Stormwater Management

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HYDROMODIFICATION AND LOW IMPACT DEVELOPMENT

Due to the recent development of new hydromodification criteria by both the California State Water Resources Control Board and the Central Coast Regional Water Quality Control Board, new development and redevelopment projects will have to be cognizant of implementing stormwater management practices into their design. Stormwater management is the mechanism for controlling stormwater runoff in order to reduce downstream erosion, reduce water quality degradation, prevent flooding, and mitigate any adverse effects on the aquatic environment caused by changes in land use. Low Impact Design ("LID") is an innovative and comprehensive stormwater management approach with a basic principle that is modeled after nature: manage rainfall at the source using uniformly distributed decentralized micro-scale controls.

LID's goal is to mimic a site's predevelopment hydrology by using design techniques that infiltrate, filter, store, evaporate, and detain runoff close to its source. Techniques are based on the premise that stormwater management should not be seen as stormwater disposal. Instead of conveying and managing / treating stormwater in large, costly end-of-pipe facilities located at the bottom of drainage areas, LID addresses stormwater through small, cost-effective landscape features located at the lot level.

These landscape features, known as Integrated Management Practices ("IMPs"), are the building blocks of LID. Almost all components of the urban environment have the potential to serve as an IMP. This includes not only open space, but also rooftops, streetscapes, parking lots, sidewalks, and medians. LID is a versatile approach that can be applied equally well to new development, urban retrofits, and redevelopment / revitalization projects.

The California State Water Resources Control Board and the Central Coast RWQCB have developed new hydromodification criteria that will require effective stormwater management practices.

This bioswale, located in San Luis Obispo, was constructed in 2005. Bioswales are an excellent method of Low Impact Design.

The Central Coast Regional Water Quality Control Board "RWQCB" (Region 3) extends from Santa Cruz County to Santa Barbara County.

Why Low Impact Design?

Regulatory Compliance

The California State Water Resources Control Board ("State Board") has been working to develop a statewide hydromodification control methodology and associated criteria, policy, and permit requirements. Similarly, the Central Coast Regional Water Quality Control Board ("RWQCB") (located in Region 3) has developed a multi-phase, multi-year "Joint Effort for Hydromodification Control" ("Joint Effort") that allows participating municipalities to aid / adhere to the development of specific hydromodification control criteria that follow specifically outlined Best Management Practices ("BMPs"). This effort is being lead by the Central Coast Low Impact Development Center. The work completed by the Central Coast RWQCB intentionally overlaps and coordinates with the State Board's work and will assist other Regional Boards and the State Board in directing municipalities in how to successfully develop scientifically sound and understandable hydromodification criteria.

It should be noted that California law requires operators of certain municipal separate storm sewer systems (MS4s) to develop and implement storm water management plans that will reduce pollutant loadings to the maximum extent practicable, and must investigate and eliminate illicit connections to the storm sewer system. MS4s are divided into three general categories based on size criteria – the "small MS4s" have been given the option to pursue the Joint Effort.

Following the initial project scoping, the Central Coast's RWQCB's "Joint Effort" will consist of two (2) phases – the first will focus on initial implementation and refinement of the methodology (for development of hydromodification control criteria), while the second will focus on further implementing the methodology that is established. The overall project goal is to develop an approach to the management of hydromodification that will meet both resource protection goals and regulatory requirements.

The hydromodification criteria developed by both the State Board and the Central Coast RWQCB will make LID a regulatory requirement for new development and redevelopment projects. Thus, it is in the best interest of those involved in these projects to implement integrated management practices into the design to achieve full regulatory compliance.

The Central Coast RWQCB would like to work with different municipalities to develop and implement stormwater management plans. Image from www.architecture.uark.

This bioswale, located at Avila Seaside Lodge, was constructed in 2005. Bioswales are an excellent method of Low Impact Design.

Environmental and Economic Sustainability

Low Impact Design ("LID") has numerous benefits and advantages over conventional stormwater management approaches. In short, it is a more environmentally sound technology and a more economically sustainable approach to addressing the adverse impacts of urbanization. By managing runoff close to its source though intelligent site design, LID can enhance the local environment, protect public health, and improve community livability - all while saving developers and local governments money.

Low Impact Design is an environmentally sound technology that addresses the adverse impact of urbanization.

Specific Integrated Management Practices:

It is important to understand how to manage the initial surface runoff of a rainstorm (i.e., "first flush"). During first flush, rapid changes in water quality can occur due to pollutants deposited in exposed areas becoming dislodged and entrained by the rainfall-runoff process. Usually the stormwater that initially runs off an area will be more polluted than the stormwater that runs off later, after the rainfall has 'cleansed' the catchment.

The existence of the first flush of pollutants provides an opportunity for controlling stormwater pollution from a broad range of techniques. First flush collection systems are employed to capture and isolate this most polluted runoff, with subsequent runoff being diverted directly to the stormwater system. The following integrated management practices have proved to be effective in managing first flush.

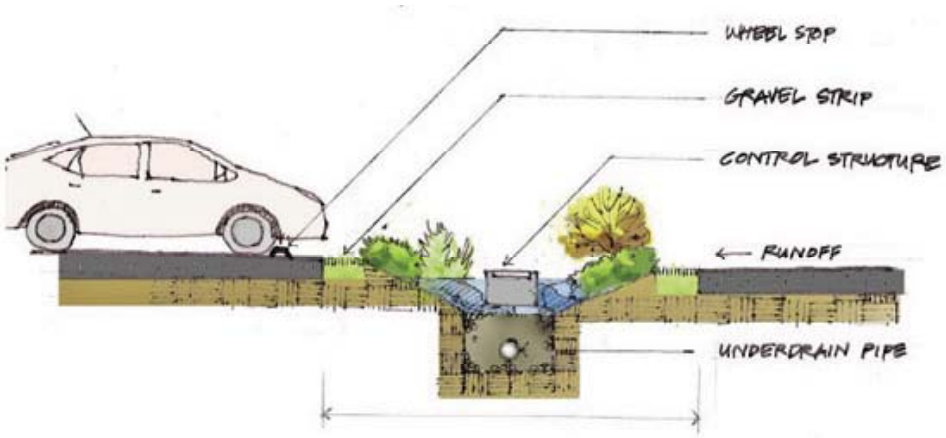
Bioswales

A biowale is a form of bioretention used to partially treat water quality, attenuate flooding potential, and convey stormwater away from critical infrastructure. These systems are linear, and are often used as an alternative to, or enhancement of, traditional stormwater piping. Bioswales are often integrated into parking lot and road medians and parallel to roadways to infiltrate and treat a portion of the stormwater volume. These systems can often be integrated into existing ditch and swale systems to increase their treatment function. Where soils are well drained, infiltration can also be facilitated in the swale by placing ditch blocks or weirs perpendicular to the flow path, causing small volumes of water to be captured in the swale and allowing more time for infiltration.

This bioswale, located at Tompkins Medical Plaza, was constructed in 2006.

The "swale" component of the bioswale provides pre-treatment of stormwater to remove coarse to medium sediments, while the bioretention system removes finer particulates and associated contaminants. Bioswales are able to filter stormwater via the following processes:

- Passing through surface vegetation;
- Percolating through prescribed filter media (which provides treatment through fine filtration, extended detention treatment, and some biological uptake);
- Disconnecting impervious areas from downstream waterways; and
- Providing protection to natural hydraulic systems from storm events by reducing storm flow velocities when compared to pipe systems.



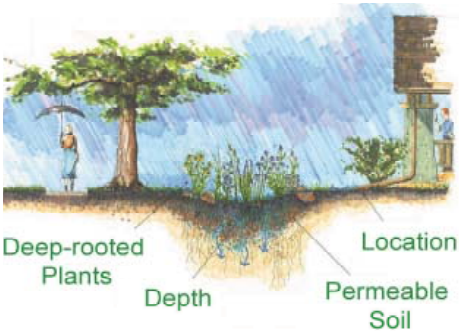
The overall design of a bioswale will vary depending upon its location, its desired outcome, etc. The cross section above depicts the general design of a bioswale with an underdrain. Surface runoff from the adjacent impervious area enters the swale through a gravel strip and then flows through vegetative buffers along the edge of the bioswale. Image from UF IFAS Extention Bioswale Fact Sheet.

Specific Integrated Management Practices:

Rain Gardens

Rain Gardens collect, absorb, and filter stormwater runoff from roof tops, driveways, patios, and other areas that are not permeable. They are shallow depressions that can be a variety of shapes and sizes and can utilize a variety of different plants. All rain gardens are constructed with soil mixes that allow water to soak in rapidly and support healthy plant growth. Specific benefits may include:

- **Filtration** of oil, grease, pesticides, etc. from driveways and lawns before they reach storm drains that lead to streams, wetlands, lakes, and marine waters.
- **Reduction** of flooding on neighboring property, overflow in sewers, and erosion in streams by absorbing water from impervious surfaces.
- **Provision** of habitat for beneficial insects and birds.
- **Increase** of the amount of water that percolates into the landscape, which will recharge local groundwater.



The deep-rooted plants, permeable soil, depth, and overall location of any given rain garden aid in the collection, absorbsion, and filtration of stormwater runoff. Image from www.thecoves.ca..

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Tree-in-a-Box

Tree box filters are mini bioretention areas installed beneath trees that can be very effective at controlling runoff, especially when distributed throughout the site. Runoff is directed to the tree box, where it is cleaned by vegetation and soil before entering a catch basin. The runoff collected in the tree-boxes will also aid in the irrigation of the trees themselves. Tree box filters are based on an effective and widely used "bioretention or rain garden" technology with improvements to enhance pollutant removal, increase performance reliability, increase ease of construction, reduce maintenance costs and improve aesthetics.

Typical landscape plants (shrubs, ornamental grasses, trees and flowers) are used as an integral part of the bioretention / filtration system and can fit into any landscape scheme, which can increase the quality of life in urban areas by adding beauty, habitat value, and reducing urban heat island effects.

The system consists of a container filled with a soil mixture, a mulch layer, under-drain system and a shrub or tree. Stormwater runoff drains directly from impervious surfaces through a filter media. Treated water flows out of the system through an under drain connected to a storm drainpipe / inlet or into the surrounding soil. Tree box filters can also be used to control runoff volumes / flows by adding storage volume beneath the filter box with an outlet control device.

The Tree-in-a-Box method can be very effective at controlling runoff. Image from www.greenvalues.cnt.org.

FOR MORE INFORMATION:

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This bioswale, located at Cal Poly State University, was constructed in 2007.