Post-Construction Stormwater Standards Manual (DRAFT)

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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) issued 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 the MS4 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 in 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 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 for the development community 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 mitigate the transport of and/or eliminate potential sources of pollution to stormwater runoff or run-on and into the municipal storm drain system 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 the risk of floods. 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 surface 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 due to surface discharge of 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 included Provision E.12, which requires that the Agencies regulate post-construction development 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 requirements for post-construction stormwater management, other program elements of the Phase II Permit focus on managing 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, owners/developers of some project sites 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).

Agency Policies

Placeholder: Are there any additional agency-specific policies that we want/need to discuss here? Agencies will need to provide Stormwater Ordinance references.

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. As required by the Phase II Permit, 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 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 of their applications for discretionary permits were deemed complete for processing 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 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.

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 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[1] 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[2] within an existing footprint;
    - Routine replacement of damaged pavement[3], such as pothole repair, or short non-contiguous sections of roadway;
    - 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;

[1] Common Plan or Development or Sale – U.S. EPA 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.

[2] 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.

[3] Pavement replacement (also known as reconstruction) is the process of installing both the subgrade asphalt layer as well as the top pavement overlay layer after penetration through the base rock to the subgrade.

- 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 types of post-construction stormwater standards that must be applied to a regulated project are presented in Table 1-1.

Table 1-1. 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.

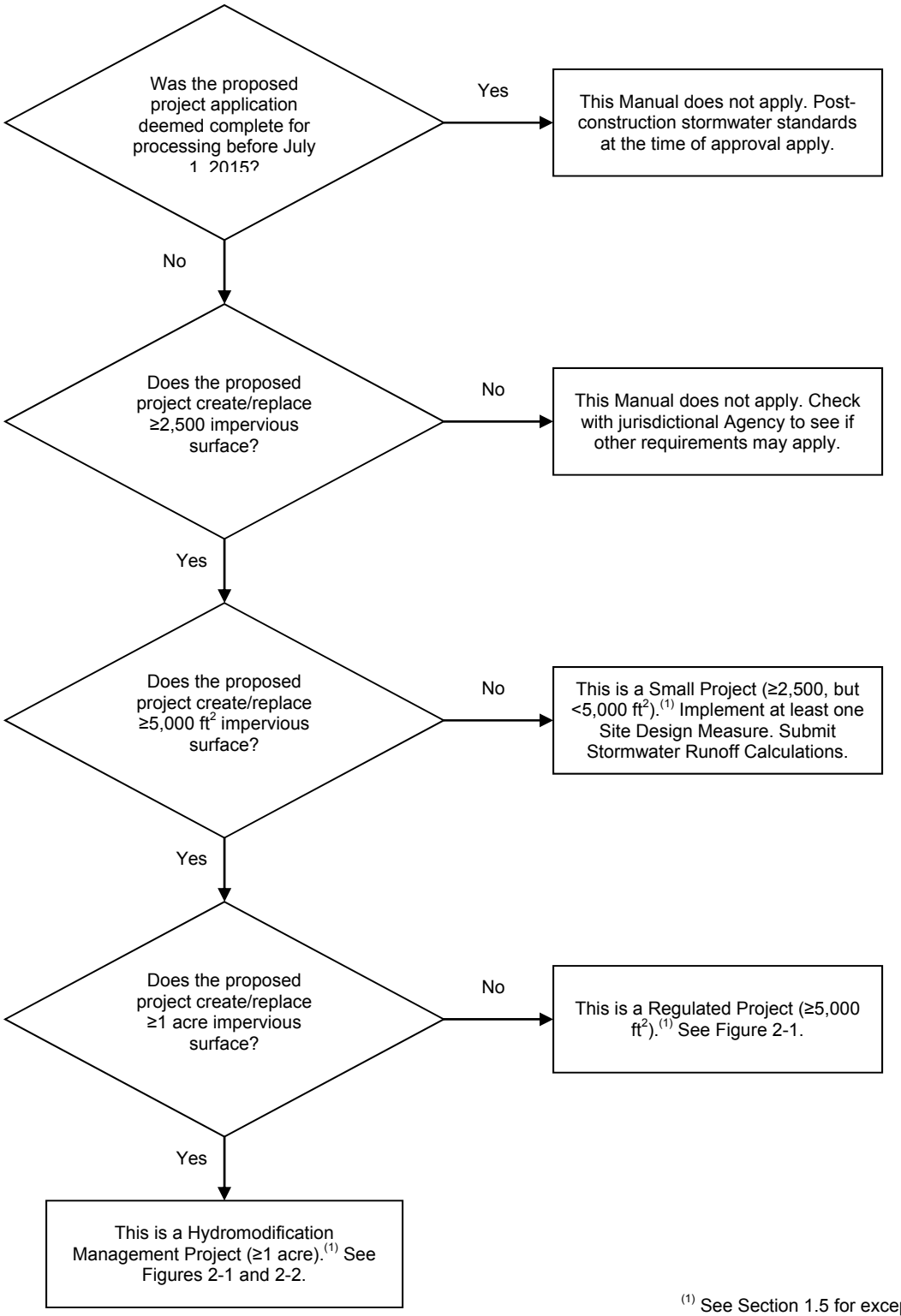

Figure 1-1. Applicability of 2015 Post-Construction Stormwater Standards Manual

Redevelopment Projects

Redevelopment is defined as any 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.

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 design storm volume or flow must be managed.
- If a redevelopment project results in an increase of less than 50 percent of the impervious surface are of the existing development, then only the stormwater runoff from the new and/or replaced impervious surfaces must be managed.

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 considered Regulated Projects, and are public road 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, for the design storm volume or flow 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, the 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).

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

The 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 plan submittals.

Section 3 Information on site assessment 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 types of projects to which hydromodification requirements apply.

Section 8 Operation and maintenance requirements for stormwater control measures.

SECTION 2. PROJECT PLAN SUBMITTAL

2.1. Introduction

The project applicant must submit proposed project plans 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. The project plan must provide a sufficient level of information for the type of project and be prepared by a licensed professional engineer or landscape architect. The project plan for Small Projects does not require a licensed professional engineer or landscape architect.

The project plan for Small Projects must include the following 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 on compliance with the requirements of this Manual. These project plans must include the following 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 summarizing relevant findings from a geotechnical evaluation;
    - Identification of each drainage management area (DMA);
    - Identification of pollutants of concern;
- Proposed site design measures to be implemented (Section 3);
- Proposed source control measure(s) 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 maintenance plan (Section 8).

Worksheets, which are included in Appendix D, must be submitted as part of the project plan. The project 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;
- Proposed locations and footprints stormwater control measures (e.g., site design measures, source control measures, stormwater treatment control measures) implemented to manage stormwater runoff;
- All DMAs with unique identifiers; 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 plan will be approved and signed off by the legally responsible person, or their approved signatory, of the jurisdictional Agency. It should be noted that there are other project plan approvals are necessary before construction of the proposed project may begin. The current project plan review processes, which may be subject to revision, for each Agency is presented in Appendix E.

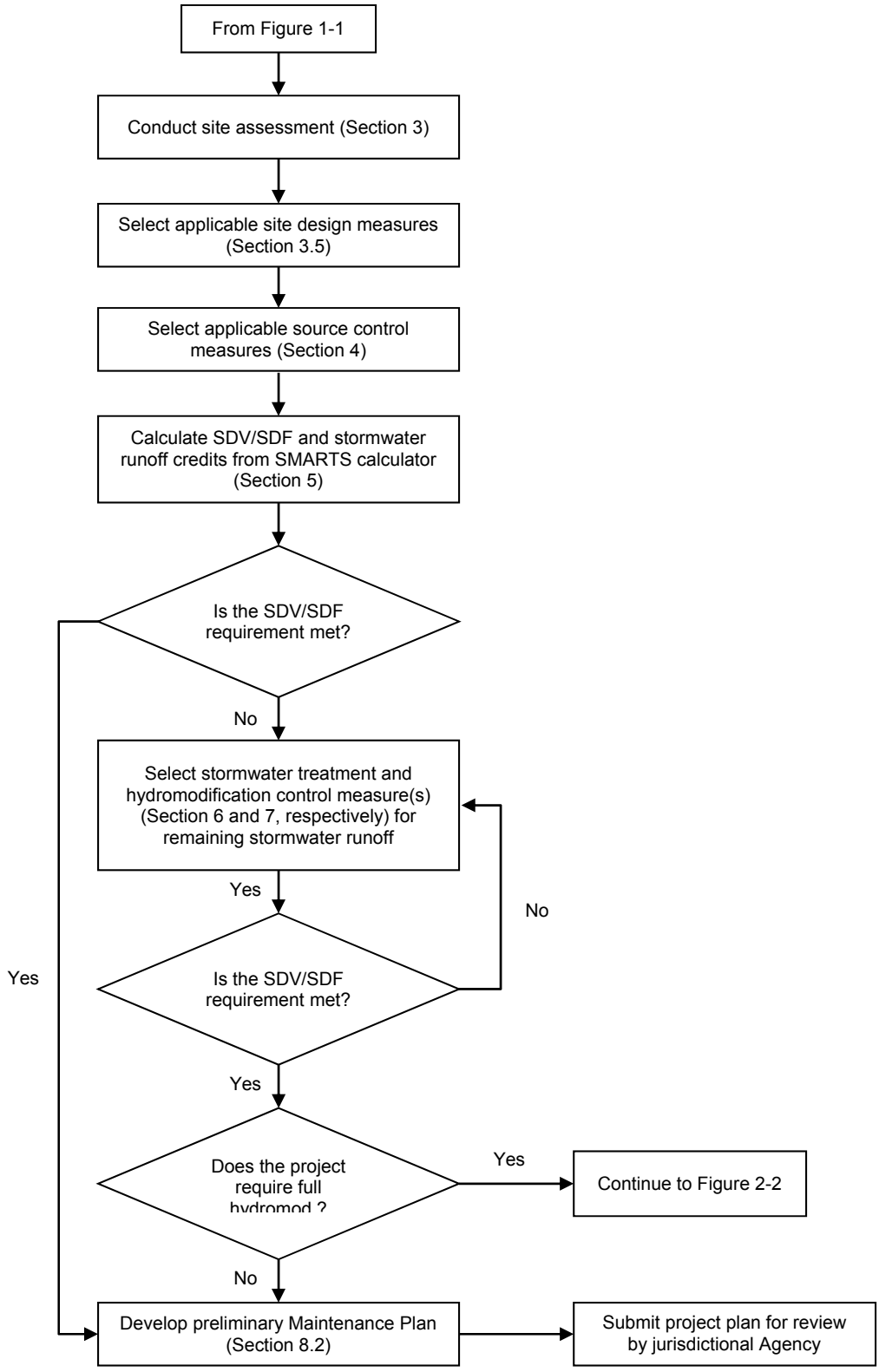

Figure 2-1. Design Process for Meeting Stormwater Requirements for Regulated and Hydromodification Management Projects

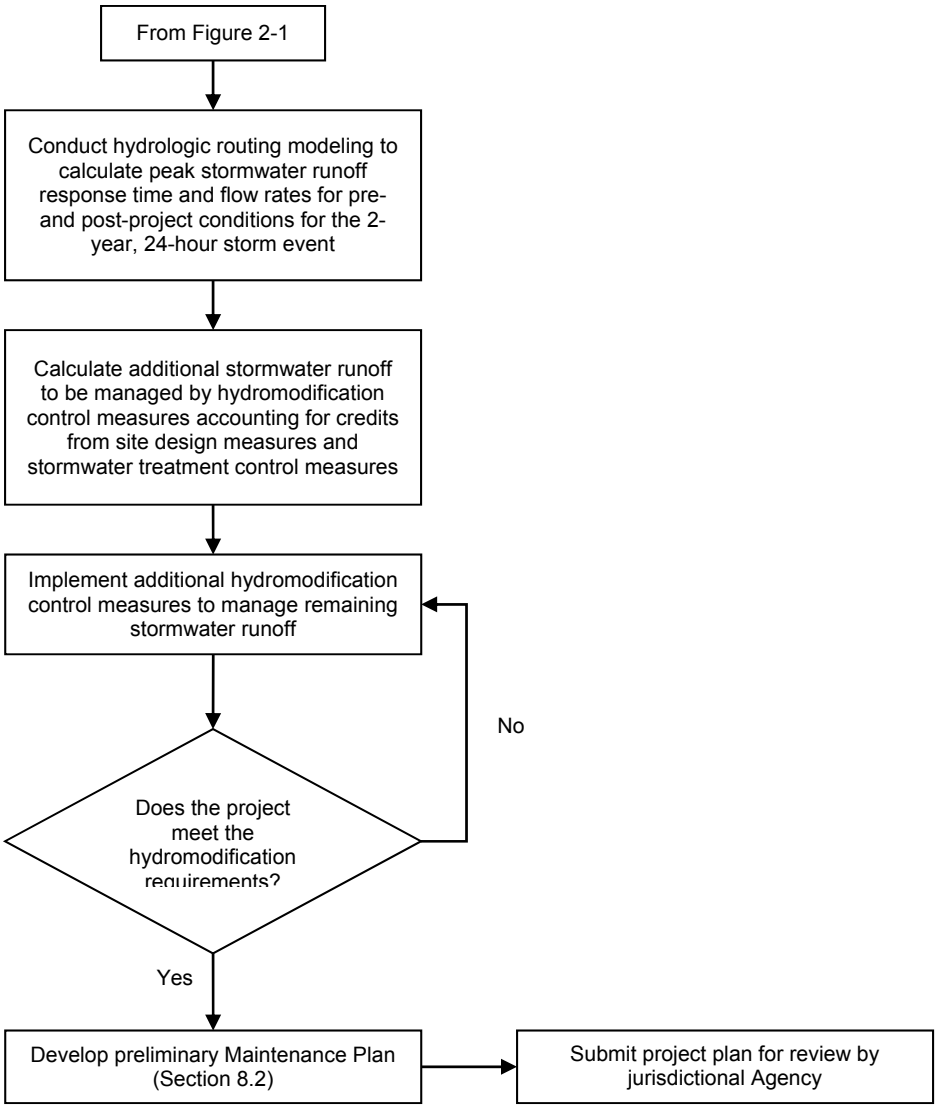

Figure 2-2. Design Process for Meeting Stormwater Requirements for Hydromodification Management Projects

SECTION 3. SITE ASSESSMENT AND SITE DESIGN MEASURES

This section discusses the steps for assessing project site conditions and identifying applicable site design measures during the planning phase of a project to determine the appropriate 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 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. It is recommended that Small Projects identify and implement the applicable activities of site assessment process to maximize consideration for 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, selection, sizing, and placement of stormwater control measures.

Geotechnical Conditions

An evaluation of geotechnical conditions at the project site 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), that considers the following conditions, which are discussed in further detail below:

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

The geotechnical evaluation 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 evaluation 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, shallow groundwater levels, and past groundwater issues.

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 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 the presence of steep 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).

Soil Type and Geology

The soil type and geologic conditions of the project site must be evaluated to determine the potential for infiltration and to identify suitable as well as unsuitable locations at the project site for infiltration-based stormwater treatment control measures. Underlying soils with corrected in-situ infiltration rates of 0.5 inches per hour (in/hr) and up to 5.0 in/hr are considered feasible for infiltration-based stormwater treatment control measures. For underlying soils with a corrected in-situ infiltration rate outside of the 0.5-5.0 in/hr range, modifications to the design of stormwater treatment control measures

may be necessary. 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 multiple sources (National Resource Conservation Service, American Society of Civil Engineers, etc.).

Groundwater

Groundwater conditions at the project site must be evaluated prior to stormwater control measure siting, selection, sizing, and design.[4] The depth to groundwater beneath the project site during the wet season 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, 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.

Areas with known groundwater impacts include sites listed by the 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, infiltration of stormwater runoff must be avoided to prevent the potential mobilization of the groundwater contamination. Under these circumstances, alternative stormwater treatment control measures may need to be implemented (see Section 6.2, Allowed Variations for Special Site Conditions).

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

[4] Site-specific groundwater information is required as part of the project plan. Some supplemental groundwater information may be available from the Eastern San Joaquin County Groundwater Basin Authority (gbawater.org/home, last accessed April 6, 2015).

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.

The geotechnical investigation, which is conducted by a licensed geotechnical engineer, must identify potential geotechnical issues and geological hazards that may result from implementing infiltration-based 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.

Setbacks

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

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 utility lines located at a project site may limit the possible locations of stormwater control measures. For example, infiltration-based stormwater treatment control measures should not be located near utility lines where an increased volume of water could damage utilities. 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 areas within the project site that drain to a common location prior to discharge off-site, and manage stormwater runoff from each DMA. Each DMA can only consist of one type of surface (e.g., pervious or impervious). The four types of DMAs are:

- Self-treating areas: These are landscaped or turf areas or natural conserved areas where rain that falls onto these areas infiltrates into the soil. Stormwater runoff from these areas is treated by the vegetation and 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 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 concave area that can be used to retain stormwater runoff. Stormwater runoff from impervious surfaces may be directed to self-retaining areas, provided it has been designed to retain the stormwater design 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 a bioretention facility: The areas that drain to a bioretention facility are used to size the bioretention system (Section 6). More than one DMA can drain to the same bioretention facility, but a DMA can drain to only one bioretention facility. Ideally, all impervious surfaces should be directed to a bioretention facility.

The project plan must include a map/diagram identifying each DMA at 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 submittal, 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 help 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 at the project site:

- Define the development envelope and protected areas, identifying 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 handle 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 reduce stormwater runoff from the design storm event from the project site.

The Phase II Permit identifies the following site design measures[5] that should 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.

Fact sheets to aid the project applicant in implementing these site design measures are presented in Appendix E.

[5] 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.

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 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;
- Properly designing and aiming sprinkler heads to only irrigate the planned application area;
- Not irrigating during precipitation events; and
- Where recycled water is used for irrigation, designing and managing holding ponds 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 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 should be contacted prior to any discharge.

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

- 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 F. These fact sheets include design specifications established 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 (1.582 and 1.963 for 24-hr and 48-hr drawdown, respectively); 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, 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 calculate the mean annual runoff-producing rainfall depth, based on historic records, for the project location.

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

Project Location	Mean Annual Runoff-Producing Rainfall Depth
Lathrop	0.32
Lodi	0.33
Manteca	0.37
Patterson	0.32
Stockton	0.42
Tracy	0.33

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].

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 listed 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

All 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 [hr/acre/in];
i = design rainfall intensity [0.2 in/hr];
A = total area of DMA [acre]; and; 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.

[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.

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 plan.

For Regulated and/or Hydromodification Management Projects, the project applicant uses the Post-Construction Calculator to quantify the stormwater runoff 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 that must be further treated by stormwater treatment control measures (i.e., bioretention, alternative stormwater treatment control measures). 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 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 results of these calculations must be submitted with the project plan.

SECTION 6. STORMWATER TREATMENT CONTROL MEASURES

6.1. Introduction

Stormwater treatment control measures are required to augment site design and source control measures to treat and reduce stormwater runoff and potential 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 necessary.

The Phase II Permit (Provision E.12.e.(f)) identifies bioretention as the preferred stormwater treatment control measure unless (1) it is determined to be technically infeasible then an alternative treatment control measure that is equivalent to bioretention must be proposed and justified (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 native, drought-tolerant plant species (e.g., wildflowers, sedges, rushes,

ferns, shrubs, small trees) that do not require fertilization and can withstand wet soils for at least 96 hours.

A schematic of a typical bioretention area is presented in Figure 6-1.

Placeholder: Schematic to be added.

Figure 6-1. Bioretention Area Schematic

Design Criteria

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

Geotechnical

Due to the potential to contaminate groundwater, 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 geotechnical investigation and summary report is required for any determination of infeasibility to implement bioretention at the project site.

Setbacks

Applicable setbacks must be implemented when siting bioretention facilities.

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, vegetated filter strips, sedimentation manholes, 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.

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 bioretention facility that may be filled with pea gravel or vegetated with 3:1 side slopes similar to a swale.
- Curb cuts for roadside or parking lot areas, if approved by the Agency. 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 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

Step 1: Determine the Adjusted SDV (SDV_{adj})

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).

Step 2: Determine the design infiltration rate

Determine the corrected in-situ infiltration rate (f_{design}) of the underlying soil. The infiltration rate must be between 0.5 and 5.0 in/hr. Soil amendments to increase the infiltration rate may be required if the infiltration rate of the underlying soil 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.

Step 3: Determine size of bioretention facility design layers

Bioretention facilities consist of several 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:

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

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} = corrected in-situ infiltration rate of the underlying soil (0.5-5.0 in/hr) [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 American Society for Testing and Materials (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.

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 one 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 eight inches using slotted PVC SDR 26 or PVC C9000. The slotted PVC allows for pressure water 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.

A rigid non-perforated observation pipe with a diameter equal to the underdrain diameter should be connected to the underdrain to provide a clean-out port as well as an observation well to monitor infiltration rates. The wells/clean-out port should 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 should also be capped.

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 (see T-1 in Appendix G).
- If the bioretention facility is located in areas with high groundwater, highly infiltrative soils (correct 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.

Vegetation

Prior to installation, a licensed landscape architect must certify that all plants, unless otherwise specifically permitted, conform to the standards of the current edition of American Standard for Nursery Stock as approved by the American Standards Institute, Inc. All plant grades must be established in the current edition of American Standards for Nursery Stock. It is recommended that a minimum of three types of tree, shrubs, and/or herbaceous groundcover species be incorporated to protect against facility failure due to disease and insect infestations of a single species. Select vegetation that:

- Can tolerate summer drought, ponding fluctuations, and saturated soil conditions for 96 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.

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 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 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 at least eight inches in 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 in 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, or 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. Under these circumstances, 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 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

If possible, the entire tributary area of the bioretention facility should be stabilized before construction commences. If this is not possible, all flows must be diverted around the bioretention facility to protect it from sediment loads during construction. Sediment controls should also be implemented to prevent sediment from entering the facility. Compaction of underling soils near and at the bioretention facility must be avoided. Establish protective perimeters 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 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, vegetation should be selected to be drought-tolerant 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 periodically, 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 in 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.
- 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 96 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 maintenance of any

privately-maintained stormwater control measures. A sample Maintenance Access Agreement is presented in Appendix H.

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 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 all of the following measures of equivalent effectiveness criteria when compared to a bioretention facility:

- 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.

Fact sheets for alternative stormwater treatment control measures that may be proposed as part of the project plan are included in Appendix G. The project plan must demonstrate how the proposed alternative stormwater treatment control measure meets the equivalent effectiveness criteria above.

6.3. Exceptions to Requirements for Bioretention Facilities

The Phase II Permit (Provision E.12.e.(i)) allows specific exemptions 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) may be used. Only Regulated Projects that meet the criteria below may receive an exemption 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.

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 the project applicant to 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 all stormwater runoff for the SDV/SDF is maintained 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.

7.2. Full Hydromodification Requirements

The Phase II Permit (Provision E.12.f) requires that Hydromodification Management Projects, which create and/or replace one acre or more of impervious surface, the post-construction stormwater runoff shall not exceed the estimated pre-project flow rate for the 2-year, 24-hour design storm event. A project that does not increase 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) to mitigate and meet the hydromodification design storm event criteria. 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 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 a 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 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 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 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 measures, and hydromodification management measures. Design and sizing requirements shall comply with the 2015 Post-Construction Stormwater Standards Manual. [Agency] approval of the project plan is precedent to issuance of any building, grading, or construction permits. Two paper copies and an electronic copy of the project 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 post-project stormwater runoff 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 plan.	Applicable to all land developments considered Hydromodification Management Projects.
Project applicant shall develop and submit a Maintenance Plan that identifies the operations, maintenance, and inspection requirements of all stormwater treatment and baseline hydromodification management control measures identified in the approved project plan. [Agency] approval of the preliminary 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 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 Maintenance Plan shall be provided to the [Agency].	Applicable to all land developments considered Regulated Projects and/or Hydromodification Management Projects.

8.2. Maintenance Plan Requirements

A Maintenance Plan, which will be part of the Maintenance Access Agreement, is required as part of the project plan submittal to the jurisdictional Agency. The 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 and date of installation.

Final As-Built Site Map and Details

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

- 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.

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 Maintenance Plan;
- Proper maintenance of all devices, including stormwater treatment control measures;
- Identification and cleanup procedures for spills and overflows;

[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.

- 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 an annual self-certification that its stormwater control measure(s) is(are) being properly operated and maintained according to the Phase II Permit requirements. For public projects, the applicable department is required to provide the annual self-certification. The 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 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. If used, easements need to be appropriately recorded and shown on the final property plat and property title documents. Easements should be secured 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.

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

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.