North Central Texas Council of Governments

integrated Stormwater Management iSWM

Bioretention

Description

Bioretention facilities, sometimes called rain gardens or bioretention filters, are vegetated basins or landscaped areas that capture stormwater runoff and provide filtration and treatment using engineered filter media. Bioretention areas are flexible per the needs of most site locations.

Design Considerations

- Consists of a grass filter, a sand bed, stormwater ponding area, an organic/mulch layer, planting soil, and selected landscaping for vegetation
- The facility works on any soil group
- Can be designed with an underdrain to send treated water into an outlet
- Use native plants as recommended
- Can be designed in-line or off-line
- Requires a footprint of 5-7% of the tributary impervious area

Key Advantages

- They are highly effective at removing pollutants and reducing peak flow storm events for small storms
- Bioretention areas work well in areas with a small drainage area (recommended for between 2 and 5 acres)
- Bioretention facilities can handle large amounts of impervious areas
- Bioretention areas have relatively low maintenance requirements
- Due to their incorporation of landscaping, bioretention facilities can be used as an aesthetic feature

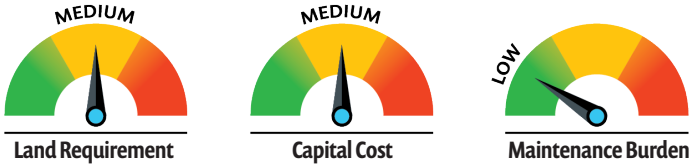
Limitations

- Landscaping of bioretention facilities in public areas must be maintained to prevent overgrowth
- Bioretention areas cannot be used in areas with steep slopes
- Bioretention areas are not designed to manage peak flows from large storm events

Bioretention Facility in San Antonio, TX. *Source: Tetra Tech*

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 that bioretention facilities are suitable for providing:

**in certain situations*

Maintenance

- Trash, leaf, debris and sediment removal
- Weeding/removing unwanted vegetation
- Replacing dead and dying vegetation
- Raking and replacing the top mulch layer
- Irrigating plants after planting and during the dry season
- Replace soil media on an as-needed basis
- Clean inlet and outlet pipes when required
- Repair eroded locations

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North Central Texas Council of Governments

integrated Stormwater Management iSWM

Dry Detention Pond

Dry Detention Facility in San Antonio, TX. *Source: Halff*

Description

Dry detention ponds are surface storage facilities that provide detention of stormwater runoff to reduce downstream water quality impacts. They temporarily detain stormwater and gradually release it following storm events. In between storm events, the facilities are typically dry.

Design Considerations

- Dry detention ponds are designed for the maximum reduction of peak flows and runoff reduction for larger storm events
- There are no restrictions for drainage area size
- Soil groups 'A' and 'B' may require a pond liner
- Often used as part of a treatment train to meet water quality requirements

Key Advantages

- Since less excavation is required, dry detention ponds are typically less costly than wet ponds for equivalent flood storage
- Dry detention ponds are often used in conjunction with water quality structural control
- In between storm events, there are opportunities for the facility to be used for recreational activities

Limitations

- Extended detention may provide limited water quality treatment and streambank protection
- The area required for dry detention ponds is greater than the area required for other best management practices

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

Implementation Considerations

Suitability

The iSWM manual has designated that dry detention ponds are suitable for providing:

Maintenance

- Trash, leaf, debris and sediment removal
- Provide removal of vegetation and weeds when overgrowth occurs
- Plant seed or sod in bare or dead spots
- Mow planted vegetation
- Clean inlets

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integrated Stormwater Management iSWM

Permeable Pavement

Permeable Pavement in San Antonio, TX. *Source: Tetra Tech*

Description

Permeable pavement is a structural alternative to a paved surface that allows for the infiltration of stormwater runoff through void spaces into a stone bed and the soil or an under-drain below. Permeable pavement can refer to a variety of surfaces, including porous asphalt, pervious concrete, and permeable interlocking concrete pavers. It is intended for use in lightly trafficked areas, such as parking lots, driveways, plazas, and rights-of-way.

Design Considerations

- Consists of structural units with void areas that are typically filled with pervious materials such as course sand, gravel, or turf
- Intended for low traffic areas, or for residential or overflow parking applications
- Soil types need to be considered—an infiltration rate of 0.5 to 3 inches/hour is required
- The ratio of the contributing impervious area to the porous paver surface should be no more than 3:1
- Slopes should be less than 5%, but preferably less than 2%
- A minimum of 2 feet of clearance between the bottom of the gravel and the seasonally high groundwater table is required

Key Advantages

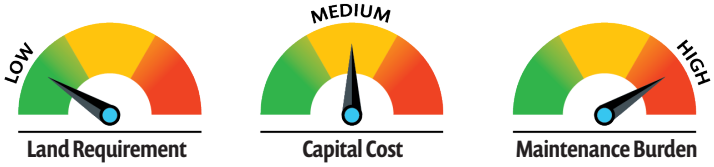
- Permeable pavement provides a reduction in runoff volume
- There is a high level of pollutant removal with these facilities
- Some types of permeable pavement can be purchased from commercial vendors

Limitations

- There are high maintenance requirements associated with permeable pavement
- Permeable pavement can fail if designed incorrectly, placed in unstabilized areas, or if maintenance is not properly done
- Permeable pavement has the potential for groundwater contamination
- Cannot be used in areas where contamination is possible (ex. industrial sites)

Target Constituent	Removal Rate (0% → 100%)
Total Suspended Solids	*not applicable*
Total Phosphorus	
Total Nitrogen	
Fecal Coliform	*insufficient data*
Heavy Metals	

Implementation Considerations



Suitability

The iSWM manual has designated that permeable pavement facilities are suitable for providing:

Maintenance

- Trash, leaf, debris and sediment removal
- Vacuum or sweep the surface
- Re-chip or reseal pavement when appropriate
- Replace fill material as needed
- Clear underdrain pipes of debris
- Perform structural repairs as needed
- Mow grass when using a permeable paver grid system

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integrated Stormwater Management iSWM

Sand Filter

Description

Sand filters, also called filtration basins, are structural stormwater controls that capture and store runoff and pass it through a bed of filter sand. The facilities are multi-chamber structures that utilize a sediment forebay or sedimentation chamber, a sand bed for filter media, and often require an underdrain collection system. Sand filter designs are typically either a surface sand filter or a perimeter sand filter.

Design Considerations

- The facility consists of a sand filter media with an underdrain system
- Sand filters typically require 2 to 6 feet of head
- The maximum drainage area for a surface sand filter is 10 acres
- The maximum drainage area for a perimeter sand filter is 2 acres
- Clay or sandy soils may require a pretreatment device; otherwise any soil type can be utilized
- In order to provide water quantity control, other best management practices are required
- The selected site should not have a grade above 6%

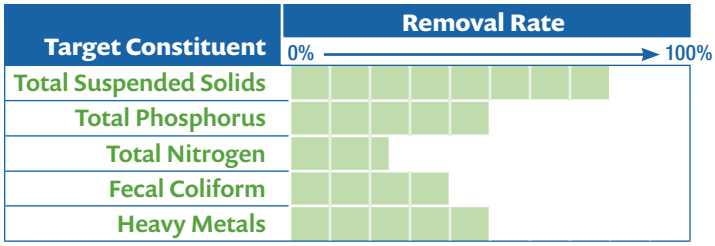
Key Advantages

- Sand filters are applicable to small drainage areas
- Highly impervious areas can be drained to sand filters for pollutant removal
- Sand filters have good retrofit capacity
- Sand filters can be used in hotspot areas
- Typically, less space is required for a sand filter than for other facilities

Limitations

- There are high maintenance requirements associated with sand filters
- Sand filters are not recommended in areas with high sediment content loads or in clay/silt runoff areas
- Relative to other best management practices, sand filters are relatively costly
- There is a potential for odor problems to arise with sand filters

Sand Filter Drain in Raleigh, NC. *Source: Tetra Tech*



Implementation Considerations

Suitability

The iSWM manual has designated that sand filter facilities are suitable for providing:

Maintenance

- Trash, leaf, debris and sediment removal
- Provide removal of vegetation (weeds) when a surface sand filter is utilized
- Scarify the media to promote pollutant removal
- Clean inlets and outlets
- Clear pipes and underdrains when required
- Provide erosion and structural repairs when required
- Address animal damage as needed
- Replace media upon failure of the device

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North Central Texas Council of Governments

integrated Stormwater Management iSWM

Underground Detention

Description

Underground detention facilities provide water quality control through detention and temporary storage of storm water. The runoff is stored in underground vaults, pipe or tank systems. Water is gradually released following storm events. Underground detention facilities are alternatives to surface treatment.

Design Considerations

- Underground detention facilities are often used in conjunction with a water quality structural control device
- There are no restrictions for soil types
- The maximum drainage area for underground detention facilities is 160 acres
- Often used as part of a treatment train to meet water quality requirements
- Prefabricated concrete vaults are available from commercial vendors

Key Advantages

- Underground facilities do not take up any surface space, which is difficult to obtain on some sites
- Designs can be flexible between a concrete vault or a pipe/tank system

Limitations

- Underground detention facilities are not intended to provide water quality treatment
- These facilities are intended for applications where space is limited
- Both construction and replacement costs are high for these types of facilities

Underground Detention Facility in Los Angeles, CA. *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 that underground detention facilities are suitable for providing:

Maintenance

- Trash, leaf, debris and sediment removal
- Utilize a subsurface vacuum to remove pollutants and debris
- Clean inlets and outlets
- Clear pipes and underdrains as needed
- Provide structural repairs when required
- Address animal damage, including providing mosquito control

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North Central Texas Council of Governments
iSWM PROGRAM IMPLEMENTATION TIERED MEASUREMENT

SUBMITTING COMMUNITY: _____

Requirements for Implementation Levels

Outcome Category	Gold	Silver	Bronze
Mandatory	11 full application	10 full or partial application	10 full or partial application
Recommended	7 full application	7 full or partial application	4 full or partial application
Optional	3 full or partial application		

Note: The following outcomes apply to land disturbing activities of 1 acre or more for water quality and streambank protection, and apply to all land disturbing activities for flood mitigation and conveyance.

#	Outcome	CHECK COMMUNITY'S LEVEL OF APPLICATION			Full Application	iSWM Criteria Manual Ref.	Equivalent Local Criteria/Ordinance Reference
		N/A	Partial	Full			
MANDATORY OUTCOMES							
1	Site Plan Review Applicability				Stormwater requirements discussed at a pre-development/pre-application meeting or equivalent (Concept iSWM)	Section 2.2, Step 3	
2	Land Use Conditions				Design stormwater infrastructure to fully-developed (built-out) land use conditions	Section 3.6.1	
3	Hydrologic Methods				Limit Rational Method applicability to drainage areas of 100 acres or less and utilize frequency factors (per TM HO Table 1.4); Limit Modified Rational Method applicability to drainage areas of 200 acres or less; For larger areas, require Unit Hydrograph methodology	Section 3.1 Table 3.2; TM HO Section 1.2*	
4	Open Channel Velocity Criteria/Energy Dissipation				Require maximum permissible channel velocity criteria be met and/or use erosion control measures for 1-, 25-, and 100-yr or similar storm events to protect receiving drainage element from erosion	Section 3.6.3, Table 3.10 and 3.11	
5	Detention Structure Discharge Criteria				When a detention structure is utilized, design facility for fully-developed 1-, 25-, and 100-yr or similar storm events matching pre-development peak flows and velocities; Provide emergency spillway with 6 inches of freeboard to convey fully-developed 100-yr storm event assuming outlet blockage	Section 3.6.3, Detention Structures	
6	Streambank Protection				Require downstream stabilization to prevent erosive velocities; maintain existing downstream velocity conditions with on-site controls; and/or control fully-developed 1-yr, 24-hr storm event release over 24 hours to prevent erosive velocities	Section 1.3, Table 1.3; Section 3.4	
7	Flood Mitigation				Require adequate downstream conveyance for peak discharges; maintain existing downstream peak discharge conditions with on-site controls; and/or provide detention to pre-development peak discharge conditions	Section 1.3, Table 1.3; Section 3.5.2	
8	Construction Controls				Limit erosion and the discharge of sediment and other pollutants from construction sites by adhering to the integrated Construction Criteria or Construction General Permit	Section 4.0	
9	Operations and Maintenance				Define responsible party and requirements for operation, maintenance, frequency of inspection, and enforcement of temporary and permanent stormwater controls and drainage facilities	Section 2.2, Step 5	
10	Downstream Assessments				Confirm no negative impact or mitigate negative impacts of peak discharges and velocities for 1-, 25-, and 100-yr or similar storm events	Section 3.3; TM HO Section 2.4*	
11	Supports Regional Public Works initiatives				The community must be annual cost-share contributor to the Regional Public Works program that provides funding to sustain the iSWM program. **(***Required for gold certification applicants and encouraged for bronze and silver***)**		
	TOTALS						

North Central Texas Council of Governments
iSWM PROGRAM IMPLEMENTATION TIERED MEASUREMENT

RECOMMENDED OUTCOMES							
12	Conveyance Limits				25-yr fully-developed design storm or higher for: streets, roadway gutters, storm drain pipe systems, inlets on-grade and parking lots; 100-yr fully-developed design storm event for: drainage in the right-of-way, drainage easements, and road low points	Section 3.6.2	
13	Storm Drain Velocity Criteria				Limit velocity in pipes with minimum and maximum values to prevent clogging and erosion	Section 3.6.1, Table 3.8	
14	Spread Criteria				Flow spread limits for various street classifications for 25-yr storm event or higher	Section 3.6.2, Table 3.7	
15	Freeboard Criteria				Minimum of 1 foot of freeboard provided for the fully-developed 100-yr storm event for culverts and detention structures; Minimum of 2 feet of freeboard for bridges for fully-developed 100-yr storm event	Section 3.6.3	
16	Finished Floor Elevations				Minimum of 1-foot above fully-developed 100-yr storm event water surface elevation or 2-feet above effective FEMA base flood elevation	Section 3.7	
17	Water Quality Protection				Require integrated site design practices; treat the water quality volume; and/or enact regional water quality programs	Section 1.3, Table 1.3; Section 3.2	
18	Drainage and Floodplain Easements				Required for all drainage systems that convey stormwater runoff across property boundaries and must include sufficient area for operation and maintenance of the public drainage system	Section 3.7	
	TOTALS						
OPTIONAL OUTCOMES							
19	Open Channel Stability Criteria				Design includes low-flow channel	Section 3.6.3	
20	Detention Downstream Timing Analysis				Confirm detention does not exacerbate peak flows in downstream reaches	Section 3.5.2, Option 3	
21	Conservation and Utilization of Natural Features and Resources				Ordinances encourage preservation of natural resources such as riparian buffers and/or natural open space areas and utilization of natural design features for stormwater conveyance	Section 3.2.2; TM PL 2.2.1**	
22	Lower Impact Site Design Techniques				Ordinances encourage reducing limits of clearing and grading and limiting impervious cover per integrated site design practices	Section 3.2.2; TM PL 2.2.2**	
23	TriSWM				Incorporate practices for improving water quality of runoff from public rights-of-way	Appendix A of the iSWM Criteria Manual	
	TOTALS						

*TM HO = iSWM Technical Manual, Hydrology Section **TM PL = iSWM Technical Manual, Planning Section

Tier Level Applied For: ☐**GOLD** ☐**SILVER** ☐**BRONZE** Note: (Gold applicants must be annual contributors to the Public Works program)

_____ _____

Print Name and Title of Local Stormwater Authority Contact Phone Number and Email

_____ _____

Signature of Local Stormwater Authority Date

For IIS Review Board Use Only:

Date of Submittal:_____ Date of Request for Additional Information:_____

Date of Approval:_____ Date Additional Information Received:_____

Approved Tier Level:_____ Date Informational Letter Sent:_____

Draft iSWM BMP Installation and Maintenance Video Comment and Response Document

	Comment	Response
1	I think its great, but I would like to hear more about what species of plants are needed and why.	We are considering addressing specific species and plants in a written case study.
2	At about 6:00 minutes in, Mr. Kendrick's comment about the engineers plans and landscaping plans being out of sync is an important one for the iSWM group to think about. I see this when I review SWPPPs. The SWPPP site map, the paving plan, the erosion control plans, the landscape plans, the demolition plans, etc., sometimes do not agree and can even conflict. Early on, project managers need a holistic eye on the plans to avoid these issues. Excellent video!	Thank you for the comment. Engineer's plans and landscaping plans being out of sync is a great topic to discuss during the site development controls workshops.
3	I understand the application of this system, but have concerns about the separation screen material scumming up over time and inhibiting the flow into the storage cells below. In addition, plants used in bioretention cells that really thrive in these systems tend to have very deep root systems of sometimes up to 8' depth. What happens when these roots hit and penetrate the separation screen/fabric? If they are reaching for the storage water in the plastic cells, then they will potentially breach that separation. The video reflected mistakes in construction such as cutting the overflow pipe to the finished grade of the planter vs. providing storage detention. Also noted is the size of the fine mulch which easily floats and will quickly flow over and clog the surface of the overflow...which was noted in one of the quick shots with mulch piled over the top. Larger mulch should be used that will not float so easily and flow over the drain structure into the underground drainage system. I did not see a sediment capture forebay from the drainage runoff flume into the planter, and noted an excessive amount of scouring into the media and excessive sediment deposit over the surface of the finished cell prior to planting. This excess in sediment would have to be addressed with significant excavation removal and testing the flow rate of the compromised media to ensure it was still achieving the rate required.	In this current draft, we were unable to incorporate the suggested comment.
4	P.S. You could perhaps clarify what plants are appropriate for such a setup.	Please see the response to comment #1.
5	In the ballpark of 00:30 the speed of transition (from images/texts/slides) starts to become noticeably fast, and around 01:05 I became overwhelmed by the speed. The rest of the video was great, and overall the video was done well. I would just suggest slowing down the transitions in the first part.	Adjustments to the transition speed have been incorporated in the June revision.
6	At 11 seconds text scrolls way too fast and cannot read it all. Bioretention "facility"?! I really hate that nomenclature. Also, there is very little 'bio' in this system for WQ, very little grasses from this video. Decent tips for communication and maintenance. @6:04 why is there so much concrete in this system? This is just a water storage system, but not a "bio" or LID system... it's very good for water quantity management, but it would be a shame to promote for water quality improvements.	Adjustments to the text scrolling speed have been incorporated in the June revision. We were unable to include additional suggested comments.

	Comments	Response
7	Heading for "Lessons Learned" didn't quite fit the information provided. It may be good to show some failure situations. Not impressed with the decision to use a brand name in the video. It would be impressive if you were able to use a situation whereby they were using a nonspecific bioretention. I took a GI class at the San Antonio River Authority and Halff helped present the course and they were able to provide the steps necessary to design a bioretention facility without using proprietary products.	A new heading has been added that is more appropriate for the information shared. Disclaimer language has been added that states that the video is for educational and information purposes only and that the NCTCOG and the Public Works Council do not endorse or a specific person, commercial product process, or service by trade name, trademark or, manufacturer.