Gray City, Green City

New thinking and new settlement patterns can bring about urban sustainability.

BY MARK DEKAY AND MICHEAL O’BRIEN

The American city, if one can still call such a sprawling, gray metropolis a city, is an ecological disaster. The way cities use land and resources profoundly alters the quality of the local and global environment. Uncontrolled growth devours land, water, and energy from the surrounding landscape. Contemporary settlement patterns create auto dependence, high energy demands for buildings, water pollution from excessive toxic runoff, air pollution, and such other adverse environmental effects as increased health risks caused by coal mining, nuclear waste, and fuel burning.

For their exorbitant ecological price, these urban patterns do not even buy a high quality of life. Early 21st century Americans are separated from the aesthetic and ecological experience of nature while spending hours every day commuting and several more hours working to pay for their cars. Neighbors are not friends, community is not tied to place, and millions, too poor to own cars, are disenfranchised. The city is noisy, congested, frustrating, and unhealthy. Our society has created this habitat for ourselves.

In addition to the global macro-ecological problems caused by or contributed to by cities, current settlement patterns create a host of local ecological problems. Wildlife habitat in cities is scarce; native species are replaced with consumptive exotics; streams are channelized, piped and buried; wetlands are filled and aquifers depleted. Urban heat islands drive up energy use for cooling and trap air pollutants in the city. Downstream areas are flooded and polluted by quick runoff from acres of paved surfaces. Each of these local problems reduces the ability of local ecosystems to accomplish their ecological functions. Local ecological systems are rapidly losing their ability to produce clean water, air, and food, and to maintain a rich variety of inhabitants—in short, they are losing the ability to sustain life.

Each of these environmental problems is related in some way to the design of cities, to our settlement pattern, to our urban spatial structure. Changes in land-use patterns take decades, so if our cities are to be ready for mid-21st-century energy and resource scarcities, increasing population, and potential extinctions, structural changes must be initiated almost immediately. Human habitat must be restructured so that we live within the limits imposed by our life-sustaining ecosystems and follow the organizing principles by which all life flourishes.

Green City Consciousness

To correct the ecological damage caused by today’s gray city, we first have to shift our perceptions. It is impossible to get us out of the urban ecological crisis with the same kind of thinking that created it. We have to learn to think ecologically. We also have to learn to integrate multiple new, and sometimes seemingly paradoxical, ways of thinking and perceiving.

A sustainable city can be built on three interrelated mental models, each depending on a different set of values for what counts as success.

- **The city as a living system.** This way of thinking asks, What form would the city take if we understood it as a manifestation of natural process?

The central insight of the living city concept is that cities and landscapes are living systems. A city is a
The city as an experience of nature. This way of thinking asks, What would the city look like if its form were in part a manifestation of these underlying life processes? The city as a particular place. This way of thinking asks, What would the city look like if its form were conceived to appeal to our innate ecological aesthetic?
form would the city take if we understood it as part of a larger whole?

Contextual thinking, according to the science theorist Fritjof Capra, is one of the two great strands of ecological thinking, process thinking being the other. In contextual thinking, we place something in its larger containing system to understand it. The ecological approach to context is based on the observation that the structure and processes of ecosystems vary with location. The pattern of human activities should fit the pattern of underlying landscape characteristics, including the avoidance of natural hazards, the preservation of stored resources for the future, and the suitability for various land uses, such as agriculture, housing, or recreation.

Moreover, the intensity of human activity on the land should be based on the land’s carrying capacity—that is, its ability to maintain the healthy functioning of landscape processes. Unfortunately, sensitive location of human activities does not inherently protect wildlife habitat, population sustainability, or biodiversity. We have the opportunity during this century to halt mass extinction. To do so, we have to make some fairly radical changes in land use and management, using applied landscape ecology. We must not only preserve existing, mostly fragmented, wildlife habitat, but also reconstruct and restore many wild lands and multiple-use habitat areas.

Table 1. Urban Strategies for Ecosystem Services

<table>
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<tr>
<th>Ecosystem Service</th>
<th>Gray City Strategy</th>
<th>Green City Strategy</th>
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<tr>
<td>Energy production</td>
<td>Centralized production: fossil fuels, nuclear power</td>
<td>Multi-scal, regionally fitted renewable energy: solar, wind, hydro, biofuels, cogeneration, conservation</td>
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<tr>
<td>Food production</td>
<td>Remote monoculture: industrial farms</td>
<td>Diversified urban, suburban, and regional agriculture: community gardens, productive parks</td>
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<tr>
<td>Air supply</td>
<td>Mechanical systems in buildings; no urban strategy</td>
<td>Wind planning: green corridors, staggered and dispersed buildings, windbreaks</td>
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<tr>
<td>Water supply</td>
<td>Municipal supply pipes and sewers, irrigation, stream channelization and burial</td>
<td>Rainwater catchment onsite and buildings; natural swales and streams; creek restoration</td>
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<tr>
<td>Nutrients/materials supply</td>
<td>Centralized production; grocery, gardening, and construction industries, national truck distribution</td>
<td>Local production; cascading uses: restaurant to community garden, sewage to fertilizer, neighborhood compost</td>
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<td>Waste removal</td>
<td>Trucks and landfills, incineration, sink disposers, sanitary sewers</td>
<td>Composting, recycling, eco-industrial parks, composting toilets, neighborhood sewage treatment</td>
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<td>Biodiversity</td>
<td>Serious habitat fragmentation from land development</td>
<td>Landscape ecology patterns: corridor, patch, matrix</td>
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<td>Water purification</td>
<td>Chemicals, mechanical filters</td>
<td>Gravewater filtration/reuse; living filters; soil percolation and recharge; constructed wetlands</td>
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<tr>
<td>Waste processing</td>
<td>Settling ponds, chlorine, chemicals, landfills</td>
<td>Constructed wetlands; composting</td>
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<td>Flood mitigation</td>
<td>Downstream export: flood walls, levees, channelization; centralized retention: dams and reservoirs</td>
<td>Locating out of flood zones; green roofs, permeable cover; recharge zones: wetlands, site retention</td>
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<tr>
<td>Drought mitigation</td>
<td>Centralized reservoirs; interbasin pumping; aquifer extraction; watering bans</td>
<td>Conservation; cisterns, site detention, local ponds and lakes; xeriscape, native plants</td>
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<tr>
<td>Erosion control</td>
<td>Physical barriers, seawall, erosion fence</td>
<td>Acceptance of natural changes; planting, ground cover, avoiding erosion zone development</td>
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<tr>
<td>Energy storage</td>
<td>Gas/oil reserves</td>
<td>Matched demand/supply cycles; buildings’ structure; ice, phase-change materials; reservoirs, forests, biofuels</td>
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aries. Each process has a spatial dimension, each creature, its own range.

Taking the long view, society has to ask, How shall we build cities to connect them to larger ecological patterns? What would the city look like if its form truly fit to its lifeplace?

**Shape of the Green City**

Each of the three modes of green-city consciousness generates a substantial list of overlapping design strategies. Each mode can inform almost any design question; yet, alone, any of the singular perspectives would be insufficient and potentially fail or even cause damage. The integration of these three mental models—living systems, landscape experience, and native context—generate a set of five patterns necessary for the emerging green city:

■ **Hydrologic city.** Cites have historically had a transformative effect on their local hydrologic systems. The green city makes an alliance with nature to provide hydrologic services to humans and the landscape. The green city must collect, store, and process water, as much as possible, within its own watershed boundaries.

Imagine every day drinking, showering in, and watering your tomatoes with soft, solar-distilled, pesticide-free, nonchlorinated rain water from your own roof.

In the subterranean city is a network of engineered waterways carrying away as much as 90 percent of urban rainfall. Nature can do this work cheaper and more aesthetically. Our streams were covered because they were used as open sewers and they often flooded. Today, we separate sanitary and storm sewers, and we have learned not to build in flood zones. So, over 50 years or so, we could resettle our cities using a renaturalized hydrologic armature with restored streams, brought back to the surface. In the process, we would vastly increase groundwater recharge and reduce downstream pollution and flooding.

Imagine a “blueway network” where streams meander through our neighborhoods, carrying away runoff and slowing its flow, providing rich natural habitat, increasing property values, and providing hundreds of miles for childhood memories.

The green city can use natural biological processes to treat the little waste it produces. Since graywater can be reused for low-grade water requirements, such as landscape irrigation, only black water from toilets needs to be processed. Many households will use efficient and odorless composting toilets, reaping a rich garden fertilizer, and some neighborhoods will proudly display the “No-Pipe Neighborhood” designation. Others will treat their sewage in local constructed wetlands. In denser areas, biological processes can be speeded up in land-efficient, solar-heated greenhouses. (Figure 1.)

■ **Productive city.** The mechanistic gray city is mostly dead. It produces almost nothing in ecological terms. It is a once-through system that depends on remote sources for food and ignores the valuable organic resources in its waste stream.

Urban agriculture in the productive city can grow a significant portion of a city’s food close to where people live. Its goals are to reduce the environmental impact of the food production system, reduce cost, increase self-sufficiency, improve quality by reducing transportation, create employment, reduce chemical and energy inputs, and...
eliminate much industrial processing and distribution. The city planning theorist Richard Meier predicts that about a third of the caloric value and two-thirds of the economic value of the urban dweller's diet will eventually be produced in the city. (Figure 2.)

Imagine a springtime Saturday morning conversing with a dozen neighbors over coffee as you plant spinach and peas in your plot of the community garden at the south edge of your block.

Several comprehensive visions have been put forth for urban landscapes that include agriculture at a wide range of scales. The most successful example is China, where 50 percent of vegetables consumed in major cities are grown there. Integrated agricultural visions generally pair small-scale production in kitchen and community gardens with larger-plot farming in the suburbs or at the urban fringe.

Imagine productive parks of fruit trees and fish ponds, street trees of pecan and walnut, and urban forests supplying local industry with agroforest products. Imagine some public lands leased to urban farmers that you actually know and some orchard yields reserved for public consumption.

**Bioclimatic city.** Buildings use about a third of the energy consumed in the United States and are responsible for an equal amount of global climate change. Yet we know how to make buildings that use vastly less energy and cost the same or less. Cities exacerbate rather than moderate local climate, creating urban heat islands without summer shade, windswept winter streets, and dense conditions that block light and air. Bioclimatic design—the use of the natural climatic forces to provide human comfort in and around buildings—can have profound effects on the way we consume resources and on our relationships to the natural cycles around us. The design of the city often determines whether a building can actually make use of the free energy it receives from the sun, wind, sky, and ground.

Imagine your home with no noisy machines running, except in the coldest and hottest weeks, to make you cool or warm. No nasal-drying, dust-distributing air whirling around your head. Imagine the gourmet thermal experience of winter breakfast in your toasty-warm sunroom, which also heats most of your house, and summer dinners in a shaded, breezy, screened porch.

The green city must provide access to sun, wind, and light by its very patterning. Through zoning and development controls, buildings can be shaped and positioned, according to the path of the sun, to prevent winter shadows from reaching adjacent buildings. Streets can be oriented to move prevailing wind through the city, and green spaces can be interwoven with buildings to reduce summer temperatures. Neighborhoods can be laid out with buildings staggered and spaced so that breezes flow to each building. (Figure 3.)

The design of the city scale, in combination with the design of the buildings in the public realm, determines the microclimates in which we spend time outdoors. Parks and plazas can be designed to be summer places or winter places, sunny and calm—or breezy and shaded.

Imagine an evening stroll down the vegetated radial ventilation corridors

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*FIGURE 2: Productive Zones in Village Homes.* Village Homes, in Davis, California, offers an example of a residential landscape where 50 percent of the land is in agricultural production, by combination of edible landscaping, private and community gardens, neighborhood orchards, and commercial farming.11

Graphic: M. DeKay12
that take advantage of cool-air drainage from upslope and direct night thermal currents into the denser and warmer centers of activity.

Transit city. Sprawl is bleeding our cities and devouring their hinterlands. The population of St. Louis is only 40 percent of what it was half a century ago, while the metro area, with a slight population increase, now occupies 13 times as much land area. St. Louis is not unique.

We know that public transit requires certain densities and that mixed uses—as opposed to single-use zoning—promote fewer auto trips and support pedestrians by reducing distances between home, work, school, and shopping. We know that, when given a choice, people like living in small scale, medium density, traditional town-like settings. We know 20 other things like this.

All this has spawned two important and related movements in urban design: New Urbanism and Transit-Oriented Development (TOD). New Urbanists advocate traditional town planning based on street grids, high levels of public open space, and a traditional mix of building types. The TOD movement advocates higher density, mixed use, pedestrian-scale development centered on bus and light-rail stops. The TOD movement advocates higher density, mixed use, pedestrian-scale development centered on bus and light-rail stops. (Figure 4.)

Imagine driving your car only for trips out of town. You can walk to the neighborhood center in five minutes, even with small children, to access all your daily services. Your commute is a pleasant 5-minute walk again, and perhaps a ride on the light rail, down a couple of stops, to one of the office, arts, or light-manufacturing centers.

Numerous transit-based metropolitan proposals exist, some of which have been around for a long time. Copenhagen’s finger plan, for example, in which light rail lines fan out from the city like the spokes of a wheel, and Paris’s satellite towns, which are connected by rail to city center, were built during the late 19th century. Today, the regional city, with one or more central cities, several edge cities, and numerous urban villages, all linked together by a rich transit network, is perhaps the most adaptable to current settlement patterns and performs better for a range of sustainability criteria than older models.

No green city should be without a bicycle plan. The bicycle is the most economical and energy efficient form of human transport ever invented. Cycling can play an important role, even in societies with high living standards. Cycling accounts for 20 percent of passenger trips in Basel; 25 percent in Tokyo; 50 percent in Groingen, Netherlands; and up to 77 percent in such Chinese cities as Tianjin and Shenyang.

Imagine the delight, character development, and mobility of a child who leaves home in the morning, riding the neighborhood bike lanes in a clear route to the dedicated bikeway paralleling the local creek and leading to the elementary school. Imagine the freedom of the parents and the need for one less car as the same child bikes safely to after-school ballet.

Habitat city. In recent years, the discipline of landscape ecology has generated an entirely new way of seeing the landscape—as a spatial structure of life processes forming...
the habitat for many species. We are beginning to develop a language to describe beneficial habitat patterns—for example, corridors, patches, matrix, mosaics. And we are beginning to understand the formal characteristics—in terms of size, number, edge configuration, degrees of connectivity, mesh size—of these patterns.19

Imagine human society living, not in a sea of suburbia with a few island parks, but rather in islands of settlement connected by transit corridors and surrounded by green space. Parks alone, even large regional parks or river corridors, do not create ecosystem health. It does not take a keen observer to see that the land-hungry monster of uncontrolled sprawl devours prime agricultural land and habitat and leaves the remaining bits fragmented and disconnected from each other. The habitat city consists of three important networked components: preserves for critical areas, such as wetlands, steep slopes, riparian corridors, endangered species territory, watersheds, and shorelines; preserves for representative habitat areas for all ecosystem types in a region; and networks of greenways linking these nondeveloped areas. (Figure 5.)

Imagine that the neighborhood, urban village, and city are fractals of the larger regional structure. Parks of varying scales and degrees of human activity are distributed throughout the city and linked with corridors ranging from tree-lined boulevards to broad paths for larger mammals. Imagine the city as a participatory ecological museum with living, functioning examples of each local habitat type.

**Challenges**

The shape of the green city that follows from ecological theory is quite different from current and developing forms. The hydrologic city asks us to unengineer the pipes and chemicals of the city-as-machine and to reengineer it in partnership with nature. The productive city requires new forms of public-private partnerships to manage the civic landscape and more collective action between property owners. The bioclimatic city has significant impacts on land rights and an expanded vision of the role of the city’s streets and open spaces. The transit city requires a reinvention of zoning laws and an integration of local and regional infrastructure planning. The habitat city requires a major restructuring of the social organization of land use. All of these have profound planning, design, and policy implications; the old way of thinking that created the gray city can not create the new green city.

Many of the green city concepts are being implemented by hundreds of cities via comprehensive plans, new forms of development rules, regional coordination, policy incentives, fee and tax structures, citizen action, energy codes, habitat conservation plans, innovative stormwater planning, creek restoration projects, community garden pro-
grams, solar access ordinances, light-rail building and new transit-oriented development, bicycle planning, and greenway networks. Many cities are implementing one or two of the green city patterns, mostly in fledgling, pilot efforts. For a sustainable green city, we will need all five patterns acting together, each operating at the scales of region, city, and neighborhood.

Beyond Sustainability
Because the green city is really a living system, it is never static. Cities change over time, just as ecosystems and landscapes do. As the underlying processes change, the form of the city itself will also shift and should exhibit successional and evolutionary characteristics of complex living systems. The key to managing the green city’s development will lie in distinguishing what nature can do on its own, given the right conditions, from what humans must orchestrate. Our success will depend on our ability to:

- raise individual and social awareness of our participation in life processes,
- receive timely feedback about system behaviors that affect human activities,
- increase our understanding of the nonlinear and counterintuitive aspects of the behavior and development of complex systems.

Sustainability is standardly defined as acting today in a way that does not diminish the quality of life and options for future generations. It’s a nice idea but a limited vision. In the green city, our investment today is love for future generations of humans and other species that share our life-place with us.

The green city is a city beyond sustainability in one other way. Maintaining the current life quality and options is really bequeathing to our descendents the same diseased environment we live in. Do we really want dead soil, lifeless streams, urban monocultures, and eight-lane freeway knots in 100 years?

If the future really matters to us as a society, we will build the restorative, regenerative green city, one in which the life and options of all future generations are better than ours.

Mark DeKay is an assistant professor of architecture at the University of Tennessee, Knoxville. Micheal O’Brien is a landscape consultant and principal of Newland Geographic, in Boulder, Colorado.

NOTES


21. Ibid.


23. Ibid.