

**DRAFT – FOR CONSIDERATION AT THE APRIL 27, 2006  
MEETING OF NATURAL RESOURCES COMMITTEE  
OF THE HIGHLANDS COUNCIL**

**RMP Component:** Resource Assessment / Ecosystem Assessment  
**Technical Report:** Highlands Open Water Protection  
**Council Committee:** Natural Resource Committee  
**Memorandum Title:** Technical Approach to Landscape Level  
Inventory and Mapping  
**Date:** April 25, 2006

## **1. INTRODUCTION**

The accurate delineation of surface waters and wetlands, which collectively comprise Highlands open waters is of great importance in order to effectively manage the Highlands Region’s critical natural resources. This technical memorandum identifies the methods and data used to inventory and map Highlands open waters and explains the basis of the surface water and wetland regulatory constraints baseline map.

The Highlands Water Protection and Planning Act (“Highlands Act”, N.J.S.A. 13:20-1 et seq.) includes goals for the development of the Regional Master Plan (“RMP”) with respect to Highlands open water as follows:

Section 10. a. The goal of the regional master plan with respect to the entire Highlands Region shall be to **protect and enhance the significant values of the resources thereof** in a manner which is consistent with the purposes and provisions of this act.

b. The goals of the regional master plan with respect to the preservation area shall be to:

(1) **protect, restore, and enhance the quality and quantity of surface and ground waters therein;**

... (3) **protect the natural, scenic, and other resources of the Highlands Region**, including but not limited to contiguous forests, **wetlands, vegetated stream corridors**, steep slopes, and critical habitat for fauna and flora;

c. The goals of the regional master plan with respect to the planning area shall be to:

(1) **protect, restore, and enhance the quality and quantity of surface and ground waters therein;**... (Emphasis added)

11. a. The regional master plan shall include, but need not necessarily be limited to:

(1) A resource assessment which:

(a) determines the amount and type of human development and activity which the ecosystem of the Highlands Region can sustain while still maintaining the overall ecological values thereof, with special reference to **surface and ground water quality and supply**; contiguous forests and woodlands; endangered and threatened animals, plants, and biotic communities; ecological factors relating to the protection and enhancement of agricultural or horticultural production or activity; air quality; and other appropriate considerations affecting the ecological integrity of the Highlands Region; (Emphasis added)

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12. In addition to the contents of the regional master plan described in section 11 of this act, the plan shall also include, with respect to the preservation area, a land use capability map and a comprehensive statement of policies for planning and managing the development and use of land in the preservation area, which shall be based upon, comply with, and implement the environmental standards adopted by the Department of Environmental Protection pursuant to sections 33 and 34 of this act<sup>1</sup>, and the resource assessment prepared pursuant to paragraph (1) of subsection a. of section 11 of this act.

These policies shall include provision for implementing the regional master plan by the State and local government units in the preservation area in a manner that will ensure the continued, uniform, and consistent protection of the Highlands Region in accordance with the goals, purposes, policies, and provisions of this act, and shall include:

a. a preservation zone element that identifies zones within the preservation area where development shall not occur in order to protect water resources and environmentally sensitive lands and which shall be permanently preserved through use of a variety of tools, including but not limited to land acquisition and the transfer of development rights; ...

The Highlands Act defines Highlands open waters as “*all springs, streams including intermittent streams, wetlands and bodies of surface water, whether natural or artificial, located wholly or partially within the boundaries of the Highlands Region, but shall not mean swimming pools.*” As a result of the passage of the Highlands Act and the New Jersey Department of Environmental Protection’s Highlands Water Protection and Planning Act Rules at N.J.A.C. 7:38 (“Highlands Rules”), Highlands open waters are required to be categorized, mapped, or regulated as a discrete resource. Highlands open waters contain both a wetland and surface water component, as follow:

With the exception of swimming pools, the surface water component of Highlands open waters includes all springs, streams including intermittent streams, and bodies of surface water, whether natural or artificial, located wholly or partially within the boundaries of the Highlands Region. The wetland component of Highlands open waters is based upon the definition of freshwater wetlands according to the Freshwater Wetlands Protection Act (N.J.S.A. 13:9B-3) and implementing rules at N.J.A.C. 7:7A. The Freshwater Wetlands Protection Act rules at N.J.A.C. 7:7A-1.4 includes the following definition for freshwater wetlands:

"Freshwater wetland" or "wetland" means an area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation; provided, however, that the Department, in designating a wetland, shall

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<sup>1</sup> The requirement in Section 12 requiring the Council to address NJDEP standards in the Preservation Area trigger various provisions including the 300 foot buffer and antidegradation requirements discuss at the end of this memorandum.

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use the three-parameter approach (that is, hydrology, soils and vegetation) enumerated in the 1989 Federal Manual as defined in this section. These include tidally influenced wetlands which have not been included on a promulgated map pursuant to the Wetlands Act of 1970, N.J.S.A. 13:9A-1 et seq.

## **2. MAPPING METHODOLOGY**

Four datasets will be used to derive Highlands open waters. These datasets include: NJDEP 2002 Hydrography Draft (HYDRO), NJDEP 2002 Land Use/Land Cover (LU/LC), NJDEP Vernal Pool Coverage and Supplemental Headwater Stream Delineation. Each coverage is briefly described below.

### **o NJDEP 2002 Hydrography Draft (HYDRO)**

The 2002 Streams Update is being created by heads-up digitizing of hydrography features from the 2002 color infrared (CIR) imagery. It is being completed in conjunction with the Land Use / Land Cover update for 2002. The polygonal water body delineation line work is derived from the land use update. The same water polygons were merged into the linear streams 2002 layer. Minimum mapping unit (MMU) is 1 acre for polygonal water features.

*Citation\_Information:*

*Originator:* New Jersey Department of Environmental Protection (NJDEP), Office of Information Resources Management (OIRM), Bureau of Geographic Information Systems (BGIS)

*Publication\_Date:* 200510

*Title:* NJDEP 2002 Streams Update for New Jersey (DRAFTS)

*Edition:* (DRAFT)

*Geospatial\_Data\_Presentation\_Form:* vector digital data

*Publication\_Place:* Trenton, NJ

*Publisher:* NJDEP

*Other\_Citation\_Details:* NJDEP 2002 Streams Update for New Jersey (DRAFTS)

*Online\_Linkage:*

<http://www.state.nj.us/dep/gis/digidownload/zips/hydro02.zip>

### **o NJDEP 2002 Land Use/Land Cover (LU/LC)**

The 2002 Land Use Land Cover dataset is the third iteration conducted by the NJDEP to capture the state of the land use and natural land cover statewide in a digital GIS file. As with both previous layers, the 2002 data were produced by visually interpreting color infrared photography.

*Citation\_Information:*

*Originator:* New Jersey Department of Environmental Protection (NJDEP), Office of Information Resources Management (OIRM), Bureau of Geographic Information Systems (BGIS)

*Publication\_Date:* 20060310

*Title:* NJDEP 2002 Land use/Land cover Update (DRAFT)

*Edition:* DRAFT/FINAL

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*Geospatial\_Data\_Presentation\_Form*: vector digital data

*Publication\_Place*: Trenton, NJ

*Publisher*: NJDEP

*Online\_Linkage*:

<http://www.state.nj.us/dep/gis/digidownload/zips/lulc02.zip>

***Streams***

Streams were taken as is from the 2002 HYDRO coverage, however due to the coverage's draft status, further categorization was necessary and based on proximity to previously categorized hydrography.

***Open waters***

Open waters were extracted from the 2002 LU/LC layers based on the following Anderson land use classification codes

- (5100) Streams and Canals
- (5200) Natural Lakes
- (5300) Artificial Lakes and Reservoirs
- (5420) Dredged Lagoons Artificial

***Wetlands***

Wetlands were extracted from the NJDEP 2002 LU/LC based on the following Anderson land use classification codes:

- (1461) Wetland Rights-of-Way
- (1850) Managed Wetland in a Built-up Maintained Recreation Area
- (2140) Agricultural Wetlands
- (2150) Former Agricultural Wetlands
- (6120) Deciduous Wooded Wetlands
- (6220) Coniferous Wooded Wetlands
- (6230) Brush-Dominated and Bog Wetlands
- (6231) Deciduous Brush and Bog Wetlands
- (6232) Coniferous Brush and Bog Wetlands
- (6233) Mixed Brush and Bog Wetlands with Deciduous Dominant
- (6240) Non-Tidal Marshes
- (6250) Mixed Wooded Wetlands
- (6251) Mixed Wooded Wetland with Deciduous Prevalent
- (6252) Mixed Wooded Wetlands with Coniferous Prevalent
- (7430) Disturbed Wetlands

***Vernal Pools***

Because of their ephemeral nature and small size vernal pools are not comprehensively mapped and as a result, is often overlooked from a planning and protection standpoint.<sup>2</sup> Vernal pools are a unique type of wetland and water feature regulated pursuant to the New Jersey Freshwater Wetlands Protection Act Rules (N.J.A.C. 7:7A) and the

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<sup>2</sup> The terms vernal pool and vernal habitat are used interchangeably. Vernal habitat is referenced in the regulatory context at N.J.A.C. 7:7A-1.4.

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Highlands Rules at N.J.A.C. 7:38. The NJDEP vernal pool mapping will be used in support of the Highlands open waters protection element of the Highlands Regional Master Plan.

The New Jersey Freshwater Wetlands Protection Act Rules, at N.J.A.C. 7:7A-1.4, includes the following definition of vernal habitat:

Vernal habitat" means a wetland or water that meets all of the criteria at 1 through 4 below. Evidence of breeding by an obligate species under 2i below creates a rebuttable presumption that the criteria at 3 and 4 below are met:

1. Occurs in a confined basin depression without a permanent flowing outlet;
2. Features evidence of breeding by one or more species of fauna adapted to reproduce in ephemeral aquatic conditions, identified in N.J.A.C. 7:7A, Appendix 1, incorporated herein by reference. The following shall constitute evidence of breeding by such a species:
  - i. One or more obligate species listed in Appendix 1, or evidence of such a species, is found in the area of ponded water; or
  - ii. Two or more facultative species listed in Appendix 1, or evidence of the presence of such a species, are found in the area of ponded water;
3. Maintains ponded water for at least two continuous months between March and September of a normal rainfall year; and
4. Is free of fish throughout the year, or dries up at some time during a normal rainfall year.

Rutgers University's Center for Remote Sensing and Spatial Analysis (CRSSA) has been partnered with the NJDEP to develop a suite of computer-aided techniques to identify and delineate vernal pool using an assortment of on-screen digitizing, image processing and GIS-based classification techniques. The Highlands Regional Master Plan (RMP) will integrate mapped vernal pool data from a variety of sources, including the NJDEP Endangered and Non-game Species Program (ENSP) New Jersey Geological Survey and NJDEP Natural Heritage Program, into the final coverage.

***Supplemental Headwater Stream Delineation***

At the landscape level, many headwater streams, or indeterminate streams, are often omitted from secondary map sources and similar to vernal pools, are often overlooked from a planning and protection standpoint. Headwater streams play a significant role in protecting downstream stream health. The RMP will incorporate GIS-based supplemental headwater mapping into the Highlands open waters map. The mapping effort is still in progress. The following section provides an overview of the data sets and methods to identify and map headwater streams

This dataset serves as an update to the 2002 NJDEP Hydrography dataset for the New Jersey Highlands Region. This update is being carried out by means of a heads-up digitization using the USDA Soil Conservation Service's (SCS) paper soils maps as a primary data source. Analysts used the historical soils data to assist in the delineation of

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streams that may have been omitted in NJDEP Hydrography mapping efforts. These newly updated streams are classified as indeterminate.

The 2002 NJDEP Digital color infrared (CIR) orthophotography of New Jersey in State Plane NAD83 Coordinates, U.S. Survey Feet served as base map data with the 2002 NJDEP Draft HYDRO file overlaid above it. The primary ancillary reference data that were used to compare the 2002 stream file to were the United States Department of Agriculture Soil Conservation Service's (SCS) soil maps. These documents exist for each county in the State and contain detailed soil and hydrography data derived from the ground surveys and sampling. Each county was divided into a multi-celled grid with each cell comprising an area of roughly 2.5 miles x 4 miles or 10 square miles.

The NJDEP 10-meter Digital Elevation Grids generated from the United States Geological Survey Digital Elevation Model (DEM) were divided by watershed management area. These types of data sets are powerful analysis tools in the sense that they can be used as source data to create other layers which require elevation information (i.e., hillside, slope, aspect, flow accumulation and flow direction).

Flow direction and flow accumulation grids were derived from the DEM data. The flow direction was determined using the elevation data to create a grid which shows the direction of flow from every cell in the grid. From this data set, a stream flow accumulation was calculated. This flow accumulation calculates accumulated flow as the accumulated weight of all cells flowing into each downslope cell in the output raster.

From the flow direction and accumulation grids, a potential vector stream network was generated. The stream flow network generated from the 10-meter DEM was used as a guide when digitizing streams that appeared in the SCS map but were not delineated in the 2002 stream file.

### **3. BASELINE REGULATORY CONDITION FOR SURFACE WATERS AND WETLANDS**

For the purpose of the Highlands buildout analysis, the current (pre-Highlands Regional Master Plan) open water and wetland constraints were established according to the following regulatory programs..

- Surface Water Quality Standards at N.J.A.C. 7:9B
- Freshwater Wetlands Protection Act Rules at N.J.A.C. 7:7A
- Stormwater Management Rules at N.J.A.C. 7:8
- Highlands Rules at N.J.A.C. 7:38

First, the existing water quality classifications were initially assigned to Highlands surface waters according to the New Jersey Surface Water Quality Standards at N.J.A.C. 7:9B because the surface water classifications correlate to certain regulatory protection strategies. Second, the Landscape Project Version 2, layers ranked 3, 4 and 5 for forest

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wetland, emergent wetland and wood turtle model were overlaid onto the Highlands open water map because the Landscape Project ranking correlates to certain regulatory protection strategies. Finally, the existing (pre-Highlands Regional Master Plan) regulatory constraints (buffers to surface waters and wetlands) were overlaid.

***Surface Water Quality Standards***

New Jersey Surface Water Quality Standards (N.J.A.C. 7:9B) establish the water quality goals and policies underlying the management of the State's water quality. These standards designate the uses of the water and establish policies, narrative and numerical criteria necessary to protect the uses. The surface water quality standards also establish antidegradation policies intended to maintain and preserve the level of quality of surface waters. The following antidegradation and water quality classifications are defined according to N.J.A.C. 7:9B:

- Outstanding National Resource Waters. "Outstanding National Resource Waters" means high quality waters that constitute an outstanding national resource (for example, waters of National/State Parks and Wildlife Refuges and waters of exceptional recreational or ecological significance). In the Highlands waters classified as FW1 are Outstanding National Resource Waters (refer to FW1 definition).
- Category one (C1) waters are designated for purposes of implementing the antidegradation policies set forth at N.J.A.C. 7:9B-1.5(d), for protection from measurable changes in water quality characteristics because of their clarity, color, scenic setting, other characteristics of aesthetic value, exceptional ecological significance, exceptional recreational significance, exceptional water supply significance, or exceptional fisheries resources. These waters may include, but are not limited to:
  1. Waters originating wholly within Federal, interstate, State, county, or municipal parks, forests, fish and wildlife lands, and other special holdings that have not been designated as FW1 at N.J.A.C. 7:9B-1.15(h) Table 6;
  2. Waters classified at N.J.A.C. 7:9B-1.15(c) through (g) as FW2 trout production waters and their tributaries;
  3. Surface waters classified in this subchapter as FW2 trout maintenance or FW2 nont trout that are upstream of waters classified in this subchapter as FW2 trout production;
  4. Shellfish waters of exceptional resource value; or
  5. Other waters and their tributaries that flow through, or border, Federal, State, county or municipal parks, forests, fish and wildlife lands, and other special holdings.
- Category two (C2) waters are all surface waters not designated FW1 or C-1. Water quality changes are allowed provided that they are in the range of changes

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permissible with existing stream uses, and that degradation is necessary to accommodate "important economic or social development".

- "FW1" means those fresh waters that are to be maintained in their natural state of quality (set aside for posterity) and not subjected to any man-made wastewater discharges or increases in runoff from anthropogenic activities. These waters are set aside for posterity because of their clarity, color, scenic setting, other characteristic of aesthetic value, unique ecological significance, exceptional recreational significance, exceptional water supply significance, or exceptional fisheries resource(s).
- FW2 is a general surface water classification applied to those fresh waters that are not designated as FW1. There are three sub-categories of FW2:
  1. FW2-TP: Trout production waters for trout spawning or nursery during their first summer
  2. FW2-TM: Trout maintenance water for the support of trout throughout the year.
  3. FW2-NT Non-trout waters, not considered suitable for trout production or maintenance, but may be suitable for other fish species.

***Freshwater Wetlands Protection Act Rules***

Through the implementation of the Freshwater Wetlands Protection Act Rules at N.J.A.C. 7:7A, NJDEP's Division of Fish and Wildlife, Endangered and Nongame Species Program (ENSP) Landscape Project has developed maps of key habitat areas for rare, threatened and endangered species of wildlife for New Jersey. The Landscape Project data provides an initial screening tool to identify large tracts of contiguous habitat for listed threatened, endangered and rare species. Generation of Landscape Project maps is a multi-step GIS process. Simply illustrated, the classes of habitat type (forested wetlands, forest, emergent wetlands, grassland and beach) are extracted from the NJDEP land use/land cover data layer and contiguous patches for each habitat type are defined. Imperiled species models (home range/territory size reported from the literature) are intersected with the habitat patches. Habitat patches are then classified based on the status of the species present. The patches are ranked as follows:

- Rank 5: Patches containing one or more occurrences of at least one wildlife species listed as endangered or threatened on the Federal list of endangered and threatened species.
- Rank 4: Patches with one or more occurrences of at least one State endangered species.
- Rank 3: Patches containing one or more occurrences of at least one State threatened species.

For the purpose of the Highlands buildout analysis, patches ranked 1 and 2 were not used, since those patches relate to non-listed species, or suitable habitat for listed species with

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no correlated occurrences. The Landscape Project also delineated critical areas for the wood turtle. Refer to <http://www.njfishandwildlife.com/ensp/landscape/index.htm> for more information on the Landscape Project.

The NJDEP Land Use Regulation Program under the Freshwater Wetlands Protection Act Rules at N.J.A.C. 7:7A impose transition areas ranging from zero to 150 feet adjacent to freshwater wetlands. The width of the transition area varies according to the resource value classification of the wetland. Two classes of wetland resource values are defined by the NJDEP were utilized.

- An exceptional resource value wetland requires the largest (150-foot) transition area, as they are considered to exhibit the highest environmental integrity. An exceptional resource value wetland is a freshwater wetland that discharges into FW1 or FW2 trout production waters or their tributaries; is a present habitat for threatened or endangered wildlife species; or is a documented habitat for threatened or endangered species, and which remains suitable for breeding, resting, or feeding by these species during the normal period these species would use the habitat.
- Intermediate resource value wetlands require a 50-foot transition area and include all wetlands not defined as exceptional.

For the purpose of the Highlands buildout analysis, exceptional wetlands were defined as those requiring a 150-foot buffer where the wetland polygon intersects with Landscape Project Rank 3, 4 and 5 for forest wetland, emergent wetland and critical areas for wood turtle; or those intersecting with a FW1/trout production stream buffer. A 50-foot buffer was assigned to all other wetlands not intersecting with Landscape Project Rank 3, 4 and 5 for forest wetland, emergent wetland, or a FW1/trout production stream.

***Stormwater Management Rules***

The Stormwater Management Rules at N.J.A.C. 7:8 provide for the designation of “Special Water Resource Protection Areas” adjacent to category one waters and their immediate tributaries. A 300-foot special water resource protection area is provided on each side of the waterway, measured perpendicular to the waterway from the top of bank outwards, or from the centerline of the waterway where the bank is not defined, consisting of existing vegetation or vegetation allowed to follow natural succession is provided. The special water resource protection area is intended as a buffer between development and these special waters in order to protect both water quality and the attributes for which the waters have been designated. Category one waters are waters that receive special protection under the Surface Water Quality Standards because of their clarity, color, scenic setting or other characteristics of aesthetic value, exceptional ecological significance, exceptional recreational significance, exceptional water supply significance or exceptional fisheries resource(s). The special water resource protection area is also required upstream to those waters that drain to the category one water within the limits of the associated sub-watershed (HUC14).

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For the purpose of the Highlands buildout analysis, all streams and open waters were assigned a 300 foot buffer for category one/trout production streams; a 150 foot buffer for non-category one streams that intersect with a Landscape Project Rank 3, 4 or 5 for forested wetland, emergent wetland and/or wood turtle feature; and a 50 foot buffer for trout maintenance and non-trout streams that do not intersect a Landscape Project feature.

***Highlands Rules***

Section 34(a) of the Highlands Act and the Highlands Rules N.J.A.C. 7:38-3.6 mandates the establishment of a 300-foot buffer adjacent to all Highlands open waters; provided however, that this buffer shall not extend into the planning area. For the purpose of the Highlands buildout model, all Highlands open waters (wetlands and surface waters) within the Preservation Area were assigned a 300-foot buffer and this buffer was contained within the limits of the Preservation Area.

Section 34(g) of the Highlands Act requires that the antidegradation provisions of the Surface Water Quality Standards (N.J.A.C. 7:9B) and Stormwater Management Rules (N.J.A.C. 7:8) applicable to category one waters be applied to Highlands open waters. For the purpose of the Highlands buildout model, and in accordance with the nondegradation provisions of the surface water quality standards and the stormwater management rules, the surface water component of category one Highlands open waters within the Preservation Area were assigned a 300-foot buffer. In addition, surface waters (excluding wetlands) located outside of the Preservation Area but within the limits of the associated HUC14 that drain into category one Preservation Area surface waters were assigned a 300-foot buffer.