# Using GIS to Implement Smart Growth in New Jersey

## The Rules and a Tool: Perfect Together

**Lawrence L. Thornton, Manager, NJDEP, OIRM, BGIS**
**John M. Tyrawski, Research Scientist, NJDEP, OIRM, BGIS**

The state of New Jersey has been moving towards establishing a statewide framework for Smart Growth through implementation of comprehensive growth management plans. The New Jersey Department of Environmental Protection (NJDEP) is contributing to the framework by classifying the state into regions reflecting environmentally sensitivity. Using GIS and detailed digital environmental data, the NJDEP Bureau of GIS will create an i-Map internet application using ArcIMS that can be used as a tool that reflects the NJDEP environmental rules and graphically illustrates an Environmental Framework for Smart Growth.

## Introduction

New Jersey is the most densely populated state in the nation. Situated between New York City and Philadelphia, New Jersey is the quintessential bedroom community that supports both cities and provides housing, shopping, recreation, and vacation opportunities for its 8,395,357 million residents (Census Bureau, 2002 estimate). But New Jersey is running out of developable lands, running out of the resources that have made the geography of New Jersey critical to the tri-state region.

Using New Jersey Department of Environmental Protection (NJDEP) detailed digital land-use/land-cover data sets, it has been estimated that New Jersey may run out of developable land sometime shortly after mid-century! The goal for NJDEP is to determine how to best encourage new development in appropriate growth areas and discourage development in environmentally sensitive areas.

This paper represents a scenario that the Bureau of GIS has been working on as a straw-man to stimulate discussion within the NJDEP. It suggests ways in which NJDEP's GIS data, and an ArcIMS template, i-MapNJ, could help in communicating the spatial aspects of Smart Growth principles.

## Developable Uplands May Be Endangered

New Jersey is the country's third smallest state with only about 5 million acres. As of 1986, 24% was urban/suburban, 21% wetland, 33% forest, 15% agriculture and 1% barren, with the remaining percentage open waters. By 1995, New Jersey had lost another 1% of agricultural lands, and 2% of forests, and gained 3% in urban/suburban lands. This may not sound alarming, but when freshwater wetlands, coastal wetlands, dedicated openspace, steep slopes and barren land are subtracted out, only non-dedicated agricultural lands and forests remain. These lands represent prime targets for development.

Between 1986 and 1995, the state lost almost 6% of available agricultural and forest lands, over 124,000 acres (Thornton et. al, 2001). By 2003, it is estimated that over 11% of all forests and agriculture had been converted to urban or other pre-development classes since 1986. After deducting lands already preserved as open space, the figure is closer to 20% of all forest and agriculture (not already developed or held in trust). Factoring in competing uses, particularly the acquisition of additional dedicated openspace, Hasse and Lathrop (2001) (using the same NJDEP GIS data), estimated that

the remaining available land would be developed in 40 years if current trends persist! Clearly the prime lands for development may soon be exhausted in New Jersey.

Developable forest and agricultural lands have been decreasing at a steady rate over the last 16 years. The ***daily change in acreage loss*** in agricultural and forests lands to urban and barren lands is as follows:

| | **Forest Loss/Day** | **Agriculture Loss/Day** | **Urban Gain Per Day** |
|---|---|---|---|
| 1986-1995 | -23.6 acres | -20.5 acres | +41.3 acres |
| 1995-2000 | -26.3 acres | -14.2 acres | +40.1 acres |

Table 1; Statewide average daily losses of agriculture and forest lands to urban and barren lands during the periods 1986 to 2000; and the average daily gain in urban lands. (Hasse and Lathrop, 2001; NJDEP, 2004; Lathrop, 2004).

These statistics have not gone unnoticed by the public. Former Governor Whitman initiated a legacy program in 1998 to preserve an additional 1 million acres of dedicated open space over the next decade--about one-half of all remaining uplands at the time. By 2001, an additional 165,000 acres had been acquired. In recent years, over 90% of all municipal and county referenda to increase property taxes to purchase dedicated open space have passed in New Jersey (Hughes and Seneca, 2004).

These well-publicized figures (Philadelphia Inquirer, 2003; Newark, NJ, Star Ledger, 2004) reflect the political outcry against sprawling development that has become common in New Jersey. Current Governor McGreevy has made Smart Growth a priority for his administration (Executive Order #4, 2002). The NJDEP has maintained an Anti-Sprawl website for the past 1.5 years. The NJ Department of Community Affairs (NJDCA) has begun a new effort to update the State Plan Policy Map to incorporate the concepts of Smart Growth.

## What is Smart Growth?

According to the NJDCA, Smart Growth is defined as:

> **"…..well-planned, well-managed growth that adds new homes and creates new jobs, while preserving open space, farmland, and environmental resources. Smart Growth supports livable neighborhoods with a variety of housing types, price ranges and multi-modal forms of transportation. Smart Growth is an approach to land-use planning that targets the State's resources and funding in ways that enhance the quality of life for residents in New Jersey."**

The NJDEP is considering a bold step to rewrite environmental regulations to support Smart Growth in New Jersey and to create a mapping tool to support those regulations. In addition, NJDEP is assisting the Smart Growth effort (by supporting the NJDCA) in preserving open space and environmental resources. The NJDEP contributed 10 strategic environmental layers as input for the State Development/Redevelopment Plan proposal to the counties and municipalities for Cross-Acceptance. "Cross-acceptance is a bottom-up approach to planning, designed to encourage consistency between municipal, county, regional, and state plans to create a meaningful, up-to-date and viable State Plan," as defined by NJDCA. NJDEP posted these 10 layers on the NJDEP website under Data Downloads, Cross-Acceptance.

The NJDEP regulates large portions of New Jersey through a variety of legislative mandates including, but not limited to:

The Coastal Area Facilities Review Act (CAFRA), N.J.S.A. 13:19-4
Surface Water Quality Standards, Category One Waters, N.J.A.C. 7:9B-1.15(c) through (h)
Stormwater Management Rules, N.J.A.C. 7:8
Water Quality Management Plan, N.J.A.C. 7:15
Non Sewer Service Areas, as defined in N.J.A.C. 7:1M-1.5.
The Freshwater Wetlands Protection Act, N.J.S.A. 13:9B
Wetlands Act of 1970 (Coastal Wetlands), N.J.S.A. 13:9A
Flood Hazard Area Control Act, N.J.S.A. 58:16A

There exist three Special Concern management areas in New Jersey with environmental and growth plans protected under the law, and an existing state-wide planning map:

The Pinelands (The Pinelands Protection Act, N.J.S.A. 13:18-1 et seq; (927,000 acres)
The New Jersey Meadowlands (the Hackensack Meadowlands Reclamation and Development Act, N.J.S.A. 13:17. (19,500 acres)
The Highlands Protection Area and Plan, N.J.S.A. 13: (795,000 acres), and:

The State Development Redevelopment Plan; (statewide)

Given these Special Concern environmental and growth plans, and the NJDEP's regulatory authority, the NJDEP *could* recast the environmental mandates into an organized Smart Growth model that would support the concept of conservation and preservation of environmental resources. At the same time, the model *could* encourage development in specified growth areas. The Bureau of GIS within NJDEP *could* assist in spatially delineating where these environmental and growth areas occur, by developing an internet mapping application that supports the Smart Growth regulations.

## Smart Growth Model Development

In order to address the issue of an organized model to support Smart Growth, the NJDEP must consider those authorized plans that already exist for Special Concern areas in New Jersey. While each of these planning maps was developed for different purposes and to different standards, they are all similar in that they identify both areas that are environmentally significant where development should be restricted, and areas that have less critical environmental resources where growth should be accommodated. The NJDEP must determine how it will define environmentally sensitive areas, and how sensitive areas that the NJDEP identifies fit within the context of the existing planning maps.

Since the planning maps created for each Special Concern area and for the State Development and Redevelopment Plan have a wide variety of planning area designations, the first step in creating the model would be to consolidate the many specific planning area types into several more general regulatory regions. Three regions are envisioned:

- Environmentally Sensitive
- Transition
- Growth

Areas within the Environmentally Sensitive Region have a preponderance of critical environmental factors, such as wetlands and endangered and threatened species habitats. Those within the Transition Region have both distinct environmentally critical factors and development potential. Environmental protection initiatives may be less clearly defined in the Transition Region than in the Environmentally Sensitive Region. All planning areas not identified as Environmentally Sensitive or Transition would be considered part of the Growth Region. While the Growth Region may still have some environmentally significant portions that are worthy of regulatory protection, in general, areas within the Growth Region would accommodate additional development with the least environmental impact. These are the areas in which growth should be encouraged.

Since the three planning groups have done a significant amount of analysis in identifying their environmentally significant areas, the NJDEP recognizes these areas as environmentally significant for the purposes of its regulatory initiatives and model. The environmental areas mapped by each planning group will be extracted from each of the four planning maps and incorporated into the new Smart Growth model directly as mapped.

However, while many important environmentally significant areas of the state are included within the existing environmental planning areas, it is the position of the NJDEP that there are additional areas outside the environmental planning area boundaries and across the remainder of the state that have critical environmental factors that could be and

should be protected. The NJDEP, therefore, should undertake its own analysis to identify these areas.

An important part of the analysis is to first identify those factors that the NJDEP would use to define critical environmentally sensitive areas. Over the past 20 years, the NJDEP has been creating detailed GIS reference and program specific GIS digital data. Numerous environmental data sets qualify for use in the model, with emphasis placed on such criteria as the environmental sensitivity of the data, the quality of the data, how successfully these data could be combined with other critical data sets, and their relevance to the statutory authority of the NJDEP. By combining and modeling this GIS data, the NJDEP could uncover what the preponderance of data reveals in terms of classifying areas as environmentally sensitive and worthy of protection.

Based on input from many NJDEP programs, the most important data sets to be used in the identification of the critical environmentally sensitive areas would most probably be:

1. **Endangered Species Habitat (Landscape Project)**
2. **Wetlands**
3. **Natural Heritage Program Priority Sites**
4. **Dedicated Open Space**
5. **Beaches**
6. **Reservoir Drainage**
7. **Flood prone Areas**
8. **Groundwater Recharge Areas**
9. **Sewer Service Areas**
10. **Category 1 Waters**
11. **Developed Areas**
12. **Impervious Cover**
13. **Water**
14. **CAFRA Zone**
15. **Steep Slopes**

Once the initial region designation of every planning area is determined, each of the environmental data sets identified for the NJDEP data analysis would be examined in relation to these initial region designations. The intent of this examination is twofold. First, the examination would be used to define rules directing which NJDEP environmental data and model rules could be used in each Special Concern area plan. Second, it will help determine if the underlying initial area designation of any portion of a Growth or Transition Region planning area should be changed to Environmentally Sensitive based on the presence of critical NJDEP environmental factors. Where significant environmental factors exist, the model could change the underlying region designation to a more environmentally significant one, based on which NJDEP factors are present.

Detailed review of the model by NJDEP data stewards, policy makers and Governor's and Commissioner's Offices would be followed by solicited comment from other state agencies. Final review from the citizens of the state takes place once the regulations are published in the New Jersey Register. Citizens are given 60days to submit comment and all comments are addressed. Public meetings are also prescribed.

## The Role of Interactive Mapping

Given the importance and scope of the new smart growth initiatives and regulations, it is imperative that everyone has the ability to view and query the data and the model output as the process develops. To assist in this, NJDEP will post an interactive mapping application using the NJDEP ArcIMS template, i-MapNJ. i-MapNJ offers a standard tool for "profiles" of NJDEP data. On the intranet, profiles include i-MapNJs for Historic Preservation, Site Remediation, Geology (the NJ Geologic Survey), and watersheds (the Division of Science, Research and Technology. Each profile contains the programs' choice of data layers, tools and queries, prototyped for that particular program. All profiles maintain the same user interface template.

On the Internet, the i-MapNJ profiles include i-MapNJ DEP, with 40 of the NJDEP's "greatest hits" of environmental data including 2002 digital imagery; and i-MapNJ NJEMS which links program data from the NJ Environmental Management System (the enterprise Oracle database) to GIS. A new profile, i-MapNJ Smart Growth, will be created.

The processed Smart Growth data classifying the state into ESA, Transition and Growth areas will be served as an i-MapNJ ArcIMS profile (tool) for the citizens, regulated community and public agencies. This tool will be used as a guide to show where the NJDEP will enforce fully the regulatory authorities through the Smart Growth rules and where the NJDEP has little or no interest based on the same statutory authority. The goal is to encourage new development in growth areas and to discourage growth in environmentally sensitive areas. Incentives by the NJDEP and other regulatory agencies as the NJDCA and the Bureau of Public Utilities, the NJ Department of Transportation would encourage the same model through their respective statutory powers. The Governor's Office could establish new incentives through legislation and or through executive orders or powers.

## i-MapNJ, the NJDEP ArcIMS Template

An i-MapNJ Smart Growth application would be accessed from a splash page on the web. The splash page for the i-MapNJ Smart Growth provides a basic introduction to the application, useful links, and a tutorial. Upon launching the application the user should see the i-MapNJ Smart Growth user interface.

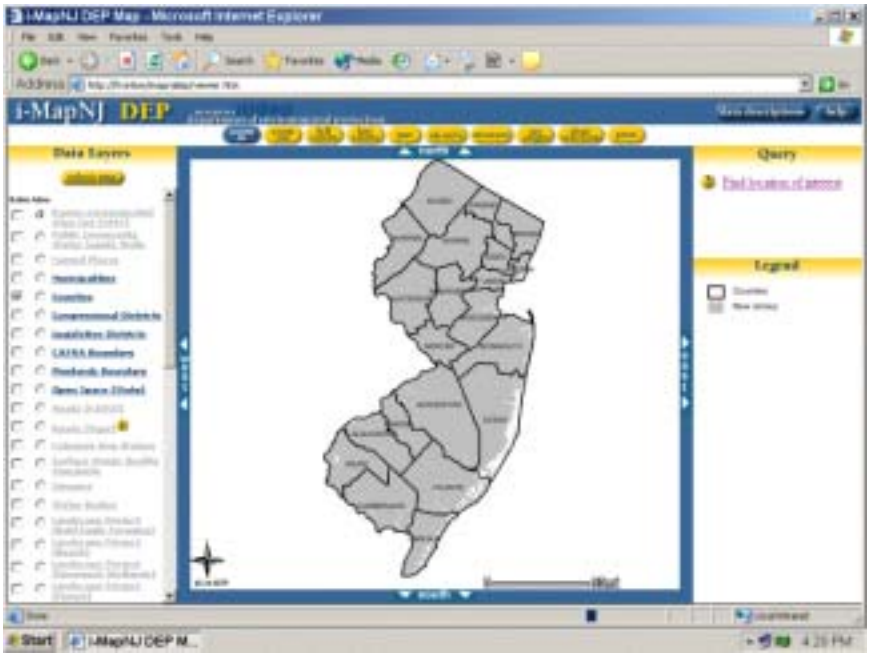


*Figure 1-1*. NJDEP's *i-MapNJ application generic user interface.*

The user interface consists of the Map View Frame in the center, the Map Tool Buttons above the Map View Frame, the Data Layers List that lists the data layers to the left of the Map View Frame, and the Query and the Legend Frames to the right of the Map View Frame. Query results are displayed in a popup box.

The Map View Frame contains the view where the map graphics will be rendered. These include the visible GIS data layers, the scale bar, and the north arrow. The application displays any combination of GIS data layers in Map View Frame at a user chosen location and displays the results of the query "Find location of interest" by the user.

The Data Layers list is along the left side of the Map View Frame. There would be approximately 30-35 GIS data layers including the Environmentally Sensitive, Transition and Growth Regions, available for viewing in this i-MapNJ application. The layers will include all the data used in the model as well as the best of the GIS reference data available.

Data layers can be made "visible" in the Map View Frame by checking their respective checkboxes in the Data Layers List and clicking on the **refresh map** button refresh map, found at the top of the Data Layers List. Users may turn on as many data layers as they wish, however the map can become difficult to read if too many are visible at the same time. Data descriptions for each layer may be accessed by clicking on the data layer's name or on the "data description" button data descriptions. Access to a link to the FGDC compliant metadata is at the end of each description.

As a user zooms into a smaller and smaller area, the highlighted (available) layers and the grayed out (unavailable) layers will change. As the user zooms in and out these relationships change and hence the layers available for view and query change. Generally, as the user zooms in, more layers are available as in Figure 1-2. The

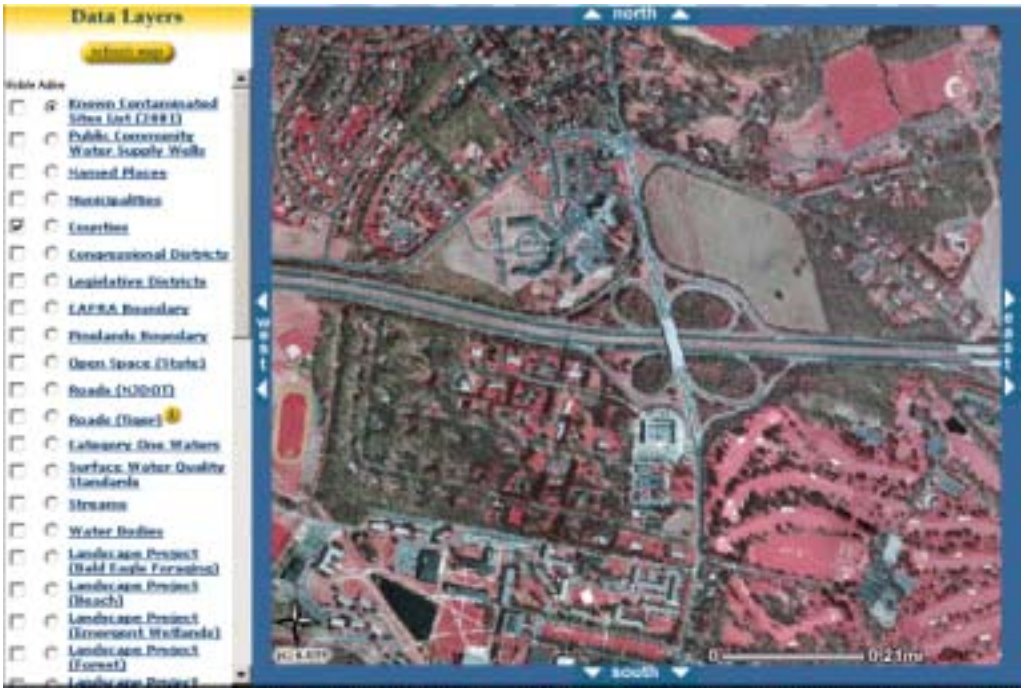


*Figure 1-2. Several layers, such as the Aerial Photos 2002 layer, are only available at larger map scales (i.e., when zoomed to a smaller area).*

Map Tools Toolbar, above the Map View Frame allows users to perform some basic but useful GIS analysis Zoom In and Out, Pan, Identify, Measure, Set Origin, and Print.

The Query Frame has two or more query or question to the right of the Map View Frame. The Query gives the user a quick start to answering finding an area in the state to zoom into quickly. When the user clicks on, "Find location of interest," a frame pops up with four choices, Address, Coordinates, County, and Municipality. To make a choice click the appropriate radio button and proceed. The second query would show the polygons of ESA, Transition and Growth.

ArcIMS and the i-MapNJ profile template is a perfect match for displaying Smart Growth spatial information. Access to the application from the NJDEP webpage through the users' browser will put this easy-to-use application in the hands of the developers, public and agencies that need the information.

## Conclusions

New Jersey faces difficult decisions regarding the fate of the remaining undeveloped uplands. The pace of development has remained steady since first measured spatially in 1986, and the competition for these lands, composed primarily of forests and agricultural lands is intense (Lathrop, 2004). Scientists have estimated that at current development rates and patterns, the state may reach build out within 30 to 50 years (Chambers 2004).

The NJDEP regulates large areas of the state and could assist the goals of Smart Growth by implementing environmental regulations to focus on the goals of protecting environmentally sensitive areas and encouraging growth in developed and marginal (transition) areas. Some incentives for redevelopment already exist.

ArcIMS offers the NJDEP an alternative for communicating Smart Growth goals to the public and regulated community through interactive mapping, without the need of GIS expertise and expensive software. The i-MapNJ series of ArcIMS applications is the NJDEP's template for communicating spatial concepts and detailed data to Internet users.

The NJDEP is currently studying ways i-MapNJ can deliver a Smart Growth spatial tool, delineating Growth, Transition and Environmentally Sensitive regions to help keep the "Garden" in New Jersey, the Garden State.

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## Appendixes

For information about this topic and other GIS activities, go to:

http://www.nj.gov/dep/gis/

## End Notes

On Thursday June 19th, 2004, the New Jersey Legislature passed a law pertaining advancing development /redevelopment to specified Growth areas in New Jersey:

> **"AN ACT concerning implementation of the State Development and Redevelopment Plan, establishing a Smart Growth Ombudsman in the Department of Community Affairs, establishing a Division of Smart Growth in the Department of Environmental Protection, a Division of Smart Growth in the Department of Transportation, and a Division of Smart Growth in the Department of Community Affairs, providing for the expediting of certain State permits in smart growth areas……."**

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## Author Information


Lawrence L. Thornton, Manager, New Jersey Department of Environmental Protection, Office of Information Resources Management, Bureau of Geographic Information Systems, P.O. Box 425, Trenton, New Jersey, 08625. (609) 633-8144 (w),

(609) 292-7900 (FAX), Lawrence.Thornton@dep.state.nj.us

John M. Tyrawski, Research Scientist 1, New Jersey Department of Environmental Protection, Office of Information Resources Management, Bureau of Geographic Information Systems, P.O. Box 425, Trenton, New Jersey, 08625. (609) 777-0151, (609) 292-7900 (FAX). John.Tyrawski@dep.state.nj.us