Town of Madbury, New Hampshire

Master Plan: Toward the Year 2010

2.3 Natural Resources

Prepared for

Town of Madbury Planning Board
Madbury, New Hampshire

by

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Natural Resources

1. Introduction

This chapter deals with natural resources, including topography, landscape features, habitat and the conservation, protection and use of these resources, and their inherent interrelationship with water resources.

Madbury's landscape is highly variable. One area of town is distinct from another area due to its unique combination of soil type, slope, groundwater availability, vegetation, presence of streams, wildlife, and scenic qualities, and the use of these resources. A detailed appraisal of these resources and their use is vital if Madbury is to be protected from flood damage, erosion, surface and groundwater pollution, depletion or destruction of wildlife habitats, loss of scenic landscapes, and the overall economic and social costs of environmental degradation.

2. Policy Statements

Preserve Madbury's rural atmosphere and landscape. Protect and manage open space, wetlands, forests, fields, agricultural resources, scenic vistas, and historic resources for the benefit of present and future generations.

The protection and sustainable management of the Town's natural and historic resources is central to this Master Plan. This focus will work to preserve the Town's rural sense of place. This policy reflects a strong desire among town residents to preserve the Town's open space and rural atmosphere as expressed during the June 2000 Master Plan survey of residents.

Acquire additional interests in land for conservation, water supply, open space, public recreation, and Town facilities.

Effective methods to ensure the preservation of environmentally and historically significant properties are the acquisition of easements and purchase of land by the Town and donations of easements and land to the Town. Through the acquisition of easements and land, develop a greenbelt linking Town facilities, schools, trails, open space, and wildlife corridors.

The Madbury Conservation Commission has highlighted the following types of landscape as priority areas for protection, preservation, and long-term resource management in the best interests of the environment and community:

- Wetlands
- Wildlife corridors
- Agricultural areas

3. Survey of Resources

3.2 Soils. The surficial materials that contribute much to the present day landscape of New Hampshire's coastal area are primarily the result of the last of four continental glaciers that appeared more than 12,000 years ago. This glacier deposited a layer of poorly sorted, highly variable, primary glacial soil or till. A variety of soil types (see Appendix 3) based on what the glacier left behind have developed since the glacial period ended. The particular characteristics of each soil type, such as drainage capabilities and structural stability, play a central role in determining both what biological communities develop on and what uses would be compatible with the land where these various soils occur**.**

In 1987 the Strafford County Conservation District adopted the *Soil Potential Ratings* system that classifies soils on the relative ease or difficulty of placing a septic system (particularly the absorption field), dwellings, and roads on a given soil/slope complex. These ratings provide a realistic and legally defensible approach to determination of land use potential, so the rating system is particularly useful as a land use-planning tool.

Refer to the Soil Potential Map (see Appendix 2). The map is revealing in several respects:

Overlaid with the areas of already developed land, the soil potential map shows that a significant portion of the land with the highest development potential has already been developed. The reasons are readily apparent. It is less expensive to build roads and buildings on land of this character, and the early settlers knew where the best land was when they laid out the major roads in town.

With much of the high potential land already used, future development will occur on increasingly marginal land. Careful planning will be needed, along with appropriate development restrictions, to ensure environmentally sound development of these lands. The Planning Board should pay particular attention to subdivision and site plan regulations designed to control erosion and sedimentation that result from construction related activities in marginal areas.

Thirdly, there are several large contiguous areas of soil with "low" and "very low" potential. These areas are prime candidates for open space and conservation land.

3.2 Topography. The undulating topography of New Hampshire's seacoast region generally corresponds to the underlying bedrock, although a number of hills are composed of glacial deposits. One such glacial "drumlin" is Hicks Hill, at 331 feet above sea level the highest point in Madbury. Madbury has few areas of high relief, though, so those few that do exist might be prominent features of the landscape and, therefore, scenic resources (see Section 3.3 below).

Madbury's topography combined with the town's abundance of water resources has led to the ecological development of many wetlands. Wetlands indeed cover more than 30% of the land area.[1] Madbury's wetlands are often flanked by glacial terraces or outwash plains that tend to be very sandy and flat and that are anywhere from 30 to 80 feet higher than the low areas. This topological arrangement of features

potentially offers views of wetlands from above, a vantage point that is not necessarily common outside of mountainous areas.

Topography takes on practical significance when the topographical characteristic of slope is considered in analyzing the suitability of a site for development. For example, flat land is appropriate for such uses as highways, large commercial and industrial buildings, and agriculture. On steeper slopes, many of these uses are not suitable. In addition, development and service costs increase. Development on steep slopes also increases the potential for greater erosion and pollution of waterways through runoff. Madbury has taken steps to prevent these negative consequences by discouraging development on slopes greater than 10% and limiting roadways to no more than an 8% grade. Appendix 4 gives descriptions of ranges of slope and discusses suitable uses in each.

3.3 Scenic Resources. Madbury possesses a rich rural character and scenic value. Forestland dominates the scenic landscape, though present and former agricultural lands, such as the Kingman Farm, also have a significant presence, especially along main roads and highways where Madbury has high visibility to visitors. Abundant wetlands and ponds, rivers, and streams in their natural states further enhance the scenic experience. Stonewalls and mature trees along roads add a distinctly New England flavor to the landscape.

Besides the presence of these scenic resources, their distribution is an important aspect of scenic value. Madbury has large, contiguous undeveloped areas that are important for wildlife and plant conservation and for ecological function as well as for landscape character. These areas could be particularly valuable in establishing a greenbelt(s) in Madbury.

The concept of "view sheds" or scenic vistas potentially comes into play where Madbury's topography is accented by particularly steep and tall hillsides that are prominent elements of distant views. Substantially visibly exposed bedrock ledge might be part of some of the scenic hillsides. These hillsides add further variety and rural ruggedness to the character of Madbury's landscape and should be considered as potential scenic resources.

3.4 Flora. Mixed forest of softwoods (coniferous) and hardwoods (deciduous) predominate Madbury's vegetation (Appendix 1, Table 1.2). The softwoods are typically white pine and hemlock, while red oak and sugar maple are typical hardwoods. Fields and pastures, as well as fields reverting to woodland are dispersed throughout town, with the largest such areas located on the Kingman farm, the former Elliot property, and the Rose Lawn Farm.

3.5 **Woodlands.** Madbury presently hosts eleven certified tree farms encompassing approximately 642 acres.[2] In addition to the certified tree farms, at least 110 acres of privately owned woodland, though not certified, are managed,[3] and fifty acres of public woodland in the vicinity of the Moharimet School are managed.

There are several significant forested areas in Madbury. These areas should be maintained in their present state for aesthetic, historical, and recreational purposes. These are areas which retain to some degree their natural character, and which exhibit native plant and animal communities or valuable individual members of such a community, or any other features of unique or unusual scientific, educational, geological, ecological or scenic value.[2] The following woodlands may, therefore, qualify for preservation measures.

- Bellamy River hardwoods
- Banks of Johnson Creek
- Bellamy Reservoir islands
- Madbury landfill site
- Town-owned land along Gerrish Brook

3.6 Rare and Endangered Species and Areas of Ecological Interest.

Madbury is the site of several rare plant species. These species have been designated[i] as imperiled in this state because of rarity or because of their characteristics demonstrably making them acutely vulnerable to extirpation from the state. Species known to exist in Madbury that meet the above criteria are listed below:

- Three-sided Mercury (*Acalypha virginica*)
- Missouri Rock-Cress (*Arabis missouriensis*)
- One-sided Rush (*Juncus secundus*)
- Fringed Gentian (*Gentiana critina*)
- Pale Green Orchis (*Platanthera flava* var *herbiola*)
- Small Whorled Pogonia (*Isotria medeoloides*)
- Exserted Knotweed (*Polygonum exsertum*)

Of the above-cited plant species, the Small Whorled Pogonia is of global concern. This orchid is one of the rarest plants in eastern North America.[3] The largest populations, some containing over 200 individual plants, are found in Maine and New Hampshire where over 80% of the known world population occurs. Madbury is close to the center of New Hampshire's Small Whorled Pogonia population. Also of particular concern in New Hampshire are the Exserted Knotweed and Pale Green Orchis, flagged in the NH Natural Heritage Inventory as *Very High Importance* and *Extremely High Importance* species respectively.

The rare species discussed above have been sited at locations in Madbury that include: near the western end of Hayes Road, at the end of Fitch Road, on Hicks Hill, at the Kingman Farm, near the old railroad depot, on Pudding Hill, and behind the Bunker Lane Mobile Home Park. The precise locations of these plant communities may be available upon request from state DRED staff.

Besides the particular plant species listed above, Madbury has several rare and endangered natural terrestrial communities. These communities are defined based on the floral communities present in combination with the physical environment,

especially soil and bedrock characteristics. The four communities identified within Madbury, each located at only one site, are:

- Central New England Mesic Transitional Forest on Acidic Bedrock or Till
- Rich Appalachian Oak-Hickory Talus Forest/Woodland
- Southern New England Lake Sediment/River Terrace Forest
- Southern New England Stream Bottom Forest

The species and communities listed above and others similarly imperiled could be located and mapped by field survey prior to development of an area to allow protective measures to be taken.

3.7 Fauna. Faunal occurrence in Madbury is less defined, especially because no threatened or endangered species are listed in the NH Natural Heritage Inventory (NHI). Anecdotal evidence points to the presence of the usual list of species to be expected in a largely wooded, coastal New Hampshire community like Madbury: larger mammals, such as deer, bear, moose, coyote, and fox; woodland and wetland birds; freshwater fish; smaller mammals, such as beaver, fisher, skunks, raccoons, and rodents; and various reptiles. Although the NHI does not list threatened or endangered faunal species as occurring in Madbury, the possibility still exists that they have just not been located yet. The rare and endangered ecological communities discussed in the previous section could be habitat for species specifically adapted to those habitats. Knowing what species of animals occur in Madbury is important, and performing an inventory of habitat and organisms can provide an excellent knowledge base for planning involving natural resources. (See especially 4.1.3 and 4.3.2 below for discussions of contiguous lands preservation and habitat protection.)

4. Resource Conservation and Protection

This section presents actions recommended by the Madbury Planning Board and Conservation Commission to address natural resource conservation and protection in the Town.

Recommendation: The Madbury Conservation Commission should take steps necessary to successfully undertake a conservation projects for land protection.

4.1 General land protection measures

4.1.1 Land ownership and easements. The Town can directly address natural resource conservation and protection through conservation easements and land ownership. Easements and municipally owned land exist in Madbury, and the Conservation Commission has addressed the need to maintain and acquire new easements and land for resource protection.[2] Also, a database of town owned easements and land (and privately protected land and easements) would allow the Town to evaluate quickly the bearing that any proposed land use would have on

resource conservation and protection policies or intentions. Statewide, the tracking of easements especially is neither standardized nor nearly complete, so progress made in this direction in Madbury would both benefit the Town and serve as a model for other communities. The significance of the latter advantage is not to be downplayed, because natural resources do not conform to political boundaries. Effective, long-term resource conservation and protection requires attention over the entire geographic range of the resources.

Of particular interest due to their potential impact on water resources are lands contiguous with the Bellamy and Oyster Rivers and their tributaries. Besides the value of resources contained within the boundaries of these lands, these lands have value as ecological transition areas between water bodies and the surrounding environment. Some of these critical lands may receive a measure of protection from existing federal, state, or local shore land protection regulations or ordinances, but acquisition of new easements or land should routinely be considered to optimize natural resource conservation and protection.

Recommendation: Develop a parcel-level plan for the Town to acquire and maintain new land and conservation easements to meet stated conservation goals.

Recommendation: Put particular emphasis on lands along the Bellamy and Oyster Rivers when considering lands for acquisition or easement.

Recommendation: Construct and maintain a database of protected land and easements that includes both Town-owned and private protected lands and conservation easements.

4.1.2 Preservation of agricultural resources. Agricultural lands are a prominent component of both natural and cultural resources in Madbury, and protecting these lands is crucial to the desired preservation of Madbury's rural atmosphere and landscape. Traditional agriculture typically produces a mosaic of visual resources and ecological communities. Croplands, woodlots, hedgerows, wetlands, and stonewalls serve as habitat for both flora and fauna. Maintenance of careful agricultural practices also preserves the quality and availability of the rich agricultural soil types.

Although agriculture usually replaces mature, native land cover types, the variety of ecological communities that result can be important for maintaining populations of the species they contain on a region-wide basis. Agricultural operations tend to create habitats that are in the quickly changing, earlier stages of ecological succession. These early stage habitats support a different assemblage of species than are found in the later stage communities. Clearing, burning, active/fallow field rotation, wall building, woodlot forestry, and hedgerow maintenance are examples of agricultural operations that have ecological and visual effects contributing to rural character.

One contemporary reality that Madbury must consider when planning for agricultural resource protection is the existence and growth of nearby residential areas. Agricultural operations can have negative impacts on these areas in terms of odors,

noise, and physical disturbance of the habitat around the homes that residents may consider unacceptable. Madbury is a small town geographically. This restriction makes the isolation of large, commercial agricultural operations from residential areas challenging.

One fine example of an agricultural resource is the Kingman Farm, owned by UNH and located along NH Route 155 in central Madbury. This farm represents the rich agricultural heritage of Madbury and is a critical resource from a conservation perspective. Although the Town cannot know the intentions of UNH toward the Farm, UNH will likely maintain its multiple-use status. Experimental agricultural research performed by UNH maintains the traditional agricultural character of the land and addresses, for example, forage, soil sampling, and woodlot forestry. Conservation of The Kingman Farm also has open space merits that could contribute fundamentally to future open space planning in Madbury. Finally, the Farm is a crucial environmental education resource for communities and for UNH, serving as an outdoor classroom for students from elementary school through college and for community members in general.

Protecting The Kingman Farm and its resources must include protection of lands that abut it, for these lands have direct ecological, visual, and other impacts. Just as agricultural land use can negatively impact surrounding lands, the reverse can be true. The Town should attempt to evaluate and restrict uses on land adjacent to The Kingman Farm to avoid negatively impacting the Farm.

In a similar manner, the Town should seek to protect other agricultural lands throughout the town. In recent years agricultural land has fallen at an increasing rate to residential subdivision. Once the agricultural use of land has been so converted, a return to agricultural use is unlikely. One of the most acute losses associated with the conversion is the loss of agricultural soil availability. Suitable agricultural soil types are limited in supply. Madbury has a long agricultural history, and such soil types have likely been largely developed for agriculture already. The Town might not have much new agricultural soil to use.

Recommendation: Discourage agricultural uses of land that are incompatible with neighboring residential development.

Recommendation: Encourage continuance of traditional, low-impact agricultural practices.

Recommendation: Protect the Kingman Farm, working as closely as possible with UNH to make known how important it is to the conservation planning efforts of the Town.

Recommendation: Madbury's land use regulations should go as far as is practical toward discouraging development on the Town's Important Farmland Soils. Very large lot zoning should be considered for areas of Prime Farmland Soils.

Recommendation: The Town should develop a long-term program for securing development rights on important farmland. Development rights could be acquired by the Town or by non-profit land trusts.

Recommendation: Carefully scrutinize development regulations in order to insure that they encourage rather than hinder compatible agricultural operations, horticulture, agricultural experimentation, so-called "alternative farming", and the local marketing of local produce.

Recommendation: Protect lands that abut the Kingman Farm to minimize impacts on the farm from surrounding areas.

4.1.3 Contiguous lands protection. The previous section discusses the values in conserving and protecting agricultural lands; however, agriculture, like many other types of use, tends to fragment the geographically continuous native land cover. Many wildlife and plant species respond positively to this disturbance, hence the enhancement effects of agriculture discussed previously. Many other species do not. Movement of individuals between different areas, reproductive processes, and other characteristics of the organisms can be affected. The New Hampshire Fish and Game Department, in its recent publication about protecting significant wildlife habitat,[3] discusses the ecological principles underlying habitat fragmentation:

> *Ecologists have learned by studying island systems that the size of an island and the distance from the mainland influence the number of species it can maintain. Small islands that are distant from the mainland support fewer species than larger ones. Natural habitats that become isolated through development become islands of habitat. The smaller and more isolated they are, the fewer species they can support.*

Madbury, for instance, is natively an area of continuous forest, and many of the species of forest birds are adapted to this forest cover. As varying land uses increasingly fragments the forest, these bird species, for example the wood warblers and forest thrushes, drop out of the community. Habitat fragmentation is a major part of the habitat loss factor that helps drive the reduction in biodiversity worldwide.

Another effect of habitat fragmentation is the opening of the native species communities to invasion by non-native species. Species invasion is, in fact, second only to habitat loss as a reason for biodiversity reduction. The resulting changes in species communities can have far-reaching ecological consequences in terms of ecosystem function, which include disruptions to nutrient and water cycling and to services to the human population.

Protection, therefore, of parcels of land that are contiguous, especially where they contain similar cover types, is crucial to mitigating the effects of habitat fragmentation. One important aspect of assembling a network of contiguous lands is to insure that there are adequate wildlife corridors with few human interactions (other that lawns and roads). These corridors provide important and undisturbed avenues of movement for wildlife and even plant dispersal.

Recommendation: Plan for protection of contiguous lands for the benefit of wildlife and plant communities.

Recommendation: Establish adequate wildlife corridors as part of the process of assembling a network of contiguous lands.

4.1.4 Open space planning. Although many may equate "open space" land with large, open fields, open space in a planning context means any land that is in a relatively undeveloped state. Open space can hold many important values for a community, including ecological, aesthetic, historical, cultural, or fiscal. For example, a sizable tract of open forestland could simultaneously serve as a recreation area for hikers, habitat for native plants, a segment of a contiguous land network, and a wildlife corridor. Open space in general helps balance the demands of development with the livability and quality of life in a community. Open space planning in Madbury could be a central process for maintaining the rural character of the Town.

One of the best ways for a community to incorporate open space considerations into its overall natural resource planning is to develop an open space plan. Such a plan identifies open space parcels throughout the town, evaluates them in terms of a set of relevant characteristics and in light of available funds, and usually classifies them in terms of their suitability for purchase, easement, or other protection.

Another way to incorporate open space into a community is through conservation subdivision. A conservation subdivision of a given parcel of land is designed to place the same number of housing units as would be allowed under a conventional subdivision into a portion of the parcel area, with the remaining area of the parcel left as open space. Housing demand is thereby balanced with conservation needs.

Recommendation: Create an open space overlay map for properties > 10 acre, and use this overlay as base data for developing an open space plan. Investigate the Town of Newmarket Open Space Plan as a model for development of a similar plan for Madbury.

Recommendation: Promote conservation subdivisions that create quality open spaces that protect resources in the existing landscape.

Recommendation: Make necessary changes to Town ordinance, subdivision regulations, and site plan regulations to support conservation subdivision.

4.1.5 **Policy-related measures.** Natural resource conservation and protection measures often require a substantial amount of funds to implement and sometimes to maintain. One of the most important sources of funds for these efforts in Madbury is the current use penalty tax. The funds can be used for planning, research, and monitoring, as well as for land purchase. Regular monitoring of activities or physical and biological parameters of the landscape that affect natural resources is an extremely important component of natural resources conservation. Existing regulations tend to do little good without monitoring and enforcement. In this way current use penalty taxes are tied

directly to effective regulation. The Madbury Conservation Commission understands the need to have multiple funding sources, relying not just upon revenue from current use penalty taxes: it is important to maintain or increase the 50% of current use penalty taxes currently applied to conservation activities.

Recommendation: Continue to apply 50% or greater of current use penalty tax revenue to conservation efforts.

Recommendation: Monitor impervious surface and shore land protection status, as these activities are important for conservation and are given some degree of defensibility by existing regulation.

Recommendation: Use the Town's capital reserve or issue bonds for resource protection.

4.1.6 **Development.** Development in Madbury has been slow and steady and mostly in the form of residential growth. Commercial and industrial activities are limited and the Planning Board sees only limited growth in this respect in the near future. A backdrop to future development in general is the fact that much of Madbury's land that is most suitable for development has already been built upon, so future development will occur on increasingly marginal land. Growth promotion and planning efforts might change the development environment in the future; however, the Town should carefully consider how it manages growth so that development does not threaten the natural resources of Madbury.

Recommendation: Limit incompatible uses within priority conservation areas.

Recommendation: During the subdivision review process, the Planning Board should pay particular attention to preventing erosion and sedimentation that could result from construction related activities in marginal lands.

Recommendation: The Town should consider adopting a Soil Type Lot Size system for determining the size of building lots. Madbury's Zoning Ordinance requires a building lot to be a minimum of 80,000 square feet, regardless of soil conditions.

Recommendation: There are several, large, contiguous areas of soil with low and very low potential for supporting development. These areas should be protected from residential development and are prime candidates for open space and conservation land.

4.2 Resource Stewardship

4.2.1 Town lands and easements database. As discussed in 4.1.1 above, a current database of Town-owned land and easements can be central to proper stewardship of those lands. This database can assist in identifying further lands to purchase or put under easement, according to the objectives of overall plans, such as open space or greenbelt initiatives. In Madbury, the lands in such a database should include Land and Community Investment Program and future Land and Community Heritage Investment Program purchases, the Town Forest, the Hicks Hill and Bolstridge properties, and, of course, any other lands as they come under town ownership or

easement. Maintenance of the database is crucial for expeditious and effective purchase and management.

Recommendation: (see 4.1.1 above) Develop and maintain a database of Town-owned land and conservation easements to assist in planning efforts. The database should include LCIP/LCHIP lands, the Town Forest, the Hicks Hill and Bolstridge properties, and all new land and easement acquisitions.

4.2.2 Access and use. In its role as a land steward the Town faces questions about land access and use—how to balance these with resource conservation and protection. Maintenance of adequate access and at least some traditional uses is important. Madbury is rich in rural recreational opportunities, such as hunting and fishing, hiking, and biking. These opportunities promote a clean environment, quality of life, health, and connection between the land and the townspeople. For the same reasons, the Town may wish to develop new access and uses.

At the same time, all access and use of land will unavoidably impact the resources on that land. Stewardship necessarily includes regular, critical evaluation of impacts and responsive adjustment of management strategies. The Town may find that it needs to consider restricting access or uses of the Town land to allow more control over management and its outcomes. Although management needs to address recreational and other demands of the townspeople, such considerations should not be at the expense of maintenance of natural resource conservation and protection.

Recommendation: Protect areas for hunting and fishing.

Recommendation: Provide for and proactively manage a Town greenbelt and trail system with trails that protect resources and that is sensitive to property owners.

Recommendation: Provide for recreational activities along roads and trails, such as biking, hiking, rollerblading, cross-country skiing, and jogging.

Recommendation: Encourage regional transit where possible to help to promote clean air and water.

Recommendation: Determine compatible uses and access levels for Town land and allow access and uses accordingly.

4.2.3 Formalize stewardship plans with owners or easement holders. Privately held lands and easements often constitute a significant portion of the inventory of protected lands in a town. Where possible, negotiation with owners or easement holders to formulate appropriate stewardship plans and to formalize those plans in writing can play an important role in the town-wide protection of natural resources. Formal plans both establish responsibility for ongoing stewardship and ensure defensible authority for stewardship actions taken.

Recommendation: Conservation Commission should evaluate private lands or easements for their contribution to overall resource protection goals and negotiate with owners and easement holders to formulate appropriate, written stewardship plans.

4.3 Habitat and species protection

4.3.1 Transition zones for habitat and buffers. The narrow areas between different land cover types, ecological systems, major landscape features, or land uses can hold great value as habitat and as buffers. Some examples of such "transition zones" include hedgerows, strips of woodland, riparian areas of both running and still waters, and forest edge bordering open areas. Many species of wildlife and plants are particularly adapted to the structure and ecological function of these zones, using them as foraging, breeding, or movement habitat or as dispersal areas. Often, the transition zones are areas of early ecological succession that occur along the edges of patches of fragmented land. Although fragmentation is a major contributor to habitat loss—and, therefore, to biodiversity reduction (see 4.1.3 above)—transition zones are an important component of the ecological landscape, especially in New England where there is a long history of agricultural land use. In contrast, one type of transition zone that is often characterized by relatively mature types of cover is the riparian area along woodland streams. Proximity to water is a crucial habitat characteristic for a majority of wildlife species, and whole communities of plants are adapted to, and therefore require, riparian micro environmental conditions.

Another important function of transition zones, especially those with substantial canopy and understory cover, is buffering between potentially conflicting land uses. For example, a sizable wooded buffer between cropland and residential development can physically block dust transport from field to residential area while combating soil loss. In addition, the spatial separation contributes to minimization of potentially objectionable odors spreading from cropland to residences. (See 4.1.2 above.)

Recommendation: Identify, protect, and maintain existing, significant transition zones, such as hedgerows, woodland buffers, riparian areas, and forest edge.

Recommendation: Balance protection and maintenance of transition zones with the need to protect unfragmented habitat components of the landscape.

Recommendation: Include transition zones in conservation subdivision process as high value areas.

4.3.2. Rare and endangered species and areas of ecological interest. Rare and endangered species and areas of ecological interest have been identified in Madbury (see 3.4.2 above). Protecting these resources successfully requires detailed knowledge about their locations and distributions. Compilation of this information typically involves the gathering of both existing and new data. Existing information can be found in many forms from various sources, some directly usable and some needing interpretation in the context of protection goals. Some examples of potential information sources are the New Hampshire Fish and Game Department; the New Hampshire Department of Resources and Economic Development; the New Hampshire Department of Environmental Services; the New Hampshire GRANIT GIS System; the Regional Planning Commissions; local environmental consultants; and local land trusts and environmental organizations that may already have performed some useful data collection.

Developing new information may be more time-consuming and potentially more expensive than using existing data alone, but existing data can often be inadequate for attainment of conservation goals. As mentioned earlier, protecting particular species or important ecological communities requires that one knows where and how these resources are located, and one excellent tool for acquiring this information is the Natural Resources Inventory (NRI). Just as a wholesaler may annually examine the stock in the warehouse, recording the identity, number, and shelf location of items, a town can inventory the natural resources found within the town boundaries.

The NRI can directly locate resources targeted for protection; however, the NRI results often prove most useful at a more general scale, giving clues as to where to look more closely to find the important species and communities. Madbury accomplished an NRI in 1975[ii] and was included in a regional NRI in 1998.[iii] A new NRI may be in order for Madbury, and The Upper Valley Land Trust and UNH Cooperative Extension in 1992 produced an excellent publication to use as an information source and guide to the NRI process.[4]

Another recent (2001) publication from the New Hampshire Fish and Game Department[4] thoroughly details the process of identifying and protecting wildlife habitat. Survival of wildlife species depends on availability of suitable habitat, so species protection efforts must include habitat protection. A similar process to that in the aforementioned publication could be applied to plant and ecological community protection, as well. Without knowledge of where the species and communities of concern are located, Madbury cannot know fully the impacts of development or existing land uses on these resources.

Recommendation: Add a survey for rare and endangered species and areas of ecological interest to the Town's subdivision application for lots > 10 ac. The survey(s) should be conducted at a time of year when species and ecological communities are most likely to be found, if present.

Recommendation: Perform a wildlife habitat analysis for Madbury, following the procedure detailed in the wildlife habitat guide by NH Fish and Game referenced above.

Recommendation: Perform a new Natural Resources Inventory of Madbury, using the NRI report and guide by Auger and McIntyre referenced above.

Recommendation: Emphasize the value of wildlife and their habitats within town through education activities for all ages.

4.4 Wetlands and watershed resources

Wetlands are foci of biological activity, ecological interactions, and ecosystem function. Their extreme value accordingly demands a high level of protection, and many federal, state, and local regulations and programs have been established for that purpose throughout the country and, indeed, the world. Wildlife and fish and other aquatic organisms rely on wetlands to provide habitat in all parts of their life cycles. A critical note here is that many organisms require wetlands for breeding, migration,

or other seasonal activities but spend much of their time in surrounding areas engaged in other mandatory activities. Consequently, wetlands, though crucial in and of themselves, need also to be considered as a part of a larger, contiguous landscape of habitats.

Wetlands also provide ecological and ecosystem services, such as filtration and groundwater recharge, to the human population. Human health depends upon clean water sources, so maintenance of wetland function is of foundational importance. Madbury has just over 300 acres of wetland, which accounts for approximately 4% of the land area of the Town. This spatially limited occurrence of wetlands in the town underscores the need to emphasize wetland protection.

On a larger scale than individual wetlands, watersheds comprise a hierarchically organized geographic structure for water availability and movement through the landscape. Most surface water within or precipitation that falls within the boundary of a watershed eventually flows out of the watershed at a single point and into the basin of another watershed (or eventually into the ocean). In this way water quality, quantity, and speed are exported from a watershed. Similarly, within a watershed water moves from one area to another. Proper protection of water resources must therefore include the landscape scale of the effects of watershed structure on water resources. Madbury straddles the boundary between the Oyster River and Bellamy River Watersheds. Consequently, anything that affects surface water characteristics within town boundaries potentially affects all downstream areas in two watersheds, both of which contain critical wetland habitat and extremely important water sources for people in Madbury and in surrounding communities.

Recommendation: Consider placing mandatory conservation easements on wetlands within subdivisions. Use the Town of Lee as a model.

Recommendation: Consider providing stricter protection of the ecological services of wetlands, such as filtration.

Recommendation: Officially designate prime wetlands for Madbury.

Recommendation: Preserve areas surrounding wetlands, particularly prime wetlands and other high value wetlands with legal standing.

Recommendation: Continue to bar development in floodplains

Recommendation: Protect water supplies around wells and rivers, possibly through establishment or upgrade of ordinances, such as wellhead protection districts, well recharge areas, aquifer protection districts, and substantial riparian setbacks for water conservation.

Recommendation: View development in light of the Town's role as a watershed steward, considering the critical combination of water and land resources.

Appendices

Appendix 5.1 Tables

Table 1.1:Soil Potential Groups

"Soil Potential Ratings" refers to a soils classification system adopted by the Strafford County Conservation District in 1987 (see Soil Potential Ratings for Development, by the SCCD, July 1987). This system classifies soils on the relative ease or difficulty of placing a septic system (particularly the absorption field), dwellings, and roads on a given soil/slope complex. The key difference between the Soil Potential system and the older Soil Limitations system is that the former takes into account common engineering techniques typically used to overcome restrictive soil conditions.

Potential	**Description of Soil Performance**	Acres	% of Acres
Very High	At or above local standards due to favorable soil conditions. Installation and management costs are low. Few limitations	**1102**	**15%**
High	Cost of measures to overcome soil limitations are slightly higher than those with very high potential.	**712**	**9%**
Medium	Cost of measures to overcome soil limitations are significant.	**2347**	**31%**
Low	Cost of measures to overcome soil limitations are very high.	**274**	**4%**
Very Low	Soil has severe limitations. Cost of measures to overcome these limitations are extremely high or prohibitive.	**3093**	**41%**
	Total	**7528**	**100%**

Table 1.2: LAND COVER SUMMARY FOR TOWN OF MADBURY

Land Cover type	Acres
(No data)	4
Residential/Commercial/Industrial	189
Transportation	401
Row Crops	7
Hay/Pasture	548
Orchards	15
Beech/Oak	556
Paper Birch/Aspen	0
Other Hardwoods (not Paper Birch/Aspen)	673
White/Red Pine	525
Spruce/Fir	0
Hemlock	122
Pitch Pine	1
Mixed Forest	2743
Alpine (Krumholtz)	0
Open Water	459
Forested Wetland	159
Open Wetland	147
Tidal Wetland	2
Disturbed Land	107
Bedrock/Vegetated	0
Sand Dunes	0
Other Cleared	870
Tundra	0
	7531

Source data for this table are from the New Hampshire Land Cover Assessment, conducted by the GRANIT staff of the Complex Systems Research Center at the University of New Hampshire, released January 2002. Summary data presented in the table were derived from digital raster land cover data in a GIS system at Strafford Regional Planning Commission.

Appendix 2: Maps

Map 2.1 SOIL POTENTIAL RATINGS

[Map inserted in document following this page]

Appendix 3: Soils Descriptions

The surficial materials that contribute to the present day landscape of New Hampshire's coastal area are primarily the result of the last of four continental glaciers that appeared more than 12,000 years ago. This glacier was a mass of ice about one mile thick when it advanced across New Hampshire from the northwest, then melted and retreated. As it moved across the earth's surface, the glacier deposited a layer of poorly sorted debris called till. This material is made up of a mixture of sand, silt, clay, gravel and boulders, and is usually 15 to 40 feet thick. Glacial till often contains a hardpan layer that may cause drainage problems. Where this layer is absent, till will usually provide an adequate building site.

As the glacier began to melt and retreat, debris from the ice was transported and deposited in a seemingly random fashion. The resulting sand & gravel deposits are among the more common surficial materials that were laid down close to the melting ice. They consist of stratified sands, gravel and boulders, and vary in thickness up to 190 feet. These materials are relatively coarse since there was little sorting by the melting water. Pudding Hill is an example of such a deposit.

Because of their high permeability, high bearing capacity, and ease of excavation, the sand & gravel deposits often provide excellent building sites. However, there are competing demands for this resource. Their drainage and load bearing characteristics make this material highly desirable for the construction of highways. The pressure to excavate these deposits is enormous. In addition, sand & gravel deposits may hold large quantities of water, known as aquifers, enough to provide municipal water supplies. Obviously, a rational policy of land use regulation must be enacted in order to protect these aquifers.

Similar to these coarse sands and gravels are the outwash sands and fine gravels. These types of deposits were better sorted by the melting water, and are therefore composed of finer particles than the sand & gravel found on Pudding Hill. Closely associated with this type of outwash are the sandy shore deposits that formed along the shorelines of the ancient sea that covered much of the Seacoast area during the latter stages of the glacial period. These deposits range in depth from 1 to 50 feet.

As the ice sheet continued to retreat, the great quantity of melting water combined with the ancient sea to bring the coast fifteen to twenty miles inland from its present location. Fine sand, silt and clay were deposited to a maximum thickness of 75 feet. These marine clays are easily recognized by their blue-gray color. Marine clays are generally poorly drained, and in many instances are highly unstable, particularly when wet. Thus, these deposits are generally unsuitable for building sites requiring on-site septic systems and development requiring stable foundations.

Most surficial materials remain today much as they did after the retreat of the glacier. The only surficial deposits that have accumulated recently are the poorly drained swamp deposits in low- lying areas, and alluvium that has been deposited along streams.

Soil Types

Soils form the upper organic layer of earth materials that developed from the interaction of climate, vegetation, slope, and surficial geology. The present characteristics of each soil type are highly dependent on its position in one of the major surficial deposits. For example, the Hinckley and Windsor soils are located in the level portions of sand and gravel deposits.

Soil conditions are a major factor in determining suitable locations for urban uses as residential development and recreation. Listed below is a description of each soil condition category, along with recommendations relative to potential development.

Wetland Soils include all those that are poorly drained and very poorly drained. Generally, the water table is at or near the ground level for most of the year. Wetlands are best left undeveloped because they serve as flood buffers, natural drainage ways, wildlife habitat, pollution filters, and aquifer recharge areas.

Highly Erodible Soils are located in marine clay deposits, often adjacent to tidal rivers such as the Oyster River. Development on these soils is generally not recommended because of the high potential for erosion and stream pollution. They are best left in vegetative cover. Where construction is necessary, proper erosion and sediment controls should be utilized.

Seasonally Wet Soils were formed in association with parent materials similar to those of the wetland soils, although they are generally better drained. This group includes all moderately drained soils. Development of seasonally wet soils should be avoided where at all possible. Wet basements and submerged leach fields can be expected, and groundwater pollution is possible. Waste disposal should be discouraged in these soils.

Shallow to Bedrock Soils are located on thin deposits of glacial till. Bedrock in these areas is typically 30 inches or less below the ground surface. In these soils, high-density development is unwise due to the high costs of constructing foundations and sewer facilities. The only type of development that is suitable for this soil type is large lot residential.

Clays and **Sands Over Clay Soils** are typically found near the ground surface. Drainage characteristics range from moderate to very poor. Septic systems generally do not function very well in these clays.

Deep, Well Drained, Stony Soils typically have a hardpan layer at about two feet that restricts the downward lateral movement of water. While deep, stony hardpan soils may be well drained, on-site septic systems should not be used on small lots. In those areas in which a hardpan layer is not present, most types of development face few limitations.

Sand & Gravel includes all well drained and excessively well-drained soils that have formed in thick sand and gravel deposits. These soils have the best potential for development since they offer few restrictions to construction. However, these soils may percolate so well that septic effluent reaches the groundwater. Therefore, high-density development should be discouraged in order to protect any aquifers that may be in the vicinity.

Appendix 4: Slope Classifications

0 to 3% Slope

Land in this category is generally suitable for most large buildings, highways, residential use, and public recreation facilities such as ball fields. Flat sites may present such problems as inadequate drainage and insufficient gravity flow for sanitary sewers. Flat areas may be located in the floodplain. One indication of a particular site being situated in the floodplain is the conspicuous absence of historic buildings.

3% to 8% Slope

Land in this category is generally suitable for single family housing on small and medium sized lots, apartment buildings, and secondary roads. Unless associated with poor soil conditions, this slope generally permits good drainage, and provides an interesting and variable landscape without the excessive cost of grading, retaining walls, and other problems associated with steeper slopes. Assuming soil conditions are adequate to assure proper septic operations, a more intensive form of development than found elsewhere could probably be justified. However, in a town that desires to retain its rural and agrarian character, it must be remembered that these soils are usually the best farmland.

8% to 15% Slope

Land in this category is suitable for single family housing on large lots. Development costs and the potential for erosion begin to increase. Particular care should be given to proper drainage and septic system installation. This slope is usually too steep for most high intensity and high density uses. Where this slope is used for such purposes, the result is often severe soil erosion and sedimentation that can damage adjacent property, cause water diversion and flooding, destroy wildlife habitats, and leave large scars on the landscape. In addition, slopes in excess of 10% generally make the construction of good roads difficult.

15% to 25% Slope

Land in this category causes the cost of development to become a major factor. Runoff and erosion control are essential. Although there seems to be a trend these days to site homes on hillsides, on slopes greater than 15%, such areas can only be developed at great expense.

Over 25% Slope

Land in this category has very high development costs and environmental impact. Such factors as shallow-to-bedrock drainage problems, runoff, and erosion severely limit construction on these slopes.

Endnotes

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[1] Department of Resources & Economic Development, New Hampshire Natural Heritage Inventory. 2002. *Rare Plants, Rare Animals, and Exemplary Natural Communities in New Hampshire Towns*. Online document, regularly updated at http://www.nhdfl.com/formgt/nhiweb/, version date 8 February 2002, Source: te_spp_by_town.pdf .

[2] Strafford Regional Planning Commission. 1975. *Madbury Natural Resource Inventory.*

[3] Strafford Regional Planning Commission. 1998. *Strafford Region Natural Resources Inventory.*

[4] The Upper Valley Land Trust and UNH Cooperative Extension. 1992. *Natural Resources: An Inventory Guide for NH Communities*

[5] NH Fish and Game Department. 2001. *Identifying and Protecting New Hampshire's Significant Wildlife Habitat: A Guide for Towns and Conservation Groups*.