White Paper on Preserving Ambient Water Quality
Policy Implications of Pinelands Commission Research Projects

Final
JANUARY 2006

Table of Contents

Appendices

List of Figures

1. INTRODUCTION

In 2003, the Pinelands Commission Science Committee reviewed the applicability of research conducted by the Commission's Science Office on Commission policy in two memos (August 11, 2003 and December 29, 2003). It was decided to further delineate the major issues that were raised through one or more white papers. This paper, and other possible papers in the future, will discuss how research projects completed by the Pinelands Commission Science Office has contributed to policy and planning decisions. This particular paper focuses on the preservation of ambient water quality in the Pinelands. It will give examples of how the Commission has or may integrate regulatory and incentive measures to mitigate or reduce water quality impacts from development activities.

The paper begins with a review and summary of relevant studies undertaken by the Science Office. This summary is followed by a discussion of how such results have been used to date by the Commission for policy and planning purposes. Subsequently, possibilities for further consideration are presented, along with an analysis of the strengths and weaknesses of these possibilities. The paper concludes with recommendations for policy action.

2. BACKGROUND RESEARCH CONCERNING AMBIENT WATER QUALITY

Following are summaries of the relevant land use and water resource research papers prepared by the Pinelands Commission's Science Office, in alphabetical order by author.

Bunnell, J. F., R. A. Zampella, R. G. Lathrop, and J. A. Bognar. 2001. Landscape changes in the Mullica River Basin of the New Jersey Pinelands, USA. *Environmental Management.*
In 2001, the Commission completed a study with Rutgers University's Center for Remote Sensing and Spatial Analysis of landscape changes in the Mullica River Basin which found that, although the percentage of "disturbed land" (developed and agricultural) increased somewhat between 1979 and 1991 (from 13% to 15%), forest cover remained the predominant land cover in the watershed (approximately 75%). There was also a small decrease in the total agricultural area over the same period, while about ¼ of the orchard land was converted to cropland. A significant shift from orchard to berry farming also occurred.

Bunnell, J. F. and R. A. Zampella. 1999. Acid water anuran pond communities along a regional forest to agro-urban ecotone. *Copeia* 1999:614-627.
This 1999 Pinelands Commission study related the distributions of adult and larval anurans (frogs and toads) to site-specific and regional environmental variables in 14 acid-water Pinelands ponds located in drainage basins with a range of developed and

agricultural land cover. The study found that human-made ponds in the Pinelands had a higher pH (4.4) compared to natural ponds (3.9). In general, ponds characterized by clear water, higher pH, lower specific conductance and a large percentage of emergent plant cover had higher larval species richness. Border-entrant species, which are usually only found in the Pinelands at disturbed sites, were heard only at ponds located closest to developed land and upland agriculture. The results suggested that the distribution of adult anurans is influenced by landscape patterns (i.e., proximity of altered lands), whereas larval recruitment may be limited by pond chemistry.

Dow, C. L. and R. A. Zampella. 2000. Specific conductance and pH as indicators of watershed disturbance in streams of the New Jersey Pinelands, U.S.A. *Environmental Management.* 26:437-445.
This study demonstrated that pH and specific conductance are useful indicators of Pinelands watershed disturbance, represented by developed land and upland agriculture.

Dow, C. L. 1996. *A summary of Pinelands surface water quality data for Atlantic County, Burlington County, and Cape May County*. Pinelands Commission, New Lisbon, NJ.
This report is a summary of water quality data collected 1988-1994 at 60 nontidal Pinelands stream stations in Atlantic, Burlington and Cape May Counties. Primary water quality parameters studied were specific conductance, pH, Ca, Mg, ammonia-nitrogen, nitrite+nitrate-nitrogen and total-P; secondary parameters studied were sulfate, dissolved oxygen (DO) and fecal coliform. Graphical analysis was used to relate water-quality parameters to land use, and associations among the primary parameters were assessed using rank correlation method.

Laidig, K. J. and R. A. Zampella. 1996. *Stream vegetation data for twenty long-term study sites in the New Jersey Pinelands*. Pinelands Commission, New Lisbon, NJ.
The purpose of this study was to provide a baseline inventory of Mullica Basin stream vegetation in order to facilitate future monitoring of the effects of upland land use patterns on these biological communities. A total of 240 species of vascular plants were identified at the sites, 56 of which were considered dominant in at least one stream section. These data were used to relate the composition of stream vegetation to land use (see Zampella and Laidig 1997).

Laidig, K. J. and R. A. Zampella. 1999. Community attributes of Atlantic white cedar (*Chamaecyparis thyoides*) swamps in disturbed and undisturbed Pinelands watersheds. *Wetlands* 19:35-49.
This study examined the relationship of watershed conditions to plant species composition and richness, the occurrence of plant species with different biogeographic and wetland affinities, cedar reproduction, and environmental conditions in Atlantic white cedar swamps of the Pinelands. Attributes were evaluated with respect to high, moderate, and low watershed disturbance, defined as the percentage of combined developed and agricultural land cover in a basin. High watershed disturbance was associated with elevated pH, specific conductance and nutrient concentrations in streams adjacent to cedar swamp study sites. The study suggested that cedar swamps located a

distance from up gradient watershed disturbances and not affected by over-bank flooding from the adjacent stream seem to be buffered from the impacts of regional land-use disturbances.

Pinelands Commission. 1988. *An assessment of sewer and water supply alternatives for Pinelands growth areas in the Mullica River Basin, Camden County*.
This report was the culmination of an assessment of sewer service alternatives for the lower Camden County area, which included all, or parts of, Chesilhurst Borough, Waterford Township, and Winslow Township. This report addressed current and future water supply, estimated recharge patterns and subbasin streamflows, compared habitat quality and environmental sensitivity, and developed scenarios in order to assess potential environmental impacts associated with altered streamflows and nutrient loading.

Windisch, M.A. 1991. *New Jersey Pinelands surface water quality data, 1990-1991*. Pinelands Commission, New Lisbon, NJ.
Windisch, M.A. 1990a. *New Jersey Pinelands surface water quality data, 1988-1990*. Pinelands Commission, New Lisbon, NJ.
Windisch, M.A. and R.A. Zampella. 1989. *New Jersey Pinelands surface water quality data, 1983-1988*. Pinelands Commission, New Lisbon, NJ.
The Pinelands Commission presented data collected from 1983-1991 by the Commission's water quality monitoring program, which monitored 11 parameters (pH, specific conductivity, temperature, alkalinity/acidity, nitrite+nitrate-nitrogen, ammonia-nitrogen, kjeldahl-nitrogen, total phosphorus, total orthophosphorus, dissolved solids and fecal coliform).

Zampella, R. A., J. F. Bunnell, K. J. Laidig, and C. L. Dow. 2001. *The Mullica River Basin: a report to the Pinelands Commission on the status of the landscape and selected aquatic and wetland resources*. Pinelands Commission, New Lisbon, NJ.
A series of long-term environmental monitoring activities in a representative Pinelands watershed was initiated in the early 1990s, culminating in the 2001 publication of the Mullica River Basin report. This report documents the Commission's efforts to characterize the effect of existing land-use patterns on aquatic and wetland resources, and to monitor long-term changes in those resources in the Pinelands. The Mullica Watershed was selected as the main focus of the study because it is centrally located, has several large sub-basins with a range of land use and zoning characteristics, includes large tracts of public land, and has been extensively studied.

In most Mullica stream systems, developed and agricultural lands (i.e., altered lands) are concentrated in the headwaters. The Commission's research staff found that the intensity of land use was related to variations in stream water quality and the composition of stream vegetation, fish, and anuran (frog and toad) communities. Although the impacts of altered land uses were mitigated somewhat downstream as the streams passed through state-owned forest lands, upstream effects were still apparent. However, off-stream aquatic and wetland plant and animal communities surrounded by forested landscapes appeared to be buffered from upstream land-use disturbances. In general, the study concluded that most surface water impacts are associated with nonpoint source pollution and reflect the long-term effects of land-use activities (development and agriculture). It was also suggested that changes in pH and specific conductance usually preceded shifts in biological community compositions, making these two parameters potentially useful early indicators of watershed disturbance.

Zampella, R. A. and J. F. Bunnell. 2000. The distribution of anurans in two river systems of a coastal plain watershed. *Journal of Herpetology* 34:210-221.
This report documented an anuran-vocalization survey in the more heavily developed and farmed Mullica River system and the minimally disturbed Wading River systems. Results showed that although native Pinelands species were widely distributed, four non-Pinelands species were heard only in the Mullica River system. Non-native bullfrogs were more common at sites with adjacent developed or upland-agricultural land, while carpenter frogs (native) were associated with unaltered sites. Carpenter frogs and Pine Barrens treefrogs were generally absent where bullfrogs occurred.

Zampella, R. A. and J. F. Bunnell. 1998. Use of reference-site fish assemblages to assess aquatic degradation in Pinelands streams. *Ecological Applications* 8:645-658.
This study compared the species composition and species richness of acid-water fish assemblages found at 5 Pinelands reference sites to samples collected from 12 other streams with a range of pH and specific conductance values and upstream land-use characteristics. Forest land comprised more than 90% of all land cover within the reference-site drainage basins. Altered land included developed land and farmland. Results showed that native fish dominated all sites and nonnative fish were present only in streams with elevated pH and specific conductance values, and a high percentage of altered land in the drainage basin. Fish community gradients generally paralleled watershed-degradation gradients.

Zampella, R. A. and K. J. Laidig. 1997. Effect of watershed disturbance on Pinelands stream vegetation. *Journal of the Torrey Botanical Society* 124:52-66.
The study related major patterns in stream-channel and stream-bank plant species composition to a Pinelands watershed disturbance gradient characterized by increasing agricultural and developed land cover, pH and specific conductance values, and channel muck. Surface waters in relatively undisturbed basins had lower pH and specific conductance, compared with waters in highly developed or farmed drainage basins. Sites within highly altered basins supported a unique group of peripheral and exotic plant species.

Zampella, R. A. 1994. Characterization of surface water quality along a watershed disturbance gradient. *Water Resources Bulletin* 30:605-611.
This study characterized the water quality of 14 Pinelands stream sites in relation to urban and agricultural land uses. The results indicated that a gradient of increasing pH, specific conductance, and concentrations of dissolved calcium, dissolved magnesium, total nitrite + nitrate-nitrogen, total ammonia-nitrogen, and total phosphorus paralleled a watershed-disturbance gradient of increasing land-use intensity and wastewater flow. The four least-disturbed streams were distinguished from all other stream stations by very low pH and nitrite + nitrate-nitrogen, calcium, and magnesium. Ammonia-nitrogen was

low in all but the four most highly disturbed streams, which also had the highest phosphorous. The report concluded that watershed disturbance can have a substantial effect on natural water chemistry in the Pinelands.

Zampella, R. A., L. Craig, and M. Windisch. 1994. *Water quality characteristics of Ocean County Pinelands streams*. Pinelands Commission, New Lisbon, NJ.
This study indicated that decreasing water quality in Ocean County streams was associated with an increase in the percentage of developed and agricultural land cover. Overall, water quality in Ocean County was representative of the less disturbed end of the Pinelands-wide watershed disturbance gradient, and no stream exceeded Pinelands surface water quality standards for nitrogen or phosphorus. Relative differences in water quality among streams were not affected by sampling season (high vs. low flow). All except one site showed nitrite + nitrate levels characteristic of moderately disturbed Pinelands streams. Toms River displayed the poorest water quality of all the streams sampled, but still can be generally categorized as moderately disturbed.

Zampella, R. A., J. F. Bunnell, K. J. Laidig, and N. A. Procopio. 2003. The Rancocas Creek Basin: A report to the Pinelands Commission on the status of selected aquatic and wetland resources. Pinelands Commission, New Lisbon, NJ.
Based on results of the 2001 Mullica River Basin study, Commission staff conducted another study using modified sampling protocols and primary ecological indicators (pH, specific conductance and presence of disturbance indicator plants, nonnative fish and bullfrogs) in four sub-basins of the Rancocas Creek Basin watershed. The report also ranked the ecological integrity of Rancocas streams using a "5-star" rating system. The results of the Rancocas and Mullica studies were similar: surface water quality and biological communities in forested (less altered land) sub-basins contrasted with sub-basins that had a higher percentage of altered land. However, differences in geology, geography and land-use patterns were given greater consideration in the Rancocas, which is more diverse in terms of land uses than the Mullica. Most impacts were associated with nonpoint source pollution, but wastewater discharges likely contributed to degradation at a few sites.

Zampella, R. A., N. A. Procopio, K. J. Laidig, and J. F. Bunnell. 2004. The essential character of the Oyster Creek watershed. Pinelands Commission, New Lisbon, NJ.
This study was a reassessment of the Oyster Creek watershed to determine if this area displays the essential character of the Pinelands. The criteria that were used in the 1980 Comprehensive Management Plan to define the essential character of the Pinelands environment, and then later, used to delineate Pinelands management areas, were analyzed. These criteria included the presence of developed or agricultural lands, surface water quality, wetlands, unique resources, threatened and endangered species, and areas of deep aquifer recharge. The study concluded that the Oyster Creek watershed and portions of the Waretown Creek, an extension of the contiguous Oyster Creek watershed, display essential characteristics of the Pinelands.

3. THE INFLUENCE OF THIS SCIENTIFIC RESEARCH ON POLICY AND PLANNING DECISIONS

The Pinelands Commission routinely considers the results of research conducted by the Science Office when formulating policy and planning decisions. Examples of how the research on ambient water quality is used are explored in the following sections.

3.1 Consideration in Subregional Planning Initiatives

As new scientific data on water quality has become available, it has been integrated into several sub-regional planning efforts. In 1988 the Pinelands Commission issued a report titled "An Assessment of Sewer and Water Supply Alternatives for Pinelands Growth Areas in the Mullica River Basin, Camden County" to evaluate the potential impact of interbasin transfer of wastewater. Through this assessment, it was determined that no more than 1.2 million gallons per day (mgd) of wastewater could be transferred out of the Mullica River watershed without adverse impact to local streams, and that no more than 1.4 mgd of treated wastewater could be recharged into groundwater. Therefore, the Pinelands Commission passed Resolution #PC4-88-65, which set forth Pinelands Commission policies for sewer and water supply planning within the portion of the Mullica River Basin located in Camden County. The resolution included four action items: 1) Reduction of future zone capacities within the Regional Growth Areas of Winslow, Waterford, and Chesilhurst by 25%; 2) Creation of a comprehensive water supply and distribution plan by the Camden County Municipal Utilities Authority (CCMUA); 3) Development of a wastewater management plan by CCMUA, and; 4) Transfer of up to 1.2 mgd of effluent for treatment and disposal outside of the Mullica River Basin, provided that an independent, comprehensive long-term stream monitoring program is implemented to ensure this withdrawal has no adverse impact.

In 2003 for the first time, the Commission authorized formation of a task force to create a subregional natural resource protection plan. This task force concentrated its efforts on the Toms River Corridor in Jackson and Manchester Townships, Ocean County. The task force relied, in part on water quality data and studies prepared by the Science Office. For example, science staff compiled unpublished surface water quality data for streams and rivers in the study area. The task force was then able to combine these data with information provided in published reports (Zampella et. al. 2003) to support their overall recommendations derived from both endangered/threatened species considerations as well as water quality.

Since August 2004 another committee appointed by the Commission has been undertaking a second sub-regional resource preservation planning initiative. This project involves Medford and Evesham Townships in Burlington County. As with the Toms River project, one of the principal objectives of the Medford/Evesham study is preservation of water quality. In fact, the regulatory strategies being developed in conjunction with this study are directly tied to water quality characteristics of the major watersheds within the project area. Science Office staff members have provided direct assistance in developing the methodology for the study's core land use and natural resource evaluations. In addition, the water quality data, studies and published reports prepared by the Science Office noted above have provided important reference sources and serve as the basis for the preservation and property acquisition priorities that are presently being refined for the final project report.

3.2 Consideration in Management Area Changes

The Pinelands Commission has changed a large Rural Development Management Area in Ocean and Lacey Townships, Ocean County, from to Forest Area. This change was based on the findings in "The Essential Character of the Oyster Creek Watershed" (Zampella et. al. 2004). This study found that while the original designation was primarily based on the presence of a landfill, this landfill did not have the negative environmental impact on water quality that was anticipated. Furthermore, because this area has seen little development activity, it retains natural Pinelands characteristics.

3.3 Consideration in Rezoning

Surface water quality monitoring data has also influenced various rezonings with respect to what sub-basins should be protected and what sub-basins can accommodate development. For example, the recent rezonings to permit additional commercial development along Route 47 in Maurice River Township were limited to disturbed basins. These disturbance considerations from various Science studies noted above were also used to design the current density transfer program for each Township's Forest Area and Rural Development Area, including where receiving areas should and should not be sited.

3.4 Consideration in Best Management Practices

Recognition of the water quality impacts of land use has contributed to a growing interest in Best Management Practices (BMPs) for specific land uses, such as golf courses (Appendix A). These golf course BMPs, which address water quality and water conservation as well as wildlife/habitat protection, are currently in use by Maurice River and Upper Townships.

4. FURTHER POSSIBLE USE OF THE RESEARCH: POLICY CHANGES

A major goal of the CMP is protection of ambient water quality and, as noted above, results from scientific studies are regularly integrated into specific planning decisions. However, broader questions arise as to whether and how these same water quality concepts could be strengthened and more universally implemented.

Additional application of land use and water quality standards could ***conceivably*** be crafted to better preserve ambient water quality in the Pinelands' most sensitive sub-basins through three methods: (1) improve on-site development standards, (2) change management area (zoning) boundaries, and (3) change Commission administrative practices and guidance documents.

4.1 Improve On-Site Development Standards

Changes to on-site development standards or additions to existing standards are one way to reflect new scientific data. Such development standards may be implemented in three different ways, which are not mutually exclusive: Performance Standards, Best Management Practices, and Procedural Changes.

4.1.1 Performance Standards

Currently, the CMP specifies nitrogen as the single element by which water quality impacts are assessed. It requires that development cannot cause the concentration of nitrate-nitrogen to increase above 2 parts per million (ppm) at a parcel's boundary (N.J.A.C. 7:50-6.84). The nitrate-nitrogen parameter is applied in two ways in current CMP regulations: 1) to limit pollution from wastewater from a single parcel (i.e., the 2 ppm standard), and 2) to limit pollution regionally (i.e., Forest Area densities are set so that at build-out, nitrate/nitrogen will not exceed the ambient level found in 1980, which was 0.17 ppm).

Chemical parameters

Water resource studies completed by the Science Office suggest that additional parameters could be utilized to more accurately determine the impacts of agricultural and urban development on ambient water quality. Figure 1 synthesizes findings from several field studies and shows other parameters that could be used in addition to nitrogen to determine surface water quality. Reference conditions refer to concentrations found in streams draining basins with less than 10 percent altered land (developed land and upland agriculture). It should be noted that there is a correlation between some of these parameters; for example, specific conductance together with pH have been found to be a good proxy for determining water quality, e.g., they could be used in the buffer delineation model when nitrate data are not available.

Figure 1 – Additional Surface Water Quality Parameters		
Factor	**Reference Conditions**	**Degraded Conditions**
Condition		
Upland agriculture	< 1.0	27.7
Wetland agriculture	< 1.0	< 1.0
Developed land	< 1.0	23.9
Total altered land	2.0	51.7
Parameter		
Calcium, dissolved (mg/L)	0.47	4.9
Magnesium, dissolved (mg/L)	0.30	2.4
Chloride, dissolved (mg/L)	3.3	13
pH (standard units)	4.4	6.8
Specific Conductance (uS/cm)	39	104
Sulfate, dissolved (mg/L)	3.6	9.6
Ammonia-N, dissolved (mg/L)	< 0.03	<0.03
Nitrate + nitrate-N, dis. (mg/L)	< 0.05	0.40
Total phosphorus (mg/L)	< 0.01	<0.01

Using this data, additional standards for the Forest Area and Preservation Area District could be suggested with varying degrees of difficulty that are discussed later. (For example, such standards could be based upon the reference levels for Calcium, Magnesium, Chloride, pH, specific conductance, or sulfate). Use of the reference levels would probably not be appropriate for other management areas.

The New Jersey Department of Environmental Protection (NJDEP) is conducting analyses of Total Maximum Daily Loads (TMDLs) for various pollutants statewide. These efforts may yield additional parameters.

Presence/absence of native aquatic and wetland communities

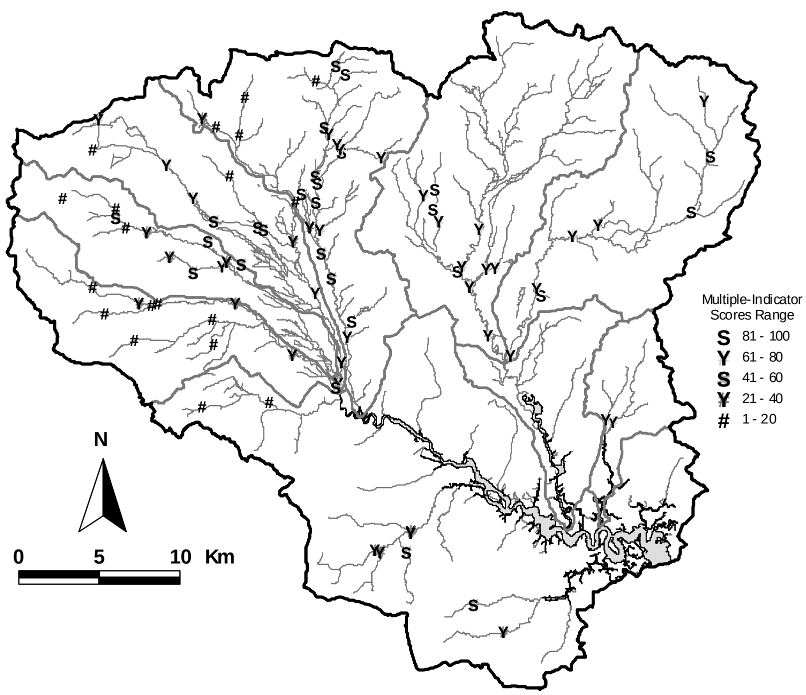
A single broadly based standard can be crafted that encompasses several chemical parameters by measuring their impact on native aquatic and wetland communities. This standard would use a survey performed by the applicant to determine the presence of native flora and fauna as a precondition of permit applications for development in certain Pinelands Management Areas (e.g., Forest Area) and restrict development in areas where particular indicators are found. For example, the presence of native frog and fish species could be used as a proxy for stream water quality.

Using Multi-indicator ecological-integrity scores

A superior alternative to *ad hoc* surveys performed by an applicant is the use of science data to pre-classify areas. The following is an example of a practical application of characteristic water-quality and biological communities data derived from the on-going monitoring/evaluations being conducted by the Science Office.

Multiple-indicator ecological-integrity scores were derived for 88 water-quality monitoring sites in the Mullica River Basin by ranking pH values, specific conductance(1) values, and community-composition scores for stream vegetation, stream-fish assemblages, impoundment-fish assemblages, and on-stream anuran (frog and toad) assemblages, converting each set of scores to a relative scale of 0 to 100, and using the rescaled scores of each variable to calculate a median multiple-indicator ecological-integrity score for each site. High multiple-indicator scores were assigned to sites with low pH (high acidity) and specific conductance (low presence of conducting ions in the waster) values, and biological communities characterized by native species. In contrast, low ecological-integrity scores were assigned to sites with high pH and specific conductance values, and biological communities with a higher percentage of nonnative plant or animal species.

Figure 2. Multiple Indicator Ecological-Integrity Scores in the Mullica River Basin



Thus, areas with high scores (e.g., >80) could be considered for more protective zoning; conversely, areas with low scores (e.g., <20) could be considered as areas not needing animal and plant species surveys.

(1) Electrical conductivity is a measure of a water's ability to conduct electricity, and therefore a measure of the water's ionic activity and content. The higher the concentration of ionic (dissolved) constituents, the higher the conductivity.

4.1.2 Best Management Practices

As an alternative to setting specific parameters that development must meet, the CMP could set forth specific designs, technologies, practices, concepts, etc. that would better meet the ambient water quality goals. For the purposes of this paper, they will be termed Best Management Practices (BMPs). For example, the CMP currently uses this approach for residential development on small lots, which is only permitted if an alternative on-site septic technology is installed.

There are many types of BMPs. BMPs can be required for future development to minimize its impact on surface water or can be initiated to retrofit existing development. Additionally, steps could be taken to create incentives to retrofit existing development with BMPs.

The Science studies noted above have highlighted goals and objectives that could be addressed through BMPs. For example, ordinances can further minimize impervious surfaces, clearing of land, and other characteristics of sprawl, as well as promote BMPs aimed at reducing the application of pesticides and fertilizer to farms and residential lawns. In addition to continuing to use CMP stormwater recharge standards to protect water quality, results from these studies suggest implementing additional BMPs to reduce nonpoint source pollution, especially in sub-basins which are already impaired or which may become impaired in the future. BMPs can be designed to address a wide range of needs, including septic systems, stormwater management, landscaping, residential development, and agriculture. Examples of BMP concepts and techniques in each of these categories are provided in Appendix B.

4.1.3 Procedural Changes

In addition to setting performance goals or specifying management techniques, procedural changes may be necessary to ensure that development is not causing unacceptable disturbance of surface waters. These changes may include encouraging all development projects greater than a specified threshold number of units to be accompanied by a comprehensive water quality monitoring program, both during and post-construction. The post-construction monitoring could ensure that water quality standards are not being violated and assess the impacts, if any, on local surface and groundwater quality. They could be required prior to, or as part of, a certificate of occupancy. Continual monitoring over an extended time period after construction might ensure that the development is meeting the new parameters or determine whether it might require remedial action. This could also help the Pinelands staff identify the need for further rule refinements. An example is post-construction monitoring of stormwater basins to ensure that construction activities do not compact the soil in the basins, thereby creating impermeable layers.

4.2 Use Management Area Designations to Protect Water Quality

Protecting surface water quality through land-use planning and appropriate management area designations provides a broader approach to protection than the setting of specific performance parameters. Reference water quality can be protected by determining if the surrounding land use designations are compatible with water quality goals, and whether additional protection is needed through management area changes. Following are three types of changes that might be considered to protect surface water quality:

- Change management areas to more protective designations for "reference" water quality streams. Use the results of the Mullica River and Rancocas stream studies (Zampella et al., 2001; Zampella et al. 2003) to identify sub-basins in need of higher levels of protection (this protection may include land acquisition). The Toms River Corridor Plan and the Medford/Evesham Plan have incorporated aspects of this approach. Although overall Pinelands-wide water quality compatibility with management area designations seems appropriate, there is an ongoing need to identify small-scale situations where a change in designation (or a rezoning) would be more in line with land use, or would protect an important resource.

- Change or limit land uses that are known to impact water quality. The management area designations and boundaries may be generally appropriate, but certain permitted uses may be inconsistent with protection of nearby surface water quality. For example, golf courses or other land-extensive managed turf uses have a high level of consumptive water use, and involve fertilization and pesticide levels that may negatively affect surrounding water quality.

- Set performance standards by Management Area/zone. Improve the current generic Pinelands-wide standards by matching the standards to the sub-watersheds by using differing standards for each Pinelands Management Area.

4.3 Commission Administrative Practices

Administrative practices represent less prescriptive ways to preserve water quality, perhaps without CMP amendment. These types of changes may be more proactive by attempting to educate users (a trait shared to some extent by the previous approaches) and are faster to implement, but their success might be less measurable in that it is more difficult to know if, when, and where they are used. For example, the Commission might determine that, instead of mandating BMPs, an outreach program should be initiated to distribute guidance documents that describe the BMP techniques and alternative practices that are available. Another administrative practice (or, alternately, a non-regulatory BMP) that could be enacted would be to target land acquisition in watersheds where water quality is least disturbed, or, alternately, those watershed areas with water quality that shows that the biota are at greatest risk from future impacts.

5. IMPLICATIONS OF THE ALTERNATIVE APPROACHES

Each of the four possible changes to planning and policy decision-making is evaluated in the charts that follow (Figures 3-6). While not exhaustive, the charts highlight the major strengths and weaknesses of the previously described alternatives, and suggest that further refinement of the alternative approach involving management area designations may offer the most promise for broadly protecting ambient water quality. To address more specific concerns, however, other approaches may be more appropriate.

Figure 3. Enhanced or New On-Site Parameter Limits	
Pros	**Cons**
1. Direct: Can be narrowly targeted to the specific parameter of concern, e.g., nitrate-nitrogen. 2. For select parameters, limits can be based upon known science. For example, the characteristic components/pollutants present in a "reference" or pristine stream are known from field studies. 3. Lets the private market meet the challenge any way it can. Instead of prescribing a technique, limiting uses, or assigning a particular solution, if parameter limits are chosen, the private sector can choose to meet them in any way possible (e.g., 2 ppm nitrate-nitrogen can, in theory, be met by area dilution, various types of treatment, flow reductions, vegetative uptake enhancements, etc. However, some possible techniques may not be specifically enabled by regulations, particularly in the more sensitive areas of the Pinelands)	1. "Tipping points" (i.e., the concentration at which degradation occurs) are unknown for many parameters. For example, what are the tipping points for calcium, sulfate, etc.? 2. Ambient water quality is already accounted for in certain management areas by restricting development density to disperse pollutants (e.g., the FA has an average density of 1 unit/23 acres resulting in nitrate-nitrogen of 0.17 ppm, which was the average of Pinelands streams in 1980). 3. Choice of which parameters to regulate will be complex (there are many). For example, parameters measured by the Science Office include: Ca, Mg, Cl, pH, SC, sulfate, ammonia-N, nitrite=nitrite-N, and P. 4. Hard to administer – Determining whether a standard is met may be difficult (e.g., it was thought RUCK and pressure dosing met 2 ppm). Are new models needed (e.g., phosphorus retention and mobility)? Is it feasible to develop these models? Will there be a need for post-construction monitoring (e.g., like that required for alternative septic systems)? 5. The ability to measure minute concentrations improves over time and standards may need to be changed. For example, the last three parameters listed in Table 1 (p. 9) were detected in only trace amounts and are reported as ranges. As measurement techniques improve, each may be found to be far less than what was reported; in that case, the standard may be too high. 6. May not be practical for some uses. Some uses may never be able to achieve ambient water quality standards as every use has some impact. 7. Cumulative impacts are hard to determine. While it may be possible to project an initial change in concentration that is attributable to a specific use, interactions with ground water, soils, and other constituents may make it difficult to predict when a tipping point is reached. 8. Parameter interactions may be unknown (and therefore, levels may be improperly set). In some cases, the sum of two or more parameters may have greater impacts than either taken alone. 9. Defining what form of the parameters will be measured, and how and where they will be measured can be complex. 10. Cause and effect relationships among parameters are unclear.

Figure 4. On-Site BMPs	
Pros	**Cons**
1. Easy to understand. Specifying how something is to be done (as opposed to what must be achieved as in the parameter limits above) is usually clear. 2. Usually easy to administer. If a technique is selected, it is often easy to verify that the technique has been successfully implemented.	1. Need BMPs for every use, e.g., golf courses, marinas, farms, parking lots, lawns, forestry, etc. 2. Time-consuming to design: each BMP becomes a research project into techniques used elsewhere and their effectiveness (e.g., moving farming activities away from a stream to lessen run-off impacts may not improve water quality if run-off is instead directed to highly permeable soils that ultimately feed the stream). 3. There are many uses for which BMPs have not yet been delineated. 4. Will evolve and need to be changed: BMPs rely upon technology which is constantly evolving. 5. Some will be costly: BMPs usually encompass a range of solutions from less expensive to very expensive (e.g., residential wastewater treatment can be improved, but at considerable cost). 6. Some will be unproven: some good ideas in theory may prove less valuable in practice. Ideally, each BMP would be tested as is being done for the alternative septic systems but this is probably impossible for all. 7. Dictates a solution when another may be better in some cases. There is a danger in prescribing a solution when another may come along that is better, e.g., pressure dosing versus the alternative septic systems. 8. Effectiveness may be tied to maintenance, an on-going problem. Again, the alternative septic systems are illustrative - they are better but only if maintained.

Figure 5. Management Area Designations	
Pros	**Cons**
1. Easily applied. Intensity or use limits are easy for applicants and administrators to understand and apply (e.g., 1 home per 20 acres; golf courses are not permitted; etc.) 2. Tipping points can be estimated (e.g., 10% disturbance is used as an estimated tipping point later in this paper). 3. Addresses cumulative impacts well. 4. Similar to past actions (e.g., the CMP's regulations are already based upon similar premises and could be readily expanded/adapted). 5. Can be selective and minimize staffing needs (e.g., using GIS to map and analyze sub-basins of various sizes)	1. Indirect. The effects are controlled from a regional basis and on average. Individual sites or small locales may be more severely impacted. 2. Difficult to know which, if any, specific uses cause problems. For example, which, if any, types of linear development can be permitted? 3. Development and farmed areas, or portions thereof, have or will exceed tipping points. It may be difficult to protect resources anywhere a specified threshold is exceeded. 4. Some sub-basins are split by two very different management areas. A sub-basin that is 50% FA and 50% RGA may be difficult to analyze. For example, is the projected disturbance due to current or future conditions? Is the disturbance up-basin or down-basin from critical natural resources (up-basin are of greater concern)? 5. Where changes are made, municipal cooperation and rezonings will be required. Changing zoning affects property owners and their development plans, as well as municipal zoning plans. 6. Some uses may not be a problem unless there are too many of them (e.g., golf courses), which is hard to manage under zoning. If a use was rarely present in the previous science analyses, its impact could be underestimated. For example, few golf courses were present, yet their known impacts are great. 7. If management area designations are only considered ad hoc when a problem arises, they may be "behind the curve" (by definition, "hot spots" are too late). If considered comprehensively now for the entire Pinelands Area, the effort may be too time-consuming. 8. Since these controls apply to future development, they are not effective in addressing impacts caused by existing development.

Figure 6. Administrative Guidelines (similar to BMPs but not “required”)	
Pros	**Cons**
1. Flexible; can be expanded or modified as new information is learned.	1. Guidelines are not mandatory. May get solutions that we are not sure of or don’t like, but lack proof of a problem. 2. Need for every use. 3. Many are uncertain. 4. Time-consuming to draft 5. Point where guidelines become a rule is often blurry: Guidelines tend to become or be perceived as rules. Many applicants (and staff) will just “blindly” follow them. 6. Significant resources needed to educate and convince people to follow them.

6 A POSSIBLE APPLICATION OF THE POLICIES – a detailed look at how either Management Area re-designations or BMPs could be used

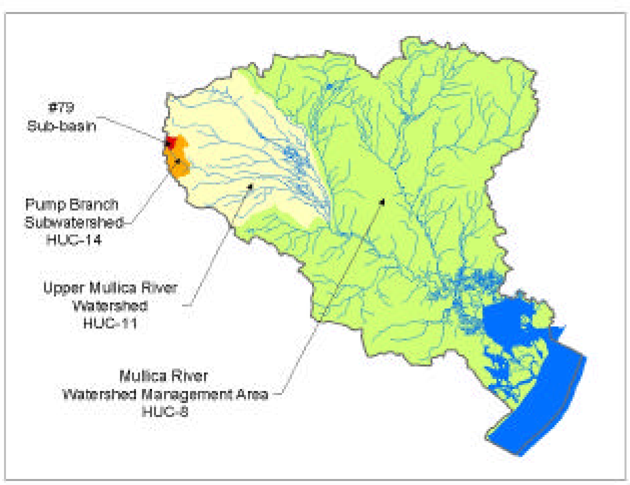
6.1 Overall Sub-Basin Water Quality Status and the Future

The Science Office has found in the studies noted above that surface water quality may be predicted by measurement against a referenced set of land disturbance (combined amount of urban and agricultural land use from 1997 NJDEP Land Use/Landcover data) within a given watershed. If less than 10% of the land within a watershed is disturbed, it is most likely that the water retains its characteristic Pinelands quality; if 10-30% of the land within a watershed is disturbed, the surface water quality is in transition; if more than 30% of the land within the watershed is disturbed, the water is considered "degraded", (that is, relative to Pinelands reference streams). Using these ranges, the Planning staff has completed a preliminary analysis of current and future build-out levels of disturbance in various sub-watersheds. Maps in Appendices C, D, and E focus on those sub-watersheds that are of particular concern (e.g., sub-basins within conservation-oriented management areas) and that may warrant more protective measures.

Maps

The United States Geological Survey (USGS) assigns hydrological unit codes (HUCs) to distinguish among drainage areas of different sizes. A HUC-14, known as a subwatershed, is a small drainage area, usually 10-15 square miles in size (see figure 7). A HUC-11, known as a watershed, is an agglomeration of these smaller subwatersheds and range between 50 and 100 square miles in size. The agglomeration of several HUC-11s forms the larger Mullica River Watershed Management Area (HUC-8). The smallest level, the sub-basin, will be discussed later in this section.

Figure 7. Drainage Area Size



The percentage of land disturbance in both current and build-out scenarios was calculated for each HUC-14 and HUC-11 in the Pinelands using a Geographic Information System. The percentage of subwatersheds that exhibit 30% or more land disturbance increases from 24% in the current scenario to 37% in the future scenario (see figure 8). Note that the percentage of subwatersheds 10 to 30% disturbed actually drops in the future.

Figure 8. Disturbance Levels for Subwatersheds (HUC-14) in the Pinelands

Disturbance Level Category	Number of subwatersheds (Current Scenario)	Percent of subwatersheds (Current Scenario)	Number of subwatersheds (Future Scenario)	Percent of subwatersheds (Future Scenario)
Less than 10%	93	42%	71	32%
10% to 30%	77	35%	69	31%
30% or Greater	53	24%	83	37%
Total	223	100%	223	100%

Appendix C shows the level of disturbance in 1995 by HUC-11 and HUC-14. The map also shows the two primary conservation-oriented management areas: the Preservation Area District and Forest Area (it is likely that watersheds will cross the disturbance threshold in other management areas since they are either targeted for development by the CMP or zoned as agricultural areas).

The map in Appendix C illustrates which HUC-11 and HUC-14 already exceed the 30% disturbance threshold (which is presented here for discussion purposes as the point at which substantial alterations/changes to Pinelands ecosystems have occurred). Appendix D similarly illustrates the projected level of disturbance by HUC-11 and HUC-14 in a build-out scenario.

Appendix E shows which watersheds surpass the 30% threshold at build-out. This latter map may help the Commission target a watershed for further analysis and/or action. The watersheds are numbered 1 through 4 for ease of discussion.

While useful from a broad sub-regional viewpoint, these maps do not provide a comprehensive assessment. For example, the maps do not indicate the extent to which disturbance upstream also causes subwatersheds downstream to cross the cumulative 30% threshold; and, for these "degraded" subwatersheds, the nature of the disturbance (sewer development, septic development, and/or agriculture).

6.2 Mullica River Watershed Headwaters: In-Depth Case Study

Examining Appendix E, there are four watersheds (HUC 11) in the Pinelands that will exceed the 30% disturbance level in a build-out scenario:

1. The Upper South Branch of the Rancocas River watershed, which flows out of the Pinelands into the Delaware River;

2. The Mullica River, above the Batsto River, watershed (herein referred to as the Upper Mullica River watershed), which flows through the heart of the Pinelands Preservation Area;
3. The headwaters of the Upper Great Egg Harbor River watershed flows through Pinelands Management Areas, predominantly within the Forest Area; and
4. The Dennis Creek watershed, located adjacent to the coast; which flows immediately out of the Pinelands into the Delaware Bay

As the Upper Mullica River watershed carries the greatest potential impact to the Pinelands, it was chosen by the Committee for a more detailed examination.

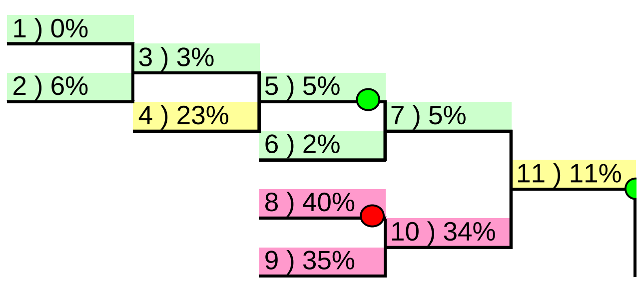
The Upper Mullica River watershed can be split into three major sections: the Mullica (main stem), the Sleeper Branch and the Nescochague Creek (see Appendix I). These three sections vary in character, as the Mullica main stem is the least developed and the Nescochague Creek is the most developed. Science Office staff, utilizing USGS digitized topographical data, subdivided the Upper Mullica River watershed into 135 distinct sub-basins, in order to better estimate cumulative impacts. These sub-basins are even smaller than the HUC-14 designation. Appendix J shows the sub-basins numbered 1 through 135 along with the land use/cover data and sewer service areas.

<u>Charts – Cumulative Effect of Upstream Distance</u>

Appendices F and G represent the tributaries of the Mullica River and the land disturbance within each sub-basin currently and at build-out. Each line is a sub-basin and its color represents disturbance. Green represents less than 10% disturbance, yellow represents streams with 10 - 29% disturbance, and pink represents streams over 30% disturbance. The number on the line represents the overall disturbance, e.g., 23%. It is important to note that within these charts, sub-basins are cumulative, e.g. #3 is the sum of sub-basins #1, #2 and #3, and #5 is the sum of sub-basins #1, #2, #3, #4 and #5. The colored circles represent water quality readings, which tend to confirm the 30% rule (the color dots red, yellow, green represent actual monitored measurements as opposed to changes predicted from disturbance).

Where two lines (sub-basins) meet a vertical line on the tree, they form a larger sub-basin and the disturbance ranking reflects this larger system. Thus, one can see the effect of a disturbed sub-basin (pink) on downstream sub-basins. In the example below, two pink sub-basins (40% and 35% disturbed) merge with an undisturbed system to form a much less undisturbed, larger system (11%).

Figure 9. Sample Section of the Disturbance Tree from Appendix F



Of the three major sections shown, in Appendix F, the Mullica (main stem) is currently the least disturbed (11% above the confluence with the Sleeper Branch) and the Nescochague is the most disturbed (46% above the confluence with the Mullica). In the current situation, the entire Upper Mullica River watershed is 16% disturbed. The same pattern holds true for the future with more disturbed sub-basins (pink) appearing and the overall downstream accumulation resulting in the entire Upper Mullica River watershed becoming disturbed. These charts could be used to target policies, e.g., protect the undisturbed sub-basins (green) or retrofit the disturbed sub-basins (pink). However it is necessary to know what makes a sub-basin disturbed to know how to address it.

<u>Type of Disturbance</u>

Appendix H breaks down the components of disturbance at various points in the Upper Mullica River watershed. Here, as in the prior two charts, the numbers on the lines refer to sub-basins that are steadily increasing in size as they accumulate and include all the land up river. The data in the rectangles provide a break out of the types of land disturbances (agriculture, septic-served development and sewer-served development) for both the current and build out scenario. For example, the Mullica main stem (#136) is currently 16% disturbed (7% agriculture, 4% septic, and 5% sewer) just after its intersection with the Sleeper Branch, while the Nescochague Creek (#135) is currently 46% disturbed (29% agriculture, 6% septic, 11% sewer) just before it joins with the Mullica main stem.

In all three major sections, the biggest component of change depends upon the CMP Management Area designation; however, the majority of the impact is from existing levels of disturbance. Comparison of the data to zoning shows the degree and type of change in disturbance is most directly correlated with the underlying CMP management area designation, although the majority of the total eventual disturbance is accounted for by existing conditions.

While this trend may seem counter to water quality preservation, a look at Appendix D shows that, other than the headwaters of the Mullica, these changes are occurring outside the Preservation Area District and the Forest Area where development and disturbance are planned (i.e., in Regional Growth Areas, Villages, Towns, Rural Development Areas, Agricultural Production Areas and Special Agricultural Production Areas).

6.2 <u>BMPs to Supplement or Replace Possible Management Area Changes</u>

In Section 5, it was suggested that Policy 4.2, Consideration of Re-designation of Management Areas, is the best approach where feasible. However, the discussion in 6.2 above suggests this might not be workable in cases where impacts may still be significant. Appendix J shows that the headwaters along the western border of the Pinelands to be extensively developed along US Route 30 and State Route 73.

Agricultural land uses are found immediately downstream, especially in Winslow Township and Hammonton Town. As such these sub-basins provide little opportunity for rezonings to better protect water quality. Therefore, another possible policy change, requiring or encouraging the use of Best Management Practices (BMPs), is examined more closely below. While it would be extremely labor intensive to review and/or evaluate each of the numerous BMPs listed in Appendix B, existing knowledge and experience may be used to screen the list for the optimal tools.

<u>Selected Best Management Practices for the Pinelands</u>

A number of Best Management Practices (BMPs) are suggested as possible considerations for further investigation by the Commission. Some may be able to be directly implemented by the Commission; others are more difficult and more appropriate for other agencies or interest groups. Following is the list of these suggested BMPs (categorized by the environmental situation they are attempting to address), the rationale or justification for inclusion and a brief survey of selected sources of further reading.

As many of the BMPs are useful for both existing and future development, discussion of existing and future development has been combined where applicable to both. These BMPs are intended as starting point, since many are underway and others may not be effectively or realistically implemented by the Pinelands Commission.

A) SITE DESIGN

1 <u>Conservation Type-Cluster Design</u>

<u>Area of Application:</u> new development

<u>Rationale:</u> The Stormwater Managers Resource Center indicates, "Open space design, also known as conservation development or cluster development, is a site design technique that concentrates dwelling units in a compact area in one portion of the development site in exchange for providing open space and natural areas elsewhere on the site. The minimum lot sizes, setbacks and frontage distances for the residential zone are relaxed in order to create the open space at the site. Open space designs have many benefits in comparison to the conventional subdivisions that they replace: they can reduce impervious cover, stormwater pollutants, construction costs, grading, and the loss of natural areas." Clustering is consistent with the CMP and is an important alternative to large lot development, because clustering may result in minimized lawn areas and impervious coverage and uses resultant open space for stormwater attenuation. Cluster development will change the disturbance dynamics (less disturbance, less impervious cover) presented in Appendices F and G.

<u>Current Level of Effort by Pinelands Commission:</u> Permitted under the CMP but not encouraged. Regulations being drafted to enhance in RDA and FA for land conservation/fragmentation purposes. Model ordinances being developed for RGA-type situations but no regulations under consideration at this time for denser clusters.

Possible Additional Role for the Pinelands Commission: CMP amendment, design guidelines and assistance

Selected Resources:

- ?? Center for Watershed Protection, Inc. 2005. Stormwater Managers Resource Center. http://www.stormwatercenter.net/
- ?? New Jersey Pinelands Commission.1980. Comprehensive Management Plan. New Lisbon, New Jersey.

2 Lower Impact Site Design

- ?? Low impact site design and construction measures (i.e. preclude vegetative clear cutting and massive site clearing)
- ?? Impacts on soil permeability during construction (e.g., excessive compaction of the development site and/or stormwater basin floor)
- ?? Rain gardens or seepage pits on individual lots to locally infiltrate roof and driveway runoff.

Area of Application: new development

Rationale: These new techniques may also affect the dynamics of the 10 - 30% watershed disturbance criterion. The NJDEP Stormwater BMP Manual indicates, "Land development can have severe adverse stormwater impacts such as an increase in stormwater runoff volume, rate, velocity, and pollutants and a corresponding decrease in the quality of runoff and stream flow. Low impact development seeks to reduce and/or prevent adverse runoff impacts through sound site planning and both nonstructural and structural techniques that preserve or closely mimic the site's natural or pre-developed response to precipitation." These measures are fairly easy to implement and are aesthetically pleasing both during and after development.

Current Level of Effort by Pinelands Commission: Several aspects (e.g. pre and post soil analyses, retention of natural vegetation and topography, reduction of basin and development compaction) are being dealt with in the new stormwater model ordinance effort.

Possible Additional Role for the Pinelands Commission: design guidelines and assistance

Selected Resources:

- ?? New Jersey Department of Environmental Protection. 2004. The New Jersey Stormwater Best Management Practices Manual. http://www.state.nj.us/dep/stormwater/.

B) STORMWATER

1 Improve Stormwater Management Measures

- ?? Failing stormwater infiltration basins that show evidence of channeled flow to streams.
- ?? Corrective measures, such as restoration of basin infiltration function via alteration of basin (maintenance or reconstruction).
- ?? Pretreatment systems (constructed wetlands, bio-filter, manufactured sediment removal device).

Area of Application: Retrofits

Rationale: Properly functioning stormwater basins decrease runoff, which could cause flooding, stream channeling, sedimentation and stream bank erosion. Pretreatment systems improve the removal of pollutants such as suspended solids, heavy metals, petroleum hydrocarbons, pathogens and nutrients. The Pinelands Commission Stormwater Basin Assessment Project, which will be submitted to the NJDEP this summer, indicates that many of the basins (70%) identified within the Upper Mullica River Watershed are not functioning properly and need to be retrofitted. Other problems associated with failing stormwater basins include aesthetic concerns (e.g. fencing) and public health concerns (e.g. habitat for mosquitoes and Canada geese). Stormwater Management attempts to, among other things, improve water quality in areas of heavy urban development. Poor management and/or design reduces the effectiveness of this technique.

Current Level of Effort by Pinelands Commission: Future stormwater management being enhanced in new model stormwater ordinances. Existing basins are being studied.

Possible Additional Role for the Pinelands Commission: Assist municipalities in seeking and obtaining financing for retrofits.

References:

- ?? New Jersey Department of Environmental Protection. 2004. The New Jersey Stormwater Best Management Practices Manual. http://www.state.nj.us/dep/stormwater/.
- ?? Monmouth County Mosquito Extermination Commission. 1999. Stormwater Management Basins and Their Maintenance. http://www.visitmonmouth.com/mosquito/pdfs/BasinsBro.pdf
- ?? Friedman, David. 2004. Personal Communication. Ocean County Soil Conservation District, Forked River, New Jersey.
- ?? Center for Watershed Protection, Inc. 2005. Stormwater Managers Resource Center. http://www.stormwatercenter.net/

2 Improve De-icing Management
- ?? Pre-treatment of road surfaces
- ?? Proper equipment use
- ?? Regular maintenance and accurate calibration of equipment
- ?? Better timing of salting
- ?? Coverage of salt storage

Area of Application: Retrofits and ongoing operations

Rationale: One of the most difficult non-point pollution sources to address is dissolved solids, especially when dissolved salts are present. Proper de-icing techniques can decrease salt concentrations that make their way into surface and ground waters and increase the effectiveness of de-icing. Dissolved salts are a major dissolved pollutant in ground and surface waters in developed areas. Excessive salt concentrations can affect the aquatic ecosystem. A reduction of the approximately 20 tons of road salt applied to each mile of four-lane highway in a normal year in the northeast region could have a positive effect on water quality in growth areas and lessen costs to towns.

Current Level of Effort by Pinelands Commission: Salt storage coverage being encouraged when it comes up in ordinances, such as recent commercial ordinances in Winslow Township.

Possible Additional Role for the Pinelands Commission: As necessary, help to disseminate current management strategies to public works agencies.

Selected Resources:
- ?? Schueler, Tom. 2005. Snow, Road Salt and the Chesapeake Bay. http://www.cwp.org/rr_photos/jan05/snowandsalt.pdf
- ?? NJ Water Supply Authority. 2005. Winter Road Maintenance Operations. http://www.raritanbasin.org/basin_bulletin/Fall2004/Fall2004BasinBulletinWinterOps.htm
- ?? The Salt Institute http://www.saltinstitute.org/
- ?? Massachusetts Department of Fish & Game. 2005. Road Salt: Some Alternatives and Strategies. http://www.mass.gov/dfwele/river/rivdeicing.htm
- ?? United States Environmental Protection Agency. 1999. Storm Water Management Fact Sheet - Minimizing Effects from Highway Deicing. http://www.epa.gov/npdes/pubs/ice.pdf

C) WASTEWATER

1 Comprehensive septic system management
- ?? System inventories
- ?? Periodic site inspections of existing systems
- ?? Regular preventive maintenance of septic systems

Area of Application: Retrofits and new development

Rationale: Two-thirds of the total estimated impact on water quality in a build-out scenario in the Upper Mullica River watershed will be from existing development. A significant portion (18%) of the current disturbance level is estimated to be from development on existing septic systems. Monitoring of existing septic systems can either maintain and/or result in improved performance and system efficiency resulting in decreased public health risks, ecological impacts and contamination of surface and ground water. Proper information, training, management and oversight build partnerships between regulators, service providers and property owners. Septic system management could prevent problems before they start by catching them during installation. Problems associated with lack of maintenance include clogging and lack of maintenance.

The Stormwater Mangers Resource Center indicates, "When septic systems are used for wastewater treatment, there is a need for homeowner education to avoid failure of both new and existing systems. Septic system maintenance education is particularly important for coastal shoreline developments near shellfish beds, where septic effluent discharges can influence water quality and lead to beach closures and algal blooms. There is also a need for educational outreach in lake communities, where nitrogen inputs can lead to lake eutrophication." Proper education is a cost effective supplement to build relationships between towns and private homeowners while reducing some of the potential of groundwater and surface water pollution.

Current Level of Effort by Pinelands Commission: New $250,000 NJDEP grant will examine septic system management opportunities.

Possible Additional Role for the Pinelands Commission: Await results of new management initiative.

Selected Resources:

?? U.S. Environmental Protection Agency. 2002. Onsite Wastewater Treatment System Manual. Washington DC.

?? U.S. Environmental Protection Agency. 2005. Decentralized Wastewater Treatment Systems - A Program Strategy. http://www.epa.gov/owm/septic/pubs/septic_program_strategy.pdf

?? New Jersey Pinelands Commission. 1996. A Field Comparison of Nitrogen Removal by On-Site Standard and Pressure Dosing Septic Systems in the New Jersey Pinelands. New Lisbon, New Jersey.

?? New Jersey Pinelands Commission. 1990. An Assessment of Nitrogen Removal Efficiency and Performance of RUCK Septic Systems in the New Jersey Pinelands. New Lisbon, New Jersey.

?? Jantrania, Anish R. 2000. Performance Expectations for Selected On-Site Wastewater Treatment Systems. Environmental Engineering Consultant, Span Management, Inc.

?? Center for Watershed Protection, Inc. 2005. Stormwater Managers Resource Center. http://www.stormwatercenter.net/

2. Reduce water quality impacts in sensitive areas from primary treatment (septic) systems:
   ?? Advanced alternative on-site systems
   ?? Small-scale community (package) treatment plants
   ?? Public sewer systems (where permitted and available)

   Area of Application: Retrofits and new development

   Rationale: As noted earlier, a significant portion (18%) of the current disturbance level is estimated to be from development on existing septic systems. The USEPA Strategic Plan identifies improperly located or functioning septic systems as a major source of pollution. In addition, pre-existing homes on lots of under 3.2 acres do not dilute total nitrogen to the 2-ppm target for new development. Nitrogen in wastewater contributes to eutrophication of surface water bodies resulting in poor water clarity, algal blooms and low dissolved oxygen levels. The invasion of non-native plant species in Pinelands aquatic and wetland habitats may also result from excess nitrogen discharges.

   Advanced on-site systems approved under the Pinelands Pilot Program are more capable of removing nitrogen than pressure dosing systems and have less maintenance and operation problems than RUCK systems. These systems are designed to meet the water quality requirements of the Comprehensive Management Plan (2 ppm total nitrogen at the property line) for single-family homes on one to three-acre lots, which could ensure the protection of high quality water resources in areas where septic systems are dominant.

   Community treatment plants are more cost effective and more manageable than individual septic systems. Small-scale wastewater treatment facilities can treat wastewater to reduce levels down to 2-4 parts per million total nitrogen, which is especially useful in isolated development areas such as Pinelands Villages (New Gretna Village, other Rural Economic Development Areas). In addition to villages, community package treatment plants are also a permitted use in Towns and Regional Growth Areas. Local recharge, if overall pollutant loading is sustainable, is better than regional export that takes place in some of the regional growth areas (e.g. Southern Camden County).

   Sewage treatment facilities are operated and maintained at a central location by trained professionals, which eliminates the costs and risks associated with on-site systems. Wastewater treatment facilities are regulated by the US EPA to ensure the high quality of water exiting the system. Many existing septic systems are located within designated sewer service areas.

   Current Level of Effort by Pinelands Commission: Alternative systems and their management are being investigated. NJDEP regulations and approaches to community wastewater feasibility is being investigated by Commission staff in Bass River Township and Buena Vista Township.

Possible Additional Role for the Pinelands Commission: Assist municipalities in seeking and obtaining financing for retrofits.

Selected Resources:

?? New Jersey Pinelands Commission. 1980. Comprehensive Management Plan. New Lisbon, New Jersey.

?? New Jersey Pinelands Commission. 2003. Alternative Design Wastewater Treatment Systems Program.

?? Jantrania, Anish R. 2000. Performance Expectations for Selected On-Site Wastewater Treatment Systems. Environmental Engineering Consultant, Span Management, Inc.

?? U.S. Environmental Protection Agency. 2005. Decentralized Wastewater Treatment Systems - A Program Strategy. http://www.epa.gov/owm/septic/pubs/septic_program_strategy.pdf

?? Various reports compiled during the Commission's Rural Economic Development initiative

D) AGRICULTURE

1 On-Farm assessments to identify nonpoint pollutant sources and implement corrective measures

Area of Application: mostly "Retrofits" to existing but could involve new agriculture

Rationale: In the Upper Mullica River Watershed case study, a significant portion (56%) of the current disturbance level is estimated to be from agricultural uses. The Farm-A-Syst program (prepared by the NJ Association of Conservation Districts) is "an important step toward a comprehensive and sustainable farm resource and management plan to protect the quality of water." The On-Farm Assessments include practical BMPs that are easy and cost effective to implement, such as: Erosion and Sediment Control; Nutrient Management; Pest and Pesticide Management; Livestock, Barnyard, Manure and Waste Management; Livestock Grazing Management; Irrigation Management. Marketing this guide and education could help some farmers better manage their resources while helping to improve water quality.

Current Level of Effort by Pinelands Commission: BMPs were explored with the Mullica River watershed agricultural sub-committee. However, NJDEP stopped funding such efforts and no further work has been done.

Possible Additional Role for the Pinelands Commission: As necessary, help to disseminate current and future management strategies to partner agencies.

Selected Resources:

?? New Jersey Association of Conservation Districts. 1998. On-Farm Strategies to Protect Water Quality - An Assessment and Planning Tool for Best Management Practices in New Jersey.

2 State or County farmland preservation programs that incorporate BMPs.

Area of Application: mostly existing agriculture but could include new agriculture

Rationale: The NJ Department of Agriculture believes, "Farmland preservation is an important part of keeping New Jersey green and prosperous. Preserved farmland limits urban sprawl, protects our water and soils, provides us with an abundance of locally grown farm products and maintains our connection to the land and the longstanding agricultural traditions that earned our reputation as the Garden State." Some farms are located in headwaters and as more become preserved, the use of BMPs that reduce non-point source pollution will improve overall stream quality. Preservation could require or reward those that use BMPs. For example, the forested area in a new 300-foot buffer could receive an additional bonus of Pinelands Development Credits over the current formula. Scientific research has shown vegetative stream buffers adjacent to agricultural areas can effectively reduce nutrient loadings to nearby streams. Trees, undergrowth and grasses uptake phosphorus and nutrients from groundwater by way of their root systems. Buffer zones have also proved to be an effective way of reducing the amount of sediment from agricultural runoff that can find its way into nearby streams.

Current Level of Effort by Pinelands Commission: SADC has incorporated such requirements into its deed restriction program. When the Commission reviews the PDC program (beginning this year) demand enhancement and additional allocations (such as to new buffers) can be considered.

Possible Additional Role for the Pinelands Commission: Await PDC studies noted above.

Selected Resources:

?? New Jersey Pinelands Commission.1980. Comprehensive Management Plan. New Lisbon, New Jersey.

?? New Jersey Department of Agriculture. 2005. The New Jersey Farmland Preservation Program Overview. http://www.state.nj.us/agriculture/index.html

?? Nutrient Dynamics in an Agricultural Watershed: Observations on the Role of a Riparian Forest. 1984. Smithsonian Environmental Research Center. Edwater, Maryland.

?? Relative Nutrient Requirements of Plants Suitable for Riparian Vegetated Buffer Strips. 1997. Interstate Commission on the Potomac River Basin. Rockville, Maryland.

E) HEADWATERS PROTECTION

1 Land protection in critical headwater areas

Area of Application: Most likely used to avoid new development

Rationale: Numerous sources cite the importance of headwaters. Significant current and future disturbance levels in the headwaters can have an impact on basins further downstream that would otherwise be considered having typical Pinelands water quality. Protection of the natural vegetation in headwaters reduces flooding, sediment delivery and non-point source pollution down stream. Watersheds with agricultural or urban development have higher pH, dissolved solid concentrations and nonnative plant and animal species than watersheds where land has been protected in its natural state.

Current Level of Effort by Pinelands Commission: 20 potential new planning areas for permanent land protection in the Pinelands were identified and presented to the Permanent Land Protection Committee several years ago. From these, two projects were selected (Mullica/Elwood corridor, Medford/Evesham) for initial work. The latter includes headwaters, as do some of the remaining 18 possible planning areas.

Possible Additional Role for the Pinelands Commission: Await results of land protection prioritization work scheduled in FY06 work plan.

Selected Resources:

?? New Jersey Pinelands Commission. The Mullica River Basin: A Report To The Pinelands Commission on the Status of the Landscape and Selected Aquatic and Wetland Resources. 2001. New Lisbon, New Jersey.

?? Upper Delaware Watershed Management Project. 2002. Riparian Zones in the Upper Delaware Watershed. http://www.upperdelaware.org/Documents/outreach/index.htm

?? State of Ohio Environmental Protection Agency. 2003. The Importance and Benefits of Primary Headwater Streams. http://www.epa.state.oh.us/dsw/wqs/headwaters/

2 Establish 300-foot wetland buffers (the maximum required by the CMP) for all new construction in critical headwaters areas.

Area of Application: new development

Rationale: Currently, wetlands buffers are set at 300-feet but can be reduced under certain circumstances. For example, buffers in the regional growth area headwaters of the Upper Mullica River Watershed average less than 200-feet even though these headwaters affect the water quality downstream.

In general, the wider the buffer, the better the protection. Use of the full buffer in headwaters could protect this important resource to the fullest extent of the CMP's protections. A University of Georgia report indicates 300 feet is the minimum buffer width needed to both protect diverse terrestrial riparian wildlife communities and preserve forest interior species habitat. More locally, NJDEP's new stormwater regulations recognized the importance of 300-foot buffers by requiring them in all Category One (C-1) waters a designation used for the State's best waters and roughly equivalent to its designation of Pinelands Waters (PL).

More generally, the Stormwater Managers Resource Center indicates, "An aquatic buffer is an area along a shoreline, wetland, or stream where development is restricted or prohibited. The primary function of aquatic buffers is to physically protect and separate a stream, lake or wetland from future disturbance or encroachment. If properly designed, buffers can provide stormwater management and act as a right-of-way during floods, sustaining the integrity of stream ecosystems and habitats." The Raritan Basin Watershed Management Project lists numerous ecological benefits of stream buffers such as: storing of flood waters, stabilizing stream banks, providing habitat, improving aesthetics and removing sediments. As indicated above, trees, underbrush and grasses are able to uptake high amounts of nutrients (Nitrogen and Phosphorus) through their root systems. Scientific studies have shown vegetative stream buffers effectively decrease the amount of nutrients that can make their way from adjacent agricultural land to nearby streams.

As a practical example, the Montgomery County Department of Park and Planning has defined special protection areas (that include wetlands buffers) in order to protect and maintain high quality or sensitive water resources. The wetland buffers include the stream channel, flood plains, riparian areas and wetlands that are hydrologically connected to the stream. Wider wetland buffers are applied to first and second order streams (found in headwaters areas) than to higher order streams (found downstream). Together with the implementation, maintenance, and monitoring of BMPs, the County believes it has an effective way of achieving watershed and stream protection.

<u>Current Level of Effort by Pinelands Commission:</u> No specific wetland buffer assessment is underway.

<u>Possible Additional Role for the Pinelands Commission</u>: Could consider the wetland buffer approach suggested in Policy Implications of Pinelands Commission Research Projects #19

<u>Selected Resources:</u>

?? New Jersey Pinelands Commission. 1980. Comprehensive Management Plan. New Lisbon, New Jersey.

?? New Jersey Pinelands Commission. 1994. A Watershed-Based Wetland Assessment Method for the New Jersey Pinelands. New Lisbon, New Jersey.

?? Upper Delaware Watershed Management Project. 2002. Riparian Zones in the Upper Delaware Watershed. http://www.upperdelaware.org/Documents/outreach/index.htm
?? Raritan Basin Watershed Management Project. 2001. The Importance of Riparian Areas Fact Sheet. http://www.raritanbasin.org/education.htm
?? Montgomery County Department of Park and Planning. 2000. Environmental Guidelines for Environmental Management of Development in Montgomery County. http://www.mc-mncppc.org/Environment/forest/guidelines_0100/toc_environ_guide.shtm
?? Office of Public Service & Outreach Institute of Ecology University of Georgia. 1999. A Review of the Scientific Literature on Riparian Buffer Width, Extent and Vegetation. Athens, Georgia.
?? Nutrient Dynamics in an Agricultural Watershed: Observations on the Role of a Riparian Forest. 1984. Smithsonian Environmental Research Center. Edwater, Maryland.
?? Relative Nutrient Requirements of Plants Suitable for Riparian Vegetated Buffer Strips. 1997. Interstate Commission on the Potomac River Basin. Rockville, Maryland.
?? Zampella, R. A., R. G. Lathrop, J. A. Bognar, L.J. Craig, and K. J. Laidig. 1994. A watershed-based wetland assessment method for the New Jersey Pinelands. Pinelands Commission, New Lisbon, NJ.

Implementation of Best Management Practices

As each sub-basin has its own distinctive development and agricultural characteristics the choice of BMPs must be tailored. Figure 10 below summarizes the predominant land use by disturbance level category for subwatersheds in the Pinelands (also see map in Appendix K). These subwatersheds already exceed the 10% threshold and will remain in the same disturbance level category in a build-out scenario as in the current scenario.

Figure 10. Subwatersheds (HUC-14) in the Pinelands With More Than 10% Disturbed Land

Current and Build-out Status	Primary Land Use in Build-out	Total Number of Subwatersheds	Percent of Total Subwatersheds
10% to 30%	Agriculture	19	9%
10% to 30%	Septic	18	8%
10% to 30%	Sewer	10	4%
10% to 30%	Total	47	21%
30% or Greater	Agriculture	20	9%
30% or Greater	Septic	15	7%
30% or Greater	Sewer	18	8%
30% or Greater	Total	53	24%

As was the case for existing disturbance, each sub-basin has its own distinct mix of future disturbance (i.e., septic, sewer, and agriculture), with implications for selecting the most appropriate BMPs. For illustrative purposes, Appendix L shows which subwatersheds will exceed 10% disturbance in a build-out scenario and the primary type of disturbance. For example, while use of alternative septic systems has been advocated, only a small portion of the future impact in the upper reaches of the Mullica River watershed is septic-related (25%), while almost half is derived from sewered development. Therefore, reducing impacts from sewered development, e.g., through clustering, might be more effective. Conversely, requiring alternative septic systems may be quicker and more practical.

The chart below shows the likely causes for the changes in disturbance level categories that occur in the build-out scenario. It suggests BMPs for all three types of disturbance should be considered, but that sewered development should take precedence (56% of the changes), followed by agriculture (23% of the changes and 66% of the changes to >30% disturbance), followed by septic (21% of the changes).

Figure 11. Subwatersheds (HUC-14) in the Pinelands that May Change Status

Current Status	Build-out Status	Land Use with Greatest Change	Total Number of Subwatersheds	Percent of Total Subwatersheds
Less than 10%	10% to 30%	Agriculture	9	4%
Less than 10%	10% to 30%	Septic	4	2%
Less than 10%	10% to 30%	Sewer	9	4%
Less than 10%	10% to 30%	Total	22	10%
10% to 30%	30% or Greater	Agriculture	5	2%
10% to 30%	30% or Greater	Septic	3	1%
10% to 30%	30% or Greater	Sewer	22	10%
10% to 30%	30% or Greater	Total	30	13%

7 CONCLUSION AND POLICY RECOMMENDATIONS

7.1 Scientific Conclusion

Studies undertaken by the Commission's Science Office have directly and indirectly influenced policy and planning decisions concerning the protection of ambient water quality. Environmental monitoring data from different sub-basins have shown varying degrees of water quality impact and degradation associated with land-use activities. In fact, these environmental monitoring data from different sub-basins indicate a direct relationship between land use and degradation (e.g., the "10%" and "30%" thresholds). Various Pinelands Commission scientific studies have provided information on selected parameters for both reference streams and degraded streams. The disturbance/ degradation concepts (e.g., the "10%" and "30%" thresholds) and parameter levels (reference stream levels) can be used to fine-tune the Pinelands Protection Program if and where necessary. Recommendations follow.

7.2 Policy Recommendation: *Sub-Regional Planning Efforts*

Review of data and findings prepared by the Commission's Science Office and their implications for the development of policies to protect ambient water quality leads to the conclusion that sub-regional land use controls like the Pinelands management areas are the best methods to protect ambient water quality in streams of reference quality. Therefore, the following recommendation is made:

?? Pursue Regional or Sub-Regional Planning Efforts: Continue to review areas where changes to Pinelands Management Area boundaries could better protect Pinelands natural resources (including water quality).

?? Aside from the three current sub-regional planning efforts (Toms River Corridor, Medford/Evesham, and Elwood Corridor), a region-wide ecological integrity assessment is underway that will focus on water quality and typical Pinelands aquatic communities, watershed disturbances and rare plant and animal habitat. These and other characteristics will be matched to management area designations and, where incompatible, lead to recommended management area changes.

?? Until this assessment is completed, other sub-regional planning efforts should be limited to "hot spots" where significant conflicts between development potential and environmental objectives exist that could be addressed by sub-regional planning. Staff is conducting such an assessment to determine if and where such situations exist.

7.3 Policy Recommendation: *Best Management Practices*

As a supplement to sub-regional land use controls, new Best Management Practices should be explored and implemented, at minimum, where the disturbance impact mapping and water quality data indicate they would be the most helpful:

✍ Utilizing the disturbance impact mapping, as confirmed by water quality data, to determine where <u>water quality is degraded</u> and impacts upon downstream natural resources, seek to implement the most effective BMPs for both existing and future development.

✍ Utilizing the disturbance impact mapping, as confirmed by water quality data, to determine where <u>water quality is currently high</u>, implement the most effective BMPs to limit potential impacts from future development.

The Commission will need to follow different paths towards implementing the various BMPs. Following is the recommended agenda for action by the various Commission committees.

7.3.1 Science Committee: Recommended Items for Research Agenda

To supplement and complete the evaluation of both known and new innovative BMPs, further work appears to be needed in the following areas:

✍ Ongoing Literature Research: New Best Management Practices

Ongoing literature searches would help in determining the most current and appropriate BMPs in the five described categories of BMPs (Site Design, Stormwater, Wastewater, Agriculture, and Headwater protection), as well as exploring other BMP possibilities that might arise. It may also be useful to inventory failing or pre-Pinelands infrastructure (e.g., stormwater basins or septic systems) to determine their overall extent, the cause of any failures, opportunities for improvements, and the impact on surrounding water quality.

✍ Experimental Research: Possible Pilot Program

Some BMPs are unsubstantiated in their impact in various conditions or have yet to be demonstrated to be cost effective. To address these uncertainties, more evaluation and monitoring will be needed before some of the BMPs can be implemented.

✍ Several factors need to be considered in the design of any pilot program:

?? What resources are available to study the BMP? It is impractical to implement all such investigations at once.
?? Are the BMPs duplicative of another effort? Investigations of such BMPs might be unnecessary since some BMPs may effectively duplicate others or change their impacts.
?? Where should such investigations be undertaken? The Upper Mullica River watershed is somewhat disturbed and through further development, will become more so. This watershed has been extensively studied and a great deal is known about it. This might be an appropriate pilot area.
?? What BMPs should be investigated for possible experimental trials? Examples include rain gardens and seepage pits to infiltrate runoff, pre-treatment of stormwater before infiltration, wetlands buffers in agricultural areas, 300' buffers in headwaters, and use of on-site wastewater treatment systems for non-residential development.

7.3.2 Public and Governmental Programs Committee: Recommended Items for Education/Partnership Agenda

Implementation of some BMPs should be the responsibility of other agencies or just need to become more widely disseminated. Examples follow.

✍ **With Department of Agriculture (DOA)**

SADC and the DOA routinely conduct assessments with farmers on BMPs. Commission staff could help as needed. Incentives to use particular BMPs, e.g., wetlands buffers, could be explored with the DOA and, if viable, result in an enhanced TDR (e.g., **in the state's SADC easements or** in the Pinelands PDC program entitlement if the Commission's upcoming supply/demand analysis shows sufficient demand **and the Policy and Implementation Committee endorses the concept, see below)**.

✍ **With municipalities and development community**

Clustering and other lower impact site design techniques are not widely known or utilized in the Pinelands.

✍ **With NJ DOT, Counties, and Municipalities**

Road salt management is rapidly advancing with better results in both de-icing and limiting runoff. Staff could work with public works managers to ensure that such state-of-the art management is more widely applied.

✍ **With NJ DEP**

Existing septic systems may be failing. Needed maintenance may be being deferred. A statewide (or Pinelands-wide) inspection system analogous to NJPDES permits could be considered. The Commission's upcoming effort on the management of septic systems will serve as a model.

7.3.3 Permanent Land Protection Committee: Recommended Items for Acquisition Agenda

Acquisition in headwaters areas should be advanced.

7.3.4 CMP Policy and Implementation Committee: Recommended Items for Possible Rulemaking Agenda

Finally, some of the BMPs are ready for possible rule making, or are in the process of being incorporated.

- ✍ Mandatory clustering has been proposed for the Rural Development and Forest Areas and is pending. Incentives for use of clustering in RGAs, Villages, and Town management areas are recommended.

- ✍ The proposed stormwater rules address excessive clearing, soil compaction during construction, and coverage of salt storage facilities. The success and need for further initiatives should be monitored and re-evaluated in a couple of years.
- ✍ Maintenance of standard septic systems is an area that is being considered statewide and in the Commission's alternative septic system pilot program. Recommendations concerning such maintenance are likely to be forthcoming in the next 12-18 months.
- ✍ Where (and with NJ DEP, how) community wastewater facilities may be used without facilitating unwarranted development should be considered.
- ✍ Use of "bonus" PDC allocations for establishment of wetlands buffers from non-wetlands agriculture and other agricultural BMPs, perhaps using the new farm conservation plans under development from SADC, could be developed. This can be considered as part of the PDC analysis that is now underway.
- ✍ 300' wetlands buffers in key headwaters areas could be required, as could the use of alternative design wastewater treatment systems (i.e., no standard septic systems).

7.4 Other Work Plan Items: Recommendations to seek infrastructure funding for Retrofits

Some of the BMPs need to be applied to existing developments. Such application would require funding sources to create incentives for retrofitting. Key areas for retrofits include channelized stormwater flow outlets, existing malfunctioning stormwater basins, and areas with septic systems on small lots where wastewater treatment of some sort would be valuable.

Appendix A

<u>Special Requirements for Golf Courses in the Pinelands Area (based on BMP research and implemented by two Pinelands municipalities to date)</u>

1. Wildlife and Habitat Preservation

(a) All golf courses/clubs shall be designed to preserve existing wooded areas and utilize existing open space. In addition to existing cleared land, the amount of additional land permitted to be cleared shall be equal to 25% of the existing wooded acreage subject to a minimum of 75 acres. Existing cleared areas not to be utilized by the course shall be mitigated by replacement with native trees and shrubs, particularly in locations where stream corridors are not shaded by vegetation at the time of development. All landscaping, with the exception of that proposed for ornamental use or screening/buffering, shall utilize native shrubs and trees in accordance with Section 20-5.14.c4.(d).

(b) A complete inventory of all wildlife and plant habitat and species on the property shall be conducted, including documentation of any endangered or threatened species habitat.

(c) Clearing, grading and other disturbances shall be designed to completely avoid the nesting, breeding and feeding areas of endangered and threatened animal species, and to avoid the locations of endangered and threatened plant species.

(d) A Wildlife Habitat and Enhancement Plan, including maps of native species habitat, shall be submitted which outlines ways in which the course will maintain or enhance conditions for native animal and plant species, particularly endangered and threatened animal and plant species.

(e) Application of pesticides or fertilizers shall be prohibited in undisturbed areas and within 300 feet of any identified endangered and threatened species habitat or rare community type.

(f) Gasoline powered golf carts shall be prohibited on any golf course (this excludes maintenance vehicles and equipment).

(g) All golf courses shall be designed to minimize the visual impact of the course on the landscape through the provision of a forested buffer not less than 100 feet in width around the perimeter of the parcel .

2. Water Quality Management

(a) A vegetated buffer at least 300 feet in width and consisting of native trees, shrubs and ground covers, shall be provided and maintained between any turf area which will be treated with fertilizers or pesticides and the closest point of any wetlands, on or off-site.

(b) The applicant shall demonstrate that the amount of managed turf used on the course has been reduced to the maximum extent practical. Primary play areas and, if the need is demonstrated, secondary play areas are permitted to use managed turf not on the list below provided that it has been shown to decrease irrigation and pesticide application requirements. Other secondary play areas and all out-of-play areas shall use only those species of drought and pest resistant turf listed below:

i. Fescue species
ii. Smooth bromegrass
iii. Reed canary grass
iv. Little bluestem
v. Deertongue
vi. Red top
vii. Switch grass
viii. Other varieties shown to be drought and pest resistant

(c) The applicant shall demonstrate that "no-mow" and "no-spray" zones have been incorporated in the course design and that such zones have been maximized in area and situated when appropriate adjacent to existing native vegetative cover and water bodies.

(d) An Integrated Turf Management (ITM) Plan and Integrated Pesticide and Pest Management (IPM) Plan shall be submitted which are specific to the operation and maintenance of the proposed golf course. These plans shall be prepared in accordance with guidelines established by the New Jersey Department of Environmental Protection (NJDEP), and shall take into account guidelines promulgated by the United States Golf Association (USGA) and the Golf Course Superintendents' Association of America (GCSAA). These plans shall use Best Management Practices (BMPs) to prevent and/or minimize adverse impacts of the golf course on groundwater and surface water resources.

(e) The ITM/IPM Plans required in 2(d) above shall incorporate at a minimum the following items:

i. Strategies to prevent or discourage recurring pest problems, which may include pest resistant turf, modifying microclimates, changing cultural practices, and using various non-chemical control measures;
ii. Selection of pesticides that have low toxicity, low solubility (<30 ppm), high sorption rates (K>300), and short half lives (<21-50 days);
iii. Delineation of high, medium and low maintenance areas and the thresholds of pest damage that the course will accept for each area;
iv. Descriptions of the planned turfgrass;
v. Identification of local disease, insect and weed problems; and
vi. Identification of aesthetic and functional thresholds for pest and disease.

(f) A Soil Erosion and Sedimentation Plan for the golf course shall be submitted which outlines coordinated soil erosion and sediment control measures by focusing on the perimeter of the graded areas. This Plan shall also limit the extent of clearing and soil exposure prior to revegetation, possibly through construction phasing. A grading plan, sufficient to determine consistency with the stormwater management requirements of Section 20-5.14.h.2(f), shall be submitted for the course, with individual grading plans submitted for specific holes as circumstances warrant.

(g) All waterway crossings shall be bridged, not designed with culverts.

(h) Monitoring of surface water and groundwater quality and quantity shall be provided by the owner(s) on a quarterly basis according to a Water Quality Monitoring Plan prepared specifically for the proposed golf course/club. This monitoring shall include testing for nitrates and all pesticides to be used on the course (only those found on the Pinelands approved list may be applied – other pesticides registered with the USEPA may be used only if they are approved by the Pinelands Commission following the submission of a report detailing their characteristics). At least 12 testing sites shall be required; such sites shall located (when deemed necessary) next to tees, greens, and fairways in order to identify turf management issues, as well as at up gradient, down gradient and side gradient locations on the golf course. Water table monitoring shall also be provided, using continuous water table monitoring equipment (data log). Such a monitoring program shall detail the type, timing and frequency of testing, as well as identify the specific chemical parameters to be tested, and shall be established at the time the Integrated Turf Management Plan and the Integrated Pesticide and Pest Management Plans required in 2(d) above are approved by the Township. The monitoring program shall be consistent with the guidelines established for monitoring plans established by the New Jersey Department of Environmental Protection (NJDEP), Bureau of Water Quality Analysis and the Pinelands Commission.

(i) Any streams that traverse the golf course shall be monitored at their entry and exit points to establish impacts on surface water quality.

(j) Detection of levels of nitrates or pesticides above those standards outlined in the Water Quality Management Plan required in 2(h) above, or the presence of prohibited chemical constituents, shall result in immediate re-testing at the impacted well site(s). A second consecutive reading above allowable levels shall result in the use of the product causing the readings to be immediately discontinued at the site. A third test shall be conducted one month later; if the problem persists, or if there are any chemical spills or other occurrences that may present a hazard to local water quality or inhabitants, they shall be immediately reported by the owner to the appropriate authorities for possible mitigation. If the level of nitrate/nitrogen exceeds 2 ppm, the golf course superintendent shall provide to the Township and the Pinelands Commission a written description of how he or she intends to modify the turf management program in order to ensure consistency with the 2 ppm standard.

(k) Fertilizer runoff shall be reduced via slow-release fertilizers and through the selection and use of organic products whenever possible.

(l) Storage, handling, and disposal of chemicals shall be conducted in compliance with State and OSHA regulations. Maintenance employees shall be properly trained with respect to these procedures.

(m) Porous materials such as wood chips and gravel shall be used as alternatives to asphalt and concrete in areas where traffic characteristics permit. Wood chips shall be generated from trees removed on-site to the maximum extent possible.

(n) Paved parking areas shall be limited to 50 spaces, with additional parking areas consisting of porous materials.

(o) Any planned renovations/upgrades on the course shall include measures to prevent stormwater runoff and non-point pollution from entering waterways during construction.

(p) Any non-point pollution control measures required as part of the course design shall be installed in a manner which protects adjacent areas from construction activities.

(q) Storage and wash areas for maintenance equipment shall be covered as to prevent runoff of chemicals. All chemical storage areas and septic systems shall maintain a minimum distance of 300 feet from all freshwater wetlands.

(r) Where applicable, grass clippings shall be composted rather than bagged.

3. Water Conservation Techniques

(a) An Irrigation Water Management Plan (IWM) shall be submitted, specific to the operation and maintenance of the proposed golf course. The IWM shall demonstrate how, through the use of innovative technologies and practices, the course will reduce water use by at least 10% as compared to state-of-the-art golf courses currently being constructed outside the Pinelands. The IWM shall include specifics on installation of an approved irrigation system that reduces to the extent practical water use, evaluation of the irrigation system and pump operation prior to season startup to ensure efficiency and proper functioning, proper scheduling of irrigations by following a predetermined monitoring and record-keeping procedure, installation of management tools and devices, and testing of irrigation water quality. All irrigation areas must be clearly delineated in the course layout. The IWM shall demonstrate that areas eligible for irrigation are limited to greens and collars, tees, greens approaches, fairway landing zones, and other fairway areas and shall demonstrate that the irrigation of roughs will be limited to the greatest extent possible. Watering shall be scheduled as to reduce evaporation and the potential for disease.

(b) A water use budget and water recycling plan that complements the IWM Plan required in 3(a) above shall be prepared and submitted, which is specific to the proposed golf course. This plan shall detail the source of potable and irrigation water, the projected amounts which will be required and the water supply capacity of any aquifer from which such water will be withdrawn, and should ensure that consumptive water use is minimized.

(c) Where native shade trees are planted, as around waterways, they shall be clumped as to reduce evaporation rates.

(d) The construction of runoff collection ponds in upland areas shall be required for use as stormwater management devices and as potential sources of irrigation water. Best Management Practices (BMPs) shall be employed to maximize recharge of surface runoff. Ponds shall be designed and constructed to prevent stagnation, including the use of aeration devices and other techniques to maintain pond water circulation.

(e) Unless the applicant can demonstrate that they are unnecessary, underdrain systems that will eventually feed lined lakes shall be required for tees and greens; these may be used as a source of irrigation water.

(f) Following the installation of any well intended to serve as a water supply source for the golf course/club, and prior to the issuance of a certificate of occupancy, a pump test shall be conducted at the maximum projected pumping rate, to assess the impact(s) on other well users in the vicinity. The results of this test shall be used to project the cone-of-depression for production wells, and to determine whether existing wells or wetlands will be adversely affected. If adverse effects on existing wells or wetlands are projected, alternative water supply sources shall be required for the golf course.

Appendix B
Best Management Practices

I. Septic Systems:

A. Expand the usage of on-site systems that treat wastewater.
B. Expand the number and types of approved on-site treatment systems.
C. Manage all septic systems.
D. Encourage community treatment systems.

II. Stormwater:

A. Structural BMPs
   1. Reduce pollution sources
      a. Cover road salt storage areas
      b. Cluster development (see below)
   2. Treat before recharge
      a. Use wet ponds before recharge to bio-remediate polluted water
      b. Add technological treatments
   3. Enhance recharge
      a. Recharge water close to the source5
      b. Avoid concentrating stormwater in one area
      c. Use porous pavement to allow for some recharge
   4. Improve the control of water volume
      a. Improve stream discharge structures to reduce water flow and allow for sedimentation
      b. Situate wet ponds before recharge areas to manage volume

B. Non-structural BMPs
   1. Reduce use of pollutants
      a. Explore alternatives to road salt
      b. Improve landscaping (see below)
      c. Enhance oil-recycling opportunities
      d. Better manage wildfowl
      e. Better manage pets
      f. Minimize impervious surface
   2. Treat water before recharge
      a. Require more flow over non-pervious surfaces
   3. Enhance recharge
      a. Ensure professional site examination and on-site management during construction
      b. Ensure maintenance
      c. Utilize existing forested areas for recharge

III. Landscaping:

A. Limit the amount of lot clearing
B. Limit the amount of turf usage
C. Use vegetation adapted to droughty, nutrient poor conditions

D. Use technologies to limit and target use of pesticides, fertilizers and water use
E. Mulch to conserve water
F. Educate lawn care providers

IV. Clustering:
A. Reduce impervious surfaces by utilizing shared driveways
B. Reduce the driveway widths
C. Reduce the road widths
D. Reduce wastewater pollution (see septic systems above)
E. Reduce disturbance (see landscaping above)

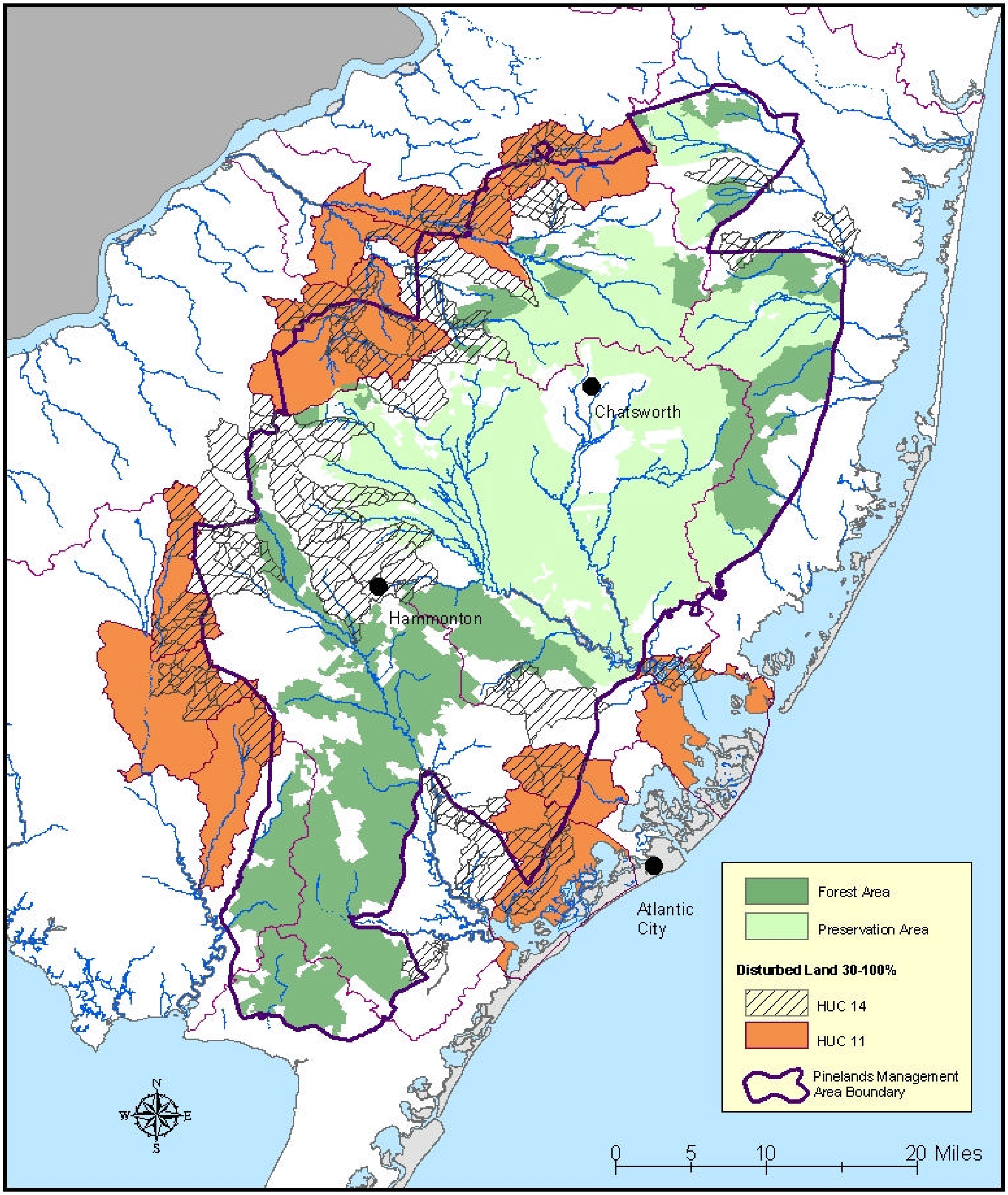
V. Agriculture:
The New Jersey Dept of Agriculture outlines the following BMPs on its website http://www.state.nj.us/agriculture/sadc/amps.htm
A. Apiary agricultural management practice
B. Poultry manure agricultural management practice
C. Food processing by-product land application agricultural management practice
D. Commercial vegetable production agricultural management practice
E. Commercial tree fruit production agricultural management practice
F. Natural resource conservation agriculture management practice
G. Agricultural management practice for on-farm compost operations operating on commercial farms
H. Fencing installation agricultural management practice for wildlife control

The Department of Agriculture also has others under development and in various stages of being adopted. They address equine, aquaculture, agrotoursim, farm markets, and production in permanent greenhouses. Finally, in a Mullica watershed workshop with farmers, there was some concern that turf farming needed BMPs (turf farmers were not in attendance but agricultural suppliers who were familiar with their needs were).

Appendix C

"Current" Status (1995)

Groupings of Smaller Subwatersheds (HUC 14) into Larger Watersheds (HUC 11) that are Currently "Disturbed"



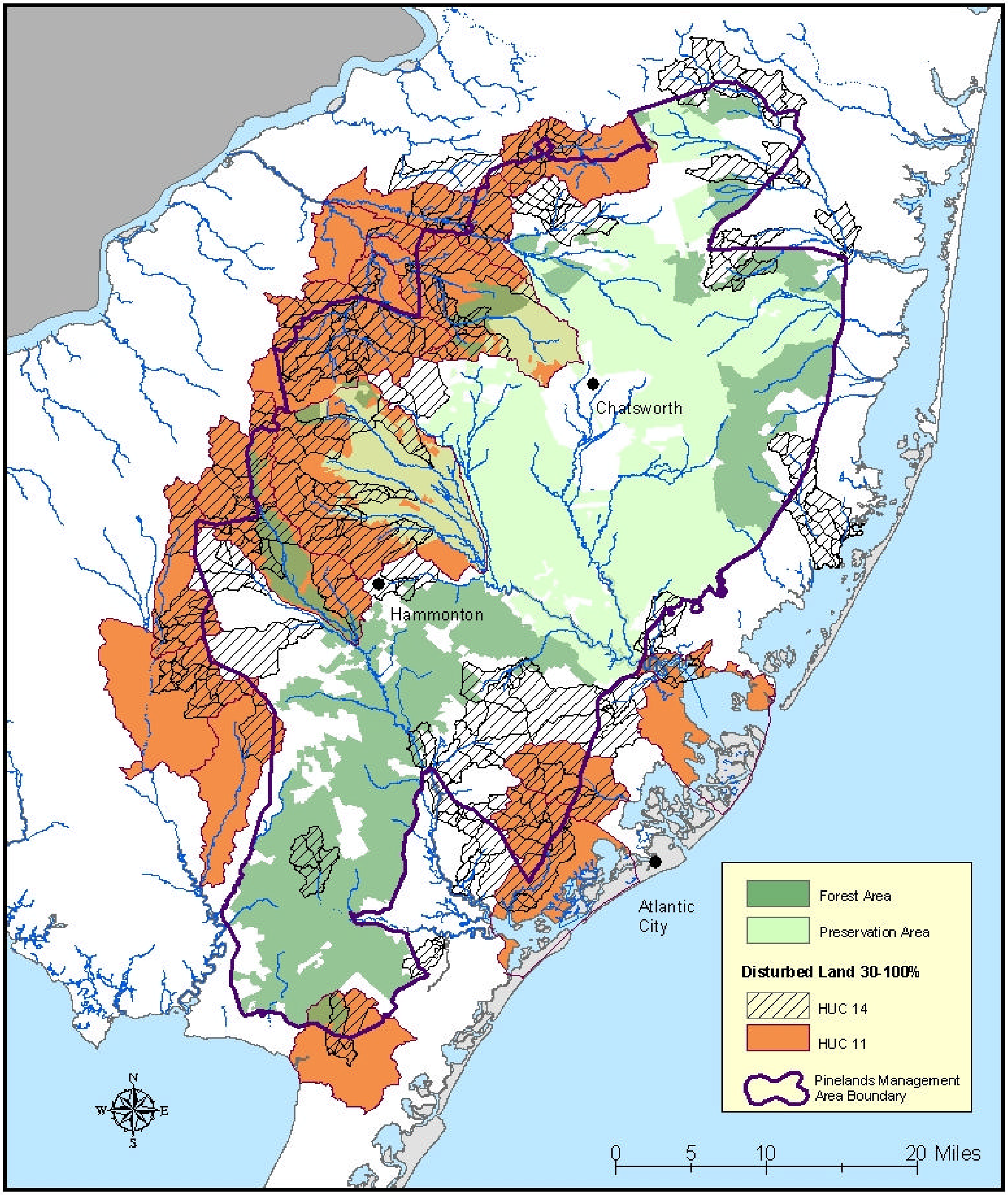
Data Sources: NJDEP, NJPC

Map Prepared By: NJ Pinelands Commission, May 2004

Appendix D

"Build-Out" Status

Groupings of Smaller Subwatersheds (HUC 14) into Larger Watersheds (HUC 11) that either are or will become "Disturbed"



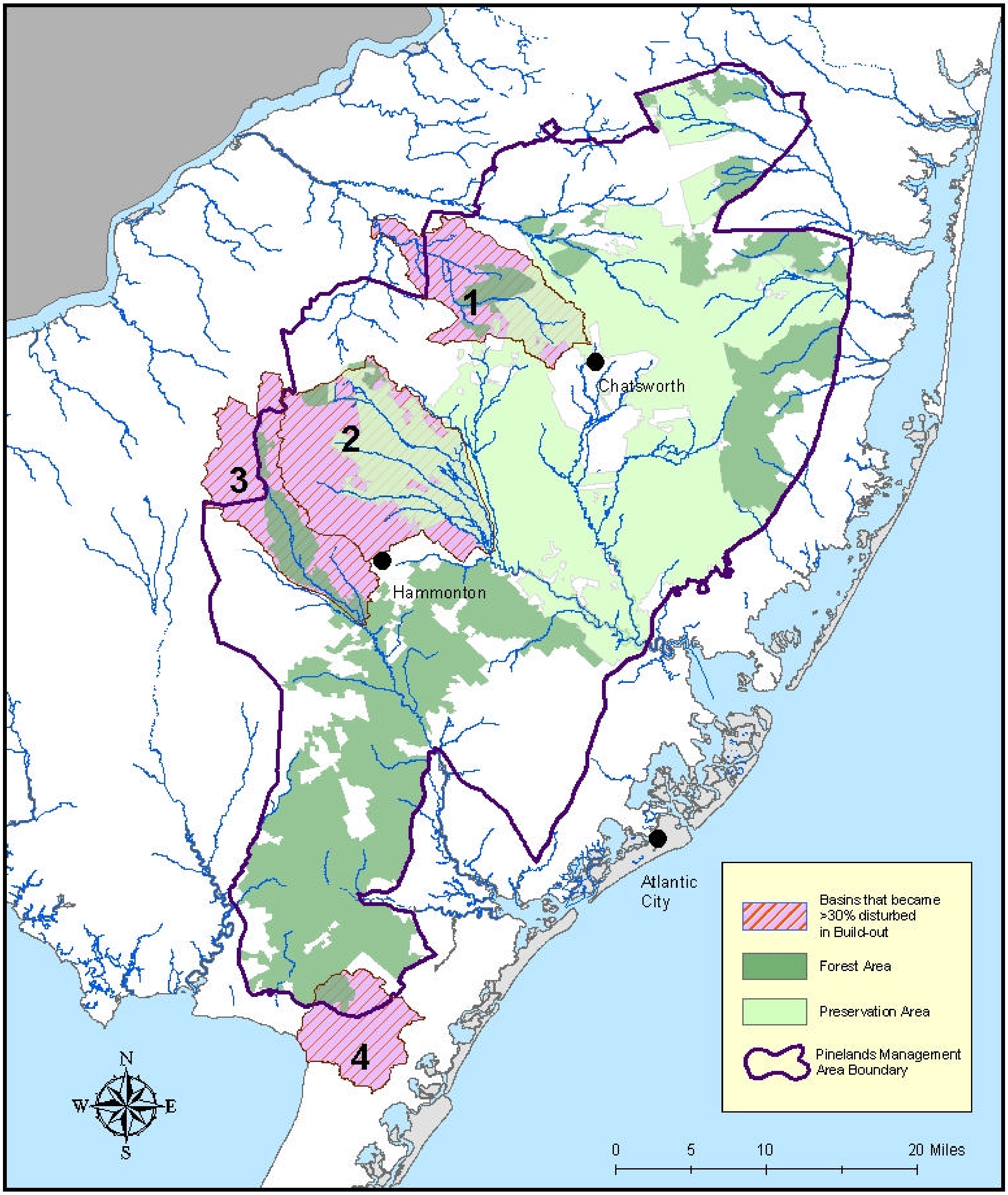
Data Sources: NJDEP, NJPC

Map Prepared By: NJ Pinelands Commission, May 2004

Appendix E

Basins that Change Status

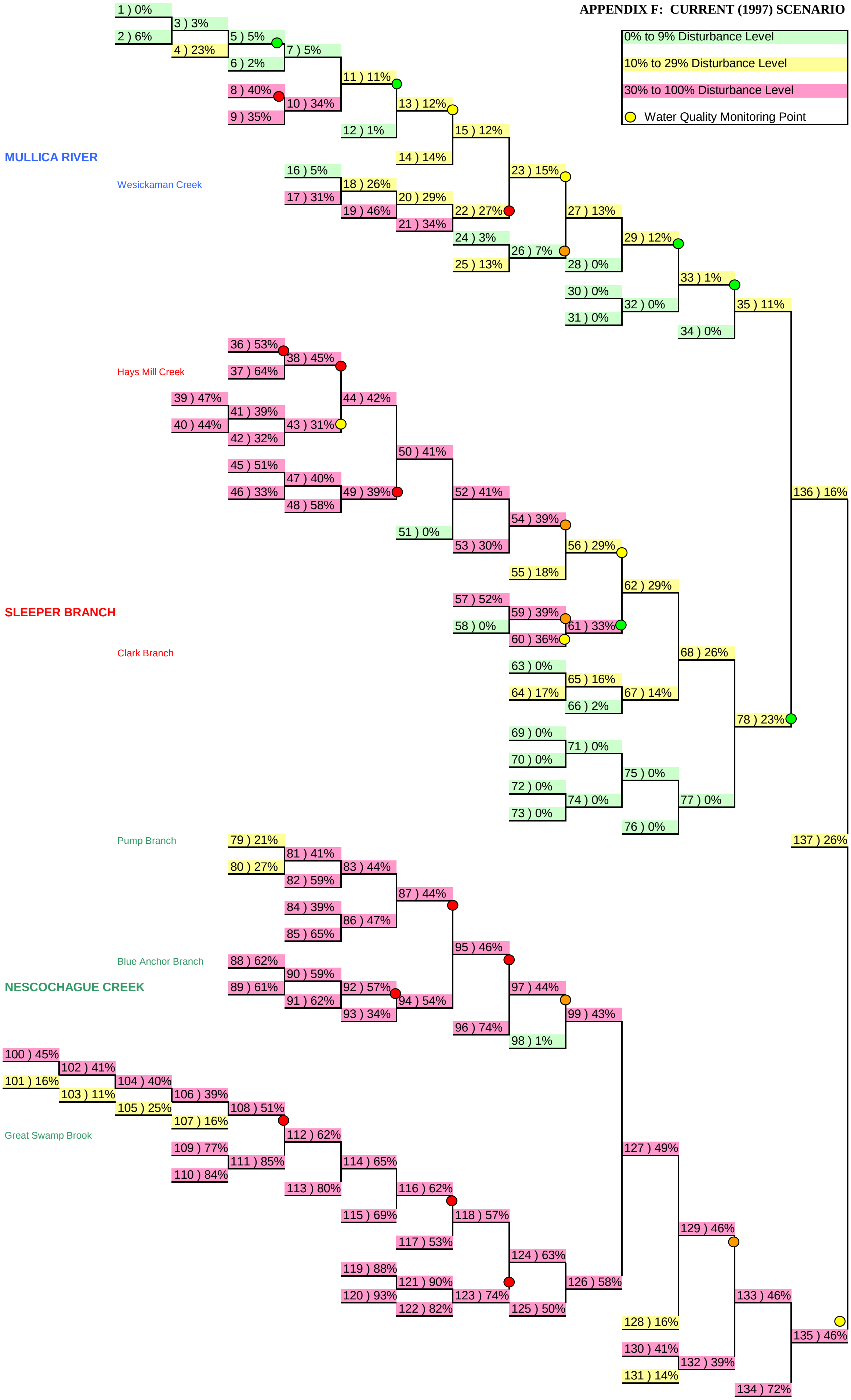
Watersheds (HUC11) that Become Disturbed Due to Land Use Changes from 1995 to Build-out



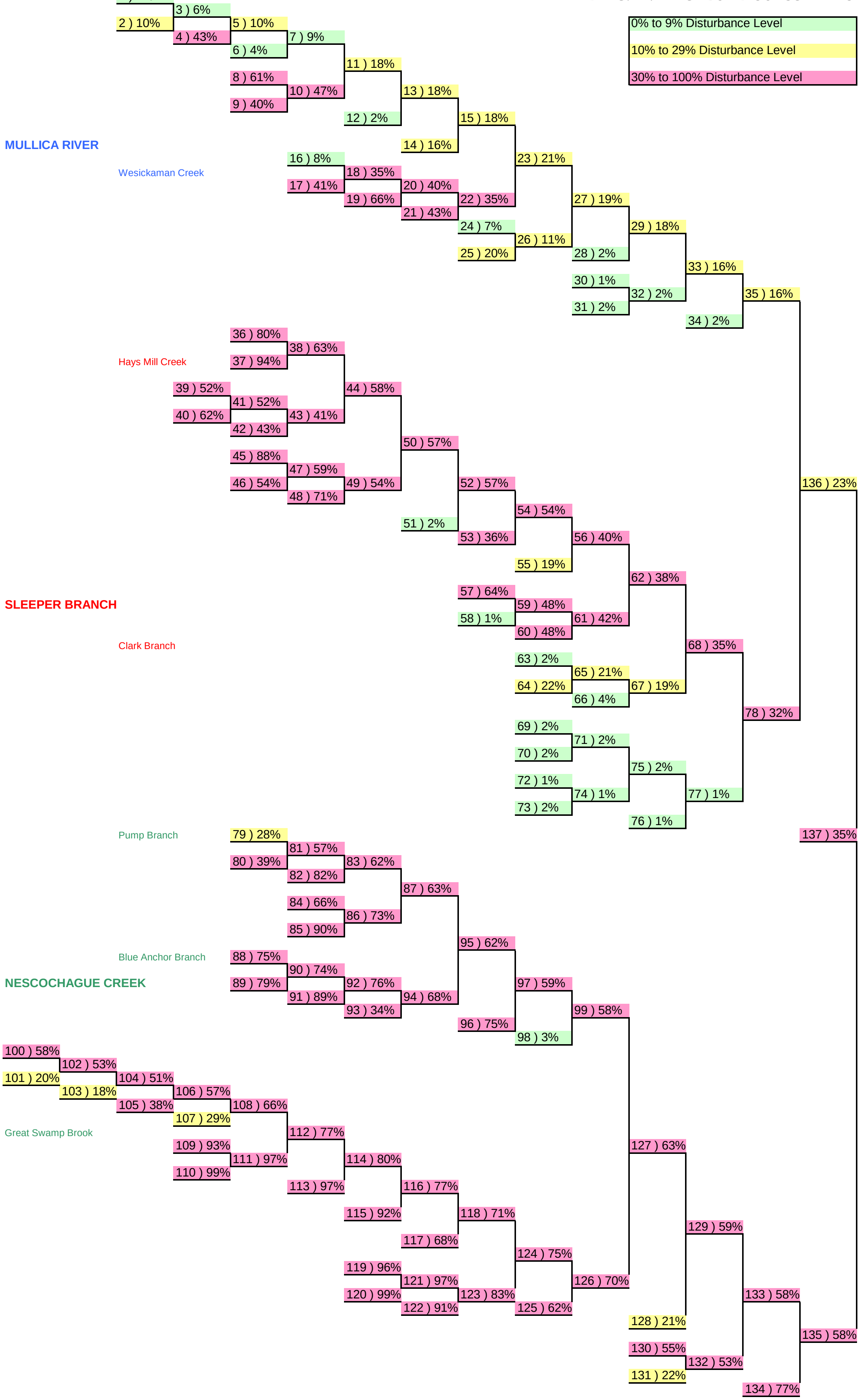
Data Sources: NJPC, NJDEP

Map Prepared By: NJ Pinelands Commission, March 2004

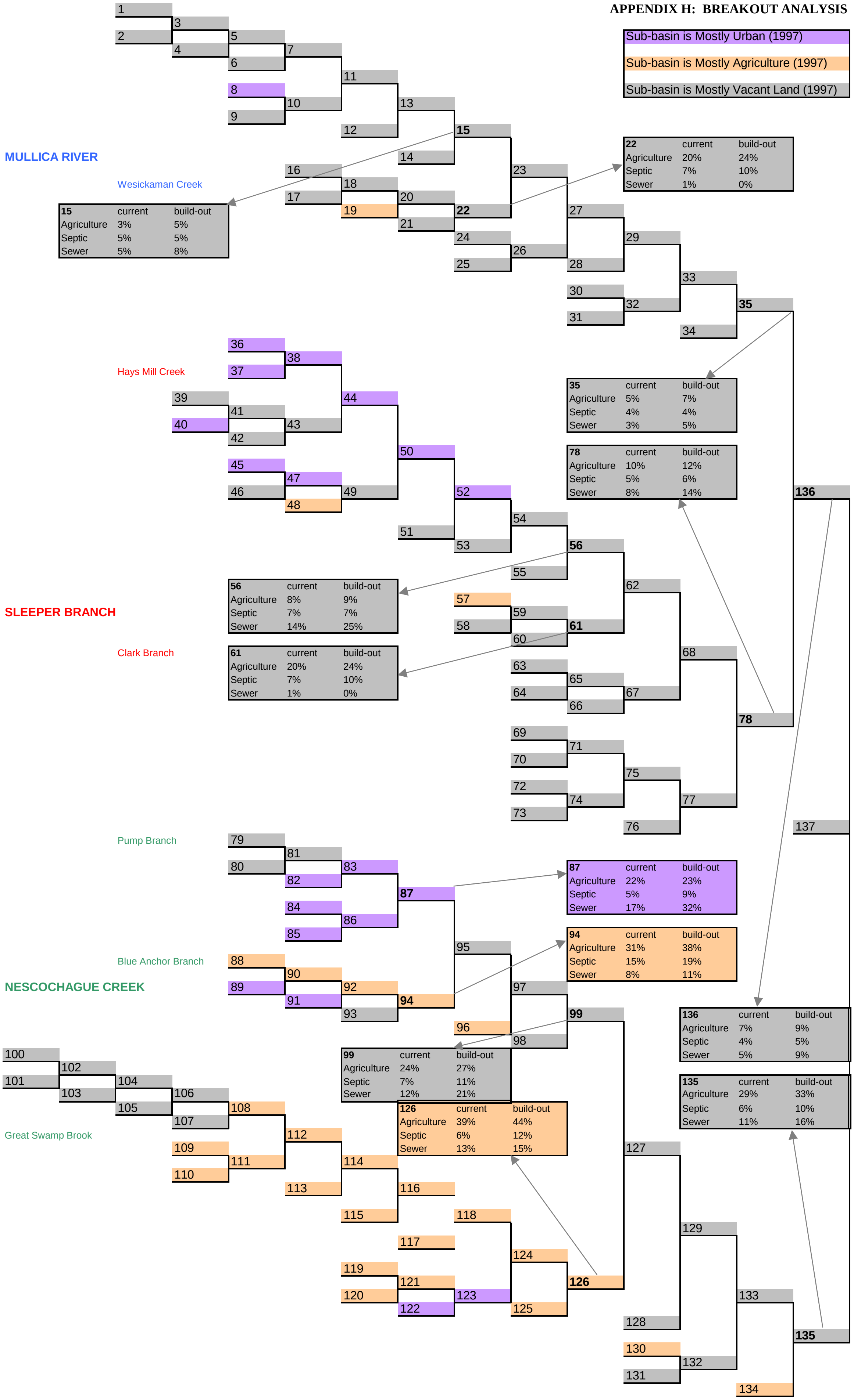
APPENDIX F: CURRENT (1997) SCENARIO



APPENDIX G: AVERAGE BUILD-OUT SCENARIO

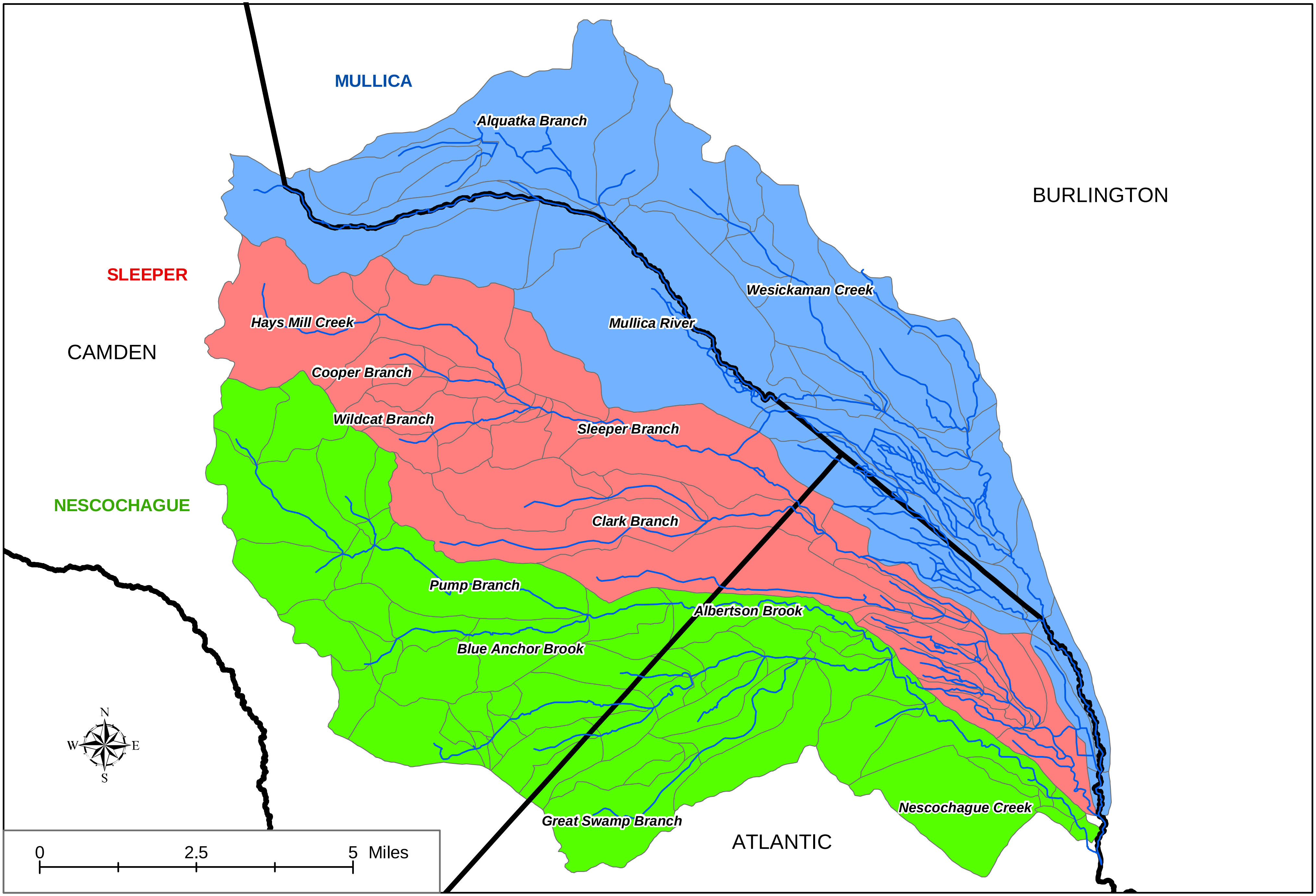


APPENDIX H: BREAKOUT ANALYSIS



Appendix I

Sub-basins within the Upper Mullica River Watershed

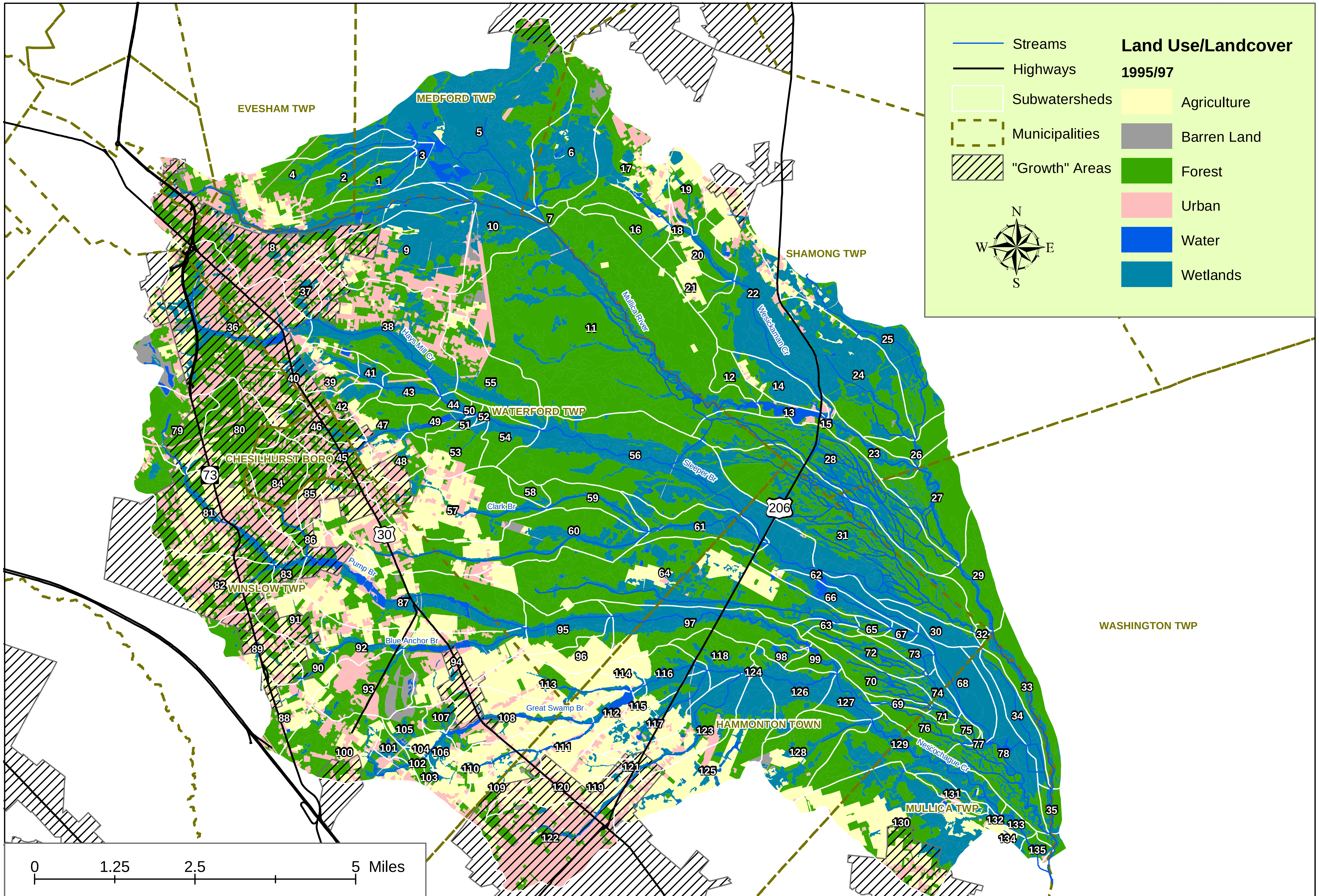


Data Sources: NJDEP, NJPC

Map Prepared By: NJ Pinelands Commission, March 2005

Appendix J

Upper Mullica River Watershed Land Use/Landcover

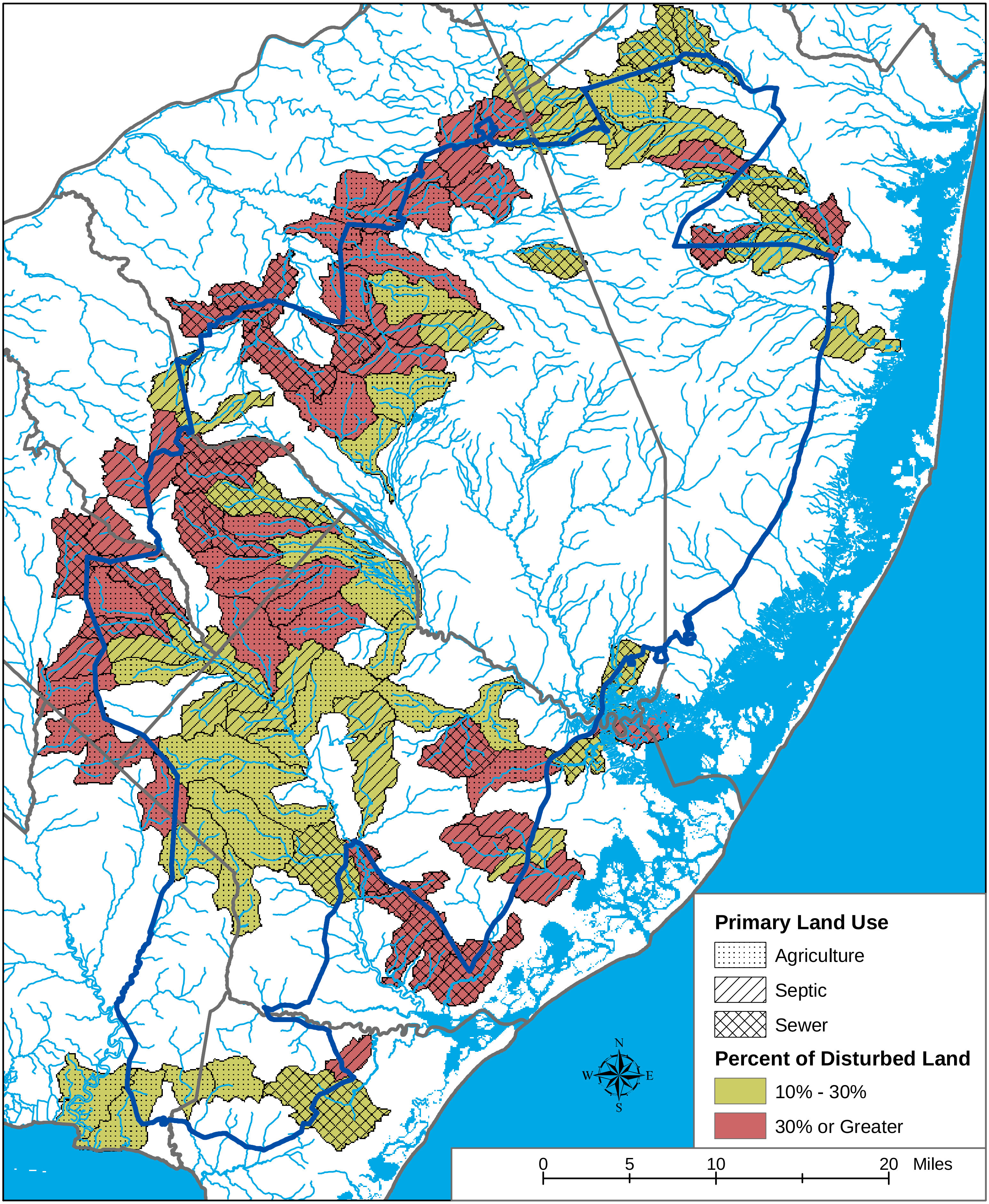


Data Sources: NJDOT, NJDEP, NJPC

Map Prepared By: New Jersey Pinelands Commission, March 2005

Appendix K

Subwatersheds that may benefit from Current BMPs

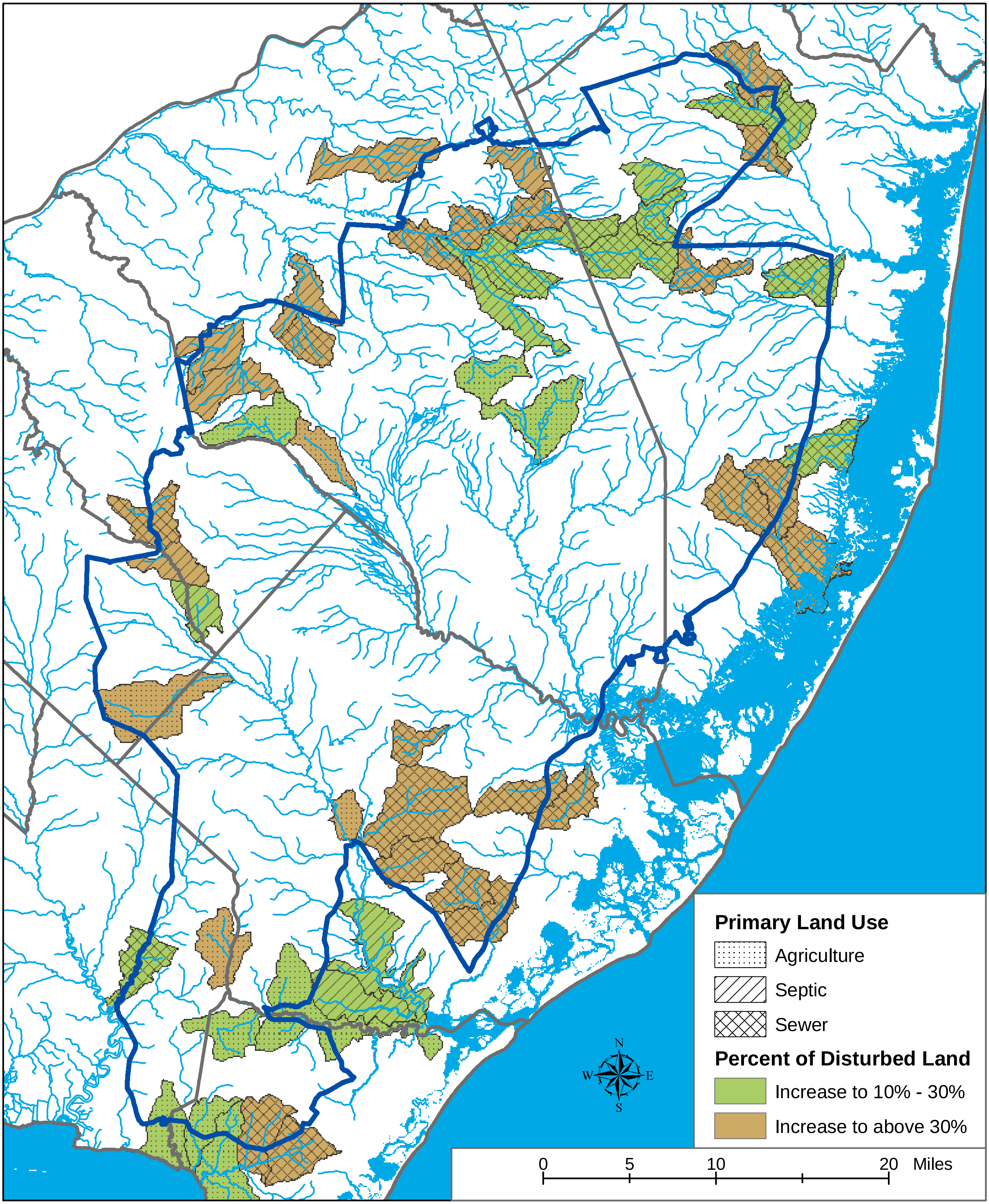


Data Sources: NJDEP, NJPC, NJOSG

Map Prepared By: NJ Pinelands Commission, March 2005

Appendix L

Subwatersheds that may benefit from Future BMPs



Data Sources: NJDEP, NJPC, NJOSG

Map Prepared By: NJ Pinelands Commission, March 2005