MODEL WATER QUALITY MANAGEMENT PLAN (WQMP)

Describes Process of Developing a Project WQMP

(Revised May 19, 2011)

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OC PLANNING
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EXHIBIT 7.II

MODEL WATER QUALITY MANAGEMENT PLAN (MODEL WQMP)

May 19, 2011

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7.II Model Water Quality Management Plan (WQMP)

7.II–1.0 Introduction

This Model Water Quality Management Plan (Model WQMP) has been developed to aid the County of Orange, the Orange County Flood Control District, and the cities in Orange County (Permittees) and project proponents with addressing post-construction urban runoff and stormwater pollution from new development and significant redevelopment projects that qualify as Priority Projects. New development Priority Projects create new impervious surface on a previously undeveloped site. The amount of new impervious surface that qualifies a project as a Priority Project depends upon the project type. Significant redevelopment projects add or replace 5,000 or more square feet of impervious surface on an already-developed site. These terms are further defined for specific project types in **Section 7.II-1.2**.

LID BMP – a BMP that provides retention or biotreatment as part of an LID strategy – these may include hydrologic source controls (HSCs), retention, and biotreatment BMPs

The purpose of the Model WQMP is to describe the process that Permittees will employ for developing a Project WQMP for individual new development and significant redevelopment projects (Project WQMP), which, when implemented will minimize the effects of urbanization on site hydrology, runoff flow rates or velocities and pollutant loads. Following approval of the final project WQMP and construction of the project, the Project WQMP will serve to maintain the terms, conditions and requirements with the project proponent and their successors and assigns. The effects of urbanization will be minimized through implementation of practicable and enforceable project-based controls or stormwater Best Management Practices (BMPs), or through a combination of project-based and regional BMPs. For most projects the process will first involve preparing a Conceptual or Preliminary WQMP to incorporate Low Impact Development (LID) and hydromodification control BMPs where necessary at the earliest conceptual planning stages of a project for early review. All Priority Projects will require a final Project WQMP be prepared, regardless of whether a Conceptual or Preliminary WQMP was prepared first. The process for preparing Conceptual or Preliminary WQMPs and/or final Project WQMPs is described in **Section 7.II-5.0** with supplemental information provided in the Technical Guidance Document (TGD).

By initiating planning for water quality (WQ) early in the development process, the Preliminary/Conceptual WQMP can be used as the principal mechanism for describing how WQ impacts of a project will be reduced to less than significant when developing documentation for the project to comply with the California Environmental Quality Act (CEQA). Further discussion of the CEQA process in the context of New Development and Significant Redevelopment Planning process and the role of the Preliminary/Conceptual Model WQMP can be found in the Orange County Drainage Area Management Plan (**DAMP**) **Section 7**.

This Model WQMP identifies controls, referred to as LID BMPs, as well as other BMPs and alternative compliance programs, for new development and significant redevelopment projects that are subject to WQMP requirements pursuant to **DAMP Section 7**.

The Permittees require that certain new development and significant redevelopment projects develop and implement a Conceptual or Preliminary WQMP, and/or final Project WQMP that includes LID and/or BMPs. Depending upon the project size and characteristics, BMPs may include:

- Site design measures
- Implementing LID BMPs on-site
- Constructing or participating in sub-regional/regional LID BMPs
- Implementing hydromodification control BMPs
- Utilizing alternative programs or treatment control BMPs
- Employing applicable source control BMPs

Explanation, definitions, and examples of the above site design measures and BMP types as well as alternative programs are provided later within this document.

7.II–1.1 Regulatory Basis

The development of this Model WQMP and preparation of Conceptual or Preliminary WQMPs and Project WQMPs is required by two municipal National Pollutant Discharge Elimination System (NPDES) permits held jointly by the Permittees. As authorized by the Federal Clean Water Act (CWA), the NPDES permit program controls water pollution by regulating sources that discharge pollutants into waters of the United States. Two separate permits apply to the respective areas of the County that lie within the jurisdiction of two Regional Water Quality Control Boards (RWQCBs). For this document, two "permit areas" are defined "North Orange County" (NOC) is that area under the jurisdiction of the Santa Ana Regional Water Quality Control Board (SARWQCB), and "South Orange County" is the area under the jurisdiction of the San Diego Regional Water Quality Control Board (SDRWQCB). **Figure 7.II-1** shows the division of the County between North and South County areas. **Table 7.11-1** shows which cities lie within each permit area. The County unincorporated area and three cities overlay both permit areas.

Within the SARWQCB jurisdiction, the Model WQMP will be reviewed and approved by the SARWQCB in accordance with the relevant Fourth Term Permit (Order No. R8 -2009-0030) (North County Permit). Based on the requirements stated in this Model WQMP, local jurisdictions within the NOC Permit Area will review and approve Conceptual or Preliminary WQMPs and final Project WQMPs as part of the development plan and entitlement approval process and the discretionary permit approval process for new development projects as defined in **DAMP Section 7.6** and **Table 7.II-2.**

Figure 7.II-1: Division of Permit Areas

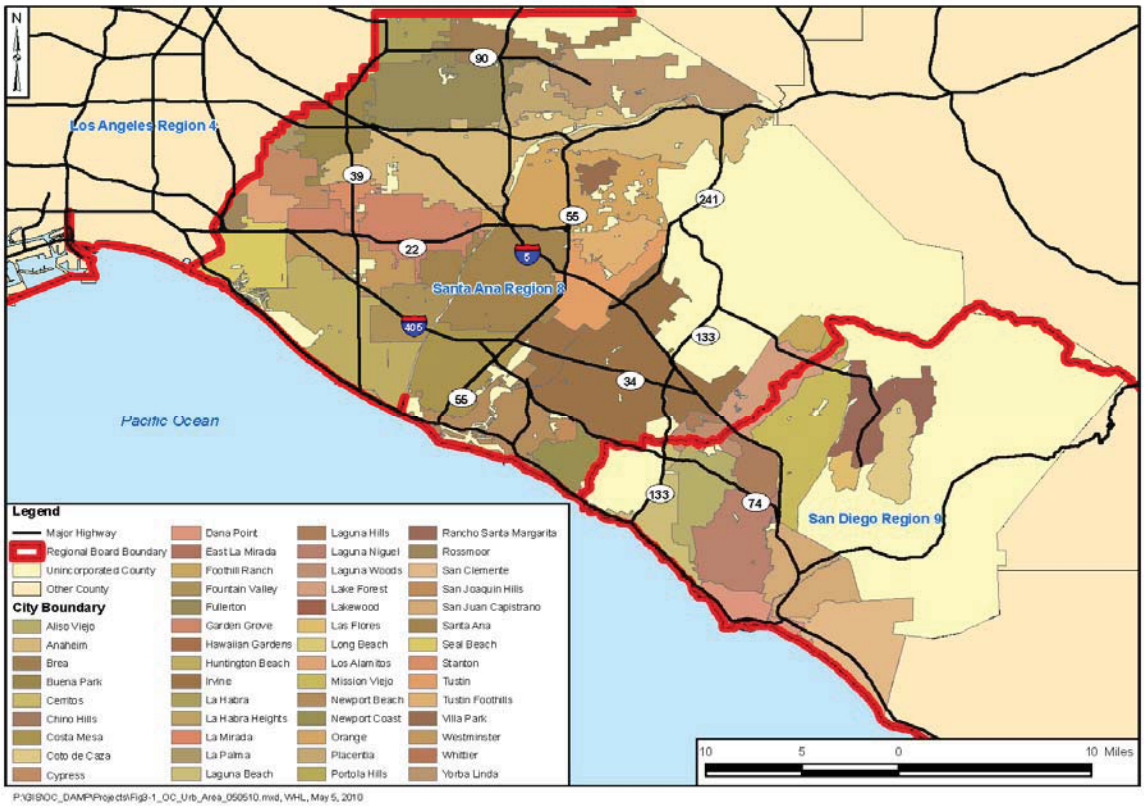


Table 7.II-1: Division of Permit Areas

Jurisdictions Wholly within Santa Ana Region (NOC)	Jurisdictions Wholly within San Diego Region (SOC)	Jurisdictions within both the NOC and SOC Regions
City of Anaheim City of Brea City of Buena Park City of Costa Mesa City of Cypress City of Fountain Valley City of Fullerton City of Garden Grove City of Huntington Beach City of Irvine City of La Habra City of La Palma City of Los Alamitos City of Newport Beach City of Orange City of Placentia City of Santa Ana City of Seal Beach City of Stanton City of Tustin City of Villa Park City of Westminster City of Yorba Linda	City of Aliso Viejo City of Dana Point City of Laguna Beach City of Laguna Niguel City of Mission Viejo City of Rancho Santa Margarita City of San Clemente City of San Juan Capistrano	County of Orange Orange County Flood Control District City of Laguna Hills City of Laguna Woods City of Lake Forest

Within the SDRWQCB jurisdiction, the SDRWQCB will review the Model WQMP for compliance with the relevant Fourth Term Permit Order (R9-2009-0002) (South County Permit). South Orange County (SOC) Area Permittees are required to adopt their own local Jurisdictional Runoff Management Program (JRMP) and Model Standard Stormwater Mitigation Plan (Model SSMP) incorporating all requirements of this Model WQMP (see **DAMP, Appendix A-7**). Using the Model SSMP as a guide, each SOC Area Permittee will review and approve Project WQMPs as part of the development plan and entitlement approval process or the ministerial permit approval process for new development projects as defined in **DAMP Section 7.6** and **Table 7.II-3**.

7.II–1.2 Priority Project Categories

This Model WQMP describes the process for preparing Conceptual or Preliminary WQMPs and final Project WQMPs for certain new development and significant redevelopment projects called "Priority Projects." A project is considered a Priority Project in the NOC Permit Area or SOC Permit Area if it meets any one of the following criteria listed in **Tables 7.II-2** or **7.II-3**, respectively.

Table 7.II-2: Priority Projects Categories for North County Permit Area

1. New development projects that create 10,000 square feet or more of impervious surface. This category includes commercial, industrial, residential housing subdivisions, mixed-use, and public projects on private or public property that falls under the planning and building authority or the Permittees.
2. Automotive repair shops. This applies to facilities that are categorized in any one of the following Standard Industrial Classification (SIC) codes 5013, 5014, 5541, 7532-7534, and 7536-7539.
3. Restaurants where the land area of development is 5,000 square feet or more including parking area. This category is defined as facilities that sell prepared foods and drinks for consumption, including stationary lunch counters and refreshment stands selling prepared foods and drinks for immediate consumption (SIC code 5812).
4. Hillside development greater than 5,000 square feet. Hillside development is defined as any development which is located in an area with known erosive soil conditions or where the natural slope is twenty-five percent or greater.
5. Impervious surface of 2,500 square feet or more located within, directly adjacent to (within 200 feet), or discharging directly into receiving waters within Environmentally Sensitive Areas (ESAs).
6. Parking lots 5,000 square feet or more including associated drive aisle, and potentially exposed to urban stormwater runoff. A parking lot is defined as a land area or facility for the temporary parking or storage of motor vehicles used personally, for business, or for commerce.
7. Streets, roads, highways, and freeways. This category includes any paved surface that is 5,000 square feet or greater used for the transportation of automobiles, trucks, motorcycles, and other vehicles. (See discussion under (**Section 7.II-1.5** relative to public projects).

8. All significant redevelopment projects, where significant redevelopment is defined as the addition or replacement of 5,000 or more square feet of impervious surface on an already developed site. Redevelopment does not include routine maintenance activities that are conducted to maintain original line and grade, hydraulic capacity, original purpose of the facility, or emergency redevelopment activity required to protect public health and safety. If the redevelopment results in the addition or replacement of less than 50 percent of the impervious area on-site and the existing development was not subject to WQMP requirement, the numeric sizing criteria discussed in **Section 7.II-2.0** only applies to the addition or replacement area. If the addition or replacement accounts for 50 percent or more of the impervious area, the Project WQMP requirements apply to the entire development.
9. Retail Gasoline Outlets (RGOs). This category includes RGOs that meet the following criteria: (a) 5,000 square feet or more, or (b) a projected Average Daily Traffic (ADT) of 100 or more vehicles per day.

Table 7.II-3: Priority Projects Categories for South County Permit Area

1. New development projects that create 10,000 square feet or more of impervious surface. This category includes commercial, industrial, residential housing subdivisions, mixed-use, and public projects on private or public property that falls under the planning and building authority or the Permittees. All pollutant generating development or redevelopment projects that result in the disturbance of one acre or more of land will be considered Priority Project starting December 16, 2012.
2. Automotive repair shops. This applies to facilities that are categorized in any one of the following Standard Industrial Classification (SIC) codes 5013, 5014, 5541, 7532-7534, and 7536-7539.
3. Restaurants where the land area of development is 5,000 square feet or more including parking area. This category is defined as facilities that sell prepared foods and drinks for consumption, including stationary lunch counters and refreshment stands selling prepared foods and drinks for immediate consumption (SIC code 5812), where the land area for development is greater than 5,000 square feet. Restaurants where land development is less than 5,000 square feet shall meet all WQMP requirements except for LID BMP, treatment control BMP, and hydro-modification/HCOC requirements.
4. Hillside development greater than 5,000 square feet. Hillside development is defined as any development which is located in an area with known erosive soil conditions or where the natural slope is twenty-five percent or greater.

5. All development located within or directly adjacent to or discharging directly to an ESA (where discharges from the development or redevelopment will enter receiving waters within the ESA), which either creates 2,500 square feet of impervious surface on a proposed project site or increases the area of imperviousness of a proposed project site to 10 percent or more of its naturally occurring condition. "Directly adjacent" means situated within 200 feet of the ESA. "Discharging directly to" means outflow from a drainage conveyance system that is composed entirely of flows from the subject development or redevelopment site, and not commingled with flows from adjacent lands.
6. Parking lots 5,000 square feet or more, or parking lots with 15 parking spaces or more, including associated drive aisle, and potentially exposed to urban stormwater runoff. A parking lot is defined as a land area or facility for the temporary parking or storage of motor vehicles used personally, for business, or for commerce.
7. Streets, roads, highways, and freeways. This category includes any paved surface that is 5,000 square feet or greater used for the transportation of automobiles, trucks, motorcycles, and other vehicles. (See discussion under (**Section 7.II-1.5** relative to public projects).
8. All significant redevelopment projects, where significant redevelopment is defined as the addition of 5,000 or more square feet of impervious surface on an already developed site, and the existing development or redevelopment project falls under another Priority Project Category. If the redevelopment results in the addition or replacement of less than 50 percent of the impervious area on-site and the existing development was not subject to WQMP requirement, the numeric sizing criteria discuss below only applies to the addition or replacement area. If the addition or replacement accounts for 50 percent or more of the impervious area, the Project WQMP requirements apply to the entire development.
9. Retail Gasoline Outlets (RGOs). This category includes RGOs that meet the following criteria: (a) 5,000 square feet or more, or (b) a projected Average Daily Traffic (ADT) of 100 or more vehicles per day.

7.II–1.3 Non-Priority Projects

A Non-Priority Project Water Quality Plan is required to be completed for private new development and significant redevelopment projects within Permittees' jurisdictions, and equivalent public agency capital projects undertaken by the Permittees that qualify as Non-Priority Projects. These are projects that do not fall under one of the Priority Project Categories defined within the Model WQMP but meet one of the following conditions:

- Require discretionary action that will include a precise plan of development, except for those projects exempted by the Permittee Water Quality Ordinance (as applicable); or
- Require issuance of a non-residential plumbing permit for pipelines conveying hazardous materials (e.g. gasoline) as defined in the Permittee Water Quality / Stormwater Ordinance.

Requirements for Non-Priority Projects are contained in a separate Non-Priority Project

Water Quality Plan, it serves as basis for completing a project-specific plan that is described in the DAMP and is available from the applicable Permittee. The Non-Priority Project Water Quality Plan requires that a Project Proponent document the selection of site design, source control and any other BMPs included in a project. Information contained in this Model WQMP and the TGD can be used as a reference for completing the Non-Priority Water Quality Project Plan.

7.II–1.4 Use of the Model WQMP, TGD, and WQMP Templates

Three documents have been developed to support new development requirements: a Model WQMP, a TGD, and a WQMP Template. The Model WQMP describes the requirements for preparing a Project WQMP. The TGD contains supporting technical guidance for how to complete these requirements and how to perform the technical analyses necessary to prepare a Project WQMP. The WQMP Template can be used to prepare a specific Project WQMP.

A TGD has been prepared as a companion to this Model WQMP as **DAMP Section 7.II-3**. The TGD contains more detailed information and explains how to complete the requirements and the technical analysis necessary for preparing a Conceptual or Preliminary WQMP, or Project WQMP. Throughout this document, references to the TGD will be made, including the section of the TGD where the corresponding information is located.

WQMP Templates are to be used by project proponents as a tool for the preparation and submittal of Project WQMPs. The WQMP Templates contain the overall structure for developing a Conceptual or Preliminary WQMP or final Project WQMP, including fields for entering general information and space for sizing calculations and other analyses necessary for WQMP completion. One template can be used for private development projects. The second one can be used for public agency projects.

The Model WQMP has been prepared to explain the requirements and types of analyses that go into producing a Conceptual or Preliminary WQMP or Project WQMP and includes the following sections:

- **Section 7.II–1.0** provides an introduction to the overall regulatory basis and purpose of the Model WQMP, an overview on the use of the Model WQMP, the TGD and the WQMP Template, an overview of applicable priority development projects, and the general process steps for developing a Conceptual or Preliminary WQMP, or Project WQMP.
- **Section 7.II–2.0** describes the Project WQMP requirements, and guides the reader through the parts of the Project WQMP.
- **Section 7.II–3.0** describes alternative compliance approaches.
- **Section 7.II–4.0** contains BMP funding and maintenance requirements.
- **Section 7.II–5.0** describes the process for Project WQMP preparation, submittal, and approval.
- **Section 7.II–6.0** provides additional project WQMP related resources and the references used for producing this Model WQMP.

The intended users of the Model WQMP are summarized in the following table.

Document	Intended users	Role of Document
Model Water Quality Management Plan	• Permittee planning, permitting and NPDES program staff • Project applicants and planning and design consultants	• Provides regulatory requirements and direction for preparing and submitting a Conceptual or Preliminary WQMP and/or Final Project WQMP
Technical Guidance Document	• Permitting and NPDES program staff • Project applicants and planning and design consultants	• Provides Technical Guidance and details for site planning and selection and of BMPs to meet the performance criteria • Provides technical basis for documenting feasibility of LID BMPs
WQMP Template	• Project applicants and planning and design consultants • City and county planning and permitting staff	• Provides a template and instructions for preparing a site-specific Preliminary/Conceptual and Final Project WQMP
DAMP Section 7	• Permittee NPDES program staff and planning staff	• Provides program direction to Permittee staff for all aspects of New Development/Significant Redevelopment Program

Both the TGD and WQMP Template are located at the Permittee websites or www.ocwatersheds.com.

7.II–1.5 Public Agency Projects

Under both permits, New Development/Significant Redevelopment requirements apply to public agency projects that meet the definitions in the Priority Project Categories described above. In general, the same Project WQMP overall development steps described herein apply to public agency projects as well as private development projects. However, there are unique issues associated with certain Public Agency Projects that are either specifically recognized in the Permits, or for which particular approaches can be considered.

Streets, roads, highways and freeways of 5,000 square feet or more of paved surface shall incorporate United States Environmental Protection Agency (USEPA) guidance, "Managing Wet Weather with Green Infrastructure: Green Streets" in a manner consistent with the maximum extent practicable (MEP) standard. A copy of the guidance is included in **Appendix B**.

Above ground linear lined drainage projects typically consist of lined vertical or trapezoidal channels. These projects may result in the creation of more than 10,000 square feet of impervious surface have BMP implementation constraints similar to streets, roads, highways and freeways and must implement similar practices, as

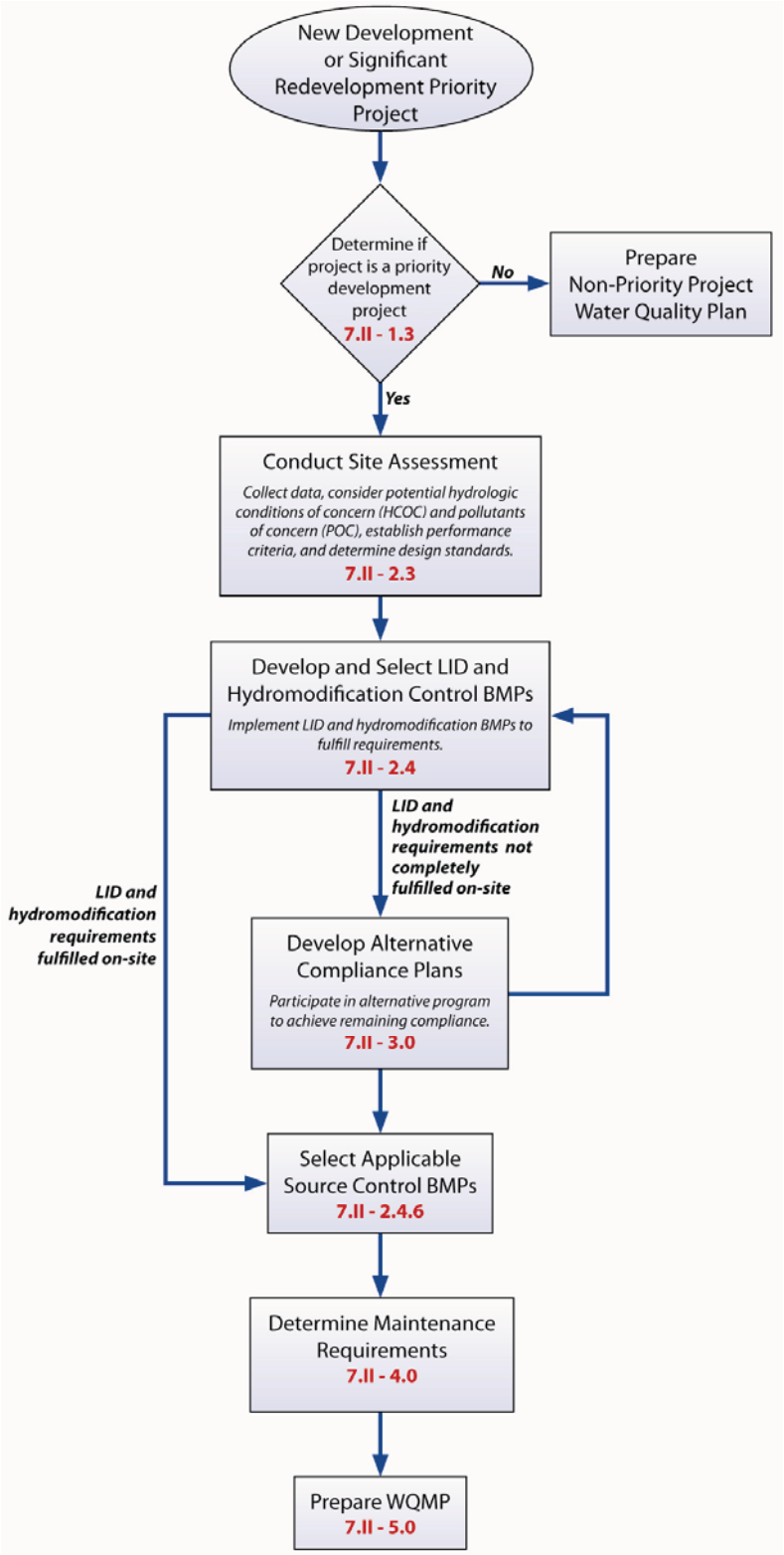
described in **Appendix B**. Individual Permittees may elect to develop a separate "Master Project WQMP" for all anticipated future projects with similar characteristics based upon the requirements outlined in this document. A Master Project WQMP document would need to list all of the qualifying streets, roads, and highways projects anticipated to occur within the Permittee's jurisdiction over a given time period and the proposed methods of compliance with this Model WQMP.

Below ground linear drainage and utility construction projects may result in the replacement of more than 5,000 square feet of impervious surface within a developed public street, road or highway such as storm drains, sewers and water lines. However such projects would not qualify as a Priority Project if they maintain original line and grade, hydraulic capacity, original purpose of the facility, or occur in response to an emergency to protect public health and safety. Consequently, these projects would not require the preparation of a project WQMP but would require a Non-priority Project Plan. Due to the circumstances, projects done in response to an emergency may have their Non-Priority Project Plan prepared after-the-fact, but within three business days of the project's completion. Projects involving extending, relocating, or replacing storm drain lines may involve replacing more than 5,000 square feet of impervious surface and maintain original line and grade at the surface. However, these projects may alter the original line and grade or hydraulic capacity of storm drain facilities below ground. Such projects are Priority Projects and will require project WQMPs.

7.II–1.6 WQMP Development Process

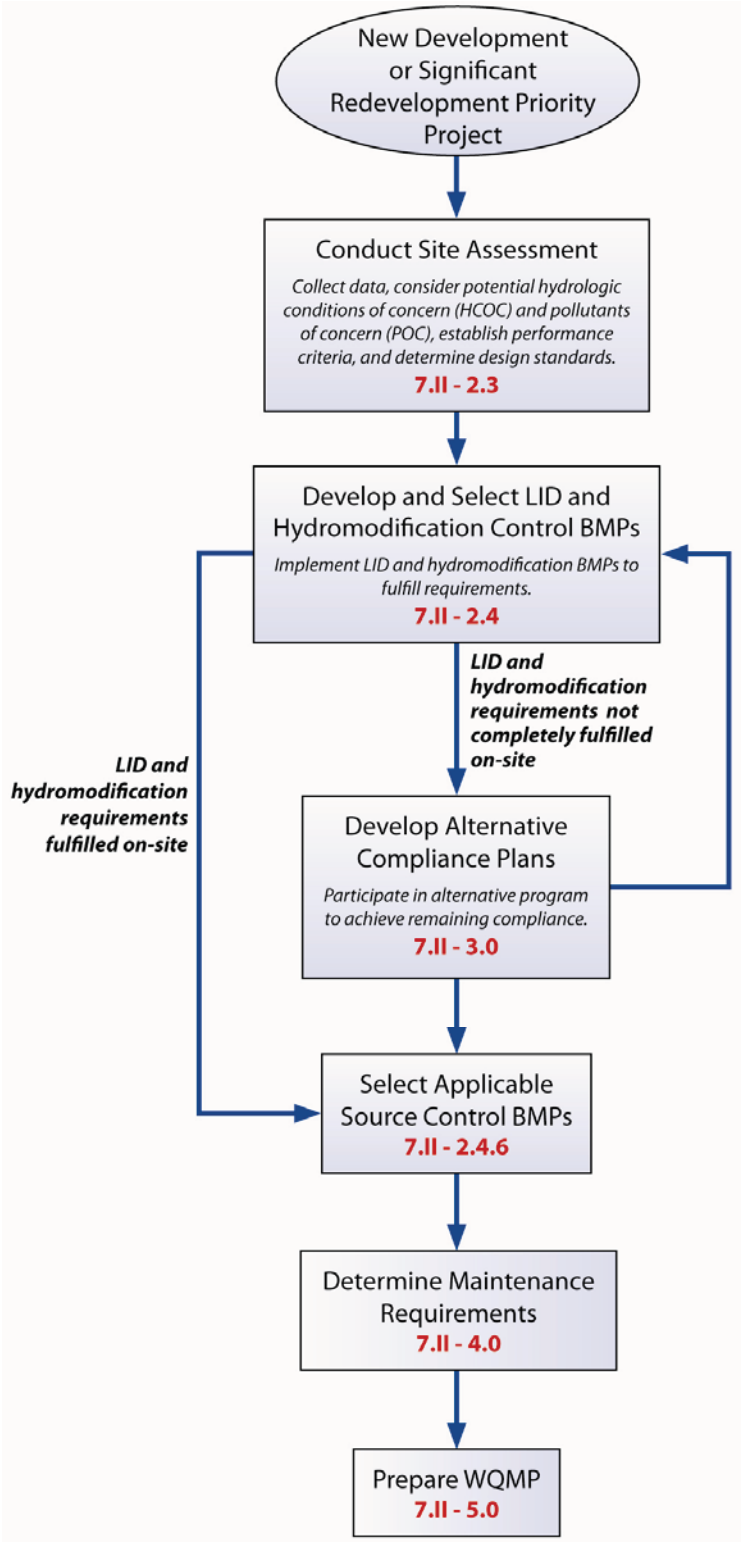
Several steps are involved in completing an approvable Conceptual or Preliminary WQMP, or final Project WQMP for new development or significant redevelopment projects. **Figures 7.II-2** and **7.II-3** display an overview WQMP flowchart and the major implementation and decision steps that must be followed to successfully complete a Project WQMP for NOC and SOC Permit Areas, respectively. Each of the steps identified in the flow chart are described in later sections of the Model WQMP. The relevant sections which detail each step are referenced in the overall WQMP flow chart. **Figure 7.II–4** for the North County permit area and **Figure 7.II-5** for the South County permit area provide a more detailed overview of the steps in the process. Each of these steps is described in more detail in **Section 7.II-2.0**.

Figure 7.II-2: Overall WQMP Development Process Flow Chart – North Orange County Permit Area



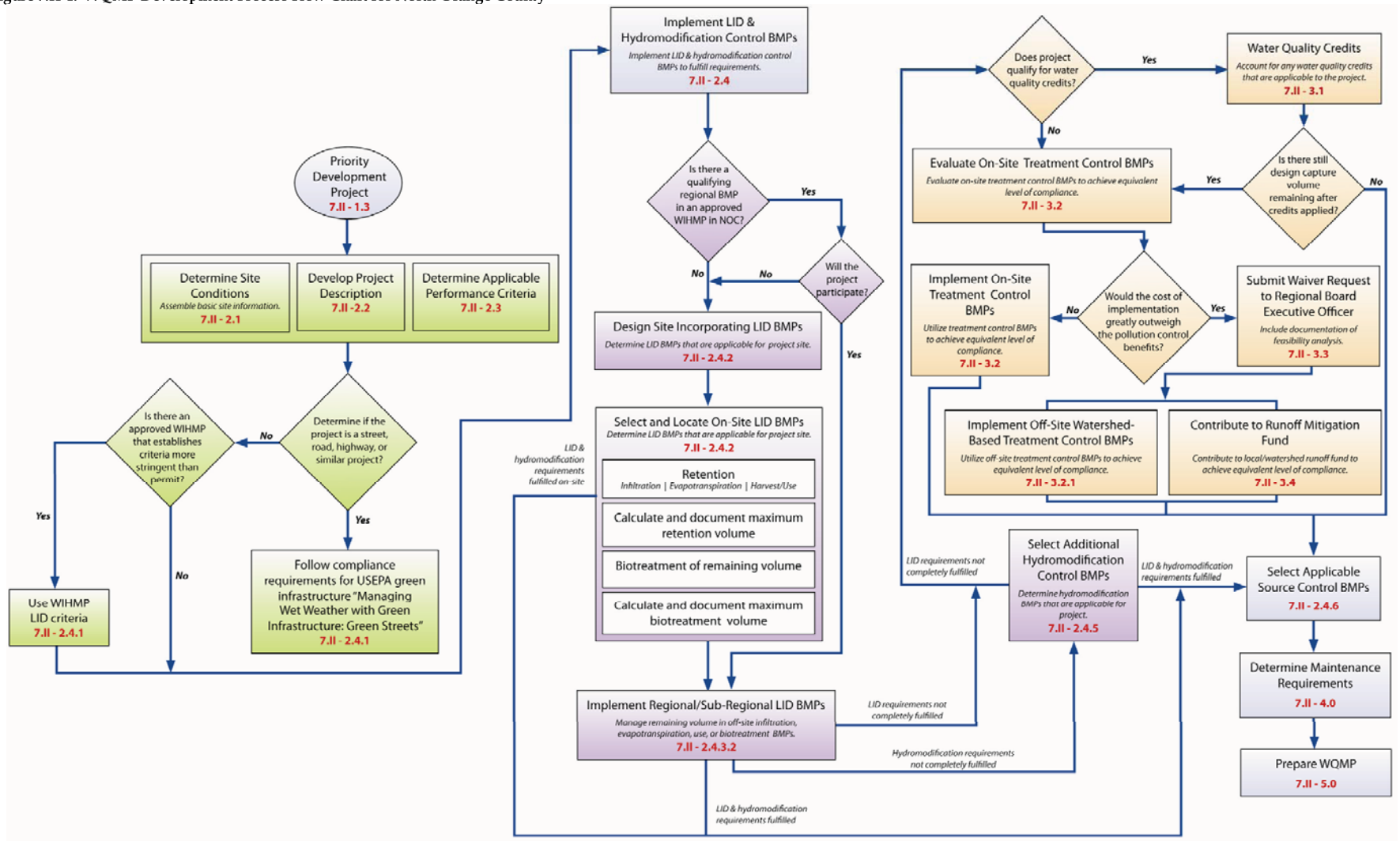
Note: Model WQMP sections shown in red.

Figure 7.II-3: Overall WQMP Development Process Flow Chart – South Orange County Permit Area



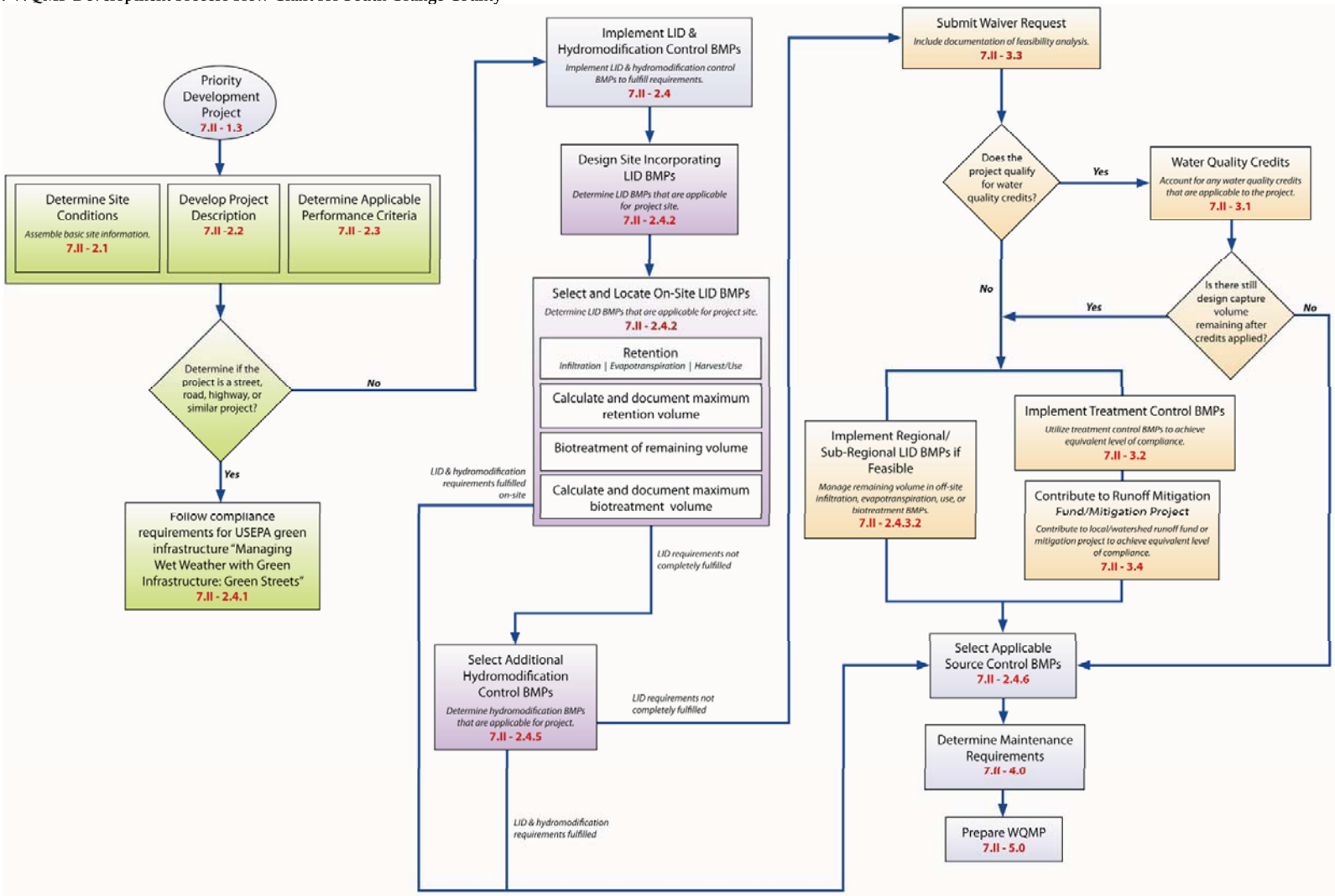
Note: Model WQMP sections shown in red.

Figure 7.II-4: WQMP Development Process Flow Chart for North Orange County



Note: Model WQMP sections shown in red

Figure 7.II-5: WQMP Development Process Flow Chart for South Orange County



Note: Model WQMP sections shown in red

7.II–2.0 Project WQMP Requirements

The purpose of the Project WQMP is to define project features and BMPs that will mitigate the project's impact on WQ and the environment. In order to complete a Project WQMP, the following steps will need to be performed:

1. Determine discretionary permits and WQ conditions that may apply – **Section 7.II-2.1**
2. Describe the project – **Section 7.II-2.2**
3. Assess the site – **Section 7.II-2.3**
4. Develop and select BMPs, including LID BMPs, site design BMPs, hydromodification control BMPs, and source control BMPs – **Section 7.II-2.4**
5. Determine any applicable alternative compliance approaches – **Section 7.II-3.0**
6. Identify parties responsible for BMP maintenance and funding sources – **Section 7.II-4.0**

The first four steps are discussed in the following subsections. Additional information with technical guidance and supporting information can be found in the **TGD**.

7.II–2.1 Discretionary Permit(s) and Water Quality Conditions

This Model WQMP provides a framework for addressing General Plan, discretionary permit conditions, WQ conditions, and complying with CEQA. Compliance with the requirements set forth in this document can provide the basis for evaluating the surface WQ impacts and any mitigation measures and can be sufficiently specific to satisfy the requirements of CEQA with regards to projects. See **TGD Section 2.1** for additional details regarding discretionary permits and WQ conditions.

7.II–2.2 Project Description

The Project WQMP shall contain an overall description of the project including permit applicability, whether the project is in NOC and SOC Permit Areas, if it is in an ESA, whether it may be eligible for water credits (as discussed in **Section 7.II-3.1**), and whether the project contains specific features such as streets that would require specific BMP approaches (as discussed in **Section 7.II-2.4.2**). If the project is within an area with a completed Watershed Infiltration and Hydromodification Master Plan (WIHMP), the applicable WIHMP shall be referenced and used as a guide in completing the Project WQMP. See **TGD Section 2.2** for additional details regarding project descriptions.

7.II–2.3 Site Assessment

7.II–2.3.1 Introduction

Site assessment involves the following steps:

1. Gather site information
2. Determine if hydrologic conditions of concern are applicable
3. Determine pollutants of concern (POCs)

Using this information, the applicable performance criteria that apply to the remaining steps in the overall process can be determined.

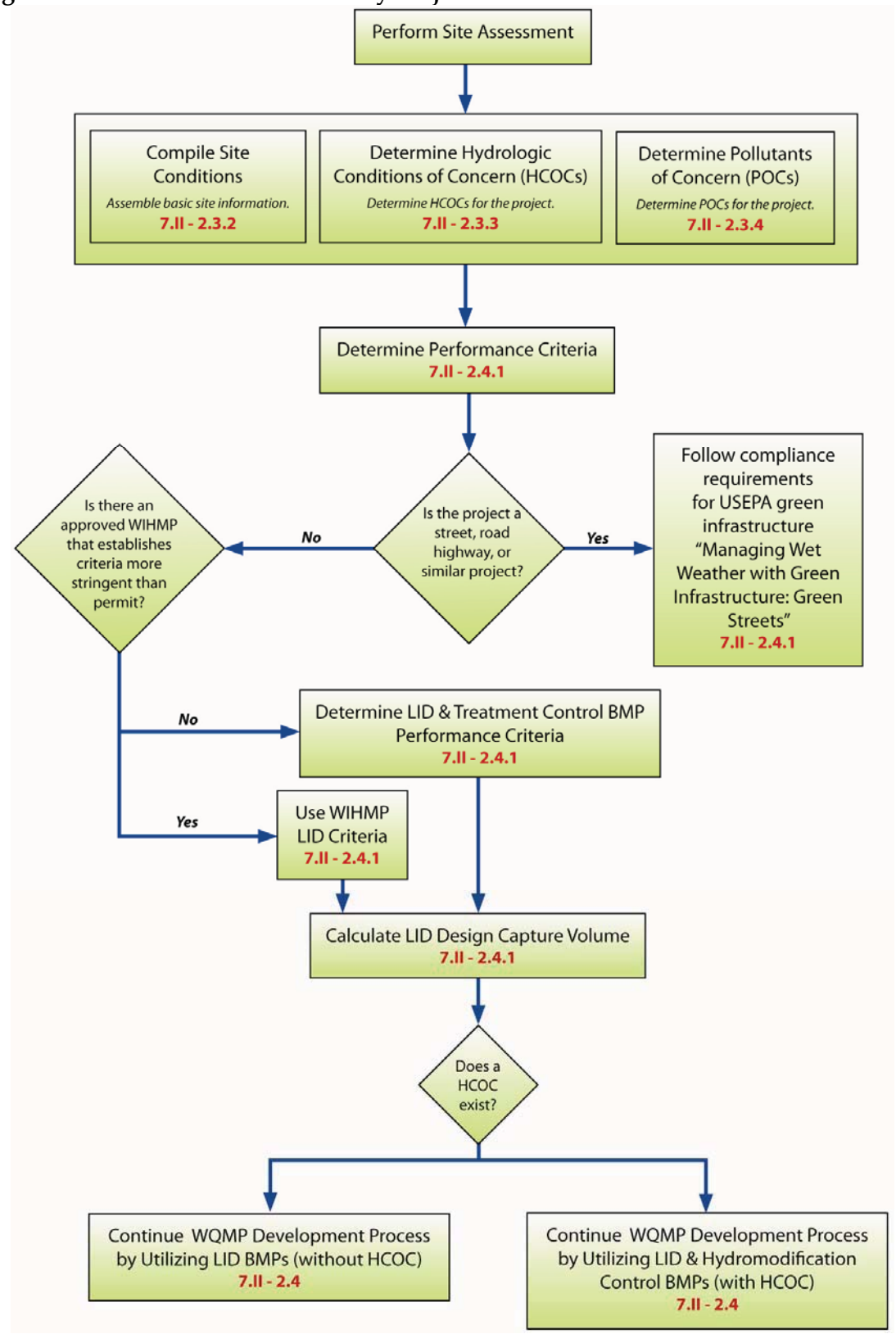
Each of these steps is described in more detail in the following subsections. A flow chart of the key steps and decisions required for site assessment is shown in **Figure 7.II-6.** See **TGD Section 2.3** for the technical basis for developing site descriptions.

7.II–2.3.2 Gather Site Information

Basic information for the site must be compiled. Specific details for compiling this information can be found in the **TGD Section 2.3**. The information that must be compiled is listed below:

- Community Name or Planning Area (if located in planned community): Provide exhibit of the boundary of the project site and surroundings in sufficient detail to allow project location to be shown on a base map.
- Site specifics such as general and specific location, site address, parcel number, and size (acreage to the nearest 1/10 acre).
- Watershed name: Provide the name of the receiving water for the proposed project discharge and information on how runoff may enter the receiving water (i.e. through an un-named tributary or discharging directly into the water).
- Site characteristics, including description of site drainage (including ownership) and how it ties with drainage of surrounding property. Reference to the Project WQMP's Plot Plan showing drainage flow arrows and how drainage ties to drainage of surrounding property.
- Additional information described in the **TGD Section 2.3**, as necessary to support evaluation of LID feasibility, selection and design, potentially regarding the following subject areas:
    - Topography
    - Soil Type and Geology
    - Groundwater and Soil Contamination
        - Groundwater Levels
        - Groundwater/Soil Contamination
        - Protection of Groundwater Quality
        - Groundwater Recharge
        - Groundwater/Surface Water Interactions
    - Geotechnical Considerations
        - Collapsible Soils
        - Expansive Soils
        - Slopes
        - Liquefaction
    - Managing Off-Site Drainage
    - Existing Utilities
    - ESAs

Figure 7.II-6: Assessment for Priority Projects



Note: Model WQMP sections shown in red

Site assessment must involve collecting relevant information to address two primary issues:

- Determine Hydrologic Conditions of Concern (HCOCs)
- Determine POCs

Technical details regarding how to determine if there is a HCOC in downstream receiving waters from the project site and how to select and size BMPs to provide for hydromodification control (hydromodification control BMPs) if HCOCs exist is provided in **TGD Section 2.2.3**. Additional information regarding how to identify POCs, and related priority POCs, and how to select a combination of source control, LID, and treatment control BMPs that are effective at removing those pollutants from stormwater runoff from the project site is provided in **TGD Section 2.2.2**.

7.II–2.3.3 Determine Hydrologic Conditions of Concern

Priority Project proponents shall use the following approach to identify if Hydrologic Conditions of Concern (HCOCs) are associated with the proposed project. An HCOC exists when a site's hydrologic regime is altered and there are significant impacts on downstream channels and aquatic habitats, alone or in conjunction with impacts of other projects.

Hydromodification is the alteration of natural flow characteristics and sediment supply in streams and channels due to urbanization, which can result from new development and significant redevelopment projects without appropriate preventative controls. Hydromodification controls are implemented in order to prevent hydromodification from happening. Urbanization commonly results in increased runoff volume and velocity; reduced infiltration; increased flow frequency, duration, and peaks; and faster time to reach peak flow. Under certain circumstances, urbanization could also result in the reduction in the amount of sediment supplied to the channel for transport. If the sediment supplied to the channel is reduced such that in-stream flows are transporting sediment faster than it can be replenished, then erosion of the channel's bed and bank may occur. These changes have the potential to permanently impact downstream channels and habitat integrity. A change to a Priority Project site's hydrologic characteristics would be considered a condition of concern if the change would have a significant impact on downstream natural channels and habitat integrity.

The first step to determine whether or not HCOCs must be evaluated is based on the Proposed Project's location and point of discharge. Both permits contain conditions under which it is presumed that the project does not have the potential to have an HCOC, based on the characteristics of downstream receiving waters, as noted below:

- North Orange County Permit area:
  - All downstream conveyance channels that will receive runoff from the project are engineered, hardened and regularly maintained to ensure design flow capacity, and no sensitive stream habitat areas will be affected.
- South Orange County Permit area:
  - Discharges of stormwater from the project are to underground storm drains discharging directly to bays or the ocean.

- Discharges of stormwater runoff from the project are to conveyance channels whose bed and bank are concrete-lined all the way from the point of discharge to ocean waters, enclosed bays, estuaries, or water storage reservoirs and lakes.

If HCOCs are associated with the proposed project then they shall be addressed in accordance the technical approach described in **TGD Section 2.2.3**.

7.II–2.3.4 Determine Pollutants of Concern

Stormwater runoff from new development and significant redevelopment project sites has the potential to contribute pollutants, including suspended solids/sediment, nutrients, metals, microbial pathogens, oil and grease, toxic organic compounds, and trash and debris from the municipal storm drain system to tributary receiving waters. Knowing the POCs is necessary to select the most effective BMPs, since some BMPs are more effective for some pollutants than others. POCs are identified based on the type of development project that is proposed. POCs are considered Primary POCs if a waterbody located downstream of a project (receiving water) has an approved TMDL or is listed as impaired, according to CWA Section 303(d), for that pollutant.

Primary POCs are any pollutants anticipated to be generated by the project that also have approved TMDLs or which are causing an impairment for which a TMDL has not yet been approved. Other POCs are those pollutants anticipated to be generated by the project that have not been identified as causing impairment or have an adopted TMDL for the project's receiving waters. **TGD Section 2.3.3** provides technical details regarding identifying POCs.

Further information on POCs may also be available from the environmental impact assessment for the project (e.g., project-specific pollutant evaluations in CEQA Environmental Impact Reports). This site-specific information should be used to supplement, or in some cases supersede, the POCs identified through the methods described in this section. Any site-specific information used to identify additional POCs or remove a pollutant from being a presumed POC must be based on substantial evidence and justified in either the project's CEQA document and/or the project WQMP. Watershed planning documents previously developed by Orange County, or WIHMPs to be adopted should also be reviewed for identification of specific implementation requirements that address POCs.

7.II–2.4 Select Low Impact Development Best Management Practices

7.II–2.4.1 Introduction

BMPs are programs and policies, including structural controls that are implemented to control the discharge of pollutants. This Model WQMP describes LID BMPs, site design BMPs, hydromodification control BMPs, source control BMPs and treatment control BMPs.

Using the information compiled above, the following steps must be taken to determine what performance criteria apply to the project: 1) LID, 2) treatment control, and 3) hydromodification control. These performance criteria are evaluated individually although they can be interrelated. It is possible to meet one and not meet the others.

This is synonymous with "performance standard" as used by other guidance documents, but only "performance criteria" is used in this document.

Several steps must be followed in order to determine what performance criteria will apply to a project. These steps include:

- Determining if the project is a street, road, highway, or above ground lined drainage facility with similar characteristics. If the project is determined to be a street, road, highway, or above ground lined drainage facility, then follow alternative compliance requirements, by incorporating US EPA guidance "Managing Wet Weather with Green Infrastructure: Green Streets." Refer to **Appendix B** of this document for the EPA guidance and **TGD Section 2.4.1** for additional technical information.
- Determining if there is an approved WIHMP or equivalent that includes more stringent LID feasibility criteria or if there are opportunities identified for implementing LID on regional or sub-regional basis (NOC Permit Area only). If the project has an approved WIHMP or equivalent, then any watershed specific criteria must be used and the project can evaluate participation in the approved regional or sub-regional opportunities. The local Permittee planning or NPDES staff should be consulted regarding the existence of an approved WIHMP or equivalent.
- Determining site design and LID performance criteria.
- Determining treatment control BMP performance criteria.
- Calculating the LID design storm capture volume.
- Determining hydromodification control performance criteria.
- Completing the LID BMP selection process.

Once the performance criteria have been established, the next step is to develop and select site design practices and on-site LID BMPs and hydromodification control BMPs based on these project-specific criteria.

7.II–2.4.2 Determine Performance Criteria

7.II-2.4.2.1 Determine if the Project is a Street, Road, Highway, or Above Ground Linear Lined Drainage Facility with Similar Characteristics

If the proposed project is a street, road, highway, or freeway with 5,000 square feet or more of paved surface, the project shall incorporate USEPA guidance, "Managing Wet Weather with Green Infrastructure: Green Streets"(see **Appendix B**) in a manner consistent with the MEP standard. This category includes the impervious area within the right-of-way associated with any paved surface used for the transportation of automobiles, trucks, motorcycles and other vehicles. Routine road maintenance activities where the footprint is not changed are excluded. Separate compliance requirements for these projects are discussed in **TGD Section 2.7**.

The alternative compliance approach described in **TGD Section 2.7** applies only to stand-alone public agency projects. Streets, roads or highway projects that are planned and constructed as part of a private new development or significant redevelopment

project, even if they will become dedicated public right-of-way upon project completion, must be included as part of the overall Project WQMP for the private project.

Access roadways of 5,000 square feet or more of paved surface associated with flood control, drainage, and wet utilities projects shall also incorporate Green Street infrastructure.

7.II–2.4.2.2 Determine Hydromodification Performance Criteria

For projects that may have an impact on the site's hydrologic regime, an assessment of potential hydromodification impacts and appropriate controls is required. The requirements are significantly different between the North County and South County permit areas as further described below:

North County Requirements

For proposed projects within the North County permit area that may have an HCOC, each Priority Project proponent must determine the impact of the proposed development on the downstream hydrologic characteristics. The evaluation of potential impacts is based on the following for a two-year frequency storm event:

- Increases in runoff volume;
- Decreases in infiltration;
- Changes in time of concentration;
- Potential for increases in post development downstream erosion; and,
- Potential for adverse downstream impacts on physical structure, aquatic and riparian habitat.

A project does not have an HCOC if either of the following conditions is met:

- The volumes and time of concentration of stormwater runoff for the post-development condition do not significantly exceed those of the predevelopment condition for a two-year frequency storm event (a difference of five percent or less is considered insignificant).
- The site infiltrates at least the runoff from a two-year storm event.

If a hydrologic condition of concern (HCOC) exists, priority projects shall implement on-site or regional hydromodification controls such that:

- Post-development runoff volume for the two-year frequency storm does not exceed that of the predevelopment condition by more than five percent, and

- Time of concentration of post-development runoff for the two-year storm event is not less than that for the predevelopment condition by more than five percent.[1]

Where the Project WQMP documents that excess runoff volume from the two-year runoff event cannot feasibly be retained and where in-stream controls cannot be used to otherwise mitigate HCOCs, the project shall implement on-site or regional hydromodification controls to:

- Retain the excess volume from the two-year runoff event to the MEP, and
- Implement on-site or regional hydromodification controls such that the post-development runoff two-year peak flow rate is no greater than 110 percent of the predevelopment runoff two-year peak flow rate.

At any point in this process, a project-specific engineering analysis conducted by a licensed geomorphic professional may find that the level of hydrologic control provided through on-site, regional, and/or in-stream hydromodification controls is adequate to addresses hydrologic conditions of concern.

Orange County will be developing WIHMPs for the North County permit area that integrates WQ, hydromodification, water supply, and habitat conditions for the following watersheds:

- Coyote Creek-San Gabriel River
- Anaheim Bay-Huntington Harbour
- Santa Ana River
- Newport Bay-Newport Coast

The WIHMP will include: (1) maps to identify areas susceptible to hydromodification including downstream erosion, impacts on physical structure, impacts on riparian and aquatic habitats and areas where stormwater and urban runoff infiltration is possible and appropriate; (2) a hydromodification model to make available as a tool to enable project proponents to readily select stormwater preventive and mitigative site BMP measures; and (3) identification of regional facilities and their tributary areas in which different site performance standards may apply.

Once a WIHMP is available for the watershed in which a the proposed project is located, the plans may specify hydromodification management standards for each sub-

[1] The North County Permit (Order R8-2009-0030), as adopted, provides the option of reducing Tc to less than the existing condition Tc (within 5 percent) as part of the primary and preferred option for mitigating HCOCs. However, a longer Tc is generally associated with natural conditions than urban conditions, and a longer Tc nearly universally results in lower concern for hydromodification impacts. In addition, it is not physically possible for a project to implement BMPs consistent with LID provisions of the permit without substantially increasing the Tc of the site. The use of retention BMPs results in water not discharged under design conditions, while the use of biotreatment BMPs general results in water not immediately discharged. Therefore, it would not generally be possible to mitigate HCOCs using the primary option for compliance described above while complying with LID requirements. This TGD therefore interprets this provision such that increases in Tc would be acceptable and reduction in Tc of more than 5 percent would not be acceptable. This interpretation is consistent with the overall goal of the permit to protect receiving waters from stormwater impacts to the maximum extent practicable.

watershed and will provide assessment tools to readily select stormwater preventive and mitigative site BMP measures. Watersheds that do not have developed WIHMPs should use the HCOC criteria detailed in this section and in the TGD.

WIHMPs will also identify integrated WQ, hydromodification, water supply, and habitat strategies. These strategies may include identification of regional facilities and their tributary areas or identification of watershed-based considerations related to retention of stormwater on-site which could be used to improve the application of feasibility criteria described in **TGD Section 2.4.2**.

South County Requirements

For new development or redevelopment projects within the SOC Permit Area, interim hydromodification criteria apply until a Hydromodification Management Plan (HMP) is adopted. Priority Projects must implement the following criteria by comparing the predevelopment (naturally occurring) and post-project flow rates and durations using a continuous simulation hydrologic model:

- For flow rates from ten percent of the two-year storm event to the five-year storm event, the post-project peak flows shall not exceed predevelopment (naturally occurring) peak flows.

For flow rates from the five-year storm event to the ten-year storm event, the post-project peak flows may exceed predevelopment (naturally occurring) flows by up to ten percent for a one-year frequency interval.

7.II-2.4.3 Determine LID and Treatment Control BMP Performance Criteria

The following performance criteria for LID implementation are stated in both permits:

- Priority Projects must infiltrate, harvest and use, evapotranspire, or biotreat/biofilter, the 85th percentile, 24-hour storm event (Design Capture Volume).
- A properly designed biotreatment system may only be considered if infiltration, harvest and use, and evapotranspiration (ET) cannot be feasibly implemented for the full design capture volume. In this case, infiltration, harvest and use, and ET practices must be implemented to the greatest extent feasible and biotreatment may be provided for the remaining design capture volume.

A diversity of controls must be provided, where feasible, to achieve the greatest feasible retention of the Design Capture Volume, then if necessary, biotreatment of the remaining design capture volume.

The Design Capture Storm Depth is the 85th percentile, 24-hr storm depth that, when applied to the project site results in the design capture volume. The design capture storm depth varies across the county and is shown in **TGD Appendices III**. The TGD provides information for determining the applicable "design capture storm depth" to apply to a project to calculate design capture volume as well as guidance for recommended hydrologic methods.

Equivalent performance criteria have been synthesized from permit requirements with consideration of the MEP standard and analysis of local precipitation and ET patterns. The following performance criteria result in capture and retention and/or biotreatment

of 80 percent of average annual stormwater runoff volume. The performance criteria for LID are stated as follows:

- LID BMPs must be designed to retain, on-site, (infiltrate, harvest and use, or evapotranspire) stormwater runoff up to 80 percent average annual capture efficiency
- LID BMPs must be designed to:
  - Retain, on-site, (infiltrate, harvest and use, or evapotranspire) stormwater runoff as feasible up to the Design Capture Volume, and
  - Recover (i.e., draw down) the storage volume as soon as possible after a storm event (see criteria for maximizing drawdown rate in the **TGD Appendix XI**), and, if necessary
  - Biotreat, on-site, additional runoff, as feasible, up to 80 percent average annual capture efficiency (cumulative, retention plus biotreatment), and, if necessary
  - NOC Permit Area only – retain or biotreat, in a regional facility, the remaining runoff up to 80 percent average annual capture efficiency (cumulative, retention plus biotreatment, on-site plus off-site), and, if necessary
  - Fulfill alternative compliance obligations for runoff volume not retained or biotreated up to 80 percent average annual capture efficiency using treatment controls or other alternative approaches as described in Section 7.II-3.

Within the South County Permit area, the volume provided in the pre-filter detention volume (surface storage) and pores of biotreatment BMPs may not be less than 75 percent of the design capture volume, regardless of the average annual capture efficiency achieved. Further discussion on determining the pre-filter detention volume is provided in the **TGD Appendix II**.

Instructions for calculating BMP sizing to meet these criteria are provided in the **TGD** and the **TGD Appendices**.

7.II–2.4.3.1 Selecting LID BMPs

The North and South County Permit Area Permits both stress the importance of project planning and design utilizing the principles of LID. The use of LID BMPs is intended to reduce the discharge of pollutants and the effects of changes to runoff patterns caused by land use modifications. Permit requirements for Priority Projects must be met through the use of structural and non-structural BMPs, with foremost consideration given to LID BMPs.

The primary goal of using LID BMPs is to preserve a site's predevelopment hydrology in order to preserve the integrity of receiving water bodies. The adverse effects of changes to runoff patterns and pollutant loading on receiving water bodies caused by land use modifications can be reduced through the use of structural and non-structural techniques that store, infiltrate, evaporate, and detain runoff.

Pre-development conditions in the NOC Permit Area are defined as the conditions of the project immediately prior to project submittal (i.e., the existing conditions). In the SOC Permit Area, pre-development is defined as the naturally occurring (pre-human disturbance) conditions.

Both the North and South County Permits contain requirements to implement LID practices in order to address the impacts of hydromodification and pollution of stormwater runoff from a Priority Project on the physical, chemical, and biological integrity of receiving waters.

A list of LID BMPs is shown in **Table 7.II–4**. Specific details and fact sheets for each BMP are provided in **TGD Sections 3-6**.

Table 7.II-4: LID BMPS by Category

Infiltration	Evapo-transpiration and Evaporation	Harvest and Use	Biotreatment
➢ Infiltration Trenches ➢ Infiltration Basins ➢ Bioretention Without Underdrains ➢ Drywells ➢ Permeable Pavement ➢ Proprietary Infiltration	➢Green Roofs ➢Brown Roofs ➢Blue Roofs	➢Cisterns ➢Underground Detention ➢Irrigation Use ➢Domestic Use	➢Bioretention With Underdrains ➢Stormwater Planter Boxes With Underdrains ➢Constructed Wetlands ➢Vegetated Swales ➢Vegetated Filter Strips ➢Dry Extended Detention Basins ➢Wet Extended Detention Basins ➢Proprietary Detention

While requirements for LID BMPs, treatment control BMPs, and hydromodification control are stated independently in the North and South Orange County Permits, and Priority Projects must demonstrate compliance with each requirement individually, the requirements overlap significantly and some management practices may fulfill or partially fulfill one or more requirements. The LID and treatment control requirements are especially interrelated because full compliance with LID requirements onsite inherently results in compliance with treatment control requirements. LID and hydromodification control requirements are also interrelated as both are based on reduction of runoff volume as their first priority. However, meeting the performance criteria for either LID BMPs or hydromodification control BMPs does not imply that the performance criteria for the other has category been met. As a result, a project that has HCOCs will need to document that it has met the performance criteria for both categories of BMPs.

The steps involved in selecting LID practices are described in more detail in the following subsections. A flow chart of the key steps and decisions required for selecting LID BMPs is shown in **Figure 7.II-7** for projects where there is no potential for HCOCs and **Figure 7.II-8** for Projects which must consider HCOCs**.** The TGD expands on these steps and provides specific instructions for selecting, designing, and documenting the use of LID practices. Where BMP fact sheets in the TGD specify selection and/or design criteria, the applicable selection and/or design criteria must be used.

The **TGD Section 2.4.2** discusses and the process of selecting, locating, and sizing LID BMPs also provides specific LID design criteria and a process that must be followed to determine if it is feasible to incorporate LID BMPs. The feasibility analysis will provide the basis for documenting project and site conditions under which it is not feasible to fully meet the LID BMP performance criteria leading to use of an alternative strategy as discussed further in **Section 7.II-3.0**.

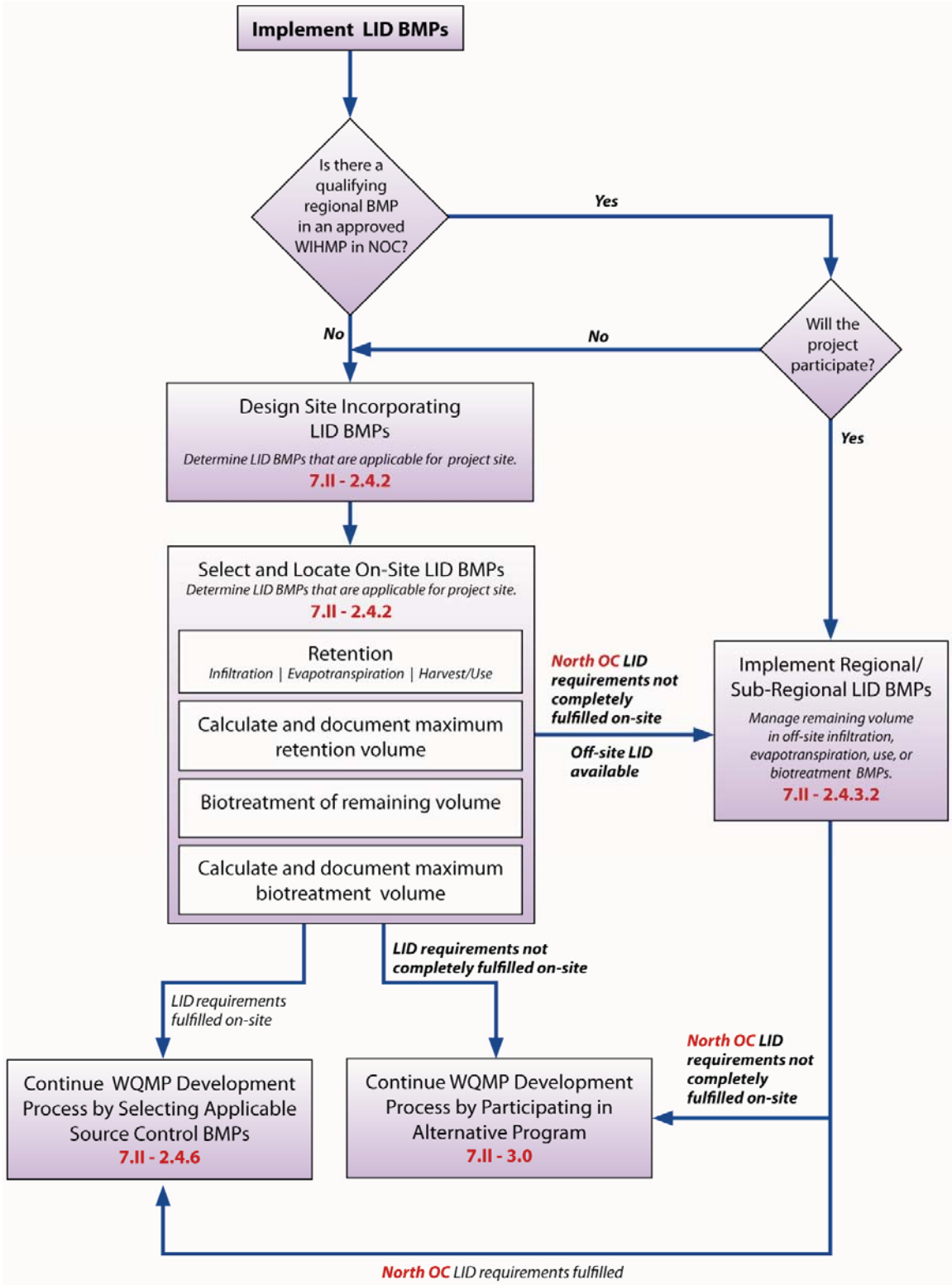
South County Condition for Specific Projects

In the SOC Permit Area, development projects greater than 100 acres in total project size, or smaller than 100 acres in size yet part of a larger common plan of development that is over 100 acres, that have been prepared using watershed and/or sub-watershed-based WQ, hydrologic, and fluvial geomorphologic planning principles that implement regional LID BMPs in accordance with the sizing and location criteria of the South Orange County Permit and acceptable to the Regional Board, such standards shall govern review of projects and shall be deemed to satisfy the Permit's requirements for LID site design, buffer zone, infiltration and groundwater protection standards, source control, treatment control, and hydromodification control standards. These projects may implement regional LID BMPs in accordance with the sizing and location criteria of the South Orange County Permit without first conducting an on-site LID feasibility analysis.

7.II–2.4.3.2 LID Practices Implemented on a Regional or Sub-Regional Basis

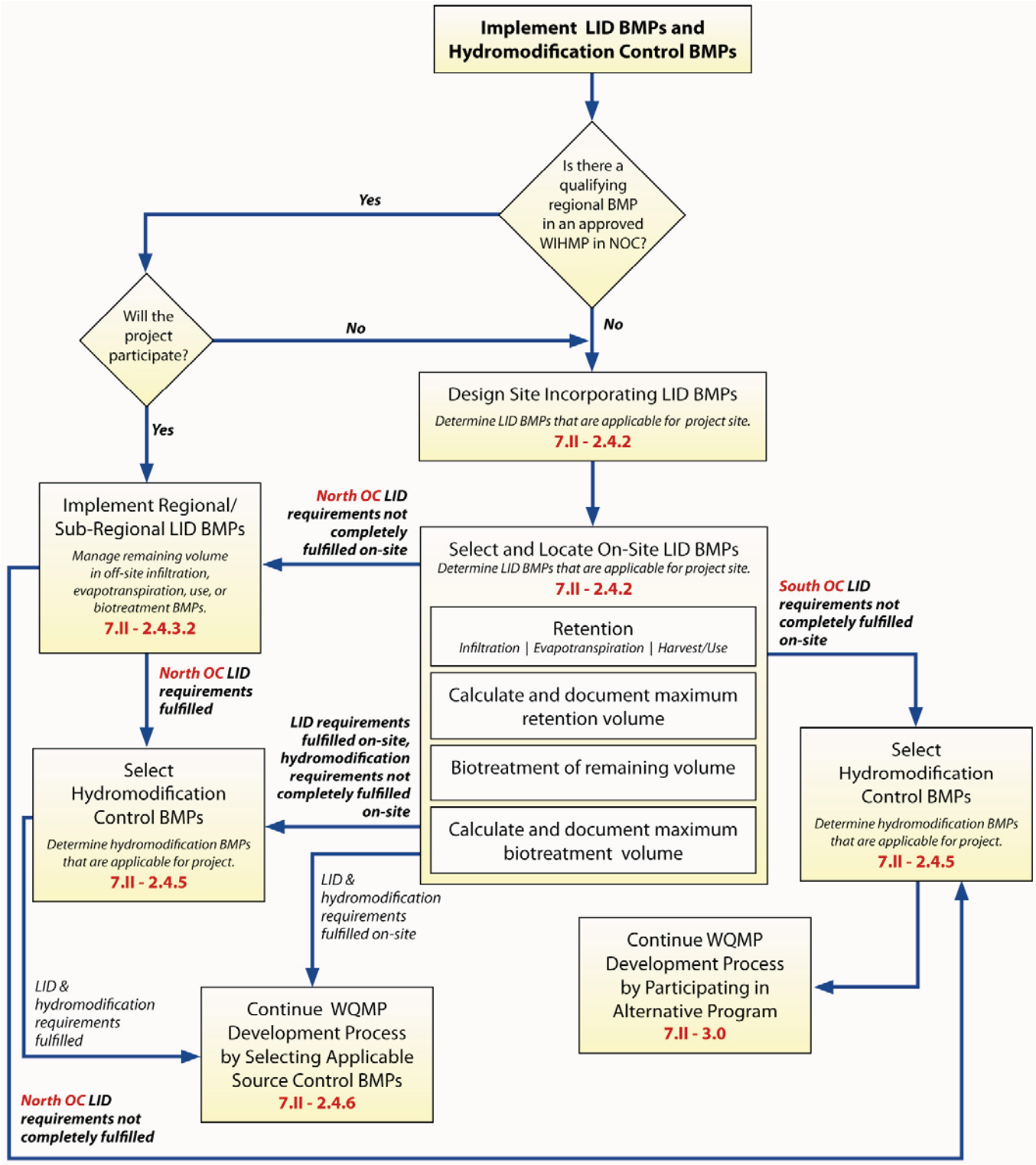
While most of the LID practices and LID BMPs described in this Model WQMP are focused at an individual project level, it may be most appropriate to implement LID BMPs beyond the boundaries of the specific development being proposed on a broader scale: (1) regional (several developments within the same watershed); or (2) sub-regional (multiple adjacent developments within the same watershed) for certain development conditions. There could be multiple benefits and/or constraining factors, including, but not limited to smart growth goals, water conservation and groundwater recharge benefits soil conditions, groundwater levels, soil and/or groundwater contaminants, space restrictions or redevelopment opportunities and economic considerations. Such conditions could result in circumstances under which it would be consistent with the MEP standard to integrate LID principles into regional or sub-regional plans without requiring upstream projects to first maximize the use of on-site LID BMPs through a project-specific infeasibility analysis. For this approach to be considered, an approved WIHMP Plan or Master Plan must include a watershed-wide feasibility analysis, based on permit requirements, that demonstrates that the use of regional BMPs is preferred and consistent with the MEP standard as further described below.

Figure 7.II-7: Design the Site Incorporating LID BMPs – Without HCOCs



Note: Model WQMP sections shown in red

Figure 7.II-8: Design the Site Incorporating LID BMPs – With Potential HCOCs



Note: Model WQMP sections shown in red

The potential availability of regional or sub-regional BMP opportunities could be identified as part of a planning process undertaken by the appropriate jurisdictions and project proponents. For this approach to be considered, a plan would have to be submitted to the Executive Officer for approval that must include a subwatershed- or watershed-wide feasibility analysis, based on permit requirements, that demonstrates that the use of regional BMPs is preferred and consistent with the MEP standard and that meets the following criteria:

- The sub-regional/regional BMP is located such that runoff from the project would be conveyed to the BMP prior to discharge to receiving water. However, stormwater runoff from an individual project may be conveyed to a regional treatment system via a receiving water if the pollutants in the runoff have been controlled on-site using LID techniques to the MEP and beneficial uses of the receiving water have not been impacted, and
- The sub-regional/regional BMP is sufficiently sized to treat runoff from the project, and
- The sub-regional/regional BMP is sited and designed such that it will provide greater overall benefit than would be achieved by biotreatment BMPs on-site, including combined considerations of pollutant loading, hydrologic loading, groundwater recharge, potable water demand, and Smart Growth goals.

Also, if there is a WIHMP that has been approved by the Executive Officer that identifies opportunities that would be provide equal or greater overall WQ benefits, discharge to Waters of the US from a new development without on-site LID or treatment control BMPs could be allowed if it is in accordance with the approved plan. For this approach to be considered, the approved Master Plan must include a watershed-wide feasibility analysis, based on permit requirements, that demonstrates that the use of regional BMPs is preferred and consistent with the MEP standard.

In the NOC Permit Area, LID BMPs must be considered on-site as appropriate. For projects located within the planning area of a watershed-based plan (WIHMP), approved by the RWQCB Executive Officer, a rigorous project-specific feasibility analysis will be prepared using the analysis provided in the WIHMP and based on a site-specific analysis in the project WQMP. These analyses will collectively provide the basis for a project to: 1) exclude or reduce requirements for LID BMPs on-site; 2) select any on-site pre-treatment BMPs, if needed; and 3) establish the project's eligibility to rely on a regional BMP. The analysis in the project WQMP must demonstrate that the project meets any criteria developed in the watershed-based plan and that the regional BMP will meet the following criteria:

- The sub-regional/regional BMP is located such that the project would drain to the BMP prior to discharge to a Waters of the US, the net pollutant removal load within the watershed is equivalent to what would be accomplished on-site, or would not impair the beneficial uses of Waters of the US.
- The sub-regional/regional BMP is sufficiently sized to treat stormwater runoff from its tributary area.

- The sub-regional/regional BMP is sited and designed such that it will provide equal or greater overall benefit than would be achieved by LID BMPs on-site as described in **TGD Section 2.4.3**, including combined considerations of pollutant loading, hydrologic loading, groundwater recharge, potable water demand, and Smart Growth goals.
- The sub-regional/regional BMP will be adequately maintained for the life of the project and the sub-regional/regional BMP will be constructed and operational to serve the project once the project is complete.
- The sub-regional or regional facility is constructed to remove pollutants from those new development projects within the watershed in a timely manner.

A sub-regional or regional BMP opportunity that meets all of the above criteria but that is not part of an approved watershed-based plan may also be considered for approval by the local jurisdiction. However the project applicant must document in the project WQMP and the local jurisdiction independently review and verify, that the sub-regional or regional BMP and the project meet all of the criteria above.

The use of regional or sub-regional BMPs could require multiple jurisdictions and project proponents within a watershed to develop a watershed-based management strategy to be implemented on a jurisdictional basis. The WIHMPs that will be prepared for the watersheds in the NOC Permit Area will identify regional opportunities and a framework for implementation. There may be multiple implementation scenarios among various jurisdictions that will need to be worked out on a case by case basis. As an example of implementing LID on a regional basis, several individual developments potentially in conjunction with other agencies could propose a project that incorporates LID BMPs to address stormwater runoff from all the developments collectively. Examples of a regional BMP would be the use of a regional infiltration basin, regional wetland, or groundwater injection and/or recharge facility as a total project or in conjunction with distributed swales and bioretention areas within the developments or at the regional site. The LID BMPs selected and designed in a regional LID approach must have the capacity to infiltrate, harvest and use, evapotranspire and/or biotreat at least the design capture volume (see **TGD Section 2.4.3**) from the entire tributary area. To the extent that the regional facility provides for additional treatment of runoff from existing developed areas, this could be considered for use as a mitigation project for other areas.

On a sub-regional basis, common areas could be used to locate LID BMPs to treat stormwater from for several projects that have conditions which make on-site implementation impractical. For example, these projects could use a neighborhood wet pond BMP for harvest and use, along to achieve LID requirements. A high density housing unit development with a small strip mall and a school could connect all roof drains to vegetated areas, and construct a stormwater infiltration gallery below the school playground as another example of sub-regional implementation.

Specific North and South County Requirements for LID BMPs are summarized below:

North County

In the North County permit area, Priority Projects shall prioritize LID practices in the following manner:

- LID practices shall be implemented on-site, which is the preferred approach.
- LID practices shall be implemented on a sub-regional basis.
- LID practices shall be implemented on a regional basis.

South County

In the South County permit area, where a development project greater than 100 acres in total project size, or smaller than 100 acres in size yet part of a larger common plan of development that is over 100 acres, has been prepared using watershed and/or sub-watershed based WQ, hydrologic, and fluvial geomorphologic planning principles that implement regional LID BMPs in accordance with the sizing and location criteria of the South County Permit and acceptable to the Regional Board, such standards shall govern review of projects and shall be deemed to satisfy the South County Permit's requirements for LID site design, buffer zone, infiltration and groundwater protection standards, source control, treatment control, and hydromodification control standards. Regional BMPs must clearly exhibit that they will not result in a net impact from pollutant loadings over and above the impact caused by capture and retention of the design storm with on-site LID BMPs.

For the SOC Permit Area, Priority Projects that do not meet the above criteria, participation in a regional program is considered Alternative Compliance and requires that an on-site LID BMP waiver request first be prepared before participating in a sub-regional/regional LID solution. Additional Alternative Compliance information can be found in **Section 7.II-3.0**, and details concerning on-site LID BMP waivers can be found in **Section 7.II-3.3**.

7.II–2.4.4 Site Design BMPs

LID site design practices include a wide range of potential practices that can be implemented to reduce the volume of stormwater runoff generated on a project site as well as improve the quality of runoff that leaves the site. LID site design is predominantly "preventative" in nature as it consists of practices that reduce the amount of runoff and other impacts before, or immediately after, they occur. Examples of "preventative" aspects of LID site design include reduction of impervious area, preservation of drainage courses, and restoration of impacted soils. Descriptions of the most common site design practices are provided in **TGD Section 2.4.2**.

There are no numeric performance criteria for site design practices, however, LID site design should be considered as the first priority in the hierarchy of LID implementation, beginning with the earliest phases of a project. The use of effective site design practices can result in a reduction in the volume of stormwater runoff that must be retained, a reduction of the design capture volume, and the related reduction in the size of structural treatment BMPs than if site design practices are not used. Including space for

BMPs in the site design at the earliest phases of the project planning process can allow projects to more easily satisfy numeric performance criteria.

On-site LID practices that should be considered include, but are not limited to, the following:

- Maximize Natural Infiltration Capacity and Groundwater Recharge (where appropriate)
- Preserve Existing Drainage Patterns and Time of Concentration
- Protect Existing Vegetation and Sensitive Areas
- Minimize Impervious Area
- Disconnect Impervious Areas
- Minimize Construction Footprint
- Re-vegetate Disturbed Areas

Each of these techniques is described further in the **TGD Section 3**. Where BMP fact sheets in the TGD specify selection and/or design criteria, the applicable selection and/or design criteria must be used.

7.II–2.4.5 Hydromodification Control BMPs

Within the NOC Permit Area, Priority Projects must employ BMPs that address hydromodification only if there is a HCOC in any downstream receiving waters (see **Section 7.II-2.3.3**). Within the SOC Permit Area, all projects must address hydromodification unless they discharge to channels which are concrete lined all the way to the ocean, or discharge directly to the ocean through concrete pipes. Projects must meet the performance criteria described in **TGD Section 2.4.2** using hydromodification control BMPs. LID BMPs may satisfy the requirements to capture the design capture volume and to address hydromodification, as described in **Section 7.II-2.4.2**. Hydromodification controls may also be regional or in-stream, although on-site hydromodification control BMPs are the first priority. Potential hydromodification control BMPs include non-structural and structural control measures that are described in the following sections.

In the NOC Permit Area, the Permit allows for Water Quality Credits to be utilized in certain cases to reduce volume of runoff from a project in order to meet hydromodification performance criteria. A Water Quality Credit is a volume of stormwater runoff that may be subtracted from the design capture volume. A detailed explanation about Water Quality Credits can be found in **Section 7.II-3.1**. Although the water quality credit program is considered part of the alternative compliance program with respect to meeting WQ obligations, in the NOC Permit Area, credits can also be applied to reduce the volume of runoff that must be retained on a project site in order to meet hydromodification as part of the LID compliance evaluation.

See **TGD Section 6** for information regarding non-structural hydromodification source control BMPs including minimization of impervious areas and preservation of open spaces, prioritizing soils for development and infiltration, riparian buffer zones, pass through sediments from open spaces. **TGD Section 5** discusses volume and flow

management structural BMPs including detention and retention basins, options for in-stream controls, drop structures, grade control structures, and bed and bank reinforcement. Where design guidance in the TGD specify selection and/or design criteria, the applicable selection and/or design criteria must be used.

7.II–2.4.6 Source Control BMPs

Source Control BMPs reduce the potential for stormwater runoff and pollutants from coming into contact with one another. Source Control BMPs are defined as any administrative action, design of a structural facility, usage of alternative materials, and operation, maintenance, inspection, and compliance of an area that aims to eliminate or reduce stormwater pollution. Each new development and significant redevelopment project is required to implement appropriate Source Control BMP(s). This Model WQMP categorizes Source Control BMPs as either Structural or Non-Structural Source Control BMPs.

Source Control BMPs are required within all new development and significant redevelopment projects regardless of whether the project is a Priority Project or a Non-Priority Project, including those identified in an applicable regional or watershed program, unless they do not apply due to the project characteristics.

The following list of Structural and Non-Structural Source Control BMPs are numbered for purposes of the Orange County Stormwater Program and Model WQMP, followed by a cross-reference for the CASQA BMP Handbook reference number in parenthesis, where applicable, for general guidance for implementing the BMPs that apply to the project as identified above. Additional information for each BMP is contained within the **TGD Section 6**. Where BMP fact sheets in the TGD specify selection and/or design criteria, the applicable selection and/or design criteria must be used.

7.II–2.4.6.1 Structural Source Control BMPs

- S1 Provide Storm Drain System Stenciling and Signage (CASQA BMP Handbook SD-13)
- S2 Design Outdoor Hazardous Material Storage Areas to Reduce Pollutant Introduction (CASQA BMP Handbook SD-34)
- S3 Design Trash Enclosures to Reduce Pollutant Introduction (CASQA BMP Handbook SD-32)
- S4 Use Efficient Irrigation Systems and Landscape Design (CASQA BMP Handbook SD-12)
- S5 Protect Slopes and Channels
- S6 Loading Dock Areas (CASQA BMP Handbook SD-31)
- S7 Maintenance Bays and Docks (CASQA BMP Handbook SD-31)
- S8 Vehicle Wash Areas (CASQA BMP Handbook SD-33)
- S9 Outdoor Processing Areas (CASQA BMP Handbook SD-36)
- S10 Equipment Wash Areas

- S11 Fueling Areas (CASQA BMP Handbook SD-30)
- S12 Site Design and Landscape Planning (Hillside Landscaping) (CASQA BMP Handbook SD-10)
- S13 Wash Water Controls for Food Preparation Areas
- S14 Community Car Wash Racks

7.II–2.4.6.2 Non- Structural Source Control BMPs

- N1 Education for Property Owners, Tenants and Occupants
- N2 Activity Restrictions
- N3 Common Area Landscape Management (CASQA BMP Handbook SC-73)
- N4 BMP Maintenance
- N5 Title 22 CCR Compliance
- N6 Local Water Quality Permit Compliance
- N7 Spill Contingency Plan (CASQA BMP Handbook SC-11)
- N8 Underground Storage Tank Compliance
- N9 Hazardous Materials Disclosure Compliance
- N10 Uniform Fire Code Implementation
- N11 Common Area Litter Control (CASQA BMP Handbook SC-60)
- N12 Employee Training
- N13 Housekeeping of Loading Docks (CASQA BMP Handbook SD-31)
- N14 Common Area Catch Basin Inspection (CASQA BMP Handbook SC-74)
- N15 Street Sweeping Private Streets and Parking Lots (CASQA BMP Handbook SC-43, SC-70)

7.II–2.4.6.3 Non-Structural Source Control Measures for Public Agency Projects

In addition to the above list of non-structural source control measures that apply to all projects, when New Development or Significant Redevelopment Public Agency Projects are completed, the source control measures and maintenance measures described in **DAMP Section 5**, Municipal Activities, will be implemented to maintain the projects.

7.II–3.0 Alternative Compliance Approaches

This section describes alternative compliance approaches for proposed projects that are not able to fully capture and infiltrate, harvest and use, or biotreat the design capture volume in one of the following ways:

- Using a combination of site design and on-site LID BMPs.
- Using approved regional or sub-regional LID projects in the NOC Permit Area as defined in **Section 7.II-2.4.3.2.**
- Development projects in the SOC Permit Area greater than 100 acres in total project size or smaller than 100 acres in size yet part of a larger common plan of development that is over 100 acres, that have been prepared using watershed and/or sub-watershed based WQ, hydrologic, and fluvial geomorphologic planning principles that implement regional LID BMPs as described in **Section 7.II-2.4** of the Model WQMP.

If a project is unable to fully meet the LID requirements summarized above, a project proponent must develop and implement an alternative compliance plan to address the remainder of the design capture volume that is not treated using LID BMPs either on or off site. Some projects may qualify for Water Quality Credits that can be applied to reduce or fully satisfy the remaining design capture volume that must be treated before evaluating alternative approaches. Water Quality Credits are discussed in **Section 7.II-3.1**.

Alternative compliance plans may include one or more of the following elements:

NOC Permit Area project proponents must:

- Implement on-site structural treatment control BMPs (see **Section 7.II –2.4.6.1**)
- Implement watershed-based structural treatment control BMPs
- Contribute to an urban runoff fund
- A combination of the above that addresses the remaining Design Storm Capture Volume.

SOC Permit Area project proponents must:

- Implement regional/sub-regional LID solutions if feasible
- Implement on-site structural treatment controls (treatment control BMPs)
    - Implement an off-site mitigation project
    - Contribute to a stormwater mitigation fund
    - A combination of these to address all remaining performance criteria

If treatment control BMPs are used as a complete alternative compliance option, the performance of these BMPs must be compared to LID Design Storm Capture Volume. The performance assessment must demonstrate that the volume treated by treatment control BMPs must be equal to the LID Design Storm Capture Volume for the project, minus any volume captured or treated by LID BMPs incorporated in the project and that the treatment control BMP has medium or high effectiveness (as described in Table 4-3

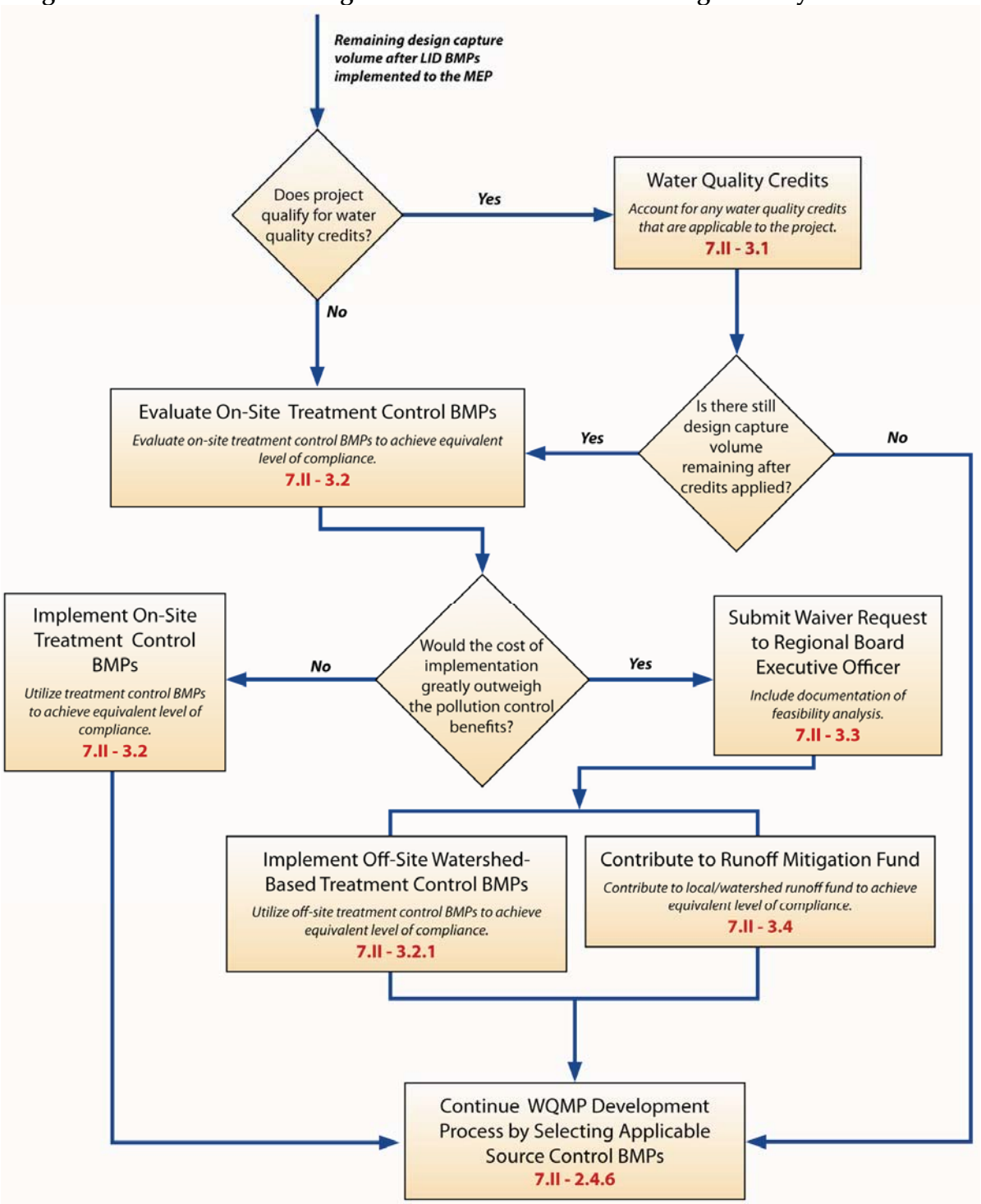
of the TGD Section 4.9) for removing the POCs for the downstream water body. For Projects in the NOC Permit Area, if a treatment control BMP or combination of BMPs can achieve this objective, the project is considered to meet the permit requirements and the Project WQMP can be completed which must include the documented feasibility analysis that demonstrates why the Design Storm Capture Volume could not be fully met with LID BMPs. However, if the cost of BMP implementation greatly outweighs the pollution control benefits, a waiver of BMPs may be granted as described under **Section 7.II-3.3** and other alternative approaches taken as described under **Section 7.II-3.4**.

Also in the NOC Permit Area, the use of structural treatment control BMPs are required before discharge to waters of the US unless there is a WIHMP which has been submitted to and approved by the Executive Officer that identifies alternative compliance approaches that achieve equivalent or better WQ benefits, and the discharge will not cause an impairment to the beneficial uses of receiving waters.

In the SOC Permit Area, if it is demonstrated to be technically infeasible to implement LID BMPs on-site to meet the full WQDV, a waiver must be submitted. Regional/sub-regional LID solutions can be implemented to fulfill alternative compliance requirements as described in **Section 7.II-2.4.3.2**. Treatment control BMPs must be incorporated into projects before discharge to waters of the US, and the project must meet remaining LID obligations though another alternative programs. The performance of treatment control BMPs could be compared to the performance that would be achieved by on-site LID to determine the amount of obligations met. The performance provided by treatment control BMPs may be demonstrated to fully or partially meet the remaining obligations.

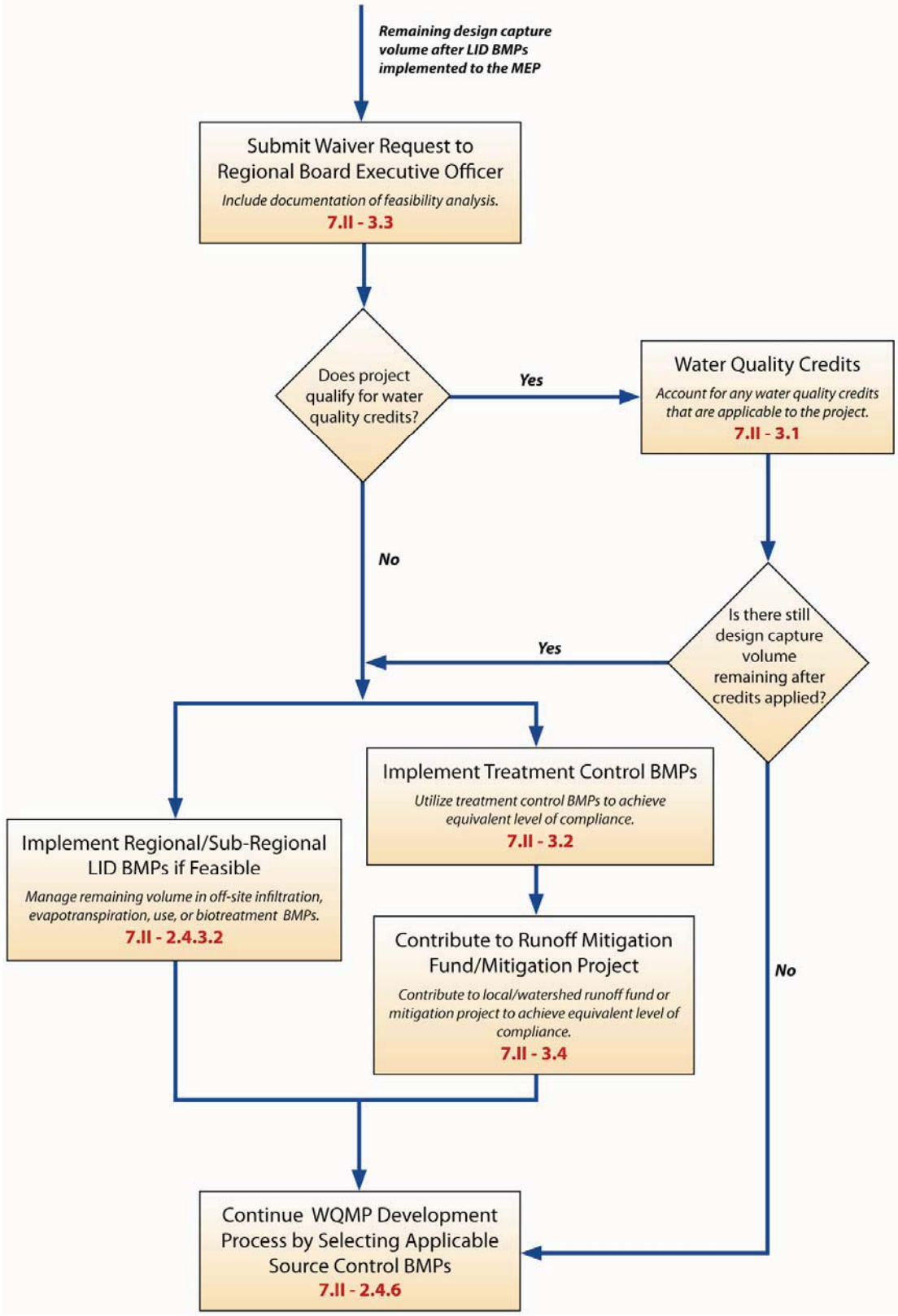
A flow chart illustrating the key steps for developing an alternative compliance plan approach for the NOC Permit Area is shown in **Figure 7.II-9** and for the SOC Permit Area in **Figure 7.II-10**. The following sections describe Water Quality Credits, Treatment Control BMPs, Waivers, Urban Runoff Funds / Mitigation Programs, and Off-Site Mitigation.

Figure 7.II-9: Alternative Program Flow Chart for North Orange County



Note: Model WQMP sections shown in red

Figure 7.II-10: Alternative Program Flow Chart for South Orange County



Note: Model WQMP sections shown in red

7.II–3.1 Water Quality Credits

For certain types of development projects, LID BMPs may be more difficult to incorporate due to the nature of the development, but the development practices may provide other environmental benefits to communities. For example, infiltration BMPs may not desirable for a Brownfield redevelopment site where infiltrated stormwater could cause an adverse impact to groundwater supply, but redevelopment of the site would be expected to have other environmental benefits such as accelerated site clean-up. Development in city centers, historic districts, or historic preservation areas often follows land-use patterns that existed before the introduction of the automobile and subsequent urban sprawl. New development or redevelopment in these areas is expected to follow those same patterns in order to be compatible with the surrounding area and thereby mimic many LID principles. Redevelopment project could be implemented in a way that reduces the overall impervious footprint of the project site rather than increasing it.

Local jurisdictions may develop a water quality credit program that applies to certain types of development projects after they first evaluate the feasibility of meeting LID requirements on-site. In order to determine if a project falls into any of the following categories, local jurisdictions will use the descriptions provided below as well as descriptions or definitions in local planning documents. If any of these descriptions or definitions is inadequate to determine a project's eligibility for credits, local jurisdictions will use published and generally accepted descriptions or definitions.

If it is not feasible to meet the requirements for on-site LID, project proponents for specific project types can apply credits that would reduce project obligations for selecting and sizing other treatment BMPs or participating in other alternative programs. For Projects in the NOC Permit Area, credits can be applied before other alternative programs are evaluated and/or a Waiver request submitted. Also in the NOC Permit Area, the Permit allows for credits to be applied for hydromodification requirements. Permittee may develop a credit system for hydromodification at a future date and submit this to the Executive Officer for approval. For projects in the SOC Permit Area, credits can be applied as part of the LID Waiver Program.

Projects potentially eligible for consideration for credits include:

- Redevelopment projects that reduce the overall impervious footprint of the project site;
- Brownfield redevelopment, meaning redevelopment, expansion, or reuse of real property which may be complicated by the presence or potential presence of hazardous substances, pollutants or contaminants, and which have the potential to contribute to adverse ground or surface WQ if not redeveloped;
- Higher density development projects which include two distinct categories (credits can only be taken for one category):
    - Those with more than seven units per acre of development (lower credit allowance);

  - Vertical density developments, for example, those with a Floor to Area Ratio (FAR) of 2, or those having more than 18 units per acre (greater credit allowance);
- Mixed use development, such as a combination of residential, commercial, industrial, office, institutional, or other land uses which incorporate design principles that can demonstrate environmental benefits that would not be realized through single use projects (e.g. reduced vehicle trip traffic with the potential to reduce sources of water or air pollution);
- Transit-oriented developments, such as a mixed use residential or commercial area designed to maximize access to public transportation; similar to above criterion, but where the development center is within one half mile of a mass transit center (e.g. bus, rail, light rail or commuter train station). Such projects would not be able to take credit for both categories, but may have greater credit assigned;
- Redevelopment projects in an established historic district, historic preservation area, or similar significant city area including core City Center areas (to be defined through mapping);
- Developments with dedication of undeveloped portions to parks, preservation areas and other pervious uses;
- Developments in a city center area;
- Developments in historic districts or historic preservation areas;
- Live-work developments, a variety of developments designed to support residential and vocational needs together – similar to criteria to mixed use development; would not be able to take credit for both categories; and
- In-fill projects, the conversion of empty lots and other underused spaces into more beneficially used spaces, such as residential or commercial areas.

Other categories of projects listed in the Santa Ana Permit include:

- Developments where a regional treatment system has a capacity to treat flows
- Developments that contribute to an urban runoff fund
- Developments with offsite mitigation or dedications within the same watershed are accounted for under other provisions of this Model WQMP.

These categories address other types of alternative opportunities or compliance approaches that are described in other sections of this MWQMP. This provision does not exempt the project proponent from first conducting the investigations to determine if is feasible to fulfill the full LID, treatment control, and hydromodification requirements through a combination of site design practices and LID BMPs consistent with the permit hierarchy.

7.II–3.1.1 Applying Water Quality Credits to LID Performance Criteria

To determine the amount of credit a project would qualify for, the first step is to calculate the volume that would need to be satisfied in the absence of any credits as

described in **Section 7.II-3.1**. Any credits would then be taken as a reduction to this remaining volume. The credits would be calculated in one of two ways:

- For redevelopment projects that reduce the overall impervious footprint of the project site compared to current use, the credits would be calculated as follows:
  - Calculate an equivalent "existing" Design Capture Volume for the site (DCV_E) using the LID BMP Performance Criteria defined in **Section 7.II-2.4.3** and current site conditions
  - Calculate the full Design Capture Volume for the site under the proposed development plan (DCV_P)
  - Subtract to obtain a "credit" volume: (DCV_E) - (DCV_P) = Credit Volume
- For all other categories of projects noted above, the remaining volume to be treated or mitigated would be reduced in accordance with the following portions of the design capture volume :
  - Historic district, historic preservation area, or similar areas – 10 percent
  - Brownfield redevelopment – 25 percent
  - Higher density development
    - 7 units/acre – 5 percent
    - Vertical density as defined – 20 percent
  - Mixed use development, transit oriented development or live-work development – 20 percent
  - In-fill development – 10 percent

If more than one category applies to a particular project, the credit percentages would be additive. Applicable performance criteria depend on the number of LID water quality credits claimed by the proposed project. Water quality credits can be additive up to a 50 percent reduction (50 percent reduction maximum) from a proposed project's obligation for sizing LID BMPs, contributing to an urban runoff / mitigation fund, or off-site mitigation projects. The volume credit would be calculated as the design capture volume of the proposed condition multiplied by the sum of the percentages claimed above.

7.II–3.1.2 Applying Water Quality Credits to Hydromodification Performance Criteria in North Orange County

To calculate the credit to be applied to the hydromodification control performance criteria in the NOC Permit Area, the sum of percentages determined above would be applied as a reduction to the 2-year, 24-hour storm depth which is used to calculate performance criteria. Water Quality Credits are not available for hydromodification control performance criteria in the SOC Permit Area.

7.II–3.2 Treatment Control BMPs

This section contains performance criteria for treatment control BMPs. Note that satisfaction of LID performance criteria also fully satisfies treatment control performance criteria.

7.II–3.2.1 Watershed-based Structural Treatment Control BMPs

In the NOC Permit Area, watershed-based Treatment Control BMPs may be implemented off-site. These should be implemented in combination with site-specific BMPs, should be located as close as possible to the project site and pollutant sources, and cannot be located within waters of the US. Pollutant removal should be accomplished prior to discharge to waters of the US.

7.II–3.2.2 Determine Treatment Control BMP Water Quality Performance Criteria

This section contains performance criteria for treatment control BMPs. Note that satisfaction of LID performance criteria also fully satisfies treatment control performance criteria.

North County Requirements

If it is not feasible to meet LID performance criteria through retention and/or biotreatment provided on-site or at a sub-regional/regional scale, then treatment control BMPs shall be provided on-site or offsite prior to discharge to waters of the US. Sizing of treatment control BMP(s) shall be based on either the unmet volume after claiming applicable water quality credits, if appropriate (See **Section 7.II-3.1** Water Quality Credits) and as calculated in **TGD Appendix VI**. If treatment control BMPs can treat all of the remaining unmet volume and have a medium to high effectiveness for reducing the primary POCs, the project is considered to be in compliance; a waiver application and participation in an alternative program is not required.

If the cost of providing treatment control BMPs greatly outweighs the pollution control benefits they would provide, a waiver of treatment control and LID requirements can be requested and alternative compliance approaches must be used to fulfill the remaining unmet volume (See **Section 7.II-3.3**).

South County Requirements

If LID performance criteria have not been met through retention and biotreatment, the Project shall participate in the LID Waiver Program (see **Section 7.II- 3.3**) and treatment control BMPs shall be provided prior to discharge to Waters of the US. Sizing of treatment control BMP(s) shall be based on either:

- The unmet volume as calculated in **TGD Appendix VI**. Treatment control sizing, or
- If no controls have been provided upstream of treatment control BMPs, permit-based sizing criteria may be used:
    - Capture and infiltrate, filter, or treat 80 percent of average annual runoff volume,

      OR
    - Capture and infiltrate, filter, or treat the runoff from the 24-hour, 85th percentile storm event, as determined from the County of Orange's 85th Percentile Precipitation Isopluvial Map and draw down the stored volume in no more than 48 hours following the end of precipitation,

      OR

- Treat the maximum flow rate of runoff produced by the 85th percentile hourly rainfall intensity, as determined from the local historical rainfall record, multiplied by a factor of two,

  OR

- The maximum flow rate of runoff produced from a rainfall intensity of 0.2 inch of rainfall per hour, for each hour of a storm event.

The alternative compliance obligations that must be provided through the LID Waiver Program (see **Section 7.II- 3.3**) shall be based on the difference between the pollutant load reduction achieved by the provided LID BMPs compared to the pollutant load reduction that would result from full implementation of LID BMPs. Pollutant load reduction achieved in treatment control BMPs that are provided per the criteria above may constitute all or part of this alternative compliance obligation. Equivalent loading calculations shall be based on the priority pollutant(s) of concern, if present. If no priority POCs exists, equivalent loading calculations shall be based on all POCs and the most stringent POC shall be used.

7.II–3.3 Waivers

Project proponents can apply for a waiver if it is determined to be infeasible to fulfill the LID performance requirements using either on-site LID practices, through regional LID approaches, through on-site treatment control BMPs in the NOC Permit Area, or through watershed approaches contained in an approved watershed management plans. Only those proposed projects that have completed a rigorous feasibility analysis as per the criteria described in **TGD Section 2.4.3** shall be considered for a BMP waiver. For projects in the NOC Permit Area, a Waiver Request is required if LID BMPs are infeasible and if the cost of BMP implementation greatly outweighs the pollution control benefits. For the SOC Permit Area, a Waiver Request is required if implementation of LID BMPs is technically infeasible.

Before a Permittee in North Orange County can approve an alternative compliance plan, a waiver request must be submitted to the Permittee for approval and to the Executive Officer of the Regional Water Quality Control Board in writing 30 days prior to approval by the Permittee. If the Executive Officer of the Regional Water Quality Control Board does not raise an objection to a waiver within 30 days, the Permittee may approve the waiver. Before approving a waiver and alternative compliance plan, the Permittee must determine that the Applicant's alternative compliance plan meets all criteria described in Section 7.II-3.4.

> *Permittees in South Orange County must develop, collectively or individually, a LID Waiver Program for incorporation into local SSMPs meeting the requirements of Section d(7) of the permit. A waiver application for an alternative compliance plan in accordance with the adopted program for a Project must be submitted for Permittee approval, which will be reported to the San Diego Regional Water Quality Control Board within the Permittee's annual stormwater program report.*

Each local jurisdiction is to use the feasibility criteria described in **TGD Section 2.4.2** to evaluate if Waiver Requests have adequately documented infeasibility. Each jurisdiction will identify in its Local Implementation Plan (LIP) or Jurisdictional Urban Runoff Management Plan the individual(s) or position(s) that is (are) authorized to review and approve Waivers.

Project proponents that have been granted a waiver must comply with requirements for the alternative compliance plan proposed by the Project Proponent and approved by the Permittee for the proposed project to mitigate potential negative impacts on the watershed due to the infeasibility of fully implementing LID BMPs.

Criteria for determining if it is technically infeasible to comply with LID BMP criteria through on-site or regional/sub-regional based approaches will need to be developed through a Watershed Plan.

7.II–3.4 Urban Runoff Funds / Mitigation Programs and Off-Site Mitigation Projects

7.II–3.4.1 Urban Runoff Funds / Mitigation Programs

For projects granted a LID BMP Waiver, participation in an urban runoff fund or mitigation program will be required. Payment into an urban runoff fund or mitigation program can be used to address the runoff volume or pollutant load that is not addressed through LID BMPs or other alternative compliance options including treatment control BMPs described above. When an approved urban runoff fund or mitigation program is available, participation in the program is allowable as long as the net effectiveness of the alternative program is the same or better than the project LID BMP design capture and/or WQ volume that would be achieved with on-site compliance. The following section describes a general basis and criteria for developing such programs. However, a specific program with established quantitative criteria and cost basis has not been established. It is expected that the Permittees will develop a specific program and submit this to the Executive Officer for future review and approval to allow specific projects to use this approach.

- In the NOC Permit Area, payment into a runoff fund or mitigation program can be an alternative to on-site treatment control if a waiver has been granted, or off-site mitigation.
- In the SOC Permit Area, payment into a runoff fund or mitigation program is an alternative to off-site mitigation, but must include implementing on-site treatment controls.

The amount of the contribution will be based on the unmet difference between the combination of the project LID BMP design capture and/or WQ volume that would be achieved through full compliance with on-site LID BMPs and the actual LID design capture volume that can be achieved through the combination of LID practices and treatment control BMPs that can be incorporated in the project. The basis for determining the "value" of the contribution will be determined by additional or future studies by the Permittees.

Certain types of projects may qualify for water quality credits that reduce the LID Design Storm Capture Volume for the project. The details of the credit program and a description of eligible projects can be found in **Section 7.II-3.1**. Projects proponents should determine if a project qualifies for credits as discussed in **Section 7.II-3.1** and subtract the credited volume from the unmet design capture volume. If the project can meet the reduced target volume through a combination of LID BMPs or Treatment Control BMPs, no contribution to an Urban Runoff Funds / or Mitigation Program is required. If there is still an unmet obligation even after applying credits, then a

contribution that needs to be made to an urban runoff fund or mitigation program as described above.

The urban runoff fund or mitigation fund must be expended for WQ improvement or other related projects. Examples of projects eligible for funding through an urban runoff/mitigation fund include, but are not limited to:

- Green street projects
- Projects which retrofit of existing development areas with LID and other BMPs to reduce existing pollutant loads
- Retrofit incentive programs
- Regional BMPs/Sub-Regional BMPs
- Stream restoration
- Projects which promote groundwater recharge to increase water supplies
- Other mitigation projects proposed by Permittees

7.II–3.4.2 Off-Site Mitigation Projects

For projects granted a LID BMP Waiver, an off-site mitigation project or alternative pollutant-reducing project may be considered when full compliance with LID options are determined infeasible. The project is not required to be upstream from the off-site mitigation, but the off-site mitigation must be implemented within the same hydrologic subarea as the proposed project. Off-site mitigation projects outside of the hydrologic subarea but within the same hydrologic unit may be developed for Permittee approval provided that the project proponent demonstrates that mitigation projects within the same hydrologic subarea are infeasible and that the mitigation project will address similar beneficial use impacts as expected from the proposed project's pollutant load types and amount. Off-site project BMPs should be located as close as possible to the project site and should address a similar mix of land uses to that proposed by the project. The off-site project shall not be located within waters of the US and it shall be demonstrated that equivalent pollutant removal is accomplished prior to discharge to waters of the US. Off-site mitigation projects may include:

- Green streets projects
- Existing development retrofit projects
- Retrofit incentive programs
- Regional BMPs
- Groundwater recharge programs
- Stream restoration

Other off-site mitigation techniques may be proposed to the Permittee for review and approval.

7.II–4.0 BMP Maintenance Requirements

A BMP Operation and Maintenance (O&M) Plan must be prepared as part of the Project WQMP (see **DAMP Section 7.6.6**) and a mechanism must be in place that will ensure ongoing long-term maintenance of all structural BMPs. This mechanism may be provided either through the local jurisdiction under a maintenance agreement or other mechanism, or by the project proponent as further described herein. As part of project review, if a project proponent is required to include interim or permanent structural BMPs in project plans, and if the local jurisdiction does not provide a mechanism for BMP maintenance, the local jurisdiction shall require that the applicant describe an approach to implement and maintain all BMPs included in approved Project WQMP through such means as may be appropriate, at the discretion of the local jurisdiction, including, but not limited to covenants, legal agreements, maintenance agreements, conditional use permits and/or funding arrangements.

7.II–4.1 Maintenance Mechanisms

The following are alternative mechanisms that may be used to provide on-going maintenance for the BMPs included in the approved Project WQMP.

Public entity maintenance: The local jurisdiction with the responsibility for WQMP approval may approve a WQMP that identifies a public or acceptable quasi-public entity (e.g., the City, the County, or County Flood Control District, an existing assessment district, an existing utility district, or a conservation conservancy) as assuming responsibility for operation, maintenance, repair and replacement of the BMP. Unless otherwise acceptable to individual local agencies, public entity maintenance agreements shall ensure estimated costs are front-funded or reliably guaranteed, (e.g., through a trust fund, assessment district fees, bond, letter of credit or similar means). In addition, the local jurisdictions may seek protection from liability by appropriate releases and indemnities.

- The Project Proponent must demonstrate that it will transfer the BMP maintenance to another public entity subject to the following provisions. The Project Proponent will negotiate maintenance requirements with the entity that it is proposing to accept maintenance responsibilities within its jurisdiction; and negotiate with the resource agencies responsible for issuing permits for the construction and/or maintenance of the facilities. If necessary, the public entity will also demonstrate through the CEQA review or the public entity's public review process that it can accept the maintenance responsibility. If a public entity is named as the responsible maintenance entity, then the local jurisdiction must include that entity in its CEQA review process as a Responsible Agency where applicable. The local jurisdiction must be identified as a third party beneficiary empowered to enforce any such maintenance agreement within their respective jurisdictions.

Project proponent agreement to maintain stormwater BMPs: The local jurisdiction may enter into a contract with the project proponent obliging the project proponent to maintain, repair and replace the stormwater BMP as necessary into perpetuity. Security or a funding mechanism with a "no sunset" clause may be required.

Assessment districts: The local jurisdiction may approve an Assessment District or other funding mechanism created by the project proponent to provide funds for stormwater BMP maintenance, repair and replacement on an ongoing basis. Any agreement with such a District shall be subject to the Public Entity Maintenance Provisions above.

Lease provisions: In those cases where the local jurisdiction holds title to the land in question, and the land is being leased to another party for private or public use, the local jurisdiction may assure stormwater BMP maintenance, repair and replacement through conditions in the lease.

Conditional use permits: For discretionary projects only, the local jurisdiction may assure maintenance of stormwater BMPs through the inclusion of maintenance conditions in the conditional use permit. Security may be required. Some jurisdictions include requirements to implement approved WQMPs in their municipal code.

Alternative mechanisms: The local jurisdiction may accept alternative maintenance mechanisms if such mechanisms are as protective as those listed above.

7.II–4.2 Maintenance Requirements

7.II–4.2.1 O&M Plan

An Operation and Maintenance Plan for the BMPs will be prepared and included as Section 5 of the final Project WQMP. The local jurisdiction shall ensure that the O&M plan, prepared by the project proponent satisfactory to the agency, is received prior to permit closeout and the issuance of certificates of use and occupancy. The O&M Plan describes the designated responsible party to manage the stormwater BMP(s), employee's training program and duties, operating schedule, maintenance frequency, routine service schedule, specific maintenance activities, copies of resource agency permits, and any other necessary activities.

The final Project WQMP shall require the project proponent or approved maintenance entity to complete and maintain O&M forms to document all maintenance requirements. Parties responsible for the O&M plan shall retain records for at least 5 years. These documents shall be made available to the local jurisdiction for inspection upon request at any time.

7.II–4.2.2 O&M Commitments

At a minimum, the final Project WQMP shall require the inspection and servicing of all structural BMPs on an annual basis.

As part of the maintenance mechanism selected above, the local jurisdiction shall require the inclusion of a copy of an executed access easement within the final Project WQMP that shall be binding on the land throughout the life of the project, until such time that the stormwater BMP requiring access is replaced, satisfactory to the local agency.

7.II–4.3 Permit Closeout Requirements

For discretionary projects, the method approved by local jurisdiction for stormwater BMP maintenance shall be incorporated into the project's permit, and shall be consistent with permits issued by resource agencies, if any. Just as with all other aspects of a project’s approved plans and designs, the local authority will make a determination that

all requirements of the Project WQMP have been satisfactorily completed prior to close-out of permits and issuance of certificates of use and occupancy (see **DAMP Section 7.6.6**).

For projects requiring only ministerial permits, the method approved by local jurisdiction for stormwater BMP maintenance shall be shown on the project plans before the issuance of any ministerial permits. Verification will occur similar to discretionary projects.

In all instances, the project proponent shall provide proof of execution of a method approved by local jurisdiction for maintenance, repair, and replacement (O&M Plan – See **DAMP Section 5.3**) before the issuance of construction approvals, permit closeout and issuance of certificates of use and occupancy. For all properties, the verification mechanism includes the project proponent's signed statement, as part of the Project WQMP, accepting responsibility for all structural BMP maintenance, repair and replacement or agreeing to an alternative mechanism that is approved by the local authority regarding maintenance, repair and replacement of the structural BMP. Local authorities implementing public projects that are not required to obtain permits shall be responsible for ensuring that stormwater BMP maintenance, repair and replacement requirements are identified prior to the completion of construction and incorporated into the agency's Municipal Activities Program under the DAMP.

7.II–5.0 WQMP Preparation And Approval

The preceding sections describe the requirements and process for developing site design, selecting the appropriate LID BMPs or other BMPs, and/or identifying other compliance approaches, and identifying the BMP maintenance requirements for Priority Projects. This section describes the process for documenting this information in a Conceptual or Preliminary WQMP, and/or Project WQMP, and for submitting and obtaining approval for the Project WQMP.

Project proponents are strongly encouraged to incorporate LID and hydromodification control BMPs at the earliest conceptual planning stages of a project for early review, to potentially avoid necessary project changes and delays during the review and approval process. For all projects requiring discretionary or land use entitlement actions, a Conceptual or Preliminary WQMP should be submitted as part of the application for project approval during the environmental review phase (CEQA) and must be submitted prior to relevant project-level approval of entitlements and Planning Commission approval of a project or other public hearing.

The local jurisdiction will assure that a final Project WQMP is submitted for review and approval prior to issuance of grading or building permits. The final Project WQMP must be prepared by or under the direction of a California Registered Civil Engineer and affixed with their stamp unless specifically exempted from this requirement by the Permittee.

7.II–5.1 Conceptual or Preliminary WQMP Preparation

To facilitate early WQ planning and ensure that WQ protection and LID principles are considered in the earliest phases of a project, a the local jurisdiction will suggest that the project proponent prepare a Conceptual or Preliminary WQMP prior to a complete or final Project WQMP for full review and approval. A Conceptual or Preliminary WQMP may be used by the local jurisdiction during the land use entitlement process or as part of a project application for discretionary project approval.

A Conceptual or Preliminary WQMP supports the CEQA process and provides documentation to support a checklist for an Initial Study and Negative Declaration or Mitigated Negative Declaration, or serves as the basis for the water quality section of an EIR. It should also serving as the basis for the Lead Agency and Responsible Agency to conclude that the MEP standard is being met, by serving as the basis that selected BMPs will not have the potential to cause significant effects and/or that the effects have been mitigated, and "are not significant with mitigation". The Conceptual or Preliminary WQMP should to be circulated with the CEQA document or summarized within the circulated CEQA document.

A WQMP Template has been produced to assist project proponents with developing a Conceptual or Preliminary WQMP (available at www.ocwatersheds.com). The level of detail in a Conceptual or Preliminary WQMP can vary somewhat upon the level of detail known at the time discretionary project approval is sought, but must contain at a minimum the following information:

- Local project identifier and description (application number, tentative tract number, review number, etc.)

- Site plan (tentative map, major project features, use exhibit, etc.) showing the following
  - Property or project boundaries
  - Locations of buildings, landscaping, streets, curb and gutter, storm drainage system, and other major project features
  - Direction of surface drainage
  - Existing easements
  - Surface waters
  - Areas of known or potential hazards such as landfills, soil and groundwater contamination, Alquist-Priolo fault zones, etc.
  - Other project features or activities that may generate pollutants such as wash racks, trash enclosures, fuelling areas, loading docks, etc.
- Preliminary site assessment information
  - Most proximate and downstream receiving waters and any impairments
  - POCs and primary POCs, and the related conclusions that are to be made from this information
  - Identification of any hydrologic conditions of concern and the supporting rationale
- LID feasibility analysis
- Proposed LID BMP selection rationale and supporting details and calculations (or sub-regional/regional LID BMPs if applicable)
- Proposed hydromodification control BMPs and calculations
- Proposed treatment control BMPs and calculations
- Any proposed project specific credits or alterative compliance methods planned
- Preliminary Source Control BMP information
- Proposed parties responsible for the long-term operation and maintenance of proposed BMPs
- Proposed funding mechanisms for the long-term operation and maintenance of the proposed BMPs
- The list of standard WQMP requirements as indicated earlier, including access easement, records to be kept, records retention, inspection frequencies, etc.

Local jurisdiction staff will review and evaluate the Conceptual / Preliminary Project WQMP for general acceptance and conceptual or preliminary approval, and will offer guidance toward plan elements necessary for approval of the full Project WQMP. Additional information and submittals may be necessary for conceptual or preliminary approval. It is the responsibility of the project proponent to provide the additional information for consideration by the local jurisdiction.

7.II–5.2 Final Project WQMP Preparation and Submittal

A completed Final Project WQMP should fully address site design measures, LID BMPs, hydromodification controls, source control BMPs, and treatment control BMPs (where applicable to the project) to address pollutants or hydrologic conditions of concern. If the project is participating in an alternative program such as a contribution to a Runoff Mitigation Fund or Participation in a Mitigation Program, the Project WQMP must describe and document the Project's participation. The Final Project WQMP, when prepared for submittal for approval, must be certified by the owner, and must include elements agreed upon at Conceptual or Preliminary WQMP acceptance and any revisions proposed. A WQMP Template has been produced to assist project proponents with developing a Project WQMP (available at www.ocwatersheds.com).

The Final Project WQMP must be consistent with the Conceptual or Preliminary WQMP. If there are any substantial differences, the local jurisdiction must make a determination that the differences do not diminish the effectiveness of the BMPs to mitigate or address the project's potential impacts to WQ. Furthermore, any changes must not result in any new environmental impacts not previously disclosed in the local jurisdiction's circulated environmental document(s). If the changes diminish the project's ability to mitigate or address its WQ impacts, or result in previously undisclosed environmental impacts, the local jurisdiction should require that the project be subject to further environmental review.

For review and approval, the completed Project WQMP must provide the information described within this Model WQMP, including but not limited to:

- Local project identifier and description (application number, tentative tract number, review number, etc.)
- Site plan (tentative map, major project features, use exhibit, etc.) showing the following
  - Property or project boundaries
  - Locations of buildings, landscaping, streets, curb and gutter, storm drainage system, and other major project features
  - Direction of surface drainage
  - Existing easements
  - Surface waters
  - Areas of known or potential hazards such as landfills, soil and groundwater contamination, Alquist-Priolo fault zones, etc.
  - Other project features or activities that may generate pollutants such as wash racks, trash enclosures, fuelling areas, loading docks, etc.
- Site assessment information
  - Most proximate and downstream receiving waters and any impairments
  - POCs and primary POCs and the related conclusions that are to be made from this information

  - Identification of any hydrologic conditions of concern and the supporting rationale
- Completed LID feasibility analysis
- LID BMP selection rationale and supporting details and calculations (or sub-regional/regional LID BMPs if applicable)
- Hydromodification control BMPs and calculations
- Treatment control BMPs and calculations
- Project specific credits taken to reduce the Design Storm Volume
- Source Control BMP information
- Identified parties responsible for the long-term operation and maintenance of proposed BMPs
- Identified funding mechanisms for the long-term operation and maintenance of the proposed BMPs
- The list of standard WQMP requirements as indicated earlier, including access easement, records to be kept, records retention, inspection frequencies, etc.
- A waiver request, if applicable
- If the project is participating in a regional or sub-regional LID project, contributing to a Runoff Mitigation Fund, or participating in a Mitigation Project, documentation and description of the program, and the Project's contribution to the program.

The completed Project WQMP is to be submitted to the local jurisdiction for review and approval. Any changes to WQMP elements agreed upon at the Conceptual or Preliminary WQMP phase should be noted within the Project WQMP submitted for final approval.

Local jurisdiction staff will review the submittal for acceptance and approval. Reviews will be documented by the local jurisdiction. Additional information and submittals may be necessary for final approval. It is the responsibility of the project proponent to provide the additional information for consideration by the local jurisdiction.

Once a project reaches the plan check phase, the project proponent must submit a completed Project WQMP for Priority Projects (or a Non-Priority Project Water Quality Plan for qualifying Non-Priority Projects) since the construction plans submitted by the project proponent for plan check must incorporate all of the structural BMPs identified in the Project WQMP (or Non-Priority Project Water Quality Plan). Local jurisdictions may encourage (but not necessarily require) project proponents to obtain approval of the project's final Project WQMP or Non-Priority Project Water Quality Plan prior to submitting construction plans for plan check. Building or grading permits for qualifying Priority or Non-Priority Projects will not be issued until the Project WQMP or Non-Priority Project Water Quality Plan has been submitted and approved.

The Project WQMP will be stored within local jurisdiction files, and will continue with the property after the completion of the construction phase, and a local jurisdiction may

require that the terms, conditions and requirements be recorded with the County Recorder's office by the property owner or any successive owner as authorized by the Water Quality Ordinance. In lieu of recordation, a local jurisdiction may require the Project WQMP to include a Notice of Transfer Responsibility Form, which serves to notify the local jurisdiction that a change in ownership has occurred and notify the new owner of its responsibility to continue implementing the Project WQMP.

7.II–5.3 Location Map, Plot Plan, and BMP Details

The Project WQMP should contain a location map showing the project site and surroundings in sufficient detail to allow the project location to be plotted on a base map. Project proponents should submit the plot plan with BMP details in electronic drawing or GIS format. The Project WQMP should also contain a plot plan showing proposed improvements to the property. The plot plan shall include the following project features:

- Each facility and its intended function (if multiple facilities and uses are present onsite)
- Areas of outdoor activities (if applicable)
- Applicable Structural Source Control BMPs and any Treatment Control BMPs
- Drainage flow information
- Storm drain facilities
- Relationship between onsite drainage and offsite drainage

The plot plan must contain the following labels:

- Title Block
  - Drainage Plot Plan
  - Project Name
  - Address
  - Owner
- Legend
- North Arrow
- Scale

The Project WQMP should contain plans and details related to the BMPs that will be included.

7.II–5.4 Educational Materials

The Project WQMP should reference standard educational materials that are applicable to the nature of the project relating to the type of development and practices that may occur on the site. Standard educational materials can be found on the Orange County Watersheds website at www.ocwatersheds.com and referenced in the Project WQMP. Any materials that are specific to the project and not included in the standard materials must be included in the Project WQMP.

7.II–6.0 Resources And References

Additional information can be obtained within the following references.

Low Impact Development Manual for Southern California: Technical Guidance and Site Planning Strategies	California State Water Resources Control Board and Low Impact Development Center, 2009
Stormwater C.3 Guidebook: Stormwater Quality Requirements for Development Applications, Fourth Edition	Contra Costa Clean Water Program, September 10, 2008
Better Site Design: A Handbook for Changing Development Rules in Your Community (1998) Presents guidance for different model development alternatives.	Center for Watershed Protection 8391 Main Street Ellicott City, MD 21043 410-461-8323 www.cwp.org
Green Streets: A Conceptual Guide to Effective Green Streets Design Solutions	USEPA, 2009
California Urban Runoff Best Management Practices Handbooks (1993) for Construction Activity, Municipal, and Industrial/Commercial Presents a description of a large variety of Structural BMPs, Treatment Control, BMPs and Source Control BMPs	Los Angeles County Department of Public Works Cashiers Office 900 S. Fremont Avenue Alhambra, CA 91803 626-458-6959
Caltrans Urban runoff Quality Handbook: Planning and Design Staff Guide (Best Management Practices Handbooks (1998) Presents guidance for design of urban runoff BMPs	California Department of Transportation P.O. Box 942874 Sacramento, CA 94274-0001 916-653-2975
Design and Construction of Urban Stormwater Management Systems, American Society of Civil Engineers (ASCE) Manuals and	ASCE
Effect of urban soil compaction on infiltration rate; Gregory, J.H.; Dukes, M.D.; Jones, P.H.; and G.L. Miller, 2006.	Journal of Soil and Water Conservation 2006 61(3):117-124
Reports on Engineering Practice No. 77/ Water Environment Federation (WEF) Manual of Practice FD-20, 1992.	WEF
Design Manual for Use of Bioretention in Stormwater Management (1993) Presents guidance for designing bioretention facilities.	Prince George's County Watershed Protection Branch 9400 Peppercorn Place, Suite 600 Landover, MD 20785

Design of Stormwater Filtering Systems (1996) by Richard A. Claytor and Thomas R. Schuler Presents detailed engineering guidance on ten different urban runoff-filtering systems.	Center for Watershed Protection 8391 Main Street Ellicott City, MD 21043 410-461-8323
Development Planning for Stormwater Management, A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), (May 2000)	Los Angeles County Department of Public Works http://dpw.co.la.ca.us/epd/ or http://www.888cleanLA.com
Florida Development Manual: A Guide to Sound Land and Water Management (1988) Presents detailed guidance for designing BMPs	Florida Department of the Environment 2600 Blairstone Road, MailStation 3570 Tallahassee, FL 32399 850-921-9472
Guidance Manual for On-Site Stormwater Quality Control Measures, Sacramento Stormwater Management Program.	City of Sacramento Department of Utilities and County of Sacramento Water Resources Division. January 2000.
Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters (1993) Report No. EPA–840-B-92-002. Provides an overview of, planning and design considerations, programmatic and regulatory aspects, maintenance considerations, and costs.	National Technical Information Service US Department of Commerce Springfield, VA 22161 800-553-6847
Guide for BMP Selection in Urban Developed Areas (2001)	ASCE Envir. and Water Res. Inst. 1801 Alexander Bell Dr. Reston, VA 20191-4400 (800) 548-2723
Low-Impact Development Design Strategies - An Integrated Design Approach (June 1999)	Prince George's County, Maryland Department of Environmental Resource Programs and Planning Division 9400 Peppercorn Place Largo, Maryland 20774 http://www.co.pg.md.us/Government/DER/PPD/pgcounty/lidmain.htm
Maryland Stormwater Design Manual (1999) Presents guidance for designing urban runoff BMPs	Maryland Department of the Environment 2500 Broening Highway Baltimore, MD 21224 410-631-3000
Methodology for Analysis of Detention Basins for Control of Urban Runoff Quality, Environmental Protection Agency (EPA-440/5-87-001).	
National Stormwater Best Management Practices (BMP) Database, Version 1.0 Provides data on performance and evaluation of urban runoff BMPs	American Society of Civil Engineers 1801 Alexander Bell Drive Reston, VA 20191 703-296-6000

National Stormwater Best Management Practices Database (2001)	Urban Water Resources Research Council of ASCE Wright Water Engineers, Inc. (303) 480-1700
Operation, Maintenance and Management of Stormwater Management (1997) Provides a thorough look at stormwater practices including, planning and design considerations, programmatic and regulatory aspects, maintenance considerations, and costs.	Watershed Management Institute, Inc. 410 White Oak Drive Crawfordville, FL 32327 850-926-5310
Potential Groundwater Contamination from Intentional and Non-Intentional Stormwater Infiltration	Report No. EPA/600/R-94/051, USEPA (1994).
Preliminary Data Summary of Urban runoff Best Management Practices (August 1999) EPA-821-R-99-012	http://www.epa.gov/ost/stormwater/
Reference Guide for Stormwater Best Management Practices (July 2000)	City of Los Angeles Urban runoff Management Division 650 South Spring Street, 7th Floor Los Angeles, California 90014 http://www.lacity.org/san/swmd/
Second Nature: Adapting LA's Landscape for Sustainable Living (1999) by Tree People Detailed discussion of BMP designs presented to conserve water, improve water quality, and to achieve flood protection.	Tree People 12601 Mullholland Drive Beverly Hills, CA 90210 (818) 623-4848 Fax (818) 753-4625
Site Planning for Urban Stream Protection, Department of Environmental Programs, Metropolitan Washington Council of Governments	
Start at the Source (1999) Detailed discussion of permeable pavements and alternative driveway designs presented.	Bay Area Stormwater Management Agencies Association 2101 Webster Street Suite 500 Oakland, CA 510-286-1255
Stormwater, Grading and Drainage Control Code, Seattle Municipal Code Section 22.800-22.808, and Director's Rules, Volumes 1-4. (Ordinance 119965, effective July 5, 2000)	City of Seattle Department of Design, Construction & Land Use 700 5th Avenue, Suite 1900 Seattle, WA 98104-5070 (206) 684-8880 http://www.ci.seattle.wa.us/dclu/Codes/sgdccode.htm

Stormwater Management in Washington State (1999) Vols. 1-5 Presents detailed guidance on BMP design for new development and construction.	Department of Printing State of Washington Department of Ecology P.O. Box 798 Olympia, WA 98507-0798 360-407-7529
The Stormwater Manager's Resource Center. This is a comprehensive site with information on BMP design and sizing. http://www.stormwatercenter.com	Stormwater Pollution Control, Municipal, Industrial and Construction NPDES Compliance, Second Edition. Roy D. Dodson, P.E., 1999.
Texas Nonpoint Source Book – Online Module (1998)www.txnpsbook.org Presents BMP design and guidance information on-line	Texas Statewide Urban runoff Quality Task Force North Central Texas Council of Governments 616 Six Flags Drive Arlington, TX 76005 817-695-9150
The Practice of Watershed Protection by Thomas R. Schueler and Heather K. Holland	Center for Watershed Protection 8391 Main Street Ellicott City, MD 21043 410-461-8323 www.cwp.org
Urban Runoff Quality Management, American Society of Civil Engineers (ASCE) Manual and Report on Engineering Practice No. 87/Water Environment Federation (WEF) Manual of Practice No.23, 1998.	
Urban Storm Drainage, Criteria Manual – Volume 3, Best Management Practices (1999) Presents guidance for designing BMPs	Urban Drainage and Flood Control District 2480 West 26th Avenue, Suite 156-B Denver, CO 80211 303-455-6277

APPENDIX A
Acronyms and Glossary

A.1 Acronyms

BMP – Best Management Practice

CEQA - California Environmental Quality Act

CWA – Federal Clean Water Act

DAMP – Drainage Area Management Plan

ESA – Environmentally Sensitive Area

ET – Evapotranspiration

HCOC – Hydrologic Condition of Concern

HMP – Hydromodification Management Plan

HSC – Hydrologic Source Control

LID – Low Impact Development

LIP – Local Implementation Plan

MEP – Maximum Extent Practicable

NOC – North Orange County (Region 8- SARWQCB Jurisdictional Area)

NPDES – National Pollutant Discharge Elimination System

POC – Pollutant of Concern

RWQCB – Regional Water Quality Control Board

SARWQCB – Santa Ana Regional Water Quality Control Board

SDRWQCB – San Diego Regional Water Quality Control Board

SOC – South Orange County (Region 9 -SDRWQCB Jurisdictional Area)

SSMP – Standard Stormwater Mitigation Plan

TGD – Technical Guidance Document

WIHMP – Watershed Infiltration and Hydromodification Master Plan

WQ – Water Quality

WQDV – Water Quality Design Volume

WQMP – Water Quality Management Plan

A.2 Glossary of Key Terms

Alternative compliance program – encompasses the elements used to satisfied remaining performance criteria after on-site LID BMPs have been implemented to the maximum feasible level (and in North Orange County, after both on-site and sub-regional/regional LID BMPs have been implemented to the maximum feasible level).

Average annual capture efficiency (a.k.a. capture efficiency) – the estimated percent of long term average annual runoff volume that is managed/controlled by a BMP. Target capture efficiency serves as one element of the performance criteria for LID and treatment control BMPs.

Biotreatment BMP – a class of LID BMPs, biotreatment BMPs are vegetated treat-and-release BMPs that also promote infiltration and/or evapotranspiration.

Biotreatment volume – the volume of storage in biotreatment BMPs, measured from the overflow elevation of the BMP outlet, which would be treated and discharged as the BMP drains; this volume includes surface storage and pore storage but does not include the volume that would be retained in the BMP and discharged to infiltration, ET, or uses.

Conceptual Project WQMP - a Project WQMP prepared at the planning phase of projects subject to discretionary approval; intended to describe, at the earliest possibly phase in the development process, the BMPs that will be implemented and maintained throughout the project (functionally equivalent to a Preliminary Project WQMP; nomenclature varies by local jurisdiction).

Design capture storm depth – the 85th percentile, 24-hr storm depth.

Design Capture Volume – the volume of storm water runoff resulting from the design capture storm depth.

Design criteria – requirements that serve as the basis for designing a BMP to meet performance criteria. Design criteria may encompass BMP sizing and other characteristics of BMP design.

Drainage Area Management Plan (DAMP) – The specific water pollutant control elements of the Orange County Stormwater Program are documented in the Drainage Area Management Plan (DAMP), which is the Permittees' primary policy, planning and implementation document for municipal NPDES Stormwater Permit compliance.

Drawdown – the act of discharging water from a BMP. Drawdown provides storage volume for subsequent storm events.

Drawdown rate – the rate at which water discharges from a BMP, making storage volume available for subsequent storm events.

Environmentally Sensitive Areas – areas such as those designated in the Ocean Plan as Areas of Special Biological Significance or waterbodies listed on the CWA Section 303(d) list of impaired waters.

Evapotranspiration (ET) - the loss of water to the atmosphere by the combined processes of evaporation (from water, soil and plant surfaces) and transpiration (from

plant tissues). As used in this TGD, evapotranspiration refers to one or both of these processes.

Evapotranspiration BMP (aka ET BMP) – a class of retention BMPs that discharges stored volume predominantly to evapotranspiration; some infiltration may occur. Evapotranspiration includes both evaporation and transpiration, and ET BMPs may incorporate one or more of these processes.

Final Project WQMP – a Project WQMP submitted at the ministerial approval phase prior to final approval of a grading or building permit; expected to reflect the detail available at the time of project ministerial-level approval.

Harvest and Use – The process of capturing rainwater or stormwater runoff, storing it, and making it available for subsequent use. This process is performed by Harvest and Use BMPs.

Harvest and Use BMP (aka Rainwater Harvesting BMP) – a class of retention BMPs that captures rainwater or stormwater runoff and stores it for subsequent use.

Hydrologic condition of concern – a combination of upland hydrologic conditions and stream biological and physical conditions that presents a condition of concern for physical and/or biological degradation of a stream.

Hydromodification – Changes in runoff and sediment yield caused by land use modifications.

Hydromodification control – Management techniques which reduce the potential for hydromodification impact.

Hydromodification impact – The physical response of stream channels to changes in runoff and sediment yield caused by land use modifications

Infiltration BMP – a class of retention BMPs that discharges stored volume predominantly to deeper percolation/infiltration; some evapotranspiration may also occur.

LID BMP – a BMP that provides retention or biotreatment as part of an LID strategy – these may include hydrologic source controls, retention, and biotreatment BMPs.

LID site design – The component of LID that relates to the way in which a site is laid out to achieve strategic stormwater management and resource management objectives. Site design practices work synergistically with LID BMPs, treatment control, and hydromodification control strategies. Example practices include minimizing impervious areas and locating pervious areas such that impervious areas can drain to pervious areas.

Liquefaction - a seismically-induced geological hazard that can result in damage to structures as a result in reduction in bulk volume of saturated granular soils.

Local Implementation Plan (LIP) - The Local Implementation Plan (LIP) describes how the DAMP is being implemented by individual permittees under the MS4 Permit. The DAMP provides a foundation for the description and detail of how the Orange County Stormwater Permittees commonly implement model programs designed to prevent pollutants from entering receiving waters to the maximum extent practicable (MEP). The

LIP is designed to supplement the DAMP and each city and the County have developed a comprehensive LIP that is specific to their jurisdiction.

Non-Priority Project – New development or significant redevelopment projects that are not Priority Projects are considered Non-Priority Projects. Non-Priority Projects are projects that do not fall under one of the priority Project categories and also require discretionary action or issue of non-residential plumbing permit. Requirements for Non-Priority Projects are contained in a separate Non-Priority Project Water Quality Plan that serves as basis for completing a project-specific plan that is described in the DAMP and is available from the applicable Permittee.

On-site LID practices – LID practices that are implemented within the project boundary.

Performance criteria – specific measurable or verifiable requirements against which the performance of a system is compared to assess compliance with a Project WQMP, the Model WQMP, and the Permit. There are three separate types of performance criteria: 1) LID, 2) treatment control, and 3) hydromodification control. These performance criteria are evaluated individually although they can be interrelated. It is possible to meet one and not meet the others. This is synonymous with "performance standard" as used by other guidance documents, but only "performance criteria" is used in this document.

Preliminary Project WQMP – a Project WQMP prepared at the planning phase of projects subject to discretionary approval; intended to describe, at the earliest possibly phase in the development process, the BMPs that will be implemented and maintained throughout the project (functionally equivalent to a Conceptual Project WQMP; nomenclature varies by local jurisdiction).

Priority Project – a new development or redevelopment project meeting the thresholds described in **Section 7.II-1.2**.

Retention BMP – a class of LID BMPs including infiltration BMPs, evapotranspiration BMPs, and harvest and use BMPs whose design does not allow the discharge of stormwater runoff to the storm drainage system or surface water up to the DCV ; these BMPs either infiltration, evapotranspire, or allow for use of the retention volume.

Retention volume – the volume of storage in retention and biotreatment BMPs, measured from the overflow elevation of the BMP, which would be retained and discharged to infiltration, ET, or uses as the BMP drains. All storage volume is retention volume in retention BMPs.

Sizing criteria – specific design criteria related to BMP size that serve as a basis for meeting performance criteria.

Standard Stormwater Mitigation Plan (SSMP) – See Project WQMP

Treatment control BMP – a structure designed to treat pollutants in stormwater runoff and release the treated runoff to surface waters or a storm drain system, but is not a biotreatment BMP. Examples include sand filters and cartridge media filters.

Waiver – Process by which project proponents must document and submit a request to implement alternative requirements if it is determined to be infeasible to fulfill the on-site LID performance requirements.

Water quality credit system – the system by which certain project types are granted reduction in the criteria for determining treatment control and/or offsite mitigation requirements for alternative program requirements.

APPENDIX B
EPA Green Streets Manual

Managing Wet Weather with Green Infrastructure

Municipal Handbook

Green Streets

Managing Wet Weather with Green Infrastructure

Municipal Handbook

Green Streets

prepared by

Robb Lukes
Christopher Kloss
Low Impact Development Center

The Municipal Handbook is a series of documents
to help local officials implement green infrastructure in their communities.

December 2008

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Front Cover Photos
Top: rain garden; permeable pavers; rain barrel;
planter; tree boxes.
Large photo: green alley in Chicago

Green Streets

Introduction

By design and function, urban areas are covered with impervious surfaces: roofs, roads, sidewalks, and parking lots. Although all contribute to stormwater runoff, the effects and necessary mitigation of the various types of surfaces can vary significantly. Of these, roads and travel surfaces present perhaps the largest urban pollution sources and also one of the greatest opportunities for green infrastructure use.

The Federal Highway Administration (FHA) estimates that more than 20% of U.S. roads are in urban areas.[1] Urban roads, along with sidewalks and parking lots, are estimated to constitute almost two-thirds of the total impervious cover and contribute a similar ratio of runoff.[2] While a significant source of runoff, roads are also a part of the infrastructure system, conveying stormwater along gutters to inlets and the buried pipe network. Effective road drainage, translated as moving stormwater into the conveyance system quickly, has been a design priority while opportunities for enhanced environmental management have been overlooked especially in the urban environment.

Table 1. Examples of Stormwater Pollutants Typical of Roads.[3, 4]

Pollutant	Source	Effects
Trash	---	Physical damage to aquatic animals and fish, release of poisonous substances
Sediment/solids	Construction, unpaved areas	Increased turbidity, increased transport of soil bound pollutants, negative effects on aquatic organisms reproduction and function
Metals • Copper • Zinc • Lead • Arsenic	 • Vehicle brake pads • Vehicle tires, motor oil • Vehicle emissions and engines • Vehicle emissions, brake linings, automotive fluids	Toxic to aquatic organisms and can accumulate in sediments and fish tissues
Organics associated with petroleum (e.g., PAHs)	Vehicle emissions, automotive fluids, gas stations	Toxic to aquatic organisms
Nutrients	Vehicle emissions, atmospheric deposition	Promotes eutrophication and depleted dissolved oxygen concentrations

The altered flow regime from traditional roadways, increased runoff volume, more frequent runoff events, and high runoff peak flows, are damaging to the environment and a risk to property downstream. These erosive flows in receiving streams will cause down cutting and channel shifting in some places and excessive sedimentation in others. The unnatural flow regime destroys stream habitat and disrupts aquatic systems.

Compounding the deliberate rapid conveyance of stormwater, roads also are prime collection sites for pollutants. Because roads are a component of the stormwater conveyance system, are impacted by atmospheric deposition, and exposed to vehicles, they collect a wide suite of pollutants and deliver them into the conveyance system and ultimately receiving streams (See Table 1). The metals, combustion by-products, and automotive fluids from vehicles can present a toxic mix that combines with the ubiquitous nutrients, trash, and suspended solids.

While other impervious surfaces can be replaced, for example using green roofs to decrease the amount of impervious roof surface, for the most part, impervious roads will, for some time to come, constitute a significant percentage of urban imperviousness because of their current widespread existence. Reducing road widths and other strategies to limit the amount of impervious surface are critical, but truly addressing road runoff requires mitigating its effects.

Green Streets achieve multiple benefits, such as improved water quality and more livable communities, through the integration of stormwater treatment techniques which use natural processes and landscaping.

Roads present many opportunities for green infrastructure application. One principle of green infrastructure involves reducing and treating stormwater close to its source. Urban transportation right-of-ways integrated with green techniques are often called "green streets". Green streets provide a source control for a main contributor of stormwater runoff and pollutant load. In addition, green infrastructure approaches complement street facility upgrades, street aesthetic improvements, and urban tree canopy efforts that also make use of the right-of-way and allow it to achieve multiple goals and benefits. Using the right-of-way for treatment also links green with gray infrastructure by making use of the engineered conveyance of roads and providing connections to conveyance systems when needed.

Green streets are beneficial for new road construction and retrofits. They can provide substantial economic benefits when used in transportation applications. Billions of dollars are spent annually on road construction and rehabilitation, with a large percentage focused on rehabilitation especially in urban areas. Coordinating green infrastructure installation with broader transportation improvements can significantly reduce the marginal cost of stormwater management by including it within larger infrastructure improvements. Also, and not unimportantly, right-of-way installations allow for easy public maintenance. A large municipal concern regarding green infrastructure use is maintenance; using roads and right-of-ways as locations for green infrastructure not only addresses a significant pollutant source, but also alleviates access and maintenance concerns by using public space.

In urban areas, roads present many opportunities for coordinated green infrastructure use. Some municipalities are capitalizing on the benefits gained by introducing green infrastructure in transportation applications. This paper will evaluate programs and policies that have been used to successfully integrate green infrastructure into roads and right-of-ways.

Green Street Designs

Green streets can incorporate a wide variety of design elements including street trees, permeable pavements, bioretention, and swales. Although the design and appearance of green streets will vary, the functional goals are the same: provide source control of stormwater, limit its transport and pollutant conveyance to the collection system, restore predevelopment hydrology to the extent possible, and provide environmentally enhanced roads. Successful application of green techniques will encourage soil and vegetation contact and infiltration and retention of stormwater.

Alternative Street Designs (Street Widths)

A green street design begins before any BMPs are considered. When building a new street or streets, the layout and street network must be planned to respect the existing hydrologic functions of the land (preserve wetlands, buffers, high-permeability soils, etc.) and to minimize the impervious area. If retrofitting or redeveloping a street, opportunities to eliminate unnecessary impervious area should be explored.

Implementation Hurdles
Many urban and suburban streets, sized to meet code requirements for emergency service vehicles and provide a free flow of traffic, are oversized for their typical everyday functions. The Uniform Fire Code requires that streets have a *minimum 20 feet of unobstructed width;* a street with parking on both sides would require a width of at least 34 feet. In addition to stormwater concerns, wide streets have many detrimental implications on neighborhood livability, traffic conditions, and pedestrian safety.[5]

Oregon State Code Granting Authority for Street Standards to Local Government

ORS 92.044 - Local governments shall *supersede and prevail over any specifications and standards for roads and streets set forth in a uniform fire code adopted by the State Fire Marshal, a municipal fire department or a county firefighting agency….* Local governments shall consider the needs of the fire department or fire-fighting agency when adopting the final specifications and standards.

The Transportation Growth and Management Program of Oregon, through a Stakeholder Design Team, developed a guide for reducing street widths titled the *Neighborhood Street Design Guidelines.*[6] The document provides a helpful framework for cities to conduct an inclusive review of street design profiles with the goal of reducing widths. Solutions for accommodating emergency vehicles while minimizing street widths are described in the document. They include alternative street parking configurations, vehicle pullout space, connected street networks, prohibiting parking near intersections, and smaller block lengths.

Figure 1. The street-side swale and adjacent porous concrete sidewalk are located in the High Point neighborhood of Seattle, WA
(Source: Abby Hall, US EPA).

In 1997, Oregon, which has adopted the *Uniform Fire Code,* specifically granted local government the authority to establish alternative street design standards but requires them to consult with fire departments before standards are adopted. Table 2 provides examples of alternative street widths allowed in U.S. jurisdictions.[7]

Swales

Swales are vegetated 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 and soil filtration, and reduce flow velocity by increasing channel roughness. In the simple roadside grassed form, they have been a common historical component of road design. Additional benefit can be attained through more complex forms of swales, such as those with amended soils, bioretention soils, gravel storage areas, underdrains, weirs, and thick diverse vegetation.

Implementation Hurdles
There is a common misconception of open channel drainage being at the bottom of a street development hierarchy in which curb and gutter are at the top. Seattle's Street Edge Alternative Project and other natural drainage swale pilot projects have demonstrated that urban swales not only mitigate stormwater impacts, but they can also enhance the urban environment.[8]

Table 2. Examples of Alternative Street Widths

Jurisdiction	Street Width	Parking Condition
Phoenix, AZ	28'	parking both sides
Santa Rosa, CA	30' 26'-28' 20' 20'	parking both sides, <1000ADT parking one side no parking neck downs @ intersection
Orlando, FL	28' 22'	parking both sides, res. Lots<55' wide parking both sides, res. Lots>55' wide
Birmingham, MI	26' 20'	parking both sides parking one side
Howard County, MD	24'	parking unregulated
Kirkland, WA	12' 20' 24' 28'	alley parking one side parking both sides – low density only parking both sides
Madison, WI	27' 28'	parking both sides, <3DU/AC parking both sides, 3-10 DU/AC

ADT: Average Daily Traffic DU/AC: dwelling units per acre

Bioretention Curb Extensions and Sidewalk Planters

Bioretention is a versatile green street strategy. Bioretention features can be tree boxes taking runoff from the street, indistinguishable from conventional tree boxes. Bioretention features can also be attractive attention grabbing planter boxes or curb extensions. Many natural processes occur within bioretention cells: infiltration and storage reduces runoff volumes and attenuates peak flows; biological and chemical reactions occur in the mulch, soil matrix, and root zone; and stormwater is filtered through vegetation and soil.

Figure 2. This bioretention area takes runoff from the street through a trench drain in the sidewalk as well as runoff from the sidewalk through curb cuts
(Source: Abby Hall, US EPA).

Implementation Hurdles

A few municipal DOT programs have instituted green street requirements in roadway projects, but as of yet, specifications for street bioretention have not yet been incorporated into municipal DOT specifications. Many cities do have street bioretention pilot projects; two of the well documented programs are noted in the table. Several concerns and considerations have prevented standard implementation of bioretention by DOTs.

Table 3. Municipalities with Swale Specifications and Standard Details

Municipality	Document	Section Title	Section #
City of Austin[9]	Standard Specifications and Standard Details	Grass-Lined Swale and Grass-Lined Swale with Stone Center	627S
City of Seattle[10]	2008 Standard Specifications for Municipal Construction	Natural Drainage Systems	7-21

Table 4. Municipalities with Bioretention Pilot Projects in the Right-of-Way

Municipality	Bioretention Type	Document
Maplewood, MN	Rain gardens	*Implementing Rainwater in Urban Stormwater Management* [11]
Portland, OR	• Curb extensions • Planters • Rain gardens	*2006 Stormwater Management Facility Monitoring Report* [12]

The diversity of shapes, sizes, and layouts bioretention can take is a significant obstacle to their incorporation with DOT specifications and standards. Street configurations, topography, soil conditions, and space availability are some of the factors that will influence the design of the bioretention facility. These variables make documentation of each new bioretention project all the more important. By building a menu of templates from local bioretention projects, future projects with similar conditions will be easier to implement and cost less to design. The documentation should include copies of the details and specifications for the materials used. A section on construction and operation issues, costs, lessons learned, and recommendations for similar designs should also be included in project documentation. Portland's Bureau of Environmental Services has proven adept at documenting each of its Green Streets projects and making them accessible online.[13]

Utilities are a chief constraint to implementing bioretention as a retrofit in urban areas. The Prince George's County, MD Bioretention Design Specifications and Criteria manual recommends applying the same clearance criteria recommended for storm drainage pipes.[14] Municipal design standards should specify the appropriate clearance from bioretention or allowable traversing.

Prince George's County, MD - 2.12.1.16 Utility Clearance

Utility clearances that apply to storm drainage pipe and structure placement also apply to bioretention. Standard utility clearances for storm drainage pipes have been established at 1' vertical and 5' horizontal. However, bioretention systems are shallow, non-structural IMP's consisting of mostly plant and soil components, (often) with a flexible underdrain discharge pipe. For this reason, other utilities may traverse a bioretention facility without adverse impact. Conduits and other utility lines may cross through the facility but construction and maintenance operations must include safeguard provisions. In some instances, bioretention could be utilized where utility conflicts would make structural BMP applications impractical.

Plants are another common concern of municipal staff, whether it is maintenance, salt tolerance, or plant height with regard to safety and security. Cities actively implementing LID practices in public spaces maintain lists of plants which fit the vegetated stormwater management practice niche. These are plants that flourish in the regional climate conditions, are adapted to periodic flooding, are low maintenance, and, if in cold climates, salt tolerant. Most often these plants are natives, but sometimes an approved non-native will best fit necessary criteria. A municipal plant list should be periodically updated based on maintenance experience, and vegetation health surveys.

Permeable Pavement

Permeable pavement comes in four forms: permeable concrete, permeable asphalt, permeable interlocking concrete pavers, and grid pavers. Permeable concrete and asphalt are similar to their impervious counterparts but are open graded or have reduced fines and typically have a special binder added. Methods for pouring, setting, and curing these permeable pavements also differ from the impervious versions. The concrete and grid pavers are modular systems. Concrete pavers are installed with gaps between them that allow water to pass through to the base. Grid pavers are typically a durable plastic matrix that can be filled with gravel or vegetation. All of the permeable pavement systems have an aggregate base in common which provides structural support, runoff storage, and pollutant removal through filtering and adsorption. Aside from a rougher unfinished surface, permeable concrete and asphalt look very similar to their impervious versions. Permeable concrete and asphalt and certain permeable concrete pavers are ADA compliant.

Implementation Hurdles

Of all the green streets practices, municipal DOTs have been arguably most cautious about implementing permeable pavements, though it should be noted that some DOTs have, for decades, specified open-graded asphalt for low use roadways because of lower cost; to minimize vehicle hydroplaning; and to reduce road noise. The reticence to implement on a large-scale, however, is understandable given the lack of predictability and experience behind impervious pavements. However, improved technology, new and ongoing research, and a growing number of pilot projects are dispelling common myths about permeable pavements.

Figure 3. Pervious pavers used in the roadway of a neighborhood development in Wilsonville, OR *(Source: Abby Hall, US EPA).*

The greatest concern among DOT staff seems to be a perceived lack of long-term performance and maintenance data. Universities and DOTs began experimenting with permeable pavements in parking lots, maintenance yards, and pedestrian areas as early as twenty years ago in the U.S., even earlier in Europe. There is now a wealth of data on permeable pavements successfully used for these purposes in nearly every climate region of the country. In recent years, the cities of Portland, OR, Seattle, WA, and Waterford, CT and several private developments have constructed permeable pavement pilots within the roadway with positive results.

> Permeable pavement concerns in the roadway often raise concerns of safety, maintenance, and durability. Municipalities can replace impervious surfaces in other non-critical areas such as sidewalks, alleys, and municipal parking lots. These types of applications help municipalities build experience and a market for the technology.

The two typical maintenance activities are periodic sweeping and vacuuming. The City of Olympia, WA has experimented with several methods of clearing debris from permeable concrete sidewalks. Each of the methods was evaluated on the ease of use, debris removal, and the performance pace. The cost analysis by Olympia, WA found that the maintenance cost for pervious pavement was still lower than the traditional pavement when the cost of stormwater management was considered.

Table 5. Municipalities with Permeable Pavement Specifications and Standard Details

Municipality	Document	Section Title	Section #
Portland	2007 Standard Construction Specifications	Unit Pavers (includes permeable pavers)	00760
Olympia	WSDOT Specification	Pervious Concrete Sidewalks	8-30

Freeze/thaw and snow plows are the major concerns for permeable pavements in cold climate communities. However, these concerns have proven to be generally unwarranted when appropriate design and maintenance practices are employed. A well designed permeable pavement structure will always drain and never freeze solid. The air voids in the pavement allow plenty of space for moisture to freeze and ice crystals to expand. Also, rapid drainage through the pavement eliminates the occurrence of freezing puddles and black ice. Cold climate municipalities will need to make adjustments to snow plowing and deicing programs for permeable pavement areas. Snow plow blades must be raised enough to prevent scraping the surface of permeable pavements, particularly paver systems. Also, sand should not be applied.

Table 6. A Study in Olympia, WA Comparison of the cost of permeable concrete sidewalks to the cost of traditional impervious sidewalks[15]

Traditional Concrete Sidewalk		Permeable Concrete Sidewalk	
Construction Cost	Maintenance Cost	Construction Cost	Maintenance Cost
$5,003,000*	$156,000	$2,615,000*	$147,000
Total = $5,159,000 $101.16 per square yard		Total = $2,762,000 $54.16 per square yard	

*The cost of stormwater management (stormwater pond) for the added impervious surface is factored into the significantly higher cost of constructing the traditional concrete sidewalk. Maintenance of the stormwater pond is also factored into the traditional concrete sidewalk maintenance cost.

Sidewalk trees and tree boxes

From reducing the urban heat island effect and reducing stormwater runoff to improving the urban aesthetic and improving air quality, much is expected of street trees. Street trees are even good for the economy. Customers spend 12% more in shops on streets lined with trees than on those without trees.[16] However, most often street trees are given very little space to grow in often inhospitable environments. The soil around street trees often becomes compacted during the construction of paved surfaces and minimized as underground utilities encroach on root space. If tree roots are surrounded by compacted soils or are deprived of air and water by impervious streets and sidewalks, their growth will be stunted, their health will decline, and their expected life span will be cut short. By providing adequate soil volume and a good soil mixture, the benefits obtained from a street tree multiply. To obtain a healthy soil volume, trees can simply be provided larger tree boxes, or structural soils, root paths, or "silva cells" can be used under sidewalks or other paved areas to expand root zones. These allow tree roots the space they need to grow to full size. This increases the health of the tree and provides the benefits of a mature sized tree, such as shade and air quality benefits, sooner than a tree with confined root space.

Figure 4. Trees planted at the same time but with different soil volumes, Washington DC
(Source: Casey Trees)

Table 7. Healthy Tree Volume and Permeable Pavement Specifications and Standard Details

Jurisdictions	Minimum Soil Volume		Section Title	Section #
Prince William County, VA	Large tree Medium tree Small tree	970 cf 750 cf 500 cf	Design Construction Manual (Sec 800)	Table 8-8
Alexandria, VA		300 cf	Landscape Guidelines	II.B. (2)

Implementation Hurdles

Providing an adequate root volume for trees comes down to a trade off between space in the right-of-way and added construction costs. The least expensive way to obtain the volume needed for roots to grow to full size is providing adequate space unhindered by utilities or other encroachments. However, it is often hard to reserve space dedicated just to street trees in an urban right-of-way with so many other uses competing for the room they need. As a result, some creative solutions, though they cost more to install, have become useful alternatives in crowded subsurface space. Structural soils, root paths, and "silva cells" leave void space for roots and still allow sidewalks to be constructed near trees.

Root Paths can be used to increase tree root volume by connecting a small tree root volume with a larger subsurface volume nearby. A tunnel-like system extends from the tree underneath a sidewalk and connects to an open space on the other side.

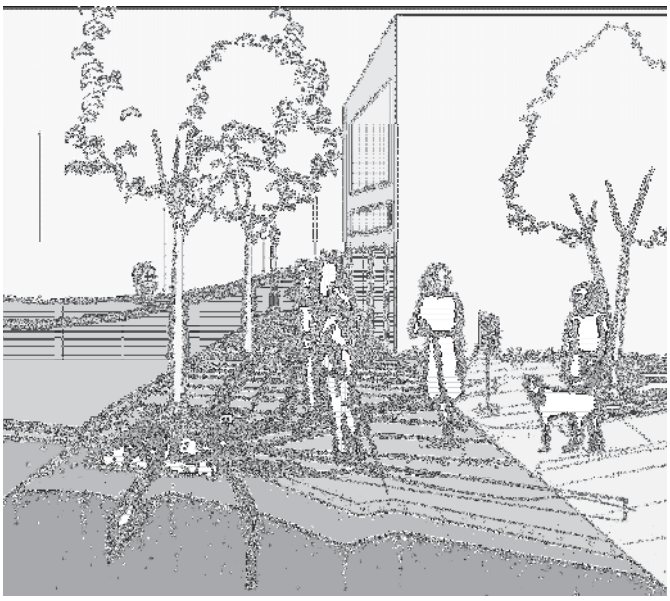

Figure 5. Root Paths direct tree roots under paving and into better soil areas for tree root growth
(Source: Arlington County, VA).

Silva Cells[17] are another option for supporting sidewalks near trees while still providing enough space for roots to grow. These plastic milk crate-like frames fit together and act as a supporting structure for a sidewalk while leaving room for uncompacted soil and roots inside the frame.

Permeable pavement sidewalks are another enhancement to the root space. They provide moisture and air to roots under sidewalks. Soils under permeable pavements can still become compacted. Structural soils[18] are a good companion tree planting practice to permeable pavement. When planting a tree in structural soils an adequate tree root volume is excavated and filled with a mix of stone and soil that still provides void space for healthy roots and allows for sidewalks, plazas or other paved surfaces to be constructed over them.

Case Studies

Portland, OR: Green Street Pilot Projects

Portland, Oregon is a national leader in developing green infrastructure. Portland's innovation in stormwater management was necessitated by the need to satisfy a Combined Sewer Overflow consent decree, Safe Drinking Water Act requirements, impending Total Maximum Daily Load limitations, Superfund cleanup measures and basement flooding. Through the 1990s, over 3 billion gallons of combined sewer overflow discharged to the Willamette River every year.[19] All of these factors plus leadership and local desires to create green solutions and industries compelled the city to implement green infrastructure as a complement to adding capacity to the sewer system with large pipe overflow interceptors. Despite gaps in long-term performance data, Portland took a proactive approach in implementing green infrastructure pilot projects.

Portland's green infrastructure pilot projects have their roots in the city's 2001 Sustainable Infrastructure Committee. The committee, consisting of representatives from Portland's three infrastructure management Bureaus, documented the city's ongoing efforts toward sustainable infrastructure, gathered research on green infrastructure projects from around the country, and identified opportunities for local pilots.[20, 21, 22]

Figure 6. Silva cell structures support the sidewalk while providing root space for street trees
(Source: Deep Root Partners, LP).

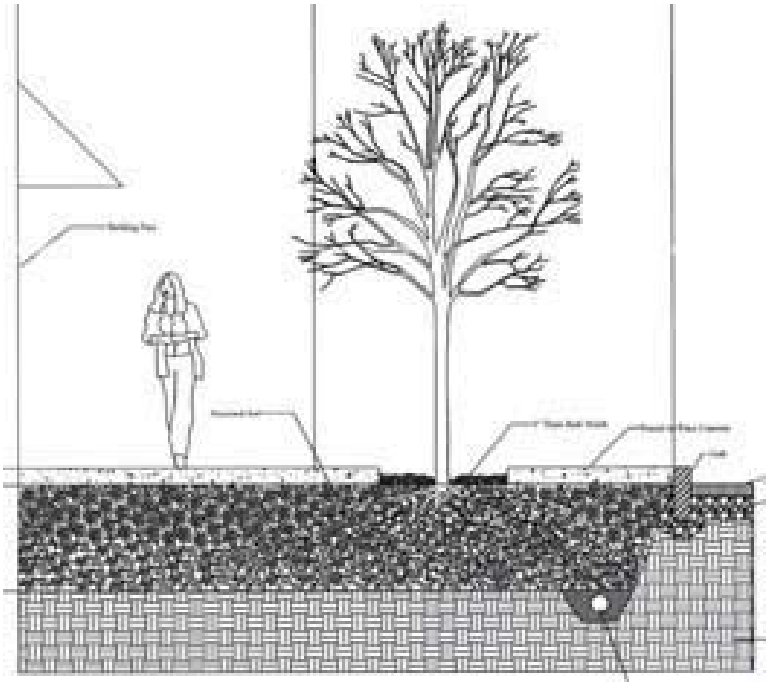

Figure 7. Structural soils provide void space for root growth and load-bearing for sidewalk
(Source: Urban Horticulture Institute, Cornell University).

One of the Bureau of Environmental Services' (BES) earliest green infrastructure retrofit projects within the right-of-way was a set of two stormwater curb extensions on NE Siskiyou Street. Portland had been retrofitting many streets with curb extensions for the purpose of pedestrian safety, but this was the first done for the purpose of treating street runoff. In a simulated 25-year storm event flow test, the curb extensions captured 85% of the runoff volume that would be discharged to the combined sewer system and reduced peak flow by 88%.[23]

Between 2003 and 2007, Portland designed and implemented a variety of Green Street pilots. Funding sources for these projects have come from BES, Portland Department of Transportation, U.S. EPA, and an Innovative Wet Weather Fund. BES combined funds with an EPA grant to create the Innovative Wet Weather Fund. In 2004, nearly $3 million from the Innovative Wet Weather Fund was budgeted for a long list of projects from city green roofs, public-private projects, and a number of pilot projects within the right-of-way.[24] Several pilots have been cost competitive with or less costly than conventional upgrades. The Bureau recognizes that costs will decrease once these projects become more routine. Many of the pilot project costs included one time costs such as the development of outreach materials and standard drawings.

Figure 8: NE Siskiyou Vegetated Curb Extensions
Source: City of Portland – Bureau of Environmental Services

Table 8. Portland, OR - Green Street Pilot Projects

Location	Design	Year Completed	Cost
NE Siskiyou b/w NE 35th Pl. and NE 36th Ave	Stormwater curb extension	2003	$20,000
3 blocks of the Westmoreland Neighborhood	Permeable Pavers in parking lanes and curb to curb	2004	$412,000
SE Ankeny b/w SE 56th and SE 57th Ave.	Stormwater curb extensions	2004	$11,946
NE Fremont b/w NE 131st and 132nd Av	Stormwater curb extension	2005	$20,400
SW 12th Ave b/w SW Montgomery and Mill	Stormwater planters	2005	$34,850
East Holladay Park	Pervious paver parking lot	2005	$165,000
4 blocks of North Gay Avenue b/w N Wygant and N Sumner	Porous concrete in curb lanes and curb to curb; porous asphalt in curb lanes and curb to curb	2005	--
SW Texas	Stormwater wetlands and swales	2007	$2.3 million
Division St. – New Seasons Market	Stormwater planters and swales	--	--
SE Tibbetts and SE 21st Ave.	Stormwater curb extension and planters	--	--

Source: Portland Bureau of Environmental Services, 2008
http://www.portlandonline.com/bes/index.cfm?c=44463&

Each of the pilot projects have been well documented by BES. A consistent format has been used to describe pilot background, features, engineering design, landscaping, project costs, maintenance, monitoring, and, most importantly, lessons learned. These case studies as well as other Green Street documentation can be found on BES's Sustainable Stormwater webpage, http://www.portlandonline.com/BES/index.cfm?c=34598. Due to physical factors (drainage, slope, soil, existing utilities, multiple uses) and development factors (retrofit, redevelopment, and new construction), there will be many variations on Green Streets. As part of the program, a continually updated Green Street Profile Notebook will catalog the successful green street projects. Users can use the Notebook for permitting guidance, to identify green streets facilities appropriate for various factors, but the document is not a technical document with standard details.

The Green Streets Team

The City of Portland, OR is widely acknowledged for long term, forward thinking, and comprehensive transportation and environmental planning. Portland recognized the fact that 66% of the City's total runoff is collected from streets and the right-of-way.[25] The city also saw the potential for transportation corridors to meet multiple objectives, including:

- Comprehensively address numerous City goals for neighborhood livability, sustainable development, increased green spaces, stormwater management, and groundwater protection;
- Integrate infrastructure functions by creating "linear parks" along streets that provide both pedestrian/bike areas and stormwater management;
- Avoid the key impacts of unmanaged stormwater whereby surface waterbodies are degraded, and water quality suffers;
- Manage stormwater with investments citizens can support, participate in, and see;
- Manage stormwater as a resource, rather than a waste;
- Protect pipe infrastructure investments (extend the life of pipe infrastructure, limit the additional demand on the combined sewer system as development occurs);
- Protect wellhead areas by managing stormwater on the surface; and
- Provide increased neighborhood amenities and value.

In a two phased process from 2005 to 2007, the Green Streets Team, a cross agency and interdisciplinary team, developed a comprehensive green streets policy and a way forward for the green streets agenda. Phase 1 identified challenges and issues and began a process for addressing them. Barriers to the public initiation of green street projects included a code and standards that would disallow or discourage green street strategies, long term performance unknowns, and maintenance responsibilities. To address these barriers, the Green Streets Team organized into subgroups focusing on outreach, technical guidance, infrastructure, maintenance, and resources.

Phase 2 of the Green Streets project synthesized the opportunities and solutions identified in Phase 1 into a citywide Green Streets Program. The first priority for this phase was the drafting of a binding citywide policy. The resolution was adopted by the Portland City Council in March 2007.

Prior to the start of the Portland effort, 90% of implemented green street projects were issued by private permits rather than city initiated projects.

Six Approaches to Implementing Green Streets	
Pathway	**Implementation**
City-initiated street improvement projects	City designs, manages, maintains
City-initiated stormwater retrofits	City designs, manages, maintains
Neighborhood-initiated LIDs	
Developer-initiated subdivisions with public streets	Developer designs and builds via City permit and review process, then turns over new right of way to the City after warranty period
Developer-initiated subdivisions with private streets	Developer designs and builds via City permit and review process, and turns over to home-owner association
Developer-related initiated frontage improvements on existing public streets	Developer designs and builds new sidewalks and curbs via City permit and review process, usually because the City required it via a building permit or via a land division

Source: Portland Green Streets, Phase 1

Portland City Council Approved Green Streets Policy

Goal: City of Portland will promote and incorporate the use of green street facilities in public and private development.

City elected officials and staff will:

1. Infrastructure Projects in the Right of Way:

   a. Incorporate green street facilities into all City of Portland funded development, redevelopment or enhancement projects as required by the City's September 2004 (or updated) Stormwater Management Manual. Maintain these facilities according to the May 2006 (or updated) Green Streets Maintenance Policy.

      If a green street facility (infiltrating or flow through) is not incorporated into the Infrastructure Project, or only partial management is achieved, then an off site project or off site management fee will be required.

   b. Any City of Portland funded development, redevelopment or enhancement project, that does not trigger the Stormwater Manual but requires a street opening permit or occurs in the right of way, shall pay into a "% for Green" Street fund. The amount shall be 1% of the construction costs for the project.
      Exceptions: Emergency maintenance and repair projects, repair and replacement of sidewalks and driveways, pedestrian and trail replacement, tree planting, utility pole installation, street light poles, traffic, signal poles, traffic control signs, fire hydrants, where this use of funds would violate contracted or legal restrictions.

2. Project Planning and Design:

   a. Foster communication and coordination among City Bureaus to encourage consideration of watershed health and improved water quality through use of green street facilities as part of planning and design of Bureau projects.
   b. Coordinate Bureau work programs and projects to implement Green Streets as an integrated aspect of City infrastructure.
   c. Plan for large-scale use of Green Streets as a means of better connecting neighborhoods, better use of the right of way, and enhancing neighborhood livability.
   d. Strive to develop new and innovative means to cost-effectively construct new green street facilities.
   e. Develop standards and incentives (such as financial and technical resources, or facilitated permit review) for Green Streets projects that can be permitted and implemented by the private sector. These standards and incentives should be designed to encourage incorporation of green street facilities into private development, redevelopment and enhancement projects.

3. Project and Program Funding:

   a. Seek opportunities to leverage the work and associated funding of projects in the same geographic areas across Bureaus to create Green Street opportunities.
   b. Develop a predictable and sustainable means of funding implementation and maintenance of Green Street projects.

4. Outreach:

   a. Educate citizens, businesses, and the development community/industry about Green Streets and how they can serve as urban greenways to enhance, improve, and connect neighborhoods to encourage their support, demand and funding for these projects.
   b. Establish standard maintenance techniques and monitoring protocols for green street facilities across bureaus, and across groups within bureaus.

5. Project Evaluation:

   a. Conduct ongoing monitoring of green street facilities to evaluate facility effectiveness as well as performance in meeting multiple City objectives for:
      - Gallons managed;
      - Projects distributed geographically by watershed and by neighborhood; and

The second priority for Phase 2 was developing communication and planning procedures for incorporating multi-bureaus plans into the scheduled Portland DOT Capital Improvement Program (CIP). Three timeframes for green street project planning were recommended. In the short term, the CIP Planning Group, backed by the citywide policy directive, will shift to a focus on "identifying and evaluating opportunities to partner." For example, coordinating Water Bureau and BES pipe replacement

projects with DOT maintenance, repair, and improvement projects. The mid-term approach is more proactive and involves forecasting potential green street projects using existing bureau data and GIS tools. As for the long term, green street objectives will be incorporated into the citywide systems plan which guides city bureaus for the next 20 years.

The Green Street Team methodology propelled Portland's early green street pilot projects into a comprehensive, citywide multi-bureau program. The program built on previous efforts by the Sustainable Infrastructure Committee as well as other efforts such as the 2005 Portland Watershed Management Plan, established a City Council mandated policy, and institutionalized green street development. The outcome of this approach is multi-agency buy-in and responsibility for the effort. For instance, because of their knowledge of plant maintenance, Portland Parks and Recreation is responsible for the maintenance of some DOT installations.

Chicago, IL: Green Alleys Program

The City of Chicago, Illinois has an alley system that is perhaps the largest in the world. These 13,000 publicly owned alleys result in 1,900 miles, or 3,500 acres, of impermeable surfaces in addition to the street network. Because the alley system was not originally paved, there are no sewer connections as part of the original design. Over time the alleys were paved and flooding in garages and basements began to occur as a result of unmanaged stormwater runoff. Since the city already spends $50 million each year to clean and upgrade 4,400 miles of sewer lines and 340,000 related structures, the preferred solution to the flooded alleys is one that doesn't put more stress on an already overburdened and expensive sewer system.[26]

In 2003, the Chicago Department of Transportation (CDOT) used permeable pavers and French drain pilot applications to remedy localized flooding problems in alleys in the 48th Ward.[27] These applications proved to be successful and by 2006, CDOT launched its Green Alley Program with the release of the Chicago Green Alley Handbook (Handbook).[28]

The Chicago Green Alley Program is unique because it marries green infrastructure practices in the public right-of-way with green infrastructure efforts on private property. The user-friendly Handbook, which describes both facets of the program including the design techniques and their benefits, is an award winning document. The American Society of Landscape Architects awarded the creators of the Handbook the 2007 Communications Honor Award for the clear graphics and simple, yet effective, message.[29] The Handbook explains to the residents why green infrastructure is important, how to be good stewards of the Green Alley in their neighborhood, and what sorts of "green" practices they can implement on their property to reduce waste, save water, and help manage stormwater wisely.

While the initial impetus behind the Green Alley Program was stormwater management, Chicago decided to use this opportunity to address other environmental concerns as well as reducing the urban heat island effect, recycling, energy conservation, and light pollution.

Green Infrastructure in the Right-of-Way

Chicago's Green Alley Program uses the following five techniques in the public right-of-way to "green" the alley:

1. Changing the grade of the alley to drain to the street rather than pond water in the alley or drain toward garages or private property.
2. Using permeable pavement that allows water to percolate into the ground rather than pond on the surface.
3. Using light colored paving material that reflects sunlight rather than adsorbing it, reducing urban heat island effect.

4. Incorporating recycled materials into the pavement mix to reduce the need for virgin materials and reduce the amount of waste going into the landfill.

5. Using energy efficient light fixtures that focus light downward, reducing light pollution.

Figure 9: Permeable Asphalt Installation Using Ground Tire Rubber.
Source: Chicago Department of Transportation, Sustainable Development Initiatives; Streetscape and Urban Design Program, CDOT Division of Project Development.

Four design approaches were created using these techniques. Based on the local conditions, the most appropriate approach is selected. In areas where soils are well-draining, permeable pavement is used. In areas where buildings come right up to the edge of pavement and infiltrated water could threaten foundations, impermeable pavement strips are used on the outside with a permeable pavement strip down the middle. In areas where soils do not provide much infiltration capacity, the alley is regraded to drain properly and impermeable pavement made with recycled materials is used. Another approach utilizes an infiltration trench down the middle of the alley. Light colored (high albedo) pavement, recycled materials, and energy efficient, glare reducing lights are a part of each design approach.

Green Infrastructure on Private Property
The Handbook also describes actions that property owners can take to "green" their own piece of Chicago. The Handbook describes the costs, benefits, and utility of the following practices:

- Recycling;
- Composting;
- Planting a tree;
- Using native landscape vegetation;
- Constructing a rain garden;
- Installing a rain barrel;
- Using permeable pavement for patios;
- Installing energy efficient lighting; and
- Utilizing natural detention.

By bringing this wide range of "green" practices to the attention of homeowners, the positive impacts of the Green Alley Program spread beyond the boundaries of the right-of-way, increasing awareness and providing practical resources to help community members be a part of the solution.

Chicago Green Alley Cost Considerations
When the program began in 2006, repaving the alleys with impermeable pavement ranged in cost from $120,000 to $150,000, whereas a total Green Alley reconstruction was more along the lines of $200,000 to $250,000.[30] While less expensive conventional rehabilitation options may seem more attractive, they don't provide a solution to the localized flooding issues or the combined sewer system overflow problems. Sewer system connections could be established to solve the localized flooding problem, but it would add to the already overburdened sewer system and increase the cost of the reconstruction to that of the impermeable alley option. Consequently, the higher priced Green Alley option proved to be the best investment as it has multiple benefits in addition to solving localized flooding and reducing flow into the combined sewer system. The additional benefits of the Green Alley Program include not only urban heat

island effect reduction, material recycling, energy conservation, and light pollution reduction, but also the creation of a new market.

In 2006, when the Green Alley Program began, the city paid about $145 per cubic yard of permeable concrete. Just one year later, the cost of permeable concrete had dropped to only $45 per cubic yard. Compared with the cost of ordinary concrete, $50 per cubic yard, permeable concrete may have seemed like an infeasible option in the past to customers wanting to purchase concrete.[31] After the city's initial investment in the local permeable concrete market, the product cost has come down making permeable concrete a more affordable option for other consumers besides the city. This has resulted in an increased application of permeable concrete throughout the region.

Figure 10: Permeable Pavers and Permeable Concrete Chicago Alleys
(Source: Abby Hall, US EPA)

The success of the Chicago Green Alley Program is evident. Not only are the alleys been "greened" as a result of the program, the surrounding properties and even the surrounding neighborhoods are experiencing the positive impacts of the program's implementation.

Conclusions and Recommendations

Incorporating green streets as a feature of urban stormwater management requires matching road function with environmental performance. Enhancing roads with green elements can improve their primary function as a transportation corridor while simultaneously mitigating their negative environmental impacts. In theory and practice many municipalities are not far removed from dedicated green streets programs. Street tree and other greenscaping programs are often identified and promoted along urban transportation corridors. Adapting them to become fully functional green streets requires minor design modifications and an evaluation of how to maximize the benefits of environmental systems.

Portland's green streets program demonstrates how common road and right-of-way elements (e.g., traffic calming curb extensions, tree boxes) can be modified and optimized to provide stormwater management in addition to other benefits. The curb cuts and design variations to allow runoff to enter the vegetated areas are subtle changes with a significant impact and demonstrate how stormwater can be managed successfully at the source. One of the biggest successes of the program was reassessing common design features and realizing that environmental performance can be improved by integrating stormwater management.

Where Portland used vegetation, Chicago's Green Alley Program similarly demonstrates that hardscape elements can be an integral part of a greening program. By incorporating permeable pavements that simulate natural infiltration, Chicago enhances the necessary transportation function of alleys while enhancing infrastructure and environmental management. Portland also contrasts the "soft" and "hard"

elements of green streets by using both permeable pavements and vegetated elements. The green options available demonstrate the flexibility of green infrastructure to satisfy road function and environmental objectives and highlight why transportation corridors are well suited for green infrastructure.

Elements necessary for a successful green streets program:

- **Pilot projects are critical.** The most successful municipal green street programs to date all began with well documented and monitored pilot projects. These projects have often been at least partially grant funded and receive the participation of locally active watershed groups working with the city infrastructure programs. The pilot projects are necessary to demonstrate that green streets can work in the local environment, can be relied upon, and fit with existing infrastructure. Pilot projects will help to dispel myths and resolve concerns.
- **Leadership in sustainability from the top.** The cities with the strongest green streets programs are those with mayors and city councils that have fully bought into sustainable infrastructure. Council passed green policies and mayoral sustainability mandates or mission statements are needed to institutionalize green street approaches and bring it beyond the token green project.
- **Buy-in from all municipal infrastructure departments.** By their nature, green streets cross many municipal programs. Green street practices impact stormwater management, street design, underground utilities, public lighting, green space planning, public work maintenance, and budgeting. When developing green streets, all of the relevant agencies must be represented. Also, coordination between the agencies on project planning is important for keeping green infrastructure construction costs low. Superior green street design at less cost occurs when sewer and water line replacement projects can be done in tandem with street redevelopment. These types of coordination efforts must happen at the long-term planning stage.
- **Documentation.** Green street projects need to be documented on two levels, the design and construction level and on a citywide tracking level. Due to the different street types and siting conditions, green street designs will take on many variations. By documenting the costs, construction, and design, the costs of similar future projects can be minimized and construction or design problems can be avoided or addressed. Tracking green street practices across the city is crucial for managing maintenance and quantifying aggregate benefits.
- **Public outreach.** Traditional pollution prevention outreach goes hand in hand with green street programs. Properly disposing of litter, yard waste, and hazardous chemicals and appropriately applying yard chemicals will help prolong the life of green street practices. An information campaign should also give the public an understanding of how green infrastructure works and the benefits and trade offs. In many cases, remedial maintenance of green street practices will be performed by neighboring property owners; they need to know how to maintain the practices to keep them performing optimally.

As public spaces, roads are prime candidates for green infrastructure improvements. In addition to enabling legislation, and technical guidance, developing a green streets program requires an institutional re-evaluation of how right-of-ways are most effectively managed. This process typically includes:

- Assessing the necessary function of the road and selecting the minimum required street width to reduce impervious cover;
- Enhancing streetscaping elements to manage stormwater and exploring opportunities to integrate stormwater management into roadway design; and
- Integrating transportation and environmental planning to capitalize on economic benefits.

The use of green streets offers the capability of transforming a significant stormwater and pollutant source into an innovative treatment system. Green streets optimize the performance of public space easing maintenance concerns and allowing municipalities to coordinate the progression and implementation of stormwater control efforts. In addition, green streets optimize the performance of both the transportation and water infrastructure. Effectively incorporating green techniques into the transportation network provides significant opportunity to decrease infrastructure demands and pollutant transport.

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