# Low Impact Development: Changing the Paradigm

**BY STEVEN TRINKAUS, P.E.**

Over the past 10 years or so, it has become widely apparent that our aquatic and natural environments have been adversely impacted by many of our current development practices. These impacts include increased rates of runoff, increased runoff volumes, erosion of our stream channels, the resultant deposition of sediment in streams, and water quality impairments due to pollutant loads in stormwater. These impacts are not due to a single cause, but more of a combination of many different practices, such as inflexible land use regulations, no protection of environmentally sensitive areas, excessive impervious areas, stormwater regulations that focus on peak rate control for large storm events only, and no consideration of the impacts of pollutant loads found in nonpoint source runoff. Let's take a look at each of these practices in more detail.

## Inflexible Land Use Regulations

Throughout many parts of the U.S., any type of development is regulated by municipal zoning rules. These regulations are generally very prescriptive, specifying required parameters for residential lots, number of parking spaces for commercial uses, and percentages of building and impervious coverage for commercial and industrial projects. What is routinely missing from these regulations are limits on the extent of impervious cover permitted on residential lots as well as consideration of the natural resources on a site prior to preparing a development plan.

Many zoning regulations indirectly lead owners to maximize the usage of the property with little or no concern for the environmental consequences. Parking requirements for commercial retail are very conservative and result in many parking spaces that are only used for one or two months a year.

While the identification of environmentally sensitive areas, such as wetlands/watercourses, steep slopes, and unique vegetative communities are often required by land use regulations, rarely are these areas protected from development.

Additionally, road standards often require wider pavement widths than are necessary for the safe movement of vehicles and pedestrians. Requirements for horizontal and vertical geometry lead to excessive grading to accommodate these geometric requirements. The road standards also require curb, gutter, and structural stormwater conveyance systems, which are responsible for the "end of pipe" stormwater approach of today.

In the late 1970s and early 1980s, the focus of stormwater management was on reducing the peak rate of runoff for postdevelopment to the peak rate of the predevelopment conditions. While this concept seemed reasonable at the time, the law of unintended consequences soon became very apparent. The excess volumes discharged at restricted flow rates for long periods caused serious erosion issues in native stream systems, contributing to loss of habitat. The eroded material also caused sedimentation issues in wetlands and open water bodies.

Besides not addressing runoff volume, the current approach to stormwater management does not address water quality in stormwater runoff. Stormwater from our developed areas, commonly referred to as nonpoint source runoff, is the single largest cause of water degradation in our streams and lakes. The pollutant loads from nonpoint source runoff are responsible for water quality impairments such as beach closures and excessive aquatic plant growth as well as losses of biological habitat and aquatic species.

## Creating Sustainable Developments:

To address these many adverse impacts associated with our current development approach and create sustainable developments, we must look to low impact development. The concept of LID was pioneered in the 1990s by Larry Coffman of the Department of Environmental Resources in Prince George's County, Maryland. The primary focus was on bioretention systems (vegetated infiltration systems) to lessen the adverse impacts of nonpoint source runoff on the Chesapeake Bay. This initial work by Coffman and his technical staff led to the development of LID and its use in many parts of this country.

The focus of LID is to mimic the natural hydrologic conditions of land in undeveloped conditions. The LID approach is different from our current approach to development and results in projects that are in harmony with the natural environment. A key concept of LID is its approach to rainfall and runoff. Currently, we treat rainfall as something to be gotten rid of, whereas LID embraces rainfall as a resource to be recycled and reused. This approach is achieved by using many LID strategies. These strategies include environmental site design, reduction of the extent and connectiveness of impervious areas, maintaining predevelopment infiltration rates and recharge to streams and wetlands, reduction of pollutant

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loads in runoff, and the application of "source controls" versus "end of the pipe" solutions.

The foremost strategy is the application of ESD concepts to all development plans, particularly residential projects. ESD is an approach to development under which the natural resources on a site, which include aquatic resources, steep slopes, soils with moderate to high infiltration capacities, and unusual vegetated systems, are not only identified, but preserved to the maximum extent practical. In the ESD approach, these resources are identified on the site and initially removed from development consideration, thus placing the development on the land that is most suitable for development. This approach also has the added benefit of preserving soils that are very suitable for the infiltration of runoff. When coupled with open space or cluster development concepts, large portions of the site can be protected from development, which helps match predevelopment hydrologic conditions as well as provide a resource for the sequestering of carbon in woodland plants and soils.

Reducing the extent of impervious areas corresponds to a reduction in the amount of runoff volume as well as a reduction in the pollutant load associated with runoff. Impervious area disconnection is an LID strategy that encourages runoff from impervious areas to be directed as overland flow across vegetated areas to encourage infiltration of runoff.

By minimizing the development on soils with good infiltration rates, an opportunity is created to infiltrate runoff into these soils, thus matching predevelopment infiltration rates. Infiltration of runoff also ensures the groundwater flows to wetlands and streams will not be reduced as a result of development. By the infiltration of runoff, surface runoff is reduced, which can also reduce the potential of flooding.

One of the largest differences between our current stormwater management process and LID is the use of "source control" versus "end of pipe" methodologies for the conveyance and treatment of runoff. Instead of conveying runoff in a structural drainage system to the bottom of the hill, LID addresses runoff at the point at which it is created. An example of this approach is the use of small bioretention systems, also known as rain gardens, for the roof drains from residential and small commercial buildings.

By using vegetation and soils on a site, pollutant loads are reduced, thus significantly improving the quality of the runoff that reaches our aquatic systems. In addition, the infiltration of runoff allows natural processes to reduce pollutant loads in the runoff.

The application of LID strategies on a widespread basis will reduce surface runoff rates, volumes, and pollutant loads that result from development. These strategies will also lead to developments that are environmentally sensitive and embrace water as resource to incorporate as a feature within development projects.

*NSPE member Steven Trinkaus, P.E., is an internationally recognized expert in the field of low impact development. He has made many conference presentations on LID, and he has written LID design manuals for four towns in Connecticut.*