Mapping Vermont's Natural Heritage

A Mapping and Conservation Guide
For Municipal and Regional Planners in Vermont

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Photo by Caitlin Drasher

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Background and Purpose

Vermont is known for its beautiful forests and agricultural lands, mountain streams and scenic landscapes. This is the *Green Mountain State*, where residents claim a love of rural places and where visitors come to ski, hunt, hike, and enjoy the scenery. Our landscape drives our economy and is largely what makes our state so special.

Surveys support these claims. Across the nation, only Alaska outranked Vermont for participation in wildlife-related recreation—fishing, hunting, or wildlife watching—in a 2011 survey (US Dept. of Interior). In the same survey, Vermont ranked first for wildlife watching activities, with 53 percent of residents participating—over half our population—and it was estimated that more than $704 million was spent in Vermont on fish-and-wildlife-based recreation. In 2015, a public attitude survey found that 83% of respondents agree that land use and development should be restricted to protect fish and wildlife and that 81% would like to see wildlife habitat protected even if it reduces the land use options of some landowners and developers (Duda et al). In Vermont, we like our wildlife and we want to see their continued presence on the landscape.

With over 80% of the state's land in private ownership and the majority of land use and development decisions made at the local or regional level, the protection of Vermont's species, habitats, and ecological processes is firmly in the hands of landowners, municipal governments, and regional planning groups. At the same time, municipal planners must balance these wildlife needs with countless other goals, and prioritization of such diverse needs can be tricky.

The Merriam-Webster Online Dictionary defines **conservation** as *"the careful preservation and protection of something, especially planned management of a natural resource to prevent exploitation, destruction, or neglect."* In this guide, we keep our use of the word broad, including *any* strategy that can aid in the protection or thoughtful use of the natural landscape to maintain or enhance its healthy condition.

This guide was created to support municipal planners in achieving their goals for protecting wildlife habitats within town boundaries. In it, we share resources developed and lessons learned by many agencies and organizations throughout Vermont, combining background information about our natural landscape, natural resources maps tailored to individual towns, and a step-by-step strategy for prioritizing ecological needs alongside diverse other goals. For those wishing to dig deeper, we have provided links to additional resources you may find helpful. Our goal is to provide planners with the knowledge and tools necessary to make wildlife-related planning decisions in their own towns or regions. If a community can identify and conserve the most important wildlife resources on *its own* landscape, it will also achieve goals set forth in Vermont's state-level Wildlife Action Plan and thereby aid with the conservation of wildlife on a state and even regional scale.

Photo by Brett Engstrom

Natural heritage: *All the natural resources Vermont residents and visitors value. Vermont's diverse resources, which include forests, clean waters, vibrant fisheries, healthy wildlife populations, rare species, significant natural communities, and a working landscape provide people with the opportunity to—among other things—hike, hunt, fish, trap, birdwatch, and work the land. Natural heritage also includes the concept of biodiversity, which is the variety of life in all its forms and all the interactions between living things and their environments.*

Using This Guide

The CD and online files that accompany this guide include a set of 7 maps centered on each town in Vermont. These maps are formatted to be printed at 44 x 36 inches, but they can also be adapted for printing on a home printer or viewed on your screen. The maps can also be recreated on an online program called *BioFinder,* described later in the introduction to this guide.

Part I provides information about each layer found on the maps. For each dataset, we describe the layer, its importance, how it was mapped, and considerations for conserving the resource.

Part II offers a step by step approach for determining which locations in a community are most important to conserve and then finding conservation strategies appropriate for the community.

An **Appendix** and **Glossary** can be found at the end of the guide.

Suggested Process:

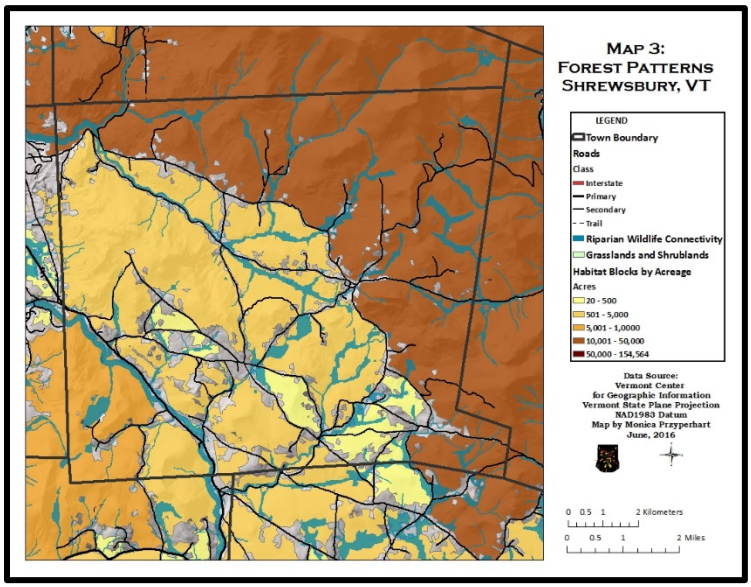
1. Start with Part I. Look at the 7 maps of your community and understand the ecological components presented in each.
2. Read Part II and prioritize important locations in your community. As described in Part II, first identify broad patterns; then add finer details.

3. Go back to Part I and dig deeper into the natural heritage features found in your priority areas. Find strategies that will conserve first the broad patterns, and then any elements not captured by these patterns.

Why Maps?

In 2008, the Vermont Supreme Court struck down a South Burlington zoning ordinance aimed at protecting a variety of natural resource values (In re Appeal of JAM Golf, LLC, 2008 VT 110). The court determined that the ordinance was too vague to effectively determine what "protection" of the natural resources listed should entail, thereby making it unenforceable. Because the South Burlington ordinance was written in language similar to that used by towns throughout the state, this ruling is a call to action for all towns wishing to protect their local natural resources. If towns want their plans and bylaws to be legally defensible, they must include clear, specific, and consistent standards that define exactly what types of development are allowed and prohibited in any given area (Garvey 2009).

A map is the first step in creating such clear, specific, and consistent standards. Before you can effectively plan, you first need to determine exactly what resources you have. The better your information, the more easily you can prioritize, and the more clarity you can provide. A map is essentially an inventory of one or several components of the landscape, and this guide highlights a series of seven maps created to feature the ecological, biological, and physical resources of each town in Vermont. When combined, these maps become even more powerful, showing how each individual dataset relates to every other.



Of course, every map also has limitations. Maps are static images, and yet they represent a changing landscape. They are also intended for use at a particular scale and can become inaccurate when used at other scales. Imagine, for example, a map of all the lakes present in the state of Vermont. At the state level, each lake appears accurately placed. However, if you were to zoom in on that map, magnifying everything within the boundaries of your hometown, you may find that the boundaries of the lake are off by 25 feet. When examining that map at the state scale, those 25 feet are unsubstantial. To a landowner whose home is depicted as partially underwater when zoomed to the parcel level, those 25 feet matter!

In this guide, we therefore explain the appropriate scales, data sources, and intended purpose of each map. We encourage you to read these descriptions thoroughly before including the maps or

the data they contain in implementation efforts. When used appropriately, this information can open new ways of seeing your community and the many natural resources located there.

But Wait! What About Private Property?

As mapping data increases in availability, some fear that the resulting maps could be used to infringe on landowners' property rights—or even that maps themselves can be an invasion of privacy. Certainly not unique to mapping, the question of how to balance protections of privacy with the collection and distribution of useful information pervades today's world. Many technological advances have forced us to consider where to draw the line between what is public and what is private. In terms of maps, there is no doubt that mapping content is substantially more detailed and descriptive today than it was in the past. This increase in detail allows us to learn more about the function of our landscape, *and* it increases the risk of invading personal privacy. The two go hand in hand.

For cartographers, this discussion is not new. The very nature of creating a map is to take what is present on the ground and draw it in a form that is easier to visualize, easier to understand, and easier to share. Maps are made in an effort to increase understanding of what is present, and to share this understanding with others. Maps by their very nature are central to this debate about balancing enhanced public knowledge and protection of privacy.

We have created this mapping guide because at this point in time, the information displayed on these maps is *known*. It already appears on public maps. While the data were collected for a variety of reasons, the people most affected by the information—and who can certainly *also* use it—are landowners and communities. At a local level, it is *your* land that appears on these maps. If anyone has a right to access these data, you do, too—along with information about the intended use of the data.

To some, the distribution of maps depicting natural heritage features is particularly concerning due to a perceived conflict between human interests and the needs of wildlife. To this end, it is true that just as what is "good" for one landowner may not be desirable for the next, some ecological priorities may conflict with a landowner's wishes for his/her land. In writing this guide, our goal is *not* to dictate any particular course of action; it is simply to describe the way the ecological landscape functions, map the components geographically, and guide you through possible techniques for making informed decisions about ecological priorities.

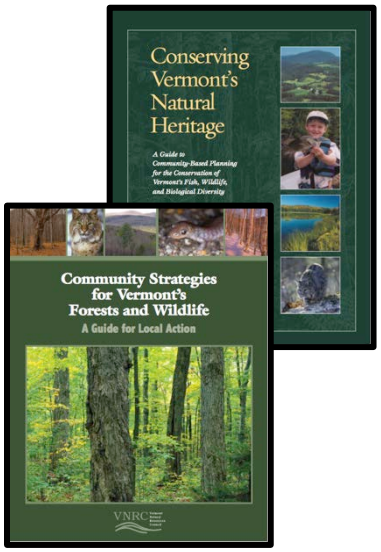
At that point, it is up to landowners and communities to decide what to *do* with the information. While this guide outlines a process for taking map information and creating a conservation strategy, the nature of that strategy needs to be decided at the local level. Some communities may use these maps purely for educational purposes. Others may use them when creating municipal plans and bylaws. Whatever the strategy, these decisions need to reflect local realities—ecological *and* societal. When implementing any strategy, some communities may find that the ecological components and priorities described in this guide *are* in conflict with community or landowner goals, and these communities may need to think very carefully about how to handle this conflict. Other communities may find that few conflicts exist. But without information about how the landscape functions ecologically, it is impossible to tell even whether there *are* conflicts.

We provide this guide to allow you to make informed decisions about how to proceed, *and* we encourage you to keep in mind the privacy of those whose land appears on these maps.

Photo by Dennis Curan

Getting the Most Out of the Maps

Maps and inventory may be the basis of natural resources planning, but there are clearly several steps between identifying features on a map and having a plan. In this guide, you will find many references to *Conserving Vermont's Natural Heritage*, published in 2004 and updated in 2013 by the Vermont Fish and Wildlife Department and Agency of Natural Resources, and *Community Strategies for Vermont's Forests and Wildlife*, a 2013 document by Vermont Natural Resources Council. Together, these books provide a background of the natural heritage features found on the maps in this guide as well as explanations of a wide range of tools a community might use to protect these resources. We encourage you to read these books alongside this guide.



Additionally, Vermont's Agency of Natural Resources has developed several online mapping tools—BioFinder and the Natural Resources Atlas—to allow anyone with an internet connection to explore state mapping data. Using these resources, you can recreate any of the maps you see here, mix and match data, and zoom in and out to different scales on any map.

In addition to the above resources, we also recommend that your planning group captures the goals and values of *your community* and includes local citizens in the planning process even as you begin. Because it will ultimately be up to your community to adopt the plans and strategies you propose, it is important to be transparent about your intentions. The *Community Heart and Soul Field Guide* outlines one method for involving your community in the planning process, published in 2014 by the Orton Family Foundation and available online at http://www.orton.org/what-we-do/what-community-heart-soul. When combined with the scientifically-based background information outlined in this guide and by natural resources professionals, this strategy can be a powerful way to connect with citizens in your community. Of course, all strategies are not for all towns, and this is just one of many possibilities!

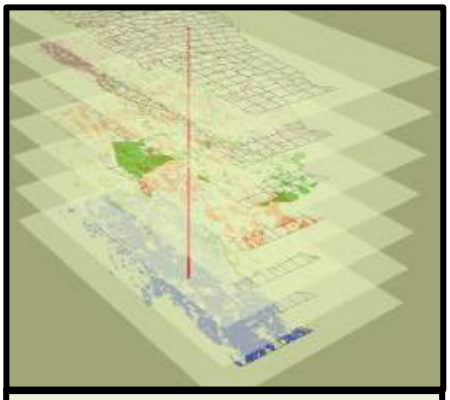
BioFinder: Vermont's Online Conservation Planning Mapping Tool

Found online at *http://biofinder.vermont.gov/*.

What is Biofinder?

BioFinder is an online mapping tool that allows Vermont citizens—planners, developers, educators, scientists, etc.—to explore the lands and waters in Vermont that are most important for supporting ecosystems, natural communities, habitats, and species. BioFinder shows a variety of ecological components known to contribute significantly to biological diversity, then categorizes these components into conservation priorities. The goal is to allow citizens not only to locate ecologically important components on a local landscape but also to identify the *most important* locations for conservation or the most ecologically logical places for development.

In recent years, digital mapping resources have become increasingly sophisticated, enabling generation of abundant landscape-based information that was previously unknown. Even with these mapping developments, however, many resources remain relatively inaccessible to the public, requiring expensive software or technical training. The Vermont Agency of Natural Resources developed BioFinder and its sister application, the Natural Resources Atlas, to allow easy public access to map information.



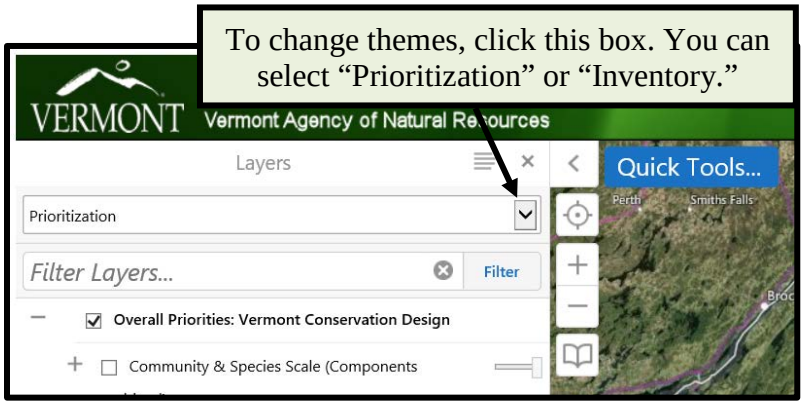
A GIS map layers datasets one on top of another, so that they align geographically.

Similar to many modern mapping programs, BioFinder uses "GIS," or a Geographical Information System that captures, stores, analyzes, and manages a diverse array of geographical information and allows it to be viewed simultaneously. In some ways, this process works just like taking physical maps, copying them onto transparent mylar, then laying one on top of another so that a location on one lines up with the same location on another. A user can look at multiple *layers*—meaning multiple sets of map data—at once and add or remove information as needed.

In other ways, GIS is much more sophisticated than a set of transparent maps because the software not only layers the maps on top of one another but also provides tools to analyze them. For example, a user can see which conserved land has public access, view all lands within 100 feet of a wildlife road crossing, or identify places that are mapped *both* as a large habitat block *and* a deer wintering yard. BioFinder also allows users to make notes, print maps, and create reports of all the "priority" and "highest priority" ecological components found in a chosen geography.

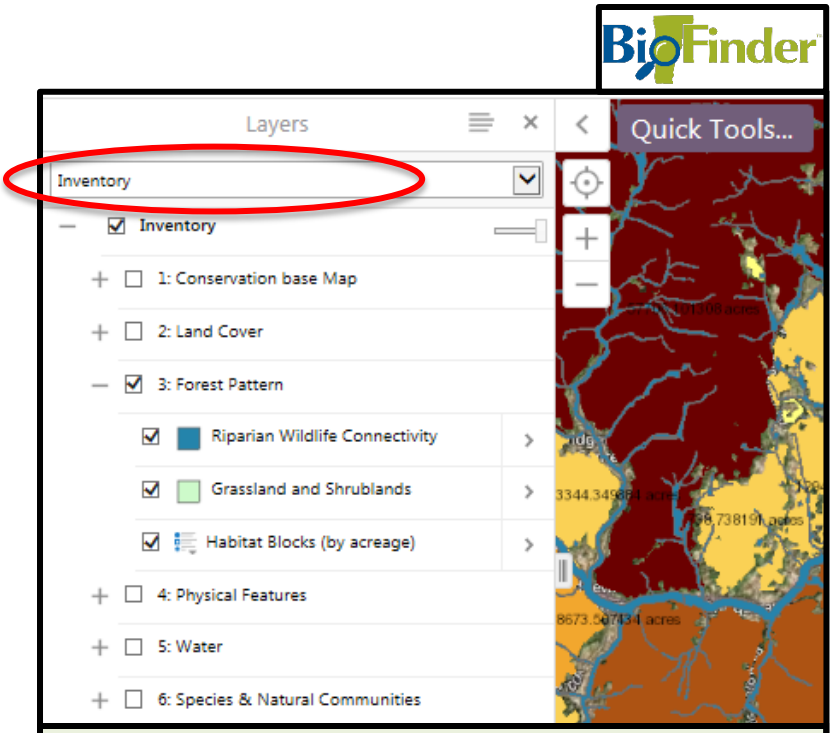
BioFinder Themes

BioFinder categorizes all information into two "themes." Each theme includes a separate list of map information that can be displayed or turned off as desired. The default theme, *Prioritization*, appears when you first open BioFinder, but an *Inventory* theme is also available. Change the theme by clicking in the box at the top of the information panel, under the word "Layers."



Inventory

Answers the question "What's here?"



Inventory Theme
Use the *Inventory* theme to find **specific** information about **which** ecological components are present in an area of interest.

The "Inventory" theme on BioFinder mirrors this guide's presentation of *Part I. Inventory Maps.* This theme displays each individual dataset, organized in the same manner as the first 6 maps here. Just as in this guide, if you begin with Map 1 and view each map in the order presented, you will find yourself beginning with broad, landscape patterns and then zooming in to see increasing detail. Many of the map layers depict the same information shown in the *Prioritization* theme, but here information is shown in its raw form, before priorities have been assigned. This allows a user to explore the breadth of ecological components at play on a local or regional landscape.

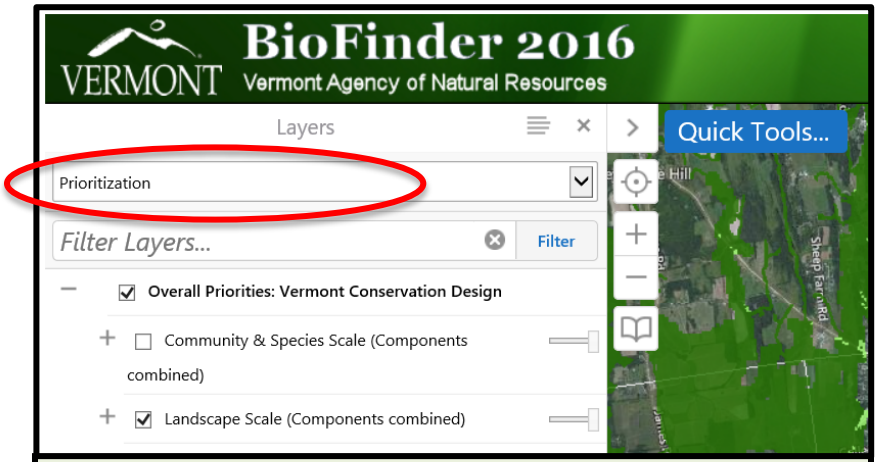
Prioritization

Answers the question "Where are the locations of highest ecological importance?"

The "Prioritization" theme matches the discussion in this guide's *Part II. Prioritization and Implementation*, displaying maps of important components by ecological priority. This theme uses variations of the same data found in the "Inventory" section, but these data are categorized here to aid with conservation planning efforts. This theme identifies statewide ecological priorities based on their contribution to regional **ecological function**—the ability of plants and animals to interact as needed in order to thrive, reproduce, migrate, and move, even as the climate changes.

The theme considers two scales: Landscape scale and Community and Species scale. Landscape scale components include the forest networks, waterways, and physical landforms that create a backdrop for interactions among the majority of Vermont's species. The community and species scale includes those components important to individual species or groups of species of conservation concern within Vermont, such as habitat for rare species, vernal pools, or locations where wildlife are most likely to cross roads.

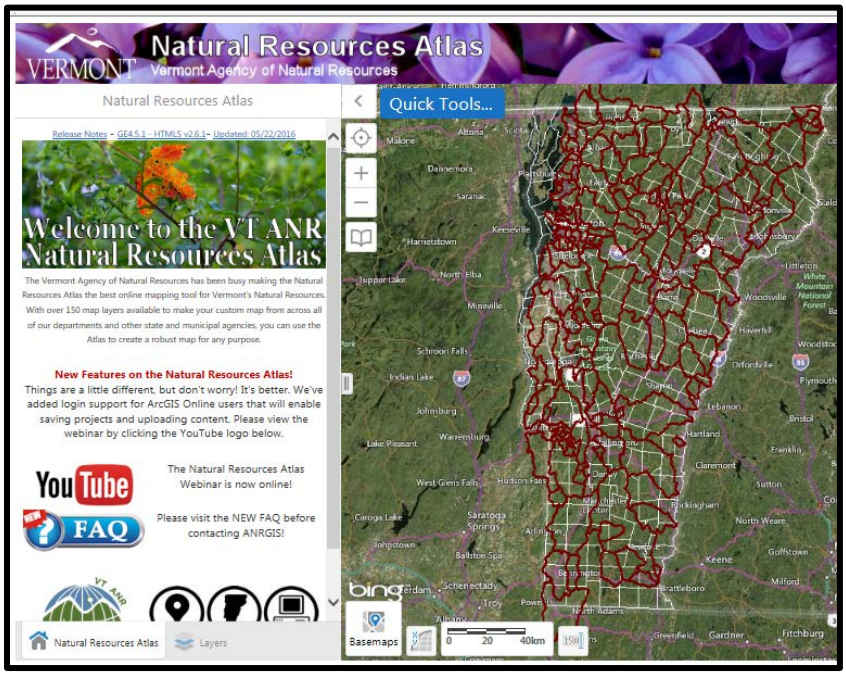
At each scale, state biologists have divided components between "highest priority" and "priority" groups. Areas tagged as "highest priority" are those critical for maintaining an ecologically functional landscape. While areas labeled "priority" are also important, they play a lesser role in maintaining *regional* ecological function—though they may remain important locally. The highest likelihood of maintaining an ecologically functional landscape will be achieved by conservation of both "highest priority" and "priority" components.



Prioritization Theme
Use the *Prioritization* theme to find **locations** containing **generalized** ecological priorities.

The Natural Resources Atlas: A Sister to BioFinder

When conducting conservation planning, BioFinder is the tool of choice, but planners should also be aware of another mapping tool created by the Vermont Agency of Natural Resources: the *Natural Resources Atlas*. This application uses the same online platform, has the same functionality, and even contains much of the same data. The main difference is that BioFinder was created specifically to aid citizens in accessing natural heritage and conservation-related data, while the Natural Resources Atlas is intended for much broader use.



The Natural Resources Atlas acts as a clearinghouse for all data generated or used by each of the departments in the Vermont Agency of Natural Resources. It includes, for example, waste management, geologic, and groundwater protection data in addition to landscape and habitat features. While useful, many municipal planners and citizens find this overwhelming. When conducting

conservation planning, you may find it simpler to start with BioFinder's pre-loaded subset of applicable data. If additional information is needed, any Atlas layer can be uploaded onto BioFinder. Because the tools contain the same functionality, users of one can generally transition to the other with ease.

Visit the Natural Resources Atlas at http://anrmaps.vermont.gov/websites/anra5/.

Getting Started

BioFinder is found at http://biofinder.vt.gov.

If you're new to online mapping tools, we suggest starting with a series of videos about BioFinder. This link takes you to a playlist of multiple videos, starting with an orientation, then continuing to tutorials about using specific mapping tools:

https://www.youtube.com/playlist?list=PLSZ35EULHP6kEyyTjFYwm6PAjrKdBNyYK

In fact, there are quite a few instructional videos produced by the Vermont Agency of Natural Resources' GIS mapping team. All are available on a YouTube channel, which is where new videos will be posted as they become available:

https://www.youtube.com/user/vtanrgis.

The "help" tools within the application may also prove helpful.

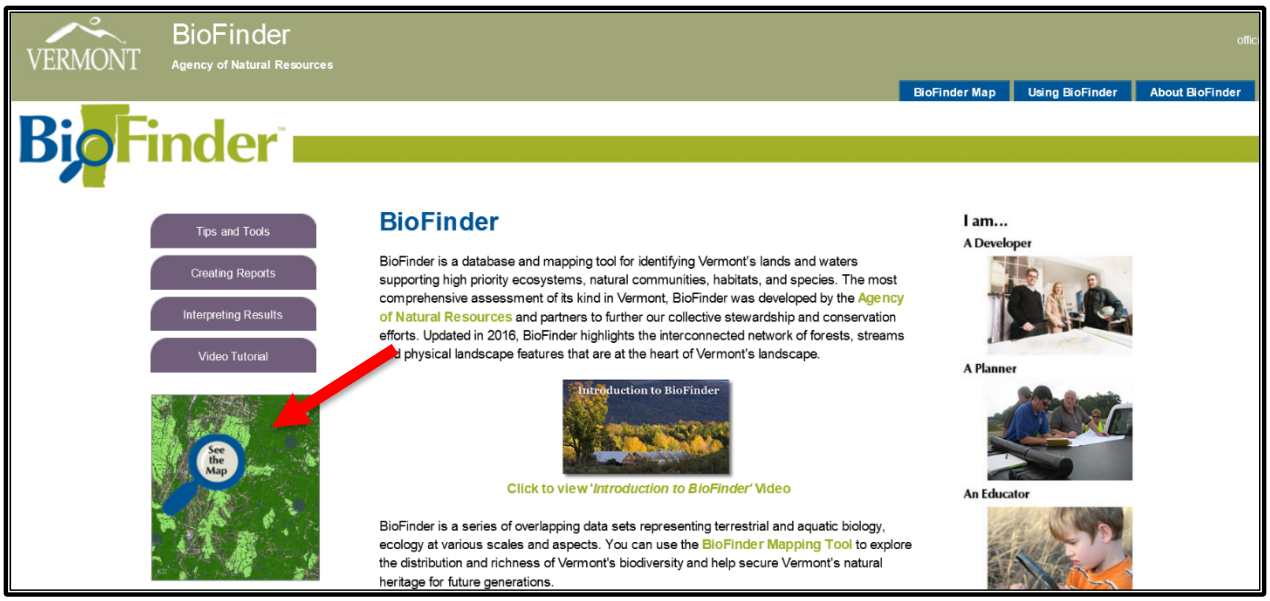
BioFinder Workshops

Want to explore BioFinder in an interactive training? Vermont Fish & Wildlife Department may be available to conduct such workshops. Please contact the Department's Community Wildlife Program for more information on bringing a workshop to your region.

Reproducing the Maps in this Guide

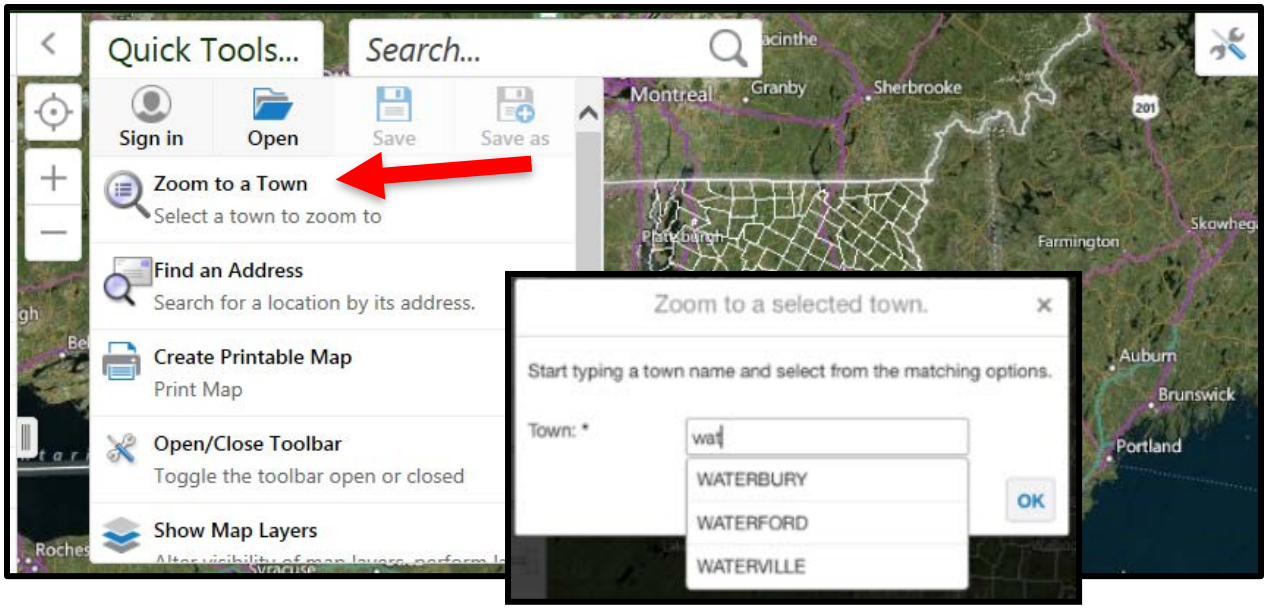
While Vermont Fish and Wildlife Department has prepared static versions of Maps 1-7 in this guide specific to every town in Vermont (included on the CD that accompanies the guide), you may find it most useful to explore the maps online, which will allow you to zoom in or out to see locations of particular interest, mix and match datasets from different maps, or see how your town compares to surrounding locations. Using BioFinder, you can follow the steps below to view any of the maps described in this guide. Please note that colors may differ between those provided in this guide and online.

1. Open the BioFinder Homepage at http://biofinder.vt.gov. This page contains links for additional information, instructions, and tutorials.

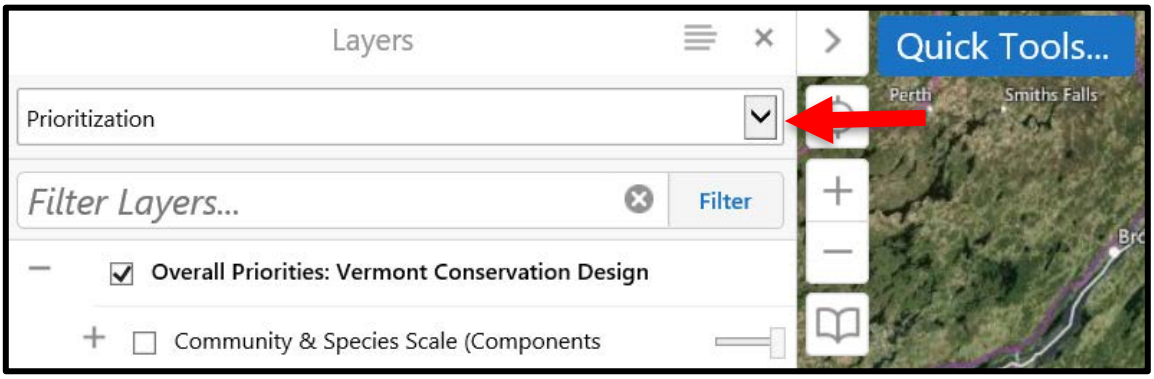


2. Click the map icon with the words "See the Map."

3. On the left-hand panel, click where it says "Click Here To Begin."



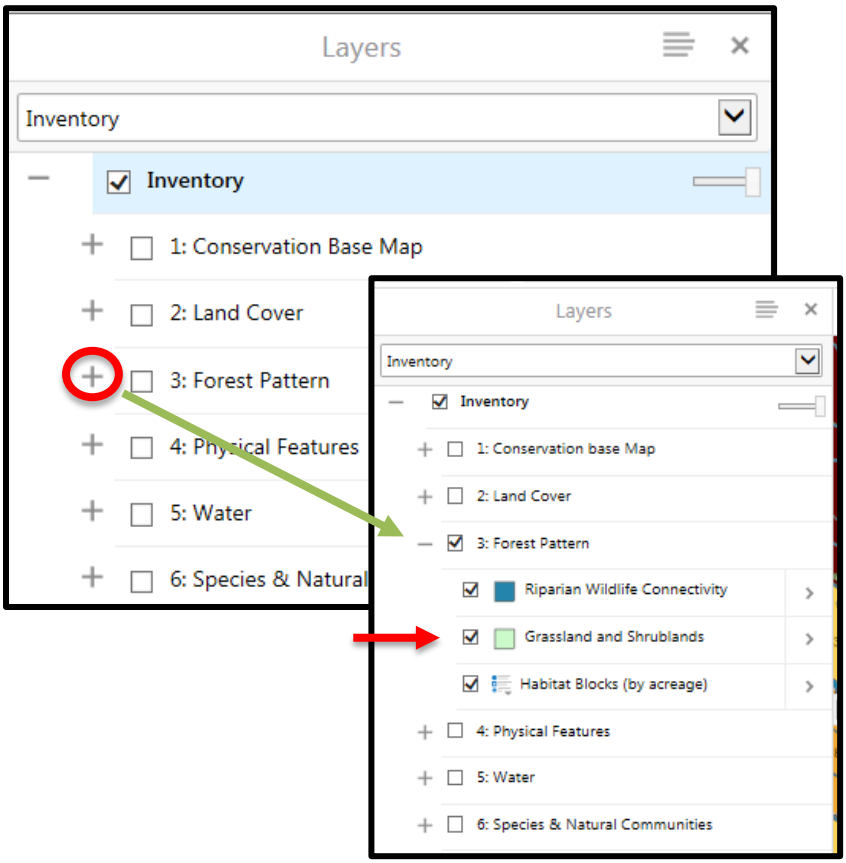
4. Find your town by clicking "Quick Tools" in the top, center of the page. Using the "Zoom to Town" feature, type the first few letters of your town's name, and select your town from the list that appears.



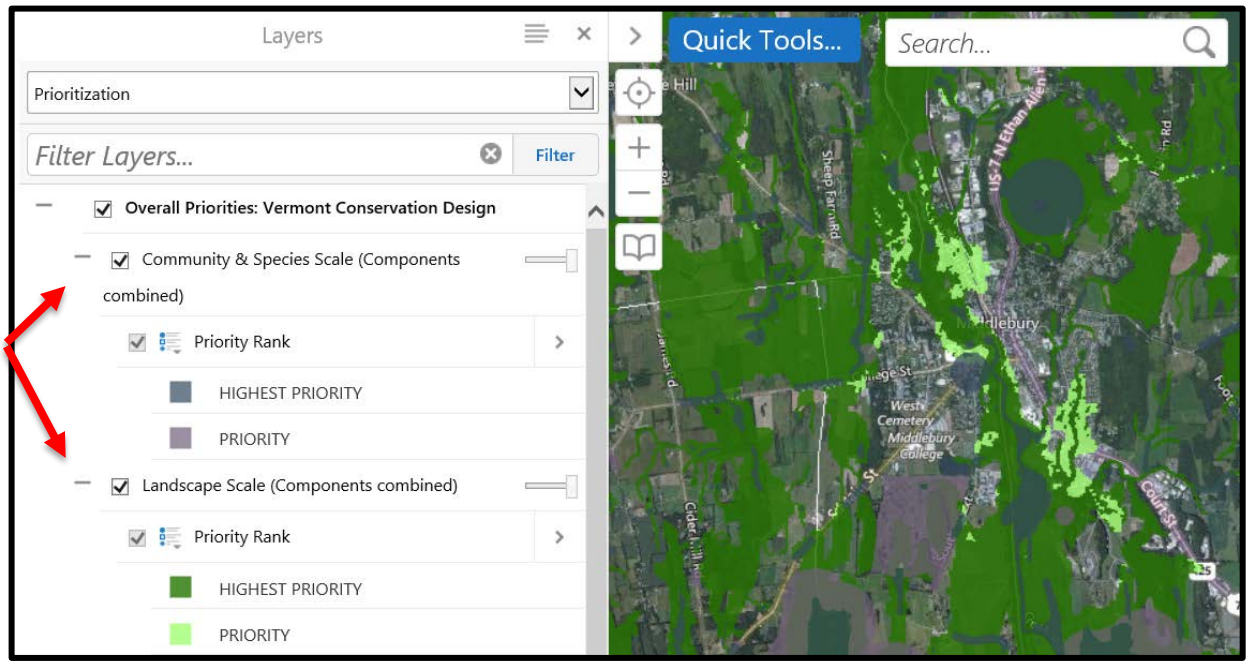
5. Find where a drop-down menu says "Prioritization," under the word "Layers" at the top, left-hand side of the page. Select "Inventory."

6. Maps 1-6 will appear underneath the word "Inventory." These are the same as Maps 1-6 described in this guide.

7. Clicking the "+" sign will display a list of information that can be turned on or off for each map (the in the image). You can control which information is displayed by clicking on the box next to each dataset (see the).



8. You can reproduce Map 7 using the default “Prioritization” theme. Change the theme back to “Prioritization,” then make sure both of the boxes beneath the “Overall Priorities: Vermont Conservation Design” category are checked. These are called “Community & Species Scale (Components combined)” and “Landscape Scale (Components combined).” The image that appears should be very similar to Map 7 of this guide.



Part I. Maps and Inventory

Maps and Inventory

There are many ways to look at any given place—even when focusing specifically on that place's natural heritage. In the following pages, seven maps provide seven different views, each with an eye toward a different aspect of the landscape. While all maps are presented zoomed to the scale of a single town, the order of Maps 1-6 is designed to begin with an overview of the landscape—as though hovering in an airplane high above, looking down—and then slowly adding detail while descending. From each vantage point, they ask the question, ***"What's here?"*** *Once we have gained knowledge from all perspectives, Map 7 flies back up for a fresh look from afar, considering all scales and prioritizing some of the most ecologically important components onto a single map.*

The maps include:

- *Map 1: Conservation Base Map*
- *Map 2: Land Cover*
- *Map 3: Forest Patterns*
- *Map 4: Physical Features*
- *Map 5: Water*
- *Map 6: Species and Community-Scale Resources*
- *Map 7: State and Regional Priorities*

Terms We Use

Components: Each inventory layer in Part I of this guide represents a separate component—a piece of the natural world. These can be natural or cultural and may include physical landforms, land cover, water resources, vegetation types or assemblages, human land use, cultural boundaries, wildlife resources, and more.

Features: We refer to individual occurrences of components as *features*, such as a single block of forest, a ridgeline, or a specific mast stand.

Example: The wetland in your town is an ecological *feature.* All wetlands in the state together make up the *component* we call *Wetlands* in this guide.

*As mentioned earlier, we suggest using this guide alongside the BioFinder website, allowing you to more carefully explore the data presented in these maps. The maps in Part I closely mirror BioFinder's "Inventory" theme. Please see the "**BioFinder**" section of the introduction for more information.*

Altogether, the maps of Part I will provide the basis for the prioritization process outlined in Part II.

Navigation Tip

Start by finding the maps of *your* community on the CD that accompanies this guide. These should matche each of the inventory maps described in the following pages. If you do not have a CD, the maps are available online as static pdf images, or you can create each map on the *BioFinder* website, following directions provided in each section of this guide. Keeping the map handy, go back and forth between map and interpretation until you fully understand what you are seeing in your community.

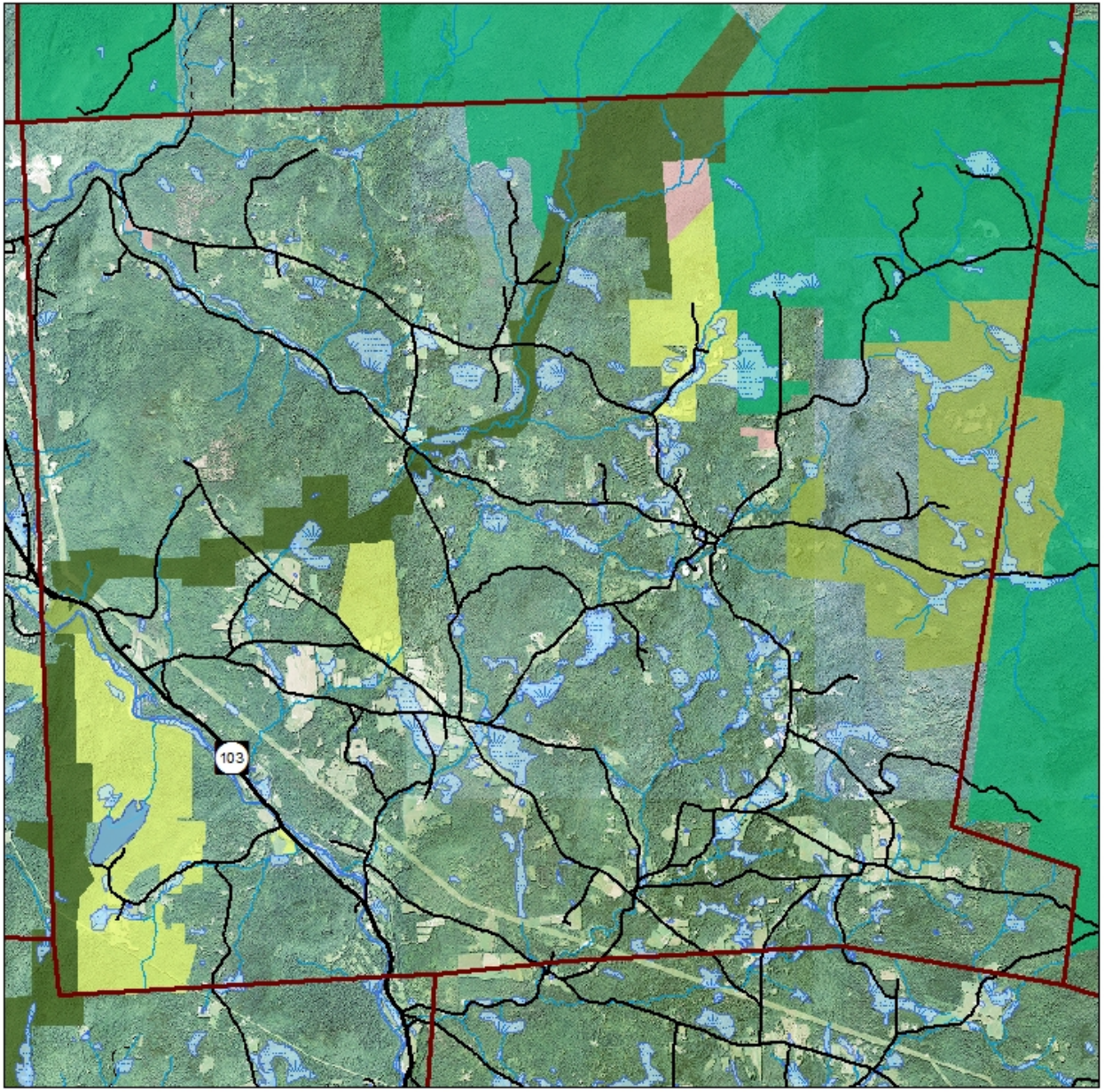
State vs. Local Priorities

It is important to recognize that this guide is produced for use across the state, using data available at the state level. After examining the maps contained herein, communities knowledgeable about the natural resources present on their landscapes may find some important ecological aspects missing from the maps. This is inevitable in statewide mapping efforts, because what creates a landscape's integrity differs from one community to the next. The information we collect and display here tells a story about the ecological patterns and contributions to biodiversity within ***Vermont as a whole*** *that may or may not exactly match the most compelling* ***local*** *ecological story.*

The next step in assembling natural heritage information is therefore to gather local, site-specific material through on-the-ground inventories and interviews with knowledgeable residents. These efforts will need to be tailored for each individual community, but we provide ideas for getting started with this kind of inventory at the end of Part I, in the "Advanced Natural Resource Inventory" section.

Photo by Nicole Corrao

Map 1: Conservation Basemap Shrewsbury, VT



LEGEND

- Town Boundary
- Roads
  - Interstate
  - Primary
  - Secondary
  - Trail
- Wetlands
- Lakes & Ponds
- Rivers & Streams
- Conserved Land
  - Local Government
  - US Fish and Wildlife Service
  - US National Park Service
  - US Forest Service
  - US Dept. of Defense
  - VT Division for Historical Preservation
  - UVM and State Colleges
  - VT ANR- General
  - State 'Natural Area' Designation
  - VT Dept. of Fish and Wildlife
  - VT Dept. of Forest Parks and Recreation
  - VT State Park
  - VT State Forest
  - VT Dept. of Environmental Conservation
  - Housing and Conservation Board
  - VT Dept. Buildings and General Services
  - Private Organization

Data Source:
Vermont Center for Geographic Information
Vermont State Plane Projection
NAD1983 Datum
Map by Monica Przyperhart
May, 2016

0 0.5 1 2 Kilometers

0 0.5 1 2 Miles

Photo by Eric Sorenson

MAP 1. Conservation Basemap

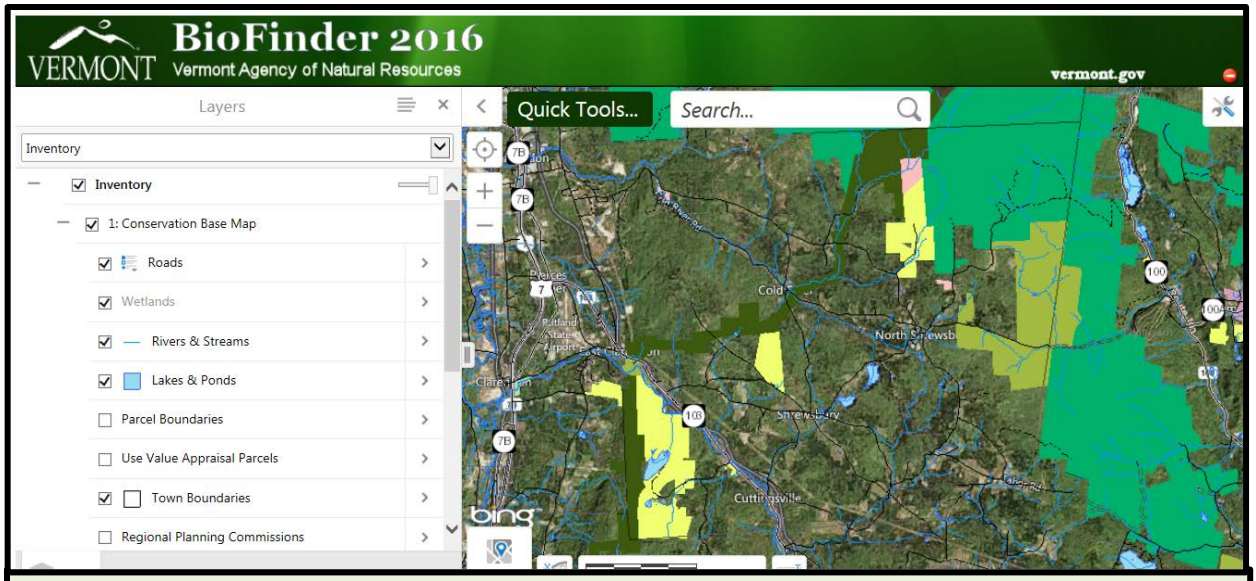
This map provides a visual overview of your community and identifies land that has been permanently conserved.

Inventory Layers *(Described Below)*	**Base Layers**	**Additional Online Data**
1. Conserved Lands	*Aerial Photo*	*Use Value Appraisal*
	Streams & Rivers	*Parcel Boundaries*
	Lakes & Ponds	
	Wetlands	
	Roads	
	Town Boundaries	

Before identifying individual pieces of the landscape, let's start by getting acquainted with the landscape as a whole. This map is a snapshot of your community from afar, frozen at one point in time. It's not intended to be studied in any detail; instead, its goal is to allow us to take stock of what we have to work with and get our bearings.

The dataset highlighted on this map outlines the locations of conserved land—land on which development has been permanently restricted. For planners, this information provides an important starting point, because conserved lands are places for which some land use decisions have already been made. These are areas of more predictable future land use, which can help to guide planning in the surrounding areas.

Other layers on this map can be considered as base layers, and most will appear on other maps as well. The aerial photo background of this map is quite literally a snapshot, capturing anything that can be viewed from above, from a distance, unfiltered. Next, we see waterways—streams, rivers, lakes, ponds, and wetlands. While we examine water in more detail in Map 5, we use it here to get a first glimpse of where water flows across the landscape so as to frame other resources. This map also shows roads—the conduits for human activity—and town boundaries, which provide our theater walls, permeable though they are in the natural world.



To load Map 1 on BioFinder: *Open the "Inventory" theme, then check the box next to "1: Conservation Base Map." Click the "+" to see all layers associated with this map.*
As you move forward in this guide, remember that this map's datasets can be displayed alongside other maps in BioFinder. For geographic reference points, you could leave town boundaries and roads "on." You may also find it interesting to see where natural features in other maps are located in relation to conserved lands. For example, are large habitat blocks (Map 3) or rare species (Map 6) located on conserved land in your region?

Conserved Lands

What are Conserved Lands?

Conserved land refers to property on which development has been permanently restricted, including buildings, paved roads, and most commercial infrastructure. The information displayed includes both land owned by a conservation entity *and* private land that has been protected through a conservation easement. These data were first published by the University of Vermont Spatial Analysis Lab and developed by a partnership between many federal and state agencies and departments, the University of Vermont, and several Vermont nonprofits.

To be more specific, the map includes all conservation lands owned by local, state, and federal government in Vermont. It also includes land owned by Vermont's nonprofit land trusts, such as The Nature Conservancy, the Vermont Land Trust, and others, and all land on which said entities have placed a conservation easement. This final category is generally land in private ownership for which a land trust or other entity holds the development rights. Conserved land therefore does not imply public funding or public access. The holdings of some small land trusts are not included in this dataset.

While the database is updated periodically, users should recognize that it may be a few years out of date at any given point in time.

Conserved Lands: Significance

The location of conserved lands in your community can frame other planning decisions, because these are known epicenters free from development. Even though surrounding land use may change, you can be confident that these lands will remain available as potential wildlife habitat.

Community Strategies for Vermont's Forests and Wildlife: Case Studies

There are many reasons why a family, individual, or group may want to conserve land, and every conservation decision has a unique story. *Community Strategies for Vermont's Forests and Wildlife* documents a few of these stories, found on page 28 of the book.

Conserved lands information may be even more useful when combined with other datasets. For example, you might look at conserved lands alongside rare species or significant natural communities (both described in Map 6 of this guide) to create a snapshot of which resources are already protected in a given area. A community may then be able to better prioritize the protection of additional natural heritage features.

In short, it can very interesting to see—at either a statewide or local scale—where the significant natural resources are located in comparison to the conserved lands. How many of your community's wetlands are on conserved land? Your largest habitat blocks? Statewide, many important natural resources are not protected, but you can see whether this is the case in your community.

Conserved Lands: Map Interpretation

While all lands in this dataset (also called the Protected Lands Database) are permanently protected from development of some type, there are several classes of conserved lands, and the map doesn't differentiate between them. Some conserved lands are managed strictly as natural areas, with activities such as timber harvesting prohibited. Others are managed specifically *for* the production of timber and other natural resources but prohibit development. Others are active, working farms where normal farming activities are expected (or even required), with development greatly restricted but not prohibited. In certain cases, conserved lands allow development for particular uses—such as public recreation—as is often true with state and town parks.

The information in the Protected Lands database can be used at any scale where precise boundaries are not important. Because many maps were digitized from paper versions that included sketch maps, deed descriptions, or old surveys that required a great deal of interpretation, no boundary line should be considered precise or used to determine protection status on a fine scale.

Because land may be conserved to protect any number of different qualities—agricultural soils, views, community resources, natural areas, historic landmarks, water quality, wildlife, and many other values—no inferences should be made about habitat quality or public access on conserved lands. This database includes large, public lands with advertised recreational trails, and it *also* includes small, privately-owned parcels with *no* public access. Similarly, this map conveys no information about management goals, though some public lands have management plans available.

Conserved Lands: Planning Considerations

Just as current areas of development are unlikely to grow into forest, conserved land is unlikely to become developed. Because wildlife populations are most likely to thrive if their habitats are interconnected and large, a community may want to consider the distribution of protected areas before planning areas of future development or conservation. From a natural resource protection perspective, it is often better to expand upon prior investments in land conservation than to create a new block of conserved habitat—although there are many exceptions. While habitat quality is not represented in this dataset, the size and interconnectedness of habitat is so important to wildlife abundance that simply having a parcel conserved elevates its general importance to resource planning. Of course, permanently protected lands are not the only places that contribute to habitat conservation. Practicing good land management or enrolling land in an established conservation incentives program can be considered conservation—at least for the short term--and these are not included on this map. As you conduct planning in your community, you may want to look further into strategies that promote working forest management or maintain larger forest blocks. For example, you could connect landowners with the US Fish and Wildlife Service's *Partners for Fish and Wildlife Program* or the many incentives program managed by the Natural Resources Conservation Service. Please also see the information below about Vermont's Use Value Appraisal Program ("Current Use").

Growing a Town Forest

Many Vermont towns have found town forests to be community assets. In Bradford, the town began with a relatively small town forest, Wright's Mountain Conservation Area. As this area became increasingly used for recreation, education, wildlife conservation, forest management, and historic preservation, the town took opportunities to expand the conserved area, one parcel at a time. Some of this story can be found at http://www.uvlt.org/2011/02/bradford-extends-wrights-mountain-conservation-area/.

Background: Aerial Photo

On Map 1—and as the default on BioFinder—the background is an orthophoto—a patchwork of aerial photographs that have been matched with geographic coordinates to align with other map data. Orthophotos are useful in helping to get oriented on a map, since we can pick out familiar features. When zoomed out, orthophotos can aid us in seeing patterns—places of dense or dispersed vegetation, road networks as they meander through the state, density of development in one place compared to another. When zoomed in, we can sometimes see details such as the locations of guardrails along a road, the width or substrate of a river bank, or even differences in forest types—conifer stands versus hardwoods, for example—that are difficult data to collect through other means.

As a photograph, an orthophoto shows *exactly* what was present at a precise moment in time. This is *raw data*; it has not been interpreted in any way. It depicts the landscape, frozen in time, as it is. In fact, orthophotos are the basis for a variety for other map data; many layers described in this guide were created through the close examination of orthophotos.

Additional Online Data

When using *BioFinder*, the following datasets can also be selected to display on Map 1.

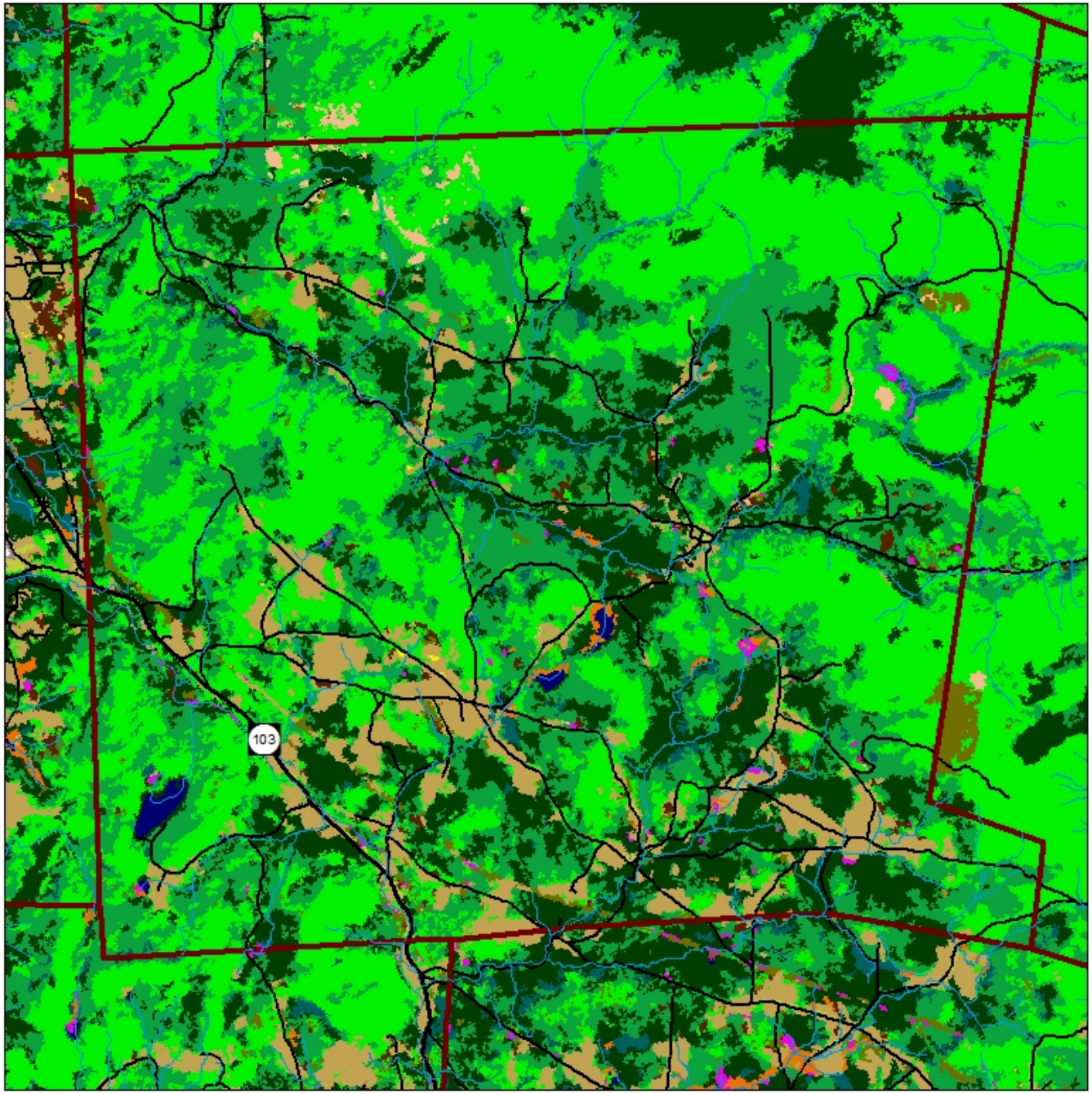
Use Value Appraisal (Current Use)

Through Vermont's Use Value Appraisal Program (also called "Current Use), eligible private lands that are managed for timber can be appraised based on the property's value for wood production rather than for its development value. The result is generally a reduction in property taxes for those enrolled in the program—often reducing the pressure on a landowner to sell. Because lands can be removed from the program (subject to a tax), this form of land conservation isn't permanent. However, data show that between 2003 and 2009, undeveloped parcels of at least 50 acres enrolled in Current Use were twice as likely to remain undeveloped than those not enrolled (Brighton et al). Enrollment suggests a willingness on the part of a landowner to play an active role in land management and an investment in maintaining the property as forest.

A map layer of lands enrolled in Vermont's Use Value Appraisal program is included in the BioFinder version of Map 1. Learn more about the program through the Vermont Department of Forests, Parks, and Recreation, at http://fpr.vermont.gov/forest/your_woods/use_value_appraisal.

Parcel Boundaries

This layer displays the parcel boundaries in many Vermont towns. They are compiled from digitized tax maps. Most do not reflect the work of a surveyor and may contain inaccuracies, particularly when viewed at close range. All boundaries should be assumed to be approximations; for accurate parcel boundary information, please visit your local town office for recorded survey and/or deed information.



Map 2: Land Cover Shrewsbury, VT

Legend

- Town Boundary
- Rivers & Streams
- Interstate
- Primary
- Secondary
- Trail

Land Cover

- Developed, High Intensity
- Developed, Medium Intensity
- Developed, Low Intensity
- Developed, Open Space
- Cultivated Crops
- Pasture/Hay
- Grassland/Herbaceous
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Scrub/Shrub
- Palustrine Forested Wetland
- Palustrine Scrub/Shrub Wetland
- Palustrine Emergent Wetland
- Estuarine Forested Wetland
- Estuarine Scrub/Shrub Wetland
- Estuarine Emergent Wetland
- Unconsolidated Shore
- Bare Land
- Open Water
- Palustrine Aquatic Bed

Data Source:
Vermont Center for Geographic Information
Vermont State Plane Projection
NAD1983 Datum
Map by Monica Przyperhart
June, 2016

0 0.5 1 2 Kilometers

0 0.5 1 2 Miles

MAP 2. Land Cover

This map is useful for seeing patterns of natural land cover and land use.

Inventory Layers *(Described Below)*	**Base Layers**
1. Land Cover	*Roads*
	Town Boundaries
	Streams & Rivers
	Lakes & Ponds

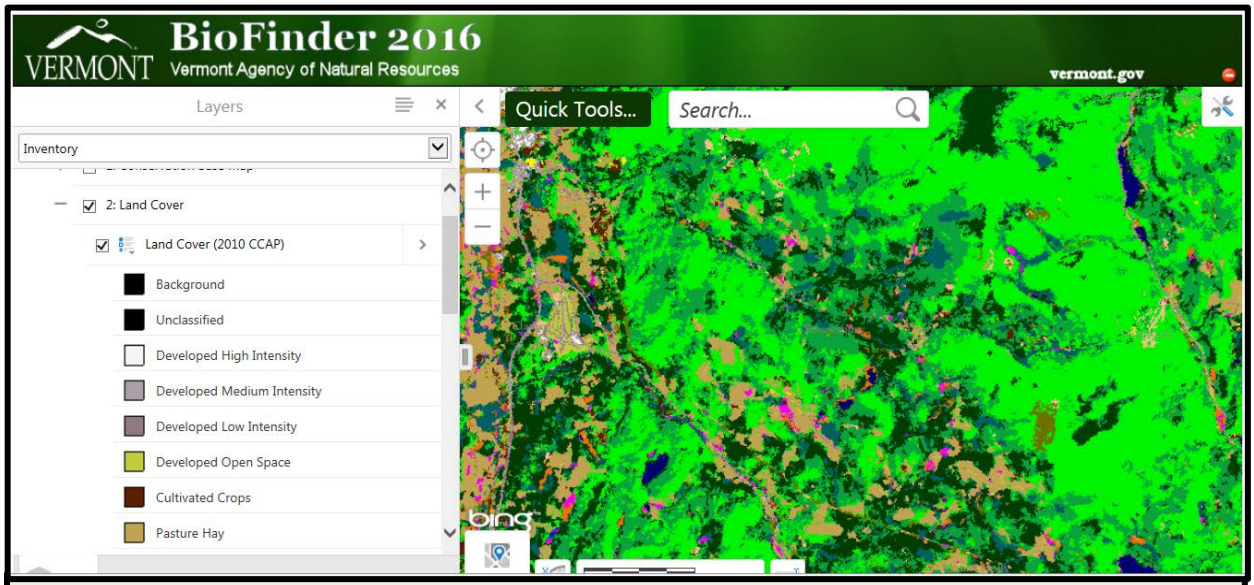
This map is useful at a broad scale for seeing patterns of natural land cover and land use. At a statewide scale, it is beneficial for picking out developed areas, agricultural areas, wetland complexes, and forested areas. More locally, these data can be used to locate forested blocks, predict where wildlife with wide home ranges may be able to travel through the landscape, and see where patterns of development may hinder wildlife movement. They can also be used to distinguish hardwood forests from softwood and mixed forests, which can be helpful in predicting locations of natural communities and wildlife species.

In a sense, this map is a simplified version of the base map presented in Map 1. We described that map as a snapshot of the action we see as we walk into a theater. This land cover map simplifies that snapshot, lumping raw data into categories so that we can more easily compare one place to another. Like Map 1, land cover information isn't intended to capture individual processes or species; it tells, very simply, what covers the ground at the present time.

What Is Land Cover?

Land cover records the landscape as surface components: forest, water, wetlands, urban, etc. For this guide, we have elected to use the National Oceanic and Atmospheric Association's (NOAA's) Coastal Change Analysis Program (C-CAP) as our data source, though other land cover datasets are available.[1] C-CAP produces a nationally standardized database of land cover

and land change information for coastal regions and adjacent uplands—including Vermont. This is the data displayed here, from the 2011 database.



To load Map 2 on BioFinder: *Open the "Inventory" theme, then check the box next to "2: Land Cover." To see the layers, click the "+" next to the layer title. For additional guidance on using BioFinder, please see* Getting Started *in the introduction to this guide.*

Land Cover: Significance

This map provides a first look at a landscape, identifying the abundance and distribution of general habitat types for animals and plants. It also provides an initial view of fragmentation—that is, how the landscape is connected or broken apart through both human and natural divisions. Because these C-CAP land cover maps are updated routinely for all of New England and New York using a standardized methodology, planners and managers can assess larger landscapes across state lines and use these maps for comparisons across geographic space and over time.

Land Cover: Map Interpretation

Across its range, this map depicts twenty-two standard categories of land cover, including detailed information on wetland types. Within Vermont, we see the following categories:

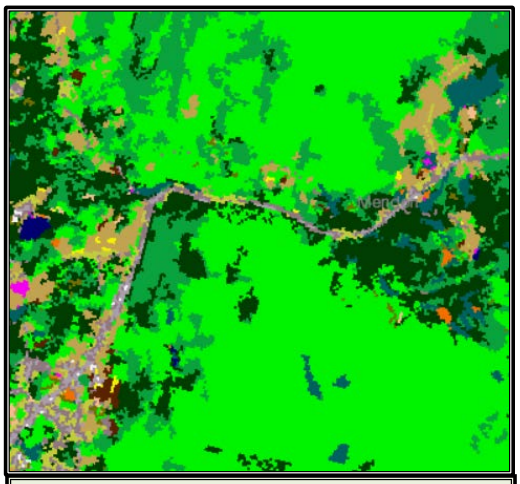
High Intensity Developed (Urban, with a high density of impervious surface)
Low Intensity Developed (Urban, with a low density of impervious surface)
Cultivated land (Active agriculture, orchards, and vineyards)
Grassland (Managed and unmanaged)
Deciduous Forest
Evergreen Forest
Mixed Forest (Forest not dominated by either deciduous or evergreen species)
Scrub/Shrub (Less than 20 feet tall)
Palustrine Forest (Freshwater wetland forest)
Palustrine Scrub/Shrub (Freshwater wetland scrub/shrub)

- Palustrine Emergent (Freshwater wetland with emergent species such as marsh, lilies, etc.)
- Bare Land (Bare exposed rock, sand, and soil)
- Water (Open water)
- Palustrine Aquatic Bed (Floating vegetation and algal communities)

Because the land cover dataset was created by analyzing satellite and aerial imagery, the accuracy of some features recorded is higher than others. For example, open, similar cover types such as row crops and grasslands are not always correctly differentiated; however, different wetland types are shown with a high degree of accuracy.

Land Cover: Planning Considerations

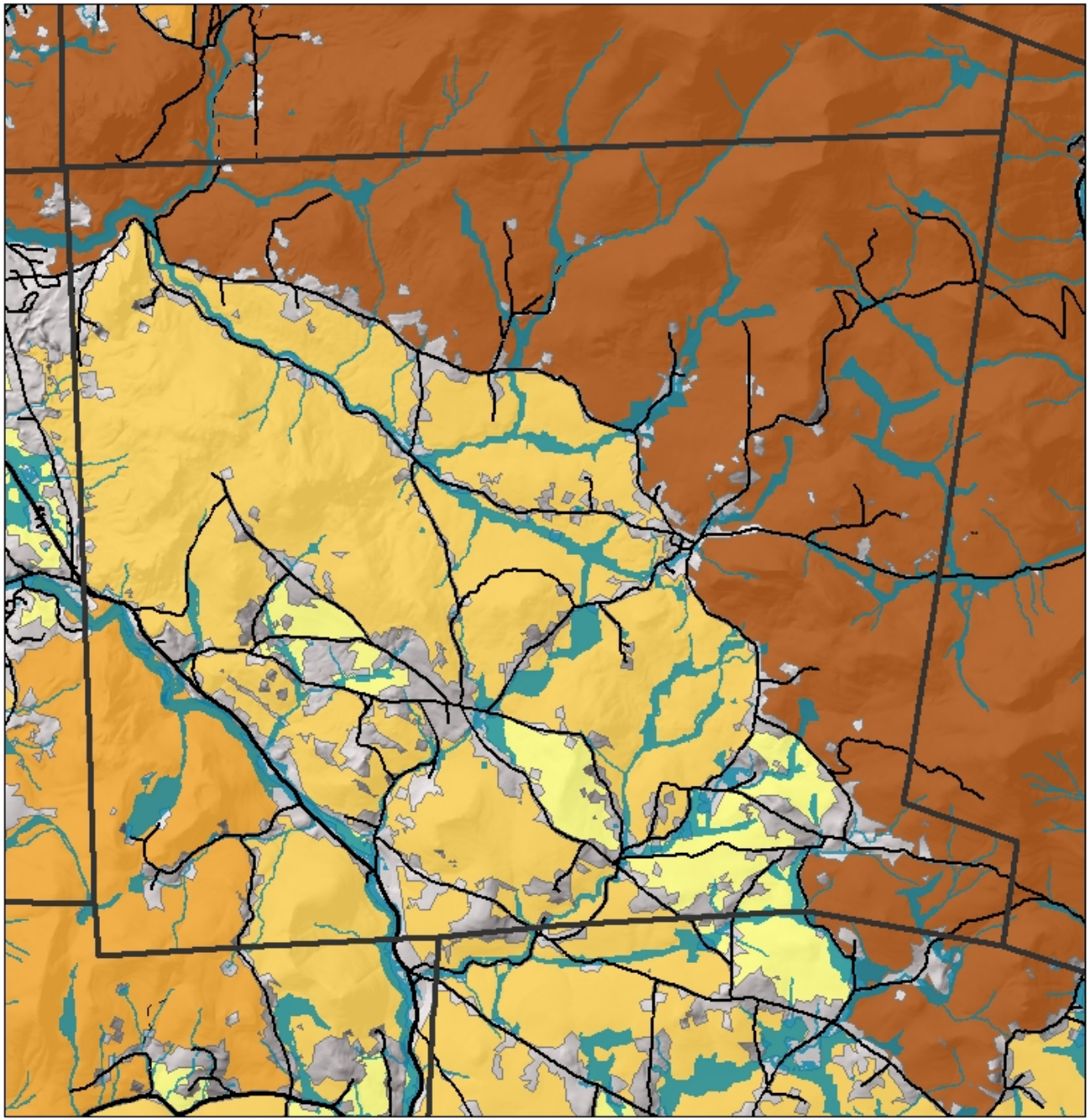
NOAA developed C-CAP land cover data to aid with identification of regional landscape patterns and major habitat types, environmental impact assessment, urban planning, and zoning applications. For municipal planning purposes, the most useful application may be in visualizing existing landscape patterns. For example, large patches of green indicate large forests, and because we can differentiate between evergreen and deciduous forest, we can get a broad sense how habitats change across a given area. Another interesting pattern can be seen in the shape of a forest as it approaches a road. Often, forest cover gives way to more developed cover classes. Where it remains forest, the resulting shape may appear like an hourglass, as pictured. For wildlife, these areas may be important links between one forest patch and another and may represent significant road crossing areas. We can also focus on patterns of development, seeing where buildings are clustered in centers and where they spread out, creeping along road corridors into more rural areas. Because remote techniques were used to create this map, data should be field-checked before being used directly for planning or zoning.



The hourglass shape that emerges in forest cover as it crosses a road may indicate a location where wildlife are able to travel between the forests on either side.

For More Information

The NOAA Coastal Change Analysis Program, who created the dataset described above, has a website offering additional data, products, and tools that may be useful in natural resources planning. For example, one map layer shows changes in land cover from 1996-2001 and from 2001 to 2006.



Map 3: Forest Patterns Shrewsbury, VT

LEGEND

Town Boundary

Roads

Class

Interstate

Primary

Secondary

Trail

Riparian Wildlife Connectivity

Grasslands and Shrublands

Habitat Blocks by Acreage

Acres

20 - 500

501 - 5,000

5,001 - 1,0000

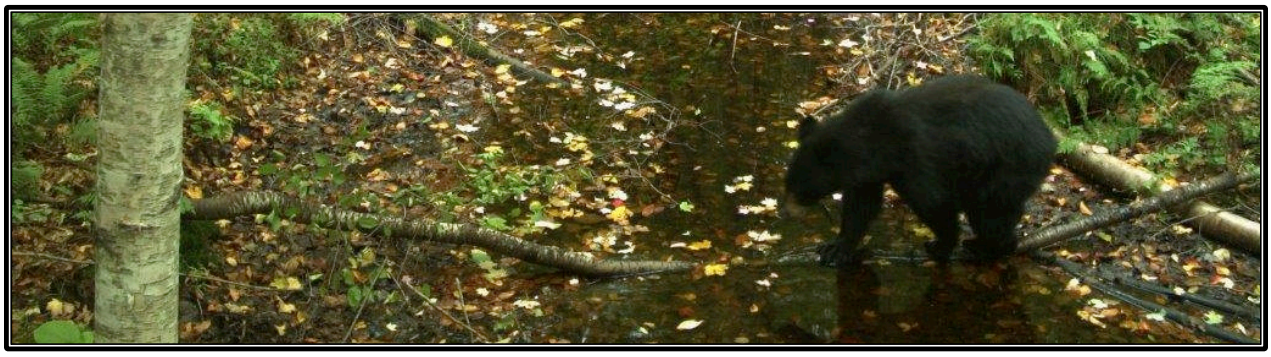
10,001 - 50,000

50,000 - 154,564

Data Source:
Vermont Center
for Geographic Information
Vermont State Plane Projection
NAD1983 Datum
Map by Monica Przyperhart
June, 2016

0 0.5 1 2 Kilometers

0 0.5 1 2 Miles



Map 3. Forest Pattern

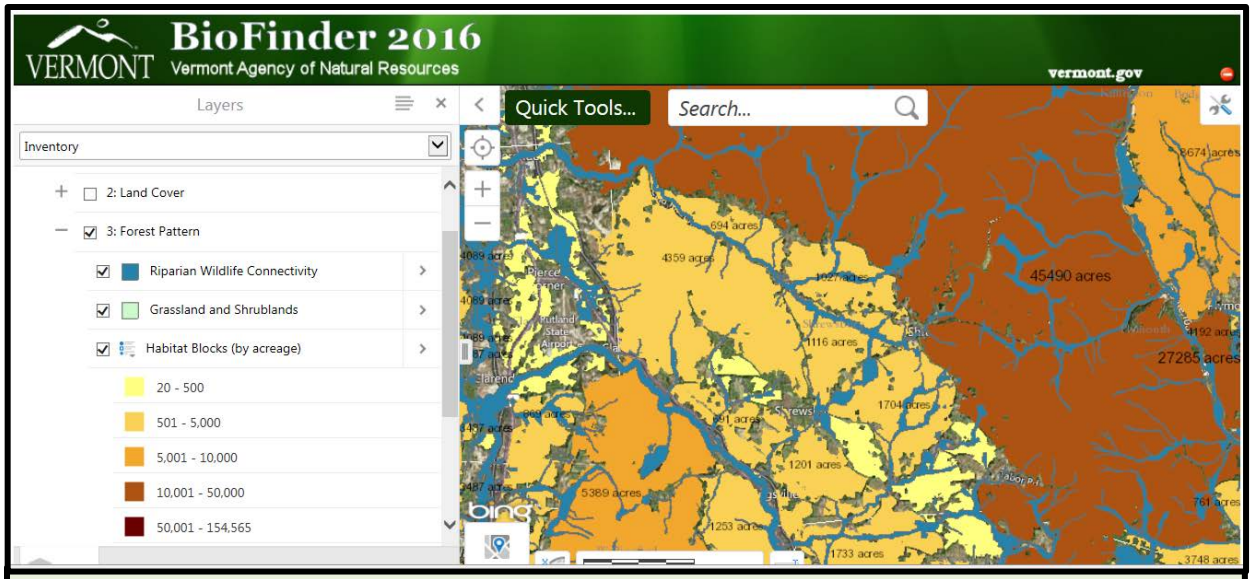
This map shows the pattern of forests and fields, separated by human activity, across your community.

Inventory Layers *(Described Below)*	**Base Layers**
1. Riparian Wildlife Connectivity	*Roads*
2. Grasslands and Shrublands	*Streams and Rivers*
3. Habitat Blocks (by Size)	*Lakes & Ponds*
	Town Boundaries

When considering wildlife on the local landscape, broad-scale vegetation patterns can be very revealing. The degree to which a landscape's vegetation is connected or separated has direct implications for *where* wildlife will be on a landscape and *which* wildlife are present. This concept of connectivity is particularly important in the face of climate change; maintaining connected pathways of natural vegetation across the landscape is a critical strategy for adapting to a changing climate, allowing animals and plants to disperse to locations that provide favorable conditions (Heller and Zavaleta 2009).

This map shows where the vegetated banks of streams, rivers, and lakes form continuous pathways in which wildlife can move. It shows where blocks of undeveloped land are located, organized by size. Finally, it shows grasslands and shrublands. These may be contained within larger habitat blocks, or they may appear isolated. Either way, there is an important assemblage of species that relies on these open fields or young stands for their survival.

In 2016, the Vermont legislature passed a bill (Act 171)[1] that requires regional and municipal planners to identify important forest blocks and habitat connectors, and then to limit fragmentation in these areas when conducting land use planning (Vermont General Assembly 2016). Map 3 allows a planner to take a preliminary look at where these forest blocks and connecters are likely to be located. In determining the ecological importance of habitat, size is primary factor, so habitat blocks are displayed here by size. Since wildlife frequently travel along the edges of waterways, Riparian Wildlife Connectivity can be used to visualize possible routes of wildlife movement.



To load Map 3 on BioFinder: *Open the "Inventory" theme, then check the box next to "3: Forest Pattern." To see all layers, checkthe box beside the layer title and then click "+"to expand the group. To see landmark locations, such as roads or town boundaries, check them on in "1: Conservation Basemap." For additional guidance on using BioFinder, please see* Getting Started *in the introduction to this guide, or "*Tips and Tools*" on the BioFinder website.*

Inventory Layer #1: Riparian Wildlife Connectivity

What is Riparian Wildlife Connectivity?

When moving from one place to another, wildlife often use the vegetated lands adjacent to streams, rivers, lakes and ponds. Sometimes these areas are called "corridors" even though they are not always linear, as the term implies. The riparian area includes all land that is directly affected by surface water (Verry et al., 2000) and often extends some distance from the channel itself. This map highlights the vegetated areas next to rivers, streams, lakes, and ponds.

Riparian Wildlife Connectivity: Significance

In general, riparian ecosystems are high in biological diversity. While they are particularly important for species associated with rivers and lakes such as mink, otter, beaver, and wood turtle, they are used by a wide assortment of wildlife, with even more substantial benefits when continuous vegetated habitat remains alongside waterways for extensive distances. Then, they function as corridors for wide ranging mammals—those animals that must maintain large home ranges to obtain sufficient food, find shelter, or have access to mates—as they traverse the landscape.

In some cases, the riparian area may need to be restored before it can become functional for wildlife. The White River Partnership's Trees for Streams program is one example of a restoration project that works with landowners, students, and volunteers to establish functional riparian corridors: http://vtconservation.com/success/content/white-river-partnership-trees-streams-program.

Riparian corridors are also important to our human communities, providing highly-valued ecological functions relating to water quality, flood attenuation, and shoreline stability.

Riparian Wildlife Connectivity: Map Interpretation

These data show *streamside* connectivity—on land—and not connected pathways within the water (referred to as *aquatic organism passage*). In other words, dams, waterfalls, or hanging culverts many prevent fish and other aquatic organisms from freely moving up and down streams even when those streams are buffered by functional riparian areas. These aquatic barriers are not represented here.

When using these data, keep in mind that all segments of vegetated riparian habitat are treated equally; habitat is either present or lacking. Ecologically, however, some locations are certainly more functional for maintaining traveling wildlife populations than others, such as longer riparian sections or those that connect to high-quality habitat or large interior habitat blocks.

Riparian Wildlife Connectivity: Planning Considerations

Conserving a connected network of lands, waters, and riparian areas can be one of the most effective strategies for maintaining an area's wildlife habitat, particularly in response to changing environmental conditions. From an ecological standpoint, maintaining riparian wildlife connectivity may be the single most important goal a community can accomplish through planning. Restoration and conservation of riparian connectivity is especially important in areas of Vermont that are highly developed.

Because conservation of riparian wildlife connectivity should be considered alongside other goals for the riparian area, we list specific conservation strategies in Map 5, Surface Waters and Riparian Areas.

Riparian Habitat: A Starting Point

Not sure where to begin conserving your community's natural heritage? Consider starting with riparian habitat. Among conservation actions taken at the community level, maintaining riparian habitat has one of the greatest impacts for wildlife. It's also an area of great benefit for a community, since conserving the riparian area not only protects wildlife habitat but also maintains water quality, reduces erosion, provides flood resilience, and can support recreational opportunities.

Inventory Layer #2: Grasslands and Shrublands

What are Grasslands and Shrublands?

Grasslands are open lands dominated by grasses, sedges, and other low vegetation, with few or no shrubs or trees. They include some wetlands, such as meadows wet enough to deter most larger vegetation, and managed lands such as hay fields.

As the name implies, shrublands are dominated by low, dense shrubs such as dogwood and willow. They are often associated with the margins of grasslands, including land managed for

agriculture or other uses. Other shrublands are created by natural disturbances that remove larger vegetation, or beavers.

Vermont's grasslands are scattered throughout the state, with the highest concentration in the Champlain Valley. While some are natural, most that we see today are associated with current or past agricultural practices, with a few resulting from other human activities such as the meadows associated with airports, landfills, utility rights-of-way, fairgrounds, and industrial complexes. Most of Vermont's grasslands are in private ownership, although the state and federal governments own small areas of this habitat.

Shrubland habitats are more widely distributed throughout Vermont. They are associated with both upland and wetland conditions, and they occur on both public and private land. Some result from natural processes, and others represent the transition of agricultural lands and cleared areas into eventual forest.

Grasslands and Shrublands: Significance

Grasslands and shrublands provide essential habitat for many bird, mammal, reptile, and invertebrate species. Numerous birds require these habitats for their survival, with species such as Upland Sandpiper (endangered), Grasshopper Sparrow (threatened), Sedge Wren (endangered), Vesper Sparrow, Savannah Sparrow, Bobolink, and Eastern Meadowlark found exclusively in grasslands. Birds specialized to life in shrubland habitat include American Woodcock, Brown Thrasher, Golden-winged Warbler, Eastern Towhee, and Field Sparrow. While some of these species are considered common in Vermont, their populations are undergoing some of the steepest declines of any birds, both in the state and across the US.

Since the agricultural boom of the 1800s, Vermont's decline in grassland bird species is primarily a result of habitat loss as farm fields have grown into forests. Grasslands have also given way to residential, commercial, and industrial development. Other threats include changes in agricultural practices, extensive use of agricultural pesticides, and loss of wintering habitats outside of Vermont.

While the ranges of these grassland birds were historically concentrated outside of Vermont, conversion of natural grasslands elsewhere in the Northeast and especially the Midwest has led to the decline of grassland birds across their historic natural habitats. This has given Vermont—and the Northeast in general—a more important role in the conservation of grassland birds.

Grasslands and Shrublands: Map Interpretation

At a state level, this layer represents the best available grassland and shrubland data. That said, geographic representation of grasslands outside the Champlain Valley is lacking, and this dataset therefore omits *many* existing grasslands. Information on the location of shrublands are limited statewide; these are captured by extending grassland habitat data and including relevant categories from Vermont wetlands data.

Data for this layer were collected remotely, through the interpretation of satellite imagery. While this technique can be used to quite accurately record the locations of grasslands, shrublands are difficult to identify in this way. They are included in this dataset primarily because it is presumed

that some grasslands identified in the original dataset will have grown into shrublands as time passes before the data is used.

In Vermont's landscape, these types of landscape are both transitional in nature. While some are entirely natural—such as wetland areas in which the soggy soil discourages the growth of larger plants and trees, the majority of grasslands and shrublands are locations of recent disturbance, where trees have been cleared. Without continual management, these lands will become forestland. Without regular cutting, grasslands convert to shrublands, which eventually become forest. When using this dataset, it is therefore wise to keep in mind that grassland and shrubland habitats are difficult to model, and their ephemeral nature renders field data quickly out-of-date.

Because of this ephemeral nature, grasslands and shrublands are combined into a single map layer, to achieve a longer lifespan. Even as the species benefitting from the mapped land change from grassland species to shrubland species, the modeled area remains relevant as a broad conservation target. Given this, we estimate this data to be relevant for 10 years from each publication update, although land use changes during this 10-year period may alter wildlife habitat value significantly

Because Vermont's grasslands are so closely associated with agriculture, conservation programs often work alongside farmers to make grassland bird conservation economically feasible. The Bobolink Project is one example of such a program: http://www.bobolinkproject.com/

Please keep in mind that these data could include row crops, which do not support grassland birds or quality habitat for most target species. These are included in this layer because many crops, such as corn and hay, are rotated year-to-year on many farms. One year the habitat may be good, and another, not.

Grasslands and Shrublands: Planning Considerations

Grasslands and shrublands, whether of natural origin or resulting from active land management, are critical to the survival of a suite of Vermont species, namely birds. Most of these species will continue to decline in Vermont if grassland habitat is not maintained.

Most strategies for maintaining grasslands and shrublands rely on individual landowners and managers. When planning, determine what the pattern of grasslands and shrublands looks like in your area. Then include important areas in your conservation planning, and consider working with landowners to ensure continued representation of these habitat types.

Keep in mind that shrubland is crucial to maintain at a *regional* level. It is wise to view this data at the scale of your town, then to zoom out and see how available this habitat type is in the regional context before taking action. While this habitat type is crucial for an assemblage of bird species in particular, it should be viewed as one relatively minor component of a diverse, connected landscape of other habitat types.

In choosing conservation strategies, your town may want to consider the following, with additional information on these strategies found in Community Strategies for Vermont's Forests and Wildlife.

Conservation Goal	Conservation Strategies	
	Nonregulatory strategies	*Regulatory Strategies*
Seek additional information	Conduct field inventories as needed to improve maps.[2]	
	Learn more about grassland bird management.[3]	
Provide baseline protection	Adopt language in the town plan, including statements about the importance of grassland and shrubland habitat and policies on how they should be managed, protected, and restored.	
Ensure that management is compatible with wildlife	Practice management compatible with nesting birds on town-owned grasslands (the fields around schools or recreation fields, etc.). [4]	In site plan review, require that developments follow sound grassland bird management guidelines.
	Connect landowners to incentives programs for wildlife-friendly management practices, such as USDA,[5] USFWS Partners for Fish and Wildlife,[6] or the Bololink Project.[7]	
	Provide citizen educational opportunities.	
	Establish a monitoring program for grassland birds.	
Maintain or protect habitat	Ensure that grasslands and shrublands are represented in local conservation efforts.	

Inventory Layer #3: Habitat Blocks (by acreage)

What are Habitat Blocks?

Habitat blocks are generally forested areas of at least 20 acres with no roads or low densities of class IV roads. They contain little or no human development such as buildings, parking areas, lawns, gravel pits, active agricultural land, etc., but can be composed of any natural land cover type: various successional stages of forest, wetland, old meadow, etc. They are then categorized by size to make it easier to view them on the map and to provide a generalized comparison among the blocks in an area.

Habitat Blocks (by Acreage): Significance

Because forest fragmentation is one of the most significant threats to Vermont's natural heritage, maintaining large habitat blocks—and connections between these blocks—may be one of the best ways to ensure conservation. All else being equal, larger habitat blocks generally contain greater biological diversity—a much higher number of species—than smaller blocks. This is because these areas often contain a great diversity of habitat types, which support the requirements of many plants and animals. Some species live only in large patches of forest habitat, and others—such as bear, bobcat, and fisher—require such large home ranges to find the food, water, shelter, and access to mates that they require that they are unable to survive in a

heavily fragmented landscape. Many human communities rely on large habitat blocks, too, to provide opportunities for recreation and forest management, which in turn support the local economy. Furthermore, large habitat blocks play a large role in maintaining the quality of our air and water.

Over time, the average size of habitat blocks has been shrinking in Vermont. As development pressure causes new roads to bisect natural areas, structures creep in from the edges. Species requiring large home ranges must increasingly use several smaller blocks rather than a single large block to get what they need to survive, although this is only possible in locations where enough cover exists *between* habitat blocks for animals to feel secure traveling from one to another. This often means crossing roads, which can be dangerous for both animals and humans. The Wildlife Road Crossings layer (Map 6) looks at such locations where wildlife are most likely to cross roads in order to link together habitat blocks. For many wildlife, the most suitable habitat is found within the largest blocks where crossing roads and other fragmenting features isn't necessary.

Vocabulary Note

Habitat block, contiguous forest, core forest, forest block… You may find resources that use each of these terms. All refer to nuances of the same basic concept. While it is important to clearly understand and define any language used in a regulatory setting, these terms are nearly interchangeable in a general sense; they refer to habitat uninterrupted by roads or other human development.

To read more about the role of these areas, see page 39 in *Conserving Vermont's Natural Heritage*.

While *size* is the important characteristic in this map, there isn't a minimum size that is considered critical as important wildlife habitat. Blocks are best considered within the context of the landscape. A 100-acre habitat block located in Vermont's heavily-fragmented Champlain Valley may play a much more ecologically important role than a 100-acre block in the Northeast Kingdom, where larger blocks are prevalent. The general rule of thumb is "the bigger, the better," and you can determine what "big" means in your region by viewing the habitat block layer at a regional scale using *BioFinder*. Habitat configuration is also important. An area that is highly irregular in shape—containing a high proportion of edge compared with interior forest—may be less functional for some species than habitat of the same acreage with a regular shape.

Vermont's development history adds an interesting twist when we think about habitat block size. Because our areas of human settlement and development have historically—and currently—been along streams and in valleys, the largest remaining areas of contiguous habitat tend to be in high elevation areas and those in which soils are unsuitable for agriculture or building. However, it is often those same valley bottoms where we would naturally see the greatest biological diversity. As you identify the largest areas of contiguous habitat in your town, keep in mind that they may be biased towards the uplands or other undevelopable landscape, but it is also important to include lowlands when planning for conservation.

Habitat Blocks (by Acreage): Map Interpretation

Habitat blocks are derived from the land cover data depicted on Map 2. They include all areas of natural cover surrounded by roads, development, and agriculture, ranging in size from 20 acres to 154,000 acres. Here, they are displayed by size. In Map 6, we show the same data again, prioritized for biological importance. To learn more, you can find the original report from Vermont Fish & Wildlife Department and Vermont Land Trust online at http://www.vtfishandwildlife.com/common/pages/DisplayFile.aspx?itemId=111635.

Habitat Blocks (by Acreage): Planning Considerations

As you examine the habitat available to wildlife in your community, you may find the following useful in evaluating and prioritizing different areas:

- *Size:* In general, larger habitat blocks are likely to have higher ecological value. They often also provide greater benefits to the civic community through opportunities to access forest resources, hunting, or recreational use.
- *Condition:* Areas that contain diverse natural habitat types normally have a greater variety of plant and animal species.
- *Landscape Context:* Locations in which several habitat blocks are close to one another and separated only by minimal fragmenting features like roads, development, or agricultural land may function better as wildlife habitat for many species.
- *Connectivity:* Connecting features can link blocks together to effectively function as larger blocks. While larger blocks generally remain better for wildlife than a series of linked smaller blocks, these features can allow a broader diversity of wildlife to inhabit human-populated areas.

Act 171 and Forest Fragmentation

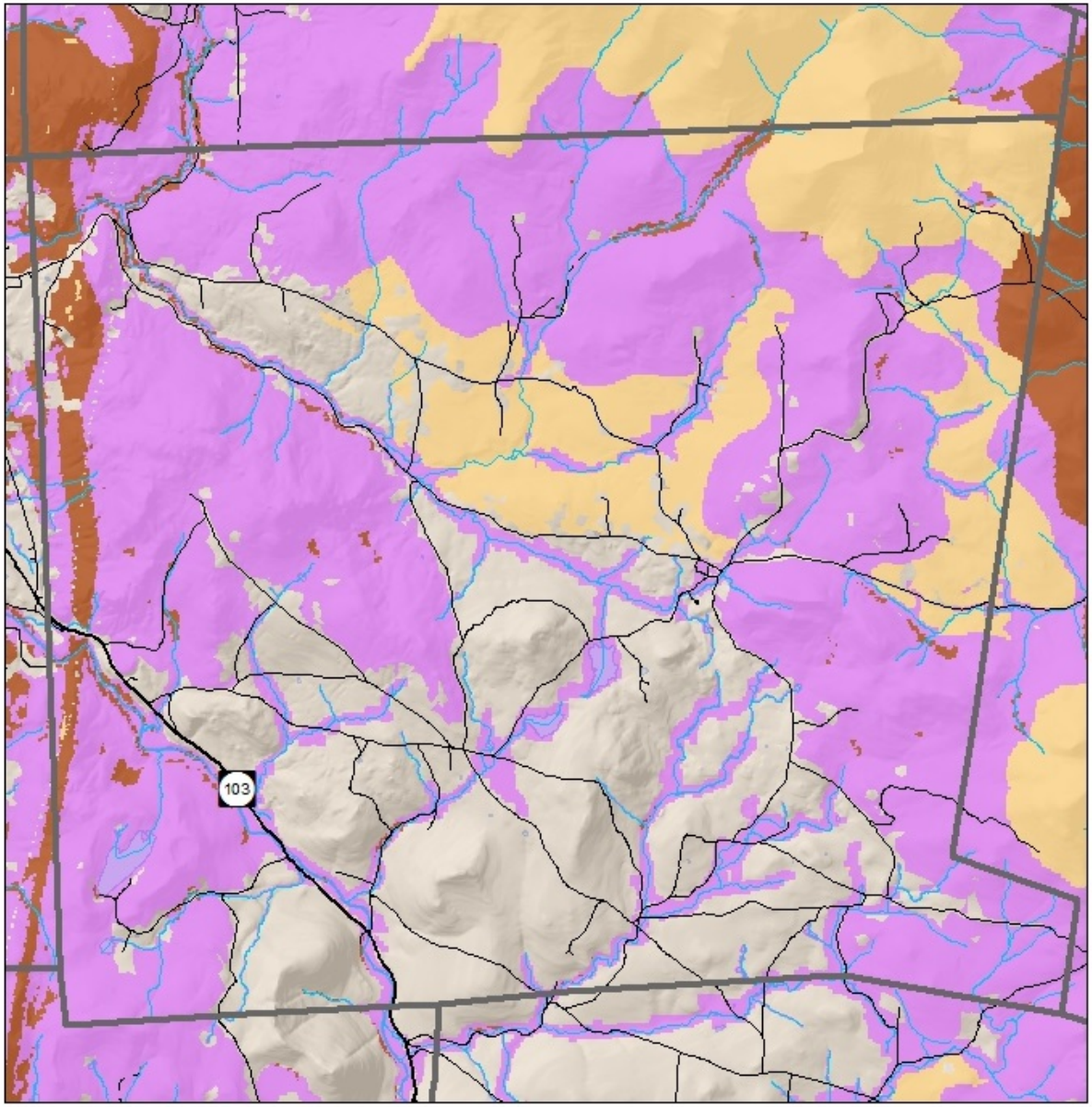
In 2016, the Vermont legislature passed a bill requiring regional and municipal planners to identify important forest blocks and habitat connectors and to plan development so as to limit forest fragmentation in these areas. Many communities may find Habitat Blocks to be a good starting point for this requirement. While size is not the only consideration, it will be helpful to know where the biggest blocks and fragmenting features are located as you begin the process. Learn more about this legislation at http://legislature.vermont.gov.

In Map 6, you can also see how these blocks have been prioritized by state biologists, keeping in mind that your *local* priorities may be somewhat different than those chosen at the state level. In Part II of this guide, these prioritized habitat blocks will appear again, this time categorized into highest priority and priority *interior forest blocks* and *connectivity blocks.*

Once you have identified priority habitat blocks, the following may be appropriate methods for conserving them. Additional information on most strategies can be found in Community Strategies for Vermont's Forests and Wildlife.

Conservation Goal	Conservation Strategies	
	Nonregulatory strategies	*Regulatory Strategies*
Provide baseline protection	Adopt language in the town plan, including statements about the importance of large forest blocks and policies on how they should be managed, protected, and restored.	Check clarity of definitions in zoning bylaws and update if needed.
	Provide citizen educational opportunities.	Review standards in zoning (subdivision, CU, or use standards), and update if needed.
	Work with neighboring communities and/or the regional planning commission to plan for forest conservation at a regional scale.	Review purpose statements in zoning and update if needed.
Provide stewardship of forestland	Encourage residents to work with a forester to create forest management plans.[8]	Establish an impact fee program.[9]
	Encourage enrollment in Current Use (or local tax stabilization program).[10]	
	Connect landowners with supporting organizations, such as Vermont Coverts[11], Vermont Woodlands Association[12], the Natural Resources Conservation Service[13], or your local Natural Resources Conservation District[14].	
Avoid fragmentation	Encourage residents to enroll in Current Use (or local tax stabilization program).[15]	Allow a greater development density in defined growth areas (like village or commercial districts) than in rural land (through a Forest, Conservation, or Rural Residential Zoning District).
	Encourage citizens to engage in estate planning.	Establish or expand a Wildlife Habitat or Wildlife Corridor Overlay District.
	Encourage residents to conserve their forestlands in important areas.[16]	Establish building envelopes, clearing standards, or limits on driveway length in bylaws to limit the impact of development.
	Create or expand a Town Forest.[17]	Establish or improve Subdivision Regulations.
		Establish road and trail standards.[18]
		Review rural residential-type districts to determine whether lot sizes and site design requirements allow

		for continued function of rural land (i.e., 2-5 acre lot sizes can cause fragmentation even if open space remains.)
Provide support for working forests	Encourage residents to enroll in certification programs that promote long-term support for land management.[19]	Institute local forest products purchasing policy (for municipal purchases).
	Encourage support for businesses that use local forest products.	Ensure that regulations include standards that allow for continued access to working forests and associated infrastructure (e.g., log landing areas).[20]



Map 4: Physical Features Shrewsbury, VT

LEGEND

- Town Boundary
- Roads
  - Interstate
  - Primary
  - Secondary
  - Trail
- Rivers & Streams
- Lakes & Ponds
- Rare Physical Landscapes
- Representative Physical Landscapes
- Responsibility Physical Landscapes

Data Source; Vermont Center for Geographic Information
Vermont State Plane Projection
NAD1983 Datum
Map by Monica Przyperhart
October, 2016

0 0.5 1 2 Kilometers

0 0.5 1 2 Miles

MAP 4. Physical Features

This map gives a big-picture view of how physical features are geographically distributed.

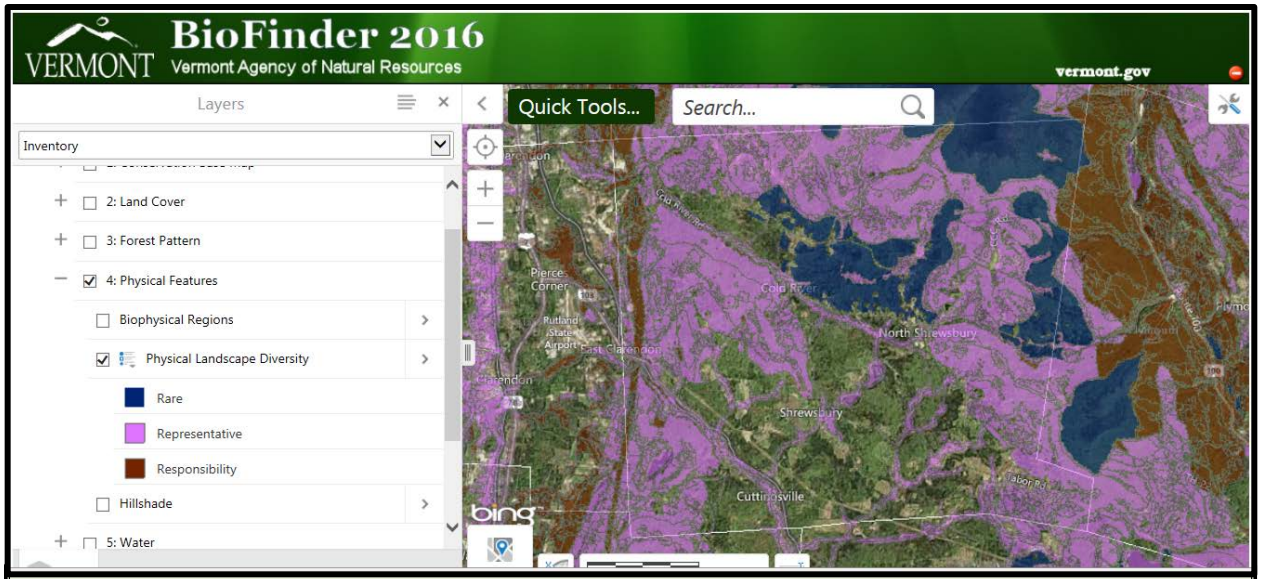
Inventory Layers *(Described Below)*	**Base Layers**	**Additional Online Data**
*1. Physical Landscape Diversity**	*Roads*	*Biophysical Regions*
	Streams & Rivers	
	Lakes & Ponds	
	Town Boundaries	

Physical landscapes—also referred to as *enduring features*—are the parts of the landscape that resist change. They are the hills and valleys, the underlying bedrock, and the deposits left behind by glaciers or ancient lakes. They remain largely static when natural or human-induced changes in land cover and wildlife occur, as plants and animals expand or contract their ranges, and even as the climate changes.

> The physical landscape is like the stage of a theater. While it doesn't change in response to the drama of a play, it *does* influence the actions of the actors—the plants, animals, and other species that live there.

Because of the strong influence of the physical landscape on which plants, animals, and natural communities appear and thrive, understanding the physical landscape can help us predict habitat conditions and species presence. Physically diverse landscapes support diverse natural communities and species (Anderson & Ferree, 2010), and so one way to ensure that biological diversity persists on our landscape is to conserve a variety of physical landscapes.

The background of this map is a representation of elevation in which steep slopes are shaded to produce a "shadow." The effect helps us to visualize the hills and valleys across a landscape. In BioFinder and on other mapping resources, this effect is called "hillshade."



To load Map 4 on BioFinder: *Open the "Inventory" theme, then check the box next to "4: Physical Features." To see all available Map 4 layers, click on the "+" next to the layer name. For additional guidance on using BioFinder, please see* Getting Started *in the introduction to this guide.*

What Is the Physical Landscape?

The physical landscape includes:

- Bedrock: the rock that underlies everything we see on the surface
- Surficial materials: the gravel, sand, silt, clay, or peat that sit on top of the bedrock
- Topography or Landforms: cliffs, coves, summits, flats, etc.
- Elevation

Individually, each of the physical attributes above influences the ecological landscape in a particular way. As any gardener or landscaper knows, different plants grow on a shady, north-facing slope than on a sunny hillside that looks south, or in shallow, rocky soils than in deep clay. When these physical attributes are mixed and matched, the resulting patterns can be quite complex. In order to describe the numerous combinations of physical features found across Vermont's landscape, we use *Ecological Land Units*, or ELUs, results of a computer analysis developed by The Nature Conservancy to standardize the way the physical landscape is described (Ferree & Anderson 2008). The model combines the physical attributes listed above with additional factors such as soil types and climatic features to create a visual representation of variation in the physical landscape. For example, the ELUs of the Green Mountains illustrate subtle variations in steep terrain with acidic bedrock and rocky glacial deposits, while the Champlain Valley features combinations of flatter, calcium-rich clay plains.

Because there are several hundred ELUs that appear on the Vermont landscape, maps displaying each ELU unit are impractical. Instead, only the ELUs considered most important for conservation are displayed, divided into *rare*, *responsibility*, and *representative* categories.

Rare Physical Landscapes
Rare physical landscapes are those types least commonly found in Vermont, each covering less than 4.5% of the state's land area. Because rare physical landscapes often correspond with the presence of rare species or natural communities, they can be used as a filter for maintaining the state's overall biodiversity. This is particularly important because there are many species about which we know very little—insects, plants, or mosses, for example—and identifying rare physical landscapes can help us to predict where diversity among these unstudied species may occur. Rare associations include the following:

- Calcareous (Calcium-rich) Metamorphic High Hills/Low Mountains
- Connecticut River Valley (Historic Lake Hitchcock) Sediments
- Enriched Slopes
- Granitic Basins
- Granitic High Hills/Low Mountains
- Granitic Mid-Elevation Hills
- Marine-Lacustrine-Glaciofluvial Coarse Sediments
- Precambrian Plateau
- Upper Mountain Slopes/Mountaintops
- Valley Floor Glacial Lake/Marine Plains
- Vermont Escarpment
- Water-deposited glacial sediments along major riverways

Responsibility Physical Landscapes
Some combinations of physical features are common in Vermont, but rare in the surrounding region or even worldwide. These are called *responsibility physical landscapes* since we have a "responsibility" to maintain them in our conservation efforts. While individual occurrence of a responsibility physical landscape may not appear particularly special within the local context, including examples of these landscapes in conservation efforts ensures that the species relying on these landscapes can persist at a grander scale.

Responsibility physical landscapes include locations with underlying calcium-rich rock, underlying mafic (magnesium- and iron-rich) rock, and cove landforms. While these are fairly common within the state, Vermont has a high responsibility for the conservation of these landscapes regionally.

Representative Physical Landscapes
For each Ecological Land Unit not included on the "rare" or "responsibility" lists, high-quality examples were selected throughout the state based on condition and patch size. These are mapped as *representative* physical landscapes since they "represent" landscapes that include our most common species and natural communities. Common species and natural communities are every bit as important as the rare species conservation efforts often focus on, but without datasets like this, it can be difficult to include their importance on a map.

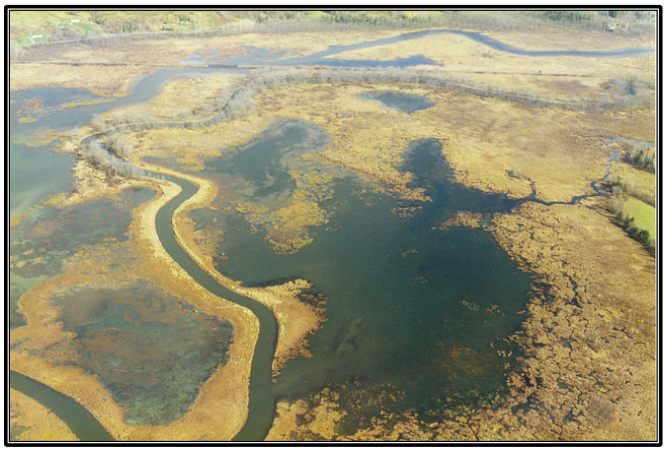
Physical Landscapes: Significance

In assessing biodiversity within Vermont, we *can't* inventory every species in every location across the state. Of Vermont's 24,000 to 43,000 species, only 426 are vertebrate animals, and 2,000 are vascular plants (trees, shrubs, flowering plants, grasses, etc.). We know very little

about the remainder, comprising invertebrates, fungi, algae, lichens, mosses, and liverworts. This leaves us unable to accurately quantify biodiversity. In the absence of such an inventory, the inclusion of physical features in planning efforts is a way to capture biodiversity. Physical features portray the *ecological potential* of the landscape.

This idea of *ecological potential* is especially important given that the distribution of species on today's landscape has been impacted heavily by human land use history. Physical features allow us to see beyond current land cover and land use to instead see where biodiversity would flourish naturally.

Since physically diverse landscapes correspond to diversity in species, conserving wildlife habitat within rare, responsibility, and representative landscapes encourages a diversity of species to flourish. This is particularly true in the face of global climate change. As changes occur over time, plant and animal species adjust their ranges to more climatically suitable conditions. Areas of diversity in the physical landscape will allow for these adjustments to be made more easily, and these areas are likely to continue as the stage for biological diversity even as species composition changes.



Physical Landscapes: Map Interpretation

This Physical Landscape map can be very useful at a statewide or multi-state scale where a high degree of accuracy is unnecessary. When viewing physical landscapes within a single town, they should be interpreted with caution. This dataset is mapped as a grid, with each box of the grid representing a 30m x 30m area. At this scale, the boundaries between two ELU types cannot be considered highly geographically accurate. However, the physical landscapes map can be used as an initial bird's eye view to help in thinking about the local landscape in a new way when determining conservation strategies.

On the printed maps associated with this guide, physical landscapes are mapped only as rare, responsibility, or representative. On BioFinder, a user can identify each ecological land unit individually.

Physical Landscapes: Planning Considerations

In many locations, mapped physical features overlap with other important components, such as forests and waterways. In these cases, the importance of the physical landscape can strengthen the prioritization of these other features in conservation work.

However, some areas highlighted as important physical landscapes are quite different from those outlined on other maps in this guide. This is because other layers tend to reflect current landscape condition, where habitat exists *now*. Rare and responsibility physical landscapes are often places where diversity in habitat types *could* exist in the future, alongside the places where

we currently find biodiversity. When planning with climate change in mind, we need to remember that the species we're now familiar with are likely to shift their ranges or be affected by a new host of stressors such as disease or drought. Meanwhile, new species will be establishing themselves in the region—not only trees and large animals that we can study easily, but also microorganisms in the soil, fungi, insects, etc. While we can't predict the exact composition of species that will be living in our communities, this map suggests some areas that together will provide the setting necessary to maintain a rich diversity of plant and animal species.

When planning, one way to look at the Physical Features map is therefore to see how current conservation lands are distributed across physical landscape types. If some significant physical features are underrepresented, consider prioritizing them in future conservation efforts.

At its core, this map provides a lens for erasing current land use patterns to allow you to think about the *ecological potential* of the land. If your community is interested in restoration or land conservation efforts—or in planning for a changing climate—you may find this map particularly enticing.

You might also try:

Conservation Goal	Conservation Strategies	
	Nonregulatory strategies	*Regulatory Strategies*
Include physical landscapes in conservation efforts.	Compare maps of physical landscape diversity to conserved lands. Prioritize under-represented features in conservation efforts.	When feasible, locate building envelopes outside these areas.
	Encourage residents to conserve their land.	
	Encourage residents to enroll in Current Use (or local tax stabilization program).	
	Conduct planning efforts so as to avoid development in these areas.	
Protect habitat blocks or waterways that include important physical landscapes.	***See Map 3, Layer #3, and Map 5, Layer #2.***	

For additional information, see Conserving Vermont's Natural Heritage.

Additional Online Data

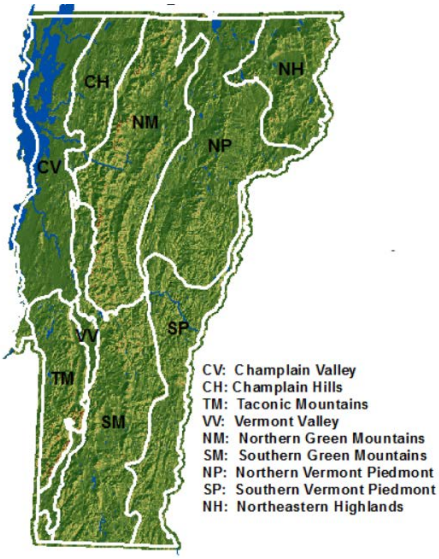
Biophysical Regions

In the *Physical Landscape Diversity* map described above, landscapes are broken into specific component pieces. However, we can also lump them into much more general categories, called *Biophysical Regions*, to divide the entire state into areas with like physical features. Each of

these regions share similarities in climate, bedrock, geologic history (glacial deposits, flooding, etc.), topography, land use history, and hydrology (water flow patterns). When conducting planning efforts (especially at a statewide or regional scale), these biophysical regions can be used as a lens through which to assess conservation priorities, because what may be common in one biophysical region of Vermont may be rare in another. In the area in which it is rare, conserving habitat for that species may be a way to preserve biodiversity. For example, the northern leopard frog is quite common in the Champlain Valley. While it can be found in other parts of the state, its habitat requirements are less widespread: permanent water in which to spend the winter, floodplains or marshes where breeding occurs, *and* wet meadows or fields for finding food. When the northern leopard frog occurs outside the Champlain Valley or Champlain Hills, it indicates the presence of a combination of habitat features that may support other species less common in the region, adding to the region's biodiversity.

Vermont's nine biophysical regions are:

Northeastern Highlands
Granite bedrock dominates this cool region, which is characterized by large wetlands, remote mountains, and lakes and ponds. Spruce and fir dominate both lowlands and high elevations, while northern hardwood forests cover the mid-elevations.



Northern Vermont Piedmont
Calcium-rich soils combine with a cool climate to support mixed forests and Northern White Cedar Swamps, Fens, and other interesting natural communities in this region. The uplands have fine agricultural soils, but a short growing season.

Southern Vermont Piedmont
Calcium-rich soils and rolling hills make this a good place for agriculture. The climate is average for Vermont, except in the extreme southeast where it is quite warm. Northern hardwoods and red oak dominate the vegetation.

Southern Green Mountains
A broad plateau is dotted with a few dominant peaks. Climate is cool and rainfall is relatively high. Northern hardwoods, spruce, and fir dominate, and there are a number of small lakes and ponds.

Northern Green Mountains
This area has a cool climate and high elevations. Northern Hardwoods dominate the sideslopes, whereas high elevations have spruce and fir as well as Alpine Meadow communities.

Champlain Valley
This region of Vermont has a warm climate and abundant fertile farmland. The Champlain Valley contains both northern hardwood forest and various species of oaks

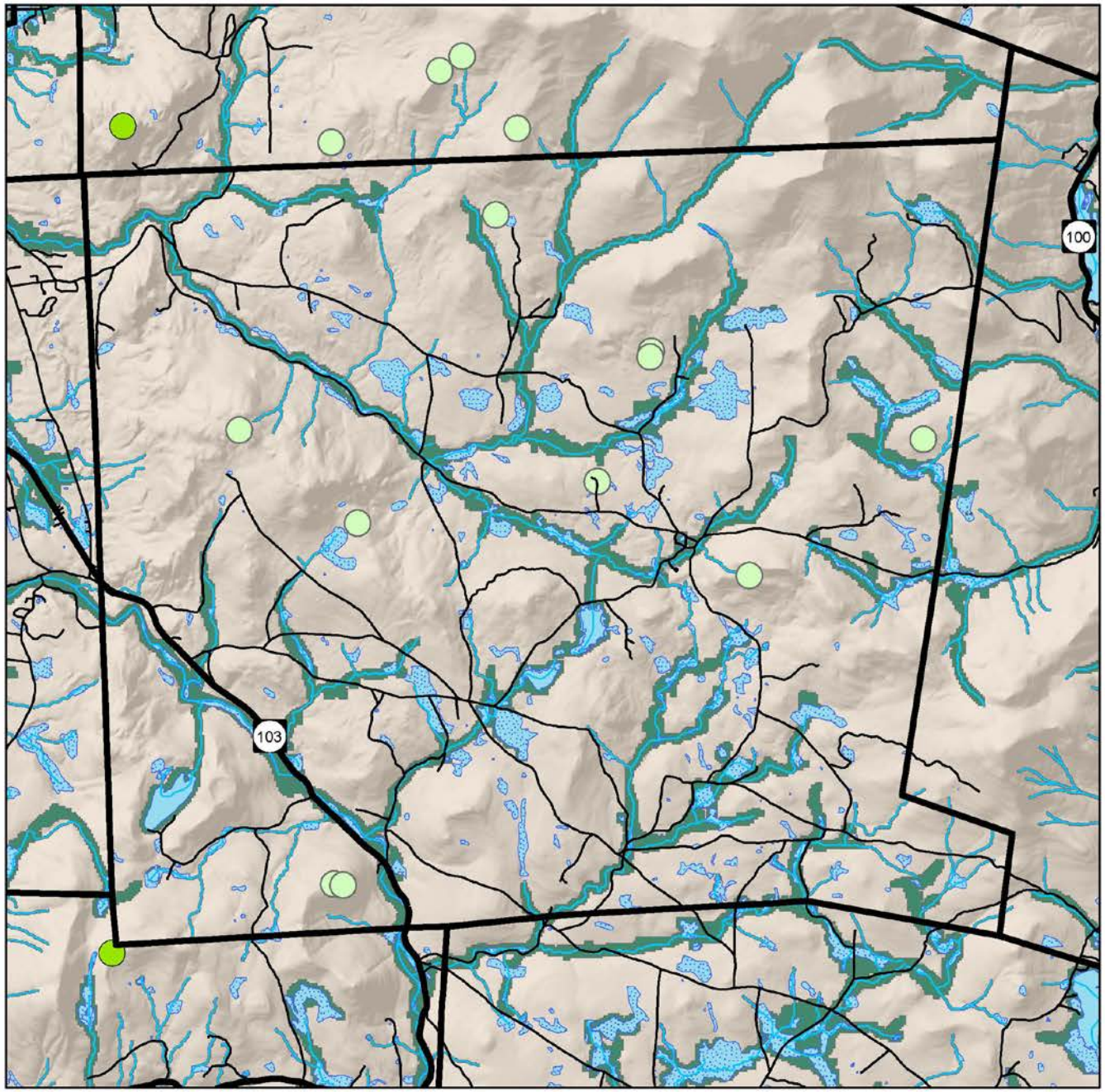
and hickory. It has some of the state's most significant natural diversity and the state's most densely populated areas.

Champlain Hills
This region consists of the hills and footslopes located between the Champlain Valley and the Green Mountains. Soils are primarily derived from glacial till and are shallower and rockier than in the Champlain Valley. There is some agriculture, but not nearly to the extent of the valley below. Northern hardwood forests dominate the region, dotted with softwood and mixed stands, dry oak communities, and wetlands.

Taconic Mountains
The slate belt of Vermont, the Taconics are dramatic wooded hills dominated by sugar maple, beech, and yellow birch forests. Dry oak and hickory forests are found on the lower elevation knolls, while spruce and fir occur at the highest elevations.

Vermont Valley
The Marble Valley has marble and limestone with glacial deposits on the valley walls, abundant springs, and wetlands.

Some communities may find it useful to visit this map on BioFinder to see where the boundaries of these regions fall geographically. If your community contains sections of different biophysical regions, you may find it useful to frame your planning efforts within the context of *each* region, even if it divides your town. For example, the regional ecological needs of the Champlain Valley and the Northern Green Mountains are somewhat different. A town spanning the boundary between these two regions may want to consider strategies for the two areas separately, keeping in mind that boundaries are approximate. The map was intended to describe landscape characteristics at a state scale; there is no way to identify an exact boundary line between any two regions.



Map 5: Water
Shrewsbury, VT

LEGEND

- Town Boundary
- **Roads**
  - Primary
  - Secondary
- Vernal Pools
- Unconfirmed Vernal Pools
- Rivers & Streams
- Lakes & Ponds
- Wetlands
- Riparian Areas
- Riparian Areas--Highest Priority

Data Source:
Vermont Center for Geographic Information
Vermont State Plane Projection
NAD1983 Datum
Map by Monica Przyperhart
September, 2017

0 0.425 0.85 1.7 Miles

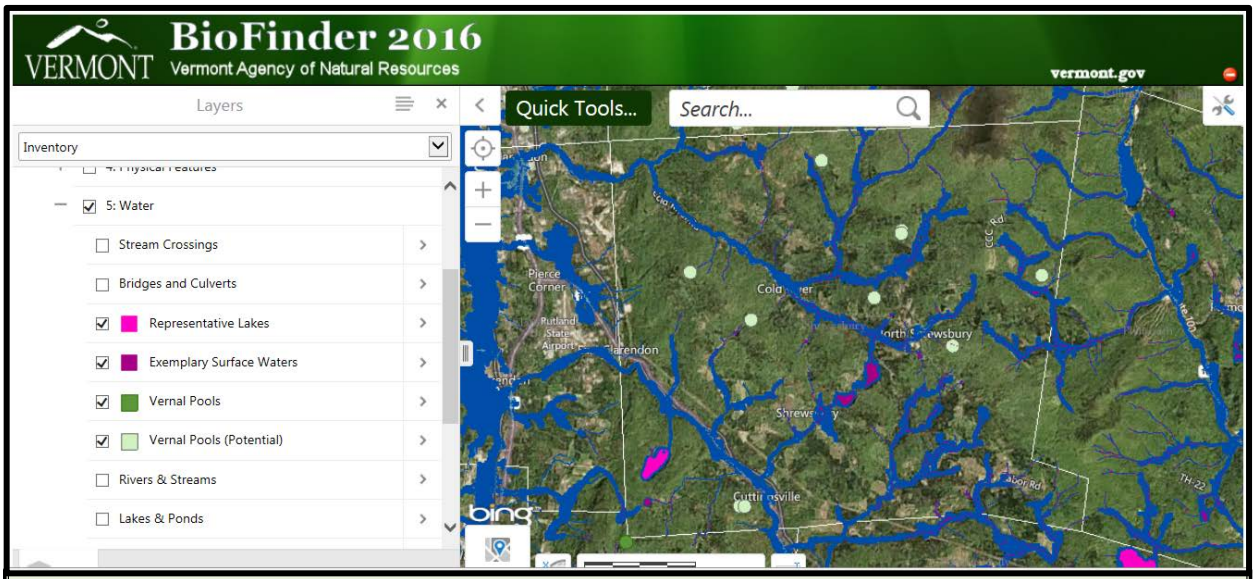
00.425 0.85 1.7 Kilometers

MAP 5. Water

This map is intended to provide a broad overview of the water resources in your community.

Inventory Layers *(Described Below)*	**Base Layers**	**Additional Online Data**
1. Rivers, Streams, Lakes & Ponds	*Town Boundaries*	*Stream Crossings*
2. Surface Waters and Riparian Areas	*Roads*	*Bridge and Culvert Inventory*
3. Vernal Pools (Confirmed and Unconfirmed)		
4. Wetlands		

Water is an important resource for both wildlife and human communities. While not particularly scarce in the Northeast, water-based ecosystems can be both highly valued and highly vulnerable. In addition to the rivers, streams, lakes, and ponds included on other maps, this map includes wetlands, vernal pools, and a more extensive layer of riparian areas than included in other maps. Additionally, you can use BioFinder to see the locations of bridges and culverts and stream crossing areas. This information has implications both ecologically and for determining safe and effective locations for human activities.



To load Map 5 on BioFinder: *Open the "Inventory" theme, then check the box next to "5: Water." To see all available Map 5 layers, click on the "+" next to the layer name. For additional guidance on using BioFinder, please see* Getting Started *in the introduction to this guide.*

Inventory Layer #1: Rivers, Streams, Lakes, & Ponds

What Do These Layers Show?

On the map, these data appear as two distinct layers: *Rivers & Streams*, and *Lakes & Ponds.* The same layers are included on other maps to provide geographic reference points. Together, this is the most complete set of rivers, streams, lakes, and ponds available in Vermont. While wetlands were not specifically delineated in this effort, those wetlands containing open water have also been captured.

Rivers, Streams, Lakes, & Ponds: Significance

Rivers, streams, lakes, and ponds are by nature diverse ecosystems, with plant and animal communities changing according to water depth, turbulence, available oxygen, and a host of other features. Shorelines contribute additional variety to the communities found in aquatic ecosystems. Together, these communities form an extensive food web that includes everything from tiny microorganisms to bears and humans. This web also includes reptiles and amphibians, plants, waterfowl, songbirds, bats, mink, and otter.

Rivers, Streams, Lakes, & Ponds: Map Interpretation

These data are formally known as the Vermont Hydrography Dataset and are part of a larger, nation-wide effort by the United States Geological Survey to map waterways across the country. Rivers and streams are represented by lines capturing the *centerline* of a stream, not the entire water body. This means that the data may be most meaningful in capturing a general sense of where water flows through the region, at the scale of an entire town or larger. We depict this information on Map 5 on top of *Riparian Areas* (Layer #2) because together, these show a much more complete picture of the geographic area influenced by each body of water.

Because waterways are dynamic by nature, their exact boundaries or extent can be expected to change, both seasonally and over time. For planning purposes, your community may therefore want to clearly define any planning or regulatory terms involving water through a measurement other than this static map that represents one moment in time—the distance from the top of the streambank or slope, for example. It should also be noted that while this layer is the most complete map available of Vermont's surface waters, data were derived through the interpretation of aerial photographs and topographic data and many have not been checked in the field.

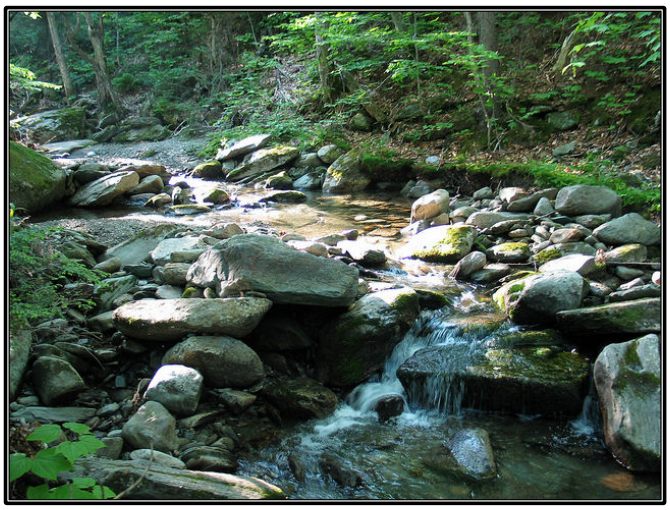


Photo by Eric Sorenson

Rivers, Streams, Lakes, & Ponds: Planning Considerations

In nearly all cases, the most important planning considerations for waterways include maintaining vegetation on the surrounding streambank, which is often called the riparian area. Conservation strategies for surface waters *and* riparian areas are therefore discussed together at the end of the Surface Waters and Riparian Areas description.

Rivers, Streams, Lakes, & Ponds: Additional Information

Buffers for Wetlands and Surface Waters: A Guidebook for New Hampshire Municipalities is a good source of detailed information about different buffer widths and the species and functions they protect.[1]

Inventory Layer #2: Surface Waters and Riparian Areas

What are Surface Waters and Riparian Areas?

Surface water refers to all water that appears on the ground's surface—rivers, streams, lakes, ponds, and some wetlands—but excludes groundwater. This layer therefore includes all the water bodies described in Layer #1, with two main differences: First, Layer #1 maps only the centerline of each stream or river. *Surface Waters and Riparian Areas* expands upon that centerline to estimate a width for the water body. Secondly, *Surface Waters and Riparian Areas* maps the entire area impacted by these waterways, including not only the water itself but also the surrounding land. This surrounding area is referred to as the *riparian area*.

The word "riparian" literally means "pertaining to the bank of a river or lake." Riparian areas are complex and interrelated networks of streams, rivers, lakes, wetlands, and the floodplains surrounding all these waterways. Because the waterways themselves are discussed in Layer #1 above, this section focuses on the terrestrial portion of the riparian area.

Riparian Wildlife Connectivity vs. Surface Waters and Riparian Areas

In Map 3, we introduced *Riparian Wildlife Connectivity*. Now we introduce *Surface Waters and Riparian Areas*. There is substantial overlap between the two datasets. The difference is that *Surface Waters and Riparian Areas* includes developed areas and agricultural lands when they occur within the floodplain and projected riparian zone; *Riparian Wildlife Connectivity* includes only areas with vegetated cover.

In general, larger bodies of water have wider riparian areas. Mountainous headwater streams are usually contained within steep, narrow valleys—with narrow riparian areas that transition into upland forests—while large streams and rivers wind through wider, flatter valleys, with riparian areas extending the width of these valleys. Even though small streams in steep valleys have narrow bands of riparian habitat, the forest surrounding these streams plays an important role in protecting the riparian habitat and stream, especially where steep slopes threaten landslides, rapid storm water runoff, and hillside gullying.

Surface Waters and Riparian Areas: Significance

Riparian ecosystems are unique in their high biological diversity. Characterized by periodic disturbances—flooding, the deposition of sediments, erosion, and the forces of water and ice movement—riparian habitats are highly complex and variable, and therefore extremely ecologically diverse (Verry et al., 2000). In fact, for a community faced with limited resources, prioritizing the conservation of riparian areas can be one of the best ways to help a wide diversity of wildlife species.

Surface Waters and Riparian Areas: Map Interpretation

As mentioned above, Layer 1 depicts the *centerlines* of rivers and streams in Vermont, along with outlines of lakes and ponds. The Riparian Area dataset was built around these centerlines through estimation of a width for each water body and then by adding a buffer to capture the floodplain. The overall width is therefore based on a combination of factors that includes relative stream size and physical landscape characteristics.

Once the floodplains were mapped, Vermont biologists divided this dataset into two categories. “Highest Priority” was given to those riparian areas in which there is currently no development. This includes areas with natural vegetation and agricultural lands. While lands covered by crops, hay, or pasture do not perform all the functions of a forested riparian area, they will be much easier to manage for function or restore than developed lands. To see a map of only vegetated riparian areas, go to Riparian Wildlife Connectivity, in Map 3.

“Priority” status was given to riparian areas in which development currently exists. While all areas mapped are likely to be inundated by floodwaters periodically, these lands will be much more difficult to maintain or restore as functional riparian area for protecting water quality, providing flood resilience, or for wildlife habitat.

In using these data, keep in mind that this is a state-wide model; there is no way to depict at this scale the specific area that functions as important habitat or protects water quality. Local factors play a large role, such as steepness of slope, the quality of surrounding habitat, etc. To get a better sense of riparian function in your town or region, a local inventory may provide more specific information.

Some communities have been able to protect riparian areas alongside human interests. For example, the Lamoille River Paddler's Trail promotes recreational use of the river by providing access points, portage trails, and primitive campsites while also promoting the conservation and stewardship of riparian areas. Learn more at http://www.lamoilleriverpaddlerstrail.org.

Surface Waters and Riparian Areas: Planning considerations

Maintaining a vegetated riparian area may be the single most effective way to protect a community's natural heritage. The riparian area provides high quality habitat for a great diversity of both aquatic and terrestrial species. Downed wood, leaves, and similar organic material filter into the water to become important components of the food base and habitat structure. Mature trees in riparian areas shade aquatic habitats, helping to control water temperatures. Terrestrial animals use riparian areas as travel corridors, while many plant and tree seeds float downstream to disperse. Streamside vegetation helps to control flooding, and it is crucial in filtering overland runoff—which protects water quality—and stabilizing stream banks, which prevents excessive streambank erosion and sediment buildup. What's more, maintaining the riparian area is one of the most cost-effective ways to provide resilience for a changing climate.

In your town, your specific conservation goals will dictate how wide an area to consider for protection around a stream or lake. These areas are often referred to as *riparian buffers*. In general, a naturally vegetated 100-foot-wide riparian buffer protected from development or intense human activity on each side of a stream will protect *many* of the functions associated with healthy riparian habitat, while a 330-foot buffer will protect *nearly all* the functions we value, including high-quality cover for many wildlife species.

Some towns in Vermont have established buffer regulations to protect the riparian area. Read Georgia's story here: http://vtconservation.com/success/node/22.

Of course, we value riparian areas for their contributions to human values, too—including water quality, recreation, education, spiritual well-being, and sense of place. Riparian habitats also play a critical role in flood resilience, which has become particularly important since Vermont is experiencing increasingly more frequent flood events. In most areas, the above buffers would protect these human values alongside wildlife needs. They would also allow rivers to be dynamic. Naturally, rivers and streams change course over time, widening their banks through erosion in some areas and depositing sediment in others as

they meander. While these maps are not intended to predict future changes in stream shape, they do include the areas in which most these changes are most likely to occur.

When looking for strategies effective at protecting water and riparian areas, you might consider:

Conservation Goal	Conservation Strategies	
	Nonregulatory strategies	*Regulatory Strategies*
Learn more	Learn about river planning, management, and protection through the Vermont Department of Environmental Conservation.[2]	*N/A*
	Learn about managing and protecting lakes and ponds through the Vermont Department of Environmental Conservation.[3]	
Provide baseline protection	Adopt language in the town plan, including statements about the importance of riparian areas policies on how they should be managed, protected, and restored.	Check clarity of definitions in zoning bylaws and update if needed.[4]
Protect surface waters and riparian areas	Support the creation of River Corridor Easements[5] (conservation easements that allow rivers to change course naturally, without human interference).	Require forested riparian buffers in the general standards section of your bylaws, to apply in all districts, or in River Corridor bylaws, if you have them. [6]
	Connect owners of riparian land to incentives programs for wildlife-friendly management practices, such as USDA or USFWS Partners for Fish and Wildlife.	Establish standards for minor activities (footpaths, etc.) acceptable within the riparian area.
		Add standards in subdivision regulations or zoning (River Corridor, Flood Hazard, Lakeshore Overlay, or Forest District) that require clustering or setting back development away from riparian areas, river meanders, or floodplains.
		Require minimum setbacks from waterways in zoning and subdivision regulations.
		Adopt town road management standards to comply with Vermont's Clean Water Act.[7]
Enhance Riparian Quality	Assist landowners in restoring riparian habitats.[8]	Require restoration of riparian habitat in site plan or subdivision review by designating "no-mow" zones, allowing for regeneration of woody vegetation, or by planting native species.
	Create an invasive species control program for riparian areas. [9]	
	Connect landowners to incentives programs, such as through USDA or USFWS Partners for Fish and Wildlife.	
Maintain Water Quality	Assist landowners in reducing stormwater runoff.[10]	

	Encourage residents to reduce use of chemical lawn care products.	Recommend or require vegetated buffers to filter pollutants before they reach waterways.
	Identify ways to reduce flood damage to major infrastructure.[11]	
	Support public awareness of the *Acceptable Management Standards for Maintaining Water Quality of Logging Jobs in Vermont.*[12]	

Most of these conservation tools are explained in detail in *Community Strategies for Vermont's Forests and Wildlife*.

Inventory Layer #3: Wetlands

What Are Wetlands?

In a sense, wetlands combine the traits of upland and aquatic habitats. While they function differently than either, they provide an interface in which species of both communities dwell and interact, alongside numerous species that occur only in wetlands. They include the vegetated, shallow-water margins of lakes and ponds, the seasonally flooded borders of rivers and streams, and an amazing diversity of topographic settings across the landscape.

Although many definitions have been developed for the term and concept of "wetland," we consider wetlands to have three basic characteristics. First, all are inundated by or saturated with water for at least two weeks during the growing season. Second, they contain wet (hydric) soils, which develop in saturated conditions and lack oxygen and other gasses. Finally, they are dominated by plant species known to be adapted to these saturated soils.

Wetlands are known by many common names, with some common names associated with particular wetland conditions. For example, *swamps* are dominated by trees or shrubs. *Marshes* are dominated by herbaceous plants. *Fens* are peat-accumulating, open wetlands that receive mineral-rich groundwater. *Bogs*, also peat-accumulating wetlands, receive most of their water and nutrients from precipitation rather than from an inflow of water from a stream, river, groundwater, or even the surrounding landscape. Recently, *vernal pools* have also been included as wetlands (although we map them separately in this guide). Each of these wetland types supports a unique group of plants and animals, many of which require these wetland habitats to survive.

Wetlands: Significance

Wetlands are beneficial to a variety of native plant and animal species, as well as to the health, safety, and welfare of the general public. They provide fish and wildlife habitat, flood and erosion protection, nutrient and pollution filtration, groundwater recharge, aesthetic diversity, and sites for educational and recreational activities.

It is estimated that 50% of Vermont's historic wetland area has been lost or severely impaired due to draining, dredging, filling, or excavation activities associated with industrial, residential, and agricultural activities. Since 1995, the current rate of wetland loss in Vermont is estimated at 20 acres per year. While restored wetlands offset this number somewhat, these restored wetlands generally take many years before they provide the full functionality of a natural wetland.

Fish and wildlife that depend on wetlands for survival tend to be easily disturbed or negatively affected by human activities, and activities often associated with residential development can disturb habitat or cause displacement of a variety of wildlife.

Community Strategies for Vermont's Forests and Wildlife: Case Study

While statewide wetland protections are offered through the Vermont Wetland Rules, some towns have chosen to further protect these important natural features. The town of Warren protected wetlands and other ecologically sensitive areas by requiring a *Conservation Subdivision Design* in the review of major subdivisions, for example. You can read more about the town's process in *Community Strategies for Vermont's Forests and Wildlife*, on page 58.

Wetlands: Map Interpretation

This map layer uses the most comprehensive source of information on wetlands available: the Vermont Significant Wetlands Inventory (VSWI), which is a subset of the larger National Wetlands Inventory. This inventory was created to provide a broad-scale overview of where wetlands are located. Keep in mind, however, that these maps were prepared using aerial photography. Wetlands that are hard to see on aerial photos—such as those that are forested—may not show up, while other features were occasionally mistaken for wetlands and displayed on this map. Before using these data for specific planning purposes, you will want to verify this information, but it can be a good starting place.

Wetlands: Planning Considerations

Wetlands receive some protection through the Vermont Wetland Rules. These rules regulate land use, including restrictions on development, guidelines on acceptable management activities, and a list of allowed uses. They apply within the wetland itself and a surrounding buffer. On maps, you will find wetlands to be classified as Class I or Class II, with Class I wetlands receiving the highest level of protection, and with most mapped wetlands falling into the Class II category. You can learn more through Vermont's Department of Environmental Conservation.[13]

Conserving Vermont's Natural Heritage Tip

There are a variety of ways to plan for the future of the wetlands in your community. *Conserving Vermont's Natural Heritage* suggests starting with creating **goals** such as the following for the conservation of wetlands:

1. Protect or provide for long-term stewardship of wetlands that support significant functions and values for natural communities, rare species habitat, or wildlife habitat, and prevent additional loss of wetlands within the town.
2. Restore and/or enhance the functions and values of wetlands already affected by human disturbance.

The book goes on to provide specific recommendations of tools—both regulatory and non-regulatory—that may be useful in fulfilling these goals. See more on page 62 of the book.

The first step in planning for wetlands locally generally involves an evaluation of how well the state-level rules achieve your community's goals for wetland conservation. To achieve local or regional goals, some communities take additional steps to protect certain functions. The most common additional steps address either the extent of the undeveloped strip of land (a "buffer") encircling the wetland or the land that extends between a wetland and a nearby natural area or body of water. While Vermont Wetland Rules generally apply within a 50-foot area around a Class II wetland, for example, a wetland that provides extensive habitat for breeding waterfowl or that is surrounded by steep slopes and is therefore at a high risk of erosion may benefit from a 100- to 300-foot buffer wherever possible. In other locations, maintaining a vegetated area that connects a wetland to nearby natural areas or waterways provides a pathway for traveling wildlife.

In addition to considering the specific benefits a wetland provides to fish and wildlife, your community may also want to consider the wetland's role in flood and erosion protection, nutrient and pollution filtration, groundwater recharge, aesthetic diversity, and potential use for educational and recreational activities.

To protect or restore wetlands in your region, consider:

Conservation Goal	Conservation Strategies	
	Nonregulatory strategies	*Regulatory Strategies*
Seek additional information	Improve knowledge of local wetlands and create a town wetlands map.	

Provide baseline protection	Adopt language in the town plan, including statements about the importance of wetlands and policies on how they should be managed, protected, and restored.	Check clarity of definitions in zoning bylaws and update if needed.[14]
Protect wetlands and surrounding habitat	Encourage residents and/or businesses to conserve their wetlands through conservation easements.[15]	Petition for reclassification of significant wetlands to Class I, which receive the highest level of protection. If wetlands are not mapped, seek to add them as Class II wetlands on inventory maps.[16]
	Encourage residents to enroll their wetlands in Current Use, in an Ecologically Significant Treatment Area (ESTA).[17]	Require buffers through the general standards section of your bylaws, to apply in all districts. [18]
	Encourage landowners to work with a forester to choose forest management practices that protect wet soils and fragile species.	Require development design that clusters development away from wetlands and their buffers in subdivision and zoning regulations.[19]
	Support public awareness of Vermont's *Wetlands Rules.*[20]	Incorporate minimum setbacks from wetlands in zoning and subdivision regulations.
Restore wetlands	Restore wetlands on town-owned lands.[21]	Create town road management standards to maintain and restore natural vegetation and hydrology. [22]
	Connect landowners with incentives programs (USDA, USFWS, etc.) to aid in restoring wetland habitat.[23]	

Information about many of the tools above can be found in *Community Strategies for Vermont's Forests and Wildlife.*

Wetlands: For More Information

National Wetlands Inventory (NWI) of the U.S. Fish and Wildlife Service (USFWF): This is the agency responsible for mapping wetlands throughout the United States, including the data displayed. Information about the USFWS's classification system can be found on the National Wetlands Inventory website[24] or in the book *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al., 1979).

Wetlands Section, Vermont Department of Environmental Conservation[25]**:** This program regulates wetlands in Vermont, monitors the biological condition and status of Vermont's wetlands, and provides technical assistance on wetland identification, delineation, and protection through planning and other mechanisms. It is also a source of information on the functions, values, and locations of wetlands throughout the state.

Inventory Layer #4: Vernal Pools

What Are Vernal Pools?

A vernal pool is a depression in the forest floor that fills with water each spring and often dries out later in the growing season. Although trees and shrubs rarely grow in vernal pools, typical vernal pools are well shaded by the surrounding forest. In the Northeast, many vernal pools start filling with fall rains, retain water, ice, and snow through the winter, and collect more water with the arrival of spring rain and snowmelt. Some are further influenced by rising groundwater in the fall and spring. The pools typically lack inlets and outlets, and while many vernal pools are dry by mid-summer, some may retain water throughout the year in wet years.

Vernal Pools: Significance

Vernal pools may take up a small amount of land area, but they are necessary habitat for amphibians and very important for a number of additional species. In Vermont, vernal pool-dependent species include mole salamanders (Spotted salamander, Blue-spotted salamander, and Jefferson salamander), Eastern four-toed salamander, and wood frog. All of these species may breed in other wetlands but rely heavily on vernal pools to maintain their populations. For vernal pools to be effective breeding habitats for these amphibians, they must retain water for at least two months during the spring and summer breeding season most years so that amphibians can complete their aquatic larval stage. The periodic drying of a vernal pool is essential, too, as this eliminates populations of fish and diving beetles that prey on amphibian larvae. Other animals use pools as well, such as fairy shrimp, fingernail clams, snails, eastern newts, green frogs, American toads, spring peepers, and a diversity of aquatic insects. Fairy shrimp are thought to survive only in these temporary pools. Because the amphibians and invertebrates found in vernal pools constitute a rich source of food, various species of birds, mammals, and reptiles may be attracted to the pools. Despite their small size and temporary nature, vernal pools are highly productive ecosystems.

Vernal Pools: Map Interpretation

The data depicted in this layer were collected through the Vermont Vernal Pool Mapping Project, a statewide effort to map the locations of vernal pools. These pools were initially mapped using aerial photographs; many have also been visited to confirm existence and to collect data. You will notice that this information is divided into two similar layers: a “vernal pools” layer and a “vernal pools (potential)” layer. “Potential” vernal pools have been mapped purely using aerial photographs but have not been confirmed in the field; others have been visited and enough data has been collected to say for certain that these pools exist and are used by wildlife. The locations of confirmed pools are therefore accurate to a fine scale and can be used even down to a parcel level; “potential” vernal pools should be visited (with landowner permission) prior to taking any next steps.

> By using a combination of professional expertise and volunteer vigor, the Vernal Pool Mapping Project continues to identify vernal pools throughout the state. Learn more at http://vtconservation.com/success/content/vernal-pool-mapping-project.

Vernal Pools: Planning Considerations

Vernal pools and the organisms that depend on them are threatened by activities that change the way water flows into and around the pool, alter the substrate at the base of the pool, or significantly modify the surrounding forest. Construction of roads and other development in the upland forests around vernal pools can negatively affect salamander migration or result in mortality (Forman et al., 2003). Some types of timber harvesting can also have significant effects on vernal pools, including alteration of the vernal pool depression, changes in the amount of sunlight, leaf fall, and woody debris—branches, decaying wood, etc.—in the pool, and disruption of amphibian migration routes by the creation of deep ruts. Even when the pool is dry, alteration of the depression substrate may affect its ability to hold water and may disrupt the eggs and other drought- resistant stages of invertebrate life that form the base of the vernal pool food chain.

In Vermont, vernal pools with breeding amphibian populations have recently been included as Class II wetlands and are therefore offered some protection under the Vermont Wetland Rules. However, many wetland maps used for regulatory purposes do not include vernal pools, limiting the rules' enforceability. Similarly, town plan and bylaw definitions of wetlands generally lack inclusion of vernal pools. When planning for the conservation of vernal pools, one starting place may be to update maps of Class II wetlands to include vernal pools and to re-define a "wetland" in the town plan or bylaws. At that point, planning for vernal pools and wetlands could be accomplished simultaneously, if this would achieve your community's goals.

You might also consider:

Conservation Goal	Conservation Strategies	
	Nonregulatory strategies	*Regulatory Strategies*
Seek additional information	Conduct field inventories as needed to improve maps of vernal pools.	
Protect vernal pools and associated amphibian populations.	Write management plans for town-owned land designed to protect vernal pools.[26]	Require buffers in the general standards section of your bylaws, to apply in all districts.[27]
	Encourage landowners to create forest management or stewardship plans to conserve vernal pools and surrounding habitat.	Create a Wildlife Habitat Overlay District that includes vernal pools and surrounding habitat.[28]
	Provide citizen educational opportunities.	Encourage subdivision and site plan designs in zoning or subdivision regulations that cluster development away from vernal pools.[29]
	Adopt language in the town plan, including statements about what resources are important, and policies on	Require minimum setbacks in zoning or subdivision regulations.

	how they should be managed, protected, and restored.	Seek to add vernal pools as Class II wetlands on inventory maps (where they are often missing).
Protect or restore forested habitat between vernal pools.	Include a map in your town plan to show possible dispersal corridors between pools.	
	Target high priority corridors in land conservation efforts.	

Information about many of the tools above can be found in *Community Strategies for Vermont's Forests and Wildlife.*

Additional Online Data

The following datasets are available on BioFinder, but they are not featured on the included inventory maps.

Stream Crossings

This dataset shows how well aquatic organisms—such as fish or bottom-dwelling macroinvertebrates—are able to pass through culverts and other road-associated structures.

Many aquatic species need to travel both up and down a stream during different life stages. For example, some trout species lay eggs in cooler, upstream locations but must find deeper pools, generally downstream, in which to spend the winter months. When culverts—or other natural landforms or human-made structures—form waterfalls too high for fish and other organisms to travel across, they are cut off from upstream habitat.

This layer describes a fish's ability to pass through culverts, bridges, and other road-related structure with the following categories:

- Fully Passable
- Reduced Passage
- Impassable except for Adult Trout [Adult trout can leap higher distances than younger trout or other species.]
- Impassible
- Bridge/Arch (fully passable)

When conducting planning efforts, your municipality may want to consider efforts to enhance structures that impair passage. In doing so, remember that roads may fall under the jurisdiction of private parties, towns, or the state.

Bridge and Culvert Inventory

In many Vermont towns, you can view data on the locations of all bridges and culverts. This information is divided into:

- VTRANS State and Town Long Structures (with a span greater than 20 feet)

- VTRANS State Short Structures (with a span less than 20 feet)
- Town Bridge
- Town Culvert

This information can be useful when thinking about how water flows through an area or how some wildlife might move safely across roads (by traveling underneath).

Suggested Additional Data

The 100-Year Floodplain

In some parts of Vermont, maps of the 100-Year Floodplain are available. While not included on BioFinder, these maps can be helpful in understanding an area's flood potential. It can be found on the Natural Resources Atlas. There, it is entitled "DFIRM" and includes several individual components. Compiled by the Federal Emergency Management Agency, these data have strong implications for *both* human and ecological communities.

The 100-Year Floodplain= 1% Annual Chance

The 100-hundred year floodplain is all the land inundated by a flood with a recurrence interval of 100 years. A flood of this magnitude has a 1% chance of occurring each year.

An insurance company might look at this statistic from a different angle: Over the life of a 30-year mortgage, property within the 100-year floodplain has a 26% likelihood of flooding.

While streams and rivers overflow their banks on a yearly basis in many communities, the highwater mark from one year to the next varies greatly. If we compare the water level reached in one flood to that of the next flood, we can calculate a recurrence interval for each inundation level. Some land is inundated every year. Some land floods on an average of every 5 years. A 100-year flood reaches very high water levels and can dramatically alter the landscape of our communities.

Climate Change and the 100-Year Floodplain

Flood recurrence intervals are based on historic averages. However, high-intensity flood events are predicted to occur with increasing frequency as our climate changes. For example, a 2015 study of the Winooski River in Waterbury found that when climate change predictions are factored in, the land currently mapped as the 500-year floodplain (with a 0.2% annual chance of inundation) will more likely be a 100-year floodplain (with a 1% annual chance of inundation) by 2065. (Schiff et al. 2015)

Hundred-year floodplain information is used commonly for economic and emergency management purposes, namely insurance. Using this map, we can visualize the area most likely to be underwater in a dramatic flood event—including houses, roads, and other infrastructure.

While the data were compiled with human communities in mind, they have ecological implications, too. Historically, these are lands in which flood sediments—sand, gravel, and other materials—have been deposited, and these materials create the substrate. Periodic flooding also creates disturbances that prevent certain vegetation from growing—allowing other species to *rely* on

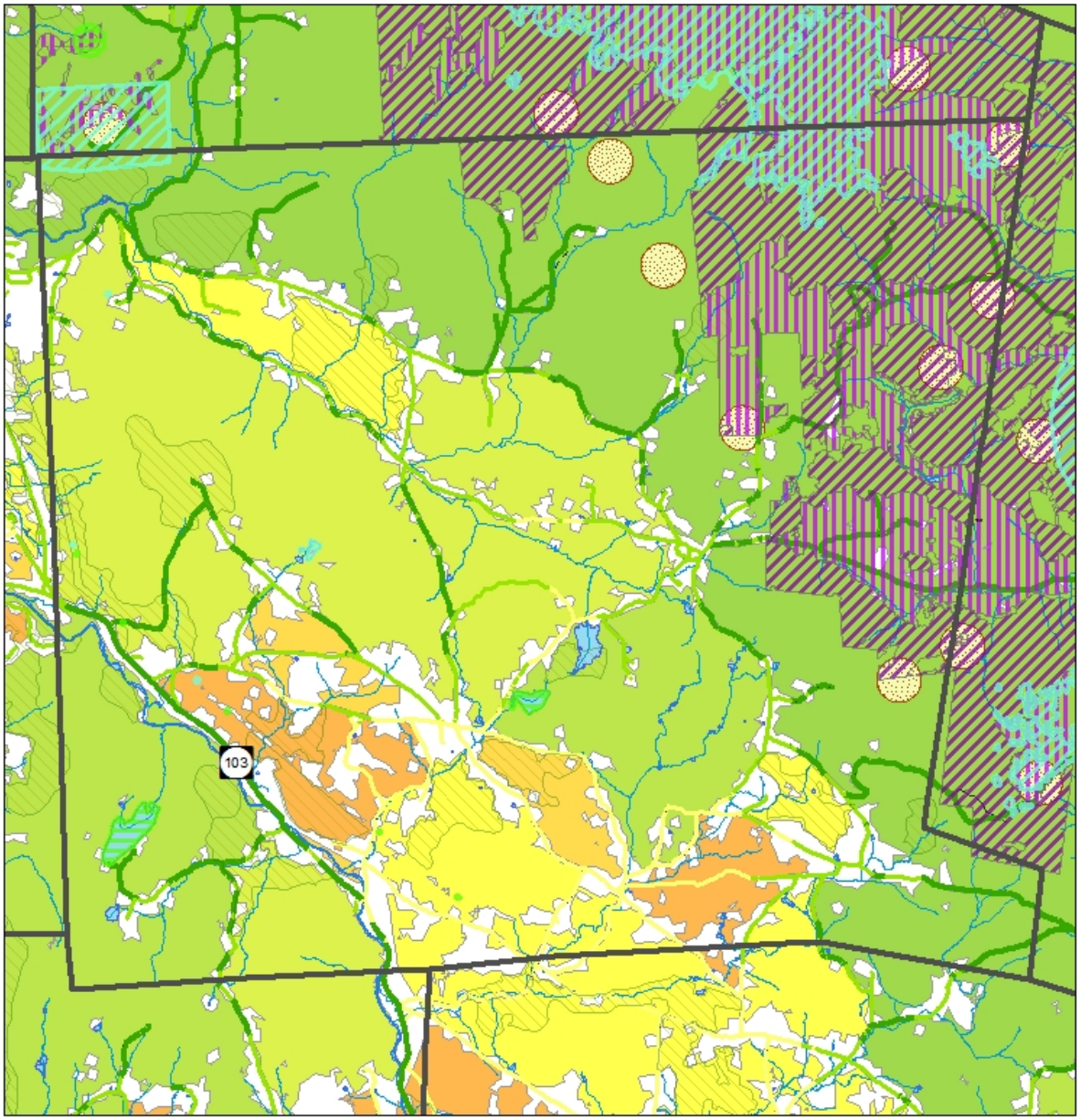
these regular inundations of water, sediments, and nutrients. In general, the 100-year floodplain is a dynamic region that acts as an interface between water and land.

Compiled by the Federal Emergency Management Agency, these data are the basis for floodplain management, mitigation, and insurance activities for the National Flood Insurance Program (NFIP). In other words, this map layer is based on the database used by flood insurance companies to predict the likelihood of flooding for any particular location. The categories pictured are therefore classifications of flood "risk:" 1% annual chance of a flood event (the 100-year floodplain) and 0.2% annual chance of a flood event (the 500-year floodplain).

Flood hazard areas are determined through the analysis of records of river flow, storm tides, and rainfall, consultation with communities, topographic surveys, and analysis of water flow. The map also uses elevation models. This information is not available in all counties of Vermont.

Of course, the extent to which water will cover any given piece of land in a future flood is not predictable, because there are so many factors affecting the locations where water will flow. Data are based on past events and provide a historic record of inundation rather than predictions for the future.

This map has strong implications for *both* human communities and ecological conservation. As described above, this information was compiled with emergency management in mind, and its implications for human safety and financial costs are clear. However, these lands are also critical for a variety of wildlife, making the 100-year floodplain a place of common ground. While historic development within this region was common and substantial infrastructure currently exists inside the limits of the 100-year floodplain, there is a good chance that infrastructure built on the floodplain will not last without substantial effort and cost. On the other hand, wildlife thrive in an undeveloped floodplain. Rivers and streams provide corridors for movement between one block of quality habitat and the next. Some species rely on floodplain sediments or nutrients.



Map 6: Species and Community Scale Resources Shrewsbury, VT

Town Boundary
Amphibian and Reptile Crossings
Rare Species
Uncommon Species
Rare Natural Communities
Uncommon Natural Communities
Common Natural Communities
Deer Wintering Areas
Wildlife Linkage Ratings
Score
1
2
3
4
5
Mast Stands
Clayplain Fragments
Roads
Interstate
Primary
Secondary
Trail
Rivers & Streams
Lakes & Ponds
Habitat Blocks
Priority Rank
10
9
8
7
6
5
4
3
2
1
0

Data Source:
Vermont Center
for Geographic Information
Vermont State Plane Projection
NAD1983 Datum
Map by Monica Przyperhart
October, 2016

0 0.5 1 2 Kilometers
0 0.5 1 2 Miles

Photo by John Hall

MAP 6. Community and Species Scale Wildlife Resources

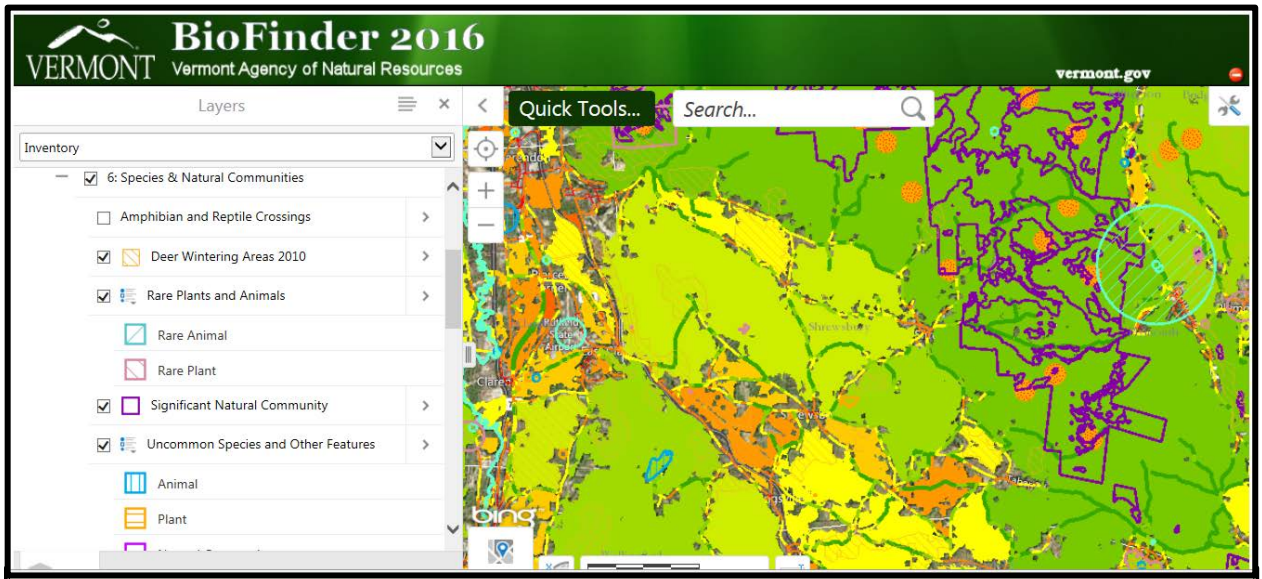
The data on this map is accurate to a finer scale than other maps.

Inventory Layers *(Described Below)*	**Base Layers**	**Additional Atlas Data**
1. Deer Wintering Areas	*Roads*	*Indiana Bat Habitat*
2: Rare and Uncommon Plants and Animals	*Streams & Rivers*	
3: Significant Natural Communities	*Lakes & Ponds*	
4: Wildlife Road Crossings	*Town Boundaries*	
5: Mast Stands		
6: Habitat Blocks (by State Priority)		
Locally-Specific Inventory Layers		

In the context of this map, the "Community Scale" includes the components and process that occur between groups of plants and animals as they interact with one another and with their physical environment. For example, mast stands are described at this scale because they are associated with a particular set of physical features, plants, and wildlife that function together as a community.

The "Species Scale" refers to those habitats necessary for the survival of specific fish, wildlife, and plants. For example, wildlife crossings are locations where bear, bobcat, fisher, and other wide-ranging species are most likely to cross roads as they travel to meet daily or seasonal dietary needs, disperse to find mates, or fulfill other requirements. While they tend to be small in size, species-scale components are essential for maintaining biodiversity by supporting species with a known conservation need in the state or region.

As you look at this map, you can imagine zooming in from previous maps to examine the details of your local landscape, even analyzing layers at the level of an individual parcel. Of course, while data are accurate at a local scale, they aren't comprehensive. For example, a mark depicting a rare species is spatially accurate, but the absence of a rare species marker is *not* a definite sign that there are no rare species present. Because the entire state has never been inventoried for all rare species, there are inevitably omissions from the database. This is true for most of the data displayed on this map. Local inventory information could greatly enhance a community's knowledge of community- and species-scale resources.



To load Map 6 on BioFinder: *Open the "Inventory" theme, then check the box next to "6: Species & Natural Communities." To see all Map 6 layers, click the "+" next to the layer title. You can add navigational landmarks such as roads and town boundaries by checking them on in Map 1, the Conservation Base Map. For additional guidance on using BioFinder, please see* Getting Started *in the introduction to this guide, or "Tips and Tools" on the BioFinder website.*

Inventory Layer #1: Deer Wintering Areas

What are Deer Wintering Areas?

Deer wintering areas vary in size from a few acres to over a hundred acres and provide essential relief to deer from winter conditions. Covered by dense, mature or maturing softwood trees, they provide protection from deep snow, cold temperatures, and wind. These areas may be characterized by a favorable aspect (south-facing, or perhaps southeast or southwest-facing but rarely north), they generally occur at moderate elevations, and they are found in places with low levels of human activity in winter. Tree cover is most often from hemlock and white pine in the southern part of the state, and white cedar, spruce, and fir in the north. Deer inhabiting these areas expend less energy walking in the reduced snowpack and maintaining their body temperature in the sheltered environment, thus enhancing their survival.

From one year to the next, wintering areas do not change significantly, so these areas can be used by generations of deer over many decades if habitat conditions are maintained. Deer annually migrate—often several miles—from fall habitats to wintering areas, and a single large deer wintering area can occasionally attract deer from a radius of several towns.

Deer Wintering Areas: Significance

The conservation of deer wintering areas is essential to maintaining and managing white-tailed deer in Vermont. Deer wintering areas make up a relatively small percentage of the land base of most towns; only 8% of the forested landscape of Vermont has been mapped as deer winter habitat. However, residential, commercial, or industrial development within or adjacent to these areas decreases the amount of winter habitat available to deer and can eventually reduce the number of deer within the area. Without adequate winter habitat, deer populations would be subject to extreme fluctuations due to heightened levels of winter mortality during moderate and severe winters.

Additional information on deer winter habitat requirements and management recommendations can be found in the publication *Wildlife Habitat Management for Vermont Woodlands, a Landowner's Guide*, which is available from the Vermont Fish and Wildlife Department.

Deer Wintering Areas: Map Interpretation

Deer wintering areas were identified in 2010 using aerial observations, infrared aerial photos, and ground confirmation. Additional areas are added to the database as they are discovered. It is important to keep in mind that not all deer wintering areas have been mapped, and that changes in forest cover and land use affect an area's use as a deer yard. If you suspect an area serves as deer winter habitat that is not mapped, we recommend that you contact us.

Deer Wintering Areas: Planning Considerations

In addition to benefits for deer, dense softwood stands provide critical winter shelter and food supplies for a variety of other wildlife species including porcupines, snowshoe hare, fox, fisher, coyotes, bobcats, crows, ravens, red and white-winged crossbills, and many others. Logging can be either detrimental or beneficial to the habitat depending on whether a dense softwood cover and food supply are maintained.

Because so many of the species that use Deer Wintering Areas use them as one type of habitat in a matrix of others, this dataset may be most useful when used to reinforce the importance of larger blocks of forest habitat that contain Deer Wintering Areas. In other words, a broad-scale conservation measure to limit forest fragmentation or support large blocks of undeveloped land that include deer wintering habitat may be the most effective way to conserve this habitat type. For specific planning considerations, please see *Layer #3: Habitat Blocks* in Map 3. If you then

decide to add additional protections specifically for deer wintering areas, you might consider the following:

Conservation Goal	Conservation Strategies	
	Nonregulatory strategies	*Regulatory Strategies*
Seek additional information	Conduct field inventories and improve maps.	
Protect habitat blocks that include deer wintering areas.	***See Map 3, Layer #3.***	
Protect deer wintering areas.	Encourage residents to conserve their land through conservation easements.[1]	Establish development design standards that cluster development away from deer wintering areas.[2]
	Encourage residents to enroll their land in Current Use, using Ecologically Significant Treatment Areas (ESTAs) in appropriate locations[3] or working with a forester to plan for the long-term health of the resource.	Establish or improve a Wildlife Habitat Overlay District.[4]
	Adopt language in the town plan, including statements about the importance of deer wintering areas, and policies on how they should be managed, protected, and restored.	Require buffers around deer wintering areas.
	Provide citizen educational opportunities.	

Additional information about using these tools is available in *Community Strategies for Vermont's Forests and Wildlife*. You can also learn more about deer wintering areas and associated conservation goals in *Conserving Vermont's Natural Heritage*.

Inventory Layer #2: Rare and Uncommon Plants and Animals

What Are Rare and Uncommon Plants and Animals?

A careful look at the map key will reveal that this data is divided into two layers, entitled "rare plants and animals" and "uncommon species and other features." Because both refer to individual known occurrences of species that are not commonly encountered in Vermont, we discuss them together.

A *rare* species is one that has only a few populations—generally less than 20, depending on the species—and faces threats to its continued existence in Vermont. *Uncommon* species also face a risk of extinction, but a more moderate one, with between 20 and 80 populations statewide. In general, rare species are subject to state or federal regulations; uncommon species are not, though there are exceptions.

Most of these species in Vermont are rare because they are on the edge of their range or they are separated from the main species population by a large distance. For example, the spiny softshell turtle is found in Vermont in parts of Lake Champlain, and the next nearest population is in the St. Lawrence River. The majority of the population is found west of New York. Several rare species occur in unique habitat types or rare natural communities. Animal species with large home ranges, like osprey, are considered rare when their overall populations consist of small numbers of breeding pairs.

Included alongside uncommon species data are "other features." These are rare species or natural communities that have been identified but incompletely documented. This means that like uncommon species, these features are unlikely to trigger state or federal regulatory review as recorded. However, this may change if these features are better studied.

Rare, Threatened, or Endangered? What's the Difference?

The maps described in this guide are based on how *common* or *rare* a species is in Vermont. This follows a system that ranks species on a scale of S1-S5 in which S1 and S2 are considered rare, S3 is considered uncommon, and S4 and S5 are common. This parallels a global ranking system that records rarity of a species throughout its range on a scale of G1-G5.

The words *threatened* and *endangered* refer to the species' legal status. Threatened and endangered species have been offered protection under the Vermont Endangered Species Law or federal Endangered Species Act. While this status is based on rarity, species are not offered protection without a legal designation.

Legal status is not included in BioFinder. However, it *is* shown on the ANR Atlas. The two maps use identical data; it is only the display format that differs. To see a complete list of Vermont's rare species that includes state and federal legal status, go to http://www.vtfishandwildlife.com/common/pages/DisplayFile.aspx?itemId=229831.

Rare and Uncommon Plants and Animals: Significance

Rare native species in Vermont, such as Indiana bat, loon, spiny softshell turtle, goldenseal, and ginseng are an important part of Vermont's natural heritage. Rare species can play crucial roles in ecosystems, with other species relying on them for their survival. Many of these species are also admired and appreciated by people for their beauty, sounds, or mere presence on the landscape.

Each town harbors its own set of rare and uncommon species that contributes to the overall diversity of the state. Even though Vermont is a small state, it has varied terrain, aquatic systems, elevations, wetlands, geology, and natural communities. It is likely that the rare species mapped in your community are in habitats that are ecologically important at the state or even regional level—even if they don't seem particularly rare in a local context.

Rare and Uncommon Plants and Animals: Map Interpretation

The data shown on this layer were compiled through the Vermont Fish & Wildlife Department's Natural Heritage Inventory (NHI), which is the state's contribution to a greater, regional database of conservation information. Unlike many layers in this guide, all information depicted about rare and uncommon species represent field-confirmed, geographically accurate data points.

Map users should be aware that when a point is used to represent a rare species observation, the size of the population may not correspond to the size of the point. A mapped point may represent only a few square yards, but it could also indicate a large wetland, a river stretch over a mile long, or an extensive ridgetop that provides habitat for the rare species. Usually, more specific data is recorded in the NHI database, and you can learn more by contacting the Vermont Fish & Wildlife Department. In addition to learning more about the location or population size of a mapped rare species, the database sometimes includes notes recorded by those conducting field inventories, such as threats or management needs like an invasive species that is affecting the rare species.

> *Conserving Vermont's Natural Heritage* details many strategies for keeping rare, threatened, and endangered species on our landscape. To read more, see chapter 6, page 106.

While rare and uncommon species *locations* are provided on this map, you will notice that plant and animal species information is missing. Nationwide, this information is omitted from mapping efforts so as not to jeopardize the survival of sensitive species. Some rare organisms are sought for collection, others are targeted as unwanted (such as the timber rattlesnake), and others draw attention from those attracted to the uniqueness of the species, which can sometimes disturb the species' natural habitat or behavior (as can happen with the peregrine falcon or bald eagle). In addition to the potential damage to the species, these behaviors can also be disruptive to land owners and managers. As a result, each location mapped here is labeled generally as a plant or animal. Landowners, land managers, and town officials can contact the Vermont Fish & Wildlife Department for additional information, but the information is not provided to the public.

Rare and Uncommon Plants and Animals: Planning Considerations

In Vermont, state and federal laws protect *threatened* and *endangered* species. However, most rare and uncommon species have not been given this legal status, and they receive no protection. Review and consideration of rare and uncommon species in local and regional planning efforts can help to ensure that important habitat remains.

When planning, the first step may be to contact Vermont Fish & Wildlife Department for more information about the rare and uncommon species found in your community. It is wise to consider the habitat needs of these species, as well as the age and quality of the data, before determining a particular conservation strategy. In some cases, collection of additional field data may also enhance your decision-making ability.

Because the planet in general—and possibly Vermont specifically—is experiencing the loss of species at a rate never before experienced, those species most at risk serve as barometers of the state of the environment (George 1998). Protecting and restoring rare and uncommon species represents one of the most difficult present-day conservation challenges in Vermont. If we are to see the continued presence of these species in our state, we need to address their needs at all levels of planning—local, regional, and statewide.

To conserve rare and uncommon species, you may consider:

Conservation Goal	Conservation Strategies	
	Nonregulatory strategies	*Regulatory Strategies*
Seek additional information	Conduct field inventories and improve maps of rare and uncommon species.	
Provide baseline protection	Adopt language in the town plan, including statements about what resources are important, and policies on how they should be managed, protected, and restored.	Check clarity of definitions in zoning bylaws and update if needed.[5]
	Provide citizen educational opportunities.	
Protect significant species	Encourage landowners to conserve land that supports rare or uncommon species.[6]	Create a Conservation or Wildlife Habitat Overlay District that protects significant wildlife habitat and a surrounding buffer.[7]
	Encourage landowners to enroll in Current use and enroll eligible areas as Ecologically Significant Treatment Areas (ESTAS)[8].	
Manage invasive species	Provide landowners with opportunities to learn about management options for invasive species.[9]	Adopt a mowing policy in which town roadsides with invasive species are mowed before they go to seed.
Restore degraded habitat	Connect landowners with incentives programs (USDA, USFWS, etc.) that aid in restoring significant natural communities or habitat.[10]	

Additional information about using these tools is available in *Community Strategies for Vermont's Forests and Wildlife*. You can also learn more about rare and uncommon species and associated conservation goals in *Conserving Vermont's Natural Heritage*.

Inventory Layer #3: Significant Natural Communities

What are Natural Communities?

A natural community is a group of plants, animals, physical features, and natural processes that can be found together wherever similar environmental conditions exist. For example, the most common natural community type in Vermont is Northern Hardwood Forest, dominated by a matrix of sugar maple, yellow birch, and American beech. Young forests of this type often contain mixes of quaking or big-tooth aspen and paper birch. In

Wetland, Woodland, Wildland
Vermont's natural communities are described in detail in a publication entitled *Wetland, Woodland, Wildland: A Guide to the Natural Communities of Vermont*, by Elizabeth H. Thompson and Eric R. Sorenson. The guide is available online at http://www.vtfishandwildlife.com/common/pages/DisplayFile.aspx?itemId=244831, or in printed form in bookstores.

Vermont's higher elevations with cooler temperatures and shallower soils, montane spruce-fir forest is more common, with red spruce, balsam fir, and paper birch as the dominant species. Each community of trees grows on specific soil types and is associated with a predictable assemblage of understory plants. Each vegetative matrix in turn provides habitat for a somewhat different array of wildlife species. Together, the combination of species commonly occurring together is considered a separate natural community.

This layer is divided into three sub-categories: rare, uncommon, and common. *Rare* natural communities have the fewest occurrences on Vermont's landscape, and they are generally associated with rare physical or environmental conditions. For example, a rare natural community may occur on a type of bedrock that has limited distribution in Vermont or be associated with climatic conditions that occur only in small parts of Vermont's geography, such as when Vermont is at the edge of a climatic range. Natural communities can also become rare as the result of habitat loss due to human activity. *Uncommon* natural communities result from similar conditions, but with a slightly heightened rate of occurrence in Vermont. *Common* natural communities include all natural community types that are not rare or uncommon.

For all categories, only those occurrences of natural communities that are considered *state-significant* appear in BioFinder or in the maps associated with this guide. Significance is determined based on the quality of an individual occurrence, coupled with the rarity of the community type. A rare natural community is considered significant for all but the poorest quality occurrences. Uncommon natural communities are considered significant when they are ranked as having either "good" or "excellent" quality. Only the highest quality occurrences of common natural communities are considered significant, included as examples of the natural communities that create the matrix of Vermont's landscape.

Using the analogy of a theater production, natural communities are our best way of representing *all* actors (species) and plot elements (natural processes) without needing to identify each individually in an extremely complex drama. Rare and uncommon natural communities are the elements of the play that stand out as different from the standard plot line. Common natural communities represent the majority of actors and plot that make up the play. Instead of pointing to each of the *many* occurrences of these groups of actors, however, this map identifies a few occurrences in which they are strongly demonstrating their roles in the play.

Natural Communities: Significance

Natural communities represent the distribution of plant and animal species that have grown in response to current and past environmental conditions and natural processes. Although the species composition of natural communities may shift over time in response to a changing climate, it is believed that locations of present-day high quality natural communities will continue to support important natural communities into the future because they represent differences in the physical landscape setting. Rare natural communities typically include rare species and occur in environmental settings that are rare. Common natural communities occur in more common environmental settings. Natural Communities can therefore act as a filter for long-range conservation efforts by showing us *locations* worthy of protection.

In such conservation efforts, it is important to include not only rare and uncommon natural communities, but common ones, too. Increasingly, conservation strategies include "keeping common species common," because it is far easier to maintain a common species or community than to work only with those that have become rare and try to restore them. Common natural communities are important ecologically because they form the natural matrix of the Vermont landscape, provide habitat for innumerable species and support ecological processes such as natural disturbance, water filtration, and carbon sequestration.

Natural Communities: Map Interpretation

The locations of the rare and uncommon natural communities mapped here represent known examples in the state. They are based on detailed site surveys, so they are accurate even at a very local scale. However, a comprehensive natural community inventory has not been done at the state level. While rare and uncommon natural community types are better represented than common types, the database contains many omissions for *all* natural communities. Nearly all mapped examples of common natural communities are on state-owned land, with few examples mapped on private land despite the numerous high-quality natural communities occurring there.

Interacting with this map on BioFinder will provide you with an opportunity to learn more about an individual natural community. A click on a mapped feature will open an information box, and the box will tell you the type of community and other information. Included in this box is also a "State Rank" category, which refers to a scale ranging from S1-S5. On this scale, S1 and S2 are considered rare, S3 is considered uncommon, and S4 and S5 are common.

Natural Communities: Planning Considerations

Because significant natural communities can encompass so many different types of habitat, this dataset may be most useful when used to reinforce the importance of the larger habitat blocks that contain them. In other words, a broad-scale conservation measure to limit forest fragmentation or support large blocks of undeveloped land is likely to also protect the natural communities in that block. For specific planning considerations, please see Layer #3: Habitat Blocks in Map 3.

However, some significant natural communities may not be located within large blocks of habitat. In these cases, communities should consider conserving them on their own. Often, these natural communities are located closer to developed areas, and they are frequently located along rivers or other waterways. When this is the case, strategies to conserve riparian areas such as those suggested in *Map 5*, Layer #2 may be appropriate.

Because natural community information is incomplete across the state, most communities wishing to conserve their natural heritage could benefit from a *local* inventory of natural communities. This would build on the data available through state resources to provide a better sense of the types and distributions of natural communities in the local area.

> Several Vermont communities have conducted natural community inventories to capture a snapshot of the diverse habitat elements present in the local landscape. The Mad River towns of Fayston, Warren, and Waitsfield together hired a consultant to conduct such an inventory. Read more: http://vtconservation.com/success/content/arrowwood-inventory-fayston-warren-and-waitsfield-natural-community-mapping

If a community's goal is to protect biodiversity, one effective approach is to then to conserve and/or restore high quality examples of all natural community types that occur within the area. To be most effective, these efforts should consider not only the natural communities themselves, but also the ecological processes that support them—hydrologic patterns throughout the landscape, for example, or movement of wide-ranging species as they travel between natural community types. Consideration should also be given to the extent to which invasive species are impacting biodiversity. In some locations, management of these invasive species may be an important step in conserving the resource.

You might then find the following strategies to be appropriate:

Conservation Goal	**Conservation Strategies**	
	Nonregulatory strategies	*Regulatory Strategies*
Seek additional information	Conduct field inventories and improve maps of natural communities.	
Protect habitat blocks that include significant natural communities.	***See Map 3, Layer #3.***	
Protect significant natural communities	Encourage landowners to conserve land that supports rare or uncommon natural communities. [11]	Create a Conservation or Wildlife Habitat Overlay District that protects significant natural communities and a surrounding buffer. [12]
	Encourage landowners to enroll in Current use and enroll eligible areas as Ecologically Significant Treatment Areas (ESTAS). [13]	
	Create or expand a Town Forest. [14]	
	Provide citizen educational opportunities.	
Manage invasive species	Provide landowners with opportunities to learn about management options for invasive species.	Adopt a mowing policy in which town roadsides with invasive species are mowed before they go to seed.

Restore degraded habitat	Connect landowners with incentives programs (USDA, USFWS, etc.) that aid in restoring significant natural communities or habitat.	

Additional information about using these tools is available in *Community Strategies for Vermont's Forests and Wildlife*. You can also learn more about natural communities and associated conservation goals in *Conserving Vermont's Natural Heritage*.

Inventory Layer #4: Wildlife Road Crossings

What are Wildlife Road Crossings?

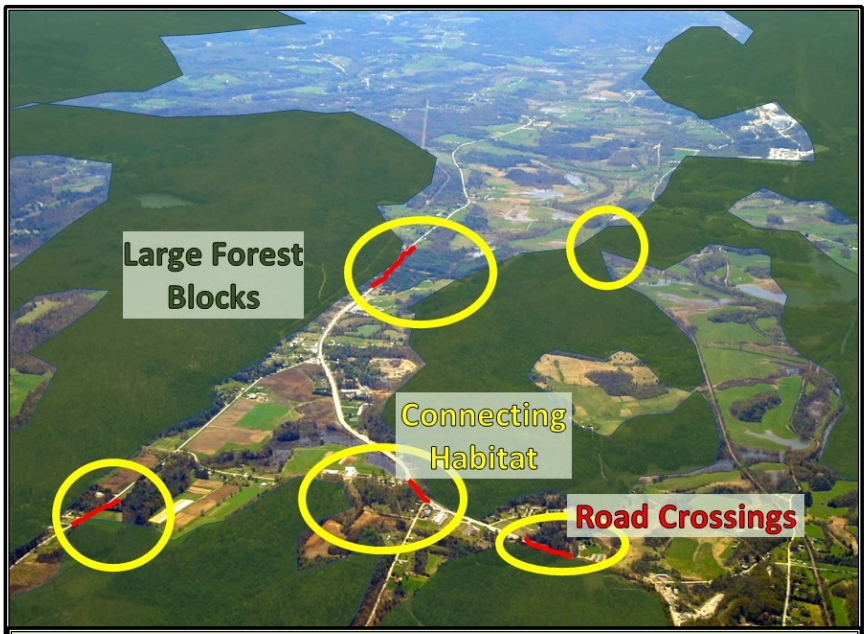
Just as the term implies, wildlife road crossings are areas where wildlife are most likely to cross roads. They are one type of *connecting habitat*—land that links together larger blocks of habitat. When wildlife can successfully cross roads between habitat blocks, these blocks sometimes fill the role of an even larger habitat block, allowing for enhanced movement and migration of animals and plants. Of course, these crossing areas are most effective for wide-ranging mammal species such as black bear, bobcat, and fisher; even a road routinely crossed by these species can present an insurmountable barrier to other species.

While each species prefers a slightly different combination of habitats that increases the likelihood of crossing a road, there are some general trends. Many species are most likely to cross a road when:

To read more about the variety of connecting habitat types that link our landscape, see page 48 in *Conserving Vermont's Natural Heritage*.

- Terrain is relatively flat, with no steep slopes on either side of the road;
- Wetland exists on at least one side of the road;
- Evergreen cover grows on both sides of the road;
- No houses are nearby (within 50m, for example);
- Animals can access larger habitat blocks on each side of the road.

For some species, the presence of guardrails also significantly reduces the likelihood of crossing in a particular location, and when a bridge or large culvert is present, some species may be able to cross *under* a road rather than across the road surface.



For wildlife to get from one large forest block to another, they need to pass through connecting habitat, *which may be composed of smaller patches of forest, shrubs, fields, or residential land. Within this connecting habitat, locations in which wildlife can successfully cross roads are crucial.*

Wildlife Road Crossings: Significance

Roads present a significant barrier for many of Vermont's wildlife species. They fragment habitat, preventing animals from accessing food, appropriate shelter, and mates. Some species live only in interior forest, far from roads, and biodiversity decreases in roadside areas. Furthermore, reproductive success for plants and trees can be impacted, water flow patterns can be altered, and roads can be conduits for the introduction of invasive species to new areas.

While most roads diminish the habitat available to Vermont species, some roads present more substantial barriers than others. The wildlife crossing areas depicted can be used by many species, but they are particularly important for wide-ranging mammals, such as bobcats and black bears that maintain large home areas to meet their needs. In some cases, roads may be crossed daily as animals fulfill routine dietary needs. Others may be crossed only periodically. For example, the food resources important to black bears change seasonally, and crossings can allow access to different foods as they become available. Crossings can also prevent the isolation of populations, avoiding problems associated with inbreeding. In these cases, an individual animal may cross a road only once during its lifetime as it seeks to establish a new territory. Even in these cases, that single successful road crossing can be critical for maintaining wildlife populations in Vermont for the long term.

Wildlife Road Crossings: Map Interpretation

These data were generated by the Vermont Fish & Wildlife Department to provide a preliminary look at where wildlife are most likely to cross Vermont roads. The department used a computer modeling process to locate areas with a high concentration of the landscape features most closely

Wildlife Road Crossings in BioFinder
There are two versions of this dataset available on the BioFinder website. The version described in the text can be found in the *Inventory* theme, on Map 6. As mentioned, roads are all ranked on a scale of 1 to 5, with 5 (in green) being the most probable crossing areas.

In the *Prioritization* theme, you can find an alternative version, broken into "Highest Priority Wildlife Crossings" and "Priority Wildlife Crossings." While these layers use the same data source, they each display only a subset of the full dataset. Highest Priority is given to those crossings ranked as 3, 4, or 5 in which a section of the crossing is located in either a riparian area or a Highest Priority Connectivity Block. Priority was given to crossings ranked 3, 4, or 5 found in other locations.

associated with wildlife crossing areas. These features were weighted according to importance, and then road segments were given a score of 1 to 5, with 1 being the locations with the fewest associated features (the worst crossing areas) and 5 being the locations with the most (the best crossing areas).

While the crossings depicted on this map are sometimes very small and can be viewed at a fine scale, please keep in mind that these are locations of *probable* wildlife road crossings—that is, places that contain landscape features associated with wildlife crossing areas. Additional field investigation is needed to confirm the frequency at which wildlife *actually* use these potential crossings.

It should also be noted that the dataset's focus is on terrestrial species. There is certainly a lot of wildlife movement that *isn't* captured by this computer model, such as amphibian crossing areas or fish passage. This layer also doesn't show the connecting habitat between the road and the bigger blocks, only the road itself. Maintaining this buffer of roadside habitat is generally critical for continued use of the crossing by wildlife. Regardless, these data offer a first step in addressing a likely pattern of wildlife movement across a town or region.

Wildlife Road Crossings: Planning Considerations

As mentioned earlier, there are other forms of habitat connectivity. Road crossings address only one feature that fragments landscapes—roads—but there are other fragmenting features, ranging from human-built infrastructure to natural features such as steep slopes or wide lakes. Your community may want to identify other potential connecting habitats through the interpretation of aerial or orthophotos and/or by enlisting a natural resources professional. Once you have identified wildlife road crossings and other potential connecting features in your community, the next step may be to confirm which areas are most heavily used by wildlife by conducting

In 2006, the Town of Salisbury set out to determine which of the town's roads were most heavily used by wildlife to cross from one patch of habitat to another. Wildlife road tracking surveys were conducted by Conservation Commission members and local volunteers over the next several years, data were analyzed and mapped, and eventually, the town changed their town plan to reflect their newfound information.

Learn more at http://www.townofsalisbury.org/town-departments/conservation-commission/news-articles.

field assessments of wildlife use in probable areas.

As you examine this layer, keep in mind that this map does not represent the *safety* of different road crossing areas. An unsuccessful wildlife crossing attempt can be disastrous for both the human and the animal involved in a collision. Some crossing areas are therefore better choices in terms of road crossing success—and human safety—such as roads with lower speed limits or straight roads that provide heightened visibility to drivers. Even more ideal are places where wide culverts or bridges provide enough space for animals to cross under roads rather than across them. As you consider strategies that allow for wildlife connectivity in your community, you may simultaneously be able to address these safety concerns.

Planning efforts that use wildlife road crossings data should also include habitat blocks, since these are the destination points for wildlife as they cross roads. Together, consideration of these two layers will benefit a wide range of native plant and animal species by enabling them to shift geographically or adapt to a changing climate. However, maintaining *only* crossing areas will not necessarily protect an area's ecological values and biological diversity in an otherwise developing area.

To conserve wildlife road crossings, you might consider the tools listed on the following table. Additional information about using these tools is available in *Community Strategies for Vermont's Forests and Wildlife*.

Conservation Goal	Conservation Strategies	
	Nonregulatory strategies	*Regulatory Strategies*
Seek additional information	Conduct field surveys and improve maps of roads used as wildlife crossings.	
Protect habitat around wildlife crossings	Adopt language in the town plan, including statements about what resources are important, and policies on how they should be managed, protected, and restored.	Check clarity of definitions in zoning bylaws and update if needed.[15]
	Encourage residents to conserve their land through conservation easements, particularly when crossings are part of larger parcels that have additional conservation values[16].	Require vegetated buffers around wildlife crossings in the general standards section of your bylaws, to apply in all districts. [17]
	Connect landowners to incentives programs, such as through USDA or USFWS Partners for Fish and Wildlife.	
	Encourage residents to enroll in Current Use.	Adopt road management standards to allow vegetation to remain up to the road.
	Encourage residents to manage their land so as to leave vegetation right up to the road.	
	Provide citizen educational opportunities.	
Limit fragmentation	When conducting planning efforts, consider wildlife road crossings and connectivity blocks together.	Establish or improve a Conservation District.
		Establish or improve a Wildlife Corridor or Wildlife Habitat Overlay District that includes both

		areas of habitat and important wildlife road crossings[18].
		Review or establish an access management plan, and consider limiting curb cuts in important wildlife crossing areas through site plan review or other standards within the zoning.[19]
Reduce danger to humans and wildlife	Work with road officials to provide appropriate signage and install/remove structures (fences, guardrails, etc.) to guide animals to cross in safer areas (under bridges, on straighter road segments, etc.).	Establish traffic rules that ensure the safety of humans and wildlife along roadways in which wildlife are most likely to cross.
	As needed, upgrade culverts and road infrastructure to VTrans standards. VTrans requires that all crossings include full-width banks and natural, at-grade bottom substrates to facilitate aquatic and terrestrial organism passage[20].	Adopt road management standards to avoid guardrails, the removal of roadside vegetation, or deep roadside ditching in crossings wherever possible.

Inventory Layer #5: Mast Stands

What are Mast Stands?

Mast is the fruit or seeds of shrubs and trees that are eaten by wildlife. It provides many species with an important calorie source, particularly in the fall months as wildlife are preparing for winter. Hard mast refers to nuts (especially those of beech and oak trees), whereas soft mast refers to berries and fruits of species such as black cherry, raspberry, blackberry, and apple. While most forested areas contain at least a few mast-producing trees and shrubs, forests producing significant concentrations of mast are much less common. In general, hard mast production areas of beech and oak that are used by wildlife represent a small fraction of the landscape. Only hard mast areas are represented on this map.

Beech nuts are used as a vital food source by numerous species.

Mast Stands: Significance

Significant mast production areas are recognized as a very important wildlife food source, both because available food is concentrated into a small land area and because the food contains a high energy content, especially when beech nuts and acorns are present. Mast stands are used by at least 170 species of wildlife in Vermont, including deer, black bear, turkey, blue jays, and cedar waxwings. Red and gray squirrels rely on beechnuts and acorns for their survival and reproductive success, and since these are prey for fisher, coyote, fox, owls, hawks, and other predators, the influence of mast stands can be seen throughout the food chain.

Hard mast production areas of beech and oak are also important for the survival and reproduction of black bear in Vermont. Studies have documented that the availability of hard mast in the fall

affects the minimum reproductive age of bears, productivity rates, and cub survival, and that female bears may "skip" reproduction after poor mast years (Elowe and Dodger 1989).

Mast Stands: Map Interpretation

A mast stand is identified as being important for bear if scars left by climbing black bears can be found on at least 15-25 tree trunks or show other evidence of use by bears, such as a "bear nest" in the crown of a tree (where bears have bent numerous branches in order to strip them of their mast). Because evidence of use by bear is easier to see than signs left by other animals, this layer relies entirely on bear data. All data on this map represent stands of hard mast as mapped by Vermont Fish and Wildlife Department. It is important to note that while mast stands are represented as points on the map, the actual habitat covered by each mast stand could be either larger or smaller. Dots cover 65 acres of area, which is the average acreage of all mapped mast stands in the state.

It should be noted that this dataset is incomplete; there has not been a statewide survey of mast production areas. Throughout the state, just 277 mast production areas appear on the map, although the real number is far larger. Because data for this map were collected by individuals visiting field locations, we can say with assurance that there are—or at least *have been*, historically—mast stands in the locations mapped. However, it cannot be assumed that there are no mast stands in areas lacking mapped points. If using mast stand information for local planning purposes, a local field inventory may reveal additional examples and provide additional accuracy.

Of the data present on this map, mast stands are more likely to have been reported in areas containing beech, because bear scarring is so prominent on this species and remains in the bark of the tree for so long. While other types of hard mast are certainly also important, this dataset favors beech. It should also be noted that the current condition and wildlife use of mapped mast production areas is not known, as they are not periodically monitored. Furthermore, Beech Bark Disease, an invasive fungus that has been reducing the health of beech in recent years, has been altering the productivity of some mast stands.

Mast Production Areas: Planning Considerations

Because the wildlife that use mast stands also rely on the surrounding forest areas, mast stand information is best used to elevate the importance of the habitat blocks that encompasses them. Any strategy used to limit fragmentation or otherwise protect or maintain these large forest blocks can then be used, such as those listed in Map 3, Layer #3.

Once that has been accomplished, you might consider:

Conservation Goal	Conservation Strategies	
	Nonregulatory strategies	*Regulatory Strategies*
Seek additional information	Conduct field inventories and improve maps.	***Improving inventory information is necessary before implementing any of the**

		regulatory strategies below. State-level information does not provide enough spatial accuracy for these actions.
Protect habitat blocks that include mast stands.	***See Map 3, Layer #3.***	
Protect mast stands.	Encourage residents to conserve their land through conservation easements.	Establish or improve a Wildlife Habitat Overlay District.
	Connect landowners with educational resources, such as landowner habitat management guidelines or mast production area guidelines.	
	Connect landowners with incentives programs (particularly USDA) to aid with possible financial and technical assistance.	Establish development design standards that cluster development away from resources.
	Encourage residents to enroll their land in Current Use, using Ecologically Significant Treatment Areas (ESTAs) in appropriate locations.	Require buffers around mast stands.

Additional information about using these tools is available in *Community Strategies for Vermont's Forests and Wildlife*. You can also learn more about mast stands and associated conservation goals in *Conserving Vermont's Natural Heritage*.

Inventory Layer #6: Habitat Blocks, by State Priority

What are Habitat Blocks?

We first introduced habitat blocks in Map 3, and the same data are used again here. Habitat blocks are areas of at least 20 acres with no roads or low densities of class III or IV roads. They contain little or no human development such as buildings, parking areas, lawns, gravel pits, active agricultural land, etc., but can be composed of any natural land cover type: various ages or stages of forest, wetland, etc., or former, inactive agricultural land.

> In Map 3, we displayed Habitat Block information by block size. This map uses the same data, categorized here through a statewide ranking system.

Habitat Blocks (by State Priority): Significance

Prioritizing habitat blocks is one way to capture the functional role that each block plays within its region. This layer allows us to evaluate habitat blocks not only as groups of trees but for their contributions as core habitat for diverse species, connected landscapes for wildlife requiring movement or migration routes, or enhancement of other natural processes.

Habitat Blocks (by State Priority): Map Interpretation

In Map 3, habitat blocks were displayed by size. However, there isn't a minimum size block that is considered critical as important wildlife habitat. While size is certainly an important factor and can sometimes be the best factor for determining priority, other features can be important, too.

> While there are many possible strategies for conserving habitat blocks, the Town of Enosburg addresses habitat block fragmentation through their zoning. Find their story at http://vtconservation.com/success/node/5.

For example, a habitat block that is well-connected to other habitat blocks through wildlife road crossing areas, stream corridors, or other means is more likely to be used by wildlife than one isolated from other blocks. A habitat block containing a variety of habitat components—wetlands, ridgelines, a high density of lakes or streams, or a mix of forest types, for example—is also likely to contain higher biodiversity than a block that contains primarily uniform habitat. The same is true for a block with a lower density of Class IV roads compared with a block containing many of these low-traffic roads.

> To learn more about how habitat blocks information was generated, you can find the original report from Vermont Fish & Wildlife Department and Vermont Land Trust online at http://www.vtfishandwildlife.com/UserFiles/Servers/Server_73079/File/Conserve/Vermont_Habitat_Blocks_and_Habitat_Connectivity.pdf. The full report is entitled *Vermont Habitat Blocks and Habitat Connectivity: An analysis using Geographic Information Systems.*

The prioritization depicted on Map 6 also considers the regional context. A 100-acre habitat block located in Vermont's heavily-fragmented Champlain Valley may play a much more ecologically important role than a 100-acre block in the Northeast Kingdom, where larger blocks are prevalent. While Champlain Valley forest blocks are smaller, they also include greater species diversity due to a low elevation and variety of habitat types. The configuration of the habitat is also important. An area that is highly irregular in shape—containing a high amount of edge—may be less functional for some species than habitat of the same acreage with a regular shape.

Habitat Blocks (by State Priority): Planning Considerations

When considering conservation measures for habitat blocks, refer to list found in the *Habitat Blocks* description in Map 3. In general, appropriate conservation measures avoid fragmenting these blocks and maintain connections between them. The added benefit of the information on this map is that it provides a sense of priority. A block labeled as a higher priority on this map indicates that biologists have recognized the block as playing a significant role in maintaining the regional ecosystem. In your conservation planning, consider focusing efforts on higher priority blocks.

Additional (Locally-Specific) Inventory Layers

In specific locations across the state, we have included additional datasets representing important wildlife habitat. While these datasets are each relevant only to particular regions of Vermont, the habitat is considered important regionally. Clayplain Fragments and Indiana Bat Hibernacula are both important in the Champlain Valley, but absent from other regions of the state. While comprehensive Amphibian and Reptile Road Crossing information *could* be relevant in most

Vermont towns, inventories have been conducted only in a few select areas, so this information, too, has been placed here.

Clayplain Fragments

Clayplain forest is a unique natural community that occurs on the clay soils of the Champlain Valley. It is dominated by oaks and hickories, and prior to European-American settlement, it was the dominant forest type in the Champlain Valley. Aided by a climate somewhat milder than in much of the state, these fertile but poorly-drained soils once grew more species of native plant than any other New England forest type. In addition to the oaks and hickories that dominate the natural community are maple, ash, elm, beech, basswood, white pine, and hemlock. Shrubs and other plants proliferate, including several that are found *only* in this type of forest. Similar diversity is found not only in plants, but in all forms of wildlife—amphibians, birds, mammals, reptiles, and insects. Because the deep, rich, soils and flat topography provided ideal agricultural lands, most clayplain forests were cleared and are now quite rare. Remaining remnants are scattered, and most are no bigger than 20 or 30 acres.

Even these small fragments represent important landscape diversity, but they alone are unable to support the variety of wildlife once found in the Champlain Valley. Larger species and those that maintain large home ranges are now rarely seen in this habitat type, and they are unlikely to return unless clayplain fragments are connected together and/or incorporated into larger blocks of forest habitat.

Amphibian and Reptile Crossing Areas

In Map 5, we described vernal pools and their importance for amphibians. Streams, rivers, lakes, ponds, and wetlands provide habitat for a host of other amphibian and reptile species.

But for many reptiles and amphibians, conserving these aquatic habitats alone isn't enough, because the animals' habitat needs change at different times of the year. Vernal pools, for example, are used only in the breeding season and for the safe development of eggs and larvae. The adult frogs and salamanders turn to other forest habitats for year-round needs. They need two different habitat types, *and* a safe travel route between them.

Consider the spotted salamander. Throughout most of its adult life, a spotted salamander lives a solitary life in woodlands, generally in hardwoods or mixed forests where it burrows into loose soil and under moist leaf litter. But each year, spotted salamanders emerge from their woodland homes and head en masse to their closest breeding spot—generally a vernal pool, but sometimes a pond or wetland. For this species, 95% of the movement occurred within 600 feet of the vernal pool (Faccio 2003)

Even where a vernal pool is surrounded by forest or other natural habitat, this journey can be hazardous for an amphibian due to predation, weather-related events, or other dangers. For vernal pools and other breeding grounds located near roads,

> In several Vermont communities, amphibian crossing areas provide opportunities for community education and science to come together. Salisbury has documented one example here: http://vtconservation.com/success/content/amphibian-road-crossing-morgan-road-salisbury-vermont

the journey can be particularly risky, in many cases putting populations at risk of extirpation (Gibbs and Shriver 2005).

This dataset displays known and suspected locations where reptiles and amphibians cross roads in order to move between year-round and breeding habitats. There are certainly omissions from this dataset; there has been no statewide survey to map all the locations important for breeding reptiles and amphibians. Locations are mapped as potential road crossing areas when first reported, confirmed when field data have demonstrated that numerous individuals of at least one species cross roads each year to reach breeding habitat.

Indiana Bat Hibernacula and Summer Habitat (Online Only)

Listed as a federally endangered species, Indiana bats have been on the decline across the United States. Because these bats live in different habitat types in summer and winter, conservation of the species requires protection of both summer and winter habitat. Summer colonies can be found in trees, rock ledges, and occasionally buildings, but the preferred habitat is trees with loose bark, such as shagbark hickory or older trees with sloughing bark. These trees must also have accessible habitat nearby for finding food, generally including a relatively open stand below a main canopy. Forest edges, connected forest patches, lakes, streams, and wetlands are all important habitat as well.

For more information on important bat habitat, see page 92 of Conserving Vermont's Natural Heritage.

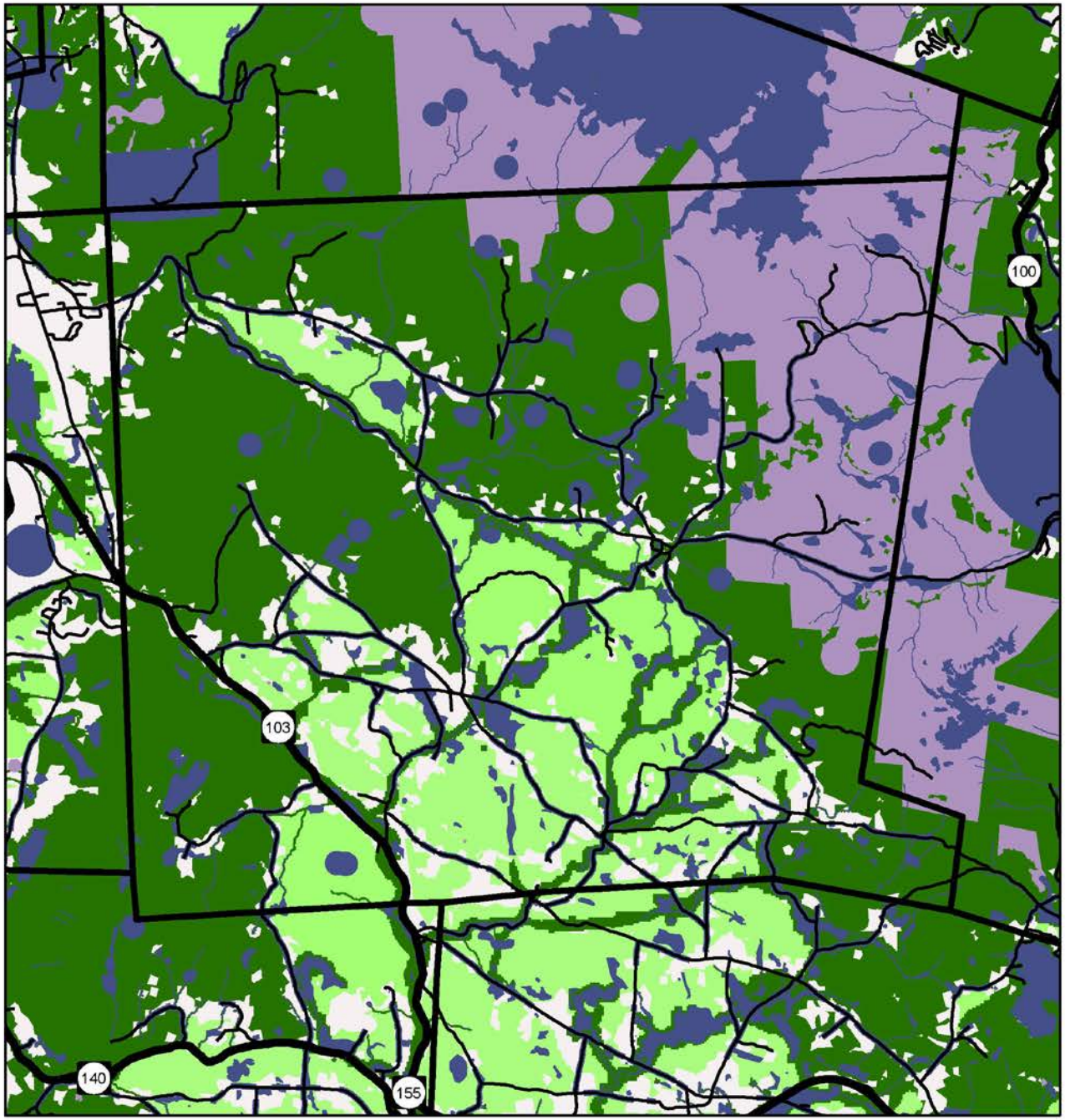
In winter, the bats migrate to a place providing a constant temperature and protection from weather and predators, often in a cave or mine. Bats may migrate from great distances to hibernate at these sites, as they are rare on the landscape.

Like Vermont's other five hibernating bats, Indiana bats are susceptible to White-nose Syndrome, a disease that was discovered in the northeastern US in 2006 and has caused drastic population declines to a species with already-low populations.

These map layers—appearing online on BioFinder only—highlight the towns in which Indiana Bats are known to occur. The map treats summer and winter habitats separately; the towns in which bats hibernate in winter are often different than those with summer habitat for maternal colonies. Because the Indiana bat is an endangered species, the map shows only very general areas—towns—where the species occurs, rather than individual caves or trees used by the animal, to protect these areas from over-visitation or abuse. However, many of these specific spots are known, and interested town officials can contact Vermont Fish & Wildlife Department for additional information.

For any of the above locally-specific layers, you might consider the following conservation strategies. Additional information about any of these tools can be found in *Community Strategies for Vermont's Forests and Wildlife.*

Conservation Goal	Conservation Strategies	
	Nonregulatory strategies	*Regulatory Strategies*
Seek additional information	Conduct field inventories and improve maps of locally important resources.	
Protect habitat blocks that include important resources.	***See Map 3, Layer #3.***	
Protect wildlife resources.	Adopt language in the town plan, including statements about what resources are important, and policies on how they should be managed, protected, and restored.	Establish or improve a Wildlife Habitat Overlay District. [21]
	Encourage residents to conserve land with important resources through conservation easements. [22]	
	Encourage residents to enroll their land in Current Use, using Ecologically Significant Treatment Areas (ESTAs) in appropriate locations[23] or working with a forester to plan for the long-term health of the resource.	Establish development design standards that cluster development away from resources. [24]
	Provide citizen educational opportunities.	Require buffers around these resources.



Map 7: State and Regional Conservation Priorities

Shrewsbury, VT

LEGEND

- Town Boundary
- Roads
  - Primary
  - Secondary
- Highest Priority: Community & Species Scale
- Priority: Community & Species Scale
- Highest Priority: Landscape Scale
- Priority: Landscape Scale

Data Source:
Vermont Center for
Geographic Information

Vermont State Plane Projection
NAD1983 Datum
Map by Monica Przyperhart
September, 2017

0 0.5 1 2 Miles

0 0.5 1 2 Kilometers

Photo by Eric Sorenson

MAP 7. State and Regional Priorities: Vermont Conservation Design

This map broadly outlines the most important regional natural heritage priorities in your community.

Map Layers *(Described Below)*	**Base Layers**
Landscape-scale Priorities	*Roads*
Highest Priority	*Surface Water*
Priority	*Town Boundaries*
Species and Communities-scale Priorities	
Highest Priority	
Priority	

This map combines datasets found in other maps.

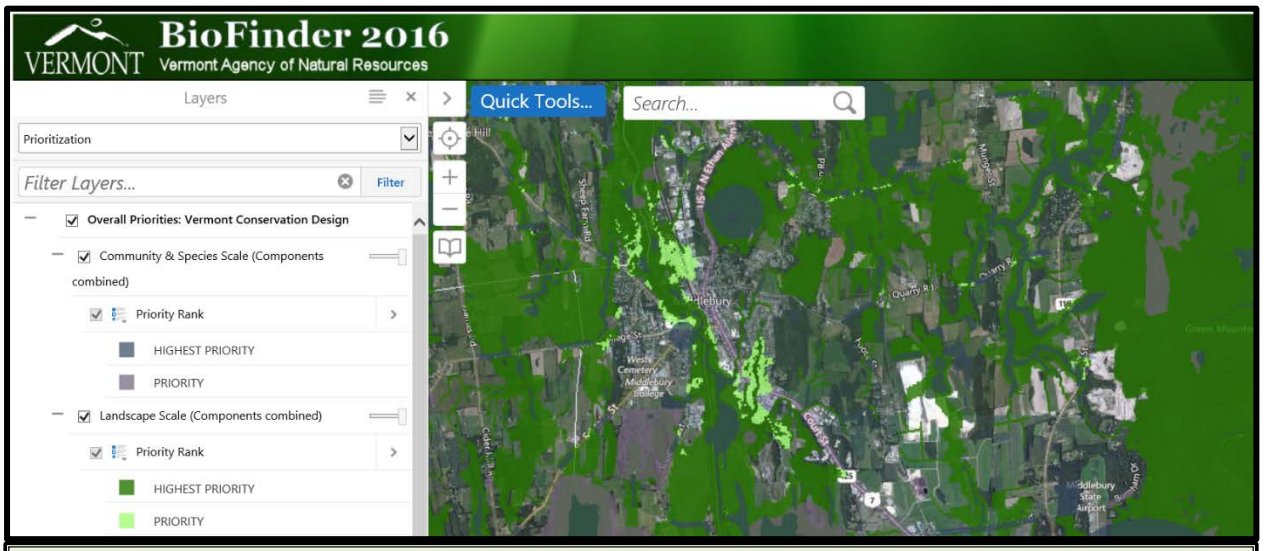
In the first six maps, we have been zooming increasingly closer to ground level, eventually identifying very specific ecological features such as deer wintering areas and rare species. Now, we'll zoom back out to see the big picture, incorporating all scales into a single map. Unlike the other maps in this guide, this map does not represent inventory information; instead, it assigns priorities to natural heritage features as we move toward action steps for conservation. A compilation of many ecosystem components, this map identifies the network of Vermont lands and waters most important for supporting ecologically functional ecosystems, natural communities, habitats, and species.

In Part II, we will get into detail about how to use this map to support planning efforts and develop conservation strategies. For now, we insert this map as a bridge between the previous maps, which ask "what's there?" and Part II of this guide, which asks "how can we move from maps and data to conservation actions?"

Map 7 on BioFinder: Prioritization
This map explores the "Prioritization" theme on BioFinder, which will be described in detail in Part II. We recommend viewing this map online, where BioFinder's interactive tools allow for a fuller understanding of the map's priority ranking system.

Vermont biologists call this map *Vermont Conservation Design*, because it looks holistically at ecological function. Instead of identifying and mapping components individually, *Vermont Conservation Design* identifies the connected network of components that create the basis for most ecological interactions. None of the data represented on this map are new; all have been introduced in previous maps. Here, datasets are combined and prioritized to provide a sense of how they work together to create an ecologically functional landscape. We introduce this concept briefly here; ecological function will be explained in detail in Part II.

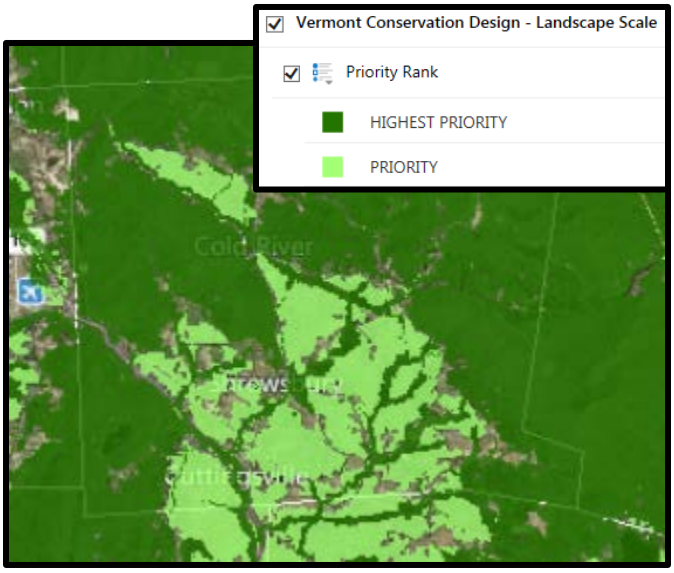
The map presents priorities at two scales. *Landscape-scale* priorities form the background of the map and represent broad ecological patterns and processes important across Vermont. We then combine the components critical to maintaining individual species and groups of species into a *Community and Species Scale* dataset. These priorities are just as important for maintaining biodiversity as the broad, landscape patterns but are much more concrete, depicted as individual occurrences rather than broad patterns.



To load Map 7 on BioFinder: *Open the "Prioritization" theme, then check the boxes next to both "Overall Priorities: Vermont Conservation Design" layers: Community & Species Scale (Components combined) and Landscape Scale (Components combined). For additional guidance on using BioFinder, please see* Getting Started *in the introduction to this guide, or "Tips and Tools" on the BioFinder website.*

Landscape Priorities

What are Landscape Priorities?



The two-toned, green background of this map depicts network of ecological priorities at the landscape scale. In a dramatic play, you can think of this map as outlining the *stage* on which most ecological interactions occur, and as such they cover 68% of Vermont's land area. Because all green areas work together as a network, all contribute significantly to overall ecological function. The dark green areas are the *most* important.

This layer combines the following datasets, described in detail below:

- Interior Forest Blocks
- Connectivity Blocks
- Riparian Wildlife Connectivity
- Surface Water and Riparian Areas
- Physical Landscape Diversity

Some of these you will recognize from the data presented in previous inventory maps. Others use the same basic data already presented, now prioritized according to particular selection criteria. All datasets have been divided into two classes: "Highest Priority" and "Priority."

Landscape Priorities: Significance

The datasets included in this map were specifically chosen because as a group, maintaining or enhancing these features is likely to conserve the majority of Vermont's species and natural communities, even as the climate changes. Put another way, these maps outline the areas of land that need to remain healthy and intact if we want to provide plants, animals, and natural resources the best chance of survival over time. On the other hand, a decline in the quality of these lands is likely to correspond to a decline in the *state's* ecological function.

Landscape Priorities: Map Interpretation

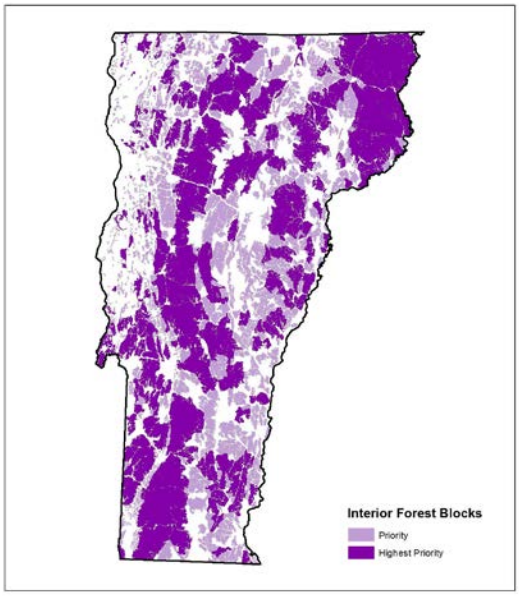
To create this map, Vermont Fish and Wildlife Department biologists assigned "priority" or "highest priority" status to interior forest blocks, connectivity blocks, riparian corridors, surface waters, and physical landscapes, taking into account the regional context in which each component was found. In other words, a smaller interior forest block in the Champlain Valley may qualify as "highest priority," because large forest blocks are less common in the Champlain Valley than in the Green Mountains or Northeast Kingdom. In these areas, large blocks are more plentiful, and an interior forest block of the same size may *not* be considered "highest priority."

Each data layer was considered within the context of its own region. To learn more about how priorities were assigned for each component layer, visit the BioFinder website.

Because a fully functional landscape includes *all* of the components mapped, the map displayed amasses *all* priority areas on *any* of the layers. Lands mapped on any component map as "highest priority" are given "highest priority" status on the compilation. Land mapped as "priority" is likewise assigned "priority" status, unless covered by another component's "highest priority" ranking. While the printed map shows only the compilation, you can see which individual components are "priority" or "highest priority" on BioFinder.

The datasets include:

Interior Forest Blocks



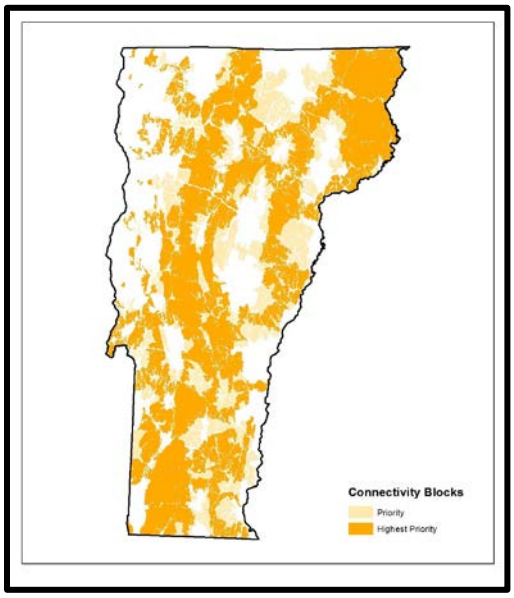
This is a subset of the Habitat Blocks layer that we described in Maps 3 and 6. This selection includes those blocks that are most important for maintaining interior forest, separated into "highest priority" and "priority" status.

Interior forests are those large enough to support the highest diversity of ecological processes, such as predator-prey interactions and natural disturbance regimes. They help to maintain air and water quality, and they promote flood resilience. They support numerous plant and animal species, including some that occur only in these large forest blocks, away from edges or development. Interior forest is also essential for wide-ranging mammals, which need sufficient habitat to support their daily and seasonal needs.

"Highest Priority" was assigned to the largest or highest quality habitat blocks within each Vermont biophysical region. This means that smaller habitat blocks were included in the Champlain Valley where large forests are relatively scarce than in the Green Mountains or Northeast Kingdom. Highest priority represents the best remaining interior forest examples within a regional context. "Priority" includes all other blocks that were assessed to be large enough or of high enough quality to perform the functions of interior forest.

Connectivity Blocks

Landscape connectivity is the degree to which blocks of suitable habitat are connected to each other (Noss and Cooperrider 1994). While *Interior Forest Blocks* generally provide the majority of suitable habitat at the landscape scale, *Connectivity Blocks* include both these large blocks *and* the necessary smaller blocks that together create a linked network. The proximity of one forest block to another is the major criterion for determining connectivity, but the presence of riparian areas and the character of intervening roads, agricultural lands, or development are also important.



Together, this network enables wide-ranging animals to move across their range, allows animals to find suitable habitat for their daily and annual life needs, provides the habitat in which young animals can disperse, provides plant and animal species places to colonize new and appropriate habitat as climate and land uses change, and contributes to ecological processes, especially genetic exchange between populations.

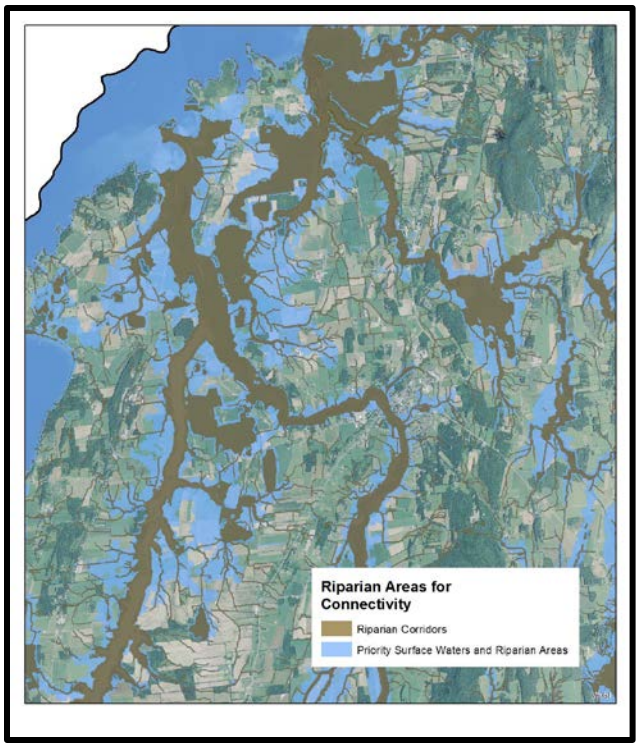
Like *Interior Forest Blocks* above, this information is a subset of the *Habitat Blocks* layers presented in Maps 3 and 6, and *Connectivity Blocks* have similarly been divided into "Highest priority" and "Priority" groups. While Interior Forest Blocks don't necessarily connect, "highest priority" Connectivity Blocks create a terrestrial network of forests that link all biophysical regions within the state. This incorporates the spines of the state's major mountain ranges, connections to unfragmented habitat outside Vermont, and interior forest blocks within fragmented biophysical regions that contain abundant rare species and significant natural communities. Small forest blocks are included as "highest priority" areas at pinch-points in the network that are critical for the continuation of the network. "Priority" areas provide a supporting buffer around the highest priority backbone and add alternative pathways for connectivity.

Riparian Wildlife Connectivity

This data matches the layer of the same name presented in Map 3. On Map 7, the entire layer is considered "highest priority," due to the high diversity of species that use these areas. To reiterate, riparian wildlife connectivity refers to the connected network of riparian areas in which natural vegetation occurs, providing natural cover for wildlife movement and plant migration. This network extends state-wide and beyond. The combination of Riparian Areas for Connectivity and Connectivity Blocks provide the best available paths for linking wildlife habitat across the landscape, especially in highly fragmented areas of Vermont.

Surface Water and Riparian Areas

This information covers the same geographic area as the data called "Surface Waters and Riparian Areas" presented in Map 5. Here, however, the layers have been prioritized into "Highest Priority" and "Priority." "Highest Priority" was given to all waterways themselves, including lakes, ponds, rivers, streams, and the valley bottoms in which they occur. The "highest priority" area also includes a buffer around each water body occurring on undeveloped land, with larger buffers for larger water bodies. "Priority" status was given to those riparian areas occurring in developed areas, even those for which some natural processes are currently limited in function. They are included here to be considered for conservation efforts or management that enhances ecosystem function.



There is substantial overlap between the areas covered by this layer and by "Riparian Wildlife Connectivity." When used together, this layer appears as a buffer around the riparian corridors, outlining the habitats and land area needed to support those critical connections.

Physical Landscape Diversity

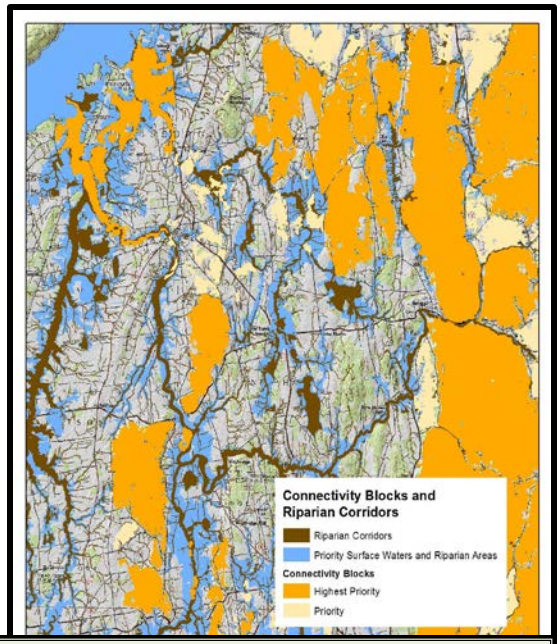
These data are the same as in the layer of the same name presented in Map 4. On Map 7, the entire layer is considered "highest priority." When viewing this map in BioFinder, you can determine whether a feature is rare, representative, or responsibility in addition to identifying the physical nature of the feature. To reiterate, these are the parts of the landscape that resist change—the hills and valleys, the underlying bedrock, and the deposits left behind by glaciers. While all are mapped as "highest priority" on these maps, a biologist may be able to provide additional information about how to incorporate physical landscape diversity into other priorities.

Landscape Priorities: Planning Considerations

Part II of this guide offers a detailed, step by step process for prioritizing natural resources information and bringing it into your planning framework. Here is a quick summary of some of the most important planning considerations:

- **Interior Forest Blocks:** Avoid fragmentation. Limited development on the margins of large forest blocks may not have significant adverse effects if it does not reduce connectivity between blocks and does not encroach on the block's interior. Forest management that maintains age structure is compatible with maintaining interior forest conditions.

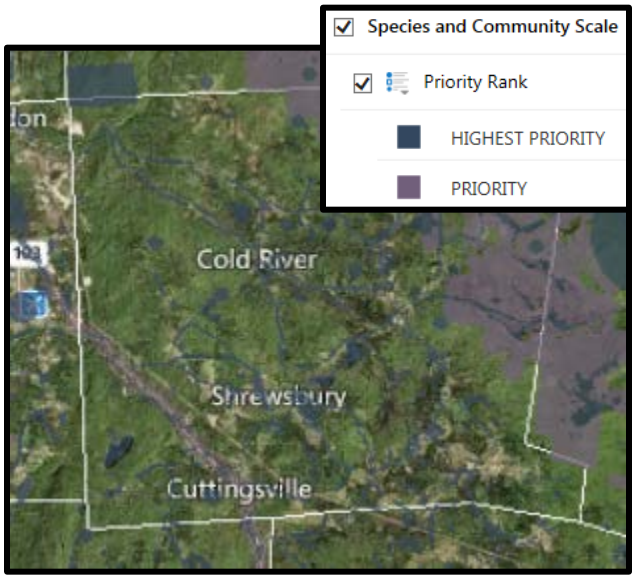
- **Connectivity Blocks:** Avoid fragmentation. Maintain forest cover and limit development along the margins where blocks border one another, to allow for movement of plants and animals throughout the network.
- **Riparian Wildlife Connectivity:** Maintain a naturally vegetated area around the waterway. This may vary from 50 feet on each side of small streams to 300 feet on each side or larger rivers. Consider restoration of areas that are currently impacted.
- **Surface Water and Riparian Areas:** Maintain or restore natural vegetation in an area wide enough to maintain water quality, stabilize shorelines, provide shade, and maintain connectivity.
- **Physical Landscape Diversity:** Where possible, maintain or restore natural vegetation and limit development on rare and responsibility physical landscapes. Forest management is compatible, so long as forest structure is maintained. Rare, responsibility, and representative physical landscapes can also be used as a prioritization tool to strengthen the importance of other features.



Landscape Connectivity: The Big Picture
To capture the complete regional network of connected lands, you can view Connectivity Blocks, Riparian Connectivity, and Wildlife Road Crossings together. To see local networks, you may also want to include Interior Forest Blocks.

Community and Species Priorities

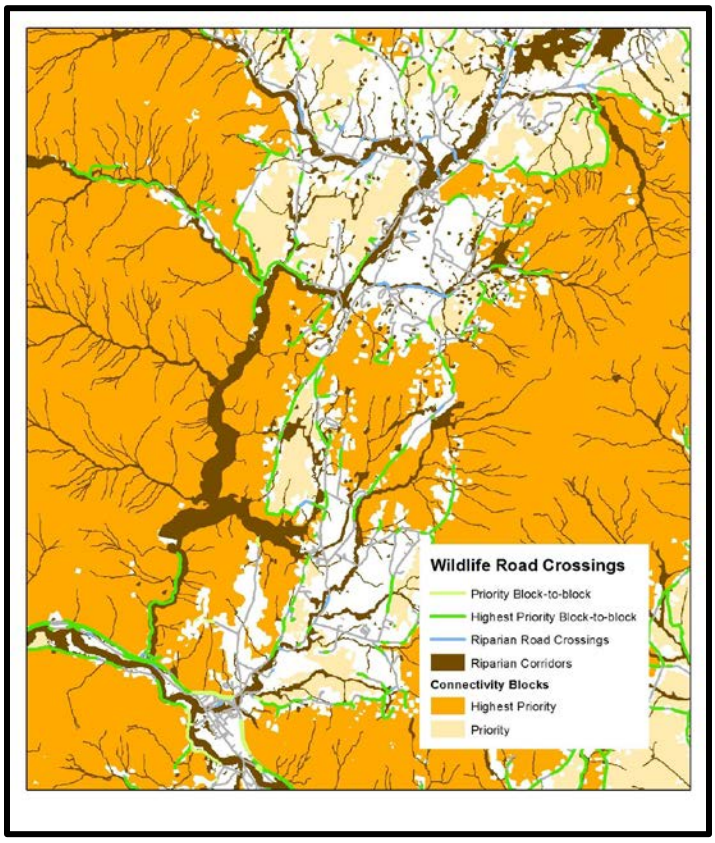
What are Community and Species Priorities?



In the foreground of Map 7—in two shades of purple—are areas representing specific features on the landscape rather than the broad ecological patterns depicted in green. These are what we call *Species and Community Scale Priorities*, and they are the lands and waters critical for maintaining individual species or groups of species identified as having a conservation need. In examining the areas highlighted, you may recognize outlines from Maps 3, 5 and 6; all data displayed here were also presented on one of those maps. Here, data have been prioritized, allowing a viewer to identify features as "priority" or "highest priority" according to a state ranking system.

The datasets prioritized here include:

- Wildlife Crossings
- Representative Lakes
- Exemplary Surface Waters
- Vernal Pools
- Wetlands
- Rare Species
- Uncommon Species
- Rare Natural Communities
- Uncommon Natural Communities
- Common (Representative) Natural Communities
- Grasslands and Shrublands
- Mast Stands



Just like with landscape-scale priorities, these data have been divided between "Highest Priority" and "Priority."

Species and Community Priorities: Significance

The datasets included in this map are considered highly important for maintaining state and regional biodiversity. Of course, you may have information on other local important features—critical bat habitat, clayplain forest, turtle habitat, etc.—and many such

datasets also contribute to local biodiversity. Included here are components that constitute priorities throughout the state. This list and the locations covered are a terrific place to start; you can then add local data if it is available.

Species and Community Priorities: Map Interpretation

To create this map, Vermont Fish and Wildlife Department biologists assigned "priority" or "highest priority" status to wildlife crossings, surface waters, vernal pools, wetlands, rare and uncommon species, significant natural communities, grasslands, shrublands, and mast stands. In assigning this status, they took into account the regional context in which the element was found, meaning that an uncommon natural community of the same size and condition may have been treated differently in the Champlain Valley and the Northeast Kingdom. To learn more about how priorities were assigned for each component layer, visit the BioFinder website.

As you interact with this map, please remember that all data were collected for use at the state level. Some of these layers contain omissions, and these omissions may be critical when translating data into implementation measures. Wherever possible, the collection of field inventory information will enhance a community's understanding of these resources.

Species and Community Priorities: Planning Considerations

Please see planning considerations presented alongside individual datasets in Maps 3-6. In general, priorities at the species and community scales are no more or less important than those at the landscape scale, but they tend to be smaller, take up less space, and are therefore more vulnerable. Resources mapped as priorities at this scale are often incompatible with development or intensive land use.

Across Vermont, many communities have already identified areas as ecologically important, and they may differ in terminology or coverage than those put forth in this guide. In most communities, it will be worth comparing your maps to these, but it will likely make sense to build on what you have rather than to start over. If you would like assistance determining next steps, Vermont Fish & Wildlife Department's Community Wildlife Program may be able to help you.

Advanced Natural Resources Inventory

While we hope that your community has found useful information in the seven maps provided, we also recognize that every town in Vermont has a different set of values *and* a different landscape. Maps 1-7 have been created at the *state* level, and they feature data available across the state. On your local landscape, there may be additional components that contribute to the ecological story—the habitat of a species of interest, perhaps, or cultural features. Also, many of the datasets available across the state were created through the interpretation of aerial photos or other remote means. They have not been checked in the field, and some datasets omit important features.

As a community, you may want to think carefully about what information will most help *you* with your efforts, and then make sure the data you use are accurate to an appropriate scale. If you are most interested in landscape-scale conservation regarding forest fragmentation, habitat connectivity and climate resilience, for example, the data provided in this guide are likely sufficient, and an inventory is unlikely to reveal anything appreciably different. However, if your goals involve individual species or natural communities, it may well be worthwhile to invest in an inventory. The information provided on state-level maps of grasslands and shrublands, the functional extent of riparian areas, vernal pools, deer wintering areas, rare and uncommon species, wildlife road crossings, and mast stands are not comprehensive. A local inventory is much more likely to add to your understanding of these components. When determining implementation measures, we suggest that you begin at the landscape level and then learn more about these finer-scaled features.

That said, many communities could benefit from local inventory data. Collecting these data *does* generally come with a price tag, however, since it involves on-the-ground fieldwork and advanced computer analysis. While some field data can be gathered by volunteers with minimal professional guidance, other information is best collected by (or under the close supervision of) a natural resources professional. Towns may therefore want to start by prioritizing what additional information is needed. Even if it takes several years to collect the new information, it is generally a worthwhile effort; the reward is better planning for the future.

A Local Inventory:
Where do you begin?

Each town has a unique set of needs and desires, but one of the biggest "bangs for your buck" may come from identifying natural communities across your town. This can be used to identify many components of wildlife habitat and other landscape features.

Natural Community: an interacting assemblage of plants and animals, their physical environment, and the natural processes that affect them. For example, the most common natural community type in Vermont is the Northern Hardwood Forest.

The following is a list of ideas (by no means exhaustive) of projects a town might undertake to get a better sense of what resources are present. A detailed inventory could include:

- Natural community mapping
- Water quality studies
- Wetland mapping
- Significant wildlife habitat assessment
- Agricultural lands assessment
- Managed forest lands inventory
- Undeveloped shorelines inventory
- Cultural features inventory (e.g. archaeological and historic sites, recreation areas, scenic areas, designated scenic roads)
- Unique geological resources mapping

Starting with Citizen Science

As you decide what data you need, it may be appropriate to use local, regional, or even national citizen science efforts to inform your planning. For example, the Vermont Center for Ecostudies maintains a Vermont Atlas of Life, in which citizens contribute sightings of birds (e-bird), butterflies (e-butterfly), and any species (inaturalist) to three separate map databases. Some towns conduct *bioblitzes* or other projects to recruit scientists and citizens to gather information about local biodiversity.

However, using citizen science data to inform the town planning or regulatory process needs to be done carefully. Often, several years of data are needed to ensure accuracy, and all data and methodologies should be reviewed by a professional before inclusion.

In addition to the above, consider field-checking the map information from the Inventory Maps of this guide, considering questions such as: Do the streams in your town have fully-functioning riparian areas? Which road crossing areas are most commonly used by wildlife? Are there current threats facing these important wildlife road crossing areas?

As you undertake your inventory, remember that while some landscape elements are not static, a map can depict only a snapshot in time. Development of a

new building site may change the size of a habitat block, and land use and land cover of a given location change routinely due not only to human alterations but also because of natural succession as forests grow up and mature over time. In addition to seeking updates on BioFinder, inventories that you undertake in your community may also benefit from routine repetition. In some cases, the success of a planning goal even *necessitates* a map update! For example, if you implement strategies to restore or enhance riparian habitat, success may require that you update your riparian habitat map on a routine basis. Each map can then become a tool that helps you track progress.

Ultimately, it will be up to your town to decide which information is most important to *you*. It is by combining your knowledge of the local natural resources with your town's own goals and interests that you will be able to create a natural resource plan that you are able to successfully implement within your community.

Part II. Prioritization and Implementation

Photo by Chief Joseph

Prioritization and Implementation

At this point, you are equipped with valuable information about the natural heritage components present in your town. You have explored BioFinder, and you may have followed links to learn about tools you can use to implement your planning efforts. Hopefully, you are now more confident in your knowledge of local natural resources.

However, you are likely left with questions. Of the habitats present, what's most important? When implementing conservation measures, where should your community start? How do you prioritize? In short, what can you do *with the inventory information presented in Part I?*

Part II of this guide is intended to help your community answer such questions, going from "what's here?" to choosing appropriate implementation strategies. Just as in Part I, our approach to prioritization will focus on the use of maps. Unlike in Part I, we will go beyond ecological features to involve your human community—your most important asset in conservation planning. While we begin with the identification of ecological priorities, the process described in Part II is designed to look holistically at the needs of your town, placing ecological priorities into the context of other human values. It is by looking at this bigger picture that your planning group will be able to choose conservation strategies that are embraced by the community and will effectively protect special places.

The following pages sketch out six steps for using maps to identify ecological priorities and determine implementation strategies. These seven steps are divided into three sections:

Determining the Ecological Context
Step 1. Locate priorities at the landscape scale.
Step 2. Locate priorities at the species and community scale.
Step 3. Identify the components.
Including Community Values
Step 4. Identify areas of high public value.
Developing and Choosing Options
Step 5. Evaluate existing protections.
Step 6. Establish a range of options.
Step 7. Evaluate options and choose strategies.

While this process can be followed entirely using the hard copy of this guide and the associated maps of your town, use of the interactive BioFinder maps online is recommended. Part I took you through the "Inventory" section of BioFinder; now Part II will make use of the

"Prioritization" theme. Please see Getting the Most Out of the Maps *in the introduction to this guide for more information.*

We'll begin by identifying locations necessary for maintaining ecological function. With these in mind, we'll add values of the community before finally determining implementation strategies. By the end of this process, you should have a better sense of:

1. *Which locations are ecologically most important to include in conservation efforts,*
2. *How ecological priorities compare with community values, and*
3. *How to move from identifying priorities to taking action toward conservation.*

Good luck!

Determining the Ecological Context

While the maps in Part I of this guide highlight many ecologically important features, it can be difficult to determine just what to *do* with that knowledge. Chances are that a good percentage of your town's land area is covered by one feature or another, and protecting all areas highlighted by all inventory maps simply isn't feasible. As a planner, do you focus on habitat for wide-ranging species, or clean water? Vernal pools, or rare physical landscapes? Clearly, all are ecologically important, but their relative importance can't be compared. They are important for different reasons.

Luckily, there are methods of prioritizing that don't rely on choosing one component *instead of* another. Rather than focusing on individual landscape *elements* as we did in Part I, we will now help you identify priority *locations*. In other words, our approach in this section asks, "Which *locations* in your town are most ecologically essential? In which areas would a substantial change in land use most impact the region's *ecological function*?

This concept of ecological function requires a holistic view. Instead of isolating components *from* one another, an ecologically functional landscape requires that features *work together* and processes are maintained. Safe wildlife road crossings are important only if high-quality habitat remains on either side of the road. A wetland or lake loses value if the stream flowing into it is impaired. When choosing conservation strategies, we must remember that protecting a vernal pool while ignoring the surrounding habitat defeats the purpose, just as impact to one section of river may affect water quality downstream, regardless of conservation measures implemented there.

To identify the locations most important for ecological function, we examine the ecological setting at two scales: the *landscape scale* and the *species and community scale*.

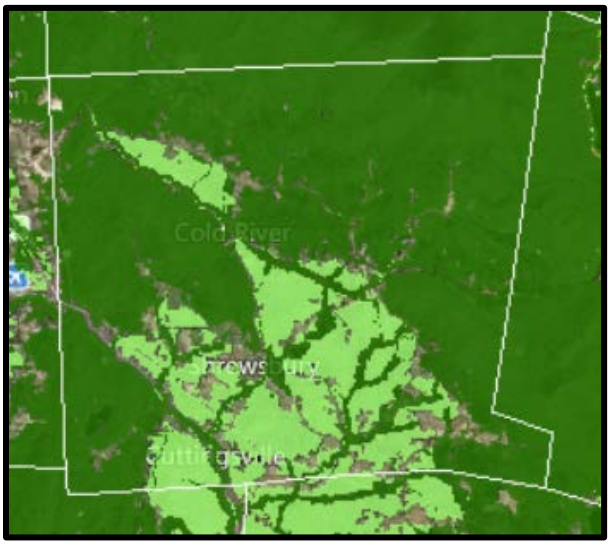
Landscape scale priorities include forest networks, waterways and their floodplains, and significant physical landforms. They include the locations with the highest biodiversity *and* the areas that connect and protect these locations to provide resilience. They outline the habitat used by most Vermont species and allow for movement as the climate changes. While they cover substantial acreage in many Vermont towns, priorities at this scale focus on *pattern*, and they are generally compatible as working lands and with recreational activities. They can therefore be managed to accommodate many values of a community. Step 1 outlines these locations.

Step 2 zooms in to identify priorities at the species and community scale. These priorities are also important for maintaining biodiversity, but they tend to be smaller and more specific to a handful of species, so they can be overlooked at the landscape scale. These include the locations where rare plants and animals have been found, wetlands, or habitats like vernal pools or forests rich in wildlife food resources. At this closer scale, human activities are much more likely to interfere with function, and these locations should be handled with greater caution.

It is in Step 3 that the inventory maps of Part I will be used in your planning efforts. Once you have identified priority locations in steps 1 and 2, you can look back at individual components to determine which are present in high-priority locations. Eventually, it is these components that will guide you toward particular conservation strategies.

Step 1: Locate Landscape Priorities

Let's start with the big stuff: the forest networks, the waterways, and the physical landforms that support them. These are the building blocks for nearly all ecological processes. By outlining these, we can effectively paint a picture of the locations most needed to maintain ecological function.



To the right, the map you see is the two-tone backdrop to Map 7. You can also find it in BioFinder, where you can identify which components constitute highlighted areas. This map shows a network of the most important components included in the following datasets, categorized into "highest priority" and "priority" areas:

- Interior Forest Blocks
- Physical Landscape Diversity
- Connectivity Blocks
- Riparian Wildlife Connectivity

- Surface Waters and Riparian Areas

Instead of looking at each component individually, we use Step 1 to examine them en masse, identifying the *network* of lands and waters necessary to maintain Vermont's ecological function. By doing this, we can divide locations into three classes: highest priority, priority, and those that don't contribute significantly to the network. Together, this network encompasses the majority of Vermont species and habitats and provides resilience for a changing climate.

In many towns, landscape priorities cover broad acreage. Mapped for their ecological importance, these lands also constitute much of Vermont's working and rural landscape. While large-scale development or intensive human land use can diminish the ecological value of these areas, many human activities and land uses can be compatible, including thoughtful forest management, many forms of recreation, and even some carefully placed development. Generally speaking, strategies seeking to avoid fragmentation and encourage working forests are compatible solutions.

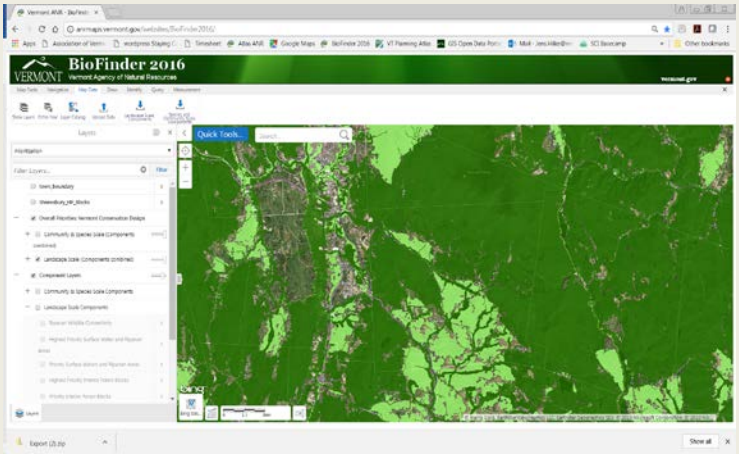
Using BioFinder in Step 1

1. Open the BioFinder map. Make sure the *Prioritization* theme is selected.

2. Double click on your area of interest to zoom in, and continue this process until you can see the entire area at the closest range possible.

3. Make sure that the box next to "Overall Priorities: Vermont Conservation Design" is checked, and also the box next to "Landscape Scale (Components combined). Highest Priority locations will appear in dark green, and Priority locations will appear in light green. Those areas on which you can still see the background aerial photo lack priority and highest priority known ecological components.

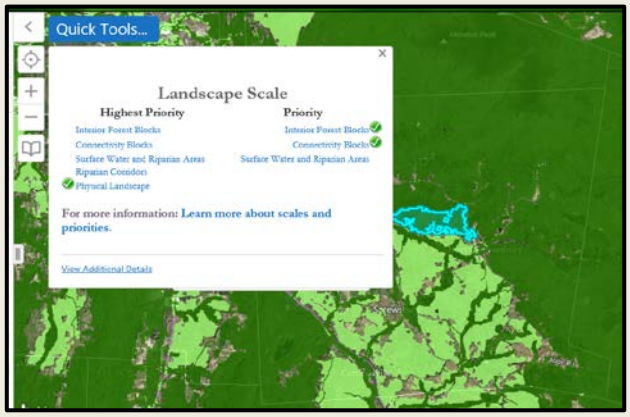
4. To see only the landscape scale priorities, click in any additional checked boxes to turn them "off."



When prioritizing for conservation, consider focusing your strongest efforts on the areas mapped as "highest priority" on this map. "Priority" lands can be considered next, and those not mapped as either may be—ecologically—the best locations to focus development efforts. However, we won't get too involved in this now; we'll collect and evaluate possible implementation strategies in Step 5. To learn more about the data and scientific process that went into creating this layer, see Map 7.

Using BioFinder in Step 1 (continued)

BioFinder has a simple tool to help identify which components are most important at any chosen location within the network. With the map open on your screen, point your cursor at a location of interest. Click once on that location and an Identification Box will pop up.



This box provides information about all map layers that are turned on and mapped in your chosen location. When *Landscape Scale* priorities are turned on, all possible components are listed, with a check indicating presence.

From this box, you can learn more about each component by clicking on the component name. A separate tab will open in your browser with a document describing the component, its ecological importance, and information about how the component was mapped.

Step 2: Locate Community and Species Priorities

Now, let's zoom in. While landscape priorities give us the network in which *most* ecological interactions occur, some species or habitats are so small or have such specialized needs that they are worth protecting where they occur, even if they are not located within the landscape network. In Step 2, we add those habitats important to species and communities

Defining Scale

The "Community Scale" refers to the scale at which assemblages of plants and animals interact with one another, with their physical environment, and with the natural processes that commonly affect them. For example, a wetland would be included at this scale due to its association with particular physical features, plants, and wildlife that function together as a community.

The "Species Scale" includes those habitats necessary for the survival of specific fish, wildlife, and plants. For example, wildlife crossings are locations where wide-ranging mammal species such as bear, bobcat, and fisher are likely to cross roads as they travel to meet their daily or seasonal dietary needs, disperse to find mates, or fulfill other requirements. While small in size relative to community or landscape scale features such as wetlands or forest blocks, these locations are essential for maintaining biodiversity across the state or region.

of conservation concern in Vermont. While often small in area, these locations are equally important for maintaining regional biodiversity and healthy fish and wildlife populations. For example, wildlife crossings are locations where wide-ranging mammal species such as bear, bobcat, and fisher are most likely to traverse roads as they travel to meet daily or seasonal dietary needs or disperse to find mates. If these crossing areas do not remain available, some populations may not persist even where other habitat needs are present.

You can identify these locations, as mapped by Vermont biologists at the state level, using Map 7 or in BioFinder, where components have been categorized as "Highest Priority" or "Priority." This information is displayed on the printed maps atop the areas identified in Step 1.

The areas mapped at this scale include the following:

- Wildlife Road Crossings
- Vernal Pools
- Wetlands
- Grasslands and Shrublands
- Mast Stands
- Rare Species
- Uncommon Species
- Rare Natural Communities
- Uncommon Natural Communities
- Common Natural Communities[1]

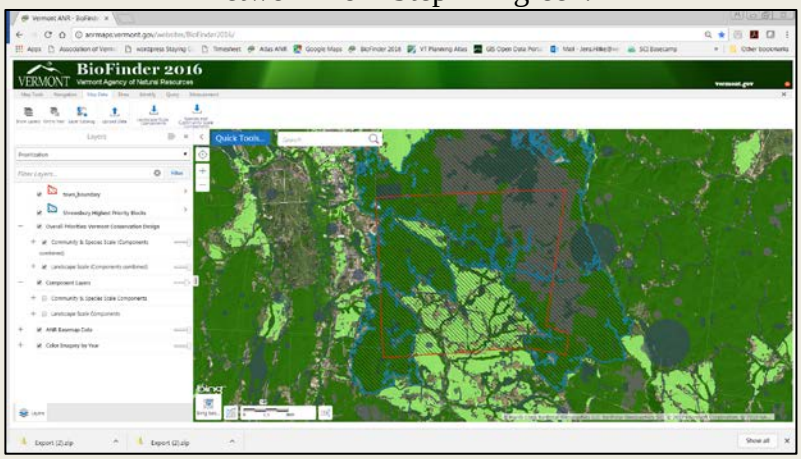
As mentioned in Part I of this guide, these datasets represent *what we know* is present, but there are certainly omissions. For example, we have not inventoried every parcel in the state for every rare species.

As you examine the locations of resources on this map, pay special attention to where they fall in relation to the landscape scale network in Step 1. When Community and Species priorities are located within larger blocks of forest or water, they can be used to elevate the priority ranking of that larger block. Many strategies for conserving the larger blocks will then benefit the Community and Species priorities, too. We'll go into detail on choosing possible strategies in Step 6.

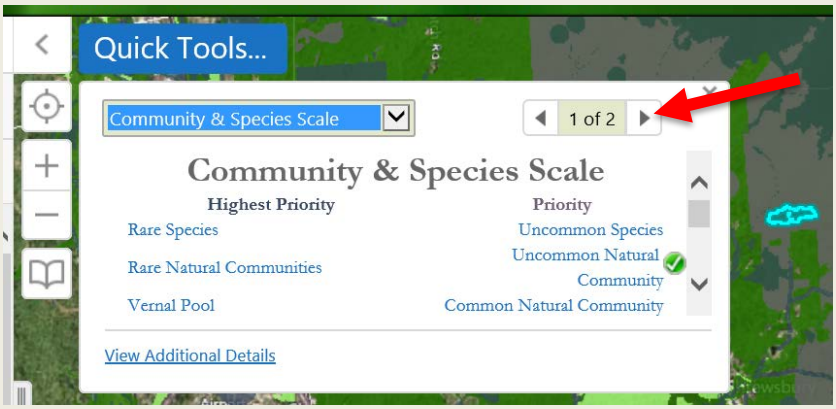
Where Community and Species priorities are located *outside* the network identified in Step 1, your community may want to consider separate conservation strategies. Because Community and Species priorities generally encompass much smaller acreage, they are often more vulnerable. For some, a seemingly minor change in land use could wipe out an entire patch of habitat—a vernal pool, for example, or a mast stand. And although the components themselves may cover little acreage, the *processes* altered by a single loss may change food webs, impact disease regimes, or alter migration or dispersal patterns across the ecosystem. Where Community and Species scale priorities fall outside Step 1 priorities, they are therefore generally places to consider focusing more direct conservation measures, due to their sensitivity.

Using BioFinder in Step 2

After conducting Step 1, click in the box next to "Community & Species Scale (Components combined)." Priorities at this scale will appear in blue and purple, on top of the landscape network from Step 1 in green.



Once again, click on a point of interest to learn more. When more than one layer is turned on and found in the selected area, the Identification Box creates a separate "page" of results for each layer. In the example below, two layers are present, indicated by the "1 of 2" symbol in the top, right corner of the box. Click on the arrows to move between pages of results.



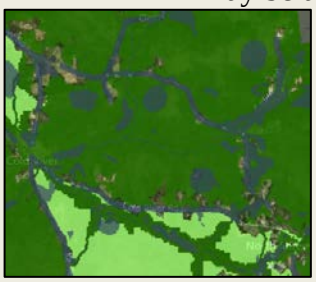
Using Local Inventory Data in Step 2

If you have local inventory data, Step 2 is the place to include it. Regardless of the scope of your inventory, we recommend first identifying landscape-scale networks (Step 1), and then using local information to fill in gaps or to evaluate how well Step 1 includes important local features.

With the help of a natural resources professional, your inventory information can be combined with state-level Communities & Species scale data to provide a clear picture of priority local resources.

Using BioFinder in Step 2 (continued)

Now, examine where priorities at the two scales overlap. When Community & Species scale features fall within the "highest priority" landscape network (in dark green, such as in the image below, on the left,), conservation of the landscape network in this location is likely to conserve the important species and habitats within it, and additional conservation measures may be unnecessary.



Where Community & Species Scale features fall within a "priority" (light green) landscape block (as in the image above, on the right), you may want to consider elevating the importance of the entire block to consider it a "highest priority" area.

Where Community & Species scale features fall outside the network mapped in Step 1 (pictured below), you may want to consider conservation measures that specifically target these resources when you get to Step 6.

Step 3: Identify the Components

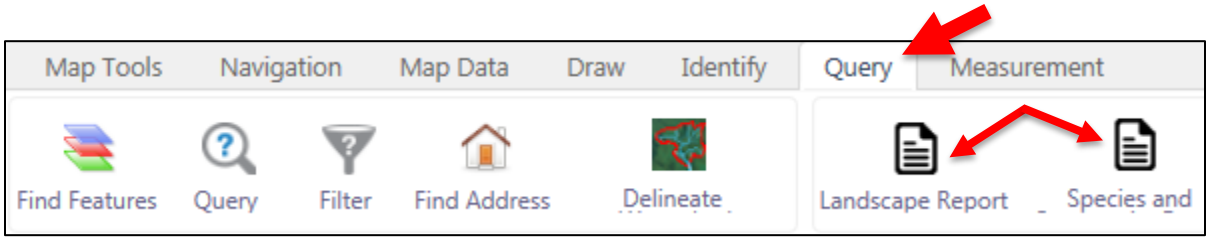
In Steps 1 and 2, the primary goal was to identify *locations* of ecological priority within the municipal planning area. Before identifying appropriate conservation strategies, it's now time to determine which resources are present in each important area. We can then use these resources to create a map of ecological priorities that will be more helpful for municipal planning. This is important because conservation strategies are not universally appropriate for all resources. Both riparian areas and mast stands may constitute priority locations, but we wouldn't generally conserve them using the same methods.

To identify components, have BioFinder and/or Part I of this guide handy. If you are comfortable using online technology, using BioFinder for this step is recommended.

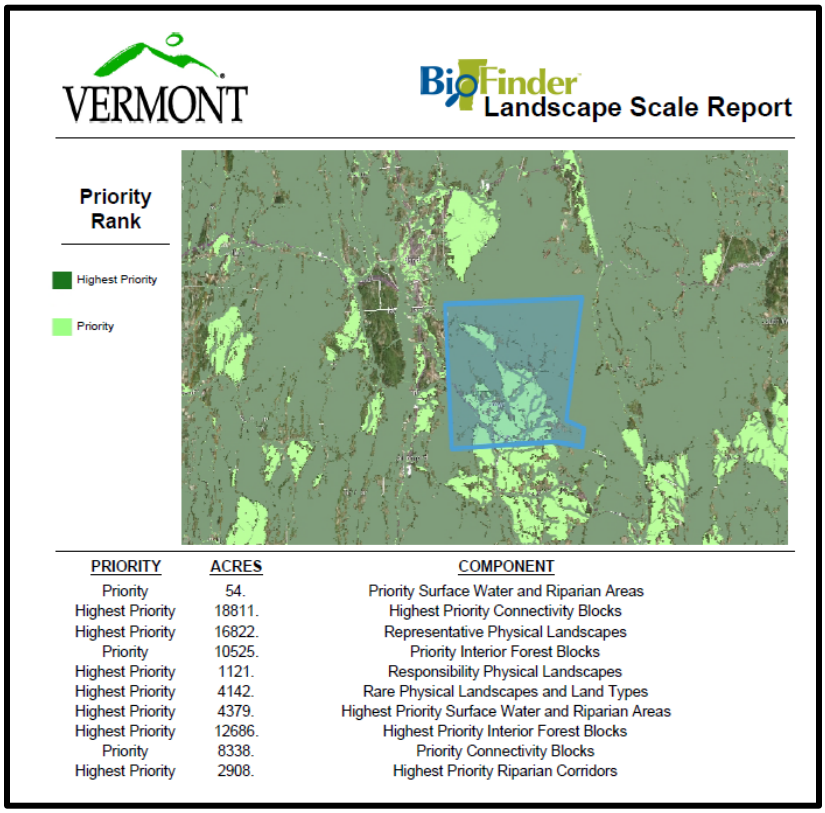
Start with landscape priorities, as seen in Step 1. Using BioFinder or by flipping back and forth between the maps in Part 1, which components are most prevalent in the "highest priority" network? Interior forest blocks? Surface water? Important physical landscapes? Does adding "priority" areas contribute additional components? Make a list or chart. Then repeat the process with community and species priorites.

To help you with this process, BioFinder can generate reports quantifying all the components present in a defined area, such as a town.

To access these reports, open the toolbox by clicking the  symbol in the top, right-hand corner. Open the "Query" tab, where you can select either a "Landscape Report" or a "Species and Communities Report."



In generating a report, you will be given an option to either draw an outline of your area of interest or upload a shapefile. If you already have a digitized map layer that outlines your area of interest (a shapefile), this is the easier option. However, you can also use your cursor to click around the edges of your target area until you have captured the entire area, double-clicking to finish the shape.



PRIORITY	ACRES	COMPONENT
Priority	54.	Priority Surface Water and Riparian Areas
Highest Priority	18811.	Highest Priority Connectivity Blocks
Highest Priority	16822.	Representative Physical Landscapes
Priority	10525.	Priority Interior Forest Blocks
Highest Priority	1121.	Responsibility Physical Landscapes
Highest Priority	4142.	Rare Physical Landscapes and Land Types
Highest Priority	4379.	Highest Priority Surface Water and Riparian Areas
Highest Priority	12686.	Highest Priority Interior Forest Blocks
Priority	8338.	Priority Connectivity Blocks
Highest Priority	2908.	Highest Priority Riparian Corridors

You can choose to see the report as a pdf or an excel file. In either case, the report lists all components present in the area outlined, the level of priority, and the acreage covered by each.

In some cases, the acreage covered by different components can give you a sense of where to focus your efforts. For example, if you have substantial acreage in Connectivity Blocks, you may want to spend some effort thinking of the best ways to avoid fragmentation of and between these blocks. However, there are some components for which acreage is an inappropriate measure of priority. For example, vernal pools are almost never large, and yet they remain an important contributor to biodiversity. Reports can therefore be extremely helpful in simply providing a list of components to look at when considering conservation strategies. Limited attention should be placed on the acreage covered by each, particularly on the Species & Communities Report.

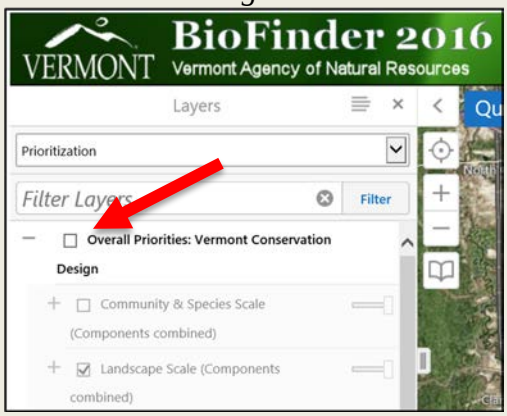
You may find that dividing priority components into broad categories will make your list easier to use. For example, the landscape network in most Vermont towns can be divided into *forests* and *waters*. Outside these forests and waters, there may be a few isolated resources located in small patches of forest, agricultural fields, or residential areas. Dividing the landscape into categories may make it easier when identifying conservation strategies in Step 6; a town may use one set of strategies within forest areas, another in waterways, and a third to conserve isolated ecological features.

Once you have created your list of components, review them to be sure you understand what they are and their implications for land use, using Part I of this guide, *Conserving Vermont's Natural Heritage*, or other sources. Take extra care to understand those features that came up multiple times on your lists or cover large expanses within your community.

Using BioFinder in Step 3

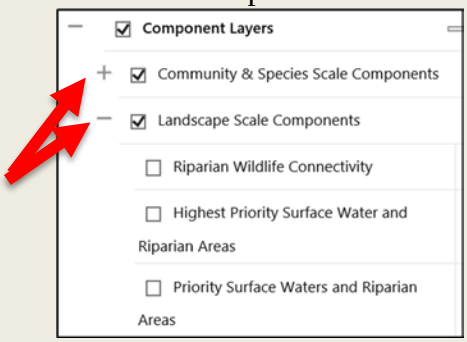
To see components individually:

1. Un-check the box next to *Overall Priorities: Vermont Conservation Design* to turn it off.



2. Check the boxes next to *Community & Species Scale Components* and/or *Landscape Scale Components*, under *Component Layers*, to turn them on. Be sure the *Component Layers* box is also checked.

3. Click the "+" next to each category to display a list of individual components that can be turned on or off.



4. Explore!

Rare and Uncommon Species Mapping
As you identify important components, you will find that many rare and uncommon species are mapped by a round circle. This circle is not an accurate representation of the land covered by the species; it is merely a dot surrounding the approximate location in which the species was found. When considering conservation strategies, identifying the *habitat* in which the species occurs will have more merit.

Once you fully understand the suite of components at play in your community, it is time to create a map of ecological priorities. For many communities, these maps can be based directly on the state priorities maps, or by incorporating local data into state maps. For some communities, however, it will be important to first refine priorities. For example, the land in some communities is mapped almost entirely as "highest priority" at the landscape scale. In this case, it is important to recognize the crucial role your local lands and waters play in maintaining *Vermont's* ecological function. However, this information is unlikely to help you in prioritizing local conservation or planning efforts. Other towns contain few or no "highest priority" features. In either case, there are some locations in your community that play a more critical ecological role than others.

In these cases, one way to further prioritize is to place a higher priority on locations with many overlapping components. You can think of these as *hotspots*—places in which many important ecological components co-occur. Wetlands are important. Interior forests are important. Rare physical features are important. Locations in which *all* of these important components are present may have even higher ecological value than those with just one component. If you find that the basic prioritization of Steps 1 and 2 did not provide you with as much variation as you would like, you can place the *highest* priority on these hotspots of overlap. They can also be terrific starting places around which to focus efforts or rally community support.

Priorities:
Lands and waters with many functions
Many highest priority areas are important not only ecologically but also for forestry, recreation, scenery, rural enterprises, and many other human uses. When mapping landscape scale priorities, keep in mind that conservation of these areas can include diverse strategies, both non-regulatory and regulatory, and can often support these human land uses in addition to ecological values. We'll discuss these strategies in Step 6. Some towns may find it appropriate to include high percentages of their land area in these highest priority areas, but conserve them with a low regulatory standard or a non-regulatory strategy.

If you choose to re-prioritize, it is important to remember that this step focuses only on *ecological* prioritization. Human values will be incorporated in Steps 4 and 5. For some communities, it may tempting to eliminate some areas from the priorities map based on a value judgment of what is most important. We encourage you to resist this temptation, ensuring that your determination of which features to include is based on a scientific process.

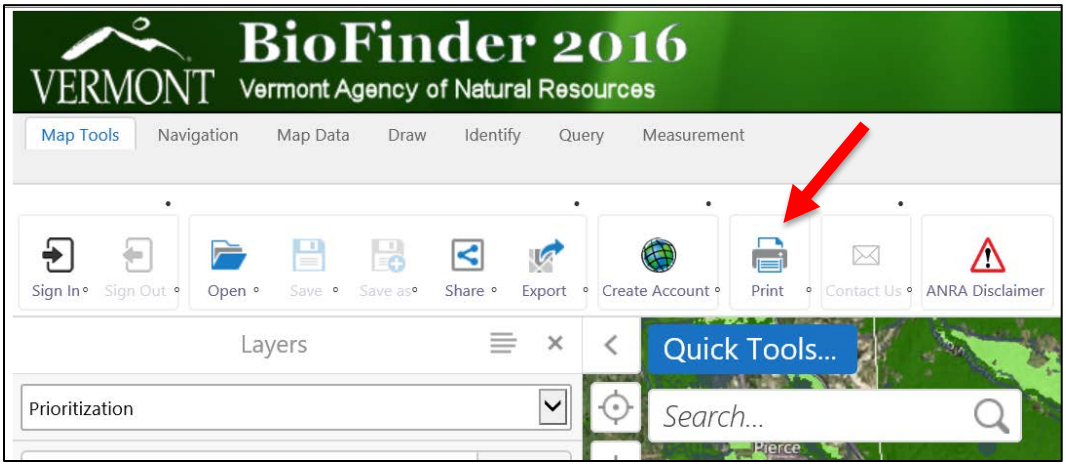
Before completing Step 3, you should have a map that outlines the ecological priorities within your community.

At this point, it is time to involve your community as you decide how to move forward.

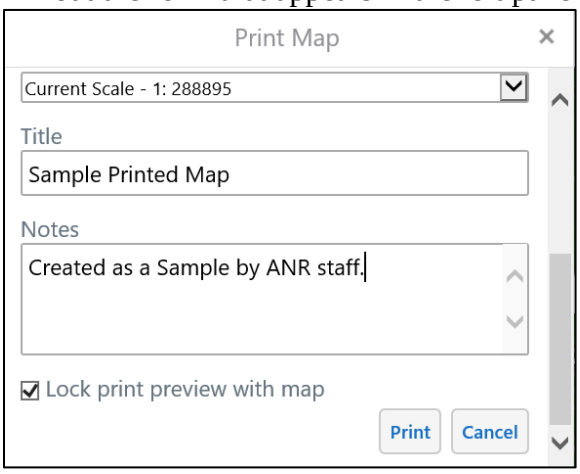
Need Help?
The Community Wildlife Program at Vermont Fish and Wildlife Department may be available to provide technical assistance to your community as you undertake this process. Please visit http://www.vtfishandwildlife.com/cms/one.aspx?pageId=132648 for more information.

Using BioFinder to Print a Map

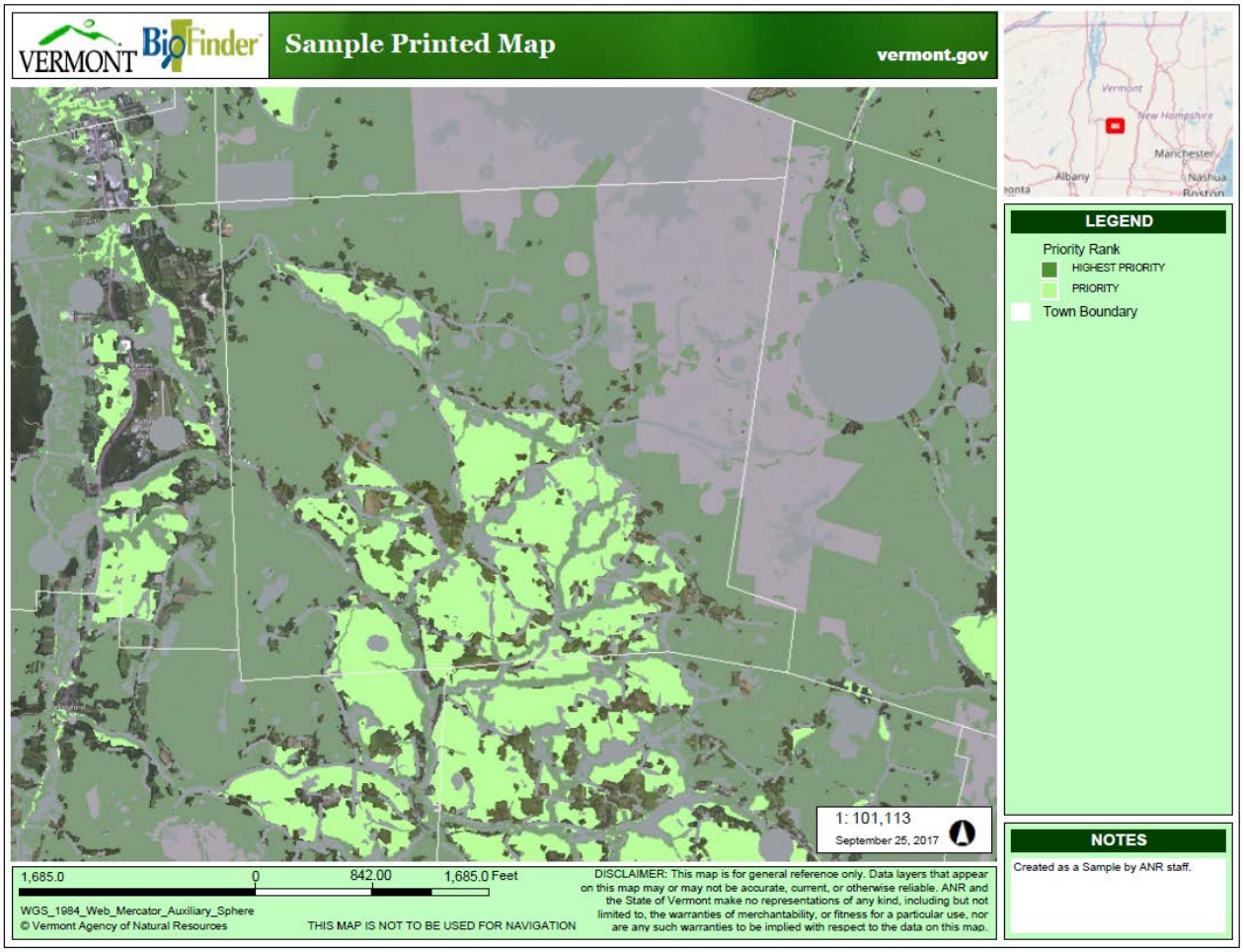
1. Open the *Map Tools* tab, inside the Toolbox.
2. Select "Print."



3. Fill out the form that appears in the left panel. Click "Print."



4. Your map will be generated, and a link will be provided.



Additional Mapping Options

BioFinder includes many additional tools that can help you select your own priorities and create your own maps. See links for tips and tutorials from the BioFinder Home Page, or seek technical assistance from Vermont Fish & Wildlife Department's *Community Wildlife Program* to learn more.

Including Community Values

Determining the Ecological Context
Step 1. Locate priorities at the landscape scale.
Step 2. Locate priorities at the community and species scale.
Step 3. Identify the components.
Including Community Values
Step 4. Locate areas of high community value.
Step 5. Compare ecological and community values.
Developing and Choosing Options
Step 6. Evaluate status and determine options.
Step 7. Evaluate and choose options.

For many communities, the biggest challenge to protecting natural resources is finding consensus among citizens. As mentioned in the introduction to this guide, most Vermonters support the protection of the state's wildlife and other natural resources; discrepancies are more often about the *methods* for achieving this vision rather than the vision itself. If measures to protect our natural heritage are to be successful, it is therefore crucial to involve the community throughout the planning process, listening to and understanding the values and concerns of citizens while also ensuring that the community understands the resources and implementation measures discussed.

In natural resources planning, disagreement about methods sometimes stems from a feeling that citizens must choose between supporting natural resources *or* other values, such as economic development, transportation, or maintaining a working landscape. As you begin your natural resources planning process, it is important to emphasize that much of the time, this is not actually a choice that needs to be made. Protection of important ecological resources can often be done while supporting other values, and sometimes conservation can even *enhance* these other values. When addressed together, wildlife habitat, working forests, recreation, and scenic beauty can be complimentary values occurring within the same geographic area. Keeping in mind the information you collected in Steps 1-3, the goal of this section is to provide you with ideas for incorporating the values and goals of citizens into your natural resources planning efforts. *Then* you can design strategies that reflect both the ecological realities of the landscape *and* your community's values.

In your planning, we suggest involving your community—and in particular any landowners who might be impacted by the information you are collecting—as much as possible *throughout* the process. As you learn about local natural resources, make the information easily available and encourage residents to join in your meetings. Ask for residents' opinions frequently, and be sure to integrate their feedback into your work.

Community involvement, which usually includes education, is an essential piece of this. Natural Resources planning efforts are less likely to be successful if a community does not fully understand where the ecological risks and benefits are—and more importantly, why it matters to them and the place they call home. However, public participation needs to be about more than just education; equally important is a process by which citizens can share ideas, needs, and opinions with one another and provide input into planning efforts. While the best tools for instigating communication may vary from one community to the next, you might consider:

- Surveys
- Interviews
- Coffee talks
- Suggestion boards in public places
- Community values mapping (described below)
- Conversations, however formal or informal (including online forums)

Combining Science and Community Involvement

The *Community Heart and Soul Guide*, by the Orton Family Foundation, outlines an approach to planning that includes the community in the entire process. Their approach is designed for use in small or rural communities and may work well in many Vermont towns. When combined with real, scientific data in your planning process, this approach can be a powerful tool for natural resources planning. The guide is available as a free download at http://www.orton.org/heart-soul.

The Vermont Agency of Natural Resources offers an educational course that blends the approach of *Community Heart and Soul* with sound science. Learn more about the course, entitled *Caring for Natural Resources—Taking Action in Your Community*, through Vermont Fish & Wildlife Department's Community Wildlife Program.

You'll need to decide on the best strategy or strategies for your community. Remember that some individuals may be more directly impacted by your decisions than others. Engagement with the entire community is important; we recommend specifically directing outreach to landowners affected by any proposed conservation or regulatory changes.

In some cases, there may even be opportunities for community involvement in natural resource inventories or other data collection efforts, and there are success stories of this throughout the state. For example, the Salisbury Conservation Commission developed a volunteer program to map wildlife road crossings. In some cases, citizens can join established volunteer efforts to learn more about their local landscape, such as Vermont's Vernal Pool Mapping Project[2]. Whatever the technique, think creatively about ways to involve your community prior to asking for their vote on a regulatory implementation measure. As you involve them, also learn about *their* values, remembering that participation is about *engagement*. What does your community care

about? Ecological conservation efforts generally work only when they are supported alongside diverse community values. No matter what your goals may be for your area's natural resources, it is worth spending the effort to get to know your community.

Step 4: Identify Areas of High Community Value

Whatever your method for assessing your community's values, the next step is to compare your ecological priority maps with the values of your community. This will be easiest if you can capture the values of your community *geographically*, identifying where values are located on a map. Because there is no precise method for delineating the boundaries of a human value, these mapping efforts are not intended to be exact representations. By their very nature, they can show only rough estimates of human value. Even so, visualizing community values—however vaguely—can be an important filter when conducting natural resources planning efforts.

Mapping Community Values

While you could try to place results of surveys, interviews, suggestion boards, or conversations onto a map, Community Values Mapping is a tool that has been used by numerous towns across Vermont to geographically capture the places most valued by local citizens. While some alterations may be necessary to best match the needs of your community, the basic procedure is as follows:

First, organizers invite community members to a

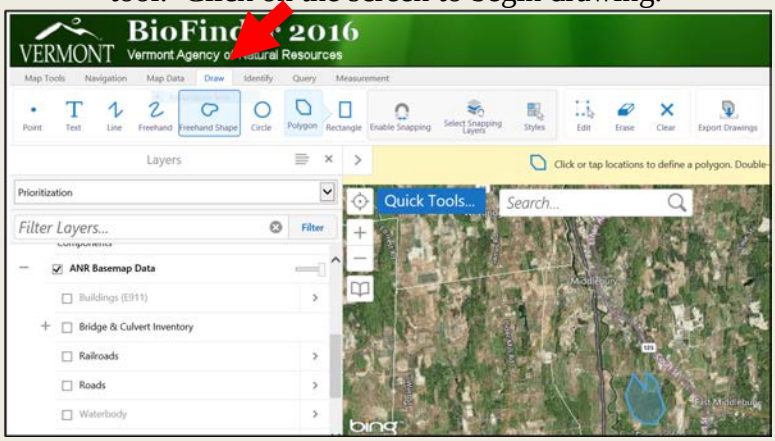
Using BioFinder in Step 4

While BioFinder is intended for mapping ecological resources, the program has tools that allow users to draw their own map layers, which you may want to use in Step 4.

For example, if you document locations of community value on paper maps, you can use BioFinder to digitize your findings.

Open BioFinder and go to the default "Prioritization" theme. Zoom to your location of interest. Turn off all layers, or use just basemap data that will help you locate landmarks.

Open the toolbar by pressing the  symbol in the top, right corner. Select the "Draw" menu, and then choose a tool. Click on the screen to begin drawing.



If you need to edit or erase errors, find those tools on the toolbar. When you are finished drawing, click "Export Drawings" to save your work. You can import your file back into BioFinder, share it with other people, or import it into a desktop mapping application.

Please note that BioFinder's drawing tools are not intended to provide precise boundaries.

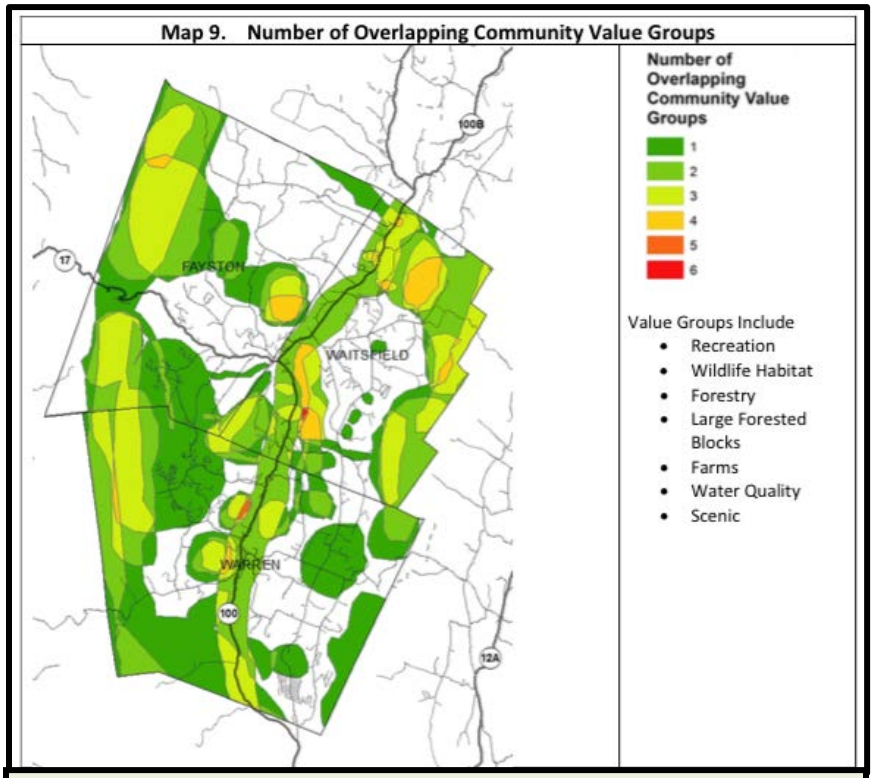
public forum and divide participants into small groups. Each group is given a map of the local area and a set of colored markers. Participants are then asked a single question: “What do you love about this place?”

Community members use markers to outline *locations* of personal value on the maps. Within each group, participants are asked to categorize and color-code the values they map. Categories could include, for example:

- Scenic areas
- Ecologically important areas
- Economically important areas
- Working Lands (agriculture, forestry, etc.)
- Recreational places
- Hunting and Fishing
- Historic and Community Resources
- Anything else—there is no limit to the possible values included!

At the end of the activity, organizers are left with a series of maps, marked up with a community’s special places. These maps can then be digitized, one value group at a time. Once all value groups are digitized, they can be overlaid onto a single map that allows for comparisons of locations representing many values and those representing few.

This map is helpful in identifying locations of *diverse* value to a community. Areas of substantial overlap tend to be places of common ground; people love them for many different reasons. For planning purposes, you may find these to be areas of *consensus* or *opportunity*; people are likely to support efforts that maintain the present-day integrity of the place.



This map, from a Community Values Mapping session in the Mad River Valley, shows the number of community values groups identified in each location across the region.

It is worth keeping in mind that when using data from community values mapping—or any data reflecting a community’s stated values—the community doesn’t necessarily have all the information needed to make

informed decisions. For example, rare plants are unlikely to come up in community values mapping, even though biologists know how important they are for maintaining biological diversity. Even a citizen who specifically values biodiversity is unlikely to outline all local rare plant habitat during a community values mapping event. Before finalizing your priority maps, you may therefore want to consider areas in which science could further inform the community about issues that aren't already at the forefront. These maps can be useful for planning efforts, but they are just as important in determining a community's level of knowledge of their own ecological landscape. Similarly, the values of a community may change after educational efforts take place—or simply as demographics change over time.

At its core, however, this activity is about capturing a community's story. Before deciding on *actions* aimed at protecting particular places, values mapping captures both the "where? and the "why?" "*Where* are our community's special places? *Why* do we care about them? *Why* would we miss these places if they were to disappear? These questions provide the justification for *what* you end up doing.

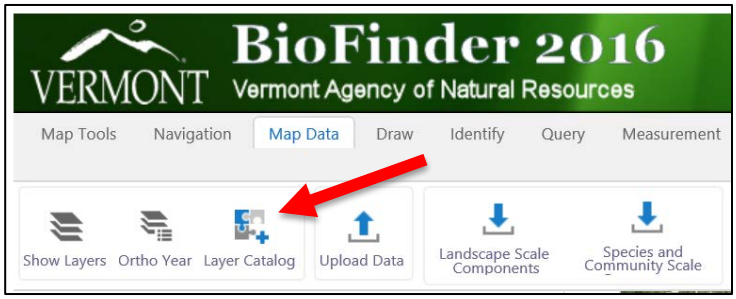
If you would like to map your community's values but don't think a public forum will be successful in your town, there is room for flexibility in the approach. For example, you could mail out a survey with a simple, attached map and ask citizens to send responses by mail. Be creative! Whatever the data collection method, mapping the values of your community can be a useful tool when it comes time to evaluate strategies, since you will have a much more secure vision of what is special to your community.

Collect Other Map Information to Represent Community Values

The method above is a technique for geographically capturing a community's values and goals, but you can also use a less direct method by identifying topics of value to citizens and then—where possible—finding maps that represent the values.

Using Existing Map Data

The Natural Resources Atlas contains numerous map layers that represent topics of interest to communities. You can also import these maps into BioFinder, using the "Layer Catalogue" tool. For example, you might look at:



- Trails
- Water quality data
- Flood hazard areas
- Agricultural soils
- Drinking and groundwater information
- Waste management information
- Erosion hazard data

This is only a small sample of the many layers that your community could examine, but these maps can be terrific filters to aid in putting community goals and values on a map using existing data.

Other Considerations

You may also want to consider mapping the following—or other values—although you won't likely find existing, state-level map data available.

- Farms
- Working Forests
- Historic Areas
- Views or Scenic Areas

Once you have collected information about the values of your community members, create a map that allows you visualize where these special places are located. While you may not be able to draw exact boundary lines for many values, capturing even a rough picture of the geographic distribution of values can be a powerful prioritization tool.

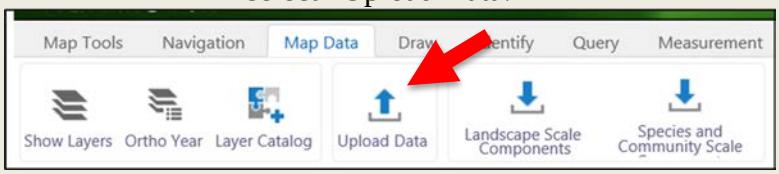
Step 5: Compare Ecological and Community Values

At this point, you have two prioritization maps: one features ecological priorities, and the other highlights the values of your community. It's time to put these together to create a single map.

A skilled cartographer can use a professional mapping program—or BioFinder or the Natural Resources Atlas—to do this digitally. However, you can create a rough approximation by drawing on a paper map of your town. Such a map can still help you decide where to place your efforts, even if you can't use it for some implementation measures.

Using BioFinder in Step 5

If you were able to digitize your maps of community values in Step 4, you can simply import them into BioFinder to compare. To import, go to the "Map Data" toolbar, and select "Upload Data."



Find your file, name it, and give it a symbol. Then turn on "Landscape Scale" and "Species and Community Scale" priorities—or upload whatever ecological priority maps your community has developed—and compare!

Start by outlining the areas of consensus, including those locations that came out as priorities on *both* ecological *and* community values maps. When later choosing implementation strategies in Steps 6 and 7, these may be the first places to focus your conservation efforts, because everyone agrees: these places are special. In these locations, protection of the area's present ecological values will likely *also* protect community values.

You can think of these areas of overlap as representing locations with potential allies—user groups that value a place for a particular reason. These reasons may be diverse: mountain biking, hunting, bird watching, walking, for scenic values, for economic potential through forestry, etc. Users may support conservation efforts, so long as the strategies used maintain ecological function *and* these other values.

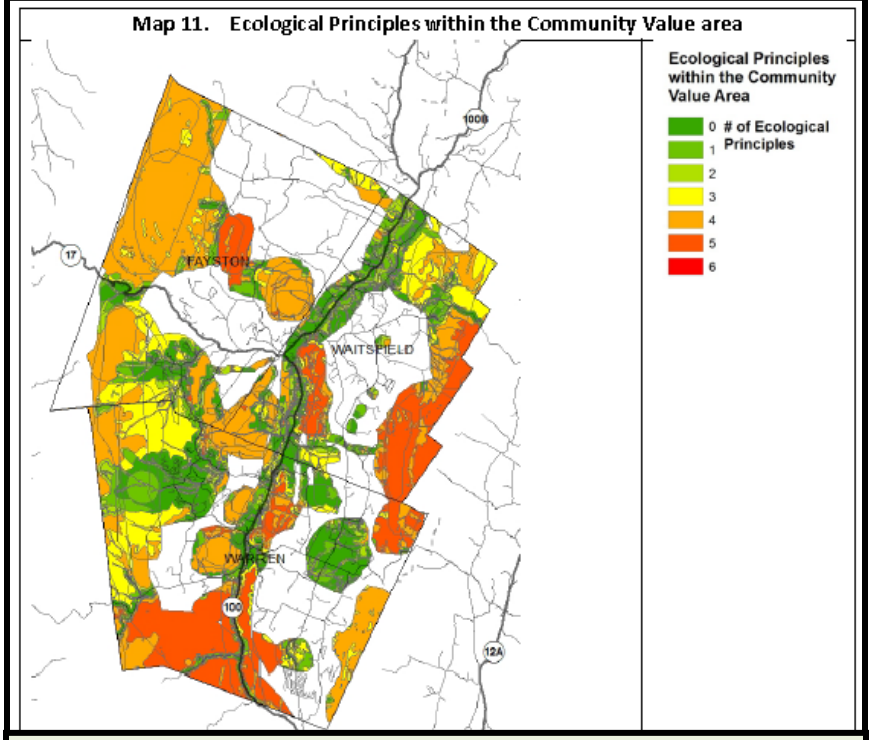
As you identify areas of overlap between your maps, think about the community values represented. Are the community values and ecological priorities compatible with one another? If so, consider involving user groups in the conservation planning process.

In some cases, overlapping values could also represent potential conflict. For example, a forest used by hunters and mountain bikers at the same time might be dangerous. Any action steps involving these lands may need to involve additional discussion or even conflict resolution, which could be as easy as awareness or a slight change in land management.

Next, outline any areas that are of high community value that *don't* appear on ecological priority maps. For these, identify the ecological components present just as we did in Step 3 and consider whether these components contribute to the place's special value to citizens. For example, if a popular bike trail is next to the water, protecting the quality of that water may enhance the resource for community enjoyment. Even if you decide to protect these community priorities through methods not based on their underlying natural resources, it is beneficial to recognize the value of these places during the planning process.

Now look at those locations identified as having priority or highest priority ecological values but that did not appear on your Community Values mapping efforts. These locations fall into several categories, so they are worth carefully examining. When high values *don't* align, it may mean that your community will have tougher choices. Measures to protect ecologically important places may be a more difficult sell in the community.

However, you may decide that some of these ecological features are still worthy of the highest level of protection. Rare species, as mentioned earlier, rarely appear on community values maps, even in communities in which citizens place high value on the protection of rare species. In many cases, these resources are so small or specific that people don't even know they exist.



On this map, community values identified within the Mad River Valley have been combined with ecological priorities. All colored areas were identified as having community values, and the map also maintains the region's ecological prioritization scheme. While the ecological prioritization method displayed is somewhat different than the one described in this guide, the method of combining community and ecological values can be the same.

You may also decide that these are places to focus education or outreach efforts before making decisions about implementation measures. In the example above, it may be that the community is unaware of the ecological feature or its important ecological function, and that education would increase the community's value of the resource.

It could also be that these locations simply aren't starting places for conservation strategies in your community, regardless of ecological importance. If this is your decision, however, remember that these locations have been highlighted as priorities in state and regional efforts to map the lands necessary to maintain ecological function. Loss of ecological function at the landscape scale doesn't occur in a vacuum; it can have direct effects on other places and ecological systems that a community does value. Also, the community may not realize how something they value (like wildlife, clean water, or the local economy) is affected if another feature (like forest blocks) are impacted.

When you complete Step 5, you should have a map that highlights the places of combined ecological and community value in your community. Like the other maps in this section, you may decide to break these locations into "highest priority" and "priority," or you can be creative and come up with another option that works for your community.

The town of Charlotte considers the following as *Areas of High Public Value*, combining ecologically important areas with locations representing other community values*:*

1. Land in active agricultural use.
2. Primary (prime & statewide) agricultural soils.
3. Steep slopes (equal to or in excess of 15%).
4. Flood hazard areas.
5. Surface waters, wetlands and associated setback and buffer areas.
6. Shoreland setback and buffer areas.
7. Special natural areas.
8. Wildlife habitat.
9. Water supply source protection areas (SPAs).
10. Historic districts, sites and structures
11. Scenic views and vistas.
12. Conserved land on adjacent parcels.

Photo by Sandy Macy

Developing and Choosing Options

Determining the Ecological Context
- *Step 1. Locate priorities at the landscape scale.*
- *Step 2. Locate priorities at the community and species scale.*
- *Step 3. Identify the components.*

Including Community Values
- *Step 4. Locate areas of high community value.*
- *Step 5. Compare ecological and community values.*

Developing and Choosing Options
- *Step 6. Evaluate status and determine options.*
- *Step 7. Evaluate and choose options.*

At this point, you should have a clear geographic idea of the locations of high value to your community, based on both ecological and community values. *Now* you can think critically about how to best strategize for the protection of some places, and perhaps the development of others, based on real data.

Because the focus of this guide is on mapping natural heritage features, the detail included in the remainder of this guide is limited. The entire implementation process is described briefly to enable planners to take the information included in Part I's inventory maps and effectively implement conservation strategies. The same process is described in detail in a course periodically offered by Vermont's Agency of Natural Resources, entitled Caring for Natural Resources—Taking Action in Your Community. *In addition, you may want to supplement this section with other resources or create your own strategies. For example, the Vermont Agency of Commerce and Community Development's Planning Manual can aid you in creating an effective municipal plan that follows state statutes. As mentioned earlier, Community Strategies for Vermont's Forests and Wildlife and Conserving Vermont's Natural Heritage may also be helpful.*

Step 6: Evaluate Status and Determine Options

Before choosing strategies, you'll need to take stock of what you have. You've identified locations of high community value. Now, look at the current protection status of these locations.

Recognizing Conservation

Do any of your priority locations occur on permanently **conserved land**? To check, compare your map of combined ecological and community values with the protected lands depicted on Map 1, the Conservation Basemap, in Part I of this guide. Remember that a conservation easement limits development but may or may not provide guidelines for management or protection of specific resources.

> ***Using BioFinder in Step 6***
>
> While you will certainly want to use more resources than just BioFinder for this step, BioFinder does have some useful datasets that might help. For example, conserved lands are located in the *Inventory* theme, under Map 1. Lands enrolled in Use Value Appraisal (Current Use) can be found in the same place.

Are there **federal, state, or regional regulations/programs** already in place that will protect the resource? If so, how do the goals of these programs line up with what your community would like to achieve? Significant wetlands, for example, are subject to the Vermont Wetlands Rules, that regulate certain uses and activities, but some towns may want to achieve somewhat different goals for local wetlands. For more information about individual ecological components, see Part I of this guide.

> ***Evaluating Your Town Plan and Bylaws***
>
> Vermont Natural Resources Council's *Resilient Communities Scorecard* will take you through a series of questions to produce a score for how well your community already protects the environment and local natural resources. Based on this score, it lists suggestions for next steps. While based on somewhat different criteria than this guide, it provides a great starting point. Try it out: http://vnrc.org/wp-content/uploads/2013/06/III.pdf.

Next, review your **town or regional plan** and **bylaws**. Do these currently offer protection for your priority resources? If so, are you satisfied with the level and type of protection offered?

For some resources, it may be helpful to check whether properties located within priority areas are enrolled in the **Use Value Appraisal Program (Current Use)**[3]. This program is one of Vermont's premiere conservation programs and enables private landowners to maintain their property in productive forest rather than subdividing and developing it, thus contributing to Vermont's forest products and working land economies as well as providing all the other benefits to the public and the environment associated with forests. County foresters with the Vermont Department of Forests, Parks and Recreation are a great source of information about this program. These lands can be seen on Map 1 of the Inventory Theme in BioFinder.

If any of your priority locations are already well protected, your planning efforts in these areas can be minimal, allowing you to focus your energy elsewhere.

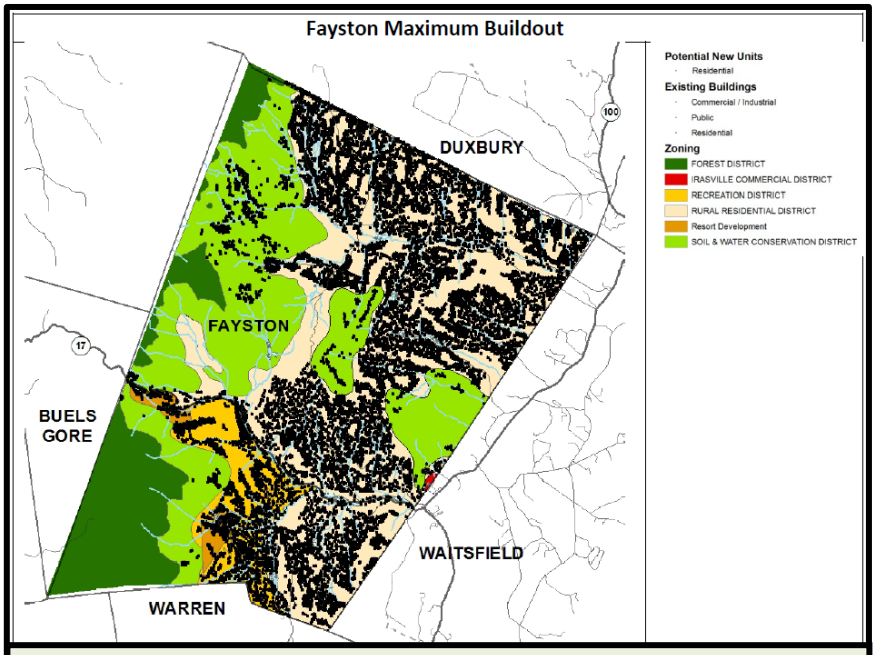
Visualizing Change

You may also find it helpful to think about the level of risk faced by priority resources. In Vermont, development generally occurs gradually. In rural areas, it may be on the scale of only

a few parcels per town per year, a pace that appears slow but that can have substantial effects over time. Of course, slow growth doesn't mean that your planning work is unimportant. Some would argue that it is precisely *because* development takes place so slowly in Vermont that every choice matters and contributes to the overall landscape we end up with.

One way to visualize future growth from routine development is to create a build-out model. This advanced computer mapping technique (which requires the aid of a skilled cartographer) is used to envision different development scenarios. A basic build-out model asks, "Based on current zoning, how many new units could be built in your town?" You can also use this method to test proposed regulations to see what the resulting maximum development would look like on a map. You can learn more about build-out models in Community Strategies for Vermont's Forests and Wildlife, on page 13.

Buildout can be used to compare the impact of different regulatory proposals. If we added a 50' buffer to all streams in town, how many fewer units could be built compared to current zoning? What about a 200' buffer? Scenarios could include anything from natural resources extraction to the development of energy structures, expansion of industrial activities to global issues like climate change.



This build-out model of Fayston is from the 2011 Communities, Forest, and Wildlife Project in the Mad River Valley. It shows a 50-year maximum buildout scenario based on current zoning.

For each scenario, evaluate (if possible) potential impacts to the areas of combined ecological and community value. What acreage could be lost to development? As you begin this discussion, keep in mind that some potential *threats* to areas of high value may be *assets* to other community or ecological goals. Where this is the case, your community may need to make tough choices between conflicting values. Regardless, recognizing the potential threat to areas of value is the first step toward making informed decisions.

The goal here is to double check your priorities. Highly-valued places with existing protections may become lower priorities for action than those places that are unprotected and face high development pressure. You may want to take some time to re-assess your priorities.

At this point, you are ready to develop strategies to protect your special places!

Brainstorm

It's now time to brainstorm action steps you *could* take to maintain the values of priority areas.

Start with the places that have now emerged as highest priority for conservation. Compare these with your list of ecological components from Step 3. Does your list of components still represent the areas of highest priority?

For each component, create a list of both regulatory and non-regulatory actions that would maintain the values of these lands and waters. To help you with this step, the chart in Appendix A matches possible conservation strategies with ecological components. Part I of this guide has additional information on each component. Of course, these charts are not comprehensive; you may have additional ideas! **At this point, consider *everything*.**

> ***The Community Planning Toolbox***
> On the Vermont Natural Resources Council website, the Community Planning Toolbox provides information about planning, implementation tools, and case studies from within Vermont.
>
> See http://vnrc.org/resources/community-planning-toolbox.

Mirroring Step 3, strategies can be divided by scale. First, consider strategies that will protect landscape scale patterns like maintaining large networks of forest habitat and waterways. Because landscape-scale components cover substantial acreage, these same lands are often used as working forests, recreational areas, scenic vistas, and for other forms human enjoyment. Therefore, the most effective strategies often consider both human and ecological values of this land.

Next, list strategies that will conserve those resources excluded from the landscape patterns above. For example, a vernal pool located in a small patch of forest may not be included in the forest network you considered above, but it remains an important resource. Such community and species-scale elements are generally more ecologically sensitive, and successful strategies often involve encouraging intensive human activities in *other* locations.

If you have not already done so, we now suggest reading through *Community Strategies for Vermont's Forests and Wildlife* for more information about tools used to protect priority natural

> Many communities have found that outdoor education and exploration are effective strategies for connecting residents to community resources. For example, the Middletown Springs Conservation Commission held monthly, family-friendly walks in their town forest to see and discuss a variety of conservation-related topics. Read more at http://success.vtconservation.com/node/19.

> *"**Conservation** means harmony between the people and the land. When the land does well by the people, and the people do well by the land; when both the land and the people end up better by reason of their partnership we have conservation."*
> *-Aldo Leopold*

resources. The Vermont Agency of Commerce and Community Development's Planning Manual[4] has information on more general planning strategies and statutes that are not specific to natural resources.

Step 7: Evaluate and Choose Options

After brainstorming possible strategies you could use to maintain the values of priority places, it is time to evaluate your list and choose those options that best match your community's needs, values, and ecological context. Most likely, you will end up choosing not a single solution but a package that works together to address identified needs—even if you take on only one strategy at a time. Below, we offer considerations as you put together this package.

> **The Importance of Communication**
> *Remember to involve your community* ***throughout*** *this process; don't wait until you have chosen a strategy to communicate your efforts with citizens!*

Addressing Needs and Realities

As you begin the evaluation process, the first step is to think carefully about exactly what each option would involve. We recommend maintaining a worksheet in which you document the following. For each potential strategy,

- How well does it protect or enhance the natural resource needs you have identified?
- How well does it support community values?
- How much effort will it take to complete?
- How much will it cost?
- Are people needed to implement the strategy? If so, are these people available?

Thinking carefully about this information will help you identify which options are realistic in your community. You also want to be sure that the options you choose do, in fact, help the ecological and/or community needs you are trying to address.

Finding Common Ground

In the previous steps, you identified first ecological priorities, then community priorities, eventually combining these into a single map of areas with high public value. As you evaluate strategies, consider options that satisfy diverse interests simultaneously. For example, strategies aimed at maintaining working forests are often effective at conserving forest wildlife habitat, too. Similarly, riparian areas are important not only for the conservation of wildlife habitat but also for water quality and flood resilience. A single conservation strategy could effectively protect multiple values.

Make a Plan

Once you have evaluated your range of options, it is time to choose those that seem most appropriate for your community and turn your decisions into a plan of action.

> **Conservation Success Stories**
> See what other towns have done! The Association of Vermont Conservation Commissions has compiled an online archive of activities completed by Vermont towns that achieve a variety of conservation-related goals. The archive details accomplishments, challenges and keys to success for each project, along with contact information for those involved. Find these stories at http://vtconservation.com/success/.

Your Action Plan could include the following:

1. **Action Steps:** What strategies do you propose implementing? Again, this probably isn't a single solution but a collection of strategies that work together to achieve your goals.
2. **Rationale:** What needs do these actions satisfy? Why did you choose this group of options over others? What community values are supported by your chosen solutions?
3. **Assign a Leader or Leadership Team:** Who will head up your efforts? The Planning Commission? The Conservation Commission? A watershed association? For each strategy, you can assign a point person and list supporters.
4. **Tasks:** Lay out the specific tasks associated with your chosen strategies.
5. **Timeline:** Identify a likely timeframe for each task *and* for the overall project. (Keep in mind that the overall project may take a *long* time—and that's okay!)
6. **Milestones:** Will there be key accomplishments that you can celebrate along the way?
7. **Resources:** Are there existing financial resources you can put toward the project? People who will be involved? Other resources?

Using BioFinder in Step 7

The maps you've been using in BioFinder may continue to provide guidance in Step 7. However, please remember that many of the data layers available on BioFinder should be field verified before being used for specific implementation strategies. In particular, please be sure that regulatory boundaries are reviewed by a skilled cartographer who can assure that data are being used at an appropriate scale.

As you get started, you also need to think about funding. Do you already have the needed finances for your project? If not, you might consider:

- Municipal Planning Grants[1]
- Local conservation funds
- Fundraisers (letters to individual donors, public events, etc.)
- Collaboration with a partner with related goals (a land trust, private landowner, foundation, etc.)
- Other grants

Regional Planning Commissions

Throughout your process, don't forget that your Regional Planning Commission can be a valuable resource! Regional Planning Commissions assist individual member municipalities with their planning processes *and* work cooperatively to address regional challenges. They also work with non-profits, State and Federal agencies, businesses, and others to implement programs or projects to address local and regional needs. See http://www.vapda.org, the Vermont Association of Regional Planning Commissions, for additional information.

For many communities, creating an action plan is not an easy process. However, if you have gone through the rigorous prioritization process above, your decisions will be based on data, and you will be able to provide a solid rationale for your decisions. In the end, you may not be able to accomplish everything that has been set on the table, and there may be places in which you have to choose from among divergent priorities. However, making these tough decisions by taking into account a diversity of information and perspectives is what will give your plan a strong foundation.

Good luck!

Need Help?

The process outlined above was developed by the Vermont Fish & Wildlife Department's Community Wildlife Program, and we're happy to provide additional guidance:

> *Contact the Community Wildlife Program, Vermont Fish & Wildlife Department.* See http://www.vtfishandwildlife.com/get_involved/partner_in_conservation/community_wildlife_program for more information about the program.

For aid with the development or implementation of planning-related work, Vermont Natural Resources Council may be able to provide assistance. For more information, visit:

> *Forests and Wildlife Program:* http://vnrc.org/programs/forests-wildlife/
> *Sustainable Communities Program:* http://vnrc.org/programs/sustainable-communities/

For technical assistance related to planning and regulatory tools, the Regional Planning Commissions are a valuable resource. See http://www.vapda.org for a list of contact information for all of Vermont's Regional Planning and Development Agencies.

Photo by Tom Rogers

Appendix A: Strategies and Components

The chart the spans the next several pages matches ecological components with appropriate regulatory and nonregulatory protection strategies. More information about most strategies can be found in Community Strategies for Vermont's Forests and Wildlife.

Scale	Component	Conservation Goal	Conservation Strategies	
			Nonregulatory strategies	*Regulatory Strategies*
ALL	General strategies for baseline protection	**Seek additional information**	Conduct field inventories and improve maps.[1]	
		Protect the resource	Adopt language in the town plan, including statements about what resources are important, and policies on how they should be managed, protected, and restored.	Check clarity of definitions in zoning bylaws and update if needed.[2]
			Conduct targeted outreach to landowners that connects them with resources on their land and options for managing these resources.[3]	Review standards in zoning (subdivision, CU, or use standards), and update if needed. [4]
			Provide citizen educational opportunities.	Review purpose statements in zoning and update if needed.
			Establish a Conservation Commission.[5]	

			Create or expand a Conservation Fund for Special Projects.[6]	Establish or improve subdivision regulations.[7]
			Encourage landowners to enroll in Current Use.[8]	
			Encourage residents to conserve land containing important features.[9]	Review minimum lot size requirements to determine whether lot sizes and site design requirements support the natural resource goals of each zoning district (i.e., 2-5 acre lot sizes can cause fragmentation even if open space remains.)
			Work with neighboring communities and/or the regional planning commission to plan for natural resources protections at a regional scale.	
			Create or expand a Town Forest.[10]	
LANDSCAPE	**Forest (Interior Forest and Connectivity Blocks)**	**Provide stewardship of forestland**	Encourage residents to work with a forester to create forest management plans.[11]	Establish an impact fee program.[12]
			Encourage enrollment in Current Use (or local tax stabilization program).[13]	
			Connect landowners with supporting organizations, such as Vermont Coverts[14], Vermont Woodlands Association[15], the Natural Resources Conservation Service[16], or your local Natural Resources Conservation District[17].	

		Avoid fragmentation	Encourage residents to enroll in Current Use (or local tax stabilization program).[18]	Allow a greater development density in defined growth areas (like village or commercial districts) than in rural land (through a Forest, Conservation, or Rural Residential Zoning District).
			Encourage citizens to engage in estate planning.	Establish or expand a Wildlife Habitat or Wildlife Corridor Overlay District.
			Encourage residents to conserve their forestlands in important areas.[19]	Establish building envelopes, clearing standards, or limits on driveway length in bylaws to limit the impact of development.
			Create or expand a Town Forest.[20]	Establish road and trail standards.[21]
				Review rural residential-type districts to determine whether lot sizes and site design requirements allow for continued function of rural land (i.e., 2-5 acre lot sizes can cause fragmentation even if open space remains.)
		Provide support for working forests	Encourage residents to enroll in certification programs that promote long-term support for land management.[22]	Institute local forest products purchasing policy (for municipal purchases).

		Encourage support for businesses that use local forest products.	Ensure that regulations include standards that allow for continued access to working forests and associated infrastructure (e.g., log landing areas).[23]
Physical Landscape Diversity	**Include physical landscapes in conservation efforts.**	Protect forest blocks and waterways that contain important physical landscapes (see Forest Blocks above and Surface Waters and Riparian Areas below).	
		Compare maps of physical landscape diversity to conserved lands. Prioritize under-represented features in conservation efforts.	When feasible, locate building envelopes outside physically diverse areas.
		Encourage land conservation among owners of physically diverse land.[24]	
		Encourage owners of physically diverse land to enroll in Current Use (or local tax stabilization program).	
		Conduct planning efforts so as to avoid development in these areas.	
Surface Water and Riparian Areas	**Protect surface waters and riparian areas**	Support the creation of River Corridor Easements[25] (conservation easements that allow rivers to change course naturally, without human interference).	Require forested riparian buffers in the general standards section of your bylaws, to apply in all districts, or in River Corridor bylaws, if you have them. [26]
			Establish standards for minor activities (footpaths, etc.) acceptable within the riparian area.

			Connect landowners to incentives programs for wildlife-friendly management practices, such as through USDA or USFWS Partners for Fish and Wildlife.	Add standards in subdivision regulations or zoning (River Corridor, Flood Hazard, Lakeshore Overlay, or Forest District) that require clustering or setting back development away from riparian areas, river meanders, or floodplains.
				Require minimum setbacks from waterways in zoning and subdivision regulations.
				Adopt town road management standards to comply with Vermont's Clean Water Act.[27]
		Enhance Riparian Quality	Assist landowners in restoring riparian habitats.[28]	Require restoration of riparian habitat in site plan or subdivision review by designating "no-mow" zones, allowing for regeneration of woody vegetation, or by planting native species.
			Create an invasive species control program. [29]	
			Connect landowners to incentives programs, such as through USDA or USFWS Partners for Fish and Wildlife.	
		Maintain Water Quality	Assist landowners in reducing stormwater runoff.[30]	Recommend or require vegetated buffers to filter

			Encourage residents and businesses to reduce use of chemical lawn care products.	pollutants before they reach waterways.
			Identify ways to reduce flood damage to major infrastructure.[31]	
			Support public awareness of the *Acceptable Management Standards for Maintaining Water Quality of Logging Jobs in Vermont.*[32]	
	Grasslands and Shrublands	**Ensure that management is compatible with wildlife**	Practice management compatible with nesting birds on town-owned grasslands (the fields around schools or recreation fields, etc.). [33]	In site plan review, require that developments follow sound grassland bird management guidelines.[34]
			Connect landowners to incentives programs for wildlife-friendly management practices, such as USDA,[35] USFWS Partners for Fish and Wildlife,[36] or the Bololink Project.[37]	
			Establish a monitoring program for grassland birds.	
		Maintain or protect habitat	Ensure that grasslands and shrublands are represented in local conservation efforts.	
COMMUNITIES AND	**Wildlife Road Crossings**	**Protect habitat around wildlife crossings**	Encourage residents to conserve their land through conservation easements, particularly when crossings are part of larger parcels that have additional conservation values[38].	Require vegetated buffers around wildlife crossings in the general standards section of your bylaws, to apply in all districts[39].

			Connect landowners to incentives programs, such as through USDA or USFWS Partners for Fish and Wildlife.	
			Encourage residents to enroll in Current Use[40].	Adopt road management standards to allow vegetation to remain up to the road.
			Encourage residents and businesses to manage their land so as to leave vegetation right up to the road.	
		Limit fragmentation	When conducting planning efforts, consider wildlife road crossings and connectivity blocks together.	Establish or improve a Conservation District[41].
				Establish or improve a Wildlife Corridor or Wildlife Habitat Overlay District that includes both areas of habitat and important wildlife road crossings[42].
				Review or establish an access management plan, and consider limiting curb cuts in important wildlife crossing areas through site plan review or other standards within the zoning.[43]
		Reduce danger to humans and wildlife	Work with road officials to provide appropriate signage (to educate drivers) and install structures to guide animals to cross in safer areas	Establish traffic rules that ensure the safety of humans and wildlife along town roads on which wildlife are most likely to cross.

		(under bridges, on straighter road segments, etc.).	
		As needed, upgrade culverts and road infrastructure to VTrans standards. VTrans requires that all crossings include full-width banks and natural, at-grade bottom substrates to facilitate aquatic and terrestrial organism passage[1].	Adopt road management standards to avoid guardrails, the removal of roadside vegetation, or deep roadside ditching in crossings wherever possible.
Species and Natural Communities (Rare, Uncommon, or Representative)	**Protect significant species and natural communities**	Protect habitat blocks that contain important species, habitats, or natural communities (see Forest Blocks above).	
		Encourage landowners to conserve land that supports rare or uncommon species or natural communities.[44]	Create a Conservation or Wildlife Habitat Overlay District that protects significant wildlife habitat and a surrounding buffer.[45]
		Encourage landowners to enroll in Current use and enroll eligible areas as Ecologically Significant Treatment Areas (ESTAS)[46].	
		Create or expand a Town Forest.[47]	
	Manage invasive species	Provide landowners with opportunities to learn about management options for invasive species.[48]	Adopt a mowing policy in which town roadsides with invasive species are mowed before they go to seed.

[1] See http://floodready.vermont.gov/improve_infrastructure/roads_culverts.

	Restore degraded habitat	Connect landowners with incentives programs (USDA, USFWS, etc.) that aid in restoring significant natural communities or habitat.[49]	
Vernal Pools	**Protect vernal pools and associated amphibian populations.**	Protect habitat blocks that contain vernal pools (see Forest Blocks above).	
		Write management plans for town-owned land designed to protect vernal pools.[50]	Require buffers in the general standards section of your bylaws, to apply in all districts.[51]
			Create a Wildlife Habitat Overlay District that includes vernal pools and surrounding habitat.[52]
		Improve maps of vernal pools.	Encourage subdivision and site plan designs in zoning or subdivision regulations that cluster development away from vernal pools.[53]
			Require minimum setbacks in zoning or subdivision regulations.
			Seek to add vernal pools as Class II wetlands on inventory maps (where they are often missing).
	Protect or restore forested habitat	Include a map in your town plan to show possible dispersal corridors between pools.	

	between vernal pools.	Target high priority corridors in land conservation efforts.	
Wetlands	**Protect wetlands and surrounding habitat**	Encourage residents and/or businesses to conserve their wetlands through conservation easements.[54]	Petition for reclassification of significant wetlands to Class I. If wetlands are not mapped, seek to add them as Class II wetlands on inventory maps.[55]
		Encourage residents to enroll their wetlands in Current Use, in an Ecologically Significant Treatment Area (ESTA).[56]	Require buffers through the general standards section of your bylaws, to apply in all districts. [57]
		Encourage landowners to work with a foresters to choose forest management practices that protect wet soils and fragile species.	Require development design that clusters development away from wetlands and their buffers in subdivision and zoning regulations.[58]
		Support public awareness of Vermont's *Wetlands Rules*.[59]	Incorporate minimum setbacks from wetlands in zoning and subdivision regulations.
	Restore wetlands	Restore wetlands on town-owned lands.[60]	Create town road management standards to maintain and restore natural vegetation and hydrology.[61]
		Connect landowners with incentives programs (USDA, USFWS, etc.) to aid in restoring wetland habitat.[62]	
Mast Stands	**Protect mast stands**	Protect habitat blocks that contain mast stands (see Forest Blocks above).	

		Encourage residents to conserve forestland through conservation easements.[63]	**Improving inventory information is necessary before implementing any of the regulatory strategies below. State-level maps do not provide enough spatial accuracy for these actions.*
		Connect landowners with educational resources, such as landowner habitat management guidelines[64] or mast production area guidelines[65].	*Establish or improve a Wildlife Habitat Overlay District.
		Connect landowners with incentives programs (particularly USDA) to aid with possible financial and technical assistance.[66]	*Establish development design standards that cluster development away from mast stands and a surrounding buffer.[67]
		Encourage residents to enroll in Current Use, using Ecologically Significant Treatment Areas (ESTAs)[68] or working with a forester to plan for the long-term health of the mast stand.	*Require buffers around mast stands.
Local Wildlife Resources (Deer Wintering Areas, Cleanlain	**Protect wildlife resources.**	Protect habitat blocks that contain important resources (see Forest Blocks above).	
		Encourage residents to conserve their land through conservation easements.[69]	Establish or improve a Wildlife Habitat Overlay District.[70]

			Encourage residents to enroll their land in Current Use, using Ecologically Significant Treatment Areas (ESTAs) in appropriate locations[71] or working with a forester to plan for the long-term health of the resource.	Establish development design standards that cluster development away from resources.[72] Require buffers around these resources.

One Size Doesn't Fit All

When considering any of the above strategies, remember that each can be adapted to match the needs and personality of your community. For example, when we say, "Encourage residents to conserve their land," one town might create a community recognition award for residents who conserve their land, while another might write letters to landowners of areas identified as high priorities and describe potential conservation opportunities. There is room for creativity in any approach!

Glossary of Terms

100-year flood: A flood having a 100-year recurrence interval. Calculated according to historical data about rainfall and stream stage for a particular location, the probability that a specific river will reach a particular water level is once in 100 years. In other words, a flood of this magnitude has a 1 percent chance of happening in any year. *(Adapted from the USGS Water Science School website, at http://water.usgs.gov/edu/100yearflood.html.)*

The **100-year floodplain** is therefore all the land inundated by a 100-year flood.

A

Aerial photo: A photograph taken from an aircraft.

Orthophoto or **orthophotograph:** An orthophoto is an aerial photo that has been matched with mapping coordinates so that locations align geographically with other maps.

B

Bat hibernaculum: A place — usually a cave or a mine — that provides a constant temperature and protection for winter bat hibernation *(From Conserving Vermont's Natural Heritage, at http://www.vtfishandwildlife.com/common/pages/DisplayFile.aspx?itemId=111195)*

Biodiversity: the variety of life in all its forms and all the interactions between living things and their environment. Biodiversity is measured at the following levels: ecosystem, landscape, community, species, and genetic. *(From Conserving Vermont's Natural Heritage, at http://www.vtfishandwildlife.com/UserFiles/Servers/Server_73079/File/Get%20Involved/Partner%20in%20Conservation/Conserving_Vermont's_Natural_Heritage.pdf)*

BioFinder: This online mapping resource is both a database and mapping tool for identifying Vermont's lands and waters supporting high priority ecosystems, natural communities, habitats, and species. The most comprehensive assessment of its kind in Vermont, BioFinder was developed by the Agency of Natural Resources and partners to further our collective stewardship and conservation efforts. The resource highlights an interconnected network of forests, streams, and physical landscape features that drive Vermont's ecological function. It can be found at http://biofinder.vermont.gov.

Biophysical region: Biophysical regions divide Vermont into areas with like physical features. Each of these regions shares similarities in climate, bedrock, geologic history (glacial deposits, flooding, etc.), topography, land use history, and hydrology (water flow patterns). When conducting planning, these biophysical regions can be used as a lens through which to assess conservation priorities. For example, what may be a common species in one biophysical region of Vermont may be rare in another. In the area in which it is rare, conserving habitat for that species may be a way to preserve biodiversity.

Buffer: An area managed in a way that shields an ecologically sensitive area—a stream or wetland, for example—from the direct impacts and influences of human activities. Buffers reduce the contrast between the type of management applied to the sensitive area (generally somewhat hands-off) and the surrounding, more human-altered matrix. Generally, a buffer is managed to retain forest or other natural habitat, although it can be compatible with some human activities.

When used in a mapping context, a "buffer" refers to the area within a specified distance of a chosen feature on the map. For example, buffer of 10 feet can be applied to the mapped centerline of a chosen section of stream, to depict the approximate width of the stream.

C

Clayplain forest: Clayplain forest is a unique natural community that grows on the clay soils of the Champlain Valley. It is dominated by oaks and hickories, and prior to European-American settlement, it was the dominant forest type in the Champlain Valley. Because the deep, rich, soils and flat topography provided ideal agricultural lands, most clayplain forests were cleared and are now quite rare.

Climate change refers to any significant change in the measures of climate lasting for an extended period of time. In other words, climate change includes major changes in temperature, precipitation, or wind patterns, among other effects, that occur over several decades or longer. *(From the Environmental Protection Agency website, at http://www3.epa.gov/climatechange/basics/)*

Community scale: In the context of this guide, the *community scale* includes the components and process that occur between groups of plants and animals as they interact with one another and with their physical environment. For example, mast stands are described at this scale because they are associated with a particular set of physical features, plants, and wildlife that function together as a community.

Community values mapping: This phrase refers to a specific community-driven planning and mapping exercise intended to identify and rank locations of high public value within particular geographic boundaries. The product of the exercise is a GIS-based map depicting community values that can be integrated with other map data, such as comparisons with locations of high ecological value.

Component: In this guide, we use "component" to refer to general categories of natural heritage elements found on a landscape. These can be natural or cultural and may include physical landforms, land cover, water resources, vegetation types, human land use, cultural boundaries, wildlife resources, and more. Each inventory layer in Part I of this guide represents a separate landscape *component.*

Connectivity: Ecologically, this refers to the capacity of individual species to move between areas of habitat via corridors and linkage zones *(Meiklejohn et al.)*

In this guide, we also use the word to indicate the degree to which similar landscape elements are connected to each other so as to facilitate the movements of organisms and

ecological processes between them *(The Staying Connected Initiative definition).* We refer to **landscape connectivity** as a network that links large blocks of contiguous, unfragmented habitat (**interior forest blocks**) with those forested habitat blocks that have good cover but are not large enough themselves to maintain populations of wide-ranging species (**connecting blocks**). While interior forest blocks provide the principle home areas for many species, connecting blocks are necessary for wildlife movement. At a fine scale, **riparian connectivity** and **wildlife road crossings** are also key to this connected network, without which there can be little genetic exchange between populations. Read more about connectivity in *Conserving Vermont's Natural Heritage*, at http://www.vtfishandwildlife.com/UserFiles/Servers/Server_73079/File/Get%20Involved/Partner%20in%20Conservation/Conserving_Vermont%27s_Natural_Heritage.pdf, starting on page 48.

Connectivity block (or **connecting habitat):** Connecting habitat links larger patches of habitat within a landscape, allowing the movement, migration, and dispersal of animals and plants. Riparian areas along streams and rivers, strips of forest cover between developed areas, and even hedgerows/ fencerows all represent potential connecting habitat for wildlife and other organisms. Sometimes these habitats are called "corridors" even though they are not always linear, as the term implies. *(Adapted from Staying Connected Initiative definition.)*

Conservation: the careful preservation and protection of something; especially planned management of a natural resource to prevent exploitation, destruction, or neglect. *(From the Merriam-Webster Online Dictionary http://www.merriam-webster.com/dictionary/conservation.)*

In this guide, we keep our use of the word broad, including *any* strategy that can aid in the protection or thoughtful use of the natural landscape to maintain or enhance its healthy condition.

Conservation easement: a voluntary, legal agreement between a landowner and a land trust or government agency that permanently limits uses of the land in order to protect its conservation values. It allows landowners to continue to own and use their land, and they can also sell it or pass it on to heirs. The limits of the conservation easement 'run with the land,' meaning that even if the land is inherited or sold the restrictions stay in place. *(Land Trust Alliance definition, found at http://www.landtrustalliance.org/what-you-can-do/conservation-options)*

Conservation fund: A dedicated pot of money that can be used for conservation projects. These can be raised in response to an immediate opportunity or they can be put into a reserve fund so that money is available when opportunities arise in the future, serving as a "savings account" that can be carried forward into future fiscal years. The most common method in Vermont of raising money for a conservation fund is through a direct appropriation at Town Meeting. *(Adapted from Community Strategies for Vermont's Forests and Wildlife, found at http://vnrc.org/wp-content/uploads/2013/08/VNRC-Forestland-Conservation-10-1-links.pdf.)*

Conservation planning: Conservation planning is the foundation of any community's efforts to protect the natural resources and values that are important to a community. For Vermont towns, this can take the form of either a stand-alone natural resources and open space plan (which must then be incorporated into the town plan by reference) or chapters in the municipal plan that

address natural resource concerns. Effective conservation planning begins with high quality data and broad community input, includes clearly articulated and measurable objectives, and lists a series of implementation steps. *(From Vermont Natural Resources Council website, at http://vnrc.org/resources/community-planning-toolbox/tools/conservation-and-open-space-plans/)*

Conservation subdivision is a method for promoting conservation by requiring creative development design that allows for the same number of homes to be built as in a standard subdivision, but in a less land-consumptive manner. At least 50% of the remaining land is permanently protected and added to an interconnected network of open space. *(Adapted from Community Strategies for Vermont's Forests and Wildlife, found at http://vnrc.org/wp-content/uploads/2013/08/15.-Subdivision-Regulations.pdf)*

Conservation zoning districts typically encompass areas defined by the presence of one or more natural features such as blocks of productive forest land, important wildlife habitat, wildlife corridors and crossing areas, rare plant communities, high elevations, scenic ridgelines, steep slopes, wetlands, riparian and water source protection areas. A conservation district can limit development and impose standards to protect locally significant resources – for example, to avoid forest fragmentation, or to ensure that the design and siting of development minimizes adverse impacts to identified resources. *(From Community Strategies for Vermont's Forests and Wildlife, found at http://vnrc.org/wp-content/uploads/2013/08/12.-Conservation-Zoning-Districts.pdf)*

Conserved land: In this guide, we use the phrase "conserved land" to refer to land protected in some way from development. This includes private land placed under a conservation easement, private land owned by a conservation organization (such as The Nature Conservancy or other land trust), or public land on which restrictions have been placed to prohibit development. In the case of conservation easements, certain land use rights—generally including the right to develop—have been sold or donated by a landowner to a land trust or other entity. These restrictions on land use are tied to the deed to the land, so that future owners are bound by the same legalities as current.

> While we use the phrase "conservation" to include a much broader range of activities (see entry above), we define "conserved land" as only that land with permanent or semi-permanent restrictions.

Contiguous habitat: Contiguous habitat is an area of forested land with either no roads or low densities of class III or IV roads and little or no human development. Contiguous forest areas may have various age classes of forest cover and, in fact, may be composed of other habitat types such as wetlands or old meadows that are part of the overall contiguous habitat complex. Ideally, these areas are connected with other similar areas so that the animals that use them can move freely to other forested areas and habitats. *(From Conserving Vermont's Natural Heritage, at http://www.vtfishandwildlife.com/UserFiles/Servers/Server_73079/File/Get%20Involved/Partner%20in%20Conservation/Conserving_Vermont's_Natural_Heritage.pdf)*

Critical habitat refers to a specific geographic area(s) that contains features essential for the conservation of a threatened or endangered species and that may require special management and

protection. Critical habitat may include an area that is not currently occupied by the species but that will be needed for its recovery. *(From U.S. Fish & Wildlife Service website, at http://www.fws.gov/midwest/endangered/saving/CriticalHabitatFactSheet.html)*

Current Use Program: Vermont's Use Value Appraisal (UVA) Program (also known as "Current Use") enables eligible private lands where owners practice long-term forestry or agriculture to be appraised based on the property's value of production of wood or food rather than its residential or commercial development value. The Department of Taxes, Division of Property Valuation and Review (PV&R) is the lead agency, but the County Foresters help to administer the Forestry Use Value Appraisal portion of the program. *(From http://fpr.vermont.gov/forest/your_woods/use_value_appraisal, with more information available at the same site.)*

D

Deer wintering yard or **Deer wintering area:** White-tailed deer in Vermont live near the northern limit of their range in eastern North America. To cope with Vermont's severe climatic conditions, deer have developed a survival mechanism that relies upon the use, access, and availability of winter habitat. These habitat areas are known as deer wintering areas, deer winter habitat or, more commonly, "deer yards." Deer winter habitat is defined as areas of mature or maturing softwood cover, with aspects tending towards the south, southeast, southwest, or even westerly and easterly facing slopes. Here, the snow tends to be shallower after big storms, and deer can "yard-up" without wasting energy. *(From Conserving Vermont's Natural Heritage, at http://www.vtfishandwildlife.com/UserFiles/Servers/Server_73079/File/Get%20Involved/Partner%20in%20Conservation/Conserving_Vermont's_Natural_Heritage.pdf)*

Development: In this guide, we use the phrase "development" to include buildings and area cleared around buildings, parking areas, lawns, gravel pits, construction, engineering or mining operations, and any material change to the use of land.

Development review standards: requirements, found in a zoning bylaw or subdivision regulation, which a proposed development must meet. *(From Community Strategies for Vermont's Forests and Wildlife, at http://vnrc.org/wp-content/uploads/2013/08/11.-Writing-Standards-for-Development-Review.pdf)*

Digital mapping: The process of collecting data and creating a virtual image that represents a particular geographic area.

> In some cases, physical maps can be digitized to create a virtual image that is visually identical to the physical map. With the aid of a **Geographic Information System (GIS),** the digital map can then be geographically matched with other data in order to conduct spatial analyses. Many digital maps, however, originate through the interpretation of virtual data such as aerial photographs, radar, or other remote sensing techniques.

Disturbance: In ecological terms, "disturbance" is an event or force, of nonbiological or biological origin, that brings about mortality to organisms and changes in their spatial patterning in the ecosystems they inhabit *(From Encyclopedia Britannica, at*

http://www.britannica.com/science/ecological-disturbance). Examples include wind, floods, disease, fire, climate phenomena, and many forms of human land use.

E

Early successional habitats: Young trees and shrubs, often occupying recently disturbed sites and areas such as abandoned farm fields, provide unique and important habitat for many wildlife. Some of the tree and shrub species that colonize abandoned agricultural land and disturbed sites include grey birch, dogwood, aspen species, cherry, willow, and alder. Due to the propensity of these plant species to quickly colonize disturbed sites, they are often referred to as "pioneer species." *(From Conserving Vermont's Natural Heritage)*

Ecological function: The ability of plants and animals to thrive, reproduce, migrate, and move as the climate changes, and the ability of natural ecosystems to function under natural processes. Ecological function is served by high-quality terrestrial and aquatic habitat, natural connections across the landscape, a wide variety of habitat features from low elevation to high, clean water, and healthy rivers, streams, lakes, ponds, and wetlands. *(Learn more from the Vermont Conservation Design report, found at http://www.vtfishandwildlife.com/UserFiles/Servers/Server_73079/File/Get%20Involved/Partner%20in%20Conservation/VT%20Conservation%20Landscape-level%20Design/Vermont-Conservation-Design%20-%20Landscapes%20(2015).pdf)*

> In this guide, mapping the "ecologically functional landscape" is also a process used to determine ecological priorities for conservation efforts. This method identifies the features most important for maintaining landscape function, including interior forest blocks, connectivity features, surface waters and riparian areas, and physical landscape diversity, and links them together.

Ecological hotspot: Hotspots are specific locations on the landscape with high ecological value. In this guide, we use the phrase to describe locations where multiple important ecological components occur in the same geographic area. In other words, wetlands, large interior forest blocks, and rare physical features are all important on their own, but locations in which all of these (or other) important features are present can be considered "hotspots" with an even higher ecological value. In these locations, conservation efforts are likely to have a high ecological payback.

Ecologically Significant Treatment Areas (ESTAs): This is a designation used by Vermont's Use Value Appraisal (Current Use) program to recognize areas particularly sensitive to forest management practices. These include old forests, state-significant natural communities, rare, threatened and endangered species, riparian areas, forested wetlands and vernal pools. While most forest land enrolled in Use Value Appraisal must be actively managed for timber or regeneration, those lands qualifying as ESTAs may be excluded from this requirement.

Endangered species: The term "endangered" generally refers to species whose continued existence as a viable component of the state's wild fauna or flora is in jeopardy.

> A **threatened species** is one whose numbers are significantly declining because of loss of habitat or human disturbance, and unless protected will become an endangered species. *(The above are both Vermont Fish and Wildlife Department definitions, found at*

http://www.vtfishandwildlife.com/learn_more/critter_cirriculum/endangered_and_threatened_species)

Extinct species: A species no longer in existence.

Extirpated species: A species no longer surviving in regions that were once part of their range. *(The above two definitions are from the U.S. Fish & Wildlife Service Glossary, at http://www.fws.gov/Midwest/endangered/glossary/index.html).*

Extirpated species can be considered to be *locally* extinct.

Endangered Species Act of 1973 aims to provide a framework to conserve and protect endangered and threatened species and their habitats. By providing States with financial assistance and incentives to develop and maintain conservation programs, the Act serves as a method to meet many of the United States' international responsibilities to treaties and conventions such as the Convention on International Trade of Endangered Species of Wild Fauna and Flora and the Western Hemisphere Convention. *(From the U.S. Fish & Wildlife website, at http://www.fws.gov/international/laws-treaties-agreements/us-conservation-laws/endangered-species-act.html)*

Enduring features: Also called **Physical features** or **Physical landscapes**, enduring features are the parts of the landscape that resist change. They are the hills and valleys, the underlying bedrock, and the deposits left behind by glaciers. They remain the same even when changes in land cover and wildlife occur. They remain the same as plants and animals move, and they remain the same even as the climate changes. *(From Conserving Vermont's Natural Heritage, at http://www.vtfishandwildlife.com/UserFiles/Servers/Server_73079/File/Get%20Involved/Partner%20in%20Conservation/Conserving_Vermont's_Natural_Heritage.pdf)*

Extirpated species: A species no longer surviving in regions that were once part of their range. [Locally extinct.]

Endangered: The classification provided to an animal or plant in danger of extinction within the foreseeable future throughout all or a significant portion of its range.

Extinct species: A species no longer in existence [anywhere].

(All definitions from U.S. Fish & Wildlife Service Glossary, at http://www.fws.gov/Midwest/endangered/glossary/index.html)

F

Field inventory or **field assessment:** These phrases are used in this guide to describe a natural resources evaluation process that takes place in the location of interest. We use these phrases to distinguish from those inventories and assessments that are conducted remotely, such as from the interpretation of aerial photos or from radar data-collection techniques.

Fluvial erosion hazard: Fluvial (or river-related) erosion hazards refer to major streambed and streambank erosion associated with the often catastrophic physical adjustment of stream channel dimensions (width and depth) and location that can occur during flooding. Fluvial erosion becomes a hazard when the stream channel that is undergoing adjustment due to its instability threatens public infrastructure, houses, businesses, and other private investments. *(From the Vermont Water Management Program 2010 guide found at http://www.watershedmanagement.vt.gov/rivers/docs/rv_vtfehqa.pdf)*

A **fluvial erosion hazard area** includes the stream and land adjacent to the stream. It identifies an area where stream processes may occur that enable the stream to re-establish and maintain a stable slope and dimensions over time. Boundaries attempt to capture lands most vulnerable to fluvial erosion in the near term and indicate the type, magnitude, and frequency of fluvial adjustments anticipated during flood events. *(Also adapted from the Vermont Water Management Program 2010 guide found at http://www.watershedmanagement.vt.gov/rivers/docs/rv_vtfehqa.pdf)*

Floodplain: An area of low-lying ground adjacent to a river, formed mainly of river sediments and subject to flooding. For planning purposes, a floodplain can be considered to be the land inundated by water during a flood event. Since floods can be of varying levels of magnitude, a floodplain is often identified by the frequency with which it floods. For example, the 100-year floodplain is the land inundated by water on an average of once every hundred years; a flood of this magnitude has a 1 percent chance of occurring in any given year.

Fragmentation: When roads, land clearing, development, or other land uses divide forests, waterways, or other natural habitats into smaller and smaller areas, the process is called *fragmentation.* Depending on the location and scale, fragmentation can negatively affect plant and animal species, wildlife habitat (called habitat fragmentation), and water quality.

G

Geographic Information System (GIS): This phrase refers to computer mapping tools and resources. When digital information is geographically referenced (meaning that the information is linked to specific places on the earth, using a system such as Latitude/Longitude) it can be used to create map layers as well as to perform analyses and even model hypothetical situations ("what if?" scenarios). *(From Vermont Center for Geographic Information webpage, at http://vcgi.vermont.gov/resources/what_is_gis)*

Grassland: Grasslands are open lands dominated by grasses, sedges, and other low vegetation, with few trees or shrubs. Grasslands can include wetlands with low vegetation, too, as well as land actively managed by people such as hay fields. In fact, most of Vermont's grasslands are associated with current or past agricultural practices. Over time, most grasslands naturally grow woody vegetation and become shrubland, and these shrublands in turn become forest if left unmanaged. Vermont's grasslands are therefore inherently ephemeral. Still, they provide important habitat to many species, especially birds.

H

Habitat block: Habitat blocks are areas of at least 20 acres of contiguous habitat that are unfragmented by roads, development, or agriculture. Vermont's habitat blocks are primarily forests, but they also include wetlands, rivers and streams, lakes and ponds, cliffs, and rock outcrops. Forests included in habitat blocks may be young, early-successional stands, actively managed forests, or mature forests with little or no recent logging activity. The defining factor is that there is little or no permanent habitat fragmentation from roads, agricultural lands and other forms of development within a habitat block. For the purposes of this guide, a Class 3 road is considered a fragmenting feature, but a Class 4 road is not.

Hydrography: The science of surveying and charting bodies of water, such as seas, lakes, and rivers. *(From the Oxford Online Dictionary, found at http://www.oxforddictionaries.com/us/definition/american_english/hydrography)*

I

Impervious surface: In an ecological context, this phrase refers to surfaces that are impenetrable to water. It is generally used in the context of surface water and runoff, referring to structures such as roads, parking lots, rooftops, heavily compacted soils, etc. that change the flow of water by prohibiting infiltration into the soil. In areas with a high density of impervious surfaces, the resulting runoff after a rainfall or snowmelt event can be associated with the overloading of a stormwater system or other drainage challenges.

Impact fee program: A regulatory tool in which developers are required to pay a fee toward the protection or restoration of town-owned open space lands, forests, parks, or recreation areas in exchange for developing land identified by a community as important.

Interior forest block: A subset of "habitat blocks," these are areas of the most highly contiguous forest and other natural habitats that are unfragmented by roads, development, or agriculture. While most of what is defined as Vermont's interior forest blocks are primarily forests, they may also include wetlands, rivers and streams, lakes and ponds, cliffs, and rock outcrops. Interior forest blocks may comprise young, early-successional stands, actively managed forests, or mature forests with little or no recent logging activity; the defining factor is that there is little or no permanent habitat fragmentation from roads, agricultural lands and other forms of development within an interior forest block.

L

Land cover records the natural landscape as surface components: forest, water, wetlands, urban, etc.

> **Land use** documents human uses of the landscape: residential, commercial, agricultural, etc.

Landscape scale: This guide categorizes ecological components into three scales: the Landscape scale, the **Community scale**, and the **Species scale.** In this context, the Landscape scale refers to those habitats that extend across town, regional, and even state boundaries—forest networks, waterways, and physical landforms—that are the basic building blocks for ecological processes. This scale is used to capture a sense of overall ecological function of a region as a whole, without consideration for the needs of individual natural communities or species.

Land trust: a private, nonprofit organization that conserves land either through land acquisition or by acquiring conservation easements. The land trust is then responsible for the stewardship of this land in perpetuity, either through active management or by ensuring that the terms of a conservation agreement are upheld.

Land use documents human uses of the landscape: residential, commercial, agricultural, etc.

> **Land cover** records the natural landscape as surface components: forest, water, wetlands, urban, etc.

Lowland: In this guide, lowlands include the valleys, meadows, and floodplains that surround the state's larger rivers, lakes, and wetlands. They are distinguished from *uplands,* which are the hills, ridges, and mountains.

M

Management plan: In this guide, "management plan" refers to a blueprint for the way land and associated water resources will be treated in the future, including both short-term and long-term goals and activities. Usually, management plans are created at the scale of an individual property.

Map layer: In this guide, each distinct dataset that appears on a map is referred to as a "layer" or "map layer." For example, we could digitally create a map that includes the location of conserved lands, wetlands, surface water, and vernal pools. Each of these individual datasets would be considered a layer.

Mast is the fruit and seeds of shrubs and trees that are eaten by wildlife. Hard mast refers to nuts (especially those of beech and oak trees), whereas soft mast refers to berries and fruits of a number of species (such as black cherry, raspberry, blackberry, and apple).

> **Mast Stands:** While most forested areas contain at least a few mast producing trees and shrubs, forests producing significant concentrations of mast are much less common. In BioFinder, a beech or oak Mast Stand exhibits bear scarring on at least 15-25 tree trunks and/or shows some evidence of use by bears. These Mast production areas are important to myriad wildlife species and crucial to the survival of Vermont's black bear population.

Monitoring program: Ecological monitoring programs are generally established in order to derive knowledge about how the plants, animals, natural processes, air, water, or soil present in an area change over time. These changes may be studied to assess the way processes or populations fluctuate naturally over time, or they may be established in order to measure the impact of a particular change, such as a flood event or a new development. They include a systematic sampling process in which data is collected and then analyzed.

Municipal plan (or **Town plan):** A plan written by a town or municipality to provide a framework toward attaining community aspirations through public investments, land use regulations, and other implementation programs such as a state-designated downtown or village centers, business improvement districts, or land conservation programs. It can also qualify the community for state grants to fund improvements or receive specialized technical assistance. *(From the Vermont Agency of Commerce and Community Development's Planning Manual, at http://accd.vermont.gov/sites/accd/files/PlanningManualModule1low.pdf)*

N

Natural Area: While this term is sometimes used to identify only those areas supporting populations of rare or endangered species or uncommon physical landscapes, this guide uses the phrase to describe any area that is managed in a way that allows natural processes to predominate, with minimal human intervention.

Natural community: an interacting assemblage of plants and animals, their physical environment, and the natural processes that affect them. These assemblages of plants and

animals repeat across the landscape wherever similar environmental conditions exist. *(Adapted from* Conserving Vermont's Natural Heritage, *at* http://www.vtfishandwildlife.com/common/pages/DisplayFile.aspx?itemId=244840.*)* More information about natural communities can be found in *Wetland, Woodland, Wildland: A Guide to the Natural Communities of Vermont*, by Elizabeth Thompson and Eric Sorenson.

Rare natural community: The Vermont Fish and Wildlife Department uses a ranking scheme that is part of the national Natural Heritage methodology to describe the relative rarity of natural community types in Vermont. The range is from S1 (very rare) to S5 (common and widespread). S1 and S2 natural community types are considered rare for BioFinder.

Uncommon natural community: S3 and S4 natural community types are considered uncommon for BioFinder. While these natural community types are generally uncommon naturally, since their soils are uncommon, some have been made more uncommon by the conversion of habitat for agricultural or development purposes.

Common natural community: Using the same ranking system, S5 communities are considered common.

Significant natural community: Only those natural communities considered significant at the state level are mapped in BioFinder and the maps associated with this guide. In addition to the rarity ranking described above, all mapped natural communities are also assigned a quality rating that ranges from A (excellent) to D (poor) based on size, condition, and landscape context. Occurrences of rare natural communities are considered significant when their quality is ranked A, B, or C. Uncommon natural communities are significant when they have a quality rank of A or B. Only A-quality occurrences of common natural communities are considered significant. *(Adapted from ANR's* "Guidelines for the Conservation and Protection of State-Significant Natural Communities,*" at* http://anr.vermont.gov/sites/anr/files/co/planning/documents/guidance/VFWD%20Natural%20Community%20Conservation%20Guidelines%2010-21-2004.pdf*)*

Natural cover: Any type of vegetation that wildlife can use for shelter. This includes forest, wetland, and shrubs. Developed land, roads, crops, grasslands, and pasture are *not* considered "natural cover."

Natural heritage: All the natural resources valued by a place's residents and visitors. In many Vermont communities, these include forests, clean waters, vibrant fisheries, healthy wildlife populations, rare species, significant natural communities, and biodiversity. *(Adapted from Conserving Vermont's Natural Heritage, at http://www.vtfishandwildlife.com/UserFiles/Servers/Server_73079/File/Get%20Involved/Partner%20in%20Conservation/Conserving_Vermont's_Natural_Heritage.pdf)*

Natural resources: Materials or substances such as minerals, forests, water, and fertile land that occur in nature and can be used for economic gain (From the Oxford English Dictionary, http://www.oxforddictionaries.com/us/definition/american_english/natural-resources).

In this guide, the phrase is used broadly to include any feature of the natural landscape valued by our human communities in any way. In addition to economic gain, this can include cultural, ecological, personal, and other means of assessing value.

Natural Resources Atlas: This publicly available online mapping resource is intended to provide geographic information about environmental features and sites. In addition to map navigation tools, the Atlas allows users to link to documents, generate reports, export search results, import data, search, measure, mark-up, query map features, and print PDF maps. It was created by Vermont's Agency of Natural Resources and can be found at http://anr.vermont.gov/maps/nr-atlas.

Non-regulatory tool: In this guide, we use this phrase to describe strategies for implementing planning goals that do *not* involve bylaws or legal requirements. In a land use context, examples include encouraging the creation of land stewardship or management plans, education initiatives, and incentives programs.

A **regulatory tool** is a strategy for implementing planning goals that *does* involve bylaws or other legal processes. Examples include defining standards for a development review process, establishing zoning districts or subdivision regulations, and the creation of road and trail policies.

O

Orthophoto or **orthophotograph:** An orthophoto is an aerial photo that has been matched up with mapping coordinates so that specific locations align geographically with other maps, taking a flat photograph and adjusting it for the curvature of the earth.

Aerial photo: a photograph taken from an aircraft

Overlay District: a resource-based zoning district that is superimposed over underlying zoning districts to limit the impacts of development on resources that have been identified for special consideration. Since overlay districts follow the *resource*, they may apply to only a portion of a parcel — allowing development on land outside of the overlay district, while protecting resources on land within the district. *(Adapted from Community Strategies for Vermont's Forests and Wildlife, at http://vnrc.org/wp-content/uploads/2013/08/14.-Overlay-Districts.pdf)*

P

Palustrine: wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens *(U.S. Fish & Wildlife definition, found at https://www.fws.gov/wetlands/Documents/classwet/palustri.htm).*

In locations near the ocean, the word can also include tidal areas with low salinity.

Patch (as in **"Vegetation Patch"** or **"Habitat Patch"):** In this guide, the term "patch" refers to a relatively small area of intact vegetation or habitat surrounded by something *different*—often development, agriculture, or other human-influenced environments, although the surrounding area could simply be a different type of vegetation or habitat. Patches often provide resources or refuge to certain wildlife species but often lack sufficient size or condition to act as these species' core habitat.

Physical landscape: Physical landscapes (also called "enduring features") are the parts of the landscape that resist change. They are the hills and valleys, the underlying bedrock, and the deposits left behind by glaciers. They remain largely unchanged when changes in land cover and wildlife occur, as plants and animals move, and even as the climate changes. In this guide and on

the Natural Resources Atlas, physical landscapes are represented as "Rare," "Responsibility" and "Representative."

> **Rare physical landscapes** are those that cover less than 4.5% of Vermont's land area. These represent rarity in the physical landscape.
>
> **Responsibility physical landscapes** are those that may be common in our region, but they are rare overall. For example, calcium-rich landscapes are fairly typical in much of Vermont, but because they are rare in a larger regional context, species requiring these areas rely heavily on our landscape for their continued presence.
>
> **Representative physical landscapes** are particular examples of more common physical landscape types, selected because they are in the best condition and/or have the largest patch size compared to others of the same type.

Protected area: A geographically defined area designated or regulated and managed to achieve specific conservation objectives. *(From the Convention on Biological Diversity, found at https://www.cbd.int/protected/pacbd/).* While specific objectives may change between one place and another, development is generally limited or prohibited.

R

Rare species: A rare species of plant or animal is one that has only a few populations in the state and that faces threats to its continued existence in Vermont. The Vermont Fish and Wildlife Department uses a ranking scheme to describe the relative rarity of species in Vermont, using a national Natural Heritage methodology. The range is from S1 (very rare) to S5 (common and widespread). Species are assigned a rarity rank based on the number of known individuals, the population size statewide, and the degree to which the populations are threatened. Rare species are generally considered to be those with twenty or fewer populations statewide, whereas **uncommon species** are generally considered those with more than 20 but 80 or fewer populations statewide.

Regional Planning Commission (RPC): A body that provides planning guidance and structure for numerous member municipalities within a defined area of Vermont. RPCs create regional plans that identify areas and activities of regional significance or potential impact, promote coordination between member municipalities, and provide guidelines for municipal planning activities. They also advise those municipalities in their individual planning processes, provide technical and legal assistance for creating and implementing municipal plans and related bylaws and implementation activities, and review municipal plans for compliance with state and regional regulations, among other activities. Learn more at https://www.vapda.org/.

Regulatory tool: In this guide, we use this phrase to describe strategies for implementing planning goals that involve bylaws or other legal requirements or processes. Examples include defining standards for a development review process, establishing zoning districts or subdivision regulations, and the creation of road and trail policies.

> A **non-regulatory tool** is a strategy for implementing planning goals that do *not* involve bylaws or legal requirements. In a land use context, examples include encouraging the creation of land stewardship or management plans, education initiatives, and incentives programs.

Restoration: In ecology, this word refers to the process of "re-establishing the structure, productivity and species diversity of the forest originally present. In time, ecological processes and functions will match those of the original forest." *(Lamb and Gilmour 2003, found at http://cmsdata.iucn.org/downloads/rehabilitation_and_restoration_of_degraded_forests.pdf)*

Riparian area: The word "riparian" literally means "of, or pertaining to, the bank of a river or lake." Riparian areas are ecosystems comprised of streams, rivers, lakes, wetlands, and floodplains that form a complex and interrelated hydrological system. These ecosystems extend up and down streams and along lakeshores and include all land that is directly affected by surface water *(Quoted from Verry et al., 2000).*

> Riparian ecosystems are generally high in biological diversity. They are "characterized by frequent disturbances related to inundation, transport of sediments, and the abrasive and erosive forces of water and ice movement that, in turn, create habitat complexity and variability…resulting in ecologically diverse communities" *(Quoted from Verry et al., 2000).*

Riparian wildlife connectivity: This phrase refers to lands along streams, rivers, lakes and ponds used by wildlife and plants to move. Sometimes these areas are called "**riparian corridors**" even though they are not always linear, as the term implies. Also see **habitat connectivity.**

River easement: A conservation easement that allows a river to change its course naturally over time, without human interference.

Runoff: Surface runoff is water from rain, snowmelt, or other sources that flows over the land surface. When runoff flows along the ground, it can pick up soil contaminants such as petroleum, pesticides, or fertilizers that become discharge or overland flow. *(Excerpted From Science Daily's Reference Terms, found at http://www.sciencedaily.com/terms/surface_runoff.htm)*

S

Satellite imagery: an image captured from a satellite. There are several types of satellite images. Some are basic photographic images (see "aerial photo" or "orthophoto") that capture the visible landscape from above. Some use other technologies, such as infrared sensors, which measure the heat emitted from different parts of the land or atmosphere. In addition to being used purely as visual images, some satellite images can be analyzed or interpreted to suggest other data, including elevation, land cover, weather, and much more.

Setback: For municipal planning and implementation purposes, a setback is a distance between a structure or land use activity and a feature such as a property line, road, or a natural element like a riverbank, vernal pool, or forest. In standards or bylaws, municipalities can require a minimum or maximum setback from a defined feature to achieve a particular planning goal.

Shrubland: These are areas dominated by low, dense shrub vegetation such as dogwood, willow, tall grasses, and sedges. They are often associated with the margins of grassland habitats and are influenced by human activities such as agriculture or active land management, as well as by natural disturbances.

Grassland: Grasslands are open lands dominated by grasses, sedges, and other low vegetation, with few trees or shrubs. Grasslands can include wetlands with low vegetation, too, as well as land actively managed by people such as hay fields. In fact, most of Vermont's grasslands are associated with current or past agricultural practices. Over time, most grasslands naturally grow woody vegetation and become shrubland, and these shrublands in turn become forest if left unmanaged. Vermont's grasslands are therefore inherently ephemeral. Still, they provide important habitat to many species, especially birds.

Species assemblage: A group of species that share similar ecological or habitat requirements and are likely to be found together.

Species richness or **Biological richness:** the number of species present in a sample, community, or taxonomic group. Species richness is one component of the concept of species diversity, which also incorporates evenness, that is, the relative abundance of species. Species diversity is one component of the broader concept of biodiversity. *(From the Encyclopedia of Earth, found at http://www.eoearth.org/view/article/156216/)*

Species scale: This guide categorizes ecological components into three scales: the **Landscape scale**, the **Community scale**, and the Species scale. In this context, the *species scale* refers to those habitats necessary for the survival of specific fish, wildlife, and plants. For example, wildlife crossings are locations where bear, bobcat, fisher, and other wide-ranging species are most likely to cross roads as they travel to meet daily or seasonal dietary needs, disperse to find mates, or fulfill other requirements. While they tend to be small in size, species-scale components are essential for maintaining biodiversity by supporting species with a known conservation need in the state or region.

Standards (as in *Road Standards* or *Trail Standards*)**:** In the context of planning, standards are defined sets of principles that guide the implementation of a plan or its associated bylaws. Standards generally include a list of recommended or required practices for achieving a particular goal.

Stewardship: This word is often used in the context of land use planning and management to refer to the manner in which we care for land. Rather than referring to any specific practices, stewardship encompasses an ethic of responsible land use that includes a thoughtful evaluation of land use activities and their impacts to natural features and human communities.

Subdivision regulation: A regulatory strategy used to guide the pattern of development within a community. Subdivision regulations evaluate the impact of land subdivision on natural resources, allowing communities to control both the configuration of lots and the location and extent of site disturbance, site improvements, and the future location of development, roads, building sites, and supporting infrastructure within lots. (*Adapted from Community Strategies for Vermont's Forests and Wildlife, at http://vnrc.org/wp-content/uploads/2013/08/VNRC-Forestland-Conservation-10-1-links.pdf)*

Substrate: The surface or material on which an organism or ecosystem lives.

Succession: Ecological succession refers to more-or-less predictable and orderly changes in the composition or structure of an ecological community. Succession may be initiated either by formation of new, unoccupied habitat (e.g., a lava flow or a severe landslide) or by some form of disturbance (e.g. fire, severe windthrow, logging) of an existing community. *(From Science Daily's Reference Terms, at http://www.sciencedaily.com/terms/ecological_succession.htm)*

Surface water: In this guide, BioFinder, and the Natural Resources Atlas, "surface water" includes all areas inundated by water (rivers, streams, lakes, and ponds). When surface water appears as a map component, it includes the entire valley bottom in which a river or stream has migrated over time and in which flooding is expected.

Surficial materials (or **Surficial geology):** This phrase is used to describe the sands, gravels, clays, peats, and other deposits found on top of the bedrock as a result of either glacial activity or post-glacial events like flooding. Bedrock and surficial geology together have a profound influence on the soils in which Vermont's plants grow. *(Adapted from Conserving Vermont's Natural Heritage, at http://www.vtfishandwildlife.com/UserFiles/Servers/Server_73079/File/Get%20Involved/Partner%20in%20Conservation/Conserving_Vermont's_Natural_Heritage.pdf)*

> Examples of surficial materials include *till*—piles of rocks and debris left behind by glaciers that cover most of the bedrock in the state—and the deep clay deposits of the Champlain Valley left by post-glacial lakes.

T

Tax stabilization program: A program in which a municipality enters into a contract with owners, lessees, or operators of land in order to promote a particular goal, such as forestry and open space preservation. These contracts can be written to stabilize taxes in a variety of ways: by fixing property values, tax rates, or the amount or percentage of annual tax assessed. *(Adapted from Community Strategies for Vermont's Forests and Wildlife, at http://vnrc.org/wp-content/uploads/2013/08/VNRC-Forestland-Conservation-10-1-links.pdf)*

Threatened species: A species whose numbers are significantly declining because of loss of habitat or human disturbance, and unless protected will become an endangered species. *(From Vermont Fish and Wildlife Department website, at http://www.vtfishandwildlife.com/learn_more/critter_cirriculum/endangered_and_threatened_species)*

> An **endangered species** generally refers to a species whose continued existence as a viable component of the state's wild fauna or flora is in jeopardy. *(Also from Vermont Fish and Wildlife Department website.)*

Town forest: Land owned by a municipality in order to protect a water supply, produce timber, provide recreation opportunities, supply affordable firewood, maintain wildlife habitat, or other purposes fulfilling a municipality's goals. *(Adapted from Community Strategies for Vermont's Forests and Wildlife, at http://vnrc.org/wp-content/uploads/2013/08/VNRC-Forestland-Conservation-10-1-links.pdf)*

Town plan (or **Municipal plan):** A plan written by a town or municipality to provide a framework toward attaining community aspirations through public investments, land use regulations, and other implementation programs such as a state-designated downtown or village centers, business improvement districts, or land conservation programs. It can also qualify the community for state grants to fund improvements or receive specialized technical assistance. *(From the Vermont Agency of Commerce and Community Development's Planning Manual, at http://accd.vermont.gov/sites/accd/files/PlanningManualModule1low.pdf)*

U

Uncommon Species: These are defined by the Natural Heritage Inventory of the Vermont Fish and Wildlife Department as facing a "moderate risk of extinction or extirpation due to restricted range, relatively few populations or occurrences (often 80 or fewer), recent and widespread declines, or other factors."

> **Rare species** face a higher risk of extirpation and generally have 20 or fewer populations statewide. The Vermont Fish and Wildlife Department uses a ranking scheme to describe the relative rarity of species in Vermont, using a national Natural Heritage methodology.

Upland: An area of high or hilly land. In this guide, uplands are distinguished from the *lowlands* which are the valleys, meadows, and floodplains that surround rivers, lakes, or wetlands.

Use Value Appraisal: Vermont's Use Value Appraisal (UVA) Program (also known as "Current Use") enables eligible private lands where owners practice long-term forestry or agriculture to be appraised based on the property's value of production of wood or food rather than its residential or commercial development value. The Department of Taxes, Division of Property Valuation and Review (PV&R) is the lead agency, but the County Foresters help to administer the Forestry Use Value Appraisal portion of the program. *(From http://fpr.vermont.gov/forest/your_woods/use_value_appraisal, with more information available at the same site.)*

V

Vermont Conservation Design: This phrase refers to a map-based blueprint for conservation developed by the Vermont Fish & Wildlife Department to aid in prioritizing the protection and enhancement of ecological function across Vermont. This blueprint maps the priority and highest priority network that together maintains the ecologically functional landscape, based on the identification of connections between large and intact forested habitat, healthy aquatic and riparian systems, and a full range of physical features (bedrock, soils, elevation, slope, and aspect) on which plant and animal natural communities depend. When conserved or managed appropriately to retain or enhance ecological function, this network will sustain Vermont's natural legacy into the future.

Vernal pool: Vernal Pools are small, ephemeral pools that occur in natural basins within upland forests. They typically have no permanent inlet or outlet streams and generally last only a few months and then disappear by the end of summer, although some pools may persist in wet years. The periodic drying prevents the establishment of fish populations, supporting a specialized assemblage of species that can include amphibians, insects, mollusks, and other invertebrates.

W

Water quality: Water quality measurements can contain diverse components. Assessments could include measures of bacteria levels, the concentration of dissolved oxygen, quantities of solids suspended in the water, algal growth, heavy metals, herbicides, or pesticides. Whether water quality is "good" or "bad" depends on the intended use of the water; water for human consumption may have a different threshold of each measurement than natural ecosystems. However "poor" water quality can pose risks for both human and ecosystem health, if these thresholds are exceeded.

Water resource: Typically, a water resource is a source of water that is useful or potentially useful in some way.

In this guide, the phrase includes all surface water: streams, rivers, lakes, ponds, wetlands, and vernal pools.

Wetland: Wetlands are vegetated ecosystems characterized by abundant water. Wetlands include the vegetated, shallow-water margins of lakes and ponds and the seasonally flooded borders of rivers and streams. They occur in an amazing diversity of topographic settings across the landscape, including basins, seepage slopes, and wet flats. All wetlands have three characteristics in common. First, all are inundated by or saturated with water during varying periods of the growing season. Second, they contain wetland or hydric soils, which develop in saturated conditions and include peat, muck, and mineral soil types. Finally, wetlands are dominated by plants that are adapted to life in saturated or inundated soils. Vermont's wetlands range in size from vernal pools and seeps that may be a few hundred square feet or less to vast swamps and marshes occupying thousands of acres along Otter Creek and Lake Champlain.

Swamps are wetlands dominated by woody plants, either trees or shrubs.

Marshes are wetlands dominated by herbaceous plants.

Fens are peat-accumulating open wetlands that receive mineral-rich groundwater.

Bogs are also peat-accumulating wetlands but are isolated from groundwater or surface water runoff by deep peat and therefore receive most of their water and nutrients from precipitation.

Vernal pools are small, isolated, seasonally inundated wetlands typically surrounded by upland forests.

A **wetland complex** is an area that includes two or more wetlands in close proximity that influence one another in function. The complex area usually includes the riparian areas that connect each wetland to the next.

Wide-ranging species: A species whose movements extend across a large geographic area. Some wide-ranging species move these distances on a regular basis, as when maintaining a large home range to access a variety of food sources (e.g. black bear). Others may move only seasonally (e.g. with a moose that inhabits different habitat types in summer and in winter).

Wildlife: Definitions of "wildlife" vary to a surprising degree. In this guide, we generally include both animals *and* plants in our definition, although the phrase often places emphasis on animals more than plants. In terms of wildlife *management*, fish and other aquatic organisms are often separated when referring to wildlife, with the word emphasizing terrestrial organisms, as in the agency title "Vermont Fish and Wildlife Department." While these words are sometimes

separated for practical management purposes, the agency recognizes fish as a component of *wildlife*, and fish should be assumed to be included in this guide's use of the word.

Wildlife corridor: Components of the landscape that provide a continuous or near continuous pathway that may facilitate the movement of target organisms or ecological processes between areas of core habitat.

Wildlife road crossings: In general, these are locations where animal wildlife are likely to cross roads. In this guide, this phrase often refers to an assessment of structural components, since data on actual wildlife movement is scarce. These structural assessments consider locations where there is forest and/or other natural vegetation on both sides of a road, an absence of guardrails, a gentle gradient, and other roadside factors to predict the ease of movement for a variety of wildlife species. While this assessment is not specific to particular species, it offers a generalized sense of where the greatest variety of species is likely to move. See also **habitat connectivity.**

Working forest: This phrase refers to forests that generate economic benefits. This usually indicates timber but can also include products such as maple syrup, Christmas trees, or other forest products.

Z

Zoning: Zoning bylaws are a regulatory strategy used by local governments to manage land use by defining districts where different uses—houses, car dealerships, day care centers, outdoor recreation, and much more—can occur. Zoning bylaws also regulate physical characteristics of development within each district such as lot sizes, setbacks, and septic system requirements. *(Adapted from Community Strategies for Vermont's Forests and Wildlife, at http://vnrc.org/wp-content/uploads/2013/08/VNRC-Forestland-Conservation-10-1-links.pdf)*

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End Notes

Map 2: Land Cover

[1] There are two land cover data sources available in Vermont: the Coastal Change Analysis Program (C-CAP), displayed here, and the National Land Cover Database (NLCD). The two databases are similar in many ways, and both are equally useful. We chose C-CAP because it is stronger at differentiating between wetland types, but planners with mapping experience who have different goals in mind—identifying agricultural land, for example—may prefer NLCD.

Map 3: Forest Pattern

[1] See http://legislature.vermont.gov/assets/Documents/2016/Docs/ACTS/ACT171/ACT171%20Act%20Summary.pdf for more information about Act 171.

[2] Contact Vermont Fish & Wildlife Department's Community Wildlife Program for more information on conducting field inventories.

[3] The Bobolink Project has management guidelines for grassland birds at http://www.bobolinkproject.com/docs/NRCS_Grassland_leaflet.pdf.

[4] EQIP or other NRCS programs may be available to assist some landowners with these practices. Delaying mowing until after the nesting season is one common practice to help grassland birds.

[5] See https://www.nrcs.usda.gov/wps/portal/nrcs/site/vt/home/ for more information about United States Department of Agriculture programs.

[6] See https://www.fws.gov/lcfwro/pdf/PFW1.pdf for more information about the Partners for Fish & Wildlife Program in Vermont.

[7] See http://www.bobolinkproject.com/docs/NRCS_Grassland_leaflet.pdf.

[8] See http://fpr.vermont.gov/forest/your_woods/mgmt_plans for more information about management plans.

[9] See http://vpic.info/Publications/Reports/Implementation/ImpactFees.pdf to learn more about impact fee programs.

[10] See http://fpr.vermont.gov/forest/your_woods/use_value_appraisal for more information about the Use Value Appraisal (Current Use) program in Vermont.

[11] See http://www.vtcoverts.org/ to learn more about Vermont Coverts.

[12] See http://www.vermontwoodlands.org/ for more information about the Vermont Woodlands Association.

[13] See https://www.nrcs.usda.gov/wps/portal/nrcs/site/vt/home/ for more information about NRCS in Vermont.

[14] See https://www.vacd.org/districts/ for more information about Vermont's Natural Resources Conservation Districts.

[15] See pg. 22 in Community Strategies for Vermont's Forests and Wildlife for more information on using the Current Use program in planning.

[16] See pg. 25 in Community Strategies for Vermont's Forests and Wildlife for more information on using conserving land as a community strategy.

[17] See pg. 31 in Community Strategies for Vermont's Forests and Wildlife for more information on town forests.

[18] See pg. 63 in Community Strategies for Vermont's Forests and Wildlife for more information on Road and Trail Standards.

[19] See pg. 16 in Community Strategies for Vermont's Forests and Wildlife for more information on certification programs.

[20] See pg. 36 in Community Strategies for Vermont's Forests and Wildlife for more information on writing standards for development review.

Map 5: Water

[1] The full citation for this book is: **Chase, V., L. Demming, and F. Latawiec.** 1995. Buffers for Wetlands and Surface Waters: A Guidebook for New Hampshire Municipalities. Concord, NH: Audubon Society of New Hampshire.

[2] DEC's Rivers Webpage has links to many resources, at http://dec.vermont.gov/watershed/rivers.

[3] DEC's Lakes and Ponds Webpage has links to many resources, at http://dec.vermont.gov/watershed/lakes-ponds.

[4] More information about writing clear definitions can be found on pg. 68 in Community Strategies for Vermont's Forests and Wildlife.

[5] See http://dec.vermont.gov/sites/dec/files/wsm/rivers/docs/rv_RiverCorridorEasementGuide.pdf for more information about River Corridor Easements.

[6] See pg. 36 in Community Strategies for Vermont's Forests and Wildlife about writing standards for development review.

[7] Town Road Management Standards can be found at http://dec.vermont.gov/watershed/stormwater/permit-information-applications-fees/municipal-roads-program. Following these standards is required by statute.

[8] See http://fpr.vermont.gov/sites/fpr/files/About_the_Department/Rules_and_Regulations/Library/Riparian%20Final%20Guidelines%20(signed%20copy)_resized.pdf for the guidelines used by the Vermont Agency of Natural Resources in riparian areas of ANR-owned lands.

[9] More information on invasive species can be found at http://anr.vermont.gov/about_us/special-topics/invasive-species.

[10] Find resources about *Green Infrastructure for Homeowners* at the Vermont Department of Environmental Conservation website.

[11] See http://floodready.vermont.gov/improve_infrastructure.

[12] *Acceptable Management Standards for Maintaining Water Quality of Logging Jobs in Vermont is available at* http://fpr.vermont.gov/about_us/rules_regulations/amps.

[13] Learn more about the Vermont Wetland Rules at http://dec.vermont.gov/watershed/wetlands/jurisdictional/rules.

[14] More information about writing clear definitions can be found on pg. 68 in Community Strategies for Vermont's Forests and Wildlife.

[15] See pg. 25 in Community Strategies for Vermont's Forests and Wildlife for more information on using conserved land as a community strategy.

[16] See http://dec.vermont.gov/watershed/wetlands for more information on Vermont Wetlands.

[17] See http://fpr.vermont.gov/sites/fpr/files/Forest_and_Forestry/Your_Woods/Library/Forest%20Land%20Eligibility%20and%20Definitions.pdf for more information on ESTAs.

[18] See pg. 36 in Community Strategies for Vermont's Forests and Wildlife about writing standards for development review.

[19] See pg. 41-62 in Community Strategies for Vermont's Forests and Wildlife.

[20] See Vermont's Wetlands Rules at http://dec.vermont.gov/watershed/wetlands/jurisdictional/rules.

[21] See http://dec.vermont.gov/watershed/wetlands/protect/restore for information about wetlands restoration.

[22] See pg. 63 in Community Strategies for Vermont's Forests and Wildlife for more information on road management standards.

[23] For more information, contact your regional NRCS office.

[24] *Learn more about the National Wetlands Inventory at http://wetlands.fws.gov*

[25] *The Vermont DEC Wetlands Section webpage is at http://www.anr.state.vt.us/dec/waterq/wetlands.htm.*

[26] See http://fpr.vermont.gov/forest/your_woods/mgmt_plans for more information about management plans.

[27] See pg. 36 in Community Strategies for Vermont's Forests and Wildlife about writing standards for development review.

[28] See pg. 50 in Community Strategies for Vermont's Forests and Wildlife for more information about Overlay Districts.

[29] More information about zoning and subdivision regulations is available on pages 41-62 of Community Strategies for Vermont's Forests and Wildlife.

Map 6: Wildlife Resources at the Community and Species Scales

[1] See pg. 25 in Community Strategies for Vermont's Forests and Wildlife for more information on using conserved land as a community strategy.

[2] See pg. 36 in Community Strategies for Vermont's Forests and Wildlife about writing standards for development review.

[3] See http://fpr.vermont.gov/sites/fpr/files/Forest_and_Forestry/Your_Woods/Library/Forest%20Land%20Eligibility%20and%20Definitions.pdf.

[4] Overlay Districts are described on page 50 in Community Strategies for Vermont's Forests and Wildlife.

[5] More information about writing clear definitions can be found on pg. 68 in Community Strategies for Vermont's Forests and Wildlife.

[6] See pg. 25 in Community Strategies for Vermont's Forests and Wildlife for more information on using conserved land as a community strategy.

[7] See pg. 41-54 in Community Strategies for Vermont's Forests and Wildlife for more information about strategies involving zoning.

[8] Learn more about ESTAs through Vermont Department of Forests, Parks, and Recreation. Eligible land is described at http://fpr.vermont.gov/sites/fpr/files/Forest_and_Forestry/Your_Woods/Library/Forest%20Land%20Eligibility%20and%20Definitions.pdf.

[9] See http://anr.vermont.gov/about_us/special-topics/invasive-species for more information about invasive species.

[10] Landowner incentives programs include those found at https://www.nrcs.usda.gov/wps/portal/nrcs/site/vt/home/, https://www.fws.gov/lcfwro/pdf/PFW1.pdf, http://www.vtfishandwildlife.com/get_involved/partner_in_conservation/eqip_for_wildlife_habitat, or http://fpr.vermont.gov/forest/your_woods/cost_share.

[11] See pg. 25 in Community Strategies for Vermont's Forests and Wildlife for more information on using conserved land as a community strategy.

[12] See pg. 41-54 in Community Strategies for Vermont's Forests and Wildlife for more information about strategies involving zoning.

[13] Learn more about ESTAs through Vermont Department of Forests, Parks, and Recreation. Eligible land is described at http://fpr.vermont.gov/sites/fpr/files/Forest_and_Forestry/Your_Woods/Library/Forest%20Land%20Eligibility%20and%20Definitions.pdf.

[14] Learn more about town forests on page 31 of Community Strategies for Vermont's Forests and Wildlife.

[15] More information about writing clear definitions can be found on pg. 68 in Community Strategies for Vermont's Forests and Wildlife.

[16] See pg. 25 in Community Strategies for Vermont's Forests and Wildlife for more information on using conserved land as a community strategy.

[17] See pg. 36 in Community Strategies for Vermont's Forests and Wildlife about writing standards for development review.

[18] See pg. 41-54 in Community Strategies for Vermont's Forests and Wildlife for more information about strategies involving zoning.

[19] Learn more about Access Management at http://vnrc.org/resources/community-planning-toolbox/tools/access-management/.

[20] Learn more about improving culverts and road infrastructure at http://floodready.vermont.gov/improve_infrastructure/roads_culverts.

[21] See pg. 41-54 in Community Strategies for Vermont's Forests and Wildlife for more information about strategies involving zoning.

[22] See pg. 25 in Community Strategies for Vermont's Forests and Wildlife for more information on using conserved land as a community strategy.

[23] Learn more about ESTAs through Vermont Department of Forests, Parks, and Recreation. Eligible land is described at http://fpr.vermont.gov/sites/fpr/files/Forest_and_Forestry/Your_Woods/Library/Forest%20Land%20Eligibility%20and%20Definitions.pdf.

[24] See pg. 36 in Community Strategies for Vermont's Forests and Wildlife about writing standards for development review.

Determining the Ecological Context

[1] The Common Natural Communities category captures several elements that appear in Part I as their own entities, including deer wintering habitat.

Including Community Values

[2] Learn more about the Vernal Pool Mapping Project and the Vermont Center for Ecostudies at https://vtecostudies.org/projects/forests/vernal-pool-conservation/vermont-vernal-pool-mapping-project/.

Developing and Choosing Options

[3] Learn more about Vermont's Use Value Appraisal program at http://fpr.vermont.gov/forest/your_woods/use_value_appraisal.

[4] The Planning Manual is available online at http://accd.vermont.gov/community-development/town-future/municipal-planning-manual.

[1] Learn more about Municipal Planning Grants at http://accd.vermont.gov/community-development/funding-incentives/municipal-planning-grant.

Appendix A: Strategies and Components

[1] Contact Vermont Fish & Wildlife Department's Community Wildlife Program for more information on conducting field inventories, at http://www.vtfishandwildlife.com/cms/one.aspx?pageId=132648.

[2] More information about writing clear definitions can be found on pg. 68 in Community Strategies for Vermont's Forests and Wildlife.

[3] See http://www.vtfishandwildlife.com/learn_more/landowner_resources for resources available through Vermont Fish & Wildlife Department. Vermont Department of Forests, Parks, and Recreation has additional resources at http://fpr.vermont.gov/forest/your_woods.

[4] See pg. 36 in Community Strategies for Vermont's Forests and Wildlife about writing standards for development review.

[5] For more information, see http://vtconservation.com/about-conservation-commissions/.

[6] See pg. 31 in Community Strategies for Vermont's Forests and Wildlife for more information about Conservation Funds and Town Forests.

[7] See pg. 54 in Community Strategies for Vermont's Forests and Wildlife for more information about subdivision regulations.

[8] See http://fpr.vermont.gov/forest/your_woods/use_value_appraisal for more information about Vermont's Use Value Appraisal program.

[9] See pg. 25 in Community Strategies for Vermont's Forests and Wildlife for more information on using conserved land as a community strategy.

[10] See pg. 31 in Community Strategies for Vermont's Forests and Wildlife for more information about Conservation Funds and Town Forests.

[11] See http://fpr.vermont.gov/forest/your_woods/mgmt_plans for more information about management plans.

[12] See http://vpic.info/Publications/Reports/Implementation/ImpactFees.pdf to learn more about Impact Fees.

[13] See http://fpr.vermont.gov/forest/your_woods/use_value_appraisal for more information about Vermont's Use Value Appraisal program.

[14] The Vermont Coverts website can be found at http://www.vtcoverts.org/

[15] See http://www.vermontwoodlands.org/ for the Vermont Woodlands Association webpage.

[16] See https://www.nrcs.usda.gov/wps/portal/nrcs/site/vt/home/ for the Vermont NRCS webpage.

[17] See https://www.vacd.org/districts/ to learn more about Natural Resources Conservation Districts across Vermont.

[18] Learn more about Local Tax Stabilization on page 22 of Community Strategies for Vermont's Forests and Wildlife.

[19] See pg. 25 in Community Strategies for Vermont's Forests and Wildlife for more information on using conserved land as a community strategy.

[20] See pg. 31 in Community Strategies for Vermont's Forests and Wildlife for more information about Conservation Funds and Town Forests.

[21] More information about road and trail policies can be found on page 63 in Community Strategies for Vermont's Forests and Wildlife.

[22] See pg. 16 in Community Strategies for Vermont's Forests and Wildlife for strategies to sustain working forests.

[23] See pg. 36 in Community Strategies for Vermont's Forests and Wildlife about writing standards for development review.

[24] See pg. 25 in Community Strategies for Vermont's Forests and Wildlife for more information on using conserved land as a community strategy.

[25] To learn more about River Corridor Easements, see http://dec.vermont.gov/sites/dec/files/wsm/rivers/docs/rv_RiverCorridorEasementGuide.pdf.

[26] See pg. 36 in Community Strategies for Vermont's Forests and Wildlife about writing standards for development review.

[27] Town Road Management Standards can be found at http://dec.vermont.gov/watershed/stormwater/permit-information-applications-fees/municipal-roads-program. Following these standards is required by statute.

[28] See http://fpr.vermont.gov/sites/fpr/files/About_the_Department/Rules_and_Regulations/Library/Riparian%20Final%20Guidelines%20(signed%20copy)_resized.pdf for the guidelines used by the Vermont Agency of Natural Resources in riparian areas of ANR-owned lands.

[29] Learn more about invasive species at http://anr.vermont.gov/about_us/special-topics/invasive-species.

[30] Find resources about *Green Infrastructure for Homeowners* at the Vermont Department of Environmental Conservation website.

[31] See http://floodready.vermont.gov/improve_infrastructure.

[32] Learn more about acceptable management practices at http://fpr.vermont.gov/about_us/rules_regulations/amps.

[33] EQIP or other NRCS programs may be available to assist some landowners with these practices. Delaying mowing until after the nesting season is one common practice to help grassland birds.

[34] See http://www.bobolinkproject.com/docs/NRCS_Grassland_leaflet.pdf.

[35] See https://www.nrcs.usda.gov/wps/portal/nrcs/site/vt/home/.

[36] See https://www.fws.gov/lcfwro/pdf/PFW1.pdf for a brochure about the Partners for Fish & Wildlife program in Vermont.

[37] See http://www.bobolinkproject.com/docs/NRCS_Grassland_leaflet.pdf.

[38] See pg. 25 in Community Strategies for Vermont's Forests and Wildlife for more information on using conserved land as a community strategy.

[39] See pg. 36 in Community Strategies for Vermont's Forests and Wildlife about writing standards for development review.

[40] See http://fpr.vermont.gov/forest/your_woods/use_value_appraisal for more information about Vermont's Use Value Appraisal program.

[41] Conservation zoning is described on page 41 in Community Strategies for Vermont's Forests and Wildlife.

[42] Overlay districts are described on page 50 in Community Strategies for Vermont's Forests and Wildlife.
[43] Learn more about Access Management at http://vnrc.org/resources/community-planning-toolbox/tools/access-management/.

[44] Information about conservation easements is available on page 25 in Community Strategies for Vermont's Forests and Wildlife.

[45] See pg. 41-54 in Community Strategies for Vermont's Forests and Wildlife for more information about strategies involving zoning.

[46] Learn more about ESTAs through Vermont Department of Forests, Parks, and Recreation. Eligible land is described at http://fpr.vermont.gov/sites/fpr/files/Forest_and_Forestry/Your_Woods/Library/Forest%20Land%20Eligibility%20and%20Definitions.pdf.

[47] See pg. 31 in Community Strategies for Vermont's Forests and Wildlife for more information about Conservation Funds and Town Forests.

[48] Learn more about invasive species at http://anr.vermont.gov/about_us/special-topics/invasive-species.

[49] A few incentives programs can be found at https://www.nrcs.usda.gov/wps/portal/nrcs/site/vt/home/, https://www.fws.gov/lcfwro/pdf/PFW1.pdf, http://www.vtfishandwildlife.com/get_involved/partner_in_conservation/eqip_for_wildlife_habitat, or http://fpr.vermont.gov/forest/your_woods/cost_share.

[50] Information about management plans can be found at http://fpr.vermont.gov/forest/your_woods/mgmt_plans.

[51] See pg. 36 in Community Strategies for Vermont's Forests and Wildlife about writing standards for development review.

[52] Overlay districts are described on page 50 in Community Strategies for Vermont's Forests and Wildlife.

[53] See pg. 41-62 in Community Strategies for Vermont's Forests and Wildlife.

[54] See pg. 25 in Community Strategies for Vermont's Forests and Wildlife for more information on using conserved land as a community strategy.

[55] See the Vermont Department of Environmental Conservation's Wetlands page at http://dec.vermont.gov/watershed/wetlands.

[56] Learn more about ESTAs through Vermont Department of Forests, Parks, and Recreation. Eligible land is described at http://fpr.vermont.gov/sites/fpr/files/Forest_and_Forestry/Your_Woods/Library/Forest%20Land%20Eligibility%20and%20Definitions.pdf.

[57] See pg. 36 in Community Strategies for Vermont's Forests and Wildlife about writing standards for development review.

[58] See pg. 41-62 in Community Strategies for Vermont's Forests and Wildlife.

[59] Find Vermont's Wetlands Rules at http://dec.vermont.gov/watershed/wetlands/jurisdictional/rules.

[60] Learn more about wetland restoration at http://dec.vermont.gov/watershed/wetlands/protect/restore.

[61] More information about road and trail policies is available on page 63 in Community Strategies for Vermont's Forests and Wildlife.

[62] For more information, contact your regional NRCS office.

[63] See pg. 25 in Community Strategies for Vermont's Forests and Wildlife for more information on using conserved land as a community strategy.

[64] For example, see *Landowner Guide: Habitat Management for Lands in Vermont, available at* http://www.vtfishandwildlife.com/cms/one.aspx?portalid=73163&pageid=216868.

[65] See http://www.vtfishandwildlife.com/common/pages/DisplayFile.aspx?itemId=111637 for guidance on optimizing mast yield.

[66] For more information, contact your regional NRCS office.

[67] See pg. 36 in Community Strategies for Vermont's Forests and Wildlife about writing standards for development review.

[68] Learn more about ESTAs through Vermont Department of Forests, Parks, and Recreation. Eligible land is described at http://fpr.vermont.gov/sites/fpr/files/Forest_and_Forestry/Your_Woods/Library/Forest%20Land%20Eligibility%20and%20Definitions.pdf.

[69] See pg. 25 in Community Strategies for Vermont's Forests and Wildlife for more information on using conserved land as a community strategy.

[70] Overlay Districts are described on page 50 in Community Strategies for Vermont's Forests and Wildlife.

[71] Learn more about ESTAs through Vermont Department of Forests, Parks, and Recreation. Eligible land is described at http://fpr.vermont.gov/sites/fpr/files/Forest_and_Forestry/Your_Woods/Library/Forest%20Land%20Eligibility%20and%20Definitions.pdf.

[72] See pg. 36 in Community Strategies for Vermont's Forests and Wildlife about writing standards for development review.