The Value of Rhode Island Forests

A Project of the Rhode Island Forest Conservation Advisory Committee and the Rhode Island Tree Council

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Trees Are Cool

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Cover Image Credit: Audubon Society of Rhode Island

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Executive Summary

The Value of Rhode Island Forests **has two primary goals: to outline the benefits that Rhode Island's forests provide to the state and to recommend practical strategies to encourage forest conservation.** The Rhode Island Tree Council, a non-profit organization dedicated to supporting healthy forests and trees, conceived of this project with the Rhode Island Department of Environmental Management (RIDEM). This report is intended as a tool for public engagement and a source of guidance for Rhode Island policymakers. The report's findings can support the work of the many stakeholders who seek to pass down the essential knowledge of forest stewardship for generations of Rhode Islanders to come.*

The Current State of Rhode Island's Forestland

While Rhode Island's nickname "The Ocean State" captures the state's image and best-known places, it does not reflect the fact that forests comprise more than half the state's land area. In fact, **368,373 acres or 56% of the state's land area is covered by forests**. Almost all of the forest has seen previous cutting and much of it has regrown on land that was once cleared for agriculture; now more than half is greater than 60 years old and maturing. **An estimated 213,000 acres, or 58% of the forested land in the state, is considered core forest**. Core forests are defined in this report as blocks of forested land greater than 250 acres in size. Such large, intact forests have high conservation value. Especially for its small size, Rhode Island is notable for its 286,000 acres of urban and community land with 52% overall tree cover. Rhode Island is in the top 5 of all U.S. states for urban and community land as a percent of total state land area.

The Majority of RI Forestland Is Privately-Owned

Rhode Island's forests are owned and managed by a combination of federal and state agencies and institutions, national and local land trusts, other nonprofit organizations, and private landowners. **The state's 38,000 private landowners are especially important – their individual properties are typically small, but they collectively control about 68% of the state's forestland**. About 125,000 acres of forestland are considered permanently protected from development, with conservation and management efforts enhanced by state and federal programs and assisted by several nonprofit organizations and three conservation districts.

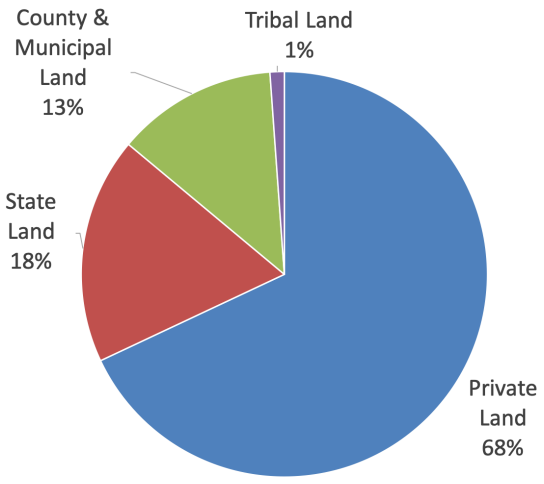

Figure ES-1: Forest Ownership in Rhode Island.
Source: USFS

**The executive summary is an overview of the contents of this report. Information in the executive summary is found in detail, with reference information, in the body of the report.*

RI Forestland Is Threatened by Fragmentation

Forest fragmentation, or the breaking of contiguous forested areas into smaller ones, and conversion to other land uses is the greatest threat to forests in Rhode Island. **An analysis found that nearly 2,000 acres of core forest was converted to other land uses between 2011 and 2018.** Half of Rhode Island is within the length of a football field from a road and 90% of the state is within 4½ football fields of a road.

Invasive species, an overpopulation of white-tailed deer, and climate change also threaten forest health. Invasive species – non-native, introduced organisms that have the ability to outcompete native species – can overwhelm the forest, especially when an area is fragmented, and create negative ecological and economic impacts. High densities of white-tailed deer eating tree seedlings and saplings influence the composition of species that are able to naturally regenerate. Climate change is also exerting complex pressures on forests, including an increase in heavy precipitation, changes in growing season, and increased numbers of forest insects and pests.

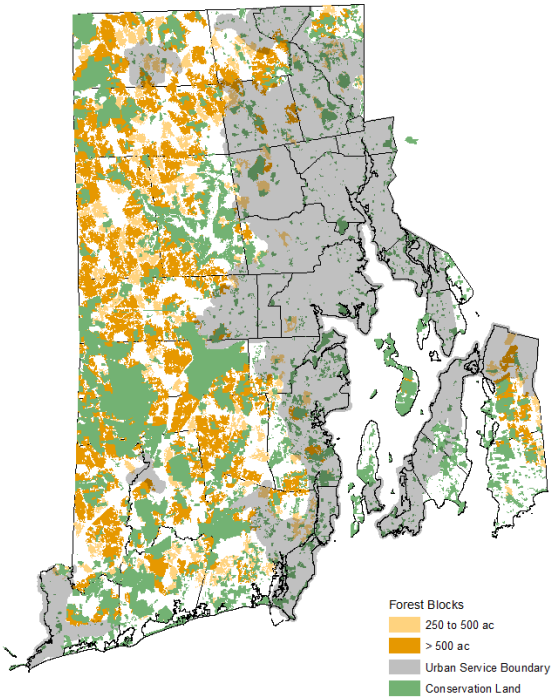

Figure ES-2: Core Forests in Rhode Island.
Source: Paul Jordan, RIDEM

The Benefits of Rhode Island's Forests

Rhode Island's forests and trees may seem like a green backdrop to our state landscape, but they are in fact hard at work generating a wide range of services and values. The state's forests make the Ocean State a place where humans and native wildlife can live and thrive. Some forest benefits can be quantified, but others are most accurately explained in words. While public interest is sometimes focused on certain forest values, the holistic value of the forest is greater than the sum of any individual value.

Clean Air

- Rhode Island's forests provide significant air quality benefits to the state by absorbing hazardous air pollution. Rhode Island's trees provide more than $30 million annually in pollution removal benefits.
- Across the United States, one study shows that trees' absorption of air pollution is preventing more than 670,000 instances of acute respiratory symptoms and more than 850 human deaths each year.

Clean Water

- Clean water is essential for drinking, safe recreation, a thriving economy, and healthy wildlife habitat, and forests play an important role in keeping Rhode Island's waterways safe and clean.

- More than 80% of Rhode Island's population relies on surface reservoirs surrounded by mostly forested watersheds for clean drinking water. Among northeastern US watersheds, Rhode Island is ranked high for the importance of watersheds and private forests for drinking water supplies and for their ability to produce clean water. Water utilities recognize that it costs less to keep drinking water supplies clean by investing in watershed management than to clean up polluted water using engineered systems alone.

Economic Importance

- Forest conservation brings economic benefits to Rhode Island cities and towns. In the forest and wood products sector, 513 firms generated 2,496 jobs with $408 million in gross sales in 2016.
- Forest-based recreational activities contribute an estimated $375 million dollars in sales annually to the Rhode Island economy, in addition to 1,500 jobs with an estimated $37 million payroll annually.
- Wildlife-related recreation plays an enormous part in Rhode Island's forest-based economy, with an estimated 503,000 residents and non-residents participating each year, bringing $348 million to the state's economy through fishing, hunting and wildlife watching.

Climate Change Mitigation

- Natural lands are increasingly becoming recognized for their unrealized potential to play a much larger role in climate mitigation efforts. In 2016, the Rhode Island Greenhouse Gas Emissions Reduction Plan prepared by the Executive Climate Change Coordinating Council advised that meeting the state's emissions goals could be compromised by continued loss of forested land and recommended exploring a "no net-loss of forests" policy. Forests contribute to climate mitigation by storing carbon as biomass and by sequestering carbon from the atmosphere.
- The more than 368,000 acres of forestland in Rhode Island sequester nearly 500,000 metric tons of carbon dioxide each year, offsetting the annual emissions of more than 100,000 passenger vehicles each year. Overall, Rhode Island forests store an estimated 26.7 million metric tons of carbon – an amount of carbon biomass with a volume equivalent to more than 3,300 Olympic-sized swimming pools. The average forested acre in the state stores 76 metric tons of carbon and absorbs an additional 1.3 metric tons of carbon from the atmosphere each year.

Human Health and Well-Being

- Numerous research studies have connected access to trees and other natural environments with better physical and mental health. Providing access to green spaces to all Rhode Islanders is necessary to ensure these benefits are distributed equitably – numerous studies have shown that it is more difficult for communities marginalized by racial and socioeconomic conditions to access green spaces.
- Forests support many of the recreational activities that Rhode Islanders engage in and 75% of residents consider state parks to be "very important."
- Trees and forests protect human communities from dangerous urban heat, flooding concerns, and the frontline impacts of climate change. Green infrastructure, including tree plantings, is a vital part of keeping Rhode Island communities safe.

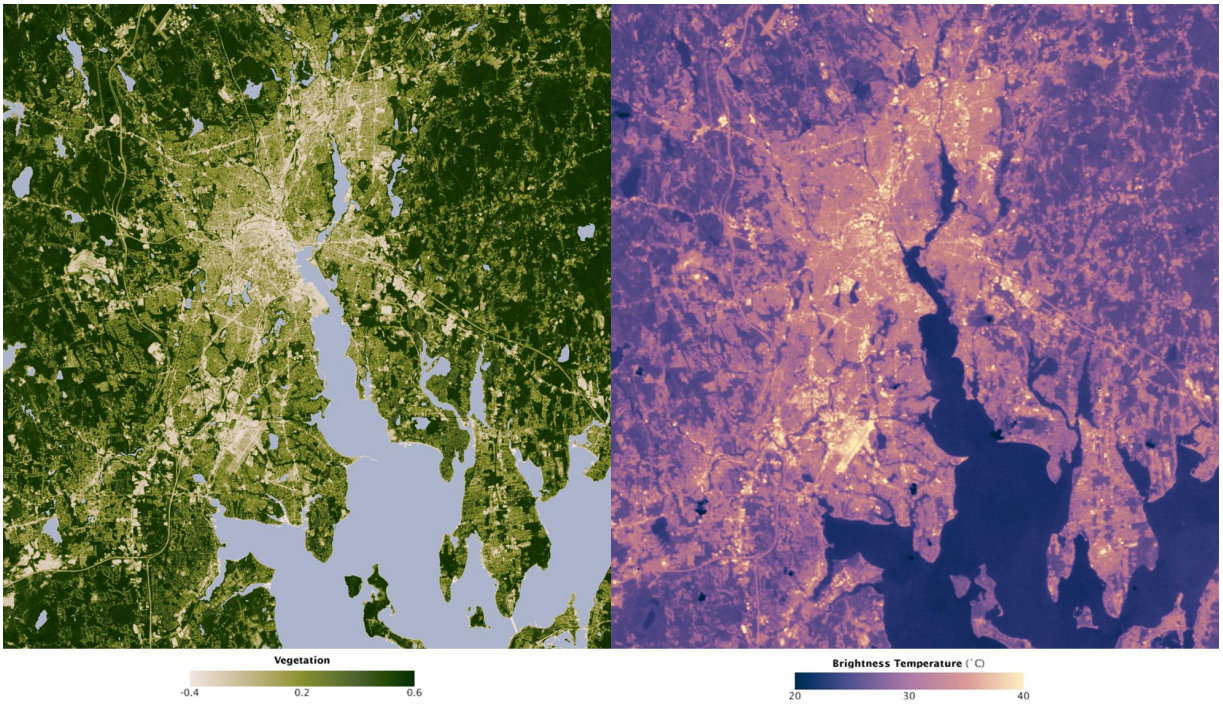

Figure ES-3: Satellite Images of Vegetation and Temperature in Providence, Rhode Island. *Source: NASA* (Left Image: Vegetation in Providence. Right Image: Temperature in Providence.)

Cultural Value

- Rhode Island's forests continue to be used by indigenous people as places to gather resources used for food, medicine, and culturally-significant ceremonies. The forest as a whole, and many resources within the forest, have cultural value to members of the Narragansett Tribe, the federally-recognized tribe in Rhode Island.
- Traditional ecological knowledge – a term used to describe knowledge of the environment that has been passed down within indigenous communities – has proven to promote positive health, biodiversity, and conservation outcomes on landscapes in the United States and around the world.
- Many of Rhode Island's rural communities are fundamentally characterized by surrounding forestland. Forests bring a "sense of place" to these communities – a meaning and connection between people and their physical environment.

Wildlife Habitat

- Rhode Island's forests provide unique habitats that support thousands of wildlife species of mammals, birds, reptiles, amphibians, fish, and invertebrates, and close to 2,900 plants. Many species are forest interior dependent and rely on core forests for their habitat requirements.
- Wildlife species play a direct role in sustaining healthy forest ecosystem function that delivers value to humans and the landscape. Studies have shown that wildlife can improve mental health, and that outdoor recreation including wildlife viewing can alleviate symptoms of stress, anxiety, and depression.

Strategies for Promoting Forest Conservation

Conserving forestland is an investment in the future. A suite of adaptable strategies can be used to incorporate conservation principles into decision-making that impacts forestland.

1) Dedicate Funding to Forest Conservation and Management

Strengthening or creating federal, state, and local sources of funding for forest conservation will allow more effective forest conservation programs and policies to be implemented. At the federal level, the Forest Legacy Program managed by the USDA Forest Service (USFS) has acquired the development rights for 3,583 acres on 22 forest tracts in Rhode Island. Through a number of programs dedicated to assisting private forest landowners, the Natural Resources Conservation Service (NRCS) has assisted with conserving over 420 acres on 20 properties. States and local municipalities have used thoughtful and creative approaches to dedicate funding to forest and open space conservation across the United States, including: bond funding for forest conservation; real estate transfer tax programs to increase dedicated funds for conservation; dedicated sales taxes to provide continuous funding for land conservation; a commitment of state matching funds to be used as an incentive for communities to adopt local property tax surcharges for forest conservation; funds from enforcement actions by both settlement and mitigation programs; funds for watershed protection; and philanthropic contributions for forest conservation.

2) Support Forest Acquisition for Conservation

Forest acquisition is the most clear and direct way of retaining forestland and preventing its conversion to other land uses. While funding is limited and often competitive, many sources and mechanisms are available. Part of the challenge can be identifying the most promising approach for a land conservation transaction involving a particular landowner or property. Two important tools are:

- Conservation easements are transactions in which the landowner transfers some of the rights on all or part of their property to conserve the land and prohibit development, while still retaining ownership. This can be an effective tool for forest acquisition and conservation.
- Regional Conservation Partnerships (RCPs) are coalitions that have emerged as effective structures in recent years to help increase the scale and pace of forestland conservation throughout New England and beyond.

3) Incentivize Forest Conservation Assistance & Stewardship

Rhode Island has a tax program known as “Farm, Forest, and Open Space” (FFOS) that allows private forests, farms and open land to be assessed at current use values rather than higher values appropriate for developed land. FFOS has been effective in deferring forestland conversion, but the program has shortcomings that prevent it from appealing to more landowners and encouraging permanent land protection. Successful provisions from Massachusetts’ current use program could be adapted to Rhode Island.

4) Incorporate Forest Conservation into Land Use Planning & Permitting

One of the greatest threats to Rhode Island’s forests is improperly managed human development. According to a study from the Society of American Foresters, if Rhode Island continues along its current trajectory of urban expansion, 52% of the state’s land area will be urbanized by 2050 and more than 70% by 2060. Rhode Island communities must plan how they will accommodate a growing population while preserving the natural resources that residents rely on. An essential part of protecting forests is creating

community centers where people want to live and development can be concentrated, thereby reducing forest loss. Using "smart growth" principles, planners at the state and municipal levels can create communities that exist sustainably within their landscapes, are healthy and vibrant, and are accessible to everyone. In addition to commercial and residential development, smart planning for transportation, energy, and other supporting infrastructure is critical to conserving forestland. A number of planning tools have been used in Rhode Island and around the country to promote sustainable development patterns that account for forest conservation. Some of the most impactful land use planning tools are:

- "Conservation development" – an approach to land use planning that combines real estate development with permanent green space protection. As of 2011, conservation development projects have conserved an estimated 9.8 million acres of land in the United States and accounted for a quarter of all private-land conservation activities in the country. The Maryland Forest Conservation Act (FCA) is a premier example of incorporating forest conservation into all development activities.
- Transfer of development rights (TDR) programs, which help communities develop in areas targeted for growth and limit development in areas with important natural resources.

5) Support Market-Based Incentives for Forest Conservation

Funding from individuals and businesses in the private sector is essential to the work of protecting important ecosystems, including forests. A number of conservation programs target private funding, like the Nature Conservancy "NatureVest" program that aims to bring $1 billion in private capital into conservation projects by 2021. The Rhode Island Infrastructure Bank (RIIB) has already established a revolving fund structure for leveraging private funds in important environmental projects. This could be expanded to include more funding for forest conservation.

Carbon offsets are an emerging finance tool that provides an opportunity for forest landowners to be compensated for making long-term commitments to storing carbon on their lands. A number of conservation organizations are exploring or experimenting with strategies to enable more small landowners to access these markets. RI Office of Energy Resources (OER) and the RI Department of Environmental Management (RIDEM) will be managing the completion of a report on carbon pricing in Rhode Island in 2019 and 2020.

6) Actively Manage Rural and Urban Forestland to Maximize Forest Value

Active stewardship by public and private forest managers is an important component of forest conservation. Engaging landowners and other groups in active forest management practices can simultaneously build understanding of forests, support forest health, and support land conservation. Management activities in rural, urban, and urban edge forests typically address and support multiple forest values at the same time.

7) Provide Education & Technical Assistance to Forest Landowners

Limited access to education, technical expertise, and financial resources have proven to be challenges to managing Rhode Island's forests. Rhode Island is the only state in New England that does not have an extension forestry program operated by a state university. Forestry extension programs are able to provide educational opportunities and on-the-ground technical assistance to landowners, while also researching management and resources issues and providing continuing education and training to natural resources

professionals. Because private landowners control 68% of Rhode Island's forestland, estate planning is an essential consideration when it comes to future land use and conservation.

Policy Recommendations to Promote Forest Conservation

The following changes and additions to Rhode Island policies and programs could support more accurate accounting for the value of the state's forest resources and subsequent conservation of key forest resources:

1. Develop and Implement a Rhode Island Forest Conservation Act
2. Devote More Public Funding to Forest Conservation
3. Leverage Private Funding for Forest Conservation
4. Encourage Long-Term Conservation through the Farm, Forest, and Open Space Program
5. Increase Landowner Benefits from Conservation Easements
6. Incorporate Forest Conservation Into Land Use Planning
7. Avoid Forest Loss from State or Municipal Incentive Programs that Encourage Development
8. Implement Forest Management Best Practices at the State and Local Level
9. Support the Cultural Value of the State's Forestland
10. Improve Private Landowner Education and Outreach on the Importance of Forest Conservation

Conserving the state's forests is a forward-looking and wise investment in Rhode Island's future. Rhode Island stakeholders have an exciting opportunity to steward existing rural and urban forest resources and pass down the benefits of this work. There is much more to do to ensure that Rhode Island's forests are conserved, and it is time for policymakers and those with authority over forest resources to fully recognize forests for their contributions to the state.

Introduction

Many Rhode Islanders have a deep connection to the state's forests.

Hilary Downes-Fortune teaches 7th and 8th grade science at the Compass School, a charter school in South Kingstown. Hilary's classes go on field trips to her 94-acre tree farm in Foster, where the students can count tree rings, learn about beekeeping, and walk through the woods to see the other treasures – like blueberry bushes and mushroom logs – that can be cultivated in a forest. Hilary says that "just building an appreciation for the forest" is critical when teaching young people lessons in forestry science. "One of the things that we focus on a lot here is helping them understand that they can make a difference, how to be stewards of the environment, and make sure that they understand that there's still hope."

Hilary Downes-Fortune with mushroom logs.

Hilary's tree farm is part of the Natural Resources Conservation Service's Conservation Stewardship Program, a program tailored to working lands. Each forest stand is managed for a specific purpose – for example, some tree stands are cultivated for white pine, others for oak species, and other parts of the land are dedicated to bird-friendly habitat with the planting of native shrubs and herbaceous plants. Hilary and her husband were selected by the RI chapter of the American Tree Farm System as tree farmers of the year in 2013. She says she feels lucky to have a family that is invested in the legacy of their forestland, which will help keep the land conserved. While offers from developers can be financially tempting to private landowners, she wishes there was more support for landowners who want to keep their forestland in conservation. "When you think about the ecosystem services that forestland provides for the state," Hilary says, "that might help encourage the land to be kept and maintained as forestland and not turned into house lots...People don't think about active forest management and what it takes and what it costs."

Bill Livingston has lived on 47 acres of land in Foster for more than 60 years. More than 45 acres of his property are forested. "I came here because I could see the forest, the woods, the blueberry bushes, the blackberry bushes in Centerdale – that's where I lived when I was a kid – disappearing," Bill says. "I could fish from my house, walk the Twin Rivers and fish, and come home with fish. Now it's all houses."

"So that's why I bought this place. Stay like this," Bill says.

Bill enthusiastically points out his bee hives, raspberry and blueberry bushes, pear and apple trees, garden plots, and stacks of wood he harvested from his land. The property is registered forestland under Rhode Island's Farm, Forest, and Open Space program, and Bill worked with a forester to create a management plan for his property. Bill lives with his wife Shirley. She values the quietness of the land and the presence of wildlife, like deer, turkeys, rabbits, birds, and even the occasional bobcat. She watches them flock to the brush piles that Bill makes for them. "I see the wondrous glory of God," she says of the surrounding forest. "He made it all, and I become a part of that. I love walking through the woods."

Bill Livingston with a brush pile on his property in Foster.

Healthy trees also play a fundamental role in Rhode Island's urban communities. Cassie Tharinger is the director of the Providence Neighborhood Planting Program (PNPP). Founded in 1988, this program provides Providence residents with free street trees and the training to plant and care for them. Since 1989, PNPP has co-funded the planting of over 13,000 street trees through more than 620 neighborhood groups.[1] Cassie says that PNPP focuses on planting trees in neighborhoods with the lowest tree canopy. Providence completed a citywide street tree inventory in 2006, which helped PNPP identify and understand where more trees are needed.[2]

"As in most cities across the country and the world, the low tree canopy neighborhoods match up with low-income levels, with low owner occupancy, with high asthma rates, and other public health indicators," Cassie says. "You can layer with historic redlining maps, I mean, you can layer map over map...where trees are and where they aren't, it's pretty striking in terms of benefits and barriers."

PNPP works with many engaged and knowledgeable city residents who are eager to plant more trees in their communities. "Especially in neighborhoods that have high immigrant populations, there are very often people with really recent and deep experience and ties to agriculture and growing things and trees,"

[1] "About PNPP," Providence Neighborhood Planting Program, accessed July 16, 2019, http://pnpp.org/history.
[2] "Providence Tree Inventory," City of Providence Open Data Portal, last modified April 20, 2019.

Cassie says. PNPP trains residents as “Community Tree Keepers,” giving them the tools to plant and care for trees in their neighborhoods, enabling residents to care for and value the “urban forest.”

During the Providence Neighborhood Planting Program’s strategic planning process, Cassie Tharinger reflected that all Rhode Islanders should be asking questions about how to support forests and trees.

“These questions like: how many trees is enough? How do we decide when and where to plant? And are we planting for carbon sequestration or stormwater?” Cassie says. “We sort of wandered around in these questions and realized, those weren't PNPP organizational questions. Those are questions that...people in cities and Rhode Island really need to answer together collectively.”

“How we tell the story of trees, and why they matter is something that I think we're always figuring out how to do,” Cassie says.

Participants at a PNPP Gathering. Credit: PNPP Facebook Page

This report is one contribution to such an effort. The Rhode Island Tree Council, a non-profit organization dedicated to supporting healthy forests and trees in the state, conceived of this project with the Rhode Island Department of Environmental Management (RIDEM). With funding from RIDEM, consultants were hired to complete a report and factsheet describing the values of Rhode Island’s forests and recommending practical policies and programs that can be implemented in the state to encourage forest conservation. The Rhode Island Tree Council convened the “Forest Conservation Advisory Committee” at the end of 2018 to oversee the writing and release of this report and the accompanying factsheet *Rhode Island Forests Provide Values for Us All*. This information is intended to be used as a tool for public engagement in addition to informing and assisting those involved in policy-making and program implementation at RIDEM. It can support the work of the many stakeholders who seek to pass down the essential knowledge of forest stewardship for generations of Rhode Islanders to come.

I. Current State of Rhode Island's Forestland

Forest Cover in Rhode Island

Rhode Island contains 368,373 acres of forested land – 56% of its total 687,380 acres of land (1,074 square miles).[3] [4] The forests of Rhode Island are considered second-growth, established on land that was once cleared for agriculture. Of the forested land in Rhode Island, around 96% is classified as timberland, or forestland that exceeds the minimum level of productivity and could potentially be harvested.[5] The 2017 USDA Forest Service (USFS) Forest Inventory and Analysis (FIA) report estimates that the oak-hickory is the predominant forest type, comprising 61% of the forest cover outside of the urban boundary. Red maple (Rhode Island's state tree) is the most common tree with the largest volume of individual trees overall, comprising 27% of the tree stems in the state.[6] More than half of the forest in Rhode Island is over 60 years old and steadily maturing.[7] When looking at the average tree size in forest stands, 77% of the timberland in the state is considered large (over 9 inches in diameter at breast height for softwoods and 11 inches for hardwoods), while only 21% is considered medium (5 to 10.9 inches) and 2% is small (less than 0.5 inches).[8] [9]

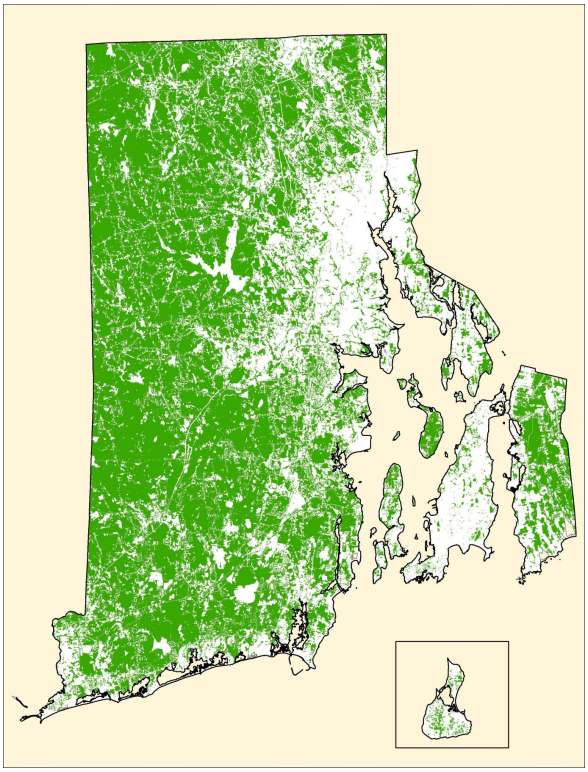

Figure 1: Extent of forest in Rhode Island. *Source: RI Wildlife Action Plan Ch 2-16. Note: RIGIS from aerial interpretation.*

[3] Brett J. Butler, *Forests of Rhode Island, 2017*, Resource Update FS-162 (Newtown Square, PA: USDA Forest Service, Northern Research Station, 2018), https://www.fs.fed.us/nrs/pubs/ru/ru_fs162.pdf. Figure 1: Rhode Island Department of Environmental Management, Division of Fisheries and Wildlife, *The 2015 Rhode Island Wildlife Action Plan*, prepared by Terwilliger Consulting Inc. and the Rhode Island Chapter of The Nature Conservancy (Providence, Rhode Island: 2015).

[4] The USDA Forest Service's Forest Inventory and Analysis (FIA) program maintains a nationwide network of "continuous forest inventory" or periodic monitoring plots that provide data for an ongoing census of the nation's forests. The first FIA survey in Rhode Island was done in the 1950s, and since 2003, FIA has conducted an annual sampling inventory in Rhode Island and currently measures 14% of the sample plots each year. RIDEM uses another estimate of forest cover which is derived from RIGIS mapping and the Land Use Land Cover dataset based on orthophotography captured in 2011. We used FIA data in this report because it has provided an ongoing census for over 60 years, can show changes over time, and can be compared to FIA estimated of forest cover in other states.

[5] Butler, *Forests of Rhode Island,* 2018.

[6] Butler, *Forests of Rhode Island,* 2018.

[7] Rhode Island Department of Environmental Management, Division of Forest Environment, *Rhode Island Forest Resources Assessment and Strategies: A Path to Tomorrow's Forests,* June 2010, http://www.dem.ri.gov/programs/bnatres/forest/pdf/assestra.pdf

[8] Diameter at breast height (DBH) is measured at 4 feet, 6 inches from the ground.

[9] Butler, *Forests of Rhode Island,* 2018.

Forests characteristics in Rhode Island differ depending on size, location, connectivity, proximity to development, vulnerable habitats and overall biodiversity. The state's forested areas differ across the landscape but are each important in their own way. When assessing overall conservation needs across the state, larger blocks of connected forests hold the most value. While over half of Rhode Island remains forested today, an estimated 213,000 acres or 58% of the state's forested lands are considered core forest.[10] Core forests are the largest intact blocks of forested land, 250 acres or greater, unbroken by development and at least 30 meters from mapped roads. Core forests improve in function with increased size, with blocks of 500+ acres providing the greatest number of benefits. Unfragmented blocks between 250 and 500 acres that connect the smallest to the largest forest blocks are important to a healthy functioning landscape, increasing the capacity for resilience over time.[11] The concept of core forest that is used in this publication has been widely accepted in Rhode Island, and the importance of making these forests a priority for conservation is highlighted in state planning documents including the Forest Action Plan, Wildlife Action Plan (core forests are a main criteria in determining Conservation Opportunity Areas), Land Use 2025, and in recent draft legislation.[12] [13] It is important to note that while this report focuses on core forests, forests less than 250 contiguous acres also provide the benefits outlined in this report and may contain important high conservation values including sensitive waterways, threatened and endangered species, and critical habitats, to name a few. This report uses the term "forest areas of high conservation value" to refer to the state's most valuable forest areas, which include but are not limited to core forests.

Rhode Island is ranked the second most densely populated state after New Jersey,[14] and the state's urban forests are important when considering the full picture of forest cover in Rhode Island. Developed as a GIS overlay for the RI Statewide Planning Program in 2006, the Urban Services Boundary is defined as the general extent of the areas within which public services supporting urban development presently exist, or are likely to be provided, through 2025.[15] According to 2011 data, there are an estimated 36,817 acres of urban forests (10% of total statewide forest acreage), which are lands that have been heavily disturbed by humans and contain a mix of exotic invasives, native generalist trees, and shrub and herb species.[16]

Urban forests are often set aside for parks, cemeteries, hospital grounds, schoolyards, and used for similar purposes where human access may be minimal, but, in many sites, overuse has resulted in heavily

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[10] Paul Jordan, Acting Deputy Chief/Supervising GIS Specialist, Rhode Island Department of Environmental Management, email communication, April 1, 2019.
[11] Rhode Island Department of Environmental Management, *2015 Rhode Island Wildlife Action Plan*.
[12] The 2015 Wildlife Action Plan identified "conservation opportunity areas," or priority areas where conservation goals can best be met and resources can be concentrated for maximum positive impact on wildlife. These areas were mapped with consideration of: unfragmented forest blocks greater than 250 acres, habitats with high value and high vulnerability, habitats with important diversity, important coastal habitat (including "Important Bird Areas" as designated by the National Audubon Society), natural corridors, and freshwater restoration opportunity areas.
[13] Paul Catanzaro, Anthony D'Amato and Emily Silver Huff, *Increasing Forest Resiliency for an Uncertain Future* (Holyoke: University of Massachusetts, Amherst, University of Vermont, and USDA Forest Service, 2016).
[14] U.S. Census Bureau, "Population, Housing Units, Area, and Density: 2010 - United States - States; and Puerto Rico" (summary table), 2010 United States Census, https://factfinder.census.gov.
[15] "Urban Services Boundary," Rhode Island Geographic Information System, accessed May 15, 2019, http://www.rigis.org/datasets/urban-services-boundary
[16] 36,817 acres: Rhode Island Department of Environmental Management, 2015 Rhode Island Wildlife Action Plan, Page 2-16. Definition of Ruderal Forest: U.S. National Vegetation Classification, *Ruderal Forest Macrogroup,* accessed May 12, 2019, https://www1.usgs.gov/csas/nvcs/nvcsGetUnitDetails?elementGlobalId=838498. *This sentence in the body of the report and footnote have been corrected and clarified from an earlier version of the report.*

degraded understory layers.[17] Urban forests do not fall within established ecological communities, and are often overlooked. Traditional forest inventories do not typically quantify urban forests. According to the 2018 study, "US Urban Forest Statistics, Values and Projections," Rhode Island had 51% tree cover on 256,000 acres of urban land in 2010.[18] When urban and community land (286,000 acres) was analyzed, tree canopy cover increased to 52%. This puts Rhode Island in the top 5 of all U.S. states for urban land (39%) and urban/community land (43%) as a percent of total state land area.[19]

Brushland comprises an estimated 7,800 acres of mixed vegetation – dominated by shrub-like growth intermingled with scarce but increasing tree density – that should also be considered as forests throughout the state.[20] As defined by the RI Geographic Information System Land Use Land Cover Code Descriptions and Metadata 2011, brushland can be characterized by lots of shrubs and very few trees (< 50% canopy) and includes areas that are being reforested but the trees are not large or dense enough to be classified as forests in the most traditional sense.[21] These brushland areas have been included in the overall calculation of forested land because they are located within or adjacent to forested parcels and provide unique and critical early successional habitat for wildlife.

Who Owns and Manages Rhode Island Forests?

Rhode Island's forests are owned and managed by a combination of federal agencies and programs, state agencies and programs, national and local land trusts and other conservation organizations, and private landowners. Of Rhode Island's 368,373 acres of forestland, 124,940 acres or 34% are protected to varying degrees.[22]

An estimated 68% of forestland is privately owned and managed by an estimated 38,000 landowners.[23] [24] [25] A breakdown of the ownership and management of forested acres in the state are provided below. Additional information on funding sources for forest conservation can be found in Section III on page 63 of this document.

[17] Rhode Island Department of Environmental Management, *2015 Rhode Island Wildlife Action Plan*.
[18] David Nowak and Eric Greenfield, "US Urban Forest Statistics, Values, and Projections," *Society of American Foresters* 116, no. 2 (2018): 164-177.
[19] Nowak and Greenfield, *US Urban Forest Statistics*.
[20] Paul Jordan, Acting Deputy Chief/Supervising GIS Specialist, Rhode Island Department of Environmental Management, email communication, April 25, 2019.
[21] Amanda Freitas, Rhode Island Wildlife Action Plan Community Liaison, Rhode Island Natural History Survey, email communication, May 10, 2019.
[22] Paul Jordan, email communication, April 25, 2019.
[23] Rhode Island Department of Environmental Management, Division of Forest Environment, *State and Private Forestry Fact Sheet Rhode Island 2019,* accessed June 25, 2019, https://apps.fs.usda.gov/nicportal/temppdf/sfs/naweb/ri_std.pdf.
[24] Butler, *Forests of Rhode Island,* 2018.
[25] The number of Private Landowners contains "other private" ownership, including lands owned by conservation organizations and nonprofits, discussed in the Land Conservation and Other Public Institutions section on page 18.

Federal Agencies: The United States Department of Agriculture Forest Service (USFS) and the USDA Natural Resources Conservation Service (NRCS) are the main federal agencies responsible for providing or administering funding, research, educational and technical assistance to the state and private citizens for the management of rural and urban forests, using funding from the Farm Bill or the Land and Water Conservation Fund. The USFS provides funding to the RI Department of Environmental Management (RIDEM) including both the Division of Forest Environment (DFE) and Department of Planning and Development (P&D) which administers funds for several grant opportunities that include the America the Beautiful Act for tree planting and improvement projects across Rhode Island, Volunteer Fire Program Grants for the protection of rural forestland, and the Forest Legacy program. The USFS Northern Research Station collects, analyzes, reports and distributes data on the state of Rhode Island forests through their Forest Inventory and Analysis (FIA) program.

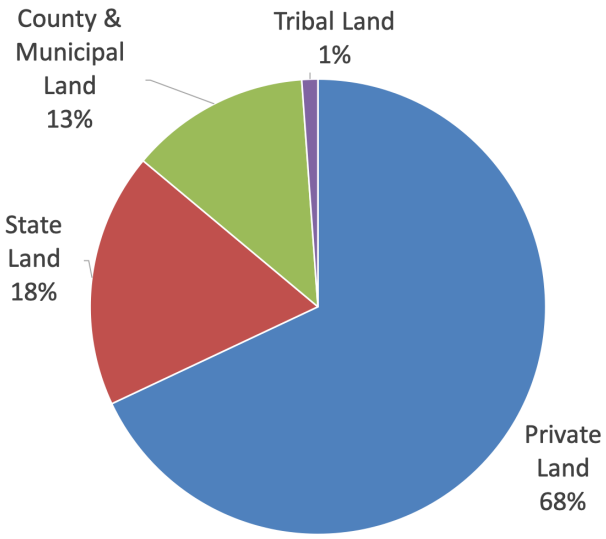

Figure 2: Forest Ownership in Rhode Island, *Source: Forests of Rhode Island, 2017 and USFS FIA Estimate Tables*

The majority of USDA agencies do not own land in Rhode Island, but the U.S. Fish & Wildlife Service (within the Department of the Interior) owns several thousand acres in five National Wildlife Refuges that include a modest amount of forestland.

State Programs: RIDEM permanently protects 73,324 acres of forestland in total, owning 47,384 acres of forestland in fee, and holding additional interests on 25,940 acres through conservation easements, deeds to development rights and recreation easements.[26] DFE is the main agency charged with overseeing the state's forest resources, managing 40,000 acres of state-owned forests and urban and community forestry programs.[27] Through DFE, state and federal funds are used for the certification of private forestland under the FFOS Program, fire protection, and forest health through the management of insects and disease.

The state's Urban and Community Forestry program cooperates with the USFS in distributing resources and providing technical assistance to urban communities in Rhode Island. The Urban and Community Forestry Coordinator manages the program (which involves federal and state agencies, cities and towns, and private organizations) to implement community forestry programs, tree plantings, the Energy Saving Trees program, Arbor Day, and other education and technical assistance efforts.

[26] Paul Jordan, Acting Deputy Chief/Supervising GIS Specialist, Rhode Island Department of Environmental Management, email communication, May 8, 2019.
[27] Rhode Island Department of Environmental Management, Division of Forest Environment. *State and Private Forestry Fact Sheet Rhode Island 2019,* accessed June 25, 2019, https://apps.fs.usda.gov/nicportal/temppdf/sfs/naweb/ri_std.pdf.

Land Conservation Organizations and Other Public Institutions: Land conservation organizations and agencies – including The Nature Conservancy (TNC), Audubon Society of RI (ASRI), municipal and private land trusts, municipal governments, private homeowner associations, Providence Water, and the University of Rhode Island W. Alton Jones Campus – hold varying degrees of protection on 51,616 acres.[28] Most of this land is permanently protected in fee or through easements, but some land held by land conservation organizations or other institutions has no legal mechanism in place for permanent protection, even though the land is not likely to be developed.

Land trusts are community-based organizations formed to protect farms, forestland and open spaces by purchasing easements and/or acquiring land to be protected for future generations. There are currently over 45 active land trusts in the state, supported by the Rhode Island Land Trust Council which is a statewide coalition. Land Trusts are responsible for sound management of the properties they own and monitoring properties that they protect with a conservation easement to ensure that the lands are being properly conserved and managed.

Private Landowners: Private landowners control the majority of Rhode Island's forested land – 68% of the state's forest is privately-owned according to the USDA Forest Service 2017 inventory.[29] When looking more closely at the number of RI landowners with at least 10 acres of forest or more, the majority have relatively small lots overall, with the average forest holding being approximately 17 acres.[30]

Of the privately-owned forests in Rhode Island, 568 landowners (15-25% of all eligible forest landowners with more than 10 acres, or an estimated 2,500 landowners) actively participate in the Farm, Forest and Open Space (FFOS) current use tax program under Forestland Classification.[31] This program reduces property taxes for forest landowners that have acquired a Forest Stewardship or Forest Management Plan that they are implementing through active forest management. Currently, over 45,549 acres are managed by private landowners through this program.[32] Additional forestland is owned under both the Farm and Open Space classifications through FFOS. Often, farms in Rhode Island are stewarding their forest resources through forest management activities and may have Forest Management Plans in place. Farm properties that are classified under the Farm portion of FFOS are required to have a Farm Conservation Plan, and their forest management activities are not tracked through the state. For more on the FFOS program, see page 73.

Organizations that Work with Private Landowners:

Private landowners work with several organizations and programs that provide financial and technical assistance to help with the management and stewardship of their forests. These organizations include: the Rhode Island Forest Conservators Organization (RIFCO) – a non-profit dedicated to the protection and wise-use of Rhode Island's forest resources; the Rhode Island Resource Conservation and Development

[28] Paul Jordan, email communication, May 8, 2019.
[29] Butler, *Forests of Rhode Island,* 2018.
[30] Brett J. Butler, *The Forests of Southern New England, 2012: A Report on the Forest Resources of Connecticut, Massachusetts and Rhode Island,* Resource Bulletin NRS-97 (Newtown Square PA: USDA Forest Service, Northern Research Station, October 2015), https://www.fs.fed.us/nrs/pubs/rb/rb_nrs97.pdf.
[31] Fern Graves, Stewardship Program Coordinator, RI Department of Environmental Management, Department of Forest Environment, email communication, July 26, 2019.
[32] Fern Graves, email communication, July 26, 2019.

Council (RI RC&D) – a non-profit that carries out projects for resource conservation and community development with volunteers and community leaders; and the three conservation districts in the state (Northern, Southern and Eastern) – non-profit, quasi-public agencies that work with private landowners to meet their natural resources and forest conservation needs.

The Rhode Island Tree Council (RITC) is a non-profit citizens group that is dedicated to sustaining, improving and expanding Rhode Island's tree resources. The Tree Council cooperates closely with USFS and the RIDEM DFE, closely supporting the Urban and Community Forestry program through partnership and collaboration. RITC also works with businesses and municipalities to implement tree planting and stewardship programs across the state.

A member of the international Programme for the Endorsement of Forest Certification (PEFC), the American Tree Farm System manages the Tree Farm Program which certifies private landowners who are actively managing their forests and promoting sustainable stewardship of their natural resources on their lands. The RI Tree Farm Database currently lists 250 Tree Farms in Rhode Island with a total of 18,112 acres certified. Of those 250 Tree Farms, 140 are listed under FFOS as well, with 9,595 acres managed under both programs.[33]

The Sustainable Forestry Initiative (SFI), another U.S. member of the PEFC, and the international nonprofit Forest Stewardship Council (FSC) also provide certification programs intended to ensure that forest products come from responsibly managed forests using sustainable methods. Both organizations provide standards and certification for forest management and chain of custody, tracing the path of forest products through the supply chain. In Rhode Island, 1,783 acres of forestland are managed sustainably under FSC certification.[34] Four Rhode Island-based companies are certified under SFI for sourcing and Chain of Custody.[35]

Threats to Rhode Island's Forest

Forest Fragmentation and Conversion in Rhode Island

Rhode Island was 67% forested as recently as 1967, but forested area has declined since then as land has been cleared for development.[36] Fragmentation is one of the greatest threats to Rhode Island's forests and many wildlife species that rely on them for habitat. Forest fragmentation is the breaking of large, contiguous, forested areas into smaller pieces of forest, which are typically separated by roads, agriculture, utility corridors, subdivisions, or other human development. The map below from the USDA Forest Service report on *The Forests of Southern New England, 2012*, illustrates the extent of the issue on a regional scale:

[33] Fern Graves, Stewardship Program Coordinator, RI Department of Environmental Management, Department of Forest Environment, email communication, March 3, 2019.
[34] Maggie Abel, Forest Stewardship Council, Program Manager, email communication, April 16, 2019.
[35] Rachael Hamilton, Sustainable Forestry Initiative, Coordinator, Statistics and Label Use, email communication, April 15, 2019.
[36] RI Department of Environmental Management, *A Path to Tomorrow's Forests*.

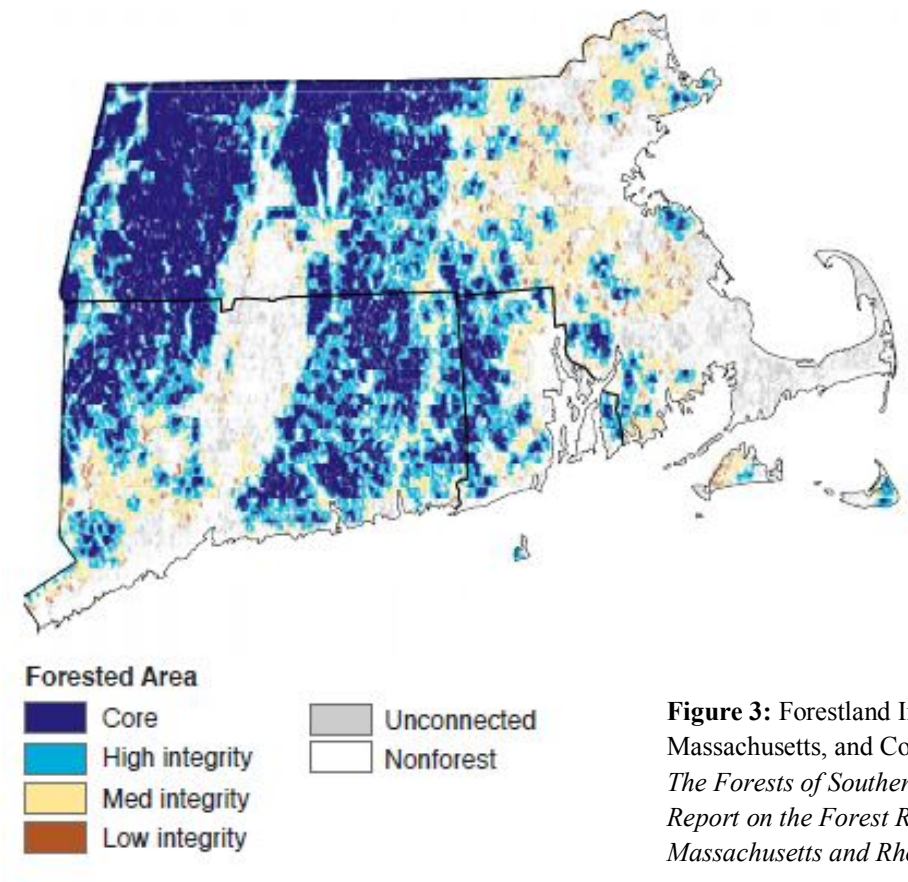

Figure 3: Forestland Integrity in Rhode Island, Massachusetts, and Connecticut. *Source: USFS, The Forests of Southern New England, 2012: A Report on the Forest Resources of Connecticut, Massachusetts and Rhode Island.*

Furthermore, according to a spatial integrity index cited in the report that factors in patch size, local forest density and connectivity, only 47% of the forest in Southern New England is not fragmented. When one takes into account the wooded wildland-urban interface, where housing densities are greater than 16 houses per square mile, the percentage of core forest drops to 23%. Regional fragmentation can be problematic for wildlife species that rely on large areas of contiguous forest and beneficial to those species that thrive on edge habitat.[37]

A University of Connecticut study identified stages of forest fragmentation that may occur to core forest beginning in its intact, unbroken state.[38] First, perforations occur when an area of forest is cleared to build a house or for another reason and small "holes" appear surrounded by interior edge. As development increases, edges come to make up the exterior periphery of core forest areas where they meet with non-forested land uses. Fragments of forest are then left entirely surrounded by non-forested areas. Finally, these islands of forest become vulnerable to disappearing altogether by conversion to other land uses.

Researchers from Harvard University have incorporated recent forest loss trends into the longer-term historical context of New England forest cover and human population going back to the early colonial

[37] Brett J. Butler, *The Forests of Southern New England*.
[38] Emily Wilson and Chester Arnold, *Forest Fragmentation in Connecticut: 1985 – 2006,* (Storrs, CT: University of Connecticut, Center for Land Use Education & Research, 2009).

period.[39] Rhode Island's pattern of forest cover over the state' history mirrors that of other New England states, particularly neighboring Connecticut and Massachusetts:

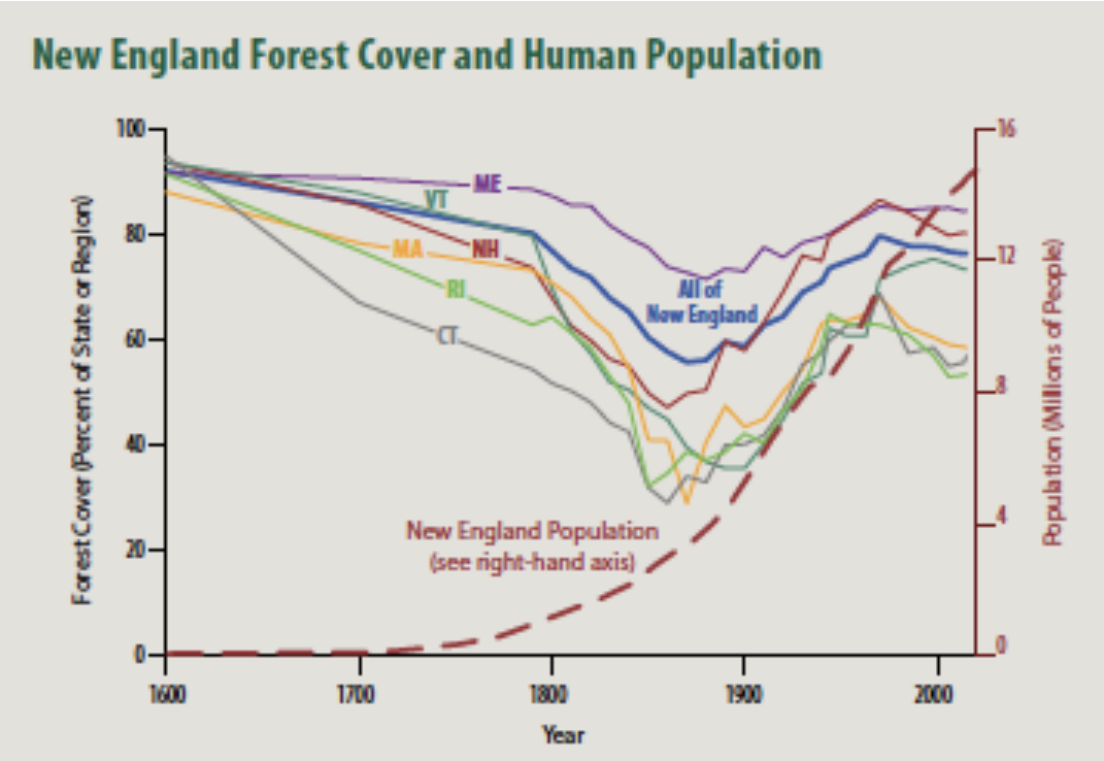

Figure 4: New England Forest Cover and Human Population. *Source: Foster et al.*

From a contemporary conservation point of view, the key point from the graph above from the Wildlands is that the recent second wave of more permanent forest loss in New England is setting back the region's most notable forest success story, the remarkable return of forests following the decline of large-scale agriculture that was the original cause of widespread forest clearing.

[39] David Foster et al., *Wildlands and Woodlands, Farmlands and Communities: Broadening the Vision for New England*, (Cambridge, MA: Harvard Forest, Harvard University Press, 2017).

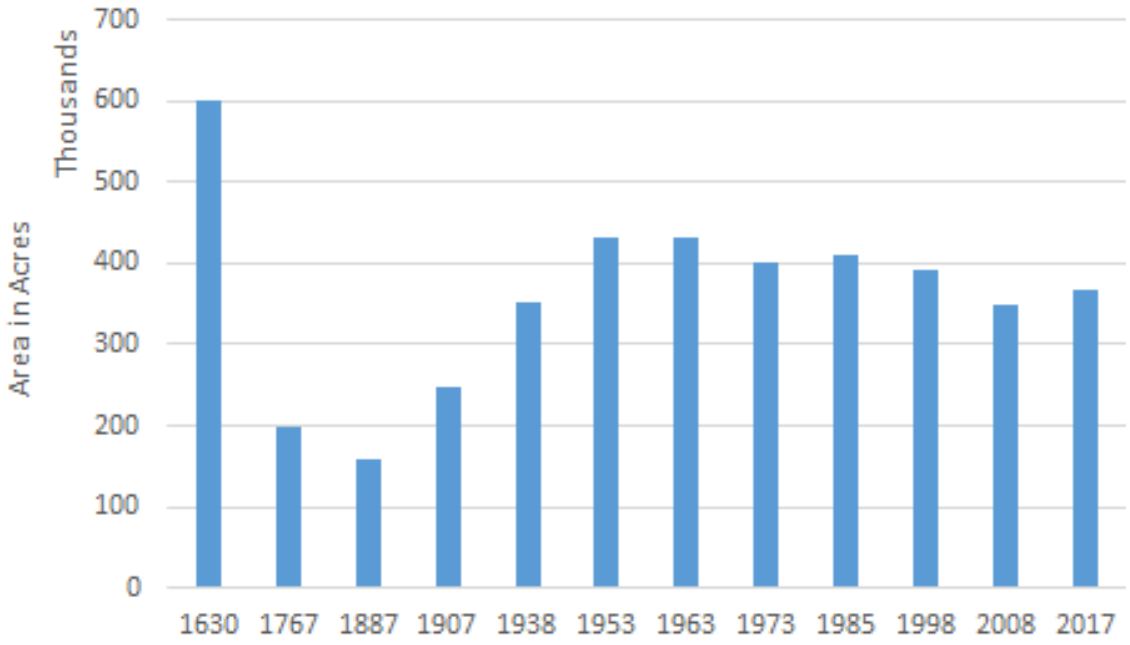

Figure 5: Approximate Forest Area in Rhode Island from 1630 to 2017.[40]

A 2019 GIS analysis by the University of Rhode Island identified significant loss of forest within large, previously unfragmented blocks of forest greater than 250 acres.[41] These blocks of remaining core forest were mapped by the RIDEM during the preparation of the 2015 State Wildlife Action Plan. The analysis compared statewide aerial imagery of forest cover in 2011 and 2018. Over the seven-year period, 1,914 acres originally classified as forest were converted to non-forest use, with most of the forest conversion occurring in small, scattered patches. Moreover, 66% of the forest loss (1,267 acres) occurred within blocks larger than 500 acres, which are particularly valuable for wildlife habitat. This analysis notably did not consider other areas of the state beyond the large forest blocks, including most of the land area within the Urban Services Boundary. Furthermore, the 2011-18 time period following the Great Recession has generally been considered a time of relatively low levels of development in rural Rhode Island.

[40] Rhode Island Department of Environmental Management, *2015 Rhode Island Wildlife Action Plan*, Ch 2-18; Butler, *Forests of Rhode Island,* 2018.
[41] Bill Buffum, *Loss of forest in large unfragmented blocks of forest in Rhode Island* (Research rief), Department of Natural Resources Science, University of Rhode Island, (Kingston, RI: 2019), https://web.uri.edu/forestry/files/2019/02/Buffum-2019-Loss-of-forest-in-large-unfragemented-blocks-of-forest-in-Rhode-Island_May2019.pdf.

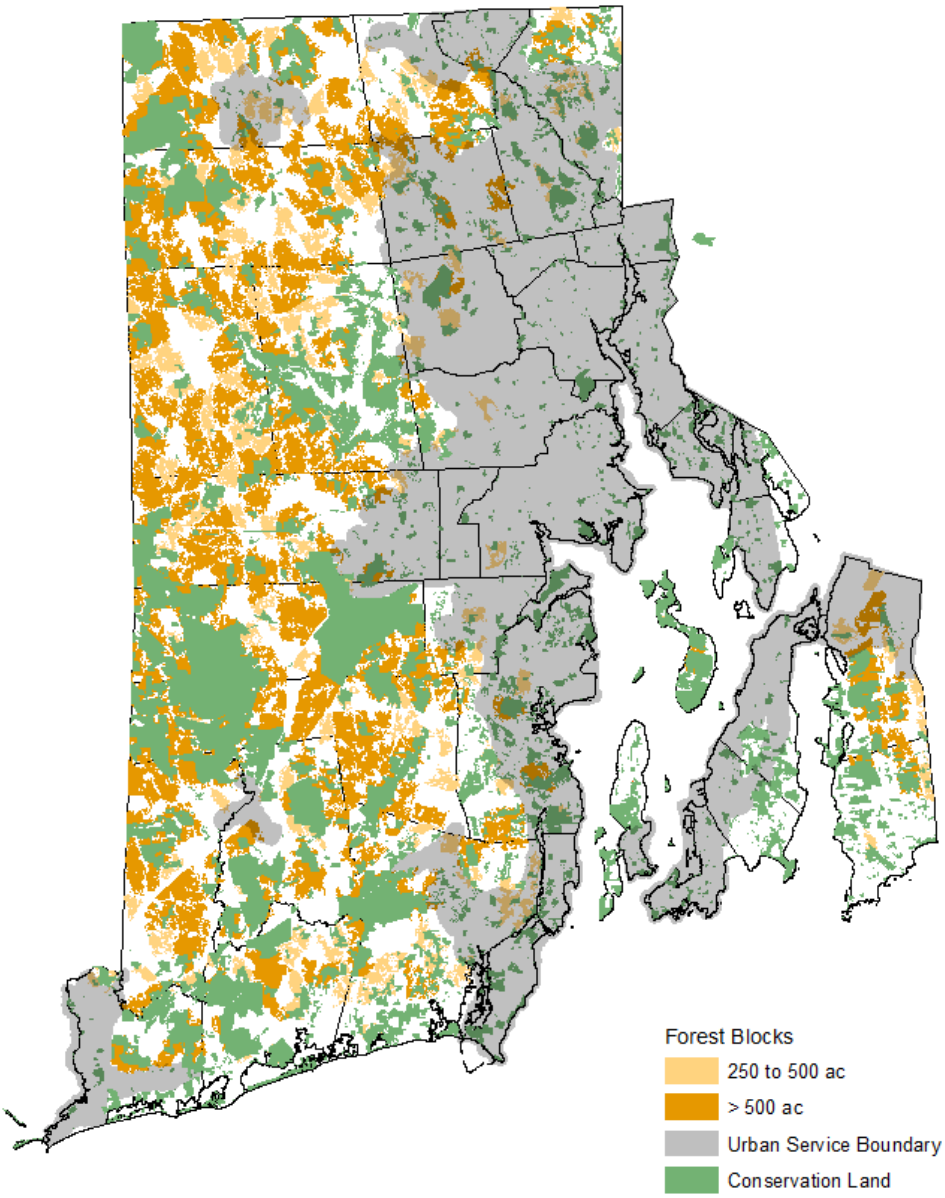

Figure 6: Core Forests in Rhode Island. *Source: Paul Jordan, RIDEM*

Another way to estimate forest fragmentation is the distance to the nearest road from a given point. URI researchers performed a statewide analysis with RIGIS land use classification data (based on a 30 x 30 foot pixels) and found that the mean distance to a road in Rhode Island in 2019 is only 613 feet (0.12 mile), with a standard deviation of 702 feet.[42]

To express these statistics using common estimates of distance, half of Rhode Island is within the length of a football field from a road and 90% of the state is within 4½ football fields of a road. Even if the forested area of the state includes most of the remaining locations that are more than 2,000 feet from a

[42] Peter August, Department of Natural Resources Science, University of Rhode Island, email communication, March 12 and 25, 2019.

road, Figure 7 shows that the only mainland locations where the distance is more than a mile are found in the State's Buck Hill and Great Swamp Management Areas and in a small patch along the Connecticut border.

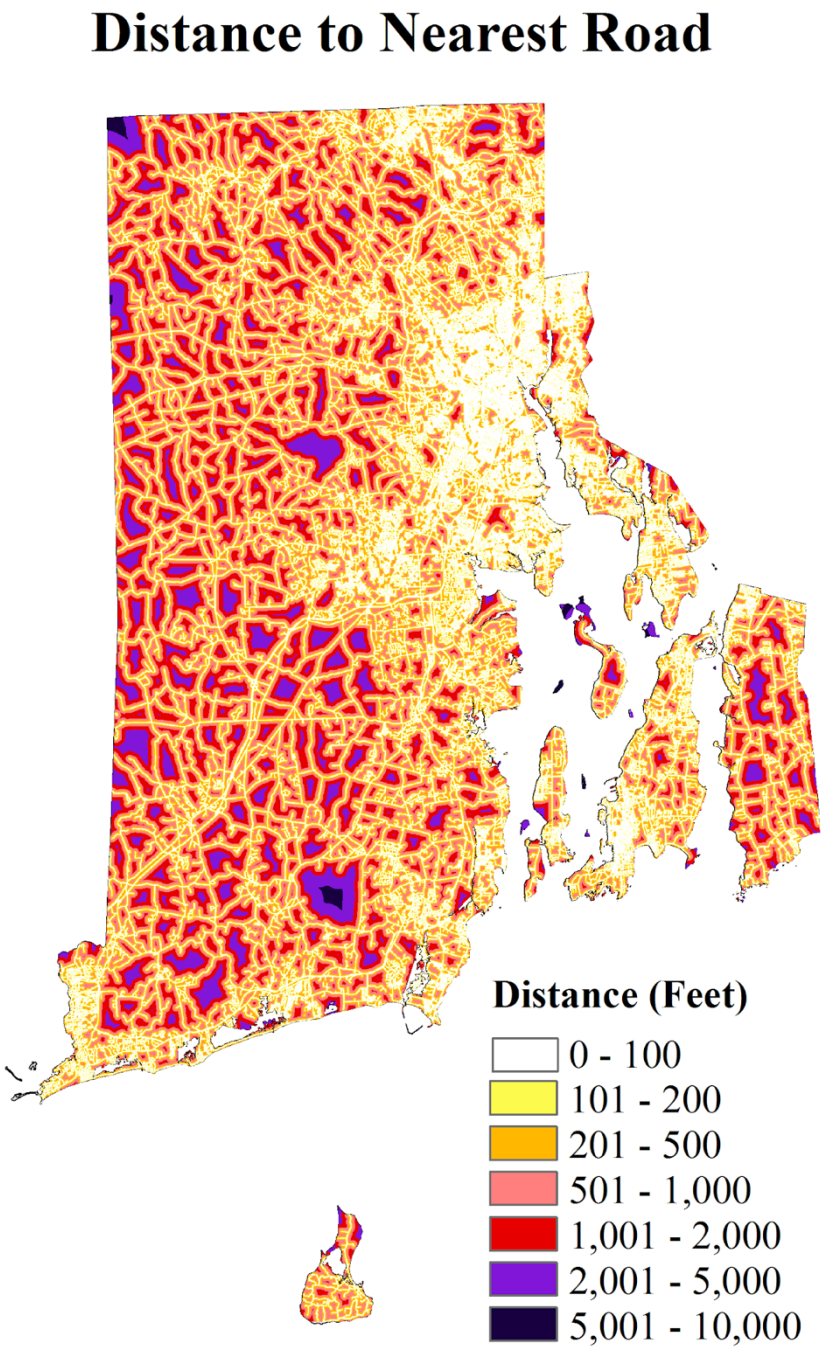

Figure 7: Distance to Nearest Road in Rhode Island. *Source: Peter August, University of Rhode Island*

Invasive Species

Invasive species are non-native, introduced organisms that have the ability to outcompete native species, reducing overall biodiversity. These invasive plants, insects, diseases, and animals can overwhelm the forest – especially when an area is disturbed, cleared, or developed – and create catastrophic ecological and economic impacts. In 2015, almost half (48%) of all invasive species identified when drafting Rhode Island's Wildlife Action Plan were associated with forest edge habitat, evidence that the problem of invasive species can be exacerbated by habitat fragmentation, and were listed as a top threat to Rhode Island's key habitats.[43] [44]

In 2012, 238 non-native species were identified to have the potential to adversely impact species of greatest conservation need in the Northeast and 68% of these were invasive plants.[45] These invasive plants outcompete native vegetation, colonize, and spread quickly through the forest, often resulting in a decline in native plant diversity. They have the ability to migrate and spread through plant root systems, or by birds eating and depositing invasive seeds along their flight paths. The most common invasive plants in the southeastern New England region were multiflora rose, Japanese barberry, and Oriental bittersweet, found on 19% of plots studied.[46] Three of the most significant invasives in Rhode Island's forest interior are Japanese barberry, glossy buckthorn, and oriental bittersweet. Many of the rest (eg. autumn olive, multi-flora rose, knotweed, and burning bush) are observed on field edges and fragmented forest areas. Climate change can also exacerbate the problem of invasive plants as many of these species thrive in warmer climates and colonize opportunistically where native plants are stressed.

The Rhode Island Invasive Species Council (RIISC) is a program of the RI Natural History Survey (RINHS), which works to gather and convey information on the presence, distribution, ecological and economic impacts, and management of invasive species in the state.[47] In 2001, RIISC compiled a comprehensive list of invasive plant species found in Rhode Island, but the RIISC has not been active in some time.[48] In 2005 RINHS wrote the Invasive Preparedness Strategy for the state, which outlined a 10 point strategy for invasives and was reviewed by the RI Environmental Monitoring Collaborative (RIEMC) for possible inclusion in a state-wide environmental monitoring strategy.[49] [50] Although the plan was never adopted, the strategy has been helpful in state-wide monitoring and response programs by conservation organizations.

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[43] Scott Klopfer, *Identifying Relationships between Invasive Species and SGCN in the Northeast,* (Blacksburg, VA: Conservation Management Institute, Virginia Tech, 2015).
[44] Rhode Island Department of Environmental Management, *2015 Rhode Island Wildlife Action Plan.*
[45] Rhode Island Department of Environmental Management, *2015 Rhode Island Wildlife Action Plan.*
[46] Brett Butler et al., *The Forests of Southern New England, 2007: A report on the forest resources of Connecticut, Massachusetts, and Rhode Island,* Resource Bulletin NRS-55 (Newtown Square, PA: USDA Forest Service, Northern Research Station, 2011).
[47] "Rhode Island Invasive Species Council," Rhode Island Natural History Survey, accessed July 8, 2019, https://rinhs.org/invasive-species-portal/riisc/
[48] "Invasives: List," Rhode Island Natural History Survey, Rhode Island Invasive Species Council, 2001, https://rinhs.org/wp-content/uploads/2011/10/RIISC_2001list_wlogos.pdf.
[49] Rhode Island Natural History Survey, *Comprehensive Invasive Species Preparedness Strategy for Rhode Island (2006) Executive Summary,* 2006, http://rinhs.org/wp-content/uploads/2011/10/RINHS-Comp-Inv-Sp-Strat-for-RI-2006.pdf.
[50] Testimony of RI Natural History Survey Executive Director David Gregg and RI Land Trust Council Executive Director Rupert Friday in "Invasive Plants Bill" (YouTube video), *ecoRI News*, April 11, 2019, https://www.youtube.com/watch?v=C1kK9A4IkrE.

While state agencies and conservation organizations agree that invasive plant species are a critical conservation issue, there are no laws or state regulations regarding invasive plants in Rhode Island. Many New England states including neighboring Massachusetts and Connecticut have passed laws prohibiting the sale, movement, distribution and import of invasive plants. Both Massachusetts and Connecticut require the compilation and periodic update of known and potential invasive plants to be kept and regulated by the state.[51]

Invasive insects are also a concern to Rhode Island forests, generally introduced to the region through trade in packaging and most commonly spread through the movement of firewood over state lines. These insects can devastate natural habitats and completely remove tree species from the forested landscape. The most common invasive insects in Rhode Island's forests are the Gypsy moth (attacks oaks and other hardwood through defoliation – see text box on the following page), the Hemlock Wooly Adelgid (sap-suckers that remove nutrients and cut off water transport in the needles of Eastern hemlocks) and the newly introduced Emerald Ash Borer (boring into ash trees and disrupting water and nutrient transport under the bark).[52]

Rhode Island forests are affected by invasive diseases as well. Historically, certain diseases like Dutch elm or Chestnut blight virtually removed the elm and chestnut tree species from the New England landscape. Today, the most common invasive diseases affecting the forests of Rhode Island are Beech Bark Disease (affects American beech), White Pine Blister Rust (white pines), and Sudden Oak Death (affects oaks and laurels).[53]

Strategic prevention and control of invasive plant species – particularly early detection and rapid response to new threats- should be a management objective for every forester and forest landowner in Rhode Island. When invasive species are present in a forest stand, they should be treated before any management activity is implemented to avoid further migration. Care should be taken to prevent the spread of the invasive through the movement of the wood. Since invasive plants are prolific and tend to reestablish after initial control measures, monitoring and multiple treatments should be administered.

[51] "Invasive Plants Bill" (YouTube video), *ecoRI News*.
[52] "Current Threats to Forest Health," RI Department of Environmental Management, accessed May 5, 2019, http://www.dem.ri.gov/programs/forestry/forest-health/forest-threats.php.
[53] "Current Threats to Forest Health," RI Department of Environmental Management.

Gypsy Moth and Oak Mortality in Rhode Island

The Gypsy Moth has played a critical role in several mass defoliation events since it was first introduced to North America from Europe in the late-1860s, with the most recent event occurring between 2015-2017.[54] Gypsy moth caterpillars and their larvae are now always present in Rhode Island's forests. They usually go unnoticed- kept in check by both a virus called *Nucleopolyhedrosis* (NVP) and the *Entomophaga maimaiga* fungus, which typically kill all caterpillars before they become adults.[55] Gypsy moth outbreaks are cyclic in nature, occurring only when the environmental factors are just right for large numbers of caterpillars to reach adulthood. Between 2013-2015, there were below average rainfalls in each spring, reducing the effectiveness of *Entomophaga* and NVP from proliferating, leading to an outbreak.[56] [57]

Trees are resilient and can survive occasional defoliations but become weakened over time. The defoliations that occurred throughout the state's forests in the late spring of 2015-2017 were exacerbated by concurrent environmental stressors, including defoliations by other insects (the also introduced winter moth and our native forest tent caterpillars) and drought conditions in 2015-2016. Gypsy moth activity reached an apex in 2017 when flyover surveys indicated that 312,000 acres were defoliated, and additional flyovers of the state in the fall of 2018 indicated that 45-50,000 acres, or 13% of Rhode Island's forests were dead from these conditions, with the western part of the state being the most hard-hit.[58] With the significant oak mortality and changes in the forest canopy throughout the most affected parts of the state, it is expected that Rhode Island will see several changes to the composition of the oak-dominated forests. These include increased dead and dying woody debris and forest fuel loads (fine-medium branches) that may increase fire risks, changes in the overall carbon balance in the soil, changes to wildlife populations that depend on white oak mast (acorns) as a main food source, increased populations of ticks, increased hydrology and moisture in forest soils, and increased populations of both invasive species and native species that can colonize aggressively after a disturbance (e.g. hay scented fern, huckleberry).[59]

White-tailed Deer

A lack of natural predators, a decrease in hunting, the spread of suburban landscapes with appealing forage for deer, and an increase in fragmented forests has caused a problematic increase in white-tailed deer populations. The Rhode Island Department of Environmental Management (RIDEM) estimates the state's deer population to be between 13,000-15,000 in over 650 square miles of suitable habitat.[60] In western Rhode Island, deer densities of 15-20 per square mile are common, however, densities of twice

[54] Jeff Ward, Department of Forestry and Horticulture, CT Agricultural Experiment Station, *Gypsy Moths and Oak Forest – Past, Present and Future* (lecture, Coventry Community Center, Coventry, RI, March 16, 2019).
[55] "Gypsy Moths in Rhode Island," RI Department of Environmental Management, accessed March 31, 2019, http://www.dem.ri.gov/programs/forestry/forest-health/gypsy-moths/index.php.
[56] Paul Ricard, Principal Biologist, Forest Health Program Coordinator, *Oak Mortality in Rhode Island* (lecture, Coventry Community Center, Coventry, RI, March 16, 2019).
[57] "Gypsy Moths in Rhode Island," RI Department of Environmental Management.
[58] Ricard, *Oak Mortality*.
[59] Ward, *Gypsy Moths and Oak Forest*.
[60] Rhode Island Department of Environmental Management, *White Tailed Deer (Odocoileus virginianus) Fact Sheet 2017* (Providence, RI: 2017).

that number may occur in some areas where hunting access is not firmly established (suburbs and coastal areas). An individual deer can browse between 5-9 pounds of food a day, consisting of tender shoots, buds, twigs, and leaves of trees and shrubs.[61]

Overbrowsing by white-tailed deer has resulted in wide-spread, long-term adverse impact on forest regeneration, altering ecosystem processes. In a recent USDA Forest Service (USFS) study, forests of the Mid-Atlantic Region (RI is included in this particular study) had the highest proportion of forestland with moderate or high deer browse impacts at 79%.[62] The oak-hickory (comprising 61% of the forest cover in RI) and maple-beech-birch forest-type groups each had percentages of forest land with moderate or high deer browse impacts above the regional average, with 69% and 65% respectfully.[63] Oak-hickory forests are considered most palatable to white-tailed deer, and where these forests once dominated Rhode Island's landscape, the state is likely to see an increase of fast-growing, disturbance-dependent trees. The regeneration of oak-hickory habitats is of particular concern because these trees rely on abundant light during their establishment stage and are particularly susceptible to deer browse. As deer browsing delays regeneration potential, recovery of forest understories can take from 20-50 years depending on conditions, varies from full to partial restoration, and may never be achieved.[64]

The most effective management action that can reduce the negative impacts of deer browsing is reducing deer numbers through increased hunting (considered the most practical and cost effective). Other methods for reducing deer impacts include leaving slash, tops and limbs in place on the forest floor or piling it around the edges of small cuts to reduce deer access, and making large clearcuts to overwhelm deer with more browse than they can eat.[65] Reforestation efforts should be considered, and it is important to promote existing native species to ensure the sustainability of forest values that the public has come to expect, such as aesthetics, wildlife, non-timber forest products, and marketable wood.[66] Deer browse can be discouraged on recent regeneration or new plantings by using temporary fencing, bud caps or tree cages, but these are expensive and often not practical.

Climate Change

Climate change is a serious threat to the health of all of Rhode Island's ecosystems, including forests. Temperatures in Rhode Island have increased more than 3 degrees since the beginning of the 20th century and, according to the Newport tide gauge, sea level has risen 10 inches since 1930.[67] Over the past 80 years, Rhode Island and southern New England have experienced a significant increase in both flood frequency severity, including a doubling of the frequency of flooding and an increase in the magnitude of

[61] RI Department of Environmental Management, *White Tailed Deer.*
[62] William McWilliams et al., *Subcontinental-Scale Patterns of Large-Ungulae Herbivory and Synoptic Review of Restoration Management Implications for Midwestern and Northeastern Forests*, General Technical Report NRS-182 (Newtown Square, PA: USDA Forest Service, Northern Research Station, 2018).
[63] McWilliams et al., *Subcontinental-Scale Patterns of Large-Ungulae Herbivory*.
[64] McWilliams et al., *Subcontinental-Scale Patterns of Large-Ungulae Herbivory*.
[65] Richard DeGraff et al., *Technical Guide to Forest Wildlife Habitat Management* (Vermont: University of Vermont Press, 2006).
[66] McWilliams et al., *Subcontinental-Scale Patterns of Large-Ungulae Herbivory*.
[67] Rhode Island Office of the Governor, *Resilient Rhody: An Actionable Vision for Addressing the Impacts of Climate Change in Rhode Island*, by Shaun O'Rourke et al., 2018, http://climatechange.ri.gov/documents/resilientrhody18.pdf.

flood events.[68] Intense rainfall events have increased 71% since 1958.[69] In southern New England, spring is arriving sooner, and leaf-out for trees and woody plants is occurring 18 days earlier than in the 1850s.[70] Temperatures are projected to rise another 5 to 10 degrees, leading to a longer growing season and more extremely hot days, and climate models predict additional changes in the years to come. Climate change is directly increasing stress on the state's forests and also playing a role in more complex, compounding factors, such as:[71] [72]

- Annual precipitation is expected to continue increasing, particularly during the spring and fall, and heavy precipitation events will occur more often. Warmer temperatures will result in more rain than snow. More rainfall during concentrated periods will significantly affect hydrological patterns, including more flooding events;
- A longer growing season, warmer temperatures, and more variable summer rain are likely to increase summer moisture stress on plants and could lead to harmful droughts;
- As the climate changes, the composition of the forest may change as well. Conditions are expected to become less favorable to trees species that are adapted to cold climates and some tree species such as sugar maple and yellow birch are likely to experience declines. At the same time, conditions may become more favorable to typically southern species that are now at the northern edge of their range, and species associated with the oak-hickory forest type could become more common;
- Warmer winters with fewer periods of sustained cold weather may lead to increased activity of forest insects and pests that have the potential to cause greater impacts to forests. Insects and other species that were formerly restricted by weather to areas further south could find favorable conditions in Rhode Island; and
- Changes in the timing of leaf-out, flowering, and fruiting in plants can be very disruptive to plant pollinators, seed dispersers, and migratory wildlife.[73]

While climate change is affecting the state's forests, management strategies to actively respond to these threats are being developed and tested. Different climate adaptation approaches to forest management are built upon the principles of resistance, resilience, and transition and can be applied to specific situations and sites.[74] Climate-smart forestry builds on time-tested management practices and these strategies are beginning to be implemented Rhode Island in different ways.

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[68] David Vallee and Lenny Giuliano, *Overview of a Changing Climate in Rhode Island*, National Oceanic and Atmospheric Administration and RI Department of Environmental Management, August 2014.
[69] John Walsh et al., "Our Changing Climate," in *Climate Change Impacts in the United States: The Third National Climate Assessment* (Washington, DC: US Global Change Research Program, 2014), https://nca2014.globalchange.gov/report.
[70] Caroline A. Polgar and Richard B. Primack, "Leaf-out phenology of temperate woody plants: from trees to ecosystems," *New Phytologist* 191, no. 4 (2011): 926-941, https://doi.org/10.1111/j.1469-8137.2011.03803.x.
[71] Maria Janowiak et al., *New England and Northern New York Forest Ecosystem Vulnerability Assessment and Synthesis: A Report from the New England Climate Change Response Framework Project,* General Technical Report NRS-173 (Newtown Square, PA: USDA Forest Service, Northern Research Station, January 2018)
[72] Maria Janowiak and Christopher Riely, "Keeping Your Woods Healthy Through the Years Ahead," (factsheet adapted from Northern Institute of Applied Climate Science materials), Rhode Island Forest Conservators Organization and Rhode Island Woodland Partnership, 2018.
[73] Rhode Island Office of the Governor, *Resilient Rhody.*
[74] Christopher W. Swanston et al., "Forest Adaptation Resources: Climate Change Tools and Approaches for Land Managers, 2nd Edition," General Technical Report NRS-87-2 (Newtown Square PA: USDA Forest Service, Northern Research Station, September 2016), https://www.nrs.fs.fed.us/pubs/52760.

II. The Benefits of Rhode Island's Forests

Rhode Island's forests clean air, filter water, and draw carbon dioxide from the atmosphere to temper the impacts of global warming. They support human health and sense of well-being, and they hold deep cultural significance for some Rhode Island communities. They keep homes from flooding and create a home for a host of non-human species. They bring millions of dollars into Rhode Island in the form of revenue from forest recreation, hunting, and tourism. Many positive impacts of Rhode Island's forests are difficult to quantify, and some important forest values are most accurately explained and understood in words rather than with numbers. The sections that follow explore the many ways that the state's forests make Rhode Island a place that humans and native wildlife can live and thrive.

Clean Air

Rhode Island's forests provide significant air quality benefits to the state by absorbing hazardous air pollution.

Good air quality is critically important to human health and well-being. National air quality standards have been established by the US Environmental Protection Agency (US EPA) under the federal Clean Air Act in order to maintain safe levels of common air pollutants. The air pollutants regulated by the US EPA are known as "criteria pollutants" and include ozone, particulate matter, nitrogen dioxide, sulfur dioxide, carbon monoxide, and lead. The RI Department of Environmental Management (RIDEM) monitors air quality in Rhode Island via a network of monitoring stations and submits an annual air quality report to the US EPA. Most criteria pollutants have remained within the safe levels designated by the US EPA, but measured ozone levels have exceeded safe standards in Rhode Island in recent years.[75] According to the 2019 "State of the Air" report by the American Lung Association, all three reporting counties in Rhode Island (Kent County, Washington County, and Providence County) received failing grades for air quality based on high ozone days.[76]

Air pollutants have a range of negative impacts on human health, including lung and heart problems, and prolonged exposure can lead to early death.[77] Air pollution likely has a more significant negative impact on low-income communities, where its impacts are often concentrated and combined with other social stressors.[78] To take one prevalent example of the negative impacts of air pollution, poor air quality has been linked to asthma exacerbation and onset.[79]

Among U.S. states, Rhode Island had the ninth-highest prevalence of children with asthma – 10.9% of Rhode Island children – according to RIDOH data released in 2019. Black children and Hispanic children

[75] RI Department of Environmental Management, Office of Air Resources, *RI 2018 Annual Monitoring Network Plan*, submitted to EPA on August 24, 2018.
[76] "Report Card: Rhode Island," American Lung Association State of the Air 2019, accessed on May 3, 2019, https://www.lung.org/our-initiatives/healthy-air/sota/city-rankings/states/rhode-island/#hide-tabs-3.
[77] C. Arden Pope et al., "Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particulate air pollution," *JAMA* 287, no. 9 (March 2002): 1132 – 1141.
[78] Jane E. Clougherty and Laura D. Kubzansky, "A Framework for Examining Social Stress and Susceptibility to Air Pollution in Respiratory Health," *Environmental Health Perspectives* 117, no. 9 (September 2009): 1351-1358.
[79] Michael Guarnieri and John R. Balmes, "Outdoor Air Pollution and Asthma." *Lancet* 383 (May 2014): 1581-1592.

are more likely to visit the emergency room or to be hospitalized due to asthma.[80] According to self-reported data collected by the Henry J Kaiser Family Foundation, more than 1 in 10 (12.3%) adults in Rhode Island had asthma in 2017.[81] Medical conditions like asthma caused by air pollution come with significant costs to quality of life and economic costs to afflicted individuals and the local medical system. A 2017 study showed that the economic cost of asthma is $3,266 per person with asthma per year.[82]

Trees contribute to cleaner air by absorbing gaseous pollutants through leaf stomata and intercepting particulate matter on tree surfaces. Trees absorb air pollutants that are detrimental to human health, including carbon monoxide, nitrogen dioxide, ozone, lead, sulfur dioxide, and particulate matter.[83] There is some variation in air pollution absorption by tree species. Trees also emit volatile organic compounds that can contribute to the formation of ozone, but, on the whole, trees reduce ozone, especially low-VOC-emitting tree species in populated areas to maximize positive health impacts.[84] Pollen can also cause adverse health reactions, making it important to plant species with a low allergy impact.[85] Studies have shown that trees can be planted strategically in urban areas to maximize their pollution-removal impacts.[86]

Studies of the relationship between trees and air quality estimate the value of pollution removal by trees in a given area by: (1) determining tree cover in the study area, (2) calculating the quantity of pollution removal by trees in the study area, and (3) calculating the incidence of adverse health effects avoided and monetary value associated with the avoided pollution. The U.S. EPA manages a tool called the Environmental Benefits Mapping and Analysis Program that is often used to complete this last step (for example, in Nowak 2014 and the 2014 i-Tree Canopy Cover Assessment and Tree Benefits Analysis Report discussed below).

According to studies estimating the value of trees to Rhode Island's air quality, **Rhode Island's trees provide more than $30 million annually in pollution removal benefits.**[87] Trees in Rhode Island remove an estimated 13,800 tons of dangerous air pollutants from the atmosphere each year according to the studies described below.

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[80] Rhode Island Department of Health, "Asthma in Rhode Island: Greater Providence Area" (presentation), accessed on August 25, 2019, https://static1.squarespace.com/static/546d61b5e4b049f0b10b95c5/t/5c65f25353450a82b2e0a4e9/1550185066098/Community+asthma+presentation+-+Greater+Providence+Area.pdf.

[81] Henry J. Kaiser Family Foundation, *Adult Self-Reported Current Asthma Prevalence Rate*, 2017. From Kaiser Family Foundation analysis of the Centers for Disease Control and Prevention (CDC)'s Behavioral Risk Factor Surveillance System (BRFSS) 2013-2017 Survey Results, https://www.kff.org/1fefc65.

[82] Tursynbek Nurmagambetov, Robin Kuwahara, and Paul Garbe, "The Economic Burden of Asthma in the United States, 2008–2013," *Annals of the American Thoracic Society* 15, no. 3 (March 2018): 348-356, doi: 10.1513/AnnalsATS.201703-259OC

[83] David J. Nowak, Satoshi Hirabayashi, Allison Bodine, and Eric Greenfield, "Tree and forest effects on air quality and human health in the United States," Environmental Pollution 193 (2014): 119-129.

[84] Nowak et al., "Tree and forest effects."

[85] Paloma Cariñanos and Manuel Casares-Porcel, "Urban green zones and related pollen allergy: a review. Some guidelines for designing spaces with low allergy impact," *Landscape and Urban Planning* 101, no. 3 (2011): 205–214.

[86] Zheming Tong et al., "Roadside vegetation barrier designs to mitigate near-road air pollution impacts," *Science of the Total Environment* 541 (January 15, 2016): 920–927.

[87] More than $30 million annually: RIDEM Division of Forest Environment, *State of Rhode Island i-Tree Canopy Cover Assessment and Tree Benefits Analysis Report*, June 2014.

According to the 2014 i-Tree Cover Assessment and Tree Benefits Analysis Report, the value of pollution-removal provided by trees in Rhode Island is greater than $38 million annually when considering the removal of carbon monoxide, nitrogen dioxide, ozone, and small and large particulate matter (not including the benefits of carbon dioxide removal, which will be discussed in the section below). When estimating the value of pollution-removal to the state and each of Rhode Island's 39 municipalities, researchers considered total tree cover, the percentage of evergreen trees, the "leaf area index" (quantifying the amount of green leaf surface over an area of land), the amount of pollution removed and pollution concentration changes, and the monetary value of pollutants removed. Using these factors, this study found that Burrillville experiences the greatest value of pollution removal by trees of Rhode Island's cities and towns with removed pollution valued at more than $3.3 million annually. When dense tree cover is located close to pollution sources and people, trees can provide the most pollution-removal benefits to people.[88]

Another study considered the pollution-removal value of trees in reference to the same pollutants except without including large particulate matter (between 2.5 and 10 microns). According to this study, 10,500 tons of air pollutants were removed by trees in Rhode Island in 2010, valued at $33.6 million in avoided human health costs. This includes 2,900 tons of pollution removed by trees in Rhode Island's urban land ($27.9 million value) and 7,600 tons of pollution removed by trees in the state's rural land ($5.7 million value). **Across the United States, this study shows that trees' ability to absorb air pollution is preventing more than 670,000 instances of acute respiratory symptoms and preventing more than 850 human deaths each year**.[89]

Clean Water

Clean water is essential for drinking, safe recreation, a thriving economy and healthy wildlife habitat, and forests play an important role in keeping Rhode Island's waterways safe and clean.

Forests are critically important in protecting water quality. They do this in two ways: (1) forests are a "sponge" for precipitation and runoff that soaks up water and filters nutrients and other chemicals that can cause pollution; and (2) live trees and their roots, decaying leaves, and organic material on the forest floor all contribute to holding underlying soil in place.[90] Forests can accept and gradually release tremendous amounts of rainfall and snowmelt over a long period of time. Some precipitation travels directly over the forest floor and drains to streams and ponds as overland flow. Most of it, however, soaks into the ground where it is stored in the soil or percolates down to recharge the groundwater. Forests thereby deliver a slow but steady supply of water to rivers and lakes, and groundwater sustains this process during dry periods when there is no precipitation. As forested watersheds become developed, urbanization typically brings an increase in impervious surfaces such as driveways, parking lots, and rooftops. These features can dramatically change the water flow in an environment and ultimately impact water quality (See page 55 for a discussion of trees for stormwater management in urban areas). Forests also allow water to permeate through the natural filtration system of the forest floor, thereby supporting high water quality.

[88] RIDEM Division of Forest Environment, *State of Rhode Island i-Tree Canopy Cover Assessment.*
[89] Nowak et al., "Tree and forest effects."
[90] Holly K. Burdett et al., *Today's Forest, Tomorrow's Legacy, Fact Sheet 6: "Working for Clean, Plentiful Water,"* (Kingston RI: University of Rhode Island Cooperative Extension and Southern New England Forest Consortium, Inc.), accessed August 26, 2019, https://web.uri.edu/rhodeislandwoods/files/6.pdf.

Although the connection may not be as direct as with surface water, land use also significantly affects the quality of groundwater supplies.

Oily residue flows into storm drain in Providence, RI. Credit: Judee Burr

Healthy forests also mitigate negative water quality impacts caused by soil erosion and sedimentation by holding soil in place. Erosion occurs when soil leaves a site, and sedimentation occurs when it enters surface water, which can choke aquatic plant and animal life and cause other problems. Disturbance events that cause soil erosion among other water-impacting issues can happen quickly or slowly – examples include severe storms, droughts, land development, acid rain, and climate change. Small disturbances may have negligible impacts on water quality, but large-scale disturbance events that cause soil erosion almost always have negative water quality impacts that include a dramatic increase in soil erosion and sedimentation to water bodies and a decline in water quality. Healthy forests protect water quality by minimizing disturbances that cause large-scale erosion and sedimentation.

Among northeastern US watersheds, Rhode Island's ranked high for the importance of watersheds and private forests for drinking water supplies and for their ability to produce clean water.[91] The development pressure on private forests in Rhode Island was also among the highest in the country, however, with the Narragansett Bay watershed ranking 13th in the country. An article in the Journal of the American Water Works Association reports on how protecting and sustainably managing forested

[91] Based on a 2009 analysis by the USDA Forest Service used to compare 540 large watersheds across 20 Northeastern States and the District of Columbia in terms of their ability to produce clean water: Martina Barnes et al., *Forests, Water and People: Drinking water supply and forest lands in the Northeast and Midwest United States,* Publication NA-FR-01-08 (Newtown Square PA: USDA Forest Service, Northeastern Area State and Private Forestry, June 2009).

watersheds makes economic sense for water utilities as a strategy that complements traditional infrastructures by reducing costs and, in some cases, even opening new funding streams.[92] In many regions of the United States, including the Northeast, water quality managers have recognized the benefits of forests as a least-cost solution compared with engineered solutions.[93] It is important to note that this is not an either-or choice and that urban, suburban, and exurban[94] human populations will always need traditional engineered treatment systems. However, an investment in maintaining the natural "green infrastructure" of forested watersheds and protecting raw water quality is complementary in that it can be less expensive than having to construct and operate the amount of engineered "gray infrastructure" facilities necessary to treat impacted raw water supplies.[95] By maintaining high quality water sources through watershed protection, utilities can reduce or avoid capital costs for some of the processes in conventional treatment and also more advanced treatment processes. For example, reduced sedimentation in source water prevents sediment buildup in reservoirs and intakes, thus lowering maintenance costs. In addition, treatment plants with high quality "raw" water can also save on variable costs because more chemicals are necessary to treat degraded water. One of the world's largest and best-known source water protection initiatives is New York City's effort to protect its upstate watersheds. Rather than spending $8-10 billion on a new filtration plant, New York City's Department of Environmental Protection is spending less than $2 billion on land protection and agricultural and forestry best management practices.[96]

Communities and Ecosystems in Rhode Island Depend on Clean Water

More than 80% of the 1.06 million people living in Rhode Island (as of 2017) rely on surface reservoirs for clean drinking water.[97] With few exceptions, the rest of the population relies on groundwater. Overwhelmingly, forested watersheds contribute significantly to filtering and protecting the raw water supply from these surface reservoirs. Forest loss to development and other land uses is a major

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[92] Todd Gartner et al., "Protecting forested watersheds is smart economics for water utilities," *Journal of the American Water Works Association* 106, no. 9 (2014).

[93] Caryn Ernst, Richard Gullick, and Kirk Nixon, "Protecting the Source: Conserving Forests to Protect Water," American Water Works Association, Opflow 30, no. 5 (May 2004), http://www.slcdocs.com/utilities/NewsEvents/pdf/Op0504_1.pdf

[94] Exurban areas are areas at the edge of the urban service boundary, where fragmentation and development tend to be concentrated.

[95] Although research shows a strong connection between forests and water quality, it is challenging to precisely quantify the positive impacts of forest cover on water quality in terms of monetary cost savings. One 2004 study found that "a 1% increase in forest cover was associated with a 2% decrease in chemical treatment costs for water systems located in watersheds with 50% of forested cover" (Ernst et al., 2004). A more recent 2016 report from the American Water Works Association concludes that forest cover likely reduces the cost of chemical treatments needed to ensure good water quality, but notes that a small sample size of water utilities surveyed and other data challenges prevent the study from identifying exact and significant monetary savings values in water treatment that are connected to forest cover. This report shows that more forest cover results in higher water quality when measured by "turbidity," defined as the transparency of the water as impacted by suspended particulate matter (which is a common way to measure water quality). Yet, lower turbidity does not automatically result in cost-savings, due to the complex economics of water treatment. Other factors, like treatment plant size and level of advancement, more readily impact water treatment costs: Warziniack, Travis, Chi Ho Sham, Robert Morgan, and Yasha Feferholtz, "Effect of Forest Cover on Drinking Water Treatment Costs," *American Water Works Association and the U.S. Endowment for Forestry & Communities Inc.*, 2016.

[96] Gartner et al., "Protecting forested watersheds is smart economics for water utilities."

[97] The federal Environmental Protection Agency's Safe Drinking Water Information System provides information on public water suppliers. According to this source (which collects data on public water suppliers of more than 500 people), 873,144 people rely year-round on public water suppliers that draw their supply from surface water sources. See "SDWIS" Overview," U.S. Environmental Protection Agency, Safe Drinking Water Information System, March 2019, https://www.epa.gov/enviro/sdwis-overview.

factor where the quality of the source water supply is compromised. A significant minority of Rhode Islanders, especially those living in exurban and rural areas, obtain their drinking water from groundwater supplies that forests also help protect.

Aquidneck Island provides a well-documented Rhode Island example of a location coming late and trying to play catch-up on drinking water supply protection.[98] [99] Land use on this large island is a mosaic of fragmented forests, agricultural fields, and dense residential development. All of the ponds that serve as supply sources for the Newport Water Division are on the State's list of impaired waters, largely as a result of elevated levels of phosphorus which cause frequent algae and cyanobacteria blooms in the reservoirs. In 2006, Newport Water partnered with the Aquidneck Land Trust and Town of Portsmouth on a conservation project that protected nearly 500 acres of remaining undeveloped land surrounding the three reservoirs at the center of the island. The utility was forced to upgrade its treatment facilities in 2014 to continue to provide safe drinking water, and the quality of the water in Newport Water's reservoirs remains a cause of concern in 2019.

In addition to providing a safe drinking water supply, **protecting clean water is critical to maintaining Rhode Island's aquatic ecosystems, fish and shellfish populations for safe consumption, and safe water recreation opportunities.** The federal Clean Water Act requires states to create water quality standards and monitor and report on water quality conditions in the state. The RI Department of Environmental Management (RIDEM) Office of Water Resources manages water quality monitoring and reporting to the EPA for Rhode Island's 1,420 miles of rivers, 20,749 acres of lakes and ponds, more than 15,000 acres of freshwater swamps, marshes, bogs and fens, 72,000 acres of forested wetlands, and 159 square miles of estuaries like Narragansett Bay and coastal ponds.[100] RIDEM has designated 96 named water bodies in the state as impaired as a result of this assessment.[101] For example, multiple junctures of the Blackstone River where it flows through Pawtucket, Central Falls, Woonsocket, North Smithfield, Cumberland and Lincoln have been designated impaired due to the presence of lead, mercury in fish tissue, and fecal coliform (among other pollutants), rendering it unsafe for drinking, fishing, wildlife habitat, and recreation.[102]

Rhode Island water suppliers contribute to a water quality protection fund for land acquisition and water quality improvement projects – including forest conservation – to support clean water. The Public Drinking Water Protection program is funded by a surcharge on the major water suppliers of the state to protect the water quality of Scituate Reservoir and other RI drinking water sources. Program funds are managed either by Providence Water or the Water Resources Board (WRB) in partnership with

[98] Frank Carini, "Sources of Newport's Drinking Water Contaminated," *ecoRI News*, April 6, 2015.
[99] Frank Carini, "Aquidneck Island's Waters Under Tremendous Pressure," *ecoRI News*, August 24, 2018.
[100] "Water Quality," Rhode Island Department of Environmental Management, accessed April 4, 2019, http://www.dem.ri.gov/programs/water/quality.
[101] RIDEM sets pollution limits (known as the "total maximum daily load" or TMDL) for those water bodies that do not meet state water quality standards for uses including drinking water supply, aquatic life habitat, shellfish consumption, fish consumption, and recreation. Currently, there is enough data to assess water quality in 65% of the river miles, 77% of the lake acres and nearly 100% of the estuarine waters in Rhode Island: "Water Quality," Rhode Island Department of Environmental Management.
[102] Rhode Island Department of Environmental Management, Office of Water Resources, *State of Rhode Island Impaired Waters Report*, March 2018, https://www.epa.gov/sites/production/files/2018-04/documents/2016-ri-303d-list-report.pdf.

the RI Infrastructure Bank.[103] Through the WRB-funded program, water suppliers have preserved 2,742 acres of land to permanently protect drinking water sources.[104] A second program – the South County Groundwater Protection and Acquisition Program – allows the WRB to purchase new drinking water sources or to acquire watershed lands to protect existing sources.[105]

Without responsible forest management, pollution from human development and poorly planned land uses can render water bodies unfit for the uses and activities that are foundational to RI communities. Maintaining healthy forests is a key part of ensuring clean water is available for the many ways Rhode Island's communities depend on it.

Figure 8: Scituate Reservoir. Source: U.S.Geological Survey

[103] "Public Drinking Water Protection Program," Rhode Island Water Resources Board, accessed July 15, 2019, http://www.wrb.ri.gov/work_programs_pdwp.html.
[104] Kathleen Crawley, Acting General Manager, Rhode Island Water Resources Board, personal communication, March 1, 2019.
[105] Kathleen Crawley, Acting General Manager, Rhode Island Water Resources Board, personal communication, July 15, 2019.

Providence Water Supply Board Maintains Healthy Forests for Clean Water

The Providence Water Supply Board (PWSB) is the largest water supplier in Rhode Island. It is a public utility that was developed by and is still operated by the City of Providence. About 600,000 people or 60% of the state's population receive their water supply for drinking and other uses (including fire protection) from the Scituate Reservoir. About half of this population is served directly by Providence Water and the rest is served by other utilities that purchase their water supply from PWSB. Providence Water has received recognition for the high quality water of its drinking water.[106]

The watershed that drains into the Scituate Reservoir is located in parts of five towns, including almost all of Scituate, large areas of Foster and Glocester, and small parts of western Cranston and Johnston. It covers 93 square miles and about two-thirds of it is private land. The watershed property is City of Providence's largest physical asset. PWSB manages about 13,000 acres of forestland surrounding the main reservoir and five smaller tributary reservoirs.[107] Providence Water's longtime policy has been to manage the property as managed forest conservation land, but it is not legally protected from conversion to development or other uses.

According to Providence Water, watershed management programs are the first step in the drinking water treatment process. These efforts include forestry and land management, land conservation, water sampling, policy and planning engagement with the state and municipalities, and outreach and education. Protecting the watershed saves ratepayers money by reducing treatment costs while also serving as a risk management strategy that provides many other benefits.

Land use strongly influences the water quality in the watershed. One of Providence Water's strategies is to protect drinking water at its source by maintaining forest cover and promoting responsible land stewardship and low-impact development. Since PWSB only owns about one third of the land in the watershed, it relies heavily on private property owners as stewardship partners. Research has shown that landowners who are actively involved with their land are less likely to engage in activities that often have negative impacts on water quality (such as selling, subdividing, or developing land).

Economic Value

The conservation of Rhode Island's forestland is an investment in the state's future, providing sound economic growth to both the state and local municipalities. It has been a long-held belief amongst many Rhode Islanders that conserving open spaces and forestland decreases revenue to cities and towns by taking those properties off the tax rolls and reducing land available for development in cities and towns. While this can be true in the short-term through a tax shift for permanently protected or conserved lands, the long-term benefits outweigh any short-term losses.

[106] "Tests Find Hundreds of Pollutants in U.S. Tap Water," Environmental Working Group, December 13, 2009, https://www.ewg.org/kid-safe-chemicals-act-blog/2009/12/tests-find-hundreds-of-pollutants-in-u-s-tap-water.
[107] "Scituate Reservoir Watershed," Providence Water, 2019, http://www.provwater.com/departments/watershed.

Evidence from numerous studies suggest that protecting forestland, farmland and open spaces can generate economic tax benefits that improve the local tax base by bringing in more revenue than is used in services.[108] [109] [110] [111]

In Rhode Island, towns with the most development pay the highest taxes overall, and development has not resulted in lower taxes.[112] The idea that traditional residential or commercial development yields the highest and best use for increasing municipal revenues by growing the tax base and lowering individual property taxes is contradicted by evidence from communities.[113] Property taxes generally increase in this scenario because the cost of providing services increases for the municipality.[114] By itself, new commercial development brings economic growth to a community without increasing the cost of services to the municipality. With new commercial development comes new jobs and new residents who rely on municipal services, providing secondary pressure to the municipality's services. When communities are more reliant on property taxes to fund local government, it is often difficult to invest in land conservation when combined with the needs for other municipal investment, but there is sound evidence that preserving land provides economic benefits.[115]

The economic benefits of land conservation in cities and towns include:

- Open spaces improve the local tax base by enhancing community property values, leading to increased property tax revenue. Properties located near parks and open spaces are assessed at higher rates and sell for more than comparable properties located elsewhere in the same city or town;[116]
- People are willing to pay more in property taxes to live near open space and forestland, and passive parks and open spaces generate the greatest premium.[117] If reflected in tax assessments, the increase in taxes paid by residents may offset the decrease in value of the abutting conserved property, resulting in little if any, tax increase;[118]
- Open spaces in cities and towns improve the quality of life and health of their residents, making them an affordable tool in addressing environmental health and justice outcomes;[119]
- Following "conservation development" principles can increase the tax base through additional residential development while conserving valuable land and directing development to areas where services are easily accessible, reducing the burden on the municipality (see page 84 for more on conservation development);

[108] Land Trust Alliance, *Economic and Tax-Based Benefits of Land Conservation* (Washington, D.C.: Land Trust Alliance, 2011).
[109] Commonwealth Research Group, Inc., *Cost of Community Services in Southern New England,* (Chepachet, RI: Southern New England Forest Consortium, Inc., 1995).
[110] Helena Murray and Paul Catanzaro, *Fiscal Impacts of Land Use in Massachusetts, Up-to date Cost of Community Services Analysis for 4 Massachusetts Communities* (Amherst, MA: University of Massachusetts, Amherst, 2019).
[111] American Farmland Trust, Farmland Information Center*, Cost of Community Services Studies* (Northampton, MA: September 2016).
[112] Southern New England Forest Consortium, Inc., *Land Conservation, Development and Property Taxes in Rhode Island.* (Chepachet: Southern New England Forest Consortium, Inc., 2001).
[113] Murray and Catanzaro, *Fiscal Impacts of Land Use in Massachusetts.*
[114] Constance TF deBrun, *Economic Benefits for Land Conservation* (San Francisco: Trust for Public Land, 2007).
[115] Southern New England Forest Consortium, *Land Conservation, Development.*
[116] deBrun, *Economic Benefits for Land Conservation.*
[117] deBrun, *Economic Benefits for Land Conservation.*
[118] Southern New England Forest Consortium, *Land Conservation, Development.*
[119] Land Trust Alliance, *Economic and Tax-Based Benefits of Land Conservation.*

- There is no change in the number of new building permits when conservation in cities and towns is increased. Conserving open spaces doesn't reduce housing development, but redirects it;[120] and
- As land protection and conservation increase, employment rates have been shown to increase over the next five-year period, with jobs focused mainly in tourism and recreation sectors, with amenity-related growth likely the factor driving positive long-term impacts.[121]

The Economic Impact of Rhode Island's Forest Economy

Rhode Island's robust forest-based economy plays a vital role in the health of the state's economy as a whole. It is comprised of the forest and wood products sector and the forest-based recreation sector. The state's forest and wood products sector include commercial loggers, arborists, foresters and forestry consultants, sawmills, wood products manufacturers, wood workers, and tree farms. The forest and wood products sector begins in the forest with the trees themselves providing the raw materials for the industry and the people who work in the forest as consultants and loggers to harvest these materials. It then follows the production chain through transportation to markets for processing, creating both primary solid wood products (saw mills, firewood) and materials for secondary manufacturers to create finished products (furniture, flooring, wood working).

In the forest and wood products sector, 513 firms generated 2,496 jobs with $408 million in gross sales in 2016. The total economic impact of the forest and wood products sector, including the spillover effects across all sectors of the Rhode Island economy, is estimated at $716 million annually, with 4,844 jobs arising from this economic activity.[122]

The value to the forest landowner from harvesting trees for fuelwood is very low relative to other products, such as sawlogs.[123] Harvesting and processing firewood can be time consuming and does not yield a substantial return in the market, with cords of firewood averaging around $200/cord to consumers. With that being said, the 2010 census results showed a marked increase in the use of wood as a source of heating fuel in Rhode Island, growing by as much as 160%.[124] [125] The increase can be attributed to the rise in the cost of propane and home heating oil, and the financial crisis of 2008. The 2015 Rhode Island Forest Based Economy study suggests that on average, Rhode Islanders used over 135,000 cords a year to heat their homes using both traditional wood stoves as well as wood boilers, which are becoming more common each year.[126] These numbers are difficult to track, as landowners do not always file or record their harvesting activities through the state. As the economy has improved over the last decade, we've

[120] Katharine Sims et al., "Assessing the local economic impacts of land protection," *Conservation Biology,* March 26, 2019, https://doi.org/10.1111/cobi.13318.
[121] Sims, "Assessing the local impacts."
[122] Thomas Sproul and Clayton Michaud, *The Economic Impacts of Rhode Island's Forestry and Wood Products Sector,* (Kingston: University of Rhode Island, 2019), https://riepr.org/pdf/ri-forestry-and-wood-products-2019.pdf.
[123] Northeast State Foresters Association, *The Economic Importance of Rhode Island's Forest Based Economy* (Concord, NH: 2015).
[124] Northeast State Foresters Association, *The Economic Importance*.
[125] U.S. Census Bureau, "House Heating Fuel Universe: Occupied housing units 2008-2012 American Community Survey 5-year Estimates," American Fact Finder, Accessed June 30, 2019, factfinder.census.gov.
[126] Northeast State Foresters Association, *The Economic Importance.*

seen a slight decrease in wood as a primary source of fuel, with estimates of 5,952 (1.5%) of Rhode Islanders heating their homes primarily with wood in 2017.[127]

The forest based economy is flourishing, but it does not receive the same support or attention that other agricultural based businesses do in the state, even though the forest industry and forest products are considered an agricultural commodity. For example, the Local Agricultural Seafood Act (LASA) of 2012 was funded by a unique public/private partnership between the state and three private foundations, the van Beuren Charitable Foundation, the Henry P. Kendall Foundation, and the Rhode Island Foundation, and is operated in partnership with the Rhode Island Food Policy Council.[128] LASA created a small grant program to support the growth, development, and marketing of local food and seafood in Rhode Island, and is now solely funded by the state at a lower funding level.[129] Through this grant opportunity, farmers have received funding for equipment, organizational capacity-building, and marketing of their operations. A similar program could support the state's forest-based economy.

To garner support and bolster the economic impact of locally-grown wood products, New England states and conservation organizations have created marketing and certification programs to help forest-based businesses thrive. For example, the **Connecticut Grown Forest Products Program** promotes products made from trees grown in Connecticut, allowing consumers to make purchasing decisions that support the state's forest-based businesses.[130] According to the Connecticut Department of Energy & Environmental Protection website, "the economic value of products from local woodlands encourage landowners and communities to keep their 'woods' and not convert their land to other uses."

The state's forest-based recreational economy includes, but is not limited to, hiking, skiing, camping, snowmobiling and fall foliage viewing and wildlife viewing. State-owned management areas, land trusts, federal wildlife refuges, hunting clubs, private and non-profit preserves all provide year-round access to forest-based recreational opportunities. **Forest-based recreational activities contribute an estimated $375 million dollars in sales annually to the Rhode Island economy and 1,500 jobs with an estimated $37 million payroll annually.[131]** Fall foliage viewing is the largest contributor with 25% of the total sales, and is followed by, in order, camping, hiking, wildlife viewing, snowmobiling and downhill skiing.[132]

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[127] U.S. Census Bureau, *Selected Social Characteristics in the United States 2017 American Community Survey 1-year Estimates,* American Fact Finder, December 14, 2018, accessed April 3, 2019, http://www.dlt.ri.gov/lmi/pdf/acs/rhodeisland.pdf.
[128] Rhode Island Department of Environmental Management, *Agriculture Grant Opportunities*, accessed June 30, 2019, http://www.dem.ri.gov/programs/agriculture/grants.php.
[129] Rhode Island Food Policy Council, *The Rhode Island Local Agriculture and Seafood Act,* accessed June 30, 2019, https://rifoodcouncil.org/lasa/.
[130] State of Connecticut Department of Energy and Environmental Protection, *Connecticut Forest Products*, accessed May 15, 2019, https://www.ct.gov/deep/cwp/view.asp?a=2697&Q=484488&deepNav_GID=1631.
[131] Northeast State Foresters Association, *The Economic Importance.*
[132] Northeast State Foresters Association, *The Economic Importance*.

Rhode Island's wildlife provides a variety of ecological, recreational, economic and aesthetic benefits to the state's citizens.[133] Efforts to estimate the true value of wildlife in monetary terms, as with most natural resources, have met with limited success and significant information gaps and research needs remain.[134]

Wildlife-related recreation plays an enormous part in Rhode Island's forest-based economy, with an estimated 503,000 residents and non-residents participating each year, bringing $348 million to the state's economy through fishing, hunting and wildlife watching.[135] Revenue generated from license and permit sales for hunting and fishing and excise taxes from sporting goods support Rhode Island fish and wildlife conservation programs. This provides a critical source of funding that is leveraged to match federal Wildlife and Sport Fish Restoration Program dollars, which in turn, support outdoor recreational opportunities for hunting, fishing and boating in Rhode Island. Fishers and hunters purchase around 70,000 licenses, permits, stamps and tags each year and contribute more than $235 million to the Rhode Island economy.[136]

Non-game species play an integral role in the ecological integrity and diversity of an area, in addition to providing immeasurable value to those who enjoy and study wildlife.[137] Rhode Islanders share in a robust wildlife watching tradition, with around 308,000 Rhode Islanders (60%) report participating in wildlife watching, bringing $200 million to the state (numbers do not add to total because approximately a quarter participated in more than one wildlife-related survey[138]).[139]

Climate Change Mitigation

Forests play an important role in mitigating the impacts of climate change. For the purposes of this report, the term **mitigation** refers to the capacity of forests to reduce the effects of climate change by removing carbon dioxide from the atmosphere and storing carbon as biomass. Rhode Island is one of the member states of the U.S. Climate Alliance, which has identified enhancing carbon sequestration on natural and working lands as a key near-term opportunity for achieving its climate goals. The Alliance's Natural and Working Lands Initiative is charged with identifying best practices for land conservation, management and restoration to develop a carbon storage policy framework for implementation. Citing the United Nations Environment Programme's emissions gap reporting, the Initiative states that "only by utilizing the power of natural and working lands to sequester carbon can we achieve the goal of negative emissions

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[133] Rhode Island Department of Administration Division of Planning and Rhode Island Department of Environmental Management, *Ocean State Outdoors: Rhode Island's Comprehensive Outdoor Recreation Plan State Guide Plan Element 152,* Report Number 113, (Providence: Amended 2009), http://www.planning.ri.gov/documents/guide_plan/scorp09.pdf.
[134] Rhode Island Department of Environmental Management, *2015 Rhode Island Wildlife Action Plan,* Chapter 1.
[135] U.S. Department of the Interior, U.S. Fish and Wildlife Service, U.S. Department of Commerce, U.S. Census Bureau, *2011 National Survey of Fishing, Hunting and Wildlife-Associated Recreation Rhode Island,* FHW/11-RI, (Washington D.C.: 2013).
[136] Rhode Island Department of Environmental Management, *Small Game Hunting Opens This Month season for pheasant, rabbit, squirrel, woodcock, quail and foxes opens October 20, 2018,* (press release), accessed May 1, 2019, https://www.ri.gov/press/view/34416.
[137] RI Department of Environmental Management, *A Path to Tomorrow's Forests.*
[138] Rhode Island Department of Environmental Management, *Community Wildlife Conservation Guide: Implementing Rhode Island's Wildlife Action Plan in Your Community* (Providence, RI: 2015), http://www.dem.ri.gov/programs/bnatres/fishwild/swap/RIWAP-Companion.pdf.
[139] U.S. Department of the Interior, *2011 National Survey of Fishing, Hunting and Wildlife-Associated Recreation.*

needed to avoid catastrophic climate change...As the impacts of climate change continue to intensify, the carbon stocks in natural and working lands need to be safeguarded and enhanced." [140] [141]

Forests and the Carbon Cycle

Rhode Island's trees and forests sequester carbon dioxide from the atmosphere through photosynthesis. Forests are also one of the state's most important "sinks" for storing carbon in their biomass and keeping it out of the atmosphere. Through these two distinct but closely related processes, forests play an outsized role among different types of land uses in mitigating and buffering climate. Carbon in forest biomass is an example of a **stock or storage pool**, while carbon sequestration is an example of a **flux or movement between two different carbon stocks**. The ability of forests to help mitigate climate change takes into account plants' unique ability to perform both carbon **sequestration** and **storage**.

Carbon is one of the Earth's most important elements and essential for life. All life is supported by the carbon cycle, which transfers carbon between living things and the environment. Carbon is stored in different places and parts of the world and individually these sources are referred to as stocks, pools, or sinks. By far the largest amount of carbon is found in the Earth's interior. Despite the significance of elevated levels of carbon dioxide that are contributing to climate change, the total amount of carbon in the atmosphere is small compared to the oceans, soils and vegetation, and even permafrost.[142]

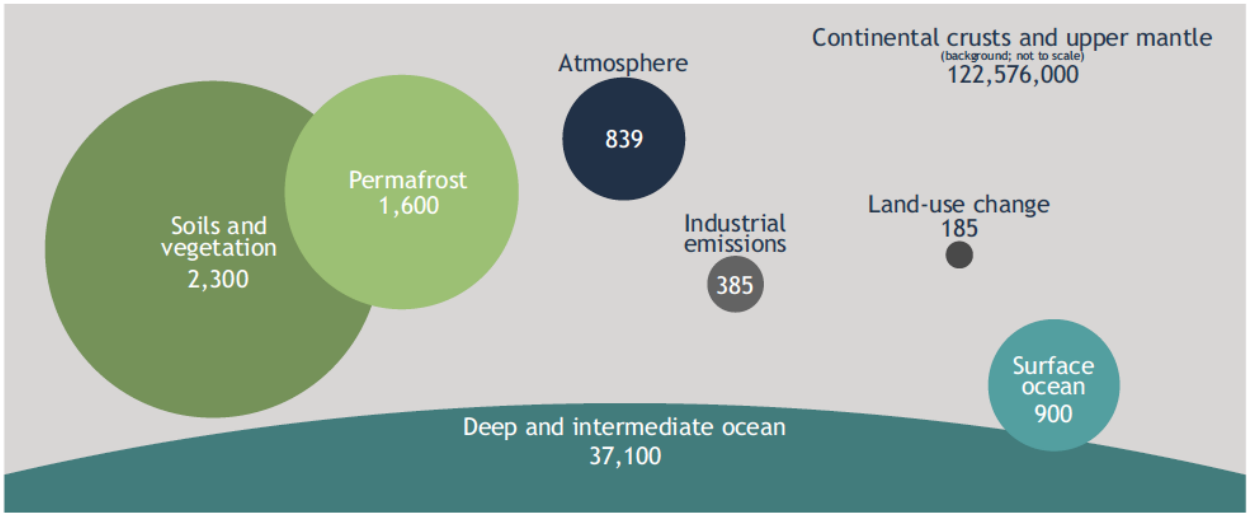

Figure 9: Global carbon stocks (carbon storage pools), shown in gigatons (Source: Janowiak et al.)

Carbon fluxes are transfers that occur when carbon moves from one stock to another, such as when plants absorb carbon dioxide from the atmosphere through photosynthesis or, conversely, when the burning of

[140] "Natural and Working Lands," United States Climate Alliance, accessed July 18, 2019, https://www.usclimatealliance.org/nwlands#_ftn1.
[141] United Nations Environment Programme, Emissions Gap Report 2017, "Bridging the Gap – Carbon dioxide removal" (Nairobi, Kenya: 2017), https://www.unenvironment.org/resources/emissions-gap-report-2017.
[142] Maria Janowiak et al., *Considering Forest and Grassland Carbon in Land Management,* General Technical Report WO-95 (Newtown Square, PA: USDA Forest Service, Northern Research Station, June 2017), https://www.fs.fed.us/sites/default/files/fs_media/fs_document/update-considering-forestandgrassland-carbonin-landmanagement-508-61517.pdf.

fossil fuels releases belowground geological carbon reserves to the atmospheric stock. Carbon stored at or near the Earth's surface is most susceptible to fluxes.

Photosynthesis is the key process that enables forests to convert massive amounts of atmospheric carbon to living biomass. Globally, forests comprise fully 92% of biomass, but this is not evenly distributed around the world. Different forest ecosystems store varying amounts of carbon in different places, largely as a result of climate variations.

While one can roughly estimate average values per tree or per acre, it is important to point out that carbon storage and absorption varies widely among different trees and forest types. A tall tree with spreading branches and a wide crown stores much more carbon than an ornamental yard tree or a small tree growing in the forest understory. Because of their higher rates of photosynthesis, fast-growing trees take up more carbon dioxide than ones of similar sizes that are growing slowly. Also, large mature trees generally absorb more carbon than smaller ones even if they are growing slowly because their larger leaf area gives them greater photosynthetic capacity -- an inch of diameter growth on a large tree amounts to much more biomass storage than an inch of growth on a small tree.

Natural lands are increasingly becoming recognized for their unrealized potential to play a much larger role in climate mitigation efforts. A 2017 study by Nature Conservancy scientists on "natural climate solutions" found that natural and working lands have the capacity to provide 37% of the mitigation needed between 2017 and 2030 to keep global temperature rise below 2 degrees Celsius. The researchers examined strategies that are available now and scalable, cost-effective, and provide other benefits to communities. Of all possible pathways to achieve this result, the study found that trees have the greatest potential to cost-effectively reduce carbon emissions. Avoided conversion of forests to other land uses alone represents a quarter of the economic carbon reduction potential.[143] In 2016, the Rhode Island Greenhouse Gas Emissions Reduction Plan prepared by the Executive Climate Change Coordinating Council advised that meeting the state's emissions goals could be compromised by continued loss of forested land and recommended exploring a "no net-loss of forests" policy (p. 22). The 2018 Statewide Climate Resilience Action Strategy identifies forests as a natural system that provides crucial services to communities and recommends that Rhode Island protect remaining forest cover, especially large, unbroken tracts of forested land, and support the development of Forest Management Plans to guide landowners in healthy forest management practices.[144]

Furthermore, the three largest options for increasing the number and size of trees (reforestation, avoided forest loss, and targeted forestry practices) could cost-effectively remove 7 billion metric tons of carbon dioxide annually by 2030. Building on research at the global level, a 2018 study published in *Science Advances* documented the potential of natural systems to mitigate greenhouse gas emissions in the United States. It identified forests as the natural system having by far the greatest carbon absorption and storage capacity, while it notably did not also consider the carbon stored in forest soils.[145] At the global level, a 2019 study published in *Science* by researchers at Swiss University ETH Zurich projects that a massive

[143] Bronson W. Griscom et al., "Natural climate solutions," *Proceedings of the Natural Academy of Sciences of the United States of America* 114, no. 44 (2017): 11645-11650, https://www.pnas.org/content/114/44/11645.
[144] Rhode Island Office of the Governor, *Resilient Rhody*.
[145] Joseph E. Fargione et al., "Natural climate solutions for the United States," *Science Advances* 4, no. 11 (2018), https://advances.sciencemag.org/content/4/11/eaat1869.

effort to restore the world's forests could remove two-thirds of the carbon that is in the atmosphere as a result of human activity (about 205 of a total of 300 billion tons). Such a campaign would involve improving management of degraded forests and replanting formerly forested areas, increasing total forest cover by a third. The researchers report that their data shows global tree restoration to be the most cost-effective way to tackle climate change at a large scale.[146] [147] Forests alone do not offset all the carbon dioxide emissions that are contributing to dangerous levels of climate change, and many strategies must be employed to reduce greenhouse gas emissions and adapt communities to a warmer world. The research shows that healthy forests have a critical role to play among climate solutions.

Rhode Island Forests Store Carbon

In the moist, cool, temperate forest ecosystems such as that of the Northeastern United States and Rhode Island, large amounts of carbon are stored in both the plant biomass and soils (carbon is mostly found in the plants in moist, wet tropical forests, while it is conversely largely concentrated in the soils of boreal forests).

While forest carbon discussions often focus on the aboveground biomass of the live trees that are the most distinctive characteristic of forests, it is important to note that there are other sources that make up important components of the total forest carbon stock. A 2007 literature review and public data analysis from the Forest Guild (now Forest Stewards Guild) reported that on average an acre of Northeastern forests hold 75 metric tons/acre (t/ac) of carbon. Of this total amount, roughly one third of the carbon stored in Northeastern forests is found in aboveground biomass and another third in the soil, respectively. Belowground biomass or roots, standing and fallen dead wood, and leaf litter are also significant contributors to the total forest carbon stock.[148]

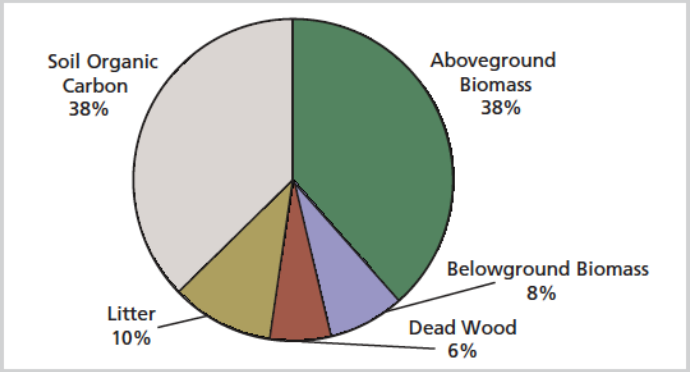

Figure 10: Northeast Forest Carbon Stocks. Source: Forest Stewards Guild

Empirical data and estimates of forest carbon in this report are based on information from the USDA Forest Service's Forest Inventory and Analysis Program (see Appendix A for more information and statistics). There are limitations in "downscaling" forest carbon data specifically to Rhode Island. For one thing, it is impossible to take the state out of its larger regional context. Secondly, statewide FIA data for Rhode Island in particular is based on a limited number of sample plots due to its small geographic area. The latest data for Rhode Island show that the Northeastern percentages cited above are relatively consistent with data specific to this state, with an average acre of Rhode Island forest across all forest

[146] Robin Chazdon and Pedro Brancalion, "Restoring forests as a means to many ends," *Science* 365, no. 6448 (2019): 24-25, https://science.sciencemag.org/content/365/6448/24.
[147] Mark Tutton, "Restoring forests could capture two-thirds of the carbon humans have added to the atmosphere," CNN, July 5, 2019, https://www.cnn.com/2019/07/04/world/forests-capture-two-thirds-of-carbon-emissions-scn-intl/index.html.
[148] Robert T. Perschel, Alexander M. Evans, and Marcia J. Summers, *Climate Change, Carbon, and the Forests of the Northeast* (Santa Fe, NM: The Forest Stewards Guild, 2007).

types storing 76 t/ac of carbon. Of this total amount, 44% is in aboveground biomass, 35% is in the soil, and the remaining 21% is in the roots, dead wood, and litter.[149] **Overall, Rhode Island forests store an estimated 26.7 million metric tons of carbon (2014).**[150] Putting this number into another context, **the state's forests store an amount of carbon biomass with a volume equivalent to more than 3,300 Olympic-sized swimming pools.**[151]

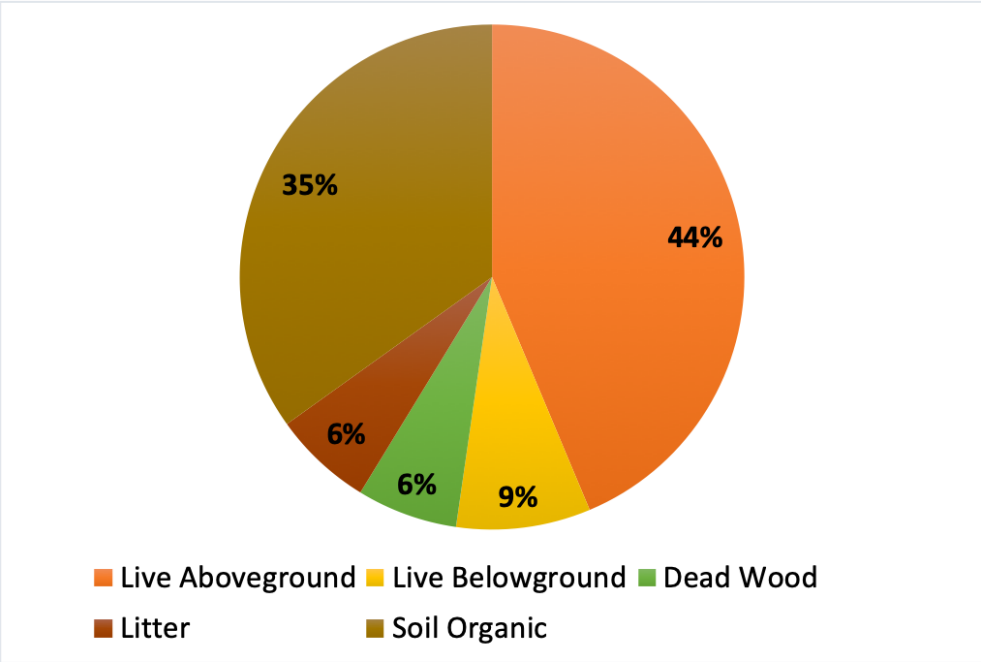

Figure 11: Rhode Island Forest Carbon Storage. *Source: FIA Data*

According to FIA data, five different forest types account for 94% of the carbon stored in Rhode Island's rural and exurban forests. The average carbon density, or storage, for these five forest types covers a range from 75-91 metric tons per acre. The percentage that different carbon pools contribute to the total follows a general pattern but varies among forest types:

[149] USDA Forest Service, Forest Inventory and Analysis Program, "Forest Inventory EVALIDator web-application Version 1.8.0.00" (St. Paul, MN: U.S. Department of Agriculture, Forest Service, Northern Research Station), http://apps.fs.usda.gov/Evalidator/evalidator.jsp.
[150] USDA Forest Service, Forest Inventory and Analysis National Program: Forest Carbon Estimation, "Standard Tables of Forest Carbon Stock Estimates by State: Total" (Spreadsheet link, 2014), accessed July 16, 2019, https://www.fia.fs.fed.us/forestcarbon/index.php.
[151] Todd Ontl, Northern Institute of Applied Climate Science, email message to authors, July 16, 2019.

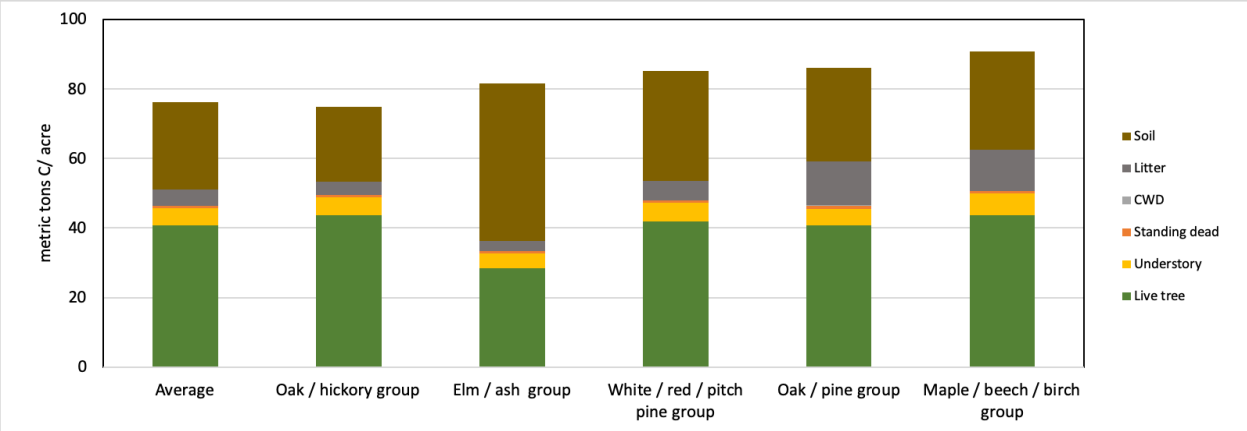

Figure 12: Carbon Density by Forest Type. *Note: Forest type groups are based on national types established by the USDA Forest Service and the names do not always reflect local species assemblages.*

Oak-hickory forests, the most common type in the state, have a mean carbon density of 75 t/acre. Average storage is very close among the elm/ash (82 t/acre) , white-red-pitch pine (85 t/acre), and oak-pine (86 t/acre) types. The maple-beech-birch type forest type represents the upper end of the spectrum, with mean carbon density estimated at 91 t/acre, although the statistical standard error is greater for this type.

Carbon stored in trees will eventually return to the atmosphere after trees die and decompose or are cut and transformed into wood products. Long-lived wood products hold stored carbon for a much longer time period than ones with a short product life cycle: wooden buildings and furniture typically often last for decades or even longer, while wood chips burned for energy and most paper products are typically in storage or use only for a short time.

Northeastern forest soils are a highly important but often overlooked pool of carbon. Minimizing heavy soil disturbance and conversion to other land uses is key to maintaining carbon storage in forest soils. The FIA data for Rhode Island indicates an average of 5 t/acre in leaf litter and 26 t/acre stored in soil organic matter. Mineral soils underlying the carbon-rich organic layer also contain significant carbon but are more difficult to access and less thoroughly studied. Heavy disturbance and conversion of forests to other land uses generally unlocks carbon stored in the soil.[152] It is worth noting that trees dying in the forest as a result of natural causes or disturbances also release carbon. For this reason, carbon stored in soils, as opposed to the wood of living trees, is desirable from a management perspective in that soils are more stable over time and therefore carbon can be locked away for hundreds to thousands of years instead of the life spans of trees.[153] Recent research is not yet conclusive on how elevated atmospheric carbon levels affect carbon cycling and soil carbon loss in forests.

[152] In a study exploring whether clearcutting changes the strength of the chemical bonds of carbon stored in mineral soils in a birch-beech-maple forest in Northern New England, researchers found that clearcutting has an effect of mobilizing the carbon, making it more likely to leave the soil and end up in the atmosphere. Another study of hardwood forests in different geographic areas of the Northeast suggested that intensive logging does not immediately send carbon stored in a forest's mineral soils into the atmosphere, but triggers a gradual release that may continue over decades: Chelsea L. Petrenko and Andrew J. Friedland, "Mineral soil carbon pool responses to forest clearing in Northeastern hardwood forests," *Global Change Biology Bioenergy* 7, no. 6 (2014): 11283-1293.

[153] Richard P. Phillips et al., "Roots and fungi accelerate carbon and nitrogen cycling in forests exposed to elevated CO2," *Ecology Letters* 15, no. 9 (2012): 1042-1049, https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1461-0248.2012.01827.

Rhode Island Forests Sequester Carbon

Plants and trees' ability to photosynthesize enables them to perform a highly valuable climate service: removing carbon that is already in the atmosphere. Representatives of the U.S. Climate Alliance, the coalition of states including Rhode Island that is committed to upholding the objectives of the 2015 Paris climate agreement, have noted research findings that even if all fossil fuel emissions and all other heat trapping gases were to cease being emitted into the atmosphere, temperatures close to the emissions peak will persist for the next millennium.[154]

The graphic below illustrates the components of the U.S. carbon cycle (2016 estimates) in the context of fossil fuel emissions (2015 estimates from EPA). **Based on this data, carbon sequestration in American forests offsets 15% of total U.S. fossil fuel emissions from all sectors including power, transportation, industrial, residential, and commercial sources.[155]** Overall, the forests of the Northeastern United States are generally recognized for their ability to sequester or offset 10-20% of annual carbon emissions from the region and therefore reduce both the rate and effects of climate change.[156] [157]

[154] Susan Solomon et al., "Irreversible climate change due to carbon dioxide emissions," *Proceedings of the Natural Academy of Sciences of the United States of America* 106, no. 6 (2009): 1704-1709.
[155] Christopher W. Woodall et al., *The U.S. Forest Accounting Framework: Stocks and Stock Change, 1990-2016* General Technical Report NRS-154 (Newtown Square PA: USDA Forest Service, Northern Research Station, November 2015 draft in publication).
[156] Duncan C. McKinley et al., "A synthesis of current knowledge on forests and carbon storage in the United States," *Ecological Applications* 21, no. 6 (2011): 1902-1924, https://www.fs.fed.us/rm/pubs_other/rmrs_2011_mckinley_d001.pdf.
[157] Michael G. Ryan et al., *A Synthesis of the Science on Forests and Carbon for U.S. Forests*, Ecological Society of America Issues in Ecology, Report No. 13 (Spring 2010).

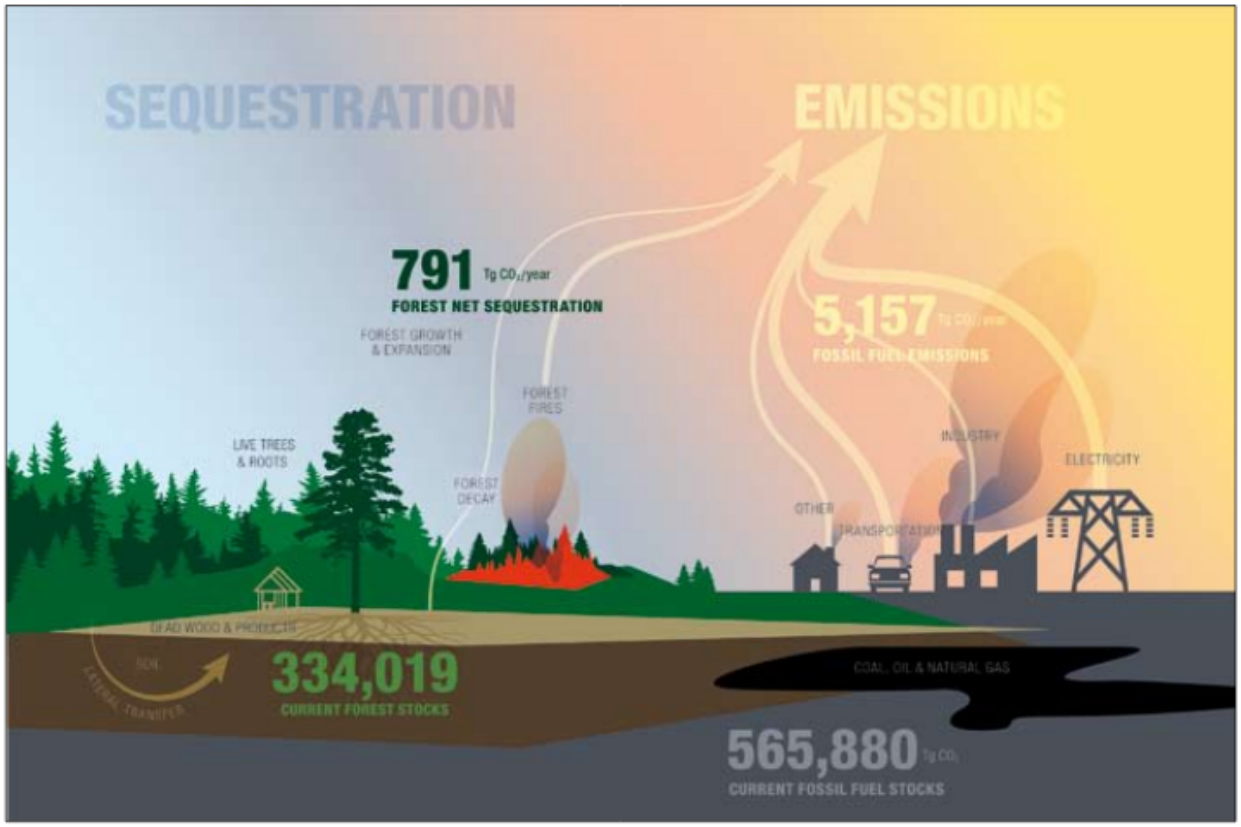

Figure 13: Components of the U.S. forest carbon cycle (2016 estimates) in the context of fossil fuel emissions (2015 values for fuel emission estimates from U.S. EPA). *Source: Woodall et al.*

When it comes to carbon sequestration, the average acre of Rhode Island forest absorbs 1.3 metric tons of carbon per year from the atmosphere. **The 368,000 acres of forestland in Rhode Island sequester nearly 500,0000 metric tons of carbon dioxide each year. Collectively, Rhode Island's forests offset the annual emissions of more than 100,000 passenger vehicles each year** (the U.S. Environmental Protection Agency estimates that an average car has a fuel economy of 22 miles per gallon and drives 11,500 miles per year[158]), equivalent to a significant percentage of Rhode Island passenger vehicle emissions. Available transportation statistics indicate that nearly 429,000 automobiles (not including buses, trucks, etc.) were registered in Rhode Island in 2016,[159] which suggests that the state's forests are capable of offsetting roughly a quarter of the annual emissions of the state's passenger vehicle fleet.

Among the same top five forest types, oak-pine has the highest rate of sequestration (1.8 t/acre/year), followed by oak-hickory (1.5 t/acre/year, closest to the statewide average), and elm/ash and white-red-pitch pine (both 1.1 t/acre/year). The data for the maple-beech-birch type show the lowest rate at 0.3 t/acre/year.

[158] U.S. Environmental Protection Agency, Office of Transportation and Air Quality, "Greenhouse Gas Emissions from a Typical Passenger Vehicle," EPA-420-F-18-008 (March 2018), https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle.
[159] "Number of registered automobiles in Rhode Island in 2016, by type," Statista.com, accessed July 16, 2019, https://www.statista.com/statistics/196068/number-of-registered-automobiles-in-rhode-island.

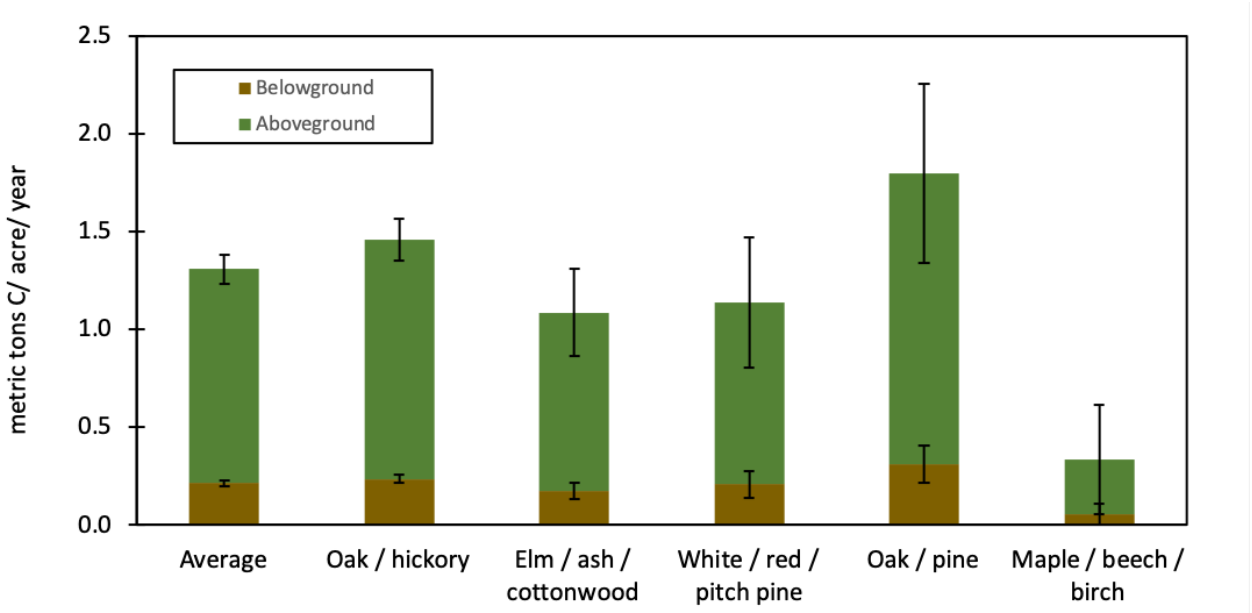

Figure 14: Annual Carbon Sequestration by Forest Type. *Source: FIA Data*

The FIA data also show that carbon sequestration rates in Rhode Island are relatively even across age classes for forests greater than 10 years old, noting that data for forests greater than 120 years old is based on limited plot data:

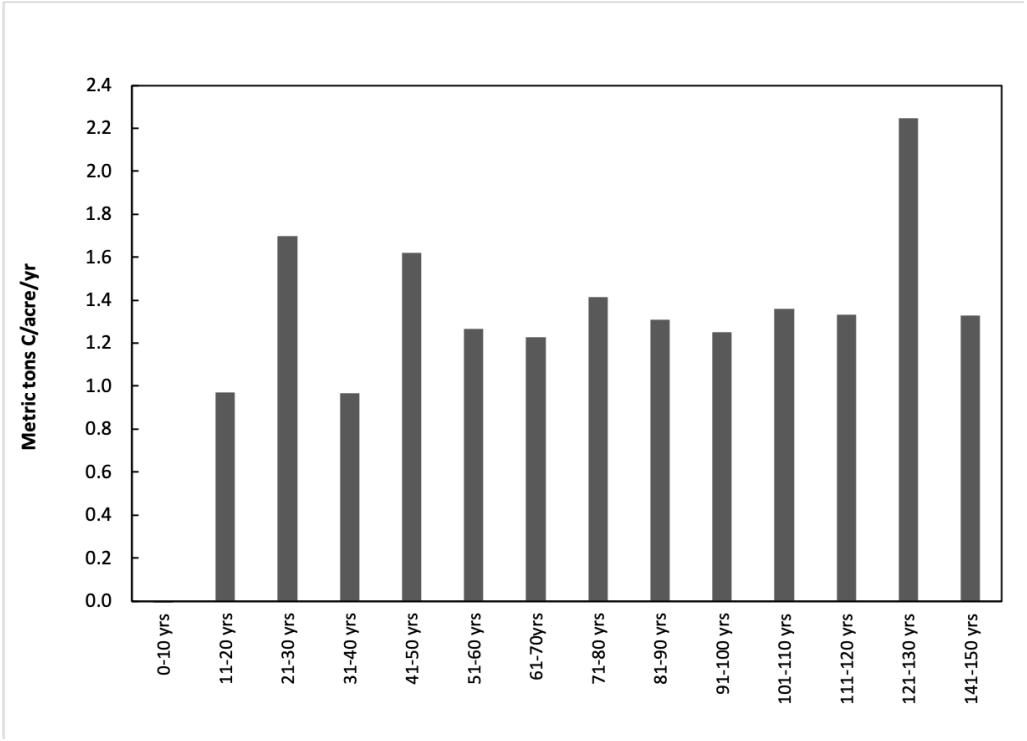

Figure 15: Annual Carbon Sequestration by Age Class. *Source: FIA Data*

Of course, different forest types and age classes are not separated but rather are typically intermingled across the Rhode Island landscape. Across all types and ages, forests on productive growing sites generally have higher levels of carbon storage and absorption than poor sites because of the larger trees and higher amount soil organic matter that providing nutrients to support higher growth rates at these sites. Also, forested wetlands are sometimes overlooked as "forests" but they are notable for their high levels of carbon storage.

Because forests support healthy communities in many ways while absorbing carbon dioxide, conserving forests is a critical strategy for climate change mitigation and adaptation. Maintaining forests should be valued as a critical piece of the state's strategy to combat global warming, especially given the many values forests provide concurrently with their climate change mitigation effects.

Human Health and Well-Being

Rhode Island's forests have a positive impact on human health. In addition to supporting clean air and water as discussed in the previous sections, forests have been connected to mental health support and stress reduction, the provision of outdoor recreation opportunities, and the ability of forests to provide safer and more comfortable human spaces. Many of the worst impacts of environmental pollution – air pollution, water quality and flooding concerns, dangerous urban heat, and the frontline impacts of climate change – disproportionately impact low-income communities. Planting trees and conserving forests in low-income areas can maximize the benefits of trees where people most need them.

Trees Support Physical & Mental Health

Forests support positive mental health outcomes in children, adults and the elderly. Numerous studies have linked time in and proximity to natural environments to reduced levels of depression and stress. These include:

- Studies have shown that walking in forested areas result in lower levels of anxious and depressive feelings. One research group has found that forest walks are associated with "a 12.4-percent decrease in the stress hormone cortisol, a 7-percent decrease in sympathetic nerve activity, a 1.4-percent decrease in blood pressure, and a 5.8-percent decrease in heart rate";[160]
- Studies show a correlation between the proximity of communities to green space and lower levels of mental illness;[161]
- In Japan, organizations have sprung up to encourage positive mental health outcomes through interaction with forests under the banner of "forest therapy" or "forest bathing." This practice involves meditative walks through wooded areas;[162] and
- Studies of children with attention-deficit disorder show that contact with nature helps children better manage their symptoms and focus their attention.[163]

[160] USDA Forest Service, *Urban nature for human health and well-being: a research summary for communicating the health benefits of urban trees and green space*, FS-1096, Washington, D.C.: GPO, 2018.
[161] USDA Forest Service, *Urban nature for human health and well-being.*
[162] USDA Forest Service, *Urban nature for human health and well-being.*
[163] USDA Forest Service, *Urban nature for human health and well-being.*

This ecosystem service of mental health support is critically needed in Rhode Island. Mental health statistics show that there are unmet needs for mental health support in the state, including:

- Rhode Island is spending more than the national average on behavioral health services as a percentage of state GDP, but adults in the state report unmet behavioral health needs at a higher rate than adults in other New England states;[164]
- Children in Rhode Island are at a greater risk for developing mental health and substance use disorders than children in other New England states;[165]
- 29% of Rhode Island high school students (grades 9-12) have experienced depression symptoms and 16% have seriously considering attempting suicide in the past year;[166]
- According to 2011 statistics from the Center for Disease Control, 11.1% of children in Rhode Island currently have attention-deficit disorder (ADD) or attention-deficit/hyperactivity disorder (ADHD) according to parent reports, ranking Rhode Island 11th among U.S. States.[167]

Many studies have connected natural environments with better physical health. Studies have connected the presence of green space with increased physical activity and have shown that people exercising in natural spaces can do so longer and at greater intensities.[168] One study used the incidence of widespread tree death caused by emerald ash borer to assess the connection between nature and human health. The emerald ash borer has killed over 100 million trees in the United States and Canada, leaving many streets and parks bare that were once lined with trees. A study of human health in places impacted by this outbreak found increased human mortality rates in counties most impacted by tree mortality. Even after controlling for socio-economic factors, the study found an association between the loss of trees to the emerald ash borer and an increase in deaths from cardiovascular diseases and lower respiratory tract illnesses.[169] Forests also harbor vast reserves of plant and fungal species with medicinal properties that support human health. Trees, plants, and mushrooms native to New England forests have long been used for medicinal purposes, and scientific research is increasingly substantiating the health benefits associated with these traditional uses.[170]

Forests play an important role in outdoor recreation throughout the state, which supports both physical exercise and mental health. When surveyed for the *Ocean State Outdoors*, 75% of Rhode Islanders considered RIDEM's operation of state park areas to be "very important." Forests support many of the recreational activities that Rhode Islanders reported engaging in: nature watching (31%), hiking (14%), overnight camping (17%), hunting (3%), off-road vehicle driving (4%) and equestrian trails (5%).[171] Rhode Islanders most often participate in the outdoor activities that are simplest to engage in, including

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[164] Rhode Island Department of Health, Executive Office of Health and Human Services, *Rhode Island Behavioral Health Project: Final Report,* by Truven Health Analytics, submitted September 15, 2015.
[165] Rhode Island Department of Health, *Rhode Island Behavioral Health Project: Final Report*.
[166] Centers for Disease Control and Prevention, Youth Online, "1991-2017 High School Youth Risk Behavior Surveillance System data," (Data viewer), 2017, accessed August 26, 2019, https://nccd.cdc.gov/Youthonline/App/Default.aspx.
[167] "State Profile: Rhode Island" (pdf) from *Trends in the Parent-Report of Health Care Provider-Diagnosis and Medication Treatment for ADHD: United States, 2003—2011,* Centers for Disease Control and Prevention and Health Resources and Services Administration, accessed on March 17, 2019, https://www.cdc.gov/ncbddd/adhd/prevalence.html.
[168] USDA Forest Service, *Urban nature for human health and well-being*.
[169] G.H. Donovan et al., "The relationship between trees and human health: evidence from the spread of the emerald ash borer," *American Journal of Preventative Medicine* 44, no. 2 (February 2013):139-45, doi: 10.1016/j.amepre.2012.09.066
[170] Eeva Karjalainen, Tytti Sarjala, and Hannu Raito, "Promoting human health through forests: overview and major challenges," *Environmental Health and Preventative Medicine* 15 (2010): 1-8.
[171] Rhode Island Department of Administration Division of Planning and Rhode Island Department of Environmental Management, *Ocean State Outdoors*, 3.12.

walking in natural environments. In a 2003 survey, 59% of RI forestland owners reported that their properties are used for recreation, including hunting, fishing, and horseback riding.[172] Urban forests and trees allow city residents to connect with nature without having to leave the city. Studies have shown that urban residents appreciate the presence of birds and other wildlife in their day-to-day lives.[173] (The economic benefits of recreation opportunities provided by forests will be discussed in a following section.)

In Rhode Island, the Rhode Island Land Trust Council has a program that encourages people to take walks and spend time outdoors in nature for their health. The Council is partnering with the healthcare community to "prescribe" walks through this "Park Rx" program. The Institute at the Golden Gate in San Francisco was one of the pioneers of this strategy for using parks and other open space lands as a community asset for improving community health.[174] The RI Land Trust Council is implementing this program to raise awareness about the connection between forests in other natural areas and human health.[175] In *Ocean State Outdoors*, 56% of Rhode Islanders indicated that participating in outdoor activities was very important to their health.[176]

Supporting the restoration and maintenance of forests and green spaces is a promising strategy for improving the state landscape of human mental and physical healthcare. Providing access to green spaces to all Rhode Islanders is necessary to ensure these benefits are distributed equitably – numerous studies have shown that it is more difficult for communities marginalized by racial and socioeconomic conditions to access green spaces.[177] The same report that found Rhode Island children are at a higher risk for developing mental health disorders than children in other New England states also recommended that Rhode Island should shift mental health treatment away from costly, reactive services and towards evidence-based, community-centers strategies for preventing and managing mental health care.[178] Given the many values that forests and other green spaces provide to our communities, maintaining forests to support mental well-being should be part of such a community-centered health care strategy.

Trees Cool Urban Spaces

Forest cover makes urban areas cooler and more comfortable places to live in hot weather. High temperatures are associated with negative health impacts, including heat cramps, heat exhaustion, heat stroke, and even heat-related death. The "heat index" is a measure of the combined effects of temperature and humidity on the human body. When the humidity is high, the temperature feels hotter and makes the human body more susceptible to heat disorders.[179] Data from the Rhode Island Department of Health shows that this relationship between extreme heat and negative health outcomes is borne out at the state level – emergency department and hospital visits spike as temperatures increase (see Figure 16). Urban

[172] RI Department of Environmental Management, *A Path to Tomorrow's Forests*.
[173] Rhode Island Department of Statewide Planning, *Rhode Island Urban and Community Forestry Plan*, State Guide Plan Element 156 (Providence: GPO), May 1999.
[174] "Park Rx," Institute at the Golden Gate, accessed April 20, 2019, http://parkrx.org.
[175] Rupert Friday, RI Land Trust Council, personal communication, June 16, 2019.
[176] Rhode Island Department of Administration Division of Planning and Rhode Island Department of Environmental Management, *Ocean State Outdoors*.
[177] USDA Forest Service, *Urban nature for human health and well-being*.
[178] Rhode Island Department of Health, *Rhode Island Behavioral Health Project: Final Report*.
[179] "Heat Index," NOAA National Weather Service, accessed July 2, 2019, https://www.weather.gov/safety/heat-index.

areas are often warmer than surrounding areas in a phenomenon known as the "urban heat island effect," a term used to describe the warming that occurs in metropolitan areas when heat is trapped by impervious services and energy-absorbing materials.[180] One study of eastern U.S. cities projects a ten-fold increase in heat related deaths between 2002-2004 and 2057-2059.[181]

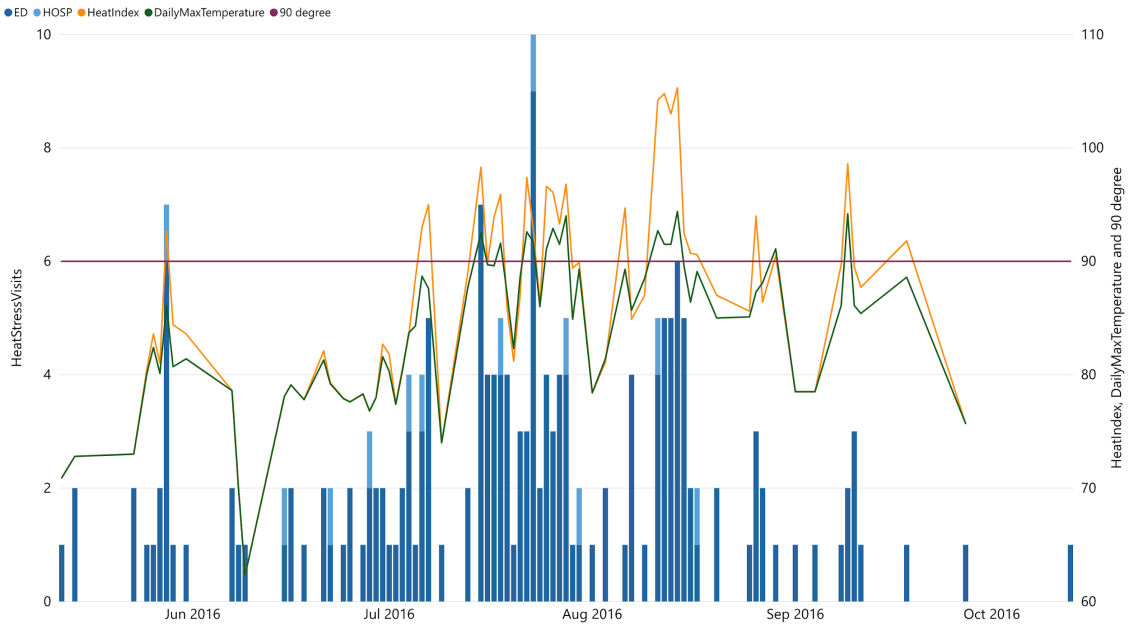

Figure 16: Rhode Island Heat Index Compared to Emergency Room and Hospital Visits. *Source: RIDOH: http://www.health.ri.gov/data/heatstress/index.php*

Trees and other vegetation provide measurable cooling effects through transpiration – the evaporation of water from plant leaves.[182] In order for water from plant leaves to be converted into vapor, heat is absorbed from the atmosphere, causing a temperature decrease. A large tree can transpire as much as 100 gallons per day – in a hot, dry climate, this provides the cooling equivalent of running five air conditioners for 20 hours.[183] Trees also provide heat relief through shading. One study estimates that there is a 2 degrees F reduction in ambient air temperature for every 10% increase in urban tree canopy.[184] A 2002 report by the National Aeronautics and Space Administration (NASA) used satellite imagery to demonstrate the relationship between acute heat island effects and vegetation, and results for Providence, RI display the expected inverse relationship between temperature and vegetation (see Figure 17). By lowering air temperature, trees and vegetation in parks also reduce energy needs for cooling in homes and

[180] USDA Forest Service, *Urban nature for human health and well-being*.
[181] Jianyong Wu et al., "Estimation and Uncertainty Analysis of Impacts of Future Heat Waves on Mortality in the Eastern United States," Environmental Health Perspectives 122, no. 1 (2014), https://ehp.niehs.nih.gov/doi/10.1289/ehp.1306670.
[182] "Evapotransporation and the Water Cycle," accessed July 15, 2019, https://www.usgs.gov/special-topic/water-science-school/science/evapotranspiration-and-water-cycle.
[183] Panagiotis Gkatsopoulos, "A Methodology for Calculating Cooling from Vegetation Evapotranspiration for Use in Urban Space Microclimate Simulations," *Procedia Environmental Sciences 38* (2017): 477-484.
[184] Wolf 2008 as cited in USDA Forest Service, *Urban nature for human health and well-being,* 24.

surrounding buildings.[185] A 2003 study of the cooling effects of existing trees in California found that these trees reduced peak electricity demand to save utilities $778.5 million annually or $4.39/tree.[186]

Since 2012, RIDEM and the Arbor Day Foundation have partnered to deliver the State's Energy-Saving Trees program. This popular program funds the annual distribution of 1,000 tree saplings to homeowners to help them conserve energy, reduce utility costs, and help manage stormwater runoff while beautifying their neighborhoods.[187]

Low-income communities are often most acutely impacted by the urban heat island effect.[188] The Rhode Island Department of Health Climate Change Program partnered with Health Equity Zones in 2019 to identify places in the state's Health Equity Zones with an above average risk for heat-related illness during extreme heat events. This understanding of where increased temperatures will most impact human health can direct resources and outreach to these communities. Planting more trees in these communities can be part of a suite of solutions to address the dangerous effects of extreme heat.[189]

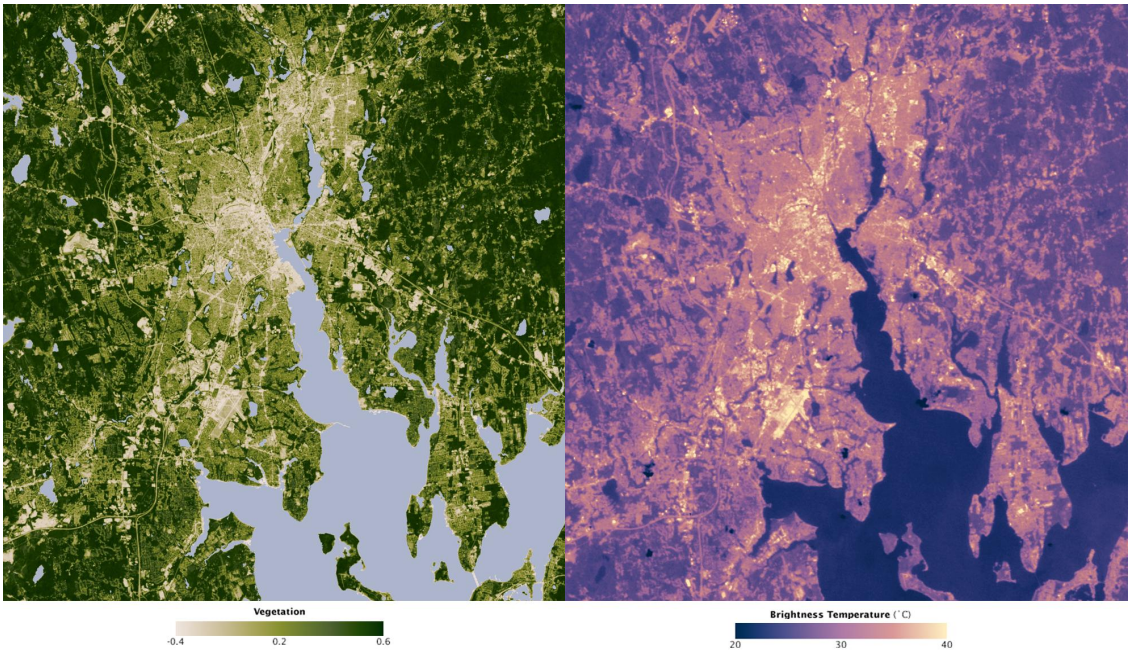

Figure 17: Satellite Images of Vegetation and Temperature in Providence, Rhode Island. *Source: NASA*[190]
(Left Image: Vegetation in Providence. Right Image: Temperature in Providence.)

[185] USDA Forest Service, *Sustaining America's Urban Trees and Forests*, General Technical Report NRS-62 (Newtown Square, PA: Northern Research Station, June 2010).
[186] E. Gregory McPherson and James R. Simpson, "Potential energy savings in buildings by an urban tree planting programme in California," *Urban Forestry & Urban Greening* 2 (2003): 73-86, https://www.fs.usda.gov/treesearch/pubs/48730.
[187] Press Release: "Just In Time for Spring Planting, Free Trees Available Soon," RI.gov, accessed July 16, 2019, https://www.ri.gov/press/view/35602
[188] USDA Forest Service, *Urban nature for human health and well-being.*
[189] Rhode Island Department of Health, "Extreme Heat Impacts in Rhode Island Health Equity Zones," (ArcGIS Story Map), accessed August 26, 2019, https://cgdc.maps.arcgis.com/apps/MapSeries/index.html?appid=d28cefb1d11044cc87adfb0f83be38db.
[190] "Satellites Pinpoint Drivers of Urban Heat Islands in the Northeast," National Aeronautics and Space Administration, last modified December 13, 2010, https://www.nasa.gov/topics/earth/features/heat-island-sprawl.html.

Trees Absorb Stormwater

Green spaces protect urban communities from flooding by absorbing stormwater that accumulates on city streets. Most urban communities are covered in pavement and other impervious surfaces. A look at two Rhode Island cities, Newport and Providence, show the extent to which impervious surfaces have taken over the city floor (See Figure 18). This causes water from rain or overflowing waterways to collect on streets and in parking lots, sweeping trash, fertilizers and pesticides from lawns, oily residues from cars, and other refuse from our streets and into city storm drains. When there are big storms, city storm drains can overflow and send untreated water, with all of its collected pollutants, into local waterways (see the previous section "Clean Water"). Big rainfall events also cause damaging floods in areas with too few places for the water to drain.[191] With climate change predicted to make precipitation events more frequent and intense in Rhode Island, impervious surfaces will create community safety challenges.[192] Green infrastructure, including tree plantings, is a vital part of keeping Rhode Island communities safe. Community planners and private landowners can plant rain gardens and protect and expand local green spaces to restore the natural cycling of water into the soil and back into the water table.[193]

A dynamic urban example is provided by the lower Woonasquatucket River, where the river corridor flows through a densely developed landscape featuring a high percentage of impervious hardscape. Following heavy rains in 2010, the lower river valley experienced dramatic flooding that led to evacuations, property damage, and loss of business. A prominent component of the Woonasquatucket Vision Plan, a recent project of the City of Providence and the Woonasquatucket River Watershed Council, is to fully develop the potential of green infrastructure along the river, including trees and vegetation to improve natural capacity to absorb the impact of future storms.[194] [195]

[191] Jim Boyd, "Stormwater Management in the Rhode Island Coastal Zone," (presentation, *Environmental Business Council of New England,* 2013), http://www.greeninfrastructureri.org/documents/CRMC_Stormwater_Management.pdf.
[192] Rhode Island Office of the Governor, *Resilient Rhody*.
[193] "Lessons in Water Cycling: Green Infrastructure in Providence, Rhode Island" (video), Green Infrastructure Coalition, accessed June 10, 2019, https://www.youtube.com/watch?v=OApAaAvDc3g.
[194] "River Restoration & Protection," Woonasquatucket River Watershed Council, accessed July 16, 2019, http://wrwc.org/restoration.php.
[195] City of Providence, Department of Planning and Development, "Woonasquatucket Vision Plan," July 2018, http://www.providenceri.gov/planning/woonasquatucket.

Figure 18: Impervious Surfaces in the centers of Providence and Newport. Impervious surfaces on these maps of Providence and Newport are highlighted in red. *Source: From RI GIS, data from 2003-2004 and 2011. Available at https://www.arcgis.com/home/webmap/viewer.html?webmap=a5d0ee6edbfc4dd3962579c9def9dd2e*

Cultural Value

Forests have a cultural importance to human communities in Rhode Island. Cultural values emerge from the interaction of human belief systems, practices, and values associated with forested landscapes. This is a unique value, in that human culture imbues forests with meaning and importance that would not exist in the absence of people.[196] Understanding the cultural value of forested land is critical to assessing and fully appreciating the roles forests play in Rhode Island communities.

In Rhode Island, the clearest example of a cultural relationship to forests is held within the indigenous community. In the context of the relationship between indigenous people and the land, cultural resources are defined as "environments, conditions, practices, places, plants, and animals that are of significance to a particular tribe's culture" in a report authored by California tribal leaders.[197] Indigenous peoples have lived in and among the forests encompassed by the state of Rhode Island for thousands of years, managing the forest for ceremonial purposes, food, and key medicinal resources. Indigenous people's relationships to the diverse lands and waters within Rhode Island have been challenged by colonial practices designed to exterminate and marginalize them. Tribal members have lost access to and management authority over most of their traditional lands. Yet, members of the Narragansett Tribe, the federally-recognized tribe in the state of Rhode Island, continue to utilize and maintain a cultural connection to forest resources in 2019.

Rhode Island's forests continue to be used by the Narragansett Tribe as places to gather resources used for food, medicine, and culturally significant ceremonies. Cassius Spears Jr., a council member of the Narragansett Tribe and a conservationist with the USDA Natural Resources Conservation Service, explains the holistic way that tribes value forestland. "In our creation story, the Creator made the first Narragansetts from the earth as a tree...we look to trees to tell us our origins," Spears Jr. says. "When clear cuts or developments are completed, we don't just think about carbon sequestration or other ecosystems services lost... but thousands of years of stories, relations, and substance that was held within those landscapes. This is who we are."[198] These landscapes have names, songs, and ceremonies held by Narragansett people, many landscapes hold prayers and memories of long ago in every stone, flower, or leaf. From the willow bark to birch sap, from elderberry to pine needle tea, from white acorn meal to medical mushrooms, from the ash splints to the maple burls, these landscapes do not just offer gifts to Narragansett people, they are members of their community and can be considered sacred.[199]

It has been a challenge for members of the Narragansett Tribe to access lands from which they have traditionally gathered. The Tribe's reservation in Rhode Island includes roughly 1,800 acres of forested land. This is a mere fraction of the historical territory held by the Narragansetts that once encompassed all of Rhode Island and went into surrounding states. The Tribe's ability to maintain these inherent

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[196] Melissa M. Kreye et al., "Forest ecosystem services: Cultural values," in: *Trees at work: economic accounting for forest ecosystem services in the U.S. South,* General Technical Report SRS-226 (Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station), 2017, https://www.nrs.fs.fed.us/pubs/55804.
[197] Ron Goode et al., *Summary Report from Tribal and Indigenous Communities within California, California's Fourth Climate Change Assessment*, September 28, 2018, http://www.climateassessment.ca.gov/state.
[198] Cassius Spears Jr., USDA NRCS Conservation Biologist and Councilmember of the Narragansett Tribe, personal communication, March 21, 2019.
[199] Spears Jr., personal communication.

relationships between people and land has become more and more difficult to practice due to public misunderstandings, limited access, or property restrictions.[200]

Indigenous value of the forest should be acknowledged and respected alongside other forest values. Involving tribal members in projects and plans that impact their traditional landscapes can help incorporate cultural values into current decision-making, allowing policies to reflect the cultural value of forests in addition to other forest values. Supporting indigenous values of forests also leads to positive ecological outcomes. Much "traditional ecological knowledge" (TEK) – a term used to describe knowledge of the environment that has been passed down within indigenous communities – has proven to promote positive health, biodiversity, and conservation outcomes on landscapes in the United States and around the world.[201] In this region, many northeastern tribes work with the Department of the Interior's Northeast Climate Adaptation Science Center to build tools that will help wildlife and natural resources adapt in the face of climate change.[202]

Non-indigenous Rhode Island communities also cultivate cultural relationships with trees and forests. Many of Rhode Island's rural communities are fundamentally characterized by surrounding forestland. Images of forestland are featured prominently on the town websites of Foster, Burrillville, and Coventry, and many Rhode Islanders move to these towns to live in a rural, wooded setting. It is difficult to imagine many of Rhode Island's rural communities without their forests. Forests bring a "sense of place" to these communities – a meaning and connection between people and their physical environment.[203]

Other forest values detailed in this report overlap with a cultural value of forests. Outdoor recreation in Rhode Island's forests is often connected to a cultural appreciation for the forested landscape in the state, a value beyond measurable mental or physical health benefits that come from a forest hike (See "Human Health and Well-Being"). Rhode Islanders appreciation for forest wildlife can also be considered a cultural value, as expressed through popular activities such as bird watching and hunting (See "Wildlife Habitat" and "Economic Importance"). Large and old trees are also a source of community significance and sense of place. The Rhode Island Tree Council maintains the "Champion Tree Registry" – a database of trees that are culturally, historically, or biologically notable to Rhode Island communities.[204]

A strong cultural relationship between people and forests has positive implications for Rhode Island forestland and the Rhode Island community. Cultural values of forests can change and diminish as they are passed down to future generations unless care is taken to cultivate a relationship between young people and the land.[205]

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[200] Spears Jr., personal communication. Dinalyn Spears, Director of the Natural Resources/Tribal Planning Departments for the Narragansett Tribe, personal communication, April 23, 2019.
[201] M. Kat Anderson, *Tending the Wild – Native American Knowledge and the Management of California's Natural Resources*, (University of California Press, Berkeley, 2005). Goode et al., *Summary Report*.
[202] "Indigenous Peoples and Tribal Partners," DOI Northeast Climate Adaptation Science Center, accessed June 18, 2019, https://necsc.umass.edu/indigenous-peoples-and-tribal-partners.
[203] Daniel R. Williams and Susan I. Stewart, "Sense of place: An elusive concept that is finding a home in ecosystem management," *Forest Science* 96, no.5 (1998): 18-23.
[204] "Helen Walker Raleigh Champion Trees of Rhode Island Registry Program," Rhode Island Tree Council, last updated 2019, https://www.ritree.org/champion-tree-registry/3-helen-walker-raleigh-champion-trees-of-rhode-island-registry-program.
[205] Melissa M. Kreye et al., "Forest ecosystem services: Cultural values," in: *Trees at work: economic accounting for forest ecosystem services in the U.S. South,* General Technical Report SRS-226 (Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station), 2017, https://www.nrs.fs.fed.us/pubs/55804.

Wildlife Habitat

Rhode Island provides unique habitats that support thousands of wildlife species of mammals, birds, reptiles, amphibians, fish and invertebrates, and close to 2,900 plants. Some wildlife species like the common box turtle make Rhode Island their home year-round, while others like the black-and-white warbler migrate to the forests to breed in the spring. According to the 2015 Rhode Island State Wildlife Action Plan (RIWAP), Rhode Island supports 92 species of mammals, 431 species of birds, 306 species of fish (both fresh and saltwater), 26 species of reptiles and 19 species of amphibians.[206] Of those, 454 species are considered Species of Greatest Conservation Need (SGCN) as identified by stakeholders and wildlife specialists through the Wildlife Action Plan planning process, many reliant on Rhode Island's forests for some or all of their life cycles.

Forests Provide Habitat for Wildlife Species

Of the eighty-four key habitat profiles identified in the 2015 RIWAP, twenty forest-dominated habitats types are represented. These habitat types vary from the state's vast oak forests (the most widely distributed habitat type in Rhode Island), to the smaller patches of pitch pine forests and floodplain forests scattered throughout the state. Rhode Island's forested habitats contain features with high values for wildlife, such as high order and cold water streams. Shrubland as defined in the RIWAP has been included in the forest-dominated habitats represented and include critical early successional habitat.[207] When considering the forests of Rhode Island overall, the largest forested tracks, or core forests, support the greatest biodiversity of species throughout the forested landscape.

Not all forest-dependent wildlife have the same habitat requirements and maintaining healthy and diverse populations requires that a range of forest types and age classes are well distributed across Rhode Island's forested landscape.[208] The suitability of forested habitat for wildlife species depends on the forest's composition and structure. Multiple stand sizes and with a range of tree ages including both early and late successional stages are required to provide habitat for all forest-associated species.[209] In addition, habitat features such as standing dead wood or snags, coarse woody material such as branches and tree tops, soft mast (shrubs like raspberry, or sumac), and leaf litter are important to the state's wildlife populations throughout. Some wildlife species only depend on forests for part of their life cycles. Reptiles, such as the wood turtle, use a mixture of diverse terrestrial and aquatic habitat types, nesting in open areas like agricultural fields, and relying on forested wetlands for only part of their life cycle.[210] Other wildlife species rely almost entirely on forests, like fisher, which are found in coniferous forests and mixed forest types throughout their range, using cavity trees for den sites and brush piles for resting sites.[211] Some wildlife species that once relied entirely on forests have grown accustomed to living near people. While there is limited information available on their status and overall numbers in the state, evidence suggests

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[206] Rhode Island Department of Environmental Management, *2015 Rhode Island Wildlife Action Plan.*
[207] The key habitat listed in the RIWAP is Ruderal Grassland/Shrubland, or uplands where the potential natural vegetation is predominantly grasses, grass-like plants, forbs, or shrubs. The shrubland habitat type in this section does not include all grasslands, but only those generally related to old fields and early successional habitat.
[208] RI Department of Environmental Management, *A Path to Tomorrow's Forests.*
[209] Butler et al., *The Forests of Southern New England, 2007.*
[210] RI Department of Environmental Management, *A Path to Tomorrow's Forests.*
[211] Rhode Island Department of Environmental Management, *Fishers in Rhode Island,* accessed May 13, 2019, https://rhodeislandwoods.uri.edu/files/fishers.pdf.

that the American black bear and North American bobcat populations are on the rise, with increased numbers of sightings of these animals each year in rural and suburban areas.[212] [213] [214]

Many species are forest interior dependent and rely on core forests for their habitat requirements. Core forests can be critical for SGCN species and provide connectivity among habitats for wildlife that depend on them for their survival and life processes. Increased development in core forests reduces the size and availability of these habitats to the wildlife species that rely on them. Migrating neotropical bird species are dependent on core forests for breeding and migration and are found only in the spring and summer months. The black-throated green warbler migrates to Rhode Island in the spring, and depends on forests greater than 250 acres with a closed overhead canopy, avoiding forested edges along the way.[215]

Black-throated green warbler. Credit: "budgora," Flickr Creative Commons, 2017, https://flic.kr/p/VY6FNd

Other wildlife species depend on open and shrubby patches or young forests found within larger blocks in the forest interior called early successional habitat.[216] The decline in early successional habitat has created a lack of diversity in forest age classes in Rhode Island and is a critical issue affecting wildlife habitat throughout the northeast.[217] Post-colonization, vast swaths of the New England region were cleared to

[212] Rhode Island Department of Environmental Management, *Living with Black Bears in Rhode Island*, accessed May 13, 2019, http://www.dem.ri.gov/programs/bnatres/fishwild/pdf/bears.pdf.
[213] Alex Kuffner, "Bears, too, finding R.I. a good place to settle down," *Providence Journal*, June 10, 2019, https://www.providencejournal.com/news/20190610/bears-too-finding-ri-good-place-to-settle-down
[214] Eric Halperin, "DEM: Bobcat sightings have doubled in RI since last year" (video), *WPRI.com Eyewitness News*, accessed May 19, 2019, https://www.wpri.com/news/dem-bobcat-sightings-have-doubled-in-ri-since-last-year/.
[215] Judee Burr and Kate Sayles, *Silviculture with Birds in Mind: Birders Dozen Pocket Guide For Rhode Island Foresters* (Providence, RI: Rhode Island Resource Conservation and Development Council, 2019).
[216] Not all early successional habitat is found within the forest interior, but the species discussed in this report rely on early successional habitat that is located in the forest interior.
[217] Burr, *Silviculture with Birds in Mind*.

create farmland; this abandoned farmland became early successional forest habitat in the late 1800s to mid-1900s. Historically, Rhode Island's forests also underwent frequent small-scale disturbances (storms, small fires, lightning strikes), which created these important habitats. Most of these once abundant habitats have matured into second growth forests – with around 5.2% of Rhode Island's forests remaining in shrubland.[218] With the decline of early successional habitat, there has been a marked decline in early successional species such as the New England Cottontail, field sparrows, and whip-poor-wills, all SGCN.[219] An increase in shrub thickets and early successional habitat will greatly benefit an additional 59 species of wildlife in New England, such as woodcock, migratory songbirds, and ruffed grouse.[220] The Rhode Island Department of Environmental Management (RIDEM), Natural Resources Conservation Service (NRCS) and other conservation organizations are committed to increasing the abundance of young forests and early successional habitat through diversifying forest age classes and structure across the forested landscape in Rhode Island.[221]

The size of early successional habitats and young forest patches matter. Certain wildlife species need larger habitat clearings than others. For example, studies show that the New England cottontail's mortality rate is twice as high on early successional habitat patches smaller than 6 acres than it is on patches over 12 acres.[222] American woodcock and ruffed grouse, on the other hand, can thrive in smaller early successional habitat areas of under 5 acres and under 10 acres, respectively.[223]

It important to consider urban forest habitats and their benefits to some wildlife populations as well. While area-sensitive resident species are not found in these areas, urban forests nevertheless play a key role in protecting biodiversity, providing connectivity between habitats, and serving as refuges for generalist wildlife species impacted by development and urbanization, as well as migrant species, both common and uncommon, who need wooded places to rest and refuel. Some species use urbanization to their advantage, with white-tailed deer feasting on shrubs and gardens in suburban areas. Others stop over to snack at bird feeders on their migration routes, like the rose-breasted grosbeak. Parks in cities can provide an urban oasis for wildlife- red foxes and coyotes are a regular site at Roger Williams Park in Providence.[224]

Wildlife Species Provide Benefits to Rhode Islanders

Rhode Island's wildlife resources play a direct and critical role in how the ecosystem functions through the complex services that they provide to humans and the landscape. Pollinators, (which include birds,

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[218] Buffum, *Loss of forest in large unfragmented blocks of forest in Rhode Island.*
[219] DeGraff et al., *Technical Guide to Forest Wildlife Habitat Management in New England.*
[220] "New England Cottontail Rabbit Working Lands for Wildlife," Natural Resources Conservation Service Rhode Island, accessed April 5, 2019, https://www.nrcs.usda.gov/wps/portal/nrcs/detail/ri/programs/financial/eqip/?cid=nrcseprd328593.
[221] Bill Buffum, University of Rhode Island; Gary Casabona, Natural Resources Conservation Service; Amanda Freitas, Rhode Island Natural History Survey; and Tanner Steeves, Rhode Island Department of Environmental Management, email communications, August 19-21, 2019.
[222] Margaret Arbuthnot, *A Landowner's Guide to New England Cottontail Habitat Management*, U.S. Fish & Wildlife Publications and the Environmental Defense Fund, 2008, https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1371&context=usfwspubs.
[223] Brian Tefft. *Best Management Practices for American Woodcock and Ruffed Grouse in Rhode Island,* Rhode Island Department of Environmental Management, Division of Fish and Wildlife, 2010, http://www.dem.ri.gov/programs/bnatres/fishwild/pdf/grousbmp.pdf.
[224] Rhode Island Department of Administration Division of Planning and Rhode Island Department of Environmental Management, *Ocean State Outdoors.*

moths, butterflies, wasps, flies and most obvious, bees) are a critical example of the benefits of whole ecosystem processes- by feeding on plant nectar, they move pollen from one plant to the next providing a function critical in the reproduction process of countless plants including those important to human food systems. According to the Food and Agriculture Organization of the United Nations, three out of four crops across the globe producing fruits or seeds for human use as food depend, at least in part, by pollinators.[225]

Other wildlife species are beneficial to people in Rhode Island. Through their movements and droppings, birds, mammals and insects disperse seeds. Squirrels inadvertently plant oaks and other nut trees by burying them for the winter and forgetting about them. All bat species in Rhode Island and New England are insectivores.[226] A bat can consume nearly 50% of its body weight in insects in a single night, and are the only major predators of night flying insects.[227] Scavengers, like the turkey vulture, clean up roadsides by consuming road killed animals.

Other mammals consume massive quantities of insects or rodents that humans deem as nuisances. Opossums have been called "nature's little sanitation engineer," because of their diverse diet, including insects, beetles, ticks, and road kill, keeping neighborhoods clean and free of unwanted, harmful garden pests and rodents.[228] The National Wildlife Federation calls opossums the unsung heroes in the fight against ticks and Lyme disease, with an individual possum consuming up to 5,000 ticks a season.[229]

Studies have shown that wildlife improves mental health, and that outdoor recreation including wildlife viewing can alleviate symptoms of stress, anxiety and depression. Surveys have shown that most city dwellers enjoy and appreciate wildlife in their day-to-day lives.[230] A 2017 study by the University of Essex shows that volunteers on wildlife projects benefit from a boost to their mental health, tracking volunteers across England on projects run by the organization The Wildlife Trusts. Surveys of participants showed that more than half who started with low mental wellbeing had improved over twelve weeks, two-thirds of all participants noticed improved wellbeing within six weeks.[231]

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[225] "The Importance of Bees and Other Pollinators for Food and Agriculture," Food and Agriculture Organization of the United Nations, accessed May 10, 2019, http://www.fao.org/3/I9527EN/i9527en.PDF.
[226] Rhode Island Department of Environmental Management, *Bats of Rhode Island* (factsheet), accessed May 10, 2019, http://www.dem.ri.gov/programs/bnatres/fishwild/pdf/bat.pdf.
[227] Rhode Island Department of Health and the Rhode Island Department of Environmental Management, *Bats: What You Should Know,* accessed May 10, 2019, https://www.maine.gov/dacf/php/gotpests/othercritters/factsheets/bats-ri.pdf.
[228] "Wildlife Species," Rhode Island Woods, accessed May 13, 2019, https://rhodeislandwoods.uri.edu/wildlife/wildlife-species/.
[229] "Opossums: Unsung Heroes in the Fight Against Ticks and Lyme Disease," National Wildlife Federation Blog, accessed May 13, 2019, https://blog.nwf.org/2017/06/opossums-unsung-heroes-in-the-fight-against-ticks-and-lyme-disease.
[230] William W. Shaw, "Residential enjoyment of wildlife resources by Americans," *Leisure Sciences* 7(3) (1985): 361-375.
[231] Mike Rogerson, Jo Barton, Rachel Bragg and Jules Pretty, *The health and wellbeing impacts of volunteering with The Wildlife Trusts* (Colchester, England: University of Essex, June 2017), https://www.wildlifetrusts.org/sites/default/files/2018-05/r3_the_health_and_wellbeing_impacts_of_volunteering_with_the_wildlife_trusts_-_university_of_essex_report_3_0.pdf.

III. Strategies for Promoting Forest Conservation

Conserving Rhode Island's forests is an investment for future generations. A suite of adaptable strategies can be used to incorporate conservation principles into decision-making that impacts forestland, including: strengthening funding sources for conservation; supporting forest acquisition for conservation; creating incentives for private landowners to conserve forests; exploring market-based incentives for conservation; enforcing conservation principles within state and local planning processes; managing forestland to provide multiple benefits; and providing technical assistance and education to private forest landowners. Each of these strategies is explored in the sections to follow.

1) Dedicate Funding to Forest Conservation & Management

Federal Funding for Forest Conservation & Management

The **Land and Water Conservation Fund** (LWCF) provides the majority of federal conservation funding to New England states. The LWCF was created in 1964 using funding from royalties paid by energy companies for drilling oil and gas in all 50 states as a bipartisan effort to conserve land, protect natural heritage and provide recreational opportunities.[232] One of the main programs that the LWCF supports is the Forest Legacy Program under the USDA Forest Service (USFS). With broad bipartisan support, the Conservation, Management and Recreation Fund approved permanent funding of the LWCF and was signed into law in March 2019.

The **Forest Legacy Program** is funded by the LWCF and administered by the USFS through the Farm Bill to protect important forestlands threatened by development. Through this program, USFS purchases conservation easements at 75% of the fair market value from willing landowners who plan to continue managing their forestland. The Forest Service has acquired the development rights to twenty-two tracts in Rhode Island, totaling 3,583 acres.[233] Funding for Forest Legacy is competitive and Rhode Island Department of Environmental Management (RIDEM) prepares and submits Rhode Island's proposals to the Forest Service.

The Natural Resources Conservation Service (NRCS) provides funding and technical assistance to non-industrial private forest landowners to manage their forested land on a voluntary basis. NRCS provides funding for the development of forest management plans and the implementation of those plans to landowners interested in conserving their forest resources. NRCS also provides forest-specific easement opportunities through the Healthy Forests Reserve Program and the Wetlands Reserve Easements Program, held by private forest landowners who have agreed to manage their land in perpetuity. The Agricultural Conservation Easement Program (ACEP-ALE) provides funding through NRCS for conservation easements on farms, and a majority of farms in Rhode Island include extensive

[232] "About LWCF," Land and Water Conservation Fund, accessed June 2, 2019, https://www.lwcfcoalition.com/about-lwcf.
[233] Gregg Cassidy, Senior Environmental Scientist, Rhode Island Department of Environmental Management, email communication, April 1, 2019.

tracts of forest. Through a combination of these programs, NRCS has assisted with conserving 20 properties and over 420 acres.[234]

State and Local Funding for Forest Conservation & Management

States and local municipalities have used thoughtful and creative approaches to forest and open space conservation across the United States. The following section outlines specific examples of funding sources used successfully to conserve forestland, enhance natural resources and mitigate environmental impacts.

Bond Funding

Rhode Island has a long history of passing voter-approved bonds on environmental issues, which provide the primary source of funding for land protection programs in the state. Bond issues are brought forth by the Governor and the General Assembly and voted on by the public in the state's general election as ballot measures. In 2018, Rhode Island voters approved the **Green Economy and Clean Water Bond**, providing $47.3 million to invest in water quality projects, land protection, coastal resiliency, preserving farmland, local recreation and bikeways, brownfield cleanup projects, and many others.[235] The bond initiative infused $2 million into the state's Open Space Grant Program for land protection and $5 million in Outdoor Recreation Grants, both administered by the RIDEM Department of Planning and Development.

Real Estate Transfer Tax

States and municipalities around the country have adopted real estate transfer tax programs to increase dedicated funds for conservation. These programs add a tax on each real estate transfer which goes directly to a fund dedicated to land or natural resources conservation measures. While real estate transfer tax programs are more common at the municipal level, the states of Pennsylvania and Vermont have statewide transfer tax programs. In Rhode Island, Little Compton and Block Island have adopted real estate transfer taxes which were enacted through enabling legislation.

- **Little Compton Agricultural Conservancy Trust (LCACT)** uses income from the town's real estate transfer tax on properties sold for more than $300,000 to leverage additional funding through grant applications to state and federal resources. Properties sold for more than $300,000 are taxed at 4% of the total purchase price.[236] These funds are used to preserve farmlands and open spaces through outright purchase, purchase of development rights, or donations of land and cash.
- Modeled after the LCACT, the **Block Island Land Trust (BILT)** is funded by a 3% transfer tax for all property sold on Block Island. Using this funding, the BILT works closely with the Block Island Conservancy and The Nature Conservancy and is authorized to issue up to $6 million in bonds for conservation projects.[237]

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[234] Joseph Bachand, Program Manager, Natural Resources Conservation Service Rhode Island, email communication, June 23, 2019.
[235] "Green Economy & Clean Water Bond," Rhode Island Department of Environmental Management, accessed May 20, 2019, http://dem.ri.gov/greenclean/.
[236] "History," Little Compton Agricultural Conservancy Trust, accessed May 20, 2019, http://lcact.net/.
[237] "Block Island Land Trust," Town of New Shoreham, "accessed May 20, 2019, http://www.new-shoreham.com/displayboards.cfm?id=14.

Dedicated State Funding Sources

Dedicated sales taxes can be an option for providing continuous funding for land conservation and environmental remediation projects. By adding sales taxes or fees on products such as tobacco and lottery tickets, funding has been made available to states around the country to aid in natural resource conservation, land protection and environmental remediation projects. For instance,

- The **Maine Outdoor Heritage Fund** uses proceeds from $1 scratch off lottery tickets created specifically for the program on conservation and wildlife projects. Proceeds from tickets are used to fund the state grant program, which awards $700,000 annually.[238] This program leverages funding among conservation groups, as grants are awarded to projects that show strong public/private partnerships and provide matching funds of at least ⅓ of the total cost of each project.[239]
- Pennsylvania established **flat taxes on tobacco and a disposal fee for municipal waste to landfills** in 2002, both used to fund the state's conservation easement purchase program. Cigarette tax revenue in Pennsylvania dedicates $20.49 million annually to the Agricultural Conservation Easement Purchase Fund in the state to protect farmland.[240] [241]
- In 2014, New Jersey's citizens voted the **Preserve New Jersey Act** into law, amending the constitution to create a permanent, two-phase dedication of a firm percentage of the Corporation Business Tax (CBT) to environmental, conservation and preservation programs. From 2015-2019, 4% of the CBT was directed to conservation funding, with an increase in July 2019 to 6% which will remain in perpetuity.[242] The majority of this funding goes to the state's Garden State Preservation Trust Programs for park and wildlife refuge acquisition, recreational development and agricultural preservation programs.[243]
- On July 1, 2019, **Georgia's Outdoor Stewardship Act** was passed by voters with 83% public support. The act created the Georgia Outdoor Stewardship Fund, allowing for up to 80% of the sales and use tax from outdoor recreation equipment as dedicated funding for land and water conservation through a grant program. Funding will be used to support parks and trails and to protect an acquire lands critical to wildlife, clean water and outdoor recreation across the state of Georgia.[244]

Local Option Surcharge

In 2000, Massachusetts signed into law the **Community Preservation Act (CPA)**. This state law combines local enabling authority in cities and towns with a commitment of state matching funds to be used as an incentive for communities to adopt local property tax surcharges of up to 3% for land

[238] "Maine Outdoor Heritage Fund," Maine Department of Inland Fisheries & Wildlife, accessed May 17, 2019, https://www.maine.gov/ifw/programs-resources/grants/outdoor-heritage-fund.html.
[239] "Maine Outdoor Heritage Fund Strategic Plan," State of Maine, accessed 17 May 2019, https://www.maine.gov/ifw/docs/stratplan_2014-2020.pdf.
[240] "Understanding Agricultural Preservation in Pennsylvania," PennState Extension, accessed May 17, 2019, https://extension.psu.edu/understanding-agricultural-preservation-in-pennsylvania.
[241] "Cigarette Tax," Pennsylvania Department of Revenue, accessed May 15, 2019, https://www.revenue.pa.gov/GeneralTaxInformation/Tax%20Types%20and%20Information/CigaretteTax/Pages/default.aspx
[242] State of New Jersey, "Understanding the Open Space dedication of the Corporate Business Tax" (Microsoft PowerPoint), https://www.state.nj.us/gspt/pdf/7IMAGEhandout.pdf.
[243] State of New Jersey, *Assembly No. 4597 State of New Jersey 217th Legislature Introduced February 15, 2017,* https://www.njleg.state.nj.us/2016/Bills/A5000/4597_I1.HTM.
[244] "Georgia Outdoor Stewardship Program," Georgia Department of Natural Resources, accessed June 9, 2019, https://gadnr.org/gosp.

conservation, historical preservation and affordable housing projects.[245] Since the law was enacted, voters in over 175 municipalities in Massachusetts have signed on. In the early years of adoption, CPA funds often exceed, sometimes substantially, those raised through other measures.[246] However, due to the economic downturn, an increase in adoption of the law by municipalities, and the decline in the real estate market, funds for CPA decreased dramatically in the mid-2000s. In 2012, Governor Baker passed a bill to use the budget surplus to bolster the fund, which continued through 2015. Since its passage, 29,289 acres of open space have been conserved, and over 2,200 recreation projects have been initiated through CPA.[247]

Settlement and Mitigation Funds

The federal government provides compensation to states through funds from enforcement actions by both settlement and mitigation programs. For instance, in 2018, The US Environmental Protection Agency found Volkswagen guilty for installing illegal software on diesel engine vehicles. Rhode Island was awarded a $14.4 million settlement for the 3,000 cars affected in the state.[248] This funding is currently being used to improve air quality by adding electric busses to the Rhode Island Transportation Authority's fleet, and to install electric vehicle infrastructure.

Individual states have also implemented programs to correct negative environmental impacts. Two of these are Maine and Maryland.

- **Maine's Natural Resources Protection Act** is a permitting program that works to ensure that companies avoid adverse environmental effects, minimize the impacts that can't be avoided, and ultimately compensate for impacts that cannot be further minimized.[249] Entities that directly impact natural resources are required to pay a fee in lieu of compensation to the Department of Environmental Protection.[250] These funds go towards the restoration, enhancement, preservation and creation of similar resources that best match the regions where the impacts occurred and are implemented by the Maine Natural Resource Conservation Program.
- Passed into law in 1991, **Maryland's Forest Conservation Act (FCA)** requires developers to meet certain thresholds for forest canopy depending on the site and to minimize forest loss due to development. Developers must map forests onsite at the beginning of the planning process for a major development. Priority areas for conservation are then identified, and thresholds are set for forest retention and reforestation if there are no trees on a site. The thresholds must be

[245] "CPA: An Overview," Community Preservation Coalition, accessed May 13, 2019, https://www.communitypreservation.org/about.
[246] Mary Buchanan, *Public Conservation Funding in New England: Recent Trends in Government Spending on Land Protection*, Wildlands and Woodlands (Redding, CT: Highstead Foundation and Harvard Forest, 2015).
[247] "CPA: An Overview, 2019," Community Preservation Coalition.
[248] "Volkswagen Settlement," Rhode Island Department of Environmental Management, accessed June 9, 2019, http://www.dem.ri.gov/programs/air/vwsettle.php.
[249] "Natural Resources Protection Act (NRPA)," Maine Department of Environmental Management, accessed July 3, 2019, https://www.maine.gov/dep/land/nrpa/.
[250] "Maine In Lieu of Fee and Natural Resource Conservation Program," Maine Department of Environmental Protection, accessed May 17, 2019, https://www.maine.gov/dep/land/nrpa/ILF_and_NRCP/index.html.

accomplished by first preserving on-site forest, then by reforestation on or near the site, and finally, as a last resort, by paying into the applicable forest conservation fund.[251] [252] [253]

Watershed Protection Funding

Rhode Island water suppliers contribute to a water quality protection fund for land acquisition and water quality improvement projects – including forest conservation – to support clean water. The **Public Drinking Water Protection** program is funded by a surcharge on the major water suppliers of the state to protect the water quality of Scituate Reservoir and other Rhode Island drinking water sources. Program funds are managed either by Providence Water or the Water Resources Board (WRB) in partnership with the RI Infrastructure Bank.[254] Through the WRB-funded program, water suppliers have preserved 2,742 acres of land to permanently protect drinking water sources.[255] This program has played a critical role in protecting land and forests in the state's watersheds.

Philanthropic Support for Forest Conservation

Attracting philanthropic contributions for forest conservation can have a significant impact on Rhode Island forest programs. In 2019, Rhode Island received a grant of $650,000 to increase urban forests from the Doris Duke Foundation.[256] The funds will:

- Support engagement with municipalities to develop a statewide urban tree canopy goal;
- Implement a tree planting and tree care program in 3 to 5 pilot communities;
- Build connections between municipalities and tree nurseries and landscape associations;
- Develop an online "decision support tool" to help optimize urban tree planting for environmental and public health benefits; and
- House an American Forest Fellow within RIDEM to lead the implementation of the state's urban forest strategy and other climate and health goals.

Building relationships with foundations and private donors who are invested in forest conservation can attract new funding to help the state meet its conservation priorities.

2) Support Forest Acquisition for Conservation

Forest acquisition for conservation purposes is the most clear and direct way of retaining forestland and preventing its conversion to other land uses. While funding is limited and often competitive, many sources and mechanisms are available, including many of the existing and potential funding sources described in the previous section. Part of the challenge can be identifying the most promising approach for a land conservation transaction involving a particular landowner or property. With a fee acquisition, a

[251] Maryland Department of Legislative Services, Office of Policy Analysis, *Forest Conservation Act and Other Forestry Programs in Maryland,* (Anapolis, MD: Maryland Department of Legislative Services, November 2017).
[252] Rupert Friday, Executive Director, Rhode Island Land Trust Council, personal communication, June 24, 2019.
[253] See *Appendix B:* Memorandum on "Strategies for balancing solar development and forest conservation in RI" for more information on the Maryland's Forest Conservation Act.
[254] "Public Drinking Water Protection Program," Rhode Island Water Resources Board, July 15, 2019, http://www.wrb.ri.gov/work_programs_pdwp.html.
[255] Kathleen Crawley, Acting General Manager, Rhode Island Water Resources Board, personal communication, March 1, 2019.
[256] Chris Bergenheim, "R.I. receives $650K grant for urban forestry projects," *Providence Business News*, April 26, 2019, https://pbn.com/r-i-receives-650k-grant-for-urban-forestry-projects/.

government or conservation entity acquires the deed to the land. Conservation easements are transactions in which the landowner sells or donates the right to develop the land while retaining ownership. Both fee and conservation easement acquisitions can be funded from various sources, with different levels of government, land trusts and conservation nonprofits, and the business sector involved in different roles.

Regional Conservation Partnerships Support Forest Conservation

Regional Conservation Partnerships (RCPs) are an innovative organizational tool that conservation organizations can use to manage forest conservation projects through collaboration. Comprised of individuals in the private, public and non-profit sector, Regional Conservation Partnerships (RCPs) are loosely organized groups with common land conservation and forest management goals. RCPs began emerging in the mid-1990s and vary in size and scope but share a desire to increase the pace and connectivity of their conservation activities. As of 2019, there are 43 RCPs throughout New England and New York.[257]

Over time, conservation organizations realized that they can accomplish more together, coordinating under a streamlined conservation vision. By collaborating on projects, individual organizations involved in RCPs use collective knowledge and strengths to leverage funding, write grants, and creatively engage in projects that conserve land on a regional scale, often across state borders. Since 2012, the Highstead Foundation has coordinated the RCP Network, a formal partnership of RCPs regionally, by providing coordination capacity, and increasing technical assistance available to RCPs by providing networking opportunities, research on best practices and targeted technical and funding assistance.[258]

Working Collaboratively Across Landscapes

The Quabbin to Cardigan Partnership (Q2C) was founded in 2002 due to development pressures and parcelization in the Monadnock Highlands of north-central Massachusetts and western New Hampshire. This collaborative effort consists of 27 entities, both private and public, working together across state lines to identify and protect one of the largest remaining areas of intact, interconnected, ecologically significant forest in New England.[259] After spending three years developing a strategic conservation vision, Q2C began to endorse Forest Legacy projects in significant core areas, and later established grant funding programs for transaction fees related to land conservation, as well as received additional funds for land conservation from NRCS.[260] As of 2015, Q2C partners permanently protected over 90,000 acres in the Q2C region through conservation easements and land acquisitions.

(Continued on the next page)

[257] "The RCP Network-Overview," Wildlands and Woodlands, accessed April 14, 2019, https://www.wildlandsandwoodlands.org/rcpnetwork.
[258] "The RCP Network-Overview," Wildlands and Woodlands.
[259] The Quabbin-to-Cardigan Partnership, Q2C: *The Quabbin-to-Cardigan Partnership A Public-Private Partnership Conserving the Monadnock Highlands of New Hampshire & Massachusetts* (factsheet), accessed May 8, 2019, https://q2cpartnership.files.wordpress.com/2017/07/fact-sheet.pdf.
[260] William Labich, *The Regional Conservation Partnership Handbook* (Redding CT: The Highstead Foundation, 2015).

The MassConn Sustainable Forest Partnership (MassConn) was formed in 2007 by a group of land trusts in south central Massachusetts and north central Connecticut who were asked to consider developing a multi-parcel land protection project between the two states. [261] The partnership worked together for several years to develop compatible mapping data and a regional conservation strategy to define priority conservation areas beyond state borders, including establishing a Forest Legacy area on the Massachusetts side which created the potential for multi-state aggregation projects. With grant support from the Norcross Wildlife Foundation, MassConn is focusing it's partnership efforts on implementing the MassConn Strategic Conservation Plan for the "Emerald Forest" and "Four Corners" conservation priority areas, implementing the MassConn Regional Conservation Fund through the Jesse B. Cox Foundation to support transaction costs of donated land or conservation easements, and continuing conservation efforts through the Forest Legacy Program.[262]

The Rhode Island Woodland Partnership (RIWP) was established in 2013, and is a collaboration among foresters, landowners, conservationists, and professionals who represent public agencies, small businesses, and non-profit organizations. Partnership members share a common goal of advancing stewardship and long-term protection of Rhode Island's forests to benefit the local economy, ecological values, community enjoyment and health.[263] Since its inception, members of the RIWP have collaborated to write a 5-year strategic plan outlining conservation and organizational goals and objectives, prepared two position papers on the importance of preventing forest loss and mitigating and adapting to climate change, and leveraged funding to secure a NRCS Conservation Innovation Grant (CIG) for Forestry for RI Birds.

Increasing Funding Opportunities by Working Together

After witnessing the merit of RCP collaboration, the federal government created the Regional Conservation Partnership Program (RCPP) through NRCS in 2014, and continued funding for this program in the 2018 Farm Bill, with $300 million/year in annual funding going to collaborative projects nationwide.[264] The RCPP program matches NRCS funding with non-federal funding and in-kind match provided by the organizations partnering and collaborating through their RCPs.

The Southern New England Heritage Forest (SNEHF) is comprised of 1.49 million acres, based on the border between Rhode Island and Connecticut and reaching the Quabbin Reservoir in Massachusetts.[265] When viewing satellite imagery of the SNEHF at night, it's the last dark landscape located between the larger metropolitan areas of Providence and Boston, with its large tracts of forest remaining nearly 76% unfragmented.

(Continued on the next page)

[261] Labich, *Regional Conservation Handbook.*
[262] Ed Hood, *Report on Norcross Grants 17-01, awarded to the MassConn Sustainable Forest Partnership, December 2017* MassConn Sustainable Partnership, October 10, 2018.
[263] "The Rhode Island Woodland Partnership," Rhode Island Woods, accessed March 24, 2019, http://rhodeislandwoods.uri.edu/ri-woodland-partnership/.
[264] "Regional Conservation Partnership Program," United States Department of Agriculture Natural Resources Conservation Service, accessed July 9, 2019, https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/rcpp/.
[265] "Southern New England Heritage Forest (SNEHF)," The Last Green Valley, accessed May 10, 2019, https://thelastgreenvalley.org/learn-protect/agriculture-forestry/southern-new-england-heritage-forest/.

Because of its ecological significance, the SNEHF RCP formed in 2012 to bring more funding for land protection to the region and is comprised of 19 partner organizations across the region.[266] The SNEHF partnership collaborated for the first time on the Woodland Ambassador project from 2012-2014, through funding from the Northeast State Foresters Association. Woodland Ambassadors hosted woods walks and forums to engage their neighbors in forest management. In 2017, SNEHF was awarded $6.1 million across the region through the NRCS RCPP program. The project is currently being implemented across the SNEHF, increasing forest management plans with birds in mind, funding the implementation for those forest management activities, and conserving significant properties through the NRCS-Healthy Forest Reserve easement program.[267]

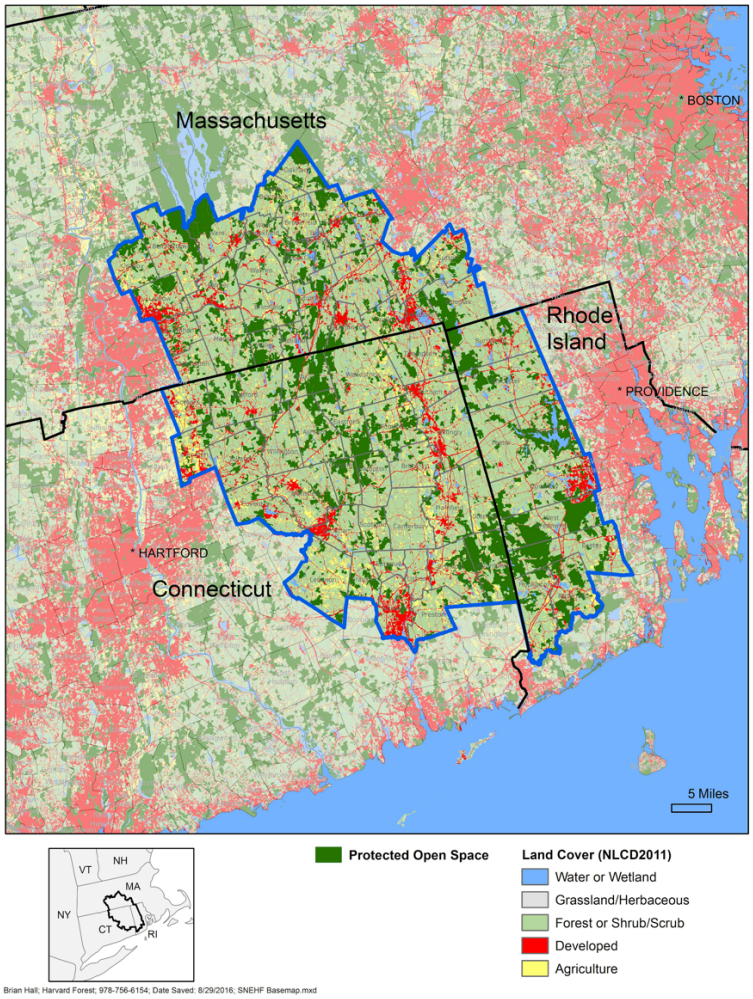

Figure 19: Southern New England Heritage Forest (SNEHF RCP Priority Area

[266] "Southern New England Heritage Forest," The Last Green Valley.
[267] Hallie Schwab, "$6.1 Million RCPP Award will Enable Southern New England Heritage Forest Partnership to Engage New Landowners in Forest Management and Conservation," Regional Conservation Partnership Network (blog) February 5, 2018, accessed July 28, 2019, https://rcpnetwork.org/blog/southern-new-england-heritage-forest-partnership-secures-6-1-mill.

Conservation Easements

Conservation easements can be a useful tool for forestland owners seeking to permanently protect their land from development while retaining ownership of the property. These transactions protect the conservation values of the land for future generations. Conservation easements transfer some of the rights of the property, prohibiting certain actions or limiting uses (subdividing, building structures or houses, ensuring management through planning), and can be put in place on all or part of the land.[268] Landowners partner with agencies interested in the conservation of their property and have the ability to craft an easement based around their landowner goals and objectives for management and future uses.

The agency who holds the conservation easement (often a land trust or RIDEM) is responsible for the monitoring and enforcement of the terms of the easement, outlined and included in the title of the property in perpetuity. Since the landowner retains ownership of the property it stays on the tax rolls (often under the state's current use program), and the landowner can sell the land, donate it, or leave it to family to enjoy for future generations, knowing that the land is permanently protected.[269]

One way for a landowner to establish an easement on their forestland is through donation. When a landowner donates their land to a conservation organization or land trust, it can be considered a tax-deductible charitable donation on the landowner's federal income tax return, specifically if the conservation of that property has important natural resource benefits. The value of the donation is determined by an appraiser. Landowners who donate a conservation easement may also be eligible for Federal estate tax benefits and property tax incentives that can make the donation the land a financially sound investment.[270] [271]

Landowners who are interested in donating a conservation easement on their forestland may be discouraged by the associated transaction costs. To establish an easement agreement between a landowner and a conservation organization, there are appraisals, fees, and baseline documentation, surveys and closing costs that must be paid for. These costs can be prohibitive to the landowner and conservation organization that they are working with, who are often willing to take on some of those costs. Depending on the property size and project, the cost of transaction fees can be thousands of dollars. In addition, land trusts and conservation organizations need to plan for the costs of future monitoring and the enforcement of the easement. These organizations often request a donation from the landowner to establish a monitoring endowment which adds to the overall cost of protecting a property.

There are grant programs available to alleviate the transaction costs of easement donations to conservation organizations looking to protect land. These include Rhode Island Open Space Grants, funded by open space bond initiatives, which provide up to 50% matching funds to conservation organizations to preserve open spaces. Awardees are eligible for reimbursement of up to 50% of the

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[268] Marina Schauffler, *Conservation Options: A Guide for Maine Landowners* (Topsham, ME: Maine Coast Heritage Trust, 2003).
[269] Schauffler, *Conservation Options*.
[270] "Income Tax Incentives for Land Conservation," The Land Trust Alliance, accessed May 11, 2019, https://www.landtrustalliance.org/topics/taxes/income-tax-incentives-land-conservation.
[271] "Estate Tax Incentives," The Land Trust Alliance, accessed May 11, 2019, https://www.landtrustalliance.org/topics/taxes/estate-tax-incentives-land-conservation.

transaction fees associated with each land conservation project.[272] In the Habitat Protection section of the Open Space Scoring Criteria, up to 5 points can be awarded for a project located in a core area, including forest and brushland blocks 30 meters from development greater than 250 acres, with the most points given to properties that are located in forest blocks greater than 500 acres.[273] It often makes the most sense for multiple conservation organizations, land trusts and state agencies to pool their resources and collaborate on projects, each taking responsibility for some portion of the easement costs.

Landowners can also sell a conservation easement on their property. Often conservation organizations and land trusts do not have enough funding to purchase the property at fair market value and will offer to purchase a conservation easement or purchase the land outright through a "bargain sale," below fair market prices. The benefit of the sale of a conservation easement by the landowner is cash compensation for the protection and resulting reduction in market value of the property.[274] A landowner may also be eligible for income tax benefits, where they can claim a charitable donation for the difference between the fair market value and price the conservation easement or property was sold to a conservation organization or land trust as an income tax deduction.

While Rhode Island forestland owners benefit from federal income tax programs only, some states in New England and beyond offer state income tax incentives for the donation of conservation easements on the state level. The Commonwealth Conservation Land Tax Credit Initiative in Massachusetts is a collaboration between the Office of Energy and Environmental Affairs and the Department of Revenue that assesses the conservation value of properties with conservation easements.[275] The program offers a state tax credit of 50% of the value of the easement donation, capped at $75,000 for each project, and has an annual budget of $2 million.[276] [277]The Massachusetts Department of Revenue provides a direct refundable credit to landowners who qualify and provide the landowner with a check for the amount when state taxes are completed for the year of the donation.[278]

The state of Maryland allows a state income tax credit for the donation of conservation easements to the Maryland Environmental Trust (state land trust) or Maryland Agricultural Land Preservation Foundation. A tax credit of 100% of the value of donations assessed by an appraiser can be claimed for up to $80,000. Individuals can claim $5,000 (or $10,000 a couple) a year, which can be carried over for 15 years. Easements donated to the Maryland Environmental Trust are also exempt from property taxes for 15 years.[279]

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[272] "Grant Opportunities," The Department of Environmental Management, accessed May 12, 2019, http://www.dem.ri.gov/programs/planning/grants/.

[273] The Department of Environmental Management, *Rhode Island Natural Heritage Preservation Commission Scoring Criteria for Open Space Grants* (Providence, RI: Rhode Island Natural Heritage Preservation Commission, 2019), http://www.dem.ri.gov/programs/planning/documents/os_grant_score.pdf.

[274] Marina Schauffler, *Conservation Easements: An Introduction for Maine Landowners* (Maine Coast Heritage Trust, 2002), https://static1.squarespace.com/static/52f117dae4b0c08037396a20/t/546b6ea9e4b06c7939173596/1416326825062/conservation_easement.pdf.

[275] "Commonwealth Conservation Land Tax Credit (CLTC)," Mass.gov, accessed May 13, 2019, https://www.mass.gov/service-details/commonwealth-conservation-land-tax-credit-cltc.

[276] "Commonwealth Conservation Land Tax Credit (CLTC)," Mass.gov.

[277] Land Trust Alliance *State Land Conservation Tax Incentives as of April 2019* (factsheet), accessed June 3, 2019, http://s3.amazonaws.com/landtrustalliance.org/State-Land-Conservation-Tax-Incentives-April-2019.pdf.

[278] Buchanan, *Public Conservation Funding in New England*.

[279] "Tax Benefits of Conservation Easement Donations," Maryland Department of Natural Resources, accessed May 24, 2019, https://dnr.maryland.gov/met/Pages/tax_benefits.aspx.

While several easement options may be available to landowners in Rhode Island, it is often difficult for landowners interested in conserving their properties to understand the options. There are several conservation organizations, land trusts and state agencies available to assist with understanding the options, but it is hard to know where to begin.

3) Incentivize Forest Conservation Assistance & Stewardship

Programs that incentivize forest conservation are critical in a state with limited land area and many competing land uses. With private landowners controlling the majority of Rhode Island's forestland, programs targeted at these stakeholders can be especially effective in promoting conservation.

Current Use Tax Incentives

Rhode Island's Farm, Forest and Open Space Program

The Farm, Forest and Open Space (RI Gen. Law § 44-37) program (FFOS) allows Rhode Island landowners to have their property assessed at the current use, and not at development values.[280] Properties enrolled in the program are assessed at a lower rate in exchange for a conservation restriction ensuring that the property will not be developed for at least 15 years without paying a penalty, or Land Use Change Tax. The law was established in 1980, recognizing that it is, "in the public's interest to prevent the forced conversion of farm, forest and open space land to more intensive uses as the result of economic pressures caused by assessment for purposes of property taxation at values incompatible for the preservation as farm, forest and open space land."[281] FFOS authorizes the RIDEM as the regulatory body governing both farm and forestland enrolled in the program, while the Open Space is administered by the city or town where the land is located. For the purposes of this report, this section will focus mainly on the Forest portion of FFOS, although the three classifications are defined below:[282]

- **Farmland:** ornamental, vegetable and orchard crops, dairy and livestock (including forage crops) and the forest and wetlands associated with the property of at least 5 acres, actively devoted to agriculture.
    - Landowner must produce at least $2,500/year in farm products (can be for personal consumption)
    - Landowner agrees to have a written Farm Conservation Plan on property, and follow Best Management Practices outlined therein, and will renew the plan every 10 years to stay in the program
- **Forestland:** Forestland of at least 10 acres bearing dense growth of trees including young regenerating forest and including wetlands, exclusive of house site

[280] "The Farm, Forest and Open Space Act," Rhode Island Department of Environmental Management, accessed May 12, 2019, http://www.dem.ri.gov/programs/agriculture/ffosa.php.
[281] Rhode Island General Law, State of Rhode Island, *Title 44 Taxation, Chapter 44-27 Taxation of Farm, Forest and Open Space Land, Section 44-27-1,* 1980, http://webserver.rilin.state.ri.us/Statutes/TITLE44/44-27/44-27-1.HTM.
[282] Rhode Island Department of Environmental Management, *A Citizen's Guide to the Farm, Forest and Open Space Act,* February 2017, http://www.dem.ri.gov/programs/agriculture/documents/ffosa_citizens_guide.pdf.

    - Landowner must have a Forest Stewardship or Management Plan at the time of application, and agrees to implement the plan and renew it every 10 years to stay in the program
- **Open Space:** undeveloped land (including farm or forestland) of at least 10 acres where the land serves to enhance agricultural or forest values, enhances wildlife habitat or protects ecosystem health
    - Classification based on soils, no management plan required

The funding methodology for land values used in the FFOS program was created in 1999 and is modeled on Connecticut and Massachusetts, while taking into consideration the higher cost of values for agricultural land in the state.[283] [284]The recommended value for lands classified as forest is currently $115/acre. There are 568 landowners who participate, and over 45,549 acres enrolled and managed through the program.[285] Of the three classifications in FFOS, the Forest program is the most well-managed, with staff dedicated to inspection and enforcement, responsible for reviewing management plans and inspecting properties every 5 years to ensure compliance.

While the FFOS program works well as a tool to defer the conversion of land by reducing the property tax burden on Rhode Island landowners, it has several shortcomings that if addressed would make the program both more appealing to landowners, and more consistent across the state.

- While the law is being applied correctly in most cities and towns, there are often inconsistencies among tax assessors on how the law is interpreted and implemented.
- The recommended current use assessment rates have not been reviewed since 2015. The recommended values were established by FFOS Land Value Subcommittee, which falls under the jurisdiction of the Rhode Island State Conservation Committee, and was formed by the Governor in 1999.[286] The FFOS valuation rates should be reviewed every three years and periodically updated to reflect economic conditions.
- To ensure that RIDEM, landowners, and tax assessors are on the same page, it is the responsibility of the RI State Conservation Committee to provide the Land Value Subcommittee's list of current use values for FFOS to each tax assessor through the Department of Administration on or before February 15th of each year in which the current use rates are evaluated, as outlined in RI Gen. Law § 2-4-3.1(c).[287] According to RI Gen. Law § 44-5-39, it is the responsibility of the Department of Revenue to annually publish all information as it relates to current use land values, and make that information available to tax assessors.[288] These steps are critical to ensure that the

[283] Rhode Island Department of Environmental Management, *A Citizen's Guide to the Farm, Forest and Open Space Act*.
[284] Chris Modisette, State Resource Conservationist and Forester, USDA Natural Resources Conservation Service Rhode Island, personal communication, May 8,2019.
[285] Fern Graves, Forest Stewardship Program Coordinator, Rhode Island Department of Environmental Management, Division of Forest Environment, personal communication, March 4, 2019.
[286] Rhode Island General Law, State of Rhode Island, *Title 2 Agriculture and Forestry, Chapter 2-4 Soil Conservation 2-4-3.1*, 2006.
[287] Rhode Island General Law, State of Rhode Island, *2017 Rhode Island General Laws Title 2- Agriculture and Forestry Chapter 2-4- Soil Conservation Section 2-4-3.1- Rhode Island farm, forest and open space land value subcommittee*, 2017, http://webserver.rilin.state.ri.us/Statutes/TITLE2/2-4/2-4-3.1.HTM.
[288] Rhode Island General Law, State of Rhode Island, *Title 44 Taxation, Chapter 44-5 Levy and Assessments of Local Taxes 44-5-39*, 1980, http://webserver.rilin.state.ri.us/Statutes/TITLE44/44-5/44-5-39.HTM.

FFOS program is functioning well across the state, but the notifications by all parties have not occurred in several years.

- There is often confusion among landowners filling out the application, specifically those who don't realize their property qualifies under Farm classification and includes their associated forestland. FFOS educational materials and fact sheets are outdated.

While provisions in the FFOS program are intended to prevent the conversion of forestland in the face of development pressures, they do little in the way of encouraging permanent conservation. The RI Land Use Change Tax only applies to a property classified as forest for the first 15 years in the program and property classified as a farm for the first 10 years in the program. After that timeframe, "...no tax shall be imposed by the provisions of the law."[289] It is also easy for a landowner to get out of the program. While a lien or legal hold is placed on properties enrolled in the program, sometimes they are overlooked.

Right of First Refusal: Massachusetts Current Use Program

Massachusetts has a similar Current Use program to Rhode Island called Chapter 61 (Ch. 61) which values farms, forests, and open spaces at reduced rates to make them more affordable for landowners, while encouraging conservation. While each program operates in a similar manner, there are a few differences in Ch. 61 that encourage long-term conservation and potential permanent protection that could be adopted in Rhode Island to further prevent development in forested areas.

When land is enrolled in Ch. 61, a lien is put on the property as a measure to ensure the status of that property is tracked through sales. If a property enrolled in Ch. 61 is sold, the designation is transferred with the property with no penalties if the property stays enrolled in the program. If the land is converted to development (outside of an immediate family member building a dwelling), landowners are responsible for paying rollback or conveyance taxes, whichever is higher and depending on how long the property has been in the program. Chapter 61 gives municipalities the Right of First Refusal in two scenarios (1) when the landowner plans to convert to non-chapter uses, the municipality has the option to purchase the land itself or to designate a conservation organization (such as a land trust) to purchase the land at full market retail value as determined by an appraiser and (2), if land will be sold to be converted to non-chapter uses, the municipality has the option to match a bona fide offer to purchase the property.[290] In both instances, the municipality reserves the right to transfer the right to purchase to a conservation organization, and has 120 days to exercise this option. Ch. 61 designation must be renewed every 10 years and landowners are required to submit a new application and updated 10 year forest management plan.[291]

Several towns in Massachusetts have adopted procedures for exercising the Right of First Refusal Option. Because of the quick 120 day turn around, it is difficult to coordinate between all decision-makers and stakeholders (town select board, conservation commission, land trust, board of assessors, open space committee, and others depending on the town), hold a public hearing to decide whether or not to exercise the right, and organizing the funding to purchase the land.[292] A town vote is necessary for a decision.

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[289] RIGL 44-5-39.
[290] Tyler Van Fleet, Paul Catanzaro, David Kitteridge and Jennifer Fish, *Chapter 61 Programs: Understanding the Massachusetts Ch. 61 Current Use Tax Programs*, PUB: 052018 (Amherst, MA: UMass Amherst, May 2018), https://masswoods.org/sites/masswoods.org/files/pdf-doc-ppt/Ch61-Programs-Revised-2018.pdf.
[291] Van Fleet et al., *Chapter 61 Programs*.
[292] Cynthia Henshaw, Executive Director, East Quabbin Land Trust, Inc., phone and email communication, July 25, 2019.

While not the most effective tool, Right of First Refusal has protected several high value conservation areas in Massachusetts through transferring the right to purchase to a conservation organization, including the 365-acre Lawton Tree Farm (now the Lawton State Forest) by Mount Grace Land Trust in Athol.[293] [294]

4) Incorporate Forest Conservation into Land Use Planning & Permitting

As residents of the smallest state in the nation and one of the most densely developed, Rhode Island communities must carefully plan how to accommodate projected population growth while preserving the natural resources upon which residents rely. Envisioning and executing plans that will dictate the future of Rhode Island's developed and natural landscapes is a task that falls into the hands of state and local government, non-profit organizations, private businesses, and engaged citizens.

Land use planning that impacts forests happens across many scales in Rhode Island:

- **At the state level:** The RI Department of Administration's Division of Statewide Planning oversees the creation and implementation of strategic plans for "the physical, economic, and social development of the state," including the creation of a State Guide Plan to serve as the state's central long-term planning document (RI Gen Laws 42-11-10). The State Guide Plan includes four elements that explicitly focus on natural resource planning: the Forest Resources Management Plan, the Urban & Community Forestry Plan, Ocean State Outdoors: Rhode Island's Comprehensive Outdoor Recreation Plan, and A Greener Path: Greenspace and Greenways for Rhode Island's Future.[295] The Division of Statewide Planning also reviews comprehensive plans from cities and towns for their consistency with state guidance.[296]
- **At the municipal level:** Cities and towns in Rhode Island are required to create and submit comprehensive plans that are consistent with state guidance, according to the Comprehensive Planning and Land Use Regulation Act (R.I. General Law 45-22.2-6(b)(8)). Comprehensive plans are required to map natural resource areas including forested areas, discuss issues facing these areas, and create goals in alignment with state goals for resource conservation.[297] Concerningly, there is little enforcement of these policies. Without enforcement of natural resource mapping and adherence to the State Guide Plan, the power of the planning process to promote forest conservation is significantly weakened.
- **At the level of individuals and organizations:** Individuals and organizations with ownership or management authority over tracts of forestland are key stakeholders in the planning process. The land use decisions of individuals and organizations are intended to be guided by local comprehensive plans and state land use plans, although implementation (for example ensuring

[293] George Barnes, "Far as eyes can see Mount Grace Land Trust grows," *Sunday Telegram*, October 15, 2006, https://www.mountgrace.org/sites/default/files/WTGcoverage06.pdf.
[294] "*Lawton State Forest (Athol),"* Mount Grace Land Conservation Trust, accessed June 2, 2019, https://www.mountgrace.org/conservation-areas/lawton-state-forest-athol.
[295] State of Rhode Island Department of Administration, Division of Statewide Planning, "State Guide Plan Elements," accessed August 4, 2019, http://www.planning.ri.gov/publications/state-guide-plan.php.
[296] RI State Planning Council, *Rhode Island Comprehensive Planning Standards Manual*, June 14, 2018.
[297] RI State Planning Council, *Rhode Island Comprehensive Planning Standards Manual*.

consistency with municipal comprehensive plans and resultant local ordinances when proposed development projects are under review) is weak in practice.

Land use planning techniques that support conservation – from conservation plans by private landowners to statewide guidance that incorporates smart growth principles – are an important strategy for protecting forest land.

Encouraging Smart Growth to Protect RI Forests

One of the greatest threats to Rhode Island's forests is improperly managed human development. As outlined at the beginning of this report, forest fragmentation driven by development is a significant driver of forest loss and degradation in Rhode Island. An essential part of protecting forested places is creating vibrant urban centers of concentrated development where people want to live. Supporting the growth and development of healthy urban communities is crucial to sustaining healthy forests.

"Smart growth" is the multi-faceted value of building human communities that can exist sustainably within their landscapes and ecosystems, are healthy and vibrant places to live, and are accessible to people across physical and social differences including income, race, and age. As outlined by Smart Growth America, the principles of smart growth include:[298]

- creating mixed land uses that encourage **walkability**;
- **compact development** within existing communities;
- preserving **open space, farmland and critical environmental areas**;
- **accessibility** to people in terms of cost, the inclusion of many transportation options, and diverse housing choices; and
- encouraging **community involvement** by creating a strong sense of place and involving residents in community planning.

Smart growth principles hedge against "sprawl," or scattered, low-density development with large lot sizes that often depends on car-based transportation. Sprawl has significant costs: it increases costs of public services for all Rhode Islanders by requiring spread-out and redundant infrastructure; it does not foster close community-building; and it isolates individuals who lack access to transportation.[299] Rhode Island's current patterns of sprawling development in the state are not sustainable according to State Guide Plan element *Land Use 2025* and other assessments. **According to a study from the Society of American Foresters, if Rhode Island continues along its current trajectory of urban expansion, 52% of the state's land area will be urbanized by 2050 and more than 70% by 2060.** This would be the greatest increase in developed land (called "urban/community land" in this study) of all states in that timeframe.[300]

RI cities and towns hold significant power to shape the future structure of their communities through the development of comprehensive plans and local zoning ordinances. Research by RIDEM provides

[298] "What is smart growth?," Smart Growth America, accessed April 20, 2019, https://smartgrowthamerica.org/our-vision/what-is-smart-growth/.
[299] Grow Smart RI, *The Costs of Suburban Sprawl and Urban Decay in Rhode Island*, December 1999, http://www.growsmartri.com/pdfs/costs_of_sprawl.pdf.
[300] Nowak and Greenfield, *US Urban Forest Statistics*.

guidance for creating "the 21st century village" in Rhode Island communities: these are compact communities that allow for mixed residential and commercial uses, transit options including walking, biking and public transit, accessible housing options, space for business development and a connection to the surrounding landscape.[301] Compact urban neighborhoods, including historic town centers and downtown corridors, are modern villages – places where people can live together, build community, and share resources efficiently. The guidance recommends that planning efforts involve extensive community discussion and input to address community concerns about shifting from a spread-out community layout to more dense development. Designing vibrant, compact communities using smart growth principles leaves areas of important natural resource value, including tracts of core forest, available for proper management and conservation.

Rhode Island communities have taken steps in the past few decades locally, regionally, and state-wide to employ smart growth principles in their planning efforts:

- **Growth center concept plans** were created by the RI State Division of Planning for Richmond, Pawtucket-Central Falls, West Warwick, Smithfield and Middletown to help these communities envision how smart growth principles of community development can be applied in their localities. The Growth Planning Council created by Governor Almond in 2000 defined growth areas as having "a core of commercial and community services, residential development, and natural and built landmarks and boundaries that provide a sense of place."[302]
- **State Land Use Plans**, created by the Division of Statewide Planning for the State Guide Plan in 1975, 1989, and 2006, set goals of protecting Rhode Island's green spaces while encouraging thoughtful development. *Land Use 2025*, the most recent land use plan from 2006, envisions Rhode Island's communities in a pattern consistent with smart growth principles – "a constellation of community centers connected by greenspace" – and suggests setting an "urban services boundary" within which the most intensive development and settlement can be confined. This plan states as a "central premise" that current patterns of land consumption are not sustainable.[303]
- RIDEM created a number of **sustainable land use planning guidance documents** between 2003 and 2015 to help communities incorporate creative land use techniques into local planning efforts. The most significant of these tools and their deployment in Rhode Island are discussed below: conservation development, low-impact development, and transfer of development rights.

[301] Rhode Island Department of Environmental Management, *Village Guidance: Tools and Techniques for Rhode Island Communities*, By Flinker, Peter et.al., Dodson & Flinker, Inc, February 2015.
[302] RI Department of Administration, Division of Statewide Planning, *Land Use 2025: Rhode Island State Land Use Policies and Plan*, State Guide Plan Element 2025, (Providence, RI: GPO), April 2006.
[303] RI Department of Administration, Division of Statewide Planning, *Land Use 2025*.

Figure 20: Community Development Incorporating Conservation Principles. Source: Village Guidance, 27.

Existing Conditions *Development Under Current Zoning*

Mixed-use Village Alternative

The best laid plans are not enough to promote a smart growth strategy. *Land Use 2025* in the State Guide Plan bluntly states that the 1975 and 1989 plans for concentrated and strategic development have not been followed: "In spite of an extensive State-municipal comprehensive planning system and centralized State environmental permitting, much of Rhode Island's development over the past 30 years has not followed the official State planning visions....low rise and scattered development has squandered many of the areas best suited for high density with low intensity uses and whole districts of buildings that are disconnected both in terms of design and land uses."[304] Some of the most significant challenges to instituting smart growth strategies are:

- Private landowners have decision-making authority over their parcels of land, making community planning a difficult to manage process involving **many stakeholders and decision-makers**;
- Land is **zoned into large residential lots** in many communities;

[304] RI Department of Administration, Division of Statewide Planning, *Land Use 2025*, 1-7 and 1-8.

- Appropriate infrastructure, including public water and wastewater facilities, is needed to encourage compact mixed-use development patterns. Many towns **lack the supporting infrastructure** needed to encourage density;
- Municipal **regulations may not allow for density of development** that is important to smart growth patterns, especially concerning building height regulations, water provisions and wastewater provisions;
- Previously developed areas, on and around which future development should be concentrated, also require significant **restoration from past uses**; and
- Important tools for sustainable development, like conservation development and transfer of development rights (discussed further below), are more complicated than conventional land use techniques. Municipalities may **require technical assistance** in order to implement them.

Building a Clean Energy Grid While Conserving the Values of Rhode Island's Forests

An increase in large ground-mounted solar and wind projects installed in Rhode Island has caused deforestation in rural areas of the state and spurred significant community concern about forest conservation. Between 2008 and 2017, there was a 23-fold increase in the amount of electricity generated by solar power in Rhode Island.[305] This increase in solar power is central to meeting the state's climate change mitigation goals, and renewable energy is urgently needed to offset greenhouse-gas emissions from the electricity sector. Yet, these installations on formerly forested land pit the benefits of renewable energy directly against the myriad benefits offered by forests.

Given the urgency of addressing climate change and the importance of reducing greenhouse gas emissions from the electricity sector to do so, the Governor and RI General Assembly have set a number of goals to support the development of clean energy resources in the state. The state Renewable Energy Standard sets a target of supplying 38.5% of electricity sales in Rhode Island from renewable energy sources by 2035. Governor Raimondo has set a statewide goal of installing 1,000 MW of clean energy by 2020 and a commitment to procure 100% of the state government's energy from renewable sources by 2025. The state also has a number of policies and programs in place to encourage clean energy use and development. These policies and programs include:[306]

- Net metering, which allows qualifying electricity customers to receive bill credits for excess electricity generated by clean energy systems located on the customers' premises;
- Virtual net metering, which allows qualifying electricity customers to receive the benefits of net metering using clean energy systems located away from the customers' premises. This also allows the benefits of net metering to be shared among multiple electricity customers;
- The Renewable Energy Fund, managed by Commerce Rhode Island, which offers grants for qualifying clean energy projects;
- The Renewable Energy Growth Program, managed by National Grid, which pays the owners of qualifying clean energy systems an above-retail-rate for electricity produced by the systems; and
- Exemptions from sales and property taxes for renewable energy products.

Clean energy programs provide important benefits: helping the state transition from fossil fuel dependence to local clean energy sources, mitigating negative climate change impacts from the energy sector, and supporting local job creation in the renewable energy industry. Yet, Rhode Island's clean energy incentive programs and policies have caused an uptick in clean energy projects installed on green spaces, especially utility-scale ground-mounted solar installations installed on green spaces.

(Continued on the next page)

[305] Gideon Weissman, Rob Sargent, and Bret Fenshaw, *Renewables on the Rise 2018: A Decade of Progress Toward a Clean Energy Future* (Frontier Group, July 2018).
[306] For detailed information on Rhode Island's programs and policies relating to clean energy projects, visit the website of the RI Office of Energy Resources: http://www.energy.ri.gov/renewable-energy.

These take up a significant amount of land area; solar projects require 3-5 acres per megawatt.[307] Under Rhode Island's laws and programs as of 2019, it is often cheaper for solar developers to install projects on green spaces instead of parking lots, rooftops, and landfills that necessitate managing land remediation, navigating additional regulatory oversight, or managing built structures. Although solar installations reduce carbon dioxide emissions and air pollution from fossil fuel sources, solar installations do not provide the clean water, human health, wildlife and recreation benefits that a forest inherently provides in addition to carbon storage and sequestration. Even when a piece of developed land is converted back into a green space, it takes centuries for the land to naturally transition from field to old growth forest.

Policy options to drive solar development away from forests and onto buildings, "brownfields" (a site that has been polluted by former uses), and other previously developed spaces can ensure forestland is conserved as Rhode Island transitions to a clean energy grid. According to the National Renewable Energy Laboratory, more than 397 million square feet of rooftop space in Rhode Island is suitable for solar panels. Solar panels on this rooftop space could produce enough electricity to meet 56.6% of Rhode Island's electricity demand.[308] Some communities, including East Providence, North Providence, and South Kingstown, are already producing solar power atop brownfields (Doiron; CME Energy; South Kingstown Rhode Island).[309] A 2018 subprogram of the Renewable Energy Fund called the Brownfields Solar PV Program has made $1 million available for projects on brownfields in the state.[310] Rhode Island has been a national leader in energy efficiency programs, ranking 3rd highest among all U.S. states according to the American Council for an Energy-Efficient Economy.[311] This is especially important because electricity is so expensive in the state: Rhode Island electricity customers paid the second-highest residential electricity prices in the United States in February 2019, second only to the island of Hawaii.[312] Rhode Island can meet the bulk of its clean energy and emissions reductions goals by continuing to support leading energy efficiency programs, directing solar energy development to previously developed sites, and conserving forests that provide a host of benefits to residents.

Local and state leaders are grappling with the question of how to manage the dual environmental concerns of building a clean electricity grid and protect forest resources. Increased clean energy development is needed in Rhode Island to meet the state's goals for climate mitigation, and such development may come with controversy and community concerns even when they do not impact green spaces.

(Continued on the next page)

[307] RI Division of Statewide Planning and RI Office of Energy Resources, "Solar Siting Information," (presentation), February 2019, http://www.energy.ri.gov/documents/renewable/Solar_Siting_Information_Public_PPT_Feb_2019.pdf.
[308] Pieter Gagnon, et al., *Rooftop Solar Photovoltaic Technical Potential in the United States: A Detailed Assessment* (Golden, CO: National Renewable Energy Laboratory, January 2016), https://www.nrel.gov/docs/fy16osti/65298.pdf.
[309] "South Kingstown Solar Consortium," South Kingstown Rhode Island, accessed May 11, 2019, https://www.southkingstownri.com/973/South-Kingstown-Solar-Consortium-SKSC; "Second Forbes Street Solar Project," CME Energy, accessed May 9, 2019, http://www.cme-energy.com/content/second-forbes-street-solar-project; Sarah Doiron, "Solar farm replaces North Providence landfill" *WPRI*, October 18, 2018, https://www.wpri.com/news/local-news/northwest/solar-farm-replaces-former-north-providence-landfill/1534101263.
[310] "Renewable Energy Fund," Commerce RI, accessed June 10, 2019, https://commerceri.com/financing/renewable-energy-fund/; RI Department of Environmental Management, *2018 Brownfield Remediation and Economic Development Fund: Announcement of Request for Proposals*, May 7, 2018, http://www.dem.ri.gov/programs/benviron/waste/pdf/bbrfp18.pdf.
[311] American Council for an Energy-Efficient Economy, "State and Local Policy Database: Rhode Island," accessed August 20, 2019, https://database.aceee.org/state/rhode-island.
[312] U.S. Energy Information Administration, "Form EIA-861M (formerly EIA-826)," *Monthly Electric Power Industry Report*.

It is increasingly important to create policies and guidelines that address the state's clean energy needs while properly valuing forest resources and communicating both values to stakeholders during community planning processes. The RI Office of Energy Resources convened a group of stakeholders in Rhode Island solar development sector, including those concerned about forest conservation, for a series of meetings on the subject of solar siting between 2017 and 2019. As of 2019, many Rhode Island cities and towns have developed solar ordinances to better manage the influx of interest in solar development and some, like Exeter and Cranston, have taken action to halt large solar installations while developing regulations that would protect forest resources.[313] Cities and towns are required to address energy production and consumption in their comprehensive plans. In 2019, the RI Office of Energy Resources released guidance on including solar siting concerns in the comprehensive plans of cities and towns.[314]

Neighboring states have taken a number of approaches to addressing the issue of forest conservation within the context of solar development. See *Appendix B: Strategies for balancing solar development and forest conservation in RI* for a detailed research memo that proposes a number of ways to account for forest values in the context of solar energy development, based on the experiences of stakeholders in other states. Solutions include: **Solar Massachusetts Renewable Target (SMART) Program** includes provisions to promote solar development on previously disturbed land. The SMART program sets base compensation rates for solar projects, which are paid by the utility to the renewable energy system owner. Projects qualify for 'adders' and 'subtractors' – tweaks to the base compensation rate – including three land categories with varying subtractors. Connecticut Department of Energy and Environmental Protection added **a screening tool—the Forest Habitat Impact Map—**to the state's 2018 solar project request for proposals in order to address deforestation. This layer identifies "prime continuous and connected core forestland blocks" built from a combination of spatial layers, all of which identify resources that could be adversely affected by development (including forest blocks, New England Cottontail habitat, high quality watersheds, early successional habitat, and other landscape features). **The Connecticut Siting Council is required to consider energy projects** and determine whether these projects (1) meet DEEP's air and water standards (2) do not have a substantial adverse environmental effect, and (3) "will not materially affect the status of such land as core forest," according to DEEP.

As a final example, after experiencing an influx of solar developments built on green spaces, Vermont also passed new legislation to guide solar projects to preferred locations. In 2017, **updated net metering regulations** went into effect. Vermont law requires Regional Planning Commissions (RPCs) to create maps of the most and least acceptable locations for solar projects. New net metering rules include incentives for projects sited on buildings or disturbed land.[315] These new rules have led to an increase in the number of solar projects sited on brownfields and buildings.[316]

[313] Town of Exeter, Emergency Ground Mounted Solar Photovoltaic Installation Temporary Moratorium Ordinance, https://www.town.exeter.ri.us/uploads/2/9/3/3/29336893/pub_hrg_-_emergency_ordinance_-_post_ad__1_.pdf; Mark Reynolds, "Moratorium on new solar projects passed by the Cranston City Council," *Providence Journal*, January 24, 2019, https://www.providencejournal.com/news/20190124/moratorium-on-new-solar-farm-projects-passed-by-cranston-city-council.
[314] RI Office of Energy Resources, *Comprehensive Plans & Solar Energy Systems*, February 2019, http://www.energy.ri.gov/documents/renewable/Comp_Plan_Solar_Siting_Report_Feb_2019.pdf.
[315] David Hill et al., *Vermont Solar Market Pathways: Becoming an Advanced Solar Economy by 2025*, December 2016.
[316] Bill Opalka, "Vermont rules spur solar development on landfills, brownfields," *Energy News Network*, May 6, 2019, https://energynews.us/2019/05/06/northeast/vermont-rules-spur-solar-development-on-landfills-brownfields/.

Embedding Forest Conservation in Development Activities

The value of forestland can be incorporated into all development activities.

"Conservation development" is an approach to land use planning that combines real estate development with permanent green space protection. This land use technique guides real-estate development to the most appropriate areas of a landscape and away from open space using a number of different planning and zoning tools.[317] RIDEM developed the Rhode Island Conservation Development Manual and a model ordinance in 2003. In Rhode Island, conservation development encourages at least 50% of the land that could otherwise be developed to be protected in perpetuity as open space. By focusing development in the best-suited parts of a given area, conservation development techniques enable communities to leave important environmental resources undeveloped and create meaningful open space and "greenways" around developed areas. By embedding land protection within the land development and zoning process, community planners can conserve open space without needing to buy and own land. Developing communities in concentrated subdivisions and villages instead of sprawling subdivisions also saves money on the creation and maintenance of public infrastructure (such as roads, sewer, and water) and other development costs.

As of 2011, conservation development projects had conserved an estimated 9.8 million acres of land in the United States and accounted for a quarter of all private-land conservation activity in the country.[318] Seventeen communities in Rhode Island have adopted regulations to promote conservation development: Bristol, Burrillville, Cumberland, Exeter, Glocester, Johnston, Middletown, New Shoreham, North Kingstown, North Providence, North Smithfield, Richmond, Smithfield, South Kingstown, Tiverton, West Greenwich, and Woonsocket.[319]

The Maryland's Forest Conservation Act (FCA) is a premier example of incorporating forest conservation into all development activities. Under the Act, developers are required to minimize forest loss from development activities. This must be accomplished by first preserving on-site forest, then by re-/afforestation on or near the site, and finally, as a last resort, by paying into the applicable forest conservation fund. Developers are required map forested areas on properties slated for development; identify which areas are priorities for conservation; and retain a percentage of the forest canopy on the property. The Maryland General Assembly passed the Forest Conservation Act (FCA) in 1991 to "minimize the loss of forest due to development and to ensure that priority areas for forest retention and forestation are identified and protected before development." The FCA is administered by the Maryland Department of Natural Resources (DNR) but implemented at the local level, requiring municipalities to adopt forest conservation programs at least as stringent as FCA standards.[320]
The Act does not in itself set a goal of "no net loss" of forests. One DNR review of changes in forestland between 1992 and 2002 found that more forest area was cleared than planted. In 2013, the Maryland General Assembly established a state policy "to achieve no net loss of forest," meaning that 40% of the

[317] Jeffrey C. Milder and Story Clark, "Conservation Development Practices, Extent and Land-Use Effects in the United States." *Conservation Biology* 25 no. 4 (2011), 10.1111/j.1523-1739.2011.01688.x.
[318] Milder and Clark, "Conservation Development."
[319] RIDEM Office of Water Resources, "DEM 2013 Community Low Impact Development Survey" (spreadsheet), copy shared by Scott Millar, August 27, 2019.
[320] Department of Legislative Services, *Forest Conservation Act and Other Forestry Programs in Maryland*, November 2017, http://dls.maryland.gov/pubs/prod/NatRes/Forest-Conservation-Act-and-Other-Forestry-Programs-in-Maryland.pdf.

state would remain covered by *tree canopy*. A technical review of changes in Maryland's tree canopy is slated for completion in December 2019. See *Appendix B: Strategies for balancing solar development and forest conservation in Rhode Island* for a detailed discussion of the Act and its impacts on forest conservation.

Maryland's Rural Legacy Program is another effective example of incorporating conservation priorities into planning at the local level. Enacted in 1997 by the Maryland General Assembly, the program allows local governments and land trusts to designate "rural legacy areas" in their communities, thereby making these areas eligible for conservation funding.[321] As of April 2019, the Rural Legacy Program has conserved more than 100,000 acres across Maryland.[322]

Community certification programs have been effective tools in other states. In Connecticut, Sustainable CT is a voluntary certification program that gives participating municipalities points toward a Sustainable CT certification, including points for actions related to "Well-Stewarded Land and Natural Resources."[323] In Massachusetts, energy-focused Green Communities designation and grant program provides more than 240 municipalities with resources to implement energy efficiency and clean energy initiatives.[324] A state program that certifies municipalities for forest protection and well-sited renewable energy development could incentivize and engage RI municipalities around these priorities.

Transfer of development rights (TDR) programs can help communities develop in areas targeted for growth and limit development in areas with important natural resources. These programs make it legal to move development rights from one area to another – allowing individuals or entities with development rights to transfer them to areas most suitable for high-density growth. For example, a woodlot owner with development rights to a forested parcel would be able to transfer these rights to the already-developed village center. This would concentrate dense development at the center of the community and incentivize conservation of the woodlot owner's valuable forest resources. These programs can be operated locally or regionally.[325] Montgomery County in Maryland has one of the oldest TDR programs in the United States, allowing development rights to be moved from a designated 90,000 acre area prioritized for conservation to areas near existing towns and cities that are suited for more development. Chesterfield Township in New Jersey is another success story of using TDR to direct development into an area targeted for village development; more than 75 percent of agricultural land threatened by development has been preserved in this area using their TDR program.[326]

A national expert in transfer of development rights (TDR) programs determined that these programs can work successfully in Rhode Island.[327] These programs have not been used extensively in the state, but

[321] "Land Acquisition and Planning: The Rural Legacy Program Process," Maryland Department of Natural Resources, https://dnr.maryland.gov/land/Pages/RuralLegacy/Rural-Legacy-Program-Process.aspx
[322] "Rural Legacy Program Reaches Milestone," Maryland Department of Natural Resources, 24 April 2019, https://news.maryland.gov/dnr/2019/04/24/rural-legacy-program-reaches-milestone/
[323] Sustainable CT, 2019, https://sustainablect.org.
[324] Commonwealth of Massachusetts, "Green Communities Designation & Grant Program," 2019, https://www.mass.gov/green-communities-designation-grant-program.
[325] RI Department of Administration, Division of Statewide Planning, *Land Use 2025.*
[326] Rhode Island Department of Environmental Management, *Village Guidance.*
[327] Rhode Island Department of Environmental Management, *Rhode Island Transfer of Development Rights Manual*, by Nathan Kelly, Horsley Witten Group, Inc., February 2015.

they have been adopted by two communities, Exeter and North Kingstown. During community planning initiatives, these towns approved higher density in central community areas subject to the use of TDR programs that concentrate development away from priority lands for protection.[328] It is important to note that both Exeter and North Kingstown use a modified approach to TDR. Developers do not need to negotiate with a landowner to purchase and transfer development rights to an area the community has designated for higher density. This process can be burdensome and time consuming for all parties. Instead, the developer is assessed a fee by the municipality for any additional density beyond what would be allowed in the underlying zoning district. The funds received by the town are then used by the local land trust to purchase priority open space elsewhere in the community. The fee to be assessed to the developer can be established to reflect current market conditions and to be advantageous for both the developer and the municipality.[329]

Other smart growth planning tools can be employed to create sustainable communities and reduce sprawling development pressure on forestland. These include:

- **Low-impact development** (LID), or the principle of mimicking natural systems in order to effectively manage stormwater in built communities. Development adhering to LID principles includes plenty of porous surfaces that allow rainwater to filter through the soil and rejoin groundwater systems or water bodies. This includes conserving green spaces that absorb stormwater runoff flowing from impervious urban surfaces or constructing man-made rain gardens or swales for stormwater capture.[330]
- **Transit-oriented development** (TOD), or the design of communities that are connected by many options for human mobility. Communities designed according to TOD principles are centered around shared modes of public transportation, like transportation hubs that link regional trains to local buses, bikes, and safe, vibrant, walkable neighborhoods. Such design principles reduce automobile dependence and protect forest resources by keeping development thoughtfully concentrated.[331]

5) Support Market-Based Incentives for Conservation

Funding from individuals and businesses in the private sector is essential to the work of protecting important ecosystems, including forests. A 2016 report sponsored by the International Union for the Conservation of Nature estimated that there is a global funding gap of at least $250 billion between what is being spent and what needs to be spent on conservation in order to protect clean air, clean water and biodiversity.[332]

[328] Rhode Island Department of Environmental Management, *Village Guidance*.
[329] Scott Millar, Grow Smart RI, personal communication, 8 August 2019.
[330] RI Department of Environmental Management and Coastal Resources Management Council, *Rhode Island Low Impact Development Site Planning and Design Guidance Manua*l, March 2011.
[331] Roger Williams University, Housing Works RI, and GrowSmart RI, *Evaluating the Potential for Transit-Oriented Development in Rhode Island*, 2018.
[332] Credit Suisse AG and McKinsey Center for Business and Environment, *Conservation Finance From Niche to Mainstream: The Building of an Institutional Asset Class*, 2016, https://portals.iucn.org/library/sites/library/files/documents/2016-001.pdf.

Private Sector Investments in Forest Conservation

Conservation finance refers to strategies to attract private investments for conservation priorities. More private sector individuals and companies are seeking ethical strategies for investment that generate a financial return while supporting social and environmental causes.

The **Nature Conservancy "NatureVest" program** aims to bring $1 billion in private capital into conservation projects by 2021. Using this program, TNC was able to purchase and conserve land from the Plum Creek Timber Company, including 47,921 acres in the Yakima River Headwaters in Washington and 117,152 acres in the Lower Blackfoot River Watershed in Montana.[333]

The **Lyme Timber Company** is an example of a private forestland investment manager that collaborates with other stakeholders on important conservation work. The company focuses on the acquisition, management, and eventual sale of lands with unique conservation values, seeking to combine these conservation strategies with operational income yields. Lyme specializes in the negotiation and sale of working forest conservation easements that restrict development but allow income generation from sources such as sustainable timber harvesting, recreational leasing, and the sale of carbon-offset credits. Lyme is based in New Hampshire but has projects across the United States. To date, the company has permanently conserved approximately 820,000 acres of its historical portfolio through the sale of easements and other conservation instruments.[334]

The **Rhode Island Infrastructure Bank (RIIB)** has already established a revolving fund structure for leveraging private funds in important environmental projects. The RIIB grew out of the RI Clean Water Finance Agency, which was established to support clean water infrastructure projects by the RI General Assembly in 1989.[335] The RIIB mandate now includes energy infrastructure and brownfield remediation initiatives as well as clean water projects (RIIB). RIIB is the financial manager of the state water quality protection fund, which allows water utilities to acquire land in order to support land uses that protect clean drinking water in their watershed areas (See text box on page 37 to read more about Providence Water's water quality protection fund). Rhode Island's forestland can be seen as essential pieces of infrastructure needing investment for drinking water as well as carbon sequestration and other values. The RIIB can play an important role in bringing private financing to forest conservation work.

Private companies can also practice and incentivize sustainable forest management and conservation. **The Wildlife Habitat Council Certification** allows businesses to receive recognition for biodiversity enhancement and conservation education activities on their own corporate landholdings.[336] Companies can support healthy forests by using (or partnering with businesses that use) good forest management practices. Walmart and Unilever made commitments at the 2018 Global Climate Action Summit to eliminate deforestation from their global supply chains.[337] Maine-based L.L. Bean has made a

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[333] "Nature Vest," Nature Conservancy, accessed June 14, 2019, https://www.nature.org/en-us/about-us/who-we-are/how-we-work/finance-investing/naturevest/?vu=r.v_invest.

[334] "About," Lyme Timber Company, accessed June 14, 2019, https://lymetimber.com/about/.

[335] "Who We Are," RI Infrastructure Bank, accessed June 11, 2019, https://www.riib.org/who-we-are.

[336] "About WHC Certification," Wildlife Habitat Council, accessed July 15, 2019, https://www.wildlifehc.org/certification/about-conservation-certification.

[337] Katie Anderson, "At GCAS, Walmart and Unilever show leadership on forests: 3 big reasons to join them," Environmental Defese Fund (blog), September 13, 2018, http://business.edf.org/blog/2018/09/13/at-gcas-walmart-and-unilever-show-leadership-on-forests-3-big-reasons-to-join-them; Walmart, "Unilever and Walmart Announce Forest Sustainability Initiatives at the Global

commitment to source paper and packaging materials from forests that have received a sustainable forest management certification.[338] Such recognition programs incentivize private companies to support healthy forest management on their own lands and in their supply chains. To date, this program has two participants in Rhode Island, Exxon Mobile in East Providence and Fidelity Investments in Smithfield, both with limited visibility.

Carbon Offsets

Carbon offsets are an emerging finance tool that provides an opportunity for forest landowners to be compensated for making long-term commitments to storing carbon on their lands. These offsets rely on markets in which producers of greenhouse gases (such as energy companies with power plants that burn fossil fuels) seek to reduce their pollution impact by purchasing "offset" credits. Carbon markets can be either regulatory or voluntary for buyers of carbon credits. The best-known regulatory markets in the United States are the California Air Resources Board (ARB) and the Regional Greenhouse Gas Initiative (RGGI) cap-and-trade programs. Voluntary buyers of carbon credits are typically companies that want to improve their philanthropic or environmental image or social license.[339]

To date, the transaction record shows that forest carbon markets have proven to be an effective conservation tool for certain types of landowners with at least a few thousand acres, but, in most cases, they are not yet economically viable for the small properties that comprise the majority of Rhode Island's forest. In addition to requiring a decades-long commitment by the landowner (currently 40-100 years), barriers to executing forest carbon projects include their complexity, high transaction costs, and public skepticism. Forest carbon offset markets are rapidly evolving, however, and a number of conservation organizations are exploring or experimenting with "aggregation" strategies to enable more small landowners to access these markets. A 2017 amendment to the Resilient Rhode Island Act required the Executive Climate Change Coordinating Council to study a possible carbon pricing program for the state. RI OER and RIDEM will be managing the completion of a report on carbon pricing in Rhode Island in 2019 and 2020.

6) Actively Manage Rural and Urban Forestland to Maximize Forest Value

Active forest management is critical to conserving healthy Rhode Island forestland. Trees and forests grow and change on their own without human intervention. In many cases, however, forests and the human communities that depend on them can benefit from active management that employs the principles of silviculture, or applied forest ecology.[340] In most cases, silviculture mimics natural processes to steer future composition of the forest toward a desired outcome.

Climate Action Summit," (press release), September 13, 2018, https://news.walmart.com/2018/09/13/unilever-and-walmart-announce-forest-sustainability-initiatives-at-the-global-climate-action-summit.

[338] "Environmental Impact," LL Bean, accessed July 10, 2019, https://www.llbean.com/llb/shop/516914?page=environmental-impact.

[339] Paul Chamas and Mary Berry, "Forest Carbon Offsets" (factsheet), *Conservation Finance Network*, 2019 https://conservationfinancenetwork.org/sites/default/files/2019-01/CFN%20Toolkit%20-%20Forest%20Carbon%20Offsets.pdf.

[340] The USDA Forest Services defines silviculture as the art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands to meet the diverse needs and values of landowners and society: "Silviculture,"

Active forest management can be used to create positive outcomes for forest health and productivity, enhancing the values provided by forestland. Management activities can enhance the value of forests in the following ways:

- For landowners interested in a yield from their land, active management reduces the length of time required to **grow trees for wood products and also improves the quality of the wood**. Forest growth and productivity can be enhanced by applying an understanding of the biological characteristics of different species.
- Active management can also be employed to **enhance forest health**. At the landscape scale, forests with a wide range of species, age classes, and conditions represented will promote health through diversity and limit exposure to damaging agents that may threaten particular types of trees or sites.
- Forest management can use silvicultural principles to **create or enhance conditions that will be favored by targeted wildlife species**. Some species such as the white-tailed deer and coyote are habitat generalists that can thrive in a wide range of conditions, but most are less adaptable and have specific habitat requirements that are necessary for the species to live or spend part of its life cycle there. For decades, wildlife management remained focused on game species and some landowners still retain this focus, but a more holistic view is increasingly becoming the norm as detailed in the Rhode Island Wildlife Action Plan.
- Forest management practices can **protect water quality** by focusing on principles for preventing and controlling erosion and sedimentation. Since forests, trees, and associated wetlands are critically important for absorbing stormwater runoff and reducing flooding, restoration and management can enhance their ability to provide these services.[341]
- Managing forests to **sequester carbon and grow or maintain forest carbon stocks** is consistent with many other values. (See "Managing Forests for Climate Mitigation and Adaptation" on the next page.) Strategies to support carbon absorption and storage by forests emphasize the importance of intentional management and long-term planning, maintaining ecological functions, responding to disturbances, and retaining forests while increasing tree canopy coverage where possible.

All stakeholders with management authority over forestland in the state can support healthy forests by taking appropriate management actions. (See page 16 for an overview of the entities with management authority in the state.)

USDA Forest Service, accessed July 16, 2019, https://www.fs.fed.us/forestmanagement/vegetation-management/silviculture/index.shtml

[341] Holly K. Burdett et al., *Today's Forest, Tomorrow's Legacy. Fact Sheet 6: Working for Clean, Plentiful Water,* Southern New England Forest Consortium, Inc. and the University of Rhode Island Cooperative Extension, accessed online July 16, 2019, https://web.uri.edu/rhodeislandwoods/files/6.pdf.

Managing Forests for Climate Mitigation and Adaptation

Forest management is critical to enhancing the ability of forests to **mitigate** climate change and **adapt** to a warming world. Managing forests for carbon sequestration and storage dovetails with other values. When considering managing for carbon benefits, it is important to consider carbon in the context of overall management objectives for a given area. Management activities will affect the flows of carbon between different stocks or pools, as illustrated for a rural forest in the diagram below:

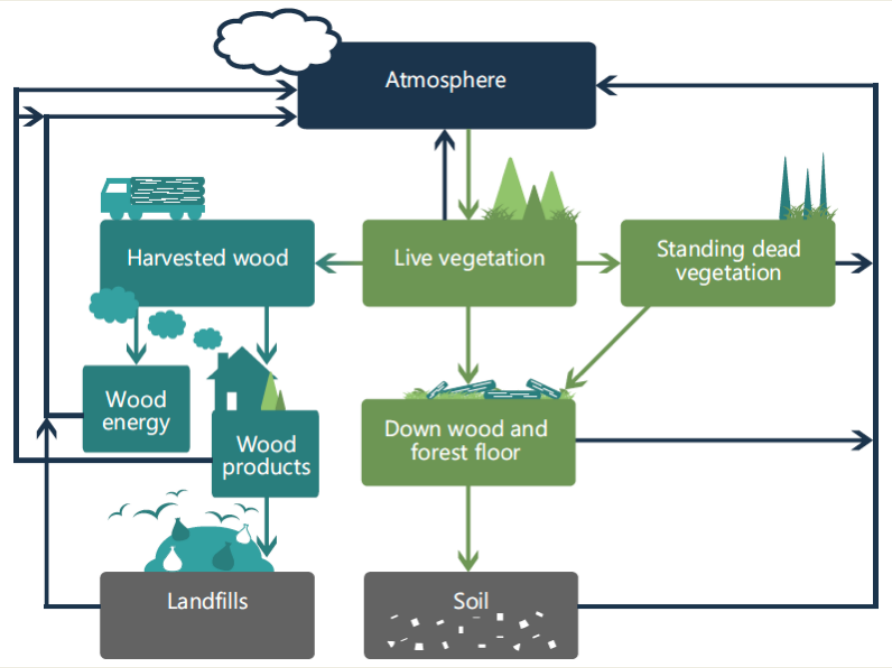

Figure 21: The forest carbon cycle includes forest carbon stocks and transfer between stocks. Source: Janowiak et al. 2017

Management impacts on carbon cycling depend heavily on scale and scope, which can vary both spatially (from a stand of trees to the state level, for example) and over time. When looking at fine scales, a management action such as planting trees along a street or conducting a timber harvest can have a significant impact on carbon stocks, whereas across larger scales and time periods the impacts may be minimal relative to the total carbon within the system.[342]

Scientists from the Northern Institute for Applied Climate Science (NIACS), a collaborative involving the USDA Forest Service, universities, and forest-dependent industries, have developed a "menu" of strategies, or responses that can be applied across a wide variety of resources and sites, for managing forest carbon (Ontl et al.).[343]

(Continued on the next page)

[342] USDA Forest Service, Northern Research Station, *Considering Forest and Grassland Carbon in Land Management,* by Maria Janowiak et al., General Technical Report WO-95 (Newtown Square PA, June 2017).
[343] Todd A. Ontil et al., *"A practitioner's menu of adaptation strategies and approaches for forest carbon management,"* (white Paper in review) (Northern Institute of Applied Climate Science, 2019).

More specific approaches and prescriptive tactics are available for each of the high-level strategies in the following list:

- Maintain or increase extent of forest ecosystems or tree canopy coverage
- Sustain fundamental ecological functions
- Reduce carbon losses from natural disturbance, including wildfire
- Enhance forest recovery following disturbance
- Prioritize management of locations that provide high carbon value across the landscape
- Maintain or enhance existing carbon stocks while retaining forest character
- Enhance or maintain sequestration capacity through significant forest alterations

Significantly, these strategies focus on carbon stocks and sequestration within forests and do not consider carbon benefits of harvested wood products. Long-lived wood products such as building materials and furniture continue to store carbon for a long time and thus have the potential to offer significant benefits over other materials when deployed at scale.

It is also important to consider how forests can help communities **adapt** to climate change. Forests have the potential to be a component of resiliency or climate adaptation planning strategies for the ecosystem services which they provide. Trees and forest ecosystems are helpful in moderating severe weather and buffering abrupt weather changes that are becoming the "new normal." In addition to filtering drinking water, forests are valuable for reducing stormwater runoff, controlling floods, and reducing the impacts of sea level rise in coastal areas. Forests also moderate extreme temperatures (both hot and cold) and buffer strong winds.

Along with other natural ecosystems, forests themselves are significantly impacted by climate change. These changes often come in the form of new or exacerbated stressors that affect the function of complex forest ecosystems. NIACS has developed a Climate Change Response Framework providing tools and approaches to help land managers (1) understand ecosystem vulnerabilities and (2) incorporate ways to help forests adapt to changing conditions into management planning and on-the-ground actions.[344] Forest adaptation approaches generally fall into three broad categories: Resistance (buffer or protect from change); Resiliency (promote the return to normal conditions after a disturbance (such as an extreme weather event)); and Transition (actively facilitate or accommodate change). The Climate Change Response Framework is not prescriptive and it does not suggest specific practices for land managers to consider and undertake. Instead, it provides "menus" or topical lists of possible types of adaptation actions for different focus areas, including both rural and urban forests and forested watersheds, to help managers move from broad ideas to specific actions. A community of practice is developing in the emerging field of forest climate adaptation and a network of demonstration sites in the Northeast and Midwest currently includes two sites in Rhode Island.

[344] Christopher W. Swanston et al., "Forest Adaptation Resources: Climate Change Tools and Approaches for Land Managers, 2nd Edition," General Technical Report NRS-87-2 (Newtown Square PA: USDA Forest Service, Northern Research Station, September 2016), https://www.nrs.fs.fed.us/pubs/52760.

Managing Rural Forestland

The majority of Rhode Island's exurban and rural forests are privately owned, providing the greatest opportunity for active management in terms of land area. Rhode Island's 38,000 private landowners are a varied group with diverse motivations for owning land. Forest management can provide many benefits. For example, through harvesting of timber and other products, landowners can earn income to offset property taxes and land management costs. In addition, research has suggested that landowners who are actively involved with their land are less likely to engage in activities that often have negative conservation impacts (such as selling, subdividing, or developing land).[345] Recent research indicates that family landowners increasingly care about the value of their land for wildlife habitat compared to traditional uses such as hunting and cutting firewood.[346] In a survey of Northeastern woodland owners conducted by the American Forest Foundation, 85% stated that protecting and improving wildlife habitat is an important reason they own their land.[347] Among private landowners, awareness and education may serve as an initial barrier to engaging in active management. Access to technical expertise and financial resources can also be challenges for private landowners pursuing active stewardship of their land.

Public and institutional forestland in Rhode Island includes land managed by different federal and state agencies, municipalities, utilities, schools and universities, and other organizations. This ownership class comprises many of the state's larger forested tracts and properties. Examples include State management areas and town-owned forests, parts of the Narragansett Bay National Estuarine Research Reserve, the Providence Water property surrounding the Scituate Reservoir, and the University of Rhode Island's W. Alton Jones Campus. Professionals or specialists are more commonly involved with managing these lands than smaller private properties. Budget levels and funding constraints, however, can similarly limit active forest management. Management of public forests typically depends on staffing and budget levels. RIDEM's Divisions of Forest Environment (DFE) and Fish and Wildlife are stretched in managing more than 40,000 acres of state-owned forests, and the DFE is further taxed with providing services to private landowners with a staff of fewer than 20 and a budget of less than $500,000. One study found that staffing at RIDEM has decreased 67% between 1989 and 2018, driven in part by a shortage of funding. There is one staff person for every 67 acres managed by RIDEM, while the best practice would be to have one staff member for every 30 acres.[348] Some public and institutional owners do not actively manage their forestlands simply because they have other priorities. Municipalities often do not have professional natural resources managers on staff and forest management is typically a low priority for funding after other public services, so management projects may depend on grants or periodic funding.

Conservation land in Rhode Island includes both small tracts and larger properties. A few large conservation organizations such as The Nature Conservancy and the Audubon Society of Rhode Island own reserves in Rhode Island, but the majority of private conservation land is held by small land trusts, many of which do not have paid staff. Therefore, conservation landowners typically have much in common with smaller private landowners when it comes to land stewardship.

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[345] See the Family Forest Research Center website at http://www.familyforestresearchcenter.org.
[346] Brett J. Butler, "Understanding and Reaching America's Family Forest Owners: Findings from the USDA Forest Service's National Woodland Owner Survey" (presentation, August 5, 2015), https://www.fs.fed.us/spf/coop/frcc/bbutler.pdf
[347] American Forest Foundation, *"Hidden In Plain Sight: Family-Owned Woodlands Are Key to Protecting and Improving Wildlife Habitats in the Northeastern U.S,"* (Washington DC: 2017), https://www.forestfoundation.org/northeastern-landowners-improve-habitats-release.
[348] RI State Parks Organizational Management & Operations Study, http://www.dem.ri.gov/riparks.

One measure of active forest management is the amount of timber harvesting on Rhode Island forestland. Net growth in Rhode Island's forests far exceeds removals from timber harvests on land not being converted to other uses. RIDEM has collected data on commercial timber harvests since 1997 through its "Intent to Cut" permitting process. Over the 21-year period from 1997-2017, an average year witnessed harvesting on 2,068 acres, removing 3 million board feet of sawtimber and 3,824 cords of low-grade wood per year. The average harvest occurred on 33 acres and yielded 56,000 board feet and 71 cords. The Intent to Cut data indicates low levels of active forest management on private lands, suggesting the presence of financial and technical knowledge barriers and a disconnect or lack of interest in seeing the potential benefits.

Managing Urban Forests

With approximately 286,000 aces or 43% of the state characterized as urban and community land, urban forests take on outsized importance in Rhode Island. Cities and large towns that have few forested areas still have many trees that provide critical benefits and ecosystem services, but require different strategies for management from rural areas. Trees in the urban environment grow in different spatial arrangements: individually (e.g. street trees, planters, and lawn trees), in groups (parks, surrounding buildings), and wooded areas (parks and greenways, private property, undeveloped land). Urban foresters typically focus on planning and caring for public trees, but can also help guide the management of trees on private lands, which usually dominate the overall urban forest composition. Management of trees on private land is typically carried out by private arborists, tree services, and landscapers, while many of these trees receive little care between planting and eventual removal. One of the benefits of urban forestry efforts is the direct human benefits they can provide, including improving health outcomes, strengthening connections within communities, reducing air pollution, and enhancing recreational opportunities.

All Rhode Island municipalities have a tree warden with responsibility for managing trees on city or town land. Urban forestry programs vary widely in scope from those in large cities such as Providence, which has a professional City forester with dedicated staff and budget, to those in rural towns where the tree warden may be a volunteer with few resources. In April 2019, RIDEM's Urban and Community Forestry Program organized what is thought to be the first meeting for the purpose gathering Rhode Island tree wardens to discuss their work. At this meeting, eleven Rhode Island tree wardens gathered to discuss available technologies to support their work, communication and education needs, and local challenges to their missions. Most tree wardens use their available time and community funding to maintain trees in public areas and remove trees that pose a hazard to surrounding properties. The ability of tree wardens to plant new trees is limited by time and funding (Notes from tree warden meeting, April 2019).[349]

Given the 43% of the State's land area classified as urban and community land, Rhode Island's populated areas provide some of the greatest opportunities for increasing forest management through tree planting and care, with the potential to dramatically boost canopy cover in the process. Urban forestry efforts typically begin with volunteers planting trees in public spaces. Follow-up maintenance such as pruning

[349] Judee Burr, notes from Tree Warden Meeting hosted by the RIDEM Division of Forest Environment, Cranston Central Library, April 4, 2019.

and eventual removal is less glamorous and may be harder to fund, but it is just as important.[350] The Providence Parks Department's Forestry Division manages the largest program in the state, with responsibility for 27,400 street trees as well as all trees in city parks and on public property.[351] Bolstering the City's municipal efforts is the Providence Neighborhood Planting Program (PNPP), a highly successful community tree program that provides multiple benefits in planting, stewarding, and advocating for trees in the capital city. (See the introduction of this report for a conversation with PNPP's director, Cassie Tharinger.) Planting an average of 500 trees a year, this effort is helping to gradually replace the city's aging trees and boost tree cover in underserved neighborhoods.[352]

Urban Edge Forests are Often Overlooked

In between the state's public and private rural forests and urban areas with street trees and defined parks and backyards is a landscape sometimes referred to as the "urban-wildland interface" that has many trees and important ecosystem components, but often receives less intentional management. In fact, most of the 150,000 acres of urban and community land that has tree cover falls into this category. Within the context of the largely developed landscape, a significant portion of this area is situated away from the focus of human attention: behind and to the sides of buildings on commercial and residential parcels, along transportation corridors, and in areas unsuitable for development. Some of these areas are disturbed landscapes where ecosystem function has been compromised and habitat value may be limited, while others may offer small intact areas where conservation values are high.

Of all Rhode Island's forested landscapes, those at the urban edge typically receive the least amount of targeted management as they often fall in the gap between traditional rural and urban forestry. Landowners do not see economic returns from managing these areas and they are usually a lower management priority compared to intact rural landscapes or higher-profile urban settings. Nonetheless, these urban edge forests are starting to gain more recognition for different values and benefits they provide.

Creating Forest Management Plans to Guide Stewardship

For rural and urban forests and those in between, a management plan is widely recognized as a guide helping advance sound stewardship. This document articulates the goals and objectives of the landowner or decision-making body and sets forth a schedule of activities intended to achieve them over a defined time period (often 10 years). A management plan summarizes attributes of an area of forest (or collection of trees, in some cases, for urban forests) within the context of the surrounding landscape and includes data from an inventory of the forest and associated natural resources.

The scope of a site-specific management plan is usually at the scale of an individual property, park, or geographic unit, but it can extend to the landscape level. Guidelines and standards for forest management plans relevant to Rhode Island include those established by the RI Department of Environmental

[350] Caroline Scanlan, "Overview of urban forestry in Rhode Island and beyond" (presentation, Rhode Island Woodland Partnership meeting, Warwick, RI, January 24, 2019).
[351] "Forestry Division," City of Providence, accessed July 16, 2019, http://www.providenceri.gov/providence-parks/forestry/
[352] "About PNPP," Providence Neighborhood Planting Program, accessed July 16, 2019, http://pnpp.org/history.

Management, the USDA Natural Resources Conservation Service (NRCS), the American Forest Foundation's Tree Farm System, and the international Forest Stewardship Council.

The process of developing a management plan often helps a landowner clarify goals and future plans and become more knowledgeable about their forest. It typically helps identify management concerns and opportunities and can help landowners access lower property tax rates and cost-share funding to implement plan recommendations. For example, a management plan is a requirement for private landowners enrolling in the State current use tax program or for receiving cost-share funding from NRCS to implement conservation practices. Still, only 15-25% of private landowners owning more than 10 acres of forest have a management plan for their land.[353]

7) Provide Education & Technical Assistance to Forest Landowners

From the planning stages through implementation and continuous monitoring, effective forest management requires resources and a long-term commitment over time. Limited access to education, technical expertise, and financial resources have proven to be challenges to managing Rhode Island's forests. Historically, income from selling timber and other forest products has helped pay for management, but while markets are constantly changing there has been an overall declining trend in markets for wood products in Rhode Island for a long time.

A challenge for many private landowners is becoming well informed about options for managing their land and leveraging resources to do so. Rhode Island is the only state in New England that does not have an extension forestry program operated by a state university. Forestry extension programs are able to provide educational opportunities and on-the-ground technical assistance to landowners while also researching management and resources issues and providing continuing education and training to natural resources professionals. The University of Rhode Island Cooperative Extension Program could be expanded to include a full-time Forest Extension Specialist to provide technical assistance. RIDEM's Forest Stewardship program is managed by one forester serving the entire state. A number of smaller organizations including the Rhode Island Forest Conservators Organization (RIFCO) and state chapter of the American Tree Farm System (ATFS) help provide educational resources for landowners. The Rhode Island Land Trust Council assists the state's many small land trusts, which often rely on volunteers or grants for stewardship work on their conserved lands. The Rhode Island Woodland Partnership is a coalition of organizations that has worked to increase the impact of forest conservation measures through education, information sharing, and coordination of activities since its establishment in 2013.

USDA Natural Resources Conservation Service (NRCS) has emerged as a major source of technical and financial assistance for private landowners since the 2008 Farm Bill expanded the scope of its mission to include forestry. In coordination with the state's three conservation districts, RI Resource Conservation & Development Council (RI RC&D), RIFCO, ATFS, and a network of forestry Technical Service

[353] Fern Graves, Stewardship Program Coordinator, RI Department of Environmental Management, Department of Forest Environment, email communication, July 26, 2019.

Providers, NRCS has become one of the most active organizations working on forest management and land conservation in Rhode Island through its range of programs.

Estate Planning Is Critical for Forest Conservation

Because private landowners control 68% of Rhode Island's forestland, estate planning is an important consideration when it comes to future land use and conservation. Individuals and families often do not give estate planning the attention it deserves, due to lack of familiarity with the process and legal tools and a natural reluctance to contemplate mortality.

With 80% of family forest owners aged 55 and older, the United States is experiencing the largest intergenerational shift of land the country has seen over a short time period. According to recent research conducted in three New England states and New York, one-third of landowners reported that they would be making decisions about their land's future ownership and use in the next five years. However, landowners show widely varying levels of preparedness: 25% have their land included in a trust, LLC, or conservation covenant in addition to a will, 42% have a will only, and 35% have no formal estate plan in place. Research specific to Rhode Island forest landowners is unavailable.

In the same study, the majority of forest landowners expressed an interest in or commitment to conservation, but it was clear that they need help in following through. Researchers concluded that property owners can benefit from professional estate planning advice and access to peer networks to help them move forward. Support from both professionals and peers is important. In addition, they noted that women play a very important role in decisions regarding the future of family land, in part because women typically live longer than men. Therefore, involving all family members in estate planning and addressing women's confidence in decisions regarding their land is a strategy that can help achieve positive conservation results.[354]

[354] Paul Catanzaro et al., "Their Land, Their Legacy: A Guide to Helping Inform Landowners' Decisions About the Future of Their Land" (Amherst, MA: Cornell University and the Universities of Maine, Massachusetts, Vermont, 2009), https://masswoods.org/sites/masswoods.org/files/pdf-doc-ppt/Their-Land-Their-Legacy-web.pdf

IV. Policy Recommendations to Promote Forest Conservation in Rhode Island

1. Develop and Implement a Rhode Island Forest Conservation Act

Although developing a statewide forest conservation act or other clear, enforceable forest conservation policies is beyond the scope of this report, enforceable policies for forest conservation tailored to Rhode Island's circumstances could be an effective long-term solution to the state's forest loss and fragmentation challenges. An enforceable statewide act could draw on and strengthen Rhode Island's existing conservation policies and programs and build on them by incorporating the mapping of forest resources; fees; or other disincentives for forest loss. Drawing on lessons learned in Maryland and other states, enforceable forest conservation policies – which could be developed as a "Rhode Island Forest Conservation Act" – could set conservation goals based on forest characteristics, make broader use of mitigation banks, and establish a "no net loss of forests" policy.

2. Devote More Public Funding to Forest Conservation

Most of the policies and programs recommended in this report require financial support to be implemented. Below is a list of possible public funding sources to support the forest conservation policies and programs outlined in the recommendations section:

- **Support State Bond Funding to Conserve Forestland**: The Governor and the General Assembly should continue to bring forth state bond issues for voter consideration that focus on land conservation, with an emphasis on the conservation of forestland and, in particular, forest areas of high conservation value.
- **Create Dedicated Funding Sources for Forest Conservation**: The Governor, the General Assembly and municipalities should consider dedicated funding sources for forestland and open space conservation through real estate transfer taxes or contributions from a general sales tax on a commodity like lottery, outdoor equipment or tobacco. Funding could be used for forest acquisition, additional support for public and private managers of forestland, covering transaction costs associated with land conservation, and many other activities recommended in this report. In particular, the Rhode Island Department of Environmental Management requires additional staff and funding to manage the state's forestlands under the jurisdiction of its urban and rural forestry programs.
- **More Water Utilities Should Conserve Watershed Land through the Public Drinking Water Protection Program**: Currently, a surcharge on drinking water creates a dedicated funding source for forestland protection, but not all utilities are participating in this program. More utilities should participate in this program to protect the forestland that ensures cleaner drinking water, and the surcharge could be increased to yield more funds.
- **State Matching Funds for Local Conservation**: The Governor and the General Assembly should adopt local enabling authority that must be approved by voters to encourage and make possible city and town investments in forest and open space protection through a local surcharge on property taxes, modeled after Massachusetts' Community Preservation Act. Ideally, this program should have a commitment of state matching funds.

3. Leverage Private Funding for Forest Conservation

- **Private Grants and Loans for Forest Conservation**: State and local governments, forest-based businesses, and conservation organizations can work with the Rhode Island Infrastructure Bank, CommerceRI, and other economic development partners to target private grants and loans and leverage available funding for forest conservation and management projects.
- **Support the Rhode Island Forest Industry**: A thriving, sustainable forest industry creates a private funding source for forest management. State programs and private foundations can support forest conservation by assisting with business plan development and financing opportunities for local forest-based businesses. The Local Agriculture and Seafood Act is a promising example of an effective grant program targeting businesses in the agriculture sector.
- **Forest-Friendly Business Certification Program**: Non-profit conservation organizations could create and manage a certification program that recognizes businesses that conserve forestland during their operations and development. Such a program would encourage private-sector involvement and investment in forest conservation.
- **Explore Carbon Offset Market Solutions**: Work with partners to explore market-based forest conservation strategies, including the sale of carbon offsets. If carbon prices increase, interest in and viability of Regional Greenhouse Gas Initiative offset projects will likely grow. The state could eventually have reason to require a certain percentage of offset projects—in particular, forest carbon offset projects—to be within Rhode Island's borders, protecting additional forestland.

4. Encourage Long-Term Conservation through the Farm, Forest, and Open Space Program

- **Revive the Farm, Forest and Open Space Valuation Committee and Notifications to Tax Assessors**: The Governor and the RI State Conservation Committee should call the Farm, Forest and Open Space (FFOS) Land Valuation Subcommittee back to order, as mandated by law (RI Gen. Law § 2-4-3.1), and should require new appointments, schedule regular meetings, and re-evaluate the current use rates in Rhode Island as soon as possible. The RI State Conservation Committee should provide a list of current use values for FFOS to each tax assessor through the Department of Administration on or before February 15th or each year in which the current use rates are evaluated, as mandated in RI Gen. Law § 2-4-3.1(c).
- **State and municipal officials should ensure consistency of FFOS implementation**: Effective program implementation relies on consistent interpretation of the law and the use of consistent tax rates between tax assessors and state officials. As mandated by law (RI Gen. Law § 44-27-8), Department of Revenue should inform cities and towns of FFOS rates on a yearly basis. RI Department of Environmental Management, RI State Conservation Committee, Department of Revenue and the Rhode Island Association of Assessing Officers should coordinate and create a program that provides tax assessors with a training in the FFOS program.
- **Adopt Right of First Refusal**: The Governor and the General Assembly could strengthen the FFOS law by adopting a Right of First Refusal clause in the FFOS program aimed to prevent development, rather than slow it down, similar to Ch. 61 in Massachusetts. Cities and towns would have the right of first refusal to purchase properties in FFOS that are slated to be converted

to a different land use. There is a need to address funding sources for cities and towns in order to make it viable for them to exercise this right and purchase land for conservation.

- **Strengthen FFOS to Include Notifications**: The Governor and the General Assembly should strengthen the FFOS law by adding a mechanism to FFOS that requires notification to the state if a parcel comes out of program, with a waiting period before the land is developed. Currently the state does not need to be notified if a parcel comes out of FFOS.
- **Strengthen FFOS to Retain Land Use Change Tax After 15 Years**: To encourage that land stays in the FFOS program, the Governor and the General Assembly could strengthen the FFOS law by retaining the Land Use Change Tax after the 15th year for a parcel of forestland and the 10th year for farmland.
- **Support outreach to increase landowner participation in the FFOS program**: State and local governments or private organizations should conduct more outreach to increase participation in the FFOS program and research reasons for lack of landowner participation.

5. Increase Landowner Benefits from Conservation Easements

- **Create a database to help educate landowners on available conservation easement programs and options**: Conservation organizations or state and local governments could collaborate to fund an easily accessible database of conservation easement programs. Currently, it is difficult for landowners to identify easement programs for which their land qualifies. A database could assist landowners in navigating the variety of programs and selecting an option that meets their unique land specifications and personal preferences.
- **Adopt state income tax benefits for landowners who donate easements**: Landowners could receive credits for their donations for properties with high conservation values.
- **Fund transaction costs**: Continue to support and fund programs that pay for transaction costs, which are the biggest barrier to landowners donating easements on their land.

6. Incorporate Forest Conservation Into Land Use Planning

- **The Rhode Island Department of Administration's Division of Statewide Planning should encourage local comprehensive plans to incorporate the forest conservation goals and policies outlined in the State Guide Plan**: Municipalities are mandated to update comprehensive plans with adherence to State Guide Plan, but not all local comprehensive plans are in compliance. State-level planning officials should ensure consistency between State Guide Plans and local comprehensive plans to support the conservation of forest areas of high conservation value.
- **The Division of Statewide Planning should coordinate with the RIDEM Division of Forest Environment and RIDEM Planning and Development to identify and map priority forest conservation areas in the State Guide Plan and Forest Action Plan**:
    - The Division of Statewide Planning and the RIDEM Division of Planning and Development should use mapping tools to identify forest areas of high conservation value, including core forest areas, and support state and local planning to guide development away from these core forest areas. The RI Wildlife Action Plan's Conservation Opportunity Areas map could be used as a starting point for mapping critical areas for conservation as part of statewide guidance to municipalities.

    - Municipalities should identify local forest areas of high conservation value and designate them for conservation during local planning processes. This process could be modeled on Maryland's "Rural Legacy Areas" program.
- **State and local planning departments should incentivize smart-growth planning tools that conserve areas of high conservation value:** Update and disseminate state technical assistance materials on smart growth planning tools – including conservation development and transfer of development rights – that can help Rhode Island municipalities adopt these planning techniques. Local planning board members should be required to take a course on the value of forests, the importance of forest conservation, and the techniques available to implement forest conservation in their municipalities, similar to courses that planning board members are required to take on climate change.
- **RIDEM should create a Statewide Community Certification Program to reward cities that protect natural resources**: Modeled on programs in Connecticut and Massachusetts, RIDEM could certify communities that protect forest areas of high conservation value and other important natural resources. Certified communities could be prioritized for state grant funding like Local Open Space Grants.
- **RIDEM should create a handbook to guide municipalities in implementing forest conservation priorities:** A handbook was created for cities and towns to adapt the Wildlife Action Plan to their comprehensive plans. A similar handbook could be created to support communities in implementing best forest conservation practices.

7. Avoid Forest Loss from State or Municipal Programs Used to Encourage Development

Large-scale development activities can cause significant deforestation. In addition to incorporating forest conservation into planning processes, policies and programs that aim to incentivize development should include forest conservation values. Although this report does not comprehensively discuss all forms of development, minimizing deforestation caused by renewable energy siting activities emerged as a prominent issue for statewide forest conservation in Rhode Island. Governments, non-profits, and individuals can actively promote responsible renewable energy siting on homes, brownfields, commercial buildings, and parking lots to support forest conservation while developing Rhode Island's clean energy grid. Opportunities for action include the following:

- **Statewide programs that fund clean energy installations should incentivize responsible project siting**: State renewable energy incentive programs should prioritize rooftop solar projects and clean energy installations on previously used land in order to direct renewable energy projects away from forestland and other green space. Like the SMART program in Massachusetts, the Rhode Island Renewable Energy Growth Program could include additional incentives for projects sited in preferred locations.
- **Municipalities should develop and implement renewable energy siting ordinances that avoid and minimize forest loss.**
- **Requests for Proposals (RFPs) for renewable energy projects should include responsible siting criteria** to solicit projects that conserve forest areas of high conservation value. Cities, towns, businesses or other entities that use electricity produced from solar projects can negotiate with developers during the RFP process to site new renewable energy projects responsibly away

from forest areas of high conservation value. A map of forest areas of high conservation concern could be used as a tool to help regulators guide solar projects away from important environmental areas.

8. Implement Forest Management Best Practices at the State and Local Level

The negative impacts of deer overpopulation and invasive species on forest health are prominent issues in Rhode Island's forestry community. Reforestation can expand the benefits of trees and forests to new communities and enhance forest health. Although this is not a comprehensive list of beneficial actions that state and local governments can take to support sustainable forest management, these are important policy changes that can support healthier forests:

- **The state government should prohibit the sale of invasive species** as they are a threat to forest health. Bans on the sale of invasive species are in place in surrounding states and should be implemented in Rhode Island in order to reduce the pressure of invasive species on native forests.
- **The Division of Fish & Wildlife should set hunting guidelines that include forest health as an objective**. Overabundant deer populations have a negative impact on forest regeneration, and hunting policies that recognize forest health goals will be most effective in promoting overall ecosystem health.
- **The RIDEM Division of Forest Environment should continue to implement and expand tree planting strategies** that increase canopy cover in urban areas to protect communities from urban heat, flooding, the effects of climate change, and improve safety in the Urban Service Boundary. Reforestation efforts should also be encouraged and funded in suburban and rural areas to support forest health and as part of a climate change mitigation strategy.

9. Support the Cultural Value of the State's Forestland

- **Allow Tribal Hunting and Gathering to Support Cultural Value of Forestland**: Rhode Island Department of Environmental Management should allow hunting and gathering by indigenous people on state lands to support the indigenous community and their cultural relationship with forests. Supporting cultural relationships between humans and forestland is beneficial to forest health and conservation across the state. The Tribal government, RIDEM, forest conservation organizations, and organizations representing landowners could also work together to facilitate communication between tribes and private landowners to support cultural uses of private forestland.
- **Involve Indigenous People in Forest Conservation Work**: Involving tribal members in projects and plans that impact their traditional landscapes can help incorporate cultural values into current decision-making, allowing policies to reflect the cultural value of forests in addition to other forest values. Tribal members should be invited early in the planning process to participate in forest conservation projects in order to support meaningful collaboration between tribal and non-tribal stakeholders.
- **Support Community Programs that Celebrate Forests and Trees**: Programs that celebrate trees, wooded parks, working woodlands, and other forested areas that provide a sense of place to Rhode Island communities are important to sustaining a culture of forest conservation. Conservation organizations and community groups can continue to celebrate trees and forests

through new and established programs, like community tree planting initiatives to encourage local engagement with forests and trees.

10. Improve Private Landowner Education and Outreach on the Importance of Forest Conservation

- **Fund a full-time Forest Extension Specialist at the URI Cooperative Extension Program to support landowner education and engagement around forest conservation issues:** This position would be dedicated to forest conservation, management and field research. This could be part of an ongoing program to help landowners with estate planning and advice on forest conservation options/opportunities and assistance for those interested in proceeding. This could be similar to the Legal Food Hub managed by the Conservation Law Foundation that helps landowner and food industry individuals with legal issues.
- **Digitize and update important forest conservation outreach materials**: State and local governments and conservation organizations should make forest conservation information accessible using engaging online platforms and social media communication. Many forest conservation-related programs do not have updated materials or digital avenues for public outreach. In particular, educational materials and brochures for the Farm, Forest, and Open Space Program should be easily accessible online and include clear and concise instructions. Materials should be updated at least every 5 years, or more often for time-sensitive programs.
- **Showcase forestry best management practices in the field for private landowners:** State and local governments and forest conservation organizations should collaborate on forest management outreach activities within Rhode Island and across state boundaries, including explanations of relevant funding sources and incentive programs. Many RI organizations hold field demonstrations without such collaboration. Regional Conservation Partnerships can be key leaders in implementing demonstrations that pool local and regional knowledge that is important for forest management. Two best management practices of primary concern that should be included in demonstrations are:
    - Addressing the impacts of deer browse on the future of RI's forest; and
    - Addressing the impacts of invasive species.
- **Support outreach to new landowners and efforts such as estate planning for longstanding forest landowners for continuing stewardship**: Conservation organizations along with state and local governments should collaborate to provide more effective outreach to new forest landowners, provide them with information on the value of forests, and connect them to conservation programs. Conservation organizations should continue to assist with forest landowner training on estate planning with the goal of establishing an ongoing program. These organizations should collaborate to strengthen outreach efforts.
- **Support the use and recognition of Rhode Island wood industry products:** Establish a recognition program for Rhode Island wood products, as neighboring states and Rhode Island's agricultural industry have done. RIDEM should consider recommendations from the RI Woodland Partnership's Wood Industry Focus Group report, especially those related to extending agricultural industry benefits to the forestry industry.

V. Conclusion

A prominent 20th Century Rhode Island conservationist and longtime director of the Audubon Society of RI, Alfred Hawkes, is sometimes remembered for referring to the state's forests as the "Invisible Green Giant." He perceived they were often seen as little more than a green backdrop in the Ocean State. In a 1979 op-ed article, Hawkes wrote: "[W]e in Rhode Island regard our forests as some sort of poor relative. We tolerate them, because they are there, we nod at them sweetly when they help us out, and we get rid of them when they are in our way…We have been interested only in short-term dollar value, and neglected the long-term attention which our forests require if they are to provide for us as they have in the past."[355]

Betty Pond. Credit: Christopher Riely

Rhode Island has come a long way in recognizing the value of its forests in recent decades. The days of extractive logging without regard to the future of the land and removing trees from our city and village centers and residential areas are behind us. The state, its 39 municipalities, and private organizations and individuals have all taken important steps to protect and take care of forests that provide us with essential services and improve our quality of life. Rhode Island's forests are quietly and efficiently providing the state and its residents with many benefits in a highly cost-effective way, including:

- Safeguarding our drinking water;
- Cleaning the air we breathe;
- Boosting the economy, especially in rural areas;
- Removing carbon from the atmosphere;
- Buffering against the effects of severe weather and climate change;
- Offering recreation opportunities for people of all ages;
- Improving human health;
- Serving as home and stopover for wildlife species;
- Holding cultural values and contributing to a sense of place; and
- Building community by bringing people together.

The sum of the benefits that Rhode Island's forests provide is greater than any single attribute. Some of these benefits are more easily quantified than others and it is impossible to adequately express some values as numbers. The hundreds of millions of dollars that forests contribute to state's economy falls far short of their intrinsic value, while a narrow focus on carbon and climate resiliency similarly misses the range of benefits that are not included in this type of accounting.

[355] Alfred L. Hawkes, "Rhode Island's Most Valuable Resource," Rhode Island Audubon Report, April 1979.

Conserving the state's forests is a forward-looking and wise investment in Rhode Island's future. Many other places with a high population density would be envious of the opportunity that Rhode Island has to enhance its rural and urban forest resources. The time to protect them is now before it becomes more expensive in the future or these chances are lost forever. The original costs of establishing or setting aside iconic landscapes such as Roger Williams Park, the Scituate Reservoir watershed lands, and the Arcadia Management Area are a small fraction of the funding, resources, and political will that similar projects would require now.

Credit: Audubon Society of Rhode Island

Forests provide an essential green fabric that contributes to the landscape mosaic of Rhode Island. We all need homes, schools and workplaces, transportation and energy infrastructure, gathering places, and field and farms, but forests are a critical presence among all of these other features. The range of benefits that forests provide is unique among land uses. It is time for Rhode Island to fully recognize its forests for their contributions to the state.

About the Consultant Team

This project was managed by the RI Tree Council, with funding from RIDEM. The RI Tree Council hired the consultant team of Christopher Riely, Kate Sayles, and Judee Burr to complete a report and factsheet with the goals of: explaining the value of Rhode Island forestland; providing an overview of reasonable options to prevent or discourage the further conversion of RI forestland; and recommending policies and programs that can be implemented in Rhode Island to encourage forest conservation. The RI Tree Council convened the Forest Conservation Advisory Committee ("the Committee") to oversee the completion of the report and associated factsheet.

The Committee met 6 times between January and August 2019 in order to oversee the completion of this project. Another collaborator on the project, Maggie Ferrato – a graduate student in the Yale School of Forestry – completed the memo found in Appendix C as part of her graduate coursework, with the goals of providing timely information to RIDEM and supporting the work of RI Tree Council.

The Consultants:

Christopher Riely is the owner of Sweet Birch Consulting, LLC. He helps families and organizations care for and make informed decisions about their land and works with partners on collaborative forest stewardship, conservation, and research projects. Christopher is a co-founder and the Coordinator of the Rhode Island Woodland Partnership and he worked on managing Providence's Scituate Reservoir watershed lands for 11 years. A Certified Forester and Arborist, he has a Master of Forestry from Yale and an MBA from the University of Rhode Island.

Kate Sayles is a conservation consultant specializing in natural resources issues. She is employed as the Agriculture and Forestry Coordinator for the Northern RI Conservation District, and the Coordinator for the Forestry for RI Birds program for RI Resource Conservation & Development Council. She is passionate about assisting landowners with conservation strategies on their land and specializes in forestry and wildlife management. She holds a Bachelor of Science degree in Wildlife and Conservation Biology from the University of Rhode Island.

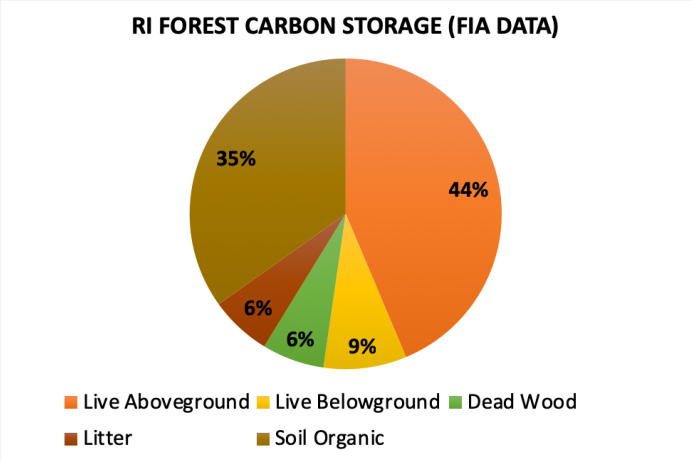
Judee Burr is a consultant specializing in environmental research, report writing, and communications work. Her recent projects include the *Forestry for Rhode Island Birds* guides, a project of the Rhode Island Woodland Partnership and RI Resource Conservation & Development Council, and *The Equity-Informed School Climate Assessment of Manchester Public Schools*, a project of RE-Center. She previously worked as a Policy Associate for the non-profit think tank Frontier Group and holds a Bachelor of Science degree in Earth Systems and a Bachelor of Arts degree in Philosophy from Stanford University.

Appendix A: Forest Carbon Data

The USDA Forest Service's Forest Inventory and Analysis (FIA) program maintains a nationwide network of "continuous forest inventory" or periodic monitoring plots that provide data for an ongoing census of the nation's forests.[356] The forest carbon estimates provided in this section are from FIA data interpreted in consultation with experts from the Forest Service's Northern Research Station. The URL data links provided below are from the FIA program's EVALIDator 1.8.0.00 database.[357]

Rhode Island Forest Carbon Density (Storage) Data

Since 2003, FIA has conducted an annual sampling inventory in Rhode Island and currently measures 14% of the sample plots each year. For the 2017 inventory, estimates of statistics such as volume and biomass were based on 222 plots sampled between 2011 and 2017.[358]



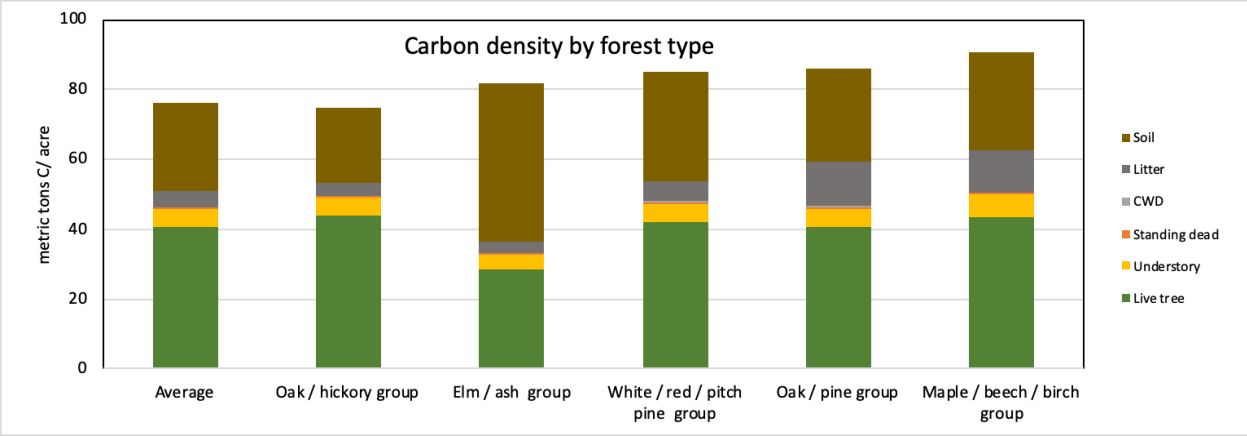
FIA EVALIDator data links[359]

Total Acres:	https://go.usa.gov/xy73s
All Carbon Pools:	https://go.usa.gov/xyfAS
Live Aboveground:	https://go.usa.gov/xyfHX
Live Belowground:	https://go.usa.gov/xyfHR
Dead Wood:	https://go.usa.gov/xyfHm
Leaf Litter:	https://go.usa.gov/xyfHV
Soil:	https://go.usa.gov/xyfH7

[356] USDA Forest Service, Forest Inventory and Analysis National Program: Forest Carbon Estimation (2019), https://www.fia.fs.fed.us/forestcarbon/index.php
[357] USDA Forest Service, Forest Inventory and Analysis Program, Forest Inventory EVALIDator web-application Version 1.8.0.00. St. Paul, MN: U.S. Department of Agriculture, Forest Service, Northern Research Station, http://apps.fs.usda.gov/Evalidator/evalidator.jsp
[358] Butler, *Forests of Rhode Island,* 2018.
[359] USDA Forest Service, Forest Inventory and Analysis Program, Forest Inventory EVALIDator web-application.

For greater statistical accuracy (lower standard deviation and tighter confidence intervals), estimates of forest carbon density and sequestration for different forest types include both FIA plots in Rhode Island and also plots in similar forest types in Connecticut.

Statistics for Forest Carbon Density (Storage) Among Different Forest Types



FOREST TYPE	# PLOTS	AVERAGE (mtC/ac)	STANDARD DEVIATION	95% CONFIDENCE INTERVAL (LOW) (mtC/ac)	95% CONFIDENCE INTERVAL (HIGH) (mtC/ac)
Total	**443**	**76.2**	**3.2**	**73.0**	**79.4**
Oak / hickory		74.8	5.7	69.1	80.5
Elm / ash		81.4	29.2	52.2	110.6
White / red / pitch pine		85.2	38.5	46.7	123.7
Oak / pine		85.8	39.7	46.1	125.5
Maple / beech / birch		90.8	38.1	52.7	128.9

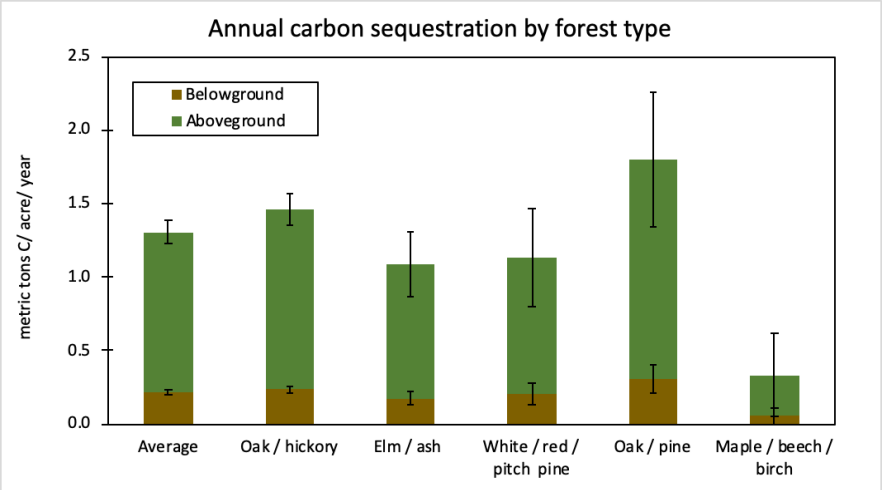
mtC/ac = metric tons of carbon per acre

FIA EVALIDator data links[360]

All Carbon Pools: https://go.usa.gov/xyfAc
Live Aboveground: https://go.usa.gov/xyfAa
Live Belowground: https://go.usa.gov/xyfAC
Dead Wood: https://go.usa.gov/xyfAY
Leaf Litter: https://go.usa.gov/xyfAg
Soil: https://go.usa.gov/xyfA4

Statistics for Forest Carbon Sequestration Among Different Forest Types

[360] USDA Forest Service, Forest Inventory and Analysis Program, Forest Inventory EVALIDator web-application.



FOREST TYPE	# PLOTS	AVERAGE (mtC/ac/yr)	STANDARD DEVIATION	95% CONFIDENCE INTERVAL (LOW) (mtC/ac/yr)	95% CONFIDENCE INTERVAL (HIGH) (mtC/ac/yr)
Total	**397**	**1.31**	**0.09**	**1.22**	**1.40**
Oak / hickory	276	1.46	0.13	1.33	1.59
Elm / ash	33	1.09	0.27	0.82	1.35
White / red / pitch pine	21	1.14	0.41	0.73	1.54
Oak / pine	19	1.8	0.55	1.24	2.35
Maple / beech / birch	30	0.33	0.33	0	0.67

mtC/ac/yr = metric tons of carbon per acre per year

FIA EVALIDator data links[361]
Total Acres: https://go.usa.gov/xyEgT
Average Annual Net Growth (Aboveground): https://go.usa.gov/xyEgE
Average Annual Net Growth (Belowground): https://go.usa.gov/xyEgs

[361] USDA Forest Service, Forest Inventory and Analysis Program, Forest Inventory EVALIDator web-application.

Appendix B: Memorandum on "Strategies for balancing solar development and forest conservation in RI"

MEMORANDUM

To: Janet Coit, Director, RI Department of Environmental Management
From: Maggie Ferrato
Date: May 8, 2019
RE: Strategies for balancing solar development and forest conservation in RI

As you know, Rhode Island is losing forestland each year to development. While the state was 67% forested as recently as 1967, only 388,992 out of 674,560 acres—57.7% of total acreage—are covered in forest today. And only 213,000 of these forested acres qualify as Core Forest (blocks of forested land 250 acres or greater, unbroken by development). One of the greatest threats to Rhode Island's forestland is fragmentation, or "the breaking of large, contiguous, forested areas into smaller pieces of forest," often due to development. You may recall that Judee Burr, Christopher Riely, and Kate Sayles are in the process of writing a thorough report on Rhode Island forestland, the development pressures it faces, and policies that might alleviate this pressure.

While forest loss and fragmentation across the state is not a new trend, solar development represents an emerging threat to Rhode Island's forestland. And, since the expansion of solar development is central to the state's climate goals, this trend is likely to continue. Governor Raimondo has set ambitious clean energy targets, including a state-wide target of 1,000 MW of clean energy by 2020 and a commitment to procure 100% of the state government's energy from renewable sources by 2025. Although some recent solar projects have been sited on previously disturbed land, a number of others have necessitated the clearing of acres of forestland.
In January, we agreed that I would provide an overview of strategies to balance solar development and forest conservation in Rhode Island. The following memo is the result of numerous conversations with state policymakers, environmental organizations, renewable energy developers, and other stakeholders on this topic. It details policies that may fit with Rhode Island's particular circumstances and provides an overview of approaches that neighboring states have taken. Further, it is designed to complement the state's current work with municipalities on solar siting, the forest report under development by Judee, Christopher, and Kate, and DEM's own experience with these topics. The majority of policy solutions suggested here can be characterized as tweaks to existing programs or processes in order to direct solar development to previously-disturbed lands (Section A), but the memo also includes suggestions that represent

broader (beyond solar) approaches (Section B). Written sources are cited at the end of the memo, while Section C contains a list of stakeholders consulted.

Strategies for balancing solar energy development and forest conservation in Rhode Island:

1. Build forest loss mitigation requirements into state-wide clean energy programs.
2. Include adders/subtractors in renewable energy incentive programs.
3. Build a core forest mapping tool into RFPs.
4. Require the Energy Facility Siting Board to review all solar projects.
5. Expand acreage protected by state conservation funding, easement agreements, etc.
6. Conduct outreach to offtakers. Establish a forest-friendly solar certification program.
7. Curate a list of potential project locations on previously disturbed lands.
8. Sell forest carbon offsets into carbon markets.
9. Pass a RI Forest Conservation Act.
10. Establish a community certification program.

Section A

Build forest loss mitigation requirements into state-wide clean energy programs, requiring renewable energy developers to offset development impacts.

Renewable energy project developers rely on statewide incentives for clean energy development, including the Renewable Energy Growth Program and the Renewable Energy Fund. The former enables distributed generation projects under 5 MW to sell energy to National Grid at a fixed, long-term price. The latter provides grants for renewable energy projects. Note: A recent REF sub-program, the Brownfields Solar PV Program, makes available $1 million for projects on brownfields. As of March 18, 2019, there was $825,000 remaining in this fund.

Participants at the March 2019 Rhode Island Land & Water Conservation Summit expressed concern that the current administration's clean energy incentives have, in practice, encouraged solar development on forested land—the protection of which is also a state priority. In order to better align the state's policy priorities, OER and DEM could implement additional restrictions or requirements for developers seeking to utilize state incentives for renewable energy development.

For example, developers seeking to site solar in core forest area could be prevented from accessing state clean energy incentives. This spring, Grow Smart, Save the Bay, and others proposed an amendment to the solar siting bill that would have eliminated incentives for solar development in 'areas of environmental concern,' including core forest. The status of this amendment is unclear. Alternatively, developers utilizing state-wide clean energy incentives could be required to mitigate forest loss, based on well-established conservation banking

principles. Under such requirements, developers would first need to avoid, then reduce, and finally mitigate unavoidable effects of solar development on forestland.

Maryland's Forest Conservation Act (FCA), discussed in more detail in Section B, might offer a useful model, though it is not specific to solar development. Under the FCA, developers are required to meet certain thresholds for forest canopy, depending on the type of site. This must be accomplished by first preserving on-site forest, then by re-/afforestation on or near the site, and finally, as a last resort, by paying into the applicable forest conservation fund.[i] Alternatively, mitigation requirements for solar developers in Rhode Island could be based on non-acreage factors, such as equivalent carbon sequestration or a bundle of equivalent ecosystem services and characteristics. However, one important feature of any such program should be predictability for developers, rather than project-by-project determinations of mitigation. The latter is characteristic of Connecticut's siting council process, discussed below.

While embedding forest loss mitigation requirements into state-wide clean energy incentives is one possible route, participation in a voluntary forest loss mitigation program or fund could instead qualify developers for streamlined permitting or enable them to take advantage of additional financial incentives for solar development.

Include adders/subtractors in renewable energy incentive programs.

One goal of the relatively new Solar Massachusetts Renewable Target (SMART) Program is to promote solar development on previously disturbed land, according to Patrick Woodcock of the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA).
In 2016, the Massachusetts General Court (the state's legislative body) passed relatively broad legislation authorizing the Department of Energy Resources (DOER) to "develop a statewide solar incentive program" that, inter alia, relies on market-based mechanisms to set incentive levels and encourages solar generation where it can provide benefits to the distribution system (St. 2016, c. 75, § 11).[ii] In 2017, DOER promulgated regulations to set the regulatory framework for the SMART program (225 CMR 20.00) and, in 2018, the program began accepting applications from developers.[iii] The SMART program will ultimately support 1,600 MW of new solar generating capacity.[iv]

In practice, the program sets base compensation rates for solar projects, which are paid by the utility (i.e. National Grid) to the renewable energy system owner. Projects qualify for 'adders' and 'subtractors' – tweaks to the base compensation rate – based on their characteristics. To address siting concerns, the SMART program established three land categories with varying subtractors: agricultural/non-agricultural land (no subtractor), undeveloped land zoned for commercial and industrial uses (a subtractor of $0.0005/kWh per acre impacted), and land not included in Category 1 or 2 (a subtractor of $0.001/kWh per acre impacted). Additional

information can be found in the SMART Land Use and Siting Guidelines (see footnote for link).[v]

Patrick Woodcock reported that while a primary objective in setting up the SMART program was to encourage geographically strategic solar development in the state's relatively mature market, it is too early to say if the program has been effective in this respect. He noted that since the program launched, the state has continued to receive applications for solar development on greenfields, though these projects were not yet constructed as of mid-March 2019. The state will be conducting a public review this year to evaluate differentiated compensation and other program characteristics, which may be of interest to Rhode Island.
Note: Projects 5 MW and under are eligible for the SMART program. This is the size at which developers typically don't need interconnection agreement with ISO NE. Larger projects are typically handled through the RFP process, and siting of these projects is qualitatively considered during project selection. The RFP process is discussed in the next section.

Build a core forest mapping tool into RFPs.

Connecticut and Massachusetts both consider forest impacts during their RFP processes. In Massachusetts, the siting of large solar projects is qualitatively considered during project selection. In Connecticut, a core forest screening tool is built into RFPs. In addition, during the RFP process, Connecticut's Department of Energy and Environmental Protection (DEEP) also requires developers to submit an analysis of their proposed project's impact on natural resources.[vi]

Connecticut's first RFP, released in 2012, resulted in significant forestland lost to clean energy development, according to DEEP staff. In response, DEEP reworked its RFP process to impose loose threshold requirements on bidders. DEEP staff members report that these changes have improved the quality of projects submitted, even as the price of solar continues to fall.
DEEP's primary change to the RFP process was the addition of a screening tool—the Forest Habitat Impact Map—to the state's 2018 RFP.[vii] Created in ArcGIS, the screening layer identifies "prime continuous and connected core forestland blocks." This layer was built from a combination of spatial layers, all of which identify resources that could be adversely affected by development (including forest blocks, New England Cottontail habitat, high quality watersheds, early successional habitat, and other landscape features). See Appendix 1 for DEEP's internal methods and guidelines documents. See footnotes for a link to the screening tool.[viii]

Developers are advised that if their project intersects with the Forestland Habitat Impact Map, it may materially affect core forest. If this is the case, the project may still be selected, but developers will be required to consult with DEEP during the subsequent siting council review in order to mitigate the project's potential effects. The statute governing the Connecticut Siting

Council review process (detailed in the next section), was updated in 2017 to better protect forestland.[ix]

Rhode Island might consider building a screening tool into its RFPs. However, a tool like Connecticut's may be useful only if the state selects projects within Rhode Island's boundaries through the RFP process and if there are regulatory implications for projects that overlap with a forest layer in the tool.

In the absence of regulatory implications, there is still merit to building a map feature of some sort into Rhode Island's RFPs. For example, a map of Rhode Island's core forest could be overlaid with National Grid's heat map (linked in footnote) and other energy-specific resources to direct solar development toward areas of greater load.[x] Developers already make use of energy data to select project sites, and a map that overlays this information with core forest could help them make smarter siting decisions more easily. This could reduce conflict between clean energy developers and local environmental groups, concerned citizens, and municipalities facing solar siting challenges. During an April conversation, Paul Raducha, Senior Developer at Kearsarge Energy, thought this could be a helpful tool.

Updates to the screening tool in Connecticut. DEEP staff reported that the release of the tool has not been seamless. There has been significant miscommunication with developers about the implications of proposed projects within the screening tool's core forest area. William Herchel, a renewable energy developer and Chief Executive Officer of Verogy, reported that it has proven difficult to identify suitable sites for solar development that do not overlap the core forest layer. While he's aware that overlapping with the core forest layer does not automatically disqualify projects, he is wary of costs of mitigation actions required by DEEP on a project-by-project basis. He noted that without a strong grasp of what these mitigation actions might be early on, the additional costs incurred can make a project economically unfeasible. While he prefers the predictability of Massachusetts' SMART program, he did acknowledge that Connecticut's screening tool and Siting Council process have made him more likely to seek out rooftop and brownfields sites for solar development.

In the coming months, DEEP's Shannon Kearney plans to update the screening tool. She noted during a conversation in April that the forest layer includes watershed-level data, which has resulted the inclusion of some developed land in the forest layer. This added to confusion about the use of the tool. Shannon was also enthusiastic about overlaying natural resource and energy data in an updated version of the tool.

Importance of complementary state policies. A contentious solar development in Connecticut highlights the shortcomings of RFP processes in New England. In October 2016, Ameresco's Candlewood Solar project was selected through the Tri-State Clean Energy RFP. If constructed

as planned, the project will necessitate the clearing of 54 acres of core forest. For this reason, it is facing significant opposition.[xi]

While Connecticut declined to select the project during the RFP process, Massachusetts opted to move forward with it. And although future projects like Candlewood Solar are unlikely to be certified under Connecticut's new siting council regulations, states will continue to select projects outside of their boundaries. In fact, Rhode Island received proposals for projects located in Massachusetts and Connecticut through its ongoing RFP.[xii] The state should take care that projects selected don't contribute to forest fragmentation either within Rhode Island or beyond its borders.

Require the Energy Facility Siting Board to review all solar projects.

If Rhode Island's Energy Facility Siting Board were to consider smaller projects, recent changes in Connecticut could offer useful lessons for Rhode Island. In 2017, the Connecticut General Assembly amended its Public Utility Environmental Standards Act to better protect forestland during the Connecticut Siting Council's review of energy projects.[xiii] It made two changes, (1) expanding the requirements of the siting council's "Certificate of Environmental Compatibility and Public Need" and (2) requiring all solar projects to obtain the certificate. Previously, the siting council could not deny approval if a solar project met DEEP's air and water standards.[xiv] Now, the siting council can approve by declaratory ruling projects that (1) meet DEEP's air and water standards (2) do not have a substantial adverse environmental effect, and (3) "will not materially affect the status of such land as core forest," according to DEEP.[xv] It is during this process that developers are required to consult with DEEP to identify necessary mitigation actions. This project-by-project process can make it difficult for developers to predict project costs, according to William Herchel, Chief Executive Officer of Verogy. In Rhode Island, solar project review by the Energy Facilities Siting Board could be implemented in conjunction with an RFP mapping tool or a mitigation program like the one previously described.

Expand forest acreage protected by state conservation funding, easement agreements, or other restrictions, as solar cannot be sited in these areas.[xvi] This can be accomplished using existing state programs or RGGI funding, through a new program aimed at carbon sequestration.

In February 2018, DEM announced $3.75 million in grants to protect 889 acres of open space and farmland in Rhode Island.[xvii] While grant scoring criteria included climate change resilience under the habitat and flood protection categories, it was limited to considerations of sea level rise and increased flooding due to climate change.[xviii] DEM might consider including additional climate change mitigation and adaptation characteristics in future grant cycles to more

fully recognize the climate related-benefits provided by forests. DEM could also assign higher priority to core forest in its evaluations.

Alternatively, DEM could establish a new program specifically to protect acreage with the highest carbon sequestration potential, potentially making use of RGGI funding. Across all RGGI states, approximately 11% of RGGI funding was allocated for GHG abatement projects in 2016. GHG abatement is a broad category encompassing other methods of greenhouse gases reduction beyond energy efficiency, etc. It includes spending on electric vehicle initiatives and climate change policy research.[xix]

In Rhode Island, the allowable use of RGGI auction proceeds is governed by §23-82-6.[xx] OER is authorized by statute to allocate RGGI auction proceeds to (1) promote cost-effective efficiency and conservation; (2) promote cost-effective renewable non-carbon emitting energy technologies in Rhode Island; (3) provide cost-effective direct rate relief for consumers; (4) provide direct rate relief for low-income consumers; (5) provide reasonable compensation to RGGI, Inc; and (6) cover reasonable costs of DEM and OER in administering the RGGI program.[xxi] In addition, per § 23-82-6, RGGI proceeds may be used for "reasonable costs of the department of environmental management and office of energy resources in administering this program, *as well as other climate change, energy efficiency, and renewable program efforts of the department of environmental management and office of energy resources*, which shall not in any year exceed three hundred thousand dollars ($300,000) or ten percent (10%) of the proceeds from sale or auction of the allowances, whichever is greater."[xxii] Note: The use of proceeds should complement existing energy efficiency and renewable energy programs, and proceeds cannot be used for projects already funded under other programs.

Rhode Island has primarily invested RGGI proceeds in energy efficiency and renewable energy technologies.[xxiii] However, the state's May 2019 plan for the allocation of RGGI proceeds did set aside funding for projects related to tree cover and solar siting. $110,000 is allocated to DEM's Energy-Saving Trees Program and $1,000,000 is allocated to the Renewable Energy Fund for brownfield solar development.[xxiv] Nevertheless, there may be an opportunity to utilize RGGI proceeds specifically for carbon sequestration (i.e. forest conservation) goals.

Conduct outreach to offtakers (i.e. cities, etc.) about the importance of embedding site characteristics into RFP processes. Establish a certification program to encourage forest-friendly solar development.

Paul Raducha, Senior Developer at Kearsarge Energy, mentioned during a presentation at the March 2019 Rhode Island Land & Water Conservation Summit that many aspects of solar projects are driven by offtakers (entities that buy power from solar developers). This dynamic, as

well as frustration throughout the state about solar siting, presents a unique opportunity to foster demand for responsibly-sited solar projects.

While cities and towns in Rhode Island (i.e. Bristol, South Kingstown, etc.) have released RFPs seeking solar development on previously disturbed land within town limits, consideration of site characteristics during RFP processes appears to be inconsistent. Additional research is needed to understand the degree to which siting is a factor in RFPs released by cities, towns, and other offtakers. According to Paul, many RFPs don't consider site characteristics or, if they do, don't include these characteristics meaningfully in project scoring. DEM and OER might consider working with potential offtakers on RFPs that embed forest considerations into the offtakers' selection process.

Alternatively, DEM might consider a type of certification for forest-friendly solar projects. Potential models include the Minnesota Board of Water & Soil Resources' Habitat Friendly Solar Certification and the Clean Development Mechanism's Gold Standard.

Habitat-friendly solar. In 2016, the Minnesota Legislature passed a law enabling solar development owners to claim their sites benefit gamebirds, songbirds, and pollinators only if they adhere to standards established by the Board of Water and Soil Resources.[xxv] The Minnesota Board of Water & Soil Resources subsequently established the nation's first habitat-friendly solar standards, which aim to promote the co-location of managed wildlife habitat and solar projects.[xxvi] The Minnesota Department of Natural Resources' technical guidance for solar projects is linked in the footnotes.[xxvii] Similar efforts to promote habitat- or pollinator-friendly solar are underway in Vermont, Wisconsin, Maryland, and Massachusetts.[xxviii] In states without habitat- or pollinator-standards, some companies (i.e. Clif Bar) are making use of Minnesota's standards.

Solar development that minimizes harm and produces local environmental benefits is an emerging area of study. The Innovative Site Preparation and Impact Reductions on the Environment (InSPIRE) project, funded by the Department of Energy, aims to better understand the benefits of and barriers to low-impact solar development (a subset of which is pollinator-friendly solar).[xxix] And Fresh Energy's Center for Pollinators in Energy, directed by Rob Davis, serves as a clearinghouse of pollinator-friendly solar information.[xxx] While habitat- or pollinator-friendly solar doesn't include forest considerations, DEM might nevertheless consider establishing such a program in Rhode Island (potentially making use of Massachusetts' efforts). The agency could separately consider a certification program for solar development that avoids or mitigates deforestation, potentially modeled on the Clean Development Mechanism's Gold Standard (detailed below).

Clean Development Mechanism's Gold Standard: The Clean Development Mechanism (CDM) enables developed nations to fund emission reduction projects in developing nations in order to meet their obligations under the Kyoto Protocol. While initial CDM projects had emission reduction benefits, they also often had unintended environmental and social consequences. In a similar way, solar developers in Rhode Island have gravitated toward cheap projects with emission reduction benefits, in some cases siting solar projects on farms or forestland.
To address criticisms of the CDM, WWF and other international NGOs established the Gold Standard certification in 2003 to "ensure projects that reduced carbon emissions under the UN's Clean Development Mechanism (CDM) also contributed to sustainable development."[xxxi] This certification recognizes emission reduction projects that "adequately address non-climate environmental and sustainable-development concerns."[xxxii]

CDM's Gold Standard is included here as an example of a certification program layered onto an existing program, with the aim of recognizing project benefits beyond greenhouse gas emission reductions. In this case, the structure of the underlying program is less important than the fact that it—like OER's energy programs—promotes clean energy development. A certification program in Rhode Island, administered by DEM or a local environmental NGO, could recognize projects that adequately mitigate the harmful environmental effects of solar development.

Curate a list of potential project locations to encourage solar development on previously disturbed land.

Connecticut DEEP staff reported that they maintained a list of preferred solar development sites identified by site owners, and that the list enabled the match of at least one developer and project site. Paul Raducha, Senior Developer at Kearsarge Energy, suggested perhaps DEM's brownfields list was sufficient. There does seem to be some opportunity for other land owners (including individuals, municipalities, the state, etc.) to list previously disturbed land that could be suitable for solar development.

Sell forest carbon offsets into carbon markets.

A *forest carbon offset* is a metric ton of CO_2e purchased by GHG emitters to compensate for emissions elsewhere.[xxxiii] These offsets provide not only emissions reductions, but also other conservation benefits of interest to DEM.[xxxiv]

Forest carbon offsets are typically generated through (1) a-/re-forestation, (2) avoided conversion, or (3) improved forest management projects.[xxxv] Importantly, these projects must represent emission reductions beyond a "business as usual" scenario. For this reason, forestland already protected by DEM or land trusts is typically not eligible (outside of improved forest

management projects, which increase forest carbon stocks). Nevertheless, carbon markets represent a potential new revenue stream for forest owners in New England.
In Maine, the Downeast Lakes Land Trust has pioneered the sale of forest carbon offsets among New England land trusts. It registered its first project, a 19,118-acre improved forest management project, with the Climate Action Reserve in 2012. Forest carbon offset proceeds from a second improved forest management project helped the Downeast Lakes Land Trust purchase a 22,000-acre property from Lyme Timber, protecting it from conversion and fragmentation. Additional information can be found on the land trust's webpage, which is linked in the footnotes.[xxxvi]

Forest carbon offsets can be sold into regulatory (or compliance) markets or voluntary markets. In a regulatory market (i.e. RGGI), entities that generate greenhouse gas emissions are required to either reduce their emissions or purchase allowances and/or offsets.[xxxvii] In a voluntary market, non-regulated entities (i.e. businesses, governments, NGOs, etc.) enter the market voluntarily to offset their emissions.

Deborah Spalding, a lecturer at the Yale School of Forestry & Environmental Studies, suggested that particular organizations in Rhode Island (i.e. Brown University) could be interested in purchasing local forest carbon offsets at a premium to complement their other climate commitments.[xxxviii] Voluntary purchasers of carbon offsets "assign higher value to projects based on the perceived quality or charismatic appeal." This may be due to a number of factors, including a project's geographic proximity or its social or environmental outcomes."[xxxix] A price premium could enable projects that would be impossible under lower prices.
Overall, current barriers to forest offset projects in Rhode Island include low carbon prices, extensive inventory, verification, and monitoring requirements of markets, and the scale and fragmentation of Rhode Island's forestland, all of which make the economics of forest carbon offset projects challenging. Nevertheless, in the future, DEM or land trusts in Rhode Island might consider forest carbon offsets as a tool for protecting additional forestland, especially if carbon prices increase.

RGGI Offsets. While forest carbon offsets can be sold into markets other than RGGI, a closer examination of RGGI-specific opportunities and constraints may be warranted. An offset under RGGI is defined as "a project-based greenhouse gas emission reduction outside of the capped electric power generation sector." A power plant may purchase offset allowances to meet up to 3.3% of its compliance obligation. While forestry is one of five offset categories, Rhode Island and Massachusetts do not award CO_2 offset allowances under the RGGI program. However, regulated power plants within Rhode Island or Massachusetts may utilize allowances awarded by another RGGI state.[xl] Forest projects eligible under RGGI include reforestation, improved forest management, and avoided conversion projects.[xli]

If carbon prices increase, interest in and viability of RGGI offset projects will likely grow. An environmental markets expert consulted for this project suggested that the state could require a certain percentage of offset projects—in particular, forest carbon offset projects—to be within Rhode Island's borders, protecting additional forestland.

There are two relevant RGGI provisions to be aware of when considering various mechanisms to protect forestland in Rhode Island: (1) offset allowances shall not be awarded to projects that are required "pursuant to any local, state or federal law, regulation, or administrative or judicial order," and (2) offset allowances shall not be awarded to projects that receive funding and/or incentives from "any system benefit fund, or funds or other incentives provided through the consumer benefit or strategic energy purpose allocation required pursuant to subdivision XX-5.3(b)."[xlii]

Section B

Forest Conservation Act

Maryland, like Rhode Island, gained forestland until the mid-1960s but has witnessed a steady decline since then.[xliii] In response to development pressures, the Maryland General Assembly passed the Forest Conservation Act (FCA) in 1991 to "minimize the loss of forest due to development and to ensure that priority areas for forest retention and forestation are identified and protected before development."[xliv] The FCA is administered by the Maryland Department of Natural Resources (DNR) but implemented at the local level, requiring municipalities to adopt forest conservation programs at least as stringent as FCA standards.

Summary. The FCA applies broadly to all activities on areas of approximately one acre or larger requiring grading or sediment control permits or an application for a subdivision. The law compels developers to submit (1) an inventory of forest cover and other environmental features, and (2) a plan for protecting existing forested areas, particularly areas with high ecological value. Priority areas under the FCA include "nontidal floodplains, streams and accompanying buffers, steep slopes, and critical habitats," and contiguous forest (not core forest) that connects vegetated tracts of land on or near the development site.[xlv] The FCA also establishes standards for forest coverage that must remain on a site after development, depending on land use category. These thresholds range from 50% for agricultural or resource areas to 15% for commercial or industrial areas. Overall, Maryland's statutory requirements require developers to first avoid deforestation, then to mitigate it through tree planting onsite or nearby, and—if neither of these options are feasible—ultimately to pay a fee-in-lieu of planting to the local or state forest conservation fund.[xlvi] Payment rates for local funds are required to be at least the same as those for the state fund. The November 2017 report titled "Forest Conservation Act and Other Forestry Programs in

Maryland" (linked in the footnotes) provides a useful overview of the law and its current function.[xlvii]

Forest mitigation banks. The FCA enabled DNR to create standards for forest mitigation banks, and numerous local jurisdictions have since established these banks. They may be used only to protect priority areas or areas identified by local comprehensive plans. Eighteen counties in Maryland allow for private landowner banking, though there are variations in eligibility requirements for projects.[xlviii] Such banks could offer useful lessons for potential forest mitigation banking in Rhode Island.

No net loss. The FCA has not functioned as a "no net loss" policy—one DNR review found that more forest acreage was cleared than planted from 1992 to 2002. Not until 2013 did the Maryland General Assembly establish that "it is the policy of the State to achieve no net loss of forest," meaning that 40% of the state is covered by *tree canopy*.[xlix]

Critiques and legislative updates. Despite the protections that the FCA offers Maryland forests, Maryland continues to lose forestland. This issue has received quite a bit of attention in recent years, and news coverage has detailed some of the shortcomings of the law, as well as proposed changes.[l] One major criticism of the current law is that it prioritizes the protection of trees rather than forests by setting requirements based on tree canopy instead of forest characteristics. Another has been the slow or ineffective use of payments collected by local forest conservation funds.

The Maryland General Assembly recently passed HB272/SB234, which will go into effect on October 1, 2019. Under this law, developers must "demonstrate that appropriate credits generated by a forest mitigation bank in the same county or watershed are not available" before they pay into a conservation fund.[li] In addition, local governments collecting fee-in-lieu money will have to identify areas for mitigation projects and track money collected and spent, according to Elain Lutz of the Chesapeake Bay Foundation. The state's General Assembly also recently passed HB735/SB729, which will go into effect on June 1, 2019. It requires the Harry H. Hughes Center for Agro-Ecology to conduct a technical review of changes in Maryland's forest cover and tree canopy, in consultation with the Maryland Departments of Natural Resources, Environment, Planning, and Agriculture and the Chesapeake Bay Program. This report is due to the Governor and the General Assembly by December 1, 2019.[lii]

Application to Rhode Island. A forest conservation law tailored to Rhode Island's circumstances is perhaps the best long-term solution to the state's forest loss and fragmentation challenges. Drawing on lessons learned in Maryland, a Rhode Island Forest Conservation Act could require an inventory of Rhode Island forests, establish goals based on forest characteristics (rather than tree canopy), make broader use of mitigation banks (instead of payments to forest conservation

funds), and enshrine a no net loss of forests policy. Such a law would address forest loss from solar development as well as development pressure from other sectors.

Establish a Community Certification Program

Rhode Island might also consider establishing a community outreach program modeled on those in Connecticut and Massachusetts. A very brief overview of these programs can be found below. In Connecticut, Sustainable CT is a voluntary certification program that provides municipalities with a range of actions and resources to build more sustainable communities. Over time, participating municipalities gain points toward Sustainable CT certification. Actions are divided into 10 categories, one of which is "Well-Stewarded Land and Natural Resources." This category includes managing woodlands and forests and developing an open space plan. The Sustainable CT website provides a useful overview of actions that help a municipality achieve certification.[liii]

In Massachusetts, energy-focused Green Communities Designation and Grant Program provides more than 240 municipalities with resources to implement energy efficiency and clean energy initiatives. The program was established by the Green Communities Act, and it requires municipalities to (1) pledge to reduce municipal energy use (2) meet the four program criteria, one of which is "passing zoning in designated locations for the as-of-right siting of renewable energy facilities." The Green Communities website provides a useful overview of the criteria that communities must meet.[liv]

Section C

To compile the information above, I've had conversations with…

- TeeJay Boudreau, Rhode Island DEM
- Christopher Riely, consultant
- Kate Sayles, consultant
- Judee Burr, consultant
- Scott Millar, Grow Smart RI
- Brad Gentry, Yale School of Forestry & Environmental Studies
- Ben Cashore, Yale School of Forestry & Environmental Studies
- Robert Klee, Yale School of Forestry & Environmental Studies
- Keri Enright-Kato (climate change), CT DEEP
- Lauren Savage (energy supply), CT DEEP
- Chris Martin (forestry), CT DEEP
- Nicole Lugli (planning and enforcement), CT DEEP
- Graham Stevens (land), CT DEEP
- Patrick Woodcock, Massachusetts Executive Office of Energy and Environmental Affairs
- Chis Kearns, RI OER

- Spencer Meyer, Highstead Foundation
- Ellen Hawes, Acadia Center
- Erika Niedowski, Acadia Center
- Becky Campbell, First Solar
- Joshua Ryor, CT DEEP (and Clean Energy Leadership Institute)
- Amy Paterson, Connecticut Land Conservation Council
- Deborah Spalding, Yale School of Forestry & Environmental Studies
- Andrea Barrios, Rockefeller Foundation
- Selya Price, CT Green Bank
- William Herchel, Chief Executive Officer, Verogy
- Christian Hofer, Sol Systems
- Paul Raducha, Senior Developer, Kearsarge Energy
- Shannon Kearney, CT DEEP
- Dick Williams, Certified Baltimore TreeKeeper

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[xli] Regional Greenhouse Gas Initiative Offset Protocol, U.S. Forest Projects, The Regional Greenhouse Gas Initiative: https://www.rggi.org/sites/default/files/Uploads/Design-Archive/2012-Review/2013-later-materials/Forest_Protocol_FINAL.pdf
[xlii] Model Rule, Regional Greenhouse Gas Initiative: https://www.rggi.org/sites/default/files/Uploads/Design-Archive/Model-Rule/2017-Program-Review-Update/2017_Model_Rule_revised.pdf
[xliii] Forest Conservation Act and Other Forestry Programs in Maryland: http://dls.maryland.gov/pubs/prod/NatRes/Forest-Conservation-Act-and-Other-Forestry-Programs-in-Maryland.pdf
[xliv] Forest Conservation Act and Other Forestry Programs in Maryland: http://dls.maryland.gov/pubs/prod/NatRes/Forest-Conservation-Act-and-Other-Forestry-Programs-in-Maryland.pdf
[xlv] Forest Conservation Act and Other Forestry Programs in Maryland: http://dls.maryland.gov/pubs/prod/NatRes/Forest-Conservation-Act-and-Other-Forestry-Programs-in-Maryland.pdf
[xlvi] https://dnr.maryland.gov/forests/Pages/programapps/newFCA.aspx; A Citizen's Guide to the Forest Conservation Act in Maryland, Chesapeake Bay Foundation (2004) https://www.baltimoresustainability.org/wp-content/uploads/2015/12/Forest_Conservation.pdf
[xlvii] Forest Conservation Act and Other Forestry Programs in Maryland: http://dls.maryland.gov/pubs/prod/NatRes/Forest-Conservation-Act-and-Other-Forestry-Programs-in-Maryland.pdf
[xlviii] Ecosystems Services Markets for MD Forests, Forests for the Bay: https://www.forestsforthebay.org/ecosystem_services_markets.cfm?sid=MD

[xlix] Forest Conservation Act and Other Forestry Programs in Maryland: http://dls.maryland.gov/pubs/prod/NatRes/Forest-Conservation-Act-and-Other-Forestry-Programs-in-Maryland.pdf
[l]Environmentalists push to improve Maryland conservation law: 'The most forested areas are the least protected', Baltimore Sun: https://www.baltimoresun.com/news/maryland/environment/bs-md-forest-conservation-act-20180212-story.html
[li] HB272, Maryland General Assembly: http://mgaleg.maryland.gov/webmga/frmMain.aspx?id=hb0272&stab=01&pid=billpage&tab=subject3&ys=2019RS
[lii] HB735, Maryland General Assembly: http://mgaleg.maryland.gov/webmga/frmMain.aspx?pid=billpage&tab=subject3&id=hb0735&stab=01&ys=2019RS
[liii] Sustainable CT: https://sustainablect.org
[liv] Green Communities Division: https://www.mass.gov/guides/becoming-a-designated-green-community#-green-communities-division-overview-

Appendix 1

Assessing Loss and Fragmentation of Core Forestland: Suggested Methods
When examining a site to interpret impact consider the following metrics:

Concern	Metrics
Forest Loss, Water Quality	% Total forest cover for local basin should not be decreased substantially
Water Quality	% Local basin impervious cover shall not be increased substantially
Water Quality, Forest Connectivity	Riparian Buffers should not be impacted
Forest Loss, Forest Connectivity	Large uninterrupted stands of trees should not be impacted
Forest Connectivity	No narrowing or removal of natural connectors
Forest Loss	No impact to unique forest classifications/critical habitats

Forest Loss, Forest Connectivity	No impact to vernal pools

Detail for Recommended Metric Calculations:

% Total Forest Cover:

To determine % total forest cover at the watershed level, we recommend you use the spatial layers available from the Center for Land Use Education & Research (CLEAR) Connecticut's Changing Landscape project. Use the most recent land cover layer. You can summarize the total forest cover within local watersheds. You may summarize using either the local basin found within the Connecticut Drainage Basin layer or the National Hydrography Dataset layer.

You can find both the Connecticut Drainage Basin Layer and the National Hydrography Dataset here:
http://www.ct.gov/deep/cwp/view.asp?a=2698&q=322898&deepNav_GID=1707%20#Hydrography
You can find the CLEAR land use layers here:
http://clear.uconn.edu/projects/landscape/download.htm
When calculating the significance of your development, you should include in the area of impact: all new impervious cover, any vegetation clearing, removal, or conversion to turf. There are certain cut off points that are correlated with significant impact. You may find the following resources useful when describing the significance of the change in total forest cover.

Environment Canada. 2013. How much habitat is enough? Third Edition. Environment Canada, Toronto, Ontario.

Hudy, M., T.M. Thieling, N. Gillespie, and E.P. Smith. 2008. Distribution, status, and land use characteristics of subwatersheds within the native range of brook trout in the eastern United States. North American Journal of Fisheries Management 28: 1069-1085.

Kanno, Y., Letcher, B.H., Rosner, A.L., O'Neil, K.P. and Nislow, K.H., 2015. Environmental factors affecting brook trout occurrence in headwater stream segments. Transactions of the American Fisheries Society, 144(2), pp.373-382.

% impervious cover (IC):

To determine % IC at the watershed level, we recommend you use the spatial layers that were created for the Connecticut MS4 Permits. These layers summarize impervious cover at the local basin level. You can also download the impervious cover and Connecticut Drainage Basin or National Hydrography Dataset and conduct your own desktop analysis. These layers can be found here:
http://www.cteco.uconn.edu/projects/ms4/index.htm

When calculating the increase in significance of your development, the increase from your project should include all impervious cover including the area covered by the new solar panels, as well as any additional turf grass that will be added. There are certain cut off points that are correlated with significant impact. You may find the following resources useful when describing the significance of the change in total forest cover:

Bellucci C. 2007. Stormwater and aquatic life: making the connection between impervious cover and aquatic life impairments. In: Water Environment Federation, TMDL 2007 Conference Proceedings, 24–27 June, Bellevue. pp. 1003–1018.

Stranko, S.A., R.H. Hilderbrand, R.P. Morgan II, M.W. Staley, A.J. Becker, A. Roseberry-Lincoln. 2008. Brook trout declines with land cover and temperature changes in Maryland. North American Journal of Fisheries Management 28:1223-1232

Riparian Buffer:

You should demonstrate that there will be no new impervious surface, or turf or grass within 300ft of a riparian area. This can be illustrated on the site plans. If impervious surface already exists within a 100ft buffer of any riparian area on your site, and it will continue to be impervious cover as part of your solar installation, you will need to demonstrate:

1. Stormwater controls that disconnect the discharge to surface waters from these areas.
2. Retention of migration and movement paths for forest organisms along the riparian buffer.

You may find the following resources useful when describing the significance of the change in total forest cover.

Fischer, R. A. and J. C. Fischenich. 2000. “Design recommendations for riparian corridors and vegetated buffer strips.” Prepared for the U.S. Army Engineer Research and Development Center. pp. 17. Vicksburg, MS: EMRRP Technical Notes Collection (TN-EMRRP-SR-24).

Interruption of Large Blocks of Vegetation:

You should summarize the following attributes of forest block from which trees will be removed.

· Total acreage
· Shape
· Distance to next nearest block
· Location of project

When describing the size of the forest block in which your site will occur, you may use both your Forest Inventory as well as the CLEAR Forest Fragmentation Analysis. When calculating the acreage of impact, you should include in this area: all new impervious cover, any vegetation clearing, removal, or conversion to turf, as well as the entire area that will be enclosed in fencing.

There are certain characteristics of forest blocks that are considered more important or at risk. You may find the following resources useful when describing the significance of your development of a block of forest.

Environment Canada. 2013. How much habitat is enough? Third Edition. Environment Canada, Toronto, Ontario.

Wilson, E. and C. Arnold. 2009. Forest Fragmentation in Connecticut: 1985-2006. CLEAR publication #09025.1. http://clear.uconn.edu/rojects/landscape/forestfrag

Natural Connectors:
All land cover that is not currently impervious cover or turf should be considered as a connector between forest blocks. Different forest organisms utilize different natural habitats for movement and dispersal. When calculating impact, you should include in the area of impact: all new impervious cover, any vegetation clearing, removal, or conversion to turf. Also include the total width and length of natural areas outside of fencing that link forest blocks, and the acreage of the forest blocks that are connected. There are certain widths of corridors considered more effective. You may find the following resources useful when describing the significance of your development of a block of forest:

Environment Canada. 2013. How much habitat is enough? Third Edition. Environment Canada, toronto, Ontario.

Fenderson, L., E., A. I. Kovach, J. A. Litvaitis. K. M. O'Brien, K. M. Boland, W. J. Jakubas. 2014. A multiscale analysis of gene flow for the New England cottontail, an imperiled habitat specialist in a fragmented landscape. Ecology and Evolution. 4(10). doi: 10.1002/ece3.1068. https://newenglandcottontail.org/resource/multiscale-analysis-gene-flow-new-england-cottontail-imperiled-habitat-specialist

Erb, L., Willey, L., Buckley, J., French, T., Haggerty, S., Jones, M., Regosin, J., Woolsey, H. (2011): Eastern box turtle conservation plan for Massachusetts. Prepared for the Massachusetts Division of Fisheries and Wildlife, Natural Heritage and Endangered Species Program. 227 p.

Unique Forest Classifications:
Unique Forest Classification include the Connecticut Critical Habitats classified as Terrestrial Habitats, Terrestrial Forested, Palustrine Forested, as well as Forested Traprock Ridge Habitat. The Connecticut Critical Habitats can be found here:
http://www.ct.gov/deep/cwp/view.asp?a=2698&q=322898&deepNav_GID=1707%20#EndangeredSpecies
Traprock ridge habitat is classified as forested habitat upon with specific bedrock geology classified as Jha, Jho, Jta. Bedrock geology layers can be found here:
http://www.ct.gov/deep/cwp/view.asp?a=2698&q=322898&deepNav_GID=1707%20#Geology
If these habitat classifications exist on your site, your development should keep a 200ft buffer from these Unique Habitats.

Vernal Pools:
You should demonstrate that there will be no new impervious surface, or turf, or grass with the 750 foot buffer of a vernal pool (Calhoun and Klemens 2002).

Calhoun, A. J. K. and M. W. Klemens. 2002. Best development practices: Conserving pool-breeding amphibians in residential and commercial developments in the northeastern United States. MCA Technical Paper No. 5, Metropolitan Conservation Alliance, Wildlife Conservation Society, Bronx, New York.

Creating Forestland Habitat Impact Screening Tool

Core Forestland includes habitat that is defined by various vegetation classifications as well as measures of habitat patch connectivity. Connectivity is a measure of the ability for the landscape to support the necessary dispersal and homerange movements of individual organisms (Taylor et al 1993, Chetkiewicz et al 2006). Forestland connectivity can be degraded significantly by installation of large development projects (Gove et al. 2016, McDonald et al. 2009, Environment Canada 2013, Chetkiewicz et al 2006, McGarrigal et al 2017a). The point at which connectivity is lost through this type of development and the resultant loss of continuity of forest land is a function of the organisms and processes specific to the site (Gilbert-Norton et al 2009).

We have created a spatial screening layer* that identifies our prime continuous and connected core forestland blocks using a combination of spatial layers (Table 1). These layers represent areas which would experience a disruption of core forestland processes. Forest processes can be disrupted through loss and degradation of habitat. Degradation of habitat can be measured in different ways that include but are not limited to increased edge effects (Falk et al 2001, Donovan et al. 1995), impediments to organism migration (Sadoti et al. 2017, Chetkiewicz et al 2006, Meyer et. al 2007), as well as decreased water quality (Alexander et al. 2007, Belucci et al. 2013). Resources were ranked with respect to the degree of effect anticipated and ranks were adjusted based on our confidence in the layer as both accurate and representative (Table 2). We would consider any conversion of natural habitats to developed habitat within our mapped core forestland to materially affect the core forestland in these areas. This corresponds to an effect rank of 7 or higher (Table 2). We define developed habitats as impervious surface, buildings, structures, roads, and turf grass. The screening layer is at a 30m resolution and may include areas that are already developed. If your project area is confined to the developed areas, it may be determined to not materially affect the core forestland in this area.

*Note that this screening layer does not include all state listed Endangered, Threatened, and Special Concern species and a Natural Diversity Data Base (NDDB) review will be required regardless of your location if your project is within an NDDB review area. NDDB Maps can be downloaded here: http://www.ct.gov/deep/cwp/view.asp?A=2702&Q=323464

Table 1. Environmental features used to develop screening map.

Environmental Feature	Layer	Description	Reference
Forest Blocks	CLEAR Forest Fragmentation Analysis	Core forest blocks greater than 250 acres, 2010	CLEAR

GCN Terrestrial Species	Terrestrial Cores and Connectors LCC	Ecological integrity; Landscape capacity; rare terrestrial natural communities; and connecting habitat features	McGarigal et al 2017
Connecticut Critical Terrestrial Habitats	Critical Habitat (terrestrial) 300ft buffer	Rare and specialized habitats in the state	DEEP-NDDB
Bats	Hibernaculums	1 mile buffer of bat hibernaculum	DEEP-NDDB
New England Cottontail	Core modeled and documented locations		DEEP-Wildlife Division
Reptiles and Amphibians	State listed forest dependent reptiles and amphibians	Environmental Review layer; 4 most sensitive forest species	DEEP-NDDB
High quality Watersheds	High quality watersheds data	Data and modeling of sensitive aquatic species and landscape characteristics indicating critical upstream drainage basins	(Bellucci et al 2013); DEEP
Early Successional Habitat	Young Forest	Land cover classes that include young forest classifications	Rittenhouse 2014

Table 2. Ranks and corresponding impact to resource

Rank	Effect
0	No Effect

1-2	Indirect effect
3-4	Temporary effect with the ability to mitigate
5-6	Temporary effect with NO ability to mitigate temporary effects
7-8	Permanent effect with ability to mitigate
9-10	Permanent effect with NO ability to mitigate

Sources:

Alexander, Richard B., Elizabeth W. Boyer, Richard A. Smith, Gregory E. Schwarz, and Richard B. Moore, 2007. The Role of Headwater Streams in Downstream Water Quality. Journal of the American Water Resources Association (JAWRA) 43(1):41-59. DOI: 10.1111/j.1752-1688.2007.00005.x

Bellucci, C.J, M.E. Becker, M. Beauchene, and L. Dunbar. 2013. Classifying the health of Connecticut streams using benthic macroinvertebrates with implications for water management. Environmental Management 51:1274-1283

Center for Landuse Education and Research (CLEAR), University of Connecticut. Forest Fragmentation Analysis Project. 2010. [Map]. http://clear.uconn.edu/projects/landscape/forestfrag/measuring/core_explained.htm (February 2018).

Chetkiewicz CLB, CC St. Clair, and MS Boyce. 2006. Corridors for conservation: integrating pattern and process. Annual Review of Ecology, Evolution, and Systematics. 37:317-342.

Donovan, T. M., R. R. Thompson III, J. Faaborg, J. R. Probst. 1995. Reproductive Success of Migratory Birds in Habita Sources and Sinks. Conservation Biology. Vol. 9(6): 1380-1395.

Environment Canada. 2013. How much habitat is enough? Third Edition. Environment Canada, Toronto, Ontario.

Falk, K J, E. Nol, D. M. Burke. 2011. Weak effect of edges on avian nesting success in fragmented and forested landscapes in Ontario, Canada. Landscape Ecology. 26: 239-251.

Gilbert-Norton, L., R. Wilson, J. R. Stevens, and K. H. Beard. 2009. A meta-analytic review of corridor effectiveness. Conservation Biology 24(3): 660-68.

Gove B, Williams LJ, Beresford AE, Roddis P, Campbell C, et al. 2016. Reconciling Biodiversity Conservation and Widespread Deployment of Renewable Energy Technologies in the UK. PLOS ONE 11(5): e0150956. https://doi.org/10.1371/journal.pone.0150956

McDonald RI, Fargione J, Kiesecker J, Miller WM, Powell J. 2009. Energy Sprawl or Energy Efficiency: Climate Policy Impacts on Natural Habitat for the United States of America. PLOS ONE 4(8): e6802. https://doi.org/10.1371/journal.pone.0006802

McGarigal K, Compton B, Plunkett EB, Deluca WV, and Grand J. 2017. Designing sustainable landscapes project. University of Massachusetts, Amherst. URL: www.umass.edu/landeco/research/dsl/dsl.html

McGarigal K, Compton BW, Plunkett EB, Deluca WV, and Grand J. 2017a. Designing sustainable landscapes: modeling connectivity. Report to the North Atlantic Conservation Cooperative, US Fish and Wildlife Service, Northeast Region.

Meyer, Judy L., David L. Strayer, J. Bruce Wallace, Sue L. Eggert, Gene S. Helfman, and Norman E. Leonard. 2007. The Contribution of Headwater Streams to Biodiversity in River Networks. Journal of the American Water Resources Association (JAWRA) 43(1):86-103. DOI: 10.1111/j.1752-1688.2007.00008.x

Rittenhouse, C. D. 2014. Estimation of early successional habitat in Connecticut. 2011. [Map] esv_mapv03_11. Report submitted to Wildlife Division.

Sadoti G, Gray ME, Farnsworth ML, Dickson BG. 2017. Discriminating patterns and drivers of multiscale movement in herpetofauna: The dynamic and changing environment of the Mojave desert tortoise. Ecol Evol. 7:7010–7022. https://doi.org/10.1002/ece3.3235

Taylor PD, L Fahrig, K Henein, and G Merriam. 1993. Connectivity is a vital element of landscape structure. Oikos 68:571-573.