OREGON LAND

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Letter from Los Angeles

raindrops keep falling

And Our Urban Rivers Are Overworked

By Wayne Stewart

On a rainy day in the Willamette Valley, when even Oregonians are carrying umbrellas, millions of gallons of rainfall runoff pour into the Willamette River. The runoff comes from residential rooftops, commercial parking lots, and city streets–all those places that don't have a practical plan for storm water management, allowing petroleum products, heavy metals, and other harmful contaminants to dump directly into the river.

Rain in Oregon is nothing new. The land is quite familiar with the sky falling; after all it's been raining in the Valley for thousands of years. What the land isn't so familiar with is impervious surfaces around city centers, where up to 95% of the total rainfall is captured and turned into runoff.

Looking back, this is a large difference, considering that over a century ago, as little as 5-10% of total rainfall left a forested site as overland flow (runoff). Up to 95% of the rainfall was intercepted by vegetation, evaporated, infiltrated into the ground, or temporarily stored in rivers, lakes, wetlands, and natural depressions.

What does this all mean?

It means that our natural systems and stream processes are taking a beating. This dramatic change in runoff has historically been accommodated by collecting the runoff in pipes and transporting the water to a discharge point–generally a river or stream. While this approach moves the problem from its point of origin, it raises havoc with natural stream processes. The greatly increased volumes and flashiness (where runoff reaches the stream faster causing flash flooding) has lead to stream erosion, channel downcutting, and streambed widening. At the same time, pollutants washed from hard surfaces flow through collection pipes and are discharged into receiving streams.

During the past three decades, efforts have been made by some jurisdiction to reduce flashiness by requiring detention and metering runoff. Sometimes this works, and sometimes it merely shifts the problem to a slightly later time period.

More recently, steps have been taken to enhance water quality—generally by the use of biological processes. Features such as bioswales, filter strips, treatment wetlands, eco-roofs, and settling basins have been used which provide various levels of water quality enhancement.

An Integrated Approach

Because of the Willamette Valley's typical low intensity rainfall, there is potential to develop a rainfall management approach that maximizes the use of interception, evaporation, infiltration, and biologically based water quality enhancement. Some advancements have already been made. The Willamette Valley is generally considered to have a "rainy climate." However, rainfall totals are approximately 40 inches a year, about the same as Chicago, and about one-half the rainfall experienced along the Oregon coast. What we do have is low-intensity drizzle over long periods of time. Rarely is rainfall very intense, such as is often experienced in the Midwest and the South. A typically wet and drizzly day often results in 0.25 to 0.5 inches of precipitation over a 24-hour period. The daily rainfall records at Portland International Airport (U.S. Weather Bureau/NOAA) for the period 1961 through 1996 were reviewed for patterns. This analysis of 35 years of record disclosed the following:

- Days with rainfall greater than 0.5 inches/day: 20.1 days/year (average)
- Days with rainfall greater than 0.75 inches/day: 9.8 days/year (average)
- Days with rainfall greater than 1.00 inches/day: 4.5 days/year (average)
- Days with rainfall greater than 2.00 inches/day: 0.25 days/year (average)
- Maximum daily rainfall (3 occurrences in 35 years): 2.44 inches

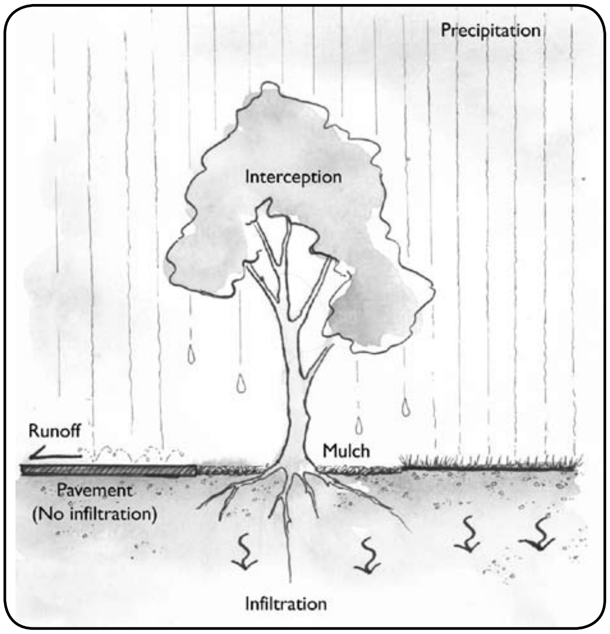
Rainfall greater than 1.00 inch in 24 hours only occurs approximately 4.5 times per year, or about once a month during the winter months (November to March).

If private property owners and public right-of-way managers are encouraged (or required) to accommodate, on site, 1.0

Residential Green Street • Photo by Ben Johnson inches of precipitation in 24 hours, significant storm runoff can be reduced to four to five times per year.

You may ask–how can this be accomplished, and what does this have to do with landscape architects? It can be accomplished through a number of simple undertakings, many of which can and should involve landscape architectural skills.

The key is to mimic natural processes–such as interception, infiltration, evaporation, dispersal, and detention–when developing site plans. In addition, whenever practical, runoff water should be captured and stored for reuse, and biofiltration should be included in rainfall management techniques.



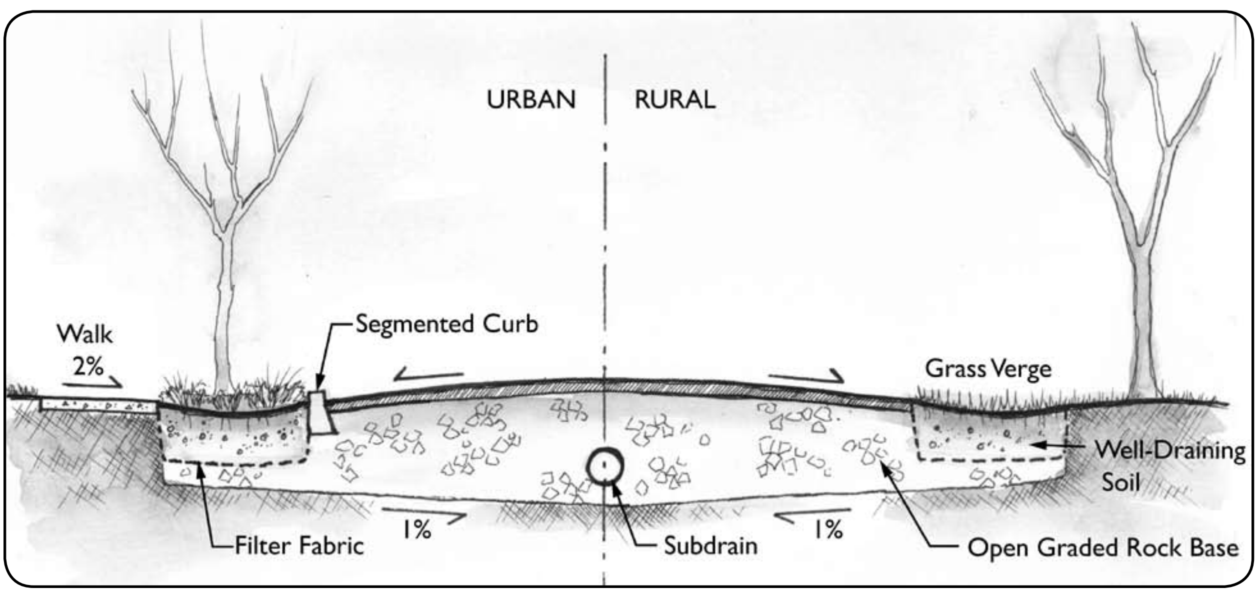
Deciduous trees intercept 15-25% of rainfall. Some evaporates into the air, and some drips through, after being detained for a period of time. Mulch holds precipitation until it can be infiltrated. • Diagram by Caitilin Pope-Daum

Interception. Studies have shown that deciduous trees intercept from 10-15% of precipitation in the winter, and up to 30% of precipitation when in leaf. Conifer trees are estimated to capture 25-35% of precipitation. In fact, any dense vegetation (trees, shrubs, grasses, eco-roofs) will intercept precipitation.

Evaporation. Evaporation occurs whenever the air has available moisture-holding capacity. Of course, most evaporation occurs during the hot summer months, when the humidity hovers around 20-30%. During July, approximately six inches of water will evaporate from water surfaces. However, even in the winter, some evaporation occurs.

Infiltration. A substantial portion of low intensity rainfall can be infiltrated into most soil types (except heavy clays); however, careful grading and soil preparation are essential to ensure that compacted soils are loosened and that sheet flow is encouraged. A thick mat of mulch or forest duff provides a "sponge" to temporarily store water until gravity and the proclivity of soil take moisture downward.

Dispersal. When water is dispersed evenly across a site, it moves slowly and is more likely to be infiltrated into the soil. Rural roads with grass-covered verges and no ditches provide good examples of the use of dispersal and vegetated filter strips. Unfortunately, many engineers continue the practice of collecting water through the use of roadside ditches, curbs and inlets. Once concentrated, moving water has great erosive potential and much effort goes into protecting ditches from erosion and installing storm drains to route water to a water course for disposal.



Infiltrating Road Section • Diagram by Caitilin Pope-Daum

Bioswale at Pennoyer Street, South Waterfront District • Photos by Tara Byler

Detention. There are many ways to temporarily detain water on site including dry and wet ponds, storm water planters and roof ponding. Detained water is held for a short period of time and then released at a slow rate. Generally, detention features are designed to empty within 24-72 hours after a rainfall event. If the detained water is slowly released to a dispersal area (rather than to a storm drain) most of the water can be infiltrated.

Reuse. Water can be captured in a cistern and used for toilet flushing, irrigation, and other non-potable purposes. Because irrigation water is needed in the dry summer months when precipitation is light, ponds are sometimes a cost effective way to store spring runoff for irrigation reuse in the summer months.

Biofiltration. Water quality in receiving streams can be enhanced if runoff from developed areas is pre-treated on site prior to release. When a thin layer of runoff water moves slowly through dense vegetation good things happen. Suspended solids drop out of the water column or adhere to vegetation, petroleum products adhere to vegetation where they can be broken down by sunlight and bacteria, and heavy metals adhere to the soil. Typical biofiltration elements include bioswales, filter strips, storm water planters, and treatment wetlands.

Runoff Management in Street Rights-of-way

A particularly vexing problem is what to do with rainwater runoff from streets and highways. Statistics from Portland's Bureau of Environmental Services suggests the magnitude of the problem:

- Streets as a percentage of total land area: 18-20%
- Street paving, as a percentage of total city impervious area: 50%
- Runoff from streets, as a percentage of total city runoff: 50%
- Pollutants from streets, as a percentage of total city pollutants: 65%

Until we learn how to effectively deal with runoff and pollutants associated with our public transportation system we will not be able to significantly enhance the water quality of our streams and rivers.

The crux of the problem is that transportation corridors are long, narrow strips of land with a mostly impervious surface. These narrow rights-of-way limit options for enhancing water quality and reducing runoff. Transportation departments are experimenting with roadside bioswales on soils with reasonable infiltration rates, as well as segmented curbs (to avoid concentrating water flows), and ditchless road sections with grass-covered verges. It is in the areas of finished grading, soil properties, and the use of plant materials that landscape architects can play a major role in solving rainwater management issues within transportation corridors.

Pervious pavement is another option being evaluated in a number of jurisdictions. The surfacing material (typically concrete or asphalt) contains many small drainage openings that allow water to pass through the pavement into the underlying base section, and then into the subgrade. Pervious pavement isn't without problems. Potential concerns include the longevity of the surface pavement, plugging and maintenance of openings, and future repair/overlay/replacement options. Porous pavement sends rainfall into an open-graded base rock section where water is temporarily stored in the void spaces. From here, the water is slowly infiltrated into the subgrade. Suspended

Urban Green Street •
Photos by Ben Johnson

solids and hydrocarbons are trapped within the pavement drainage openings, within the base rock, and on the surface of the subgrade. Heavy metals are generally trapped on the surface of the subgrade.

Another approach, which is essentially untried but is worthy of additional experimentation, is to use the entire right-of-way to infiltrate precipitation. This approach accepts the use of traditional impervious pavement (concrete, asphalt, unit pavers) to avoid the potential issues associated with porous pavement. Roadside bioswales are used to provide water quality enhancement and temporary storage of runoff. These bioswales drain into a thickened, open-graded base rock section which allows the water to move laterally back under the pavement where it is temporarily stored until it is infiltrated into the subgrade. This approach has the potential of greatly reducing the water quality and flashiness impacts that our transportation corridors have on our streams and rivers.

An integrated rainwater management approach championed by landscape architects can lead to greatly enhanced urban streams and rivers. In fact, increased infiltration will lead to recharging of groundwater levels, which will discharge cool water into nearby streams year-round and increase base flows. This approach also moves rainwater management back upstream to the point of origin, the site, where landscape architects can develop biologically-based, low-tech rainwater management techniques.

The next time you put on your rain jacket or open your umbrella, think about how it has been raining here for thousands of years and the millions of gallons of water that have been recaptured by the land. Since Oregonians have been removing vegetation cover, adding impervious surfaces, and piping runoff to the nearest water source, we have seriously compromised and polluted our rivers and streams. We can do better.

Rainfall and Runoff

One inch of rainfall on an acre of land equals slightly over 27,000 gallons of water. How much of this rainfall runs off depends on a number of factors, including soil type, vegetation cover, steepness, and amount of impervious surface. The following indicates how much of this rainfall probably leaves the acre as runoff, based on land use.

Land use (1.0 acre)	Runoff (Gallons)
Forest	1,300-2,700
Single Family Residential	7,000-9,000
Downtown Commercial	25,000