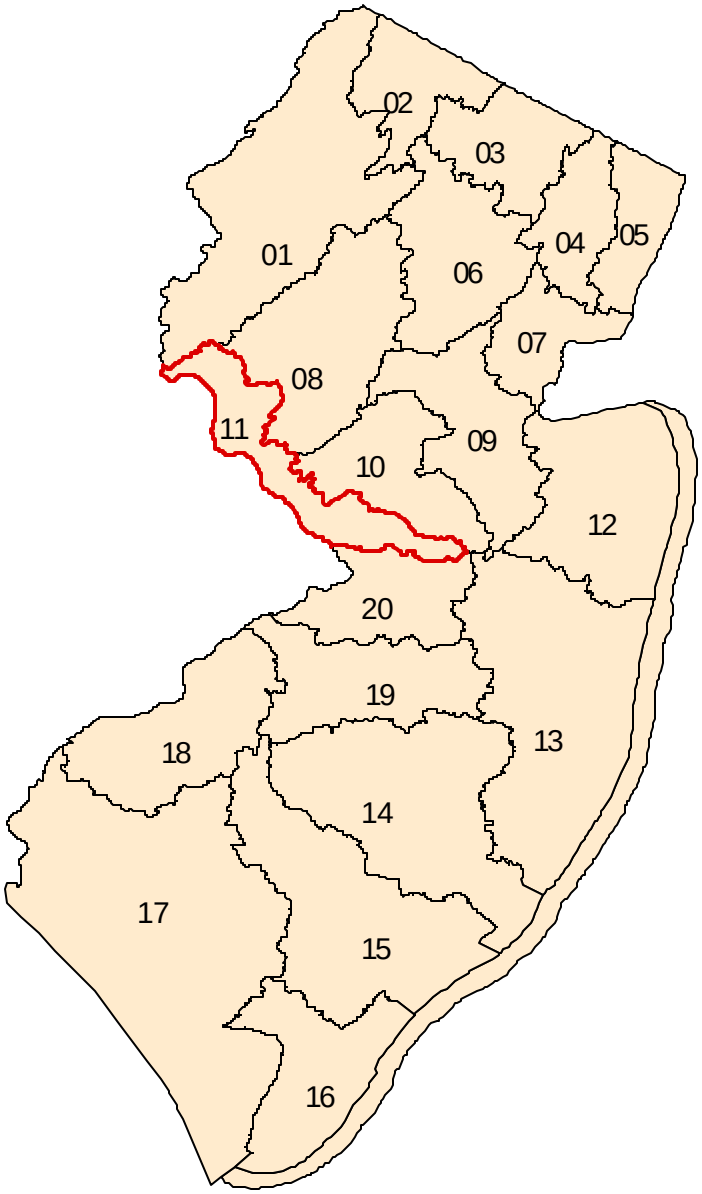
# GUARDING THE WATER RESOURCES OF THE CENTRAL DELAWARE RIVER COMMUNITIES

## WMA 11 Watershed Action Plan




**Prepared by:** The Regional Planning Partnership
February 28, 2003

**Prepared for:** The New Jersey Department of Environmental Protection

## ACKNOWLEDGEMENTS

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- Characterization and Assessment Committee,
- Land Use and Action Now Committee,
- Education and Outreach Committee, and
- Public Advisory Committee (Working Group).

In particular we would like to thank the following individuals for their contributions: Ms. C. Altomari, Lawrence Environmental Commission; Mr. J. Amon, D&R Canal Commission and Wild and Scenic River Management Committee; Ms. J. Aspinwall, New Jersey Department of Environmental Protection; Ms. C. Armstrong, Hunterdon County Planning Department; Ms. A. Bacon, NJ Conservation Foundation and Lockatong/Wickecheoke Watershed Group, Ms. A. Bowman, New Jersey Department of Environmental Protection; Mr. J. Coyne, West Amwell Environmental Commission, Mr. B. Rawlyk, D & R Greenway (and the Lockatong/Wickecheoke Watershed Group); Mr. T. Cosmas President, the Assunpink Creek Watershed Association; Mr. T. Baxter, New Jersey Water Supply Authority; Mr. W. Brash, Mercer County Soil Conservation District; Mr. C. Carmalt, Transportation Planner; Ms. T. Carluccio, Delaware River Keeper Network and East Amwell Board of Health; Ms. A. Fair, Association of New Jersey Environmental Commissions; Ms. K. Flagel, Mercer County Planning; Ms. K. Fullerton, Washington Township Planner; Mr. J. Haimowitz, President, Sourlands Planning Council; Mr. H. Kasabach, Hamilton Environmental Commission; Mr. K. Klipstein, New Jersey Department of Environmental Protection; Mr. R. Limbeck, Delaware River Basin Commission; Ms. P. Mount, Lawrence Township Planning Board; Mr. R. Nichols, Hopewell Environmental Commission, the members of the West Amwell Planning Board; Ms. T. Romagna, New Jersey Department of Environmental Protection; Ms. M. Ruf, Isles, Inc.; Mr. C. Testa, Hunterdon County Soil Conservation District; Ms. M. Upmeyer, Delaware Township; Ms. P. V'Combe, Delaware River Basin Commission; Mr. E. Wengryn, New Jersey Farm Bureau; and Ms. L. Yasenchak, City of Trenton Brownfields Program.

We would also like to thank our partners: Association of New Jersey Environmental Commissions (ANJEC); Delaware River Basin Commission; Hunterdon County Soil Conservation District; Isles, Inc.; Mercer County Soil Conservation District; and the New Jersey Department of Environmental Protection, Division of Watershed Management.

Finally we would like to thank the AmeriCorps Watershed Ambassadors for the Central Delaware Tributaries.

## EXECUTIVE SUMMARY

This *Watershed Action Plan* for the Central Delaware communities (Watershed Management Area 11) was prepared for the New Jersey Department of Environmental Protection's (NJDEP) Division of Watershed Management, Northwest Bureau.

The NJDEP established the watershed planning program for twenty watershed management areas in 2000. The goal of the program was to bring together all the issues and stakeholders that affect water resources to devise plans to improve protection of the state's water. A watershed approach was adopted to demonstrate the links between activities that usually are considered in isolation from each other (e.g., road selection and construction, farming practices, subdivision approval, disposal of pet waste), their effects on water quality and supply, and ways to plan those activities to reduce their impacts on water resources.

The *Watershed Action Plan* is divided into two sections. The first section, *A Report on Phase One*, summarizes background information, including issues, goals, and principles that stakeholders prioritized in order to produce the recommendations of the *Watershed Action Plan.* The first section also contains a summary of risks and opportunities for the Central Delaware communities.

The second section of this document represents suggested actions for stakeholders. In Phase Two of this watershed planning process, these suggested actions should be refined by stakeholders to produce targets that would make up the Final Watershed Plan for the area.

Two years of research (September 2000 to December 2002) and almost two years of public and committee meetings (February 2001 to December 2002) were undertaken by the Regional Planning Partnership (RPP) and its partners in the development of this *Watershed Action Plan.* The issues and goals identified by stakeholders during this time are listed below.

| **WATER RESOURCE ISSUES IN THE CENTRAL DELAWARE COMMUNITIES** | |
|---|---|
| Funding needed for contaminated site remediation | Expanded biological monitoring sites needed; perform more biological assessments |
| Open space needed in urban areas | Address rural groundwater recharge |
| Definition needed of role of agriculture in creating sedimentation | Encroachment of development in headwaters |
| Incomplete long-term protection of D&R Canal | Incomplete data with which to define all the issues (e.g., need land cover model to determine impacts) |
| Need sampling of sediments for Polyaromatic Hydrocarbons | Concern over TMDL model |
| Unclear which BMPs would have the most impact in our watershed – better stormwater management needed | Incentives needed for retrofitting storm basins and urban areas |
| Need a watershed organization(s) | Need to understand where our water comes from |
| Need to educate public about watersheds | Deal with known impairments - stop further degradation |
| Improve zoning, master plans | |

| GOALS FOR THE CENTRAL DELAWARE COMMUNITIES |
|---|
| ▪ Maintain and improve surface and groundwater quality<br>▪ Maintain a balanced hydrologic system<br>▪ Conserve natural resources and protect the region's unique resources<br>▪ Educate the public on water quality and quantity issues<br>▪ Encourage economic development or redevelopment that reflects Smart Growth principles |

As well as incorporating issues and goals, the *Watershed Action Plan* also reflects the natural resource and institutional inventory previously completed by RPP (available on the project website www.delawaretribs.org as the *Settings Report*). The results of RPP's *Smart Growth Alternatives for the Central Delaware Communities: Avoiding the Unintended Impacts of Build Out* also shaped the *Action Plan*. Research undertaken by the Delaware River Basin Commission for the project produced *A Water Quality Overview of the Central Delaware Tributaries*, and its findings are included in this report. The results of applying the North Jersey Resource Conservation and Development's Water Resource Evaluation System to WMA 11 are also included in this *Action Plan* (and are also available on the project website).

Risks and opportunities identified for water resources in the Central Delaware Tributaries include:

| RISKS | OPPORTUNITIES |
|---|---|
| Few water resource protection ordinances exist in WMA 11 even though all the streams are tributaries either to the D&R Canal drinking water supply, Lambertville water supply, or the Delaware River – water supply for over 1,000,000 New Jersey residents. | Raritan, West Amwell, Hopewell, Pennington, Millstone and Upper Freehold Townships have stream corridor setbacks that could be reviewed as models. Washington Township is developing a stream corridor ordinance. A watershed overlay zone has been proposed for the Lockatong Wickechoke sub-sheds. |
| Where ordinances exist they are not consistent across WMA 11 | ANJEC has a library of ordinances and can provide assistance on preparing ordinances. |
| Lack of municipal awareness of the water resource implications of the build out of current zoning – at build out 72% of WMA 11 will be above the 10% impervious cover threshold for healthy streams. Currently the situation is reversed with 65% of WMA 11 below the 10% impervious threshold. | This *Action Plan* identifies water resource vulnerability to build out for WMA 11 (see figure 7). Alternative smart growth scenarios have been tested by RPP for Mercer County and will be developed by Hunterdon County. |
| Unilateral downzoning in designated growth areas puts growth pressure in other inappropriate areas. | Appropriate downzoning in East Amwell can serve as a model for areas that should be protected from development. Alternative zoning scenarios developed by RPP for Mercer County indicate where increasing density is appropriate. |
| Incomplete information is available on sources of pollution. | NJDEP is developing more information through TMDLs & Existing WQ Network. |

| ▪ RISKS | ▪ OPPORTUNITIES |
|---|---|
| Lack of protection for groundwater stress areas identified in figure 4 of this report. | Environmental Commissions could work together in sub-regions to raise awareness of groundwater stress and impervious cover implications |
| Lack of adequate protection for unique natural resources e.g., the Sourlands | Sourland Planning Council is working to develop a plan for the Sourlands.<br>The Water Resource Evaluation System identifies lands with high water resources value to be prioritized for open space protection.<br>New Category One streams can be proposed to NJDEP |
| Redevelopment could worsen water quality and supply. | EPA has given Trenton a grant to investigate how redevelopment can improve water resources through the use of green infrastructure, etc. |
| Forest fragmentation in the northern sub-watersheds can be seen in the map of new development in WMA 11 between 1986-1995 prepared for the *Settings Report*. | Forest protection ordinances have been proposed by the Lockatong Wickecheoke Watershed Project. |
| Municipalities eligible for Wild and Scenic River designation only have until October 2003 to become signatories – Alexandria Township has not signed on yet. | Signatories to the Wild and Scenic River designation are eligible for Municipal Incentive Grants for water resource projects. |

RPP and committee members developed specific watershed protection strategies for state, county, and local governments; businesses; schools; watershed associations; service organizations; industries; and residents in the Central Delaware communities as a whole and for the five distinct sub-regions of the area.

The strategies recognize that Phase Two of watershed planning will require:

i) **Working Cooperatively:** To achieve greater participation, stakeholders within the five sub-regions (approximately 50 square miles each) that share similar issues should be encouraged to work together. While Phase One required a watershed-wide focus for gathering data and identifying goals, Phase Two will require a greater focus on implementation through changing local government practices at the sub-watershed level.

ii) **Smart Growth Alternatives—Testing Land Use Options and Setting Targets:** Where build-out of existing zoning will not achieve the goals of a community's Master Plan or the water quality and quantity protection goals of the *Watershed Action Plan*, alternative zoning should be tested. Agreement should be reached regionally on targets for growth and conservation as the basis for land use alternatives so that actions affecting water quality and quantity can be evaluated within a meaningful context.

iii) **Meeting Regulatory Targets:** Stormwater plans and Total Maximum Daily Load (TMDL) establishment will be required in Phase Two of the watershed planning process. Regional cooperation will be necessary to meet the regulatory requirements.

Municipalities that want to take immediate action to protect their water resources are advised to focus on three tasks: 1) adopt stream corridor protection ordinances or ordinances requiring remediation of stream corridors; 2) review the build-out vulnerability and groundwater stress analyses, available on the project web-site www.delawaretribs.org; and 3) participate in the TMDL process.

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## 1.0 PURPOSE OF THE PLAN

This *Watershed Action Plan* for the Central Delaware communities was developed for the Northwest Bureau of the New Jersey Department of Environmental Protection's Division of Watershed Management.

Because water runs over and through land to streams, lakes, and aquifers (underground sources of water), how we use land affects the amount of water in our streams and wells and affects how clean that water is to drink and to support wildlife. The NJDEP established the watershed planning program for twenty watershed management areas in 2000 to bring together all of the issues and stakeholders that affect water resources to devise plans to better protect the state's waters. A watershed approach was adopted to demonstrate the links between activities that usually are considered in isolation from each other (e.g., road selection and construction, farming practices, subdivision approval, disposal of pet waste), their effects on water, and ways to reduce their impacts on water resources.

The *Watershed Action Plan* identifies suggested actions state, county, and local governments; businesses; schools; watershed associations; service organizations; industries; and residents need to take to protect water quality and quantity.

### 1.1 Significance of the Central Delaware Communities

Watershed Management Area 11 (WMA 11) is 41 miles long and ranges from 2 to 11 miles wide. Its western border is the Delaware River. WMA 11 encompasses the western half of Hunterdon and Mercer Counties, and includes part of the panhandle of Monmouth County. Its 24 municipalities range from agricultural Holland Township in the north, through heavily urbanized Trenton in the center, to the National Historic Register town of Roosevelt in the east, with parts of agricultural Washington and Upper Freehold Townships in the south (see Figure 1). All the tributaries north of Washington Crossing State Park are included in the Lower Delaware Wild and Scenic River designation while the tributaries to the south are included in the Study Area and are, therefore, also under the guidelines of the *Lower Delaware Management Plan*.

The streams in the Central Delaware communities either drain into the Delaware River or the Delaware and Raritan Canal. The former is the source of drinking water for Trenton, parts of Hamilton, Ewing, and Lawrence Townships, as well as Burlington County in New Jersey, and Philadelphia and Morrisville in Pennsylvania. The latter is the source of drinking water for approximately 1,000,000 central New Jersey residents. The actions undertaken by the Central Delaware communities will, therefore, affect the health of millions of New Jersey and Pennsylvania residents, and impact the habitats of New Jersey's "west coast" along the Delaware River.

The natural resource value of the section of the Delaware River that flows along the Central Delaware communities was recognized at the federal level in 2001 with the designation of Wild and Scenic River status.

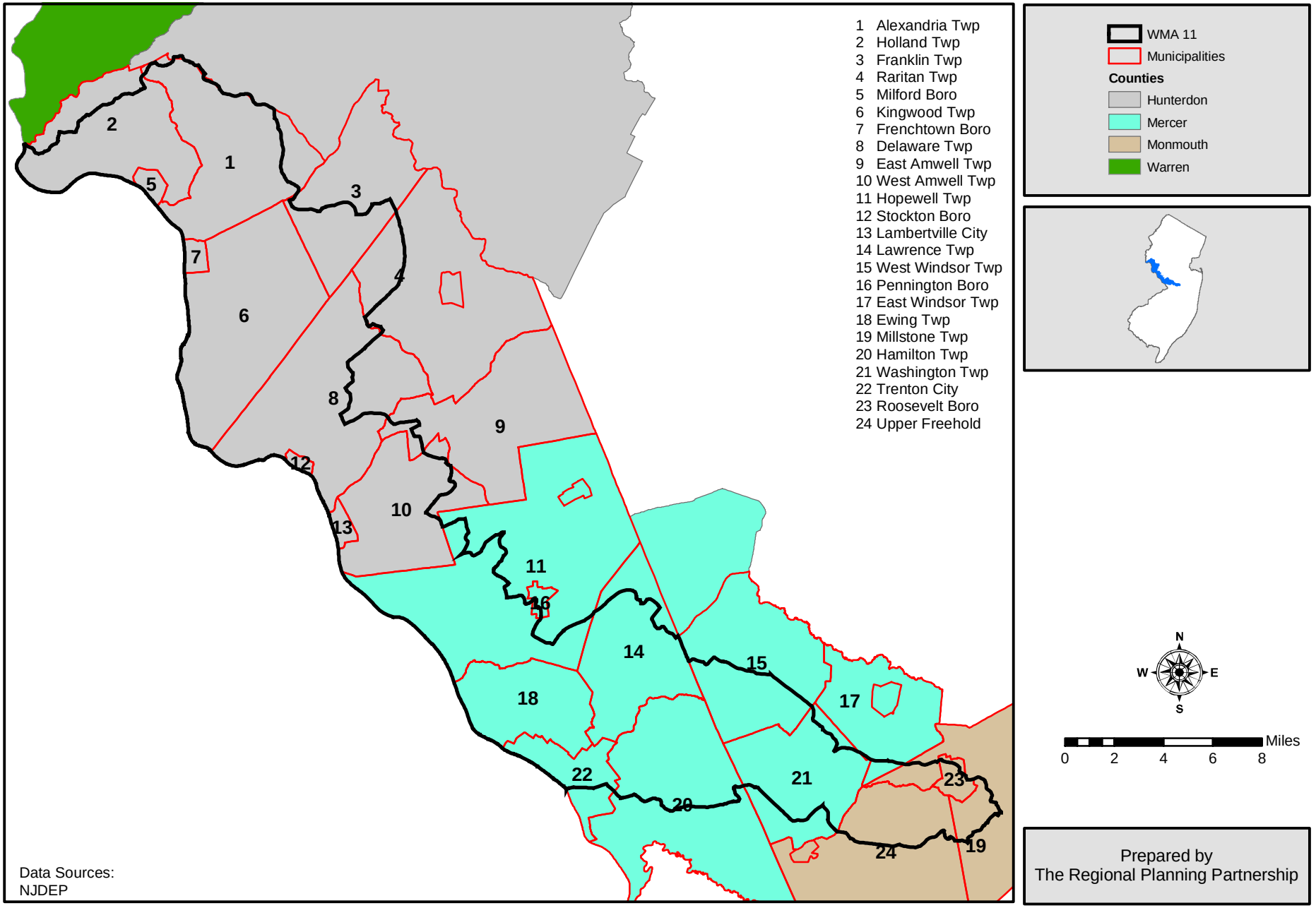
### 1.2 Creating the Plan

This plan was developed as the result of two years of research (September 2000 to December 2002) and almost two years of public and committee meetings (February 2001 to December 2002) undertaken by the Regional Planning Partnership (RPP) and its partners—the Association of New Jersey Environmental Commissions (ANJEC), the Delaware River Basin

Figure 1

# Watershed Management Area 11

## Municipalities & Counties



Commission (DRBC), the Hunterdon County Soil Conservation District, Isles Inc., the Mercer County Soil Conservation District, and the New Jersey Department of Environmental Protection (NJDEP) – as part of the NJDEP Watershed Planning Process. (See Appendix 1 for the organizational structure of committees in WMA 11.)

### 1.3 How to Use this Plan

The *Watershed Action Plan* is divided into two sections. The first section, *A Report on Phase One*, summarizes the background information, including issues, goals, and principles that stakeholders prioritized in order to produce the recommendations of the *Watershed Action Plan.* (See chapters two and three for a summary of the issues and goals.)

Chapter four outlines the basis for the new direction for Phase Two of watershed planning in the Central Delaware Tributaries, developed through committee meetings. While Phase One required a watershed-wide focus for gathering data and identifying goals, Phase Two will require a greater focus on local government practices at the sub-watershed level. This new emphasis is needed to increase participation and to provide direct assistance to municipalities to enable them to make meaningful changes to protect water quality and quantity. The strategies proposed in the second section of the *Watershed Action Plan* reflect this shift in emphasis.

The second section of this document contains charts outlining suggested actions for stakeholders. In Phase Two of this watershed planning process, these suggested actions should be refined by stakeholders to produce targets that would make up the Final Watershed Plan for the area.

The strategies are laid out in two ways: 1) for the Central Delaware Communities as a whole (see chapter five); and 2) for the five proposed sub-regions of the watershed (see chapters six through ten). The sub-regions are based on hydrogeologic, natural resource, and economic features of the communities (see figure 2 for sub-region locations). The community groupings for these sub-regions were proposed by RPP and accepted by the Project Working Group to provide a meaningful scale for municipalities to work together.

Suggested actions are detailed for specific stakeholder groups at both the watershed-wide and sub-region level. Stakeholders include state, county, and local governments; businesses; schools; watershed associations; service organizations; industries; and residents. Each stakeholder has an interest in and can affect the quality and quantity of water resources available in the region.

Potential users of the charts in the *Watershed Action Plan* can, therefore, get direction either by choosing a location in the watershed management area to focus on (from a watershed-wide or sub-region perspective) or by identifying their interest as a stakeholder.

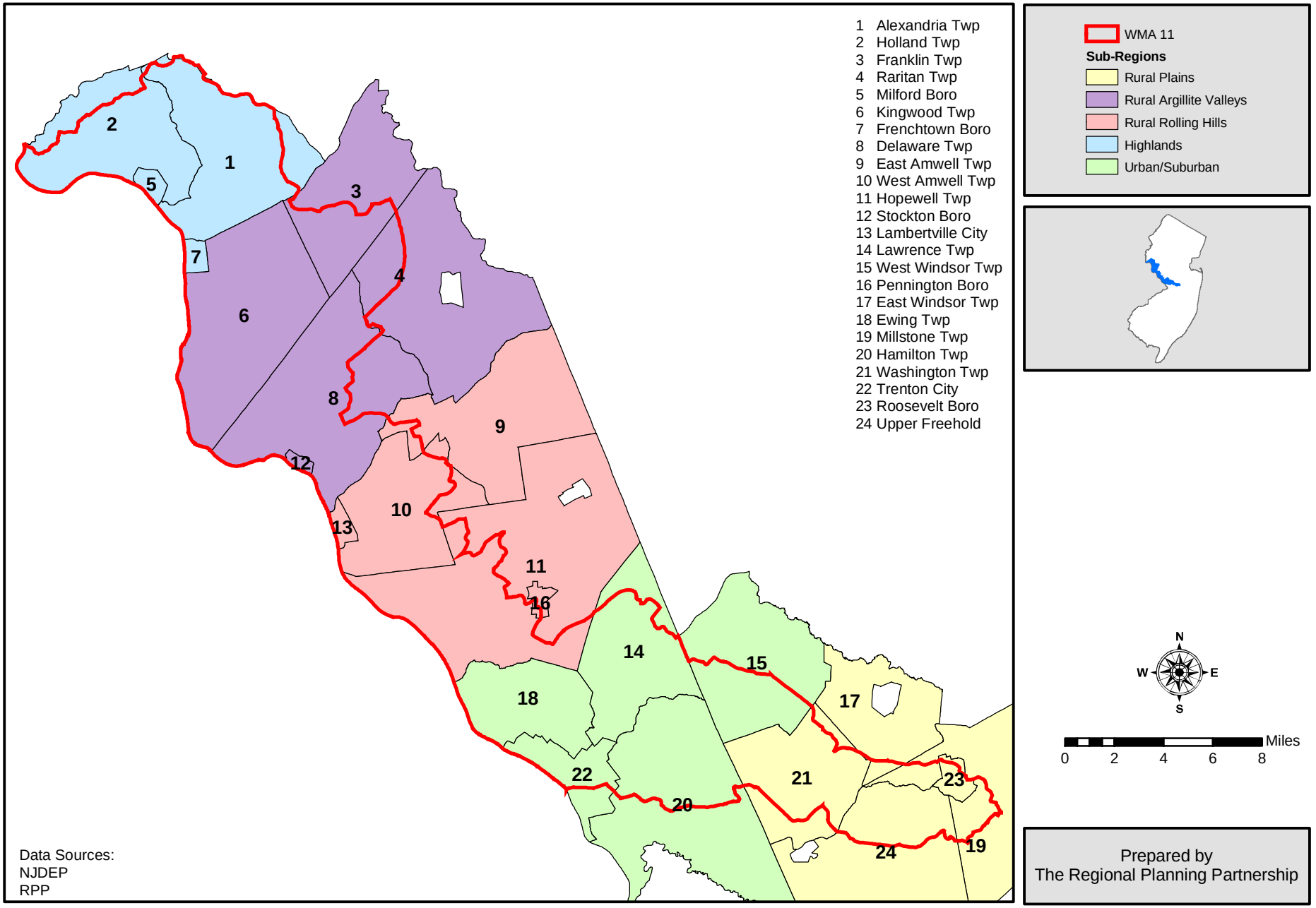
The *Watershed Action Plan* ends with steps to guard the water resources of the Central Delaware Communities by monitoring the progress of the implementation of the Plan. These steps include recommendations for state agencies as well as local government and local organizations. Indicators of progress are proposed and funding sources are identified.

This *Watershed Action Plan* does not include detailed information on the natural resources and institutional capacity of the Central Delaware communities. For that material see the project web site www.delawaretribs.org to view the *Settings Report for the Central Delaware Tributaries Watershed Management Area 11* (RPP, 2001); *A Water Quality Overview of the*

Figure 2

# Watershed Management Area 11

## Five Sub-Regions



*Central Delaware Tributaries* (DRBC, 2002)*; Smart Growth Alternatives for the Central Delaware Communities: Avoiding the Unintended Impacts of Build Out* (RPP, 2002)*;* and *A Water Resource Evaluation System for WMA 11* (NJRC&D, 2002).

## PART 1 — REPORT ON PHASE ONE

## 2.0 ISSUES FACING THE CENTRAL DELAWARE COMMUNITIES

### 2.1 Central Delaware Tributaries Working Group

At the February 28, 2002 Working Group meeting, participants were given a list of 17 issues compiled from previous Working Group and committee meetings (see Table 1).

| **TABLE 1: ISSUES IN THE CENTRAL DELAWARE COMMUNITIES** |
|---|
| Funding needed for contaminated site remediation |
| Need to expand biological monitoring sites and perform more biological assessments |
| Address rural groundwater recharge |
| Open space acquisition in urban areas |
| Role of agriculture in creating sedimentation |
| Encroachment of development in headwaters |
| Incomplete long-term protection of D&R Canal |
| Incomplete data with which to define all the issues. Land cover model needed to determine impacts. Need a technical watershed definition study. |
| Need more sampling of sediments for polyaromatic hydrocarbons |
| Concern over TMDL model – shaky science and prospect of lawsuits |
| Unclear which BMPs would have the most impact in our watershed – better stormwater management needed |
| Incentives needed for retrofitting storm basins and urban areas |
| Need a watershed organization(s) |
| Need public education about watersheds |
| Need better zoning, master plans, stormwater management |
| Understand where our water comes from |
| Deal with known impairments - stop further degradation |

The Working Group participants were asked to identify their top five issues from the large issues list. Top five issues were also identified by committees and through e-mail responses to RPP staff. (See Table 2.)

| **TABLE 2: TOP FIVE ISSUES** |
|---|
| 1) Encroachment by development in headwaters |
| 2) Open space acquisition in urban areas |
| 3) Funding for cleaning up contaminated sites |
| 4) Education of the public |
| 5) Rural groundwater recharge and water quality problems |

At the Land Use and Action Now Committee meeting May 29, 2002 three further issues were emphasized:

- flooding in urban areas;

- the importance of the Delaware River as the water supply for most of the population of the Central Delaware communities; and
- concern over drinking water quality and supply of both surface water and groundwater.

## 2.2 Federal, State, County, and Local Programs

Twenty-three agencies have developed twenty-five plans or projects (identified in Table 3) covering all or part of the Central Delaware communities (see Appendix 2 for details). The water quality and quantity issues identified by these plans and projects are similar to and reinforce the issues identified by the participants in the WMA 11 watershed planning process. Additional issues raised by these other plans include: the need for more recreational opportunities, the need to protect heritage buildings and sites, and the need to reduce forest fragmentation.

| TABLE 3: FEDERAL, STATE, COUNTY, AND LOCAL PROGRAMS THAT IDENTIFY WATER RELATED ISSUES FACING THE CENTRAL DELAWARE COMMUNITIES | | | |
|---|---|---|---|
| **Federal Programs** | **State Programs** | **County Programs** | **Local or Non-Profit Programs** |
| National Park Service, Lower Delaware River Wild and Scenic River Designation | D&R Canal State Master Plan | Mercer County Master Plan, Open Space Plan | City of Trenton Brownfields Program, Assunpink Greenway Program |
| Delaware River Basin Commission Comprehensive Plan | NJDEP 303(d) List | Monmouth County Master Plan, Open Space Plan | NJ Conservation Foundation Garden State Greenways Vision |
| National Forest Service Highlands Study | NJ State Water Supply Plan | Hunterdon County Master Plan, Open Space Plan | Central New Jersey Greenways, D&R Greenway |
| USEPA TMDLs, Brownfields Plans | NJDEP Source Water Assessment Plan | | Lockatong and Wickecheoke Watershed Plan |
| Army Corps of Engineers Floodway Plans | NJDOT Capital to Coast Trail | | |
| Delaware Valley Regional Planning Commission *Horizons 2005 Transportation Plan*, DVRPC Heritage Trail | NJDEP Green Acres Program | | |
| North Jersey Transportation Authority *Access and Mobility Plan* | NJDEP Landscape Project | | |
| | NJ State Development and Redevelopment Plan | | |
| | Coalition On Affordable Housing | | |

## 2.3 Issues Identified by Research for this Project: Water Quality Impairment, Groundwater Stress, Impervious Cover Impacts from Build-Out, High Water Resource Value Lands, Forest Fragmentation

The *Settings Report* (RPP 2001) and *A Water Quality Overview of the Central Delaware Tributaries* (DRBC 2002) identify water quality impairment issues at the level of individual streams such as priority pollutants and channel stability problems (see www.delawaretribs.org for the full reports).

Water quality issues identified include:

- Nutrient problems (phosphorus and nitrogen) in the Assunpink Creek, Jacobs Creek, Lockatong Creek and Wickecheoke Creek, Assunpink Lake, Colonial Lake, Whitehead Pond, and Mercer Lake
- Heavy metal contamination (arsenic, cadmium, copper, iron, lead, mercury) of the Assunpink Creek near Edinburg and in Trenton at Peace Street
- Fecal coliform in the Assunpink Creek, Wickecheoke Creek, Plum Brook, Jacobs Creek, Miry Run, Copper Creek, and Nishisakawick Creek
- Stream channel instability of the Shabakunk, Shipetaukin, Rock, Lockatong, and Wickecheoke Creeks
- Organic compounds in bottom sediments in Jacobs Creek
- pH in Jacobs, Lockatong, and Wickecheoke Creeks
- Elevated temperature in the Lockatong, Wickecheoke, and Jacobs Creeks
- Dissolved oxygen in the Shabakunk and Warsaw Creeks
- DRBC's standards for enteroccocus were exceeded in all the tributaries tested in 1999 including the Hakihokake, Harihokake, Warsaw, Alexauken, Swan, Moores, Jacobs, and Fiddlers Creeks
- Biological impairment was reported for all the streams in the southern part of WMA 11 as well as Copper Creek in the north near Frenchtown (see figure 3).

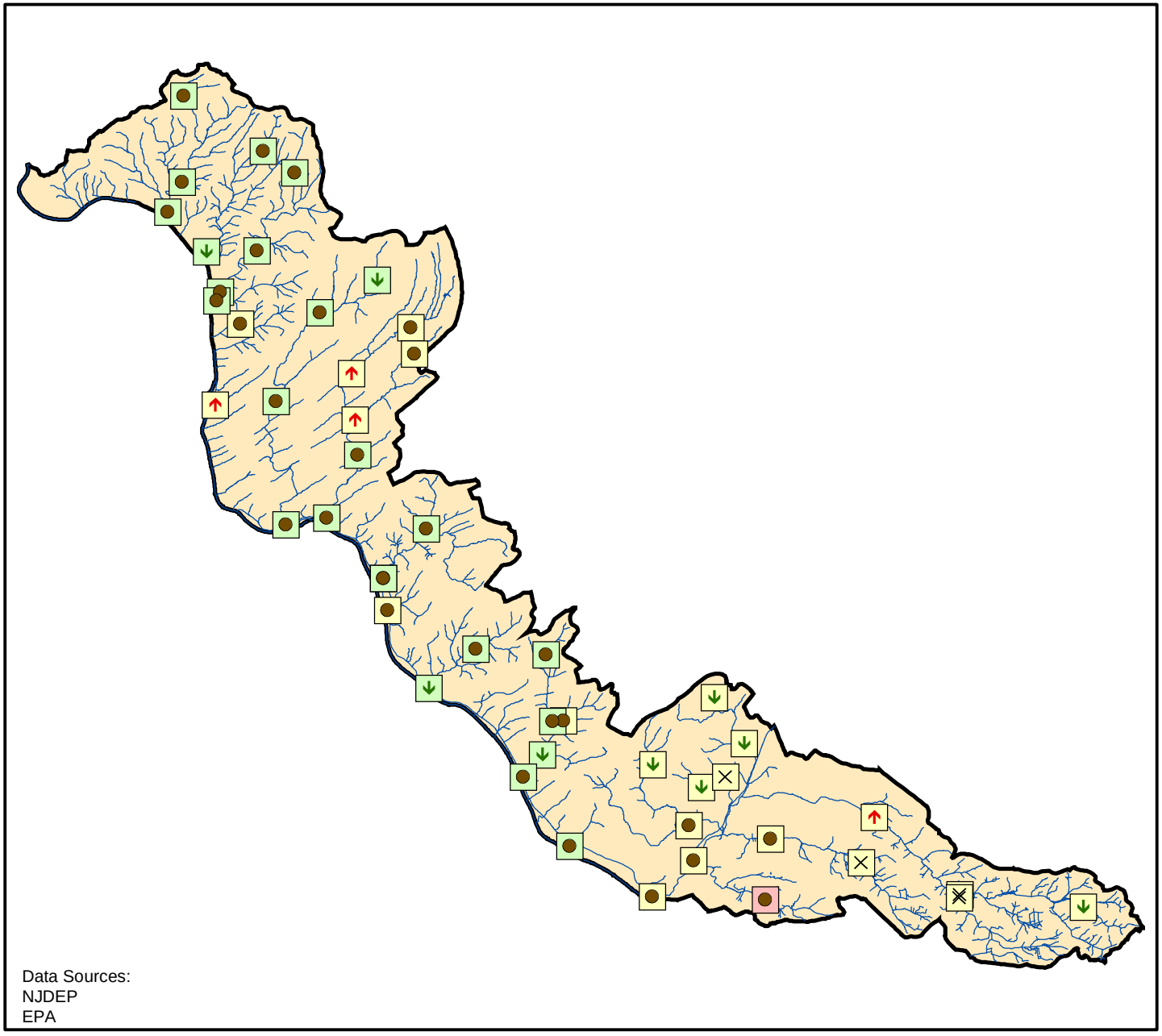
The *New Jersey Statewide Water Supply Plan* has identified water supply issues for the southern portion of WMA 11. This plan states that on or before 2040 water supply capacity is expected to be reached for the southern part of WMA 11. Preliminary estimates of groundwater stress developed by DRBC in *A Water Quality Overview of the Central Delaware Tributaries* indicate new, additional areas of concern in the southwest and northwest portions of Franklin and Raritan Townships, respectively, and the northeast sections of Kingwood and Delaware Townships. Holland Township near Milford, a northeast band through Alexandria Township, and a band through the southwest of Washington Township and the center of Hamilton Township have been identified by the DRBC as being the most potentially stressed areas in the Central Delaware communities (see figure 4).

In *A Water Quality Overview of the Central Delaware Tributaries,* DRBC also determined the existing impervious cover in the Central Delaware communities (see figure 5). In *Smart Growth Alternatives for the Central Delaware Communities: Avoiding the Unintended Impacts of Build-Out*, RPP determined the additional impervious cover that would result from build-out based on the existing zoning of the municipalities in the Central Delaware communities (see figure 6). The existing impervious cover and the projected impervious cover at build-out were added together to determine the total impervious cover at build-out (see figure 7). This total can be used to determine the surface water vulnerability to impervious cover (see figure 7).

Figure 3

# Watershed Management Area 11

## Biological Impairment of Streams



Data Sources:
NJDEP
EPA

Streams
WMA 11

**Impaired 1997**

MODERATE
NONE
SEVERE

**1992 - 1997 Change**

Decrease in Impairment
Increase in Impairment
No Change
Only One Sample

N
W E
S

0 2 4 6 8 Miles

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Figure 4

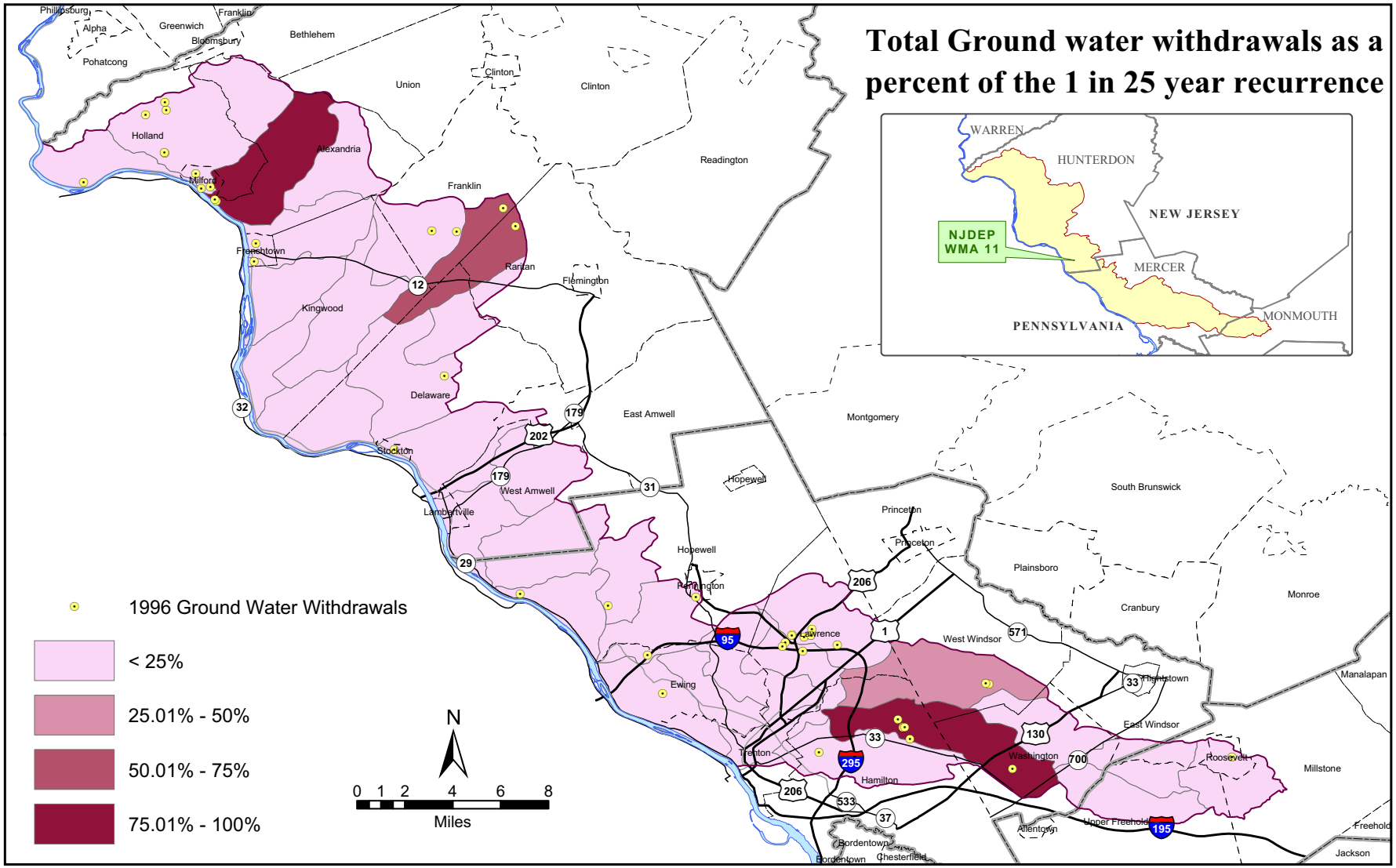
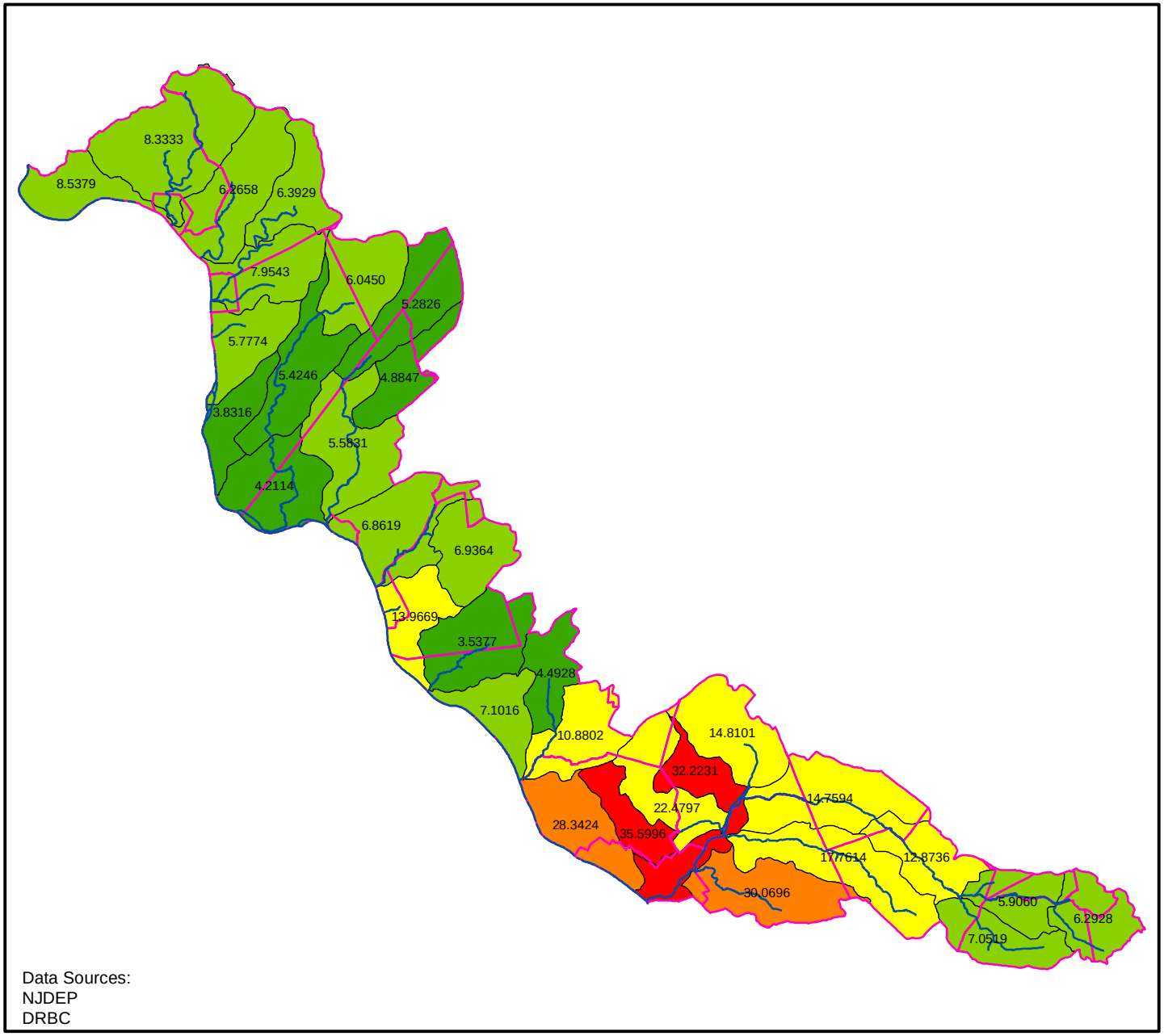

Total Ground water withdrawals as a percent of the 1 in 25 year recurrence
WARREN
HUNTERDON
NEW JERSEY
NJDEP WMA 11
MERCER
MONMOUTH
PENNSYLVANIA
1996 Ground Water Withdrawals
< 25%
25.01% - 50%
50.01% - 75%
75.01% - 100%
N
0 1 2 4 6 8
Miles
Phillipsburg
Alpha
Greenwich
Franklin
Bloomsbury
Bethlehem
Pohatcong
Union
Clinton
Clinton
Holland
Alexandria
Readington
Milford
Franklin
Frenchtown
Raritan
Flemington
Kingwood
Delaware
Stockton
East Amwell
Montgomery
Lambertville
West Amwell
Hopewell
Princeton
South Brunswick
Plainsboro
Cranbury
Monroe
Lawrence
West Windsor
Ewing
Trenton
Hamilton
Washington
Roosevelt
East Windsor
Millstone
Manalapan
Upper Freehold
Allentown
Bordentown
Chesterfield
Jackson
Freehold
12
32
179
202
31
29
206
95
1
571
33
130
700
295
533
37
195

Figure 5

# Watershed Management Area 11

## Existing Impervious Surface (1995/97)




Municipalities

Rivers

Impervious Surface (%)

0 - 5

6 - 10

11 - 25

26 - 30

31 +

N

W E

S

Miles

0 2 4 6 8

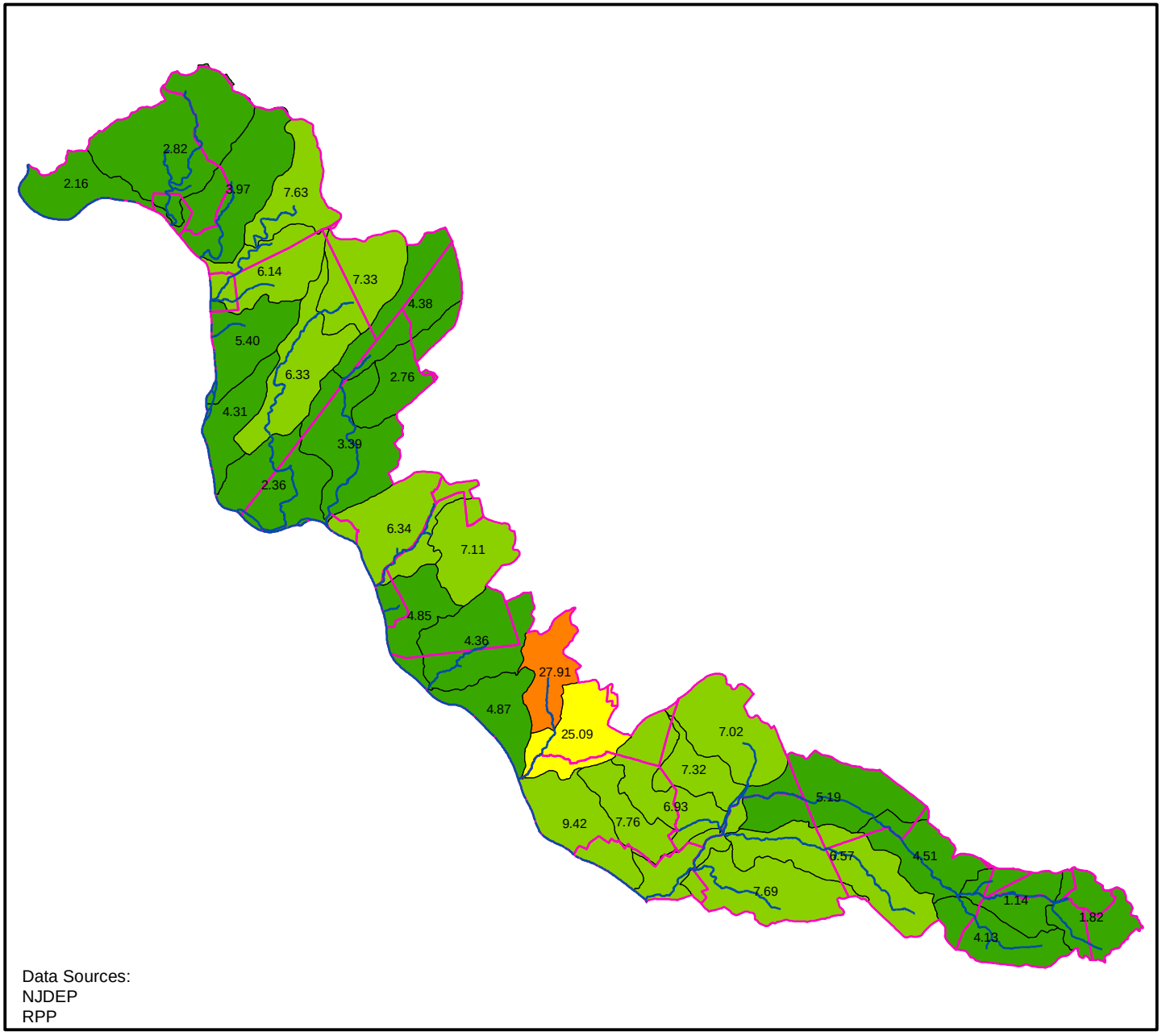
Data Sources:
NJDEP
DRBC

Prepared by
The Regional Planning Partnership

Figure 6

# Watershed Management Area 11

## Additional Impervious Cover Due to Build-Out




Municipalities

Rivers

**Impervious Surface (%)**

- 0 - 5
- 6 - 10
- 11- 25
- 26 - 30
- 31 +

N

W E

S

Miles

0 2 4 6 8

Data Sources:
NJDEP
RPP

Prepared by
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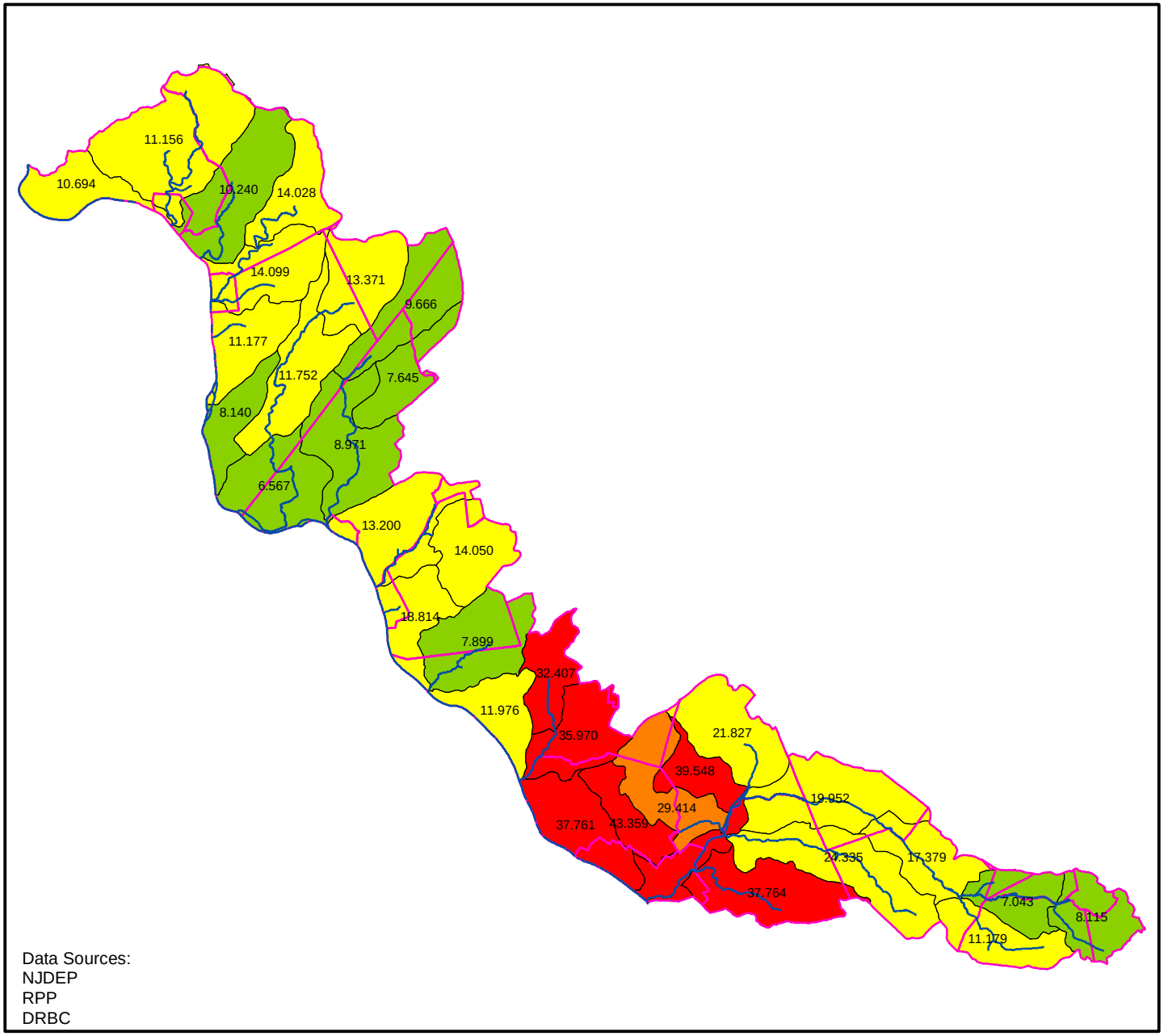
Figure 7

# Watershed Management Area 11

## Vulnerability to Impervious Cover at Build-Out




Municipalities
Rivers

**Impervious Surface (%)**

- 0 - 5
- 6 - 10
- 11 - 25
- 26 - 30
- 31 +

N
W E
S

Miles
0 2 4 6 8

Data Sources:
NJDEP
RPP
DRBC

Prepared by
The Regional Planning Partnership

Schueler (1994) has identified three general categories of streams using the amount of impervious cover in the stream's sub-watershed as an indicator of stream health:

- Sensitive streams have less than 10% impervious cover;
- Impacted streams have between 11 and 25% impervious cover; and
- Non-supporting streams have greater than 25% impervious cover.

It is important to keep in mind that this categorization is a risk assessment tool and individual streams need to be assessed using their own characteristics. For example, for some headwater or trout production streams in WMA 11, impacts have been noted at 2% impervious cover (Lockatong and Wickecheoke Project 2001).

The results of RPP's analysis of watershed vulnerability for the Central Delaware communities are dramatic. While 65% of the watershed management area currently meets the 10% impervious cover threshold for healthy streams, based on 1995/97 land use/land cover data (DRBC 2002), at build out under current zoning the condition of the watershed will be reversed. At build out, 72% of the watershed management area will be above the 10% threshold for maintaining healthy streams (RPP 2002).

Other factors also influence water resources including soils, agricultural practices, percent turf cover (lawns), mine drainage, percent forest cover and riparian continuity (Schueler, 2002). Studies by the University of Virginia (2002) and by Schueler (1993, 2002) underline the importance of maintaining a forested riparian corridor, particularly in the headwaters of streams. A forested buffer prevents narrowing and deepening of headwaters, extreme fluctuations in temperature, and reduced aquatic productivity and diversity. Forest cover, riparian forest continuity, and turf (lawn) cover are several other noteworthy watershed variables that can be included in predicting the future health of streams. (In humid areas [such as New Jersey] forest cover is frequently the inverse of impervious cover.)

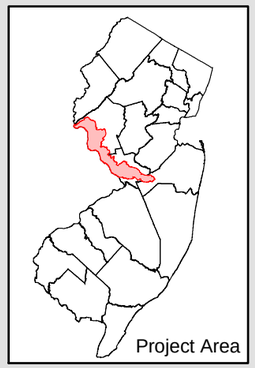
The research for the *Settings Report* showed that the second largest growth in new housing development between 1987-1995 occurred in the forested headwaters of the streams in the north of WMA 11.

North Jersey Resource Conservation and Development's *Water Resource Evaluation System* identifies areas of high water resource value as well as areas of poor riparian corridor habitat (see figures 8, 9, and 10). Much of the high water resource value lands currently lack protection.

Figure 8

# Relative Health of Riparian Zones in the Central Delaware Watershed Management Area

BETHLEHEM TWP
UNION TWP
POHATCONG TWP
ALEXANDRIA TWP
FRANKLIN TWP
HOLLAND TWP
MILFORD BORO
FRENCHTOWN BORO
RARITAN TWP
KINGWOOD TWP
EAST AMWELL TWP
DELAWARE TWP
STOCKTON BORO
WEST AMWELL TWP
HOPEWELL TWP
LAMBERTVILLE CITY
PENNINGTON BORO
WEST WINDSOR TWP
LAWRENCE TWP
EAST WINDSOR TWP
ROOSEVELT BORO
MILLSTONE TWP
WASHINGTON TWP
EWING TWP
TRENTON CITY
HAMILTON TWP
UPPER FREEHOLD TWP




## Relative Health Value

- Excellent
- Very Good
- Good
- Fair
- Poor

North Jersey Resource Conservation and Development

Note: This map was developed using New Jersey Department of Environmental Protection Geographic Information Systems digital data, but this secondary product has not been verified by the original data creators. The combination of these datasets reveal general trends about the resource characteristics of the area and should be used for general planning purposes only.

1:176,154

0 25,000 50,000 75,000 Feet

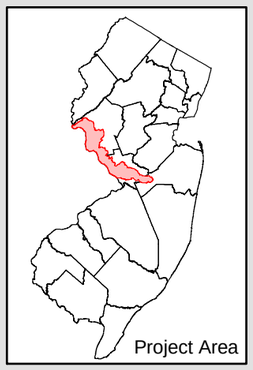
**Figure 9**

# New Jersey Geological Survey Groundwater Recharge Model for WMA-11

BETHLEHEM TWP
UNION TWP
POHATCONG TWP
ALEXANDRIA TWP
FRANKLIN TWP
HOLLAND TWP
MILFORD BORO
FRENCHTOWN BORO
RARITAN TWP
KINGWOOD TWP
EAST AMWELL TWP
DELAWARE TWP
STOCKTON BORO
WEST AMWELL TWP
HOPEWELL TWP
LAMBERTVILLE CITY
PENNINGTON BORO
WEST WINDSOR TWP
LAWRENCE TWP
EAST WINDSOR TWP
ROOSEVELT BORO
MILLSTONE TWP
WASHINGTON TWP
EWING TWP
TRENTON CITY
HAMILTON TWP
UPPER FREEHOLD TWP

**Groundwater Recharge (inches/year)**

- 14 - 16
- 11 - 13
- 7 - 10
- 4 - 6
- 0 - 3




North Jersey Resource Conservation and Development

NOTE: This map was developed using New Jersey Department of Environmental Protection and New Jersey Geological Survey Geographic Information Systems digital data, but this secondary product has not been verified by either and is not state-authorized.

Groundwater Recharge Source: New Jersey Geological Survey

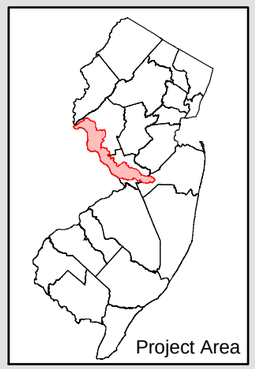
1:176,154

0 25,000 50,000 75,000 Feet

Figure 10

# Water Resource Evaluation System for the Central Delaware Watershed Management Area

BETHLEHEM TWP
UNION TWP
POHATCONG TWP
ALEXANDRIA TWP
FRANKLIN TWP
HOLLAND TWP
MILFORD BORO
FRENCHTOWN BORO
RARITAN TWP
KINGWOOD TWP
EAST AMWELL TWP
DELAWARE TWP
STOCKTON BORO
WEST AMWELL TWP
HOPEWELL TWP
LAMBERTVILLE CITY
PENNINGTON BORO
WEST WINDSOR TWP
LAWRENCE TWP
EAST WINDSOR TWP
ROOSEVELT BORO
MILLSTONE TWP
EWING TWP
WASHINGTON TWP
TRENTON CITY
HAMILTON TWP
UPPER FREEHOLD TWP




**Water Resource Evaluation System Scoring**

- Highest Water Resource Value
- Lowest Water Resource Value
- Lakes (Greater than 1 Acre)
- Streams

North Jersey Resource Conservation and Development

1:176,154

0 25,000 50,000 75,000 Feet

NOTE: The Water Resource Evaluation System values are derived using a composite score from the NJGS's Groundwater Recharge Model (GSR-32) and North Jersey Resource Conservation and Development Council's Riparian Health Assessment.

NOTE: This map was developed using New Jersey Department of Environmental Protection Geographic Information Systems digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

## 3.0 GOALS OF THE CENTRAL DELAWARE COMMUNITIES

### 3.1 Central Delaware Tributaries Working Group

Five goals were approved by the Working Group at its February 2002 meeting based on a synthesis of goals proposed at previous sub-committee and Working Group meetings (see Table 4).

| **TABLE 4: GOALS FOR THE CENTRAL DELAWARE COMMUNITIES** |
|---|
| 1) Maintain and improve surface and groundwater quality |
| 2) Maintain a balanced hydrologic system |
| 3) Conserve natural resources and protect the region's unique resources |
| 4) Educate the public on water quality and quantity issues |
| 5) Encourage economic development or redevelopment that reflects Smart Growth principles |

### 3.2 Goals Identified by Federal, State, County and Local Programs

As well as being guided by goals identified by participants in the watershed planning process, this plan recognizes that federal, state, and county programs also affect the Central Delaware communities by providing incentives, regulations, and technical expertise in support of their agency's programs. Goals developed by the twenty-three agencies identified in Table 3 are largely the same as those identified by WMA 11 committees with the exception of the following additional goals: protecting historic character, marketing a watershed image, and developing good science. (See Appendix 3 for details of the various program goals.)

## 4.0 TURNING GOALS INTO RESULTS — A NEW DIRECTION FOR WATERSHED PLANNING IN PHASE 2

### 4.1 Three New Directions

Phase One of the watershed planning process focused on collecting data for all of the Central Delaware Communities and working with interested stakeholders to raise awareness of the benefits of watershed planning for the region. Phase One also defined the problems to be solved and the goals by which to measure successful implementation. Phase Two is expected to develop regional and sub-watershed agreements on refinements to the actions proposed in the second section of this *Watershed Action Plan.*

Lessons learned from the first phase suggest the need for a new structure in the second phase. For example, in the first phase participants indicated that the elongated shape of the watershed management area reduced the feasibility of locating a central meeting place. In addition, most stakeholders felt a stronger sense of connection to a single tributary than to the watershed management area as a whole. Local environmental commissions and municipal governments also wanted more help in understanding the connections between their land use decisions and water resources. These stakeholders wanted more information on how Smart Growth relates to water resources.

The experience gained from Phase One led participants to propose three new directions for Phase Two:

- The watershed planning process needs to focus more on the local level in order to engage broader participation from a larger variety of stakeholders;

- Local governments need to work cooperatively on a sub-regional basis addressing a shared tributary and be helped to develop an understanding of the impact of their land use decisions on water resources. Once this understanding is made clear at the level of local tributaries, a watershed-wide understanding can be fostered to encourage stewardship of the Delaware River; and

- Smart Growth alternatives to current zoning need to be developed if the currently proposed land uses are shown, through build-out analysis, to produce unwanted impacts on water resources.

Local government involvement is crucial for successful watershed planning since local governments control land use decisions affecting water resources. The rest of this chapter, therefore, focuses on risks and opportunities, tools and techniques for local governments.

### 4.2 Risks for the Central Delaware Communities

Numerous studies (Arnold, 1996; EPA, 1999; Schueler, 1994) have identified a relationship between land use and water quality and quantity. Local governments in the Central Delaware communities face increasing pressure on water resources as sprawl development occurs. Sprawl is here defined as low-density development that is not centered and requires dependence on the automobile for transportation.

An analysis of urban development in the Central Delaware Communities between 1986 and 1995, undertaken by RPP for *The Settings Report,* showed that the second largest increase in

new urban development occurred in the most pristine sub-watersheds of the management area (24% occurred here compared to 29% in the outer-ring suburbs of Trenton). Sprawl development in these headwater areas is of particular concern for water quality.

A further indicator of sprawl, developed by New Jersey Future, is the change between 1990 and 2000 in the percentage of housing units having nine or more rooms. Of the 52 municipalities that experienced 5%, 10%, or 25% growth in units with nine or more rooms, ten are located in WMA 11. Almost half the municipalities in WMA 11 (10 out of 24) rank high in this sprawl index with Millstone Township in Monmouth County having the distinction of greatest increase – 17%.

The *State Development and Redevelopment Plan* projects Hunterdon County to have the greatest increase in population. The Central New Jersey Transportation Forum projects a 64% increase in car travel on Route One. County population projections for 2005 for WMA 11 towns in Monmouth County were already exceeded in the 2000 census. Additional areas of risk to water resources besides sprawling growth pressure are identified in Table 5.

| **Table 5: Risks to Water Resources in the Central Delaware Communities** |
|---|
| Few water resource protection ordinances exist in WMA 11 even though all the streams are tributaries either to the D&R Canal drinking water supply, or the Delaware River – water supply for over 1,000,000 New Jersey residents |
| Where ordinances exist they are not consistent across WMA 11 |
| Lack of municipal awareness of water resource implications of the build out of current zoning – at build-out 72% of WMA 11 will be above the 10% impervious cover threshold for healthy streams. Currently the situation is reversed with 65% of WMA 11 below the 10% impervious threshold. |
| Unilateral downzoning in designated growth areas puts growth pressure in other inappropriate areas |
| Incomplete information is available on sources of pollution |
| Lack of protection for groundwater stress areas described in this report |
| Lack of adequate protection for unique natural resources (e.g., the Sourlands) |
| Redevelopment could adversely impact water quality and supply. |
| Forest fragmentation can be seen in the map of new development in WMA 11 between 1986-1995 prepared for the *Settings Report* |
| Municipalities eligible for Wild and Scenic River designation only have until October 2003 to become signatories – Alexandria Township has not signed on yet. |

All of these risks, trend projections, and actual reported growth figures affecting water quality require municipalities to take a hard look at how their land use decisions will affect water resources. What steps can municipalities take to plan for a different scenario from that presented by the trend projections? The answers to this question are provided below.

### 4.3 Opportunities for the Central Delaware Communities

Over one-third of the 24 Central Delaware municipalities and 2 of the 3 counties are beginning or are already involved in Master Plan updates. The Master Plan revision process provides an immediate opportunity for local governments to incorporate watershed protection issues in their community's guiding document. Master Plan revisions also provide an audience for public education through Master Plan hearings and media attention.

In addition counties and municipalities will be required for the first time to have Stormwater Permits under the New Jersey Pollutant Discharge Elimination System (NJPDES). These permits will require municipalities to adopt stormwater management ordinances and Best Management Practices (BMPs). The stormwater rules will also include a public outreach component. Development of regional stormwater management plans will be strongly encouraged by the NJDEP. Stormwater management planning is one part of watershed planning and this *Watershed Action Plan* includes recommendations regarding stormwater management in sections 5 -10.

Other opportunities for improving water resource protection in the Central Delaware communities are identified in Table 6.

| **Table 6: Opportunities for Improving Water Resource Protection in the Central Delaware Communities** |
|---|
| Raritan, West Amwell, Hopewell, Pennington, Millstone, and Upper Freehold Townships currently have stream corridor setbacks that could be reviewed as models. Washington Township is developing a stream corridor ordinance. A watershed overlay zone has been proposed for the Lockatong and Wickecheoke sub-sheds. |
| ANJEC has a library of ordinances and can provide assistance on preparing ordinances. |
| This Action Plan identifies water resources' vulnerability to build-out for WMA 11. Alternative smart growth scenarios have been tested by RPP for Mercer County and will be developed by Hunterdon County. |
| Appropriate downzoning in East Amwell can serve as a model for areas that should be protected from development. Alternative zoning scenarios developed by RPP for Mercer County indicate where increasing density is appropriate. |
| NJDEP is developing more information on sources of pollutants through its TMDL process and Existing Water Quality Network stream monitoring |
| Environmental Commissions could work together in sub-regions to raise awareness of groundwater stress and impervious cover implications. |
| Sourland Planning Council is working to develop a protection plan for the Sourlands. |
| New Category One streams may be proposed to NJDEP |
| The Water Resource Evaluation System identifies lands with high water resources value to be prioritized for open space protection. |
| EPA has given Trenton a grant to investigate how redevelopment can improve water resources through the use of green infrastructure, etc. |
| Proposed BMP manual to accompany the new Stormwater Rule identifies forest buffers as more effective than detention ponds and large tracts of forest are still present in the north and south of WMA 11. The Lockatong Wickecheoke Project has developed a forest protection ordinance |
| Signatories to the Wild and Scenic River designation are eligible for Municipal Incentive Grants for water resource projects. |

## 4.4 How Watershed Planning Can Help Local Governments

### 4.4.1 Determine Vulnerability to Impervious Cover Impacts

One key piece of information local governments need in order to make sound decisions about water resource protection is an assessment of existing and projected impervious cover. Using its Goal-Oriented Zoning GOZ® computer model, RPP completed an initial vulnerability assessment has been completed for the Central Delaware communities (see Figure 7). At build-out under current zoning, 72% of the watershed would be above the 10% impervious cover threshold identified by Schueler for maintaining healthy streams. As part of Phase Two of the watershed planning process, municipalities will require assistance to develop specific impervious cover limits to meet their goals for their water resources.

### 4.4.2 Align Zoning with the Master Plan – Alternative Zoning Analysis

Municipalities are often unaware of the inconsistencies between their zoning ordinances and Master Plan goals related to growth, open space, and water resource protection. GOZ®, RPP's Goal Oriented Zoning computer model, was used to develop and compare alternative scenarios to existing zoning in parts of the watershed (see www.delawaretribs.org for *Smart Growth Alternatives for the Central Delaware Communities: Avoiding Unintended Impacts of Build Out)*. In Phase Two these initial results can be refined and further scenarios tested to lead to zoning changes where appropriate.

### 4.4.3 Respond to Priority Pollutants

Municipalities are also faced with responding to existing water quality and quantity problems. In Phase Two of the watershed planning process, municipalities will need assistance to identify appropriate Best Management Practices and remediation techniques to address priority pollutants. (See chapters 6-10 and appendices 5-8 for details.)

## 4.5 How Watershed Planning Can Help Local Governments Address Regional Issues

### 4.5.1 Regions within the Central Delaware Communities

Five sub-regions have been identified within the Central Delaware communities by the stakeholders of WMA 11 based on their hydrogeologic, economic, and natural resource attributes. From the north, the sub-regions include: the Highlands Communities, the Rural Argillite Valley Communities, the Rural Rolling Hills Communities, the Urban and Suburban Communities, and the Rural Plains Communities (see figure 2).

Each of these sub-regions has unique water resource characteristics associated with it. All but the Rural Argillite Valley communities directly affect the Delaware River, the source of drinking water for Trenton, parts of Hamilton, Lawrence, and Ewing Townships, and Burlington County in New Jersey and Philadelphia and Morrisville in Pennsylvania. The rural Argillite communities, in turn, affect the D&R Canal, also a drinking water source.

The *Watershed Action Plan* suggests municipalities in these regions work together to identify their common concerns and opportunities related to water resource management.

The **Highlands Communities** are well forested and contain the only trout production streams in the watershed management area. The Musconetcong Mountains contain the oldest rock in New Jersey and are generally unproductive aquifers, affecting the availability of well water.

The **Rural Argillite Valley Communities** contain scenic streams that drain directly into the D&R Canal, the source of drinking water for over 1,000,000 New Jersey residents. They are well forested closer to the Delaware River with agricultural uses in the upper reaches. The naturally impervious argillite rock influences the erodibility of the streams and affects the groundwater resources for this area – the least productive aquifers in the state are found here.

The **Rural Rolling Hills Communities** contain the Sourland Mountain – the last contiguous forest in Central New Jersey. Species that require deep forest (600 feet from the forest edge) to breed rely on the forest remaining contiguous. The Mountain influences groundwater availability (as it allows little recharge) and provides many vernal pools. Agriculture is a major influence on this sub-region. Swan Creek, the water supply for Lambertville, is found in this sub-region.

The **Historic Mill Towns** along the Delaware River - Milford, Frenchtown, Stockton, and Lambertville - located in the three northern sub-regions, are influenced by the scenic and recreational opportunities the Delaware River provides. These towns also share an interest in revitalization and tourism opportunities. Shadfest in Lambertville has proved the most successful tourist celebration of the Delaware River to date. This *Watershed Action Plan* encourages the mill towns to work together on economic strategies through the Wild and Scenic River office.

The **Urban and Suburban Communities** focused on the Delaware River and its major tributary, the Assunpink Creek, during the 18$^{th}$ and 19$^{th}$ centuries when industrial uses along these waterways were at their height. By the 20$^{th}$ century, these waterways had lost their attractiveness when these industries declined. However, there appears to be some movement toward focusing attention on the Delaware River in Trenton with the construction of the Mercer County Waterfront Park and a proposal to turn part of Route 29 into a boulevard. The agreement to implement the recommendations of the *Closing the Missing Link on the Assunpink Creek Greenway* plan also represents a commitment by the Urban and Suburban communities to see the Assunpink Creek as an asset and not just a flood concern. The *Watershed Action Plan* encourages recognizing and enhancing the green infrastructure value of both the Assunpink Creek and the Delaware River.

At the southern end of the watershed management area, the topography has fallen from the 800-foot heights of the Musconetcong Mountains all the way to nearly sea level at the Inner Coastal Plain. The **Rural Plains Communities** located here share the headwaters of the Assunpink Creek and share a concern for farmland preservation. Headwaters protection is important for the unique species within the National Register Historic town of Roosevelt and for Millstone Township, which contains not only the Assunpink headwaters but four other headwaters as well.

## PART TWO — ACTION PLAN

## 5.0 STRATEGIES FOR THE CENTRAL DELAWARE COMMUNITIES

### 5.1 Smart Growth Alternatives and the Water Resources of the Central Delaware Communities

The Land Use Committee and Working Group recognized early in the watershed planning process that to achieve water quality and water supply protection, a Smart Growth approach to land use was necessary. The participants realized that protecting open space and directing growth to appropriate areas were both necessary to develop a meaningful watershed plan for the Central Delaware Communities.

To achieve Smart Growth on the ground, however, requires identifying key points for change. By viewing activity within the Central Delaware Communities as occurring in three systems- environment, economy and transportation - key points or targets could be identified for each system. As is discussed above in section 4.4.1, an impervious cover target can be set to protect the environment system. The economic system can be addressed through growth targets. By identifying locations for clustering growth, municipalities can prevent encroachment of sprawl on greenfields. The location of transportation corridors is also of importance for reducing impacts on water resources as the more frequently a stream is crossed the lower its water quality. Transit is also necessary to reduce the atmospheric deposition of pollutants from automobile exhaust.

The following recommendations are made to support achieving Smart Growth alternatives for the Central Delaware communities:

**i)** **Working Cooperatively:** To achieve greater participation, stakeholders within the five sub-regions (approximately 50 square miles each) that share similar issues should be encouraged to work together. While Phase One required a watershed-wide focus for gathering data and identifying goals, Phase Two will require a greater focus on local government practices at the sub-watershed level.

**ii)** **Smart Growth Alternatives — Testing Land Use Options and Setting Targets:** Where build-out of existing zoning will not achieve the goals of a community's Master Plan or the water quality and quantity protection goals of the *Watershed Action Plan*, alternative zoning should be tested. Agreement should be reached regionally on targets for growth and conservation as the basis for land use alternatives so that actions affecting water quality and quantity can be evaluated within a meaningful context.

**iii)** **Meeting Regulatory Targets:** Stormwater plans and Total Maximum Daily Loads (TMDLs) will be required in Phase Two of the watershed planning process. Regional cooperation will be necessary to meet the regulatory requirements.

An impervious cover risk assessment has been developed for each municipality. This information should be presented to local governments and the public in an easily understood format such as that shown below, adapted from Schueler 1998. (See *Smart Growth Alternatives for the Central Delaware Communities: Avoiding the Unintended Impacts of Build-Out* for an example of this technique applied to Kingwood Township in WMA 11.) The target impervious cover would be developed through a facilitated process in the second phase of watershed planning with municipalities working together in sub-regions. The target impervious cover would then be

used by individual municipalities to change their current zoning ordinances, if necessary, to protect water resources.

| **Table 7: Watershed-Based Zoning for a Hypothetical Sub-watershed** | | | | | |
|---|---|---|---|---|---|
| Subwater-shed Name | Subwatershed Impervious Cover | | | Subwatershed Classification | Stream Protection Goal or Technique |
| | Current | Zoned | Target | | |
| Tributary | 9% | 15% | 10% | Sensitive | Set impervious cap at 10%, restore stream banks |

This *Watershed Action Plan* also proposes that performance standards (similar to those being developed by DRBC for its Poconos Project) should be set at key locations for each major tributary to the Delaware River, preferably at the entry to the Delaware River and upstream in the tributary headwaters. DRBC data on whether the tributaries in WMA 11 improve or degrade water quality in the Delaware River combined with the data being gathered by NJDEP's Existing Water Quality Network program should result in information for setting targets for the following for each major tributary:

- Chemical water quality parameters;
- Minimum baseflows;
- Desired macroinvertebrate community; and
- Index of stream bank stability.

## 5.2 Strategies for all the Central Delaware Communities

A number of specific strategies were developed by the stakeholders of WMA 11 that are applicable to all of the municipalities in the Central Delaware communities. The goals (from section 3.1) that these strategies are intended to achieve are listed horizontally across Table 8. The strategies are listed vertically. Specific actions stakeholders can take to implement the strategies are listed in the cells under the stakeholder category. Strategies for each sub-region of the watershed management area are outlined in subsequent sections.

The strategies are not prescriptive (i.e., they do not limit impervious cover to a 2% increase for HUC 14 sub-watersheds along tributary "x"). The strategies set the stage for Phase 2 of the watershed planning process by informing stakeholders of their roles in water resource protection. To develop prescriptive strategies, stakeholders will need to participate in negotiations to implement the strategies proposed in this *Action Plan.*

Municipalities that want to take **immediate action** to protect their water resources are advised to focus on three tasks: 1) adopt stream corridor protection ordinances (or in urban areas remediate stream corridors); 2) review the build-out vulnerability and groundwater stress analyses, available on the project web-site www.delawaretribs.org; and 3) participate in the TMDL process.

| Table 8: STRATEGIES FOR ALL THE CENTRAL DELAWARE COMMUNITIES | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Local Govern-ment** | **Business** | **Watershed Manage-ment Association** | **Contract Manager** | **Schools** | **Industry** | **Residents** | **Agriculture** | **Service Organiza-tions** | **NJDEP** | **Ameri-Corps** |
| **Goal 1: Maintain and improve surface and groundwater quality**<br>**Goal 2: Maintain a balanced hydrologic system** | | | | | | | | | | | |
| Headwater Protection, Impervious Cover Limit | Adopt headwater protection ordinances, implement BMPs[1], adopt impervious cover cap | Locate outside of headwaters, Reduce existing impervious cover where possible | Explain River Friendly[2] Designation to business, agriculture, and residents | Prepare a package of model ordinances, suggest impervious cover target | Monitor Headwaters | Locate outside of headwaters | Locate outside of headwaters, if existing use qualify for River Friendly Designation | Qualify for River Friendly Designation | Sponsor school monitoring or conduct their own | Limit permits[3] in headwaters | Share monitor-ing protocol & lesson plans with schools |
| Restore Floodplain over Time | Investigate Blue Acres funding | Locate new businesses outside of the floodplain | Educate about the economic benefits of a functioning floodplain | Provide information on economic value of functioning floodplain | Include floodplain protection and value in lessons | Locate new industry outside of the floodplain | Locate new residential develop-ment outside of the floodplain | Avoid erosion in the floodplain | Encourage protection of the floodplain | Prohibit new develop-ment in the floodplain where possible | |

[1] See Appendices 4-6 for details.
[2] This is a certification process developed by the Stony Brook Millstone Watershed Association.
[3] Issue no general permits in wetlands. Invoke and strengthen the environmental standards of the Stream Encroachment regulations.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Buffers and Channel Stability | Adopt stream corridor protection ordinances appropriate to stream type | Qualify for River Friendly Designation | Monitor Buffers | Identify appropriate buffer width and stream type for Planning Boards, identify model ordinance | Monitor buffers | Qualify for River Friendly Designation | Consider an easement on your property | Apply for Conserva-tion Resource Enhance-ment Program funding to protect buffers | Promote benefits of stream buffers | For water supply and Category 1 streams expand buffer require-ments | Include import-ance of stream buffers in presenta-tions |
| Address Priority Pollutants & Set Targets for Stream Health | Adopt ordinances targeting applicable pollutants, Participate in TMDL process | Participate in TMDL[4] process | Contribute any monitoring data to NJDEP for use in TMDL modeling; educate about TMDL process | Facilitate TMDL process through Technical Advisory Committee for WMA 11; Identify BMPs | Contribute monitoring data to NJDEP for use in TMDL modeling | Participate in TMDL process | Participate in TMDL process | Participate in TMDL process | Participate in TMDL process | Provide scientific data for establishing the TMDL and targets for stream health | Contrib-ute RATS and BATS data to NJDEP |
| Stormwater Manage-ment & Flood Protection | Recognize stormwater as a recharge resource; adopt regional stormwater plan implement nonstructur-al BMPs | Install bioretention measures where feasible | Identify issues; educate public on nonpoint source pollution | Inform local government of EPA II rules; support regional stormwater planning; Identify BMPs; adopt | Identify stormwater outfalls; reduce nonpoint source pollution from the school; include nonpoint source | Practice good housekeep-ing of onsite materials | Identify stormwater outfalls; Reduce NPS from fertilizers, motor oil, pet wastes, etc. | Adopt BMPs to reduce stormwater and erosion | Sponsor NPS awareness | Emphasize use of non-structural alternatives for stormwater control; pursue legislation allowing stormwater utilities | Make Presenta-tions on NPS reduction |

[4] While only the Assunpink Creek currently requires a "classical" TMDL by 2007 to remediate metal problems identified on EPA's 303d list, other streams in the watershed require fecal coliform TMDLs by June 2003 and other streams could have "protective" TMDLs developed for them to prevent degradation.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | impervious cover target, Educate public on NPS | pollution information in lesson plans | | | | | | |
| Ground-water Recharge Stress Areas and Quality | Adopt well head and ground-water protection ordinances in high stress areas, impervious cover limits | Install bioretention water conserva-tion measures where feasible | Collect data on well levels; promote water conserva-tion | Provide information on recharge protection areas. Suggest impervious cap | Collect data on well levels; promote water conservation | Practice good housekeep-ing of onsite materials & water conserva-tion | Reduce NPS from fertilizers, motor oil, pet wastes, etc. | Practice water conserva-tion; Look into Integrated Pest Manage-ment | Collect data on well levels; promote water conserva-tion | Identify areas at risk for ground-water depletion; address contaminate d sites | Promote water conserva-tion |
| **Goal 3: Conserve Natural Resources** | | | | | | | | | | | |
| Open Space Protection for Wetlands, T&E species, Greenways, Farmland | Each municipal-ity should have an open space plan for critical habitat, wetlands, recharge areas, farmland | Sponsor protection efforts | Work with municipal-ities to obtain funding for protection and easements | Use Water Resource Evaluation System[5] information for setting priorities | Use GIS cd to supplement lesson plans | Promote green infrastruct-ure on site[6] | Consider open space conserva-tion easements on your property | Consider Farmland preserva-tion options | Sponsor protection efforts | Adopt Garden State Greenways Plan; include recharge in Green Acres ranking; recognize urban open space needs | Check to make sure schools are aware of priority areas |

[5] Available on the project website www.delawaretribs.org.

[6] Green infrastructure means the natural resources and systems including trees, wetlands, open space and other land assets which provide "services" such as cleaning the air or water and form part of the foundation for community development.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Goal 4: Educate the Public** | | | | | | | | | | | |
| Disseminate Information Undertake Projects | Create an award for water resource protection by a group, business, or individual | Sponsor a water resource protection coloring contest | Hold walks and talks; work with schools to "adopt" HUC 14 sub-watersheds; inform residents where their water comes from | Create outreach plan based on Phase 1 successes; identify HUC 14 sub-watersheds for schools to "adopt" | "Adopt" nearby HUC 14 sub-watershed for monitoring, clean up, public awareness. Hold Project Wet Water Festivals | Share success stories of changes in practices to benefit water resources | Learn more about your local watershed association | Share success stories of changes in practices to improve water resources | Sponsor a watershed talk or walk | | Lead stream walks, make presenta-tions to groups, coordin-ate school efforts, Submit Data to NJDEP |
| **Goal 5: Encourage Economic Development or Redevelopment that Reflects Smart Growth Principles** | | | | | | | | | | | |
| Promote Economic Develop-ment & Redevelop-ment where appropriate | Set growth targets and transit corridors; obtain endorse-ment for hamlets, villages, etc.; improve & enhance waterfront areas & access | Provide input to growth target setting; promote ecotourism opportunit-ies, do not block scenic corridors | Promote improving waterfront access | Assess alternative develop-ment scenarios | Link planning for new schools with growth targets | Provide input on growth targets, do not block scenic corridors | Help restore waterfront access | Provide input on growth targets | Help restore waterfront access | | |

## 6.0 Strategies for the Highlands Communities: Holland, Alexandria, Milford, Frenchtown

### 6.1 Watershed Priorities

Watershed priorities for the Highlands Communities are focused on preserving the pristine character of its trout production waters and groundwater supplies from the effects of encroaching development. *The Settings Report* found that the second highest increase in new urban development in the watershed occurred in this region between 1986-1995. *A Water Quality Overview of the Central Delaware Tributaries* identified portions of Alexandria, Holland and Milford as being near their limits for groundwater replenishment. (See figure 4). The Water Resource Evaluation System model applied to WMA 11 determined that the greatest amount of lands with the highest water resource value are found in this sub-region (see figure 10). .

### 6.2 Pollutants of Concern

Identified pollutants of concern include fecal coliform and temperature in the Nishisackawick Creek. DRBC also identified enterococcus accidences in the Hakihokake and Harihokake Creeks. TMDL development is underway for fecal coliform in the Nishisackawick Creek with a completion date of June 2003. Stakeholders can participate in the TMDL process by attending meetings, reviewing and providing comments on documents as they are proposed in the New Jersey Registrar.

### 6.3 Successes to Build On

Successes to build on in this area include: ongoing redevelopment in Frenchtown recognizing the Delaware River as an ecotourism resource, and sign-on by three of the four municipalities in this sub-region to the Wild and Scenic River Management Plan (with Alexandria Township the non-signatory). Recently, the Friends of Holland Highlands formed to educate area residents about water quality and supply concerns in part of this sub-region. Their web-site is www.hollandhighlands@netcarrier.com.

### 6.4 Strategies

Strategies for this area are presented in Table 9. While sub-regions have different priorities and pollutants, the four sub-regions outside of the urban/suburban municipalities share common strategies based on their existing level of development and water protection goals. In Phase 2 of the watershed planning process, refinements would need to be made through negotiations to develop individualized strategies for each sub-region.

| Table 9: STRATEGIES FOR THE RURAL COMMUNITIES | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Local Govern-ment** | **Business** | **Watershed Manage-ment Association** | **Contract Manager** | **Schools** | **Industry** | **Residents** | **Agriculture** | **Service Organiza-tions** | **NJDEP** | **Amer-iCorps** |
| **Goal 1: Maintain and Improve Surface and Groundwater Quality**<br>**Goal 2: Maintain a Balanced Hydrologic System** | | | | | | | | | | | |
| Impervious Cover, Ground-water Stress Areas | Limit watershed impervious cover[7] and develop-ment in stress areas[8] through overlay zone, special protection area, or clustering | Reduce existing impervious surface where possible | Educate about impervious cover impacts | Identify areas at risk for impervious impacts | Break up existing impervious surface where possible; include information on impervious impacts in lesson plans | Break up existing impervious surface where possible | Use porous pavers and other landscaping to reduce impervious surface | Locate highly impervious operations outside this sub-region | Assist projects to break up impervious surface | Minimize impervious cover in proposed projects | |

[7] See figure 7.
[8] See figure 4.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Corridor Protection | Apply 150 – 300 foot riparian buffers | Locate outside of the buffer, sponsor restoration | Promote stream habitat repair and reforesta-tion of riparian buffer | Identify priority areas for protection | Include information on buffer benefits in lesson plans | Locate outside of the buffer | Locate outside of the buffer; participate in restoration | Farmers apply for CREP funding to leave a buffer | Participate in restoration | Strengthen Stream Encroach-ment regulations | Partici-pate in Restora tion Projects |
| Stormwater Manage-ment | Limit road crossings; place restrictions on in-stream ponds to minimize thermal impacts | Use non-structural techniques where possible | Identify stormwater outfalls; educate about BMPs[9] | Identify BMP;s | Identify stormwater outfalls | Use non-structural techniques where possible | Use BMP;s (e.g., downspout socks, rain gardens, etc.) Reduce nonpoint source pollution from pesticides, pets, etc. | Use IPM to reduce pesticides; implement BMPs | Assist projects using non-structural techniques | Require stormwater plans be developed regionally | Identify storm-water outfalls |
| Maintain Channel Stability | Stabilize stream banks, apply for 319 grant funding | Sponsor restoration of stream banks | Assist with restoration of stream banks | Identify streams with poor riparian cover from WRES[10] data and RATS | Groundtruth areas of poor riparian cover and participate in restoration | Sponsor restoration | Participate in restoration of stream banks | Use erosion reduction BMPs | Participate in restoration of stream banks | Strengthen Stream Encraoch-ment protection | |

[9] See appendices 4-7 (from NJDEP Best Management Practices Manual).
[10] See Figure 10 (follows page 8) and www.delawaretribs.org for maps of high water resource lands.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Remove Designated Pollutant of Concern And set Targets for Stream Health | Adopt ordinances targeting applicable pollutants & participate in TMDL process | Participate in TMDL process | Contribute any monitoring data to the NJDEP & participate in TMDL process | Paricipate in TMDL process identify BMPs to meet targets | Contribute any monitoring data & participate in TMDL process | Participate in TMDL process | Participate in TMDL process | Participate in TMDL process | Participate in TMDL process | Identify sources of pollutants and set targets for reduction and for stream health | Contri-bute any monitoring data to NJDEP |
| **Goal 3: Conserve Natural Resources** | | | | | | | | | | | |
| Conserve Natural Resources | Adopt ordinances protecting seeps, springs, riparian wetlands and areas of high water resource value from WRES[11]. Protect steep slopes, forest conserva-tion areas, critical habitat | Sponsor protection efforts | Encourage conserva-tion techniques such as easements and farmland or open space preservation | Provide municipal-ities with location of areas requiring protection and model ordinances for their protection | Include importance of natural resource protection in lesson plans | Promote green infrastruct-ure on-site | Consider open space conservation easements on your property | Consider Farmland preservation options | Sponsor protection efforts | Adopt Garden State Greenways Plan; include recharge in Green Acres ranking; | Check to make sure schools are aware of cd and priority areas |

[11] See project website for details at www.delawaretribs.org.

## 7.0 Strategies for the Rural Argillite Valley Communities: Franklin, Raritan, Kingwood, Delaware, Stockton

### 7.1 Watershed Priorities

The watershed priority in this sub-region is maintaining the surface water quality of the Lockatong and Wickecheoke Creeks as surface water drinking supply streams. These creeks drain directly into the D&R Canal and severe erosion of the streambeds is having a negative effect on it (Gibs, 2001). The extreme natural imperviousness of the bedrock contributes to the high peaks in runoff (or "flashiness") of the streams following development and limits the amount of groundwater available for wells. DRBC (2002) identified the southern portions of Franklin and Kingwood Townships and the northern portion of Delaware and Raritan Townships as areas of moderate groundwater stress. The Water Resource Evaluation System identified Kingwood and Delaware Townships as containing large sections of high water resource value lands. Maintaining or improving stormwater management will be necessary to safeguard the health of the watershed.

### 7.2 Pollutants of Concern

Fecal coliform is a priority pollutant for the Plum Brook and the Lockatong and Wickecheoke Creeks. Phosphorus, pH, and temperature accidences have also been identified for both the Lockatong and Wickecheoke Creeks (USEPA 1998). DRBC (unpublished 1999 data) reported low Dissolved oxygen in Warsaw Creek. The Copper Creek and Warford Creek are identified by the NJDEP (1999) as biologically impaired. Stakeholders can participate in the TMDL process by attending meetings and reviewing and providing comments on documents as they are proposed in the New Jersey Registrar.

### 7.3 Successes to Build On

Successes to build on include: previous work on watershed planning undertaken by the Lockatong/Wickecheoke project jointly sponsored by ANJEC and the municipalities of Franklin, Raritan, Kingwood, and Delaware Townships. Stream monitoring data are available from this project to supplement those of the NJDEP and there is an interested public thanks to the outreach efforts of this project which include the development of a "virtual tour" of the watershed. Delaware Township has recently adopted overlay zoning that can be used to protect water quality and may be a model for other townships to follow. The results of the preliminary draft report of the Lockatong/Wickecheoke project were included in the strategies outlined below.

### 7.4 Strategies

Strategies for this area are presented in Table 9. While sub-regions have different priorities and pollutants, the four sub-regions outside of the urban/suburban municipalities share common strategies based on their existing level of development and water protection goals. In Phase 2 of the watershed planning process, refinements would need to be made through negotiations to develop individualized strategies for each sub-region.

## 8.0 Strategies for the Rural Rolling Hills Communities: West Amwell, East Amwell, Lambertville, Hopewell, Pennington

### 8.1 Watershed Priorities

Watershed priorities for this sub-region include: protecting the Swan Creek Reservoir as the drinking supply for Lambertville and protecting groundwater supplies for other residents, determining the appropriate location for growth, defining appropriate zoning to protect the quality of its trout maintenance creeks, and protecting the unique habitat of the Sourland Mountain.

### 8.2 Priority Pollutants

Priority pollutants include: phosphorus, nitrogen, and pH accidences, as well as organic compounds in the bottom sediments of Jacobs Creek, accidences of DRBC's enterococcus standards by the Alexauken, Swan, Moores, Jacobs, and Fiddlers Creeks, and biological impairment of Airport Run and Warsaw Creek. Stakeholders can participate in the TMDL process by attending meetings reviewing and providing comments on documents as they are proposed in the New Jersey Registrar.

### 8.3 Successes to Build On

Successes to build on include: the annual celebration of the Delaware River at Lambertville during Shadfest, monitoring data for the Alexauken Creek by Scott Ward's biology class at South Hunterdon High School, monitoring data for Moores Creek by the Delaware River Keeper, public training sessions in stream monitoring offered by the Delaware River Keeper, and West Amwell Township's inclusion of protection of natural resources, including water quality, in its current Master Plan review.

### 8.4 Strategies

Strategies for this area are presented in Table 9. While sub-regions have different priorities and pollutants, the four sub-regions outside of the urban/suburban municipalities share common strategies based on their existing level of development and water protection goals. In Phase 2 of the watershed planning process, refinements would need to be made through negotiations to develop individualized strategies for each sub-region.

## 9.0 Strategies for the Urban Suburban Communities: Trenton, Hamilton, Ewing, Lawrence, West Windsor

The watershed issues in these communities differ from the northern and southern regions because of the greater amount of urban development in these urban and suburban communities. All of the streams in this area are listed as moderately biologically impaired (unlike most of the northern streams which were listed by the NJDEP as biologically unimpaired).

### 9.1 Watershed Priorities

Watershed priorities for this sub-region include:

- encouraging redevelopment that maintains or improves water quality;
- implementing projects that capitalize on the green infrastructure and amenity values of the Delaware River and the Assunpink Creek;
- rehabilitating degraded streams; and
- participating in the Total Daily Maximum Load (TMDL) process to reduce pollutants in this region of the watershed and prevent degradation of other streams not currently identified on EPA's 303(d) list. Stakeholders can participate in the TMDL process by attending meetings and reviewing and providing comments on documents as they are proposed in the New Jersey Registrar.

In addition, DRBC identified the central portion of Hamilton, and southern portions of Washington and West Windsor as high groundwater stress areas. The northern portion of Hamilton, the eastern portion of Lawrence and the central portion of West Windsor are in a moderate groundwater stress area.

### 9.2 Priority Pollutants

Priority pollutants include: heavy metals, phosphorus, nitrogen, fecal coliform accidences for the Assunpink Creek; fecal coliform in Miry Run, low dissolved oxygen in the Shabakunk Creek; eutrophication of Colonial Lake and Whitehead Pond, and biological impairment of Pond Run, the Little Shabakunk, and Shipetaukin Creeks.

### 9.3 Successes to Build On

Successes to build on include: the City of Trenton's work to remove concrete channelization and replace it with natural systems for flood prevention along the Assunpink Creek; the City of Trenton's research project to determine how to redevelop and improve stormwater management; a partnership between the Townships of Lawrence and Ewing to rehabilitate Colonial Lake; Ewing's stream channel protection project for the Shabakunk Creek using Infrastructure Funds; Ewing's process of establishing a town center; Hamilton, West Windsor, Lawrence and Trenton's commitment to create a greenway along the Assunpink Creek; Isles Inc.'s stream walks in Cadwallader Park and throughout WMA 11; Isles' commitment to community vegetable gardens in Trenton and the demonstration of gray-water reuse; Isles' development of lesson plans about watershed protection; monitoring data collected by Lorraine D'Zerilla at Hamilton Elementary School; monitoring data collected by Lawrence Day School, the Mercer County Soil Conservation District's outreach program and Science Fairs; and the Assunpink Creek Watershed Association's monitoring data.

### 9.4 Strategies

Strategies for this area are presented in Table 10. The urban/suburban municipalities share common strategies based on their existing level of development (and requirements for redevelopment)

and their water resource restoration goals. In Phase 2 of the watershed planning process, refinements would need to be made through negotiations to develop individualized strategies for this sub-region.

| Table 10: STRATEGIES FOR THE URBAN SUBURBAN COMMUNITIES | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Local Govern-ment** | **Business** | **Watershed Manage-ment Association** | **Contract Manager** | **Schools** | **Industry** | **Residents** | **Agriculture** | **Service Organizations** | **NJDEP** | **Ameri Corps** |
| **Goal One: Maintain a and Improve Surface and Groundwater Quality**<br>**Goal Two: Maintain a Balanced Hydrologic System** | | | | | | | | | | | |
| Impervious cover, Ground-water Stress Area[12] | Encourage infill and redevelop-ment that reduces current stormwater impacts, consider stress areas when considering (re)develop-ment | Disconnect impervious cover where possible | Educate public on BMPs[13] to reduce pollution | Provide information on green infrastruct-ure options | Include information on impervious impacts in lesson plans | Disconnect impervious cover where appropriate | Implement BMPs; use porous pavers to reduce impervious surface | | Assist projects to reduce impervious surface | Minimize impervious cover in proposed projects | |
| Reduce Flooding & Manage Stormwater | Reduce parking ratios; encourage non-structural flood control; storm drain stenciling | Use non-structural techniques where possible | Identify illicit storm drain connections | Give local government information on design options & BMP retrofits to reduce runoff | Identify stormwater outfalls | Use non-structural techniques | Use BMPs to reduce runoff | Use erosion reduction BMPs; implement IPM | Assist projects using non-structural techniques | Require stormwater plans be developed regionally | Identify storm-water outfalls |

[12] See figure 4.
[13] See appendices 4-7.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Remove designated pollutants of concern & set targets for stream health | Adopt storm water retro-fit targets (turn detention basins into wet ponds) Participate in TMDL process | Retrofit where applicable; participate in TMDL process | Participate in TMDL process | Give local government information on retrofit designs; participate in TMDL process | Contribute any monitoring data to the NJDEP and Participate in TMDL process | Participate in TMDL process | Participate in TMDL process | Participate in TMDL process | Participate in TMDL process | Set TMDL through modeling; set Targets for stream health | Contribute any monitoring data to the NJDEP |
| Corridor Protection and Restoration | Complete the "Missing Links" along the Assunpink Creek | Sponsor restoration | Assist with restoration | Identify streams with poor riparian buffer[14] | Participate in restoration | Locate outside the designated buffer area | Participate in restoration | Sign up farmers for CREP | Participate in restoration | Streamline permits for redevelopment that restores stream buffer | Participate in Restorations |
| **Goal Three: Conserve Natural Resources** | | | | | | | | | | | |
| Conserve & Restore Natural Resources and Open Space | Prioritize areas for protection and restoration | Sponsor protection and restoration efforts | Encourage conserva-tion techniques such as easements and open space preservation | Provide municipal-ities with location of areas requiring protection or restoration and model ordinances | Include importance of natural resource protection in lesson plans | Promote green infrastruct-ure on-site | Consider open space conserva-tion easements on your property | Consider Farmland preservation options | Sponsor protection efforts | Adopt Garden State Greenways Plan; include recharge in Green Acres ranking; recognize urban open space needs | Check to make sure schools are aware of priority areas |

[14] See WRES information at project website www.delawaretribs.org

## 10.0 Strategies for the Rural Plains Communities: Millstone, Upper Freehold, Roosevelt, East Windsor, Washington

### 10.1 Watershed Priorities

Watershed priorities for this sub-region are similar to those of the northern sub-regions although growth pressures are felt more strongly in this southern end of the watershed management area. Protecting farmland and protecting headwaters are important considerations for this sub-region. Stream restoration is also important for this sub-region since all its streams monitored by the NJDEP are listed as moderately biologically impaired.

### 10.2 Priority Pollutants

Priority pollutants include phosphorus and nitrogen.

### 10.3 Successes to Build On

Successes to build on include: Washington Township's construction of a mixed-use Town Center to center growth coupled with a strong commitment to farmland and open space preservation and the layout of Roosevelt around its stream corridors could be used as a models of conservation design. Washington Township has a Green Acres Planning Incentive Grant and a 5-cent open space tax and is working on a stream corridor preservation ordinance. The creation of the Assunpink Wildlife Management Area as a natural solution to flood protection is another success.

### 10.4 Strategies

Strategies for this area are presented in Table 9. While sub-regions have different priorities and pollutants, the four sub-regions outside of the urban/suburban municipalities share common strategies based on their existing level of development and water protection goals. In Phase 2 of the watershed planning process, refinements would need to be made through negotiations to develop individualized strategies for each sub-region.

## 11.0) Guarding the Water Resources of the Central Delaware Communities: Continuing Watershed Planning

### 11.1) Indicators of Progress

As part of the new direction recommended for Phase Two of the watershed planning process, this *Action Plan* suggests an entity (possibly County Planning staff or Environmental Commissions) be charged with the task of providing a yearly report on progress to Planning Boards and the media. At the December 3, 2002 meeting of the Lower Delaware Wild and Scenic River Management Committee, that committee agreed to consider expanding its role in watershed protection and could possibly take on this reporting role. Indicators suggested for inclusion in the report are identified in Tables 11 and 12.

**Table 11: Indicators of Water Resource Protection Success Developed by the Land Use Committee**

| Indicator | Target |
|---|---|
| Watershed Association | Send flyer about Delaware Riverkeeper, Assunpink Watershed Association, and Lockatong/Wickecheoke Watershed Project to all schools by March 2003 |
| Stream monitoring | Increase number of schools participating by 10% a year |
| Headwater Protection Ordinance | Under development by all applicable municipalities in year 3, adopted by year 4 |
| Stream Corridor Ordinance | Under development in year 3 by all municipalities, adopted by year 4 |
| Steep Slope Ordinance | Under development in applicable municipalities year 3, adopted by year 4 |
| Open Space Plan and Tax | Under development in year 3 for applicable municipalities, adopted by year 4 |
| Farm Preservation Plan | Under development in year 3 for applicable municipalities, adopted by year 4 |
| Stormwater Management Plan | Developed by NJDEP deadline |
| BMP maintenance | Inspections of 20% of BMPs a year |
| Erosion and Sediment Control | Meet NJDEP Permit standards |

| | |
|---|---|
| Site Design | Permit cluster development, adopt maximum parking demand ratios, , bioretention islands in parking lots by 2005 |
| Stream Remediation | Increase 319(h) grant proposals for priority areas by 25% by 2005 |
| Zoning matches Master Plan | Review in year 3, make changes in year 4 |
| Water Festivals | Increase project WET funded festivals in schools by 10% a year |
| Taken from WMA 11 Land Use and Action Now Committee, Schueler 1996, Lockatong and Wickecheoke Watershed Group 2001 | |

To promote watershed planning, the process must be a part of ongoing daily local land use decisions and be reflected in local government Master Plans. Tying the watershed process into the six-year State Plan Endorsement Review Process would provide another mechanism for keeping the process alive.

**Table 12: State Development and Redevelopment Plan Indicators of Water Resource Protection Success**

| Indicator | Target |
|---|---|
| Location of New Development, Population, and Employment | Percent of acres converted to developments that are located in the Metropolitan and Suburban Planning Area or within Centers in the Fringe Rural and Environmentally Sensitive Planning Areas is 70% from 1995 – 2005 and 90% from 2005 – 2020 |
| Amount of Land permanently dedicated to open space and farmland preservation | Amount of land preserved must increase by a factor of 5 by 2010 |
| Percent of New Jersey streams that support aquatic life | By 2020 95% of streams assessed support aquatic life |
| Progress in socioeconomic revitalization for Urban Coordinating Council eligible municipalities | For Ewing Twp, Hamilton Twp, and Trenton City demonstrate progress in reducing the gap between their revitalization needs and those of other municipalities to 1.5 in 2005 and to 1.1 by 2020 |

| | |
|---|---|
| Degree to which local plans are consistent with State Plan | By 2005 50% of local plans are consistent with the State Plan, by 2020 100% |
| Brownfield Redevelopment | 80% of Brownfield sites identified by the Brownfield Redevelopment Task Force will be undergoing redevelopment by 2005 and 100% by 2020 |
| Conversion of Wetlands | Reduce conversion of wetlands to not exceed 50 acres per year statewide by 2005, no net loss by 2020 |
| Percent of development on individual septic systems | New housing units using individual septic systems should not exceed 10% of all new housing units by 2005, and reduce further by 2020 |
| Municipalities participating in comprehensive multi-jurisdictional regional planning processes | From 2000 to 2005, 60% of the municipalities that received Plan Endorsement do so through a multi-jurisdictional regional planning process. From 2005 to 2020, 80% |
| Adapted from the New Jersey *State Development and Redevelopment Plan*, 2001 | |

## 11.2) Potential Sources of Funding

Potential sources of funding for continuing watershed planning are identified in Table 13.

| Table 13: Potential Funding Sources for Watershed Projects | |
|---|---|
| **Source** | **Purpose** |
| Federal 319(h) NPS Grant | NPS Implementation Projects |
| Corporate Business Tax | Watershed Management Groups |
| TEA-21 (Department of Transportation) | NPS Restoration |
| Agricultural NPS Grants (CREP, EQUIP, WIP etc.) | Agricultural NPS Projects |
| Brownfields and Natural Damages Funds | Hazardous Waste Site Improvement |
| Federal CWA 106 Funds | Ground Water Protection |
| Federal CWA 604(b) | Water Quality Management Planning |
| Clean Communities Grants | Recycling/Solid Waste Management |
| County Environmental Health Act | County Health Departments |
| Office of Environmental Services Grants | Municipalities, Environmental Commissions |
| Community Forestry Program | Tree Planting/Beautification |
| Parks & Forestry Trails Program | Public Access |
| Private Foundations (Dodge, William Penn, Kellogg, etc.) | Watershed/Environmental Projects |
| Wild & Scenic River Management Committee Municipal Incentive Grants | Municipalities that are signatories to the Wild And Scenic River Designation |
| New Jersey Environmental Infrastructure | Stormwater/Wastewater Loans |

## 11.3 Next Steps

While the *Watershed Action Plan* represents a series of next steps for completing a final watershed plan, there are clearly some next steps to be taken in the short term. The Plan was presented to the Working Group December 9, 2002 for approval. The Working Group recommended that the Action Plan be posted on the project web-site www.delawaretribs.org. The Working Group also recommended the plan be circulated to all the Environmental Commissions and copied to the Planning Boards in WMA 11 and other key stakeholders as well. The suggestion was also made that the plan be adopted as part of the Natural Resource Inventory or Critical Resources element of WMA 11 municipal Master Plans. There was some discussion of whether the Plan could be proposed as an amendment to Areawide Water Quality Management Plans that cover WMA 11. However, DEP staff did not feel that was a viable option.

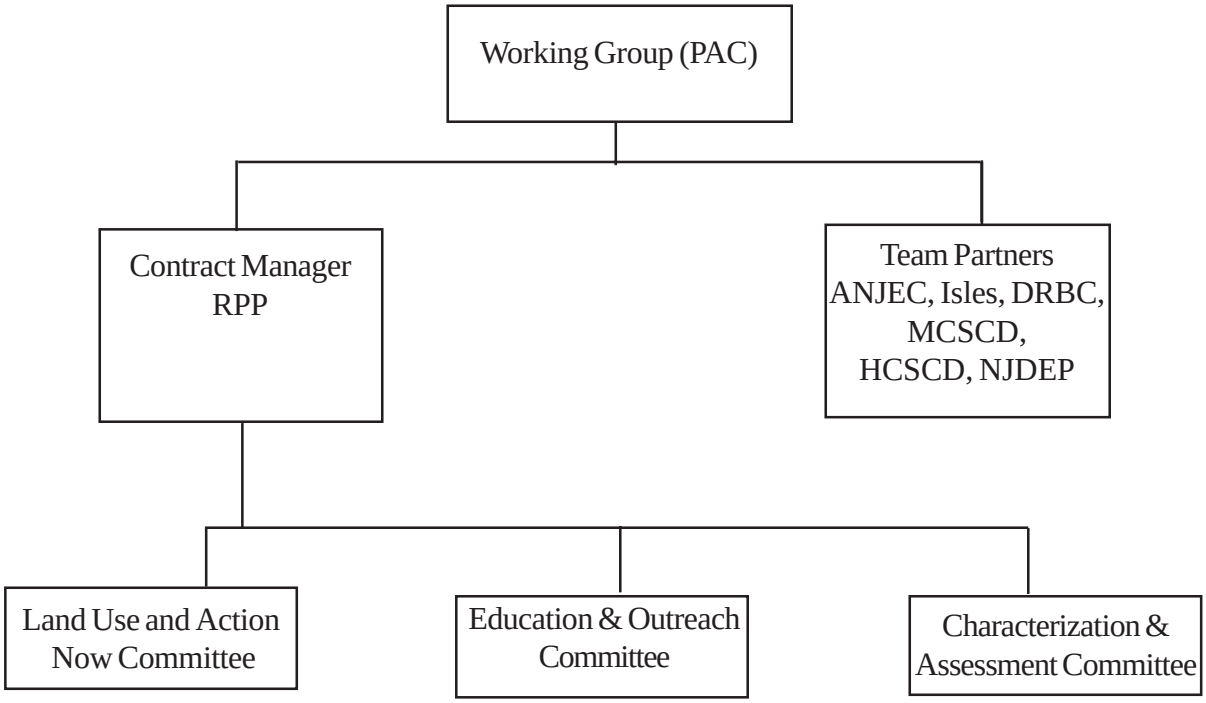
Three immediate steps municipalities can take are:

- participate in NJDEP's TMDL process;
- adopt stream corridor protection (or rehabilitation) ordinances (available from ANJEC); and
- examine the impacts of the build-out of their current zoning to determine appropriate areas for growth (or redevelopment) and to determine appropriate areas for protection (see project website www.delawaretribs.org).

**Appendix 1:**

**WMA 11 Central Delaware Tributaries**

**Organizational Structure**



## APPENDIX 2: FEDERAL, STATE, COUNTY, AND LOCAL PROGRAMS THAT IDENTIFY WATER RELATED ISSUES FACING THE CENTRAL DELAWARE COMMUNITIES

The section of the Delaware River bordered by the Central Delaware communities was designated a Wild and Scenic River by the federal government in November of 2000. A management plan was developed for this section of the Delaware River by the **Lower Delaware National Wild and Scenic River** Study Task Force. The *River Management Plan* identified six issues:

- water quality degradation;
- natural resource species and habitat loss;
- threats to historic structures and landscapes;
- recreational uses incompatible with water quality;
- open space loss; and
- adverse impacts of economic development within the river corridor.

The **Delaware River Basin Commission**'s 1999 *Flowing Toward the Future* identified a number of issues including:

- concern over adequate water supply;
- contaminated water and fish;
- incursions of non-native species;
- urban sprawl;
- determining the proper balance between the commercial and industrial use of waterfronts and other uses; and
- lack of understanding of the role of residents as stewards of the watershed.

DRBC is currently developing a deeper understanding of the issues in its region through a planning process expected to be completed by 2004.

The recently completed **National Forest Service** *Draft Highlands Study* identifies six issues:

- water quality degradation;
- biodiversity impacts;
- lack of protection for recreation and open space areas;
- forest fragmentation;
- increasing impervious surface; and
- lack of protected riparian buffers.

**The USEPA, US Army Corps of Engineers, Mercer County, and the City of Trenton** continue to work on the *Assunpink Creek Watershed Project* to:

- mitigate flooding issues along the Assunpink;
- address brownfields redevelopment; and
- restore appropriate sections of the Assunpink to a natural state.

***The Delaware and Raritan Canal State Park Master Plan*** (second edition) identifies nine issues including:

- water quality degradation (from point sources, overland flow of water runoff, or groundwater exchange);
- compatibility of recreational uses;
- incursion of 20th century development upon the historic character of the canal setting and its ten nationally registered historic districts;
- improvement of the Canal Park's role as a migratory route for plants and animals;
- the need to strengthen the Canal's connection to Trenton's urban fabric;

- lack of sufficient funds to preserve historic features;
- acquisition of additional open space for buffer areas;
- additional patrols needed in the park for safety; and
- the need to harmonize municipal plans in a manner that benefits the Canal Park.

The **NJDEP *303(d) list*** of impaired streams identifies streams requiring development of Total Maximum Daily Loads. Seven streams in WMA 11 require TMDLs for fecal coliform by June 2003. To learn more about the TMDL process see the WMA 11 project website at www.delawaretribs.org. Stakeholders can participate in the TMDL process by attending meetings and reviewing and providing comments on documents as they are proposed in the New Jersey Registrar.

The ***New Jersey Statewide Water Supply Plan*** (NJSWSP) places the northern part of WMA 11 (known as Planning Area 9 in the NJSWSP) among the Planning Areas not anticipated to be in deficit during the planning period - through 2040 (p. 97). Members of the WMA 11 Characterization and Assessment Committee and participants in Working Group meetings disputed this designation and raised concerns about recent developments that had dried up neighboring wells. The southern portion of WMA 11 is located in Planning Area 14 in the NJSWSP. Planning Area 14 is anticipated to face a deficit by 2040.

The NJSWSP is currently being revised and additional water budget work is being undertaken by the NJDEP. The results of this analysis are expected to be available within a year. Recommendations regarding in-stream flows and ranking of water uses as well as links to the State Plan and a proposed Environmental Master Plan will need to be incorporated into the final Watershed Plan for the Central Delaware Communities.

The **NJDEP *Source Water Assessment Plan*** is currently being developed and is proposed for release by June 2002. The potential sources of contamination to surface water supply and public community wells identified in this plan will need to be reflected in watershed planning for the Central Delaware communities.

A number of organizations are working on **Greenway Plans** for the Central Delaware communities. The gaps remaining to be filled in to achieve a greenway for the entire **Assunpink Creek** have been identified in a report called *Closing the Missing Link on the Assunpink Greenway*. The NJDEP **Green Acres program** has identified the preservation of historic landscapes as an issue in the central part of the watershed management area with trails and landmarks associated with the Cross Roads of the American Revolution passing through Trenton as a priority. The **D&R Greenway** has identified priorities for connecting existing acquisitions. The **Delaware Valley Regional Planning Commission** is working on a Delaware River Heritage Trails Project. There is also an **East Coast Greenway** plan that has been developed to link trails in other states. Two routes for a **Capital to Coast Trail** have also been identified, one by DOT and one by Green Acres. The **NJ Conservation Foundation** *Garden State Greenways Vision* project has identified the issue of lack of protection for greenway corridors throughout the state. Its final report will be available at the end of 2002. Issues identified by the report should be incorporated into the watershed plan. Most recently, a **Central New Jersey Greenways** group has been formed in Lawrence Township to identify potential trail linkages in Central New Jersey.

The NJDEP **Landscape Project** identifies locations of threatened and endangered species throughout the state. At issue is the lack of protection for priority areas in the Central Delaware communities identified by the NJDEP including: bluff areas in the northern part of the

Watershed Management Area, Baldpate Mountain and grasslands in the center of the WMA, and endangered species located in the Township of Roosevelt in the southeastern section of WMA 11.

The ***State Development and Redevelopment Plan*** population projections highlight growth pressure issues throughout the state. For the Central Delaware communities, growth is projected to be highest in the more undeveloped areas of the watershed management area. Trenton, located in Planning Area 1 (where the State Plan indicates growth should go) is projected to have little growth. At issue is the spread of sprawl to greenfields rather than the infill and redevelopment of urban areas that are already sewered.

A recent indicator of new sprawl development identified by New Jersey Future is the change between 1990 and 2000 in the percentage of housing units having nine or more rooms. Of the 52 municipalities that experienced 5%, 10%, or 25% growth in units with nine or more rooms, ten are located in WMA 11. Almost half the municipalities in WMA 11 (10 out of 24) rank high in this sprawl index with Millstone Township in Monmouth County having the distinction of greatest increase – 17%.

The **Council on Affordable Housing** has not yet released its third round targets for WMA 11 communities (to cover 1999-2005) but affordable housing requirements are linked to population, employment growth, and wealth within this region.

Two Metropolitan Planning Organizations largely determine transportation issues within the Central Delaware communities. The North Jersey Transportation Planning Authority's ***Access and Mobility: The 2025 Regional Transportation Plan for Northern New Jersey*** affects Hunterdon and Monmouth Counties. The Delaware Valley Regional Planning Commission's ***Horizons 2025*** affects Mercer County. A number of specific projects have the potential to increase shade trees along streets within Trenton and to improve pedestrian and bicycle access to the D&R Canal. Other transportation issues raised by watershed planning participants include: the possible expansion of Route 29, the possible expansion of the Trenton Mercer Airport, the possible expansion of the Scudders Falls bridge, and the possibility of turning Route 29 into a boulevard along the Delaware River in Trenton at the mouth of the Assunpink Creek. The West Trenton Line and the Camden Trenton Light Rail Line will also affect transportation within the watershed management area.

**Mercer County** is working on developing an *Access Code* that will consider environmental as well as traffic safety and flow issues in the design of new roads. They will begin reviewing their Master Plan in the near future. The part of WMA 11 located in Mercer County is more urbanized than the rest of the watershed and consequently issues in Mercer County involve redevelopment and stream remediation as well as open space protection.

**Hunterdon County's** Master Plan revision process has just begun gathering data. Issues related to water that it would focus on include: septic capacity as determined by the NJGS nitrate dilution model, impervious cover, and riparian corridor health. The Hunterdon County Planning Board's Open Space, Farmland, and Historic Preservation Trust Fund Plan identifies priority issues in these areas. Hunterdon County has a Green Table that meets to address environmental issues.

**Monmouth County** has an Environmental Council that addresses water quality and quantity issues. A Green Table has recently been established in Monmouth County. Important issues for this area are similar to those in Hunterdon County and include the relationship between agriculture and water resources as well as development in headwaters.

## APPENDIX 3: GOALS OF FEDERAL AND STATE PROGRAMS RELATED TO WATER RESOURCES IN THE CENTRAL DELAWARE COMMUNITIES

### A) *Lower Delaware National Wild and Scenic River Management Plan*

The Plan identifies six goals for water resource protection.

**Goal 1: Water Quality**
Maintain existing water quality in the Delaware River and its tributaries from measurable degradation and improve it where possible.

**Goal 2: Natural Resources**
Preserve and protect the Delaware River's outstanding natural resources, including rare and endangered plant and animal species, river islands, steep slopes, and buffer areas in the river corridor and along its tributaries.

**Goal 3: Historic Resources**
Preserve and protect the character of historic structures, districts, and sites, including landscapes, in the river corridor.

**Goal 4: Recreation**
Encourage recreational use of the river corridor that has a low environmental and social impact and is compatible with public safety, the protection of private property, and with the preservation of natural and cultural qualities of the river corridor.

**Goal 5: Economic Development**
Identify principles for minimizing adverse impact of development within the river corridor.

**Goal 6: Open Space Preservation**
Preserve open space as a means of maximizing the health of the ecosystem, preserving scenic values, and minimizing the impact of new development in the river corridor.

The **Delaware River Basin Commission's** *Flowing Toward the Future* identified six goals:
- develop good science;
- promote watershed education;
- develop a watershed image and market it;
- promote sound land preservation and planning;
- practice sound water management; and
- work better together.

The **National Forest Service**'s *Draft Highlands Regional Study* identifies five goals:
- manage future growth;
- maintain an adequate supply of water;
- conserve contiguous forests;
- provide appropriate recreational opportunities; and
- promote economic prosperity that is compatible with goals 1-4.

***The Delaware and Raritan Canal State Park Master Plan*** (second edition) identifies ten goals including:
- enhance the linear nature of the park;

- enhance the role of the park as a connector;
- retain a degree of serenity and separation from the man-made world;
- balance the primary roles of the park;
- maintain the canal as a source of water;
- provide a wide range of recreational activities;
- emphasize the historic character of the canal;
- maintain the park in its natural state to the extent possible;
- enhance urban areas; and
- use the park as an outdoor classroom.

**Hunterdon, Mercer, and Monmouth Counties** have each identified stream corridor protection as a priority goal of open space protection.

The ***State Development and Redevelopment Plan*** contains thirty-three specific goals for water resources that need to be placed in the context of other *Plan* goals related to economic development and housing.

**Goal 11: Water Resource Policies**

1. Intergovernmental Coordination
2. Integration of Water Quality and Land-use Programs
3. Watershed Based Resource Planning and Permitting Program
4. Prevention of Water Pollution by managing the character, location, and magnitude of development
5. Water Quality/Individual and Community On-site Wastewater Treatment Systems - produce treated effluent suitable for groundwater recharge
6. Toxic and Hazardous Materials - contamination prevention
7. Protect and Enhance Wetlands
8. Reduce and Eliminate Non-point Source Pollution where possible
9. Integrate Land Use Planning and Natural Resource Information
10. Protect Groundwater Sources - by including standards for managing development and redevelopment in county and municipal plans to protect aquifer recharge areas and well heads
11. Delineate Prime and Locally Important Aquifer Recharge Areas - and include them in municipal and county plans
12. Management Programs for On-site Waste Disposal and Septage Removal
13. Water Quality and Limestone Areas - protection through state of the art design
14. Managing Development for Water Quality - by assuring proper siting, design and installation of stormwater and on-site wastewater treatment systems
15. Aquifer Protection - by managing development
16. Well Field Protection - by managing development
17. Identification and Delineation of Surface Water Systems - to protect headwaters, reservoirs and other sensitive surface water resources.
18. Stream Corridor Protection and Management - through buffers
19. Site Disturbance - should be minimal
20. Stormwater Management Facilities - should convey stormwater to surface water bodies at a quantity, quality, and rate equal to that which would be achieved through natural processes, emphasizing the use of non-structural methods
21. Regional Stormwater Management
22. Development and Water Supply - establish development and redevelopment based on the quantity of water available without adversely affecting water-dependent habitats and ecosystems and without exceeding the sustainable yield of the water resource

23. Water Supply and Facilities Capacity - in water stressed areas manage water use and development intensity to minimize the need for additional water facilities
24. Water Supply Planning - coordinate the *Statewide Water Supply Master Plan* with the *State Plan*, and coordinate local land use with the Master Plan to ensure that water demands of new development do not exceed or degrade water resources
25. Water conservation - encourage design, agricultural best management practices, water reclamation and reuse, pricing and other measures to reduce demand for water
26. Agricultural Water Supply - needs should be considered in water supply planning by all levels of government
27. Drought Planning System Interconnections - should be made to create an emergency system that can meet water supply need during periods of drought
28. Flood Plain Development and Redevelopment - should be avoided in designated floodplains and wetlands should be protected and enhanced.
29. Natural Systems and Non-structural Methods - should be used for flood control
30. Stormwater Management Systems - should be planned for on a watershed basis incorporating, where feasible, natural systems and increased filtration
31. Flood Protection - where non-structural methods, including buy-outs, are insufficient to provide flood protection, design and construct adequate flood protection facilities to minimize risk to life and property and to preserve water-dependent ecosystems
32. Flood Hazard Areas - should be included within stream corridors
33. Managing Development and Redevelopment outside of Flood Plains - design and construct new development so there is no net increase in the runoff rate or flood peak in order to prevent increases in flooding and damage to stream corridors

Other policy areas outlined in the State Plan that affect water resources are outlined below.

1. **Equity** – the achievement, protection and maintenance of equity should be a major objective of public policy decisions.
2. **Comprehensive Planning** – assess master and functional plans to identify their social, economic, and environmental impacts; include indicators and targets in plans; resolve conflicts between development and environmental objectives and/or infrastructure capacity through the master planning process; achieve Endorsement of master or regional plans.
3. **Public Investment Priorities** – first priority is public health and safety followed by the maintenance and repair of existing structures. Expansion of capacity is then determined on the basis of location within urban areas and level of distress, followed by municipalities with Endorsed Plans.
4. **Infrastructure Investments** – investments should be made to:
    - guide growth in PA1 and 2 and in centers in the Environs to protect the Environs;
    - promote maximum use of non-automotive transport and the sharing of parking
    - protect the functional integrity of natural resources;
    - ensure a safe and sufficient supply of water for present and anticipated needs according to a comprehensive watershed plan that includes water quality standards, water conservation measures, measures that protect future supplies from the cumulative impacts of development, and use of land assets that protect water supplies;
    - attain National and State Ambient Air Quality Standards;
    - provide integrated flood control and stormwater infrastructure addressing both point and non-point sources and maximize the use of nonstructural alternatives to minimize flooding, water pollution, and damage to structures and ecological systems
    - promote growth in urban areas and accommodate growth in centers in the Environs in ways that achieve water quality goals;

- encourage the use of innovative technologies and decentralized wastewater systems in centers in the Environs; and
- protect and maintain the functional integrity of contiguous open space areas and corridors, farmland, and environmentally sensitive features, except where necessary to provide emergency access to existing uses.

5. **Economic Development** – locate public facilities to anchor redevelopment and development, preserve and enhance the capability of New Jersey's public use airports, provide for adaptive reuse, invest in facilities that capitalize on natural resources for tourism, balance housing and employment.

6. **Urban Revitalization** – establish design criteria to improve and enhance waterfront areas, corridors, neighborhoods, and gateways, maintain existing trees and plant new ones.

7. **Housing** – provide a reasonable balance in Master Plans and development regulations between residential and other land uses, promote the location of housing within walking distance of schools, transit, employment

8. **Transportation** – promote development that is conducive to mass transit services, reduces consumption of land, and reduces total vehicle miles of travel

9 **Historic, Cultural and Scenic Resources** – include historic surveys and scenic corridors in local Master Plans

10. **Air Resources** – reduce air pollution by promoting development patterns that reduce both mobile and stationary sources of pollution

11. **Open Lands and Natural Systems** –
    - establish and maintain undeveloped publicly owned lands within the watersheds of potable water supply reservoirs as public open space;
    - acquire open space in Critical Environmental Sites, greenbelts, greenways, land in agricultural production, and parks and plazas in urban areas;
    - maintain and improve public access to waterfront areas;
    - preserve and restore the functional integrity of natural systems, including large contiguous tracts of forest, grasslands and other natural land to protect biological diversity;
    - connect large contiguous tracts of forest grasslands and other natural lands with stream and river corridors with corridors and greenways;
    - protect habitats of threatened and endangered species;
    - design forest management practices to protect watersheds, wetlands, stream corridors, and water bodies from nonpoint source pollution and other adverse effects to water quality and aquatic habitat; and
    - protect critical slopes and ridgelines.

12. **Energy Resources** – promote energy efficient community design in higher intensity mixed use Centers and redesigned Nodes that accommodate shared parking.

13. **Waste Management, Recycling, Brownfields** – plan, locate and market redevelopment to capitalize on opportunities presented by brownfields sites.

**14. Agriculture** – plan and locate new development to avoid negative impacts on agriculture, include consideration of the water needs of the agricultural industry in water supply planning at all levels of government, promote economic development that supports the agricultural industry, encourage the use of agricultural management practices to ensure sustainable and profitable farming while protecting natural resources, expand opportunities for agro-tourism and eco-tourism.

**15. Special Resource Areas** – The Highlands is the first Special Resource Area in New Jersey. SPRAs are recognized as having unique characteristics or resources of statewide importance and are to have established in them a receptive environment for regional planning efforts. Link the planning and implementation strategies to the ongoing watershed planning initiative established by the NJDEP.

**16. Design** – mix uses and activities as closely and as thoroughly as feasible, redesign existing areas of sprawl to look and function more like Centers, replace expansive pesticide and fertilizer intensive lawns with low maintenance indigenous species to minimize runoff and reduce nonpoint source water pollution.

| **Appendix 4: Best Management Practices (BMP) Estimated Pollutant Concentration Reduction, In Percent** (NJ Department of Agriculture, 2000**)** | | | | | | |
|---|---|---|---|---|---|---|
| | Total Phoshorous | Nitrate Nitrogen | Ammonia Nitrogen | Total Suspend-ed solids | Fecal Coliform | Metals |
| Extended Detention Basin | 30 | 0 | ---- | 70 | ---- | 40 |
| Wet pond | 50 | 30 | 25 | 80 | 70, if no res. Waterfowl | 60 |
| Stormwater Wetland | 40 | 60 | 30 | 80 | 50, if no res. Waterfowl | 60 |
| Surface Sand Filter | 50 | Negative | ---- | 80 | 40 | 40 |
| Perimeter Sand Filter | 60 | Negative | 70 | 80; Needs pretreatment | 40 | 50 |
| Bioretention System | 60 | ---- | 50 | 80 | ---- | 80 |
| Enhanced Swale | 30 | 50 | 50 | 60 | ---- | |
| Dry Well | 80 | ---- | ---- | 80 | ---- | ---- |
| Pervious Paving | 50 | ---- | ---- | 60 | ---- | 60 |
| Infiltration Structure W/ Filter Strip | 60 | 25 | 70 | 70 | 70 | 60 |
| Manufactured Treatment Devices | Case-by-Case | ---- | ---- | Case-by-Case | Case-by-Case | Case-by-Case |
| Filter Strip | 20 | 10 | 20 | 60 | ---- | 40 |
| Riparian Forest Buffer | 50 | 80 | 40 | 70 | ---- | 60 |

| Appendix 5: BMP Selection for Various Land Uses | | | | | | |
|---|---|---|---|---|---|---|
| | **Land Use** | | | | | |
| **BMP** | Ultra-Urban or Retrofit | Parking Lots | Roads | Residential | Pervious (parks, golf) | Rooftop |
| Extended Detention Basin | Depends | Yes | Depends | Yes | Yes | Yes |
| Wet pond | No | Ideal | Depends | Yes | Yes | Yes |
| Stormwater Wetland | No | Ideal | Depends | Depends | Yes | Yes |
| Surface Sand Filter | Depends | Ideal | Yes | Yes | Yes | Yes |
| Perimeter Sand Filter | Yes | Ideal | Depends | Depends | No | Yes |
| Bioretention System | Yes | Ideal | Depends | Depends | No | Yes |
| Enhanced Swale | Yes | Ideal | Depends | Depends | No | Yes |
| Dry Well | No | Depends | Ideal | Ideal | Yes | Depends |
| Pervious Paving | No | No | No | No | No | Ideal |
| Infiltration Structure w/ Filter Strip | Depends | Ideal | Depends | Depends | No | No |
| Manufactured Treatment Devices | Depends | Depends | Depends | Depends | Yes | Yes |
| Filter Strip | No | Depends | Yes | Yes | Ideal | Yes |
| Riparian Forest Buffer | No | Depends | Yes | Yes | Ideal | Yes |

| Appendix 6: Stormwater Treatment Suitability | | | | | |
|---|---|---|---|---|---|
| **BMP** | **Recharge Capability** | **Quantity Control** | **Safety** | **Space Required** | **Accept Hotspot Runoff** |
| Extended Detention Basin | Possible;varies w soil porosity | Yes | Fair | Substantial | Yes, if no infiltration capability |
| Wet Pond | No | Yes | Poor unless fenced | Substantial | If 4 ft. from pond bottom to water table |
| Stormwater Wetland | No | Yes | Varies | Substantial | Same as pond |
| Bioretention System | Not usually | Not usually | Good | Varies | Yes, if no infiltration |
| Perimeter Sand Filter | No | No | Good | Minimal | Yes |
| Surface Sand Filter | No | No | Good | Minimal to Moderate | Yes |
| Manufactured Treatment Devices | No | No | Good | Minimal | Yes |
| Enhanced Swale | Varies | No | Good | Varies | Yes |
| Dry Well | Yes | No | Good | Minimal | No |
| Pervious Paving | Varies | No | Good | Varies | No |
| Infiltration Struct-ure w/ Filter Strip | Yes | Varies | Good | Minimal | No |
| Filter Strip | Yes | No | Good | Moderate to Minimal | No |
| Riparian Forest Buffer | Yes | No | Good | Moderate | No |

| Appendix 7: Initial Cost of Construction and Maintenance Burden | | | |
|---|---|---|---|
| **BMP** | **Initial Construction Cost** | **Maintenance Burden** | **Other Issues** |
| Extended Detention Basin | Medium - High | Medium | Slight to moderateWQ benefit |
| Wet Pond | High | Medium | Aesthetically beneficial; can increase property value |
| Stormwater Wetland | Medium - High | Medium - High | Wildlife habitat benefits; |
| Bioretention System | Medium - High | Low | Landscaped;<br>Plant selection is key |
| Perimeter Sand Filter | High | Medium; Removal of top sand layer and debris | Located outside of curbstops |
| Surface Sand Filter | Medium | Medium; Removal of top sand layer and debris | Often combined with an organic layer to improve removal of pollutants |
| Manufactured Treatment Devices | Medium | Medium | Several different types, using vortex hydraulics, and filtration, maintenance is crucial |
| Enhanced Swale | Low | Low;<br>Mowing, debris removal | Needs pretreatment;<br>Check dams integral |
| Dry Well | Low | Low | Mostly for rooftop runoff |
| Pervious Paving | Medium | High | |
| Infiltration Structure | Low - Medium | High; Removal of sediments, debris from top | No 'hotspot' runoff |
| Filter Strip | Low | Low; Edge debris removal, scraping for flow, mowing annually, clipping removal | Along water course; can provide wildlife habitat benefit; minimum 35' width |
| Riparian Forest Buffer | Low - Medium | Low | Along water course; Wildlife habitat benefit;<br>minimum 100' width |

**References**


Amon, James. 1989. *D&R Canal State Park Master Plan 2nd edition.*

Arnold, C.L. Jr., and C. J. Gibbons. "Impervious Surface Coverage: The Emergence of a Key Environmental Indicator". *Journal of the American Planning Association* Vol. 62, No. 2, Spring 1996: 243-258.

Association of New Jersey Environmental Commissions. "Municipal Options for Stormwater Management". *Resource Paper* 2001.

ANJEC Ordinances Sheet.

Brady, A. and D. Brake and C. Stark. 2001. *The Green Infrastructure Guide.* Princeton, NJ: The Regional Planning Partnership.

City of Trenton Department of Recreation, Natural Resources and Culture. *Open Space Plan.*

Delaware River Basin Commission. 2002. *A Water Quality Overview of the Central Delaware Tributaries Watershed Management Area 11*. West Trenton, NJ: DRBC.

Delaware River Basin Commission. 1999. *Flowing Toward the Future 21st Century Visions and Directions for the Delaware River and Its Watersheds*. West Trenton, NJ: DRBC.

DRBC Unpublished data. "1999 Survey of the Lower Non-tidal Delaware River and Pilot Study for a Long Term Water Quality Monitoring Network."

Delaware Riverkeeper Network. 2001. *Stormwater runoff, Lost Resource or Community Asset?* Washington Crossing, PA: Delaware Riverkeeper Network.

Delaware Valley Regional Planning Commission. *Horizons 2025.* www.dvrpc.org

Delaware Valley Regional Planning Commission. 2000. *Closing the Missing Link on the Assunpink Greenway*. Philadelphia, PA. Delaware Valley Regional Planning Commission.

Gibs, J. et al. 2001. *Water Quality of the Delaware and Raritan Canal, New Jersey, 1998-1999.* West Trenton, NJ: USGS.

Hunterdon County Planning Board. 2000. *The Hunterdon County Open Space Farmland, and Historic Preservation Trust Fund Plan*. Hunterdon County, NJ, HCPB.

Institute for Environmental Negotiation, Department of Urban and Environmental Planning, University of Virginia. 2002. *A Stream Corridor Protection Strategy for Local Governments*, Charlottesville, VA: University of Virginia.

Jones, Renee. Green Acres Program, personal comment.

Lockatong and Wickecheoke Watershed Project. Draft Watershed Plan.

Mednick, Adam. New Jersey Conservation Foundation Garden State Greenways, personal

comment.

Mercer County Planning Board. Open Space and Recreation Plan, as amended 8/5/98.

Mercer County Soil Conservation District www.mercersoil.org

Monmouth County Planning Board. 2000. *Monmouth County Farmland Preservation Plan: the Comprehensive Plan.* Freehold, NJ: MCPB.

Monmouth County Planning Board. Park, Recreation and Open Space Plan.

National Forest Service. *Draft Highlands Study*. www.fs.fed.us/na/highlands/study/study.html.

National Park Service Northeast Region. 1999. *Lower Delaware National Wild and Scenic River Study Report*. Philadelphia, PA: U.S. Department of the Interior.

New Jersey Department of Agriculture, Department of Community Affairs, Department of Environmental Protection, Department of Transportation. 2000. *Best Management Practices for Control of Nonpoint Source Pollution from Stormwater, 5th Draft.* Trenton, NJ: NJDEP.

New Jersey Department of Environmental Protection, Division of Parks and Forestry, Office of Natural Lands Management. 2002. Landscape Project.

New Jersey Department of Environmental Protection. 1996. *New Jersey Statewide Water Supply Plan Water for the 21st Century the Vital Resource.* Office of Environmental Planning.

New Jersey State Planning Commission. 2001. *The New Jersey State Development and Redevelopment Plan*. Trenton, NJ: New Jersey Department of Community Affairs.

North Jersey Resource &Conservation Development. *Water Resource Evaluation System.* Map. Clinton NJ: NJRC&D.

North Jersey Transportation Planning Authority. Access and Mobility: the 2025 Regional Transportation Plan for Northern New Jersey www.njtpa.org

Rawlyk, Bill. Personal comment.

Regional Planning Partnership. 2002. *Smart Growth Alternatives: Avoiding the Unintended Consequences of Build-Out.* Princeton NJ: The Regional Planning Partnership.

Regional Planning Partnership. 2001. *The Settings Report for the Central Delaware Tributaries.* Princeton NJ: The Regional Planning Partnership.

Regional Planning Partnership (formerly MSM Regional Council). 1998. Mercer County Greenlinks Plan.

Schueler, T.R. 1993. Impact of Riparian Forest Cover on Mid-Atlantic Stream Ecosystems. Watershed Protection Techniques 1,1: 29.

Schueler, T.R. 1994. The Importance of Imperviousness. Watershed Protection Techniques 1,3:

100-11.

Schueler, T.R. 1998. *Rapid Watershed Assessment Handbook*. Center for Watershed Protection, Maryland.

Schuylkill Watershed Conservation Plan www.schuylkill

USEPA. 1998 Section 303d Water Quality Limited Waters in New Jersey.

USGS 2000 Water Resources Data – NJ Water Quality www.usgs.org

Van Orden, George and Fred Kelly. 1999. *A Cleaner Whippany River Watershed Nonpoint Source Pollution control Guidance Manual for Municipal Officials, Engineers, and DPW Personnel.* NJDEP