



Changes to the Land: Four Scenarios for the Future of the Massachusetts Landscape

Executive Summary with Policy Addendum

Jonathan Thompson, Kathy Fallon Lambert, David Foster, Meghan Blumstein,
Eben Broadbent, Angelica Almeyda Zambrano

The forests of Massachusetts are more than just a collection of trees; they function as living infrastructure that works 24-hours a day to support basic needs of people and nature. Today, as through our state's history, these woods provide abundant resources – timber, fuel, and paper; habitat for plants and animals; and a reliable source of clean water. They also supply fresh air, flood protection, the storage of carbon that would otherwise warm our earth, and local shading and cooling. In essence, forests support the “common wealth” of Massachusetts – the shared natural resources we all depend on.

In 2005, a group of scholars at the Harvard Forest published *Wildlands and Woodlands: A Vision for the Forests of Massachusetts* which called for conserving at least half the landscape as forestland, continuing the tradition of private landownership in the Commonwealth. The vision also proposed supporting development and striking a balance between extensive “woodlands” that are sustainably managed for wood products and “wildlands” where nature is left to take its course. The vision is rooted in history, cultural heritage, and the acknowledgement that, in the face of all current and future environmental threats, perhaps the single most important action we can take is to maintain forested landscapes on a scale that allows natural and human communities to flourish and adapt.

In 2011, with the input of many groups and individuals from across the state, Harvard Forest launched a new project to evaluate potential futures for the Massachusetts landscape, and for forests in particular. The purpose of the project was to compare a set of contrasting scenarios to help inform and motivate conservation and land-use decisions. The scenarios were created by a group of eight natural resource professionals from conservation and forestry organizations, academia, and state government. The group gathered for six meetings over the two-year-study period to articulate four different trajectories for how land-use could change in the state over the next 50 years. While the scenarios do not attempt to predict the future – experience has demonstrated the futility of that – they do enable us to see and evaluate some of the many consequences of different approaches to using and caring for the land.

The four landscape scenarios developed and analyzed for Massachusetts are: *Recent Trends*, *Opportunistic Growth*, *Regional Self-Reliance*, and *Forests as Infrastructure*. The scenarios reflect different amounts and intensities of land development, timber harvesting, farmland expansion, and forest conservation. All scenarios also include the assumption that average temperature and precipitation will increase with climate change.



Scenario #1: Recent Trends

The *Recent Trends* scenario represents a future in which patterns of forest conversion to development, agriculture, land conservation, and timber harvest resemble land use during the period from 1999 to 2005. Land-use data from that period were used to reconstruct patterns for the extent, intensity, and geographic distribution of forest change.



Scenario #2: Opportunistic Growth

The *Opportunistic Growth* scenario represents a future of rapid economic growth and new development in which regulatory controls to protect the environment are sharply curtailed, land-use planning is absent, and the management and use of natural resources is directed by economic opportunity with minimal government oversight.



Scenario #3: Regional Self-Reliance

The *Regional Self-Reliance* represents a future in which the region's reliance on oil, its growing energy demand, and soaring food prices have driven up interest in biomass harvesting for energy and clearing of forests for agricultural production so that more food and energy needs can be supplied from within the region.



Scenario #4: Forests as Infrastructure

The *Forests as Infrastructure* scenario represents a future in which the forested landscape is actively managed and protected from development as valuable living infrastructure. As growth and development continue, emphasis is given to retaining forests as a source of low-cost carbon storage, renewable energy, local wood products, clean water, and habitat.

Climate change assumption: Increased fossil-fuel emissions lead to an estimated increase in average annual temperature of 4 degrees Fahrenheit and increase in average annual precipitation of 5% to 7% in Massachusetts by 2060. These assumptions are applied to all land-use scenarios.

Synopsis of Results

Tremendous land conservation gains have been made in Massachusetts over the last eight years, with 112,000 acres of land protected between 2007 and 2013 (EEA personal communication). But the continued loss of thousands of acres of open space each year to development undermines this progress and erodes the many benefits forests provide. If *Recent Trends* continue or if development increases as depicted in *Opportunistic Growth*, the consequences for people and nature will be far-reaching, even exceeding some of the anticipated land-based impacts of climate change.

The good news is that scenarios are not predictions and our fate is not sealed. Opportunities abound for building on the positive advances of the past several years to keep our forests, safeguard their value as living infrastructure, and bolster the contributions of forests to our communities and rural economies. The scenario called *Forests as Infrastructure* incorporates nearly the same amount of development as *Recent Trends* but doubles the percentage that occurs as clustered development. It also raises the rate of timber harvest by 70% but implements “improvement forestry” on two-thirds of the harvested acres. Finally, it increases the rate of forest conservation by 30% from 2005 levels and targets two-thirds of that to “priority habitat.” By 2060, the land-use decisions reflected in the *Forests as Infrastructure* scenario yield profound benefits to people and nature.

- In the woods, the *Forests as Infrastructure* scenario yields a 20% increase in tree species with high commercial and wildlife value, twice as much local wood harvested, and a 35% increase in the amount of carbon stored in forests from the 2010 baseline (nearly the same as *Recent Trends*).

- For water resources, *Forests as Infrastructure* results in less impervious area than *Recent Trends*, protects water quality, and holds increases in average annual runoff to less than 10% in 26 of the state's 27 major watersheds.
- In terms of habitat, *Forests as Infrastructure* results in 25% less forest fragmentation, conserves 750,000 acres of forest for a variety of uses including forestry, and protects 280,000 more acres of priority forest habitat than *Recent Trends*.

While not explicitly quantified in this study, the direct and substantial benefits of the *Forests as Infrastructure* scenario, and the land-use choices and policies they represent, help to strengthen rural economies, enhance the vitality of cities, and increase the resilience of towns and communities to climate change.

Key Findings

1. *The Forests as Infrastructure scenario ranks first among the four land-use scenarios in terms of the benefits provided to people and nature.*

The *Forests as Infrastructure* scenario increases the pace of conservation, expands sustainable forestry, and implements proactive more clustered development than the other land-use scenarios. Those choices lead to the highest ranking for six out of the nine nature-based benefits and outcomes analyzed. *Recent Trends* ranks second overall, followed by *Regional Self-Reliance* and *Opportunistic Growth*.

2. *Targeted and accelerated land conservation protects approximately 550,000 acres of priority forest habitat and limits forest habitat degradation and fragmentation.*

Approximately 10,000 acres of land per year were conserved between 1999 and 2005. State-funded land conservation has since increased to an average of 17,000 acres per year, with around 12,000 acres as forestland (EEA 2013). The *Forests as Infrastructure* scenario protects 15,000 acres of forestland per year and targets two-thirds of all new forest conservation to “priority habitat.” This targeted and accelerated conservation protects more than half a million acres of priority habitat by 2060, compared to 265,000 acres in *Recent Trends*. Given the continued conversion of forests to development, all scenarios degrade forest habitat somewhat and increase fragmentation but this is lowest in *Forests as Infrastructure*.

3. *The widespread adoption of “improvement forestry” maintains critical forest benefits while supporting increased local wood production.*

The *Forests as Infrastructure* scenario employs “improvement forestry” practices that were suggested by forestry experts. Harvesting increases to as much as 45,000 acres per year from 25,000 acres per year in *Recent Trends*. These forest management choices result in twice as much local wood harvested with only a slight (4%) decrease in amount of carbon stored in the forest that helps mitigate climate change, at the end of the 50-year period. These forestry practices also select for and increase the abundance of tree species with high economic and ecological value. In contrast, the extensive harvesting and agricultural expansion in the *Regional Self-Reliance* scenario and the permanent loss of forests to development in *Opportunistic Growth* leads to much lower levels of stored forest carbon. The results suggest that forestry practices determine how much would can be harvested while maintaining environmental benefits.

4. *Clustered development concentrated near existing cities and towns minimizes forest loss and reduces the impact of growth on water resources and forest habitat.*

Under *Forests as Infrastructure*, nearly the same amount of development occurs as in *Recent Trends* but two-thirds takes the form of clustered development. As a result, it uses land more efficiently, reduces growth impacts, and maintains more forest benefits for people and nature. By 2060, only one watershed experiences more than a 10% increase in surface water runoff in *Forests as Infrastructure*, compared to six in *Recent Trends* and 25 in *Opportunistic Growth*. In addition, 25% less forest area is fragmented into small patches than in *Recent Trends*. The results for some urban watersheds point to the need to retain green space *within* areas of compact development to minimize adverse effects on water quality.

5. *The loss of forests to development has more immediate and pronounced impacts on several nature-based benefits than the gradual forest changes associated with average increases and temperature and precipitation due to climate change.*

An analysis of *Recent Trends* shows that, over a 50-year period, the loss of forests to development has greater impacts on carbon storage and water quality than shifts in forest composition and growth associated with climate change. The analysis is based on anticipated increases in average annual temperature and precipitation. Climate change has a greater impact on water runoff than land use in *Recent Trends*. But land-use nearly doubles the estimated increase in annual water runoff from climate change in *Opportunistic Growth*. The results underscore the influence that local land-use decisions have on the capacity of our forests to help offset greenhouse gas emissions and moderate the effects of climate change.

Policy Implications

The results of the Massachusetts scenario study demonstrate that the consequences of our land-use choices will be profound, exceeding some of the serious impacts of climate change. As the *Recent Trends* scenario shows, land conservation and land-use policies during the period from 1999 to 2005 yield many important benefits to people and nature. But the extensive and relatively young forests in the state offer tremendous opportunities for enhancing these benefits and further minimizing the impacts of growth. The results show how land conservation, clustered development near cities and town centers, and sustainable forestry are highly compatible and yield multiple benefits to society. While no single scenario is intended as a formal set of recommendations, the policy implications from the scenario results are clear. The people of Massachusetts have much to gain from conserving forests and managing them well by: (1) recommitting to land conservation, (2) redoubling land-use policy and smart-growth efforts, and (3) promoting sustainable forestry in the Commonwealth.

Changes to the Land: Four Scenarios for the Future of the Massachusetts Landscape elaborates on these conservation and policy directions by detailing the results of the four land-use scenarios in the year 2060. As we consider the fate of the Commonwealth's land resources, perhaps the knowledge gained from these scenarios can inform and galvanize support for land-use action at a scale commensurate with the opportunity presented by the remarkable return of the forests of Massachusetts.

Addendum: A Summary of Policy Implications of *Changes to the Land*

Kathy Fallon Lambert, Harvard Forest, Harvard University; Emily M. Bateson, Highstead Foundation; and James N. Levitt, Harvard Forest, Harvard University

Changes to the Land demonstrates that how we develop, conserve, and manage forests and other lands will have tremendous consequences for the people of Massachusetts over the next 50 years. Given the major transitions the Commonwealth is facing today—not only in forest cover, but also in state leadership, and public policy—it is important to consider the policy implications of this new scientific study. To distill the policy implications, we reviewed several state plans, legislative proposals, and commission reports¹ that are related to the study's three broad policy areas: (1) recommitting to land conservation, (2) redoubling land-use policy and planning, and (3) promoting sustainable forestry. We find that the following near-term policy opportunities and supporting programs and initiatives are consistent with the findings of the report.

Near-Term Policy Opportunities

1. Land conservation spending in the Environmental Bond Bill

An investment of \$50 million per year for land conservation in the Environmental Bond Bill would support land conservation at or above levels achieved over the past eight years, including funding for high-priority programs, including:

- The *Landscape Partnership Program* to preserve large, un-fragmented, ecologically valuable conservation lands (including working forests and farms) through private-public collaborative partnerships protecting 500 acres or more.
- The *Conservation Partnership Grant Program*, including a provision to allow nonprofit land trusts to hold the conservation restrictions.
- The *Local Acquisition for Natural Diversity Program* (LAND) and the *Parkland Acquisition and Renovation for Communities* (PARC), which provide competitive grants and incentives to communities to protect natural resources and conserve land.
- A new *Land Protection Capital Investment Trust Fund* for the permanent care, monitoring, and enforcement of state-held conservation restrictions.
- An expanded *Land Conservation Tax Credit Program* for private landowners who donate land to municipalities, the state, or nonprofit conservation organizations that includes an increased \$5 million total spending cap and an increased landowner income tax credit cap of \$75,000.
- A tax credit for landowners to incentivize adoption of 10-year forest stewardship plans developed with licensed, professional foresters.

2. Zoning reform at municipal and state levels

Current efforts to update zoning laws and increase zoning incentives and tools at the municipal and state level are consistent with the findings of the study, including:

- Zoning reform to update the existing state zoning laws and provide incentives for communities to increase their ability to focus future development and to achieve transit-friendly, walkable communities with efficient land use and protected lands.
- An expanded state grant program to help municipalities adopt and implement Natural Resource Protection Zoning.

- Expanded Green Communities Program designation criteria that include green transportation planning and zoning measures to support compact, low impact development.

3. Land use in climate change mitigation and adaption

Opportunities exist for more fully integrating land use and forest conservation into climate change mitigation and adaptation plans, including:

- Accelerated implementation of the smart-growth policy package of the Clean Energy and Climate Plan 2020 and additional land-use policy measures that promote both mitigation and adaptation through smart growth, low-impact development, tree planting, and enhanced forest carbon storage.
- Stronger MEPA policy related to avoiding, mitigating, and compensating for the loss of carbon storage and sequestration due to loss of trees and conversion of forests to development.
- An overarching policy directive from the Executive Office of Energy and Environmental Affairs for all agencies to follow a set of common principles that protect and enhance the functions of nature for mitigating and adapting to climate change.

4. Forestry and forest products

Measures to link improved forest management with energy needs in the Commonwealth include:

- New programs to support appropriately scaled community wood heat and use of advanced high-efficiency, low-emission forest-derived biomass thermal energy systems that increase markets for sustainably harvested wood products and reduce life-cycle carbon emissions from heating while maintaining air quality.

Supporting Programs and Initiatives

1. Robust state matching funds for the *Community Preservation Act*, which provides funds to eligible communities for open space conservation, affordable housing, and historic preservation.
2. A new “forest conservation due diligence program” to assist landowners who want to donate conservation restrictions with transaction and due diligence expenses.
3. Increased enrollment in the Chapter 61 or “current use” tax law program and consideration of expanded categories that reward landowners for enhancing non-market ecosystem services.
4. A new grant program to expedite funding for municipalities seeking to exercise their right of first refusal for the purchase of lands withdrawn from Chapter 61 within the 120-day deadline.
5. Additional grants, incentives, assistance programs, and regulatory markets for landowners who enhance and conserve non-market ecosystem services (e.g., water filtration and carbon storage) that benefit the broader public.
6. Support for partnerships and programs to promote landowner outreach, wood marketing cooperatives, land conservation options, and “buy local wood” campaigns to support sound stewardship, forest conservation, and associated rural economic development.

ⁱ Smart Growth Policy Package of the *Massachusetts Clean Energy and Climate Plan for 2020* (2010), *Report of the Commission on Financing Forest Conservation* (Levitt and Youngblood 2011), *Draft Environmental Bond Bill, HB 1859: An Act Promoting the Planning and Development of Sustainable Communities, Recommendations from the Commonwealth Conservation Council on the draft Environmental Bond Bill*.