Appendix B: Example Scenarios

B.1 Parking-Lot Example

Introduction

This example shows a proposed parking lot in San Mateo County with bioretention as the method of stormwater treatment, and demonstrates the use of the "4 percent method" (see Chapter 5, Section 5.1) for sizing bioretention facilities.

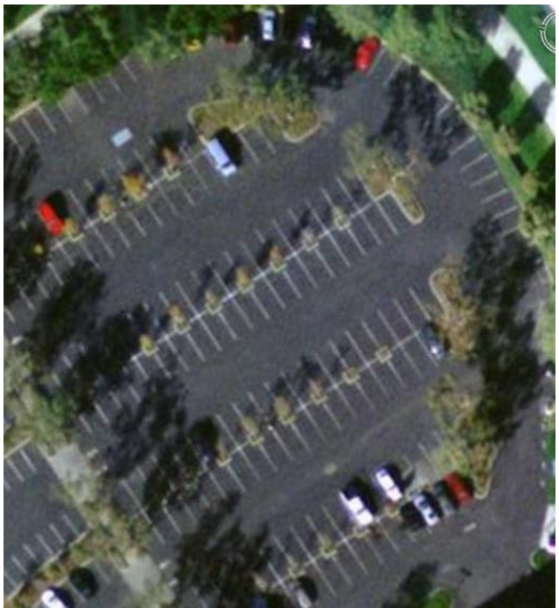


Figure B-1: Aerial view of a parking-Lot

Summary of Stormwater Controls

Site Design Measures

- Some of the landscaped areas are designed to function as self-treating (S-T) areas

Source Control Measures

- Stenciling storm drain inlets
- Parking lot sweeping
- Landscape architect will be asked to select drought tolerant plants and specify maintenance with IPM techniques

Treatment Measures

- Bioretention facilities

Example Parking Lot Site Description

- The project site is 1.2 acres with 1% slope from edge of lot to street.
- Sidewalks will be graded toward landscaped areas.
- The parking lot will have some landscaping as an amenity (not used for stormwater treatment).
- All areas will be graded to drain to bioretention facilities along the perimeter of the site. There are two drainage management areas.

B.1 Parking-Lot Example

The site was divided into drainage management areas (DMAs). DMAs A and B each drain to one bioretention facility. The self-treating (S-T) areas do not need to drain to a treatment measure. The DMA data is as follows:

DMA	Impervious Area (sf)	Pervious Area (sf)	Total Area (sf)
A	6,788	7,868	14,656
B	24,491	0	24,491
S-T Areas	0	13,125	13,125
Totals	31,279	20,993	52,272

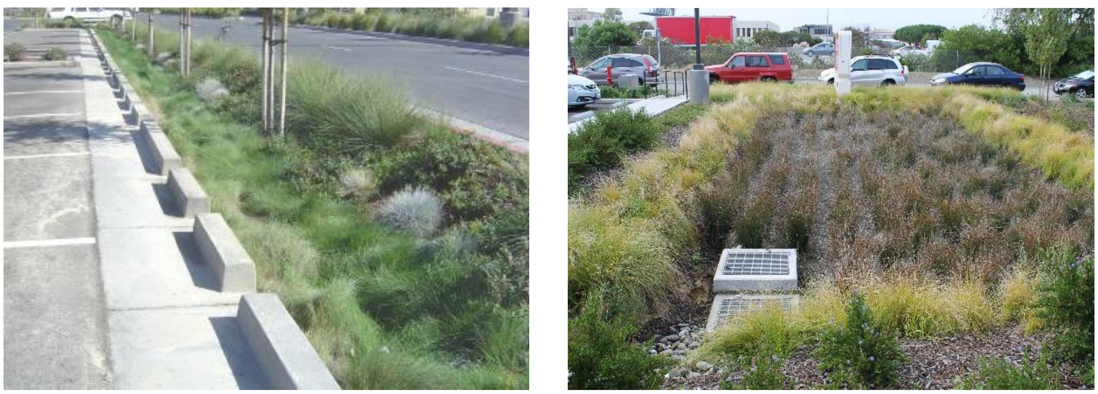


Figure B-2: Examples of Bioretention Areas

Procedure for BMP Sizing (4 Percent Method)

Use the following procedure for sizing bioretention facilities using the 4 percent method (perform for each DMA and treatment measure):

1. List the area of impervious surface and the area of pervious surface (if any) that drains to the treatment measure.
2. Multiply the pervious area by a factor of 0.1.
3. Add the product obtained in Step 2 to the area of impervious surface to obtain the "effective impervious area."
4. Multiply the effective impervious area by a factor of 0.04. This is the required surface area of the bioretention facility.

Results of Steps 1 through 4 for the example DMAs are shown below:

DMA	Impervious Area (sf)	Pervious Area (sf)	Pervious Area x 0.1 (sf)	Effective Impervious Area (EIA) (sf)	EIA * 0.04 (sf)
A	6,788	7,868	786.8	7,575	303
B	24,491	0	0	24,491	980

B.2 Podium-Type Building Example

Introduction

This example consists of a proposed podium type building in San Mateo County, with flow-through planters as the method of stormwater treatment. The flow-through planters are sized using the combination flow and volume sizing method.

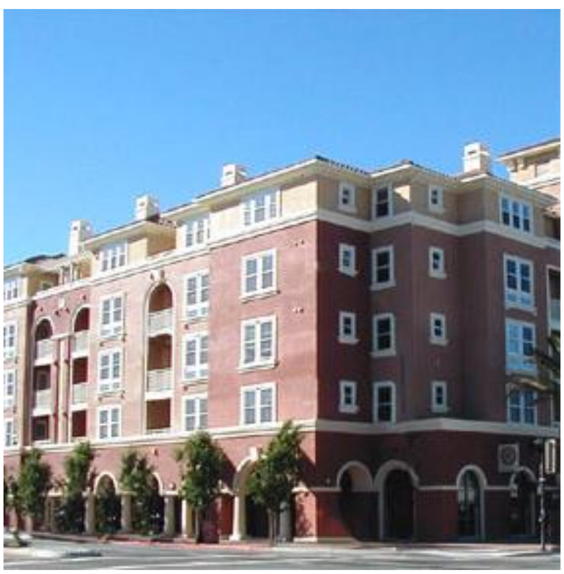


Figure B-3: Building with opportunities for podium-type treatment measures

Summary of Stormwater Controls

Site Design Measures

- Multistory building above covered parking structure (minimized surface parking)

Source Control Measures

- Covered trash storage areas
- Landscape architect will be asked to select drought tolerant plants and specify maintenance with IPM techniques

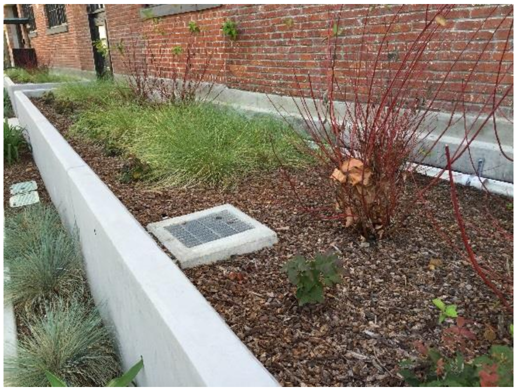
Treatment Measures

- Flow-through planters

Example Podium Type Development Description

- The project site is approximately 25,000 square feet.
- Lot line is assumed to be to the edge of city right-of-way (sidewalks).

- The podium building is a mixed-use building with residential units on the top floors, retail space on the second floor and parking on the bottom floor.
- The ground floor is a concrete slab with buildings and a covered parking structure. There is no potential for infiltration.
- The podium building roof area is 15,000 square feet.
- There is a 9,000 square foot concrete patio on the top of the podium in the center of the building.
- Treatment will be provided using flow-through planters in the center of the building around the concrete patio and down at ground level.
- Runoff will be conveyed to the treatment measures via roof leaders and sheet flow.
- Flow-through planters will be designed per the guidelines in Section 6.2 of the C.3 Technical Guidance Manual.
- Off-site sidewalks and driveways will be graded toward street (stormwater treatment not required).



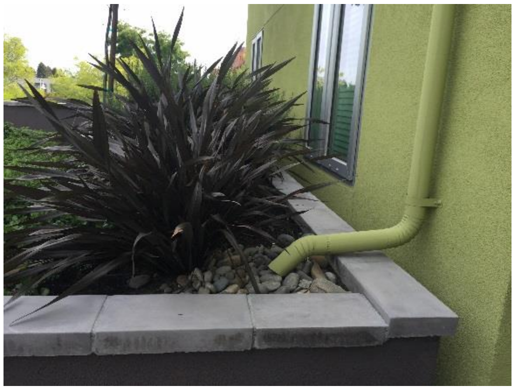


Figure B-4: Typical Flow-Through Planters on-grade (left) and on podium level (right)

Procedure for BMP Sizing (Combination Flow and Volume Method):

For bioretention areas and flow-through planters, the following approach may be used to take into consideration both the flow of stormwater through the planting media and the volume of stormwater in the surface ponding area. This treatment system design approach meets both the flow-based and volume-based criteria in MRP Provision C.3.d. Note that the approach assumes that all of the design rainfall becomes runoff, and thus it is appropriate for use where the drainage area to the bioretention area is mostly impervious (contributing pervious area should be converted to effective impervious areas by multiplying by a runoff coefficient of 0.1).

The steps below describe the calculations for sizing the example podium building treatment measures, using the combination flow and volume method described in Chapter 5, Section 5.1, and the following assumptions:

- Design flow criterion: rainfall intensity = 0.2 in/hr
- Design volume criterion: capture 80% of the average annual runoff

B.2 Podium-Type Building Example

- The project site is located in Rainfall Region 4, per the rainfall region map in Appendix C, and has a mean annual precipitation (MAP) of 16 inches
- The surface loading rate for the biotreatment soil is 5 in/hr
- Desired ponding depth is approximately 6 inches

1. List the DMAs draining to each treatment measure (note that for this example, it is assumed that all the runoff drains to one large flow-through planter):

   Impervious Patio Surfaces: 9,000 square feet

   Roof Surfaces: 15,000 square feet

   Total Impervious Area: 24,000 square feet

2. Determine the unit basin storage volume for 80 Percent Capture with 48-hour drawdown using Table 5-2 of Chapter 5 based on an effective impervious area runoff coefficient of 1.0. Adjust this volume based on the ratio of the MAP at the site to the MAP at the nearest rain gage.

   Region 4 (Palo Alto gage) has a MAP of 14.6 inches and a unit basin storage volume of 0.64 inches. The MAP at the site is 16 inches. Therefore, the unit basin storage volume at the site = (0.64 in. × 16/14.6) = **0.7 inches**.

3. Calculate the water quality design volume by multiplying the total impervious area from Step 1 times the adjusted unit basin storage volume from Step 2. (24,000 sq. ft. × 0.7" × 1/12 feet per inch = **1,403 cubic feet**.)

4. Assume that the rain event that generates the design volume of runoff determined in Step 3 occurs at a constant intensity of 0.2 in/hr from the start of the storm (i.e., assume a rectangular hydrograph). Calculate the duration of the rain event by dividing the adjusted unit basin storage volume from Step 2 by the intensity. In other words, determine the amount of time required for the adjusted unit basin storage volume to be achieved at a rate of 0.2 in/hr.

   For this example, with an adjusted unit basin storage volume of 0.7 inches, the rain event duration = (0.7 in. ÷ 0.2 in/hr) = **3.5 hours**.

5. Make a preliminary estimate of the surface area of the bioretention facility or flow-through planter by using the 4% method (i.e., multiplying the area of impervious surface in Step 1 by a sizing factor of 0.04).

   For this example, 24,000 sq. ft. × 0.04 = **960 square feet** of surface area

6. Assume a surface area that is about 25% smaller than the area calculated in Step 5. Using the example above, 960 – (0.25 × 960) = **720 square feet**.

7. Calculate the volume of runoff that filters through the treatment soil at a rate of 5 inches per hour (the design surface loading rate), for the duration of the rain event calculated in Step 4.

   For this example, with a surface area of 720 square feet and an infiltration rate of 5 in/hr for a duration of 3.5 hours:
   Volume of treated runoff = 720 sq. ft. × 5 in/hr × (1 ft/12 in) × 3.5 hrs = **1,052 cubic feet**.

8. Calculate the portion of the water quality design volume remaining after treatment is accomplished by filtering through the treatment soil. The result is the amount that must be stored in the ponding area above the reduced surface area assumed in Step 6.

   For this example, the amount remaining to be stored comparing Step 3 and Step 7 is 1,403 cu. ft. – 1,052 cu. ft. = **351 cubic feet**.

   If this volume is stored over a surface area of 720 square feet, the average ponding depth would be 351 cu. ft. ÷ 720 sq. ft. × 12 in/ft = **5.8 inches**.

9. The final step is to check if the average ponding depth is between 6 and 12 inches, which is the recommended range for ponding in a flow-through planter. (Check with the local municipality to determine what is allowed.) If the ponding depth is less than 6 inches, the bioretention design can be optimized with a smaller surface area (i.e., repeat Steps 7 and 8 with a smaller area). If the ponding depth is greater than 12 inches, a larger surface area will be required.

In this example, the recommended size of the flow-through planter is 715 square feet with a ponding depth of 6 inches.

B.3 Sizing Worksheets

The Countywide Program has developed Excel-based worksheets for sizing treatment measures using the volume-based method and the combination flow and volume-based method. The worksheets are available for download from the Countywide Program's website at the following link:

http://flowstobay.org/newdevelopment