Starting Small in Stella: Learning How to Plan for Sustainability

2 August 2007

Verle Hansen, PhD
US Environmental Protection Agency/Office of Research and Development
Land Remediation Pollution Control Division
National Risk Management Research Laboratory
Cincinnati, Ohio
Hansen.Verle@epa.gov

A paper to be presented in:
Forum on the application of sustainability theory to urban development practice
10-11 August 2007
College of Design, Art, Architecture and Planning
University of Cincinnati, Cincinnati, Ohio

Abstract:

Concepts of sustainability are rarely clearly defined and their applications often seem abstract. Because these concepts must address systems scale, even simple strategies often seem complex, abstract, and overwhelming. The opportunity to apply a theory for sustainable development to the real small Missouri town of Stella enabled us to learn how to navigate and strategize through the application. Although development to meet the plan will likely be slow and uncertain, the process revealed specific common denominators between community, developer, and those of us interested in protecting the environment that can be applied to larger urban and regional scales. It also provided a field laboratory for study of the human and environment relationship.

Keywords:

Sustainability, sustainability criteria, natural systems, community planning, urban, community development, rural development, Stella, Missouri,

Concepts of Sustainability

> "…economic development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs." (WCED 1987)

This phrase introduced in the Brundland Commission report and universally accepted as a common goal at the UNCED in 1992 is the foundation for a concept of 'sustainability'. Although it seems simple, putting it into practice has lead to confusion, conflicting definitions, and only incremental applications. It is a popular concept that has become a 'buzzword' for commercial products, industrial processes, buildings, agriculture, management, and a good night sleep. It is difficult to be against a concept that banners "the kind of human activity that nourishes and perpetuates the historical fulfillment of the world community of life on earth;" (Engel 1990) However, the concept of sustainability is riddled with problems. It does not indicate: what should be sustained; what length of time applies; who should benefit; who is to pay any costs; how it is to be justified when needs of existing people cannot be met; what values should be placed upon future generations and their needs when we do not know what their needs will be or whether they will exist; or what future conditions will exist that will define its contexts. This has led to numerous attempts to define sustainability, to place it within a context that we can work with, or to exclaim it cannot be defined.

According to the dictionary: *Sustain* – means "1.To keep in existence; maintain, or 2. To supply with necessities or nourishment; provide support for…" --sustainable *adj*. (Dictionary 2000). It is tempting to consider sustainability as an end-state, but a 'definitive definition' is impossible (Atkisson and Hatcher 2001). "…In the end, sustainable development is not a fixed state of harmony, but rather a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are made consistent with future as well as present needs." (WCED 1987) "Sustainability must be made operational in each specific context (eg forestry, agriculture), at scales relevant for its achievement, and appropriate methods must be designed for its long-term measurement." (Bell and Morse 1998) "Sustainability in an evolving world can only mean sustainable development."(Bossel 1999)

A way to consider environment factors in human actions is to use land so as to assure environmental capacities are not negatively impacted. Sustainable land-use "…refers to

maintaining the three ecological functions of soils: (a) bio-mass production; (b) filtration, buffering and transformation of incoming materials and water; (c) habitats for organisms, including people. It also refers to maintaining its suitability for three spatial attributes (a) space for housing, industry, infrastructure, etc.; (b) space for extraction of mineral and other non-renewing resources; (c) areas of cultural heritage (Blume, H. Eger et al. 1998)." It "…can have two meanings: (a) with ecological overtones, maintaining all the land in a particular area in a condition of usefulness (as opposed to dereliction), long-term productivity and ecological stability; or (b) with socio-economic overtones, maintaining a particular use on a particular piece of land, for example food security and income generation (Blume, H. Eger et al. 1998)." Sustainability invokes concepts of 'prediction' and 'future expectation' (Fisher 2001), that incorporates applying technologies and/or planning to integrate ecological, social, and political principles in land management (Hurni 2000).

Foundation for a Theory of Application

The Brundland Commission definition makes the goal of economic development conditional on not compromising. That would mean proposed responses to meeting the goal are guided and limited by criteria. Such conditions are common throughout the literature.

1. "…*development* that improves the quality of human life *while living within the capacity* of supporting ecosystems (Bell and Morse 1998);"
2. "…*development* that delivers basic environmental, social, and economic services to all *without threatening the viability* of the natural, built, and social systems upon which these services depend (Brugmann 1996)."
3. It is *economic development compatible with natural environments* (Novartis 2002).
4. "…*global development* that can be *maintained across generations in an environmentally and socially acceptable way* (Umweldbundesamt 1997)."
5. "…*maximizing the net benefits* of economic development, *subject to maintaining* the services and quality of natural resources over time ---"The sustainability of natural ecosystems can be defined as the dynamic equilibrium between natural inputs and outputs, modified by external events such as climate change and natural disasters (Bell and Morse 1998)."

6. It is global stewardship and safeguarding ecological systems, but it also is about "*Improving the quality* of human life *while living within the carrying capacity* of supporting ecosystems (Farrell and Hart 1998)."

Barbara Ward, to whom the term sustainability is attributed, made the point[1] that development and environmental protection must be linked (Novartis 2002). This linkage is evident throughout the literature. Whatever the perspective concerning 'sustainability', the concept of development relates to humanity and all perspectives are meaningless without humanity. Although we use sustainability to refer to management actions for our food supply, water resources, etc. our primary interest in sustainability is the assurance that this planet is 'able to sustain' human life. Human concern with protecting and sustaining the environment is to assure that our species is able to remain and adapt in-place (Benyus 1997). This leads to the primary conflict between a planet 'able to sustain' and its most numerous non-insect species, *Homo sapiens*, but it also reveals a theory of how the concept of sustainability might be applied.

The Earth, including its natural capital, is primarily a closed and finite system that will support a limited amount of biomass. Humanity incrementally, cumulatively, and increasingly consumes natural capital. It does not matter that we do not know the capacity of Earth to provide the goods and services humanity requires; we know that at some point demand and supply curves do and will cross. These crossings mark the beginning of environmental phase shifts to lesser productive ecosystems when the human demand for natural goods and services are increasing. They signify the beginning of a more frugal lifestyle for many and/or the reduction of the human biomass that Earth will support. If we intend to remain and adapt in-place, it is essential that human numbers align with what this planet is able to provide. Because we are unwilling or unable to limit our numbers, 'ability to sustain' relates directly to expanding the planet's carrying capacity.

Expanding carrying capacity has been topical since people began growing things. Irrigation and the 'green revolution' are responses to this concern, and are the outcome of people making plans either to improve efficiencies or limit losses. Development of pesticides, herbicides, fertilizers, and biotechnological seed stocks are responses to losses due to insects or depleted soils. Because the process of development incrementally and cumulatively erodes natural systems it is appropriate to apply planning to sustain them.

[1] Ward, Barbara. 1972. The Care and Maintenance of a Small Planet. Deutsch, London.

A Theory of Application

Natural systems without human influences would change and adapt to natural phenomenon and cosmic influences. We cannot know whether its adaptive trajectory will forever include humanity. However, because we exist within an environment that we did not create and can not replicate, our fate is within nature's capacity to recover from disturbances and efficiently utilize energy. If human population growth were to remain unchecked it would not be possible to meet human needs and keep natural systems intact (Bartlett 1998). Because that condition would effectively check population growth by impoverishment, our sustainability concern is to assure that we never reach that state. Because our existence is conditional upon the existence of natural systems, it is our responsibility to assure that natural systems remain intact.

The central presumption is that if natural systems would exist without humanity; they should also exist with humanity and provide condition that human life requires as-long-as the essential attributes of natural systems remain intact. If so, any human act that could alter natural systems must be anticipated and altered before action is taken to make certain that essential attributes of natural systems are not negatively affected. Because this is the essence of planning, it is appropriate to determine how best to use planning to assure that the environment is able to sustain human life.

The process of planning allows contemplation of goals and limitations. Because humanity must take something from the natural environment to meet human needs, it is inevitable and unavoidable that we will inflict losses on the natural environment. Because our existence also depends upon what we leave, anthropogenic effects on natural systems do have limits that can guide decisions within environmental conditions. Because the planning process routinely meets various sets of planning criteria, those that relate to intact natural systems should be readily integrated. Planning criteria include: owner needs, user needs, financier limitations, planning regulations, zoning codes, building codes, Newton's Laws of Physics, etc. Because human existence is at stake, intact natural systems are no less important and should be used as planning criteria.

The condition that natural systems must remain intact provides a broad, but fundamental parameter within which human needs are to be met, i.e., to develop without compromising our ability to survive. The assumption that natural systems would remain intact as-long-as the

essential attributes of natural systems remain intact narrows that parameter so as to guide the planning process. These essential attributes become criteria that define the conditions that must exist to assure natural systems performance and, therefore, define or restrict acceptable anthropogenic change.

Application of Planning to Achieve Sustainability

Application of essential attributes of intact natural systems to the planning process requires three things: a list of essential attributes of intact natural systems; a project with willing stakeholders; and sufficient knowledge about specific natural systems concerning the project area.

Natural System Criteria

A list of essential attributes of natural systems was compiled[2] with reference to conditions for maintaining ecosystem integrity, i.e., near-natural conditions of productivity, biodiversity, soils, and water (Forman 1995). The human focus of sustainability necessitates that human needs and limitations be included. Therefore, conditions for air and atmosphere are added. These near-natural conditions define parameters of acceptable anthropogenic changes to the natural environment. 'Near-natural' does not eliminate humanity, nor require perfection. Because people are as 'natural' as any other creature, they have a 'right' to be here, occupy space, use resources, and inflict change to the environment. The limitation on what humanity uses, consumes, inflicts harm, or changes is that enough must remain intact and functional so as to provide goods and services needed for human survival. Because nature is constantly in a process of decay, renewal, and change, 'near-natural' does not eliminate erosion, floods, forest fires, etc. These too are natural and essential to the process of evolution, self-management/maintenance, and intact natural systems.

Analysis of six near-natural conditions of natural systems produced seventeen 'sustainability criteria'[3] (Hansen and Studer 2005) that provide unambiguous guidance to the planning process. However, it is not possible to ascertain whether this list is complete or sufficient to guide the planning process until they have been applied. This will require application on several projects which would become field laboratories. Because science does not want to wait too long for

[2] See Appendix A
[3] See Appendix A

results, these projects should develop quickly so that pre- and post-developed environments can be compared. Sufficient knowledge of the natural environment in the region of the project must exist to adequately inform planning decisions that also meet human needs. If this theory is correct, it should be possible to develop to meet human needs without degrading natural systems. Field studies will confirm whether this is so. Because development will incrementally and cumulatively take something from natural systems, decisions that will meet planning goals within these criteria must: assure every essential attribute remains intact; and account for losses and counteract them.

The use of essential attributes of natural systems as planning criteria promises to enable land-use or development decisions, but they are not sufficient to protect or sustain the environment. Because natural systems are vulnerable to social and economic development or lack of development, these systems also need to remain sufficiently intact. Adequate foundation for social and economic systems integrity are not well established. However, if essential attributes were to become planning criteria for natural systems, essential attributes of social and economic systems should similarly apply.

Essential attributes of social systems were derived from twelve sources of sustainability indicators (Hansen 2003b). These lists of indicators were refined to determine their lowest common denominators regarding their true importance to providing for stable human society. A list was compiled containing ten essential attributes of social systems.[4]

Essential attributes of economic systems were derived from their reason for being, i.e., to efficiently and equitably allocate resources to need. These two conditions generated a list of eight essential attrubutes intact economic systems.[5]

First Application

The inability to protect the environment and fully recover once it is compromised requires investigation into how losses might be avoided. Protecting and sustaining the environment would reduce the need for clean-up and the resources it requires. It would also enlist people who are

[4] See Appendix B
[5] See Appendix C

charged with changing the environment to protecting it. EPA's Land Remediation and Pollution Control Division[6], developer of this strategy, was looking for sites where this strategy could be applied. A project presented itself at a time when we knew little about application of the sustainability criteria and needed a project that would enhance our learning. The town of Stella, Missouri, population 178, had an abandoned, deteriorating, and asbestos-laden hospital that qualified for cleanup under the Comprehensive Environmental Response, Compensation, and Liability Act (1980). US Environmental Protection Agency Region 7 assumed the responsibility to assess the hospital condition and to remove it. The vacant site left a void and townspeople wondering what to do. Although the town's population had declined and stabilized, development in nearby Bentonville, Arkansas is inflicting growth pressure region-wide. Citizens of Stella realized that growth was needed to support local services, but that uncontrolled growth might degrade or eliminate valued characteristics of the town and environment. Citizens had already been using the web-site SMARTe[7] that is a revitalization decision support tool designed to provide information, resources, and tools concerning revitalization of sites that were previously used and potentially contaminated. Because SMARTe is in continual development and does not yet contain information concerning 'sustainability', it was suggested that the town of Stella might be a venue for early study to develop this information. This provided US EPA's Office of Research and Development (ORD) with an opportunity to approach citizens with a concept to develop the former hospital site and the town that would meet citizen needs, conform with their values, and meet sustainability criteria so as to protect the environment from this more holistic perspective. Stella would receive a master plan while EPA would receive a learning experience and field laboratory to test its new strategy.

[6] LRPCD is a division of the Office of Research and Development within the National Risk Management Research Laboratory located in Cincinnati, Ohio.

[7] Sustainable Management Approaches and Revitalization Tools – electronic: a web site collaboratively developed by US EPA, the German Federal Ministry of Education and Research, and the Interstate Technology and Regulatory Council.

Figure 1- Base aerial photo – by Terraserver

Figure 2- Master plan

Citizen input was elicited by US EPA Region 7 and US EPA's ORD to assure that citizen needs and values were at the forefront of all planning efforts and outcomes. ORD analyzed each need/want of the community relative to each sustainability criteria. It was anticipated that the project would be a collection of responses to citizen input that would be guided by sustainability criteria. Some criteria, however, do generate their own responses.

The planning process required assembly of information relevant to the project area, i.e. location, site characteristics, climate, hydrology, soils, biodiversity, cultural and natural histories, methods of governance and regulatory environment, demographics, institutions, infrastructures, and strengths and weaknesses. Many of these were acquired easily from internet sources produced by reputable sources, e.g., Missouri Department of Natural Resources, USGS, Terraserver (see figure 1), US Bureau of Census. Others were collected from historic publications, phone calls, US EPA data and web-sites, University of Missouri, and information provided by local citizens.

Responses are in two categories: physical responses that can be illustrated on a plan; and programmatic response descriptions. These responses generated two documents, i.e., a master plan (see figure 2), and a table describing possible responses. The format for all responses was to meet citizen needs within the constraints of meeting environmental, social, and economic sustainability criteria. However, citizen need did not fully address all sustainability criteria. Because criteria either constrained responses to meet human needs or defined how systems should perform, it was sometimes necessary to include planning responses that assure systems

performance alone. The purpose of this paper is not to describe these responses, but to identify a strategy to plan for sustainable environments and lessons learned in its application.

Problems of Scale and Scope

Meeting citizen needs and application of sustainability criteria to a planning process for a small town may have limited value to other communities that are larger, but this project gave us a place to start. Its size allowed us to visualize the entirety of the application process perhaps more easily than it would have on a larger project. Scale, however, limited our ability to fully respond to citizen needs and some of the sustainability criteria.

The small population of Stella, being too small to support some community services/facilties, (e.g., a grocery store), necessitated some creative planning. Because it was not possible to fulfill a request for a grocery store, the concept of what a grocery store does, i.e., provide food gave us the opportunity to fill the need for food in ways that would not only provide the needed products, but help to build a sustainable economic base for the community. It was then possible to plan for a future grocery store that would help to support a renewed economic base.

Because the project covered an area less than 1 mile square and its environmental impacts are likely less than 2.5 miles square, it is not possible to evaluate and respond to criteria that will address minimum dynamic habitat and their distributions beyond the range of stochastic events. Because of the small scope and scale of this project, it did not permit total analysis of habitat requirements for all native species and their communities. Ideally, the roles this region plays in maintaining biodiversity should have been analyzed and possible adjustments made to the plan. Because this task was too complex and costly for this learning experience, the assumption was made by an ecologist that 99.5% of native species that this project area would accommodate could be accommodated within contiguous riparian corridors. Therefore, the planning response was to assure that riparian corridors were protected and remain undeveloped.

Responses that met citizen needs often needed to be adjusted or alternatives suggested to meet sustainability criteria. Although the physical form of these responses could be determined and depicted in plan, their true size could not. Example: A response to providing a safe environment for humanity might be slowing or retarding storm surges. This could be accomplished by

providing dry basins that would capture storm surges and allow percolation into groundwater and/or slow release of surface flows to prevent flooding. This response might also retain soils, reduce erosion, and eliminate contaminates from streams. However, the size of these basins should be based upon known storm surge volumes, intensities, and durations, but this data was unknown.

Barriers to Application

Resistance

Citizen participation and support for this project was excellent. Local coordination by Mona Hart[8] and a dedicated Stella Betterment Committee[9] enlisted community participation by reaching out into the community. Press coverage in local and regional newspapers and television was always timely and positive. A community meeting to elicit community input was attended by approximately 150 people. Subsequent community meetings to present a draft and final plans attracted approximately 100 people to each meeting. Citizens were always interested and expressed concerns and gratitude for our efforts. Because of community outreach, people were informed and resistance was low. However, a few people expressed complete resistance to change, and a few heard and saw what they desired, not what was said or illustrated. A few others that were not involved received information second-hand and were against this project until Mona Hart made the effort to provide them with accurate and complete information.

Perceptions

Citizens predominantly recognized that their town needs to change and supported our efforts. The largest barrier to application is the perception that resources do not exist in this small town to effect meaningful change. Because there is not enough money, the town's greatest resource is its people. The challenge is to collect, focus, and mobilize every resource that exists to demonstrate that the town can anticipate and direct change to meet local needs and values.

This has always been an EPA/ORD research project that is also intended to benefit a small community. Although the point was made clear on numerous occasions that this was not a

[8] Co-chairperson of the Stella Betterment Committee

[9] Chairman of the Board of Trustees and co-chair, Bill Alsop; Co-chairperson, Mona Hart, Lamelia Beckett, Secretary; Loretta Taylor, Treasurer; Doris Dalbom, Chuck Dalbom, Bill Beckett, Samantha Beckett, Lorenna Beckett, Scott Sears, Nina Johnston, Don Johnston, Steve Martin, John Oliphant, Glenn Ennis, Judy Ennis, Stacy Williams, Teresa Allison, Robert L. Hart.

‘government project’ and the EPA is not going to provide funds to develop the town of Stella, those uninvolved citizens and the spread of incomplete information by word-of-mouth gave the perception that the government was going to redevelop the town. This negatively affected the project in several ways. First, people who were not involved in the process seemed to feel it was all right to be uninvolved because ‘the government was going to do it’. Second, people who do not like the government appeared to be against this project, but did not openly express their opposition. Third, a few people developed the expectation that property owners could sell at a high price to the government, or conversely that the government was going to take their property.

Self interest

A plan that purposes to create a sustainable environment and a community that presents opportunities and a better quality of life to citizens will inevitably add value to local properties. Rather than combine property resources for the benefit of environment, society, and economy that would also benefit individuals, the temptation for individuals is to capitalize on property values. As an example, property that could have been obtained for $15,000 prior to the planning process was increased to $150,000 during the planning process. Although this property could have become a ballpark for the town to enjoy and be a key element in the community plan and its activities, such expectations of profit will likely restrict the town’s ability to improve and the property is likely to languish unused for decades. If this cannot be overcome, it lends credence to those who say that economic concerns drive everything. If so, this community is unlikely to survive.

Lack of data

Use of essential attributes of natural systems as planning criteria necessitate that they are known entities. Because there is not one universally accepted list, it is not known whether natural systems would be fully sustained using the lists that USEPA/ORD developed. Responding to needs within sustainability criteria was relatively easy, but it was not possible to determine the extent of any needed response because data concerning many of the criteria do not exist, e.g, effects of climate change on productivity, biodiversity, soils, and water. Because moving toward sustainability is often the best measure after responses are appropriately made to needs, it was often acceptable to provide general responses. Because there is a chance that any response might be insufficient to move the project toward sustainability, flexibility to alter the response on the ground may be necessary.

Lack of resources

Any project that broadly affects natural, social, and economic systems, and relies upon expertise from numerous and diverse disciplines should have the full support of many people and financial resources to gain as much knowledge as possible. This project sparked the curiosity of hundreds and allowed us to convene an admirable project team. Unfortunately, because funding did not exist and everyone had other work to do, only a few people were directly involved. Most of the support from other disciplines involved refining the list of essential attributes of natural, social, and economic systems.

Inability to understand

Natural, social, and economic systems are complex and dynamic. Science can perhaps tell us how they did work, but not how they will work. It may be possible to identify patterns of system change so that we might anticipate change and learn their signals so that we might remain in step, or models of systems might someday estimate how they work.

Common Denominators

It is not simply a cliché to state that ‘everything matters’ regarding sustinability. It is not possible to separate environment, society, and economy. They are as nested as ‘Russian dolls’. The economy may act as if it is all powerful and directs all decisions, but it should be a tool of and embodied within society; and along with society is dependent upon capacities and limitations of the natural environment. Therefore, concerns of each are concerns of all. It does not matter whether individuals or groups take stances that environment, society, or economy is more important. It is not possible to have one system in good shape unless all systems are in good shape. Therefore, community concerns are developer and environmental concerns; developer concerns are community and environmental concerns; and environmental concerns are developer and community concerns. Everyone in this community shares common interests in environment, society, and economy. John Donne’s Meditation XVII is no less relevant today than when it was written in 1839 and perhaps especially so for small communities:

> *No man is an island. entire of itself; every man is a piece of the continent, a part of the main; if a clod be washed away by the sea, Europe is the less, as well as if a promontory were, as well as if a manor of thy friend's or of thine own were; any*

man's death diminishes me, because I am involved in mankind, and therefore never send to know for whom the bell tolls; it tolls for thee.

Lessons

Application of this strategy to plan so as to achieve sustainable systems exposed some surprising consistencies that might be considered as overriding planning criteria. These seem to trump each planning response or serve as a second set of filters to evaluate individual responses to each need that also meets sustainability criteria.

1. Sustainability is first and foremost about creating a place where people want to be. If all of the decisions that are made to create the built environment, develop an economy, or protect the environment do not create a place where people genuinely want to be, everything fails.
2. Every resource must be retained within the local built and natural environment for as long as possible so that the maximum benefit can be gleaned from each resource; and everything should be considered as a resource.
3. The above is accomplished by garnering and focusing every asset on building community. This may be especially true in small communities where many resources are restricted or limited. Bringing people together as much as possible enables chance interactions between individuals so that needs can be known and addressed, and opportunities shared.
4. Achieving ‘sustainability’ is not something that is to be achieved someday. It is a condition that must daily exist. It does not matter whether a sustainable economy must have 5000 people to support it, it must also be sustainable with 178.
5. The words of E.F. Schumacher still ring true, “Small is Beautiful”. Sweat equity can replace money and it is immediately visible. No town or city has the resources it wants and needs. Large cities might spend $Millions without seeing the results. Small towns can spend effort and see miracles.
6. Visible results are important. They demonstrate positive change and elicit more effort.

Measuring Sustainability

The measure of sustainability for Stella, Missouri is ultimately whether citizens are able to remain and adapt in-place. This is made possible by building the environmental, social, and economic

systems that enable everyone to meet their needs. It is these intact systems that provide opportunities to make a living. Sustainability criteria become the ‘sheet music’ for assuring that opportunities exist. As sheet music, sustainability criteria inform how planning is applied and become the measure of how well it is performed. If planning is performed well, natural systems will be as robust after development as they were before. An excellent performance will see natural systems improved. Social systems will provide a higher quality of life, and economic systems will equitably and efficiently allocate resources so that everyone has a quality of life above an agreeable minimum.

Measuring whether systems are as or more robust after development requires comparisons. Environmental, social, and economic baselines are essential to make comparisons. Baselines can be readily established using historic data or pre-development surveys. Comparisons need time. If planning for new development and society is to benefit from comparative studies, the development period must be compressed. It is uncertain whether Stella will develop rapidly enough for comparisons to be valuable.

Because making comparisons also require stable end points, they lose accuracy and relevancy when they refer to systems that evolve. ‘As or more robust after development’ assumes that a normal trajectory of evolving systems would have produced robust conditions. However, the laws of thermodynamics, stochastic events, major cataclysmic events, and non-anthropogenic climate change do not support this conclusion. It may also be that humanity may not be present in future evolved states of this planet. However, because sustainability is a human concern, the comparative measures we choose likely are those that maintain native structures, functions, and processes in their existing or more robust conditions.

Conclusions

The conditional nature of sustainability and the planning process that accommodates conditions provide an opportunity for planning to be used as a tool to attain sustainability. The planning process may be an ideal platform from which to attempt this goal. Sustainability involves elements of predictability and expectation which is the principle reason for planning. Because sustainability is intended to keep something intact and the function of planning is to initiate change, planning might be able to tailor change to accommodate what must be kept intact. Because the planning process largely addresses development of the socio-physical environment

that can permanently compromise sustainability within hours, it is a responsibility of and essential that planners evaluate alternatives before change is initiated and losses are incurred. Planning is at the interface between economics and society at one hand and the environment that makes them possible. It cannot avoid its position and has the opportunity to assure all systems are intact. Although this positioning seemed plausible, its application presented challenges, unknowns, and surprises. Its application to the small community of Stella, Missouri enabled us to remain simple and free of complexities that are inevitable in larger communities. The lessons it taught will enable scaling up this strategy to larger communities.

Appendix A: Essential Attributes of Intact Natural Systems

1. Native plant communities predominate
2. Habitats exist in forms that support MDP native species (Baydack, Campa et al. 1999).
3. Unique features of landscapes are protected.
4. Contiguous habitats exist beyond the reach of stochastic events.
5. Connectivity between habitats is redundant and grain appropriate for native species.
6. Resources essential to migratory species exist.
7. Natural disturbance regimes exist.
8. Soils retain natural mineral nutrient levels and moisture content to sustain native plant species.
9. Soils retain natural porosity and percolation, stormwater retention, and erosion resistance.
10. Soils remain clean enough to support native plants, bacteria, fungi, and soil organisms.
11. Water quantity and speed of surface flows meet historic cycles, durations, and intensities.
12. Average volumes of groundwater is balanced between withdrawals and recharge.
13. Water quality of all surface and groundwater is free of contaminates that threaten life.
14. Flowing water has no non-negotiable obstruction to passage of native life.
15. Air quality poses no threats to life and photosynthesis.
16. Global climate is unaffected by human actions with energy budgets on land similar to native landscapes and no increase in airborne pollutants that increase greenhouse gases.
17. Atmospheric radiation shield is maintained.

Appendix B: Essential Attributes of Intact Social Systems

1. Basic needs are met
2. Future options protected
3. Natural resources benefit people
4. Resources are accessible
5. Institutions exist to serve collective
6. Individuals have a voice
7. Community values affect change
8. Human life is isolated from stochastic events
9. Risks to human life/health are known
10. Right to safe environment is institutionalized

Appendix C: Essential Attributes of Intact Economic Systems

The purpose of an economic system is to efficiently and equitably allocate resources to needs. This system is necessary because resources are always limited and needs are always great. These two conditions, i.e., efficiently and equitably define categories of attributes of a workable economic system. These primarily account for the human and environmental costs of doing business (Hollender 2002).

Economic Efficiency

1. Primary Criteria - *Resource use* must be **linked** with *resource investment*.
    a. Maximize efficient use of natural resources and invest savings in increasing supply of natural resources (Daly 2002).
    b. Economic investments preserve the capacity for natural capital to be re-invested (Lovins, Lovins et al. 1999).

Economic Equity

2. Qualitative community resources are improved (Kinsley 1994; USEPA 1998).
3. Net economic effects are greater than costs incurred to natural and social systems.
    a. Economic multipliers are raised.
        i. Capital is available and circulates within the region.
    b. Costs are calculated prior to being incurred.
        i. Consumption of natural resources is counted as a cost (Daly 2002).
        ii. There are no externalities.
        iii. Financial resources are sufficient to maintain community infrastructures, institutions, and services.

Sources

Atkisson, A. and R. L. Hatcher (2001). "The Compass Index of Sustainability: Prototype for a Comprehensive Sustainability Information System." Journal of Environmental Assessment Policy Management **3**(4): 509 (24).

Bartlett, A. A. (1998). "Reflections on Sustainability, Population Growth, and the Environment - Revisited." Renewable Resources **15**(4): 6-23.

Baydack, R. K., H. Campa, et al., Eds. (1999). Practical Approaches to the Conservation of Biological Diversity. Washington, D.C., Island Press.

Bell, S. and S. Morse (1998). Sustainability Indicators: Measuring the immeasurable. London, Earthscan.

Benyus, J. M. (1997). Biomimicry: Innovation inspired by Nature. New York, HarperCollins Publishers Inc.

Blume, H.-P., H. Eger, et al., Eds. (1998). Towards Sustainable Land Use: Furthering Cooperation Between People and Insitutions. Reiskirchen, Germany, Catena Verlag GMBH.

Bossel, H. (1999). Indicators for Sustainable Development: Theory, Method, Application. Winnipeg, International Institute for Sustainable Development.

Brugmann, J. (1996). "Planning for Sustainability at the Local Government Level." Environmental Impact Assessment Review **16**: 363-379.

Daly, H. E. (2002). Five Policy Recommendations for a Sustainable Economy. Sustainable Planet: Solutions for the Twenty-first Century. J. B. Schor and B. Taylor. Boston, Beacon Press**:** 209-221.

Dictionary (2000). The American Heritage Dictionary of the English Language. Boston, Houghton Mifflin Company.

Engel, J. R. (1990). Introduction: The ethics of sustainable development. Ethics of Environmental Development: Global Challenge, International Response. J. R. Engel and J. G. Engel. London, Belhaven Press**:** 10-11.

Farrell, A. and M. Hart (1998). "What Does Sustainability Really Mean?: The Search for Useful Indicators." Environment **40**(9): 4-9, 26-31.

Fisher, D. E. (2001). "Sustainability: the principle, its imlementation and its enforcement." Environmental and Planning Law Journal **18**(4): 361-8.

Forman, R. T. T. (1995). Land Mosaics: The Ecology of Landscapes and Regions. New York, Press Syndicate of the University of Cambridge.

Hansen, V. E. (2003b). "Maintaining Social Systems: A Precondition to Sustainable Environments." Unpublished draft.

Hansen, V. E. and R. G. Studer (2005). Counteracting Ecosystem Losses Due to Development. Cabernet: The International Conference on Managing Urban Land, Belfast, Northern Ireland.

Hollender, J. (2002). Changing the Nature of Commerce. Sustainable Planet: Solutions for the Twenty-first Century. Juliet. Boston, Beacon Press**:** 61-77.

Hurni, H. (2000). "Assessing sustainable land management (SLM)." Agriculture, Ecosystems and Environment **81**(2000): 83-92.

Kinsley, M. (1994). "Sustainable Development: Prosperity without Growth." Public Management **76**(10).

Lovins, A. B., L. H. Lovins, et al. (1999). "A Road Map for Natural Capitalism." Harvard Business Review **77**: 145-158.

Novartis (2002). Sustainable Development: A Common Challenge for North and South, Novartis Foundation for Sustainable Development**:** 1-14.

Umweldbundesamt (1997). Sustainable Germany: Towards an Environmentally Sound Development. Berlin, Federal Environmental Agency, Federal Republic of Germany.

USEPA (1998). Characteristics of Sustainable Brownfield Projects, Office of Solid Waste and Emergency Response (5101)**:** 216.

WCED (1987). Our Common Future. New York, Oxford University Press.