

A Field of Dreams:

Green Roofs, Ecological Design and the Future of Urbanism



W I L L I A M M C D O N O U G H

I am strolling in a field listening to crickets and watching birds pluck insects from the dirt. Wildflowers bend in the wind. Warblers and thrushes flit about in tall native grasses and soar over the rolling terrain. The scene is rich, beautiful, lively, delightful—some might say wild. But this landscape is also a cultural space: I am standing on top of a building.

The building, the centerpiece of Gap Inc.'s corporate campus in San Bruno, California, is a pioneering office building with a green roof—and the rooftop is more than just a pretty patch of sod. Blanketed in soil, flowers and grasses, the roof's undulating terrain echoes the ancient local landscape, reestablishing several acres of the surrounding coastal savannah ecosystem. The native plants and soil also absorb storm water, filter the air, and provide thermal and acoustic insulation. And from inside the building, one can look out the window at the rooftop grasses being tossed by the wind or enjoy a breeze scented with the living perfume of healthy plants and soil. In these and many other ways the roof makes the landscape an integral part of the building's design.

This is rich, new territory and it has brought to the fore a whole realm of design questions not often considered by architects, planners and their clients. In addition to the obvious practical questions of good business, such as those relating to cost and scheduling, we began the Gap project also asking "What would native birds hope to see as they fly over the site?" and "Wouldn't it be marvelous if the birds could see the habitat with which they evolved?" Questions such as these, in a quite literal way, change the nature of the design process, expanding its concerns into multidisciplinary terrain that includes ecology, botany, conservation biology, and environmental history. These disciplines offer a lens through which one can see the natural systems at work in a place—the landforms, hydrology, vegetation and climate of each particular locale—and, thoughtfully applied, they empower architects and planners to develop designs that "fit," designs that encourage healthy and creatively interactive relationships between a building and its environs. In other words, the human impact on the environment can be positive, vital and good—even regenerative. And as this idea takes root and is elevated in the world of architecture and planning, it offers hope for a flowering of mutually enriching relationship between nature and human culture, as well as a fresh, inspiring direction for urban design.

Technology and performance also have critical roles in the pursuit of ecological intelligence. Indeed, the design and construction of green roofs and buildings demands an extraordinary range of technical expertise, from understanding storm water hydrology or the flux of ultraviolet radiation to constructing an effective waterproofing system that allows rain to be retained in rooftop soils. What's crucial is a design approach attentive to a wide spectrum of concerns, including a diverse range of economic, environmental and cultural criteria. When such an approach is supported by technological know-how, a truly delightful, high-performance building can result.

Consider again, the Gap building. The green roof is one of several integrated building systems designed to create a productive, comfortable, culturally rich workplace. While

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the rooftop soils and grasses insulate the building from the midday sun and the sound of jets flying overhead, a raised-floor cooling system allows evening breezes to flush the building at night. The concrete slabs beneath the floor store the cool air and release it during the day. The windows can be opened, the delivery of fresh air is under individual control, and daylight provides natural illumination. There are public gathering areas indoors and out, which are enlivened by fine art sculpture and paintings, thriving plants, and a splendid cafe. In short, it's a delightful place to go to work. And when the birds fly by they don't see a flat, ugly tarmac broiling in the sun, they see a rolling, flowering grassland that looks like home.

All that, and the Gap building is also one of the most energy-efficient buildings in California. By setting out to create a positive, regenerative human footprint, by tapping local energy flows and integrating building and landscape, the design outperforms buildings that set energy efficiency as their highest goal. It also enables the building and its inhabitants to participate in natural processes in ways that allow an ongoing celebration of the rich relationship between human creativity and the abundance of the nature.

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Imagine that sensibility alive in our cities. Imagine New York City and Atlanta, Detroit and Los Angeles tuning in to the natural processes at work in the urban world. That would be something marvelous and new. For most of the last 150 years urban nature has been synonymous with urban parks, not the city itself. Even as Frederick Law Olmsted's landscape designs continue to naturally ease urban flooding and improve air and water quality on our cities, just as he imagined they would, few urban dwellers see his works as anything more than ornamental wonders and respite from the harder urban world. They are loved, but separate.

There is another view. In the words of landscape architect Anne Spirn, "The city is a granite garden, composed of many smaller gardens, set in a garden world....The city is part of nature."

It is the air we breathe, the earth we stand on, the water we drink and excrete, and the organisms with which we share our habitat. Nature in the city is a powerful force that can shake the earth and cause it to slide, heave, or crumple. It is a broad flash of exposed rock strata on a hillside, the overgrown outcrops in an abandoned quarry, the millions of organisms cemented in the fossiliferous limestone of a downtown building. It is rain and the rushing sound of underground rivers buried in storm sewers. It is the water from the faucet, delivered by pipes from some outlying river or reservoir, then used and washed away into the sewer, returned to the waters of the river or the sea. Nature in the city is an evening breeze, a corkscrew eddy swirling down the face of a building, the sun and the sky...It is the natural processes that govern the transfer of energy, the movement of air, the erosion of the earth, and the hydrologic cycle. The city is part of nature.

With this sense of the city in mind, architects and planners can begin to integrate natural processes into urban life. And they are. Already we can see urban building and street designs that use natural air flows to cool the city. We see urban rivers unearthed, riparian corridors reforested, and wetlands reclaimed and reconstructed within the city to purify the urban water supply. We see solar collection on skyscrapers and geothermal heating and cooling rising into buildings from underground. We see a profusion of community gardens where urban residents have daily interactions with soil, water and living things. We see living roofs filtering storm water, easing the heat-island effect and providing urban habitat for native species of plants, birds and insects. We see an emerging marriage between nature and the city that has the potential to create a life affirming urban realm.

Green roofs are a key element of this transformation, both as regenerative living systems and as symbolic urban forms. Imagine, for example, the effect of community kitchen gardens on the rooftops of New York City. All sorts of neighborhoods might become urban agricultural districts, the growing of food providing sustenance, conviviality, a relationship with nature and an opportunity to enjoy the fruits of ones labor. The gardens could also make visible the vital connection between water, soil, food and human culture. At the same time, they would create a network of living landscapes stretching across the ancient archipelago that is New

York City. Add to that the energy savings a sea of green roofs might provide as they cool buildings in summer and insulate them in winter—according to *The New York Times*, those savings could amount to as much as \$16 million a year.

And how better to signal a sea change in the priorities of local government than a green roof on city hall? That is exactly what happened in Chicago. There, Mayor Richard Daley has proclaimed that Chicago will become "the greenest city in America." As his administration plants hundreds of thousands of trees, restores the Lake Michigan shoreline and invests in renewable energy, the green roof on Chicago's City Hall, which covers half a block, has become a symbol of the City's commitment to change.

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It is a change worth watching. Mayor Daley not only says he wants the city to be the greenest in America, he is making environmental initiatives an integral part of a long-term strategy for growing economic and social health. To that end, says Department of the Environment First Deputy Commissioner David Reynolds, the City is working "to bring industry back to Chicago while also revitalizing local ecology." The mayor is committed, he says, to "making the city a national model of how industry and ecology can exist side-by-side."

The work is already underway. Along with a host of traditional beautification efforts, the city has undertaken the largest brownfield redevelopment effort in the United States. It has committed to buying 20 percent of its electricity—for schools, libraries, subways and streetlights—from renewable sources by 2006. Meanwhile, renewable energy companies, such as the solar panel manufacturer Spire, have moved their headquarters to the Chicago Center for Green Technology, a new ecologically intelligent facility built on a restored industrial site. Spire is already supplying Chicago with locally manufactured solar panels, which the City has installed on the roofs of the Field Museum, the Mexican Fine Arts Museum and the Art Institute of Chicago. Seems the rooftop is where it's at.

Unfortunately, positive changes such as these in our cities could end up being a flash in the pan unless they are seen in the context of a sustaining, long-term vision. A green roof is a wonderful addition to a city neighborhood, but its impact grows when it is conceived as a humble first step toward a deep revitalization of urban life. In other words, urban design can be strategic rather than piecemeal, with each initiative supporting the goals of a holistic, integrated plan. This is not news in Chicago. There, the city government is developing a set of urban planning principles to guide decision-making over the long haul, not just during the Daley Administration, but well into the future.

David Reynolds put it this way:

We have been saying that we are going to be the greenest city in America. But to truly become a thriving green city we need to carefully define what that means and what we should be striving for, day-by-day and year-by-year. No city in the United States has really gotten this right yet, and we believe that part of the problem has been that no American city has developed a set of guiding green principles—akin to the timeless principles of the Constitution—that describes its ideals, sets its course and defines its means. That's what we are trying to do in Chicago. And we hope the principles we develop become so well known and so well understood that they define how we operate as a city government for the next one hundred years.

The fruits of this labor, *The Chicago Principles*, will serve as a reference point for the City as it pursues Mayor Daley's dream. Developed with William McDonough + Partners, the Principles, it is hoped, will provide a coherent, ecologically intelligent foundation for urban design. They support strategic decision-making and encourage planning choices that enhance not just environmental health, but economic productivity and social welfare as well. Based on the timeless laws of nature, they hold out the promise of an urban world that is restorative and regenerative by design.

Soon to be published, the Chicago Principles share the spirit and aim of the nine declarations of The Hannover Principles, which my colleague Michael Braungart and I crafted for the city of Hannover, Germany, in 1992. The Hannover Principles, among other things, insist on the right of humanity and nature to co-exist in a healthy, supportive, diverse, and sustainable condition; recognize the interdependence between elements of human design and the natural world; are committed to the elimination of the concept of waste; and embrace a reliance on natural energy flows.

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In our work over the past decade, my colleagues and I have found that striving to recognize interdependence or rely on natural energy flows in everything we do—from designing buildings and community plans to products and factories—yields a positive, inspiring perspective on urban design, as well as extraordinarily satisfying results. The green-roofed Gap building is one example of our approach. Another is the revitalization of Ford Motor Company's historic Rouge River manufacturing complex in Dearborn, Michigan, where we designed a 600,000 square foot factory with the largest green roof in the world.

The Rouge River restoration illustrates the fruits of considering a diverse range of economic, social and ecological concerns in urban design. As we approached the design process with Ford, which had decided to invest \$2 billion over 20 years to transform the Rouge into an icon of 21st century industry, many wondered if a blue chip company with a sharp focus on the bottom line could take a step toward something truly new and inspiring. Could environmental restoration and profits co-exist?

Well, yes. In fact, for this agenda to become widespread, they must. Using the Hannover Principles as a guide, we explored with Ford's executives, engineers, and designers a variety of innovative ways of creating value. Rather than simply using conventional economic metrics to try to reconcile apparent conflicts between environmental concerns and the bottom line, Ford's leaders began to examine how smart design decisions could grow not just profits but social and ecological value as well.

The results were inspiring. Instead of trying to meet its environmental responsibilities as efficiently as possible, Ford opted for a manufacturing facility that would create habitat, make oxygen, connect employees to their surroundings and invite the return of native species. The new plant features skylights for daylighting the factory floor and a 10-acre roof covered with healthy soil and growing plants. The living roof provides habitat for birds, insects and micro-organisms and, in concert with porous paving and a series of constructed wetlands and swales, will absorb and filter storm water run-off for \$10 million less than conventional water treatment systems. In addition, native grasses and other plants are ridding the soil of contaminants and a variety of trees are being planted to aid in the bio-remediation. This is a landscape of renewal.

The Rouge restoration has important meanings for cities and urban designers. It shows not only that green roofs and other biological technologies can be effectively and profitably deployed in large-scale urban projects, but also that industry and ecology, nature and the city, can indeed flourish side-by-side. With this in mind, we can begin to imagine cities participating ever more creatively with nature. Cities where skyscrapers harvest the energy of the sun and rooftop gardens become part of the watershed. Cities where industry becomes a regenerative thread in the urban fabric.

This is possible when we design each thing we make as a nutrient that can circulate in safe, regenerative closed-loop cycles—a technical cycle in which high-tech, synthetic materials are perpetually produced, used, recovered and remanufactured; and a biological cycle in which organic materials are returned to the soil. An upholstery fabric I designed with my colleague Michael Braungart, for example, can be tossed on the ground to nourish the soil when it wears out; in the city it could become food for rooftop gardens. Just so, high-tech products, such as perpetually recyclable fibers or windmill blades, can be "food" for technical systems, providing safe materials for generation after generation of useful goods. These cradle-to-cradle mate-

rial flows (as opposed to the typical cradle-to-grave flow of materials from producer to consumer to landfill) are crucial to urban design. Not only do they ensure that the materials with which we build our cities will be healthful and beneficial, they eliminate the very concept of waste and provide a clean, productive economic base for healthy urban growth.

And so we can begin to see the city not only fitting elegantly into its place but becoming a revitalizing force in its region. In this new, regional metropolis, biological and technical nutrition flow back and forth between city and countryside, enriching both. The city receives food, water and energy from a very broad nexus of solar-powered, biologically based, photosynthetic systems. The energy of the sun is harvested on rooftops; rural windmills power city buildings; water falls on a network of green roofs and rooftop gardens, flowing safely into the soil, into the watershed, into the air. In the countryside, farmers grow good food using implements manufactured in the city—technical nutrients—and the city receives this nourishment, digests it and then excretes it back to its source, returning biological nutrients to the rural soil. The windmills on the farm, source of a new cash crop, are forged in the city, produce power for the region in the countryside, and then are returned to the city every 20 years to be refurbished and returned to the farm. Everything moves in regenerative cycles, from city to country, country to city, all the polymers, metals, and synthetic fibers flowing safely in the technical metabolism, all the photosynthetic nutrients—food, wood, natural fibers—flowing in the biological metabolism. These flows of nutrients are the twin metabolisms of the living city that allow human settlements and the natural world to thrive together. If we are to make our cities truly sustaining, we need to take this as a literal, strategic truth that informs all of our designs.

Our vision, simply put, is this: A world of interdependent natural and human systems, powered by renewable energy, in which everything we make flows in safe, healthful biological and technical cycles, elegantly and equitably deployed for the benefit of all.

The view from the rooftop suggests that this dream is within our grasp and, indeed, that it has already taken root in the granite gardens of our garden world.

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