Sustainable Design: A Balancing Act

Planning for rainwater neutrality can help ensure a development project's success

By Stephen M. Benz, P.E., LEED AP

Sustainable design is about establishing a series of balances within many aspects of building development. One such balance—the carbon balance—has received most of the attention with respect to its effect on global climate change.

Within the context of a building project, however, the carbon balance is very difficult to manage, as most of a building's energy systems rely heavily on the consumption of carbon-rich fossil fuels. The ability to significantly reduce or eliminate these fuel sources is not easily achieved as a matter of sustainable building design practice.

One development-related balance that is often overlooked is a project's rainwater balance. Sustainable site design techniques are evolving to acknowledge and minimize a project's impact within its hydrological setting. Designing a site toward rainwater neutrality will help to minimize ecological impact from development, allow for effective storm water management and optimize utilization of a project's water resources.

Carbon Neutrality

Carbon-neutral living means that a person, family or development project strives for a carbon-neutral footprint. Everyday use of fossil fuels for driving, heating homes and the like results in an increased carbon footprint by dumping tons of greenhouse gases such as carbon dioxide into the atmosphere.

Alternatively, renewable energy sources such as solar energy and wind power do not contribute to the addition of carbon in the environment. Because these energy sources are considered clean, using them instead of traditional fossil fuels will help avoid the generation of greenhouse gases and tip the balance in favor of carbon neutrality.

State-of-the-art sustainable carbon-neutral buildings and developments can be designed—but only at a great cost using renewable energy sources. Designing new facilities that strike a carbon-neutral balance can be difficult and prohibitively expensive.

Rainwater Neutrality

The carbon balance is an illustration of how sustainable design practice seeks to repair a cycle broken by development. Just as sustainable-building designs call for a carbon-neutral approach, so sustainable design should strive for rainwater neutrality.

In a natural landscape, rainwater falling on a site strikes a balance over time with the land itself. Rainwater becomes storm water runoff only after interfacing with a site's land cover

surfaces—grass, rooftops, parking lots, etc. Rainwater that cannot percolate into the ground becomes runoff.

Storm water runoff increases where development causes a decrease in pervious land cover. For example, paving a parking area prevents rainwater from leaching into the ground and increases the amount of runoff from the site, upsetting the balance. The entire rainwater balance scenario for a site establishes its rainwater footprint.

As in the carbon balance analogy, careless development can also throw the rainwater balance off center. Building rooftops and surface parking lots choke off natural soil recharge, thereby depleting aquifers, starving streams of their critical base flows, causing pollution and increasing erosion and flooding downstream. Holistic sustainable site design techniques can help restore the rainwater balance.

Development Design

Storm water runoff from a developed site is often considered an unavoidable and disposable byproduct of which, in turn, is managed by creating detention basins. These basins attempt to hold back detrimental storm water increases from causing downstream damage. By understanding that rainwater itself should be managed rather than storm water alone, site designers can work toward accomplishing true rainwater neutrality for their projects.

Accounting for all the rainwater in the cycle yields a new perspective on the challenge. Trees take up rainwater and return water vapor to the atmosphere through a process called evapotranspiration. Groundwater aquifers are recharged by infiltration of rainwater. Even slight imperfections in the ground surface that cause puddles are quite beneficial because they hold rainwater back from downstream waters and encourage infiltration.

Sustainable design techniques can improve a site's rainwater performance and help restore the rainwater balance. When applied to new, undeveloped greenfield sites, these techniques can help offset the disruption caused by development. In previously disturbed areas, new sustainable development techniques can actually repair rainwater balances disrupted by previous construction.

Low-impact design and working landscapes can help restore a site's water balance.

The following are effective design techniques to consider:

Build less. Called low-impact design, this approach creates less site disruption, meaning there will be less of a problem to fix.

Use permeable surfaces. Remove barriers to groundwater recharge. Even low-permeability soils can accept some

Spread out. Avoid concentrating point sources of runoff. Instead, distribute rainwater around the site in rain gardens and grading pockets. This practice maximizes the potential for infiltration and minimizes the possibility of erosion and flooding by not concentrating large flows in any one area.

Think small. In many climates, designing systems that can manage up to 1 in. of rainfall will account for up to 90 percent of the annual rainfall volume. Efficient rainwater management systems are realistic, efficient and affordable at this scale.

Disconnect impervious surfaces. Avoid connecting roof drains and parking areas directly to drains. Rather, allow rainwater to flow in shallow pathways across the ground before it enters drain inlets. This tactic will allow pollutants to filter out along the way, and it will promote infiltration.

Build green—literally. Plants can remove up to 65 percent of the rainwater they receive and return it directly to the atmosphere by means of evapotranspiration. Ultimately, more plants and trees mean less runoff.

Use rain gardens and landscape filters. These are not complicated or costly systems but are simply planted landscape areas that are graded to receive rainwater and filter it to the ground. Areas of this sort also contribute to a project's biodiversity.

Recharge groundwater. Depending on a site's soils and climate, most of the annual rainwater falling upon it can be easily returned to the ground, where it can recharge depleted aquifers and restore stream base flows. Consider infiltration systems such as recharge chambers and galleys.

Capture and reuse rainwater. Water is a resource. Every gallon of captured rainwater used for toilet flushing, mechanical systems' makeup or irrigation means less treated municipal water has to be purchased and consumed.

Rhythms and Restoration

Rainwater neutrality is a fundamental concept for a well-designed sustainable site development project. Storm water management is one component of the equation, and sustainable site designers now understand that the bigger picture involves looking far past the traditional aspects and into the entire rainwater management realm.

Understanding how natural site rhythms such as the rainwater balance are impacted by development is key to a project's success. Sustainable site design practices that take into consideration and respect these rhythms will serve to restore these balances. Rainwater neutrality—like carbon neutrality—should be a goal of every sustainable design project. SWS

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