



# WATER POLLUTION PREVENTION

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## Low Impact Development:

Guidance and Standards for  
Transportation Projects for the Santa Ana  
Region Riverside County Co-Permittees

October 2012



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# Section 1

## Introduction

### A. Purpose of the Guidance

The federal Clean Water Act (CWA) establishes requirements for the discharge of urban runoff from Municipal Separate Storm Sewer Systems (MS4) under the National Pollutant Discharge Elimination System (NPDES) program. On January 29, 2010, the Santa Ana Regional Water Quality Control Board (RWQCB) issued Permit Order No. R8-2010-0033 ("MS4 Permit") to authorize the discharge of urban runoff from MS4 facilities in Riverside County within the Santa Ana Region MS4 Permit area.

The MS4 Permit requires development of a standard design and post-development Best Management Practices (BMPs) guidance to guide application of Low Impact Development (LID) BMPs to the maximum extent practicable (MEP) on public street, road, highway, and freeway ("road") improvement projects to reduce the discharge of pollutants to Receiving Waters. This requirement is based on Finding II.G.18 in the MS4 Permit:

*"...Permittee streets, roads and highways capital projects have special limitations. For example, the footprint of street, road and highway capital projects is often limited and may have hydraulic constraints due to lack of underground storm drain systems that would otherwise be necessary to hydraulically facilitate treatment of runoff. There are also limitations specified in state and federal design and code specifications that may limit or prohibit certain BMPs. Permittees may also be subject to flow diversion liability and limited road maintenance budgets and equipment. Street, road and highway projects that function as part of the MS4 also receive runoff and associated Pollutants from both existing urban areas and other external sources, including adjacent land use activities, aerial deposition, brake pad and tire wear and other sources that may be outside the Co-Permittee's authority to regulate and/or economic or technological ability to control. These offsite flows can overwhelm Treatment Control BMPs designed to address the footprint (consistent with the typical requirements for a WQMP [Water Quality Management Plan]) of street, road or highway capital projects incorporating curb and gutter as part of its storm water conveyance function. Despite these limitations, the Regional Board finds that Permittee construction of streets, roads and highway capital projects may provide an opportunity to address Pollutant loads from existing urban areas. However, due to the nature of the facilities and projects, it would be unduly burdensome for the Co-Permittees to maintain WQMP documents for transportation projects (in addition to Facility Pollution Prevention Plans and other overlapping requirements of this Order). The Permittees are therefore not required to prepare WQMP documents for street, road and highway capital projects, but instead are required to develop functionally equivalent documents that include site specific consideration utilizing BMP guidance to address street, roads and highway capital project runoff to the MEP."*

The Santa Ana Region MS4 Permittees prepared this *Low Impact Development: Guidance and Standards for Transportation Projects* ("Guidance") to provide direction to Transportation Project owners and operators (including city engineers, planners, and MS4 program staff) regarding how to address MS4 Permit requirements for public works Transportation Projects (including Class I Bikeway and sidewalk projects) within their jurisdictions.

The LID-based BMP techniques contained within this document are based on information provided by a variety of sources, including the *Design Handbook for Low Impact Development Best Management Practices* prepared by the Riverside County Flood Control and Water Conservation District, Environmental Protection Agency's (USEPA) Municipal Handbook, *Managing Wet Weather with Green Infrastructure: Green Streets*, and the *Low Impact Development Manual for Southern California* prepared for the Southern California Stormwater Monitoring Coalition, in cooperation with the State Water Resources Control Board, by the Low Impact Development Center. This Guidance also provides links and references to other sources of information regarding the application of LID-based BMPs to Transportation Projects (Section 6).

The remaining parts of this section provide information regarding the applicability and appropriate use of this Guidance. Subsequent sections of this document provide detailed information regarding how to apply this Guidance to applicable projects.

## B. NPDES Permit Requirement

MS4 Permit Section XII.F.1 states:

*"Within 24 months of adoption of this Order, the Co-Permittees shall develop standard design and post-development BMP guidance to be incorporated into projects for streets, roads, highways, and freeway improvements, under the jurisdiction of the Co-Permittees to reduce the discharge of Pollutants from the projects to the MEP. The draft guidance shall be submitted to the Executive Officer for review and approval and shall meet the performance standards for site design/LID BMPs, Source Control and Treatment Control BMPs as well as the HCOC [Hydrologic Conditions of Concern] criteria. The guidance and BMPs shall address streets, roads or highways under the jurisdiction of the Co-Permittees used for transportation of automobiles, trucks, motorcycles, and other vehicles, and excludes routine road maintenance activities where the surface footprint is not increased. The guidance shall incorporate principles contained in the USEPA guidance, "Managing Wet Weather with Green Infrastructure: Green Streets" to the MEP and at a minimum shall include the following:*

- a. *Guidance specific to new road projects;*
- b. *Guidance specific to projects for existing roads;*
- c. *Size or impervious area criteria that trigger project coverage;*
- d. *Preference for green infrastructure approaches wherever feasible;*
- e. *Criteria for design and BMP feasibility analyses on a project-specific basis.*

This Guidance fulfills this MS4 Permit requirement. Also, as noted above, this document also addresses Class I Bikeway and sidewalk projects. All jurisdictions subject to the requirements of the Santa Ana Region MS4 Permit shall implement this Guidance to the extent that it is applicable to their project.

## C. Applicability

The effective date of this Guidance is six months after the approval of the Guidance by the Santa Ana RWQCB Executive Officer. Its requirements do not apply to all proposed projects. Transportation Projects are implemented to address many needs, ranging from improving the transportation network to support local and regional development, to meeting public safety and maintenance needs. Given the vast array of potential activities carried out to develop and manage transportation networks, project owners and operators should consult this Guidance, as needed, to evaluate its applicability to a proposed project.

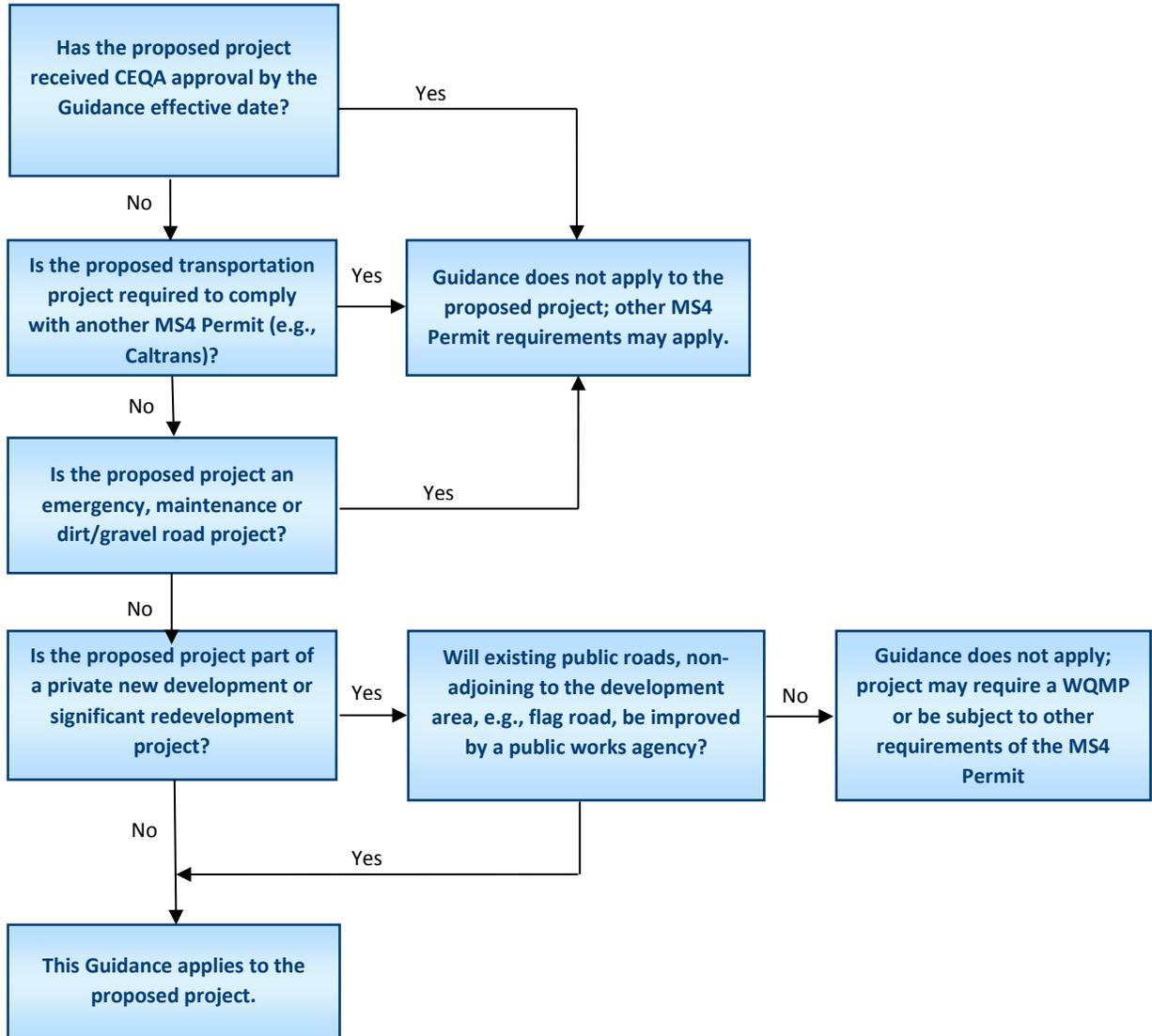
**Table 1-1** and **Figure 1-1** summarize Guidance applicability.

If a finding is made that this Guidance applies, then the project owner and operator should continue to use this Guidance to ensure compliance with MS4 Permit requirements applicable to Transportation Projects. If it is determined that this Guidance does not apply to the Transportation Project, this finding, along with the basis for the finding, should be documented in the project file.

**Table 1-1. Transportation Project Guidance Applicability**

<p><b>This Guidance applies to the following projects:</b></p> <ul style="list-style-type: none"> <li>• Public Transportation Projects in the area covered by the Santa Ana Region MS4 Permit, which involve the construction of new transportation surfaces or the improvement of existing transportation surfaces (including Class I Bikeways and sidewalks).</li> </ul>
<p><b>This Guidance does not apply to the following projects:</b></p> <ul style="list-style-type: none"> <li>• Transportation Projects that have received CEQA approval by the effective date of this Guidance</li> <li>• Emergency Projects, as defined by this Guidance (see Section 2)</li> <li>• Maintenance Projects, as defined by this Guidance (see Section 2)</li> <li>• Dirt or gravel roads</li> <li>• Transportation Projects that are part of a private new development or significant redevelopment project and required to prepare a Water Quality Management Plan (WQMP)</li> <li>• Transportation Projects subject to other MS4 Permit requirements, e.g., California Transportation Department (Caltrans) oversight projects, cooperative projects with an adjoining County or an agency outside the jurisdiction covered by the Santa Ana Region MS4 Permit</li> </ul>

Figure 1-1. Applicability of the Transportation Project Guidance to a Proposed Project

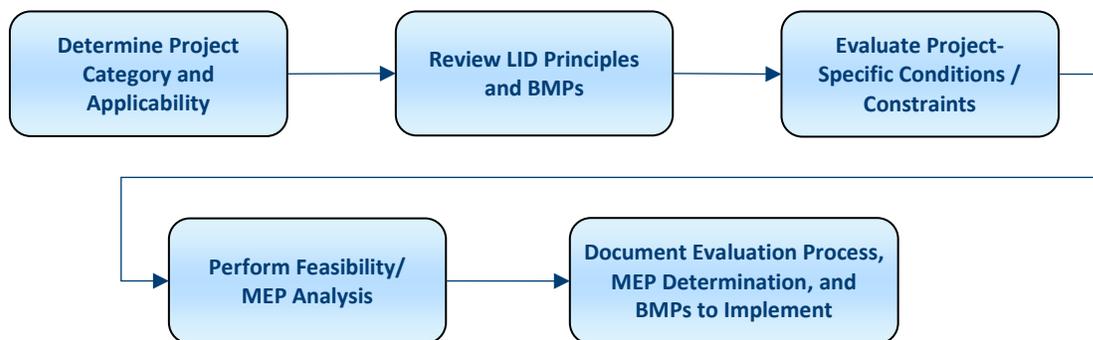


## D. Functional Equivalence to WQMP

As stated in MS4 Permit Finding II.G.18, the Santa Ana Region MS4 Permit requires the establishment of guidance that facilitates the development of project documents that are functionally equivalent to WQMP documents prepared for new development and significant redevelopment projects. These functionally equivalent documents should "include site specific considerations utilizing BMP guidance to address road capital project runoff to the MEP." This Guidance establishes minimum LID Principles and BMPs that will treat runoff and address Hydrologic Conditions of Concern to the MEP. For each specific project the feasibility analysis in Section 3 of this Guidance determines what is MEP, within the constraints associated with the project. Depending on the nature of the project and BMPs selected, this Guidance also establishes source control requirements.

## E. Organization and Use of the Guidance

The project category, project type, and project-specific feasibility analysis determines the extent to which LID Principles and BMPs are applicable to a project. **Figure 1-2** summarizes the key process steps for evaluating a proposed Transportation Project.



**Figure 1-2. Project Evaluation Steps**

The remaining sections of this Guidance describe each step in the process, specifically:

- **Section 2, Project Categories** – This section further refines Guidance applicability based on the type of project.
- **Section 3, Project Evaluation** – This section establishes Guidance specific to new and existing Transportation Projects. The Guidance does not establish specific minimum size or impervious area criteria that trigger project coverage. Instead, Section 3 establishes (a) minimum BMP design principles and techniques that shall be considered for all projects to which the Guidance applies; (b) summarizes site constraints that should be evaluated with each project; and (c) provides project-specific BMP feasibility criteria for consideration to evaluate the feasibility of incorporating green infrastructure elements (LID Principles and BMPs) into the proposed project.
- **Section 4, Source Control BMPs** – This section notes the Source Control BMPs that should be evaluated for applicability to Transportation Projects.

- **Section 5, Project Implementation Requirements** – This section describes the minimum documentation requirements applicable to projects and the nexus between the project evaluation and other permit requirements.
- **Section 6, Resources** – This section includes resources for implementation, including planning and design information to facilitate implementation of LID-based BMPs in Transportation Projects, a Glossary, and Transportation Project BMP Template that should be used as part of the evaluation process for proposed Transportation Projects.

## Section 2

# Project Categories

This Guidance establishes four categories of projects (**Table 2-1**):

- Category 1 – Emergency Projects
- Category 2 – Maintenance Projects
- Category 3 – Existing Transportation Projects
- Category 4 – New Transportation Projects

Consistent with MS4 Permit Provisions XII.F.1 and XII.D.2, Category 1 or 2 projects are considered exempt from the LID and Source Control BMP implementation requirements contained within this Guidance and the WQMP. The project owner and operator should consult the Local Implementation Plan (LIP) for the jurisdiction within which the project will be built to identify applicable requirements, such as for Category 2 – Maintenance Projects.

If the project falls within Category 3 or 4, this Guidance applies to the project. Accordingly, the LID Principles and BMPs applicable to the project type shall be evaluated and incorporated into the project design to the MEP (see Section 3).

Category 3 projects may be subcategorized into capacity improvement, non-capacity improvement, or Class I Bikeway and sidewalk projects (not adjoining an existing road). This sub-categorization may be important for the selection and evaluation of appropriate LID Principles and BMPs for incorporation into the project (see Section 3). If a road project includes adjoining bikeway or sidewalk features, the selection and evaluation of BMPs should consider both the road and the adjoining bikeway/sidewalk features as a single project.

The design of new bridge projects as identified in Category 4 on Table 2-1 below will be evaluated using the following references from the U.S. Department of Transportation, Federal Highway Administration, for design considerations and channel stability assessments:

- Hydraulic Engineering Circular No. 14, *Hydraulic Design of Energy Dissipators for Culverts and Channels*

<http://www.fhwa.dot.gov/engineering/hydraulics/pubs/o6o86/hecl4.pdf>

- Publication No. FHWA-HRT-05-072, *Assessing Stream Channel Stability at Bridges in Physiographic Regions*

<http://www.fhwa.dot.gov/publications/research/infrastructure/hydraulics/o5o72/o5o72.pdf>

**Table 2-1. Project Categories and Example Projects<sup>1</sup>**

Exempt from Guidance Requirements		Category 3 Existing Transportation Project	Category 4 New Transportation Project
Category 1 Emergency Project	Category 2 Maintenance Project		
<ul style="list-style-type: none"> <li>▪ Emergency road work of any nature that occurs outside the normal planning process</li> </ul>	<ul style="list-style-type: none"> <li>▪ Routine, reactive, or preventive maintenance activities</li> <li>▪ Pavement preservation, preventive maintenance, pavement reconstruction, or pavement rehabilitation activities within the existing surface footprint</li> <li>▪ Traffic control device improvements to address safety concerns</li> <li>▪ Bridge rehabilitation within existing surface footprint (no traffic capacity change or modification of existing drainage)</li> <li>▪ Seismic enhancement / retrofit projects</li> <li>▪ Safety enhancement projects that result in the addition of no new transportation surfaces</li> <li>▪ Median improvement projects with no new road surface that does not increase the overall median imperviousness by more than 5%.</li> <li>▪ Curb and gutter improvements</li> <li>▪ Utility cuts</li> <li>▪ Alteration of the existing road profile within the existing surface footprint</li> </ul>	<ul style="list-style-type: none"> <li>▪ <b>Roadway Capacity Improvement Projects</b> <ul style="list-style-type: none"> <li>— Lane additions</li> <li>— Bridge capacity improvements</li> <li>— Grade separation projects, where capacity is increased</li> </ul> </li> <li>▪ <b>Non-Capacity Roadway Improvement Projects</b> <ul style="list-style-type: none"> <li>— Shoulder / parking lane improvements</li> <li>— Turn pocket additions</li> <li>— Signal project that adds a turn lane</li> <li>— Horizontal alignment correction to improve sight distance</li> <li>— Grade separation projects, where no change in capacity</li> <li>— Addition of passing lane</li> <li>— Addition of a turn out</li> <li>— Addition of a bike lane or sidewalk that adjoins an existing roadway</li> </ul> </li> <li>▪ <b>Class I Bikeway or Sidewalk Projects</b> <ul style="list-style-type: none"> <li>— Improvements to existing Class I Bikeway or sidewalk, not adjoining a roadway</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>▪ New road or bridge project</li> <li>▪ New Class I Bikeway or sidewalk project, not adjoining a roadway</li> </ul>

<sup>1</sup> The described project types for each Category are considered as examples that a Co-Permittee can use in determining which category is applicable to the project.

## Section 3

# Project Evaluation

### A. LID Principles and BMPs

Transportation Projects shall incorporate the following LID Principles and BMPs to the maximum extent practicable:

- Conservation of natural areas to the extent feasible
- Minimization of the impervious footprint
- Minimization of disturbances to natural drainage
- Design and construction of pervious areas to receive runoff from impervious areas
- Use of landscaping that minimizes irrigation and runoff, promotes surface infiltration, and minimizes the use of pesticides and fertilizers

The extent to which these design principles may be incorporated into a project through the use of LID Principles and BMPs techniques depends on the project type and the project-specific feasibility analysis (see below). For Transportation Projects, potential LID Principles and BMPs to be evaluated include:

- Minimizing Road Widths
- Drainage Swales
- Bioretention
- Permeable Pavements
- Sidewalk Trees and Tree Boxes
- Infiltration Basins

These LID Principles and BMPs are described in more detail in the references provided in Section 6.C. The use of an infiltration basin as a BMP for a Transportation Project shall be consistent with Santa Ana Region MS<sub>4</sub> Permit requirements for pretreatment of runoff prior to infiltration. The following sections provide an overview of each of the above LID Principles and BMPs.

Where the bikeway or sidewalk features are part of or adjoining to a road project, the BMP evaluation is based on the entire project. For separate Class I Bikeway or sidewalk projects that do not adjoin the road surface, only a select group of BMP techniques are required for evaluation. These are discussed separately at the end of this section.

## Minimizing Road Widths

- a. Plan site layout and road network to respect the existing hydrologic functions of the land (preserve wetlands, buffers, high-permeability soils, etc.) and minimize the impervious area.
- b. Minimize road widths while maintaining jurisdictional code requirements for emergency service vehicles and a free flow of traffic.
- c. Look for opportunities to eliminate imperviousness within all areas of the proposed project site.

## Drainage Swales

- a. Plan site drainage using vegetated swales (preferably without irrigation) to accept sheet flow runoff and convey it in broad shallow flow to reduce stormwater volume through infiltration, improve water quality through vegetative and soil filtration, and reduce flow velocity by increasing channel roughness.
- b. Consider use of vegetated or pervious material swales for site drainage before considering use of hard-lined impervious channels.
- c. Identify additional benefits that may be attained from swales through amended soils, bioretention soils, gravel storage areas, underdrains, weirs, and thick diverse vegetation, including, where possible, use of native vegetation.



*Green Streets: EPA-833-F-09-002, August 2009, [www.epa.gov/greeninfrastructure](http://www.epa.gov/greeninfrastructure)*

## Bioretention

- a. Plan site layout using bioretention features such as curb extensions, sidewalk planters, and tree boxes designed to take runoff from the road.
- b. Look for opportunities to incorporate site specific bioretention features into specifications and standards.
- c. Look for opportunities to use the roadway median as a bioretention feature.
- d. Evaluate road configurations, topography, soil conditions, and space availability for opportunities to incorporate bioretention features.
- e. Evaluate existing site utilities for opportunities to incorporate bioretention features as a retrofit.
- f. Evaluate and select plants with respect to maintenance requirements, salt tolerance, and plant height considering traffic safety and security. If an approved plant list is available, plants should be selected from this list.



*Green Streets: EPA-833-F-09-002, August 2009, [www.epa.gov/greeninfrastructure](http://www.epa.gov/greeninfrastructure)*

## Permeable Pavement

- a. Plan low speed and parking areas within a site layout for incorporating permeable pavement.
- b. Evaluate permeable gutters.
- c. Evaluate permeable concrete, permeable asphalt, permeable interlocking concrete pavers, and grid pavers as alternatives to conventional, less pervious concrete and asphalt surfaces.
- d. Incorporate an aggregate base to provide structural support, runoff storage, and pollutant removal through filtering and adsorption.



*Green Streets: EPA-833-F-09-002, August 2009, [www.epa.gov/greeninfrastructure](http://www.epa.gov/greeninfrastructure)*

## Sidewalk Trees and Tree Boxes

- a. Incorporate tree cover into the site layout.
- b. Evaluate site opportunities for sidewalk tree features and tree boxes.
- c. Provide sufficient uncompacted soil and space for proper tree health and growth via larger tree boxes, structural soils, root paths, or "silva cells" that allow sufficient tree root space.
- d. Consider sufficient tree space in the right-of-way (ROW) while maintaining traffic and pedestrian safety. Consider sufficient tree space for root growth to prevent road structural impacts.
- e. Evaluate space for trees vs. added construction costs.



*Green Streets: EPA-833-F-09-002, August 2009, [www.epa.gov/greeninfrastructure](http://www.epa.gov/greeninfrastructure)*

## Infiltration Basins

- a. Plan roadway drainage to be directed away from the road surface to infiltration basins. Typical detention or retention basins may be designed as infiltration facilities in some cases, with the ability to store runoff until it gradually exfiltrates through the soil. A 72-hour draw down is usually recommended.
- b. Incorporate infiltration basins, which can have high pollutant removal efficiency and can reduce flows to mimic pre-development hydrologic conditions. Use of infiltration BMPs shall be consistent with the pretreatment of runoff prior to infiltration requirements established by the MS4 Permit for areas subject to high vehicular traffic (25,000 or more average daily traffic).
- d. Evaluate appropriate soil conditions for infiltration and site constraints. Groundwater separation should be at least 10 feet from the basin invert to the measured ground water elevation.



*[www.casqa.org](http://www.casqa.org) – California BMP Handbooks*

- e. Evaluate traffic / pedestrian safety and site aesthetics while locating infiltration basins.
- f. Reference the county's design criteria for infiltration basins for consistency with these and other design elements. Caltrans also has specific design requirements for infiltration basins in their ROW.

## LID Principles and BMPs Applicable to Class I Bikeway and Sidewalk Projects

LID Principles and BMPs for Class I Bikeway and sidewalk projects not adjoining the road surface:

- Directing drainage to pervious surfaces
- Minimizing path width
- Use of tree wells
- Use of permeable pavement

## B. Feasibility/MEP Analysis of LID Principles and BMP Design Techniques

The extent to which the BMP techniques described above are applied to a Transportation Project depends on the results of the BMP feasibility analysis completed for each project. All potential BMP techniques described above shall be considered for each project.

The transportation template on page 6-11, Table 5.2, and page 6-28 provide LID BMP green streets design information implemented within the permit area and in other U.S. jurisdictions. In evaluating the feasibility of these designs for the transportation project, please consider designs implemented in areas with a hydrologic regime similar to the Santa Ana Region. Additionally, alternative street width designs and specifications must meet appropriate local agency and fire department requirements.

Each Transportation Project is unique and will have site-specific constraints that influence the feasibility of BMP implementation. Therefore, project site constraints must be considered as part of the effort to evaluate the feasibility of implementing the BMP techniques contained within this Guidance (**Figure 3-1**). For example, available ROW may constrain BMP options and

feasibility from a space perspective. As space is typically a limiting factor for BMP implementation, Category 4 projects (new Transportation Projects) should acquire as much available space as feasible early in the process, where feasible. Site drainage features, characteristics and connectivity, site grades, and underground utilities may make some BMPs desirable over others, while making others infeasible. For example, inability to access irrigation water and power for components and controls will limit the

**Figure 3-1. Potential Project Constraints**

- **Regulatory Requirements**
  - TMDL/Impaired Waters requirements
  - Environmentally sensitive areas
  - CEQA conditions
- **Site-specific Characteristics**
  - Drainage characteristics
  - Soil characteristics, geologic conditions
  - Elevated groundwater conditions
  - Groundwater protection areas
  - Natural sediment loads
- **Infrastructure & Project-specific Characteristics**
  - Programmatic or funding restrictions
  - Right of way constraints
  - Existing features (drainage, curb and gutter, grades, etc.)
  - Utility constraints (e.g., pipelines, cables)
  - Availability of irrigation water
  - Availability of power
  - Types of traffic loads
  - Maintenance resources and expertise

functionality of certain vegetated BMPs. The type of traffic or intended road use may make some BMPs infeasible (i.e., heavy traffic on pervious pavement).

The following sections identify common Transportation Project elements that should be evaluated as part of the analysis to determine the feasibility of implementing BMPs to the MEP. They should also be used to demonstrate where specific BMPs are infeasible. This list is not necessarily exhaustive given the unique nature of each Transportation Project; accordingly, other considerations may be evaluated and documented, as appropriate. These elements should also be evaluated for Class I Bikeway and sidewalk projects, not adjoining a roadway surface to determine the feasibility of incorporating BMPs potentially applicable to these projects.

### **Programmatic Requirements / Funding Restrictions**

- a. The BMPs techniques described within this Guidance may be implementable and approvable for a wide variety of Transportation Projects, capital improvement programs, and funding sources; however, some programs or funding sources may place constraints on the nature or type of project features that can be implemented. For example, funding sources for certain safety improvement projects may have strict project / program requirements that only allow funding for select project features. Such constraints may restrict the feasibility of some BMP techniques.
- b. Other programs may require project features that affect BMP implementation, such as compliance with Americans with Disabilities Act (ADA) requirements.
- c. Some BMP techniques may be too costly for the scope of the project.

### **Drainage Connectivity and Utilities**

- a. The project may alter previously established drainage patterns. New Transportation Projects and improvements to existing transportation facilities must tie into adjoining drainage features creating opportunities for and potential constraints on implementation of BMP techniques. The drainage characteristics of each project site must be evaluated to determine which BMP techniques will be feasible, and the extent to which such BMPs may be implemented.
- b. Run-on conditions from adjoining properties or existing roadway surfaces will affect how certain BMP techniques can be implemented within a project. Run-on conditions should be determined and analyzed to determine the extent to which they influence BMP selection and implementation. Opportunities for re-directing run-on prior to entering the project site to reduce the hydraulic impact on water quality BMPs should be considered.
- c. Location of existing utilities may reduce the feasibility of certain BMP techniques.
- d. Design and placement of new utilities can provide opportunities for implementation of BMP techniques. New utilities should be considered along with BMP design and placement to maximize implementation opportunities and minimize feasibility constraints.

### **Environmentally Sensitive Areas and Impaired Waterbodies**

- a. A Transportation Project's proximity to an Environmentally Sensitive Area (ESA), which includes impaired waters or waters governed by Total Maximum Daily Load (TMDL) requirements, a drinking water well or other location requiring enhanced water quality protection may necessitate the use of specific BMP techniques.

- b. The LIP(s) applicable to the project area include any specific BMPs required for implementation where the receiving water is impaired or subject to an urban wasteload allocation under a TMDL. The LIP(s) should be consulted to identify any specific BMP techniques required for incorporation into the project design.

### Road Widths and Parking Requirements

- a. General Plan roadway classifications and local code requirements may place minimum width restrictions on roads, limiting the amount impervious surface that can be reduced and the remaining space available for BMP technique implementation.
- b. Parking area requirements and restrictions may limit the amount of pervious surface that can be reduced and the remaining space available for BMP implementation.

### Drainage Swales

- a. Sufficient ROW must be present for proper swale installation. Proper grade and drainage connectivity must be available to provide for broader, shallower flows while tying into existing local drainage.
- b. The size of the project's drainage area, amount of site run-on, and ability to redirect the run-on will affect the size and feasibility of drainage swales.
- c. Vegetated drainage swales require healthy vegetation for proper functionality. Irrigation water and power must be available for maintaining proper vegetative growth during dry periods. Using non-native vegetation may increase maintenance costs and resource requirements, which may affect feasibility of implementation.
- d. Soil characteristics should allow for infiltration.
- e. Aesthetic goals and vector control requirements may necessitate specific swale features or affect the feasibility of their implementation.

### Infiltration Basins

- a. Appropriate soil conditions for infiltration must exist. Area slopes that are no steeper than 4:1 should be present and baseflow conditions should not exist.
- b. Infiltration basins should be located at least 100 feet from bridge structures.
- c. Groundwater separation should be at least 10 feet from the basin invert to the measured groundwater elevation.
- d. A 72-hour drawn down period is recommended for proper functionality.
- e. Use of infiltration BMPs shall be consistent with the pretreatment of runoff prior to infiltration requirements established by the MS4 Permit for areas subject to high vehicular traffic (25,000 or more average daily traffic).
- f. Traffic and pedestrian safety and site aesthetics may affect locating infiltration basins and their feasibility.

## Bioretention

- a. Sufficient ROW must be present for using the median for bioretention or including bioretention curb extension or sidewalk planters within a Transportation Project, including ADA requirements.
- b. Bioretention features must tie into existing drainage conditions.
- c. Traffic and pedestrian safety and site aesthetics may affect the feasibility of the use of medians for bioretention or the feasibility of identifying locations for installation of curb extensions or sidewalk planters.
- d. Irrigation water and power must be available for proper plant maintenance. Using native vegetation vs. non-native may reduce the need for maintenance, improving feasibility.

## Permeable Pavement

- a. Permeable pavement can be an effective BMP technique in selected low speed areas, e.g., entrance/exits to parking lots, or parking areas (e.g., dedicated areas or along existing streets) applications, but is not considered suitable for most city and county Transportation Projects.
- b. Permeable pavement is not suitable for transportation surfaces with high traffic or that may bear a heavy load.
- c. Using permeable pavement for parking surfaces may be feasible unless soil characteristics will not support infiltration or drainage conditions affect functionality.
- d. Specialized maintenance is necessary for permeable pavements to maintain the intended infiltration capacity. The ability for a public agency to provide resources (funding, labor, and equipment) for proper maintenance of permeable surfaces will affect feasibility.

## Sidewalk Trees and Tree Boxes

- a. Sufficient ROW within the Transportation Project site must be present for implementation of this BMP technique.
- b. Irrigation water and power must be available for proper tree maintenance. Using native vs. non-native trees may reduce the need for maintenance, improving feasibility.
- c. Traffic and pedestrian safety and site aesthetics may affect locating sidewalk trees or tree boxes and their feasibility.

## Maintenance Requirements

- a. Every BMP technique described in this Guidance requires maintenance to help ensure long term effectiveness. The feasibility of any BMP technique will depend upon the level of maintenance resources available in the long term.
- b. The feasibility of BMP techniques will depend on the level of expertise necessary to maintain the BMPs. Project owners and operators must have the expertise and equipment necessary to maintain all aspects of the BMP techniques selected for a project, or have the resources to contract for the maintenance.

- c. Several BMP techniques may require another public agency or department for proper maintenance. For example, maintenance of vegetated BMPs may fall within a local landscape maintenance program. As such, the resources, equipment, expertise available from other agencies may affect BMP feasibility.
- d. Several BMP techniques may require consideration of existing source control programs, e.g., catch-basin cleaning or street sweeping. The local LIP should be consulted for applicable source control requirements.

## Section 4

# Source Control BMPs

Each Transportation Project must evaluate and incorporate applicable Source Control BMPs into project planning to control pollutants after project construction is complete and the project is put into its intended service.

**Table 4-1** identifies recommended Source Control BMPs. The agency responsible for implementing and maintaining the applicable Source Control BMPs should be identified and documented. In addition, it is recommended that the project proponent review the Source Control BMP section of the WQMP of the jurisdiction within which the project is planned to determine if any additional Source Control BMPs may apply to the project.

**Table 4-1. Potential Source Control BMPs for Transportation Projects**

Recommended Source Control BMPs	
Category 3 or 4 Projects (other than Class I Bikeway or sidewalk projects)	Class I Bikeway and Sidewalk Projects
Non-Structural Source Control BMPs	Non-Structural Source Control BMPs
<ul style="list-style-type: none"> <li>▪ Irrigation System and Landscape Maintenance</li> <li>▪ Sweeping of Transportation Surfaces Adjoining Curb and Gutter</li> <li>▪ Drainage Facility Inspection and Maintenance</li> </ul>	<ul style="list-style-type: none"> <li>▪ Public Education Program</li> <li>▪ Use of Signage</li> <li>▪ Installation and Maintenance of Trash Bins and Pet Waste Collection Bags</li> </ul>
<b>Structural Source Control BMPs</b>	
<ul style="list-style-type: none"> <li>▪ MS4 Stenciling and Signage</li> <li>▪ Landscape and Irrigation System Design</li> <li>▪ Protect Slopes and Channels</li> </ul>	



## Section 5

# Project Implementation Requirements

### A. Project Documentation

For Category 1 and 2 projects (Emergency and Maintenance Projects, respectively), the project development file should contain documentation showing that this Guidance and the implementation of LID-based BMP practices did not apply.

All Category 3 and 4 projects require supplemental documentation in the project development file that includes the following:

- Project category and type;
- Site constraints;
- Project feasibility analysis findings; and
- LID-based BMPs incorporated into the project.

Permittee MS<sub>4</sub> staff responsible for assuring compliance with MS<sub>4</sub> Permit requirements will evaluate the applicability and feasibility determination made by the project owner and operator for each project. Where appropriate, these staff may require additional information to demonstrate compliance with this Guidance in order for acceptance and permitting. Appendix A includes a template for documenting the project specific analysis for Category 3 and 4 projects.

If the funding source of a project has requirements that affect what project features and/or BMPs may be incorporated or implemented, such as block grant funding, the funding requirements may be used in determining the feasibility of BMPs. Funding requirements affecting BMP implementation must be documented to demonstrate how the requirements affect the feasibility determinations and must be included in the project file.

A project owner and operator may document the proposed BMP techniques via a supplementary document to the proposed project plans, such as contract documents or specifications, or directly within the project plans as plan notes. Project plans and file documentation will show or describe the types, sizes, and locations of BMP techniques proposed for each proposed project. The Permittee shall maintain the documentation along with all other information required for approval and permitting the proposed project within the project files.

## B. Compliance with Other Permit Requirements

Other regulations and requirements are applicable to proposed projects, for example, 404 Permit/401 Certification requirements, and NPDES General Construction Permit requirements. Other permit conditions may require additional or more (or less) stringent BMP implementation. Compliance with this Guidance does not supplant all conditions associated with other permits and programs. In cases where other requirements are similar but not prescriptive nor specific, they do not automatically overrule a feasibility evaluation performed using this Guidance. In such cases, the feasibility evaluation performed using this Guidance shall be considered the most thorough evaluation also meeting the intent of the other similar requirements.

Projects that have completed design phases but have not been constructed (shelved projects) do not have to be redesigned to incorporate the requirements of this Guidance as long as they have satisfied CEQA approval at the time of the implementation date of this Guidance.

## C. Other Considerations

This Guidance has been developed to assist project owners and operators and Permittee staff with implementing the Transportation Project requirements in the MS4 Permit. Project owners and operators or Permittees wishing to go beyond MEP requirements to develop "demonstration projects" for stormwater quality design may do so, as long as the minimum MEP requirements for each BMP technique are met. Such demonstration projects would be developed under a different, more expansive determination of feasibility not considered to be the standard applicable to conventional Transportation Projects.

## Section 6 Resources

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- A. Glossary
- B. Transportation Project BMP Template
- C. LID-based BMP Planning and Design Information

## A. Glossary

**Adjoining** – Proposed project sites (or land parcels) that share a common border. For example, a parcel slated for new development or significant redevelopment that has a common border with an existing road ROW that will be modified as a result of the development project.

**Average Daily Traffic (ADT)** - The average 24-hour volume of traffic, being the total volume during a stated period divided by the number of days in that period. The period is a year, unless stated otherwise.

**Baseflow** - Sustained natural stream flow or channelized flow caused by groundwater and/or uncontrolled irrigation flows. Sometimes referred to as groundwater flow or dry-weather flow.

**Best Management Practice (BMP)** – Defined in 40 CFR 122.2 as schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of Waters of the U.S. BMPs also include treatment requirements, operating procedures and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage. In the case of MS4 permits, BMPs are typically used in place of numeric effluent limits.

**Bioretention** - BMP that functions as a soil and plant-based filtration device that removes pollutants through a variety of physical, biological, and chemical treatment processes. These facilities normally consist of a grass buffer strip, sand bed, ponding area, organic layer or mulch layer, planting soil, and plants. The runoff's velocity is reduced by passing over or through the buffer strip and subsequently distributed evenly along a ponding area. Exfiltration of the stored water in the bioretention area planting soil into the underlying soils occurs over a period of days. Bioretention BMPs are feasible on all soil types and distinguished from biotreatment BMPs (below) by the fact that their design will process the design volume entirely through a biologically active soil media, and that they inherently maximize both infiltration and evapotranspiration of runoff.

**California Environmental Quality Act (CEQA) Approval** – Formal approval of a proposed project under CEQA (California environmental legislation that establishes procedures for conducting an environmental analysis for all projects in California [California Public Resources Code, Section 21000, et. seq.]).

**Capacity Improvement Project** – Transportation Project that changes the maximum sustainable flow rate at which vehicles or persons reasonably can be expected to traverse a point or uniform segment of a lane or roadway during a specified time period under given roadway, geometric, traffic, environmental, and control conditions; usually expressed as vehicles per hour, passenger cars per hour, or persons per hour.

**Class I Bikeway** – Bike path that provides a completely separated right of way for the exclusive use of bicycles and pedestrians.

**Curb Extension** - Landscaped areas within the parking zone of a street that capture urban runoff. Curb extensions are enclosed by a curb on the street side, which has openings, called "curb cuts," that allow street runoff to enter and exit the facility. Extending into the street from the curb narrows the road width which also increases pedestrian safety and helps calm traffic. A curb extension allows water to flow into a landscaped area that may include vegetated swales, planters, or rain gardens.

**Drainage Swale** - Open channels designed to accept sheet flow runoff and convey it in broad shallow flow. The intent of swales is to reduce stormwater volume through infiltration, improve water quality through vegetative or soil filtration, and reduce flow velocity by increasing channel roughness.

**Drawdown Time** - The time required for a stormwater detention or infiltration facility to drain and return to the dry weather condition. For detention BMPs, drawdown time is a function of basin volume and outlet orifice size. For infiltration BMPs, drawdown time is a function of basin volume and infiltration rate.

**Emergency** - Any sudden, unexpected occurrence, involving a clear and imminent danger, demanding immediate action to prevent or mitigate loss of, or damage to, life, health, property, or essential public services. "Emergency" includes such occurrences as fire, flood, earthquake, or other soil or geologic movements, as well as such occurrences as riot, accident, or sabotage.

**Emergency Project** - Work on a highway, street, road, Class I Bikeway or sidewalk in response to an emergency. Emergency Projects are Category 1 projects per this Guidance.

**Environmentally Sensitive Area (ESA)** - An area "in which plant or animal life or their habitats are either rare or especially valuable because of their special nature or role in an ecosystem and which would be easily disturbed or degraded by human activities and developments" (California Public Resources Code § 30107.5). ESAs subject to stormwater mitigation requirements are:

- Areas adjacent to Receiving Waters designated as "Preservation of Biological Habitats of Special Significance (BIOL)", "Spawning, Reproduction, and Development (SPWN)" or "Rare, Threatened, or Endangered Species (RARE)" Beneficial Uses in the Basin Plan;
- Areas within the MSHCP [Multi-Species Habitat Conservation Plan] that contain rare or especially valuable plant or animal life or their habitat. These areas are considered mitigated as the MSHCP contains substantive alternatives analysis for any proposed development that has the potential to impact resources;
- Areas adjacent to CWA 303(d) Listed Water Bodies or adopted TMDLs with implementation plans that have yet to achieve the urban WLA [wasteload allocation] or LA [load allocation] goals; and
- Any other equivalent environmentally sensitive areas which the Permittees have defined.

**Existing Transportation Project** - Proposed project that will modify an existing transportation surface in a manner that increases the surface footprint or impervious area of the roadway; includes both capacity and non-capacity improvement projects.

**Flag Road** - A non-capacity improvement project that modifies an existing road that is non-adjointing to a new development or significant redevelopment to accommodate traffic access to the development project when completed.

**Freeway** - A divided arterial highway with full control of access and with grade separations at intersections.

**General Plan** - Blueprints for jurisdictions in the Santa Ana Region MS4 Permit area that describe the future growth and development planned within the area over the long term. The General Plan acts as a constitution for both public and private development, the foundation upon which local leaders make growth and use related decisions. The General Plan is meant to express goals with respect to both human-made and natural environments and sets forth the policies and implementation measures to achieve them for the welfare of those who live, work, and do business in the area (e.g., see <http://www.tlma.co.riverside.ca.us/genplan/default.aspx>, for Riverside County General Plan).

**Grade Separation** - A crossing of two highways or a highway and a railroad at different levels.

**Horizontal Alignment Correction** - A Transportation Project designed to increase the sight distance for drivers that does not change existing road capacity.

**Hydrologic Conditions of Concern (HCOC)** - An HCOC exists when the alteration of a site's hydrologic regime caused by development would cause significant impacts on downstream channels and aquatic habitats, alone or in conjunction with impacts of other projects.

**Impervious** - Any surface in the landscape that cannot effectively absorb or infiltrate urban runoff; for example conventional paved: sidewalks, rooftops, roads, and parking areas.

**Lane Addition** - Addition to an existing road of a strip of roadway to be used for a single line of vehicles.

**Local Implementation Plan (LIP)** - Document describing an individual Permittee's procedures, ordinances, databases, plans, and reporting materials for compliance with the Santa Ana Region MS4 Permit.

**Low Impact Development (LID)** - Comprises a set of technologically feasible and cost-effective approaches to stormwater management and land development that combines a hydrologically functional site design with pollution prevention measures to compensate for land development impacts on hydrology and water quality. LID techniques mimic the site's predevelopment hydrology by using site design techniques that store, infiltrate, evapotranspire, bio-treat, bio-filter, bio-retain or detain runoff close to its source.

**LID BMPs** - A type of stormwater BMP that is based upon Low Impact Development concepts. LID BMPs not only provide highly effective treatment of stormwater runoff, but also yield potentially significant reductions in runoff volume - helping to mimic the pre-project hydrologic regime, and also require less ongoing maintenance than Treatment Control BMPs.

**LID Principles** - LID Principles are site design concepts that help prevent or minimize the causes (or drivers) of project impacts, and help mimic the pre-development hydrology. Implementing LID Principles will help minimize the need for specific stormwater BMPs on a project.

**Maintenance Project**- A project conducted to maintain original line and grade, hydraulic capacity, or original purpose of the facility. Maintenance Projects are Category 2 projects, as described in Table 2-1 of this Guidance.

**Maximum Extent Practicable (MEP)** - As defined in Appendix 4 (Glossary) of the Santa Ana Region MS4 Permit (Order No. R8-2010-0033).

**Median Improvement** - Improvements made to the portion of a divided street, road, or highway separating travel lanes for traffic moving in opposite directions.

**MS4 Permit** -NPDES Permit and Waste Discharge Requirements for the Riverside County Flood Control and Water Conservation District, the County of Riverside, and the incorporated Cities of Riverside County within the Santa Ana Region (Order No. R8-2010-0033, NPDES Permit No. CAS618033).

**New Development** - Categories of development identified in Section XI.D of the Santa Ana Region MS4 Permit. "New Development" does not include routine maintenance to maintain original line and grade,

hydraulic capacity, or original purpose of a facility, nor does it include Emergency Projects required to protect public health and safety.

***New Transportation Project*** – Proposed project will establish a new street, road, or highway, rather than modify an existing road.

***Non-Adjoining*** – Proposed project sites (or land parcels) that do not share a common border. For example, a parcel slated for new development or significant redevelopment that does not share a common border with an existing road that will be improved as a result of the development project.

***Non-Capacity Improvement Project*** - Transportation Project that does not change the maximum sustainable flow rate at which vehicles or persons reasonably can be expected to traverse a point or uniform segment of a lane or roadway during a specified time period under given roadway, geometric, traffic, environmental, and control conditions; usually expressed as vehicles per hour, passenger cars per hour, or persons per hour.

***Overlay*** – An overlay is a layer, usually hot mix asphalt, placed on existing flexible or rigid pavement to restore ride quality, to increase structural strength (load carrying capacity), and to extend the service life of a road.

***Parking Lane*** - An auxiliary lane primarily for the parking of vehicles.

***Pavement Preservation*** – The sum of all activities undertaken to provide, maintain and extend the life of a street, road, or highway. This includes corrective, routine and preventive maintenance to keep the roadway in a safe and usable condition and delay the need for rehabilitation.

***Pavement Reconstruction*** - Replacement of an existing pavement structure by the placement of the equivalent of a new pavement structure. Reconstruction usually involves complete removal and replacement of the existing pavement structure and may include new and/or recycled materials.

***Pavement Rehabilitation*** - Structural enhancements that extend the service life of an existing pavement and/or improve its load carrying capability. Rehabilitation techniques include restoration treatments and structural overlays.

***Pervious*** – Surface or area that is not impervious, that is, at least some portion of urban runoff or run-on to the surface infiltrates to underlying soil (see also definition for "impervious").

***Pollutant*** – Broadly defined as any agent that may cause or contribute to the degradation of water quality such that a condition of pollution or contamination is created or aggravated.

***Preventive Maintenance*** - A planned treatment on a road in good condition that is intended to preserve the surface, retard future deterioration, prolong service life and delay the need for rehabilitation.

***Project Owner and Operator*** – The agency or jurisdiction responsible for the management and maintenance of the Transportation Project following its completion.

***Public Works Project*** – A Transportation Project implemented under the jurisdiction of the Santa Ana Region MS4 Permit by a Permittee with authority to finance, build, operate, or maintain the facility.

**Reactive Maintenance** - Maintenance applied to restore a pavement to an acceptable level of service due to unforeseen conditions. Activities such as pothole, crack, rutting, or spalling repairs, performed to correct random or isolated localized pavement distresses or failures, are considered reactive.

**Receiving Water** – Waters of the U.S. (as defined in Appendix 4 (Glossary) of the Santa Ana Region MS4 Permit) within the area under the jurisdiction of the MS4 Permit.

**Right-of-Way (ROW)** - A general term denoting land, property, or interest therein (usually in a strip) acquired for or devoted to transportation purposes.

**Road** – see "Street, Road, or Highway."

**Routine Maintenance** – Maintenance work that is planned and performed on a regular basis to maintain and preserve the condition of the street, road or highway, or to respond to specific conditions and events that restore the street, road or highway to an adequate level of service.

**Run-On** - Stormwater that flows from another property or properties onto a subject property via overland flow (uncontrolled run-on) or via a local storm drain (directed run-on).

**Safety Enhancement** - A project that corrects or improves high hazard locations, eliminates roadside obstacles, improves highway signing and pavement marking, installs priority control systems for emergency vehicles at signalized intersections, installs or replaces emergency motorist aid call boxes, or installs traffic control or warning devices at locations with high accident potential.

**Seismic Enhancement/Retrofit** – Maintenance activity to modify an existing transportation infrastructure to comply with structural requirements for seismic activity.

**Shoulder** - The paved or unpaved portion of the roadway adjoining the traveled way for accommodating stopped vehicles, for emergency use, and for lateral support of base and surface courses.

**Sight Distance** - The length of highway ahead that is visible to the driver.

**Significant Redevelopment** – As defined in Section XII.D.2.a of the Santa Ana Region MS4 Permit.

**Site Design BMPs** – Any project design feature that reduces the creation or severity of potential pollutant sources or reduces the alteration of the project site's natural flow regime. Redevelopment projects that are undertaken to remove pollutant sources (such as existing surface parking lots and other impervious surfaces) or to reduce the need for new roads and other impervious surfaces (as compared to conventional or low density new development) by incorporating higher densities and/or mixed land uses into the project design, are also considered site design BMPs.

**Street** – see "Street, Road, or Highway."

**Street, Road, or Highway** – A general term denoting a public way for the transportation of people, materials, goods, and services but primarily for vehicular travel.

**Surface Footprint** – The area of an existing road that is part of the active transportation surface.

**Total Maximum Daily Load (TMDL)** - Maximum amount of a pollutant that can be discharged into a water body from all sources (point and non-point) and still maintain water quality standards. Under CWA Section 303(d), TMDLs must be developed for all waterbodies that do not meet water quality standards after application of technology-based controls.

**Traffic Control Device** - A sign, signal, marking, or other device placed on or adjacent to a street or highway by authority of a public body or official having jurisdiction to regulate, warn, or guide traffic.

**Transportation Projects** – Streets, roads, highways, Class I Bikeways, or sidewalks within the area under the jurisdiction of the Santa Ana Region MS4 Permit used for transportation of automobiles, trucks, motorcycles, bicycles and other vehicles; excludes routine, reactive, or preventive maintenance activities where the surface footprint is not increased (Maintenance Projects) and Emergency Projects. Category 3 and Category 4 projects, described in Table 2-1 of this Guidance, are considered Transportation Projects.

**Turn Pocket** – Addition of impervious surface at an existing road intersection for the purpose of facilitating right or left turns.

**Water Quality Management Plan (WQMP)** – The WQMP is a plan for managing the quality and quantity of stormwater or urban runoff that flows from a developed site after construction is completed and the facilities or structures are occupied and/or operational. WQMPs are required for new development and significant redevelopment projects as described in Section XII.D of the Santa Ana Region MS4 Permit and Section 6 of the Riverside County Flood Control & Water Conservation District Drainage Area Management Plan (DAMP).

## **B. Transportation Project BMP Template**

INSERT TEMPLATE



## C. LID-based BMP Planning and Design Information

The purpose of this Guidance section is to provide examples of LID-based BMPs that may be considered for use in Transportation Projects. This information is provided in two parts (1) general LID-based BMP information; and (2) LID-based BMP-specific information. These sources are intended to guide decision-making with regards to making feasibility determinations about the efficacy of incorporating these BMPs into Transportation Project planning and design. This information does not represent an exhaustive list of source material; in fact, new information regarding how to design LID-based BMPs is regularly published. This information is not to be used as a substitute for development of engineering designs appropriate to the Transportation Project site.

### General LID-based BMP Guidance

The following documents provide general information regarding the application of LID-based BMPs in various scenarios including Transportation Projects. While reference material is available from other areas outside the southwestern United States, these references have not been included, primarily because of their lack of relevance to the hydrologic regime that exists in the Santa Ana Region:

- *Design Handbook for Low Impact Development Best Management Practices*. 2011. Riverside County Flood Control and Water Conservation District. September 2011.  
<http://rcflood.org/NPDES/LIDBMP.aspx>.
- *Low Impact Development Manual for Southern California: Technical Guidance and Site Planning Strategies*. 2010. Prepared for the Southern California Stormwater Monitoring Coalition. April 2010.  
<http://www.casqa.org/LID/SoCalLID/tabid/218/Default.aspx>.
- *Municipal Handbook: Green Streets, Managing Wet Weather with Green Infrastructure*. 2008. U.S. Environmental Protection Agency, EPA-833-F-08-009. December 2008.  
[http://water.epa.gov/infrastructure/greeninfrastructure/upload/gi\\_munichandbook\\_green\\_streets.pdf](http://water.epa.gov/infrastructure/greeninfrastructure/upload/gi_munichandbook_green_streets.pdf)
- *Low Impact Development Handbook: Stormwater Management Strategies*. 2007. County of San Diego, Department of Planning and Land Use. December 2007. <http://www.sdcounty.ca.gov/dplu/docs/LID-Handbook.pdf> (General Information); <http://www.sdcounty.ca.gov/dplu/docs/LID-Appendices.pdf> (Fact Sheets)
- *Storm Water BMP Guidance Manual*. 2008. City of Santa Barbara. June 2008.  
[http://www.santabarbaraca.gov/Resident/Community/Creeks/Storm\\_Water\\_Management\\_Program.htm](http://www.santabarbaraca.gov/Resident/Community/Creeks/Storm_Water_Management_Program.htm)
- *County of Los Angeles Low Impact Development Standards Manual*. January 2009.  
[http://dpw.lacounty.gov/wmd/LA\\_County\\_LID\\_Manual.pdf](http://dpw.lacounty.gov/wmd/LA_County_LID_Manual.pdf)
- *Rainwater Harvesting Program: Green Streets and Green Alleys Design Guidelines Standards*, 1<sup>st</sup> Edition. City of Los Angeles, Department of Public Works, Bureau of Sanitation, Watershed Protection Division, September 4, 2009. <http://www.lastormwater.org/siteorg/program/green.htm>
- *Evaluation of Best Management Practices for Highway Runoff Control: Low Impact Development Design Manual for Highway Runoff Control*. 2006. Prepared for the National Cooperative Highway Research Program, Transportation Research Board, and National Research Council.  
<http://www.coralreef.gov/transportation/evalbmp.pdf>

- *Green Infrastructure for Southwest Neighborhoods*. 2010. Watershed Management Group, Tucson, AZ. August 2010. [http://watershedmg.org/sites/default/files/greenstreets/WMG\\_GISWNH\\_1.0.pdf](http://watershedmg.org/sites/default/files/greenstreets/WMG_GISWNH_1.0.pdf)
- Low Impact Development Center, <http://www.lowimpactdevelopment.org>

## Specific LID-Based BMP Information

The following sections provide design-related information for the LID-based BMPs described in Section 3 of this Guidance.

### Minimum Road Width

- *Municipal Handbook: Green Streets, Managing Wet Weather with Green Infrastructure*. 2008. U.S. Environmental Protection Agency, EPA-833-F-08-009. December 2008. [http://water.epa.gov/infrastructure/greeninfrastructure/upload/gi\\_munichandbook\\_green\\_streets.pdf](http://water.epa.gov/infrastructure/greeninfrastructure/upload/gi_munichandbook_green_streets.pdf) - [see pages 2-4](#)
- *Low Impact Development Handbook: Stormwater Management Strategies*. 2007. County of San Diego, Department of Planning and Land Use. December 2007. <http://www.sdcounty.ca.gov/dplu/docs/LID-Appendices.pdf> (Fact Sheets) – [Fact Sheets 14, 15](#)

### Drainage Swales

- *Design Handbook for Low Impact Development Best Management Practices*. 2011. Riverside County Flood Control and Water Conservation District. September 2011. <http://rcflood.org/NPDES/LIDBMP.aspx> - [see Section 3.2](#)
- *Low Impact Development Manual for Southern California: Technical Guidance and Site Planning Strategies*. 2010. Low Impact Development Center, Inc. April 2010. <http://www.casqa.org/LID/SoCalLID/tabid/218/Default.aspx> - [see pages 137-138](#)
- *Storm Water BMP Guidance Manual*. 2008. City of Santa Barbara. June 2008. [http://www.santabarbaraca.gov/Resident/Community/Creeks/Storm\\_Water\\_Management\\_Program.htm](http://www.santabarbaraca.gov/Resident/Community/Creeks/Storm_Water_Management_Program.htm) – [see Section 6.6.2](#)
- *Treatment BMP Technology Report*. 2008. California Department of Transportation (Caltrans), CTSW-RT-08-167.02.02. April 2008. [http://www.dot.ca.gov/hq/env/stormwater/annual\\_report/2008/annual\\_report\\_06-07/attachments/Treatment\\_BMP\\_Technology\\_Rprt.pdf](http://www.dot.ca.gov/hq/env/stormwater/annual_report/2008/annual_report_06-07/attachments/Treatment_BMP_Technology_Rprt.pdf) - [see page D-5](#)
- *Evaluation of Best Management Practices for Highway Runoff Control: Low Impact Development Design Manual for Highway Runoff Control*. 2006. Prepared for the National Cooperative Highway Research Program, Transportation Research Board, and National Research Council. <http://www.coralreef.gov/transportation/evalbmp.pdf> - [see Section 14](#)

### Infiltration Basins

- *Design Handbook for Low Impact Development Best Management Practices*. 2011. Riverside County Flood Control and Water Conservation District. September 2011. <http://rcflood.org/NPDES/LIDBMP.aspx> - [see Section 3.1](#)

## Bioretention

- *Design Handbook for Low Impact Development Best Management Practices*. 2011. Riverside County Flood Control and Water Conservation District. September 2011. <http://rcflood.org/NPDES/LIDBMP.aspx> - **see Section 3.5**
- *Low Impact Development Manual for Southern California: Technical Guidance and Site Planning Strategies*. 2010. Low Impact Development Center, Inc. April 2010. <http://www.casqa.org/LID/SoCalLID/tabid/218/Default.aspx> - **see pages 68-84**
- *Low Impact Development Handbook: Stormwater Management Strategies*. 2007. County of San Diego, Department of Planning and Land Use. December 2007. <http://www.sdcounty.ca.gov/dplu/docs/LID-Appendices.pdf> (Fact Sheets) – **see Fact Sheets 15, 19**
- *Storm Water BMP Guidance Manual*. 2008. City of Santa Barbara. June 2008. [http://www.santabarbaraca.gov/Resident/Community/Creeks/Storm\\_Water\\_Management\\_Program.htm](http://www.santabarbaraca.gov/Resident/Community/Creeks/Storm_Water_Management_Program.htm) – **see Section 6.6.1**
- *Treatment BMP Technology Report*. 2008. California Department of Transportation (Caltrans), CTSW-RT-08-167.02.02. April 2008. [http://www.dot.ca.gov/hq/env/stormwater/annual\\_report/2008/annual\\_report\\_06-07/attachments/Treatment\\_BMP\\_Technology\\_Rprt.pdf](http://www.dot.ca.gov/hq/env/stormwater/annual_report/2008/annual_report_06-07/attachments/Treatment_BMP_Technology_Rprt.pdf) - **see pages B-11 - B-12**
- *Evaluation of Best Management Practices for Highway Runoff Control: Low Impact Development Design Manual for Highway Runoff Control*. 2006. Prepared for the National Cooperative Highway Research Program, Transportation Research Board, and National Research Council. <http://www.coralreef.gov/transportation/evalbmp.pdf> - **see Section 5**

## Sidewalk Trees & Tree Boxes (including planter boxes)

- *Design Handbook for Low Impact Development Best Management Practices*. 2011. Riverside County Flood Control and Water Conservation District. September 2011. <http://rcflood.org/NPDES/LIDBMP.aspx> - **see Section 3.5, page 5** for information regarding planter boxes
- *Low Impact Development Manual for Southern California: Technical Guidance and Site Planning Strategies*. 2010. Low Impact Development Center, Inc. April 2010. <http://www.casqa.org/LID/SoCalLID/tabid/218/Default.aspx> - **see page 71** for information regarding planter boxes
- *County of Los Angeles Low Impact Development Standards Manual*. January 2009. [http://dpw.lacounty.gov/wmd/LA\\_County\\_LID\\_Manual.pdf](http://dpw.lacounty.gov/wmd/LA_County_LID_Manual.pdf) - **see pages 49-52** for information regarding planter boxes
- *Storm Water BMP Guidance Manual*. 2008. City of Santa Barbara. June 2008. [http://www.santabarbaraca.gov/Resident/Community/Creeks/Storm\\_Water\\_Management\\_Program.htm](http://www.santabarbaraca.gov/Resident/Community/Creeks/Storm_Water_Management_Program.htm) – **see Section 6.9.2** for information regarding planter boxes
- *Treatment BMP Technology Report*. 2008. California Department of Transportation (Caltrans), CTSW-RT-08-167.02.02. April 2008. [http://www.dot.ca.gov/hq/env/stormwater/annual\\_report/2008/annual\\_report\\_06-07/attachments/Treatment\\_BMP\\_Technology\\_Rprt.pdf](http://www.dot.ca.gov/hq/env/stormwater/annual_report/2008/annual_report_06-07/attachments/Treatment_BMP_Technology_Rprt.pdf) - **see pages B-7 - B-10**

## Permeable Pavement

- *Design Handbook for Low Impact Development Best Management Practices*. 2011. Riverside County Flood Control and Water Conservation District. September 2011. <http://rcflood.org/NPDES/LIDBMP.aspx> - see **Section 3.3**
- *Low Impact Development Manual for Southern California: Technical Guidance and Site Planning Strategies*. 2010. Low Impact Development Center, Inc. April 2010. <http://www.casqa.org/LID/SoCalLID/tabid/218/Default.aspx> - see **pages 83-113**
- *Low Impact Development Handbook: Stormwater Management Strategies*. 2007. County of San Diego, Department of Planning and Land Use. December 2007. <http://www.sdcounty.ca.gov/dplu/docs/LID-Handbook.pdf> (General Information); <http://www.sdcounty.ca.gov/dplu/docs/LID-Appendices.pdf> (Fact Sheets) – see **pages 46-51, Fact Sheets 8, 9, 10**
- *County of Los Angeles Low Impact Development Standards Manual*. January 2009. [http://dpw.lacounty.gov/wmd/LA\\_County\\_LID\\_Manual.pdf](http://dpw.lacounty.gov/wmd/LA_County_LID_Manual.pdf) - see **pages 53-57**
- *Storm Water BMP Guidance Manual*. 2008. City of Santa Barbara. June 2008. [http://www.santabarbaraca.gov/Resident/Community/Creeks/Storm\\_Water\\_Management\\_Program.htm](http://www.santabarbaraca.gov/Resident/Community/Creeks/Storm_Water_Management_Program.htm) – see **Section 6.8**
- *Evaluation of Best Management Practices for Highway Runoff Control: Low Impact Development Design Manual for Highway Runoff Control*. 2006. Prepared for the National Cooperative Highway Research Program, Transportation Research Board, and National Research Council. <http://www.coralreef.gov/transportation/evalbmp.pdf> – see **Section 10**