Trickle Down Methods of Stormwater Management

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Rakauskas • Architecture

HOW MUCH will the Program cost?

A STORMWATER UTILITY is based on the premise that the urban drainage system is a public system, similar to water or wastewater systems. When a demand is placed on these systems, the user pays.

When a forested or grassy area is paved, a greater flow of water enters the drainage system. The greater the demand created (i.e. the more the parcel of land is paved), the greater the user fee.

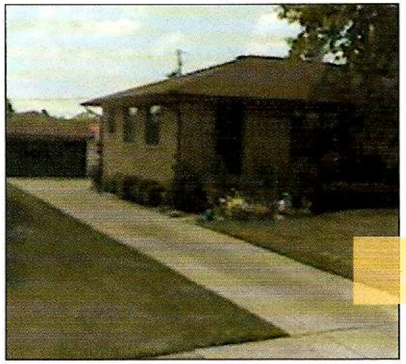
Residential Properties

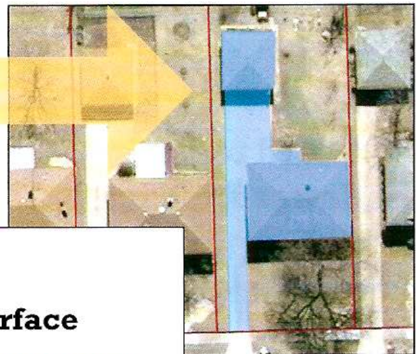
The stormwater user fee is based on an **Equivalent Residential Unit** (ERU) equal to 3,000 sq. ft. of impervious surface (such as roof and driveway). The approved rate for one (1) ERU is $4.75 per month.

Residences are placed in one of three categories:

- **Small (less than 2,000 sq. ft.)**
- **Medium (2,000 to 4,000 sq. ft.)**
- **Large (more than 4,000 sq. ft.)**

A small house pays about $2.85 per month, a medium house pays about $4.75 per month, and a large house pays about $8.55 per month.





Roof + driveway

= 3,000 sq. ft. impervious surface

= 1 Equivalent Residential Unit (ERU)

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3133.05 Required Sanitary Drainage, Storm Drainage and Water Supply Systems

(b) *Storm Water Drainage.*

Roofs and paved areas, yards, courts, and open shafts and every open excavation or part of a lot or premises where water stands or accumulates shall be drained into a storm-sewer system or a combined sewer system or, they shall be drained to an approved receptacle or conducted to a point of disposal approved by the Director of Building and Housing; except that roof gutters or drains and downspouts shall not be mandatory on buildings or structures of miscellaneous occupancy classification.

(c) *Water Supply Systems.* All buildings or other structures or premises equipped with plumbing fixtures shall have provisions for supplying fixtures with an adequate supply of water.

(Ord. No. 1767-07. Passed 4-21-08, eff. 4-28-08)

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Using LID Tools in Residential Development

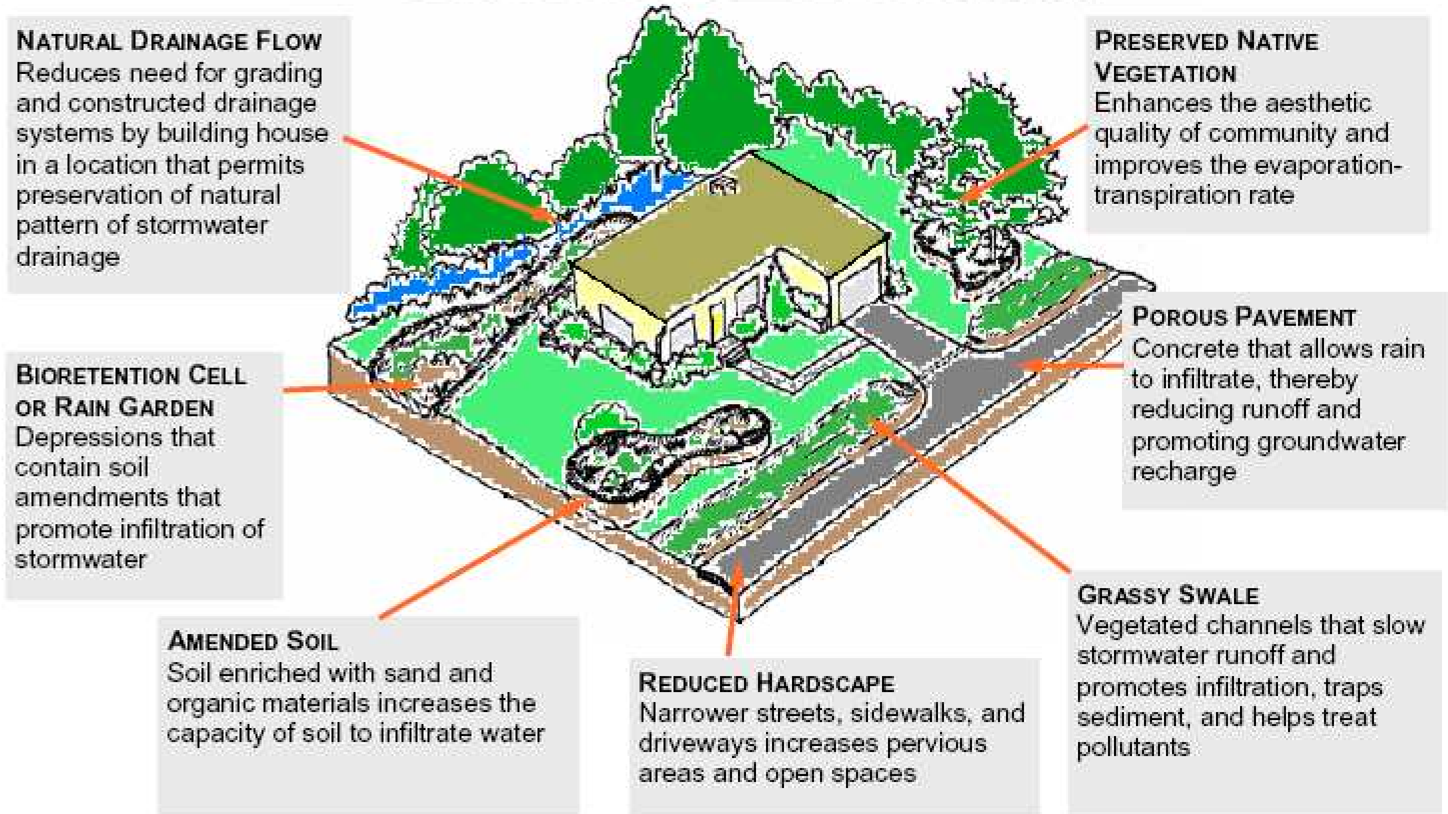

Diagram adapted from Prince George's County Maryland Low-Impact Development Design Strategies

Hollywood Driveways have a dividing strip of grass in order to reduce the amount of impervious surface. Another way to reduce driveway space is to share one with a neighbor.

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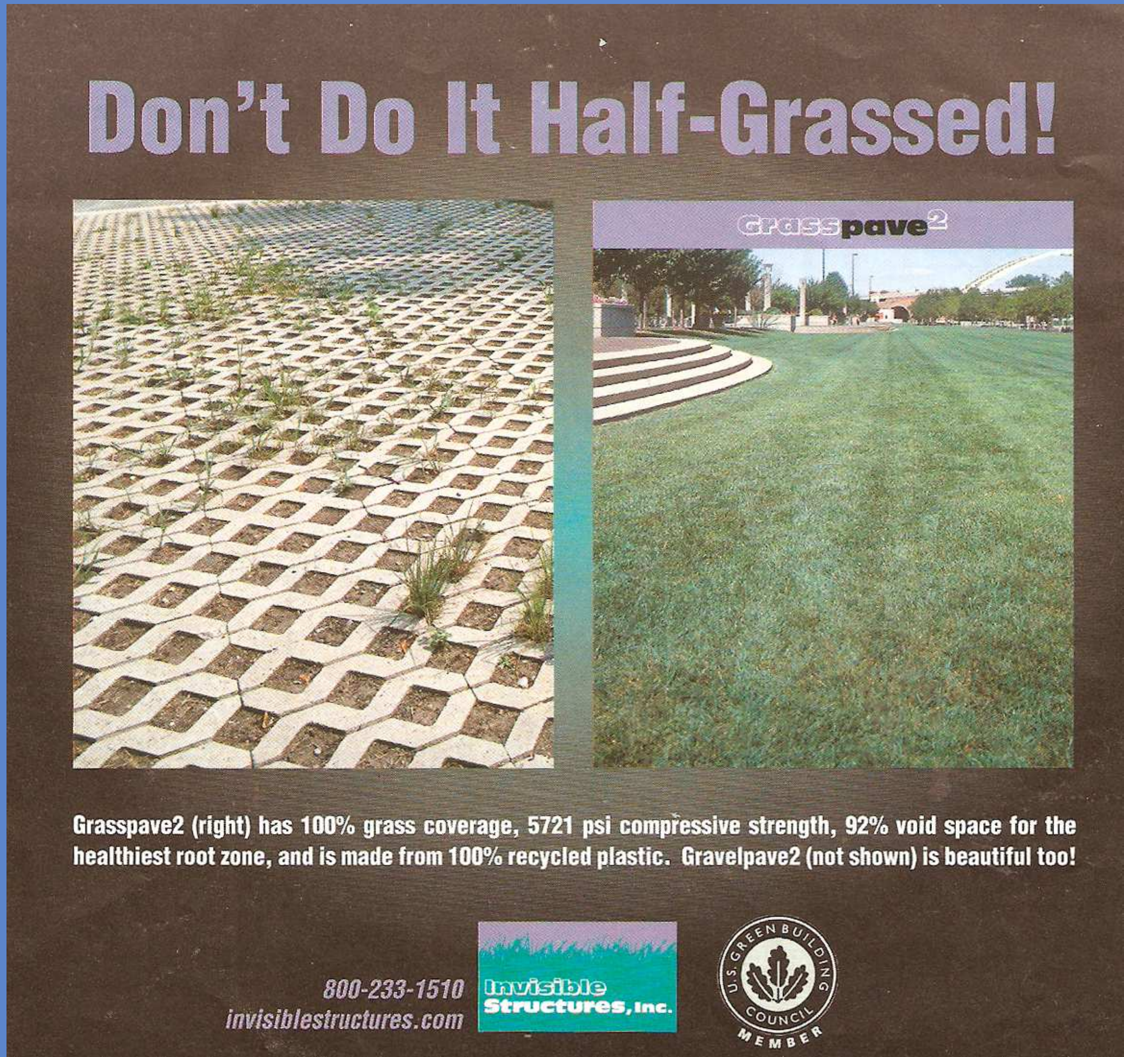

Don't Do It Half-Grassed!
Grasspave2
Grasspave2 (right) has 100% grass coverage, 5721 psi compressive strength, 92% void space for the healthiest root zone, and is made from 100% recycled plastic. Gravelpave2 (not shown) is beautiful too!
800-233-1510
invisiblestructures.com
Invisible Structures, Inc.
U.S. GREEN BUILDING COUNCIL MEMBER

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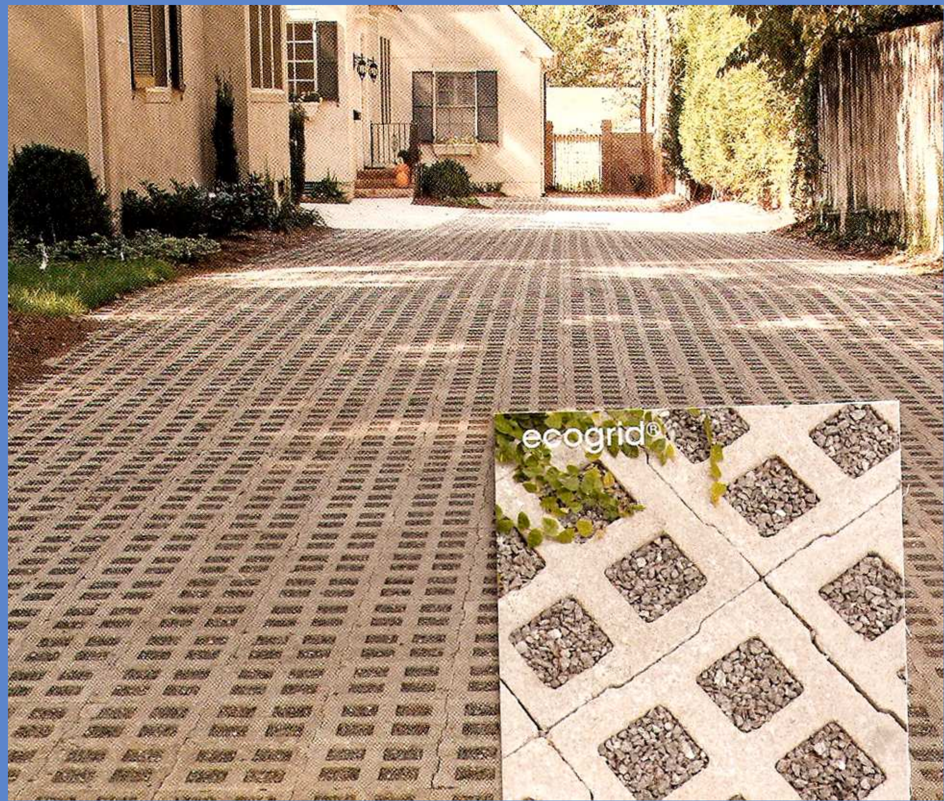

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A PASSION FOR PERMEABLE

Permeable stone reduces storm water runoff, flooding, erosion and drainage problems, just like Boral's new Permeable Pavers. Made in a standard paver size, each paver is notched out every 3 inches around its perimeter to produce six rectangular voids (two on each side, one on each end). It is available 2 ¼ inches thick for pedestrian and light vehicular applications. **For FREE information, visit http://pr.hotims.com/23742-254**

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MUTUAL MATERIALS; LEFT: UNI-GROUP USA; BOTTOM RIGHT: INVISIBLE STRUCTURES, INC.

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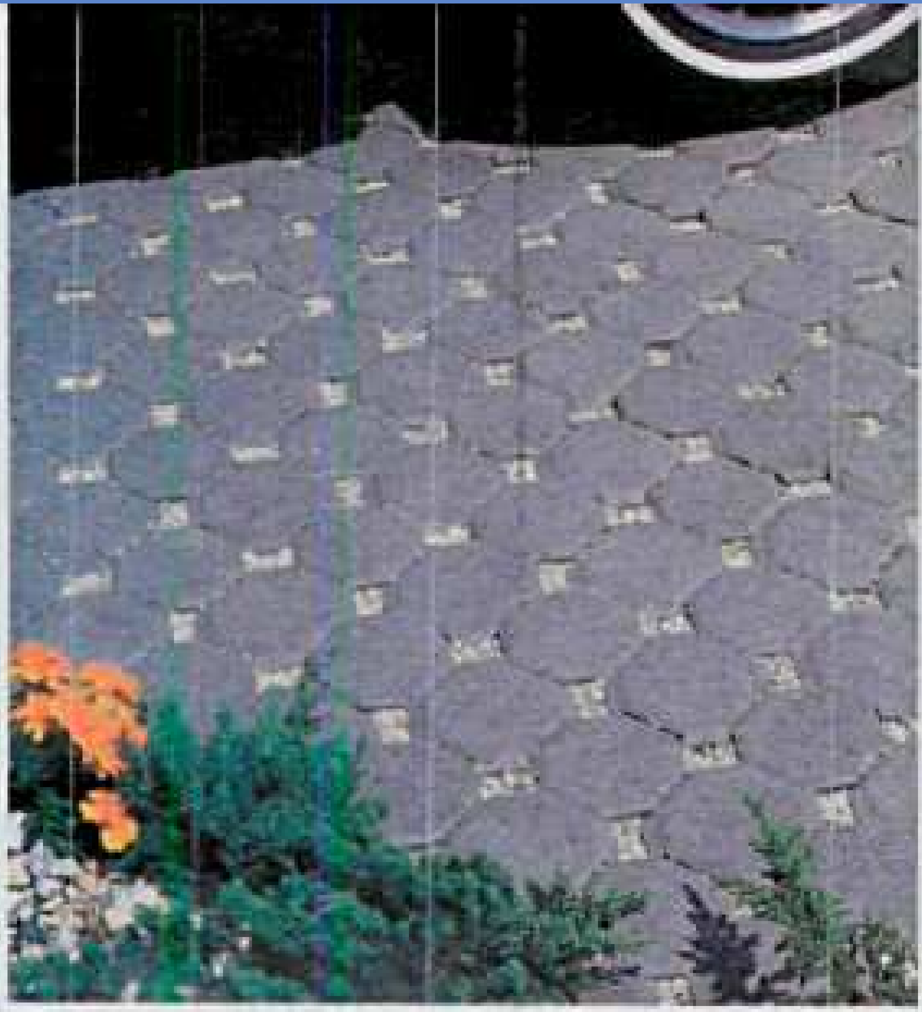

Permeable pavers are used to create attractive driveways that support the weight of vehicles. Rain and melting snow can drain through the spaces to replenish groundwater.

Porous Asphalt: A great advantage to porous asphalt is that the same mixing and application equipment is used as for impervious asphalt. Only the formula for the paving material changes with porous bituminous pavement. For more details on the various layers of materials see, the Pennsylvania Stormwater Management Manual Porous pavement specification used by the City of Seattle Washington Park Department. The amount of asphalt binder required is about 6% by weight which is somewhat higher than required for standard impermeable asphalt mixes.

Bituminous permeable paving is appropriate for pedestrian-only areas and for very low-volume, low-speed areas such as overflow parking areas, residential driveways, alleys, and parking stalls. Permeable paving is an excellent technique for dense urban areas because it does not require any additional land. With proper design, cold climates are not a major limitation.

Permeable paving is not ideal for high traffic/high speed areas because it has lower load-bearing capacity than conventional pavement. Nor should it be used on stormwater "hotspots" with high pollutant loads because stormwater cannot be pretreated prior to infiltration. Perkiomen Watershed Conservancy has an on line video presentation on Porous Pavement which requires the "Real Player" Media Player, to view.

Porous Concrete: Again, the same equipment may be used as for standard concrete. Larger pea gravel and a lower water-to-cement ratio is used to achieve a pebbled, open surface that is roller compacted. This material was recently used in a parking area in Fair oaks, California as a way to reduce solar heat-gain solar from absorption. Project costs were reduced because no retention pond or connection to the municipal storm drain system was required.

Plastic Grid Systems: High strength plastic grids (often made from recycled materials) are placed in roadway areas. Some are designed to be filled with gravel on top of an engineered aggregate material, while others are filled with a sand/soil mixture on top of an aggregate/topsoil mix that allow grass to be planted on the surface. The grids provide a support structure for heavy vehicles, and prevent erosion. After heavy rains, the grids act as mini holding-ponds, and allow water to gradually absorb into the soil below.

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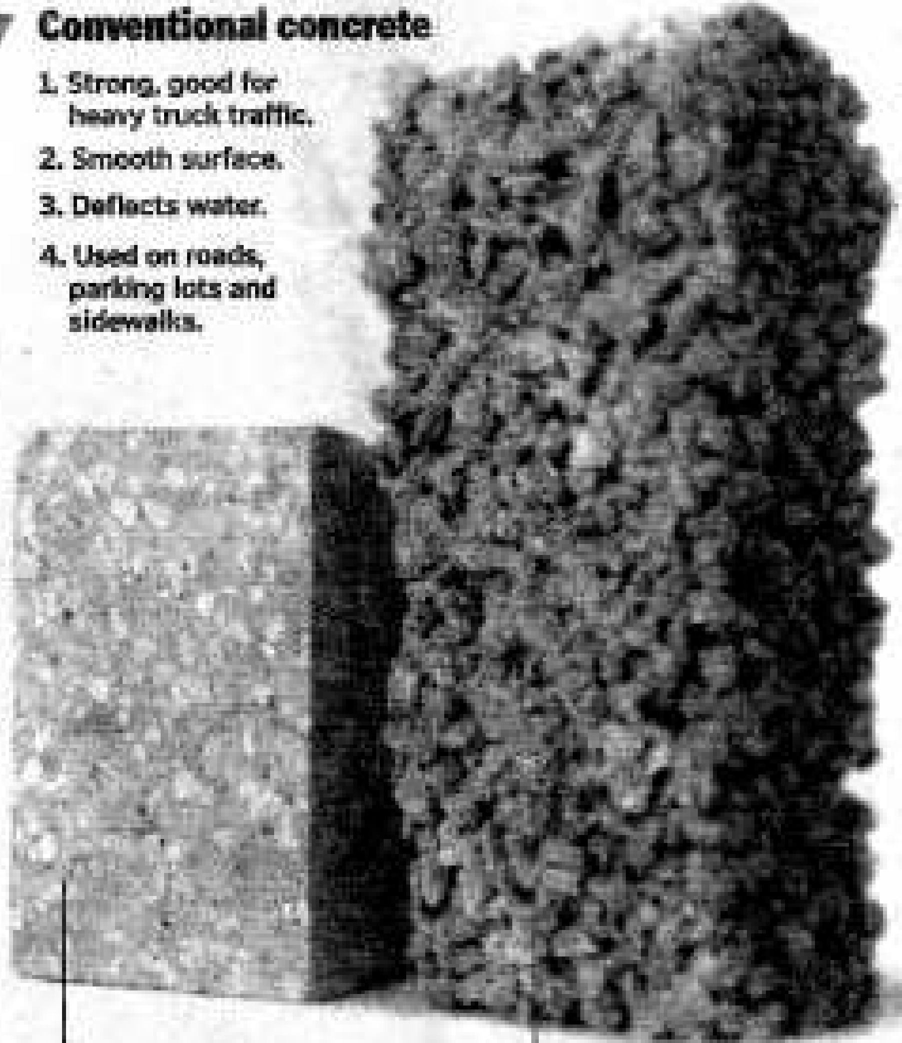
Conventional concrete

1. Strong, good for heavy truck traffic.
2. Smooth surface.
3. Deflects water.
4. Used on roads, parking lots and sidewalks.



Pervious concrete

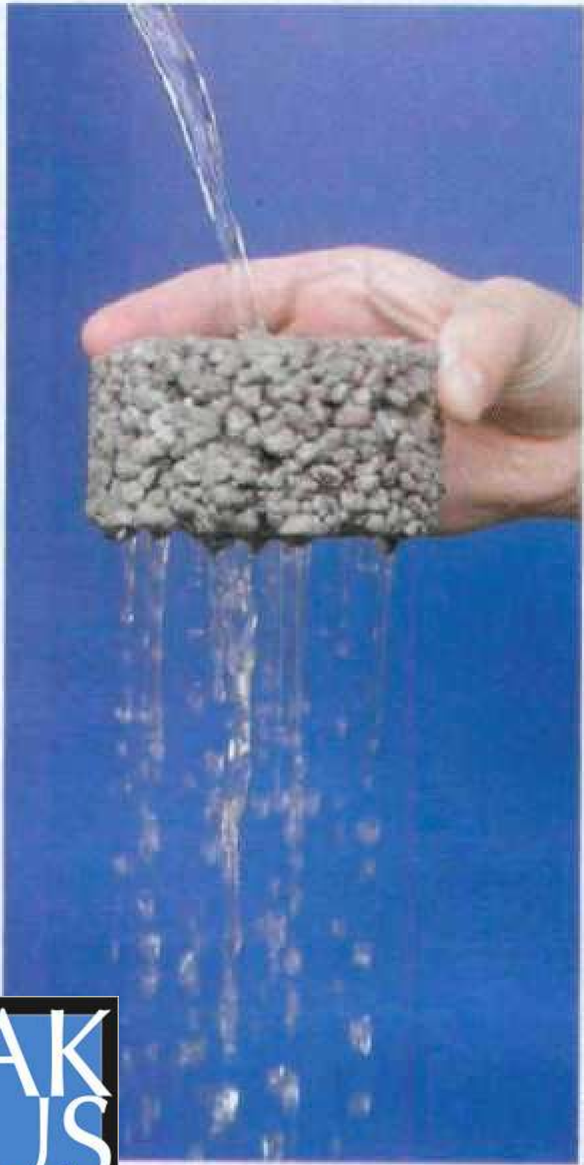
1. Not as strong as conventional concrete.
2. Rougher surface.
3. Water seeps through, reducing stormwater runoff.
4. Muffles noise and reduces hydroplaning.
5. Used on parking lots and sidewalks, mostly in the Southeast United States.
6. Also used on roads in Europe and Japan where trucks are lighter.

Aggregrate (stone) held together by a mixture of sand and cement makes a solid core that is impervious to water.

Uses stone that is more uniform in size than conventional concrete and cement with little or no sand in the mixture. This creates porous spaces that allow water to pass through.

SOURCE: Researchers at Cleveland State University and Iowa State University

PHOTO ILLUSTRATION BY ANDREA LEVY | THE PLAIN DEALER



MISSISSIPPI CONCRETE INDUSTRIES ASSOCIATION AND THE SOUTHEAST CEMENT ASSOCIATION

Left: Pervious concrete reduces the problem of storm water runoff from driveways. Above: A gravel driveway made with the Gravelpave2 system allows water to filter through the gravel.

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Bioswale

From Wikipedia, the free encyclopedia

Two bioswales for a housing development. The foreground one is under construction while the background one is established.

Bioswales are landscape elements designed to remove silt and pollution from surface runoff water. They consist of a swaled drainage course with gently sloped sides (less than six percent) and filled with vegetation, compost and/or riprap. The water's flow path, along with the wide and shallow ditch, is designed to maximize the time water spends in the swale, which aids the trapping of pollutants and silt. Depending upon the geometry of land available, a bioswale may have a meandering or almost straight channel alignment. Biological factors also contribute to the breakdown of certain pollutants.

A common application is around parking lots, where substantial automotive pollution is collected by the paving and then flushed by rain. The bioswale, or other type of biofilter, wraps around the parking lot and treats the runoff before releasing it to the watershed or storm sewer.

Contents [hide]

Contaminants addressed [edit]

There are several classes of water pollutants that may be arrested with bioswales. These fall into the categories of silt, inorganic contaminants, organic chemicals and pathogens. In the case of silt, these effects are resultant turbidity to receiving waters. Inorganic compounds may be metallic compounds such as lead, chromium, cadmium and other heavy metals. Lead is the most prevalent chemical of this class, deriving from automotive residue (e.g. surface spillage of leaded gasoline). Other common inorganic compounds are macronutrients such as phosphates and nitrates. Principal sources of these nutrients are excess fertilization, which can cause eutrophication in receiving waters. Chief organic chemicals are pesticides, frequently over-dosed in agricultural and urban landscaping. These chemicals can lead to a variety of organism poisoning and aquatic ecosystem disturbance. Pathogens typically derive from surface runoff containing animal wastes and can lead to a variety of diseases in humans and aquatic organisms.

Examples [edit]

Bioswale

What is a Bioswale?

Also known as infiltration swales, biofilters, grassed swales, or in-line biorentention, bioswales are vegetated open channels specifically designed to attenuate and treat stormwater runoff for a defined water volume. Like open ditches, they convey larger stormwater volumes from a source to a discharge point, but unlike ditches, they intentionally promote slowing, cleansing and infiltration along the way. A sloped base to facilitate this water movement distinguishes bioswales from rain gardens.

There are some design variations of the bioswale, including grassed channels, dry swales and wet swales. These designs may also include an underlying rock reservoir, with or without a perforated underdrain. The specific design features and treatment methods differ in each variation, but all are considered improvements on traditional drainage ditches.

Each type of swale incorporates modified geometry and other design features to allow it to treat and convey stormwater runoff. A typical swale bottom is flat in cross section, 600 to 2400 mm wide, with a 1-2% longitudinal slope, or dished between weirs on steeper slopes. Bioswale side slopes are usually no more than 3:1, horizontal to vertical.

Bioswale vegetation is typically lawn grasses, but more and more of the low volume swales being built in North America are finished with a combination of grasses, perennials, shrubs, groundcover and trees in order to meet other community goals in addition to stormwater management.

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Grassed Channels

These are similar to a conventional drainage ditch, with the major differences being flatter side slopes and longitudinal slopes, and a slower design velocity for water quality treatment of small storm events. Grass channels are the least expensive option, but also provide the least reliable pollutant removal. The best application of a grassed channel is as pretreatment to other structural stormwater treatment practices.

A major difference between the grassed channel and other stormwater treatment practices is the method used to size the practice. Most stormwater treatment practices are sized by volume of runoff. That is, the process captures and treats a defined water quality volume, or the volume of water. The grassed channel, on the other hand, is based on flow rate (i.e., a peak flow from the water quality storm; this varies from region to region but a typical value is the one inch storm), grass channels should be designed to ensure that runoff takes an average of ten minutes to flow from the top to the bottom of the channel.

Wet Swales

These swales intersect the groundwater, and behave almost like a linear wetland cell. The design variation incorporates a shallow permanent pool and wetland vegetation to provide stormwater treatment. Wet swales are rarely used in residential settings because the shallow standing water is often unpopular with homeowners.

Dry Swales

Dry swales incorporate a deep fabricated soil bed into the bottom of the channel. Existing soils are replaced with a sand/soil mix that meets minimum permeability requirements. An underdrain system is also placed under the soil bed. Typically, the underdrain consists of a layer of gravel encasing a perforated pipe. Stormwater treated by the soil bed flows into the underdrain, which conveys treated stormwater back to the storm drain system.

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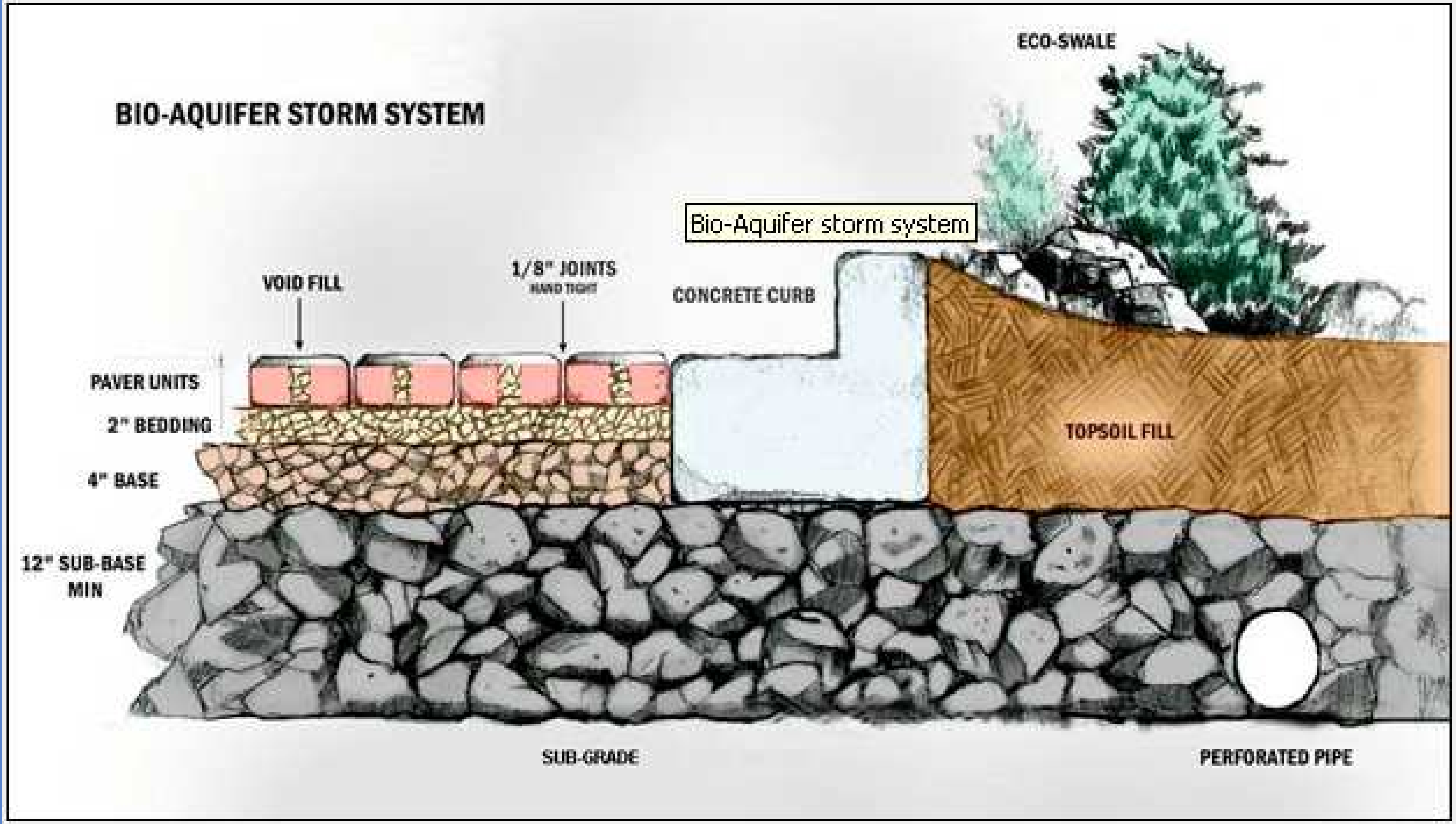

Bioswales are gently sloped areas of the property that are designed to collect silt and other rainwater runoff - and slow down the speed with which water collects. The swales are shaped so that water is diverted, but not so sharply as to encourage erosion of the ground and soil.

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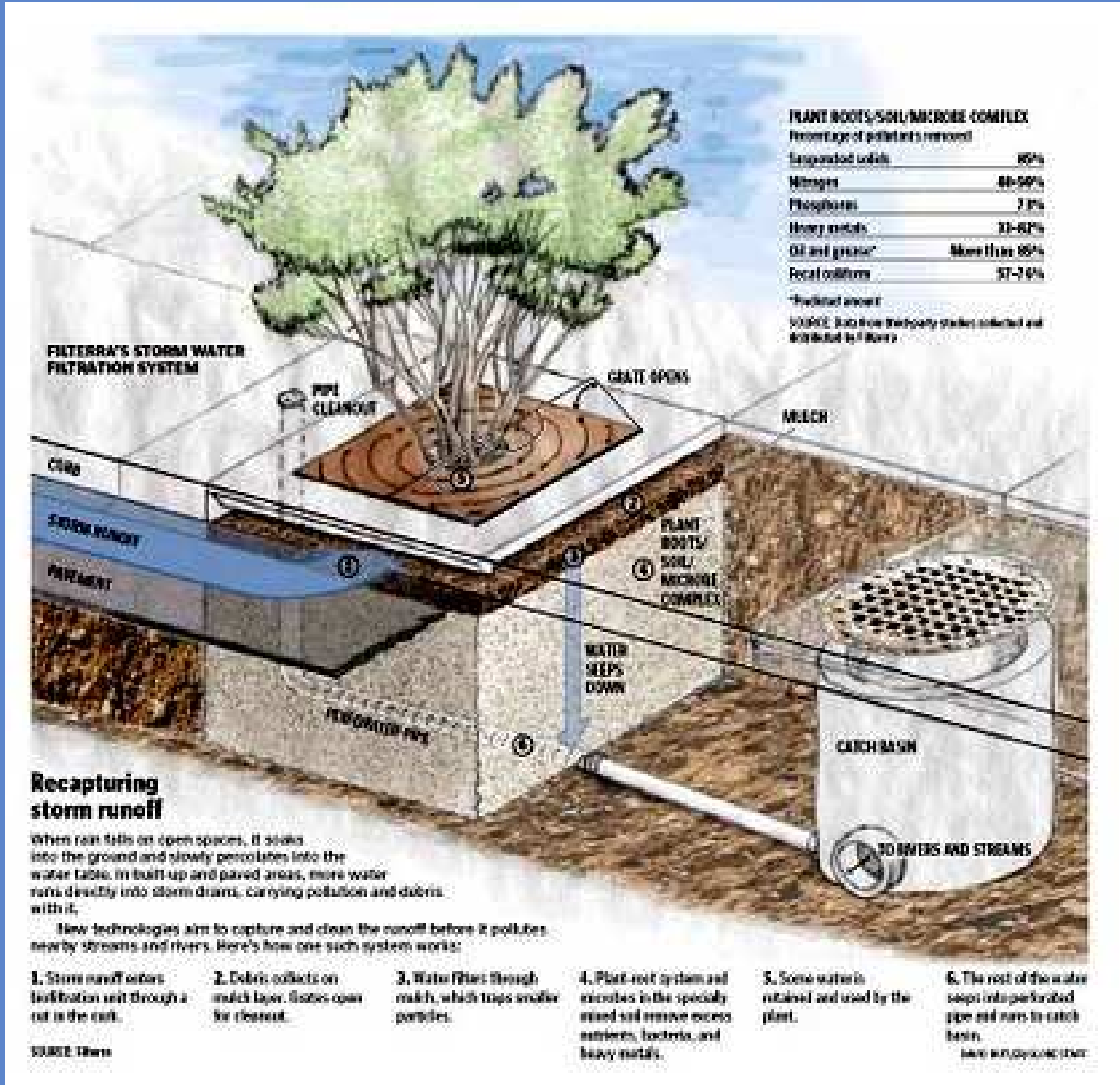
FILTERRA'S STORM WATER FILTRATION SYSTEM
PIPE CLEANOUT
GRATE OPENS
MULCH
CURB
STORM RUNOFF
PAVEMENT
PLANT ROOTS/ SOIL/ MICROBE COMPLEX
WATER SEEPS DOWN
PERFORATED PIPE
CATCH BASIN
TO RIVERS AND STREAMS
PLANT ROOTS/SOIL/MICROBE COMPLEX
Suspended solids
Nitrogen
Phosphorus
Heavy metals
Oil and grease*
Fecal coliform
Recapturing storm runoff
When rain falls on open spaces, it soaks into the ground and slowly percolates into the water table. In built-up and paved areas, more water runs directly into storm drains, carrying pollution and debris with it.
New technologies aim to capture and clean the runoff before it pollutes nearby streams and rivers. Here's how one such system works:
1. Storm runoff enters biofiltration unit through a cut in the curb.
2. Debris collects on mulch layer. Grates open for cleanout.
3. Water filters through mulch, which traps smaller particles.
4. Plant-root system and microbes in the specially mixed soil remove excess nutrients, bacteria, and heavy metals.
5. Some water is retained and used by the plant.
6. The rest of the water seeps into perforated pipe and runs to catch basin.

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Novato, aesthetic top dressing to drainage system
-dry stream bed look.

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