

Coordinated Review of Land Use Planning Documents with respect to Wildlife Habitat, Natural Resources, and Smart Growth Principles: Sandwich, NH



February 2012

Prepared by the Lakes Region Planning Commission
and the Audubon Society of New Hampshire Conservation Department
in consultation with the
Sandwich Planning Board
Support for the project was provided by the Samuel P. Pardoe Foundation

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Introduction

History

“Smart Growth” is a set of planning principles that guide communities toward mixed uses, greater development density in village centers, walkable, involved communities, and a working rural landscape with a healthy environment. The concept of Smart Growth has been around for many years, and in many ways is exemplified by the traditional New England village. In 2003 New Hampshire officially adopted eight Smart Growth Principles. Since 2006 the Lakes Region Planning Commission (LRPC) has been working with local planning boards throughout the region to conduct assessments of their planning documents with respect to these adopted Smart Growth Principles. From 2006 - 2008 these efforts by LRPC were funded through the NH Department of Environmental Resources, Resource and Environmental Protection Program (NH DES REPP).

Historically, New Hampshire has depended on natural resources to support its economy – from forest products to agriculture to tourism. These resources also provide important ecological services and contribute to our quality of life. Aquifers, productive soils, flood storage areas, productive forest lands, and high quality wildlife habitat are not distributed evenly across the landscape. As development affects increasing areas of New Hampshire land, it becomes increasingly important to identify and protect the natural resource values on which our economy and quality of life depend.

The N.H. Fish & Game Department completed the State’s first Wildlife Action Plan in 2005, with goals of restoring declining species and keeping common species common. Engaging municipalities in this effort is a critical component of the plan, since the vast majority of land use decisions are made at the local level. To that end, the Department contracted with the Audubon Society of New Hampshire (ASNH) and The Jordan Institute in 2007 to develop tools that would aid municipalities in efforts to protect important wildlife habitat and other natural resources. The process for reviewing land use planning documents with respect to wildlife habitat and natural resources is one of the products of that contract. The Jordan Institute has since focused their work on energy-efficient buildings, and ASNH has continued to adapt and apply the review process for communities across the State.

LRPC and ASNH worked collaboratively with the town of Bristol in 2008, and the cities of Franklin and Laconia in 2009 to produce a “Coordinated Review of Land Use Planning Documents with respect to Wildlife Habitat, Natural Resources, and Smart Growth Principles,” with funding from NH DES REPP and the Samuel P. Pardoe Foundation. The Samuel P. Pardoe Foundation funded the entirety of a review for the town of Gilmanton in 2010-11, and is the sole funder for this Smart Growth, Natural Resources, and Wildlife Habitat review for the Town of Sandwich.

We believe that the smart growth and natural resource reviews complement each other and provide an efficient and effective road map for improving the municipal planning process. The two tables that immediately follow this introduction illustrate the relationships between

the smart growth principles and the habitat and natural resource topics addressed in this document.

Summary of Findings

Most of the statements and recommendations put forth in Sandwich's Master Plan are consistent with the Smart Growth Principles. The town is actively working on implementing several of these recommendations. The primary recommendations of this assessment are aimed at addressing current issues with the zoning in Center Sandwich and accommodating modest growth in the future. It is recommended that village districts be developed with dimensional and use requirements that reflect the current and historic conditions of the town. To limit scattered development along roads, to get the most out of infrastructure investments, to help maintain the village character, and to protect the town's natural resources, it is recommended that a street plan be developed for the village area. Adopting mapped lines of future streets would ensure that any subdivisions of the large lots adjacent to village centers maintain the potential for interconnecting roads. A couple of changes are recommended regarding the types of housing permitted in an effort to provide all residents greater choice in the type and cost of housing in town. Finally, it is recommended that the Cluster Subdivision Ordinance be changed to a Conservation Subdivision Ordinance, which effectively clusters residences, protects open space, and offers incentives to developers to include features that are good for land protection and which can make housing more affordable to Sandwich residents.

Sandwich has implemented a number of policies to protect the Town's natural resources, including Floodplain Management, Groundwater Protection, Skyline Protection, and strong Shoreland Protection ordinances and provisions to encourage energy efficiency. Several recommendations from the Wildlife Habitat and Natural Resources review echo those from the Smart Growth Review, including village districts, planning for future streets, and converting the Cluster Subdivision Provision to a Conservation Subdivision Ordinance, with such subdivisions permitted by right. We strongly recommend adopting a Preliminary Conceptual Consultation process for subdivisions, and requiring pre-application discussions for both subdivisions and site plans, at least in areas of special concern. Pre-application meetings provide the opportunity to identify important resources on a parcel and determine appropriate strategies for their protection *before* survey and engineering investments commit a developer to a specific site plan or subdivision layout. We also recommend consideration of agricultural overlay district, stormwater management, landscaping, outdoor lighting, and ridgeline protection ordinances.

Document Description

This report is divided into several sections: the first two sections address Smart Growth in Sandwich, the next two sections address Wildlife Habitat and Natural Resources; Section 6 synthesizes recommendations from the two assessments, and the final section provides voluntary practices to protect wildlife habitat features and a supplementary list of resources.

How to use this document

The intended use of this document is two-fold. Firstly, it should serve as reference for community leaders as they review and revise municipal planning documents with such questions as, "Are we working towards Smart Growth and doing the best we can to protect our natural resources?" and "Are our land use planning documents consistent with one

another?” This should also be a “living document” - as policies are adopted and documents revised, these changes should be noted in this binder.

This document is intended to be a resource, and contains references to additional resources and model ordinances. In particular, we refer frequently to *Innovative Land Use Planning Techniques: A Handbook for Sustainable Development*. This reference, published in 2008 by the NH Department of Environmental Services, NH Association of Regional Planning Commissions, NH Office of Energy and Planning, and NH Municipal Association, is a critical reference for New Hampshire planning boards. We also strongly recommend use of *Integrated Landscaping: Following Nature's Lead* to advise developers on landscaping strategies. We also provide links to pertinent information available on the worldwide web. In the end, however, there is no substitute for direct assistance and advice. Sandwich is fortunate to have a large number of active Planning Board members with a range of experiences and talents. The town can also draw upon the Lakes Region Planning Commission for assistance in drafting changes to ordinances and regulations.

Habitat/Natural Resource Topic	Smart Growth Principle
Agriculture and Productive Soils	4. Working landscape
Energy Efficiency	1. Compact settlement patterns 5. Transportation choices and safety
Floodplains	6. Environmental quality
Forests and Forestry	4. Working landscape 6. Environmental quality
Green Infrastructure	4. Working landscape 6. Environmental quality
Groundwater	6. Environmental quality 8. Work with neighboring towns
Growth Management and Sprawl	1. Compact settlement patterns 2. Human scale of development 5. Transportation choices and safety
Impervious Surfaces	6. Environmental quality
Landscaping and Natural Vegetation	6. Environmental quality
Light Pollution	6. Environmental quality
Natural Hazards	6. Environmental quality 8. Work with neighboring towns
Shorelands, Surface Waters, and Wetlands	6. Environmental quality
Steep Slopes and Ridgelines	6. Environmental quality 8. Work with neighboring towns
Stormwater Management and Erosion Control	6. Environmental quality
Terrain Alteration	6. Environmental quality
Village District	1. Compact settlement patterns 2. Human scale of development 3. Mix of uses
Watersheds	6. Environmental quality 8. Work with neighboring towns
Wildlife Habitat	6. Environmental quality

Smart Growth Principle	Habitat/Natural Resource Topic
1. Compact settlement patterns	Energy Efficiency Growth Management and Sprawl Village District
2. Human scale of development	Growth Management and Sprawl Village District
3. Mix of uses	Village District
4. Working landscape	Agriculture and Productive Soils Forests and Forestry Green Infrastructure
5. Transportation choices and safety	Energy Efficiency Growth Management and Sprawl
6. Environmental quality	Stormwater Management and Erosion Control Floodplains Forests and Forestry Green Infrastructure Groundwater Impervious Surfaces Landscaping and Natural Vegetation Light Pollution Natural Hazards Shorelands, Surface Waters, and Wetlands Steep Slopes and Ridgelines Terrain Alteration Watersheds Wildlife Habitat
7. Community involvement	All
8. Work with neighboring towns	Groundwater Natural Hazards Steep Slopes and Ridgelines Watersheds

Smart Growth Assessment: Sandwich, NH

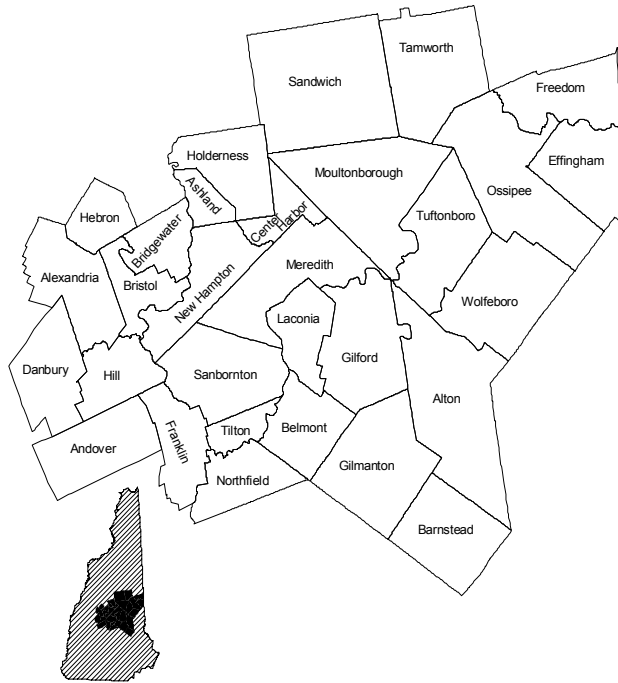


Center Sandwich, NH

February 2012

Prepared by the Lakes Region Planning Commission in consultation with the Sandwich Planning Board. Support for the project was provided by the Samuel P. Pardoe Foundation.

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I. What is Sprawl?

Since the 1980s, New Hampshire has had the fastest growing population rate of all the New England states¹. While this rate has decreased during the past decade to 6.5%, it still represents an additional 8,000 residents per year². Economically, this growth is often perceived as good for New Hampshire; it brings new jobs, new people, and new ideas. At the same time, however, it also brings new challenges.

Unmanaged, growth can become sprawl, which threatens to destroy the very qualities that make New Hampshire a great place to live.

“Sprawl is a pattern of development that results when:

- we use more and more land for various human activities;
- the places where we conduct activities are farther apart, and tend to be in homogeneous rather than mixed-use groupings; and
- we rely on automobiles to connect us to those places.

Development or change in land use contributes to sprawl when:



- it increases the need or demand for motor vehicle trip miles per housing unit in the community;
- it increases the per-person or per-unit amount of land space devoted to cars; and
- it otherwise increases the per-person or per-unit consumption or fractionalization of land areas that would otherwise be open space.”³

<http://www.mercola.com/ImageServer/Public/2005/september/9.16sprawl.jpg>

“Sprawling growth moves away from our town centers, leaving downtowns struggling. It spreads residential development across the rural landscape on large lots, eliminating the farms and woodlots of the working landscape - the pieces that are the very essence of rural character. The resulting pattern of development leaves islands of single uses widely spread apart from each other. In many areas the automobile becomes the only logical way of reaching these far-flung districts. Instead of the traditional mixed use patterns of development, where at least some residential development was directly accessible to downtowns that provided a variety of commercial, industrial, and institutional activities, we have residential subdivisions and office parks far outside of downtown. Instead of small-scale retail centers, we have stores and retail complexes hundreds of thousands of square feet in size, surrounded by acres of parking. In doing so, we are losing any traditional, distinctive New Hampshire character.”⁴

The NH Department of Environmental Services has studied the pattern of land use in New Hampshire and has this to say about its impact on the state’s environment, “‘Sprawl’ describes a pattern of development

¹ NH Office of Energy and Planning webpage, <http://nh.gov/ocp/programs/DataCenter/Population/PopulationEstimates.htm> (visited 11/12/10).

² US Census, <http://2010.census.gov/2010census/data/index.php> (visited 1/25/11).

³ NH Office of State Planning, *Annual Report to the General Court and the Governor on Growth Management*, December 2001 p.2.

⁴ NH Office of State Planning, *Report to Governor Shaheen on Sprawl*, December 1999. p. 1.

characterized by increasing amounts of developed land per person, scattered, low-density development, and the fragmentation and loss of open space. Sprawl and other poor development practices impose significant negative impacts on air and water quality, reduces the quantity and quality of wildlife habitat, and limit recreational opportunities for area residents.”⁵

Sprawl is expensive because it increases the cost of municipal services and thus taxes; it destroys the traditional land uses of forestry and agriculture; it makes us more dependent on the automobile, thus increasing traffic, congestion and air pollution; it increases water pollution through increased pavement; and it destroys the small town, rural character that is so important to many of New Hampshire’s communities.

This type of development occurs not because of the ill will of developers or the ineffectiveness of government. Developers respond to market forces within the rules established by state and municipal governments. At times, however, the rules are not coherent, consistent, or logically linked to the goals they are intended to realize. Sometimes rules designed for one desirable purpose have unintended, undesirable consequences. For example:

- Two acre zoning intended to preserve a rural setting results in the fragmentation of wildlife habitat;
- Land use regulations regulating odors intended to protect health in a residential area results in limits on farming that hastens the loss of large tracts of working open space.

The term ‘smart growth’ is sometimes substituted for policies and techniques that prevent or counteract sprawl. The central focus of a Smart Growth Assessment is to provide a useful link between the Principles of Smart Growth and their application in municipal land use practice. This report is a step in providing that link for the town of Sandwich, NH. It is intended to be a guide as the town updates its regulations, ordinances, and master plan.

⁵ Smart Growth webpage, NH Department of Environmental Services, <http://www.des.state.nh.us/wmb/was/smartgrowth.htm> (visited November 12, 2010).

II. Patterns in Sandwich

A. Population and Demographics

Sandwich is a rural town with the largest land area in the Lakes Region. Its small population has been growing slowly for the past two decades. Like most Lakes Region communities, Sandwich serves a sizable seasonal population, most noticeably in the summer.

In the 1980s the population of New Hampshire increased by 20% with an additional 11% increase in the 1990s. The Lakes Region population grew at 17.6% in the 1980s and 15.8% in the 1990s. During the 1980s Sandwich's rate of growth (7.8%) was far lower than both the state and region but was higher than both areas in the 1990s (20.6%).⁶ Census 2010 records indicate that Sandwich's population stood at 1,326 yielding a growth rate of 3.1% since the 2000 Census, lower than both the state (6.5%) and regional (5.9%) figures. The communities adjacent to Sandwich as a group have shown higher growth rates since 2000.

As a group Sandwich's residents are much older than the rest of New Hampshire, having a higher median age (53.2 vs. 41.1) and a larger percentage of residents over 65 years old (23% vs. 13%) and a smaller proportion of residents under 25 years of age (20% vs. 31%). According to the 2010 Census, the proportion of young people in Sandwich is even lower than what was indicated in the recent master plan, which was based on projections, as the census data was not yet available.

B. Housing

In the 1980s the number of housing units in Sandwich increased by nearly 20% from 722 to 864. By 2000 Sandwich had 965 housing units, an increase of 11.7% from 1990. In 2010 there were 1,057 housing units in Sandwich, an increase of 9.5%. The housing boom of the 1980s had an even greater impact around the region and throughout the state with growth rates of 29% and 30%; in the 1990s the rate growth in housing units in the Lakes Region and the state had slowed to 6% and 8.6%, respectively.

A large proportion of Sandwich's housing stock has always been seasonal but that has gradually been dropping (from 43% in 1980 to 37% in 2000) but remained above the Lakes Region average of 30% and more than three times higher than the state average of 10%.

In Sandwich, one finds about the same percentage of manufactured housing as the rest of the Lakes Region (2.9% vs. 2.7%) and about half as much multi-family housing (4.7% vs. 10.5%). Single family housing represents 92% of Sandwich's housing stock, significantly more than the Lakes Region average of 78%.⁷

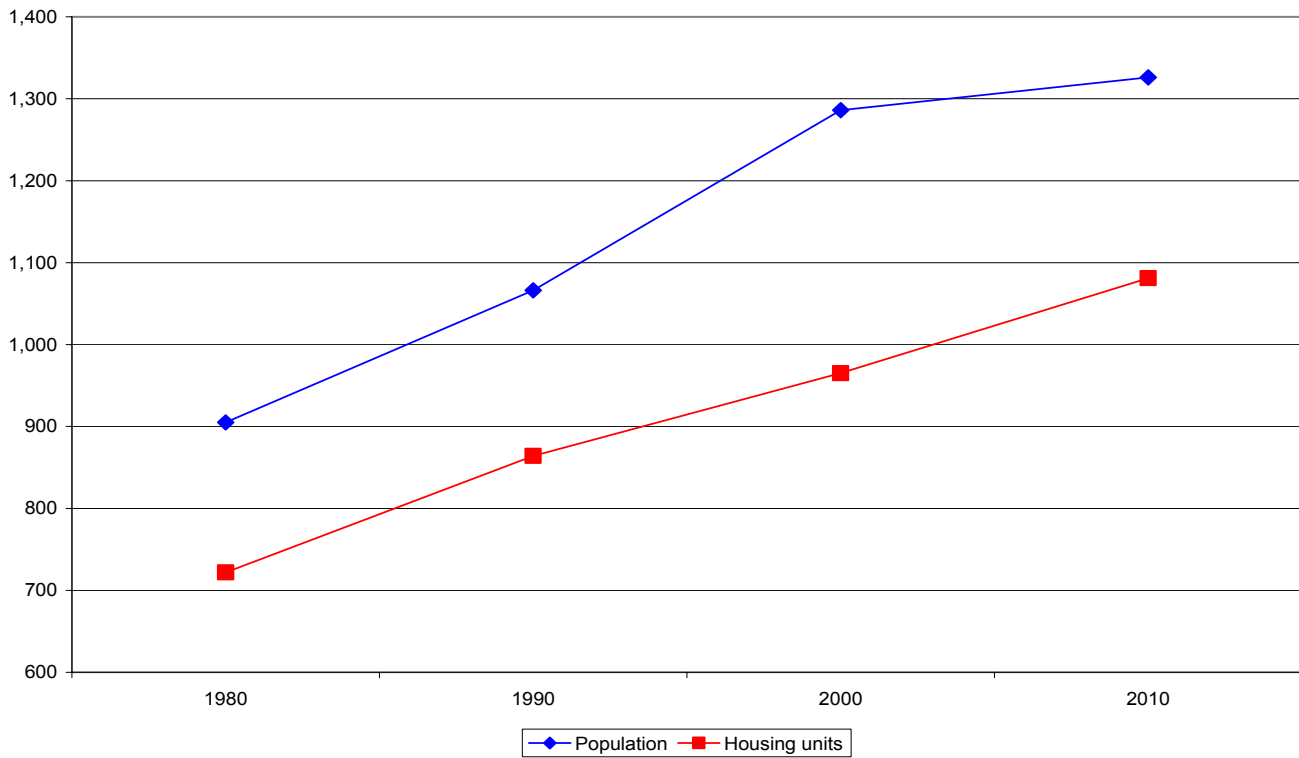
For much of the past decade the town has granted building permits for ten or eleven units per year. This figure jumped to seventeen to eighteen between 2003 and 2005. In 2009 only one new permit was reported. There were no new multi-family permits granted during the past decade.

Rate of Growth	1980-1990	1990-2000	2000-2010
Population	17.8%	20.6%	3.1%
All Housing Units	19.7%	11.7%	12.0%

⁶ *Lakes Region Demographic Profile*, Lakes Region Planning Commission, 2003.

⁷ *Development Activities in the Lakes Region: 2011 Annual Report*, Lakes Region Planning Commission.

Population and Housing Change: Sandwich, NH



C. Summary

Since 1980 Sandwich's population has increased by 47% and the number of housing units has increased 50% over that same time period. While the population of Sandwich grew at nearly 20% per decade from 1980 - 2000, that rate has dropped substantially since then. The construction of new housing units has fluctuated. During the past decade housing construction has outpaced population growth.

III. What is Smart Growth?⁸

Change is occurring in New Hampshire - more people, more traffic, changing jobs, higher taxes, and various stresses on the environment. Given these pressures, it is understandable that taxpayers and communities often respond with a loud "STOP!" Growth management, tax caps, and budget cuts are all natural responses to situations that appear overwhelming.

Smart Growth says, "First, decide on your vision. Then explore the possible ways to achieve it." In practical terms, Smart Growth consists of evaluating and shaping all new development and re-development initiatives according to the following eight principles:

⁸ Text in Sections I and II is adapted from *GrowSmart NH Tool-Kit Project*, 2002, NH Office of Energy and Planning and Planning Decisions, Inc. http://nh.gov/oep/programs/SmartGrowth/docs/chester_report.pdf pp.3, 4.

1. Maintain traditional **compact settlement** patterns to efficiently use land, resources and infrastructure investments;
2. Foster the traditional character of New Hampshire downtowns, villages, and neighborhoods by encouraging a **human scale** of development that is comfortable for pedestrians and conducive to community life;
3. Incorporate a **mix of uses** to provide a variety of housing, employment, shopping, services and social opportunities for all members of the community;
4. Preserve New Hampshire's **working landscape** by sustaining farm and forest land and other rural resource lands to maintain contiguous tracts of open land and to minimize land use conflicts;
5. Provide **choices and safety in transportation** to create livable, walkable communities that increase accessibility for people of all ages, whether on foot, bicycle, or in motor vehicles;
6. Protect **environmental quality** by minimizing impacts from human activities and planning for and maintaining natural areas that contribute to the health and quality of life of communities and people in New Hampshire;
7. **Involve the community** in planning and implementation to ensure that development [supports] and enhances the sense of place, traditions, goals, and values of the local community; and
8. Manage growth locally in the New Hampshire tradition, but **work with neighboring towns** to achieve common goals and address common problems more effectively.

IV. What is a Smart Growth Assessment?

A Smart Growth Assessment evaluates where the community stands regarding the Smart Growth Principles. To accomplish this, several steps must be taken:

- Trends in the municipality's population and development are compiled along with projections for these patterns.
- The community reviews the eight NH Smart Growth Principles and identifies which of these they support.
- The most recent Master Plan goals and objectives are reviewed for statements that support the Smart Growth Principles,
- The current local land use ordinances and regulations are reviewed for consistency with each of the town-supported Smart Growth Principles.
- Patterns and practices in town are assessed as they pertain to Smart Growth.
- Suggestions are made regarding what steps the community might take to better implement the identified Smart Growth Principles.

This assessment is based upon the most current documents available for Sandwich, including the *Master Plan, 2011, Zoning Ordinances, 2011; Subdivision Regulations, 2004, Site Plan Review Regulations, 2004, and Historic District Regulations, 2001.*

V. Smart Growth in Sandwich

A. Sandwich's Smart Growth Principles

The Sandwich Planning Board reviewed the eight Principles of Smart Growth outlined by the NH OEP that apply to New Hampshire communities and agreed that all of the Principles apply to Sandwich.

B. Smart Growth Checklist and Sandwich's Planning Documents

The intent of this Smart Growth Assessment is to provide the town of Sandwich and especially the Sandwich Planning Board with tools for understanding how the town stands in its efforts to embrace and implement Smart Growth identifying any impediments to implementation that might exist.

After reviewing the town's planning documents, a Smart Growth Matrix (Section 3) was developed and statements from the various documents were placed in appropriate sections. Those statements which contradict the Principle are in **red text**.

The section which immediately follows this text builds upon the information in the Smart Growth Matrix analyzing how closely the guiding documents of the municipality are aligned with each Principle. Where appropriate, the analysis addresses some of the impediments to implementing Smart Growth and makes suggestions for improvement. Such recommendations are referenced to the Master Plan (MP), Zoning Ordinance (ZO), Subdivision Regulations (Sub), Site Plan Review Regulations (SPR), or Actions and Policies (A&P).

Efforts were made to link each reference's individual goal, objective, ordinance, or regulation with one Principle; however, some repetition was necessary. Due to the interrelated nature of the Smart Growth statements, there are some statements that play an important role in shaping the town's ability to implement multiple Principles. Many foster the Smart Growth Principles; in a number of cases the Sandwich Master Plan has statements supportive of a Principle and there are no statements contrary to the Principle, but in other documents they are merely silent on the topic.

Our work with Sandwich has been unique, since the town has just recently developed its new master plan. There was much opportunity for community input into the plan. This plan takes a hard look at the existing conditions in Sandwich and puts forward a number of practical changes, several of which the Board has already begun implementing. The Plan also proposes several bold changes, most of which support these Smart Growth Principles. In many instances, the master plan points to a current circumstance which runs contrary to the Smart Growth Principles and proposes a method for the community to change the circumstances. In these situations, we have used **blue text** to signify these statements.

General Topic Observations:

The Site Plan Review Regulations do describe the Preliminary Consultation process at the end of the Application Requirements; however, Planning Board should do everything it can to encourage the use of this process. It is recommended that the description of the Preliminary Consultation process be moved to the front of the Application Requirements section. (SPR)

The Subdivision Regulations should also include a provision for the Preliminary Consultation process either under "General Procedure" or at the beginning of "Plat Requirements". (Sub)

For ease of use, it is recommended that a Table of Uses and a Dimensional Table be developed for the Zoning Ordinance. (ZO)

Smart Growth Principle 1:

Maintain traditional compact settlement patterns

Maintain traditional compact settlement patterns to efficiently use land, resources and infrastructure investments.

Description:

The town of Sandwich has two village areas (Center Sandwich and North Sandwich) with being of a much smaller scale. Most of the municipal buildings are located in Center Sandwich. There is a concentration of residences near Center Sandwich and North Sandwich but are otherwise scattered throughout the town. There are a number of businesses located in Center Sandwich and a couple in North Sandwich. There are two commercial Districts along NH Route 25.

Sandwich has the largest land area of any community in the Lakes Region and one of the largest in the state. However, the White Mountain National Forest dominates the northwestern section of town leaving about a third of the town unbuildable.

Residential development in Sandwich follows historic village and farming patterns but one also sees vacation home and lakefront development.

Town facilities include Police, Fire, and Highway Departments, the Elementary School, the Transfer Station, the Library, and Town Offices. All but the Highway Department, Transfer Station are located in Center Sandwich (there is a secondary fire station in Whiteface). The town does have a community sewer system for Center Sandwich; all other lots must have the capacity to accommodate both a well and a septic system.

Analysis:

The town of Sandwich's Vision Statement includes the desire to "Maintain its high quality of community facilities and services in a cost effective manner..." which speaks very directly to this Principle. Sandwich prides itself on making good use of its public funds. The town has a limited amount of infrastructure, some of which is very closely linked to its land use policy.

The Master Plan points out a number of "trouble-spots" in Sandwich's infrastructure, specifically the limitations associated with the zoning in and around the village areas and the sewer system. The vast majority of Sandwich is Rural Residential with a 100,000 sq. ft. (2.3 acre) minimum lot size, 160' of frontage required, and a 75' structural setback from the road. The reality is that most of the existing lots in the Center Sandwich area cannot meet these thresholds.

The Master Plan indicates that the sewer system may be operating at nearly full capacity effectively eliminating the opportunity for further growth in Center Sandwich without the upgrade of the current system (about 20 years old) or the development of a new, separate system. What can be done is complicated by how the system is funded.

While population growth slowed during the past decade and is not occurring at the pace projected by the Office of Energy and Planning in 2007, the Planning Board is prudent to plan for modest population growth over the next twenty years. It is the Board's responsibility to plan how best to incorporate such growth into the town.

The commercial districts along NH Route 25 have structural setback requirements of 200' of vegetated buffer. From a land use and natural resources perspective, this is not beneficial as it scatters development and fragments habitat. From the perspective of a business, this limits visibility to potential customers.

More and more small businesses, including many home-based businesses are depending upon reliable Internet access. Low density, scattered development leads to limited opportunities for high-speed internet connections.

Effective use of land is important to the character of Sandwich. Through community survey and the Master Plan it is clear that the citizens of the town value the rugged forested landscape, preservation of natural resources, the agricultural feel of the town, scenic views, the historic village area, the fact that a high proportion of residents have home occupations, and there is a strong sense of community.

The Master Plan noted that there was a desire at the Community Forums to encourage a sustainable village energy system or district.

Recommendations:

To improve its land use patterns and better utilize its resources in the future, it is recommended that Sandwich shift away from the idea of development happening along existing roads. This shift takes the form of creating zoning districts for the village areas (beyond simply the Historic District) which better represent the current conditions (smaller lot sizes, frontage, and setback requirements). This would acknowledge existing conditions, honor the historic pattern of development, and accommodate anticipated growth without promoting low density, linear development. More compact development in the village area may also improve the ability to provide services and infrastructure improvements such as internet service. (ZO)

The problems with the sewer system need to be identified and addressed to determine whether growth in the village can be accommodated on the existing system or whether an additional system needs to be developed. (A&P)

Consider reducing the front setback in the Commercial District to be more accommodating to businesses and make better use of the land on each lot (more space available on the backside for wildlife habitat). (ZO)

Smart Growth Principle 2:

Foster a human scale of development

Foster the traditional character of New Hampshire downtowns, villages, and neighborhoods by encouraging a human scale of development that is comfortable for pedestrians and conducive to community life.

Description:

In addition to the two villages in Sandwich, there is a local Historic District as part of Center Sandwich. While North Sandwich is a cluster of homes, a post office, and a general store along NH Route 113 near the junction with NH Route 113A, the focal point of community life and is Center Sandwich. These are rural village areas; buildings are separated by lawns. In Center Sandwich buildings are closer together and there are some sidewalks in town. A major element of Center Sandwich is the open space associated with the school and the fairgrounds and scenic views of the nearby hills and mountains.

Analysis:

In the Master Plan residents said that one of the most important features is maintaining Sandwich's rural small town character. There is a desire for housing that fits in with the existing smaller building styles which dominate the Sandwich landscape. One of the Master Plan Action Items is to develop a Heritage Walking Trail for Center Sandwich and Sandwich Lower Corner (about a mile south on NH Route 109) with interpretive markers. The Master Plan also calls for a long-range plan for sidewalks in Center Sandwich. Another Action Item is to ensure that the Site Plan Review Standards provide for appropriate pedestrian walkways.

The Historic District Regulations ensure that the scale of development will be compatible with surrounding buildings.

The large setbacks and minimum frontages work to push residences further apart from one another, as does the minimum lot size in the Rural Residential District, which covers both village areas.

In Sandwich, as with other rural communities, the scale of construction is not a problem; development occurs at "human scale". The real challenge is that a vehicle is required to go most places in town.

Recommendations:

Develop and implement a long-term plan for sidewalks in Center Sandwich. (A&P)

Insert language into the subdivision and site plan regulations addressing pedestrian connectivity with neighboring structures (Sub., SPR)

Explore the support and resources available for designing and developing sidewalks through the Safe Routes to Schools program at the NH Department of Transportation. (A&P)

Consider reducing the minimum lot size, frontage, and setbacks in the Center Sandwich area. (ZO)

Smart Growth Principle 3:

Incorporate a mix of uses

Incorporate a mix of uses to provide a variety of housing, employment, shopping, services and social opportunities for all members of the community.

Description:

Sandwich holds firmly to its rural/agricultural roots. The town has a smattering of commercial activity with some in Center Sandwich, a limited amount in the Commercial Districts, and numerous home occupations. There is not, however, a shopping area where one might go to do regular shopping, especially since the General Store in Center Sandwich closed. Residents need to drive to another community (Center Harbor, Meredith, Ossipee, or Plymouth) to meet their daily needs. Almost all of the housing in Sandwich is single family residential. Sandwich is an active community with a number of social activities occurring in town.

Analysis:

The community survey indicated a desire to maintain single family residential housing but also add options for “in-law” apartments and senior housing. The same survey showed a majority of residents saying “No” to multi-unit structures and workforce housing. There was a recognized need for more diverse and affordable housing. The Vision charges the town to “provide reasonable opportunity for housing choice so that greater age and income diversity can be achieved”.

Also in the Community Survey, the preferred future activities to be encouraged included tourism, arts/crafts businesses, home business, professional offices, agriculture, health practices, B&B’s/inns, and restaurants/cafes/coffee shops. There was a call for more jobs/retail/services. The Vision seeks to “provide opportunities for employment and small-scale businesses consistent with our rural character”, including “limited village business activity (e.g., general store/professional offices)”.

According to the 2000 Census more than 40% of the employed residents of Sandwich worked in town, one of highest rates of the thirty Lakes Region communities.

The ZO has a misleading definition of Accessory Dwelling Unit, “Any accessory structure *without kitchen and sanitary facilities* whose interior spaces are designed, adapted or used to accommodate human habitation on an ongoing, seasonal, or occasional basis.” For if a dwelling unit is intended for human habitation, then kitchen and sanitary facilities are a reasonable expectation.

The Cluster Residential Zoning Ordinance shall consist of single-unit dwellings, accessory uses, and home occupations. Multi-unit dwellings are prohibited from this type of development.

Recommendations:

Consider including some of the “activities to be encouraged” noted above as permitted uses in the Rural Residential District. (ZO)

The town should take steps to enhance affordable housing opportunities for younger people in Sandwich entering the workforce as well as making it easier for the elderly to remain in town. Consider permitting and

promoting multi-family housing to help diversify the town's housing stock and make it more affordable for folks to live in Sandwich. (ZO, A&P)

Consider revising the definition of an Accessory Dwelling Unit to include kitchen and sanitary facilities. (ZO)

Consider permitting the use of "Accessory" or "in-law" apartments as a means of providing housing options to young people as well as older residents. (ZO)

In order to provide diversity and affordability in housing options, consider allowing multi-unit dwellings under the Cluster Housing Ordinance. (ZO)

Smart Growth Principle 4:

Preserve New Hampshire's working landscape

Preserve New Hampshire's working landscape by sustaining farm and forest land and other rural resource lands to maintain contiguous tracts of open land and to minimize land use conflicts.

Description:

The people of Sandwich are quite proud of their agricultural and forestry heritage. A large portion of the town's landscape is federal forest land, supplemented by county and municipal parcels; additionally, much has been done to protect private tracts of land. While some of these pieces are isolated, many are contiguous, especially around Squam Lake and near the White Mountain National Forest. While the number of residents who earn their living by farming is not large, there is little doubt that there is community support this form of land use. The town does have an Agricultural Commission.

Analysis:

"Protect and enhance opportunities for agriculture." "Promote local agriculture and forestry." These sentiments come through clearly from the Community Forums. The Master Plan estimates that there are over 5,000 acres of managed forest land in Sandwich; however, those parcels in town ownership are not managed.

Land Use Action 3.1 charges the Planning Board with reviewing its regulations to ensure that there are as few limits on local agriculture as possible. Despite Sandwich's rigorous Wetland Overlay and Skyline District regulations, there are specific exemptions permitting agriculture and silviculture using Best Management Practices in these areas.

There is a weekly Farmer's Market near the Library running June – November, the long-running and successful Sandwich Fair, and just this year a very successful food truck selling burritos made with exclusively local ingredients.

Recommendations:

The town should continue to promote the local Farmer's Market as a venue for local farmers to sell their produce and as a means of keeping local farms in the public eye. (A&P)

The town should explore working with the current farmers and the USDA and NRCS to purchase development rights for these parcels if farmers are considering getting out of the business to ensure that they can remain working farmsteads. (A&P)

Smart Growth Principle 5:

Provide choices and safety in transportation

Provide safety and choices in transportation to create livable, walkable communities that increase accessibility for people of all ages, whether on foot, bicycle, or in motor vehicles.

Description:

State routes dominate Sandwich's landscape, with the intersection of NH Routes 109 and 113 defining the Center Sandwich area. NH Route 113A offers scenic vistas of the Sandwich Range and NH Route 25 is the major regional east-west artery and the location of the town's two small Commercial Districts. Most town facilities are located along these roadways. There are a few local streets in the Center Sandwich area, most other local roads do intersect (few dead ends) but have long distances between intersections. All are 'country roads'; due to the relatively low volume of traffic they are walkable but realistically, one must have a vehicle to get around in Sandwich. There are sidewalks on several but not all of the streets in Center Sandwich.

Analysis:

In the Community Forums, residents expressed a desire for bicycle and walking paths. There are several Transportation Actions directing the town to enhance walking and bicycling opportunities throughout Sandwich.

There is some need to look at the adequacy of parking in Center Sandwich associated with businesses. There are several statements in the current Subdivision and Site Plan Regulations that lay the groundwork for parking requirements; at this point they are broad, using terms such as 'adequate' and 'sufficient'. This leaves the specifics to be worked out between the applicant and the Planning Board.

As the town grows, it may wish to concentrate that growth in the village centers instead of spreading out along roadways. Village growth would be enhanced by developing a road network of intersecting streets in the village areas.

Recommendations:

To enhance the development of a Village Zoning District, the Planning Board should consider developing a road network plan of cross streets connecting the major roadways in town. This would enable modest development within and around the villages, reduce the need for more sprawling development along unbroken linear roadways and enhance walking and bicycling opportunities around the villages. (A&P)

The Planning Board could take steps to help the town make better use of its resources by requiring road connectivity in subdivisions. The more development that is permitted along "non-interconnected" roads, the more pressure is placed on municipal services. Additionally, the Planning Board could work with the Police and Fire Departments to incorporate elements of the CPTED (Crime Prevention Through Environmental Design⁹) into the planning process. Many of these elements are consistent with Smart Growth Principles. (Sub)

⁹ <http://www.thecptedpage.wsu.edu/Intro.html> (Accessed January 15, 2010).

The town should explore greater representation on the Lakes Region Transportation Technical Advisory Committee (for issues related to regional transportation). (A&P)

Smart Growth Principle 6:

Protect Environmental Quality

Protect environmental quality by minimizing impacts from human activities and planning for and maintaining natural areas that contribute to the health and quality of life of communities and people in New Hampshire.

Description:

The landscape of Sandwich is dominated by forests, mountains, and fields. From the White Mountain National Forest lands in the north to the wetlands near Squam Lake, the town is rich in natural resources and scenic beauty. The Conservation Commission has been active, working with the Planning Board and regional land protection organizations to develop protective ordinances and work with local landowners to preserve sections of town that have important natural characteristics. There are numerous local protections to both ensure that development projects are sited in a manner such that their impacts are limited as well as encouraging sustainable development practices.



Analysis:

Through the community forums there is acknowledgement that the town has done much to protect natural resources; at the same time there is also a push to do more in terms of acquisition and educational outreach to the community. The Shoreland District covers most bodies of water in town and exceeds the protections in the state shoreland protection act; however, it does not cover riverine land. Minimum frontage is 320' measured in a straight line. The town also has a Skyline District, protecting both steep slopes and high elevation lands from development. The town has designated eight prime wetlands. In 2011 a Groundwater Protection Ordinance was developed in conjunction with several other communities to limit the use of certain potential pollutants overtop the aquifer. The Master Plan guides the Planning Board to ensure that erosion controls are sufficient. The town recently adopted a Small Wind Energy Systems ordinance to regulate and encourage the development of locally sustainable energy.

The definition of 'wetland' in the Zoning Ordinance refers to Table 1, which was not found.

While much has been done to protect lands in town and many parcels are contiguous, enhancing their benefits to wildlife habitat, the master plan notes that the development of a digitized tax map and Geographic Information System could enhance the protection and conservation process.

While the town requires forest management plans in conjunction with the timber tax program, the town forests do not have management plans.

While Sandwich has had a Cluster Residential Ordinance for quite some time, it has rarely been utilized. The intent of such ordinances is to preserve contiguous open space. These usually work best when it is presented as the preferred method of development and there are incentives associated with certain steps being taken. As written, it provides few if any incentives for the developer while imposing additional hurdles for them to clear.

Recommendations:

The Board should consider adjusting the method of shoreline measurement to follow the shoreline as defined in RSA 483-B. (Sub)

The Planning Board should consider making Cluster Residential Development Ordinance into a Conservation Subdivision Ordinance and making it mandatory on parcels of a certain size (10 or 20 acres). With a Conservation Subdivision Ordinance fifty percent of the developable land would remain as open space and there would be incentives awarded to the developer for features such as contiguity with other open lands, larger percentages of open land, footpaths into the open land, and public access to footpaths. The *Innovative Land Use Guide* (2008) provides model language for this. Multi-unit dwellings should be permitted in this type of development. If an applicant wishes to utilize ‘conventional subdivision’, then a Special Exception would be needed. (ZO)

The Conservation Commission should develop management plans for the town’s forests. (A&P)

The town should explore the incorporation of digital tax maps and GIS in its land use planning and conservation practices. (A&P)

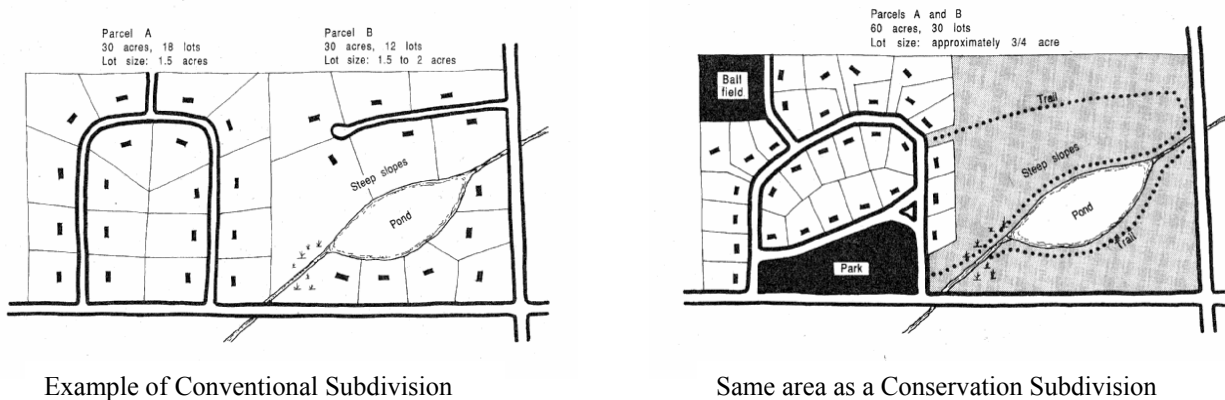
Make Table 1 more readily available in the Zoning Ordinance. (ZO)

Consider incorporating incentives into the subdivision process of all applications for those that preserve linkages between habitats. (Sub)

The town should continue its collaboration with the regional land organizations to protect parcels that include important habitats. (A&P)

Consider requiring that lighting not only be limited to the premises but also be downward facing. (ZO)

Consider including more specific language regarding erosion control requirements using elements of the model ordinance in the *Innovative Land Use Guide* (Chapter 2.8).



Smart Growth Principle 7:

Involve the community

Involve the community in planning and implementation to ensure that development retains and enhances the sense of place, traditions, goals, and values of the local community.

Description:

The Sandwich Planning Board meetings are open to the public; their schedule and minutes are available at the town's website. The update of the Master Plan was published in 2011 and involved dozens of volunteers, a community survey, and three public forums. The Sandwich Historical Society and the Historic District Commission play important roles in the community. The Sandwich Elementary School also holds an important place in the community. A number of events throughout the year bring the community together to celebrate a variety of events and cultures.

Analysis:

Throughout the Master Plan there are numerous directives to ensure that there is public input. The Master Plan is featured prominently on the home page of the town's website but the monthly agenda is not. The town's active and caring attitude is noted as a strong point but concern was expressed about maintaining high levels of volunteerism. The Planning Board has a large and active membership that relies on team review, providing opportunities for mentoring. The Historical Society and the Historic District Commission are quite active and help to maintain an awareness of traditions and sense of place. With an aging population, it is important that active steps be taken to engage younger people in community affairs, whether through the school, municipal, or other types of volunteer activities. Development of a Heritage Commission is proposed in the Master Plan (Action HR 1.1) along with several potential projects.

Recommendations:

Consider posting the Planning Board agenda on the town website. (A&P)

Continue to use a team approach to plan review; it seems to be successful at engaging board members in the process. (A&P)

The town should consider applying to Plan NH to work with the community and conduct a charrette related to developing, visualizing, and promoting a village zoning district (A&P)

Consider forming a Heritage Commission under RSA 673:4-a in order to carry out cultural and historical inventories and advise the planning board on such issues. (A&P)

Work with the Historic District Commission or Heritage Commission, if one is formed to explore and promote the resources available for restoration and other activities through the New Hampshire Division of Historical Resources. (A&P)

Smart Growth Principle 8:

Manage growth locally

Manage growth locally in the New Hampshire tradition, but work with neighboring towns to achieve common goals and address common problems more effectively.

Description:

Many of Sandwich's departments work with neighboring municipalities in an effort to offer services at the best available rate. Examples include police and fire mutual aid as well as the arrangement between the Sandwich school and Inter-Lakes School District. The community supports and is involved with a number of regional planning efforts including the Lakes Region Planning Commission and several regional land conservation organizations.

Analysis:

The Sandwich Master Plan states "Although the focus of this Master Plan is the Town of Sandwich, the town is also part of a larger region that sits in a transition area geographically between the Lakes Region and the White Mountains....Similarly actions that adjacent communities may take will also affect Sandwich." This year the town adopted a Groundwater Protection Ordinance that was developed in coordination with five other communities in the region. The town does have active representation on the regional planning commission but does not have representation on the Transportation Advisory Committee.

Recommendations:

It is vital to maintain communication and involvement with neighboring communities on environmental issues and development proposals. It also benefits the town to work with neighboring communities on other issues that could have mutual benefits. (A&P)

The Planning Board and Conservation Commission should work to coordinate their land preservation and planning efforts with adjacent communities to ensure that such efforts are done effectively. (A&P)

Sandwich should continue to collaborate with surrounding towns on projects such as road construction and infrastructure needs. Furthermore, should there be a development of regional impact proposed in the future the Planning Board should notify surrounding communities as per RSA 36: 54-57. This notification will allow neighboring communities and the regional planning commission to engage in discussion of the proposal as abutters and will give them a voice in the development process. (A&P)

Consider greater involvement on regional transportation planning efforts through the Transportation Technical Advisory Committee. (A&P)

Smart Growth Assessment Matrix: Sandwich, NH

Principle Number	Reference in Master Plan	Master Plan Goals and Objectives	Reference in Zoning Ordinance	Zoning Ordinances	Reference in Subdivision Regulations	Subdivision Regulations	Reference in Site Plan Regulations	Site Plan Review Regulations
Principle 1: Maintain traditional compact settlement patterns to efficiently use land, resources and infrastructure investments.								
1	Intro: Community Spoken - Forum	Challenges included the need: to maintain municipal services without raising taxes	150-4 Purpose	To prevent the overcrowding of land	Design Standards: 170-21 Lot Area	A. The minimum lot size permitted shall be 100,000 square feet of unrestricted area or, if the slope of the terrain is 15% or greater, 260,000 square feet of buildable area contiguous to, and including the site of the structure.	160.2 Purpose	The Planning Board may exercise its broadest discretion to assure that the site usage is compatible with the stated objectives of the Master Plan of the Town. [Good, strong statement]
1	Intro: Community Spoken - Forum	Improving Internet access (for economic opportunity)	150-4 Purpose	To facilitate the adequate provision of transportation, solid waste facilities, water, sewerage, schools, parks, child day care	Design Standards: 170-21 Lot Area	B. In the case of multiple-unit structures or multiple-unit nonresidential developments, the minimum lot size permitted shall be 175,000 square feet of unrestricted area or, if the slope of the terrain is 15% or greater, 455,000 square feet of buildable area. For multiple-unit developments, the area per unit shall not be less than one-quarter of the minimum lot size.	160-6 Applixation Requirements	D. Consultations. The Board may provide for preliminary consultation and review upon application as long as this consultation is limited to discussions of proposals in conceptual form..
1	Intro: Community Spoken - Forum	(Village Character) Study the Center Sandwich sewer capacity and options	150-7 Permitted Structures and Uses	All uses within the [Commercial] district shall have a wooded buffer zone of not less than 200 feet between the center line of the public way and the business buildings, parking lot or storage area. [Limiting]	Design Standards: 170-22 Lot Frontage	C. Lots which front on a public or private way shall be required to have not less than 160 feet of frontage. This does not apply to a lot which is the only lot at the end of a street or right-of-way.	Continued	only and in such general terms as the desirability of types of development and proposals under the Comprehensive Master Plan.
1	Intro: Community Spoken - Forum	(Village Character) Encourage sustainable village energy system or district	General Provisions: 150-10 Lot Area	The minimum lot size permitted shall be 100,000 square feet of unrestricted area or, if the slope of the terrain is 15% or greater, 260,000 square feet of buildable area contiguous to, and including the site of the structure.	Design Standards: 170-23 Setbacks	(1) Setback from center line of any road or street: 75 feet.	Continued	Such discussion may occur without the necessity of giving formal public notice, but such discussions may occur only at formal meetings of the Board. Preliminary consultation and
1	Vision	Maintain its high quality of community facilities and services in a cost effective manner	General Provisions: 150-10 Lot Area	In the case of multiple-unit structures, the minimum lot size permitted shall be 175,000 square feet of unrestricted area or, if the slope of the terrain is 15% or greater, 455,000 square feet of buildable area.	Design Standards: 170-23 Setbacks	(2) Setback from any lot side or back lines or edge of right-of-way: 50 feet.	Continued	review shall be separate and apart from formal consideration under Subsection B. [Should be under procedure 160-8 at its outset.]
1	Vision Goals	5. Preserve the town's rural, small town character and the traditional New England style of its villages.	General Provisions: 150-11 Lot Frontage	Lots which front on a public or private way shall be required to have not less than 160 feet of frontage. This does not apply to a lot which is the only lot at the end of a street or right-of-way.	Design Standards: 170-23 Setbacks	G. Commercial lots shall have a wooded buffer zone of not less than 200 feet between the center line of any public way and the business buildings, parking lot or storage area. The coverage of a lot used for commercial purposes, including buildings, parking areas, driveways and other impervious surfaces, shall not exceed 50% of the lot.		
1	Vision Goals	9. Encourage a sustainable community, one that meets our present needs without compromising the ability of future generations to meet their needs.	General Provisions: 150-13 Setbacks	Setback from center line of any road or street: 75 feet.		No Preliminary Consultation		
1	Vision Goals	10. Provide, in a cost effective manner, the quality and level of municipal services and facilities that are enjoyed in Sandwich today.	General Provisions: 150-13 Setbacks	Setback from any lot side or back lines or edge of right-of-way: 50 feet.				
1	Vision Goals	11. Encourage modern communication facilities, systems and services to meet the needs and diversity of Sandwich's residents and businesses, now and in the years to come.						
1	Land Use	Much of Sandwich's developed areas occur in a linear fashion along the town's roads or in small village areas, such as Center Sandwich.						

Smart Growth Assessment Matrix: Sandwich, NH

Principle Number	Reference in Master Plan	Master Plan Goals and Objectives	Reference in Zoning Ordinance	Zoning Ordinances	Reference in Subdivision Regulations	Subdivision Regulations	Reference in Site Plan Regulations	Site Plan Review Regulations
1	Land Use: Current Zoning	[Historic District does not permit much commercial.]						
1	Land Use: Current Zoning	[Commercial] Specific standards for this district include a requirement for a 200 foot wooded buffer between the center line of a public way and any business building, parking lot or storage area.						
1	Land Use: Issues & Challenges	Since much of Sandwich is undeveloped land in forest or open space/agricultural land cover or use, it will be important for the town to manage these lands in a manner that protects its rural and village character.						
1	Objective LU:1	Implement a digital information system that will link both spatial and community information into an integrated data base.						
1	Vision Goal for Historic Resources	Preserve the town's rural, small town character and the traditional New England style of its villages.						
1	Village Centers	[Gives a clear definition of Village Center.]						
1	Village Centers:Issues and Challenges	Sandwich places a high value on its villages.						
1	Village Centers:Issues and Challenges	The Historic District overlay, created in 1982, is currently being used as a de facto village center zoning classification, but it does not address the broader needs of the town to allow incremental compact development in and around the existing town center.						
1	Village Centers:Issues and Challenges	The zoning requirements for this district do not reflect the dimensional characteristics currently found in the village center. In addition, they do not provide the detailed regulatory guidance, such as dimensional standards, needed to retain the historic compact character of the village.						
1	Village Centers:Issues and Challenges	Anticipated future growth and possible changes of use in the mix of residential and non-residential properties in Center Sandwich village will cause incremental demand for sewage capacity.						
1	Village Centers:Issues and Challenges	Given current capacity limitations, a detailed engineering study of the sewer system needs to be undertaken and decisions made about whether it could be upgraded or expanded.						
1	Actions VC 1.3	Explore creating a Center Sandwich District and North Sandwich District with boundaries that would encompass the existing villages and include some space for incremental new growth around both.						
1	Actions VC 2.1	Retain the current design guidelines for buildings in the Historic District, incorporating sustainability and energy efficiency initiatives wherever they do not detract from the visual harmony of the District.						

Smart Growth Assessment Matrix: Sandwich, NH

Principle Number	Reference in Master Plan	Master Plan Goals and Objectives	Reference in Zoning Ordinance	Zoning Ordinances	Reference in Subdivision Regulations	Subdivision Regulations	Reference in Site Plan Regulations	Site Plan Review Regulations
1	Actions VC 3.2	Develop a long range plan for parking in the villages, including, if created, the Center Sandwich and North Sandwich Districts -- one that minimizes visual impacts and emphasizes sharing existing resources to avoid paving new areas.						
1	Vision Goals	Vision Goal #10 seeks to provide municipal services in a cost effective manner, including exploration of energy efficiency efforts to improve services and/or reduce overall costs.						
1	Objective E.1	Undertake Energy Efficiency Improvements in all areas of town government, including buildings, vehicles and operations.						
1	Vision Goals: Community Facilities	Provide in a cost effective manner the quality and level of municipal services and facilities that are enjoyed in Sandwich today						
1	Actions: CS 6.2	Undertake a comprehensive engineering study to determine current functional capacity of the Center Sandwich sewer system considering system limitations and provide alternative strategies for system configuration to accommodate future demand.						
1	Actions: CS 10.1	Work with existing commercial providers and advocate for the provision of state-of-the-art electronic communication services throughout Sandwich.						
1	Land Use: Issues & Challenges	Building area—Except for the limiting provisions for steep slopes and wetland setbacks, the Sandwich Zoning Ordinance requires a building lot to be 100,000 sf. Applying the setbacks of 25 feet per side with 165 foot frontage, the building envelope is 63,250 sf or more than 60% of the lot. While it is important in a rural community like Sandwich to provide flexibility in siting a home, it is not necessary to allow for such a substantial disturbance to take place within an area of this size. A building area can be more narrowly defined and the most suitable areas for development used.						

Principle 2: Foster the traditional character of New Hampshire downtowns, villages, and neighborhoods by encouraging a human scale of development that is comfortable for pedestrians and conducive to community life.

2	Intro: Community Spoken	Most important to future of town:—highest rating = Maintaining our rural, small-town character	150-4 Purpose	To avoid undue concentration of population	General Requirements: 170-17 Easements: Open Space	The Board may require open spaces and/or parks (not to exceed 15% of the total subdivision area) suitably located for recreational purposes, and of appropriate area and physical characteristics for this use.		
2	Intro: Community Spoken - Forum	Strengths included the town's: small town and community character	General Provisions: 150-13 Setbacks	When handicapped access ramps are required they are exempt from setback requirements.	Continued	Areas set aside for parks and playgrounds to be dedicated or to be reserved for the common use of all property owners by a covenant in the deed, whether or not required by the Board, shall be of reasonable size and character for neighborhood playgrounds or other recreational uses.		

Smart Growth Assessment Matrix: Sandwich, NH

Principle Number	Reference in Master Plan	Master Plan Goals and Objectives	Reference in Zoning Ordinance	Zoning Ordinances	Reference in Subdivision Regulations	Subdivision Regulations	Reference in Site Plan Regulations	Site Plan Review Regulations
2	Vision	(R)etain its quiet, rural, small-town character through protection of its valuable natural resources, preservation of its cultural and architectural heritage and scenic beauty;						
2	Vision Goals	1. Allow for modest growth of residential development of a size, design and quality compatible with Sandwich's small town, rural character and recognizes Sandwich's evolving demographics.						
2	Population & Housing - Survey	The community prefers housing that fits in with the existing smaller building styles that dominate the Sandwich landscape						
2	Action 3.1	Establish permanent heritage walking trails in Center Sandwich and Lower Corner that would include a map and permanent interpretive markers for specific historic properties.						
2	Actions VC 2.2	If zoning districts are created for North and Center Sandwich, develop design standards for additions, renovations and new construction outside the Historic District, that are compatible with existing historic building shapes, scale and character.						
2	Actions EB 1.2	Consider a set of design standards in the Site Plan Review Regulations that ensure that building renovations, additions and new structures are constructed in a way that they are compatible with the scale, architectural character and building placement of other buildings in the community.						
2	Actions EB 1.2	Review the setback requirement of 200 feet in the Commercial District. If the Town wishes to encourage small-scale commercial and industrial activity along the Whittier Highway, this setback may discourage such activity.						
2	Action T2.2	Develop a long-range plan for sidewalks in Center Sandwich. In the implementation phase, give first priority to a Maple Street link from Church Street to Main Street.						
2	Action T3.2	Update Site Plan Review standards to ensure that commercial development provides appropriate levels of landscaping and pedestrian walkways.						

Principle 3: Incorporate a mix of uses to provide variety of housing, employment, shopping, services and social opportunities for all members of the community.

3	Intro: Community Spoken	<ul style="list-style-type: none"> Preferred housing:--single family homes (50%); adding "mother-in law "apartment (71%); senior housing (57%) 	150-5 Definitions	ACCESSORY DWELLING – Any accessory structure without kitchen and sanitary facilities whose interior spaces are designed, adapted or used to accommodate human habitation on an ongoing, seasonal, or occasional basis.	Multiple-Unit Structures 170-36 Lot Size and Unit Density	No multiple-unit structure will contain more than four units. [Inconsistent with ZO Article V-F.]		
3	Intro: Community Spoken	<ul style="list-style-type: none"> Preferred future activities to be encouraged: (all greater than 50%) -tourism, arts/crafts businesses, home business, professional offices, agriculture, health practices, B&B's/inns, and restaurants/cafes/coffee shops 	150-7 Permitted Structures and Uses	Single-family unit, cluster single-unit, residential multiple-unit, mobile homes and manufactured housing dwellings. [Diversity]				

Smart Growth Assessment Matrix: Sandwich, NH

Principle Number	Reference in Master Plan	Master Plan Goals and Objectives	Reference in Zoning Ordinance	Zoning Ordinances	Reference in Subdivision Regulations	Subdivision Regulations	Reference in Site Plan Regulations	Site Plan Review Regulations
3	Intro: Community Spoken - Forum	Challenges included the need: for more jobs/retail/services	150-7 Permitted Structures and Uses	Home occupations, professional practices, business offices (such as, but not limited to, real estate offices and insurance agencies), located on the premises and employing not more than the equivalent of four full-time employees (excluding the residents), provided such use is secondary to the use of the premises for dwelling purposes, provided that:				
3	Intro: Community Spoken - Forum	More diversified and affordable housing	continued	(a) The premises can provide parking for employees and customers; (b) The business does not generate excess trips, traffic or deliveries; and (c) The business does not materially harm or affect the residential or rural quality of the area. [Diversity]				
3	Intro: Community Spoken - Forum	(Village Character) Re-examine village land use regulations	General Provisions: 150-11 Lot Frontage	Minimum frontage for multiple-unit property containing multiple-unit structures or nonresidential developments may be required by the Planning Board to exceed 160 feet, depending upon the number of units and individual building layouts and configurations.				
3	Vision	Provide opportunities for employment and small-scale businesses consistent with our rural character.	Cluster Residential 150-23	Cluster residential development shall consist of single-unit dwellings, accessory uses and home occupations as established in § 150-7A preceding.				
3	Vision Goals	2. Provide reasonable opportunity for housing choice so that greater age and income diversity can be achieved.						
3	Vision Goals	6. Provide opportunity for limited village business activity (e.g., general store/professional offices) that is consistent with the architectural qualities that the town values.						
3	Vision Goals	7. Encourage home occupations that are compatible with and supportive of the town's rural character.						
3	Population and Housing	Multi-family housing availability declined slightly between 1990 and 2007 offering limited opportunity for rental housing.						
3	Population & Housing - Survey	Allowing "mother-in-law apartments" Yes=70% No=21%						
3	Population & Housing - Survey	Multi-unit structures Yes=19% No=69%						
3	Population & Housing - Survey	Senior housing Yes=57% No=30%						
3	Population & Housing - Survey	Workforce housing Yes=29% No=49%						

Smart Growth Assessment Matrix: Sandwich, NH

Principle Number	Reference in Master Plan	Master Plan Goals and Objectives	Reference in Zoning Ordinance	Zoning Ordinances	Reference in Subdivision Regulations	Subdivision Regulations	Reference in Site Plan Regulations	Site Plan Review Regulations
3	Population & Housing - Housing Units	93% of the units in Sandwich are single family homes, compared to 77% for the county at and 63% for the state.						
3	Population & Housing - Housing Units	. The supply of multi-family dwelling units is one-third of the county percentage and one-sixth of the state's 30%.						
3	Population & Housing - Affordability	(T)hat there is a total of 1,052 residential properties in town. Two of those are listed as 2-family structures and one is listed as a 3-family building, leaving a total of 1,049 properties that have single family homes. [Limited choice for types of housing]						
3	Population & Housing - Affordability	[T]here are 277 (or 26%) ownership properties in Sandwich that are affordable at \$211,000 or less.						
3	Population & Housing - Affordability	[I]t is clear that housing prices have risen considerably faster than median incomes and that housing is becoming increasingly less affordable.						
3	Population & Housing - Issues and Challenges	With the high cost of housing and aging population in Sandwich, consideration should be given to providing more flexible housing options including accessory dwelling units.						
3	Action PH 1.1	Consider amending the zoning ordinance to permit fully independent accessory dwelling units (that include separate kitchen and sanitary facilities) in residential zoning districts.						
3	Land Use: Current Zoning	Rural/Residential zoning dominates the town. It is a zone that allows primarily residential structures, including mobile and manufactured homes. It also provides for accessory structures, home occupations, day care, agriculture, recreational uses, gravel pits, such institutions as churches, municipal buildings and schools.						
3	Historic Resources: Issues and Challenges	The key challenge will be to preserve the town's rural, historic and small town character while managing change and growth.						
3	Village Centers: Issues and Challenges	The town's base zoning, the Rural/Residential District (that incorporates the current village areas), allows a variety of uses, many of which may not be reasonable in areas where there are very small lot sizes, such as Center and North Sandwich. At present, such uses as Inns, retail stores, restaurants, professional offices, studios and banks are allowed only by special exception within the Historic District.						
3	Village Centers: Issues and Challenges	Based on the 2009 community survey, many residents supported the desire to have a mix of uses in Center Sandwich.						

Smart Growth Assessment Matrix: Sandwich, NH

Principle Number	Reference in Master Plan	Master Plan Goals and Objectives	Reference in Zoning Ordinance	Zoning Ordinances	Reference in Subdivision Regulations	Subdivision Regulations	Reference in Site Plan Regulations	Site Plan Review Regulations
3	Village Centers: Issues and Challenges	Nor do these requirements enable appropriate incremental growth and a mix of residential, retail and office uses just beyond the present Historic District boundaries.						
3	Action VC 1.1	Maintain a mix of residential, commercial and civic service properties and uses in the Historic District that is consistent with natural and historic resource preservation and respects the wishes of both the neighborhood and wider community.						
3	Objective EB 1	Promote a limited mix of residential, retail and office uses that are compatible with the existing visual character of the village and rural character of the town.						
3	Actions EB 1.1	Review provisions for a mix of residential uses and limited opportunities for small business activities in Center and North Sandwich.						
3	Objective EB 2	Encourage home occupations that are compatible with the rural character of Sandwich without infringing on neighbors ability to achieve quiet enjoyment of their property.						
3	Vision Goals: Community Facilities	Encourage modern communication facilities, systems and services to meet the needs and diversity of Sandwich's residents and businesses, now and in the years to come.						
3	Land Use: Current Zoning	[Historic District does not permit much commercial.]						

Principle 4: Preserve New Hampshire's working landscape by sustaining farm and forest land and other rural resource lands to maintain contiguous tracts of open land and to minimize land use conflicts.

4	Intro, Existing Plan	Consistently, the town identified several important community values that provided the foundation for plan updates: Providing opportunity for economic growth consistent with the community's rural character	150-4 Purpose	To encourage the preservation of agricultural lands and buildings				
4	Intro: Community Spoken - Forum	Protect and enhance opportunities for agriculture	150-7 Permitted Structures and Uses	Agriculture uses, including all recognized forms of farming, truck gardening, silviculture, livestock raising, tree, shrub, plant or flower nurseries and roadside stands for the sale of produce grown primarily on the premises.				
4	Intro: Community Spoken - Forum	Promoting local agriculture and forestry	150-7 Permitted Structures and Uses	Skyline Districts - E. Agriculture and silviculture as permitted				
4	Land Use	Although diminished, agriculture continued to contribute to the open spaces and character of the community in subsequent decades.	150-48 Wetland: Permitted Uses	Regardless of the criteria set forth in paragraph A, the following uses are specifically permitted: (1) Forestry or tree farming, using the best management practices to protect streams and standing water from pollution and sedimentation.				

Smart Growth Assessment Matrix: Sandwich, NH

Principle Number	Reference in Master Plan	Master Plan Goals and Objectives	Reference in Zoning Ordinance	Zoning Ordinances	Reference in Subdivision Regulations	Subdivision Regulations	Reference in Site Plan Regulations	Site Plan Review Regulations
4	Land Use	As an indicator of the support for agricultural activity in Sandwich, the 2010 Town Meeting voted to establish an Agricultural Commission with the purpose of protecting agricultural lands, preserving rural character, providing a voice for farmers and encouraging agriculture-based businesses.	150-48 Wetland: Permitted Uses	Regardless of the criteria set forth in paragraph A, the following uses are specifically permitted: (2) Agriculture according to recommended soil conservation practices, including protection of wetlands from pollution by fertilizers, pesticides and herbicides.				
4	Land Use	there are likely to be over 5,000 acres of managed forest in Sandwich.						
4	Land Use: Forest Lands	There is no management plan for any of the [town forest] parcels.						
4	Land Use: Forest Lands	The total stumpage fee was \$3.1M, a significant income to the landowners.						
4	Land Use: Current Zoning	Agriculture, silvaculture and recreation are permitted [in Skyline District]						
4	Land Use: Issues & Challenges	Encouraging environmentally sound forest management and agricultural activity is critical to maintaining this character						
4	Action LU 3.1	Review local zoning, subdivision and site plan review regulations to ensure that the full range of agricultural activities are permitted including subsidiary uses such as: • roadside stands (size, can any percentage of products be from elsewhere, etc.); • greenhouses; • signs—regulations on temporary signs; off-site signs allowed; and • consideration of nuisance issues.						
4	Objectives EB 3	To preserve the rural character of the town, encourage businesses that are related to maintaining and enhancing the value and sustainability of natural resources.						

Principle 5: Provide choices and safety in transportation to create livable, walkable communities that increase accessibility for people of all ages, whether on foot, bicycle, or in motor vehicles.

5	Intro: Community Spoken	• Changes to town roads:--Bicycle paths/lanes/trails (59%); increased rebuilding of existing paved roads (57%); increased rebuilding of gravel road beds (58%); better ditching (57%)	150-4 Purpose	To lessen congestion in the streets	General Requirements: 170-24: Road Design Standards	L. The arrangement of streets in the subdivision shall provide for the continuation of the principal streets in adjoining subdivisions or for their proper projection when adjoining property is not subdivided, and shall be of a width at least as great as that of such existing connecting streets.	160-7 Requirements for Site Plan Approval	A. Adequate traffic access, circulation, and parking are provided to ensure the safety of vehicles and pedestrians.
5	Vision Goals	8. Provide a balanced transportation system with well-maintained public roadways lined with stone walls, open fields and trees; and encourage opportunities and facilities for pedestrians, bicyclists and recreational users.			General Requirements: 170-25: Access Points	All access points, including driveway entrances, shall be located to most adequately promote safety, efficiency and convenience of the traveling public and the residents adjacent to the roadway. Access points to through highways, public roads and streets shall be limited in number to protect the long-term utility of the roadway.	160-7 Requirements for Site Plan Approval	(2) It is expected that shoppers, employees, and/or residents will require access to sidewalks running from the streetside to the establishment(s). Sidewalks shall be provided for pedestrian traffic to provide connection between the main entrances of business, housing, or industrial establishments and parking areas; [Not always available.]

Smart Growth Assessment Matrix: Sandwich, NH

Principle Number	Reference in Master Plan	Master Plan Goals and Objectives	Reference in Zoning Ordinance	Zoning Ordinances	Reference in Subdivision Regulations	Subdivision Regulations	Reference in Site Plan Regulations	Site Plan Review Regulations
5	Future of the Region	The primary connection among area towns is the roadway system that is described in its regional context in the Transportation Chapter. Changes to these roadways or increased development in adjacent communities may have impacts in Sandwich.			General Requirements: 170-25: Access Points	D. For proposed residential or commercial development along Town or state roadway frontages that exceed 600 feet, the construction of an internal street system, or a service road outside of the roadway right-of-way, shall be required to provide greater safety for the development occupants, as well as the highway users.	160-7 Requirements for Site Plan Approval	(3) Sufficient off-street parking for the vehicles of employees, customers and/or residents so that no parking is forced onto public streets... [Opinions vary on whether sufficient parking is available.]
5	Village Centers: Issues and Challenges	Two out of three people who responded to the 2009 survey did not feel a need for either more sidewalks or parking in the village center. The 2008 Historic District Commission survey provided a different perspective. Those survey respondents felt that current parking was adequate to meet existing needs, but it was felt that adequate parking should be provided for businesses, and that the design of new parking would have to be treated carefully to fit in with the village center.					160-7 Requirements for Site Plan Approval	(5) Access, parking, and loading areas constructed to minimize dust, runoff and erosion conditions that would have a detrimental effect of on abutting properties [See above.]
5	Actions VC 3.1	Provide appropriate opportunities for safe pedestrian and bicycle circulation within the village, including, if created, the Center Sandwich and North Sandwich Districts. Where possible, do so without increasing paved surfaces, favoring permeable and green alternatives that reduce storm water runoff.						
5	Action T1.1	Consider adding an additional 2 feet of pavement to the edge of current pavement on existing roadways when undertaking repaving or reconstruction. This additional pavement will reduce pavement deterioration along the edge as well as provide a safer area for bicyclists and pedestrians.						
5	Action T1.2	Consider requiring a traffic impact analysis in the subdivision and site plan regulations for any development that exceeds a threshold of 50 vehicle trips in any one hour.						
5	Action T2.1	Work cooperatively with the NHDOT to assure that any state bridges that are rebuilt or reconstructed provide adequate space for sidewalks and/or bicycle lanes.						
5	Action T2.3	Using the existing local trail system as a starting point, work toward a system of bicycle routes and multi-use trails/paths for the enjoyment of Sandwich citizens and visitors that is coordinated with state and regional trail systems.						
5	Action T2.4	In cooperation with the NH DOT, properly mark and sign the state designated bike routes, including Routes 113 and Route 109.						
5	Action T3.3	Review the town's policy with respect to Scenic Roads and determine if all roads should be considered scenic.						

Smart Growth Assessment Matrix: Sandwich, NH

Principle Number	Reference in Master Plan	Master Plan Goals and Objectives	Reference in Zoning Ordinance	Zoning Ordinances	Reference in Subdivision Regulations	Subdivision Regulations	Reference in Site Plan Regulations	Site Plan Review Regulations
5	Vision Goals	Vision Goal #8 refers to provision of a balanced transportation system, including facilities for pedestrians and bicyclists.						
Principle 6: Protect environmental quality by minimizing impacts from human activities and planning for and maintaining natural areas that contribute to the health and quality of life of communities and people in New Hampshire.								
6	Intro, Existing Plan	Consistently, the town identified several important community values that provided the foundation for plan updates: • Protection of the natural, ... and scenic environment	Article IV	[Have Cluster Residential, though it is rarely utilized]	Design Standards: 170-21 Lot Area	F. Wetlands, areas with slopes exceeding 25% and rights-of-way may not be included in the area used to meet the minimum lot size requirement.	160-7 Requirements for Site Plan Approval	C. Adequate measures to protect against adverse environmental impacts. Criteria for such a determination include, but are not limited to, the following:
6	Intro: Community Spoken	• Choices for future initiatives-The highest rated:-- Acquisition of additional land for conservation (65%);	Article IX	[Have Wetland Protection Ordinance]	Design Standards: 170-21 Lot Area	H. If a lot is divided into parts by a wetland, or by a slope in excess of 25%, there must be a contiguous area where the soil type and other conditions are such as to permit construction of a dwelling and septic system within the required setbacks.	continued	(1) Sewage disposal and water supply systems designed to meet the regulations of the NH Department of Environmental Services and/or the Town of Sandwich;
6	Intro: Community Spoken	• Generally satisfied with protection of town's natural resources.	Article X	[Have Steep Slope Protection Ordinance]	Design Standards: 170-22 Lot Frontage	A. When any boundary of a lot is the shore of a lake or pond, or the shore of a navigable stream, the minimum frontage on the water of that boundary shall be not less than 320 feet measured on a straight line.	continued	(2) If the proposed development is located within a flood-hazard area, adequate measures to minimize flood damage to structures, public utilities, and septic systems located on the site;
6	Intro: Community Spoken - Forum	Strengths included the town's: natural and water resources,	Article XVI	[Have Small Wind Energy Systems Ordinance]	Design Standards: 170-23 Setbacks	A. Septic tanks and leach fields. (1) Setback from high-water mark of any lake, pond, stream or wetland: 125 feet.	continued	(3) Adequate provisions for safe storage of hazardous materials and/or waste to protect against environmental pollution, negative effects on neighboring properties and danger to users or residents of the site;
6	Intro: Community Spoken - Forum	Challenges included the need: to embrace sustainability/climate change and energy conservation	Article XVII, 150-55, 150-59	[Have Groundwater Protection Ordinance (defined as 15% or greater). Any work on such areas requires a PB permit and Operation Plan.]	Design Standards: 170-23 Setbacks	(3) Setback from high-water mark of any lake, pond, stream or wetland: 100 feet	continued	(4) Adequate provisions for surface drainage.
6	Intro: Community Spoken - Forum	More effort to protect land through acquisition & easement	150-4 Purpose	To assure proper use of natural resources and other public requirements; and as granted by RSA 674:21 through 674:22: (1) To provide innovative land use controls; and	Steep Slopes Areas: 170-40 General	In keeping with purposes stated in Article I, and inasmuch as a great portion of the Town of Sandwich occupies land that slopes in excess of 15%, and the nature of the soils is such that slopes render the land exceptionally vulnerable to erosion and attendant problems of water pollution and sedimentation, potentially affecting not only an individual landowner's property but that of abutters and ultimately the community, the Town of Sandwich deems it necessary and proper to regulate certain practices upon and uses of such lands to preserve and protect the health and well-being of all the inhabitants. The special provisions of this article apply to any lot where steep slopes are a part of the land area used to meet the minimum lot size requirement (§ 170-21).		

Smart Growth Assessment Matrix: Sandwich, NH

Principle Number	Reference in Master Plan	Master Plan Goals and Objectives	Reference in Zoning Ordinance	Zoning Ordinances	Reference in Subdivision Regulations	Subdivision Regulations	Reference in Site Plan Regulations	Site Plan Review Regulations
6	Intro: Community Spoken - Forum	Provide more educational outreach about importance of natural resource protection	150-4 Purpose	(2) To regulate and control the timing of development at an orderly and reasonable rate. This ordinance reflects the wishes of the citizenry as expressed through the ballot and through the comprehensive Master Plan.	Steep Slopes Areas: 170-42 Special Plat Requirements	B. Delineate all slope areas, with a clear indication by hatching of areas with slopes over 15% and counter-hatching of areas with slopes over 25%.		
6	Intro: Community Spoken - Forum	Encouraging a green economy (sustainable energy, buy local, sustainable land use/agriculture-forestry)	continued	A principal ingredient of this ordinance is the effort to preserve the scenic beauty and healthfulness of the Town through particular attention to land use in the vicinity of lakes, ponds, streams, wetlands and steep slopes, to preserve the natural beauty of the land within view of the lakes and ponds, and to preserve for recreation and wildlife habitat forests, wetlands and wild lands. Because of the uniqueness of some wetlands, and the importance of water sources and quality to the well-being of the Town, the minimum distances specified in this ordinance may exceed the minimum distances specified in state statutes.	Steep Slopes Areas: 170-42 Special Plat Requirements	C. Show areas within each lot, computed in square feet, of wetlands and stream beds, land with slopes less than 15%, land with slopes between 15% and 25% and land with slopes exceeding 25%.		
6	Intro: Community Spoken - Forum	(I)n the long term an improved cluster or Open Space Development (OSD) regulation that provides high quality open space is an approach the town should consider. This would help to preserve the town's rural character.	150-4 Purpose	To encourage the installation and use of solar, wind, or other renewable energy systems and protect access to energy sources by the regulation of orientation of streets, lots, and buildings; establishment of maximum building height, minimum setback requirements, and limitations on type, height, and placement of vegetation; and encouragement of the use of solar skyspace easements under RSA Chapter 477.	Cluster Residential Developments: 170-29 Lot Size and Density	The total buildable area of a cluster development shall not be less than the number of dwelling units times the minimum lot size for a single unit as specified in § 170-21.		
6	Vision Goals	3. Protect historic resources, natural environment, scenic beauty, open space, clean water, and wildlife through well-managed growth and careful planning.	150-5 Definitions	WETLANDS — Defined in § 150-47. Soil series and land types are defined in Table 1. [Table 1 was not found.]	Cluster Residential Developments: 170-29 Lot Size and Density	The minimum area for individual building lots within the development shall be determined by the Planning Board based on the circumstances of the development proposal and in the interest of encouraging flexibility in site design and the preservation of open space.		
6	Vision Goals	4. Support and encourage protection and management of high value conservation and open space lands that are linked by trails and/or wildlife and natural resource corridors.	150-7 Permitted Structures and Uses	Recreational uses consistent with the preservation of open spaces and natural resources, and which do not materially harm or affect the residential or rural quality of the area	Cluster Residential Developments: 170-29 Lot Size and Density	However, the individual lot area shall be no less than one-quarter of the minimum lot size for a single-unit dwelling.		
6	Future of the Region	Many of the area's natural resources and open spaces as described in the Natural Resources Chapter are also intertwined....Appropriate land use regulations to protect this resource need to be considered in all communities.	150-7 Permitted Structures and Uses	Shoreland Districts -D [No cluster permitted.]	Cluster Residential Developments: 170-31 Common Open Space	The common space in a cluster development, i.e., the difference between the total area and the sum of the individual lot areas, shall not be less than 25% of the total area and shall be designated as permanent common open space exclusive of road rights-of-way and common parking areas.		

Smart Growth Assessment Matrix: Sandwich, NH

Principle Number	Reference in Master Plan	Master Plan Goals and Objectives	Reference in Zoning Ordinance	Zoning Ordinances	Reference in Subdivision Regulations	Subdivision Regulations	Reference in Site Plan Regulations	Site Plan Review Regulations
6	Land Use	While almost 90% of Sandwich is forested, only about 1.5% is developed as buildings	150-7 Permitted Structures and Uses	Lakefront lots within the Shoreland Districts, used for the purpose of granting deeded rights or access to a lake for residential dwellings, regardless of the location of such dwellings, shall have not less than 320 feet of shore frontage, measured on a straight line, for the first dwelling having the right of access, and 50 feet of additional shore frontage for each additional dwelling. Also, for each dwelling having a right of access, and located more than one-half mile from the shoreline, one parking space shall be provided.				
6	Land Use: Current Zoning	[Shoreland District] This zone includes all areas within 600 feet of the following lakes and ponds: Squam, Red Hill, Bearcamp, Little's, Dinsmore, Kusumpe, Intervale and Barville. It allows for single family residential and accessory structures, beaches, parks and boat access, as well as home occupation. There are a number of district standards, including length of shoreline per lot, limits on tree-cutting, stormwater, use of herbicides, pesticides and fertilizer and a prohibition on certain types of uses, such as underground fuel storage tanks. This district covers the main surface water bodies, but does not include riverine shorelands.	150-7 Permitted Structures and Uses	No more than 50% of the basal area of trees shall be cut or otherwise felled, within a twenty-year period, leaving a well distributed stand within 150 feet of a great pond, or within 50 feet of a navigable river or a public highway right-of-way. Stumps and their root systems which are located within 50 feet of a great pond or navigable river shall be left intact in the ground. [Is this enforced locally?]				
6	Land Use: Current Zoning	[Skyline District] This zoning district is noted on the Sandwich Steep Slopes Map and recently revised Zoning Map, and corresponds to areas above certain elevations and ridgelines. No structures are permitted.	150-7 Permitted Structures and Uses	New structures within the protected shoreland shall be designed and constructed to prevent the release of surface run-off across exposed soils. All new driveways and parking lots shall be constructed of natural porous materials.				
6	Land Use: Issues & Challenges	The missing piece is the digitized tax maps that can help identify key parcels that might be affected by future land use change or that might be suitable for protection or conservation.	General Provisions: 150-11 Lot Frontage	When any boundary of a lot is the shore of a lake or pond, or the shore of a navigable stream, the minimum frontage on the water of that boundary shall be not less than 320 feet measured on a straight line.				
6	Land Use: Issues & Challenges	As part of the town's policy for timber management for the timber tax program, individual forest management plans are required. This practice should continue.	General Provisions: 150-13 Setbacks	Setback from high-water mark of any lake, pond, stream or wetland: 100 feet.				
6	Land Use: Issues & Challenges	Sandwich owns four parcels totaling 161 acres that are designated as town forest, but no management plan has been prepared for this valuable property.	Cluster Residential 150-23	At least 25% of the cluster development shall be designated as permanent common open space exclusive of road rights-of-way and common parking areas. [Different from the definition.]				
6	Land Use: Issues & Challenges	While forest management plans are a good practice on individual properties, there is no mechanism for coordinating management plans on adjacent properties. Facilitating timber management plans would encourage groups of adjacent property owners to implement more efficient timber management, as well as coordinating wildlife management and recreational opportunities.	Cluster Residential 150-23	When the common open space is set aside for recreational purposes it must be usable and accessible. When open space is designated for preservation or conservation necessary covenants, deeds or other legal arrangements must be filed to ensure that the land will remain unimproved. [To whom?]				

Smart Growth Assessment Matrix: Sandwich, NH

Principle Number	Reference in Master Plan	Master Plan Goals and Objectives	Reference in Zoning Ordinance	Zoning Ordinances	Reference in Subdivision Regulations	Subdivision Regulations	Reference in Site Plan Regulations	Site Plan Review Regulations
6	Land Use: Issues & Challenges	While there is a small amount of land devoted to agriculture, and the acreage has declined since the Master Plan of 1981. At the same time there are more active, although smaller, farms. The town should work to maintain or enhance both the amount of agricultural land and the number of farms.	Cluster Residential 150-23	Optional with no incentives. Density bonuses? Access bonuses?				
6	Land Use: Issues & Challenges	The establishment of an Agricultural Commission is a good first step in providing a local tool for preservation of agriculture. It is important that this commission undertake activities that will fulfill this mission.	Sign Regulations 150-38	Permitted signs may be lighted by continuous illumination only, and shall be so erected that the source of light is not visible outside the premises. For this purpose, the source of light shall include all transparent or translucent surfaces of arc lights, incandescent and fluorescent lamps, and lights producing illumination by electrical discharge in gases or vapors. [Downward facing?]				
6	Land Use: Issues & Challenges	The land use regulations in Sandwich must allow the greatest possible opportunity to conduct agricultural activities as per NH RSA 672:1, III-b.	150-51 Wetlands: Special Provisions	[Septic setback - 125', structure setback - 100']				
6	Land Use: Issues & Challenges	The Shoreland District covers the major surface waters, but not all streams and brooks. While the state Comprehensive Shoreland Protection Act (CSPA) includes Great Ponds and 4th and 5th order streams, it does not regulate lower order streams (1, 2, and 3)	150-53 Prime Wetlands	[Have eight prime wetlands incorporating more than 800 acres.]				
6	Actions LU 2.5	Review Subdivision and Site Plan Review Regulations to be sure that they reflect the need to protect rural character and that any development under these provisions minimize environmental impact. Consider appropriate standards for: <ul style="list-style-type: none"> Public roads and driveways, Stormwater management, and Landscaping. 	150-5 Definitions	CLUSTER RESIDENTIAL DEVELOPMENT — A form of residential subdivision that permits single-unit housing units to be grouped on sites or lots with dimensions reduced from conventional sizes, provided the density of the tract as a whole shall not be greater than the density allowed by single-unit zoning under existing regulations, and the remaining land area is devoted to common open space.				
6	Action LU 3.2	Establish forest management plans for all town forests.	Cluster Residential 150-23	Cluster development is an option which: permits greater flexibility in design; discourages development sprawls; provides a more efficient use of land in harmony with the land's natural characteristics; and preserves more usable open space, agricultural land, tree cover, recreational areas or scenic vistas.				
6	Actions VC 1.4	Identify key open spaces and vistas that need to be protected and consider acquisition, easements or other alternatives to permanently protect these visual resources.	150-5 Definitions	BUILDABLE AREA — The net area after excluding wetlands, rights-of-way and areas with slopes exceeding 25%. [No mention of contiguity.]				
6	Action T3.1	Review and, as appropriate, update the current roadway design standards to ensure that there is minimal impact to the town's streams and brooks, as well as to ensure impacts from drainage do not degrade stream and pond water quality.						

Smart Growth Assessment Matrix: Sandwich, NH

Principle Number	Reference in Master Plan	Master Plan Goals and Objectives	Reference in Zoning Ordinance	Zoning Ordinances	Reference in Subdivision Regulations	Subdivision Regulations	Reference in Site Plan Regulations	Site Plan Review Regulations
6	Population & Housing - Survey	Cluster residential Yes=35% No=54%						
6	Land Use: Current Zoning	Cluster residential housing is allowed within this [Rural Residential] district. Additional guidelines or standard with flexible provisions might provide a more predictable review process.						
6	Land Use: Issues & Challenges	It would appear that this purpose may not be achieved under the current regulation for the following reasons: <ul style="list-style-type: none"> • No minimum size for such a development is provided. • This regulation only provides for 25% open space. This should be increased. • There are no dimensional standards. • There is no documentation of what are permitted and non-permitted uses in the open space area. 						
6	Action LU 2.1	Amend the Cluster Provision in the Zoning Ordinance to ensure that the quality of development is consistent with the town's rural character.						
6	Intro: Community Spoken - Forum	Greater municipal intervention in land use regulation to protect natural resources and water quality						

Principle 7: Involve the community in planning and implementation to ensure that development retains and enhances the sense of place, traditions, goals, and values of the local community.

7	Intro, Existing Plan	Consistently, the town identified several important community values that provided the foundation for plan updates: <ul style="list-style-type: none"> • Protection of the ...historic ...environment 						
7	Intro, Planning Process	With the support of the town, the Committee then set out an ambitious program to develop the 2011 Master Plan. This effort included a Community Survey, three public forums, numerous drafts of various sections of the Plan and dozens of meetings over the past two years.						
7	Intro, Planning Process	Historic District:--permit modern bldg. methods/materials (80% yes); more businesses if consistent with current building style: (71% yes)						
7	Intro: Community Spoken - Forum	Strengths included the town's: active and caring attitude.						
7	Intro: Community Spoken - Forum	Challenges included the need: to retain high levels of social connectivity/volunteerism						

Smart Growth Assessment Matrix: Sandwich, NH

Principle Number	Reference in Master Plan	Master Plan Goals and Objectives	Reference in Zoning Ordinance	Zoning Ordinances	Reference in Subdivision Regulations	Subdivision Regulations	Reference in Site Plan Regulations	Site Plan Review Regulations
7	Intro: Community Spoken - Forum	Keeping the Central School viable						
7	Intro: Community Spoken - Forum	(Village Character) Encourage tax incentive programs for historic preservation and maintenance						
7	Vision	Be vibrant and diverse by promoting social, cultural, housing, and recreational opportunities for all age groups;						
7	Vision Goals	12. Encourage and foster high levels of citizen volunteerism in both public and non-profit activities to promote social capital and keep the cost of municipal services at a reasonable level.						
7	Historic Resources: Issues and Challenges	Through various recent surveys and community forums, it has been made clear that the community wishes to maintain and preserve the natural and historic heritage. This heritage includes numerous buildings, village areas, churches cemeteries, mill sites, scenic roads and National Register Historic sites.						
7	Action HR 1.1	Consider establishing a Heritage Commission under the provisions of RSA 674:44 that can advise the Planning Board or other community boards relative to the value of the town's heritage (historical, archaeological, and cultural) resources.						
7	Action HR 1.2	Prepare a comprehensive historic resources inventory—both written and photographic—of all historic sites and buildings in the Town of Sandwich based upon information collected and published for the Heritage Walks (ref HR 3.1) and other relevant documents.						
7	Action HR 1.3	As a complement to Action HR 1.2, consider conducting a comprehensive historic landscape survey of Sandwich, including its villages and rural landscapes, based on the guidance document General Guidelines for Identifying and Evaluating Historic Landscapes.						
7	Action HR 1.4	Apply to become a Certified Local Government (CLG) through the NH Division of Historic Resources to allow Sandwich greater opportunity to identify, evaluate, and protect local properties of historic, architectural and archaeological significance.						
7	Village Centers: Issues and Challenges	Further, if new development or changes were to be proposed immediately adjacent to the Historic District boundaries, how would that affect the views from the village to the countryside and the overall “feel” of the village?						

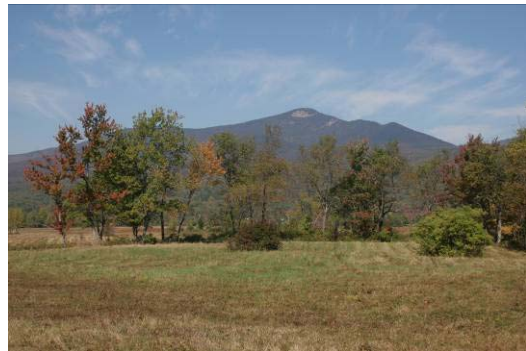
Smart Growth Assessment Matrix: Sandwich, NH

Principle Number	Reference in Master Plan	Master Plan Goals and Objectives	Reference in Zoning Ordinance	Zoning Ordinances	Reference in Subdivision Regulations	Subdivision Regulations	Reference in Site Plan Regulations	Site Plan Review Regulations
7	Actions VC 1.3	To initiate this effort, one or more design workshops or charrettes should be conducted to explore in detail how the Town would like to see the villages grow and evolve over time, leading to development of a long range plan.						
7	Vision Goals: Community Facilities	Encourage and foster high levels of citizen volunteerism in both public and non-profit activities to promote social capital and keep the cost of municipal services at a reasonable level.						

Principle 8: Manage growth locally in the New Hampshire tradition, but work with neighboring towns to achieve common goals and more effectively address common problems

8	Future of the Region	Although the focus of this Master Plan is the Town of Sandwich, the town is also part of a larger region that sits in a transition area geographically between the Lakes Region and the White Mountains....Similarly actions that adjacent communities may take will also affect Sandwich.	Article XVII	Groundwater Protection Ordinance was developed on conjunction with five other communities in aquifer.				
8	Future of the Region	At present, there are a number of areas of cooperation in place including the practice of mutual aid and assistance for fire/safety and police. Sandwich schools have been consolidated internally over the years ... As municipal budgets increase there may be opportunity for greater cooperation among area communities.						
8	Action T4.1	Participate in the Lakes Region Planning Commission (LRPC) planning process for regional transportation planning. Advocate for the Town's interests through staff communications. Consider having a representative on both the Technical Advisory Committee and Policy Committee of the RPC.						

Review of Land Use Planning Documents with respect to Wildlife Habitat and Natural Resources: Sandwich, NH



February 2012

Prepared by the
Audubon Society of New Hampshire Conservation Department
in consultation with the
Sandwich Planning Board
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Analysis by Topic

The intent of this review is to assess the current level of protection for wildlife habitat and natural resources provided by the Town of Sandwich’s land use regulations and identify additional opportunities for regulatory protection. The review included the following:

- Master Plan (adopted 2011);
- Hazard Mitigation Plan (adopted 2007);
- Zoning Ordinance (adopted 1969, amended 1996, 2002, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011);
- Site Plan Review Regulations (adopted 1983, amended 1989, 1990, 1997, 2001, 2002, 2004);
- Subdivision Regulations (adopted 1967, amended 1973, 1974, 1977, 1981, 1988, 1989, 1990, 1991, 1992, 1993, 1995, 1997, 2000, 2004);
- Excavation Regulations (adopted 2011).

This chapter provides a comprehensive analysis of current provisions for protecting important natural resources and wildlife habitat in the Town’s land use planning documents. Some topics are interrelated and provide alternate strategies for protecting a given resource or addressing a particular problem, such as sprawl. Each section includes a brief description of the topic and how it affects human quality of life and wildlife survival, a brief summary of pertinent provisions in current documents and recommendations for revisions if stronger protections are desired by the Town. Legal review of proposed revisions is always advisable.

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Agriculture and Productive Soils

Agriculture is an important component of New Hampshire's economy and environment, and makes vital contributions to the State's food supply. New Hampshire's glacial history has left the state with limited areas of productive soils suitable for agriculture. These soils are critical to the future of food production in New Hampshire. Prime agricultural soils and soils of statewide importance are included in the NH Natural Services Network. Agricultural lands are important to native wildlife by providing breeding habitat for grassland birds, migration stopover habitat for waterfowl, and wintering habitat for wild turkeys.

The New Hampshire Natural Services Network identifies 1,153 acres of productive soils in Sandwich; the Natural Resources Chapter of the Master Plan recognizes 438 acres of Prime Farmland Soils, 511 acres of Farmland Soils of Statewide Importance, and 23,674 acres of farmland soil of local importance - a total of 24,623 acres of good to excellent agricultural soils. The Land Use Chapter of the Master Plan indicates that approximately 4,100 acres are currently in field or cropland.

Current Provisions

The Community Survey expressed strong support for agriculture, and the 2010 Town Meeting authorized establishment of an Agricultural Commission to protect agricultural lands, preserve rural character, provide a voice for farmers, and encourage agriculture-based businesses. The Master Plan cites the importance of agriculture in chapters on Natural Resources, Land Use, Historic Resources and Economic Base; recommended actions include working to maintain or enhance the amount of agricultural land and the number of farms, activities of the Agricultural Commission to preserve agriculture, and ensuring that land use regulations encourage agricultural activities. The Zoning Ordinance includes encouraging the preservation of agricultural lands and buildings in the Purpose, and provides for agricultural uses in the Rural/Residential, Historic, Commercial, and Skyline districts.

Recommendations

Master Plan:

- Consider recommending an overlay district to protect agricultural soils and exploring incentives for maintaining active agriculture.

Zoning Ordinance:

- Consider adopting an agricultural overlay district ordinance to protect the Town's most important soils and active agricultural lands. "Agricultural Incentive Zoning" (Chapter 1.7) in *Innovative Land Use Planning Techniques: A Handbook for Sustainable Development* provides model language for an Agricultural Conservation District Ordinance and examples of agricultural zoning in New Hampshire municipalities.
- Consider including a Right to Farm provision in the Permitted structures and uses (Article II). (See Lyme, NH Zoning Ordinance Article IV. 4.51 www.lymenh.gov/Public_Documents/LymeNH_PlanZone/2011%20Zoning%20Ordinance/Article%20IV%20-%20Use%20Regulations.pdf)

Analysis by Topic

Subdivision Regulations:

- Consider including provision for protecting natural resources, including agricultural lands and productive soils in Authority and Purpose (Article I, 170-1) of Subdivision Regulations.
- Consider including preliminary conceptual consultation or equivalent in the general procedure for subdivisions (Article II, 170-4); including agricultural lands and productive soils in the associated submission and information requirements; and requiring such consultation for applications involving agricultural lands and productive soils.
- Consider including active agricultural lands in plat requirements (Article II, 170-5).

Site Plan Review Regulations:

- Consider including protection of important natural resources, including agricultural lands and productive soils, in the Purpose of the Site Plan Review Regulations (160-2).
- Consider requiring a Pre-Submission Discussion for site plans involving agricultural lands or productive soils (160-8.A).
- Consider including boundaries of agricultural lands and productive soils among the existing natural features specified in the application requirements (160-6.B.(2)[2][e]).

Energy Efficiency

Energy efficient design of neighborhoods and buildings has long-term economic benefits for residents and taxpayers as well as environmental benefits of resource conservation and reduced pollution. Energy efficiency benefits wildlife by decreasing the habitat loss and degradation associated with producing electricity and the global impacts of burning fossil fuels.

Current Provisions

The Community Survey expressed strong support for a green community, and the 2007 Town Meeting established the Sandwich Energy Committee to promote energy conservation and the use of renewable resources in Sandwich. The Master Plan includes an Energy chapter, with recommended actions of undertaking energy efficiency improvements throughout town government and seeking ways to reduce energy use in the transportation sector; Transportation and Village Centers chapters also address energy efficiency. The Zoning Ordinance Purpose includes encouragement of renewable energy systems and protection of access to energy sources and includes provisions for small wind energy systems.

Recommendations

Master Plan:

- Consider adding language to the Vision that specifically addresses energy efficiency.
- Consider including energy efficiency actions to the Population and Housing, Land Use, and Community Facilities & Services sections.

Zoning Ordinance: None

Subdivision Regulations:

- Consider including encouraging energy efficiency in the Authority and Purpose of the Subdivision Regulations (Article I, 170-1).
- Consider including Preliminary Conceptual Consultation in the general procedure for subdivisions (Article II, 170-4) and including energy conservation aspects of road and lot layouts among topics for discussion.

Site Plan Review Regulations:

- Consider including encouraging energy efficiency in the Purpose of the Site Plan Review Regulations (160-2).
- Consider including description of energy conservation features of building orientation and layout, landscaping, and exterior lighting in Application Requirements (160-6).

Floodplains

Floodplains are low-lying lands where water spreads out after overflowing the banks of streams and rivers during periods of snowmelt or heavy precipitation. In addition to providing critical storage areas for floodwaters, they provide the surface over which a river's meanders can shift over time. Development in floodplains may result in damage to private property and public investments such as roads and utilities, risks to public health and safety, and increased flooding downstream. Floodplains are included in the NH Natural Services Network as Flood Storage Areas. Floodplains provide important habitat for furbearing mammals, a number of amphibians, several species of turtles, and numerous breeding and migrating birds.

The New Hampshire Natural Services Network identifies 7,467 acres of flood storage area in Sandwich; the Natural Resources Chapter of the Master Plan recognizes 5,767 acres of 100-year floodplain in the Town.

Current Provisions

The Master Plan addresses Floodplains in the Water Resources section of the Natural Resources chapter, and includes action items for several amendments to the Zoning Ordinance. The Hazard Mitigation Plan rates flooding as a localized high risk, and identifies areas subject to flooding and road washouts. The Zoning Ordinance includes a Floodplain Management article. Excavation Regulations require inclusion of flood prone areas on plat of affected property.

Recommendations

Master Plan:

- Consider encouraging conservation ownership or easements on floodplain areas.

Zoning Ordinance:

- Consider implementing Master Plan recommendations for amending the Zoning Ordinance provisions for floodplain management.

Subdivision Regulations:

- Consider including preliminary conceptual consultation or equivalent in the general procedure for subdivisions (Article II, 170-4); including soils subject to frequent or occasional flooding and lands below the 1% flood frequency (100-year flood) elevation in the associated submission and information requirements; and requiring such consultation for applications involving soils subject to frequent or occasional flooding and lands below the 1% flood frequency (100-year flood) elevation.
- Consider clarifying the Plat Requirements by revising 170-5.E to read "The plat shall indicate all areas of soils subject to frequent or occasional flooding and lands below the 1% flood frequency (100-year flood) elevation."

Analysis by Topic

Site Plan Review Regulations:

- Consider requiring a Pre-Submission Discussion for site plans involving soils subject to frequent or occasional flooding and lands below the 1% flood frequency (100-year flood) elevation (160-8.A).
- Consider including soils subject to frequent or occasional flooding and lands below the 1% flood frequency (100-year flood) elevation among the existing natural features specified in the application requirements (160-6.B.(2)[2]).
- Consider requiring a plan for on-site stormwater management (160-7.C).

Forests and Forestry

Forests provide the natural vegetation for most of New Hampshire's landscape. They play important roles in providing clean air and water, and opportunities for recreation; moderating climate; protecting watersheds; and contributing to aesthetic values and rural character. Forestry is a significant component of New Hampshire's economy, providing fuel, fiber, and solid wood products to state, regional, national, and international markets. Forests provide essential habitat for the majority of New Hampshire's wildlife species. Harvesting patterns contribute to the diversity of forest age classes, species compositions, and structures on the New Hampshire landscape, providing diverse habitats for native wildlife.

Sandwich is approximately 86% forested, with about 17,000 acres on the White Mountain National Forest and about 35,000 acres in the Town's jurisdiction. The latter acreage includes private working forests and unmanaged forest lands. Four parcels of Town Forest totaling 161 acres are not actively managed.

Current Provisions

The Master Plan acknowledges the importance of forest resources as an economic driver in Sandwich; recognizes the importance of encouraging environmentally sound forest management; includes objective to preserve and protect Sandwich's valuable forest and agricultural resource base by maintaining and enhancing existing unfragmented lands and active farming and forestry activities. The Hazard Mitigation Plan considers Wild Land Fire a medium risk hazard. The Zoning Ordinance includes assuring proper use of natural resources in purpose; includes silviculture as a permitted use in the Rural/Residential and Skyline districts. The Subdivision Regulations provide for documentation of impacts on forest productivity.

Recommendations

Master Plan:

- Consider including an Action to encourage continued practice of sustainable forestry on private lands under Objective LU 3.

Hazard Mitigation Plan:

- Consider including education of residents and developers regarding firewise landscaping, practices, and building materials as a mitigation strategy for wildland fires. "Firewise Landscaping in North Carolina" ranks the flammability of many plant species that also occur in New Hampshire. (http://www.ces.ncsu.edu/forestry/pdf/ag/firewise_landscaping.pdf) "Firewise Construction: Design and Materials" discusses design elements and building materials that improve a structure's fire resistance. (http://csfs.colostate.edu/pdfs/construction_booklet.pdf)
- Consider including collaboration with U.S. Forest Service in forest fire prevention and management as a recommended mitigation action.

Analysis by Topic

Zoning Ordinance:

- Consider including language such as “to encourage sustainable forestry” in the Purpose of the Zoning Ordinance (Article I, 150-4. H (2)).
- Consider including a Forest and Timber Harvesting provision in the Permitted structures and uses (Article II). (See Lyme, NH Zoning Ordinance Article IV. 4.50

www.lymenh.gov/Public_Documents/LymeNH_PlanZone/2011%20Zoning%20Ordinance/Article%20IV%20-%20Use%20Regulations.pdf

- Consider establishing a Forest Conservation District, with a larger (e.g., 20- to 50- acre) minimum lot size, to encourage continued forest management and discourage ownership fragmentation in areas of town with large contiguous ownerships of actively managed forest lands. The Lyme, NH zoning ordinance includes a Mountain and Forest Conservation District, which could provide a useful model.

www.lymenh.gov/Public_Documents/LymeNH_PlanZone/2011%20Zoning%20Ordinance%20Index; see Article III Zoning Districts, Article IV Use Regulation, Article V Dimensional Controls)

- Consider adopting *maximum* setback from center line of any street for principal structures and accessory dwellings (Article III, 150-13.C(1) and *maximum* driveway length (Article III, 150-20).

Subdivision Regulations:

- Consider including preliminary conceptual consultation or equivalent in the general procedure for subdivisions (Article II, 170-4); including potentially viable commercial forest areas in the associated submission and information requirements; and requiring such consultation for applications involving potentially viable commercial forest areas or forest lands of 50 acres or more.

Site Plan Review Regulations:

- Consider requiring a Pre-Submission Discussion for site plans involving potentially viable commercial forest areas or forest lands of 50 acres or more (160-8.A).
- Consider adding potentially viable commercial forest areas to features for which location and boundary information is required on a Site Plan (160-6.B).

Groundwater

Groundwater includes water stored in stratified drift (i.e., sand and gravel) aquifers and in bedrock (i.e., deep or artesian) aquifers, and is the most common source of drinking water in New Hampshire. Potable groundwater is a critical resource for New Hampshire communities. High-yield aquifers are included in the NH Natural Services Network as Water Supply Lands. Groundwater is important to wildlife as the source of springs and seeps which provide water in upland areas and feed surface waters and wetlands.

The NH Natural Services Network identifies approximately 1,300 acres of water supply lands in Sandwich; the Natural Resources Chapter of the Master Plan recognizes more than 4,000 acres of stratified drift aquifers with potential yields ranging from less than 1,000 ft²/day up to 8,000 ft²/day.

Current Provisions

The Master Plan addresses groundwater in the Surface Geology and Water Resources sections of the Natural Resources Chapter (2); Action Plan includes objectives of protecting water resources, including aquifers; considering ordinance changes to better protect prime wetlands, considering development of a town-wide Water Resource Inventory and Management Plan; and adopting an Aquifer/Groundwater Protection Ordinance to protect the quality of the water in the Town's stratified drift aquifers. Zoning Ordinance purpose includes assuring proper use of natural resources; Zoning Ordinance includes Groundwater Protection Ordinance with overlay district. Subdivision Regulations authorize Planning Board to require environmental impact statement addressing ground-water quality when deemed necessary; require well-head protection. Site Plan Review Regulations include protection of public health and protection against adverse environmental impacts from a development in Purpose. Excavation Regulations require inclusion of seasonal high groundwater within or next to the proposed excavation and the location of any aquifers as identified by the U.S. Geological Survey or other sources on plat of affected property; prohibit excavation that would damage an aquifer listed by the U.S. Geological Survey.

Recommendations

Master Plan:

- Consider adopting an objective of working with adjacent towns to protect shared aquifers.

Zoning Ordinance:

- Consider specifying the minimum contents of any report prepared by a professional geologist or engineer to resolve district boundary disputes (Article XVII, 150-112). (See Town of Newington Zoning Ordinance 5.01 (C)(3), pp. 48-49 [<http://web2.newmarketnh.gov/docs/ZoningOrd.pdf>]).
- Consider including injection wells as a Prohibited Use (Article XVII, 150-115).

Analysis by Topic

- Consider adding a Performance Standard relative to minimizing the use of deicing chemicals (Article XVII, 150-117) (See Town of Newington Zoning Ordinance 5.01 (D)(4), p. 50 [<http://web2.newmarketnh.gov/docs/ZoningOrd.pdf>]).

Subdivision Regulations:

- Consider including preliminary conceptual consultation or equivalent in the general procedure for subdivisions (Article II, 170-4); including boundaries of the Groundwater Protection District in the associated submission and information requirements; and requiring such consultation for applications involving the Groundwater Protection District.
- Consider requiring delineation of Groundwater Protection District boundaries in the Plat Requirements (Article II, 170-5).

Site Plan Review Regulations:

- Consider requiring a Pre-Submission Discussion for site plans involving the Groundwater Protection District (160-8.A).
- Consider including boundaries of mapped aquifers among the existing natural features specified in the application requirements (160-6.B.(2)[2][e]).

Growth Management and Sprawl

Growth management includes a variety of techniques and strategies intended to encourage orderly growth and development in areas appropriate for development, protect important natural resources, and discourage sprawl. Growth management helps to prevent deterioration of human quality of life and property values and loss and degradation of wildlife habitat that result from uncontrolled growth. Sprawl refers to dispersed, automobile-dependent development that segregates residential, commercial, industrial, and business uses. Sprawl contributes to air pollution and inefficient use of time and resources, which have negative impacts on human health, economic well-being, and quality of life. The inefficient use of land associated with sprawl results in excessive loss and degradation of wildlife habitat.

Current Provisions

Public outreach process for 2011 Master Plan identified maintaining rural, small-town character as important theme. Master Plan includes goals to allow for modest growth of residential development that is of a size, design and quality that is compatible with Sandwich's small town, rural character and recognizes Sandwich's changing demographics and to protect historic resources, natural environment, scenic beauty, open space, clean water, and wildlife through well-managed growth and careful planning; includes actions to implement Land Use Regulations that enable growth to be managed in a manner that will maintain Sandwich's rural and village character and amend the Cluster Provision in the Zoning Ordinance to ensure that the quality of development is consistent with the town's rural character. Zoning Ordinance includes preventing the overcrowding of land in Purpose; includes a Cluster Residential Development Provision. Subdivision Regulations include protection of thoroughfares from excessive number of curb cuts.

Recommendations

Master Plan:

- Consider including a street plan for the villages in the next Master Plan. (See RSA 674.9 Mapping of Street Lines by Planning Board, included in this document in Village District section, p. 30)

Zoning Ordinance:

- Consider creating Village Districts in Center Sandwich and North Sandwich as recommended in the Master Plan (VC-1.3).
- Revise the Cluster Provision as recommended in the Master Plan (LU-2.1) to a Conservation Subdivision provision, permit these subdivisions by right and conventional subdivisions by special exception, require that at least 50% or 60% of the lot be reserved as open space, and require that the open space be contiguous with open space on abutting parcels. ("Conservation Subdivision" (Chapter 1.4) in *Innovative Land Use Planning Techniques: A Handbook for Sustainable Development* provides a model Conservation Subdivision Ordinance.)
- Consider adopting *maximum* setback from center line of any street for principal structures and accessory dwellings (Article III, 150-13.C(1) and *maximum* driveway length (Article III, 150-20).

Analysis by Topic

Subdivision and Site Plan Review Regulations: None

Actions and Policies:

- Consider developing a street plan for the villages for inclusion in the next Master Plan, and subsequently seeking authorization to locate mapped lines of future streets. Opportunities for future connecting streets within the villages include Dale Road to Diamond Ledge Road, Diamond Ledge Road to Skinner Street, Grove Street to Skinner Street, Skinner Street to Squam Lakes Road, Upper Road to Route 113.

Impervious Surfaces

Impervious surfaces include buildings, exposed rock, concrete, and other materials through which water cannot move. Impervious surfaces increase run-off of precipitation, potentially leading to erosion, sedimentation, flooding, and reduced groundwater supplies which are detrimental to both humans and wildlife. Impervious surfaces also contribute to heat island effects and reduce air quality.

Current Provisions

The Master Plan recommends providing opportunities for safe pedestrian and bicycle circulation within the village, if possible without increasing paved surfaces, and amending regulations to require best management practices for Low Impact Development and minimizing impervious surfaces for land use activities that disturb more than 20,000 ft² of land. Zoning Ordinance restricts impervious surfaces to maximum of 50% of lot in Commercial District; prohibits impervious driveways and parking lots in Shoreland District. Subdivision Regulations provide for gravel roads in subdivisions of up to 40 lots. Site Plan Review Regulations include dimensions and surface type of parking areas in Application Requirements.

Recommendations

Master Plan:

- Consider adopting a goal of reviewing and revising road standards to encourage road sizes that minimize paving while ensuring safety for bicyclists and pedestrians and adequate access for emergency response vehicles.

Zoning Ordinance:

- Consider reducing lot coverage restriction in Commercial District to a maximum of 25% or less (Article II, 150-7.C(2)(b). “Permanent (Post-construction) Stormwater Management” (Chapter 2.1) in *Innovative Land Use Planning Techniques: A Handbook for Sustainable Development* recommends 10%.
- Consider adopting *maximum* setback from center line of any street for principal structures and accessory dwellings (Article III, 150-13.C(1) and *maximum* driveway length (Article III, 150-20).
- Consider adopting an ordinance to address impervious surfaces. “Permanent (Post-construction) Stormwater Management” (Chapter 2.1) in *Innovative Land Use Planning Techniques: A Handbook for Sustainable Development* provides model language for a zoning ordinance article that addresses impervious surfaces.

Subdivision Regulations:

- Consider including a provision that subdivision layouts shall be designed to maximize the efficiency of the road network and minimize impervious surfaces (Article IV).

Analysis by Topic

Site Plan Review Regulations:

- Consider including a provision that access, parking, and loading areas shall be designed and constructed so as to minimize impervious surfaces in Requirements for site plan approval (160-7).
- Consider including total impervious surface and percent of project area in Application Requirements (160-6).

Landscaping and Natural Vegetation

Landscaping refers to visible, human-modified features of a plot of land, including vegetation, water features, shape of terrain, fences and other material objects. Landscaping contributes to the aesthetics of neighborhoods and communities, enhances property values, improves urban air quality, and can reduce heating and cooling costs. Natural vegetation includes the native trees, shrubs, wildflowers, grasses, ferns, and mosses that grow on a land parcel before it is cleared for development. Maintaining as much natural vegetation on a development site as practical prevents erosion, mediates microclimate, contributes to human quality of life and property values, and saves the time, cost, and risks of installing new plantings. Landscaping benefits wildlife by providing backyard habitat. Natural vegetation provides higher wildlife habitat value than new plantings.

Current Provisions

The Master Plan vision encourages protection of natural resources and scenic beauty; includes goals of considering appropriate standards for landscaping in a review of regulations to foster protection of rural character and minimization of environmental impact and encourage town beautification through planting and preservation of trees, shrubs and flowers. The Zoning Ordinance requires wooded buffers between mobile home parks and public ways. The Subdivision Regulations require that subdividers give due regard to the preservation and protection of existing features such as trees, in order to preserve the existing environment. The Site Plan Review Regulations require adequate buffers and landscaping and include vegetative cover, specimen trees, and location and type of landscape planting and existing trees to remain as part of Application Requirements. The Excavation Regulations require an Excavation Plan that includes plans for planting vegetative buffers between the site and the surrounding area and a Reclamation Plan that includes seeding and mulching specifications and a list of the names, quantities, and sizes of plant materials to be used.

Recommendations

Master Plan:

- Consider adopting goals/objectives such as:
 - Review and revise local policies and regulations to minimize destruction of natural vegetation during construction activities.
 - Review and revise local policies and regulations to encourage the use of native species in landscaping.
 - Review and revise local policies and regulations to discourage the use of plants that require significant inputs of water and nutrients in landscaping.
 - Encourage landscaping designs that reduce heating and cooling costs.

Zoning Ordinance:

- Consider adopting a landscaping ordinance. “Landscaping” (Chapter 3.6) in *Innovative Land Use Planning Techniques: A Handbook for Sustainable Development* includes a model ordinance addressing landscaping. *Integrated Landscaping: Following Nature’s Lead* provides information about sustainable landscaping systems for developments in the Northeast.

Analysis by Topic

Subdivision Regulations:

- Consider adopting landscaping standards and guidelines. “Landscaping” (Chapter 3.6) in *Innovative Land Use Planning Techniques: A Handbook for Sustainable Development* provides model language for subdivision regulations addressing landscaping. *Integrated Landscaping: Following Nature’s Lead* provides information about sustainable landscaping systems for developments in the Northeast.

Site Plan Review Regulations:

- Consider adopting landscaping standards and guidelines. “Landscaping” (Chapter 3.6) in *Innovative Land Use Planning Techniques: A Handbook for Sustainable Development* provides model language for site plan review regulations addressing landscaping. *Integrated Landscaping: Following Nature’s Lead* provides information about sustainable landscaping systems for developments in the Northeast.

Light Pollution

Light pollution includes any adverse effects of artificial light, including sky glow, glare, light trespass, decreased night visibility and energy waste. Controlling light pollution conserves energy and resources, saves money, and prevents public health and safety hazards and nuisances. Controlling light pollution can avoid negative impacts of artificial light on wildlife, particularly on migratory birds.

Current Provisions

Master Plan includes goal of identifying and developing strategies to protect high-value natural and visual resources. Zoning Ordinance prohibits sign lighting visible beyond the premises, prohibits lighting of wireless communications towers unless required by the FAA, and requires shielding of any required lighting. Site Plan Review Regulations prohibit outdoor lighting that glares on abutting properties or on public highways or streets; Application Requirements include location of lights.

Recommendations

Master Plan:

- Consider adopting a goal pertaining to dark sky preservation.

Zoning Ordinance:

- Consider adopting lighting performance standards for all zoning districts, including dark sky provisions as well as prohibitions on light trespass. The New England Light Pollution Advisory Group (NELPAG) provides model language for an outdoor lighting ordinance to address light pollution, successful ordinances in Kennebunkport, ME, Tucson, AZ, and Cloudcroft, NM; and other useful information pertaining to light pollution.
(www.icq.eps.harvard.edu/nelpag/nelpag.html)

Subdivision Regulations:

- Consider requiring a lighting plan for proposed streets in the Completed Application if street lighting is to be provided (Article II.170-6).
- Consider including a Design Standard that street lighting is not required but where provided may not cause sky glow or glare onto adjacent properties (Article IV, 170-24) or referencing design standards in a new Dark Sky Ordinance.

Site Plan Review Regulations:

- Consider amending the outdoor lighting design standard to also prohibit sky glow (160-7.B(5)).
- Consider amending Proposed Site Details in Application Requirements to include type as well as locations of lights (160-6(B)(2)[3][h]).

Natural Hazards

Natural hazards are dangers to people and property associated with natural phenomena such as geological and ecological processes and weather. New Hampshire's most common natural hazard is flooding. Forest fires are infrequent in the State, and are usually controlled before spreading very far. Landslides are most likely in mountainous areas, but can occur locally anywhere slopes exist.

Land use practices can mitigate or exacerbate the risks of natural hazards. Development that reduces infiltration and storage of precipitation can exacerbate downstream flooding. Scattered residential development in extensive forests both increases the risk of forest fires and makes fighting them more difficult and dangerous. On steep slopes, increased water in soils from precipitation or leach fields, soil vibration from construction or traffic, undercutting at the foot of slope, and increased weight from new buildings) above all can trigger slope failure.

Climate change may alter the frequency of these hazards if precipitation events become more sporadic and intense. Natural hazards can threaten human health and safety, damage public and private property, and degrade or destroy wildlife habitat.

Current Provisions

The Hazard Mitigation Plan assesses the risk of flooding as high, wildfire as medium, and landslide as low; cites eight locations that are prone to flooding and 22 that are prone to washouts; notes that many Sandwich residences are scattered throughout forested areas of Town which are vulnerable to wildland fire; recommends beaver control and formal maintenance programs for ditches and culverts as flood mitigation actions. The Zoning Ordinance includes an article on floodplain management.

Recommendations

Master Plan (Hazard Mitigation Plan):

- Consider including a map of natural hazards in the Hazard Mitigation Plan, identifying areas prone to flooding as well as formally recognized floodplains, and areas vulnerable to wildfire. “Firewise Construction: Design and Materials” provides guidelines for identifying high risk areas for wildland fire based on topographic position. (http://csfs.colostate.edu/pdfs/construction_booklet.pdf)
- Consider including natural resource protection strategies, including sediment and erosion control, watershed management, and wetland protection as mitigation strategies for flooding.
- Consider including land use regulations, including maximum setbacks and driveway lengths, as a mitigation strategy for wildland fires.
- Consider including education of residents and developers regarding firewise landscaping, practices, and building materials as a mitigation strategy for wildland fires. “Firewise Landscaping in North Carolina ranks the flammability of many plant species that also occur in New Hampshire. (http://www.ces.ncsu.edu/forestry/pdf/ag/firewise_landscaping.pdf) “Firewise Construction: Design and Materials” discusses design elements and building materials

Analysis by Topic

that improve a structure's fire resistance.
(http://csfs.colostate.edu/pdfs/construction_booklet.pdf)

- Consider including collaboration with U.S. Forest Service in forest fire prevention and management as a recommended mitigation action.

Zoning Ordinance:

- Consider adopting overlay districts to address site-specific hazards (flood hazard areas, wildland fire hazard areas).
- Consider adopting *maximum* setback from center line of any street for principal structures and accessory dwellings (Article III, 150-13.C(1)) and *maximum* driveway length (Article III, 150-20).

Subdivision Regulations:

- Consider requiring Preliminary Conceptual Consultation for subdivisions in the Rural/Residential district.
- Consider adopting special standards for subdivisions in the Rural/Residential district (or in identified wildland fire hazard areas) to minimize the possibility of wildland fires involving structures and structural fires involving wildlands. Such standards might include maximum distance from collector road, maximum driveway length, on-site water supply, and landscaping specifications. (See National Fire Protection Association. 2008. NFPA 1144: Standard for Reducing Structure Ignition Hazards from Wildland Fire.)

Site Plan Review Regulations:

- Consider requiring Pre-Submission Discussion for site plans in the Rural/Residential district.
- Consider adopting special standards for site plans in the Rural/Residential district (or in identified wildland fire hazard areas) to minimize the possibility of wildland fires involving structures and structural fires involving wildlands. Such standards might include maximum distance from collector road, maximum driveway length, on-site water supply, and landscaping specifications. (See National Fire Protection Association. 2008. NFPA 1144: Standard for Reducing Structure Ignition Hazards from Wildland Fire.) (Building code standards, such as inflammable roofing and siding materials, may also be desirable.)

Shorelands, Surface Waters, and Wetlands

Shorelands, surface waters, and wetlands comprise the visible parts of the land's hydrological network. These resources govern the quality and availability of water for human and livestock consumption, recreational activities, industrial uses, and wildlife habitat. Shorelands, also called riparian areas, are frequently used as travel corridors for wildlife moving across the landscape.

Sandwich encompasses 17 ponds in addition to a substantial proportion of Squam Lake, nearly 100 miles of first, second, third, and fourth order streams, and more than 6,500 acres of hydric soils.

Current Provisions

The Master Plan addresses shorelands, surface waters and wetlands in the Water Resources, Water Quality, and Wetland Resources sections of the Natural Resources chapter and the Current Zoning section of the Land Use chapter; includes a goal of protecting clean water through well-managed growth and careful planning; recognizes that Shoreland District does not regulate lower order streams; Action Plan includes objectives of protecting water resources including surface waters, shorelines, and wetlands, and preserving Sandwich's surface water resources by meeting state water quality standards; Transportation chapter includes action to review and update roadway design standards to ensure minimal impact to streams and brooks, and to ensure that drainage impacts do not degrade water quality of streams and ponds. Zoning Ordinance addresses lakes, ponds, streams, and wetlands in purpose language; includes articles for shoreland and wetlands protection. Subdivision Regulations require delineation of wetlands and stream beds and notation of their square footage on plats; require that subdividers give due regard to the preservation and protection of brooks, streams, and water bodies; exclude wetlands from area used to meet minimum lot size requirement; require 125 foot setback of septic tanks and leach fields from high-water mark of wetlands and water bodies; require minimum lot frontage on shores of lakes, ponds, and navigable streams. Site Plan Review Regulations require boundaries of existing natural features, including rivers, lakes, intermittent runoffs, and wetlands in Application Requirements. Excavation Regulations require inclusion of streams, ponds, and wetlands, and identification of all measures to control erosion and sedimentation on plat of affected property.

Recommendations

Master Plan: None

Zoning Ordinance:

- Implement Master Plan recommendations to update Prime Wetland designations and documentation and consider expanded setbacks for Prime Wetlands.
- Implement Master Plan Recommendations to adopt a Shoreland Protection Overlay District to separate shorelands regulations from wetlands regulations, address protection of headwater streams, and adopt more restrictive shoreland and watershed protection measures within specific watersheds. ("Shoreland Protection: The Importance of Riparian Buffers" (Chapter 2.6) in *Innovative Land Use Planning Techniques: A Handbook for Sustainable Development* provides recommended language for protecting first and second order streams.)

Analysis by Topic

Subdivision Regulations:

- Consider including preliminary conceptual consultation or equivalent in the general procedure for subdivisions (Article II, 170-4); including shorelands and wetlands in the associated submission and information requirements; and requiring such consultation for applications involving shorelands and wetlands.
- Consider requiring that boundaries of wetland and shoreland buffers be permanently marked to facilitate awareness of future landowners. This can be accomplished by adding a special condition to appropriate subdivision approvals to the effect of “The wetland buffers shall be clearly and permanently marked before, during, and after construction; building permits will not be issued until the buffers are marked” or by adding such language into the Subdivision Regulations.
- Consider revising measurement of shoreline frontage (170-22) to “the average of the distances of the actual natural navigable shoreline footage and a straight line drawn between property lines, both of which are measured at the normal high water line” to conform to the NH Code of Administrative Rules (Env-Wt 101.89).
- Delete second statement in 170-24.H “Natural watercourses shall be cleaned and increased in size where necessary to take care of storm run-off.”

Site Plan Review Regulations:

- Consider requiring Pre-Submission Discussion for site plans involving wetlands or shorelands.
- Consider requiring that boundaries of wetland and shoreland buffers be permanently marked to facilitate awareness of future landowners. This can be accomplished by adding a special condition to appropriate site plan approvals to the effect of “The wetland buffers shall be clearly and permanently marked before, during, and after construction; building permits will not be issued until the buffers are marked” or by adding such language into the Site Plan Review Regulations.
- Consider including wetland soils in Definitions (160-5).

Summary of changes to Comprehensive Shoreland Protection Act of 1991 effective July 2011

- Comprehensive Shoreland Protection Act renamed Shoreland Water Quality Protection Act.
- Stumps and rocks can now be removed from within the waterfront buffer and replaced with pervious surfaces, new trees, or other woody vegetation.
- Points are now awarded for shrubs and natural ground cover in compensating for tree removal.
- The new tree and sapling scoring methodology is as follows:

Tree Diameter

1 to 3 inches	1 point
>3 to 6 inches	5 points
>6 to 12 inches	10 points
>12 to 24 inches	15 points
>24 inches	25 points

Shrubs and Ground Cover

4 sq ft of shrub area	1 point
50 sq ft of ground cover	1 point

- Using the new scoring methodology when trees are removed, 50 points must remain within each grid segment.
- “Unaltered state” now means vegetation allowed to grow without cutting, limbing, trimming, pruning, mowing, or other similar activities except as needed for plant health, normal maintenance, and renewal. The vegetation no longer needs to be native, and there is greater freedom to modify existing “unaltered areas.”
- Regardless of lot area, 25% of the area between 50 ft and 150 ft of the reference line must remain in an unaltered state.
- Examples of pervious surfaces now include roofs and, unless designed to effectively absorb and infiltrate water, decks, patios, and paved, gravel, or crushed stone driveways, parking areas, and walkways.
- There is no longer a limit on impervious area, as long as there is a stormwater management system in place designed and certified by a professional engineer and each grid segment meets at least the minimum required tree, sapling, shrub, and groundcover score.

Analysis by Topic

- Providing additional plantings within deficient grid segments is now required only when landowners and developers exceed 30% impervious area. Projects that propose greater than 20% impervious area still must incorporate stormwater management systems.
- With a permit, is now permissible to convert existing decks into permanent living space on non-conforming structures.
- The former provision that allowed construction of a 12-ft deck on non-conforming structures was repealed. Thus, no new decks can be constructed and existing decks cannot be expanded within the waterfront buffer of non-conforming structures.
- There is a new Permit By Notification process (PBN) for projects that propose no more than 1,500 sq ft of total impact, of which no more than 900 sq ft is new impervious area.

A presentation illustrating these changes as well as the basic provisions of the Shoreland Water Quality Protection Act is available at:

<http://des.nh.gov/organization/divisions/water/wetlands/cspa/documents/changes-swqa.pdf>

Steep Slopes and Ridgelines

Steep slopes are often defined as grades equal to or exceeding 15%, i.e., areas where the elevation increases 15 feet in 100 feet of horizontal distance. Slopes with such high gradients are vulnerable to failure, when the pull of gravity on slope materials exceeds the forces of friction and cohesion that hold them in place. Protecting steep slopes prevents damage to public and private property resulting from slope failure; environmental damage such as erosion, sedimentation, and drainage problems; excessive cuts and fills; and unsightly slope scars. Ridgelines form the boundary between watersheds, and land uses in these sensitive areas can have negative impacts for great distances downstream. Ridgeline development is also visible over large areas and affects community aesthetics and rural character. Many ridgelines have shallow soils that support mast-bearing trees, such as oaks, hickories, and beech, which provide important food sources for wildlife. Ridgeline protection benefits wildlife by protecting these food sources and important travel routes for large mammals. Protection of steep slopes benefits wildlife by preventing habitat degradation of uplands, wetlands, and surface waters.

Current Provisions

The Master Plan addresses Steep Slopes and Ridgelines in the Topography and Elevation section of the Natural Resources Chapter and in the Land Use Chapter; recommends evaluating town ordinances to limit steep slope development and cuts; recommends amending the Zoning Ordinance such as through additions to the Skyline District or Steep Slope Protection to provide for greater protection of scenic quality from the impact of development; recommends various amendments to the subdivision regulations for steep slopes and adoption of a steep slopes ordinance. The Zoning Ordinance includes a Skyline District in which structures are prohibited; requires increased buildable area on lots with slopes exceeding 15%; requires an acceptable formal environmental impact statement for cluster developments and multiple-unit structures on lots involving steep slopes; specifies conditions for permitted uses on steep slopes; requires a Steep Slopes Permit for work to be conducted on slopes exceeding 15%. The Subdivision Regulations require that areas of steep slopes be shown on plats; specify that land that cannot be safely used for building development purposes because of excessive slope shall be platted but not included in minimum lot sizes without an acceptable design solution by a professional engineer. The Excavation Regulations require inclusion of any slopes exceeding 15% on plat of affected property.

Recommendations

Master Plan: None

Zoning Ordinance:

- Explore adopting a Ridgeline Protection ordinance or overlay district as recommended in the Master Plan. (See Lakes Region Planning Commission. 2005. *Regulating Development on Steep Slopes, Hillsides, and Ridgelines*; “Steep Slope and Ridgeline Protection” [Chapter 2.2] in *Innovative Land Use Planning Techniques*; and the “Ridgeline and Hillside Viewshed Protection Area Overlay Zone” of Lafayette Township, NJ [http://www.lafayettetwp.org/ordinances/2010/2010_03.pdf] for ideas.)

Analysis by Topic

Subdivision Regulations:

- Consider including preliminary conceptual consultation or equivalent in the general procedure for subdivisions (Article II, 170-4); including steep slopes and ridgelines in the associated submission and information requirements; and requiring such consultation for applications involving steep slopes and ridgelines.

Site Plan Review Regulations:

- Consider including a definition of ridgelines (160-5). (See the “Ridgeline and Hillside Viewshed Protection Area Overlay Zone” of Lafayette Township, NJ)
http://www.lafayettetwp.org/ordinances/2010/2010_03.pdf
- Consider requiring a Pre-Submission Discussion for site plans involving steep slopes and ridgelines (160-8.A).
- Consider including boundaries of steep slopes and ridgelines among the existing natural features specified in the application requirements (160-6.B.(2)[2][e]).

Stormwater Management and Erosion Control

Stormwater runoff refers to precipitation that cannot soak into the ground and subsequently ponds or flows over the earth's surface. Management of this runoff is important for preventing soil erosion, water pollution, and flooding, and for ensuring adequate recharge of groundwater. Erosion control prevents damage to private property and public investments such as roadways, conserves the productivity of upland soils, and prevents degradation of wetlands and surface waters. Stormwater management and erosion control benefit wildlife by preventing degradation of upland and aquatic habitats.

Current Provisions

The Master Plan acknowledges the potential for increased land development and associated stormwater runoff; includes action items pertaining to stormwater management (NR1.5, LU2.5, VC3.1), including review of regulations to consider appropriate standards for stormwater management. Zoning Ordinance prohibits surface run-off across exposed soils in Shoreland District; requires permit for work on steep slopes. Subdivision Regulations include provisions for erosion control. Site Plan Review Regulations require adequate provisions for surface drainage for site plan approval. Excavation Regulations require identification of all measures to control erosion and sedimentation on plat of affected property.

Recommendations

Master Plan:

- Consider revising LU2.5 to include erosion control.

Zoning Ordinance:

- Consider including an article addressing removal of natural material that addresses revegetation and regarding of areas within 100 feet of a public highway, street, roadway, or property line within 90 days of the finish of operation and/or material removed in order to protect abutters from erosion and washouts.
- Consider adopting a stormwater ordinance. "Permanent (Post-construction) Stormwater Management" (Chapter 2.1) in *Innovative Land Use Planning Techniques: A Handbook for Sustainable Development* provides model language for a zoning ordinance article that addresses stormwater management and information about pertinent existing ordinances in New Hampshire.

Subdivision Regulations:

- Consider requiring a stormwater management plan for all subdivisions, or those exceeding a threshold number of lots.
- As recommended in the Master Plan, consider adopting design standards for stormwater management.

Analysis by Topic

- Review “Erosion and Sediment Control During Construction” (Chapter 2.8) in *Innovative Land Use Planning Techniques: A Handbook for Sustainable Development* and adopt new regulations and standards as appropriate.

Site Plan Review Regulations:

- Consider requiring a stormwater management plan for all site plans.
- Consider adopting design standards for stormwater management.
- Review “Erosion and Sediment Control During Construction” (Chapter 2.8) in *Innovative Land Use Planning Techniques: A Handbook for Sustainable Development* and adopt new regulations and standards as appropriate.

Terrain Alteration

Terrain alteration refers to earth-moving operations, including cut and fill, which reshape the topography of the land. State law requires a permit from the Department of Environmental Services for activities that disturb more than 100,000 square feet of terrain (50,000 square feet within protected shorelands), but municipalities may adopt more stringent regulations. Terrain alteration can result in soil erosion and increased stormwater runoff, leading to water pollution and damage to public and private property damage. Terrain alteration results in direct and indirect loss of wildlife habitat.

Current Provisions

The Master Plan addresses Terrain Alteration in the Surface Geology section of the Natural Resources Chapter. The Zoning Ordinance requires an Environmental Impact study report deemed favorable by the Planning Board for excavations in areas governed by the Steep Slopes Protection provision. The Subdivision Regulations require inclusion cross sections, including cut and fill, of any roads to be constructed. The Excavation Regulations require filing of Excavation and Reclamation plans and prohibit excavations in specified locations.

Recommendations

Master Plan:

- Consider including a goal such as “Adopt policies to minimize the extent of terrain alteration associated with development in order to maintain natural hydrologic patterns, maintain rural character, and protect property and public safety.”

Zoning Ordinance: None

Subdivision Regulations:

- Consider including statement such as “Avoidance of extensive excavation, grading, and filling shall be avoided to the extent practicable” in Design Standards for All Subdivisions (Article IV 170-21).

Site Plan Review Regulations:

- Consider including cut and fill volumes in Application Requirements (160-6).
- Consider including statement such as “Extensive excavation, grading, and filling shall be avoided to the extent practicable” in Requirements for Site Plan Approval (160-7).

Excavation Regulations:

- Consider revising Prohibitions (2.8) to include areas within the meander belt of any third or higher order stream. (Detailed information about the potential consequences of locating gravel pits close to a stream are presented in Vanasse Hangen Brustlen, Inc. 2008. Geomorphology-

Analysis by Topic

based Restoration Alternatives, Suncook River, Epsom, New Hampshire, Final Technical Report. Available at <http://des.nh.gov/organization/divisions/water/wmb/rivers/documents/suncook-avulsion-report.pdf>)

Village District

A village district is a defined zoning area that accommodates mixed development, including the residential, commercial, and office uses that evolved in traditional New England villages. Village districts can be designed to encompass or expand existing village centers or to enable the development of new villages at desired locations, such as at crossroads or other nodes of activity. This planning tool provides economic benefits by concentrating services and infrastructure needs and helps to prevent sprawl. Village districts benefit wildlife by concentrating development on the landscape, resulting in larger contiguous areas of undeveloped land.

Current Provisions

The Master Plan includes a chapter on Village Centers; includes goals of preserving rural, small-town character and traditional New England villages while allowing for modest residential development and limited business activity.

Recommendations

Master Plan:

- Consider including a street plan for the villages in the next Master Plan. (See RSA 674.9 Mapping of Street Lines by Planning Board, included in this document in Village District section.)

Zoning Ordinance:

- Consider creating Village Districts in Center Sandwich and North Sandwich as recommended in the Master Plan (VC-1.3).
- Consider reducing the minimum lot size, frontage, and setbacks in the Center Sandwich area to conform more closely to existing conditions (See Table 6 in *Spatial Analysis of Important Natural Resources in Sandwich with Respect to Current Zoning*, Tab 5).

Subdivision and Site Plan Review Regulations: None

Actions and Policies:

- Consider developing a street plan for the villages for inclusion in the next Master Plan, and subsequently seeking authorization to locate mapped lines of future streets. Opportunities for future connecting streets within the villages include Dale Road to Diamond Ledge Road, Diamond Ledge Road to Skinner Street, Grove Street to Skinner Street, Skinner Street to Squam Lakes Road, Upper Road to Route 113.

RSA 674:9 Mapping of Street Lines by Planning Board. – At any time after a planning board has adopted a master plan of the municipality which includes a major street plan or has progressed in its master planning to the stage of the making and adoption of a major street plan, the local legislative body may authorize the planning board to make or cause to be made from time to time surveys for the exact locating of the lines of new, extended, widened, or narrowed streets in the whole or in any

Analysis by Topic

portion of the municipality. The local legislative body may also empower the planning board to make and certify to the local legislative body, when completed, a plat of the area thus surveyed on which are indicated the locations of the lines recommended by the planning board as the planned or mapped lines of future streets, street extensions, street widenings, or street narrowings. The making or certifying of a plat by the planning board, under the authorization of the local legislative body, shall not in and of itself constitute or be deemed to constitute the opening or establishment of any street or the taking or acceptance of any land for street purposes.

Watersheds

A watershed is the area of land that drains into a particular water body. The cumulative effects of land uses within a watershed can lead to problems with water quality and flooding, and their associated negative impacts on humans and wildlife. Stream health deteriorates when impervious surfaces cover more than 10% of the watershed area; streams may become incapable of supporting beneficial uses when impervious coverage exceeds 25%.¹

Current Provisions

The Master Plan addresses Watersheds in the Water Resources, Forest Resources and Unfragmented Lands, and Wetland Resources sections of the Natural Resources Chapter (2); includes objectives of protecting water resources including surface waters, watersheds, shorelines, wetlands, floodplains, and aquifers; considering adoption of specific, more restrictive shoreland and watershed protection measures within the Beebe River Watershed and portions of the Ossipee River and Winnepesaukee River watersheds, and establishing water monitoring programs in all watersheds and major rivers and ponds in town.

Recommendations

Master Plan:

- Consider adding a recommendation to adopt land use policies that manage cumulative impacts of land use within a watershed.
- Consider adding a recommendation to collaborate in regional efforts to protect watersheds that include portions of Sandwich.

Zoning Ordinance:

- Implement Master Plan Recommendations to adopt a Shoreland Protection Overlay District to separate shorelands regulations from wetlands regulations, address protection of headwater streams, and adopt more restrictive shoreland and watershed protection measures within specific watersheds. (“Shoreland Protection: The Importance of Riparian Buffers” (Chapter 2.6) in *Innovative Land Use Planning Techniques: A Handbook for Sustainable Development* provides recommended language for protecting first and second order streams.)
- See also Floodplains; Impervious Surfaces; and Stormwater Management and Erosion Control.

Subdivision and Site Plan Review Regulations:

- See Floodplains; Impervious Surfaces; Shorelands, Surface Waters, and Wetlands; and Stormwater Management and Erosion Control.

¹ Schueler, T. 2000. Basic Concepts of Watershed Planning. Pp. 145-161 in T. Schueler and H. Holland, eds., *The Practice of Watershed Protection*. Center for Watershed Protection, Ellicott City, MD.

Wildlife Habitat

Wildlife habitat includes the resources that native species need to survive: food, water, and shelter, including safe places to produce young, and safe travel routes between areas of critical resources. High quality wildlife habitat identified in the NH Fish & Game Department's Wildlife Action Plan is included in the NH Natural Services Network. The NH Wildlife Connectivity Model identifies potential travel corridors between large areas of protected land. Wildlife habitat contributes to human amenities such as clean water, clean air, recreation opportunities, aesthetic values, and rural character.

The New Hampshire Wildlife Action Plan identifies nine habitat types occurring within Sandwich, including peatland, wet meadow/shrub wetland, forest floodplain, grassland, rocky ridge/talus slope, high-elevation spruce-fir, lowland spruce-fir, northern hardwood-conifer, and hemlock-hardwood-pine. Portions of each of these habitats, totaling 32,320 acres (approximately 54% of Town area), are the highest ranked by ecological condition in the State or biological region. Sandwich also includes several highly ranked montane watersheds.

Current Provisions

The Master Plan addresses Wildlife Habitat in the Forest Resources and Unfragmented Lands, Wetland Resources, Wildlife, Areas of Ecological Interest and Conservation Lands sections of the Natural Resources Chapter (2); Vision includes goals of protecting historic resources, natural environment, scenic beauty, open space, clean water, and wildlife through well managed growth and careful planning, and supporting and encouraging protection and management of high value conservation and open space lands that are linked by trails and/or wildlife and natural resource corridors; includes action item to protect the Town's valuable forest and agricultural resource base by maintaining and enhancing existing unfragmented lands and active farming and forestry activities. Zoning Ordinance includes preservation of forests, wetlands, and wild lands for wildlife habitat in Purpose; includes provisions for cluster residential development and wetland protection.

Recommendations

Master Plan:

- Consider identifying local priorities for open space protection that include core areas of important wildlife habitat.
- Consider recommending strategies to maintain wildlife connectivity zones within the Town.

Zoning Ordinance:

- Consider adopting *maximum* setback from center line of any street for principal structures and accessory dwellings (Article III, 150-13.C(1)) and *maximum* driveway length (Article III, 150-20) to minimize habitat fragmentation resulting from development.

Analysis by Topic

- Consider establishing a Forest Conservation District, with a larger (e.g., 20- to 50- acre) minimum lot size, in areas of large unfragmented blocks. The Lyme, NH zoning ordinance includes a Mountain and Forest Conservation District, which could provide a useful model to work from. (www.lymenh.gov/Public_Documents/LymeNH_Regs/regs/ZoneOrd.doc)
- Revise the Cluster Provision as recommended in the Master Plan (LU-2.1) to a Conservation Subdivision provision, permit these subdivisions by right and conventional subdivisions by special exception, allow multi-family housing therein, require that at least 50% or 60% of the lot be reserved as open space, and require that the open space be contiguous with open space on abutting parcels. (“Conservation Subdivision” (Chapter 1.4) in *Innovative Land Use Planning Techniques: A Handbook for Sustainable Development* provides a model Conservation Subdivision Ordinance.)

Subdivision Regulations:

- Consider including preliminary conceptual consultation or equivalent in the general procedure for subdivisions (Article II, 170-4); including highly ranked wildlife habitat and identified wildlife connectivity zones in the associated submission and information requirements.
- Consider requesting identification and protection of special habitats such as vernal pools, deer wintering areas, and important mast stands in subdivision layouts (see Voluntary Practices, Section 7).
- Consider revising application requirements and review process for subdivisions to facilitate conservation subdivisions if such an ordinance is adopted. (“Conservation Subdivision” (Chapter 1.4) in *Innovative Land Use Planning Techniques: A Handbook for Sustainable Development* provides model language for revisions to subdivision regulations and application procedures to facilitate Conservation Subdivisions.)
- Consider adopting special standards for identified wildlife connectivity zones. Such standards could include maintenance of open space connectivity and stream crossing structures (e.g., culverts) that provide for wildlife passage.
- Consider requiring sloped (Cape Cod) curbing where curbing is required. Sloped curbing prevents small animals from becoming trapped in the roadway.

Site Plan Review Regulations:

- Consider requiring Pre-Submission Discussion for site plans involving highly ranked wildlife habitat or identified wildlife connectivity zones.
- Consider including highly ranked wildlife habitat and identified wildlife connectivity zones in Application Requirements (166.B.[2]).
- Consider adopting special standards for identified wildlife connectivity zones. Such standards could include maintenance of open space connectivity and stream crossing structures (e.g., culverts) that provide for wildlife passage.

Analysis by Topic

- Consider requesting identification and protection of special habitats such as vernal pools, deer wintering areas, and important mast stands in site plans (see Voluntary Practices, Section 7).
- Consider requiring sloped (Cape Cod) curbing where curbing is required. Sloped curbing prevents small animals from becoming trapped in the roadway.

Spatial Analysis of Important Natural Resources in Sandwich with respect to Current Zoning

Introduction

Maps provide useful tools for understanding the distribution of important natural resources on the landscape and how current zoning supports or hinders their protection. Several tools have been developed recently to help municipalities assess the spatial distribution of natural resources within their boundaries. The New Hampshire Natural Services Network (NSN) is a GIS-based tool created by a collaborative of planning and natural resource professionals. The NSN identifies lands throughout the State that provide important ecological services on which human life and economic opportunity depend, and which are difficult and expensive to replicate.

Natural Services Network base maps (Figure 1) include four components:

- **Water supply lands** include highly transmissive aquifers identified by the US Geological Survey and favorable gravel well sites identified by the NH Department of Environmental Services.
- **Flood storage lands** include 100-year floodplains identified by FEMA and lacustrine (associated with lakes), riverine (associated with rivers), and palustrine (other non-tidal) wetlands identified by the USFWS National Wetlands Inventory.
- **Productive soils** include prime farmland and farmland of statewide importance identified by the Natural Resource Conservation Service.
- **Highly ranked wildlife habitat** includes areas of highest ranked habitat by ecological condition in the State and within each of the State's nine ecoregions, as identified by the NH Fish & Game Department Wildlife Action Plan. A detailed explanation of the ranking process is provided at http://www.wildlife.state.nh.us/Wildlife/Wildlife_Plan/highest_ranking_habitat.htm.

The NH Wildlife Connectivity Model was developed in 2008 by NH Audubon and NH Fish & Game biologists. It is a basic GIS-based landscape permeability model that predicts potential broad-scale wildlife connectivity zones across the State. The model includes a set of raster data layers consisting of cost surfaces for 16 native wildlife species, chosen to represent a range of variation in their dispersal behavior. Each raster surface was created by assigning a "cost" value for each species on each 30 meter square of land. The cost value reflects the ease or difficulty of moving across the landscape for the species in question. Cost is based on land cover, distance to road (weighted for traffic volume), distance to riparian area, and slope. The 16 cost surfaces can be used individually or in combination to identify wildlife connectivity zones by determining least cost movement corridors between selected polygons. The mean cost surface (Figure 2), which averages cost values for the 16 species, is useful for general planning purposes. It is strongly encouraged that users incorporate best available local data sources wherever possible and ground-truth results of corridor analyses, which is essential for identifying critical connectivity zones.

Sandwich currently has five zoning districts (Figure 3). The Rural/Residential District is the largest (48,616 acres) and includes most of the Town. The Skyline District (7,110 acres) encompasses 11 areas of 34 to 2,053 acres, including land above 550 ft. elevation on the Rattlesnakes; above 1,000 ft. on Eagle Cliff; above 1,300 ft. on Black Snout Mtn. (N); above 1,400 ft. on Young Mtn.; above 1,600 ft. on Dinsmore and

Doublehead mtns, Mts. Israel and Squam, and Guinea Hill; above 1,650 ft. on Mt. Weetamoo; and above 2,300 ft on Black, Flat, and Sandwich mts. The Shoreland District (2,079 acres) includes a 600-ft buffer around the shores of Squam Lake and Barville, Bearcamp, Dinsmore, Intervale, Kusumpe, Little, and Red Hill ponds. Two Commercial Districts (529 acres in total) are located along Route 25, south of the Mason Road/Palmer Hill Road intersection and east of Middle Road. The Historic District (84 acres) encompasses 200 ft from the center line of various streets within the village of Center Sandwich.

Data Sources

<u>Data layer</u>	<u>Source</u>
Sandwich Zoning 2008	Lakes Regional Planning Commission
NH Natural Services Network	GRANIT
NH Wildlife Connectivity Model mean cost surface	NH Fish & Game Department
NH Conservation/Public Lands	GRANIT

Methods

Using ArcView software, we overlaid the Sandwich zoning districts on each component of the New Hampshire Natural Services Network and calculated resource areas within each zoning district. We used the mean cost surface from the Wildlife Connectivity Model to evaluate connectivity zones at the regional and local scales. For the regional assessment, we used contiguous conservation land polygons associated with the Burleigh Tract/Owl Brook Training Facility/Science Center of New Hampshire (Holderness), Ossipee Mountains (Freedom, Moultonborough, Ossipee, Tamworth, Tuftonboro), Ossipee Pine Barrens (Freedom, Madison, Ossipee), Red Hill (Moultonborough, Sandwich), White Mountain National Forest (Albany, Bartlett, Bath, Beans Purchase, Benton, Bethlehem, Campton, Carroll, Chandlers Purchase, Chatham, Conway, Crawford's Purchase, Cutts Grant, Easton, Ellsworth, Franconia, Gorham, Greens Grant, Hadleys Purchase, Hales Location, Harts Location, Haverhill, Jackson, Jefferson, Landaff, Lincoln, Low and Burbanks, Martins Location, Orford, Piermont, Pinkhams Grant, Randolph, Rumney, Sandwich, Sargents Purchase, Shelburne, Tamworth, Thompson and Meserve, Thornton, Warren, Waterville Valley, Wentworth, Woodstock) as endpoints for the analysis. For the local assessment, we used contiguous conservation polygons associated with the Alice Bemis Thompson Wildlife Refuge, Armstrong Natural Area, Coolidge Beede Forest, Red Hill River Conservation Area, Red Hill River Lot, Sharp Forest, and White Mountain National Forest; Appendix A lists the various parcels associated with each of the endpoint polygons used in these analyses.

Results and Discussion

Water supply lands

Sandwich encompasses 1,303 acres of water supply lands, of which 1,295 acres are in the Rural Residential District and eight are in the Commercial District (Table 1, Figure 4). A (1,284-acre) aquifer spans the boundary between Sandwich and Tamworth, associated with the confluence of Heath and Meadow brooks and the Bearcamp and Cold rivers; a (357-acre) aquifer is located entirely within Sandwich in Whiteface Intervale, associated with Captain Neal and White brooks and the Whiteface River. A (433-acre) aquifer located primarily in Albany and Tamworth extends into the northeastern corner of Sandwich along the Wonalancet River. Approximately 1.9% of the aquifer acreage in Sandwich is currently protected by conservation ownership or easement.

Table 1. Distribution of Water Supply Lands across Sandwich Zoning Districts

Zoning District	Acres of water supply lands
Rural/Residential District	1,295
Skyline District	0
Shoreland District	0
Commercial District	8
Historic District	0

Flood storage areas

Sandwich encompasses 7,467 acres of flood storage areas, distributed among the Town’s five zoning districts (Table 2, Figure 5). Flood storage areas are most abundant in the southern and eastern quadrants of the Town, and include many small wetlands as well as several Great Ponds. The majority of flood storage areas in Sandwich fall within the Rural/Residential District. Portions of the Commercial and Historic districts fall within flood storage areas. Approximately 25% of the total flood storage acreage is protected by conservation ownership or easement. Given changing precipitation patterns with more intense storms, monitoring actual flooding conditions will be important to keeping spatial information up to date. Identifying the watershed of road segments subject to flooding and considering development constraints upstream of these locations could help to prevent worsening of these problems.

Table 2. Distribution of Flood Storage Areas across Sandwich Zoning Districts

Zoning District	Acres of flood storage areas
Rural/Residential District	4,884
Skyline District	2
Shoreland District	690
Commercial District	63
Historic District	5

Productive soils

Sandwich encompasses 1,153 acres of productive soils, distributed among four of the Town’s five zoning districts (Table 3, Figure 6). Approximately 19% of this acreage is currently protected by conservation ownership or easement. An agricultural overlay district would be an effective strategy for safeguarding the future of this important resource. Acquisition of agricultural easements could also be considered for some key areas.

Table 3. Distribution of Productive Soils across Sandwich Zoning Districts

Zoning District	Acres of productive soils
Rural/Residential District	1,116
Skyline District	0
Shoreland District	9
Commercial District	24
Historic District	3

Highly ranked wildlife habitat

Sandwich encompasses 32,320 acres of highly ranked wildlife habitat, distributed among the Town’s five zoning districts (Table 4, Figure 7). Approximately 48% of highly ranked wildlife habitat in Sandwich is currently protected by conservation ownership or easement, largely within the White Mountain National Forest. With so much of the Town’s land area in highly ranked habitat, emphasis might focus on extra protection for highly ranked watersheds (i.e., Red Hill and Cold rivers and their tributaries and direct tributaries to Squam Lake) and maintaining connectivity between protected lands.

Table 4. Distribution of Highly Ranked Wildlife Habitat across Sandwich Zoning Districts

Zoning District	Acres of highly ranked wildlife habitat
Rural/Residential District	27,506
Skyline District	3,666
Shoreland District	1,486
Commercial District	96
Historic District	45

Wildlife connectivity zones

Major areas providing connectivity between currently protected lands occur in the southern part of town east of Squam Lake. (Figure 8, Table 5).

Table 5. Distribution of Local and Regional Wildlife Connectivity Zones across Sandwich Zoning Districts

Zoning District	Acres of wildlife connectivity zones Total (Local; Regional)
Rural/Residential District	9,898 (5,032; 6,916)
Skyline District	141 (0; 141)
Shoreland District	886 (394; 672)
Commercial District	114 (0; 114)
Historic District	8 (8; 0)

Considerations

Figure 9 illustrates water supply lands, flood storage areas, productive soils, and highly ranked wildlife habitat in Sandwich. Whiteface Intervale and the area east of North Sandwich stand out as areas with multiple important natural resource values. The Town might consider designing special natural resource overlay districts in these areas to protect their various functions and values.

One approach the Planning Board might consider in order to focus future growth and protect areas with important natural resources is to establish village districts in Center Sandwich and North Sandwich. With five major roads radiating from the village center, there are numerous opportunities to adopt interconnecting mapped lines of future streets in Center Sandwich. This forward-thinking approach would preserve opportunities for future expansion of the village with a development pattern that matches that of the current village. Property maps U-1, U-2, and U-3, which cover the village center, include a total of 108 lots. Of these, less than one third meet the 2 acre zoning standard that is presently in place; more than half are one acre or less, and more than one third are less than half an acre (See Table 6). Defining a village district with half acre zoning or one acre zoning with an option for smaller lots of at least half an acre by

special exception, and providing for new interconnecting streets would enable the village to grow over the long-term while maintaining its present character. Opportunities exist in Center Sandwich for connecting Dale and Diamond Ledge roads, Diamond Ledge Road and Skinner Street, Grove and Skinner streets, and Skinner Street and Squam Lakes Road with a minimum of landowners involved. Opportunities exist in North Sandwich to improve a Class 6 road between Maple Ridge Road and Basket Street and to connect Upper Road with Route 113.

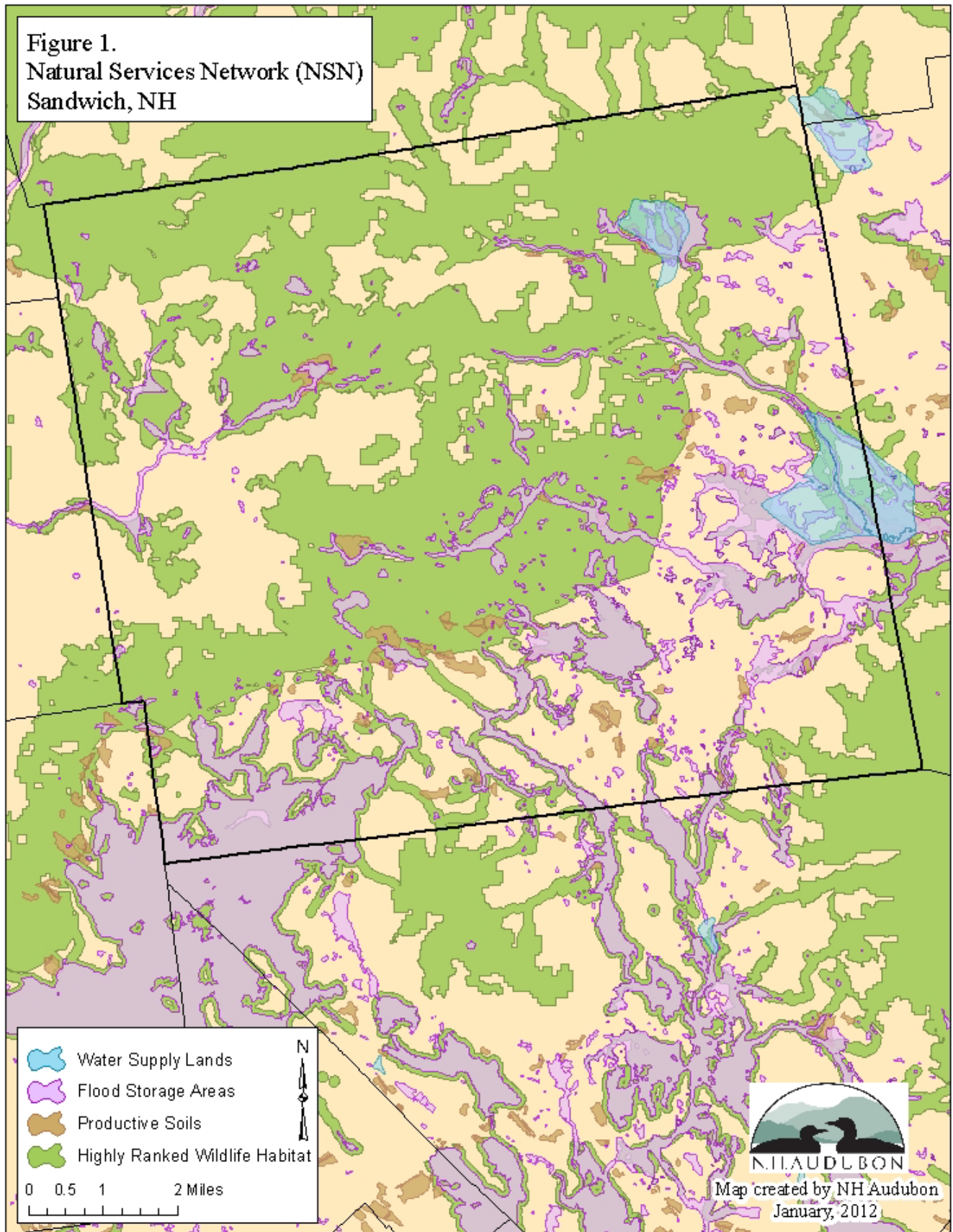
Table 6. Lot size distribution within Center Sandwich village (Tax maps U-1, U-2, and U-3)

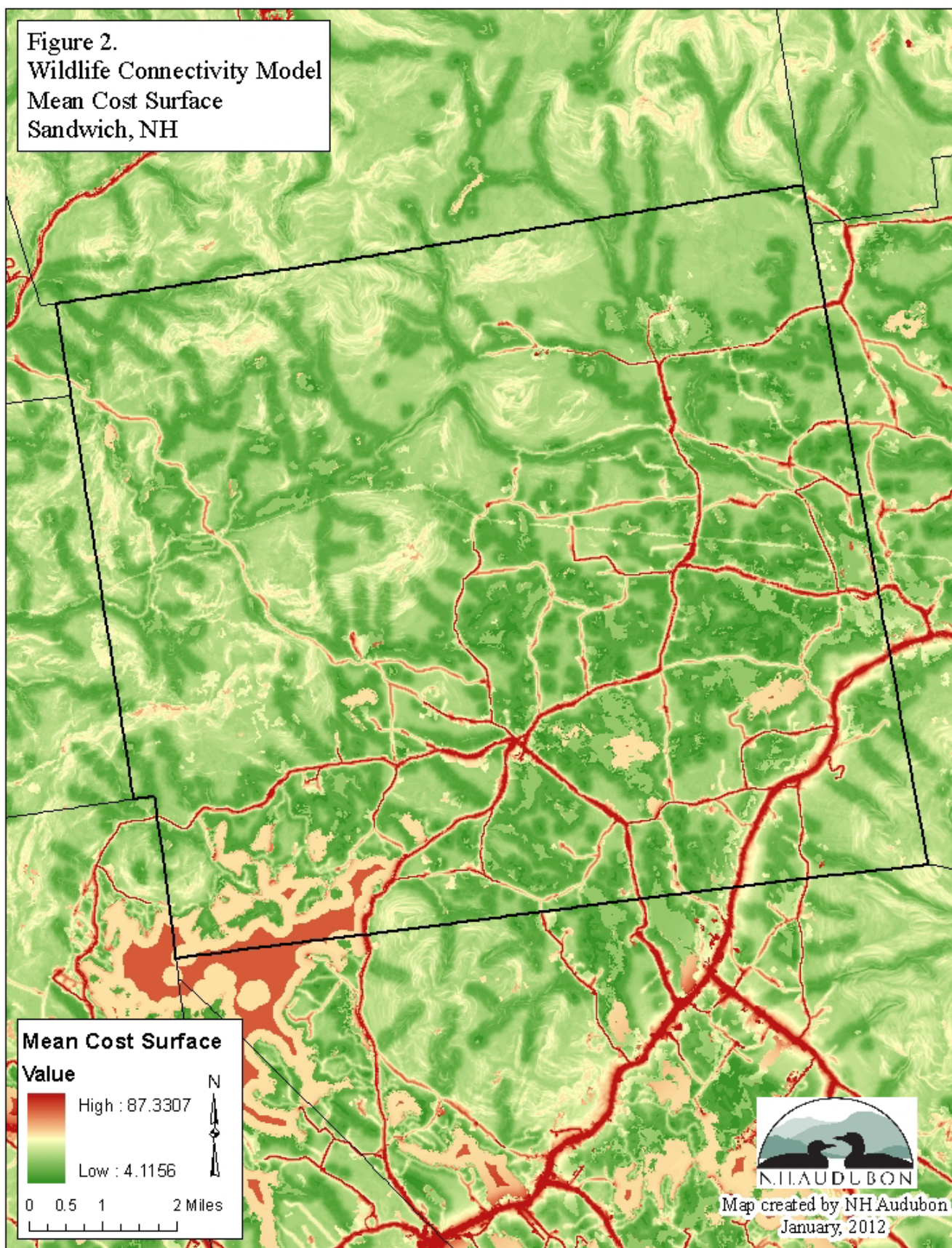
Lot size (acres)	Number	Percent
>=2.0	30	28
1.0-1.99	15	14
0.5-0.99	25	23
<0.5	38	35
Total	108	100

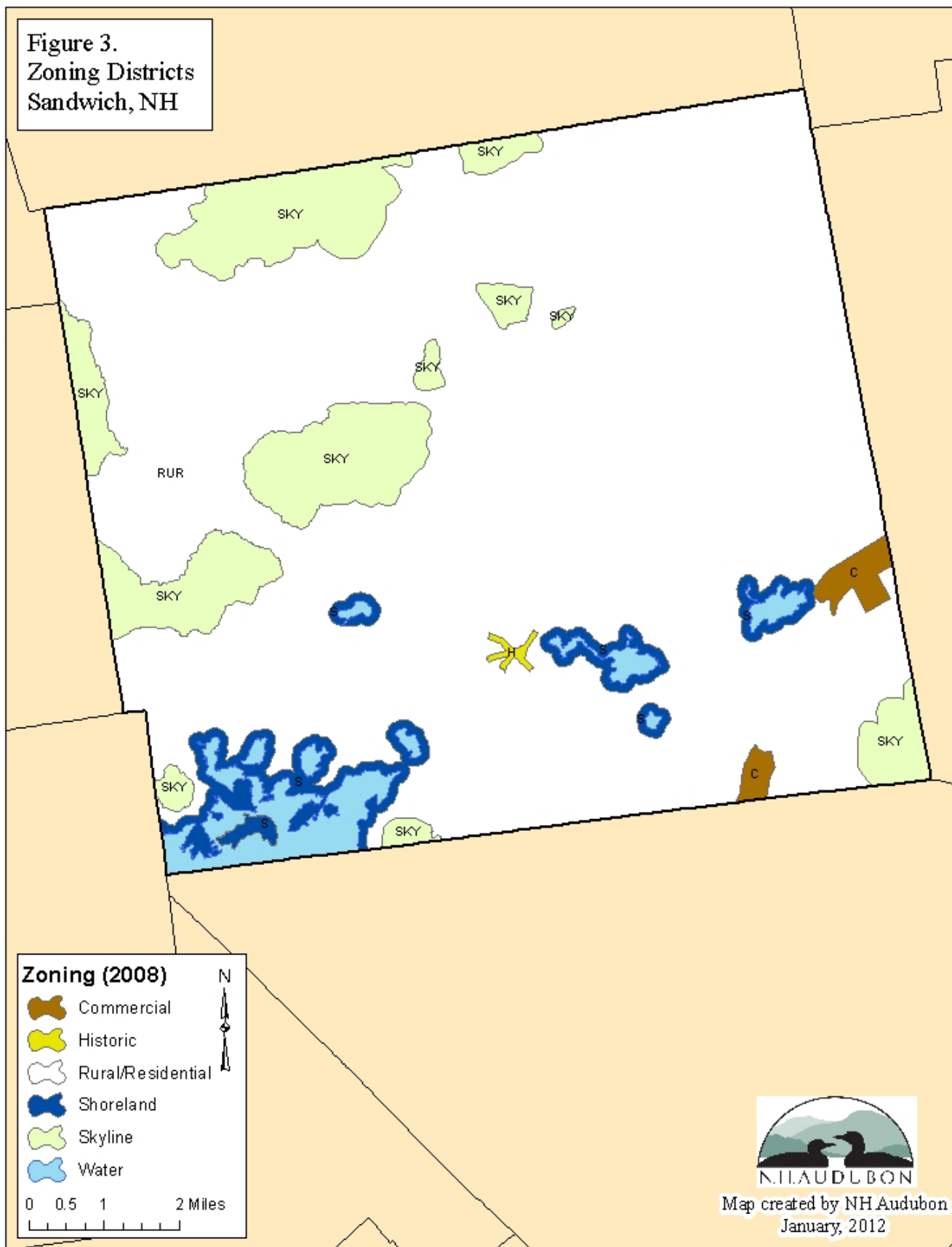
A number of regulatory tools exist that could strengthen natural resource protection in Sandwich. The functions of some tools overlap with those of others, so careful consideration will be needed to select the best combination of tools and resources to effectively meet the Town’s needs.

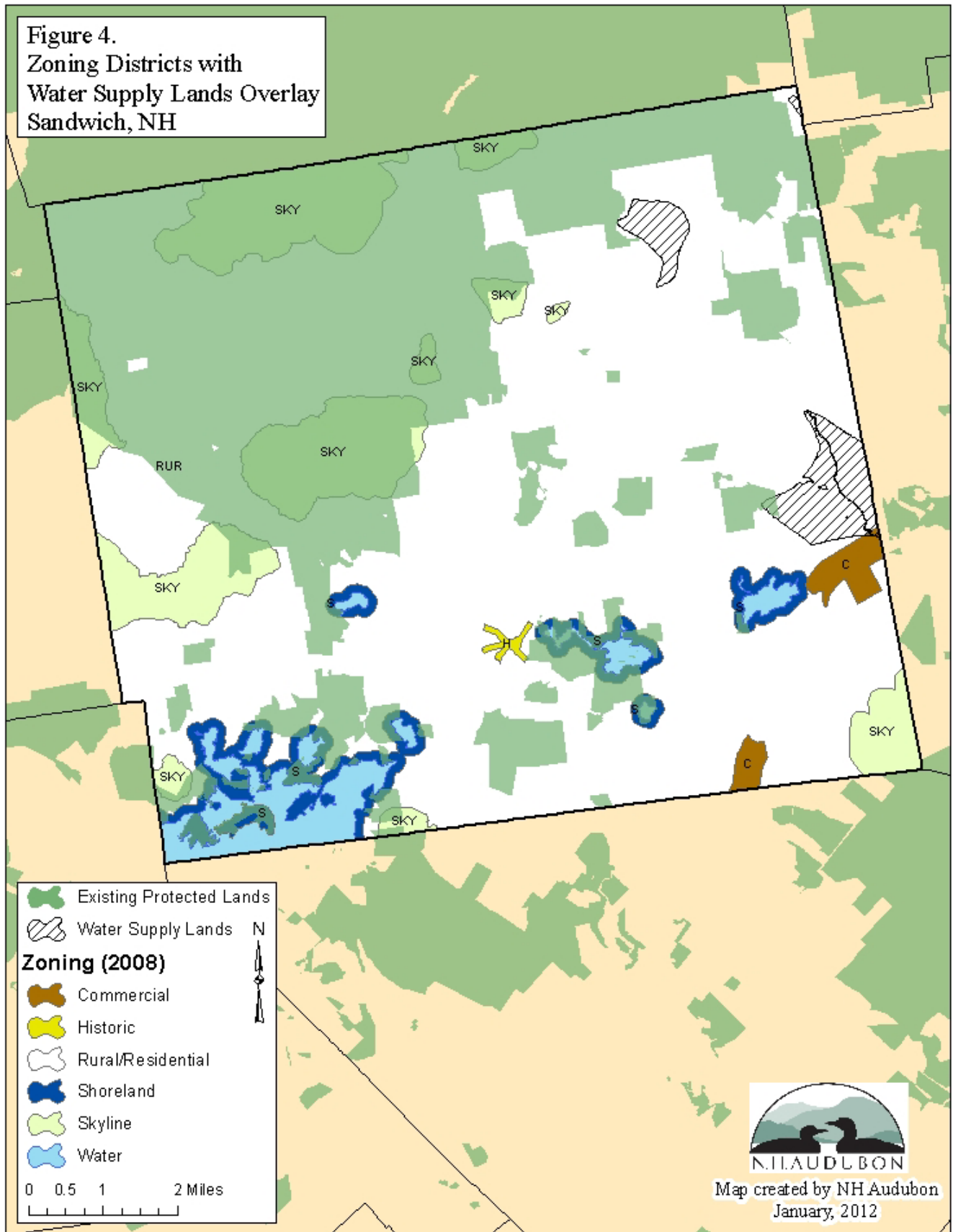
- Agricultural Overlay District – provides protection for productive soils regardless of underlying zone.
- Natural Resource Overlay District – could be designed to include areas of productive soils, aquifers, wetlands, large unfragmented forest blocks, highly ranked wildlife habitat, and wildlife connectivity zones in a single district, rather than addressing various resources with separate overlay districts.
- Open Space Subdivision by right in Rural/Residential district, with conventional subdivision allowed by special exception - serves multiple purposes.

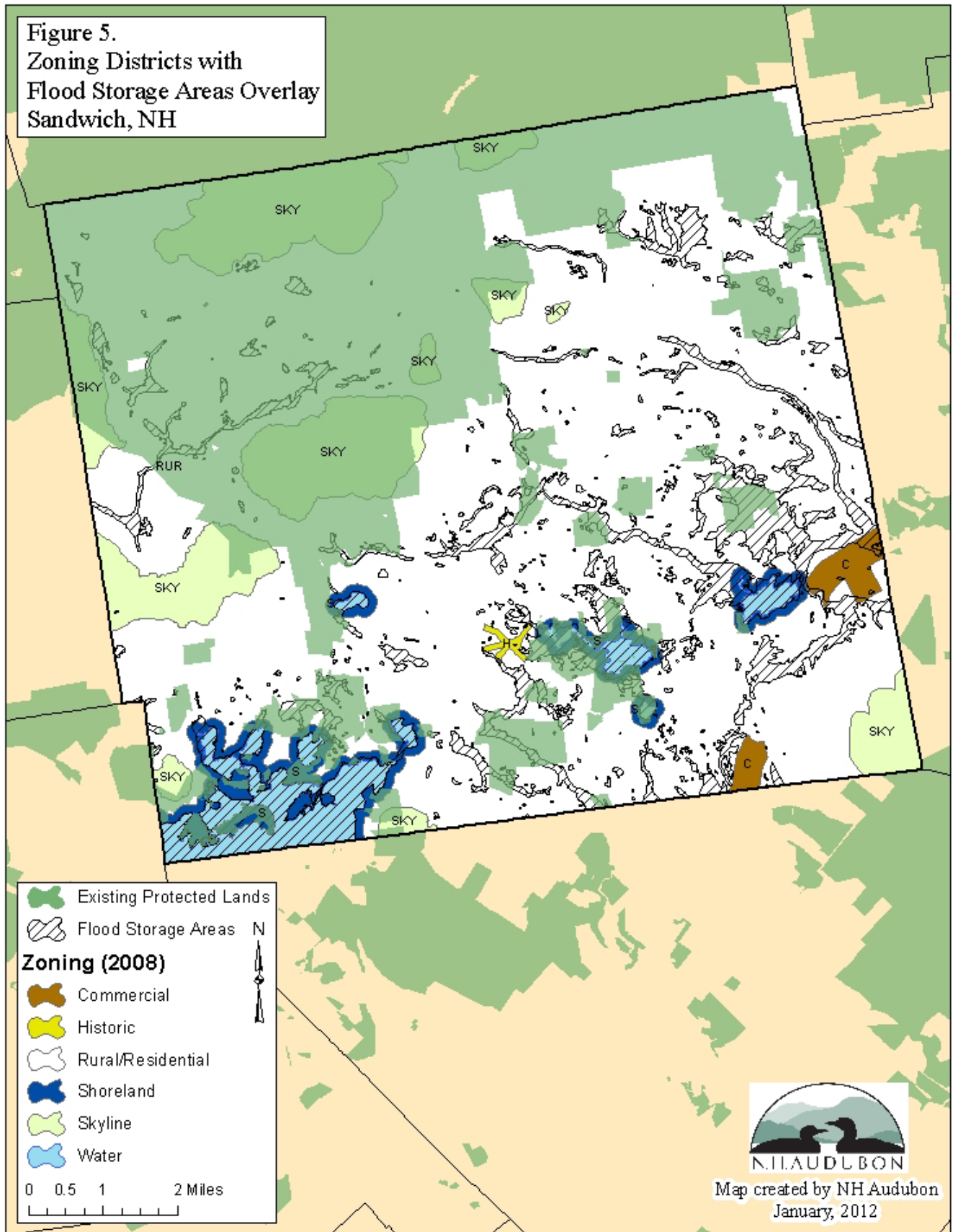
Sandwich has the benefit of quality natural resources and, at present, relatively low growth pressure. This enviable situation provides town officials with the opportunity to carefully weigh land use planning options and identify the most strategic choices for future growth.

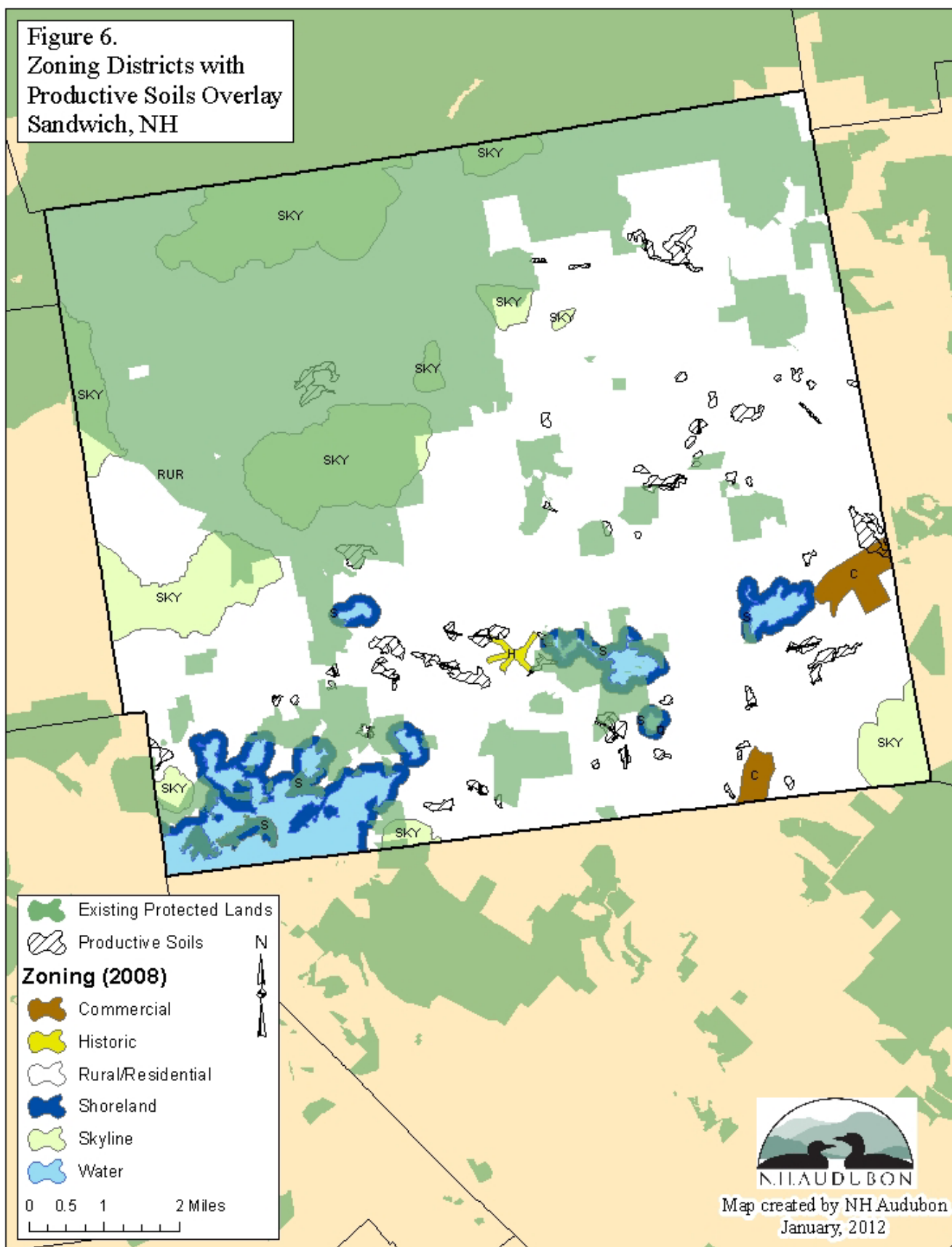


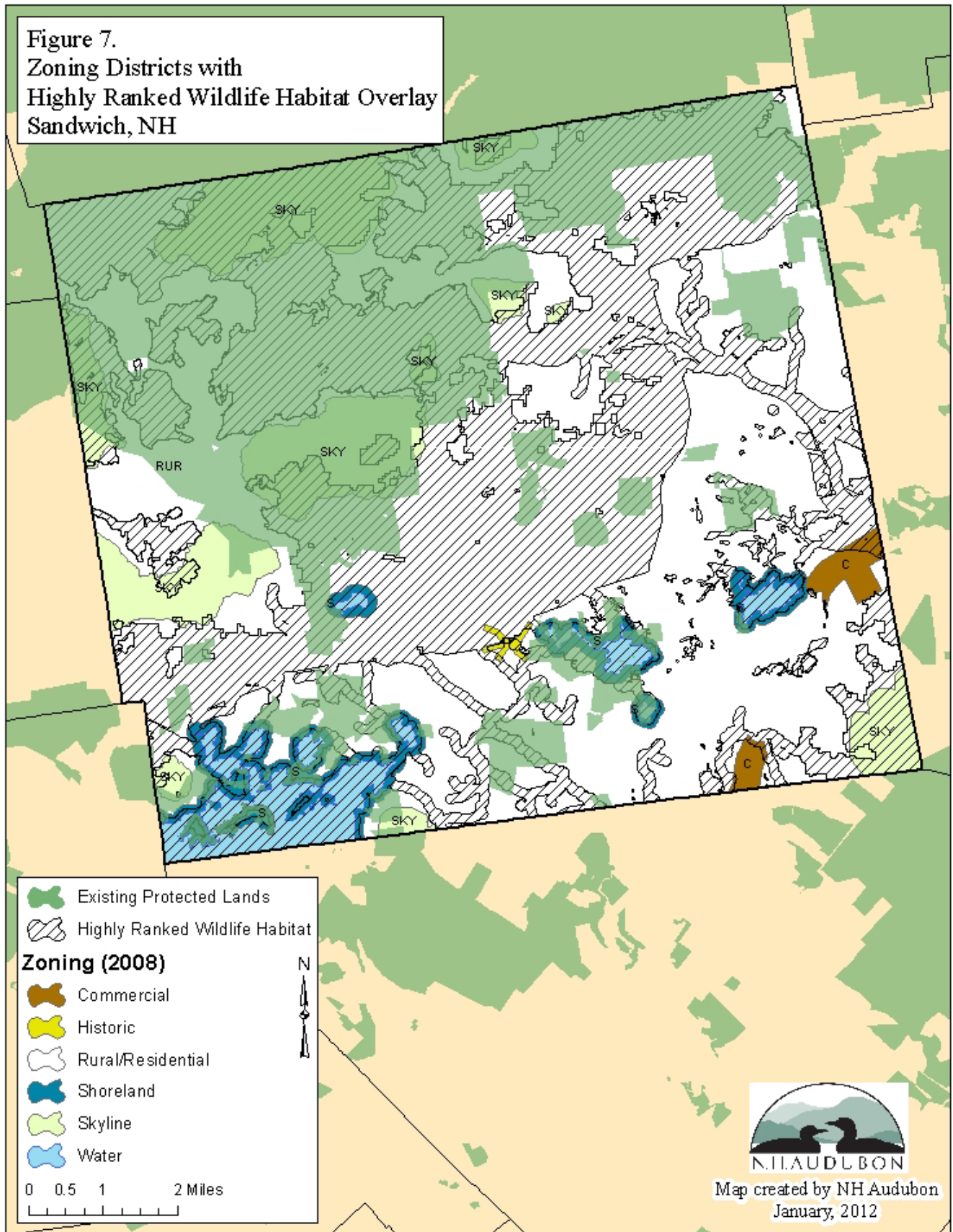


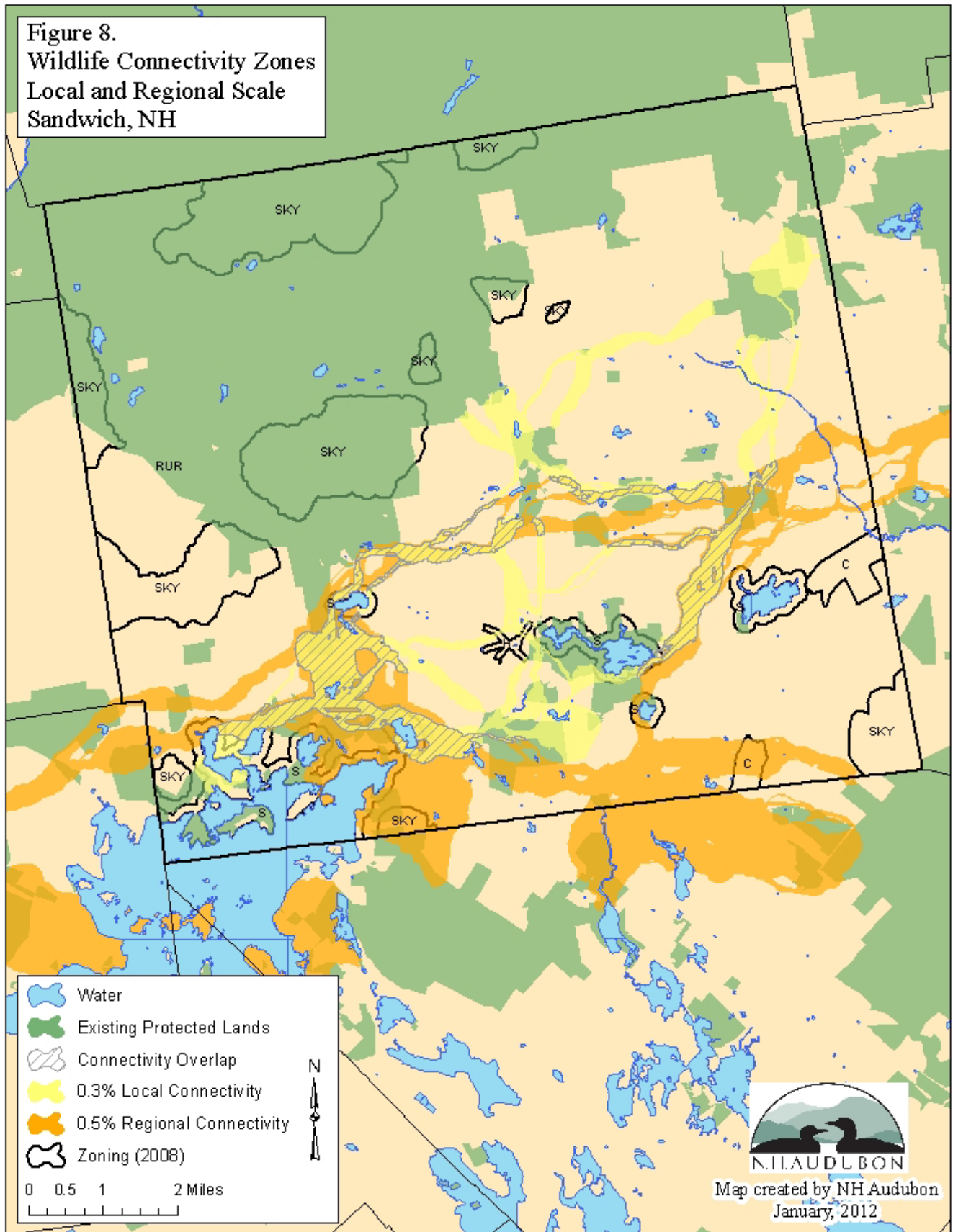


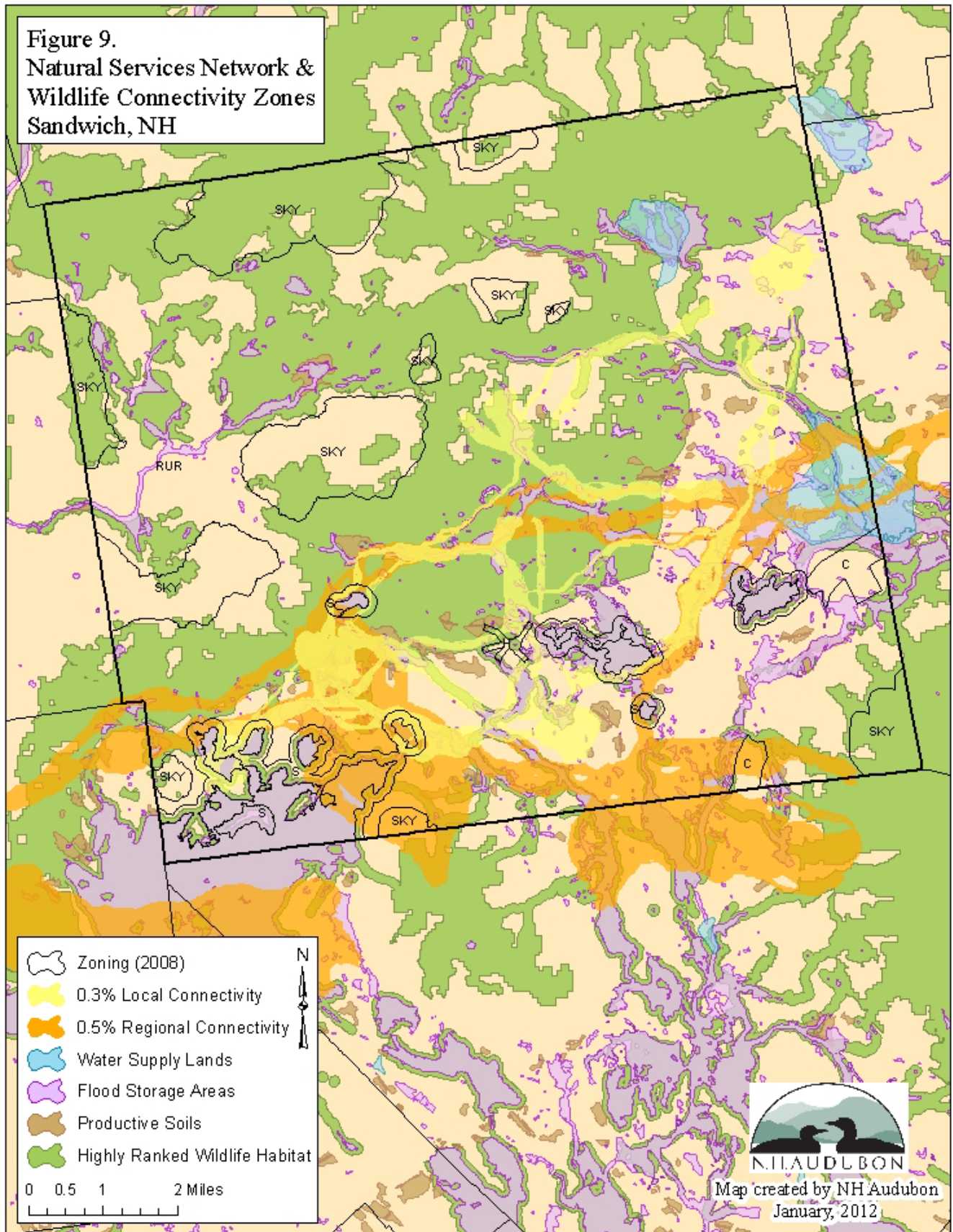












Appendix A. GRANTT parcels included in endpoint polygons for connectivity analysis

Analysis Polygon	Parcels in Polygon	Number of parcels
Alice Bemis Thompson Wildlife Refuge	Alice Bemis Thompson Wildlife Refuge	2
	Morton Lot	1
	Wyman Easement	1
Armstrong Natural Area	Allen Preservation Easement	1
	Armstrong Natural Area	1
	East Rattlesnake	2
	Kirk Campstead Easement	1
	Lilly Cove	3
	Pinehurst	1
Burleigh Tract/Owl Brook/Science Center of NH	Burleigh Tract	1
	Cotton Mountain	1
	Owl Brook Training Facility	3
	Science Center of New Hampshire	1
Coolidge Beede Forest	Beede Farm/Lost Lake	1
	Coolidge Beede Forest	2
	Coolidge Land	1
	Isaacs Easement	1
	Kusumpe Pond-Welch	1
	Lost Lake-Coolidge	1
	Otter Cove	1
	Ponzi Conservation Area	1
	Nye Easement	1
	Ossipee Mountains	AB Thompson Trust
Castle in the Clouds		1
Ossipee Mountain Preserve		1
Ossipee Mountains Tract		2
Retsof/Chocorua Forest Lands		1
Thompson #2/Chocorua Forest Lands		1
Thompson #3/Sanger Brook Inc.		1
Ossipee Pine Barrens	Downs Easement	2
	Everett Parker Property	1
	Freedom Town Forest	1
	Goodwin Town Forest	1
	McNair	2
	Ossipee Pine Barrens	8
	Town of Madison Land	1
	West Branch Conservation Land	2
West Branch Pine Barrens Preserve	1	

Spatial Analysis of Important Natural Resources in Sandwich with respect to Current Zoning

Appendix A continued Analysis Polygon	Parcels in Polygon	Number of Parcels
Red Hill River Conservation Area	Adriance	1
	Crooker	1
	Dyer	1
	Emerson	2
	Henry Easement	9
	Red Hill River Conservation Area	1
Red Hill River Lot	Red Hill River Lot – Emerson 2	1
	Myers-Schneider	1
Sharp Forest	Pohl Easement	1
	Sharp Forest	2
	Walsh	3
White Mountain National Forest	Lots in Sandwich	28
	Lots in other towns	248

Summary of Recommendations

This section of the report consolidates recommendations from both the Smart Growth Assessment and the Wildlife Habitat and Natural Resource review. The first group of recommendations pertains to potential revisions of land use planning documents, and is organized by document. The second group of recommendations pertains to actions and policies that could be undertaken by Town government, including the Select Board, Planning Board, Conservation Commission, Heritage Commission, and Department of Public Works. Before implementing any of the following recommendations, it is critically important to refer back to the previous sections, which provide detailed information and justifications. (References to pertinent smart growth principles and natural resource topics are provided at the end of each recommendation.)

Category	Page
Document Revisions	2
Master Plan	2
Hazard Mitigation Plan	4
Zoning Ordinance	5
Subdivision Regulations	9
Site Plan Review Regulations	12
Excavation Regulations	15
Actions and Policies	16

Document Revisions

Master Plan

Introduction and Vision Statement

- Consider adding language to the Vision that specifically addresses energy efficiency. (*Energy Efficiency*)
- Consider including a goal such as “Adopt policies to minimize the extent of terrain alteration associated with development in order to maintain natural hydrologic patterns, maintain rural character, and protect property and public safety.” (*Terrain Alteration*)

1. Population and Housing

- Consider including energy efficiency actions to this section. (*Energy Efficiency*)

2. Natural Resources

- Consider encouraging conservation ownership or easements on floodplain areas. (*Floodplains*)
- Consider adopting an objective of working with adjacent towns to protect shared aquifers. (*Groundwater*)
- Consider adopting goals/objectives such as:
 - Review and revise local policies and regulations to minimize destruction of natural vegetation during construction activities.
 - Review and revise local policies and regulations to encourage the use of native species in landscaping.
 - Review and revise local policies and regulations to discourage the use of plants that require significant inputs of water and nutrients in landscaping.
 - Encourage landscaping designs that reduce heating and cooling costs. (*Landscaping and Natural Vegetation*)
- Consider adding a recommendation to collaborate in regional efforts to protect watersheds that include portions of Sandwich. (*Watersheds*)
- Consider identifying local priorities for open space protection that include core areas of important wildlife habitat. (*Wildlife Habitat*)
- Consider recommending strategies to maintain wildlife connectivity zones within the Town. (*Wildlife Habitat*)

3. Land Use

- Consider recommending an overlay district to protect agricultural soils and exploring incentives for maintaining active agriculture. (*Agriculture and Productive Soils*)
- Consider including an Action to encourage continued practice of sustainable forestry

Summary of Recommendations

on private lands under Objective LU 3. (*Forests and Forestry*)

- Consider revising LU2.5 to include erosion control. (*Stormwater Management and Erosion Control*)
- Consider adding a recommendation to adopt land use policies that manage cumulative impacts of land use within a watershed. (*Watersheds*)
- Consider including energy efficiency actions to this section. (*Energy Efficiency*)

5. Village Centers

- Consider including a street plan for the villages in the next Master Plan. (See RSA 674.9 Mapping of Street Lines by Planning Board, included in this document in Village District section.) (*Village District*)
- Consider recommending that the Town explore opportunities to adopt mapped lines of future streets in the vicinity of the village center. (See RSA 674.9 Mapping of Street Lines by Planning Board) (*Growth Management and Sprawl*)

7. Transportation and Circulation

- Consider adopting a goal of reviewing and revising road standards to encourage road sizes that minimize paving while ensuring safety for bicyclists and pedestrians and adequate access for emergency response vehicles. (*Impervious Surfaces*)

8. Energy

- Consider adopting a goal pertaining to dark sky preservation. (*Light Pollution*)

9. Community Facilities

- Consider including energy efficiency actions to this section. (*Energy Efficiency*)

Hazard Mitigation Plan

- Consider including a map of natural hazards in the Hazard Mitigation Plan, identifying areas prone to flooding as well as formally recognized floodplains, and areas vulnerable to wildfire. “Firewise Construction: Design and Materials” provides guidelines for identifying high risk areas for wildland fire based on topographic position. (http://csfs.colostate.edu/pdfs/construction_booklet.pdf) (*Natural Hazards*)
- Consider including natural resource protection strategies, including sediment and erosion control, watershed management, and wetland protection as mitigation strategies for flooding. (*Natural Hazards*)
- Consider including land use regulations, including maximum setbacks and driveway lengths, as a mitigation strategy for wildland fires. (*Natural Hazards*)
- Consider including education of residents and developers regarding firewise landscaping, practices, and building materials as a mitigation strategy for wildland fires. “Firewise Landscaping in North Carolina ranks the flammability of many plant species that also occur in New Hampshire. (http://www.ces.ncsu.edu/forestry/pdf/ag/firewise_landscaping.pdf) “Firewise Construction: Design and Materials” discusses design elements and building materials that improve a structure’s fire resistance. (http://csfs.colostate.edu/pdfs/construction_booklet.pdf) (*Natural Hazards*)
- Consider including collaboration with U.S. Forest Service in forest fire prevention and management as a recommended mitigation action. (*Natural Hazards*)
- Consider including education of residents and developers regarding firewise landscaping, practices, and building materials as a mitigation strategy for wildland fires. “Firewise Landscaping in North Carolina” ranks the flammability of many plant species that also occur in New Hampshire. (http://www.ces.ncsu.edu/forestry/pdf/ag/firewise_landscaping.pdf) “Firewise Construction: Design and Materials” discusses design elements and building materials that improve a structure’s fire resistance. (http://csfs.colostate.edu/pdfs/construction_booklet.pdf) (*Forests and Forestry*)
- Consider including collaboration with U.S. Forest Service in forest fire prevention and management as a recommended mitigation action. (*Forests and Forestry*)

Zoning Ordinance

Article I (General Provisions)

- Consider including language such as “to encourage sustainable forestry” in the Purpose of the Zoning Ordinance (Article I, 150-4. H (2)). (*Forests and Forestry*)
- Make Table 1 more readily available in the Zoning Ordinance. (*Principle 6*)
- Consider revising the definition of an Accessory Dwelling Unit to include kitchen and sanitary facilities. (*Principle 3*)

Article II (Districts and District Regulations)

- Consider including a Forest and Timber Harvesting provision in the Permitted structures and uses (Article II). (See Lyme, NH Zoning Ordinance Article IV. 4.50 www.lymenh.gov/Public_Documents/LymeNH_PlanZone/2011%20Zoning%20Ordinance/Article%20IV%20-%20Use%20Regulations.pdf) (*Forests and Forestry*)
- Consider including a Right to Farm provision in the Permitted structures and uses (Article II). (See Lyme, NH Zoning Ordinance Article IV. 4.51 www.lymenh.gov/Public_Documents/LymeNH_PlanZone/2011%20Zoning%20Ordinance/Article%20IV%20-%20Use%20Regulations.pdf) (*Agriculture and Productive Soils*)
- Consider reducing lot coverage restriction in Commercial District to a maximum of 25% or less (Article II, 150-7.C(2)(b). “Permanent (Post-construction) Stormwater Management” (Chapter 2.1) in *Innovative Land Use Planning Techniques: A Handbook for Sustainable Development* recommends 10%. (*Impervious Surfaces*)
- Consider reducing the minimum lot size, frontage, and setbacks in the Center Sandwich area to conform more closely to existing conditions (See Table 6 in *Spatial Analysis of Important Natural Resources in Sandwich with Respect to Current Zoning*, Tab 5). (*Principle 2, Village District*)
- Consider reducing the front setback in the Commercial District to be more accommodating to businesses and make better use of the land on each lot (more space available on the backside for wildlife habitat). (*Principle 1*)
- Consider including some of the “activities to be encouraged” as permitted uses in the Rural Residential District. (*Principle 3*)

Article III (General Provisions Applicable to All Districts)

- Consider adopting *maximum* setback from center line of any street for principal structures and accessory dwellings (Article III, 150-13.C (1)) and *maximum*

Summary of Recommendations

driveway length (Article III, 150-20). (*Forests and Forestry, Growth Management and Sprawl, Impervious Surfaces, Natural Hazards, Wildlife Habitat*)

- Consider adopting lighting performance standards for all zoning districts. The New England Light Pollution Advisory Group (NELPAG) provides model language for an outdoor lighting ordinance to address light pollution, successful ordinances in Kennebunkport, ME, Tucson, AZ, and Cloudcroft, NM; and other useful information pertaining to light pollution.
(www.icq.eps.harvard.edu/nelpag/nelpag.html) (*Principle 6, Light Pollution*)

Article IV (Cluster Residential Development)

- Revise the Cluster Provision as recommended in the Master Plan (LU-2.1) to a Conservation Subdivision provision, permit these subdivisions by right and conventional subdivisions by special exception, require that at least 50% or 60% of the lot be reserved as open space, and require that the open space be contiguous with open space on abutting parcels. (“Conservation Subdivision” (Chapter 1.4) in *Innovative Land Use Planning Techniques: A Handbook for Sustainable Development* provides a model Conservation Subdivision Ordinance.)(*Principle 6, Growth Management and Sprawl, Wildlife Habitat*)
- Provide incentives for developers of Conservation Subdivisions for features such as , larger percentages of open land, footpaths into the open land, and public access to footpaths. (Principle 6)
- Consider allowing multi-unit dwellings in Conservation Subdivisions. (*Principle 3*)

Article V (Multiple Unit Structures)

- Consider permitting and promoting multi-family housing to help diversify the town’s housing stock and make it more affordable for folks to live in Sandwich. (*Principle 3*)
- Consider allowing multi-unit dwellings in Conservation Subdivisions. (*Principle 3*)
- Consider permitting the use of “Accessory” or “in-law” apartments as a means of providing housing options to young people as well as older residents. (*Principle 3*)

Article IX (Wetland Protection)

- Implement Master Plan recommendations to update Prime Wetland designations and documentation and consider expanded setbacks for Prime Wetlands. (*Shorelands, Surface Waters and Wetlands*)
- Implement Master Plan Recommendations to adopt a Shoreland Protection Overlay District to separate shorelands regulations from wetlands regulations, address protection of headwater streams, and adopt more restrictive shoreland and watershed protection measures within specific watersheds. (“Shoreland Protection: The Importance of Riparian Buffers” (Chapter 2.6) in *Innovative Land Use Planning*

Summary of Recommendations

Techniques: A Handbook for Sustainable Development provides recommended language for protecting first and second order streams.) (*Shorelands, Surface Waters and Wetlands, Watersheds*)

Article XII (Floodplain Management)

- Consider implementing Master Plan recommendations for amending the Zoning Ordinance provisions for floodplain management. (*Floodplains*)

Article XVII (Groundwater Protection Ordinance)

- Consider specifying the minimum contents of any report prepared by a professional geologist or engineer to resolve district boundary disputes (Article XVII, 150-112). (See Town of Newington Zoning Ordinance 5.01 (C) (3), pp. 48-49 [<http://web2.newmarketnh.gov/docs/ZoningOrd.pdf>]). (*Groundwater*)
- Consider including injection wells as a Prohibited Use (Article XVII, 150-115). (*Groundwater*)
- Consider adding a Performance Standard relative to minimizing the use of deicing chemicals (Article XVII, 150-117) (See Town of Newington Zoning Ordinance 5.01 (D) (4), p. 50 [<http://web2.newmarketnh.gov/docs/ZoningOrd.pdf>]). (*Groundwater*)

Potential New Articles

- Consider adopting an agricultural overlay district ordinance to protect the Town's most important soils and active agricultural lands. "Agricultural Incentive Zoning" (Chapter 1.7) in *Innovative Land Use Planning Techniques: A Handbook for Sustainable Development* provides model language for an Agricultural Conservation District Ordinance and examples of agricultural zoning in New Hampshire municipalities. (*Agriculture and Productive Soils*)
- Consider establishing a Forest Conservation District, with a larger (e.g., 20- to 50-acre) minimum lot size, to encourage continued forest management and discourage ownership fragmentation in areas of town with large contiguous ownerships of actively managed forest lands. The Lyme, NH zoning ordinance includes a Mountain and Forest Conservation District, which could provide a useful model. www.lymenh.gov/Public_Documents/LymeNH_PlanZone/2011%20Zoning%20Ordinance%20Index; see Article III Zoning Districts, Article IV Use Regulation, Article V Dimensional Controls) (*Forests and Forestry*)
- Consider adopting a landscaping ordinance. "Landscaping" (Chapter 3.6) in *Innovative Land Use Planning Techniques: A Handbook for Sustainable Development* includes a model ordinance addressing landscaping. *Integrated Landscaping: Following Nature's Lead* provides information about sustainable landscaping systems for developments in the Northeast. (*Landscaping and Natural Vegetation*)
- Consider adopting overlay districts to address site-specific hazards (flood hazard

Summary of Recommendations

- areas, wildland fire hazard areas). (*Natural Hazards*)
- Consider creating Village Districts in Center Sandwich and North Sandwich as recommended in the Master Plan (VC-1.3). (*Principle 1, Growth Management and Sprawl, Village District*)
 - Consider including an article addressing removal of natural material that addresses revegetation and regarding of areas within 100 feet of a public highway, street, roadway, or property line within 90 days of the finish of operation and/or material removed in order to protect abutters from erosion and washouts. (*Stormwater Management and Erosion Control*)
 - Consider adopting a stormwater ordinance. “Permanent (Post-construction) Stormwater Management” (Chapter 2.1) in *Innovative Land Use Planning Techniques: A Handbook for Sustainable Development* provides model language for a zoning ordinance article that addresses stormwater management and information about pertinent existing ordinances in New Hampshire. (*Stormwater Management and Erosion Control*)
 - Consider adopting an ordinance to address impervious surfaces. “Permanent (Post-construction) Stormwater Management” (Chapter 2.1) in *Innovative Land Use Planning Techniques: A Handbook for Sustainable Development* provides model language for a zoning ordinance article that addresses impervious surfaces. (*Impervious Surfaces*)
 - Explore adopting a Ridgeline Protection ordinance or overlay district as recommended in the Master Plan. (See Lakes Region Planning Commission. 2005. *Regulating Development on Steep Slopes, Hillsides, and Ridgelines*; “Steep Slope and Ridgeline Protection” [Chapter 2.2] in *Innovative Land Use Planning Techniques*; and the “Ridgeline and Hillside Viewshed Protection Area Overlay Zone” of Lafayette Township, NJ [http://www.lafayettetwp.org/ordinances/2010/2010_03.pdf] for ideas.) (*Steep Slopes and Ridgelines*)

Subdivision Regulations

Section I Introduction

- Consider including provision for protecting natural resources, including agricultural lands and productive soils in Authority and Purpose (Article I, 170-1) of Subdivision Regulations. (*Agriculture and Productive Soils*)
- Consider including encouraging energy efficiency in the Authority and Purpose of the Subdivision Regulations (Article I, 170-1). (*Energy Efficiency*)

Section II Application Procedure

- Consider including preliminary conceptual consultation or equivalent in the general procedure for subdivisions (Article II, 170-4); including agricultural lands and productive soils, soils subject to frequent or occasional flooding and lands below the 1% flood frequency (100-year flood) elevation, potentially viable commercial forest areas, boundaries of the Groundwater Protection District, shorelands and wetlands, and highly ranked wildlife habitat and identified wildlife connectivity zones in the associated submission and information requirements; and requiring such consultation for applications involving agricultural lands and productive soils, soils subject to frequent or occasional flooding and lands below the 1% flood frequency (100-year flood) elevation, potentially viable commercial forest areas or forest lands of 50 acres or more, the Groundwater Protection District, shorelands and wetlands, and steep slopes and ridgelines (or for all major subdivisions); and including energy conservation aspects of road and lot layouts among topics for discussion. (*Agriculture and Productive Soil; Energy Efficiency; Floodplains; Forests and Forestry; Groundwater; Natural Hazards; Shorelands, Surface Waters and Wetlands; Steep Slopes and Ridgelines; Wildlife Habitat*)
- Consider including delineation of active agricultural lands and Groundwater Protection District boundaries in plat requirements (Article II, 170-5). (*Agriculture and Productive Soils, Groundwater*)
- Consider clarifying the Plat Requirements by revising 170-5.E to read “The plat shall indicate all areas of soils subject to frequent or occasional flooding and lands below the 1% flood frequency (100-year flood) elevation.” (*Floodplains*)
- Consider requiring a lighting plan for proposed streets in the Completed Application if street lighting is to be provided (Article II.170-6). (*Light Pollution*)

Section IV Design Standards for all Subdivisions

- Consider including a Design Standard that street lighting is not required but where provided may not cause sky glow or glare onto adjacent properties (Article IV, 170-

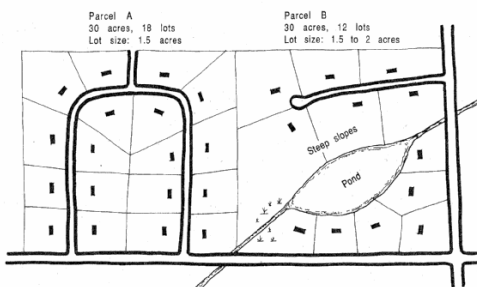
Summary of Recommendations

- 24) or referencing design standards in a new Dark Sky Ordinance. (*Light Pollution*)
- Consider revising measurement of shoreline frontage (170-22) to “the average of the distances of the actual natural navigable shoreline footage and a straight line drawn between property lines, both of which are measured at the normal high water line” to conform to the NH Code of Administrative Rules (Env-Wt 101.89). (*Shorelands, Surface Waters and Wetlands*)
 - Delete second statement in 170-24.H “Natural watercourses shall be cleaned and increased in size where necessary to take care of storm run-off.” (*Shorelands, Surface Waters and Wetlands*)
 - Consider including a provision that subdivision layouts shall be designed to maximize the efficiency of the road network and minimize impervious surfaces (Article IV). (*Impervious Surfaces*)
 - Consider including statement such as “Avoidance of extensive excavation, grading, and filling shall be avoided to the extent practicable” in Design Standards for All Subdivisions (Article IV 170-21). (*Terrain Alteration*)
 - Consider adopting landscaping standards and guidelines. “Landscaping” (Chapter 3.6) in *Innovative Land Use Planning Techniques: A Handbook for Sustainable Development* provides model language for subdivision regulations addressing landscaping. *Integrated Landscaping: Following Nature’s Lead* provides information about sustainable landscaping systems for developments in the Northeast. (*Landscaping and Natural Vegetation*)
 - Consider adopting special standards for subdivisions in the Rural/Residential district (or in identified wildland fire hazard areas) to minimize the possibility of wildland fires involving structures and structural fires involving wildlands. Such standards might include maximum distance from collector road, maximum driveway length, on-site water supply, and landscaping specifications. (See National Fire Protection Association. 2008. NFPA 1144: Standard for Reducing Structure Ignition Hazards from Wildland Fire.) (Building code standards, such as inflammable roofing and siding materials, may also be desirable.) (*Natural Hazards*)
 - Consider requiring that boundaries of wetland and shoreland buffers be permanently marked to facilitate awareness of future landowners, by adding a special condition to appropriate subdivision approvals such as “The wetland buffers shall be clearly and permanently marked before, during, and after construction; building permits will not be issued until the buffers are marked” or by adding such language into the Subdivision Regulations. (*Shorelands, Surface Waters and Wetlands, Watersheds*)
 - Consider requiring a stormwater management plan for all subdivisions, or those exceeding a threshold number of lots. (*Stormwater Management and Erosion Control*)
 - Consider adopting design standards for stormwater management. (*Stormwater*)

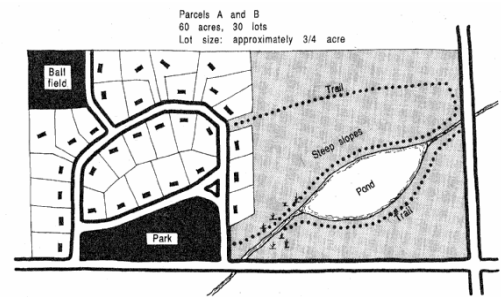
Summary of Recommendations

Management and Erosion Control

- Review “Erosion and Sediment Control During Construction” (Chapter 2.8) in *Innovative Land Use Planning Techniques: A Handbook for Sustainable Development* and adopt new regulations and standards as appropriate. (*Principle 6, Stormwater Management and Erosion Control*)
- Consider requesting identification and protection of special habitats such as vernal pools, deer wintering areas, and important mast stands in subdivision layouts (see Voluntary Practices, Section 7). (*Wildlife Habitat*)
- Consider adopting special standards for identified wildlife connectivity zones. Such standards could include maintenance of open space connectivity and stream crossing structures (e.g., culverts) that provide for wildlife passage. (*Wildlife Habitat*)
- Consider requiring sloped (Cape Cod) curbing where curbing is required to prevent small animals from becoming trapped in the roadway. (*Wildlife Habitat*)
- Consider inserting language into the subdivision regulations addressing pedestrian connectivity with neighboring structures. (*Principle 2*)
- Consider requiring road connectivity in subdivisions. Development along “non-interconnected” roads disproportionately increases pressure on municipal services. Additionally, the Planning Board could work with the Police and Fire Departments to incorporate elements of the CPTED (Crime Prevention Through Environmental Design) into the planning process. Many of these elements are consistent with Smart Growth Principles. (*Principle 5*)
- Consider incorporating incentives for subdivision applications that preserve linkages between habitats. (*Principle 6*)



Example of Conventional Subdivision



Same area as a Conservation Subdivision

Summary of Recommendations

Site Plan Review Regulations

160-2 Purpose

- Consider including encouraging energy efficiency and protection of important natural resources in the Purpose of the Site Plan Review Regulations (160-2). (*Energy Efficiency, Groundwater*)

160-5 Definitions

- Consider including wetland soils in Definitions (160-5). (*Shorelands, Surface Waters and Wetlands*)
- Consider including a definition of ridgelines (160-5). (See the “Ridgeline and Hillside Viewshed Protection Area Overlay Zone” of Lafayette Township, NJ) http://www.lafayettewp.org/ordinances/2010/2010_03.pdf (*Steep Slopes and Ridgelines*)

160-6 Application Requirements

- Consider including boundaries of agricultural lands and productive soils, soils subject to frequent or occasional flooding and lands below the 1% flood frequency (100-year flood) elevation, boundaries of mapped aquifers, boundaries of steep slopes and ridgelines, and among the existing natural features specified in the application requirements (160-6.B.(2)[2][e]). (*Agriculture and Productive Soils, Floodplains, Groundwater, Steep Slopes and Ridgelines*)
- Consider including description of energy conservation features of building orientation and layout, landscaping, and exterior lighting in Application Requirements (160-6). (*Energy Efficiency*)
- Consider adding potentially viable commercial forest areas to features for which location and boundary information is required on a Site Plan (160-6.B). (*Forests and Forestry*)
- Consider amending Proposed Site Details in Application Requirements to include type as well as locations of lights (160-6(B)(2)[3][h]). (*Light Pollution*)
- Consider including highly ranked wildlife habitat and identified wildlife connectivity zones in Application Requirements (166.B.[2]). (*Wildlife Habitat*)
- Consider including total impervious surface and percent of project area in Application Requirements (160-6). (*Impervious Surfaces*)
- Consider including cut and fill volumes in Application Requirements (160-6). (*Terrain Alteration*)

Summary of Recommendations

160-7 Requirements for Site Plan Approval

- Consider requiring a plan for on-site stormwater management (160-7.C). (*Floodplains*)
- Consider amending the outdoor lighting design standard to also prohibit sky glow (160-7.B(5)). (*Light Pollution*)
- Consider including a provision that access, parking, and loading areas shall be designed and constructed so as to minimize impervious surfaces in Requirements for site plan approval (160-7). (*Impervious Surfaces*)
- Consider including statement such as “Extensive excavation, grading, and filling shall be avoided to the extent practicable” in Requirements for Site Plan Approval (160-7). (*Terrain Alteration*)

160-8 Procedure for Site Plan Review

- Consider requiring a Pre-Submission Discussion for site plans involving agricultural lands or productive soils, soils subject to frequent or occasional flooding and lands below the 1% flood frequency (100-year flood) elevation, potentially viable commercial forest areas or forest lands of 50 acres or more, the Groundwater Protection District, steep slopes and ridgelines, wetlands or shorelands, and highly ranked wildlife habitat or identified wildlife connectivity zones (or for all site plans) (160-8.A). (*Agriculture and Productive Soils; Floodplains; Forests and Forestry; Groundwater; Natural Hazards; Steep Slopes and Ridgelines; Shorelands, Surface Waters and Wetlands; Wildlife Habitat*)

Other Recommendations

- Consider adopting landscaping standards and guidelines. “Landscaping” (Chapter 3.6) in *Innovative Land Use Planning Techniques: A Handbook for Sustainable Development* provides model language for site plan review regulations addressing landscaping. *Integrated Landscaping: Following Nature’s Lead* provides information about sustainable landscaping systems for developments in the Northeast. (*Landscaping and Natural Vegetation*)
- Consider adopting special standards for site plans in the Rural/Residential district (or in identified wildland fire hazard areas) to minimize the possibility of wildland fires involving structures and structural fires involving wildlands. Such standards might include maximum distance from collector road, maximum driveway length, on-site water supply, and landscaping specifications. (See National Fire Protection Association. 2008. NFPA 1144: Standard for Reducing Structure Ignition Hazards from Wildland Fire.) (Building code standards, such as inflammable roofing and siding materials, may also be desirable.) (*Natural Hazards*)
- Consider requiring that boundaries of wetland and shoreland buffers be permanently marked to facilitate awareness of future landowners. This can be accomplished by adding a special condition to appropriate site plan approvals to the effect of “The

Summary of Recommendations

- wetland buffers shall be clearly and permanently marked before, during, and after construction; building permits will not be issued until the buffers are marked” or by adding such language into the Site Plan Review Regulations. (*Shorelands, Surface Waters and Wetlands*)
- Consider requiring a stormwater management plan for all site plans. (*Stormwater Management and Erosion Control*)
 - Consider adopting design standards for stormwater management. (*Stormwater Management and Erosion Control*)
 - Review “Erosion and Sediment Control During Construction” (Chapter 2.8) in *Innovative Land Use Planning Techniques: A Handbook for Sustainable Development* and adopt new regulations and standards as appropriate. (*Stormwater Management and Erosion Control*)
 - Consider adopting special standards for identified wildlife connectivity zones. Such standards could include maintenance of open space connectivity and stream crossing structures (e.g., culverts) that provide for wildlife passage. (*Wildlife Habitat*)
 - Consider requesting identification and protection of special habitats such as vernal pools, deer wintering areas, and important mast stands in site plans (see Voluntary Practices, Section 7). (*Wildlife Habitat*)
 - Consider requiring sloped (Cape Cod) curbing where curbing is required. Sloped curbing prevents small animals from becoming trapped in the roadway. (*Wildlife Habitat*)
 - Insert language into the subdivision and site plan regulations addressing pedestrian connectivity with neighboring structures. (*Principle 2*)

Excavation Regulations

Recommendations

- Consider revising Prohibitions (2.8) to include areas within the meander belt of any third or higher order stream. (Detailed information about the potential consequences of locating gravel pits close to a stream are presented in Vanasse Hangen Brustlen, Inc. 2008. Geomorphology-based Restoration Alternatives, Suncook River, Epsom, New Hampshire, Final Technical Report. Available at <http://des.nh.gov/organization/divisions/water/wmb/rivers/documents/suncook-avulsion-report.pdf>) (*Terrain Alteration*)

Actions and Policies

- Consider developing a street plan for the villages for inclusion in the next Master Plan, and subsequently seeking authorization to locate mapped lines of future streets. Opportunities for future connecting streets within the villages include Dale Road to Diamond Ledge Road, Diamond Ledge Road to Skinner Street, Grove Street to Skinner Street, Skinner Street to Squam Lakes Road, Upper Road to Route 113. *(Growth Management and Sprawl, and Village District)*
- Consider identifying and addressing the problems with the sewer system in order to determine whether growth in the village can be accommodated on the existing system or whether an additional system needs to be developed. *(Principle 1)*
- Consider developing and implementing a long-term plan for sidewalks in Center Sandwich. *(Principle 2)*
- Consider exploring the support and resources available for designing and developing sidewalks through the Safe Routes to Schools program at the NH Department of Transportation. *(Principle 2)*
- Consider taking steps to enhance affordable housing opportunities for younger people in Sandwich entering the workforce and elderly residents wishing to remain in town. Consider permitting and promoting multi-family housing to help diversify the town's housing stock and make it more affordable for folks to live in Sandwich. *(Principle 3)*
- Continue to promote the local Farmer's Market as a venue for local farmers to sell their produce and as a means of keeping local farms in the public eye. *(Principle 4)*
- Consider working with current farmers and the USDA and NRCS to purchase development rights for these parcels if farmers are considering getting out of the business to ensure that they can remain working farmsteads. *(Principle 4)*
- Consider developing a road network plan of cross streets connecting the major roadways in town. This would enable modest development within and around the villages, reduce the need for more sprawling development along unbroken linear roadways and enhance walking and bicycling opportunities around the villages. *(Principle 5)*
- Explore greater representation on the Lakes Region Transportation Technical Advisory Committee (for issues related to regional transportation). *(Principle 5)*
- Explore the incorporation of digital tax maps and GIS into land use planning and conservation practices. *(Principle 6)*
- Continue collaboration with the regional land trusts to protect parcels that include important habitats. *(Principle 6)*
- Consider posting the Planning Board agenda on the town website. *(Principle 7)*

Summary of Recommendations

- Continue to use a team approach to plan review; it seems to be successful at engaging board members in the process. *(Principle 7)*
- Consider applying to Plan NH to work with the community and conduct a charrette related to developing, visualizing, and promoting a village zoning district. *(Principle 7)*
- Consider forming a Heritage Commission under RSA 673:4-a in order to carry out cultural and historical inventories and advise the planning board on such issues. *(Principle 7)*
- Work with the Historic District Commission or Heritage Commission, if one is formed, to explore and promote the resources available for restoration and other activities through the New Hampshire Division of Historical Resources. *(Principle 7)*
- Maintain communication and involvement with neighboring communities on environmental issues and development proposals. It also benefits the town to work with neighboring communities on other issues that could have mutual benefits. *(Principle 8)*
- Work with the Conservation Commission to coordinate land protection and planning efforts with adjacent communities. *(Principle 8)*
- Continue to collaborate with surrounding towns on projects such as road construction and infrastructure needs. Furthermore, should there be a development of regional impact proposed in the future the Planning Board should notify surrounding communities as per RSA 36: 54-57. This notification will allow neighboring communities and the regional planning commission to engage in discussion of the proposal as abutters and will give them a voice in the development process. *(Principle 8)*
- Consider greater involvement on regional transportation planning efforts through the Transportation Technical Advisory Committee. *(Principle 8)*

**Balancing Development and Rural Character:
Voluntary Practices to Protect Important Wildlife Habitat Features
During Development and Other Land Use Changes**

Prepared by

**New Hampshire Audubon
and
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**for the
New Hampshire Fish & Game Department
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Voluntary Practices to Protect Important Wildlife Habitat Features

Introduction

Voluntary practices provide opportunities for communities to encourage protection of habitat and other natural resources during development in the absence of regulations. Voluntary practices are particularly useful tools for protecting habitat features that are scattered on the landscape, such as deer wintering areas or vernal pools. Such features benefit from flexible approaches to protection that can be designed through discussions between planners and developers, rather than by “one-size-fits-all” regulations. Voluntary practices also can be incorporated into incentive approaches, such as density bonuses, to protect natural resources in communities with minimal land use regulations.

Successful application of voluntary practices depends on pre-application conferences between planners and developers. These meetings provide an opportunity for developers to share ideas about prospective use of a land parcel before investing in surveys and engineering studies, and for municipal planners to share concerns about natural resources associated with the parcel that are important to the community. The parties can then develop consensus on an approach to development that protects the important resources, and the points of agreement become special conditions of the subdivision or site plan permit.

This document includes voluntary practices designed to protect the following habitats:

- Deer wintering areas
- Important mast stands
- Headwater streams
- Natural vegetation
- Raptor nest trees
- Shorelands and riparian areas
- Vernal pools

For each topic, we provide a brief issue statement, objectives for the voluntary practices, a justification and benefits section, a list of implementation strategies, and technical references.

We welcome comments and suggestions from municipalities on the usefulness of these practices, ways in which they might be improved, and additional topics for which voluntary practices might be helpful.

Deer Wintering Areas

Issue: Human activity in deer wintering areas can have negative impacts on both people and deer.

Objectives

- Avoid destruction of deer wintering habitat.
- Minimize disturbance of wintering deer from human activity and domestic dogs.
- Minimize negative interactions between deer and people, including
 - Wildlife/vehicle collisions
 - Human exposure to wildlife-borne diseases
 - Property damage from foraging deer.

Justification/Benefits

The white-tailed deer is both ecologically and economically important in New Hampshire. Deer hunting has a significant economic impact in the state, with estimated annual expenditures of \$47,344,000 associated with big game hunting in New Hampshire, based on data from 2001 (U.S. Dept. of the Interior and U.S. Dept. of Commerce 1993). Deer are also popular subjects for wildlife observation and photography. Such “non-consumptive use” of wildlife (not specifically deer) in New Hampshire generated an estimated \$325,658,000 in 2001, more than half of which was spent by non-residents.

Local deer densities in New Hampshire range from less than 6 per sq. mi. in the White Mountains to 16-19 per sq. mi. in the southern part of the state, and average about 10 per square mile statewide (Gustafson 2004).

New Hampshire is near the northern limit of the white-tailed deer’s range, which extends to the north shore of the Saint Lawrence River in Quebec (Halls 1984). In northern areas with severe winters, deer maintain distinctly different ranges during the winter and during the milder part of the year.

Nutritional stress during severe winters may result in more than 30% mortality of adults, as well as high mortality of fawns born the following spring (Lavigne 1999).

Studies in the northeast indicate that deer begin to move from summer/fall range to wintering areas when snow depths reach approximately 15 inches (Tierson et al. 1985). They commonly move 4-5 miles between summer and winter ranges, and may move more than 25 miles (Lavigne 1999).

Roads do not pose barriers to deer movement, as they do with many other species of wildlife. Deer commonly cross highways and other busy roads. In fact, collisions with vehicles on New Hampshire highways have killed more than 1000 deer annually since 1989 (Gustafson 2004). Based on recent population estimates of approximately 82,000 deer statewide, about 12% of the deer herd is lost to road mortality each year. With increasing numbers of vehicles, there is increasing mortality due to collisions. Deer killed by cars has increased from 662 in 1987

(accounting for 80% of all deer mortality) to 1292 in 2003 (91 % of total mortality (Gustafsen 2004). From 1995 to 2003, there were seven years in which collisions accounted for 93% or more of deer mortality, and three years in which vehicle collisions caused 96% of all deer mortality.

Deer wintering areas occur in softwood stands of various types, often in riparian areas. In northern New Hampshire, deer wintering areas are typically located in low elevation stands of red spruce, balsam fir, and northern white cedar. These areas may cover areas of more than 1000 acres and support hundreds of deer. In the southern part of the state, wintering areas are typically scattered patches of hemlock as small as a half acre. Such small wintering areas accommodate 20 or 30 deer during bouts of severe weather and 15 inches or more of snow, but deer in southern New Hampshire do not typically spend long periods of time in these “yards.” In mild winters, deer may not “yard up” at all in southern New Hampshire (Gustafson, pers. commun.).

Deer wintering areas consist of core areas with dense coniferous trees that reduce snow accumulation and provide shelter from wind, adjacent to mixed hardwood and coniferous trees that provide an accessible food supply. Softwood canopy height of at least 35 feet and average canopy cover of 65-70% are required to provide functional shelter (Reay et al.1990).

Deer are hosts of the black-legged tick (or “deer tick”), which is a vector in the transmission of Lyme disease. Black-legged ticks occur throughout most of southern and central New Hampshire. Many factors influence the occurrence of black-legged ticks and incidence of Lyme disease among humans, but in general, areas of high deer densities are more likely to exhibit greater black-legged tick abundance and higher Lyme disease incidence rates in humans (Gustafsen 2004).

Deer and human populations have increased since the early 1980’s, especially in the southern part of the state, resulting in greater potential for human-deer conflicts. Calls to Wildlife Services for assistance with deer damage rose sharply from 1988 through 1993, but have remained fairly consistent since then. From 1993 to 2002, requests that were agriculturally related accounted for about half of all calls, varying from 39-62% for that time period (Gustafsen 2004).

Implementation Strategies

- Identify deer wintering areas on site map, including core shelter area, surrounding hardwood buffer extending at least 200 feet from perimeter of core, and corridors connecting wintering areas to surrounding habitats.
- Avoid any clearing or other construction activity within identified deer wintering areas.
- Locate houses to discourage winter intrusion of humans and domestic dogs into identified wintering areas.

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- Locate roads to avoid fragmenting of deer use areas, and plan for low traveling speeds to minimize the potential for vehicle-deer collisions.
- Install fences around residential properties adjacent to buffer habitat to discourage intrusions of humans and dogs.
 - Avoid landscaping techniques that attract deer into the interior of the neighborhood.
 - Discourage intentional feeding of deer, and encourage fencing of gardens to reduce attraction of deer to residential properties.

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Floodplain Forests

Issue: Clearing floodplain forests increases bank erosion and downstream flood damage and destroys important wildlife habitat.

Objectives:

- Protect floodplain forest vegetation to mitigate flood damage and maintain biodiversity.
- Minimize recreational activity in floodplain forests to prevent soil compaction and wildlife disturbance.

Justification/Benefits

A floodplain is a valley floor where water spreads out after overtopping the banks of a stream (Gordon et al. 1992, Riley 1998).

Annual shallow river flooding is common in the northern United States during spring snowmelt (Daniels and Daniels 2003).

The timing, duration, and depth of flooding are important influences on floodplain vegetation (Mitsch and Gosselink 1986, McKevlin et al. 1997).

In New Hampshire, floodplain forests occur primarily along third and higher order rivers (Sperduto 2005).

Floodplain plants are specially adapted to tolerate inundation for part of the year (Mitsch and Gosselink 1986, Verry et al. 2000).

Small elevation changes within a floodplain result in large changes in the depth and duration of flooding, and in the resulting plant communities (Mitsch and Gosselink 1986).

Long histories of stream meanders, erosion, and deposition create variable topography within floodplains, resulting in complex vegetation patterns. Floodplain systems often include sloughs, oxbows, shrub swamps, wet meadows, and vernal pools, as well as floodplain forests.

Two major types of floodplain forests occur in northern New Hampshire and the White Mountains. These forests develop along rivers with floods of high intensity and short duration that result from mountain runoff. One type consists primarily of sugar maple, red oak, ironwood, white ash, black cherry, and white pine; the other of balsam fir, red maple, white pine, and speckled alder (Sperduto 2005).

Silver maple floodplain forests occur along the Connecticut and Merrimack rivers and the lower reaches of their major tributaries. White ash, American elm, hackberry, and Eastern cottonwood also may grow in these forests (Sperduto 2005).

Red maple dominates the floodplain forests along smaller rivers in central and southern New Hampshire. These forests also may include black ash, black cherry, and ironwood (Sperduto 2005).

During floods, floodplain forests slow water movement, capture sediment and nutrients, and shelter aquatic organisms from strong currents (Gordon et al. 1992).

Floodplain forests provide buffers between developed areas and waterways (Daniels and Daniels 2003).

Floodplain forests facilitate the recharge of aquifers during periods of inundation (Verry et al. 2000, Gordon et al. 1992).

Floodplain forests facilitate the transfer of nutrients from aquatic to terrestrial ecosystems by capturing organic matter and sediments from floodwaters during periods of inundation (Gordon et al. 1992).

Floodplain forests provide a natural filtering system for stormwater runoff (Daniels and Daniels 2003).

New Hampshire's floodplain forests provide important habitat for native wildlife, including wood turtle, northern leopard frog, American woodcock, northern oriole, blue-gray gnatcatcher, yellow-throated vireo, otter, eastern red bat, and silver-haired bat (NHFG 2005).

Implementation Strategies

- Avoid or minimize clearing and other construction activity within floodplain forests.
- Locate houses to discourage intrusion of pets into floodplain forests.
- Design recreational facilities to minimize impacts on floodplain forests.

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Headwater Streams

Issue: Alteration of headwater streams can degrade important aquatic habitat and affect flow regimes and water quality downstream in the watershed.

Objective

- Avoid destruction and degradation of headwater streams and adjacent riparian habitats from development and other human activities.

Justification & Benefits

Streams are categorized based on their size and relationship to the rest of the stream network. Ephemeral streams flow only during snowmelt or heavy rains; intermittent streams flow for several, but not all months of the year; and perennial streams flow year-round. First-order perennial streams are the smallest distinct channels, and originate from springs and seeps, where groundwater comes to the surface. Second-order streams are formed when two first-order streams join. Third-order streams are formed from two second-order streams, and so on up to fifth-order streams, which are large rivers.

A river's headwaters include the small streams and wetlands in the higher elevations of a watershed. Headwater streams are typically only a few feet wide and a few inches to a few feet deep. They include ephemeral, intermittent, and first- and second-order perennial streams. Headwaters also include small wetlands that are hydrologically connected to stream channels by groundwater.

Headwater streams are numerous and widespread, comprising at least 80% of the stream network in the United States (Meyer et al. 2007a).

Several comprehensive watershed surveys suggest that USGS maps show less than 20% of the actual stream network in humid regions of the country, such as the northeast (Meyer et al. 2007a).

Headwater streams and wetlands are critically important to the health and functions of the rivers they feed, and their destruction or degradation can severely impair downstream reaches. Headwaters play key roles in maintaining water quality and quantity, stream and river channel integrity, and aquatic biodiversity (Lowe and Likens 2005).

Because they are small, headwater streams are highly vulnerable to impacts from terrain alteration and other human activities.

The winding channels, streambed rocks and gravel, debris dams of logs and leaf litter, and streamside vegetation of headwater streams slow surface runoff and enable water to seep into and recharge underlying groundwater.

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In the northeastern U.S., first-order streams contribute approximately 70% of the mean annual water volume in second order streams and approximately 55% of that in fourth and higher order rivers (Alexander et al. 2007).

Terrain alteration and impervious surfaces that increase the rate of flow in headwater streams can increase erosion and sedimentation along downstream reaches.

A study in northern New Hampshire documented declines of spring salamander populations in streams degraded by sedimentation (Lowe and Bolger 2002).

Heavy sediment loads retard the growth of submerged aquatic plants, clog fish and larval amphibian gills, smother fish eggs, disrupt fish behavior, and eliminate habitat for fish eggs and fry (Bjornn and Reiser 1991, Waters 1995).

Streams receive nutrients in the form of leaf litter and other debris, which supports a variety of aquatic invertebrates. Many invertebrates, their eggs and larvae are prey for small fish, salamanders, and mammals such as the water shrew.

Headwater streams remove or transform nutrients more effectively than larger streams through physical, chemical, and biological processes.

Recent research on a sampling of watersheds across North America suggests that half the nitrate removal within a river basin occurs in headwater streams (Meyers et al. 2007).

A study of eight northeastern watersheds suggests that wetlands associated with first order streams are responsible for 90% of wetland phosphorus removal (Meyers et al. 2007a).

A mathematical model based on field data from 14 headwater streams across North America suggests that 64% of inorganic nitrogen entering a small stream is retained or transformed within 1,000 yards (Meyers et al. 2007a).

Some headwater streams process organic material eight times more efficiently than fourth-order reaches downstream (Meyers et al. 2007a).

Processed organic matter forms the basis of food web for the entire river. Nutrients in the form of dissolved organic carbon, particles of fungus and leaf litter, dead plants, insects, fish and other animals, all flow downstream to support populations of other species. In Alaska, a study of fishless headwater streams concluded that enough insects and other invertebrates drifted downstream to support half of the fish population of downstream river reaches (Meyers et al. 2007a).

Headwater streams include a broad array of habitats, from cold, fast-moving brooks with alternating pools and riffles to shallow, muddy seeps, outflows of beaver ponds, and cool, clear springs. Elevation, slope, substrate, channel shape, water chemistry, and surrounding uplands all influence the aquatic life of headwater streams. Studies of three unmapped headwater streams in North Carolina documented more than 290 species of bacteria, fungi, plants, snails,

insects, crayfish, fish, and amphibians, some of which were unique to these environments (Meyer et al. 2007b).

Some fish species, including brook trout, use headwater streams for reproduction, seasonal feeding areas, and refuge during flood conditions.

Headwater wetlands also support important biological diversity. Studies have documented 274 at-risk plant and animal species in isolated wetlands, more than one-third of which are restricted to these habitats (Meyer et al. 2007).

Implementation strategies

- Conduct field survey of parcel to identify headwater streams and wetlands, including springs and seeps.
- Avoid disturbance to headwater streams and wetlands.
- Avoid terrain alteration and impervious surfaces that will increase flow rates in headwater streams.
- Avoid or minimize road crossings of headwater streams.
- Avoid construction activity within 100 ft. of ephemeral, intermittent, first and second order streams, and headwater wetlands.

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Mast stands

Issue: Development may destroy or eliminate wildlife access to stands of nut-producing trees, especially oak, beech, and hickory, which provide high value food sources important to winter survival of some wildlife species, especially black bears.

Objectives

- Ensure access to adequate fall food supply for mast-dependent wildlife.
- Minimize negative interactions between mast-dependent wildlife and people, including
 - Wildlife/vehicle collisions
 - Human exposure to wildlife-borne diseases
 - Property damage from deer and bears.

Justification/Benefits

Wild nuts, known as hard mast, are especially important food sources for native wildlife. New Hampshire's wild nut crops become available during the time of year when wildlife are preparing for winter by storing food or increasing their fat reserves.

American beech and red, white, and black oaks are the most widespread and abundant mast-producing tree species in New Hampshire. Scarlet, chestnut, and swamp white oaks; bitternut, mockernut, pignut, and shagbark hickories; beaked and American hazelnuts; and butternut also occur in New Hampshire, but are less abundant and have limited distribution in the state.

The American chestnut, formerly one of the most important mast-bearing trees in eastern North America, has nearly disappeared since accidental introduction of an Asian virus from Asia in the early 1900's. The resulting blight essentially eliminated the chestnut from New Hampshire's forests by about 1920 (Silver 1957). This loss increases the importance of the remaining mast-producing species.

Another New Hampshire mast-bearing tree, the butternut, is falling victim throughout its range in eastern North America to a rapidly spreading fungus disease (Schlarbaum et al. 1997).

American beech is also being severely impacted by a disease (an insect and fungus complex), which was introduced to Nova Scotia in the mid-1800's (Houston 2004) and reached New Hampshire by 1949 (Gavin and Peart 1993). Studies have shown that diseased beech forests have reduced foliage and mast compared to healthy stands (Storer et al. 2004).

Single ounces of acorns, beechnuts, hazelnuts, and hickory nuts contain 109, 163, 177, and 186 calories, respectively (compared to 15 calories in one ounce of apple) (Nutrition Data 2005).

Production of heavy wild nut crops is typically cyclical. Intervals between heavy crops are typically 2-8 years for American beech, 1-3 years for shagbark hickory, 4-10 years for white oak, 2-5 years for red oak, 2-3 years for black oak, and 4-5 years for chestnut oak (Burns and Honkala 1990). Maintaining a diversity of nut-bearing species within a local area increases the likelihood of at least one good mast crop in a given year.

New Hampshire's native nut-bearing trees typically begin to produce large numbers of nuts at 40-60 years of age (Burns and Honkala 1990).

A typical white oak tree growing in a forest probably produces about 10,000 acorns in a good year (Rogers 1990).

Wildlife species that rely heavily on nuts (hard mast) include black bear; white-tailed deer; red, gray, and northern and southern flying squirrels, eastern chipmunk, white-footed mouse, fisher, pine marten, wood duck, ruffed grouse, wild turkey, and blue jay (Martin et al. 1961).

Black bears are especially dependent on beech nuts in order to accumulate fat reserves for winter, and may concentrate on finding beech nuts above other foods during the fall. Bears may travel up to 100 linear miles outside of their normal range during the fall in order to take advantage of localized sources of nuts, as well as berries, other fruits, and agricultural crops (Miller 1975, Elowe 1987, Kolenosky and Strathearn 1987, Pelton 2003 in Timmins 2004).

Food abundance influences the age at which bears first reproduce, the size and frequency of litters, seasonal movements, and mortality rates (Pelton 1980).

Research in Maine indicates that nearly four times as many female black bears may reproduce in years of high beechnut production as do so in years of poor production (Jakubas et al. 2004).

When female bears lack sufficient fat reserves, fertilized eggs may not implant, fetuses may be absorbed, or cubs may die at birth from malnutrition (Timmins 2004).

Bears are more likely to damage field corn and raid dumpsters, bird feeders, and beehives in years of poor acorn and beechnut crops (Timmins 2004).

Bears prefer birdseed to most available natural foods (Hammond 2002).

Bears that overcome their natural wariness of humans to approach backyard bird feeders are at increased risk of being killed as nuisance bears or by collisions with vehicles (Hammond 2002).

Adult black bears followed by radio telemetry in the vicinity of the Stratton Mountain Ski Resort in Vermont stayed an average of 200-400 m from year-round houses, with avoidance distances varying by sex and season (Hammond 2002).

Implementation Strategies

- Consult with New Hampshire Fish & Game Department biologists to identify locations of
 - black bear habitat blocks
 - important mast standsin your area of interest.

Within or adjacent to black bear habitat blocks

- Avoid construction of houses within 300 m of important mast stands.
- Avoid construction of paved roads within 200 m of important mast stands.
- Maintain travel opportunities between important mast stands and large blocks of protected or undeveloped habitat.

In other areas

- Avoid locating house lots within important mast stands.
- Avoid locating roads between important mast stands and large blocks of protected or undeveloped habitat.

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Natural Vegetation

Issue: Some development approaches remove excessive natural vegetation from the site and replace it with generic landscaping after road and building construction have been completed.

Objectives

- Minimize loss of natural vegetation resulting from construction activities.
- Capture asset value of existing vegetation by retaining special vegetative features of the site (e.g., large diameter shade trees, clumps of native flowering shrubs, patches of native vegetation).

Justification/Benefits

Most of New Hampshire's natural vegetation consists of forests, which currently cover about 84% of the state's area. Retaining natural vegetation on developed sites reduces air pollution, soil erosion, stormwater runoff, heating and cooling costs, and glare and reflection from street traffic. Natural vegetation also provides privacy and visual screening, absorbs sound, and contributes to the aesthetic quality and uniqueness of a property, neighborhood, and community.

Generic landscaping materials often are poorly adapted for site conditions, require water and fertilizer, have a high mortality rate, and require numerous growing seasons to mature enough to provide full benefits. Natural vegetation maintains rural character by enabling new developments to blend into the New Hampshire landscape.

An acre of trees uses about 2.6 tons of carbon dioxide each year (American Forestry Association).

Large (diameter >30 inches) trees in Chicago removed approximately 70 times more pollution from the air in 1991 than small (diameter < 3 inches) trees (Nowak 1994).

The surfaces of leaves and twigs trap particulate pollution that contributes to asthma and other respiratory problems. One study found that a street with no trees had 4-100 times more dust particles in the air than a nearby street with trees (Nelson 1975).

Thirty-seven medium-sized trees on approximately 6 acres can slow stormwater runoff by 37% during heavy rain (Maine Forest Service 2000).

Pavement and roofs retain 5-30% of the rainfall from a 5- to 10-year storm; an average lawn (2-7% slope) retains 75-82%, and a forested area retains 80-95% (Anderson 2000).

Red and sugar maple, basswood, and northern red oak trees in full foliage block more than 80% of the sun's visible radiation (Moffat et al. 1994).

Air pressure from winter winds affects the air in a building by pushing out air that is already warmed and pushing in cold air that has to be heated. A building's heat loss due to wind is

proportional to wind speed squared - as wind speed doubles, heat loss quadruples (Moffat et al. 1994).

A study in central Pennsylvania found that wind speeds 2 meters above the ground were 60% lower in winter and 67% lower in summer in a residential neighborhood with 67% tree cover compared to a neighborhood with no trees (Heisler 1990).

A typical mature deciduous tree evaporates 100 gallons of water per day during sunny summer weather, using about 660,000 BTUs of energy and cooling the air as effectively as five average (10,000 BTU) air conditioners (Moffat et al. 1994).

Approximately 3-8% of current electric demand for cooling is used to compensate for urban heat islands. A city's resulting demand for electricity increases by 1.5-2% for each temperature increase of one degree Fahrenheit (Akbari et al. 1990 in McPherson 1994).

Computer simulations suggest that increasing vegetation is a more cost-effective strategy for mitigating heat island effects than reducing fuel use with energy-efficient vehicles and appliances (Akbari et al. 1988 in McPherson 1994).

Vegetation scatters transmitted sound (Aylor 1972); wind moving through foliage and birds singing from trees and shrubs can mask offensive noise (Robinette 1972).

Mature vegetation can add 6-15% to the value of developed land and 20-30% to that of undeveloped land (Minnesota Society of Arboriculture 1996).

Twenty years of extensive research suggests that 15% tree cover in urban districts, 25% in urban residential and light commercial districts, and 50% in suburban residential districts are appropriate landscaping goals (Smith 1999).

Tree replacement (including purchase, delivery, and planting) costs \$214-\$455 for a one-inch diameter sapling and \$1360-\$2890 for a 5-inch diameter tree, depending on delivery distance (information from a central New Hampshire nursery).

Implementation Strategies

- On large lots, minimize the disturbed footprint of the development.
- Identify existing trees and vegetation patches to retain for landscaping.
- Design site plan to incorporate existing trees and vegetation patches into permanent site landscaping. Large shade trees, such as oaks and maples, and native flowering shrubs, such as dogwoods and shadberries, make attractive choices for retention in lawn areas.
- Avoid locating driveways, high pedestrian-use areas, and excavation and fill sites within the root protection zones of trees and vegetation patches designated for retention .
- Protect designated trees and vegetation patches during construction activities.

Definitions

Root Protection Zone: the area extending from a tree's trunk to the dripline of its longest branches.

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Shorelands and Riparian Areas

Issue: Development near wetlands and surface waters may result in removal of natural vegetation along banks and shorelines. Naturally vegetated streambanks and shorelines protect water quality and provide important wildlife habitat. Removal of riparian vegetation can result in serious damage to water quality and overall health of aquatic habitats within a watershed.

Objectives

- Maintain functional riparian and shoreland buffers to protect water quality.
- Maintain functional riparian habitat.

Justification/Benefits:

Riparian areas are upland habitats adjacent to wetlands and water bodies.

Soils in riparian areas are highly productive. Runoff from surrounding uplands and occasional flooding concentrate nutrients, sediments, and organic debris in riparian areas and high water tables provide abundant moisture to support plant growth.

Riparian areas support lush, diverse vegetation. Many plant species growing in riparian areas are adapted to tolerate flooding.

Natural vegetation in riparian areas slows surface runoff during storm events and snowmelt, enabling water to infiltrate the soil and sediments, nutrients, and debris to settle out before reaching the wetland or water body.

During flood events, riparian vegetation stabilizes stream banks and shorelines and traps debris and sediments, thus reducing erosion and sedimentation which can degrade water quality.

Riparian vegetation physically slows floodwaters and uses large volumes of water and nutrients that would otherwise enter wetlands and water bodies.

Loss of riparian vegetation along small intermittent streams can mobilize large amounts of sediment and cause significant water level fluctuations in wetlands and waterbodies downstream (Chase et al. 1995).

Riparian habitats typically support higher biological diversity than adjacent upland and aquatic habitats (Porter 1981).

Natural vegetation along streams and rivers helps maintain suitable conditions for aquatic wildlife by shading the water, minimizing sedimentation and nutrient input, and providing large woody debris which is essential to many aquatic species.

Loss of shade increases water temperatures and temperature fluctuations, reducing dissolved oxygen available to aquatic animals and can increase stress from toxic compounds.

Some aquatic animals, such as brook trout, require clear, cool, well-oxygenated water.

Heavy sediment loads in water inhibit the growth of algae and other aquatic plants that form the basis of the food web in these ecosystems, reduces visibility for aquatic animals, and clog gills of fish and larval amphibians.

Riparian vegetation is an important source of organic debris in aquatic habitats. This debris provides nutrients, shelter, and substrates for attachment of eggs and non-mobile invertebrates.

Reduced riparian buffers are associated with decreased in aquatic biodiversity in streams (Vannote et al. 1980).

The lush vegetation of riparian areas provides an important wildlife food source in the spring. Snow melts earlier in valleys than surrounding uplands, and large mammals seek the green vegetation of riparian areas after emerging from hibernation (bears) or leaving their wintering areas (deer and moose).

Insects and feed on lush riparian vegetation and flying species with aquatic larvae provide important food sources for breeding and migrating birds. Riparian forests tend to support higher bird density and species richness than adjacent upland forests of similar vegetative structure and composition (Stauffer and Best 1980).

Riparian vegetation provides nest sites for waterfowl, which nest in tree cavities (wood duck, common goldeneye, common and hooded mergansers) or on the ground (American black duck, mallard, ring-necked duck,) up to several hundred meters away from the water (DeGraaf and Rudis 1986).

At least 15 of New Hampshire's breeding bird species require both wetlands or water bodies for foraging and nearby upland areas for nesting (DeGraaf and Rudis 1986).

Riparian areas provide relatively safe corridors for wildlife to travel through developed areas between important habitats.

Turtles spend much of their lives in aquatic habitats but nest in upland habitats, and may travel long distances to find suitable nest sites in loose dry soil.

Wood, spotted, and Blanding's turtles travel overland for many miles during spring and summer to forage and find mates as well as to nest, and depend on dense vegetation to protect them from predators.

Star-nosed moles, water shrews, northern ribbon snakes spend their lives in riparian areas.

Implementation Strategies

- Identify and map wetlands and water bodies, including streams and wetlands not shown on USGS topographic maps, and associated buffers on or adjacent to the property.
- Delineate boundaries of buffer areas on all lots with permanent markers (e.g., metal markers attached to trees).
- Avoid removal of natural vegetation within designated buffers.
- Avoid road crossings of streams and wetlands.
- Avoid construction of roads or houses within 100 ft. of wetlands and water bodies.
- Maintain connectivity among wetland and water bodies.

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Vernal Pools

Issue: Development can destroy the temporary wetlands and adjacent upland areas that populations of vernal pool-breeding amphibians require for survival.

Objectives

- Maintain adequate upland and wetland habitat to support populations of vernal pool-breeding amphibians.
- Minimize degradation of pools and surrounding habitats by development and human activity.

Justification/Benefits

Vernal pools are small, seasonally flooded wetlands that are isolated from permanent waterbodies. Because they are isolated and typically shallow, most pools dry up during summer months, and thus do not support fish populations.

Some amphibians and invertebrates are specifically adapted to breed in temporary, fishless ponds. In New Hampshire, these species include Wood Frogs, Marbled, Blue-spotted, Jefferson, and Spotted salamanders, and fairy shrimp. Wood frog egg masses lack toxic compounds characteristic of the eggs of amphibians that breed in permanent water that have fish (Henrikson 1990, Crossland 1998 *in* Calhoun and deMaynadier 2004), and the larvae of wood frogs and pool-breeding salamanders have insufficient defensive adaptations to survive fish predation (Kats et al. 1988 *in* Calhoun and deMaynadier 2004).

Additional species of amphibians and invertebrates use vernal pools for feeding, breeding, or safe resting areas but do not require them. These include clam shrimp, fingernail clams, caddisflies, four-toed salamanders, eastern newts, spring peepers, American toads, grey treefrogs, and green frogs.

Vernal pools provide important foraging habitat for many animal species, including Spotted and Blanding's turtles. Vernal pools are critically important to these turtles in the early spring, when they emerge from hibernation with low energy reserves. Vernal pools, with concentrated invertebrate and amphibian eggs and larvae, provide rich food sources and relative safety from predators.

The total weight of amphibians breeding in a vernal pool in Massachusetts was greater than the total weight of breeding birds and small mammals in 50 acres of surrounding forest (Windmiller 1990).

Among the vernal pool amphibians, spotted and blue-spotted salamanders and wood frogs are relatively common and widespread, while others are rare. Marbled Salamanders are endangered in New Hampshire; Blanding's and Spotted turtles and Jefferson's salamanders are species of conservation concern.

Although vernal pool specialists sometimes breed in permanent waters that support fish populations, their breeding success is extremely limited in such sites, resulting in low

recruitment of juveniles and thus, low long-term survival (Petranka 1998 in Calhoun and deMaynadier 2004).

Individuals typically return to breed in the same vernal pool they grew up in (Duellman and Trueb 1986, Berven and Grudzin 1990, Sinsch 1990).

Vernal pool amphibians typically remain in a pool for about two weeks to breed and spend the rest of the year in the surrounding landscape, leaving their eggs in the pool to develop and hatch.

Researchers have found that salamanders travel at least 500 ft (152 m) from their breeding pools, and juvenile wood frogs disperse as far as $\frac{3}{4}$ mile (1200 m) from the pools in which they hatch (Calhoun and deMaynadier 2004).

More than 700 species of multi-cellular animals, including 22 vertebrates, have been reported from vernal pools in the glaciated Northeast. (Colburn 2004).

The diversity of species in a particular pool depends on many factors, including size, depth, hydrology, water chemistry, and surrounding upland habitat. Pools in close proximity often support very different species of wildlife (especially invertebrates), so each pool contributes significantly to the biodiversity of the surrounding landscape (Colburn 2004).

Vernal pools produce a substantial amount of invertebrate and vertebrate prey for other wildlife in the forest ecosystem, and are important linkages, or “stepping stones” for wildlife traveling among wetlands.

Adult vernal pool amphibians play an important role in the ecology of the surrounding forest up to 0.25 mi from a breeding pool, consuming insects on the forest floor and providing prey for other wildlife species (Semlitsch et al. 1996, Skelly et al. 1999, Wilbur 1980, Pough 1983, Ernst and Barbour 1989).

Vernal pool amphibians may play an important role in forest nutrient cycling by regulating soil invertebrates that break down organic materials (Burton and Likens 1975, Wyman 1998 in Calhoun and deMaynadier 2004).

Frogs and salamanders are vulnerable to drying out, due to their thin skin, and therefore require upland habitats that are damp and relatively cool. They survive best in areas with deep, uncompacted leaf litter, downed woody debris, and patches of canopy shade (deMaynadier and Hunter 1995, DiMaura and Hunter 2002 *in* Calhoun and deMaynadier 2004).

Wood frog numbers declined by 40% and spotted salamander numbers by 53% within four years after construction began at a development that affected approximately 25% of the forested upland within 1000 ft. of a breeding pool in Massachusetts (Windmiller *in* Calhoun and Klemens 2002).

Vernal pools are commonly destroyed or degraded simply because they are not recognized as important habitats.

Alteration of the uplands surrounding a vernal pool can seriously degrade its habitat value.

Existing federal and state wetlands regulations do not adequately protect vernal pools, primarily because of their small size and isolation from permanent waterbodies.

Implementation Strategies

- Identify shallow, isolated wetlands that could be seasonal pools on National Wetland Inventory (NWI) Maps and on aerial photos. Conduct field surveys to verify whether identified wetlands are seasonal pools. Document locations of vernal pools on the site plan.
- Avoid any disturbance to a pool basin and associated vegetation.
- Avoid actions that will degrade the water quality in a vernal pool.
- Avoid actions that will cause a loss of tree canopy, compaction of soil and leaf litter, creation of deep ruts, erosion, sedimentation, or alteration of vegetation and coarse woody debris within 100 feet of a pool.
- Avoid permanent construction and minimize vegetation removal and terrain alteration within 400 feet of a pool.
- Minimize roads, developments, and other fragmenting features between pools, and between pools and other wetlands.

Definitions

Mole salamander: Any salamander of the genus *Ambystoma*, all of which spend most of their time in underground burrows.

Vernal pool: A seasonal water body that is deepest in spring or fall, lacks a permanent surface water connection with other wetlands or water bodies, and lacks an established fish population (Calhoun and Klemens 2002).

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Woodland Raptor Nests

Issue: Suitable trees for raptor nests are limited in number and elimination of nest trees can lead to population declines.

Objectives

- Avoid disturbance of nesting raptors
- Avoid removal of or damage to active and potential nest trees
- Minimize disturbance to areas surrounding known and potential nest trees
- Avoid removal or degradation of critical nesting, foraging, and wintering habitat

Justification/Benefits

Raptors, or birds of prey, capture other vertebrate animals for food. Prey for various raptor species may include birds, mammals, reptiles, amphibians, fish, and large insects.

Hawks and owls are important predators in New Hampshire's forests, helping to regulate populations of prey species, particularly rodents.

Eleven species of forest-dwelling raptors breed in New Hampshire, including seven species of hawks and four species of owls.

Raptors need large home ranges compared to other forest birds in order to find enough food to survive and raise young. Saw-whet owls, New Hampshire's smallest raptors, have home ranges of about 350 acres (Simpson 1972). Larger species of hawks and owls may use areas ranging from 0.3 sq mi to more than 2 square miles (DeGraaf and Rudis 1987).

Forest-dwelling hawks build large stick nests supported by strong branches. Such nests are typically placed against the trunk of a white pine on a whorl of branches or in a three-pronged fork of a large deciduous tree.

Large trees are necessary to support hawk nests. Northern Goshawk nest trees typically have diameters of at least 12" (Speiser and Bosakowski 1987) and those of Red-shouldered Hawks, at least 17" (Nelson and Titus 1988).

Unlike songbird nests, which seldom survive a New England winter, the large stick nests of hawks persist for multiple years and may be used by the same pair or by a succession of species over the course of many breeding seasons.

Owls do not build their own nests, but use tree cavities and old nests of hawks or great blue herons.

Saw-whet Owls and Eastern Screech-Owls nest in cavities of trees at least 12" in diameter; Barred Owl cavity nests are in trees with diameters of at least 20" (Thomas et al. 1979).

Many of New Hampshire's forest raptors are relatively tolerant of human activity, and may nest within sight of houses if there is adequate habitat for hunting nearby.

Implementation Strategies

- Inspect large trees for the presence of cavities and large stick nests.
- Maintain undeveloped open space for approximately 165 ft (50 m) around trees with large stick nests.
- Retain large cavity trees when clearing for development.

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Wetlands

Issue: Development sometimes results in degradation of wetland habitat through alteration of adjacent uplands, dredging or filling of the wetland itself, or increased human activity.

Objectives

- Avoid loss and degradation of wetland habitats.
- Maintain ecological functions of wetlands.

Justification/Benefits

Wetlands occur in sites where the water table is at or near the surface of the ground. They may be transitional areas between open water and upland ecosystems, or they may be isolated from open water habitats. Wetlands occur in freshwater, saltwater, and estuarine environments.

All wetlands share three characteristics:

- very poorly drained (hydric) soils;
- flooding during all or part of the year; and
- presence of plants that are adapted to survive in flooded or saturated soils.

In New Hampshire, common wetland types include floodplain forests, swamps, marshes, peatlands, seasonal pools (see separate topic), seeps, and springs (see definitions below).

Wetlands and their associated riparian areas are ecologically important, supporting a high diversity of plant and animal life.

Wetlands play important roles in protecting water quality, storing floodwaters, and replenishing groundwater.

Wetlands protect and improve water quality by acting as filters that trap or transform excess nutrients, heavy metals, and other harmful pollutants.

Wetlands act as sponges during storm events or snow melt, absorbing large volumes of water and releasing water gradually into groundwater and downstream flow.

Research suggests that wetland draining and levee construction reduced the storage capacity of Mississippi River floodplains from the equivalent of 60 days worth of river discharge before European settlement to about 12 days of discharge in the late twentieth century, resulting in more frequent and more severe floods (Mitsch and Gosselink 1986).

Coastal wetlands are extremely important for reducing damage from hurricanes and other severe storms. Salt marshes and estuaries absorb much of the energy of storm surges and buffer coastal uplands from the full force of the water.

Wetlands increase the volume of water able to replenish groundwater by holding precipitation and runoff for long periods of time.

Nearly one third of New Hampshire's wildlife species depend on wetlands for all or part of their life cycle.

Aquatic species of invertebrates, fish, amphibians, reptiles, birds, and mammals inhabit permanent wetlands. Terrestrial animals often forage on the abundant food sources in wetlands, including plants, insects, and other prey.

Wetlands provide "stepping stones" across the landscape for small animals that require water and dense cover while seeking food, mates, or nest sites, or when dispersing.

Riverine wetlands that extend along watercourses provide travel corridors for many wildlife species, including wide-ranging animals such as moose, deer, black bear, and bobcat.

Seeps provide important water sources and foraging areas for black bears in spring and early summer (Elowe 1984), and for early spring migrants such as robins and woodcocks.

Seeps and springs provide cool water to nearby streams during hot summer months when water temperature and dissolved oxygen may limit survival of some fish and other aquatic species.

Implementation Strategies

- Avoid dredging and filling of wetlands.
- Use cluster subdivision design to minimize impacts on wetlands.
- Avoid fragmenting wetland clusters with roads and buildings.
- Avoid use of heavy equipment within 50 ft. of a spring or seep.
- Avoid constructing roads or buildings downstream of seeps where they would intercept water flow.
- Maximize undeveloped open space adjacent to wetlands.
- Minimize disturbance of uplands that drain directly into wetland basins.
- Minimize human activities near wetlands that negatively impact water quality, wildlife populations, or wildlife habitat.
- See also implementation strategies for Shorelands and Riparian Areas.
- Maintain safe access for wildlife between wetlands and areas of undeveloped upland habitat.

Definitions

Floodplain forest: forest on low terraces along river banks that are inundated by overflow during periods of high water. Silver maple dominates floodplain forests along New Hampshire's major rivers; floodplain forests along smaller rivers are more diverse, with red maple, black ash, black cherry, and ironwood as major components and hackberry, American elm, eastern cottonwood, boxelder, sycamore, swamp white oak, and river birch sometimes present.

Marsh: wetland dominated by herbaceous (non-woody) vegetation such as cat-tails, grasses, sedges, and rushes.

Peatland: wetland where dead vegetation accumulates in a thick mat because highly acidic conditions inhibit decomposition. Sphagnum moss is characteristic of peatlands; typical vegetation also includes leatherleaf, labrador tea, bog rosemary, pitcher plant, sundew, wild cranberries, and several species of orchids.

Seep: small area where groundwater comes to the surface, saturating the soil for much or all of the growing season. Sensitive fern, skunk cabbage, and jewelweed often grow in seeps.

Spring: location where water flows out of the ground, originating a stream or feeding an existing water body.

Swamp: wetland dominated by woody vegetation. Shrub swamps and red maple swamps are common in New Hampshire.

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Firewise Construction

DESIGN AND MATERIALS



Colorado
State
FOREST
SERVICE



Firewise Construction

DESIGN AND MATERIALS

Peter Slack



First edition printing, 1999

Revised printing, 2000

To obtain copies of this publication contact the
Colorado State Forest Service at
970-491-6303 or online at csfs.colostate.edu



About the Author

Peter Slack of Boulder, Colorado was a practicing architect for 26 years, until his untimely death in June 2000. Peter's practice included many homes and other buildings in the Interface. His design emphasized the integration of fire-resistive elements with other important design principles such as proper site development for limited impact, low energy and water consumption, and the use of appropriate, resource conserving materials.

Peter was a firefighter and a officer in a high-risk mountain fire district for 19 years. He specifically worked with wildland fire suppression and mitigation issues for much of that time. After fighting Boulder County's two major interface fires, Black Tiger, 1988 and Olde Stage, 1990, Peter participated in Boulder County's WHIMS Program (Wildfire Hazard Identification and Mitigation System). FEMA funded the WHIMS program as a result of those fires. This publication is developed from a lecture on firewise construction that Peter presented for several years.

Acknowledgements

This publication combines Peter's professional knowledge as an architect and builder in the Interface with his experience as a firefighter for 19 years. Added to his experiences is the wealth of information and experience so generously given by the firefighting community. Most of all, it was their assistance in learning to visualize fire in its environment and around our buildings that facilitated the creation of these illustrations.

The following people contributed to this pamphlet by providing a wealth of information.

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Mike Tombolato, chief, Cherryvale Fire Protection District

The many members of the Boulder County WHIMS program, who over many years have developed, to this date, one of the most comprehensive and systematic approaches to understanding the hazards of wildland fire to homes in the Interface.

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I. Introduction

This publication provides homeowners and builders in the Wildland Urban Interface with design and building techniques that can offer more protection from wildland or forest fires. The Federal Emergency Management Agency (FEMA), the Colorado State Forest Service and the Colorado Office of Emergency Management funded this project.

What is the Urban Wildland Interface?

The Urban Wildland Interface, or Interface, is any area where man-made buildings are built close to or within natural terrain and flammable vegetation, where high potential for wildland fires exists.

During the past few decades, population growth in the Interface has increased. Subdivisions and other high-density developments have created a situation where a wildland fire can involve more buildings than any amount of fire equipment can possibly protect.

Fire suppression and increased fuels

The past 100 years of wildland fire and suppression has created more vegetation for fuel.

As population in the Interface has increased, so too has the difficulty of protecting that population from wildland fires. When fires occur in the Interface, we put them out to prevent the destruction of homes. This creates a problem because forests have historically depended on fire to maintain good

health. Fire thins trees and brush and eliminates dead material. By suppressing fires to protect our homes and population, we have interfered with this natural process. Since natural fires are now infrequent, vegetation density has increased, which provides more fuel for fires. When fires do occur, the denser vegetation burns with more intensity, and the fire is more destructive and dangerous.

How can we protect our buildings?

This publication offers a two-part approach to the problem:

1. Build more fire-resistive structures and
2. Reduce the hazards of forest fuels.

If we consider the specific needs of Interface structures, we can combine design elements and construction materials to build more fire-resistive structures. Our goal is to create buildings that can either resist fire on their own, or at least make it easier for firefighters to protect structures safely.

We recognize that building a fireproof structure, as we do in an urban setting, can be prohibitively expensive. This publication discusses how to consider a combination of cost effective strategies that increase the probability of a building surviving a wildland fire.



Combustible house with no defensible space

Solutions to problems in the Interface depend on a two-part approach: Make our buildings more fire resistive and manage the surrounding wildlands. If we leave the surrounding wildland in its current state, we need to build structures that are nearly fireproof. Fireproof structures are far too expensive to build. Conversely, trying to provide a defensible space large enough for a typical, combustibile structure may not be practical or desirable. Choosing the best combination of these two strategies for a particular site requires a basic understanding of wildland fire behavior.

Another goal of this publication is to give the homeowner and builder a better understanding of how buildings in the Interface ignite during a wildland fire. With this information they can make better choices when considering building techniques and materials.

When reading this publication keep in mind that fire is only one of many considerations during building construction. We are not suggesting that any one technique is absolutely necessary, or that you cannot use alternate materials or design elements.

Rather, we want to show you how an awareness of the unique issues facing Interface buildings can direct you toward a more comprehensive solution in the design process. Some design elements and materials may help mitigate fire hazards; and some may not. It is possible, however, to compensate for less appropriate fire protection choices and meet design goals.

Fire intensity and duration related to the fire resistance of a house

How fire resistive should a house be? The answer to this question depends on the fire intensity, (how hot the fire burns), and the fire duration, (how long the fire will last a your site). If the fire hazard is low to moderate, only a few precautions may be needed. If the fire hazard is high or very high, most, or all, of the strategies we describe may be needed.

In Colorado, generally any area surrounded by natural vegetation faces some hazard due to wildland fires. In mountainous regions between elevations of 5,000 and 10,000 feet, hazard is increased due to topography and increased vegetation density. The next section discusses this in more detail.

Evaluating fire hazards

A good way to determine the specific hazard rating at a site is to look at a fire hazard map or study located at the county building or land use department. The Colorado State Forest Service or your local fire protection district may also have information. If this information is not immediately available, use this short evaluation to determine a site's hazard level.

Note: We refer to this hazard rating throughout this publication with respect to design and material elements in building design.

This short evaluation is based on the Wildland Home Fire Risk Meter developed by the National Wildfire Coordinating Group (www.nwccg.com).

Slope	Score
Level:	0
0° - 10°	1
10° - 20°	2
20° - 30°	3
30°+	4

Vegetation

water, bare rock, irrigated lawn	0
grass, shrub, less than 2 feet tall, no trees	1
grass, shrub, less than 4 feet widely dispersed trees	2
dense young shrubs, no dead wood or trees	2
many trees, touching, some grass and brush	3
dense shrubs with some trees	3
thick, tall grass	3
dense evergreen trees with grass and shrubs	4
dense mature shrub with dead branches	4

After selecting the appropriate slope and vegetation scores, add them together to determine the hazard rating.

Scores	Hazard Rating
0	0
1 - 2	low
3 - 4	medium
5 - 6	high
7 - 8	very high

2. Fire Behavior: Fuels, Topography and Weather

Wildland fires and the nature of burning structures

Wildland fires have been studied in great detail to help predict fire behavior. Anticipating the intensity, duration and movement of a wildland fire is very important for both firefighter safety, and as the basis of tactical decisions made during the suppression of a fire.

Understanding fire behavior, especially its intensity and duration at a building site, will help homeowners and builders decide how fire-resistive a house needs to be.

Three factors affect wildland fire behavior:

1. **The fuel for the fire.** The type, continuity and density of the surrounding vegetation provides fuel to keep the fire burning.
2. **The topography of the site.** The steepness of slopes and other land features affects the fire behavior.
3. **The weather.** Wind and humidity affect each fire.

Vegetation is the fuel for wildland fires

The type and density of a specific plant determines how it will burn. Not all vegetation burns the same way. Some vegetation almost never burns; others burn at different times of the year; and some can burn almost anytime.

Deciduous trees and bushes: Trees such as aspen, cottonwood and mountain ash; bushes such as mountain maple and dwarf lilac usually burn only during severe droughts.

Bushes, such as the Gambel oak, serviceberry and sage, can burn either in the fall when leaves have changed or dropped, or when there is an extended dry period.

Evergreen trees with resinous sap:

Pines, spruce and firs can burn any time of year. They usually burn during extended dry weather or high wind events.

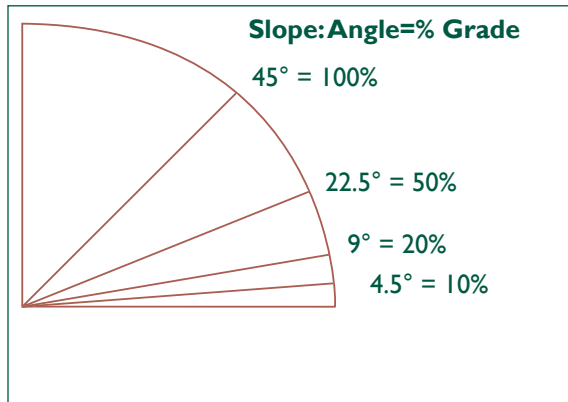
Evergreen bushes: Cedar and juniper can also burn any time of year when conditions are dry.

Grasses. Grasses can burn any time of the year and only need a short dry period before they are receptive to fire. Grass is fire resistive only when it is very green or a good snow cover exists.

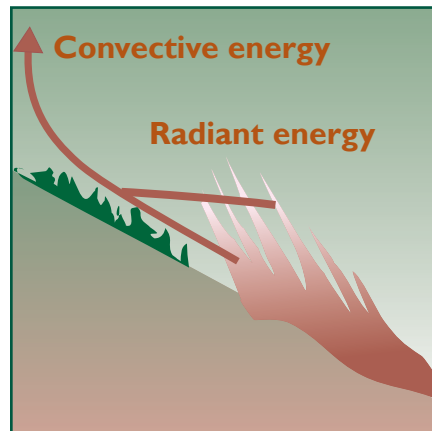
Fire duration and fuel

Fire duration is how long a fire will burn at a particular site. The type of fuel and its density determines a fire's duration. For example, grass is a light fuel. It will burn in less than five minutes and produce relatively less heat than heavier fuels would produce. Medium fuels, such as brush, burn five to 10 minutes with more heat. Large trees are considered heavy fuels because they burn from 10 minutes to over an hour with the most heat.

Understanding this is very important to determine how long a house must



Slope chart



Convective and radiant energy from a fire

resist a fire. Different building materials can resist fire for different time periods.

Fire behavior and slope

Slope is the angle of the ground relative to the horizon. It is commonly measured in either degrees or as a percent. Slope topography shows the steepness of the slope and the shape of the land.

The steeper the slope, the more quickly a fire moves and the hotter it burns.

For example, **a fire will spread twice as fast on a 30 percent slope than it will on level ground.**

This means that a house located on a steep slope needs more fire resistance.

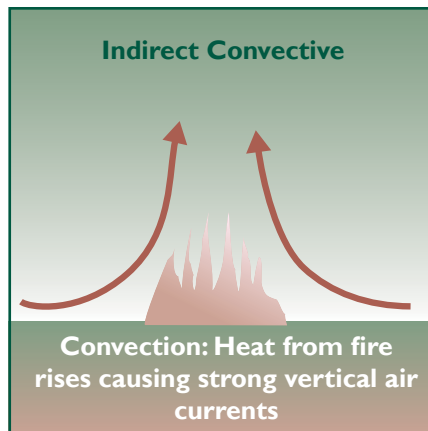
Fire behavior, ignition of fuels: mechanisms of heat transfer

As a fire burns, it releases hot gas and air from the combustion of burning vegetation or buildings. These gases move up the slope, drying and preheating any vegetation in the fire's path. The fire also releases large amounts of radiant energy, like that of the sun, which also heats and dries the fuels. Once flames make contact with these plants, they ignite more easily. This in turn speeds up the rate at which the fire moves and increases its intensity. Look more closely at the mechanisms of fire and how fire ignites a building by studying three categories of heat transfer:

1. indirect convective heating and lifting
2. indirect radiant
3. direct contact or impingement.

Convective lifting

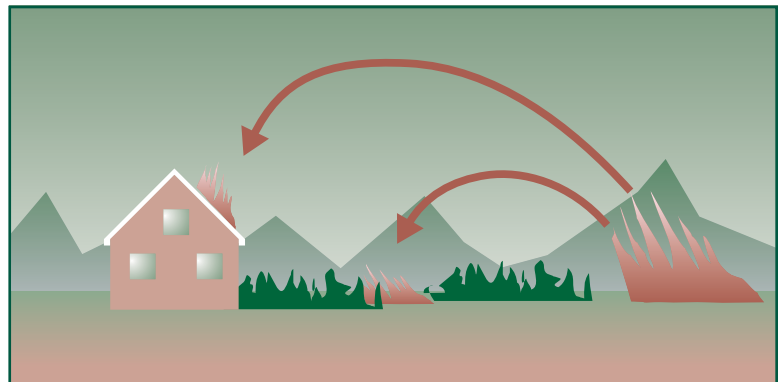
Fire produces hot gases that rise and carry partially burned substances and smoke into the atmosphere. During a wildland fire this atmospheric effect can be very strong, even causing its own wind as cooler air rushes in to replace the rising hot air.



Convective lifting

Convective vertical air currents can also lift burning materials or embers, called firebrands, and carry them horizontally for long distances from the fire.

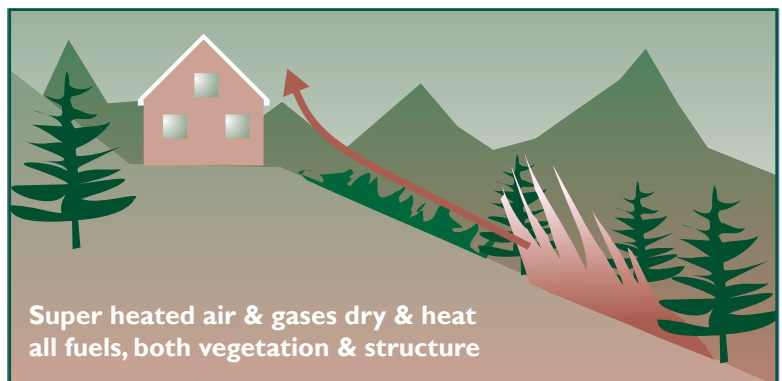
Once out of the rising air currents, firebrands fall back to the ground and onto horizontal surfaces such as combustible roofs, decks and dry vegetation around a house. This effect, called spotting, can be very widespread. Firebrands often travel hundreds or even thousands of feet in front of the actual fire.

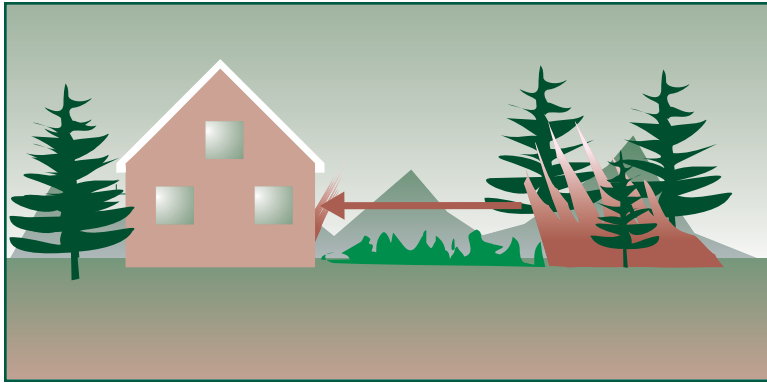


Firebrands, transported by convective lifting, create spot fires

Indirect: Convective Heating

The same hot air and gasses that dry and preheat vegetation do the same thing to a building, making any combustible materials ready to ignite once the fire gets closer.





Radiant heating

Indirect: radiant heating

Buildings can be preheated, even ignite and burn, from the transfer of heat by radiant energy from the fire. This is similar to sunlight heating objects, but fire heats only in the infrared portion of the light spectrum. Radiant heat transfers on a straight line of sight and can be reduced by barriers.

Vertical surfaces, such as siding, can ignite from this effect well before fire actually reaches the building. Large heavy fuels, once ignited, burn with high temperatures that amplify radiant energy, creating more potential for ignition through heat transfer.



Fire directly impinging on a house

Direct contact or impingement

Continuous and abundant fuels like those found in unmanaged vegetation areas provide a direct path for a fire to contact a building. Creating defensible space and fuel breaks around a building is specifically intended to reduce this effect.

Weather

Weather is a major factor affecting fire behavior and is, of course, highly variable in terms of time, intensity and location. During extended periods of low moisture, the possibility of wildfire increases. Weather can also increase and intensify fire behavior when there is low humidity and high winds.

Colorado's fire season is highly variable. Typically, winter and spring have few

wildfires; summer and fall have more wildfires. However the period between winter and spring, after the snow has melted but the vegetation has not yet greened, is often a period of high fire occurrence.

Colorado typically has 50 to 100 days a year of critical fire weather when severe wildfires are possible. More "fire days" occur at lower elevations while fewer "fire days" occur at higher elevations.

3. Building Site Location

Topography and vegetation: fire behavior and intensity

The location of a structure will influence the intensity and duration of the fire to which it is exposed. As discussed in the fire behavior section, we know at any location how intense a fire will be; how long it will be there; and how fast it will travel, based on the surrounding topography and vegetation.

When choosing a site location or determining the level of fire resistance a building requires, the builder or homeowner should be aware of how the local vegetation and topographic variations affect fire behavior.

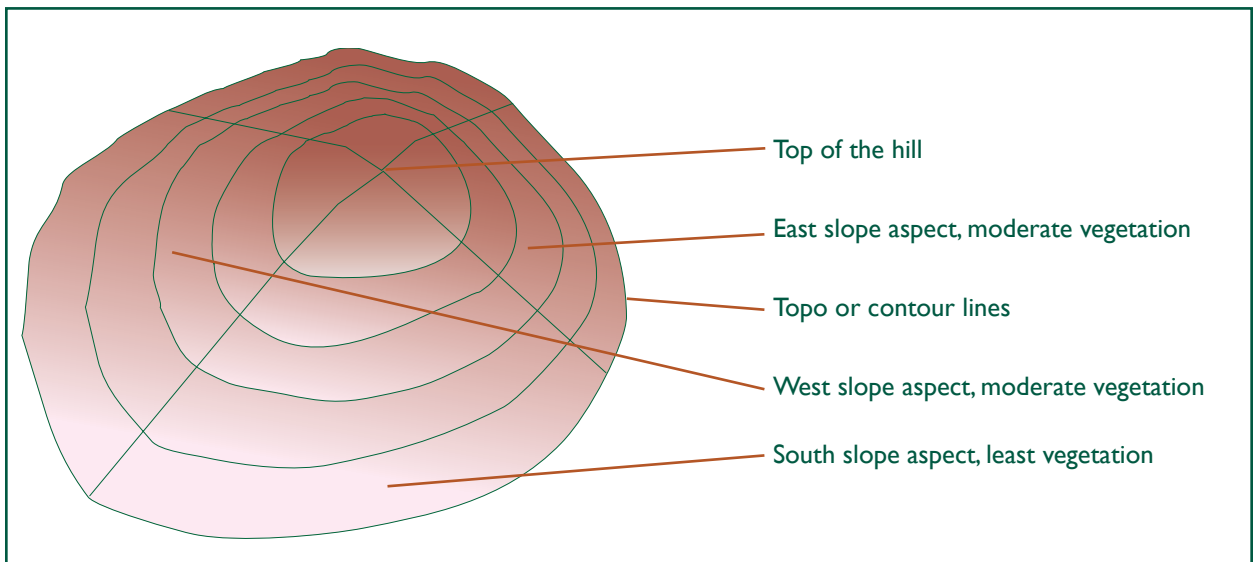
Aspect

Aspect is the direction that a site's slope faces. Vegetation varies widely between the extremes of south facing and north facing slopes.

South slopes tend to have the least vegetation in an area because they quickly dry out and have less available moisture for plants. Since there is less fuel on south facing slopes, fire burns with less intensity than on other slopes with more fuel.

East and west slopes generally have more vegetation than south slopes. They are more prone to drying out in the summer when the sun is high in the sky. Fire potential increases on these slopes during the summer season.

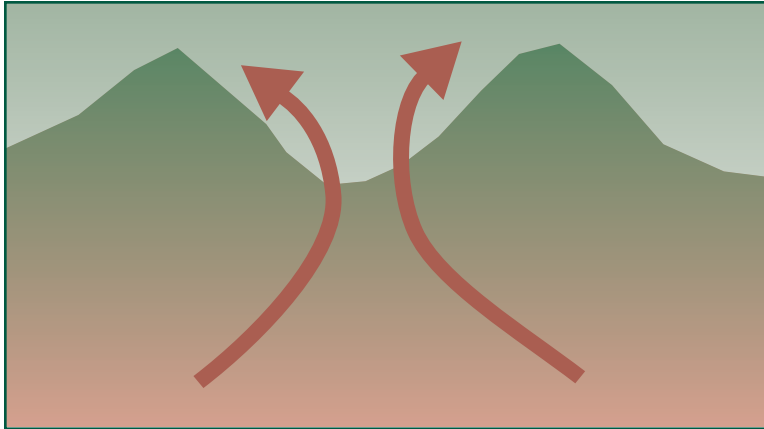
North slopes typically have the most dense vegetation because there is more water available for plants. The higher moisture content of the vegetation on north slopes means that fires occur there less frequently. However, when fires do occur, they burn with more intensity because there is more fuel.



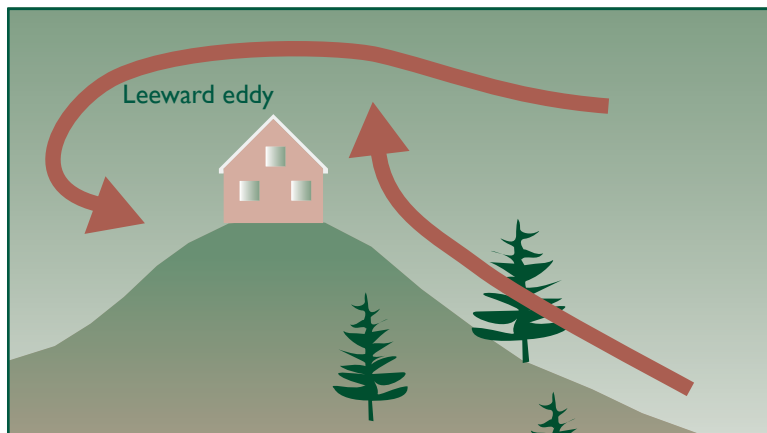
Aspect of slope

Dangerous topographic features: areas of more intense fire behavior

Variations of topographic features such as valleys, ridges, canyons and saddles can be dangerous areas that further intensify or attract a fire.



Saddle, low area on a ridge



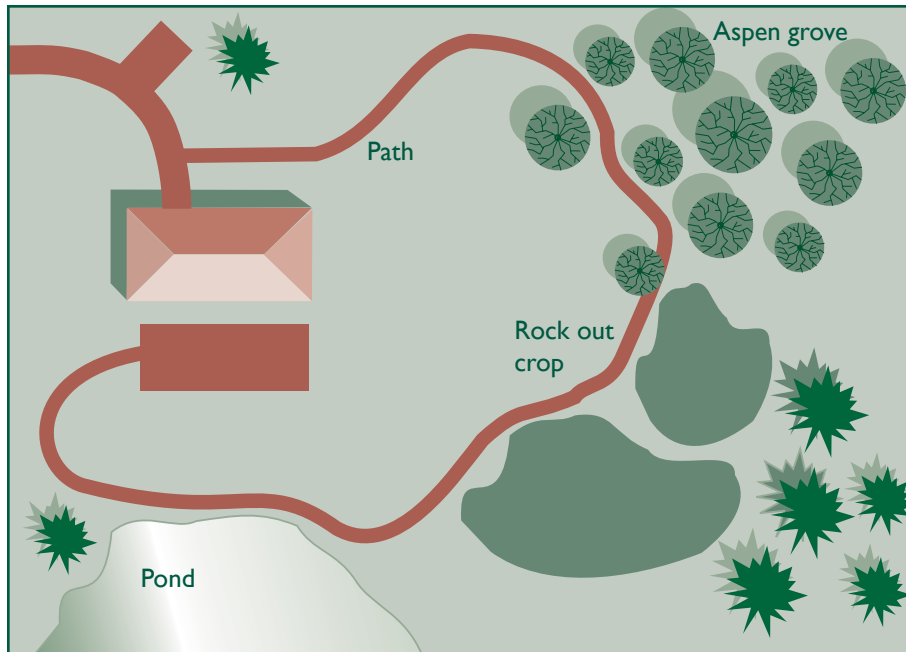
Ridge with wind exposure

A **valley**, as a concave form, tends to collect and concentrate winds. This means that a wildland fire's intensity increases as it moves through a valley. If the valley is narrow with steep sides, such as a **canyon**, this effect is more pronounced.

When a valley crosses a ridge it creates a **saddle** between the higher parts of that ridge. Like a valley, saddles will channel, intensify and speed up a fire. These areas tend to be built upon because they offer some shelter and often flat areas. It is important to recognize that saddles are natural fire paths where fire will travel first, and with more intensity.

Ridges experience more wind primarily because they are elevated above the surrounding land. When a fire moves up a slope toward a ridge, it gathers speed and intensity.

As the wind crosses a ridge it usually has a leeward eddy where the wind rolls around and comes up the leeward side, exposing both sides of the structure to wind and fire. There are usually no areas on ridges to provide protection from the fire.



Site: House located relative to natural features that buffer against fire

Natural barriers and buffer zones

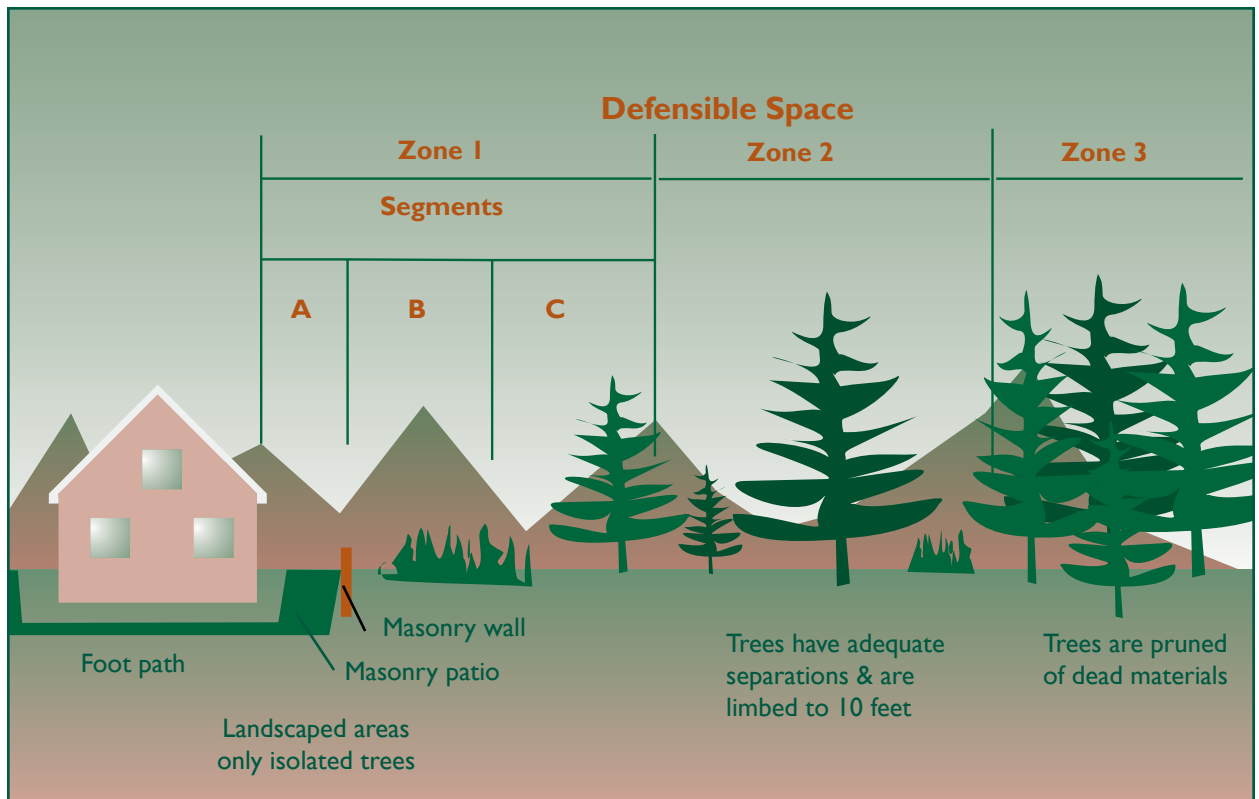
Some physical features will reduce fire behavior and can be used to slow, reduce or deflect a fire. Some examples of these beneficial barriers are natural rock outcroppings, wetlands, streams, lakes and deciduous tree stands, (aspen, cottonwood, etc). Take advantage of these features by placing a building so that the natural barrier is between the building and the anticipated path of a fire.

the primary consideration will depend on how high the fire hazard is in the area.

On smaller parcels there may be only one suitable building location. The site's physical features will determine the probable fire intensity and dictate what combination of site modifications and fire-resistive construction is necessary to prevent the building from igniting.

How this affects building location and design decisions

On large parcels of land consider these physical features when choosing the final location of a building. Many other factors such as privacy, views, access and aesthetic values will also effect site location decisions. Fire is just one of these factors. Whether or not fire is



Defensible space

Site design and modifications to the forest: developing a defensible space

After evaluating the fire hazard rating of a site, develop a plan to manage the surrounding forest and defensible space. This is the first part of our two-part strategy to build a fire-resistant structure. **Defensible space** is the area around a building that has been significantly modified to reduce a wildfire's intensity just enough to prevent the fire from igniting the house. The defensible space will also allow firefighters to more safely defend the house. It can also help prevent a house fire from spreading to surrounding vegetation.

A diagram of the features at a building site would show that moving away from

the building out into the wildland, the features gradually shift from man-made to more natural elements. We divide this gradation into zones. Developing a defensible space plan requires an inventory of the existing site features and analysis of how hazardous they are. Man-made elements are landscaping features such as masonry walls, patios, footpaths and driveways. These features create barriers and buffer zones.

The area next to the building (Zone I-A) should contain primarily noncombustible surfaces. Any planting in this zone should be only deciduous, well-trimmed and irrigated. Ground covers should be flowerbeds and cut grass.

Moving away from the building, the next area (Zone I-B) can have more

landscaping and less man-made surfaces. Vegetation should still be deciduous trees, bushes and grass can be native, but they must be kept trimmed to fewer than 6 inches tall.

Moving farther away from the building to (Zone 1-C) the landscaping should change from introduced deciduous plants to natural vegetation, including evergreens. These trees or bushes should be far apart and well maintained by trimming.

In Zone 2 the landscape is entirely natural vegetation that is intensely managed or modified. Trim dead material from natural vegetation closest to the buildings. Prune all limbs to 10 feet above the ground. Thin trees so that a minimum of 10 feet separates the tree crowns.

Moving vegetation farther away from the building into Zone 3, the forest management gradually becomes less intensive and subtler. Tree limbs need to be pruned only 4 to 5 feet above

the ground. Tree crowns can be closer together.

Remember, the more intensive and wide-ranging modifications you make in the defensible space, the less the need for fire-resistive materials and building design. Conversely, fewer modifications to the surrounding wildland increase the need to use fire-resistive materials and design for the building. These two strategies work together to achieve the goal of building a firewise structure that does not burn when wildfires occur.

4. Building Design

So far we have discussed elementary fire behavior and how to manage the wildlands surrounding an Interface building. The second part of our approach to building fire-resistive structures is learning about appropriate design and material choices.

Simple vs. complex forms

Simple building forms have less surface area relative to the volume of the building. Complex building forms have much more surface area relative to volume. Simple building forms are less expensive to build, more energy efficient and easier to protect from wildland fires. There is simply less exterior surface to protect.

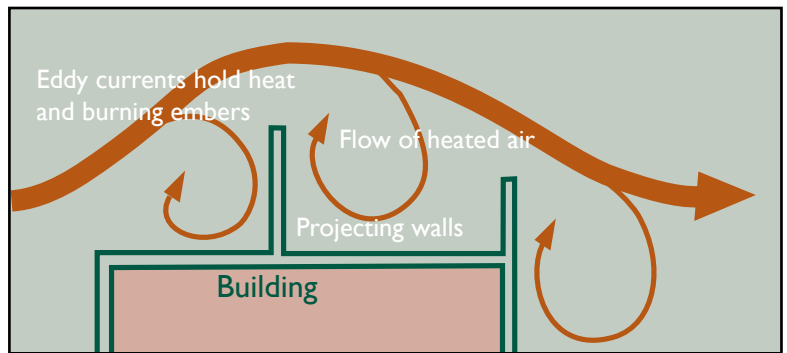
Complex forms not only increase the surface area of the structure, but also create shapes that trap the fire's heat. These areas are called heat traps. Transitions between vertical surfaces and horizontal surfaces, inside corners between two walls or abrupt intersections of different solid planes form pockets where wind velocity drops and eddies form.

Parapet walls, solar collectors, roofs intersecting walls, roof valleys and decks are examples of heat traps.

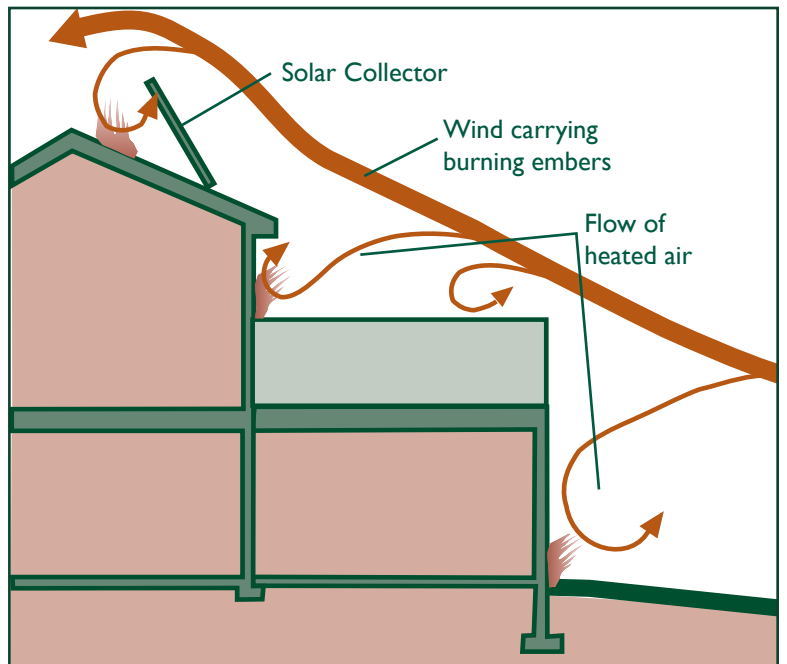
These forms cannot be avoided, and their locations require much more attention to fire-resistive materials.

When wind speed decreases burning embers falls most often at the locations described above.

Roofs are very susceptible to firebrands in a wind driven fire.

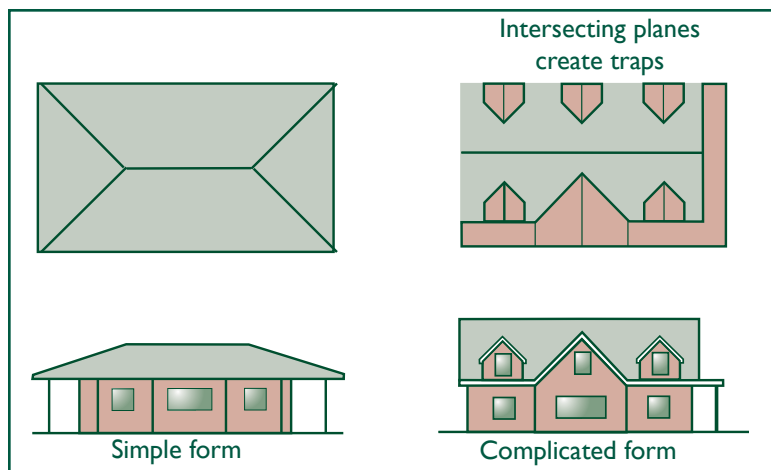


Heat traps around walls



Heat traps around roofs

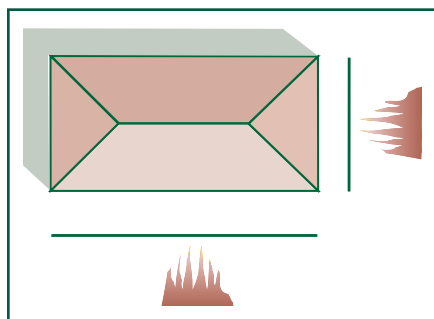
A simple roof form such as a hip or straight gable is best. Complicated roofs with intersecting planes and valleys form dead air pockets and eddy currents. The use of complicated forms further highlights the importance of a truly fire-resistive roof.



Roof forms

Aspect ratio

Aspect ratio is the ratio between the east-west axis and the north-south axis. In Colorado's climate it is generally better to have a structure that is longer on the east-west axis than the north-south axis. Such a structure has a more favorable energy relationship with the



climate and can gain the benefits of the sun's passive solar heat.

With regard to fire, if a house presents its widest exterior in the direction from which a fire is likely to come, it will be more vulnerable. More fire-resistant materials and components are needed on the side that faces the oncoming

fire. On a flat site the direction of a fire is somewhat unpredictable, but it will generally be determined by the predominant winds and fuel.

The probable fire path is more easily predicted on sloping sites. Fire can be expected to approach up the slope. On east and west facing slopes, placing the building on the longer east-west axis works well for both energy and fire considerations. The building presents its widest side to the winter sun and its narrowest side to the fire path.

Remember, a building can contradict these principles. In that case the building will require more fire-resistant building materials and components when simple forms and optimum aspect ratios cannot be used.

Vents, eaves, soffits and decks

Building a fire-resistant house can be compared to building a watertight roof. One little hole in the roof allows water to leak in, and it doesn't matter how well the job was done on the rest of the roof, it failed and damage occurred.

Small building elements like soffits and vents can be the weak link in a fire. An otherwise fire-resistant house is damaged or destroyed because fire found a way in through these areas.

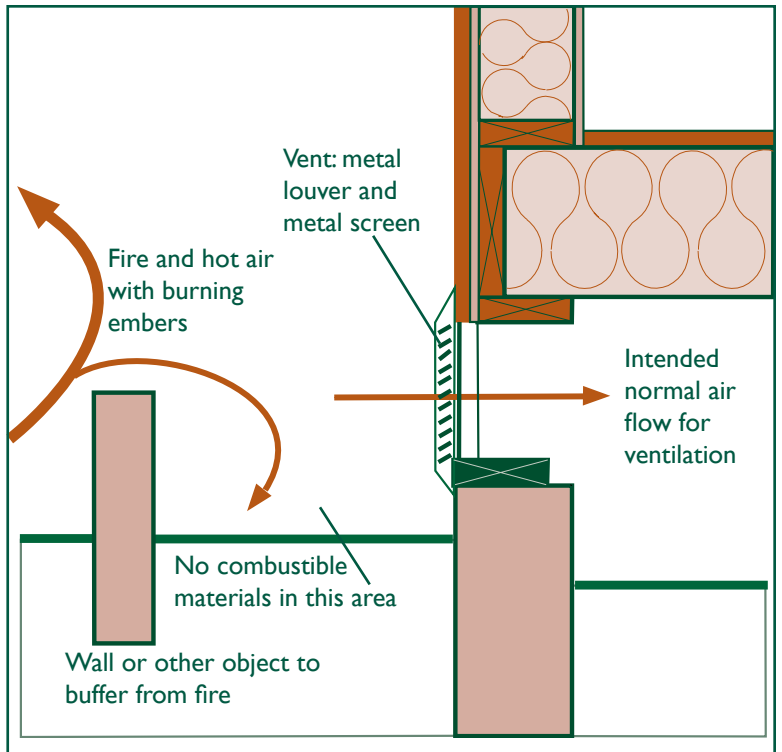
Vents

Vents are required by the building code to prevent accumulation of water vapor. All crawl spaces under wood floors are required to have ventilation. One square foot of vent is required for

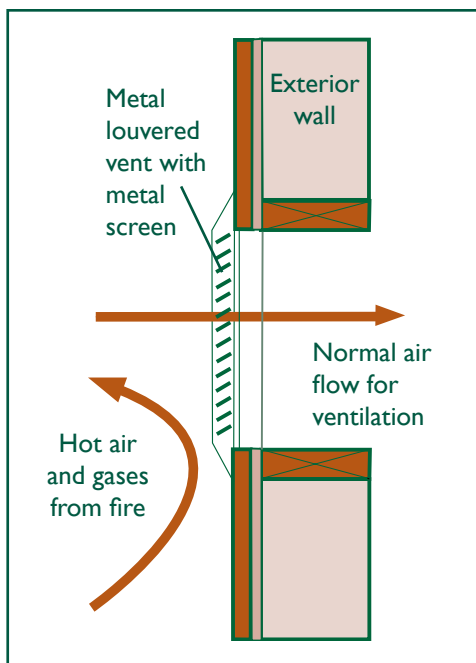
every 150 square feet of floor area. Since these vents are typically located near the ground, care should be taken to not have any combustible vegetation immediately next to them.

Vents located on the downhill side of the house should have landscaping elements like stone patios or walls that block the direct path of the fire. Building codes typically allow alternatives to traditional vents. In some cases louvered vents are permitted. These can be closed when moisture is not a problem. (Fire season is usually the dry season.) Mechanical ventilation with intakes and exhaust located away from the ground or other vulnerable locations can also be used.

All attic spaces and roof cavities are required to have ventilation. One square foot of vent is required for every 300 square feet. of roof. (See eaves and soffits on page 18.) In both cases the vents should be made of metal with wire screen material that has 1/4 inch or smaller openings.



Crawl space ventilation



Attic Vent

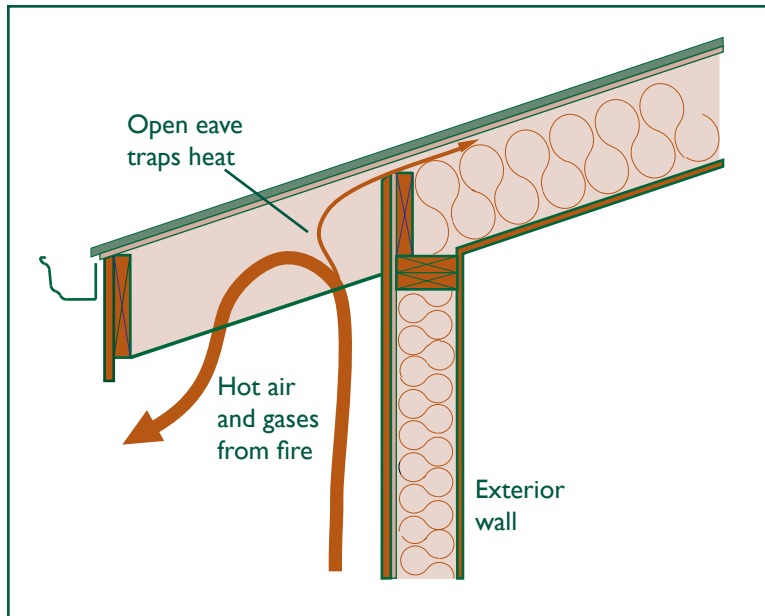
Eaves and soffits

The extension of the roof beyond the exterior wall is the eave. This architectural form is particularly prone to ignition. As fire approaches the building, the exterior wall deflects the hot air and gasses up into the eave. If the exterior wall is combustible this effect is amplified.

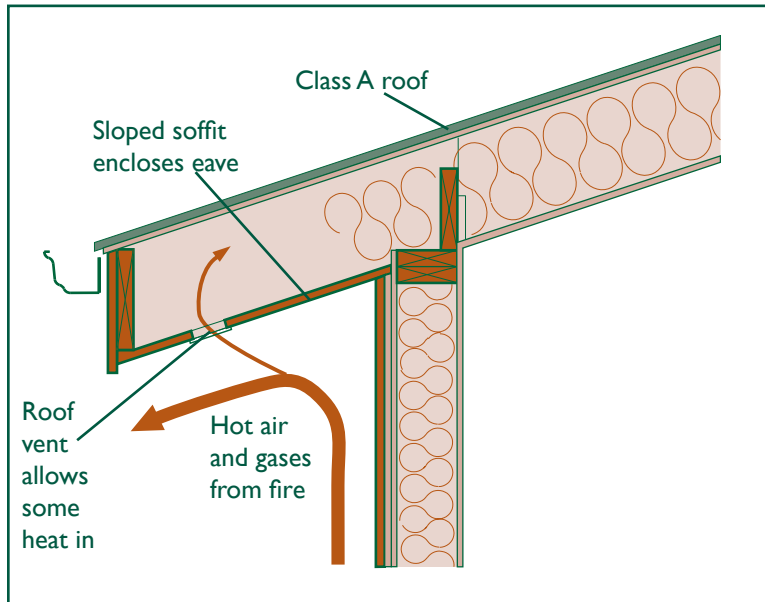
The solution is to cover the eave with a soffit. If the soffit is applied directly to the rafter eave, it forms a sloping soffit. This still makes a pocket that can trap fire.

A better detail is to form a flat soffit that allows the building to more readily deflect fire outward.

The soffit material should be at least 3/4 inch plywood in low fire hazard areas, noncombustible in moderate and high areas, and one-hour rated material in very high hazard areas.

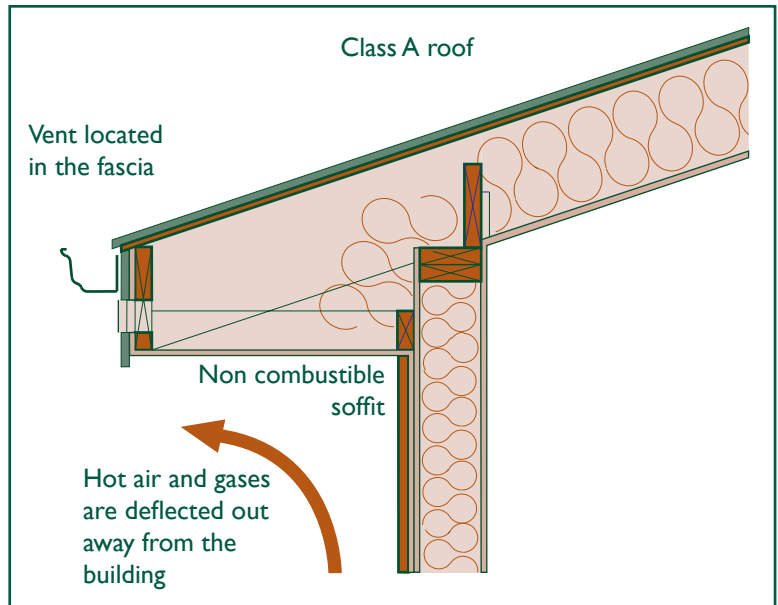


Open eave with no soffit



Open eave with soffit

Vents for roof ventilation are often found in the soffit. **Placing vents in these locations creates a perfect path for fire to enter the roof structure.** If the vent must be in this location it is better to place it farther from the wall and closer to the fascia. The vent can also be placed in the fascia or near the lower edge of the roof.

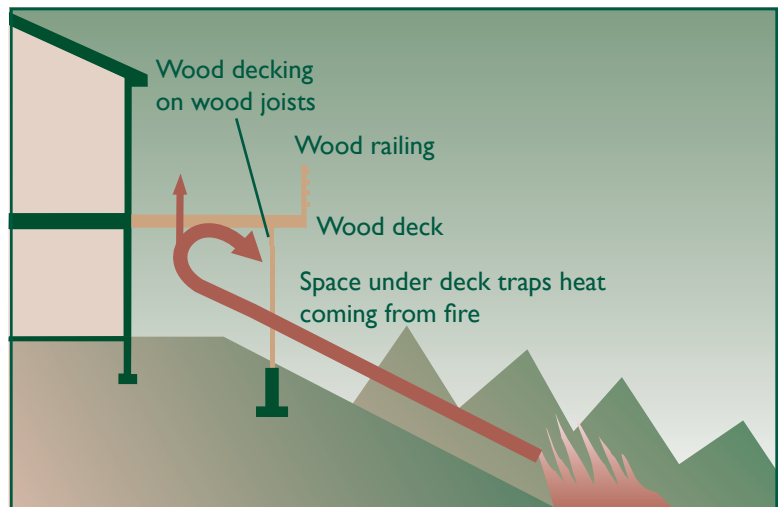


Fully enclosed soffit with isolated vent

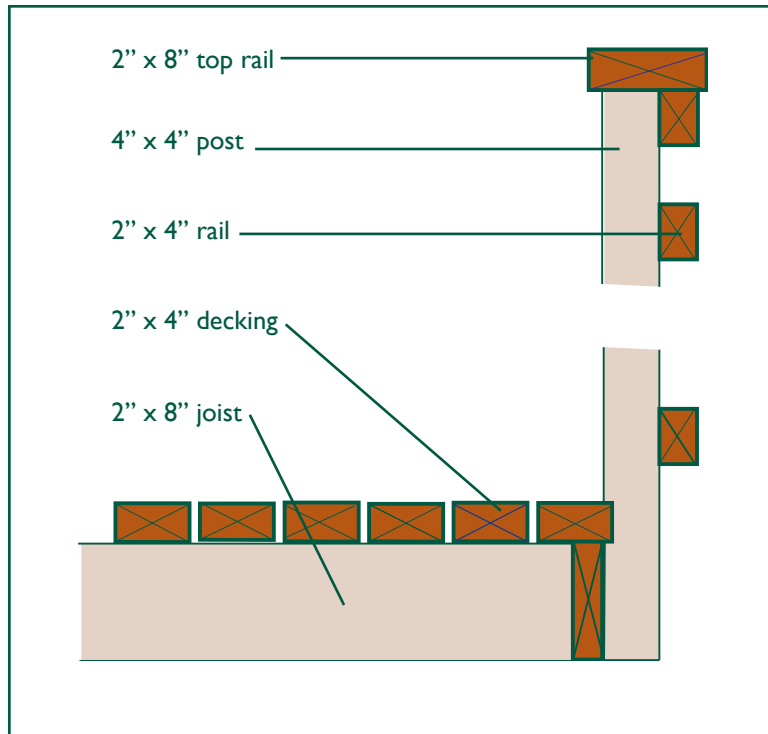
Decks

Decks are a very popular and well-used part of the house, especially in mountainous terrain. Because they provide elevation above the terrain and surrounding vegetation, they offer a better view. They also supply flat areas for walking on otherwise sloping terrain.

The problem is that most decks are highly combustible structures. They are the ultimate heat traps. Their shape traps hot gasses from an approaching fire. Decks often face downhill towards a fire's most likely approach up a slope.



Conventional deck in a fire



Conventional deck construction detail

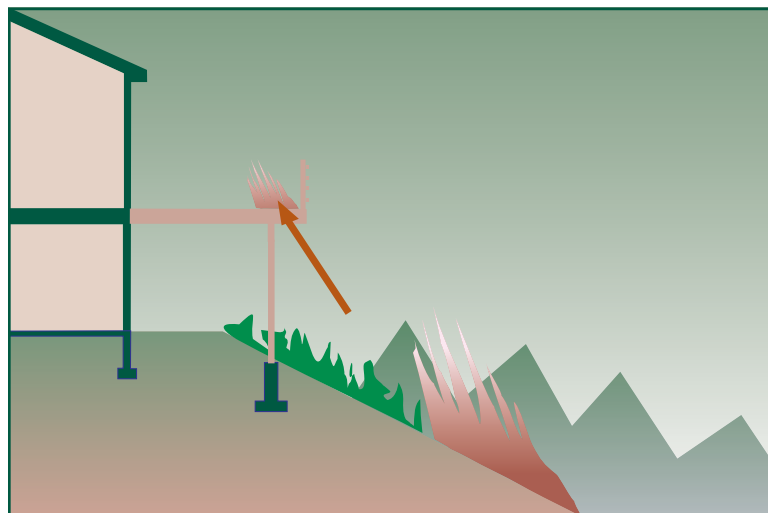


Decks are built perfectly to burn, almost as easily as wood stacked in a fireplace. All the components of a deck; joists, decking and railings, are made of only 2 inch thick wood with a high surface-to-volume ratios.

When fire approaches, the wood quickly dries out and heats up. Ignition can occur very easily when either the radiant energy from the fire gets hot enough or a burning ember lands on it.

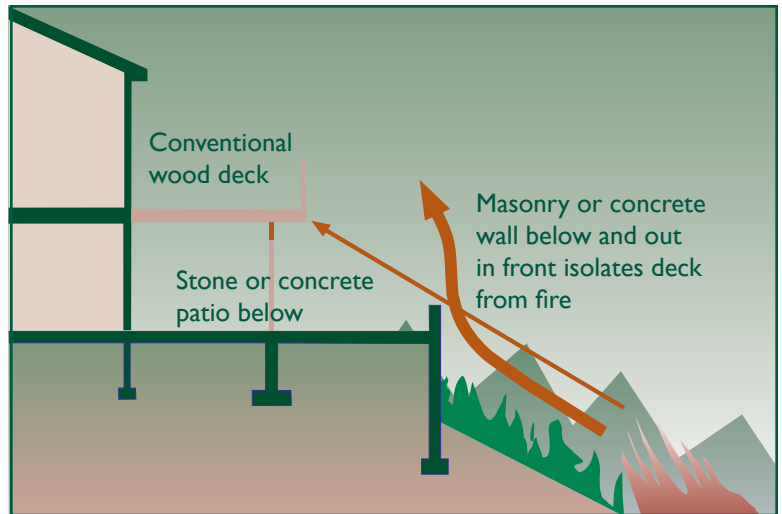
Ignition of decks

Conventional wood decks are so combustible that when wildland fire approaches, the deck often ignites before the fire gets to the house. Sometimes unburned vegetation exists between the house and the fire, demonstrating that the deck was more flammable than the vegetation.



Isolate the deck from the fire with a patio and a wall

In low and moderate fire areas, it may be sufficient to isolate the deck from the fuels and fire by building a noncombustible patio and wall below it. The patio will assure that no combustible materials are below the deck. The wall will act as a shield, deflecting both the radiant and convective energy of the fire.

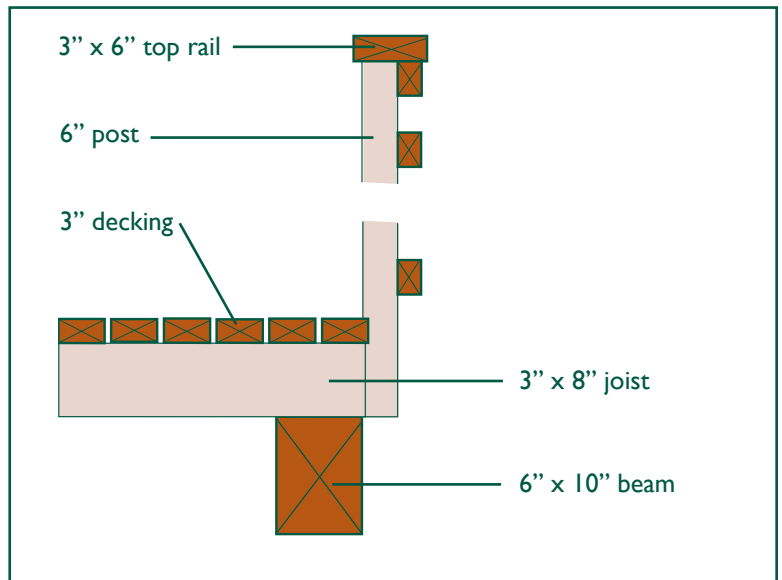


Deck with a patio and a wall below

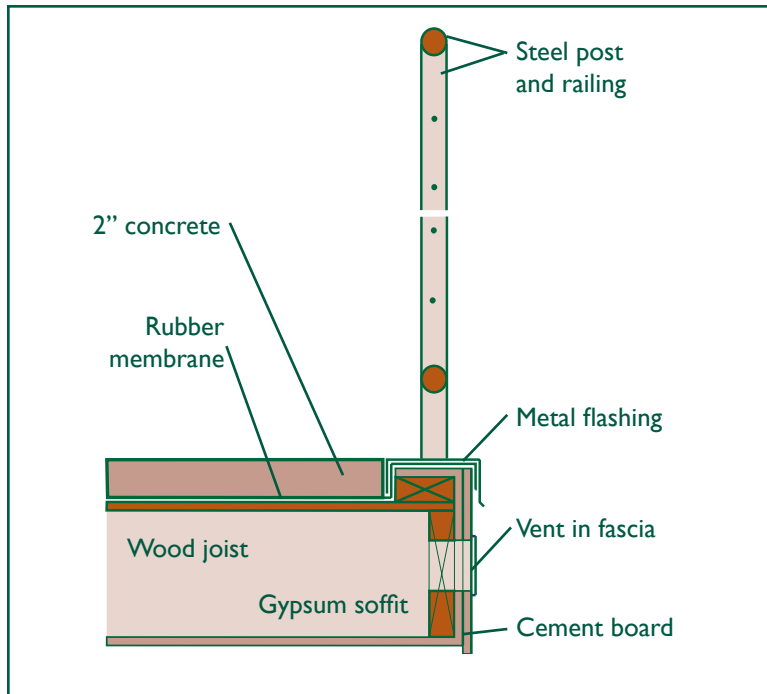
Heavy timber construction

In moderate hazard areas the use of heavy timber construction is acceptable. Like log siding, heavy timber is combustible but so thick that it burns very slowly.

Minimum thickness for a heavy timber deck is 6 inches for the posts and structural members and 3 inches for the decking and rails. This type of construction can be used with a patio below for additional protection.



Heavy timber deck



Fire-resistant deck construction detail

Fire-resistant deck construction

In the highest fire hazard areas, consider noncombustible surfaces and fire-resistant building materials for a deck. Wood frame construction is permitted, but change the surface to noncombustible or one-hour rated materials.

To build this type of surface, place a waterproof membrane over the top of the deck. This allows the use of fire-resistant soffit materials, which cannot tolerate moisture. The most common materials are cement fiber panels or metal (noncombustible), or gypsum (noncombustible and one-hour rated).

Cover the membrane with decking. One suggestion is plastic wood which has low combustibility; it will burn but only very slowly. Better yet, use 1 to 2 inches of concrete or stone. This surface is fire-proof and protects the deck from air-born firebrands. However, this covering requires that the structure be strengthened to support the additional weight.

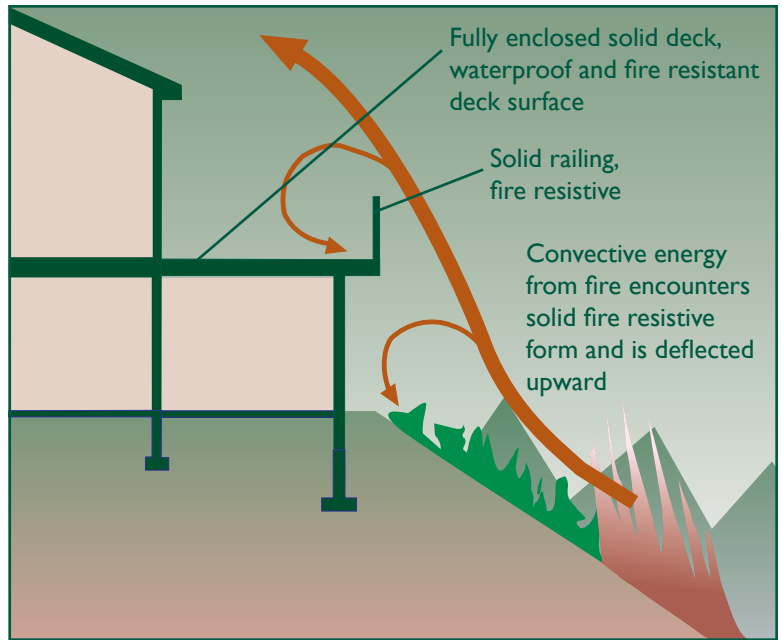
Posts and railings can be economically built from steel. Wood posts near the ground can have stone, brick, or noncombustible coverings. A popular baluster design is steel wire, but this is expensive. Steel pipe, usually 1 to 2 inches in diameter, is very economical and easy to work with. Square steel shapes can look like traditional wood railings.

Fully enclosed decks

The best design is to convert the deck to a solid form by fully enclosing it. This completely eliminates the heat trap. This form also complies with the new Urban/Wildland Interface code (1997).



In the photo above, the deck is over the garage. It has a metal railing with heavy timber posts and concrete deck.



Fully enclosed solid deck

5. Building Materials and Components

Ratings

When discussing building materials and components we make frequent references to ratings. Through testing various national organizations provide ratings or evaluations for the fire resistivity of materials or building assemblies. A building assembly is a combination of materials forming a component of a building such as a roof or wall. The ratings are in the following categories:

Combustible or noncombustible

Classes: A (best), B, and C

Time: 20 minute, one-hour, two-hour and four-hour

The organizations that provide these ratings are: the International Conference of Building Officials (ICBO) through its publication, the Uniform Building Code (UBC); Also a founding member of the International Code Council (ICC) through its publication the International Building Code (IBC); The American Society for Testing and Materials (ASTM); the Underwriters Laboratory (UL); and the National Fire Protection Association (NFPA).

The difference between a non-combustible material and a rated material or assembly is the surface resistance to ignition versus the protection afforded the building behind it. A good example of a non-combustible material is metal roofing and siding. Metal is non-combustible, but an excellent conductor of heat. If the fire remains present long enough, the heat will be conducted through the metal and ignite the material behind it. An example of

a fire-rated assembly is wood siding applied over gypsum sheathing. This assembly is rated as one hour. The surface can ignite, but the building is protected from the fire for one hour.

The importance of this is the difference between intensity of fire and duration of fire as described in the fire behavior section.

Most ratings are for commercial buildings in urban settings, but some apply to residential structures. For example, the wall between a garage and a house must be rated as one-hour fire resistive. The door between the garage and the house must have a “C label” rated for 20 minutes with an automatic closer.

Material ratings for the wildland fire environment have been directly addressed by the I.C.B.O, through a subsidiary, the International Fire Code Institute, Fire Service Division and its publication, the Urban Wildland Interface Code and N.F.P.A. Standard 299. These publications also address other issues covered in this publication such as access, utilities and water supplies for fire suppression. Much of what is contained in this publication is based on or refers to these publications.

Roofing

Roofing is one of the most important ways to protect a house from wildland fire. As shown earlier, when wildland fires become more intense, the lofted firebrands become a significant cause of the fire spread. Since most roofing has a rough surface and numerous cracks, it can trap wind blown embers and firebrands. In all major Interface fires, houses thousands of feet from the fire have been observed with burning roofs.

Wood shakes and shingles

Simply put, wood shakes and shingles are made perfectly to burn. They are almost like kindling. They are thin, 1/2 to 1 inch thick, with a very rough surface and many cracks. When a wood roof burns it also lofts burning embers, contributing to the spread of fire. Another important characteristic of wood roofs is that they dry out in Colorado's dry climate.



A cedar roof can be modified to be fire-resistant. Pressure treatment with chemicals can change wood shingles to a class B or C roof. Chemically treated cedar roofs built with a gypsum underlayment can have a class A assembly rating. However, many doubt that the testing conditions for these shingles matched Colorado's climate of low

humidity, high winds, elevated ultraviolet radiation and extreme temperature variations.

The use of wood shakes in the Colorado region is diminishing, not because of the fire risk they pose, but because of the unavailability of insurance coverage for damage due to hail and high winds. Cost wise, hail losses in Colorado are 10 times greater than fire losses.

Asphalt shingles

Asphalt shingles are probably the most economical way to roof a building, especially in terms of dollars spent per years of guaranteed life. Conventional mineral reinforced asphalt shingles have been around for more than 60 years. They are normally guaranteed for 10 to 20 years, and usually have a class C rating.



Mineral reinforced shingles have gradually been replaced by fiberglass reinforced asphalt shingles. These offer guarantees of 20 to 40 years and are a class A material. They are available in many colors and textures and can even imitate wood or slate shingles.

Metal: sheet and shingles

Metal roofing has always been available in sheet form in many colors. It usually has standing seams or ribs. The most common metal roof is galvanized steel with factory-applied paint (usually a two-part epoxy type, not too different from automobile paint).



Metal roofing is also available as an imitation wood shingle. This product is made by stamping a texture and shape on the metal and then applying the appropriate color. This imitation is so good that at a distance of 100 feet or more it is difficult to tell the difference between it and a wood shingle.

The advantage of metal roofing, both flat and stamped shingle, is that it is non-combustible, durable and very lightweight. It requires a gypsum underlayment in order to have a class A assembly rating, but that is only necessary in high or very high fire hazard situations. Guarantees start at 20 years and go to 50 years.

In addition to galvanized steel with paint, metal roofing is also available in aluminum with paint, stainless steel and copper. These tend to be more expensive but also last longer.

Fiber-cement shingles

These shingles are made of cement and fiberglass, or cement and wood. Like the metal shingle, they are made to imitate a wood shingle's texture, shape and color. The cement in these products is altered with polymers to make it less brittle. These products are also noncombustible but require an underlayment for a class A assembly rating.

Membrane roofs

These materials include both rubber and hot applied, bituminous saturated mineral felt for flat roofs. These materials are marginally combustible but are most often used with other covering systems like concrete. It can be applied over a gypsum underlayment for a class A assembly rating. Guarantees are only in the 10 to 20 year range, but these products can be considered permanent when covered with concrete.

Concrete shingles and tile, slate shingles, clay tile

These products provide the best fire-resistive roof, but they are expensive. They are 1 inch thick, heavy (10 pounds per square foot), non-combustible, class A rated and usually come with 50 year guarantees. Concrete shingles are manufactured to look like wood shingles. When having a tile roof installed, pay careful attention to the closure of the round openings of the tiles at the edge of the roof.



Exterior walls: siding

The exterior walls of a building are most affected by radiant energy from the fire and, if there is not enough defensible space provided, by the direct impingement of the fire.

Wood panels and boards

Wood panels and boards are the most common and economical forms of siding, but they are readily combustible. This siding is usually not very thick, 1/2 inch to 3/4 inch, and will burn through to the structure behind it in less than 10 minutes. A one-hour rating can be achieved by adding gypsum sheathing behind the siding. However, this addition is of limited value because the building can still ignite, and the fire can spread to other parts of the building such as the eaves above the exterior wall or the windows.



Fiber cement panels, boards and shingles

These products are non-combustible, but they may not be rated and may need gypsum sheathing to achieve a one-hour rating. These materials are very economical and cost just a little more than wood products. When these products are applied with the gypsum

sheathing they offer the most economical way to side a house that will resist almost all fire hazard conditions. These materials are virtually permanent on a vertical surface and come with a 50 year guarantee, but they need to be painted. Some can even take a stain with satisfactory results. These products are available with textures molded to imitate wood grain.

Metal: galvanized steel,

aluminum, boards, panels and shingles
Like their counterparts in roofing, these products are available in either flat sheets with seams, a stamped board or shingle that imitates a wood product. They are factory painted with two-part epoxy paint and usually have a 50 year guarantee. Unlike the fiber cement product, the paint on this product is a part of the guarantee; thus, it is an almost permanent, no-maintenance material. It is non-combustible, but like other metal products needs a gypsum sheathing to achieve a one-hour rating.

“Real” Stucco

Real stucco, as base material, is 3/4 inch to 1 inch thick cement and gypsum. The stucco is applied in two or three coats with metal mesh reinforcing. The color is integrated into the final coat and thus lasts a very long time. Guarantees are 10 to 20 years. It is both a non-combustible and one-hour rated material, which makes it a very good material for high hazard areas. Real stucco tends to be expensive and is also prone to cracking if not applied absolutely correctly.

Synthetic stucco, exterior

insulating finish system (EIFS)

This product is a 1/8 inch thick acrylic cement finish on fiberglass mesh. This is applied to the tap surface 1 to 2 inches of expanded polystyrene (EPS). The color, like real stucco, is in the cement coat and thus lasts a long time. This is the preferred way to do stucco because it takes less labor and is therefore cheaper. The foam insulation isolates the stucco finish from the building, which virtually eliminates cracking.

The surface is noncombustible and has no rating by itself. This product is interesting in a fire because it significantly delays a fire due to the insulation quality of the rigid foam and the fact that the system does not ignite; it actually fails and falls away. In moderate to high fire hazard situations this product will work well. It can, like other products, obtain a one-hour rating with gypsum sheathing, which should be used in a very high fire hazard area.

Heavy timber or log construction

This wood product has a minimum thickness of 6 inches for frame members and exterior siding, and



3 inches for decking and steps. Heavy timber is recognized by building codes as a separate fire-resistive category.

Even though heavy timber is combustible, the low surface-to-volume ratio causes it to burn very slowly. This makes it very appropriate for medium and high fire risk situations.

Concrete synthetic stone

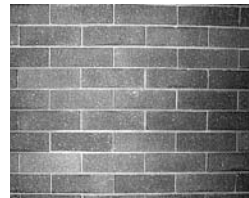
These products are cast concrete with integral color forming the texture and shape of the stone being imitated. They are modular shapes that have consistent dimensions with flat backs, keeping labor costs down.



Synthetic stone is reinforced with fiberglass and steel mesh, making it very resistant to cracking. It is fully noncombustible and is usually rated as a one-hour material.

Brick, stone and block

These materials are both permanent and fireproof. Ratings are usually two hours. These are the best products to use in regard to fire resistivity but are the most expensive.



Windows and Glass

Windows are one of the weakest parts of a building with regard to fire. They usually fail before the building ignites, providing a direct path for the fire to reach the building interior.

Glass failure

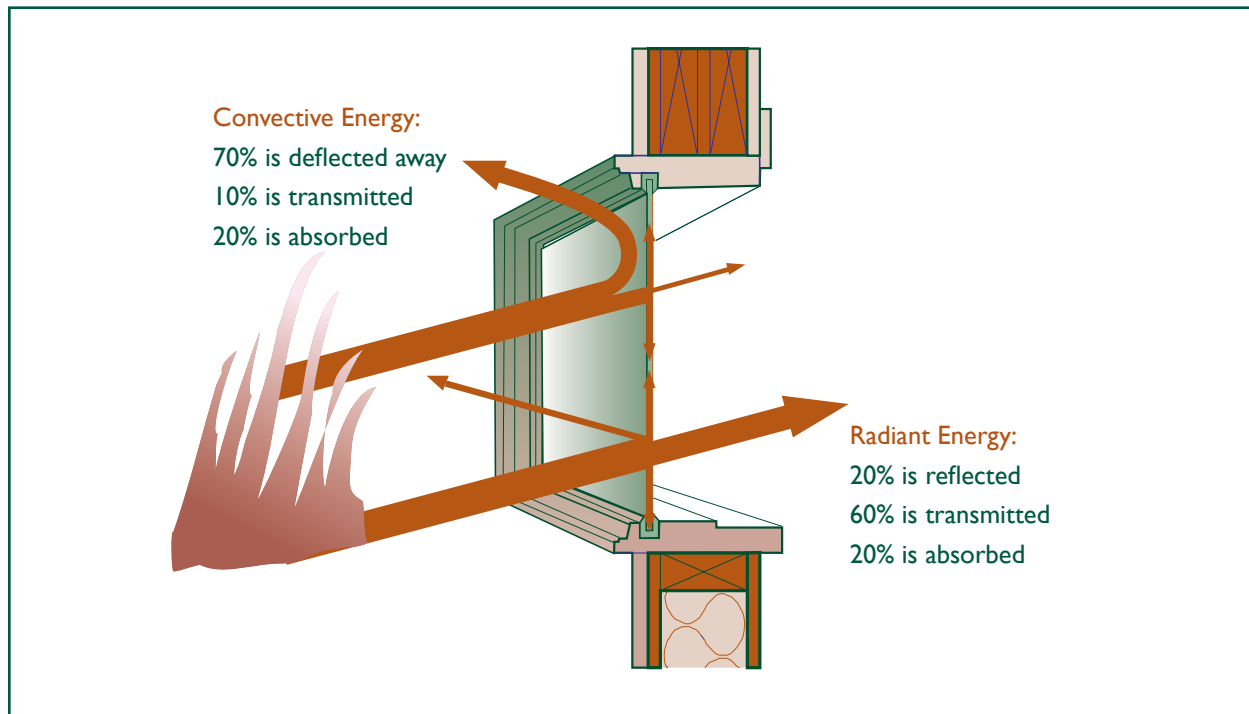
Glass provides only a partial barrier to fire and only for a short time. It fractures in the presence of heat. In the case of a wildland fire, this will happen in about five minutes. Glass deflects most of the convective energy, but not the radiant energy of the fire.

Convective energy is hot air and gasses. About 70 percent of the heat is deflected by window glass; about 20 percent of the heat is absorbed; and 10

percent of the heat is transmitted to the interior of the building.

Radiant energy from a fire is infrared light energy, like the energy we experience from the sun. Most radiant energy from a fire, 60 percent, is transmitted through the glass to the interior of the building; about 20 percent is reflected; and about 20 percent is absorbed by the window glass.

Both the radiant and convective energy heats the glass, but the perimeter of the glass is covered and protected by a sash. This causes a differential heating and stressing of the glass, which causes it to crack.



Energy transmission, conventional glass

Large and small windows

Even if the glass does fracture, the hot gasses (convective energy) from the fire and the fire itself cannot enter the building if the glass stays in place. Only the radiant energy heat can get through. Eventually, even with the glass in place, combustible materials behind the window may ignite. (See Low E glass).

Small windows, less than 2 feet wide or tall on a side, will keep fractured glass in place. The size of glass held in place by the sash is relatively small with little weight.

Large windows (more than 2 feet wide or tall on a side) cannot keep the fractured glass in place. The size and weight of glass in relationship to the length of sash is too great.

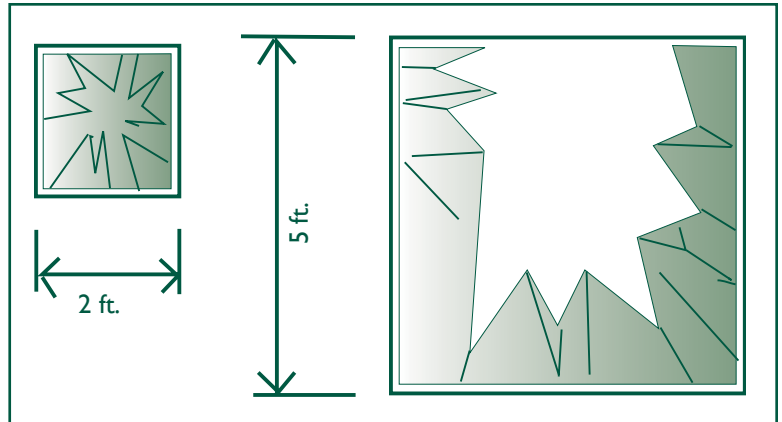
Thermopane or double glazed windows

Because of current energy codes, most glass today is double glazed or Thermopane. Double-glazed windows last about twice as long as a single pane, or about 10 minutes.

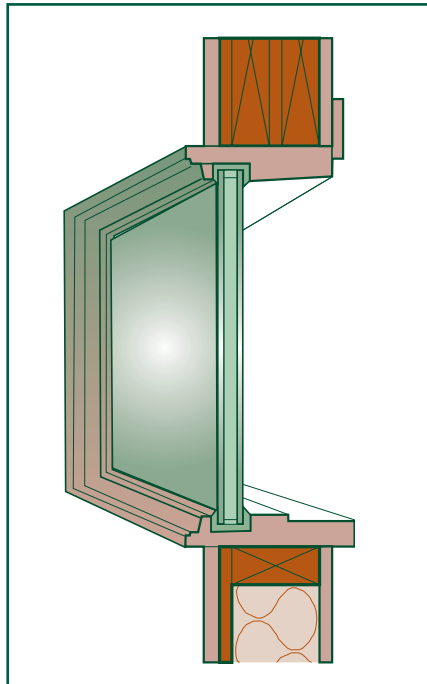
The same processes of convective and radiant energy affect the front pane of glass. As long as the front pane is in place, the second pane is partially protected. When the front pane fails and falls away, the process continues on the second pane until it fails and falls away.

As shown earlier in the fire behavior section, the duration of a fire at a site is dependent on the slope and the fuels. It can be as short as 5 minutes in the case of a grass fire.

If the duration of the fire is any longer than 10 minutes due to significant fuel



Small and large windows

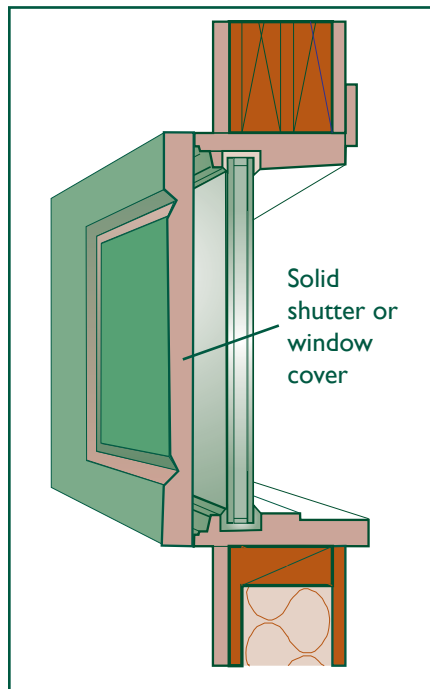


Thermopane window

supply around the house or preheating, additional protection will be necessary to prevent glass failure and fire entering the house.

Exterior window covers, shutters and screens

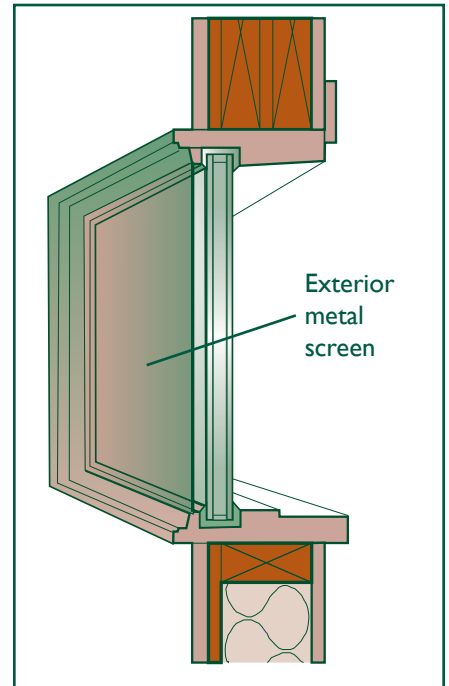
Only an additional 10 to 20 minutes of protection is necessary for a window to survive most fires. Exterior window covers, such as in-place shutters, can add this time. Shutters originated in New England as protection from storms when the wind would break the glass. They are now readily available in the Southeast for hurricane protection.



Wood shutters are the most common and economical, but they will ignite within five minutes. However, as shown in the fire behavior section, if the wildland fire duration is short enough, an additional five minutes of protection may be all that is needed. Also, even though fire departments may use foam to protect structures, it will not stick to glass. Therefore, shutters may still be advisable.

Metal shutters are better. They will protect the window long enough to last through the fire event and will not ignite.

The disadvantage of shutters is that they are not completely passive, that is, they require intervention on the part of the homeowner or the fire department to work.



Permanently placed exterior metal screens eliminate the deployment problem. Exterior screens are not going to protect the window as much as a solid cover, but as mentioned before, only five to 10 minutes of additional protection may be needed. Screens also provide a surface to which foam can adhere. These screens cannot be used with outward acting windows, like casement or awning windows, but they can be used with horizontal sliding and double hung windows.

Tempered glass

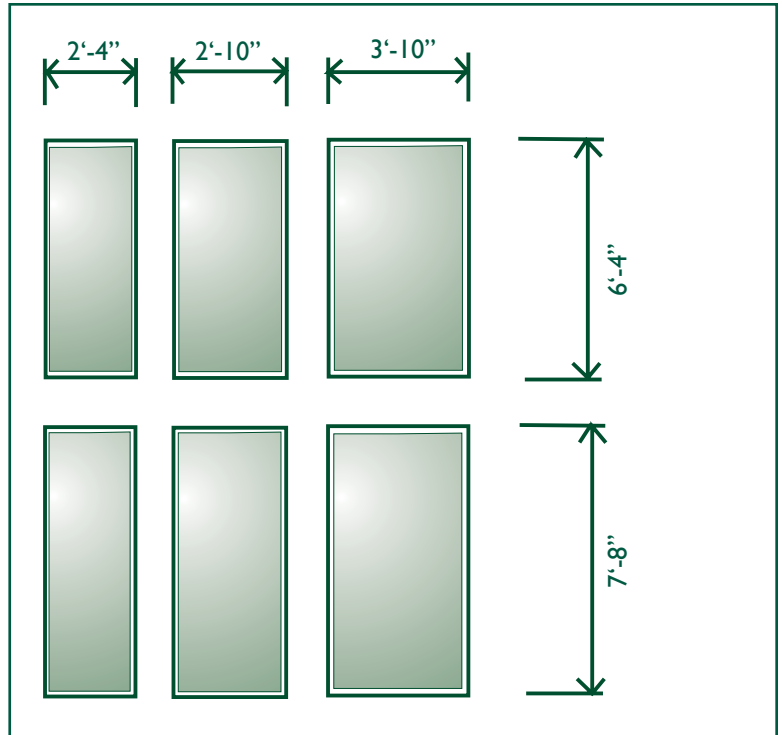
Tempered glass is both resistant to high impact and high heat. Most of us are familiar with it. Building codes require that tempered glass be used in patio doors and all areas subject to human impact. It is also the glass used in front of fireplaces. Tempered glass will stay in place and intact throughout the wildland fire event.

A problem with tempered glass is cost. Windows with tempered glass typically cost 50 percent more than regular glass. There are strategies around this, and costs are coming down.

Patio door replacement units are, as they infer, used to replace glass in patio doors. These units are mass produced and stocked by virtually every glass business. As a result they are very economical. In fact they are less expensive than conventional glass. They come in six sizes, as shown at right, and typically can be used as a picture unit, or combined to make a window wall or solar structure.

Using patio door replacement units provides a lot of tempered glass at a very economical price.

A few brands of windows are marketed as replacement windows in existing mid-rise urban buildings where the use of tempered glass is required. As a result, the additional cost for these brands of tempered glass is only 25 percent more than standard glass. Your local window supplier can suggest appropriate manufacturers.



Patio door replacement unit sizes

Low E glass

Low E stands for low emissivity. This is an ultra thin, several microns thick, metallic coating on glass that appears white or reflective to infrared and ultraviolet light. It is used in windows for energy efficiency because it holds more heat in during the winter and keep more heat out during the summer. It also protects fabrics from fading and wood from yellowing.

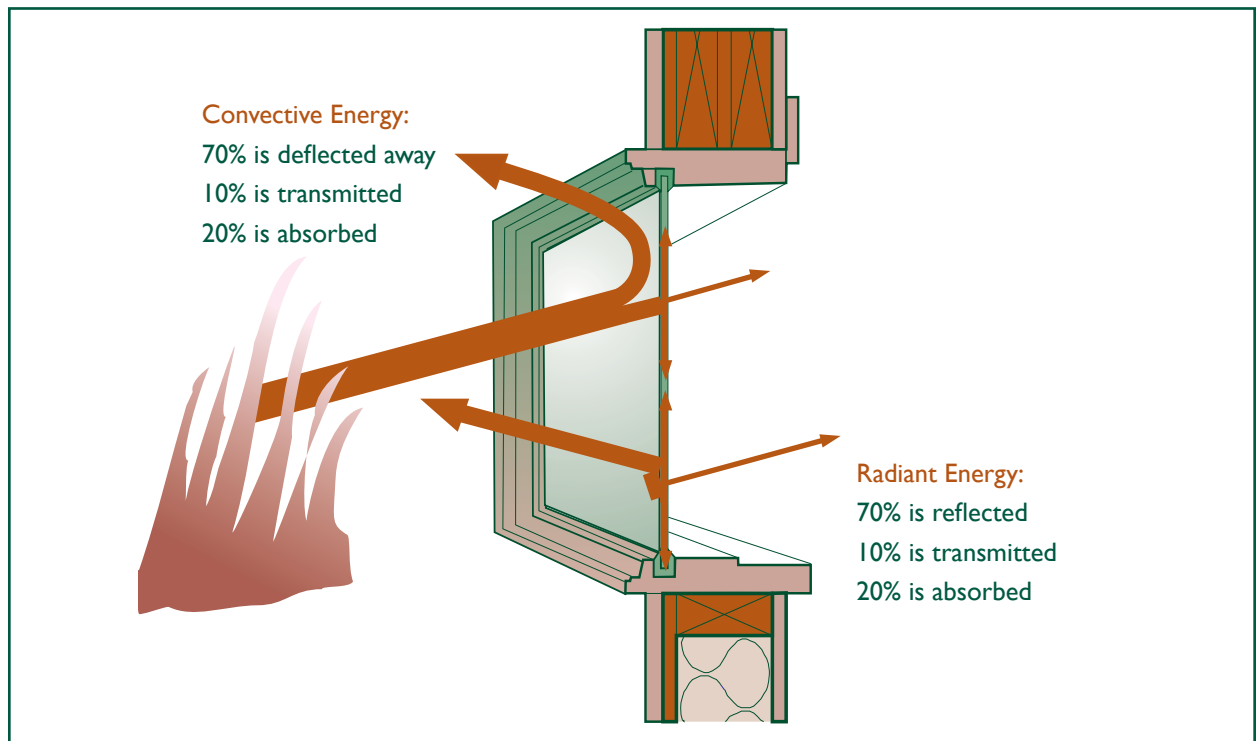
This glazing option is widely used in windows today and only costs about 10 percent more than standard double glazed units.

The advantage of this glass in a wildland fire is that it stops the radiant energy

transfer to combustible materials behind the glass such as drapes, wood furniture and walls.

The combination of Low E and tempered glass features for windows provides the best possible solution for windows in a wildland fire. The glass will stay intact throughout the fire event and will transfer less radiant energy to combustibles in the structure.

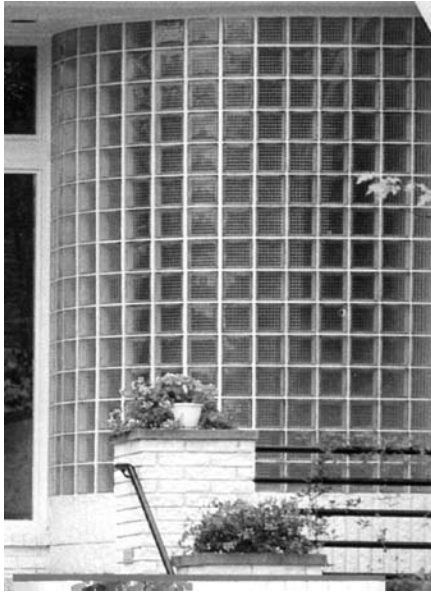
It should be noted that the use of tempered and Low E glass is a recommendation based on observations in the field. Actual laboratory studies in a wildland fire setting need to be conducted to give these types of glass specific quantitative values.



Energy transmission, Low E glass

Glass block

Glass block is the most fire- resistant glass available. It has the highest available rating of 90 minutes. It has an excellent appearance but provides a poor view. It does not have the Low E option.



A good use may be in a situation where only day lighting is needed, a view is not a factor and the orientation of the window may be toward a very high fire hazard.

Frames and sashes

Windows with improved glass technology will only work as long as the glass remains in place. The glass is held in place by the frame, so the frame needs to withstand the fire.

Wood frames will burn. Since they have a high surface-to-volume ratio they will readily ignite and burn freely. They are not a good choice.

Vinyl frames seldom ignite, and if they do, the combustion rate is very slow.

It does not contribute to the combustion of the house. The problem is that vinyl frames melt and structurally fail, allowing the glass to fall away. They are not a good choice either.

Aluminum clad wood frames delay the ignition of the wood frame. They do not completely protect the window because the aluminum conducts the heat to the wood. This delay is enough in most wildland fires.

All aluminum frames are even better. Since there are no combustible materials, they remain fully intact during a fire. These frames are now available with a thermal break, a plastic spine that connects the interior frame to the exterior frame.

Doors

Wood doors

Residential buildings typically use wood doors with glass inserts. The same fire issues related to window glass apply to glass in doors. An unrated wood door is typically 1 1/2 to 2 inches thick. It can readily ignite and burn through in only 10 minutes, which is much faster than the rest of the structure will burn.

Wood doors are available with a class C, 20 minute rating. These doors are typically used between the garage and the house. They are a good solution in moderate fire hazard situations. In very high fire hazard situations, they may not resist burning for the fire duration and will allow other exterior building components to ignite.

Metal doors, steel and aluminum

Metal doors are non-combustible and available with 20 minute, 45 minute and one and one half-hour ratings, which makes them the most appropriate solution for very high hazard situations. Glass sizes are restricted in these doors. The surfaces are available with embossing to simulate wood grain and raised panel designs.

Just as in energy conservation, a good fire-resistive door requires adequate weatherstripping so that the seal prevents hot gasses or burning embers from entering the building.

6. Summary

A major wildfire can be an overwhelming event to experience. It can be huge, blotting out the sun and creating its own winds. It can throw flames and burning embers everywhere. Wildfire is a natural part of our environment that we can either respect or fear. If we make adjustments and modifications to our homes and the sites they occupy, then we can live confidently with fire. Each Interface resident must understand the basic characteristics of wildland fire and how it puts their property and lives at risk. Then the actions they take by building appropriate structures and properly caring for their Interface environment can significantly reduce the fire hazard.

A comparison is often made between fire and water. Fire, like water, tries to find a way into our homes. It does not matter how fire-resistant some parts of a structure are if weak points let a fire in. An awareness of how each building component is affected by fire will enable the owner, architect or builder to eliminate those weak points.

And finally, each of us needs to understand that, when we suppress wildland fires we must enhance our forest management policy to reduce fire fuels. When fires do occur they will be more manageable and less destructive to both the forest and our buildings.

References and additional information

The following is a partial list of publications and/or organizations can provide more information on this topic.

California's I-Zone

Rodney Slaughter, editor.

Available from the CFESTES bookstore in the California State Fire Marshal's Office, 1131 S St., Sacramento, California 95814.

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Construction of Buildings in Bushfire Prone Areas

Queensland Department of Local Government and Planning

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The Urban Wildland Interface Code

The International Fire Code Institute, International Conference of Building Officials

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Ph: 562-699-0541

NFPA 299 Standard for Protection of Life and Property from Wildfire

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a web site maintained by NFPA covers much of what is in this pamphlet.