North Central Texas Council of Governments

integrated Stormwater Management iSWM

Green Roof

Description

A green roof uses a small amount of substrate over an impermeable membrane to support a covering of plants. The green roof slows down runoff from the otherwise impervious roof surface as well as moderating rooftop temperatures. Intensive green roofs, or roof gardens, can support a diversity of plants including shrubs and trees. Extensive green roofs, or roof meadows, consist of more limited vegetation requiring less soil depth and minimal maintenance. Due to the considerably greater costs and structural limitations, only extensive green roofs are discussed in this manual.

Design Considerations

- A green roof typically consists of several layers, including (from bottom to top) a waterproof membrane, root barrier, drainage layer, growth media, and vegetation.
- Building structure capacity must support an additional 10 to 25 pounds per square foot (psf), depending on vegetation and growth medium used.
- Roof can be flat or pitched up to 40%. On roof slopes greater than 20%, additional support must be provided to ensure plant layer does not slip or slump when wet.
- Vegetation should ideally be perennial, drought-tolerant, fire resistant, able to withstand extreme weather conditions, have shallow root structure, and require little to no mowing or trimming.

Key Advantages

- Provides runoff volume reduction.
- May extend life of conventional roof if constructed properly, potentially lowering life cycle costs.
- In addition to stormwater management, provides benefits such as reduced urban "heat island" effect, improved building insulation, additional wildlife habitat, improved aesthetics, and noise reduction.
- Native prairie green roof installations in semi-arid, sub-tropical environments using 50+ grassland species can manage up to 100% of 0.25" storm events.

Limitations

- Requires additional roof support.
- Higher initial costs than conventional roof.
- Requires more maintenance than conventional roof.
- Potential for leakage if not properly designed or maintained.

Green Roof in San Antonio, TX. *(Source: courtesy Joss Growers)*

Target Constituent	Removal Rate (0% → 100%)
Total Suspended Solids	
Total Phosphorus	
Total Nitrogen	
Fecal Coliform	*insufficient data*
Heavy Metals	

Implementation Considerations

Suitability

The iSWM manual has designated green roofs as suitable for providing:

Water Quality Protection

Streambank Protection

Maintenance

- Water as needed to establish vegetation.
- Inspect monthly for plant health and replant as needed.
- Conduct weeding as needed, at least two to three times per year.
- Inspect drains for clogging at least twice per year.
- Inspect roof for leakage at least once per year.
- If leaks occur, replace membrane and root barrier, then reinstall drainage layer, growth media, and vegetation.
- Maintenance plans must be highly specific to plants and media specified and varies throughout the establishment and ongoing care phases of each project.

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Multi-Purpose Detention Areas

Multi-Purpose Detention Area in Denton, TX. *(Source: Tetra Tech)*

Description

Multi-purpose detention areas are facilities designed primarily for one or more specific activities in addition to stormwater management. They can serve as parking lots, rooftops, sports fields, or recessed plazas while also providing temporary detention storage of stormwater runoff. Multi-purpose detention areas are designed to be dry between rain events so that they can provide their primary function.

Design Considerations

- Adequate grading and drainage must be provided to allow multi-purpose detention areas to serve their primary purpose following a storm event.
- Routing calculations must be performed to demonstrate that the provided detention storage volume is adequate.
- All multi-purpose detention facilities must be designed to minimize potential risk to public safety and property.
- An emergency overflow must be provided to bypass rain events larger than the design storm.
- Refer to the guidance provided herein for additional facility-specific design requirements.
- Combining multi-purpose detention areas with site controls to manage lower flow events, including bioswales and bioretention areas, can provide additional water quality and aesthetic improvements.

Key Advantages

- Allows for multiple uses of a site, reducing the need for downstream detention facilities.
- Can be used in conjunction with structural water quality controls in a treatment train approach.

Limitations

- Multi-purpose detention areas are designed for temporary stormwater detention (water quantity control) only and do not provide significant pollutant reduction.
- May cause localized flooding, potentially resulting in property damage and liability.

Target Constituent	Removal Rate (0% → 100%)
Total Suspended Solids	
Total Phosphorus	
Total Nitrogen	
Fecal Coliform	
Heavy Metals	

Implementation Considerations

Suitability

The iSWM manual has designated multi-purpose detention areas as suitable for providing:

Maintenance

- Annually and after large rain events, remove debris from ponding area to minimize outlet clogging and improve aesthetics.
- Perform routine inspections of the facility including structural components.
- Remove accumulated sediment as needed.
- Repair and revegetate areas of erosion as needed.
- Perform structural repairs to inlet(s) and outlet(s) as needed.

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Open Conveyance Channel

Description

An open conveyance channel is a conduit in which water flows with a free surface. Open conveyance channels are also known as drainage ditches. While other types of open channels including grass channels and enhanced swales are designed to provide water quality benefits, an open conveyance channel is designed for conveyance purposes only.

Design Considerations

- Channel side slopes should not exceed 2:1.
- Roadside ditches should have maximum side slope of 3:1.
- Channel design should incorporate a trapezoidal or parabolic cross-section.
- If channel bottom width exceeds 10 feet, a minimum bottom cross slope of 12:1 should be used, or the channel should be designed with compound cross-sections.
- Slope stability should be confirmed with a geotechnical investigation.
- Channel banks should be stabilized at site.

Key Advantages

- Open conveyance channels often offer opportunities to integrate low profile flow controls and planting areas (enhanced swale) to provide some level of water quality improvement and enhanced aesthetics.
- Open conveyance channels can be aesthetically pleasing.
- Vegetated channels can provide natural habitat.
- Once established, they typically require little maintenance.

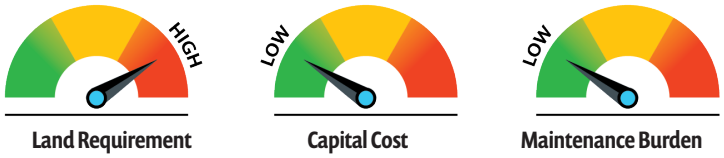
Limitations

- Velocity will limit the type of channel lining. Vegetated channels require slower velocities and lower longitudinal slopes.
- Open conveyance channels are designed for conveyance purposes only and do not provide significant pollutant reduction.

Open Conveyance Channel in Herdberger Park, San Antonio, TX. *(Source: Tetra Tech)*

Target Constituent	Removal Rate (0% → 100%)
Total Suspended Solids	
Total Phosphorus	
Total Nitrogen	
Fecal Coliform	
Heavy Metals	

Implementation Considerations



Suitability

The iSWM manual has designated open conveyance channels as suitable for providing:

Maintenance

- Inspect channels after large storm events to check for debris blockages.
- Inspect vegetated channels periodically for vegetation health and to remove woody vegetation.
- Inspect channels with flexible liners (such as rock riprap) periodically and remove grass, weeds, and woody vegetation.
- Inspect concrete channels periodically for scour at channel lining transitions and channel head cutting.

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Organic Filter

Organic Filter in Austin, TX. *(Source: courtesy Troy Dorman)*

Description

Organic filters capture runoff and pass it through a bed of organic filter media, similar to a surface sand filter. The organic material, typically leaf compost or a peat/sand mixture, enhances pollutant removal, particularly for dissolved pollutants. Organic filters consist of a pretreatment chamber, one or more filter cells, and an underdrain collection system. They are typically designed as offline systems, receiving runoff via a flow diversion structure or flow splitter.

Design Considerations

- Maximum contributing drainage area of 10 acres.
- Minimum head requirement of 5 to 8 feet between inlet and outlet.
- Typical media bed configurations are the 50/50 peat/sand filter and compost filter.
- Only certain types of peat are acceptable for organic filters; refer to the media selection guidance provided herein.
- To provide water quantity control, other best management practices are required.
- Grade of the selected site should be 6% or less.

Key Advantages

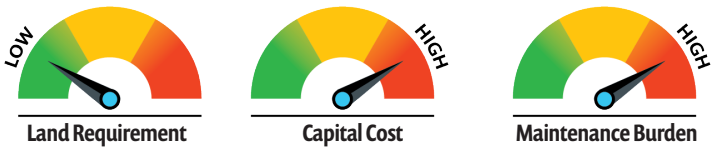
- High pollutant removal capability, especially for soluble metals, hydrocarbons, and other organic chemicals.
- Suitable for small drainage areas, space-limited applications, and hotspot areas.
- Can provide water quality treatment for runoff from highly impervious areas.
- Typically requires less space than other structural controls.

Limitations

- High maintenance requirements.
- Not recommended for use in clay/silt runoff areas or areas producing runoff with high sediment content due to the potential for clogging.
- Relatively costly compared to other stormwater control structures.

Target Constituent	Removal Rate 0% → 100%
Total Suspended Solids	
Total Phosphorus	
Total Nitrogen	
Fecal Coliform	
Heavy Metals	

Implementation Considerations



Suitability

The iSWM manual has designated organic filters as suitable for providing:

Water Quality Protection

Maintenance

- Trash, leaf, debris and sediment removal
- Removal of vegetation (weeds)
- Clean inlets and outlets
- Clear pipes and underdrains when necessary
- Provide erosion and structural repairs as needed
- Address animal damage as needed
- Replace filter media upon device failure

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