Design Handbook

for

Low Impact Development

Best Management Practices

Prepared by:

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APPENDICES

Riverside County Design Handbook for

Low Impact Development Best Management Practices

1.0 Introduction

What is Low Impact Development?

According to the State Water Resources Control Board, Low Impact Development (LID) is:

> *… a sustainable practice that benefits water supply and contributes to water quality protection. Unlike traditional storm water management, which collects and conveys storm water runoff through storm drains, pipes, or other conveyances to a centralized storm water facility, LID takes a different approach by using site design and storm water management to maintain the site's pre-development runoff rates and volumes. The goal of LID is to mimic a site's predevelopment hydrology by using design techniques that infiltrate, filter, store, evaporate, and detain runoff close to the source of rainfall.*[1]

When implemented correctly on a site, LID provides two primary benefits: 1) The post-construction site hydrology will more closely mimic the pre-development hydrology, thus reducing the downstream erosion that may occur due to increased runoff from impervious surfaces; and 2) Pollutants in runoff from the site will be significantly reduced.

Additionally, the California Stormwater Quality Association (CASQA) LID Manual[2] identifies that a properly and effectively designed site will incorporate two forms of LID: LID Principles and LID BMPs. Whereas LID Principles focus on planning and designing a site in a manner that minimizes the causes, or drivers, of project impacts (sometimes referred to as site design), this Handbook discusses LID BMPs which are implemented to help mitigate any impacts that are otherwise unavoidable.

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[1] State Water Resources Control Board, *Low Impact Development – Sustainable Storm Water Management*, 2010; http://www.waterboards.ca.gov/water_issues/programs/low_impact_development/index.shtml

[2] California Stormwater Quality Association, *Low Impact Development Manual for Southern California: Technical Guidance and Site Planning Strategies*, April 2010

About this Handbook

This Handbook supplements the Riverside County Water Quality Management Plan (WQMP) by providing guidance for the planning, design and maintenance of Low Impact Development (LID) BMPs which may be used to mitigate the water quality impacts of developments within Riverside County.

This Handbook is the culmination of over five years of research, wherein manuals, studies, and experts from across the country were consulted to identify the most effective LID BMPs and designs. Although there are many types of BMPs that can be considered LID, this research found that the BMPs that are likely to be the most effective for the life of the project are those that are integrated into the design of the site and passively remove pollutants from runoff (without human intervention) through natural processes such as infiltration, biofiltration, and evapotranspiration. Further, it was found that BMPs are only effective as a function of how well they are maintained. Proprietary BMPs, underground BMPs or BMPs that require complicated maintenance equipment and procedures are all much less likely to be appropriately maintained, therefore, less reliable for the protection of water quality.

Based on that research, this Handbook contains detailed information and designs for seven (7) LID BMPs that are designed to encourage replication of the site's natural hydrologic processes. This includes maximizing direct or incidental infiltration and evapotranspiration, and using vegetation and other biological processes to filter and absorb pollutants. For each BMP, pertinent information is provided such as the maximum tributary drainage area, siting considerations, design procedures, and maintenance requirements. This Handbook also includes detailed guidance for infiltration testing, and basin considerations. By following these standardized designs and procedures, the citizens of Riverside County can be assured that water quality will be protected to the maximum extent practicable.

Selecting appropriate LID BMPs

LID BMPs are a highly effective and naturally-based form of Treatment Control BMPs. Before selecting any particular BMPs for a site, refer to the WQMP applicable to the project (based on the watershed the project is located in). The WQMP may specify particular types of LID or Treatment Control BMPs that can or must be considered for use on the project. Such considerations may include whether or not the LID BMP will maximize on-site retention of runoff, or be based on the types of pollutants that the site may generate, types of pollutants that are impairing the downstream receiving waters, and which BMPs are effective at addressing those pollutants. Generally infiltration BMPs have advantages over other types of BMPs, including reduction of the volume and rate of runoff, as well as full treatment of all potential pollutants potentially contained in the stormwater runoff. It is recognized however that infiltration may not be feasible on sites, such as those with high groundwater, low infiltration rates, or located on compacted engineered fill. In those situations, harvest and use, bioretention and/or biotreatment based BMPs that provide opportunity for evapotranspiration and incidental infiltration may be a more feasible option. The WQMP may specify criteria that can be used to determine when particular BMPs are considered feasible.

Who should be involved in the selection, siting and design of LID BMPs?

Everyone involved with the project site development, including owners, architects, engineers, and geologists, should be informed about the proposed/required BMPs as early as possible in the planning of a project. This reduces the chance of costly redesign, the need for additional testing and produces a better and more integrated site overall. For most basins and all infiltration BMPs, it is important that the responsible engineer/geologist be made aware of the location of BMPs, so they can make design recommendations including setbacks and perform the appropriate infiltration testing, if required. Landscape architects will need to know the locations and types of proposed BMPs as these might change the types of plants that can be used. Owners must be made aware of the long term maintenance and total cost of ownership for the BMPs in order to make informed decisions during the BMP selection process.

Many of the BMP fact sheets reference the 'Engineering Authority' (EA). Who is the EA for my project?

The engineering authority for a project is the public agency responsible for reviewing and approving the proposed project. Usually the EA is the City/County wherein the project is located.

Do I need to do additional studies?

Most infiltration BMPs and basins will require a geotechnical report prepared by either a licensed geotechnical engineer, civil engineer or certified engineering geologist. The report must provide characterization of site specific soil conditions, recommendations of any required testing, and site specific recommendations for setbacks as well as commentary on slope stability and potential offsite impacts. See Infiltration Testing Requirements and Basin Guidelines in Appendices A and C, respectively, for more information.

Designing the BMPs

The BMPs in this Handbook are designed based on volume. Volume based BMPs are designed to capture a particular volume of stormwater runoff (referred to as V_{BMP}), and either infiltrate that volume, re-use the water, or slowly and naturally filter pollutants from that stormwater, and discharge the volume within a specified drawdown time.

This Handbook contains worksheets to assist the designer in determining the required V_{BMP} based on the location of the site. While there are likely significant direct or indirect volume reduction benefits associated with each of the included LID BMPs, these sizing worksheets are not intended to meet the requirements listed in the Hydraulic Conditions of Concern (HCOC) section of the WQMP.

Can I make my BMP smaller?

The worksheets in this Handbook calculate the minimum required size for each LID BMP based on the amount of runoff reaching the BMP. However, early and aggressive implementation of LID Principles (site design) during the planning stages of a project will translate directly to less runoff, and in turn will help minimize the required size of the BMPs. To further reduce the required size, consider looking for additional ways to increase the percentage of landscaped areas and porous surfaces on the site, and opportunities to drain impervious areas into pervious areas.

Can I place my BMP underground?

Under most circumstances, in areas of new development or significant redevelopment, the use of underground treatment control BMPs in lieu of the LID BMPs in this Handbook is not justifiable.

What are Drawdown Times?

Volume based BMPs are usually associated with a required drawdown time. The drawdown time refers to the amount of time the design volume takes to pass through the BMP. The specified or incorporated drawdown times are to ensure that adequate contact or detention time has occurred for treatment, while not creating vector or other nuisance issues. It is important to abide by the drawdown time requirements stated in the fact sheet for each specific BMP.

What is the tributary drainage area?

The tributary drainage area is the entire area that drains to the proposed onsite BMP. While small sites could be tributary to a single BMP, usually the site is broken up into several drainage management areas (DMAs), each draining to a discrete BMP. Although it is usually desirable to address offsite flows separately, if flows from offsite areas commingle with onsite flows they shall also be included in the sizing calculation. At the beginning of each fact sheet, the maximum (or minimum) tributary drainage area for each BMP is listed. The tributary areas for each BMP will be required to be clearly shown on one or more drainage exhibits. Such exhibits shall be clearly labeled to show which areas drain to which BMP.

What are pervious and impervious areas?

Project sites are made up of both pervious and impervious surfaces. The pervious portion of a site is where stormwater has the opportunity to infiltrate into the ground, such as but not limited to landscaped or natural areas. Impervious areas are where water has no opportunity to infiltrate and immediately becomes surface runoff. When a site is developed, the percentage of impervious area typically increases from the natural state. This higher impervious percentage increases the volume and flow rate of stormwater runoff.

2.0 Sizing Calculations

The following section includes sizing calculations for three regions: Santa Ana, Santa Margarita and Whitewater. These calculations are based on approved methodologies within the currently active Municipal Separate Storm Sewer System (MS4) permits for each of these three watershed regions of Riverside County. In this manual, all BMP designs are sized based on the design capture volume, V_{BMP}. However, there may be circumstances when flow based Treatment Control BMPs are utilized and therefore this section also includes guidelines for calculating the design flow rate, Q_{BMP}.

2.1 Calculating V_{BMP}

Volume based BMPs, including all of the BMPs in this manual, are sized to capture and treat the design capture volume, V_{BMP}. As the method for calculating and documenting the design capture volume varies by watershed, the designer must first know which watershed the proposed project is within, and then follow the corresponding guidelines below.

The watershed a particular project is within can be determined from the 'Locate my Watershed' tool available at:

www.rcflood.org/npdes/

2.1.1 Santa Ana Watershed (including the San Jacinto sub-watershed)

In order to meet Regional Water Quality Control Board (RWQCB) requirements, in the Santa Ana Watershed the design capture volume (V_{BMP}) is based on capturing the volume of runoff generated from an 85^{th} percentile, 24-hour storm event. Follow the steps below to calculate V_{BMP} in the Santa Ana Watershed. For convenience, these steps have also been integrated into an excel worksheet that has been provided in Appendix F of this Handbook.

1) Delineate Drainage Management Areas (DMAs) draining to the BMP as described in the WQMP. Wherever possible, use separate DMAs for each surface type (e.g., landscaping, pervious paving, or roofs). Assign each DMA a unique ID code and determine its area in square feet. Multiple DMAs can be combined to individual downstream BMPs.

2) Compile a list of DMAs draining to each volume based BMP using the V_{BMP} calculation worksheet provided in Appendix F to this Handbook. An example of the table from that worksheet is provided below. Account for all areas that will contribute runoff to the proposed BMP, including runoff from off-site areas that commingle with on-site runoff. Enter the unique DMA ID, area, and post-project surface type for each DMA, into the first three columns of the table. The remaining steps describe the process for filling in the remaining parts of the table.

DMA Type/ ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imper-vious Fraction, I_F	DMA Runoff Factor, C	DMA Area × Runoff Factor	LID BMP Name/Identifier		
						Design Storm Depth (in)	Design Capture Volume (cubic feet)	Proposed Volume on Plans (cubic feet)
	Σ= A_T		***Total***		*Σ= [A]*	**[B]**	***[C]***	

3) Determine the effective impervious fraction (I_f) for each DMA, and fill in the fourth column of the table described in Step 2.

For DMAs comprised of a single post-project surface type (as described in the WQMP, most DMAs should be designed in this manner), the effective Impervious Fraction should be derived from the following table:

Surface Type	Effective Impervious Fraction, I_f
Roofs	1.00
Concrete or Asphalt	1.00
Grouted or Gapless Paving Blocks	1.00
Compacted Soil (e.g. unpaved parking)	0.40
Decomposed Granite	0.40
Permeable Paving Blocks w/ Sand Filled Gap	0.25
Class 2 Base	0.30
Gravel or Class 2 Permeable Base	0.10
Pervious Concrete / Porous Asphalt	0.10
Open and Porous Pavers	0.10
Turf block	0.10
Ornamental Landscaping	0.10
Natural (A Soil)	0.03
Natural (B Soil)	0.15
Natural (C Soil)	0.30
Natural (D Soil)	0.40

If a single DMA contains mixed post-project surface types, a composite or area-weighted average effective impervious fraction should be used. The following equation can be used for determining an area-weighted average:

$$\frac{\left[\left(I_f\right)_1 \cdot A_1\right] + \left[\left(I_f\right)_2 \cdot A_2\right] + [\ldots]}{A_T}$$

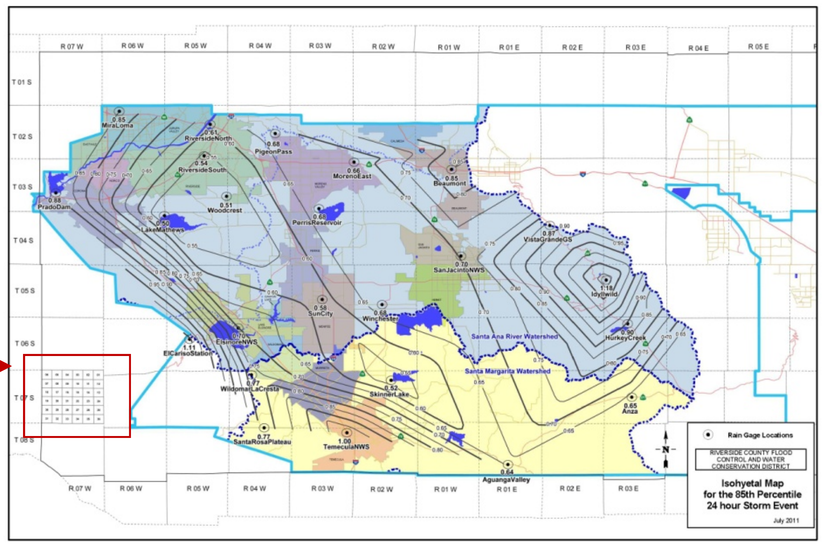
4) Calculate a runoff factor, ‘C’, using the following equation, and enter this value into the fifth column of the table described in Step 2:

$$C = 0.858 \cdot {I_f}^3 - 0.78 \cdot {I_f}^2 + 0.774 * I_f + 0.04$$

5) For each tabulated DMA, multiply the area by the runoff factor, and enter the resulting value in the sixth column of the table described in Step 2. Enter the sum of the sixth column in the field identified with “[A]” in the table.

6) Determine the Design Storm Depth (D_{85}) by locating the project site on the full sized Isohyetal Map for the 85th Percentile 24-hour Storm Event, contained in Appendix D of this Handbook. These values were determined throughout Riverside County using rain gauges with the greatest periods of record. Use township, range and section information to locate the project site, and interpolate the closest value for the site. Enter this value (inches) in the field identified with “[B]” in the table from Step 2.

Tip: Make a clear acetate copy of the township, range and section grid to use as an overlay on other sections of the map.



7) Determine the Design Capture Volume or ‘VBMP’ using the equation below:

$$V_{BMP}(\mathrm{ft}^3) = \frac{[\mathrm{A}] \times [\mathrm{B}]}{12\ (\mathrm{in/ft})}$$

Enter this value in the field identified with “[C]” in the table from Step 2. This is the volume to be used in the design of BMPs presented in this Handbook.

2.1.2 *Santa Margarita Watershed*

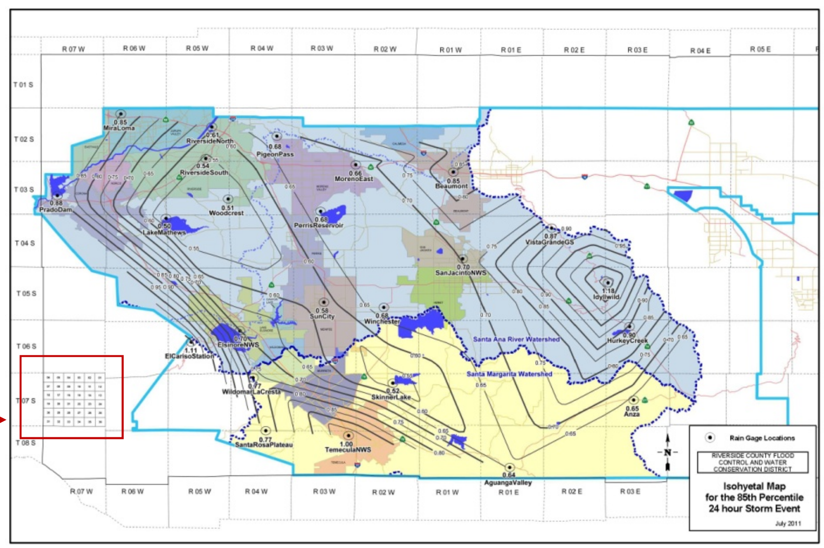
In order to meet RWQCB requirements, in the Santa Margarita Watershed, the design capture volume (V_{BMP}) is based on capturing the volume of runoff generated from an 85th percentile, 24-hour storm event. Follow the steps below to calculate V_{BMP} in the Santa Margarita Watershed. For convenience, these steps have also been integrated into an excel worksheet that has been provided in Appendix F of this Handbook.

1) Determine the tributary drainage area to the BMP, A_T. This includes all areas that will contribute runoff to the proposed BMP, including pervious areas, and runoff from off-site areas that commingle with on-site runoff. Calculate this area in acres.

2) Locate the project site on the full sized Isohyetal Map for the 85th Percentile 24-hour Storm Event contained in Appendix D of this Handbook. These values were determined throughout Riverside County using rain gauges with the greatest periods of record. Use township, range and section information to locate the project site, and interpolate the closest value, D85, for the site.

NOTE: *The use of the Isohyetal Map in Appendix D of this Handbook requires the use of BMPs identified in this LID BMP Design Handbook. This Isohyetal Map cannot be used with older BMP designs.*

Tip: Make a clear acetate copy of the township, range and section grid to use as an overlay on other sections of the map.



3) Determine the effective impervious fraction (I_f) for the area tributary to the BMP, using the following table:

Surface Type	Effective Impervious Fraction, I_f
Roofs	1.00
Concrete or Asphalt	1.00
Grouted or Gapless Paving Blocks	1.00
Compacted Soil (e.g. unpaved parking)	0.40
Decomposed Granite	0.40
Permeable Paving Blocks w/ Sand Filled Gap	0.25
Class 2 Base	0.30
Gravel or Class 2 Permeable Base	0.10
Pervious Concrete / Porous Asphalt	0.10
Open and Porous Pavers	0.10
Turf block	0.10
Ornamental Landscaping	0.10
Natural (A Soil)	0.03
Natural (B Soil)	0.15
Natural (C Soil)	0.30
Natural (D Soil)	0.40

If the area tributary to the BMP contains mixed post-project surface types, a composite or area-weighted average effective impervious fraction should be used. The following equation can be used for determining an area-weighted average:

$$\frac{\left[\left(I_f\right)_1 \cdot A_1\right] + \left[\left(I_f\right)_2 \cdot A_2\right] + [\ldots]}{A_T}$$

4) Calculate a runoff factor, 'C', using the following equation:

$$C = 0.858 \cdot {I_f}^3 - 0.78 \cdot {I_f}^2 + 0.774 * I_f + 0.04$$

5) Determine unit storage volume, V_U. This is found by multiplying the Design Storm Depth found in Step 2 by the runoff coefficient found in Step 4.

$$V_U = D_{85} \times C$$

6) Determine V_{BMP} using the equation below or the worksheet provided in Appendix F of this Handbook. This is the volume to be used in the design of selected BMPs presented in this Handbook. Multiply the BMP tributary drainage area, A_T, by the unit storage volume, V_U, to give the BMP design storage volume.

$$V_{BMP}(ft^3) = \frac{V_U(in - ac/ac) \times A_T(ac) \times 43{,}560(ft^2/ac)}{12\ (in/ft)}$$

2.1.3 Whitewater Watershed

In order to meet RWQCB requirements, in the Whitewater Watershed the design capture volume (V_{BMP}) is based on the CASQA methodology referenced in Section F.1.c.v.4.a.ii of the MS4 permit. The Palms Springs Thermal Airport rain gauge was used as the reference gauge. Follow the steps below to calculate V_{BMP} in the Whitewater Watershed. For convenience, these steps have also been integrated into an excel worksheet that has been provided in Appendix F of this Handbook.

7) Determine the tributary drainage area, A_T. This includes all areas that will contribute runoff to the proposed BMP, including pervious areas, and runoff from offsite areas that commingle with site runoff. Calculate this area in acres.

8) Determine the effective impervious fraction (I_f) for the area tributary to the BMP, using the following table:

Surface Type	Effective Impervious Fraction, I_f
Roofs	1.00
Concrete or Asphalt	1.00
Grouted or Gapless Paving Blocks	1.00
Compacted Soil (e.g. unpaved parking)	0.40
Decomposed Granite	0.40
Permeable Paving Blocks w/ Sand Filled Gap	0.25
Class 2 Base	0.30
Gravel or Class 2 Permeable Base	0.10
Pervious Concrete / Porous Asphalt	0.10
Open and Porous Pavers	0.10
Turf block	0.10
Ornamental Landscaping	0.10
Natural (A Soil)	0.03
Natural (B Soil)	0.15
Natural (C Soil)	0.30
Natural (D Soil)	0.40

If the area tributary to the BMP contains mixed post-project surface types, a composite or area-weighted average effective impervious fraction should be used. The following equation can be used for determining an area-weighted average:

$$\frac{\left[\left(I_f\right)_1 \cdot A_1\right] + \left[\left(I_f\right)_2 \cdot A_2\right] + [\ldots]}{A_T}$$

9) Calculate a runoff factor, 'C', using the following equation:

$$C = 0.858 \cdot {I_f}^3 - 0.78 \cdot {I_f}^2 + 0.774 * I_f + 0.04$$

10) Determine 85th percentile unit storage volume, V_U. This is found by multiplying the runoff coefficient found in Step 3 by 0.40.

$$V_U = 0.4 \times C$$

11) Determine the design capture volume, V_{BMP} using the equation below or the worksheet provided in Appendix F of this Handbook. This is the volume to be used in the design of selected BMPs presented in this Handbook.

$$V_{BMP}(ft^3) = \frac{V_U(in - ac/ac) \times A_T(ac) \times 43{,}560(ft^2/ac)}{12\ (in/ft)}$$

2.2 Calculating Q_{BMP}

While the BMPs in this Handbook are designed based on V_{BMP} as discussed in 2.1 above, in some circumstances flow based BMPs may be used. Flow-based BMPs are sized to treat the design flow rate. As the method for calculating and documenting the design flow rate varies by watershed, the designer must first know which watershed the proposed project is within, and then follow the corresponding guidelines below.

The watershed a particular project is within can be determined from the 'Locate my Watershed' tool available at:

www.rcflood.org/npdes/

2.2.1 Santa Ana Watershed (including the San Jacinto sub-watershed)

In the Santa Ana Watershed, Q_{BMP} is the runoff flow rate resulting from a design rainfall intensity of 0.2 inches per hour. Follow the steps below to calculate and document Q_{BMP} in the Santa Ana Watershed. For convenience, these steps have also been integrated into a worksheet that has been provided in Appendix F of this Handbook.

1) Delineate Drainage Management Areas (DMAs) draining to the BMP, as described in the WQMP. Wherever possible, use separate DMAs for each surface type (e.g., landscaping, pervious paving, or roofs). Assign each DMA a unique code and determine its size in square feet. Multiple DMAs can be combined to individual downstream BMPs.

2) Compile a list of DMAs draining to each flow based BMP using the Q_{BMP} calculation worksheet provided in Appendix F to this Handbook. An example of the table from that worksheet is provided below. Account for all areas that will contribute runoff to the proposed BMP, including runoff from off-site areas that commingle with on-site runoff. Enter the unique DMA ID, area, and post-project surface type for each DMA, into the first three columns of the table. The remaining steps describe the process for filling in the remaining parts of the table.

DMA Type /ID	*DMA Area (square feet)*	*Post-Project Surface Type*	*Effective Imper-vious Fraction, I_F*	*DMA Runoff Factor, C*	*DMA Area × Runoff Factor*	*LID BMP Name/Identifier*		
						Design Rainfall Intensity	*Minimum Flow (cfs)*	*Proposed Flow (cfs)*
	Σ= A_T		***Total***		***Σ= [A]***	**0.2**	***[B]***	

3) Determine the effective impervious fraction (I_f) for each DMA, and fill in the fourth column of the table described in Step 2.

For DMAs comprised of a single post-project surface type (as described in the WQMP, most DMAs should be designed in this manner), the effective Impervious Fraction should be derived from the following table:

Surface Type	Effective Impervious Fraction, I_f
Roofs	1.00
Concrete or Asphalt	1.00
Grouted or Gapless Paving Blocks	1.00
Compacted Soil (e.g. unpaved parking)	0.40
Decomposed Granite	0.40
Permeable Paving Blocks w/ Sand Filled Gap	0.25
Class 2 Base	0.30
Gravel or Class 2 Permeable Base	0.10
Pervious Concrete / Porous Asphalt	0.10
Open and Porous Pavers	0.10
Turf block	0.10
Ornamental Landscaping	0.10
Natural (A Soil)	0.03
Natural (B Soil)	0.15
Natural (C Soil)	0.30
Natural (D Soil)	0.40

If a single DMA contains mixed post-project surface types, a composite or area-weighted average effective impervious fraction should be used. The following equation can be used for determining an area-weighted average:

$$\frac{\left[\left(I_f\right)_1 \cdot A_1\right] + \left[\left(I_f\right)_2 \cdot A_2\right] + [\ldots]}{A_T}$$

4) Calculate a runoff factor, 'C', using the following equation, and enter this value into the fifth column of the table described in step 2:

$$C = 0.858 \cdot {I_f}^3 - 0.78 \cdot {I_f}^2 + 0.774 * I_f + 0.04$$

5) For each tabulated DMA, multiply the area by the runoff factor. Enter the resulting value in the sixth column of the table described in Step 2. Enter the sum of the sixth column in the field identified with "[A]" in the table.

6) Determine the BMP Design Flow Rate (Q_{BMP}) using the equation:

$$\text{QBMP} = \frac{(0.2\ x\ \text{“}[A]\text{”})}{43{,}560}$$

Enter Q_{BMP} in the field identified with "[B]" in the table.

2.2.2 Santa Margarita and Whitewater Watersheds

In the Santa Margarita and Whitewater Watershed regions of Riverside County, Q_{BMP} is the runoff flow rate resulting from a design rainfall intensity of 0.2 inches per hour. Follow the steps below to calculate Q_{BMP} for both the Santa Margarita and Whitewater watersheds.

1) Determine the tributary drainage area, A_T, that drains to the proposed BMP. This includes all areas that will contribute runoff to the proposed BMP, including pervious areas, impervious areas, and runoff from offsite areas that commingle with site runoff, whether or not they are directly or indirectly connected to the BMP. Calculate this area in units of acres.

2) Determine the effective impervious fraction (I_f) for the area tributary to the BMP, using the following table:

Surface Type	Effective Impervious Fraction, I_f
Roofs	1.00
Concrete or Asphalt	1.00
Grouted or Gapless Paving Blocks	1.00
Compacted Soil (e.g. unpaved parking)	0.40
Decomposed Granite	0.40
Permeable Paving Blocks w/ Sand Filled Gap	0.25
Class 2 Base	0.30
Gravel or Class 2 Permeable Base	0.10
Pervious Concrete / Porous Asphalt	0.10
Open and Porous Pavers	0.10
Turf block	0.10
Ornamental Landscaping	0.10
Natural (A Soil)	0.03
Natural (B Soil)	0.15
Natural (C Soil)	0.30
Natural (D Soil)	0.40

If the area tributary to the BMP contains mixed post-project surface types, a composite or area-weighted average effective impervious fraction should be used. The following equation can be used for determining an area-weighted average:

$$\frac{\left[\left(I_f\right)_1 \cdot A_1\right] + \left[\left(I_f\right)_2 \cdot A_2\right] + [\ldots]}{A_T}$$

3) Calculate a runoff factor, 'C', using the following equation:

$$C = 0.858 \cdot {I_f}^3 - 0.78 \cdot {I_f}^2 + 0.774 * I_f + 0.04$$

4) Determine the BMP Design Flow Rate using the equation:

$$Q_{BMP} = C \times I \times A_T$$

Where,

A_T = Tributary Area to the BMP, in acres

I = Design Rainfall Intensity, 0.2 inch/hour is used for this Handbook

C = Runoff Factor, found in Step 3

3.0 BMP Fact Sheets

This section provides fact sheets for the following seven types of BMPs:

3.1 - Infiltration Basins

3.2 - Infiltration Trenches

3.3 - Permeable Pavement

3.4 - Harvest and Use

3.5 - Bioretention Facilities

3.6 - Extended Detention Basins

3.7 - Sand Filter Basins

►For portability, the fact sheets for each BMP, as well as Calculation worksheets for sizing and documenting the design of these BMPs, are provided as separate downloadable files on the LID Handbook page at www.rcflood.org/NPDES/developers.aspx

BEFORE selecting any particular BMP for use on your project, review the requirements of the applicable WQMP, and the discussions in sections 1 and 2 of this Handbook. These provide important context and instructions that may dictate that particular BMPs be used.

APPENDIX A

Infiltration Testing

APPENDIX B

Underdrains

APPENDIX C

Basin Guidelines

APPENDIX D

Isohyetal Map for the 85th Percentile 24-hour Storm Event

For the Santa Ana and Santa Margarita Watersheds

APPENDIX E

BMP Pollutant Removal Effectiveness

APPENDIX F

Worksheets for calculating V_{BMP} and Q_{BMP}