Stormwater Quantity: Effects of Urbanization on Hydrology

Land development impacts natural systems in many ways. One of the most dramatic of these is its effect on hydrology. Natural land cover generally acts as a sponge, with well-vegetated soils and wetlands absorbing the majority of rainfall and snowmelt that falls on them and slowly releasing the small amount of water that is not absorbed. As that natural land cover is paved over with impermeable surfaces, rain and snow can no longer soak into the ground and instead accumulates as runoff. This urban runoff flows in much higher volumes and with greater velocity than it had pre-development. To mitigate flooding within urban areas, cities direct this runoff to a storm sewer system or along city streets, where the runoff gathers volume and speed. When the runoff reaches the receiving water body, it can cause extensive damage such as bankside erosion, channel scour and widening, and vegetation damage or removal. In addition to dangerous speeds, urban runoff tends to be warmer, upsetting habitat needs and the ecological balance within streams. Urbanization also severely impacts runoff quality, as the water picks up pollutants as it flows across the urban environment. Further, because streams in urban areas no longer benefit from infiltration of rainwater and snowmelt, they tend to be drier during non-storm periods. This is in contrast to storm periods, when they have a much higher volume than they naturally would.

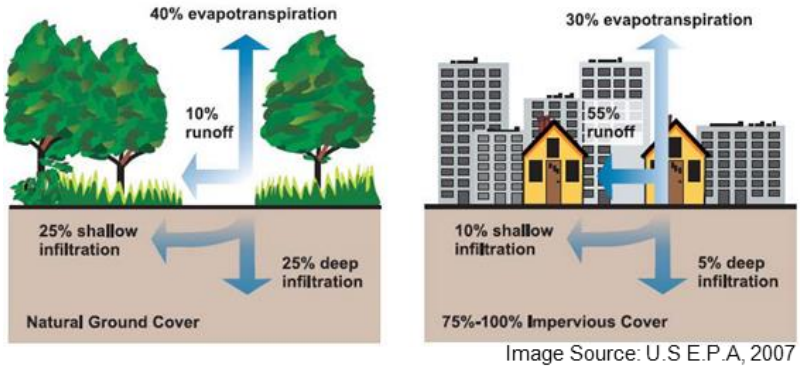

Figure 1: Comparison of runoff rates in natural vs. urban areas

Rainwater harvesting can help ameliorate the effects of development on natural hydrology. In fact, a major goal of low impact development (LID) is to mimic a site's natural hydrology as much as possible. LID practices can even restore a watershed's hydrological functions. Water harvesting, LID, and green infrastructure (GI) emphasize the importance of keeping rainwater and snowmelt as close to the source as possible. This means infiltrating as much of that runoff as possible into the ground by slowing it down and spreading it out. By pairing water harvesting with vegetation, practitioners can keep large amounts of stormwater from the sewer or other conveyance system. Vegetation sends out roots into the soil, helping to transform compacted urban soils into effective stormwater sponges. Sinking water back into the soil can also help rainwater reconnect with creeks, streams, and other receiving water bodies.

Further reading and resources:

- http://water.epa.gov/polwaste/nps/outreach/point7.cfm
- http://water.epa.gov/polwaste/green/index.cfm
- http://water.epa.gov/polwaste/nps/urban/report.cfm
- http://www.cabnr.unr.edu/saito/Classes/nres482/readings/hood07.pdf
- https://engineering.purdue.edu/ecohydrology/Pubs/2012%20WASP%20Ahiablame%20et%20al.pdf