

DESIGNING SUSTAINABLE SYSTEMS: FACT OR FANCY

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HIGH FLIGHT

Oh, I have slipped the surly bonds of Earth
And danced the skies on laughter-silvered wings.
Sunward I've climbed and joined the tumbling mirth
Of sun-split clouds, and done a hundred things
You have not dreamed of. Wheeled and soared and swung,
Hung in the sunlit silence hov'ring there, I've chased
The shouting wind along and flung my
Eager craft through footless halls of air.
Up, up, the long delirious, burning blue I've topped the
Windswept heights with easy grace,
Where never lark nor even eagle flew.
And while with silent lifting mind I've trod
The high untresspassed sanctity of space, put out
my hand and touched the face of God.

—by John Gillespie Magee, Jr.

"Sustainability" has truly become the buzzword throughout our culture. Some consider the notion of sustainable design and development as fancy. We believe it is an economic and ecological imperative. A philosophy of design, development, and long term management firmly grounded in the incorruptible realities of place. Substantive, innovative planning and design will result in the evolution of a new infrastructural aesthetic, one based on environmental as well as visual functions. Sustainable approaches will illustrate that sound economic development and environmental stewardship are not only compatible, but inseparable. You do not have to diminish one to maximize the other. In fact, the entire process will be market driven. Education at all levels throughout our society is the single most critical factor if we are to successfully approach sustainability.

Today, much of the land throughout the country has been obliterated by modern agriculture or development and is dominated by a small number of plants adapted to such conditions. What little remains of the natural landscape contains within it those species adapted to sustain self-replicating ecosystems, wherein our future lies. An understanding of the story of these two floras and the people with whom they co-evolved is of paramount importance as society addresses the critical issue of sustainability. It is an old, old story, but it wasn't until recently that we began to rediscover and tell this story.

By the advent of the Ice Age, the co-evolution of human beings and the natural systems in which they lived was well underway. These lands contained all the elements necessary to sustain early humans. During this time, the Human Being began to manage the land to optimize these resources and began to become a profound factor in the evolution of life on earth. The well-being of the Earth and the Human became inextricably linked.

The Shawnee of southern Ohio, like many aboriginal people, called themselves the "Human Beings", as opposed to the other people that lived elsewhere, such as the Wyandot and the

Delaware. They knew where the bison watered, the elk roamed, the edible plants grew, and the salt licks were located. The flora and fauna of the region adapted to a people who defined themselves in relation to their land. There was recognition that every place was unique unto itself, quite apart and different from all other places on the earth, and that they must always be attentive to these realities. They understood that there were limits. One was not free to dirty the water and plunder the fertility of the soil. They were immediately accountable for such behavior. The importance of understanding natural processes may have had little to do with cultural preferences or morals. Their daily existence depended on it.

When the people of the Old World began migrating to the New World, the inevitable clash of cultures began, each characterized by a radically different land ethic. The extent to which the struggle for land occupation and natural resources took place between the two cultures mirrored the competition between the Old World and the New World floras. As the land became depleted, these civilized people moved on or developed technologies which brought in resources from remote areas, deferring accountability for their actions. All the while, they became hubristic with their own influence on the land and ever less respectful of the realities, continually less aware of the function of natural systems. As the civilization spread across the arable lands of the earth, so also did the old world plants. It seems that the more wealth they amassed and the more they felt free to waste, correlated with the extent to which they regarded themselves "civilized".

Pilots must know the limits of their aircraft. They are immediately accountable for understanding the laws and realities of flight. If they are inattentive, or simply unaware of these laws, they may die. They may be a most caring, well-meaning person. It does not matter. They failed to observe the limits of their aircraft. On the other hand, if the pilot is attentive to the realities and acts within the limits, as described so eloquently in Magee's poem, one possesses infinite freedoms.

Over the past 150 years of civilization, we have become a society that is largely unaware of the realities, disconnected from the function of natural systems, and unmindful of the importance of the human relationship with the natural environment. Our civilized people have become distant, no longer attentive, no longer accountable, and quite oblivious to the way the world works. We have become too comfortable living with only inanimate things, and tragically uncomfortable living with life.

Traditional site planning and development, from corporate and institutional campuses to residential subdivisions, epitomizes this loss of connection. Home and working environments are often characterized by vast tracts of closely mowed turf grass, installed as one might a carpet, accompanied by regimented beds of ornamental shrubs, flowers and ground covers, and a wide variety of introduced or non-native trees. Common to all of these landscapes is the high level of maintenance required to preserve the desired appearance. Traditional approaches in landscape development generally require frequent lawn watering, mowing, pruning, weeding, trimming, and the liberal application of chemical fertilizers and pesticides. This perpetual cycle of care is executed in the name of maintaining a desired visual aesthetic that is repeated over and over with little relationship to site or regional environmental functions.

One of the realities is that water falls on the site. Here in the Chicago area, approximately 37 inches of precipitation fall annually, equaling about one million gallons of non-compressible fluid over each acre of land. Another reality is that most turf grass lawns possess shallow root systems, incapable of infiltrating even minor rainfall events. Pore spaces quickly become saturated, resulting in an environment that is extremely efficient at divesting itself of water.

Since water is non-compressible, it flows downhill. When it flows it generates energy. The energy, in turn, transports resource. The resource being transported may be in the form of fertilizers, topsoil, pesticides, and other potential pollutants. Buildings, roadways, parking lots, and water bodies generate pure runoff. Runoff generated from roadways and parking areas often contains a variety of harmful constituents.

Instead of treating water as a precious resource, it is handled as a waste product, to be safely and efficiently conveyed from the site just as quickly as the law will allow. Depending upon the local ordinance, this can range from almost immediately, to 0.15 cfs/acre to 0.05 cfs/acre. Since the water must leave quickly, but not too quickly, it requires the incorporation of an intricate and costly storm sewer network, coupled with the construction of holes in the ground. We refer to these holes in the ground as detention or retention basins. They are required to delay the release of the water until it can be metered into area streams, lakes, or rivers, in accordance with the locally allowable release rate. The excess resource is often carried with it. Most of us know that the water flows into the nearby storm inlet. We are not sure where it goes from there. It is, however, out of "site". During major storm events our rivers exhibit massive surges of filthy water. Sometimes we get flooded. Sometimes, areas downstream from us get flooded. We are not sure why, but we believe that creating bigger holes to detain the water will relieve the flooding. This seems to help, so we continue building in the floodplain.

There is another reality here in the Chicago area. While it precipitates approximately one million gallons of water on each acre per year, about one million gallons of water are also evaporated from each acre per year. Since we precipitate one million gallons, much of which is sent off-site, and we evaporate one million gallons on each acre per year, a total water budget deficit is created. Traditional cool season turf grasses, mostly Eurasian such as Kentucky Bluegrass, possess shallow root systems incapable of penetrating clay tills. Since they can hold little water, the turf dries out within hours of the last rain. The solution is to install expensive irrigation systems to mine water deep from within the ground. The shallow root system also renders these grasses incapable of competing with other, more aggressive weeds, particularly when they become stressed during the summer heat. In order to maintain the desired green, weed free appearance, we water, fertilize, and apply pesticides. Of course the next time it rains, these resources head for the detention basins, and eventually nearby streams. Constant mowing is required to maintain the neat, trimmed rug appearance. For every gallon of gas burned, about 15 pounds of carbon dioxide, among other harmful things, are released into our atmosphere. This carbon dioxide has not been a part of the earth's ecosystem since the Paleozoic.

The relatively small palette of plants chosen to be placed within the landscape in clever groupings of 5's and 7's is repeated at nearly every site. The buildings and the landscape look very similar throughout the area, the region, the country. The preferred infrastructural aesthetic demands that the outdoors look ever more like the indoors. We appear to have become discomfited with any idea other than that. We also demand that the desired appearance must be attained immediately, like decorating your living room. This requires the installation of costly, large trees and plants in rooting environments where they are often short-lived.

The result is the creation of residential and working environments composed of few other living things, save a very few weeds that have become highly adapted to such landscapes. The plants are not part of a self sustaining, self replicating ecosystem. Rather, they lead more or less independent, disconnected existences, without community or future. Biodiversity being so depauperate as to scarcely exist, the site is so inherently unstable that few organisms can reside long enough to establish long-term, resource-recycling systems. Instead of systems rich in a

community of organisms, composed of a connected and interconnected diversity of living things, our environments are largely composed of steel, tar, concrete, vast blankets of monoculture, and a few weeds. The result of a contrived visual aesthetic with little or no understanding, relationship, or grounding in the unique realities place.

Unaware of the limits, unmindful of the laws, detached from the natural processes, it is easy to understand how a culture could adapt a land ethic and an economy based upon divesting the earth of its natural resources. Only a culture that has forgotten the realities of a world put together with infinities would rely on technology alone for the ultimate, finite scientific answer. In *A Sand County Almanac*, Aldo Leopold wrote that "We abuse land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect".

The notion of belonging is a profound concept. Our detachment from the natural world has resulted in the manifestation of an ideology that separates the human from nature. Instead of viewing ourselves as an active "part of" the natural process, we have become separated, and quite "apart from" the natural process.

The idea that human involvement is not natural is a serious misconception. Throughout the post-glacial period, and perhaps for 100,000 years or more, Human Beings have been making conscious choices about their relationships to the land. As Human cultures have matured and evolved, so also have their natural environments, including both flora and fauna. The misconception of "letting nature take its course" continues to threaten the stability and restoration potential of remaining natural areas and hinders attempts to create new naturalized systems. Regardless, the degree of human alteration of the physical environment in the past 150 years across America has rendered the concept of self sustainable evolution unfeasible.

There is no one factor more critical to the concept of sustainability than education. In the words of David W. Orr from his recent article, *Educating for the Environment*, we are a society which "must be educated into existence". We are of the opinion that most humans, given the choice and an awareness of the problem, would prefer to conduct their lives in a more sustainable manner. First, however, we must educate the public that a problem really does exist, that the standard approaches are not sustainable, and that economically and environmentally sensible alternatives are available. The basic constraint is that most people are simply unaware of the impacts associated with traditional site planning and development standards, and therefore, default to the current norms which are legally and aesthetically acceptable. Orr suggests that "One of the principal tasks of education in the coming century is to foster ecological design intelligence, which requires a careful meshing of human purposes with the larger patterns of the natural world."

One of the obstacles facing sustainable planning and design is that it requires a multi-disciplinary approach. No one profession has the in-depth training and skills necessary to implement it alone. We view this as an advantage because ultimately, the hope for tomorrow is so locally relevant that all must be involved in it. Decision makers at every level must be educated, from local, state and federal governmental representatives to the individual consumer. We must also reassess traditional educational principles. According to Orr, "The ideal of a broadly informed, renaissance mind has given way to the far smaller idea of the academic specialist." When the Shawnee chief Tecumseh learned that an expedition of scientists from Harvard were traveling to Iowa during the summer of 1806 to observe an eclipse, he was curious. He asked his friend, Galloway, to explain what a scientist is. Galloway described a scientist as someone who "studies

the things of earth and heaven...Scientists watch plants and animals, they watch stars, they watch clouds and rain, and the earth..." "Does not all white men do this?" Tecumseh asked. "All Shawnee do this".

A basic role of education should be to teach us how to learn, to prepare us for a lifetime journey of learning. Our good friend and colleague, Jock Ingels of LaFayette Home Nursery in northwest Illinois, has been advocating the integration of natural plant communities and a sustainable approach to planning for more than 25 years. He scoffs at the notion of that he, or anyone would be referred to as an expert. Rather, he prefers to describe himself as an "explorer." Educators would do well to train a generation of explorers.

We believe that an increased understanding and awareness of the relationship of human activities and natural systems will result in a fundamental shift in the preferred aesthetic. The current visual aesthetic will be replaced with an infrastructural aesthetic based upon a combination of environmental and visual functions. In a sense, systems that work, within the unique patterns of place, will be perceived to be attractive. As peoples awareness of these limits and realities expand, the attributes of good, well grounded design will be simply and clearly communicated.

Something better than the standard default may not presently be in demand. We are optimistic, however, that public perception and general market demand may change rapidly once the problem is better understood and practical solutions are illustrated. We concur with Paul Hawken when he suggests in *The Ecology of Commerce*, that "shifts in culture can occur in rare moments with remarkable speed and vigor."

If we are to successfully shift toward sustainability, we must first address several basic shortcomings that are pervasive throughout the planning and design professions. Design professionals must learn to recognize the drawbacks associated with continued reliance on the standard default visual aesthetic. The following quote in a leading professional design journal typifies the problem: "if it comes down to a decision between good design and the environment, I'll always opt for good design". Many architects and landscape architects view environmental considerations as a constraint on their artistic design freedom. In our opinion, it is not possible to achieve "good design" without properly incorporating an understanding of a project's dynamic relationship between the built and natural environments. The design of environments where humans and other organisms interact, where one's actions create reactions, requires the assumption of certain responsibilities. We do not have limitless design freedom, as if an artifact of pure fancy. Sustainable design is more than artwork, more than a painting or a piece of sculpture, that may be viewed or admired based upon individual whim. The design of sustainable environments, be it building or site, must facilitate human purposes in association with other dynamic processes.

Another reality that must be clearly understood is that every site is totally unique unto itself. The real challenge to planning and design professionals becomes the development of aesthetically pleasing, innovative design solutions that creatively integrate environmental considerations, along with other relevant development factors, into the design process. Such designs must still incorporate critical visual interest, but also integrate physical and behavioral patterns within both the built and natural environment.

Once we understand the realities of place, and that true freedom is possible only within these limits, there are infinite opportunities for design expression. Since every place is unique, every design will require new creativity, innovation and technology. A new infrastructural aesthetic

will emerge in accordance with how successful we are at designing whole systems. This requires a design process based on the interconnection of dynamic systems, from the individual site through to the regional level.

Standard design and development approaches generally involve an attempt to mitigate impacts after the project is completed. Instead of having to mitigate impacts after the fact, their causes should be anticipated during design, thus turning potential impacts into site development assets. The building and site must be viewed as one continuous system, with tremendous potential to influence, either positively or negatively, the success of the whole.

An understanding of the unique physical characteristics of the site is critical, including, but not limited to, soils, flora, fauna, geology, aspect, and drainage patterns. In our opinion, if sustainability is to be achieved, water management, including both surface and ground water hydrology, is the key. There is no other resource or form of energy beyond light, with the ability to sustain, or destroy, more powerful than water. Structural problems, soil erosion, flooding, degraded water quality and aquatic systems, and the loss of plant and animal species diversity can all be directly related to the mismanagement of water. Most planners and engineers address the need to understand pre-development hydrology. We recommend the need to comprehend pre-settlement hydrology. The earth's natural systems did not evolve with the type of surface water hydrology, both in terms of quantity and quality, to which they have become regularly subjected. Any success for the restoration of remaining natural areas, those remnants of the earth's living tissue, will first have to address the form of hydrology under which they evolved and can be sustained.

The primary goal of both the building and site should be, wherever possible, to retain the water where it falls, to be treated as a resource, not discharged as a waste product. This will require new design innovations throughout the built environment in the form of buildings which detain water, redesigned drainage systems, and the integration of plant systems uniquely adapted to the region with specific water holding capabilities.

The integration of plant systems adapted to the specific locale is an important component of the sustainable process. The reality that the native flora of any region is the only flora on earth with the genetic memory and capability to coalesce itself into self replicating ecosystems is of profound importance. This is not to suggest that we abolish the use of traditional ornamental plant species, rather, a balance between the use of native and traditional elements should be considered. This balance is determined by the site itself, in association with existing and proposed land use functions. From a design standpoint, the tremendous variety of native species found throughout most regions provides a limitless array of design opportunities. Whole micro-climates may be designed to respond to soils, hydrology, orientation, and the relationship to building and other natural systems.

A primary goal of sustainability is the design of environments that enhance one's ability to comprehend, that encourage exploration and involvement, and are supportive of human needs and actions. Sustainable environments will communicate an understanding of environmental patterns and processes and engage human interaction. We agree with Orr's contention; "When human artifacts and systems are well designed, they are in harmony with the ecological patterns in which they are embedded. When poorly designed, they undermine those larger patterns creating pollution, higher costs, and social stress."

Management is another critical component of the sustainable process. Typically, design professionals remain actively involved through the completion of project construction. Afterwards, the designer rarely returns to the site to evaluate its performance. Sustainable design, regardless of whether its building or site, requires a more active follow-up role. From the site perspective, the integration of naturalized plant communities in more traditional development settings and the incorporation of innovative water management measures, necessitates follow-up in the form of curation, or on-going site stewardship. This highlights another important point. Sustainability is based, in part, on the incorrupt realities of the natural environment. This does not ensure, however, that our initial applications will be incorrupt. We must not be afraid to fail in our attempts to design sustainable systems. If we continue to examine our defaults, many of which are proven failures, a case can be made to support an approach that is only 10% right, versus 100% wrong. Early attempts may prove to be of little success, which only highlights the need to index what works, and provide for continued refinement.

Some consider advocating the integration of native plant species and naturalized plant communities into traditional site planning projects as an attempt to reverse evolution, or restore some romantic, historical concept of the landscape. We disagree. A commonly accepted ecological tenet is that plants and animals grow in habitats to which they are adapted. A corollary is that if the habitat is changed, so also will the inhabitants change. Within the timeframe of natural evolution, 150 years is little more than a blink of the eye. Plant species, through millennia, have become adapted to the specific combinations of biotic and abiotic factors, processes, and floral and faunal interactions uniquely characterizing the site they inhabit. An area with a long history of biome-level stability, such as characterized most of the presettlement landscape in the North America, will almost always support a diverse assemblage of conservative species in self-replicating, interactive arrays. The diversity and complexity facilitate system adaptability to the gradual but inexorable changes that occur in all landscapes on a scale of thousands of years. Environmental factors may change over time, but they are gradual and sufficiently buffered by system complexity to allow the system to adapt at a rate commensurate with the life cycles and the genetic dynamics of the populations of its component biota. The result is that each variance of topography, physiography, geographic position, and substrate is characterized by an essentially unique response and inhabitancy by plants and animals.

Impacts to native biological systems and processes associated with European settlement, however, have occurred with a magnitude and rapidity without precedent in the history of the continent's biota. There is a striking difference between areas inhabited by a full component of conservative plants and animals and one inhabited prevalingly by weeds. Conservative systems contain a biodiversity involving species suited to long-term inhabitancy of an area. Weed communities, by comparison, are adapted either to regular, essentially catastrophic disturbance, or to the kinds of activities associated with traditional cultural landscapes. These weed communities contain neither the biodiversity nor the aggregate adaptive ability to coalesce into self-sustaining, self-replicating systems. In our contemporary, fragmented landscapes, the conservative elements of our native systems, supplanted in place, have neither refugia, effective migration routes, nor the time to adapt or relocate. Rather, their populations are decimated time and time again until their local extirpation or ultimate extinction occurs. The destiny of many systems dominated by weeds is further destabilization, during which resources such as soil, nutrients, and water are often lost at rates faster than they are replaced. To site an example, the average topsoil depth across the state of Iowa at the time of settlement was estimated at 18 inches. In 1990, the average topsoil depth was estimated to have been reduced to 8 inches. These are rich, organic soils of the prairie, formed over thousands of years of dynamic

interaction with the flora and fauna of the region, through the annual process of carbon fixation, organic matter decomposition, oxidation and reduction. Once these soils are lost, no amount of fertilizer, or technology will replace their viability.

Establishing a sustainable relationship with the living earth requires that we reintroduce the “capacity” for change. The real world is alive in the sense that each acre is inhabited by a community of species interlinked in time, space, and genetics, with a vital adaptive memory of the genius loci. It is alive in the sense that each new year the community supplies the stability necessary for each species, relying on the great strength and adaptive success of their last generation, to persist long enough to experiment with new combinations of genes the earth has never seen to respond to an earth that is never exactly as it was the year before. Ironically, without this long term, community-enforced stability, evolutionary change for most plants and animals cannot occur. To do this, we must first preserve and nurture those little remaining natural areas, the refugia of the living tissues of the earth. These are the places where the wisdoms of sustained existence are housed.

Sustainable development is inherently cost-effective. Not only in terms of reducing environmental costs, but also with respect to the reduction of initial capital development and long term maintenance costs. The integration of buildings and landscapes which hold water, coupled with stormwater management systems that rely on naturalized surface drainage systems, can result in a significant overall reduction of site infrastructure. The use of plants which do not require supplemental irrigation systems, also serves to reduce initial construction costs. Our experience indicates that annual maintenance costs associated with native plant systems can be as little as 10% or less than comparable maintenance of traditional landscapes.

While new development may offer the most design flexibility for integrating sustainable measures, retrofitting existing buildings and sites will likely have a more immediate, positive impact, both in terms of cost savings and environmental benefits.

SUMMARY

Building a sustainable relationship with the living earth requires an ethic. Since the beginning of the Holocene, and perhaps for much of the Quaternary, an important component involved in the shaping of the landscape has been man. Human beings are not only governed by stochastic or random interactions within the ecosystem, but by choice. Fundamental interactions such as predation, competition, and foraging are now complicated by the fact that humans can decide how to act, with no ecological parameter coming to bear on this decision other than a human ethic. According to Leopold, “All ethics so far evolved rest upon a single premise: that the individual is a member of a community of individual parts. His instincts prompt him to compete for his place in the community, but his ethics prompt him also to cooperate...The land ethic simply enlarges the boundaries of the community to include soils, waters, plants and animals, or collectively: the land. We can be ethical only in relation to something we can see, feel, understand, love and otherwise have faith in. A land ethic, then reflects the existence of an ecological conscience, and this in turn reflects a conviction of individual responsibility for the health of the land.”

Currently, we define progress, economic growth, and prosperity by the extent to which we divest ourselves of natural resources and diminish the life of the earth. What if we learned to define progress by the extent to which we reinvested in the natural resources of the earth, and stewarded the land that it might work with us in that pursuit? Imagine the jobs, prosperity, and capital

formed, as we redesigned and rebuilt agricultural, corporate, residential and industrial North America intelligently, attentive to the realities and an eye toward tomorrow. Humans becoming again connected to the land, connected to something solid, something incorrupt, where memories of yesterday foreshadow the glories of tomorrow.

Too often, the response of people who are acquainted with a new idea or an unlikely vision is to dismiss it. “That will never work”, or “Nobody would ever do that”, or “Current ordinances won’t allow that.” Think back to 1830. In Chicago, prior to the steel plow, the prairies around Chicago and west into Iowa were too tough to till, and in many instances, too wet anyway. A young farmer, standing at Fort Dearborn and looking west across the vast land, could not have imagined, in his wildest fantasies, that it would be farmed from there to the Rocky Mountains in his lifetime. There was no market for it, no government to administer it, and no community base to support it. Yet it occurred, and it was achieved by one farmer, one at a time and in the aggregate, seeking to accommodate the economic imperatives of their day.

Currently, we have only a glimpse of such a tomorrow. If we are to create lands and ultimately regions, woven together by interconnected, sustainable systems, it cannot be done all at once. Rather, it will be implemented in increments, by a diversity of people, in a diversity of places, learning from small mistakes, and making small progresses.

Hawken suggests that “It is precisely in the discipline imposed by the limitations of nature that we discover and imagine our lives. It is only in the fullest context of the world as it is presented to us, and not as we manipulate it, that we may celebrate our humanity and create true prosperity. Such perspectives can lead us to a very different type of economy and way of doing business, one that will be healthier for all species, not only the butterfly and owl, but our own.”

Given an acclamation for a sustainable ethic, the only Achilles heel, with respect to our tomorrow, is the continued loss of our natural areas. These areas contain the capital, principal, the endowment upon which tomorrow’s sustained economy depends, the living fabric of the earth that we must graft back into our land. There is wisdom in an ancient metaphor; The Creator, in defining the Human Being, established a covenant between the human and the very earth itself. The Creator mandated that the Human Being has dominion over the birds of the air, the fishes of the sea, and the beasts of the land. It is an awesome responsibility, subject to the casual, sometimes self-destructive tendencies of humans, because if that covenant is real, then the corollary is true: The extent to which we divest the air of the birds, the sea of the fishes, and the land of the beasts, is the extent to which we forsake our humanity.

The world has its realities, yet its possibilities are infinite if we stay within the rules. Let us learn and glory in them. If we apply ourselves to those realities, set out the specifications to accommodate them, only few of which we know how to achieve at the moment, whole new technologies, industries, agricultures, and societies will develop, each needing its practitioners. Let us set the specifications for tomorrow, driven by an underlying ethic of sustainability. An ethic that utterly refuses to accept the idea of waste, replaced by a view of all things as a resource, and an urge to grow.