Chapter 6

Urban and Community Forestry: Planning and Design

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1. Planning the Urban Forest

Most communities have not planned their urban forest; it has just happened. This does not mean that communities do not plan. Many communities have open space plans, park and recreation plans, and street tree programs. Very rarely, however, these plans are coordinated or comprehensive with respect to community forest resources.

As with any planning effort, three basic questions must be addressed as part of the process: What is being planned; who is responsible; and what are the objectives? In seeking answers to these questions, the complexity of the urban forest and the practice of urban forestry become readily apparent.

1.1. What Is the Urban Forest?

A clearly articulated operational definition as to what constitutes the urban forest is essential to the planning process. The nature and composition of the urban forest has been described in many ways. The following description is an adaptation of a rather succinct but encompassing definition developed by the Washington State Department of Natural Resources (McFarland, 1994). The urban forest is the land in and around areas of intensive human influence, ranging from small communities to dense urban centers, which is occupied or potentially occupied by trees and associated natural resources. Urban forest land may be planted or unplanted, used or unused, and includes public and private property and street, transportation and utility corridors. This is a compelling definition, because it not only describes what the urban forest is but also what it might become.

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In analyzing this definition, the urban forest is not simply street trees and parks. The urban forest is an ecosystem that includes soil, water, animals, utilities, buildings, transportation systems, people, and, of course, vegetation. Vegetation includes all plants—woody and herbaceous—regardless of where they are growing: private yards, parks, school grounds, cemeteries, vacant lots, utility rights-of-way, streets, parking lots, and so forth (Moll *et al.*, 1995).

1.2. Who Is Responsible

In a democratic society, planning should be a participatory process. Ultimately, however, someone needs to assume responsibility. It is perhaps the lack and fragmentation of responsibility that in many cases have hindered a comprehensive approach to urban natural resource planning. The issue of responsibility needs to be addressed on many levels: ownership, investment, management, regulatory authority, and the establishment of policy.

Ownership, because of its implication with respect to control, is a critical point. The extent to which the urban forest is publicly held versus privately owned will directly shape investment and management strategies as well as public policy. Although highly place-dependent, an assumption is that the higher the population density, the greater the percentage of publicly owned urban forest. Support for this assumption may be extrapolated from the Chicago study (McPherson *et al.*, 1994). This study found that street trees accounted for 1 of every 4 trees in 1 to 3 family residential districts in Chicago, 1 of every 10 to trees for residential land in suburban Cook County, and 1 of every 26 trees in the residential areas of the less urbanized DuPage County.

On the basis of the street-tree-to-residential-tree gradient observed in the Chicago study, certain inferences can be made. In dense urban areas, trees within the public realm represent a significant portion of the urban forest. Thus, in these communities it would seem that the health of the urban forest is highly dependent on public commitment and investment. If urban forest resources are to be enhanced, sustained, and integrated into the planning and development process in these dense, urban communities, then "green" infrastructure needs to be elevated to the same level of importance as "gray" infrastructure. Wide-reaching and strongly supported urban forestry programs are a key component in this process.

Conversely, in communities where urban forest resources are predominantly privately owned, regulatory mechanisms, such as landscape and tree ordinances and zoning codes, may play a much larger role in the protection and enhancement of these resources. An interesting finding in a public opinion survey conducted in California (Underhill, 1995) revealed that the amount respondents were willing to pay for urban forestry programs decreased with home ownership. Since ownership tends to increase with decreased density, this would support the need for regulatory techniques. It should be pointed out that regardless of density, communities need to develop a publicly supported urban forestry program and establish appropriate regulatory measures.

1.3. What Are the Objectives?

Objectives can be viewed as to what a community wants and, perhaps more importantly, what it is willing to do to achieve those desires. Objectives may be singu-

lar or multiple; however, singular objectives may result in multiple benefits. For example, a community with considerable steep terrain may decide to prevent development on steep, wooded hillsides to control storm water runoff and prevent erosion. However, additional benefits, such as air quality, reduced summer cooling demands, preserved animal habitat, and the establishment of an upland greebelt, could result from this decision.

Needs and desires will vary from community to community or even neighborhood to neighborhood, depending on availability and accessibility to community forest resources and population profile. A method for achieving consensus and guiding decision making is essential to the process (Miller, 1988).

2. Elements of the Urban Forest

For descriptive purposes the elements of the urban forest, primarily within the public realm, can be categorized in two broad groups: nodes and links (Hartman and Strom, 1995). Nodes are spatially defined parcels of land that may serve as focal points, attractions, and/or destinations (Fig. 1). They have the potential to become recognizable and identifiable places within the urban fabric. Links, by their nature, are linear. Links may connect nodes and establish corridors by which we experience and perceive a place as we move through it. They also may preserve and protect natural resource corridors. Links include streets, greenway corridors, stream and river corridors, and abandoned railroad right-of-ways (Fig. 2).

2.1. Nodes

2.1.1. Parks and Open Spaces

These spaces primarily consist of active and passive parks, playgrounds, squares, and plazas (Fig. 3). In dense urban settings these spaces, together with conservation areas, form the backbone of the urban forest system. If properly managed and protected, existing parks and open spaces can be the basis on which a larger urban natural resource system can be established.

2.1.2. Conservation and Natural Areas

Watershed lands, wetlands, coastal marshes, wildlife sanctuaries, and lands with similar functions constitute the major elements of this category. Generally these are sensitive landscapes that have intrinsic environmental value.

2.1.3. Civic and Institutional Facilities

This broad category includes land uses such as churches, cemeteries, schools, college campuses, museums, and other cultural institutions. Arboreta, botanical gardens, and zoological parks may be included here or in either of the two previous categories (Fig. 4).

Vacant land

- Vacant land has no permanent structures and provides a valuable urban land resource
- Vacant land presents a variety of open space and development opportunities including:
  - expansion of natural resource base,
  - expansion of park and open space systems,
  - development of community gardens and working landscapes, and
  - community redevelopment and revitalization.

Existing green/open spaces

- Existing urban green/open spaces must be preserved and maintained to have an impact on the future urban landscape.
- Existing green/open spaces of the urban landscape represent a valuable natural resource including wildlife habitat.
- If managed properly and protected, existing green/open spaces can be the basis upon which a larger urban forest can grow.

Community gardens

- Community gardens are vacant urban spces that have been turned into horticultural or agricultural oases.
- The gardens are often managed by neighborhood or community groups or associations.
- Community gardens provide a focus for the community and help to foster pride among the citizens who manage and maintain them.
- The gardens present opportunities for environmental education.
- Community gardens are a productive use for vacant land.

Productive landscapes

- Productive landscapes provide the potential for economic and social benefits.
- Productive landscapes include commercial horticultural gardens and nurseries.
- This type of use provides the opportunity for environmental education and training in the "green industries."
- The potential exists for the generation of revenue for the municipality or organization managing the resource.
- Employment of residents may help to reduce financial burdens on other entities.

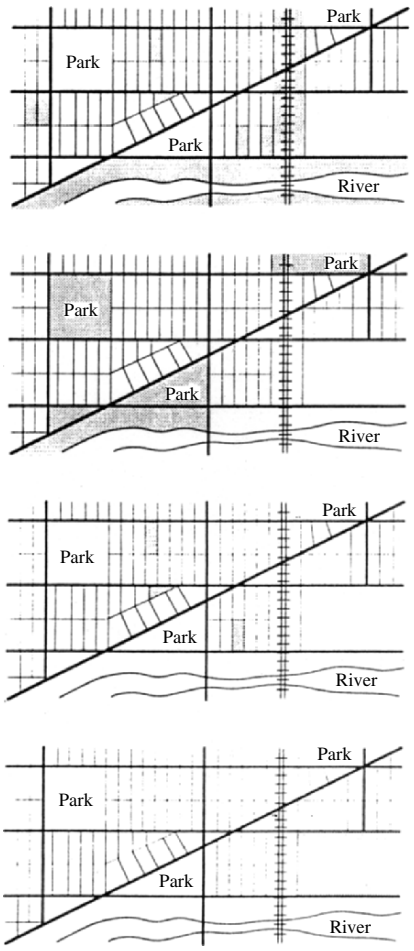


FIGURE 1. Diagram of nodes (source: Newark Urban Forestry Demonstration Project: Findings and Recommendations).

2.1.4. Community Gardens

Community gardens are usually vacant lots that have been turned into horticultural oases. Usually, the gardens are managed by community groups or neighborhood associations. They have the potential to provide a focus for the neighborhood, foster community pride, and present opportunities for environmental education.

2.2. Links

2.2.1. Streets

Streets are the single-most abundant public space within the urban fabric. They are the primary setting for public life, and the network of streets may be thought of

Street corridors

- Streets are an abundant and often underutilized urban forest resource.
- Streets provide existing corridors that can be enhanced to provide a vegetated linkage between nodes.
- Street tree plantings enhance the pedestrian scale, microclimate and aesthetic qualities of the urban environment.
- Street tree plantings enhance the pedestrain experience by providing shade and separation from vehicular traffic.

Greenways

- Greenways are an appropriate use of contiguous and linear areas of vacant land.
- Greenways can provide a vehicular free link between nodes.
- Greenways can be extensively planted with vegetation to become long, narrow parks through the built urban environment.
- Greenways protect and enhance the urban natural resource base.

Blueways (river and stream corridors)

- Blueways are greenways that are directly associated with stream or river corridors.
- Blueways provide a buffer between the built, terrestrial environment, and the aquatic environment.
- The development of blueway networks allow streams and rivers to be maintained and function in a natural state.
- Blueways enhance habitat and water quality.

Visual linkages

- A visual linkage can be created, even when it is not possible to physically link two nodes.
- Visual linkages present the impression of greenness even if the area where one is standing is not green.
- Visual linkages draw people toward green spaces by indicating a green area in the distance.

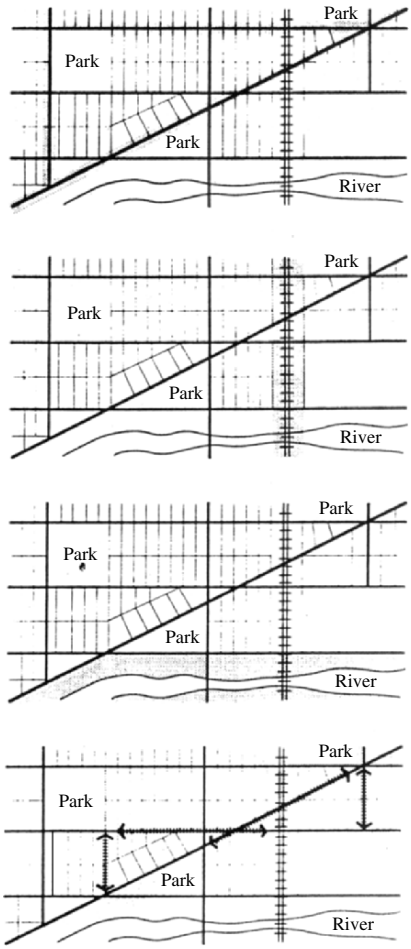


FIGURE 2. Diagram of links (source: Newark Urban Forestry Demonstration Project: Findings and Recommendations).

as the thread that binds together the physical and social fabric of our cities. In many communities, streets are an underutilized urban forest resource. Streets provide existing corridors that can be planted to create vegetated linkages between nodes while enhancing the pedestrian scale, microclimate, and anesthetic quality of the urban environment (Fig. 5).

2.2.2. Greenways

Greenways are an appropriate use of contiguous and linear areas of vacant land such as abandoned rail rights-of-way. On a grander scale, greenways can become greenbelts within metropolitan regions.

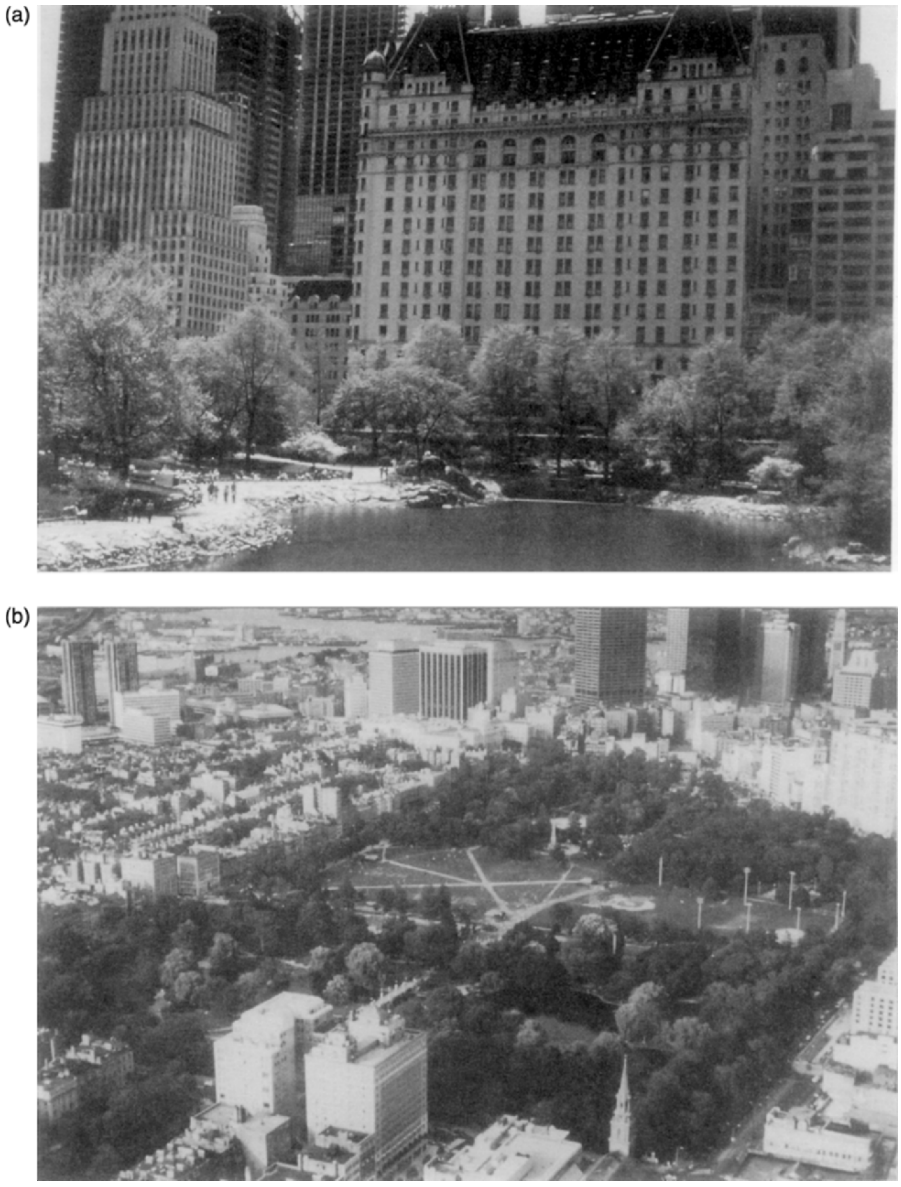


FIGURE 3. Urban green spaces, such as (a) Central Park in New York and (b) the Boston Common and Public Garden, are important components of the urban forest.

2.2.3. Blueways

Blueways are greenways, which are directly associated with stream and river corridors (Fig. 6). Blueways may perform an important environmental function by buffering the aquatic environment from the built environment, thus preserving or enhancing water quality. The development of blueway networks helps to preserve the natural functions of streams and rivers.

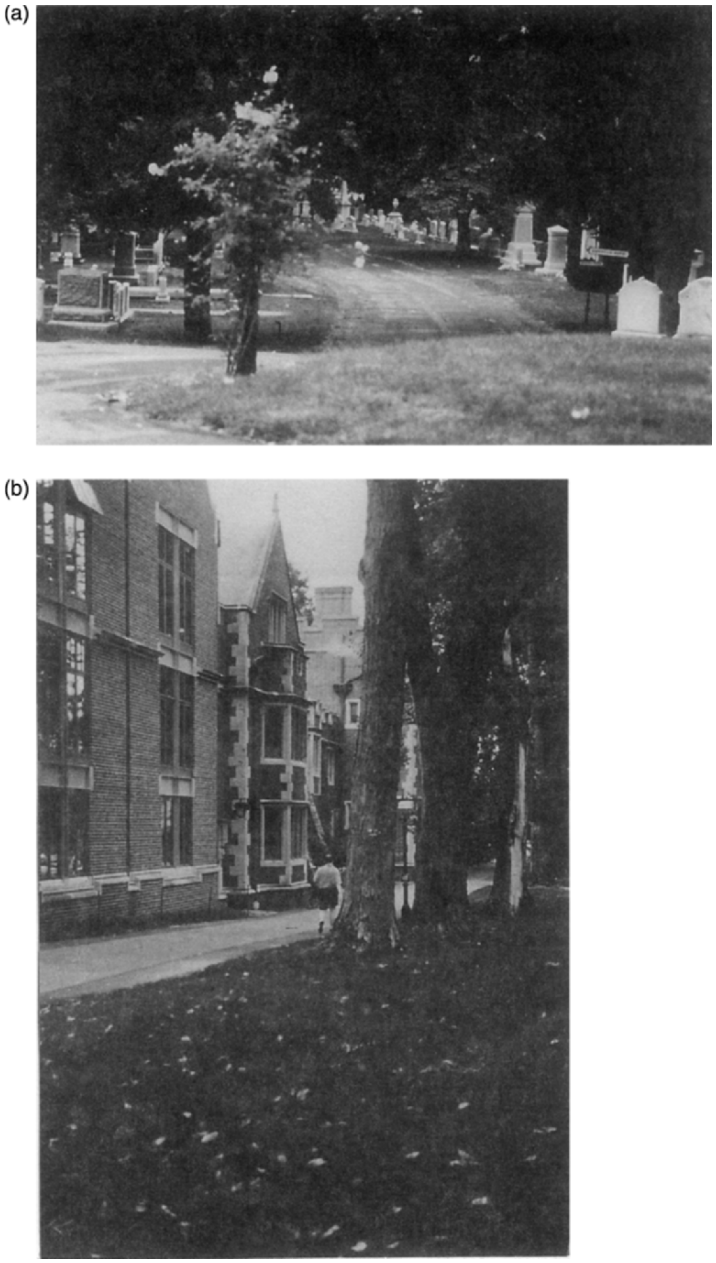


FIGURE 4. Public and private institutional facilities including: (a) cemeteries and (b) universities are often overlooked as components of the urban forest.

FIGURE 5. Majestic oaks, with their canopy and column-like trunks, clearly define this street space.

FIGURE 6. The Delaware & Raritan Canal forms a continuous 60 mile blueway/greenway across central New Jersey.

2.2.4. Highway and Rail Corridors

Highway corridors can occupy a significant portion of the urban landscape. Although there may be limitations in terms of safety and access, the potential exists for these landscapes to perform multiple functions. Active rail rights-of-way pose even greater safety, access, and maintenance limitations but should not be overlooked in terms of connecting fragmented landscapes.

2.2.5. Visual Linkages

Where it is not physically possible to link nodes, a perceptual connection may be created by visual linkages. A visual linkage presents the impression of greenness, even if the area where one is standing is not green (Fig. 7).

3. Design and Urban Forestry

The primary underlying principles that guide physical design within an urban forest context are the same as those that would be applied to good urban design. These principles are appropriate to the site, block, and neighborhood scale of development and include spatial organization, unity, and coherence. Trees can be used to create, define, or reinforce spatial structure and/or sequence and to add a humanizing

FIGURE 7. Tree plantings are clustered in groups (rather than in the typical linear manner for street tree plantings) along the downtown pedestrian zone in Munich, Germany. As a result of the cluster locations, tree groupings are always in view to the pedestrian.

scale to the urban environment. Coherence is the principle of making a place readily understandable. Unity serves visually to unify a variety of elements or spaces, often of a disparate nature. At the very detailed level of design, principles, such as rhythm, pattern, and texture, are also applicable. Issues of biological diversity and ecological connectivity also should be addressed; however, these principles need to be planned and managed from a regional perspective. The following sections suggest design considerations for specific components of the urban public landscape.

3.1. Streets

As noted previously, streets constitute the greatest percentage of the public landscape. Without a doubt, they have the greatest impact on public perception and visual quality of a community's residential neighborhoods and commercial shopping districts.

In addition to the environmental and economic benefits, street tree plantings provide spatial enclosure and definition that contribute to the aesthetic quality of the urban environment. Street trees perform functions similar to architecture in which the canopy acts like a ceiling and trunks are analogous to columns. However, for trees to perform these spatial functions effectively, specific design principles must be applied (Strom and Hartman, 1995).

First, large deciduous trees are preferred over small or ornamental trees. Large trees are effective in defining and containing space and are appropriately sized in relationship to pedestrians and the scale of street corridors (Fig. 8). Small trees do not define spaces, interrupt the visual continuity of the street, or permit pedestrians to sit or stroll beneath them easily. Small trees should not be used in deference to overhead

FIGURE 8. London Planetrees are appropriately scaled to the width of the street and center island.

utilities. Examples of large trees and utilities coexisting can be found in almost every community. The Tree Line USA Program, sponsored by the National Arbor Day Foundation, promotes quality tree care and a number of techniques that allow large trees and utility lines to coexist.

Second, trees should be planted close to the curb, preferably in the space between side-walk and street with sufficient soil depth and area. Trees planted close to the curb reduce the apparent width of the street and thus reduce the overall street scale. This placement also separates the pedestrian from vehicular traffic both visually and psychologically. Trees should not be moved back from the curb to accommodate overhead utilities. This approach is similar to moving the walls of a corridor further apart. When this happens, the proportions of the space are lost, as is the sense of enclosure and containment (Fig. 9).

Third, trees should be spaced so that they form a continuous overhead canopy. This continuity provides visual unity that contributes a sense of order and coherence to the urban environment (Fig. 10). Design criteria for streets should establish maximum distances between trunks to ensure a sufficient number of trees to achieve good design rather than a minimum spacing distance between trees (Arnold, 1980). Where it is not possible to create a continuous canopy, trees should be grouped to define their mass and reinforce their ability to define spaces within the urban fabric.

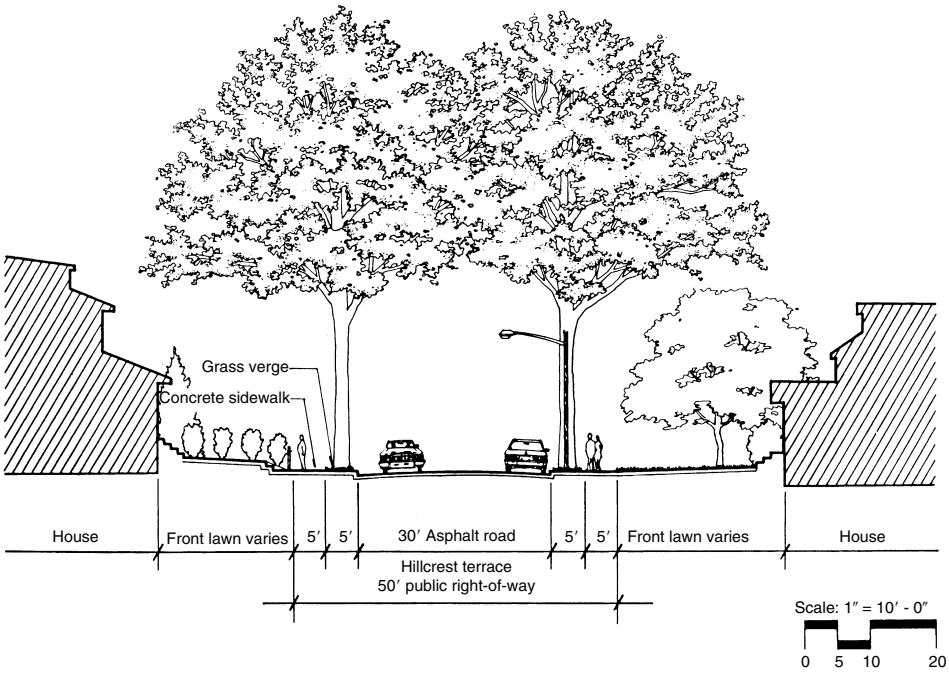


FIGURE 9. Trees placed between sidewalk and street clearly define and separate pedestrian space from vehicular space (source: East Orange Urban Forestry Demonstration Project: Findings and Recommendations).

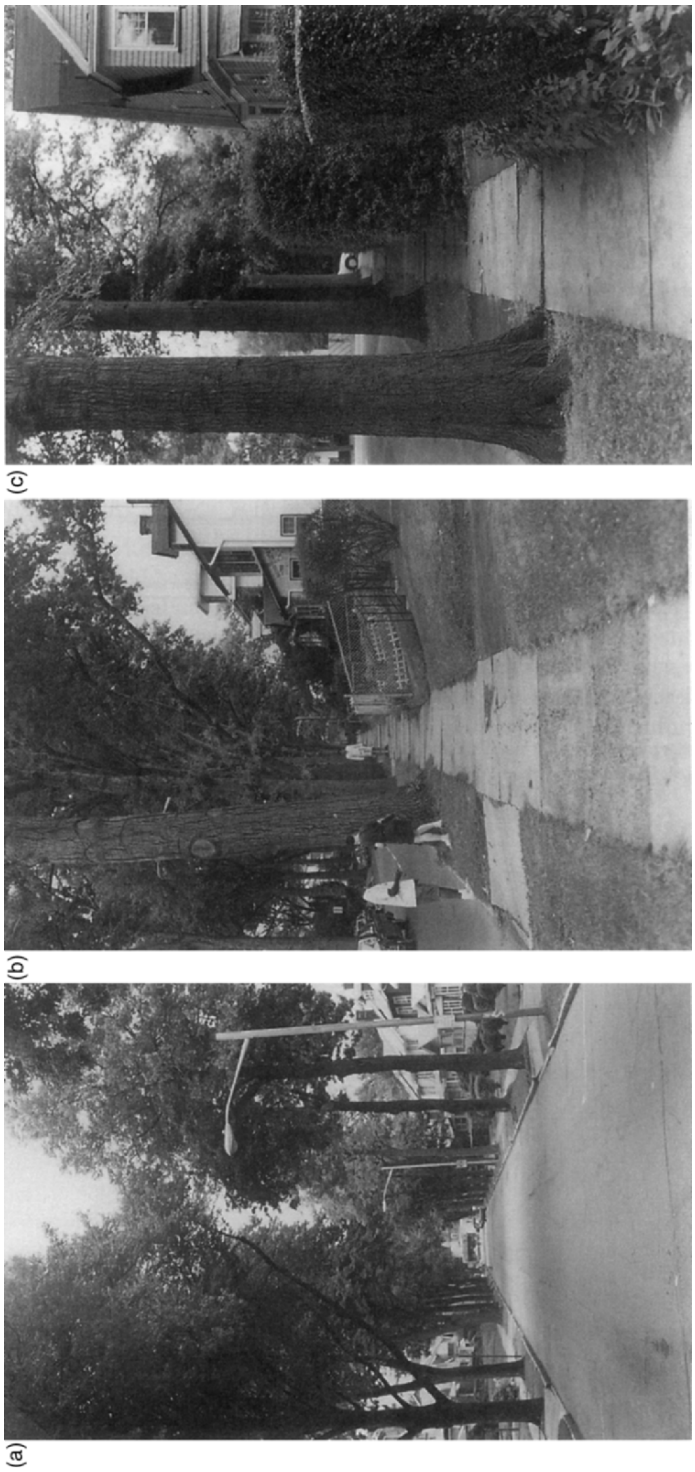


FIGURE 10. This shows the appropriateness of large canopy trees regardless of the width of the street right-of-way (a), setbacks to buildings (b), or neighborhood density (c).

Finally, sufficient space should be provided to ensure long-term survival. Research has shown that soil volume is critical to the health and survival of street tree plantings. The concept of tree pits has been replaced by continuous trenches with suitable soil mixes and proper aeration and drainage. Urban planting techniques continue to evolve and are addressed in Chapter 13 of this volume and other sections of this text.

3.2. Plazas and Squares

These spaces are usually extensions of the street spaces. Such spaces serve as outdoor rooms, which are most effective when clearly defined by an ordered geometry of tree plantings. Plantings can be used to define spatial limits, create implied walls, or subdivide the space into a series of rooms. In addition to creating voids (i.e., rooms), trees can be used to create volume or mass. In the latter case, a much more architectural type of room is created by the columns of the tree trunks and the ceiling of the canopy. In addition, the mass of the canopy may serve as a boundary to define adjacent spaces (Fig. 11a).

3.3. Parks and Open Spaces

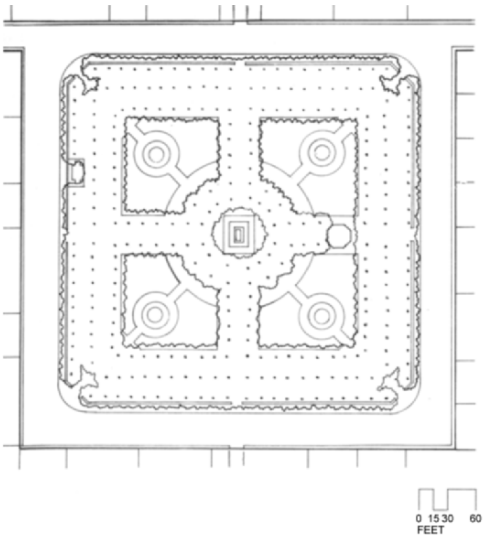
This category is highly diverse and can include large and small passive green spaces, active recreation, and conservation lands. There are no recipes or formulas that can guide the design of these places. Each site must be evaluated within its specific cultural and ecological context to determine its most appropriate function or functions and design responses to accommodate those functions.

Such responses may include ordered geometries, stylized interpretations of natural environments, or ecological restoration. Grids of trees or other geometries may be appropriate for small parks and playgrounds, whereas a large regional park may be an integration of all three approaches.

3.4. Parking Lots

It may be argued that parking lots are incredibly inhospitable environments to plant trees. Parking lots have high surface temperatures, provide little opportunity for proper root aeration and water infiltration, and have degraded water quality and vehicular traffic that can scrape and scar tree trunks. However, the environmental consequences of not planting trees in parking lots are simply not acceptable.

The standards by which parking lots are designed and constructed must be reconsidered so that more hospitable environments can be created for both plants and people. The objectives of revised guidelines should be to reduce the amount of pavement and increase the amount of landscaping. These objectives can be achieved by (1) using realistic rather than inflated parking demand ratios, (2) designing parking stalls and aisles using dimensions that reflect the size of today's automobiles, and (3) increasing requirements for tree plantings and landscaping. Biofilters and bioretention areas should be integrated into most parking lot designs to increase the amount of pervious surface and enhance the quality of storm water runoff.



(a)

(b)

FIGURE 11. The plan (a) of Place des Vosges in Paris is a classic example of a formal, geometrically structured tree planting of a neighborhood square (photo courtesy of John Webster). (b) Louisburg Square in Boston is another excellent example of the importance of small squares to the quality of the urban life.

FIGURE 12. The island in this corporate parking lot provides an opportunity for significant tree plantings as well as storm water detention and infiltration.

Surface parking lots represent a significant land use in small- to medium-size cities and for office developments and corporate campuses in suburban areas (Fig. 12). It is essential to look beyond their utilitarian use as temporary storage areas for automobiles and recognize that they represent a significant environmental impact and opportunity.

In designing parking lots it is also important to realize that drivers become pedestrians when they leave their car and the experience from parking to destination should be safe, easily understood for orientation purposes, and comfortable.

Trees planted in parking lots can provide spatial order and human scale and can significantly reduce heat island conditions. The capital investment is relatively small compared to the benefits gained. However, trees cannot continue to be placed in parking lots as a token gesture using improper planting techniques. Under these circumstances tree growth will be minimal and tree mortality will be high.

3.5. Community Gateways

Gateways announce the arrival or entry to a community or place. They can be simple markers, a designed space, or a sequence of spaces. Regardless of the technique, however, gateways set the stage for how a community is perceived and have the potential to become memorable symbols of a place.

FIGURE 13. (a) The allée combined with the scale and detailing of the sidewalk create a gateway to New Brunswick, NJ. (b) A mass planting of annuals provides seasonal interest and reinforces the gateway.

Trees may be used effectively to create community gateways. A particular species of tree may be used on major streets leading into a community to announce the passage from one town, or even one neighborhood, to another. A combination of spaces, street tree plantings, and seasonal or special plantings can also be used (Fig. 13). Appropriate scale and spatial structure are important to the design of these spaces so that they do not appear trite or impermanent.

4. Planning and Design: Future Opportunities

4.1. Vacant and Underutilized Land and Brownfields

Vacant and underutilized land has no permanent structures, or the existing structures have become derelict or obsolete. Such places provide a valuable urban land resource for a variety of uses. Brownfields, a term used to describe contaminated sites, is a special category of vacant and underutilized land. In a number of cities there is an abundance of brownfield sites because of the high cost of cleanup, health risks, and general level of uncertainty and anxiety associated with these places. As a result, the supply of brownfield sites appears to be significantly greater than demand (Simons and Iannouly, 1997).

If brownfield sites represent surplus urban land, then these sites should be inventoried and analyzed for the potential of reweaving the natural landscape with the built landscape. Cities should seize the opportunity for reclaiming river and lakefronts, developing and expanding parkland, and creating new urban forests. It is important in this process to realize that formerly developed industrial sites may represent a greater economic benefit to a community as undeveloped or public land.

4.2. Productive Landscapes

Productive landscapes provide the potential for economic and social benefits and are primarily oriented toward urban horticulture. Uses include commercial and community nurseries, greenhouse production, and urban farming. These types of uses provide an opportunity for environmental education, job training in the "green industries," and reconnecting people with their agrarian roots.

For the public sector, the establishment of urban nurseries, tree farms, and greenhouses provides a readily available and regionally acclimated source of plant material. Although such ventures may not be directly profitable for communities because of issues like higher wage and utility costs and investments in programs, such as job training and environmental education, the potential for social benefits and the development of job skills may help to stabilize neighborhoods and relieve fiscal burdens on other social programs.

4.3. Highway Interchanges

Highway interchanges consume a considerable amount of urban and suburban land. The plantings for most of these interchanges have been designed primarily for ease of maintenance and do little to promote ecological diversity. Thus most are large areas of grass allowing for easy mowing (Fig. 14). These interchanges, although highly fragmented landscapes, represent a lost opportunity in developing and expanding the urban forest.

Lessons can be gained from European countries where the availability of land is limited. Perhaps most importantly, interchanges are designed to consume much less land than in the United States, resulting in less pavement and landscape degradation. Oftentimes, land contained by approach and exit ramps perform multiple functions

FIGURE 14. This cloverleaf highway interchange demonstrates a lost opportunity in terms of urban forestry and greater biodiversity 4(/h). photo courtesy of Roy H. Deboer.

such as agricultural production and managed wood lots. Serious consideration must be given to reforesting these landscapes and the potential positive impacts in terms of air quality, microclimate, and storm water runoff that can result.

5. Conclusion

Henry Arnold (1980) said that tree density may be a better indication of the health and liveability of our cities than population density. Whether true or not, this statement underscores the need for a strong vision that integrates the natural and biological environment with the built environment. A continuous network of urban forests from yards, streets, squares, and parks to regional greenbelts, forests, and agricultural lands must become the goal of all future planning and development efforts.

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