, LLC and will be provided with the final report. If blank contamination is found in the equipment rinse blank, all water quality data with results less than five (5) times the concentration found in the blank will be flagged "B." The "B" qualifier indicates that the reported result may be an anomaly as a result of contamination of the blank.

Performance and Systems Audits

A. Performance Auditing

ECM is a State-certified laboratory (#18630). The laboratory participates in Performance Evaluation (PE) Studies for each category of certification and accreditation and is required to pass each of these PE studies in order to maintain certification. The NJDEP conducts performance audits of each laboratory that is certified or accredited.

ECM also participates in several additional programs to ensure data accuracy. The laboratory participates in USEPA water pollution (WP) and water supply (WS) studies and the discharge monitoring report (DMR-QA/QC) program.

New Jersey Laboratories is a State-certified laboratory (#12128). The laboratory participates in Performance Evaluation (PE) Studies for each category of certification and accreditation and is required to pass each of these PE studies in order to maintain certification. The NJDEP conducts performance audits of each laboratory that is certified or accredited.

New Jersey Laboratories also participates in several additional programs to ensure data accuracy. The laboratory also participates in FDA (#2219935) programs.

Princeton Hydro is State-certified (# 10006) for the collection of water samples and in situ field monitoring of temperature, pH, dissolved oxygen and conductivity using a multi-probe data sonde and similar monitoring meters. The laboratory participates in USEPA water pollution (WP) and studies annually.

B. Systems Auditing

The NJDEP periodically conducts on-site Technical Systems Audits (TSA) of each certified laboratory. The findings of these audits, together with the USEPA Performance Evaluation results, are used to update each laboratory's certification status.

Corrective Action

The project QA/QC Officer will ensure that all data for the project are generated in accordance with procedures outlined in this QA/QC Project Plan. Quality control samples will be analyzed with each sample batch and results will be provided with the data reports. If a QC sample provides unacceptable results during any given day, the sample analysis must be repeated for those parameters affected. All project participants will immediately report any deficiencies to the QA/QC Officer. The QA/QC Officer will recommend appropriate corrective action and determine the acceptability of affected data when deficiencies are noted.

The QA/QC Officer will notify the Project Officer of any unacceptable data to ensure that it is not included in evaluations of water quality for reporting purposes. The QA/QC Officer shall notify the Project Officer in writing anytime a deviation from the approved plan occurs. Results of all corrective actions will then be documented.

Reports

Monthly progress reports will be submitted to East Amwell Township and NJDEP. The progress reports will include monitoring data, a description of completed and planned activities, and other project task-related information. All data collected as part of this project will be integrated into the RSWMP. All stream and watershed data will also be included in the final report and will be provided to East Amwell Township and the NJDEP. In addition, the approved QAPP and all monitoring data will be submitted to the NJDEP in both electronic form and hard copy.

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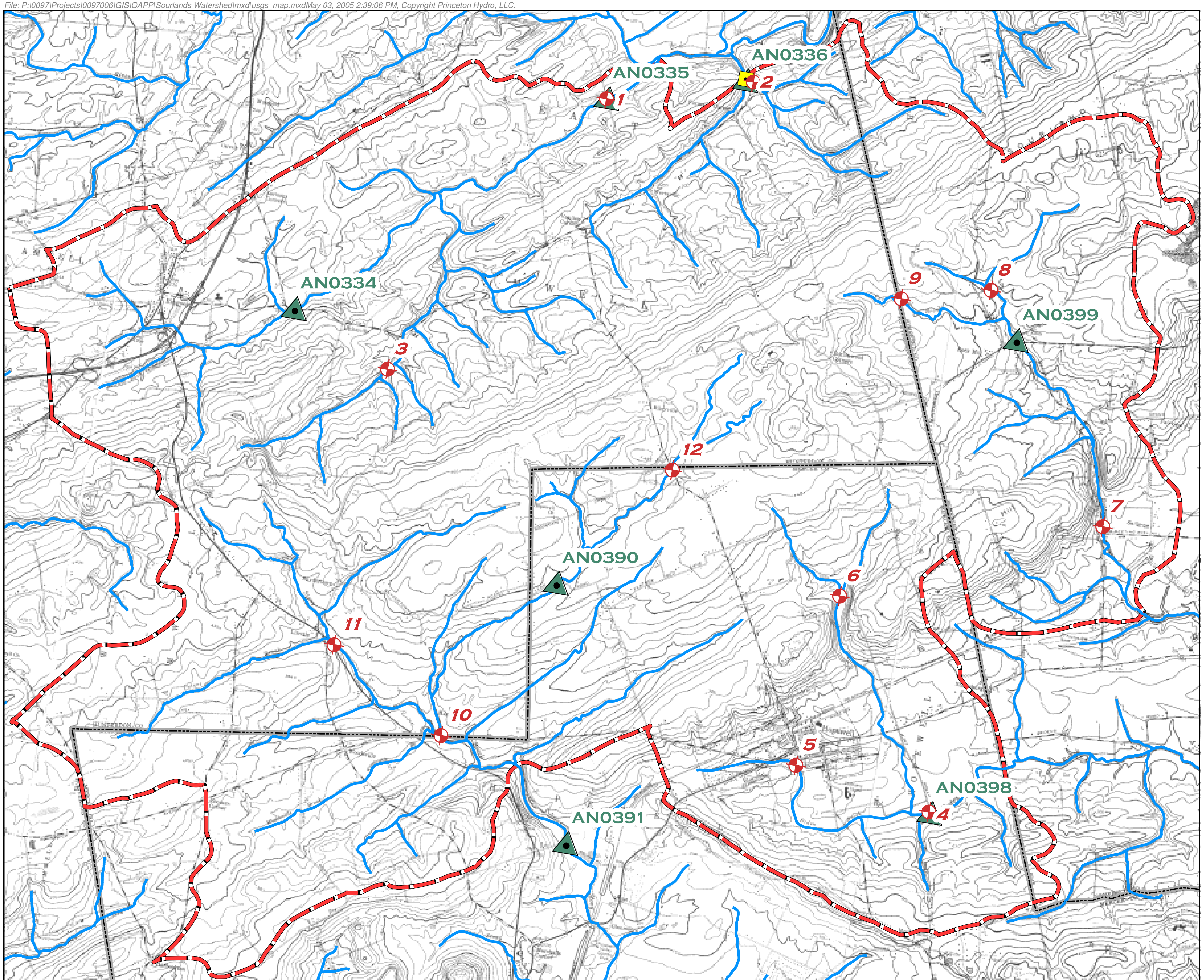
Grant #RP04-084 - Regional Stormwater Mgmt. Plan for the Sourland Mountain Watershed
Quality Assurance Project Plan (QAPP) - Water Quality Monitoring Program
Proposed Sampling Locations

At chemical stations, data will be collected for in situ (dissolved oxygen, temperature, pH and conductivity) and discrete water quality parameters (total phosphorus, **soluble reactive phosphorus,** total suspended solids and nitrate-nitrogen. At biological stations, benthic macroinvertebrates will be sampled. **Pathogens (fecal coliform and fecal streptococcus) will be sampled at stations # 1, 2, 4, 7, 8, 9 and 10.**

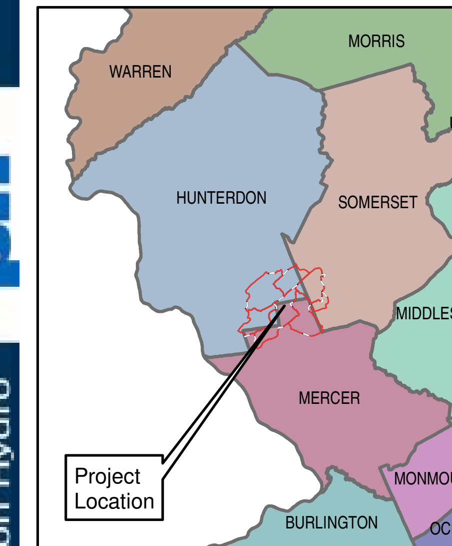
Station #	Major Stream	Station Location	Sampling Type (C = Chemical, B = Biological, P = Pathogens)
1	Back Brook	where Manners Rd crosses Back Brook in East Amwell Twp; northernmost station	C, B**, P**
2	Furmans Brook (Neshanic River tributary)	Furmans Brook at Welisewitz Rd in East Amwell	C, B**, P**
3	Back Brook	where Linvale Rd crosses unnamed tributary of Back Brook, south of Rocktown Rd; southern headwaters	B
4	Bedens Brook	where Aunt Molly Rd crosses Bedens Brook in Hopewell Twp; south mainstem	C, B**, P**
5	Bedens Brook	headwaters in Hopewell Borough Park	B
6	Bedens Brook	near headwater forks of unnamed tributary east of Hopewell Borough, along Hopewell-Amwell Rd in Hopewell Twp	B
7	Rock Brook	where Camp Meeting Ave crosses Rock Brook in Montgomery Twp; mainstem	C, B**, P**
8	Rock Brook	headwaters along Montgomery Rd near Pschorn Lane in Hillsborough Twp; eastern headwaters	B**, P**
9	Rock Brook	Cat Tail Brook (major headwater tributary) south of Pschorn Lane, near boundary between East Amwell and Hillsborough Twps; western headwaters	B**, P**
10	Stony Brook	where Lambertville-Hopewell Tpk crosses Stony Brook at border of East Amwell and Hopewell Twps; mainstem	C, B**, P**
11	Stony Brook	headwaters adjacent to Rt 31 north of Rt 518 junction in East Amwell	B
12	Stony Brook	on unnamed tributary, where it crosses Hopewell-Wertsville Rd in Hopewell Twp	B

File: P:\0097\Projects\0097006\GIS\QAPP\Sourlands Watershed\mxd\usgs_map.mxdMay 03, 2005 2:39:06 PM, Copyright Princeton Hydro, LLC.



Princeton Hydro

NEW JERSEY COUNTY MAP



PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551

N

Feet

0 1,000 2,000 4,000

1 inch equals 4,000 feet

SOURCES:

1. USGS quadrangles for Stockton NJ-PA, Hopewell NJ, Rocky Hill NJ, Lambertville PA-NJ, Pennington NJ, and Princeton NJ as obtained from NJDEP GIS website.

APPENDIX:

SAMPLING LOCATION MAP

QUALITY ASSURANCE PROJECT PLAN
SOURLAND MOUNTAIN WATERSHED
EAST AMWELL TOWNSHIP
HUNTERDON COUNTY, NEW JERSEY

Legend

- Stream Stations
- AMNET Reference Sites
- AMNET Stations
- Streams
- County Boundary
- Study Area

ECM

environmental compliance monitoring, inc

NO.

CHAIN OF CUSTODY RECORD

PROJECT NO.	PROJECT NAME				NO. OF CON- TAINERS	NO PRESERVATIVE	SULFURIC ACID	NITRIC ACID	SODIUM HYDROXIDE	SODIUM THIOSULFATE	Hydrochloric Acid	OTHER	SAMPLE DESIGNATION NUMBERS				
DATE	SAMPLERS																
SAMPLE DATE	TIME	COMP	GRAB	STATION LOCATION									JOB #	LOT #	SAMPLE DATE	SAMPLE #	BOTTLE ID
													L	A	B		
														U	S	E	
															O N	L	Y

COOLER TEMP	pH < 2 Y N N/A pH > 10 Y N N/A	COMMENTS

RELINQUISHED BY: (*Signature*)	DATE/TIME	RECEIVED BY: (*Signature*)	DATE/TIME
RELINQUISHED BY: (*Signature*)	DATE/TIME	RECEIVED BY: (*Signature*)	DATE/TIME

State of New Jersey
Department of Environmental Protection

Certifies That

Princeton Hydro, L.L.C.

Laboratory Certification ID # 10006

having duly met the requirements of the

Regulations Governing The Certification Of
Laboratories And Environmental Measurements N.J.A.C. 7:18 et. seq.

is hereby approved as a

State Certified Environmental Laboratory

to perform the analyses as indicated on the Annual Certified Parameter List
which must accompany this certificate to be valid

Expiration Date June 30, 2005

THE GREAT SEAL OF THE STATE OF NEW JERSEY

Joseph F. Aiello, Chief
Office of Quality Assurance

THIS CERTIFICATE IS TO BE CONSPICUOUSLY DISPLAYED AT THE LABORATORY WITH THE ANNUAL CERTIFIED PARAMETER LIST IN A LOCATION ON THE PREMISES VISIBLE TO THE PUBLIC

New Jersey Department of Environmental Protection
Environmental Laboratory Certification Program

ANNUAL CERTIFIED PARAMETER LIST AND CURRENT STATUS

Effective as of 07/01/2004 until 06/30/2005

Laboratory Name: PRINCETON HYDRO LLC Laboratory Number: 10006 Activity ID: SLC040001
1108 OLD YORK RD
Ringoes, NJ 08551

Category: WPP02 -- Inorganic Parameters, Nutrients and Dema

Status	Code	Parameter Description	Technique Description	Approved Method
Certified	WPP02.45500	Specific conductance	Wheatstone Bridge	[SM 2510 B]

Category: WPP03 -- Analyze-Immediately Inorganic Parameters

Status	Code	Parameter Description	Technique Description	Approved Method
Certified	WPP03.08000	Oxygen (dissolved)	Electrode	[SM 4500-O G]
Certified	WPP03.09000	pH - hydrogen ion	Electrometric	[SM 4500-H B]
Certified	WPP03.14000	Temperature	Thermometric	[SM 2550 B]

For

Joseph F. Aiello, Chief

APPENDIX C:
2005 WATER QUALITY MONITORING
QUALITY ASSURANCE PROJECT PLAN

QUALITY ASSURANCE PROJECT PLAN (QAPP)

Sourland Mountain Watershed
Back Brook, Bedens Brook, Rock Brook, Stony Brook and Furmans Brook
East Amwell Township, Hunterdon County, New Jersey

319(h) Contract RPF # 04-084

Prepared by:______________________ Date: 5/11/2005
Stephen J. Souza, Ph.D., Project Manager
Princeton Hydro, LLC

Reviewed by:______________________ Date: 5/11/05
Fred S. Lubnow, Ph.D., QA/QC Officer
Princeton Hydro, LLC

Reviewed by: Teresa Stahl Date: May 11, 2005
Teresa Stahl, RMC, Municipal Clerk
319(h) Grantee and Lead Planning Agency
East Amwell Township

Reviewed by:______________________ Date: 6-1-05
Nick Zripko, 319(h) Project Manager
Bureau of Watershed Planning

Reviewed by:______________________ Date: 05/23/05
Helen Rancan, Statewide NPS Coordinator
Bureau of Watershed Planning

Approved by:______________________ Date: 06/2/05
Marc Ferko, Quality Assurance Officer
Office of Quality Assurance

QUALITY ASSURANCE PROJECT PLAN

SOURLAND MOUNTAIN WATERSHED (BACK BROOK, BEDENS BROOK, ROCK BROOK, STONY BROOK AND FURMANS BROOK) EAST AMWELL TOWNSHIP HUNTERDON COUNTY, NEW JERSEY

Submitted for the Section 319H NPS
Pollution Control and Management Implementation Grant:
Sourland Mountain Watershed Regional Stormwater Management Plan

Grant # RP04-084

Submitted to:

New Jersey Department of Environmental Protection
Division of Watershed Management
P.O. Box 418
Trenton, New Jersey 08625-0418

Prepared by:

Princeton Hydro, LLC
P.O. Box 720
1108 Old York Road, Suite 1
Ringoes, New Jersey 08551

October 2004
Revision #1 - March 2005
Revision #2 - May 2005

Project Name: Development of the Sourland Mountain Watershed Regional Stormwater Management Plan

Project Requested By: Township of East Amwell

Date Project Initiated: May 2004 (As per receipt of NJDEP executed grant agreement)

Project Officer Name: Stephen J. Souza, Ph.D.

Address: Princeton Hydro, LLC
P.O. Box 720
1108 Old York Road, Suite 1
Ringoes, New Jersey 08551

Phone: (908) 237-5660

QA/QC Officer Name: Fred Lubnow, Ph.D.

Address: Princeton Hydro, LLC
P.O. Box 720
1108 Old York Road, Suite 1
Ringoes, New Jersey 08551

Phone: (908) 237-5660

Project Description

A. Objective and Scope Statement

The Sourland Mountain is a unique and special natural feature spanning Southern Hunterdon, Southwestern Somerset and Northwestern Mercer counties. The Sourland Mountain serves as the headwater for three important regional waterbodies: the upper reaches of the Neshanic River, the Stony Brook and the Millstone River, including two of its major tributaries, Rock Brook and Bedens Brook. Although the Sourland Mountain is recognized as an important and sensitive natural resource, the headwater streams that originate on the Mountain, specifically those within the proposed project area are not protected in any particular manner by existing New Jersey Department of Environmental Protection (NJDEP) regulations. That is, none have been elevated to Category 1 status. Furthermore, because many of these streams are intermittent, due to groundwater being their primary source of base flow, they tend not to be associated with extensive or significant wetlands. As such, they are not protected by current wetland regulations because of the lack of any substantial riparian transitional area adjacent to the streams. Finally, the gradient of these streams tends to be too steep to support a significant fish community. As such, they are designated only as FW2-NT waters. With this designation, many fail to understand the sensitivity of these streams and their aquatic, non-fish, communities, thereby further subjecting these streams to risk and disturbance. Based on data compiled over the past 15 years by East Amwell and Montgomery Townships alone, it is clear that without proper management and protection these streams are at peril. Furthermore, the streams to which these headwater streams drain, specifically Bedens Brook, Back Brook, and Rock Brook, show evidence of both hydrologic and water quality stress and degradation.

The lack of a concerted, well-designed Regional Stormwater Management Plan for the headwater streams simply magnifies the opportunity for the continued degradation of these streams as well as the Neshanic River and Millstone River, to which they drain. The Township, as a result of the active work of the Planning Board, Environmental Commission and Township Committee, has worked hard over the past 20 years to properly manage land use activities in the Township and preserve its rural and agricultural nature. Representative of these efforts are the Township's commitment to open space and farmland acquisition, the development of advanced stormwater management regulations, the protection of groundwater recharge areas, and guidance concerning silvaculture and other land disturbance activities on steeper sloped, fragile areas of the Sourland Mountain.

With the development of a comprehensive Regional Stormwater Management Plan (RSWMP), it will be possible to more effectively reduce the influx of pollutants, control sedimentation, protect riparian habitats, promote recharge and minimize stream channel erosion of the headwater streams on the Sourland Mountain and first and second order streams of the adjoining valley areas. The development of a RSWMP is consistent with the past efforts of East Amwell with respect to the management of the Sourland Mountain and its associated resources. Specifically, it is reflective of the efforts of East Amwell, working independently and in concert with other local and regional stakeholders, to protect surface and groundwater resources of the Sourland Mountain, preserve habitat for threatened and endangered species, better manage development within the watershed, prevent loss of baseflow and reduce stormwater pollutant loading.

B. Data Usage

The data collected during this study will be utilized to develop a Regional Stormwater Management Plan for the Sourland Mountain Watershed.

C. Sampling Procedures

Note: All sampling activity will occur downstream first, then move upstream to eliminate contamination of samples.

Water Quality Monitoring Procedures

All sampling procedures shall be in conformance with standard practices and procedures listed in *Standard Methods for the Analysis of Water and Wastewater, 18th Edition* (American Public Health Association 1992), State protocol (NJDEPE 1992, NJDEP 2003) and any applicable USEPA guidance documents (e.g., USEPA 1997, USEPA 2001, USEPA 2002). Instrumentation used for the collection of field data (dissolved oxygen, temperature, pH and conductivity) shall be properly calibrated in conformance with manufacturer's instructions. It should be noted that Princeton Hydro is a state-certified lab (State ID # 10006) for the use of in situ monitoring equipment to measure dissolved oxygen, temperature, pH and conductivity. Please note that Princeton Hydro received its full certification on June 25, 2004. A copy of Princeton Hydro's Laboratory Certificate and Annual Certified Parameter List is included in this QAPP. This certification covers the four in situ water quality parameters that will be monitored for this project (pH, temperature, dissolved oxygen, conductivity). In collecting such data, Princeton Hydro will follow all procedures required under that certification. All sampling sites were chosen to be representative sites and are subject to the approval of the NJDEP. All sampling sites will be identified, then mapped using GPS technology. Once the sites have been recorded using GPS, the data will be downloaded utilizing GIS technology, and maps will be produced.

A single discrete (i.e., grab) sample will also be collected at each chemical sampling station during each water quality sampling event. Specifically, during each sampling event, a lab-cleaned sample bottle provided by our State-certified laboratory will be used. The bottle will be inverted as it is placed in the water, and then turned over to fill the bottle with water from the central portion of the water column. Samples will be placed in a cooler with wet ice to maintain their temperature at 4ºC and transported to a NJ State-certified analytical lab for analysis of total phosphorus, **soluble reactive phosphorus (SRP),** total suspended solids and nitrate-nitrogen.

Fecal coliform **and fecal streptococcus** samples will also be collected at **selected stations (# 1, 2, 4, 7, 8, 9 and 10) during eight (8) additional water quality sampling events.** Fecal coliform **and fecal streptococcus** sample collection will follow established procedures as outlined in the NJDEP Field Sampling Procedures Manual, 1992. Pre-labeled, sterile bacteriological sample containers will be used to collect a single grab sample from the middle of the stream at each chemical sampling station. Samples will be placed in a cooler with wet ice to maintain their temperature at 4ºC and transported to a NJ State-certified analytical lab for analysis. Arrangements will be made with the lab to ensure that samples are analyzed for fecal coliform **and fecal streptococcus** within six (6) hours of collection.

The results of all chemical and pathogen analyses will be discussed with the Regional Stormwater Planning Committee (RSWMPC) and provided to NJDEP. It is anticipated that the results of the pathogen analyses will provide useful information not only for the development of the RSWMP, but also for the refinement of the proposed fecal coliform TMDL for the Rock Brook and the assessment of progress toward achieving the goals of that TMDL.

Biological Monitoring Procedures

Benthic macroinvertebrates will be sampled at each sampling station a single time during the **May** 2005 sampling survey in accordance with USEPA Rapid Bioassessment Protocols (Plafkin et al. 1989, Barbour et al. 1999), NJDEP Ambient Biomonitoring Network (AMNET) guidelines (NJDEP 2003), and Mid-Atlantic Coastal Streams Workgroup guidelines (USEPA 1997). A single composite sample will be collected from each sampling station from the best available hard-substrate habitat at that site. Each composite sample will be composed of 10 unit-area samplings from different locations at each site. At each location, all invertebrates on the selected hard substrate will be disturbed and washed into a 500 µm D-frame net. Material from all 10 locations will then be pooled and preserved using 95% ethanol.

Invertebrate samples will be returned to and processed at Princeton Hydro's in-house biological laboratory. Following NJDEP's standard protocols (NJDEP 2003), 100 organism sub-samples will be obtained by sorting all invertebrates from randomly selected grids in a gridded tray until a minimum of 100 organisms are found. Invertebrates will then be identified to family level using the best available taxonomic references (e.g., Pennak 1989, Merritt and Cummins 1996). From these data, a number of ecological metrics will be calculated for each site, and a single AMNET bioassessment rating will be calculated for each site and compared to statewide biological impairment tables to determine the level of impairment of each study site.

Invertebrate identification will be made by Dr. Erik Silldorff. Dr. Erik Silldorff has over 12 years of experience and training as an aquatic invertebrate ecologist and taxonomist for projects throughout the United States. His experience includes extensive work in the northeastern states while at Cornell University, the Academy of Natural Sciences of Philadelphia, and Princeton Hydro. He specializes in the identification of all freshwater macroinvertebrates, with particular strength in the aquatic insect groups. In addition, Dr. Silldorff provides QA/QC services for the Stony Brook Millstone Watershed Association as part of their various stream characterization projects. Princeton Hydro will send 10% of the samples to EcoAnalysts in Moscow, Idaho, for a QA/QC check on the invertebrate identifications. EcoAnalysts is the laboratory currently used by the New Jersey AMNET program (as well as other state programs) for such QA/QC checks.

Notification will be provided by phone and email by Princeton Hydro to Marc Ferko, NJDEP Office of Quality Assurance, at least one week prior to scheduled sampling activities. However, in order to maintain consistency with the project workplan and NJDEP's AMNET sampling schedule, the macroinvertebrate sampling event **was intended to be conducted** in April 2005. **Due to the time spent reviewing and revising the QAPP, the macroinvertebrate sampling event was conducted on May 12 and 13, 2005 with the approval of the NJDEP Project Manager. Notice was also provided to Marc Ferko.** Due to the weather-dependent nature of the monitoring program, it must be recognized that the sampling schedule is subject to change with less than one week's notice of any individual sampling event. Princeton Hydro will make every attempt to notify NJDEP promptly in the event of any sampling schedule changes.

D. Water Quality Monitoring Parameters and Frequency

1. Back Brook, Bedens Brook, Rock Brook, Stony Brook and Furmans Brook will be monitored for in situ and discrete water chemistry a total of eight (8) times through the course of the 2005 growing season under baseflow conditions. Specifically, monitoring events will be conducted from **May** through October. Baseflow is defined as a condition

of 72 continuous hours where less than 0.05 inches of rain has fallen. Baseflow conditions will be determined by reference to precipitation data collected at the National Weather Service station located at Wertsville (Cooperative Network ID #289363). The sampling events will intentionally span different seasons and a variety of baseflow conditions in order to document and quantify the variability in water quality condition at baseflow. As a result, there will be no restrictions on either flow or dissolved oxygen prior to sampling. The single exception to this will be a re-scheduling of a sampling event for a given site if that site contains no surface water at the time of sampling (i.e., intermittent streams).

2. Sampling stations will be located on each stream near the headwater limit of its respective HUC-14. Based on discussions with the RSWMP Committee and the Lead Planning Agency, East Amwell Township, at the January 2005 RSWMP Committee meeting, the study area boundaries were refined to more accurately delineate the Sourland Mountain drainage area. The refined project boundary is depicted on the attached map. Specifically, the northern boundary of the watershed was extended to include a portion of HUC14 02030105030060 in East Amwell Township. This will allow us to assess conditions of the headwaters of the Neshanic River that receive drainage from the Sourland Mountain ridgeline. (When the proposal for this project was initially developed, this entire HUC14 was considered for inclusion in the study area. However, based on consultation with NJDEP, due to this HUC 14's extensive area (which includes significant acreage beyond the Sourland Mountain ridgeline), it was recommended that it not be included. However, after reviewing the initial maps of the watershed, the RSWMP Committee and Lead Planning Agency requested that the portion of this HUC 14 exhibiting characteristic Sourland Mountain topography be included as a logical part of the stormwater planning area. Specifically, Furmans Brook has a relatively large watershed which lies entirely within the Sourlands area, including a number of headwater tributaries. As a result, the omission of a monitoring station on this stream was determined to be an important gap in the existing study design.) Therefore, in consultation with the RSWMP Committee and the Lead Planning Agency, a sampling station has been proposed to coincide with AMNET station AN0336 (Furmans Brook at Welisewitz Road in East Amwell) and is identified on the enclosed chart and map as Station #2. This proposed sampling site will be used to collect both physical/chemical and biological water quality data to assess conditions in the portion of the Sourland Mountain watershed draining to the headwaters of the Neshanic River.

   On Back Brook, the station will be located where Manners Rd. crosses the stream in East Amwell Township **(Station #1)**. For Bedens Brook, the sampling will occur at Aunt Molly Road where it crosses the stream in Hopewell Twp. **(Station #4)**. Rock Brook will be sampled in Montgomery Township at Camp Meeting Ave. where it crosses Rock Brook **(Station # 7)**. Sampling for Stony Brook will occur where Lambertville-Hopewell Turnpike crosses the stream at the border of East Amwell and Hopewell Townships **(Station # 10)**. Finally, sampling for Furmans Brook (a tributary of the Neshanic River) will be conducted at the current AMNET station sampling site at Welisewitz Road in East Amwell Township **(Station # 2)**.

All of these proposed sampling station locations are being submitted to the NJDEP for review and approval. The location of each will be recorded using GPS technology, and subsequently plotted on a map using GIS technology. A map is included to display these sampling station locations as well as the locations of the six (6) existing AMNET stations within the study area. A chart identifying each sampling location and parameter to be sampled is also enclosed.

The proposed sampling sites were initially identified by reviewing topographic and other maps in consultation with representatives of East Amwell Township, the Lead Planning Agency. Based on their input, sites were chosen specifically to ensure not only that they would be representative of water quality conditions for each stream within the study area, but also that each site could be accessed safely. Where this could not be determined by map review alone, Princeton Hydro staff conducted a brief site visit to visually confirm site accessibility. Furthermore, Princeton Hydro staff have conducted water quality monitoring at some of the proposed locations, or in close proximity to them, as part of past work efforts conducted for East Amwell and Montgomery Townships. The RSWMP Committee was also given the opportunity to review and provide input on the proposed site locations and found them to be appropriate.

3. At each sampling station, a calibrated Eureka Manta multi-probe will be used to monitor the in situ parameters dissolved oxygen (DO), temperature, pH and conductivity. During sampling events, discrete water quality samples will be collected at each sampling station also. These samples will be collected and delivered to a State-certified laboratory for the analysis of total phosphorus, **soluble reactive phosphorus (SRP),** total suspended solids **and** nitrate-nitrogen.

4. **During eight (8) additional sampling events, samples will also be collected at seven (7) sampling stations and delivered within the required six (6) hour maximum holding time to another State-certified laboratory for the analysis of pathogens (fecal coliform and fecal streptococcus). Fecal coliform and fecal streptococcus samples will be collected at chemical stations # 1, 2, 4, 7 and 10 and biological stations # 8 and 9 (described below in Section E).**

5. A field duplicate and rinse blank will also be collected during each sampling event. Field duplicates will be collected for a different water quality parameter during each individual sampling event.

6. **Two methods of flow estimation will be used to cross-validate discharge estimates for each water quality sampling location. First, discharge measurements from the USGS station on Pike Run at Belle Mead (Station ID 01401650) will be obtained from the USGS for the dates and times of sample collection. This station is the only continuous recording station draining the Sourlands region with a relatively small watershed area (5.36 mi^2) and thus serves as the only plausible extrapolation point for other headwater streams draining the Sourlands. Discharge measurements**

from Pike Run at Belle Mead will be obtained for each sampling date and time from the USGS, and estimates of flow at the project sampling stations will be obtained by area-weighting the discharge measurements at this station with the watershed areas for each sampling station. These empirical discharge estimates will then be cross-validated with modeled discharges for each stream based on land cover, soils group, slope, and precipitation history for the upstream catchment of each sampling station. Specifically, the Modified Rational model will be used in combination with precipitation data from the National Weather Service station located at Wertsville (Cooperative Network ID #289363) to model the expected discharge at each sampling station at the time of sampling. The two discharge values for each station will then be compared, with a final discharge calculated as a weighted average of the two flow estimates.

E. Biological Monitoring Parameters and Frequency

1. In addition to the water quality parameters, biological assessment of the stream invertebrate community will be conducted at 12 stations throughout the watershed, with a single sampling event in April 2005 for each station. Five of the stations will correspond to the water quality stations above, and the remaining 7 stations will be distributed in the primary headwater streams of each of the 4 watersheds. A chart identifying each sampling location and parameter to be sampled is enclosed. Field and laboratory methods will conform to the NJDEP and USEPA standards for macroinvertebrate assessments (see Section C above for detailed protocols).

2. The seven (7) additional biological monitoring stations will be located at the following sites: in the Back Brook watershed, the headwaters of the major unnamed tributary to Back Brook will be monitored where Linvale Road crosses the stream just south of Rocktown Road (both in East Amwell Township) **(Station # 3)**. In the Bedens Brook watershed, the headwaters of Bedens Brook will be monitored in Hopewell Borough Park **(Station # 5)**, and the large unnamed tributary to Bedens Brook east of Hopewell Borough will be monitored near its headwater forks along Hopewell-Amwell Road in Hopewell Township **(Station # 6)**. The headwaters of Rock Brook will be sampled along Montgomery Rd. near Pschorn Lane in Hillsborough Township **(Station # 8)**, while Cat Tail Brook (the major headwater tributary to Rock Brook) will be sampled south of Pschorn Lane near the boundary between East Amwell and Hillsborough Townships **(Station # 9)**. Finally, Stony Brook's headwaters will be sampled adjacent to Rt. 31 north of the Route 518 junction in East Amwell Township **(Station # 11)**, and on the large unnamed headwater tributary to Stony Brook where this tributary crosses Hopewell-Wertsville Road in Hopewell Township **(Station # 12)**.

3. Through the AMNET program, the NJDEP sampled the stream invertebrate community at six (6) locations in these watersheds in April 1994 and April 1999. To maximize the utility of the existing data, the biological assessments for this RSWMP **were intended to occur** in April at all stations. **As described above, the QAPP review and revision time necessitated rescheduling this sampling in early May. It is anticipated that this**

change in the sampling date will still permit direct comparisons among the data sets because of the comparable sampling seasons and the comparable methods, thus providing a broader picture of the watershed and the ecological conditions of these streams.

F. Parameter Table

Summaries of all water quality parameters to be measured and analytical methods to be used are shown in Table 1. This table was developed in coordination with the independent analytical laboratories, Environmental Compliance Monitoring, Inc. (ECM) and New Jersey Laboratories (fecal coliform **and fecal streptococcus** analysis), who will follow the methods and protocols listed in Table 1. ECM will be responsible for all laboratory analyses except for macroinvertebrates, which will be identified and enumerated by Princeton Hydro, and **pathogens (**fecal coliform **and fecal streptococcus)**, which will be analyzed by New Jersey Laboratories. Princeton Hydro will also conduct all in situ water quality monitoring.

Information on project detection limits, levels of interest, precision and accuracy for parameters of interest is listed in Table 2. This table was developed in conjunction with Mr. Thomas Grenci of ECM and indicates the data quality that is expected for this study. In addition, Mr. John Jaglowski, Microbiology laboratory manager for New Jersey Laboratories, provided similar data for fecal coliform **and fecal streptococcus** analyses.

Data Comparability: Analytical data comparability will be achieved by following the analytical methodology, preservation practices and holding times described in Table 1. Each parameter will be analyzed using the referenced methodology and changes in analytical procedures will not take place from sample to sample. The same holds true for sample preservation, holding times and QA/QC practices. The methods used are standard analytical methods that will also allow comparisons with data from the earlier projects.

Data Completeness: Data will be considered complete and usable for decision making when all results have been completed and submitted to the NJDEP in accordance with the sampling and analytical methodology and the required QA/QC practices listed in this project plan. However, it is recognized that some data loss may occur as a result of factors such as sampling equipment malfunction, losses during sample handling, or analysis outside of laboratory acceptance limits. Samples will be re-analyzed if results are outside of laboratory acceptance limits, providing that sufficient sample volume is available and that holding times for the affected parameter(s) have not been exceeded.

Table 1 – Parameters for the Sourland Mountain Watershed Regional Stormwater Management Plan Water Quality Monitoring Program

Parameter	Analytical Method Reference* (Standard Methods)	Sample Container and Preservation Method	Holding Time (Maximum)
Fecal Coliform	9221B and 9221D	Sterile with $Na_2S_2O_3$ added, cool to 4°C	6 hours
Fecal Streptococcus	**9230A and 9230B**	**Sterile with $Na_2S_2O_3$ added, cool to 4°C**	**6 hours**
Total Phosphorus	4500-P B-5 and 4500-P E	1 pint plastic, H_2SO_4 added to sample to pH <2, cool to 4°C	28 days
Soluble Reactive Phosphorus (SRP)	**4500-P E**	**250 mL plastic, no preservative**	**48 hours**
Total Suspended Solids	2540 D	1 pint plastic, cool to 4°C	7 days
Nitrate-nitrogen	352.1 (EPA)	1 pint plastic, cool to 4°C	48 hours
Conductivity Profile	2510 B	in situ	N/A
pH Profile	4500-H^+ B	in situ	N/A
Dissolved Oxygen Profile	4500-O G	in situ	N/A
Temperature Profile	2550 B	in situ	N/A

* As per Standard Methods (American Public Health Association 1992).

Table 2 - Information on Detection Limits, Precision and Accuracy for Water Quality Parameters

Parameter	Sample Matrix	Detection Limit	Level of Interest	Relative Percent Difference*	Percent Recovery*
Fecal Coliform	Water	1 cfu/100 mls	**1 cfu/100 mls**	N/A	N/A
Fecal Streptococcus	**Water**	**1.8 cfu/100 mls**	**1.8 cfu/100 mls**	**N/A**	**N/A**
Total Phosphorus	Water	0.02 mg/L	0.02 mg/L	-18.9 to 18.9	67 to 121
Soluble Reactive Phosphorus	**Water**	**0.003 mg/L**	**0.007 mg/L**	**-17 to 17**	**75 to 121**
Nitrate-N	Water	0.02 mg/L	0.05 mg/L	-13.8 to 13.8	8 to 188
Total Suspended Solids	Water	3.0 mg/L	5.0 mg/L	-76 to 76	N/A

* As supplied by Environmental Compliance Monitoring, Inc. and New Jersey Laboratories (fecal coliform **and fecal streptococcus**).

Table 2 - Information on Detection Limits, Precision and Accuracy for Water Quality Parameters (continued)

Parameter	Sample Matrix	Detection Limit	Level of Interest	Relative Percent Difference*	Percent Recovery*
Conductivity Profile	Water	1 μmhos/cm	1 μmhos/cm	N/A	N/A
pH Profile	Water	0.1 Standard Unit	0.1 Standard Unit	N/A	N/A
Dissolved Oxygen Profile	Water	0.1 mg/L	0.1 mg/L	N/A	N/A
Temperature Profile	Water	0.1° Celsius	0.5° Celsius	N/A	N/A

* As supplied by Princeton Hydro, LLC

Project Schedule, Organization and Responsibility

Table 3 displays the sampling schedule for all field-related activities associated with the development of the Regional Stormwater Management Plan. The sampling schedule shown in Table 3 was developed to comply with East Amwell Township's schedule for completing the Regional Stormwater Management Plan by June 30, 2006.

Princeton Hydro, LLC, under the direction of Dr. Stephen J. Souza, will serve as the project manager. As project manager, responsibilities will include overall project coordination, data management, and the preparation of project reports, documents and deliverables. Dr. Fred S. Lubnow, Director of Princeton Hydro's Aquatics Program, will be responsible for QA/QC for the project. The review and approval of this QAPP will be under the direction of the representatives appointed by the NJDEP: Nick Zripko, 319(h) Project Manager, Bureau of Watershed Planning; Helen Rancan, Statewide NPS Coordinator, Bureau of Watershed Planning; and Marc Ferko, Quality Assurance Officer, Office of Quality Assurance. East Amwell Township, as grantee and Lead Planning Agency (LPA), will serve as the Project Manager for the project and will be responsible for ensuring that all identified tasks are conducted and completed in an acceptable manner.

Fiscal management and administration of the project will also be the responsibility of East Amwell Township. Additional project support will be provided by members of the Regional Stormwater Management Plan Committee.

The key individuals who will be responsible for various project tasks are listed in Table 4. Dr. Erik Silldorff of Princeton Hydro, LLC will also be responsible for stream sampling operations and macroinvertebrate identification. ECM Inc., of Neshanic Station, NJ, will perform the chemical analyses for the project under the direction of Mr. Thomas Grenci. New Jersey Labs of New Brunswick, NJ, will perform the fecal coliform **and fecal streptococcus** analyses under the direction of Mr. John Jaglowski.

Table 3

Proposed Schedule of Field Activities for the Development of the Regional Stormwater Management Plan for the Sourland Mountain Watershed

Year 2005[1]

Task	A	M	J	J	A	S	O
Water Quality Monitoring [2] Back Brook, Bedens Brook Rock Brook, Stony Brook and Furmans Brook							
Macroinvertebrate Survey of Back Brook, Bedens Brook Rock Brook, Stony Brook and Furmans Brook							

1. Sampling will be conducted on eight (8) sampling dates between **May** and October 2005. Sampling will be influenced by stream flow conditions under baseflow. As such, sampling will occur only during those times within the bracketed timeframe when stream conditions are appropriate and conducive.

2. Water quality monitoring includes in situ monitoring and the collection of discrete samples for chemical analyses.

Table 4 - Project Responsibility

Area of Responsibility	Name	Affiliation
State-Based Project Management	Nick Zripko, Project Manager, Bureau of Watershed Planning	New Jersey Department of Environmental Protection
Project Management	Stephen J. Souza, Ph.D.	Princeton Hydro, LLC
Laboratory Analysis	Thomas Grenci	Environmental Compliance Monitoring, Inc.
	Mr. John Jaglowski	New Jersey Laboratories
Laboratory QC	Suzanne Armbruster	Environmental Compliance Monitoring, Inc.
Macroinvertebrate Analyses	Erik Silldorff, Ph.D.	Princeton Hydro, LLC
Data Processing	Christine Krupka	Princeton Hydro, LLC
Data Processing QA/QC Officer	Christopher Mikolajczyk	Princeton Hydro, LLC
Data Quality Review	Fred Lubnow, Ph.D.	Princeton Hydro, LLC
Performance Auditing	Teresa Stahl, RMC	East Amwell Township
Systems Auditing	Marc Ferko, Quality Assurance Officer	New Jersey Department of Environmental Protection
Overall QA	Fred S. Lubnow, Ph.D.	Princeton Hydro, LLC
Overall Coordination	Stephen J. Souza, Ph.D.	Princeton Hydro, LLC

Chain of Custody Procedures

Chain of Custody (COC) procedures will be utilized once the samples are collected and transported to the laboratory for analysis. Personnel responsible for sampling operations will inform the analytical laboratory at least twenty-four (24) hours in advance of the date that stream monitoring samples will be delivered. A copy of the ECM COC form is included with this QAPP.

The sample collector will be required to record the following information on the sampling container and field data sheet: sample number and/or station, date and time of collection, source, preservation technique and collector's name. The sample collector will also record pertinent field data, field observations and the analyses required on the field data sheets. A COC form will be completed to identify the analyses requested and will be submitted to the laboratory at the time of sample delivery.

Following collection, samples will be placed on ice in an insulated container for transport to the laboratory. The sample collector or Princeton Hydro, LLC will deliver the samples to the laboratory, where laboratory personnel will visually inspect all sample containers to confirm the method of transportation, date of collection and preservation technique. Samples will not be accepted and fresh samples will be requested if for any reason the holding time was exceeded, proper preservation techniques were not followed or transportation conditions were unsuitable.

Calibration Procedures and Preventive Maintenance

Field equipment will be calibrated on each sampling date in accordance with the manufacturer's instructions. Any problems will be corrected before samples are collected.

A Eureka Manta multi-probe will be used to monitor temperature, dissolved oxygen, pH and conductivity. Prior to each sampling event, the Manta multi-probe will be calibrated for these water quality parameters. The calibration standards will bracket the expected range for the monitoring. All of the calibration information will be documented. Calibration information will include, but will not be limited to, dates of calibration, name of person performing calibration, any problems and, if so, how they were corrected. Princeton Hydro is a State-certified laboratory (#10006) in these analyze immediately parameters.

ECM, Inc. is a State-certified Laboratory (#18630) that maintains an active Quality Assurance/Quality Control (QA/QC) program to ensure that the collected data will meet all project requirements and that laboratory instruments are properly calibrated. Standards will be analyzed with each batch of samples to ensure that instruments are operating properly. These procedures are in accordance with all applicable State and Federal regulations.

New Jersey Laboratories is a State-certified Laboratory (#12128) that maintains an active Quality Assurance/Quality Control (QA/QC) program to ensure that the collected data will meet all project requirements and that laboratory instruments are properly calibrated. Controls will be analyzed with each batch of samples to ensure that instruments are operating properly. These procedures are in accordance with all applicable State and Federal regulations.

Documentation, Data Reduction, and Reporting

All data will be included in the final RSWMP reports and will be kept on file by Princeton Hydro, LLC for a minimum of five years, as per the Regulations Governing the Certification of Laboratories and Environmental Measurements (NJAC 7:18-8.5(a)), the NJ Pollutant Discharge Elimination System rules (NJAC 7:14A-6), USEPA's "Guidance for Quality Assurance Project Plans" (December 2002), and USEPA's "Requirements for Quality Assurance Project Plans" (March 2001).

Data Validation

Data validation will be performed by Princeton Hydro, LLC and will be provided with the final report. If blank contamination is found in the equipment rinse blank, all water quality data with results less than five (5) times the concentration found in the blank will be flagged "B." The "B" qualifier indicates that the reported result may be an anomaly as a result of contamination of the blank.

Performance and Systems Audits

A. Performance Auditing

ECM is a State-certified laboratory (#18630). The laboratory participates in Performance Evaluation (PE) Studies for each category of certification and accreditation and is required to pass each of these PE studies in order to maintain certification. The NJDEP conducts performance audits of each laboratory that is certified or accredited.

ECM also participates in several additional programs to ensure data accuracy. The laboratory participates in USEPA water pollution (WP) and water supply (WS) studies and the discharge monitoring report (DMR-QA/QC) program.

New Jersey Laboratories is a State-certified laboratory (#12128). The laboratory participates in Performance Evaluation (PE) Studies for each category of certification and accreditation and is required to pass each of these PE studies in order to maintain certification. The NJDEP conducts performance audits of each laboratory that is certified or accredited.

New Jersey Laboratories also participates in several additional programs to ensure data accuracy. The laboratory also participates in FDA (#2219935) programs.

Princeton Hydro is State-certified (# 10006) for the collection of water samples and in situ field monitoring of temperature, pH, dissolved oxygen and conductivity using a multi-probe data sonde and similar monitoring meters. The laboratory participates in USEPA water pollution (WP) and studies annually.

B. Systems Auditing

The NJDEP periodically conducts on-site Technical Systems Audits (TSA) of each certified laboratory. The findings of these audits, together with the USEPA Performance Evaluation results, are used to update each laboratory's certification status.

Corrective Action

The project QA/QC Officer will ensure that all data for the project are generated in accordance with procedures outlined in this QA/QC Project Plan. Quality control samples will be analyzed with each sample batch and results will be provided with the data reports. If a QC sample provides unacceptable results during any given day, the sample analysis must be repeated for those parameters affected. All project participants will immediately report any deficiencies to the QA/QC Officer. The QA/QC Officer will recommend appropriate corrective action and determine the acceptability of affected data when deficiencies are noted.

The QA/QC Officer will notify the Project Officer of any unacceptable data to ensure that it is not included in evaluations of water quality for reporting purposes. The QA/QC Officer shall notify the Project Officer in writing anytime a deviation from the approved plan occurs. Results of all corrective actions will then be documented.

Reports

Monthly progress reports will be submitted to East Amwell Township and NJDEP. The progress reports will include monitoring data, a description of completed and planned activities, and other project task-related information. All data collected as part of this project will be integrated into the RSWMP. All stream and watershed data will also be included in the final report and will be provided to East Amwell Township and the NJDEP. In addition, the approved QAPP and all monitoring data will be submitted to the NJDEP in both electronic form and hard copy.

References

American Public Health Association. 1992. Standard Methods for the Analysis of Water and Wastewater, 18th Edition. Washington, D.C.

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency, Office of Water, Washington, D.C.

New Jersey Department of Environmental Protection and Energy. 1992. Field Sampling Procedures Manual. Trenton, New Jersey.

New Jersey Department of Environmental Protection. 2003. Ambient Biomonitoring Network, Watershed Management Areas 17, 18, 19, and 20: Lower Delaware Region. 2000-2001 Benthic Macroinvertebrate Data.
Available at http://www.state.nj.us/dep/wmm/bfbm/downloads.html

Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross, and R.M. Hughes. 1989. Rapid bioassessment protocols for use in streams and rivers: Benthic macroinvertebrates and fish. U.S. Environmental Protection Agency, Office of Water Regulations and Standards, Washington, D.C. EPA 440-4-89-001.

United States Environmental Protection Agency. 1997. Field and Laboratory Methods for Macroinvertebrate and Habitat Assessment in Low Gradient Nontidal Streams. Mid-Atlantic Coastal Streams Workgroup, Environmental Services Division, Region 3, Wheeling, WV. 23 pp

United States Environmental Protection Agency. 2001. Requirements for Quality Assurance Project Plans (EPA QA/R-5). Office of Environmental Information, Washington, DC.

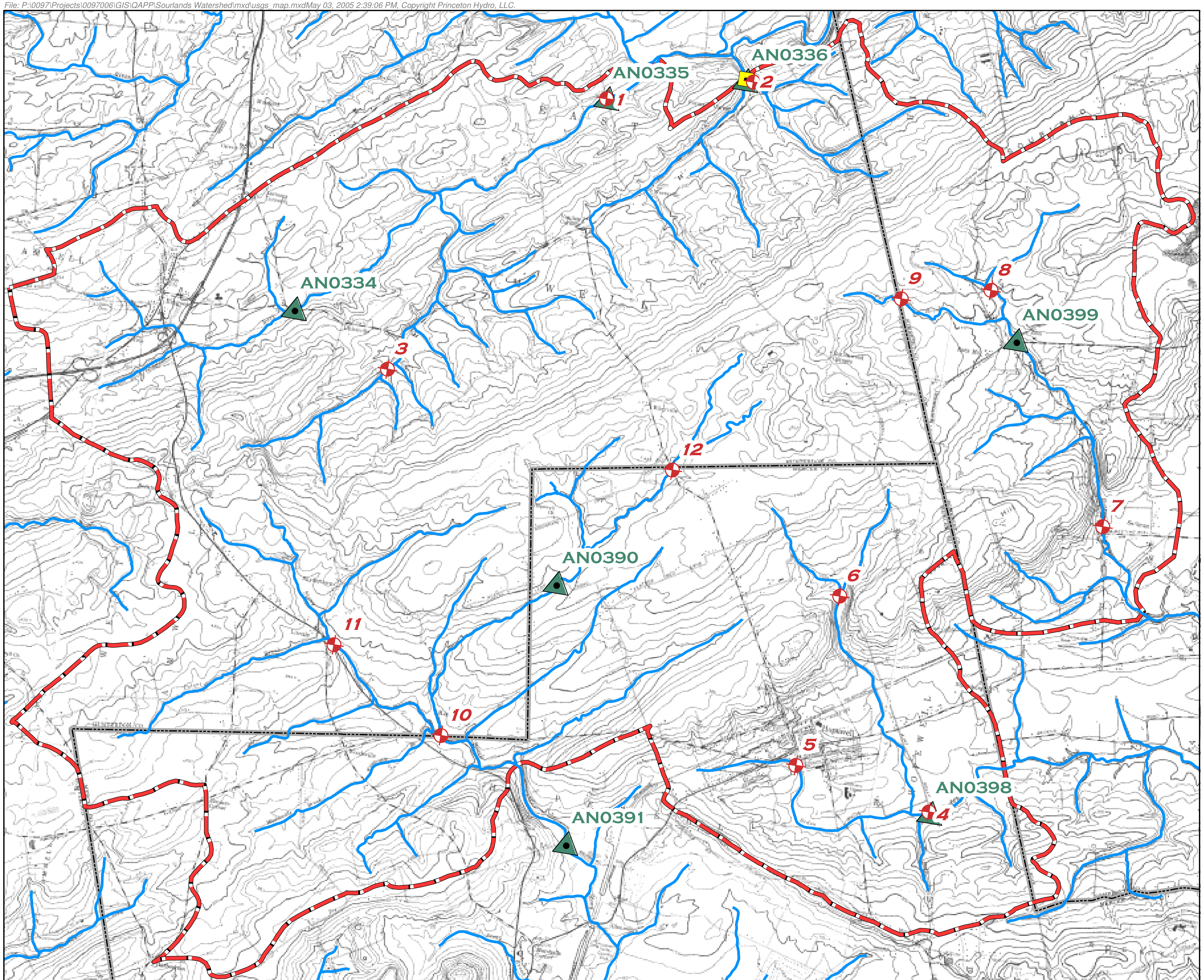
United States Environmental Protection Agency. 2002. Guidance for Quality Assurance Project Plans (EPA QA/G-5). Office of Environmental Information, Washington, DC.

Grant #RP04-084 - Regional Stormwater Mgmt. Plan for the Sourland Mountain Watershed Quality Assurance Project Plan (QAPP) - Water Quality Monitoring Program Proposed Sampling Locations

At chemical stations, data will be collected for in situ (dissolved oxygen, temperature, pH and conductivity) and discrete water quality parameters (total phosphorus, **soluble reactive phosphorus,** total suspended solids and nitrate-nitrogen. At biological stations, benthic macroinvertebrates will be sampled. **Pathogens (fecal coliform and fecal streptococcus) will be sampled at stations # 1, 2, 4, 7, 8, 9 and 10.**

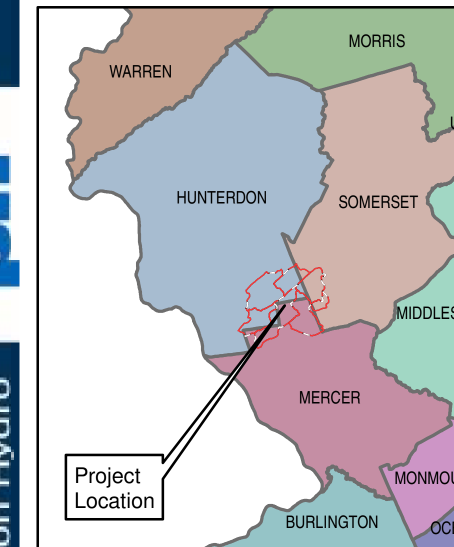
Station #	Major Stream	Station Location	Sampling Type (C = Chemical, B = Biological, P = Pathogens)
1	**Back Brook**	where Manners Rd crosses Back Brook in East Amwell Twp; northernmost station	C, B**, P**
2	**Furmans Brook (Neshanic River tributary)**	Furmans Brook at Welisewitz Rd in East Amwell	C, B**, P**
3	**Back Brook**	where Linvale Rd crosses unnamed tributary of Back Brook, south of Rocktown Rd; southern headwaters	B
4	**Bedens Brook**	where Aunt Molly Rd crosses Bedens Brook in Hopewell Twp; south mainstem	C, B**, P**
5	**Bedens Brook**	headwaters in Hopewell Borough Park	B
6	**Bedens Brook**	near headwater forks of unnamed tributary east of Hopewell Borough, along Hopewell-Amwell Rd in Hopewell Twp	B
7	**Rock Brook**	where Camp Meeting Ave crosses Rock Brook in Montgomery Twp; mainstem	C, B**, P**
8	**Rock Brook**	headwaters along Montgomery Rd near Pschorn Lane in Hillsborough Twp; eastern headwaters	B**, P**
9	**Rock Brook**	Cat Tail Brook (major headwater tributary) south of Pschorn Lane, near boundary between East Amwell and Hillsborough Twps; western headwaters	B**, P**
10	**Stony Brook**	where Lambertville-Hopewell Tpk crosses Stony Brook at border of East Amwell and Hopewell Twps; mainstem	C, B**, P**
11	**Stony Brook**	headwaters adjacent to Rt 31 north of Rt 518 junction in East Amwell	B
12	**Stony Brook**	on unnamed tributary, where it crosses Hopewell-Wertsville Rd in Hopewell Twp	B

File: P:\0097\Projects\0097006\GIS\QAPP\Sourlands Watershed\mxd\usgs_map.mxdMay 03, 2005 2:39:06 PM, Copyright Princeton Hydro, LLC.



Princeton Hydro

NEW JERSEY COUNTY MAP



PRINCETON HYDRO, LLC.
1108 OLD YORK ROAD
P.O. BOX 720
RINGOES, NJ 08551

N

Feet
0 1,000 2,000 4,000

1 inch equals 4,000 feet

SOURCES:

1. USGS quadrangles for Stockton NJ-PA, Hopewell NJ, Rocky Hill NJ, Lambertville PA-NJ, Pennington NJ, and Princeton NJ as obtained from NJDEP GIS website.

APPENDIX:

SAMPLING LOCATION MAP

QUALITY ASSURANCE PROJECT PLAN
SOURLAND MOUNTAIN WATERSHED
EAST AMWELL TOWNSHIP
HUNTERDON COUNTY, NEW JERSEY

Legend

- Stream Stations
- AMNET Reference Sites
- AMNET Stations
- Streams
- County Boundary
- Study Area

ECM

environmental compliance monitoring, inc

NO.

CHAIN OF CUSTODY RECORD

PROJECT NO.	PROJECT NAME	NO. OF CON-TAINERS	SAMPLE DESIGNATION NUMBERS
DATE	SAMPLERS		

SAMPLE DATE	TIME	COMP	GRAB	STATION LOCATION	NO. OF CON-TAINERS	NO PRESERVATIVE	SULFURIC ACID	NITRIC ACID	SODIUM HYDROXIDE	SODIUM THIOSULFATE	Hydrochloric Acid	OTHER	JOB #	LOT #	SAMPLE DATE	SAMPLE #	BOTTLE ID
													L	A	B		
														U	S	E	
															O N	L	Y

COOLER TEMP	pH < 2 Y N N/A pH > 10 Y N N/A	COMMENTS

RELINQUISHED BY: (*Signature*)	DATE/TIME	RECEIVED BY: (*Signature*)	DATE/TIME
RELINQUISHED BY: (*Signature*)	DATE/TIME	RECEIVED BY: (*Signature*)	DATE/TIME

State of New Jersey

Department of Environmental Protection

Certifies That

Princeton Hydro, L.L.C.

Laboratory Certification ID # 10006

having duly met the requirements of the

Regulations Governing The Certification Of
Laboratories And Environmental Measurements N.J.A.C. 7:18 et. seq.

is hereby approved as a

State Certified Environmental Laboratory

to perform the analyses as indicated on the Annual Certified Parameter List
which must accompany this certificate to be valid

Expiration Date June 30, 2005

THE GREAT SEAL OF THE STATE OF NEW JERSEY

Joseph F. Aiello, Chief
Office of Quality Assurance

THIS CERTIFICATE IS TO BE CONSPICUOUSLY DISPLAYED AT THE LABORATORY WITH THE ANNUAL CERTIFIED PARAMETER LIST IN A LOCATION ON THE PREMISES VISIBLE TO THE PUBLIC

New Jersey Department of Environmental Protection

Environmental Laboratory Certification Program

ANNUAL CERTIFIED PARAMETER LIST AND CURRENT STATUS

Effective as of 07/01/2004 until 06/30/2005

Laboratory Name: PRINCETON HYDRO LLC Laboratory Number: 10006 Activity ID: SLC040001
1108 OLD YORK RD
Ringoes, NJ 08551

Category: WPP02 -- Inorganic Parameters, Nutrients and Dema

Status	Code	Parameter Description	Technique Description	Approved Method
Certified	WPP02.45500	Specific conductance	Wheatstone Bridge	[SM 2510 B]

Category: WPP03 -- Analyze-Immediately Inorganic Parameters

Status	Code	Parameter Description	Technique Description	Approved Method
Certified	WPP03.08000	Oxygen (dissolved)	Electrode	[SM 4500-O G]
Certified	WPP03.09000	pH - hydrogen ion	Electrometric	[SM 4500-H B]
Certified	WPP03.14000	Temperature	Thermometric	[SM 2550 B]

For

Joseph F. Aiello, Chief

Table D-1
Benthic Macroinvertebrate Data
Sourland Regional Stormwater Management Plan

Princeton Hydro Benthos 06	**Sourlands Streams**											
EcoAnalysts, Inc.	**05-12-2005**											
Site	**1-Back Br. @ Manner Rd.**	**2-Furmans Br.**	**3-Back Br. @ Unionville Winery**	**4-Bedens Br. @ Aunt Molly Rd.**	**5-Hopewell Boro Park**	**6-Graf property headwaters of Bedens Br.**	**7-Rock Br. mainstem in Park**	**headwaters on Clarke property**	**9-Cattail Br. Bromley property**	**10-mainstem Stony Br.**	**11-W. Stony Br. headwaters, Feryok prope**	**12-Stony Br. in preserve**
Abundance Measures												
Corrected Abundance	15744.00	8680.88	5904.00	4512.00	66666.25	12384.00	6096.00	2880.00	2432.00	7680.00	1840.00	4140.00
EPT Abundance	2880.00	5234.06	1440.00	800.00	4952.35	8160.00	2832.00	1728.00	816.00	4352.00	944.00	1740.00
Dominance Measures												
Dominant Taxon	Chironomidae	Chironomidae	Chironomidae	Chironomidae	Chironomidae	Baetidae	Chironomidae	Chironomidae	Chironomidae	Baetidae	Baetidae	Chironomidae
% Dominant Taxon	66.46	33.09	65.85	46.81	52.00	26.36	35.43	23.33	54.61	45.83	40.00	42.75
Richness Measures												
Species Richness	12.00	19.00	13.00	14.00	6.00	16.00	14.00	17.00	23.00	17.00	15.00	19.00
EPT Richness	6.00	12.00	7.00	8.00	2.00	9.00	8.00	9.00	14.00	9.00	6.00	9.00
Community Composition												
% EPT	18.29	60.29	24.39	17.73	7.43	65.89	46.46	60.00	33.55	56.67	51.30	42.03
Biotic Indices												
Hilsenhoff Family Biotic Index	5.44	4.30	5.07	5.74	6.21	4.11	4.54	3.60	4.53	4.67	4.76	4.47
NJIS Score												
Taxa Richness	6	6	6	6	3	6	6	6	6	6	6	6
EPT	6	6	6	6	0	6	6	6	6	6	6	6
% Dominance	0	6	0	3	3	6	6	6	3	3	6	3
% EPT	3	6	3	3	0	6	6	6	3	6	6	6
FBI	3	6	6	3	3	6	6	6	6	6	6	6
NJIS Score	**18**	**30**	**21**	**21**	**9**	**30**	**30**	**30**	**24**	**27**	**30**	**27**
	Mod Impaired	**Non-Impaired**	**Mod Impaired**	**Mod Impaired**	**Mod Impaired**	**Non-Impaired**	**Non-Impaired**	**Non-Impaired**	**Non-Impaired**	**Non-Impaired**	**Non-Impaired**	**Non-Impaired**

Appendix D
Sourlands – Benthic Macroinvertebrate Sampling Results
May 2005

In May 2005, samples for benthic macroinvertebrates were collected by Princeton Hydro staff in accordance with protocol outlined in the approved sampling QAPP. At least two upstream samples and one downstream sample were collected from each of the four streams located within the project study area. The biological analysis and results were provided by EcoAnalysts, located in Moscow, Indiana.

The New Jersey Department of Environmental Protection (NJDEP) utilizes the USEPA Rapid Bioassessment Protocol to evaluate the benthic macroinvertebrate communities in a stream and determine whether or not the stream is biologically impaired. Based on the NJDEP Rapid Bioassessment Protocol it was determined that sample locations in Furmans Brook, Rock Brook, Cattail Brook and the Stony Brook samples were all Non-Impaired for benthic macroinvertebrates. Sample locations in Back Brook and Beden Brook were determined to be Moderately Impaired. The sampling locations are depicted on Figure 15, Appendix B, and the details of this macroinvertebrate analysis are provided in the narrative below and summarized in the attached Table.

Back Brook – Furmans Brook
The upstream sample on Furmans Brook (PH#2 - at Welisewitz Rd in East Amwell) was identified as Non-impaired for macroinvertebrates. However, both the Back Brook upstream sample (PH #3 - near where Linvale Rd crosses an unnamed tributary of Back Brook, south of Rocktown Rd) and the downstream sample (PH#1 -near Manner Road) were identified as moderately impaired. While the number of species present was high (Taxa richness), the macroinvertebrate populations were dominated (over 60%) by Chironomidae, midges, a pollutant tolerant species. There was also a low number and low percentage (less than 25%) of pollution sensitive species such as mayflies, stoneflies and caddisflies (% EPT). In addition the Hilsenhoff Family Biotic Index (FBI), which measures the overall pollution tolerance of the macroinvertebrates present in the sample, was high (> 5). Together the biometrics indicate that pollution may be present because these tolerant macroinvertebrate species are more dominant.

Beden Brook
The upstream sample location (PH#6 - near the headwater of an unnamed tributary east of Hopewell Borough, along Hopewell-Amwell Rd) was identified as Non-impaired for macroinvertebrates. However, the upstream sample (PH #5 - headwaters in Hopewell Borough Park) and the downstream sample (PH#4 - where Aunt Molly Rd crosses Bedens Brook in Hopewell Twp) were both identified as moderately impaired. The Aunt Molly Road sample (PH#4) had a high number of species present (Taxa richness), the macroinvertebrate populations were dominated (over 40%) by Chironomidae, midges, a pollutant tolerant species. There was also a low number and low percentage (less than 18%) of pollution sensitive species such as mayflies, stoneflies and caddisflies (% EPT). In addition the Hilsenhoff Family Biotic Index (FBI), which measures the overall

pollution tolerance of the macroinvertebrates present in the sample, was high (> 5). Together the biometrics indicate that pollution may be present because these tolerant macroinvertebrate species are more dominant.

The Hopewell Borough Park sample (PH#5) was the worst sample for the watershed study area. There was a low number of species present (Taxa richness < 10 species), the macroinvertebrate populations were dominated (over 50%) by Chironomidae, midges, a pollutant tolerant species. There was also a low number and low percentage (less than 8%) of pollution sensitive species such as mayflies, stoneflies and caddisflies (% EPT). In addition the Hilsenhoff Family Biotic Index (FBI), which measures the overall pollution tolerance of the macroinvertebrates present in the sample, was high (> 6). Together the biometrics indicate that pollution may be present because these tolerant macroinvertebrate species are more dominant.

Stony Brook and Rock Brook
Overall the six samples from both of these streams identified a high number of species present (Taxa richness > 10), the dominant macroinvertebrate taxon, the pollutant tolerant Chironmidae, midges, varied from 23 to 54%. Mayflies or Baetidae, a pollutant sensitive species dominated two samples in the Stony Brook (PH# 11 and #12). There was also a high number and high percentage (> 35%) of pollution sensitive species such as mayflies, stoneflies and caddisflies (% EPT). In addition the Hilsenhoff Family Biotic Index (FBI), which measures the overall pollution tolerance of the macroinvertebrates present in the sample, was low (< 5). Together the biometrics indicate that pollution is not likely present because these sensitive macroinvertebrate species are more dominant in these two streams.

Causes and Conditions of Impairment
http://www.state.nj.us/dep/wms/bfbm/rbpinfo.html.

The NJDEP identifies a monitoring station as impaired when species of pollution-tolerant groups (such as worms and midges) tend to dominate over pollution-intolerant forms (e.g. mayflies, stoneflies, etc.), with an overall depression in species diversity. Such results typically occur due to degraded in-stream environmental conditions, which may be caused by various human activities or land-uses and, in some cases, by natural features or events. The NJDEP identifies that environmental factors that may adversely affect stream biology, can include both chemical and physical parameters, as listed below:

- Lack of dissolved oxygen
- Higher than normal temperature
- Excessive turbidity
- Presence of toxicants (in various chemical forms)
- Eutrophication = excessive nutrients promoting undesirable vegetation or algal blooms, and increased turbidity
- Degraded habitat
    - a. lack of bank vegetation/canopy (= poor bank stability, lack of shade)
    - b. excessive sedimentation (= poor substrate and water clarity)

c. lack of streamflow (= low dissolved oxygen, possible sedimentation, undesirable vegetation)

Human activities or practices, land uses, and natural features or events can also contribute to degraded stream quality:

- Deforestation/development/construction (largely via runoff from non-point sources)
- Urbanization/industrialization (largely via runoff from non-point sources)
- Agricultural operations (largely via runoff from non-point sources)
- Municipal or industrial wastewater discharge (point source)
- Artificial channelization or habitat alteration
- Upstream impoundment, lake or pond
- Drought conditions

Potential Causes for the Impairments Identified in Back Brook and Beden Brook

Back Brook

The Characterization and Assessment Report prepared for the Sourland Regional Stormwater Management Plan by Princeton Hydro in March 2006 identified that land use in the Back Brook watershed is dominated by horse farms, and elevated levels of fecal coliform were also detected, which could possibly be attributed to livestock or septic systems. In addition, significant stream bank erosion was also noted along several segments of Back Brook. The impacts from excessive sedimentation, habitat alterations, fecal coliform, and excessive nutrients could be the primary causes of biological impairments noted in Back Brook.

Beden Brook

The land use in the Beden Brook watershed is dominated by dense housing and commercial development in Hopewell Borough, a community park and some farmlands. The elevated levels of fecal coliform detected in Beden Brook may be attributed to discharge from septic systems, pet waste, or leaking sanitary sewer conveyance lines to the Regional Wastewater Treatment plant. In addition, significant stream bank erosion was also noted along several segments of Beden Brook. The impacts from excessive sedimentation, habitat alterations, fecal coliform and excessive nutrients could be the primary causes of biological impairments noted in Beden Brook.

The NJ Rapid Bioassessment Protocol

http://www.state.nj.us/dep/wms/bfbm/rbpinfo.html.

The Rapid Bioassessment Protocol procedure used by the NJDEP is based on the USEPA Rapid Bioassessment Protocols for use in Streams and Wadeable Rivers (EPA 841-B-99-002 Nov. 1999). The procedure involves the use of a net in sampling of stream bottoms to collect insects, mollusks, crustaceans, and worms that are collectively referred to as "macroinvertebrates". Macroinvertebrates are larger-than-microscopic, primarily benthic (bottom-dwelling) fauna, which are generally ubiquitous in freshwater and estuarine environments, and play an integral role in the aquatic food web. Insects (largely immature forms) are especially characteristic of freshwaters; other major groups include worms, mollusks (snails, clams) and crustaceans (scuds, shrimp, etc.). Benthic macroinvertebrates are bottom-dwelling invertebrate organisms easily viewed with the naked eye.

Species comprising the in-stream community occupy various niches, based on functional adaptation or feeding mode (for example, predators, filter or detritus feeders, scavengers, etc.). Their presence and relative abundance is governed by environmental conditions (which may determine available food supply), and by pollution tolerance levels of the respective species.

Benthic macroinvertebrate communities integrate the effects of short-term environmental variations and provide an ecological measure of fluctuating environmental conditions. Since benthic macroinvertebrates have limited migration patterns, or a sessile mode of life, they are particularly well-suited for assessing site-specific ecosystem health. Benthic macroinvertebrate assemblages are made up of species that constitute a broad range of trophic levels and pollution tolerances, thus providing strong information for interpreting cumulative effects.

Each sample is analyzed to determine the number of individuals by family, genus, and species. The data analysis scheme uses five biometric indicators to calculate the New Jersey Impairment Score (NJIS). Each biometric measures a different component of community structure and has a different range of sensitivity to pollution stress. The current NJDEP current NJIS (Rapid Bioassessment Protocol) is based on family-level taxonomy and uses the following metrics:

1. **Total Taxa or Taxa Richness** (number of families) - an index of community diversity; the number usually increases with increasing water or habitat quality.
2. **Percent Contribution of the Dominant Family** (to the total number of families) - dominance by relatively few species/families would indicate environmental stress.
3. **Number of EPT Families** — the number of families represented within the orders Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies), which are generally pollution-sensitive.
4. **Percent EPT** (of the total number of individuals) — would increase with increasing water quality.
5. **Hilsenhoff (Family) Biotic Index** — tolerance values of 0 - 10 are assigned to individual families (zero = most intolerant); these values are used in the formula for calculating the Biotic Index which summarizes the overall pollution tolerance of the entire benthic macroinvertebrate community with a single value.

Each biometric is scored a 6, 3, or 0. The scores for each biometric are then added together to calculate the New Jersey Impairment Score. A sample result with a NJIS of 24 to 30 is classified as nonimpaired. Results indicating an NJIS score of 6 or less are classified as severely impaired, while results with an NJIS score between 9 and 21 indicate moderate impairment.

Table 1 : Evaluation of water quality using the family-level biotic index (Hilsenhoff, 1988)		
Family Biotic Index	**Water Quality**	**Degree of Organic Pollution**
0.00-3.75	Excellent	Organic pollution unlikely
3.76-4.25	Very good	Possible slight organic pollution
4.26-5.00	Good	Some organic pollution probable
5.01-5.75	Fair	Fairly substantial pollution likely
5.76-6.50	Fairly poor	Substantial pollution likely
6.51-7.25	Poor	Very substantial pollution likely
7.26-10.00	Very poor	Severe organic pollution likely

Advantages of Using Benthic Macroinvertebrates:

1. They are good indicators of localized conditions of water quality due to their limited mobility. As such, they are well suited for the assessment of site-specific pollution impacts.
2. They are sensitive to environmental impacts from both point and non-point sources of pollution.
3. They integrate the effects of short-term environmental variations, such as oil spills and intermittent discharges.
4. Sampling is relatively easy and inexpensive.
5. They are holistic indicators of overall water quality, even for substances that may be present, but at lower than detectable levels.
6. They are normally abundant in New Jersey waters as well as aquatic environments in general.
7. They serve as the primary food source for many species of commercially and recreationally important fishes.
8. Unlike chemical monitoring, where impacts to the environment tend to be by inference, not direct determination, they provide a direct measure of water quality in a manner consistent with the goals of the Clean Water Act.
9. They can be used to assess non-chemical impacts to the aquatic habitat, such as by thermal pollution, excessive sediment loading (siltation), or eutrophication.
10. To the general public, impacts to resident benthic macroinvertebrate communities are more tangible measurements of water quality than more esoteric listings of chemical test results.
11. When monitored together with relevant chemical/physical parameters, benthic macroinvertebrate communities can be used to identify sources of impairment.

Princeton Hydro Benthos 06							
EcoAnalysts, Inc.							
Data are adjusted for subsampling							
Stream	**Sourlands Streams**	**Sourlands Streams**	**Sourlands Streams**	**Sourlands Streams**	**Sourlands Streams**	**Sourlands Streams**	**Sourlands Streams**
Site	**1-Back Br. @ Manner Rd.**	**2-Furmans Br.**	**3-Back Br. @ Unionville Winery**	**4-Bedens Br. @ Aunt Molly Rd.**	**5-Hopewell Boro Park**	**6-Graf property-headwaters of Bedens Br.**	**7-Rock Br. mainstem in Park**
Date	**05-12-2005**	**05-12-2005**	**05-12-2005**	**05-12-2005**	**05-12-2005**	**05-12-2005**	**05-13-2005**
Percent Subsampled	**1.04**	**1.57**	**2.08**	**3.13**	**0.26**	**1.04**	**2.08**
Device	**10kicks-500um net**	**10kicks-500um net**	**10kicks-500um net**	**10kicks-500um net**	**10kicks-500um net**	**10kicks-500um net**	**10kicks-500um net**
Habitat							
EcoAnalysts Sample ID	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Abundance Measures							
Corrected Abundance	15744.00	8680.88	5904.00	4512.00	66666.25	12384.00	6096.00
EPT Abundance	2880.00	5234.06	1440.00	800.00	4952.35	8160.00	2832.00
Dominance Measures							
Dominant Taxon	Chironomidae	Chironomidae	Chironomidae	Chironomidae	Chironomidae	Baetidae	Chironomidae
Dominant Abundance	10464.00	2872.35	3888.00	2112.00	34666.45	3264.00	2160.00
2nd Dominant Taxon	Perlidae	Baetidae	Baetidae	Naididae	Naididae	Chironomidae	Baetidae
2nd Dominant Abundance	1440.00	2297.88	480.00	1440.00	25523.65	2592.00	816.00
3rd Dominant Taxon	Elmidae	Perlidae	Nemouridae	Ephemerellidae	Baetidae	Philopotamidae	Nemouridae
3rd Dominant Abundance	768.00	829.79	288.00	288.00	4571.40	1536.00	768.00
% Dominant Taxon	66.46	33.09	65.85	46.81	52.00	26.36	35.43
% 2 Dominant Taxa	75.61	59.56	73.98	78.72	90.29	47.29	48.82
% 3 Dominant Taxa	80.49	69.12	78.86	85.11	97.14	59.69	61.42
Richness Measures							
Species Richness	12.00	19.00	13.00	14.00	6.00	16.00	14.00
EPT Richness	6.00	12.00	7.00	8.00	2.00	9.00	8.00
Ephemeroptera Richness	3.00	5.00	2.00	4.00	1.00	3.00	3.00
Plecoptera Richness	1.00	3.00	3.00	2.00	0.00	4.00	3.00
Trichoptera Richness	2.00	4.00	2.00	2.00	1.00	2.00	2.00
Chironomidae Richness	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Oligochaeta Richness	1.00	1.00	0.00	1.00	1.00	2.00	2.00
Non-Chiro. Non-Olig. Richness	10.00	17.00	12.00	12.00	4.00	13.00	11.00
Rhyacophila Richness	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Community Composition							
% Ephemeroptera	7.32	36.76	8.94	13.48	6.86	32.56	15.75
% Plecoptera	9.15	19.12	13.01	2.13	0.00	19.38	25.20
% Trichoptera	1.83	4.41	2.44	2.13	0.57	13.95	5.51
% EPT	18.29	60.29	24.39	17.73	7.43	65.89	46.46
% Coleoptera	6.10	0.74	7.32	1.42	1.14	0.00	4.72
% Diptera	66.46	35.29	67.48	46.81	53.14	23.26	37.01
% Oligochaeta	1.22	1.47	0.00	31.91	38.29	8.53	11.02
% Baetidae	2.44	26.47	8.13	5.67	6.86	26.36	13.39
% Brachycentridae	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Chironomidae	66.46	33.09	65.85	46.81	52.00	20.93	35.43
% Ephemerellidae	0.00	1.47	0.81	6.38	0.00	4.65	0.79
% Hydropsychidae	0.61	0.74	1.63	1.42	0.57	1.55	0.00
% Odonata	0.00	0.74	0.00	0.71	0.00	0.00	0.00
% Perlidae	9.15	9.56	4.88	1.42	0.00	5.43	7.09
% Pteronarcyidae	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Simuliidae	0.00	2.21	1.63	0.00	1.14	1.55	0.00

Stream	Sourlands Streams	Sourlands Streams	Sourlands Streams	Sourlands Streams	Sourlands Streams	Sourlands Streams	Sourlands Streams
Site	**1-Back Br. @ Manner Rd.**	**2-Furmans Br.**	**3-Back Br. @ Unionville Winery**	**4-Bedens Br. @ Aunt Molly Rd.**	**5-Hopewell Boro Park**	**6-Graf property-headwaters of Bedens Br.**	**7-Rock Br. mainstem in Park**
Date	**05-12-2005**	**05-12-2005**	**05-12-2005**	**05-12-2005**	**05-12-2005**	**05-12-2005**	**05-13-2005**
Percent Subsampled	**1.04**	**1.57**	**2.08**	**3.13**	**0.26**	**1.04**	**2.08**
Device	**10kicks-500um net**	**10kicks-500um net**	**10kicks-500um net**	**10kicks-500um net**	**10kicks-500um net**	**10kicks-500um net**	**10kicks-500um net**
Habitat							
EcoAnalysts Sample ID	**10**	**11**	**12**	**13**	**14**	**15**	**16**
Functional Group Composition							
% Filterers	0.61	5.15	4.07	1.42	1.71	15.50	3.94
% Gatherers	78.66	69.12	76.42	92.91	98.29	60.47	61.42
% Predators	17.07	11.03	8.13	3.55	0.00	9.30	14.17
% Scrapers	2.44	4.41	4.88	0.71	0.00	1.55	6.30
% Shredders	0.00	9.56	4.88	0.71	0.00	13.18	12.60
% Piercer-Herbivores	1.22	0.00	0.00	0.71	0.00	0.00	1.57
% Unclassified	0.00	0.74	1.63	0.00	0.00	0.00	0.00
Filterer Richness	1.00	3.00	3.00	1.00	2.00	3.00	1.00
Gatherer Richness	5.00	8.00	4.00	6.00	4.00	5.00	6.00
Predator Richness	3.00	3.00	2.00	4.00	0.00	4.00	3.00
Scraper Richness	2.00	2.00	1.00	1.00	0.00	1.00	2.00
Shredder Richness	0.00	2.00	1.00	1.00	0.00	3.00	1.00
Piercer-Herbivore Richness	1.00	0.00	0.00	1.00	0.00	0.00	1.00
Unclassified	0.00	1.00	2.00	0.00	0.00	0.00	0.00
Diversity/Evenness Measures							
Shannon-Weaver H' (log 10)	0.59	0.89	0.60	0.64	0.44	0.95	0.89
Shannon-Weaver H' (log 2)	1.95	2.95	2.01	2.14	1.48	3.16	2.97
Shannon-Weaver H' (log e)	1.35	2.04	1.39	1.49	1.02	2.19	2.06
Margalef's Richness	1.14	1.98	1.38	1.54	0.45	1.59	1.49
Pielou's J'	0.54	0.69	0.54	0.56	0.57	0.79	0.78
Simpson's Heterogeneity	0.54	0.80	0.55	0.67	0.58	0.85	0.82
Biotic Indices							
% Indiv. w/ HBI Value	92.07	98.53	98.37	99.29	100.00	98.45	100.00
Hilsenhoff Biotic Index	5.44	4.30	5.07	5.74	6.21	4.11	4.54
% Indiv. w/ MTI Value	1.22	5.88	1.63	33.33	39.43	10.08	12.60
Metals Tolerance Index	6.00	3.38	4.00	4.96	4.97	3.00	4.63
% Indiv. w/ FSBI Value	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Indiv. w/ TPM Value	82.32	61.76	84.55	58.87	54.86	49.61	62.99
Temp. Pref. Metric - average	2.25	3.26	3.85	3.00	3.33	3.69	2.86
TPM - weighted average	5.27	5.85	5.42	5.30	5.01	6.25	6.11
Karr BIBI Metrics							
Long-Lived Taxa Richness	2.00	2.00	2.00	1.00	1.00	0.00	1.00
Clinger Richness	7.00	11.00	11.00	8.00	4.00	10.00	9.00
% Clingers	20.73	57.35	33.33	18.44	9.71	67.44	51.18
Intolerant Taxa Richness	1.00	6.00	4.00	3.00	0.00	5.00	4.00
% Tolerant Individuals	0.01	0.02	0.00	0.02	0.00	0.05	0.03
% Tolerant Taxa	8.33	10.53	0.00	7.14	0.00	6.25	14.29
Coleoptera Richness	2.00	1.00	3.00	1.00	1.00	0.00	1.00
UIN	**927-10**	**927-11**	**927-12**	**927-13**	**927-14**	**927-15**	**927-16**

Princeton Hydro Benthos 06					
EcoAnalysts, Inc.					
Data are adjusted for subsampling					
Stream	**Sourlands Streams**	**Sourlands Streams**	**Sourlands Streams**	**Sourlands Streams**	**Sourlands Streams**
Site	**8-Rock Br. headwaters on Clarke property**	**9-Cattail Br.-Bromley property**	**10-mainstem Stony Br.**	**11-W. Stony Br. headwaters, Feryok prope**	**12-Stony Br. in preserve**
Date	**05-12-2005**	**05-13-2005**	**05-12-2005**	**05-12-2005**	**05-12-2005**
Percent Subsampled	**4.17**	**6.25**	**1.56**	**6.25**	**3.33**
Device	**10kicks-500um net**	**10kicks-500um net**	**10kicks-500um net**	**10kicks-500um net**	**10kicks-500um net**
Habitat					
EcoAnalysts Sample ID	**17**	**18**	**19**	**20**	**21**
Abundance Measures					
Corrected Abundance	2880.00	2432.00	7680.00	1840.00	4140.00
EPT Abundance	1728.00	816.00	4352.00	944.00	1740.00
Dominance Measures					
Dominant Taxon	Chironomidae	Chironomidae	Baetidae	Baetidae	Chironomidae
Dominant Abundance	672.00	1328.00	3520.00	736.00	1770.00
2nd Dominant Taxon	Philopotamidae	Nemouridae	Chironomidae	Chironomidae	Taeniopterygidae
2nd Dominant Abundance	504.00	176.00	2112.00	496.00	600.00
3rd Dominant Taxon	Nemouridae	Baetidae	Naididae	Naididae	Perlodidae
3rd Dominant Abundance	360.00	160.00	576.00	208.00	420.00
% Dominant Taxon	23.33	54.61	45.83	40.00	42.75
% 2 Dominant Taxa	40.83	61.84	73.33	66.96	57.25
% 3 Dominant Taxa	53.33	68.42	80.83	78.26	67.39
Richness Measures					
Species Richness	17.00	23.00	17.00	15.00	19.00
EPT Richness	9.00	14.00	9.00	6.00	9.00
Ephemeroptera Richness	2.00	3.00	3.00	3.00	1.00
Plecoptera Richness	5.00	5.00	4.00	2.00	5.00
Trichoptera Richness	2.00	6.00	2.00	1.00	3.00
Chironomidae Richness	1.00	1.00	1.00	1.00	1.00
Oligochaeta Richness	1.00	1.00	2.00	1.00	2.00
Non-Chiro. Non-Olig. Richness	15.00	21.00	14.00	13.00	16.00
Rhyacophila Richness	0.00	1.00	0.00	0.00	0.00
Community Composition					
% Ephemeroptera	15.83	14.47	48.33	42.61	0.72
% Plecoptera	24.17	11.84	5.83	7.83	36.96
% Trichoptera	20.00	7.24	2.50	0.87	4.35
% EPT	60.00	33.55	56.67	51.30	42.03
% Coleoptera	10.83	5.26	5.00	6.09	2.17
% Diptera	24.17	57.89	27.50	30.43	43.48
% Oligochaeta	0.83	0.66	8.33	11.30	7.97
% Baetidae	7.50	6.58	45.83	40.00	0.00
% Brachycentridae	0.00	0.00	0.00	0.00	0.00
% Chironomidae	23.33	54.61	27.50	26.96	42.75
% Ephemerellidae	8.33	0.00	0.00	0.87	0.00
% Hydropsychidae	2.50	1.32	0.83	0.87	1.45
% Odonata	0.83	0.66	0.83	0.00	0.72
% Perlidae	0.83	1.32	3.33	6.96	0.72
% Pteronarcyidae	0.00	0.00	0.00	0.00	0.00
% Simuliidae	0.00	0.00	0.00	1.74	0.00

Stream	Sourlands Streams	Sourlands Streams	Sourlands Streams	Sourlands Streams	Sourlands Streams
Site	**8-Rock Br. headwaters on Clarke property**	**9-Cattail Br.-Bromley property**	**10-mainstem Stony Br.**	**11-W. Stony Br. headwaters, Feryok prope**	**12-Stony Br. in preserve**
Date	**05-12-2005**	**05-13-2005**	**05-12-2005**	**05-12-2005**	**05-12-2005**
Percent Subsampled	**4.17**	**6.25**	**1.56**	**6.25**	**3.33**
Device	**10kicks-500um net**	**10kicks-500um net**	**10kicks-500um net**	**10kicks-500um net**	**10kicks-500um net**
Habitat					
EcoAnalysts Sample ID	**17**	**18**	**19**	**20**	**21**
Functional Group Composition					
% Filterers	21.67	2.63	2.50	3.48	2.90
% Gatherers	50.00	73.03	87.50	83.48	52.90
% Predators	10.83	4.61	5.00	9.57	15.22
% Scrapers	0.83	3.95	2.50	2.61	0.72
% Shredders	16.67	15.79	2.50	0.87	25.36
% Piercer-Herbivores	0.00	0.00	0.00	0.00	1.45
% Unclassified	0.00	0.00	0.00	0.00	1.45
Filterer Richness	3.00	3.00	2.00	3.00	2.00
Gatherer Richness	5.00	5.00	7.00	6.00	6.00
Predator Richness	4.00	4.00	3.00	4.00	5.00
Scraper Richness	1.00	4.00	2.00	1.00	1.00
Shredder Richness	4.00	7.00	3.00	1.00	3.00
Piercer-Herbivore Richness	0.00	0.00	0.00	0.00	1.00
Unclassified	0.00	0.00	0.00	0.00	1.00
Diversity/Evenness Measures					
Shannon-Weaver H' (log 10)	0.99	0.83	0.73	0.77	0.87
Shannon-Weaver H' (log 2)	3.30	2.75	2.44	2.56	2.88
Shannon-Weaver H' (log e)	2.29	1.91	1.69	1.77	2.00
Margalef's Richness	2.01	2.82	1.79	1.86	2.16
Pielou's J'	0.81	0.61	0.60	0.65	0.68
Simpson's Heterogeneity	0.87	0.68	0.70	0.75	0.77
Biotic Indices					
% Indiv. w/ HBI Value	100.00	100.00	100.00	100.00	94.93
Hilsenhoff Biotic Index	3.60	4.53	4.67	4.76	4.47
% Indiv. w/ MTI Value	5.00	5.26	10.00	16.52	8.70
Metals Tolerance Index	2.83	1.13	4.67	4.84	3.50
% Indiv. w/ FSBI Value	0.00	0.00	0.00	0.00	0.00
% Indiv. w/ TPM Value	68.33	73.68	40.00	41.74	81.16
Temp. Pref. Metric - average	3.65	2.61	3.06	3.13	2.79
TPM - weighted average	6.46	5.51	5.46	5.48	6.65
Karr BIBI Metrics					
Long-Lived Taxa Richness	3.00	4.00	2.00	4.00	3.00
Clinger Richness	11.00	13.00	10.00	8.00	9.00
% Clingers	70.83	29.61	60.83	56.52	41.30
Intolerant Taxa Richness	7.00	11.00	6.00	4.00	6.00
% Tolerant Individuals	0.03	0.08	0.01	0.00	0.13
% Tolerant Taxa	5.88	8.70	5.88	0.00	5.26
Coleoptera Richness	2.00	2.00	2.00	3.00	3.00
UIN	**927-17**	**927-18**	**927-19**	**927-20**	**927-21**

TOWNSHIP OF MONTGOMERY
ORDINANCE NO.________

AN ORDINANCE AMENDING AND SUPPLEMENTING CHAPTER XVI, "LAND DEVELOPMENT", OF THE CODE OF THE TOWNSHIP OF MONTGOMERY (1984) COUNTY OF SOMERSET, STATE OF NEW JERSEY, WITH REFERENCE TO SATISFYING THE REQUIREMENTS OF THE NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION REGARDING STORMWATER MANAGEMENT AND SPECIFICALLY SUBSECTION 16-5.2 REGARDING DRAINAGE

BE IT ORDAINED BY THE TOWNSHIP COMMITTEE OF THE TOWNSHIP OF MONTGOMERY, in the County of Somerset and the State of New Jersey, that Chapter XVI, "Land Development", of the Code of the Township of Montgomery (1984) is hereby amended and supplemented as follows:

SECTION 1. Amend Section 16-5.2, entitled "Drainage", of the Code of the Township of Montgomery (1984) to read in its entirety as follows:

"16-5.2 STORMWATER MANAGEMENT & GRADING.

A. **Policy Statement.**

Flood control, groundwater recharge, and pollutant reduction shall be accomplished to the maximum extent practicable through the use of nonstructural Best Management Practices or Low Impact Development (LID) before relying on structural Best Management Practices (BMPs). Nonstructural strategies include both environmentally sensitive site design and source controls that prevent pollutants from being placed on the site or from being exposed to stormwater. Source control plans should be developed based upon physical site conditions and the origin, nature, and the anticipated quantity or amount of potential pollutants. When using structural BMPs, multiple stormwater management measures, smaller in size and distributed spatially throughout the land development site, shall be used wherever possible to achieve the performance standards for water quality, quantity and groundwater recharge established through this ordinance before relying on a single, larger stormwater management measure to achieve these performance standards. Nonstructural and structural management strategies should be used together on site development projects. Maintenance plans must be provided for structural best management practices.

B. **Purpose.**

It is the purpose of this ordinance to establish minimum stormwater management requirements and controls for “major development,” as defined in Section 16-5.2 E. herein below as well as grading requirements for all development.

C. **Applicability.**

1. This ordinance relative to stormwater management shall be applicable to all major and minor site plans and subdivisions for the following “major development,” as defined in Section 16-5.2 E. herein below, that require minor, preliminary or final site plan or subdivision review.

    a. Non-residential major developments (commercial development); and

    b. Aspects of residential major developments that are not pre-empted by the Residential Site Improvement Standards at N.J.A.C. 5:21.

2. This ordinance shall also be applicable to all “major developments” undertaken by Montgomery Township.

3. Subsections 16-5.2 G.7., 16-5.2 O.3.(2), and 16-5.2 O.3.(3) of this Ordinance shall be applicable to the following if deemed to be “minor developments”, as defined in Section 16-5.2 E. herein below:

    a. If an additional 1/4 acre of impervious surface is being proposed on a development site; and/or

    b. If the applicant is seeking subdivision or minor or major site plan approval or approval for “d” variances pursuant to N.J.S.A. 40:55D-70d or for “c” variances for lot coverage.

D. **Compatibility with Other Permit and Ordinance Requirements.**

Development approvals issued for subdivisions and major and minor site plans pursuant to this ordinance are to be considered an integral part of development approvals under the subdivision and major and minor site plan review process and do not relieve the applicant of the responsibility to secure required permits or approvals for activities regulated by any other applicable code, rule, act, or ordinance. In their interpretation and application, the provisions of this ordinance shall be held to be the minimum requirements for the promotion of the public health, safety, and general welfare. This ordinance is not intended to interfere with, abrogate, or annul any other ordinances, rule or regulation, statute, or other provision of law except that, where any provision of this ordinance imposes restrictions different from those imposed by any other ordinance, rule or regulation, or other provision of law, the more restrictive provisions or higher standards shall control.

E. **Definitions.**

Unless specifically defined below, words or phrases used in this ordinance shall be interpreted so as to give them the meaning they have in common usage and to give this ordinance its most reasonable application. The definitions below are applicable to this section of the Land Development Ordinance.

"*Compaction*" means the increase in soil bulk density.

"*Core*" means a pedestrian-oriented area of commercial and civic uses serving the surrounding municipality, generally including housing and access to public transportation.

"*County review agency*" means an agency designated by the County Board of Chosen Freeholders to review municipal stormwater management plans and implementing ordinance(s). The county review agency may either be:

A county planning agency; or

A county water resource association created under N.J.S.A 58:16A-55.5, if the ordinance or resolution delegates authority to approve, conditionally approve, or disapprove municipal stormwater management plans and implementing ordinances.

"*Department*" means the New Jersey Department of Environmental Protection.

"*Designated Center*" means a State Development and Redevelopment Plan Center as designated by the State Planning Commission such as urban, regional, town, village, or hamlet.

"*Design engineer*" means a person professionally qualified and duly licensed in New Jersey to perform engineering services that may include, but not necessarily be limited to, development of project requirements, creation and development of project design and preparation of drawings and specifications.

"*Design permeability*" means the tested permeability rate with a factor of safety of two (2) applied to it (for example, if the field tested permeability rate of the soils is 10 inches per hour, the design rate would be 5 inches per hour).

"*Development*" means the division of a parcel of land into two or more parcels, the construction, reconstruction, conversion, structural alteration, relocation or enlargement of any building or structure, any mining excavation or landfill, and any use or change in the use of any building or other structure, or land or extension of use of land, by any person, for which permission is required under the Municipal Land Use Law, N.J.S.A. 40:55D-1 et seq. In the case of development of agricultural lands, development means: any activity that requires a State permit, any activity reviewed by the County Agricultural Board (CAB) and the State Agricultural Development Committee (SADC), and municipal review of any activity not exempted by the Right to Farm Act , N.J.S.A 4:1C-1 et seq.

"*Drainage area*" means a geographic area within which stormwater, sediments, or dissolved materials drain to a particular receiving waterbody or to a particular point along a receiving waterbody.

"*Environmentally critical areas*" means an area or feature which is of significant environmental value, including but not limited to: stream corridors; natural heritage priority sites; habitat of endangered or threatened species; large areas of contiguous open space or upland forest; steep slopes; well head protection and groundwater recharge areas; freshwater wetlands; transition areas; 100-year flood plains; and hydric soils as defined in Section 16-6.4 G. of the ordinance. Habitats of endangered or threatened species are identified using the Department's Landscape Project as approved by the Department's Endangered and Nongame Species Program.

"*Erosion*" means the detachment and movement of soil or rock fragments by water, wind, ice or gravity.

"*Exception*" means the approval by the approving authority of a variance or other material departure from strict compliance with any section, part, phrase or provision of this ordinance. An exception may be granted only under certain specific narrowly-defined conditions set forth in this ordinance.

"*Groundwater*" means water below the land surface in a zone of saturation.

"*Groundwater mounding analysis*" means an analysis performed to demonstrate that the groundwater below a stormwater infiltration basin will not rise up and encroach upon the unsaturated zone and break the surface of the ground at the infiltration area or downslope, thereby creating an overland flow situation or drainage problem. ModFlow® or any ground water mounding analysis program may be used as long as the input parameters and the method of analysis consider all of the significant hydraulic conditions of the site.

"*Heavy Equipment*" means equipment that exerts pressure on the ground in excess of eight pounds per square inch.

"*Impervious surface*" means a surface that has been covered with a layer of material so that it is highly resistant to infiltration by water and has a CN value equal or greater than 76 for hydrologic soil group A, equal or greater than 85 for hydrologic soil group B, equal or greater than 89 for hydrologic soil group C and equal or greater than 91 for hydrologic group D.

"*Infiltration*" is the process by which water seeps into the soil from precipitation.

"*Low impact development*" means a stormwater management measure, strategy or combination of strategies to reduce the negative stormwater runoff impacts through such practices as minimizing site disturbance, preserving natural site features, reducing impervious cover, disconnecting impervious cover, flattening slopes, utilizing native vegetation, minimizing turf grass lawns, maintaining natural drainage features, maintaining natural drainage characteristics, controlling stormwater runoff closer to the source, and controlling stormwater pollutants closer to the source. The term "nonstructural best management measure" has the same meaning as "low impact development".

"*Major development*" means any "development" that provides for ultimately disturbing one or more acres of land or increasing impervious coverage by more than one quarter acre or 10,890 square feet. Disturbance for the purpose of this rule is the placement of impervious surface or exposure and/or movement of soil or bedrock or clearing, cutting, or removing of vegetation.

"*Minor development*" means all development other than major development.

"Mitigation" means acts necessary to compensate for conditions that may result from development where the applicant has demonstrated the inability of strict compliance to the stormwater management regulations and an exception from strict compliance is granted by Montgomery Township.

"*Municipality*" means any city, borough, town, township, or village.

"*Node*" means an area designated by the State Planning Commission concentrating facilities and activities which are not organized in a compact form.

"*Nonpoint Source*" or "NPS" means:

1. Any human-created activity, factor, or condition, other than a point source, from which pollutants may be discharged.

2. Any activity, factor or condition, other than point source that may contribute to water pollution.

3. Any human-created activity, factor or condition, other than a point source, that may temporarily or permanently change any chemical, physical, biological, or radiological characteristic of the waters of the State of New Jersey from what was or is the natural, pristine condition of such waters, or may increase the degree of such change.

"*Nonstructural best management measure (BMP)*" means a stormwater management measure, strategy or combination of strategies to reduce the negative stormwater runoff impacts through such practices as minimizing site disturbance, preserving natural site features, reducing impervious cover, disconnecting impervious cover, flattening slopes, utilizing native vegetation, minimizing turf grass lawns, maintaining natural drainage features, maintaining natural drainage characteristics, controlling stormwater runoff closer to the source, and controlling stormwater pollutants closer to the source. The term “low impact development” has the same meaning as “nonstructural best management measure”.

“*Nutrient*” means a chemical element or compound, such as nitrogen or phosphorus, which is essential to and promotes the development of organisms.

“*Person*” means any individual, corporation, company, partnership, firm, association, Montgomery Township, or political subdivision of this State subject to municipal jurisdiction pursuant to the Municipal Land Use Law , N.J.S.A. 40:55D-1 et seq.

“*Permeability”* means the rate at which water moves through a saturated unit area of soil or rock material at a hydraulic gradient of one, determined as prescribed in N.J.A.C. 7:9A-6.2 (Tube Permeameter Test), N.J.A.C. 6.5 (Pit Bailing Test) or N.J.A.C. 6.6 (Piezometer Test). The Soil Permeability Class Rating Test Alternative per N.J.A.C. 7:9A-6.3 and the Percolation Test per N.J.A.C. 7:9A-6.4 are not acceptable tests for establishing permeability rates for the purposes of complying with this ordinance. See Section 16-5.2.N. of this ordinance.

“Permeable” means having a permeability of one (1) inch per hour or faster. The terms “permeable rock” and “permeable soil” shall be construed accordingly.

“Point source” means any discernible and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel, floating craft, from which pollutants may be discharged. The term does not include flows from irrigated agriculture.

“*Pollutant*” means any dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, refuse, oil, grease, sewage sludge, munitions, chemical wastes, biological materials, medical wastes, radioactive substance (except those regulated under the Atomic Energy Act of 1954, as amended (42 U.S.C. 2011 et seq.), thermal waste, wrecked or discarded equipment, rock, sand, cellar dirt, industrial, municipal, agricultural, and construction waste or runoff, or other residue discharged directly or indirectly to the land, ground waters or surface waters of the State, or to a domestic treatment works. “Pollutant” includes both hazardous and nonhazardous pollutants.

“*Recharge*” means the amount of water from precipitation that infiltrates into the ground and is not evapotranspired.

“*Sediment*” means solid material, mineral or organic, that is in suspension, is being transported, or has been moved from its site of origin by air, water or gravity as a product of erosion.

"*Seasonal high water table*" means the upper limit of the shallowest zone of saturation which occurs in the soil, identified as prescribed in N.J.A.C. 7:9A-5.8.

"*Sensitive receptor*" means a specific area or natural feature that will be sensitive to a stormwater impact.

"*Site*" means the lot or lots upon which a major development is to occur or has occurred.

"*Soil*" means all unconsolidated mineral and organic material of any origin.

"*State Development and Redevelopment Plan Metropolitan Planning Area (PA1)*" means an area delineated on the State Plan Policy Map and adopted by the State Planning Commission that is intended to be the focus for much of the state's future redevelopment and revitalization efforts.

"*State Plan Policy Map*" is defined as the geographic application of the State Development and Redevelopment Plan's goals and statewide policies, and the official map of these goals and policies.

"*Stormwater*" means water resulting from precipitation (including rain and snow) that runs off the land's surface, is transmitted to the subsurface, or is captured by separate storm sewers or other sewage or drainage facilities, or conveyed by snow removal equipment.

"*Stormwater runoff*" means water flow on the surface of the ground or in storm sewers, resulting from precipitation.

"*Stormwater management basin*" means an excavation or embankment and related areas designed to retain stormwater runoff. A stormwater management basin may either be normally dry (that is, an extended detention basin or an infiltration basin), retain water in a permanent pool (a retention basin or wet pond), or be planted mainly with wetland vegetation (constructed stormwater wetlands).

"*Stormwater management measure*" means any structural or nonstructural strategy, practice, technology, process, program, or other method intended to control or reduce stormwater runoff and associated pollutants, or to induce or control the infiltration or groundwater recharge of stormwater or to eliminate illicit or illegal non-stormwater discharges into stormwater conveyances.

"*Urban Redevelopment Area*" is defined as previously developed portions of areas:

1. Delineated on the State Plan Policy Map (SPPM) as the Metropolitan Planning Area (PA1), Designated Centers, Cores or Nodes;

2. Designated as CAFRA Centers, Cores or Nodes;

3. Designated as Urban Enterprise Zones; and

4. Designated as Urban Coordinating Council Empowerment Neighborhoods.

"*Waters of the State*" means the ocean and its estuaries, all springs, streams, wetlands, and bodies of surface or ground water, whether natural or artificial, within the boundaries of the State of New Jersey or subject to its jurisdiction.

"*Wetlands*" or "*wetland*" means an area that is inundated or saturated by surface water or ground water at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation.

F. **General Design and Performance Standards for Stormwater Management Measures.**

1. Stormwater management measures for major development and redevelopment shall be developed by incorporating nonstructural (low impact design) measures found in Subsection 16-5.2 G.5. in order to meet to meet the erosion control, groundwater recharge, stormwater runoff quantity, and stormwater runoff quality standards in Section 16-5.2 H. of this ordinance. As set forth in Subsection 16-5.2 G.5, the applicant shall provide the Nonstructural Stormwater Management Strategies Point System (NSPS) to demonstrate that sufficient low impact design strategies have been incorporated into the design. If the NSPS fails to demonstrate compliance, the applicant shall demonstrate compliance through additional means such as the Low Impact Development (LID) checklist.

2. The standards in this ordinance apply only to new major development and redevelopment and are intended to minimize the impact of stormwater runoff on water quality and water quantity in receiving water bodies and maintain groundwater recharge. The standards do not apply to new major development and redevelopment to the extent that alternative design and performance standards are applicable under a regional stormwater management plan or Water Quality Management Plan adopted in accordance with Department rules.

G. **Stormwater Management Requirements.**

1. The development shall incorporate a maintenance plan for the stormwater management measures incorporated into the design of a major development in accordance with Section 16-5.2 O. of this ordinance.

2. Stormwater management measures shall avoid adverse impacts of concentrated flow on habitat for threatened and endangered species as documented in the Department’ Landscape Project or Natural Heritage Database established under N.J.S.A. 13:1B-15.147 through 15.150, particularly *Helonias bullata* (swamp pink) and/or *Clemmys muhlnebergi* (bog turtle).

3. The following linear development projects are exempt from the groundwater recharge, stormwater runoff quantity, and stormwater runoff quality requirements of Subsections 16-5.2 G.6. (Recharge & Runoff Quantity) and 16-5.2 G.7.(Runoff Water Quality):

   a. The construction of an underground utility line provided that the disturbed areas are revegetated upon completion;

   b. The construction of an aboveground utility line provided that the existing conditions are maintained to the maximum extent practicable; and

   c. The construction of a public pedestrian access, such as a sidewalk or trail with a maximum width of 14 feet, provided that the access is made of permeable material.

4. A waiver from strict compliance from the groundwater recharge, stormwater runoff quantity, and stormwater runoff quality requirements of Subsections 16-5.2 G.6. (Recharge & Runoff Quantity) and 16-5.2 G.7 (Runoff Water Quality) may be obtained for the enlargement of an existing public roadway or railroad, or the construction or enlargement of a public pedestrian access, provided that the following conditions are met:

   a. The applicant demonstrates that there is a public need for the project that cannot be accomplished by any other means;

   b. The applicant demonstrates through an alternative analysis, that through the use of nonstructural and structural stormwater management strategies and measures, the option selected complies with the requirements of Subsections 16-5.2 G.6. (Recharge & Runoff Quantity) and 16-5.2 G.7 (Runoff Water Quality) to the maximum extent practicable;

   c. The applicant demonstrates that, in order to meet the requirements of Subsections 16-5.2 G.6. (Recharge & Runoff Quantity) and 16-5.2 G.7 (Runoff Water Quality), existing structures currently in use, such as homes and buildings, would need to be condemned; and

d. The applicant demonstrates that it does not own or have other rights to areas, including the potential to obtain through condemnation lands not falling under Subsection 16-5.2 G.4.c. above within the upstream drainage area of the receiving stream that would provide additional opportunities to mitigate the requirements of Subsections 16-5.2 G.6. (Recharge & Runoff Quantity) and 16-5.2 G.7 (Runoff Water Quality) that were not achievable on-site.

5. Nonstructural Stormwater Management Strategies (Low Impact Design).

a. The standards in Subsections 16-5.2 G.6. (Recharge & Runoff Quantity) and 16-5.2 G.7 (Runoff Water Quality) shall be met by incorporating nonstructural stormwater management (low impact design) strategies set forth at Subsection 16-5.2 G.5.b into the design to the maximum extent possible.

(1) A total of nine (9) strategies are to be used to meet the groundwater recharge, stormwater quality, and stormwater quantity requirements prior to utilizing structural stormwater management measures.

(2) The applicant shall provide the New Jersey Nonstructural Stormwater Management Strategies Point System (NSPS) created by the New Jersey Department of Environmental Protection *as it may be amended from time to time* and currently found on the web site www.nj.gov/dep/stormwater to identify the nonstructural measures incorporated into the design of the project and to assist the reviewing board in determining that the strategies have been used to the "maximum extent practicable".

(3) If the Nonstructural Stormwater Management Strategies Point System (NSPS) demonstrates that sufficient nonstructural stormwater management measures have been utilized at a major development, no further proof of compliance with the maximum extent practicable requirement shall be required.

(4) However, if the NSPS fails to demonstrate such compliance, such a result shall not be used to disapprove any municipal development application sought by a proposed major development. Instead, the applicant for such approval will be required to demonstrate compliance through other and/or additional means.

(5) This includes the Low Impact Development (LID) Checklist contained in Appendix A of the New Jersey Stormwater Best Management Practices Manual *as it may be amended from time to time*, which includes a rigorous alternatives analysis for each non structural measure.

(6) Finally, it should be noted that the NSPS is not presently intended for use on roadway construction, improvement, and other linear development projects. As a result, other means, including the LID Checklist, should be used for linear development projects.

b. Nonstructural stormwater management strategies incorporated into site design shall:

(1) Protect areas that provide water quality benefits or areas particularly susceptible to erosion and sediment loss;

(2) Minimize impervious surfaces and break up or disconnect the flow of runoff over impervious surfaces;

(3) Maximize the protection of natural drainage features and vegetation;

(4) Minimize the decrease in the “time of concentration” from pre-construction to post construction. “Time of concentration” is defined as the time it takes for runoff to travel from the hydraulically most distant point of the watershed to the point of interest within a watershed;

(5) Minimize land disturbance including clearing and grading;

(6) Minimize soil compaction;

(7) Provide low-maintenance landscaping that encourages retention and planting of native vegetation and minimizes the use of lawns, fertilizers and pesticides;

(8) Provide vegetated open-channel conveyance systems discharging into and through stable vegetated areas;

(9) Provide other source controls to prevent or minimize the use or exposure of pollutants at the site, in order to prevent or minimize the release of those pollutants into stormwater runoff. Such source controls include, but are not limited to:

(a) Site design features that help to prevent accumulation of trash and debris in drainage systems, including features that satisfy Subsection 16-5.2 G.5.c. below;

(b) Site design features that help to prevent discharge of trash and debris from drainage systems;

(c) Site design features that help to prevent and/or contain spills or other harmful accumulations of pollutants at industrial or commercial developments; and

(d) When establishing vegetation after land disturbance, applying fertilizer in accordance with the requirements established under the Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 et seq., and implementing rules.

These strategies are implemented through a variety of non-structural stormwater management measures. When properly integrated into the site design, these nonstructural measures can be effective in reducing development-induced increases in runoff volumes, rates, pollutant loads, and concentrations. The New Jersey Stormwater Best Management Practices (BMP) Manual contains guidelines for the design of individual nonstructural measures.

c. Site design features identified under Subsection 16-5.2 G.5.b.(9)(b) above shall comply with the following standard to control passage of solid and floatable materials through storm drain inlets. For purposes of this paragraph, “solid and floatable materials” means sediment, debris, trash, and other floating, suspended, or settleable solids. For exemptions to this standard, see Subsection 16-5.2 G.5.c.(3) below.

(1) Design engineers shall use either of the following grates whenever they use a grate in pavement or another ground surface to collect stormwater from

that surface into a storm drain or surface water body under that grate:

(a) The New Jersey Department of Transportation (NJDOT) bicycle safe grate, which is described in Chapter 2.4 of the NJDOT Bicycle Compatible Roadways and Bikeways Planning and Design Guidelines (April 1996); or

(b) A different grate, if each individual clear space in that grate has an area of no more than seven (7.0) square inches, or is no greater than 0.5 inches across the smallest dimension.

Examples of grates subject to this standard include grates in grate inlets, the grate portion (non-curb-opening portion) of combination inlets, grates on storm sewer manholes, ditch grates, trench grates, and grates of spacer bars in slotted drains. Examples of ground surfaces include surfaces of roads (including bridges), driveways, parking areas, bikeways, plazas, sidewalks, lawns, fields, open channels, and stormwater basin floors.

(2) Whenever design engineers use a curb-opening inlet, the clear space in that curb opening (or each individual clear space, if the curb opening has two or more clear spaces) shall have an area of no more than seven (7.0) square inches, or be no greater than two (2.0) inches across the smallest dimension.

(3) This standard does not apply:

(a) Where the review agency determines that this standard would cause inadequate hydraulic performance that could not practicably be overcome by using additional or larger storm drain inlets that meet these standards;

(b) Where flows from the water quality design storm as specified in Subsection 16-5.2 H.2. are conveyed through any device (e.g., end of pipe netting facility, manufactured treatment device, or a catch basin hood) that is designed, at a minimum, to prevent delivery of all solid and floatable materials that could not pass through one of the following:

(i) A rectangular space four and five-eighths inches long and one and one-half inches wide (this option does not apply for outfall netting facilities); or

(ii) A bar screen having a bar spacing of 0.5 inches.

(c) Where flows are conveyed through a trash rack that has parallel bars with one-inch (1”) spacing between the bars, to the elevation of the water quality design storm as specified in Subsection 16-5.2 H.2..; or

(d) Where the New Jersey Department of Environmental Protection determines, pursuant to the New Jersey Register of Historic Places Rules at N.J.A.C. 7:4-7.2(c), that action to meet this standard is an undertaking that constitutes an encroachment or will damage or destroy the New Jersey Register listed historic property.

(4) Any land area used as a nonstructural stormwater management measure to meet the performance standards in Subsections 16-5.2 G.6. and 16-5.2 G.7. shall be dedicated to a government agency, subjected to a conservation deed restriction filed with the appropriate County Clerk’s office, or subject to an approved equivalent restriction that ensures that the non structural measure approved by the reviewing agency is maintained in perpetuity. The applicant must provided proof of the filing (receipt) of the conservation deed restriction with the County prior to final approval of the subdivision or site plan by the Township Engineer.

(5) Guidance for nonstructural stormwater management strategies is available in the New Jersey Stormwater Best Management Practices Manual. The BMP Manual may be obtained from the address identified in Section 16-5.2 K., or found on the Department’s website at www.njstormwater.org.

6. Erosion Control, Groundwater Recharge and Runoff Quantity Standards.

a. This subsection contains minimum design and performance standards to control erosion, encourage and control infiltration and groundwater recharge, and control stormwater runoff quantity impacts of major development.

(1) The minimum design and performance standards for erosion control are those established under the Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 et seq. and implementing rules.

(2) The minimum design and performance standards for groundwater recharge are as follows:

(a) The design engineer shall, using the assumptions and factors for stormwater runoff and groundwater recharge calculations at Section 16-5.2 H., either:

(i) Demonstrate through hydrologic and hydraulic analysis that the site and its stormwater management measures maintain 100 percent of the average annual pre-construction groundwater recharge volume for the site; or

(ii) Demonstrate through hydrologic and hydraulic analysis that the increase of stormwater runoff volume from pre-construction to post-construction for the 2-year storm is infiltrated.

(b) This groundwater recharge requirement does not apply to projects within the “urban redevelopment area,” or to projects subject to Subsection 16-5.2 G.6.a.(2)(c) below.

(c) The following types of stormwater shall not be recharged:

(i) Stormwater from areas of high pollutant loading:

High pollutant loading areas are areas in industrial and commercial developments where solvents and/or petroleum products are loaded/

unloaded, stored, or applied, areas where pesticides are loaded/unloaded or stored; areas where hazardous materials are expected to be present in greater than "reportable quantities" as defined by the United States Environmental Protection Agency (EPA) at 40 CFR 302.4; areas where recharge would be inconsistent with Department approved remedial action work plan or landfill closure plan and areas with high risks for spills of toxic materials, such as gas stations and vehicle maintenance facilities; and

(ii) Industrial stormwater exposed to "source material":

"Source material" means any material(s) or machinery, located at an industrial facility that is directly or indirectly related to process, manufacturing or other industrial activities, which could be a source of pollutants in any industrial stormwater discharge to ground-water. Source materials include, but are not limited to, raw materials; intermediate products; final products; waste materials; by-products; industrial machinery and fuels, and lubricants, solvents, and detergents that are related to process, manufacturing; or other industrial activities that are exposed to stormwater.

(d) The design engineer shall assess the hydraulic impact on the groundwater table and design the site so as to avoid adverse hydraulic impacts. Potential adverse hydraulic impacts include, but are not limited to, exacerbating a naturally or seasonally high water table so as to cause surficial ponding, flooding of basements, or interference with the proper operation of subsurface sewage disposal systems and other subsurface structures in the vicinity or downgradient of the groundwater recharge area.

(3) In order to control stormwater runoff quantity impacts, the design engineer shall, using the assumptions and factors for stormwater runoff calculations at Section 16-5.2 H., complete one of the following:

(a) Demonstrate through hydrologic and hydraulic analysis that for stormwater leaving the site, post-construction runoff hydrographs for the 2, 10, and 100-year storm events do not exceed, at any point in time, the pre-construction runoff hydrographs for the same storm events;

(b) Demonstrate through hydrologic and hydraulic analysis that there is no increase, as compared to the pre-construction condition, in the peak runoff rates of stormwater leaving the site for the 2, 10, and 100-year storm events and that the increased volume or change in timing of stormwater runoff will not increase flood damage at or downstream of the site. This analysis shall include the analysis of impacts of existing land uses and projected land uses assuming full development under existing zoning and land use ordinances in the drainage area;

(c) Design stormwater management measures so that the post-construction peak runoff rates for the 2, 10 and 100 year storm events are 50, 75 and 80 percent, respectively, of the pre-construction peak runoff rates. The percentages apply only to the post-construction stormwater runoff that is attributable to the portion of the site on which the proposed development or project is to be constructed. The percentages shall not be applied to post-construction stormwater runoff into tidal flood hazard areas if the increased volume of stormwater runoff will not increase flood damages below the point of discharge; or

(d) In tidal flood hazard areas, stormwater runoff quantity analysis in accordance with Subsections 16-5.2 G.6.a.(3)(a), (b) and (c) above shall only be applied if the increased volume of stormwater runoff could increase flood damages below the point of discharge.

b. Any application for a new agricultural development that meets the definition of major development at Section 16-5.2 E. shall be submitted to the appropriate Soil Conservation District for review and approval in accordance with the requirements of this section and any applicable Soil Conservation District guidelines for stormwater runoff quantity and erosion control. For the purposes of this section, “agricultural development” means land uses normally associated with the production of food, fiber and livestock for sale. Such uses do not include the development of land for the processing or sale of food and the manufacturing of agriculturally related products.

7. Stormwater Runoff Quality Standards.

a. Stormwater management measures shall be required for water quality control for the following:

(1) If an additional 1/4 acre of impervious surface is being proposed on a development site; and/or

(2) If the applicant is seeking subdivision or minor or major site plan approval or approval for “d” variances pursuant to N.J.S.A. 40:55D-70d or for “c” variances for lot coverage.

b**.** Stormwater management runoff quality measures shall be designed to reduce the post-construction load of total suspended solids (TSS) in stormwater runoff by 80 percent of the anticipated load from the developed site, expressed as an annual average. The calculations shall follow Section 16-5.2 H. of this ordinance.

c. Runoff quality measures shall also include the calculation of the removal rate of phosphorus and nitrogen expressed as an annual average, from the proposed best management practice. In achieving reduction of nutrients to the maximum extent feasible, the design of the site shall include nonstructural strategies and structural measures that optimize nutrient removal while still achieving the performance standards in Subsections 16-5.2 G.6. and 16-5.2 G.7. The runoff quality calculations for nutrient removal rates shall follow Table 2 in Subsection 16-5.2 H.2.e. of this ordinance.

d. The requirement to reduce TSS does not apply to any stormwater runoff in a discharge regulated under a numeric effluent limitation for TSS imposed under the New Jersey Pollution Discharge Elimination System (NJPDES) rules, N.J.A.C. 7:14A, or in a discharge specifically exempt under a NJPDES permit from this requirement.

e. Additional information and examples are contained in the New Jersey Stormwater Best Management Practices Manual, which may be obtained from the address identified in Section 16-5.2 K.

f. In accordance with the definition of FW1 at N.J.A.C. 7:9B-1.4, stormwater management measures shall be designed to prevent any increase in stormwater runoff to waters classified as FW1.

g. Special water resource protection areas shall be established along all waters designated Category One at N.J.A.C. 7:9B, and perennial or intermittent streams that drain into or upstream of the Category One waters, as shown on the USGS Quadrangle Maps or in the County Soil Surveys, within the associated HUC14 drainage area. These areas shall be established for the protection of water quality, aesthetic value, exceptional ecological significance, exceptional recreational significance, exceptional water supply significance, and exceptional fisheries significance of those established Category One waters. These areas shall be designated and protected as follows:

(1) The applicant shall preserve and maintain a special water resource protection area in accordance with one of the following:

(a) A 300-foot special water resource protection area shall be provided on each side of the waterway, measured perpendicular to the waterway from the top of the bank outwards or from the centerline of the waterway where the bank is not defined, consisting of existing vegetation or vegetation allowed to follow natural succession is provided.

(b) Encroachment within the designated special water resource protection area under Subsection 16-5.2 G.7.g.(1)(a) above shall only be allowed where previous development or disturbance has occurred (for example, active agricultural use, parking area or maintained lawn area).

(c) The encroachment shall only be allowed where the applicant demonstrates that the functional value and overall condition of the special water resource protection area will be maintained to the maximum extent practicable.

(d) In no case shall the remaining special water resource protection area be reduced to less than 150 feet as measured perpendicular to the top of bank of the waterway or centerline of the waterway where the bank is undefined.

(e) All encroachments proposed under this subparagraph shall be subject to review and approval by the Department.

(2) All stormwater shall be discharged outside of and flow through the special water resource protection area and shall comply with the Standard for Off-Site Stability in the "Standards For Soil Erosion and Sediment Control in New Jersey," established under the Soil Erosion and Sediment Control Act , N.J.S.A. 4:24-39 et seq.

(3) If stormwater discharged outside of and flowing through the special water resource protection area cannot comply with the Standard For Off-Site Stability in the "Standards for Soil Erosion and Sediment Control in New Jersey," established under the Soil Erosion and Sediment Control Act , N.J.S.A. 4:24-39 et seq., then the stabilization measures in accordance with the requirements of the above standards may be placed within the special water resource protection area, provided that:

(a) Stabilization measures shall not be placed within 150 feet of the Category One waterway;

(b) Stormwater associated with discharges allowed by this section shall achieve a 95 percent TSS post-construction removal rate;

(c) Temperature shall be addressed to ensure no impact on the receiving waterway;

(d) The encroachment shall only be allowed where the applicant demonstrates that the functional value and overall condition of the special water resource protection area will be maintained to the maximum extent practicable;

(e) A conceptual project design meeting shall be held with the appropriate Department staff and Soil Conservation District staff to identify necessary stabilization measures; and

(f) All encroachments proposed under this section shall be subject to review and approval by the Department.

(4) A stream corridor protection plan may be developed by a regional stormwater management planning committee as an element of a regional stormwater management plan, or by a municipality through an adopted municipal stormwater management plan.

(a) If a stream corridor protection plan for a waterway subject to Subsection 16-5.2 G.7.f. has been approved by the Department of Environmental Protection, then the provisions of the plan shall be the applicable special water resource protection area requirements for that waterway.

(b) A stream corridor protection plan for a waterway subject to Subsection 16-5.2 G.7.f. shall maintain or enhance the current functional value and overall condition of the special water resource protection area as defined in Subsection 16-5.2 G.7.g.(1)(a) above.

(c) In no case shall a stream corridor protection plan allow the reduction of the Special Water Resource Protection Area to less than 150 feet as measured perpendicular to the waterway subject to this subsection.

(5) Subsection 16-5.2 G.7.g. (Special Water Resource Protection along Category One Streams) does not apply to the construction of one individual single family dwelling that is not part of a larger development on a lot receiving preliminary or final subdivision approval on or before February 2, 2004, provided that the construction begins on or before February 2, 2009.

H. **Calculation of Stormwater Runoff Rate and Volume, Stormwater Runoff Quality and Groundwater Recharge.**

1. Method of Calculating Stormwater Runoff Rate and Volume.

a. In complying with the Stormwater Runoff Quantity and Rate Standards in Subsection 16-5.2 G.6., the design engineer shall calculate the stormwater runoff rate and volume using the USDA Natural Resources Conservation Service (NRCS) Runoff Equation, Runoff Curve Numbers, and Dimensionless Unit Hydrograph, as described in the NRCS National Engineering Handbook Part 630 – Hydrology and Technical Release 55 – Urban Hydrology for Small Watersheds as amended and supplemented or the Rational Method for peak flow and the Modified Rational Method for hydrograph computations.

b. In calculating stormwater runoff using the NRCS methodology, the design engineer shall separately calculate and then combine the runoff volumes from pervious and directly connected impervious surfaces within each drainage area within the parcel.

c. Calculation of stormwater runoff from unconnected impervious surfaces shall be based, as applicable, upon the Two-Step method described in the current New Jersey Stormwater Best Management Practices Manual or the NRCS methodologyIn calculating stormwater runoff using the NRCS methodology, the design engineer shall use appropriate 24-hour rainfall depths as developed for the project site by the National Oceanic and Atmospheric Administration, available online, at: http://hdsc.nws.noaa.gov/hdsc/pfds/index.html.

d. When calculating stormwater runoff for pre-developed site conditions, the design engineer shall use the following criteria:

(1) When selecting or calculating Runoff Curve Numbers (CNs) for pre-developed project site conditions, the project site's land cover shall be assumed to be woods in good condition. However, another land cover may be used to calculate runoff coefficients if:

(a) Such land cover has existed at the site or portion thereof without interruption for at least five (5) years immediately prior to the time of application; and

(b) The design engineer can document the character and extent of such land cover through the use of photographs, affidavits, and/or other acceptable land use records.

(2) If more than one land cover has existed on the site during the five (5) years immediately prior to the time of application, the land cover with the lowest runoff potential shall be used for the computations.

(3) All pre-developed land covers shall be assumed to be in good hydrologic condition and, if cultivated, shall be assumed to have conservation treatment.

(4) In calculating pre-developed site stormwater runoff, the design engineer shall include the effects of all land features and structures, such as ponds, wetlands, depressions, hedgerows, and culverts, which affect pre-developed site stormwater runoff rates and/or volumes.

(5) Where tailwater will affect the hydraulic performance of a stormwater management measure, the design engineer shall include such effects in the measure's design.

2. Method of Calculating Stormwater Runoff Quality.

a. In complying with the Stormwater Runoff Quality Standards in Subsection 16-5.2 G.7., the design engineer shall calculate the stormwater runoff rate and volume using the USDA Natural Resources Conservation Service (NRCS) Runoff Equation, Runoff

Curve Numbers, and Dimensionless Unit Hydrograph, as described in the NRCS National Engineering Handbook Part 630 – Hydrology and Technical Release 55 – Urban Hydrology for Small Watersheds, as amended and supplemented or the Rational Method for peak flow and the Modified Rational Method for hydrograph computations.

b. The design engineer shall also use the NJDEP Water Quality Design Storm, which is one and one-quarter (1.25) inches of rainfall falling in a nonlinear pattern in two (2) hours. Details of the Water Quality Design Storm are shown in Table 1.

c. Calculation of runoff volumes, peak rates, and hydrographs for the Water Quality Design Storm may take into account the implementation of nonstructural and structural stormwater management measures.

Table 1: Water Quality Design Storm Distribution[1]

Time (minutes)	Cumulative Rainfall (inches)	Time (minutes)	Cumulative Rainfall (inches)
0	0.0000	65	0.8917
5	0.0083	70	0.9917
10	0.0166	75	1.0500
15	0.0250	80	1.0840
20	0.0500	85	1.1170
25	0.0750	90	1.1500
30	0.1000	95	1.1750
35	0.1330	100	1.2000
40	0.1660	105	1.2250
45	0.2000	110	1.2334
50	0.2583	115	1.2417
55	0.3583	120	1.2500
60	0.6250		

[1] Source: N.J.A.C. 7:8-5.5(a).

d. Total Suspended Solids (TSS) Reduction Calculations.

(1) If more than one stormwater BMP in series is necessary to achieve the required eighty percent (80%) TSS reduction for a site, the applicant shall utilize the following formula to calculate TSS reduction:

$R = A + B – (A \times B) / 100$, where:

R = total TSS percent load removal from application of both BMPs;
A = the TSS percent removal rate applicable to the first BMP; and
B = the TSS percent removal rate applicable to the second BMP.

(2) If there is more than one onsite drainage area, the eighty percent (80%) TSS removal rate shall apply to each drainage area, unless the runoff from the subareas converge on site, in which case the removal rate can be demonstrated through a calculation using a weighted average.

e. TSS Removal Rates for Stormwater BMPs.

(1) For purposes of TSS reduction calculations, Table 2 presents the presumed removal rates for certain BMPs designed in accordance with the New Jersey BMP Manual. The BMP Manual may be obtained from the address identified in Section 16-5.2 K. or found on the NJDEP's website at www.njstormwater.org. TSS reduction shall be calculated based on the removal rates for the BMPs in Table 2 below.

(2) Alternative stormwater management measures, removal rates and methods of calculating removal rates may be used if the design engineer provides documentation demonstrating the capability of these alternative rates and methods to Montgomery Township. Any alternative stormwater management measure, removal rate or method of calculating the removal rate shall be subject to approval by Montgomery Township and a copy shall be provided to: The Division of Watershed Management, New Jersey Department of

Environmental Protection, PO Box 418, Trenton, NJ, 08625-0418.

Table 2: Pollutant Removal Rates for BMPs[2]			
Best Management Practice	**TSS Percent Removal Rate**	**Total Phosphorus Percent Removal Rate**	**Total Nitrogen Percent Removal Rate**
Bioretention Systems	**90**	**60**	**30**
Constructed Stormwater Wetland	**90**	**50**	**30**
Extended Detention Basin	**40-60 (final rate based upon detention time; see New Jersey BMP Manual, Chap. 9)**	**20**	**20**
Infiltration basin	**80**	**60**	**50**
Manufactured Treatment Device	**Pollutant removal rates as certified by NJDEP; see Section III.**	**Pollutant removal rates as certified by NJDEP; see Section III.**	**Pollutant removal rates as certified by NJDEP; see Section III.**
Pervious Paving Systems	**80 (porous paving)**	**60**	**50**
	80 (permeable pavers with storage bed)		
	0 - volume reduction only (permeable pavers without storage bed)	**0 - volume reduction only (permeable pavers without storage bed)**	**0 - volume reduction only (permeable pavers without storage bed)**
Sand Filter	**80**	**50**	**35**
Vegetative Filter Strip (For filter strips with multiple vegetated covers, the final TSS removal rate should be based upon a weighted average of the adopted rates shown in Table 2, based upon the relative flow lengths through each cover type.)	**60 (turf grass)**	**30**	**30**
	70 (native grasses, meadow and planted woods)		
	80 (indigenous woods)		
Wet Pond / Retention Basin	**50-90 (final rate based upon pool volume and detention time; see NJ BMP Manual)**	**50**	**30**

[2] Source: 7:8-5.5(c) and New Jersey BMP Manual Chapter 4.

f. Nutrient Removal Rates for Stormwater BMPs.

For purposes of post-development nutrient load reduction calculations, Table 2 presents the presumed removal rates for certain BMPs designed in accordance with the New Jersey BMP Manual. If alternative stormwater BMPs are proposed, the applicant shall demonstrate that the selected BMPs will achieve the nutrient removal standard required in Subsection 16-5.2 G.7**.** of this ordinance.

3. <u>Methods of Calculating Groundwater Recharge</u>.

a. In complying with the groundwater recharge standards contained in Subsection 16-5.2 G.6.a., the design engineer may calculate groundwater recharge in accordance with the New Jersey Groundwater Recharge Spreadsheet (NJGRS) computer program incorporated herein by reference as amended and supplemented. Information regarding the methodology is available from the New Jersey BMP Manual. In accordance with the “Evaluation of Groundwater Resources of Sourland Mountain Region of Central New Jersey” dated November 19, 2004 prepared by Matthew J. Mulhall, P.G., of M^2 Associates and Peter M. Demicco, P.G. of Demicco and Associates. The GSR-32 soil recharge rates used by the recharge spreadsheet shall not be used to assess recharge in the Sourland Mountain region located in Montgomery Township as shown in Figure 2 of the referenced report.

b. Alternative groundwater recharge calculation methods to meet these requirements may be used upon approval by the municipal engineer.

c. In complying with the groundwater recharge standards contained in Subsection 16-5.2 G.6.a.(2), the design engineer shall:

(1) Calculate stormwater runoff volumes in accordance with the USDA Natural Resources Conservation Service (NRCS) methodology, including the NRCS Runoff Equation and Runoff Curve Numbers, as described in the NRCS National Engineering Handbook Part 630 – Hydrology and Technical Release 55 – Urban Hydrology for Small Watersheds as amended and supplemented; and

(2) Use appropriate 2-year, 24-hour rainfall depths as developed for the project site by the National Oceanic and Atmospheric Administration, available

online at:
http://hdsc.nws.noaa.gov/hdsc/pfds/index.html.

d. When calculating groundwater recharge or stormwater runoff for pre-developed site conditions, the design engineer shall use the following criteria:

(1) When selecting land covers or calculating Runoff Curve Numbers (CNs) for pre-developed project site conditions, the project site's land cover shall be assumed to be woods. However, another land cover may be used to calculate runoff coefficients if:

(a) Such land cover has existed at the site or portion thereof without interruption for at least five (5) years immediately prior to the time of application; and

(b) The design engineer can document the character and extent of such land cover through the use of photographs, affidavits, and/or other acceptable land use records.

(2) If more than one land cover, other than woods, has existed on the site during the five (5) years immediately prior to the time of application, the land cover with the lowest runoff potential (including woods) shall be used for the computations. All pre-developed land covers shall be assumed to be in good hydrologic condition and, if cultivated, shall be assumed to have conservation treatment.

I. **Standards for Structural Stormwater Management Measures.**

1. General Design Standards for structural stormwater management measures are as follows:

a. Structural stormwater management measures shall be designed to take into account the existing site conditions, including, for example: environmentally critical areas; wetlands; flood-prone areas; slopes; depth to seasonal high water table; soil type, permeability and texture; drainage area and drainage patterns; and the presence of solution-prone carbonate rocks (limestone).

b. Structural stormwater management measures shall be designed to minimize maintenance, facilitate maintenance and repairs, and ensure proper functioning.

(1) Trash racks shall be installed at the intake to the outlet structure, as appropriate, and shall have parallel bars with one-inch (1”) spacing between the bars to the elevation of the water quality design storm.

(2) For elevations higher than the water quality design storm, the parallel bars at the outlet structure shall be spaced no greater than one-third (1/3) the width of the diameter of the orifice or one-third (1/3) the width of the weir, with a minimum spacing between bars of one-inch and a maximum spacing between bars of six inches.

(3) In addition, the design of trash racks must comply with the requirements of Subsection 16-5.2 L.2.a. of this ordinance.

c. Structural stormwater management measures shall be designed, constructed, and installed to be strong, durable, and corrosion resistant. Measures that are consistent with the relevant portions of the Residential Site Improvement Standards at N.J.A.C. 5:21-7.3, 7.4, and 7.5 shall be deemed to meet this requirement.

d. At the intake to the outlet from the stormwater management basin, the orifice size shall be a minimum of two and one-half (2.5) inches in diameter.

e. Stormwater management basins shall be designed to meet the minimum safety standards for stormwater management basins at Section 16-5.2 L. of this ordinance.

f. Stormwater management basins shall be designed in a manner that complements and mimics the existing natural landscape, including but not limited to the following design strategies:

(1) Use of natural, non-wetland wooded depressions for stormwater runoff storage; and

(2) Establishment of attractive landscaping in and around the basin that mimics the existing vegetation and incorporates native plants.

g. After all construction activities and required field testing have been completed on the development site, as-built plans depicting design and as-built elevations of all stormwater management measures shall be prepared by a Licensed Land Surveyor and submitted to the municipal engineer. Based upon the municipal engineer’s review of the as-built plans, all corrections or remedial actions deemed by the municipal engineer to be necessary due to the failure to comply with the standards established by this ordinance and/or any reasons of public health or safety, shall be completed by the applicant. In lieu of review by the municipal engineer, Montgomery Township reserves the right to engage a Professional Engineer to review the as-built plans. The applicant shall pay all costs associated with such review.

2. Design and Construction Standards for Stormwater Infiltration BMP's.

a. Stormwater infiltration BMP's, such as bioretention systems with infiltration, dry wells, infiltration basins, pervious paving systems with storage beds, and sand filters with infiltration, shall be designed, constructed and maintained to completely drain the total runoff volume generated by the basin's maximum design storm within seventy-two (72) hours after a storm event. Runoff storage for greater times can render the BMP ineffective and may result in anaerobic conditions; odor and both water quality and mosquito breeding problems.

b. Stormwater infiltration BMPs shall be designed, constructed and maintained to provide a minimum separation of at least two (2) feet between the elevation of the lowest point of the bottom of the infiltration BMP and the seasonal high water table.

c. The minimum design permeability rate for the soil within a BMP that relies on infiltration shall be one-half (0.5) inch per hour. A factor of safety of two (2) shall be applied to the soil's field-tested permeability rate to determine the soil's design permeability rate. For example, if the field-tested permeability rate of the soil is four (4) inches per hour, its design permeability rate would be two (2) inches per hour). The minimum design permeability rate for the soil within a stormwater infiltration basin shall also be sufficient to achieve the minimum seventy-two (72) hour drain time described in Subsection 16-5.2 I.2.a. above. The maximum design permeability shall be ten (10) inches per hour.

d. A soil's field tested permeability rate shall be determined in accordance with the following:

(1) The pre-development field test permeability rate shall be determined according to the methodologies provided in Section 16-5.2 N. of this ordinance;

(2) The results of the required field permeability tests shall demonstrate a minimum tested infiltration rate of one (1) inch per hour;

(3) After all construction activities have been completed on the site and the finished grade has been established in the infiltration BMP, post-development field permeability tests shall also be conducted according to the methodologies provided in Section 16-5.2 N. of this ordinance;

(4) If the results of the post-development field permeability tests fail to achieve the minimum required design permeability rates in 5 above utilizing a factor of safety of two (2), the stormwater infiltration BMP shall be renovated and re-tested until such minimum required design permeability rates are achieved; and

(5) The results of all field permeability tests shall be certified by a Professional Engineer and transmitted to the municipal engineer.

e. To help ensure maintenance of the design permeability rate over time, a layer of infiltration soil shall be placed on the bottom of a stormwater infiltration BMP. This soil layer shall meet the textural and permeability specifications of a K5 soil as provided at N.J.A.C. 7:9A, Appendix A, Figure 6, and be certified to meet these specifications by a Professional Engineer licensed in the State of New Jersey. The depth to the seasonal high water table shall be measured from the bottom of the infiltration layer.

f. The design engineer shall assess the hydraulic impact on the groundwater table and design the project site and all stormwater infiltration basins so as to avoid adverse hydraulic impacts. Adverse hydraulic impacts include, but are not limited to: raising the groundwater table so as to cause surface ponding; flooding of basements and other subsurface structures and areas; preventing a stormwater infiltration basin from completely draining via infiltration within seventy-two (72) hours of a design storm event; and interference with the proper operation of subsurface sewage disposal systems and other surface and subsurface structures in the vicinity of the stormwater infiltration basin.

g The design engineer shall conduct a mounding analysis, as defined in Section 16-5.2 E., of all stormwater infiltration basins. The mounding analysis shall be conducted in accordance with the requirements in Subsection 16-5.2 N.l2. of this ordinance. Where the mounding analysis identifies adverse impacts, the stormwater infiltration basin shall be redesigned or relocated, as appropriate.

h. Stormwater infiltration BMPs shall be constructed in accordance with the following:

(1) To avoid sedimentation that may result in clogging and reduce the basin's permeability rate:

(a) All other infiltration BMP construction in this section shall be followed when the drainage area is completely stabilized, all accumulated sediment shall be removed from the infiltration BMP, which shall then be excavated to its final design elevation in accordance with the construction requirements of this section and the performance standards in Sections 16-5.2 F. and 16-5.2 G.

(b) To avoid compaction of subgrade soils of BMP's that rely on infiltration, no heavy equipment such as backhoes, dump trucks or bulldozers shall be permitted to operate within the footprint of the BMP. All excavation required to construct a stormwater infiltration BMP shall be performed by equipment placed outside the BMP. If this is not possible, the soils within the excavated area shall be renovated and tilled after construction is completed to reverse the effects of compaction. In addition, post-development soil permeability testing shall be performed in accordance with the soil field test permeability rate Section 16-5.2 I.2.d of this ordinance.

(c) Earthwork associated with stormwater infiltration BMP construction, including excavation, grading, cutting or filling, shall not be performed when soil moisture content is above the lower plastic limit.

3. Stormwater management measure guidelines are available in the New Jersey Stormwater Best Management Practices Manual. Other stormwater management measures may be utilized provided the design engineer demonstrates that the proposed measure and its design will accomplish the required water quantity, groundwater recharge and water quality design and performance standards established by Sections 16-5.2 F. and 16-5.2 G. of this ordinance.

4. Manufactured treatment devices may be used to meet the requirements of Section 16-5.2 G. of this ordinance, provided the pollutant removal rates are verified by the New Jersey Corporation for Advanced Technology and certified by the Department.

5. Storm Pipe Systems Strategy and Design.

   a. A system emphasizing a natural as opposed to an engineered drainage strategy shall be encouraged. This shall include, but not be limited to, the use of vegetative swales in lieu of storm sewer inlets and piping.

   b. The applicability of a natural approach depends on such factors as site storage capacity, open channel hydraulic capacity, and maintenance needs and resources.

   c. Hydraulic capacity for open channel or closed conduit flow shall be determined by the Manning Equation, or charts/nomographs based on the Manning Equation:

      Q = (1.486 AR^ 2/3 S^ ½)/n, where:

      n = Manning's roughness coefficient;
      A = Cross-sectional area of flow in square feet;
      R = Hydraulic radius in feet (R = A/P, where P is equal to the Wetted Perimeter); and
      S = Slope of conduit in feet per foot.

   d. Velocities in open channels at design flow shall not be less than 0.5 foot per second and not greater than that velocity which will begin to cause erosion or scouring of the channel. In no case shall the longitudinal slope of an open channel be less than 1%. The following are the maximum allowable velocities for various soils:

Soil Texture	**Allowable Velocity (ft./sec.)**
Sand and sandy loam (noncollodial)	2.5
Silt loam (also high lime clay)	3.0
Sandy clay loam	3.5
Clay loam	4.0
Clay, fine gravel, graded loam to gravel	5.0
Cobbles	5.5
Shale	6.0

e. Velocities in closed conduits at design flow shall be at least two feet per second but not more than the velocity which will cause erosion damage to the conduit. For reinforced concrete pipe, the maximum velocity shall not exceed 10 ft/sec.

f. Pipe size shall be dictated by design runoff and hydraulic capacity.

g. In general, no pipe size in the storm drainage system shall be less than fifteen inch diameter. A twelve-inch diameter pipe will be permitted as a cross-drain to a single inlet.

h. Materials used in the construction of storm sewers shall be reinforced concrete, ductile iron, or high density polyethylene pipe. In normal circumstances, reinforced concrete pipe is preferred. Use of other types shall be justified by the designer and approved by the Township Engineer. Specifications referred to, such as ASA, ASTM, AWWA, etc., should be the latest revision.

(1) Reinforced concrete pipe:

(a) Circular reinforced concrete pipe and fittings shall meet the requirements of ASTM C-76.

(b) Elliptical reinforced concrete pipe shall meet the requirements of ASTM C-507.

(c) Joint design and joint material for circular pipe shall conform to ASTM C-443.

(d) Joints for elliptical pipe shall be bell and spigot or tongue and groove sealed with butyl, rubber tape, or external sealing bands conforming to ASTM C-877.

(e) All pipe shall be Class III unless a stronger pipe (i.e., higher class) is indicated to be necessary.

(f) The minimum depth of cover over the concrete pipe shall be as designated by the American Concrete Pipe Association.

(2) Ductile iron pipe shall be centrifugally cast in metal or sand-lined molds to ANSI A21.51-1976 (AWWA C151-76). The joints shall conform to AWWA C111. Pipe shall be furnished with flanges where connections to flange fittings are required.

Pipe should be Class 50 (minimum). The outside of the pipe should be coated with a uniform thickness of hot applied coal tar coating and the inside lined cement in accordance with AWWA C104. Ductile iron pipe shall be installed with Class C, Ordinary Bedding.

(3) High Density Polyethylene Pipe may used at the discretion of the Township Engineer. Same shall not be used in areas of a shallow seasonal high water table.

i. Pipe bedding shall be provided as specified in "Design and Construction of Sanitary and Storm Sewers," ASCE Manuals and Reports on Engineering Practice No. 37, prepared by a Joint Committee of the Society of Civil Engineers and the Water Pollution Control Federation, New York, 1969.

j. Where storm pipes will be located within the seasonal high water table, they shall be constructed using reinforced concrete piping with watertight "o"-ring gaskets, or approved equal as determined by the Township Engineer.

k. Inlet spacing shall be designed to limit gutter flow width to six feet but shall not be more than 400 feet.

l. Manhole spacing shall be increased with pipe size.

Pipe Size (inches)	Manhole Spacing (feet)
15 or less	500
18 to 36	600
42 to 60	700
60+	700+

m. All Manholes or Inlets shall be precast concrete or concrete block coated with two coats of portland cement mortar.

n. If precast manhole barrels and cones are used, they shall conform to ASTM Specification C-473 with round rubber gaskets joints, conforming to ASTM Specification C-923. Maximum absorption shall be 8% in accordance with ASTM Specification C-478, Method A.

o. If precast manholes are utilized, the top riser section shall terminate less than one foot below the finished grade and the manhole cover shall be flush with the finished grade.

p. Manhole frames and covers shall be of American made cast iron conforming to ASTM Specification A-48 Class 30 and be suitable for H-20 loading capacity. All manhole covers in rights-of-way or in remote areas shall be provided with a locking device. The letters "Year 20___" and the words "MONTGOMERY STORM SEWER" shall be cast integrally in the cover.

q. All discharge pipes shall terminate with a precast or cast-in-place concrete headwall with or without wingwalls as conditions require. In normal circumstances, a cast-in-place concrete headwall is preferred. Use of other types shall be justified by the designer and approved by the Township Engineer.

r. Headwalls and endwalls shall extend a minimum of twenty-five (25) feet from all roadways unless there is an existing natural barrier (trees, shrubs, berms) or a guardrail installed. When such conditions exist, the headwall or endwall may be placed at the right-of-way line or at a minimum distance of ten (10) feet from the edge of the roadway, whichever is greater.

s. The stormwater system strategy and design, for all commercial or residential projects, shall meet the requirements of Residential Site Improvement Standards at N.J.A.C. 5:21-7.2, 7.3, and 7.4, unless otherwise more restrictive requirements are set forth in this section.

J. **Mitigation.**

1. Variance or Exemption from Stormwater Design Standards.

a. The Planning or Zoning Board having jurisdiction over an application requiring a stormwater management plan shall have the jurisdiction to grant a waiver from strict compliance with the performance requirements of this Ordinance or the Stormwater Management Plan. The waiver may be granted where an applicant has demonstrated the inability or impracticality of strict compliance with the Ordinance, and/or the Stormwater Management Plan upon the following conditions. The applicant must demonstrate one of the following:

(1) An inability to apply any of the Best Management Practices and methodologies as defined and approved herein and in the Stormwater Management Plan, due to an extraordinary and

exceptional situation uniquely affecting the subject property or the structures thereon, resulting in a peculiar and exceptional practical difficulty or undue hardship; or

(2) That the purposes of this Ordinance and Stormwater Management Plan can be advanced by a deviation from the Best Management Practices and methodologies as defined and approved herein and in the Stormwater Management Plan, where the benefits of such deviation substantially outweigh any detriment.

b. In requesting a waiver as to any application, the applicant may submit as reasons for the waiver the site conditions of the proposed project, including soils types; thin soil cover; low permeability soils, and/or shallow depths to groundwater (high groundwater levels), unique conditions which would create an unsafe design, or conditions which would provide a detrimental impact to public health, welfare or safety.

c. The waiver cannot be granted due to conditions created by the applicant. If the applicant can comply with the requirements of the Ordinance and Stormwater Management Plan through reduction of the size of the project, the hardship is self-imposed, and the Montgomery Planning Board or Zoning Board lacks jurisdiction to grant any waiver under this section.

2. Mitigation Projects.

a. Any waiver is to be granted only upon the condition that the applicant provides a mitigation project within the same sub-watershed as delineated by the HUC 14. The applicant must propose a suitable mitigation method through submission of a mitigation plan as described in the Stormwater Management Plan which will conform as closely as possible to the design and performance standards of this Ordinance, through structural or non-structural stormwater management measures, governing stormwater quality, quantity, and groundwater recharge.

b. For purposes of this section, “Mitigation” shall incorporate the definition set forth in Section 16-5.2 E. of this Ordinance and shall include situations where the applicant has demonstrated the inability or impracticality of strict compliance with the stormwater management requirements set forth in N.J.A.C. 7:8 in addition to the requirements set forth in this Ordinance and the Municipality’s Stormwater Management Plan.

c. The mitigation plan shall include as a minimum the data and analyses, including an alternatives analysis, listed in the Mitigation Plan Section of the Stormwater Management Plan which demonstrate how on-site compliance is to be maximized.

d. The mitigation plan must provide stormwater management results compatible with the same HUC-14 watershed within which the subject project is proposed. Alternatively, the mitigation plan may:

(1) Provide for funding toward an offsite or regional stormwater control project, if available and practicable, or

(2) Fund an analysis to determine a more appropriate mitigation method to be presented to the Land Use Board for approval; or

(3) Provide for equivalent stormwater treatment at an alternate location, or

(4) Provide some other equivalent water quality benefit, if an on-site method is not proposed, provided the results required herein are achieved.

e. The applicant shall be responsible for locating an appropriate site for mitigation of the performance section for which the waiver is sought. Mitigation may occur on municipal property or on a private property as long as permission is provided in writing from the owner of the property and a temporary construction easement obtained.

f. General types of mitigation projects permitted and encouraged within the Township of Montgomery are:

(1) Repair of Roadside Swales;

(2) Stormwater Basin Retrofit;

(3) Stream and Stream Bank Stabilization;

(4) Stormwater Outfall Restoration; and/or

(5) Inlet Retrofit.

g. The funding option shall be allowed only in situations where there will be no immediate impact upon a sensitive receptor. Contribution to a regional, municipal or offsite mitigation plan shall be allowed for any application for one individual single-family residence. When approved by the Board, receipt of the financial contribution shall be deemed to satisfy the mitigation requirement for that application.

h. The Board having jurisdiction over the individual application may determine that, due to the size of the project necessary to mitigate for the waiver, it is not practical to require a mitigation project.

i. In all instances the Board having jurisdiction shall have the power to impose additional conditions as may be appropriate under the circumstances of the application. The Board shall make specific findings of fact and conclusions consistent with this section:

(1) Showing the inability or impracticality of strict compliance with the Ordinance and Stormwater Management Plan; and

(2) Justifying the approval of the applicant's mitigation plan, in order to satisfy the reporting requirements of the municipality's NJPDES permit and other applicable state law requiring the submission of reports to any state or county review agency.

The Board shall also have the power to require mitigation as to applications which have received waivers from the New Jersey Department of Environmental Protection.

j. In compliance with the New Jersey Pollutant Discharge Elimination System (NJPDES) Tier A Municipal Stormwater Master General Permit, the Township shall provide the New Jersey Department of Environmental Protection information regarding any variance or exception granted from stormwater requirements and the corresponding mitigation projects in accordance with N.J.A.C. 7:8.

K. **Sources for Technical Guidance.**

1. Technical guidance for stormwater management measures can be found in the documents listed at Subsections 16-5.2 K.1.a. and b. below, which are available from Maps and Publications, New Jersey Department of Environmental Protection, 428 East State Street, P.O. Box 420, Trenton, New Jersey, 08625; telephone (609) 777-1038.

a. Guidelines for stormwater management measures are contained in the New Jersey Stormwater Best Management Practices Manual, as amended from time to time. Information is provided on stormwater management measures such as: bioretention systems, constructed stormwater wetlands, dry wells, extended detention basins, infiltration structures, manufactured treatment devices, pervious paving, sand filters, vegetative filter strips, and wet ponds.

b. The New Jersey Department of Environmental Protection Stormwater Management Facilities Maintenance Manual, as amended.

2. Additional technical guidance for stormwater management measures can be obtained from the following:

a. The “Standards for Soil Erosion and Sediment Control in New Jersey” promulgated by the State Soil Conservation Committee and incorporated into N.J.A.C. 2:90. Copies of these standards may be obtained by contacting the State Soil Conservation Committee or any of the Soil Conservation Districts listed in N.J.A.C. 2:90-1.3(a)4. The location, address, and telephone number of each Soil Conservation District may be obtained from the State Soil Conservation Committee, P.O. Box 330, Trenton, New Jersey 08625; (609) 292-5540;

b. The Rutgers Cooperative Extension Service, 732-932-9306; and

c. The Soil Conservation Districts listed in N.J.A.C. 2:90-1.3(a)4. The location, address, and telephone number of each Soil Conservation District may be obtained from the State Soil Conservation Committee, P.O. Box 330, Trenton, New Jersey, 08625, (609) 292-5540.

L. **Safety Standards for Stormwater Management Basins**.

1. This section sets forth requirements to protect public safety through the proper design and operation of stormwater management basins. This section applies to any new stormwater management basin.

2. Requirements for Trash Racks, Overflow Grates and Escape Provisions.

a. A trash rack is a device designed to catch trash and debris and prevent the clogging of outlet structures. Trash racks shall be installed at the intake to the outlet from the stormwater management basin to ensure proper functioning of the basin outlets in accordance with the following:

(1) The trash rack shall have parallel bars, with no greater than six (6) inch spacing between the bars.

(2) The trash rack shall be designed so as not to adversely affect the hydraulic performance of the outlet pipe or structure.

(3) The average velocity of flow through a clean trash rack is not to exceed 2.5 feet per second under the full range of stage and discharge. Velocity is to be computed on the basis of the net area of opening through the rack.

(4) The trash rack shall be constructed and installed to be rigid, durable, and corrosion resistant, and shall be designed to withstand a perpendicular live loading of 300 lbs/ft sq.

b. An overflow grate is designed to prevent obstruction of the overflow structure. If an outlet structure has an overflow grate, such grate shall meet the following requirements:

(1) The overflow grate shall be secured to the outlet structure but removable for emergencies and maintenance.

(2) The overflow grate spacing shall be no less than two (2) inches across the smallest dimension.

(3) The overflow grate shall be constructed and installed to be rigid, durable, and corrosion resistant, and shall be designed to withstand a perpendicular live loading of 300 lbs./ft sq.

c. For purposes of this subsection, escape provisions means the permanent installation of ladders, steps, rungs, or other features that provide easily accessible means of egress from stormwater management basins. Stormwater management basins shall include escape provisions as follows:

(1) If a stormwater management basin has an outlet structure, escape provisions shall be incorporated in or on the structure. With the prior approval of the reviewing agency identified in Subsection 16-5.2 L.3., a free-standing outlet structure may be exempted from this requirement.

(2) Safety ledges shall be constructed on the slopes of all new stormwater management basins having a permanent pool of water deeper than two and one-half (2.5) feet. Such safety ledges shall be

comprised of two (2) steps. Each step shall be four (4) to six (6) feet in width. One step shall be located approximately two and one-half (2.5) feet below the permanent water surface, and the second step shall be located one to one and one-half (1.5) feet above the permanent water surface. See Subsection 16-5.2 L.4. for an illustration of safety ledges in a stormwater management basin.

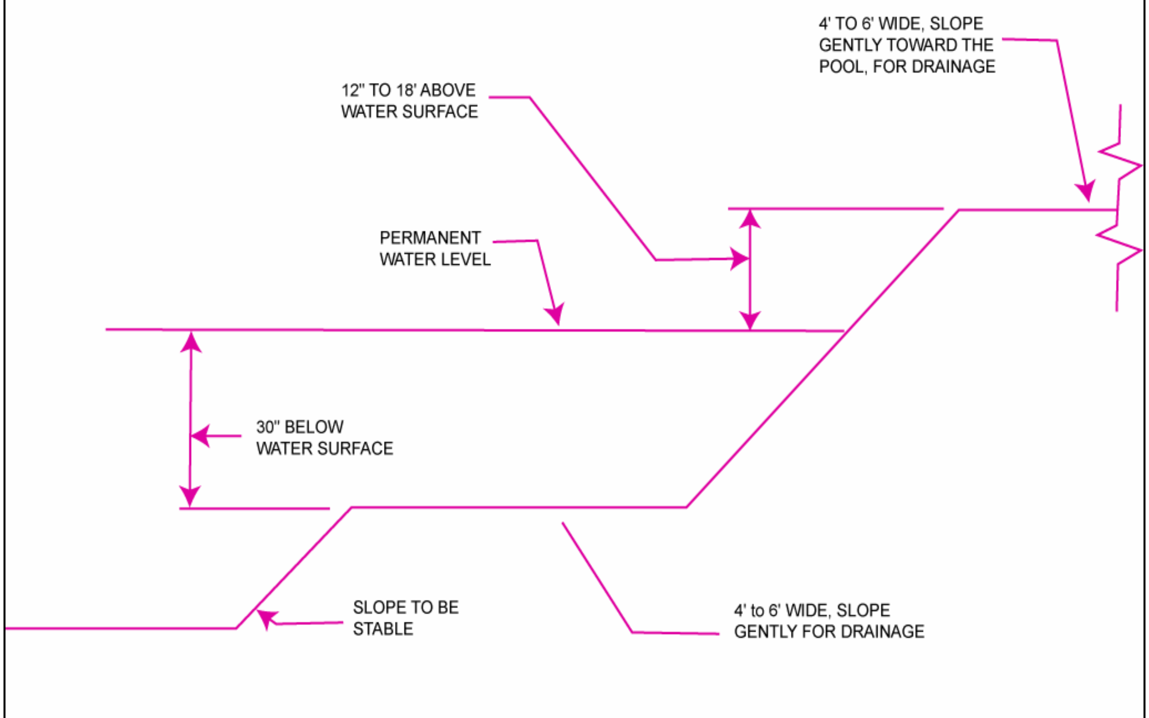
(3) In new stormwater management basins, the maximum interior slope for an earthen dam, embankment, or berm shall not be steeper than three (3) horizontal to one (1) vertical.

3. Variance or Exemption from Safety Standards.

A variance or exemption from the safety standards for stormwater management basins may be granted only upon a written finding by the appropriate reviewing agency (municipality, county or Department) that the variance or exemption will not constitute a threat to public safety.

4. Illustration of Safety Ledges in a New Stormwater Management Basin.

Depicted is an elevational view.



NOTE: NOT DRAWN TO SCALE

NOTE: FOR BASINS WITH PERMANENT POOL OF WATER ONLY

M. **Requirements for a Site Development Stormwater Plan**.

1. Submission of Site Development Stormwater Plan.

a. Whenever an applicant seeks municipal approval of a development subject to this ordinance, the applicant shall submit all of the required components of the Checklist for the Site Development Stormwater Plan at Subsection 16-5.2 M.3. below as part of the submission of the applicant's application for subdivision or site plan approval. These required components are in addition to any other non-stormwater related information required under Montgomery Township’s Land Development Ordinance.

b. The applicant shall demonstrate that the project meets the standards set forth in this ordinance.

c. The applicant shall submit three (3) copies of the materials listed in the checklist for site development stormwater plans in accordance with Subsection 16-5.2 M.3. of this ordinance.

2. Site Development Stormwater Plan Approval.

The applicant's Site Development project shall be reviewed as a part of the subdivision or site plan review process by the municipal board or official from whom municipal approval is sought. That municipal board or official shall consult the engineer retained by the Planning and/or Zoning Board (as appropriate) to determine if all of the checklist requirements have been satisfied and to determine if the project meets the standards set forth in this ordinance.

3. Checklist Requirements.

The following information shall be required:

a. Topographic Base Map.

The reviewing engineer may require upstream tributary drainage system information as necessary. It is recommended that the topographic base map of the site be submitted which extends a minimum of 200 feet beyond the limits of the proposed development, at a scale of 1”=200' or greater, showing 2-foot contour intervals. The map as appropriate may indicate the following: existing surface water drainage, shorelines, steep slopes, soils, erodible soils, perennial or intermittent streams that drain into or upstream of the Category One waters, wetlands and 100 year flood plains along with their appropriate buffer strips, marshlands and other wetlands, pervious or vegetative surfaces, existing man-made structures, roads, bearing and distances of property lines, and significant natural and manmade features not otherwise shown.

b. Environmental Site Analysis.

A written and graphic description of the natural and man-made features of the site and its environs shall include a discussion of soil conditions, slopes, wetlands, waterways and vegetation on the site.

(1) The geology and hydrogeology information from the National Resource Conservation Service maps and Township soil maps shall be provided, with particular attention to the "Evaluation of Groundwater Resources of Sourland Mountain Region of Central New Jersey" dated November 19, 2004 prepared by Matthew J. Mulhall, P.G., of M^2 Associates and Peter M. Demicco, P.G. of Demicco and Associates.

(2) A recharge map shall be provided, showing location where recharge is possible on the site.

(3) Particular attention should be given to unique, unusual, or environmentally critical areas and to those that provide particular opportunities or constraints for development.

c. Project Description and Site Plan(s).

A map (or maps) at the scale of the topographical base map indicating the location of existing and proposed buildings, roads, parking areas, utilities, structural facilities for stormwater management and sediment control, and other permanent structures. The map(s) shall also clearly show areas where alterations occur in the natural terrain and cover, including lawns and other landscaping, and seasonal high ground water elevations.
A written description of the site plan and justification of proposed changes in natural conditions may also be provided.

d. Land Use Planning and Source Control Plan.

This plan shall provide a demonstration of how the goals and standards of Sections 16-5.2 G. through J. are being met. The focus of this plan shall be to describe how the site is being developed to meet the objective of controlling groundwater recharge, stormwater quality and stormwater quantity standards of this ordinance through use of nonstructural or low impact development techniques and source controls to the maximum extent practicable before relying on structural BMPs.

(1) The Land Use Planning and Source Control Plan shall include the New Jersey NonStructural Stormwater Measures Strategies (NSPS) point system spread sheet, a Low Impact Development Checklist, a detailed narrative and associated illustrative maps and/or plans that specifically address how the nine (9) nonstructural strategies will be implemented on the site to the maximum extent practicable in accordance with Subsections 16-5.2 G.6. and 16-5.2 G.7. of this ordinance.

(2) A detailed Land Use Planning and Source Control Plan shall provide a description of how the site will be developed to meet the erosion control, groundwater recharge and stormwater runoff quantity and quality standards. If one or more of the nine (9) nonstructural strategies will not be implemented on the site, the applicant shall provide a detailed rationale establishing a basis for the contention that use of the strategy is not practicable on the site.

e. Stormwater Management Facilities Map.

The following information, illustrated on a map of the same scale as the topographic base map, shall be included:

(1) Total area to be paved or built upon, proposed surface contours at one foot intervals, land area to be occupied by the stormwater management facilities and the type of vegetation thereon, details of the proposed plan to control and dispose of stormwater, soil boring locations, and existing contours; and

(2) Details of all stormwater management facility designs, during and after construction, including discharge provisions, discharge capacity for each outlet at different levels of detention and emergency spillway provisions with maximum discharge capacity of each spillway.

(3) Utility Plan showing all stormwater systems proposed, if any.

(4) Grading Plan showing existing and proposed contours, storm grate elevations and all storm invert elevations.

f. Calculations and Soils Report.

(1) Comprehensive hydrologic and hydraulic design calculations (groundwater recharge and stormwater runoff rate, volume and quality) for the pre-development and post-development conditions for the design storms specified in Section 16-5.2 H. of this ordinance.

(2) A soils report shall be submitted in accordance with Section 16-5.2 N. of the ordinance.

g. Maintenance and Repair Plan.

The applicant shall submit a detailed plan describing how the proposed stormwater management measure(s) shall meet the maintenance and repair requirements of Section 16-5.2 O. of this ordinance. Said plan shall include, at a minimum, the following elements:

(1) The frequency with which inspections will be made;

(2) The specific maintenance tasks and requirements for each proposed structural and nonstructural BMP;

(3) The name, address and telephone number for the entity responsible for implementation of the maintenance plan;

(4) The reporting requirements; and

(5) Copies of the inspection and maintenance reporting sheets.

h. Waiver from Submission Requirements.

The municipal official or board reviewing an application under this ordinance may, in consultation with the municipal engineer, waive submission of any of the requirements in Subsections 16-5.2 M.3.a. through 16-5.2 M.3.f. of this ordinance when it can be demonstrated that the information requested is impossible to obtain or it would create a hardship on the applicant to obtain and its absence will not materially affect the review process.

N. **Requirements For Soil Testing And Methods For Assessing Soil Suitability For Infiltration Stormwater Management BMPs.**

The results of a subsurface investigation shall serve as the basis for the site selection and design of stormwater infiltration BMPs. The subsurface investigation shall include, but not be limited to, a series of soil test pits and soil permeability tests conducted in accordance with the following:

1. All soil test pits and soil permeability results shall be performed under the direct supervision of a Professional Engineer. All soil logs and permeability test data shall be accompanied by a certification by a Professional Engineer. The results and location (horizontal and vertical) of all soil test pits and soil permeability tests, both passing and failing, shall be reported to Montgomery Township.

2. During all subsurface investigations and soil test procedures, adequate safety measures shall be taken to prohibit unauthorized access to the excavations at all times. It is the responsibility of persons performing or witnessing subsurface investigations and soil permeability tests to comply with all applicable Federal, State and local laws and regulations governing occupational safety.

3. A minimum of two (2) soil test pits shall be excavated within the footprint of any proposed infiltration BMP to determine the suitability and distribution of soil types present at the site.

   a. Placement of the test pits shall be within twenty (20) feet of the basin perimeter, located along the longest axis bisecting the BMP.

   b. For BMPs larger than ten thousand (10,000) square feet in area, a minimum of one (1) additional soil test pit shall be conducted within each additional area of ten thousand (10,000) square feet.

   c. The additional test pit(s) shall be placed approximately equidistant to other test pits, so as to provide adequate characterization of the subsurface material.

   d. In all cases, where soil and or groundwater properties vary significantly, additional test pits shall be excavated in order to accurately characterize the subsurface conditions below the proposed infiltration BMP.

e. Soil test pits shall extend to a minimum depth of eight (8) feet below the lowest elevation of the basin bottom or to a depth that is at least two (2) times the maximum potential water depth in the proposed infiltration BMP, whichever is greater.

4. A soil test pit log shall be prepared for each soil test pit.

a. The test pit log shall, at a minimum, provide the elevation of the existing ground surface, the depth and thickness (in inches) of each soil horizon or substratum, the dominant matrix or background and mottle colors using the Munsell system of classification for hue, value and chroma, the appropriate textural class as shown on the USDA textural triangle, the volume percentage of coarse fragments (larger than two (2) millimeters in diameter), the abundance, size, and contrast of mottles, the soil structure, soil consistence, and soil moisture condition, using standard USDA classification terminology for each of these soil properties.

b. Soil test pit logs shall identify the presence of any soil horizon, substratum or other feature that exhibits an in-place permeability rate less than one (1) inch per hour.

5. Each soil test pit log shall report the depth to seasonally high water level, either perched or regional, and the static water level based upon the presence of soil mottles or other redoximorphic features, and observed seepage or saturation.

a. Where redoxomorphic features including soil mottles resulting from soil saturation are present, they shall be interpreted to represent the depth to the seasonal high water table unless soil saturation or seepage is observed at a higher level.

b. When the determination of the seasonally high water table shall be made in ground previously disturbed by excavation, direct observation of the static water table during the months of January through April shall be the only method permitted.

6. Any soil horizon or substratum which exists immediately below a perched zone of saturation shall be deemed by rule to exhibit unacceptable permeability (less than one (1) inch per hour). The perched zone of saturation may be observed directly, inferred based upon soil morphology, or confirmed by performance of a hydraulic head test as defined at N.J.A.C. 7:9A-5.9.

7. Stormwater infiltration BMPs shall not be installed in soils that exhibit artesian groundwater conditions. A permeability test shall be conducted in all soils that immediately underlie a perched zone of saturation. Any zone of saturation which is present below a soil horizon which exhibits an in-

place permeability of less than 0.2 inches per hour shall be considered an artesian zone of saturation unless a minimum one (1) foot thick zone of unsaturated soil, free of mottling or other redoximorphic features and possessing a chroma of four (4) or higher, exists immediately below the unsuitable soil.

8. A minimum of one (1) permeability test shall be performed at each soil test pit location.

   a. The soil permeability rate shall be determined using test methodology as prescribed in N.J.A.C. 7:9A-6.2 (Tube Permeameter Test), 6.5 (Pit Bailing Test) or 6.6 (Piezometer Test).

   b. When the tube permeameter test is used, a minimum of two (2) replicate samples shall be taken and tested.

   c. Alternative permeability test procedures may be accepted by the approving authority provided the test procedure attains saturation of surrounding soils, accounts for hydraulic head effects on infiltration rates, provides a permeability rate with units expressed in inches per hour and is accompanied by a published source reference.

   d. Examples of suitable sources include hydrogeology, geotechnical or engineering text and design manuals, proceedings of American Society for Testing and Materials (ASTM) symposia, or peer-review journals.

   e. Neither a Soil Permeability Class Rating Test, as described in N.J.A.C. 7:9A-6.3, nor a Percolation Test, as described in N.J.A.C. 7:9A-6.4, are acceptable tests for establishing permeability values for the purpose of complying with this ordinance.

9. Soil permeability tests shall be conducted on the most hydraulically restrictive horizon or substratum to be left in place below the basin as follows:

   a. Where no soil replacement is proposed, the permeability tests shall be conducted on the most hydraulically restrictive horizon or substratum within four (4) feet of the lowest elevation of the basin bottom or to a depth equal to two (2) times the maximum potential water depth within the basin, whichever is greater.

   b. Where soil replacement is proposed, the permeability tests shall be conducted within the soil immediately below the depth of proposed soil replacement or within the most hydraulically restrictive horizon or substratum to a depth equal to two (2) times the maximum potential water depth within the basin, whichever is greater.

c. Permeability tests may be performed on the most hydraulically restrictive soil horizons or substrata at depths greater than those identified above based upon the discretion of the design or testing engineer.

d. The tested infiltration rate should then be divided by two (2) to establish the soil's design permeability rate. Such division will provide a 100% safety factor to the tested rate.

10. The minimum acceptable "tested permeability rate" of any soil horizon or substratum shall be one (1) inch per hour.

a. Soil materials that exhibit tested permeability rates slower than one (1) inch per hour shall be considered unsuitable for stormwater infiltration.

b. The maximum reportable "tested permeability rate" of any soil horizon or substratum shall be no greater than twenty (20) inches per hour regardless of the rate attained in the test procedure.

11. After all construction activities have been completed on the development site and the finished grade has been established in the infiltration BMP, a minimum of one (1) permeability test shall be conducted within the most hydraulically restrictive soil horizon or substratum below the as-built BMP to ensure the performance of the infiltration BMP is as designed.

a. Hand tools and manual permeability test procedures shall be used for the purpose of confirming BMP performance.

b. In addition, the infiltration BMP shall be flooded with water sufficient to demonstrate the performance of the BMP.

c. Test results shall be certified to the municipal engineer.

12. A groundwater mounding analysis shall be provided for each stormwater infiltration BMP.

a. The groundwater mounding analysis shall calculate the maximum height of the groundwater mound based upon the volume of the maximum design storm.

b. The Professional Engineer conducting the analysis shall provide the municipal engineer with the methodology and supporting documentation for the mounding analysis used and shall certify to Montgomery Township, based upon the analysis, that the groundwater mound will not cause stormwater or groundwater to breakout to the land surface or cause adverse impact to adjacent surface water bodies, wetlands or subsurface structures including but not limited to basements and septic systems.

c. If there is more than one infiltration BMP proposed, the model shall indicate if and how the mounds will interact.

d. The mounding analysis shall be calculated using the most restrictive soil horizon that will remain in place within the explored aquifer thickness unless alternative analyses are authorized by the municipal engineer.

e. The mounding analysis shall be accompanied by a cross section of the infiltration BMP and surrounding topography and the mound analysis shall extend out to the point(s) at which the mound intersects with the preexisting maximum water table elevation.

13. The applicant shall demonstrate that stormwater infiltration BMPs meet the seventy-two (72) hour drain time requirement established in Subsection 16-5.2 I.2. of this ordinance.

O. **Maintenance and Repair.**

1. Projects subject to review as in Section 16-5.2 C. of this ordinance shall comply with the requirements of the following subsections.

2. Operation and Maintenance Plan.

a. The design engineer shall prepare an Operation and Maintenance Plan for the stormwater management measures incorporated into the design of a major development.

b. The maintenance plan shall contain specific information as required in N.J.A.C. 7:8, including but not limited to:

(1) Accurate and comprehensive drawings of the site’s stormwater management measures;

(2) Specific locations of each stormwater management measure identified by means of longitude and latitude as well as block and lot number;

(3) Specific preventative and corrective maintenance tasks and schedules for such tasks for each stormwater BMP in easy to understand language;

(4) Cost estimates, including estimated cost of sediment, debris or trash removal;

(5) The name, address and telephone number of the person or persons responsible for regular inspections and preventative and corrective maintenance (including repair and replacement). If the responsible person or persons is a corporation, company, partnership, firm, association, municipality or political subdivision of this State, the name and telephone number of an appropriate contact person shall also be included; and

(6) Inspection Logs.

c. Responsibility for maintenance shall not be assigned or transferred to the owner or tenant of an individual property in a residential development or project, unless such owner or tenant owns or leases the entire residential development or project.

d. If the person responsible for maintenance identified under Subsection 16-5.2 O.2.b.(5) above is not a public agency, the maintenance plan and any future revisions, based on Subsection 16-5.2 O.2.f. below, shall be recorded upon the deed of record for each property on which the maintenance described in the maintenance plan must be undertaken.

e. Preventative and corrective maintenance shall be performed to maintain the function of the stormwater management measure, including repairs or replacement to the structure; removal of sediment, debris, or trash; restoration of eroded areas; snow and ice removal; fence repair or replacement; restoration of vegetation; and repair or replacement of nonvegetated linings.

f. The person responsible for maintenance identified under Subsection 16-5.2 O.2.b.(5) above shall maintain a detailed log of all preventative and corrective maintenance for the structural stormwater management measures incorporated into the design of the development, including a record of all inspections and copies of all maintenance-related work orders.

g. The person responsible for maintenance identified under Subsection 16-5.2 O.2.b.(5) above shall evaluate the effectiveness of the maintenance plan at least once per year and adjust the plan and the deed as needed.

h. The person responsible for maintenance identified under Subsection 16-5.2 O.2.b.(5) above shall retain and make available, upon request by any public entity with administrative, health, environmental, or safety authority over the site, the maintenance plan and the documentation required by Subsections 16-5.2 O.2.f. and 16-5.2 O.2.g. above.

i. The requirements of Subsections 16-5.2 O.2.c. and 16-5.2 O.2.d. do not apply to stormwater management facilities that are dedicated to and accepted by Montgomery Township or another governmental agency.

j. In the event that the stormwater management facility becomes a danger to public safety or public health, or if it is in need of maintenance or repair, the municipality shall so notify the responsible person in writing.

(1) Upon receipt of that notice, the responsible person shall have fourteen (14) days to effectuate maintenance and repair of the facility in a manner that is approved by the municipal engineer or his designee.

(2) Montgomery Township, in its discretion, may extend the time allowed for effecting maintenance and repair for good cause.

(3) If the responsible person fails or refuses to perform such maintenance and repair, Montgomery Township may immediately proceed to do so with its own forces and equipment and/or through contractors.

(4) The costs and expenses of such maintenance and repair by Montgomery Township may be entered on the tax roll as a special charge against the property and collected with any other taxes levied thereon for the year in which the maintenance and repair was performed.

k. Nothing in this section shall preclude Montgomery Township from requiring the posting of a performance or maintenance guarantee in accordance with N.J.S.A. 40:55D-53.

l. All paved parking areas, walkways and roads shall be cleaned, as required by State regulations, and the use of deicing agents shall be minimized to the amount necessary to allow safe pedestrian and vehicular access. Trash, debris and sediments shall be removed from drainage systems as needed. The prevention, containment and clean up of chemical spills or other accumulations of pollutants shall be made in a timely manner pursuant to all local, State and Federal requirements.

3. Stormwater Management Facility Maintenance Responsibilities.

The following shall apply to allocate responsibility for stormwater management facilities:

a. Stormwater management facility required for any non-residential (commercial) development.

Whenever a detention or retention basin or other stormwater management facility is required for a non-residential development, the basin or stormwater management facility shall be a part of an individual lot owned and maintained by the property owner, or in the case of a business park or other similar complex, part of the common open space owned by a business association. Provisions for long term maintenance of the basin shall be established. No responsibility, maintenance or otherwise, shall be transferred to the Township.

b. Stormwater management facility required for any multi-family (e.g. apartments or townhouses) development.

Whenever a detention, retention basin or other stormwater management facility is required for a development approval for a multi-family building, the basin or stormwater management facility shall be a part of the individual lot owned and maintained by the property owner of the development consisting of rental units or a part of the common open space owned by a homeowners' association of a development of for-sale units, and provisions for long term maintenance of the basin shall be established. No responsibility, maintenance or otherwise, shall be transferred to the Township.

c. Stormwater management facility required for any conventional, non-clustered development of single-family detached dwellings.

(1) Whenever a detention basin, retention basin or other stormwater management facility is required in connection with a development approval for any conventional, non-clustered development of single-family detached dwellings, the detention or retention basin(s) or other large stormwater management facilities shall be owned and

maintained by a homeowners' association unless it is not reasonably feasible to establish a homeowners' association.

When it is not reasonably feasible to establish a homeowners' association, the basin(s) or large stormwater management facilities shall be constructed, under the following conditions:

(a) A separate lot shall be created for the stormwater basin or management facility and dedicated to the Township.

(b) If the site plan or subdivision is approved by the Planning or Zoning Board without a separate lot for the stormwater basin or management facility, then a drainage and access easement dedicated to the Township of Montgomery shall be created on the single family residential lot to ensure that the responsibility for maintenance is not transferred to owner of an individual property. The easement shall be recited in metes and bounds in the deed of the property and shall be reviewed and approved by the Township Engineer and Township Attorney prior to recording.

(c) The developer shall deposit a cash escrow maintenance guarantee with the Township of Montgomery in an amount reasonably determined by the Township Engineer and approved by the Township Committee to be sufficient to complete routine maintenance such as mowing and to maintain the grates and control structures for one hundred (100) years after initial construction and to replace such grates and control structures as required during the one hundred (100) year time period.

(d) The cash escrow maintenance guarantee shall ensure that all stormwater management measures required under this ordinance will be maintained in accordance with the design specifications required and established under this ordinance. The calculation of the maintenance guarantee shall be based in part upon the Inspection, Maintenance and Repair Plan (Plan), required to be prepared by the applicant and approved by Montgomery Township. The Plan shall include an estimate of the present value of the cost to inspect, maintain and repair the stormwater management measure(s) in accordance with the Plan for the useful life of those measure(s).

(e) The calculation of the cash escrow maintenance guarantee also shall consider the costs associated with the reconstruction of stormwater management measures that are reasonably anticipated to be subject to long term failure after an agreed number of years, depending on the type of measure(s) that might need to be reconstructed. The amount shall be based on the future value of the measure(s) being reconstructed.

(f) This up-front cash escrow maintenance guarantee shall be placed in a dedicated cash management account and expended by Montgomery Township for the sole purpose of conducting inspection, maintenance and repair activities for all stormwater management measures required under the applicant's major development application approval. Such funds shall not be used for maintenance of any lands or improvements other than stormwater management facilities.

(2) The maintenance of small stormwater management facilities, as defined below, on individual residential lots are to remain as the lot owners' responsibility.

(a) A small stormwater management facility is hereby defined as rain gardens, dry wells, water quality basins, vegetated swales which are entirely situated and designed to handle the runoff from a structure on a residential lot.

(b) Small stormwater management facilities shall not control runoff from a public street. Stormwater management facilities which are primarily intended to manage stormwater generated on a residential lot shall be situated and contained on such lot.

(c) Such facilities shall be designed in accordance with the Best Management Practices Manual from NJDEP as revised from time to time, Ordinances of the Township of Montgomery, the developmental approvals, and accepted engineering standards of design and practice.

(3) A small stormwater management facility, as defined above, shall not be maintained by the Township of Montgomery, but shall be the responsibility of the owner of the single residential lot upon which the facilities were constructed.

(a) The aforesaid obligation of maintenance shall be required by the approving board to be memorialized and recorded as a deed restriction.

(b) The area of the stormwater facility shall also be recorded on the deed in metes and bounds.

(c) No such facility shall be modified or eliminated following issuance of the initial certificate of occupancy unless the Township of Montgomery permits such modification or elimination by adoption of an Ordinance.

d. Nothing herein shall reduce or eliminate the developer’s obligation to adequately construct all stormwater management facilities. Adequate performance guarantees shall be posted to assure the good and workmanlike installation of such stormwater maintenance facilities pursuant to N.J.S.A. 40:55D-53. The Township Engineer shall not accept any stormwater management facilities unless and until the developer's engineers shall have submitted to the Township Engineer as-built drawings certifying that the said facilities were constructed in accordance with the approved plans.

e. During a period of maintenance immediately following the release of performance guarantees, it shall continue to be the developer's obligation, together with the surety, to adequately maintain the stormwater management facilities. Only after the expiration of maintenance guarantees shall any escrowed funds be utilized for maintenance of stormwater management facilities.

4. Requirements for Inspection, Maintenance and Repair of Stormwater BMP's that Rely on Infiltration.

If a stormwater infiltration BMP is incorporated into the design of a major development, the applicant shall include the following requirements in its Inspection, Maintenance and Repair Plan:

a. Once per month (if needed): Mow side slopes, remove litter and debris, stabilize eroded banks, and repair erosion at inflow structure(s);

b. After every storm exceeding one (1) inch of rainfall: Ensure that infiltration BMPs drain completely within seventy-two (72) hours after the storm event. If stored water fails to infiltrate seventy-two (72) hours after the end of the storm, corrective measures shall be taken. Raking or tilling by light equipment can assist in maintaining infiltration capacity and break up clogged surfaces;

c. Four (4) times per year (quarterly): Inspect stormwater infiltration BMPs for clogging and excessive debris and sediment accumulation within the BMP, and remove sediment (if needed) when completely dry;

d. Two (2) times per year: Inspect for signs of damage to structures, repair eroded areas, check for signs of petroleum contamination and remediate;

e. Once per year: Inspect BMPs for unwanted tree growth and remove if necessary, disc or otherwise aerate bottom of infiltration basin to a minimum depth of six (6) inches; and

f. After every storm exceeding one (1) inch of rainfall, inspect and, if necessary, remove and replace basin infiltration layer and accumulated sediment, to restore original infiltration rate.

g. Additional guidance for the inspection, maintenance and repair of stormwater infiltration BMPs can be found in the New Jersey BMP Manual.

P. **Grading**.

1. Lots shall be graded to secure proper drainage away from the buildings. Additionally, drainage shall be provided in a manner which will prevent the collection of stormwater in pools or other unauthorized concentrations of flow and, to the greatest extent possible, water shall not flow across adjacent property lines. No areas of concentrated flow via gutters, channels, swales and/or pipe discharge shall be directed across driveways or sidewalks.

2. A final drainage plan shall accompany the final subdivision or site plan. Such drainage plan shall show the same information as required on the preliminary plan with the addition that the individual lot grading shall be shown as follows:

   a. Final grades shall be shown for each lot corner, all high and low points and breaks in grade, finished floor elevation of structures, finished grade of septic systems, if applicable, and at the corners of tentative structure locations. If the use of drainage swales is intended, the elevation of these swales shall be shown. The minimum grade of disturbed areas shall be one and one-half (1 1/2%) percent.

   b. Prior to construction of foundation walls, an as-built plan of the horizontal and vertical location of the foundation footing shall be submitted to the Zoning Officer for review and approval. As a condition precedent to the issuance of certificates of occupancy, the developer shall submit an as-built lot grading plan to the Township bearing an engineer's certification that the lot grading complies with the approved final lot grading and soil erosion control plans.

3. Grading and finished floor elevations shall be adjusted for the house model selected, located within the building envelope and final architectural plans conforming to applicable codes. Final information shall be submitted to the Township as part of the building permit application for each lot.

4. Each individual lot's grading plan, which is submitted as part of a building permit application for footings and foundations shall identify the International Building Code grading requirements. In all cases, the grade shall pitch away from the buildings at not less than one (1) inch in twelve (12) inches for a distance of eight (8) feet. Where cross lot drainage is reasonably unavoidable and contradicts Subsections 16-5.2 P.1. and 2. above, the footing and foundation permit application shall include a grading plan which defines the proposed final grading of all abutting lots affecting the lot for which the foundation permit is being made.

Q. **Dedication of Easements**.

The approving board may require easements along drainage ways, natural water courses, steep slopes and other unique botanical, historical, geological and paleontological areas located therein or adjacent to a proposed development. The easement shall be indicated on the plan and shall be marked on the land by iron pipes at angle points and or property corners at sufficient locations to enable the easements to be surveyed. In such cases, the approving board shall consult with the Township Planner, Township Engineer, and the Environmental Commission in determining the required shape and size of the easement. The easement shall be in a form approved by the approving board's attorney and shall include provisions assuring the following:

1. Preservation of the channel and flood plain of the water course, including the right to clean, de-snag and all such work necessary to maintain the shape, slope and water flow of the water course.

2. Prohibition of any removal of trees and other cleaning and grading not directly related to the preservation of the channel of a water course.

3. Grant of a right to the Township to install and maintain any drainage facilities necessary for the health and safety of the public.

4. Right-of-entry to the Township to install and maintain any drainage facilities therein.

R. **Penalties**.

Any person who erects, constructs, alters, repairs, converts, maintains, or uses any building, structure or land in violation of this ordinance shall be subject to the penalties stipulated in Section 16-10.6 of this chapter.

SECTION 2. Add a new subsection to Subsection 16-5.14a., entitled “Streets”, of the Code of the Township of Montgomery (1984) to read in its entirety as follows:

“11. No privately owned above ground or below ground improvement, including but not limited to landscaping and lawn sprinkler systems, may be installed within the street right-of-way, except mailboxes in accordance with Post Office regulations, without the expressed written approval of the Montgomery Township Engineer.”

SECTION 3. If any section, paragraph, subsection, clause or provision of this Ordinance shall be adjudged by the Courts to be invalid, such adjudication shall apply only to the subsection, clause or provision so adjudged and the remainder of this Ordinance shall be deemed valid and effective.

SECTION 4. This Ordinance shall take effect upon final adoption, publication and the filing of a copy of said Ordinance with the Somerset County Planning Board, all in accordance with the law.

Appendix F
Sourland Watershed Protection Plan
NPS Educational Brochures and Exhibits

What is Low Impact Development (LID)?

Ever wish you could simultaneously lower your site infrastructure costs, protect the environment, and increase your project's marketability? With LID techniques, you can. LID is an ecologically friendly approach to site development and storm water management that aims to mitigate development impacts to land, water, and air. The approach emphasizes the integration of site design and planning techniques that conserve the natural systems and hydrologic functions of a site.

Source: Prince George's County DER

Residential Lot with Bioretention

Somerset Development
Prince George's County, MD

LID Benefits

In addition to the practice just making good sense, LID techniques can offer many benefits to a variety of stakeholders.

<u>Developers</u>

- Reduce land clearing and grading costs
- Potentially reduce infrastructure costs (streets, curbs, gutters, sidewalks)
- Reduce storm water management costs
- Potentially reduce impact fees and increase lot yield
- Increase lot and community marketability

<u>Municipalities</u>

- Protect regional flora and fauna
- Balance growth needs with environmental protection
- Reduces municipal infrastructure and utility maintenance costs (streets, curbs, gutters, sidewalks, storm sewer)
- Increase collaborative public/private partnerships

<u>Environment</u>

- Preserve integrity of ecological and biological systems
- Protect site and regional water quality by reducing sediment, nutrient, and toxic loads to water bodies
- Reduce impacts to local terrestrial and aquatic plants and animals
- Preserve trees and natural vegetation

Cover Photo: R. Arendt

Case Study

Kensington Estates is a conventional development on 24 acres consisting of 103 single-family homes in Pierce County, WA. A study was conducted to redesign the site using a new state storm water model and to illustrate the full range of LID practices and technologies available to developers.

Overall, the redesigned LID site could have:

- Resulted in construction cost savings of over 20%;
- Preserved 62% of the site in open space;
- Maintained the project density of 103 lots;
- Reduced the size of storm pond structures and eliminated catchments and piped storm conveyances; and
- Achieved "zero" effective impervious surfaces.

Cost Comparison: LID vs. Conventional Development

For More Information

- Low Impact Development Center
  http://www.lowimpactdevelopment.org
- Prince George's County, Maryland
  http://www.goprincegeorgescounty.com
- NAHB Research Center Toolbase Services
  http://www.toolbase.org
- U.S. EPA
  http://www.epa.gov/owow/nps/urban.html

NAHB RESEARCH CENTER

*Assumes paving costs of $15/sq. yd.

Printed on recycled paper with soy ink

Builder's Guide to Low Impact Development

Would you be interested in saving upwards of $70,000* per mile in street infrastructure costs by eliminating one lane of on-street parking on residential streets?

Did you know that communities designed to maximize open space and preserve mature vegetation are highly marketable and command higher lot prices?

Are you aware that most homeowners perceive Low Impact Development practices, such as bioretention, as favorable since such practices are viewed as additional builder landscaping?

Did you know that by reducing impervious surfaces, disconnecting runoff pathways, and using on-site infiltration techniques, you can reduce or eliminate the need for costly storm water ponds?

LID Site Planning and Design Concepts

Successful LID projects simultaneously reduce land development and infrastructure costs while protecting a property's natural resources and functions. During the development process, the designer, developer, and reviewing agency should work together to identify solutions that integrate the following concepts:

- Preserve Open Space and Minimize Land Disturbance;
- Protect and Incorporate Natural Systems (wetlands, stream/wildlife corridors, mature forests) as Design Elements;
- Utilize Neo-Traditional Street and Lot Layouts and Designs; and
- Decentralize and Micromanage Storm Water at its Source Using LID Storm Water Management Practices.

LID and Storm Water Management

LID aims to mimic natural hydrology and processes by using small-scale, decentralized practices that infiltrate, evaporate, and transpire rainwater. Specifically, LID aims to:

- Minimize impervious surfaces;
- Disconnect hydrologic elements (roofs, downspouts, parking areas);
- Maintain/increase flow paths and times; and
- Utilize decentralized treatment practices.

Bioretention Areas
Storm water directed to these shallow topographic depressions in the landscape is filtered, stored, and infiltrated into the ground using specialized vegetation and engineered soils.

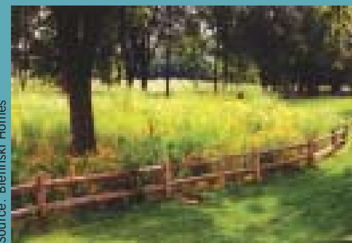
Grassed Swales
Water moving through these systems is slowed, filtered, and percolated into the ground. These systems can act as low cost alternatives to curbs, gutters, and pipes.

Source: Low Impact Development Center

LID Lot Level Source Controls

Preserve Open Space and Minimize Land Disturbance

Source: Bielinski Homes

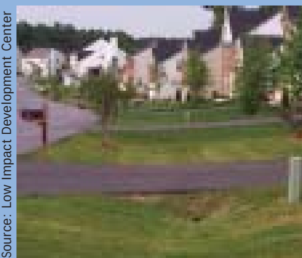


Community Open Space

Bielinski Homes
Waukesha, WI

Decentralize and Micromanage Storm Water at its Source using LID Storm Water Management Practices

Source: Low Impact Development Center



Grassed Swales

Somerset Development
Prince George's County, MD

From Conservation Design for Subdivisions: A Practical Guide to Creating Open Space Networks, by Randall G. Arendt. Copyright (©) 1996 by Island Press. Reprinted by permission of Island Press, Washington, D.C. and Covelo, CA.

Protect and Incorporate Natural Systems as Design Elements

Source: Applied Ecological Services, Inc.

Wetland System

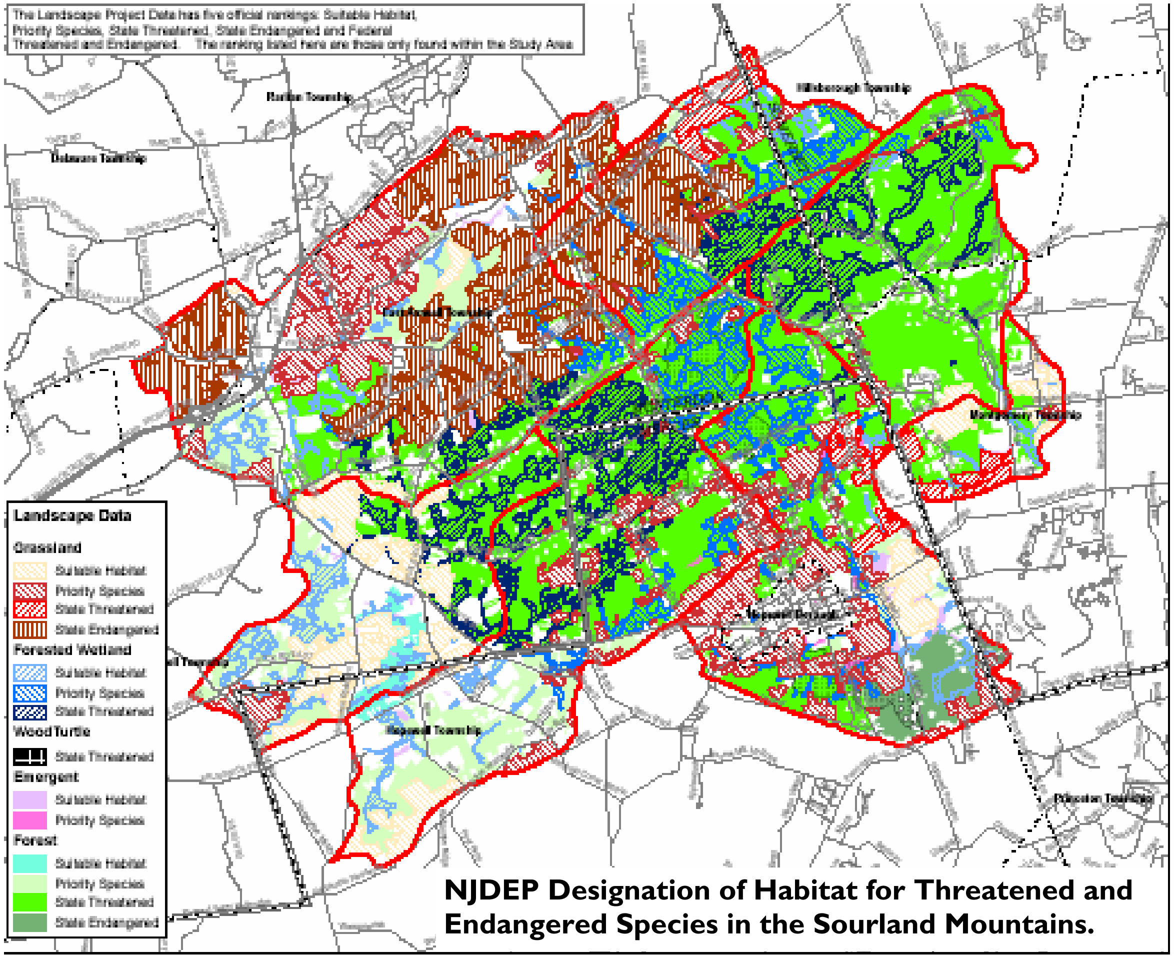
Prairie Crossing
Grayslake, IL

Utilize Neo-Traditional Street and Lot Layouts and Designs

Source: DPZ & Co.

Bowman Park

Vermillion Community
Vermillion, NC



NJDEP Designation of Habitat for Threatened and Endangered Species in the Sourland Mountains.

Conservation Planning & Management

The NJDEP funded the Sourland Mountain Regional Stormwater Management Plan to help protect the picturesque mountain streams, groundwater resources, and critical habitat for rare threatened and endangered species in this area. However, much of the land in this watershed area is privately owned and good stewardship by landowners is needed to minimize impairments to streams, groundwater and habitat areas.

The USDA Natural Resource Conservation Services (NRCS) offers farmers and landowners a variety of services and grant funding opportunities to encourage environmental stewardship of private lands. A Conservation Plan outlines voluntary management decisions to implement conservation practices on private lands. A NRCS Soil Conservationist will work with the landowner to inventory and evaluate soil, water, air, plant and animal resources on the property and then help identify conservation strategies appropriate for your needs. The plan can also help direct the landowner to other available programs under the Farm Bill.

Visit the NRCS website at http://www.nj.nrcs.usda.gov/

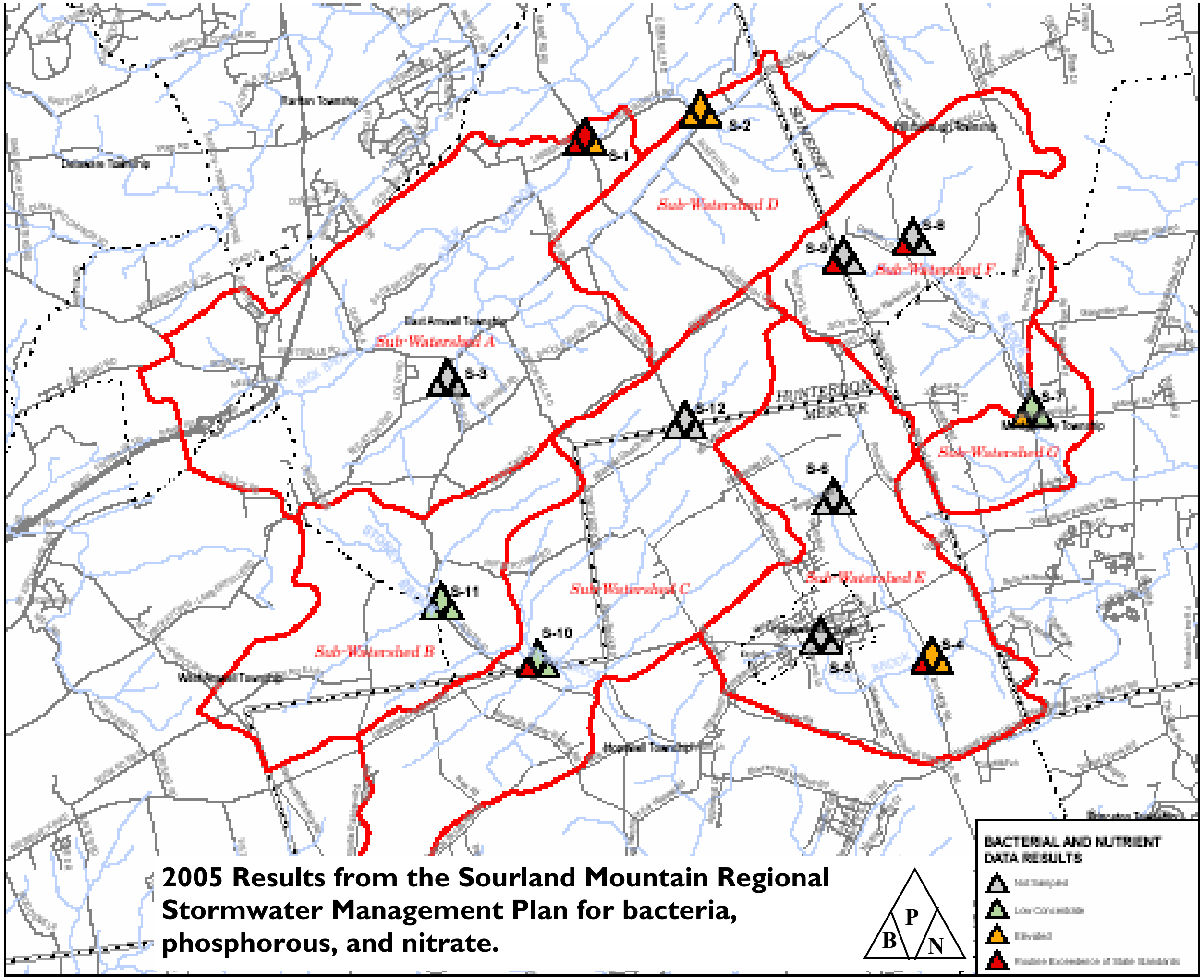
Sourland Mountain Regional Stormwater Management Plan

Conservation Solutions For Landowners

Sponsored by
New Jersey Department of Environmental Protection (NJDEP)

Hunterdon, Somerset & Mercer Counties

East Amwell, Montgomery, Hillsborough, West Amwell, and Hopewell Townships, and Hopewell Borough



2005 Results from the Sourland Mountain Regional Stormwater Management Plan for bacteria, phosphorous, and nitrate.

Comprehensive Management & Restoration Strategies

- Fencing
- Contour Farming
- Field Rotation—Delay Mowing until July 15th
- Manure Storage & Use
- Stream Buffer Plantings and Management
- Weed Control
- Pond Design /Aerators
- Grass Carp Stocking
- Wetland Restoration
- Goose Control

Comprehensive Nutrient Management Plans for Farmers USDA -NRCS Objectives

- Protect ground and surface water, soils, and public health.
  - Storing, handling or applying livestock manure properly.
  - Applying fertilizers and other nutrient sources minimally.
  - Reducing potential health and safety risks.
- Maintain and improve economic returns.
- Reduce erosion.
- Improve soil structure and reduce soil compaction.
- Maximize nutrient benefits while minimizing nutrient losses from leaching and runoff.
- Manage phosphorus to allow manure application.
- Improve storage and utilization of nutrients in manure and organic by-products.
- Utilize manure to provide organic matter to soils.

Princeton Hydro
1108 Old York Road
Suite One
PO Box 720
Ringoes, NJ 08551
(P) 908.237-5660
ssouza@princetonhydro.com

www.princetonhydro.com

The decisions are up to you!

- **You** make the decisions. The NRCS planner will give you many good alternatives and make some economic comparisons. However, you decide how, what, and when. It's your plan!
- Decisions are needed on both the uses of the land and its treatment. When you make a decision on land use, you will need to consider how to treat each field to get the desired results. These treatments are known as conservation practices. Several practices may be used in combination to solve resource problems, and collectively are called a resource management system.
- The NRCS planner can help you understand how the conservation practices fit together in a resource management system, and what is necessary to provide the maintenance for continued effectiveness in the future.
- The planner will record your decisions and will help in scheduling and applying planned conservation practices.
- The plan can be a guide for you for several years, and can be modified as your goals and objectives change.

Applying the conservation practices

Once planning decisions have been made, additional NRCS technical assistance to assist you in implementing the planned conservation practices can include engineering designs, operation and maintenance agreements, and standards and specifications. Federal, state and local permits are the responsibility of you the client, though NRCS can assist with certain information to support the permit applications.

Keeping your plan current

Your written conservation plan provides you with a ready reference guide for your year-to-year operations. Economics or other circumstances may change, and prevent you from following your conservation plan. NRCS conservationists can help you revise the plan when needed.

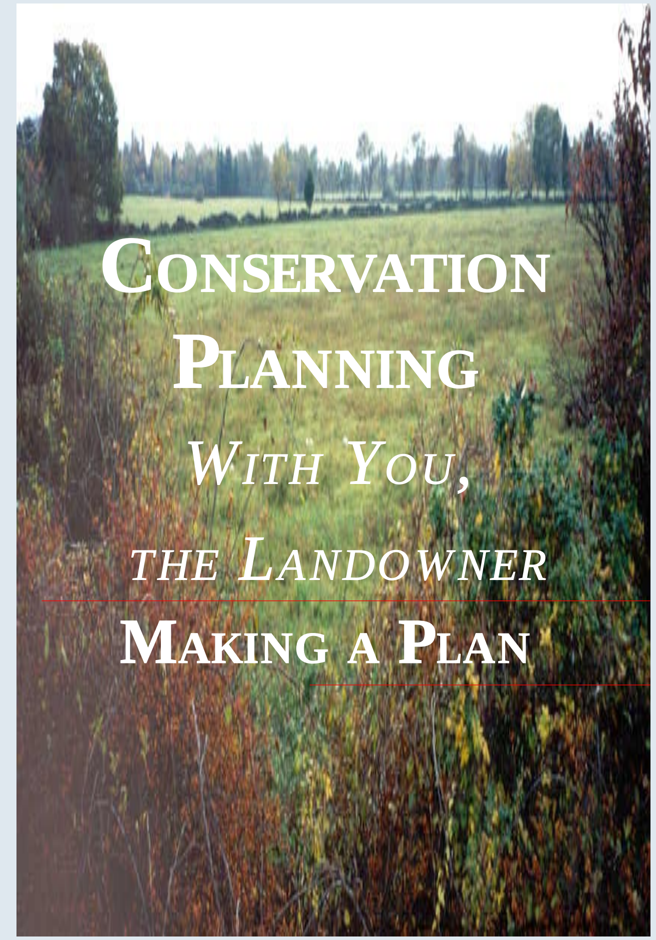
Remember, in conservation planning

- The process is voluntary and flexible.
- **You** make the decisions and carry them out, including maintenance.
- It is **your** plan for the land **you** own or use.
- NRCS is ready to help you.

Before, barnyard waste a detriment for livestock health and water quality.

After, manure storage structure with concrete livestock loafing area.

NRCS Natural Resources Conservation Service



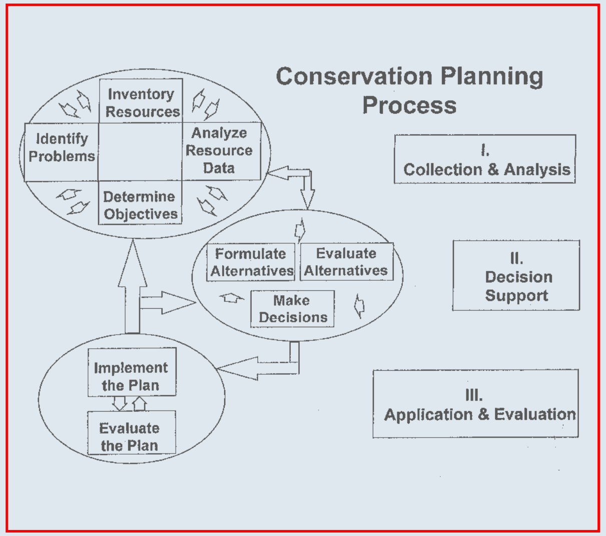
Conservation Planning

With You, the Landowner

Making a Plan

USDA NRCS
60 Quaker Lane, Suite 46
Warwick, Rhode Island 02886
401.828.1300 phone
401.828.0433 fax
www.ri.nrcs.usda.gov

*The success of conservation planning depends on you, the landuser being involved in every phase of the process. The decisions made are **your** decisions! Technically trained NRCS planners will help you reach informed decisions about soil, water, air, plants, and animal resources while considering human, social and economic concerns......*



What is a Conservation Plan?

A conservation plan is a customized document that outlines the use and best management practices of the natural resources on public or private lands. The plan defines and explains the resources in a simple, easy to understand manner. Typically, the plan will include land use maps, soils information, inventory of resources, engineering notes, and other supporting information. You, the landuser, make **all** the decisions, but do not have to tackle resource problems alone.

Farm Viability

A conservation plan can result in more viable and productive land, earning the farmer a higher income. Farm plans help to keep farmers farming!

Who needs a conservation plan?

Farmers and landusers on public or private land that want to achieve a healthy working landscape; landusers that participate in one of NRCS's many programs must have a plan or be developing one, before or during enrollment. However, you do not need to be enrolled in NRCS programs to obtain a conservation plan.

Consider why you may need a conservation plan

NRCS can help you develop a conservation plan one step at a time, while looking at the whole parcel of land. Remember, there is no cost to you, the landuser.

- Would you like the opportunity to enhance the natural resources on your land?
- Do you have muddy runoff, carrying precious soil nutrients and water away?
- Is your barnyard full of mud and manure?
- Are your gullies growing and difficult to cross?
- Do you see sediment accumulations at the lower part of your land or field?
- Are your fields less productive now than they once were?
- Is your property providing wildlife habitat?
- Is your livestock creating an environmental problem in the watershed?
- Do you need more and more fertilizer and water to sustain yields?
- Are there invasive species where once native species and productive pastureland thrived?
- Do you need to comply with certain regulations?

Making a Plan

When you are ready to start a conservation plan, a NRCS planner will meet with you to discuss your goals, plans, resource problems, the soils, and the NRCS's conservation programs. The planner will ask which crops you want to grow, the livestock you want to keep, the wildlife or recreation uses you want to plan, and any other interests you have that will affect the land. The planner will help you consider the effects a planned practice may have on a neighboring farm or parcel of land. Think on-site as well as off-site.

The first step in developing a conservation plan is to gather information for a resource inventory such as:

- nutrient management, which can include manure and wastewater
- irrigation water management
- erosion estimates
- topographic maps, geologic and other maps/inventories
- soil maps

The next step, the planner will help you address all land-use designations at a sustainable level, such as:

- cropland, forestland, and hay and pasture land
- recreation areas
- water resources, both quality and quantity
- wildlife habitat
- natural or sceinic areas
- dwellings - barns, barnyard paddocks/pens manure storage structures and other areas

Initial project areas will focus within the **South Branch, Spruce Run,** and the **Neshanic Watersheds**. These subwatersheds were selected based on water quality test results.

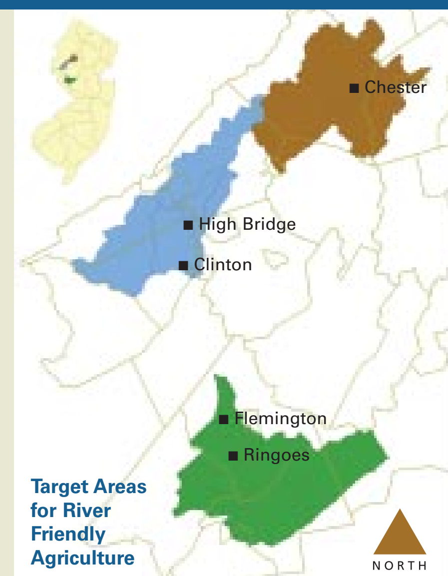
Successful implementation of the program in these target areas could lead to future state-wide opportunities for the River-Friendly Farm Program.

River-Friendly Farm Target Area Descriptions

■ **South Branch Watershed** encompasses portions of Mount Olive, Washington and Chester Townships in Morris County, and Lebanon and Tewksbury Townships in Hunterdon County. The main agricultural area extends from the area of Chester Borough southwest through Long Valley and towards Califon Borough.

■ **Spruce Run Watershed** includes the major tributaries within Lebanon, Union and Bethlehem Townships in Hunterdon County that feed the Spruce Run Reservoir. The target area extends from Califon Borough southwest to County Route 579 and east to County Route 513 north of Clinton.

■ **Neshanic Watershed** is located within Flemington Borough, Raritan, Delaware, East Amwell and West Amwell Townships in Hunterdon County and in Hillsborough Township, Somerset County. It includes Back Brook and the First, Second, and Third Neshanic Rivers. This target area extends east from Sergeantsville, Hunterdon County, to Montgomery, Somerset County, and runs from Hunterdon County Route 612 to Route 579 just south of Ringoes.



■ **Municipal Center**
■ **South Branch Watershed**
■ **Spruce Run Watershed**
■ **Neshanic Watershed**

Program Supporters
North Jersey Resource Conservation & Development
NJ Water Supply Authority
Raritan Watershed Agricultural Committee
USDA-Natural Resources Conservation Service
South Branch Watershed Association
Stony Brook-Millstone Watershed Association
New Jersey State Department of Agriculture
Rutgers Cooperative Research and Extension
New Jersey Farm Bureau
County Soil Conservation Districts
County Boards of Agriculture
County Agricultural Development Boards
USDA-Farm Service Agency
Garden State Grazing Coalition

The North Jersey RC&D serves and is sponsored by the Freeholders and Soil Conservation Districts of Hunterdon, Morris, Somerset, Sussex, Warren and Union Counties. Through partnerships with municipal, state and federal agencies, as well as many private entities, the Council develops and manages programs and projects that promote the improvement and wise use of the region's human and natural resources.

The River-Friendly Farm program is supported by a Conservation Innovation Grant from the USDA Natural Resources Conservation Service, the New Jersey Water Supply Authority, and the US Environmental Protection Agency Targeted Watershed Grant for the Raritan Basin.

Although the information in this document has been funded wholly or in part by the United States Environmental Protection Agency under assistance agreement WS982909-03-0 to the Stony Brook-Millstone Watershed Association, it has not gone through the Agency's publications review process and, therefore, may not necessarily reflect the views of the Agency and no official endorsement should be inferred.

River-Friendly Farm

Certification Program

Giving public recognition
to farms which protect and enhance
the Raritan Basin's rivers, lakes and streams

River-Friendly Farm

River-Friendly Farm

What is the River-Friendly Farm Program?

The River-Friendly Farm Program seeks to recognize farms that, through good management, help to protect water resources within the watershed. The voluntary River-Friendly Farm Program was initiated to address water quality concerns within the Raritan River Basin. Many of the streams within the watershed have been assessed as impaired for phosphorus. Conservation planning assistance will be offered to those farms that do not meet the certifying criteria, but would like to install or adapt the necessary components to become certified as River-Friendly.

Program Goals

Publicly recognize and reward farmers who do an outstanding job of managing their farms in an environmentally sound way that protects and improves water resources within the Raritan River Basin

Publicize and promote agricultural best management practices that help improve water quality while maintaining and improving agricultural viability of New Jersey farms

Increase public awareness of farmers' voluntary contributions to resource protection

Benefits of becoming a River-Friendly Farm

- Provides public recognition for implementing and maintaining stewardship practices
- Increases availability of funding sources for conservation practice implementation
- Creates an avenue for increased marketing strategies with River-Friendly Farm label
- Provides access to free technical assistance from a conservation planner
- Improves water quality in streams while maintaining productive farmland
- Promotes more efficient use of fertilizers and pesticides
- Provides a healthier soil structure



For more information about the
River-Friendly Farm Certification Program contact:

North Jersey RC&D
Dana Ronyack
(908) 735-0733 x102
dronyack@northjerseyrcd.org
www.njriverfriendlyfarm.org

How to Participate in the River-Friendly Farm Program

Applications are available at USDA Service Centers, Rutgers Cooperative Research and Extension Offices, Soil Conservation District Offices, and the North Jersey RC&D Office. Completed applications should be forwarded to the North Jersey RC&D Office.

Priority will be given to those farming operations meeting the requirements of a commercial farm as defined within the SADC's Right to Farm Act or those properties meeting farmland assessment requirements.

Priority will be given to those farms having water resources on the property, although it is not required for participation in the program.

Applications will be evaluated in the following areas:

Soil loss management

Nutrient management

Pest management

Stream corridor management

Irrigation water management

If all criteria are not currently met, conservation planning assistance will be made available to the applicant to help them implement the best management practices needed for the farm to become certified as River-Friendly.

Runoff & Nonpoint Source Pollution Self-Assessment

Greenhouses & Container Nurseries

Ag Water Quality Program

University of California Cooperative Extension
County of San Diego

http://cesandiego.ucdavis.edu
858-694-2845

Introduction

Agriculture is under increasing scrutiny for its contributions to runoff and nonpoint source pollution. Nonpoint source (NPS) pollution, unlike pollution from industrial and sewage treatment plants, comes from many diffuse sources. As runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters, and groundwater. Although agriculture is not the only concern, runoff from agricultural properties may contain contaminant levels that exceed water quality standards. Certain management practices can contribute to nonpoint source pollution in the form of excess sediments, nutrients, salts, pesticides, or pathogenic organisms. In San Diego County, new regulations adopted in 2001 have created new requirements for runoff entering the storm drain system. These new requirements affect many different types of businesses, including agriculture.

San Diego County's storm water permit specifically requires the county and cities to inspect greenhouses and nurseries for storm water violations. ***Other types of agriculture are not exempt from complying with water quality regulations. However, at this time other types of agriculture are not required to be regularly inspected for storm water violations.***

Instructions

This self-assessment provides a basis for assessing runoff and nonpoint source pollution potential from greenhouses and container nurseries. Runoff and nonpoint source pollution management on any agricultural property will involve a combination of practices. Not every property will have the same issues or utilize the same Best Management Practices to address them.

The self-assessment questions are divided into the following categories:

A. **Property Management**
B. **Road Management**
C. **Irrigation Practices**
D. **Leaching & Runoff**
E. **Nutrient Assessment & Fertilizer Management**
F. **Integrated Pest Management**

Each question may be checked "Yes, No, or Not Applicable." ***Answering "No" to any question indicates an issue that may need to be assessed or reconsidered as a Best Management Practice.*** **However, this does not necessarily determine evidence of nonpoint source pollution or violation of storm water regulations. A brief explanation is provided under each question explaining its importance to runoff, nonpoint source pollution, and/or Best Management Practices.**

Acknowledgements

Funding for this program has been provided in full or in part through a contract with the State Water Resources Control Board (SWRCB) pursuant to the Costa-Machado Act of 2000 (Proposition 13) and any amendments thereto for the implementation of California's Nonpoint Source Pollution Control Program. The contents of this document do not necessarily reflect the views and policies of the SWRCB, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

Funding also provided by Kee Kitayama Research Foundation, Environmental Quality Incentives Program (EQIP), California Association of Nurserymen, City of Encinitas, and UC Cooperative Extension - County of San Diego.

A. Property Management

1. Does irrigation and other operation runoff during dry weather remain on the property? ***All dry weather runoff is prohibited from entering the storm drain system, which includes street gutters, public waterways, and other conveyances that drain to public waters. Discharging dry weather runoff onto neighboring properties is not allowed unless done with consent. Dry weather runoff may also not be discharged onto public streets and roads.***	___Yes ___No ___N/A _______public street/road _______storm drain _______surface waters _______neighbor property
2. Is the property located away from public waterways, which includes streams, rivers, lakes, lagoons, wetlands, and bays? ***A higher potential to pollute exists when public water bodies are located directly on or adjacent to a growing operation. In addition, commercial operations near public water bodies designated as "impaired" under Clean Water Act section 303(d), or regulated under a "total maximum daily load" (TMDL) requirement may have more stringent requirements.***	___Yes ___No ___N/A
3. Has the location of all storm drain inlets, drainage pipes, and ditches and their outfalls been determined?	___Yes ___No ___N/A
Are storm drain inlets, drainage pipes, and ditches designated with anti-dumping signs (*e.g., No Dumping*)?	___Yes ___No ___N/A
Is buffer/filter vegetation located between production areas and storm drains?	___Yes ___No ___N/A
Are storm drain inlets, drainage pipes, and ditches protected during activities such as washing and loading/unloading activities that may result in discharge? ***Growers must be aware of all drainage pipes and ditches on their properties and know where they drain. Designating storm drains and ditches with signs to prevent dumping is encouraged but not required. The regulatory community is looking to detect and disconnect illicit connections to the storm drain system. A storm drain must only convey wet weather runoff. Buffer/filter vegetation can help absorb both dry and wet weather runoff.***	___Yes ___No ___N/A
4. Are outdoor driveways, parking areas and loading areas periodically dry cleaned for debris, vehicle residues, and other contaminants?	___Yes ___No ___N/A
If wet cleaned, does all runoff remain on the property? ***Periodic dry cleaning is recommended to prevent debris and residues from washing into the storm drain system during wet weather. Driveways, parking areas, and loading/packing areas may contain contaminants from vehicle fluids and emissions. Oil and other vehicle fluid spills must be cleaned up. Wash runoff may not leave the property. Dry cleaning methods are recommended to avoid creating runoff, and dust control practices also must not create runoff.***	___Yes ___No ___N/A

5. Does wash runoff from indoor packing/loading areas and walkways remain on the property? ***Walkways and loading/packing areas may contain contaminants from storage, mixing, or use of fertilizers and other chemicals. Wash runoff may not leave the property. Dry cleaning methods are recommended to avoid creating runoff.***	___Yes ___No ___N/A
6. Is roof runoff prevented from flowing across polluted areas, such as animal pens, parking areas, loading areas, etc.? **Is roof runoff directed into pervious areas (gravel, landscaping) or collection ponds?** ***Roof runoff should not be directed to flow across polluted areas where contaminants will be picked up and washed into the storm drain. If possible, roof runoff should be directed to flow into pervious areas where it can be absorbed or collected. Roof runoff may contain sediments, shading compounds, and organic materials.***	___Yes ___No ___N/A ___Yes ___No ___N/A
7. Are roof shading compounds managed to avoid washing into the storm drain system during application and removal? ***When wet, many shading compounds and paints contain toxic components that may be hazardous to marine life. Wet shading compounds and paints, as well as wash water from application equipment, must not enter the storm drain. Wash water from removal of dried shading compounds and paints may contribute very fine solid particles to water that remain suspended for long periods of time. Suspended solids can cause problems for aquatic life by blocking sunlight for submerged vegetation and clogging fish gills.***	___Yes ___No ___N/A
8. In landscaped *non-production areas*, are irrigation, fertilization, and pest management properly managed to avoid contaminated runoff? **Are all *non-production* areas managed to prevent erosion?** ***Landscaped areas must not create runoff. Highly erodible areas should be managed with appropriate vegetation or other means to avoid contributing sediments to runoff. Non-production areas may be appropriate for reuse of collected irrigation runoff or constructing collection ponds.***	___Yes ___No ___N/A ___Yes ___No ___N/A
9. Are fuel tanks and nozzles checked and maintained to prevent leaks? **Are fuel tanks located away from waterways, drainage ditches, and storm drains?** **Are fuel tanks equipped with secondary containment to contain spills?** ***A small amount of petroleum product can contaminate a large body of water. Locating fuel tanks away from waterways, drainage ditches, and storm drains minimizes risk of contamination. Secondary containment provides a method to contain hazardous liquids in the event of an accidental spill or leak.***	___Yes ___No ___N/A ___Yes ___No ___N/A ___Yes ___No ___N/A

10. Are vehicles, trucks, tractors, forklifts, pallet jacks and other equipment regularly maintained to detect and prevent fluid leaks?	___Yes ___No ___N/A
Are equipment spills and leaks immediately and properly cleaned up?	___Yes ___No ___N/A
Are collected fluids and solid waste from maintenance properly disposed (e.g., oil, antifreeze, batteries)?	___Yes ___No ___N/A
Are maintenance/storage areas located away from waterways, drainage ditches, and storm drains?	___Yes ___No ___N/A
Are maintenance/storage areas cleaned to avoid oil and grease buildup?	___Yes ___No ___N/A
Does runoff from equipment washing remain on the property?	___Yes ___No ___N/A
These types of equipment use numerous fluids that are very toxic to the environment. Wash runoff may not leave the property. Washing activities should be done over pervious areas (gravel, landscaping) where runoff will soak into the ground.	
11. Are spill clean-up materials available for all potential types and sizes of spills?	___Yes ___No ___N/A
Are significant spills immediately promptly reported?	___Yes ___No ___N/A
Preparedness for spills can eliminate or minimize runoff of harmful substances into the storm drain in the event of an accident. Basic spill materials include: adequate amount of absorbent material (e.g., kitty litter), broom and dustpan, chemically resistant gloves, and large labeled container to dispose of contaminated absorbent material.	
12. Is the property kept clean and free of solid waste and debris?	___Yes ___No ___N/A
Are trash and disposal areas kept clean and located away from waterways, drainage ditches, and storm drains?	___Yes ___No ___N/A
Are dumpsters and waste containers maintained in good condition, regularly emptied, and kept closed?	___Yes ___No ___N/A
Solid waste and debris can wash away during wet weather or blow off during windy conditions. Solid waste and debris can clog storm drains and cause fatalities for marine life through strangulation or ingestion. It can also create an unsightly mess in waterways and on beaches.	

13. Are pesticides, fertilizers and other chemical products stored in closed, labeled containers, under cover and off the ground? **Are pesticides, fertilizers, and other chemical products disposed according to label directions and all applicable regulations?** **Are chemical tanks and storage areas equipped with secondary containment to contain spills and leaks?** ***Pesticides, fertilizers, and other chemical products must be properly stored and disposed to prevent spills and wet weather washing into the storm drain system. Secondary containment provides a method to contain hazardous liquids in the event of an accidental spill or leak.***	___Yes ___No ___N/A ___Yes ___No ___N/A ___Yes ___No ___N/A
14. Are outdoor stockpiles of materials that are susceptible to wet weather covered and located away from waterways, drainage ditches, and storm drains? ***Materials stockpiled outdoors, such as potting mixes and containers/flats, should be properly located and covered to prevent wet weather washing into the storm drain system.***	___Yes ___No ___N/A
15. Are adequate restrooms or portable sanitation available? **Are restroom toilets, floor, and sink drains properly hooked up to the municipal sewer or a septic system?** **Is portable sanitation located away from waterways, drainage ditches, and storm drains?** **Is portable sanitation regularly maintained?** **Are septic systems and leach fields properly maintained?** ***Properly maintained restrooms and portable sanitation are necessary to prevent human waste and sewage from entering the storm drain system or contaminating groundwater. Human waste contains fecal coliforms, which are monitored by county officials to determine beach closures.***	___Yes ___No ___N/A ___Yes ___No ___N/A ___Yes ___No ___N/A ___Yes ___No ___N/A ___Yes ___No ___N/A
16. Have all employees received training in runoff, spill, waste, and sanitation management and all applicable regulations? **Are records kept of employee training at the facility?** ***Officially approved employee training checklists are available for nurseries and greenhouses that cover all required regulations. All employees must be trained annually. It is recommended all employees sign a completed checklist to document storm water training. Records must be kept of employee training. Training may additionally include educational workshops, company training manuals, and posted signs.***	___Yes ___No ___N/A ___Yes ___No ___N/A

17. Has a record-keeping system for water quality issues been started and maintained? *Record-keeping helps to document management practices A record-keeping system is available from UC Cooperative Extension – County of San Diego at http://cesandiego.ucdavis.edu. Click on "Ag Water Quality Program", then "Grower Resources."*	___Yes ___No ___N/A

B. Road Management & Erosion Control

1. Are new nursery roads properly permitted?	___Yes ___No ___N/A
In road design, is soil type for erodibility and suitability evaluated?	___Yes ___No ___N/A
In road design, are excessive slopes avoided?	___Yes ___No ___N/A
In road construction, is grading performed during dry months?	___Yes ___No ___N/A
In road construction, are exposed soils seeded and mulched to establish vegetation before winter rains?	___Yes ___No ___N/A
To avoid future complications with regulatory agencies, it is necessary to comply with all grading regulations. This may require the submission of an engineering plan for the roads along with specifications and an environmental assessment. Roads that are properly designed, constructed, and maintained will avoid long-term costs of erosion and grading. Exposed soils are subject to erosion losses during winter rains. Sediments are a contaminant in waterways.	
2. Are waterbreaks (or waterbars) utilized on nursery roads with gradients exceeding 8%?	___Yes ___No ___N/A
Are earthen waterbreaks properly sized (6 in. above and 6 in. below the road surface)?	___Yes ___No ___N/A
Are waterbreaks placed only where water flow has an outlet?	___Yes ___No ___N/A
Does diverted water from waterbreaks flow only into stable areas, avoiding septic fields or waterways?	___Yes ___No ___N/A
Are filter strips used at the outlet of waterbreaks and culverts to trap sediments?	___Yes ___No ___N/A
On gradients over 8%, waterbreaks (or waterbars) are effective in diverting accumulated water from the road surface onto a vegetated fill bank or toward a cutback. Diverted flow should not directly enter into waterways. Filter strips are vegetated areas between roads and waterways that can help trap sediments before they reach waterways. Sediments are a contaminant in waterways.	

3. Is nursery road use restricted during wet weather? **Are culverts inspected and cleaned out during winter rains?** **Is excessive road maintenance avoided?** *Using roads during wet weather will aggravate erosion and drainage problems. Maintaining culverts will allow water to drain freely. Avoid excessive road maintenance. Only regrade to remove deep ruts or damaged areas caused by severe storms.*	___Yes ___No ___N/A ___Yes ___No ___N/A ___Yes ___No ___N/A

C. Irrigation Practices

1. Is irrigation water quality regularly monitored by nursery personnel and/or professionally by a lab? **Are water quality records maintained?** *Regularly testing irrigation water quality is important for maintaining good plant health. Simple equipment can be used to test such parameters as EC, pH, and nitrate-nitrogen. Regularly testing fertigation water is also recommended to monitor fertilizer levels and to ensure injectors are operating properly.*	___Yes ___No ___N/A ___Yes ___No ___N/A
2. Do spray patterns of overhead or impact sprinkler systems uniformly deliver water without creating overspray in walkways and edges? **Are overhead and impact sprinkler systems used only in watering zones where pots/plants are spaced closely together to avoid runoff?** *Overhead and impact sprinkler systems have a higher potential to create runoff. Spray patterns should be checked to ensure water is being applied only to plants. Overhead emitters with check-valves can be installed to prevent line drainage and drip damage. Containers should be placed closely together to capture applied water and minimize runoff in the spaces between containers. If necessary, other irrigation methods should be utilized to more efficiently deliver water.*	___Yes ___No ___N/A ___Yes ___No ___N/A
3. Do fogging/misting systems effectively produce fine water particles? *Equipment for controlling temperature and humidity should be sized appropriately to prevent runoff.*	___Yes ___No ___N/A
4. Is hand watering performed with the use of an on/off mechanism? *Hand watering should be performed carefully to avoid creating runoff in spaces between containers and in walkways.*	___Yes ___No ___N/A

5. **Are appropriate emitter flow rates for spray stakes/drippers utilized in each watering zone?** **Are flow rates the same for all spray stakes/dripper emitters in each watering zone?** **Are spray stake/dripper systems managed to ensure every emitter is located in a container?** ***Emitter flow rates must be correlated with plant types and container sizes. Emitters with flow rates that are too high will apply water faster than containers can absorb, resulting in runoff. Emitters with different flow rates should not be combined in the same watering zone to maintain good uniformity. Each emitter should be located in a container to prevent runoff. Some emitters, such as spray stakes, can be "turned off" when not in use. Emitters that hang below the bench can drain the lateral line after irrigation. The cumulative effect of many emitters creating small individual amounts of runoff can result in large overall runoff volumes.***	___Yes ___No ___N/A ___Yes ___No ___N/A ___Yes ___No ___N/A
6. **Has the irrigation system been assessed for worn, outdated, and/or inefficient equipment that can be replaced?** **Is appropriate filtration in place for all irrigation equipment?** **Is appropriate pressure regulation in place for all irrigation equipment?** **Is all irrigation equipment regularly checked and repaired for leaks?** **Is all irrigation equipment regularly flushed and managed for clogging?** ***Adapting efficient irrigation technologies can help reduce the amount of runoff. Appropriate filtration will prevent problems associated with clogging, and appropriate pressure regulation will improve uniformity. General maintenance that includes managing leaks and clogging will also improve uniformity and prevent runoff.***	___Yes ___No ___N/A ___Yes ___No ___N/A ___Yes ___No ___N/A ___Yes ___No ___N/A ___Yes ___No ___N/A
7. **Is a uniformity evaluation regularly performed on the irrigation system?** ***A uniformity evaluation measures the capability of an irrigation system to evenly deliver water. A system with low uniformity will typically overwater some containers in order to provide adequate water to other containers with lower flowing emitters. High uniformity can be achieved with good system design, pressure regulation, prevention of clogs and leaks, and prevention of line draining. Mission Resource Conservation District (760-728-1332) provides free uniformity evaluations.***	___Yes ___No ___N/A
8. **Are specific methods/equipment, such as pot weight, evapotranspiration (ET) data, solar monitoring, or tensiometers, used to help determine irrigation schedules?** **Are irrigation duties performed only by employees who understand and practice appropriate irrigation scheduling?** ***Common watering practices can be imprecise and result in runoff. Irrigation scheduling should be based on environmental conditions and plant moisture requirements, and this must constantly be monitored.***	___Yes ___No ___N/A ___Yes ___No ___N/A

9. Are container sizes and plant types grouped in watering zones according to moisture requirements? ***Grouping together plant or containers with different moisture requirements will likely result in overwatering some plants or containers to provide adequate moisture to others.***	___Yes ___No ___N/A
10. Is pulse irrigation used? ***Pulse irrigation is the practice of splitting irrigations into smaller increments. The goal is to apply water in smaller increments that can be more effectively used by the plants, rather than one larger increment that produces excessive leach rates and runoff.***	___Yes ___No ___N/A
11. Are automatic timers and clocks regularly checked and adjusted to correlate schedules with environmental conditions and plant growth stage? ***Automatic timers/clocks can help implement more complicated irrigation schedules, such as pulsing. They can also reduce labor and avoid operator errors associated with manual systems. However, clocks/timers must also be checked for accuracy, including those that operate during unsupervised hours (i.e., night, early morning).***	___Yes ___No ___N/A

D. Leaching & Runoff

1. Are specific factors, such as appearance of plants or salinity measurements (EC), used to determine leaching practices? **Are irrigation schedules set to perform leaching at specific irrigation events, rather than at every irrigation?** **Is leaching performed only with fertilizer injectors turned off?** ***Leaching is necessary to flush excess salts from the root zone. Excessive leaching, or leaching performed too frequently may contribute to runoff or leaching into groundwater. Different plant species have different tolerances to salts. Use of high fertilizer concentrations may require more leaching to avoid build-up in the root zone.***	___Yes ___No ___N/A ___Yes ___No ___N/A ___Yes ___No ___N/A
2. Is the amount of leaching that occurs measured or monitored? ***The optimum amount of leaching is 10-15%. This means 10-15% of the water applied runs through the container or root zone. Taking the time to measure will demonstrate how easy it is to excessively leach. Excessive leaching represents wasted water, fertilizer, and greater runoff volumes to manage.***	___Yes ___No ___N/A
3. Do container mixes/media have high water holding capacity while providing adequate drainage? ***Utilizing container media/mixes with higher water holding capacity can reduce leaching and prevent runoff.***	___Yes ___No ___N/A

4. Is irrigation runoff collected from production areas? **Are collection reservoirs/tanks managed to avoid overflow during both dry and wet weather?** ***Collection capacity should be designed to handle runoff needs and probable storm events. Collection should also be designed or lined to prevent contamination of groundwater.***	___Yes ___No ___N/A ___Yes ___No ___N/A
5. Is runoff water quality regularly monitored? **Are runoff water quality records maintained?** ***Knowing what contaminants are present in runoff is key to proper management. Various options for reuse will depend on the quality of runoff. Basic water quality parameters to test for include pH, EC, nitrates, and phosphates. This can be performed with simple, inexpensive equipment. In addition, it is recommended to test for other contaminants according to the products utilized, such as specific pesticides, that may be present in runoff.***	___Yes ___No ___N/A ___Yes ___No ___N/A

E. Nutrient Assessment & Fertilizer Management

1. Are container mix/media tests performed? **Are leaf analyses performed?** **Is information from soil or leaf analyses used in fertilizer management?** **Are the most recent nutrient recommendations for your plants used in nutrient management?** ***The goal of successful nutrient management is to provide adequate plant nutrition through various growth stages without over-fertilization. Mix/media testing and leaf analyses can help better manage nutrients. Consult UC Cooperative Extension to obtain the most recent research-backed nutrient recommendations available for your specific crops.***	___Yes ___No ___N/A ___Yes ___No ___N/A ___Yes ___No ___N/A ___Yes ___No ___N/A
2. Are nutrients already present in irrigation water and/or recovered runoff considered in nutrient management? **Are nutrients already present in soil amendments considered in nutrient management?** ***Over-fertilization can result if nutrients already present in water and amendments are not taken into account.***	___Yes ___No ___N/A ___Yes ___No ___N/A

3. Are incorporated solid fertilizers thoroughly mixed throughout the container mix/media and at the correct rate? **Are organic materials or manures thoroughly composted before application?** ***Incorporated fertilizers must be thoroughly and evenly applied at appropriate rates to provide good plant nutrition and to avoid excessive leaching. Composts and manures that are not thoroughly composted have the potential to contribute bacteria and other contaminants to runoff. Organic materials and manures not fully composted may also cause a nitrogen imbalance in the soil, as these materials require nitrogen to break down.***	___Yes ___No ___N/A ___Yes ___No ___N/A
4. Are slow-release or controlled-release fertilizers utilized? ***Slow-release and controlled-release fertilizers can be successfully used in some situations to minimize leaching losses of nutrients.***	___Yes ___No ___N/A
5. Are topdressed solid fertilizers carefully applied at the correct rate and at the appropriate plant growth stage? ***Topdressed fertilizers must be carefully applied at the correct rate while taking care to keep granules in the container. Application should be timed to correspond with plant growth stage and nutrient needs to provide good nutrition and to avoid excessive leaching.***	___Yes ___No ___N/A
6. Are injected fertilizers carefully mixed and applied at the correct rate? **Is an electrical conductivity (EC) meter or other method regularly used to monitor the liquid fertilizer mix?** **Are injectors calibrated to accurately deliver liquid fertilizer through the irrigation system?** ***Highly soluble liquid fertilizers are easily leached and must be carefully managed. An electrical conductivity (EC) meter can be utilized to easily monitor the fertigation water.***	___Yes ___No ___N/A ___Yes ___No ___N/A ___Yes ___No ___N/A

F. Integrated Pest Management

1. Are plants regularly monitored for pests with proper scouting and monitoring methods, such as traps and plant inspection?	___Yes ___No ___N/A
Does the decision to use chemical pesticides include scouting and monitoring information?	___Yes ___No ___N/A
Establishing an ongoing monitoring system will help detect pest infestations early. By regularly inspecting plants, growers can detect troublesome pests while they are still manageable and before major damage is done. ***Evaluating pest populations on a regular basis also helps determine the actual need for chemical control, rather than relying on regularly scheduled chemical applications. Reducing the number of applications will lower production costs and reduce the amount of chemical released into the environment.***	
2. Are weather conditions, such as fog and rain, considered in scheduling pesticide applications?	___Yes ___No ___N/A
Are irrigation schedules considered in scheduling pesticide applications?	___Yes ___No ___N/A
Schedule applications to avoid pesticide leaching and runoff.	
3. Are diagnostic lab services or other professional assistance used to determine unknown pathogens, insects, or other growth problems?	___Yes ___No ___N/A
Different pathogens can have similar symptoms. Some insects can also be difficult to identify. Some symptoms may be related to environmental conditions or nutrient and water issues. Accurately diagnosing a problem may sometimes require professional assistance. Successful treatment will depend on an accurate diagnosis.	
4. Are low-toxicity and/or non-toxic chemicals selected for pest control whenever possible?	___Yes ___No ___N/A
Using less toxic materials reduces risk of pollution. Always read and follow label directions.	
5. Are pesticides applied only according to the label?	___Yes ___No ___N/A
Are improved application techniques used when recommended (e.g., ultra low volume application, surfactants, stickers and sticker-spreaders)?	___Yes ___No ___N/A
Is chemical spray equipment calibrated to ensure accurate application rates?	___Yes ___No ___N/A
It is illegal to use a chemical product in a manner inconsistent with the label, and this may also pose additional water quality risks. Adopt improved application technology where available, registered and legal, to reduce the amount of chemicals applied and to maximize effectiveness.	

6. Are biological controls integrated when possible and where effective? ***The use of natural predators or parasites to keep harmful pests in check can be highly effective in combination with good management practices and judicious use of chemical agents.***	___Yes ___No ___N/A
7. Is the growing area treated or fumigated before establishing a new crop?	___Yes ___No ___N/A
Are weeds eliminated?	___Yes ___No ___N/A
Is contact between hoses and plants minimized to prevent spreading diseases?	___Yes ___No ___N/A
Is standing water eliminated? ***A clean production environment is essential to pest management. By fumigating or treating greenhouses before establishing a new crop, pest problems from previous crops can be eliminated. Eliminating weeds and other hosts for pest populations makes it more difficult for a pest to establish itself in the growing environment. Standing water should be eliminated to avoid creating ideal conditions for pathogens and insects to reproduce.***	___Yes ___No ___N/A
8. Are all plants, plugs, cuttings, and transplants shipped in inspected for pests?	___Yes ___No ___N/A
Are plants quarantined before introduction to the growing area?	___Yes ___No ___N/A
Are plants with pests properly treated or disposed before entering the growing area? ***Only clean plants, plugs, cuttings, or transplants should be allowed to enter the growing area. Carefully inspect all new shipments, discarding or treating any plants with pest problems. Quarantines allow time to monitor plants for any potential pathogen or insect problems. Proper disposal of disease or pest-infested plants will keep these problems out of the growing area.***	___Yes ___No ___N/A

Additional Assistance

Additional assistance is available from UC Cooperative Extension – County of San Diego.
Please call 858-694-2845.

CA

Established

EAST AMWELL TOWNSHIP

1846

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Municipal Offices
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August 17, 2007

Gary J. Brower, Esquire
NJ Department of Environmental Protection
Office of Legal Affairs
401 East State Street
Trenton, New Jersey 08625-0402

**Re: Proposed Designation of Stony Brook to a Category One Waterway
Proposed Amendments to N.J.A.C. 7:9B-1.4 and 1.15
DEP Docket Number 11-07-04/557**

Dear Mr. Brower:

This letter is written in support of the recent proposal by the NJ Department of Environmental Protection to designate portions of Stony Brook to a Category One (C1) waterway. The efforts of the Department to conserve endangered species habitat and protect water quality of the Stony Brook are commendable and valued by the members of the East Amwell Township Committee. This proposed designation encompasses the portion of the stream approximately from Pennington Hopewell Road (in Hopewell Township) to the Pumping Station at the Delaware & Raritan Canal (Princeton Township).

The East Amwell Township Committee also proposes that the Category One (C1) Designation be extended further upstream to include portions of the headwater areas of the Stony Brook, reiterating our request to the Division of Watershed Management on February 17, 2003. At that time, East Amwell nominated the following headwater stream segments which are located in either conservation easements or publicly owned land and pass through an Environmentally Sensitive State Planning Area, a Forested and Wetland Land Use area, and/or a New Jersey Landscape Project Rank 4 Critical Forest Habitat. The areas are as follows:

- The portion of the Stony Brook Stream headwaters (in Stony Brook (74d 48m 10s to 74d 49m 15s) Subwatershed), which pass through the Hunterdon County Sourlands Preserve and the conservation easement south of Ridge Road. These portions are located within Forested and Wetland Land Use areas, NJ Landscapes Project Rank 4 Critical Habitat, and both PA-5 and PA4B.

- The portions of the Stony Brook headwater stream and entering and leaving Amwell Lake that fall within the Amwell Lake Wildlife Management Area (within the "Stony Brook (above 74d 49m 15s) Subwatershed).

East Amwell Township would be happy to consider nomination of other portions of those waters which do not pass through conservation easements or publicly owned land once the specific impact of the C1 Designation is better understood pending further structuring of the Stormwater Management regulations.

Enclosed please find a copy of a separate letter of support for the C1 designation from the East Amwell Township Environmental Commission, which was approved at their July 23, 2007, meeting.

Thank you for the opportunity to comment.

Sincerely,

Kathleen Machnik
Kathleen Machnik
Deputy Mayor
Member of the Regional Stormwater Management
Lead Agency Team

TC
TMA
copy List ✓

KM/ts
CC: Township Committee
Environmental Commission
Ad Hoc Stormwater Committee
Princeton Hydro

Stony Brook Millstone Watershed Association

RARE TODAY . . . PRICELESS TOMORROW

August 20, 2007

Mr. Gary J. Brower, Esq.
Attn. DEP Docket Number 11-07-04/557
Office of Legal Affairs
New Jersey Department of Environmental Protection
401 East State Street, Floor 4
P.O. Box 402
Trenton, N.J. 08625-0402

RE: DEP docket number 11-07-04/557

Dear Mr. Brower,

The Stony Brook-Millstone Watershed Association, Friends of Hopewell Valley Open Space, Washington Crossing Audubon Society, and Sourland Planning Council appreciate this opportunity to express our strong support for the proposed designation of portions of the Stony Brook and its tributaries in Hopewell, Lawrence, and Princeton Townships as a Category One water under the Surface Water Quality Standards (SWQS) at N.J.A.C. 7:9B. We urge the Department to promptly adopt the proposal while expanding it to include the headwaters of Stony Brook. In addition, we urge the department to also upgrade the headwaters of the Stony Brook to Category One status. Finally, we are concerned by several provisions in the proposed new criteria and urge the department to defer action on this part of the proposal at this time.

The Stony Brook-Millstone Watershed Association was very pleased to host Commissioner Lisa Jackson for her announcement of this important environmental proposal in April and to have the Mayors of Hopewell Township and Pennington Borough in the audience to lend their support. The mission of the Stony Brook-Millstone Watershed Association (Watershed Association) is to protect clean water and the environment in the 265-square mile region of central New Jersey drained by Stony Brook and the Millstone River.

The mission of the Friends of Hopewell Valley Open Space is to promote conservation in the Hopewell Valley region through open space preservation, informed land use, wise stewardship, education and outreach. Washington Crossing Audubon Society, a chapter of the National Audubon Society, is dedicated to conserving and restoring native plants and animals and their habitats; furthering the intelligent utilization of land, water and natural resources; promoting citizen science; and encouraging greater understanding and appreciation of the natural environment. The Sourland Planning Council is a non-profit organization working to protect the ecological integrity, historical resources and special character of the Sourland Mountain region

J. Seward Johnson, Sr.
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Adopt the proposed Category One proposal for Stony Brook

In 2003, the Watershed Association worked closely with Hopewell Township to identify waterways in the Stony Brook Watershed and other areas that warranted designation as Category One. We nominated areas of the Stony Brook and its tributaries as well as other waterways in our region that we believed to be of such exceptional value as to warrant the protection from measurable change in water quality afforded this designation.

The segment of the Stony Brook and its tributaries identified in the Department's proposed rule contains exceptional ecological significance that very clearly meets the standards for Category One designation under both the existing and proposed criteria for this designation. As the Department pointed out in its proposed rule, the Stony Brook provides critical habitat for several threatened and endangered species of freshwater mussels, including the State Endangered brook floater, the State Threatened triangle floater and eastern pondmussel. The Stony Brook also is the location of the last known sighting of the State Endangered green floater.

Freshwater mussels are sedentary, and long lived. They also depend on host fish, such as darters, shiners and alewife to propagate. The vitality of rare freshwater mussels has been impacted by poor water quality, sedimentation, damming and channelization of streams, removal of stream bank vegetation, poor land practices, and urbanization. Organic pollution, eutrophication, low dissolved oxygen also affects their survival, as can extreme changes in stream flows, such as flashy storm runoff or drought conditions. (Nature Serve, 2005). The Department's Wildlife Action Plan published in February 2007 recommends that in order to protect the long term productivity and distribution of these species, the Division of Fish and Wildlife will recommend that certain stream segments be upgraded to the Category One designation.

In addition, lands surrounding the Stony Brook and its tributaries provide habitat for a variety of other threatened and endangered species not specifically listed in Department's proposed rule, including the wood turtle, whose presence has been used in the past by the Department to support Category One listing. Other listed species present in the area of these streams include pied-billed grebe, Cooper's hawk, osprey, red headed woodpecker, grasshopper sparrow, henslow's sparrow, red shouldered hawk, long-eared owl, and northern harrier. The protections afforded by Category One designation will help ensure their continued existence and the protection of clean water upon which several of these species depend.

The Department's Landscape Project database indicates extensive areas of threatened and endangered species habitats within and near the proposed Stony Brook Category One segment. (See Attachments A-E for maps of habitat for wood turtles, forest, grassland, forested wetlands, and emergent wetland species from Landscape Project data).

Stony Brook headwaters also warrant Category One protections

While we strongly support the proposed designation of the identified segment of the Stony Brook and its tributaries, we also urge the Department to designate as Category One the headwaters of the Stony Brook and tributaries north of Pennington Hopewell Road in HUC 14s numbered 02030105090030, 02030105090020, and 02030105090010.

This reach of the Stony Brook and tributaries also contain exceptional ecological significance and clean water that warrant the additional protections afforded by Category One designation under both the existing and proposed criteria for this d designation. Furthermore, by protecting the headwaters of the Stony Brook, the Department would significantly enhance the prospects for protecting the threatened and endangered species that are the target for its proposed rule.

The following specific information supports the designation of the Stony Brook headwaters and tributaries as Category One:

- The Watershed Association has regularly monitored Stony Brook at Mine Road, north of the Pennington-Hopewell Road through our StreamWatch program. Our most recent investigation in March, 2007, found the benthic macroinvertebrate community non-impaired.

Table 1: StreamWatch 2007 Benthic Macroinvertebrate Results for Stony Brook at Mine Road (March 17, 2007)

Number in sample	131
FBI	4.2
Taxa Richness	21
EPT Richness	7
% EPT	66%
% Dominance	23%
Scoring	**Non-impaired**

FBI = Family Biotic Index. The average pollution-tolerance ("sensitivity") of individuals in the sample.

Total Taxa Richness = Number of different families in the sample.

EPT Richness = Total number of families in *Ephemeroptera, Plecoptera,* and *Tricoptera* Orders.

% EPT = Percent of the macroinvertebrates in the *Ephemeroptera, Plecoptera,* and *Tricoptera* Orders.

% Dominance = Percent of sample composed of individuals from one family.

- The Watershed Association's data also indicate that standards for dissolved action and temperature are also being met (See Attachments F and G for data). We do not measure total suspended solides or total phosphorus.

- State data shows that the AMNET site at Mine Road was non-impaired in 2004, which is the last time they sampled there.

- Benthic macro-invertebrate surveys conducted in 2005 by Princeton Hydro for the Sourland Mountain Regional Stormwater Management Plan from three separate locations (stations 10, 11 and 12) indicate that the upper headwater segments of the Stony Brook are Non-Impaired.

Table 2: 2005 Sourlands RSWMP Benthic Macroinvertebrate Results

	Station 10 Main Stem Stony Brook	Station 11 W. Stony Brook Headwaters Feryok property	Station 12 Stony Brook County Preserve
Taxa Richness	17.00	15.00	19.00
EPT[1]	9.00	6.00	9.00
Dominant Taxon	Baetidae	Baetidae	Chironomidae
% Dominance	45.83	40.00	42.75
% EPT	56.67	51.30	42.03
FBI[2]	4.67	4.76	4.47
NJIS Score[3]	**27 non-impaired**	**30 non-impaired**	**27 non-impaired**

[1]EPT refers to species sensitive to impairments of water quality, including Ephemeroptera, Plecoptera, Trichoptera also known as Mayflies, Stoneflies, and Caddisflies.
[2] FBI refers to the Hilsenhoff Family Biotic Index
[3] NJIS Score refers to the New Jersey Impairment Score. A sample result with a NJIS of 24 to 30 is classified by NJDEP as non-impaired.

- Significant portions of the upper segments of the Stony Brook watershed are currently preserved as open space, protected by conservation easements or enrolled in the farmland preservation program.

- The Department's Landscape Project database indicates extensive areas of threatened and endangered species habitats within and near the proposed Stony Brook Category One segment. Approximately 40% is designated as *forested habitat* for state threatened species; 15% provide forested habitat for priority species; approximately 20% is designated as *forested wetland habitat* for state threatened species; 10% providing forested wetland habitat for priority species: and approximately 15% is designated as suitable *grassland habitat* and habitat for priority grassland species. Several vernal pools are also present in these forested wetlands. (See Attachments A-E for maps of habitat for wood turtles, forest, grassland, forested wetlands, and emergent wetland species from Landscape Project data.)

- Furthermore, affording the upper reaches of the Stony Brook Category One protections, would better safeguard the baseflow, water quality, and habitat of the endangered and threatened freshwater mussels documented in the lower reaches of the Stony Brook.

The Department should defer modifications to the Category One listing criteria

While we strongly support the proposed designation of portions of Stony Brook and its tributaries as Category One, and urge the Department also to so designate the Stony Brook headwaters, we are concerned that the proposed new designation criteria could unnecessarily and inappropriately limit which water bodies could receive this protective designation in the future.

For example, we understand that the Department has used its authority in the past to designate water bodies as Category One based on their value to wood turtles and other threatened and endangered species not among the seven species included in the proposed rule. This agency discretion should be preserved moving forward.

In addition, the Department has previously taken the position that impairment for certain water quality parameters should not preclude a water body from designation as Category One under the "exceptional ecological significance" criteria. The flexibility provided by this current approach should be maintained.

Finally, we believe that the Department should continue to have the discretion to designate as Category One under the Exceptional Drinking Water Supplies criteria such water bodies that provide drinking water for fewer than 100,000 people. With our state continuing to grow, and legitimate concerns being raised about the future of our drinking water supplies, it does not make sense to limit which water bodies can be protected for their importance to drinking water supplies in this manner.

Thank you, again for this opportunity to provide our strong support for the protection of the Stony Brook and its tributaries. We urge you to promptly adopt this measure.

Sincerely,

James R. Waltman
Executive Director,
Stony Brook-Millstone Watershed Association

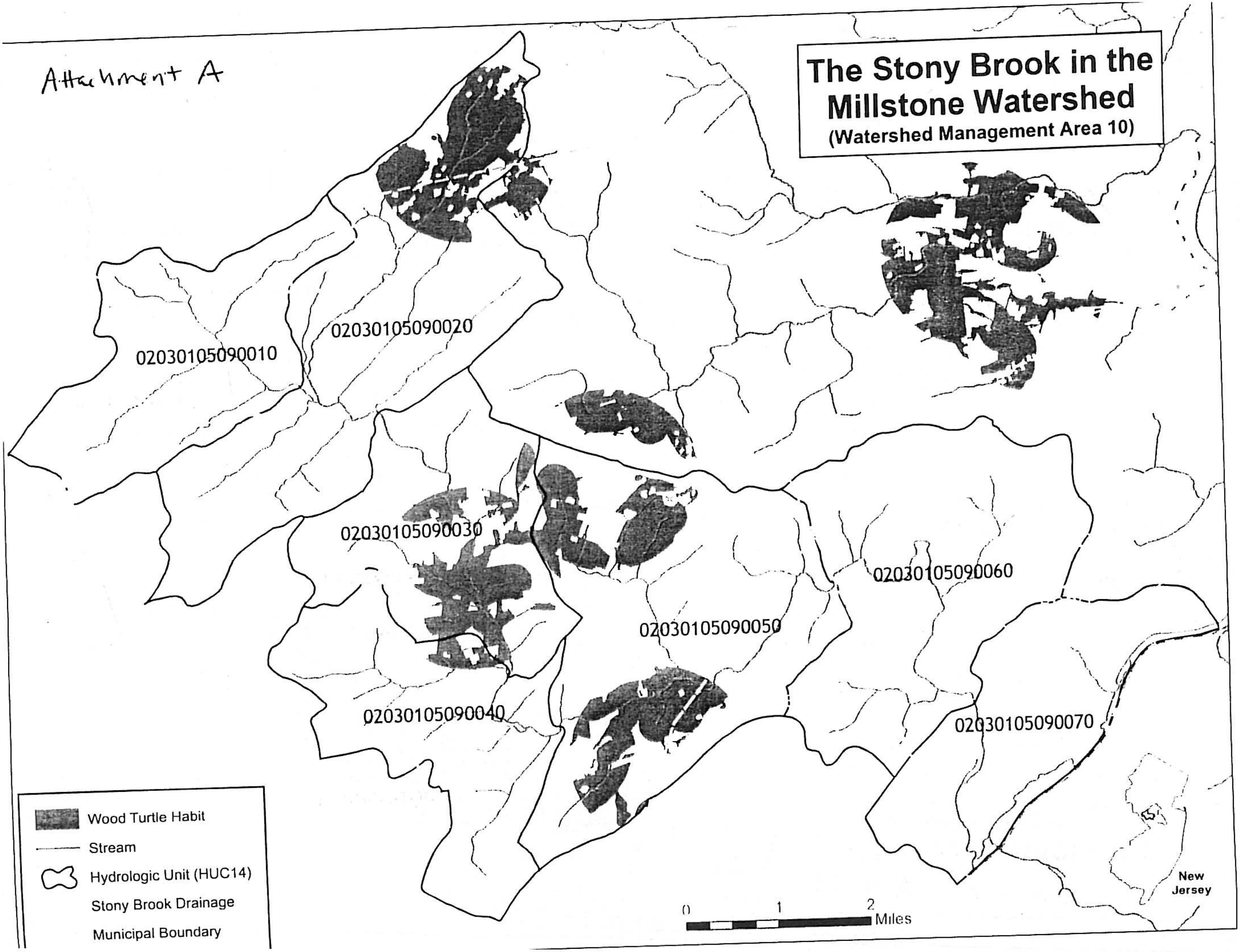
Jessica Wilkinson
President
Friends of Hopewell Open Space

Joseph Pylka

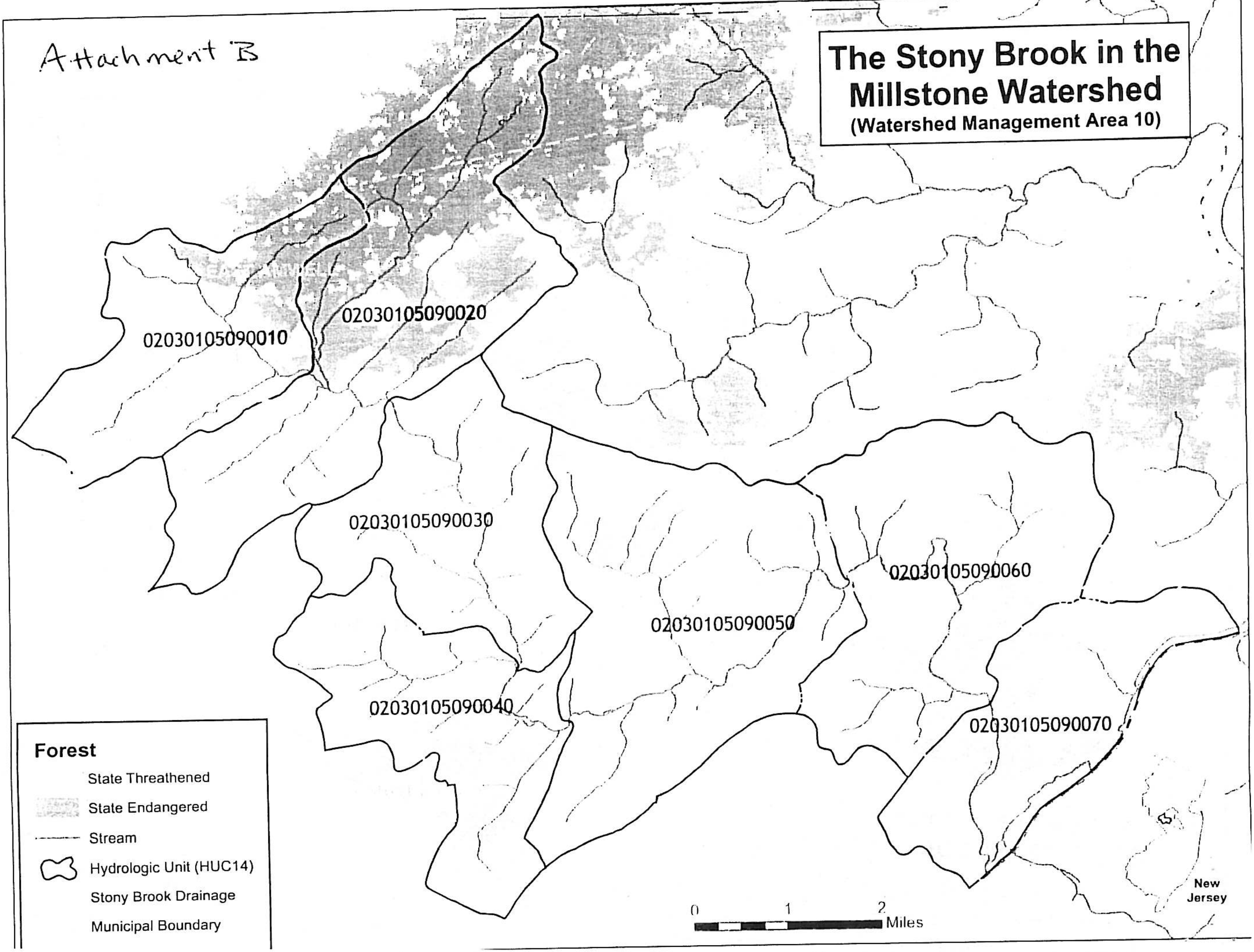
Joseph M. Pylka
President
Washington Crossing Audubon Society

John P. Brunner
Executive Director,
Sourlands Planning Council

Attachment A

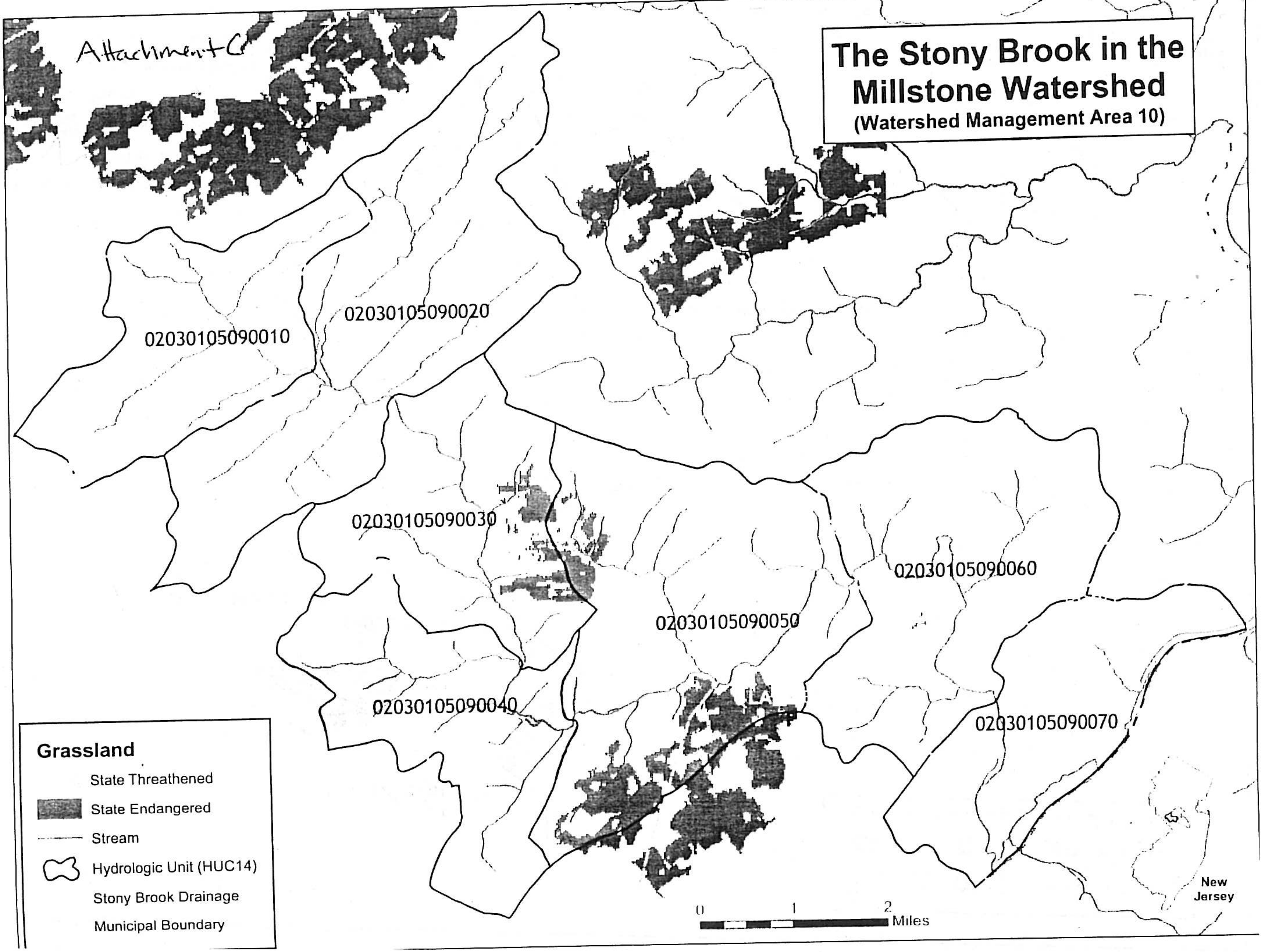


Attachment B

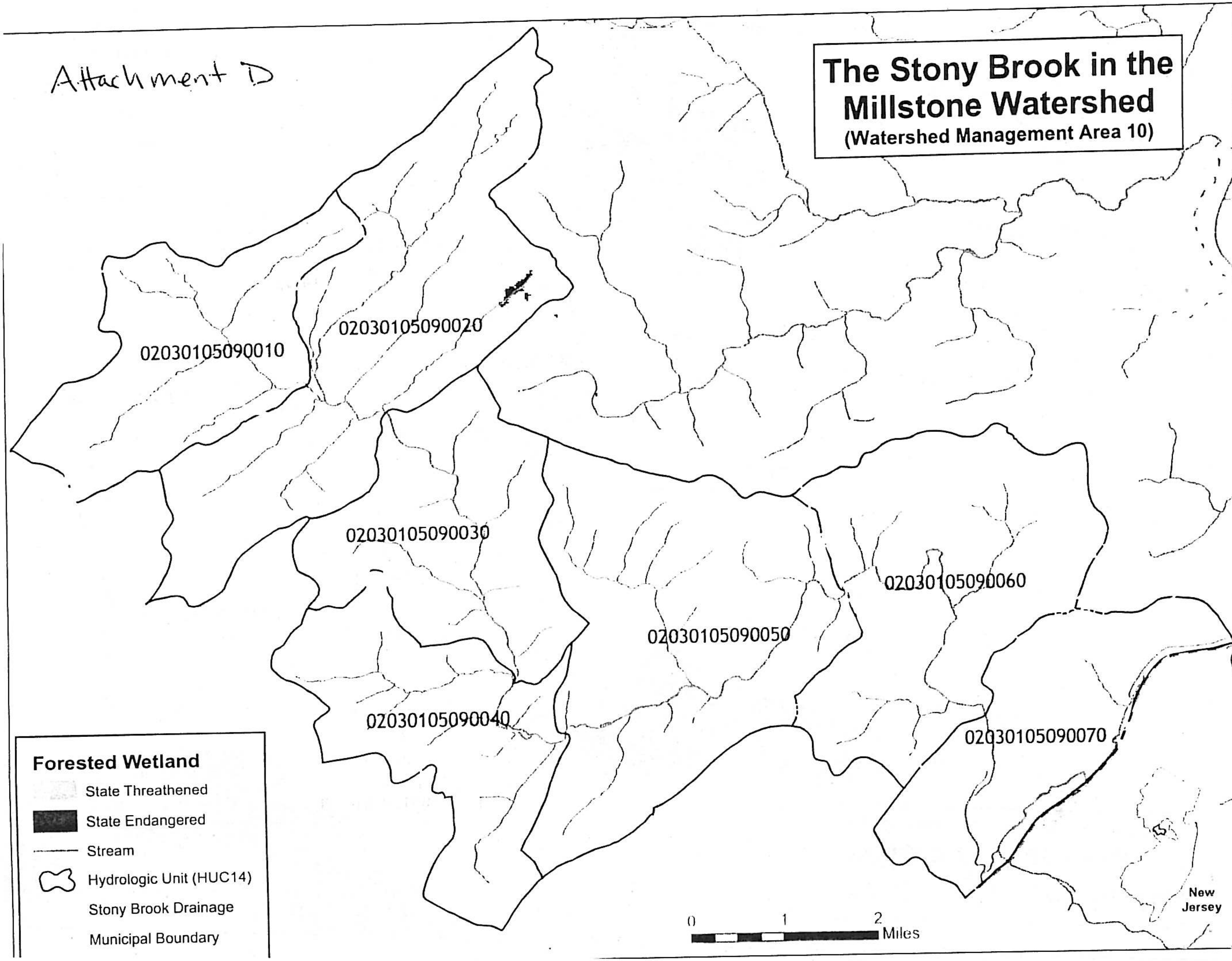


Attachment C

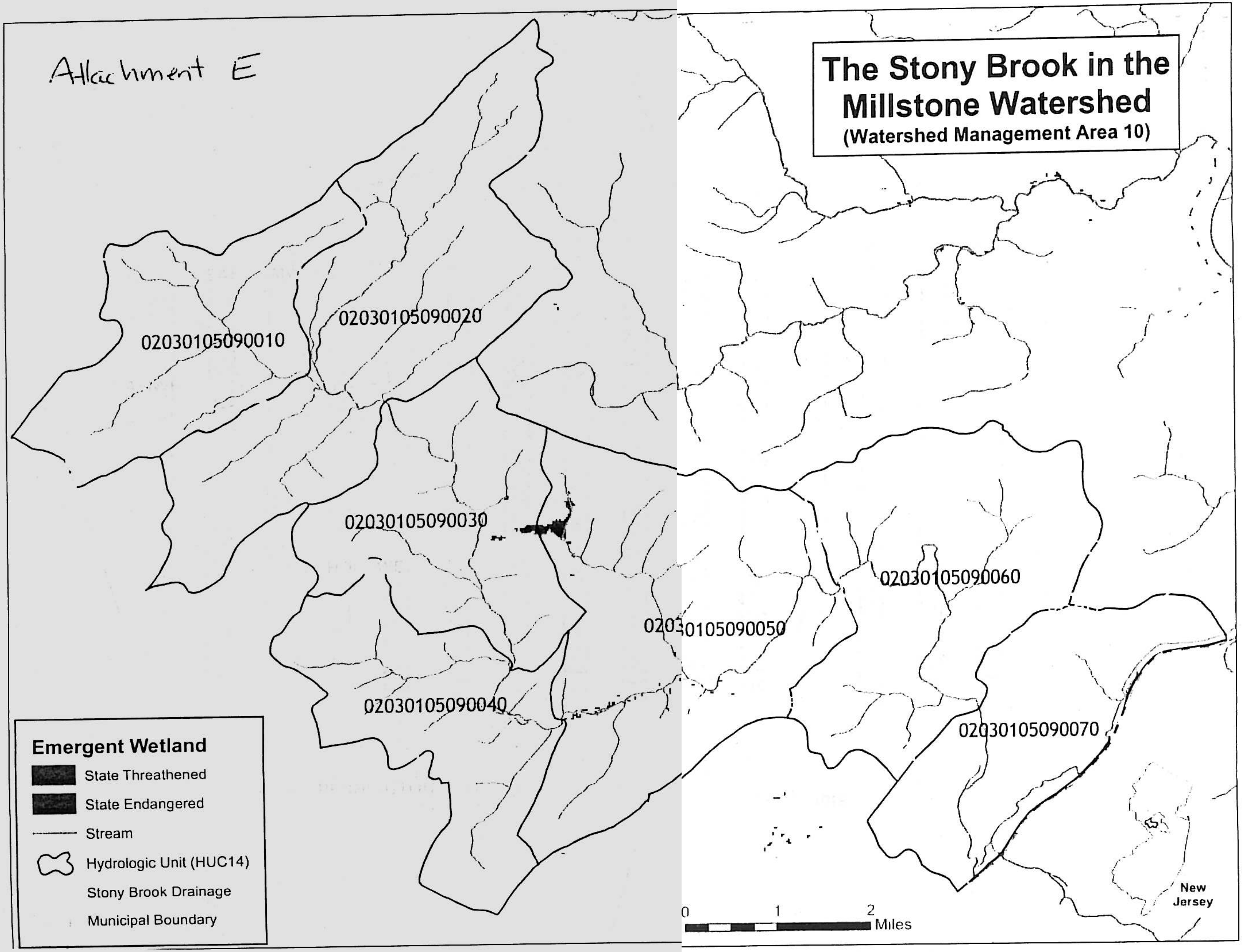
The Stony Brook in the Millstone Watershed
(Watershed Management Area 10)



Attachment D

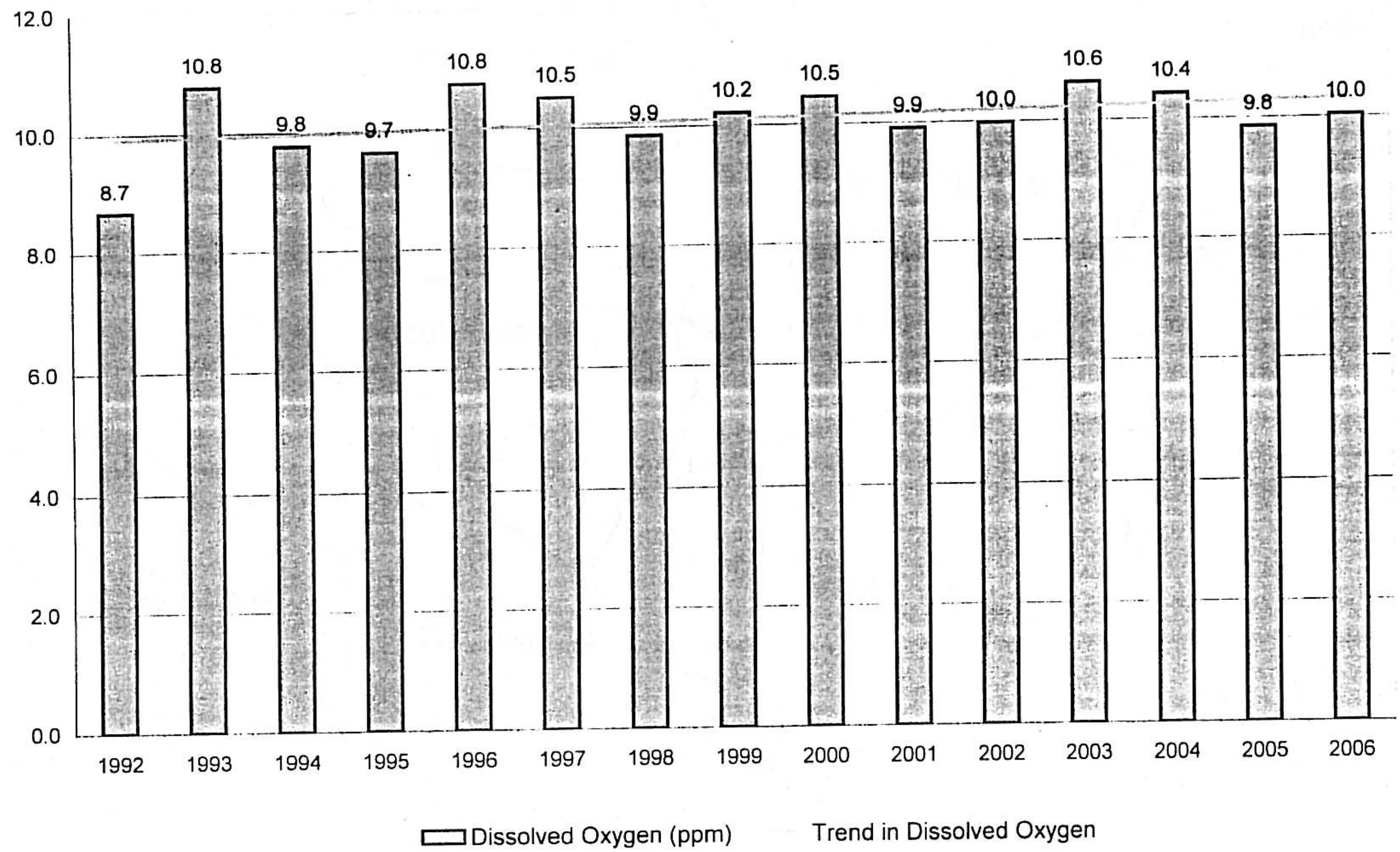


Attachment E



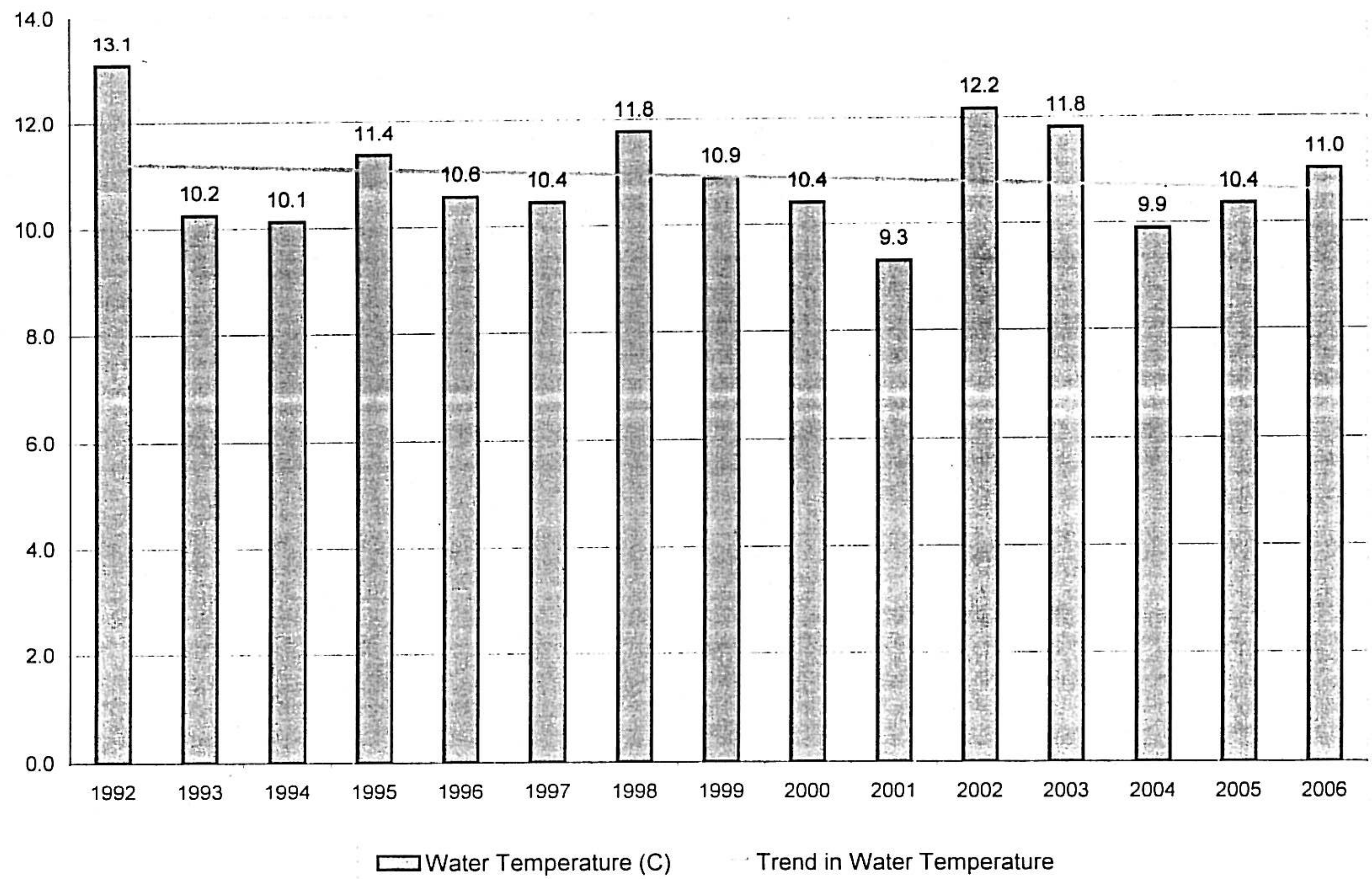
Attachment F

Stony Brook (SB5) Annual Average Dissolved Oxygen Levels



Attachment G

Stony Brook (SB5) Annual Average Water Temperature



EAST AMWELL TOWNSHIP
Established 1846

Municipal Offices
1070 Route 202/31
Ringoes, NJ 08551-1051
(908) 782-8536
Fax (908) 782-1967

August 15, 2007

Ms. Christine Altomari
Princeton Hydro, LLC
Ringoes, New Jersey 08551

RE: Proposed Designation of Stony Brook to a Category One Waterway

Dear Ms. Altomari:

Please be advised that the Environmental Commission of East Amwell Township has recently voted and approved an endorsement to designate the Stony Brook as a Class C-1 Stream Status. The Environmental Commission believes that the land management requirements of the C-1 Stream Status are in line with our priorities for the Township. The Stony Brook is currently in such a pristine condition that we hope by recommending this C-1 Stream Status, we can preserve it in this condition for generations to come. C-1 Status enforced by the State will be an important part of preserving the quality of this stream and its watershed.

Cordially yours,

Dee Kellogg (jsc)

Dee Kellogg, Chair
Environmental Commission

/jsc

Septic System Management Brochure, 2007

Phone: 908-237-5660
Fax: 908-237-5666
www.princetonhydro.com

Princeton Hydro

Why Septic System Management is Important

Sixteen percent of homes in New Jersey rely on wells and septic systems and many of them are located near lakes and or streams. Many people may not realize that the way they maintain their septic system and yard can affect the local water quality. Regular maintenance of a septic system can protect water resources, can extend the life of a septic system, and it is generally less expensive than repairing a failed system.

A septic system that is overloaded or not maintained can discharge bacteria, viruses, nitrates, phosphorous, and hazardous chemical to the groundwater that you drink and to the streams and lakes where you may fish, swim, or boat.

This brochure has been developed to:

- Help residents and businesses better understand how septic systems function,
- Address potential impacts from septic systems,
- Help the municipality learn the conditions of these systems, and
- Develop recommendations for the long term management of the systems and protect the health of our drinking water, streams and lakes.

Conventional Septic System Have Three Components:

- The septic tank, which separates, stores and begins to treat solid wastes
- The distribution system, which disperses the liquid effluent over a large area of soil
- The soil in the drain field which absorbs effluent and treats it by natural physical, chemical and biological processes.

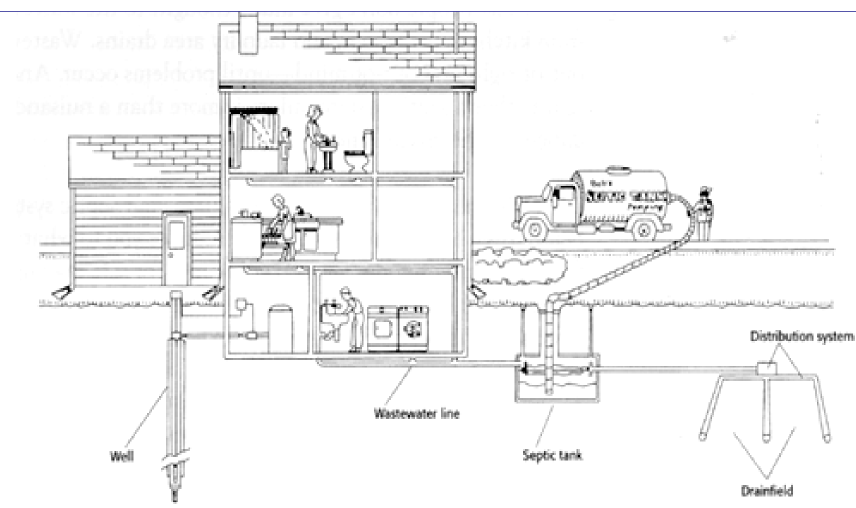


FIGURE 4.1 Household wastewater carries, dirt, soap, food, grease, and bodily wastes "down the drain" and out of your house to an on-site septic or municipal wastewater treatment system.

http://virtual.clemson.edu/.../Water/WQL21A/chpt44.htm

This survey brochure was prepared from the Home*A*Syst Program guidance sponsored and created by the USDA-Natural Resource Conservation Service (NRCS) and Rutgers University Cooperative Extension Service.. For more information visit: http://www.nj.nrcs.usda.gov/partnerships/homeasyst/ This work was partially funded by the New Jersey Department of Environmental Protection (NJDEP).

System Features and Maintenance Concerns

The following information will help identify general features of your septic system. Please circle or identify the criteria that best describes your septic system and maintenance practices.

	Low Risk	Medium risk	High risk
System type	Leach field New Alternative system		Cess pool Leach pit
Age of System Installation Year _____	Less than 5 years old	Between 6 and 20 years old.	System > 20 years old.
Proximity to well and surface water	Disposal field >100 ft from any well and > 50 ft from any waterbody.	Disposal field >100 ft from any well and > 50 ft from any waterbody.	Disposal field < 50 ft from any well or waterbody.
Tank Pumping	The septic tank is made of concrete and is water tight, and pumped out about every 3 years.	The septic tank is metal and pumped, but not regularly.	The septic tank is metal and has not been for over ten years.
Condition of tanks and Baffle	The tank and baffles are inspected for cracks every three years, and repairs are made promptly.	The tank and baffles are inspected for cracks — infrequently, but repairs are eventually made.	The condition of the tank and baffles are unknown.
Capacity of System	Tank designed to handle more wastewater than required.	Capacity meets load requirements .	Bathrooms, bedrooms, or water using appliances added without expanding wastewater system.
Effluent filter	Effluent filter installed on tank outlet and cleaned regularly.	Effluent filter is installed on tank outlet but not maintained .	No Effluent filter on septic tank outlet.
Protection of Disposal field.	Heavy vehicles and objects are kept away from the field. Grass and shallow rooted plants cover the field.	Occasional compaction on the field may occur.	Vehicles, livestock, heavy objects are permitted on the field. Trees and shrubs grow on or near the field.
Diverting Surface Water	All surface runoff is diverted from the disposal field.	Some surface water flows into the disposal field.	Runoff from the land, rooftop and driveway flows into the disposal field.

This survey was prepared from the Home*A*Syst Program guidance sponsored and created by the USDA-Natural Resource Conservation Service (NRCS) and the NJ Rutgers University Cooperative Extension. For more information visit: http://www.nj.nrcs.usda.gov/partnerships/

Septic System Inputs and Site Features

The following information identifies general septic problems and concerns. Please circle or identify the criteria that best describes maintenance issues with your septic system.

	Low Risk	Medium risk	High risk
Signs of Trouble	Household drains empty quickly. No sewage odors inside or outside. Disposal field is dry and firm. Well tests are good.	Household drains empty slowly. Disposal field is sometimes wet or ponded.	Sewage odors noticed inside or outside. Household drains backup. Disposal field is wet or spongy. Well tests are positive for bacteria.
Solid Waste	There is no garbage disposal in kitchen. No grease or coffee grounds are put down the drain. Only toilet tissue is put in toilet..	There is moderate use of garbage disposal and some solids are disposed down the drain.	There is heavy use of a garbage disposal in kitchen. Many paper products and some plastics are flushed down the toilet.
Cleaners, solvents, other chemicals	There is careful use of household chemicals, like paint or cleaning products. No fuels, solvents, or other hazardous chemicals are pored down drains.	There is occasional disposal of hazardous chemicals to the wastewater system.	There is heavy use of cleaning products that end up in the wastewater. Hazardous chemicals are disposed in wastewater system.
Water conservation	Only water conserving fixtures and practices are used. Drips and leaks are fixed immediately.	Some water conserving steps are used, like low flow shower heads, fully loading washing and dishwashing machines.	Standard high volume bathroom fixtures are used. No effort is made to conserve water. Leaks are not repaired.
Water usage	Laundry and other major water uses are spread out over the week.		Several water using appliances and fixtures are used in a short period of time.
Soil type and risk to groundwater and surface water	Sand/gravel	Silt loam	Clay
Depth to water table or bedrock.	Over 20 feet	10-20 feet	Less than 10 feet.
Maps and Records *	Maps and records of repairs and maintenance are kept.	The location of the septic tanks and date of last pumping are known, but not recorded.	The location of the septic system, and date of last pumping or repairs are unknown, and records are not kept.

* On a separate paper sketch your home and locations of your well, septic tank and leach field or septic tank and begin tracking your maintenance activities.

Princeton Hydro

1108 Old York Road
Suite One, P.O. Box 720
Ringoes, New Jersey 08551

Name
Address
______ New Jersey

Septic System Management Brochure

Tips to Maintain Your Septic System

1. Use less water.
    - Run the dishwasher and laundry when the machines are full
    - Avoid running these activities at the same time to give the septic system time to dry between loads.
    - Take shorter showers and run water only when needed.
    - Fix leaky faucets or toilets to avoid overloading the system.
2. Don't put chemicals in your system or on your lawn.
3. Don't use the toilet as a waste basket.
4. Don't use a garbage disposal.
5. Have your septic tank pumped every three years.
6. Divert stormwater runoff away from your septic system.
7. Keep a map and records of your system and your maintenance activities.

For more information visit:
http://www.nj.nrcs.usda.gov/partnerships/homeasyst

AN AMENDMENT TO THE BOARD OF HEALTH CODE
CHAPTER BH: XIII,
ON-SITE WASTEWATER DISPOSAL MANAGEMENT DISTRICT

Be it ordained by the Board of Health of the Township of Montgomery in the County of Somerset and State of New Jersey as follows:

SECTION ONE

Chapter BH: XIII, On-Site Wastewater Disposal Management District is amended as follows:

BH: 13-5 LICENCE TO OPERATE.

a. Each application for a license or renewal thereof shall be accom,panied by a fee of fifteen dollars ($15.00) plus an administrative application fee of forty-five dollars ($45.00) shall also accompany the license or renewal fee.

BH: 13-24 PENALTY AND ENFORCEMENT

A late charge of $15.00 per month will be assessed to persons who do not comply with any part of the licensing requirements, unless the system owner/operator has applied for, and received, a waiver of such requirement from the Board of Health Administrative Authority or his designated representative.

SECTION TWO

This ordinance shall take effect thirty (30) days after the first publication hereof in accordance with the provisions of N.J.S.A. 26:3-69.

____
President
Montgomery Township Board of Health

February 18, 1999

**AN AMENDMENT TO THE BOARD OF HEALTH CODE,
CHAPTER BH: XIII,
ON-SITE WASTE WATER DISPOSAL MANAGEMENT DISTRICT**

BE IT ORDAINED by the Board of Health of the Township of Montgomery in the County of Somerset and State of New Jersey as follows:

SECTION ONE

Chapter BH:XIII, On-Site Wastewater Disposal Management District is hereby deleted and replaced in its entirety as follows:

BH:13-1 SHORT TITLE.

This chapter shall be known and cited as the "On-Site Waste Water Disposal Management District Ordinance of the Board of Health of the Township of Montgomery." (Ord. #92-2, S 1)

BH:13-2 FINDINGS OF BOARD.

It is found and declared that:

a. On-site subsurface waste water disposal systems are in widespread use within the Township.

b. Such systems constitute a potential source of pollution of ground and surface waters, contamination of potable water supplies, foul odors, nuisance problems and other hazards to public health.

c. It is determined to be in the interest of public health, safety and welfare to establish a Management District to regulate the maintenance of such systems to protect the public against system failures and resultant pollution. (Ord. #92-2, S 1)

BH:13-3 DEFINITIONS.

Definitions, words and terms as used in this chapter shall have the meanings as set forth in N.J.A.C. 7:9A-2.1, adopted by reference in Chapter BH:VI of the Montgomery Township Board of Health Code. (Ord. #92-2, S 1)

BH:13-4 SCOPE.

The owner and/or occupant of any realty improvement serviced by an on-site subsurface waste water disposal system located in the Management District shall be a member of the Management District and subject to all of the requirements of this chapter. The Management District shall be comprised of all on-site subsurface waste water disposal systems that had been licensed by the Board of Health prior to the effective date of this chapter, and all on-site subsurface waste water disposal systems which shall be installed, altered or repaired subsequent to the effective date of this chapter. (Ord. #92-2, S 1)

*Editor's Note: Prior ordinances codified herein include portions of Ordinance Nos. 64.82,99-89 and 100-89

BH:13-5 LICENSE TO OPERATE.

a. The Board of Health or its designee shall issue a license to operate and a copy of the Board of Health's operation and maintenance manual to the owner/occupant at the time that a certificate of compliance is issued. The licenses shall be issued on forms provided by the Board of Health. Licenses shall be transferable upon change of ownership or occupancy of the premises with respect to which the license has been issued. Each application for a license or renewal thereof shall be accompanied by a fee of fifteen ($15.00) dollars.

b. The license to operate shall expire three (3) years after issuance. The applicant shall be notified by the Board of Health or its designee before the license expires and shall be directed to apply for a renewal of the license. The Board of Health or its designee shall not renew the license unless the licensee has submitted the following to the Board of Health or its designee:

   1. Evidence that the septic tank has been pumped as prescribed in this chapter; or A septic tank inspection report on a MTHD approved form, prepared by a registered septic installer, NJDEP registered waste hauler, licensed professional engineer, or other person acceptable to the Board of Health or its designee, indicating that the system has been maintained, is not in need of pumping, and is functioning in conformance with the requirements of this chapter; and

   2. Payment of any fees that are required herein or in Chapter BH:XV of this Code.

c. The Board of Health or its designee may suspend or revoke the license to operate in the following circumstances:

   1. It has been determined that the system is malfunctioning based upon criteria outlined in N.J.A.C. 7:9A-3.4(a) and the licensee fails to take steps to correct said malfunction as directed by the Board of Health or its designee;

   2. The owner or occupant of the premises served by the system violates any provision of this chapter with respect to operation and maintenance of the system; or

   3. The owner or occupant of the premises served by the system denies right of entry to the Board of Health or its designee, or the New Jersey Department of Environmental Protection (NJDEP), as required in N.J.A.C. 7:9A-3.19, or in any way interferes with the administration or enforcement of this chapter. (Ord. #92-2, S 1)

BH:13-6 APPEAL TO BOARD OF HEALTH

Any person aggrieved by any decision of a designee of the Board of Health made pursuant to this chapter shall have the right to appeal that decision to the Board of Health in accordance with the procedures set forth in Section BH:1-3.

BH:13-7 SYSTEM USE.

a. The subsurface waste-water disposal system shall be used only for the disposal of wastes of the type and origin provided for in the approved engineering design. No permanent or temporary connection shall be made to any source of wastes, waste water or clean water other than those plumbing fixtures which are normally present within the type of facility indicated in the approved engineering design.

b. Drainage from basement floors, footings or roofs shall not enter the waste water disposal system and shall be diverted away from the area of the disposal field. Backwash from water softeners shall be discharged away from the area of the disposal field by a means not conflicting with other Township ordinances.

c. As set forth in N.J.S.A. 58:10A-17, no person shall use or introduce or cause any other person to use or introduce into any waste water disposal system any sewage system cleaner containing any restricted chemical material.

d. Disposal of materials containing toxic substances into a subsurface waste water disposal system is prohibited. Materials containing toxic substances include, but are not limited to, waste oil (other than cooking oil), oil based or acrylic paints, varnishes, photographic solutions, pesticides, insecticides, paint thinners, organic solvents or degreasers and drain openers.

e. Inert or non-biodegradable substances should not be disposed of in the subsurface waste water disposal system. Such substances include, but are not limited to, disposable diapers containing plastic, cat box litter, coffee grounds, cigarette filters, sanitary napkins, facial tissues and wet-strength paper towels.

f. Large quantities of cooking greases or fats shall not be discharged into systems not equipped with a grease trap designed and constructed as prescribed in N.J.A.C.7:9A-8.1.

g. Major plumbing leaks shall be repaired promptly to prevent hydraulic overloading of the system. (Ord. #92-2, S 1)

BH:13-8 SYSTEM INSPECTION REQUIREMENTS.

a. In accordance with section BH:13-15, but subject to section BH:13-10, inspection of the system shall be required once every three (3) years following its installation, alteration or repair. Inspection or walk-over of the system shall begin or resume three (3) years after installation. Based on the results of these inspections, the frequency may be reduced if prior satisfactory inspections are noted.

b. During each inspection, information shall include but is not limited to the following:

1. A complete walkover of the septic field.

2. Measurement of effluent in inspection ports, and a reading of the groundwater monitoring port when such ports were included in the original septic design.

c. In the following cases, the Board of Health or its designee may require inspection of the system once every year regardless of whether the septic tank has been pumped out:

1. The system is malfunctioning or has malfunctioned in the past;

2. The size or capacity of one or more components of the system does not meet the current requirements of the standards set forth in N.J. AC. 7:9A-1 .1 et seq.;

3. When actual measured water usage is greater than the design capacity of one or more system components;

4. In residential facilities, when the estimated water usage based upon the actual number of residents is greater than the design capacity of one or more system components. For the purpose of making this determination, the design flow shall be estimated by multiplying the number of persons living in the residence by a factor of one hundred (100) gallons per day; or

5. Facilities in which a grease trap is required.

d. When applicable, the results of system inspections shall be reported on standard forms provided by the Board of Health, or on equivalent forms which are acceptable to the Board of Health or its designee.

e. Any problems or malfunctions noticed during the inspection shall be corrected in a manner and within a time frame acceptable to the Board of Health or its designee. (Ord. # 92-2, S 1)

BH:13-9 SEPTIC TANK MAINTENANCE.

a. The contents of the septic tank shall be pumped out within three years after the tank has been installed. The tank may be pumped at more frequent intervals. A septic tank inspection report may be submitted in lieu of pumping if the scum/sludge levels are not within the parameters listed in 1. and 2. below:

1. The bottom of the scum layer is within three (3) inches of the bottom of the outlet baffle.

2. The top of the sludge layer is within eight (8) inches of the bottom of the outlet baffle when noted during an inspection.

b. Pumping of septic tanks shall be performed by a solid waste hauler registered with the NJDEP in accordance with the requirements of N.J.A.C. 7:26-3.1.

c. Equipment used in the pumping of septic tanks shall meet the following requirements:

1. Mobile tanks shall be securely mounted on trucks or trailers, shall be water-tight and provided with a leak-proof cover and shall be vented to permit the escape of gases but not the liquid or solid contents of the tank.

2. Pumps and hoses shall be maintained and operated in a condition that will prevent the leakage of sewage.

3. Equipment shall be available to permit accurate measurement of the sludge and scum levels in relation to the bottom of the outlet baffle.

d. Pumping of septic tanks shall be conducted in such a manner that the entire contents of the septic tank including both liquids and solids are removed.

e. Pumping shall be carried out in a manner that will prevent spillage of sewage onto the ground. If any spillage occurs, the solid portion shall be immediately removed and disposed of in a sanitary manner and the area of the spill shall be disinfected using a suitable chlorine-bearing compound.

f. Septage shall be disposed of at a sewage treatment plant designated in accordance with District and/or State Solid Waste Management Plans pursuant to the Statewide Sludge Management Plan adopted pursuant to N.J.S.A. 13:1E-1 et seq. and N.J.SA 58:1 IA-1 et seq. (Ord. #92-2, S 1)

BH:13-10 ADDITIONAL INSPECTION AND MAINTENANCE REQUIREMENTS FOR GREASE TRAPS.

a. Grease traps shall be inspected and cleaned out at a frequency adequate to prevent the volume of grease from exceeding the grease retention capacity. Grease shall be removed whenever seventy-five (75%) percent of the grease retention capacity has been reached. Grease traps serving restaurants may require pumping as frequently as once a week to once every two to three (2-3) months.

b. Pumping of grease traps shall be performed by a solid waste hauler registered with the NJDEP in accordance with the requirements of N.J.A.C. 7:26-3.1

c. Equipment used in the pumping of grease traps shall meet the following requirements:

1. Mobile tanks shall be securely mounted on trucks or trailers, shall be water-tight and provided with a leak-proof cover and shall be vented to permit the escape of gases but not the liquid or solid contents of the tank.

2. Pumps and hoses shall be maintained and operated in a condition that will prevent the leakage of sewage.

3. Equipment shall be available to permit accurate measurement of the volume of grease in relation to the grease retention capacity of the grease trap.

d. Pumping of grease traps shall be conducted in such a manner that the entire contents of the grease trap including both liquids and solids are removed.

e. Pumping shall be carried out in a manner that will prevent spillage of sewage onto the ground. If any spillage occurs, the solid portion shall be immediately removed and disposed of in a salutary manner and the area of the spill shall be disinfected using a suitable chlorine-bearing compound.

f. Grease and other waste materials removed from grease traps shall be disposed of in accordance with the requirements of the Statewide Sludge Management Plan adopted pursuant to N.J. S .A. 13:1E-1 et seq. and N.J.S.A. SS:11A-1 et seq., as well as any other applicable State or local rules, regulations, ordinances or directives. (Ord. #92-2, S 1)

BH: 13-11 MAINTENANCE OF DOSING TANKS.

a. Dosing tanks and associated pumps, siphons, switches, alarms, electrical connections and wiring shall be maintained in proper working order.

b. Any solids which accumulate in the dosing tank shall be removed and disposed of in a sanitary manner. (Ord. #92-2, S 1)

BH:13-12 DISPOSAL FIELD MAINTENANCE.

a. (Ref. N.J.A.C. 7:9A - Table 4.3) The area or the disposal field shall be kept free of encroachments from decks, pools, sprinkler systems, driveways, patios, accessory buildings, additions to the main building and trees or shrubbery whose roots may cause clogging of any part of the system.

b. Grading shall be maintained in a condition that will promote run-off of rainwater and prevent ponding.

c. Drainage from roofs, footing drains, ditches or swales shall be diverted away from the disposal field.

d. Vegetation shall be maintained to prevent soil erosion.

e. Vehicle traffic shall be kept away from the area of the disposal field. (Ord. #92-2, S 1)

BH:13-13 CLASSIFICATION OF ON-SITE SUBSURFACE WASTE WATER DISPOSAL SYSTEMS.

Every licensed on-site subsurface waste water disposal system shall be assigned one (1) principal classification. The principal class shall be determined according to the residential or non-residential nature of the system's use and configuration. The assigned principal classification designations shall be from one of the following classes:

CLASS R.I. denotes a system which is an individual onsite subsurface waste water disposal system serving one (1) single family home on one (1) individual lot.

CLASS N.R.I. denotes a system which is an individual on-site subsurface waste water disposal system serving one (1) non-residential realty improvement on one (1) individual lot.

CLASS R.C. denotes an on-site subsurface waste water disposal system which in whole or component part serves more than one (1) residential property and/or more than one (1) residential realty improvement.

CLASS N.R.C. denotes an on-site subsurface wastewater disposal system which in whole or component part serves more than one (1) non-residential property and/or more than one (1) non-residential realty improvement. (Ord. #92-2, S 1)

BH:13-14 SUBCLASSIFICATIONS OF ONSITE SUBSURFACE WASTE WATER DISPOSAL SYSTEMS.

Dependent upon a system's design components, its use and configuration, none, all, or combinations of the following subclassifications shall be assigned to licensed systems:

SUBCLASS A denotes that a system has two (2) or more disposal fields designed to be alternated from the receipt of effluent flow from time to time. Alternation intervals shall be determined by the Board of Health or its designee.

SUBCLASS E denotes that the system, by virtue of a Board of Health condition of approval and/or by virtue of the requirements of other state or local codes, shall be operated and/or inspected under the direct supervision of a licensed New Jersey Professional Engineer and/or a licensed New Jersey Sewer Plant Operator.

SUBCLASS F denotes that a system receives wastes in total, or in part, from food preparation or food handling operations.

SUBCLASS G denotes that a system has an outside grease collection trap/tank as one of its components.

SUBCLASS M denotes that there are ground water monitoring wells located on the property. (Ord. #92-2, S 1)

BH:13-15 SYSTEM INSPECTION, MAINTENANCE AND MONITORING TIME FRAMES ACCORDING TO SYSTEM CLASS.

For the purposes of system inspections, maintenance, and monitoring, the following management parameters shall prevail, notwithstanding BH:13-8 et seq., BH:13-9 et seq., and BH:13-10 et seq., to the contrary:

CLASS RI AND NRI licensed systems shall be maintained and inspected a minimum of once every three (3) years or at a time interval deemed appropriate by the Board of Health or its designee, or any other qualified or licensed person, partnership, corporation, or public agency delegated to function within specific limits as an agent of the Board of Health to carry out provisions of this chapter. If these systems are covered under a New Jersey Pollution Discharge Elimination System (NJPDES) permit, than those requirements may be considered instead/or in addition to the ones listed above. (Ord. #92-2, S 1)

CLASS RC AND NRC licensed Systems shall be inspected a minimum of once every year or at a frequency as determined by the Board of Health or its designee, or any other qualified or licensed person, partnership, corporation, or public agency delegated to function within specific limits as an agent of the Board of Health or its designee to carry out provisions of this chapter. If these systems are covered under a New Jersey Pollution Discharge Elimination System (NJPDES) permit, then those requirements may be considered instead/or in addition to the ones listed above. (Ord. #92-2, S 1)

BH:13-16 ADDITIONAL SYSTEM INSPECTION, MAINTENANCE AND MONITORING TIMEFRAMES ACCORDING TO SYSTEM SUBCLASS.

In addition to the requirements of section BH:13-15, any licensed system which has been assigned a subclassification or a combination of subclassifications, shall be subject to the following management parameters:

a. The owner of every licensed system assigned a subclass A designation shall have disposal fields alternated semi-annually, or as determined by the Administrative Authority, unless otherwise specified by State requirements under a NJPDES permit. The alternation event shall be reported to the Board of Health on appropriate forms provided by the Board of Health.

b. The owner of every licensed system assigned a subclass E designation shall be inspected semiannually by a licensed New Jersey Professional Engineer who shall report the results of the semiannual inspection to the Board of Health on appropriate forms provided by the Board of Health, unless otherwise specified by State requirements under a NTPDES permit.

c. The owner of every licensed system assigned a subclass F designation shall have septic tanks pumped and cleaned a minimum of once annually, and the pumping occurrence shall be reported to the Board of Health on appropriate forms provided by the Board of Health, unless otherwise specified by State requirements under a NJPDES permit.

d. The owner of every licensed system assigned a subclass G designation shall have the outside grease tanks)/trap(s) emptied by a licensed pumper as frequently as needed, but in no case any less frequently than once every three (3) months (quarterly). Proof of all grease tank/trap(s) pumping occurrences shall be furnished to the Board of Health within five (5) days following the pumping event on forms provided by the Board of Health.

e. The owner of every licensed system assigned a subclass M designation shall have ground water monitored by samples derived from each monitoring well located on the property a minimum of once a year. The monitoring well's sample water shall be analyzed for nitrates and volatile organic chemicals in accordance with accepted practices and performance standards established by the NJDEP. The method and techniques of obtaining the samples shall be to the satisfaction of a certifying licensed New Jersey Professional Engineer. The samples shall be analyzed by a New Jersey NJDEP certified water laboratory. (Ord. #92-2, S 1)

f. All systems covered by a NJPDES permit must submit copies of all NJPDES Reports to the Health Department on a semi-annual basis.

BH: 13-17 OTHER MAINTENANCE.

The Board of Health or its designee shall require the owner or occupant to conduct other necessary maintenance activity during regularly scheduled pump out of the on-site waste water disposal system such as cleaning and unclogging of lines, cleaning of the distribution box and mechanical equipment. The owner or occupant shall, in each case, be responsible to pay for the cost of such other maintenance. In the event that the owner or occupant shall refuse to conduct such additional maintenance, the Board of Health or its designee may be subject to administrative penalty. (Ord. #92-2, S 1)

BH:13-18 NUISANCES TO BE CORRECTED.

Any on-site waste water disposal system or component thereof that is found to be malfunctioning (as defined in N.J. A.C. 7:9A-2. I) shall constitute a nuisance and shall be repaired, modified or replaced pursuant to an order of the Board of Health or its designee to correct the condition caused by the malfunction. Alterations shall be performed in accordance with "Standards for the Construction of Individual Subsurface Sewage Disposal Systems" as adopted and implemented by the Board of Health of the Township by virtue of this Code and any amendments thereto. (Ord. #92-2, S 1)

BH:13-19 DECLARATION AND ABATEMENT OF NUISANCES.

The Board of Health hereby retains its authority to abate any nuisance in the Management District in accordance with the provisions of N.J.S.A. 26:3-45 et seq. (Ord. #92-2, S 1)

BH:13-20 RIGHT OF ENTRY.

In furtherance of the rights granted to the Board of Health in N.J.S.A. 26:3-45 et seq., the Health Officer or his designee, upon presentation of identification, shall have the right to enter upon property of members of the Management District for the purpose of observation, inspection, monitoring and/or sampling of the on-site waste water disposal system. This authority is exercised by virtue of N.J.S.A. 26:3-31 as a necessary and reasonable method of furthering the duties of the Board of Health as enumerated therein. (Ord. #92-2, S 1)

BH:13-21 SYSTEM TESTING.

No person shall test an individual subsurface sewage disposal system in a manner that will adversely affect the functioning of the system. Hydraulic loading shall not be applied in excess of the design flow capacity. All solids shall have been removed from the septic tank and/or grease trap prior to testing unless the hydraulic loading is applied at a point that will bypass the septic tank and/or grease trap.

BH:13-22 ABANDONED SYSTEMS.

a. When it is necessary to abandon a system or components of a system, all septic tanks, dosing tanks, seepage pits, dry wells and cesspools which are to be abandoned shall be emptied of wastes and removed or filled completely with sand, gravel, stones or soil material in a manner which is acceptable to the Board of Health or its designee. (Ord. #92-2, S 1)

b. Except when done as part of or in conjunction with a repair, a permit must be obtained prior to abandoning a septic system or component of a septic system.

BH:13-23 RULES AND REGULATIONS.

The Board of Health may adopt and promulgate procedural rules and regulations in furtherance of the goals of this chapter. (Ord. #92-2, S 1)

BH:13-24 PENALTY AND ENFORCEMENT.

Any person violating any of the provisions of this chapter or any order promulgated under this chapter shall, upon conviction thereof, pay a penalty of not less than one hundred ($100.00) dollars nor more than five hundred ($500.00) dollars for each violation. Each day a particular violation continues shall constitute a separate offense. (Ord. # 92-2, S 1)

A late charge of $10 per month will be assessed to persons who do not comply with any part of the licensing requirements, unless the system owner/operator has applied for, and received, a waiver of such requirement from the Board of Health Administrative Authority or his designated representative. Surcharges and penalties shall be paid administratively.

<u>SECTION TWO</u>

This ordinance shall take effect thirty (30) days after the first publication hereof in accordance with the provisions of N.J. S.A. 26:3-69.

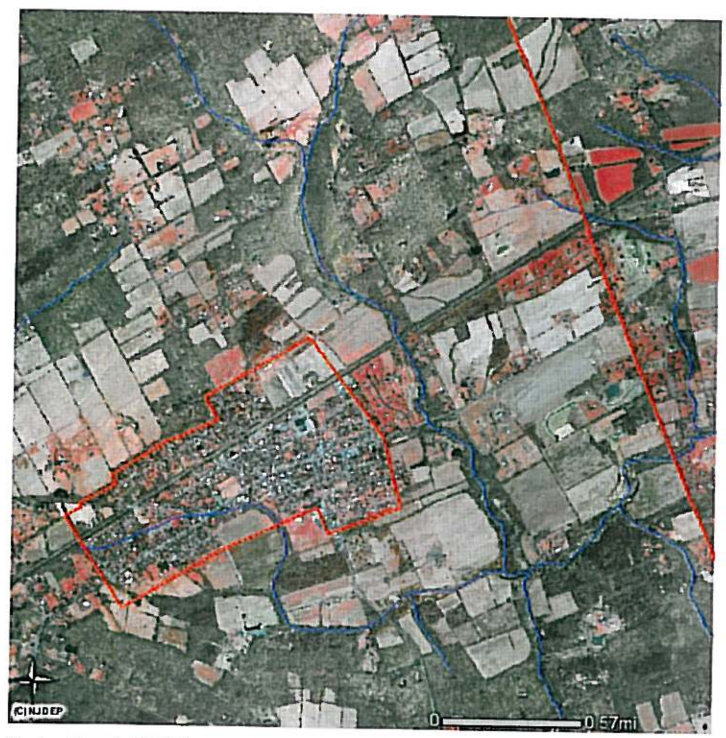
_____/s/ (Signature Unreadable)_
President
Montgomery Township Board of Health

Appendix J
Sourland Watershed Protection Plan
NJDEP 1930 Historic Aerial Photographs

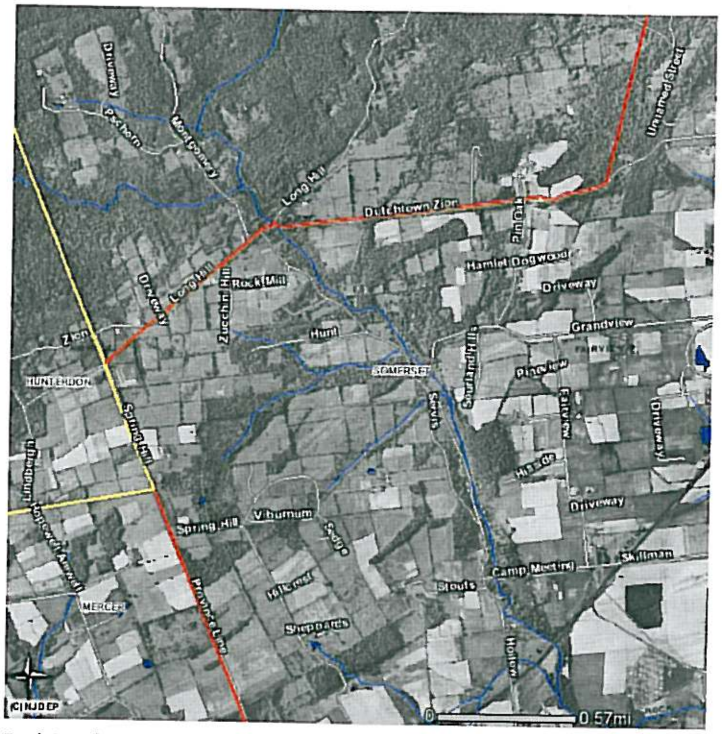
Back Brook 1930.jpg

Back Brook 2002.jpg

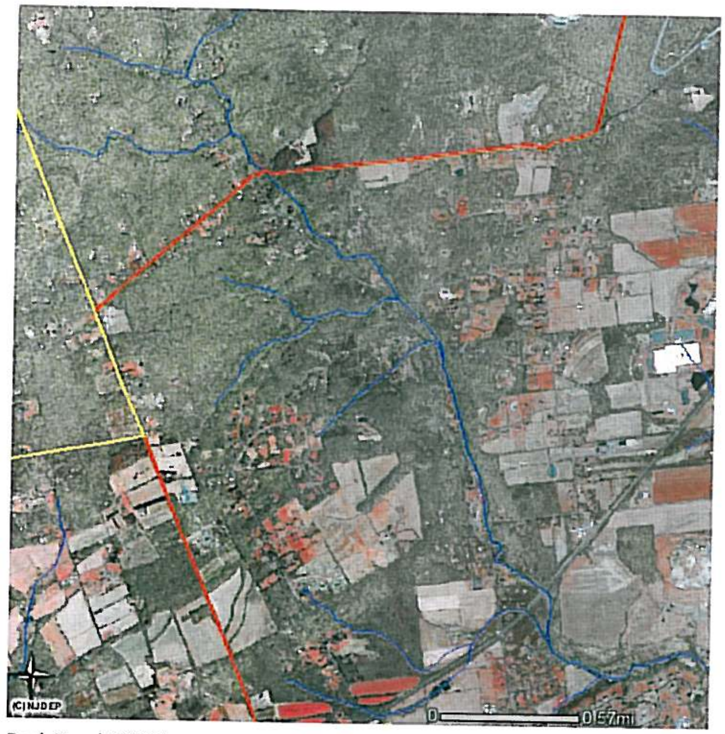
Beden Brook 1930.jpg



Beden Brook 2002.jpg

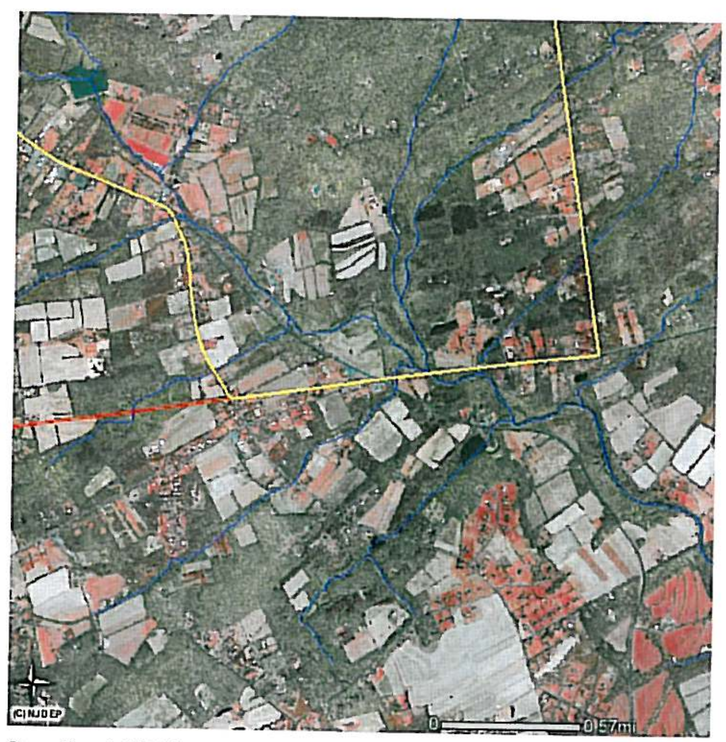


Rock Brook 1930.jpg



Rock Brook 2002.jpg

Stony Brook 1930.jpg



Stony Brook 2002.jpg