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Low impact development: Non-linear solutions applied in a non-linear world

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These days, more often than not, the predominant task for a civil engineer involved in land development is addressing the delicate relationship between land use and natural resource protection. In this role, the civil engineer's effort often focuses on stormwater management. This presents a challenge in that historically, storm water management design has essentially consisted of applying engineering controls designed by constructing linear mathematical models of the natural and built world.

However, we live in a world of non-linear, complex systems. The weather is a non-linear, complex system. Traffic flow is a non-linear, complex system. A child is a non-linear, complex system.

The environment is also a non-linear, complex system. Addressing complex environmental and natural resources issues with linear solutions often creates problems unimagined by the designer. The list of environmental problems created by development is long: the drying up of inland wetlands and associated habitat loss caused by capturing runoff and discharging directly to rivers; the inundation of wetland systems caused by capturing runoff and discharging directly to wetlands; and damaged streams and lakes caused by polluted runoff from point-source storm water discharges.

Enter Low Impact Development, or LID.

What is LID? In essence, LID is a development strategy based on the concept that stormwater management and other engineering measures should be modeled after nature. LID techniques are designed to imitate a site's predevelopment hydrology by using design methods that infiltrate, filter, store, evaporate, and detain runoff close to its source. The most effective way to do this is by copying nature.

LID attempts to create a developed condition that mimics the undeveloped condition, to the extent possible. And it is proving to be extremely effective at just that. LID incorporates design techniques such as porous pavements and vegetated (a.k.a."green") roofs, and replaces typical stormwater detention and conveyance structures with grass swales, and bioretention basins.

The University of Connecticut in Storrs has recently taken a large step in the LID direction and provided a great local example of its implementation at heavily used facilities. Two on-campus parking lots were reconstructed last summer, using innovative, porous pavement surfaces. Designed to recharge stormwater directly through the pavement section, filtering through a crushed stone reservoir and into the underlying soil, these unique parking surfaces are a sight to see, especially during a downpour.

If you happen to visit the UConn Storrs Campus during a rainfall event, take a drive behind the Towers Residence Halls. The first thing you'll notice upon approaching the porous asphalt parking area is the lack of light reflection off of puddled water or sheet-flow runoff typically seen in a parking lot. The flat-black pervious asphalt surface persists through the steady rain. Every drop of rain

appears to be grabbed by the pavement's aggregate and pulled into the pavement structure. (It can be likened to pouring water onto a Rice Krispy Treat.) Bituminous curbs are not required and there is no resulting gutter flow typically associated with the use of curbs. Landscaping is kept off the pavement through the use of rounded riverstone aprons, hiding infiltration trenches designed to handle the larger storms not regularly experienced. But in a storm of up to one inch of rain, which represents on average 90% of all storms annually, there is no need for such a trench. The pervious pavement section handles it all.

What does this mean to the surrounding environment? The recharge of stormwater back into the ground supports the underlying aquifer and provides steady continuous flow to local streams and rivers. Runoff from this lot is no longer eroding the adjacent fill slope and carrying silt into the stream below, as there is no longer any runoff from this lot. Any oils or other contaminants that occasionally may be found dripping from parked cars are filtered by the pavement section, where they experience biodegradation in-place. Pollutants never have a chance to reach receiving waters.

According to Business and Legal Reports, Inc., "EPA has concluded that, in general, LID measures are more cost-effective and require lower maintenance than conventional, structural storm water controls. And aesthetically, LID practices are more pleasing because of their integration into the landscape." These types of blanket statements are hard to make without qualification, as every situation is different and needs to be treated as such.

Nonetheless, LID as a design philosophy is a big step in the right direction. LID does require engineers to think more creatively. It demands integrated design with architects and landscape architects. It requires engineers to evaluate and work with innovative materials and technology and to recognize the non-linear, complex world in which we exist.

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