SECTION 4:
ENVIRONMENTAL INVENTORY AND ANALYSIS

This section explores the biological and physical components of some of the town's ecosystems. These components include soils, surface and ground water, vegetation, fisheries and wildlife. *Geology, Soils, and Topography* provides a general understanding of the ways different soil characteristics can impact land use values. *Landscape Character* provides an overall scenic context. *Water Resources* describes all of the water bodies in town, above and below ground, including their recreational value, public access, and any current or potential quality or quantity issues. In the subsection *Vegetation*, Gill's forest, farmland, and wetlands are documented and in *Fisheries and Wildlife*, wildlife, habitat, special corridors, and rare, threatened, and endangered species are discussed. Gill's *Scenic Resources and Unique Environments* are identified. Finally, *Environmental Problems* addresses current and potential problems that may influence open space or recreation planning.

The natural resources and scenic landscapes of the Town of Gill have been cherished by residents for generations. This Open Space and Recreation Plan is intended to help residents protect the town's scenic value and natural resources in the face of potential increasing development and changes in land use, while recognizing that people need places to live, learn, work and play. These needs – when sited in areas previously unsettled rather than as infill in existing developed areas – can require infrastructure such as homes, roads, power, water, and wastewater systems. These collective needs, in turn, depend upon and impact critical natural systems. One way to understand the impact of development on natural resources is to understand the ecosystem of the town and the region.

A. ECOSYSTEMS AND MAPPING

An ecosystem is a geographically specified system of organisms, including humans, their environment, and the processes that control their dynamics. Ecosystems involve complex connections between organisms and their environment, and the processes that drive the system and can occur at different scales.[1] A large forest and a decayed tree trunk are both examples of ecosystems. The health and function of ecosystems depend on the relationship between living beings and their environment.

Ecosystems provide a variety of "services" that are very important to human communities. Wetlands, for example, filter rainwater, store floodwaters, recharge water to groundwater aquifers, and provide habitat for many aquatic plant and animal species. All ecosystems are vulnerable to any changes to the environment, whether naturally occurring or human made. Understanding the complexity of the systems in which we live can help Gill residents to consider the impact of actions and land uses on the environment and on their quality of life.

[1] http://ecosystems.noaa.gov/what_eco.htm

A.1 Documenting and Mapping Ecosystems: BioMap2

Just as the Town of Gill contains multiple and varied ecosystems, the state of Massachusetts, while relatively small, has many diverse ecosystems and habitats. Documentation and mapping of such ecosystems and habitats – and their associated flora and fauna – can be a first step toward protecting and preserving these resources.

To that end, in 2010 The Massachusetts Department of Fish and Game and The Nature Conservancy launched *BioMap2: Conserving the Biodiversity of Massachusetts in a Changing World.*[2] This project, produced by the Natural Heritage and Endangered Species Program (NHESP), is a comprehensive biodiversity conservation plan for Massachusetts, and endeavors to protect the state's biodiversity in the context of projected effects of climate change.

BioMap2 combines NHESP's 30 years of rare species and natural community documentation with the Division of Fish and Wildlife's[3] 2014 State Wildlife Action Plan (SWAP). It also integrates The Nature Conservancy's assessment of ecosystem and habitat connections across the State and incorporates ecosystem resilience in the face of anticipated impacts from climate change. Note: *BioMap2* data replaced former BioMap and Living Waters data.

Figures 4-1 and 4-2 and Table 4-1 show the core findings summed up in *BioMap2's* Executive Summary.

Figure 4-1: Core Habitat Statewide Summary

Core Habitat: Core Habitats consists of 1,242,000 acres that are critical for the long-term persistence of rare species and other Species of Conservation Concern, as well as a wide diversity of natural communities and intact ecosystems across the Commonwealth. Core Habitat includes:

- Habitats for rare, vulnerable, or uncommon mammal, bird, reptile, amphibian, fish, invertebrate, and plant species;
- Priority Natural Communities;
- High-quality wetland, vernal pool, aquatic, and coastal habitats; and
- Intact forest ecosystems.

Figure 4-2: Critical Natural Landscape Statewide Summary

***Critical Natural Landscape*:** Critical Natural Landscapes (CNLs) consists of 1,783,000 acres complementing the Core Habitats, including large natural Landscape Blocks that provide habitat for wide-ranging native species, support intact ecological processes, maintain connectivity among habitats, and enhance ecological resilience. The areas include buffering uplands around coastal, wetland and aquatic Core Habitats to help ensure their long-term integrity. CNLs, which may overlap with Core Habitats, include:

- The largest Landscape Blocks in each of 8 ecoregions; and
- Adjacent uplands that buffer wetland, aquatic, and coastal habitats.

[2] http://www.mass.gov/dfwele/dfw/nhesp/land_protection/biomap/biomap_home.htm
[3] http://www.mass.gov/dfwele/dfw/

Table 4-1: BioMap2 Statewide Summary Total Acres and Acres Protected

	Total Acres	*Percent of State*	*BioMap2 Acres Protected*
Core Habitat	1,242,000	24%	559,000
Critical Natural Landscape	1,783,000	34%	778,000
BioMap2 Total *(with overlap)*	2,092,000	40%	861,000

A.2 Documenting and Mapping Ecosystems: NHESP Priority Habitats

Priority and Estimated Habitats is a program administered by NHESP. Identification and mapping of Priority and Estimated Habitats is based on the known geographical extent of habitat for all state-listed rare species, both plants and animals, and is codified under Massachusetts Endangered Species Act (MESA). Habitat alteration within Priority Habitats is subject to regulatory review by the Natural Heritage & Endangered Species Program. Priority Habitat maps are used for determining whether or not a proposed project must be reviewed by the NHESP for MESA compliance.[4]

A.2.1 Benefits of BioMap2 and NHESP Priority Habitats

On the statewide level, mapping Core Habitat and Critical Natural Landscapes helps to guide strategic conservation to protect those areas that are most critical to the long-term survival and persistence of rare and other native species and their related habitats and ecosystems. On the local level, Gill can use this information to better understand where the Town's ecosystems and habitats fit into the bigger picture. For example, a seemingly insignificant parcel of land could be a key link to two larger, intact ecosystems. BioMap2 can help the Town of Gill look beyond its municipal boundary to plan for open space and recreation needs.

On an individual landowner level, BioMap2 – as well as NHESP Priority and Supporting Habitats – is an important tool that can be used to apply for grants to help improve, manage and monitor certain lands. An example is the Mass Wildlife Landowner Incentive Program, which helps fund efforts to maintain grasslands and create areas of young tree and shrub growth (early woodlands) to enhance wildlife habitat, with preference given to land that is classified as or nearby NHESP areas.

Information and mapping from BioMap2 and NHESP Priority Habitats will be referenced throughout this section on Environmental Inventory and Analysis. BioMap2 Core Habitat and Supporting Natural Landscapes, and NHESP Priority Habitats, are shown on the Soils and Environmental Constraints Map at the end of this section.

[4] http://www.mass.gov/dfwele/dfw/nhesp/regulatory_review/priority_habitat/priority_habitat_home.htm

B. CLIMATE CHANGE

In 2011, the Massachusetts Executive Office of Energy and Environmental Affairs issued the *Massachusetts Climate Change Adaptation Report*.[5] Climate change will result in potentially profound effects on the economy, public health, water resources, infrastructure, coastal resources, energy demand, natural features, and recreation throughout the state. The issue of climate change, and in particular climate change adaptation, is complex. The impacts of climate change will vary not only geographically but also temporally—some of the impacts may not be felt for another 30 years or further in the future, while others are already upon us. When considering land conservation strategies and suitable sites for recreation facilities, climate change adaptation and resiliency should enter into the decision-making process of the town.

The Nature Conservancy (TNC) released a report in 2013 entitled "Resilient Sites for Terrestrial Conservation in the Northeast and Mid-Atlantic Region."[6] According to the Introduction of the TNC report, climate change is expected to alter species distributions. As species move to adjust to changing conditions, federal, state and local agencies and entities involved in land conservation need a way to prioritize strategic land conservation that will conserve the maximum amount of biological diversity despite shifting species distribution patterns. Current conservation approaches based on species locations or on predicted species' responses to climate, are necessary, but hampered by uncertainty. TNC states that it offers a complementary approach, one that aims to identify key areas for conservation based on land characteristics that increase diversity and resilience. The central idea of this project is that by mapping key geophysical settings and evaluating them for landscape characteristics that buffer against climate effects, conservationists can identify the most resilient places in the landscape.

The Nature Conservancy's resilience analysis aims to identify the most resilient examples of key geophysical settings (landscapes) to provide conservationists with locations where conservation is most likely to succeed over centuries. The Massachusetts Division of Conservation Services' Landscape Partnership Grant Program, which seeks to preserve large, unfragmented, high-value conservation landscapes, including working forests and farms of at least 500 acres in size, specifically references the TNC report and mapping.[7]

Annual precipitation averaged around 46" between 1971 and 2000 in the Connecticut Basin, which encompasses the entire Town of Gill.[8] Precipitation in the winter season is expected to experience the greatest change between now and the end of the century, with an increase of 1-25% by mid-century (up 6 inches more by the 2050s), and of 7-37% by end of century (potentially increasing more than 8 inches by the 2090s). Annual and seasonal projections for consecutive dry days, or for a given period, the largest number of consecutive days with precipitation less than 1 mm (~0.04 inches), are variable throughout the 21st century.

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[5] http://www.mass.gov/eea/air-water-climate-change/climate-change/climate-change-adaptation-report.html

[6] https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/edc/reportsdata/terrestrial/resilience/Pages/default.aspx

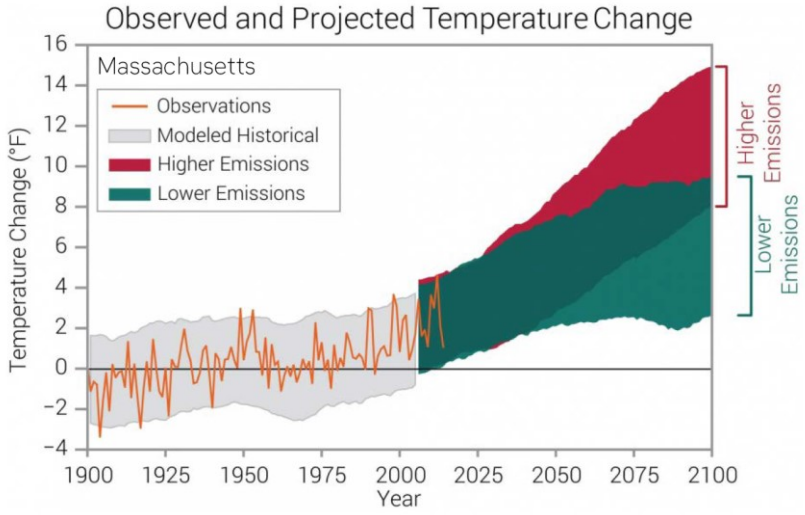
[7] http://www.mass.gov/eea/grants-and-tech-assistance/grants-and-loans/dcs/grant-programs/landscape-partnershipprogram.html

[8] Massachusetts Climate Change Projections 2017, Northeast Climate Science Center, UMass Downscaled Projections for Major Basins in MA. www.resilientma.org.

Seasonally, the fall and summer seasons are expected to continue to experience the highest number of consecutive dry days. The fall season is expected to experience an increase of 0-3 days in consecutive dry days by the end of the century.

Climate projections for Massachusetts indicate that in future decades, winter precipitation could increase, but by the end of the century most of this precipitation is likely to fall as rain instead of snow due to warmer winters. There are many human and environmental impacts that could result from this change including reduced snow cover for winter recreation and tourism, less spring snow melt to replenish aquifers, higher levels of winter runoff, and lower spring river flows for aquatic ecosystems.[9]

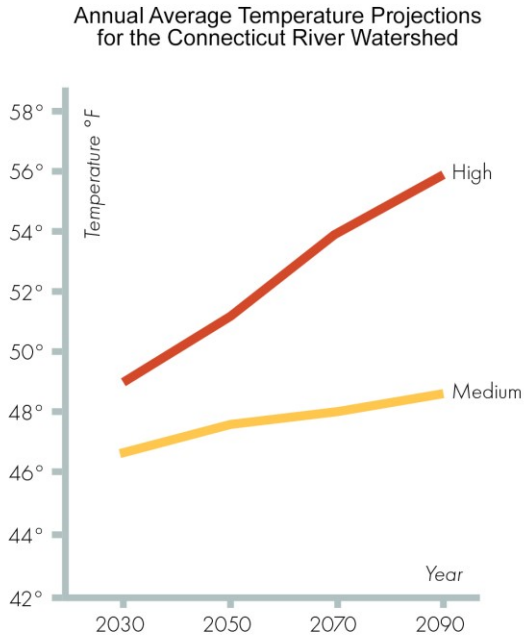
Between 1971 and 2000, the average annual temperature was 47 degrees Fahrenheit. Average temperatures ranged from 25 degrees Fahrenheit in winter to about 68 degrees in summer. The Connecticut basin is expected to experience increased average temperatures throughout the 21st century. Maximum and minimum temperatures are also expected to increase throughout the end of the century. These increased temperature trends are expected for annual and seasonal projections. Seasonally, maximum summer and fall temperatures are expected to see the highest projected increase throughout the 21st century, but minimum winter and fall temperatures are also expected to increase throughout the 21st century.[10]



The above graph demonstrates temperature changes in the State of Massachusetts between the years 1900 and 2100. Temperature projections for the rest of the 21st century are based on models used by the International Panel on Climate Change (IPCC) and two scenarios of future greenhouse gas emissions: 'medium' and 'high.' A 'medium' scenario (shown in the graph as "Lower Emissions") assumes a peak in global greenhouse gas emissions around 2050, which then declines rapidly over the second half of the century due to carbon reduction efforts. A 'high' scenario assumes a "business as usual" continuation of the current emissions course. These scenarios represent different pathways that society may or may not follow, to reduce emissions

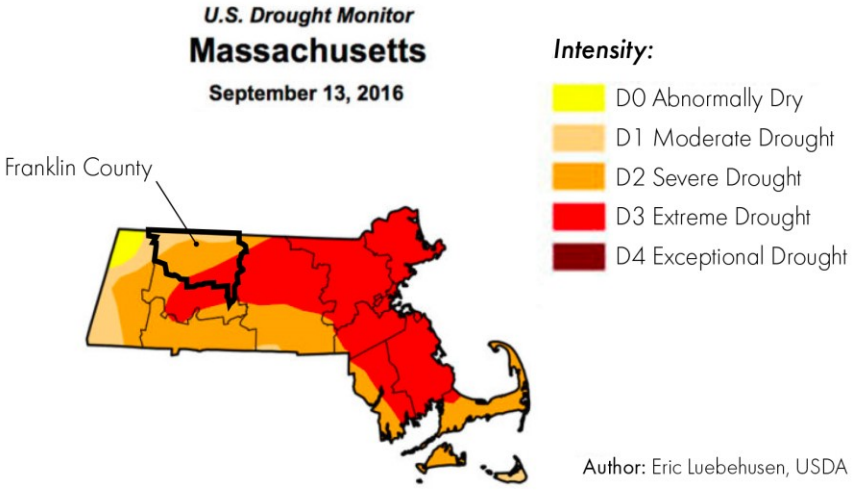
[9] Ibid.
[10] Ibid.

through climate change mitigation measures. For more information, see http://resilientma.org/resources/resource::2152



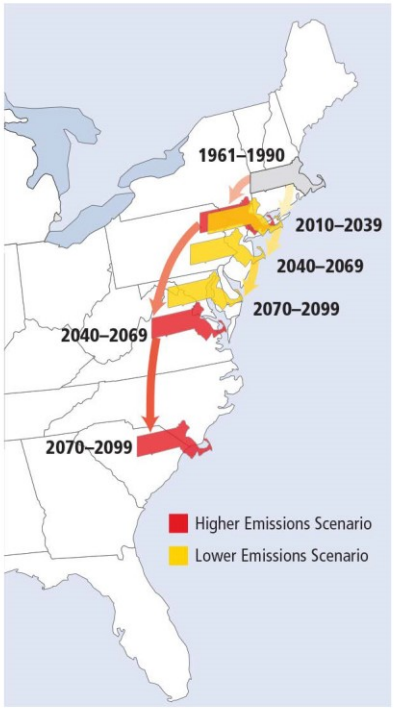
The temperature projections shown in this graph have been localized to accuracy at the watershed scale, by researchers from the Northeast Climate Science Center at the University of Massachusetts, Amherst. These highly valuable projections demonstrate how the climate is likely to transform in the Connecticut River Watershed over the course of the 21st century, based on climate models used by the IPCC and 'Medium' and 'High' emissions scenarios, as defined above. See http://resilientma.org/resources/resource::2152 for more information.

In the summer of 2016, Massachusetts was gripped with the worst drought conditions in recent memory. The prolonged period of warm, dry weather served as a stark reminder of how residents, communities, and industries depend upon the Commonwealth's fresh water resources. On September 21 of that year, the U.S. Department of Agriculture designated Franklin County, along with most other parts of the state, as primary natural disaster areas due to the ongoing drought and its effect on agriculture. During the summer of 2020, the state once again experienced a drought and reached Severe Drought Conditions. A small projected decrease in average summer precipitation could combine with higher temperatures to increase the frequency of episodic droughts in the future.



Droughts will create challenges for local water supplies by reducing surface water storage and the recharge of groundwater supplies, including private wells. Droughts can weaken tree root systems, making them more susceptible to topping during high wind events. More frequent droughts can also exacerbate the impacts of flood events by damaging vegetation that could otherwise help mitigate flooding effects. (http://resilientma.org/resources/resource::2152)

Projected Summer Temperatures in Massachusetts by 2099



Changes in average summer heat index will strongly alter how summer feels to residents in the Northeast. Red arrows in the above map track what summers in Massachusetts could feel like over the course of this century if we follow a higher emissions pathway. Yellow arrows track what Massachusetts could feel like on a lower emissions pathway. Source: Union of Concerned Scientists (2006).

The growing season (last frost in spring to first frost in fall) has roughly extended from May 8 to October 1, but varied greatly with topography. The long-term average historically is 146 days.

Changing weather patterns have already begun to affect the frequency, intensity, duration and geographic extent of extreme weather event. As the weather continues to change over the coming decades, we can expect to see the following effects:

- Higher temperatures
- Shorter winters
- More frequent & intense storms
- Droughts

The number of days with temperatures over 90° are predicted to increase. Annually, the Connecticut basin is expected to see days with daily maximum temperatures over 90 °F increase by 10 to 35 more days by mid-century, and 15 to 76 more days by the end of the century. Seasonally, summer is expected to see an increase of 8 to 30 more days with daily maximums over 90 °F by mid-century. By end of century, the Connecticut basin is expected to have 12 to 60 more days over 90 °F.[11] Increased demand could strain energy infrastructure and increase the potential for widespread brownouts or blackouts to disrupt service. Higher temperatures will likely require more frequent maintenance to address deterioration of asphalt roads, buckling of railroad tracks, and thermal expansion of bridges.

Between 1971 and 2000, our region experienced an average of 7 days with precipitation over 1". By the end of the century, it is predicted that Western Massachusetts could have 5 additional days of rainstorms that dump over 1 inch of rain over the course of the year. On October 29 and 30, 2017, Franklin County experienced 2+ inches of rain and 40 to 50 mph winds due to moisture associated with the remnants of Tropical Storm Philippe, causing localized flooding and downed power lines.

In terms of observed increase in very heavy precipitation: between 1958 to 2012, New England experienced a striking increase of 71% over this period, nearly twice the next highest increase of 37% in the Midwest.

[11] Ibid.

Previous climate studies have been based on the premise that the extreme rainfall series do not change through time. Therefore it is assumed that older analyses reflect current conditions. Recent analyses show that this is not the case, particularly in New York and New England where the frequency of 2 inch rainfall events has increased since the 1950s and storms once considered a 1 in 100 year event have become more frequent. Such storms are now likely to occur almost twice as often.[12] Environmental effects that are anticipated to result from increased precipitation include:

- Flooding
- Erosion
- Impacts to water quality and quantity
- Loss of species diversity
- Invasive pests and plants
- Wetland soils becoming less absorptive
- More stormwater runoff, and less groundwater recharge

The drought of 2016 and 2020 were reminders of the widespread impacts droughts can have on our region. In addition to impacting the water quality and quantity of rivers, streams and other water bodies, drought can fuel wildfires. In Gill, there were 5 brush fires reported in 2016, the highest number for any one year since 2010.

The health of the town's natural resources directly affects the climate change resiliency of the municipal infrastructure, public safety and economic and physical welfare of watershed residents. Societal risks associated with changing weather include:

- Heat-related illness and death
- Danger from storms & flooding
- Insect-borne diseases
- Allergies & Pollen
- Waterborne disease & algal blooms
- Vulnerable populations

Maintaining healthy and intact wetlands, floodplains, riparian corridors, forests and other vegetated open spaces will help to mitigate the impacts from severe storm events and flooding. To assist with this, Gill has applied for a Municipal Vulnerability Preparedness (MVP) Planning Grant and if awarded will be able to address climate change impacts and improved the town's resiliency. In addition, the town has updated its Multi- Hazard Mitigation Plan in 2020, which evaluates the town's risks from various hazards such as flooding and hurricanes and recommends ways to minimize the damages to Gill's infrastructure, as well as its natural, cultural, and historic resources.

[12] Northeast Regional Climate Center (NRCC) and Natural Resources Conservation Service (NRCS), Cornell extreme precipitation tool: http://precip.eas.cornell.edu/

C. Geology, Soils, and Topography

C.1 Geology[13]

The Town of Gill as we know it today is the result of millions of years of geologic history such as great upheavals of the earth's crust and the sculpting power of moving water, ice and wind. This distinctive physical base has determined the distribution of the town's water bodies, its soils and vegetation and its settlement patterns, both prior to and since colonial times. Gill's current landscape can be better understood through its geologic history.

500,000,000 years ago, the area now known as Gill, Massachusetts, was located on the margin of an enormous land mass centered on the equator. Much of North America, including New England, was covered by the Iapetus Ocean, the precursor to the Atlantic Ocean. There were no cell phones and no people, but there were jawless fishes, the first vertebrates with true bones. Over the course of time, this ancient "paleo" North American continent, known as *Laurentia*, would travel far and be transformed numerous times by cataclysmic geological processes.
The Connecticut River Valley of 2018 is the result of these literally earth-shaking events, which have been thoroughly studied by geologists and other scientists. The geology of Gill, while sharing much in common with the surrounding region, has several notable features that make it an exciting place to explore. Many of these are to be found in the Riverside section of town, bounded by the Connecticut River. The River's varied course over time directly reflects the area's geological history.

Multiple Orogenies—500 to 250 million years ago (mya)

The process of mountain formation, particularly by the folding of the earth's crust, is called an *orogeny.* It is driven by the slow but steady movement of tectonic plates on which continental landmasses float as the plates collide and separate. Several distinct orogenies occurred during a vast stretch of time, which roughly coincides with the Paleozoic Era. Each left its mark on the northeast region.

Taconic Orogeny: During the Ordovician Period, the Bronson Hill Plate, which began as an island chain of volcanoes ("tropical terranes"), collided with the eastern margin of Laurentia (North America). The result, by the end of the Ordovician, was the Taconic Mountains of western Massachusetts. Several researchers cite evidence that another plate, the Shelburne Falls Arc, may have collided earlier with Laurentia. One or both of these plates became the main ancestral bedrock beneath the Connecticut River Valley.

Appalachian Orogeny: This great mountain building event consisted of several distinct waves, with the Acadian Orogeny to the north being followed by the Alleghenian Orogeny further south. As enormous crustal plates continued to converge and drive a string of great landmasses towards Laurentia, the first, named *Baltica*, crashed into its eastern margin. Several smaller micro-continents, named Merrimack, Nashoba, and Avalon, followed suit. Their collective uplifting

[13] The material in this section was reprinted with permission from the Gill Historical Commission from its 2016 publication entitled ***Riverside: Life Along the Connecticut in Gill.*** Ivan Ussach, former GHC Chair, authored the section. Footnotes have been removed; resources cited are included in Section 11: Bibliography.

formed the Acadian Mountains and created, as Professor Richard Little notes in his book *Dinosaurs, Dunes, and Drifting Continents,* "the folding, faulting, metamorphism and melting that results in New England's notoriously complicated geology."
These collisions were followed 100 million years later by Meguma and Gondwana, the latter composed of Africa, South America, Antarctica, India, and Australia. Little views this succession of events "like having an economy car pile-up that was then rammed by a tractortrailer." Subsequent erosion over eons washed away much of these Northern Appalachians as sediment and flattened the landscape.

Gondwana, the great southern supercontinent, continued to push, creating the Central and Southern Appalachians. These events also affected New England. Little quotes J. W. Skehan, author of *Roadside Geology of Massachusetts* (2001): "It appears that the Alleghenian mountain building event may have been one of the more widespread and complex events in southern New England, involving renewed compression and overthrusting." By the end of the Paleozoic, great mountains had formed, the Iapetus Ocean had closed, and the world's great landmasses had fused into the supercontinent of Pangaea. Gill was located somewhere near the middle of Pangaea.

The Valley: Creation and Disappearance—250 mya to 66 mya

Several million years of tremendous pressure and energy generated by the consolidation of the Pangaea supercontinent heated and expanded the roughly 2,000-mile thick mantle layer below the earth's surface. This caused the overlying continental crusts to uplift, split, and start sliding *away* from each other. Africa and Europe now began to drift away from the North American mainland. These massive stresses created rift valleys bounded by steep-sloped hills. The original, ancient Connecticut Valley, one of many rift valleys along the eastern seaboard from the Grand Banks to Florida, was created in this way by the Eastern Border Fault, a series of parallel breaks running north through all of Connecticut and Massachusetts and terminating near Keene, New Hampshire.

The location of the Border Fault is most dramatically seen from Riverside by walking to the center of the French King Bridge, which crosses the Connecticut River on Route 2, and facing north. To the west side of the River are 250 million-year-old sedimentary rocks, while those to the east are metamorphic rocks dating to 450 mya—the latter once belonging to Europe and Africa but now "stuck" onto North America. The fault has been inactive for the last 140 million years, but for many millions of years before that it was hammered by earthquakes—perhaps a big one every century.

As Pangaea separated during the Jurassic Period 194 mya, volcanic activity brought magma up from the earth's mantle to the surface in parts of the rift valley created by the Eastern Border Fault. One of the resulting lava flows hardened into the Deerfield Basalt. The northern tip of this igneous rock formation is clearly visible on Route 2, just east of the Fall River and the Gill-Greenfield Line. The Fall River, Gill's western boundary, flows along a smaller fault line associated with the Border Fault. A pull-off for cars on the south side of Route 2 provides excellent viewing of the Deerfield Basalt and Fall River from across the road.

The Deerfield Basalt formation is sandwiched between sedimentary rock on both sides, and the boundary is clearly visible at the eastern edge of the portion visible from Route 2, where sedimentary sandstone rests atop the igneous basalt. The basalt ridge extends south to South Deerfield, and includes Greenfield's Poets Seat Tower. Four forms of bedrock can be found in the Town of Gill: Deerfield Basalt, Mount Toby Conglomerate, Turners Falls Sandstone, and Sugarloaf Arkose.

Conglomerate, a sedimentary rock made from gravel eroded by ancient streams and deposited in the original Connecticut Valley—Route 2, 1 mile west of French King Bridge. Photo by Ivan Ussach.

Ongoing earthquakes had the effect of lowering the original Connecticut Valley on the west side of the fault and raising the hills on the east side of the fault. The constant erosion of these hills and mountains deposited sand, gravel, and mud that hardened into nearly 16,000 feet (three miles) of sedimentary rock in today's valley, stretching from North-field, MA, to New Haven, CT. In between, the eastern edge of the valley is well-marked: the Border Fault follows the boundary between the more highly erodible sedimentary rocks of the valley lowlands to the west and the resistant metamorphic rocks of the Eastern Highlands.

View northwest of the French King Bridge from confluence of Millers River (foreground) and Connecticut River (distance), with southeast corner of Riverside in background formed from 250 million-year-old sedimentary rock. Photo by Ivan Ussach.

The sedimentary deposits were excellent repositories for preserving footprints of dinosaurs and other creatures during the Mesozoic Era, and present an exception to the complex mosaic of igneous and metamorphic bedrock underlying most of southern New England. Continued faulting tilted sedimentary layers downward to the Eastern Border Fault, with this characteristic dip visible along Route 2 in Riverside and elsewhere in the valley. In fact, the Riverside area along Route 2 is tilted to the east and south, resembling a bowl. The sediment that collected in this bowl was covered, not eroded, which accounts for the preservation of dinosaur tracks at Barton Cove.

On Route 2—Turners Falls sandstone, a sedimentary rock made of sandy particles, tilted down to the east like much of Riverside's bedrock. Barton Cove is in the distance. Photo By Ivan Ussach.

By the Cretaceous Period, which followed the Jurassic Period, the ancestral Connecticut Valley became completely filled with sediment, and was gone. The Eastern Border Fault became inactive as plate tectonics now separated the giant landmass containing Europe and Africa from North America, and the Atlantic Ocean formed in the widening gap. The Valley had reached the ultimate erosional stage, becoming a *peneplain*, a flat and gentle landscape with little vertical relief rolling ever-so-slightly down towards the warm, shallow sea. A few places that were harder to erode, like Mount Monadnock in southwest New Hampshire and Mount Wachusett in central Massachusetts, remained above the peneplain. This habitat was excellent for dinosaurs.

The Valley Returns—65 mya to 10 mya

Around 65 mya, as the Rocky Mountains rose in the West, the long-quiet eastern peneplain began to shift and warp upward. Its major uplifting occurred about 10 mya, in the late Miocene Period of the current Cenozoic Era, driven by the expansion of the Earth's mantle. This epeirogenic uplift, involving no faulting or folding, ranged from several hundred to several thousand feet and was greatest to the north. The uplift turned lazy rivers and streams into steep, quick-flowing channels that carved out V-shaped canyons in the rising peneplain. The water's erosional power was greatest on soft rocks like the sedimentary rocks that had filled the former Connecticut Valley.

While some streams continued to flow east, new "pirate" streams began to flow south, parallel to the weak layers of sedimentary rock that eroded faster. As these south-flowing streams cut deeper, they captured the flow of other, east-flowing streams and rivers to unite them. In this way, the Connecticut River was born.

Now, fast forward to only 20,000 years ago—a blink in geological time: Glacial ice covers New England. . . .

Ice Age and Lake Hitchcock—20,000 years ago to 10,000 years ago

Of the more than 20 glacial advances during the last 2 million years or so, most did not reach the Connecticut Valley. Only two glacial "till" deposits, consisting of unlayered material left behind by retreating glaciers and ranging in size from clay particles to boulders, have been located in New England. The older till has been eroded or covered by the deposits from the more recent advance of the Laurentide Ice Sheet, two miles thick and over 70,000 years old. About 20,000 years ago, the continental glacier began to retreat from its southernmost position—Long Island, itself a terminal moraine made of bouldery till left at the glacier's front when it melted. Glacial meltwater created lakes where large holes had been scoured out of the earth, and by 18,000 years ago Lake Middletown had formed on the Connecticut River in southern Connecticut. A large delta was created by the meltwater's sediment. When the lake drained, the delta served to dam the River, aided by a spillway located to the west that kept the pressure off the delta dam. As the glacier continued to recede northward over the next 4,000 years, its meltwater created Lake Hitchcock, a linked series of lakes extending into northern Vermont.

Lake Hitchcock is named for Amherst College's Edward Hitchcock, whose many scientific accomplishments included the early study of footprints of creatures later determined to be dinosaurs. Lake Hitchcock and its aftermath have been a subject of geological interest and study among modern researchers.

The eventual draining of Lake Hitchcock returned the Connecticut River to its valley course, but the River continued to battle against obstructions. Sediment deposits from glaciers or lakes sometimes made it impossible for the Connecticut and its tributaries to find their pre-glacial channels. The Connecticut's pre-glacial course ran a half-mile to the east of the French King Bridge and then south through Millers Falls.

According to Professor Richard Jahns, that segment of the Connecticut River "was effectively blocked by the large delta outwash plain of the glacial Millers River,

Armored Mud Balls

Armored mud balls are commonly produced in some streams and have been found at many locations throughout the world. The ones preserved in ancient bedrock are much rarer; they have been found in less than a dozen sites. Those discovered by Little in the 1980s, the majority embedded in Mesozoic sandstone, are the only ones in the world situated by a river, making them both fluvial and fossil.

Armored mud ball recipe: Start with a block of hard, dry mud that falls into a stream. Allow to tumble in the current until it becomes round and soft enough to stick to pebbles in the stream bed. Note: For fossil mud balls, be prepared to wait a very long time.

Little found a total of fifty-five armored mud balls. He first noticed them in the suspension cable foundations on the Turners Falls side of the Red Bridge that spanned the Connecticut River from Gill to Turners Falls from 1878-1942. Those cable foundations contained thirty-two armored mud balls; thirteen were found in an exposed sedimentary layer below the Turners Falls and Gill dams; ten were part of boulders along the Connecticut River's banks.

The "armor" on each mud ball is typically only one grain or pebble thick. Some mud balls are only an inch across with the largest reaching a foot in its widest dimension. The sandstone was probably quarried close by. The mud balls themselves likely traveled very short distances.

Given their abundance in some modern-day streams, Little called it "puzzling" that more armored mud balls have not been found in early Mesozoic rocks of the Connecticut Valley and in other locations with similar conditions.

Connecticut River armored mud ball.
Courtesy of Gill Historical Commission.

extending westward and southwestward from Millers Falls." Archaeologist Peter Thomas has stated that the delta extended from the vicinity of the French King Bridge to the top of the hill at Main and West Gill Roads on its northern shoreline and formed the Montague Plains to the south. As a result, "the river tried to cut various channels through these delta sands," forming one or more "braided" rivers. Dr. Thomas notes that the Connecticut "initially tried to cut a channel south through Montague Plains."

Another early channel ran west along the northern margin of the outwash plain through the area that is now Riverside. Its course went around the west side of Canada Hill and south through Greenfield. Within a relatively short time, as the River dropped further through the sandy delta, the channel encountered the hard basalt of Canada Hill and cut a new course to the south, along the east side of Canada Hill.

The Connecticut was eventually captured within the mile-wide valley that then existed above the current site of the Gill-Turners Falls dams. This valley became narrower as the River eroded another 50 feet of sand and clay from the old lake bottom. The River eventually encountered a hard outcrop of resistant shale known as the Lily Pond Barrier, today the Barton Cove peninsula.

From 9,000–14,000 years ago, two waterfalls existed side by side atop the Barrier. Little has used the term "mini-Niagara" to describe them. He writes: "The power of falling water scoured two plunge pools into the bedrock before the River found a channel through the obstruction."

According to Thomas, the River stabilized after going over the top of the Lily Pond barrier. This led to the formation of floodplains, as natural fluctuations in the River's course over time, known as "lateral channel migration" (shifts from side to side), deposited sediment adjacent to its banks. Riverside is essentially a high flood terrace. Dropping river levels created a series of alluvial terraces consisting of silt and sand with the highest located along Walnut Street. Due to the area's modern transformation, these terraced floodplains are not easily visible today. A broad, low floodplain, upstream of the Great Falls and now submerged below Barton Cove, is evident in 19th-century maps and aerial photographs compiled by Thomas.

The River continued to erode the Lily Pond Barrier until the shale ridge was finally breached at the site of what Thomas has described as a third plunge pool beneath the current river channel. Upstream, once the Lily Pond Barrier was breached, the River worked its way even deeper into the underlying metamorphic bedrock to create the 400-foot deep French King Gorge. Downstream, on the east side of Canada Hill, the River exposed the sandstone and shale bedrock that forms the base of the river channel as we know it.

In the 19th century the Lily Pond was a real lily pond, located above the large plunge pool closest to the northern shoreline and beneath a scenic cliff. It was also the site of the busy quarry where the same shale was mined for local use—including the Greenfield sidewalk that in 1835 was found to contain curious "turkey tracks." This quarry became the source of thousands of track specimens, many sold by Gill residents Roswell Field and T. M. Stoughton to collectors and researchers from around the world. The second plunge pool was known as Poag's Hole. Although rising water levels from dam construction spelled the end of the lily pond, Barton Cove and the peninsula remain an attractive destination for boaters and fishers.

Barton Cove with the Lily Pond Barrier extending into the Connecticut River and showing the Lily Pond (left) and Poag's Hole (right)—two plunge pools formed by waterfalls after the end of Ice Age. Aerial photo by Christopher D. Condit, Assoc. Professor of Geosciences, UMass, Amherst.

The Great Falls themselves, no longer visible after construction of several dams and rising water levels, appear to be a series of stepped rapids. Evidence compiled by Thomas indicates that these rapids extend approximately 400 yards upstream from the current Gill and Turners Falls dams to near the site of the Red Bridge, built in 1878 and taken down in 1942. Along with historical maps and photographs, Thomas cites an 1892 *Greenfield Gazette* article by Gill Poet Josiah Canning, in which he wrote: "In olden times, instead of a perpendicular fall of water, as now, the falls were a mad rush of waters down a rocky declivity with irresistible force."

The view up through the forest understory reveals jutting cliffs near Barton Cove's plunge pools.

C.2 Soils

Soil is the layer of minerals and organic material that covers the rock of the earth's crust. All soils have characteristics that make them more or less appropriate for different land uses. Scientists classify soils by these characteristics, including topography; physical properties including soil structure, particle size, stoniness and depth of bedrock; drainage or permeability to water, depth to the water table and susceptibility to flooding; behavior or engineering properties, and biological characteristics such as presence of organic matter and fertility Soils are classified and grouped into associations that are commonly found together.

The majority of Gill's soils fall into two major soil groups: Hollis-Charlton (about 45 percent) and Hinckley-Windsor-Merrimac (about 40 percent). The Hollis-Charlton group is typically well drained, varies in soil depth and can be characterized by both rolling and steep wooded hills. Ledges and rock outcroppings are also common to this group. The Hinckley-Windsor-Merrimac group also has prime farmland capabilities. It is characterized by deep well-drained soils consisting of glaciofluvial deposits of sand, gravel and cobbles.

Within these soil types, soils can be classified as "hydric," or having certain qualities from occurring in or near a wetland. Hydric soils are good indicators for wetland delineation. The identification of hydric soils can aid in the preservation and remediation of freshwater wetlands as mandated by the Wetlands Protection Act.

The Soils and Environmental Constraints Map at the end of this section illustrates the principal soil associations according to their level of drainage and the related constraints on development. The driving factor is soil suitability for septic systems, but typically the same factors affect the ability to build new roads, driveways and structures.

C.2.1 Prime Farmland and Development

Many of the soil types in Gill have prime farmland capabilities. Agricultural soils, especially Prime Farmland and Farmland of Statewide Importance, have characteristics that make them suitable for, and therefore vulnerable to, development. (In the remainder of this section, these two types of soils are referred to together as "prime.") This is in conflict with the fact that farmland is a critical resource in providing locally grown food and contributing to the rural character of the landscape of Gill. Areas of Prime Farmland are also shown on the Soils and Environmental Constraints Map.

It is not possible for the Town of Gill to protect all of its farmland, but these areas with a prime farm land classification are good candidates for land conservation and use restrictions. Farming will be most profitable on the best soils. Farms that remain in operation help to maintain the historical land use patterns that people so commonly relate to rural landscapes. The presence of fresh, locally grown produce in roadside farm stands is often taken for granted by residents, until they are gone.

Prime Farmland soils can be reclaimed from forestland. Houses, on the other hand, are not a land use from which farming can recover. Once farmland is converted through development to residential uses, its agricultural value is negated and it will likely never be farmland again. Gill fortunately has the opportunity to work with willing landowners to preserve as much of the remaining farmland as possible. An effective way of conserving farmland would be to prioritize the parcels of those landowners that want their land protected. The Agricultural Preservation Restriction (APR) Program is a voluntary program that provides a non-development alternative to farmers and other owners of "prime" and "state important" agricultural land. The program offers to pay farmland owners the difference between the "fair market value" and the "agricultural value" of their farmland in exchange for a permanent deed restriction, which restricts any use of the property that will have a negative impact on its agricultural viability.[14]

What is Prime Farmland?

According to Natural Resources Conservation Service (NRCS), Prime Farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and that is available for these uses. It has the combination of soil properties, growing season, and moisture supply needed to produce sustained high yields of crops in an economic manner if managed with acceptable farming methods.

In general, prime farmland has an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, an acceptable level of acidity or alkalinity, an acceptable content of salt or sodium, and few or no rocks. Its soils are permeable to water and air. Prime farmland is not excessively eroded or saturated with water for long periods of time, and it either does not flood frequently during the growing season or is protected from flooding.

In order for land to qualify for an Agricultural Preservation Restriction, it must meet several criteria including soil type. Included in any application for an APR must be a United States Department of Agriculture (USDA) Natural Resources Conservation Services (NRCS) Soils Map showing a breakdown of the Project's various soil types and acreage possessing soil capability Class I through VIII as well as prime farmland, soils of state or local significance, and unique soils.[15]

The APR program requires a local match for the program that can come from any combination of three sources: the municipality, a non-governmental organization such as a land trust, and from a bargain sale conducted by the landowner. The local match requirement is 20 percent, however this percent is reduced if the town has implemented certain policies, including establishing an Agricultural Commission and adopting a Right-to-Farm bylaw.

[14] Massachusetts Agricultural Preservation Restriction Program: http://www.mass.gov/eea/agencies/agr/land-use/agricultural-preservation-restriction-program-apr.html.
[15] http://www.mass.gov/agr/legal/regs/330_CMR_22.00.pdf

Gill has both an Agricultural Commission and a Right-to-Farm bylaw in place. Agricultural Commissions advocate for farmers, farm businesses, and farm interests in town, and can help work with other boards and committees on farm related issues or concerns. A Right-to-Farm bylaw encourages the pursuit of agriculture, promotes agriculture-based economic opportunities, and protects farmlands within a town by allowing agricultural uses and related activities to function with minimal conflict with abutters and town agencies.[16] Many towns with Right-to-Farm bylaws publicly display their support for farming through signage indicating they are a "Right-to-Farm" community.

Examples of "Right-to-Farm" signage in Massachusetts' towns. Source: MA Executive Office of Energy and Environmental Affairs.

With the issues of global warming and the need for energy conservation, farmland protection becomes more vital. Locally grown and harvested products allow communities to be more self-sufficient and to help contribute to the reduction of pollution and use of fossil fuels. Protecting farmland for agricultural use has larger implications beyond the town level for the region's food supply. Protecting farmland and local food supplies was identified as the top natural resource goal through the public participation process for the 2013 *Sustainable Franklin County: Franklin County's Regional Plan for Sustainable Development (RPSD).* To examine whether Franklin County has the land resources needed to support an increasing demand for local food—and to achieve some level of food self-reliance—the Conway School of Landscape Design (CSLD) was hired to undertake an analysis of Franklin County's farmland for the RPSD.

The study found that currently over half of all pasture land in Franklin County is in West County, as is nearly all of the orchard land. The study finds that in order for the County to achieve food self-reliance, an additional 3,880 acres of pasture and 13 acres of orchard would need to be put into production (see Table 4-2 below). Currently the County has adequate cropland for self-reliance; however, it is important to note that many farms produce crops for local markets as well as markets outside of the County. The study also notes that while population growth in the County overall is expected to be low in the future, many of East County's farm parcels are along roadways, making them more vulnerable to development.

[16] Massachusetts Executive Office of Energy and Environmental Affairs: http://www.mass.gov/eea/agencies/agr/land-use/right-to-farm-by-law.html.

Table 4-2: Franklin County Farmland Needed for Self Reliance

Farmland Type Needed	Existing Farmland Acreage	Farmland Acreage Needed	Balance
Cropland	23,750	16,547	**+7,203**
Pasture	12,320	16,200	**-3,880**
Orchard	1,180	1,193	**-13**
TOTAL	**37,250**	**33,940**	**+3,310**

Source: *Franklin County Farmland and Foodshed Study*, Conway School of Landscape Design, 2012. As presented in the *2013 Sustainable Franklin County: Franklin County's Regional Plan for Sustainable Development's* Natural Resources Chapter.

Agricultural trends in Franklin County between 2002 and 2012 show a steady increase in the number of farms and the amount of land in farms in the County, which is contrary to national trends. At the same time the size of farms is decreasing. Additionally, the number of farms where farming is the primary occupation of the principal operator has increased in Franklin County since 2002.[17] All of these trends seem to suggest that farming is a growing economic sector in the County, where small farms operated as the owner's primary business are surviving and thriving. Ensuring that good farmland remains available and affordable for farming will help continue to support the growth of this important part of the region's rural economy.

An inactive fault line runs along the French King Gorge, separating the towns of Gill and Erving.

[17] U.S. Census of Agriculture, 2002, 2007, and 2012. http://www.agcensus.usda.gov/

C.3 Topography

The Town of Gill's topography is a result of glacial deposition and river erosion. Gill's terrain varies greatly in slope from level floodplains to steep river valley terraces. Elevations in Gill range from 150 feet at the junction of the Fall and Connecticut Rivers to 816 feet at the top of Pisgah Mountain. Unsorted glacial deposits of soil and rocks, or drumlins, are present throughout Gill's landscape. A fault line, inactive for more than 140 million years, is located along the French King Gorge at the border of Gill and Erving. Other significant geologic features include the plunge pools at Barton Cove, the falls at the Turners Falls Dam, and glacial eskers at the Town Forest.

D. LANDSCAPE CHARACTER

As discussed in Section 3, Gill's landscape character is one of rolling hills, river terraces, farmlands, and upland forests. Distinguishing Gill from other towns in the area are its woodland brooks and streams, the Connecticut and Fall Rivers that form its eastern, southern, and western borders, and Barton Cove in the southwestern corner of town. In addition, the majority of Gill is still either forest or rolling pasture, and it boasts a number of distinctive archaeological and geologic sites of interest.

Gill also has a number of wooded wetland areas, which contribute greatly to the overall scenic quality of the town and to wildlife habitat. Gill's rural character stems from its long history as both a farming community and a mill town.

D.1 Potential Changes in Development

The overall scenic character of Gill could be affected by a number of potential changes. Potential impacts of climate change could begin to push populations further west in the State and more of Gill's land could be used for residential development. Diminishing supplies of fossil fuels – and their potential rising costs – continue to cause people to turn to alternate sources of locally produced energy sources, such as wood, which could impact Gill's woodlands. Related to the rising costs of fossil fuels, costs of shipping foods long distances could cause an even greater demand for locally grown and processed food, potentially causing more land to be farmed in Gill. Land that is currently forested and that contains prime farmlands could be converted to farmland. With thoughtful planning, though, Gill's landscape character, and the Town overall, could remain largely intact and could even return to a more lively and productive farming community.

E. WATER RESOURCES

The water resources discussed in this section are shown on Map 4-5 at the end of this section.

E.1 Surface Water

The following inventory describes Gill's watersheds, rivers, streams, brooks, and ponds and focuses on water quality issues and the public access and recreational value of these waters.

E.1.1 Watersheds

The Town of Gill contains one major watershed, the Connecticut River Watershed. Fall River Watershed is a sub-watershed of the Connecticut. The Connecticut River is nationally significant in that in 1991, Congress established the Silvio O. Conte National Fish and Wildlife Refuge, the only refuge in the country to encompass an entire watershed – the Connecticut River watershed in New Hampshire, Vermont, Massachusetts and Connecticut. Seven years later, in 1998, the Connecticut River became one of only fourteen rivers in the country to earn Presidential designation as an American Heritage River.

Watershed Protection

Local watershed associations include the Connecticut River Conservancy[18] (CRC) which advocates for the entire, four-state Connecticut River watershed. The CRWC works to protect water—the river, its tributaries, lakes, fish; and the land, plants, and creatures connected to that water.

The CRWC has been conducting the following activities that include Gill:

- Bacteria Monitoring at Barton Cove: The CRWC has been conducting weekly monitoring of the state boat ramp at Barton Cove in the summer of 2011. In the last couple of years prior to 2011, they have done additional bacteria monitoring around the Cove, on the Gill and Montague sides, in order to better understand sources of occasional high readings at the state ramp. See http://www.umass.edu/tei/mwwp/ctrivermonitoring.html.
- CRWC continues to participate in advocacy related to the operation of Northfield Mountain pumped storage facility and the Turners Falls dam, with issues related to erosion, fish passage, and recreation. The CRWC are a member of the Connecticut River Streambank Erosion Committee. From 2009-2013, there are five ongoing streambank restoration projects along the riverfront in Gill.
- CRWC owns one piece of conservation land in Gill and has a conservation restriction on a riverfront property in Gill.
- In 2011, the CRWC facilitated a rain barrel workshop with the Gill Energy Committee as part of an effort to mitigate the impact of stormwater runoff on water resources.
- In 2008 and 2009, the CRWC received grants from several town cultural commissions (including Gill) to do a river song writing contest.

At the local level in Gill, the main mechanism in place to protect watersheds and surface waters are private and non-profit land trusts. The Conservation Commission also has the ability to impact watershed protection.

[18] https://www.ctriver.org/

Source Water Assessment Program (SWAP)[19]

Massachusetts has over 1,700 public water systems that provide drinking water to homes, schools, businesses, and industries. Over 90 percent of the state's population depends on public water supply sources, which are often vulnerable to contamination. More than 70 communities have shut down at least one source because it was contaminated. The Massachusetts Department of Environmental Protection (MassDEP) has had a strong water supply protection program since 1980. As a result, local water suppliers and municipal officials received more hydrogeological and planning assistance from MassDEP for improved protection of local drinking water sources.

MassDEP's SWAP process included the following:

- Delineated protection areas for all public ground and surface water sources;
- Inventoried land uses in these areas that may present potential threats to water quality;
- Determined the susceptibility of water supplies to contamination from these sources; and
- Publicized the results.

Source Water Assessment reports help local and state officials target inspections and focus technical assistance where they are needed the most, encourage cooperative emergency response, and contribute to comprehensive protection of all public water sources.

The results of the Assessment show the top five potential threats to public water sources are:

1. Residential lawn care/gardening;
2. Residential septic systems and cesspools;
3. Residential fuel oil storage;
4. Stormwater discharge; and
5. State-regulated underground storage tanks.

MassDEP is using this information to target technical assistance and outreach work. What does the Assessment tell the residents of Gill? The Assessment will tell the following:

- Whether your drinking water is from a surface or a groundwater source;
- The locations of the wells or the intakes;
- The water supply protection area;
- Potential Sources of Contamination (PSC) within the protection areas; and
- What recommended steps you should take to maintain or improve protection.

Four drinking water well or intake locations were identified in Gill including:

1. Northfield Mount Hermon
2. Gill Elementary School

[19] The 2014 Massachusetts Integrated List of Waters prepared by the Department of Environmental Protection (DEP) is used as a source document for the Connecticut River and all listed surface waters within the Town of Gill. The State is required by the United States Environmental Protection Agency to identify water bodies that are not expected to meet surface water quality standards after the implementation of technology-based controls. In each case, the most severe pollutant is identified. Although the affected water bodies may contain other pollutants, the Integrated List of Waters only includes the results of evaluations upon which DEP has performed some measure of quality control.

3. Gill Tavern
4. Oak Ridge Golf Club

Each location has an overall ranking of susceptibility to contamination for the wells as "high." The Assessments are available to the public and can be accessed via the Massachusetts Department of Environmental Protection's website.[20]

E.1.2 Connecticut River

The Connecticut River has a "Class B" water quality designation from the New Hampshire-Vermont border to Holyoke and is classified as a warm water fishery. Class B waters should provide suitable habitat for fish and other wildlife, and should support primary recreational activities such as fishing and swimming. Class B water should also be suitable for irrigation and other agricultural uses. According to the 2014 Massachusetts Department of Environmental Protection's (DEP) Integrated List of Waters, the Connecticut River in Gill is impaired by polychlorinated biphenyls (PCBs) found in fish tissue, Total Suspended Solids (TSS), and impacts to fish and aquatic wildlife from fluctuations in water levels, and other flow regime alterations.[21] Land along the Connecticut River – and the River itself – contains NHESP/TNC BioMap2 and NHESP Priority Habitats of Rare Species.

Connecticut River Water Quality Assessment

The "Connecticut River Basin 2003 Water Quality Assessment Report" published in 2008[22] by the Massachusetts Department of Environmental Protection presents a summary of water quality data/information in the Connecticut River Watershed by segment. The segment relevant to Gill runs from the Route 10 bridge in Northfield to the Turners Falls Dam in Gill.

Report Summary Status
This segment of the Connecticut River is assessed "Support" – or supporting of – all designated uses with the exception of fish consumption, which was assessed as "Impaired". See Table 4-3 below.

Aquatic Life Status
Although aquatic life status is "support", based upon the good survival of test organisms in toxicity tests and good water quality conditions. There is an alert status however, due to the regulated flow regime, severe bank erosion issues, the presence of non-native plant species and the risk that fish tissue contaminants pose to fish-eating wildlife.

[20] https://www.mass.gov/lists/source-water-assessment-and-protection-swap-program-documents
[21] 2014 Integrated List of Waters Interactive Map: http://maps.massgis.state.ma.us/images/dep/omv/il2014viewer.htm. Massachusetts Department of Environmental Protection. Accessed December 27, 2016.
[22] Note: The Connecticut River Basin 2003 Water Quality Assessment Report is the most current data report.

Table 4-3: Connecticut River Use Summary Table

Connecticut River (Segment MA34-02) Use Summary Table

Designated Uses		Status
Aquatic Life		SUPPORT*
Fish Consumption		IMPAIRED Cause: PCB in fish tissue Source: Unknown
Primary Contact		Recreation Primary Contact
Secondary Contact		Recreation Secondary Contact
Aesthetics		SUPPORT*

* Alert Status, see details in use assessment

Source: Connecticut River Basin 2003 Water Quality Assessment Report (2008)

Fish Consumption Status

Because of the site-specific fish consumption advisory for the Connecticut River due to PCB contamination, fish consumption status is assessed as "impaired". Note: As this report is a number of years old, the impaired fish consumption was reviewed to determine whether the status was still valid. In August 2018, the Massachusetts Health and Human Services Department had in place a Public Health Fish Consumption Advisory[23] as follows in Table 4-4.

Table 4-4: Public Health Fish Consumption Advisory

Water Body	Hazard	Advisory	Fish Type
Connecticut River	PCBs (polychlorinated biphenyls)	P1 Children younger than 12 years of age, pregnant women, women of childbearing age who may become pregnant, and nursing mothers should not eat any fish from this water body.	All fish
		P2 The general public should not consume Channel Catfish, White Catfish, American Eel or Yellow Perch from this water body.	American Eel Channel Catfish White Catfish Yellow

Source: Massachusetts Public Health Fish Consumption Advisory, accessed August 15, 2018.

Primary and Secondary Contact Recreation and Aesthetics Status

These uses are assessed as "support" based upon the low bacteria counts and the lack of objectionable deposits, odors or oils. However, these uses did receive an "alert" status given the turbid conditions, regulated flow regime and severe erosion issues identified upstream.

Report Recommendations

Report recommendations include the following:

1. Due to the presence of an invasive algae found in the river, boaters should follow a check-clean-dry protocol when exiting waters
2. Continue river-bank stabilization projects
3. Continue water quality testing
4. Continue monitoring for the presence of invasive non-native aquatic vegetation.

[23] https://eohhs.ehs.state.ma.us/DPH_FishAdvisory/SearchTown.aspx

According to the Connecticut River Five Year Action Plan 2002-2007 developed by the Massachusetts Executive Office of Environmental Affairs, the Town of Gill lies in the most rural portion (the Northern Reach) of the Connecticut River Watershed in Massachusetts. Important characteristics of this part of the watershed include agricultural lands, large tracts of forestland, and the presence of two hydroelectric facilities. The Plan lists the following objectives for the Northern Reach:

- Increase awareness of the importance of riparian buffers along the mainstem of the Connecticut River and its tributaries;
- Reduce human-influenced erosion along the mainstem and its tributaries;
- Restore vegetative riparian buffers where appropriate;
- Protect water quality through the implementation of growth management strategies;
- Obtain additional water quality data;
- Reduce non-point source pollution with a particular focus on the mainstem and four priority tributaries;
- Assist communities with the protection of drinking water resources;
- Improve fish passage;
- Encourage the protection of important wildlife habitat;
- Complete an updated inventory of existing boat access points;
- Implement an education program for boaters; and
- Assist with the development of a public access point on the Fall River in Bernardston.

Barton Cove Boat Access and Campground

Located on a rocky peninsula jutting into the Connecticut River, Barton Cove is a recreational area owned and managed by FirstLight Power Resources. A part of the Connecticut River Greenway State Park, the Barton Cove Access Ramp is located on Route 2, 1.5 miles east of the Gill-Montague Bridge. The boat ramp can accommodate recreational motorboats, canoes, and fishing boats. The Barton Cove state boat ramp is one of three state-managed public access points on the Connecticut River in Franklin County. The two others are Pauchaug Access in Northfield and the Sunderland Access.

Barton Cove and buffering lands contain areas of NHESP/TNC BioMap2 and NHESP Priority Habitats of Rare Species. Of special significance is the Bald Eagle, which uses the shoreline as nesting, feeding and perching habitat.

People can use the site for day trips and picnicking or for a week-long camping trip. The Barton Cove Campground has bathroom and tent camping facilities and minimal automobile access. The area boasts a nature trail along a scenic rocky ridge overlooking the river, an abandoned dinosaur footprint quarry, unusual rock formations, a multitude of ferns and wildflowers, plunge pools of ancient waterfalls, and views of sunsets and bald eagles over the Connecticut River. Canoes and kayaks can be rented on an hourly or daily basis in season. Rock formations hanging out over small coves are best viewed in a canoe or kayak.

E.1.3 Fall River

Remnant of one of several grist mills in Gill tumbles into a stream.

Fall River is located along the town's western border with Greenfield. This river empties into the Connecticut just below the Turners Falls dam and is a scenic and historic asset to the town. There are former mill sites along the Fall River, and its course meanders between cascades, small waterfalls and pools. The mills once used it for hydropower, but it is now primarily a place for fishing, swimming and is an important habitat corridor for wildlife. The middle third of section of Fall River that borders Gill is within the BioMap2 Critical Natural Landscape. The southern-most quarter mile of the river is within the NHESP Priority Habitat of Rare Species.

D.1.4 Other Streams and Brooks

Otter Run

Otter Run flows into the Connecticut River approximately opposite the midpoint of Kidd Island's western shore.

Dry Brook

Dry Brook originates in the Town of Bernardston and flows into the Connecticut River near Grist Mill Road. At one time, Dry Brook was used to power five mills along its banks. Two of the mills were known as Janes' Grist Mill and were located approximately 1,500 feet from the brook's confluence with the Connecticut River.

Dry Brook supports a dense population of Eastern Pearlshell, a species of freshwater mussel known from only twenty-two water bodies in Massachusetts. This species inhabits streams and rivers that are cool and clean enough to support trout, its fish host.

Otter Brook

Otter Brook is located in the northern portion of Gill, is a tributary of Dry Brook and is fed by Otter Pond. There is also a sixty-acre marsh on Otter Brook off Ben Hale Road.

Beaver Brook
Beaver Brook is a tributary of Dry Brook. It originates in a wetland off Mountain Road and flows through Gill Center. It contains habitats for rare and endangered species.

Ashuela Brook
Ashuela Brook originates at Shadow Lake and flows into the Connecticut River approximately opposite the downstream end of Kidd Island. Parts of Ashuela Brook are within the NHESP/TNC BioMap2 and are also designated as NHESP Priority Habitat of Rare Species.

Cascade Brook
Cascade Brook, located in western Gill, flows into the Fall River near South Cross Road. The brook has a set of falls known as the Cascades located off South Cross Road. A wheelwright shop was once located at the falls.

D.1.6 Lakes, Ponds, and Other Surface Water Bodies

Lily Pond
Lily Pond is located off Barton Cove and is a plunge pool created by a glacial dam. It is considered part of the same NHESP area as Barton Cove.

Shadow Lake
Shadow Lake is a five and one-half acre lake located on the Mount Hermon Campus in the northeastern portion of Gill.

Otter Pond
Otter Pond is a shallow six-acre pond located in the northwestern corner of Gill between Hoe Shop Road and Dole Road.

There are a number of other un-named streams, ponds and wetlands in Gill that are located in the Connecticut River Watershed.

E.2 Cold Water Fish Resources (CFRs)

According to the Massachusetts Division of Fisheries and Wildlife (MassWildlife), cold water fish resources are particularly sensitive habitats. Changes in land and water use can reduce the ability of these waters to support trout and other kinds of cold water fish. Identification of CFRs are based on fish samples collected annually by staff biologists and technicians. MassWildlife updates the list of CFRs in the state on an annual basis and maintains an interactive map online. Conservation commissions, planning boards, land trusts, regional planning agencies, and town open space committees can refer to the list and map of CFRs to better inform conservation planning.[24]

In Gill, Fall River is categorized as a CFR, as is the Dry Brook and an unnamed tributary to it. There is also an unnamed tributary flowing into Barton Cove that is classified as a CFR.

[24] Massachusetts Division of Fisheries and Wildlife website: http://www.mass.gov/eea/agencies/dfg/dfw/wildlife-habitat-conservation/coldwater-fish-resources-map.html. Accessed December 30, 2016.

E.3 Flood Hazard Areas

Flooding along rivers is a natural occurrence. Floods happen when the flow in the river exceeds the carrying capacity of the channel. Some areas along rivers flood every year during the spring, while other areas flood during years when spring runoff is especially high, or following severe storm events. The term "floodplain" refers to the land affected by flooding from a storm predicted to occur at a particular interval. For example, the "one hundred-year floodplain," is the area predicted to flood as the result of a very severe storm that has a one percent chance of occurring in any given year. Similarly, the 500-year floodplain is the area predicted to flood in a catastrophic storm with a 1 in 500 chance of occurring in any year.

According to the Town of Gill Multi-Hazard Mitigation Plan, there are approximately 583 acres within the 100 year floodplain in Gill. The plan identifies the Riverside section of Gill as a flood prone area in Town. Other areas within floodplain include the area along the Connecticut River in the farmland area northeast of Stacey Mountain, and in the area of Barton Cove, along the Fall River, Dry Brook and Otter Brook.

E.4 Wetlands

Wetlands are transitional areas where land-based and water-based ecosystems overlap. Inland wet-lands are commonly referred to as swamps, marshes and bogs. Technically, wetlands are places where the water table is at or near the surface or the land is covered by shallow water. Sometimes, the term wetland is used to refer to surface water as well.

This woodland wetland provides important habitat for wildlife in Gill.

Historically, wetlands have been viewed as unproductive wastelands, to be drained, filled and "improved" for more productive uses. Over the past several decades, scientists have recognized that wetlands perform a variety of extremely important ecological functions. They absorb runoff and prevent flooding. Wetland vegetation stabilizes stream banks, preventing erosion, and trap sediments that are transported by runoff. Wetland plants absorb nutrients, such as nitrogen and phosphorus, which would be harmful if they entered lakes, ponds, rivers and streams. They also absorb heavy metals and other pollution. Finally, wetlands are extremely productive, providing food and habitat for fish and wildlife. Many plants, invertebrates, amphibians, reptiles and fish depend on wetlands to survive. Wetlands have economic significance related to their ecological functions: it is far more cost-effective to maintain wetlands than build treatment facilities to

manage stormwater and purify drinking water, and wetlands are essential to supporting lucrative outdoor recreation industries including hunting, fishing and bird-watching.

In recognition of the ecological and economic importance of wetlands, the Massachusetts Wetlands Protection Act is designed to protect eight "interests" related to their function: public and private water supply, ground water supply, flood control, storm damage prevention, prevention of pollution, land containing shellfish, fisheries, and wildlife habitat. To this end, the law defines and protects "wetland resource areas," including banks of rivers, lakes, ponds and streams, wetlands bordering the banks, land under rivers, lakes and ponds, land subject to flooding, and "riverfront areas" within two hundred feet of any stream that runs all year. Local Conservation Commissions are responsible for administering the Wetlands Protection Act; some towns also have their own, local wetlands regulations.

Many of Gill's wetlands can be found in its uplands in isolated forested areas. Some of these wetlands are mapped by the National Wetlands Inventory (NWI).[25] Nearly all the wetlands mapped by NWI in Gill are classified as "freshwater forested/shrub", defined as a forested swamp or wetland shrub bog or wetland.[26] Most upland wetlands are associated with the headwaters of the major stream systems in town.

E.5 Aquifers

Aquifers are composed of water-bearing soil and minerals, which may be either unconsolidated (soil-like) deposits or consolidated rock. Consolidated rock, also known as bedrock, consists of rock and mineral particles that have been welded together by heat and pressure or chemical reaction. Water flows through fractures, pores and other openings. Unconsolidated deposits consist of material from the disintegrated consolidated rock like gravel and sand. Water flows through openings between particles.

As water travels through the cracks and openings in rock and soil, it passes through a region called the "unsaturated zone," which is characterized by the presence of both air and water in the spaces between soil particles. Water in this zone cannot be pumped. Below this layer, water fills all spaces in the "saturated zone". The water in this layer is referred to as "groundwater". The upper surface of the groundwater is called the "water table" (Masters, Gilbert. *Introduction to Environmental Engineering and Science, Second Edition*, 1998).

The route groundwater takes and the rate at which it moves through an aquifer is determined by the properties of the aquifer materials and the aquifer's width and depth. This information helps determine how best to extract the water for use, as well as determining how contaminants, which originate on the surface, will flow in the aquifer.

Aquifers are generally classified as either unconfined or confined (EPA and Purdue U.; 1998). The top of an unconfined aquifer is identified by the water table. Above the water table, in the unsaturated zone, interconnected pore spaces are open to the atmosphere. Precipitation recharges the groundwater by soaking into the ground and percolating down to the water table. Confined

[25] http://www.fws.gov/wetlands/Data/Mapper.html
[26] http://www.mass.gov/mgis/nwi.htm

aquifers are sandwiched between two impermeable layers (Masters; 1998). Almost all the public wells in Massachusetts, including those in Gill, and many private wells tap unconfined aquifers (Mass. Audubon Society; 1985). Wells that rely on confined aquifers are referred to as "artesian wells."

Gill's surficial geology has characteristics that would support medium yield aquifers. A medium-yield aquifer provides a yield of between 25 and 1000 gallons per minute. According to MassGIS[27] and the United States Geological Survey (USGS), the following areas support medium-yield aquifers:

- An area approximately three-fourths of a mile to the north of Munn's Ferry Road and approximately one mile to the south of Munn's Ferry Road, along the Connecticut River;
- An area approximately one half mile to the north of Pisgah Mountain Road and approximately one half mile to the south of Pisgah Mountain Road, along the Connecticut River; and
- An area bordered by the town's border with Bernardston, Boyle Road, the intersection of Main Road and Cross Road and Dry Brook.

A mixed hardwood forest rises up alongside Barton Cove.

F. VEGETATION

The vegetated landscape of Gill includes mixed hardwood forests, farmlands and riparian lands. Farmland is made up of crop fields and rolling fields for grazing. Land that borders the Connecticut River is not the broad, flat plains characteristic of much of the Connecticut River Valley but instead is often quite steep wooded embankments. Examples of this can be seen at Barton Cove and at the French King Gorge.

F.1 Forests

Forests constitute one of the most important natural resources in the Town of Gill and in the region. While much of the town's lands are forested, privately owned forest is much more common than publicly owned. The extent of forest cover in Gill is shown in the Regional

[27] MassGIS 2007 Aquifer Data Layer information: http://www.mass.gov/mgis/aq.htm

Context Map at the end of Section 3. The values of large blocks of contiguous forestland are many. Some primary values include:[28]

- Ecosystem Services. Woodlands have significant ecosystems values, including water supply, nutrient retention, carbon sequestration, and climate stabilization. Large blocks of contiguous forests support groundwater recharge and provide ample clean water for humans. Another significant woodland service is mitigation of climate change through carbon dioxide uptake and storage.
- Habitat Connectivity. Large blocks of contiguous forest help support biodiversity and the successful migration of plant and animal species impacted by fragmentation such as that caused by new development. Forestland provides habitat for wildlife species that require a certain amount of deep forest cover and separation for humans.
- Recreation and Tourism. Forestland also provides a natural infrastructure for tourism and recreation economy. Fall foliage season is a vital part of the Western Massachusetts economy, drawing visitors to the area for leaf peeping, contributing to the hospitality industry and other sectors of the economy. Forestland also provides places for hiking, skiing, bird watching, hunting, paddling, and other outdoor activities.

Fragmentation of large blocks of contiguous forestland can be caused by a variety of impacts including:[29]

- Deforestation and development including subdivisions, commercial complexes, roads and infrastructure.
- Perforation of contiguous forestland including individual houses – and their associated driveways, lawns and human activities – on large parcels of land.
- Climate change – including wide fluctuations in temperature, precipitation, and length of growing season – causing impacts such as outbreaks of certain diseases and pests and changes in the range of certain plants and animals. These changes could have real impacts to the local economy such as a decline in maple sugaring.
- Adverse forest practices such as clear cutting with erosion that often follows.
- Parcelization including increased number of owners – often absentee – and decreased parcel size.
- Invasive organisms including insects, plant species and pathogens.

The woodlands in Gill are used for hiking and nature study and are important habitat for wildlife. They also add to the scenic and rural character of the town. Gill's forests include species associations common to the Hemlock-Northern Hardwoods Forest to the north and the Appalachian-Oak Forest to the south.

Forested lands in Gill are at varied stages of growth due to the changes in landscape, elevation and exposure to elements. Table 4-5 gives a general inventory of the typical species in Gill.

[28] Wildlands and Woodlands: A Vision for the New England Landscape, Harvard Forest, Harvard University, 2010.
[29] Ibid.

Table 4-5: General Inventory of Forest Types in the Town of Gill

Forest Type	Common Trees, Shrubs and Herbaceous Vegetation
Hemlock-Northern Hardwoods Forest	Eastern hemlock, sugar maple, red maple, American beech, yellow birch, paper birch, white ash, white pine, willow, speckled alder, sedges
Appalachian-Oak Forest	
Higher elevations	White oak, red oak, shagbark hickory, bitternut hickory, black cherry, white ash, American basswood, Eastern cottonwood
Lower elevations	American sycamore, silver maple, box elder, staghorn sumac, smooth sumac

Source: USDA; 1992

F.2 Public Shade Trees

Public shade trees are located in Gill Town Center, most notably, a majestic sycamore adjacent to the Town Hall. Public shade trees are also located in Town right of ways, at the Slate Library and in Town cemeteries. In a Town as heavily forested as Gill, preserving public shade trees may seem unnecessary; however, loss of trees in public spaces can significantly change the character of that place. Some methods towns use to protect shade trees include adopting a scenic roads bylaw, limiting the amount of salt used on roads, and requiring replacement of any trees that are lost.

The benefits of street trees include the following:[30]

- Air quality improvement
- Water quality improvement (incl. improved stormwater management)
- Cooler air temperatures
- Greenhouse gas reduction
- Building energy conservation
- Noise reduction
- Wildlife habitat
- Social/psychological benefits
- Human health benefits
- Aesthetics

The USDA Forest Service has created a a state-of-the-art, peer-reviewed software suite that provides urban and rural forestry analysis and benefits assessment tools, called **i-Tree**.[31] The i-Tree tools can help strengthen forest management and advocacy efforts by quantifying forest structure and the environmental benefits that trees provide. Since the initial release of the i-Tree Tools in August 2006, thousands of communities, non-profit organizations, consultants, volunteers and students around the world have used i-Tree to report on individual trees, parcels, neighborhoods, cities, and even entire states. By understanding the local, tangible ecosystem

[30] Rick W. Harper, Ext. Assist. Professor-Urban and Community Forestry, UMass, "Realizing the Benefits of our Urban Trees," *3rd Annual Massachusetts Clean Energy Conference: Helping Communities with Renewables and Efficiency;* 2016.
[31] http://www.itreetools.org/

services that trees provide, i-Tree users can link forest management activities with environmental quality and community livability. Analysis tools and utility programs include:

- **i-Tree Eco,** which provides a broad picture of the entire urban or rural forest;
- **i-Tree Hydro,** an application designed to simulate the effects of changes in tree and other land cover characteristics within a watershed on stream flow and water quality;
- **i-Tree Species**, a web application designed to help urban foresters select the most appropriate tree species based on environmental function and geographic area;
- **i-Tree Streets,** focusing on the benefits provided by a municipality's street trees;
- **i-Tree Pest Detection Module,** a portable, accessible and standardized protocol for observing a tree for possible insect or disease problems; and
- **i-Tree Storm**, a method for a community to assess widespread storm damage in a simple, credible, and efficient manner immediately after a severe storm.

The Franklin Regional Council of Governments has also compiled a list of Climate Resilient Trees for Streetside Tree Belt Planting, including both shade and ornamental trees. The list provides information on the characteristics of 28 species of trees, including height and spread of the mature tree, whether it is native to North America, the USDA grow zone, light and watering requirements. In addition, the list indicates whether each species is tolerant to drought, salt, air pollution and clay soils; whether it has showy fall foliage or flowers; and whether it is appropriate to plant under utility lines.

F.3 Agricultural Land

In 2005, according to MassGIS data, of the total 9,478 acres of land in Gill, there were approximately 1,600 acres or 17% of agricultural land (includes cropland and pastureland). This number is down slightly from the estimated 20% in 1999. However, during this time, methodology for classifying land has changed. This change may account for the decline from 1999 to 2005.

In 2011, the Gill Agricultural Commission's ***Gill Farms: A Guide to Buying Gill Products and Supporting Agriculture in Our Community*** indicated the number of small family farms are on the rise.[32] Active farmland with prime farmland soils (shown in Map 4-3) in Gill is primarily located along the Connecticut River, the upper Fall River, Cascade Brook, Otter Brook, Dry Brook, Ashuela Brook, and along Main Road. Other active farmland can be found along West Gill Road, River Road, North Cross Road, Mount Hermon Road, Boyle Road, Route 2 and Franklin Road.

Vegetation in agricultural lands can include crops and fields for grazing. Along with grasses, farm fields contain many perennial herbaceous plant as well as some invasive plants, such as multiflora rose, buckthorn, and bittersweet. Farm field edges are often in an early successional forest stage, containing shrubs and small trees. These edges serve as important areas for forage, cover and escape for wildlife.

[32] Steve Damon, Chairperson, 2011 Gill Agricultural Commission

F.4 Wetland Vegetation

As discussed on previously in the Wetlands subsection, wetlands provide important ecological functions and offer important wildlife habitat. Typical wetlands in Gill are forested deciduous swamps. Vegetation found in these wetlands can vary, depending upon shade and other conditions. Some typical plants found in and near Gill wetlands are red maple (*Acer rubrum*), eastern hemlock (*Tsuga Canadensis*), winterberry (*Ilex verticillata*), sedges (*Carex spp*.), ferns, and skunk cabbage (*Symphlocarpus*).

F.5 Rare, Threatened, and Endangered Plant Species

Statewide, NHESP has identified 256 native plant species as rare, threatened or endangered. Plants (and animals) listed as *endangered* are at risk of extinction (total disappearance) or extirpation (disappearance of a distinct interbreeding population in a particular area). *Threatened* species are likely to become endangered in the foreseeable future. Species of *Special Concern* have been documented to have suffered a decline that could result in its becoming threatened, or occur in very small numbers and/or have very specialized habitat, the loss of which could result in their becoming threatened.

Nineteen rare plant species have been documented in the Town of Gill (see Table 4-6). These plants occur in some of the Priority Habitats identified above.

Table 4-6: NHESP Rare Plant Species in the Town of Gill

Scientific Name	Common Name	MESA Status*	Most Recent Observation
Celastrus scandens	American Bittersweet	T	2016
Elatine americana	American Waterwort	E	2012
Trichomanes intricatum	Appalachian Bristle-fern	E	2011
Carex grayi	Gray's Sedge	T	2016
Boechera missouriensis	Green Rock-cress	T	2008
Desmodium cuspidatum	Large-bracted Tick-trefoil	T	2013
Ludwigia polycarpa	Many-fruited False-loosestrife	E	2010
Minuartia michauxii	Michaux's Sandwort	T	2013
Cerastium nutans	Nodding Chickweed	E	2014
Clematis occidentalis	Purple Clematis	SC	2012
Aplectrum hyemale	Putty-root	E	2007
Crassula aquatica	Pygmyweed	T	2012
Morus rubra	Red Mulberry	E	1987
Viola adunca	Sand Violet	SC	2005
Prunus pumila var. depressa	Sandbar Cherry	T	2014
Symphyotrichum tradescantii	Tradescant's Aster	T	2014
Deschampsia cespitosa ssp. glauca	Tufted Hairgrass	E	2016
Oligoneuron album	Upland White Aster	E	2014
Malaxis monophyllos var. brachypoda	White Adder's-mouth	E	2014

*SC – Special Concern; T - Threatened; E – Endangered.

Source: Massachusetts Natural Heritage and Endangered Species Program, Town Species Viewer: http://www.mass.gov/eea/agencies/dfg/dfw/natural-heritage/species-information-and-conservation/town-species-viewer.html

As part of annual Biodiversity Days, efforts have been started to map vegetation in the Town Forest. A goal for future mapping projects are included in the Seven-Year Action Plan.

NHESP identifies *Morus rubra* (Red Mullberry) as endangered. Photos from NHESP *Morus Rubra* fact sheet and by Charles S. Eiseman

G. FISHERIES AND WILDLIFE

Gill's forests, rivers, wetlands and open farmland provide habitat for a variety of common and rare wildlife species. This section discusses wildlife species and their habitats from the perspective of natural communities, individual species, and patterns of wildlife distribution and movement across the landscape.

G.1 General Description and Inventory of Wildlife and Wildlife Habitats

Natural Heritage Endangered Species Program and the Natural Conservancy BioMap2 show Core Habitats critical for the long-term persistence of rare species and Critical Natural Landscape, including buffers along Core Habitats. (BioMap2 is discussed in more detail at the beginning of Section 4.) (*These areas mapped in Gill are shown on the Soil and Environmental Constraints Map at the end of this section.)* Nine areas comprising 2,492 acres within Gill are BioMap2 Core Habitat; including 1 Forest Core, 2 Aquatic Cores, 2 Wetland Cores, 1 Priority Natural Community Core, and areas for 33 Species of Conservation Concern. Some of these areas overlap. Adjacent to and overlapping some of these Core Habitats in Gill is one area of BioMap2 Critical Natural Landscape comprising 6,208 acres, including 1 Aquatic Buffer, 2 Wetland Buffers, and 1 Landscape Block.

The most notable pattern of Core Habitat is the significant area that buffers the entire length of the Connecticut River in Gill. These areas provide habitat for rare species in Gill. Other Core Habitat areas include:

- An area in the northeastern corner of Gill along Mount Hermon Road and the intersection of Mount Hermon Road and Main Road;
- An area along the eastern end of North Cross Road;
- Along Ashuela Brook from its confluence with the Connecticut River to approximately three-fourths of a mile upstream;
- An area along Main Road in the central portion of Gill, just northeast of Wyart Road;
- Along Pisgah Mountain Road; and
- An area to the west of Barney Hale Road (see Water Resources and Wildlife Habitat Maps).

There are five examples of Priority Natural Communities documented by NHESP in Gill:

- Calcareous Rock Cliff Community
- High-terrace Floodplain Forest
- Sugar Maple-Oak-Hickory Forest

There is one other type of more common natural community documented from Gill, as well, the Freshwater Mud Flat Community.

The Natural Heritage Endangered Species Program maintains a list of all Massachusetts Endangered Species Act (MESA)-listed species observed and documented in each Massachusetts town. These lists are updated once a year or when there are approved MESA list changes and are shown in the following pages.

G.2 Vernal Pools[33]

Vernal pools are unique wildlife habitats best known for the amphibians and invertebrate animals that use them to breed. Vernal pools, also known as ephemeral pools, autumnal pools, and temporary woodland ponds, typically fill with water in the autumn or winter due to rising ground water and rainfall and remain ponded through the spring and into summer. Vernal pools may be very shallow, holding only 5 or 6 inches of water, or they may be quite deep. They range in size from fewer than 100 square feet to several acres. Vernal pools are found across the landscape, anywhere that small woodland depressions, swales or kettle holes collect spring runoff or intercept seasonal high groundwater, and along rivers in the floodplain. Many species of amphibians and vertebrates are completely dependent on vernal pools to reproduce. Loss of vernal pools can endanger entire populations of these species.

NHESP has a program to certify the existence of vernal pools when evidence is submitted to document their location and the presence of breeding amphibians that depend on vernal pools to

[33] http://www.mass.gov/dfwele/dfw/nhesp/vernal_pools/vernal_pools.htm

survive. Certified vernal pools are protected by the Massachusetts Wetlands Protection Act and by additional state and federal regulations. Landowners are not required to report the existence of vernal pools on their property and landowner permission must be obtained prior to any person attempting to certify a vernal pool on private property. According to MassGIS data, there are 46 potential vernal pools in Gill and 3 certified vernal pools.[34]

G.3 Wildlife Corridors

Wildlife and fisheries populations move along corridors such as rivers, riparian areas, ridgelines, farm fields, and forested slopes. Wildlife seek natural cover for shelter and food and forage where human uses, such as horticultural and ornamental plantings, provide browse or food. Remote large blocks of forestland, riparian areas, farm fields, and the parcels of land connecting them together, are important areas to preserve and protect in Gill.

G.4 Rare and Endangered Wildlife Species

G.4.2 Amphibians and Reptiles

Diverse amphibian and reptile species inhabit Gill. Large tracts of forested uplands and forested riparian corridors provide excellent habitat that supports amphibians and reptiles. Vernal pools and wetlands are essential habitat for two-thirds of the Commonwealth's amphibious species. Table 4-7 shows the rare amphibian and reptile species identified in Gill. The Jefferson salamander is a species of concern that inhabits upland forest areas near ponds or vernal pools. Also found in Gill are the marbled salamander, a threatened species and the wood turtle, a species of special concern. Identifying and protecting the habitats are the best means to ensure that these species remain a part of the New England biota.

Table 4-7: NHESP Rare Amphibian and Reptile Species in the Town of Gill

Taxonomic Group	Scientific Name	Common Name	MESA Status	Most Recent Observation
Amphibian	*Ambystoma jeffersonianum*	Jefferson Salamander	Special Concern	1997
Amphibian	*Ambystoma opacum*	Marbled Salamander	Threatened	1997
Reptile	*Glyptemys insculpta*	Wood Turtle	Special Concern	2003

Source: Massachusetts Natural Heritage and Endangered Species Program, Town Species Viewer: http://www.mass.gov/eea/agencies/dfg/dfw/natural-heritage/species-information-and-conservation/town-species-viewer.html

The forests, wetlands and other surface waters in Gill are also home to nine snake species, five turtle species, nine frog and toad species and seven species of salamanders, such as the spotted salamander and the eastern newt.

[34] According to January 2010 MassGIS Data, http://www.mass.gov/mgis/ftpstate.htm, there are 3 certified vernal pools in Gill. The NHESP website data, also from 2010, there are 4.

G.4.3 Fish and Mussels

Migratory fish species such as shad and salmon once inhabited the Connecticut River in great numbers. When the Turners Falls dam was built in 1798 and subsequent dams were built further downstream, the salmon stopped running in the Connecticut River. FirstLight Power Resources is maintaining a fish ladder at Turners Falls in order to aid the comeback of this once abundant species.

As shown in Table 4-8, three fish species and one mussel species make NHESP's list of rare species. The shortnose sturgeon is listed as endangered on both the state and federal level. Shortnose sturgeon spawn in fast flowing rocky areas and Longnose suckers are found primarily in cool upper sections of streams and rivers.

Table 4-8: NHESP Rare Fish and Mussel Species in the Town of Gill

Taxonomic Group	Scientific Name	Common Name	MESA Status	Federal Status	Most Recent Observation
Fish	*Acipenser brevirostrum*	Shortnose Sturgeon	Endangered	Endangered	1993
Fish	*Catostomus catostomus*	Longnose Sucker	Special Concern		2005
Fish	*Lota lota*	Burbot	Special Concern		2000
Mussel	*Alasmidonta varicosa*	Brook Floater (Swollen Wedgemussel)	Endangered		Historic

Source: Massachusetts Natural Heritage and Endangered Species Program, Town Species Viewer: http://www.mass.gov/eea/agencies/dfg/dfw/natural-heritage/species-information-and-conservation/town-species-viewer.html

Other migratory species found in Gill are shad, blueback herring and alewife. Non-migratory species present in the Connecticut River are walleyed pike, carp and bass. Shadow Lake has a native population of blue-gill, crappie, perch and pickerel. Fall River is stocked with trout for recreational fishing and native brook trout are found throughout the town's waterways.

G.4.4 Birds

The Connecticut River Valley is a part of a major migratory flyway from North to South and vice versa. Game birds include ruffed grouse, woodcock, black duck, and mallard. Many shorebirds visit the Connecticut riverbanks in the summer months. Some examples of Gill shorebirds are killdeer, yellow legs, green heron, great blue heron, and spotted sandpiper.

Other bird species in Gill include the common loon, osprey, snow geese, wild turkey, Canada goose, hawks, falcons, nighthawks and swallows. In addition, the river valley is important habitat for songbirds and other migratory birds. A nesting pair of American Bald Eagles has resided on Barton Island for about a decade. After having disappeared completely around the turn of the 20th century, the number of bald eagles nesting in Massachusetts appears to be steadily growing amid three decades of efforts by MassWildlife and Mass Audubon to re-

establish a natural population of the nation's animal here. In 2018, state wildlife officials identified 76 territorial pairs of bald, up from 68 pairs in 2017 and the 59 pairs counted in 2016.

As shown in Table 4-9, the American bald eagle and the sedge wren are the two bird species in Gill currently identified as endangered by NHESP.

Cistothorus platensis – or Sedge Wren – is one of two bird species listed as endangered in Gill.

Table 4-9: NHESP Rare Bird Species in the Town of Gill

Taxonomic Group	Scientific Name	Common Name	MESA Status	Most Recent Observation
Bird	*Cistothorus platensis*	Sedge Wren	Endangered	1996
Bird	*Haliaeetus leucocephalus*	Bald Eagle	Endangered	2018*

*Recent local siting reported
Source: Massachusetts Natural Heritage and Endangered Species Program, Town Species Viewer: http://www.mass.gov/eea/agencies/dfg/dfw/natural-heritage/species-information-and-conservation/town-species-viewer.html

G.4.5 Dragonflies and Damselflies

As shown in Table 4-10, there are nine species in the dragonfly/damselfly taxonomic group on NHESP's list of rare species for Gill.

Table 4-10: NHESP Rare Dragonfly/Damselfly Species in the Town of Gill

Taxonomic Group	Scientific Name	Common Name	MESA Status	Most Recent Observation
Dragonfly/Damselfly	*Enallagma carunculatum*	Tule Bluet	Special Concern	1997
Dragonfly/Damselfly	*Gomphus abbreviatus*	Spine-crowned Clubtail	Endangered	2008
Dragonfly/Damselfly	*Gomphus fraternus*	Midland Clubtail	Endangered	2002
Dragonfly/Damselfly	*Gomphus vastus*	Cobra Clubtail	Special Concern	2008
Dragonfly/Damselfly	*Gomphus ventricosus*	Skillet Clubtail	Special Concern	2008
Dragonfly/Damselfly	*Neurocordulia yamaskanensis*	Stygian Shadowdragon	Special Concern	2008
Dragonfly/Damselfly	*Ophiogomphus aspersus*	Brook Snaketail	Special Concern	2007
Dragonfly/Damselfly	*Stylurus amnicola*	Riverine Clubtail	Endangered	2008
Dragonfly/Damselfly	*Stylurus spiniceps*	Arrow Clubtail	Threatened	2008

Source: NHESP MESA Massachusetts List of Endangered, Threatened and Special Concern Species, updated 2008

G.4.6 Mammals

Though many larger mammals were driven out or killed off by colonists in the nineteenth century, some are slowly returning to the area as forests have grown back across the landscape. Mammal species common to Gill and surrounding towns are: Black bear, white-tailed deer, beaver, Eastern coyote, opossum, gray fox, red fox, eastern cottontail, New England cottontail, flying squirrel, gray squirrel, red squirrel, varying hare, mink, otter, porcupine, skunk, raccoon, fisher cat, bobcat and weasel.

The NHESP list of rare species cites no mammals for Gill.

G.5 Conserving Gill's Biodiversity

Island Biogeography and landscape ecology are concepts which can be used to help explain Gill's options for pursuing the conservation of the town's biodiversity. The theory of island biogeography is based on observations that biodiversity is greater on large islands than on small ones, and greater on islands that are close to the mainland. The concept of islands surrounded by water has been applied to the idea of "islands" of protected open land surrounded by developed areas. Based on this theory, ecologists predict that increasing the size of a protected land area increases its biodiversity (MacArthur and Wilson; 1967). Therefore, connecting two protected areas via a protected corridor to create one large area should also increase natural biodiversity (Wilson and Willis; 1975).

Another model for wildlife habitat protection aggregates similar land uses while allowing other uses in discrete areas (Forman; 1997). This model is reflected in Gill in areas where agriculture is concentrated along river or stream corridors. This model allows large blocks of forest to remain intact. Individual animals move within a landscape and seek cover for shelter and food. Some species willingly forage where human uses, such as farm fields, gardens and trash cans provide browse or food. As the land within Gill continues to be fragmented by development, it

is reasonable to expect that remaining large blocks of undeveloped forest and the parcels of land connecting them will become more important to area wildlife.

Many species of wildlife in Gill have home ranges greater than fifty acres in size. Even those species with smaller home ranges move across the landscape between sources of shelter, water, food and mating areas. Some animals, including white-tailed deer and black bear, seek both interior forest habitat and wetland edges where food sources may be more abundant. Permanently protected wildlife corridors are particularly critical in a landscape which is experiencing development pressures, to ensure that animals have the ability to travel across vegetated areas between large blocks of habitat.

Connections between bodies of water and sub-watersheds are also important for wildlife and fisheries species. Some of the more common animals that use river and stream corridors are beaver, muskrat, raccoon, green heron, kingfish, snapping turtle, and many species of ducks, amphibians, and fish. Since many species rely on a variety of habitats during different periods of their life cycle, species diversity is greatest in areas where several habitat types occur in proximity to each other. With this in mind, the protection of all habitat types is vital for maintaining and enhancing biodiversity in Gill.

How will the Town of Gill determine the most appropriate conservation strategies for wildlife habitat? There are some general paths to follow in conserving the health of wildlife populations. One is to protect the habitat of specific species that are rare, threatened, or endangered. It is thought that other species will also benefit from this strategy. A second path is to conserve landscape-level resources such as contiguous forest or riparian areas. This helps to protect the habitats of a large number of species, but it might not meet the needs of all rare and endangered species. The third method is a combination of the first two. Maintaining the biodiversity of Gill over the long term will likely require the protection of both unique habitats for specific species and networks of habitat across the landscape.

Conservation strategies for the town to consider include monitoring of species locations, numbers, and movements; the protection of core habitat areas as identified by the NHESP BioMap2; the continued protection and linkage of large blocks of contiguous forestland; the retention of early successional habitats like fields and grasslands; and the protection of vernal pools, wetlands, and riparian corridors that sustain the greatest diversity of life in Gill.

H. SCENIC RESOURCES AND UNIQUE ENVIRONMENTS

This section – along with the natural and historic resources discussed in Section 3 – identifies the scenic resources and unique environments that most town residents would agree represent the essence of Gill's character. In many ways the history of Gill – how people came to settle the land, use its resources, and enjoy its forests, streams, and bodies of water – can be seen in the landscapes that have retained a sense of the past. The unique environments in Gill play a very important role in providing residents with a sense of place. Dinosaur footprint quarries, a record of Gill's history, are located in several areas. Other unique natural resources include the French King Gorge and Barton Cove. Brooks, mountains, wetlands, and village centers provide markers on the landscape within which we navigate our lives.

Scenic landscapes often derive their importance from their location relative to other landscape features. The purpose of inventorying scenic resources and unique natural environments in Gill is to provide a basis for setting resource protection. The locations of the resources shown in Table 4-4 are shown in the Scenic Resources and Unique Environments Map at the end of this Chapter.

Table 4-11: Significant Gill Resources and Scenic Landscapes/Environments

HISTORICAL SITES	
Map #	**Location of Landscape**
H2	Riverside Historic District
H3	Bascom Hollow
H4	French King Bridge
H5	Water power mill sites (three)
H6	Old bridge crossing
H7	Cemeteries (four)
H8	Factory Hollow
H9	Capt. Turner Monument
H10	Old Red Bridge Anchor/ Riverview Dr.
H11	Sunset Rock
H12	Munn's Ferry
H13	Stacy's Ferry
H14	Miller's Ferry

SCENIC RESOURCES	
Map #	**Location of Landscape**
S2	Bascom Hollow/Bascom Road
S3	West Gill Road
S4	Historic & Scenic Farm Area (Main Road north)
S5	Munn's Ferry Road
S6	Pisgah Mountain
S7	Historic & Scenic Farm Area (Main Road south)
S8	Grist Mill Road
S9	Pisgah Mountain Road
S10	Stacey Mountain & Scenic Vista
S11	River Road
S12	Riverview Drive
S13	Great Falls Overlook
S14	Mohawk Trail
S15	French King Bridge & Scenic Vista

NATURAL RESOURCES	
Map #	**Location of Landscape**
N2	Otter Pond
N3	Otter Brook
N4	Dry Brook (formerly known as Unadilla Brook)
N5	Ashuela Brook
N6	Otter Run
N7	Fall River
N8	Fall River Tributary "Cascades"
N9	Beaver Brook
N10	Dry Brook "Cascades"
N11	Connecticut River
N12	Great Falls & Great Island
N13	Route 2 Geologic Corridor
N14	Submerged dinosaur footprint quarry
N15	Armored mudballs
N16	Dinosaur footprint quarry
N17	Dinosaur footprint quarry
N18	Barton Island
N19	Dinosaur footprint quarry
N20	French King Gorge
N21	French King Rock
N22	Lily Pond
N23	Horse Race
N24	King Phillip's Abyss

RECTREATION RESOURCES	
Map #	**Location of Landscape**
R2	Riverside School Recreation Area
R3	Barton Cove Recreation Area (FirstLight Power Resources)
R4	State Boat Ramp
R5	Gill Elementary School
R6	Blake Town Forest
R7	Franklin County Bikeway
R8	Conn. River Greenway State Park
R9	Geocaches

Source: 2018 Open Space and Recreation Plan Committee

I. ENVIRONMENTAL CHALLENGES

There are three main environmental challenges in Gill:

- Fragmentation of farm and forestland;
- Connecticut River bank erosion; and
- Invasive plants and species.

Other environmental challenges in the Town of Gill discussed below include: new development, recreational boating waves, chronic flooding areas, landfills and hazardous waste disposal sites, ground and surface water pollution, potential sources of public and private drinking water supply contamination, and environmental equity.

I.1 Farm and Forestland Fragmentation

Although there may not be agreement as to its severity or solution, the demand for single-family detached housing in Gill and in the region appears to be growing at a faster rate than in the state overall. Gill is far from immune to these regional trends.

Many of the largest undeveloped parcels in town are also the most suitable for development and include farm and forestland with slopes under 25 percent, which are also not protected from development. These open and forested lands contribute most to the town's rural character and are owned by a handful of families. Their agricultural businesses maintain the landscapes as they are: pastoral, historic, and overall, simply breathtaking. Were these farm businesses to fail, the future of the farms and their families, the farm and forestlands, as well as the rural character of the town itself, would be in jeopardy.

I.2. Erosion and Sedimentation on the Connecticut River

The Turners Falls dam, located near the bridge into Turners Falls between Montague and Gill, and the Vernon Dam in Vernon, Vermont form a 22 mile long impoundment in the Connecticut River that is referred to as the Turners Falls Impoundment (TFI) or the Turners Falls Pool. This impounded reach of the river includes the Franklin County towns of Montague, Gill, Northfield and Erving. Since the Northfield Mountain Pumped Storage Project came on-line in 1972, landowners in Northfield and Gill have watched their prime farmland soils and mature riparian trees slump and topple into the Connecticut River. Less dramatic but no less distressing is the erosion of shoreline around Barton Cove in the towns of Montague and Gill. In Erving, the Connecticut River flows through the French King Gorge, which is bedrock, and thus less prone to erosion. The Millers River empties into the Connecticut in Erving.

The intake structure (tailrace) of the Northfield Mountain Pumped Storage facility is located in Northfield near Four Mile Brook. The hydropower project sucks up enormous volumes of water from the river up to the Northfield Mountain Reservoir. Torrents of water are released back to the river through turbines to generate electricity. This cycle of pump and release results in river level fluctuations that erode and destabilize the river banks. Combined with the highly-erodible, prime farmland soils and bank sediments along this reach of the Connecticut River, the dramatic daily fluctuations in water surface elevations have led to severe bank erosion in which riparian

buffers and adjacent farmland have been steadily undermined and continually collapsing into the river. Land owners have been losing land along the river for decades, and bank stabilization efforts have had limited success in stopping the loss of this land.[35]

Citizens along the Connecticut River have been voicing concern about the erosion issue since the early 1970's and successfully lobbied congressional representatives to get the Army Corps of Engineers to assess the causes of streambank erosion. The 1979 Army Corps study determined that significant changes in river water surface elevations (impoundment fluctuations due to hydropower operations) were the second most important cause of the streambank erosion.[36] Efforts during the 1990's by the Connecticut River Streambank Erosion Committee, which was convened by the Franklin Regional Council of Governments, garnered enough public pressure to require the previous and current owners of the Northfield Mountain project to follow a FERC-approved Erosion Control Plan and pay the costs of repairing eroded streambanks.

FirstLight Power Resources (FirstLight) owns the Turners Falls dam, Cabot Station and Station No.1 (collectively this hydropower project is referred to as the Turners Falls Project) and the Northfield Mountain Pumped Storage project. These facilities are not the only hydropower projects that affect the river as it flows through Franklin County. FirstLight's projects are part of a broader system that includes three other hydropower projects in Vermont and New Hampshire, which together affect the flow and bank stability of nearly half of the 410-mile Connecticut River. The Federal Energy Regulatory Commission (FERC) licenses for all five of these projects are up for renewal. The FERC relicensing process for these five projects started in 2012 and is just coming to the end stages in late 2020 – early 2022. To date, the FERC relicensing process for these five projects has included 72 studies and thousands of pages of data.[37] The image below, courtesy of the Connecticut River Conservancy (CRC), shows the locations of the five projects.

[35] https://www.youtube.com/watch?v=ezzT4FDGvZw
[36] https://www.youtube.com/watch?v=ezzT4FDGvZw
[37] https://www.recorder.com/my-turn-fisk-FirstLight-TurnersFallsDam-33905989

FirstLight submitted the Amended Final License Applications (AFLAs) for their two hydropower projects to FERC in early December 2020. These documents and all related documents going back to the beginning of the relicensing process (2012) are available at FirstLight's relicensing website.[38] While the AFLA for the Turners Falls project includes strategies to address water surface elevations, improve fish passage and habitat resources for endangered species in the project area south of the Turners Falls Dam, Cabot Station and Station No.1, the AFLA for Northfield Mountain does not include any strategies for addressing streambank erosion in the TFI. FirstLight did an erosion causation study as part of relicensing but stakeholders, including landowners, FRCOG, CRC and the towns expressed their strong skepticism of the analysis and FirstLight's use of the Bank Stability and Toe Erosion Model (BSTEM) to parse out responsibility for erosion. According to FirstLight, the BSTEM analysis found that the major cause of erosion in the TFI was attributed to either naturally high flows or boat waves and that project operations are not a major cause of erosion anywhere in the TFI except for at only two sites. FirstLight claims that the first of these sites has already been remediated under the existing license, and that its operating regime contributes only 8% of the erosion processes at the second site. FirstLight considers 8% to be a negligible amount of erosion attributable to their proposed operations and is not proposing any additional erosion remediation measures. Stakeholder groups, landowners and local officials are not pleased with FirstLight's refusal to take responsibility for erosion in the TFI and refusal to properly steward a treasured public resource, the Connecticut River, which generates hundreds of millions of dollars in revenue each year. In fact, FirstLight is proposing to pump additional water from the river up to the upper reservoir to use the full capacity of the upper reservoir while proposing no changes to the 9-ft water level fluctuation (pump & release cycle impacts to the river) allowed in their current license.

Environmental impacts from project operations are not stakeholders' only concern. The Connecticut River is an important recreational resource and a key economic driver in Franklin County's natural resource and recreation based tourism economy. In their AFLA, FirstLight proposes to maintain their existing recreational facilities in Northfield, Montague and Gill (which were installed in the late 1970's) and fund only ongoing maintenance needs. The Americans with Disabilities Act (ADA), which became law in 1990, was not in effect at the time these facilities were built. The relicensing process is an opportunity to evaluate the ADA needs of the existing recreation facilities and propose upgrades but FirstLight did not do this. Instead, FirstLight is proposing to maintain their existing facilities in Gill, which include the Barton Cove Nature Area and Campground and the Barton Cove Canoe and Kayak Rental Facility. FirstLight proposes no upgrades to these existing facilities and in not proposing any new recreation facilities in Gill. FirstLight proposes no remediation of the invasive aquatic plants or sediment that are choking Barton Cove, degrading water quality and habitat and interfering with paddling, swimming and boating in Baron Cove. The list of existing FirstLight facilities is shown in the excerpt from Table 3.0-1 from the AFLA Recreation Management Plan, below.

[38] http://www.northfieldrelicensing.com/Pages/default.aspx

Table 3.0-1: Northfield Mountain Project: Existing FERC-Approved Recreation Sites and Facilities Summary

Barton Cove Nature Area and Campground	• nature area parking area (approximately 26 single vehicle spaces) • campground parking (approximately 28 single vehicle spaces) • showers • restroom facilities (2 facilities; ADA compliant) • picnic area (approximately 15 tables) • overlook • interpretive sign • walk-in campground (approximately 2 group sites; 28 campsites; and 1 ADA campsite) • nature trail • dock
Barton Cove Canoe and Kayak Rental Area/Turners Falls Canoe Portage	• parking area (approximately 28 single vehicle spaces) • picnic area (approximately 6 tables) • seasonal restroom • paddlecraft rental service • canoe put-in and take-out (serves as portage take-out) • on-call vehicular canoe & kayak transport service

FirstLight should be proposing significant investments in recreation resources that reflect the Town's needs and support the local and regional economies and recreation needs for the life of the FERC license, which will be in effect through 2070. This is truly a "once in a lifetime" opportunity for the Town's voice to be heard in the FERC relicensing process. As part of the FERC process, the MassDEP will issue a 401 Water Quality Certificate (401WQC) permit for each of the two FirstLight projects (it could be one permit for both but this depends on how FirstLight structures their 401WQC permit application). There are multiple opportunities in the coming 12-18 months for stakeholders in the Town of Gill to continue advocating for the river, for the protection of valuable prime farmland and riparian and aquatic habitat and recreation resources. The Town should continue working closely with the FRCOG and other local and regional stakeholders during the FERC and 401WQC permitting processes to ensure that the Town's voices are heard.

I.3 Invasive Plants and Species

The Northern Hardwoods-Hemlock-White Pine Forest (NHHWPF), which is one of the predominant forest types in Gill, is particularly susceptible to non-native exotic species and pests. Gill's woodlands have begun to suffer from invasive non-native plants—those which can outcompete the native vegetation and interrupt natural succession if they escape into natural areas to reproduce. The species presently seen in the woods and wetlands are barberry, multiflora rose, burning bush euonymus, Norway maple, Japanese (and other) honeysuckle, Asiatic bittersweet, Japanese knotweed, buckthorn, phragmites and purple loosestrife.

Garlic Mustard plant

Other invasive plant species that potentially threaten the Gill ecosystem are garlic mustard and giant hogweed. The invasions of autumn olive and Russian olive frequently seen in the highway right-of-way in the Pioneer Valley are not yet such a problem in Gill. Most of the above-named plants, as pure stands, do not have the same wildlife habitat or timber value as the indigenous plant species, nor is their fall color the same. Other potential threats to Gill's forests include the beech fungus which has rendered a once economically important species almost useless; the Asian Longhorned Beetle, an invasive wood-boring insect that attacks hardwood trees, including maple, birch and elm; and the Emerald Ash Borer, a non-native invasive insect that attacks ash trees. These pests have been confirmed in Massachusetts and are being monitored to avoid further spreading.

Hemlock pests may have significant consequences for Gill's forests, especially in the wooded ravines and wetlands. The hemlock wooly adelgid is killing virtually all hemlocks in PA, NY, NJ, and CT. According to experts at Smith College, the wooly adelgid came up from Connecticut into the Springfield area in the early 1990s. Since then it has extended its range north to Amherst and Northampton, and the limit of its cold hardiness is likely to be farther north than Gill, where it is now found. Another threat to the hemlocks has been the hemlock looper, which has killed over 1,000 acres of hemlock in Franklin County.

Invasive aquatic plants are also a potential threat to the ecosystem in Gill. Slightly more than half of the nonindigenous organisms reported in Massachusetts are species that arrived from outside of North America and are commonly referred to as "aliens" or "exotics." Examples of nonindigenous species from other continents include Eurasian Water-milfoil (a plant native to Eurasia; *Myriophyllum spicatum*), Brazilian waterweed (a plant native to South America; *Egeria densa*), and Water Chestnut (a plant native to Eurasia; *Trapa natans*).[39]

I.4 New Development

Unplanned residential development across town would also increase non-point source pollution like road runoff and reduce the value of remaining wildlife habitat. Increases in runoff would diminish the biodiversity in the stream network all over town. One solution to the problem could be a combination of zoning techniques applied to encourage development in suitable areas and land conservation to minimize development in those areas with the cultural, historic, scenic, natural, archeological, and natural resources values, which are also most threatened from development.

[39] Massachusetts Department of Conservation and Recreation, Division of Water Supply Protection, Office of Watershed Management,; *Aquatic Invasive Species Assessment and Management Plan*; October 2010.

Planning for development – where and how to develop – is perhaps just as important as planning for conservation. Conserving any and all land without considering its value as a potential residential, commercial or industrial site might ultimately force further fragmentation. As such, an action item to continue to assess areas of potential development is included in the Action Plan.

I.5 Recreational Boating Waves

Boat waves continue to be a significant problem on the Connecticut River in Gill. As is mentioned in the ACOE's 1979 study, stream bank erosion and other problems are caused by boat waves. The Commonwealth of Massachusetts General Laws include a prohibition of open water speeds in excess of 45 mph. However, there are no restrictions on motor craft speed near the banks of a river or on the number of craft that can be in operation at any one time. Other problems that are associated with the amount and speed of motor craft on the Connecticut River in Gill include water pollution from silt and mud churned-up by motorboats, noise pollution, and the impacts of large numbers of big motor craft on other forms of recreational boating (e.g. canoeing and kayaking).

I.6 Chronic Flooding Areas

The Town of Gill Multi-Hazard Mitigation Plan identifies the Riverside section of Gill as a flood-prone area in Town. No other areas subject to significant chronic flooding have been identified.

I.7 Landfills and Hazardous Waste Disposal Sites

According to 2005 MassGIS data, there are no hazardous waste sites in Gill. According to MassDEP data[40], there is one inactive private landfill owned by Northfield Mount Hermon School and located at 1 Lamplighter Way. The 3-acre site operated from 1982 to 2001 and is now capped but unlined. Illegal dumping is a chronic problem in several areas in Town, including in the Town Forest and along Barney Hale Road.

I.8 Ground and Surface Water Pollution

The Town of Gill has no known major problems with nonpoint source pollution. However, as described in the **Erosion and Sedimentation on the Connecticut River** section earlier in this chapter, the Connecticut River is subject to erosive forces which have destabilized many sections of 20-foot-high river banks near the Northfield Mountain Pumped Storage Project. The resulting slumping and mass wasting of large sections of bank and the loss of trees and other riparian vegetation on the top of the banks could contribute to issues with water quality. Erosion could cut channels from the upland areas into the River, encouraging potential runoff from farm fields. Ongoing riverbank stabilization projects will continue to address these issues.

[40] https://www.mass.gov/lists/massachusetts-landfills-transfer-stations-compost-sites-recycling-facilities?_ga=2.24869245.659102792.1534355038-1441907277.1465834554

Other potential ground and surface water pollution causes include run off from roads, including salt and chemicals, agricultural fertilizers and pesticides, and issues with failing septic systems. Public outreach and education can assist in making people aware of ways to mitigate such potential issues.

I.9 Potential Sources of Public and Private Drinking Water Supply Contamination

Potential sources of contamination of public and private wells include septic systems, sub-surface fuel tanks, manure piles, improper use, storage and disposal of hazardous materials, herbicide runoff from farmland, utility rights-of-way, and state highway vegetation control, and road runoff.

In addition, many private wells in Gill are drying up, especially on Boyle Road, North Cross Road, and near the school.

More information on drinking water supply contamination and mitigation can be found at http://www.mass.gov/dep/water/drinking/sourcewa.htm.

I.10 Environmental Equity

One potential issue in regard to environmental equity is the rapidly rising sewer rates in the Riverside Area. In the last year, residents in this area have experienced a 40% increase in the sewer rates. Such a large increase may cause financial difficulties for families with more limited resources.