# CHAPTER 4: NATURAL RESOURCES

## BACKGROUND

Natural resources are elements such as forests, mineral deposits, or fresh water, which are necessary or useful to humans. A natural resource's value is derived through either an economic use or through its conservation for continued future access and public benefit. Beneficial use and conservation of natural resources begins with an understanding of the complex balance of energy, ecosystems, and all living organisms. This interconnected web of life-support systems makes the sustainability of natural resources both a global and a local issue. Rapid consumption, misuse, or degradation can deplete and destroy both renewable and non-renewable natural resources.

The Windham Region is fortunate to have a wealth of valuable natural resources. Extensive forested lands, prime agricultural soils, river valleys, upland streams, and wetlands create a diversity of ecosystems in the region that sustain numerous plant and animal communities in addition to supporting human habitation. These interconnected ecosystems, consisting of humans, animals, plants, earth, air, and water, can be sustained through careful resource use and conservation.

The Windham Regional Commission continues to assist Towns in planning efforts to protect these resources, collaborates with regional and state-wide organizations who are working in our region, and focuses on education as a means of promoting natural resource knowledge and protection.

## FOREST RESOURCES

### REGIONAL OVERVIEW

Vermont's forests have recovered from a time when agriculture dominated a largely treeless landscape, followed by heavy logging of the young forests that first colonized the unused farmlands. These habitat changes have altered the relative abundance of various plant and animal species. With the maturing of today's forest, a mosaic of fields, pastures and woodlots in rural portions of the region has been shifting to a forested landscape punctuated by residential and recreational development, roadways, and powerline corridors. By contrast, in and around villages and other settled areas, an expansion of suburban development onto former farms and farm woodlots is reducing forest acres and lowering their productivity. Forested areas dominate the region at 82.8% of the

landcover. [1]

## A MULTI-VALUED RESOURCE

Forests play a major role in the ecological, economic, and social health of the region. As a major component of our landscape, forests are a mix of rich ecological habitats for wildlife that support flora and fauna, contribute to water and air quality, make a significant contribution to reducing climate change effects though carbon sequestration, and form the environmental setting for human activity. Forest land provides employment to foresters, loggers, truckers, artisans, and forest-product manufacturers, and also supports a thriving recreation and tourism industry. In an increasingly populous and urban world, the region's forests offer reminders of Vermont's heritage and a traditional, rural lifestyle that appeal to residents and visitors alike.

These multiple and inter-related values create the potential for conflict and a need for thoughtful planning and management that embodies sound silvicultural practices while permitting multiple, compatible uses and for some fraction set aside as permanently protected natural areas. While it is clear that economic pressures can threaten many forested lands with conversion to non-forest uses, it is important to acknowledge that forest resource values are also threatened or degraded if these lands cannot be maintained in large, interconnected blocks. Fragmentation of large wood lots into smaller parcels with multiple owners decreases the practicality of commercial timber harvest, and diminishes the ability to use sound sustainable forest management practices.

## FOREST ECONOMICS

With 82.8% of the region being forested, the region's forestry industry is one of the state's leading producers, especially of high-quality northern hardwoods and white pine. Eighty eight percent of the region's forests are in private, non-industrial ownership, with industrial firms and Federal, State and local governments sharing the rest. The headwaters of the region's major streams and rivers are heavily buffered by forestland, preserving soils, and water purity at the source. Nevertheless, steady population growth, dispersed settlement patterns, and second-home development have increased development pressure in forested areas.

Forests make a significant contribution to the economy of the Windham Region, leading the State in Sawlog and Veneer log harvest.[2] In past years, the forest products industries as a group had been a leader in the regional manufacturing sector in number of establishments and number of employees; however, recent trends have shown that the number of establishments has decreased as other sectors have risen. The forest industry has also slipped behind other types of manufacturing in the region in terms of payroll and average wage.[3] Recent economic

[1] 2021 national Cover Dataset. Assumption made that forested wetlands is counted as wetlands and developed open land is counted as open.

[2] Vermont Department of Forests, Parks & Recreation, Vermont Harvest Report 2022, https://fpr.vermont.gov/sites/fpr/files/documents/Harvest_Report_2022.pdf

[3] Vermont Department of Labor Economic & Labor Market Information, Covered Employment and Wages, Windham County 2022,

hardship, caused by a slowing economy, resulted in some forest owners cutting timber intensively without regard for good forest management practices, leading to forest land that will not produce high quality timber for many years to come. Other forestland in the region has been sold for development. Research suggests, however, that the private owners of the great majority of the region's forests are not motivated by economic pressures alone, but highly value the non-economic resource attributes of their land. The top three reasons for forest ownership has been reported as 1) to enjoy scenery and beauty, 2) to protect or improve wildlife habitat and 3) to protect nature of biological diversity.[4] Nevertheless, the typical forestland owner is of mature age, and the potential for permanent conversion to non-forest uses looms large when ownership passes to the next generation, who may or may not have similar views in forest ownership. Two strategies have proven effective over time in keeping forestland intact, the Use-Value Appraisal Program in the short-term and the purchase of conservation easements in the long-term. Each of these programs should be supported and used in appropriate situations to help maintain the forest economy in Windham Region.

### THE FOREST'S SOCIAL VALUE

The region's forests offer a rich selection of recreational options. Skiing and snowboarding, snowmobiling, mountain biking, hiking, hunting and fishing, wildlife observation and photography, and foliage appreciation all are popular in their seasons. Many view forestlands as valuable as a precious natural environment and a source of solitude, as well as a host for recreation and forest-based employment. The resource accommodates and satisfies this wide range of values, although some competing uses may at times be in conflict. State and Federal public lands offer opportunities for a backcountry wilderness experience that individual private lands in smaller block sizes cannot match, and they also support the most concentrated commercial recreation in the form of ski resorts. In spite of this, private lands dominate the forested landscape, and their contribution to recreation and aesthetics is essential. The management of forest resources needs to happen at a larger scale than most individual parcels have available. As such, it is important to work in cooperation with landowners and through public planning processes help preserve the value of larger forested blocks in the region.

## ISSUES FACING THE REGION'S FORESTS

### FRAGMENTATION

Fragmentation of the forested landscape can be caused by any number of development activities. Subdivision of

http://www.vtlmi.info/indareanaics.cfm

[4] The Efficacy of Wildlife Conservation Assistance Programs for Vermont Family Forest Owners (2020) by Meg Harrington and Brett Butler

land and construction of new homes and businesses, and their attendant infrastructure, create smaller, separated, even isolated parcels that are too small or inaccessible to be managed or harvested efficiently. Sales by long-term industrial owners may add to this trend. Even if these lots are not developed, there is often a change in attitude of the landowners and a decrease in the land base available for management. This can affect the movement of wildlife across the landscape, the sharing of genetic information between different populations of plants and animals, people employed in the forest products industry and decrease opportunities for recreational activities.

Fragmentation is especially harmful to wildlife as habitats and habitat elements are eliminated or separated. With multiple owners and smaller woodlots the consistency of management practices that favor wildlife, and the connectivity among tracts of land is lost, with a result that can be detrimental to wildlife diversity and species vitality. Fragmentation also relates to climate change impacts influencing how animals will move and adapt as temperatures warm and forest tree species composition changes.

Act 171 was signed into law in June of 2016, amending Vermont's planning statutes to allow regions and municipalities to plan for management of forest and wildlife resources. Statute provides the following definitions for forest blocks and habitat connectors:

- **Forest block:** a contiguous area of forest in any stage of succession and not currently developed for non-forest use. A forest block may include recreational trails, wetlands, or other natural features that do not themselves possess tree cover, and uses exempt from regulation under subsection 4413(d) of this title.
- **Habitat connector:** land or water, or both, that links patches of wildlife habitat within a landscape, allowing the movement, migration, and dispersal of animals and plants and the functioning of ecological processes. A habitat connector may include recreational trails and uses exempt from regulation under subsection 4413(d) of this title. In a plan or other document issued pursuant to this chapter, a municipality or regional plan commission may use the phrase "wildlife corridor" in lieu of "habitat connector."

A look at the larger forested landscape pattern shows our forests are being fragmented by rural sprawl. It occurs incrementally, beginning with cleared swaths or pockets of non-forest within an otherwise unbroken expanse of tree cover. Over time, non-forest pockets tend to multiply and expand. Eventually the forest is fragmented and reduced to scattered, disconnected forest islands. These remnant forest islands are surrounded by land uses that threaten the health, function, and value of them for animal and plant habitat, and for human use. As forest fragments become smaller, practicing forestry can become operationally impractical, economically nonviable, and culturally unacceptable. In turn, we lose the corresponding and significant contributions that forestry makes to our economy and culture.

Forest pattern addresses the configuration of forest blocks and habitat connectors. The pattern is the degree to which forest blocks and habitat connectors connect across the landscape or within a particular town. A healthy forest pattern is one where a town's largest forest blocks connect to one another via smaller forest blocks and riparian areas. These large blocks also connect to large forest blocks beyond the town boundaries. This healthy forest pattern is a network of contiguous streams and forest blocks that extends across town, interrupted only by a few roads or non-forest land cover (see Forest Blocks Map).

The degree of ecological functionality and connectivity varies with landscape condition. Conservation of only narrow threads of vegetative cover within a developing landscape will not maintain an area's ecological values, biological diversity, or plant and animal habitat needs. However, vegetative corridors can serve as habitat connectors. Conservation of vegetative corridors in conjunction with the maintenance of forest blocks with diverse habitat conditions will assist in supporting ecosystem functions and related public benefits.

An ecologically functional landscape is especially important in the context of climate change. Populations of species are already adjusting their home ranges to adapt to new conditions. Northward migration is occurring in response to warming temperatures, as well as in response to more complex changes in soil moisture and micro-climates. Movement resulting from climate change may also occur in more than one direction. Therefore, the overall network of connected lands and waters made up of forest blocks and habitat connectors in Vermont and throughout the northeast region is instrumental in allowing for migration of both plants and animals as our climate changes.

Forest uses directly serving economic ends must be reconciled with the need for large, undeveloped and relatively undisturbed, and interconnected blocks of forest that can meet the habitat needs of wide-ranging wildlife while minimizing human-wildlife conflicts. Forested sites of special natural value need identification and may require protection. Education aimed at improving understanding and appreciation by landowners and by the general public of the natural communities within the forest is essential to striking the right balance between natural, economic, and social uses of those resources. Conservation of forested helps ensure that large tracts of forested land will remain off limits to development and ensure the multiple productive, wildlife and scenic values of this resource.

### DIMINISHED ECOLOGICAL DIVERSITY

Forested lands contribute to ecological diversity that will allow a healthy mix of plant and animal communities to thrive. Reduced plant diversity and change in forest structure (elimination of the mid-story and expansion of ferns) negatively affects wildlife diversity. There are a few different reasons why there may be diminished ecological diversity in the future. One factor working against such diversity is the impact of deer herd browsing on

saplings. The state of Vermont has been keeping a close watch on deer heard numbers and base yearly hunting regulations on deer health and population.

Another factor is the increasing numbers of invasive plant and animal pest species that displace native plants and animals. There is a correlation between invasive plant species taking hold in our region's forests and reduced densities of tree seedlings. Invasive pests, such as the Emerald Ash Borer, will likely change the nature of the region's forests as the amount of living Ash trees decreases.

With the need to manage for ecological diversity in a changing climate, there is an important role for planning in facilitating private landowner cooperation at the regional, town or neighborhood level.

### CHANGING DEMOGRAPHICS

The changing demographics of the Windham Region, particularly in woodland ownership, are beginning to have an effect on forest management practices, as well as on public perceptions, attitudes and influence on regional forestry policies. Some research indicates that new woodland owners in the Windham Region, and in Vermont in general, are younger and less traditionally "land-connected" than historic owners, and that these younger owners are more likely to sell or subdivide their woodlands.

## MAINTAINING THE REGION'S WOODLAND LEGACY

Approximately two-thirds of the land area in the Windham Region remains in parcels larger than 50 acres in size. Stronger local policies can be enacted to promote the viability of forestland, especially on intact parcels between 50 and 100 acres. Some forest resource protection tools available to towns include;[5]

- Designating a forest zoning district (24 V.S.A. § 4414, (1)(B)(ii))
- Requiring new developments to have smaller road setbacks, small lot sizes, clustered development, and land in conservation helps minimize forest fragmentation
- Encouraging development in existing growth centers to help prevent further fragmentation of natural resources
- Enacting overlay districts to restrict development in buffer areas near lakes, ponds, streams, rivers or steep slopes
- Developing subdivision bylaws that require development be kept away from sensitive areas as a

[5] The Conway School Student Project, *Woodlands of the Windham Region: Our Working Landscape*, 2013.

requirement for obtaining subdivision approval. It is important to note that "sensitive areas" should be identified and defined prior to enactment of the subdivision bylaws.

There are numerous resources for town officials and woodland owners to learn about forest management options, Acceptable Management Practices (AMP's) for maintaining water quality on logging jobs, and climate resiliency in our changing forests. Many organizations, such as Vermont Woodlands and Vermont Coverts provide training and peer to peer connections statewide. In the Windham Region, the Windham Regional Woodlands Association promotes education, conservation science, and recommended forestry practices. Professional programs for loggers and other forest workers (for example, the Vermont Logger Education, Training and Certification program and the Game of Logging program) have increased safety levels and improved forestry practices. Recreational use of forestland is enhanced by a variety of educational programs, such as those offered by the Bonnyvale Environmental Education Center of Brattleboro and the Nature Museum of Grafton.

At the State level, legislative intervention in forest-management practices and changes in forestland taxation under the Use Value Appraisal (Current Use) Program have affected both industrial and private ownership. In particular, private owners have created or inherited long-term management plans that are professionally monitored. At this time there are approximately 140,000 forested acres, or 27.6% percent of forests in the Windham Region, enrolled in the Use Value Appraisal Program, which is nearly 50% of the land that is eligible.

The Use Value Appraisal program offers a moderate amount of protection for forestland; however, owners can always withdraw from the program by paying a penalty fee, and then are free to develop their land. Permanent protection of forest land is best achieved through increased funding to support conservation easements. Land Trusts and non-profit land conservation groups are very effective in permanently conserving land and have been steadily adding more forest to the Windham Region's inventory of lands protected through conservation easements.

### WORKING LANDS ENTERPRISE INITIATIVE

The Working Lands Enterprise Initiative mission is to strengthen and grow the economies, culture and communities of Vermont's working landscape. The Working Lands Enterprise Fund invests in the working lands economy by: giving grants to small and start-up working lands businesses; supporting working lands service providers that are starting up or in a growth phase; and investing in infrastructure to supporting working lands.

# SURFACE WATERS

Surface waters are prominent landscape features that have often determined both the location and form of regional settlement. Surface waters include lakes and ponds (both natural and impounded), rivers and streams (permanent and intermittent), vernal pools, and wetlands (see Water Resources Map). The region's abundant surface waters are critical for sustaining ecological systems and provide numerous valuable resources. The region's landscape is 4.7% covered by water and wetlands.[6]

## RIVER BASINS AND WATERSHEDS

The majority of the Windham Region is located within the Connecticut River Basin with small portions located in the Hudson River and Lake Champlain Basins. These basins contain many rivers and tributaries, each with their own unique watersheds. Table 5-1 shows the Windham Region's major watersheds and their respective acreage. A map of the major river basins is available in the map section, Basins and Watersheds Map.

TABLE 5-1: WINDHAM REGION WATERSHEDS

| Watershed | State Watershed Basin Number | Acreage in Region | Percent of Region |
|---|---|---|---|
| **Connecticut River Basin** | | 582,598 | 99.0% |
| **West, Williams and Saxtons Rivers** | 11 | 306,150 | 52.0% |
| **Deerfield River** | 12 | 172,221 | 29.0% |
| **Lower Connecticut River** | Now incorporated into Basins 11 and 12 | 104,237 | 18.0% |
| **Lake Champlain Basin** | | 660 | 0.1% |
| **Otter Creek** | 3 | 660 | 0.1% |
| **Hudson River Basin** | | 6,630 | 1.0% |
| **Batten Kill** | 1 | 6,630 | 1.0% |
| **Total** | | 589,888 | 100.0% |

*Source: Windham Regional Commission GIS Department*

[6] 2021 National Cover Dataset. Forested wetlands were counted as wetlands for a breakdown of landcover for the region.

## LAKES AND PONDS

Within the watersheds of the Windham Region, there are 33 lakes and ponds over 20 acres in area. These water bodies provide their own special habitats and recreational opportunities, as well as conservation and water quality issues. Some of the issues particularly pertinent to lakes and ponds are exotic invasive species such as Eurasian watermilfoil, competing recreational uses, dam management, and extraction of water for snowmaking and other commercial uses.

The Vermont Watershed Management Division's Lakes and Ponds Section developed the Lake Score Card to provide a method for conveying the large amount of data gathered through their monitoring efforts. The Score Card rates Vermont lakes in terms of water quality, aquatic invasive species, atmospheric pollution, and shoreland and lake habitat. Most of the lakes within the Windham Region are in good condition for water quality and invasive species parameters. The region has many lakes who score in fair condition for mercury pollution, which comes from atmospheric deposition.

## RIVERS AND STREAMS

Rivers and streams are dynamic systems that are constantly shifting in response to streamflow and ecological conditions making them complicated to understand. As a result, thorough study is required to understand how different sections of a stream relate to each other. Rivers and streams are critical waterways that provide vital breeding, resting, and feeding areas for fish, birds, and other wildlife species as well as critical habitat for plants, including rare, threatened, and endangered species. Rivers and streams provide water for drinking and domestic use, for generating electricity, for powering machinery, for irrigating crops, and for transporting goods. They enhance the beauty of the landscape and the quality of scenic and recreational experiences in the region. Healthy rivers and streams also provide vital ecological services such as helping to purify water, transport water and nutrients through the region, and moderate floods and droughts.

Undeveloped and undisturbed land along rivers and streams (riparian buffers) and along the shores of lakes and ponds (lacustrine buffers) are important for a number of reasons. They provide water quality values in terms of shade (temperature), pollutant filtration, and bank stability. They also provide habitat values both in the water, including direct sources of food and shelter for fish, and on shore, including viable habitat for plants and feeding, foraging, and travel corridors for wildlife. Finally, undeveloped waters shorelines provide a direct benefit to society in terms of scenery, recreation, and in many cases, buffering of flood waters.

### FLOODPLAINS

Floodplains are lowlands along rivers, streams, and lakes that periodically become inundated with water during

periods of high rainfall or spring runoff. They are important to the healthy functioning of river systems for retaining and infiltrating waters that might cause damage or destruction downstream. Floodplains are often the best agricultural lands because of their thick glacial deposits, minimum slope and proximity to surface water. Floodways are stream channels and adjacent floodplain areas that carry the bulk and force of the river's flow, and must be kept free of encroachment.

Nearly three-quarters of Vermont streams have become disconnected from their historic floodplains through human impacted changes to the landscape. A stream's lack of access to its floodplain, including many wetland areas, creates an unstable condition in which the stream no longer has its "release valve" or ability to dissipate energy out of the stream channel and onto the surrounding landscape. Excessive streambank erosion, depositing of sediments, fast moving floodwaters, and increased damage to infrastructure and vulnerable development are all potential outcomes of a stream or river that has lost connection with its floodplain.[7]

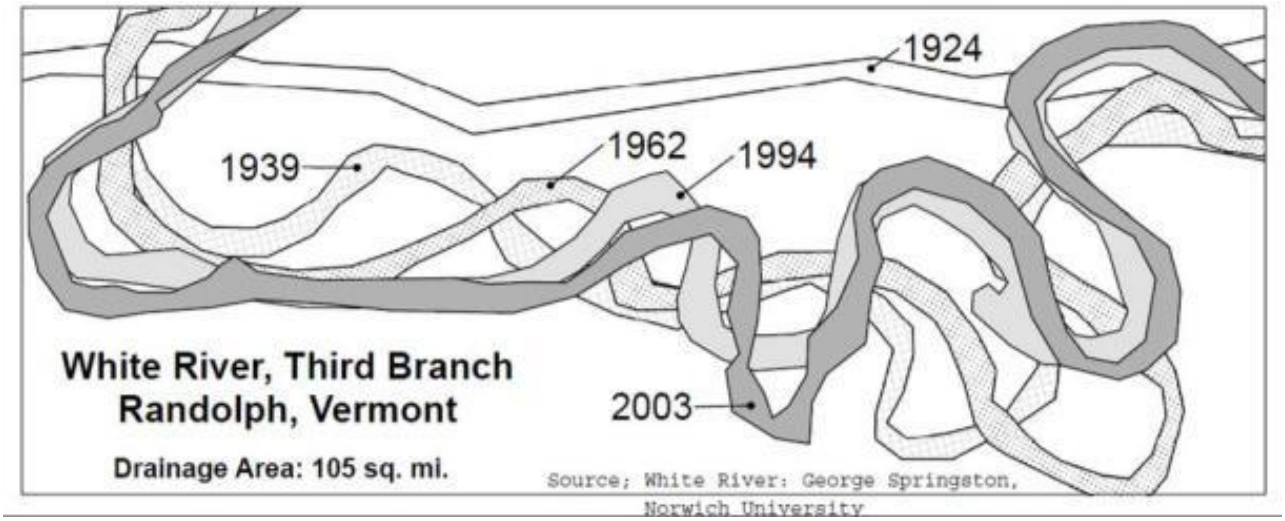
## RIVER CORRIDORS

Fluvial (or river-related) erosion refers to major streambed and stream bank 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. The mapped area subject to fluvial erosion risk is called the river corridor.

Rivers and streams are not static in the landscape. The shape of a river channel, including its width, depth, pattern, and slope, changes over time due to the action of water, sediment, and debris from the surrounding watershed as shown in the example (Figure 5-5). Rivers in "dynamic equilibrium" carry water, sediment, and debris, even during high water, without changes occurring in the depth, width, length, or slope of the channel. The channel may move and shift position within the landscape, but these other factors remain relatively constant. Human development, especially within river corridors, that significantly alters the runoff pattern of water and sediment can disrupt the equilibrium of a river system. When development changes the relationship of the river with its floodplain or constrains the river from maintaining or re-establishing equilibrium conditions, the result is often costly losses due to erosion. This erosion can also contribute to increased sediment and nutrients that can compromise water quality and aquatic habitat.

[7] Friends of the Winooski River, *Living in Harmony with Streams: A Citizen's Handbook to How Streams Work*, http://www.vtwaterquality.org/rivers/docs/rv_streamguide.pdf.

FIGURE 5-1: WHITE RIVER CHANNEL OVER TIME




*Source: Agency of Natural Resources DEC Watershed Management Division*

The degree of adjustment that streams will go through to establish and maintain equilibrium (having a dimension, pattern, and profile where erosion is minimized) is significant and a changing landscape makes finding that equilibrium more difficult. It is not safe or environmentally sound to encroach within a river corridor, as these areas are naturally unpredictable and are changing to seek equilibrium. Consideration of stream geomorphology and long-term river dynamics in land-use decision-making can protect and restore water quality and habitats, and mitigate damages and economic losses incurred as a result of floods and fluvial erosion.

## FLOOD RESILIENCY

The Windham Region is vulnerable to the destructive impacts of the region's surface waters as we are reminded on an increasingly frequent basis. Although flooding is common in the Region, the severity of both Tropical Storm Irene in 2011 and the flooding of July 2023 raised considerable public awareness and community discussions about the need to address flood resiliency. Resiliency is the ability of a community to respond and adapt to natural and human-caused disasters. Potential flood damage in this region is exacerbated by a combination of frequent intense storm events and traditional settlement patterns which historically placed road networks, villages, and other development along river and stream corridors, often within the floodplain and river corridor.

Flooding is a natural ecological process. While river and stream channels serve to convey water downstream, floodplains and wetlands are critical for the infiltration and temporary storage of water during large storm events, thereby reducing peak flows and mitigating flooding downstream. Each of these ecosystems fulfills critical functions that have significant downstream benefits and thus should be preserved to the greatest extent possible.

Experience has repeatedly demonstrated that development in floodplains and river corridors, and especially in floodways, is inherently dangerous, due both to the immediate hazards associated with flood water inundation and to the increased flooding that may occur downstream when developed floodplains are no longer capable of retaining flood waters. Such development can also interfere with the function and quality of waterways, floodplains, and wetlands. While engineering techniques may help to mitigate the consequences of flooding on development within floodplains and river corridors, the fact that development *can* take place in these areas does not mean that development *should* occur in these areas. Development in river and stream corridors fundamentally places life and property at risk, and may exacerbate problems downstream. Towns are encouraged to develop policies and regulatory and non-regulatory local strategies to protect floodplains and river corridors.

There are many tools available to the region and towns for assessing their waterways and for promoting development that will allow existing waterways and future development to co-exist in a manner respectful of each other's needs. These tools include Stream Geomorphic Assessments, River Corridor Plans, Stormwater Master Plans, and Bridge and Culvert assessments. The Vermont Watershed Management Division has multiple guidance documents and reports available to towns and groups interested in pursuing this type of assessment.

## NATIONAL FLOOD INSURANCE PROGRAM

Under the National Flood Insurance Program (NFIP), the Federal Emergency Management Agency makes insurance available to property owners in communities that implement and enforce zoning bylaws that meet standards to reduce future flood risk to new development and improvements to existing development. A major purpose of the NFIP is to alert communities to the danger of flooding and to reduce flood related property damage. The only option for property owners seeking flood insurance in a community that does not participate in the NFIP is to purchase it through the private insurance market, which can be more costly.

Special Flood Hazard Areas (SFHAs) are officially designated on Federal Insurance Rate Maps (FIRMs), prepared and published by the Federal Emergency Management Agency. The current FIRMs in Vermont are dated and map updates are a digitization of old data; therefore, in many instances SFHAs do not reflect the realistic extent of flood prone areas. For this reason, and to more accurately and adequately regulate the risk, communities should regulate both the SFHA and the river corridor. Communities can also adopt more stringent standards than the minimum measures acceptable for NFIP participation as a way to lessen the gap between the older map data and the true risk. As well, property owners that have built structures that may be subject to flooding or fluvial erosion are able to purchase flood insurance regardless if they are located in a mapped flood hazard area or not.

## VERNAL POOLS

Vernal pools are small wetlands resulting from the persistence of standing water for a portion of the year, characterized by a lack of vegetation, though they may support some herbaceous wetland species. Vernal pools are perhaps best known as important breeding habitat for amphibians. Typical Vermont species that rely on vernal pools for reproduction include the Spotted Salamander, Blue-spotted Salamander, the Jefferson Salamander, the Eastern Four-toed Salamander, and the Wood Frog. 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. The Vermont Center for Ecostudies hosts an on-line interactive database of vernal pools in the state in the Vermont Vernal Pool Atlas.

Vernal pools and the organisms that depend on them are threatened by activities that alter pool hydrology and substrate, as well as by significant alteration of the surrounding forest. Construction of roads and other development in the upland forests around vernal pools can negatively affect salamander migration and mortality. Adjacent timber harvesting can have significant effects on vernal pools, including alteration of the vernal pool depression, changes in the amount of sunlight, leaf fall, and coarse woody debris in the pool, and disruption of amphibian migration routes by the creation of deep ruts.

## WETLANDS

The region's wetlands are vital for their role in recharging groundwater, regulating and filtering surface water flow, storing water, mitigating floods, and providing significant aquatic and wildlife habitat. For example, several Windham Region wetlands are host to a federally listed endangered plant species, the northeastern bulrush. Consequently, they require careful protection. The Vermont Agency of Natural Resource's Natural Resources Atlas provides an inventory map showing Class I and Class II wetlands. There are currently no Class I wetlands in the Windham Region. New to the Natural Resources Atlas are the results from wetland health monitoring. This is a growing area of monitoring, but at this time only wetlands that have been reported as having some level of concern have been monitored.

## WATER QUALITY

The surface waters of the Windham Region are monitored by both the State of Vermont and non-profit entities in the area. The 2022-2023 Water Quality Monitoring and Assessment Summary Report shows the majority of surface waters in the Windham Region to be in good condition. The Vermont Integrated Watershed Information System hosts an on-line data portal for water quality information. The Connecticut River Conservancy (CRC), and the Deerfield River Watershed Alliance in conjunction with the CRC, conduct water quality monitoring along several streams throughout the region. Information from their water monitoring efforts can be found on the Is it Clean?

website.

Based on the results of the Vermont Lake Score Card the most common issue found in lakes and ponds in the Windham Region is atmospheric pollution. The most common pollutants for this region are acid and sediment, and the most common use impaired is aquatic life support. The sources of pollution identified as causing the greatest stresses on the region's rivers and streams are:

- Streambank erosion and de-stabilization
- Agricultural land uses and activities
- Removal of riparian vegetation from streambanks
- Developed land and road stormwater runoff
- Flow alteration from hydroelectric facilities
- Snowmaking water withdrawals to support ski resort operations
- Channel instability and confined streams

FIGURE 5-2: BALL MOUNTAIN DAM
*Source: US Army Corp of Engineers Digital Visual Library*

Riparian buffers are important for mitigating many of these pollution sources, preventing them from entering surface waters.

## DAMS

There are numerous dams of various sizes constructed on streams and rivers in the Windham Region. They provide a variety of benefits including power generation, flood control, and recreational opportunities, such as swimming and boating. However, these structures can have significant negative environmental impacts, contributing to stream siltation, altered water levels and flow fluctuations, increased water temperature, decreased dissolved oxygen, and impeded fish passage

Dams used for power generation impact rivers in many ways beyond those listed above. Storage and release cycles of water for generating power need to be monitored to ensure aquatic habitats are not adversely impacted, generator turbines must be situated and designed to minimize damage to passing fish and storage capacities of dams holding water for future release, and power generation must be monitored to ensure dam structural safety.

Dams whose removal might provide substantial or unique environmental restoration potential, or that produce very little in terms of cost-effective renewable energy, might be candidates for removal. The removal decision

must be made with consideration of the benefits derived, as well as the costs of removal and, if an energy generation facility, for replacement power that would be passed on to power companies and consumers. Evaluation on a case-by-case basis, use of appropriate guidelines and agreement on a replacement value is important. The Vermont Department of Environmental Conservation Dam Safety Program administers the State Dam Safety Rule, manages the Vermont Dam Inventory (VDI) database, oversees a permit program for construction and alteration of dams, an inspection program, and an annual registration program.

## MANAGEMENT OF SURFACE WATER RESOURCES

Improved watershed management and cooperation among towns, state, and federal agencies, and area residents, will be required to meet competing uses of the region's rivers, lakes, and ponds. There are several plans and assessments that help with the management of surface waters. These include Tactical Basin Plans, Stormwater Master Plans, Stream Geomorphic Assessments, River Corridor Management Plans, and Stream Classification.

Vermont's Tactical Basin Planning process develops management plans for the waters of the state. The goal of the Tactical Basin Plan is to provide a roadmap for achieving watershed health. In the Windham Region, the two primary Basins are Basin 12, for the watersheds drained by the Deerfield, Green, and North Rivers, and several Connecticut River direct tributaries, and Basin 11, for the West, Williams, and Saxtons Rivers, and several Connecticut River direct tributaries. The basin planning process is on a five-year update cycle.

Stormwater Management Plans (SWMP's) are developed for municipalities to identify runoff from infrastructure and what can be done to mitigate the hazardous effects of the runoff before surface waters become impaired. The Vermont Department of Environmental Conservation(DEC) maintains a list of communities that currently have SWMP's. At the start of 2024, Brattleboro is the only town in the Windham Region with a Stormwater Master Plan and Londonderry, Wilmington, and the Greater Bellows Falls Area have SWMP's in progress.

Stream Geomorphic Assessments examine and address the condition of a river system. The River Corridor Management Plan then provides recommendations of projects that will help improve the aquatic environment, such as river corridor protection, restoration projects, and hazard mitigation. DEC maintains a list of all Stream Geomorphic Assessments and River Corridor Plans conducted throughout the State.

All surface waters in the state are divided into four possible classes based on water quality: **B(2) – good; B(1) very good; A(2) public water source; and A(1) excellent**. All waters at or below 2,500 feet are designated Class B(2) for all uses, unless specifically designated as Class A(1), A(2), or B(1) for any use. All waters above 2,500 feet are designated Class A(1) for all uses, unless specifically designated Class A(2) for use as a public water source. All waters must continue to meet the criteria for their class, otherwise they are then listed as impaired, and a restoration plan must be developed and implemented. There are many surface waters below 2,500 feet that

achieve a very high level of water quality. There is an effort to reclassify some of these waters to an A(1) status. Recommendations for reclassification are listed in the Tactical Basin Plans.

Efforts should be made to protect all surface water in the region (lakes, ponds, streams, vernal pools, wetlands) by maintaining their riparian zone in an undisturbed (or minimally disturbed) vegetated state, preferably in woodland, the recommended width depending upon various factors. When area for this type of protection is not available, such as in downtown areas, other best management practices (BMPs) should be implemented to slow the rate of runoff from a site, such as through the use of minimized development footprints, bioswales, or green roofs. Of special concern is the West River watershed, including the Rock River, Winhall Brook and Wardsboro Brook, which see a high rate of bank failures and are hazardous to infrastructure.

## GROUNDWATER

Groundwater provides the primary supply of potable water for most of the region. Despite its high resource value, it remains a poorly understood resource. Groundwater moves beneath the ground through aquifers, which are underground water-bearing formations of sand, gravel and fractured rock. Due to Vermont's geology, groundwater is often unpredictable as it travels through a maze of cracks in bedrock formations. It can infiltrate rock fractures and travel quickly in unknown directions for long distances, or break out to the surface in a short distance.

Groundwater occurs in the unconsolidated sediment of streams and buried valleys and in bedrock fractures. While groundwater potential in areas of unconsolidated sediment is generally favorable, wells producing water from rock fractures usually have low yields (ranging from two to fifteen gallons per minute). The region's mountains and uplands have either exposed bedrock or bedrock covered by a thin layer of glacial till with low permeability; in these areas bedrock fractures are the primary source of groundwater.

### GROUNDWATER

The Vermont Department of Environmental Conservation (DEC) maintains a comprehensive groundwater management program and puts groundwater in trust for the public now and for future generations. The three main components are:

- **Information** or the science and mapping of groundwater resources, including the location and movement of groundwater, its use, contamination, remediation, and protection.
- **Regulation:** classifying types of groundwater and developing and implementing rules that govern or permit activities that may impact groundwater.

- **Communication** or outreach to provide help and guidance to towns, municipalities, and the public through partnerships with EPA, USGS, VGS, VRWA, and other groups to encourage and support protecting groundwater resources.

Technical assistance for municipalities is available through DEC to help towns analyze the groundwater potential within town boundaries. The towns of Londonderry and Rockingham have undertaken such studies. These types of studies are especially important in the siting of landfills and in planning for village centers that need a public water supply to accommodate village expansions.

By statute, all groundwater of the state is classified as Class III water unless reclassified by the Secretary of ANR under provisions of 10 V.S.A., Chapter 48 Groundwater Protection, Subchapter 2, § 1394. The groundwater beneath the Windham Solid Waste Management District landfill in Brattleboro has been reclassified to Class IV, as has the Southern Windsor/Windham Counties Solid Waste Management District landfill in Rockingham. All other groundwater in the region remains Class III.

### GROUNDWATER QUALITY

Groundwater generally moves through soils very slowly. As a result, the cleansing processes that occur through dilution and movement in surface water do not take place underground. When an aquifer becomes polluted, simply removing the source of contamination does not clean up the groundwater. A contaminated aquifer may remain polluted for many years, and practically forever in some cases. Groundwater occurring in rock fractures is highly susceptible to contamination. While unconsolidated sediment can usually filter out organic pollution contained in water, the same water can travel for miles through rock fractures without appreciable purification. Once contamination occurs, control and abatement are extremely difficult. Consequently, one of the most important challenges of environmental planning is to prevent pollutants from entering rock fractures.

Potential groundwater pollutants include septage from improperly designed or malfunctioning septic tanks and leaching fields, leakage from underground gas and oil tanks, from commercial fuel, cooling and supply pipes, and from improper disposal of chemicals, both stable and radioactive. Public Community and Non-Transient, Non-Community Water Systems must have an approved Source Protection Plan (SPP). This Plan addresses the actions the public water system will perform to minimize the contaminant risks to their drinking water supply source(s). The water system is required to submit an updated plan to the Division every three years for approval.

## SOILS AND TOPOGRAPHY

Soil characteristics impact farming, forestry, mineral extraction, and commercial development. Prime agricultural

soils that are rated high for crop production potential are very limited in the region and are located primarily in the river valleys. Since most primary agricultural soils are flat and well drained, they are also desirable for many other uses. Soils suitable for sand and gravel extraction, found primarily in the Connecticut River Valley, are also limited. Many of the region's soils are shallow, unstable, highly erodible, wet, and/or poorly drained. Wet soils may cause basement flooding and failure of footings, foundations, underground piping, and septic systems. Road construction on wet sites can be damaging and prohibitively expensive. Drainage of excessively wet soils is often not an acceptable solution because of expense, rate of failure, and potential for environmental damage. Any of these features alone, or in combination with steep slopes and/or high elevations, are potentially critical factors in determining appropriate land use in the region.

## PRIME AGRICULTURAL SOILS

Vermont soils are mapped based on their physical characteristics through the Natural Resources Conservation Service (NRCS) of the U.S. Department of Agriculture. There are three levels of classification that have an impact on development on these soils. These soils are classified as “prime,” of “statewide significance,” or of “local importance.” Within the Windham Region, prime agricultural soils are primarily located within the Connecticut River Valley. Agricultural soils are both a vital and limited resource in this region, and for that reason must be protected from development pressures either through conservation or effective mitigation practices. If a development project is subject to Act 250 jurisdiction and contains soils that are mapped by NRCS as of “prime”, “statewide”, or "local" importance, the VT Agency of Agriculture Food and Markets will review and provide recommendations. See the Important Farmland Soils map for a look at important soils in our region.

## SEWAGE DISPOSAL

Development in the region has traditionally been encouraged on soils suitable for in-ground sewage disposal systems; however, because permeable soils are often closely associated with sites having high potential for aquifer recharge, their development may result in pollution of subsurface and surface waters. The “travel time” of liquid wastes, the rate of absorption, and the location of groundwater and surface waters are all important factors to consider when planning development on permeable soils. Installation of public waste water systems, especially in villages located in close proximity to rivers and streams, would help alleviate this issue.

## MINERAL RESOURCES

Mineral resources in the Windham Region include deposits of sand, gravel, and other minerals, such as granite, slate, limestone, sulfide, uranium, iron ores, and ultramafics (sulfide, talc, soapstone, and serpentine). With the exception of sand and gravel operations, extractive industries have steadily declined in the region. This decline

and abandonment of mining industries is primarily due to decreasing demand, changes in economic value, and local opposition to mining operations, rather than to exhaustion of the region's reserves. Public and private interests often are in conflict over extraction of mineral resources, making the balance between the need to use these resources with public's right to minimize potential nuisances an increasingly visible issue.

Sand and gravel deposits of varying quality are scattered throughout the region and are the principal mineral resources being extracted. Sand occurs in good quality deposits, with large reserves along the Connecticut River and near most of its larger tributaries. Deposits of good quality gravel, however, are usually small. The region's good quality, accessible gravel reserve is low.

Sand and gravel are economically important regional resources and significant portions of them occur in only a few towns: Brattleboro, Dummerston, Vernon, Halifax, Guilford, Newfane, and Jamaica. Few towns own and operate their own gravel pits, even though they experience a steady demand for highway construction and maintenance of unpaved roads. During the reconstruction period following Tropical Storm Irene large quantities of gravel were trucked in from out of state, supplemented by gravel extraction from impacted streams as local gravel pits could not keep up with demand. As the region grows, sand and gravel deposits will continue to be extracted for construction, fill, erosion control, and highway maintenance.

In recent years, the limited availability of aggregate, in the form of gravel, sand, and stone, has drawn the attention of State, as well as town highway officials. Rising costs and the future prospect of decreasing availability impacts maintenance and construction costs of all road improvements, whether paved or unpaved. In our region, towns farther from the aggregate sources in the Connecticut River Valley are often the hardest hit. In coming years, a significant issue in land use planning may be standards, regulations, and community acceptance of new or expanded aggregate facilities.

## NATURAL AREAS, FRAGILE AREAS, AND WILDLIFE RESOURCES

Healthy, functioning ecosystems are important for ecological, educational, scenic and contemplative value. The Vermont Conservation Design project is a landscape level of design to promote ecological functioning. According to the Agency of Natural Resources, "The lands and waters identified in this project are the areas of the state that are the highest priority for maintain ecological integrity. Together, these lands comprise a connected landscape of 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 plan and animal natural communities depend." The identified elements of Vermont Conservation Design can be found on Vermont BioFinder. Outside of the high priority areas, some areas are unique and considered rare. They provide ecological preserves of relatively unaltered environments that are important to wildlife, biological diversity and the natural heritage of the region.

In addition to the state identified natural and fragile locations, the WRC identifies bear habitat and corridor areas, deer wintering areas, brook trout fish habitat, large blocks of forested lands, critical wildlife corridors, areas where threatened or endangered species are found, significant natural communities, amphibian and reptile crossings and locally identified important natural areas as important wildlife resources.

## DESIGNATED NATURAL OR FRAGILE AREAS

Vermont law enables the State to designate Natural Areas (10 V.S.A. § 2607) and Fragile Areas (10 V.S.A. § 6551).

- A Natural Area is a "limited areas of land that have retained their wilderness character, although not necessarily completely natural and undisturbed, or have rare or vanishing species of plant or animal life or similar features of interest that are worthy of preservation for the use of present and future residents of the State and may include unique ecological, geological, scenic, and contemplative recreational areas on State lands." Designated Natural Areas are owned by the Vermont Department of Forests, Parks and Recreation.
- The State of Vermont defines a Fragile Area as "… an area of land or water that has unusual or significant flora, fauna, geological, or similar features of scientific, ecological, or educational interest." Any party can own a Fragile Area, but it must have been determined to be of statewide significance.

These designations provide protection and the assurance that the areas will be managed to maintain their natural integrity. Hamilton Falls, on Cobb Brook in Jamaica State Park, and Terrible Mountain on the eastern border of Weston are the Windham Region's only state-registered Natural Areas. The only state-registered Fragile Area is the J. Maynard Miller Memorial Forest (the Black Gum Swamps) in Vernon.

## LANDS ABOVE 2,500 FEET

Although not formally designated as such, areas above 2,500 feet in elevation are often fragile areas in Vermont. Lands above 2,500 feet are especially vulnerable natural environments because of their generally thin soils, steep slopes, sensitive vegetation, important wildlife habitats and often greater than average precipitation and wind. Some 24,800 acres (4 percent) of the Windham Region are above 2,500 feet in elevation. By state law, all waters above 2,500 feet are classified A1 – Ecological Waters.

## BEAR HABITAT & CORRIDORS

Eastern black bears require forest territory for survival. Stands of oak and beech trees are especially important in that these trees produce nuts for food in summer and fall. Bears also need wetland forest habitat, where they get food in spring. Because bears use different habitats seasonally, they must also have a way to move between them.

Bears travel through "corridors" to move across roads or through developed areas from one habitat area to another.

Bears are large animals, and they require large, unbroken areas of habitat. Habitat fragmentation causes many problems for bears by restricting their movement within their home ranges, by reducing food supplies, and by increasing the chance of collisions with automobiles. It also increases the frequency of contact with humans, a situation that often ends badly for the bears. Fragmentation of bear habitat should be minimized and bear travel corridors should be protected. Visit the WRC Ecological Resources map to see regionally identified bear corridors.

## DEER WINTERING AREAS

Deer wintering areas or "deer yards" are a critically important habitat type for deer to survive through the winter. Only 7 to 8 percent of Vermont's forests make up such wintering areas. An important part of a deer yard is the evergreen trees that catch the snow in their branches, thus reducing snow depth underneath and making deer travel easier and less energy intensive when food is relatively scarce. The trees also provide thermal cover that gives the deer protection from the wind. Deer may move 10 to 15 miles to go to a yard and stay in the protection of the area all winter. Deer wintering areas can be found on the Vermont Natural Resources Atlas.

## COLD WATER FISH HABITAT

Most of the region's rivers and streams provide important cold-water fish habitats. Shaded stream banks, clean gravel and rocky bottoms, and clean, cool water are necessary to maintain these cold-water fisheries (e.g. brook trout). Lakes, ponds, and larger, slower moving rivers provide warm-water fish habitat. Healthy fisheries are important for both their ecological and economic value. Sedimentation from runoff, bacteria from septic systems, clearing of streambank vegetation, damming of rivers and streams, development of on-stream ponds and lowering in-stream water flows all negatively impact important fish habitats. Stream crossings that do not provide aquatic organism passage and/or are not geomorphically compatible can also have negative impacts. Wetlands, vernal pools and other surface waters also provide specialized habitats for fish, reptiles, amphibians, mammals and migratory birds. Vegetated stream buffers and corridors provide important wildlife travel corridors, help maintain cooler water temperatures and stabilize stream banks from erosion. Additionally, connectivity both laterally and vertically is important for the ecologically health of the waterway.

## FOREST BLOCKS AND CORRIDORS

The mountainous, forested landscape remote from community centers is the stronghold and haven for the region's large mammals, including black bear, moose, deer, bobcat, fisher, coyote, otter, and beaver. Large populations of

deer and coyotes can also be found in the less remote areas. Completing the forest ecosystem are the smaller mammals, reptiles, amphibians, game birds, raptors, and many valued songbirds, insects and a network of plants, fungi, mosses and micro-organism working together to create a diverse forested landscape. New roads, guardrails, and construction of homes and other forms of development, as well as indiscriminate timber cutting, outbreaks of tree disease and replacement of native vegetation with invasive plant species, endanger both the quantity and quality of these important wildlife habitats.

## RARE, THREATENED OR ENDANGERED SPECIES

A rare species is one that has only a few populations in the state and that faces threats to its continued existence. Rare species face threats from development of their habitat, harassment, collection, and suppression of natural processes, such as fire.

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, while "threatened" species are those whose numbers are significantly declining because of loss of habitat or human disturbance, and unless protected will become an endangered species. The Vermont Natural Resources Atlas, can be used to identify areas where threatened or endangered plant and animals are located in the state. Due to threat of threatened and endangered species being harvested from the wild, the map does not name the species of concern nor give a pinpointed location.

In the Windham Region, the Town of Vernon, the West River, Herrick's Cove at the mouth of the Williams River and other Connecticut River direct tributaries have high occurrences of rare, threatened or endangered species.

## CRITICAL NATURAL AREAS (HIGH LEVELS OF BIODIVERSITY)

Critical natural areas are zones that can support a high level of biodiversity because of their natural characteristics. Based on Vermont Conservation Design, BioFinder is a map and database identifying Vermont's lands and waters supporting high priority ecosystems, natural communities, habitats, and species. Within the Windham Region, Stratton and Somerset mountains, the Black Gum Swamp in Vernon, Herrick's Cove in Rockingham, and the upper and lower West River reaches and tributaries all have areas supporting high levels of biodiversity.

## BEAVER FLOWAGES

Beavers are unique amongst wildlife in the region in that they have the ability to change the environment that they live in through their activities. Beavers can create and/or enhance wetlands which become an important part of the broader ecosystem. The benefits of beaver created wetlands are multi-faced, including habitat enhancement, creation of wetlands that support a wide variety of terrestrial and aquatic plants and animals, flood storage,

improvement of water quality and increased recharging of groundwater. As beaver populations continue to rise in the region, the ecosystem services that they provide are to be encouraged.

Conflicts between beavers and humans can exist in areas where beaver activities cause disruption to human infrastructure. Conflicts can occur when culverts become plugged, roads are overtopped with damned water, ornamental trees are toppled, dams fail due to the inability of beavers to maintain them, or dry land becomes a new wetland on areas that are actively managed by humans. There is a long history of trapping “nuisance” beavers. This human intervention has a short-term effect of eliminating the activity of current beaver residents, but is not necessarily the most cost effective or efficient alternative in the long run. Beavers move through the landscape to establish new suitable habitats and the site is likely to be re-inhabited by new beavers in the future.

In order to protect and enhance the many public benefits provided by beavers, the WRC encourages local governments and landowners to minimize interference with beavers and the wetland habitats that they create. WRC also encourages the undisturbed protection of headwater lands where beaver habitats can reduce flooding at lower elevations. In cases where intervention is deemed necessary, valuable trees, property, and infrastructure can be protected using a variety of well-proven strategies that allow beavers to remain on site to do their important work. There are several public and private consulting services available to help towns and individuals assess beaver and human conflict zones.

## INVASIVE SPECIES

Invasive species, also called invasive exotics or simply exotics, are "non-indigenous" or "non-native" species that adversely affect the habitats and bioregions they invade economically, environmentally, and/or ecologically. Such invasive species may be either plants or animals and may disrupt the native habitat by weakening or eliminating natural controls such as predators or herbivores. In the Windham Region, the most notable terrestrial invasive plants are Japanese Knotweed, Barberry, Garlic Mustard, and Glossy Buckthorn. Aquatic invasives include Eurasian Watermilfoil, Water Chestnut, Hydrilla, and Curly Leaf Pondweed. Forest pests include emerald ash borer, hemlock woolly adelgid, elongate hemlock scale, Asian longhorned beetle, spotted lanternfly, beech leaf disease, oak wilt, and jumping worms. To find out more information on invasive species of Vermont, including identification, biology, management options, and Vermont distribution, visit Vermont Invasives.

Early detection is very important in controlling the spread of invasive species. When detected at the early stage, there is some hope, that with treatment, the species root hold can be disrupted. Once established, evasive species are not likely to be eradicated, but there are steps for managing their spread. In Windham County, the Southeast Vermont Cooperative Invasive Species Management Association (SE VT CISMA) is a non-profit volunteer group working on educating the public about terrestrial invasive species. For aquatic invasive education, the Windham

County Natural Resource Conservation District hosts the Vermont Public Access Greeter Program at several lakes throughout the region . Vermont DEC runs an aquatic invasive monitoring program called the Vermont Invasive Patrollers (VIP) Program and volunteer monitors in the region report sightings to Vermont DEC's ponds and lake division.

## AIR QUALITY

The Clean Air Act of the Environmental Protection Administration identifies two types of national ambient air quality standards. ***Primary standards*** provide public health protection, including protecting the health of "sensitive" populations such as asthmatics, children, and the elderly. ***Secondary standards*** provide protection against decreased visibility and damage to animals, crops, vegetation, and buildings. The Vermont Department of Environmental Conservation Air Monitoring Section operates the division's statewide ambient air monitoring network for the measurement of EPA criteria pollutants- ozone, particulate matter, nitrogen oxides, carbon monoxide and sulfur dioxide, as well as meteorological parameters such as wind speed and direction, temperature, barometric pressure, precipitation and solar radiation. The two closest monitoring stations to the Windham Region can be found in the Towns of Bennington and Rutland.

Aside from national air quality standards, outdoor air pollution in significant concentrations can raise aesthetic and nuisance issues such as impairment of scenic visibility; unpleasant smoke or odors; atmospheric impacts to water quality; and can also pose human health problems, especially for more sensitive populations like children, asthma sufferers, and the elderly. The region's air quality is impacted by both local and distant sources of air pollution. Local sources include discharges from industries, combustion of fuels for residential heating, and significantly from non-point sources such as automobile operation. As in other parts of New England, the topography, prevailing wind and weather patterns also bring air pollution to southeastern Vermont from other areas of the country.

## SCENIC RESOURCES

The region enjoys exceptional scenic quality. Mountain and farm landscapes, historic villages and towns, ridgelines, the night sky and nighttime landscapes, shorelines, and scenic corridors are all highly vulnerable to development and should be reviewed.

Structures such as utility poles, telecommunication towers, wind turbines, cleared powerline rights of way, large-scale signage, and streetlights are considered by many to be incongruous with our scenic landscape. Careful planning and design will often provide development opportunities without adversely affecting the scenic value of the landscape. Some towns in the region have developed specific zoning or policies related to ridgeline

development, such as limiting residential, commercial or industrial development on certain ridgelines. It is important for towns to identify the specific scenic resources that they deem significant and to clearly delineate those resources in their plans. Scenic resources can be a highly subjective topic in review processes, which is why it is important to be proactive about clarifying the scenic resources the town wishes to preserve.

## LIGHT AND NOISE POLLUTION

Light pollution is a cumulative and increasing problem that can disrupt wildlife patterns, impact human health, waste money and energy, and contribute to climate change. In the Windham Region, light pollution is especially increasing near the urban clusters along the region's eastern border and near major resort development centers. Light projecting upwards from these areas produces a glow near the horizon that diminishes the natural quality of the nighttime landscape and night sky. As these urbanized areas continue to expand, special consideration needs to be given to lighting design in order to minimize this cumulative adverse effect. Automatic shut-off mechanisms and down-shielding of light sources should be considered for any development with outdoor lighting.

In the Windham Region, Green Mountain National Forest, especially in the towns of Somerset and Searsburg is a popular dark sky location for stargazing and astronomy activities.

Unpleasant or otherwise unwanted sound that travels through the air is another type of pollution that may be caused by traffic, airplanes, snowmobiles & all terrain vehicles, construction and industrial activity such as mining, quarrying and logging, sound equipment, and yard equipment. Noise pollution can negatively affect both humans and wildlife. One often-discussed noise problem is the vehicular and truck traffic passing though the region's villages.

Noise Impact Assessments model the potential impact of noise from a particular project on the surrounding environment. These assessments are essential for evaluating the impacts of projects that will emit significant sound levels, either during construction or through ongoing activities. The assessments identify vulnerable areas and evaluate the effectiveness of possible mitigation measures in reducing the decibel level of sound reaching surrounding areas. Towns can further improve the outcomes of these noise impact assessments by predetermining noise standards for specific land uses or identified vulnerable areas. The Vermont Act 250 process has determined some baseline standards for certain uses, but towns should evaluate these standards based on their specific circumstances.

## FOREST RESOURCES

1. Maintain a mixed aged forested landscape in the region composed of a variety of forest blocks that support ecological and economic functions.
    a. Encourage the use of conservation subdivision models, conservation easements, and purchase and ownership of lands for conservation purposes by conservation organizations, land trusts, and state and local government.
    b. Continue to support the Vermont Use Value Appraisal (Current Use) Program—a program critical to the forest resource in the region—on a fully funded basis.
    c. Encourage the preservation of old growth forest blocks.
2. Encourage public, private and business landowners to maintain and enhance forests on their lands to support both ecological and human use functions.
    a. Encourage the development of local markets for all forest products.
        i. Encourage the local manufacture and marketing of value-added forest products.
        ii. Promote the purchase of locally produced forest products.
3. Support early detection, rapid response and long-term management of invasive species in the region.
    a. Require the mitigation of invasive species as a condition on permits for development where the introduction or spread of invasive species is likely.
4. Support the establishment and protection of public access to forested lands.
    a. Encourage preservation of historic access points.
    b. Promote public access connections in development proposals.
5. Facilitate the understanding and appreciation of the environmental, economic, and recreational benefits offered by the region's forests.
    a. Support organizations and educational programs that teach or demonstrate sustainable forestry and Acceptable Management Practices.

6. Forestlands should be managed so as to maintain and improve forest blocks and habitat connectors.

    a. Direct development to locations that will avoid the fragmentation of identified important natural areas, wildlife habitat and large forest blocks.

    b. Encourage the sale or gift of land rights to land trusts or private conservation groups to maximize forest land and contiguous forest tracts.

## SURFACE WATERS

7. Maintain and restore the chemical, biological, and physical quality of the region's surface water and, at a minimum, meet the objectives stated in State and Federal water regulations.

    a. Encourage towns and community organizations to identify critical surface waters and support efforts to protect these exceptional natural resources.

    b. Encourage municipalities and other regional organizations to purchase easements on land bordering streams to establish woody vegetation for the purpose of mitigation of erosion during flash flood events and provide wild animal cover for movement between forest blocks.

8. Support efforts that reduce Nitrogen and other pollutants from entering our streams and rivers.

9. Maintain and/or restore woody buffers of vegetation along watercourses, lakes, ponds, wetlands, and vernal pools consistent with State regulations and the highest precedent established by the District Environmental Commission and State Environmental Court.

    a. Protect shorelines, provide shading to prevent undue increase in stream temperatures, minimize effects of erosion, sedimentation and other sources of pollution, and to maintain scenic, recreational, and habitat values.

    b. Bioengineered bank stabilization is the preferred method of streambank restoration. When rock armament of streambanks is necessary, efforts should be made to revegetate on top of the rock to reduce water temperature.

10. Restore floodplain areas along rivers in order to accommodate floodwaters.

11. Evaluate the licensing or re-licensing of hydroelectric power generating facilities in a manner that supports the provisions of this plan.

    a. When considering either licensing of new dams, or relicensing of existing dams, the WRC will

ensure that all issues are addressed and given balanced consideration.

12. Maintain any designated Class I wetlands in their natural condition and restore wetlands when possible.

    a. Ensure that any permitted alterations to Class II and Class III wetlands do not significantly diminish their functional, ecological, or aesthetic values.

    b. All projects shall provide evidence that onsite wetlands have been field checked and verified by an environmental official or State agency representative.

13. Evaluate inter-basin transfers of water and require project proposals to demonstrate that the water quality in both the sending and receiving basins will not be significantly lowered, that the water table and stream flow in the sending basin will not be detrimentally lowered, and that peak flows in the receiving basin will not be detrimentally increased. For purposes of this policy, a basin is the drainage area of a watercourse that is at least 1,000 acres in area.

14. Support surface water classification and management strategies which are consistent with the municipal and regional land use planning objectives for the affected watershed, and which will effectively maintain or improve existing water quality.

15. Maintain water flows in streams at levels that support a full range of in-stream uses, habitat needs, and water quality values.

    a. Follow state regulations in relation to water withdrawals.

    b. The WRC will give due consideration to the economic, safety, and environmental factors involved in the construction of surface water impoundments and withdrawals for any development activities.

16. Support flood hazard policies.

    a. The WRC shall continue to assist in the study of the region's waterways, and discourage development in river and stream corridors, floodways, floodplains, and fluvial erosion hazard zones unless appropriate and proven mitigation measures are taken.

17. Continue to support State regulations and programs to protect surface waters from run-off and sedimentation caused by agriculture, forestry, recreation, and development activities.

    a. Support the use of tools and programs such as: Acceptable Agricultural Practices (AAP's), Acceptable Management Practices (AMP's) for forestry, Better Roads, and Best Management Practices (BMP's) for erosion control.

18. Continue to support municipalities in employing road maintenance techniques to prevent soil erosion and road surface deterioration.

19. New or replacement bridges and culverts must be adequately designed and constructed to handle stormwater, flood waters (i.e. provide for a 100-year flood event at the minimum), provide sediment transport, and accommodate fish and wildlife passage.

20. Support towns and dam owners with the removal of dams, high-hazard and otherwise, that no longer serve a use and are a hindrance to aquatic organism passage and/or create a flood hazard.

## GROUNDWATER

21. Maintain or Improve Class I groundwater. These are high-quality resource areas mapped by the Agency of Natural Resources and so classified by the Secretary as currently being used or suitable for a public water supply source.

    a. In undertaking the above, regional land use policy and decision making should limit human activities in these areas.

22. To ensure that groundwater in the region is not contaminated.

    a. Avoid contamination of wells and groundwater by encouraging the use of proper drilling technology and appropriate well placement.

    b. Require testing for large amounts of material deposited on soil surfaces to ensure that no elements or chemicals are present that could contaminate ground water.

    c. Require facilities that house or generate hazardous waste to meet Tier II reporting requirements, and to have storage and disposal plans demonstrating that contamination risks have been minimized per the requirements of the Emergency Planning and Community Right to Know Act (EPCRA).

    d. Support efforts to make appropriate disposal of small-quantities of hazardous waste convenient and effective in the region.

23. Groundwater aquifers are important communal resources and need to be sustainably allocated and used.

    a. Support the Department of Environmental Conservation Water Supply Division in regulating and monitoring water withdrawal from underground sources to ensure that aquifers and surface waters are not significantly depleted, and that water is properly allocated. Promulgation of specific

laws and regulations to control water withdrawal and to ensure minimum flows is encouraged.

b. Evaluate new development plans through the lens of groundwater usage. New development should not deplete water resources currently being used by existing developments.

## SOILS, TOPOGRAPHY AND MINERAL RESOURCES

24. Protect the region's soils.

    a. Require developers to take special precautions on slopes to avoid environmental damage, including negative consequences associated with erosion and landslides.

    b. Minimize areas of earth disturbance, grading, and vegetation clearing on slopes over 15 percent;

    c. Design development on slopes over 15 percent such that it minimizes the potential impacts of slides and earthquakes; and

    d. Avoid development (other than appropriately designed recreational trails and ski lifts) in areas with slopes exceeding 25 percent or above 2,500 feet in elevation.

25. Recommend detailed site studies to determine suitability for development where steep slopes occur with shallow soils. Ensure that all development proposals on such soils provide and conform to a site drainage plan and an ANR approved erosion control plan for construction phases of the development.

26. Avoid development on wet soils, mucks, clays, silts, and other unstable soils that offer poor support for foundations or footings or that are subject to slippage.

27. Ensure that any ground disturbance (including quarry activity) does not have negative impact on groundwater, surface waters, recreation sites, historic sites, scenic areas, and special community resources. Future access to gravel resources should be considered in development proposals.

    a. When ground disturbance occurs, best practices are to be used to minimize dust, noise, and other degradation of air quality.

    b. Ensure that effective site rehabilitation plans are provided and implemented for new development projects.

## NATURAL AREAS, FRAGILE AREAS AND WILDLIFE RESOURCES

28. Support the designation and protection of State or regionally significant natural areas, fragile areas, and

rare, threatened or endangered species.

a. Support local, regional, state and federal programs and incentives that encourage private and public landowners to restore or enhance fish and wildlife habitats and ecosystems.

29. Protect Natural and Fragile Areas from development.

    a. When development is proposed near a natural or fragile area a buffer strip, designed in consultation with the appropriate state agency, must be designated and maintained between the development and any natural or fragile area.

    b. Vernal pools and their surrounding terrestrial amphibian habitat should be identified and protected from development.

30. Development should be designed and sited in a manner to preserve contiguous areas of active or potential wildlife habitat. Corridors connecting habitat areas for large mammals must be incorporated in plans for management and conservation of forested areas. Fragmentation of critical wildlife habitat should not be approved.

    a. Development should utilize existing roads and field edges to avoid additional forest fragmentation.

    b. Developers must demonstrate that they have taken reasonable steps during development planning to minimize impacts on critical habitats, including, but not limited, to the following:

        i. Habitat connectors.

        ii. Grassland regions.

        iii. Cliff areas identified as potential or active nesting places for peregrine falcons.

        iv. Areas over 2,500 feet in elevation.

        v. Large tracts of contiguous forest land identified as priority or high priority forest blocks.

## AIR QUALITY

31. Require that development activities meet state and federal standards for air quality.

    a. Proposed developments must be reviewed for their direct and *indirect* impact upon air quality and acceptability by local and regional airshed users.

    b. Air pollution impact reviews should include visual quality in addition to contaminant

concentrations over time and distance.

32. Any emissions of hazardous or toxic air pollutants by commercial operations shall monitored for public health and safety so that concentrations of hazardous or toxic air contaminants in local and regional airsheds are below those listed for human health protection by federal and state regulations.

## LIGHT AND NOISE POLLUTION

33. Minimize visual impacts of existing and new high-elevation or ridgeline structures through co-location, design, siting, and color choice.

34. Require illumination of structures and exterior areas only at levels necessary to ensure safety and security of persons and property. Require arrangement of all exterior lighting so that the light source (lamp) is not directly visible from public roads, adjacent residences or distant vantage points. Require shielding of exterior lighting so that the light does not project above the lamp. Discourage exterior area illumination of regionally prominent physical features and landscapes.

35. Require that development activities meet state and federal standards for noise.

    a. Proposed development that may have noise impacts should include a noise study to understand those impacts before they are permitted.

    b. When deemed appropriate, mitigation strategies should be utilized to reduce noise pollution to acceptable levels.

## SCENIC RESOURCES

36. Encourage towns to identify their scenic resources and support efforts for their enhancement and maintenance.

    a. Encourage towns to accept suggestions and input on scenic resources from neighboring towns and WRC.

    b. Encourage towns to develop policies in their town plan that identify and protect their scenic resources.

    c. Encourage donation of scenic easements to public agencies or to private conservation organizations.

37. Require that the scale, siting, design, and management of new development maintains or enhances the landscape and protects high quality scenic landscapes and scenic corridors as identified by town plans.

38. Plan new or improve existing roads so that they maintain or enhance scenic resources.

39. Screen new development from I-91 and state highways and other identified scenic roads and rivers, as identified by town plans, to the greatest extent practicable using vernacular perimeter plantings of hedges, hedgerows, and trees.