New ways to better manage urban stormwater runoff

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As meteorologists monitor the El Nino condition currently gaining strength in the Pacific Ocean, Californians look with hope to the much-needed rain and snow it could yield. But if we're going to make the most of the precipitation, we need to put a LID on it.

LIDs, or low-impact development technologies, mimic pre-urban stream functions. Examples are green roofs that absorb and evapotranspire rainfall; rainwater tanks attached to homes and other buildings; and permeable pavement for roads, driveways and parking lots. Rainwater could even be used in the home for toilet flushing and laundry.

These are just some of the strategies suggested by an international group of experts who recently collaborated on a review article in the American Chemical Society journal *Environmental Science & Technology*.

Stanley Grant, senior author of the paper and professor of civil & environmental engineering at the University of California, Irvine, brought together academics from three UC campuses (UCI, UCLA and UC San Diego) and Australia's University of Melbourne; water managers from Orange County Public Works; and engineers from consulting firm Michael Baker International to examine how urban population centers could better meet water supply needs while protecting natural stream ecosystems.

"This team offers a key example of the significant role that University of California scientists can play in finding innovative solutions for major state problems," said co-author Lisa Levin, a Distinguished Professor at Scripps Institution of Oceanography. "With drought so pervasive, California cannot afford to waste its precious stormwater; nor can it afford to send contaminants into the ocean. The options addressed in this article tackle both of these issues."

Managing stormwater runoff in urban environments is a challenge for engineers and water officials. During pre-industrial times, rainwater gradually seeped into the ground and, from there, into rivers, lakes and oceans. Humans, however, have replaced forests and grasslands with a lot of impermeable surfaces that send runoff in a torrent directly to the closest waterways. "The massive volumes and pollutants associated with stormwater runoff are a deadly one-two punch for streams and lead to a condition known as 'urban stream syndrome,'" said Asal Askarizadeh, lead author and UCI graduate student in civil & environmental engineering.

Symptoms include erosion, flooding and rising stream temperatures; an imbalance in nutrients, carbon and oxygen in the water; and an increase in unwanted sediments, chemical pollutants and human pathogens.

The antidote, Askarizadeh said, is to harvest and reuse as much of the stormwater runoff as possible and allow a portion to infiltrate into the ground to support streams and groundwater.

"Using LIDs to create this kind of localized, widely distributed approach to stormwater management will require individuals and public agencies to be open to significant change," said co-author David Feldman, professor and chair of UCI's Department of Planning, Policy & Design. "We expect the government to manage our water supply completely, and in some places, it's even illegal to harvest rainwater locally. Laws and habits are going to have to change if we are to adapt to new climate and urban realities."

One of the significant changes the authors argue for is a movement toward distributed infrastructure (rainwater tanks and green roofs) as a complement to the centralized infrastructure (aqueducts, water treatment plants and, more recently, desalination plants) cities have long relied on. "The reason is that in order to protect receiving waters and streams, we need to capture the runoff as close to where it's generated - for example, your home - as possible," said co-author Brett Sanders, professor and chair of the Department of Civil & Environmental Engineering at UCI.

"The question then becomes: What do you do with the stormwater once you've captured it?" said co-author Megan Rippy, a UCI postdoctoral researcher in civil & environmental engineering. "Our work provides a blueprint for estimating how much of the captured water should be infiltrated into the ground and how much should be harvested for any purpose that keeps it out of the stream, such as for nonpotable purposes in the home. The ratio of those two volumes depends on local climate and what the landscape looked like in pre-industrial times."

"The bottom line is that these solutions are good for the environment and good for people too; they just require changing habits," Grant said. "For example, over 2 million people in Australia use rainwater from their roofs to flush toilets - and that makes good sense. Using drinking water to flush toilets is literally washing our future down the drain."

With funding from a National Science Foundation PIRE grant, he and his colleagues were able to spend time in southeastern Australia studying how people there have dealt with their historic drought. "They have had a positive experience implementing LID technologies to manage scarce water resources, and in doing so, they've provided a good example of how universities can work with governments and private-sector entities to come up with solutions to water challenges," Grant said. "And the best part is that after emerging from one of the longest droughts in Australia's history, Melbourne has been voted year after year as the most livable city in the world. We could definitely use some of their magic."

Provided by University of California, Irvine