SECTION 6: Land Use, Buildings, & Vegetation Management

Principles

- Maintaining a socially, economically, ethnically, racially, and culturally diverse population is important for Cambridge.
- A mixture of land uses makes the city healthier, more livable, and more economically sustainable.
- Planting native and water-efficient plant species improves the city's microclimate and reduces energy use.
- Life-cycle costs and benefits of buildings, landscaping, and infrastructure should be considered when planning, building, or renovating.[1]
- It is important to think regionally about land use; regional sprawl affects Cambridge.

Role of Land Use and Vegetation in Cambridge

Cambridge is densely populated, with 14,899 people per square mile and 111,325 jobs.[2] This density can foster energy efficiency, but Cambridge has not yet taken full advantage of its opportunities. With so many jobs, stores, places of worship, neighborhoods, and cultural destinations in easy walking distance of each other, people need to drive much less than they do in other communities. The density also helps support relatively convenient public transportation services.

Ninety-one percent of the housing stock in Cambridge is multifamily housing, which tends to be more energy efficient than single-family housing. There is continuing demand both for more housing and for more commercial and institutional buildings, with a considerable amount of new construction planned in some areas of the city.

The high percentage of land paved for roads and parking and the many rooftops packed close together, with a relatively small percentage of green space and tree canopy in many neighborhoods, mean that the city absorbs a great deal of heat, creating a "heat island effect." This raises the air temperature during the summer, which in turn increases the use of air conditioning. It impairs air quality and affects people's health.

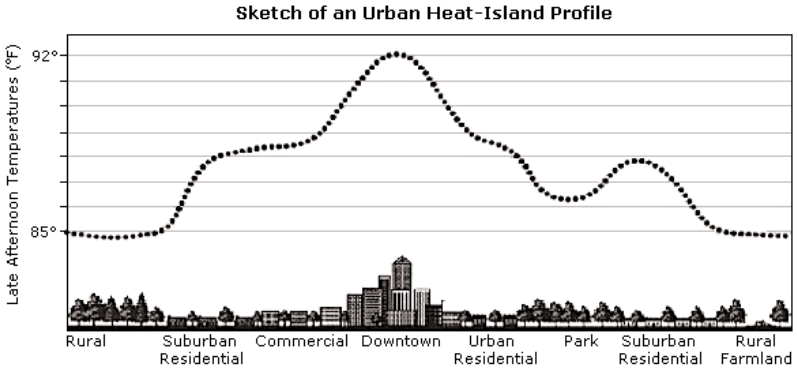
The challenge is to create a city that benefits from its density, reduces its environmental impact, and remains livable. Land use planning and vegetation management play an important role in meeting this challenge and can affect both emissions of greenhouse gases and the removal of CO_2 from the atmosphere (sequestration). Environmental justice considerations include ensuring the proximity of the less affluent neighborhoods and residents to employment, public services, stores, and safe and pleasant green space.

1 Life-cycle costs are the costs associated with producing a product, transporting it, using it, and disposing of it.

2 Boston, by comparison, has 11,860 people/square mile, and Belmont has 5,305. Somerville has 18,797 people/square mile, but only 22,932 employees. These numbers are from the 2000 census.

Vegetation, especially trees, cools the city in summer both by shading buildings, cars, parking lots, sidewalks, and streets, and through transpiration (i.e., giving off water vapor). It also removes a small amount of CO_2 from the atmosphere, storing it in roots, stems, and leaves. Effective vegetation management, which requires good on-site water management, will also help mitigate some of the anticipated changes in the weather due to climate change-more extreme storms, floods, and droughts. Both flooding and drought-induced water shortages can be reduced by re-using on-site water and maintaining healthy vegetation that increases water infiltration and absorption. Well-maintained trees are less likely to suffer or inflict damage due to high winds or snowfall.

As the climate warms, it becomes ever more important to reduce the urban heat island effect and create cool natural outdoor spaces for people to enjoy in the summer.



Trends

- ***Land use trends:*** Cambridge is a desirable location for housing, businesses, and industries. The number of jobs in the city increased from 109,490 to 111,325 between 1990 and 2000. The high demand for commercial, industrial, and residential buildings, along with the end of rent control, has driven up real estate prices and led to both new construction and extensive renovation of existing buildings. These competing uses create more pressure on existing open space-as well as higher demand for it.

- ***Demographic trends:*** The number of people per housing unit is decreasing, which means that each person is taking up more space. This is in line with national trends. In 1950, the 120,740 Cambridge residents lived in 32,921 units (an average of 3.67 people/unit); in 2000, the 101,355 residents occupied 41,320 units, (2.45 people/unit).

- ***Tree cover/vegetation trends:*** Cambridge has about 11,118 street trees and another 2,500 to 3,000 trees in parks and other City property, but there is no hard data about the total number of trees in the city or about trends. There is no striking decrease in the amount of vegetative cover; while there is considerable new development, most of it replaces less intensive uses, such as parking lots or buildings with lower heights, rather than trees or other vegetation. The percentage of land that is paved or built on is not known. The City is currently assessing tree canopy cover.

- ***Open space trends:*** Approximately 11%, or 492 acres, of the city's total land area is public open space that is owned by entities such as the City and MDC and is accessible to all. However the open space is distributed unevenly; much of it is concentrated in the north and west sections of Cambridge.

- ***Regional trends:*** Sprawl continues to dominate regional land use changes, resulting in more traffic, lower regional air quality, less access to open space, and loss of farmland and natural habitats. From 1972 to 1996 developed land in Massachusetts increased by 59%, while the population grew by only 6%.[3] Sprawl undermines urban environments and increases the number of people who commute to or through Cambridge, adding noise, air pollution, and traffic congestion. With sprawl has come a dramatic increase in vehicle miles traveled.

Tools and Resources

Zoning

The Cambridge Zoning Ordinance governs how land and buildings may be used. It is a local law, adopted by the City Council, but it must conform to state zoning law. The zoning ordinance covers four areas: how land may be used; the intensity of activity and size and location of buildings on a piece of land; the amount of off-street parking required for each type of land use; and special regulations for activities and land uses that would not be sufficiently regulated under the first three areas.

The ordinance has two parts, a map and the text. The map shows the boundaries of the city's complex zoning districts, which include ten kinds of residential district, four classes of office district, eight categories of business district, seven classes of industrial district, eleven special districts, and several special overlay districts. The text lists the regulations for each class of district and the procedures for enforcing and administering the regulations.

The ordinance is often amended. In 2000, after an extensive community process, the City Council adopted a comprehensive rezoning package to encourage more housing, including affordable housing, especially in areas where other uses have dominated; limit future density and traffic growth; and provide additional opportunities for public review of large projects.

Toward a Sustainable Cambridge

This Cambridge growth policy document, published in 1993 by the Community Development Department, advocates many directions and strategies that are congruent with the Climate Protection Plan. While the growth policy document, which was written with extensive citizen involvement, has no formal legal status, it continues to guide policy decisions.

3. *Losing Ground*, Mass. Audubon Society, 1999.

Green Ribbon Report
In 1999 the City Manager appointed the 17-member Green Ribbon Open Space Committee to develop criteria for expanding and improving the city's open space system. Its recommendations are included in the possible actions listed below.

Community Preservation Act
In November 2001, Cambridge voters adopted the Community Preservation Act (CPA). The CPA allows communities to increase their property taxes and devote the funds to open space protection, affordable housing, and historic preservation. The allocation of the funds is determined through the preparation of a community preservation plan.

Citizen groups, boards, and committees
Civic activism is a great asset of the city. Cambridge and the region have a number of citizen organizations working on issues related to land use and vegetation management, among them the Friends of the Alewife Reservation, Cambridge Tree Project, Charles River Conservancy, Charles River Watershed Association, and Mystic River Watershed Association, and several friends groups for local parks.

Citizen boards and advisory committees are also important assets. Those that perform roles relevant to land use and vegetation management include the Planning Board, Conservation Commission, and Committee on Public Planting.

Regional planning organizations
The Metropolitan Area Planning Council, based in Boston, is the regional planning organization for the area's 101 cities and towns. While it is advisory, without much clout for regional land use planning, its staff and other resources can provide valuable modeling and other services. The Metropolitan Planning Organization does regional transportation planning and approves allocations of some roadway funds.

LEED
A growing trend in architecture and development is to design buildings in an environmentally holistic manner so that site choice, energy performance, indoor air quality, resource efficiency, water consumption, and waste management are optimized in terms of environmental values. The U.S. Green Building Council (USGBC) developed the Leadership in Energy and Environmental Design (LEED) rating system to provide a process and guidelines by which to evaluate buildings for their environmental and energy performance. The current system is applicable to commercial, industrial, institutional, and multifamily residential buildings of 40,000 square feet or more area. The USGBC is in the process of developing rating systems for residential buildings and for building remodeling. The City became a member of the USGBC in June 2001.

Green Ribbon Committee

The 2000 Green Ribbon Committee report recommended that the City consider several next steps while pursuing open space acquisition:

- *establish a permanent open space committee to provide advice on open space acquisition and enhancement;*
- *form or closely affiliate with an open space non-profit;*
- *expand resources for open space enhancement, maintenance, and design, with a focus on facilities in priority areas and for priority uses;*
- *continue the city's efforts to improve access to open space; and*
- *incorporate review of open space into the permitting process for large development projects.*

LEED-Registered Projects in Cambridge

- *Cambridge Park Place Apartments/Oaktree Development*
- *823 Main Street/Gravestar, Inc.*
- *Genzyme Headquarters*
- *Stata Center/MIT*
- *City Hall Annex/City of Cambridge*

The LEED rating system provides a standard that can be used as a reference in design and construction documents, government policies, and laws and regulations. It is being widely adopted as a guideline across the nation. In Cambridge, five projects have been registered as having been designed using the LEED standards. The City's renovation of City Hall Annex is using LEED, as will the main library expansion. Other projects in Cambridge are using LEED but have not sought official designation from the USGBC.

The recent revisions to the zoning ordinance established a new project review process with urban design objectives. One objective calls for developments to minimize environmental impact from resource use and cites LEED as a means to document these impacts. The Planning Board will take the objective into account when it reviews applications for special permits.

The Green Roundtable
This Boston area non-profit organization, which is an USGBC affiliate, includes architects, engineers, developers, environmentalists, government agency staff, and other interested people. It provides education and training programs and technical assistance and also advocates for policies that promote green buildings.

Northeast Center for Urban and Community Forestry
This office, based at the University of Massachusetts at Amherst, is a partnership of the U.S. Forest Service, private and state forestry concerns, and the university. It provides information and assistance in planning and conducting urban forestry activities.

Massachusetts DEM Urban Forestry Program
The state Department of Environmental Management helps communities and nonprofit groups build long-term management programs and develop support for urban forest management. Grants are offered for urban forest planning and education and for tree plantings.

Actions to Reduce GHG Emissions from Land Use Activities

Note: Actions are classified based on which sectors of the community would be directly involved:

B=Business community
G=City government
R=Residents
I=Institutions

Proposed actions are listed by sector in Appendix III.

Strategy 1: Foster Mixed Use, Transit-Oriented Development and Redevelopment and Public Open Space through Zoning and Incentives

Life-cycle analysis of buildings shows significant energy savings and reduced environmental impact when existing structures are reused or rehabilitated rather than replaced. Compact mixed-use development lowers energy use within buildings, promotes less automobile travel, and helps make the city livelier and more livable.

Unpaved open space offers opportunities to grow vegetation that can serve as a CO_2 sink and reduce the heat island effect. Opportunities for new open space are limited in Cambridge, because most land has been built on and buying and converting property to green space is very expensive. Opportunities for new green space include converting small spaces to vegetated miniparks, establishing a multi-use path along the Grand Junction railroad line, developing rooftop gardens, and redesigning lawns around office buildings in areas like Kendall Square to include more varied vegetation and public access.

The City's Green Ribbon Committee recommendations on open space provide a blueprint for open space preservation and acquisition. In addition, existing natural areas should be conserved, and restored where damaged. Open space should maximize tree canopy cover compatible with proposed uses and be maintained with energy- and water-efficient practices and vegetation (see strategies 3 and 5).

Having access to wilder nature—woods, fields, and beaches—is also important for people who live in the city. If access is difficult, it encourages more out-of-town travel and, for those who can afford them, second homes, creating a negative spiral of more sprawl, less access, more desire for vacation homes, etc.

Actions: 1990-2001

- The city's mixture of building uses has been strengthened with the comprehensive rezoning adopted in 2000.
- The City committed to making City Hall Annex and the new main library green buildings.
- The Green Ribbon Committee was formed and delivered a plan for acquiring more open space.
- New public parks were built as components of developments at Kendall Square, University Park, and Quincy Square. A landfill site was reclaimed to create Danehy Park, now the city's largest park. The buildings at 238 Broadway were acquired for demolition to expand park space, and two large new parks are planned for eastern Cambridge.
- Citizens and community activists, along with City staff, Harvard, and MIT, have worked with the MDC on the master plan for improving the Charles River Basin.
- Residents have led efforts to restore urban wilds at Blair Pond and Alewife Reservation.

Possible Actions

Ongoing

- Use zoning to continue to encourage pedestrian-scaled mixed-use development, with residential infill throughout the city. Strengthen orientation toward denser development near public transportation. [G]
- Design and construct durable buildings with flexible re-use options. [G,I,B,R]
- Conduct consistent open space review during the permitting process for development projects to incorporate public open space into project design. [G]
- Provide incentives for planting trees and creating additional green space open to the public as part of new development and major renovations. [G]
- Carry out the recommendations in the Green Ribbon Report. [G]
- Create appealing small-scale public gathering spaces with well-adapted vegetation as part of development and redevelopment projects. [B,I]

Chicago's Green Rooftop Demonstration Projects

Summer roof temperatures can reach up to 140˚F in cities. This intense heat creates updrafts of tiny particles that can clog lungs as well as increase the need for more electricity for air conditioning, which is a major contributor to air pollution. In response, the city of Chicago is planting gardens atop several city buildings as part of a U.S.

EPA program studying ways to help cool cities and reduce smog. A study conducted by Weston Design Consultants concluded that the greening of all city roofs in Chicago would produce $100,000,000 in saved energy annually, with the peak demand cut by 720 megawatts. The city will also plant trees and other vegetation in medians to help cool pavement and will consider using light-colored paving surfaces. Green roofs help capture and filter air pollutants and retain 50-70% of storm water. They require less maintenance and repair and help muffle noise. Because green roofs can't get hotter than 77˚F they should help to cool Chicago by 5˚F during the hot summer months.

Strategy 2: Optimize Use of Vegetation to Shade Buildings and Reduce the Urban Heat Island Effect

The tree canopy reduces the urban heat island effect, sequesters carbon, reduces gasoline evaporation from parked motor vehicles, and makes the city more visually attractive. Preserving existing trees is the key to increasing the canopy since mature trees provide significantly more canopy than recently-planted ones. Trees grow slowly, and typically it takes many years for a tree to reach its full growth and capacity to sequester carbon. Vines and arbors can also be used in constrained spaces.

Removal of CO_2 from the air by trees is on the order of 25 tons/tree/year. There are about 13,000 to 15,000 City-owned trees and an unknown number of privately owned trees. Conditions for trees are more difficult than they used to be, so it is important to boost maintenance of old trees, as well as to add trees wherever possible. For trees and other vegetation, sufficient water and good soil, with the proper nutrients and drainage, are crucial. Selection of species adapted to the local environment, and minimizing lawns, keep maintenance and energy costs low. There are multiple benefits to good vegetation maintenance and on-site water management, including avoidance of costs of storm damage and loss of vegetation from droughts, energy savings for building owners, and a pleasant summer environment.

Benefits from Trees

Urban trees have many benefits besides sequestering CO_2:

"*Forest Service research suggests that when the economic value of benefits trees produce (e.g., removal of air pollutants, heating energy savings, reduced storm water runoff, increased property values, scenic beauty, and biological diversity) are assessed, total benefits can be two to three times greater than costs for tree planting and care . . . Furthermore, many of these benefits extend beyond the site where a tree grows, to influence quality of life in the local neighborhood, community, and region.*"

McPherson & Simpson, Carbon Dioxide Reduction through Urban Forestry. USDA, 1999.

Actions: 1990-2001

- The City has implemented new tree programs, including a four-year pruning cycle for its trees to help them survive storms and minimize the need for later more drastic pruning, and an expanded client and commemorative tree program, through which residents and businesses can pay for new street and park trees and work with the City to maintain them.
- Tree education has included the City Arborist's neighborhood tree walks and Arbor Day celebrations in local schools, both of which feature tree identification and tips on caring for trees, and educational activities conducted by the Cambridge Tree Project.
- The Department of Public Works has carried out efforts to reduce storm runoff into the storm-water system.
- Renovations to the parking lot at the Porter Square shopping center included a system to capture and reuse runoff.

Proposed Actions

Short-term

- Use GIS or other computer imaging, such as the CITYgreen software developed by American Forests, to accurately determine current canopy cover, assess environmental benefits, and plan plantings. [G]
- Increase public education efforts on stormwater management practices, particularly those that complement GHG emission reductions. [G]
- Increase public education on the benefits and proper care of trees. [G,R]

Medium and Long-term

- Develop and carry out policies and programs to maximize the canopy cover, with special attention to parking lots and other heat-absorbing locations and to shading air-conditioning units. This should include attention to soils, water retention, and appropriate species. [G, B,I,R]

Strategy 3: Reduce the Urban Heat Island Effect through Design of the Built Environment

The less incoming solar radiation buildings, streets, and other surfaces absorb, the cooler the city becomes. There are two main ways to reduce the absorption of heat: increase transpiration and shading by vegetation and increase the albedo (reflectance) of surfaces. There are many low-cost ways to make surfaces more reflective. It can be as simple as selecting light-colored asphalt shingles instead of black shingles when re-roofing a building.

Actions: 1990-2001

- The City Council passed an order requiring that green roofs be considered in new construction or major renovations of City buildings and to encourage their use in private construction.

Cool Roofs

Black surfaces in the sun can become up to 70°F hotter than most reflective white surfaces. The heat from a roof can increase the surrounding air temperature by up to 5°F, contributing to the heat island effect. Cool roofs can reduce the heat island effect and save energy for air conditioning.

While there are benefits to using black roofs in some colder areas in the United States, Cambridge would see better results from using a cool roof system. A white roof system is both environmentally conscious and economically sound. The installation cost for a white membrane roof per 10,000 sq. ft. is up to $22.80 cheaper than a traditional black roof system. The use of cool roof systems is an important method Cambridge can use to reduce its growing air pollution problem.

Proposed Actions

Short-term

- Provide developers and property owners with information about using green roofs or high reflectance roofs on buildings and other reflectance and shading techniques. [G]
- Provide developers and property owners with information about reflectance and shading for parking lots. [G]

Medium and long-term

- Provide incentives for new construction and renovations to meet LEED standards for reflectance and shading. [G]
- Incorporate LEED standards for reflectance and shading in all City and private parking lots and in new construction and major renovations. [G,B,I,R]

Strategy 4: Promote the Design and Construction of Green Buildings

Designing green buildings involves different approaches and techniques than does conventional design. It explicitly considers factors such as the energy efficiency of a structure and the level of air quality that will result. It requires tools such as energy modeling to support the design process. The aim of the green building approach is to construct buildings that are more durable, are sited optimally, use less energy, provide a safe and comfortable indoor environment, and conserve natural resources—in other words, to minimize the environmental footprint of our built environment.

On July 1, 2001, a new energy code for commercial and high-rise residential buildings took effect in Massachusetts. The code affects the construction of new buildings and is projected to save 27 trillion BTUs of power generation. It is estimated that statewide the new code requirements will reduce annual emissions of CO_2 by about 2.4 million tons, sulfur dioxide by about 14,500 tons, and nitrogen oxides by about 3,500 tons. The new code does not affect existing buildings, which outnumber new buildings, except when they undergo major renovations.

Actions: 1990-2001

- The 2000 city-wide rezoning includes a provision to advise developers on the merits of using LEED standards.
- Several projects have been constructed as green buildings. Some projects predated the LEED rating system, including Cambridge Co-housing (on Richdale Ave.), the Union of Concerned Scientists headquarters (top three floors of 2 Brattle Square), and the renovation of the Porter Square shopping plaza. Several construction projects proposed or under way are planned with the goal of meeting LEED certification criteria.

Proposed Actions

Short-term

- Provide developers, citizens, and City staff with information to assist them in applying LEED standards. [G]
- Develop green standards for renovation of City-owned properties. Utilize the City energy management workgroup to coordinate department implementation. [G]

Medium-term

- Strengthen zoning incentives to include LEED in project review and planned unit development (PUD) processes. [G]
- Reuse materials from existing structures during renovation or redevelopment projects (See LEED Materials Credit 1). [G,I,B,R]

Strategy 5: Work for Transit-Oriented Regional Land Use Planning

Currently, the mechanisms for doing regional land use planning in the Boston area are weak. The metropolitan area includes 101 cities and towns, many of them quite small geographically. The Metropolitan Area Planning Council is advisory, and there is no governing regional body. While sprawl is not an issue within Cambridge, which is already very densely developed, it directly affects the city in important ways as it promotes increased traffic to and from the city. In addition, the loss of open space outside Cambridge is a loss to Cambridge residents who seek access to forests, beaches, other natural areas, and farms.

Regional concerns may sometimes conflict with local concerns: People looking at transportation issues in the region may want to concentrate new jobs near places easily reached by public transportation, e.g., Cambridge, while many Cambridge residents, concerned about traffic on their streets, may not. In addition, new jobs draw people to Cambridge at the same time that the high cost of housing makes it impossible for many of them to live in or near the city, which induces further sprawl and more driving.

It is important for the entire Boston metropolitan area that there be a regional land-use plan that includes powerful incentives to stop sprawl and shift to in-fill development. While there is growing agreement among planners that in-fill development is often preferable to sprawl, there seems to be a lack of consensus on what kind of in-fill development is desirable or on how to make it happen.

Actions: 1990-2001

- Through participation in the Metropolitan Area Planning Council and other regional and statewide organizations, the City works to promote a regional approach to land use.

Proposed Actions

Ongoing

- Increase support for and involvement in regional land use planning activities. [R]
- Work with legislators and other public officials toward creating a regional land use plan with teeth. [G,R,I,B]