Multi-Agency Post-Construction Stormwater Standards Manual

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A collaboration by:

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SECTION 1. INTRODUCTION

1.1. Purpose and Goals

The Cities of Lathrop, Lodi, Manteca, Patterson, and Tracy, and portions of the County of San Joaquin (collectively Agencies) are each classified as Phase II Municipal Separate Storm Sewer System (MS4) communities. In 2013, the California State Water Resources Control Board (State Water Board) adopted a National Pollutant Discharge Elimination System (NPDES) general permit, henceforth referred to in this document as the Phase II Permit, for Phase II MS4 communities to regulate stormwater and non-stormwater discharges from MS4s to waters of the United States. As part of the Phase II Permit, the Agencies are required to develop/update post-construction standards to address stormwater quality for regulated new development and redevelopment projects (Provision E.12).

The Agencies have collaborated to prepare this 2015 Multi-Agency Post-Construction Stormwater Standards Manual (Manual) to assist the development community in complying with the requirements of Provision E.12 of the Phase II Permit and local ordinances. This Manual is not intended to conflict or contradict any local ordinances or standards. Any conflicts or issues should be discussed with the appropriate jurisdictional Agency.

The jurisdictional areas where this Manual is applicable are identified in Appendix B.

This Manual provides guidance for planning, implementing, and maintaining effective control measures with the intention of improving water quality and mitigating potential water quality impacts, including hydromodification, from stormwater and non-stormwater discharges. This Manual provides tools to address the following objectives:

- Establish the methodology to consider the effects of stormwater runoff from a new development or redevelopment project during the project planning phase;
- Minimize contiguously-connected impervious surfaces in areas of new development and redevelopment, and where feasible, to maximize on-site infiltration of stormwater runoff;
- Implement site design measures to preserve, create, or restore areas that provide important water quality benefits such as riparian corridors, wetlands, stream and buffers, and maintain, protect, and improve underlying soil quality;
- Provide source control measures to minimize the transport of and/or eliminate potential sources of pollution to stormwater runoff or run-on into the MS4 and receiving waters;
- Implement Low Impact Development (LID) control measures to reduce and/or eliminate the volume of stormwater runoff and pollutants leaving the project site;

- Control post-construction peak stormwater runoff discharge volumes and velocities (hydromodification) to mitigate impacts from downstream erosion and to protect downstream habitat; and
- Develop tools for effectively operating, managing, and maintaining stormwater control measures.

1.2. Environmental Background

Historically, stormwater management consisted of a network of impervious surfaces that directly convey stormwater runoff to curb and gutter systems, the storm drain system, and downstream receiving waters as quickly as possible to manage flood risks. In a natural setting, the following hydrologic functions occur:

- Rainfall interception: In a vegetated watershed, the surfaces of trees, shrubs, and grasses capture initial light precipitation before it reaches the ground. The interception of precipitation can delay the start and reduce the volume of stormwater runoff.
- Shallow surface storage: Shallow pockets present in natural terrain store precipitation and stormwater runoff, filter it, and allow it to infiltrate. Shallow surface storage can delay the start and reduce the volume of stormwater runoff.
- Evaporation and transpiration: Evaporation occurs when water changes from a liquid to a gas and moves into the air. Transpiration occurs when vegetation releases water vapor into the atmosphere. Both processes, collectively termed evapotranspiration, reduce the volume of stormwater runoff, locally return moisture into the atmosphere, and provide local cooling effects.
- Infiltration: Infiltration is the movement of surface water down through the soil into groundwater. Such movement filters and reduces the volume of stormwater runoff and replenishes groundwater supplies.
- Runoff: Runoff is the flow of water across the land surface that occurs after rainfall interception, surface storage, and infiltration reach capacity.

In natural settings, the majority of precipitation is either infiltrated into the soil or lost to evapotranspiration. Through urbanization and development, pervious surfaces (e.g., wooded areas, meadows, agricultural fields) are converted into impervious areas (e.g., building footprints, roads, parking lots), and the percentage of precipitation that becomes stormwater runoff increases. The impacts of such conversion may include:

- Increased concentrations of solids, nutrients, toxic pollutants, bacteria, and other nuisance organisms in storm drain system and receiving waters (e.g., creeks, rivers, streams);
- Higher stormwater runoff volumes and peak flow rates produced by storms;
- Decreased wet season groundwater recharge due to a reduced infiltration area;
- Increased dry weather urban runoff due to outdoor irrigation;

- Introduction of base flows in ephemeral streams resulting from increased dry weather urban runoff;
- Increased stream and channel instability and erosion due to increased stormwater runoff volumes, flow durations, and higher stream velocities (i.e., hydromodification impacts); and
- Increased stream temperature, which decreases dissolved oxygen levels and adversely impacts temperature-sensitive aquatic life, due to loss of riparian vegetation as well as stormwater runoff warmed by impervious surfaces.

1.3. Regulatory Background

In 1972, the Federal Water Pollution Control Act (Clean Water Act [CWA]) was amended to require NPDES permits for discharge of pollutants to waters of the United States from any point source. In 1987, the CWA was amended to add section 402(p), which required that municipal, industrial, and construction stormwater discharges be regulated under the NPDES permit program. In 1990, the United States Environmental Protection Agency (USEPA) promulgated rules that established the Phase I NPDES program to regulate stormwater from medium and large MS4s, which were defined as those serving populations of 100,000 or greater. In 1999, USEPA promulgated rules that established the Phase II NPDES program to regulate stormwater from small MS4s.

Phase II General Permit

On April 30, 2003, the State Water Board adopted the first general NPDES permit (CAS000004) under Order No. 2003-0005-DWQ for small MS4s, including non-traditional small MS4s (e.g., military bases), that required compliance with section 402(p) of the CWA and defined the minimum acceptable elements of stormwater management programs for small MS4s. On February 5, 2013, the State Water Board adopted Order No. 2013-0001-DWQ, which replaced Order No. 2003-0005-DWQ and required that the Agencies regulate post-construction development (Provision E.12) through the following program elements:

- Site design measures (Provision E.12.b)
- Regulated projects (Provision E.12.c)
- Source control measures (Provision E.12.d)
- Low impact development design standards (Provision E.12.e)
- Hydromodification measures (Provision E.12.f)
- Enforceable mechanisms (Provision E.12.g)
- Operation and maintenance of stormwater control measures (Provision E.12.h)
- Post-construction Best Management Practice condition assessment (Provision E.12.i)
- Planning and development review process (Provision E.12.j)

- Post-construction stormwater management requirements based on assessment and maintenance of watershed processes (Provision E.12.k); and
- Alternative post-construction stormwater management program (Provision E.12.l).

The underlined topics, above, are discussed in this Manual. The other topics are administrative aspects of the stormwater management program and are not pertinent to project planning, design, implementation, maintenance, and operation.

In addition to the Provision E.12 requirements for post-construction stormwater management, other elements of the Phase II Permit focus on managing other aspects of the stormwater program such as providing public education and outreach, detecting and eliminating illicit discharges, controlling pollutants from construction sites and municipal operations, and a variety of reporting, assessment, and monitoring elements.

Other State of California Regulations

In addition to the Phase II Permit requirements, proposed projects may be subject to the State Water Board's *Waste Discharge Requirements for Discharges of Storm Water Associated with Industrial Activities Excluding Construction Activities* (Industrial General Permit, Order No. 2014-0057-DWQ) and/or the *General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities* (Construction General Permit, Order No. 2012-0006-DWQ).

If dewatering is necessary at the project site, proposed projects may be subject to the Central Valley Regional Water Quality Control Board's (Central Valley Regional Water Board) *Waste Discharge Requirements for Dewatering and Other Low Threat Discharges to Surface Waters* (Order No. R5-2013-0074).

Agency Regulations and Policies

Implementation of stormwater standards are required in each Agency's municipal codes and/or ordinances. A summary of the applicable stormwater requirements for each Agency is presented in **Table 1-1**.

Table 1-1. Summary of Agency Municipal Codes and Ordinances Regulating Stormwater

Agency	Municipal Code/Ordinance Reference
City of Lathrop	Municipal Code Chapter 13.28
City of Lodi	Municipal Code Chapter 13.14
City of Manteca	Municipal Code Section 13.28
City of Patterson	Municipal Code Chapter 13.32
City of Tracy	Municipal Code Chapter 11.32
County of San Joaquin	Code of Ordinances Division 10

1.4. Effective Date of the 2015 Post-Construction Stormwater Standards Manual

The Phase II Permit requires that these post-construction stormwater standards become effective July 1, 2015. Projects submitted for development approvals on or after July 1, 2015 must incorporate these post-construction stormwater standards into project designs. The effective dates for implementation of these post-construction stormwater standards for private and public projects are discussed further in the sections below.

Effective Date for Private Projects

Project applicants who have submitted development applications for discretionary permits that have been deemed complete for processing by or received approval of a Vesting Tentative Map from the jurisdictional Agency before July 1, 2015 are not subject to the requirements of this Manual. However, these projects must comply with the post-construction and drainage standards in effect at the time the development applications for discretionary permits were deemed complete for processing or received approval of a Vesting Tentative Map and any conditions of approval required by the jurisdictional Agency. Project applicants who submit development applications beginning July 1, 2015, or who have not had their applications deemed complete for processing by or received approval for a Vesting Tentative Map from the jurisdictional Agency before July 1, 2015 must comply with the post-construction stormwater standards outlined in this Manual.

Broad planning documents (e.g., land use master plans, conceptual master plans, or broad-based California Environmental Quality Act [CEQA] or National Environmental Policy Act [NEPA]) approved or adopted by an Agency prior to July 1, 2015 does not exempt a project applicant from the requirements of this Manual unless the development application for the project has been deemed complete or there is an approved Vesting Tentative Map.

For projects that are not subject to the planning review process (i.e., projects that do not need Vesting Tentative Maps, Tentative Maps, or Parcel Maps), project applicants must comply with this Manual unless the development application was deemed complete by the jurisdictional Agency before July 1, 2015.

Effective Date for Public Projects

For public projects, the effective date of the project is the date on which the Agency approves initiation of project design. If approval occurs prior to July 1, 2015, then the requirements of this Manual do not apply. If approval occurs on or after July 1, 2015, then the requirements of this Manual apply.

1.5. Applicability of the 2015 Post-Construction Stormwater Standards Manual

The Phase II Permit specifies three types of projects (both public and private new development and redevelopment) that must implement post-construction stormwater standards, to varying degrees, as discussed below:

- Small Projects (Provision E.12.b(i)) – These are projects that create and/or replace at least 2,500, but less than 5,000 square feet of impervious surface; or detached single-family homes that create and/or replace a minimum of 2,500 square feet of impervious surface and are not part of a larger plan of development. Small Projects exclude linear underground/overhead utility projects (LUPs).
- Regulated Projects – These are projects that create and/or replace greater than or equal to 5,000 square feet of impervious surface and LUPs that create 5,000 square feet or more of newly constructed contiguous impervious surfaces.
- Hydromodification Management Projects – These are a subset of Regulated Projects that create and/or replace one acre or more of impervious surface. A project that does not increase the impervious surface area over the pre-project condition is not considered a Hydromodification Management Project.

The Phase II Permit also establishes exceptions for specific types of projects, which would otherwise be considered Regulated Projects. These exceptions and examples are discussed as follows:

- Detached Single-Family Homes that are not part of a common plan of development regardless of the amount of impervious area created or replaced are considered Small Projects. See Appendix A for a definition of the term common plan of development.
- Routine Maintenance and Repair Projects that maintain the original line and grade, hydraulic capacity, and original purpose of the facility. Such projects include:
  - Exterior wall surface replacement;
  - Pavement resurfacing[1] within an existing footprint;
  - Routine replacement of damaged pavement[2], such as pothole repair, or short non-contiguous sections of roadway;

[1] Pavement resurfacing (also known as an overlay, asphalt overlay, or pavement overlay) is the process of installing a new layer of pavement over the existing pavement.

  - Re-roofing regardless of whether it is a full roof replacement or an overlay;
- Interior remodels that do not modify the existing footprint;
- Excavation, trenching, and resurfacing associated with LUPs;
- Pavement grinding and resurfacing of existing roadways and parking lots;
- Construction of new sidewalks, pedestrian ramps, or bicycle lanes on existing roadways;
- Sidewalks and bicycle lanes built as part of new streets or roads when they are graded to runoff to adjacent vegetated areas;
- Impervious trails when they are graded to runoff to adjacent vegetated areas or other non-erodible areas; and
- Sidewalks, bicycle lanes, and trails when constructed with permeable surfaces.

The applicability of this Manual is presented in a flow chart in **Figure 1-1**. A summary of the post-construction stormwater standards that are applicable to a project are presented in **Table 1-2**.

Table 1-2. Applicable Post-Construction Stormwater Standards

Post-Construction Stormwater Standard	Small Project	Regulated Project	Hydromodification Management Project
Site Assessment (Section 3)	(1)	X	X
Site Design (Section 3)	X	X	X
Source Control Measures (Section 4)		X	X
Treatment Control Measures (Section 6)		X	X
Baseline Hydromodification (Section 7)		X	X
Full Hydromodification (Section 7) (2)			X
Operations & Maintenance (Section 8)		X	X

(1) It is recommended that Small Projects implement the applicable activities of site assessment process to maximize consideration for post-construction stormwater runoff.

(2) Hydromodification management is required by June 30, 2016.

[2] Pavement replacement (also known as reconstruction) is the process of removing existing pavement down to the subbase and replacing it with new base course and new pavement. If the native soil is exposed, this is considered a redevelopment project.

Redevelopment Projects

Redevelopment is defined as any land-disturbing activity that results in the creation, addition, or replacement of exterior impervious surface area at a site on which some past development has occurred.

The following thresholds are used to determine the level of post-construction stormwater standards that must be implemented for a redevelopment project:

- If a redevelopment project results in an increase of 50 percent or more of the impervious surface area of the existing development, then the stormwater runoff from the entire project, consisting of all existing, new, and/or replaced impervious surfaces, for the stormwater design volume or flow must be managed under these standards.
- If a redevelopment project results in an increase of less than 50 percent of the impervious surface of the existing development, then only the stormwater runoff from the new and/or replaced impervious surfaces must be managed under these standards.

Depending on the size of the redevelopment project, it may be considered a Small, Regulated, or Hydromodification Management Project.

Road Projects and Linear Underground/Overhead Utility Projects

The following road projects and LUPs that create 5,000 square feet or more of newly constructed contiguous impervious surface, which are classified as Regulated Projects, must comply with the post-construction stormwater standards in this Manual:

- Construction of new streets or roads, including sidewalks and bicycle lanes built as part of the new streets or roads; or
- Widening of existing streets or roads with additional traffic lanes:
    - If the addition of traffic lanes results in an alteration of 50 percent or more of the impervious surface of the existing street or road, then the stormwater runoff from the entire project, consisting of all existing, new, and/or replaced impervious surfaces, must be managed; or
    - If the addition of traffic lanes results in an alteration of less than 50 percent (but 5,000 square feet or more) of the impervious surface of the existing street or road, then only the stormwater runoff from the new and/or replaced impervious surfaces must be managed; or
- Construction of LUPs.

For road and LUP projects when the stormwater runoff from the design storm event cannot be infiltrated on-site, excess stormwater runoff must be managed through the use of practices identified in USEPA's *Managing Wet Weather with Green Infrastructure*

Municipal Handbook Green Streets (EPA 833-F-08-009, December 2008) (see Appendix J).

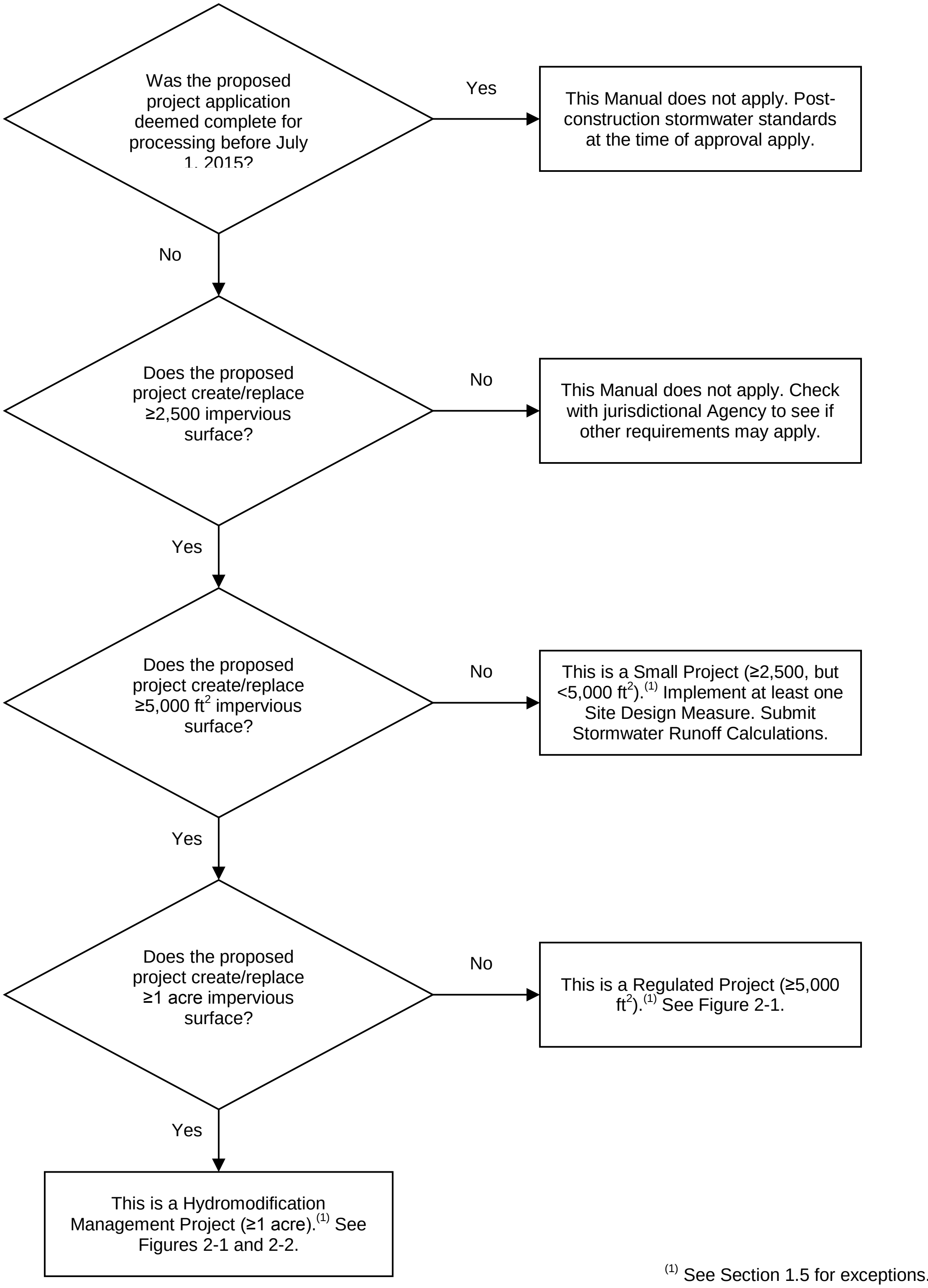

Figure 1-1. Applicability of 2015 Post-Construction Stormwater Standards Manual

1.6. Organization of the 2015 Post-Construction Stormwater Standards Manual

This Manual is organized as follows:

Section 1	Introduction to the Manual and presentation of the environmental basis for stormwater management, applicable regulations, and applicability of the Manual.
Section 2	Development of Project Stormwater Plan.
Section 3	Information on site assessment, site planning, and site design measures.
Section 4	Information on source control measures.
Section 5	Methodology for calculating the stormwater design volume or flow that must be mitigated for a project site.
Section 6	Information on stormwater treatment control measures.
Section 7	Information on the applicability of hydromodification requirements.
Section 8	Operation and maintenance requirements for stormwater control measures.

SECTION 2. PROJECT STORMWATER PLAN

2.1. Introduction

The project applicant must submit a Project Stormwater Plan to the appropriate jurisdictional Agency (i.e., City of Lathrop, City of Lodi, City of Manteca, City of Patterson, City of Tracy, or County of San Joaquin) for review as part of its development application. The Project Stormwater Plan must provide a sufficient level of information depending on the type of project and be prepared and stamped by a licensed professional engineer or landscape architect. The Project Stormwater Plan for Small Projects does not require a licensed professional engineer or landscape architect. Worksheets, which are included in Appendix D, must be submitted as part of the Project Stormwater Plan.

The Project Stormwater Plan for Small Projects must include the following information:

- Basic project information;
- Proposed site design measures (Section 3.5); and
- Results from the Post-Construction Stormwater Runoff Calculator showing the change in pre-project and post-project stormwater runoff (Section 5.5).

Project applicants for Regulated and Hydromodification Management Projects must submit a comprehensive, technical discussion describing compliance with the requirements of this Manual. These Project Stormwater Plans must include the following information:

- Basic project information;
- Identification of whether the proposed project is a Regulated or Hydromodification Management Project (Section 1.5);
- Findings from a site assessment (Section 3) that, at a minimum, must include:
  - A Site Conditions Report, if required by the Agency, summarizing relevant findings from geotechnical investigations;
  - Identification of each drainage management area (DMA);
  - Identification of pollutants of concern;
- Proposed site design measures to be implemented (Section 3.5);
- Proposed source control measures to be implemented (Section 4);
- Calculation of the Stormwater Design Volume and/or Stormwater Design Flow and results from the Post-Construction Stormwater Runoff Calculator (Section 5);
- Proposed stormwater treatment control measures, if necessary (Section 6);
- Proposed hydromodification control measures and hydromodification modeling results, if required (Section 7); and

- Proposed Operations and Maintenance Plan (Section 8).

The Project Stormwater Plan must also include a site plan that, at a minimum, illustrate:

- Existing natural hydrologic features (e.g., depressions, watercourses, wetlands, riparian corridors, undisturbed areas) and significant natural resources;
- Proposed locations and footprints of improvements creating new, or replaced impervious surfaces;
- Existing and proposed site drainage system and connections to off-site drainage;
- All DMAs with unique identifiers;
- Proposed locations and footprints of stormwater control measures (e.g., site design measures, source control measures, stormwater treatment control measures) implemented to manage stormwater runoff; and
- Maintenance areas.

Flow charts of the design process for managing stormwater runoff for proposed Regulated and Hydromodification Management Projects are presented in **Figure 2-1** and **Figure 2-2**, respectively.

Upon meeting the requirements of this Manual and other applicable requirements, the Project Stormwater Plan will be approved and signed off by the legally responsible person, or their approved designee, of the jurisdictional Agency. Note that other overall project plan approvals are necessary before construction of the proposed project may begin. The current Project Stormwater Plan review processes, which may be subject to revision, for each Agency are presented in Appendix C. A general schematic of the plan review and approval process is presented in **Figure 2-3**.

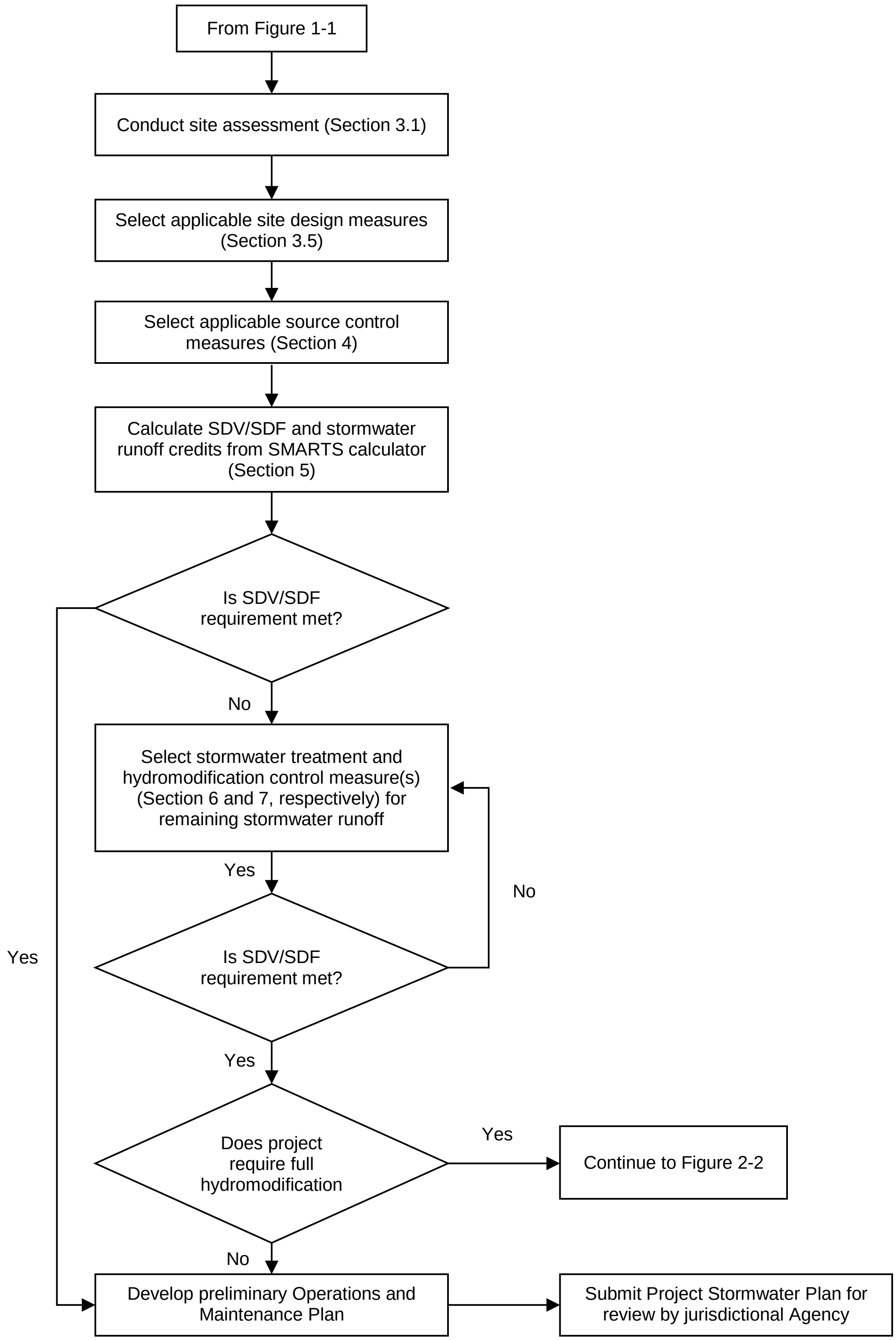

Figure 2-1. Design Process for Meeting Stormwater Requirements for Regulated and Hydromodification Management Projects

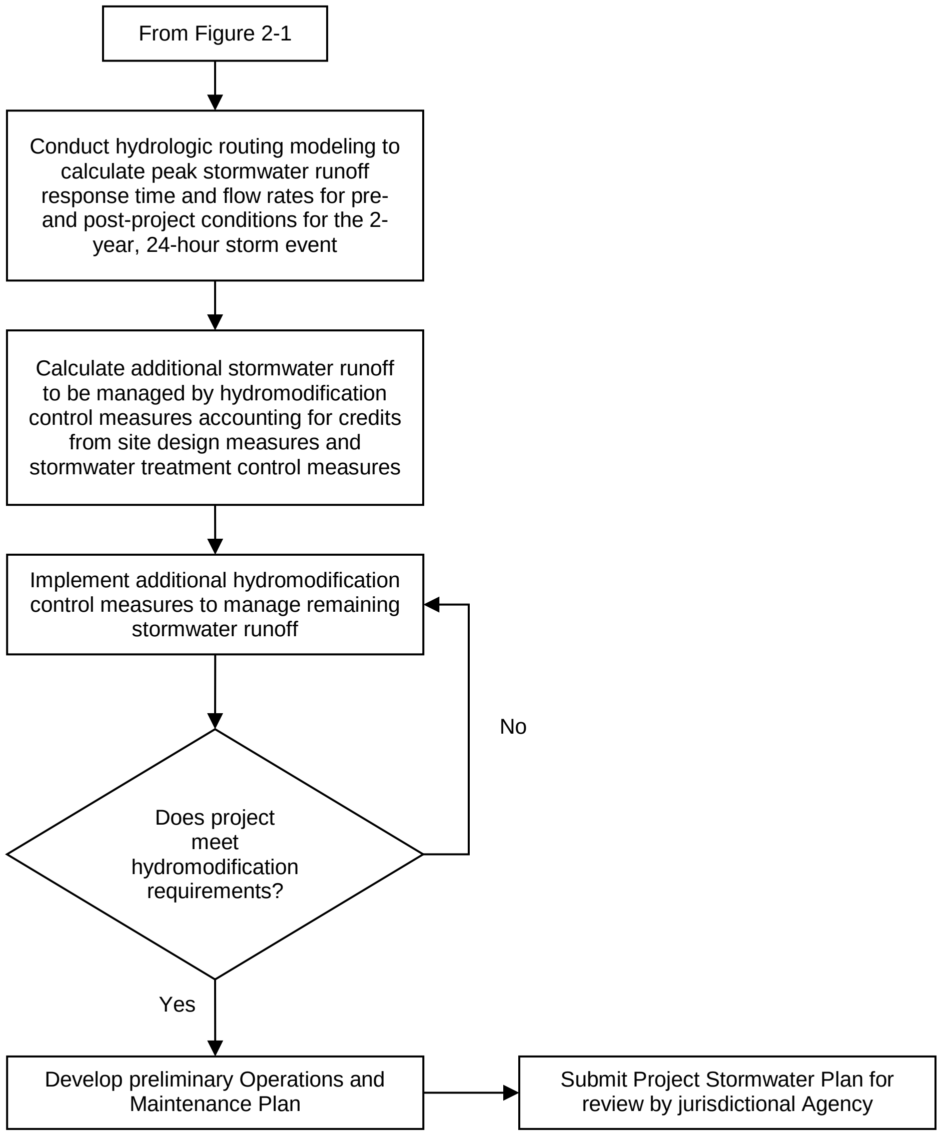

Figure 2-2. Design Process for Meeting Stormwater Requirements for Hydromodification Management Projects

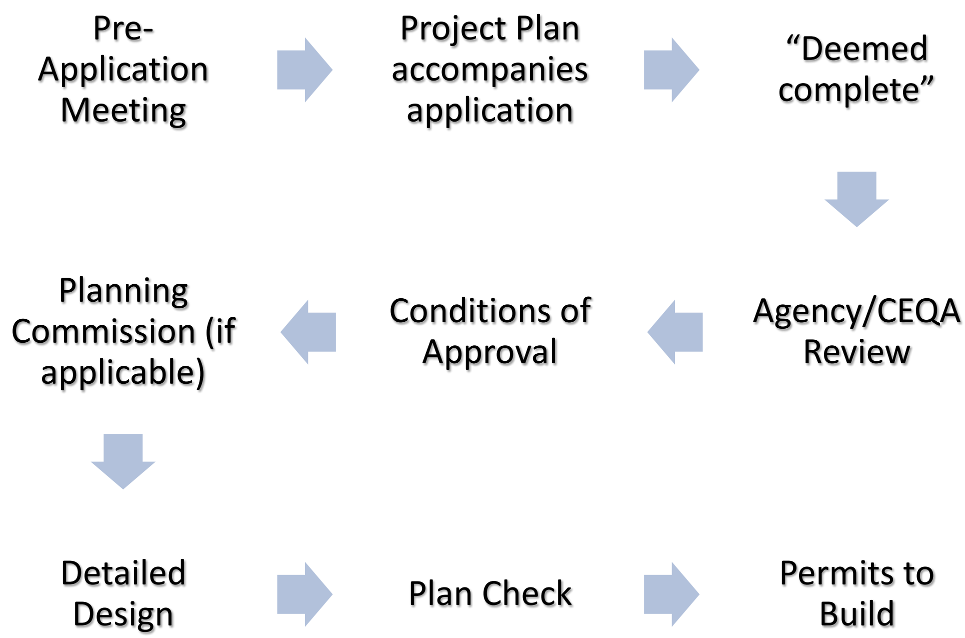

Figure 2-3. General Project Plan Review and Approval Process

SECTION 3. SITE ASSESSMENT AND SITE DESIGN MEASURES

This section outlines the steps for assessing project site conditions, implementing site planning principles, and identifying applicable site design measures during the planning phase of a project to determine applicable stormwater control measures for the project. This step in the planning and design process is important for identifying project site constraints that may limit or reduce the ability of a project site to mitigate stormwater runoff associated with the stormwater design volume or flow. Conducting this step early in the planning process reduces the possibility of having to re-design the project site if the proposed stormwater control measures cannot meet the applicable requirements.

The project applicant must conduct a site assessment, integrate site planning principles, and identify applicable site design measures for Regulated and Hydromodification Management Projects. For Small Projects, the project applicant must implement at least one site design measure. While not required by the Phase II Permit, it is recommended that Small Projects identify and implement applicable site planning principles to maximize management of post-construction stormwater runoff.

3.1. Assessing Site Conditions and Other Constraints

Assessing the applicable stormwater control measures to implement at a project site requires the review of existing information and collection of site-specific data. In assessing the project site, the project applicant must identify the following:

- Project location and description;
- Project area size (acreage), including pre-and post-construction impervious surface area;
- Delineated drainage management areas (DMAs) (see Section 3.2);
- Location of point(s) of stormwater runoff discharge from the project site (e.g., storm drain system, receiving water);
- Land use types;
- Activities expected on-site;
- Geotechnical conditions; and
- Other site considerations and constraints.

The project area size, DMAs, and point(s) of discharge of stormwater runoff are important factors for sizing and determining the placement of stormwater runoff conveyance and/or stormwater control measures. Information on the land use type(s) and activities expected to be conducted on-site before, during, and after construction is used to identify potential pollutants of concern that may be present in stormwater runoff from the project site. Determining geotechnical conditions and other potential site conditions and constraints is critical in identifying potential impacts to site layout and feasibility, selection, sizing, and placement of stormwater control measures.

Geotechnical Conditions

An investigation, which must be conducted by or under the supervision of a competent, licensed professional (e.g., civil engineer, geotechnical engineer, engineering geologist, landscape architect, land surveyor), of geotechnical conditions at the project site must be conducted and, at a minimum, considers the following conditions, which are discussed in further detail below:

- Topography;
- Soil type and geology;
- Groundwater;
- Other geotechnical issues; and
- Setbacks.

The geotechnical investigation must be conducted in accordance with the requirements or standards, including, but not limited to, approved investigation, evaluation, and testing methodologies, of the jurisdictional Agency. Available geologic or geotechnical reports on local geology may be used to aid and supplement the investigation of the geotechnical conditions at the project site. These available reports may identify relevant features such as depth to bedrock, rock type, lithology, faults, hydrostratigraphic or confining units, historic groundwater levels, areas of shallow groundwater, and past soil and groundwater issues (e.g., contamination).

If required by the Agency, a Site Conditions Report, which addresses and discusses relevant findings, must be prepared by or under the supervision of a competent, licensed professional and submitted as part of the Project Stormwater Plan. If a geotechnical report is required for the project, the Site Conditions Report may be included as part of the geotechnical report.

Topography

The project site topography must be evaluated for surface drainage patterns, topographic high and low points, and slopes. Each of these site characteristics impacts the type(s) of stormwater control measure(s) that will be most effective for the project site. For example, infiltration-based stormwater treatment control measures are more effective on level/or gently-sloped (i.e., slopes less than 10 percent) sites and may not be feasible on steeply-sloped sites (i.e., slopes greater than 10 percent). As part of this investigation, existing topographic mapping information and data or site-specific land surveying may be necessary to obtain the required information. The Site Conditions Report must discuss potential changes in the topography of the project site that may result from the project.

Soil Type and Geology

The soil type and geologic conditions of the project site must be investigated to evaluate the potential for infiltration and identify suitable and unsuitable locations at the project site for infiltration-based stormwater treatment control measures. Resources such as the National Resources Conservation Service may be used to identify soil types and information. For this Manual, soil types are classified and defined according to **Table 3-1**.

Table 3-1. Typical Soil Types and Infiltration Rates

Type	Description	Typical Infiltration Rate (in/hr) (1)
A	Sands, gravels	>1.0
B	Sandy loams with moderately fine to moderately coarse textures	0.5-1.0
C	Silty-loams or soils with moderately fine to fine texture	0.17-0.27
D	Clays	0.02-0.10

(1) Infiltrate rates presented are adapted from multiple sources (National Resource Conservation Service, American Society of Civil Engineers, etc.).

Site-specific testing of the infiltration rate(s) of the underlying soil is required, and the infiltration rate(s) must be determined using the Double-Ring Infiltrometer standard (American Society for Testing and Materials [ASTM] D3385). Underlying soils with in-situ infiltration rates of 0.5 inches per hour (in/hr) and up to 5.0 in/hr are may be considered feasible for infiltration-based stormwater treatment control measures. For underlying soils with an in-situ infiltration rate greater than 5.0 in/hr, modifications to the design of stormwater treatment control measures may be necessary. For underlying soils with an in-situ infiltration rate less than 0.5 in/hr, the soils may need to be amended to increase the infiltration rate or infiltration-based stormwater treatment control measures may not be feasible for the project site, and alternative stormwater treatment control measures must be implemented.

Groundwater

Groundwater conditions at the project site must be evaluated prior to selecting, siting, sizing, and design stormwater control measures. The seasonal high depth to groundwater beneath the project site may preclude infiltration if less than ten (10) feet of separation is maintained between the lowest flow line or invert elevation of an infiltration structure. In all cases and if approved by the jurisdictional Agency, at least five (5) feet of separation must be maintained between the flow line or invert of an infiltration structure and the seasonal high groundwater or mounded groundwater levels.

Regional groundwater information and data[3] may be used in lieu of site-specific groundwater information if it shows that at least ten (10) feet of separation can be maintained between the lowest flow line or invert elevation of an infiltration structure. For project sites that have less than ten (10) feet of separation between the seasonal high groundwater depth and the lowest flow line or invert of an infiltration structure, site-specific groundwater information and data are required as part of the Site Conditions Report. In the Site Conditions Report, the project applicant must demonstrate that the minimum groundwater separation will be maintained and that the implementation of infiltration-based stormwater treatment control measures will not cause mounding. The Site Conditions Report must also discuss potential changes in the groundwater conditions that may be result from the proposed project.

Areas with known groundwater impacts include sites listed by the Central Valley Regional Water Board's Leaking Underground Fuel Tank (LUFT) Program and Spills, Leaks, Investigations, and Cleanups (SLIC) Program. The State Water Board also maintains a database of registered contaminated sites through its Geotracker Program. For projects located in areas with known groundwater pollution, modifications to the design of stormwater treatment control measures may be necessary to prevent the potential mobilization of the groundwater contamination.

For project sites where there may be high groundwater levels or if there are known groundwater or soil impacts, alternative stormwater treatment control measures may need to be implemented (see Section 6.2, Allowed Variations for Special Site Conditions).

Note that groundwater conditions do not preclude the project applicant from implementing applicable stormwater control measures for a project site.

Other Geotechnical Issues

Infiltration of stormwater runoff can also cause geotechnical issues, including, but not limited to, settlement through collapsible soil, expansive soil movement, slope instability, and increased liquefaction hazard, due to a temporary increase in groundwater levels near infiltration-based stormwater treatment control measures. Increased water pressure in soil pores reduces soil strength, which can make foundations more susceptible to settlement and slopes more susceptible to failure.

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[3] Supplemental groundwater information and data may be available from the Eastern San Joaquin County Groundwater Basin Authority (gbawater.org/home, last accessed June 30, 2015), California Department of Water Resources Groundwater (water.ca.gov/groundwater, last accessed June 30, 2015), California Department of Water Resources Water Data Library (water.ca.gov/waterdatalibrary, last accessed June 30, 2015), and/or State Water Resources Control Board Geotracker (geotracker.waterboards.ca.gov, last accessed June 30, 2015).

The geotechnical investigation must identify potential geotechnical issues and geological hazards that may result from implementing stormwater treatment control measures. Recommendations from the geotechnical engineer may be based on soils boring data, drainage patterns, and proposed plan for stormwater management (e.g., if infiltration is used, the anticipated stormwater design volume). These recommendations are essential to preventing damage from increased subsurface water pressure on surrounding properties, public infrastructure, sloped banks, and even mudslides. Relevant findings from these investigations must be presented and discussed in the Site Conditions Report.

Setbacks

The site assessment must also identify any required setbacks between stormwater control measures and property lines, public right-of-way, building foundations, slopes, drinking water wells, waterbodies, etc. The project applicant must confer with the jurisdictional Agency to identify all applicable setback requirements.

Other Site Considerations and Constraints

Managing Off-Site Drainage

Concentrated flows from off-site drainage may cause erosion if it is not properly conveyed through or around the project site or otherwise managed. The locations and sources of off-site run-on onto the project site must be identified and considered when identifying appropriate stormwater control measures so that the run-on can be properly managed. By identifying the locations and sources of off-site drainage, the volume of stormwater run-on may be estimated and factored into the siting and sizing of stormwater control measures at the project site.

Existing Utilities

Existing utilities located at a project site may limit the possible locations of stormwater control measures. For example, infiltration-based stormwater treatment control measures cannot be located near utility lines where an increased volume of water could damage utilities. The proximity of water supply wells, septic systems (and its expansion area), and underground storage tanks must also be identified for the project site. Stormwater runoff must be directed away from existing underground utilities, and project designs that require relocation of existing utilities should be avoided, if possible.

Environmentally-Sensitive Areas (ESAs)

The presence of ESAs at or near the project site may limit the siting of certain stormwater control measures, such as facilities that do not provide sufficient treatment of pollutants of concern. ESAs are typically delineated by, and fall under the regulatory oversight of state and federal agencies (e.g., United States Army Corps of Engineers, California Department of Fish and Wildlife or United States Fish and Wildlife Service, California Environmental Protection Agency). Stormwater control measures must be selected and appropriately sited to avoid adversely affecting ESAs.

3.2. Drainage Management Areas

The Phase II Permit requires that the project applicant delineate discrete DMAs, which are sub-watersheds within the project site that consist of one type of surface (i.e., pervious, impervious), and manage stormwater runoff from each DMA. The four types of DMAs are:

- Self-treating areas: These are landscaped or turf areas or natural conserved areas (i.e., pervious surfaces) where precipitation that falls onto these areas infiltrates directly into the soil. Stormwater runoff from these areas is treated by the vegetation and its volume is minimized through evapotranspiration and infiltration. Self-treating areas do not receive stormwater runoff from impervious surfaces. These areas are not required to drain to a bioretention facility. There should be minimal slope in these areas to ensure that stormwater runoff will effectively infiltrate into the vegetation and soil.
- Self-retaining areas: These are landscaped or turf areas (i.e., pervious surfaces) where the site layout or topography allows or encourages ponding. Self-retaining areas can be created on flat, heavily landscaped sites by using berms or a depressed grade to create a concaved area that can be used to retain stormwater runoff. Stormwater runoff from impervious surfaces may be directed to self-retaining areas, provided the self-retaining area has been designed to retain the stormwater runoff volume.
- Areas draining to self-retaining areas: Stormwater runoff from impervious surfaces can be managed by routing and dispersing it into self-retaining areas. The ratio of the impervious to pervious surface areas is dependent on the permeability of the soil in the self-retaining area. A high ratio may result in extended ponding of the self-retaining area and should be avoided to prevent vector issues.
- Areas draining to facilities designed to infiltrate, evapotranspire, or bioretain: The areas that drain to a facility that is designed to infiltrate, evapotranspire, or bioretain are used to size the facility (Section 6). More than one DMA can drain to the same facility, but a DMA can drain to only one facility. Ideally, all impervious surfaces should be directed to a facility that is designed to infiltrate, evapotranspire, and bioretain.

The Project Stormwater Plan must include a map/diagram identifying each DMA for the project site.

3.3. Pollutants of Concern

Urbanization can result in an increased discharge of pollutants to receiving waters. Pollutants of concern for a project site depend on the following factors:

- Project location;
- Land use and activities that have occurred on the project site in the past;

- Land use and activities that are likely to occur in the future; and
- Receiving water impairments.

As land use activities and stormwater management practices evolve, particularly with increased incorporation of stormwater control measures, characteristic stormwater runoff concentrations and pollutants of concern from various land use types are also likely to change. Common post-construction pollutants of concern based on typical land use activities are presented in **Table 3-2**.

As part of the Project Stormwater Plan, the project applicant must identify potential pollutants of concern that may be present at the project site prior to, during, and following construction. If necessary, the project applicant may be required to implement appropriate source control measures and/or stormwater treatment control measures to mitigate and/or eliminate the pollutants of concern in stormwater runoff.

Table 3-2. Typical Pollutants of Concern and Sources for Post-Construction Areas

Pollutant	Potential Sources
Sediment (total suspended solids and turbidity)	Streets, landscaped areas, driveways, roads, construction activities, atmospheric deposition, soil erosion (channels and slopes)
Pesticides and herbicides	Residential lawns and gardens, roadsides, utility right-of-ways, commercial and industrial landscaped areas, soil wash-off, past agricultural activities
Organic materials/oxygen demanding substances	Residential laws and gardens, commercial landscaping, animal waste
Metals	Automobiles, bridges, atmospheric deposition, industrial areas, soil erosion, metal surfaces, combustion processes
Oil and grease, organics associated with petroleum	Roads, driveways, parking lots, vehicle maintenance areas, gas stations, illicit dumping to storm drains, automobile emissions, and fats, oils, and grease from restaurants
Bacteria and viruses	Lawns, roads, leaking sanitary sewer lines, sanitary sewer cross-connections, animal waste (domestic and wild), septic systems, homeless encampments, sediments/biofilms in storm drain system
Nutrients	Landscape fertilizers, atmospheric deposition, automobile exhaust, soil erosion, animal waste, detergents
Trash and debris (gross solids and floatables)	Trash management areas, including dumpsters, trash enclosures, and trash cans, typically from commercial, industrial, and high-density residential developments

Source: Adapted from Preliminary Data Summary of Urban Storm Water BMPs (USEPA, 1999); and Final Staff Report Amendments to the Water Quality Control Plan for the Ocean Waters of California to Control Trash and Part 1 Trash Provisions of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, and Estuaries of California (State Water Board, 2015).

3.4. Site Planning Principles

Project applicants must implement a holistic approach to site design in order to develop a more hydraulically-functional site, help to maximize the effectiveness of LID, and integrate stormwater management throughout the project site. The use of multi-disciplinary approach that includes planners, engineers, landscape architects, and architects for site planning can facilitate and ensure that applicable requirements are met. The Phase II Permit (Provision E.12.e.(ii)(a)) identifies the following site planning principles that must be considered, and implemented if feasible, to increase the effectiveness of managing post-construction stormwater runoff at the project site:

- Define the development envelope and protected areas and identify areas that are most suitable for development and areas to be left undisturbed.
- Concentrate development on portions of the site with less permeable soils and preserve areas that can promote infiltration.
- Limit overall impervious coverage of the site with paving and roofs.
- Set back development from creeks, wetlands, and riparian habitats.
- Preserve significant trees.
- Conform the site layout along natural landforms.
- Avoid excess grading and disturbance of vegetation and soils.
- Replicate the site’s natural drainage patterns.
- Detain and retain stormwater runoff throughout the site.

Other site planning principles that may be considered, and implemented if feasible, include the following:

- Use vegetated swales to convey stormwater runoff instead of paved gutters.
- Use alternative building materials instead of conventional materials for the project. Studies have indicated that metal used as roofing material, flashing, gutters, siding, and/or fences can leach metals into the environment.
- Identify flood control requirements early in the design stages. Stormwater treatment control measures designed in compliance with this Manual are not designed to manage stormwater runoff in excess design storm event (Section 5). Additional measures will need to be implemented to manage flood-related flow rates in accordance with Agency and state standards.

3.5. Site Design Measures

Site design measures can protect sensitive environmental features such as riparian areas, wetlands, and steep slopes. The intention of site design principles is to reduce pollution, stormwater runoff peak flows and volumes, and other impacts associated with development. All projects subject to this Manual (see Section 1.4) must apply site design measures to reduce stormwater runoff from the project site. For Small Projects, a project applicant is required to implement at least one site design measure. For Regulated and Hydromodification Management Projects, a project applicant must implement site design measures to the extent technically feasible to help meet the numeric sizing criteria for stormwater retention and treatment under Provision E.12.e(ii)(c) of the Phase II Permit.

The Phase II Permit identifies the following site design measures[4] that must be considered for each project:

- Stream setbacks and buffers;
- Soil quality improvement and maintenance;
- Tree planting and preservation;
- Rooftop and impervious area disconnection;
- Porous pavement;
- Vegetated swales; and
- Rain barrels and cisterns.

The following sections present information for implementing these site design measures.

Stream Setbacks and Buffers

Setbacks for development projects are required to prevent discharge directly into receiving waters. Stream setbacks and buffers are areas at a project site that are left undeveloped and pervious in order to prevent stormwater runoff from flowing directly from impervious surfaces into a stream or other waterbody. These buffer areas can reduce the volume of stormwater runoff, reduce peak stormwater runoff flow rates, and provide some treatment and removal of pollutants in stormwater runoff. If stream setbacks and buffers are implemented, the volume of stormwater runoff that may need to be managed by stormwater treatment control measures may be reduced, which also reduces sizing requirements for the stormwater treatment control measures. See Section 5.5 for calculation of stormwater volume or flow credits.

Soil Quality Improvement and Maintenance

Soil characteristics (e.g., soil type, porosity) can determine the methods that can be used at a project site to manage stormwater. These soil characteristics as well as soil

[4] The Phase II Permit also lists green roofs. This practice has been omitted from this Manual as a practice that may not be suitable due to the climate of the region and water conservation requirements. Project applicants may propose green roofs as a site design measure, but must demonstrate the water efficiency of the system.

compaction determine the feasibility of implementing stormwater treatment control measures. Soil amendments, such as compost and aeration, can improve soils and provide an environment that promotes healthy vegetation, increase storage and provide treatment of stormwater runoff as it infiltrates into the subsurface, recharge groundwater levels, reduce the needs for chemical supplements (e.g., fertilizers), and minimize erosion and sedimentation.

Because soil amendments can reduce the volume of stormwater runoff that may need to be managed by stormwater treatment control measures may be reduced, credits for may be applied for reducing the sizing requirements for the stormwater treatment control measures. See Section 5.5 for calculation of stormwater volume or flow credits.

Tree Planting and Preservation

Trees are essential to the hydrologic cycle and provide multiple benefits for stormwater management. Tree canopies provide significant precipitation interception (10-40 percent) depending on the type of tree and climate and result in a reduction in potential stormwater runoff volumes and flow rates, which can help meet hydromodification requirements. Precipitation that infiltrates near trees will be absorbed by roots and transpired. Trees also provide some pollutant removal through root uptake. Finally, trees enhance site aesthetics, increase property values, provide shading and cooling, provide erosion control, and improve air quality.

In general, consider, and implement if feasible, the following:

- Concentrate or cluster development on less sensitive areas of a project site.
- Limit clearing and grading of trees and vegetation at the project site.
- Provide adequate setbacks from structures and other infrastructure to prevent root intrusion and potential damage.
- Coordinate any necessary irrigation requirements with the site irrigation system.

When site planning, the project applicant should preserve existing trees and other vegetation at the project site. Preserving healthy existing site trees and vegetation is more effective for managing stormwater runoff than completely removing existing trees and vegetation and planting new trees and vegetation. Because trees provide a reduction in the volume and flow rate of stormwater runoff, stormwater runoff that may need to be managed by stormwater treatment control measures, including sizing requirements may be reduced.

The project applicant can also complement existing trees and vegetation with new climate-appropriate trees and vegetation as part of the project to provide additional stormwater management benefits. To receive these credits for stormwater management, the trees that are planted must meet the following requirements:

- Be planted within 25 feet of the DMA for which the credit is applied;
- Have a minimum 25-foot diameter at tree maturity;

- Spaced so that crowns do not overlap at 15 years of growth;

See Section 5.5 for calculation of stormwater volume or flow credits for preserving and planting trees at the project site. Note that other Agency-specific standards for tree requirements may apply.

Rooftop and Impervious Area Disconnection

Rooftop and impervious area disconnection can reduce stormwater runoff volumes and flows that enter the storm drain system. Rooftop drains can be disconnected from the storm drain system by directing stormwater runoff from rooftops across vegetation (e.g., rain garden) or other pervious surface. Rooftop drains can also be disconnected from the storm drain system by directing stormwater runoff from rooftops to systems (e.g., rain barrels, cisterns) that collect, store, and allow the use of stormwater runoff. Disconnected impervious areas are any impervious areas that drain stormwater runoff over an adjoining vegetated area or other pervious surface. When these areas are disconnected from the storm drain system, stormwater runoff that moves through the vegetated area or other pervious surface will have decreased flow rate and reduced volumes due to infiltration and evaporation.

If the vegetated area to which stormwater runoff will flow is designed, climate-appropriate vegetation that will withstand periods of inundation must be used. See Appendix H for examples of suitable vegetation. The vegetated area or pervious surface receiving the stormwater runoff must also properly drain to prevent vector breeding.

If rooftop and impervious area disconnected from the storm drain system, the volume of stormwater runoff that may need to be managed by stormwater treatment control measures may be reduced, which also reduces sizing requirements for the stormwater treatment control measures. See Section 5.5 for calculation of stormwater volume or flow credits.

Porous Pavement

Porous pavement (e.g., permeable interlocking concrete pavers, pervious concrete, or porous asphalt pavement) can be used to manage stormwater runoff by storing stormwater runoff in porous pavement and its sublayers of sand and gravel and infiltrating it into the underlying soil. Potential applications of porous pavement include, but are not limited to, sidewalks, patios, walkways, residential driveways, and parking lots. However, porous pavement may not be appropriate in heavily used areas, industrial or other locations where activities may introduce pollutants of concern, or areas where there are contaminated soils or groundwater. A geotechnical investigation, which is conducted in the Site Assessment (Section 3.1), must verify that porous pavement is technically feasible for the site. Because porous pavement relies on infiltration to mitigate stormwater runoff, regular maintenance to prevent occlusion is required to maintain the effectiveness of the porous pavement.

When implementing porous pavement:

- Establish protective perimeters around the porous pavement to prevent inadvertent compaction by construction activities. If the underlying soils are compacted, ripping or loosening the top two inches of the underlying soils prior to construction may be needed to improve infiltration.
- Protect the area designated for porous pavement from construction-related sediment loads. If possible, divert all flows around the areas intended for porous pavement. Implement sediment controls to prevent sediment from entering the porous pavement area.
- Follow all manufacturers' specifications for constructing and maintaining porous pavement.
- Stabilize the entire tributary area before allowing stormwater runoff into the porous pavement.

Use of porous pavement may reduce stormwater runoff volumes and flow rates. See Section 5.5 for calculation of credits for implementing porous pavement for a project.

Vegetated Swales

See Appendix F (Fact Sheet T-4) for more information on vegetated swales and its applications. Use of vegetated swales may reduce stormwater runoff volumes and flow rates. See Section 5.5 for calculation of stormwater volume or flow credits for implementing vegetated swales at the project site.

Rain Barrels and Cisterns

Rain barrels and cisterns are containers that collect and store precipitation from rooftop drainage systems that would otherwise be lost to stormwater runoff and diverted to the storm drain system or receiving water. Collection of this precipitation reduces the volume of stormwater runoff and reduces the potential for mobilization of pollutants. Other benefits include providing water conservation benefits and using a small footprint on a project site. Rain barrels are placed above ground beneath a shortened downspout next to a home or building and typically range in size from 50 to 180 gallons. Cisterns are larger storage tanks that may be located above or below ground.

Stored precipitation is typically used for landscape irrigation, but may also be used for washing. Water stored in rain barrels or cisterns must be emptied between storm events to prevent overflow or within 96 hours following a storm event to prevent vector breeding, but must not be discharged to the storm drain system. Rain barrels and cisterns must be properly maintained according to manufacturers' specifications to ensure continued effectiveness.

Because rain barrels and cisterns provide a reduction in the volume and flow rate of stormwater runoff, stormwater runoff that may need to be managed by stormwater treatment control measures may be reduced, including sizing requirements. See Section 5.5 for calculation of stormwater volume or flow credits for implementing rain barrels and/or cisterns at the project site.

SECTION 4. SOURCE CONTROL MEASURES

Source control measures are designed to prevent pollutants from contacting stormwater runoff or prevent discharge of contaminated stormwater runoff to the storm drain system and/or receiving water. This section describes source control measures to be considered for implementation in conjunction with appropriate non-structural source control measures, such as good housekeeping and employee training, to optimize pollution prevention. The Agencies may require additional source control measures not included in this Manual for specific pollutants, activities, or land uses for a project.

At a minimum, all projects that include landscape irrigation must implement water efficient landscape irrigation design, in accordance with all applicable landscape irrigation codes and ordinances, including, but not limited to the applicable Water Efficient Landscape Ordinance (WELO) requirements, which may change over time, as a source control measure.

Irrigation systems must be designed to conserve water and prevent water leaving the area of application. The design of irrigation system shall prevent excessive irrigation runoff by:

- Detecting and correcting leaks from the irrigation within 72 hours of discovering the leak. A pressure sensor can be incorporated to shut off the irrigation system if there is a sudden pressure drop, which may indicate a broken sprinkler head or water line;
- Properly designing and aiming sprinkler heads to only irrigate the planned application area;
- Not irrigating during precipitation events. Precipitation sensors can be installed to shut off irrigation system during and after storm events; and
- Designing and managing holding ponds for recycled water such that no discharge occurs unless it is the result of a minimum 25-year, 24-hour storm event. Any releases from holding ponds must be reported to the Central Valley Regional Water Board and the jurisdictional Agency within 24 hours of discharge.

Source control measures presented in this Manual apply to both stormwater and non-stormwater discharges. Non-stormwater discharges are discharges of any substance (e.g., excess irrigation, leaks and drainage from trash dumpsters, cooling water, and process wastewater) that is not comprised entirely of stormwater runoff. Any stormwater runoff that is mixed or comingled with non-stormwater flows is considered non-stormwater. Stormwater and non-stormwater discharges to the storm drain system or receiving water may be subject to local, state, or federal permitting prior to commencing discharge. The jurisdictional Agency must be contacted prior to any discharge.

The following source control measures must be implemented to the extent technically feasible to mitigate pollutant mobilization in stormwater and non-stormwater runoff from the project site:

- Parking/storage areas and maintenance;
- Landscape/outdoor pesticide use;
- Building and grounds maintenance;
- Refuse areas;
- Outdoor storage of equipment or materials;
- Vehicle and equipment cleaning;
- Vehicle and equipment repair and maintenance;
- Fuel dispensing areas;
- Pools, spas, ponds, decorative fountains, and other water features;
- Indoor and structural pest control;
- Accidental spills and leaks;
- Restaurants, grocery stores, and other food service operations;
- Interior floor drains;
- Industrial processes;
- Loading docks;
- Fire sprinkler test water;
- Drain or wash water from boiler drain lines, condensate drain lines, rooftop equipment, drainage sumps, and other sources; and
- Unauthorized non-stormwater discharges.

Fact sheets for each source control measure are presented in Appendix E. These fact sheets include pollution prevention activities, Best Management Practices, design considerations, and maintenance requirements to ensure effective implementation of the source control measure.

SECTION 5. STORMWATER DESIGN VOLUME/FLOW CALCULATION

5.1. Introduction

The requirements of the Phase II Permit are based on managing a specific volume or flow of stormwater runoff from the project site (stormwater design volume [SDV] or stormwater design flow [SDF]). By treating the SDV/SDF, it is expected that pollutant loads, which are typically higher at the beginning of storm events, will be prevented from or reduced in the discharge into the receiving waters. Additionally, treating the SDV/SDF will also reduce peak flow rates, which can reduce downstream impacts to the receiving water. This section presents information on how to calculate the SDV and/or SDF for a project site that is used in designing stormwater treatment control measures. The design standards for stormwater management outlined in this section do not meet applicable flood control requirements.

5.2. Stormwater Design Volume

All stormwater treatment control measures, based on the SDV, must mitigate (infiltrate or treat) the volume of stormwater runoff produced by the 85th percentile, 24-hour storm event based on historic rainfall records, determined as the maximized capture stormwater volume for the tributary area, from the formulae recommended in *Urban Runoff Quality Management, WEF Manual of Practice No. 23/ASCE Manual of Practice No. 87* (1998). This approach uses the following two regression equations to calculate the unit stormwater volume, which is multiplied by the area of the DMA to calculate the SDV for sizing volume-based stormwater treatment control measures:

$$C = 0.858 \times i^3 - 0.78 \times i^2 + 0.774 \times i + 0.04$$

Where:

C = stormwater runoff coefficient [unitless]; and
i = DMA imperviousness ratio [expressed as a decimal].

$$P_0 = (a \times C) \times P_6$$

Where:

P_0 = unit stormwater volume [in];
a = regression constant (1.963 for 48-hr drawdown); and
P_6 = mean annual runoff-producing rainfall depth [in] (see **Table 5-1**).

For the Agencies, except the County of San Joaquin, the mean annual runoff-producing rainfall depth, based on historic records and the NetSTORM model[5], to be used for calculating the unit stormwater volume in the region are presented in **Table 5-1**. For projects located in the jurisdiction of the County of San Joaquin, the mean annual runoff-producing rainfall depth presented in **Table 5-1** may be used if the project is near the project locations. For projects located in the jurisdiction of the County of San Joaquin that are not located in the areas identified in **Table 5-1**, the project applicant must determine the mean annual runoff-producing rainfall depth, based on historic records, for the project location. The mean annual runoff-producing rainfall depth was determined by assuming a minimum 0.1-inch storm event with a 24-hour inter-storm event period was required to produce stormwater runoff.

Table 5-1. Mean Annual Runoff-Producing Rainfall Depth

Project Location	Mean Annual Runoff-Producing Rainfall Depth	Rain Gage
Lathrop	0.36	Global Historic Climatology Data Network Station USW00023237
Lodi	0.33	Global Historic Climatology Data Network Station US1CASJ0005
Manteca	0.37	California Irrigation Management System Station #70
Patterson	0.32	Global Historic Climatology Data Network Station USC00046168
Stockton	0.36	Global Historic Climatology Data Network Station USW00023237
Tracy	0.33	California Irrigation Management System Station #167

The SDV for each DMA is calculated using the following equation:

$$SDV = A \times \frac{P_0}{12}$$

Where:

SDV = stormwater design volume [ft^3];
A = total area of DMA [ft^2]; and
P_0 = unit stormwater volume [in].

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[5] The NetSTORM computer program, which was developed by CDM Smith, was used to conduct precipitation intensity, duration, and frequency analysis. This program was also used in the development of the California Association of Stormwater Agencies (CASQA) Stormwater Best Management Practices (BMP) Handbooks.

If necessary, the project applicant must also consider run-on from areas surrounding the project site as part of the determination of the SDV.

5.3. Stormwater Runoff Coefficient

Projects typically comprise of a variety of site elements that have variable associated stormwater runoff coefficients. The stormwater runoff coefficient is a function of roughness and permeability across the surface which stormwater runoff drains. Stormwater runoff coefficients based on soil type for typical site elements that will be used to calculate the SDF are presented in **Table 5-2**.

Table 5-2. Stormwater Runoff Coefficients for Typical Site Elements

Site Element	Stormwater Runoff Coefficient (C_r) (1)	
	Type A and B Soils	Type C and D Soils
Agricultural	0.25 (2)	0.45 (2)
Asphalt/concrete pavement	0.95	0.95
Disturbed soil	0.18	0.25
Forest/undisturbed open space	0.03	0.05
Gravel pavement	0.35	0.35
Managed turf	0.18	0.25
Permeable pavement	(3)	(3)
Roofs	0.95	0.95

(1) Source: Adapted from the Center for Watershed Protection, Ellicott City, Maryland.

(2) Source: Adapted from *The Erosion and Sediment Control Handbook* (Stephen Goldman, et al., 1986).

(3) Varies with product type. Consult manufacturer for appropriate design values.

5.4. Stormwater Design Flow

Stormwater treatment control measures, based on the SDF, must mitigate (infiltrate or treat) the flow rate of stormwater runoff produced by a rain event equal to at least 0.2 in/hr intensity. The Rational Method is used to calculate the SDF according to the following equation:

$$SDF = 1.008 \times i \times A \times C_r$$

Where:

SDF = stormwater design flow [ft^3/s];
1.008 = unit conversion factor;
i = design rainfall intensity [0.2 in/hr];
A = total area of DMA [acre]; and
C_r = stormwater runoff coefficient for DMA (see **Table 5-2**).

5.5. Post-Construction Stormwater Runoff Reduction Calculators

The State Water Board developed a Post-Construction Calculator[6] to quantify the stormwater runoff reduction resulting from implementation of site design measures. Instructions for using the Post-Construction Calculator are available in the calculator spreadsheet. The Post-Construction Calculator is located on the State Water Board website at:
http://www.swrcb.ca.gov/water_issues/programs/stormwater/phase_ii_municipal.shtml.

For Small Projects, the project applicant must use the Post-Construction Calculator to quantify the stormwater runoff reduction from implementing site design measures. The results of these calculations must be submitted with the Project Stormwater Plan.

For Regulated and/or Hydromodification Management Projects, the project applicant can use the Post-Construction Calculator to quantify the stormwater runoff volume or flow reduction resulting from implementing site design measures. The stormwater runoff reduction resulting from implementing site design measures, to the extent technical feasible, is a credit that reduces the amount of stormwater runoff volume or flow that must be further treated by stormwater treatment control measures (i.e., bioretention, alternative stormwater treatment control measures) for the DMA. By reducing the amount of stormwater runoff that requires additional treatment, the size of the stormwater treatment control measure will also be reduced. It may be possible to completely manage stormwater runoff from the project site using site design measures, thereby potentially eliminating the need to include stormwater treatment control measures at the project site.

The output of the Post-Construction Calculator for each DMA must be submitted with the Project Stormwater Plan.

[6] Although the Post-Construction Calculator states that it is for Small Projects, it is the same calculator that is used for Regulated and Hydromodification Management Projects.

SECTION 6. STORMWATER TREATMENT CONTROL MEASURES

6.1. Introduction

Stormwater treatment control measures are required for Regulated and Hydromodification Management Projects to augment site design and source control measures to treat and reduce stormwater runoff and pollution loads that are potentially discharged to the receiving water to the extent technically feasible. Stormwater treatment control measures are designed to handle the frequent, smaller storm events, or the first flush stormwater runoff from larger storm events. The first flush of larger storm events is the initial period of the storm where stormwater runoff typically carries the highest concentration and loads of pollutants. Small, frequent storm events represent most of the total annual average precipitation in the Agencies' service area.

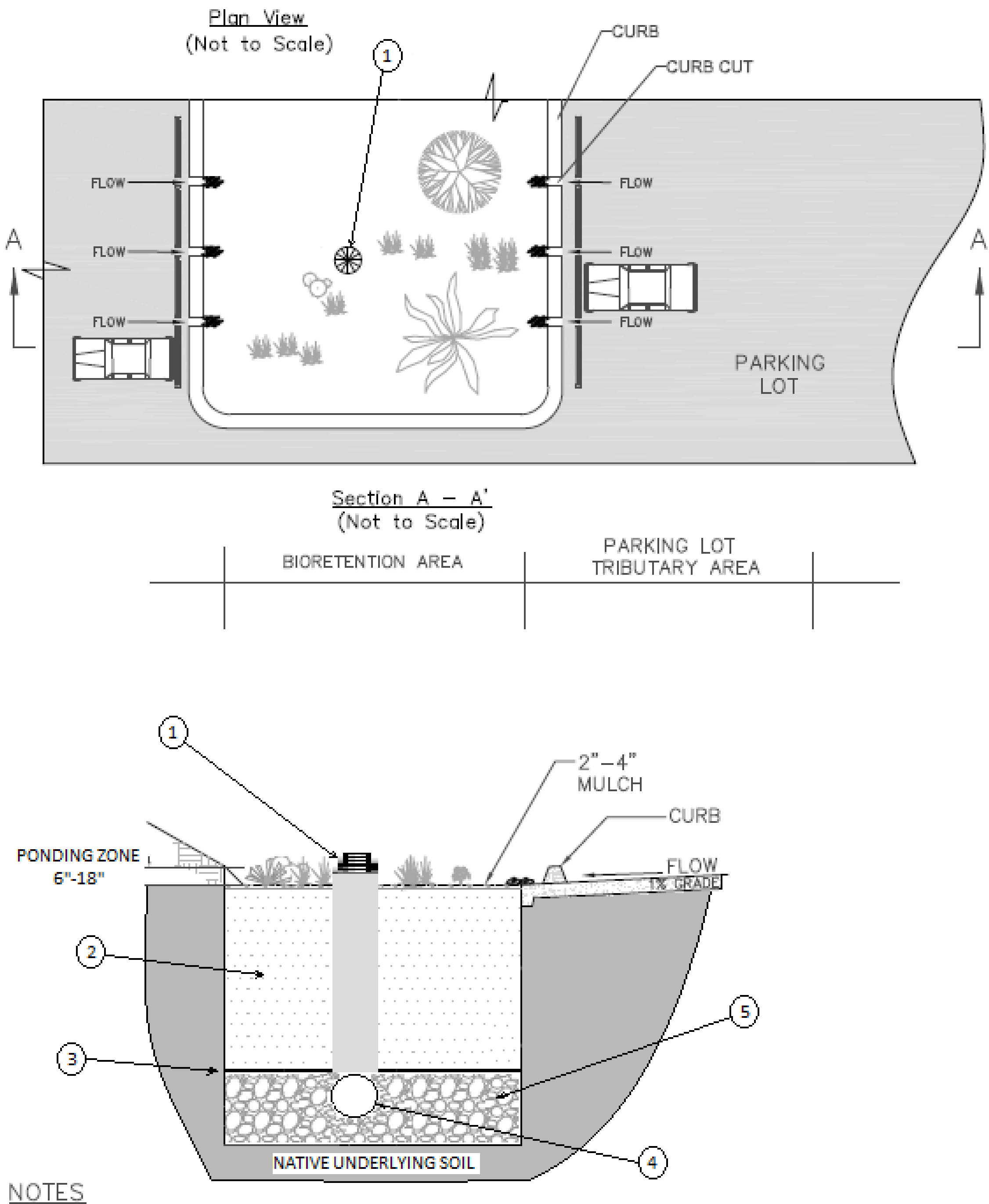
The Phase II Permit requires that all Regulated and Hydromodification Management Projects use stormwater treatment control measures to manage the portion of the SDV or SDF that is not reduced by site design measures. If a project site is able to manage the entire SDV or SDF using site design measures, stormwater treatment control measures may not be necessary.

The Phase II Permit (Provision E.12.e.(f)) identifies bioretention as the standard stormwater treatment control measure unless (1) an alternative treatment control measure that is equivalent to bioretention is proposed and demonstrated (Provision E.12.e.(g)), or (2) a specific exception applies (Provision E.12.e.(i)). The following section describes how to implement bioretention at a project site.

6.2. Bioretention

A bioretention facility, which is an LID stormwater control measure, is a vegetated shallow depression that is designed to receive, retain, and infiltrate stormwater runoff from downspouts, piped inlets, or sheet flow from adjoining impervious areas. A shallow ponding zone above the vegetated surface provides temporary storage of stormwater runoff. During storm events, stormwater runoff accumulates in the ponding zone and gradually infiltrates and filters through the engineered planting media before infiltrating into the underlying soil. Vegetation also holds water in the root zone that can be returned to the atmosphere by transpiration. Bioretention facilities are typically planted with climate-appropriate vegetation that do not require fertilization and can withstand periodic wet soils.

An example schematic of a typical bioretention area is presented in **Figure 6-1**.



NOTES

1. OVERFLOW DEVICE: VERTICAL RISER OR EQUIVALENT
2. 1.5' PLANTING MEDIA; 3' PREFERRED. PLANTING MEDIA SPECIFICATIONS PER BIORETENTION TECHNICAL SPECIFICATIONS
3. 2-4" CALTRANS CLASS 2 PERMEABLE MATERIAL (PLANTING MEDIA/GRAVEL LAYER SEPARATION ZONE)
4. PERFORATED 6" MIN PVC SDR 26 OR C900
5. 1' MIN 1"-2.5" DIAMETER STONE

Figure 6-1. Example Bioretention Facility Schematic

Design Criteria

The following sections describe the minimum design criteria for bioretention facilities.

Geotechnical

Due to the potential to contaminate groundwater and/or soils, cause slope instability, impact surrounding structures, and potential for insufficient infiltration capacity, a geotechnical investigation must be conducted during the site assessment process to verify the site suitability for bioretention. It is critical to understand how stormwater runoff will move through the soil (horizontally and vertically) and if there are any geological conditions that may inhibit the movement of water. Soil infiltration rates and the depth to the groundwater table must be evaluated to ensure that conditions are satisfactory for proper operation of a bioretention system. Bioretention facilities cannot be located on sites with a slope greater than 10 percent. A Site Conditions Report summarizing the relevant findings from the geotechnical investigation must be submitted with the Project Stormwater Plan.

Setbacks

Applicable setbacks must be implemented when siting a bioretention facility.

Pretreatment

Pretreatment, which refers to design features that provide settling of large particles before stormwater runoff enters a stormwater treatment control measure, is important to ensure proper operation of a bioretention facility and reduce the long-term maintenance burden. Pretreatment (e.g., vegetated swales, proprietary devices) must be provided to reduce the sediment load entering a bioretention facility in order to prevent the engineered planting media and/or underlying soil from being occluded prematurely and maintain the infiltration rate of the bioretention facility. Additionally for sites with high infiltration rates, pretreatment is required to protect groundwater quality.

Flow Entrance and Energy Dissipation

The DMA(s) tributary to a bioretention facility must be graded to minimize erosion as stormwater runoff enters the facility by creating sheet flow conditions rather than a concentrated stream condition or by providing energy dissipation devices at the inlet. Typically, a minimum slope of 1 percent for pervious surfaces and 0.5 percent for impervious surfaces to the inlet of the bioretention facility should be maintained. The following types of flow entrances can be used for bioretention facilities:

- Level spreaders (e.g., slotted curbs) can be used to facilitate sheet flow.
- Dispersed low velocity flow across a landscaped area. Dispersed flow may not be possible given space limitations or if the bioretention facility controls roadway or parking lot flows where curbs are mandatory.

- Dispersed flow across pavement or gravel and past wheel stops for parking areas.
- Flow spreading trench around perimeter of the bioretention facility that may be filled with pea gravel or vegetated with 3:1 side slopes.
- Curb cuts for roadside or parking lot areas. Curb cuts must include rock or other erosion controls in the channel entrance to dissipate energy. The flow entrance should drop two to three inches from curb line and provide an area for settling and periodic removal of sediment and coarse material before flow disperses to the remainder of the bioretention facility.
- Piped entrances, such as roof downspouts, must include rock, splash blocks, or other erosion controls at the entrance to dissipate energy and disperse flows.

Drainage

Bioretention facilities provide stormwater runoff storage in the ponding zone and in the voids of the planting media and gravel layers and must completely drain into the underlying soils within 48 hours. The planting media and gravel layers and underlying soils must be allowed to dry out periodically in order to restore hydraulic capacity to receive stormwater runoff from subsequent storm events, maintain infiltration rates, maintain adequate soil oxygen levels for healthy soil biota and vegetation, and provide proper soil conditions for biodegradation and retention of pollutants.

Sizing

<u>Step 1: Determine the Adjusted SDV (SDV_{adj})</u>

Bioretention facilities are designed to capture and retain the SDV_{adj}, which is the difference between the SDV (Section 5.2) and the volume of stormwater runoff managed through site design measures (Section 5.5), for the tributary DMA(s).

<u>Step 2: Determine the design infiltration rate</u>

Determine the in-situ infiltration rate of the underlying soil using the Double-Ring Infiltrometer standard (ASTM D3385). Apply a safety factor to the in-situ infiltration rate to determine the design infiltration rate. A typical safety factor of 4 can be used (i.e., multiply in-situ infiltration rate by 0.25). The design infiltration rate (f_{design}) must be between 0.5 and 5.0 in/hr. Amending the underlying soil may improve the flow of stormwater runoff into the underlying soil if the design infiltration rate is less than 0.5 in/hr. If the infiltration rate of the underlying soil is greater than 5.0 in/hr, an underdrain may not be necessary. The infiltration rate will decline between maintenance cycles as the surface of the bioretention facility becomes occluded and particulates accumulate in the infiltrative layer.

<u>Step 3: Determine size of bioretention facility design layers</u>

Bioretention facilities consist of multiple layers that are designed to retain stormwater runoff. The design depths, which are used to size the bioretention facility, are presented in **Table 6-1**. Other design parameters for these layers are discussed in further detail in the following sections.

Table 6-1. Design Depths of Bioretention Facility Layers

Bioretention Facility Layer	Design depth
Ponding zone	0.5-1.5 ft
Planting media (excluding the mulch layer, if provided)	1.5-3.0 ft
Planting media/gravel layer separation zone (1)	2-4 in
Gravel	1 ft (min)

(1) In calculating the required bottom surface area of the bioretention facility, the planting media/gravel layer separation zone is not considered because it is designed primarily to separate the planting media and gravel layer and not to retain stormwater runoff.

Step 4: Calculate the bottom surface area of the bioretention facility

Determine the bottom surface area (surface area at the base of side slopes, not at the top of side slopes) of the bioretention facility using the following equation:

$$A = \frac{SDV_{adj}}{d_{pz} + (\eta_{pm} \times d_{pm}) + (\eta_{gl} \times d_{gl})}$$

Where:

A = bottom surface area of bioretention facility [ft^2];
SDV_{adj} = adjusted stormwater design volume [ft^3];
d_{pz} = depth of ponding zone (0.5-1.5 ft) [ft];
η_{pm} = porosity of planting media [unitless];
d_{pm} = depth of planting media (min 1.5 ft) [ft];
η_{gl} = porosity of gravel layer [unitless]; and
d_{gl} = depth of gravel layer (min 1 ft) [ft].

The total depth of the bioretention facility must meet the following condition to ensure that the stormwater runoff will be infiltrated within the maximum drawdown time:

$$d_{pz} + (\eta_{pm} \times d_{pm}) + (\eta_{gl} \times d_{gl}) \leq \frac{f_{design}}{12} \times t_{max}$$

Where:

d_{pz} = depth of ponding zone (0.5-1.5 ft) [ft];
η_{pm} = porosity of planting media [unitless];
d_{pm} = depth of planting media (min 1.5 ft) [ft];
η_{gl} = porosity of gravel layer [unitless];

d_{gl} = depth of gravel layer (min 1 ft) [ft]
f_{design} = design infiltration rate [in/hr]; and
t_{max} = drawdown time (max 48 hrs) [hr].

For the site layout and planning purposes, the top surface area, which can be calculated from the bottom surface area and slopes of the bioretention facility, will need to be determined.

Planting Media Layer

The Phase II Permit requires that the planting media layer:

- Have a minimum depth of 1.5 feet, excluding the mulch layer, if provided;
- Achieve a long-term, in-place minimum infiltration rate of at least 5 in/hr to support maximum stormwater runoff retention and pollutant removal; and
- Consist of 60 to 70 percent sand meeting the specifications of the ASTM C33 and 30 to 40 percent compost.

Compost must be a well-decomposed, stable, weed-free organic matter source derived from waste materials including yard debris, wood wastes, or other organic material and not including manure or biosolids meeting standards developed by the US Composting Council (USCC). The product must be certified through the USCC Seal of Testing Assurance (STA) Program (a compost testing and information disclosure program).

Mulch is recommended for the purpose of retaining moisture, preventing erosion, and minimizing weed growth. Projects subject to the California Model Water Efficiency Landscaping Ordinance (or comparable local ordinance) will be required to provide at least two inches of mulch. Aged mulch, also called compost mulch, reduces the ability of weeds to establish, keeps soil moist, and replenishes soil nutrients. If mulch is used for a bioretention facility, two to four inches (average three inches) of mulch should be used at the initiation of the facility. Annual placement (preferably in June after weeding) of one to two inches of mulch beneath plants will maintain the mulch layer.

Planting Media/Gravel Layer Separation Zone

The planting media and gravel layer must be separated by a permeable 2-4 inch layer of sand and stone that meets the grading requirements in **Table 6-2** to prevent migration of the planting media into the gravel layer.

Table 6-2. Planting Media/Gravel Layer Separation Layer Grading Requirements

Sieve Size	Percent Passing
1”	100
3/4”	90-100
3/8”	40-100
No. 4	25-100
No. 8	18-33
No. 30	5-15
No. 50	0-7
No. 200	0-3

Source: Caltrans Standard Specifications (2010) Class 2 Permeable Material

Gravel Layer

The gravel layer must consist of washed 1- to 2.5-inch diameter stone with a minimum 1-foot depth.

Underdrain

If necessary, an underdrain may be included in the design of a bioretention facility to convey treated stormwater runoff for further treatment, to the storm drain system, or to the receiving water. The underdrain must have a discharge elevation at the top of the gravel layer and a mainline diameter of six inches using slotted PVC SDR 26 or C900. The slotted PVC allows for pressure cleaning and root cutting, if necessary. The slotted pipe should have two to four rows of slots cut perpendicular to the axis of the pipe or at right angles to the pitch of corrugations. Slots should be 0.04 to 1 inches wide with a length of 1 to 1.25 inches. Slots should be longitudinally-spaced such that the pipe has a minimum of one square inch opening per lineal foot and should face down. Underdrains should be sloped at a minimum of 0.5 percent in order to drain freely to an approved location.

The Phase II Permit (Provision E.12.e.(h)) identifies the following two allowed variations for special site conditions, which must be demonstrated by the project applicant, for underdrain placement:

- Bioretention facilities located in areas with documented high concentrations of pollutants in the underlying soil or groundwater, where infiltration may contribute to a geotechnical hazard, or on elevated plazas or other structures may locate the underdrain at the bottom of the subsurface drainage/storage layer.
- If the bioretention facility is located in areas with high groundwater, highly infiltrative soils (in-situ infiltration rate greater than 5.0 in/hr), or where connection of the underdrain to a surface drain or to a subsurface storm drain is infeasible, the underdrain may be omitted.

Observation Well

A rigid non-perforated observation pipe with a diameter equal to the underdrain diameter must be connected to the underdrain to provide a clean-out port as well as an observation well to monitor infiltration rates. If the underdrain is located at the top of the gravel layer, the observation well may also extend to the bottom of the gravel layer to monitor drainage of the gravel layer. The wells/clean-out port must be connected to the slotted underdrain with the appropriate manufactured connections. The wells/clean-outs must extend at least six inches above the top elevation of the bioretention facility mulch and be capped with a lockable screw cap. The ends of the underdrain pipes not terminating in an observation well/clean-out port must also be capped.

Vegetation

It is recommended that a minimum of three climate-appropriate types of tree, shrub, and/or herbaceous groundcover species be incorporated in a bioretention facility to protect against failure due to disease and/or insect infestations of a single species. Trees may be planted on the slopes or above the slopes of the bioretention facility (i.e., not planted in the planting media layer). All vegetation selected must be climate appropriate. Select vegetation that:

- Can tolerate summer drought, ponding fluctuations, and saturated soil conditions for 48 hours;
- Will be dense and strong enough to stay upright, even in flowing water;
- Does not require fertilizers;
- Is not prone to pests and is consistent with Integrated Pest Management (IPM) practices; and
- Is consistent with local water conservation ordinance requirements.

A sample list of suitable vegetation species is included in Appendix H. The vegetation species presented in Appendix H may not be suitable for all Agencies. The jurisdictional Agency may restrict the species list as deemed appropriate for the local environment and operational needs and conditions. Prior to installation, a landscape architect with experience in bioretention facility design must certify that all proposed vegetation is appropriate for the project site. Stormwater runoff must be diverted around the bioretention facility during the period of vegetation establishment.

Irrigation System

Provide an irrigation system to maintain viability of vegetation, if necessary. If possible, the general landscape irrigation system should incorporate the bioretention facility. The irrigation system must be designed to current local code or ordinance specifications and must comply with the requirements in Section 4. Supplemental irrigation may be required for the establishment period even if it is not needed later.

Overflow Device

An overflow device is required at the ponding depth near the inlet to the bioretention facility to divert stormwater runoff in excess of the design capacity of the bioretention facility. The following, or equivalent, should be provided:

- A vertical PVC pipe (SDR 26) to act as an overflow riser.
- The overflow riser(s) should be sized with a diameter equal to the underdrain diameter so it can be cleaned without damage to the pipe.
- The inlet to the riser must be at the ponding depth and capped with a spider cap to exclude floating mulch and debris. Spider caps must be screwed on or glued (i.e., not removable). The overflow device must convey stormwater runoff in excess of the design capacity of the bioretention facility to an approved discharge location (e.g., another stormwater treatment control measure, storm drain system, receiving water).

Hydraulic Restriction Layer (Special Site Condition only)

The Phase II Permit (Provision E.12.e.(h)) identifies an allowed variation for special site conditions, which must be demonstrated by the project applicant, for bioretention facilities located in areas with documented high concentrations of pollutants in the underlying soil or groundwater, where infiltration may contribute to a geotechnical hazard, or on elevated plazas or other structures. In these situations, a hydraulic restriction layer may be incorporated at the bottom of the gravel layer to prevent infiltration of stormwater runoff into the underlying soil. The hydraulic restriction layer should be installed generously with overlapping seams below the gravel layer of the bioretention facility prior to placing the gravel layer, planting media and gravel layer separation zone, and planting media layer. The specifications of the hydraulic restriction layer are presented in **Table 6-3**.

Table 6-3. Hydraulic Restriction Layer Specifications

Parameter	Test Method	Specifications
Material		Nonwoven geomembrane liner
Unit weight		8 oz/yd^3 (minimum)
Filtration rate		0.08 in/sec (minimum)
Puncture strength	ASTM D-751 (Modified)	125 lbs (minimum)
Mullen burst strength	ASTM D-751	400 lb/in^2 (minimum)
Tensile strength	AST D-1682	300 lbs (minimum)
Equiv. opening size	US Standard Sieve	No. 80 (minimum)

Construction Considerations

As part of the site planning process, the areas designated for bioretention must be identified. Compaction of underlying soils near and at the bioretention area at the project site must be avoided. Establish protective perimeters to prevent inadvertent compaction by construction activities.

The area identified for bioretention must be protected from construction-related sediment loads. During construction activities if possible, divert all flows around the areas intended for bioretention. Sediment control measures should also be implemented to prevent sediment from impacting the areas identified for bioretention. If the underlying soils are compacted or the area identified for a bioretention facility is occluded, ripping or loosening the top two inches of the underlying soils prior to construction of the bioretention facility may be needed to improve infiltration. After construction is completed, the entire tributary area to the bioretention facility must be stabilized before allowing stormwater runoff to enter it.

Maintenance Requirements

Regular maintenance and inspection are important for proper function of bioretention facilities. Bioretention facilities require annual plant, soil, and mulch layer maintenance to ensure optimal infiltration, storage, and pollutant removal. Bioretention facility maintenance requirements, which consist primarily of landscape care, include:

- Irrigate vegetation as needed during prolonged dry periods. In general, climate-appropriate vegetation should be selected and not require irrigation after full establishment (two to three years). Regularly inspect the irrigation system, if provided, for clogs or broken pipes and repair as necessary.
- Inspect flow entrances, ponding area, and surface overflow areas, at a minimum annually, and replace soil, vegetation, and/or mulch layer in areas if erosion has occurred. Properly-designed facilities with appropriate flow velocities should not cause erosion except possibly during extreme events. If erosion occurs, the flow velocities and gradients within the bioretention facility and energy dissipation and erosion protection strategies in the pretreatment area and flow entrance should be reassessed. If sediment is deposited in the bioretention facility, identify the source of the sediment within the tributary area, stabilize the source, and remove excess surface deposits.
- Inspect the bioretention facility after major storms to ensure that water infiltrates into the subsurface completely within the maximum drawdown time. If water is present in the bioretention facility more than 48 hours after a storm, the bioretention facility may be clogged. Maintenance activities triggered by a clogged facility include:
    - Check for debris/sediment accumulation, remove sediment (if any), and evaluate potential sources of sediment and vegetative or other debris. If suspected upstream sources are outside of the Agency’s jurisdiction, additional pretreatment may be necessary.

  - Determine if it is necessary to remove and replace the planting media and/or gravel layer to restore functionality of the bioretention facility.

- Prune and remove dead vegetation as needed. Replace all dead vegetation, and if specific vegetation has high mortality rates, assess the cause and, if necessary, replace with more appropriate species.
- Remove weeds and other invasive, poisonous, nuisance, or noxious vegetation as needed until the vegetation is established. Weed removal should become less frequent if the appropriate species are used and planting density is attained.
- Remove and properly dispose of trash and other litter.
- Select the proper soil mix and plants for optimal fertility, vegetation establishment, and growth to preclude the use of nutrient and pesticide supplements. Addition of nutrients and pesticides may contribute pollutant loads to receiving waters.
- In areas where heavy metals deposition is likely (e.g., tributary areas to industrial, vehicle dealerships/repair, parking lots, roads), replace mulch, if provided, annually. In areas where metals deposition is less likely (e.g., residential lots), replace or add mulch as needed to maintain a two- to three-inch depth at least once every two years.
- Eliminate standing water to prevent vector breeding. If standing water is observed more than 48 hours after a storm event, it may be necessary to remove and replace the planting media and/or gravel layer to restore functionality of the bioretention facility.
- Inspect, and clean if necessary, the underdrain and observation well/clean-out port. Inspect overflow devices for obstructions or debris, which should be removed immediately. Repair or replace damaged pipes upon discovery.

The Agencies require execution of and compliance with a Maintenance Access Agreement to be recorded by the property owner for the on-going operation and maintenance of any privately-maintained stormwater control measures. An example Maintenance Access Agreement is presented in Appendix G.

Variations for Special Site Conditions

The Phase II Permit (Provision E.12.e.(h)) allows for the bioretention design criteria discussed above to be modified for the following special site conditions, which must be demonstrated by the project applicant:

- Facilities located within 10 feet of structures or other potential geotechnical hazards established by a geotechnical engineer for the project may incorporate an impervious cutoff wall between the bioretention facility and the structure or other geotechnical hazard;
- Facilities with documented high concentrations of pollutants in underlying soil or groundwater, facilities located where infiltration could contribute to a geotechnical

hazard, and facilities located on elevated plazas or other structures may incorporate an impervious liner and may locate the underdrain discharge at the bottom of the subsurface drainage/storage layer (this configuration is commonly known as a “flow-through planter”);

- Facilities located in areas of high groundwater, highly infiltrative soils or where connection of underdrain to a surface drain or to a subsurface storm drain are infeasible, may omit the underdrain; and
- Facilities serving high-risk areas such as fueling stations, truck stops, auto repairs, and heavy industrial sites may be required to provide additional treatment to address pollutants of concern unless these high-risk areas are isolated from stormwater runoff or bioretention areas with little chance of spill migration.

While variations for special site conditions may be allowed, these are not exceptions for implementing bioretention or alternative stormwater treatment control measures at the project site.

Alternative Stormwater Treatment Control Measures

The Phase II Permit (Provision E.12.e.(g)) allows the use of alternative stormwater treatment control measure(s) if the project applicant demonstrates that the proposed measure meets <u>all</u> of the following measures of equivalent effectiveness criteria when compared to the bioretention standards outlined in the Phase II Permit (Provision E.12.e.(f)):

- Equal or greater amount of stormwater runoff infiltrated or evapotranspired;
- Equal or lower pollutant concentrations in stormwater runoff that is discharged after biotreatment;
- Equal or greater protection against shock loadings and spills; and
- Equal or greater accessibility and ease of inspection and maintenance.

While not specifically required in the Phase II Permit, the project applicant should also considered if a proposed alternative stormwater treatment control measure provides equal or lower pollutant loads in stormwater runoff that is discharged after treatment.

Fact sheets for alternative stormwater treatment control measures that may be proposed in the Project Stormwater Plan are included in Appendix F. Infiltration basins, infiltration trenches, and dry wells, which are each designed to infiltrate stormwater runoff, are typically accepted alternatives to bioretention. Other stormwater treatment control measures are may or may not meet the equivalent effectiveness criteria listed above. The project applicant must demonstrate, in the Project Stormwater Plan, how a proposed alternative stormwater treatment control measure meets all of the equivalent effectiveness criteria.

6.3. Exceptions to Requirements for Bioretention Facilities

The Phase II Permit (Provision E.12.e.(i)) allows specific exceptions to implementing bioretention upon demonstration by the project applicant that bioretention or alternative designs equivalent to bioretention are technically infeasible for a project. Under these situations, other types of biotreatment or media filters (e.g., tree-well filters, in-vault media filters, proprietary treatment control measures) may be used. Only Regulated and/or Hydromodification Management Projects that meet the criteria below may receive an exception from the bioretention requirements:

- Projects creating or replacing one acre or less of impervious area, and located in a designated pedestrian-oriented commercial district (i.e., smart growth projects), and having at least 85 percent of the entire project site covered by permanent structures;
- Facilities receiving stormwater runoff solely from existing (pre-project) impervious areas; and
- Historic sites, structures, or landscapes that cannot alter their original configuration in order to maintain their historic integrity.

Meeting an exception listed above does not preclude the project applicant from proposing and implementing an alternative stormwater treatment control measure to manage stormwater. The project applicant must demonstrate that the exception(s) from implementing bioretention for managing stormwater runoff and propose alternative stormwater treatment control measures applicable to the project site.

SECTION 7. HYDROMODIFICATION REQUIREMENTS

Hydromodification is the modification of hydrologic pathways (precipitation, surface runoff, infiltration, groundwater flow, return flow, surface water storage, groundwater storage, evaporation, and transpiration) that results in negative impacts to watershed health and function. The Phase II Permit requires that the project applicant determine if hydromodification requirements apply and if they do apply, what hydromodification control measures will be implemented. Baseline hydromodification requirements apply to both Regulated and Hydromodification Management Projects while full hydromodification requirements apply to only Hydromodification Management Projects. The following sections describe the baseline and full hydromodification requirements.

7.1. Baseline Hydromodification Requirements

The Phase II Permit requires that Regulated and Hydromodification Management Projects implement baseline hydromodification requirements for the design storm event. If the entire SDV/SDF is retained at the project site through site design measures and/or stormwater treatment control measures, the baseline hydromodification requirement is met. If stormwater runoff is discharged to the receiving water, hydromodification control measures (e.g., detention basin) may be required to mitigate the hydromodification impacts on the receiving water from the stormwater runoff and meet the baseline hydromodification requirements. Fact sheets for designing hydromodification control measures are presented in Appendix F (HM-1 Extended Detention Basins and HM-2 Wet Ponds).

7.2. Full Hydromodification Requirements

For Hydromodification Management Projects, which create and/or replace one acre or more of impervious surface, the Phase II Permit (Provision E.12.f) requires that the post-construction stormwater runoff flow rate not exceed the estimated pre-project flow rate for the 2-year, 24-hour design storm event. A project that does not result in a net increase of impervious surface area over the pre-project condition is not considered a Hydromodification Management Project.

Hydrologic routing modeling (e.g., USEPA's Storm Water Management Model [SWMM]) must be conducted to calculate peak stormwater runoff response time and peak project stormwater runoff rate for the entire project site for the pre- and post-construction conditions. The results of the model are then used to design hydromodification control measures (e.g., detention basins, wet ponds) to mitigate and meet the hydromodification design storm event criteria. Fact sheets for hydromodification control measures are included in Appendix F. Stormwater runoff managed by site design measures and stormwater treatment control measures will reduce additional hydromodification control measures that will need to be implemented. Flood control facilities may also be used to help meet the hydromodification requirements.

The Project Stormwater Plan must include the results of the hydromodification routing modeling and demonstrate that the project meets the hydromodification requirements.

SECTION 8. STORMWATER CONTROL MEASURE OPERATION AND MAINTENANCE

Continued effectiveness of stormwater control measures presented in this Manual requires on-going inspection and maintenance. To ensure that such maintenance is provided, the jurisdictional Agency requires the submittal of an Operations and Maintenance Plan and execution of a Maintenance Access Agreement with the owner/operator of stormwater control measure(s). In situations where the stormwater control measure(s) will be publicly-owned or maintained, the Agency will require an easement for access and maintenance of the stormwater control measure(s) or that the stormwater control measure(s) be located in lots dedicated to the Agency in fee title.

The property owner or his/her designee is responsible for complying with the Maintenance Access Agreement until the responsibility is legally transferred. Failure to properly implement the Operations and Maintenance Plan and Maintenance Access Agreement may result in enforcement by the Agency.

This section presents Conditions of Approval that may be applicable to a project, requirements for the Operations and Maintenance Plan and Maintenance Access Agreement, and the Operations and Maintenance Verification Program.

8.1. Conditions of Approval

Projects subject to this Manual will include Conditions of Approval to specify the implementation of stormwater management requirements. Example Conditions of Approval are presented in **Table 8-1**. Submittal of required plans is precedent to issuance of building, grading, or construction permits. Failure by the project applicant to meet these Conditions of Approval will delay the permitting processes.

Table 8-1. Example Stormwater Management Conditions of Approval

Example Condition of Approval	Applicability
Project applicant shall incorporate appropriate site design measure(s) and submit the results of the Post-Construction Runoff Calculator pursuant to the 2015 Post-Construction Stormwater Standards Manual. [Agency] approval of the proposed measures is precedent to issuance of any building, grading, or construction permits.	Applicable to all land developments and permit applications for projects considered Small Projects.
Project applicant shall develop and submit a Project Stormwater Plan that identifies the methods to be employed to reduce or eliminate stormwater pollutant discharges through the construction, operation and maintenance of source control measures, low impact development design, site design measures, stormwater treatment control measures, and hydromodification control measures. Design and sizing requirements shall comply with the 2015 Post-Construction Stormwater Standards Manual. [Agency] approval of the Project Stormwater Plan is precedent to issuance of any building, grading, or construction permits. Two paper copies and an electronic copy of the Project Stormwater Plan shall be provided to the [Agency].	Applicable to all land developments considered Regulated Projects.
Project applicant shall develop a hydromodification management plan to ensure the post-project stormwater runoff flow rate shall not exceed estimated pre-project flow rate for the 2-year, 24-hour storm. The hydromodification management plan shall be incorporated into the Project Stormwater Plan.	Applicable to all land developments considered Hydromodification Management Projects.
Project applicant shall develop and submit an Operations and Maintenance Plan that identifies the operations, maintenance, and inspection requirements of all stormwater treatment and baseline hydromodification control measures identified in the approved Project Stormwater Plan. [Agency] approval of the preliminary Operations and Maintenance Plan is precedent to issuance of any building, grading, or construction permits. Two paper copies and an electronic copy of the Maintenance Plan shall be provided to the [Agency]. [Agency] approval of the final Operations and Maintenance Plan and recordation of the Maintenance Access Agreement is precedent to issuance of the Certificate of Occupancy and release of Performance Bonds. Two paper copies and an electronic copy of the final Operations and Maintenance Plan shall be provided to the [Agency].	Applicable to all land developments considered Regulated Projects and/or Hydromodification Management Projects.

8.2. Operation and Maintenance Plan Requirements

A draft Operations and Maintenance Plan is required as part of the Project Stormwater Plan submittal to the jurisdictional Agency. Upon completion of the project, a final Operations and Maintenance Plan will be incorporated as part of the Maintenance Access Agreement, The Operations and Maintenance Plan must address the following requirements, which are discussed in the following sections:

- Baseline information;

- Final as-built site map and details;
- Operation, inspection, and maintenance requirements and schedule;
- Spill plan;
- Training; and
- Annual Self-Certification Report.

Baseline Information

- List property owners and persons responsible for operation and maintenance of the stormwater control measure(s) including contact information (i.e., phone numbers and addresses).
- Identify the intended method of funding (e.g., Drainage Benefit Assessment Area) of on-going operation and maintenance of the stormwater control measure(s).
- List all installed stormwater control measure(s) including description of each stormwater control measure, date of installation, and design specifications.

Final As-Built Site Map and Details

A preliminary site map must be included in the Operations and Maintenance Plan as part of the Project Stormwater Plan submittal. When available, final as-built site map and details, stamped by a licensed professional engineer or landscape architect, must be included in the final Operations and Maintenance Plan.

- Provide a final as-built site map showing boundaries of the project site, acreage, drainage patterns/contour lines, and DMAs as well as any field modifications to approved designs during construction.
- Include stormwater treatment control measure ponding depth(s) and design infiltration rate(s).
- Show each discharge location from the project site and any drainage flowing onto the project site (i.e., run-on).
- Distinguish between pervious and impervious surfaces on the map.
- Identify the location of each stormwater control measure, private sanitary sewer systems, and grade breaks for purposes of pollution prevention.
- With a legend, identify locations of expected sources of pollution generation (e.g., outdoor work and storage areas, heavy traffic areas, delivery areas, trash enclosures, fueling areas, wash-racks). Identify any areas having contaminated soil or where pollutants are stored or have been stored/disposed of in the past.

Operation, Inspection, and Maintenance Requirements and Schedule

- Identify cleaning activities, including litter removal and disposal, and schedule. Identify any housekeeping procedures that may reduce maintenance requirements.
- Identify vegetation/landscape management methods and schedule. Distinguish between maintenance appropriate for the vegetation establishment period and expected long-term maintenance. These procedures must provide sufficient detail to a person unfamiliar with these maintenance methods to perform the activity or identify the specific skills or knowledge to perform and document the maintenance.
- Identify vector control practices.[7]
- Identify equipment resource requirements necessary to operate and maintain stormwater control measures.
- Identify regulatory approvals (if any) that may be needed for on-going operation and maintenance and address acquisitions of those approvals.
- Create a checklist and schedule, preferably in the form of a table or matrix, for each activity for all facility components and stormwater control measure to be inspected and/or tested.
- Create an inspection and/or maintenance log template to document inspection and/or maintenance activities, including inspector names, dates, and stormwater control measure(s) inspected and maintained. The log should note any significant maintenance requirements due to spills or unexpected discharges.

Spill Plan

- Identify person(s) responsible for monitoring and reporting spills.
- Provide emergency notification procedures (phone and agency/persons to contact).
- As appropriate for site, provide emergency containment and cleanup procedures.
- Note downstream receiving waters, wetlands, or ESAs that may be affected by spills or chronic untreated discharges.
- As appropriate, create emergency sampling procedures for spills. Emergency sampling can protect the property owner from erroneous liability for downstream receiving area cleanups.

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[7] California Department of Public Health. (2012). Best Management Practices for Mosquito Control in California. Retrieved on July 20, 2012 from http://www.westnile.ca.gov/resources.php.

Training

Provide information about training persons responsible for operating and maintaining stormwater control measure(s). This training should include:

- Good housekeeping procedures defined in the Operations and Maintenance Plan;
- Proper maintenance of all devices, including stormwater treatment control measures;
- Identification and cleanup procedures for spills and overflows;
- Large-scale spill or hazardous material response; and
- Safety concerns when maintaining devices and cleaning spills.

Self-Certification Annual Report

The owner/operator of the stormwater control measure(s) must provide to the jurisdictional Agency an annual self-certification that its stormwater control measure(s) is(are) being properly operated and maintained. For public projects, the applicable department is required to provide the annual self-certification. The final Operations and Maintenance Plan must provide details on how the owner/operator will conduct its annual self-certification.

8.3. Maintenance Access Agreement

The Maintenance Access Agreement, which includes the final Operations and Maintenance Plan, is a legally-binding contract requiring the on-going proper operation and maintenance of stormwater control measures after the Certificate of Occupancy is issued. At a minimum, the Phase II Permit (Provision E.12.h.(ii)(a)) requires that Maintenance Access Agreement include the owner's/developer's signed statement accepting responsibility for inspection and maintenance until the responsibility is legally transferred and either:

- A signed statement from the public entity assuming responsibility for stormwater control measure operation, inspection, and maintenance and certifying that it meets all design standards; or
- Written conditions in the sales or lease agreement that require the recipient to assume responsibility for inspection and maintenance activities and to conduct a maintenance inspection at least once a year; or
- Written text in project conditions, covenants, and restrictions for residential properties that assign maintenance responsibilities to the entity (e.g., Community Services District) for inspection and maintenance of stormwater control measures; or
- A legally enforceable agreement that assigns responsibility for operation, inspection, and maintenance of stormwater control measures to the

owner/operator. A Maintenance Access Agreement with jurisdictional Agency must be executed by the owner/operator before occupancy of the project is approved.

During the plan review process, the jurisdictional Agency will also assess whether easements or performance bonds are needed. Easements are required if the Agency will assume all or part of the responsibilities for operations and maintenance (O&M) of stormwater control measures. Proposed easements should identified during the Tentative Map/Parcel Map process, or where a Tentative Map or Parcel Map is not used prior to issuance of a building/grading permit, as securing easements after properties are built and occupied can be time consuming. If used, easements need to be appropriately recorded and shown on the final property plat and property title documents.

The jurisdictional Agency will require performance bonds for construction and during the initial establishment period. For vegetative-based control measures (i.e., bioretention facilities), a bond that is extended one year upon project site stabilization and acceptance by the jurisdictional Agency is required to ensure proper maintenance of the vegetation during the initial establishment period.

8.4. Operation and Maintenance Verification Program

Note: this section applies to only the Agencies. The Phase II Permit (Provision E.12.h.) requires that the Agencies implement an Operations and Maintenance Verification Program for all stormwater treatment and baseline hydromodification control measures. As part of this requirement, the Agencies are required to develop a database or equivalent table of all regulated projects (public and private) that have installed stormwater treatment and baseline hydromodification control measures. The following information must be included in the database or equivalent table:

- Name and address of the regulated project;
- Specific description of the location (or a map showing the location) of the installed stormwater treatment and/or baseline hydromodification control measure(s);
- Date(s) that the stormwater treatment and/or baseline hydromodification control measure(s) (if any) were installed;
- Description of the type and size of the stormwater treatment and/or baseline hydromodification control measure(s) (if any) installed;
- Responsible operator(s) for each stormwater treatment and/or baseline hydromodification control measure(s) (if any) installed;
- Dates and findings of inspections (routine and follow-up) of the stormwater treatment and/or baseline hydromodification control measure(s) (if any) by the Agency; and
- Any problems and/or corrective or enforcement actions taken.

APPENDIX A

Glossary and List of Acronyms

List of Acronyms

ASTM	American Society for Testing and Materials
BMP	Best Management Practice
CCR	California Code of Regulations
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
cfs	Cubic feet per second
CWA	Clean Water Act (Federal Water Pollution Control Act)
DMA	Drainage Management Area
ESA	Environmentally Sensitive Area
HUC	Hydrologic Unit Code
IPM	Integrated Pest Management
LID	Low Impact Development
LUFT	Leaking Underground Fuel Tank
LUP	Linear Underground/Overhead Utility Projects
MEP	Maximum extent practicable
MS4	Municipal Separate Storm Sewer System
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Unit
PAH	Polycyclic aromatic hydrocarbons
SDF	Stormwater Design Flow
SDV	Stormwater Design Volume
SLIC	Spills, Leaks, Investigations, and Cleanups
STA	Seal of Testing Assurance
SWMM	Stormwater Management Model
TMDL	Total maximum daily load
TSS	Total suspended solids
USCC	United States Composting Council
USEPA	United States Environmental Protection Agency
USC	United States Code
USC	Water Efficient Landscaping Ordinance

Glossary

Agency – This refers to any of the following municipalities: City of Lathrop; City of Lodi; City of Manteca; City of Patterson; City of Tracy; County of San Joaquin.

Beneficial Uses – The uses (e.g., domestic, municipal, agricultural, and industrial supply, power generation, recreation, aesthetic enjoyment, navigation and preservation of fish and wildlife, other aquatic resources or preserves) of waters of the state protected against degradation.

Berm – Earthen mound used to direct the flow of stormwater runoff around or through a structure.

Best Management Practices (BMPs) – Methods, measures, or practices designed and selected to reduce or eliminate the discharge of pollutants to surface waters from point and nonpoint source discharges including stormwater runoff. BMPs include structural and non-structure controls and operations and maintenance procedures that can be applied before, during, and/or after pollution producing activities.

Catch Basin – A catch basin, which is also known as a storm drain inlet, is an inlet to the storm drain system that typically includes a grate or curb inlet where stormwater runoff enters the catch basin and a sump to capture sediment, debris, and associated pollutants. Catch basins act as pretreatment for other treatment practices by capturing large sediments. The performance of catch basins at removing sediment and other pollutants depends on the design of the catch basin (e.g., the size of the sump), and routine maintenance to retain the storage available in the sump to capture sediment.

Clean Water Act – This is the Federal Water Pollution Control Act of 1972, as amended, Title 33 of the United States Code (USC) 1251, et. seq., which has been incorporated by reference in Chapter 5.5 of the California Water Code.

Commercial Development – Any development on private land that is not heavy industrial or residential. This category includes, but is not limited to, hospitals, laboratories and other medical facilities, educational institutions, recreational facilities, plant nurseries, car wash facilities, mini-malls, business complexes, shopping malls, hotels, office buildings, public warehouses, and light industrial complexes.

Common Plan or Development or Sale – United States Environmental Protection Agency (USEPA) regulations include the term “common plan of development or sale” to ensure that acreage within a common project does not artificially escape the permit requirements because construction activities are phased, split among smaller parcels, or completed by different owners/developers. In the absence of an exact definition of “common plan of development or sale,” the State Water Board is required to exercise its regulatory discretion in providing a common sense interpretation of the term as it applies to construction projects and permit coverage. The common plan of development is generally a contiguous area where multiple, distinct construction activities may be taking place at different times under one plan. A plan is generally defined as any piece of documentation or physical demarcation that indicates that construction activities may occur on a common plot. Such documentation could consist of a tract map, parcel map, demolition plans, grading plans, or contract documents. Any of these documents could delineate the boundaries of a common plan area. However, broad planning documents, such as land use master plans, conceptual master plans, or broad-based CEQA or NEPA documents that identify potential projects for an agency or facility are not considered common plans of development. An overbroad interpretation of the term would render meaningless the clear “one acre” federal permitting threshold and would potentially trigger permitting of almost any construction activity that occurs within an area that had previously received area-wide utility or road improvements.

Conduit – Any channel or pipe directing the flow of water.

Construction Site – Any project, including projects requiring coverage under the General Construction Permit, that involves soil disturbing activities, including, but not limited to, clearing, grading, paving, disturbances to ground such as stockpiling, and excavation.

Culvert – A covered channel or a large diameter pipe that crosses under a road, sidewalk, etc.

Deemed Complete – The Agency approves the completed application and vesting tentative map; or 2) the Agency neither approves nor requests additional information on a project application within 30 days of the submittal by the project applicant.

Detached Single Family Home Project – The building of one single new house or the addition and/or replacement of impervious surface associated with one single existing house, which is not part of a larger plan of development.

Detention – The temporary storage of stormwater runoff to allow treatment by sedimentation and metered discharge of stormwater runoff at reduced peak flow rates. The capture and subsequent release of stormwater runoff form the site at a slower rate than it is collected with the difference being held in temporary storage.

Development – Any construction, rehabilitation, redevelopment, or reconstruction of any public or private residential project (e.g., single-family, multi-family, planned unit of development); industrial, commercial, retail, and other non-residential project projects, including public agency projects; or mass grading for future construction.

Direct Discharge – A discharge that is routed directly to waters of the United States by means of a pipe, channel, or ditch, including a municipal separate storm sewer system, or through surface runoff.

Discharge of a Pollutant – The addition of any pollutant or combination of pollutants to waters of the United States from any point source, or any addition of any pollutant or combination of pollutants to waters of the contiguous zone or the ocean from any point source other than a vessel or other floating craft which is being used as a means of transportation. The term includes additions of pollutants to waters of the United States from: surface runoff which is collected or channeled by man; discharges through pipes, sewers, or other conveyances owned by a State, municipality, or other person which do not lead to a treatment works; and discharges through pipes, sewers, or other conveyances, leading into privately-owned treatment works.

Discharger – Any responsible party or site owner or operator within the Agency's jurisdiction whose site discharges stormwater runoff or a non-stormwater discharge.

Disturbed Area – Area that is altered as a result of clearing, grading, and/or excavation.

Dry Weather – This refers to the season where prolonged dry periods occur. In California's Mediterranean climate, this usually corresponds to the period between May and September.

Erosion – The physical detachment of soil due to wind or water. Often the detached fine soil fraction becomes a pollutant transported by stormwater runoff. Erosion occurs naturally, but can be accelerated by land disturbance and grading activities such as farming, development, road building, and timber harvesting.

Erosion Control Measures – Measures used to minimize soil detachment. These may include:

- Vegetation, either undisturbed or planted (e.g., grasses, wildflowers); and
- Other materials, such as
    - Straw (applied over bare soil, crimped into soil);
    - Protective erosion control blankets;
    - Fiber (applied as mulch or hydromulch); and
    - Mulch (avoid plastics if possible).

Excavation – The process of removing earth, stone, or other materials, usually by digging.

Final Stabilization – All soil disturbing activities at each individual parcel within the site that have been completed in a manner consistent with the requirements of the State Water Resources Control Board *General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities* (Order No. 2012-0006-DWQ).

Flood Management Facilities – Facilities or structures designed for the explicit purpose of controlling flood waters safely in or around populated areas (e.g., dams, levees, bypass areas). Flood management facilities do not include traditional stormwater conveyance structures (e.g., stormwater sewerage, pump stations, catch basins).

Grading – The cutting and/or filling of the land surface to a desired slope or elevation.

Hydromodification – Modification of hydrologic pathways (i.e., precipitation, surface runoff, infiltration, groundwater flows, return flow, surface-water storage, groundwater storage, evaporation, transpiration) that results in negative impacts to watershed health and functions.

Hydrologic Unit Code (HUC) 12 Watershed – The HUC is the "address" of the watershed. The HUC is a numeric code of the United States Geological Survey (USGS) watershed classification system used to identify the watersheds, or drainage basins, at various scales. The HUC organizes watersheds by a nested size hierarchy, so large watershed boundaries for an entire region may be assigned a two-digit HUC, while small scale, local watershed boundaries (within the larger regional watershed) may be assigned a 12-digit HUC. A HUC-12 watershed averages 22 square miles in size.

Illicit Discharge – Any discharge to a storm drain system that is prohibited under local, state, or federal statutes, ordinances, codes, or regulations. The term illicit discharge includes all non-stormwater discharges not composed entirely of stormwater and discharges that are identified under the Discharge Prohibitions section of the 2013 MS4 Permit. The term illicit discharge does not include discharges that are regulated by a National Pollutant Discharge Elimination System (NPDES) permit (other than the NPDES permit for discharge from a municipal separate storm sewer system).

Impaired Waterbody – A waterbody (e.g., stream reaches, lakes, waterbody segments) with chronic or recurring monitored violations of the applicable numeric and/or narrative water quality criteria. An impaired water is a water that has been listed on the State of California 303(d) list or has not yet been listed, but otherwise meets the criteria for listing. A water is a portion of a surface water of the state, including ocean, estuary, lake, river, creek, or wetland. The water currently may not be meeting state water quality standards or may be determined to be threatened and have the potential to not meet standards in the future. The State of California's 303(d) list can be found at http://www.swrcb.ca.gov/quality.html.

Impervious Surface – A surface covering or pavement of a developed parcel of land that prevents the land's natural ability to absorb and infiltrate rainfall/stormwater. Impervious surfaces include, but are not limited to, roof tops, walkways, patios, driveways, parking lots, roads, storage areas, impervious concrete and asphalt, and any other continuous watertight pavement or covering. Landscaped soil and pervious pavement, including pavers with pervious openings and seams, underlain with pervious soil or pervious storage material, such as a gravel layer sufficient to hold a specific volume of stormwater runoff are not impervious surfaces.

Industrial Development – Development or redevelopment of property to be used for industrial purposes, such as factories, manufacturing buildings, and research and development parks.

Infill Site – A site in an urbanized area where the immediate adjacent parcels are developed with one or more qualified urban uses or at least 75 percent of the perimeter of the site adjoins parcels that have previously been developed for qualified urban uses and no parcel within the site has been created within the past 10 years.

Infiltration – The downward entry of water into the surface of the soil.

Integrated Pest Management (IPM) – An ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism.

Linear Underground/Overhead Utility Projects (LUPs) – Include, but are not limited to, any conveyance, pipe, or pipeline for the transportation of any gaseous, liquid (including water and wastewater for domestic municipal services), liquiescent, or slurry substances; any cable line or wire for the transmission of electrical energy; any cable line or wire for communications (e.g., telephone, telegraph, radio, or television messages); and associated ancillary facilities. Construction activities associated with LUPs include, but are not limited to: (a) those activities necessary for the installation of underground and overhead linear facilities (e.g., conduits, substructures, pipelines, towers, poles, cables, wires, connectors, switching regulating and transforming equipment, and associated ancillary facilities); and include, but are not limited to, (b) underground utility mark-out, potholing, concrete and asphalt cutting and removal, trenching, excavation, boring and drilling, access road and pole/tower pad and cable/wire pull station, substation construction, substructure installation, construction of tower footings and/or foundations, pole and tower installations, pipeline installation, welding, concrete and/or pavement repair or replacement, and stockpile/borrow locations.

Low Impact Development (LID) – A sustainable practice that benefits water supply and contributes to water quality protection. Unlike traditional stormwater management, which collects and conveys stormwater runoff through storm drains, pipes, or other conveyances to a centralized stormwater facility, LID takes a different approach by using site design and stormwater management to maintain the site's pre-development stormwater runoff rates and volumes. The goal of LID is to mimic the sites' pre-development hydrology by using design techniques that infiltrate, filter, store, evaporate, and detain stormwater runoff close to the source of rainfall.

Maximum Extent Practicable (MEP) – The minimum required performance standard for implementation of the municipal stormwater management programs to reduce pollutants in stormwater. Clean Water Act §402(p)(3)(B)(iii) requires that municipal permits "shall require controls to reduce the discharge of pollutants to the maximum extent practicable, including management practices, control techniques and system, design and engineering methods, and such other provisions as the [United States Environmental Protection Agency] Administrator or the State determines appropriate for the control of such pollutants". MEP is the cumulative effect of implementing, evaluating, and making corresponding changes to a variety of technically appropriate and economically feasible BMPs, ensuring that the most appropriate controls are implemented in the most effective manner. This process of implementing, evaluating, revising, and adding new BMPs is commonly referred to as the iterative process.

Mixed-Use Development – Development or redevelopment of property to be used for two or more different uses, all intended to be harmonious and complementary. An example is a high-rise building with retail shops on the first 2 floors, office space on floors 3 through 10, apartments on the next 10 floors, and restaurant on the top floor.

Municipal Separate Storm Sewer System (MS4) – The regulatory definition of an MS4 (Title 40 of the Code of Federal Regulations [40 CFR] Part 122.26(b)(8)) is "a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains): (i) owned or operated by a state, city, town, borough, county, parish, district, association, or other public body (created to or pursuant of state law) including special districts under state law such as a sewer district, flood control district or drainage discharge, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under section 208 of the Clean Water Act that discharges into waters of the United States; (ii) designed or used for collecting or conveying stormwater; (iii) which is not a combined sewer; and (iv) which is not part of a Publicly-Owned Treatment Works (POTW) as defined at 40 CFR Part 122.2".

In practical terms, operators of MS4s can include municipalities and local sewer districts, state and federal departments of transportation, public universities, public hospitals, military bases, and correctional facilities.

National Pollutant Discharge Elimination System (NPDES) – The federal program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits, and imposing and enforcing pretreatment requirements, under sections 307, 402, 318, and 405 of the Clean Water Act.

New Development – New development means land disturbing activities; structural development, including construction or installation of a building or structure, creation of impervious surfaces; and land subdivision on an area that has not been previously developed.

Nonpoint Source Pollution – Pollution that does not come from a point source. Nonpoint source pollution originates from diffuse sources that are mostly related to land use.

Non-Stormwater Discharge – A discharge that does not originate from precipitation events. They can include, but are not limited to, discharges of process water, air conditioner condensate, non-contact cooling water, vehicle wash water, sanitary wastes, concrete washout water, paint wash water, irrigation water, or pipe testing water.

Outfall – A point source as defined by 40 CFR Part 122.2 at the point where an MS4 discharges to the waters of the United States and does not include open conveyances connecting two MS4s, or pipes, tunnels, or other conveyances which connect segments of the same stream or other waters of the United States and are used to convey waters of the United States.

Parking Lot – Land area or facility for the parking or storage of motor vehicles used for business, commerce, industry, or personal use.

Pavement Replacement (also known as reconstruction) – Process of removing existing pavement down to the subbase and replacing it with new base course and new pavement.

Pavement Resurfacing (also known as overlay, asphalt overlay, pavement overlay) – Process of installing a new layer of pavement over existing pavement.

Pervious Pavement – Pavement that stores and infiltrates rainfall at a rate that exceeds conventional pavement.

Point Source – Any discernible, confined, and discrete conveyance, including, but not limited to, any pipe, ditch, channel, tunnel conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operations, landfill leachate collection systems, vessel, or other floating craft, from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture or agricultural stormwater runoff.

Pollutant – Dredged spoils, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials (except those regulated under the Atomic Energy Act of 1954, as amended [42 USC 2011 et. seq.]), heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste discharged into water.

Pollutants of Concern – Pollutants of concern found in urban runoff include sediments, non-sediment solids, nutrients, pathogens, oxygen-demanding substances, petroleum hydrocarbons, heavy metals, floatables, polycyclic aromatic hydrocarbons (PAHs), trash, and pesticides and herbicides.

Pollution – An alteration of the quality of the waters of the state by waste to a degree which unreasonably affects the beneficial uses of the water or facilities which serve those beneficial uses.

Precipitation – Any form of rain or snow.

Project Acceptance – Completion of all construction discretionary permitting to finalize project.

Publicly-Owned Treatment Works (POTW) – A treatment works defined by Section 212 of the Clean Water Act (33 USC 1292).

Redevelopment – Land-disturbing activity that results in the creation, addition, or replacement of exterior impervious surface area on a site on which some past development has occurred. Redevelopment does not include trenching, excavation and resurfacing associated with LUPs; pavement grinding and resurfacing of existing roadways; construction of new sidewalks, pedestrian ramps, or bike lanes on existing roadways; or routine replacement of damaged pavement such as pothole repair or replacement of short, non-contiguous sections of roadway.

Regulated Project – Refers to projects subject to the new development and redevelopment standards in Section E.12 of the 2013 MS4 Permit.

Residential Housing Subdivision – Any property development of multiple single-family homes or of dwelling units intended for multiple families/households (e.g., apartments, condominiums, town homes).

Retention – The storage of stormwater runoff to prevent it from leaving the development site.

Riparian Areas – Plant communities contiguous to and affected by surface and subsurface hydrologic features of perennial or intermittent waterbodies. Riparian areas have one or both of the following characteristics: (1) distinctively different vegetative species than adjacent areas; and (2) species similar to adjacent areas but exhibiting more vigorous or robust growth forms. Riparian areas are usually transitional between wetland and upland.

Routine Maintenance and Repair Projects – Projects that maintain the original line and grade, hydraulic capacity, and original purpose of the facility.

Run-on – Discharges that originate off-site and flow onto the property of a separate project site.

Rural Area – Encompasses all population, housing, and territory not included within an urban area.

Sediment – Solid particulate matter, both mineral and organic, that is in suspension, is being transported, or has been moved from its site of origin by air, water gravity, or ice and has come to rest on the earth's surface either above or below sea level.

Sediment Control Measures – Measures used to trap and/or retain detached soil before discharging to receiving waters. These may include:

- Fiber rolls (e.g., keyed-in straw wattles, compost rolls);
- Silt fences;
- Retention basins; and
- Active treatment systems.

Sedimentation – The process of depositing soil particles, clays, sands, or other sediments that were picked up by stormwater runoff.

Smart Growth Projects – Projects that produce multiple-benefits such as economic, social, and environmental benefits. Smart growth projects commonly include high-density development projects that result in a reduction of stormwater runoff volume per capita as a result of reduced impervious surface.

Sheet Flow – Flow of water that occurs overland in areas, where there are no defined channels, such that water spreads out over a large area at a uniform depth.

Soil Amendment – Any material that is added to the soil to change its chemical properties, engineering properties, or erosion resistance that could become mobilized by stormwater runoff.

Source Control – Land use or site planning practices, or structural or non-structural measures, that aim to prevent runoff pollution by reducing the potential for contact with stormwater runoff at the source of pollution. Source control measures minimize the contact between pollutants and urban runoff.

Surface Drainage – Any above-ground runoff (e.g., sheet, shallow concentrated, open channel) that flows into the storm drain system.

Storm Drain – Above- and below-ground structures for transporting stormwater runoff.

Storm Drain System – The basic infrastructure in an MS4 that collects and conveys stormwater runoff to a treatment facility or receiving water.

Stormwater – Stormwater runoff, snowmelt runoff, surface runoff, and drainage, excluding infiltration and irrigation tailwater. Urban runoff and snowmelt runoff consisting only of those discharges, which originate from precipitation events. Stormwater is that portion of precipitation that flows across a surface to the storm drain system or receiving water.

Stormwater Runoff – Stormwater runoff is generated when precipitation from rain and snowmelt events flows over land or impervious surfaces and does not percolate into the ground. As stormwater runoff flows over land or impervious surfaces, it accumulates debris, chemicals, sediment, or other pollutants that could adversely affect water quality if the stormwater runoff is discharged untreated.

Stormwater Treatment System – Any engineered system designed to remove pollutants from stormwater runoff by settling, filtration, biological degradation, plant uptake, media absorption/adsorption, or other physical, biological, or chemical process. This includes landscape-based systems such as vegetated swales and bioretention facilities as well as proprietary stormwater treatment measures.

Structural Controls – Any structural facility designed and constructed to mitigate the adverse impacts of stormwater and urban runoff pollution.

Time of Concentration – The time it takes the most hydraulically-remote drop of water to travel through a watershed to a specific point of interest.

Total Maximum Daily Loads (TMDLs) – The maximum amount of a pollutant that can be discharge into a waterbody from all sources (point and nonpoint) and still maintain water quality standards. Under Section 303(d) of the Clean Water Act, TMDLs must be developed for all waterbodies that do not meet water quality standards even after the application of technology-based controls, more stringent effluent limitations required by a state or local authority, and other pollution control requirements, such as BMPs.

Total Suspended Solids (TSS) – The measure of the suspended solids in a water sample includes inorganic substances (e.g., soil particles) and organic substances (e.g., algae, aquatic plant/animal waste, particles related to industrial/sewage waste). The TSS test measures the concentration of suspended solids in water by measuring the dry weight of a solid material contained in a known volume of a sub-sample of a collected water sample. Results are reported in milligrams per liter.

Trash and Debris – Trash consists of litter and particles of litter. Section 68055.1(g) of the California Code of Regulations (CCR) defines litter as all improperly discarded waste material, including, but not limited to, convenience foods, beverage, and other product packages or containers constructed of steel, aluminum, glass, paper, plastic, and other natural and synthetic materials, thrown or deposited on the lands and waters of the state, but not including the properly discarded waste of the primary processing of agriculture, mining, logging, sawmilling, or manufacturing.

Treatment – Any method, technique, or process designed to remove pollutants and/or solids from polluted stormwater runoff, wastewater, or effluent.

Turbidity – The “cloudiness” of water quantified by the degree to which light traveling through a water column is scatted by the suspended organic and inorganic particles it contains. Results are typically reported in Nephelometric Turbidity Units (NTU).

Urbanized Area – A densely settled core of census tracts and/or census blocks that have a population of at least 50,000, along with adjacent territory containing non-residential urban land uses as well as territory with low population density included to link outlying densely settled territory with the densely settled core. It is a calculation used by the Bureau of the Census to determine the geographic boundaries of the most heavily developed and dense urban areas. Data utilized in the 2013 MS4 Permit was derived from the 2010 United States Census Data. Source: Phase II final rule (Revised June 2012), http://www.epa.gov/npdes/pubs/fact2-2.pdf.

Waste – Includes sewage and any and all other waste substances liquid, solid, gaseous, or radioactive, associated with human habitation, or of human or animal origin, or from any producing, manufacturing, or processing operation, including waste placed within containers of whatever nature, prior to, and for the purposes of, disposal.

Waste Load Allocation – The portion of the receiving water’s TMDL that is allocated to one of its existing or future point sources of pollution. Waste load allocations constitute a type of water quality-based effluent limitation.

Water Efficient Landscape Ordinance (WELO) – The Model Water Efficient Landscape Ordinance (Title 23, Division 2, Chapter 2.7 of the CCR) took effect January 1, 2010 and is designed to: (1) promote the values and benefits of landscapes while recognizing the need to invest water and other resources as efficiently as possible; (2) establish a structure for planning, designing, installing, maintaining and managing water efficient landscapes in new construction and rehabilitated projects; (3) establish provisions for water management practices and water waste prevention for existing landscapes; (4) use water efficiently without waste by setting a Maximum Applied Water Allowance as an upper limit for water use and reduce water use to the lowest practical amount; (5) promote the benefits of consistent landscape ordinances in neighboring local and regional agencies; (6) encourage local agencies and water purveyors to use economic incentives that promote the efficient use of water, such as implementing a tiered-rate structure; and (7) encourage local agencies to designate the necessary authority that implements and enforces provisions of the Model Water Efficient Landscape Ordinance or its local landscape ordinance.

Water Quality Objectives – The limits or levels of water quality elements or biological characteristics established to reasonably protect the beneficial uses of water or to prevent pollution problems within a specific area. Water quality objectives may be numeric or narrative.

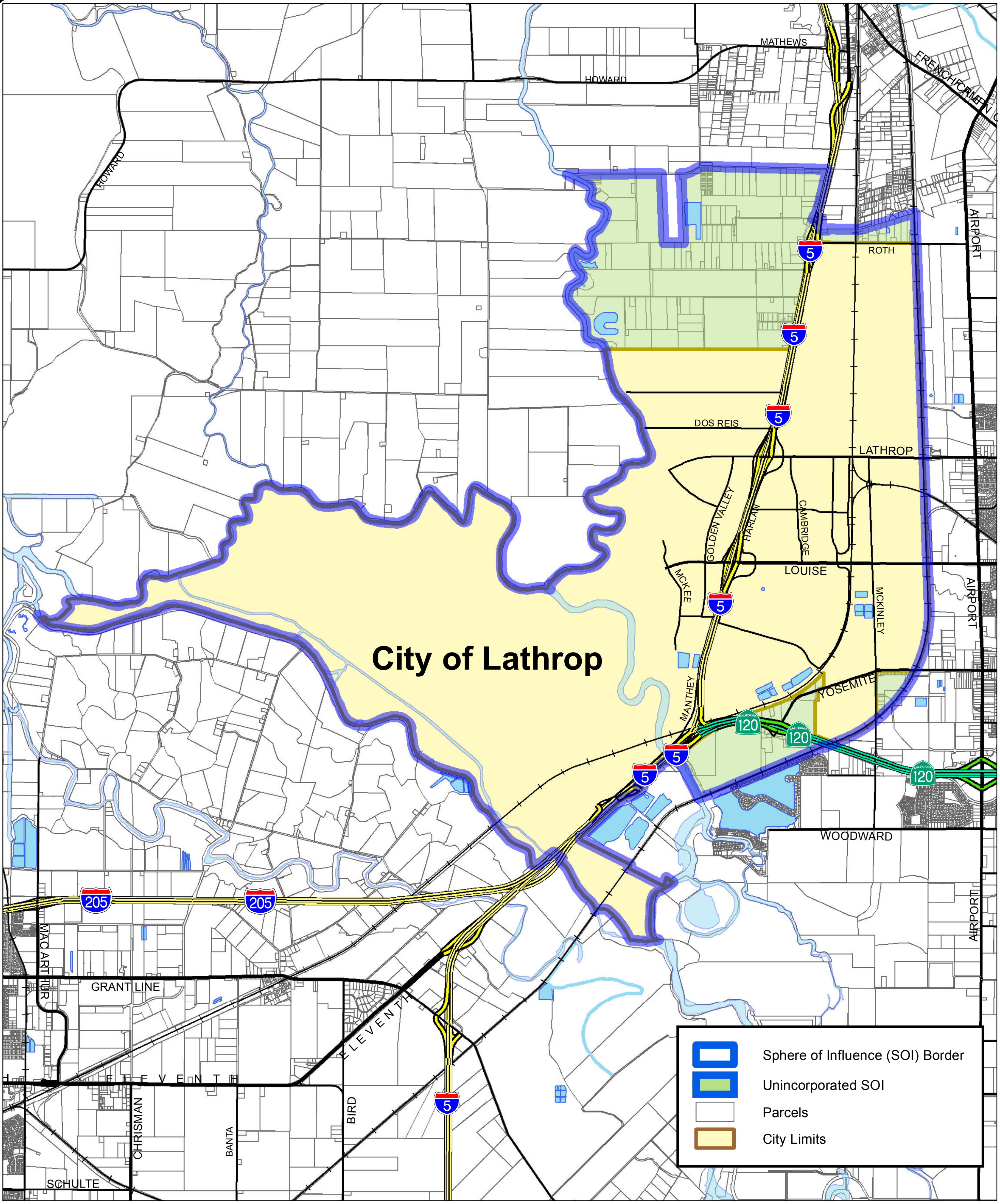
Water Quality Standards – State-adopted and USEPA-approved water quality standards for waterbodies. The standards prescribe the use of the waterbody and establish the water quality criteria that must be met to protect designated uses. Water quality standards also include the federal and state antidegradation policy.

Waters of the United States – This generally refers to surface waters, as defined by the USEPA in 40 CFR Part 122.2.

Watershed Processes – Functions that are provided by watersheds, including, but not limited to, groundwater recharge, sediment supply and delivery, streamflow, and aquatic habitat.

APPENDIX B

Jurisdictional Boundary Maps



LATHROP SPHERE OF INFLUENCE

San Joaquin County Geographic Information Systems
1810 East Hazelton Avenue, Stockton, CA 95205

The information on this map is based on the most current information available to San Joaquin County Geographic Information Systems.
The County of San Joaquin does not warrant its accuracy, completeness, or suitability for any particular purpose.
The information on this map is not intended to replace engineering, financial or primary records research.

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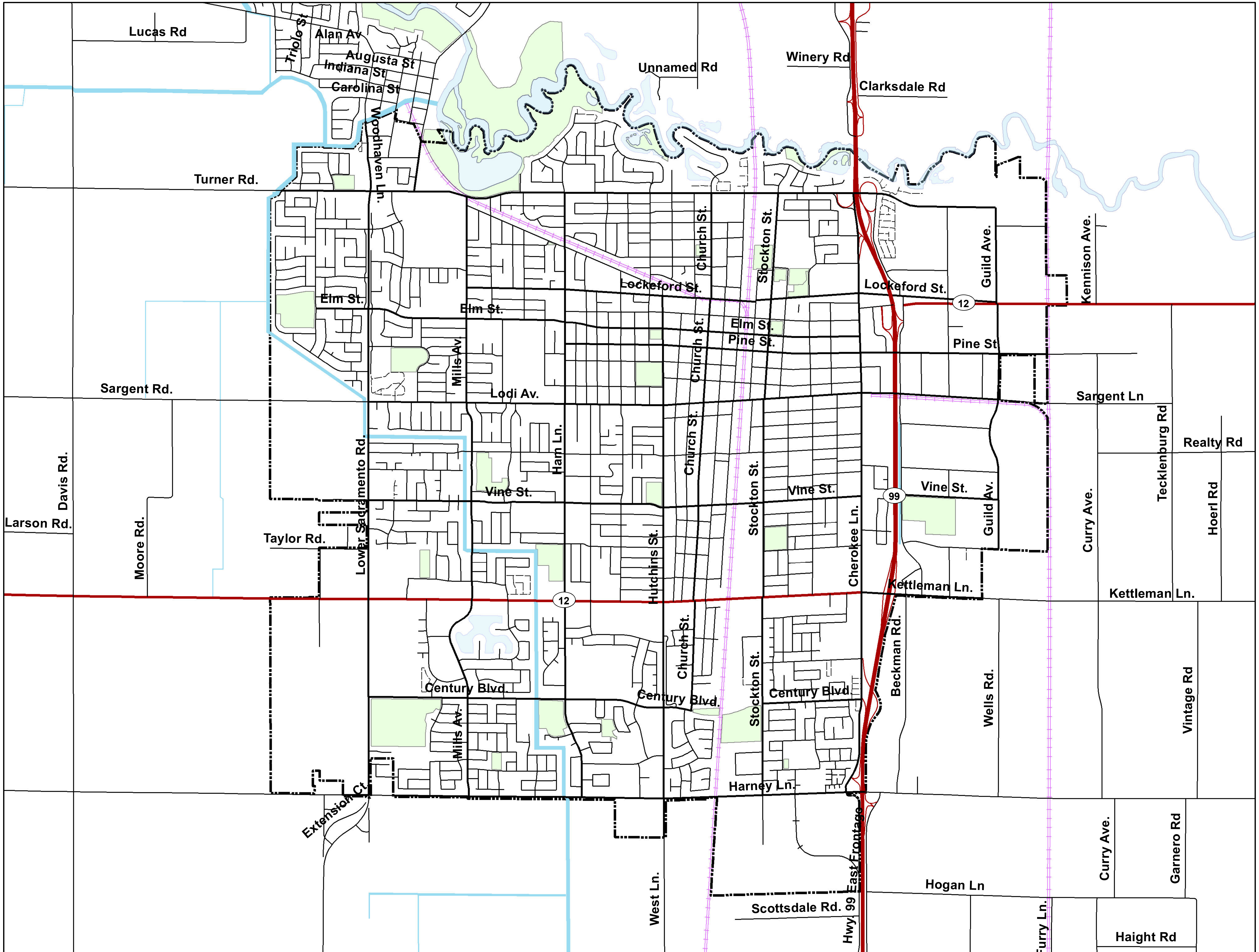
September 5, 2012 - GIS-rmt



CITY OF LODI CALIFORNIA

City of Lodi Phase II MS4 Storm Water Permit Boundary

Legend

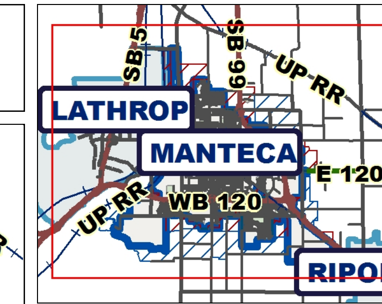
- Parks
- Woodbridge Irrigation District Canal
- Mokelumne River
- Lodi City Limits
- Railroad
- Interstate
- Highway
- HighwayRamps
- Major
- Minor
- County
- Private

N W E S

1 inch = 2,500 feet

Path: K:\DESIGN\Projects\GIS\SD_Permit_Boundary.mxd

CITY OF MANTECA



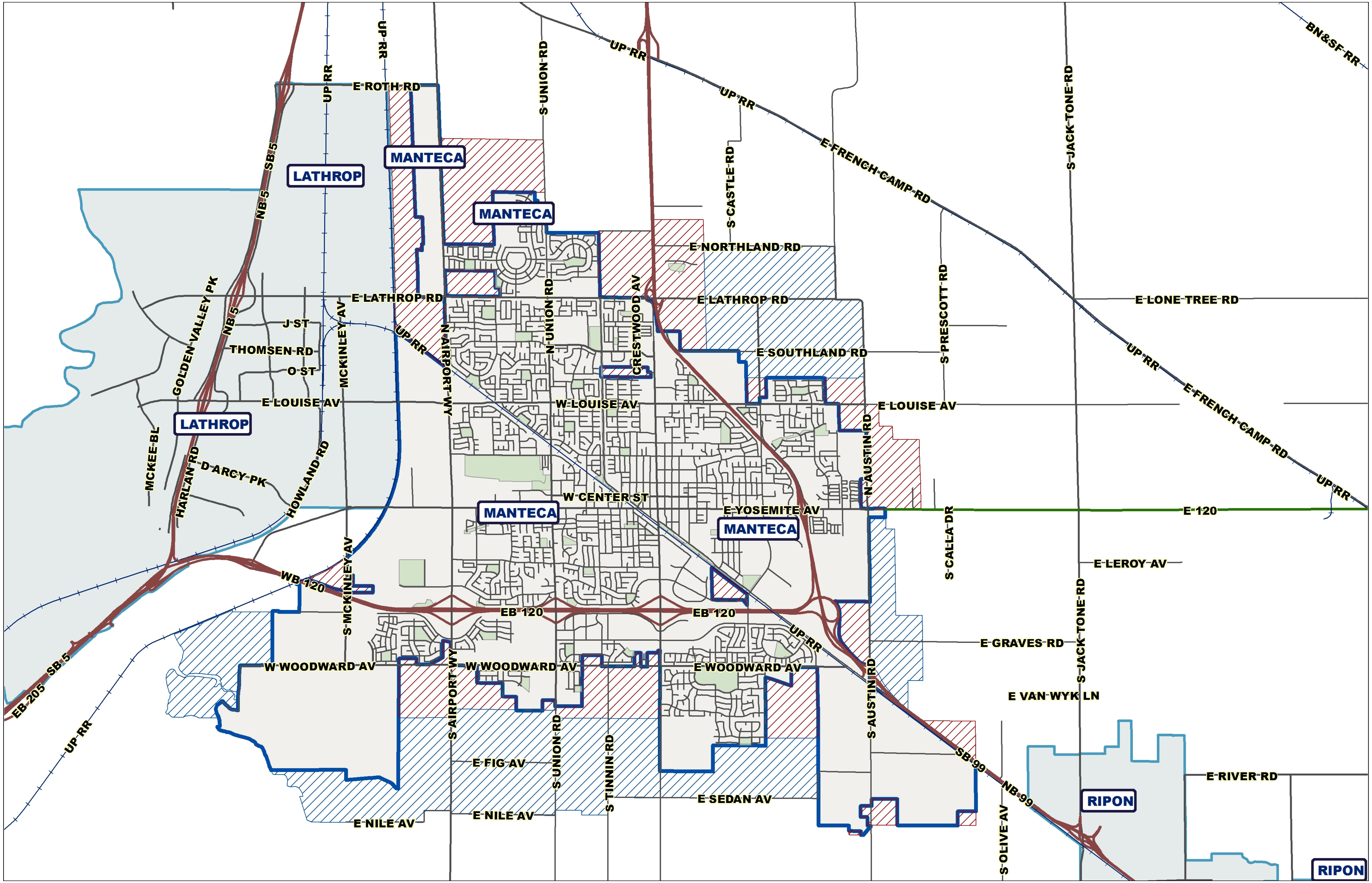
Legend

PARKS

SPHERE OF INFLUENCE

10-Year Planning Horizon

20-Year Planning Horizon



1.8 0 0.90 1.8 Miles

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