Natural Resources Inventories

University of New Hampshire
Cooperative Extension

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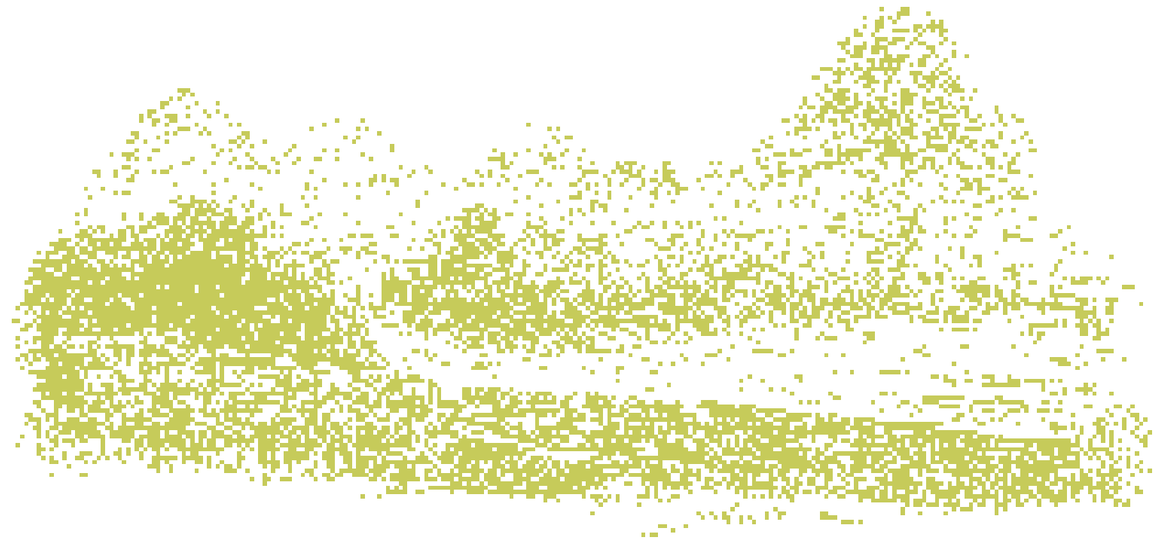
A Guide for New Hampshire Communities and Conservation Groups



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A Guide for New Hampshire Communities and Conservation Groups

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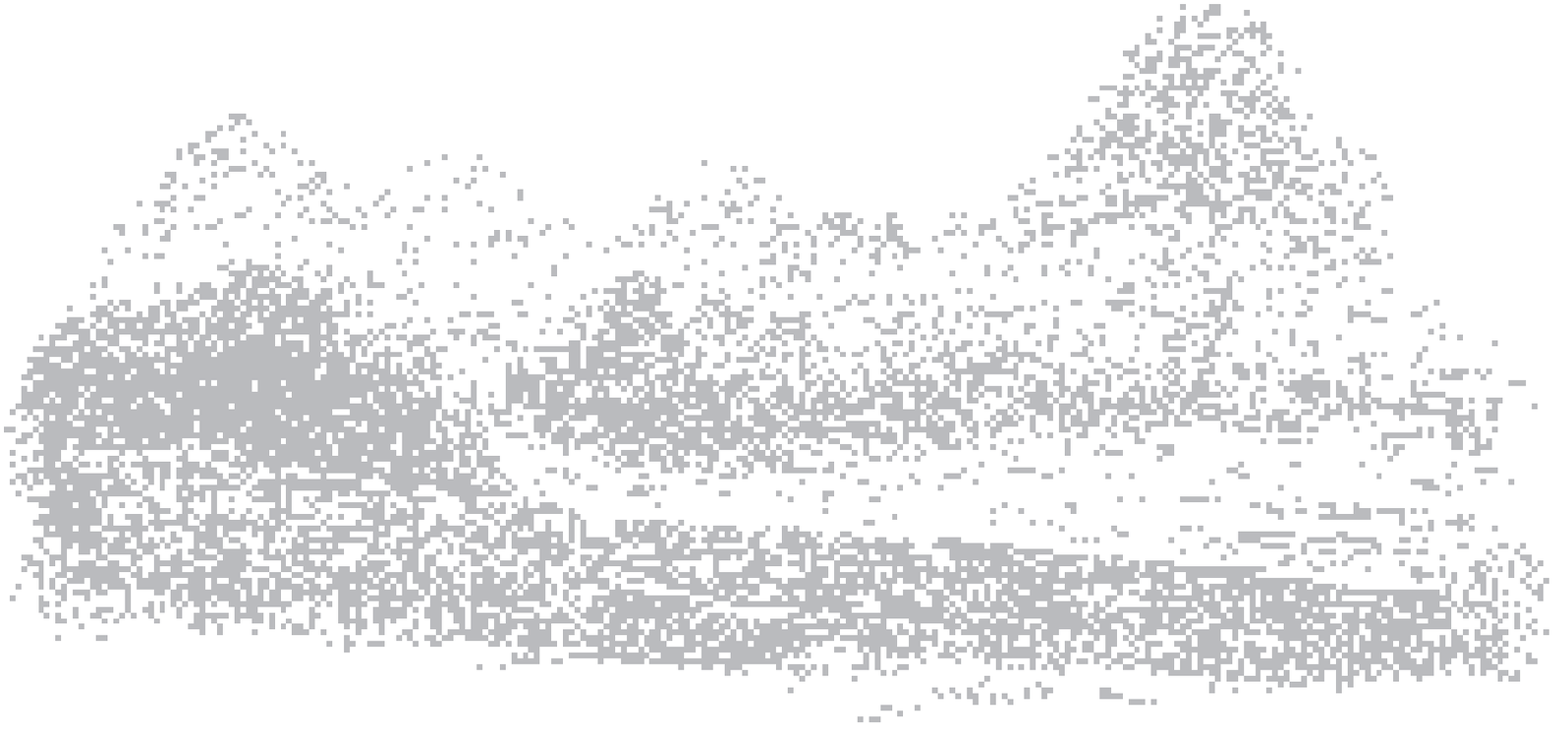

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1. Introduction

Why inventory natural resources?

Human health and welfare are dependent on healthy, functioning natural ecosystems. As appreciation of the importance and value of natural resources increases, so has awareness of how land use can impact these resources. Natural resources are a vital part of New Hampshire's cultural, economic, and community structure.

Since 1960, New Hampshire has led New England in population growth and will continue to face predicted, unprecedented growth in the next 20 years, with a projected increase of 23% between 1997 and 2020 (NH Office of State Planning, Population Estimates & Projections database, 1998). Most of this growth will continue to focus on the southern part of the state.

Several decades of rapid growth have already drawn heavily on New Hampshire's natural resources. Some communities have experienced displacement of wildlife, loss of recreational areas, scenic vistas, and open space, contamination of ground and surface waters, and increased erosion and flooding.

The challenge is to conserve significant resources in the face of a rapidly expanding population and its associated development. By incorporating natural resources into every level of decision-making and planning, communities can make a meaningful contribution toward preserving the natural resource heritage of the state.

The future of the natural resource base is largely dependent on land use decisions made at the local level. Communities frequently need to make decisions affecting natural resources, but very often don't have adequate data available to back those decisions. By identifying and describing natural resources in a local setting, a natural resources inventory provides communities with a strong foundation for more informed decision-making. It also encourages participation in identifying and protecting natural resources important to the community, and provides information that will support careful land use planning, voluntary land conservation, and improved resource protection measures.

What is a natural resources inventory (NRI)?

Broadly defined, a natural resources inventory lists and describes important, naturally occurring resources within a given locality (which may be a town, watershed,

or region). At its simplest, an NRI is the compilation and description of existing natural resources data. At its most complex, it includes detailed analysis of specific resources.

A comprehensive NRI provides the basis for land conservation planning, and allows natural resources information to be included in local planning and zoning. An NRI isn't a static "one-time" report. New and revised data emerge frequently, and the inventory needs periodic updating and refining. The initial NRI provides a baseline for observing changes over time.

Ideally, an NRI should include the following three components:

Maps: Inventory maps show the location and extent (as known) of existing resources, such as farmlands, surface and ground waters, and related features. They can dramatically illustrate both assets and potential problems that might not be readily apparent. Inventory maps are useful for a variety of applications, e.g., land use planning, local land protection programs, and development proposal reviews. Note that site-specific details won't be accurately depicted at the scale of town-wide natural resources inventory maps.

Associated Data and Information Sources: An NRI is more than just a mapping process. The data that serve as the basis for the maps can provide specific details about the information displayed on the inventory maps, acreage of specific resource features, etc. Documentation of the data source and the standards and scale used for the inventoried resources also should be included. This eases the task of future updates and provides a stronger basis for resource protection and planning efforts.

Descriptive Report: A written report is an important element of a resource inventory. The report should describe the project's goals and methods, summarize its findings and recommendations, list inventory participants, and detail the methods used to evaluate the results. It should also include descriptive summaries of each resource inventoried. With the inevitable turnover on municipal boards and commissions, this report provides a valuable record to familiarize new officials with the inventory work.

How can a natural resources inventory be used?

Until they have conducted a natural resources inventory, many communities don't have a clear picture of where the resources are located, which are significant to them, and why. A major accomplishment of an NRI is the provision of visual images (maps and photos), the associated data tables and descriptions, and a better understanding and appreciation of the community's natural resources.

The results of an NRI should be available for use by town officials, other interested community groups, and citizens. Some ways that an NRI can be used include the following (Section 5 provides a more detailed discussion of these applications):

- Document current conditions so changes over time can be assessed
- Develop a conservation plan
- Educate local officials and the public about natural resources
- Initiate and support land protection efforts
- Provide a basis for land use planning efforts
- Develop or update the natural resources section of the municipal master plan
- Evaluate the effects of proposed land use and zoning changes
- Develop amendments to existing zoning ordinances
- Screen development proposals

Rather than being an end in itself, a natural resources inventory is simply a tool for achieving some of the goals listed above. While an NRI is useful in the planning process, it is generally not suitable for site-specific issues. However, the NRI may be used as a screening tool to identify areas where more site-specific assessments may be required.

About this guide

This guide is designed for use by local officials (e.g., conservation commissions and planning boards), conservation organizations, watershed associations, and other interested citizens. It was written to help community groups prepare, evaluate, and use the results of a natural resources inventory. The guide can be used by both communities which are embarking on an NRI for the first time, and communities which are updating or adding to an existing NRI.

With the use of Geographic Information Systems (GIS) becoming more commonplace, GIS is recommended for compiling inventory maps. GIS provides an efficient computer-based tool for managing, updating, and combining NRI information that lends itself to a mapped format. This will require the assistance of a group that has GIS capabilities, such as regional planning commissions, consulting groups, or the development of local GIS capacity.

However, there will often be locally important resource information that may not be available as GIS data layers. These data may be displayed manually or added into the GIS database using a variety of techniques. Keep in mind that some data (e.g., the results of wetland evaluation) don't lend themselves to a GIS-based map (or database) format, and are best reported in descriptive summaries.

Summary Steps: Getting Started

1	**Establish a Work Group** Invite local boards, other local groups, and area residents to attend an initial planning meeting to brainstorm NRI goals and objectives. Establish a smaller work group of 5-7 interested people to direct the project. Elect a project leader/coordinator. Solicit volunteers from the planning meeting.
2	**Determine Goals and Scope of Project** Review community needs and prioritize NRI goals.
3	**Determine Study Area** Decide on the study area (e.g., the town, a subwatershed within the town, a region involving several towns).
4	**Review Existing Natural Resources Documents** Collate and review existing natural resources documents, e.g., master plan, water resources protection plan, existing natural resource studies, etc.
5	**Develop a Draft Inventory Outline** Develop a draft inventory outline that addresses project goals, a work plan, and a rough time line.
6	**Develop a Budget** Investigate costs, identify potential funding sources, and develop a budget.
7	**Publicize the Inventory and Solicit Input** Publicize the project - keep the community informed. Hold displays at public events and run articles in the local paper.

2: Getting Started

Establish a work group

New Hampshire's municipal conservation commissions are established by statute (RSA 36-A:2) "...for the proper utilization and protection of the natural resources and for the protection of the watershed resources of said city or town." The law also specifically states that conservation commissions shall "...conduct research into its local land and water areas," and "...keep an index of all open space and natural, aesthetic or ecological areas, with the plan of obtaining information pertinent to proper utilization of such areas, including lands owned by the state or lands owned by a town or city." The index referred to is a natural resources inventory.

While a conservation commission is a logical leader in developing a community natural resources inventory, not all New Hampshire communities have active conservation commissions, nor should any one group carry the entire load of an inventory project. An inventory that relies primarily on volunteers will be accomplished most effectively by pooling a variety of local talent into a well-organized work group.

Local Officials: Invite members of the conservation commission, planning, zoning, and select boards, recreation commission, historic society, and other local groups to participate in the project. This ensures a variety of interests are represented.

Members of the Community: Advertise the project locally and keep the community informed. Identify people in town who have natural resources backgrounds who might be willing to provide some assistance with the project. If your town has been involved in a visioning process, such as a Community Profile through UNH Cooperative Extension or another organization, and natural resources or open space were identified as a priority, make sure the profile participants interested in natural resources are involved.

Other groups: Local land trusts and watershed associations are key groups to involve in an NRI project. The Society for the Protection of NH Forests maintains and updates a listing of all the land trusts in the state (see Appendix A). If your town is within or contains a watershed that has a river, lake, or watershed association, notify them of your project and solicit their input. Find out what work they have done that could be used in your inventory. High school groups and local teachers also could get involved. As well as providing assistance, this would also help to meet public education goals.

Invite these groups to a planning meeting. This can set the stage for brainstorming a list of inventory goals and common objectives. This approach provides all constituents with an opportunity to have input to the NRI, facilitates communication between groups, and strengthens support for the NRI.

Establish a steering committee and project leader to oversee the NRI project. Small work groups on specific inventory components also could be formed. Tasks can be delegated based on people's interests, such as mapping, field observation, tracking down local information, etc.

Determine goals and scope of project

At the outset, establish the goals, objectives, and scope of the project. An NRI isn't an end in itself. The real purpose is to use it as the basis for future planning. Key questions include:

* Why do you want to do a natural resources inventory?
* What do you hope to accomplish?
* What are the community's needs and desires?
* Are natural resources goals identified in the master plan? If so, which recommendations have been followed through? How can the inventory address recommendations that haven't yet been implemented?
* What natural resources information would you like to see included in the inventory?
* Are there specific natural resource priorities in the study area, e.g., water resources, wetlands, farmlands?

The goals will help to determine the scope of the project. Both short- and long-term goals could be identified. Inventory goals can be specific, such as water resources evaluation, wetlands inventory and evaluation, wildlife habitat assessment, and identification of important farmlands. Other broader goals for using the results of the inventory might include conservation planning, land protection, updating the master plan, updating local regulations (e.g., zoning ordinances), and public education (see Section 5 for a more detailed discussion).

Determine the study area

Setting goals and objectives will help define the study area. Below are some examples of potential study areas:

- ***Town Boundary:*** If the goal is to inventory the town's natural resources, the town boundary will define the study area. It is important to recognize that natural resources cross town boundaries. Geographic Information Systems (GIS) mapping provides the flexibility to show resources that extend beyond the town boundary by including a portion of the surrounding area on the maps (see examples of inventory maps in Appendix C).
- ***Local watersheds:*** Since water resources-related issues such as water quality and supply commonly extend beyond political boundaries, watersheds provide logical units to study and manage natural resources. One town started its NRI by inventorying a specific watershed in town (see Warner example in Appendix D). Watersheds don't follow political boundaries, and may include adjacent towns. Look at opportunities for collaborating with an adjacent town. Unless you have a clear starting point, it would be helpful to identify all watersheds in town. Appendix G provides some basic information on how to delineate a watershed boundary. Larger

The word **watershed** *is used to describe an area of the landscape that collects and directs water flow to a particular river or lake system. All the water within a given watershed drains to a common point downstream, such as the mouth of a river or outlet of a lake.*

A watershed can be made up of many smaller or subwatersheds. For example, the Exeter River Watershed includes a number of tributaries, each with its own watershed. Similarly, the Exeter River Watershed itself is a subwatershed of the larger Piscataqua River Watershed.

watershed boundaries have already been delineated by the NH Department of Environmental Services.

- ***Regional studies involving several towns:*** Some regional watershed groups have decided to inventory the natural resources within their watershed. These watersheds usually encompass several towns, resulting in a cooperative study. A similar approach is followed where regional land conservation groups have initiated a natural resources project in their area (e.g., the Moose Mountain Greenways Project involves representatives from six adjacent towns).

Review existing natural resources documents

Before you start, collect and review existing natural resources studies completed in the study area. This may require going through town records, searching the town library, and checking with other municipal boards (e.g., the planning board) and your regional planning commission about what studies may have been done in your area. Include the natural resources section of the master plan in your review. An NRI should be part of, and contribute to, future revisions to the master plan. Knowing what natural resources information is already available will help avoid duplication and can provide a head start on the inventory.

The document *New Hampshire's Changing Landscape* (see Appendix B) provides some useful background about population growth and development in New Hampshire, predicted growth in the next 20 years, and how much land has already been protected. It also provides a rationale for continued land protection. Another helpful resource is the New Hampshire section of the Natural Resource Conservation Service's *National Resources Inventory*. This can be accessed on-line at the website *http://www.nh.nrcs.usda.gov*.

Develop a draft inventory outline

Work with local officials and other interested citizens to develop a draft project outline that addresses project goals. Include a list of items to be inventoried, maps to be compiled, a rough time line, and some idea of costs. Identify tasks and assign responsibilities. Refer to Tables 1 and 3 for a listing of inventory items and suggested maps. Encourage local boards and commissions to endorse the project outline and contribute funds to the project.

Develop a budget

The direct cost of an inventory depends on the goals and scope of the project, and the extent of the GIS work. Investigate the costs of producing inventory maps, factor in other potential costs (e.g., using a consultant, student interns, photocopies, etc.), and develop a budget. The next step is to identify potential funding sources, which could include conservation commission funds, conservation funds, contributions from the planning and select boards, town funds (e.g., a warrant article at town meeting), private grants, etc.

Publicize the inventory and solicit public input

Publicize the NRI project from the start. Townspeople are more likely to be supportive of a project if they feel involved. Some natural resources may be best identified and evaluated based on community input. For instance, a questionnaire asking residents to list the most attractive natural landscapes in the community may provide information about popular scenic areas.

Attend community events (e.g., town meeting) to display initial inventory maps. Have members of the NRI work group on hand to ask for ideas, answer questions, and provide information. Write articles documenting project progress for publication in the local paper. Run an information tape on the local access TV channel. Throughout the project, it is important to keep the community informed.

Where to find help

There are a number of private and public organizations that can help with an inventory project. Communities can benefit from their technical knowledge, experience and objectivity. Lists of organizations which can provide assistance and their addresses are given in Appendix A.

3. Mapping Options

Using Geographic Information Systems (GIS)

Maps are often the most visible and frequently used products of a natural resources inventory. Resource inventory maps can highlight important resources, and show where potential problems exist that may threaten these features.

Geographic information system (GIS) technology greatly enhances the mapping process, allowing complex projects that would otherwise be extremely time consuming to be completed more quickly. The mapping process described in this guide uses GIS data as the primary source for inventory maps. Guidance is given on how to incorporate natural resources information that isn't available on GIS.

What is a geographic information system?

A geographic information system (GIS) is a computer-based tool that aids in the management, analysis, and display of geographic information. GIS data include the location of geographic features and characteristics about those features. Digital maps showing features of interest can be produced from the GIS data.

Different types of information, such as soils, wetlands, well locations, roads, and town boundaries are stored as separate "data layers". Using GIS, several different data layers can be combined to generate a composite map. For example, a map of surface waters could include rivers, streams, lakes, ponds, floodplains, and local or regional watersheds, as well as roads, political boundaries, and topographic contours. By combining information from a variety of sources into a common scale and format, these maps help planners consider the interactions of many resources and land uses in their decision-making.

The real power of GIS lies in its capacity to combine mapped information with advanced database and analytic capabilities. The GIS database can be queried to answer a variety of questions regarding land use and natural resources, and the answers displayed in the form of maps and/or tables and graphs. GIS can also be used to generate buffers and perform various related distance and measurement calculations (such as acreages).

GIS is usually coupled with large-format color printers which can produce intermediate or large-scale paper or mylar (transparency) originals. These digitally-produced maps can be easily updated or corrected. For a more detailed discussion of GIS, refer to the NH Office of State Planning publication *GIS Guidebook* (see Appendix B).

Map-related information can be automated and entered into a GIS in several ways, including:

1. **Digitizing from existing maps or aerial photographs:** *A commonly used method for automating data involves the use of a digitizing tablet (an electronic tracing device) or an optical scanner. The end result is that the original information is available as a digital (computerized) data file.*

2. **Global Positioning Systems (GPS):** *GPS receivers are portable devices that can be used in the field to accurately capture and store the locations of features in the landscape. They rely on a constellation of satellites to pinpoint their location on the earth. GPS can be an efficient way to add local data, that doesn't already exist in digital format, to GIS.*

3. **Satellites:** *Digital data from satellites and airborne sensors can be used in a GIS. With new satellites that can offer high resolution information, these data may be used more frequently for community-scale inventory work in the future.*

What is the GRANIT GIS database?

New Hampshire's GIS network, known as GRANIT (Geographically Referenced Analysis and Information Transfer), is a collaborative effort among the Office of State Planning, the University of New Hampshire, and several other state, federal and non-profit agencies. GRANIT offers a large computerized statewide database including many of the data layers required for a Natural Resources Inventory. The GRANIT system, under development since 1984, was designed primarily for land use planning applications. Database management and technical coordination are overseen by the UNH's Complex Systems Research Center. More information on GRANIT can be obtained from the web site *http://www.granit.sr.unh.edu*.

Where can you obtain GIS maps and assistance?

The GRANIT Data Catalog provides descriptions of the contents of each data layer and its availability.

Data layers that have already been entered into the GRANIT database can be accessed by organizations with GIS mapping capabilities.

- Regional planning commissions have experienced staff who can help combine natural resources data layers on maps in an easy to read format. There is usually a fee to generate these maps for member towns.
- A growing number of private organizations (such as engineering, planning, and environmental consulting firms) now offer GIS mapping services.
- Some municipalities have developed their own GIS capacity.

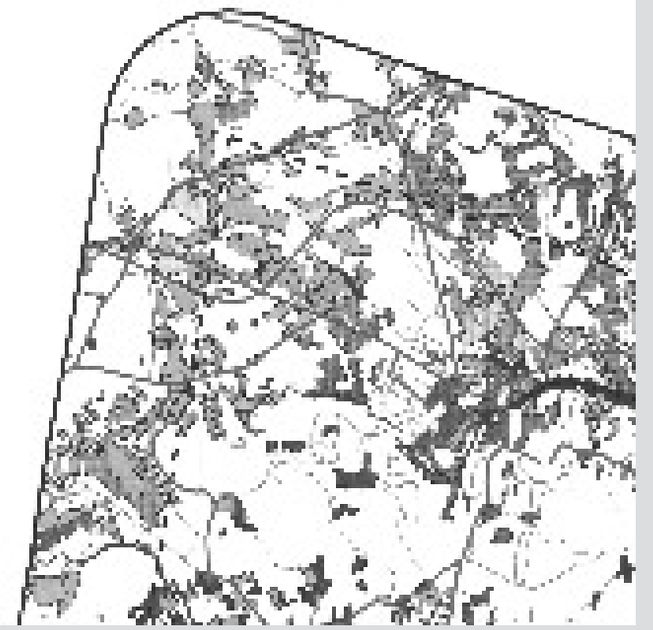
Some GIS data layers (which aren't available through GRANIT) are also available from the regional planning commissions and some non-profits.

A copy of the GRANIT data catalog can be obtained from the NH Office of State Planning (Appendix A). Appendix E provides a sample listing of the data layers available in the GRANIT system as of February 2000. Not all these data layers are available for the entire state.

When you request GIS maps, it is helpful to have some idea of the combinations of data layers that will appear on each map. Tables 1 and 3 (pages 18 and 32) provide suggested combinations of data layers to achieve specific objectives.

Communities may want to consider having some of their work group become more knowledgeable about geographic information systems. UNH Cooperative

Sample of GIS Map showing important soils



Extension offers basic training in the application of GIS technology through workshops and courses. This training combines learning about natural resources management and planning, with developing skills in using ArcView, a desktop GIS software.

What map scale should be used?

Since most of the source data in GRANIT are at a scale of 1:24,000 (1" = 2,000'), it is recommended that this scale be used to generate NRI maps. GIS data are only accurate for the scale of the original mapping. Displaying maps at a larger scale than the original source data implies a level of accuracy that can't be supported by the data, and can lead to misinterpretation. The 1:24,000 scale is also compatible with several other published maps such as the US Geological Survey topographic maps, and the National Wetlands Inventory maps.

Map scale *is the relationship of map measurement to actual ground distance and can be expressed as:*

- **Ratio:** *The most common form of scale that you will see on a map is written as a ratio, e.g., 1:24,000. This means that one unit (e.g., inches) on the map is equivalent to 24,000 units (inches) on the ground, or 1 map inch equals 2,000 feet on the ground (24,000" divided by 12 (to convert inches to feet) = 2000').*
- **Bar scale**: *A bar scale shows map scale graphically, usually expressed in miles.*

Maps are generally referred to as small, intermediate, or large scale. Small scale maps are in the range 1:100,000 or smaller and usually show a large geographic area such as a state or a country. Intermediate scale maps range between 1:10,000 and 1:100,000. Maps in this range provide the accuracy and detail necessary for natural resource inventories. Large scale maps (more than 1:10,000) are used in specific applications, such as surveys of individual parcels of land where the additional detail and accuracy justify their higher expense.

What do you do if the information you need isn't available digitally?

The GRANIT system doesn't currently have complete data layers for the entire state for all types of information. Similarly, some of the local information you may want to include in your natural resources inventory, such as scenic roads, scenic areas, local watersheds, etc., may not be available on GIS. How do you make this information compatible with the computerized maps? Several options are available:

- ***Digitizing new data:*** Additional information (if already on a compatible map base) can be digitized and entered as a new GIS data layer for the study area. Digitizing is labor-intensive work, and can be costly. However, it can be well worth the effort to get the information into GIS. Once in the system, data can be easily accessed and modified for future updates. Note that digitizing produces data that is only as accurate as the source data.
- ***Using a Global Positioning System (GPS) instrument:*** GPS instruments can be used to record new natural resource information. This is a lower cost option than digitizing, and has a higher level of accuracy, but it requires intensive field work, and a trained operator. Note that hand-held GPS instruments aren't as accurate for this type of work. A mapping-quality GPS unit will provide more accurate information. Many land surveyors have GPS capability and experience. UNH Cooperative Extension conducts workshops in the use of GPS and loans out mapping-quality units for community projects.
- ***Creating manual overlays:*** This is the least expensive option for including information not currently in GIS. It can also be used to temporarily update existing GIS data. For example, if you decide to update your town's natural resources

inventory GIS maps periodically, the manual overlay method could be used to keep the maps current during the intervening years. To include data manually, there are two options:

(a) Ask your GIS group to generate an outline of the study area on architectural tracing paper or mylar. These transparent materials can be overlaid with the color maps generated for the NRI. This outline could be as simple as just the town boundary and check marks to facilitate registration. Local or updated natural resource information can be manually drawn onto this overlay.

(b) An alternative option for entering data manually is to transfer the new or updated information directly onto the paper copies of the existing maps. It is important to ensure that the information is entered as accurately as possible. These data can subsequently be digitized.

It is recommended that communities generating their own digital data layers use GRANIT 1:24,000-scale mapping standards as a minimum requirement. If the data is being developed at a larger scale, it will be necessary to modify these standards accordingly. Contact the Complex Systems Research Center at UNH or your regional planning commission (see Appendix A) for information about mapping standards.

How recent are your GIS data?

Some data layers used in an inventory don't change much over time, e.g., soils, aquifers, watersheds, etc. Others, such as roads, conservation lands, groundwater and surface water contamination sites, and rare, threatened and endangered species information, need periodic updating.

Data available through GRANIT and other GIS data providers are only as accurate as the original data from which they were created. Check the creation date for each data layer being used. Some data may be several years old. It is important to be aware of the limitations of interpreting these data. Where the data aren't recent (i.e., not within the last two or three years), more recent or updated information may be available in another format (or it could be entered manually). Find out when future updates might become available or how frequently the data set is updated on GIS. All data sources should be listed (with dates) on inventory maps and documented in the natural resources inventory report. Sample maps in Appendix C show documentation for the data layers being displayed.

Summary Steps: Conducting The Inventory

1 Basic Inventory

Conduct Basic Inventory.

Review the resulting maps and identify any information gaps.

Re-prioritize inventory goals if necessary.

2 Detailed Inventory Studies

Begin Detailed Inventory Studies, starting with the highest priority.

3 Document the Inventory

Compile data associated with inventory maps and studies.

Write descriptive summaries to accompany inventory maps and data tables.

4 Analyze the Information

Review NRI findings and draw up recommendations for future studies.

5 Putting the Inventory to Work

Develop and implement an action plan based on the results of the inventory.

Make the inventory report and associated maps available to other to boards and the general public.

Incorporate inventory results into the master plan.

Consider developing a conservation plan for long-term resource protection and incorporate into the master plan.

After completion of the NRI, periodically review and update information and revise goals as appropriate.

4. What To Include In The NRI

The inventory procedure described here involves a two-phase process: *Basic Inventory*, and *Detailed Inventory Studies*. The Basic Inventory relies on readily available GIS data layers. Examples of some of the Basic Inventory maps are provided in Appendix C. Detailed Inventory Studies include a combination of both GIS and non-GIS-based data, and the associated documentation. The end result is additional GIS maps (where applicable), and narrative descriptions of the resources.

It is recommended that the Basic Inventory be completed before proceeding with the Detailed Inventory Studies. For communities that have already started work on an NRI, or are updating an existing NRI, the data requirements for the Basic Inventory (see Table 1) should be reviewed and gaps identified. The same should be done for Detailed Inventory Studies (Table 3 on page 32).

All inventory maps should include either a one-mile extension around the study area borders, or the map "window" that accommodates the town and extends around adjacent communities should be filled. This will help show the extent of resources that extend beyond town boundaries, and can also help identify opportunities for cooperation with adjacent towns.

Basic Inventory

The first step in an NRI is to collect and map readily available natural resources information to get an initial picture of the community's natural resources. Most of the information required for the Basic Inventory is already available through GRANIT with the following exceptions: in some communities County Soil Survey and National Wetlands Inventory data may not yet be available in digital format for use with GIS (as of 2000).

The purpose of the Basic Inventory is to give a quick visual overview of a community's natural resources. It provides a basis for assessing the current status of natural resources in the study area and helps set goals for future steps in the inventory process. This can help the work group refine their focus, identify information gaps, and prioritize next steps. The Basic Inventory provides a basis for making decisions on what additional data are needed to make the inventory meaningful in the context of the study's goals and objectives.

Table 1 describes the GIS maps and associated data requirements recommended for the Basic Inventory. Each of the data requirements is discussed in more detail starting on page 19. Regional planning commissions and other groups with GIS capabilities can provide assistance with compiling inventory maps. Appendix C provides some examples of Basic Inventory maps.

The Basic Inventory maps can be put to immediate use by taking these maps to community events to familiarize residents and officials with the NRI project. This provides an opportunity both for public education and to solicit additional input from the community.

Table 1: Basic Inventory

Recommended Maps and Associated Data Requirements

MAP TITLE	DATA REQUIREMENTS	Page
Base Map	• Political boundaries, transportation and utility networks, surface water features, topography, regional watershed boundaries	19
Conservation Lands Overlay	• Conservation Lands (including detail on type of ownership)	19
Drinking Water Resources and Potential Contamination Sources *This map can be generated by the NH Department of Environmental Services for New Hampshire towns. NHDES supplied each town with a copy of this map in 1999. Additional updated copies may be obtained from NHDES (see Appendix A). There is usually no charge for this map. DES will produce this map for watersheds as well as municipal boundaries.*	GIS data layers shown on the NHDES map include the following: • Political boundaries, transportation and utility networks • Surface Water Resources (including regional watershed boundaries) • Ground Water Resources (stratified drift aquifers, wellhead protection areas, public water supply sources) • Known and Potential Contamination Sources • National Wetlands Inventory Data • Conservation Lands (does not include detail, such as type of ownership, etc.)	 19 21 22 23 29 19
Lands of Special Importance	• Prime Farmland Soils • Soils of Statewide Importance • Rare, Threatened, and Endangered Plant and Animal Species and Plant Communities (NH Natural Heritage Inventory)	25 25 27
Unfragmented Open Space Blocks overlay	• This map is derived by using existing roads data, which are available as a GIS data layer.	28
Wetlands Composite *If hydric soils and NWI data are available in digital format, and wetlands are a priority in town, it may be useful to generate this map during the Basic Inventory. If hydric soils and/or NWI wetlands haven't been digitized, this map can be generated at a later stage during the Detailed Inventory Studies. Note that the National Wetlands Inventory data, if available in digital format, is displayed on the Drinking Water Resources map described above.*	• National Wetlands Inventory Wetlands • Hydric Soils	29 29

* A more detailed description of each of the listed data requirements is given on the corresponding page number.

If already digitized and available on GIS, tax map and zoning information could be included in the Basic Inventory (see further discussion under Detailed Inventory Studies on page 51 and 52 and in Appendix C).

Basic Inventory Components

Base Map Data

Background:

The base map should be prepared, reviewed and finalized before proceeding with other NRI maps. With the exception of topography (which may not appear on all maps) the base map data should serve as the basis for subsequent inventory maps.

What to include:

Base map data should include the following:

- Community political boundaries.
  Abutting towns should be identified for easier map interpretation.
- Study area boundary.
  The study area boundary may include the entire community, a portion of the community (e.g., a local watershed), or several communities (e.g., a regional watershed). It should include at least a one-mile extension beyond the study areas to show the resources that extend beyond study area boundaries.
- Transportation (roads and railroads).
  It may be necessary to update the GRANIT roads data layer as this is subject to frequent change. Key road names should be added for easier map interpretation.
- Utility networks.
- Surface water features (lakes, ponds, rivers and streams).
- Topography.
  It isn't necessary to use the topographic base on all subsequent maps. It can clutter a map that already has several other data layers, making interpretation difficult.

Note: All of the above information is available statewide through GRANIT.

Where to find help:

See Appendix A for a list of contact addresses for these organizations.

UNH Cooperative Extension
Technical assistance

Regional Planning Commissions
Mapping assistance

Conservation and Public Lands

Background:

By definition, conservation lands are properties that are generally undeveloped and protected from future development. Mapping the study area's conservation lands will help identify potential needs and opportunities for expanding these areas to provide links between protected areas, or to add protected buffers to sensitive areas.

Protected lands can include a variety of public and privately-owned lands. Public lands may include federal, state, and municipally-owned lands. Note that public land ownership doesn't necessarily ensure that land is protected in perpetuity. Conservation lands data are available as a data layer in GRANIT (see discussion below). The GIS data includes information on what type of protection is in place (e.g., conservation easement, fee ownership, etc.).

The town's list of publicly-owned properties can be examined to determine what, if any, deed restrictions apply to the properties. For example, conservation easements are permanent deed restrictions where the development rights have been removed. Lists of town-owned lands can be found in annual town reports or in the list of properties, by owner, that accompanies the town tax maps.

Land trusts are private, nonprofit organizations that protect land through a variety of voluntary methods, including outright purchase and conservation easements. If a land trust is working in your community or region, contact them for an up-to-date listing of their protected parcels. The Society for the Protection of NH Forests maintains and regularly updates a list of land trusts in the state. A sample listing is provided in Appendix A.

What to include:

Conservation lands are mapped for the whole state by the Society for the Protection of NH Forests (SPNHF) in cooperation with the NH Office of State Planning and UNH Complex Systems Research Center. This involves considerable input from local communities. This data set has been automated for use in the GRANIT database. The accuracy of parcel boundaries varies depending on the source documents used (tax maps, deeds, etc.). When displaying conservation lands on GIS maps, it is helpful to show these by category, e.g., federal, state, town, or private ownership.

The conservation lands data layer is updated on a regular basis, depending on funding availability. Plans are underway to create a conservation lands registry on the GRANIT website to help communities regularly add updated information. Check the GRANIT website *http://www.granit.sr.unh.edu/* for future updates. While most conservation lands have been mapped statewide, each town can play an important role in updating the database.

Publications that can be helpful for land protection issues include *Conservation Options: A Landowner's Guide*, *Does Open Space Pay*, and *New Hampshire's Land and Community Heritage at Risk* (see Appendix B).

Where to find help:

See Appendix A for a list of contact addresses for these organizations.

Society for the Protection of NH Forests
Directory of NH Land Trusts

UNH Cooperative Extension
Map of NH showing Land Trust coverage, and SPNHF Directory of Land Trusts; Technical assistance

Regional Planning Commissions
Mapping assistance

Surface Waters

Background:

New Hampshire's 1,300 lakes and ponds cover about 280 square miles of the state's area. Over 10,000 miles of streams and rivers flow through the state. The quality of surface water resources can be affected by point and non-point pollution sources. These water quality issues are discussed further on page 23 under the heading Ground and Surface Water Known and Potential Contamination Sites.

What to include:

An inventory of surface water features would include (at the least) streams, rivers, lakes, and ponds (all available through GRANIT GIS). Regional watershed boundaries (defined by NHDES) provide logical units for evaluating surface water resources. Additional items such as floodplains, local watershed boundaries, and stream order could be included at a later stage in the inventory (see Detailed Inventory Studies).

Where to find help:

See Appendix A for a list of contact addresses for these organizations.

NH Department of Environmental Services - Biology Bureau
Water quality monitoring in lakes and great ponds

NH Department of Environmental Services -
Rivers Management and Protection Program
Stream order, designated rivers, list of watershed associations

UNH Cooperative Extension
Technical assistance
Water quality monitoring of lakes, Great Ponds, streams, rivers and estuaries (Lakes Lay Monitoring Program and Great Bay Coast Watch)

Regional Planning Commissions
Mapping assistance

Groundwater Resources

Background:

More than 50% of New Hampshire's population depends on groundwater supplies for drinking water. Groundwater also provides over 40% of the total annual river flow in New Hampshire's rivers and streams.

Groundwater is the source of water for wells and springs. It is found below the land surface within cracks and fractures in bedrock, or in the spaces between particles of soil and rocks. Saturated zones in sediments such as sand and gravel, and in fractured rock formations that receive, store and transmit water to wells and springs are called aquifers. Rain and melting snow percolate downward into this zone as groundwater recharge.

As the water moves down, plants consume a portion, some is evaporated, and some is retained in the soil. The remainder percolates down, usually very slowly, to recharge the aquifers. Some of this will eventually discharge to streams, lakes and wetlands. The land surface that is principally involved with a specific groundwater recharge is called the recharge area.

While groundwater quality in New Hampshire is generally good, drinking water quality can't always be assumed to be the same. An assumption is often made that groundwater is less vulnerable to spills and pathogens than surface water and less likely to be contaminated. In reality, groundwater is vulnerable to contamination from buried sources such as toxic leachate from underground storage tanks and landfills, and effluent from septic systems. Other factors potentially affecting groundwater quality include: salt contamination from winter spreading and year-round storage, sand and gravel mining, commercial and manufacturing operations located within or in close proximity to aquifer areas, and common household, lawn and garden chemicals (e.g., polish, thinners, paints, herbicides, etc.). Refer to the section "Known and Potential Contaminants" below for further discussion of contaminants.

A useful reference is the *NHDES Guide to Ground Water Protection* (see Appendix B). Information and fact sheets on groundwater protection can also be obtained from the American Ground Water Trust, based in Concord, NH (see Appendix A).

Stratified drift aquifers *consist of sorted and layered coarse-grained sediments (sands and gravels) deposited by glacial meltwaters at the time of deglaciation. Interconnected spaces between sediment particles provide space through which stored ground water can flow.*

What to include:

Many of New Hampshire's reliable aquifers are found in deep, coarse-grained stratified drift aquifer deposits (sand and gravel deposits). The Basic Inventory should include identification of the location and extent of these aquifers.

In a joint program between the US Geological Survey (NH) and the NH Department of Environmental Services, all stratified drift aquifers in the state have been mapped and accompanying reports published. These data are available from GRANIT for all of the state. Other related information that can be included in the Basic Inventory, and is available

from GRANIT, includes public well locations and active public drinking water supplies (the latter include both groundwater wells and surface water intakes). A public water supply is defined as a piped water system having its own sources of supply, serving 15 or more services or 25 or more people for 60 or more days per year.

Additional data are available that aren't necessary for the Basic Inventory, but which could be included at a later stage (e.g., if a Water Resources study is done as part of the Detailed Inventory Studies). These data includes information on aquifer location, size, and shape, type of sediments, water table, well locations, water quality, water yield, and wellhead protection areas. The state wellhead protection program, which began operating in 1991, enables certain municipal authorities, water suppliers, and other local entities to delineate protection areas, to identify potential contamination sources, and to actively manage land use in protection areas. As of 1998, wellhead protection programs were underway for 444 of the state's 1,657 public water supply wells.

Where to find help:

NH Department of Environmental Services - Drinking Water Program
NHDES Drinking Water Resources and Potential Contamination Sources Map

UNH Cooperative Extension
Technical assistance

Regional Planning Commissions
Mapping assistance

Ground and Surface Water Known and Potential Contamination Sites

Background:

One of the most important natural resources is water. Maintenance of a quality water supply in ample quantity, prevention of point and non-point sources of pollution, and management of water resources for recreation and wildlife habitat should have high priority. In any assessment of natural resources, it is important to know where actual and potential contamination areas are located.

For further information, refer to the following New Hampshire publications: *Following the Flow (non-point source pollution assessment)*, also available on video, *Stream Study and Water Quality Assessment Guide,* and the *Guide to Non-Point Source Pollution for Local Towns* (see Appendix B for full references).

What to include:

These data can be used to determine potential or actual threats to water resources. Each of the data layers are discussed below:

NPDES Outfalls: The coverage for the National Pollution Discharge Elimination System (NPDES) Outfalls was developed by the NH Department of Environmental

Services (NHDES) Wastewater Engineering Bureau. It contains the locations of outfalls for facilities registered under the National Pollution Discharge Elimination System. Under this program, established by Public Law 92-500, all facilities that discharge any pollutant from point sources to surface waters (directly or indirectly) are required to obtain a federal permit from the US Environmental Protection Agency. The NHDES also issues a State Water Discharge Permit for the same outfalls.

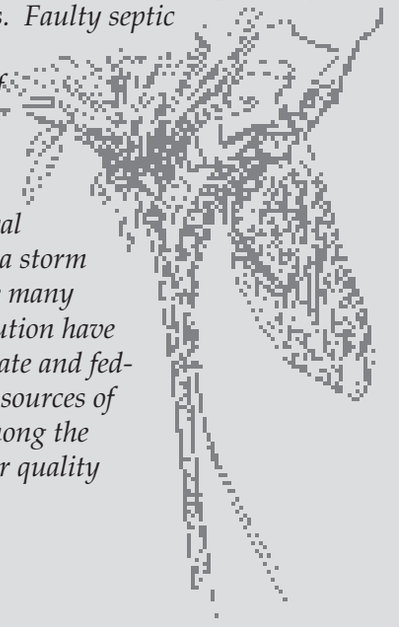
Groundwater Hazards Inventory: Data are provided by the NHDES. The Hazards Inventory provides a listing of potential and existing threats to groundwater quality. Examples of the type of data included are: hazardous waste sites, landfills/dumps, community septic systems, and superfund sites.

Underground Storage Tanks: These data is provided by the NHDES Underground Storage Tank registration database. The database includes all registered underground storage tanks.

Point/Non-Point Pollution Sources: These data represents selected types of point and non-point pollution sources, as collected by NHDES and NH Office of State Planning. Communities may be aware of other locally significant non-point pollution sources that don't appear on the maps. Communities could identify these sources on the maps using a transparent or tracing paper overlay. Additional non-point source problem sites could be identified by following the procedure in Following the Flow (see Appendix B).

Point sources of pollution *are relatively easy to identify because they come from a particular point such as a pipe, e.g., industrial discharges and the outfall from a wastewater treatment plant are point sources.*

Non-point source pollution *is generated from many scattered sources, and can't be traced to a single point. Non-point source pollutants are generated when surface runoff waters wash over lawns, parking lots, city streets, farm fields, and construction sites and pick up pollutants such as sediments, bacteria, gas, oil, pesticides and fertilizers. Faulty septic systems are another non-point source of pollutants. The resulting polluting runoff may travel to waterways via natural drainage or through a storm drain system. While many point sources of pollution have been controlled by state and federal laws, non-point sources of pollution are still among the major causes of water quality problems.*



Where to find help:

See Appendix A for a list of contact addresses for these organizations.

NH Department of Environmental Services - Water Supply and Engineering Bureau
Drinking Water Resources and Potential Contamination Sources Map

UNH Cooperative Extension
Technical assistance

Regional Planning Commissions
Point/non-point pollution sources, mapping and technical assistance

Prime Farmland Soils and Soils of Statewide Importance

Background:

Prime Farmland, as defined by the USDA Natural Resource Conservation Service (NRCS), is land best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland or other land, but it isn't urban or built-up land or water areas. It either is used for food or fiber crops or is available for those crops. Prime farmland soils produce the highest yields with minimal expenditure of energy and economic resources. Farming them results in the least damage to the environment.

Areas of prime farmland soil are derived from the County Soil Surveys, based on soil unit attributes supplied by the NRCS. Prime farmland soils have increased significance when these areas coincide with current agricultural use.

Soils of Statewide Importance are lands, in addition to prime and unique farmlands, that are of statewide importance for the production of food, feed, fiber, and forage. As with prime farmland soils, soils of statewide importance are derived from the County Soil Surveys, based on soil unit attributes supplied by the NRCS.

What to include:

Prime farmland soils and soils of statewide importance data are available from GRANIT for those communities where digitized soils data are available.

Information not available in GIS: If soils data aren't available on GIS, this information can be derived from the county soil survey, which lists prime farmland soils and soils of statewide importance for the county, and shows these areas on the soil maps (coded by soil type). These areas should be traced manually. Be sure to use the most recent soil survey update.

Where to find help:

See Appendix A for a list of contact addresses for these organizations.

Natural Resource Conservation Service
Prime Farmland Soils, Soils of Statewide Importance

UNH Cooperative Extension
Technical assistance

Regional Planning Commissions
Mapping assistance

Table 2: Sample Summary Information on Known Rare Plant, Rare Wildlife, and Exemplary Natural Community Occurrences in a Hypothetical Town.

Species/Natural Community Name	Federal/State Listing	State Ranking	Global Ranking	# Locations Reported in the Last 20 Years	
				Town	State
WILDLIFE					
**Wood turtle (*Clemmys insculpta*)	--	G4	S3	1	23
***Dwarf wedge mussel (*Alasmidonta heterodon*)	state endangered fed. endangered	G1	S1	2	19
PLANTS					
*Ambiguous sedge (*Carex amphibola* var. *rigida*)	state threatened	G5	S2	1	4
Barren strawberry (*Waldsteinia fragarioides*)	state threatened	G5	S1	historical only	8
**Dwarf ragwort (*Senecio pauperculus*)	state threatened	G5	S2	1	13
***Jesup's milk-vetch (*Astragalus robbinsii* var. *jesupii*)	state threatened	G5	S2	1	3
NATURAL COMMUNITIES					
***Calcareous Riverside Seep Community	--	G2	S1	1	6
**Circumneutral Cliff Community	--	--	S3	1	2

Flags

To help planners assess the relative importance of rare species and exemplary natural communities in their towns, NHNHI can attach "flags" to occurrences that have been recorded in the last 20 years. The flags are as follows:

****	Highest	An excellent example of a globally rare species or natural community
***	Extremely High	A good example of a global rarity or an excellent example of a state rarity
**	Very High	A marginal example of a global rarity or a good example of a state rarity
*	High	A marginal example of a state rarity

Planners should remember that there are many different ways to assess the value of a rare species population or a natural community. It is therefore recommended that towns contact NHNHI to discuss why occurrences in their towns were flagged at a particular level.

State and Global Ranks

Examples		*Description*
G1	S1	Critically imperiled because extreme rarity (generally one to five occurrences) or some factor of its biology makes it particularly vulnerable to extinction.
G2	S2	Imperiled because rarity (generally six to 20 occurrences) or other factors demonstrably make it very vulnerable to extinction.
G3	S3	Either very rare and local throughout its range (generally 21 to 100 occurrences), or found locally (even abundantly at some of its locations) in a restricted range, or vulnerable to extinction because of other factors.
G4	S4	Widespread and apparently secure, although the species may be quite rare in parts of its range, especially at the periphery.
G5	S5	Demonstrably widespread and secure, although the species may be quite rare in parts of its range, particularly at the periphery.
GH	SH	Known only from historical records, but may be rediscovered. A G5 SH species is widespread throughout its range (G5), but considered historical in New Hampshire (SH).

Rare Plant and Animal Species and Exemplary Natural Communities

Background:

Since 1986, the NH Natural Heritage Inventory (NHNHI) has been finding, tracking, and providing information about New Hampshire's biodiversity. NHNHI maintains a database of known rare plant populations, rare wildlife populations, and exemplary natural community occurrences (different types of forests, wetlands, grasslands, etc.). Rare wildlife occurrences are maintained in cooperation with the NH Fish & Game Department's Nongame and Endangered Wildlife Program, which has legal jurisdiction over these species.

NHNHI tracks rarity at both state and global levels using a scale from 1 to 5, with 1 indicating "critically imperiled," 3 denoting "uncommon," and 5 indicating "common." For example, the small yellow lady's-slipper (*Cypripedium parviflorum*) is quite rare in New Hampshire (and therefore has a state ranking of "S1") but is common elsewhere (and therefore has a global ranking of "G5"). Jesup's milk-vetch (*Astragalus robbinsii* var. *jesupii*), on the other hand, is a wildflower with only three occurrences in the world, all in a 16-mile stretch of the Connecticut River. It is therefore critically imperiled both in New Hampshire and globally.

NHNHI also keeps information on the relative quality of rare species populations and natural community occurrences. Quality is an important consideration when assessing an area's conservation importance. NHNHI considers all rare species populations and exemplary natural communities to be of high conservation value, but an "excellent" rare plant population (say with several hundred plants) of a globally rare species is particularly important when compared to a "marginal" population (say with only five plants).

Table 2 (see facing page) provides an example of summary information available from NHNHI.

What to include:

Some NHNHI data are available through GRANIT. This data layer contains locational information on known rare species and exemplary natural community occurrences. It is important to note that there hasn't been a comprehensive biodiversity inventory of New Hampshire. Since many areas have never been surveyed, a negative result (no records in the NHNHI database) shouldn't be interpreted as proving that no rare species or exemplary natural communities are present.

Due to the data's sensitive nature and landowner privacy concerns, the actual location data maintained by NHNHI are generalized prior to distribution by GRANIT. That is, rather than displaying point locations, a large diameter circle is used to show the generalized location of a rare species population and/or exemplary natural community. This generalized locational data may be limited in its usefulness. It is recommended that communities focus on protecting the habitat of species listed in the NHNHI data rather than simply focusing on the point location. The NHNHI database is constantly growing, and the data layer available through GRANIT is updated every six months.

Note: Written permission needs to be obtained from NHNHI prior to the use of this data layer.

Where to find help:

See Appendix A for a list of contact addresses for these organizations.

NH Natural Heritage Inventory (NHNHI)
Listings of rare, threatened, and endangered plant and animal species

NH Fish & Game Department
Identifying and Prioritizing Significant Wildlife Habitat: A Guide for New Hampshire Communities and Conservation Groups

Regional Planning Commissions
Mapping assistance

Unfragmented Open Space Blocks

Background:

Unfragmented open space blocks are undeveloped sections of the landscape with few or no roads. These unfragmented areas can include forested areas, open water, wetlands, and agricultural lands (and may include gravel pits and clear-cuts as well). These blocks are unrelated to ownership boundaries. Unfragmented lands have significance for wildlife habitat, as well as identifying large areas of open space.

The size of these unfragmented blocks of land varies depending on the location. For example, in southeastern New Hampshire where there is a high level of development, an unbroken block in the hundreds of acres is significant. In northern New Hampshire, where there has been less development and there are large timberland areas, significant unfragmented blocks are much larger, in the thousands of acres.

Unfragmented blocks often encompass many habitat types, supporting a diverse array of native wildlife. Large tracts with diverse habitats support wide-ranging animals that can't survive in small, less diverse habitat areas. Unfragmented areas that are largely forested are important for a number of wildlife species, and provide safe travel corridors and migratory pathways. Reducing the size of forest tracts affects many species, even if all other habitat features remain the same. Studies of North American birds have shown that larger forest tracts support more species than comparable smaller tracts. Some neotropical migrant birds don't nest in isolated woodlands of less than 500 acres since smaller tracts are less likely to include essential microhabitats.

Fragmentation of undisturbed habitats may also result in barriers for many terrestrial species. For example, roads are a source of mortality and a barrier to wildlife movement. The impact of roads varies according to their type and intensity of use. An unmaintained dirt road with infrequent traffic doesn't represent the same threat to wildlife that a busy highway does.

Identifying unfragmented blocks can also be helpful to those communities working on open space plans, conservation plans, or land protection. Maintaining areas of open space in rapidly developing environments is becoming increasingly significant as those areas diminish. Unfragmented blocks can also provide important recreation areas for people. Knowing the location and size of unfragmented tracts can help communities identify areas that may be threatened, or which are priorities for protection. Communities need to be aware of the importance of keeping unfragmented lands intact.

What to include:

Unfragmented blocks information can be mapped using NH DOT or USGS data on roads available in GRANIT. This analysis should exclude all NHDOT Class 6 roads, and USGS Class 5 roads because these types of roads aren't considered significant barriers to wildlife (and many of them can be regarded as trails). Using GIS, the remaining road classes are buffered by a 500 foot width, where it is assumed that most development occurs. This results in unfragmented areas characterized by little or no development. Check how recently the road data being used were updated, and if private roads are included in the data. If the road data haven't been updated recently, there may be occasional inaccuracies.

Areas could be categorized according to block size, e.g., 250-500 acres, 500-1,000 acres, and 1,000+ acres. The number and size of unfragmented blocks will vary for each community, depending on the existing level of development and land fragmentation. Urban areas may find only a few unfragmented blocks, and those that exist may be small. More rural areas could find blocks of 1,000 acres and more. Since some unfragmented blocks may extend across town boundaries, it is advisable to include the adjacent towns in the overall analysis.

Where to find help:

Regional Planning Commissions
Mapping assistance

UNH Cooperative Extension
Technical assistance

Wetlands

Background:

The New Hampshire Wetlands Bureau and the Army Corps of Engineers define wetlands as "...those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and do support, a prevalence of vegetation typically adapted for life in saturated soil conditions."

While many communities have used poorly and very poorly drained soils on the County Soil Survey maps to define wetlands, a more complete image of wetland coverage can be obtained by combining these data with National Wetlands Inventory (NWI) data. Note that these data provide a general picture of wetlands, and aren't

suitable for site-specific analysis (except as a screening tool to indicate the possible occurrence of wetland conditions. Both of these data sets have some limitations, noted below.

County Soil Survey Data: County soil survey data provides information about poorly and very poorly drained soils* which are commonly used as wetland indicators. In general, the soils maps tend to somewhat overestimate the acreage of wetland soils, due in part to the scale of the soils mapping (the smallest mapping unit is two acres). For the same reason, they may also miss some of the smaller wetlands. Soils data are available from GRANIT for many parts of the state.

National Wetlands Inventory Data: The National Wetlands Inventory (NWI) provides information about the type of wetland, vegetative cover, and flooding regime. Wetlands in the NWI data were identified from aerial photographs acquired in 1985 or 1986 at a relatively small scale (1:58,000). As a result, certain types of wetlands that may be more difficult to identify, e.g., forested wetlands, may be under-represented. However, the areas designated as wetlands in NWI data have a high probability of being wetlands, since these wetter sites are more easily identified using infrared imagery. A strength of the NWI data is that they show vegetation classes, giving a quick cut on uncommon (e.g., Atlantic white cedar swamps), and complex (high vegetation class diversity) wetlands. NWI data are available in digital form from GRANIT for much of the state.

What to include:

Soils and NWI data available on GIS: For those areas that have both information sources available from GRANIT, it is recommended they be combined on a single base to form a composite wetlands map.

Soils and/or NWI data not available on GIS: If these data aren't available on GIS, there are other options for including the information in the inventory:

i) Contract with your regional planning commission to digitize the NWI data for use in GIS. It can be expensive to digitize soils data because of the complexity in the soils maps. A less expensive route is to use the following option.

ii) If funds aren't immediately available for digitizing, obtain copies of the NWI quadrangles and/or soils maps for the study area. Since the NWI maps are already at a scale of 1:24,000, and if the GIS maps are being produced at the same scale, the quadrangles can be manually joined to get the best match. Recently updated soils maps also use a scale of 1:24,000. Identify all poorly and very poorly drained soil areas (lists of these soils by county are available at each NRCS county office). Trace the wetland soils onto mylar or some other transparent

Hydric soils *are defined by the NH Wetlands Bureau and The Army Corps of Engineers as; "...saturated, flooded or ponded long enough during the growing season to develop anaerobic (oxygen-deprived) conditions in the upper part."*

paper/film that can be overlaid onto the NWI map to create a composite wetlands image (or a town could have the maps scanned, georeferenced and reprinted onto transparent mylar).

Where to find help:

See Appendix A for a list of contact addresses for these organizations.

NH Office of State Planning
Copies of NWI maps

NWI website: *http://www.fws.gov/pullen/pointers/nwipoint.html*
Information on the National Wetlands Inventory

Suggested Additional Information

While much of the inventory may be GIS-based, it can be helpful to obtain copies of several existing maps (e.g. USGS Topographic, National Wetlands Inventory, and NRCS Soil Survey maps) and aerial photos that can be used as a base reference during the course of an inventory. These items are discussed in more detail in Appendix F.

Table 3: Detailed Inventory Studies

INVENTORY STUDY	DATA REQUIREMENTS	PAGE*	ASSOCIATED MAPS**	DOCUMENTATION
Water Resources Evaluation	• Local watershed boundaries • 100-year floodplains • Favorable Gravel Well Analysis (NHDES) Other water resources studies could include water quality monitoring, etc.	34 35 36	Additional water resources data (e.g., local watersheds and floodplains) can be added to the **Base Map** **Favorable Gravel Well Analysis Map** (this map can be generated by NHDES, and is available to NH towns at no charge) **Drinking Water Resources & Potential Contamination Sources Map** (used in Basic Inventory)	Description of data used in and major findings of the water resources studies (include any data tables)
Wetland Studies	• Wetland evaluation & prioritization	37	**Composite Wetlands Map** (may already have been generated for Basic Inventory)	Description of wetland evaluation and prioritization studies and results
Agricultural Lands Assessment	• Active farmlands	38	Add to **Lands of Special Importance Map** (these data build on the Lands of Special Importance Map compiled for the Basic Inventory)	Documentation of active agricultural lands
Forest Resources	• Productive Forest soils, managed forest lands and unusual forest types	40	These data could be added to the **Lands of Special Importance Map** (providing they don't clutter the map), or they could be shown on a separate map titled **Forest Resources**	Narrative description of significant forest lands
Undeveloped Shorelands	• Undeveloped shorelands	43	These data could be added to the **Lands of Special Importance Map** (providing they don't clutter the map), or they could be shown on a separate map titled **Undeveloped Shorelands**	Document methods used to identify undeveloped shorelands
Significant Wildlife Habitats	• Follow procedure in Identifying and Prioritizing Wildlife Habitat: A Guide for NH Communities and Conservation Groups	44	**Significant Wildlife Habitats Map**.	Documentation of the results of the Wildlife Habitat study
Cultural and Natural Resource Features	• Archaeologic and historic sites • Scenic areas & designated scenic roads • Recreation areas • Unique geological resources	46 47 48 50	**Cultural and Natural Resource Features Map**	Documentation can include descriptions, photographs and tables of information

* A more detailed description of each of the listed data requirements is given on the corresponding page number.

** Associated maps include several maps that were generated for the Basic Inventory as well as additional maps generated for specific Detailed Inventory Studies

Detailed Inventory Studies

Once the Basic Inventory is complete, it can be expanded according to the work group's specific needs and prioritized goals. The purpose of the Detailed Inventory Studies is to collect additional information that supports the primary goals of the NRI. This may involve incorporating information from other studies, initiating new studies, using existing GIS-based data, and/or collecting local data.

Detailed Inventory Studies involve more than GIS maps. Documentation in the form of narrative descriptions and supporting data tables are an important component of these studies. While the maps provide an important and often enlightening visual image (valuable for public education), their primary function is to provide a tool to help achieve inventory goals, such as land protection, conservation planning, etc.

Table 3 lists some suggested Detailed Inventory Studies and the associated data requirements, documentation, and maps. This listing isn't exhaustive, but rather gives some of the more common studies completed for an NRI. Other studies or data sources may be added depending on the work group's goals.

It is often more efficient to focus on one study (or one priority) at a time, noting that there can be multiple data requirements involved in evaluating a single resource or priority. Not all the Detailed Inventory Studies listed in Table 3 need to be completed by all communities. Depending on the prioritized goals, the work group can select to undertake those Detailed Inventory Studies that best meet their needs.

Detailed Inventory Studies may not necessarily add any information to the inventory maps, but provide valuable information for, and further the goals of the NRI. For example, wetland evaluation and prioritization provides additional information about the functions and values of wetlands. This information may best be presented in tabular, graphic, or narrative form and included in the accompanying NRI descriptive report. In one community the wetland evaluation study (and associated documentation) was used as the basis for a wetland and watershed protection ordinance (see Conway example in Appendix D).

Detailed Inventory Studies that involve the use of GIS data layers can be further extended by querying the GIS database to answer a variety of questions regarding land use and natural resources. For example, the GIS database could be queried to show all potential pollution sources within a certain distance of a particular waterbody, or it could be queried to show wetlands associated with stratified drift aquifers.

GIS can also be used to map buffers and perform a number of related distance, acreage, and other measurement calculations. For example, if a community were to adopt a 100-foot wetlands setback requirement for certain land uses, the GIS database could be queried to determine which areas would be impacted, and how much acreage those areas represented.

Detailed Inventory Components

Local Watersheds

Background:

A watershed may be made up of many smaller drainage areas, or "subwatersheds". Regional watersheds can encompass several towns, while a local watershed can include a section of town, based on a local drainage. For example, the Exeter River Watershed in southeastern New Hampshire spans ten towns and includes a number of tributaries, each with its own watershed. Similarly, the Exeter River Watershed itself is a subwatershed of the larger Piscataqua River Watershed, which drains into the Atlantic Ocean at Portsmouth. Because water resources issues such as water quality and water supply commonly extend beyond political boundaries, surface drainage systems (i.e., watersheds) provide logical units to study and manage natural resources.

A natural resources inventory and land protection effort could be conducted on a watershed basis involving several towns occupying a single watershed, or a community could look at smaller local watersheds or subwatersheds. One community started its natural resources inventory by first focusing attention on just one watershed in town (see example in Appendix D). This approach enabled the community to conduct a natural resources inventory and land conservation in an easily accomplished manner. However, when processing the GIS data, it may be better to initially cover the entire area of interest and then collect detailed information in smaller or more focused units, such as subwatersheds.

Where a local watershed straddles more than one town, there is potential for intercommunity participation in natural resources projects. Similarly, regional watershed studies involving several communities present another opportunity for intercommunity participation, and provide a perspective on natural resources in their broader context.

Defining the major subwatersheds in town can be particularly helpful in assessing land use impacts on water quality. Mapped watershed boundaries also provide a quick visual reference of how surface waters relate to other features.

What to include:

GRANIT data includes statewide coverage of watersheds as defined by the USGS Hydrologic Unit Classification in New Hampshire. A more detailed coverage of watersheds than previously existed will be available in digital format on GRANIT in late 2000 through NHDES. GRANIT doesn't provide information on local watersheds at the town level. If needed, these watersheds should be delineated using the procedure outlined in Appendix G. Alternatively, the group doing the GIS work may be able to help with this task. In order to define local watershed boundaries, the surface water drainage network in the study area needs to be identified.

Local watershed boundaries can be easily and relatively inexpensively digitized into GIS for use with other GIS-related natural resources inventory maps. Note

that some local watersheds may have already been delineated and digitized by the regional planning commissions, NHDES, Natural Resource Conservation Service, UNH Cooperative Extension, or UNH Complex Systems for specific projects.

Where to find help:

See Appendix for a list of contact addresses for these organizations.

NHDES Rivers Program
List of Watershed Associations

UNH Cooperative Extension
Technical assistance

Floodplains

Background:

By slowing and storing floodwaters, floodplains reduce downstream flood damage. The expected extent of land covered by water during a 100-year flood is the standard by which floodplains are delineated, since this is assumed to be the worst extent of flooding that can reasonably be expected.

Flood frequency is a statistical measure of the probable occurrence of a flood of a given magnitude. Large floods occur relatively infrequently, with recurrence intervals measured in hundreds of years, while small floods occur quite frequently, perhaps two or three times a year, consequently having a very short return period. While the one-year and 100-year floods can occur at any time, the former is more likely. A 100-year flood is the level of flooding that has a one in 100 chance of happening in any given year.

As development occurs upstream in a watershed, runoff volume and rate are increased by the larger area of paved and other impervious surfaces (e.g., roofs of buildings). Flooding can consequently become more frequent and floodwaters more damaging since they are moving faster. Preserving floodplains becomes increasingly important as uplands are developed, as does attention in local ordinances to minimizing the extent of impervious surfaces.

A floodplain in its natural state is the most cost-effective way to reduce flood damages, and has been found to be far less expensive than dams, channelization, and other structural methods. Undeveloped floodplains also trap sediments and pollutants and reduce erosion. Protecting floodplains helps to reduce water pollution; con-

Floodplains *are relatively flat areas of land bordering a river or stream that result from the accumulation of sediment deposited by the river during times of flood. By trapping sediments and reducing erosion, undeveloped floodplains play an important role in preventing pollution of river and stream waters.*

versely development in the floodplain leads to more rapid movement of pollutants into the stream channel, degrading water quality.

What to include:

Floodplain areas subject to periodic (100-year frequency) flooding have been identified on maps by the Federal Emergency Management Agency (FEMA) and the US Department of Housing and Urban Development (HUD). Approximately 200 communities in New Hampshire have been mapped. Automation of floodplain data for use in GIS has been completed for some towns in the state. If floodplain data are available on the GIS database for the study area, it is relatively easy to include this information. If floodplain data aren't available in digital format, investigate the options for getting this information digitized. Using the printed maps available through the Office of Emergency Management in Concord is another option.

Where to find help:

See Appendix A for a list of contact addresses for these organizations.

Office of Emergency Management
Floodplain (FIRM) maps

UNH Cooperative Extension
Technical assistance

Regional Planning Commissions
Mapping assistance

Favorable Gravel Well Analysis

Background:

The NHDES Drinking Water Source Protection Program has created several tools for use in developing protection measures at the local level. The recently developed Favorable Gravel Well Analysis (FGWA) is being used by several municipalities and organizations around the state to take a pro-active look at protecting groundwater sources that may be needed for future public water supplies.

Favorable Gravel Well Analysis is a technique developed to help water suppliers and community planners take into account quantity and quality constraints when analyzing stratified drift aquifer maps to review potential sites for new community wells. Often the stratified-drift aquifer maps show large areas underlain by stratified-drift which might be interpreted to mean that a community has a wealth of potential future sites for water supply wells. However, not all of this area is available for well siting because there are numerous regulations concerning where a community well can be located.

FGWA buffers out (based on state regulations) all potential and known contamination sources within an area underlain by stratified-drift aquifers and takes into account potential well yield to show the actual area that is potentially suitable for

siting a community well. The FGWA maps also show these sites in relation to existing conservation lands.

What to include:

The FGW analysis has been completed statewide, and maps are generated on request. In addition, the publication *A Guide to Identifying Potentially Favorable Areas to Protect Future Municipal Wells in Stratified-Drift Aquifers* describes and details the FGWA process (see Appendix B). For more information about the FGWA maps for a particular community/study area, contact the NHDES Drinking Water Source Protection Program (see Appendix A).

Where to find help:

See Appendix A for a list of contact addresses for these organizations.

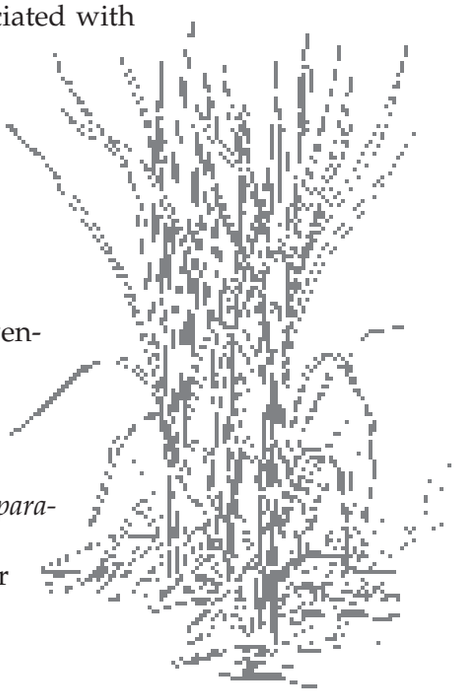
NHDES Drinking Water Source Protection Program
Favorable gravel well maps and associated fact sheets

UNH Cooperative Extension
Technical assistance

Wetland Evaluation and Prioritization Studies

Background:

Wetland evaluation is the process of determining the functions and values of a wetland based on an assessment of the wetland's potential to perform those functions. Very often communities need to prioritize wetlands based on their value in relation to other natural resources (e.g., wetlands associated with stratified-drift aquifers, wildlife habitat, etc.). Wetland evaluation and prioritization aren't specifically GIS-based (although some GIS data layers may be used, such as NWI wetlands and hydric soils data). For many communities, wetland evaluation and prioritization are an important feature of their natural resources inventory.



What to Include:

Examples of wetland studies that can be included in an inventory are listed below:

Wetland Evaluation: Using the GIS map showing wetland areas generated for the Basic Inventory, wetlands can be selected for detailed evaluation. The *Method for the Comparative Evaluation of Nontidal Wetlands in New Hampshire* (NH Method) is the most commonly used evaluation method for inland freshwater wetlands. See Appendix B for a more detailed reference.

Vernal Pool Assessment: Many communities are interested in documenting vernal pools. These ephemeral spring (and sometimes fall) pools don't always support wetland vegetation, but are critical breeding grounds for several species of frogs and salamanders. Due to their small size, vernal pools often aren't documented, but are an important resource to report. The publication *Identification and Documentation of Vernal Pools in New Hampshire* (see Appendix B) provides guidelines for undertaking a study of vernal pools.

Wetland Buffers: If a goal of your inventory is to protect buffers around significant wetlands (such as through an overlay zoning ordinance, or voluntary land conservation), reference should be made to the publication *Buffers for Wetlands and Surface Waters - A Guidebook for New Hampshire Municipalities* (see Appendix B).

Unusual Wetland Communities: During any wetlands-specific study, it is useful to include a listing of unusual wetland types in the study area. This can contribute important information to a natural resources inventory. The location of these wetlands could be marked on the Lands of Special Importance Map. Unusual wetland types can include bogs, fens, kettleholes, vernal pools, black gum (or tupelo) swamp, Atlantic white cedar swamp, etc. The NH Natural Heritage Inventory database may already have documented occurrences of these and other unusual wetland communities.

Other useful publications regarding wetland studies include *Study Guide to New England's Freshwater Wetlands*, and the *Municipal Guide to Wetland Protection*. (see Appendix B).

Where to find help:

See Appendix A for a list of contact addresses for these organizations.

UNH Cooperative Extension
Technical assistance for wetland studies

NH Wetlands Bureau
Prime wetlands, regulatory and permitting information

NH Natural Heritage Inventory
Exemplary plant communities

Active Farmlands

Background:

Farmlands produce agricultural crops, and include hayfields, pastures, cropland, orchards, and nurseries. Today, about seven percent of New Hampshire's total land area is devoted to farming - down from more than 50 percent in the 1870's. Despite agriculture's dwindling land resources, farming continues to make significant economic contributions. According to 1997 agricultural census data, approximately 2,900 farms in the state generated about $150 million in cash receipts.

Farmlands provide much more than a place to produce crops and livestock. In a state as heavily forested as New Hampshire, fields and other farmland provide habitat for a variety of wildlife species and are important elements of scenic views. Farmlands also provide an important historic link with the past.

Prime farmland soils (as discussed in the Basic Inventory) have increased significance when these areas coincide with current agricultural use.

What to include:

The list of farmlands in a specific community is probably longer than most townspeople realize. They may include pastures that support beef, sheep and horse farms, and diverse "pick-your-own" operations, as well as dairy farms. In addition to active farmlands, potential farmlands could also be identified.

The publication *Preserving Rural Character Through Agriculture* (see Appendix B) includes a wealth of information on agricultural lands, and how to evaluate their value in a community. Consider developing an agricultural profile for your town. An agricultural profile is a comprehensive overview of a community's agricultural industry. It includes information pertaining to soil type and acres, number and type of farms, zoning and agricultural land use, economic impact, protection of natural resources, farmland acres lost to development, and related issues of concern.

By conducting agricultural surveys, communities have learned that farms play an important role in protecting open space, stabilizing property tax rates, protecting natural and historical resources, promoting quality of life, and providing farm-fresh food to its residents. A copy of the factsheet *Developing an Agricultural Profile for your Town* can be obtained from county UNH Cooperative Extension offices (see Appendices A & B).

Information not available in GIS: Where active farmlands don't exist as a GIS data layer, recent aerial photographs and topographic maps can provide this information. Topographic maps use white to designate non-forested areas. While these maps are revised periodically, some of the information may be outdated. Aerial photographs and "windshield surveys" can help verify the information from topographic maps. It is also a good idea to check with your regional planning commission to see what information they might have available.

You may wish to screen out farmlands that are too small to support agriculture. Specialists from the Farm Service Agencies, Natural Resources Conservation Service (NRCS) and UNH Cooperative Extension can provide assistance in identifying and evaluating farmlands and determining realistic size limits.

Where to find help:

See Appendix A for a list of contact addresses for these organizations.

Farm Service Agencies
Active farms

Natural Resource Conservation Service
Active farms

UNH Cooperative Extension
Technical assistance, active farms

Regional Planning Commissions
Technical assistance, Land use maps

Forest Resources

Background:

Forests are a dominant feature in New Hampshire's landscape, occupying around 84% of the state's total land area. Forests provide open space and a scenic background for recreation and tourism, and supply raw materials for traditional forest industries. In addition, forests serve as habitat for many species of wildlife, prevent soil erosion, and protect water quality.

Despite the extent of this resource, experts are still concerned with the future of our forests. It takes many years and considerable acreage to produce forest crops economically. New Hampshire's forest land is largely privately owned and unprotected from development. Fragmentation of large tracts of forested acreage into smaller unmanageable units is a problem of statewide concern.

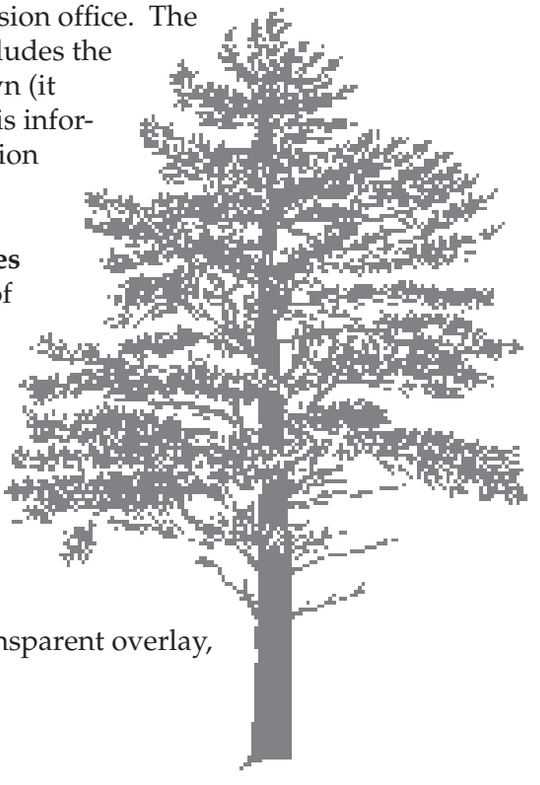
Large blocks of uninterrupted forest lands are rapidly disappearing from much of New Hampshire's landscape. What is considered a large block is relative and varies from community to community. Many urban areas would be hard pressed to locate

contiguous blocks of 500 or more acres. By comparison, the Pittsburg, NH natural resource project inventoried contiguous blocks of land greater than 5,000 acres in the 1980s.

What to include:

Productive Forest Soils: Information on prime farmland soils and soils of statewide importance (shown on the Lands of Special Importance Map in the Basic Inventory) can provide some initial information on areas suitable for timber production. Groups needing more detailed work may want to use productive forest soils data. Based on data developed by NRCS, productive forest soil groups give the best indication of relative productivity of lands for timber production. Productive forest soils data includes five categories: IA, IB, IC and IIA and IIB. The following three categories of productive forest soils (those that are most productive) are recommended for the purposes of a natural resources inventory:
1A: Fertile, deep, loamy, moderately well and well-drained, with few limitations for forest management, best suited to hardwoods.
1B: Loamy and sand soils over sandy textures. Moderately well and well-drained soils. Primarily suited to hardwoods.
1C: Somewhat droughty, less fertile sands and gravel derived from glacial outwash, excessively well-drained, ideally suited to softwoods, especially white pine.
These categories of productive forest soils data can be obtained in digital format for use with GIS from the Society for the Protection of NH Forests. These data aren't currently available on GRANIT.

Managed Forest Lands: The **Tree Farm** program is a voluntary system that recognizes and promotes long-term forest management practices on private forest lands. Tree farms are forested properties greater than ten acres in size on which a significant level of forest management has been accomplished. Tree farm and other managed forest information is available through each County Extension office. The NH Tree Farm Program has developed a GIS map that includes the number of farms (and total tree farm acreage) for each town (it doesn't include information on individual tree farms). This information can be accessed through the Society for the Protection of NH Forests.



A forest resource inventory might also include **sugarbushes** and **Christmas tree** plantations. Sugarbushes are groves of sugar maple trees that have been managed extensively to produce maple sap and are unique to the forests of the Northeast. Christmas trees are an important and growing component of New Hampshire's forest industry and are a good alternative crop for land that was formerly used for traditional agricultural crops.

Managed forest land data aren't available as a GIS data layer. This information needs to be collected locally, and manually added to an existing GIS map, prepared as a transparent overlay, or digitized for use with GIS.

Unusual Forest Communities: Unusual forest types can be found in many locations throughout the state. These include Atlantic white cedar and black gum swamps, pine barrens, floodplain forests, and patches of old growth forests or other unique plant communities that occur in forest lands. Floodplain forests include several uncommon plant communities, such as silver maple. Silver maple floodplain forests support an intense seasonal flooding regime which is important in the ecology of riverine systems. They also support several other uncommon plant species. Many silver maple floodplain forests have been converted to corn fields or other agricultural uses.

Many unusual ("exemplary") forest communities have been identified by the NH Natural Heritage Inventory (NHNHI). Data on these forest communities can be accessed through GRANIT (written permission needs to be obtained from NHNHI to access these data). Additional data can also be collected locally.

Unfragmented Blocks: Information on unfragmented blocks (already compiled for the Basic Inventory) can also help to provide a picture of large tracts of forested lands that remain. Keep in mind, however, that unfragmented blocks can also include farmlands, wetlands, and gravel pits. Overlaying the unfragmented blocks transparent overlay with a land use map (such as that derived from remote sensing imagery) can provide a better view of what proportion of the unfragmented blocks are forested.

For further reference, review *Good Forestry in the Granite State: Recommended Voluntary Forest Management Practices for New Hampshire* (see Appendix B).

Where to find help:

See Appendix A for a list of contact addresses for these organizations.

UNH Cooperative Extension
Technical assistance
Information on Tree Farms and other managed forest lands in each county (through county offices)

NH Natural Heritage Inventory
Exemplary Natural Communities

Society for the Protection of NH Forests
Tree Farm GIS data layer, Productive Forest Soils data in digital format

Regional Planning Agencies
Mapping assistance

Undeveloped Shorelands

Background:

The shorelines of rivers, streams, lakes, ponds and estuaries have significance for both wildlife habitat and water quality. As ownership of shorefront property continues to rise in popularity and shorelands become increasingly developed, the potential for pollution of water bodies and loss of wildlife habitat have become significant issues.

Undeveloped shorelands (also known as naturally vegetated buffers, or riparian areas) provide nesting sites and perch trees for a number of bird species, and travel corridors for mammals. River corridors are particularly important as migration routes for many kinds of birds. Natural vegetation along river corridors provides valuable shelter and feeding areas for spring and fall migrants, and helps maintain suitable conditions for wildlife species in aquatic habitats. For example, brook trout inhabit only cool, well-oxygenated water which occurs where sufficient shading by trees and other vegetation keeps solar energy from raising water temperatures during the day. These riparian areas also provide a variety of food sources important to a number of wildlife species in late summer and fall as mammals prepare for winter hibernation.

The vegetation in undisturbed shoreland areas provides hydrologic stabilization by intercepting rainfall, slowing overland flow, and promoting infiltration. These factors effectively prevent erosion of mineral soils, and minimize sedimentation of streams. Hydrologic stabilization also results in reduced flood peaks during storm events, minimizing downstream flooding potential. For further information on the value of naturally vegetated shorelands, refer to the document *Buffers for Wetlands and Surface Waters - A Guidebook for New Hampshire Municipalities* (see Appendix B).

Recognizing the need for shoreland protection on public waters, the Comprehensive Shoreland Protection Act (RSA 483-B) became fully

Stream Ordering: *The river network within any given watershed can be subdivided into individual channel segments (or stream orders) according to a hierarchy of orders of magnitude. A sequence of numbers is assigned to the orders as follows:*

Each headwater channel is designated as a first order stream. At the junction of any two first-order streams, a channel of the second-order is formed. Where two second-order channels join, a channel of the third-order results. A fourth-order stream results at the junction of two third-order channels, and so on. However, should a segment of the first-order join a second- or third-order stream, no increase in order occurs at that point of junction. In this way, the main channel at the mouth of the watershed bears the highest order number of the entire system.

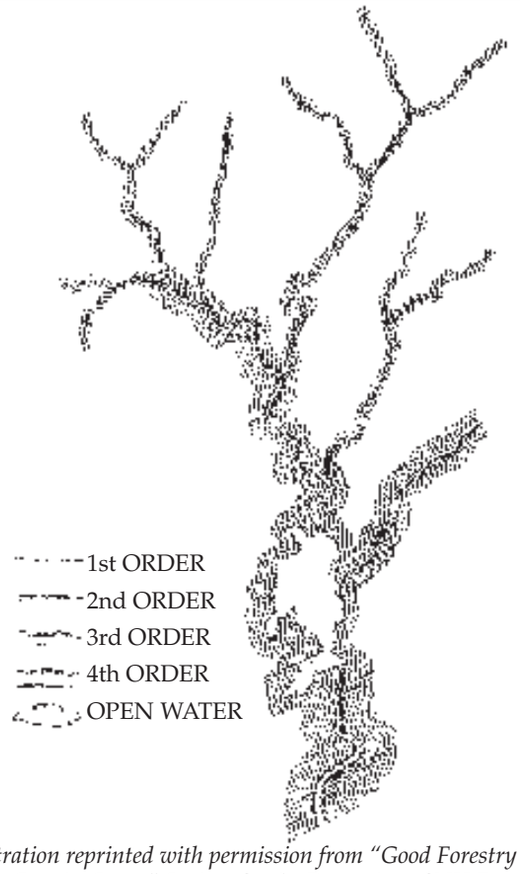


Illustration reprinted with permission from "Good Forestry in the Granite State," Society for the Protection of NH Forests & DRED, Division of Forests and Lands, 1997

effective in 1994. The Act establishes a "protected shoreland" of 250 feet. It requires that "... where existing, a natural wooded buffer shall be maintained within 150 feet of the public boundary line" (the public boundary line refers to the reference line of public waters). There are other restrictions (primarily no junkyards, industrial or related activities allowed) that encompass the full 250 feet. The law affects public water bodies that are natural ponds or artificial impoundments of ten acres or larger, as well as fourth order or higher rivers, and tidal waters.

What to include:

It is important to note that the Shoreland Protection Act doesn't give protection to first, second and third order streams or ponds less than 10 acres. The only protection these rivers and streams receive is through local regulation and voluntary land protection. For example, the Exeter River in southeastern New Hampshire is classified as fourth order only in the lower third of its length. The upper two thirds of the river, which has third and second order classification, doesn't receive protection under the Shoreland Protection Act. The NH Rivers Program (see Appendix A) maintains a list of fourth order rivers in the state.

Using GIS, a 250 foot buffer around the shorelines of the rivers, streams, lakes and ponds in the study area can be digitally generated on the Base Map. Black and white aerial photographs can be used to initially identify undeveloped shorelands within the 250 foot buffer. These areas can be marked on the base map. Once the shorelands have been mapped in this way, the information should be field checked with a windshield survey (keeping in mind that the aerial photos may be several years old and may not reveal recent development). This information could subsequently be digitized for inclusion in the inventory as GIS data layer.

Where to find help:

See Appendix A for a list of contact addresses for these organizations.

UNH Cooperative Extension
Technical assistance

Regional Planning Commissions
Mapping assistance

Comprehensive Shoreland Protection Act (CPSA) Website
http://www.des.state.nh.us/cspa
Description of the CPSA; List of 4th order streams in New Hampshire

Wildlife Habitat

Background:

New Hampshire's natural resources provide habitat for an abundance and diversity of native wildlife. However, studies of flora and fauna are seldom conducted at the

community level. People tend to be conscious of rare or endangered species, but are unfamiliar with the complex ecosystems in their own neighborhoods. Incorporating wildlife needs into community planning is a critical component that is often missing from the process. A community habitat inventory is the first step in protecting wildlife. By creating awareness of how the community's landscape supports wildlife, you can better work to protect it.

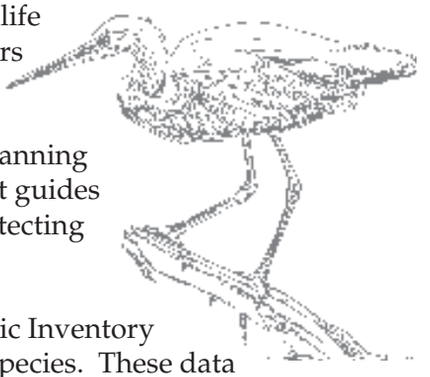
The challenge of conserving enough habitat to support healthy native wildlife populations is complicated by the varying habitat requirements of our diverse species. Some require less than an acre of undisturbed forest, while others need territories covering more than a thousand acres. Many wildlife species require several different habitat types throughout the course of a year.

A major concern for wildlife is that haphazard patterns of development of the landscape have caused habitat fragmentation. Wildlife that are sensitive to human encroachment are restricted to islands of undisturbed land, and may die out if the area is too small. Fragmentation also creates barriers to the movement of many terrestrial species.

Wildlife corridors are tracts of undeveloped land that provide linkages between significant habitat areas. Travelways and migratory routes are often located along streams and rivers and significant geologic land features (along ridgelines, mountain ranges, etc.). Linkage corridors can be virtually any type of traversable land of at least 200 feet in width that provide avenues for wildlife movement and discourage the creation of habitat islands.

What to include:

The recently published document *Identifying and Prioritizing Significant Wildlife Habitat: A Guide for New Hampshire Communities and Conservation Groups* (see Appendix B for reference) provides a GIS-based procedure for mapping wildlife habitats in New Hampshire communities. Several of the data layers that have already been collected for the Basic Inventory are used in the wildlife habitat assessment (e.g., unfragmented blocks, NHNHI data). The document identifies ways in which the local planning process may be linked to wildlife and wildlife habitat protection. It guides communities through the steps of identifying, evaluating, and protecting wildlife and wildlife habitat.



Note that the NH Natural Heritage Inventory data used in the Basic Inventory includes some data on rare, threatened, and endangered wildlife species. These data are maintained in cooperation with the NH Fish & Game Department's Nongame and Endangered Wildlife Program.

Where to find help:

See Appendix A for a list of contact addresses for these organizations.

NH Fish & Game Department

Identifying and Prioritizing Significant Wildlife Habitat: A Guide for New Hampshire Communities and Conservation Groups

NH Natural Heritage Inventory
Uncommon and protected species

UNH Cooperative Extension
Technical assistance

Regional Planning Commissions
Mapping assistance

Historic and Archaeologic Resources

Background:

Through time, natural resources may have supported a variety of local economic activities. Past mining, milling, lumbering and farming activities reflected the availability of local resources, as well as the industriousness and ingenuity of our predecessors. An examination of your town's history will demonstrate a link between these historical and often unique uses of the land and a way of life that may or may not continue to exist.

New Hampshire's landscape has many examples of historical features: saltmarsh and riverbottom farming, stonewalls in reforested hill pastures, granite, mica and gold mines, abandoned settlements, and monuments and structures created from local resources, such as stone and covered bridges, and historic barns. Town libraries and historians are often excellent sources of information.

Communities may have an historical commission or society that maintains archives. Historic tax records will show milling and other business activities that can give clues to historic sites. County maps were completed at various times in the 19th century. These show buildings, roadways, and other features of potential historic significance. The National Register of Historic Places and NH Division of Historic Resources document historic sites of statewide importance. Prehistoric and historic archaeologic sites, such as Native American sites, also contribute to the understanding of a community's past.

What to include:

Data from the National Register of Historic Places are included on the GRANIT GIS database. The locations of locally important historic sites in the context of natural resources, e.g., mill sites, lumbering, farms, etc. can be added to the inventory maps manually once the information has been collected from local sources. Involve the local historical society in this aspect of the inventory. Significant historic sites should also be listed and briefly described for inclusion in the inventory report.

Archaeologic information is currently not available as a GIS data layer. Information on archaeologic sites in your community may be obtained from the State Archaeologist's office in the NH Division of Historic Resources. Given the sensitive nature of this information, the data have to be generalized. Site specific information can only be obtained by getting permission from the State Archaeologist's office (see Appendix A). The level of detail included in the Historic/Archaeologic resources

inventory will depend on both the availability of information and the goals of the natural resources inventory.

Where to find help:

See Appendix A for a list of contact addresses for these organizations.

NH Division of Historical Resources
National Register of Historic Places
Archaeologic information

Local sources
Historical societies, libraries, landowners

Scenic Resources

Background:

The landscape of an area defines its cultural, natural, and historic heritage. Scenic routes and vistas contribute to a community's character and aesthetic quality. Consequently, growth-related problems can have negative effects on communities by threatening their scenic areas.

Under RSA 253 Sections 17 & 18, towns may designate any road (other than Class I or Class II state highways) as a Scenic Road by town meeting vote. Scenic Roads designation requires a public hearing prior to removal of trees in a public road right-of-way and enables municipalities to adopt other regulations.

What to include:

There are typically two parts to identifying a scenic vista: the area being viewed (the vista) and the point(s) from which it is seen (the viewing area). Preserving the integrity of scenic vistas requires protection of both components.

Refer to your town's master plan which may have specific descriptions of scenic areas. Some communities may have a more detailed plan that includes scenic areas, such as designated Scenic Roads. Local surveys of community residents can provide the work group with a list of popular scenic areas, vantage points, and focal points in the community. Appendix H describes a technique used by the Vermont Land Trust in its evaluation of the Mad River Valley's scenic resources (See reference in Appendix B). Field visits by members of the work group can provide additional information that can help detail the scope of the town's scenic resources.

Scenic information can be added manually to an existing GIS map, or digitized for use in GIS. Scenic vistas can be marked by numbered point locations that correspond to numbered sites listed in an accompanying descriptive table. Designated Scenic Roads can be shown by highlighting the appropriate section of road on the map. Photographs of scenic vistas can be documented in the report that accompanies the inventory maps. Using GIS data layers, GIS providers can also conduct a viewshed analysis from multiple vantage points to determine which areas in town are most seen, and thus more important as scenic resources.

Where to find help:

See Appendix A for a list of contact addresses for these organizations.

Vermont Land Trust
Mad River Valley study (see Appendix B)

UNH Cooperative Extension
Technical assistance

Regional Planning Commissions
Mapping assistance

Recreation Resources

Background:

New Hampshire is well-known for the quality and variety of its recreational resources which include hiking trails, camping areas, trout streams, mountains, whitewater, ski areas, lakes, ponds, and wetlands.

Public lands such as the White Mountains National Forest, state parks, and town forests provide important recreational opportunities. With much land in private ownership, many landowners allow the public to access and use their land for recreational purposes, e.g., snowmobile and hiking trails. Land use changes, ownership changes, and misuse of recreational areas can threaten the availability of privately owned land for recreational use.

What to include:

Information on conservation lands and the Office of State Planning's Outdoor Recreation Inventory is available through GRANIT. Information on recreation facilities for some parts of the state is also available from GRANIT. These data can be supplemented with local information, and can include trails.

The NH Office of State Planning has mapped public boat access points for lakes, ponds, rivers, and tidal areas statewide. Accompanying the map is a report which includes a tabular summary of the access points: *Public Access Report for New Hampshire Lakes, Ponds, and Rivers* (see Appendix B).

Maintaining and establishing public access to local lakes and ponds, ridgetops and trail corridors will be a key consideration in evaluating the community's recreational resources. What important resources would be jeopardized if access to private lands were denied? The town's master plan may include a list of public access points and municipally-owned recreation areas. Check with state and federal agencies to identify public access sites on the community's rivers, lakes and ponds. While the state has jurisdiction over all bodies of water greater than ten acres, it doesn't guarantee access to them.

If the community has a recreation commission, it may have a priority list of important recreation needs. Work with the recreation commission and/or other local

groups to identify popular areas where public access is "unofficial" or permitted at the discretion of the landowner. Local fishermen can help to identify popular fishing spots for inclusion in the inventory.

Trails for hiking, skiing and snowmobiling may be maintained by local groups that can supply maps and other information (e.g., snowmobile clubs). In addition, a number of state and private organizations participate in maintaining trail networks. Old town roads are often used for recreation, such as Class VI and discontinued roads. Topographic maps and aerial photographs can be used to map their locations. You may wish to record whether these roads are closed to gates and bars, abandoned, or of unknown status.

A tabulated list of recreation areas should be included in the written NRI report.

Where to find help:

See Appendix A for a list of contact addresses for these organizations.

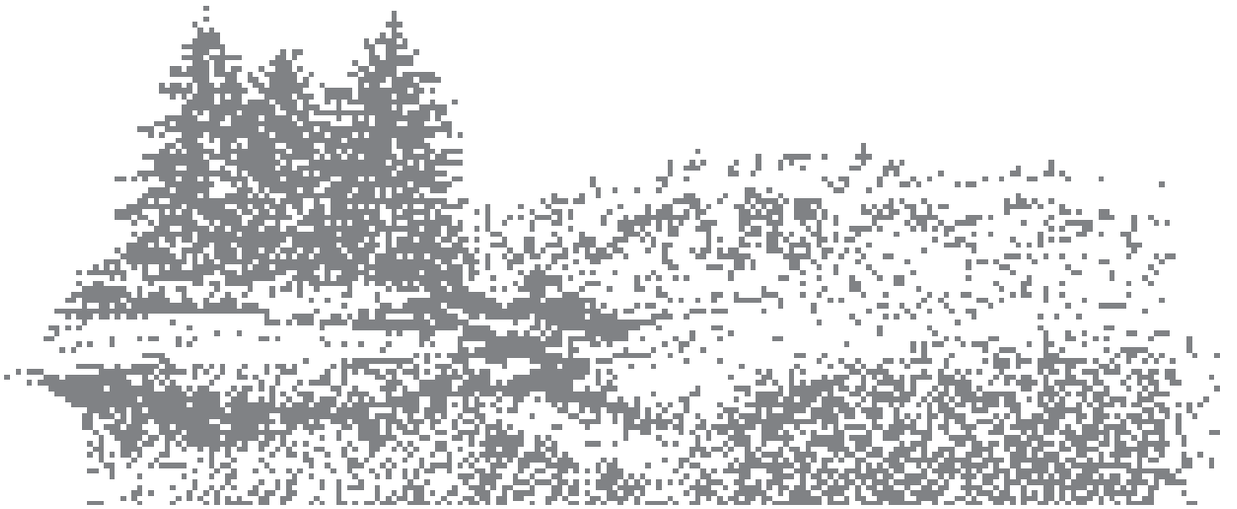
Department of Resource and Economic Development - Bureau of Trails
Information and assistance with planning trails
Recreational Trails Grants Program

NH Office of State Planning
Public Access Report for NH Lakes, Ponds, and Rivers (includes a map)
OSP Outdoor Recreation Inventory

NH Snowmobile Association
Trail networks, list of local clubs

UNH Cooperative Extension
Technical assistance

Regional Planning Commissions
Mapping assistance



Unique Geologic Resources

Background:

The geologic history of any area is the basis for many of its natural characteristics such as topography, groundwater systems, drainage patterns, mineral resources and origin of the soil. New Hampshire's geologic history has left a variety of land features and mineral resources. Plate tectonics contributed to the formation of granite bedrock. Long periods of erosion shaped the hills and mountains. Most recently, repeated glacial activity provided some finishing touches to a land that had been evolving for perhaps 400 million years. Current landscape features remind us of this rich geologic history. Ring dikes indicate past volcanic activity, fault lines demonstrate where the land was uplifted by tremendous forces, and eskers, drumlins, kettleholes, and many other features are evidence of glaciation.

What to include:

An inventory of locally significant geologic features should consider items related to the underlying bedrock and surficial materials that are truly unique on a regional or state-wide basis. Bedrock-related geologic features include prospects and mines, quarries and faults, and calcareous areas that may provide habitat for endangered plant species. Surficial materials include the various soils, gravels, rocks, and other loose materials that lie on top of the bedrock. Some geologic features produced by surficial deposits include drumlins, eskers, kames and kame terraces, and outwash plains.

Some information on surficial geology (specifically drumlins, surficial exposures, and surficial materials) and bedrock geology is available through GRANIT for a few limited areas in the state. Information on sand and gravel deposits can be identified through the use of County Soil Surveys. Town records can also be a useful source of information.

New Hampshire's geology has been extensively researched. The DES publication *Bibliography and Index of New Hampshire Geology* (see Appendix B) can be used to locate sources of printed materials and maps. A Bedrock Geology data layer covering all of the state is available through GRANIT. While this is the best available statewide data, it should be used with caution as it was mapped at a scale of 1:250,000 (i.e., the level of detail is very broad). Other sources of information include the state geologist's office and knowledgeable members of the community.

Surficial geologic features resulting from glacial activity

Drumlin
Smoothly rounded, oval hill resembling the bowl of an inverted teaspoon. Consists of glacial till (a mixture of clays, sands, rocks, and boulders). The long axis of a drumlin parallels the direction of ice movement, serving as an indicator of the direction of ice movement.

Esker
A long sinuous ridge formed by the deposit of sand and gravel formerly laid upon the floor of an ice tunnel. Ice formed the sides and roof of the tunnel; the disappearance of the ice left merely the stream-bed deposit which now forms a ridge, that can be many miles long.

Kame
A mound or cone-shaped deposit of sand and gravel laid down by sediment-laden meltwaters draining off the tip of the glacial ice. Generally deposited against an ice front.

Kame terrace
An elongated steep ridge of sand and gravel formed adjacent to glaciers by glacial deposition. Often important for recharge and storage of groundwater

Outwash plain
Clay, sand, and gravel deposits that were washed out by glacial meltwater streams, forming extensive flat or gently sloping plains

Kettlehole
A depression left in the land surface when ice, formerly covered by glacial drift, melts.

Where to find help:

See Appendix A for a list of contact addresses for these organizations.

NH Department of Environmental Services
State Geologist's office - Water Well Board
Geologic information of statewide significance

UNH Cooperative Extension
Technical assistance

Regional Planning Commissions
Mapping assistance

Zoning

Background:

Mapping land use controls, such as zoning, can add strength to the inventory. This information can be used to identify potential conflicts with the community's important natural resources. For example, an overlay map of zoning might point out that portions of the community's groundwater supply are zoned to allow for conflicting land uses.

What to include:

Many New Hampshire towns have had their zoning maps digitized by the regional planning commissions for use in GIS. If the zoning maps aren't digitized, find out if the town plans to put zoning information onto a GIS. It is relatively inexpensive and easy to digitize zoning boundaries.

If zoning is mapped manually, the data will need to be mapped at the same scale as the other inventory maps. The group doing the GIS work can produce an outline of the study area on a mylar overlay. The zoning information can be transferred to this outline, and used as an overlay with the other resource maps. Zoning information can also be combined with a composite tax map base (see information below).

Tax Maps

Background:

Parcel-based tax map information is helpful when reviewed together with the other inventory maps. A tax map overlay can help in the implementation phase of your resource inventory project, and can provide helpful information for a land protection program.

What to include:

Some towns have had their tax map digitized for use in GIS or other computer applications Check with your town to see what future plans they have for computerizing tax map information.

Information provided on tax maps isn't always accurate. If a community is considering a complete revision of its tax maps, this might be a convenient time to have the maps digitized. The advantages of accuracy and easy low-cost updating make digitized tax mapping an attractive option. This service is offered by a growing list of surveying and engineering companies.

An alternative to digitizing the tax maps is to have them compiled into a scale-reduced composite map and printed on transparent mylar. Many engineering firms and copy centers offer this kind of service. This is best accomplished by using mylar tax map originals. Be sure to specify that you want the finished product to be scale accurate.

Document the Inventory

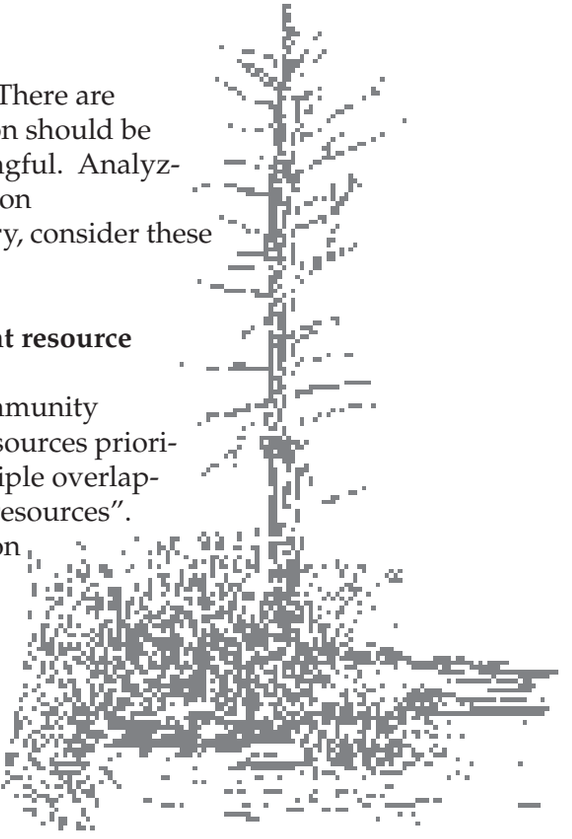
Documentation is an important element of a natural resources inventory. Given the turnover of members of volunteer boards, a written report provides an important record to familiarize new officials with the inventory work. This report also provides valuable backup information as the inventory work group uses the results of the inventory to achieve conservation goals. An inventory report should include:

Descriptive summary: This summary should describe the project's goals, summarize its findings and detail the methods used to evaluate the results. It may also include brief descriptive summaries of each of the resources inventoried. It can be helpful to include the date the report was generated on each page (as a footer) so that future readers are aware of the age of the information. The descriptive summary can also provide the basis for the narrative included in the natural resources section of the master plan. The report should include specific conservation recommendations arising from the inventory that will require action by the community.

Database of Information Sources: The descriptive summary of each of the resources inventoried can be enhanced by documenting the data sources used. These may include both GIS data layers and non-GIS studies. Documentation can include the standards used for the inventoried resources, data tables providing specific details about the results of a specific inventory study, or information displayed on the inventory maps, acreage of specific resource features, data sources, etc. It is also important to include data sources on any maps produced for the inventory. All data documented should support the NRI project. Documentation eases the task of future updates and provides a stronger basis for resource protection and planning efforts.

Analyze the Information

Collecting the data is just one piece of the NRI process. There are several stages during the inventory when the information should be reviewed to ensure it is meeting the goals, and is meaningful. Analyzing the information can also help to set resource protection priorities. As the group progresses through the inventory, consider these questions:



Which areas in the community have the most important resource values, and where do resource combinations occur?
One goal of an NRI project is to identify areas in the community where key resources are located. These may be single resources prioritized by the community, or they may be areas with multiple overlapping resource features, sometimes called "co-occurring resources". These can provide helpful information for land protection projects and land use planning measures to assure long-term resource protection. This analysis may point out a need for re-evaluating zoning, and updating the master plan.

Computer-generated analysis using GIS can be helpful for identifying areas with co-occurring resources. Co-occurring resource analysis is essentially a composite of several of the individual data requirements used in an inventory. It pulls the available natural resources information together for a broad-based analysis of areas that could be prioritized for protection. For example, if there is groundwater, plus undeveloped prime farmland, plus an unfragmented block of open space, this could be an important area to focus conservation efforts. Co-occurring resources can be displayed on a composite GIS map. This information should be reviewed with adequate cross referencing to the individual GIS maps and written NRI reports for more detailed information. There are several methods for identifying co-occurring resources. The group doing the GIS work can provide technical assistance with this.

Activities on adjacent land can have impacts on the abutting natural resource areas. Where there are several co-occurring resources in a particular location, consideration should also be given to the protection of the surrounding areas. Protecting the buffers associated with particular resources can be equally important as the resource itself.

While co-occurring resource analysis can help to analyze some "hot spots" with regard to protection strategies, the significance of single resource values shouldn't be overlooked. Key single resources may be accorded high priority for protection, based on the extent and value of that resource for the community. For example, a highly productive aquifer area that has good potential for future water supply may receive high priority.

Why is the resource important to the community?

Which resources are important will vary from town to town, depending on perceived needs. For example, water resources may be a priority for one town, while in another town, agricultural land may top the list. Identifying the value of significant resources can help suggest an appropriate protection strategy. Some resources, such as water supplies, are important to the health and safety of the town and may be appropriately protected through regulation. Others, such as recreational areas, may be more appropriately protected through public purchase or voluntary initiatives.

What are the threats to the continued availability of these important natural resources?

Determining threats to resource availability will involve an evaluation of the impact that current land use regulations and land use trends are having on the resource, as well as economic factors, etc. Consider whether land use regulations are inhibiting or promoting the continuation of resource-dependent industries. What would happen if the resource was lost?

Are there natural resources identified that are important to other communities or the region?

Natural resources don't respect political boundaries. Important resources such as aquifers frequently straddle several communities. Protection of these may require cooperative efforts with adjacent communities or local watershed groups.

5. Putting The Inventory To Work

An NRI provides a window on the future. Using the results of the NRI requires evaluating the community's long-term goals and how they relate to natural resources. The NRI can be used as a planning tool to look at the current situation and project ahead. This view on the future can help preserve the character of many communities. What can be done to ensure that the important natural resources in the community will be available for future generations?

At this stage, the inventory workplan can evolve into an action-based strategy for regular review of inventory data, incorporating updated information and revising inventory maps as appropriate, adding in additional goals as future community needs become apparent, and ensuring that the inventory becomes an integral part of community planning. Conservation planning (discussed later in this section) can be an effective way to implement the inventory results. For an NRI to be effective over the long term, the results should continually be in active use.

As major inventory goals are accomplished, planning boards, conservation commissions, and other town officials as appropriate, should consider a range of activities designed to protect sensitive environmental areas from inappropriate development. Where natural resources extend beyond town boundaries, opportunities exist for inter-community cooperation.

Below are several suggestion for making good use of the NRI results:

Make the Inventory Available

The group's efforts will quickly be forgotten if there aren't some permanent reminders around for town officials and the public to use. Consider the various groups that might use the maps and have additional copies made for them. These might include the planning board, conservation commission, selectmen, and/or other organizations such as land trusts and regional planning commissions. Display a selection of the inventory maps in a public area, such as the town hall (alongside tax maps if these are displayed). GIS-generated maps can be easily reduced or enlarged for all or part of the study area to reflect the needs of specific boards or projects.

Educate the Public

A natural resources inventory provides a valuable opportunity to educate community residents about the value of the town's resources. It is important that the results of the inventory and evaluation be made public. This can be accomplished by publicizing the work group's meetings, through articles in local newspapers and/or by holding public meetings.

The primary goal of educational programs should be to provide factual and objective information about the issues. Community events can be used as opportunities to display the inventory results and have NRI project work group participants on hand to answer questions and provide information. Town meeting is a good time to hold a display of inventory maps. A brochure or fact sheet describing the major findings

of your inventory can help to get information out. Work with local landowners to encourage stewardship of the land, and to show them how they can contribute to the environmental health of the community. The more informed the community is about the NRI, the more likely it is that the inventory will be used on a regular basis.

Once key priorities for using the inventory have been decided, sponsor public education programs focused on those priorities. For example, if land protection is a priority, sponsor a land protection workshop for local landowners; if the objective is to evaluate water resources, focus on issues centered around that topic. Educational programs are an effective method for clarifying key natural resource issues and establishing the groundwork for their protection.

Initiate a Land Protection Effort

Natural resources can't be protected through regulatory controls alone. Communities should investigate actively pursuing voluntary (i.e., nonregulatory) land protection techniques such as conservation easements. Voluntary land protection is one of the most effective ways to protect natural resources, resulting in more permanent protection than regulatory techniques.

A natural resources inventory can be used to establish specific goals for land protection efforts. Selections can be made based on properties and areas within the community that exhibit outstanding resource values. For example, the map of co-occurring resources identifies those areas where several resources overlap. Once priorities for natural resource protection have been set, a search can be made for areas where several of these priority values occur together. Areas for protection might be identified as those with combinations of valuable resources or those that have one significant feature. A review of the Conservation Lands map can help identify land protection priorities and opportunities for connecting or adding to existing protected parcels.

The natural resources in the study area shouldn't be viewed in isolation, but should be considered in the context of the overall environment. Activities on adjacent land can have impacts on the abutting natural resource areas. In most instances, protecting the buffers associated with particular resources is equally important as the resource itself. For example, where a community wants to protect a wetland system, protecting an adequate buffer of upland around that system would do much to both protect and enhance that system. If that same system were protected without a buffer, adjacent development could adversely impact the wetland and lessen the value of the protection effort. When devising natural resource protection strategies, communities should keep the "big picture" and overall context in mind.

As a result of the inventory process, the conservation commission or a volunteer group might work with a local land trust to begin contacting landowners. There are a number of publications available that can help (refer to Appendix B for a list of useful land protection publications).

An important step is to establish an adequate and stable land protection fund. Funding could be obtained from public appropriations, private donations, and/or foundation grants. Conservation funds may be established by communities through RSA 36-A. A town conservation fund may have all or a percentage of the Current Use Penalty Tax deposited in it annually, to be used for conservation purposes (note that establishing such a fund requires both a conservation commission and a vote at town meeting). Conservation funds can be carried forward from one fiscal year to the next, and can be expended without a town meeting vote.

Other public appropriations are often easier to secure once there is a proven track record for land protection efforts. Other methods for conservation funds include using the unexpended portions of the previous annual budget, line item appropriations, gifts of money, and bonding. A combination of all or a few of these options may be the best approach for establishing a conservation fund that adequately addresses a given community's needs.

Throughout the process of public discussion and evaluation of resources, emphasize the opportunities that exist for voluntary land protection. It is recommended that there is an education and outreach component in any land protection program. This could include public meetings to foster the concepts of land stewardship for natural resources protection, and to discuss what is involved in land protection, publications that encourage awareness of the value of the natural resource, and public workshops, such as the role of land protection in estate planning. Start a small reference library of land conservation publications that could be available through the public library or the town hall.

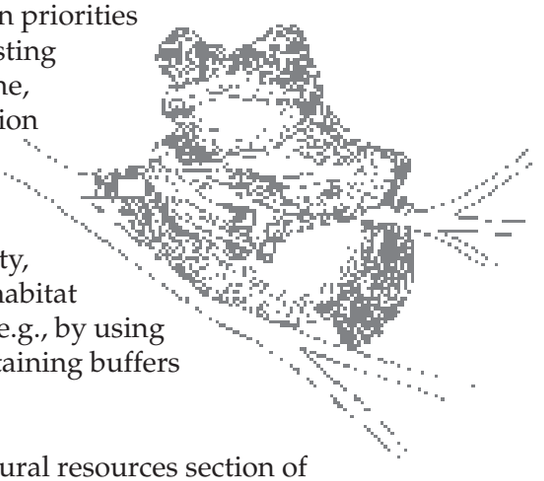
There are a number of groups who can help communities with land conservation guidance training and specific projects. Appendix B provides a listing of local land trusts in New Hampshire. UNH Cooperative Extension also provides educational assistance through its Community Conservation Assistance Program and local county offices.

Developing a working knowledge of land protection techniques will help in your group's work with landowners. Options for permanent protection of important areas include acquisition, conservation easements, and management agreements.

Land Protection Techniques

- **Fee Simple Acquisition** *is the acquisition by purchase or donation of land. The purchase of land for conservation can be expensive and doesn't guarantee long-term protection. If the land is resold without restrictions, there is no assurance that it will be managed as the owner wished, or that it will remain permanently protected.*
- **Conservation Easements** *are legally enforceable permanent agreements between landowners and private or governmental organizations. Essentially, the easement separates the development rights from the property and places restrictions on its use. The organization agrees to monitor the land to ensure that the provisions of the easement are honored. Conservation easements can be donated or purchased for full or partial value. Land protected by easements can remain privately owned.*
- **Deed Restrictions** *are restrictions placed in a property's deed at the time of sale and represent an agreement between the buyer and the seller about the future use of the land. Unlike conservation easements, there is no third-party to enforce and defend the restrictions if the original owner doesn't. Deed restrictions have lost popularity with conservationists because they are relatively easy to overturn.*
- **Mutual Covenants** *are similar to deed restrictions, and are often used by a group of landowners who share a resource such as a lakefront property.*

Develop a Conservation Plan



A conservation plan involves identifying land conservation priorities (a consensus process) and resource protection goals. By listing specific objectives, actions to achieve them and a time frame, you have the makings of a conservation plan. Conservation planning allows the information collected for the inventory to be used in a constructive and productive way, and provides a structured process for achieving conservation goals. For example, if wildlife habitat protection is a priority, a conservation plan could include: identifying important habitat areas, conserving large habitat areas, connecting habitats (e.g., by using greenways), conserving habitats of rare species, and maintaining buffers around important habitats.

The conservation plan should be incorporated into the natural resources section of the master plan. If you need help getting started with a conservation plan, contact UNH Cooperative Extension or your RPC to find out more about the assistance they can offer.

Screen Development Proposals

Information from the natural resources inventory can be used for reviewing development proposals in general terms (but note that NRI data aren't generally suitable for site specific analysis). For this purpose, it is important that the information is applied consistently by the various community boards. One way of accomplishing this is through the use of checklists used by planning and zoning boards to review subdivision and other land use proposals. Both the inventory maps and accompanying NRI source documents can be consulted for details about affected resources and their value to the community. The accuracy of mapped information should be verified on a site by site basis as needed, since the scale of the inventory maps isn't suitable for interpretation on individual parcels.

Develop and Update Master Plans

Communities rely on master plans to justify and defend land use regulations. The NRI provides an effective tool for developing or updating the conservation/natural resources section of the master plan. Further, developing such a natural resource conservation strategy can serve as the basis for future land use regulations, and as a basis for acquisition and other conservation implementation strategies.

If an NRI is being done after a recent master plan update, it can serve the purpose of implementing recommendations in the master plan that pertain to natural resources. The inventory can also build on the natural resources information put together for the master plan. If the master plan is outdated, the NRI can provide the basis for revising and updating the natural resources section of the plan.

By including the NRI in the master plan, it provides the necessary base information from which municipal officials decide the management or future use of these resources. Ideally, the master plan should also include a conservation plan or open space plan based on the natural resources inventory. The master plan is the founda-

tion for zoning, and the statutory prerequisite for a zoning ordinance is planning board adoption of the statement of objectives and future land use sections of the master plan.

Evaluate Land Use and Regulatory Controls

The next logical step after the master plan is to develop or revise a set of land use regulations that will give the planning board, landowners, and developers the ability to do the best possible job of protecting important natural resources on developed properties. Land use regulations are widely used in New Hampshire communities. Ninety percent of the state's communities have adopted master plans. A similar percentage have zoning ordinances and nearly every community in the state has subdivision regulations.

Community zoning and subdivision regulations often don't adequately protect natural resources. For example, while large-lot subdivision is often perceived as an effective tool for protecting natural resources and controlling growth, it can work against natural resource protection by spreading development over a much larger area than necessary. This can result in the loss of important farm and forest lands as they are converted into large grid-patterned house lots.

Before it is possible to establish more effective land use regulations in your community, it may be necessary to make residents and public officials aware of the long-term impacts of existing land use regulations. Build-out scenarios can be an effective tool for this purpose. These combine tax maps, resource inventory overlays, and existing land use regulations to create maps that depict what the community's land use pattern might be if all possible properties were developed to their maximum, as allowed by local regulations. For further guidance on effective land use regulations, or information on model ordinances (e.g., shoreland protection, groundwater protection, etc.) contact the NH Office of State Planning or your regional planning commission.

Evaluate the Effects of Land Use and Zoning Changes

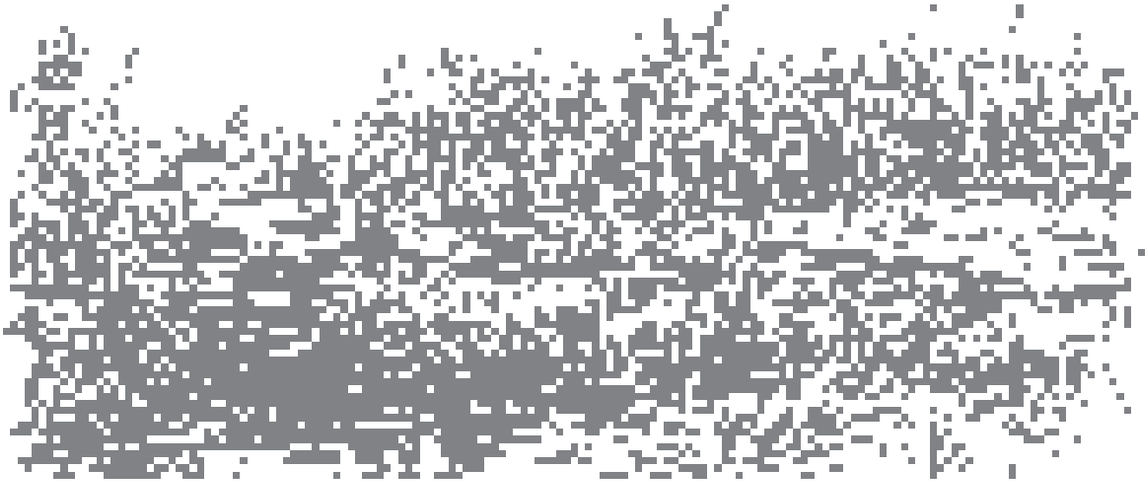
Using the inventory data and GIS maps, the effects of proposed land use or zoning changes can be evaluated to determine potential effects on natural resources. The tax map overlay could also be consulted to determine how and in what way land owners might be affected. "What if" scenarios could be run that would summarize the total area impacted, and display the locations of impact. For example, a "what if" scenario of new buffer width requirements around wetlands would allow the community to see which additional lands would be impacted to a range of increasing widths.

Amend Existing Zoning Ordinances

Local ordinances and regulations should be reviewed to determine their adequacy for natural resource protection. Zoning ordinances for wetland and watershed protection should be evaluated in the context of the recommendations of the guidebook *Buffers for Wetlands and Surface Waters in New Hampshire* (Appendix B).

Municipalities commonly recognize the importance of critical resource areas by adding protective overlay zoning districts to their town-wide zoning ordinances. This type of zoning (Environmental Characteristics Zoning) has traditionally been used to protect wetlands, floodplains, watersheds, aquifers, steep slopes, and shorelines. A natural resources inventory can provide much of the information needed to determine the location of the district, and the effects of proposed zoning changes.

For further information on regulatory options, reference can be made to the publication *New Hampshire Planning and Land Use Regulation*, updated annually, and published by Lexus Law Publishing, PO Box 7587, Charlottesville, VA 22906-7587.



Appendices

APPENDIX A Resource List - Agencies and Organizations

APPENDIX B Publications and Suggested Further Reading

APPENDIX C Examples of Selected Inventory Maps

APPENDIX D Examples of Selected NRI Projects

APPENDIX E List of GRANIT Data Layers

APPENDIX F NRCS Soils Maps and NWI Maps

APPENDIX G Delineating Watershed Boundaries

APPENDIX H Evaluating Scenic Resources

APPENDIX A
Resource List - Agencies and Organizations

UNH Cooperative Extension Offices

UNH Cooperative Extension Website: ***ceinfo.unh.edu***

Statewide Offices
131 Main Street
Nesmith Hall - UNH
Durham, NH 03284-3597
Water Resources 862-1029
Forestry and Wildlife 862-1028
Lakes Lay Monitoring Program 862-3848

Kingman Farm
Durham, NH 03824-3512
Great Bay Coast Watch and Sea Grant
749-1565

Belknap County Office
36 County Drive
Laconia, NH 03246-2900
Tel: 527-5475
Fax: 527-5477

Carroll County Office
75 Main Street
Center Ossipee
NH 03814
Tel: 539-3331
Fax: 539-3335

Cheshire County Office
800 Park Ave,
Keene, NH 03431-1513
Tel: 352-4550
Fax: 358-0494

Coos County Office
629A Main Street
Lancaster, NH 03584-9612
Tel: 788-4961
Fax: 788-3629

Grafton County Office
3785 Dartmouth College Highway, Box 8
North Haverhill, NH 03774-4936
Tel: 787-6944
Fax: 787-2009

Hillsborough County Offices
468 Route 13 South
Milford, NH 03055
Tel: 673-2510
Fax: 672-1727

329 Mast Road, Unit 3
Goffstown, NH 03045-2418
Tel: 621-1478
Fax: 621-1481

Merrimack County Office
315 Daniel Webster Highway
Boscawen, NH 03303
Tel: 225-5505
Fax: 796-2271

Rockingham County Office
113 North Road,
Brentwood, NH 03833
Tel: 679-5616
Fax: 679-8070

Strafford County Office
259 County Farm Road, Unit 5
Dover, NH 03820-6015
Tel: 749-4445
Fax: 743-3431

Sullivan County Office
24 Main Street
Newport, NH 03773
Tel: 863-9200
Fax: 863-4730

Family, Home and Garden Education Center
470 Commercial Street, Room 289
Manchester, NH 03101-1113
Tel: 629-9494
Fax: 629-9998

Natural Resource Conservation Service (NRCS) and Conservation District Offices

NRCS Website: ***www.nh.nrcs.usda.gov***

Belknap County Conservation District & NRCS
719 North Main Street, Room 203
Laconia, NH 03246-2772
Tel: 527-5880 / 527-9146

Carroll County Conservation District & NRCS
The Grindle Center
73 Main Street
PO Box 533
Conway, NH 03818-0533
Tel: 447-2771
Fax: 447-8945

Cheshire County Conservation District & NRCS
Rt. 12 South, Walpole Industrial Park
R1 Box 315
Walpole, NH 03608-9744
Tel: 756-2988
Fax: 756-2978

Coos County Conservation District & NRCS
4 Mayberry Lane
Lancaster, NH 03854-3616
Tel: 788-4651
Fax: 788-2538

Grafton County Conservation District & NRCS
Swiftwater Road
RR 2, Box 148-B
Woodsville, NH 03785-0229
Tel: 747-2001
Fax: 747-3477

Hillsborough County Conservation District & NRCS
Chappell Professional Center
#468, Route 13 South
Milford, NH 03055-3442
Tel: 673-2409
Fax: 673-0597

Merrimack County Conservation District & NRCS
The Concord Center
10 Ferry Street, Box 312
Concord, NH 03301-5081
Tel: 223-6023
Fax: 223-6030

Rockingham County Conservation District Office
118 North Road
Brentwood, NH 03833-6614
Tel: 679-2790
Fax: 679-2860

Rockingham County NRCS
243 Calef Highway
Telly's Plaza
Epping, NH 03042
Tel: 679-1587
Fax: 679-4658

Strafford County Conservation District & NRCS
USDA Agriculture Service Center
259 County Farm Road, Unit #3
Dover, NH 03820-6015
Tel: 749-3037
Fax: 743-3667

Sullivan County Conservation District Office & NRCS
24 Main St
Newport, NH 03733-1500
Tel: 863-4297
Fax: 863-4730

Regional Planning Commissions

North Country Council, Inc.
The Cottage at the Rocks
107 Glessner Road
Bethlehem, NH 03574-5800
Tel: 444-6303
Fax: 444-7588
Website: *www.NCCouncil.org*

Lakes Region Planning Commission
Humiston Building
103 Main Street, Suite 3
Meredith, NH 03253-5862
Tel: 279-8171
Fax: 279-0200
Website: *www.lakesrpc.org*

Upper Valley Lake Sunapee Regional Planning Commission
77 Bank Street
Lebanon, NH 03766-1704
Tel: 448-1680
Fax: 448-0170
Website*: www.uvlsrpc@valley.net*

Southwest Regional Planning Commission
20 Central Square, 2nd Floor
Keene, NH 03431-3771
Tel: 357-0557
Fax: 357-7440
Website: *www.swrpc.org*

Central New Hampshire Planning Regional Commission
28 Commercial Street
Concord, NH 03301
Tel: 226-6020
Fax: 226-6023
Website: *www.cnhrpc.org*

Southern New Hampshire Planning Commission
338 Dubuque Street
Manchester, NH 03102-3546
Tel: 669-4664
Fax: 669-4350
Website: *www.snhpc.org*

Nashua Regional Planning Commission
115 Main Street
PO Box 847
Nashua, NH 03061-0847
Tel: 883-0366
Fax: 883-6572
Website: *www.nashuarpc.org*

Rockingham Planning Commission
156 Water Street
Exeter, NH 03833-2487
Tel: 778-0885
Fax: 778-9183
Website: *www.nh.ultranet.com/~rpc*

Strafford Regional Planning Commission
259 County Farm Road, Unit 1
Dover, NH 03820-6019
Tel: 742-2523
Fax: 742-7986
Website: *www.strafford.org*

Farm Service Agencies

Cheshire-Sullivan County FSA Office
R1, Box 315
Walpole Industrial Park
Walpole, NH 03608
Tel: 756-2970
Fax: 756-2978

Coos-Carroll County FSA Office
4 Mayberry Lane
Lancaster, NH 03854-3616
Tel: 788-4602
Fax: 788-2538

Grafton County FSA Office
Swiftwater Road
RR2, Box 148C
Woodsville, NH 03785
Tel: 747-3751
Fax: 747-3477

Hillsborough County FSA Office
Chappel Professional Building
468 State Route 13 S
Milford, NH 03055
Tel: 673-1222
Fax: 673-0597

Merrimack-Belknap County FSA Office
10 Ferry Street
Box 22, Suite 212
Concord, NH 03301
Tel: 223-6003
Fax: 223-6030

Rockingham-Strafford County FSA Office
243 Calef Highway, Route 125
Epping, NH 03042-2326
Tel: 679-4656
Fax: 679-4658

Other Organizations

American Ground Water Trust
16 Center Street
Concord, NH 03301
Tel: 228-5444
Website*: www.agwt.org*

NH Department of Resources and Economic Development (DRED)
Division of Parks and Recreation - Bureau of Trails
PO Box 1856
Concord, NH 03302-1856
Tel: 271-3254
Website*: www.nhparks.state.nh.us/trbureau.html*

NH Association of Conservation Commissions
54 Portsmouth Street
Concord, NH 03301
Tel: 224-7867
Website*: www.nhacc.org/nhacc.htm*

NH Department of Environmental Services
6 Hazen Drive
Concord, NH 03301
Biology Bureau 271-3414
Drinking Water Maps 271-1168
Favorable Gravel Well Maps 271-7061
Rivers Protection and Management Program 271-1152
Water Well Board (State Geologist's office) 271-3503
Wetlands Bureau 271-2147
Website*: www.des.state.nh.us*

NH Division of Historical Resources (includes State Archaeologist's office)
19 Pillsbury Street
Box 2043
Concord, NH 03301-2043
Tel: 271-3558
Website*: www.state.nh.us/nhdhr*

NH Fish & Game Department
2 Hazen Drive
Concord, NH 03301
Tel: 271-2462
Website*: www.wildlife.state.nh.us*

NH Natural Heritage Inventory
PO Box 1856
Concord, NH 03302-1856
Tel: 271-3623
Website*: www.webster.state.nh.us/nhnhi.html*

NH Office of State Planning
2 ½ Beacon Street
Concord, NH 03301
Tel: 271-2155
Website*: www.state.nh.us/osp*

NH Snowmobile Association
722 Rte 3A
Bow, NH 03304-4010
Tel: 224-8906
Website*: www.nhsa.com/*

Office of Emergency Management
107 Pleasant Street
State Office Park South
Concord, NH 03301
Tel: 223-3467 or 1-800-852-3792

Society for the Protection of NH Forests
54 Portsmouth Street
Concord, NH 03301
Tel: 224-9945
Website*: www.spnhf.org*

New Hampshire Land Trusts (June 2000)

Contact the Society for the Protection of NH Forests for an updated listing

(L) Amherst Land Trust
Peggy Miller
81 Christian Hill Road
Amherst NH 03031
(603) 672-3758

(S) Archaeological Conservancy
Rob Crisell - Eastern Regional Dir.
1307 S. Glebe Road
Arlington VA 22204
(703) 979-4410

(R) * Bearpaw Regional Greenways
Phil Auger - President
PO Box 19
Deerfield NH 03037
(603) 679-5616

(L) Chocorua Lake Conservation Found.
Cornelia W. Lanou - President
90 Keene Street
Providence RI 02906

(L) Francestown Land Conservation Inc.
Bob Lindgren
Box 132
Francestown NH 03043
(603) 547-2515

(R) Green Mountain Conservation Group
Blair Folts President
PO Box 95
So. Effingham NH 03882
(603) 539-7926
baf@landmarknet.net

(R) Ammonoosuc Conservation Trust
Rebecca Brown
80 Old Post Road
Sugar Hill NH 03585
(603) 823-8119

(S) Audubon Society of N.H.
Joanna Magoon - L.P. Specialist
Silk Farm Road
Concord NH 03301-8200
(603) 224-9909

(L) Bedford Land Trust
Patricia Cobb - Chairman
PO Box 10315
Bedford NH 03110-0315
(603) 471-0780
Susan Tufts@msn.com

(L) Concord Conservation Trust
Thomas Masland - Chairman
54 Portsmouth Street
Concord NH 03301
(603) 224-9945

(L) Gilmanton Land Trust
Gary Ambelas - Chair
PO Box 154
Gilmanton Iron Works NH 03837
(603) 364-2828

(L) Hanover Conservation Council
Nancy Prosser - President
PO Box 516
Hanover NH 03755
(603) 643-6075

(R) Appalachian Trail Conf. Land Trust
Kevin Peterson - N.E. Field Rep.
PO Box 312
Lyme NH 03768-0312
(603) 795-4935

(R) * Ausbon Sargent Land Preser. Trust
Deborah Stanley - Executive Dir.
PO Box 2040
New London NH 03257
(603) 526-6555
aslpt@tds.net

(L) Bow Open Spaces
Robert Dawkins - Treasurer
41 South Bow Road
Bow NH 03304
(603) 225-3678

(L) Dan Hole Pond Watershed Trust
Bob Pratt - President
PO Box 8
Center Ossipee NH 03814
(603) 539-2073
alixandbob.pratt@erols.com

(R) Great Bay Stewards
89 Depot Road
Stratham NH 03885
(603) 778-0015

(R) Harris Center for Conserv. Education
Meade Cadot - Director
341 Kings Highway
Hancock NH 03449
(603) 525-3394

*** Accepted LTA's Statement of Land Trust Standards and Practices**

S = Statewide
R = Regional (multi-town)
L = Local (one town or waterbody)

New Hampshire Land Trusts (Cont'd.)

(L) Highland Lake Association
James E. Lane - President
PO Box 103
Washington NH 03280

R) * Lakes Region Conservation Trust
Tom Curren - Executive Dir.
PO Box 1097
Meredith NH 03253
(603) 279-3246

(R) * Monadnock Conservancy
Benjamin Mahnke - Director of L.P.
PO Box 337
Keene NH 03431-0337
(603) 357-0600
Ben@MonadnockConservancy.org

(S) * New England Forestry Foundation
Keith Ross - Dir. of Land Protection
PO Box 1099
Groton MA 01450-3099
(978) 448-8380

(L) Nichols-Smith Conserv. Land Trust
Tom Mullin - Director
PO Box 266
Hollis NH 03049
(603) 465-7787

(R) Rockingham Land Trust
Peter Dow - President
c/o Rockingham Planning Commission
156 Water Street
Exeter NH 03833
(603) 772-6157

(R) Seacoast Land Trust
PO Box 4183
Portsmouth NH 03802-4183
(603) 433-0963
seacoast@rcn.com

(R) Howfirma Trust
James B. VanBokkelen
45 Hilldale
South Hampton NH 03827
(603) 394-7832

(L) Lyme Hill & Valley Association
Freda Swan
133 Breck Hill Road
Lyme NH 03768
(603) 353-9834

(R) Moose Mountain Regional Greenway
Cynthia Wyatt
PO Box 191
Union NH 03887
(603) 473-2535

(S) New England Wildflower Society
Ann Moore - NH State Chair
8 Boulters Cove
North Hampton NH 03862
(603) 964-1982

(L) Nissitissit River Land Trust
Peter W. Smith - President
40 Nartoff Road
Hollis NH 03049
(603) 882-1431

(L) Roland Park Land Trust
Christopher T. Mabley - President
PO Box 92
Center Ossipee NH 03814

(L) Silver Lake Land Trust
William Walker - Chairman
PO Box 222
Harrisville NH 03450
(603) 827-3731

(S) HSUS Wildlife Land Trust
John Kullberg - Executive Dir.
700 Professional Drive
Gaithersburg MD 20879
(202) 452-1100

(L) * Marlborough-Roxbury Land Assn.
John LeCraw - President
50 Clapp Pond Road
Marlborough NH 03455
(603) 876-4503

(R) Nashua River Watershed Association
Christa Hawryluk -Land Protection Director
592 Main Street
Groton MA 01450
(978) 448-0299
nrwa@ma.ultranet.com

NH Preservation Alliance
Jennifer Goodman - Executive Dir.
PO Box 268
Concord NH 03302-0268
(603) 224-2281
jg@nhpreservation.org

(R) * Piscataquog Watershed Association
Jed Callen - Land Agent
Shedd Road
New Boston NH 03070
(603) 487-3823
jedcallen@aol.com

(L) Sanbornton Agriculture and Land Trust
Frances Belcher
PO Box 202
Sanbornton NH 03269
(603) 286-7715
rgtyler@alo.com

(S) * Society for the Protection of NH Forests
Paul Doscher - Sr. Dir. of Land Prot.
54 Portsmouth Street
Concord NH 03301
(603) 224-9945
pdoscher@spnhf.org

*** Accepted LTA's Statement of Land Trust Standards and Practices**

S = Statewide
R = Regional (multi-town)
L = Local (one town or waterbody)

New Hampshire Land Trusts (Cont'd.)

(R) Squam Lakes Association
PO Box 204
Holderness NH 03245
(603) 968-7336

(R) * Squam Lakes Conservation Society
Bertram Read - President
PO Box 696
Holderness NH 03245-0696
(603) 968-7900

(R) Strafford Rivers Conservancy
Linda Hornyak-Grieve - Executive Dir.
PO Box 623
Dover NH 03820
(603) 868-1494
grieve2@earthlink.net

(S) The Nature Conservancy - NH Office
Mark Zankel - Dir. of Conservation Programs
2 ½ Beacon Street, Suite 6
Concord NH 03301
(603) 224-5853
mzankel@tnc.org

(S) Trust for Public Land-N.E.Field Office
David Houghton - Dir. & Julie Iffland
33 Court Street
Montpelier VT 05602
(802) 223-1373
julie.iffland@tpl.org

(L) Turkey River Basin Trust
Mary Louise Hancock - Chairwoman
33 Washington Street
Concord NH 03301
(603) 225-9721

(R) * Upper Valley Land Trust
Jeanie McIntyre - Executive Dir.
19 Buck Road
Hanover NH 03755
(603) 643-6626

*** Accepted LTA's Statement of Land Trust Standards and Practices**

S = Statewide
R = Regional (multi-town)
L = Local (one town or waterbody)

APPENDIX B
Publications and Suggested Further Reading

Publication	Source
WATER RESOURCES	NHDES
A Guide to Identifying Potentially Favorable Areas to Protect Future Municipal Wells in Stratified-Drift Aquifers, Volume 1 (1999). NH Department of Environmental Services, Water Division	NHDES
The DES Guide to Groundwater Protection (1996). New Hampshire Department of Environmental Services (NHDES-WSPCD-96-4)	NHDES (Water Resources Div.)
Groundwater Resources in New Hampshire - Stratified Drift Aquifers. (1995). USGS/NH-VT, Report 95-4100	UNHCE
Following the Flow (non-point source pollution assessment) (also available as a video). Jeff Schloss, UNH Cooperative Extension & Alan Ammann, NRCS	UNHCE and NHF&G
Stream Study & Water Quality Assessment Guide (1997). Kelly Mackenzie, NH Fish & Game Department and Frank Mitchell, UNH Cooperative Extension	
WETLANDS	NH OSP, ASNH, UNHCE
Buffers for Wetlands and Surface Waters: A Guide for New Hampshire Municipalities (1997 - revised edition). Vicki Chase, Laura Deming and Francesca Latawiec. Audubon Society of NH.	NHDES
Method for the Comparative Evaluation of Non-Tidal Wetlands in New Hampshire (NH Method) (1991). Alan P. Ammann and Amanda J. Lindley Stone. NH Department of Environmental Services.	NH OSP
Municipal Guide to Wetland Protection (1993). Amanda J. Lindley Stone, Janet M. Bourne, Julie L. Cummings, Marjory M. Swope, Kenneth N. Kettenring, James F. McLaughlin. NH Office of State Planning.	UNHCE and NHF&G
A Study Guide to New England's Freshwater Wetlands (1994). Laura Vincent, Frank Mitchell, Ronald Miller. NH Fish & Game Department.	NHF&G
Identification & Documentation of Vernal Pools in NH (1997). Anne Tappan (Editor). NH Fish & Game Department.	

Publication	Source
FARMLANDS	
Preserving Rural Character through Agriculture (1999). NH Coalition for Sustaining Agriculture.	UNHCE
Developing an Agricultural Profile for Your Town (1999). David Seavey, UNH Cooperative Extension	UNHCE
FOREST RESOURCES	
New Hampshire Forest Land Evaluation and Site Assessment (FLESA). (In progress)	RC&D
Good Forestry in the Granite State: Recommended Voluntary Forest Management Practices for New Hampshire (1997). NH Forest Sustainability Standards Work Team. Society for the Protection of NH Forests and DRED, Division of Forests & Lands.	SPNHF
WILDLIFE HABITAT	
Identifying and Prioritizing Significant Wildlife Habitat: A Guide for NH Communities and Conservation Groups (2001). John Kanter, Rebecca Suomala, Ellen Snyder. NH Fish & Game Department.	NHF&G

Publications for Further Reference

Publication	Source
LAND PROTECTION	
Conservation Options: A Landowner's Guide. (1996) Land Trust Alliance, Washington DC	LTA
Protecting your land with a Conservation Easement. Brochure, Land Trust Alliance, Washington DC	LTA
Preserving Family Lands: Book 1. Essential Tax Strategies for the Landowner (1998) Stephen J. Small (Attorney at Law), Landowner Planning Center, Boston, Massachusetts.	LPC
Does Open Space Pay? (1996). Phil Auger, UNH Cooperative Extension	UNHCE
Innovative Land Use Techniques. (1990). UNH Cooperative Extension	UNHCE
Protecting Your Land: Conservation Options for NH Landowners. Fact sheet. Society for the Protection of NH Forests	SPNHF
Conservation Easements: Questions and Answers. Fact sheet, Society for the Protection of NH Forests	SPNHF
Estate Planning and Land Protection Issues for Landowners: A Basic Outline. Thomas Masland, Concord, NH.	R&S
The New Conservation Easement Tax Incentive. Thomas Masland, Concord, NH	R&S
Open Space for New Hampshire – A Toolbook of Techniques for N.H. Communities for the new Millennium (2000). Dorothy Taylor, NH Wildlife Trust	NHWF
GEOGRAPHIC INFORMATION SYSTEMS	
GIS Guidebook for New Hampshire Municipalities. (1994). NH Office of State Planning.	OSP
New Hampshire GRANIT Data Catalog (1999). NH Office of State Planning	NH OSP Also available on the Web at *www.granit.sr.unh.edu*

Publication	Source
GENERAL	
Handbook for Municipal Conservation Commissions in New Hampshire. (1997 - revised edition). Marjory M. Swope, NH Assn. of Conservation Commissions.	NHACC
New Hampshire's Land and Community Heritage at Risk (1999). Citizens for New Hampshire Lands and Community Heritage.	CNHL&CH
Managing and Restoring Native Ecosystems: A Guide for New Hampshire Towns (in progress). Alan Ammann, USDA Natural Resource Conservation Service.	NRCS
New Hampshire's Changing Landscape - Population Growth, Land Use Conversion and Resource Fragmentation in the Granite State. (1999). Dan Sundquist and Michael Stevens. Society for the Protection of NH Forests. This report may be viewed at the Forest Society website: www.spnhf.org	SPNHF
Bibliography and Index of New Hampshire Geology NH Department of Environmental Services	NHDES
Public Access Report for NH Lakes, Ponds, and Rivers (in progress, 2001) NH Office of State Planning	NHOSP
Mad River Valley Study. The Vermont Land Trust	VLT

Key To Sources For Obtaining Publications

ASNH **Audubon Society of New Hampshire**
3 Silk Farm Road
Concord, NH 03301
Tel: 224-9909
Website: *www.nhaudubon.org*

CNHL&CH **Citizens for NH's Lands and Community Heritage**
PO Box 1566
Concord, NH 03302-1566
Tel: 230-9729
Website: *www.specialplaces.org*

LTA **Land Trust Alliance**
1319 F Street NW
Suite 501
Washington DC 20014-1106
Tel: 202-638-4725
Website: *www.lta.org*

LPC **Landowner Planning Center**
PO Box 4508
Boston, MA 02101-4508
Tel: 617-357-1644

NHACC **NH Association of Conservation Commissions**
54 Portsmouth Street
Concord, NH 03301
Tel: 224-7867
Website: *www.nhacc.org/nhacc.html*

NHDES **NH Department of Environmental Services**
Public Information and
Permitting Office
6 Hazen Drive
Concord, NH 03301
Tel: 271-2975
Website: *www.des.state.nh.us*

NHF&G **NH Fish & Game Department**
2 Hazen Drive
Concord, NH 03301
Tel: 271-2462
Website: *www.wildlife.state.nh.us*

NH OSP **NH Office of State Planning**
2 ½ Beacon Street
Concord, NH 03301
Tel: 271-2155
Website: *www.state.nh.us/osp*

NHWF **NH Wildlife Federation**
54 Portsmouth Street
Concord, NH 03301
Tel: 224-5953

NRCS **Natural Resource Conservation Service**
Federal Building
Durham, NH 03824
Tel: 868-7581
Website: *www.nh.nrcs.usda.gov/*

R&S **Ransmeier & Spellman**
One Capital Street
PO Box 600
Concord, NH 03302-0600
Tel: 228-0477 or 1-800-367-0477
Website: *www.law-nh.com*

RC&D **Resource Conservation and Development, Southern Area Office**
The Concord Center
10 Ferry Street
Concord, NH 03301-5081
Tel: 223-0083

SPNHF **Society for the Protection of NH Forests**
54 Portsmouth Street
Concord, NH 03301
Tel: 224-9945
Website: *www.spnhf.org*

UNHCE **UNH Cooperative Extension**
Publications Center
Nesmith Hall, Room 16
131 Main Street
Durham, NH 03824-3597
Tel: 862-2346
Website: *ceinfo.unh.edu*

VLT **The Vermont Land Trust**
The King Farm
Woodstock, VT 05091
Tel: (802) 457-2369

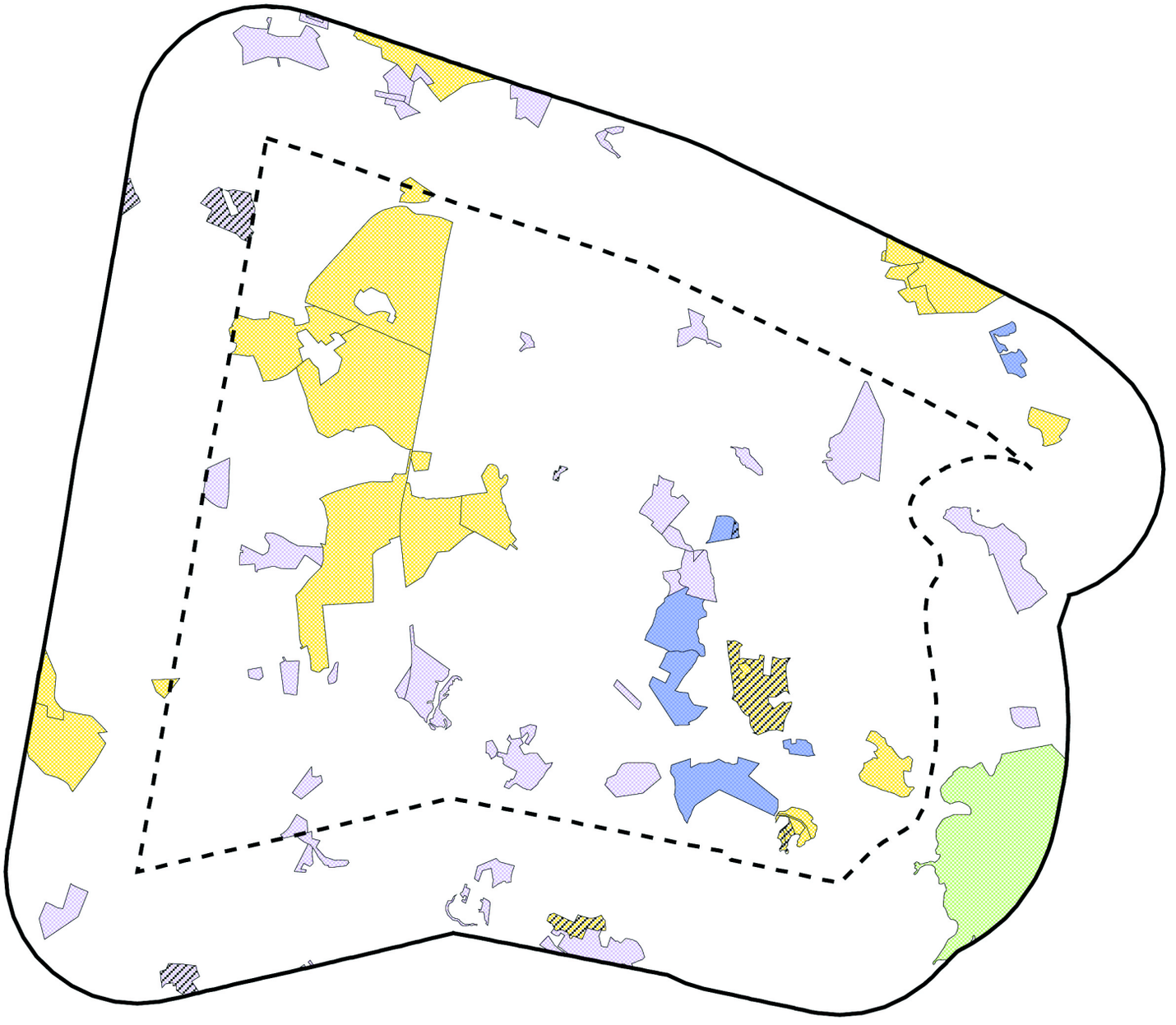
APPENDIX C
Examples of Selected Basic Inventory Maps

All examples of the selected Basic Inventory maps are for the town of Durham. The maps were produced using GIS.

- Durham Conservation Lands*
- Drinking Water Resources and Potential Contamination Sources map for Durham (NHDES)
- Durham Lands of Special Importance map
- Durham Unfragmented Lands*
- Durham Wetlands Composite map
- Durham Zoning map*
- Durham Tax map*

* These maps can be prepared as transparent overlays, as per the examples, or they can be incorporated into the base map.

Durham Conservation Lands



Town Boundary

1 Mile Extension Beyond Study Area

Conservation Easement

Primary Protecting Agency/ Organization

Federal

State

Local

Private

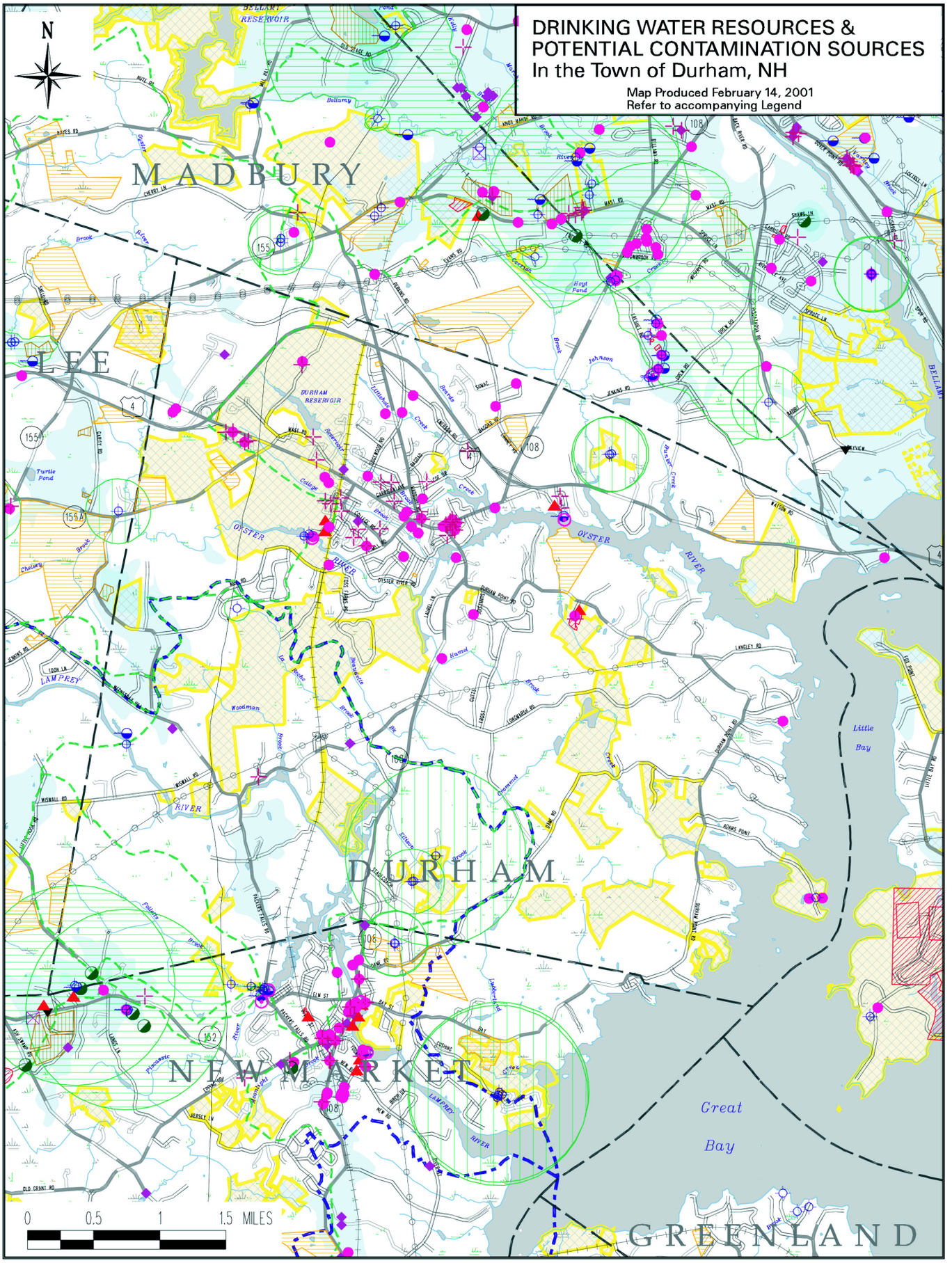
Map Created By:
UNH Cooperative Extension
02/02/00

N
W E
S

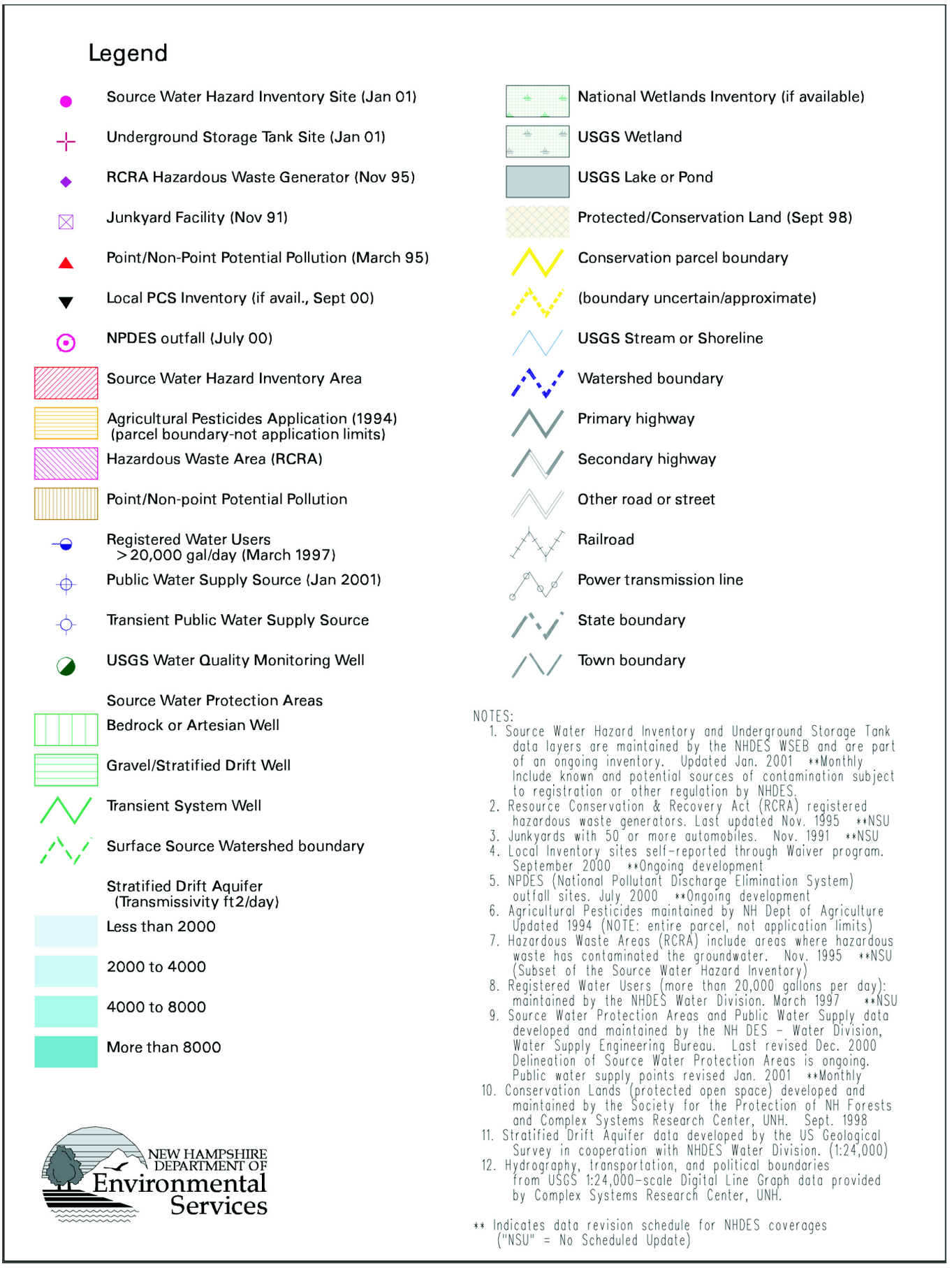
1 0 1 Miles

Data sources:
Conservation lands data obtained from the Society for the Protection of NH Forests, last revised September 1998.
Original scale 1:24,000/1/25,000.

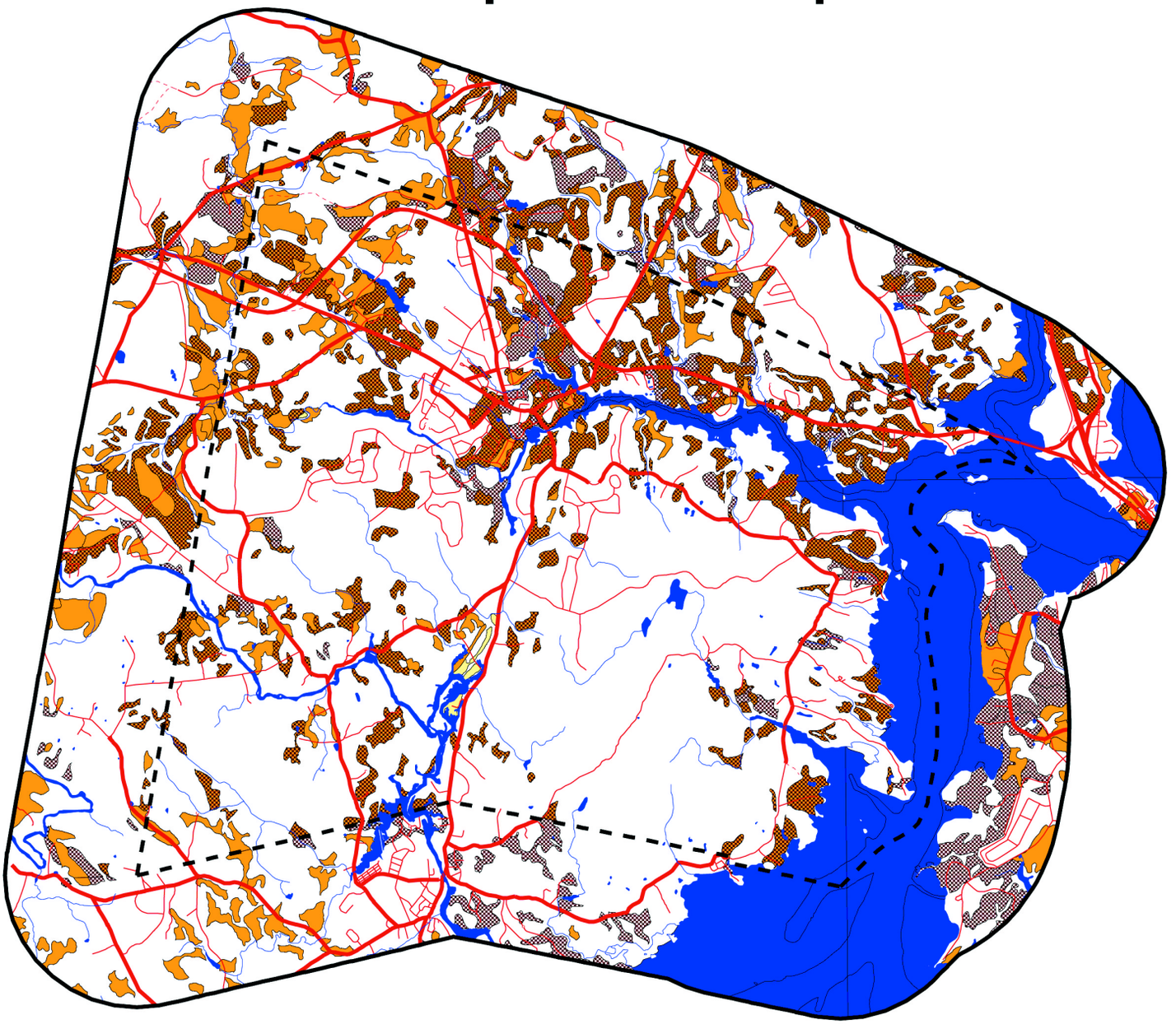
Digital data in NH GRANIT represent the efforts of the contributing agencies to record information from the cited source materials. Complex Systems Research Center (CSRC), under contract to the Office of State Planning (OSP), and in consultation with cooperating agencies, maintains a continuing program to identify and correct errors in these data. Neither OSP nor CSRC make any claim as to the validity or reliability or to any implied uses of these data.


DRINKING WATER RESOURCES &
POTENTIAL CONTAMINATION SOURCES
In the Town of Durham, NH
Map Produced February 14, 2001
Refer to accompanying Legend
N
MADBURY
LEE
DURHAM
NEWMARKET
GREENLAND
Great Bay
Little Bay
OYSTER RIVER
LAMPREY RIVER
DURHAM RESERVOIR
BELLAMY RESERVOIR
Hoyt Pond
Turtle Pond
0 0.5 1 1.5 MILES

Drinking Water Resources and Potential Contamination Sources map for Durham (NHDES)



Lands of Special Importance



Town Boundary

1 Mile Extension Beyond Study Area

Roads

Primary and Secondary Routes

Road or street, Class 3 & 4

Trail & other

Surface Waters

Soils

Statewide Importance

Prime Farmland

Prime Where Not Flooded

Map Created By:
UNH Cooperative Extension
02/02/00

N
W E
S

1 0 1 Miles

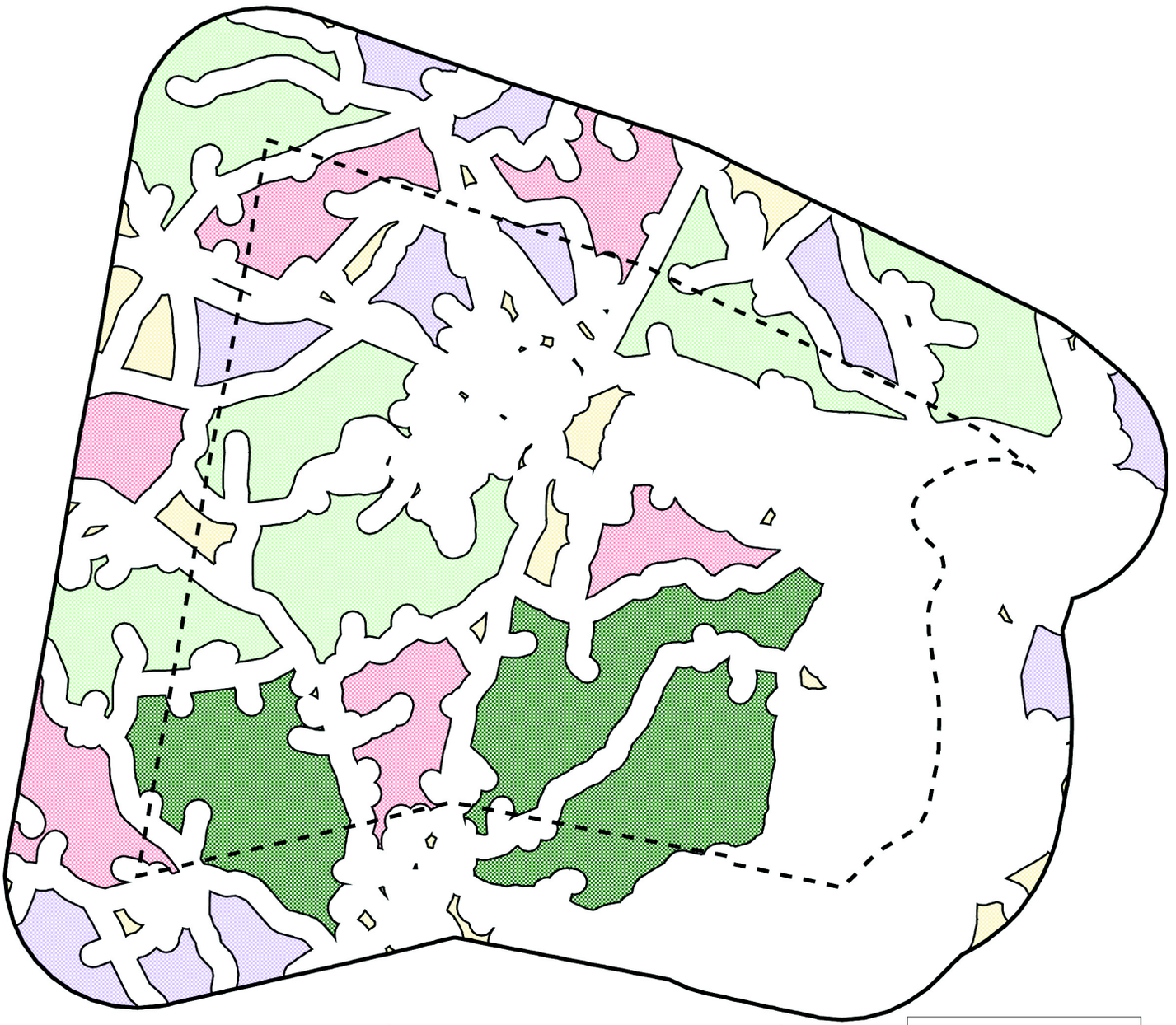
Data Sources:
Hydrography data obtained from US Geologic Survey, last revised October 1995. Original scale 1:24,000/1:25,000.

Roads and Trails data obtained from US Geologic Survey, last revised January 1993. Original scale 1:24,000/1:25,000.

Soil Units data obtained from Natural Resource Conservation Service, last revised November 1993. Original Scale 1:24,000/1:25,000.

Digital data in NH GRANIT represent the efforts of the contributing agencies to record information from the cited source materials. Complex Systems Research Center (CSRC), under contract to the Office of State Planning (OSP), and in consultation with cooperating agencies, maintains a continuing program to identify and correct errors in these data. Neither OSP nor CSRC make any claim as to the validity or reliability or to any implied uses of these data.

Durham Unfragmented Lands



Town Boundary
1 Mile Extension Beyond Study Area

Fragment Size (acres)
- 0 - 100
- 100 - 249
- 250 - 499
- 500 - 999
- 1000 - 1499

Map Created By:
UNH Cooperative Extension
02/02/00

N W E S

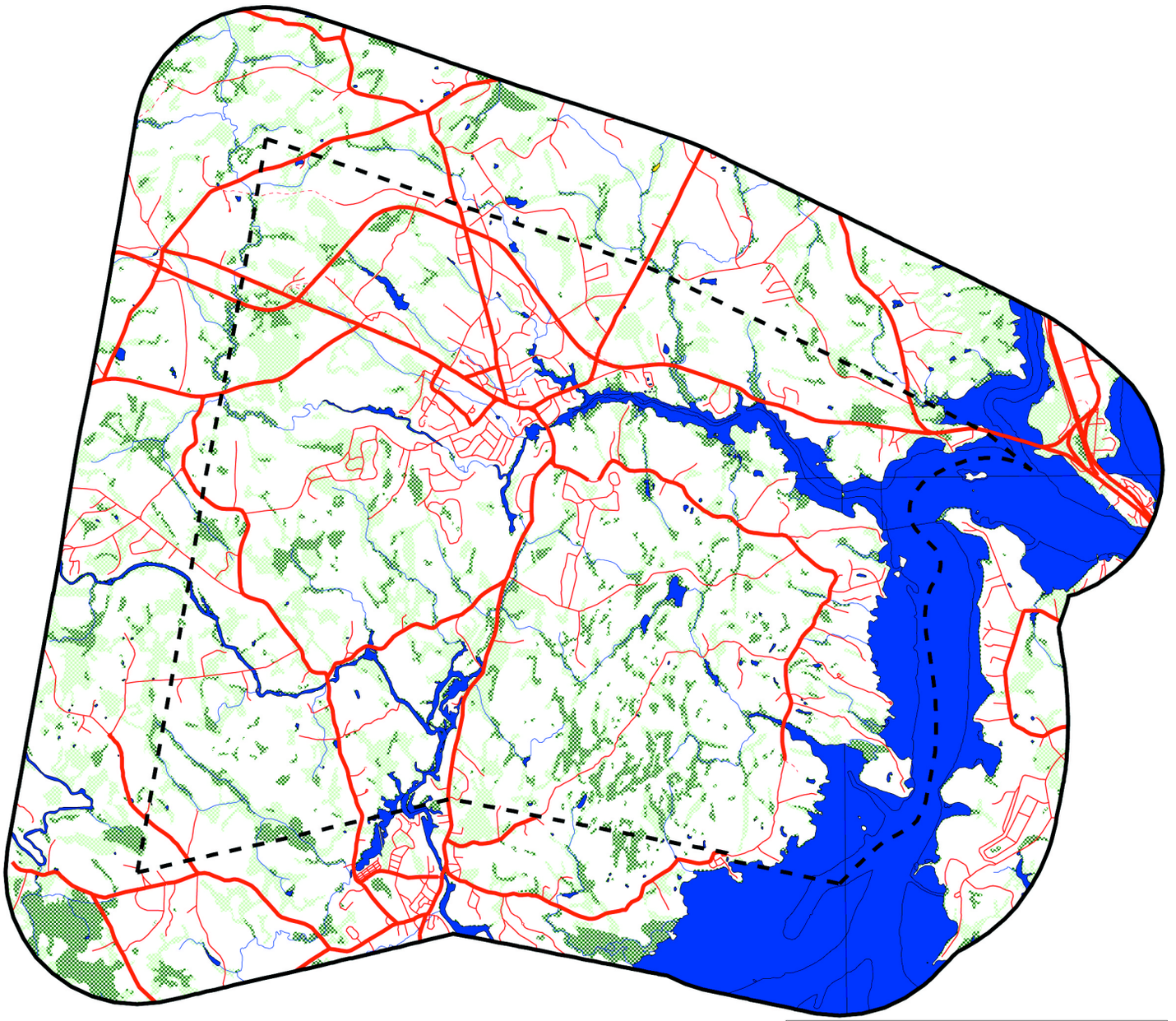
1 0 1 Miles

Data sources:
Fragments were derived from generating a 500ft buffer around all road classes except those represesnting trails.

Roads and Trails data obtained from US Geological survey, last revised January 1993. Original scale 1:24,000/1:25,000.

Digital data in NH GRANIT represent the efforts of the contributing agencies to record information from the cited source materials. Complex Systems Research Center (CSRC), under contract to the Office of State Planning (OSP), and in consultation with cooperating agencies, maintains a continuing program to identify and correct errors in these data. Neither OSP nor CSRC make any claim as to the validity or reliability or to any implied uses of these data.

Durham Wetland Composite



Town Boundary

1 Mile Extension Beyond Study Area

Roads

Primary and Secondary Routes

Road or street, Class 3 & 4

Trail & other

Surface Waters

NWI Wetlands

Hydric Soils

Map Created By:
UNH Cooperative Extension
02/02/00

N
W E
S

1 0 1 Miles

Data Sources:
Hydrography data obtained from US Geological Survey, last revised October 1995. Original scale 1:24,000/1:25,000.

Composite wetlands derived from NWI and Soils data.:
National Wetlands Inventory data obtained from US Fish and Wildlife Service, last revised October 1998.
Original scale 1:24,000/1:25,000.

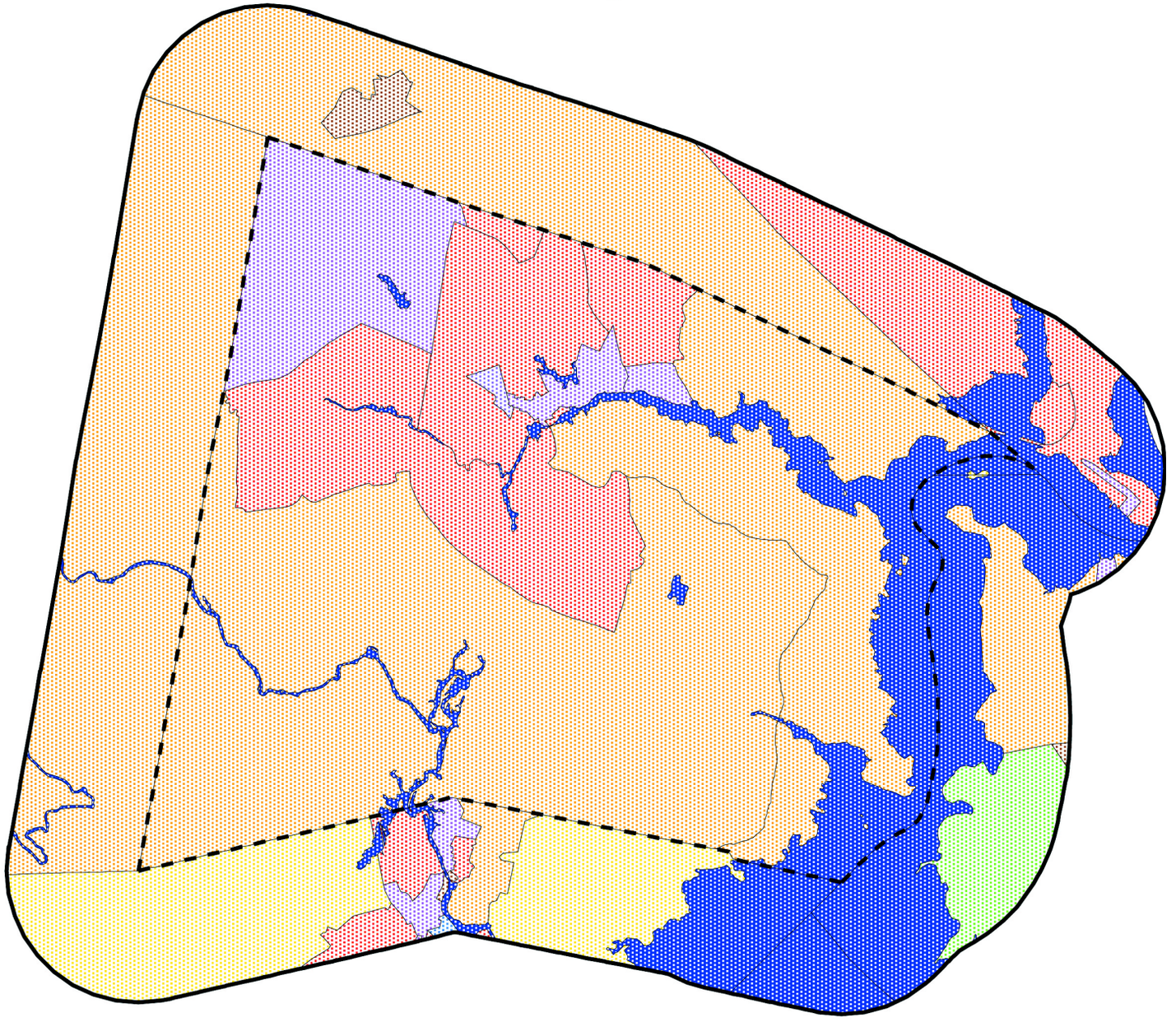
Soils data obtained from Natural Resources Conservation Service, last revised November 1993. Original scale 1:24,000/1:25,000.

Hydrography data obtained from US Geological Survey, last revised October 1995. Original scale 1:24,000/1:25,000.

Roads and Trails data obtained from US Geologic Survey, last revised January 1993. Original scale 1:24,000/1:25,000.

Digital data in NH GRANIT represent the efforts of the contributing agencies to record information from the cited source materials. Complex Systems Research Center (CSRC), under contract to the Office of State Planning (OSP), and in consultation with cooperating agencies, maintains a continuing program to identify and correct errors in these data. Neither OSP nor CSRC make any claim as to the validity or reliability or to any implied uses of these data.

Durham Zoning Information



Town Boundary

1 Mile Extension Beyond Study Area

Zoning Information

- Commercial
- High Density Residential
- Industrial
- Low Dens. Res.
- Med. Dens. Res.
- Mixed/Urban
- Open/Conservati
- Public/Institut
- Water

Map Created By:
UNH Cooperative Extension
02/02/00

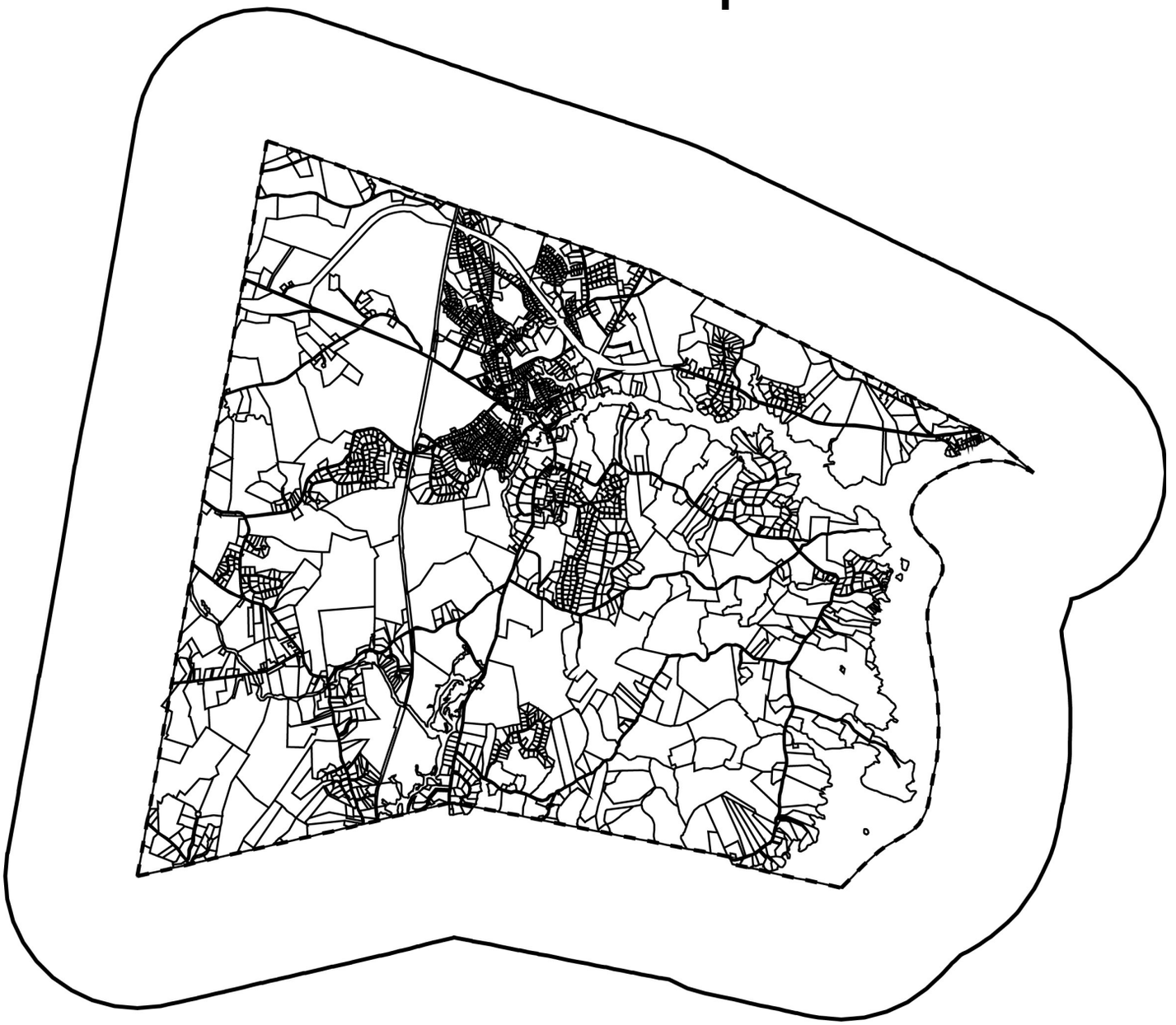
N W E S

1 0 1 Miles

Data sources:
Zoning infromation data obtained from Strafford Reginal Planning, last revised 1995/1996. Original scale unknown.

Digital data in NH GRANIT represent the efforts of the contributing agencies to record information from the cited source materials. Complex Systems Research Center (CSRC), under contract to the Office of State Planning (OSP), and in consultation with cooperating agencies, maintains a continuing program to identify and correct errors in these data. Neither OSP nor CSRC make any claim as to the validity or reliability or to any implied uses of these data.

Parcel-based Tax Map Information



Map Created By:
UNH Cooperative Extension
02/02/00

N
W E
S

1 0 1 Miles

Data sources:
Tax map data obtained from Strafford Regional Planning. Unknown last revision and original scale.

Digital data in NH GRANIT represent the efforts of the contributing agencies to record information from the cited source materials. Complex Systems Research Center (CSRC), under contract to the Office of State Planning (OSP), and in consultation with cooperating agencies, maintains a continuing program to identify and correct errors in these data. Neither OSP nor CSRC make any claim as to the validity or reliability or to any implied uses of these data.

APPENDIX D
Examples of Some Inventory Projects

Examples of Some Inventory Projects

There are many different ways to approach a natural resources inventory. How a group goes about an inventory will depend on several factors, such as:

- the specific goals of the inventory,
- natural resource priorities,
- the needs of the community,
- the extent of existing (documented) natural resources information, and
- the current status of natural resources, e.g., a polluted water body may be a priority.

The examples provided here demonstrate ways that different groups have gone about their natural resources inventories. Some communities have completed a comprehensive inventory first, and then have gone on to focus on specific issues, such as land protection (e.g., Warner). Others have focused on a prioritized issue that needed immediate attention before tackling a comprehensive NRI (e.g., Kingston). While many communities conduct town-wide inventories (e.g., Deerfield), some have taken a watershed-based approach (e.g., Warner, Exeter River Watershed).

CONWAY

Study Area: Town of Conway

Type of Inventory: Comprehensive Natural Resources Inventory, Wetland Inventory and Evaluation

Date Completed: 1996

Resources Inventoried: Surface waters, 100-year floodplain, subwatersheds, aquifers, wells, threats to water quality (e.g., NPDES outfalls, groundwater hazards inventory, underground storage tanks, toxics release inventory), rare/ threatened/ endangered species (NH Natural Heritage Inventory data), archaeologic resources, historic resources, prime farmland soils, scenic resources, recreation resources, conservation lands, wildlife habitat (based on land cover types), unfragmented lands, and development limitations based on soil characteristics.

Project Goals: Integrate protection of prioritized resources into local natural resources protection strategies. Prioritize wetland resources.

GIS Used: Yes

Study done by: Audubon Society of NH under grant funding from the US Environmental Protection Agency

Description: The Town of Conway's interest in an NRI stemmed from the recognition of the extraordinary value of the biogeographical resources of the Mount Washington Valley, and the need to preserve them. As part of an EPA-funded project, a comprehensive natural resources inventory using GIS was completed. The purpose of the inventory was to assist Conway town municipal officials in their efforts to set up a mechanism for integrating protection of prioritized resources into local natural resource protection strategies.

The data tables associated with these data layers were generated from the GIS database and included in the final documentation, as well as being presented on GIS maps. The inventory also included a detailed wetlands evaluation study of 42 wetlands, using the *Method for the Comparative Evaluation of Nontidal Wetlands in NH* (NH Method). The town has since used the final natural resources inventory report and detailed wetland study in several ways:

1. Adopted the NRI report as part of the master plan
2. Used the wetlands study to follow through with on-going work to update the town's Wetland Conservation District map.
3. Modified the master plan to establish a clear policy foundation for protective buffers adjoining wetlands and surface waters.
4. Added a Wetland and Watershed Protection District to the Town Zoning Ordinance

   Having a written report documenting the procedures and findings of the natural resources inventory and wetlands study, in addition to the GIS maps, was critical in getting the results implemented.

DEERFIELD

Study Area: Town of Deerfield

Type of Inventory: Comprehensive Natural Resources Inventory

Date Completed: 1991

Resources Inventoried: Surface water and groundwater resources, protected lands, tree farms, farmlands, historic sites, rare species and habitats, scenic roads, gravel deposits, wetlands, soil limitations for septic, buildings and roads. A composite tax map (not digitized) was also generated for this project.

Project Goals: (a) Identify important community natural resources; (b) Examine the land use/natural resource relationship; and (c) Use the project's findings to adapt or change land use and other planning decisions, and in the review of subdivision proposals.

GIS Used: Yes

Study done by: Volunteers (led by Deerfield Conservation Commission); GIS work was contracted out.

Description: The Town of Deerfield completed a comprehensive inventory of its natural resources in 1991. The inventory, one of the first to use GIS technology and the GRANIT database, was done by a volunteer group, led by the conservation commission. For inventory map features not in the GRANIT database, the volunteers collected the data and made tracings suitable for digitizing into the GRANIT system, e.g., property outlines, watershed boundaries and farmlands.

At the outset, they included both public officials and community residents in planning the inventory. The planning board, select board, and conservation commission jointly contributed funds to this project. A questionnaire listing potential inventory items was used to poll the town officials and interested residents.

Since 1991, the inventory has been used in a number of ways: to document existing natural resource conditions; review development proposals; derive mapped resource information for larger properties being considered for conservation; and to identify areas for possible protection as part of the Regional Resource Protection Project. In addition, over 20 wetlands have been evaluated using the NH Method. The inventory has also helped the community to focus land conservation efforts. The local Historic Society mapped historical sites using the NRI base map. Information from the natural resources inventory has been incorporated into the master plan. The inventory also served as a model providing ideas for the Bear-Paw Regional Greenways Project's mapping.

EXETER RIVER WATERSHED

Study Area: Region drained by the Exeter River, including 10 towns (Exeter, Kingston, East Kingston, Brentwood, Fremont, Kensington, Chester, Raymond, Sandown, Danville).

Type of Inventory: Broad-based Natural Resources Inventory, including evaluation of 12 prioritized wetland systems

Date Completed: 1998

Resources Inventoried: surface water resources (including active dams, subwatersheds, and the 100-year floodplain), groundwater (aquifers and wells), wetlands, prime farmland soils, rare, threatened and endangered species, conservation lands, archaeologic sites, scenic roads, hazards and threats to resources, unfragmented blocks of land, generalized wildlife habitat, co-occurring resources.

Project Goals: Comprehensive Natural Resources Inventory to serve as the basis for a long term management and protection plan for the natural resources of the Exeter River and its Watershed.

GIS used: Yes

Study done by: Audubon Society of NH under grant funding from the US EPA

Description: The primary purpose of this project was to provide a broad-based inventory of the Exeter River Watershed, identifying priority areas for protection. The inventory was primarily reliant on existing sources of information, most of which was available through the GRANIT GIS database. Data on archaeologic sites, scenic roads, and subwatersheds of the Exeter River were collected and digitized for use with GIS. The wetland evaluation study was undertaken to evaluate the

functions of significant wetland systems. This information was used in resource prioritization and determination of co-occurring resources. Prioritized wetlands were selected based on input from each of the Watershed towns, as well as size and extent of the wetland systems. The NRI was done collaboratively with the Exeter River Local Advisory Committee (ERLAC). The results of the NRI were used as the basis for the Management Plan for the Exeter River Corridor and Watershed, which is being implemented by ERLAC.

KINGSTON

Study Area: Town of Kingston

Type of Inventory: Water Resources Evaluation; Comprehensive Natural Resources Inventory

Date Completed: 1997 (Water Resources), 1999/2000 (NRI)

Resources Inventoried: Surface water resources (including major subwatersheds, floodplains, and rivers and streams covered by the shoreland protection act), wetlands, ground water resources, farmlands and forest lands (based on soils), tree farms, town forests, protected lands, recreation resources, wetlands, wildlife habitat

Project Goals: Assess the current status of water resources for municipal land use planning. Gain a more comprehensive understanding of natural resources in their community.

GIS Used: Yes

Study done by: The town contracted with the regional planning commission to undertake all work relating to GIS maps, and to provide assistance in compiling the written Natural Resources Inventory Report. Additionally, conservation commission members have contributed volunteer time.

Description: Kingston has extensive water resources - at least one-third of the town includes surface water resources in the form of rivers, streams, ponds, and wetlands. In addition, Kingston is underlain by a large aquifer. With rapidly increasing development in town, water supply became a pressing issue. Consequently, the town focused on water resources evaluation as an initial prioritized area of study (prior to conducting a comprehensive NRI).

Using GIS, a series of maps was produced showing groundwater resources, surface water resources, and wetlands. The results of this work were used to update zoning ordinances relating to water resources, and information incorporated into their master plan.

A few years later, the town moved on to look at other natural resources. Using GIS assistance from their regional planning commission, they completed a Natural Resources Inventory in 1999. The town plans to incorporate the inventory results into the master plan, and to update the information in their existing zoning ordinances

and maps associated with these ordinances. With the NRI completed, this information will be used as the basis for a land conservation effort.

To fund the NRI, the conservation commission used conservation funds, the select board and planning board contributed some funds, and remaining 50% of the cost came from a grant the regional planning commission received to help communities with natural resources projects.

NEWMARKET

Study Area: Town of Newmarket

Type of Inventory: Comprehensive Natural Resources Inventory

Date Completed: 1996

Resources Inventoried: Aquifers, protected lands, wetlands (hydric soils), unfragmented blocks were overlaid to identify critical areas for protection

Project Goals: Collect natural resources information for the town.

GIS Used: Not in original inventory. GIS was used to update some of the original inventory maps a few years later.

Study done by: Initial inventory work was contracted out to a firm of consultants. GIS work was contracted out to the regional planning commission.

Description: The Town of Newmarket hired a firm of consultants to do their natural resources inventory in 1991. The inventory maps were generated manually (i.e., not using GIS). The recommendations from the NRI study were incorporated directly into the town's master plan. In 1996, the town updated some of the original inventory maps using GIS. The GIS maps included a base map, land cover map, unfragmented lands, wetlands, aquifer/groundwater map and a conservation lands map. A set of maps was given to the Planning Office, the Town Administrator, and the conservation commission.

The GIS inventory maps have since been used at numerous educational workshops and community events to highlight the important natural resources within the town. The Groundwater Resources map, in particular, has been used to help address the need to protect the town's drinking water. In 1999, and again in 2000, the town voted in favor of a $60,000 fund for conservation easements around the aquifer. The conservation commission feels that their educational efforts, including the NRI and the subsequent GIS maps, helped them achieve this support. The map of conservation lands has been used to show where and how existing conservation lands might be linked with other protected lands, and also to show how little conservation land they currently have. This will form the basis for future land protection efforts.

NEWFIELDS

Study Area: Focus on Newfields, with Newmarket and Exeter included for context.

Type of Inventory: Comprehensive natural/cultural resources inventory and ranking linked to land ownership database.

Date completed: 1999

Resources Inventoried:
Natural resources: Surface water features (ponds, rivers, streams, tidal areas), 100-year floodplains, stratified drift aquifers (USGS and hydrogeology consultant mapping), wetlands (USGS & NWI), soils (hydric A, prime agricultural farmland, most productive hardwood and softwood forest soils), rare species and exemplary natural communities, unfragmented core forest blocks, riparian zones and shorelines, and USFWS wildlife habitat mapping.
Cultural resources: NHDES drinking water protection areas, public wellheads, Regional Environmental Protection Program datapoints (historic and natural features ranked high for protection), conservation and public lands, road system by functional classification, recreation trails, and tax map parcels. Project study areas for other, ongoing land protection projects in the vicinity were also mapped for coordination purposes.

Project Goals: Identify those parcels of land with highest priority for land protection in the vicinity of the George Smith Woodlot, an 80-acre Forest Society reservation located in the rapidly urbanizing Seacoast town of Newfields, either by addition of land to the existing reservation or by protecting key parcels that link to other conservation and public land in the immediate area.

GIS Used: Yes.

Study Done By: *Linking Lands* study done by the Society for the Protection of NH Forests, Research Department and GIS staff, with assistance in the form of data provided by the Strafford and Rockingham Regional Planning Commissions.

Description: Digital data were collected from multiple sources, including several readily available GRANIT databases, specialized resource mapping of Newfields generated by the Rockingham Planning Commission and consultants to the town, digital tax mapping, and wildlife habitat datasets from the US Fish & Wildlife Service.

Natural and cultural resources were first mapped for display and discussion purposes with the Newfields conservation commission, and revisions were made according to community input. Then all datasets were converted to grid format in the GIS and assigned a numerical value based on a comprehensive 5-point scoring system developed by the Forest Society staff team.

Finally, a composite of all the grid data layers was made to reveal a range of low to high cumulative scores, with the larger number indicating higher priority for land

protection. This spatial information was then overlaid with tax map parcel mapping to determine which parcels of land are most significant for land protection and why.

WARNER

Study Area: Subwatershed of the Warner River

Type of Inventory: Comprehensive Natural Resources Inventory

Date Completed: 1999

Resources Inventoried: Watershed boundaries; soils; soils with limitations; steep slopes; land use types; forest types; surface waters; (including water quality sample points); wetlands; floodplains; aquifers.

Project Goals: Develop a conservation plan

GIS Used: Yes

Study done by: Volunteers (Warner Conservation Commission); written inventory report was contracted out to a consultant. The conservation commission wrote proposals for and received several small grants to fund this study.

Description: The Town of Warner, recognizing the need to plan for the protection of water resources and ecologically sensitive areas, developed a plan to identify and document key natural resources in town (1998/99). A pilot project was designed that would produce (1) a natural resources inventory to document natural resources and features in a portion of the town, and (2) a conservation plan to make recommendations for appropriate use of these resources. The watershed of Willow Brook was selected since it was a tributary to the Warner River, was close to the downtown area, had a documented abundance of wildlife, and was valuable for recreation.

The natural resources inventory used data from the GRANIT GIS database to produce inventory maps. Following analysis of those maps, they used the NRI study to identify priority areas for conservation. Once the NRI was completed, the town put together a conservation plan to address land protection in the watershed. It is anticipated that this study will help improve land use planning on a town-wide basis, including providing input to the town master plan.

Through this project, the conservation commission has worked to contact all landowners in the watershed to inform them of their NRI efforts, and to bring the fundamental values of land protection to their attention. The commission successfully pursued several conservation easements in the watershed - all a direct result of the NRI work.

With their goals in the Willow Brook watershed accomplished, they plan to move on to another watershed in town to repeat the process. By tackling their NRI in small watersheds within the community, the conservation commission has created several small projects that can be easily accomplished.

APPENDIX E
List of GRANIT Data Layers

Functional Listing Of Granit Data Layers

(as of February, 2001)

DATA LAYERS	**SOURCE**
GEOLOGY/SURFICIAL MATERIALS	
Bedrock Geology	NH GS
Soil Units	NRCS
Surficial Geology:	
Glacial Features	NH GS
Stratified Deposits	NH GS
Surficial Materials	NH GS
Miscellaneous Surficial Materials Exposures	NH GS
TERRAIN	
Bathymetry	Various
Elevation - DEM	USGS
Elevation - Hypsography (DLG's)	USGS
Elevation - Tagged Vector Contours	USGS
HYDROGRAPHY	
Aquifers:	
Low Flow Stream Measurements	USGS
Saturated Thickness	USGS
Seismic Lines	USGS
Stratified Drift Aquifers	USGS
Transmissivity	USGS
Water Table	USGS
Wells, Borings, and Spring Sites	NH DES
Dams	NH DES
Floodplains	FEMA/HUD
Hydrography - Surface Waters	USGS
Public Drinking Water Supplies	NH DES
Watershed Boundaries	NH DES
Well Locations	NH DES
Wetlands:	
Coastal Wetlands	OSP
Great Bay Wetlands	UNH
LANDSAT Wetlands	EOSAT
NWI Wetlands	USF&WS
LAND USE	
Developed Shorelines	SPOT
Environmental Factors:	
Groundwater Hazards Inventory	NH DES
Junkyards	NH DES
National Pollution Discharge Elimination System Outfalls	NH DES
Pesticides - Agricultural	NHDES/Agr.
Point/Non-Point Pollution Sources	NHDES
Toxics Release Inventory	EPA
Underground Storage Tanks	NH DES
Graveyards	NHOGA
Historical and Cultural Features Inventory	OSP/DHR
Land Use Change	UNH
National Register of Historic Places	NPS
OSP Recreation Inventory	OSP
Recreation Facilities	DRED

Transportation Facilities:
- Pipelines ..... USGS
- Railroads ..... USGS
- Roads and Trails ..... USGS

SPOT Derived Land Use ..... SPOT

LAND COVER
- Clear Cut Inventory ..... EOSAT/SPOT
- LANDSAT TM 13 (Land cover) ..... EOSAT/F&G
- LANDSAT TM 23 ..... EOSAT/F&G
- Natural Heritage Inventory ..... DRED

BOUNDARIES
- Conservation Lands ..... SPNHF
- Geodetic Control ..... NOS-NGS/NH DOT
- Geographic Names Information System (GNIS) ..... GNIS
- Political Boundaries ..... USGS
- Statistical Census Boundaries ..... USCB
- USGS Quadrangles ..... CSRC

PHOTOGRAPHY/IMAGERY
- Digital Orthophotoquads (DOQ's) ..... USGS
- Digital Raster Graphics (DRG's) ..... USGS

AGENCY ABBREVIATIONS

Agr, NH Agriculture Department
CSRC, Complex Systems Research Center, UNH
NH DES, NH Department of Environmental Services
DHR, Division of Historic Resources
NH DOT, NH Department of Transportation
DRED, NH Department of Resources and Economic Development
EOSAT, Earth Observation Satellite Company
EPA, Environmental Protection Agency
FEMA, Federal Emergency Management Agency
F&G, NH Fish & Game Department
HUD, Housing and Urban Development
NGS, National Geodetic Survey
NH GS, NH Geological Survey (State Geologist)
NHOGA, NH Old Graveyards Association
NOS, National Ocean Survey
NPS, National Park Survey
NRCS, Natural Resources Conservation Service
OSP, Office of State Planning
SPNHF, Society for the Protection of NH Forests
USCB, US Census Bureau
USF&WS, US Fish and Wildlife Service
USGS, US Geological Survey

APPENDIX F
Additional Sources of Information

- USGS Topographic Maps
- NRCS County Soil Survey Maps
- National Wetlands Inventory Maps
- Aerial Photographs

USGS Topographic Maps

USGS topographic maps (see Figure F-1) include a broad range of landscape features, have a relatively high level of accuracy, are low cost and readily available. They may be used to augment or assist in checking certain information. They can also help identify and delineate local watersheds if these are to be used in the Natural Resources Inventory. Note that you may need to purchase several adjacent maps to ensure that you have coverage of the whole town/study area.

Topographic maps may be obtained from most bookstores and outdoor supply stores, by calling 1-888-ASK-USGS or through the website *http://mapping.usgs.gov/esic*. To order or purchase topographic maps, you need to know the name(s) of the quadrangles in your study area. To determine the names and extent of the maps you need, you can obtain an index of topographic maps from the USGS toll free number and website given above.

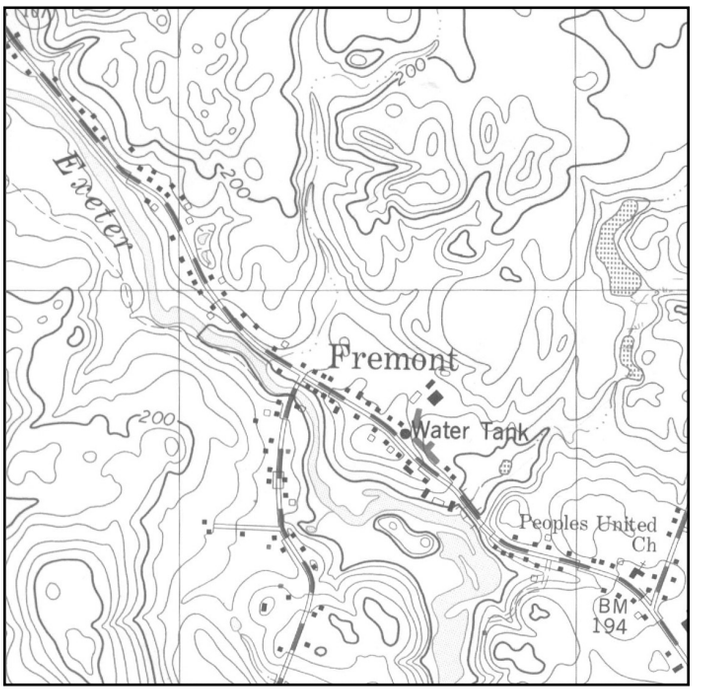
The USGS topographic maps are also available digitally through GRANIT. Some advantages of this digital data (known as "Digital Raster Graphics") are:

- maps may be joined for a selected study area
- scale may be adjusted to match the scale of other maps used in the inventory
- features identified on the topographic map may be translated into coordinates that can be used in GIS applications
- other features available as GIS data can be shown as overlays on a topographic base map

Quadrangle: *The US Geological Survey (USGS) uses the geographic grid to determine the position of individual map sheets in a series. A single map sheet, or quadrangle, is bounded on the right and left hand margins by meridians, and on the top and bottom by parallels which are a specified number of minutes or degrees apart. In this way, individual map sheets can be fitted together to form unified groups.*

Most towns span several USGS topographic quadrangles. All the quadrangles including portions of the town (or study area) should be obtained and matched to make a composite topographic map of the whole town.

Figure F-1: *Sample of USGS Topographic map*



NRCS County Soil Survey Maps

The USDA Natural Resources Conservation Service has mapped the soils for each of New Hampshire's ten counties at various times. More recently, most counties have been mapped a second time to reflect changes in land use, mapping procedures, and soil classification.

Published soil surveys include maps and detailed information about the types of soils found in the survey area, and the uses and limitations associated with each soil type. They provide valuable information to farm and forest landowners, planners, and natural resource managers. County soil survey data are available in digital form from the GRANIT database for most parts of the state.

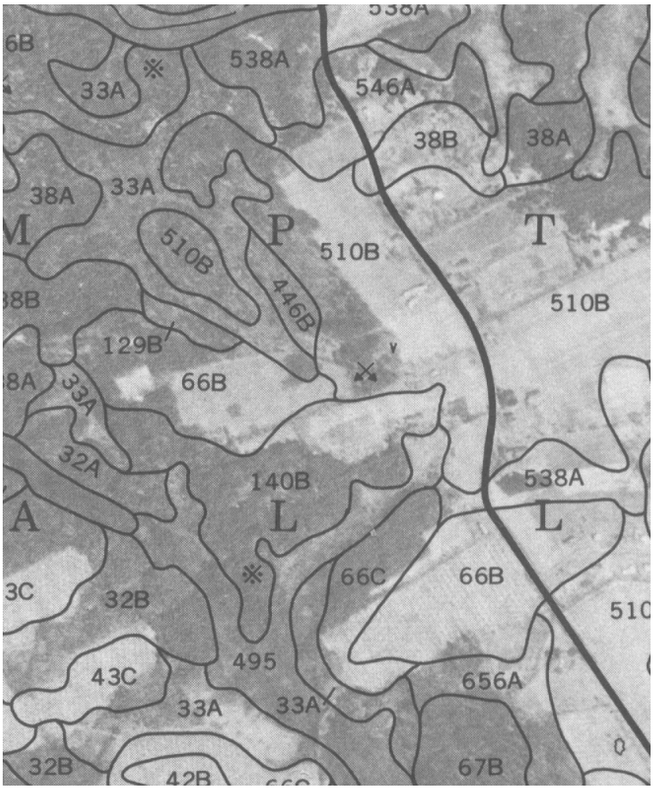
To classify soils, soil scientists study the landscape and dig test holes to expose and compare soil profiles. A soil profile is a sequence of natural layers referred to as horizons. These differ from one another because of physical, chemical, and biological properties and the effects of weathering and man. Soil horizons extend from the surface to the parent material, a zone that hasn't been altered by leaching or the action of plant roots.

Soils with similar horizons that have developed in comparable climates make up what is referred to as a soil series. Each soil series is named for a town or geographic feature near the place where it was first observed and mapped.

Soils maps show the relative location of a soil series overlaid onto aerial photographic base maps. An example of a soil survey map follows. The soil survey map (see Figure F-2) uses a combination of numerical and letter codes to differentiate soils mapping unit locations on the map. Soil mapping units are areas with the same soil series and a similar slope class.

In the following example, each numerical code refers to a soil series name while the letter code denotes the average slope class for the soil mapping unit. For example, soils mapped with a code 67C are soils that belong to the Paxton Soil Series and have slopes that range between 8 and 15 percent.

Figure F-2: *Sample of soils map*



National Wetlands Inventory Maps

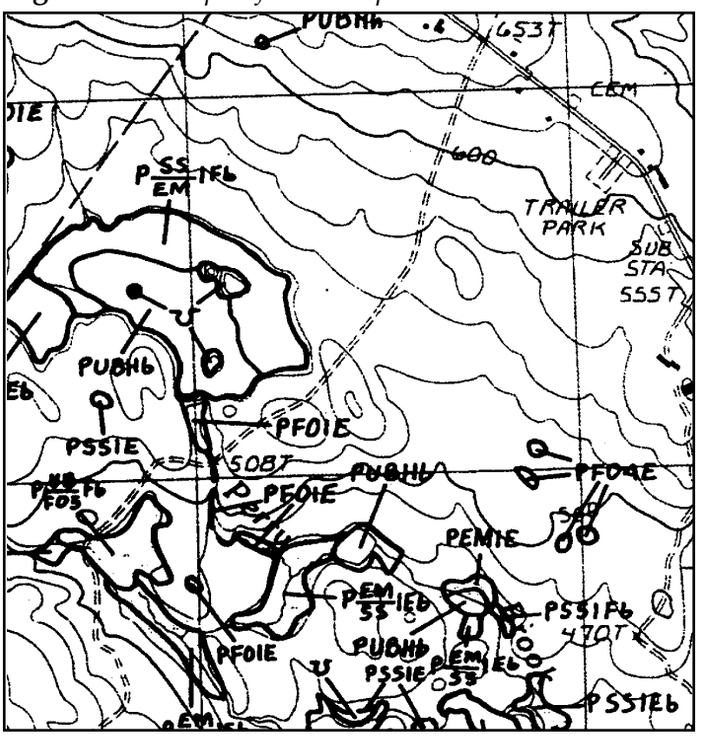
The following information about National Wetlands Inventory maps was compiled from a number of sources including, "Open Space Lands, A Community Resource," Jeanie McIntyre, Upper Valley Land Trust, and "Classification of Wetland and Deepwater Habitats of the United States," Lewis Cowardin, US Fish and Wildlife Service.

In the mid 1980's, the US Fish and Wildlife Service undertook a project called the National Wetland Inventory (NWI) to map all the wetlands in the United States. NWI maps are produced on the USGS topographic base at a scale of 1:24,000. These maps provide information about the wetland vegetation classes, flooding regime, and location in the landscape.

NWI maps are available as black-and-white photocopies from the Office of State Planning for a relatively low cost (see Figure F-3). The maps are identified by the corresponding USGS quadrangle name. NWI data are available in digital form from the GRANIT database for much of the state.

National Wetlands Inventory (NWI) maps for New Hampshire have been developed by the US Fish and Wildlife Service (USFWS) using color infrared aerial photography taken in 1986. From these aerial photographs, preliminary maps were then randomly field checked for accuracy.

Figure F-3: *Sample of NWI map*



The USFWS classifies wetlands using a hierarchical method of classification that combines plant, soil, and frequency of flooding information. This method classifies wetlands by System, Subsystem, Class, Subclass, and Dominance Type. System and Subsystem are the most general levels of classification. Class, Subclass, and Dominance Types are very specific.

Wetlands are grouped into five major **Systems**: Marine, Estuarine, Riverine, Lacustrine, and Palustrine. The Marine System is comprised of open ocean areas with salinities in excess of 30%. Estuarine System areas are semi-enclosed by land, have sporadic or obstructed access to the open ocean, and salinities ranging from 30% to 0.5%. Riverine Systems are associated with all freshwater rivers and streams. Lacustrine Systems are primarily associated with lakes and include bodies of open water that are greater than 20 acres with depths exceeding 6.6 feet. Palustrine Systems are nontidal marsh and swamp associated wetlands dominated by trees, shrubs, or persistent emergent herbaceous plants.

The **Subsystem** level is next. All but the Palustrine System have Subsystems. Subsystem defines whether the wetlands system is tidal or nontidal, perennial or intermittent, limnetic (deepwater), or littoral (shallow).

The **Class** level describes the general appearance of the wetlands habitat in terms of either the dominant life-form of the vegetation or the nature of the substrate underlying the wetland. Vegetation is used to define the Class level if it covers 30% or more of the substrate.

Subclass is identified for some Classes when additional detail is desirable and can be determined accurately. Subclass is usually noted for only forested and scrub-shrub classes.

Water Regime describes the frequency and duration of water on each wetland.

Special **Modifiers** are sometimes added to the classification to describe certain circumstances that are pertinent to the description of the wetland. Examples are excavated or partially drained special modifiers that denote impacts to the wetland System.

Example: The classification information about each wetland is abbreviated and displayed on NWI maps according to the hierarchical order described. Figure F-3 provides an example of an NWI wetlands map. If for example, the wetland selected is coded as **PFO1E** we would refer to the legend and find that the wetland is classified as follows: **P**alustrine (System), **FO**rested (Class), **1** broad-leaved deciduous (Subclass), **E** seasonally saturated (Water Regime).

Aerial Photographs

Aerial photographs are useful for verifying or updating maps generated from other sources. Comparison of older photographs with more recent ones can provide a visual overview of land use changes, such as land clearance, beaver activity, etc.

Statewide aerial photographic coverage is available for New Hampshire at about ten year intervals starting in the early 1950's. County Farm Service Agency offices (listed in Appendix A) have the most current USDA aerial photographs with coverage for their respective counties at a scale of 1:7,920 (1"= 660'). They allow public viewing of the aerial photos and provide order forms and purchasing information. Reproductions can be ordered in a number of scales ranging from 1:58,000 (1" = 4,833') to 1:2,400 (1" = 200') and on paper sizes that range from 10 inches by 10 inches to 38 inches by 38 inches. Aerial photographs can also be purchased through the County Conservation Districts (see Appendix A). UNH Cooperative Extension county offices have inventories of the same photography (not for purchase) but in a variety of scales depending on the county.

Orthophotoquads are maps developed from scale-corrected aerial photographs with identified transportation networks and other features. The quads use the same indexing and quadrangle names as the USGS topographic maps. They are available in black and white or color infrared, at the 1:24,000 scale. Orthophotoquads are available from the US Geological Survey at 1-888-ASK-USGS. They are available in digital format through GRANIT for certain areas of the state.

Figure F-4: *Sample of Aerial Photograph*

APPENDIX G
Delineating Watershed Boundaries

Delineating Watershed Boundaries

The following information about topographic map interpretation and watershed delineation is an excerpt from the "Method of the Comparative Evaluation of Nontidal Wetlands in New Hampshire."(1991) The New Hampshire Method, as it is most often referred to, is an excellent tool for communities to use in doing comprehensive wetlands inventories. To obtain copies of this manual see the listing in Appendix B.

Interpretation of Topographic Maps

In order to successfully delineate a watershed boundary, the evaluator will need to visualize the landscape as represented by a topographic map. This isn't difficult once the following basic concepts of the topographic maps are understood.

Each contour line on a topographic map represents a ground elevation or vertical distance above a reference point such as sea level. A contour line is level with respect to the earth's surface just like the top of a building foundation. All points along any one contour line are at the same elevation.

The difference in elevation between two adjacent contours is called a contour interval. This is typically given in the map legend. It represents the vertical distance you would need to climb or descend from one contour elevation to the next.

On the other hand, the horizontal distance between contours is determined by the steepness of the landscape and can vary greatly on a given map. On relatively flat ground, two 20-foot contours can be far apart horizontally. On a steep cliff face, two 20-foot contours might be directly above and below each other. In each case the vertical distance between the contour lines would still be twenty feet.

One of the easiest landscapes to visualize on a topographic map is an isolated hill. If this hill is relatively circular, the map will show it as a series of more or less concentric circles (Fig. G-1). Imagine that a surveyor actually marks these contour lines into the ground. If two people start walking in opposite directions on the same contour line beginning at Point A, they will eventually meet face to face.

Figure G-1: *Isolated Hill*

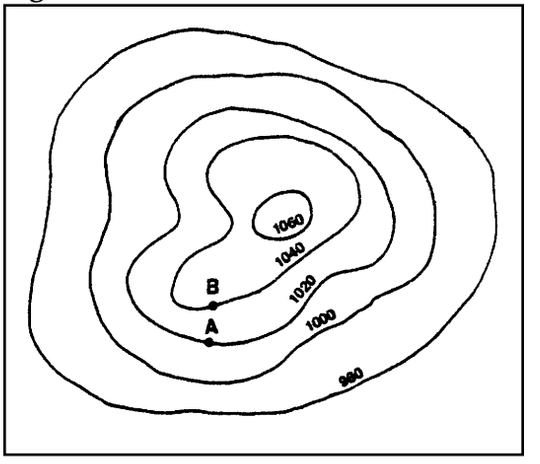
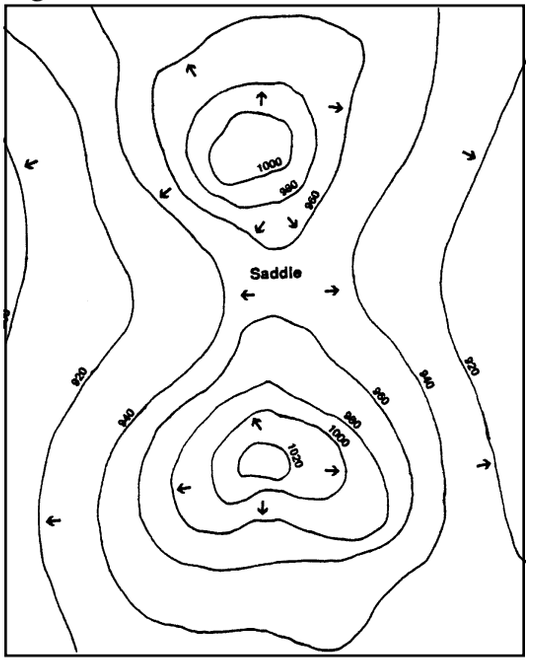


Figure G-2: *Saddle*



A more complex situation is where two hills are connected by a saddle (Fig. G-2). Here each hill is circled by contours but at some point toward the base of the hills, contours begin to circle both hills.

How do contours relate to water flow? A general rule of thumb is that water flow is perpendicular to contour lines. In the case of the isolated hill, water flows down on all sides of the hill. Water flows from the top of the saddle or ridge, down each side in the same way water flows down each side of a garden wall (See arrow on Fig. G-2).

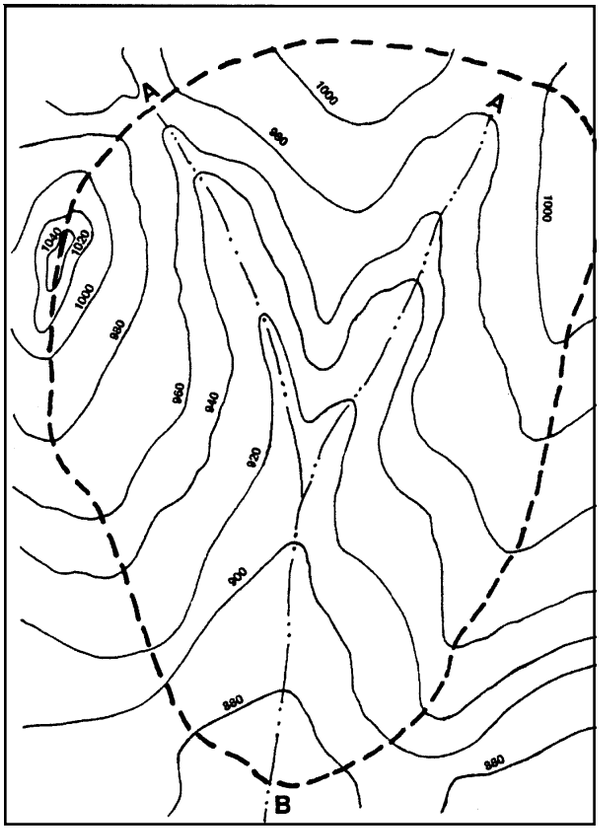
As the water continues downhill it flows into progressively larger watercourses and ultimately into the ocean. Any point on a watercourse can be used to define a watershed. That is, the entire drainage area of the Merrimack River can be considered a watershed, but the drainage areas of each of its tributaries are also watersheds. Each tributary in turn has tributaries, and each of these tributaries has a watershed. This process of subdivision can continue until very small, local watersheds are defined which might only drain a few acres, and might not contain a defined watercourse.

Figure G-3 shows an idealized watershed of a small stream. Water always flows downhill perpendicular to the contour lines. As one proceeds upstream, successively higher and higher contour lines first parallel then cross the stream.

This is because the floor of a river valley rises as you go upstream. Likewise the valley slopes upward on each side of the stream. A general rule of thumb is that topographic lines always point upstream. With that in mind, it isn't difficult to make out drainage patterns and the direction of flow on the landscape even when there is no stream depicted on the map. For example, in Fig.G-3 the direction of streamflow is from point A to point B.

Ultimately, you must reach the highest point upstream. This is the head of the watershed, beyond which the land slopes away into another watershed. At each point on the stream the land slopes up on each side to some high point then down into another watershed. If you were to join all the high points around the stream, you would have the watershed boundary.

Figure G-3: *Idealized Watershed Boundary*



Delineation of a Watershed

The following procedure and example will help you locate and connect all the high points around a watershed on a topographic map. Visualizing the landscape represented by the topographic map will make the process much easier than simply trying to follow a method by rote.

1. Draw a circle at the outlet or downstream point of the water body in question (shown by the hatched area in Figure G-4).
2. Put small "X's" at the high points along both sides of the watercourse, working your way upstream toward the headwaters of the watershed.
3. Starting at the circle made in Step 1, draw a line connecting the "X's" along one side of the watercourse (Fig. G-5). This line should cross the contours at right angles (i.e., it should be perpendicular to each contour line it crosses).
4. Continue the line until it passes around the head of the watershed and down the opposite side of the watercourse. Eventually it will connect with the circle from which you started. The watershed delineation appears as a solid line around the watercourse. At this point you have delineated the watershed of the selected water body.

Figure G-4: *Delineating a Watershed Boundary, Step 1*

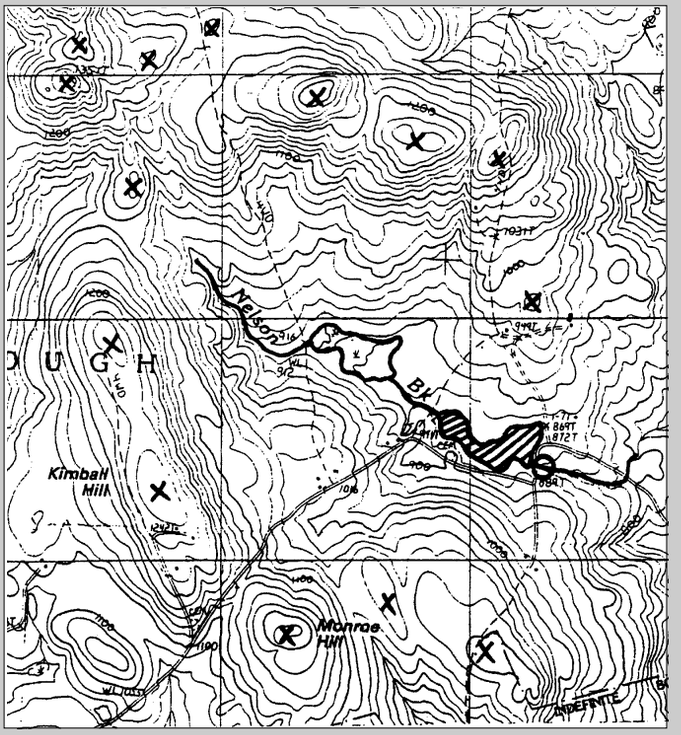
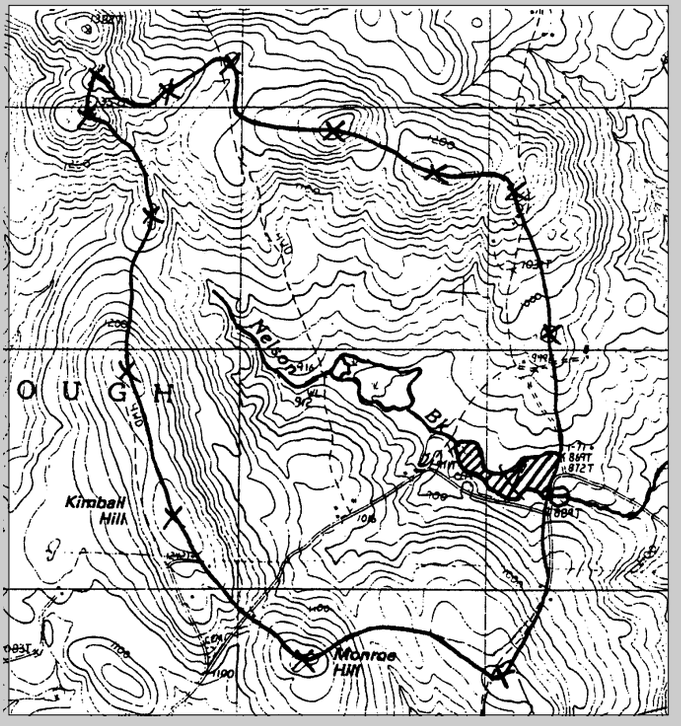


Figure G-5: *Delineating a Watershed Boundary, Step 2*



Measuring Watershed Areas

The watershed boundaries can be digitized off the topographic maps, and GIS used to calculate watershed acreage. Digitizing watershed boundaries is relatively quick, but the boundaries must be marked clearly and accurately on the topographic map.

If the watershed boundaries aren't digitized, there are two commonly used options for calculating acreage. The dot grid method is a simple, inexpensive technique. The user places a sheet of acetate or Mylar, which has a series of dots about the size of the period at the end of this sentence printed on it, over the map area to be measured. The user counts the number of dots which fall within the area to be measured and multiplies by a factor to determine the area.

A second method involves using a planimeter. This is a small device with a hinged mechanical arm. One end of the arm is fixed to a weighted base while the other end has an attached magnifying lens with a cross hair or other pointer. The user places the base of the planimeter in a convenient location, and traces around the area to be measured with the pointer. A dial or other readout registers the area being measured.

Both dot grids and planimeters are available from engineering and forestry supply companies.

APPENDIX H
Evaluating Scenic Resources

Evaluating Scenic Resources

The following information about inventorying and evaluating scenic resources is an excerpt from the "Mad River Resource Protection Plan." For additional information about this project contact the Vermont Land Trust, King Farm, Woodstock, VT, 05091 (802) 457-2369

The landscape of an area defines its cultural, natural, and historical heritage and thus provides community members with a sense of identity. This is particularly true in the Mad River Valley where an historically agriculture-based economy is combined with a growing tourist economy reliant to a large degree on outdoor recreational opportunities. Residents and visitors have an affinity to the Mad River Valley, assessing these resources is a difficult task for the following reasons:

- Although many methods of scenic assessment have been used in planning efforts, there is no widely accepted standard method.
- The whole Valley can be considered scenic and beautiful, giving us a tremendous resource to evaluate.
- Views in themselves are complex, with a combination of elements that work together to make up a view, often making it difficult to articulate why a particular view is special

Assessment of scenic resources has occurred throughout the country and the world in a variety of ways. Reaching a balance between subjectivity and objectivity in scenic resource assessment has been a major challenge for many communities. Evaluating scenic resources is a somewhat subjective undertaking. However, as a community more closely examines why scenic resources are important, a "collective subjectivity" begins to emerge. In other words, the community's collective feelings toward its scenic resources can begin to be understood. As important scenic attributes are identified by the community, an objective inventory emerges and priorities can be established.

Inventory Methodology

To begin the effort of identifying visual resources, staff conducted an extensive literature review which uncovered many visual assessment methods (see Appendix for summary). The literature review revealed some important principles in identifying scenic areas including:

- The British have been bold in identifying and protecting visual resources and thus the rural character of their country is well maintained. They have embraced the personal aspect of landscape assessment, giving credit to emotional attachments to the land. This emotional expression is part of the collective subjectivity of the community. For example, they use a common sense approach in the designation of Areas of Outstanding Natural Beauty. A committee identifies those areas where there is a general feeling that an area is highly scenic. The list is then shared with the public and further defined.
- Never discredit the emotional and subjective aspects of scenic assessment.
- The protection and management of scenic resources must recognize their complexity.
- Any combination of major attributes in a view makes the view more intriguing. A prime example of a dynamic combination of the scenic features found in the Valley is the interrelationship of open land and woodland. This combination creates a patchwork illusion that is typical in rural communities. Valley residents find this relationship comforting to view. This patchwork effect of the landscape

reflects the community character and thus reinforces a sense of place.
- Views must be closely examined to determine their importance and sensitivity.

By examining a view's scenic attributes and spatial components (see below) a sense of why the view is important emerges. In addition, understanding the components of a view leads to an understanding of how a view can be managed, recognizing that some components are more sensitive that others. The ability of views to handle development varies. Where development activity on some lands may be detrimental to the quality of a view or the access to a view, development can sometimes be worked into other lands so the view isn't diminished.

Because of the complexity found in each individual view, scenic resource protection measures must be tailored accordingly. Generally, all scenic assessment methods include a breakdown of scenic resources into various components or scenic attributes. These attributes include physical features of the land such as water, mountains, and farmland. They also include important aspects of view such as diversity and contrast, land of disturbances, and access to views. Rather than simply borrow scenic attributes from other scenery identification efforts, the subcommittee decided to use local surveys to determine favorite Valley views, the important aspects of those views, and then to develop a scenic attributes list designed specifically for the Mad River Valley.

First, a list of popular scenic areas, vantage points, and focal points was developed (Table I-1). **Scenic areas** are those areas of the Valley which were repeatedly mentioned in the surveys. **Vantage points** are spots which provide access or openings to important views. **Focal points** are those natural or cultural features which grab the view's eye and provide drama or interest in a view. By examining this list of places and drawing on the surveys, a composite list of scenic attributes was developed. Basically, these scenic attributes are the raw components of all the scenic places. See Table I-2.

The committee then decided that a more thorough inventory of scenic places was possible by applying the scenic attributes list to the landscape. This was done with the help of a landscape architect.

To establish a framework for examining individual views, scenic sources were broken into three spatial components; the foreground, the middle ground, and the background. Together these components constitute a viewshed. Understanding each of these components can help determine the viewshed's sensitivity to disruption. The foreground is generally composed of open lands framed by woodland, stonewalls, or hedgerows. This area in a view is critical because it is the window to the larger view and is often vulnerable to degradation by development. The middle ground of the view is generally a more complex composition of wooded and open lands, hillsides, and man-made features. The middle ground tends to be more able to absorb the visual impacts of development. However, high pastures in the middle ground can be vulnerable because of the lack of vegetative screening. The background is composed of hillsides and ridgelines which enclose the view. This area in a view is sometimes able to absorb the impacts of development with proper siting, screening, and density.

The focus of the field work was to identity foreground areas because they are the most critical aspects of a scenic resource, and could be easily mapped on the USGS topographic map scale. A mapped inventory of important scenic foregrounds with an

accompanying reference list of each site describing its scenic attributes was developed. Critical high pastures (middle ground areas) such as Bragg Hill are also included in the inventory. These areas constitute both foregrounds and middle grounds depending upon the viewer's perspective. Background areas are shown on the map as popular focal points such as Green Mountain and the Northfield Ranges and various intermediary knolls. These scenic ridgeline and hillside areas are sometimes considered protected due to their natural limitations for development such as steepness and shallow soils. However, as sewage disposal technology becomes more advanced, these areas will become under increasing pressure for development. Middle ground areas (other than high pastures) aren't shown on the map. These areas constitute a large geographic area and are somewhat flexible in their ability to absorb disturbances. These facts don't diminish the importance of middle ground areas to views, however. Instead, middle ground areas should be considered for protection measures as opportunities arise, especially as associated with other scenic attributes or rural resources.

It is hoped that this combination of methodologies has resulted in a comprehensive inventory, sensitive to the values of local residents and reflective of the community's collective subjectivity about scenic resources.

Table I-1: Popular Scenic Areas, Vantage Points, and Focal Points

Popular Scenic Areas:

Rt. 100/Mad River Corridor
East Warren/(Commons) Area
East Waitsfield Commons/Meadow Road Area
Bragg Hill

Popular Vantage Points:

Center Fayston Road
Rt. 17/Appalachian Gap
East Warren Commons and Four Corners Area
Bragg Hill
Fuller Hill Road
Top of Ski Areas
Lincoln Gap
Sugarbush Golf Course Area
Roxbury Gap
Long Trail

Popular Focal Points:

Covered bridges
Church steeple (Waitsfield)
Round barn
Ridgelines and hillsides of scenic sensitivity

Table I-2: Key Scenic Attributes

Physical Features

1. Mountains, foothills, ridgetops, and hillsides.
2. Rivers, streams, and other water courses and bodies.
3. Agricultural lands.
4. Vegetation, greenery, foliage, wildflowers.
5. Elements of a working landscape - animals, buildings, hay cutting, crops, commercial enterprise, farms.
6. Wildlife.
7. Natural focal points - hills and mountains, landscapes or landmarks, high pastures, hill farms, especially easily recognizable areas such as Burnt Rock Mountain, Bragg Hill, etc.
8. Cultural focal points - such as sections of northeastern Waitsfield, Finn Basin, Big Basin (Burnt Rock Area), Baird of the Bush Road, Plum Creek area. These areas provide visitors with a sense of being "out there." Very few man-made structures or activities are present.
9. Sky, preferably blue.

Important Aspects of Views

1. Diversity and contrast within a view, patchwork of open and wooded land, location of open space (fields) adjacent to village areas, variety of vegetation and natural features, hedgerows and stone walls, a combination of foreground, middle ground and background.
2. Continuous Views - views which continue as you travel along a road or trail, such as Rt. 100.
3. Lack of scattered or inappropriate development and other disturbances in views; unbroken ridgelines; minimal artificial lighting to disturb night sky.
4. Vantage Points - areas which provide critical viewing access. A key component is management of the view (e.g., cutting to keep a view open, maintenance of a trail corridor). High point vistas (views from the Green and Northfield ranges) are particularly important. The vantage point is also a critical aspect of the view. Access to a view is extremely important in assessing scenic resources because if the public no longer has access to the view, the view loses its importance. To ensure the continued enjoyment of the splendid view throughout the Valley, critical vantage points must be maintained.

Note: Focal points are elements of the landscape generally perceived as "attractive," "dynamic," or indicative of the character of the area. They are points which "grab the eye." Focal points which enhance (rather than detract from) scenic character are the object of this discussion.