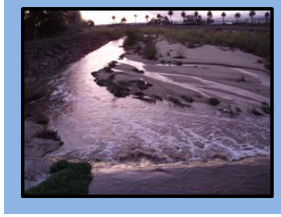
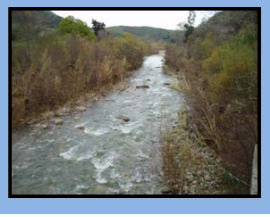
Ventura County Technical Guidance Manual for Stormwater Quality Control Measures

2011Manual Update Workshop
June 21, 2011





Rebecca Winer-Skonovd, Larry Walker Associates

Lisa Austin, Geosyntec Consultants

Ventura Countywide Stormwater Quality Management Program

Geosyntec consultants

LARRY WALKER ASSOCIATES

Presentation Outline

8:50 – 9:30 AM	**Introduction: Project Applicability Overview**
9:30 – 10:15 AM	**TGM Contents Part I: Standards, Site Assessment & BMP Selection**
10:15 – 10:25 AM	***Break***
10:25 – 11:00 AM	**TGM Contents Part II: Site Design & Source Control**
11:00 – 12:00 PM	**TGM Contents Part III: BMP Design, Maintenance & Appendix Highlights**
12:00 – 1:00 PM	***Lunch***
1:00 – 2:00 PM	**Redevelopment Development Scenario**
2:00 – 2:10 PM	**Break**
2:10 – 2:55 PM	**Mixed Use & Residential Development Scenarios**
2:55 – 3:20 PM	**Q & A**
3:20 – 3:30 PM	**Summary and Closing**

TGM Contents

1. Introduction
2. Stormwater Management Standards
3. Site Assessment and BMP Selection
4. Site Design Principles and Techniques
5. Source Control Measures
6. Stormwater BMP Design
7. Maintenance Plan

Applicability Overview

TGM Contents Part I

TGM Contents Part II

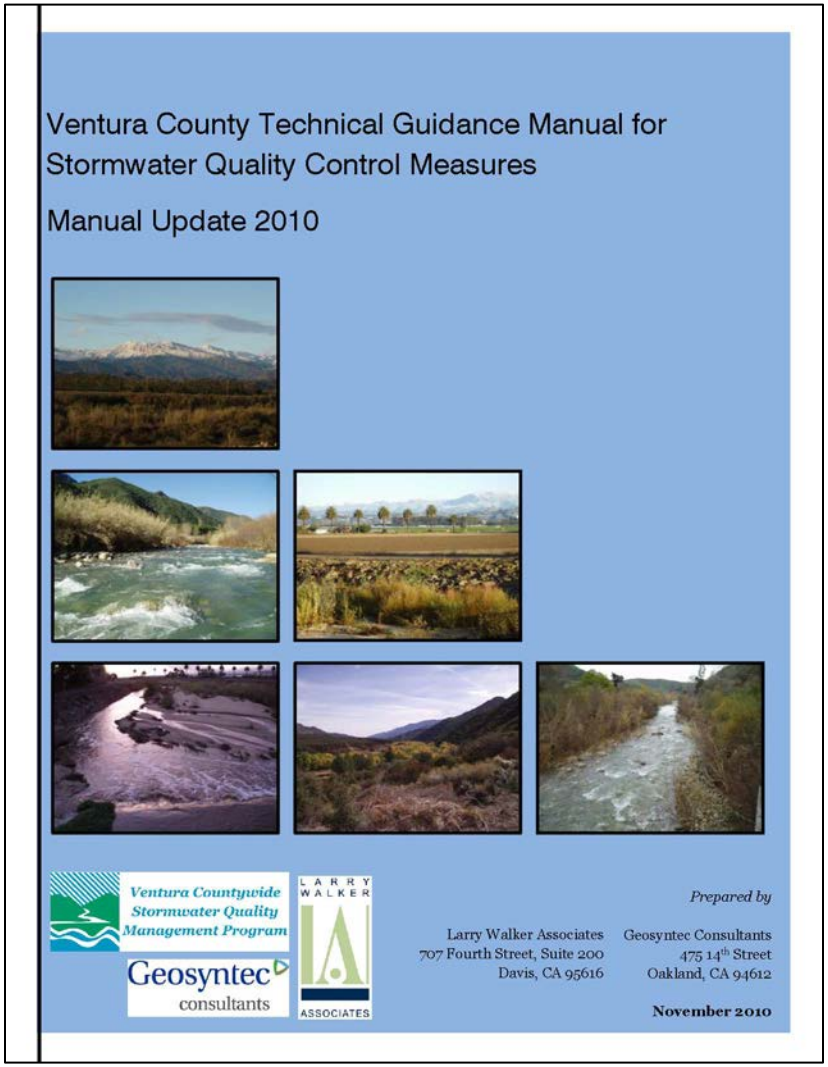
TGM Contents Part III

Appendices:

Appendix A: Glossary of Terms
Appendix B: Maps
Appendix C: Site Soil Type and Infiltration Testing
Appendix D: BMP Performance Guidance
Appendix E: BMP Sizing Worksheets
Appendix F: Flow Splitter Design
Appendix G: Design Criteria Checklist for Stormwater Runoff BMPs
Appendix H: Stormwater Control Measure Access and Maintenance Agreements
Appendix I: Stormwater Control Measure Maintenance Plan Guidelines and Checklists

Permit and Project Applicability Overview

1. Stated Purpose of Permit Requirements
2. Project Applicability
3. Special Project Categories
4. Effective Date
5. Submittals



Section 1: Introduction

- 1.1 Goals
- 1.2 Regulatory Background
- 1.3 Impacts of Land Development
- 1.4 Stormwater Management Principals
  - Integrated Water Resource Management (IWRM)
  - Low Impact Development (LID)
- 1.5 Applicability
  - New Development/ Redevelopment
- 1.6 Use and Organization of the Manual

Ventura County MS4 Permit

Stated Purpose (Section 4.E.1)

- Lessen water quality impacts of development
  - Promote Smart Growth, Compact Development, Infill, Redevelopment
- Minimize impacts on biological integrity of Natural Drainage Systems
- Minimize Effective Impervious Area (EIA) to mimic predevelopment water balance

Ventura County MS4 Permit

Stated Purpose, cont.

- Minimize pollutant loading from impervious surfaces through source control, Low Impact Development (LID), and treatment control BMPs
- Proper design of BMPs to address pollutants of concern and to ensure long-term adequate function

Project Applicability

New Development

- All projects ≥ 1 acre disturbed area and >10,000 sf impervious area
- Parking lots 5,000 sf impervious area or 25 spaces
- Commercial strip mall ≥ 10,000 sf impervious area
- Projects located in or directly adjacent to, or discharging directly to an Environmentally Sensitive Area (ESA) and ≥ 2,500 sf impervious area

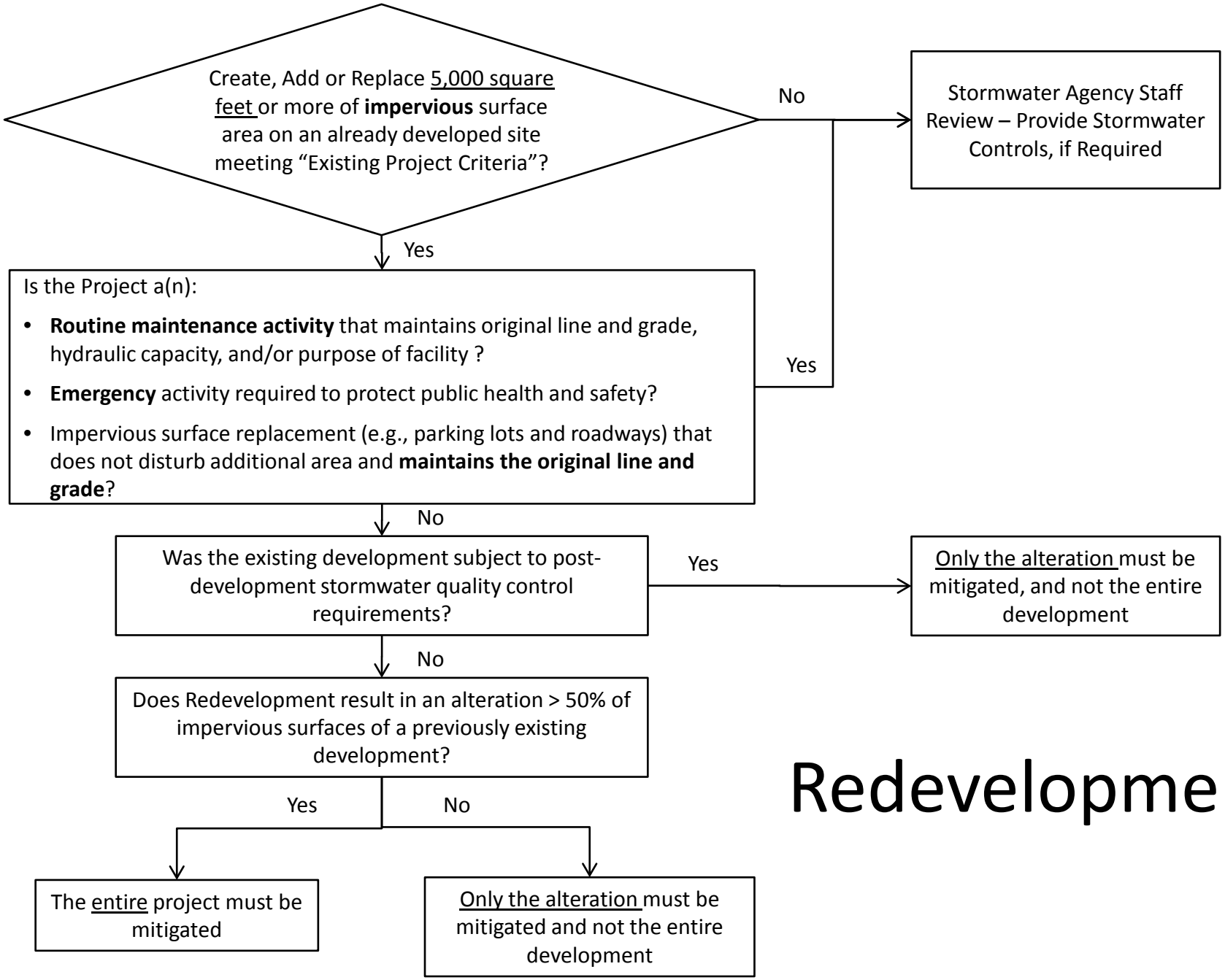
ESAs

- Areas subject to stormwater mitigation requirements:
- 303d listed waterbodies
- Coastal Commission's Environmentally Sensitive Habitat Areas
- RARE and BIOL designated waterbodies
- CDFG's Significant Natural Areas

Project Applicability

New Development, cont.

- Industrial park ≥ 10,000 sf of surface area
- Retail gasoline, restaurants, automotive service facilities ≥ 5,000 sf surface area



Redevelopment

Special Project Categories

Separate Requirements Exist for:

- Projects located within a Redevelopment Project Area Master Plan (RPAMP)
- Single Family Hillside Home
- Roadway Projects

Redevelopment Project Area Master Plan (RPAMP)

- RPAMP requirements take precedent
- A municipality may apply to the Regional Board for approval
- RPAMP requirements
- Currently no plans to develop an RPAMP

Single Family Hillside Home

- Disturb <1 ac and add < 10,000 sf impervious area
- Known erosive conditions
- Grading on slope ≥ 20% or designated as a “hillside area” by General Plan

Single Family Hillside Home

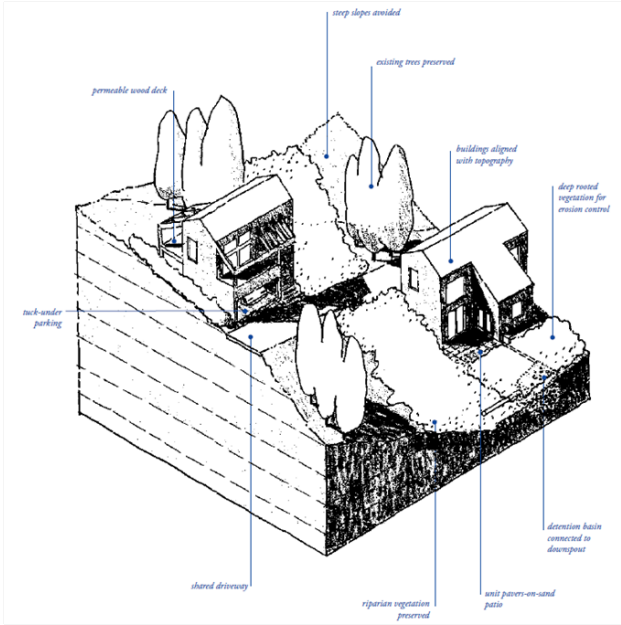
- Conserve Natural Areas
  - Concentrate development on least-sensitive portion of the lot
  - Limit clearing and grading
  - Plant additional vegetation; use native/drought-tolerant plants
- Provide stenciling at all storm drain inlets

Single Family Hillside Home

- Slope Protection
  - Safely convey runoff from the top of slopes
  - Vegetate slopes using native or drought-tolerant species
- Channel Protection
  - Minimize runoff
  - Stabilize permanent channel crossings
  - Install energy dissipaters (e.g., riprap) at outlets

Single Family Hillside Home

- Direct Runoff to:
  - Vegetated pervious area
    - Use dispersion method such as a splash block
    - Flow path should be 25 ft in length
      or utilize stub-out connection
    - Avoid creation of erosive conditions
      and do not discharge above slopes >20%
  - Rainwater collection system

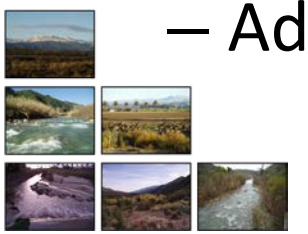


Roadway Projects

- Applies to impervious area within right-of-way assoc. with public streets, roads, highways, and private roads ≥ 10,000 sf
- Does not apply to routine maintenance activities that maintain original line and grade
- US EPA's *Managing Wet Weather with Green Infrastructure: Greet Streets*

Roadway Projects

- Provide Retention or Biofiltration BMPs designed to capture and treat the SQDV or SQDF
- Apply the following to the MEP:
  - Minimize street width while accommodating traffic flow and public safety
  - Use porous pavement for low traffic roadways, on-street parking, shoulders or sidewalks
  - Add tree canopy



Effective Date

- 90 calendar days after the Regional Board Executive Officer's approval of the revised TGM, except:

  1. Projects or phases of projects where the project's applications have been "**deemed complete for processing**" (or words of equivalent meaning)

Effective Date

- Except, cont.
  2. Projects that are the subject of an approved Development Agreement and/or an adopted Specific Plan; or an application for a Development Agreement and/or Specific Plan where the application for the **Development Agreement and/or Specific Plan has been "deemed complete for processing"** (or words of equivalent meaning)

Effective Date (cont.)

- Except, cont.

  3. All private projects in which, prior to the Effective Date, the private party has **completed public improvements; commenced design, obtained financing, and/or participated in the financing of the public improvements**; or which requires the private party to reimburse the local agency for public improvements upon the development of such private project

Effective Date (cont.)

- Except, cont.

4. Local agency projects for which the governing body or their designee has **approved initiation of the project design** prior to the Effective Date
5. A **Tentative Map or Vesting Tentative Map deemed complete** or approved by the local permitting agency prior to the Effective Date, and subsequently a Revised Map is submitted, the project would be exempt from the 2010 TGM provisions if the revisions substantially conform to original map design, consistent with Subdivision Map Act requirements. Changes must also comply with local and state law.

Effective Date (cont.)

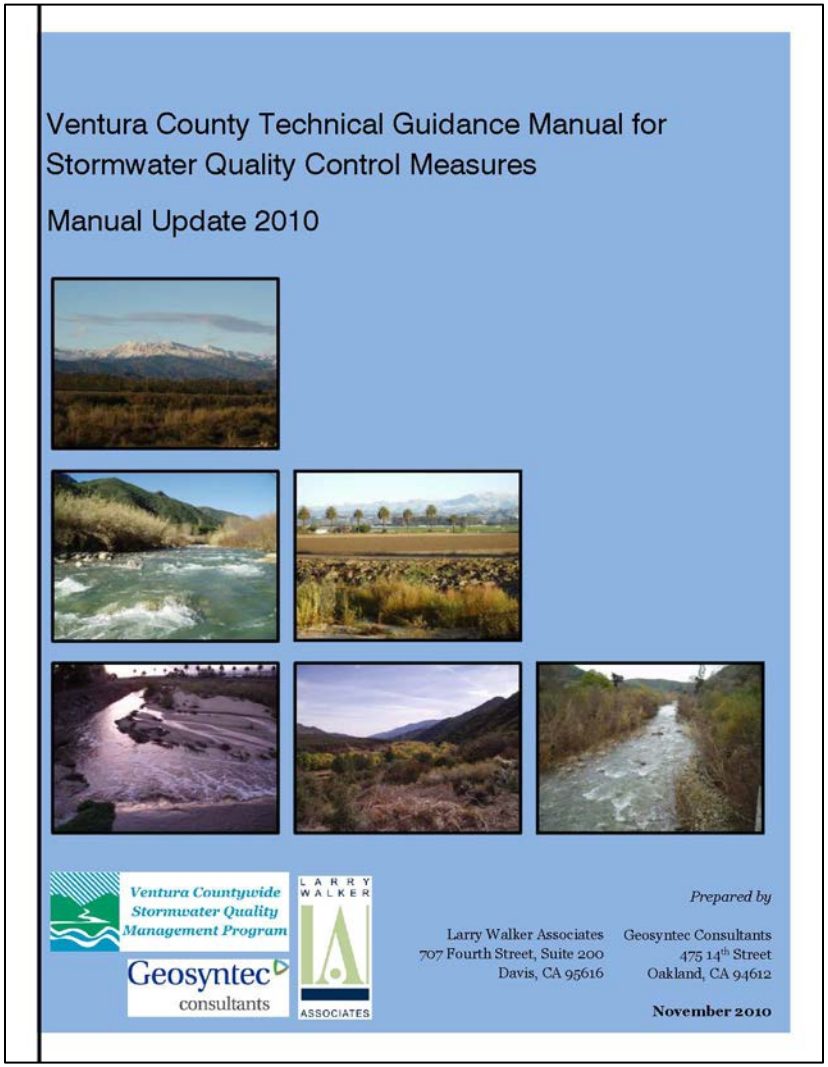
- Intent:
  - Applicants that have filed complete applications with a final, or substantially final, drainage concept and site layout that includes water quality treatment based upon the performance criteria set forth in the 2002 TGM are not required to redesign the proposed project for purposes of complying with the new permit.

Submittals

- Site Map
  - Latitude and longitude coordinates of approved BMPs and Treatment Control Measures
- Retention BMP, Biotreatment BMP, and Treatment Control Measure Design Details and Sizing Calculations
- Site-specific hydrologic and/or design infeasibility analyses conducted and endorsed by a registered professional engineer and/or geologist
- Maintenance Plan & Agreement

TGM Contents Part I

2. Stormwater Management Standards
3. Site Assessment and BMP Selection



Section 2: Stormwater Management Standards

- 3 Flow Charts:
  - Management Decision Flow Chart
  - BMP Selection Process / Reduce EIA to 5%
  - Alternative Compliance
- The flow charts and TGM Section 2 establish the framework and decision process to address permit requirements

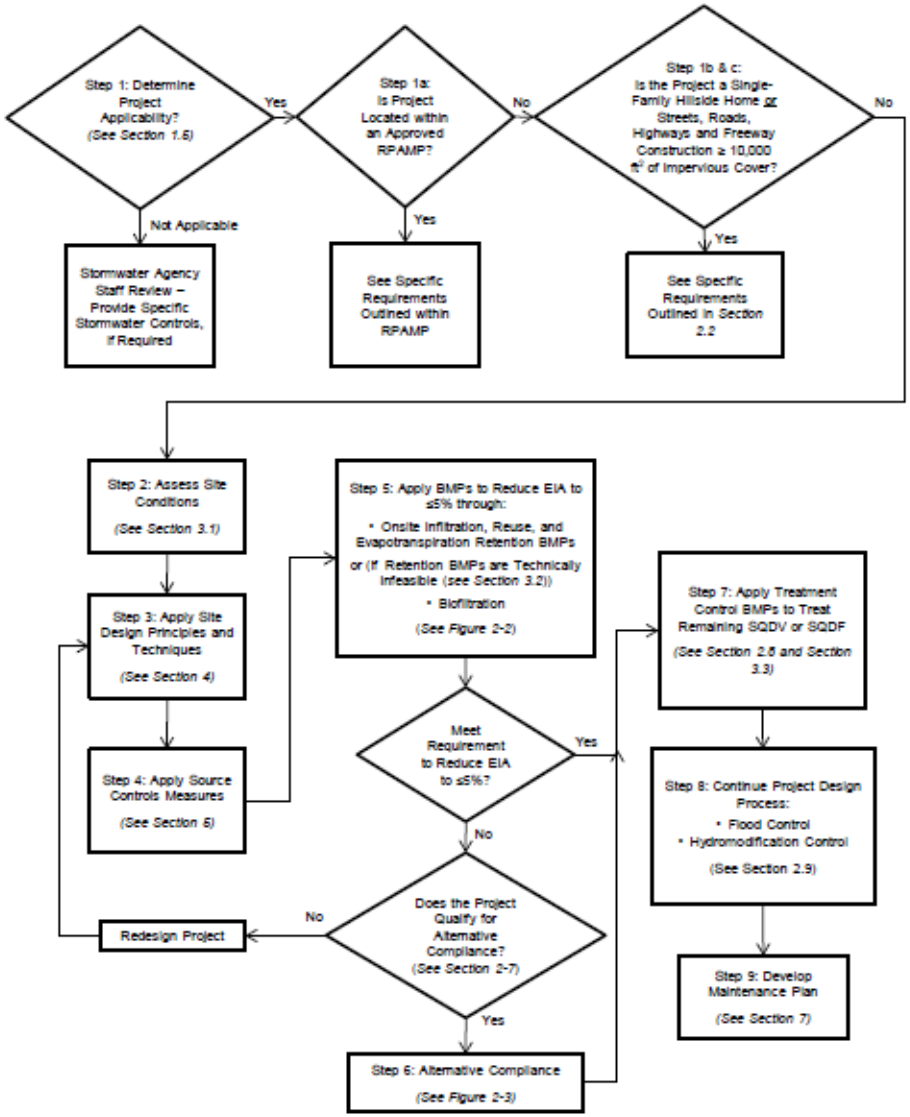


Figure 2-1: Stormwater Management Control Measures Design Decision Flowchart

Stormwater Management Control Measures Design Decision Flowchart

- 9 overall steps
- Guidance on each step in TGM Section 2
- More detailed guidance in TGM Sections 3 - 7

Step 1

- Determine if Project is Subject to TGM
  - Project Categories, Thresholds and Effective Date in Section 1.5
  - If Project is Subject to RPAMP, implement requirements in RPAMP
  - If Single-Family Hillside Home or Street, Road or Highway Project, implement BMPs in Section 2.2

Step 2

2. Assess Site Conditions (Section 3.1)
   - Understanding site conditions and constraints is critical to laying out the site and selecting and siting BMPs

3.1 Assessing Site Conditions and Other Constraints

- Topography
- Soil Type and Geology
- Groundwater Considerations
- Geotechnical Considerations
- Managing Off-site Drainage
- Existing Utilities
- Environmentally Sensitive Areas

Steps 3 - 4

3. Apply Site Design Principles & Techniques (Section 4)
   - Protect Natural Areas
   - Minimize Land Disturbance
   - LID Considerations Early in Site Planning Process
4. Apply Source Controls (Section 5)

Step 5

5. Select BMPs to Reduce EIA to ≤5%

   – Move to next flow chart,

   but first

   – A few key definitions

Key Definitions

- "**Impervious surface**" is a man-made hard surface area which causes water to run off the surface in greater quantities or at an increased rate of flow from the flow present under natural conditions prior to development. Common impervious surfaces include, but are not limited to, rooftops, walkways, patios, driveways, parking lots or storage areas, concrete or asphalt paving, compacted gravel roads, packed earthen materials, and oiled, macadam or other surfaces which similarly impede the natural infiltration of stormwater. Open, uncovered retention/ detention facilities and exposed bedrock shall not be considered as impervious surfaces for purposes of determining EIA retention volume.

- "**Total project area**" (or "gross project area") for new development and redevelopment projects is defined as the disturbed, developed, and undisturbed portions within the project's property (or properties) boundary, at the project scale submitted for first approval. Areas proposed to be permanently dedicated for open space purposes as part of the project are explicitly included in the "total project area." Areas of land precluded from development through a restrictive covenant, conservation easement, or other recorded document for the permanent preservation of open space prior to project submittal shall not be included in the "total project area."

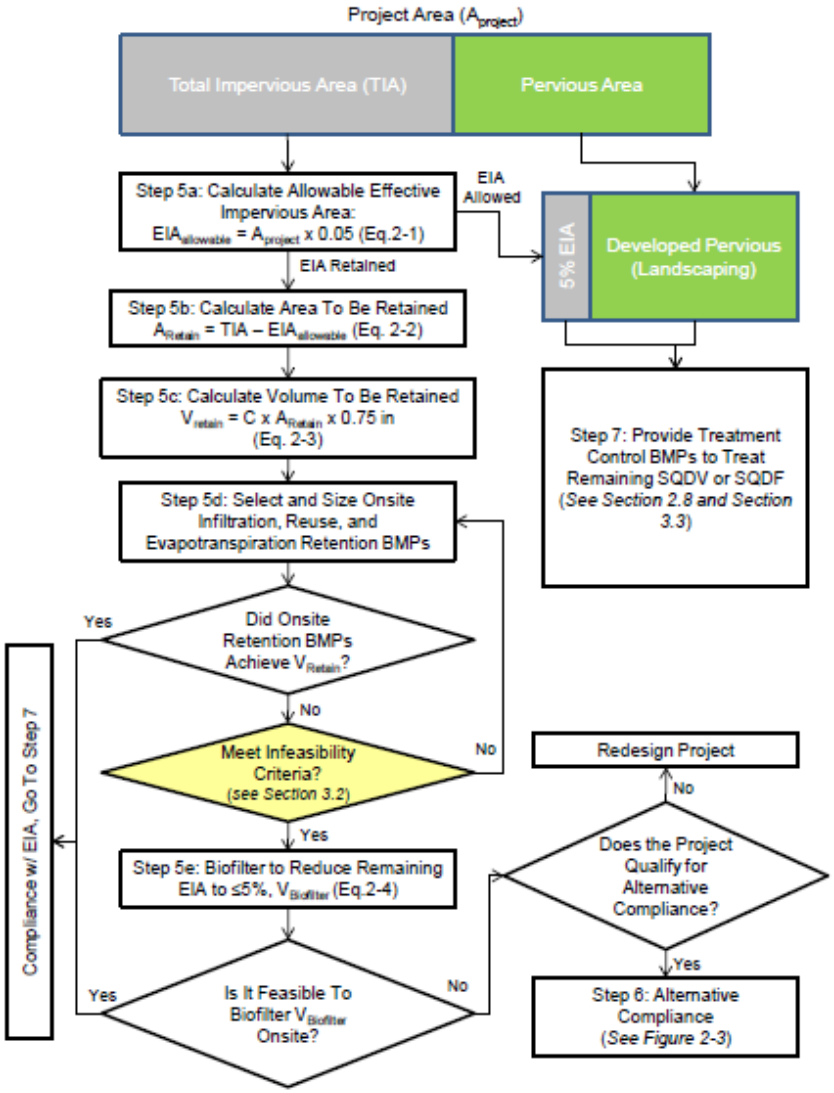
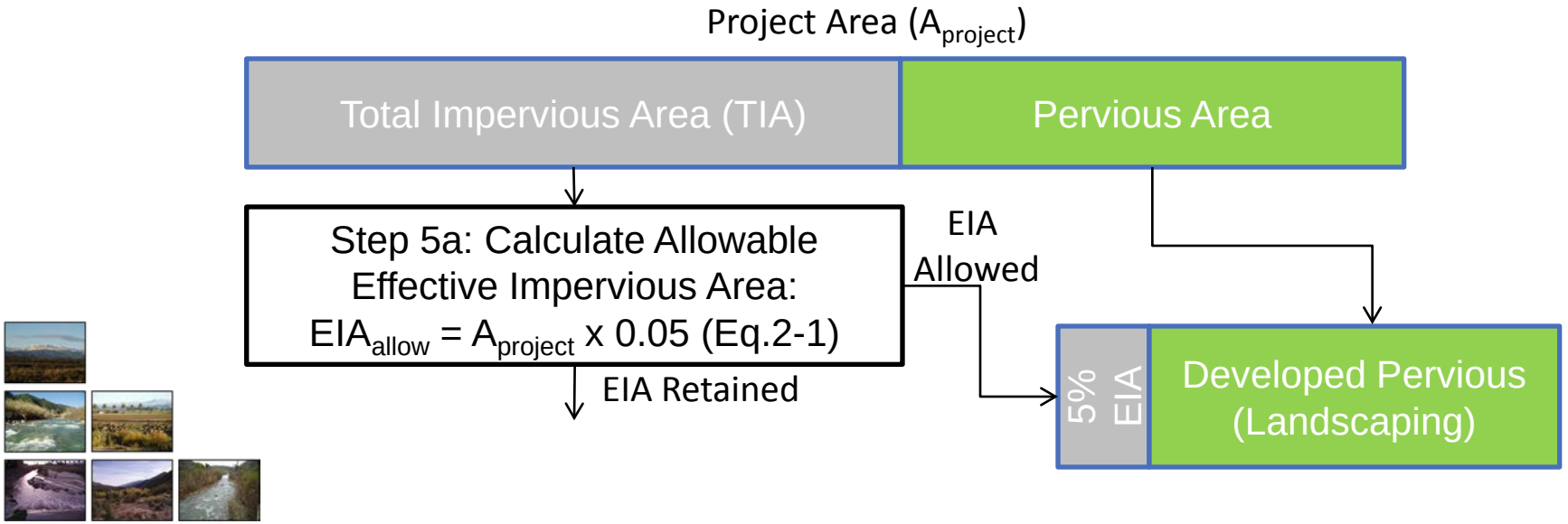


Figure 2-2. Step 5: Apply BMPs to Reduce EIA to ≤5%

Step 5

5a. Calculate Allowable EIA

- the maximum impervious area from which runoff can be treated and discharged offsite (acres)
- No more than 5% of total project area



Total Project Area: A_{total} = 10 acres

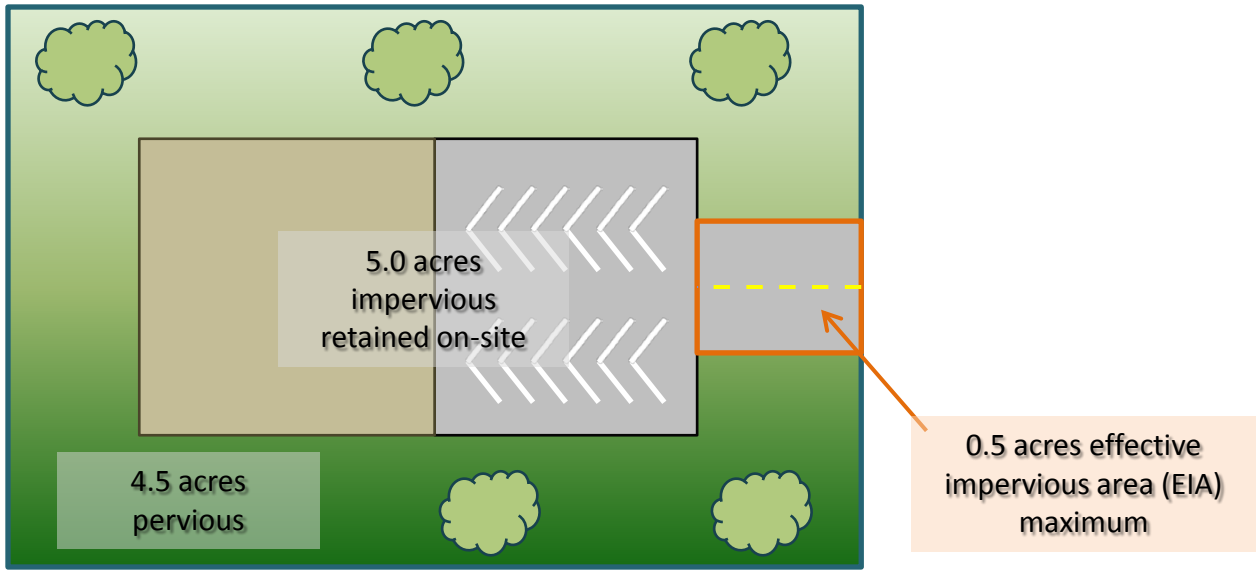
Maximum allowed EIA = A_{total} * 0.05 = 0.5 acres

$A_{impervious}$ = 5.5 acres (building, parking lot, driveway)

$A_{pervious}$ = 4.5 acres (surrounding landscaping)

$A_{retained}$ = 5.5 – 0.5 = 5 acres retained onsite (minimum)

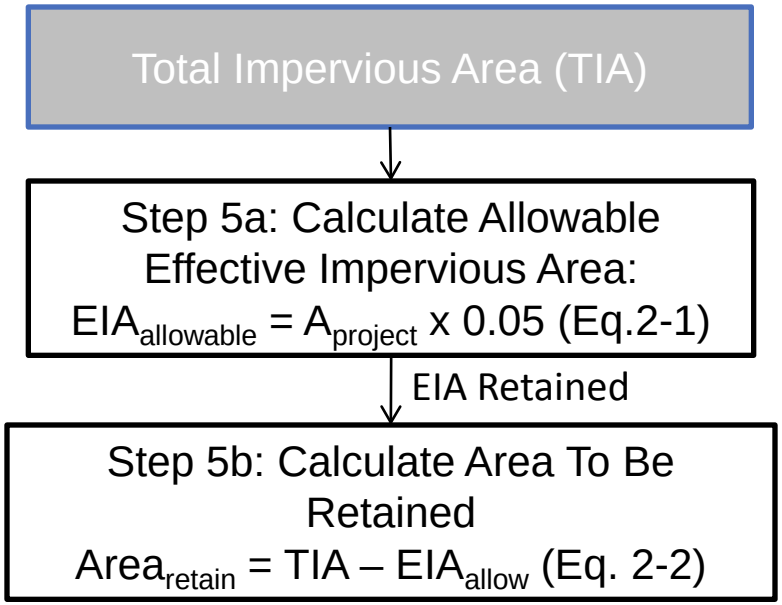
$A_{treated}$ = 0.5 + 4.5 = 5 acres treated



Step 5

5b. Calculate the Impervious Area to be Retained

- The impervious area from which runoff must be retained onsite is the total impervious area minus the Allowable EIA ($EIA_{allowable}$)



Step 5

5c. Calculate the Volume to be Retained

Step 5c: Calculate Volume To Be Retained

$V_{Retain} = C \times Area_{retain} \times 0.75$ inch (Eq. 2-3)

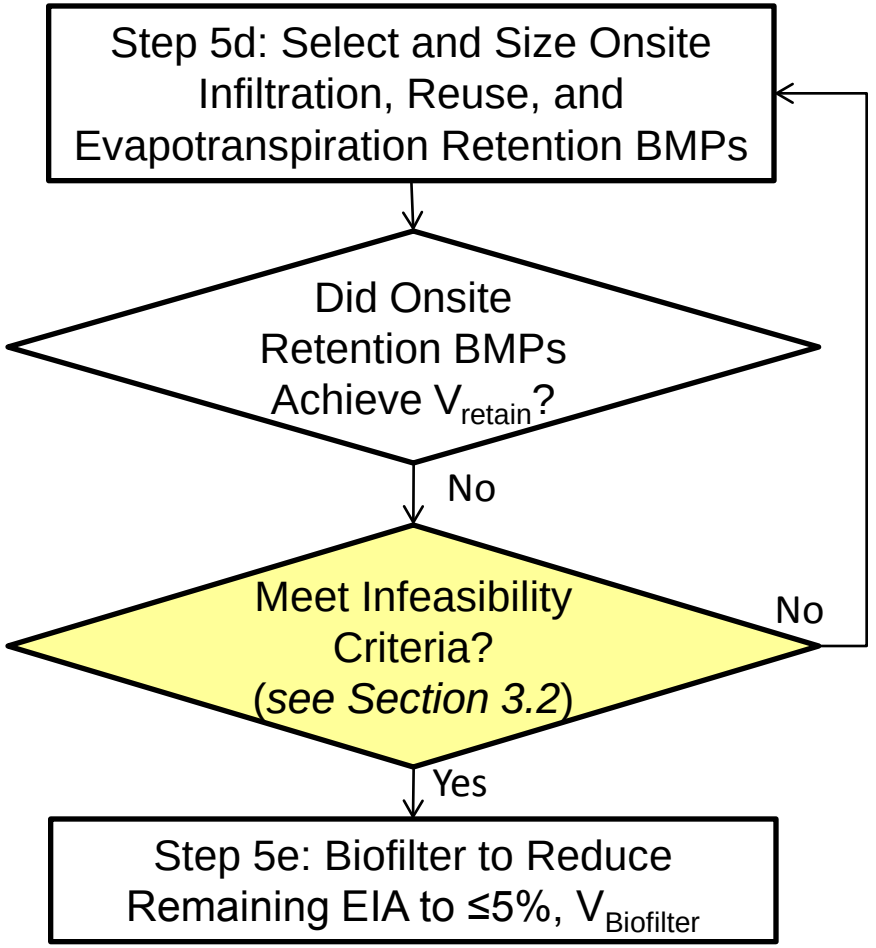
5d. Select and Size Retention BMPs

In order to render impervious surfaces “ineffective”, Retention BMPs must be sized to retain the Stormwater Quality Design Volume (SQDV)

Step 5

5e. Biofilter to Reduce Remaining EIA to ≤5%

- Demonstrate technical infeasibility
- Apply Retention BMPs to the MEP
- Use Biofiltration BMPs sized to treat 1.5 times the remaining volume



3.2 Technical Feasibility Screening

- Technical infeasibility may result from:
  - Seasonal High Groundwater Table (≤5 feet below BMP bottom surface)
  - Within setbacks:
    - 100 feet of a groundwater well used for drinking water, non-potable wells, drain fields, and springs
    - 50 feet from slopes steeper than 15 percent or an alternative setback established by the geotechnical expert for the project
    - 8 feet from building foundations or an alternative setback established by the geotechnical expert for the project
  - Sites with documented potential for groundwater pollutant mobilization

3.2 Technical Feasibility Screening

- Technical infeasibility (continued):
  - Locations with geotechnical hazards established by geotechnical engineer
  - Projects with high-risk areas such as service/gas stations, truck stops, and heavy industrial sites, unless a site-specific evaluation demonstrates that:
    - Treatment is provided to address pollutants of concern, and/or
    - High risks areas are isolated from stormwater runoff or infiltration areas with little chance of spill migration.

3.2 Technical Feasibility Screening

- Technical infeasibility (continued):
  - Locations where reduction of runoff may impair beneficial uses
  - Locations where increase in infiltration could impair beneficial uses

    - Either of these infeasibility criteria must be documented in a site-specific study such as CEQA analysis or watershed plan

3.2 Technical Feasibility Screening

- Technical infeasibility (continued):
  - Ventura Soil No. 1-2 (measured infiltration <0.3 in/hr)

    - If the site has Ventura Soil No. 3 (measured infiltration 0.3 to 0.5 in/hr) and no other infiltration-related infeasibility criteria apply, use a Bioinfiltration BMP or Rainwater Harvesting (if feasible) to achieve the 5% EIA requirement.

3.2 Technical Feasibility Screening

- Technical infeasibility (continued):
  - Green roofs are optional subject to the approval of the permitting authority
  - Insufficient demand for harvested stormwater
    - 80% capture with a 72 hour drawdown time
    - Considering all allowable and reliable demand
      - the rate of use under average wet season conditions (November through March) from sources meeting the following criteria

Allowable and Reliable Demand

- The use is permitted by building codes and health codes without requiring disinfection and fine filtration.
- The use is reliable on a seasonal basis, such that the lowest weekly demand on an average annual basis is no less than 2/7th of the wet season average.
  - Intent: Under worst-case conditions, the demand should still be sufficient to use the entire tank volume within a week.
- Where a reliable use is present on the site that is not permitted by building codes and/or health codes, a variance has been sought to allow use without disinfection and fine filtration.
- The use does not conflict with mandatory use of reclaimed water. It is assumed that uses do not conflict unless water balance calculations are provided to demonstrate the contrary.
- The estimated use rates are consistent with requirements for low water use landscaping requirements under local and statewide ordinance (including California Assembly Bill 1881).

3.2 Technical Feasibility Screening

- Technical infeasibility (continued):
  - Green roofs are optional subject to the approval of the permitting authority
  - BMPs that are not allowable per current federal, state or local codes.
    - Local codes will be updated by mid-2012.
  - Project where density and/or nature of the project would create significant difficulty for compliance
    - Redevelopment (defined in Section 1.5)
    - Infill and Smart Growth

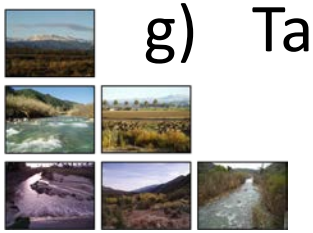
Infill Definition

- Infill projects meet the following conditions:
  a) consistent with applicable general plan and zoning designations
  b) occurs on a project site of no more than 5 ac substantially surrounded by urban uses
  c) no value as habitat for endangered, rare, or threatened species
  d) not result in any significant effects relating to traffic, noise, air quality, or water quality
  e) can be adequately served by all required utilities and public services

(modified from State Guidelines § 15332)

Smart Growth Definition

- Projects that occur within existing urban areas (mapped in Appendix B) designed to achieve the majority of the following principles:
  a) Create a range of housing choices
  b) Create walkable neighborhoods
  c) Mix land uses
  d) Preserve open space, natural beauty, and critical areas
  e) Provide a variety of transportation choices
  f) Direct development towards existing communities
  g) Take advantage of compact building design



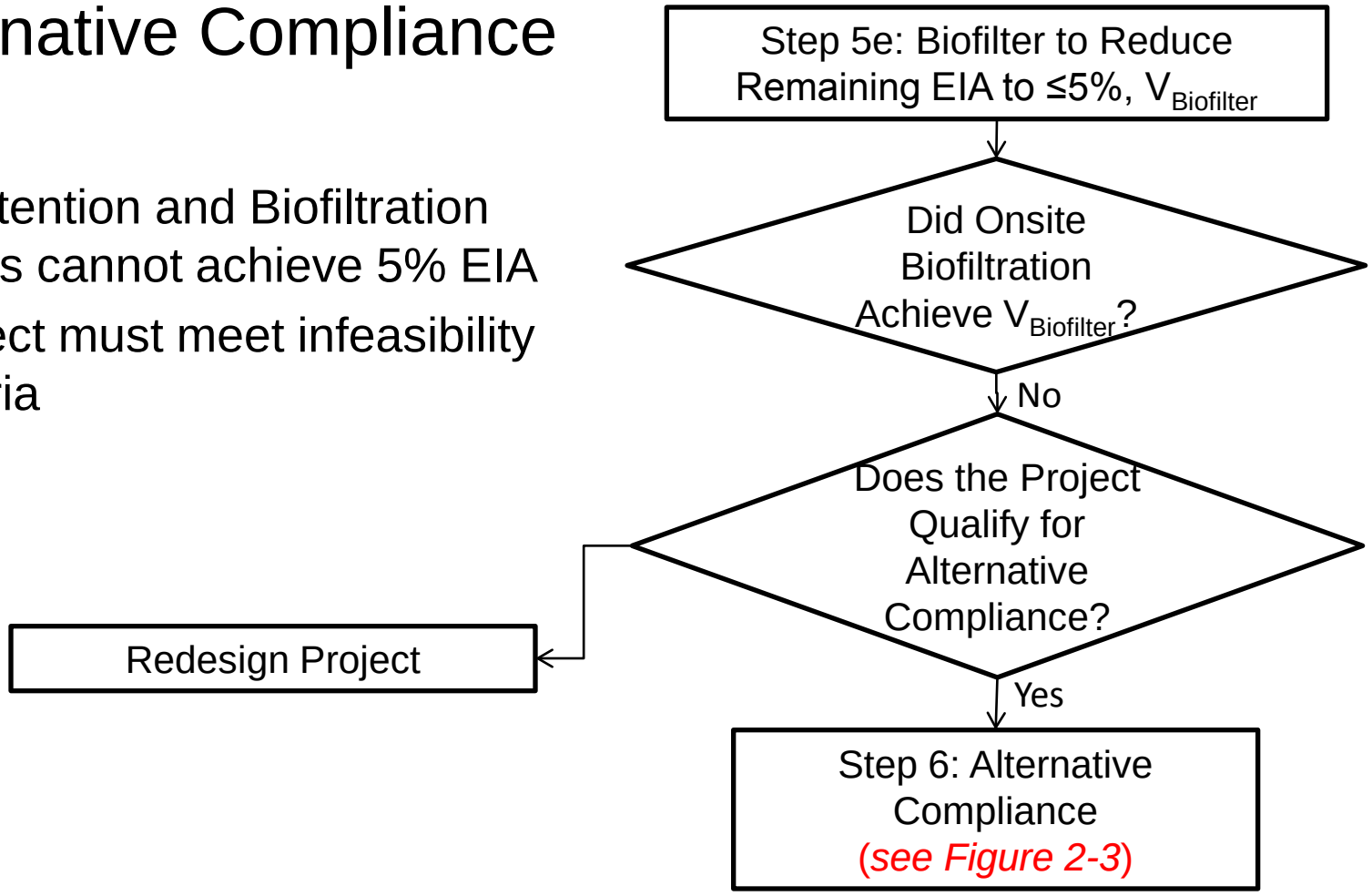
3.2 Technical Feasibility Screening

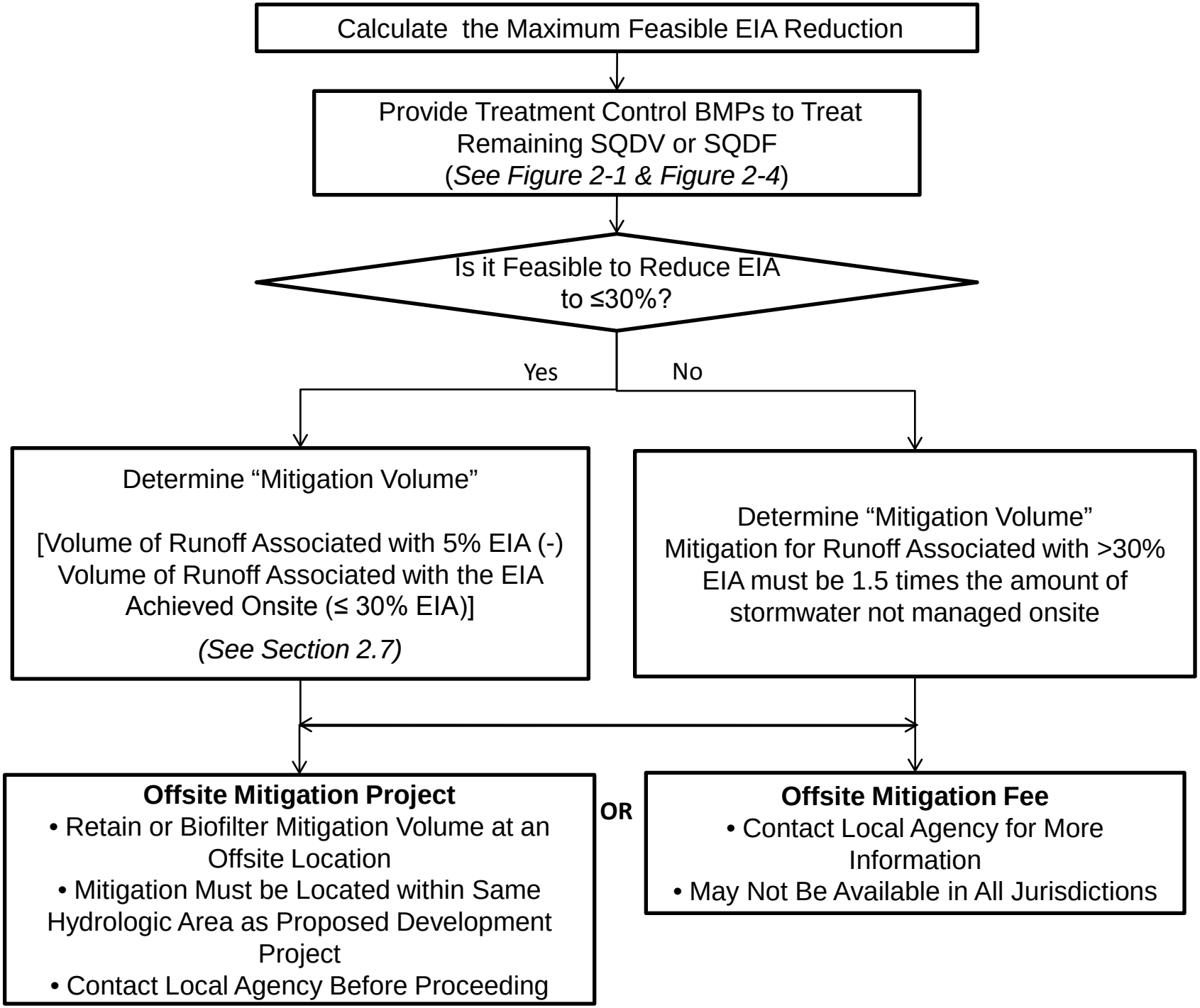
- Technical infeasibility (continued):
  - Pedestrian/bike trail projects
    - Located along side of a road and ROW width is inadequate
  - Agency flood control, drainage, and wet utilities projects
    - Located within waterbody and is therefore not increasing functional impervious cover; or
    - Located on top of a narrow flood control feature (such as a levee) and space is unavailable for the implementation of Retention and/or Biofiltration BMPs; or
    - Where the integrity of the flood control feature (such as a dam or levee) may be compromised through Retention and/or Biofiltration BMPs (e.g., infiltration of stormwater is not appropriate in a levee).
  - Historical preservation projects
    - Where the extent of the designated preservation area restricts the amount of land available for the implementation of Retention BMPs.
  - Low income housing projects that occur within existing urban areas
    - Where density requirements restrict the amount of land available for the implementation of Retention BMPs and/or
    - Where project financing constraints restrict the amount of land available for the implementation of Retention BMPs.

Step 6

6. Alternative Compliance

- If Retention and Biofiltration BMPs cannot achieve 5% EIA
- Project must meet infeasibility criteria




Calculate the Maximum Feasible EIA Reduction
Provide Treatment Control BMPs to Treat Remaining SQDV or SQDF (See Figure 2-1 & Figure 2-4)
Is it Feasible to Reduce EIA to ≤30%?
Yes
No
Determine "Mitigation Volume"
[Volume of Runoff Associated with 5% EIA (-) Volume of Runoff Associated with the EIA Achieved Onsite (≤ 30% EIA)]
(See Section 2.7)
Determine "Mitigation Volume"
Mitigation for Runoff Associated with >30% EIA must be 1.5 times the amount of stormwater not managed onsite
Offsite Mitigation Project
• Retain or Biofilter Mitigation Volume at an Offsite Location
• Mitigation Must be Located within Same Hydrologic Area as Proposed Development Project
• Contact Local Agency Before Proceeding
OR
Offsite Mitigation Fee
• Contact Local Agency for More Information
• May Not Be Available in All Jurisdictions

Step 6

Calculate the Maximum Feasible EIA Reduction

- Section 3.2 provides criteria for determining “maximized” volume for Retention and Biofiltration BMPs
- Table 3-1 lists % of site feasible to dedicate to BMPs based on project type

Project Type		Percent of Site[1]
New Development	SF/MF Residential < 7 du/ac	10
	SF/MF Residential 7 – 18 du/ac	7
	SF/MF Residential > 18 du/ac	5
	Mixed Use, Commercial, Institutional/Industrial w/ FAR < 1.0	10
	Mixed Use, Commercial, Institutional/Industrial w/ FAR 1.0 – 2.0	7
	Mixed Use, Commercial, Institutional/Industrial w/ FAR > 2.0	5
	Podium (parking under > 75% of project)	3
	Projects with zoning allowing development to lot lines	2
	Transit Oriented Development	5
	Parking	5

[1] If subsurface BMPs are used, dedicated area may have other surface land uses which do not structurally impact the subsurface BMP (see INF-6: Proprietary Infiltration).

“Maximized” Volume for Retention and Biofiltration BMPs

- Volume can be considered to be maximized when all of the following conditions are met:
  - Infiltration BMPs are not required to exceed the depth that infiltrates within 48 hours at the design percolation rate
  - All practicable methods are employed to enhance the design percolation rate for infiltration BMPs
  - Drain time and/or treatment rate of Biofiltration BMP is consistent with design guidance contained in Section 6
  - The maximum pervious area feasible for BMPs has been provided and the proposed BMPs have been configured to make use of this area

Step 6

- Alternative compliance options will be based on the "mitigation volume"
- The mitigation volume is the difference between the volume that must be retained per the 5% EIA requirement and the amount feasibly retained and/or biofiltered onsite
  - Mitigation for volume assoc. w/ ≤30% EIA is 1:1
  - Mitigation for >30% EIA is 1.5 times the amount of stormwater not managed onsite

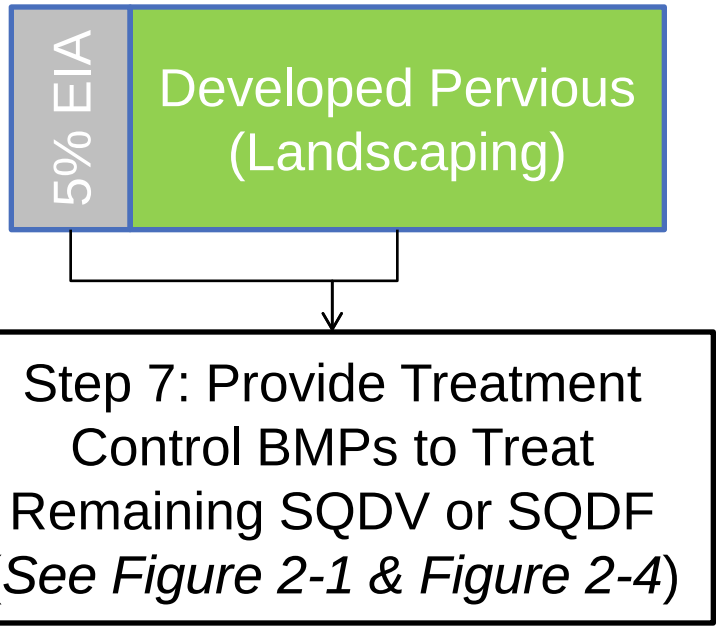
Alternative Compliance

- Offsite Mitigation Project
  - Mitigation volume must be retained at offsite location
  - Must be within same hydrologic area

- Offsite Mitigation Fee
  - May be an option in future

Step 7

7. SQDV/SQDF from impervious surfaces and developed pervious surfaces not fully retained onsite must be mitigated onsite using Treatment Control Measures

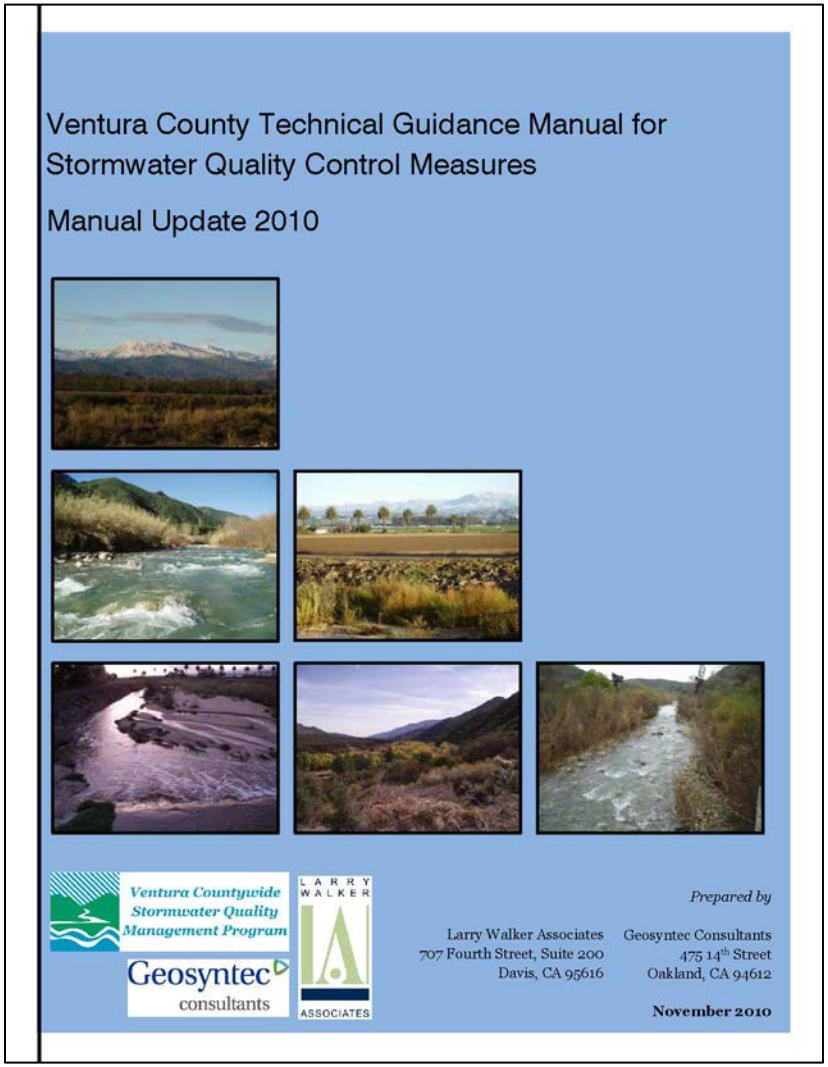


3.3 Treatment Control Measure Selection Guidance

- Treatment Control Measures shall be selected based on the primary class of pollutants likely to be discharged from the project
  - See Table 3-2
- For projects that discharge to an impaired waterbody and whose discharges contain the pollutant causing impairment, the project shall select Treatment Control Measures from the top three performing BMP categories, or alternative BMPs that are designed to meet or exceed the performance of the highest performing BMP, for the pollutant causing impairment
  - See Table 3-4
- Proprietary BMPs must meet or exceed the performance standards listed in Attachment C in Order R4-2010-0108 (provided in Appendix D)

TGM Contents Part II

4. Site Design Principles and Techniques
5. Source Control Measures



Section 4: Site Design Principles & Techniques

Includes:

- Site Planning
- Protect and restore natural areas
- Minimize land disturbance
- Minimize impervious cover
- Apply LID at various scales
- Implement integrated Water Resource Mgt Practices

- Primary Objective is to reduce the hydrologic and water quality impacts assoc. with development
- Most applicable to greenfield development

Section 4: Site Design Principles & Techniques

4.2 Site Planning

- Consider retention BMPs as early in the process as possible
- Look for opportunities to simultaneously address flood control and EIA requirements
- Multidisciplinary approach
- Consider use of alternative building materials; avoid materials made out of copper and zinc

Section 4: Site Design Principles & Techniques

Table 4-1: Rule of Thumb Space Requirements

BMP Type	% of Contributing Drainage Area
Infiltration	3 to 10
Rainwater Harvesting (Cistern)	0 to 10
Evapotranspiration (Green Roof)	1 to 1 ratio of impervious cover treated
Biofiltration	3 to 5
Dry Extended Detention Basin	1 to 3
Wet Detention Basin	1 to 3
Sand Filters	0 to 5
Cartridge Media Filter	0 to 5

Section 4: Site Design Principles and Techniques

4.3 Protect and Restore Natural Areas

- Cordon off streams, wetlands, and steep slopes
- Reserve areas with high permeability soils for infiltration BMPs
- Concentrate development on least-sensitive portion of site

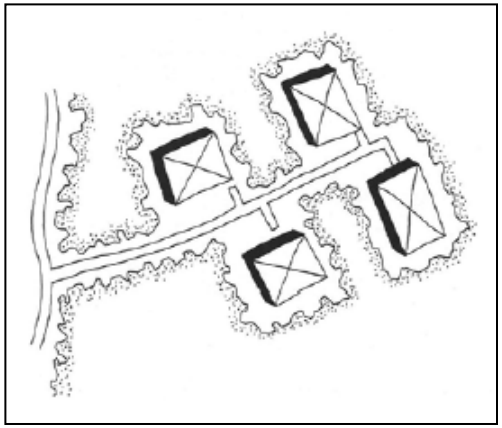
Stream Buffer

Larry Walker Associates

Section 4: Site Design Principles and Techniques

4.4 Minimize Land Disturbance

- Preserve natural hydrologic function of the site
- Delineate and flag development envelope
- Restrict clearing and grading activities to development envelope
- Consider soil amendments to restore permeability



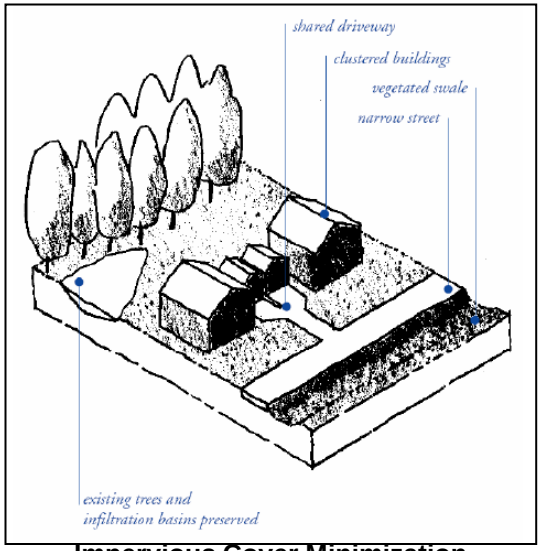
Minimized Clearing and Grading

Greenfield et al., 1991

Section 4: Site Design Principles and Techniques

4.5 Minimize Impervious Cover

- Reduces size needed for treatment BMPs
- Minimizes impacts assoc. with development
- Use minimum allowable roadway widths and driveway lengths
- Reduce building footprints
- Use permeable pavement
- Build more compactly in infill and redevelopment sites



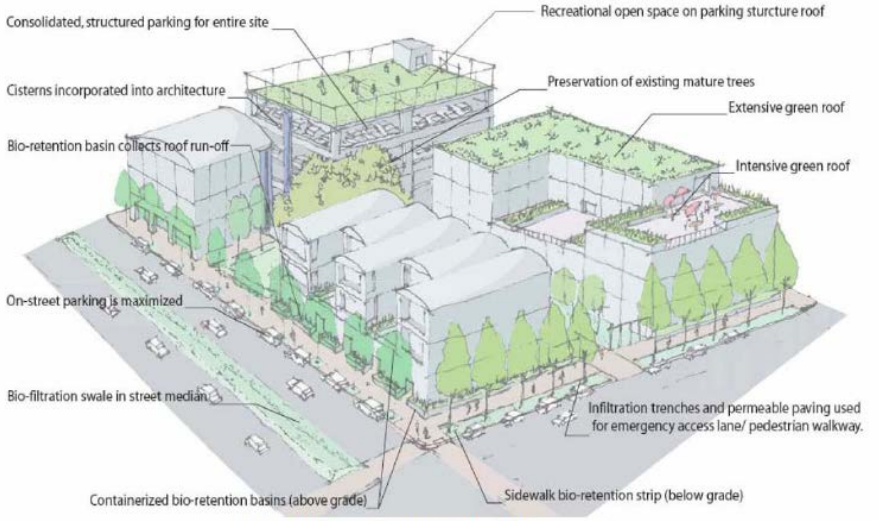
Impervious Cover Minimization

BASMAA, Start at the Source

Section 4: Site Design Principles and Techniques

4.6 Apply LID at Various Scales

- Regional/Watershed Scale
  - Density
  - Open Space
  - Redevelopment
- Site Level
  - Public Spaces
  - Compact Project Design
  - Multi Mode Transportation



LID BMPs Considered at Various Scales

C. Anderson, Sustainable Urbanism

Section 4: Site Design Principles and Techniques

4.7 Implement Integrated Water Resource Management Practices

- Multi-benefit BMPs (flooding, habitat, recreation, groundwater recharge)

Integrated Regional Water Management Plan

Ventura County

Section 5: Source Control Measures

- Designed to prevent pollutants from contacting stormwater runoff

Site-Specific Source Control Measure [1]	DESIGN FEATURE OR ELEMENT						
	Signs, placards, stencils	Surfacing (compatible, impervious)	Covers, screens	Grading/berming to prevent run-on	Grading/berming to provide secondary containment	Sanitary sewer connection	Emergency Storm Drain Seal
Storm Drain Message and Signage (S-1)	X						
Outdoor Material Storage Area Design (S-2)		X	X	X	X		X
Outdoor Trash Storage and Waste Handling Area Design (S-3)		X	X	X		X	
Outdoor Loading/Unloading Dock Area Design (S-4)		X	X	X	X		
Outdoor Repair/Maintenance Bay Design (S-5)		X	X	X	X		X
Outdoor Vehicle/Equipment/ Accessory Washing Area Design (S-6)		X	X	X	X	X	X
Fueling Area Design (S-7)		X	X	X	X		X
Parking Lot Design [2]							

Section 5: Source Control Measures

S-1: Storm Drain Message and Signage

- Required at all storm drain inlets within project boundary
- Consult local permitting agency

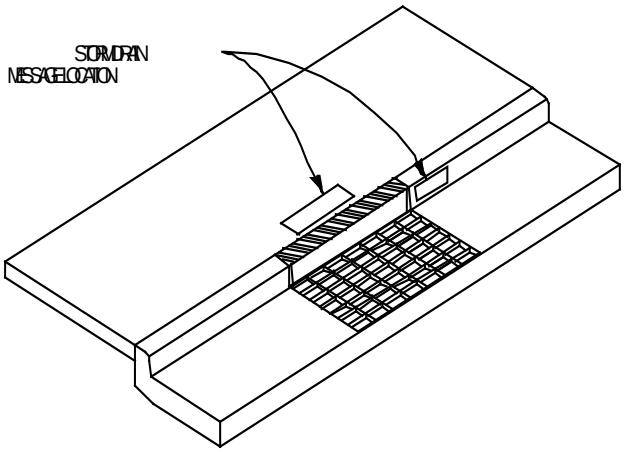


Figure 5-1: Storm Drain Message Location

Section 5: Source Control Measures

S-2: Outdoor Material Storage Area Design

- Eliminate possibility of stormwater contact with material storage areas
- Diversion, cover, or capture

Source Control Design Feature	Design Criteria
Surfacing	• Construct the storage area base with a material impervious to leaks and spills.
Covers	• Install a cover that extends beyond the storage area, or use a manufactured storage shed for small containers.
Grading/Containment	• Minimize the storage area. • Slope the storage area towards a dead-end sump to contain spills. • Grade or berm storage areas to prevent run-on from surrounding areas. • Direct runoff from downspouts/roofs away from storage areas.

Section 5: Source Control Measures

S-3: Outdoor Trash Storage Area Design

- Requirements governed by local codes and ordinances including Building and Fire codes
- Enhance local codes and ordinances

Source Control Design Feature	Design Criteria
Surfacing	• Construct the storage area base with a material impervious to leaks and spills.
Screens/Covers	• Install a screen or wall around trash storage area to prevent offsite transport of loose trash. • Use lined bins or dumpsters to reduce leaking of liquid wastes. • Use water-proof lids on bins/dumpsters or provide a roof to cover enclosure (local permitting agency discretion) to prevent rainfall from entering containers.
Grading/Contouring	• Berm or grade the waste handling area to prevent run-on of stormwater. • Do not locate storm drains in immediate vicinity of the trash storage area.
Signs	• Post signs on all dumpsters informing users that hazardous materials are not to be disposed of therein.

Section 5: Source Control Measures

S-4: Outdoor Loading/Unloading Dock Area Design

- Prevent run-on
- Direct downspouts away
- Storm drain prohibited

Section 5: Source Control Measures

S-5: Outdoor Repair/ Maintenance Bay Design

- Cover or enclose all maintenance/ repair areas
- Direct connection to storm drain prohibited
- Cover areas where parts and fluids are stored

CASQA Industrial & Commercial BMP Handbook

Section 5: Source Control Measures

S-6: Outdoor Vehicle/ Equipment/ Accessory Washing Area Design

- Wash waters are not allowed in the storm drain system
- Contain wash water and direct to pretreatment and sanitary sewer

Sacramento Stormwater Quality Program

Section 5: Source Control Measures

S-7: Fueling Area Design

- Area must be covered
- Grade to prevent run-on
- Do not drain to storm drains

Section 5: Source Control Measures

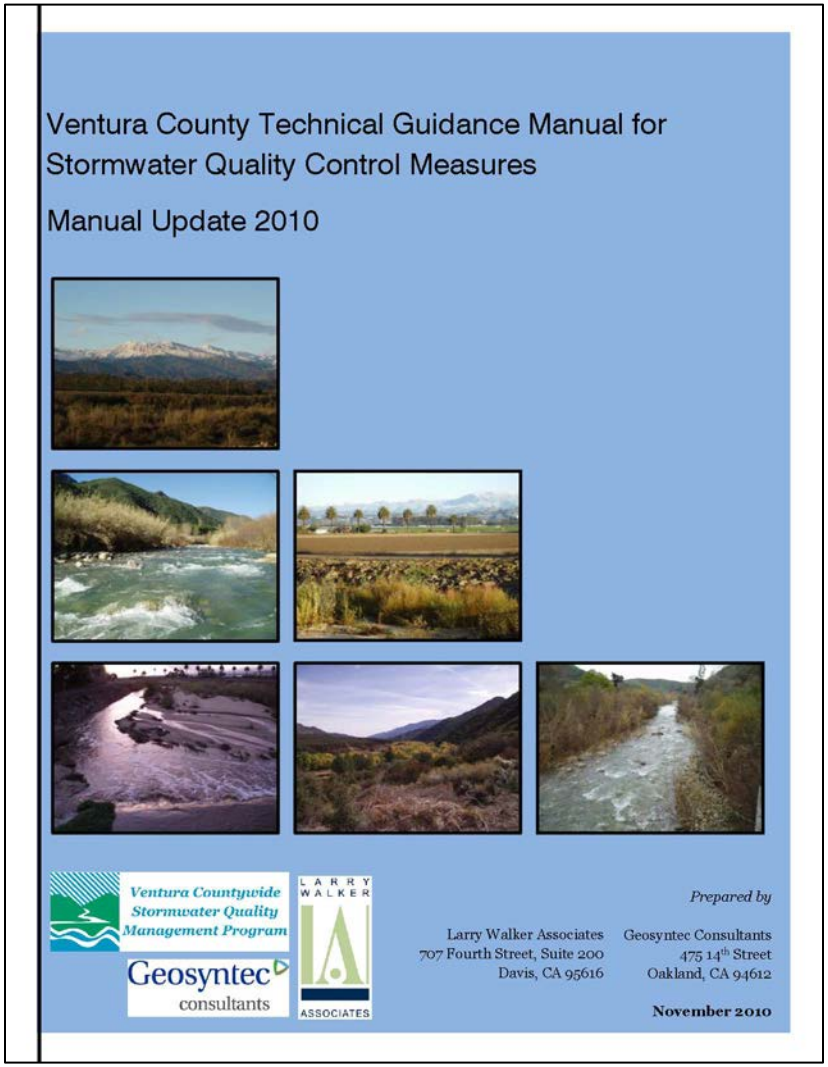
S-8: Proof of Control Measure Maintenance

- Maintenance Agreement
- Maintenance Plan
- *Refer to Appendix H*

TGM Contents Part III

6. Stormwater BMP Design
7. Maintenance Plan

Appendices



Section 6: Stormwater BMP Design

- General Considerations
  - Maintenance Responsibility
  - Pretreatment
  - Infiltration
  - Biofiltration BMPs
  - Treatment Control Measures
    - Filtration
    - Wetpools
  - “On-line” and “Off-line” Facilities

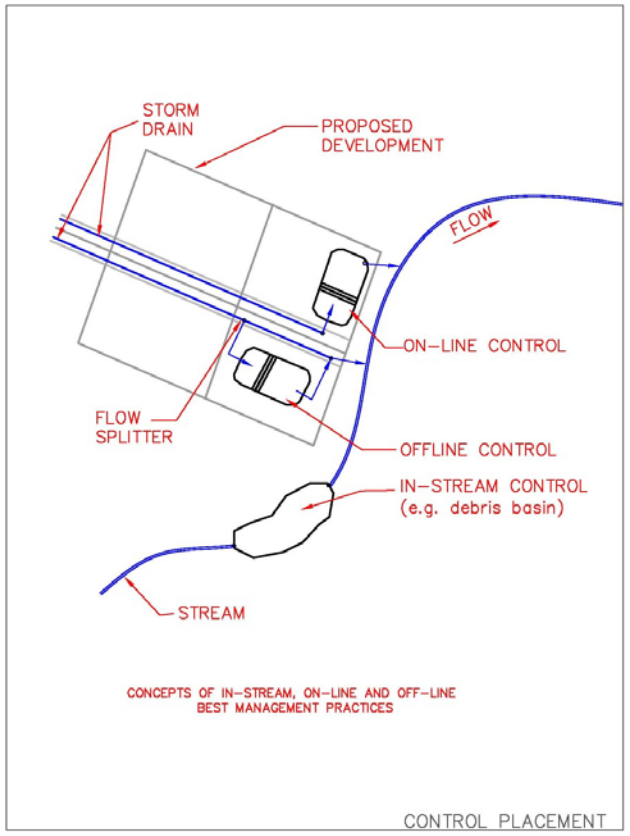


Figure 6-1: Differences between On-line, Off-line, and In-stream Control Measures

Section 6: Stormwater BMP Design

- Retention BMPs
  - Infiltration BMPs
    - INF-1: Infiltration Basin
    - INF-2: Infiltration Trench
    - INF-3: Bioretention
    - INF-4: Drywell
    - INF-5: Permeable Pavement
    - INF-6: Proprietary Infiltration
    - INF-7 Bioinfiltration

Bioretention in Parkway and parking lots

Photo Credit: Geosyntec Consultants

Permeable pavement application

Photo Credit: Geosyntec Consultants

Section 6: Stormwater BMP Design

- Retention BMPs
  - Rainwater Harvesting BMPs
    - RWH-1: Rainwater Harvesting
  - Evapotranspiration BMPs
    - ET-1: Green Roof
    - ET-2: Hydrologic Source Control BMPs
- Pretreatment/Gross Solids Removal BMPs
  - PT-1: Hydrodynamic Device
  - PT-2: Catch Basin Insert

Green Roof Example

Photo Credit: Geosyntec Consultants

Section 6: Stormwater BMP Design

- Biofiltration BMPs
  - BIO-1: Bioretention with Underdrain
  - BIO-2: Planter Box
  - BIO-3: Vegetated Swale
  - BIO-4: Vegetated Filter Strip
  - BIO-5: Proprietary Biotreatment

Proprietary Biotreatment Example

Photo Credit: Filterra®

Vegetated swale captures flow from a residential street

Photo Credit: Geosyntec Consultants

Section 6: Stormwater BMP Design

- Treatment Control Measures
  - TCM-1: Dry Extended Detention Basin
  - TCM-2: Wet Detention Basin
  - TCM-3: Constructed Wetland
  - TCM-4: Sand Filter
  - TCM-5: Cartridge Media Filter

Wet Detention Basin

Photo Credit: Geosyntec Consultants

INF-1: Infiltration Basin

- Description:
  - Earthen basin placed in naturally pervious soils
  - Forebay or settling basin recommended prior to infiltration
- Applications:
  - Mixed-use/ Commercial/ Single- or Multi-Family
  - Roads, Parking Lots
  - Parks and Open Space

INF-1: Infiltration Basin

An infiltration basin consists of an earthen basin constructed in naturally pervious soils (Type A or B soils) with a flat bottom and provided with an inlet structure to dissipate energy of incoming flow and an emergency spillway to control excess flows. An optional relief underdrain may be provided to drain the basin if standing water conditions occur. A forebay settling basin or separate Treatment Control Measure must be provided as pretreatment. An infiltration basin functions by retaining the SQDV in the basin and allowing the retained runoff to percolate into the underlying native soils over a specified period of time. The bottoms of infiltration basins are typically vegetated with dry-land grasses or irrigated turf grass. A typical layout of an infiltration basin system is shown in Figure 6-2.

Infiltration Basin in a Fresno, CA Park, Before and After a Rain Event

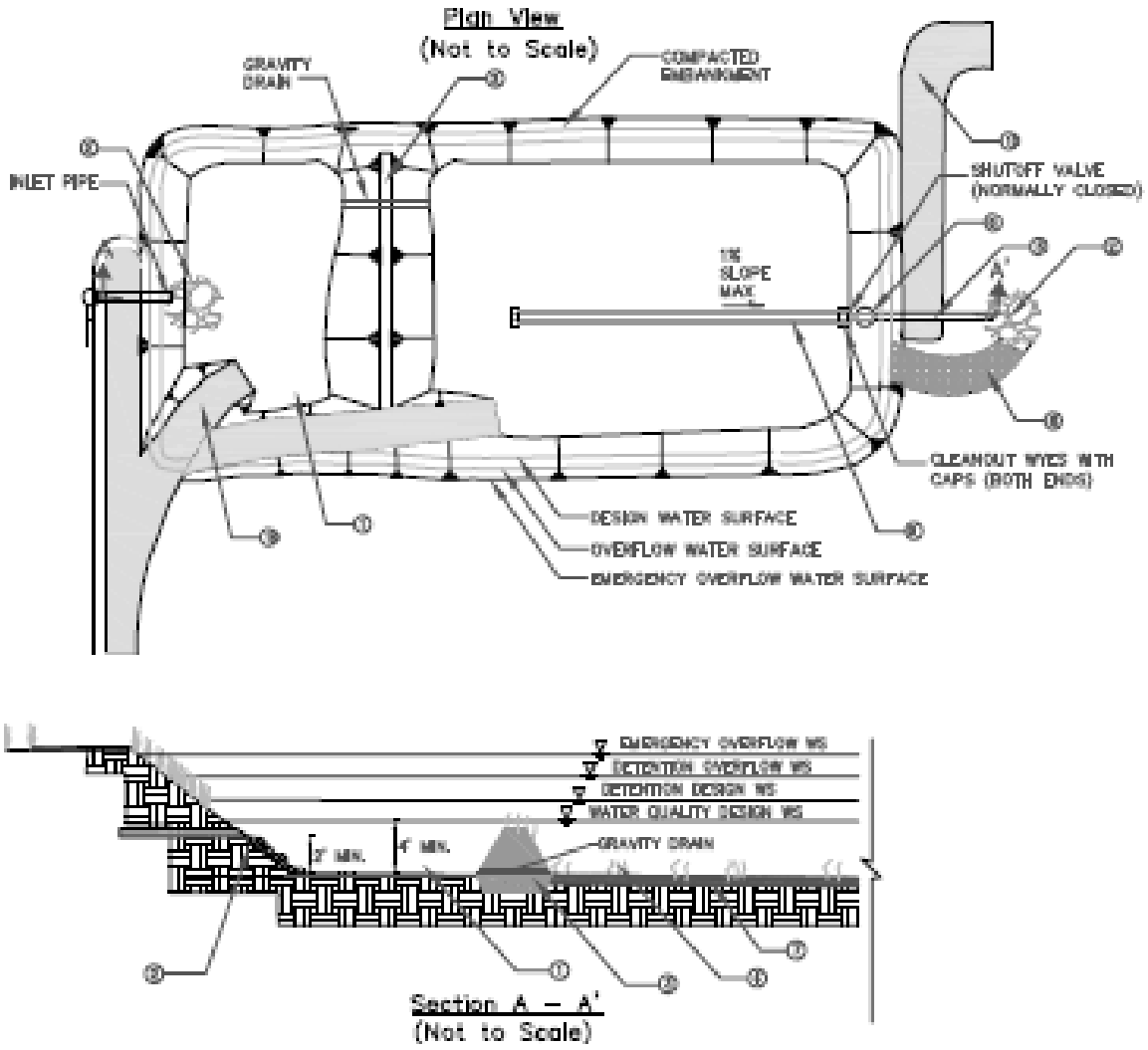
Photo Credit: Geosyntec Consultants

Application

- Mixed-use and commercial
- Roads and parking lots
- Parks and open spaces
- Single and multi-family residential
- Can integrate with parks

Routine Maintenance

- Removal trash, debris, and sediment at inlet and outlets
- Wet weather inspection to ensure drain time
- Remove weeds
- Inspect for mosquito breeding


Plan View
(Not to Scale)
GRAVITY DRAIN
COMPACTED EMBANKMENT
INLET PIPE
SHUTOFF VALVE (NORMALLY CLOSED)
1% SLOPE MAX
CLEANOUT WYES WITH CAPS (BOTH ENDS)
DESIGN WATER SURFACE
OVERFLOW WATER SURFACE
EMERGENCY OVERFLOW WATER SURFACE
EMERGENCY OVERFLOW WS
DETENTION OVERFLOW WS
DETENTION DESIGN WS
WATER QUALITY DESIGN WS
3' MIN.
4' MIN.
GRAVITY DRAIN
Section A – A'
(Not to Scale)

INF-2: Infiltration Trench

- Description:
  - Long narrow gravel-filled trenches for smaller areas – may include surface depressions
- Applications:
  - Areas adjacent to parking lots, driveways, buildings (with required set-backs)
  - Roadway medians and shoulders

INF-2: Infiltration Trench

Infiltration trenches are long, narrow, gravel-filled trenches, often vegetated, that infiltrate stormwater runoff from small drainage areas. Infiltration trenches may include a shallow depression at the surface, but the majority of runoff is stored in the void space within the gravel and infiltrates through the sides and the bottom of the trench.

Rural Highway Infiltration Trench

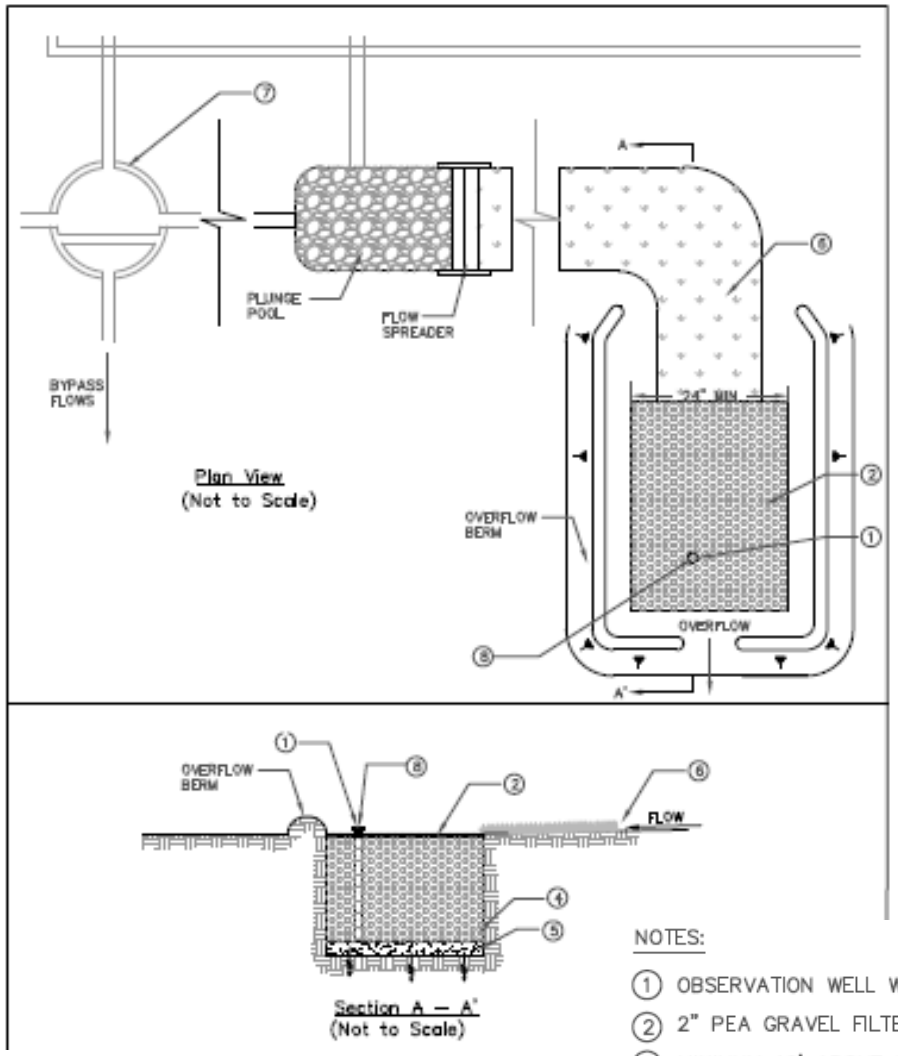
http://stormwater.wordpress.com/2007/05/23/infiltration--trenches/

Application

- Open areas adjacent to parking lots, driveways, and buildings
- Roadway medians and shoulders

Routine Maintenance

- Removal trash, debris, and sediment at inlet and outlets
- Wet weather inspection to ensure drain time
- Remove weeds
- Inspect for mosquito breeding

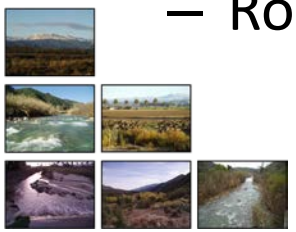


NOTES:

1. OBSERVATION WELL WITH LOCKABLE ABOVE–GROUND CAP.
2. 2" PEA GRAVEL FILTER LAYER.
3. MINIMUM 10' ABOVE SEASONAL HIGH GROUNDWATER TABLE AND 3' ABOVE BEDROCK.
4. 3' – 5' DEEP TRENCH FILLED WITH 2" – 6" DIAMETER CLEAN STONE WITH 30% – 40% VOIDS.
5. 6" DEEP SAND FILTER LAYER (OR FABRIC EQUIVALENT).
6. RUNOFF FILTERS THROUGH GRASS FILTER STRIP OR VEGETATED SWALE.
7. OPTIONAL FLOW CONTROL DEVICE FOR OFF–LINE CONFIGURATIONS.

INF-3: Bioretention

- Description:
  - Landscaped shallow depressions that capture and filter runoff
- Applications:
  - Mixed-use/ Commercial/ Single- or Multi-Family/ Institutional/ Recreational
  - Parking lot islands/ traffic circles
  - Road medians



INF-3: BIORETENTION

INF-3: Bioretention

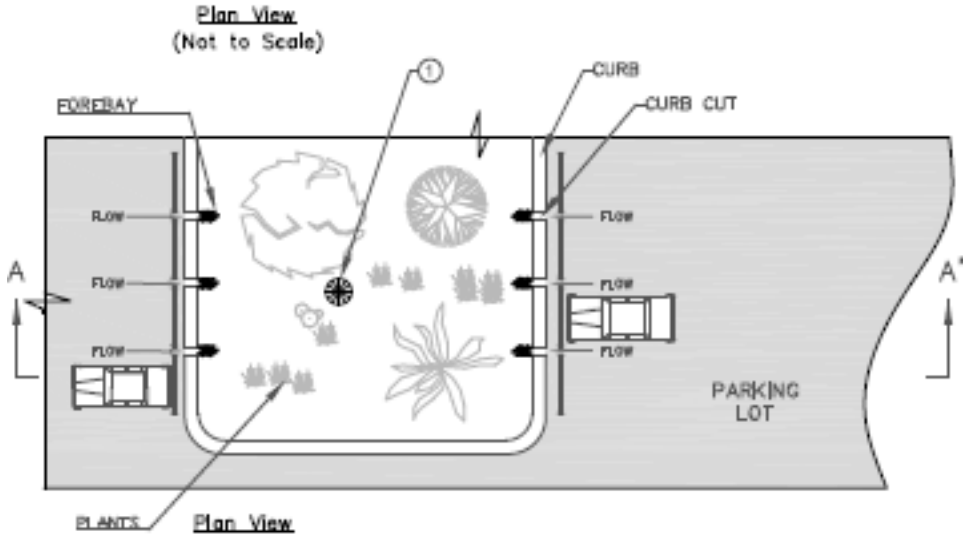
Bioretention stormwater treatment facilities are landscaped shallow depressions that capture and filter stormwater runoff. These facilities function as a soil and plant-based filtration device that removes pollutants through a variety of physical, biological, and chemical treatment processes. The facilities normally consist of a ponding area, mulch layer, planting soils, and plantings. As stormwater passes down through the planting soil, pollutants are filtered, adsorbed, and biodegraded by the soil and plants. For areas with low permeability native soils or steep slopes, bioretention areas can be designed with an underdrain system that routes the treated runoff to the storm drain system rather than depending entirely on infiltration. See the section BIO-1: Bioretention with Underdrain for relevant design specifications.

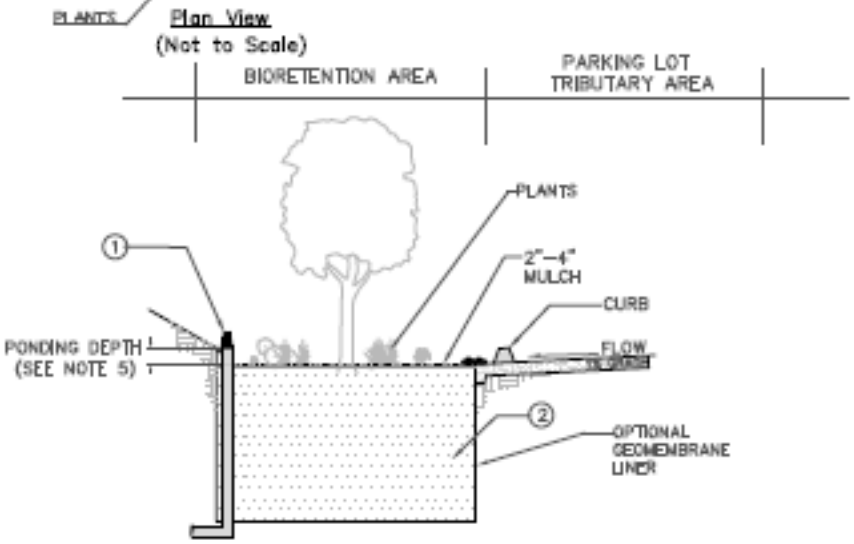
Application

- Commercial, residential, mixed use, institutional, and recreational uses
- Parking lot islands, traffic circles
- Road parkways & medians

Preventative Maintenance

- Repair small eroded areas
- Remove trash and debris and rake surface soils
- Remove accumulated fine sediments, dead leaves and trash
- Remove weeds and prune back excess plant growth
- Remove sediment and debris accumulation near inlet and outlet structures
- Periodically observe function under wet weather conditions


Plan View
(Not to Scale)
FOREBAY
1
CURB
CURB CUT
FLOW
FLOW
FLOW
FLOW
FLOW
FLOW
A
A'
PARKING
LOT
PLANTS


Plan View
(Not to Scale)
BIORETENTION AREA
PARKING LOT
TRIBUTARY AREA
PLANTS
1
2"–4"
MULCH
CURB
PONDING DEPTH
(SEE NOTE 5)
FLOW
2
OPTIONAL
GEOMEMBRANE
LINER

INF-4: Drywell

- Description:
  - Similar to trenches but with vertical configuration and lateral flow
- Applications:
  - Infiltration of roof runoff
  - Other applications require detailed design analysis

INF-4: Drywell

A dry well is defined as a bored, drilled, or driven shaft or hole whose depth is greater than its width. A dry well is designed specifically for flood alleviation and stormwater disposal. Drywells are similar to infiltration trenches in their design and function, as they are designed to temporarily store and infiltrate runoff, primarily from rooftops or other impervious areas with low pollutant loading. A dry well may be either a small excavated pit filled with aggregate or a prefabricated storage chamber or pipe segment.

Dry wells can be used to reduce the increased volume of stormwater runoff caused by roofs of buildings. While generally not a significant source of runoff pollution, roofs are one of the most important sources of new or increased runoff volume from land development sites. Dry wells can also be used to indirectly enhance water quality by reducing the amount of SQDV to be treated by the other, downstream stormwater management facilities.

Drywell installation

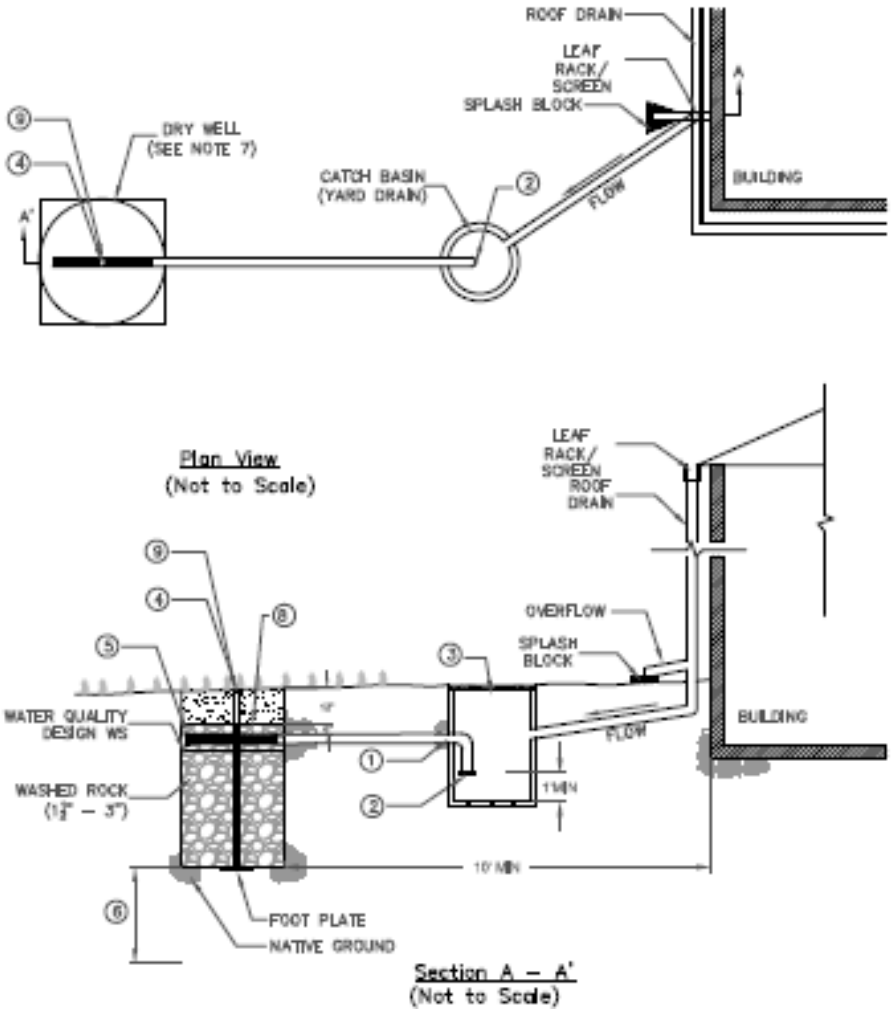
Photo Credits: 1. K&A Enterprises; 2. Canale Landscaping

Application

- Infiltration of roof runoff

Preventative Maintenance

- Remove trash, debris, and sediment at inlet and outlets
- Wet weather inspection to ensure drain time
- Inspect for mosquito breeding


ROOF DRAIN
LEAF RACK/ SCREEN
SPLASH BLOCK
DRY WELL (SEE NOTE 7)
CATCH BASIN (YARD DRAIN)
FLOW
BUILDING
Plan View
(Not to Scale)
OVERFLOW
WATER QUALITY DESIGN WS
WASHED ROCK
FOOT PLATE
NATIVE GROUND
Section A – A'
(Not to Scale)

INF-5: Permeable Pavement

- Description:
  - Permeable pavements contain small voids that allow water to pass through to a stone base
  - Modular paving systems (concrete pavers, grass-pave, gravel-pave)
  - Poured-in-place (porous concrete or permeable asphalt)
- Applications:
  - Parking lots
  - Driveways
  - Sidewalks and walkways
  - Outdoor athletic courts

INF-5: Permeable Pavement

Permeable pavements contain small voids that allow water to pass through to a stone base. They come in a variety of forms; they may be a modular paving system (concrete pavers, grass-pave, or gravel-pave) or a poured-in-place solution (porous concrete or permeable asphalt). All permeable pavements with a stone reservoir base treat stormwater and remove sediments and metals to some degree. While conventional pavement result in increased rates and volumes of surface runoff, porous pavements when properly constructed and maintained, allow some of the stormwater to percolate through the pavement and enter the soil below. This facilitates groundwater recharge while providing the structural and functional features needed for the roadway, parking lot, or sidewalk. The paving surface, subgrade, and installation requirements of permeable pavements are more complex than those for conventional asphalt or concrete surfaces. For porous pavements to function properly over an expected life span of 15 to 20 years, they must be properly sited and carefully designed and installed, as well as periodically maintained. Failure to protect paved areas from construction-related sediment loads can result in their premature clogging and failure. Note that the 2010 TGM does not provide specific instructions on how to design and construct pavement.

Permeable pavement applications

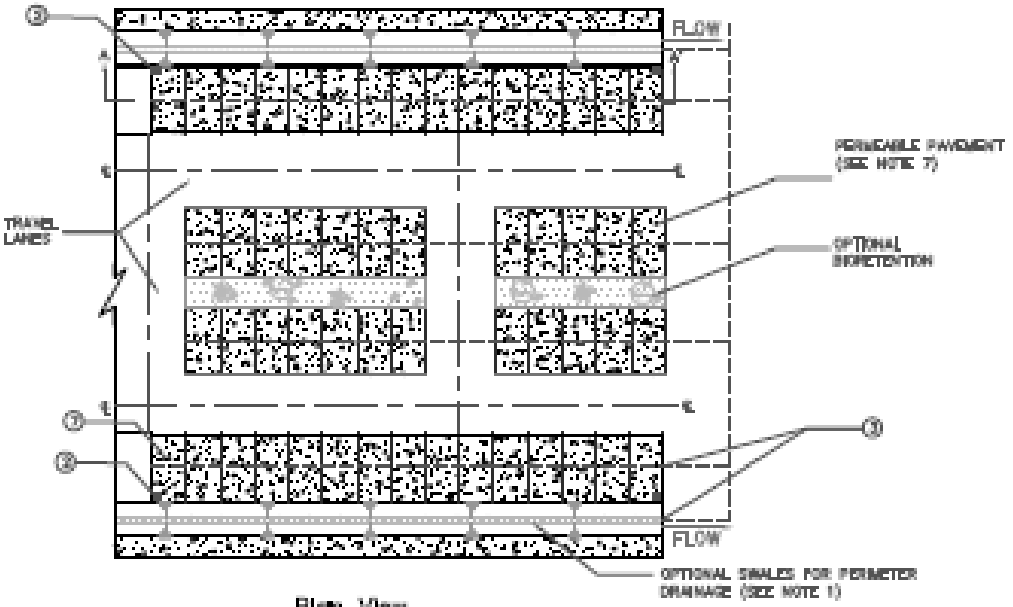
Photo Credits: 1. Geosyntec Consultants; 2. EPA Stormwater Management

Application

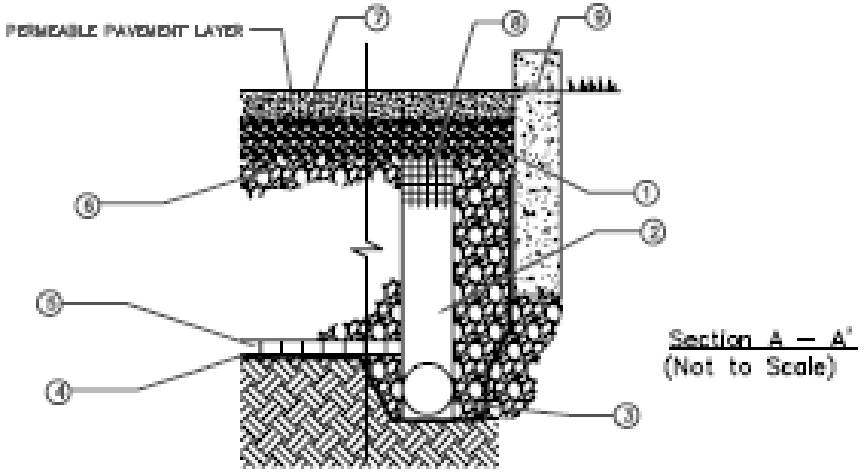
- Parking lots
- Driveways
- Sidewalks and walkways
- Outdoor athletic courts

Preventative Maintenance

- Trash removal
- Post-rain inspections
- Vacuum sweeping
- Vegetation inspection and removal



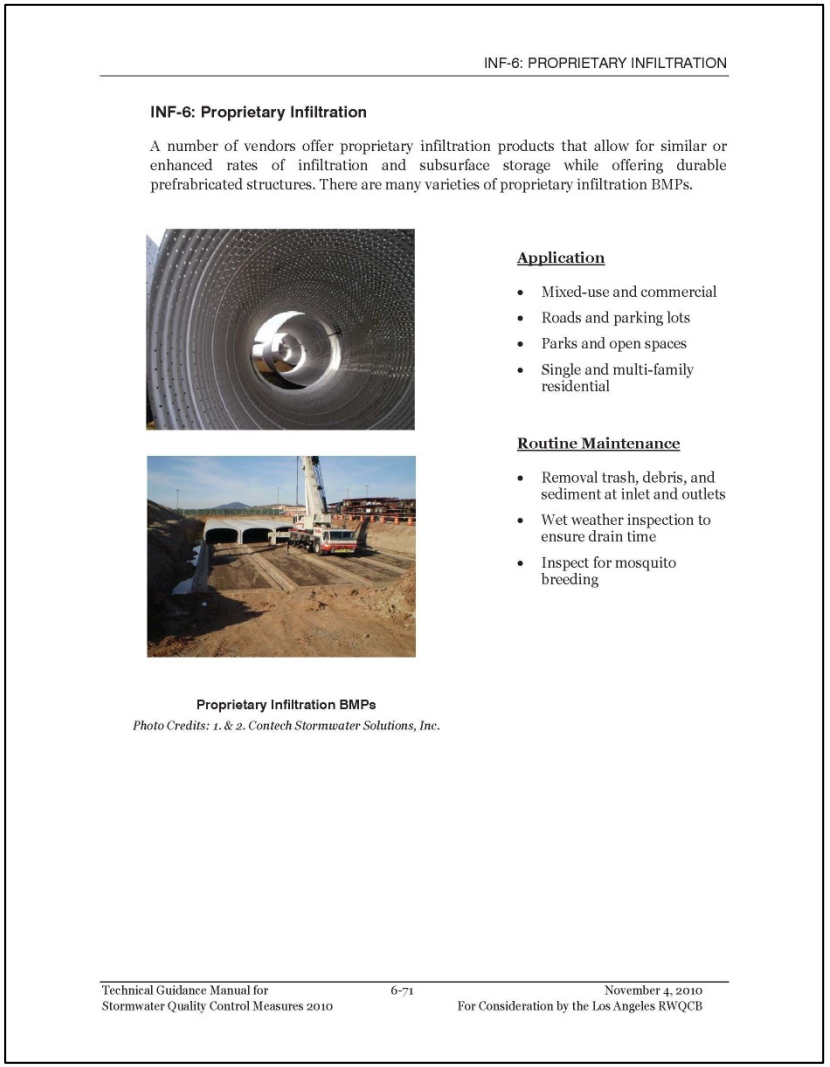
Plan View
(Not to Scale)



Section A – A'
(Not to Scale)

INF-6: Proprietary Infiltration

- Description:
  - Prefabricated structures that allow for subsurface vertical infiltration
- Applications:
  - Mixed-use/ Commercial/ Single- and Multi-Family
  - Roads and Parking Lots
  - Parks, Open spaces



INF-6: PROPRIETARY INFILTRATION

INF-6: Proprietary Infiltration

A number of vendors offer proprietary infiltration products that allow for similar or enhanced rates of infiltration and subsurface storage while offering durable prefrabricated structures. There are many varieties of proprietary infiltration BMPs.

Proprietary Infiltration BMPs

Photo Credits: 1. & 2. Contech Stormwater Solutions, Inc.

INF-7: Bioinfiltration

- Description:
  - Bioretention with an underdrain placed above a storage layer
  - Promotes infiltration but allows discharge of biofiltered runoff
- Applications:
  - Same as bioretention, but where native soil infiltration rates are 0.3 – 0.5 in/hr

INF-7: Bioinfiltration

Bioinfiltration facilities are designed for partial infiltration of runoff and partial biotreatment. These facilities are similar to bioretention devices with underdrains, but the underdrain is raised above the gravel sump to facilitate infiltration. These facilities can be used in areas where there are no hazards associated with infiltration, but infiltration of the full DCV may not be feasible due to low infiltration rates (Soil Type 3) or high depths of fill. These facilities may not result in retention of the DCV but they can be used to meet the MEP standards.

Bioretention in Parkway and parking lots

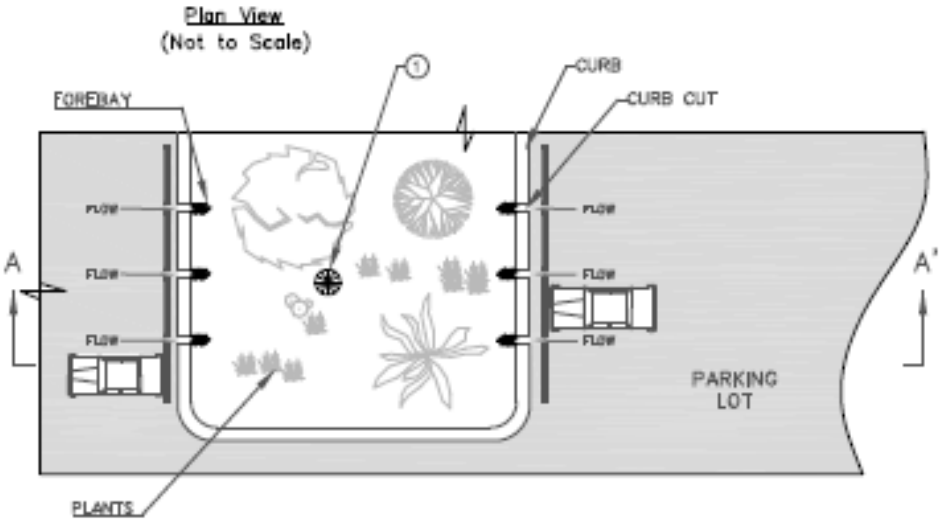
Photo Credits: Geosyntec Consultants

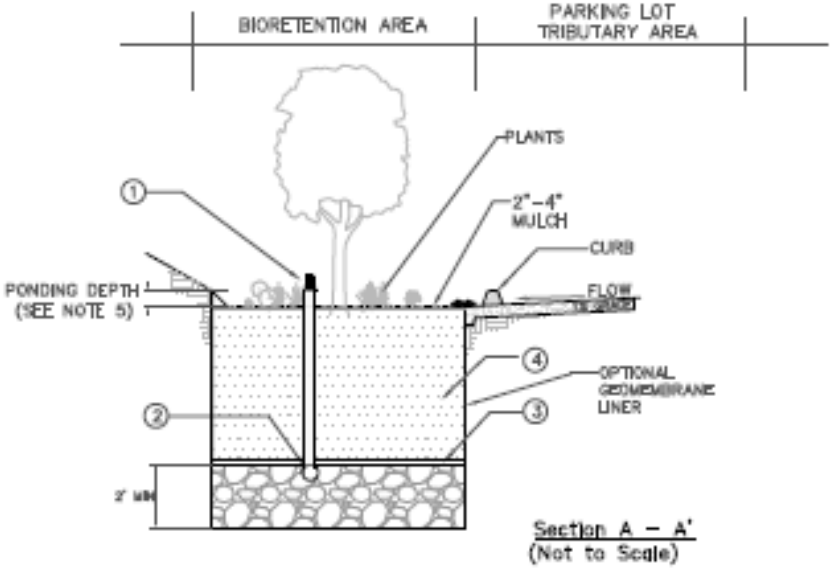
Application

- Commercial, residential, mixed use, institutional, and recreational uses
- Parking lot islands, traffic circles
- Road parkways & medians

Preventative Maintenance

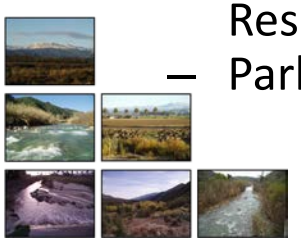
- Repair small eroded areas
- Remove trash and debris and rake surface soils
- Remove accumulated fine sediments, dead leaves and trash
- Remove weeds and prune back excess plant growth
- Remove sediment and debris accumulation near inlet and outlet structures
- Periodically observe function under wet weather conditions

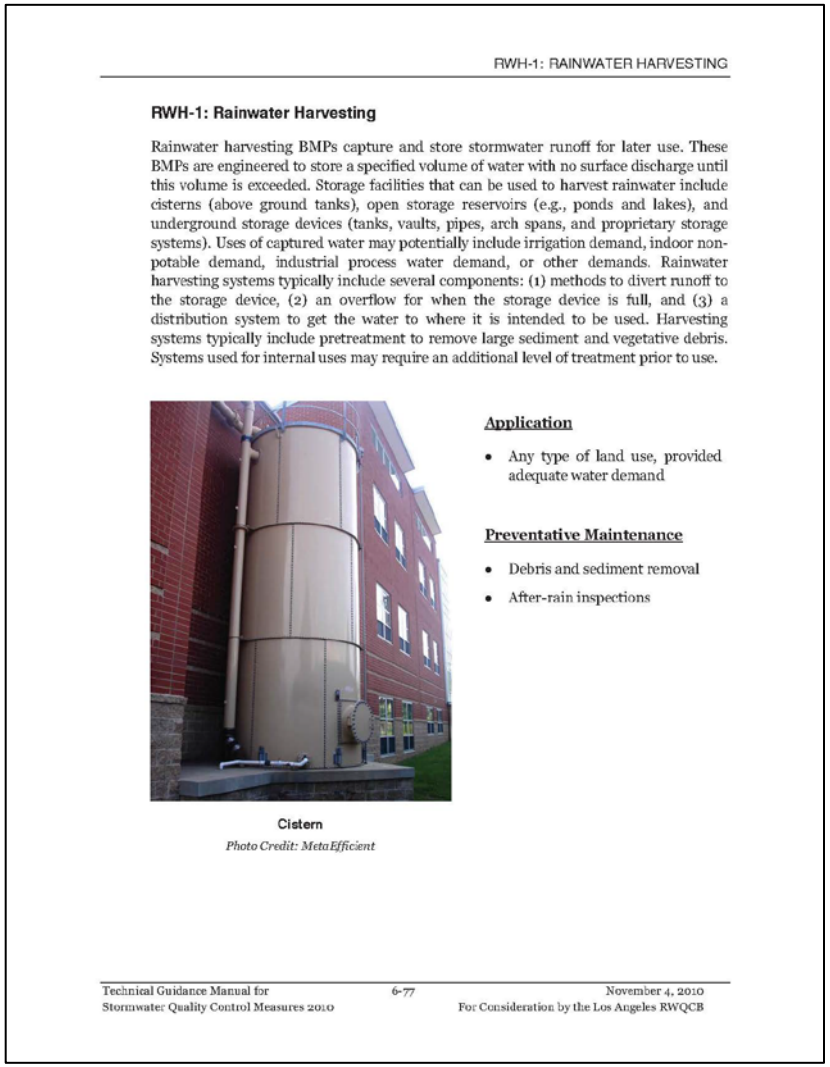

Plan View
(Not to Scale)
FOREBAY
1
CURB
CURB CUT
FLOW
FLOW
FLOW
FLOW
FLOW
FLOW
A
A'
PARKING
LOT
PLANTS


BIORETENTION AREA
PARKING LOT
TRIBUTARY AREA
PLANTS
1
2"-4"
MULCH
CURB
PONDING DEPTH
(SEE NOTE 5)
FLOW
4
OPTIONAL
GEOMEMBRANE
LINER
2
3
Section A – A'
(Not to Scale)

RWH-1: Rainwater Harvesting

- Description:
  - Facilities that capture and store stormwater runoff for later use.
  - Storage facilities that can be used include cisterns (above ground tanks), open storage reservoirs (e.g., ponds and lakes), and underground storage devices (tanks, vaults, pipes, arch spans, and proprietary storage systems).
  - Uses include irrigation demand, indoor non-potable demand, industrial process water demand
- Applications:
  - High Density Mixed-use/ Commercial/Multi-Family Residential/Industrial
  - Parks and Golf Courses





RWH-1: RAINWATER HARVESTING

RWH-1: Rainwater Harvesting

Rainwater harvesting BMPs capture and store stormwater runoff for later use. These BMPs are engineered to store a specified volume of water with no surface discharge until this volume is exceeded. Storage facilities that can be used to harvest rainwater include cisterns (above ground tanks), open storage reservoirs (e.g., ponds and lakes), and underground storage devices (tanks, vaults, pipes, arch spans, and proprietary storage systems). Uses of captured water may potentially include irrigation demand, indoor non-potable demand, industrial process water demand, or other demands. Rainwater harvesting systems typically include several components: (1) methods to divert runoff to the storage device, (2) an overflow for when the storage device is full, and (3) a distribution system to get the water to where it is intended to be used. Harvesting systems typically include pretreatment to remove large sediment and vegetative debris. Systems used for internal uses may require an additional level of treatment prior to use.

Cistern

Photo Credit: MetaEfficient

Application

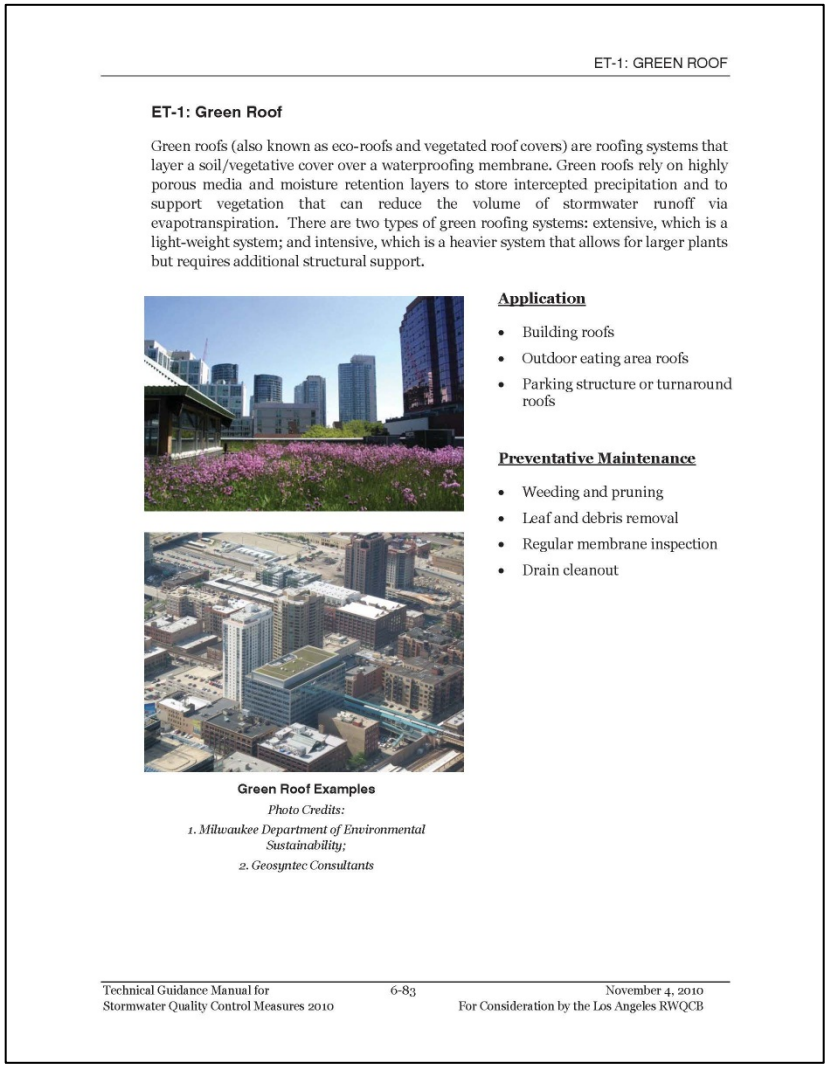
- Any type of land use, provided adequate water demand

Preventative Maintenance

- Debris and sediment removal
- After-rain inspections

ET-1: Green Roof

- Description:
  - Eco-roofs or vegetated roof covers with soil/vegetative layers.
- Applications:
  - Building Roofs
  - Outdoor Eating Areas
  - Parking Structure Roofs



ET-1: GREEN ROOF

ET-1: Green Roof

Green roofs (also known as eco-roofs and vegetated roof covers) are roofing systems that layer a soil/vegetative cover over a waterproofing membrane. Green roofs rely on highly porous media and moisture retention layers to store intercepted precipitation and to support vegetation that can reduce the volume of stormwater runoff via evapotranspiration. There are two types of green roofing systems: extensive, which is a light-weight system; and intensive, which is a heavier system that allows for larger plants but requires additional structural support.

Green Roof Examples

Photo Credits:

1. Milwaukee Department of Environmental Sustainability;

2. Geosyntec Consultants

ET-2: Hydrologic Source Control BMPs

- Description:
  - Simple BMPs that are integrated into the site design to reduce runoff volume at the source.
  - Includes impervious area dispersion, soil amendments, street trees, and rain barrels
- Applications:
  - Building Roofs
  - Sidewalks and Patios
  - Landscaping Hardscapes
  - Parks and Trails

ET-2: HYDROLOGIC SOURCE CONTROL

ET-2: Hydrologic Source Control BMPs

Hydrologic source control (HSC) BMPs are simple BMPs that are highly integrated with the site design to reduce runoff volume. The practices described in this fact sheet include impervious area dispersion, street trees, and rain barrels.

Application

- Building roofs
- Sidewalks and patios
- Landscaping hardscapes

Preventative Maintenance

- Weeding and pruning
- Leaf and debris removal

Hydrologic Source Control Examples

Photo Credits:

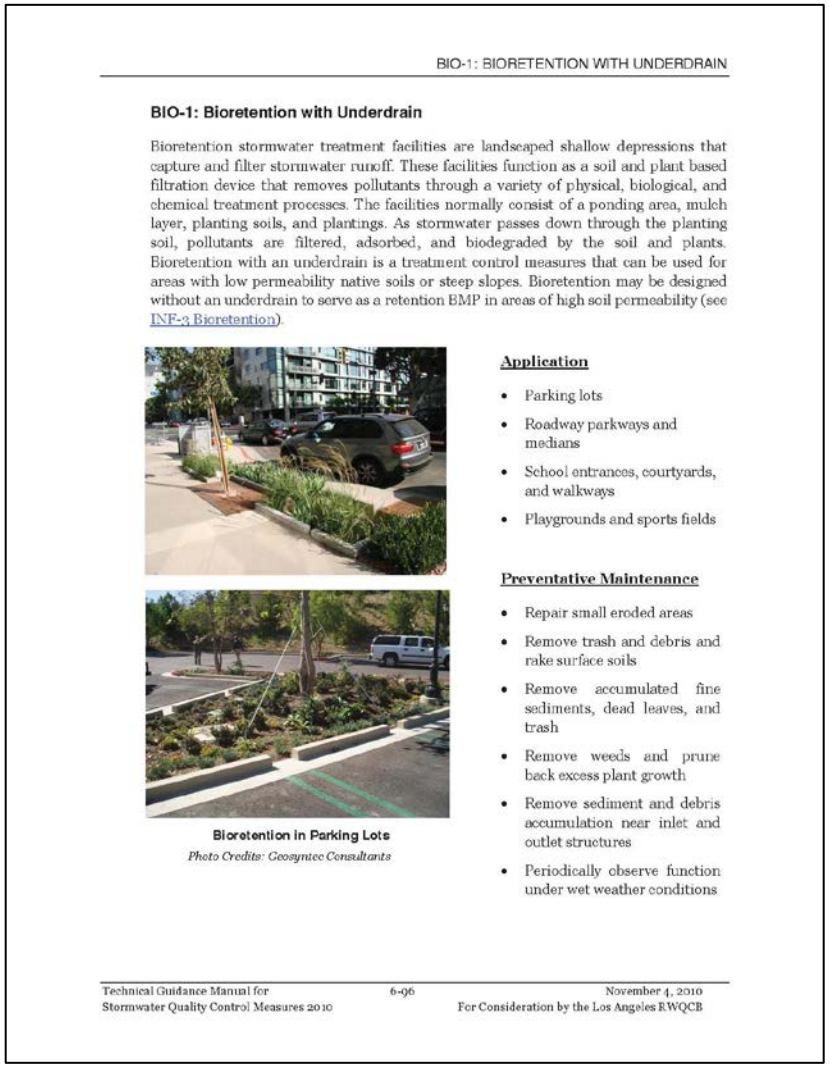
1. http://www.auburn.edu/projects/sustainability/website/newsletter/0910.php;

2. Geosyntec Consultants;

Technical Guidance Manual for Stormwater Quality Control Measures 2010 | 6-89 | November 4, 2010 For Consideration by the Los Angeles RWQCB

BIO-1: Bioretention with Underdrain

- Description:
  - Bioretention facilities with underdrains. Used for low infiltrating soils or lined facilities.
- Applications:
  - Parking Lots
  - Roadway Parkways and Medians
  - School Entrances, Courtyards, Walkways
  - Playgrounds and Sports Fields



BIO-1: BIORETENTION WITH UNDERDRAIN

BIO-1: Bioretention with Underdrain

Bioretention stormwater treatment facilities are landscaped shallow depressions that capture and filter stormwater runoff. These facilities function as a soil and plant based filtration device that removes pollutants through a variety of physical, biological, and chemical treatment processes. The facilities normally consist of a ponding area, mulch layer, planting soils, and plantings. As stormwater passes down through the planting soil, pollutants are filtered, adsorbed, and biodegraded by the soil and plants. Bioretention with an underdrain is a treatment control measures that can be used for areas with low permeability native soils or steep slopes. Bioretention may be designed without an underdrain to serve as a retention BMP in areas of high soil permeability (see INF-3 Bioretention).

Application

- Parking lots
- Roadway parkways and medians
- School entrances, courtyards, and walkways
- Playgrounds and sports fields

Preventative Maintenance

- Repair small eroded areas
- Remove trash and debris and rake surface soils
- Remove accumulated fine sediments, dead leaves, and trash
- Remove weeds and prune back excess plant growth
- Remove sediment and debris accumulation near inlet and outlet structures
- Periodically observe function under wet weather conditions

BIO-2: Planter Box

- Description:
  - Completely contained bioretention-like facilities with underdrains.
- Applications:
  - Areas Adjacent to Buildings and Sidewalks
  - Building Entrances, Courtyards, and Walkways

BIO-2: Planter Box

Planter boxes are bioretention treatment control measures that are completely contained within an impermeable structure with an underdrain (they do not infiltrate). These facilities function as a soil and plant based filtration device that removes pollutants through a variety of physical, biological, and chemical treatment processes. The facilities normally consist of a ponding area, mulch layer, planting soils, plantings, and an underdrain within the planter box. As stormwater passes down through the planting soil, pollutants are filtered, adsorbed, and biodegraded by the soil and plants. Planter boxes are comprised of a variety of materials, usually chosen to be the same material as the adjacent building or sidewalk.

Planter boxes may be placed adjacent to or near buildings, other structures, or sidewalks. Planter boxes can be used directly adjacent to buildings beneath downspouts as long as the boxes are properly lined on the building side and the overflow outlet discharges away from the building to ensure water does not percolate into footings or foundations. They can also be placed further away from buildings by conveying roof runoff in shallow engineered open conveyances, shallow pipes, or other innovative drainage structures.

Planter boxes extending along a building wall

Photo Credit: Geosyntec Consultants

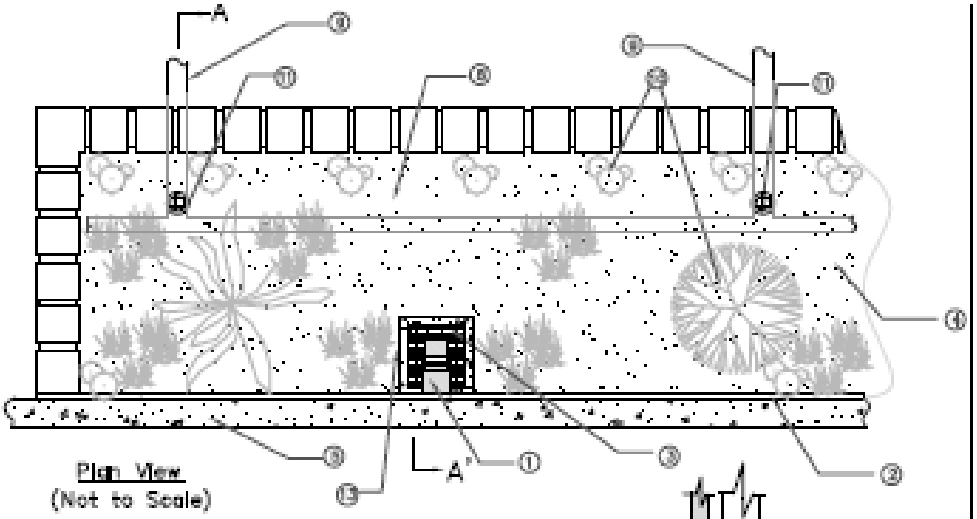
Application

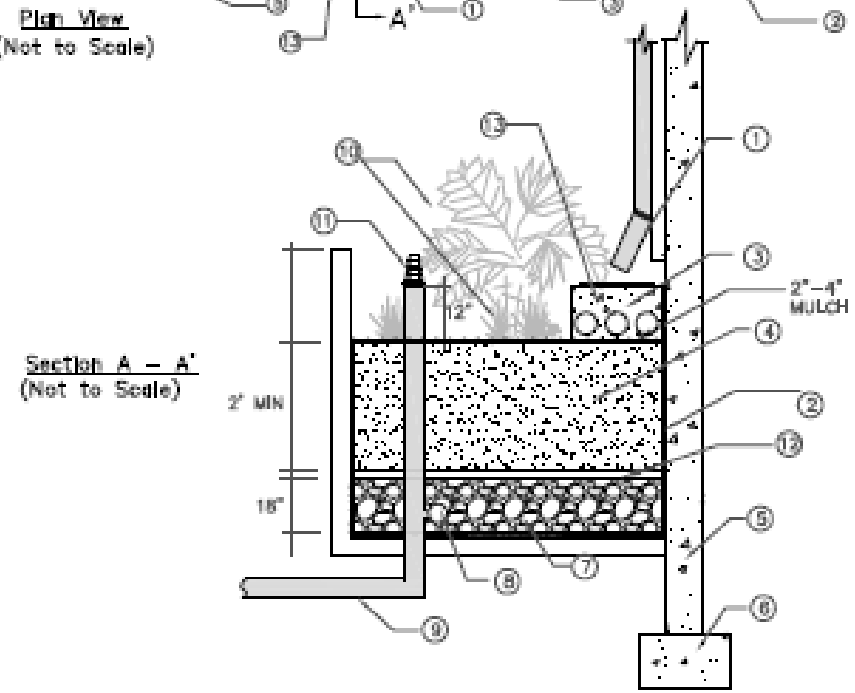
- Areas adjacent to buildings and sidewalks
- Building entrances, courtyards, and walkways

Preventative Maintenance

- Repair small eroded areas
- Remove trash and debris and rake surface soils
- Remove accumulated fine sediments, dead leaves, and trash
- Remove weeds and prune back excess plant growth
- Remove sediment and debris accumulation near inlet and outlet structures

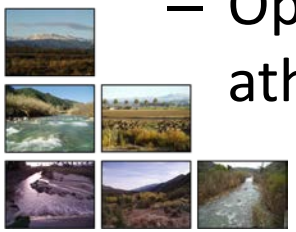
Periodically observe function under wet weather conditions

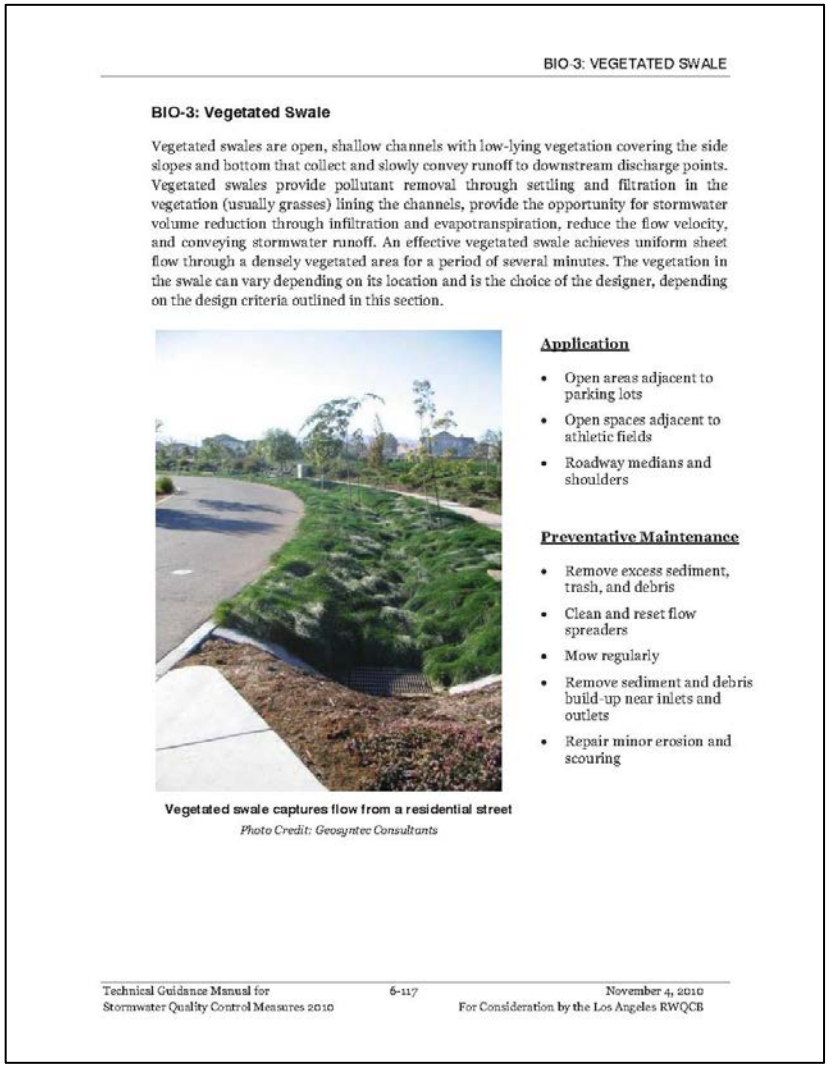

A
A'
Plan View
(Not to Scale)


12"
2"–4"
MULCH
2' MIN
18"
Section A – A'
(Not to Scale)

BIO-3: Vegetated Swale

- Description:
  - Open shallow channels with low-lying vegetation and slow-flowing water. Treatment through settling and filtration.
- Applications:
  - Areas adjacent to parking lots and roadways
  - Open space adjacent to athletic fields





BIO-3: VEGETATED SWALE

BIO-3: Vegetated Swale

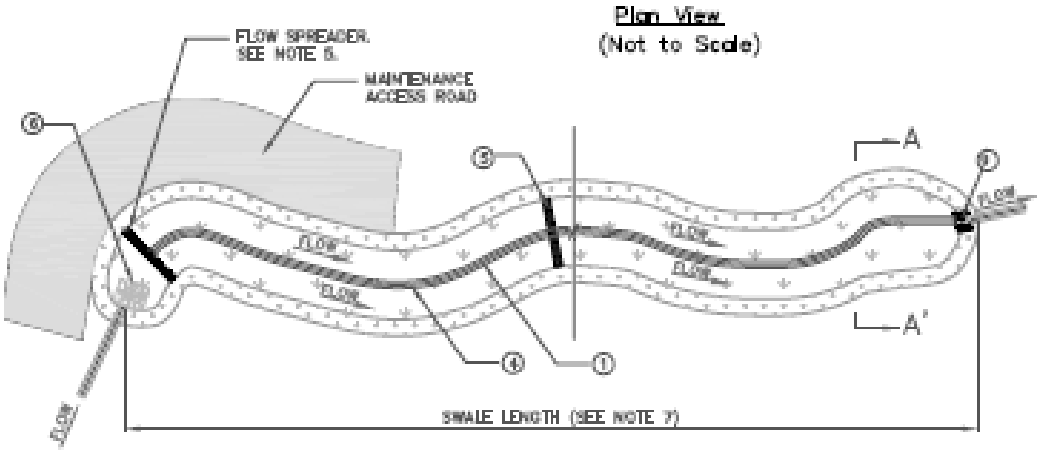
Vegetated swales are open, shallow channels with low-lying vegetation covering the side slopes and bottom that collect and slowly convey runoff to downstream discharge points. Vegetated swales provide pollutant removal through settling and filtration in the vegetation (usually grasses) lining the channels, provide the opportunity for stormwater volume reduction through infiltration and evapotranspiration, reduce the flow velocity, and conveying stormwater runoff. An effective vegetated swale achieves uniform sheet flow through a densely vegetated area for a period of several minutes. The vegetation in the swale can vary depending on its location and is the choice of the designer, depending on the design criteria outlined in this section.

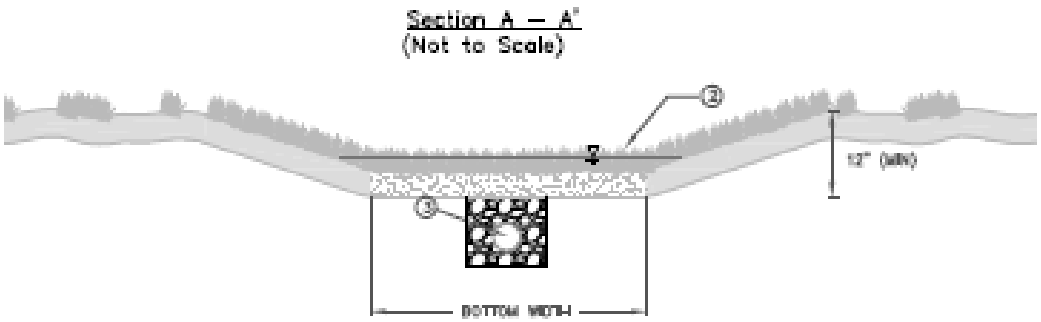
Application

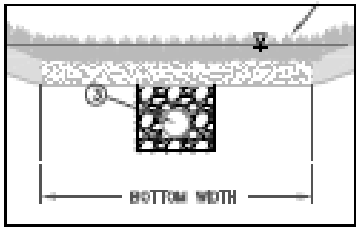
- Open areas adjacent to parking lots
- Open spaces adjacent to athletic fields
- Roadway medians and shoulders

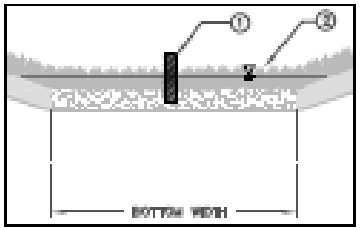
Preventative Maintenance

- Remove excess sediment, trash, and debris
- Clean and reset flow spreaders
- Mow regularly
- Remove sediment and debris build-up near inlets and outlets
- Repair minor erosion and scouring


Plan View
(Not to Scale)
FLOW SPREADER.
SEE NOTE 5.
MAINTENANCE
ACCESS ROAD
A
A'
FLOW
SWALE LENGTH (SEE NOTE 7)


Section A – A'
(Not to Scale)
12" (MIN)
BOTTOM WIDTH


BOTTOM WIDTH


BOTTOM WIDTH

BIO-4: Vegetated Filter Strip

- Description:
  - Vegetated areas designed to treat sheet flow runoff from adjacent impervious areas
- Applications:
  - Areas adjacent to parking lots and driveways
  - Roadway shoulders

BIO-4: Vegetated Filter Strip

Filter strips are vegetated areas designed to treat sheet flow runoff from adjacent impervious surfaces or intensive landscaped areas such as golf courses. Filter strips decrease runoff velocity, filter out total suspended solids and associated pollutants, and provide some infiltration into underlying soils. While some assimilation of dissolved constituents may occur, filter strips are generally more effective in trapping sediment and particulate-bound metals, nutrients, and pesticides. Filter strips are more effective when the runoff passes through the vegetation and thatch layer in the form of shallow, uniform flow. Biological and chemical processes may help break down pesticides, uptake metals, and use nutrients that are trapped in the filter.

Vegetated filter strip captures runoff from freeway

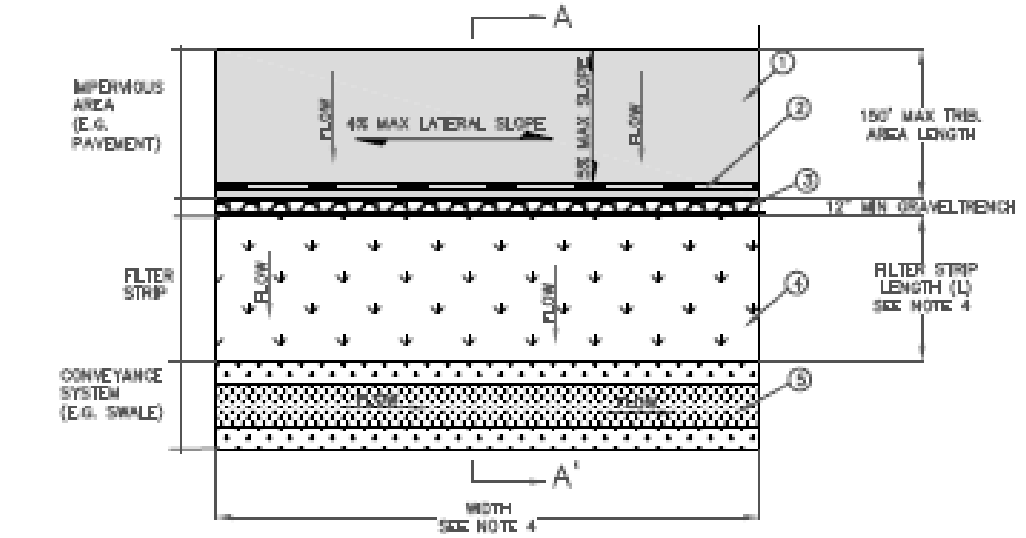
Photo Credit: Washington Department of Transportation

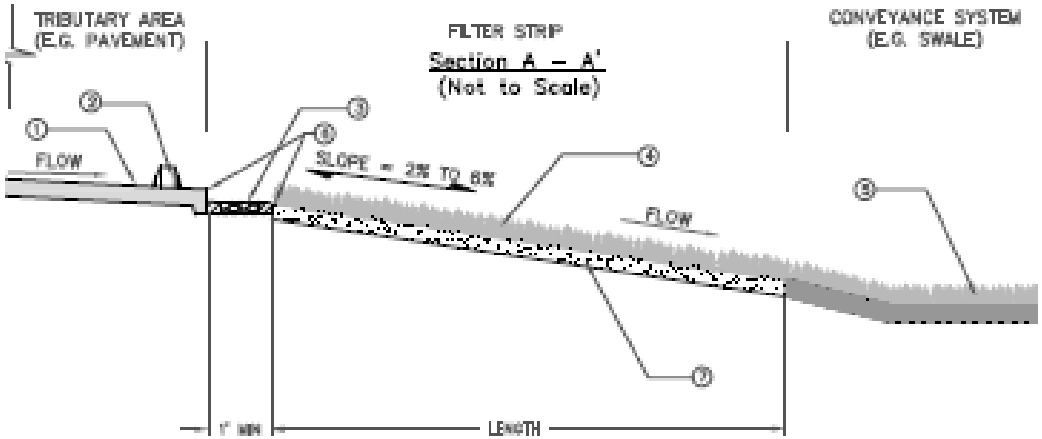
Applications

- Areas adjacent to parking lots and driveways
- Road medians and shoulders

Preventative Maintenance

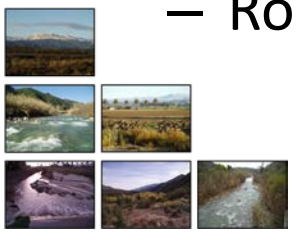
- Remove excess sediment
- Stabilize/repair minor erosion and scouring
- Remove trash and debris
- Mow regularly


A
IMPERVIOUS AREA (E.G. PAVEMENT)
FLOW
4% MAX LATERAL SLOPE
5% MAX SLOPE
FLOW
150' MAX TRIB. AREA LENGTH
12" MIN GRAVEL TRENCH
FILTER STRIP
FLOW
FLOW
FILTER STRIP LENGTH (L) SEE NOTE 4
CONVEYANCE SYSTEM (E.G. SWALE)
FLOW
FLOW
A'
WIDTH SEE NOTE 4


TRIBUTARY AREA (E.G. PAVEMENT)
FILTER STRIP
Section A – A'
(Not to Scale)
CONVEYANCE SYSTEM (E.G. SWALE)
FLOW
SLOPE = 2% TO 6%
FLOW
1' MIN
LENGTH

BIO-5: Proprietary Biotreatment

- Description:
  - Proprietary biotreatment BMPs that incorporate plants, soils, microbes engineered to provide higher flow rates/volumes for treatment
- Applications:
  - Parking Lot Islands
  - Turnarounds
  - Roadway Curbs



BIO-5: PROPRIETARY BIOTREATMENT

BIO-5: Proprietary Biotreatment

Proprietary biotreatment devices are manufactured treatment BMPs that incorporate plants, soil, and microbes engineered to provide treatment at higher flow rates or volumes and with smaller footprints than their non-proprietary counterparts. Incoming flows are typically pretreated to remove larger particles/debris, filtered through a planting media (mulch, compost, soil, and plants), collected by an underdrain, and delivered to the stormwater conveyance system.

Application

- Parking lot islands
- Pickup/drop off turnarounds
- Roadway curbs

Maintenance

- Filter media replacement
- Sediment, trash, and debris removal
- Mulch replacement
- Vegetation upkeep and replacement

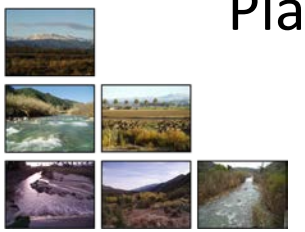
Proprietary Biotreatment Examples

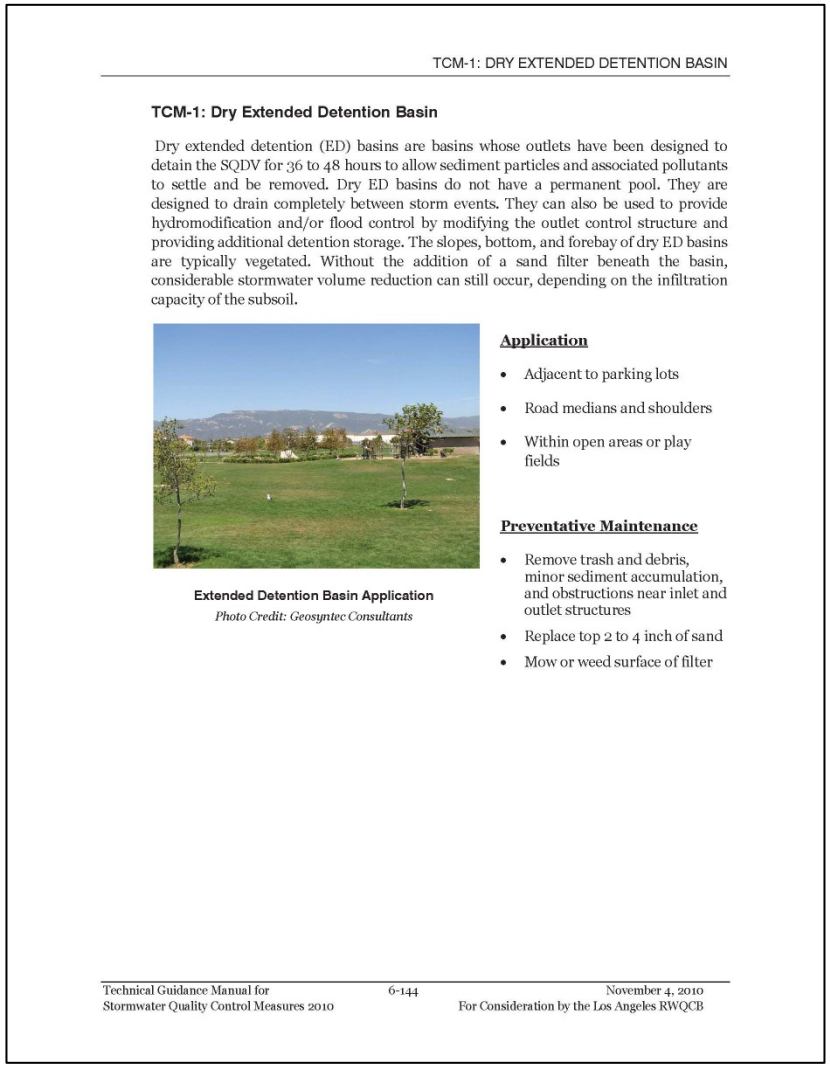
Photo Credits: 1. Filterra®; 2. Stormtreat™

Technical Guidance Manual for Stormwater Quality Control Measures 2010 | 6-141 | November 4, 2010 For Consideration by the Los Angeles RWQCB

TCM-1: Dry Extended Detention Basin

- Description:
  - Basins designed to detain the SQDV for 36 to 48 hours to promote settling and flow control.
- Applications:
  - Regional Detention and Treatment
  - Highways, Parking Lots, Commercial, Residential
  - Within Open Areas or Play Fields





TCM-1: DRY EXTENDED DETENTION BASIN

TCM-1: Dry Extended Detention Basin

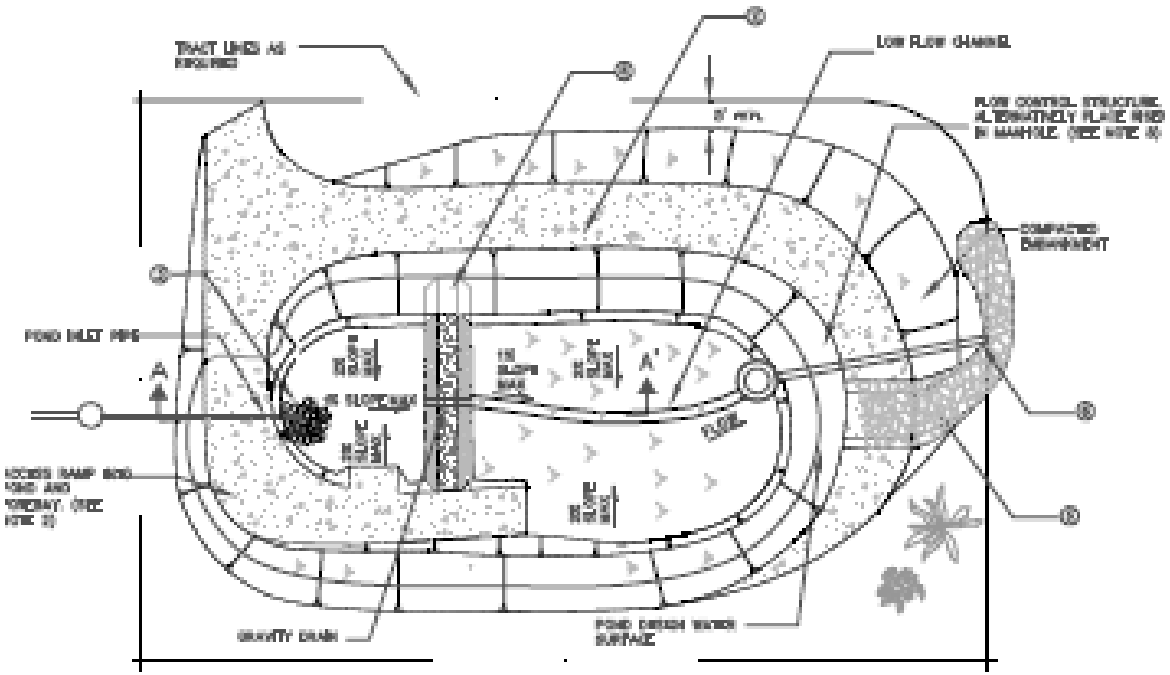
Dry extended detention (ED) basins are basins whose outlets have been designed to detain the SQDV for 36 to 48 hours to allow sediment particles and associated pollutants to settle and be removed. Dry ED basins do not have a permanent pool. They are designed to drain completely between storm events. They can also be used to provide hydromodification and/or flood control by modifying the outlet control structure and providing additional detention storage. The slopes, bottom, and forebay of dry ED basins are typically vegetated. Without the addition of a sand filter beneath the basin, considerable stormwater volume reduction can still occur, depending on the infiltration capacity of the subsoil.

Application

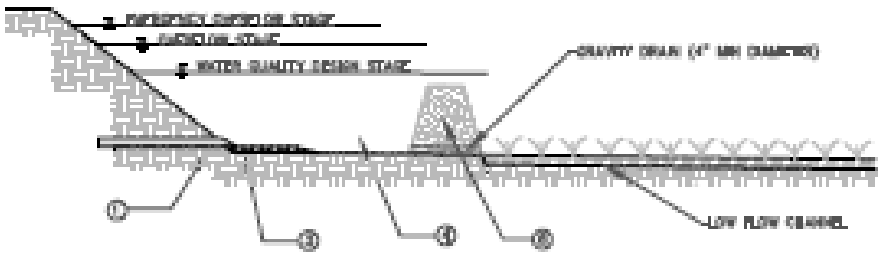
- Adjacent to parking lots
- Road medians and shoulders
- Within open areas or play fields

Preventative Maintenance

- Remove trash and debris, minor sediment accumulation, and obstructions near inlet and outlet structures
- Replace top 2 to 4 inch of sand
- Mow or weed surface of filter



Plan View
(Not to Scale)



Section A – A'
(Not to Scale)

TCM-2: Wet Detention Basin

- Description:
  - Basins designed with a permanent pool of water and with extended detention for the SQDV.
- Applications:
  - Regional Detention and Treatment
  - Highways, Parking Lots, Commercial, Residential
  - Parks, Open Space, Golf Courses

TCM-2: WET DETENTION BASIN

TCM-2: Wet Detention Basin

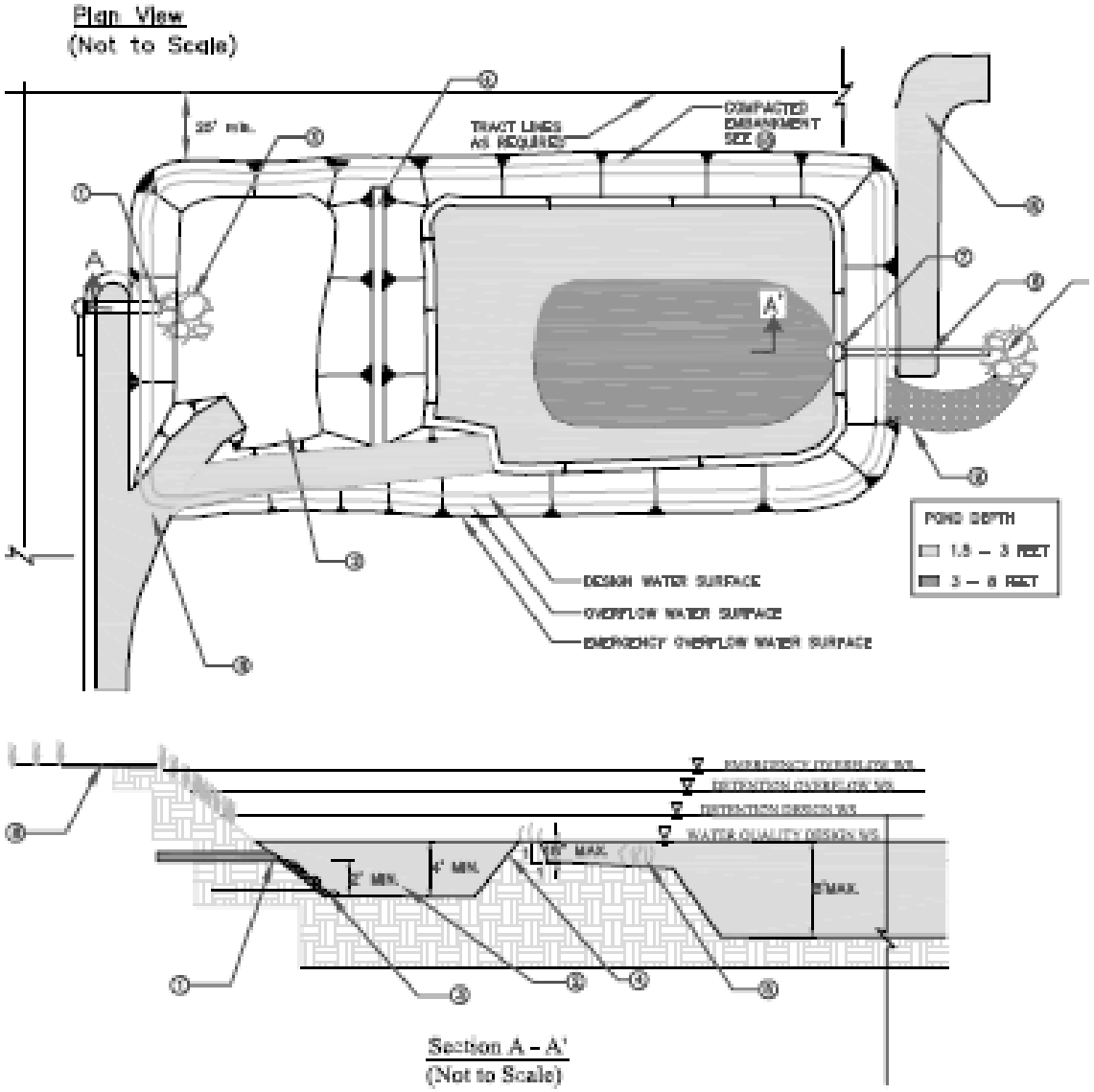
Wet detention basins are constructed, naturalistic ponds with a permanent or seasonal pool of water (also called a "wet pool" or "dead storage"). Aquascape facilities, such as artificial lakes, are a special form of wet pool facility that can incorporate innovative design elements to allow them to function as a stormwater treatment facility in addition to an aesthetic water feature. Wetponds require base flows to exceed or match losses through evaporation and/or infiltration and they must be designed with the outlet positioned and/or operated in such a way as to maintain a permanent pool. Wetponds can be designed to provide extended detention of incoming flows using the volume above the permanent pool surface.

Application

- Regional detention & treatment
- Roads, highways, parking lots, commercial, residential
- Parks, open spaces, and golf courses

Preventative Maintenance

- inspected at a minimum annually and inspections after major storm events
- Pruned or remove vegetation, large shrubs, or trees that limit access or interfere with basin operation
- Remove sediment buildup at inlets and outlets


Plan View
(Not to Scale)
25' min.
TRACT LINES AS REQUIRED
COMPACTED EMBANKMENT SEE
A
A'
POND DEPTH
1.5 – 3 FEET
3 – 6 FEET
DESIGN WATER SURFACE
OVERFLOW WATER SURFACE
EMERGENCY OVERFLOW WATER SURFACE
2' MIN.
4' MIN.
6' MAX.
6' MAX.
Section A – A'
(Not to Scale)

TCM-3: Constructed Wetland

- Description:
  - Treatment system with a forebay and one or two permanent pools.
- Applications:
  - Regional Detention and Treatment
  - Commercial, Residential
  - Parks, Open Space, Golf Courses

TCM-3: Constructed Wetland

A constructed treatment wetland is a system consisting of a sediment forebay and one or more permanent micro-pools with aquatic vegetation covering a significant portion of the basin. Constructed treatment wetlands typically include components such as an inlet with energy dissipation, a sediment forebay for settling out coarse solids and to facilitate maintenance, a base with shallow sections (1 to 2 feet deep) planted with emergent vegetation, deeper areas or micro pools (3 to 5 feet deep), and a water quality outlet structure. The interactions between the incoming stormwater runoff, aquatic vegetation, wetland soils, and the associated physical, chemical, and biological unit processes are a fundamental part of constructed treatment wetlands.

Constructed Wetlands

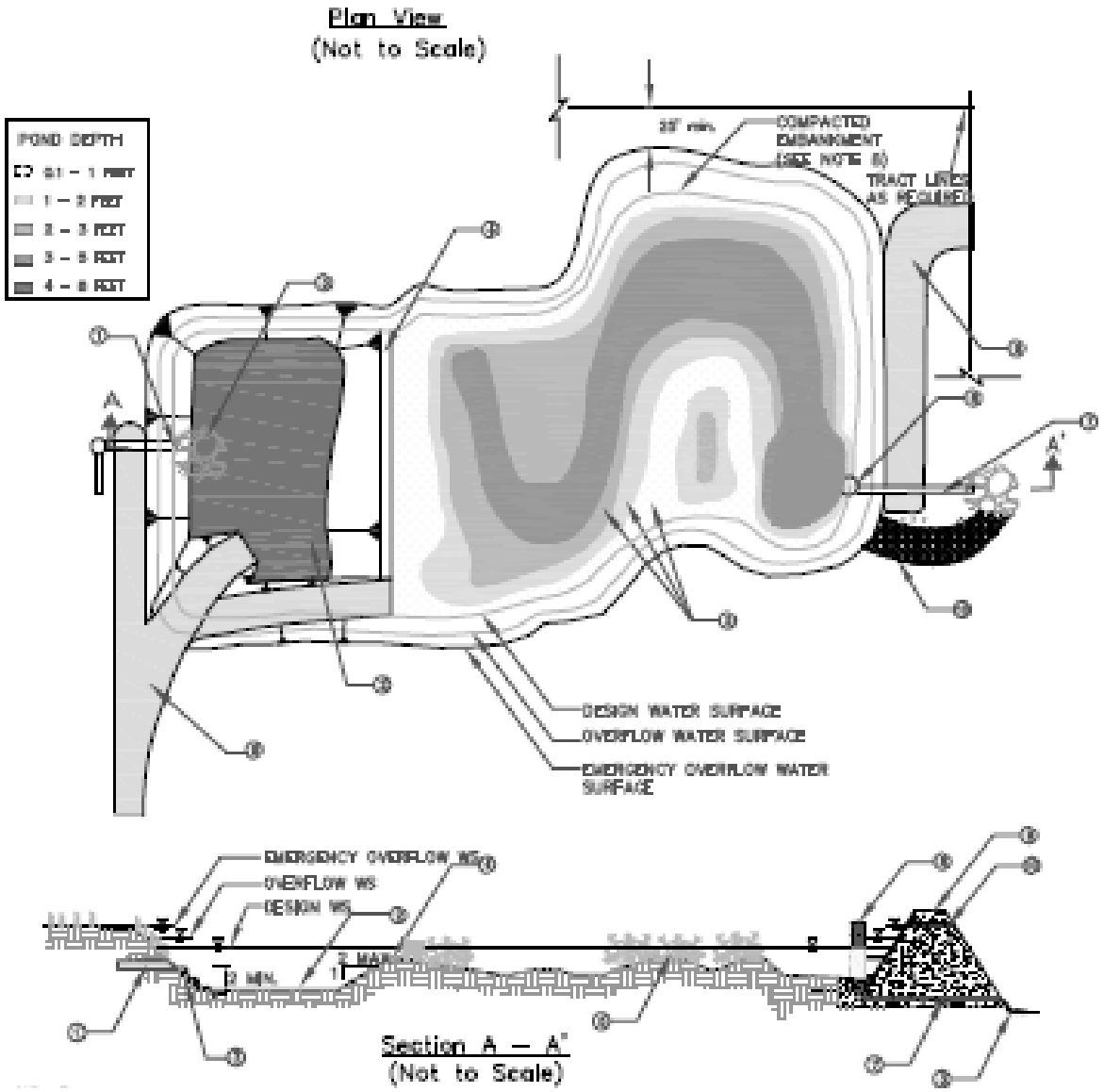
Photo Credits: Geosyntec Consultants

Application

- Regional detention & treatment
- Roads, highways, parking lots, commercial, residential
- Parks, open spaces, and golf courses

Preventative Maintenance

- inspected at a minimum annually and inspections after major storm events
- Pruned or remove vegetation, large shrubs, or trees that limit access or interfere with basin operation
- Remove sediment buildup at inlets and outlets


Plan View
(Not to Scale)
POND DEPTH
0.1 – 1 FEET
1 – 2 FEET
2 – 3 FEET
3 – 4 FEET
4 – 5 FEET
COMPACTED EMBANKMENT
TRACT LINES AS REQUIRED
DESIGN WATER SURFACE
OVERFLOW WATER SURFACE
EMERGENCY OVERFLOW WATER SURFACE
EMERGENCY OVERFLOW WS
OVERFLOW WS
DESIGN WS
Section A – A'
(Not to Scale)

TCM-4: Sand Filters

- Description:
  - Similar to a bioretention with underdrain, but with filtration of water through a constructed sand bed and typically not vegetated
- Applications:
  - Adjacent to Parking Lots
  - Road Medians and Shoulders
  - Open Areas and Play Fields

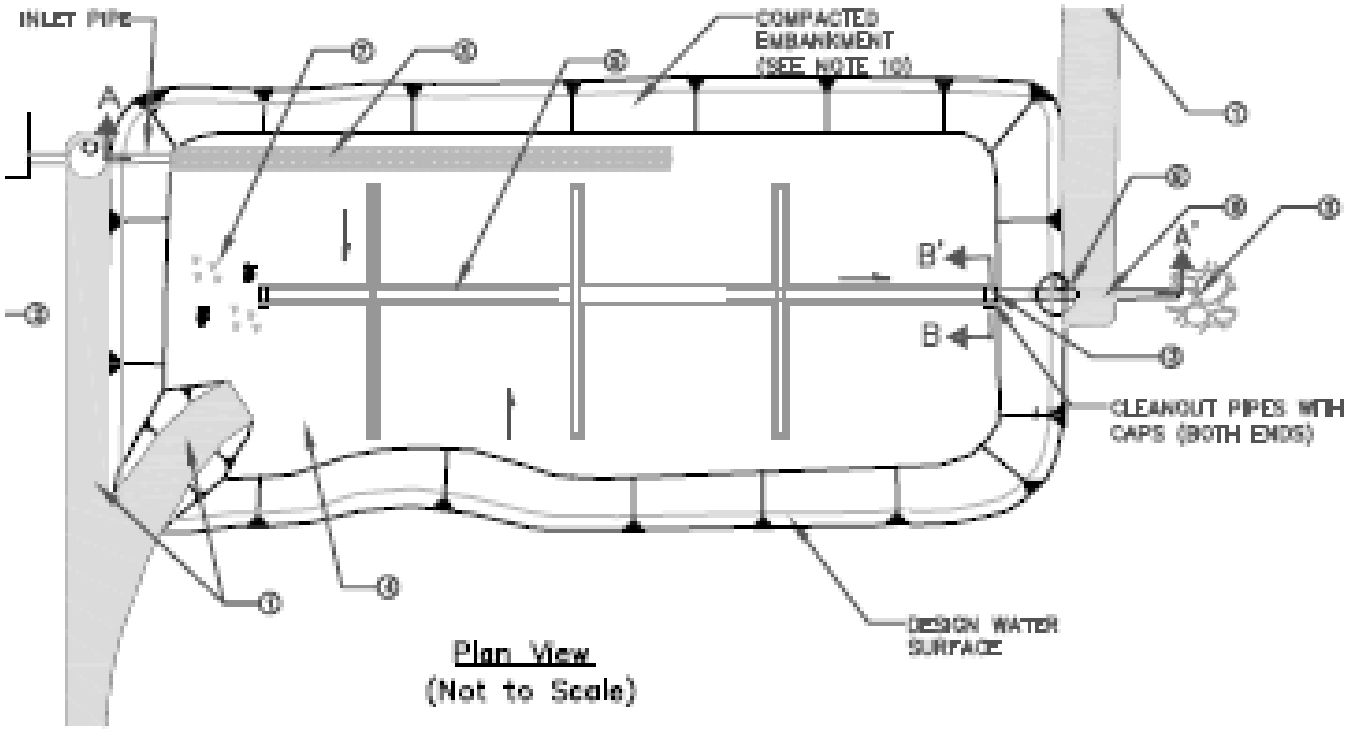
TCM-4: SAND FILTER

TCM-4: Sand Filters

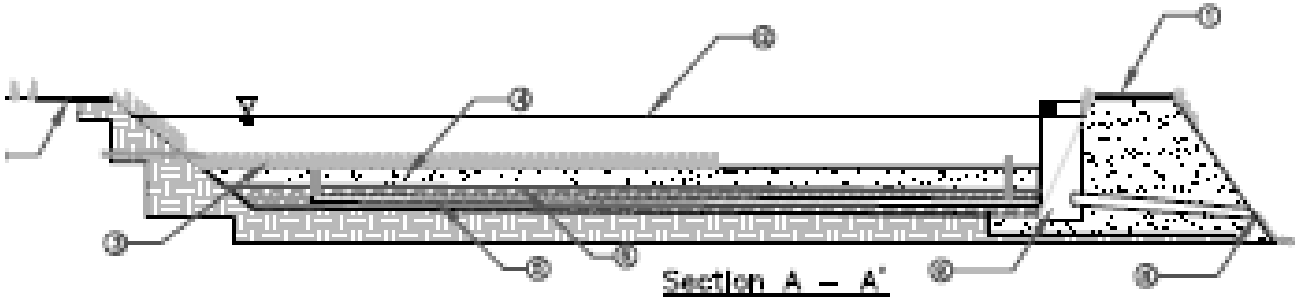
Sand filters operate much like bioretention facilities; however, instead of filtering stormwater through engineered soils, stormwater is filtered through a constructed sand bed with an underdrain system. Runoff enters the filter and spreads over the surface. As flows increase, water backs up on the surface of the filter where it is held until it can percolate through the sand. The treatment pathway is vertical (downward through the sand) to a perforated underdrain system that is connected to the downstream storm drainage system or to an infiltration facility. As stormwater passes through the sand, pollutants are trapped in the small pore spaces between sand grains or are adsorbed to the sand surface.

Sand filters connected to impervious surfaces

Photo Credits: Geosyntec Consultants



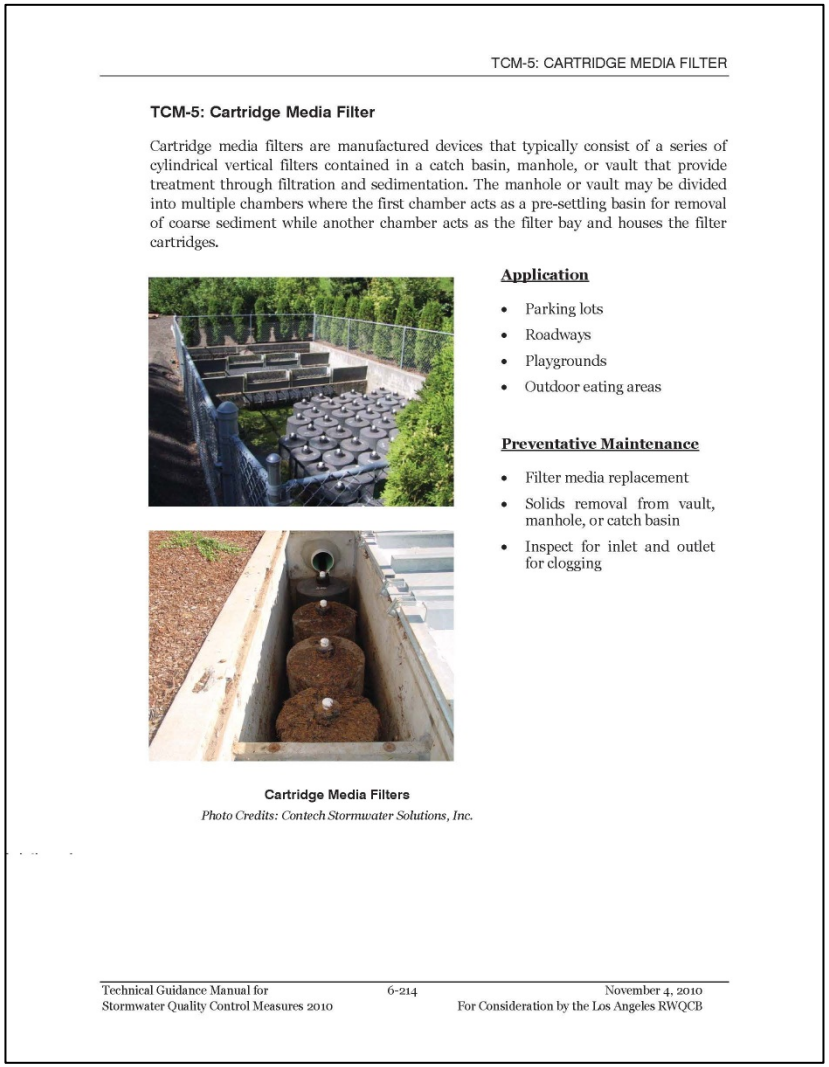
Plan View
(Not to Scale)



Section A – A'
(Not to Scale)

TCM-5: Cartridge Media Filter

- Description:
  - Proprietary devices typically consisting of cylindrical vertical filters contained in CBs, manholes, or vaults
- Applications:
  - Parking Lots
  - Roadways
  - Playgrounds
  - Outdoor Eating Areas



TCM-5: CARTRIDGE MEDIA FILTER

TCM-5: Cartridge Media Filter

Cartridge media filters are manufactured devices that typically consist of a series of cylindrical vertical filters contained in a catch basin, manhole, or vault that provide treatment through filtration and sedimentation. The manhole or vault may be divided into multiple chambers where the first chamber acts as a pre-settling basin for removal of coarse sediment while another chamber acts as the filter bay and houses the filter cartridges.

Cartridge Media Filters

Photo Credits: Contech Stormwater Solutions, Inc.

PT-1: Hydrodynamic Separation Device

- Description:
  - Proprietary devices that remove trash, debris, and coarse sediment by screening, gravity and centrifugal forces.
- Applications:
  - Parking Lots
  - Road Medians and Shoulders
  - High Trash Areas

PT-1: Hydrodynamic Separation Device

Hydrodynamic separation devices (alternatively, swirl concentrators) are devices that remove trash, debris, and coarse sediment from incoming flows using screening, gravity settling, and centrifugal forces generated by forcing the influent into a circular motion. By having the water move in a circular fashion, rather than a straight line, it is possible to obtain significant removal of suspended sediments and attached pollutants with less space as compared to wet vaults and other settling devices. Hydrodynamic devices were originally developed for combined sewer overflows (CSOs), where they were used primarily to remove coarse inorganic solids. Hydrodynamic separation has been adapted for stormwater treatment by several manufacturers and is currently used to remove trash, debris, and other coarse solids down to sand-sized particles. Several types of hydrodynamic separation devices are also designed to remove floating oils and grease using sorbent media.

Hydrodynamic Separation

Photo Credits: 1. Contech Stormwater Solutions, Inc.; 2. Dave Weller, FedCo Construction

Application

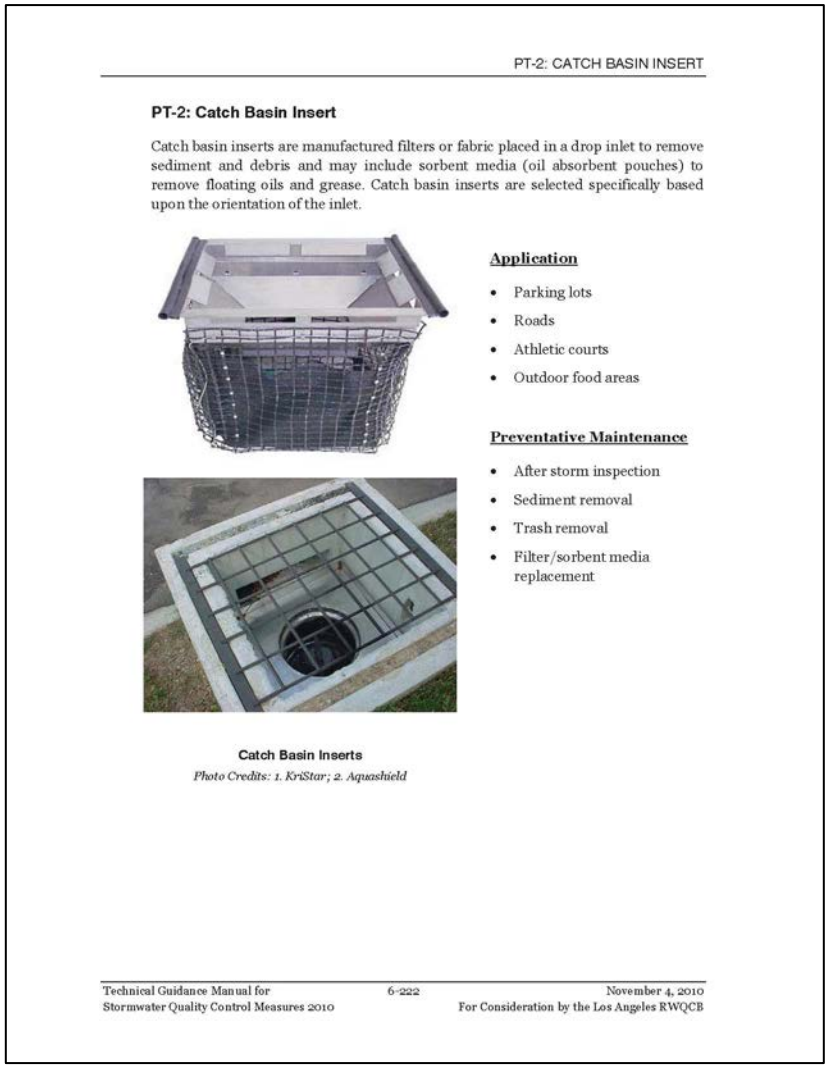
- Parking lots
- Areas adjacent to parking lots
- Areas adjacent to buildings
- Road medians and shoulders

Preventative Maintenance

- Sediment, trash and debris removal
- Vector control

PT-2: Catch Basin Insert

- Description:
  - Manufactured inserts installed within catch basins.
- Applications:
  - Parking Lots
  - Roads
  - Athletic Courts
  - Outdoor Food Areas



PT-2: CATCH BASIN INSERT

PT-2: Catch Basin Insert

Catch basin inserts are manufactured filters or fabric placed in a drop inlet to remove sediment and debris and may include sorbent media (oil absorbent pouches) to remove floating oils and grease. Catch basin inserts are selected specifically based upon the orientation of the inlet.

Application

- Parking lots
- Roads
- Athletic courts
- Outdoor food areas

Preventative Maintenance

- After storm inspection
- Sediment removal
- Trash removal
- Filter/sorbent media replacement

Catch Basin Inserts

Photo Credits: 1. KriStar; 2. Aquashield

Technical Guidance Manual for Stormwater Quality Control Measures 2010 | 6-222 | November 4, 2010 For Consideration by the Los Angeles RWQCB

Section 7: Maintenance Plan

- 7.1 Site Map
- 7.2 Baseline Descriptions
- 7.2 Spill Plan
- 7.4 Facility Changes
- 7.5 Training
- 7.6 Basic Inspection and Maintenance Activities
- 7.7 Revisions of Pollution Mitigation Measures
- 7.8 Monitoring and Reporting Program

Appendices

- A: Glossary of Terms
- B: Maps
  - Hydrologic Areas (consistent with Basin Plan sub-basins)
  - Environmentally Sensitive Areas
  - 85th Percentile Rain Depths
  - Existing Urban Areas
  - Soil Classification
  - Liquefaction and Expansive Soil Potential

Appendices

- C: Site Soil Type and Infiltration Testing
  - Soil investigations
  - Infiltration testing analyses
  - Assessment of test results
- D: BMP Performance Guidance
  - Using Performance Statistics for BMP Selection
  - Comparison of the Performance of Biofiltration BMPs and Retention BMPs
    - International BMP Database Performance Summaries

Appendices

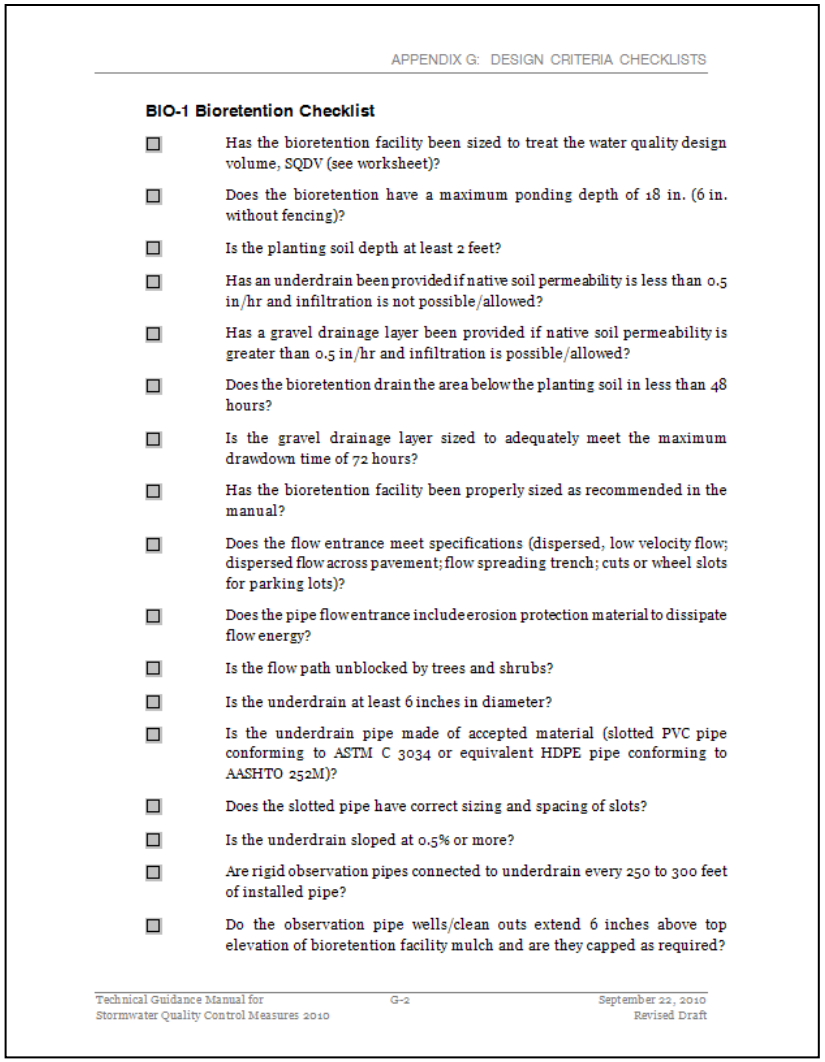
- E: BMP Sizing Worksheets
  - Sizing Criteria
  - Step by Step sizing instructions for BMPs
  - Worksheet Form
  - Worksheet Form Example

Sizing Worksheet

Step 1: Determine water quality design volume		
1-1. Enter Project area (acres), $A_{project}$	$A_{project}$ =	acres
1-2. Enter the maximum allowable percent of the Project area that may be effective impervious area (%) (refer to permit), ranges from 5-30%, $\%_{allowable}$	$\%_{allowable}$ =	%
1-3. Determine the maximum allowable effective impervious area (acres), $EIA_{allowable} = (A_{project})*(\%_{allowable})$	$EIA_{allowable}$=	acres
1-4. Enter Project impervious fraction, *Imp* (eg. 60% = 0.60)	Imp=	
1-5. Determine the Project Total Impervious area (acres), $TIA=A_{project}*Imp$	TIA=	acres
1-6. Determine the total area from which runoff must be retained (acres), $A_{retain}=TIA-EIA_{allowable}$	A_{retain} =	acres
1-7. Determine pervious runoff coefficient using Table E-1, C_p	C_p =	
1-8. Calculate runoff coefficient, $C = 0.95*imp + C_p\ (1-imp)$	C =	
1-9. Enter design rainfall depth of the storm (in), P_i (see Table D-3)	P_i =	in
1-10. Calculate rainfall depth (ft), $P = P_i/12$	P =	ft
1-11. Calculate water quality design volume (ft^3), $SQDV=43560\times C*P*A_{retain}$	SQDV=	ft^3
Step 2: Determine the design percolation rate		
2-1. Enter measured soil percolation rate (in/hr, 0.5 in/hr min.), $P_{measured}$	$P_{measured}$ =	in/hr

Appendices

- F: Flow Splitter Design Specifications
- G: Design Criteria Checklists for Stormwater Runoff BMPs



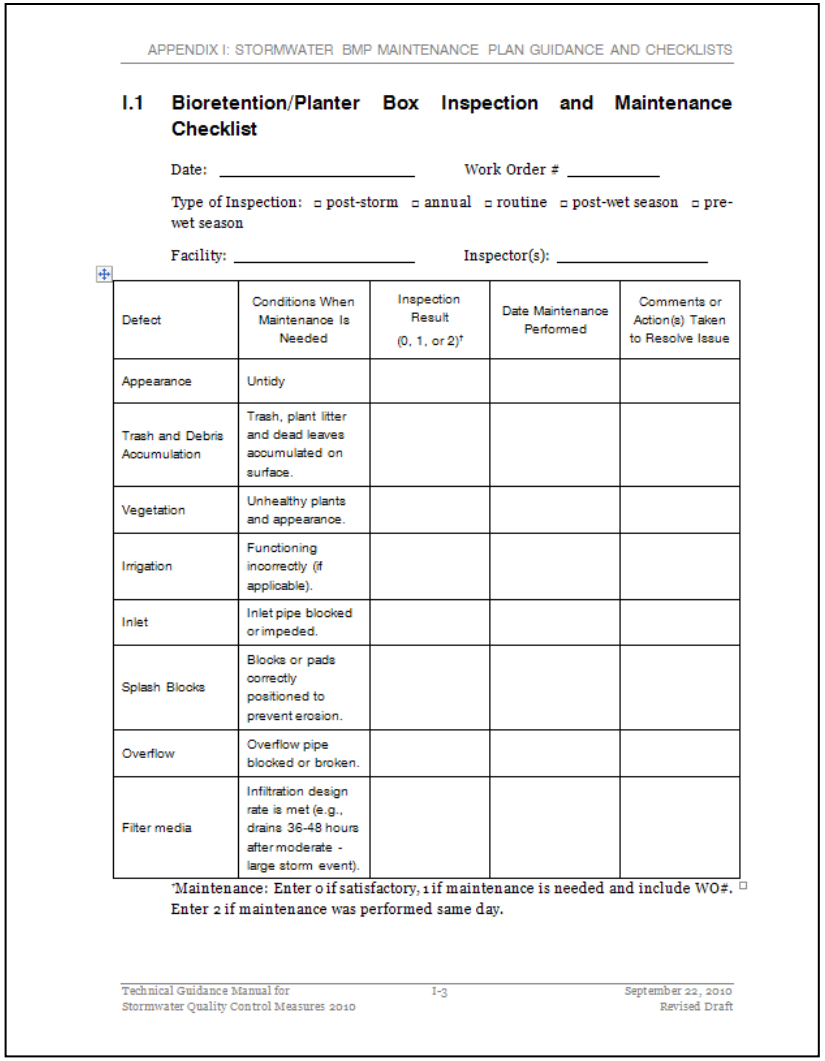
APPENDIX G: DESIGN CRITERIA CHECKLISTS

BIO-1 Bioretention Checklist

- ☐ Has the bioretention facility been sized to treat the water quality design volume, SQDV (see worksheet)?
- ☐ Does the bioretention have a maximum ponding depth of 18 in. (6 in. without fencing)?
- ☐ Is the planting soil depth at least 2 feet?
- ☐ Has an underdrain been provided if native soil permeability is less than 0.5 in/hr and infiltration is not possible/allowed?
- ☐ Has a gravel drainage layer been provided if native soil permeability is greater than 0.5 in/hr and infiltration is possible/allowed?
- ☐ Does the bioretention drain the area below the planting soil in less than 48 hours?
- ☐ Is the gravel drainage layer sized to adequately meet the maximum drawdown time of 72 hours?
- ☐ Has the bioretention facility been properly sized as recommended in the manual?
- ☐ Does the flow entrance meet specifications (dispersed, low velocity flow; dispersed flow across pavement; flow spreading trench; cuts or wheel slots for parking lots)?
- ☐ Does the pipe flow entrance include erosion protection material to dissipate flow energy?
- ☐ Is the flow path unblocked by trees and shrubs?
- ☐ Is the underdrain at least 6 inches in diameter?
- ☐ Is the underdrain pipe made of accepted material (slotted PVC pipe conforming to ASTM C 3034 or equivalent HDPE pipe conforming to AASHTO 252M)?
- ☐ Does the slotted pipe have correct sizing and spacing of slots?
- ☐ Is the underdrain sloped at 0.5% or more?
- ☐ Are rigid observation pipes connected to underdrain every 250 to 300 feet of installed pipe?
- ☐ Do the observation pipe wells/clean outs extend 6 inches above top elevation of bioretention facility mulch and are they capped as required?

Appendices

- H: Stormwater Control Measure Access and Maintenance Agreements
- I: Stormwater Control Measure Maintenance Plan Guidelines and Checklists



APPENDIX I: STORMWATER BMP MAINTENANCE PLAN GUIDANCE AND CHECKLISTS

I.1 Bioretention/Planter Box Inspection and Maintenance Checklist

Date: _____ Work Order # _____

Type of Inspection: ▫ post-storm ▫ annual ▫ routine ▫ post-wet season ▫ pre-wet season

Facility: _____ Inspector(s): _____

Defect	Conditions When Maintenance Is Needed	Inspection Result (0, 1, or 2)†	Date Maintenance Performed	Comments or Action(s) Taken to Resolve Issue
Appearance	Untidy			
Trash and Debris Accumulation	Trash, plant litter and dead leaves accumulated on surface.			
Vegetation	Unhealthy plants and appearance.			
Irrigation	Functioning incorrectly (if applicable).			
Inlet	Inlet pipe blocked or impeded.			
Splash Blocks	Blocks or pads correctly positioned to prevent erosion.			
Overflow	Overflow pipe blocked or broken.			
Filter media	Infiltration design rate is met (e.g., drains 36-48 hours after moderate - large storm event).			

†Maintenance: Enter 0 if satisfactory, 1 if maintenance is needed and include WO#. Enter 2 if maintenance was performed same day.