A Planning Framework for Sustainable Land Development

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From the redwood forest to the Gulf Stream waters, we are fortunate to have abundant, wide-open spaces in the United States. A third of our country is covered in forest, and almost another third is covered in grassland. Only three percent of the U.S. was classified as urban in 2007.[1] Thus, we appear to have plenty of land for producing food and fiber, enjoying recreational uses, and obtaining other ecosystem services.

But – as just about any urban planner, forester, agricultural producer, wildlife biologist, hunter, or citizen can tell you – there is also plenty of concern about future land use nationwide. With so many different stakeholders on the landscape, and with the U.S. population projected to grow from 309 million in 2010 to 420 million in 2060,[2] now is the time to implement proactive and innovative land use strategies.

In a previous Dovetail report, *"Working Lands Conservation Offers Path to Sustainable Land Use,"*[3] we discussed how the sustainability of land use in rural areas could be enhanced by integrating the conservation of natural resources (such as soil, water, and wildlife habitat) with agricultural production, rather than focusing solely on a "set-aside" approach for natural areas. Here, we address the same principle – efficient, integrated land use – from the perspective of *urban development*. Our goal is to offer a multi-functional approach to land use and present a planning framework for sustainable land development.

BACKGROUND

In an effort to meet the inherent challenge of developing land in a manner that meets present needs while also protecting future opportunities, many approaches to sustainable site design have arisen in recent decades (see sidebar on next page). Each of the approaches described in the sidebar has clear advantages compared to conventional strategies. Each approach also embodies one or more elements of sustainability's "triple bottom line" – economics, environment, and people.[4] Often, however, one approach is implemented in isolation from others, thus missing out on

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[1] Source: Nickerson, C., R. Ebel, A. Borchers, and F. Carriazo. 2011. Major Uses of Land in the United States, 2007. Economic Information Bulletin No. (EIB-89). Economic Research Service, U.S. Department of Agriculture, Washington, D.C.

[2] Source: U.S. Census Bureau; U.S. population on April 1, 2010 = 308,746,000; U.S. population projection for July 1, 2060 = 420,268,000, based on 2012 National Projections (updated May 2013) (http://www.census.gov/population/projections.)

[3] Available at: http://www.dovetailinc.org/reportsview/2011/responsible-consumption/pdr-sarah-staip/working-lands-conservation-offers-path-sust.

[4] Although the concept of the triple bottom line has been visually represented in many different ways, one of the most familiar depictions is a Venn diagram, with economics, environment, and people as three intersecting circles. This representation dates back to Barbier, E. 1987. The concept of sustainable economic development. Environmental Conservation 14(2):101–110.

potential additional benefits. For example, Conservation Design [5] and Integrated Stormwater Management[6] have distinct benefits in terms of resource protection and water quality (respectively), but if these techniques are used in a low-density development (i.e., large-lot residential), then the land is not being used as efficiently as in a New Urbanist[7] or Smart Growth [8] scenario (Figure 1). Similarly, as discussed further below, New Urbanist and Smart Growth scenarios do not provide optimal benefits if implemented without consideration of natural resource protection or water quality.

Examples of Approaches to Sustainable Site Design

Conservation Design (also called "Conservation Development") protects one or more portions of a project site for their natural resource value; development is restricted to other portions where environmental impact is minimal, and the development finances the conserved areas. It has been used most often in rural and suburban developments.

Integrated Stormwater Management (also known as "Low Impact Development" and "Green Infrastructure" in the U.S. and "Water Sensitive Urban Design" in Europe and Australia) involves the use of on-site methods, such as infiltration, for managing stormwater runoff, rather than conveying it off-site through stormwater pipes, which can cause downstream problems with water volume and water quality.

Smart Growth and **New Urbanism** emphasize compact, walkable, mixed-use developments to reduce sprawl and transportation impacts, increase the tax base, and promote a stronger sense of community.

Figure 1. ***The Cotton District in Starkville, Mississippi***
Widely considered the first New Urbanist development in the U.S.

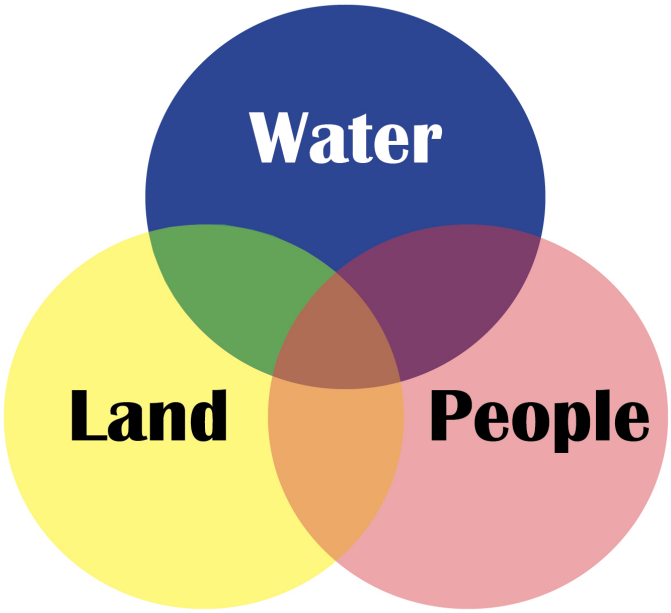
Photos: S .M. Stai

[5] See also Milder, J. 2007. A framework for understanding conservation development and its ecological implications. BioScience 57(9):757-768.
[6] See also the U.S. Environmental Protection Agency's Stormwater Best Management Practices, http://www.epa.gov/oaintrnt/stormwater/best_practices.htm.
[7] See also the Congress for the New Urbanism, http://www.cnu.org.
[8] See also the Smart Growth Network, http://www.smartgrowth.org.

PURPOSE

This report presents an approach that encourages a holistic look at project and site design and serves as a guidepost for the planning process. The *Sustainable Land Development Planning Framework* (hereafter "Framework") is illustrated in a series of interrelated diagrams (starting with Figure 2) and is adaptable to diverse discussions about what it means to make land development sustainable. *The premise of the Framework is that development results from an interaction among three components – people, land, and water* (Figure 2).

Figure 2. ***Critically Interrelated Components of Land Development***



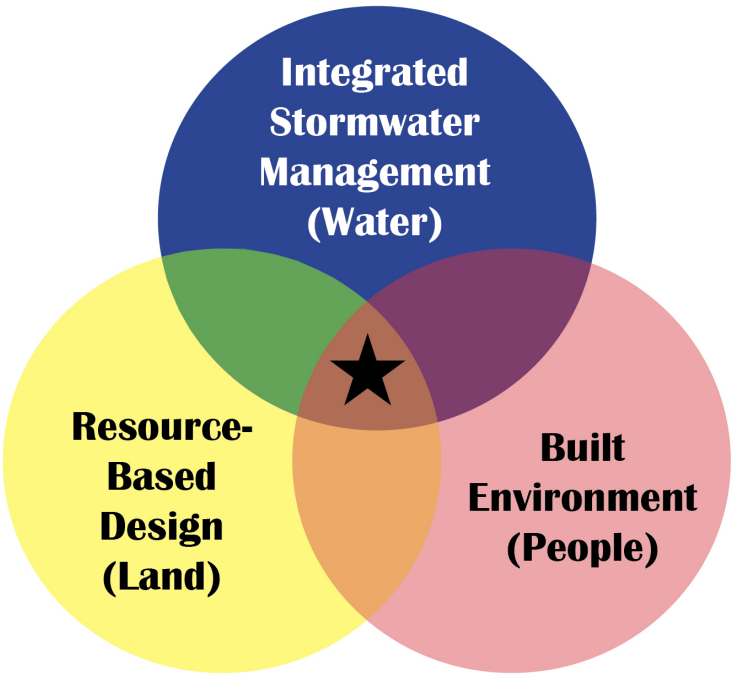
Our representation of the Framework (in Figure 2 and others) parallels the Venn diagram often used to show the intersection of environment, economics, and people in sustainable endeavors.[4] A key point in sustainable land development is that the financial benefits must outweigh the costs, just as the environmental and social cost-benefit ratios must be favorable.

While many forms of guidance to sustainable site design (such as green building standards and rating systems) are available, this Framework is meant to provide a first-step, high-level overview that is accessible to diverse stakeholders and that integrates existing and varied approaches. In this report, we also provide an example of the Framework's application, and we profile four projects that illustrate the use of integrated approaches. We conclude by touching on barriers to sustainable land development.

SUSTAINABLE LAND DEVELOPMENT PLANNING FRAMEWORK

Figure 3 represents a holistic approach to sustainable land development – one that addresses sustainability for people, land, and water. In the Framework, the Water component from Figure 2 is addressed through *Integrated Stormwater Management* (ISM) strategies, the People component is addressed through *Built Environment* (BE) strategies, and the Land component is addressed through *Resource-Based Design* (RBD).[9] Figure 3 is the "core" diagram of the Framework.

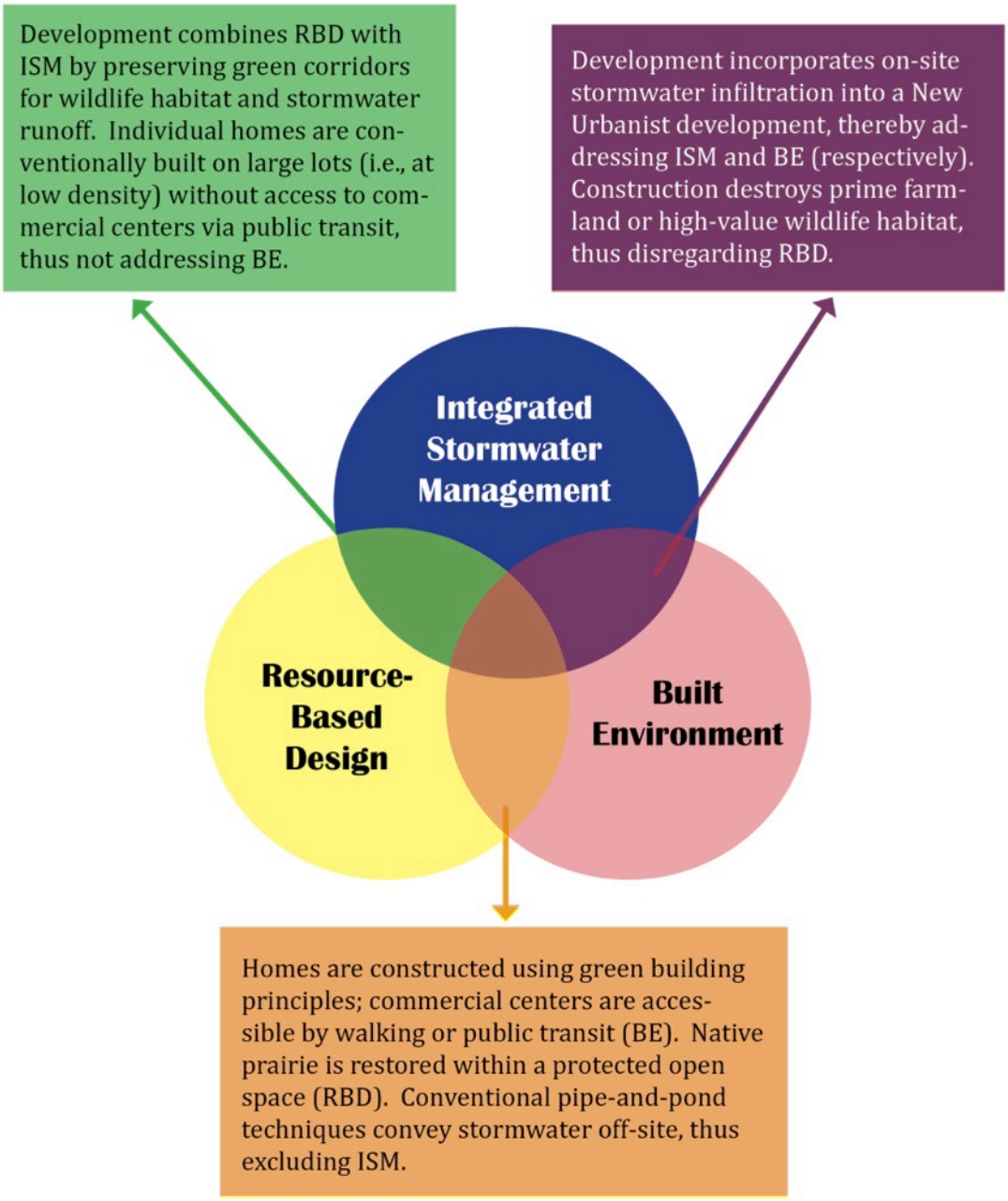
Figure 3. ***The Framework's Core Diagram: Three Sets of Strategies For Sustainable Land Development***



The overlapping circles emphasize that sets of strategies are not mutually exclusive. The goal of the holistic approach is to produce developments in which all three sets of strategies are used in site design (as represented by the star in Figure 3), though achieving two components is better than one. The hypothetical developments in Figure 4 combine two components. These examples describe the benefits of including two components and the drawbacks of excluding the third.

[9] We use the term Resource-Based Design instead of Conservation Design to provide a broader concept that includes the full spectrum of rural, suburban, and urban areas.

Figure 4. ***Hypothetical Developments That Address Two Components of the Framework***

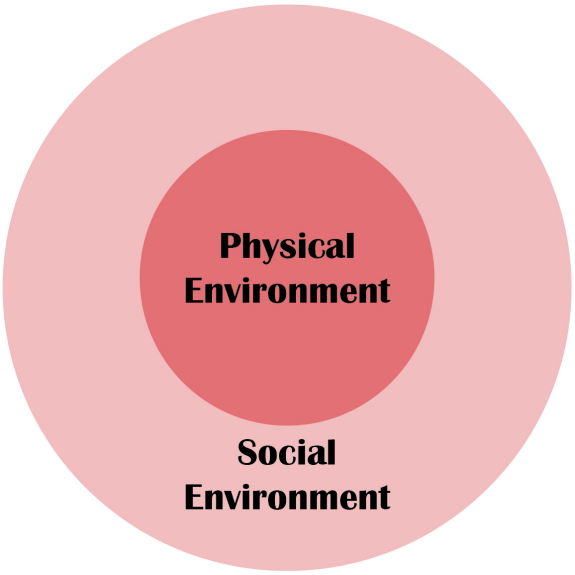


The following sections take a closer look at the strategies of the Built Environment, Integrated Stormwater Management, and Resource-Based Design. The next section describes an application of the Framework to a proposed development.

Built Environment

Built Environment strategies can be divided into two parts (Figure 5). The first, the *physical environment*, involves strategies that address green buildings and green infrastructure.[10] Green buildings typically entail higher water and energy efficiency, more sustainably sourced building materials, fewer impacts to natural resources, and improved indoor environmental quality compared to conventional buildings. Green buildings may also incorporate the on-site production and use of renewable energy. Generally, the process of green building also incorporates aspects of site selection and design, such as stormwater infrastructure (which overlaps with ISM) and landscaping[11] (which can overlap with RBD).

Figure 5. *Built Environment*



The physical environment, in turn, is embedded within the *social environment* (Figure 5). In other words, buildings and infrastructure exist within a broader context of different community types (neighborhoods, villages, towns, and cities) where people interact on many different levels. A sustainable social environment emphasizes communities that are *complete* (i.e., "mixed use," or a combination of commercial, residential, and other land uses), *compact* (i.e., medium- to high-density), and *connected* (in terms of transportation, greenways, and walkability). For example, Traditional Neighborhood Development (TND) principles promote healthy lifestyles, social interactions, and a sense of community identity by integrating residential, commercial, industrial, civic, and

[10] See also the Dovetail report *"Innovative Approaches to Municipal Stormwater Management,"* available at: http://www.dovetailinc.org/reportsview/2012/responsible-consumption/pmatt-frankp/innovative-approaches-stormwater-management.

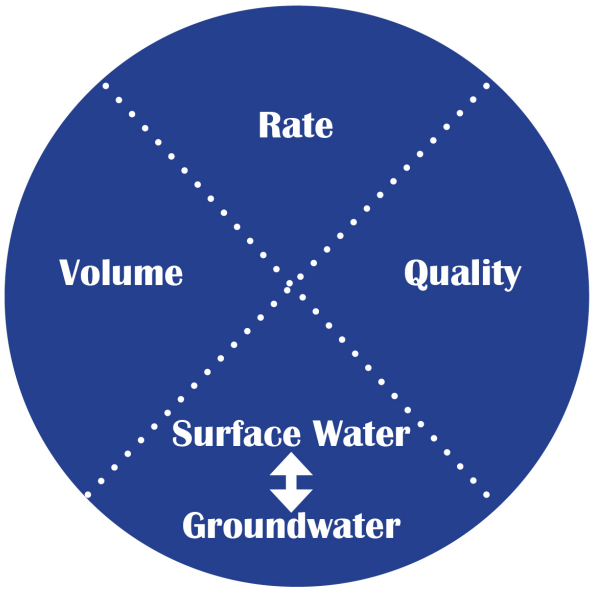
[11] See, for example, The Sustainable Sites Initiative™ (http://www.sustainablesites.org), an interdisciplinary effort by the American Society of Landscape Architects and other partners to create voluntary national guidelines and performance benchmarks for sustainable land design, construction, and maintenance practices.

educational land uses into a pedestrian-friendly community.[12] TND also reduces environmental impacts by decreasing the dependence on automobiles that results when different land uses are compartmentalized and spread out.

Integrated Stormwater Management

Integrated Stormwater Management considers all factors that affect runoff from rain and snow melt as it moves across land surfaces to wetlands, streams, rivers, lakes, and ultimately, to oceans.[13] This approach to stormwater management addresses four key elements: water *volume*, water *flow* (rate), water *quality*, and the *interaction* of surface water and groundwater (Figure 6).

Figure 6. *Integrated Stormwater Management*



Conventional stormwater management relies on curbs, gutters, and storm drains to convey runoff away from developed sites as quickly as possible. Runoff travels through storm sewers to stormwater ponds, where it is treated before discharging to surface waters. Although this approach can improve the quality of receiving waters compared to unmanaged stormwater runoff, it can create other problems such as flooding, thermal pollution, and groundwater depletion.

By contrast, ISM is based on the *Stormwater Treatment Train™* (Figure 7). In this approach, the reduction of runoff volume and pollution starts as soon as the rain falls or the snow melts. Some reduction occurs through on-site infiltration and filtration, and additional volume and pollutants are addressed through a series of best management practices before runoff is discharged to surface waters. This

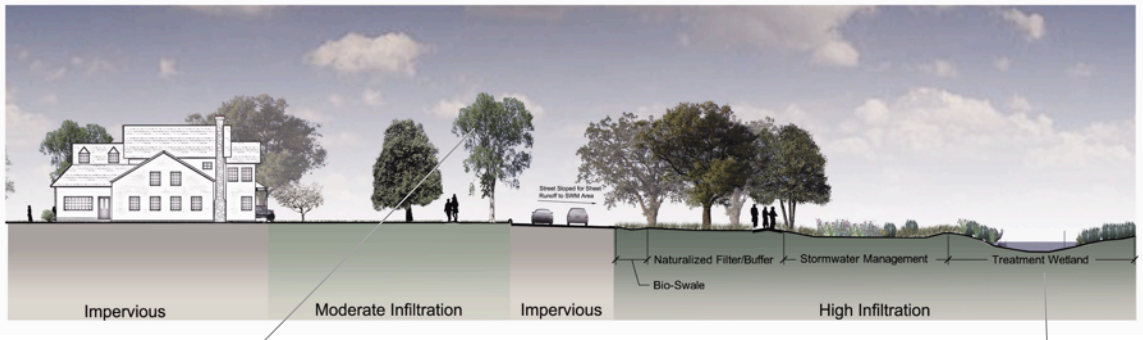
[12] TND principles originated in legal form in New Hampshire in the early 1990s upon recognition that zoning laws needed to be adapted to facilitate the integration of housing types, community usage, commercial needs, and transportation requirements. TND principles are increasingly incorporated into community planning processes nationally today. See also http://www.tndtownpaper.com/neighborhoods.htm for an extensive list of TND examples throughout the U.S. and internationally.

[13] Source: Minnesota Stormwater Manual contributors. 2013. Minnesota Stormwater Manual. Revised 6/18/13, accessed 6/20/13. Available at http://stormwater.pca.state.mn.us/index.php?title=Main_Page&oldid=7980.

approach reduces flooding and water pollution (including physical, chemical, and thermal pollution) while recharging groundwater.

Figure 7. ***Stormwater Treatment Train™***

(a) Runoff from impervious surfaces, such as roofs, driveways, sidewalks, and streets is allowed to infiltrate on-site instead of being piped away.



(b) A close-up of (a) shows that street runoff is directed to a naturalized buffer instead of a storm drain, then passes through a vegetated stormwater management zone before reaching a wetland.

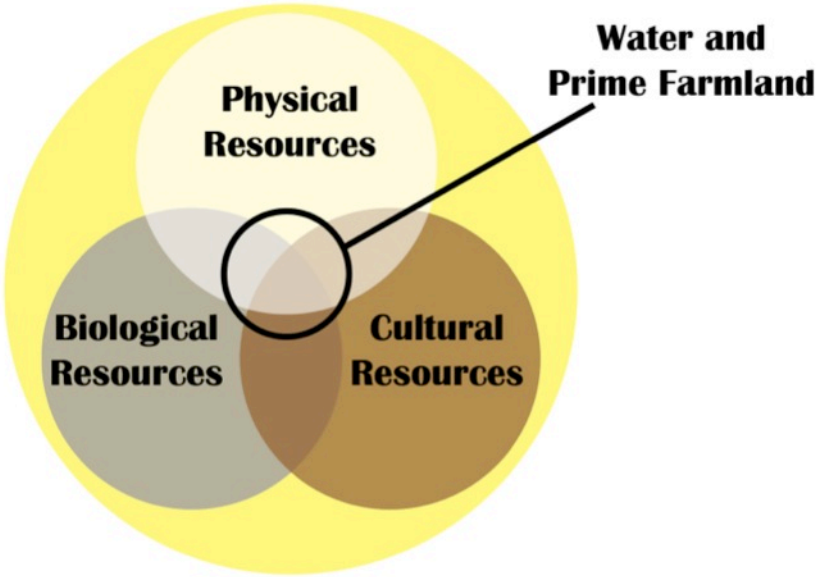
Resource-Based Design

Resource-Based Design (Figure 8) refers to site design that addresses three categories of resources: *physical* (air, soils, geology, and topographic features), *biological* (ecosystems, habitats, plants, animals, and other organisms), and *cultural* (history, architecture, and archaeology). Resource-Based Design also includes water and prime farmland, two resources that cut across all three categories.

First and foremost, RBD strategies focus on avoiding or minimizing impacts to physical, biological, and cultural resources from site development, construction, and land use. RBD, however, is not just about protecting and preserving existing resources (such as a wetland or native prairie) in rural areas *(with which Conservation Design is most often associated).* Nor is it just about setting resources

apart from human activity. RBD also includes opportunities to restore and improve natural resources in open space and in stormwater treatment trains, and to integrate those resources into greenfield as well as "urban infill"[14] developments. For example, some practitioners have restored streams that were routed through pipes or ditches back into meandering surface waters. Typically a permanent funding mechanism is established to carry out the ecological restoration and management program.

Figure 8. ***Resource-Based Design***



Application of the Framework

The proposed Oak Hills[15] development provides an illustration of how the sustainable land development planning framework can be applied. The Oak Hills planning team proposed to develop approximately 1,000 acres (405 ha) of previously undeveloped land in an expanding region of a metropolitan area in the Midwestern U.S. They proposed to build approximately 1,500 single-family homes and 750 multi-family homes and to combine residential land use with retail space, institutional space (e.g., churches, day cares), community gathering space, parks and

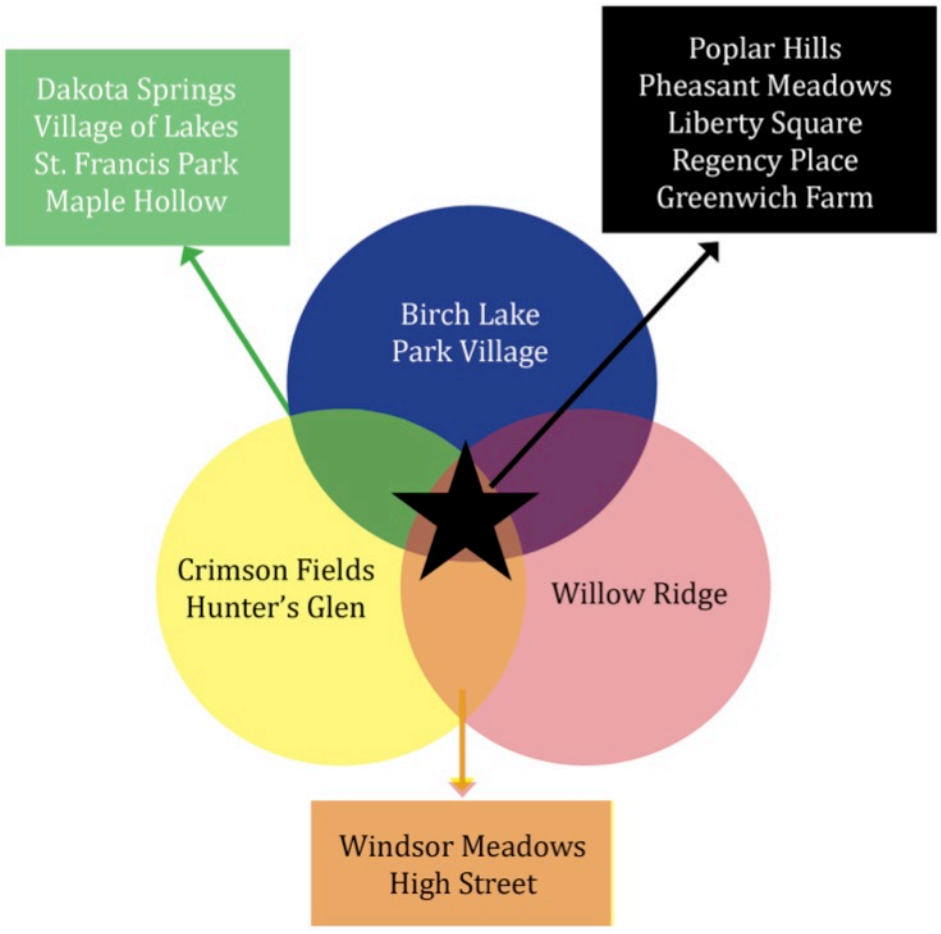
[14] The Sustainable Cities Institute defines *urban infill* as "new development that is sited on vacant or undeveloped land within an existing community and that is enclosed by other types of development. The term 'urban infill' itself implies that existing land is mostly built-out and what is being built is in effect 'filling in' the gaps." Source: http://www.sustainablecitiesinstitute.org/view/page.basic/class/feature.class/Lesson_Urban_Infill_Overview.

[15] All project names in this example, including "Oak Hills" and other developments named in Figure 9a, have been changed to protect project confidentiality. Any similarity to actual developments, existing or proposed, is purely coincidental.

trails, and undeveloped open space. The vision was to create a community that differed from the typical suburban tract by offering affordable living options; opportunities to shop, dine, exercise, and grow food within walking distance of home; connection to the metropolitan area through public transit; and integration with natural and cultural resources for a sense of place.

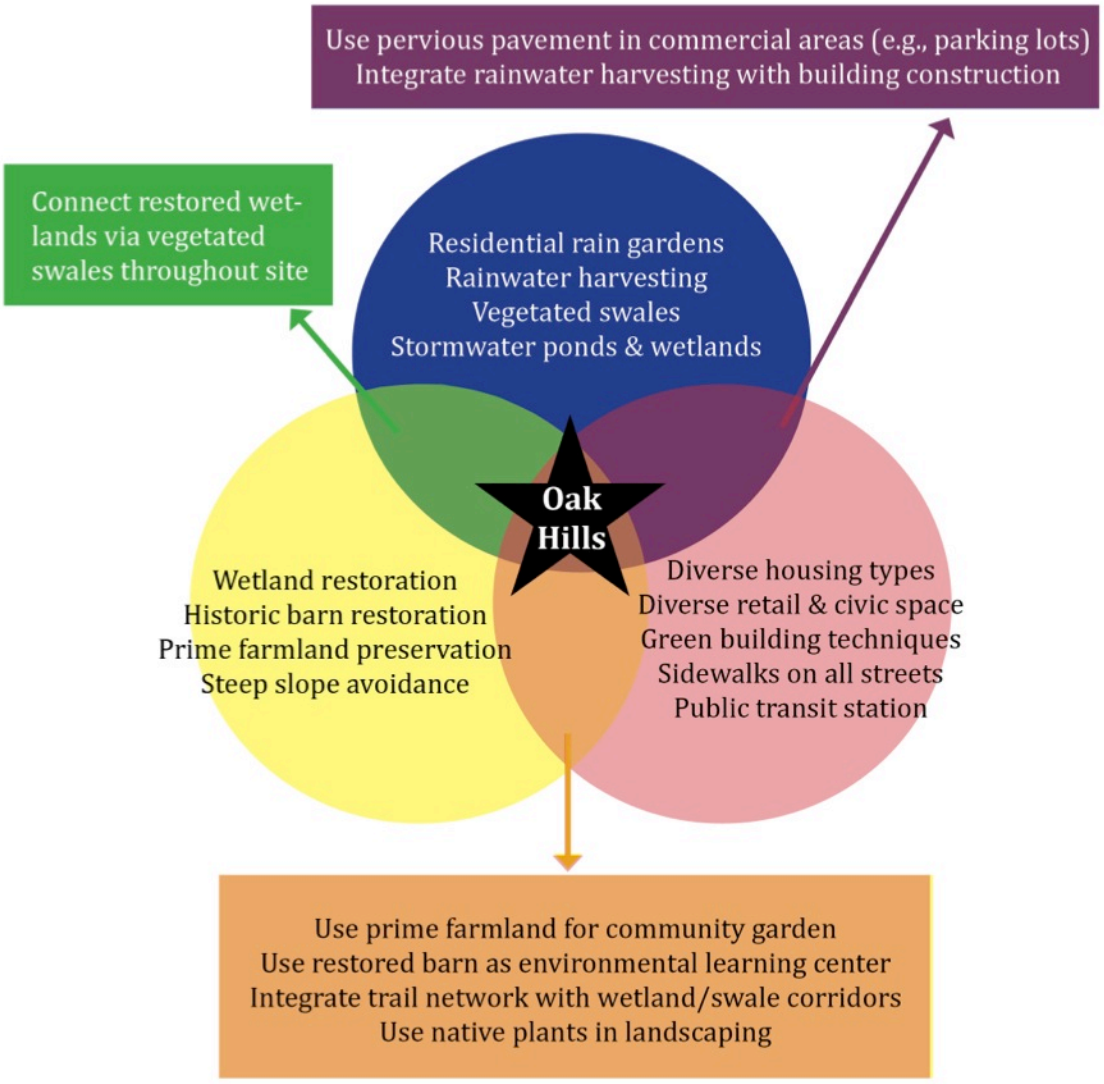
Having been introduced to the Framework during their planning process, the Oak Hills team decided to apply it to their project in two ways. First, they used the Framework to evaluate other projects in the metropolitan area. By categorizing existing projects and "mapping" them onto the core diagram based on their development strategies (Figure 9a), the team gained a better understanding of opportunities for differentiating their community and identifying marketing strategies. Specifically, the mapping showed that there were other projects in the region that incorporated one (e.g., Willow Ridge), two (e.g., Maple Hollow), or three (e.g., Poplar Hills) components of the Framework. Oak Hills, however, was unique in proposing to incorporate all three components at the scale of 1,000 acres (at least five times larger than the other five projects that integrated three components).

Figure 9a. ***Mapping Similar Developments Onto the Core Diagram (i.e., Figure 3)***



The Oak Hills team then used the Framework to identify project elements that could be solidified or fine-tuned in a way that would further differentiate the project (Figure 9b). The team concluded from this exercise that the sustainability of their project plans would be enhanced by maintaining their commitment to restoration of an ecologically sensitive area, strengthening their approach to integrated stormwater management, and articulating the role of educational programs in the completed development.

Figure 9b. ***The Framework as a Guidepost for Project Planning & Design***



EXAMPLES OF SUSTAINABLE LAND DEVELOPMENT

The next several pages provide examples of projects in the U.S. and Europe that incorporate *all three components* of the Framework. The projects demonstrate, in part, that development goals vary considerably from site to site and from region to region. The examples also illustrate that integrated approaches can work in a wide range of situations, and there is no one-size-fits-all approach.

Issaquah Highlands Development: Port Blakely, Washington

At Issaquah Highlands (Figure 10) in the Seattle area, an overriding goal was land use efficiency (i.e., emphasis on the Built Environment):

> *"In the early 1990's, the area we now know as Issaquah Highlands was envisioned to encompass five-acre lots—with one single-family home per lot—over its entire 2,200 acres. The city of Port Blakely chose instead to create a high-density urban village... When fully completed, Issaquah Highlands could include up to 4,540 residences and up to 3.035 million square feet of commercial/retail space."*[16]

Figure 10. ***Issaquah Highlands Hosts zHome***
The first zero-energy, carbon-neutral multi-family community in the U.S.

Photo: http://www.issaquahhighlands.com/zHome.php.

[16] The quote (*"In the early 1990s..."*) and all content in the table (unless otherwise noted) are from the Issaquah Highlands website, http://www.issaquahhighlands.com.

Color-coding in this column corresponds to the colors that represent the components of the Framework in the core diagram (i.e., Figure 3).	**Issaquah Highlands (Port Blakely, Washington)**[16] 
Built Environment	• Development is a high-density, walkable urban village integrating homes, a shopping and commercial district, public services, a Park & Ride, more than 10 miles (16 km) of hiking trails, and more than 100 acres (40 ha) for parks, recreation, and sports fields. • Urban expansion areas have been carefully planned and are clustered around the town center in order to focus on increased density and to foster walking, biking, and transit use. • Homeowners are encouraged to use Built Green 4-Star,[17] Energy Star,[18] or equivalent standards. • Development contains zHome, the first zero-energy, carbon-neutral, multi-family community in the U.S. (Figure 10). • Guiding principles address (among other things) human and structural diversity, community values, and a sense of place.
Integrated Stormwater Management[17]	• Development contains no more than 10% effective impervious surfaces. • Low Impact Development techniques mimic the site's predevelopment water flow. • Vegetated swales provide on-site stormwater runoff treatment. • Infiltration basins and detention ponds control water flow. • Parking areas and pathways utilize porous pavement to minimize stormwater runoff. • Development is landscaped with drought-tolerant and native species, which aid in stormwater infiltration.
Resource-Based Design	• Development is concentrated in 734 acres (297 ha) out of the total 2,200 acres (890 ha). • Over 1,400 acres (567 ha) are permanently dedicated to undeveloped open space.

[17] Built Green is a residential building program developed by partners in the state of Washington. Integrated stormwater management at Issaquah Highlands was described in a case study at the Built Green website, http://www.builtgreen.net.

[18] Energy Star is a voluntary energy efficiency program administered by the U.S. Environmental Protection Agency, http://www.energystar.gov.

Prairie Crossing Development: Grayslake, Illinois

In contrast to Issaquah Highlands, the Prairie Crossing development (Figure 11), near Chicago, prioritized the region's cultural and natural resources over land use efficiency:

> *"The land that is Prairie Crossing was purchased in 1987 by a group of neighbors who wanted to preserve open space and agricultural land. They formed a company with the goal of developing this beautiful 677 acres responsibly, with a total of only 359 single-family homes and 36 condominiums as opposed to 2,400 homes that were planned by another developer."*[19]

Figure 11. ***Prairie Crossing Charter School & Byron Colby Barn***
An elementary school that emphasizes environmental education and global citizenship, and a restored dairy barn from 1885 that now serves as a community center

Photo: http://www.prairiecrossing.com/pc/site/barn_gallery.php

[19] The quote (*"The land that is..."*) and all content in the table (unless otherwise noted) are from the Prairie Crossing website, http://www.prairiecrossing.com.

Color-coding in this column corresponds to the colors that represent the components of the Framework in the core diagram (i.e., Figure 3).	**Prairie Crossing (Grayslake, Illinois)**[19] 
Built Environment	• Development is a walkable community with access to rail transit. • On-site opportunities for recreation, health, and wellness include trails, a cooperatively managed stable, a beach, a certified organic farm, and individual garden plots. • Development includes energy-efficient homes, a wind turbine that provides energy to the farm, and a charter school (Figure 11) designed according to LEED standards.[20] • Guiding principles address (among other things) a sense of place, a sense of community, and economic and racial diversity.
Integrated Stormwater Management[21]	• Native plants are integrated into the community and serve to cleanse stormwater, protect water quality in Lake Leopold, minimize watering needs, prevent flooding, and lower maintenance costs. • Stormwater is managed through a system of open swales, upland prairie biofiltration, wetlands, and a human-made lake. • Lakeshore stabilization has resulted in exceptional lake water quality that allows for swimming, fishing, and habitat for threatened fish species and other wildlife.
Resource-Based Design[21]	• Sixty percent of the site's 677 acres (274 ha) is protected open space. • The development incorporates greenways and is part of a 5,000 acre (2,024 ha) reserve including natural habitats, farms, and trails. • Over 165 acres (67 ha) of prairie communities, 20 acres (8 ha) of wetlands, and 16 acres (6 ha) of historic hedgerows were restored. • There is a permanent easement on 150 acres (61 ha) of farmland.

Pringle Creek: Salem, Oregon

At 32 acres (13 ha), Pringle Creek is a much smaller development than Issaquah Highlands (2,200 acres [890 ha]) or Prairie Crossing (677 acres [274 ha]). Here, a top priority was the social environment: 16 of Pringle Creek's 35 Sustainable Goals related to planning for community.

[20] LEED (Leadership in Energy and Environmental Design) is a voluntary green building program administered by the U.S. Green Building Council, http://www.usgbc.org/leed.

[21] Source: "Prairie Crossing Conservation Development," project profile prepared by Applied Ecological Services, http://appliedeco.com/Projects/PrairieX.pdf.

Color-coding in this column corresponds to the colors that represent the components of the Framework in the core diagram (i.e., Figure 3).	**Pringle Creek (Salem, Oregon)**[22] 
Built Environment	• Development has walkable neighborhoods; all areas of community are connected by paths and streetscapes to encourage walking and biking, homes include front porches, and garages are accessed from rear or side alleys. • All housing is within a short distance of the transit center and the town center. • Development goals include LEED-certified buildings,[20] homes that exceed Earth Advantage[23] and Energy Star[18] standards, a neighborhood of carbon-neutral homes, and the use of FSC[24] lumber for all construction. • Guiding principles address (among other things) community gatherings, community gardens, local economic growth, and home-based businesses.
Integrated Stormwater Management	• "Green street" system allows 90% of rainwater to filtrate through soil and recharge the aquifer. • Porous asphalt lets water seep through, with excess water flowing onto strips of grass and other plants on either side. • Bioswales take up excess water at the corners of intersections. • "Zero-Impact" stormwater system uses street/path infiltration strips, rainwater gathering and storage, and improved flow to creek.
Resource-Based Design	• Development goals include restoration and protection of Pringle Creek, its riparian zone, and on-site wetlands. • Twelve of 32 acres (13 ha) are dedicated to community open space and natural green space. • Development plans conserve 80% of existing trees.

[22] All content in the table is from the Pringle Creek website, http://www.pringlecreek.com.
[23] The Earth Advantage Institute (http://www.earthadvantage.org) administers green building programs.
[24] The FSC (Forest Stewardship Council, http://www.fsc.org) promotes responsible forest management through certification of forests and forest products.

Eco-Viikki: Helsinki, Finland

Eco-Viikki is one of several developments in Europe that incorporates all three components of the Framework. Eco-Viikki is a development on the same scale as Issaquah Highlands, with a similar focus on high-density housing. A key directive in Eco-Viikki's planning process was the need for sustainable management of stormwater runoff.

Color-coding in this column corresponds to the colors that represent the components of the Framework in the core diagram (i.e., Figure 3).	**Eco-Viikki (Helsinki, Finland)**[25] 
Built Environment	• The development consists of apartment blocks and row houses for 2,000 residents, plus services (e.g., day care centers, health center, school, clubhouse, and commercial center). • The buildings are grouped in residential precincts (where pedestrians have the right of way), with "green fingers" of vegetation penetrating between the built areas. • Alternative energy and energy efficiency strategies include district heating, solar heating, extra insulation, heat recovery, and passive techniques such as large south-facing windows, natural ventilation, and "conservatories" (glazed balconies). • "Allotment gardens" for rent by residents include fruit trees and berry bushes, and some have traditional earth cellars.
Integrated Stormwater Management	• One of the city's main directives for the development was to reduce flow rates and to infiltrate stormwater runoff. • The site's clay soil prevents infiltration, but runoff is directed via gutters and depressions to the green fingers between residential blocks, which slows down runoff.

[25] Content in the table is from the following sources:

- Ademe (French Environment and Energy Management Agency). 2008. Guidebook of Sustainable Neighbourhoods in Europe. Produced in collaboration with Energie-Cités, Besançon, France.
- Butters, C. (ed.). Date unknown. Urban Ecology: Projects in Europe – Visions for Oslo? Prepared for the Oslo Port Authority by NABU, a project of the National Association of Norwegian Architects, Oslo, Norway.
- Hakaste, H., R. Jalkanen, A. Korpivaara, H. Rinne, and M. Siiskonen (eds.). 2005. Eco-Viikki: Aims, Implementation, and Results. Ministry of the Environment, City of Helsinki, Finland.
- Photo: City of Helsinki, http://en.uuttahelsinkia.fi/sections/5/environment/areas/156/viikki.

	• Runoff flows from the green fingers to the Viikonoja ditch (a restored stream), where riparian vegetation and structural features further slow runoff and improve water quality before discharging to an adjacent conservation area. • Rainwater wells with hand pumps irrigate allotment gardens.
Resource-Based Design	• The development is part of a newer suburb (Viikki) that covers 2,718 acres (1,100 ha), only 741 acres (300 ha) of which will be built. • Open space in Viikki includes a university bioscience campus, its associated farmlands and fields, and a conservation area for bird nesting and migration.

BARRIERS TO SUSTAINABLE LAND DEVELOPMENT

There are many potential barriers to sustainable land development. Design-phase barriers include increased up-front costs (known or perceived), potentially long payback periods for sustainable practices, a tendency to maintain the status quo, and limited experience by many professionals.[26] Data from research and monitoring of early sustainable design projects are helping to overcome cost objections,[27] and educational opportunities are continually increasing the knowledge and skill level of design and construction professionals. There are also barriers related to zoning, permitting, and building codes,[28] but these barriers, too, are gradually being overcome.

In the U.S., the mass suburbanization occurring after World War II (and joined by a pattern of exurbanization[29] starting in the 1970s) led to a cultural norm of single-family homes at relatively low density and reliance on automobiles. This trend, and others like it, can act as a social and/or cultural barrier to sustainable development. A widespread acceptance of high-density communities with shared amenities and public transit will take time.

[26] Source: Ahn, Y.H., A.R Pearce, Y. Wang, and G. Wang. 2013. Drivers and barriers of sustainable design and construction: The perception of green building experience. International Journal of Sustainable Building Technology and Urban Development 4(1):35-45.
[27] See, for example, Odefey, J., T. Poltrack, M. Buckley, and L. Harrison. 2012. Banking on Green: How Green Infrastructure Saves Municipalities Money and Provides Economic Benefits Community-wide. Published by American Rivers, the Water Environment Federation, the American Society of Landscape Architects, and ECONorthwest.
[28] See also the Dovetail report, *"Building Codes: Barriers to Green Innovation,"* available at: http://www.dovetailinc.org/reportsview/2011/responsible-consumption/pjennifer-garmanp/building-codes-barriers-green-innovation.
[29] Exurbanization is the term for process of moving from the city central to the suburbs. Source: Auch, R., J. Taylor, and W. Acevedo. 2004. Urban Growth in American Cities. Circular 1252, U.S. Geological Survey, Denver, CO.

BOTTOM LINE

Land is a non-renewable resource that needs to be utilized as efficiently as possible. This report presents a holistic framework for sustainable land development. The Framework consists of a core diagram showing that Integrated Stormwater Management, Resource-Based Design, and Built Environment strategies are meant to work together as an adaptable tool for sustainable land development. Each of the three key components can be broken down further and emphasized in project-specific ways. This Framework helps to make planning for sustainable land development accessible to all stakeholders and highlights the possibilities for integrated urban and suburban land use. The Framework and the case studies presented here suggest that there is reason for optimism about the sustainability of future land use.

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