Final
Environmental Assessment Analysis

Developed by the
Hunterdon County Planning Board
with assistance from the
Hunterdon County Smart Growth
Natural Resource Committee

March 31, 2003
Revised September 30, 2003

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ACKNOWLEDGEMENT

The Hunterdon County Planning Board would like to thank the following for their assistance in preparing this analysis and report:

Hunterdon County Smart Growth Natural Resources Committee

Hunterdon County Division of GIS

North Jersey Resource Conservation & Development Council

New Jersey Water Supply Authority
Land preservation and environmental protection are priorities for Hunterdon County communities, but how do municipalities decide what properties to protect or preserve? The Hunterdon County Smart Growth Natural Resources Committee first met in January 2002 to discuss environmental criteria that could be used to help identify priority areas based on their natural resource value or environmental sensitivity. Hunterdon County Planning Board staff took direction from the Natural Resources Committee to develop an Environmental Assessment Model that presents a regional, quantitative assessment of land based on its natural resource value. Communities can use this model to help guide land acquisition decisions and also to identify natural features that are important to protect in the land development process.

In developing the assessment, the Committee decided to place emphasis on quantity and quality of our water resources, and trees or forested areas, which replenish and clean our water supplies and support a diverse ecosystem. As the group continued discussions, two distinct evaluation methods evolved. The first method, the Natural Resource Evaluation Model, can be used to evaluate land according to the inherent value of the natural resources, while the second method, the Vulnerability Model, can be used to evaluate a number of development constraints posed by the landscape.

The data analysis provided by these models can serve as an important first review of the natural resource value of the local landscape. While the scoring of the data layers is somewhat subjective, the data layers themselves are based on scientifically sound data. A second benefit is the independent nature of the data layers. Each data layer can be viewed and examined individually or the scoring can be modified to reflect local concerns. In addition, the analysis can be expanded to include other available GIS data layers to produce a custom analysis tool that reflects local preservation and planning goals.

**The Natural Resource Model** ranks each data layer between one (1) and five (5), one (1) being a lowest natural resource value and five (5) being the highest natural resource value. The Natural Resource Model includes:

  - Ground Water Recharge is defined by the NJGS as the water that percolates below the root zone of the plants. It can then travel laterally and become surface water or travel vertically into the aquifer and become part of the aquifer yield. Both are components of the ground water system for purposes of generating the ground water recharge GIS data layer. Note that mapped results can be significantly different if one only considers water that enters the aquifer. Lebanon and Tewksbury Townships showed the highest recharge rates estimated at 17 to 23 inches per year.

  - This data layer describes the potential for aquifers to yield ground water to high-capacity wells. It estimates aquifer yield based on geology and the underlying aquifer description and confining units. The highest aquifer yield areas scored 5. Aquifer Yield is based on 8,000 industrial, non-domestic wells. These high-capacity wells are tested for maximum water yields that often exceed domestic-well yields for the same aquifer; however, for the purposes of this model, the data remains relevant to water
resources. The best aquifer yield areas, estimated at 101 to 500 gallons per minute, are along the Musconetcong River along the County’s Northwest boundary and the area around Spruce Run Reservoir and in central Clinton Township.

The assessment was initially prepared by the Center for Remote Sensing and Spatial Analysis (CRSSA, Rutgers University). It identifies riparian corridors using flood plains, wetlands, and hydric soils. Once identified, the relative health of these riparian corridors is based on NJDEP Surface Water Quality Classification, NJDEP 1995/97 Land Use/Land Cover and the NJDEP Endangered and Non-game Species Landscape Project. Relative health is scored with the highest score of 5 and lowest score of 1. North Jersey Resource Conservation and Development Council (NJRC&D) expanded the original model to include a standard 40’ buffer on both sides of the streams to connect the riparian areas when other parameters were absent/CRSSA then ran the refined model for Hunterdon County. Over 70% of Hunterdon County’s riparian areas ranked Good, Very Good, or Excellent in terms of relative health. Riparian Health Assessment scores may change depending on recent and anticipated C1 reclassification of many of the streams within the County.

**Non-Riparian Wetlands** were added from the NJDEP 1995/97 Land Use/Land Cover dataset to capture wetlands that are not included in the riparian corridor health assessment. All wetlands outside the riparian area were scored a 5 because of the multiple water quality, flood control, and habitat values they serve. Note, no distinction was made between wetlands based on NJDEP definitions on exceptional, intermediate, or ordinary value because we lacked data sufficiently comprehensive to make such determinations. The most concentrated area of non-riparian wetlands is within the Croton Plateau.

This data was included to capture all recognized threatened and endangered species identified in the NJDEP Landscape Project. The Landscape Project first identified all significant patches of grasslands, woodlands, and wetlands within the State and then used the presence or absence of significant wildlife as an indication of habitat value. Areas where Federally Threatened and Endangered Species were observed received the highest score of 5. Threatened or Endangered species within the Grasslands and Forested Areas are most prominent within Hunterdon County.

This data layer was created using the Natural Heritage database to identify critically important natural areas. These areas are considered to be top priorities for the preservation of New Jersey’s biological diversity. It recognizes the best habitats for rare plant and animal species and natural communities. Areas identified by NJDEP as having outstanding significance scored a 5, very high significance scored a 4, and high significance scored a 3. The largest Natural Heritage Site in Hunterdon County encompasses the agricultural landscape of East Amwell and southern Raritan Township.

**Forested Areas** were identified using the NJDEP 1995/97 Land Use/Land Cover information and were included to recognize their contribution to water resources. The forested areas within the Highlands and the Sourland Mountain were given the highest score of 5 because of their recognized interstate and statewide significance, while all other forested areas scored a 3. Forested areas were added to this model through the committee review process. The forested areas within the Highlands received a higher score to recognize the interstate importance of the New York-
New Jersey Highlands region and the extent and value of remaining forests within this region. (Source: U.S. Forest Service, New York-New Jersey Highlands Regional Study, 2002 Update.)

The Highlands have been recognized in the State Plan as a “Special Resource Area” and part of the 1,000 square mile region known as the New Jersey Highlands which provides drinking water for more than 3.5 million people, hosts many threatened and endangered species, contains cultural and historic amenities and habitats of national importance.

The Sourland Mountain forested areas received higher scores to recognize their significance as one of a limited number of large contiguous forest patches in the Piedmont physiographic province, which extends from Maryland to New York and includes New Jersey and Pennsylvania. (Source: NJDEP Office of Natural Lands Management, Tom Breden, 12/12/2000.)

Steep Slopes were considered initially in the Natural Resource Model but were shifted to the Vulnerability Model. The committee identified steep slopes more as a development constraint rather than an inherently important natural resource.

**Natural Resource Final Analysis:** Each selected criterion was ranked and scored from 1 (lowest value) to 5 (highest value). Then the seven criteria were combined and reclassified with scores ranging from 1 (low value) to 5 (high value).

<table>
<thead>
<tr>
<th>Original Value</th>
<th>New Grouping Value</th>
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</thead>
<tbody>
<tr>
<td>2 to 5</td>
<td>1</td>
</tr>
<tr>
<td>5 to 10</td>
<td>2</td>
</tr>
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<td>10 to 15</td>
<td>3</td>
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<td>15 to 20</td>
<td>4</td>
</tr>
<tr>
<td>20 to 25</td>
<td>5</td>
</tr>
</tbody>
</table>

Results of the final calculation for the Natural Resource Model are as follows:

<table>
<thead>
<tr>
<th>Natural Resource Score</th>
<th>Acreage</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>17,048</td>
<td>6.12%</td>
</tr>
<tr>
<td>2</td>
<td>111,596</td>
<td>40.08%</td>
</tr>
<tr>
<td>3</td>
<td>114,626</td>
<td>41.17%</td>
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<tr>
<td>4</td>
<td>33,278</td>
<td>11.95%</td>
</tr>
<tr>
<td>5</td>
<td>1,906</td>
<td>0.68%</td>
</tr>
</tbody>
</table>

**Observations**

The area with the highest Natural Resource Score is located in Tewksbury Township. This area ranks high in ground water recharge, significant forest cover, and significant habitat for rare plant species. The Natural Heritage Priority Site located in East Amwell and southern Raritan Township is easily identifiable in the final Natural Resource analysis.
### Natural Resource Assessment Model

#### Total Acres by Municipality

**August 20, 2003**

<table>
<thead>
<tr>
<th>MUNICIPALITY</th>
<th>Value 1</th>
<th>Value 2</th>
<th>Value 3</th>
<th>Value 4</th>
<th>Value 5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LOW</td>
<td>MODERATE</td>
<td>HIGH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALEXANDRIA TWP</td>
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<td>11,238.16</td>
<td>502.59</td>
<td>0.00</td>
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<td>3,409.22</td>
<td>6,347.47</td>
<td>3,131.31</td>
<td>12.53</td>
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<tr>
<td>BLOOMSBURY BORO</td>
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<td>157.87</td>
<td>102.44</td>
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<td>CALIFON BORO</td>
<td>31.48</td>
<td>303.25</td>
<td>150.49</td>
<td>143.76</td>
<td>2.61</td>
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<tr>
<td>CLINTON TOWN</td>
<td>90.32</td>
<td>662.88</td>
<td>166.46</td>
<td>2.20</td>
<td>0.00</td>
</tr>
<tr>
<td>CLINTON TWP</td>
<td>4,153.61</td>
<td>8,507.00</td>
<td>6,750.38</td>
<td>2,281.32</td>
<td>2.02</td>
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<td>12,883.53</td>
<td>9,159.82</td>
<td>929.77</td>
<td>37.58</td>
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<tr>
<td>EAST AMWELL TWP</td>
<td>39.23</td>
<td>1,440.15</td>
<td>11,225.42</td>
<td>4,854.88</td>
<td>701.52</td>
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<td>FLEMINGTON BORO</td>
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<td>GLEN GARDNER BORO</td>
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<td>229.86</td>
<td>272.69</td>
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<td>458.07</td>
<td>324.08</td>
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<td>HIGH BRIDGE BORO</td>
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<td>HOLLAND TWP</td>
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<td>5,982.37</td>
<td>8,312.65</td>
<td>287.31</td>
<td>9.11</td>
</tr>
<tr>
<td>KINGWOOD TWP</td>
<td>839.89</td>
<td>11,072.21</td>
<td>9,787.11</td>
<td>713.13</td>
<td>48.74</td>
</tr>
<tr>
<td>LAMBERTVILLE CITY</td>
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<td>442.98</td>
<td>196.25</td>
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<td>4.63</td>
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<tr>
<td>LEBANON BORO</td>
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<td>432.76</td>
<td>108.72</td>
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<tr>
<td>LEBANON TWP</td>
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<td>5,060.17</td>
<td>4,892.64</td>
<td>9,407.75</td>
<td>56.90</td>
</tr>
<tr>
<td>MILFORD BORO</td>
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<td>291.79</td>
<td>11.46</td>
<td>0.00</td>
</tr>
<tr>
<td>RARITAN TWP</td>
<td>1,250.95</td>
<td>10,507.81</td>
<td>10,636.33</td>
<td>1,603.31</td>
<td>55.17</td>
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<tr>
<td>READINGTON TWP</td>
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<td>16,332.34</td>
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<tr>
<td>STOCKTON BORO</td>
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<td>181.78</td>
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<td>13.70</td>
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<tr>
<td>TEWKSURY TWP</td>
<td>720.40</td>
<td>5,409.26</td>
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<td>4,585.45</td>
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<tr>
<td>UNION TWP</td>
<td>1,716.58</td>
<td>4,778.59</td>
<td>4,953.50</td>
<td>1,677.17</td>
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<tr>
<td>WEST AMWELL TWP</td>
<td>717.21</td>
<td>7,600.40</td>
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<td>629.79</td>
<td>19.94</td>
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<td>COUNTY TOTALS</td>
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<td>111,595.63</td>
<td>114,625.93</td>
<td>33,278.27</td>
<td>1,905.79</td>
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<tr>
<td>TOTAL PERCENTAGES</td>
<td>6.12%</td>
<td>40.08%</td>
<td>41.17%</td>
<td>11.95%</td>
<td>0.68%</td>
</tr>
<tr>
<td>TOTAL COUNTY ACRES</td>
<td>278,453.15</td>
<td></td>
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<td></td>
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</tbody>
</table>
Natural Resource Assessment
Inherently Valuable
Hunterdon County, New Jersey

Data Layers: Aquifer Yield, Critical Habitat, Natural Heritage Priority Sites, Ground Water Recharge, Riparian Health Assessment, Non-Riparian Wetlands, and Forested Areas
The Vulnerability Assessment Model is designed to identify areas based on development constraints. The highest development constraint received the highest vulnerability score of 5. The Vulnerability Assessment Model includes:

**NJGS Ground Water Recharge Methodology**, New Jersey Geological Survey, Geological Survey Report GSR-32, A Method for Evaluating Ground-Water-Recharge Areas in New Jersey. 1993. This data layer uses local climate factors, local soil survey data, and NJDEP Land Use/Land Cover to rank ground water recharge in inches per year; Ground Water Recharge is defined by the NJGS as the water that percolates below the root zone of the plants. It can then travel laterally and become surface water or travel vertically into the aquifer and become part of the aquifer yield. Both are components of the ground water system for purposes of generating the ground water recharge GIS data layer. Note that mapped results can be significantly different if one only considers water that enters the aquifer.

This is the same data used in the Natural Resource Assessment Model, but the data was reclassified to assign the highest constraint score of 5 to the lowest groundwater recharge areas. This assumes that any development in these areas would further reduce existing low recharge conditions.

**Aquifer Yield**, Aquifers of New Jersey, New Jersey Geological Survey Digital Geodata Series DGS98-5, May 1998, revised April 1999. This data layer describes the potential for aquifers to yield ground water to high-capacity wells. It estimates aquifer yield based on geology and the underlying aquifer description and confining units. Aquifer Yield is based on 8,000 industrial, non-domestic wells. These high-capacity wells are tested for maximum water yields that often exceed domestic-well yields for the same aquifer; however, for the purposes of this model, the data remains relevant to water resources.

This is the same data used in the Natural Resource Assessment Model, but the data was reclassified to assign the highest constraint score of 5 to the lowest aquifer yield areas. This assumes that any development in these areas would further reduce existing low aquifer yields.

**Steep Slopes** were created by the Hunterdon County Planning Department using the 30 meter USGS Digital Elevation Models (DEMs). Steep slopes of greater than 25% present the highest development constraint and were assigned the highest score of 5. Many municipalities within Hunterdon County have adopted Steep Slope ordinances that restrict development in these areas. The Highlands physiographic province and the area adjacent to the Delaware River contain the most concentrated areas of steep slopes.

**Soil Erodibility**, U.S. Department of Agriculture, Natural Resources Conservation Service, Soil Survey Geographic (SSURGO) for Hunterdon County, January 19980323. According to the Soil Survey, potential erodibility is based on the soil loss tolerance established for the soil, rainfall and a runoff factor, susceptibility of the soil to water erosion, and combined effects of slope length and steepness. Highly Erodible land requires supplemental measures to ensure stability of the soil and was given the highest constraint score of 5.


These three data layers were combined to avoid duplicate counting. Areas identified as Wetlands, located within the 100-Year Flood Zone, or containing Hydric Soils were recognized as development constraints and received a score of 5.

Well Head Protection Areas were considered for inclusion in the Vulnerability Model, but were ultimately left out. Data revealed that this dataset skewed areas of importance to more urban areas where public wells tend to exist. This dataset could be used when reviewing areas where public water supply wells exist.

**Vulnerability Assessment Final Analysis:** Each selected criterion was ranked and scored from 1 (lowest value) to 5 (highest value). Then the five criteria were combined and reclassified with scores ranging from 1 (low value) to 5 (high value).

<table>
<thead>
<tr>
<th>Original Value</th>
<th>New Grouping Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 to 7</td>
<td>1</td>
</tr>
<tr>
<td>7 to 12</td>
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</tr>
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<td>12 to 17</td>
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<tr>
<td>17 to 22</td>
<td>4</td>
</tr>
<tr>
<td>22 to 27</td>
<td>5</td>
</tr>
</tbody>
</table>

Results of the final calculation for the Vulnerability Assessment Model are as follows:

<table>
<thead>
<tr>
<th>Vulnerability Score</th>
<th>Acreage</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>913</td>
<td>0.33%</td>
</tr>
<tr>
<td>2</td>
<td>130,683</td>
<td>47.23%</td>
</tr>
<tr>
<td>3</td>
<td>113,912</td>
<td>41.17%</td>
</tr>
<tr>
<td>4</td>
<td>30,783</td>
<td>11.12%</td>
</tr>
<tr>
<td>5</td>
<td>425</td>
<td>0.15%</td>
</tr>
</tbody>
</table>

**Observations**

The Highlands and the Sourland Mountain contain the areas of highest development constraint. The Croton Plateau, a broad plateau extending from the Delaware River through the center of the Piedmont region of Hunterdon County, also contains areas of highest development constraint. Steep Slopes, Erodible Soils, and Wetlands contribute to the high scores.
Table of final municipal calculations for the Vulnerability Assessment Model

## Vulnerability Assessment Model

### Total Acres by Municipality

**August 20, 2003**

<table>
<thead>
<tr>
<th>MUNICIPALITY</th>
<th>Value 1</th>
<th>Value 2</th>
<th>Value 3</th>
<th>Value 4</th>
<th>Value 5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LOW</strong></td>
<td><strong>MODERATE</strong></td>
<td><strong>HIGH</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALEXANDRIA TWP</td>
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<td>10,230.63</td>
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<td>495.43</td>
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<td>1.03</td>
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<td>CALIFON BORO</td>
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<td>261.67</td>
<td>63.76</td>
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<td>CLINTON BORO</td>
<td>7.97</td>
<td>496.79</td>
<td>344.72</td>
<td>64.46</td>
<td>0.37</td>
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<td>3.27</td>
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<td>GLEN GARDNER BORO</td>
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<td>HIGH BRIDGE BORO</td>
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<td>967.46</td>
<td>181.30</td>
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<td><strong>TOTAL PERCENTAGES</strong></td>
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<td><strong>TOTAL COUNTY ACRES</strong></td>
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</table>
Vulnerability Assessment
Development Constraints

Data Layers: Aquifer Recharge, Ground Water Recharge, Soil Erodibility, Steep Slopes, Wetlands (Includes Wetlands, Hydric Soils, 100-Year Flood Zones)
Benefits of the Natural Resource and Vulnerability Models

The Environmental Assessment Models were developed for use as an analytical tool for regional and municipal land planning. As an educational tool these models help others to understand the breadth and diversity of natural resources in Hunterdon County. The results do not preclude development; the intent is to highlight areas where natural resources should be included in the review process.

As a preservation tool these models can help to identify where the most important natural resources are located within a municipality. This information can then be used to assist in prioritizing municipal lands for future acquisition and preservation.

As a planning tool these models can provide information useful for master plan updates. However, there are many other important environmental factors and analysis to consider when making planning decision, such as nitrate dilution, septic suitability, well-head protection, etc. These data layers can each be reviewed on their own merit or as additional layers of data within the models.

The utility of these models is in the transparent nature of the data layers. Each layer can be viewed independently and as such, can be used alone, modified, or used in concert with any number of data sets for additional analysis. Municipalities with GIS capabilities can customize these models by weighing different data layers or, where more detailed local data exists, substituting local data to reflect local concerns.
Bibliography


**GIS DATA LAYERS**

**Natural Resource Assessment**

*Non-Riparian Wetlands*, NJDEP 1995/97 Land Use/Land Cover
*Natural Heritage Priority Sites*, NJDEP, New Jersey Office of Natural Lands Management (ONLM), 1999.
*Forested Areas*, 1995/97 NJDEP Land Use/Land Cover

**Vulnerability Assessment**

*Aquifers of New Jersey*, NJGS, DGS98-5
Hunterdon County Ground Water Recharge, *NJGS, GSR-32*
*Steep Slopes*, Hunterdon County Division of GIS, 2000. Created by the Hunterdon County Planning Board using the USGS Digital Elevation Models (30 meter DEMs).
*Wetlands*, NJDEP 1995/97 Land Use/Land Cover