

WILLARD CLAY

A meadow landscape atop City Hall incorporates a range of plant materials and elevates the prominence of vegetated roofs.

Chicago's G

It's a testament to Chicago's urban greening.
But is it a model for other green roofs?

BY THEODORE EISENMAN

2002 ASLA AWARD WINNER

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CHICAGO IS UNDERGOING a green makeover. Set atop City Hall, a 12th-floor meadow landscape symbolizes the city's new commitment to urban greening, and vegetated roofs in particular.

Under Mayor Richard M. Daley, Chicago has installed 400,000 trees, planted 63 miles of medians, and remediated over 1,000 acres of brownfield sites. The city requires all new municipal buildings to follow a green building standard patterned upon LEED (Leadership in Energy and Environmental Design), and Chicago has also instituted one of the most progressive green roof policies in the country: Over one million square feet of vegetated roofs are in various stages of development. Completed in 2001, City Hall's roof garden is a prominent element in this citywide greening.

Unlike many vegetated roofs that are driven largely by stormwater management concerns, this roof garden was designed as a pilot project with the U.S. Environmental Protection Agency Urban Heat Island Initiative. The urban heat island effect occurs when dark surfaces such as streets, parking lots, and rooftops absorb and retain heat, collectively increasing ambient air temperature. On hot summer days, for example, city air can be up to 10 degrees Fahrenheit hotter than the surrounding countryside. These elevated temperatures raise summertime cooling costs for buildings and exacerbate air pollution by increasing ground-level ozone (smog).

Chicago is the first U.S. city to undertake an urban heat island initiative of such an ambitious size and scope: The initiative includes testing and applying reflective roofing materials and light-colored paving materials and calculating the energy benefits to be derived from a citywide application of green roof systems. The City Hall roof garden is a crowning statement, and initial results have been encouraging.

The green roof and the other energy efficiency upgrades in the building have reduced the building's summertime cooling costs

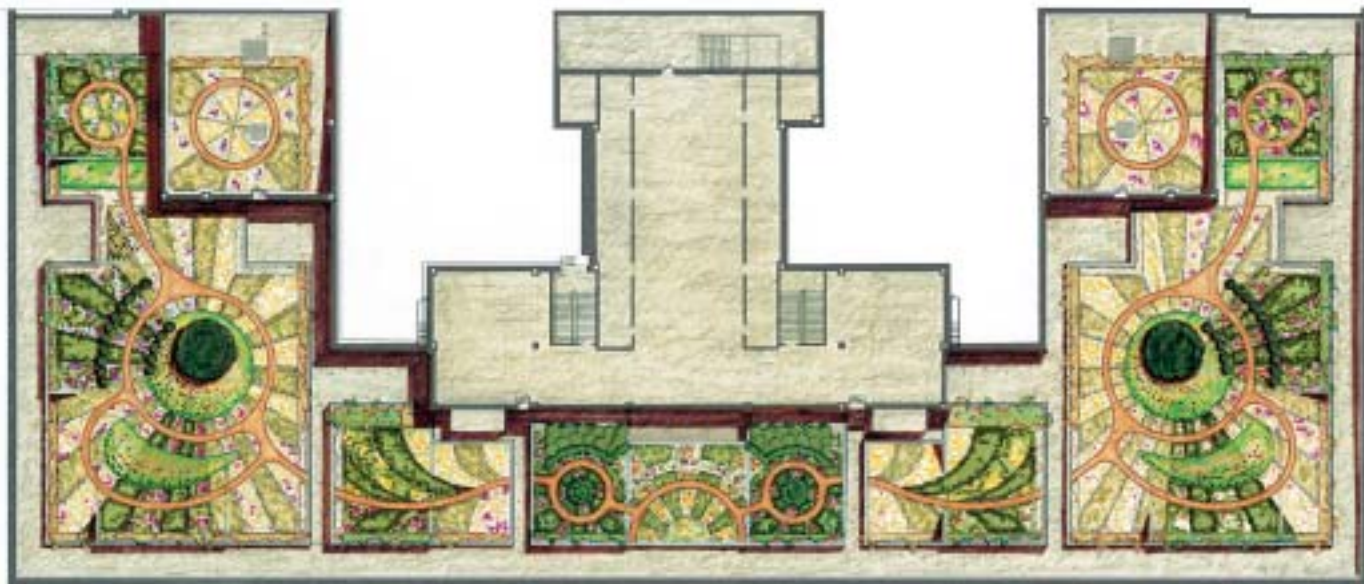
by \$10,000 per month, according to Sadhu Johnston, assistant to the mayor for green initiatives. In August 2001, only three months after final installation, the surface temperature of the garden was between 85 and 100 degrees Fahrenheit, whereas the surface temperature of an adjoining black tar roof was 165 degrees. The plants achieve these temperature reductions by providing shade, reflecting heat, and cooling surrounding air through evapotranspiration.

GREEN ROOF CASE STUDY

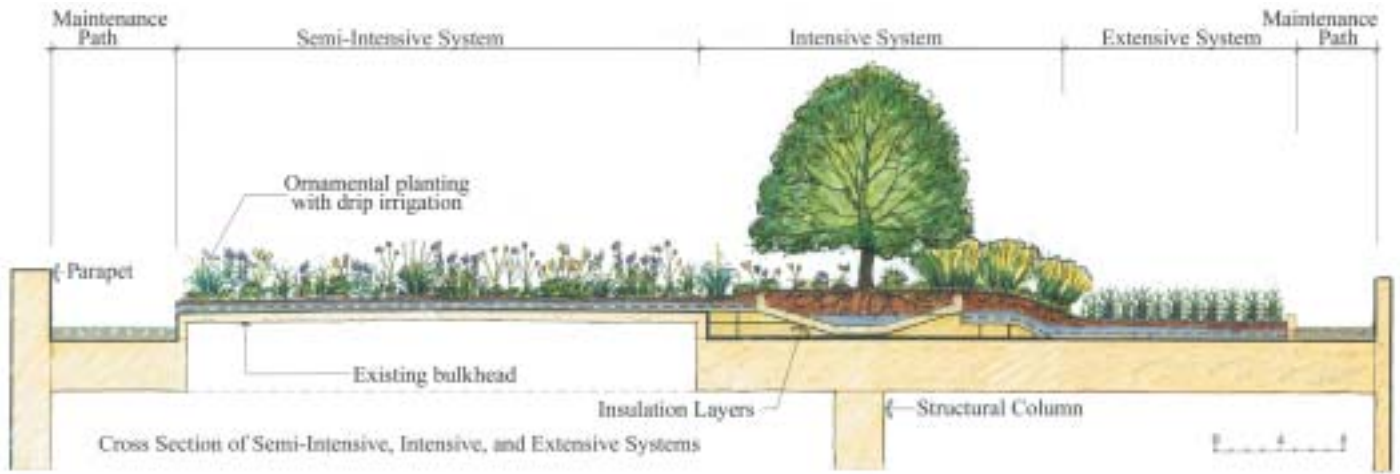
The City Hall roof garden was conceived as a demonstration project. According to David Yocca, a principal of the Chicago-area firm Conservation Design Forum (CDF), which developed the conceptual plan, grading, and planting scheme, the design goal was to create an undulating meadow landscape typical of a Midwest prairie. But the design also had to meet City Hall's desire for a roof garden that would demonstrate a range of green roof typologies and plants. To achieve this multifaceted goal, CDF turned to green roof pioneer Charlie Miller of Roofscapes, Inc., in Philadelphia; the result is a vegetated roof design that is complex and not easily categorized.



The City Hall roof garden, above, in downtown Chicago is organized in two sunburst patterns that respond to the symmetry of the building, below.



CONSERVATION DESIGN FORUM



Unlike the typical green roof, which is a uniformly thin layer of substrate planted with sedums, the 33,000-square-foot roof garden is a blend of extensive (lightweight), semi-intensive, and intensive (heavier) profiles, ranging in depth from 3.5 to 24 inches. To accommodate existing features and the materials required for a manufactured rolling rooftop landscape, Miller devised a

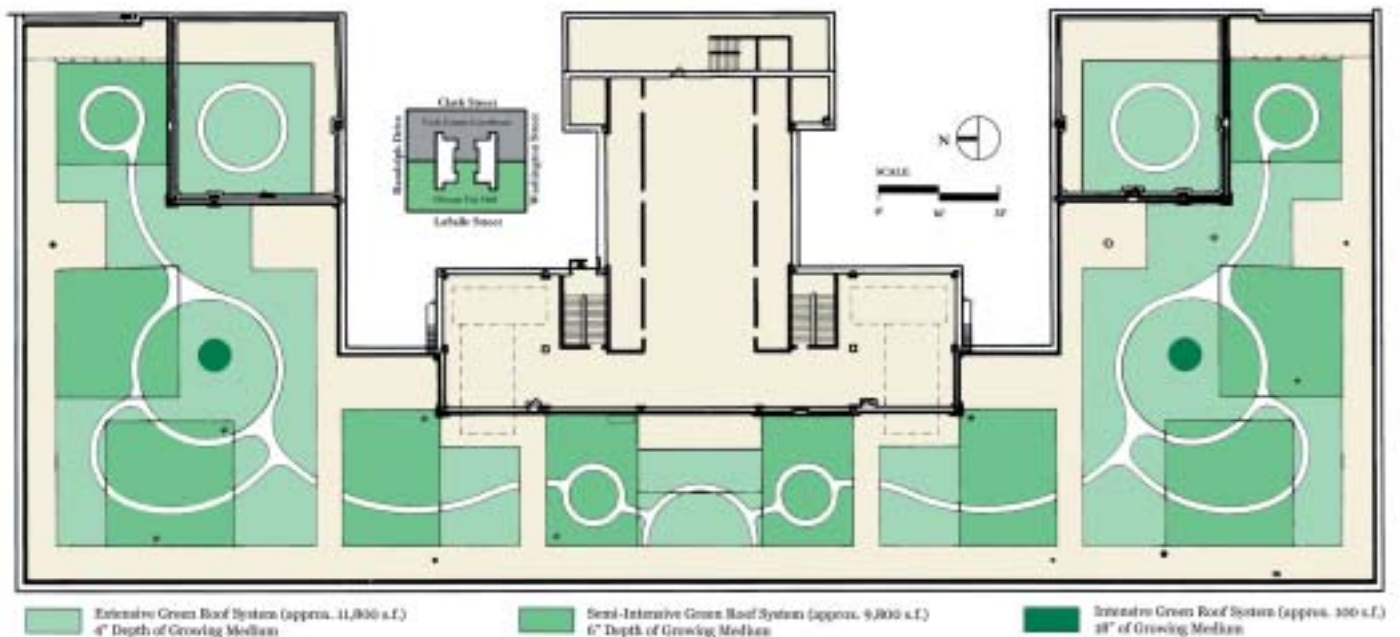
plan that includes six systems—differing primarily in depth and type of growing media—that are integrated through a continuous base drainage layer and a drip irrigation system.

With many vegetated roof projects, the weight-bearing capacity of the roof is a major consideration. In contrast, the City Hall building was designed for an additional floor that was never built, so the structural capacity of the roof deck was calculated at a fairly generous 30 pounds per square foot, which is more than many conventional roofs. The roof could, therefore, have taken a heavier, deeper system. But since a goal of the project was to demonstrate a range of roof garden types, including extensive systems, a 3.5-inch single layer of lightweight medium was installed.

The 10 defunct skylights that occupy roughly 30 percent of the City Hall roof surface proved to be a design challenge. Not only were these prominent structures an aesthetic problem, but they also had to be structurally retrofitted to accommodate the additional weight of roof garden components. With reinforcement, these retrofitted skylights now support semi-intensive systems between six and nine inches deep. To minimize the visual impact of the 2- to 2.5-foot-high skylight frames, large sections of the former skylights are embedded in mounded contours of polystyrene.



The roof garden, being installed *above*, incorporates a range of profiles (*top and below*) that differ in depth and type of growing media to accommodate existing features.



The building's structural support columns provided an opportunity to site heavier loads. Reinforced concrete pedestals resting on columns were constructed to support 24 inches of growing medium and mature, midsize trees. These pedestals are concealed within an artificial landform constructed of lightweight polystyrene, and 14,500 cubic feet of extruded polystyrene covered with growing media create the illusion of a rolling terrain.

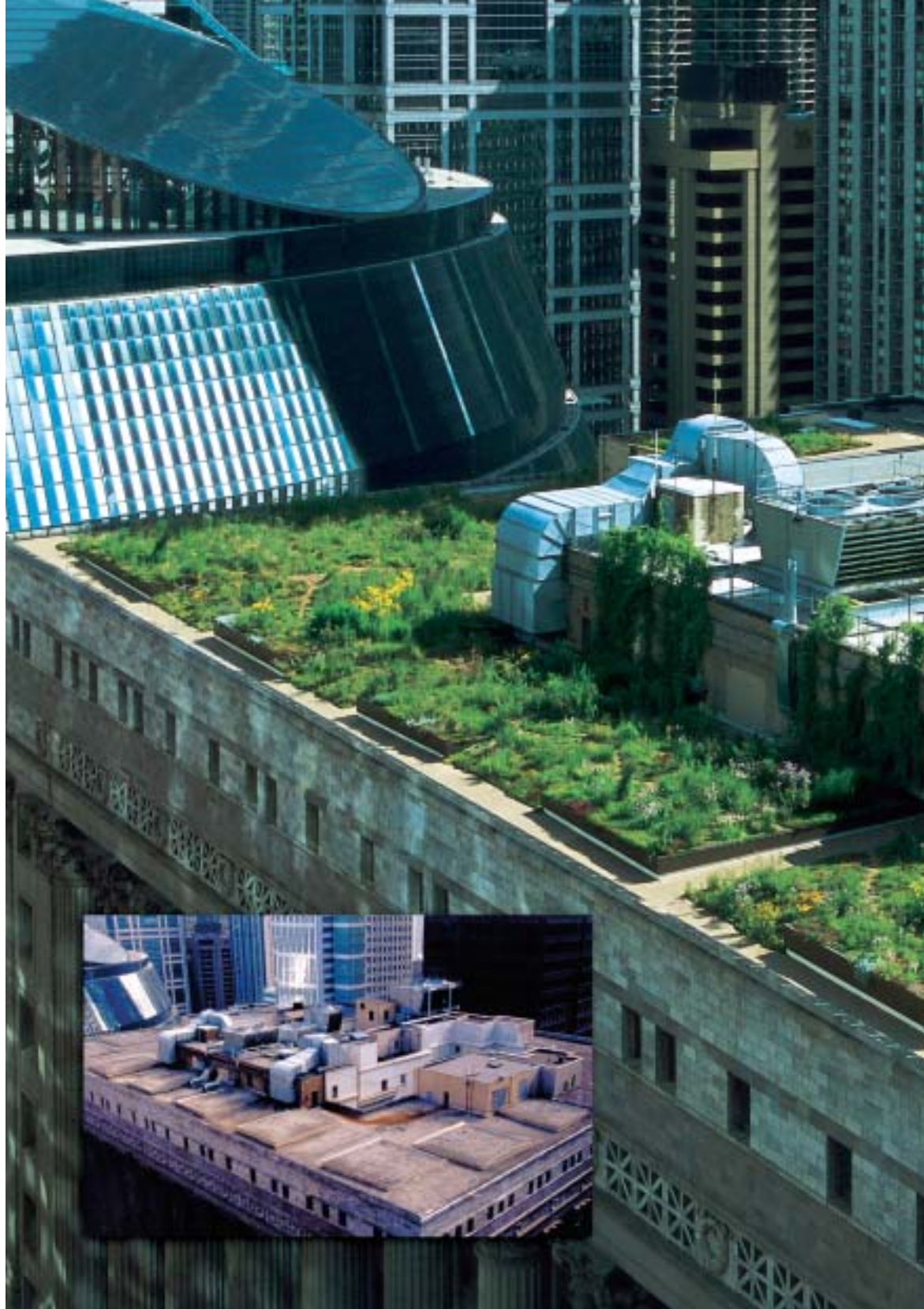
Above this manufactured substrate are 12,700 cubic feet of growing medium and 20,000 plants from about 150 species. Of these species, roughly 80 percent have little history of rooftop applications. In addition to proven green roof performers such as sedums, the City Hall roof garden includes native prairie grasses, forbs, shrubs, and two trees, prairie crabapple (*Malus ioensis*) and cockspur hawthorne (*Crataegus crus-galli*).

To ensure the viability of the plants, most of the roof garden area is drip irrigated with a combination of harvested rainwater and municipal water. However, to manage moisture, the design calls for three different planting media that absorb moisture efficiently and drain well. The design is multilayered, and the growing media consist primarily of coarse-grained, water-absorptive mineral particles, with organic content between 5 and 10 percent.

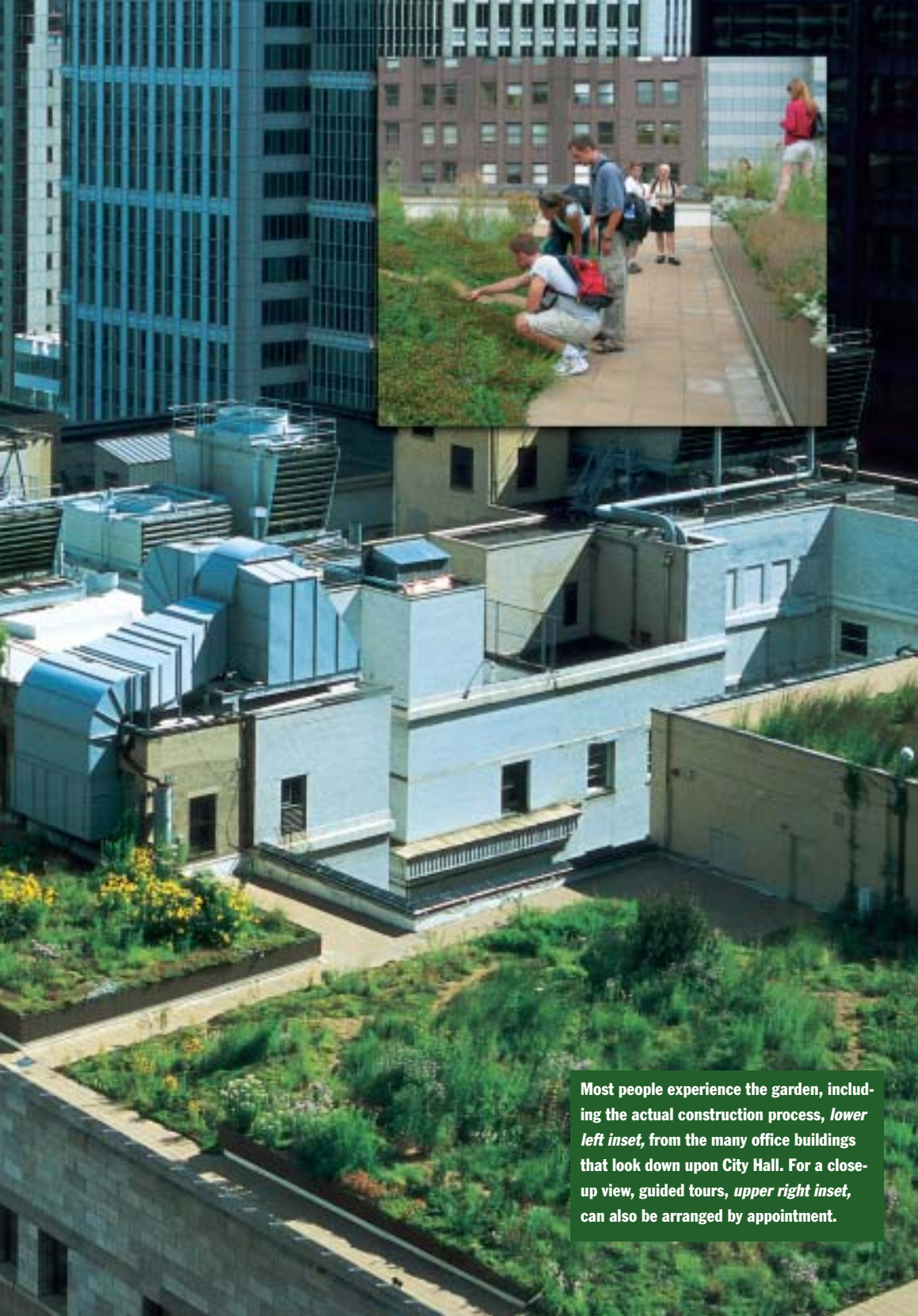
The multilayer media design employed in the semi-intensive and intensive zones mimics natural soil profiles. A fine-grain surface course provides primary water absorption and nutrient cycling. The high capillary potential of this 4.5- to 18-inch surface layer also creates a moisture "cap" over the underlying, more coarse-grained drainage zone. This provides a moist, cool, subsurface rooting area—the preferable roof garden profile for prairie plants in a Midwest climate, according to Miller. The growing media were developed by Roofscapes based on guidelines pub-

lished by the Research Society for Landscape Development and Landscape Construction (see www.roofmeadow.com/FLLguide.htm) reflecting over 20 years of direct experience building and testing vegetated roofs.

Because of safety concerns, this project is not physically accessible without an appointment. The parapet wall along the roof's



WILLARD CLAY, MAIN PHOTO; CONSERVATION DESIGN FORUM, INSETS



Most people experience the garden, including the actual construction process, lower left inset, from the many office buildings that look down upon City Hall. For a close-up view, guided tours, upper right inset, can also be arranged by appointment.

edge is no higher than a few inches in some places, making a walk along the perimeter of the garden unnerving. This is unfortunate. It is only up close that you can fully experience and appreciate the range of plant textures and colors and the buzz of bees against the dramatic backdrop of Chicago architecture.

Most people actually experience the garden from the 33 taller

(turning brown). This natural aesthetic attracted the attention of the garden's most frequent "users"—the thousands of office workers in high-rise buildings whose windows overlook the elevated landscape of City Hall. Many of these people called City Hall with their concerns, and the high-profile project drew some criticism. One particularly shrill column in a local newspaper

buildings that look down upon City Hall. "The original design was intended to be read from these elevated vantage points, and plantings were organized in two sunburst patterns, respecting the symmetry of the building," says Yocca. "Plants were also organized by bloom color and season, progressing from spring through fall across the radiating sunburst pattern." These bands also provided opportunities to evaluate the success of the same plants being applied over various depths of soil, ranges of slope, and drainage patterns.

Three years after installation, the plan is not as legible as it was when initially conceived because certain plants have reseeded and migrated throughout the garden. In particular, many of the grasses have flourished, according to Kevin Carroll, a City of Chicago Department of Transportation horticulturist who is maintaining and monitoring the garden. Grasses include prairie dropseed (*Sporobolus heterolepis*), sideoats grama (*Bouteloua curtipendula*), bottlebrush grass (*Hystrix patula*), and big blue stem (*Andropogon gerardii*). In an ironic twist, these native grasses have proved to be overly successful (that is, aggressive) and are being selectively thinned to maintain color and textural variation in the garden.

The garden has performed well overall, despite the severe drought conditions in the second growing season before the drip irrigation system had been installed. Many of the prairie plants responded as they naturally do: They adapted to desiccating conditions by conserving energy and moisture in their roots, stopping photosynthesis, and going dormant

Nevertheless, this project does not qualify as a cost-effective, widely replicable model.

proclaimed, “If your neighbor had a yard like that, you’d call the police.”

The young plants, however, rebounded when rains returned. Nevertheless, to alleviate public concern and criticism, 2,000 additional perennials and annuals were installed in the spring of 2003 to add more color, and the drip irrigation system was completed. Over the past two growing seasons, the garden has received 15 to 30 minutes per day of drip irrigation. Yet most of the professionals associated with the project agree that many of the plantings could survive quite well with little or no irrigation. On the roof of an associated penthouse with no irrigation, sedums are doing well and the big blue stem has thrived, reaching a height of 8 feet in only 3.5 inches of soil.

The total cost of the 33,000-square-foot green roof project was \$1.5 million, which comes to \$45 per square foot. However, this figure includes needed repairs to the existing rooftop, so it’s difficult to ascertain the exact cost of the green roof. According to City Hall, the garden itself cost roughly \$500,000. It is important to note that, despite a popular misconception, the project was not funded with public money. The project was actually financed through a \$100 million settlement with Commonwealth Edison Company, a local utility. The new roof garden, in turn, is generating real savings in monthly energy bills, and city officials believe the elevated green space will also increase the real estate value of the offices that look down upon it.

Nevertheless, this project does not qualify as a cost-effective, widely replicable model, and that is arguably its greatest flaw. But replicability was not the overriding goal. The greatest value of the City Hall roof garden, says Miller, is its role as a highly visible demonstration of vegetated roofing. “For this project to attract public attention, the added cost of establishing an elevated meadow landscape was worth it,” he says. “This

project is centrally located, many people have seen it, and its diversity of plants and design types gives you an idea of what’s possible.”

City Hall officials echo this view. In an April 2004 speech on Earth Day, Mayor Daley spoke about the important role of municipal leadership in promoting environmentally friendly design. “Chicago will lead by example and incorporate our commitment to the environment into the everyday work of city government,” said Daley. The City Hall roof garden is a visible example of this approach.

Indeed, Chicago has initiated an exceptionally progressive green roof policy that applies to all new construction projects receiving public assistance or subject to review by the Department of Planning and Development—or roughly 10 percent of all new development in the city. In addition to the 1 million square feet of vegetated roofs that are already built or under construction, significant green roof projects under way include big box retailers Wal-Mart and Target, a McDonald’s, and a new Trump Tower. Several municipal buildings, including firehouses and police stations, have also installed green roofs, as has the new Chicago Center for Green Technology (CGT), the city-sponsored green design research center housed in the Chicago Green Tech building, which is the first municipal structure in the country to achieve the LEED Platinum rating, the highest of the LEED ratings. The center functions as a research and demonstration hub for cutting-edge sustainable design techniques, and one of its many exciting initiatives is a green roof test plot.

This research project on CGT’s grounds is evaluating the temperature and stormwater runoff characteristics of six leading green roof systems as they compare to three conventional rooftop materials (black tar, gravel, and white reflective surface). The results show that all six of the green roof systems behave similarly with regard to temperature and storm-

SELECTED PLANT LIST

EXTENSIVE & SEMI-INTENSIVE SYSTEMS

1 plug per square foot @ 23,800 square feet

PERENNIAL FORBS BY PLUG

Achillea millefolium	YARROW
Allium canadense	WILD ONION
Allium cernuum	NODDING WILD ONION
Linaria vulgaris	BUTTERANDEGGS
Ruellia humilis	HAIRY RUELLIA
Sedum acre	WALL PEPPER
Sedum album	WHITE STONECROP
Sedum reflexum	ROCK STONECROP
Sedum sarmentosum	STRINGY STONECROP
Sedum spurium	FALSE WILD STONECROP
Verbena simplex	NARROWLEAVED VERVAIN
Viola sororia	COMMON BLUE VIOLET

SEMI-INTENSIVE SYSTEM

5 plugs per square yard, @ 414 square yards

PERENNIAL FORBS BY PLUG

Anemone cylindrica	THIMBLEWEED
Anemone patens wolfgangiana	PASQUE FLOWER
Asclepias tuberosa	BUTTERFLY WEED
Aster ericoides	HEATH ASTER
Aster laevis	SMOOTH BLUE ASTER
Aster oblongifolius	AROMATIC ASTER
Campanula rotundifolia	HAREBELL
Chrysanthemum leucanthemum	OXEYE DAISY
Coreopsis lanceolata	SAND COREOPSIS
Geum triflorum	PRAIRIE SMOKE
Heuchera richardsonii	PRAIRIE ALUM ROOT
Lespedeza capitata	ROUNDHEADED BUSH CLOVER
Monarda fistulosa	WILD BERGAMOT
Pedicularis canadensis	WOOD BETONY
Penstemon digitalis	FOXGLOVE BEARD TONGUE
Petalostemum purpureum	PURPLE PRAIRIE CLOVER
Physostegia virginiana arenaria	PRAIRIE OBEDIENT PLANT
Potentilla simplex	COMMON CINQUEFOIL
Ratibida pinnata	YELLOW CONEFLOWER
Rudbeckia hirta	BLACKEYED SUSAN
Solidago nemoralis	OLDFIELD GOLDENROD
Tradescantia ohimensis	COMMON SPIDERWORT
Verbena stricta	HOARY VERVAIN
Zizia aurea	GOLDEN ALEXANDERS

PERENNIAL GRASSES BY PLUG

Andropogon scoparius	LITTLE BLUESTEM GRASS
Bouteloua curtipendula	SIDEOATS GRAMA
Buchloë dactyloides	BUFFALO GRASS
Danthonia spicata	POVERTY OAT GRASS
Eragrostis spectabilis	PURPLE LOVE GRASS
Panicum oligosanthos scribnerianum	SCRIBNER’S PANIC GRASS
Sporobolus heterolepis	PRAIRIE DROPSEED

SHRUBS BY PLUG

Ceanothus americanus	NEW JERSEY TEA
Rhus aromatica ‘Gro Low’	DWARF FRAGRANT SUMAC
Rosa carolina	PASTURE ROSE
Salix humilis	PRAIRIE WILLOW



This elevated landscape, here, incorporates proven green roof performers such as sedums as well as many meadow plants, bottom middle, and a colony of bees, bottom left. It also attracts native insects such as butterflies, bottom right.

water. Green roof systems retain up to 60 percent more stormwater than conventional systems for typical Chicago rain events, and daytime temperature peaks on green roofs were often 10 to 20 degrees Fahrenheit cooler than conventional roofs. This research, coupled with progressive policies and many new projects, places Chicago at the vanguard of a municipal green roof movement for which City Hall's roof garden is a symbolic crown.

LAW

Theodore Eisenman is a regular contributor to Landscape Architecture.

PROJECT CREDITS **Project manager:** Weston Solutions. **Green roof designer:** Roofscapes, Inc. **Landscape architect:** Conservation Design Forum. **Architect:** William McDonough + Partners. **Water consultant:** Atelier Dreiseitl. **Structural engineer:** Halverson & Kaye. **Energy consultant:** J. T. Katrakis & Associates.

WILLARD CLAY, TOP AND BOTTOM LEFT; CONSERVATION DESIGN FORUM, BOTTOM MIDDLE AND RIGHT

