Connecticut Highlands: Part 1
Resource Assessment

Technical Report

Joel Stocker
Thomas Worthley
University of Connecticut
Cooperative Extension System.

26 February 2007

Final Report Prepared for:

United States Forest Service
Northeastern Area State and Private Forestry

Introduction

The Connecticut portion of the Highlands Regional Study 2006 was coordinated by the U.S. Forest Service, Northeastern Area, State and Private Forestry, and carried out by the University of Connecticut Cooperative Extension System in partnership with the Connecticut Department of Environmental Protection (CT DEP), the Regional Plan Association, the Housatonic Valley Association, and the U.S. Geological Survey. The Forest Service provided funding for the Connecticut analysis and public outreach.

The study is a continuation of the work completed for the New York-New Jersey Highlands Regional Study in 2002. The resource assessment followed the procedures outlined in the NY-NJ Highlands Regional Study Technical Report. Departures from these procedures were in response to better or different data and interpretations, or to comments from the public. The questions answered by the resource assessment are:

* What are the natural resources important to the Highlands?
* Where are these resources located?
* How are conservation values distributed across the Highlands?

Additional questions about the impacts of land use change on resources will be addressed in Part 2 of the Highlands Regional Study.

This technical report describes the procedures used to create and analyze the Geographic Information System (GIS) datasets for the Connecticut Highlands. The output consists of five maps, one for each resource category, and a map combining all five resource categories to provide a synopsis of the important conservation areas in the Highlands of Connecticut.

In this report, for each resource category, the base GIS layers used and the parameters created by those base layers are listed in table format and the associated procedures for each of the parameter layers are described. All required GIS layers are listed, even if duplicated in other tables, providing all of the information needed to rebuild each individual parameter. The difference between duplicate GIS layers can be the treatment or attribute selection (i.e. forest versus agriculture from the same land cover feature) or the distance for a buffer. Parameters were identified for each resource category; they were assigned weights, and then combined using the MAX value function to create the assessment map for that resource category. In the overlay operation the maximum (MAX) value priority rule selects a cell's highest value from all the layers used in a resource category. The steps were combined for each resource assessment using ArcGIS model builder. The individual processed layers are temporary datasets, deleted after the model run. The model creates temporary layers as it converts the base GIS data to the parameter files. These temporary layers are automatically deleted after the operation is complete; they are not listed in the tables.

Descriptive items

Connecticut GIS numbering scheme. In Connecticut, to assist with data tracking during and after the analysis, each of the five resource categories was assigned a four digit number (1000 to 5000). Data subsets used within the weighting analysis for these layers were assigned values based on the last three digits. For example: Because the water grouping was assigned the number 1000, the well head protection zone layer, a weighted layer within the water analysis, was assigned the number 1201.

Raw GIS data vs. subset layers. Base (raw) GIS data should not be confused with the weighted subset (parameter) layers. Many subset layers have their origin as a combination of several base datasets. For example, wetland features are actually a sub selection from the NRCS Soils shape file (hydric soils). The process identifying what constitutes a wetlands soil was pre-determined by NRCS independent of this project. Others, such as steep slopes greater than 15%, were created using several GIS operations applied to one or more base layers. In this case the Digital Elevation Model (DEM) provided through the USGS web site (NED 30 meter data), was analyzed to produce slope then reclassed to select slopes greater than 15 %. Most of the model operations within the project start with the base GIS layers to create the parameters, weights are assigned, then the parameters combined to make the final map.

The layers with assigned numbers and associated weights are listed in the Map Layers and Weighted Parameters tables. Actual datasets may change if the study is repeated depending on the availability of new layers or changes in the model designs. The details are provided to help with understanding the process rather than repeat the analysis verbatim.

The use of Model Builder. Throughout this report there are terms relating to use of "the model". ArcGIS ArcView 9.1 was the primary software used for the study. Within the software is a Model Builder tool. This tool provides the option to create a "toolbox" for storing repetitive tasks and complex spatial routines. The user works in a graphics interface, adding items to a type of flow chart. The items contain procedures and spatial operations that can be applied in a set order. The 'raw' GIS data is added to the model on one side as base data, manipulated to create parameters, then weighted and combined to create the final output dataset (or maps). A unique model was created for each of the project 'goal' layers as well as a final combination model for the overall Conservation Values Assessment Layer (CVA).

The use of vector and raster data. Vector datasets are identified as features on the ground using polygons, lines, or point coordinate systems. For example, a lake would be represented by a line enclosing an area and attributes would be assigned to the enclosed polygon. Raster datasets apply a spatial grid system with evenly distributed pixels, each with an associated value, using a concept similar to that of a digital photograph. A lake would be identified as a cluster of pixels, each assigned the same 'lake' value. For GIS applications there are advantages and disadvantages of each depending on the application or analysis being applied. Vector operations are more scale independent and provide the

best precision for detailed operations such as buffering and line work. Raster (GRID) operations on the other hand are much faster than vector operations when working with overlay calculations. To maintain resolution for as long as possible, all items retained their vector characteristics until the steps for statistical overlay were required; at that point they were converted to an ESRI Grid format with a pixel resolution of 30 x 30 meters. For alignment purposes, all grid features were 'snapped' to a base grid created from a 2002 Landsat image – it was determined this layer provided the most reliable spatial alignment and grid pattern for the study area.

Water resources conservation values assessment (model code 1000)

Maintaining adequate supplies of high quality water is a high priority throughout the Highlands. The objective for the water resource component was to identify those locations on the landscape that play a critical role in protecting water quality. The Connecticut Department of Environmental Protection, Water Resources Division, provided valuable help mapping, interpreting, and evaluating water resource data.

Base GIS datasets (raw data):

Layername	Usage	Source
13. basins	Selected for Surf Water Watersheds	DEP CD
29. bedrock	Bedrock Aquifer	DEP CD
31. hydroz	Headwaters	DEP CD
51. wqsclas	Water quality ratings – polygons	DEP web
52. wqsclasz	Water quality ratings – line features	DEP web
53. groundwaterquality	Ground water polygons – for Wtshds	DEP web
92. soil	For wetland selection	DEP web
130. highbxdem	Digital elevation for steep slopes	USGS web
143. highbxlc2002	Satellite Land Cover 2002, for forests	CLEAR
98. aquiferprotectionarea	Aquifer protection zone polygons	DEP web
152. valleyfill	Vfill aquifers Special derived by DEP	Matte Thomas

Parameter Layers (weighted):

Layername	Weight	GIS base layers used
1101 Valley fill aquifer	4	152
1102 Carbonate aquifers	3	29
1103 Other bedrock aquifer	1	29
1104 Forested over aquifer	+1	29, 143, 152
1201 Public water supply wellhead & buff	4	98
1202 Forested over wellhead buffer	+1	98, 143
1301-5 Water quality ranking of stream buff	(5-1)	51, 52
1401 Headwater stream centerline	3	33
1402 Headwater stream buffer to 300 ft	2	33
1403 Headwater stream buff inside sup wtshd	+1	13, 51, 52, 33
1501 Steep slopes > 15% inside sup wtshd	3	13, 51, 52, 130

1502 Steep slopes > 15% other watersheds	2	130
1601 Wetlands > 50 acres	3	92
1602 Wetland soils > 5 and <= 50 acres	2	92
1603 Wetlands with forest cover	+1	92, 143
1701 Public water supply watersheds	4	53
1702 Forest cover over wtr supply wtshd	+1	53, 143

Note: The surface water supply watersheds layer was derived from a selection within the DEP ground water protection layer. Originally, only the features found within these boundaries were given additional weight. After public comment, the full surface supply watershed features were assigned a weight.

Detailed procedures – water assessment:

1101 Valley fill aquifer. Layer provided by CT DEP (Matte Thomas) and classified as a:

> "Surficial Materials derivative product identifying 'Valley Fill' as stratified drift aquifers. Various surficial materials textural types are identified as stratified drift. Deposits are grouped into 'c' coarse, 'f' fines, 'f/c' fine overlying coarse, and 'c/f' coarse overlying fine grained deposits. Textural group mapping derived from Stone et al (1992) Surficial Materials Map of Connecticut utilizing the Wentworth grain size classification scheme (1922). The map has been created as part of an Aquifer Potential analysis conducted by the CT Geological Survey, Department of Environmental Protection, funded by the U.S. Environmental Protection Agency. The primary consideration for the aggregation of Surficial Materials map units is for hydrologically similar textures relative to ground water flow."

1102 Carbonate aquifers. Carbonate features selected from CT DEP bedrock layer. Any overlap with valley fill would be compensated for later because of its higher weight (valley fill taking precedence in a maximum weight procedure). The selection by attribute command was used on the bedrock vector polygon layer with the following SQL expression:

Select by attributes from bedrock were
"UNIT" IN ('Csa', 'Csb', 'Csc', 'OCs', 'Osg', 'Owm')

Csa = Unit a of Stockbridge Marble, white to gray dolomite marble
Csb = Unit b of Stockbridge Marble, white to light-gray dolomite marble and schist
Csc = Unit c of Stockbridge Marble, gray dolomite marble
OCs = Stockbridge Marble, white to gray dolomitic marble
Osg = Units g and f of Stockbridge Marble, white to gray calcite marble
Owm = Basal marble member of Walloomsac Schist, dark to light colored schistose marble

See http://dep.state.ct.us/gis/dataguides/dep/fields/bedunit.htm for additional details.

1103 Other bedrock aquifer. All other bedrock areas (reversed selection from carbonate features). Again, valley fill would take precedence in any area where it overlapped bedrock aquifer.

1104 Forested over aquifer. Forest values were selected from the 2002 satellite derived land cover, given a weight of one (1), and added to the combined max value aquifer dataset. Any areas of overlap increased cell weight by 1.

1201 Public water supply wellhead and buffer. For the New York/New Jersey study, well heads were identified and given 2500 foot buffers. In Connecticut, the State has already identified primary zones of influence for public water supply wells. This CT DEP polygon layer, called aquifer protection areas (apa) was used in place of the buffer. Following the original run of the model and public review, an updated layer was provided by CT DEP. Some areas increased in coverage, others were eliminated or reduced in size.

1202 Forested over wellhead buffer. Forest values were selected from the 2002 satellite derived land cover, given a weight of one (1), then added onto wellhead protection area. All wellhead area pixels with forest overlay increased weight by 1. Forest areas outside the wellhead zones were not included.

1301 through 1305. Riparian Zone ranked by water quality. A separate model was created to buffer the water quality features and break out the specific weights for each of the five water quality rankings. Weight ranges for the WQClassA and P categories were provided by CT DEP and applied to the model. The individual arcs and polygons were selected based upon the State criteria, buffered to 150 feet (without dissolve), converted to grid format, then weighted. Five individual grid layers were created, each assigned its respective weight. They were then recombined using Max value (Mathmatically there were 10 layers; the 5 polygon and 5 line features were calculated separately). The output was a single raster layer with values for each of the five weights. SQL queries used in the model were:

Weight 5: "HY_LEGEND" in ('Water', 'Intrmt Wtr') AND "WQCLASSA" in ('A', 'A/AA', 'AA')
Weight 4: "HY_LEGEND" in ('Water', 'Intrmt Wtr') AND "WQCLASSA" in ('B/A', 'B/AA','C/A')
Weight 3: "HY_LEGEND" in ('Water', 'Intrmt Wtr') AND "WQCLASSA" in ('B', 'B*')
Weight 2: "HY_LEGEND" in ('Water', 'Intrmt Wtr') AND "WQCLASSA" in ('C/B', 'D/B')

For the wqsclas (polygon features) the field was WQCLASS*P*.

Tables defining the values for the WQClass fields can be found at http://dep.state.ct.us/gis/dataguides/dep/fields/wqsclas.htm

TIP: To save processing time the dissolve function should be set to NONE during multi-ring buffer operations. It is actually faster to separate the individual vector features before the buffer, create separate grid layers, assign weights, and then recombine them.

The process takes minutes rather than the hours it would take to use the dissolve options within the multi-ring buffer operation.

Note: In the first run of the model, stream buffers ranked according to water quality were given higher values if they fell inside water supply watersheds. Because the values for the state water quality layer are directly tied to the water supply watershed rankings this step was removed.

1401 Headwater stream centerline. Headwater streams as a combined unit are critical to the health of the watershed and are easily degraded by land use activities. For this study, stream centerline features from the hydroz layer were considered the finest delineation of a water feature using the AV_Legend "WATER" field value. Shoreline and polygon outlines were not used. No attributes exist to define a tighter unit of measure (i.e. streams restricted to uplands). Perennial stream attributes were only available for a small number of quadrangles along the Massachusetts border, so they were not separated for the analysis.

1402 Buffered headwater streams. The centerlines in 1401 were buffered by 300 feet on a side, creating a 600 foot zone. This buffered area was assigned a slightly lower weight than the stream centerline itself. No attempts were made to vary this buffer using surrounding terrain, slope, or stream size.

1403 Stream centerline and buffers falling inside surface water supply watersheds. Pixels falling within this zone were given an additional weight of 2 (plus 2). Note: At the 30 meter grid resolution all centerlines have a width of at least one pixel along their length (even if small streams).

1501 Steep slopes (>15%) inside surface water supply watersheds. The NED 30 meter digital elevation model (DEM) layer was selected from the USGS web site using a box surrounding the CT Highlands study site. This box was pixel matched (snapped and resampled) to match the base GRID file used for the project. The slope subroutine was run within ArcGIS and the range greater than 15% selected. Because slope and other grid operations require neighboring pixels to create output values, the routines were run on this larger block area. Afterwards the slope GRID was 'clipped' to match the boundary area. Slope values falling within the surface supply watersheds were given a higher weight than those outside the supply watersheds (see 1502).

1502 Steep slopes (>15%) outside surface water supply watersheds. All other steep slopes not falling in 1501. In the original study, wetlands outside riparian areas and inside surface water supply watersheds were separated and given weights. After the public comment period, this process was changed to reflect polygon size classes and forest cover (not watersheds).

1601 Wetlands greater than 50 acres in size. For the model, Connecticut wetland areas are identified based on soil types. The Natural Resources Conservation Service (NRCS) has a complete digital soils data set for Connecticut with field attributes identifying

wetland soils. These were selected from the statewide soils layer and applied to this project. Riparian areas, already identified in the headwater and water quality section, supersede these in weighted value. The SQL query used to separate the wetland features is below:

```
"HYDRIC" = 'Yes' AND "ACRE_GIS" > 50
"HYDRIC" = 'Yes' AND ("ACRE_GIS" > 5 AND "ACRE_GIS" <= 50)
```

1602 Wetlands greater than 5 acres and less than or equal to 50 acres were assigned a slightly lower weight. Those less than five acres were removed from model.

1603 Soils-based wetlands greater than five acres falling within forested areas were given an added weight of 1.

1701 Surface Water Supply Watersheds. This layer was derived using the ground water layer provided by the State. Within the layer is field value for GAAs, highlighting watersheds with the rating for water supply (leading to surface water supply reservoirs or wells). The layer was separated and converted to raster.

1702 Forest cover over Water Supply Watersheds. A weight of 1 was added if the cell was forested.

Biodiversity resource conservation values assessment (model code 2000)

The goal of biodiversity analysis is to identify areas that play a significant role in maintaining regional biodiversity and conserving critical wildlife habitat. The set of rules designed to identify and rank critical habitat for endangered and threatened animals, plants, and natural communities, were developed by the New York-New Jersey Highlands study and translated to match Connecticut species and communities. The spatial locations of many features within these GIS datasets are confidential, for this reason the State could not release un-modified data. To achieve the study goal, the GIS analysis was completed by the CT DEP Wildlife Division and provided to the Highlands study as parameter layers. The records were limited to the fields required for weighting in the composite model, but the layers retained their spatial accuracy for the model. Final printed and digital forms were spatially generalized for the public review and for reports.

Base GIS datasets (raw data):

Layername	Usage	Source
153. plants	State derived plants layer	CT DEP
154. animal_all	State derived animals layer	CT DEP
155. community	State derived bio community area (B2)	CT DEP

Parameter Layers (weighted):

Layername	Weight	GIS base layers used
2101 Habitat - Federal endangered animals	5	154

2102 Habitat - state endangered animals	4	154
2103 Habitat - state threatened animals	3	154
2104 Habitat - state animals of concern	2	154
2105 Other significant habitat for animals	1	154
2201 Habitat – Fed threatened plants	5	153
2202 Habitat – State endangered plants	4	153
2203 Habitat – State threatened plants	3	153
2204 Habitat – State listed plants	2	153
2302 Natural Heritage biodiversity – B2	4	153

These parameters were created by selecting coded attributes within these layers.

Detailed procedures – biodiversity assessment:

Analysis was provided by Karen Zyco of the CT DEP; the following is her report:

> "In Connecticut's addition to the Highlands project we followed, as best we could, the methodology as described in the New York-New Jersey Highlands Technical Report and the original animal species models from the New Jersey Landscape Project. The Connecticut Natural Diversity Data Base (CTNDDB) tracks locations of state and federally listed species in Connecticut using the Natural Heritage Methodology developed by NatureServe, a non-profit conservation organization.
>
> **Input layers:**
>
> 1. CTNDDB Element occurrence representations are an area of land or water in which a species or natural community is or was present. Locations are mapped as accurately as possible given the ability of the observer to relocate their position and the accuracy of the basemap used. Point locations mapped on a topographic base often receive a 100m buffer. Point locations mapped on aerial photographs may have as little as a 25m buffer. Other polygons may be delimited to the extent of habitat visible or between landmarks.
>
> Animal records were selected from the element occurrence dataset having a last observed date from 1970 – present. No extirpated sites or species were included. No records with questionable identification were included. Only records mapped to a precision of seconds or better were included.
>
> For plant records, no date restriction was set. The dataset includes historic occurrences of plant species. Only records mapped with a precision of seconds or better were included. No extirpated sites or species were included. No plants of questionable identification were included.

All natural community records were included. Some community records have digitized boundaries from 1:12,000 digital orthophotos, but others are only center points.

2. UCONN CLEAR 2002 Land use/Land cover shapefile created from 30 meter grid. While this is a fairly simplistic classification, it is the most current and best available coverage. It is a LANDSAT Thematic Mapper (TM) satellite imagery based land cover classification, circa 2002, for the state of Connecticut. The classification depicts 11 land cover categories. These are: 1. Developed, 2. Turf & Grass, 3. Other Grasses & Agriculture, 4. Deciduous Forest, 5. Coniferous Forest, 6. Water, 7. Non-forested Wetland, 8. Forested Wetland, 9. Tidal Wetland, 10. Barren Land, 11. Utility Right-of-Ways. Source Landsat TM image data were from September 8, 2002 and July 31, 2002. The classification was compiled using ERDAS Imagine 8.6 by the Center for Land use Education And Research (CLEAR) in the College of Agriculture and Natural Resources at the University of Connecticut.)"

In order to create land cover types similar to the other participants we categorized the coverage into forest, forested wetland, emergent wetland, and grassland as follows:
Coniferous Forest + Deciduous Forest = Forest
Forested wetland = Forested wetland
Non-forested wetland = Emergent wetland
Other grasses and agriculture = Grassland

Animal Models: Five animal models were used to more accurately depict critical areas for these species as described in the original New Jersey Landscape project report and the New York-New Jersey Technical Report.

Bog Turtle: Areas of appropriate habitat were digitized from vegetation and soil data.

Timber rattlesnake: Current reports and maps, which combined sightings and potential suitable habitat, were used to create critical areas within a 3.5 km average home range. Reviewed digital elevation models and aspect, for south facing ledges. Excluded some large areas of non-south facing habitat at the edge of range.

Bald eagle: Used NJ methodology. (Open water up to 660 ha and 90 meter buffer along shore). Breeding records only.

Wood turtle: Used NJ Landscape methodology. (1.6km radius, 322m stream buffer)

Blue-spotted salamander: 300 meter buffer as per NJ Landscape methodology.

Protection Status Definitions:

State of Connecticut, The Connecticut Endangered Species Act, General Statutes of Connecticut, Chapter 495, section 26-304:

> "Endangered species" means any native species documented by biological research and inventory to be in danger of extirpation throughout all or a significant portion of its range within the state and to have no more than five occurrences in the state, and any species determined to be an "endangered species" pursuant to the federal Endangered Species Act.
>
> "Threatened species" means any native species documented by biological research and inventory to be likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range within the state and to have no more than nine occurrences in the state, and any species determined to be a "threatened species" pursuant to the federal Endangered Species Act, except for such species determined to be endangered by the commissioner in accordance with section 4 of this act.
>
> "Species of Special Concern" means any native plant species or any native non-harvested wildlife species documented by scientific research and inventory to have a naturally restricted range or habitat in the state, to be at a low population level, to be in such high demand by man that its unregulated taking would be detrimental to the conservation of its population or has been extirpated from the state."

These final parameters from the DEP analysis were then separated by attributes and assigned weights with the model builder program.

Recreation and Cultural conservation values assessment (model code 3000)

As modeled after the New York-New Jersey study, the objective for the recreation and open space resources component was to identify those areas that are important for various outdoor recreation pursuits or those that serve as open space. High weights were assigned if the areas already have public access or are adjacent to public access, if they protect resources associated with public lands, or if they are valuable to the public but do not yet have public access. The process ranks lands according to their value for outdoor recreation, historical or cultural use, and scenic importance. The majority of parameters in the New York-New Jersey study had close comparisons with the Connecticut study, but data layers representing view points and valley roadways were limited. For Connecticut, several procedures were attempted to identify scenic viewsheds or visible

ridgetops, however, a process could not be derived in reasonable time that would allow a realistic scenic analysis for the entire study area.

Base GIS datasets (raw data):

Layername	Usage	Source
31. hydro	Lakes, rivers, marsh polys	DEP CD
39. boatdep	Boat launch sites (1996)	DEP CD
41. propfed	Federal property (1997)	DEP CD
42. propmun	Municipal property	DEP web
132. NHDHydro	USGS NHD hydro line features	USGS Web
144. trailsCFPA	Trails from CT Forest and Parks	CFPA
156. DEPTrails	Trails from CT DEP (special request)	CT DEP
157. trail_at_rawto83	Appalacian trail projected	AT Web
158. trails_GPS_jws	Additional trails via GPS	Joel Stocker
159. wildbktrt	Wild brook trout survey points	CT DEP

Parameter Layers (weighted):

Layername	Weight	GIS base layers used
3101 Trail centerlines	5	144, 156, 157, 158
3102 Trail buffer to 150 ft	4	144, 156, 157, 158
3103 Trail buffer 150 to 300 ft	3	144, 156, 157, 158
3401 Dedicated parkland	5	41, 42, 99
3402 Easements or watershed mgmt lands	4	41, 42, 99
3403 Park/preserve buffer to 1000 ft	3	41, 42, 99
3404 Park/preserve buffer 1000 to 2000 ft	2	41, 42, 99
3405 Park/preserve buffer 2000 to 3000 ft	1	41, 42, 99
3406 Buffer areas that connect parklands	+1	41, 42, 99 – ETGeo

Detailed Procedures for Parameter layers:

3101 Trail centerlines. Trail line features were collected from the available sources; The Connecticut Forest and Parks Association (CFPA), CT DEP (per special request), the Appalachian Trail from the AT web site, and several closure sections available from in-house GPS data. The Appalachian Trail was projected to the State projection and clipped to the buffered study area. To avoid duplication between the various sources, a priority system was used, starting with the AT data as the uppermost layer, then in descending order, CFPA, CT DEP, and in-house data. Spatial selection was made using the upper layer on the layer below. Selected segments within the lower layer were removed, and the layers re-saved. The process was repeated for each trail shape file. The final shapes were combined using the Merge operation. After the merge the line was converted to raster, and a weight was assigned. Note: Conversion to raster creates a series of 30 meter (98.4 ft) squares along the centerline.
+

3102 Trail buffer area to 150 feet. A multi-ring geoprocessing buffer operation was applied to the final trail shape out to distances of 150 feet and 300 feet. The dissolve option was set to None to save processing time, conversion to raster eliminates the boundaries. After conversion to raster the feature was reclassified, replacing distance values with weights (150 = 2, 150-300 = 1, noData = 0).

3103 Trail buffer area 150 to 300 ft. This was part of procedure for the 150 foot buffer. Because of the use of maximum value, and the assignment of a lower number to the larger distance, any overlaps with the trail or 150 foot buffer are automatically taken as higher values. If the values increased instead, or an additive method was used, a different procedure would be required.

3401 Dedicated parkland. Dedicated park and preserve features were selected using attributes within each of the available public land layers. Unique fields were added to the Municipal layer after the layer was compared to 2004 ortho photography. The intent was to pull out schools, dumps, and other non-recreational open space. Golf courses, while not natural, were included if also considered protected from conversion to urban use. Ball fields and several other non-natural recreation features were included, but ranked within the easement layer. The SQL queries used for parks and preserves are identified in the list below. No ski slopes were classified for CT:

Federal Lands: "CD" = 'EXIST' AND "NAME" <> 'National Park Service' *(not fully protected yet).*
Municipal: ("ACRE_GIS" > 5 AND ("highgrp" = 'habitat' OR "highgrp" = 'hunting') AND ("CATEGORY" LIKE '%Preserved%' Or "CATEGORY" LIKE '%Recreation%') AND "FNCT" in ('M-1', 'M-2', 'P-1', 'P-2')) OR ("ACRE_GIS" > 5 AND "hightype" = 'camp' AND ("CATEGORY" LIKE '%Preserved%' Or "CATEGORY" LIKE '%Recreation%') AND "FNCT" in ('M-1', 'M-2', 'P-1', 'P-2')) OR ("ACRE_GIS" > 5 AND "hightype" = 'golf' AND ("CATEGORY" LIKE '%Preserved%' Or "CATEGORY" LIKE '%Recreation%') AND "FNCT" in ('M-1', 'M-2', 'P-1', 'P-2'))
DEPProp: "AGNCYFN_CD" IN ('EC','EFA','EFH','EO','EP','EPS','ERN','EW','EWS','EXF') AND "OBJECTID" <> 460

Note: Using 'IN' is an alternative to a list of OR statements.

These features were selected from each layer, converted to raster, combined as one, then assigned the weight for parks and preserves.

3402 Conservation easements or watershed management lands. As with the dedicated parks, features considered as conservation easements were selected from the public land shape files. The SQL queries used for easements are identified in the list below:

Federal Lands: "CD" = 'PRES'
Municipal: "ACRE_GIS" > 5 AND (("highgrp" <> 'urban' AND "highgrp" <> 'historic' AND "highgrp" <> 'agriculture') AND "FNCT" in ('P', 'P-3','M-3'))
DEPProp: "AGNCYFN_CD" = 'EC'

Acronym descriptions:

M-1 Municipal, open to public without fee
M-2 Municipal, open to public with fee

P	Access unknown
P-1	Private, open to public without fee
P-2	Private, open to public with fee
P-3	Private, members or owners only
EC	Flood control
EFA	Water Access
EP	State Park
EPS	State Park Scenic Reserve
ERN	Natural Area Preserve
EW	Wildlife Area
EWS	Wildlife Sanctuary
EXF	State Forest

CATEGORY values: Cemetery, Conservation, General Recreation, Preservation, Recreation, School, Existing Preserved Open Space, Uncategorized.
These features were selected from each layer, converted to raster, combined as one, then assigned the weight for conservation easements. Watershed management lands for the entire study area were not available for the first draft. With only selected coverage, it was determined the input from these data would improperly bias the maps. The watersheds themselves were highlighted in the water model. The property boundaries, if made available, could be used in phase 2 of the study.

3403 Park/preserve buffer area out to 1000 feet. A multi-ring geoprocessing buffer operation was applied to the final trail shape out to distances of 1000, 2000, and 3000 feet. The dissolve option was set to None to save processing time, conversion to raster eliminates the boundaries. After conversion to raster the feature was reclassified, replacing distance values with weights (1000 = 3, 1000-2000 = 2, 2000-3000 =1, noData = 0).

3404 Park/preserve buffer area 1000 to 2000 feet. This feature was identified and weighted as part of the multi-ring buffer operation (see 3402).

3405 Park/preserve buffer area 2000 to 3000 feet. This feature was identified and weighted as part of the multi-ring buffer operation (see 3402).

3406 Buffer areas that connect parklands. The intent with this operation is to select the 1000 foot buffers that fill in the gap between two or more parkland features. Simply selecting for the area where one 1000 foot buffer overlaps another creates islands floating in space (where the buffers overlap is usually small). To eliminate the island effect, only those areas where the buffers overlapped and also came within 1000 feet of the neighboring park were used. Functions within ETGeoWizard were used to create this layer; the operations were completed outside the model builder environment and added as a separate layer to the final recreation model.

Using ETGeoWizard the parks were merged as one layer, cleaned and dissolved. Gaps were closed and slivers removed. Areas greater than 100 acres were selected, these were

considered of significant size to remove the excess effect of a large buffer. (?) A 1000 foot buffer operation was applied. The resulting layer was cleaned with the option to identify overlaps as a point feature. A proximity layer was created by selecting polygons that intersect the points *and* touch a park feature. If both criteria are satisfied it can be assumed the overlapping polygons actually provide a bridge between two park features, the overlap will touch both. Existing park features were erased to leave only the proximity areas. The result can cover more area than the proximity, editing the selected polygons by hand would provide a more natural shape.

3501 Historic/cultural area or point with 150 ft buffer. Attributes with historic features were selected from the municipal and DEP property layers. The SQL queries used for historic features are identified in the list below:

Federal Lands: No historic categories in fields, used Heritage. "NAME" = 'National Park Service'.
Municipal: "highgrp" = 'historic'
DEPProp: "AGNCYFN_CD" = 'ERH'

These features were selected from each layer and each selected layer buffered to 150 feet. The buffer includes the original polygon layer, these were converted to raster, combined as one, then assigned the weight for historic and cultural features.

3601 Lakes/reservoirs with public access. Lakes and reservoirs were selected from the DEP hydro polygon layer. No attributes are available to designate them as publicly accessible. To separate water bodies with public access water bodies were selected using the *by location* function, setting a 100 foot distance from the boat launch points. These selected water bodies were categorized as publicly accessible, converted to raster, and weighted accordingly.

3602 Buffered area upland out to 300 feet from public lakes. The selected public access lakes (3601) were buffered to 300 feet. The buffered area was converted to raster and weighted accordingly.

3603 Canoeable river or stream. Most of the rivers and streams in northwestern Connecticut are canoeable or can be run with river kayaks. To hold to a basic canoeable level, only those river features identified as polygons were used. Single line features may or may not be accessible depending on width and ownership issues, data not available for the study. A selection criterion was applied to separate river polygon features using the following SQL:

"STREAM" <> '' (blank) AND "LAKE" = '' AND "STREAM" LIKE '%River%' AND "ACREAGE" > 10

Only river features greater than 10 acres were considered. These features were converted to raster and assigned weights.

3604 Buffered area upland out to 150 feet from canoeable river. A multi-ring geoprocessing buffer operation was applied to the final canoeable shape (3603) out to

distances of 150 and 300 feet. The dissolve option was set to None to save processing time, conversion to raster eliminates the boundaries. After conversion to raster the feature was reclassified, replacing distance values with weights (150 = 2, 150-300 = 1, noData = 0).

3605 Buffered area upland 150 to 300 feet from canoeable river. The weight was applied to the 150 to 300 foot buffer range (see detail in 3604).

3606 Trout production stream (natural regeneration). This layer was derived using a combination of NHD hydro line data and wild brook trout survey points provided by DEP fisheries. The survey points identified locations where native brook trout were found. Hydro lines within 400 feet of the survey points were identified as native trout production streams. After selection by distance, an attribute subset-selection was made with the following SQL to select for smaller streams:

"FCode" = 46003 OR 'FCode=46006"

The NHD hydro lines were used in place of the DEP hydroz line shape file because of these attributes. In addition, the plan was to use the selection to identify the stream segments, then use the NHD stream segment codes to traverse up and down the segments until a dam or barrier was reached. In the end the entire selected segments were used.

3607 Buffered area upland out to 150 from trout production stream. A 150 ft buffer operation was applied to the stream segments identified as trout production streams (3606). The result was converted to raster and assigned a weight.

Note: No data was available for trout maintenance (put and take) stream segments.

3610 Other lakes. A switch_selection operation was applied to the publicly accessible lakes layer (3601). A subset_selection was applied to this layer using the following SQL:

"HYPOLY_COD" = 421 AND "ACREAGE" > 2.

Removing lakes smaller than 2 acres reduced excessive influence of the large 300 foot buffer on the model (3611). A progressive buffer based on lake size may help reduce this influence to a manageable size, but no decision was made on how the progression should be scaled. The lakes layer was converted to raster and assigned a weight.

3611 Buffer area upland out to 300 feet from other lakes. A 300 foot buffer operation was applied to the Other lake features (3610). The result was converted to raster and assigned a weight.

Agricultural resources conservation values assessment (model code 4000)

The objective for the Connecticut Highlands agricultural resource assessment was, as in the New York-New Jersey study, to identify those areas that have the highest value for

maintaining agriculture as a viable activity. The weighting scheme ranks areas higher if they have prime farm soils, are already preserved farms, or contain large, contiguous tracts of farmland. In Connecticut, there was significant input from the public sessions to protect farmland because of its scarcity, scenic value, or simply to forestall development. Weights were increased in response to these concerns.

Base GIS datasets (raw data):

Layername	Usage	Source
42. propmun	Municipal layer has a farm component	DEP web
133. farmCES	Active farm fields	Rich Meinert
143. highbxlc2002	Satellite derived agriculture 2002	CLEAR
160. farmprot_hvasel	Protected farms HVA	Kirk Sinclair
161. nrcs_soilspi	Farmland soil types	NRCS/Nels
162. nrcs_farmsprotected	Protected farms NRCS	NRCS/Nels

Parameter Layers (weighted):

Layername	Weight	GIS base layers used
4101 Cultivated land on prime farm soils	3	133, 143, 161
4102 Cultivated land on non-prime farm soils	1	133, 143, 161
4103 Contiguous cultivated farms > 500 acre	+1	133, 160, 162
4201 Preserved farm	5	133, 160, 162
4202 Buffer 1000 ft from Preserved farm	3	133, 160, 162
4203 Contiguous cultivated farms > 500 acre	+1	133, 160, 162

Note: Prime agricultural soils were given a stand alone value of one (1). This value was not an original parameter layer, but was added by the study team in response to public comments. It was selected from the GIS layer (161-nrcs_soilspi). Areas already urban were deleted from prime agricultural soils.

Detailed Procedures for Parameter layers:

4101 Cultivated land on prime farmland soils. Cultivated lands were identified from two GIS sources: Farm fields identified and digitally mapped through a field management project organized by Rich Meinert of the University of Connecticut Cooperative Extension System. Agricultural fields identified in the 2002 satellite-derived land use/land cover dataset from the University of Connecticut LERIS program. Active farms were determined based on the assumption there would be haying or crop activity within the aerially-interpreted CES layer and plowed lands or fields identified within the satellite-derived land cover layers. Prime agricultural soils were selected from a prime soils layer provided by USDA Natural Resources Conservation Service and converted to raster. Cultivated lands were combined as one raster layer. Cultivated lands on prime agricultural soils were derived by multiplying the cultivated land by the prime soils layer. Zero values eliminated all non-overlapping pixels. The resulting layer was assigned a weight.

4102 Cultivated land on non-prime agricultural soils. For the model, the cultivated layer was given its weight in the previous step (4101) and simply re-attached using a MAX value. No individual layer was created. If necessary it could be separated as a single layer using reclass. If a technique other than MAX value is used, it will have to be recoded as a single layer and weighted separately.

4103 Contiguous cultivated farmland greater than 500 acres or blocks where 25 percent or more of the land was used as farmland. Contiguous cultivated farms for New York-New Jersey included blocks with greater than 25 percent farmland. We had not identified blocks of farmland, only the farmed land itself was included in the contiguous calculations. If blocks are identified this percentage option would help to expand the influence of farmland on the final map view (vs. just the scattered nature of the farms themselves).

For this study, actively farmed fields from the Cooperative Extension System dataset, and farms protected by agricultural easements were combined as a single layer. Satellite-derived agriculture areas were considered too general to include in this data set. After the sets were combined, a patch operation was run to identify contiguous blocks. Using Region Group and Zonal Geometry operations, contiguous blocks were given area values in square meters. Blocks greater than 500 acres (500 x 4046.87 sq meters) were selected for this analysis and given a weight of one (1). The result adds a value of one to those pixels identified in the cultivated layer that fall within the contiguous blocks.

4201 Preserved farms. Three sources were used to identify preserved or protected farms. The Housatonic Valley Association (HVA), the Natural Resources Conservation Service (NRCS), and protected farms identified in the DEP municipal open space layer. HVA farms not already found in the NRCS layer were selected and merged with the NRCS layer, the HVA layer was considered as an update. Overlapping polygons between the two layers were not combined to avoid the possibility of sliver polygons if the boundaries between the shapes were not identical. After the layers were merged they were converted to raster and given a weight. Attributes identified as protected farms in the state municipal layer were also added here.

4202 Buffer area to 1000 feet from preserved farm. A 1000 foot buffer operation was applied to the merged shape polygon in the preserved farm analysis (4201). The buffered layer was converted to raster. Using reclass a weight was assigned to the buffer area.

4203 Contiguous cultivated farmland greater than 500 acres or blocks of greater than 25 percent farmland. The layer identified as contiguous cultivated land was added to the protected and buffered pixels, providing and additional weight of one (1) for areas of overlap.

Forest resources conservation values assessment (model code 5000)

In the New York-New Jersey study, the emphasis was on maintaining productive forests and active forest management on both public and private lands, and on identifying areas that have the highest value for forestry. Productivity, as it relates to harvesting trees, occassioned several comments during the public sessions in Connecticut. Non-commercial values, such as the production of biomass or the provision of habitat were given equal importance, at least by some non-forest owners. There was general agreement that the resource values of forest land are greater than the value of its timber alone. Technically this is not an issue; the parameters chosen for the forest resource analysis apply whether the forest is managed for timber or for habitat. Large contiguous forest blocks and better soil types provide increased value in both. Forest activities are easier to manage over large areas, providing more viable long term planning and economic return, and biodiversity and wildlife are more robust in larger blocks.

Base GIS datasets (raw data):

Layername	Usage	Source
143. highbxlc2002	Satellite derived agriculture 2002	CLEAR
149. stew2006	Digitized Stewardship Polygons	Tom Worthley
161. nrcs_soilspi	Farmland soil types	NRCS/Nels

Parameter Layers (weighted):

Layername	Weight	GIS base layers used
5101 Stewardship property polygon	4	149
5102 Buffer 500 feet out from Stew prop	3	149
5103 Buffer 500 to 1000 feet from stew prop	2	149
5103b Buffer 1000 to 1500 feet from stew	1	149
5104 Prime soils (agr) over stew and buffer	+1	149, 161
5201 Contiguos forest tracts > 5000 acres	5	143
5202 Contiguos forest 1000 to 5000 acres	4	143
5203 Contiguos forest 300 to 1000 acres	3	143
5204 Contiguos forest 100 to 300 acres	2	143
5205 Contiguos forest 25 to 100 acres	1	143

Note: Prime farmland soils include forested lands (not all are under agricultural use). Privately owned forests in Connecticut with Stewardship Plans were identified with their actual boundaries.

Detailed Procedures for forest analysis:

5101 Stewardship property polygons. Forest Stewardship property and management areas have been digitized for all of the land owners enrolled in Connecticut's Forest

Stewarship Program and assigned a weight. The weight was assigned regardless of forest coverage (assumes forest potential).

5102 Buffer 500 feet out from forest stewardship polygons. In vector mode a multi-ring buffer operation was applied to the stewardship property polygons. The rings were set to 500, 1000, and 1500 feet. After the buffer operation the features were converted to raster then reclassified to assign weights (500 = 3, 500-1000 = 2, 1000-1500 =1, noData = 0).

5103 Buffer 500 to 1000 feet from forest stewardship polygons. Used the results from the multi-ring buffer operation (5102).

5103b Buffer 1000 to 1500 feet from forest stewardship polygons. A decision was made to at an additional ring out to 1500 feet. Used the results from the multi-ring buffer operation (5102).

5201 Contiguous forest tracts greater than 5000 acres. Forest categories were selected from the 2002 satellite derived land cover. The values 4, 5, and 8 were reclassed to 1, all others to noData. Because roads are included in the data set (fused from a vector layer) no further overlays were required to identify fragmentation features. The Region Group function was used to provide unique 'patch' identifiers for each unfragmented block of forest. A 4 pixel neighborhood was used to prevent crossover across diagonal touching pixels. The Zone group was set to WITHIN.

The grouped raster layer was then sent through the Zonal Geometry function to set area values for each unique patch in square map units (meters). After the area values were assigned, the layer was reclassed to assign weights to the various unbroken patch sizes. Weights were assigned based on the following size ranges:

Acres	Weight
0 – 25	0
25 – 100	1
100 – 300	2
300 – 1000	3
1000 – 5000	4
> 5000	5

Note: The units for the reclass model were square meters (acres x 4046.87).

5202 Contiguous forest tracts 1000 to 5000 acres. The values for this range were selected from the regroup operation described in 5201.

5203 Contiguous forest tracts 300 to 1000 acres. The values for this range were selected from the regroup operation described in 5201. The New York/New Jersey study used a range of 500 to 1000 acres. The value of 300 was considered during discussion to be more representative of the importance of smaller forest blocks within Connecticut.

5204 Contiguous forest tracts 100 to 300 acres. The values for this range were selected from the regroup operation described in 5201.

5205 Contiguous forest tracts 25 to 100 acres. The values for this range were selected from the regroup operation described in 5201. Polygons less than 25 acres were removed from the forest layer.

Composite Conservation Values Assessment

Maps of Water, Biological, Recreational/Cultural, Agricultural, and Forest Conservation Values were created using the MAX value assessment. If a layer was high, it remained dominant. This produced maps with pixel values ranging from 0 to 5.

The five resource categories were then combined using a summation model, providing values that could possibly reach 25 if all pixels aligned. The resulting composite map of Conservation Values was summarized into an Excel table. The range of scores was broken into five quantiles, or ranks of nearly equal area. The final CVA layer contains values from 1 to 5, referenced as Low to High conservation value on the final maps.