

**APPENDIX L – PRELIMINARY WATER QUALITY MANAGEMENT PLAN**

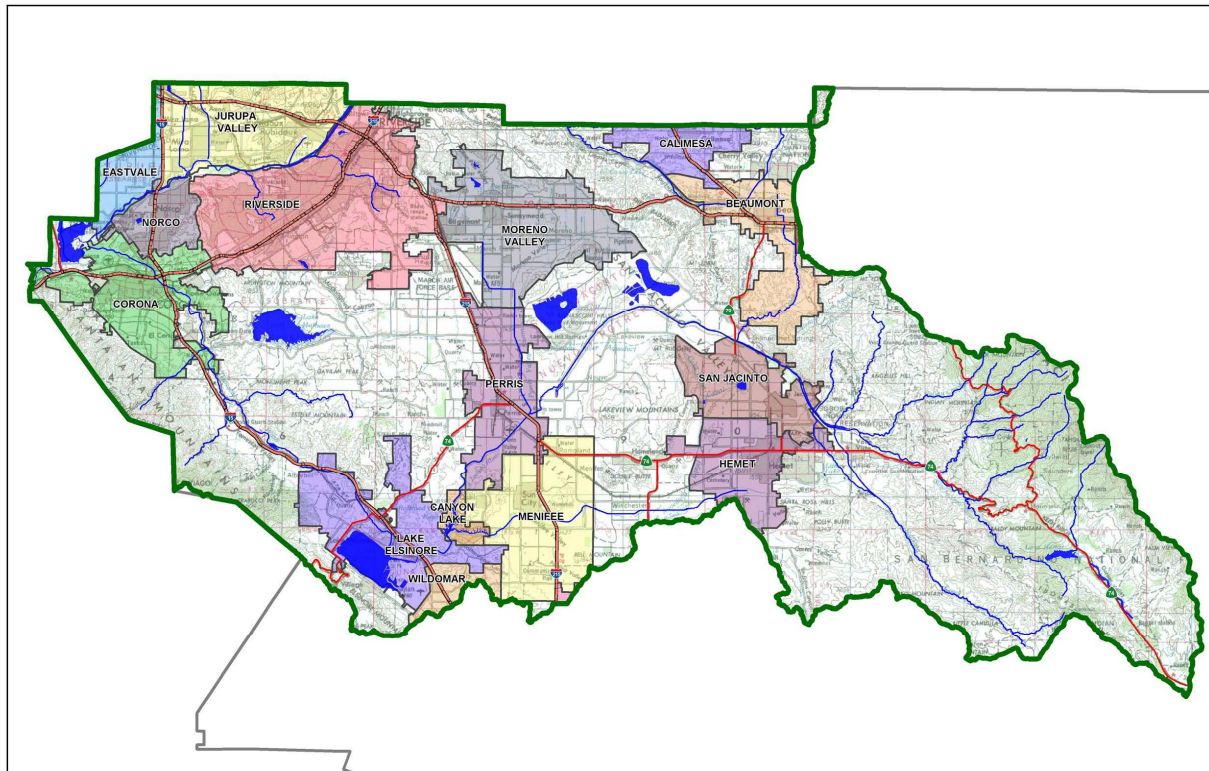
# Project Specific Water Quality Management Plan

Preliminary WQMP

Project Title: Moreno Valley Mall Redevelopment

Development No: TBD

Design Review/Case No: LWQ22-018



Preliminary

Final

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Regional Board Order No. R8-2010-0033  
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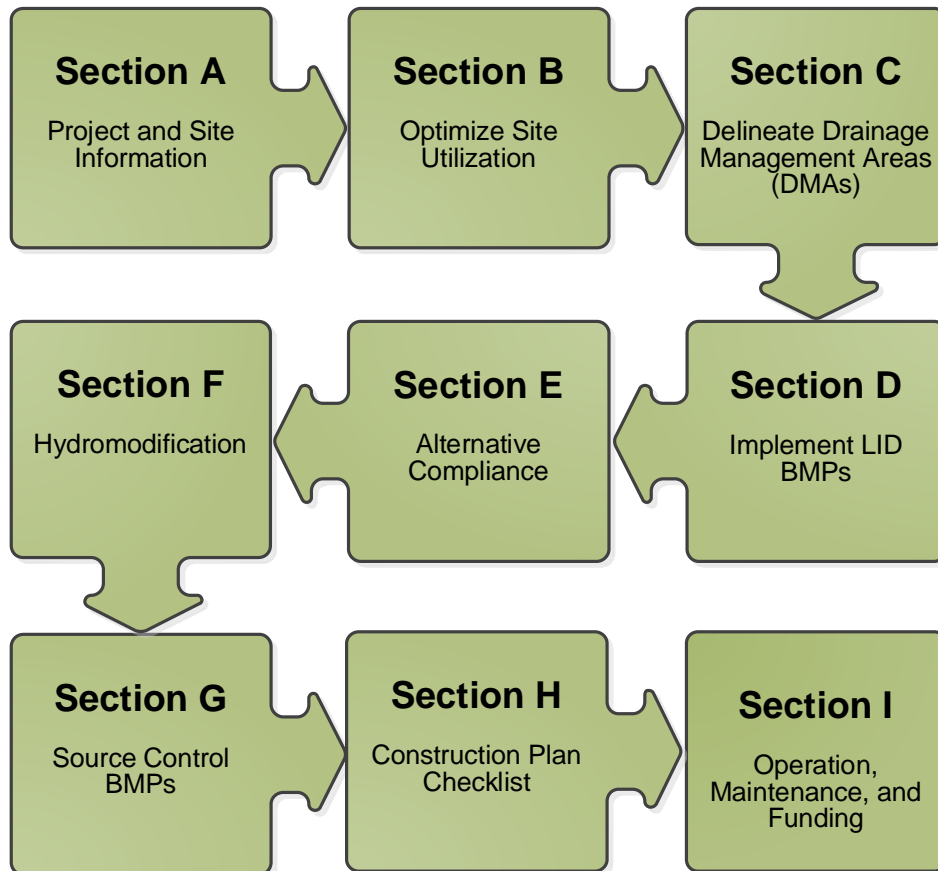
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## A Brief Introduction

This Project-Specific WQMP Template for the Santa Ana Region has been prepared to help guide you in documenting compliance for your project. Because this document has been designed to specifically document compliance, you will need to utilize the WQMP Guidance Document as your “how-to” manual to help guide you through this process. Both the Template and Guidance Document go hand-in-hand, and will help facilitate a well prepared Project-Specific WQMP. Below is a flowchart for the layout of this Template that will provide the steps required to document compliance.



## OWNER'S CERTIFICATION

This Project-Specific Water Quality Management Plan (WQMP) has been prepared for IGP Business Group by Kimley-Horn and Associates for the Moreno Valley Mall Redevelopment project.

This PWQMP is intended to comply with the requirements of City of Moreno Valley for Ordinance Number 827 which includes the requirement for the preparation and implementation of a Project-Specific WQMP.

The undersigned, while owning the property/project described in the preceding paragraph, shall be responsible for the implementation and funding of this WQMP and will ensure that this WQMP is amended as appropriate to reflect up-to-date conditions on the site. In addition, the property owner accepts responsibility for interim operation and maintenance of Stormwater BMPs until such time as this responsibility is formally transferred to a subsequent owner. This WQMP will be reviewed with the facility operator, facility supervisors, employees, tenants, maintenance and service contractors, or any other party (or parties) having responsibility for implementing portions of this WQMP. At least one copy of this WQMP will be maintained at the project site or project office in perpetuity. The undersigned is authorized to certify and to approve implementation of this WQMP. The undersigned is aware that implementation of this WQMP is enforceable under City of Moreno Valley Water Quality Ordinance (Municipal Code Section 827).

"I, the undersigned, certify under penalty of law that the provisions of this WQMP have been reviewed and accepted and that the WQMP will be transferred to future successors in interest."

\_\_\_\_\_  
Owner's Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Owner's Printed Name

\_\_\_\_\_  
Owner's Title/Position

## PREPARER'S CERTIFICATION

"The selection, sizing and design of stormwater treatment and other stormwater quality and quantity control measures in this plan meet the requirements of Regional Water Quality Control Board Order No. R8-2010-0033 and any subsequent amendments thereto."

\_\_\_\_\_  
Preparer's Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Preparer's Printed Name

\_\_\_\_\_  
Preparer's Title/Position

Preparer's Licensure:

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## Section A: Project and Site Information

| PROJECT INFORMATION  |  |
|--|--|
| Type of Project:   | Commercial Redevelopment   |
| Planning Area:   |  |
| Community Name:  | City of Moreno Valley  |
| Development Name:  | Moreno Valley Mall Redevelopment   |
| PROJECT LOCATION   |  |
| Latitude & Longitude (DMS):  | 33.93873, -117.27118   |
| Project Watershed and Sub-Watershed:   | Santa Anna Watershed, Sub-watershed San Jacinto Valley Hydrologic Unit       |
| Gross Acres:   | 87 Acres   |
| APN(s):  | 291-110-032, 291-110-033, 291-110-034, 291-110-035, 291-110-051, 291-110-052 |
| Map Book and Page No.:   |  |
| PROJECT CHARACTERISTICS  |  |
| Proposed or Potential Land Use(s)  | Mixed Use  |
| Proposed or Potential SIC Code(s)  | TBD  |
| Area of Impervious Project Footprint (SF)  | 3,881,196  |
| Total Area of <u>proposed</u> Impervious Surfaces within the Project Footprint (SF)/or Replacement | 1,234,829  |
| Does the project consist of offsite road improvements?   | <input checked="" type="checkbox"/> Y <input type="checkbox"/> N             |
| Does the project propose to construct unpaved roads?   | <input type="checkbox"/> Y <input checked="" type="checkbox"/> N             |
| Is the project part of a larger common plan of development (phased project)?                       | <input type="checkbox"/> Y <input checked="" type="checkbox"/> N             |
| EXISTING SITE CHARACTERISTICS  |  |
| Total area of <u>existing</u> Impervious Surfaces within the Project limits Footprint (SF)         | 1,413,446  |
| Is the project located within any MSHCP Criteria Cell?   | <input type="checkbox"/> Y <input checked="" type="checkbox"/> N             |
| If so, identify the Cell number:   |  |
| Are there any natural hydrologic features on the project site?                                     | <input type="checkbox"/> Y <input checked="" type="checkbox"/> N             |
| Is a Geotechnical Report attached?   | <input checked="" type="checkbox"/> Y <input type="checkbox"/> N             |
| If no Geotech. Report, list the NRCS soils type(s) present on the site (A, B, C and/or D)          | N/A  |
| What is the Water Quality Design Storm Depth for the project?                                      | 0.65 inches  |

### A.1 Maps and Site Plans

When completing your Project-Specific WQMP, include a map of the local vicinity and existing site. In addition, include all grading, drainage, landscape/plant palette and other pertinent construction plans in Appendix 2. At a minimum, your WQMP Site Plan should include the following:

- Drainage Management Areas
- Proposed Structural BMPs
- Drainage Path
- Drainage Infrastructure, Inlets, Overflows
- Source Control BMPs
- Buildings, Roof Lines, Downspouts
- Impervious Surfaces
- Standard Labeling
- BMP Locations (Lat/Long)

Use your discretion on whether or not you may need to create multiple sheets or can appropriately accommodate these features on one or two sheets. Keep in mind that the Co-Permittee plan reviewer must be able to easily analyze your project utilizing this template and its associated site plans and maps.

The Moreno Valley Mall Redevelopment project consists of redeveloping approximately 60 acres of an existing mall to include residential, hospitality and office buildings. The project will be split into five Drainage areas that consist of pervious and impervious surfaces. Each area will be treated with a bioclean modular wetland system that was sized with flow-based calculations to meet the water quality flow rate demand. The treated water discharges offsite to an existing RCP storm drain that ultimately flows to the Santa Ana River. See Appendix 1 for Drainage Management area delineation and treatment quantities.

## A.2 Identify Receiving Waters

Using Table A.1 below, list in order of upstream to downstream, the receiving waters that the project site is tributary to. Continue to fill each row with the Receiving Water's 303(d) listed impairments (if any), designated beneficial uses, and proximity, if any, to a RARE beneficial use. Include a map of the receiving waters in Appendix 1.

Table A.1 Identification of Receiving Waters

| Receiving Waters                               | EPA Approved 303(d) List Impairments                 | Designated Beneficial Uses  | Proximity to RARE Beneficial Use |
|--|--|---|----------------------------------|
| Tequesquite Arroyo (Sycamore Creek)            | N/A  | Municipal and Domestic Supply (MUN), Ground Water Recharge (GWR), Contact Water Recreation (REC1), Non-Contact Water Recreation (REC2), Warm Freshwater Habitat (WARM), Wildlife Habitat (WILD), Rare Threatened or Endangered Species (RARE), Spawning, Reproduction, and Development (SPWN) | ~1.4 miles                       |
| Santa Ana River (802.21) Reach 3               | Copper (during wet season only), lead, and pathogens | Agricultural Supply (AGR), Ground Water Recharge (GWR), Contact Water Recreation (REC1), Non-Contact Water Recreation (REC2), Warm Freshwater Habitat (WARM), Wildlife Habitat (WILD) and Rare Threatened or Endangered Species (RARE)  | ~9.1 miles                       |
| Prado Flood Control Basin                      | Indicator Bacteria, pH                               | Contact Water Recreation (REC1), Non-Contact Water Recreation (REC2), Warm Freshwater Habitat (WARM), Wildlife Habitat (WILD), and Rare Threatened or Endangered Species (RARE)   | ~22.7 miles                      |
| Santa Ana River Reach 2                        | Indicator Bacteria                                   | Agricultural Supply (AGR), Ground Water Recharge (GWR), Contact Water Recreation (REC1), Non-Contact Water Recreation (REC2), Warm Freshwater Habitat (WARM), Wildlife Habitat (WILD) and Rare Threatened or Endangered Species (RARE), Spawning, Reproduction, and Development (SPWN)        | ~25.9miles                       |
| Santa Ana River Reach 1                        | N/A  | Contact Water Recreation (REC1), Non-Contact Water Recreation (REC2), Warm Freshwater Habitat (WARM), Wildlife Habitat (WILD)   | ~43.6miles                       |
| Pacific Ocean (Tidal Prism of Santa Ana River) | N/A  | Municipal and Domestic Supply (MUN), Contact Water Recreation (REC1), Non-Contact Water Recreation (REC2), (COMM), Wildlife Habitat (WILD), and Rare Threatened or Endangered Species (RARE), (MAR)   | ~ 44.6miles                      |



### A.3 Additional Permits/Approvals required for the Project:

Table A.2 Other Applicable Permits

| Agency   | Permit Required                       |                                       |
|--|---------------------------------------|---------------------------------------|
| State Department of Fish and Game, 1602 Streambed Alteration Agreement                     | <input type="checkbox"/> Y            | <input checked="" type="checkbox"/> N |
| State Water Resources Control Board, Clean Water Act (CWA) Section 401 Water Quality Cert. | <input type="checkbox"/> Y            | <input checked="" type="checkbox"/> N |
| US Army Corps of Engineers, CWA Section 404 Permit   | <input type="checkbox"/> Y            | <input checked="" type="checkbox"/> N |
| US Fish and Wildlife, Endangered Species Act Section 7 Biological Opinion                  | <input type="checkbox"/> Y            | <input checked="" type="checkbox"/> N |
| Statewide Construction General Permit Coverage   | <input checked="" type="checkbox"/> Y | <input type="checkbox"/> N            |
| Statewide Industrial General Permit Coverage   | <input type="checkbox"/> Y            | <input checked="" type="checkbox"/> N |
| Western Riverside MSHCP Consistency Approval (e.g., JPR, DBESP)                            | <input type="checkbox"/> Y            | <input checked="" type="checkbox"/> N |
| Other <i>(please list in the space below as required)</i>                                  | <input type="checkbox"/> Y            | <input type="checkbox"/> N            |

If yes is answered to any of the questions above, the Co-Permittee may require proof of approval/coverage from those agencies as applicable including documentation of any associated requirements that may affect this Project-Specific WQMP.

## Section B: Optimize Site Utilization (LID Principles)

Review of the information collected in Section 'A' will aid in identifying the principal constraints on site design and selection of LID BMPs as well as opportunities to reduce imperviousness and incorporate LID Principles into the site and landscape design. For example, constraints might include impermeable soils, high groundwater, groundwater pollution or contaminated soils, steep slopes, geotechnical instability, high-intensity land use, heavy pedestrian or vehicular traffic, utility locations or safety concerns. Opportunities might include existing natural areas, low areas, oddly configured or otherwise unbuildable parcels, easements and landscape amenities including open space and buffers (which can double as locations for bioretention BMPs), and differences in elevation (which can provide hydraulic head). Prepare a brief narrative for each of the site optimization strategies described below. This narrative will help you as you proceed with your LID design and explain your design decisions to others.

The 2010 Santa Ana MS4 Permit further requires that LID Retention BMPs (Infiltration Only or Harvest and Use) be used unless it can be shown that those BMPs are infeasible. Therefore, it is important that your narrative identify and justify if there are any constraints that would prevent the use of those categories of LID BMPs. Similarly, you should also note opportunities that exist which will be utilized during project design. Upon completion of identifying Constraints and Opportunities, include these on your WQMP Site plan in Appendix 1.

Consideration of "highest and best use" of the discharge should also be considered. For example, Lake Elsinore is evaporating faster than runoff from natural precipitation can recharge it. Requiring infiltration of 85% of runoff events for projects tributary to Lake Elsinore would only exacerbate current water quality problems associated with Pollutant concentration due to lake water evaporation. In cases where rainfall events have low potential to recharge Lake Elsinore (i.e. no hydraulic connection between groundwater to Lake Elsinore, or other factors), requiring infiltration of Urban Runoff from projects is counterproductive to the overall watershed goals. Project proponents, in these cases, would be allowed to discharge Urban Runoff, provided they used equally effective filtration-based BMPs.

### Site Optimization

The following questions are based upon Section 3.2 of the WQMP Guidance Document. Review of the WQMP Guidance Document will help you determine how best to optimize your site and subsequently identify opportunities and/or constraints, and document compliance.

Did you identify and preserve existing drainage patterns? If so, how? If not, why?

*Existing Drainage patterns were preserved. The project proposes to capture and convey stormwater to modular wetland biofiltration systems. This water will be treated and conveyed into the existing RCP storm drain in Town Circle.*

Did you identify and protect existing vegetation? If so, how? If not, why?

*There is minimal existing vegetation on site. Proposed landscaping will be comprised of native and drought tolerant species.*

Did you identify and preserve natural infiltration capacity? If so, how? If not, why?

*Per infiltration testing performed by Terracon Consultants, Inc., infiltration is considered infeasible for the site.*

Did you identify and minimize impervious area? If so, how? If not, why?

*The existing site consists of large impervious areas with minimal landscaping. Impervious areas were minimized whenever possible, and as a result there are more proposed pervious surfaces than in existing conditions.*

Did you identify and disperse runoff to adjacent pervious areas? If so, how? If not, why?

*Infiltration is considered infeasible for the project site. All storm water runoff is captured and conveyed via inlets and storm drainpipes and routed to the proposed water quality BMP for treatment.*

# Section C: Delineate Drainage Management Areas (DMAs)

Utilizing the procedure in Section 3.3 of the WQMP Guidance Document which discusses the methods of delineating and mapping your project site into individual DMAs, complete Table C.1 below to appropriately categorize the types of classification (e.g., Type A, Type B, etc.) per DMA for your project site. Upon completion of this table, this information will then be used to populate and tabulate the corresponding tables for their respective DMA classifications.

Table C.1 DMA Classifications

| DMA Name or ID | Surface Type(s) <sup>12</sup> | Area (Sq. Ft.) | DMA Type |
|----------------|-------------------------------|----------------|----------|
| DA 1           | Concrete or Asphalt           | 107,982        | D        |
| DA 2           | Concrete or Asphalt           | 269,165        | D        |
| DA 3A          | Concrete or Asphalt           | 154,217        | D        |
| DA 3B          | Concrete or Asphalt           | 176,350        | D        |
| DA 4           | Concrete or Asphalt           | 432,894        | D        |
| DA 5           | Concrete or Asphalt           | 231,423        | D        |

<sup>1</sup>Reference Table 2-1 in the WQMP Guidance Document to populate this column

<sup>2</sup>If multi-surface provide back-up

Table C.2 Type 'A', Self-Treating Areas

| DMA Name or ID | Area (Sq. Ft.) | Stabilization Type | Irrigation Type (if any) |
|----------------|----------------|--------------------|--------------------------|
| N/A            |                |                    |                          |

Table C.3 Type 'B', Self-Retaining Areas

| Self-Retaining Area |                           |                    |                      | Type 'C' DMAs that are draining to the Self-Retaining Area |                          |   |
|---------------------|---------------------------|--------------------|----------------------|--|--------------------------|---|
| DMA Name/ ID        | Post-project surface type | Area (square feet) | Storm Depth (inches) | DMA Name / ID  | [C] from Table C.4 = [C] | Required Retention Depth (inches) = [D] |
|                     |                           | [A]                | [B]                  |  |                          |   |
| N/A                 |                           |                    |                      |  |                          |   |

$$[D] = [B] + \frac{[B] \cdot [C]}{[A]}$$

Table C.4 Type 'C', Areas that Drain to Self-Retaining Areas

| DMA | Receiving Self-Retaining DMA |
|-----|------------------------------|
|     |                              |

| DMA Name/ ID | Area (square feet) | Post-project surface type | Impervious fraction | Product         | DMA name /ID | Area (square feet) | Ratio   |
|--------------|--------------------|---------------------------|---------------------|-----------------|--------------|--------------------|---------|
|              | [A]                |                           | [B]                 | [C] = [A] x [B] |              | [D]                | [C]/[D] |
| N/A          |                    |                           |                     |                 |              |                    |         |

Table C.5 Type 'D', Areas Draining to BMPs

| DMA Name or ID | BMP Name or ID |
|----------------|----------------|
| DA 1           | BMP 1          |
| DA 2           | BMP 2          |
| DA 3A          | BMP 3A         |
| DA 3B          | BMP 3B         |
| DA 4           | BMP 4          |
| DA 5           | BMP 5          |

*Note: More than one drainage management area can drain to a single LID BMP, however, one drainage management area may not drain to more than one BMP.*

## Section D: Implement LID BMPs

### D.1 Infiltration Applicability

Is there an approved downstream 'Highest and Best Use' for stormwater runoff (see discussion in Chapter 2.4.4 of the WQMP Guidance Document for further details)?  Y  N

If yes has been checked, Infiltration BMPs shall not be used for the site; proceed to section D.3

If no, continue working through this section to implement your LID BMPs. It is recommended that you contact your Co-Permittee to verify whether or not your project discharges to an approved downstream 'Highest and Best Use' feature.

#### Geotechnical Report

A Geotechnical Report or Phase I Environmental Site Assessment may be required by the Copermitee to confirm present and past site characteristics that may affect the use of Infiltration BMPs. In addition, the Co-Permittee, at their discretion, may not require a geotechnical report for small projects as described in Chapter 2 of the WQMP Guidance Document. If a geotechnical report has been prepared, include it in Appendix 3. In addition, if a Phase I Environmental Site Assessment has been prepared, include it in Appendix 4.

Is this project classified as a small project consistent with the requirements of Chapter 2 of the WQMP Guidance Document?  Y  N

#### Infiltration Feasibility

Table D.1 below is meant to provide a simple means of assessing which DMAs on your site support Infiltration BMPs and is discussed in the WQMP Guidance Document in Chapter 2.4.5. Check the appropriate box for each question and then list affected DMAs as applicable. If additional space is needed, add a row below the corresponding answer.

Table D.1 Infiltration Feasibility

| Does the project site...   | YES | NO |
|--|-----|----|
| ...have any DMAs with a seasonal high groundwater mark shallower than 10 feet?<br>If Yes, list affected DMAs:  |     | X  |
| ...have any DMAs located within 100 feet of a water supply well?<br>If Yes, list affected DMAs:  |     | X  |
| ...have any areas identified by the geotechnical report as posing a public safety risk where infiltration of stormwater could have a negative impact?<br>If Yes, list affected DMAs:   |     | X  |
| ...have measured in-situ infiltration rates of less than 1.6 inches / hour?<br>If Yes, list affected DMAs:   | X   |    |
| ...have significant cut and/or fill conditions that would preclude in-situ testing of infiltration rates at the final infiltration surface?<br>If Yes, list affected DMAs: Entire Site | X   |    |
| ...geotechnical report identify other site-specific factors that would preclude effective and safe infiltration?<br>Describe here:   |     | X  |

If you answered "Yes" to any of the questions above for any DMA, Infiltration BMPs should not be used for those DMAs and you should proceed to the assessment for Harvest and Use below.

## D.2 Harvest and Use Assessment

Please check what applies:

- Reclaimed water will be used for the non-potable water demands for the project.
- Downstream water rights may be impacted by Harvest and Use as approved by the Regional Board (verify with the Copermitttee).
- The Design Capture Volume will be addressed using Infiltration Only BMPs. In such a case, Harvest and Use BMPs are still encouraged, but it would not be required if the Design Capture Volume will be infiltrated or evapotranspired.

If any of the above boxes have been checked, Harvest and Use BMPs need not be assessed for the site. If none of the above criteria applies, follow the steps below to assess the feasibility of irrigation use, toilet use and other non-potable uses (e.g., industrial use).

### Irrigation Use Feasibility

Complete the following steps to determine the feasibility of harvesting stormwater runoff for Irrigation Use BMPs on your site:

Step 1: Identify the total area of irrigated landscape on the site, and the type of landscaping used.

*Total Area of Irrigated Landscape: 3.15*

*Type of Landscaping (Conservation Design or Active Turf): Conservative Design*

Step 2: Identify the planned total of all impervious areas on the proposed project from which runoff might be feasibly captured and stored for irrigation use. Depending on the configuration of buildings and other impervious areas on the site, you may consider the site as a whole, or parts of the site, to evaluate reasonable scenarios for capturing and storing runoff and directing the stored runoff to the potential use(s) identified in Step 1 above.

*Total Area of Impervious Surfaces: 28.35*

Step 3: Cross reference the Design Storm depth for the project site (see Exhibit A of the WQMP Guidance Document) with the left column of Table 2-3 in Chapter 2 to determine the minimum area of Effective Irrigated Area per Tributary Impervious Area (EIATIA).

*Enter your EIATIA factor: 1.05*

Step 4: Multiply the unit value obtained from Step 3 by the total of impervious areas from Step 2 to develop the minimum irrigated area that would be required.

*Minimum required irrigated area: 29.77*

Step 5: Determine if harvesting stormwater runoff for irrigation use is feasible for the project by comparing the total area of irrigated landscape (Step 1) to the minimum required irrigated area (Step 4).

| Minimum required irrigated area (Step 4) | Available Irrigated Landscape (Step 1) |
|--|--|
| 29.77                                    | 3.15                                   |

## Toilet Use Feasibility

Complete the following steps to determine the feasibility of harvesting stormwater runoff for toilet flushing uses on your site:

Step 1: Identify the projected total number of daily toilet users during the wet season, and account for any periodic shut downs or other lapses in occupancy:

*Projected Number of Daily Toilet Users: 1233*

*Project Type: Residential*

Step 2: Identify the planned total of all impervious areas on the proposed project from which runoff might be feasibly captured and stored for toilet use. Depending on the configuration of buildings and other impervious areas on the site, you may consider the site as a whole, or parts of the site, to evaluate reasonable scenarios for capturing and storing runoff and directing the stored runoff to the potential use(s) identified in Step 1 above.

*Total Area of Impervious Surfaces: 12.4*

Step 3: Enter the Design Storm depth for the project site (see Exhibit A) into the left column of Table 2-2 in Chapter 2 to determine the minimum number of toilet users per tributary impervious acre (TUTIA).

*Enter your TUTIA factor: 108*

Step 4: Multiply the unit value obtained from Step 3 by the total of impervious areas from Step 2 to develop the minimum number of toilet users that would be required.

*Minimum number of toilet users: 1339*

Step 5: Determine if harvesting stormwater runoff for toilet flushing use is feasible for the project by comparing the Number of Daily Toilet Users (Step 1) to the minimum required number of toilet users (Step 4).

| Minimum required Toilet Users (Step 4) | Projected number of toilet users (Step 1) |
|--|---|
| 1339                                   | 1233                                      |

## Other Non-Potable Use Feasibility

Are there other non-potable uses for stormwater runoff on the site (e.g. industrial use)? See Chapter 2 of the Guidance for further information. If yes, describe below. If no, write N/A.

N/A

Step 1: Identify the projected average daily non-potable demand, in gallons per day, during the wet season and accounting for any periodic shut downs or other lapses in occupancy or operation.

*Average Daily Demand:*

Step 2: Identify the planned total of all impervious areas on the proposed project from which runoff might be feasibly captured and stored for the identified non-potable use. Depending on the configuration of buildings and other impervious areas on the site, you may consider the site as a whole, or parts of the site, to evaluate reasonable scenarios for capturing and storing runoff and directing the stored runoff to the potential use(s) identified in Step 1 above.

*Total Area of Impervious Surfaces:*



Step 3: Enter the Design Storm depth for the project site (see Exhibit A) into the left column of Table 2-4 in Chapter 2 to determine the minimum demand for non-potable uses per tributary impervious acre.

*Enter the factor from Table 2-4:*

Step 4: Multiply the unit value obtained from Step 3 by the total of impervious areas from Step 2 to develop the minimum number of gallons per day of non-potable use that would be required.

*Minimum required use:*

Step 5: Determine if harvesting stormwater runoff for other non-potable use is feasible for the project by comparing the projected average daily use (Step 1) to the minimum required non-potable use (Step 4).

|   |                                      |
|---|--------------------------------------|
| Minimum required non-potable use (Step 4) | Projected average daily use (Step 1) |
|---|--------------------------------------|

If Irrigation, Toilet and Other Use feasibility anticipated demands are less than the applicable minimum values, Harvest and Use BMPs are not required and you should proceed to utilize LID Bioretention and Biotreatment per Section 3.4.2 of the WQMP Guidance Document.

### D.3 Bioretention and Biotreatment Assessment

Other LID Bioretention and Biotreatment BMPs as described in Chapter 2.4.7 of the WQMP Guidance Document are feasible on nearly all development sites with sufficient advance planning.

*Select one of the following:*

- LID Bioretention/Biotreatment BMPs will be used for some or all DMAs of the project as noted below in Section D.4 (note the requirements of Section 3.4.2 in the WQMP Guidance Document).
- A site-specific analysis demonstrating the technical infeasibility of all LID BMPs has been performed and is included in Appendix 5. If you plan to submit an analysis demonstrating the technical infeasibility of LID BMPs, request a pre-submittal meeting with the Copermittee to discuss this option. Proceed to Section E to document your alternative compliance measures.

## D.4 Feasibility Assessment Summaries

From the Infiltration, Harvest and Use, Bioretention and Biotreatment Sections above, complete Table D.2 below to summarize which LID BMPs are technically feasible, and which are not, based upon the established hierarchy.

Table D.2 LID Prioritization Summary Matrix

| DMA Name/ID | LID BMP Hierarchy        |                          |                          |                                     | No LID (Alternative Compliance) |
|-------------|--------------------------|--------------------------|--------------------------|-------------------------------------|---------------------------------|
|             | 1. Infiltration          | 2. Harvest and use       | 3. Bioretention          | 4. Biotreatment                     |                                 |
| DA 1        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>        |
| DA 2        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>        |
| DA 3A       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>        |
| DA 3B       | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>        |
| DA 4        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>        |
| DA 5        | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/>        |

For those DMAs where LID BMPs are not feasible, provide a brief narrative below summarizing why they are not feasible, include your technical infeasibility criteria in Appendix 5, and proceed to Section E below to document Alternative Compliance measures for those DMAs. Recall that each proposed DMA must pass through the LID BMP hierarchy before alternative compliance measures may be considered.

N/A

## D.5 LID BMP Sizing

Each LID BMP must be designed to ensure that the Design Flow Rate will be addressed by the selected BMPs. First, calculate the Design Flow Rate for each LID BMP using the  $V_{BMP}$  worksheet in Appendix F of the LID BMP Design Handbook. Second, design the LID BMP to meet the required  $V_{BMP}$  using a method approved by the Copermittee. Utilize the worksheets found in the LID BMP Design Handbook or consult with your Copermittee to assist you in correctly sizing your LID BMPs. Complete Table D.3 below to document the Design Capture Volume and the Proposed Volume for each LID BMP. Provide the completed design procedure sheets for each LID BMP in Appendix 6. You may add additional rows to the table below as needed.

Table D.3-1 DCV Calculations for LID BMPs

| DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type | Effective Impervious Fraction, $I_f$ | DMA Runoff Factor | DMA Areas x Runoff Factor | BMP 1                   |   |                                       |
|-------------|------------------------|---------------------------|--------------------------------------|-------------------|---------------------------|-------------------------|---|---------------------------------------|
|             |                        |                           |                                      |                   |                           | Design Storm Depth (in) | Design Capture Volume, $V_{BMP}$ (cubic feet) | Proposed Volume on Plans (cubic feet) |
| DA 1        | 97,184                 | Conc. or Asphalt          | 1                                    | 0.89              | 86,688                    |                         |   |                                       |
| DA 1        | 10,798                 | Orn. LS                   | .1                                   | 0.11              | 1,192                     |                         |   |                                       |
|             | $A_T = 107982$         |                           |                                      |                   | $\Sigma = 87,880$         | 0.64                    | $[F] = 4,687$                                 | 4,687                                 |

Table D.3-2 DCV Calculations for LID BMPs

| DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type | Effective Impervious Fraction, $I_f$ | DMA Runoff Factor | DMA Areas x Runoff Factor | BMP 2                   |   |                                       |
|-------------|------------------------|---------------------------|--------------------------------------|-------------------|---------------------------|-------------------------|---|---------------------------------------|
|             | [A]                    |                           | [B]                                  | [C]               | [A] x [C]                 |                         |   |                                       |
| DA 2        | 242,249                | Conc. or Asphalt          | 1                                    | 0.89              | 216,086                   | Design Storm Depth (in) | Design Capture Volume, $V_{BMP}$ (cubic feet) | Proposed Volume on Plans (cubic feet) |
| DA 2        | 26,916                 | Orn. LS                   | .1                                   | 0.11              | 2,973                     |                         |   |                                       |
|             | $A_T = 269,165$        |                           |                                      |                   | $\Sigma = 219,059$        | 0.64                    | [F] = 11,683                                  | 11,684                                |

Table D.3-3A DCV Calculations for LID BMPs

| DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type | Effective Impervious Fraction, $I_f$ | DMA Runoff Factor | DMA Areas x Runoff Factor | BMP 3A                  |   |                                       |
|-------------|------------------------|---------------------------|--------------------------------------|-------------------|---------------------------|-------------------------|---|---------------------------------------|
|             | [A]                    |                           | [B]                                  | [C]               | [A] x [C]                 |                         |   |                                       |
| DA 3A       | 138,795                | Conc. or Asphalt          | 1                                    | 0.89              | 123,805                   | Design Storm Depth (in) | Design Capture Volume, $V_{BMP}$ (cubic feet) | Proposed Volume on Plans (cubic feet) |
| DA 3A       | 15,422                 | Orn. LS                   | .1                                   | 0.11              | 1,703                     |                         |   |                                       |
|             | $A_T = 154,217$        |                           |                                      |                   | $\Sigma = 125,509$        | 0.64                    | [F] = 6,694                                   | 6,695                                 |

Table D.3-3B DCV Calculations for LID BMPs

| DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type | Effective Impervious Fraction, $I_f$ | DMA Runoff Factor | DMA Areas x Runoff Factor | BMP 3B                  |   |                                       |
|-------------|------------------------|---------------------------|--------------------------------------|-------------------|---------------------------|-------------------------|---|---------------------------------------|
|             | [A]                    |                           | [B]                                  | [C]               | [A] x [C]                 |                         |   |                                       |
| DA 3B       | 158,715                | Conc. or Asphalt          | 1                                    | 0.89              | 141,574                   | Design Storm Depth (in) | Design Capture Volume, $V_{BMP}$ (cubic feet) | Proposed Volume on Plans (cubic feet) |
| DA 3B       | 17,635                 | Orn. LS                   | .1                                   | 0.11              | 1,948                     |                         |   |                                       |
|             | $A_T = 176,350$        |                           |                                      |                   | $\Sigma = 143,522$        | 0.64                    | [F] = 7,655                                   | 7,656                                 |

Table D.3-4 DCV Calculations for LID BMPs

| DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type | Effective Impervious Fraction, $I_f$ | DMA Runoff Factor | DMA Areas x Runoff Factor | BMP 4        |                |                 |
|-------------|------------------------|---------------------------|--------------------------------------|-------------------|---------------------------|--------------|----------------|-----------------|
|             | [A]                    |                           | [B]                                  | [C]               | [A] x [C]                 |              |                |                 |
| DA 4        | 389,605                | Conc. or Asphalt          | 1                                    | 0.89              | 347,527                   | Design Storm | Design Capture | Proposed Volume |

|      |                             |         |    |      |               |                   |   |                              |
|------|-----------------------------|---------|----|------|---------------|-------------------|---|------------------------------|
| DA 4 | 43,289                      | Orn. LS | .1 | 0.11 | 4,781         | <i>Depth (in)</i> | <i>Volume, V<sub>BMP</sub> (cubic feet)</i> | <i>on Plans (cubic feet)</i> |
|      | A <sub>T</sub> =<br>432,894 |         |    |      | Σ=<br>352,309 | 0.64              | [F] = 18,790                                | 18,792                       |

Table D.3-5 DCV Calculations for LID BMPs

| DMA Type/ID | DMA Area (square feet)      | Post-Project Surface Type | Effective Impervious Fraction, I <sub>f</sub> | DMA Runoff Factor | DMA Areas x Runoff Factor | <i>BMP 5</i>                   |  |  |
|-------------|-----------------------------|---------------------------|---|-------------------|---------------------------|--------------------------------|--|--|
|             | [A]                         |                           | [B]   | [C]               | [A] x [C]                 |                                |  |  |
| DA 5        | 208,281                     | Conc. or Asphalt          | 1   | 0.89              | 185,787                   | <i>Design Storm Depth (in)</i> | <i>Design Capture Volume, V<sub>BMP</sub> (cubic feet)</i> | <i>Proposed Volume on Plans (cubic feet)</i> |
| DA 5        | 23,142                      | Orn. LS                   | .1  | 0.11              | 2,556                     |                                |  |  |
|             | A <sub>T</sub> =<br>231,423 |                           |   |                   | Σ=<br>188,343             | 0.64                           | [F] = 10,045   | 10,046                                       |

[B], [C] is obtained as described in Section 2.3.1 of the WQMP Guidance Document

[E] is obtained from Exhibit A in the WQMP Guidance Document

[G] is obtained from a design procedure sheet, such as in LID BMP Design Handbook and placed in Appendix 6

## Section E: Alternative Compliance (LID Waiver Program)

LID BMPs are expected to be feasible on virtually all projects. Where LID BMPs have been demonstrated to be infeasible as documented in Section D, other Treatment Control BMPs must be used (subject to LID waiver approval by the Copermittee). Check one of the following Boxes:

LID Principles and LID BMPs have been incorporated into the site design to fully address all Drainage Management Areas. No alternative compliance measures are required for this project and thus this Section is not required to be completed.

- Or -

The following Drainage Management Areas are unable to be addressed using LID BMPs. A site-specific analysis demonstrating technical infeasibility of LID BMPs has been approved by the Co-Permittee and included in Appendix 5. Additionally, no downstream regional and/or sub-regional LID BMPs exist or are available for use by the project. The following alternative compliance measures on the following pages are being implemented to ensure that any pollutant loads expected to be discharged by not incorporating LID BMPs, are fully mitigated.

## E.1 Identify Pollutants of Concern

Utilizing Table A.1 from Section A above which noted your project's receiving waters and their associated EPA approved 303(d) listed impairments, cross reference this information with that of your selected Priority Development Project Category in Table E.1 below. If the identified General Pollutant Categories are the same as those listed for your receiving waters, then these will be your Pollutants of Concern and the appropriate box or boxes will be checked on the last row. The purpose of this is to document compliance and to help you appropriately plan for mitigating your Pollutants of Concern in lieu of implementing LID BMPs.

Table E.1 Potential Pollutants by Land Use Type

| Priority Development Project Categories and/or Project Features (check those that apply) | General Pollutant Categories |                          |                          |                          |                          |                          |                          |                          |
|--|------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
|  | Bacterial Indicators         | Metals                   | Nutrients                | Pesticides               | Toxic Organic Compounds  | Sediments                | Trash & Debris           | Oil & Grease             |
| <input type="checkbox"/> Detached Residential Development                                | P                            | N                        | P                        | P                        | N                        | P                        | P                        | P                        |
| <input checked="" type="checkbox"/> Attached Residential Development                     | P                            | N                        | P                        | P                        | N                        | P                        | P                        | P <sup>(2)</sup>         |
| <input checked="" type="checkbox"/> Commercial/Industrial Development                    | P <sup>(3)</sup>             | P                        | P <sup>(1)</sup>         | P <sup>(1)</sup>         | P <sup>(5)</sup>         | P <sup>(1)</sup>         | P                        | P                        |
| <input type="checkbox"/> Automotive Repair Shops   | N                            | P                        | N                        | N                        | P <sup>(4, 5)</sup>      | N                        | P                        | P                        |
| <input checked="" type="checkbox"/> Restaurants (>5,000 ft <sup>2</sup> )                | P                            | N                        | N                        | N                        | N                        | N                        | P                        | P                        |
| <input type="checkbox"/> Hillside Development (>5,000 ft <sup>2</sup> )                  | P                            | N                        | P                        | P                        | N                        | P                        | P                        | P                        |
| <input checked="" type="checkbox"/> Parking Lots (>5,000 ft <sup>2</sup> )               | P <sup>(6)</sup>             | P                        | P <sup>(1)</sup>         | P <sup>(1)</sup>         | P <sup>(4)</sup>         | P <sup>(1)</sup>         | P                        | P                        |
| <input type="checkbox"/> Retail Gasoline Outlets   | N                            | P                        | N                        | N                        | P                        | N                        | P                        | P                        |
| <b>Project Priority Pollutant(s) of Concern</b>  | <input type="checkbox"/>     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

*P = Potential*

*N = Not Potential*

*(1) A potential Pollutant if non-native landscaping exists or is proposed onsite; otherwise not expected*

*(2) A potential Pollutant if the project includes uncovered parking areas; otherwise not expected*

*(3) A potential Pollutant is land use involving animal waste*

*(4) Specifically petroleum hydrocarbons*

*(5) Specifically solvents*

*(6) Bacterial indicators are routinely detected in pavement runoff*

## E.2 Stormwater Credits

Projects that cannot implement LID BMPs but nevertheless implement smart growth principles are potentially eligible for Stormwater Credits. Utilize Table 3-8 within the WQMP Guidance Document to identify your Project Category and its associated Water Quality Credit. If not applicable, write N/A.

Table E.2 Water Quality Credits

| Qualifying Project Categories        | Credit Percentage <sup>2</sup> |
|--------------------------------------|--------------------------------|
| N/A                                  |                                |
| Total Credit Percentage <sup>1</sup> |                                |

<sup>1</sup>Cannot Exceed 50%

<sup>2</sup>Obtain corresponding data from Table 3-8 in the WQMP Guidance Document

## E.3 Sizing Criteria

After you appropriately considered Stormwater Credits for your project, utilize Table E.3 below to appropriately size them to the DCV, or Design Flow Rate, as applicable. Please reference Chapter 3.5.2 of the WQMP Guidance Document for further information.

Table E.3-1 Treatment Control BMP Sizing

| DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type | Effective Impervious Fraction, $I_f$ | DMA Runoff Factor | DMA Area x Runoff Factor | BMP 1                                   |   |                                      |                              |
|-------------|------------------------|---------------------------|--------------------------------------|-------------------|--------------------------|---|---|--------------------------------------|------------------------------|
|             | [A]                    |                           | [B]                                  | [C]               | [A] x [C]                |   |   |                                      |                              |
| DA 1        | 97,184                 | Conc. or Asphalt          | 1                                    | 0.89              | 86,688                   | Design Storm Rainfall Intensity (in/hr) | Minimum Design Capture Volume or Design Flow Rate (cubic feet or cfs) | Total Storm Water Credit % Reduction | Proposed Flow on Plans (cfs) |
| DA 1        | 10,798                 | Orn. LS                   | .1                                   | 0.11              | 1,192                    |   |   |                                      |                              |
|             | $A_T = 107982$         |                           |                                      |                   | $\Sigma = 87,880$        | 0.2                                     | [F] = 0.4   | N/A                                  | 0.462                        |

Table E.3-2 Treatment Control BMP Sizing

| DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type | Effective Impervious Fraction, $I_f$ | DMA Runoff Factor | DMA Area x Runoff Factor | BMP 2                                   |   |                                      |                              |
|-------------|------------------------|---------------------------|--------------------------------------|-------------------|--------------------------|---|---|--------------------------------------|------------------------------|
|             | [A]                    |                           | [B]                                  | [C]               | [A] x [C]                |   |   |                                      |                              |
| DA 2        | 242,249                | Conc. or Asphalt          | 1                                    | 0.89              | 216,086                  | Design Storm Rainfall Intensity (in/hr) | Minimum Design Capture Volume or Design Flow Rate (cubic feet or cfs) | Total Storm Water Credit % Reduction | Proposed Flow on Plans (cfs) |
| DA 2        | 26,916                 | Orn. LS                   | .1                                   | 0.11              | 2,973                    |   |   |                                      |                              |

|  |                 |  |                    |     |         |     |      |
|--|-----------------|--|--------------------|-----|---------|-----|------|
|  | $A_T = 269,165$ |  | $\Sigma = 219,059$ | 0.2 | [F] = 1 | N/A | 1.15 |
|--|-----------------|--|--------------------|-----|---------|-----|------|

Table E.3-3A Treatment Control BMP Sizing

| DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type | Effective Impervious Fraction, $I_f$ | DMA Runoff Factor  | DMA Area x Runoff Factor |   | BMP 3A  |                                      |                              |
|-------------|------------------------|---------------------------|--------------------------------------|--------------------|--------------------------|---|---|--------------------------------------|------------------------------|
|             | [A]                    |                           | [B]                                  | [C]                | [A] x [C]                |   |   |                                      |                              |
| DA 3A       | 138,795                | Conc. or Asphalt          | 1                                    | 0.89               | 123,805                  | Design Storm Rainfall Intensity (in/hr) | Minimum Design Capture Volume or Design Flow Rate (cubic feet or cfs) | Total Storm Water Credit % Reduction | Proposed Flow on Plans (cfs) |
| DA 3A       | 15,422                 | Orn. LS                   | .1                                   | 0.11               | 1,703                    |   |   |                                      |                              |
|             | $A_T = 154,217$        |                           |                                      | $\Sigma = 125,509$ | 0.2                      | [F] = 0.6                               | N/A   | 0.693                                |                              |

Table E.3-3B Treatment Control BMP Sizing

| DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type | Effective Impervious Fraction, $I_f$ | DMA Runoff Factor  | DMA Area x Runoff Factor |   | BMP 3B  |                                      |                              |
|-------------|------------------------|---------------------------|--------------------------------------|--------------------|--------------------------|---|---|--------------------------------------|------------------------------|
|             | [A]                    |                           | [B]                                  | [C]                | [A] x [C]                |   |   |                                      |                              |
| DA 3B       | 158,715                | Conc. or Asphalt          | 1                                    | 0.89               | 141,574                  | Design Storm Rainfall Intensity (in/hr) | Minimum Design Capture Volume or Design Flow Rate (cubic feet or cfs) | Total Storm Water Credit % Reduction | Proposed Flow on Plans (cfs) |
| DA 3B       | 17,635                 | Orn. LS                   | .1                                   | 0.11               | 1,948                    |   |   |                                      |                              |
|             | $A_T = 176,350$        |                           |                                      | $\Sigma = 269,030$ | 0.2                      | [F] = 0.7                               | N/A   | 0.7                                  |                              |

Table E.3-4 Treatment Control BMP Sizing

| DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type | Effective Impervious Fraction, $I_f$ | DMA Runoff Factor  | DMA Area x Runoff Factor |   | BMP 4   |                                      |                              |
|-------------|------------------------|---------------------------|--------------------------------------|--------------------|--------------------------|---|---|--------------------------------------|------------------------------|
|             | [A]                    |                           | [B]                                  | [C]                | [A] x [C]                |   |   |                                      |                              |
| DA 4        | 389,605                | Conc. or Asphalt          | 1                                    | 0.89               | 347,527                  | Design Storm Rainfall Intensity (in/hr) | Minimum Design Capture Volume or Design Flow Rate (cubic feet or cfs) | Total Storm Water Credit % Reduction | Proposed Flow on Plans (cfs) |
| DA 4        | 43,289                 | Orn. LS                   | .1                                   | 0.11               | 4,781                    |   |   |                                      |                              |
|             | $A_T = 432,894$        |                           |                                      | $\Sigma = 352,309$ | 0.2                      | [F] = 1.6                               | N/A   | 1.731                                |                              |



Table E.3-5 Treatment Control BMP Sizing

| DMA Type/ID | DMA Area (square feet)   | Post-Project Surface Type | Effective Impervious Fraction, I <sub>f</sub> | DMA Runoff Factor | DMA Area x Runoff Factor | BMP 5  |  |   |                                     |
|-------------|--------------------------|---------------------------|---|-------------------|--------------------------|--|--|---|-------------------------------------|
|             | [A]                      |                           | [B]   | [C]               | [A] x [C]                |  |  |   |                                     |
| DA 5        | 208,281                  | Conc. or Asphalt          | 1   | 0.89              | 185,787                  | <i>Design Storm Rainfall Intensity (in/hr)</i> | <i>Minimum Design Capture Volume or Design Flow Rate (cubic feet or cfs)</i> | <i>Total Storm Water Credit % Reduction</i> | <i>Proposed Flow on Plans (cfs)</i> |
| DA 5        | 23,142                   | Orn. LS                   | .1  | 0.11              | 2,556                    |  |  |   |                                     |
|             | A <sub>T</sub> = 231,423 |                           |   |                   | Σ = 188,343              | 0.2  | [F] = 0.9  | N/A   | 0.924                               |

[B], [C] is obtained as described in Section 2.3.1 from the WQMP Guidance Document

[E] is for Flow-Based Treatment Control BMPs [E] = .2, for Volume-Based Control Treatment BMPs, [E] obtained from Exhibit A in the WQMP Guidance Document

[G] is for Flow-Based Treatment Control BMPs [G] = 43,560, for Volume-Based Control Treatment BMPs, [G] = 12

[H] is from the Total Credit Percentage as Calculated from Table E.2 above

[I] as obtained from a design procedure sheet from the BMP manufacturer and should be included in Appendix 6

## E.4 Treatment Control BMP Selection

Treatment Control BMPs typically provide proprietary treatment mechanisms to treat potential pollutants in runoff, but do not sustain significant biological processes. Treatment Control BMPs must have a removal efficiency of a medium or high effectiveness as quantified below:

- High: equal to or greater than 80% removal efficiency
- Medium: between 40% and 80% removal efficiency

Such removal efficiency documentation (e.g., studies, reports, etc.) as further discussed in Chapter 3.5.2 of the WQMP Guidance Document, must be included in Appendix 6. In addition, ensure that proposed Treatment Control BMPs are properly identified on the WQMP Site Plan in Appendix 1.

Table E.4 Treatment Control BMP Selection

| Selected Treatment Control BMP Name or ID <sup>1</sup> | Priority Pollutant(s) of Concern to Mitigate <sup>2</sup> | Removal Efficiency Percentage <sup>3</sup> |
|--|---|--|
| N/A  |   |  |

<sup>1</sup> Treatment Control BMPs must not be constructed within Receiving Waters. In addition, a proposed Treatment Control BMP may be listed more than once if they possess more than one qualifying pollutant removal efficiency.

<sup>2</sup> Cross Reference Table E.1 above to populate this column.

<sup>3</sup> As documented in a Co-Permittee Approved Study and provided in Appendix 6.

## Section F: Hydromodification

### F.1 Hydrologic Conditions of Concern (HCOC) Analysis

Once you have determined that the LID design is adequate to address water quality requirements, you will need to assess if the proposed LID Design may still create a HCOC. Review Chapters 2 and 3 (including Figure 3-7) of the WQMP Guidance Document to determine if your project must mitigate for Hydromodification impacts. If your project meets one of the following criteria which will be indicated by the check boxes below, you do not need to address Hydromodification at this time. However, if the project does not qualify for Exemptions 1, 2 or 3, then additional measures must be added to the design to comply with HCOC criteria. This is discussed in further detail below in Section F.2.

**HCOC EXEMPTION 1:** The Priority Development Project disturbs less than one acre. The Co-permittee has the discretion to require a Project-Specific WQMP to address HCOCs on projects less than one acre on a case by case basis. The disturbed area calculation should include all disturbances associated with larger common plans of development.

Does the project qualify for this HCOC Exemption?       Y     N

If Yes, HCOC criteria do not apply.

**HCOC EXEMPTION 2:** The volume and time of concentration<sup>1</sup> of storm water runoff for the post-development condition is not significantly different from the pre-development condition for a 2-year return frequency storm (a difference of 5% or less is considered insignificant) using one of the following methods to calculate:

- Riverside County Hydrology Manual
- Technical Release 55 (TR-55): Urban Hydrology for Small Watersheds (NRCS 1986), or derivatives thereof, such as the Santa Barbara Urban Hydrograph Method
- Other methods acceptable to the Co-Permittee

Does the project qualify for this HCOC Exemption?       Y     N

If Yes, report results in Table F.1 below and provide your substantiated hydrologic analysis in Appendix 7.

Table F.1 Hydrologic Conditions of Concern Summary

|                       | 2 year – 24 hour |                |              |
|-----------------------|------------------|----------------|--------------|
|                       | Pre-condition    | Post-condition | % Difference |
| Time of Concentration | 31.99            | 27.69          | N/A          |
| Volume (Cubic Feet)   | 405,543          | 424,273        | 4.6%         |

<sup>1</sup> Time of concentration is defined as the time after the beginning of the rainfall when all portions of the drainage basin are contributing to flow at the outlet.

HCOC EXEMPTION 3: All downstream conveyance channels to an adequate sump (for example, Prado Dam, Lake Elsinore, Canyon Lake, Santa Ana River, or other lake, reservoir or naturally erosion resistant feature) that will receive runoff from the project are engineered and regularly maintained to ensure design flow capacity; no sensitive stream habitat areas will be adversely affected; or are not identified on the Co-Permittees Hydromodification Susceptibility Maps.

Does the project qualify for this HCOC Exemption?       Y     N

If Yes, HCOC criteria do not apply and note below which adequate sump applies to this HCOC qualifier:

The immediate discharge location is an existing Reinforced Concrete Pipe, which ultimately discharges into the Santa Ana River which is an HCOC qualifier.

## F.2 HCOC Mitigation

If none of the above HCOC Exemption Criteria are applicable, HCOC criteria is considered mitigated if they meet one of the following conditions:

- a. Additional LID BMPS are implemented onsite or offsite to mitigate potential erosion or habitat impacts as a result of HCOCs. This can be conducted by an evaluation of site-specific conditions utilizing accepted professional methodologies published by entities such as the California Stormwater Quality Association (CASQA), the Southern California Coastal Water Research Project (SCCRWP), or other Co-Permittee approved methodologies for site-specific HCOC analysis.
- b. The project is developed consistent with an approved Watershed Action Plan that addresses HCOC in Receiving Waters.
- c. Mimicking the pre-development hydrograph with the post-development hydrograph, for a 2-year return frequency storm. Generally, the hydrologic conditions of concern are not significant, if the post-development hydrograph is no more than 10% greater than pre-development hydrograph. In cases where excess volume cannot be infiltrated or captured and reused, discharge from the site must be limited to a flow rate no greater than 110% of the pre-development 2-year peak flow.

Be sure to include all pertinent documentation used in your analysis of the items a, b or c in Appendix 7.

N/A

## Section G: Source Control BMPs

Source control BMPs include permanent, structural features that may be required in your project plans — such as roofs over and berms around trash and recycling areas — and Operational BMPs, such as regular sweeping and “housekeeping”, that must be implemented by the site’s occupant or user. The MEP standard typically requires both types of BMPs. In general, Operational BMPs cannot be substituted for a feasible and effective permanent BMP. Using the Pollutant Sources/Source Control Checklist in Appendix 8, review the following procedure to specify Source Control BMPs for your site:

1. *Identify Pollutant Sources:* Review Column 1 in the Pollutant Sources/Source Control Checklist. Check off the potential sources of Pollutants that apply to your site.
2. *Note Locations on Project-Specific WQMP Exhibit:* Note the corresponding requirements listed in Column 2 of the Pollutant Sources/Source Control Checklist. Show the location of each Pollutant source and each permanent Source Control BMP in your Project-Specific WQMP Exhibit located in Appendix 1.
3. *Prepare a Table and Narrative:* Check off the corresponding requirements listed in Column 3 in the Pollutant Sources/Source Control Checklist. In the left column of Table G.1 below, list each potential source of runoff Pollutants on your site (from those that you checked in the Pollutant Sources/Source Control Checklist). In the middle column, list the corresponding permanent, Structural Source Control BMPs (from Columns 2 and 3 of the Pollutant Sources/Source Control Checklist) used to prevent Pollutants from entering runoff. Add additional narrative in this column that explains any special features, materials or methods of construction that will be used to implement these permanent, Structural Source Control BMPs.
4. *Identify Operational Source Control BMPs:* To complete your table, refer once again to the Pollutant Sources/Source Control Checklist. List in the right column of your table the Operational BMPs that should be implemented as long as the anticipated activities continue at the site. Copermittee stormwater ordinances require that applicable Source Control BMPs be implemented; the same BMPs may also be required as a condition of a use permit or other revocable Discretionary Approval for use of the site.

Table G.1 Permanent and Operational Source Control Measures

| Potential Sources of Runoff pollutants | Permanent Structural Source Control BMPs   | Operational Source Control BMPs   |
|--|--|---|
| Onsite storm drain inlets              | Mark all inlets with the words “Only Rain Down the Storm Drain” or similar. Catch basin markers may be available from the RCFC&WCD, call 951.955.1200 to verify.<br><br>(CASQA BMP SD-13, “Storm Drain Signage”) | Maintain and periodically repaint or replace inlet markings;<br><br>Provide stormwater pollution prevention information to new site owners, lessees, or operators;<br><br>See applicable operational BMPs in Fact Sheet SC-74 “Drainage System Maintenance” Provided in Appendix 8 of this report. Include in the following lease agreements: “Tenant shall now allow anyone to discharge anything to storm |

|   |   |  |
|---|---|--|
|   |   | drains or to store or deposit materials so as to create a potential discharge to storm drains.”  |
| Interior parking garages                                  | State that parking garage floor drains will be plumbed to the sanitary sewer.   |  |
| Landscape/<br>Outdoor<br>Pesticide Us                     | <p>State that final landscape plans will accomplish the following:</p> <p>Preserve existing native trees, shrubs, and ground cover to the maximum extent possible.</p> <p>Design landscaping to minimize irrigation and runoff, to promote surface infiltration where appropriate, and to minimize the use of fertilizers and pesticides that can contribute to stormwater pollution.</p> <p>Where landscaped areas are used to retain or detain stormwater, specify plants that are tolerant of saturated soil conditions.</p> <p>Consider using pest-resistant plants, especially adjacent to hardscape.</p> <p>To insure successful establishment, select plants appropriate to site soils, slopes, climate, sun, wind, rain, land use, air movement, ecological consistency, and plant interactions.</p> <p>(CASQA BMP SD-10, “Site Design and Landscape Planning” and SD-12, “Efficient Irrigation”)</p> | <p>Maintain landscaping using minimum or no pesticides.</p> <p>See applicable operational BMPs in “What you should know for...Landscape and Gardening” at <a href="http://rcflood.org/stormwater/Downloads/LandscapeGardenBrochure.pdf">http://rcflood.org/stormwater/Downloads/LandscapeGardenBrochure.pdf</a></p> <p>Provide IPM information to new owners, lessees and operators.</p> <p>Applicable operational BMPs in “What you should know for...Landscape and Gardening”</p> <ul style="list-style-type: none"> <li>• Never apply pesticides or fertilizers when rain is predicted within the next 48 hours</li> <li>• Do not overwater</li> <li>• Do not rake or blow leaves, clippings, or pruning waste into the street, gutter, or storm drain. Dispose of green waste by composting, hauling it to a permitted landfill, or recycling it through the City’s program</li> </ul> |
| Pools, spas, ponds, decorative fountains, and other water | <p>Show location of water feature and a sanitary sewer cleanout in an accessible area within 10 feet.</p> <p>(Exception: Public pools must be plumbed according to</p>  | <p>See applicable operational BMPs in “Guidelines for Maintaining Your Swimming Pool, Jacuzzi and Garden Fountain” at <a href="http://rcflood.org/stormwater/">http://rcflood.org/stormwater/</a></p>  |

|              |  |   |
|--------------|--|---|
| features.    | County Department of Environmental Health Guidelines.)   |   |
| Food service | <p>For restaurants, grocery stores, and other food service operations, show location (indoors or in a covered area outdoors) of a floor sink or other area for cleaning floor mats, containers, and equipment.</p> <p>On the drawing, show a note that this drain will be connected to a grease interceptor before discharging to the sanitary sewer.</p>  | <p>Describe the location and features of the designated cleaning area.</p> <p>Describe the items to be cleaned in this facility and how it has been sized to insure that the largest items can be accommodated.</p>   |
| Refuse areas | <p>Show where site refuse and recycled materials will be handled and stored for pickup. See local municipal requirements for sizes and other details of refuse areas.</p> <p>If dumpsters or other receptacles are outdoors, show how the designated area will be covered, graded, and paved to prevent run-on and show locations of berms to prevent runoff from the area.</p> <p>Any drains from dumpsters, compactors, and tallow bin areas shall be connected to a grease removal device before discharge to sanitary sewer.</p> <p>State how site refuse will be handled and provide supporting detail to what is shown on plans.</p> <p>State that signs will be posted on or near dumpsters with the words "Do not dump hazardous materials here" or similar.</p> | <p>State how the following will be implemented:</p> <p>Provide adequate number of receptacles. Inspect receptacles regularly; repair or replace leaky receptacles. Keep receptacles covered. Prohibit/prevent dumping of liquid or hazardous wastes. Post "no hazardous materials" signs. Inspect and pick up litter daily and clean up spills immediately. Keep spill control materials available on-site. See Fact Sheet SC-34, "Waste Handling and Disposal" in the CASQA Stormwater Quality Handbooks at <a href="http://www.cabmphandbooks.com">www.cabmphandbooks.com</a></p> |

|  |   |  |
|--|---|--|
| <p>Loading Docks</p>   | <p>Show a preliminary design for the loading dock area, including roofing and drainage. Loading docks shall be covered and/or graded to minimize run-on to and runoff from the loading area. Roof downspouts shall be positioned to direct stormwater away from the loading area. Water from loading dock areas shall be drained to the sanitary sewer, or diverted and collected for ultimate discharge to the sanitary sewer.</p> <p>Loading dock areas draining directly to the sanitary sewer shall be equipped with a spill control valve or equivalent device, which shall be kept closed during periods of operation.</p> <p>Provide a roof overhang over the loading area or install door skirts (cowling) at each bay that enclose the end of the trailer.</p> | <p>Move loaded and unloaded items indoors as soon as possible.</p> <p>See Fact Sheet SC-30, "Outdoor Loading and Unloading," in the CASQA Stormwater Quality Handbooks at <a href="http://www.cabmphandbooks.com">www.cabmphandbooks.com</a></p> |
| <p>Fire Sprinkler Test Water</p>   | <p>Provide a means to drain fire sprinkler test water to the sanitary sewer.</p>  | <p>See the note in Fact Sheet SC-41, "Building and Grounds Maintenance," in the CASQA Stormwater Quality Handbooks at <a href="http://www.cabmphandbooks.com">www.cabmphandbooks.com</a></p>   |
| <p>Miscellaneous Drain or Wash Water or Other Sources:</p> <ul style="list-style-type: none"> <li>• Boiler drain lines</li> <li>• Condensate drain lines</li> <li>• Rooftop</li> </ul> | <ul style="list-style-type: none"> <li>• Boiler Drain lines shall be directly or indirectly connected to the sanitary sewer system and may not discharge to the storm drain system</li> <li>• Condensate drain lines may discharge to landscaped areas if the flow is small enough that runoff will not occur. Condensate drain</li> </ul>  | <p>Additional Operational BMPs suggested on Fact Sheet SC-10:</p> <ul style="list-style-type: none"> <li>• Train employees to identify non-stormwater discharges and report them to appropriate departments</li> </ul>                           |



|  |   |   |
|--|---|---|
| <ul style="list-style-type: none"> <li>• equipment</li> <li>• Drainage</li> <li>• sumps</li> <li>• Roofing,</li> <li>• gutters,</li> <li>• and trim</li> <li>• Other</li> <li>• sources</li> </ul> | <p>lines may not discharge to the storm drain system</p> <ul style="list-style-type: none"> <li>• Rooftop equipment with potential to produce pollutants shall be roofed and/or have secondary containment</li> <li>• Any drainage sumps onsite shall feature a sediment sump to reduce the quantity of sediment in pumped water</li> <li>• Avoid roofing, gutters, and trim made of copper or other unprotected metals that may leach into runoff</li> </ul> |   |
| <p>Plazas, sidewalks, and parking lots</p>   |   | <p>Sweep plazas, sidewalks, and parking lots regularly to prevent accumulation of litter and debris. Collect debris from pressure washing to prevent entry into the storm drain system. Collect wash water containing any cleaning agent or degreaser and discharge to the sanitary sewer not to a storm drain.</p> |

## Section H: Construction Plan Checklist

Populate Table H.1 below to assist the plan checker in an expeditious review of your project. The first two columns will contain information that was prepared in previous steps, while the last column will be populated with the corresponding plan sheets. This table is to be completed with the submittal of your final Project-Specific WQMP.

Table H.1 Construction Plan Cross-reference

| BMP No. or ID | BMP Identifier and Description | Corresponding Plan Sheet(s) | BMP Location (Lat/Long) |
|---------------|--------------------------------|-----------------------------|-------------------------|
| 1             | To be provided at final design |                             |                         |
| 2             | To be provided at final design |                             |                         |
| 3             | To be provided at final design |                             |                         |
| 4             | To be provided at final design |                             |                         |
| 5             | To be provided at final design |                             |                         |

Note that the updated table — or Construction Plan WQMP Checklist — is only a reference tool to facilitate an easy comparison of the construction plans to your Project-Specific WQMP. Co-Permittee staff can advise you regarding the process required to propose changes to the approved Project-Specific WQMP.

## Section I: Operation, Maintenance and Funding

The Copermittee will periodically verify that Stormwater BMPs on your site are maintained and continue to operate as designed. To make this possible, your Copermittee will require that you include in Appendix 9 of this Project-Specific WQMP:

1. A means to finance and implement facility maintenance in perpetuity, including replacement cost.
2. Acceptance of responsibility for maintenance from the time the BMPs are constructed until responsibility for operation and maintenance is legally transferred. A warranty covering a period following construction may also be required.
3. An outline of general maintenance requirements for the Stormwater BMPs you have selected.
4. Figures delineating and designating pervious and impervious areas, location, and type of Stormwater BMP, and tables of pervious and impervious areas served by each facility. Geo-locating the BMPs using a coordinate system of latitude and longitude is recommended to help facilitate a future statewide database system.
5. A separate list and location of self-retaining areas or areas addressed by LID Principles that do not require specialized O&M or inspections but will require typical landscape maintenance as noted in Chapter 5, pages 85-86, in the WQMP Guidance. Include a brief description of typical landscape maintenance for these areas.

Your local Co-Permittee will also require that you prepare and submit a detailed Stormwater BMP Operation and Maintenance Plan that sets forth a maintenance schedule for each of the Stormwater BMPs built on your site. An agreement assigning responsibility for maintenance and providing for inspections and certification may also be required.

Details of these requirements and instructions for preparing a Stormwater BMP Operation and Maintenance Plan are in Chapter 5 of the WQMP Guidance Document.

Maintenance Mechanism: Maintenance and cleaning of the LIP BMPs shall be in accordance with the Maintenance Responsibility/Frequency Matrix in Appendix 9.

IGP Business Group will be responsible for all BMP implementation, operation, and maintenance until such time that the buildings are sold.

Will the proposed BMPs be maintained by a Home Owners' Association (HOA) or Property Owners Association (POA)?

Y       N

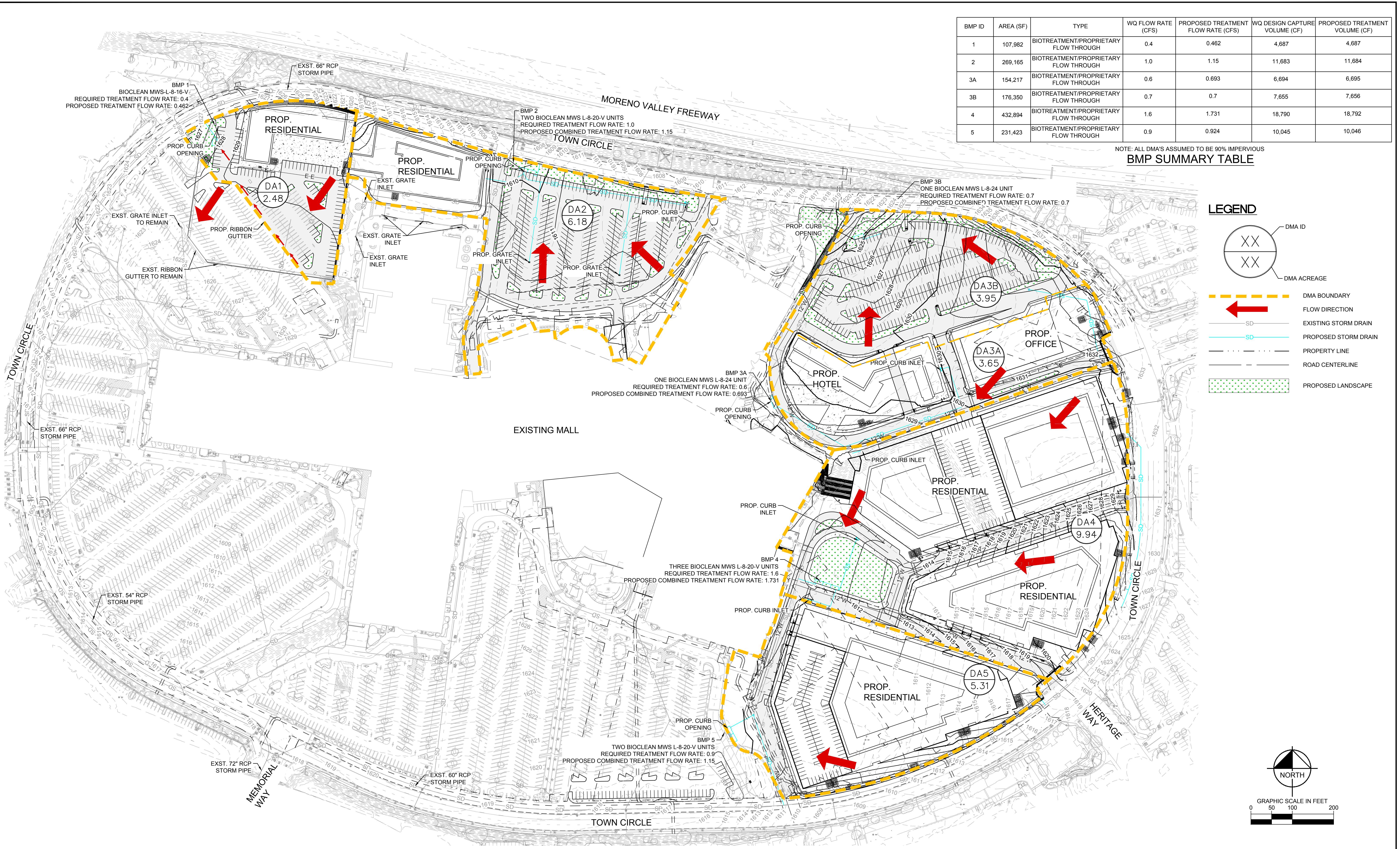
Include your Operation and Maintenance Plan and Maintenance Mechanism in Appendix 9. Additionally, include all pertinent forms of educational materials for those personnel that will be maintaining the proposed BMPs within this Project-Specific WQMP in Appendix 10.

# Appendix 1: Maps and Site Plans

*Location Map, WQMP Site Plan and Receiving Waters Map*

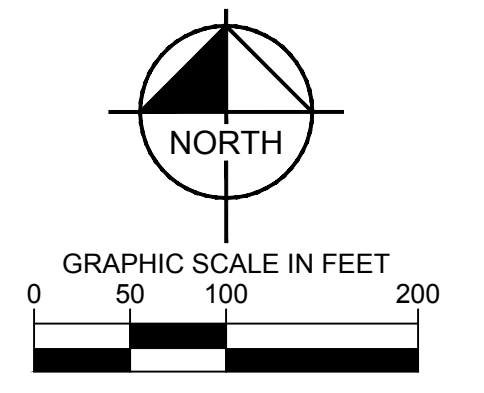
| BMP ID | AREA (SF) | TYPE                                  | WQ FLOW RATE (CFS) | PROPOSED TREATMENT FLOW RATE (CFS) | WQ DESIGN CAPTURE VOLUME (CF) | PROPOSED TREATMENT VOLUME (CF) |
|--------|-----------|---------------------------------------|--------------------|------------------------------------|-------------------------------|--------------------------------|
| 1      | 107,982   | BIOTREATMENT/PROPRIETARY FLOW THROUGH | 0.4                | 0.462                              | 4,687                         | 4,687                          |
| 2      | 269,165   | BIOTREATMENT/PROPRIETARY FLOW THROUGH | 1.0                | 1.15                               | 11,683                        | 11,684                         |
| 3A     | 154,217   | BIOTREATMENT/PROPRIETARY FLOW THROUGH | 0.6                | 0.693                              | 6,694                         | 6,695                          |
| 3B     | 176,350   | BIOTREATMENT/PROPRIETARY FLOW THROUGH | 0.7                | 0.7                                | 7,655                         | 7,656                          |
| 4      | 432,894   | BIOTREATMENT/PROPRIETARY FLOW THROUGH | 1.6                | 1.731                              | 18,790                        | 18,792                         |
| 5      | 231,423   | BIOTREATMENT/PROPRIETARY FLOW THROUGH | 0.9                | 0.924                              | 10,045                        | 10,046                         |

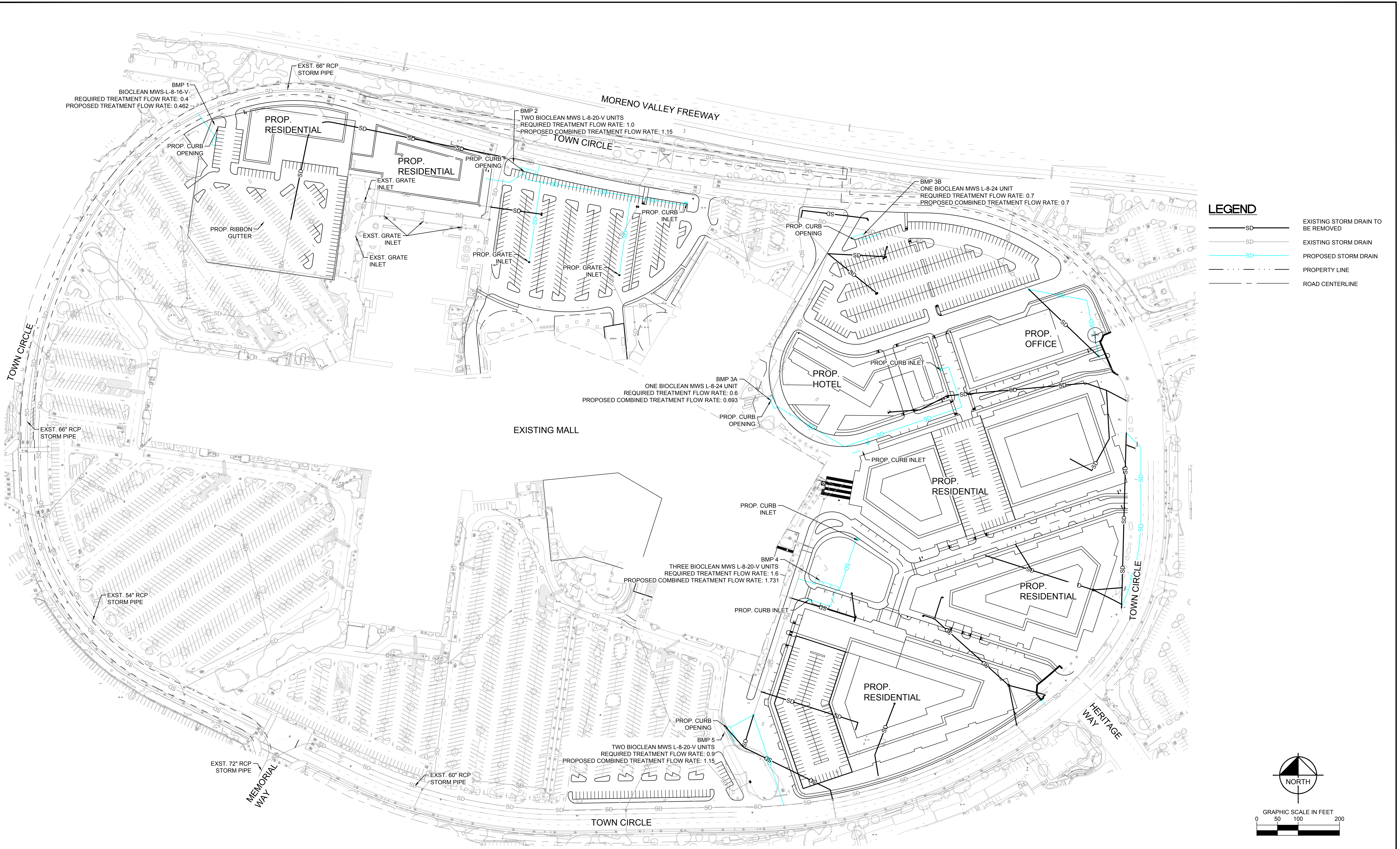
NOTE: ALL DMA'S ASSUMED TO BE 90% IMPERVIOUS  
**BMP SUMMARY TABLE**

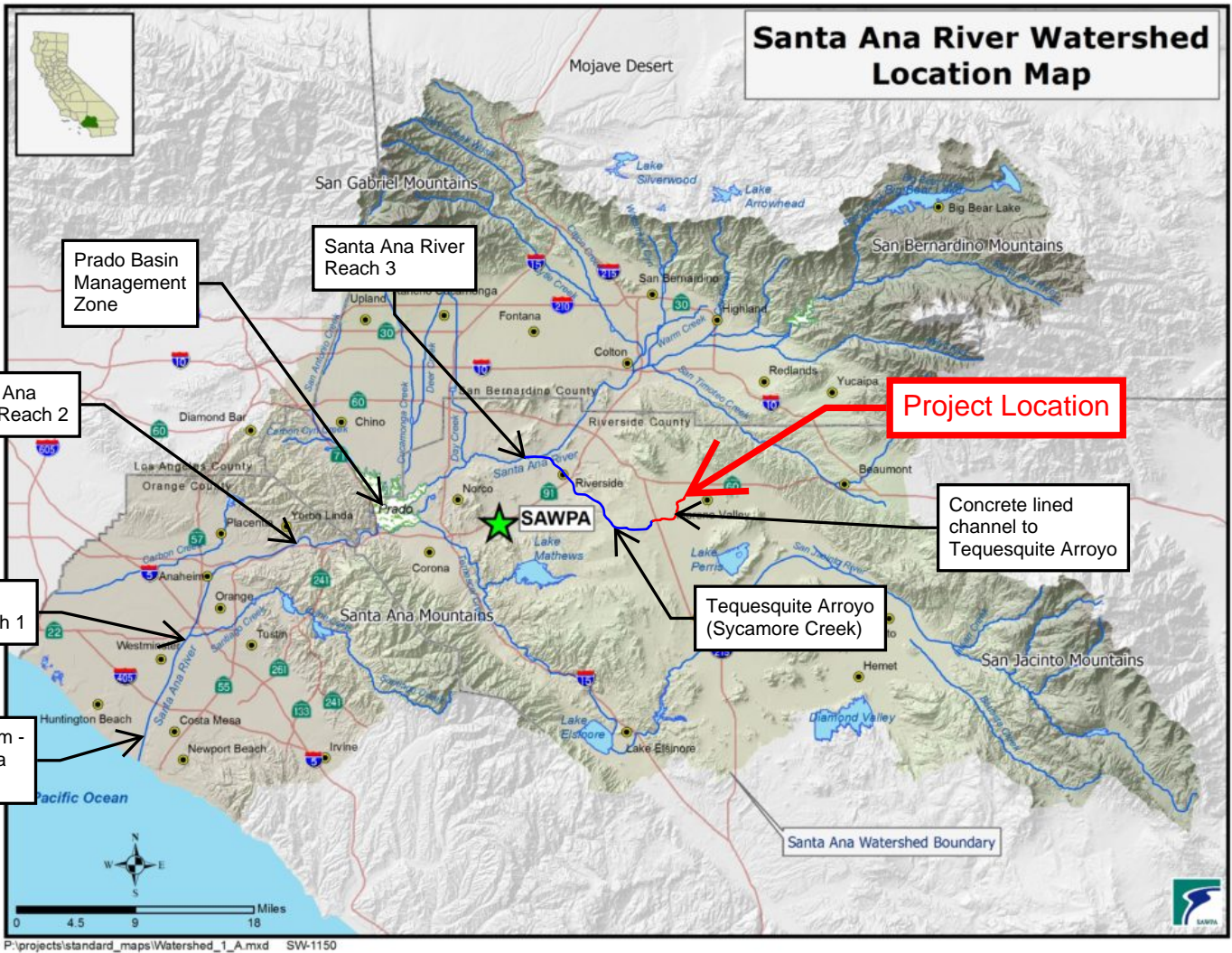


**LEGEND**

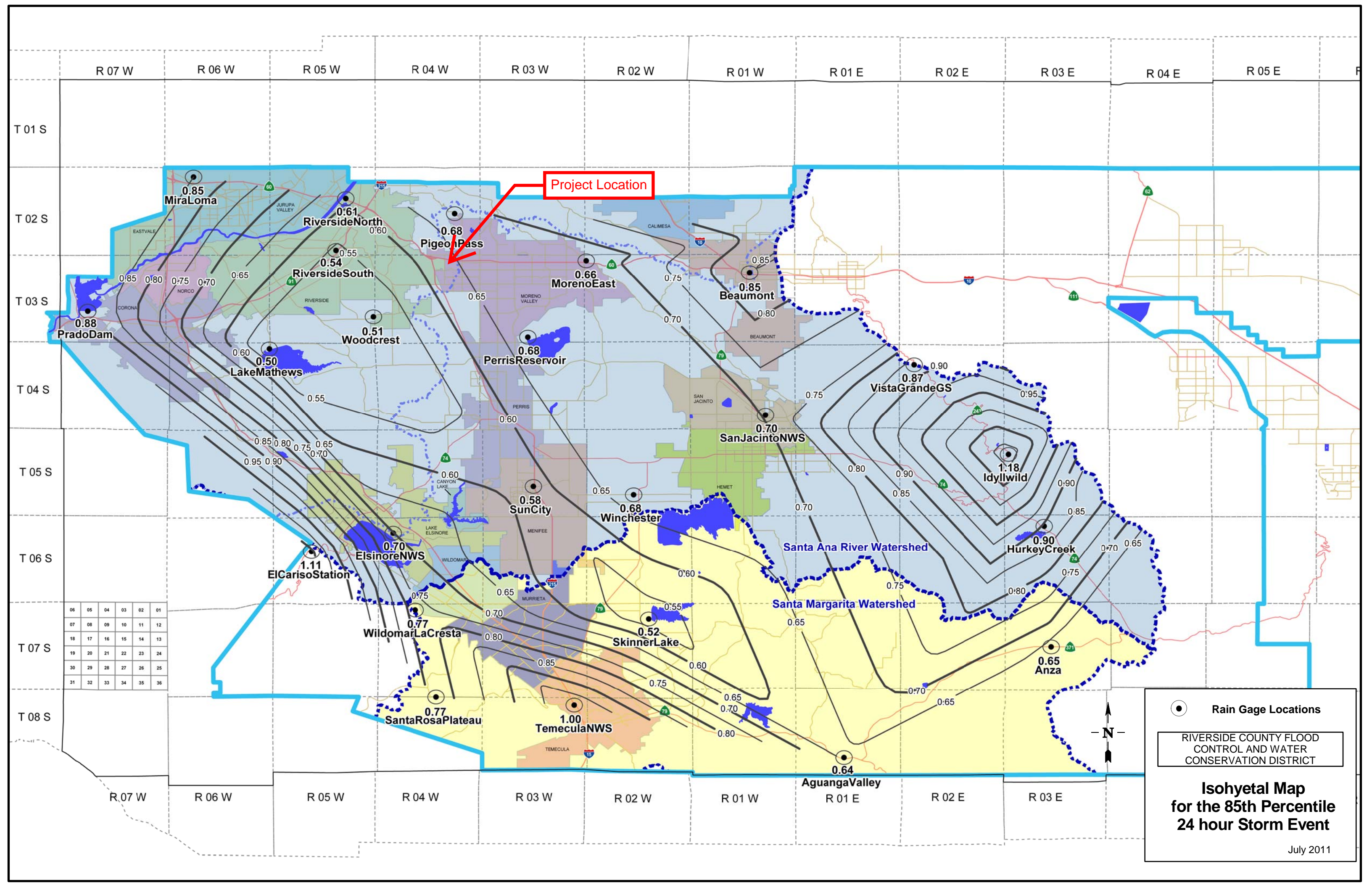
- DMA ID (XX)
- DMA ACREAGE (XX)
- DMA BOUNDARY (dashed yellow line)
- FLOW DIRECTION (red arrow)
- EXISTING STORM DRAIN (SD - solid grey line)
- PROPOSED STORM DRAIN (SD - solid blue line)
- PROPERTY LINE (dashed black line)
- ROAD CENTERLINE (dashed black line)
- PROPOSED LANDSCAPE (dotted green area)







**Receiving Waters Map**



Project Location

|    |    |    |    |    |    |
|----|----|----|----|----|----|
| 06 | 05 | 04 | 03 | 02 | 01 |
| 07 | 08 | 09 | 10 | 11 | 12 |
| 18 | 17 | 16 | 15 | 14 | 13 |
| 19 | 20 | 21 | 22 | 23 | 24 |
| 30 | 29 | 28 | 27 | 26 | 25 |
| 31 | 32 | 33 | 34 | 35 | 36 |

● Rain Gage Locations  
 RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT  
**Isohyetal Map for the 85th Percentile 24 hour Storm Event**  
 July 2011



## Appendix 2: Construction Plans

*CONSTRUCTION PLANS WILL BE PROVIDED AT FINAL WQMP*

# Appendix 3: Soils Information

*Geotechnical Study and Other Infiltration Testing Data*



# Infiltration Testing Report

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**Proposed Redevelopment of Moreno Valley Mall  
Moreno Valley, California**

January 24, 2022

Terracon Project No. CB215157

**Prepared for:**

Moreno Valley Mall Holding, LLC  
Moreno Valley, California

**Prepared by:**

Terracon Consultants, Inc.  
Colton, California



January 24, 2022

Moreno Valley Mall Holding, LLC  
22500 Town Circle, Suite 1206  
Moreno Valley, California 92553



Attn: Mr. Matt Ilbak

Re: Infiltration Testing Report  
Proposed Redevelopment of Moreno Valley Mall  
22500 Town Circle  
Moreno Valley, California  
Terracon Project No. CB215157

Dear Mr. Ilbak:

We have completed the Infiltration Testing services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. PCB215157 dated October 25, 2021. This report presents the findings of the subsurface drilling and provides the results of our field infiltration testing.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,

**Terracon Consultants, Inc.**

Jay Martin, E.G.  
Principal Geologist

Keith Askew, G.E.  
Department Manager

## REPORT TOPICS

|  |          |
|--|----------|
| <b>INTRODUCTION</b> .....                        | <b>1</b> |
| <b>SITE CONDITIONS</b> .....                     | <b>1</b> |
| <b>PROJECT DESCRIPTION</b> .....                 | <b>2</b> |
| <b>DRILLING, COORDINATION, AND TESTING</b> ..... | <b>2</b> |
| <b>GENERAL COMMENTS</b> .....                    | <b>5</b> |

**Note:** This report was originally delivered in a web-based format. **Orange Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the **GeoReport** logo will bring you back to this page. For more interactive features, please view your project online at [client.terracon.com](http://client.terracon.com).

## ATTACHMENTS

**SITE LOCATION AND EXPLORATION PLANS**  
**EXPLORATION RESULTS**  
**SUPPORTING INFORMATION**

**Note:** Refer to each individual Attachment for a listing of contents.

# Infiltration Testing Report

## Proposed Redevelopment of Moreno Valley Mall

### 22500 Town Circle

### Moreno Valley, California

### Terracon Project No. CB215157

### January 24, 2022

## INTRODUCTION

This report presents the results of our subsurface infiltration testing services performed for the proposed biofiltration basins to be located at 22500 Town Circle in Moreno Valley, California. The purpose of these services is to provide measured infiltration rates at the locations tested.

The Scope of Services for this project included performing six field infiltration tests at depths varying from approximately 5 to 15 feet below existing site grades. We modified the testing protocol (from proposed) as summarized below to accommodate shallow bedrock that was encountered.

Maps showing the site and infiltration test locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are in the **Exploration Results** section.

## SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

| Item                         | Description   |
|------------------------------|---|
| <b>Parcel Information</b>    | <p>The project is located at 22500 Town Circle in Moreno Valley, California, within the Moreno Valley Mall.</p> <p>The footprint provided to us depicting the new construction proposed for mall redevelopment is approximately 28 acres. Buildings with proposed interior modifications are not included in this total area; no geotechnical investigation services were requested for those buildings.</p> <p>The center of the proposed redevelopment area is Latitude 33.9384° N /Longitude 117.2678° W (approximate)</p> |
| <b>Existing Improvements</b> | <p>The project is located within existing mall parking locations. These areas were previously graded into five different parking areas with existing improvements including asphalt concrete pavement, earthen landscape slope and planter areas, landscape irrigation, light poles, curbs and fencing.</p>   |

## Infiltration Testing Report

Proposed Redevelopment of Moreno Valley Mall ■ Moreno Valley, California

January 24, 2022 ■ Terracon Project No. CB215157



| Item                        | Description   |
|-----------------------------|---|
| <b>Current Ground Cover</b> | Mostly asphalt concrete pavement, earthen landscape slope and planter areas, light poles, curbs and fencing.  |
| <b>Existing Topography</b>  | Overall, the site slopes down toward the southwest at a gentle gradient. Landscaped slopes and retaining walls with heights up to approximately 15 feet accommodate grade changes between the various parking lots and existing structures. |

## PROJECT DESCRIPTION

Our initial understanding of the project was provided in our proposal and was discussed during project planning.

| Item                                   | Description   |
|--|---|
| <b>Information Provided</b>            | Various documents from a submittal package (July 27) to the City of Moreno Valley were provided by Hanna Partners, the development and construction advisor for the project. This package includes conceptual design plans and conceptual grading plans. It also includes a Letter of Intent with a narrative description of proposed site development.   |
| <b>Project Description</b>             | <p>The project consists of a proposed redevelopment of the existing Moreno Valley Mall. Most of the area proposed for new construction is located within existing mall parking locations.</p> <p>Based on conversation with Mr. Steve Hanna of Hanna Partners, no significant stormwater retention is needed for the project; the primary water storage system will be using biofiltration structures.</p> <p>Cut/fill type grading was performed to develop the existing grades of the mall; the previous grading plans depicting the as-graded conditions have not been provided.</p> |
| <b>Grading/Slopes</b>                  | Grading (up to 20 feet of cut and 15 feet of fill) may be required to develop final grade for proposed improvements, excluding remedial grading. Permanent slopes may be required.  |
| <b>Infiltration</b>                    | As indicated by Mr. Hanna, new biofiltration systems are planned on site to filter parking lot stormwater runoff.   |
| <b>Estimated Start of Construction</b> | Unknown   |

## DRILLING, COORDINATION, AND TESTING

Our proposal included six infiltration tests to be conducted at a depth of 15 feet. Immediately prior to drilling, Mr. Hanna requested that four of the tests (P-1, P-2, P-5 and P-6) be moved to areas located in the northeast portion of the project, slightly south and west of Town Circle.

## Infiltration Testing Report

Proposed Redevelopment of Moreno Valley Mall ■ Moreno Valley, California  
January 24, 2022 ■ Terracon Project No. CB215157



During the drilling operation, we encountered shallow bedrock at depths varying from of 2 to 14 feet bgs in five of the borings (P-1 through P-5). Bedrock was not encountered to the planned depth of 15 feet bgs in boring P-6. Per Appendix A of the Riverside County Low Impact Development BMP Design Handbook, the bottoms of infiltration structures must maintain a separation of at least 5 feet above bedrock or other impermeable layer. Performance of our original scope was precluded by encountering shallow bedrock in five of the borings. A telecon with Mr. Steve Hanna was held on January 11, 2022, to discuss the drilling results with respect to shallow bedrock. Mr. Hanna indicated that the infiltration should now be focused on biofiltration structures and that the structures typically infiltrate at depths of 0 to 10 feet below finish grade.

The in-situ infiltration test borings were drilled to depths of 15 feet bgs with an 8-inch diameter auger, and the soil was logged and classified in the field using a visual/manual procedure. The depth to bedrock was recorded if encountered. Two borings, P-3 and P-5, encountered bedrock at depths shallow enough to preclude infiltration testing.

In borings where bedrock was encountered, the boring was backfilled with auger cuttings to a depth of 5 feet above the bedrock, and a layer of bentonite chips was placed immediately below the test zone to prevent the infiltration of water below the test zone. A 2-inch thick, 3/8-inch gravel layer was then placed in the bottom of each testing interval above the bentonite. Three-inch diameter perforated pipes were installed on top of the gravel layer and gravel was used to backfill between the perforated pipes and the boring sidewall. The infiltration test depths for each boring are provided in the table below. The test depths were selected to capture shallower infiltration and one deeper zone since percolation rates were expected to be slow based on the soil types encountered. The borings were then filled with water for a pre-soak period.

At the beginning of each infiltration test, the perforated pipes were refilled with water and readings were taken at periodic time intervals as the water level dropped. The infiltration velocity is presented as the infiltration rate and is summarized in the following table. The infiltration rates provided do not include safety factors.



## Infiltration Testing Report

Proposed Redevelopment of Moreno Valley Mall ■ Moreno Valley, California

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| Test Location | Depth to Bedrock (ft.) <sup>1</sup> | Test Depth Range (ft.) <sup>1</sup> | Soil Type | Water Head (ft) | Percolation Rate Average (in./hr.) | Infiltration Rate Average (in./hr.) <sup>2</sup> |
|---------------|-------------------------------------|-------------------------------------|-----------|-----------------|------------------------------------|--|
| P-1           | 10                                  | 0 to 5                              | CL        | 5               | 1.50                               | 0.05   |
| P-2           | 14                                  | 4 to 9                              | SC        | 5               | 6.00                               | 0.18   |
| P-3           | 8                                   | N/A                                 | --        | --              | --                                 | --   |
| P-4           | 12                                  | 2 to 7                              | CL and SC | 5               | 0.6                                | 0.02   |
| P-5           | 2                                   | N/A                                 | --        | --              | --                                 | --   |
| P-6           | Not encountered                     | 10 to 15                            | SC        | 5               | 6.48                               | 0.18   |

1. Below existing ground surface.

2. If proposed infiltration system will mainly rely on vertical downward seepage, the correlated infiltration rates should be used. The Porchet Method was used to convert percolation rates to infiltration rates.

The above infiltration rates determined by the percolation test method are based on field test results utilizing clear water. Infiltration rates can be affected by silt buildup, debris, degree of soil saturation, site variability and other factors. The rate obtained at specific location and depth is representative of the location and depth tested and may not be representative of the entire site. Application of an appropriate safety factor is prudent to account for subsoil inconsistencies, possible compaction related to site grading, and potential silting of the percolating soils, depending on the application.

The design engineer should also check with the local agency for the limitation of the infiltration rate allowed in the design. If the maximum allowable design infiltration rate is lower than the above recommended rate, the maximum allowable design infiltration rate should be used. The designer of the basins should also consider other possible site variability in the design.

The percolation tests were performed with clear water, whereas the storm water will likely not be clear, but may contain organics, fines, and grease/oil. The presence of these deleterious materials will tend to decrease the rate that water percolates from the infiltration systems. Design of the storm water infiltration systems should account for the presence of these materials and should incorporate structures/devices to remove these deleterious materials.

Based on the soils encountered in our borings, we expect the percolation rates of the soils could be different than measured in the field due to variations in fines and gravel content. The design elevation and size of the proposed infiltration system should account for this expected variability in infiltration rates.

## Infiltration Testing Report

Proposed Redevelopment of Moreno Valley Mall ■ Moreno Valley, California  
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Infiltration testing should be performed after construction of the infiltration system to verify the design infiltration rates. It should be noted that siltation and vegetation growth along with other factors may affect the infiltration rates of the infiltration areas. The actual infiltration rate may vary from the values reported here. Infiltration systems should be located at least 10 feet from any existing or proposed foundation system.

## GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

**ATTACHMENTS**

DRAFT

## **SITE LOCATION AND EXPLORATION PLANS**

### **Contents:**

Site Location Plan  
Exploration Plan

Note: All attachments are one page unless noted above.

**SITE LOCATION**

Proposed Redevelopment of Moreno Valley Mall ■ Moreno Valley, California  
January 24, 2022 ■ Terracon Project No. CB215157

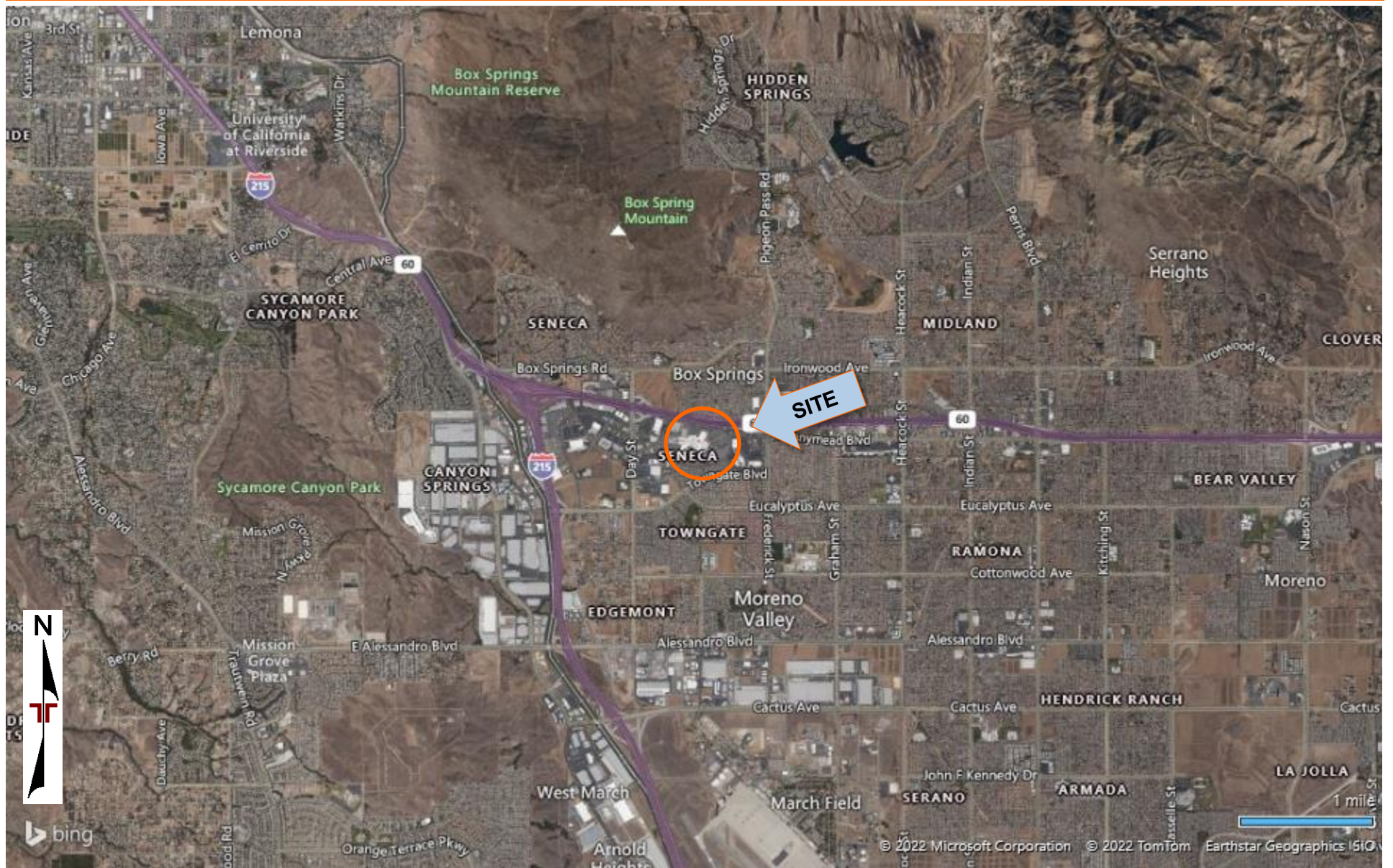


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

**EXPLORATION PLAN**

Proposed Redevelopment of Moreno Valley Mall ■ Moreno Valley, California  
January 24, 2022 ■ Terracon Project No. CB215157

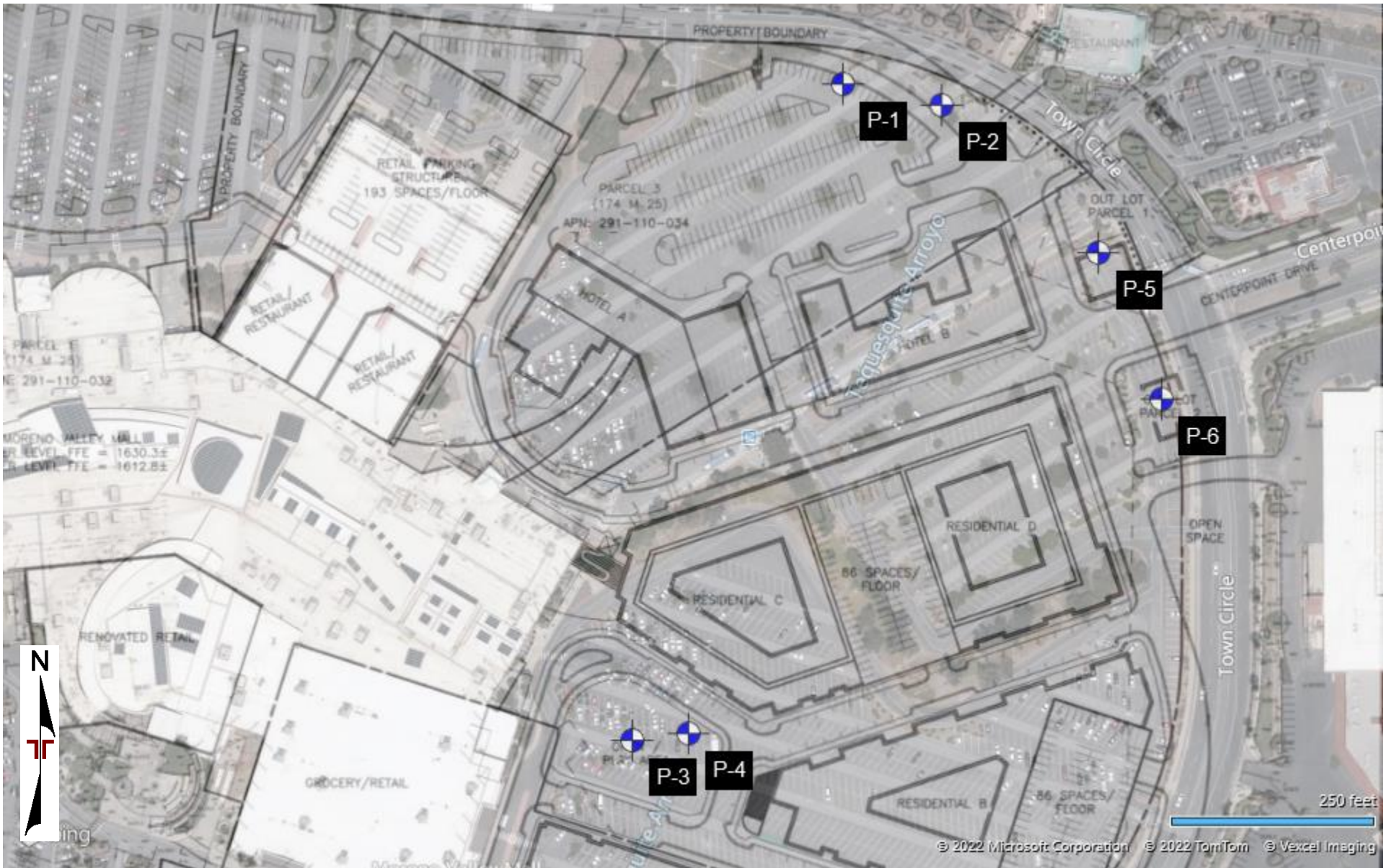


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

## **EXPLORATION RESULTS**

### **Contents:**

Boring Logs  
Grain Size Distribution  
Field Infiltration Results (4 pages)

Note: All attachments are one page unless noted above.

# BORING LOG NO. P-1

**PROJECT:** Moreno Valley Mall Redevelopment

**CLIENT:** Moreno Valley Mall Holding LLC  
Moreno Valley, CA

**SITE:** 22500 Town Circle  
Moreno Valley, CA

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL CB215157 MORENO VALLEY MALL GPJ TERRACON DATATEMPLATE.GDT 1/20/22

| GRAPHIC LOG | LOCATION See <a href="#">Exploration Plan</a><br>Latitude: 33.9401° Longitude: -117.2679° | INSTALLATION<br>DETAILS                  | DEPTH (Ft.) | WATER LEVEL<br>OBSERVATIONS | SAMPLE TYPE | FIELD TEST<br>RESULTS | PERCENT FINES |
|-------------|---|--|-------------|-----------------------------|-------------|-----------------------|---------------|
| DEPTH       |   |  |             |                             |             |                       |               |
| 0.3         | <b>ASPHALT, 3"</b>  |  |             |                             |             |                       |               |
| 0.8         | <b>AGGREGATE BASE COURSE, 6"</b><br><b>SANDY LEAN CLAY (CL),</b> reddish brown            |  |             |                             |             |                       |               |
| 4.0         | <b>CLAYEY SAND (SC),</b> fine to coarse grained, brownish gray, medium dense              | Perforated 3"<br>pipe<br><br>3/8" gravel |             |                             |             |                       |               |
| 10.0        | <b>GRANITIC BEDROCK,</b> tan, severely weathered, excavates as silty sand                 | Bentonite<br>Seal                        | 5           | X                           |             | 9-11-8<br>N=19        |               |
| 15.0        | <b>Boring Terminated at 15 Feet</b>   | Backfilled<br>auger cuttings             | 10          | X                           |             | 34-50/5"              | 28            |

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:  
6" Hollow-Stem Auger

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

Abandonment Method:  
Boring backfilled with Auger Cuttings  
Surface capped with asphalt

See [Supporting Information](#) for explanation of symbols and abbreviations.

**WATER LEVEL OBSERVATIONS**

*Groundwater not encountered*



Boring Started: 01-11-2022

Boring Completed: 01-11-2022

Drill Rig: CME 75

Driller: Martini Drilling

Project No.: CB215157



# BORING LOG NO. P-2

**PROJECT:** Moreno Valley Mall Redevelopment

**CLIENT:** Moreno Valley Mall Holding LLC  
Moreno Valley, CA

**SITE:** 22500 Town Circle  
Moreno Valley, CA

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL CB215157 MORENO VALLEY MAL.GPJ TERRACON.DATATEMPLATE.GDT 1/20/22

| GRAPHIC LOG | LOCATION See <a href="#">Exploration Plan</a><br>Latitude: 33.9401° Longitude: -117.2675° | INSTALLATION<br>DETAILS   | DEPTH (Ft.) | WATER LEVEL<br>OBSERVATIONS | SAMPLE TYPE | FIELD TEST<br>RESULTS | PERCENT FINES |
|-------------|---|---------------------------|-------------|-----------------------------|-------------|-----------------------|---------------|
|             | DEPTH   |                           |             |                             |             |                       |               |
| 0.3         | <b>ASPHALT, 4"</b>  |                           |             |                             |             |                       |               |
| 0.9         | <b>AGGREGATE BASE COURSE, 7"</b>  |                           |             |                             |             |                       |               |
| 4.0         | <b>SANDY LEAN CLAY (CL)</b> , reddish brown   | Blank 3" pipe             |             |                             |             |                       |               |
| 4.0         | <b>CLAYEY SAND (SC)</b> , fine to coarse grained, brownish gray, medium dense             | 3/8" gravel               |             |                             |             |                       |               |
| 14.0        | reddish brown   | Perforated 3" pipe        | 5           | X                           |             | 4-11-12<br>N=23       | 24            |
| 14.0        |   | Bentonite Seal            | 10          | X                           |             | 6-8-12<br>N=20        |               |
| 15.0        | <b>GRANITIC BEDROCK</b> , tan, severely weathered, excavates as silty sand                | Backfilled auger cuttings |             |                             |             |                       |               |
|             | <b>Boring Terminated at 15 Feet</b>   |                           | 15          |                             |             |                       |               |

Stratification lines are approximate. In-situ, the transition may be gradual.

|   |  |                       |                   |
|---|--|-----------------------|-------------------|
| Advancement Method:   | See <a href="#">Exploration and Testing Procedures</a> for a description of field and laboratory procedures used and additional data (If any). | Notes:                |                   |
| Abandonment Method:   | See <a href="#">Supporting Information</a> for explanation of symbols and abbreviations.   |                       |                   |
| <b>WATER LEVEL OBSERVATIONS</b><br><i>Groundwater not encountered</i> |  | Boring Started:       | Boring Completed: |
|   |  | Drill Rig:            | Driller:          |
|   |  | Project No.: CB215157 |                   |



# BORING LOG NO. P-3

**PROJECT:** Moreno Valley Mall Redevelopment

**CLIENT:** Moreno Valley Mall Holding LLC  
Moreno Valley, CA

**SITE:** 22500 Town Circle  
Moreno Valley, CA

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL CB215157 MORENO VALLEY MALL.GPJ TERRACON DATATEMPLATE.GDT 1/20/22

| GRAPHIC LOG                         | LOCATION See <a href="#">Exploration Plan</a><br>Latitude: 33.9379° Longitude: -117.2687° | INSTALLATION<br>DETAILS      | DEPTH (Ft.) | WATER LEVEL<br>OBSERVATIONS | SAMPLE TYPE | FIELD TEST<br>RESULTS | PERCENT FINES |
|-------------------------------------|---|------------------------------|-------------|-----------------------------|-------------|-----------------------|---------------|
| DEPTH                               |   |                              |             |                             |             |                       |               |
| 0.3                                 | <b>ASPHALT, 3"</b>  |                              |             |                             |             |                       |               |
| 0.5                                 | <b>AGGREGATE BASE COURSE, 3"</b><br><b>SANDY LEAN CLAY (CL), reddish brown</b>            |                              |             |                             |             |                       |               |
| 5.0                                 | <b>CLAYEY SAND (SC), fine to coarse grained, brownish gray, medium dense</b>              |                              | 5           | X                           |             | 6-7-4<br>N=11         |               |
| 8.0                                 | <b>GRANITIC BEDROCK, tan, severely weathered, excavates as silty sand</b>                 | Backfilled<br>auger cuttings |             |                             |             |                       |               |
| 10.0                                | gray  |                              | 10          |                             |             | 50/3"                 |               |
| 15.0                                |   |                              | 15          |                             |             | 50/3"                 |               |
| <b>Boring Terminated at 15 Feet</b> |   |                              |             |                             |             |                       |               |

Stratification lines are approximate. In-situ, the transition may be gradual.

|   |  |                       |                   |
|---|--|-----------------------|-------------------|
| Advancement Method:   | See <a href="#">Exploration and Testing Procedures</a> for a description of field and laboratory procedures used and additional data (If any). | Notes:                |                   |
| Abandonment Method:   | See <a href="#">Supporting Information</a> for explanation of symbols and abbreviations.   |                       |                   |
| <b>WATER LEVEL OBSERVATIONS</b><br><i>Groundwater not encountered</i> | <br>1355 E Cooley Dr, Ste C<br>Colton, CA  | Boring Started:       | Boring Completed: |
|   |  | Drill Rig:            | Driller:          |
|   |  | Project No.: CB215157 |                   |

# BORING LOG NO. P-4

**PROJECT:** Moreno Valley Mall Redevelopment

**CLIENT:** Moreno Valley Mall Holding LLC  
Moreno Valley, CA

**SITE:** 22500 Town Circle  
Moreno Valley, CA

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL CB215157 MORENO VALLEY MALL GPJ TERRACON DATATEMPLATE.GDT 1/20/22

| GRAPHIC LOG | LOCATION See <a href="#">Exploration Plan</a><br>Latitude: 33.9380° Longitude: -117.2685° | INSTALLATION<br>DETAILS                     | DEPTH (Ft.) | WATER LEVEL<br>OBSERVATIONS | SAMPLE TYPE | FIELD TEST<br>RESULTS | PERCENT FINES |
|-------------|---|---|-------------|-----------------------------|-------------|-----------------------|---------------|
|             | DEPTH   |   |             |                             |             |                       |               |
| 0.3         | <b>ASPHALT</b> , 4"   |   |             |                             |             |                       |               |
| 1.0         | <b>AGGREGATE BASE COURSE</b> , 8"<br><b>SANDY LEAN CLAY (CL)</b> , reddish brown          | Blank 3" pipe<br>3/8" gravel                |             |                             |             |                       |               |
| 5.0         | <b>CLAYEY SAND (CL)</b> , fine to coarse grained, brownish gray, medium dense             | Perforated 3" pipe                          | 5           |                             |             | 4-8-15<br>N=23        | 33            |
| 12.0        | <b>GRANITIC BEDROCK</b> , tan, severely weathered, excavates as silty sand                | Bentonite Seal<br>Backfilled auger cuttings | 10          |                             |             | 4-6-9<br>N=15         |               |
| 15.0        | <b>Boring Terminated at 15 Feet</b>   |   | 15          |                             |             |                       |               |

Stratification lines are approximate. In-situ, the transition may be gradual.

|   |  |                       |                   |
|---|--|-----------------------|-------------------|
| Advancement Method:   | See <a href="#">Exploration and Testing Procedures</a> for a description of field and laboratory procedures used and additional data (If any). | Notes:                |                   |
| Abandonment Method:   | See <a href="#">Supporting Information</a> for explanation of symbols and abbreviations.   |                       |                   |
| <b>WATER LEVEL OBSERVATIONS</b><br><i>Groundwater not encountered</i> |  | Boring Started:       | Boring Completed: |
| <br>1355 E Cooley Dr, Ste C<br>Colton, CA                             |  | Drill Rig:            | Driller:          |
|   |  | Project No.: CB215157 |                   |

# BORING LOG NO. P-5

**PROJECT:** Moreno Valley Mall Redevelopment

**CLIENT:** Moreno Valley Mall Holding LLC  
Moreno Valley, CA

**SITE:** 22500 Town Circle  
Moreno Valley, CA

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL CB215157 MORENO VALLEY MALL.GPJ TERRACON\_DATATEMPLATE.GDT 1/20/22

| GRAPHIC LOG   | LOCATION See <a href="#">Exploration Plan</a><br>Latitude: 33.9396° Longitude: -117.2669°   | INSTALLATION<br>DETAILS              | DEPTH (Ft.)                  | WATER LEVEL<br>OBSERVATIONS | SAMPLE TYPE | FIELD TEST<br>RESULTS | PERCENT FINES |
|---|---|--------------------------------------|------------------------------|-----------------------------|-------------|-----------------------|---------------|
| <p>DEPTH</p> <p>0.3</p> <p>0.8</p> <p>2.0</p> <p>15.0</p> | <p><b>ASPHALT, 3"</b></p> <p><b>AGGREGATE BASE COURSE, 6"</b></p> <p><b>SANDY LEAN CLAY (CL), reddish brown</b></p> <p><b>GRANITIC BEDROCK, reddish brown, excavates as silty sand</b></p> <p>gray</p> <p>tan and gray</p> <p><b>Boring Terminated at 15 Feet</b></p> | <p>Backfilled<br/>auger cuttings</p> | <p>5</p> <p>10</p> <p>15</p> | <p>50/6"</p> <p>50/6"</p>   |             |                       |               |

Stratification lines are approximate. In-situ, the transition may be gradual.

|  |   |  |                 |                   |            |          |                       |  |
|--|---|--|-----------------|-------------------|------------|----------|-----------------------|--|
| <p>Advancement Method:</p> <p>Abandonment Method:</p>                            | <p>See <a href="#">Exploration and Testing Procedures</a> for a description of field and laboratory procedures used and additional data (If any).</p> <p>See <a href="#">Supporting Information</a> for explanation of symbols and abbreviations.</p> | <p>Notes:</p>  |                 |                   |            |          |                       |  |
| <p><b>WATER LEVEL OBSERVATIONS</b></p> <p><i>Groundwater not encountered</i></p> | <p>1355 E Cooley Dr, Ste C<br/>Colton, CA</p>   | <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; border-bottom: 1px solid black;">Boring Started:</td> <td style="width: 50%; border-bottom: 1px solid black;">Boring Completed:</td> </tr> <tr> <td style="border-bottom: 1px solid black;">Drill Rig:</td> <td style="border-bottom: 1px solid black;">Driller:</td> </tr> <tr> <td colspan="2" style="border-bottom: 1px solid black;">Project No.: CB215157</td> </tr> </table> | Boring Started: | Boring Completed: | Drill Rig: | Driller: | Project No.: CB215157 |  |
| Boring Started:  | Boring Completed:   |  |                 |                   |            |          |                       |  |
| Drill Rig:   | Driller:  |  |                 |                   |            |          |                       |  |
| Project No.: CB215157  |   |  |                 |                   |            |          |                       |  |

# BORING LOG NO. P-6

**PROJECT:** Moreno Valley Mall Redevelopment

**CLIENT:** Moreno Valley Mall Holding LLC  
Moreno Valley, CA

**SITE:** 22500 Town Circle  
Moreno Valley, CA

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-WELL CB215157 MORENO VALLEY MALL GPJ TERRACON DATATEMPLATE.GDT 1/20/22

| GRAPHIC LOG | LOCATION See <a href="#">Exploration Plan</a><br>Latitude: 33.9391° Longitude: -117.2666° | INSTALLATION<br>DETAILS | DEPTH (Ft.) | WATER LEVEL<br>OBSERVATIONS | SAMPLE TYPE | FIELD TEST<br>RESULTS | PERCENT FINES |
|-------------|---|-------------------------|-------------|-----------------------------|-------------|-----------------------|---------------|
| DEPTH       |   |                         |             |                             |             |                       |               |
| 0.3         | <b>ASPHALT</b> , 3.5"   |                         |             |                             |             |                       |               |
| 1.1         | <b>AGGREGATE BASE COURSE</b> , 10"  |                         |             |                             |             |                       |               |
| 5.5         | <b>SANDY LEAN CLAY (CL)</b> , reddish brown, very stiff                                   | Blank 3" pipe           | 5           | X                           |             | 3-8-8<br>N=16         | 23            |
| 15.2        | <b>CLAYEY SAND (SC)</b> , fine to coarse grained, brownish gray, medium dense             | 3/8" gravel             | 10          | X                           |             | 7-11-16<br>N=27       | 31            |
| 15.2        | <b>Boring Terminated at 15.2 Feet</b>   | Perforated 3" pipe      | 15          |                             |             |                       |               |

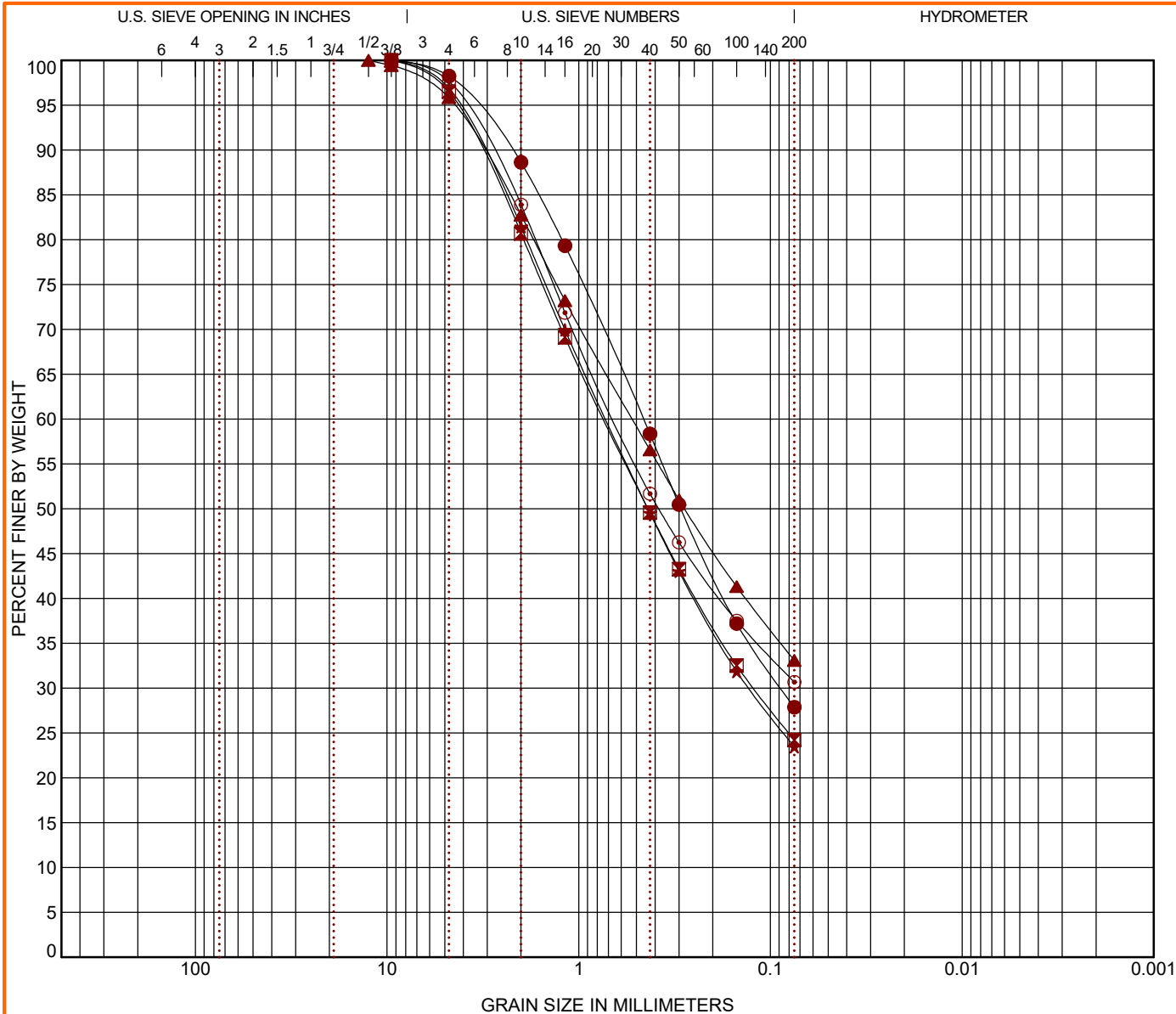
Stratification lines are approximate. In-situ, the transition may be gradual.

|   |  |                       |                   |
|---|--|-----------------------|-------------------|
| Advancement Method:   | See <a href="#">Exploration and Testing Procedures</a> for a description of field and laboratory procedures used and additional data (If any). | Notes:                |                   |
| Abandonment Method:   | See <a href="#">Supporting Information</a> for explanation of symbols and abbreviations.   |                       |                   |
| <b>WATER LEVEL OBSERVATIONS</b><br><i>Groundwater not encountered</i> |  | Boring Started:       | Boring Completed: |
|   |  | Drill Rig:            | Driller:          |
|   |  | Project No.: CB215157 |                   |



# GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



| COBBLES | GRAVEL |      | SAND   |        |      | SILT OR CLAY |
|---------|--------|------|--------|--------|------|--------------|
|         | coarse | fine | coarse | medium | fine |              |

| Boring ID | Depth     | USCS Classification | WC (%) | LL | PL | PI | Cc | Cu |
|-----------|-----------|---------------------|--------|----|----|----|----|----|
| ● P-1     | 10.1 - 15 | GRANITIC BEDROCK    |        |    |    |    |    |    |
| ☒ P-2     | 5 - 6.5   | CLAYEY SAND (SC)    |        |    |    |    |    |    |
| ▲ P-4     | 5 - 6.5   | CLAYEY SAND (SC)    |        |    |    |    |    |    |
| ★ P-6     | 5 - 6.5   | CLAYEY SAND (SC)    |        |    |    |    |    |    |
| ⊙ P-6     | 10.1 - 15 | CLAYEY SAND (SC)    |        |    |    |    |    |    |

| Boring ID | Depth     | D <sub>100</sub> | D <sub>60</sub> | D <sub>30</sub> | D <sub>10</sub> | %Cobbles | %Gravel | %Sand | %Silt | %Fines | %Clay |
|-----------|-----------|------------------|-----------------|-----------------|-----------------|----------|---------|-------|-------|--------|-------|
| ● P-1     | 10.1 - 15 | 9.5              | 0.461           | 0.088           |                 | 0.0      | 1.8     | 70.4  |       | 27.9   |       |
| ☒ P-2     | 5 - 6.5   | 9.5              | 0.733           | 0.122           |                 | 0.0      | 3.5     | 72.3  |       | 24.2   |       |
| ▲ P-4     | 5 - 6.5   | 12.5             | 0.525           |                 |                 | 0.0      | 4.2     | 62.7  |       | 33.1   |       |
| ★ P-6     | 5 - 6.5   | 9.5              | 0.718           | 0.129           |                 | 0.0      | 3.1     | 73.4  |       | 23.5   |       |
| ⊙ P-6     | 10.1 - 15 | 9.5              | 0.648           |                 |                 | 0.0      | 2.3     | 67.0  |       | 30.7   |       |

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 CB215157 MORENO VALLEY MALL GPJ TERRACON\_DATA TEMPLATE.GDT 1/20/22

PROJECT: Moreno Valley Mall  
Redevelopment

SITE: 22500 Town Circle  
Moreno Valley, CA



PROJECT NUMBER: CB215157

CLIENT: Moreno Valley Mall Holding LLC  
Moreno Valley, CA

Job No.: CB215157

## PERCOLATION TEST DATA

BORING NUMBER: P-1  
LOT No: N/A  
TRACT No: N/A

CLIENT: Moreno Valley Mall Holding LLC  
PROJECT: Moreno Valley Mall

DATE OF DRILLING: January 11, 2022  
DATE OF PRESOAK: January 11, 2022  
DATE OF TEST: January 12, 2022  
TESTED BY: SP

DEPTH BEFORE (ft.): 5.2  
DEPTH AFTER (ft.): 5.2  
PVC PIPE DIA. (in.): 3.0  
PERC HOLE DIA. (in.): 8.0

| Time Interval<br>(min.) | Total Elapsed Time<br>(min.) | Initial Water Level<br>(in.) | Final Water Level<br>(in.) | Change in Water Level<br>(in.) | Initial Hole Depth<br>(in.) | Final Hole Depth<br>(in.) | Percolation Rate<br>(in/hr) | Infiltration rate<br>(Porchet Method)<br>(in/hr) |
|-------------------------|------------------------------|------------------------------|----------------------------|--------------------------------|-----------------------------|---------------------------|-----------------------------|--|
| 1260                    | 1260                         | -4.0                         | 56.0                       | 60.0                           | 62.0                        | 62.0                      | 2.9                         | 0.15   |
| 25                      | 1285                         | -2.8                         | 0.9                        | 3.6                            | 62.0                        | 62.0                      | 8.7                         | 0.27   |
| 25                      | 1310                         | -2.5                         | -1.3                       | 1.3                            | 62.0                        | 62.0                      | 3.0                         | 0.09   |
| 30                      | 1340                         | -1.3                         | -0.3                       | 1.0                            | 62.0                        | 62.0                      | 2.0                         | 0.06   |
| 30                      | 1370                         | -2.4                         | -1.4                       | 1.0                            | 62.0                        | 62.0                      | 2.0                         | 0.06   |
| 30                      | 1400                         | -1.4                         | -0.4                       | 1.0                            | 62.0                        | 62.0                      | 2.0                         | 0.06   |
| 30                      | 1430                         | -3.3                         | -2.3                       | 1.0                            | 62.0                        | 62.0                      | 2.0                         | 0.06   |
| 30                      | 1460                         | -2.3                         | -1.4                       | 0.9                            | 62.0                        | 62.0                      | 1.8                         | 0.05   |
| 30                      | 1490                         | -1.4                         | -0.1                       | 1.3                            | 62.0                        | 62.0                      | 2.5                         | 0.08   |
| 30                      | 1520                         | -2.6                         | -1.4                       | 1.3                            | 62.0                        | 62.0                      | 2.5                         | 0.08   |
| 30                      | 1550                         | -2.4                         | -1.6                       | 0.8                            | 62.0                        | 62.0                      | 1.5                         | 0.05   |
| 30                      | 1580                         | -1.6                         | -0.8                       | 0.9                            | 62.0                        | 62.0                      | 1.8                         | 0.05   |
| 30                      | 1610                         | -2.6                         | -2.3                       | 0.4                            | 62.0                        | 62.0                      | 0.8                         | 0.02   |
| 30                      | 1640                         | -2.3                         | -1.4                       | 0.9                            | 62.0                        | 62.0                      | 1.8                         | 0.05   |
| 30                      | 1670                         | -2.1                         | -1.4                       | 0.8                            | 62.0                        | 62.0                      | 1.5                         | 0.05   |

Final Reading: 1.50 0.05

Job No.: CB215157

### PERCOLATION TEST DATA

BORING NUMBER: P-2  
LOT No: N/A  
TRACT No: N/A

CLIENT: Moreno Valley Mall Holding LLC  
PROJECT: Moreno Valley Mall

DATE OF DRILLING: January 11, 2022      DEPTH BEFORE (ft.): 9.2  
DATE OF PRESOAK: January 17, 2022      DEPTH AFTER (ft.): 9.2  
DATE OF TEST: January 18, 2022      PVC PIPE DIA. (in.): 3.0  
TESTED BY: GA      PERC HOLE DIA. (in.): 8.0

| Time Interval (min.) | Total Elapsed Time (min.) | Initial Water Level (in.) | Final Water Level (in.) | Change in Water Level (in.) | Initial Hole Depth (in.) | Final Hole Depth (in.) | Percolation Rate (in/hr) | Infiltration rate (Porchet Method) (in/hr) |
|----------------------|---------------------------|---------------------------|-------------------------|-----------------------------|--------------------------|------------------------|--------------------------|--|
| 1247                 | 1247                      | 44.0                      | 104.0                   | 60.0                        | 110.0                    | 110.0                  | 2.9                      | 0.15                                       |
| 25                   | 1272                      | 44.0                      | 50.0                    | 6.0                         | 110.0                    | 110.0                  | 14.4                     | 0.44                                       |
| 25                   | 1297                      | 44.0                      | 49.1                    | 5.1                         | 110.0                    | 110.0                  | 12.2                     | 0.37                                       |
| 30                   | 1327                      | 44.0                      | 48.5                    | 4.5                         | 110.0                    | 110.0                  | 9.0                      | 0.27                                       |
| 30                   | 1357                      | 44.0                      | 47.9                    | 3.9                         | 110.0                    | 110.0                  | 7.8                      | 0.24                                       |
| 30                   | 1387                      | 44.0                      | 47.3                    | 3.3                         | 110.0                    | 110.0                  | 6.6                      | 0.20                                       |
| 30                   | 1417                      | 44.0                      | 46.1                    | 2.1                         | 110.0                    | 110.0                  | 4.2                      | 0.13                                       |
| 30                   | 1447                      | 44.0                      | 45.2                    | 1.2                         | 110.0                    | 110.0                  | 2.4                      | 0.07                                       |
| 30                   | 1477                      | 44.0                      | 44.9                    | 0.9                         | 110.0                    | 110.0                  | 1.8                      | 0.05                                       |
| 30                   | 1507                      | 44.0                      | 44.6                    | 0.6                         | 110.0                    | 110.0                  | 1.2                      | 0.04                                       |
| 30                   | 1537                      | 44.0                      | 44.6                    | 0.6                         | 110.0                    | 110.0                  | 1.2                      | 0.04                                       |
| 30                   | 1567                      | 44.0                      | 44.6                    | 0.6                         | 110.0                    | 110.0                  | 1.2                      | 0.04                                       |
| 30                   | 1597                      | 44.0                      | 44.6                    | 0.6                         | 110.0                    | 110.0                  | 1.2                      | 0.04                                       |
| 30                   | 1627                      | 44.0                      | 47.0                    | 3.0                         | 110.0                    | 110.0                  | 6.0                      | 0.18                                       |
| 30                   | 1657                      | 44.0                      | 47.0                    | 3.0                         | 110.0                    | 110.0                  | 6.0                      | 0.18                                       |

Final Reading: 6.00 0.18



Job No.: CB215157

### PERCOLATION TEST DATA

BORING NUMBER: P-4  
 LOT No: N/A  
 TRACT No: N/A

CLIENT: Moreno Valley Mall Holding LLC  
 PROJECT: Moreno Valley Mall

DATE OF DRILLING: January 11, 2022      DEPTH BEFORE (ft.): 7.2  
 DATE OF PRESOAK: January 17, 2022      DEPTH AFTER (ft.): 7.2  
 DATE OF TEST: January 18, 2022      PVC PIPE DIA. (in.): 3.0  
 TESTED BY: GA      PERC HOLE DIA. (in.): 8.0

| Time Interval (min.) | Total Elapsed Time (min.) | Initial Water Level (in.) | Final Water Level (in.) | Change in Water Level (in.) | Initial Hole Depth (in.) | Final Hole Depth (in.) | Percolation Rate (in/hr) | Infiltration rate (Porchet Method) (in/hr) |
|----------------------|---------------------------|---------------------------|-------------------------|-----------------------------|--------------------------|------------------------|--------------------------|--|
| 1182                 | 1182                      | 20.0                      | 82.4                    | 62.4                        | 86.0                     | 86.0                   | 3.2                      | 0.17                                       |
| 25                   | 1207                      | 20.0                      | 21.8                    | 1.8                         | 86.0                     | 86.0                   | 4.3                      | 0.13                                       |
| 25                   | 1232                      | 20.0                      | 21.8                    | 1.8                         | 86.0                     | 86.0                   | 4.3                      | 0.13                                       |
| 30                   | 1262                      | 20.0                      | 21.8                    | 1.8                         | 86.0                     | 86.0                   | 3.6                      | 0.11                                       |
| 30                   | 1292                      | 20.0                      | 21.5                    | 1.5                         | 86.0                     | 86.0                   | 3.0                      | 0.09                                       |
| 30                   | 1322                      | 20.0                      | 20.9                    | 0.9                         | 86.0                     | 86.0                   | 1.8                      | 0.05                                       |
| 30                   | 1352                      | 20.0                      | 20.6                    | 0.6                         | 86.0                     | 86.0                   | 1.2                      | 0.04                                       |
| 30                   | 1382                      | 20.0                      | 20.3                    | 0.3                         | 86.0                     | 86.0                   | 0.6                      | 0.02                                       |
| 30                   | 1412                      | 20.0                      | 20.0                    | 0.0                         | 86.0                     | 86.0                   | 0.0                      | 0.00                                       |
| 30                   | 1442                      | 20.0                      | 20.3                    | 0.3                         | 86.0                     | 86.0                   | 0.6                      | 0.02                                       |
| 30                   | 1472                      | 20.0                      | 20.3                    | 0.3                         | 86.0                     | 86.0                   | 0.6                      | 0.02                                       |
| 30                   | 1502                      | 20.0                      | 20.3                    | 0.3                         | 86.0                     | 86.0                   | 0.6                      | 0.02                                       |
| 30                   | 1532                      | 20.0                      | 20.0                    | 0.0                         | 86.0                     | 86.0                   | 0.0                      | 0.00                                       |
| 30                   | 1562                      | 20.0                      | 20.3                    | 0.3                         | 86.0                     | 86.0                   | 0.6                      | 0.02                                       |
| 30                   | 1592                      | 20.0                      | 20.0                    | 0.0                         | 86.0                     | 86.0                   | 0.0                      | 0.00                                       |

Final Reading: 0.00 0.00

Job No.: CB215157

### PERCOLATION TEST DATA

BORING NUMBER: P-6  
LOT No: N/A  
TRACT No: N/A

CLIENT: Moreno Valley Mall Holding LLC  
PROJECT: Moreno Valley Mall

DATE OF DRILLING: January 11, 2022      DEPTH BEFORE (ft.): 15.2  
DATE OF PRESOAK: January 11, 2022      DEPTH AFTER (ft.): 15.2  
DATE OF TEST: January 12, 2022      PVC PIPE DIA. (in.): 3.0  
TESTED BY: SP      PERC HOLE DIA. (in.): 8.0

| Time Interval (min.) | Total Elapsed Time (min.) | Initial Water Level (in.) | Final Water Level (in.) | Change in Water Level (in.) | Initial Hole Depth (in.) | Final Hole Depth (in.) | Percolation Rate (in/hr) | Infiltration rate (Porchet Method) (in/hr) |
|----------------------|---------------------------|---------------------------|-------------------------|-----------------------------|--------------------------|------------------------|--------------------------|--|
| 1465                 | 1465                      | -4.0                      | 148.5                   | 152.5                       | 182.0                    | 182.0                  | 6.2                      | 0.11                                       |
| 25                   | 1490                      | 108.1                     | 112.0                   | 4.0                         | 182.0                    | 182.0                  | 9.5                      | 0.26                                       |
| 25                   | 1515                      | 76.5                      | 82.8                    | 6.2                         | 182.0                    | 182.0                  | 15.0                     | 0.29                                       |
| 30                   | 1545                      | 82.8                      | 88.4                    | 5.6                         | 182.0                    | 182.0                  | 11.3                     | 0.23                                       |
| 30                   | 1575                      | 88.4                      | 92.7                    | 4.3                         | 182.0                    | 182.0                  | 8.6                      | 0.18                                       |
| 30                   | 1605                      | 92.7                      | 97.4                    | 4.7                         | 182.0                    | 182.0                  | 9.4                      | 0.21                                       |
| 30                   | 1635                      | 97.4                      | 101.5                   | 4.1                         | 182.0                    | 182.0                  | 8.2                      | 0.19                                       |
| 30                   | 1665                      | 101.5                     | 104.8                   | 3.4                         | 182.0                    | 182.0                  | 6.7                      | 0.17                                       |
| 30                   | 1695                      | 104.8                     | 108.9                   | 4.1                         | 182.0                    | 182.0                  | 8.2                      | 0.21                                       |
| 30                   | 1725                      | 108.9                     | 112.0                   | 3.1                         | 182.0                    | 182.0                  | 6.2                      | 0.17                                       |
| 30                   | 1755                      | 103.8                     | 107.1                   | 3.4                         | 182.0                    | 182.0                  | 6.7                      | 0.17                                       |
| 30                   | 1785                      | 107.1                     | 111.1                   | 4.0                         | 182.0                    | 182.0                  | 7.9                      | 0.21                                       |
| 30                   | 1815                      | 111.1                     | 114.2                   | 3.1                         | 182.0                    | 182.0                  | 6.2                      | 0.17                                       |
| 30                   | 1845                      | 105.3                     | 108.7                   | 3.4                         | 182.0                    | 182.0                  | 6.7                      | 0.17                                       |
| 30                   | 1875                      | 108.7                     | 111.9                   | 3.2                         | 182.0                    | 182.0                  | 6.5                      | 0.18                                       |

Final Reading: 6.48 0.18

## **SUPPORTING INFORMATION**

### **Contents:**

General Notes  
Unified Soil Classification System

Note: All attachments are one page unless noted above.

# GENERAL NOTES

## DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

|                 |  |  |  |   |  |  |                    |  |           |
|-----------------|--|--|--|---|--|--|--------------------|--|-----------|
| <b>SAMPLING</b> |  |  |  | <b>WATER LEVEL</b>  |  | Water Initially Encountered                  | <b>FIELD TESTS</b> | (HP) Hand Penetrometer                           |           |
|                 |  |  |  |   |  | Water Level After a Specified Period of Time |                    | (T) Torvane                                      |           |
|                 |  |  |  |   |  | Water Level After a Specified Period of Time |                    | (b/f) Standard Penetration Test (blows per foot) | N N value |
|                 |  |  |  | Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations. |  |  |                    |  |           |

## DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

## LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

| <b>STRENGTH TERMS</b> | RELATIVE DENSITY OF COARSE-GRAINED SOILS<br>(More than 50% retained on No. 200 sieve.)<br>Density determined by Standard Penetration Resistance<br>Includes gravels, sands and silts. |   |                        | CONSISTENCY OF FINE-GRAINED SOILS<br>(50% or more passing the No. 200 sieve.)<br>Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance |  |   |                        |
|-----------------------|---|---|------------------------|---|--|---|------------------------|
|                       | Descriptive Term (Density)  | Standard Penetration or N-Value Blows/Ft. | Ring Sampler Blows/Ft. | Descriptive Term (Consistency)  | Unconfined Compressive Strength, Qu, psf | Standard Penetration or N-Value Blows/Ft. | Ring Sampler Blows/Ft. |
| Very Loose            | 0 - 3   | 0 - 6                                     | Very Soft              | less than 500   | 0 - 1                                    | < 3                                       |                        |
| Loose                 | 4 - 9   | 7 - 18                                    | Soft                   | 500 to 1,000  | 2 - 4                                    | 3 - 4                                     |                        |
| Medium Dense          | 10 - 29   | 19 - 58                                   | Medium-Stiff           | 1,000 to 2,000  | 4 - 8                                    | 5 - 9                                     |                        |
| Dense                 | 30 - 50   | 59 - 98                                   | Stiff                  | 2,000 to 4,000  | 8 - 15                                   | 10 - 18                                   |                        |
| Very Dense            | > 50  | ≥ 99                                      | Very Stiff             | 4,000 to 8,000  | 15 - 30                                  | 19 - 42                                   |                        |
|                       |   |   | Hard                   | > 8,000   | > 30                                     | > 42                                      |                        |

## RELATIVE PROPORTIONS OF SAND AND GRAVEL

| Descriptive Term(s) of other constituents | Percent of Dry Weight |
|---|-----------------------|
| Trace                                     | < 15                  |
| With                                      | 15 - 29               |
| Modifier                                  | > 30                  |

## GRAIN SIZE TERMINOLOGY

| Major Component of Sample | Particle Size                        |
|---------------------------|--------------------------------------|
| Boulders                  | Over 12 in. (300 mm)                 |
| Cobbles                   | 12 in. to 3 in. (300mm to 75mm)      |
| Gravel                    | 3 in. to #4 sieve (75mm to 4.75 mm)  |
| Sand                      | #4 to #200 sieve (4.75mm to 0.075mm) |
| Silt or Clay              | Passing #200 sieve (0.075mm)         |

## RELATIVE PROPORTIONS OF FINES

| Descriptive Term(s) of other constituents | Percent of Dry Weight |
|---|-----------------------|
| Trace                                     | < 5                   |
| With                                      | 5 - 12                |
| Modifier                                  | > 12                  |

## PLASTICITY DESCRIPTION

| Term        | Plasticity Index |
|-------------|------------------|
| Non-plastic | 0                |
| Low         | 1 - 10           |
| Medium      | 11 - 30          |
| High        | > 30             |

| Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests <sup>A</sup> |   |  |  | Soil Classification |                                   |                                    |      |
|--|---|--|--|---------------------|-----------------------------------|------------------------------------|------|
|  |   |  |  | Group Symbol        | Group Name <sup>B</sup>           |                                    |      |
| <b>Coarse-Grained Soils:</b><br>More than 50% retained on No. 200 sieve                  | <b>Gravels:</b><br>More than 50% of coarse fraction retained on No. 4 sieve | <b>Clean Gravels:</b><br>Less than 5% fines <sup>C</sup>       | $Cu \geq 4$ and $1 \leq Cc \leq 3$ <sup>E</sup>              | GW                  | Well-graded gravel <sup>F</sup>   |                                    |      |
|  |   |  | $Cu < 4$ and/or $[Cc < 1 \text{ or } Cc > 3.0]$ <sup>E</sup> | GP                  | Poorly graded gravel <sup>F</sup> |                                    |      |
|  |   | <b>Gravels with Fines:</b><br>More than 12% fines <sup>C</sup> | Fines classify as ML or MH                                   | GM                  | Silty gravel <sup>F, G, H</sup>   |                                    |      |
|  |   |  | Fines classify as CL or CH                                   | GC                  | Clayey gravel <sup>F, G, H</sup>  |                                    |      |
|  | <b>Sands:</b><br>50% or more of coarse fraction passes No. 4 sieve          | <b>Clean Sands:</b><br>Less than 5% fines <sup>D</sup>         | $Cu \geq 6$ and $1 \leq Cc \leq 3$ <sup>E</sup>              | SW                  | Well-graded sand <sup>I</sup>     |                                    |      |
|  |   |  | $Cu < 6$ and/or $[Cc < 1 \text{ or } Cc > 3.0]$ <sup>E</sup> | SP                  | Poorly graded sand <sup>I</sup>   |                                    |      |
|  |   | <b>Sands with Fines:</b><br>More than 12% fines <sup>D</sup>   | Fines classify as ML or MH                                   | SM                  | Silty sand <sup>G, H, I</sup>     |                                    |      |
|  |   |  | Fines classify as CL or CH                                   | SC                  | Clayey sand <sup>G, H, I</sup>    |                                    |      |
| <b>Fine-Grained Soils:</b><br>50% or more passes the No. 200 sieve                       | <b>Silts and Clays:</b><br>Liquid limit less than 50                        | <b>Inorganic:</b>  | $PI > 7$ and plots on or above "A" line                      | CL                  | Lean clay <sup>K, L, M</sup>      |                                    |      |
|  |   |  | $PI < 4$ or plots below "A" line <sup>J</sup>                | ML                  | Silt <sup>K, L, M</sup>           |                                    |      |
|  |   | <b>Organic:</b>  | Liquid limit - oven dried                                    | < 0.75              | OL                                | Organic clay <sup>K, L, M, N</sup> |      |
|  |   |  | Liquid limit - not dried                                     |                     |                                   | Organic silt <sup>K, L, M, O</sup> |      |
|  | <b>Silts and Clays:</b><br>Liquid limit 50 or more                          | <b>Inorganic:</b>  | $PI$ plots on or above "A" line                              | CH                  | Fat clay <sup>K, L, M</sup>       |                                    |      |
|  |   |  | $PI$ plots below "A" line                                    | MH                  | Elastic Silt <sup>K, L, M</sup>   |                                    |      |
|  |   | <b>Organic:</b>  | Liquid limit - oven dried                                    | < 0.75              | OH                                | Organic clay <sup>K, L, M, P</sup> |      |
|  |   |  | Liquid limit - not dried                                     |                     |                                   | Organic silt <sup>K, L, M, Q</sup> |      |
|  |   | <b>Highly organic soils:</b>                                   | Primarily organic matter, dark in color, and organic odor    |                     |                                   | PT                                 | Peat |

<sup>A</sup> Based on the material passing the 3-inch (75-mm) sieve.

<sup>B</sup> If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

<sup>C</sup> Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

<sup>D</sup> Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

$$E \quad Cu = D_{60}/D_{10} \quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

<sup>F</sup> If soil contains <sup>3</sup> 15% sand, add "with sand" to group name.

<sup>G</sup> If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

<sup>H</sup> If fines are organic, add "with organic fines" to group name.

<sup>I</sup> If soil contains <sup>3</sup> 15% gravel, add "with gravel" to group name.

<sup>J</sup> If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

<sup>K</sup> If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

<sup>L</sup> If soil contains <sup>3</sup> 30% plus No. 200 predominantly sand, add "sandy" to group name.

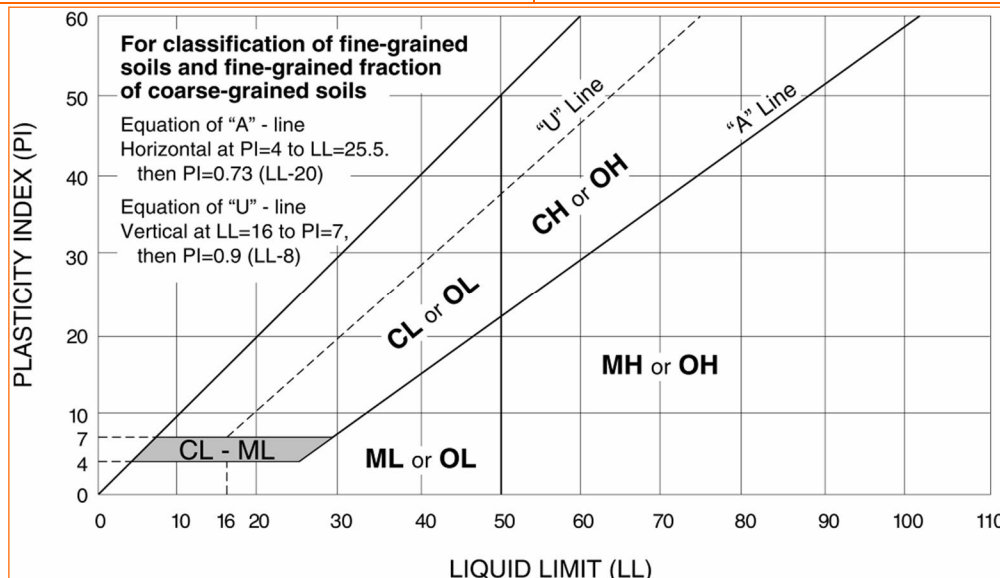
<sup>M</sup> If soil contains <sup>3</sup> 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

<sup>N</sup>  $PI \geq 4$  and plots on or above "A" line.

<sup>O</sup>  $PI < 4$  or plots below "A" line.

<sup>P</sup>  $PI$  plots on or above "A" line.

<sup>Q</sup>  $PI$  plots below "A" line.



# Appendix 4: Historical Site Conditions

*Phase I Environmental Site Assessment or Other Information on Past Site Use*

*NOT APPLICABLE*

# Appendix 5: LID Infeasibility

*LID Technical Infeasibility Analysis*

*NOT APPLICABLE – LID BMPS INCORPORATED TO TREAT THE DCV*

# Appendix 6: BMP Design Details

*BMP Sizing, Design Details and other Supporting Documentation*



# Santa Ana Watershed

$V_{\text{BMP}}$  and  $Q_{\text{BMP}}$  worksheets

These worksheets are to be used to determine the required

Design Capture Volume ( $V_{\text{BMP}}$ )

or the

Design Flow Rate ( $Q_{\text{BMP}}$ )

for BMPs in the Santa Ana Watershed

To verify which watershed your project is located within, visit

[www.rcflood.org/npdes](http://www.rcflood.org/npdes)

and use the 'Locate my Watershed' tool

**If your project is not located in the Santa Ana Watershed,**

Do not use these worksheets! Instead visit

[www.rcflood.org/npdes/developers.aspx](http://www.rcflood.org/npdes/developers.aspx)

To access worksheets applicable to your watershed

**Use the **tabs** across the bottom  
to access the worksheets for the Santa Ana Watershed**

**Santa Ana Watershed - BMP Design Volume,  $V_{BMP}$**

Legend:

Required Entries

Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name **Kimley-Horn and Associates**

Date

Designed by **Tammie Moreno, P.E.**

Case No

Company Project Number/Name

**BMP Identification**

BMP NAME / ID **BMP 1**

*Must match Name/ID used on BMP Design Calculation Sheet*

**Design Rainfall Depth**

85th Percentile, 24-hour Rainfall Depth,  
from the Isohyetal Map in Handbook Appendix E

$D_{85}$  = **0.64** inches

**Drainage Management Area Tabulation**

*Insert additional rows if needed to accommodate all DMAs draining to the BMP*

| DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type | Effective Imperivous Fraction, $I_f$ | DMA Runoff Factor | DMA Areas x Runoff Factor | Design Storm Depth (in) | Design Capture Volume, $V_{BMP}$ (cubic feet) | Proposed Volume on Plans (cubic feet) |
|-------------|------------------------|---------------------------|--------------------------------------|-------------------|---------------------------|-------------------------|---|---------------------------------------|
| DA 1        | 97184                  | Concrete or Asphalt       | 1                                    | 0.89              | 86688.1                   |                         |   |                                       |
| DA 1        | 10798                  | Ornamental Landscaping    | 0.1                                  | 0.110458          | 1192.7                    |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             | 107982                 |                           |                                      |                   | 87880.8                   | 0.64                    | 4687  | 4687                                  |

Notes:

**Santa Ana Watershed - BMP Design Volume,  $V_{BMP}$**

Legend:

Required Entries

Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name **Kimley-Horn and Associates**

Date

Designed by **Tammie Moreno, P.E.**

Case No

Company Project Number/Name

**BMP Identification**

BMP NAME / ID **BMP 2**

*Must match Name/ID used on BMP Design Calculation Sheet*

**Design Rainfall Depth**

85th Percentile, 24-hour Rainfall Depth,  
from the Isohyetal Map in Handbook Appendix E

$D_{85}$  = **0.64** inches

**Drainage Management Area Tabulation**

*Insert additional rows if needed to accommodate all DMAs draining to the BMP*

| DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type | Effective Imperivous Fraction, $I_f$ | DMA Runoff Factor | DMA Areas x Runoff Factor | Design Storm Depth (in) | Design Capture Volume, $V_{BMP}$ (cubic feet) | Proposed Volume on Plans (cubic feet) |
|-------------|------------------------|---------------------------|--------------------------------------|-------------------|---------------------------|-------------------------|---|---------------------------------------|
| DA 2        | 242249                 | Concrete or Asphalt       | 1                                    | 0.89              | 216086.1                  |                         |   |                                       |
| DA 2        | 26916                  | Ornamental Landscaping    | 0.1                                  | 0.110458          | 2973.1                    |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             | 269165                 |                           |                                      |                   | 219059.2                  | 0.64                    | 11683.2                                       | 11684                                 |

Notes:

**Santa Ana Watershed - BMP Design Volume,  $V_{BMP}$**

Legend:

Required Entries

Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name **Kimley-Horn and Associates**

Date

Designed by **Tammie Moreno, P.E.**

Case No

Company Project Number/Name

**BMP Identification**

BMP NAME / ID **BMP 3A**

*Must match Name/ID used on BMP Design Calculation Sheet*

**Design Rainfall Depth**

85th Percentile, 24-hour Rainfall Depth,  
from the Isohyetal Map in Handbook Appendix E

$D_{85} =$  **0.64** inches

**Drainage Management Area Tabulation**

*Insert additional rows if needed to accommodate all DMAs draining to the BMP*

| DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type | Effective Imperivous Fraction, $I_f$ | DMA Runoff Factor | DMA Areas x Runoff Factor | Design Storm Depth (in) | Design Capture Volume, $V_{BMP}$ (cubic feet) | Proposed Volume on Plans (cubic feet) |
|-------------|------------------------|---------------------------|--------------------------------------|-------------------|---------------------------|-------------------------|---|---------------------------------------|
| DA 3A       | 138795                 | Concrete or Asphalt       | 1                                    | 0.89              | 123805.1                  |                         |   |                                       |
| DA 3A       | 15422                  | Ornamental Landscaping    | 0.1                                  | 0.110458          | 1703.5                    |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
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|             |                        |                           |                                      |                   |                           |                         |   |                                       |
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|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             | 154217                 |                           |                                      |                   | 125508.6                  | 0.64                    | 6693.8  | 6694                                  |

Notes:

**Santa Ana Watershed - BMP Design Volume,  $V_{BMP}$**

Legend:

Required Entries

Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name **Kimley-Horn and Associates**

Date

Designed by **Tammie Moreno, P.E.**

Case No

Company Project Number/Name

**BMP Identification**

BMP NAME / ID **BMP 3B**

*Must match Name/ID used on BMP Design Calculation Sheet*

**Design Rainfall Depth**

85th Percentile, 24-hour Rainfall Depth,  
from the Isohyetal Map in Handbook Appendix E

$D_{85}$  = **0.64** inches

**Drainage Management Area Tabulation**

*Insert additional rows if needed to accommodate all DMAs draining to the BMP*

| DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type | Effective Imperivous Fraction, $I_f$ | DMA Runoff Factor | DMA Areas x Runoff Factor | Design Storm Depth (in) | Design Capture Volume, $V_{BMP}$ (cubic feet) | Proposed Volume on Plans (cubic feet) |      |        |      |
|-------------|------------------------|---------------------------|--------------------------------------|-------------------|---------------------------|-------------------------|---|---------------------------------------|------|--------|------|
| DA 3B       | 158715                 | Concrete or Asphalt       | 1                                    | 0.89              | 141573.8                  |                         |   |                                       |      |        |      |
| DA 3B       | 17635                  | Ornamental Landscaping    | 0.1                                  | 0.110458          | 1947.9                    |                         |   |                                       |      |        |      |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |      |        |      |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |      |        |      |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |      |        |      |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |      |        |      |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |      |        |      |
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|             |                        |                           |                                      |                   |                           |                         |   |                                       |      |        |      |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |      |        |      |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |      |        |      |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |      |        |      |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |      |        |      |
|             | 176350                 |                           | Total                                |                   | 143521.7                  |                         |   |                                       | 0.64 | 7654.5 | 7655 |

Notes:

**Santa Ana Watershed - BMP Design Volume,  $V_{BMP}$**

Legend:

Required Entries

Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name **Kimley-Horn and Associates**

Date

Designed by **Tammie Moreno, P.E.**

Case No

Company Project Number/Name

**BMP Identification**

BMP NAME / ID **BMP 4**

*Must match Name/ID used on BMP Design Calculation Sheet*

**Design Rainfall Depth**

85th Percentile, 24-hour Rainfall Depth,  
from the Isohyetal Map in Handbook Appendix E

$D_{85}$  = **0.64** inches

**Drainage Management Area Tabulation**

*Insert additional rows if needed to accommodate all DMAs draining to the BMP*

| DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type | Effective Imperivous Fraction, $I_f$ | DMA Runoff Factor | DMA Areas x Runoff Factor | Design Storm Depth (in) | Design Capture Volume, $V_{BMP}$ (cubic feet) | Proposed Volume on Plans (cubic feet) |
|-------------|------------------------|---------------------------|--------------------------------------|-------------------|---------------------------|-------------------------|---|---------------------------------------|
| DA 4        | 389605                 | Concrete or Asphalt       | 1                                    | 0.89              | 347527.7                  |                         |   |                                       |
| DA 4        | 43289                  | Ornamental Landscaping    | 0.1                                  | 0.110458          | 4781.6                    |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
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|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             | 432894                 |                           |                                      |                   | 352309.3                  | 0.64                    | 18789.8                                       | 18792                                 |

Notes:

**Santa Ana Watershed - BMP Design Volume,  $V_{BMP}$**

Legend:

Required Entries

Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name **Kimley-Horn and Associates**

Date

Designed by **Tammie Moreno, P.E.**

Case No

Company Project Number/Name

**BMP Identification**

BMP NAME / ID **BMP 5**

*Must match Name/ID used on BMP Design Calculation Sheet*

**Design Rainfall Depth**

85th Percentile, 24-hour Rainfall Depth,  
from the Isohyetal Map in Handbook Appendix E

$D_{85}$  = **0.64** inches

**Drainage Management Area Tabulation**

*Insert additional rows if needed to accommodate all DMAs draining to the BMP*

| DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type | Effective Imperivous Fraction, $I_f$ | DMA Runoff Factor | DMA Areas x Runoff Factor | Design Storm Depth (in) | Design Capture Volume, $V_{BMP}$ (cubic feet) | Proposed Volume on Plans (cubic feet) |
|-------------|------------------------|---------------------------|--------------------------------------|-------------------|---------------------------|-------------------------|---|---------------------------------------|
| DA 5        | 208281                 | Concrete or Asphalt       | 1                                    | 0.89              | 185786.7                  |                         |   |                                       |
| DA 5        | 23142                  | Ornamental Landscaping    | 0.1                                  | 0.110458          | 2556.2                    |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
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|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             |                        |                           |                                      |                   |                           |                         |   |                                       |
|             | 231423                 |                           |                                      |                   | 188342.9                  | 0.64                    | 10045   | 10046                                 |

Notes:

**Santa Ana Watershed - BMP Design Flow Rate,  $Q_{BMP}$**

Legend:

Required Entries

Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

|                             |                            |         |  |
|-----------------------------|----------------------------|---------|--|
| Company Name                | Kimley-Horn and Associates | Date    |  |
| Designed by                 | Tammie Moreno, P.E.        | Case No |  |
| Company Project Number/Name |                            |         |  |

**BMP Identification**

BMP NAME / ID **BMP 1**  
*Must match Name/ID used on BMP Design Calculation Sheet*

**Design Rainfall Depth**

Design Rainfall Intensity I = **0.20** in/hr

**Drainage Management Area Tabulation**

*Insert additional rows if needed to accommodate all DMAs draining to the BMP*

| DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type (use pull-down menu) | Effective Imperivous Fraction, $I_f$ | DMA Runoff Factor | DMA Areas x Runoff Factor | Design Rainfall Intensity (in/hr) | Design Flow Rate (cfs) | Proposed Flow Rate (cfs) |      |     |       |
|-------------|------------------------|--|--------------------------------------|-------------------|---------------------------|-----------------------------------|------------------------|--------------------------|------|-----|-------|
| DA 1        | 97184                  | Concrete or Asphalt                            | 1                                    | 0.89              | 86688.1                   |                                   |                        |                          |      |     |       |
| DA 1        | 10798                  | Ornamental Landscaping                         | 0.1                                  | 0.11046           | 1192.7                    |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
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|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
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|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
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|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
| 107982      |                        | Total  |                                      |                   | 87880.8                   |                                   |                        |                          | 0.20 | 0.4 | 0.462 |

Notes:



**Santa Ana Watershed - BMP Design Flow Rate,  $Q_{BMP}$**

Legend:

Required Entries

Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

|                             |                            |         |  |
|-----------------------------|----------------------------|---------|--|
| Company Name                | Kimley-Horn and Associates | Date    |  |
| Designed by                 | Tammie Moreno, P.E.        | Case No |  |
| Company Project Number/Name |                            |         |  |

**BMP Identification**

BMP NAME / ID **BMP 2**  
*Must match Name/ID used on BMP Design Calculation Sheet*

**Design Rainfall Depth**

Design Rainfall Intensity I = **0.20** in/hr

**Drainage Management Area Tabulation**

*Insert additional rows if needed to accommodate all DMAs draining to the BMP*

| DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type (use pull-down menu) | Effective Imperivous Fraction, $I_f$ | DMA Runoff Factor | DMA Areas x Runoff Factor | Design Rainfall Intensity (in/hr) | Design Flow Rate (cfs) | Proposed Flow Rate (cfs) |      |   |      |
|-------------|------------------------|--|--------------------------------------|-------------------|---------------------------|-----------------------------------|------------------------|--------------------------|------|---|------|
| DA 2        | 242249                 | Concrete or Asphalt                            | 1                                    | 0.89              | 216086.1                  |                                   |                        |                          |      |   |      |
| DA 2        | 26916                  | Ornamental Landscaping                         | 0.1                                  | 0.11046           | 2973.1                    |                                   |                        |                          |      |   |      |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |   |      |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |   |      |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |   |      |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |   |      |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |   |      |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |   |      |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |   |      |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |   |      |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |   |      |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |   |      |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |   |      |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |   |      |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |   |      |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |   |      |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |   |      |
| 269165      |                        | Total  |                                      |                   | 219059.2                  |                                   |                        |                          | 0.20 | 1 | 1.15 |

Notes:

**Santa Ana Watershed - BMP Design Flow Rate,  $Q_{BMP}$**

Legend:

Required Entries

Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

|                             |                            |         |  |
|-----------------------------|----------------------------|---------|--|
| Company Name                | Kimley-Horn and Associates | Date    |  |
| Designed by                 | Tammie Moreno, P.E.        | Case No |  |
| Company Project Number/Name |                            |         |  |

**BMP Identification**

BMP NAME / ID **BMP 3A**  
*Must match Name/ID used on BMP Design Calculation Sheet*

**Design Rainfall Depth**

Design Rainfall Intensity I = **0.20** in/hr

**Drainage Management Area Tabulation**

*Insert additional rows if needed to accommodate all DMAs draining to the BMP*

| DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type (use pull-down menu) | Effective Imperivous Fraction, $I_f$ | DMA Runoff Factor | DMA Areas x Runoff Factor | Design Rainfall Intensity (in/hr) | Design Flow Rate (cfs) | Proposed Flow Rate (cfs) |      |     |       |
|-------------|------------------------|--|--------------------------------------|-------------------|---------------------------|-----------------------------------|------------------------|--------------------------|------|-----|-------|
| DA 3A       | 138795                 | Concrete or Asphalt                            | 1                                    | 0.89              | 123805.1                  |                                   |                        |                          |      |     |       |
| DA 3A       | 15422                  | Ornamental Landscaping                         | 0.1                                  | 0.11046           | 1703.5                    |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
| 154217      |                        | Total  |                                      |                   | 125508.6                  |                                   |                        |                          | 0.20 | 0.6 | 0.693 |

Notes:

**Santa Ana Watershed - BMP Design Flow Rate,  $Q_{BMP}$**

Legend:

Required Entries

Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook** )*

|                             |                            |         |  |
|-----------------------------|----------------------------|---------|--|
| Company Name                | Kimley-Horn and Associates | Date    |  |
| Designed by                 | Tammie Moreno, P.E.        | Case No |  |
| Company Project Number/Name |                            |         |  |

**BMP Identification**

BMP NAME / ID **BMP 3B**  
*Must match Name/ID used on BMP Design Calculation Sheet*

**Design Rainfall Depth**

Design Rainfall Intensity I = **0.20** in/hr

**Drainage Management Area Tabulation**

*Insert additional rows if needed to accommodate all DMAs draining to the BMP*

| DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type (use pull-down menu) | Effective Imperivous Fraction, $I_f$ | DMA Runoff Factor | DMA Areas x Runoff Factor | Design Rainfall Intensity (in/hr) | Design Flow Rate (cfs) | Proposed Flow Rate (cfs) |      |     |     |
|-------------|------------------------|--|--------------------------------------|-------------------|---------------------------|-----------------------------------|------------------------|--------------------------|------|-----|-----|
| DA 3B       | 158715                 | Concrete or Asphalt                            | 1                                    | 0.89              | 141573.8                  |                                   |                        |                          |      |     |     |
| DA 3B       | 17635                  | Ornamental Landscaping                         | 0.1                                  | 0.11046           | 1947.9                    |                                   |                        |                          |      |     |     |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |     |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |     |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |     |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |     |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |     |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |     |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |     |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |     |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |     |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |     |
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|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |     |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |     |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |     |
| 176350      |                        | Total  |                                      |                   | 143521.7                  |                                   |                        |                          | 0.20 | 0.7 | 0.7 |

Notes:

**Santa Ana Watershed - BMP Design Flow Rate,  $Q_{BMP}$**

Legend:

Required Entries

Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

|                             |                            |         |  |
|-----------------------------|----------------------------|---------|--|
| Company Name                | Kimley-Horn and Associates | Date    |  |
| Designed by                 | Tammie Moreno, P.E.        | Case No |  |
| Company Project Number/Name |                            |         |  |

**BMP Identification**

BMP NAME / ID **BMP4**

*Must match Name/ID used on BMP Design Calculation Sheet*

**Design Rainfall Depth**

Design Rainfall Intensity I = **0.20** in/hr

**Drainage Management Area Tabulation**

*Insert additional rows if needed to accommodate all DMAs draining to the BMP*

| DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type (use pull-down menu) | Effective Imperivous Fraction, $I_f$ | DMA Runoff Factor | DMA Areas x Runoff Factor | Design Rainfall Intensity (in/hr) | Design Flow Rate (cfs) | Proposed Flow Rate (cfs) |      |     |       |
|-------------|------------------------|--|--------------------------------------|-------------------|---------------------------|-----------------------------------|------------------------|--------------------------|------|-----|-------|
| DA 4        | 389605                 | Concrete or Asphalt                            | 1                                    | 0.89              | 347527.7                  |                                   |                        |                          |      |     |       |
| DA 4        | 43289                  | Ornamental Landscaping                         | 0.1                                  | 0.11046           | 4781.6                    |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
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|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
| 432894      |                        | Total  |                                      |                   | 352309.3                  |                                   |                        |                          | 0.20 | 1.6 | 1.731 |

Notes:

**Santa Ana Watershed - BMP Design Flow Rate,  $Q_{BMP}$**

Legend:

Required Entries

Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

|                             |                            |         |  |
|-----------------------------|----------------------------|---------|--|
| Company Name                | Kimley-Horn and Associates | Date    |  |
| Designed by                 | Tammie Moreno, P.E.        | Case No |  |
| Company Project Number/Name |                            |         |  |

**BMP Identification**

BMP NAME / ID **BMP 5**

*Must match Name/ID used on BMP Design Calculation Sheet*

**Design Rainfall Depth**

Design Rainfall Intensity I = **0.20** in/hr

**Drainage Management Area Tabulation**

*Insert additional rows if needed to accommodate all DMAs draining to the BMP*

| DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type (use pull-down menu) | Effective Imperivous Fraction, $I_f$ | DMA Runoff Factor | DMA Areas x Runoff Factor | Design Rainfall Intensity (in/hr) | Design Flow Rate (cfs) | Proposed Flow Rate (cfs) |      |     |       |
|-------------|------------------------|--|--------------------------------------|-------------------|---------------------------|-----------------------------------|------------------------|--------------------------|------|-----|-------|
| DA 5        | 208281                 | Concrete or Asphalt                            | 1                                    | 0.89              | 185786.7                  |                                   |                        |                          |      |     |       |
| DA 5        | 23142                  | Ornamental Landscaping                         | 0.1                                  | 0.11046           | 2556.2                    |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
|             |                        |  |                                      |                   |                           |                                   |                        |                          |      |     |       |
| 231423      |                        | Total  |                                      |                   | 188342.9                  |                                   |                        |                          | 0.20 | 0.9 | 0.924 |

Notes:

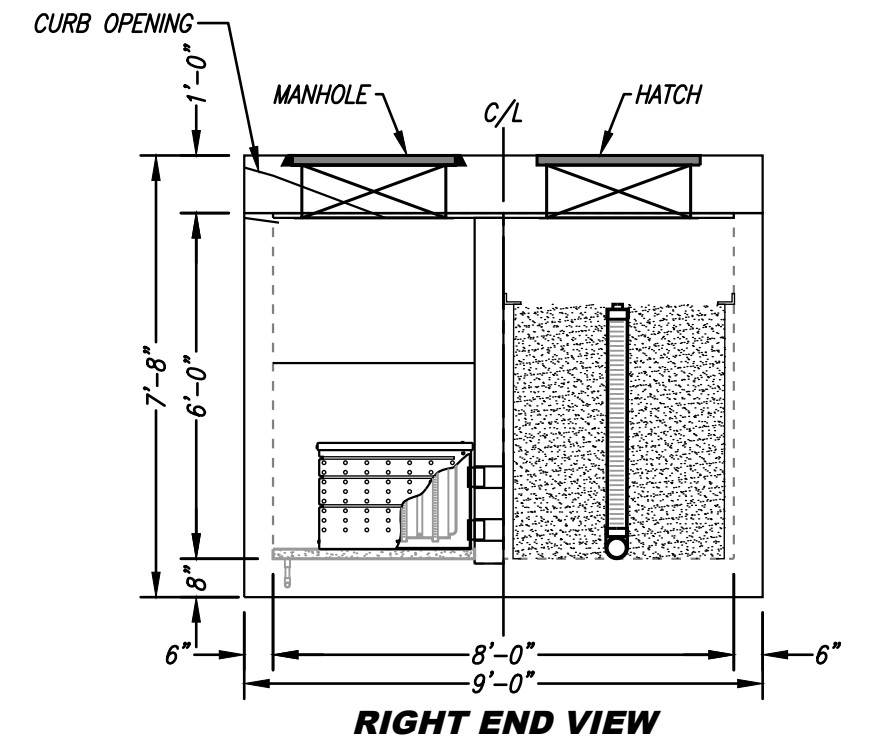
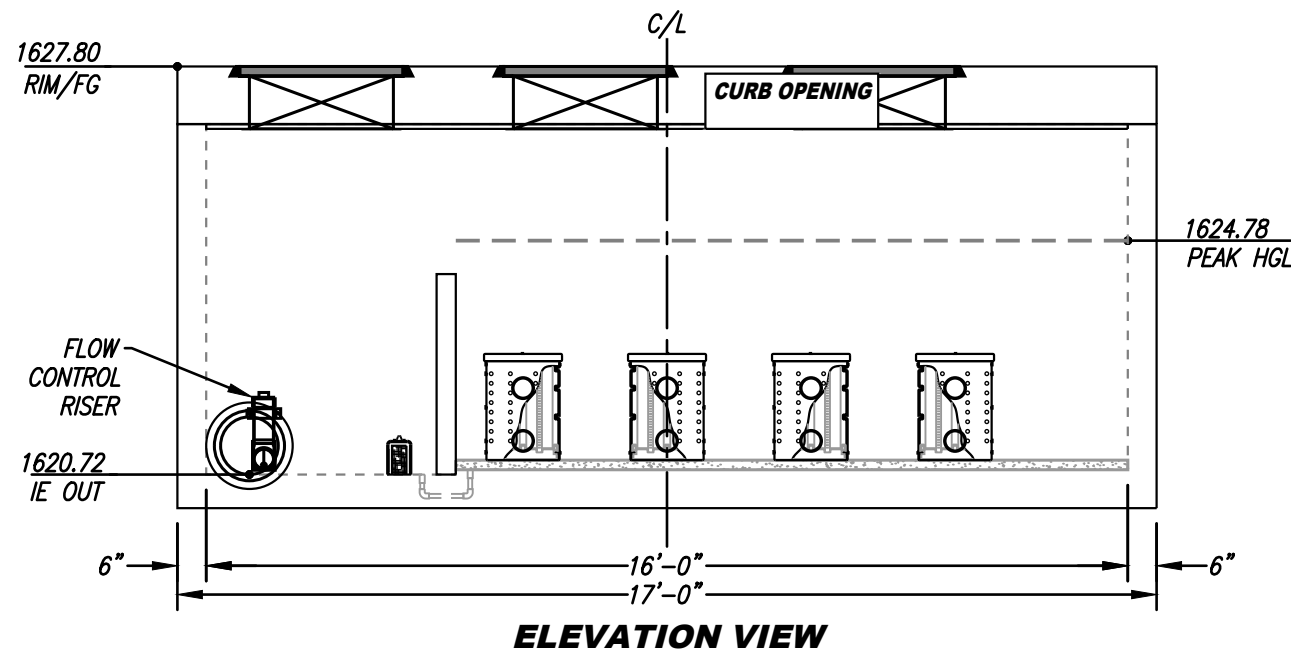
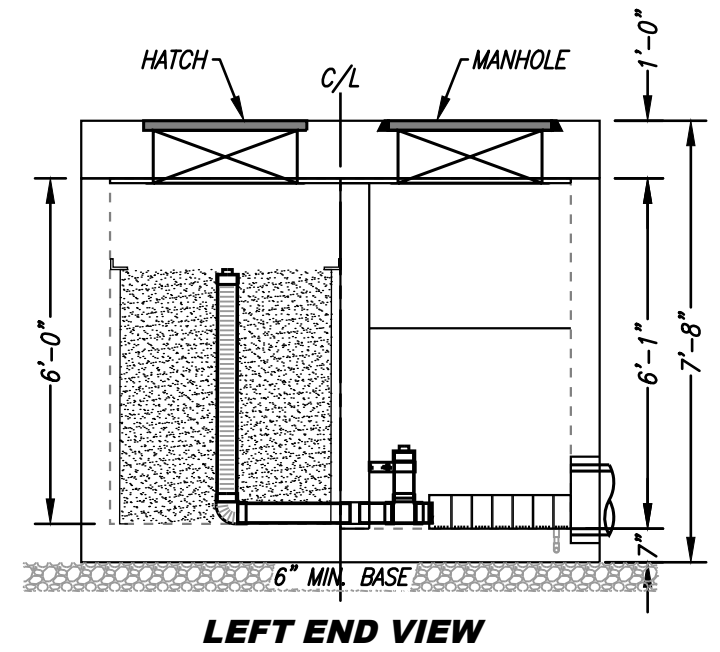
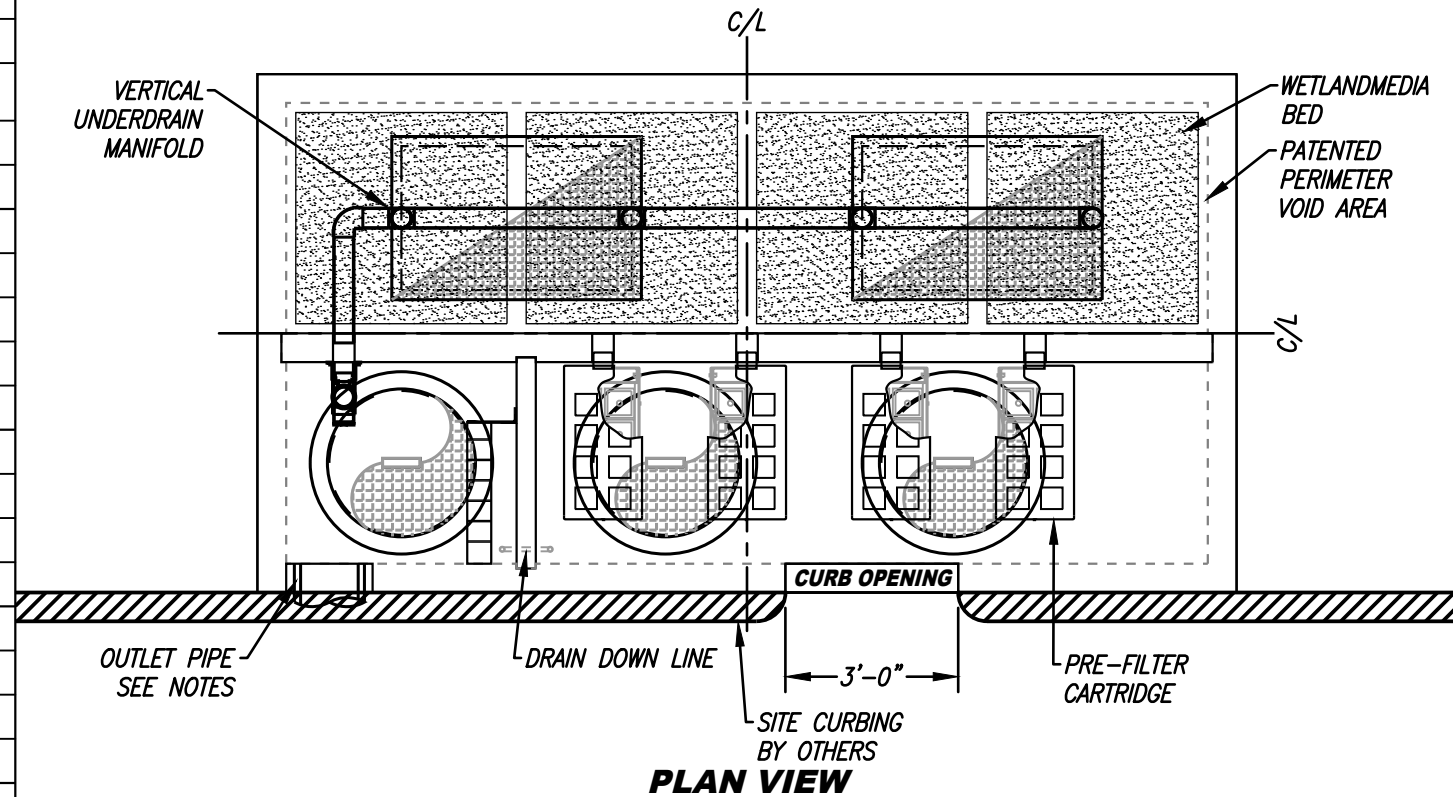
## Effective Impervious Fraction

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

Mixed Surface Types

Use this table to determine the effective impervious fraction for the  $V_{BMP}$  and  $Q_{BMP}$  calculation sheets

| SITE SPECIFIC DATA                         |                                  |               |            |
|--|----------------------------------|---------------|------------|
| PROJECT NUMBER                             | 15516                            |               |            |
| PROJECT NAME                               | MORENO VALLEY MALL REDEVELOPMENT |               |            |
| PROJECT LOCATION                           | MORENO VALLEY, CA                |               |            |
| STRUCTURE ID                               | BMP 1                            |               |            |
| TREATMENT REQUIRED                         |                                  |               |            |
| VOLUME BASED (CF)                          | FLOW BASED (CFS)                 |               |            |
| 4,687                                      | 0.4                              |               |            |
| TREATMENT HGL AVAILABLE (FT)               | N/K                              |               |            |
| PEAK BYPASS REQUIRED (CFS) - IF APPLICABLE | 5.33                             |               |            |
| PIPE DATA                                  | I.E.                             | MATERIAL      | DIAMETER   |
| INLET PIPE 1                               | N/A                              | N/A           | N/A        |
| INLET PIPE 2                               | N/A                              | N/A           | N/A        |
| OUTLET PIPE                                | 1620.72                          | PVC           | 12"        |
|  | PRETREATMENT                     | BIOFILTRATION | DISCHARGE  |
| RIM ELEVATION                              | 1627.80                          | 1627.80       | 1627.80    |
| SURFACE LOAD                               | PEDESTRIAN                       | PEDESTRIAN    | PEDESTRIAN |
| FRAME & COVER                              | 2EA $\phi$ 30"                   | 2EA 30" X 48" | $\phi$ 30" |
| WETLANDMEDIA VOLUME (CY)                   | 8.96                             |               |            |
| ORIFICE SIZE (DIA. INCHES)                 | $\phi$ 3.07"                     |               |            |
| NOTES: PRELIMINARY NOT FOR CONSTRUCTION.   |                                  |               |            |



**INSTALLATION NOTES**

1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURERS' SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURER'S CONTRACT.
2. UNIT MUST BE INSTALLED ON LEVEL BASE. MANUFACTURER RECOMMENDS A MINIMUM 6" LEVEL ROCK BASE UNLESS SPECIFIED BY THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE FOR VERIFYING PROJECT ENGINEER'S RECOMMENDED BASE SPECIFICATIONS.
4. CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE (PIPES CANNOT INTRUDE BEYOND FLUSH). INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR. ALL PIPES SHALL BE SEALED WATERTIGHT PER MANUFACTURER'S STANDARD CONNECTION DETAIL.
5. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL PIPES, RISERS, MANHOLES, AND HATCHES. CONTRACTOR TO USE GROUT AND/OR BRICKS TO MATCH COVERS WITH FINISHED SURFACE UNLESS SPECIFIED OTHERWISE.
6. CONTRACTOR RESPONSIBLE FOR CONTACTING BIO CLEAN FOR ACTIVATION OF UNIT. MANUFACTURER'S WARRANTY IS VOID WITHOUT PROPER ACTIVATION BY A BIO CLEAN REPRESENTATIVE.

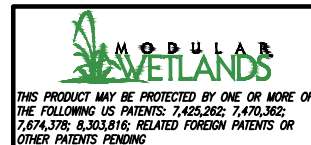
**GENERAL NOTES**

1. MANUFACTURER TO PROVIDE ALL MATERIALS UNLESS OTHERWISE NOTED.
2. ALL DIMENSIONS, ELEVATIONS, SPECIFICATIONS AND CAPACITIES ARE SUBJECT TO CHANGE. FOR PROJECT SPECIFIC DRAWINGS DETAILING EXACT DIMENSIONS, WEIGHTS AND ACCESSORIES PLEASE CONTACT BIO CLEAN.

**INTERNAL BYPASS DISCLOSURE:**

THE DESIGN AND CAPACITY OF THE PEAK CONVEYANCE METHOD TO BE REVIEWED AND APPROVED BY THE ENGINEER OF RECORD. HGL(S) AT PEAK FLOW SHALL BE ASSESSED TO ENSURE NO UPSTREAM FLOODING. PEAK HGL AND BYPASS CAPACITY SHOWN ON DRAWING ARE USED FOR GUIDANCE ONLY.

|                                     |       |
|-------------------------------------|-------|
| TREATMENT FLOW (CFS)                | 0.462 |
| TREATMENT VOLUME (CF)               | 4687  |
| DRAINDOWN DURATION (HOURS)          | 2.82  |
| OPERATING HEAD (FT)                 | 3.4   |
| PRETREATMENT LOADING RATE (GPM/SF)  | 2.0   |
| WETLAND MEDIA LOADING RATE (GPM/SF) | 1.0   |

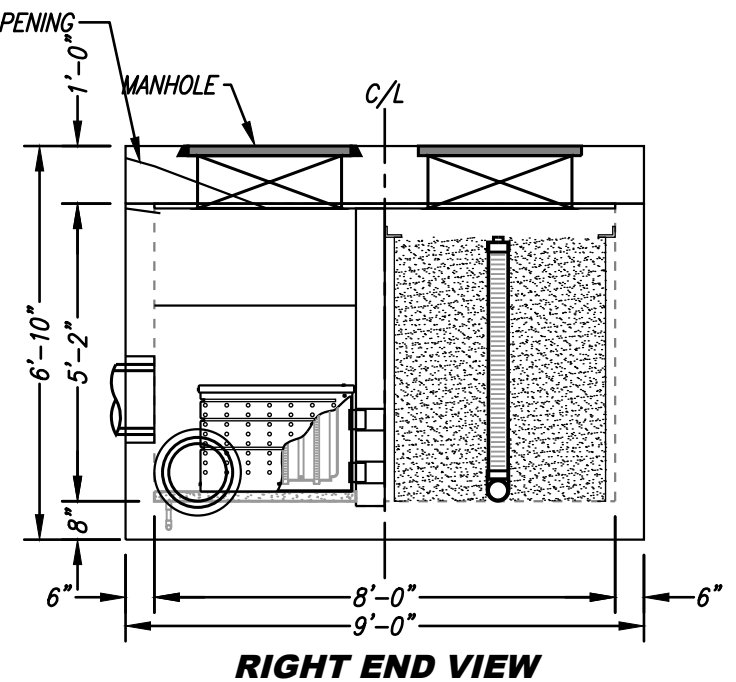
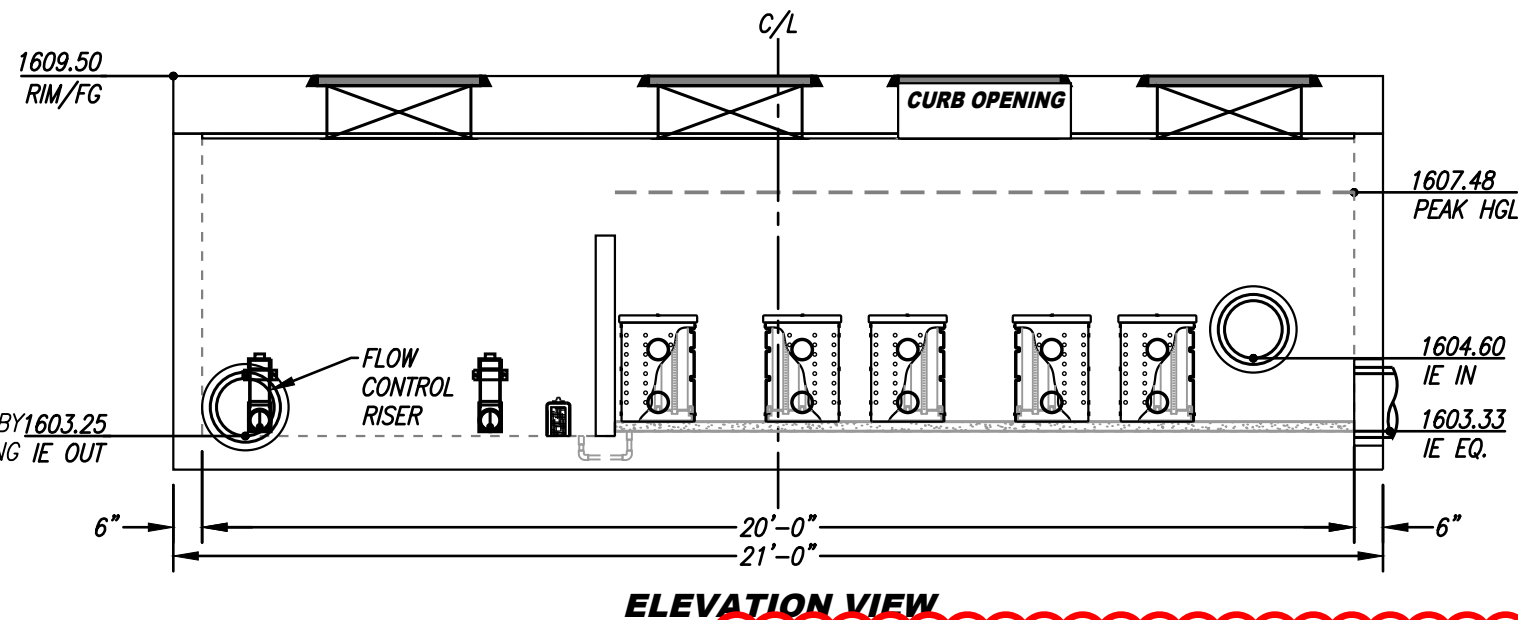
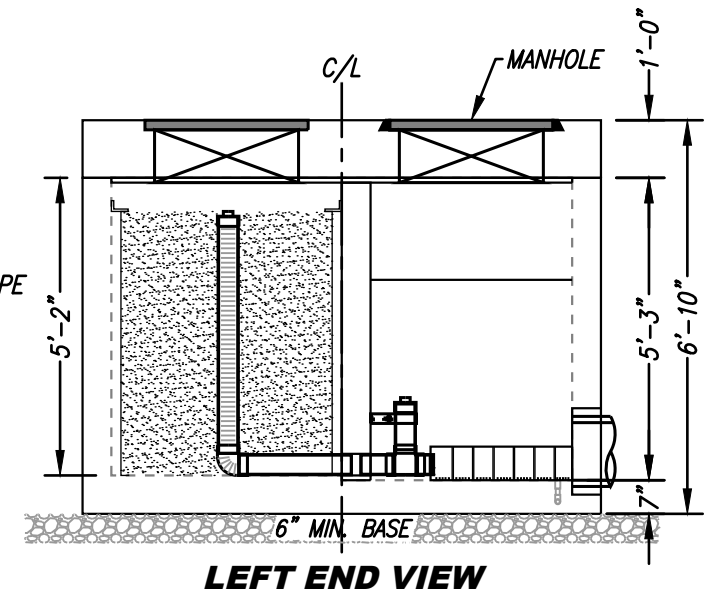
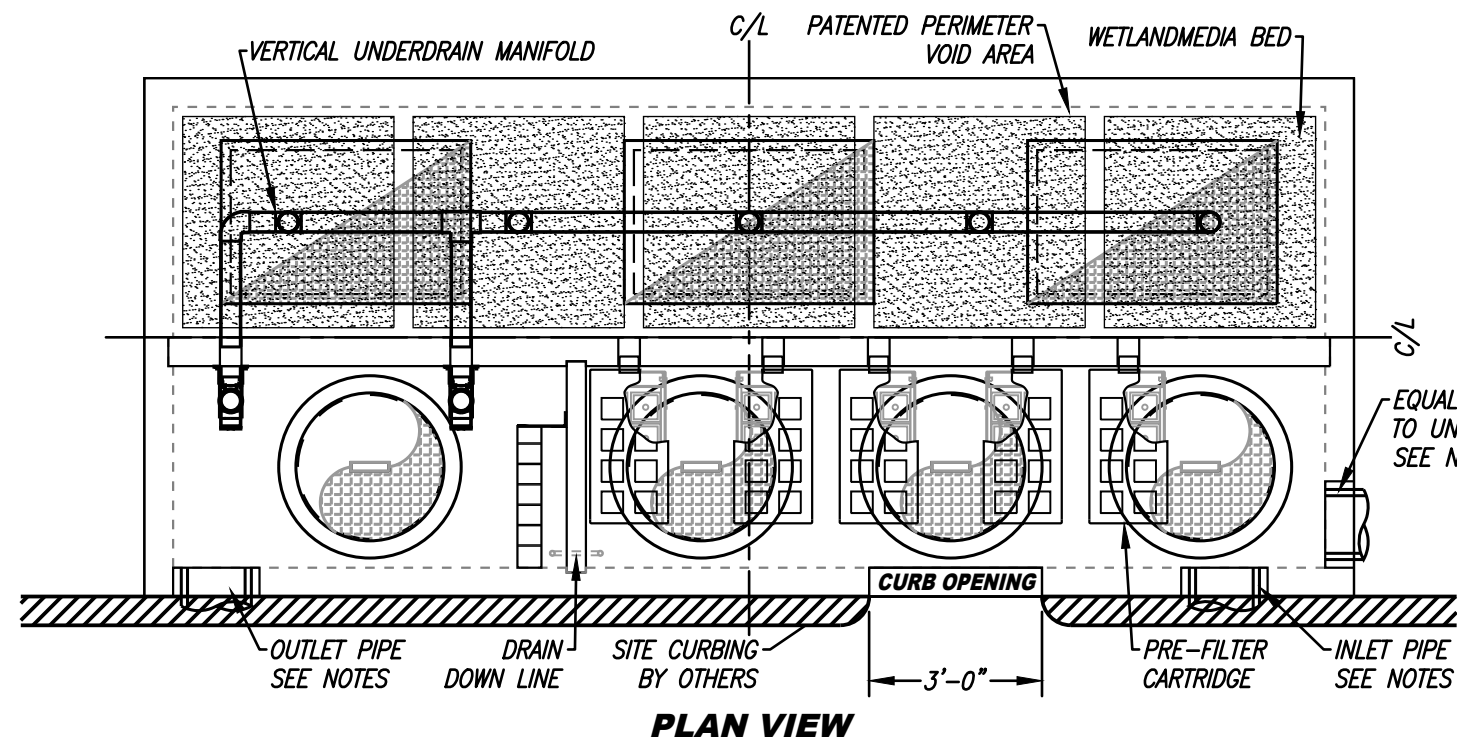


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**MWS-L-8-16-6'-0"-C-UG**  
**STORMWATER BIOFILTRATION SYSTEM**  
**STANDARD DETAIL**

| SITE SPECIFIC DATA   |                                  |               |            |
|--|----------------------------------|---------------|------------|
| PROJECT NUMBER   | 15516                            |               |            |
| PROJECT NAME   | MORENO VALLEY MALL REDEVELOPMENT |               |            |
| PROJECT LOCATION   | MORENO VALLEY, CA                |               |            |
| STRUCTURE ID   | BMP 2 - UNIT 1 OF 2              |               |            |
| TREATMENT REQUIRED   |                                  |               |            |
| VOLUME BASED (CF)  | FLOW BASED (CFS)                 |               |            |
| 11,683   | 1.0 (TWO UNITS REQUIRED)         |               |            |
| TREATMENT HGL AVAILABLE (FT)   | N/K                              |               |            |
| PEAK BYPASS REQUIRED (CFS) - IF APPLICABLE   | 7.75                             |               |            |
| PIPE DATA  | I.E.                             | MATERIAL      | DIAMETER   |
| INLET PIPE 1   | 1604.60                          | PVC           | 12"        |
| EQ. PIPE   | 1603.33                          | PVC           | 12"        |
| OUTLET PIPE  | 1603.25                          | PVC           | 12"        |
|  | PRETREATMENT                     | BIOFILTRATION | DISCHARGE  |
| RIM ELEVATION  | 1609.50                          | 1609.50       | 1609.50    |
| SURFACE LOAD   | PEDESTRIAN                       | PEDESTRIAN    | PEDESTRIAN |
| FRAME & COVER  | 3EA $\phi$ 30"                   | 3EA 30" X 48" | $\phi$ 30" |
| WETLAND MEDIA VOLUME (CY)  | 11.62                            |               |            |
| ORIFICE SIZE (DIA. INCHES)   | $\phi$ 2.43 EA                   |               |            |
| NOTES: PRELIMINARY NOT FOR CONSTRUCTION. TWO MWS-L-8-20 REQUIRED TO MEET REQUIRED TREATMENT FLOW CAPACITY. |                                  |               |            |



**INSTALLATION NOTES**

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- UNIT MUST BE INSTALLED ON LEVEL BASE. MANUFACTURER RECOMMENDS A MINIMUM 6" LEVEL ROCK BASE UNLESS SPECIFIED BY 1603.25 THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE FOR VERIFYING IE OUT PROJECT ENGINEER'S RECOMMENDED BASE SPECIFICATIONS.
- CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE (PIPES CANNOT INTRUDE BEYOND FLUSH). INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR. ALL PIPES SHALL BE SEALED WATERTIGHT PER MANUFACTURER'S STANDARD CONNECTION DETAIL.
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**GENERAL NOTES**

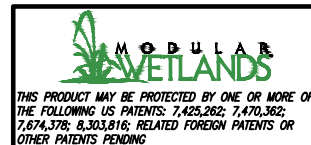
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**PROJECT PROPOSES TWO UNITS, SIDE BY SIDE FOR A COMBINED TREATMENT FLOW RATE OF 1.15 CFS**

|                                     |       |
|-------------------------------------|-------|
| TREATMENT FLOW (CFS)                | 0.577 |
| TREATMENT VOLUME (CF)               | 5842  |
| DRAINDOWN DURATION (HOURS)          | 2.8   |
| OPERATING HEAD (FT)                 | 3.4   |
| PRETREATMENT LOADING RATE (GPM/SF)  | 2.0   |
| WETLAND MEDIA LOADING RATE (GPM/SF) | 1.0   |



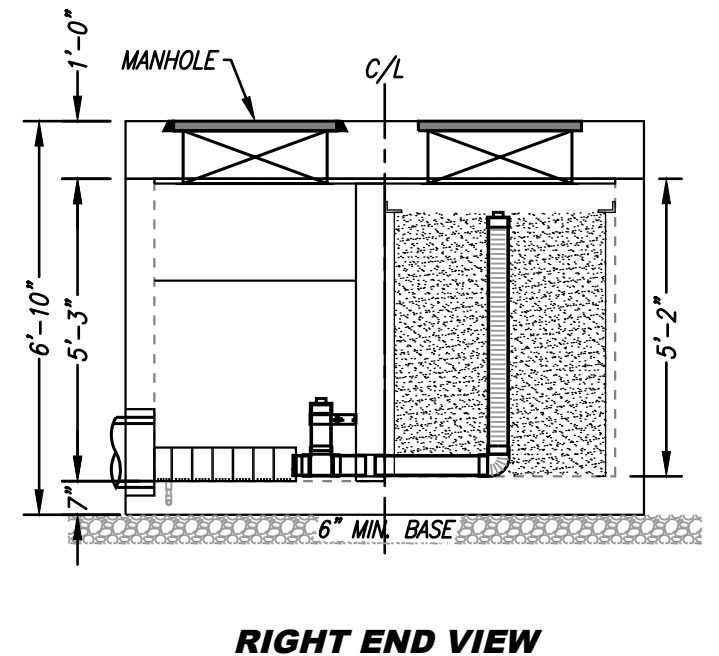
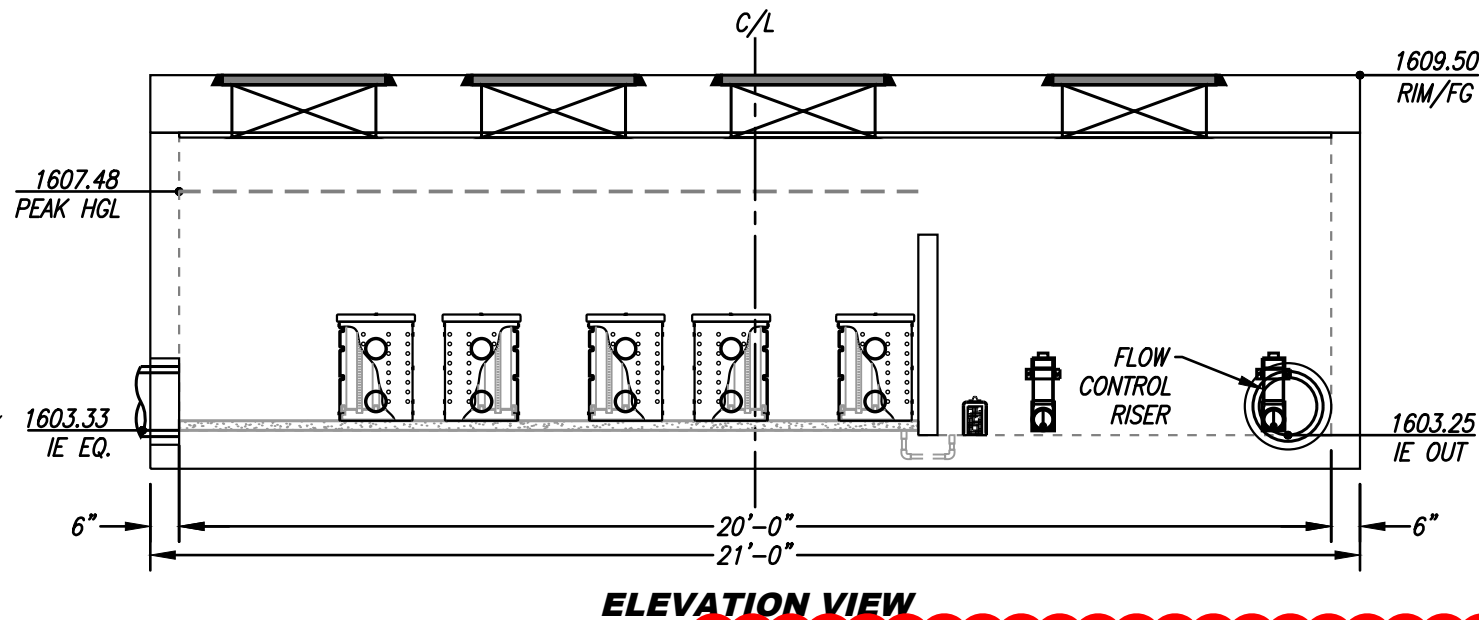
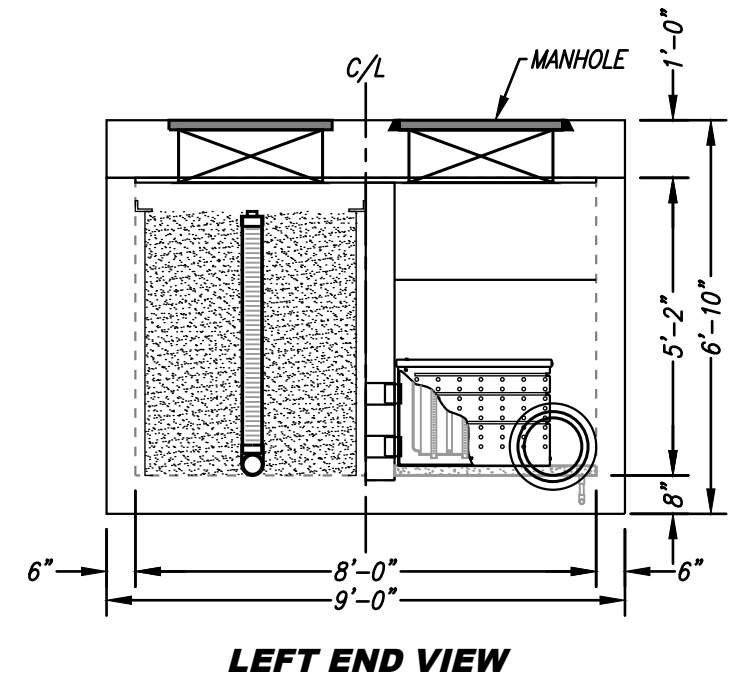
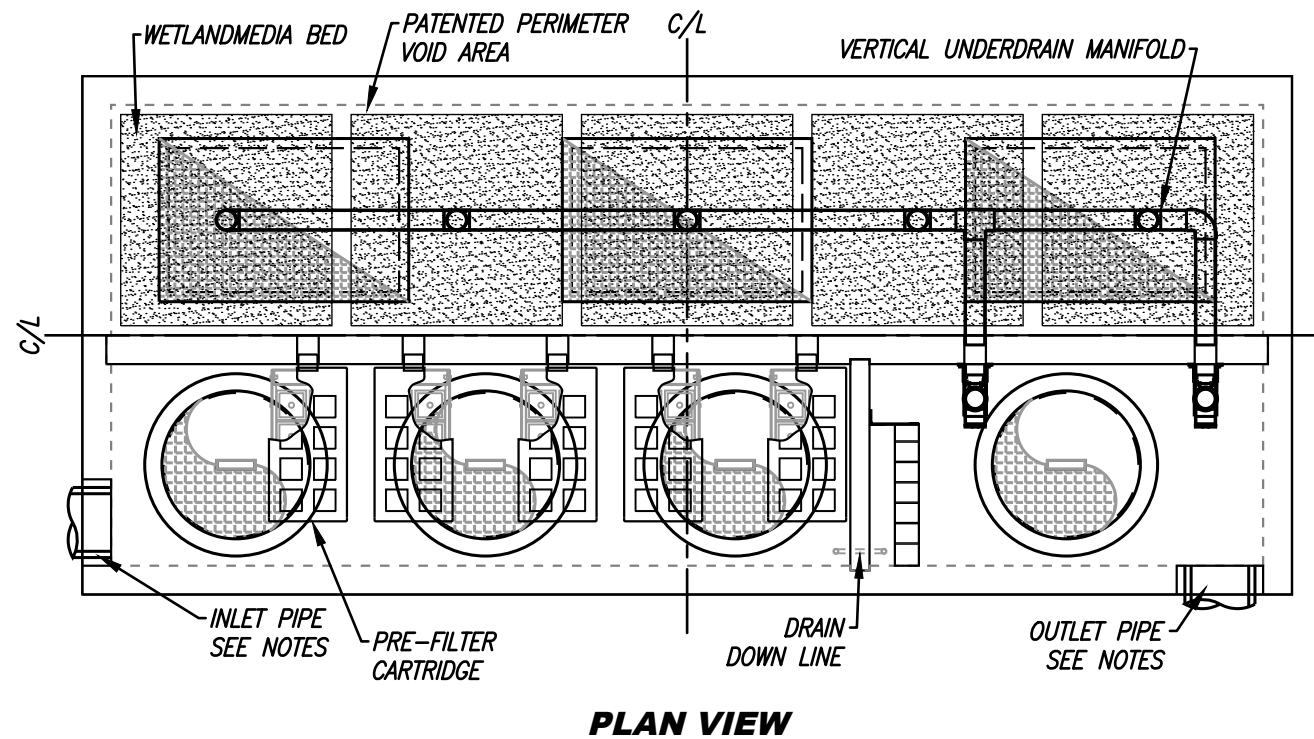
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**MWS-L-8-20-5'-2"-V-UG**  
**STORMWATER BIOFILTRATION SYSTEM**  
**STANDARD DETAIL**



| SITE SPECIFIC DATA   |                                  |               |            |
|--|----------------------------------|---------------|------------|
| PROJECT NUMBER   | 15516                            |               |            |
| PROJECT NAME   | MORENO VALLEY MALL REDEVELOPMENT |               |            |
| PROJECT LOCATION   | MORENO VALLEY, CA                |               |            |
| STRUCTURE ID   | BMP 2 - UNIT 2 OF 2              |               |            |
| TREATMENT REQUIRED   |                                  |               |            |
| VOLUME BASED (CF)  | FLOW BASED (CFS)                 |               |            |
| 11,683   | 1.0 (TWO UNITS REQUIRED)         |               |            |
| TREATMENT HGL AVAILABLE (FT)   | N/K                              |               |            |
| PEAK BYPASS REQUIRED (CFS) - IF APPLICABLE   | 7.75                             |               |            |
| PIPE DATA  | I.E.                             | MATERIAL      | DIAMETER   |
| EQUALIZER PIPE   | 1603.33                          | PVC           | 12"        |
| INLET PIPE 2   | N/A                              | N/A           | N/A        |
| OUTLET PIPE  | 1603.25                          | PVC           | 12"        |
|  | PRETREATMENT                     | BIOFILTRATION | DISCHARGE  |
| RIM ELEVATION  | 1609.50                          | 1609.50       | 1609.50    |
| SURFACE LOAD   | PEDESTRIAN                       | PEDESTRIAN    | PEDESTRIAN |
| FRAME & COVER  | 3EA $\phi$ 30"                   | 3EA 30" X 48" | $\phi$ 30" |
| WETLANDMEDIA VOLUME (CY)   | 11.62                            |               |            |
| ORIFICE SIZE (DIA. INCHES)   | $\phi$ 2.43 EA                   |               |            |
| NOTES: PRELIMINARY NOT FOR CONSTRUCTION. TWO MWS-L-8-20 REQUIRED TO MEET REQUIRED TREATMENT FLOW CAPACITY. |                                  |               |            |



### INSTALLATION NOTES

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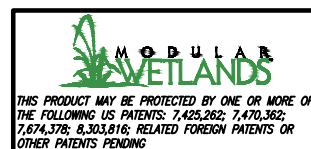
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**PROJECT PROPOSES TWO UNITS, SIDE BY SIDE FOR A COMBINED TREATMENT FLOW RATE OF 1.15 CFS**

|                                     |       |
|-------------------------------------|-------|
| TREATMENT FLOW (CFS)                | 0.577 |
| TREATMENT VOLUME (CF)               | 5842  |
| DRAINDOWN DURATION (HOURS)          | 2.8   |
| OPERATING HEAD (FT)                 | 3.4   |
| PRETREATMENT LOADING RATE (GPM/SF)  | 2.0   |
| WETLAND MEDIA LOADING RATE (GPM/SF) | 1.0   |

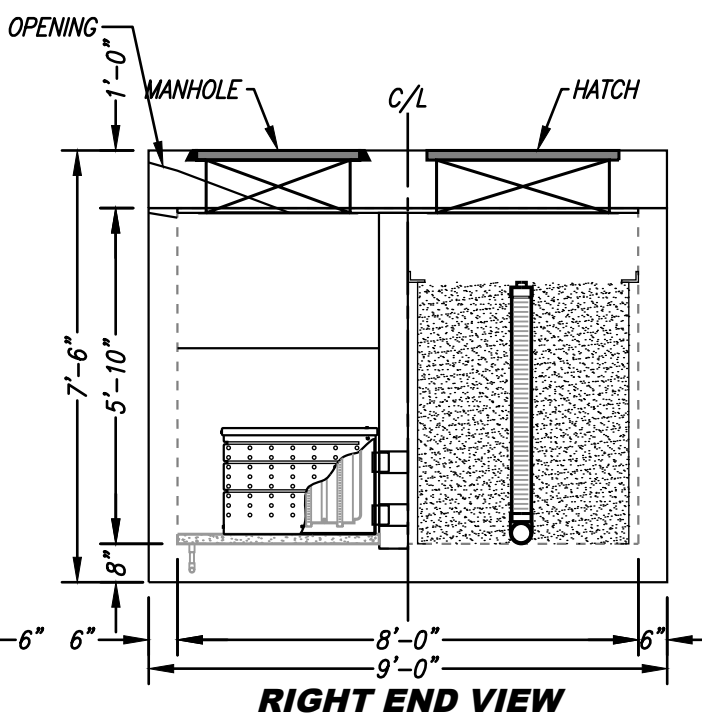
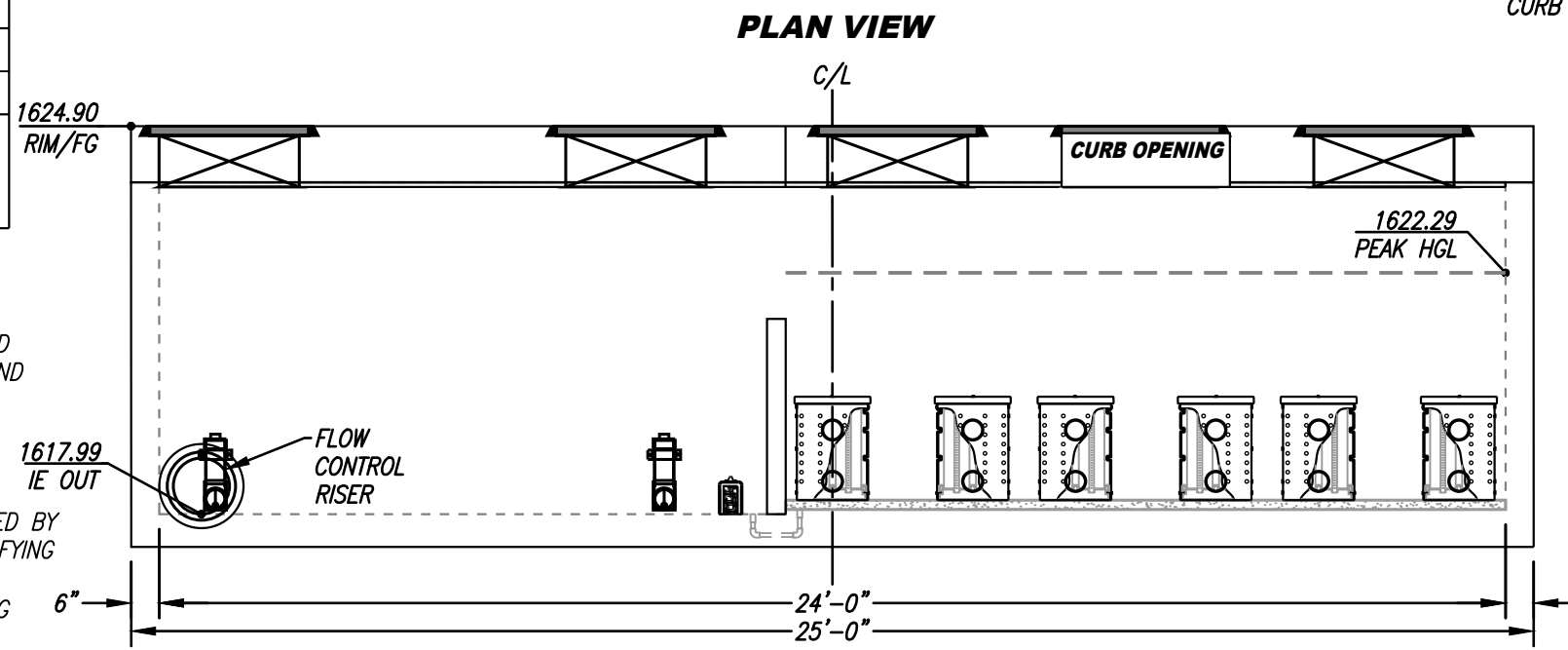
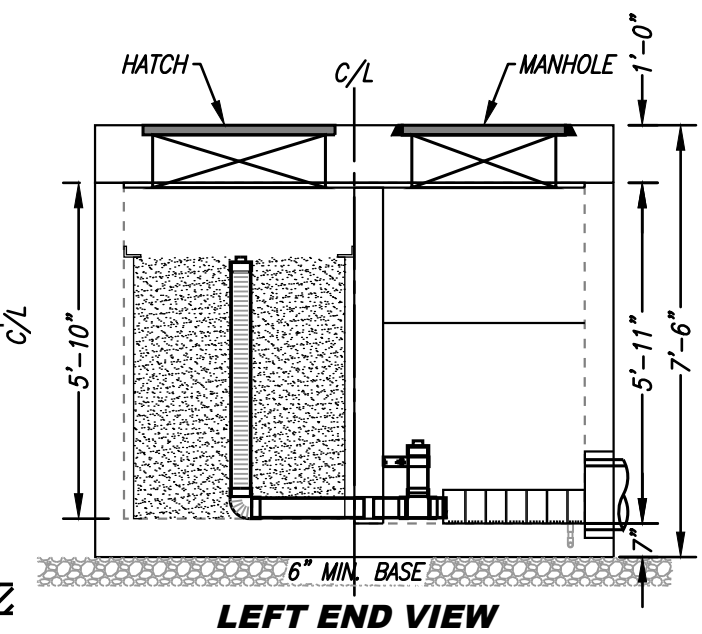
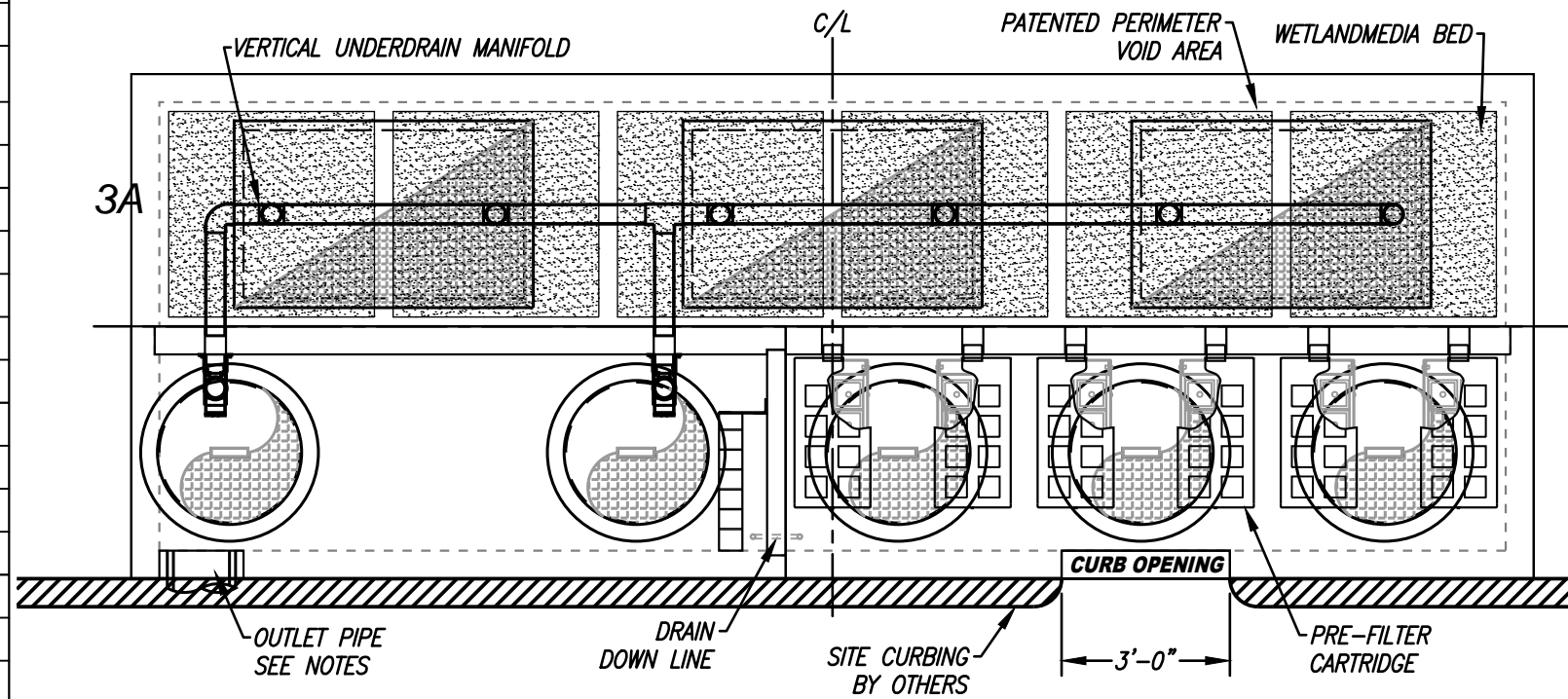


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**MWS-L-8-20-5'-2"-V-UG**  
**STORMWATER BIOFILTRATION SYSTEM**  
**STANDARD DETAIL**

| SITE SPECIFIC DATA                         |                                  |               |            |
|--|----------------------------------|---------------|------------|
| PROJECT NUMBER                             | 15516                            |               |            |
| PROJECT NAME                               | MORENO VALLEY MALL REDEVELOPMENT |               |            |
| PROJECT LOCATION                           | MORENO VALLEY, CA                |               |            |
| STRUCTURE ID                               | BMP 3A                           |               |            |
| TREATMENT REQUIRED                         |                                  |               |            |
| VOLUME BASED (CF)                          | FLOW BASED (CFS)                 |               |            |
| 6,694                                      | 0.6                              |               |            |
| TREATMENT HGL AVAILABLE (FT)               | N/K                              |               |            |
| PEAK BYPASS REQUIRED (CFS) - IF APPLICABLE | 8.83                             |               |            |
| PIPE DATA                                  | I.E.                             | MATERIAL      | DIAMETER   |
| INLET PIPE 1                               | N/A                              | N/A           | N/A        |
| INLET PIPE 2                               | N/A                              | N/A           | N/A        |
| OUTLET PIPE                                | 1617.99                          | PVC           | 12"        |
|  | PRETREATMENT                     | BIOFILTRATION | DISCHARGE  |
| RIM ELEVATION                              | 1624.90                          | 1624.90       | 1624.90    |
| SURFACE LOAD                               | PEDESTRIAN                       | PEDESTRIAN    | PEDESTRIAN |
| FRAME & COVER                              | 3EA Ø30"                         | 3EA 36" X 60" | 2EA Ø30"   |
| WETLANDMEDIA VOLUME (CY)                   | 13.82                            |               |            |
| ORIFICE SIZE (DIA. INCHES)                 | Ø2.66 EA                         |               |            |
| NOTES: PRELIMINARY NOT FOR CONSTRUCTION.   |                                  |               |            |



**INSTALLATION NOTES**

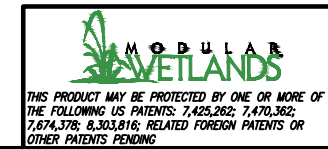
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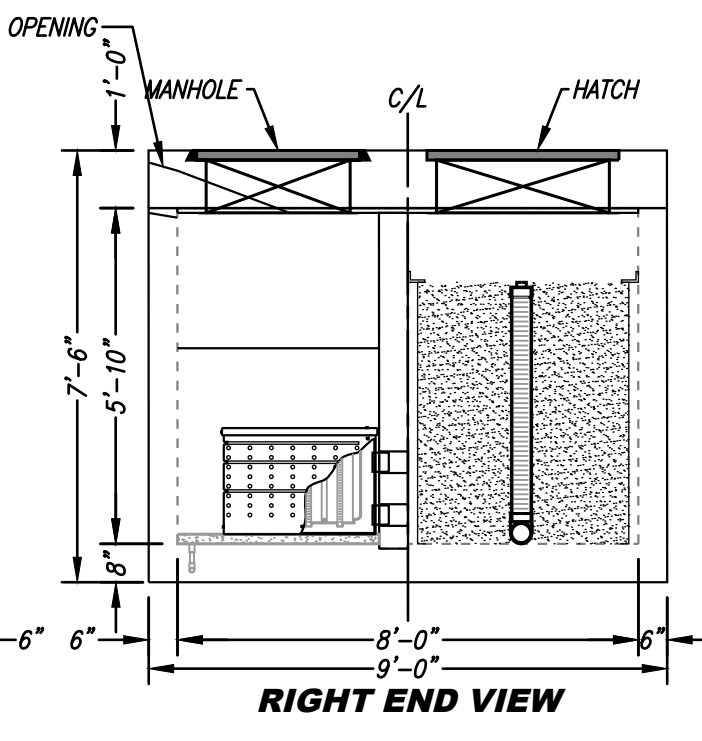
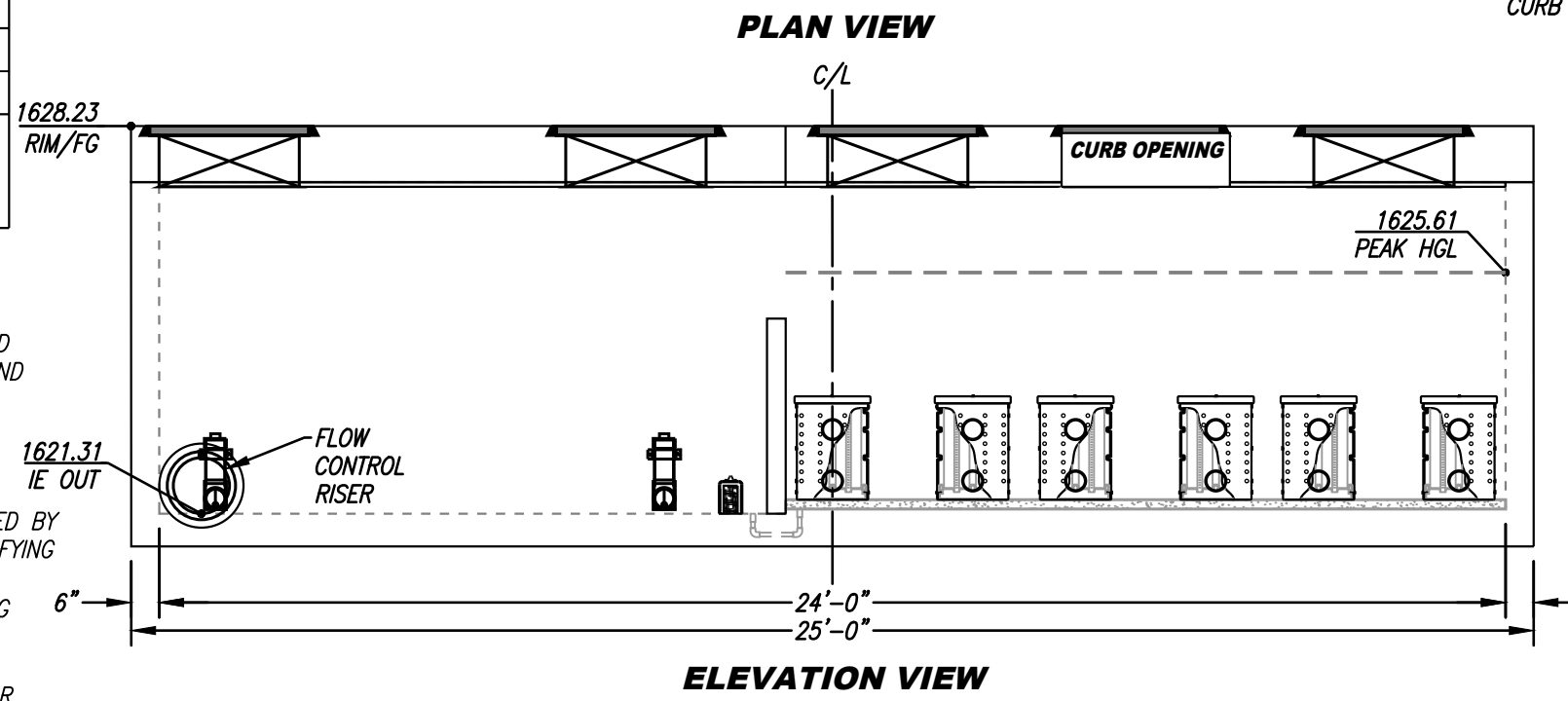
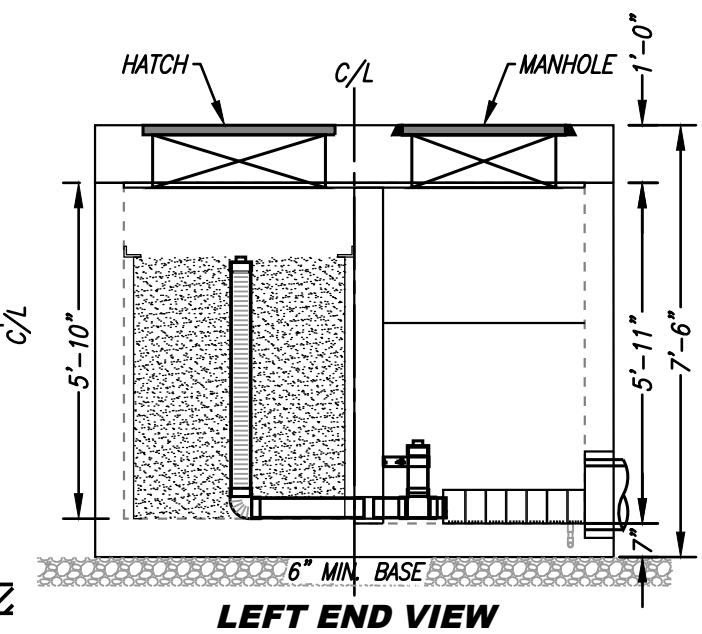
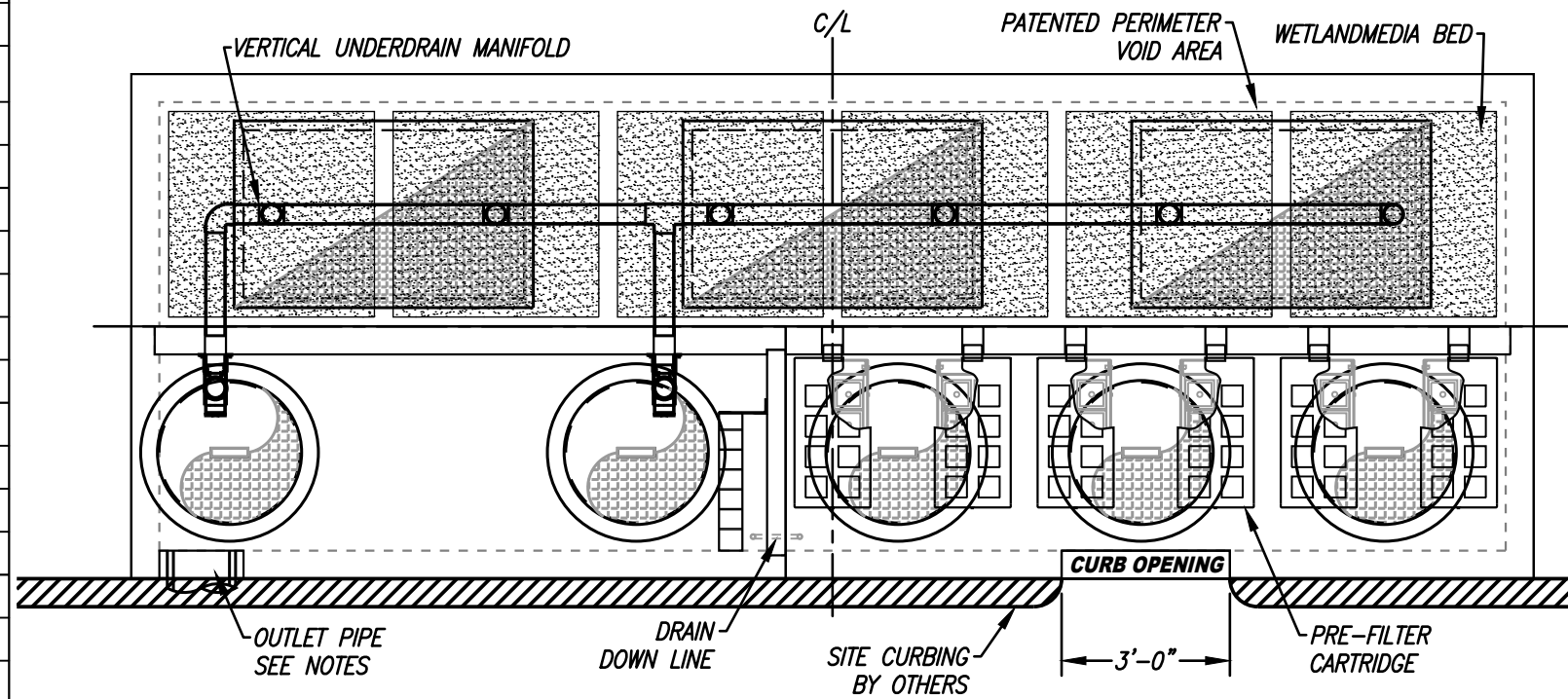


|                                     |       |
|-------------------------------------|-------|
| TREATMENT FLOW (CFS)                | 0.693 |
| TREATMENT VOLUME (CF)               | 6694  |
| DRAINDOWN DURATION (HOURS)          | 2.7   |
| OPERATING HEAD (FT)                 | 3.4   |
| PRETREATMENT LOADING RATE (GPM/SF)  | 2.0   |
| WETLAND MEDIA LOADING RATE (GPM/SF) | 1.0   |

**MWS-L-8-24-5'-10"-C-UG**  
**STORMWATER BIOFILTRATION SYSTEM**  
**STANDARD DETAIL**

Z18/22GSHIPPER

| SITE SPECIFIC DATA                         |                                  |               |            |
|--|----------------------------------|---------------|------------|
| PROJECT NUMBER                             | 15516                            |               |            |
| PROJECT NAME                               | MORENO VALLEY MALL REDEVELOPMENT |               |            |
| PROJECT LOCATION                           | MORENO VALLEY, CA                |               |            |
| STRUCTURE ID                               | BMP 3B                           |               |            |
| TREATMENT REQUIRED                         |                                  |               |            |
| VOLUME BASED (CF)                          | FLOW BASED (CFS)                 |               |            |
| 7,655                                      | 0.7                              |               |            |
| TREATMENT HGL AVAILABLE (FT)               | N/K                              |               |            |
| PEAK BYPASS REQUIRED (CFS) - IF APPLICABLE | 8.83                             |               |            |
| PIPE DATA                                  | I.E.                             | MATERIAL      | DIAMETER   |
| INLET PIPE 1                               | N/A                              | N/A           | N/A        |
| INLET PIPE 2                               | N/A                              | N/A           | N/A        |
| OUTLET PIPE                                | 1621.31                          | PVC           | 12"        |
|  | PRETREATMENT                     | BIOFILTRATION | DISCHARGE  |
| RIM ELEVATION                              | 1628.23                          | 1628.23       | 1628.23    |
| SURFACE LOAD                               | PEDESTRIAN                       | PEDESTRIAN    | PEDESTRIAN |
| FRAME & COVER                              | 3EA Ø30"                         | 3EA 36" X 60" | 2EA Ø30"   |
| WETLANDMEDIA VOLUME (CY)                   | 13.82                            |               |            |
| ORIFICE SIZE (DIA. INCHES)                 | Ø2.66 EA                         |               |            |
| NOTES: PRELIMINARY NOT FOR CONSTRUCTION.   |                                  |               |            |



**INSTALLATION NOTES**

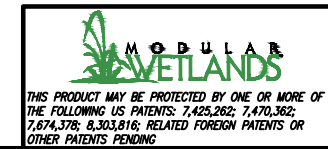
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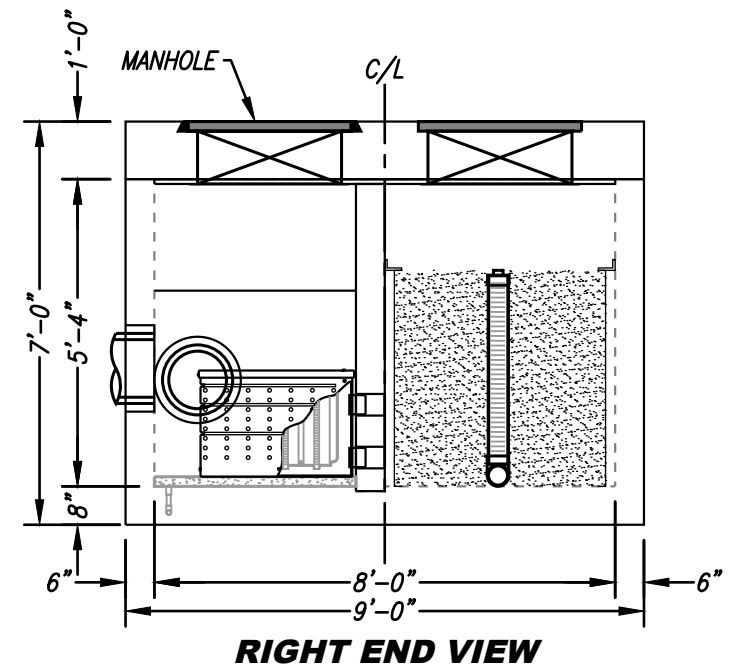
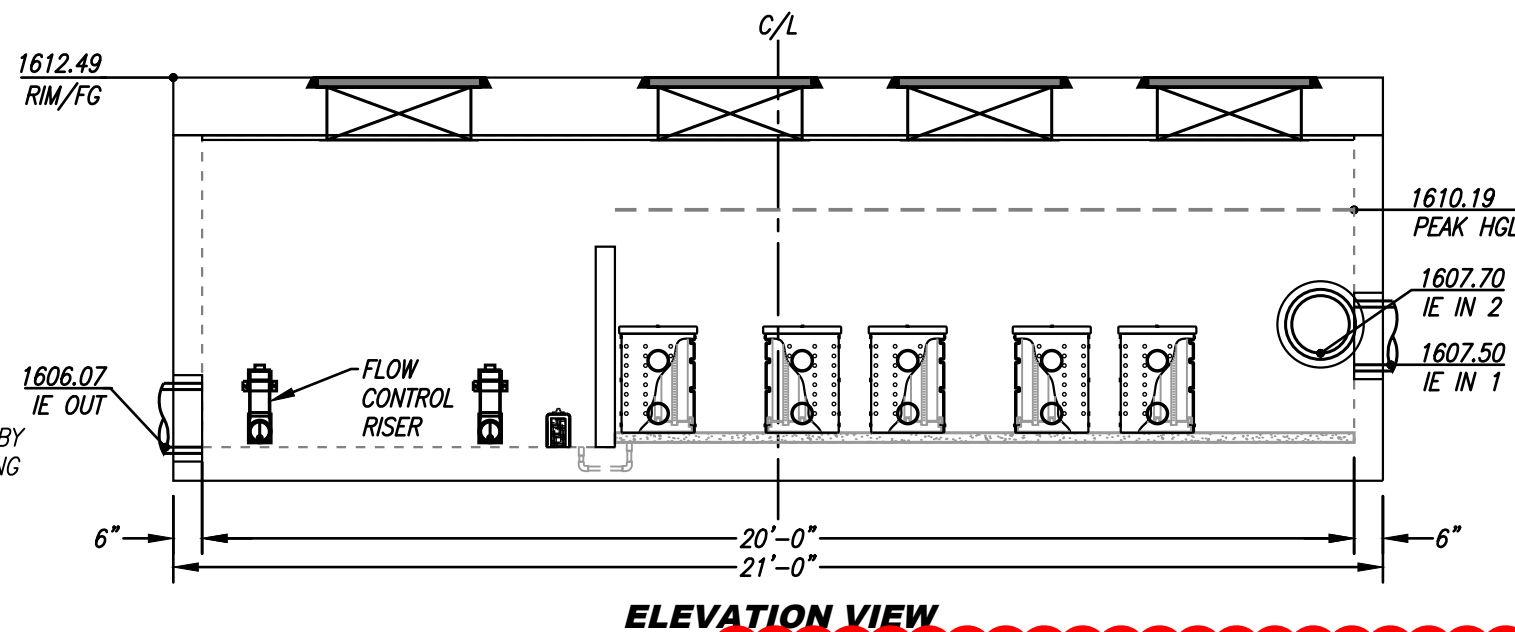
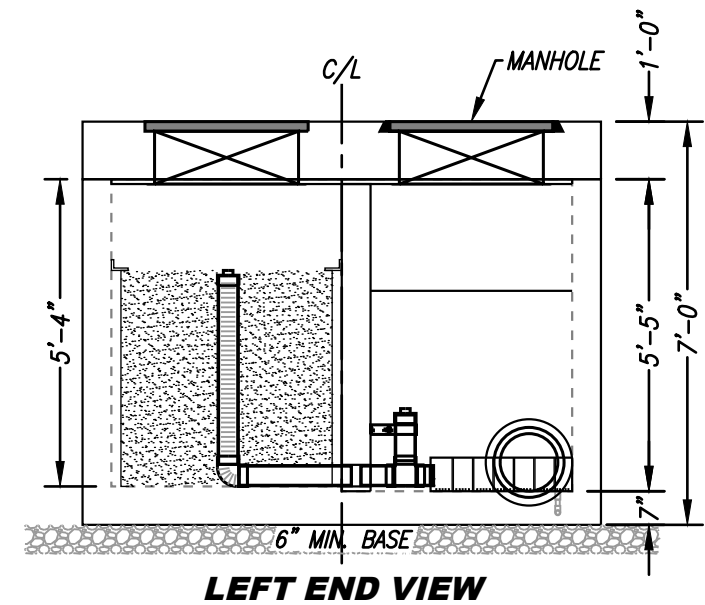
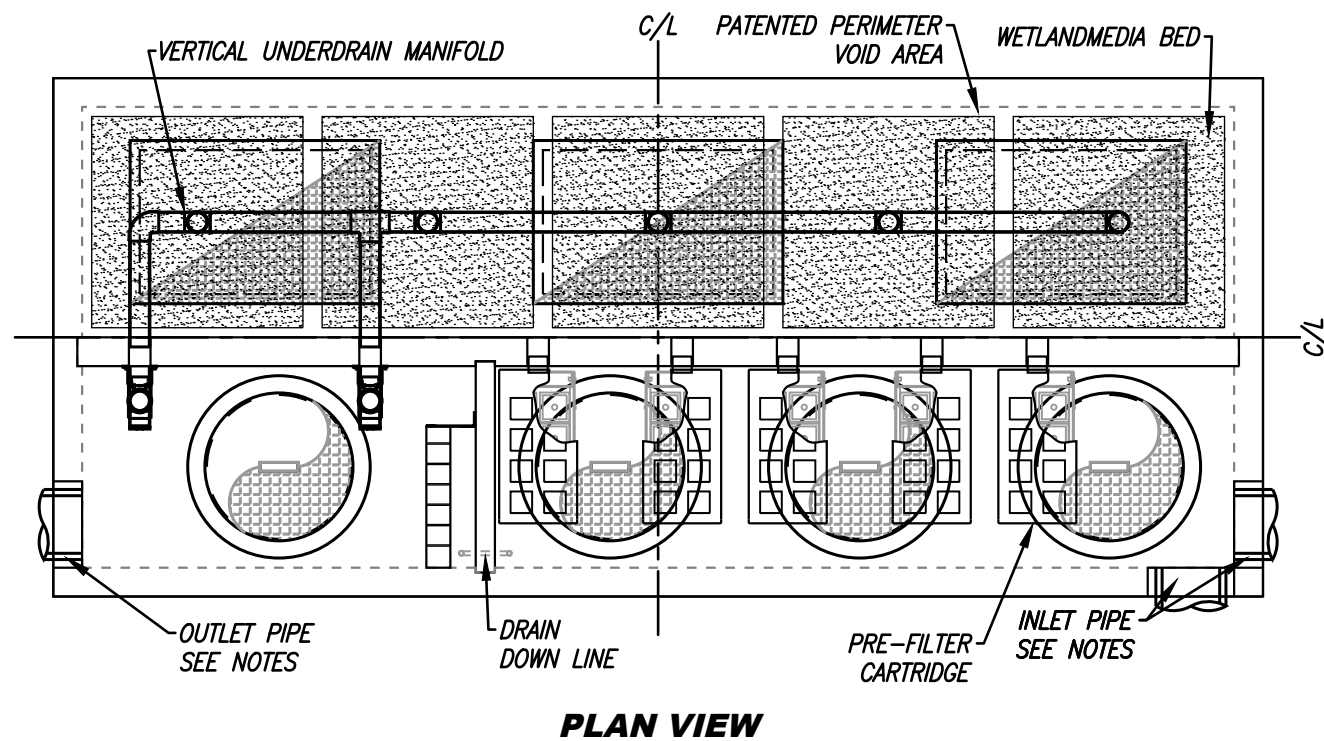


|                                     |      |
|-------------------------------------|------|
| TREATMENT FLOW (CFS)                | 0.70 |
| TREATMENT VOLUME (CF)               | 7655 |
| DRAINDOWN DURATION (HOURS)          | 3.0  |
| OPERATING HEAD (FT)                 | 3.4  |
| PRETREATMENT LOADING RATE (GPM/SF)  | 2.0  |
| WETLAND MEDIA LOADING RATE (GPM/SF) | 1.0  |

**MWS-L-8-24-5'-10"-C-UG**  
**STORMWATER BIOFILTRATION SYSTEM**  
**STANDARD DETAIL**

Z18/22GSHIPPER

| SITE SPECIFIC DATA   |                                  |               |            |
|--|----------------------------------|---------------|------------|
| PROJECT NUMBER   | 11516                            |               |            |
| PROJECT NAME   | MORENO VALLEY MALL REDEVELOPMENT |               |            |
| PROJECT LOCATION   | MORENO VALLEY, CA                |               |            |
| STRUCTURE ID   | BMP 4 - UNIT 1 OF 3              |               |            |
| TREATMENT REQUIRED   |                                  |               |            |
| VOLUME BASED (CF)  | FLOW BASED (CFS)                 |               |            |
| 18,790   | 1.6 (THREE UNITS REQUIRED)       |               |            |
| TREATMENT HGL AVAILABLE (FT)   | N/K                              |               |            |
| PEAK BYPASS REQUIRED (CFS) - IF APPLICABLE   | 6.13                             |               |            |
| PIPE DATA  | I.E.                             | MATERIAL      | DIAMETER   |
| INLET PIPE 1   | 1607.50                          | PVC           | 12"        |
| INLET PIPE 2   | 1607.70                          | PVC           | 12"        |
| OUTLET PIPE  | 1606.07                          | PVC           | 12"        |
|  | PRETREATMENT                     | BIOFILTRATION | DISCHARGE  |
| RIM ELEVATION  | 1612.49                          | 1612.49       | 1612.49    |
| SURFACE LOAD   | PEDESTRIAN                       | PEDESTRIAN    | PEDESTRIAN |
| FRAME & COVER  | 3EA $\phi$ 30"                   | 3EA 30" X 48" | $\phi$ 30" |
| WETLANDMEDIA VOLUME (CY)   | 9.51                             |               |            |
| ORIFICE SIZE (DIA. INCHES)   | $\phi$ 2.43 EA                   |               |            |
| NOTES: PRELIMINARY NOT FOR CONSTRUCTION. THREE MWS-L-8-24 REQUIRED TO MEET REQUIRED TREATMENT FLOW CAPACITY. |                                  |               |            |



**INSTALLATION NOTES**

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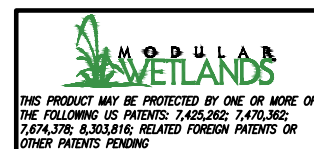
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**PROJECT PROPOSES THREE UNITS, SIDE BY SIDE FOR A COMBINED TREATMENT FLOW RATE OF 1.731 CFS**

**INTERNAL BYPASS DISCLOSURE:**

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|                                     |       |
|-------------------------------------|-------|
| TREATMENT FLOW (CFS)                | 0.577 |
| TREATMENT VOLUME (CF)               | 6264  |
| DRAINDOWN DURATION                  | 3.0   |
| OPERATING HEAD (FT)                 | 3.4   |
| PRETREATMENT LOADING RATE (GPM/SF)  | 2.0   |
| WETLAND MEDIA LOADING RATE (GPM/SF) | 1.0   |

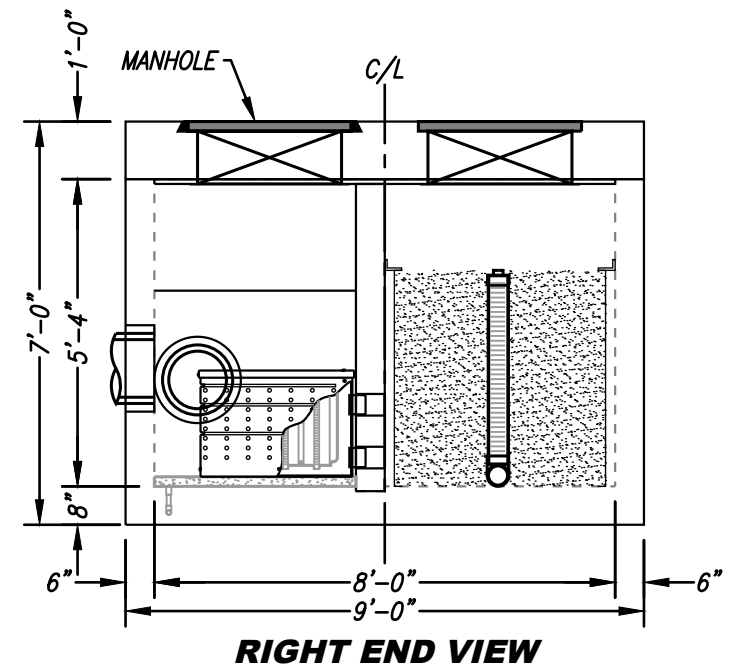
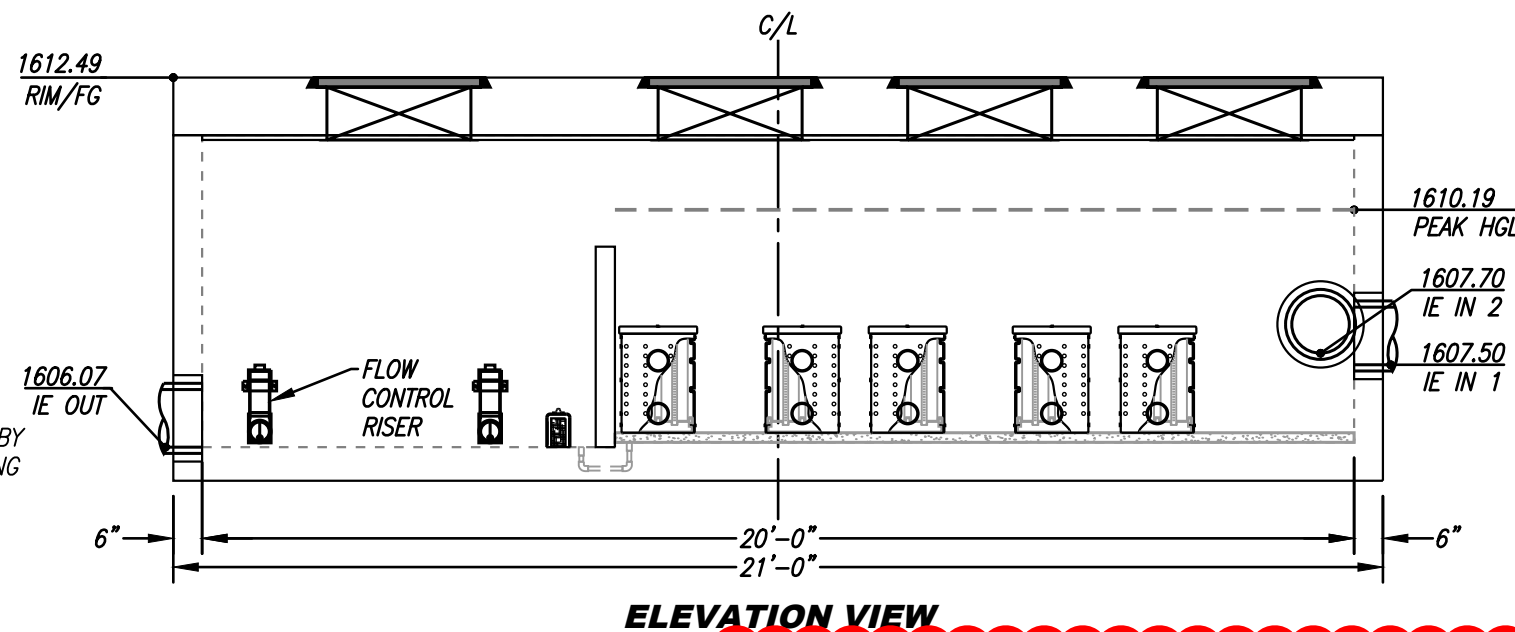
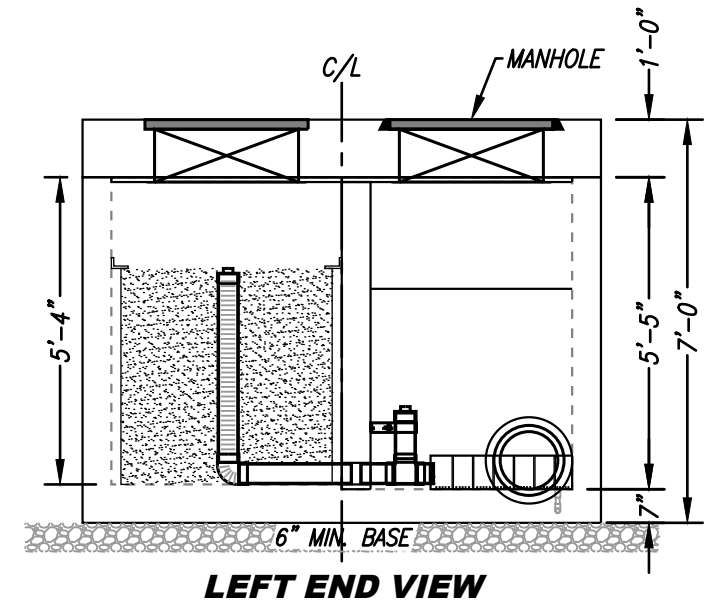
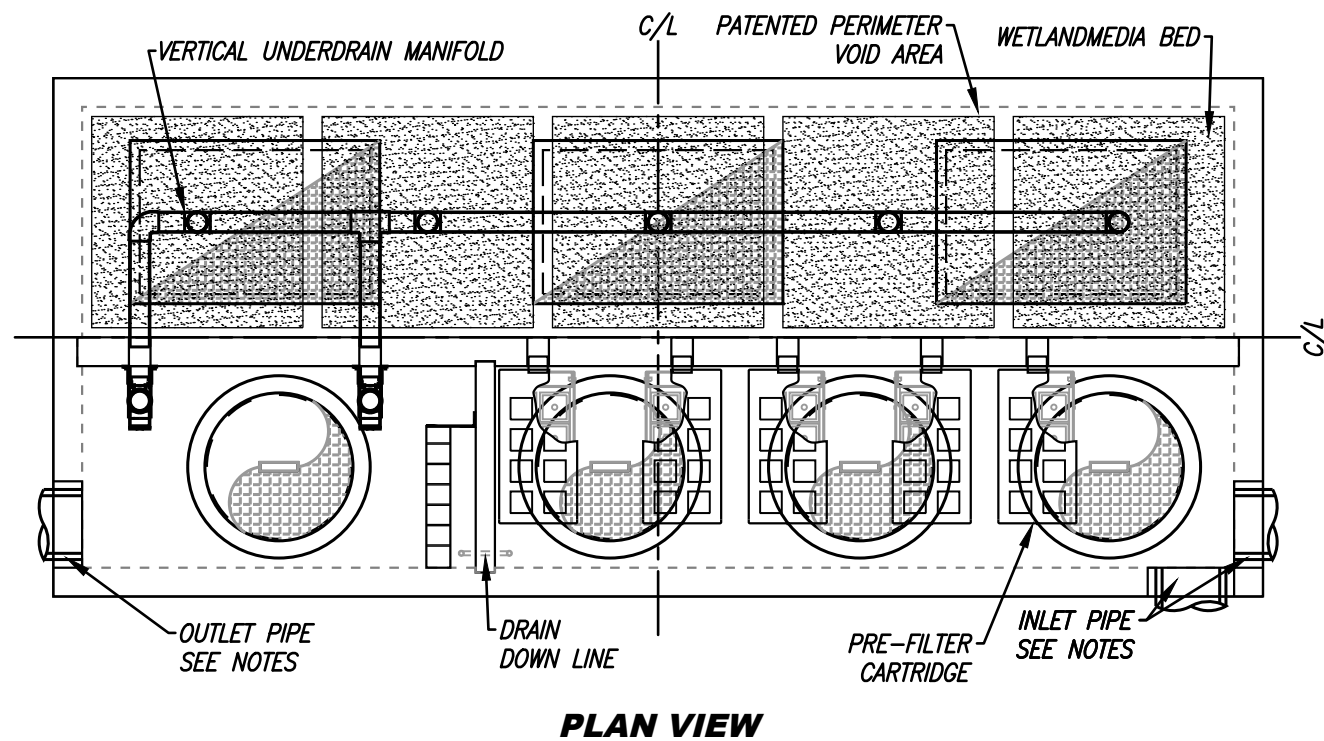


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**MWS-L-8-20-5'-4"-V-UG**  
**STORMWATER BIOFILTRATION SYSTEM**  
**STANDARD DETAIL**

| SITE SPECIFIC DATA   |                                  |               |            |
|--|----------------------------------|---------------|------------|
| PROJECT NUMBER   | 11516                            |               |            |
| PROJECT NAME   | MORENO VALLEY MALL REDEVELOPMENT |               |            |
| PROJECT LOCATION   | MORENO VALLEY, CA                |               |            |
| STRUCTURE ID   | BMP 4 - UNIT 2 OF 3              |               |            |
| TREATMENT REQUIRED   |                                  |               |            |
| VOLUME BASED (CF)  | FLOW BASED (CFS)                 |               |            |
| 18,790   | 1.6 (THREE UNITS REQUIRED)       |               |            |
| TREATMENT HGL AVAILABLE (FT)   | N/K                              |               |            |
| PEAK BYPASS REQUIRED (CFS) - IF APPLICABLE   | 6.13                             |               |            |
| PIPE DATA  | I.E.                             | MATERIAL      | DIAMETER   |
| INLET PIPE 1   | 1607.50                          | PVC           | 12"        |
| INLET PIPE 2   | 1607.70                          | PVC           | 12"        |
| OUTLET PIPE  | 1606.07                          | PVC           | 12"        |
|  | PRETREATMENT                     | BIOFILTRATION | DISCHARGE  |
| RIM ELEVATION  | 1612.49                          | 1612.49       | 1612.49    |
| SURFACE LOAD   | PEDESTRIAN                       | PEDESTRIAN    | PEDESTRIAN |
| FRAME & COVER  | 3EA $\phi$ 30"                   | 3EA 30" X 48" | $\phi$ 30" |
| WETLANDMEDIA VOLUME (CY)   | 9.51                             |               |            |
| ORIFICE SIZE (DIA. INCHES)   | $\phi$ 2.43 EA                   |               |            |
| NOTES: PRELIMINARY NOT FOR CONSTRUCTION. THREE MWS-L-8-24 REQUIRED TO MEET REQUIRED TREATMENT FLOW CAPACITY. |                                  |               |            |



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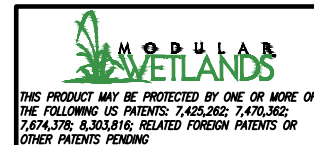
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**PROJECT PROPOSES THREE UNITS, SIDE BY SIDE FOR A COMBINED TREATMENT FLOW RATE OF 1.731 CFS**

|                                     |       |
|-------------------------------------|-------|
| TREATMENT FLOW (CFS)                | 0.577 |
| TREATMENT VOLUME (CF)               | 6264  |
| DRAINDOWN DURATION                  | 3.0   |
| OPERATING HEAD (FT)                 | 3.4   |
| PRETREATMENT LOADING RATE (GPM/SF)  | 2.0   |
| WETLAND MEDIA LOADING RATE (GPM/SF) | 1.0   |

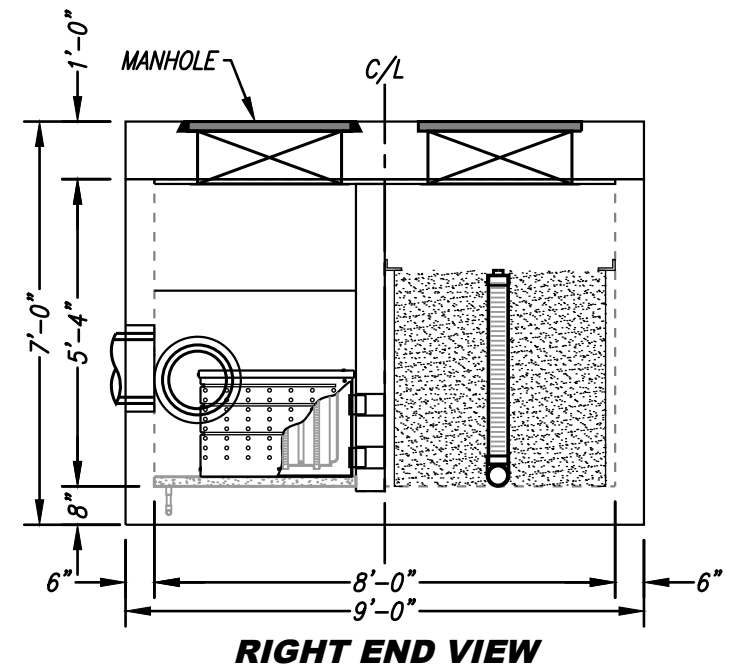
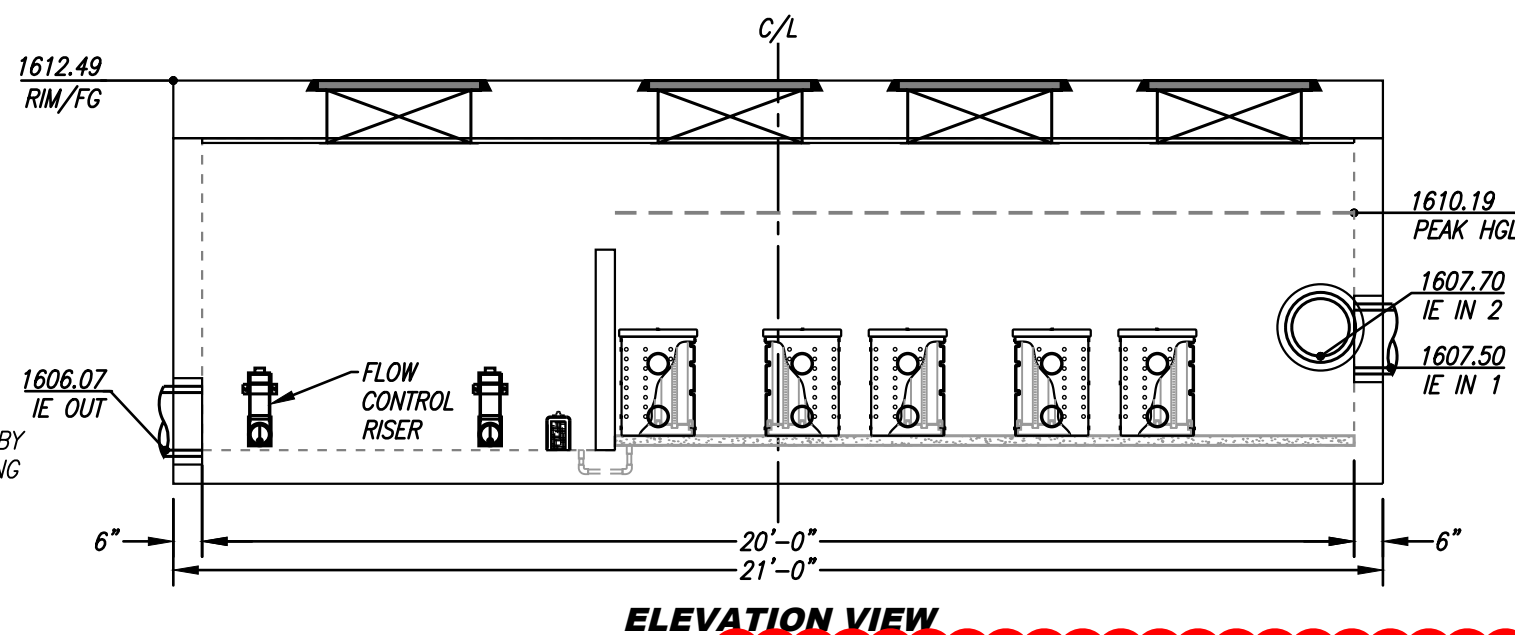
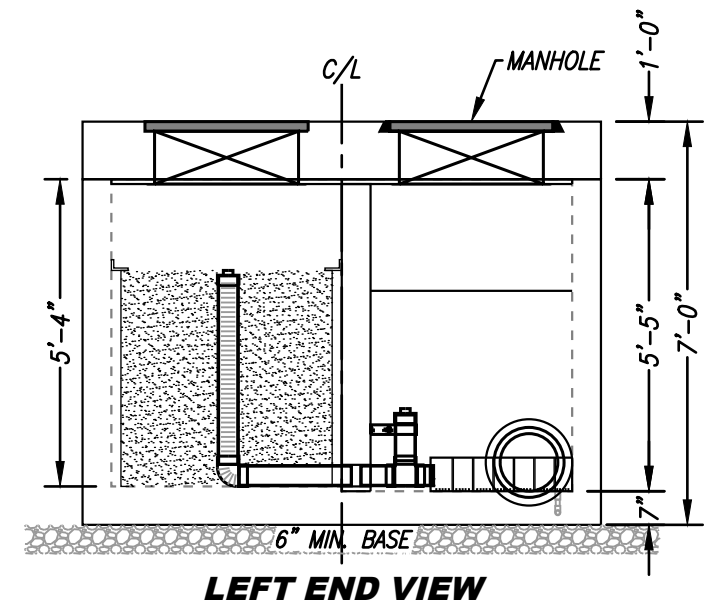
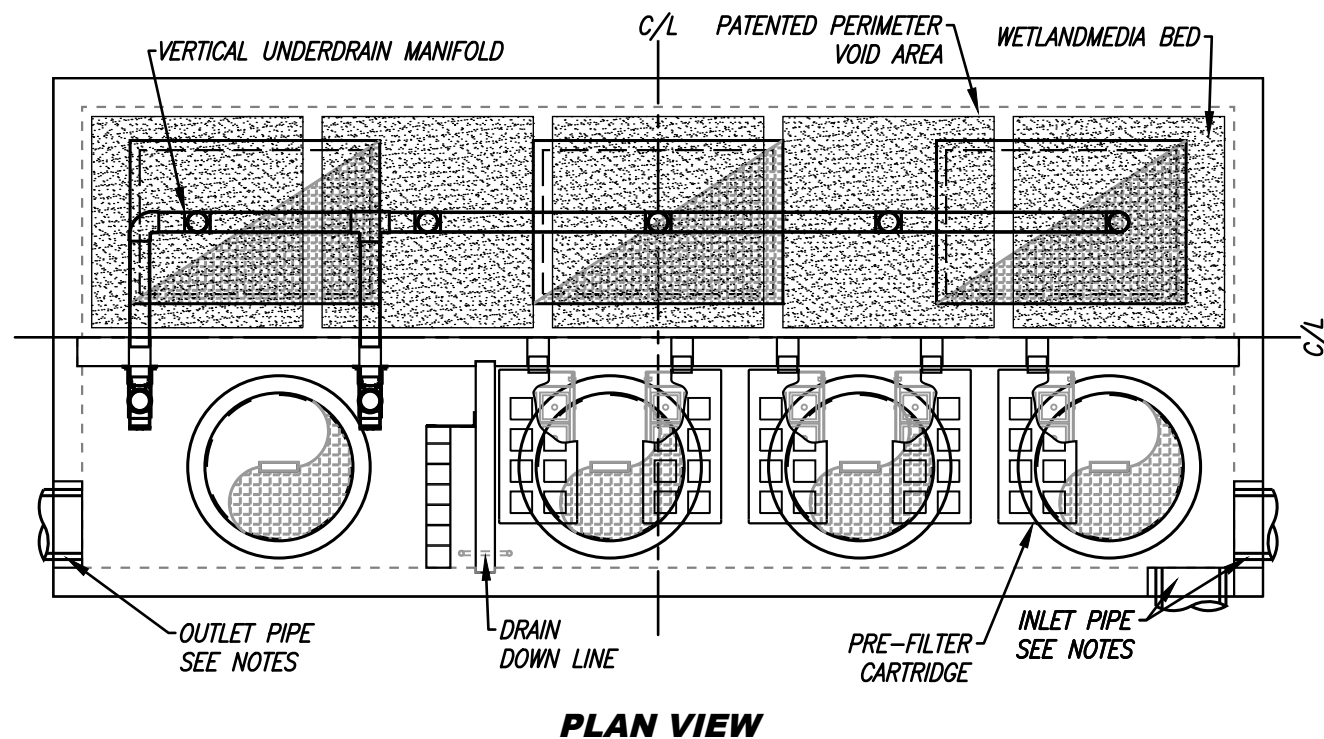


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**MWS-L-8-20-5'-4"-V-UG**  
**STORMWATER BIOFILTRATION SYSTEM**  
**STANDARD DETAIL**

| SITE SPECIFIC DATA   |                                  |               |            |
|--|----------------------------------|---------------|------------|
| PROJECT NUMBER   | 11516                            |               |            |
| PROJECT NAME   | MORENO VALLEY MALL REDEVELOPMENT |               |            |
| PROJECT LOCATION   | MORENO VALLEY, CA                |               |            |
| STRUCTURE ID   | BMP 4 - UNIT 3 OF 3              |               |            |
| TREATMENT REQUIRED   |                                  |               |            |
| VOLUME BASED (CF)  | FLOW BASED (CFS)                 |               |            |
| 18,790   | 1.6 (THREE UNITS REQUIRED)       |               |            |
| TREATMENT HGL AVAILABLE (FT)   | N/K                              |               |            |
| PEAK BYPASS REQUIRED (CFS) - IF APPLICABLE   | 6.13                             |               |            |
| PIPE DATA  | I.E.                             | MATERIAL      | DIAMETER   |
| INLET PIPE 1   | 1607.50                          | PVC           | 12"        |
| INLET PIPE 2   | 1607.70                          | PVC           | 12"        |
| OUTLET PIPE  | 1606.07                          | PVC           | 12"        |
|  | PRETREATMENT                     | BIOFILTRATION | DISCHARGE  |
| RIM ELEVATION  | 1612.49                          | 1612.49       | 1612.49    |
| SURFACE LOAD   | PEDESTRIAN                       | PEDESTRIAN    | PEDESTRIAN |
| FRAME & COVER  | 3EA $\phi$ 30"                   | 3EA 30" X 48" | $\phi$ 30" |
| WETLAND MEDIA VOLUME (CY)  | 9.51                             |               |            |
| ORIFICE SIZE (DIA. INCHES)   | $\phi$ 2.43 EA                   |               |            |
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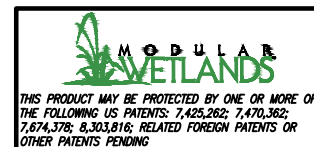
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THE DESIGN AND CAPACITY OF THE PEAK CONVEYANCE METHOD TO BE REVIEWED AND APPROVED BY THE ENGINEER OF RECORD. HGL(S) AT PEAK FLOW SHALL BE ASSESSED TO ENSURE NO UPSTREAM FLOODING. PEAK HGL AND BYPASS CAPACITY SHOWN ON DRAWING ARE USED FOR GUIDANCE ONLY.

**PROJECT PROPOSES THREE UNITS, SIDE BY SIDE FOR A COMBINED TREATMENT FLOW RATE OF 1.731 CFS**

|                                     |       |
|-------------------------------------|-------|
| TREATMENT FLOW (CFS)                | 0.577 |
| TREATMENT VOLUME (CF)               | 6264  |
| DRAINDOWN DURATION                  | 3.0   |
| OPERATING HEAD (FT)                 | 3.4   |
| PRETREATMENT LOADING RATE (GPM/SF)  | 2.0   |
| WETLAND MEDIA LOADING RATE (GPM/SF) | 1.0   |

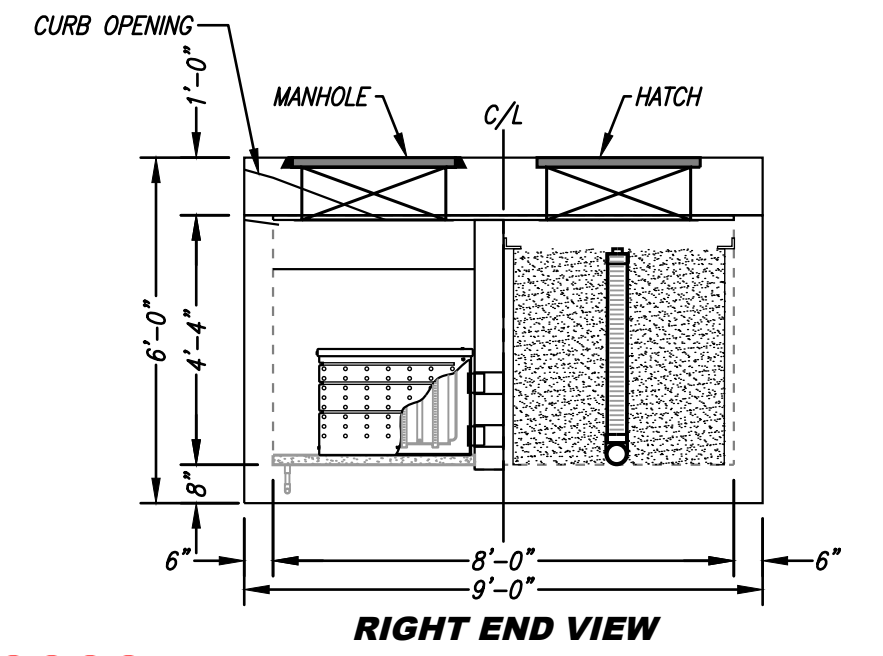
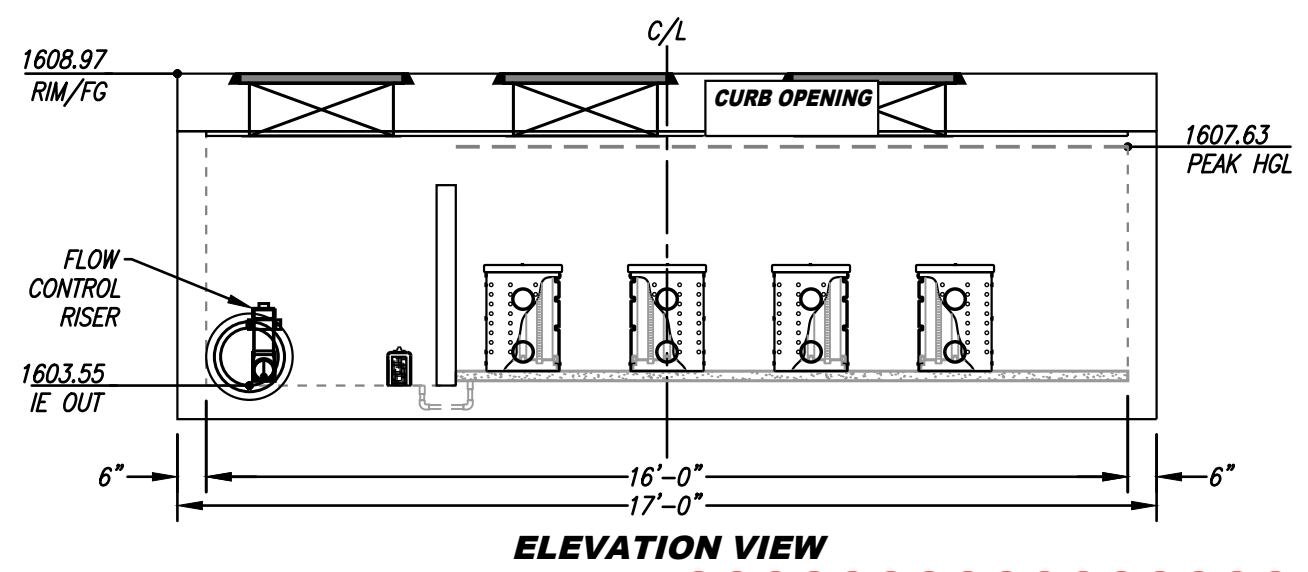
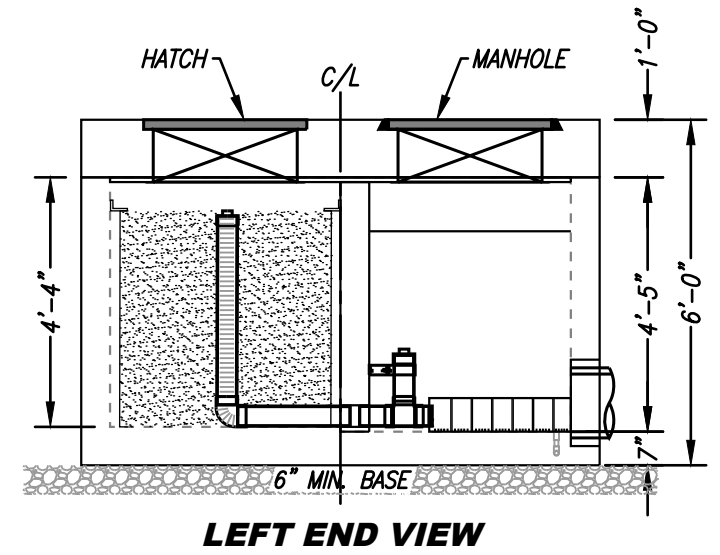
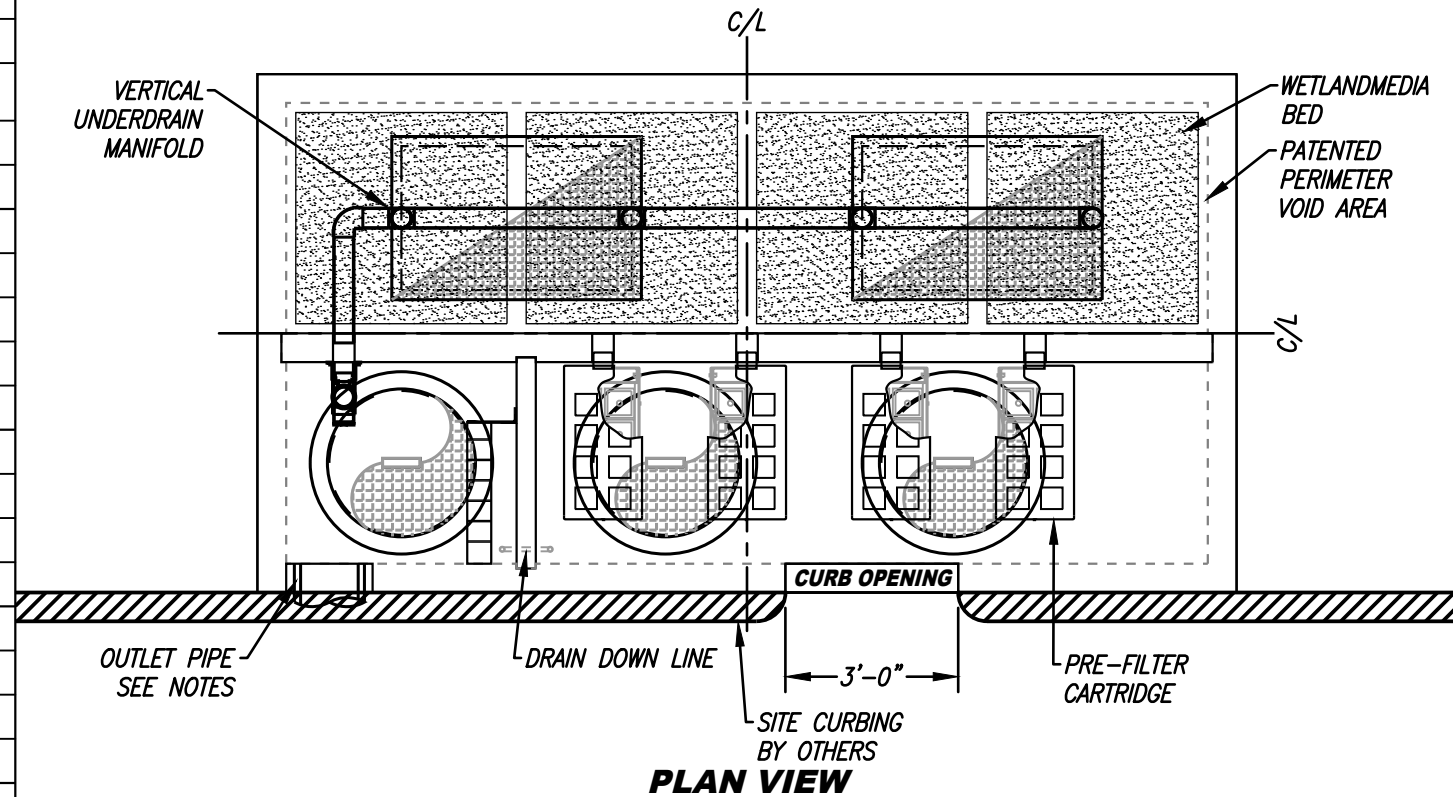


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**MWS-L-8-20-5'-4"-V-UG**  
**STORMWATER BIOFILTRATION SYSTEM**  
**STANDARD DETAIL**

| SITE SPECIFIC DATA                         |                                  |               |            |
|--|----------------------------------|---------------|------------|
| PROJECT NUMBER                             | 15516                            |               |            |
| PROJECT NAME                               | MORENO VALLEY MALL REDEVELOPMENT |               |            |
| PROJECT LOCATION                           | MORENO VALLEY, CA                |               |            |
| STRUCTURE ID                               | BMP 5 - UNIT 1 OF 2              |               |            |
| TREATMENT REQUIRED                         |                                  |               |            |
| VOLUME BASED (CF)                          | FLOW BASED (CFS)                 |               |            |
| 10,045                                     | 0.9 (TWO UNITS REQUIRED)         |               |            |
| TREATMENT HGL AVAILABLE (FT)               | N/K                              |               |            |
| PEAK BYPASS REQUIRED (CFS) - IF APPLICABLE | 5.6                              |               |            |
| PIPE DATA                                  | I.E.                             | MATERIAL      | DIAMETER   |
| INLET PIPE 1                               | N/A                              | N/A           | N/A        |
| INLET PIPE 2                               | N/A                              | N/A           | N/A        |
| OUTLET PIPE                                | 1603.55                          | PVC           | 12"        |
|  | PRETREATMENT                     | BIOFILTRATION | DISCHARGE  |
| RIM ELEVATION                              | 1608.97                          | 1608.97       | 1608.97    |
| SURFACE LOAD                               | PEDESTRIAN                       | PEDESTRIAN    | PEDESTRIAN |
| FRAME & COVER                              | 2EA $\phi$ 30"                   | 2EA 30" X 48" | $\phi$ 30" |
| WETLANDMEDIA VOLUME (CY)                   | 7.61                             |               |            |
| ORIFICE SIZE (DIA. INCHES)                 | $\phi$ 3.07"                     |               |            |
| NOTES: PRELIMINARY NOT FOR CONSTRUCTION.   |                                  |               |            |



**INSTALLATION NOTES**

1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURERS' SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURER'S CONTRACT.
2. UNIT MUST BE INSTALLED ON LEVEL BASE. MANUFACTURER RECOMMENDS A MINIMUM 6" LEVEL ROCK BASE UNLESS SPECIFIED BY THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE FOR VERIFYING PROJECT ENGINEER'S RECOMMENDED BASE SPECIFICATIONS.
4. CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE (PIPES CANNOT INTRUDE BEYOND FLUSH). INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR. ALL PIPES SHALL BE SEALED WATERTIGHT PER MANUFACTURER'S STANDARD CONNECTION DETAIL.
5. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL PIPES, RISERS, MANHOLES, AND HATCHES. CONTRACTOR TO USE GROUT AND/OR BRICKS TO MATCH COVERS WITH FINISHED SURFACE UNLESS SPECIFIED OTHERWISE.
6. CONTRACTOR RESPONSIBLE FOR CONTACTING BIO CLEAN FOR ACTIVATION OF UNIT. MANUFACTURER'S WARRANTY IS VOID WITHOUT PROPER ACTIVATION BY A BIO CLEAN REPRESENTATIVE.

**GENERAL NOTES**

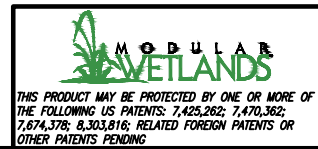
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**PROJECT PROPOSES THREE UNITS, SIDE BY SIDE FOR A COMBINED TREATMENT FLOW RATE OF 0.924 CFS**

**INTERNAL BYPASS DISCLOSURE:**

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|                                     |       |
|-------------------------------------|-------|
| TREATMENT FLOW (CFS)                | 0.462 |
| TREATMENT VOLUME (CF)               | 5023  |
| DRAINDOWN DURATION (HOURS)          | 3.0   |
| OPERATING HEAD (FT)                 | 3.4   |
| PRETREATMENT LOADING RATE (GPM/SF)  | 2.0   |
| WETLAND MEDIA LOADING RATE (GPM/SF) | 1.0   |



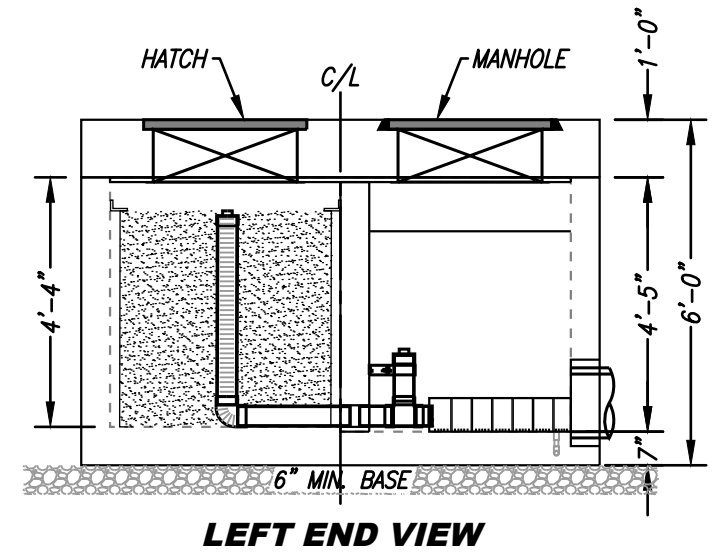
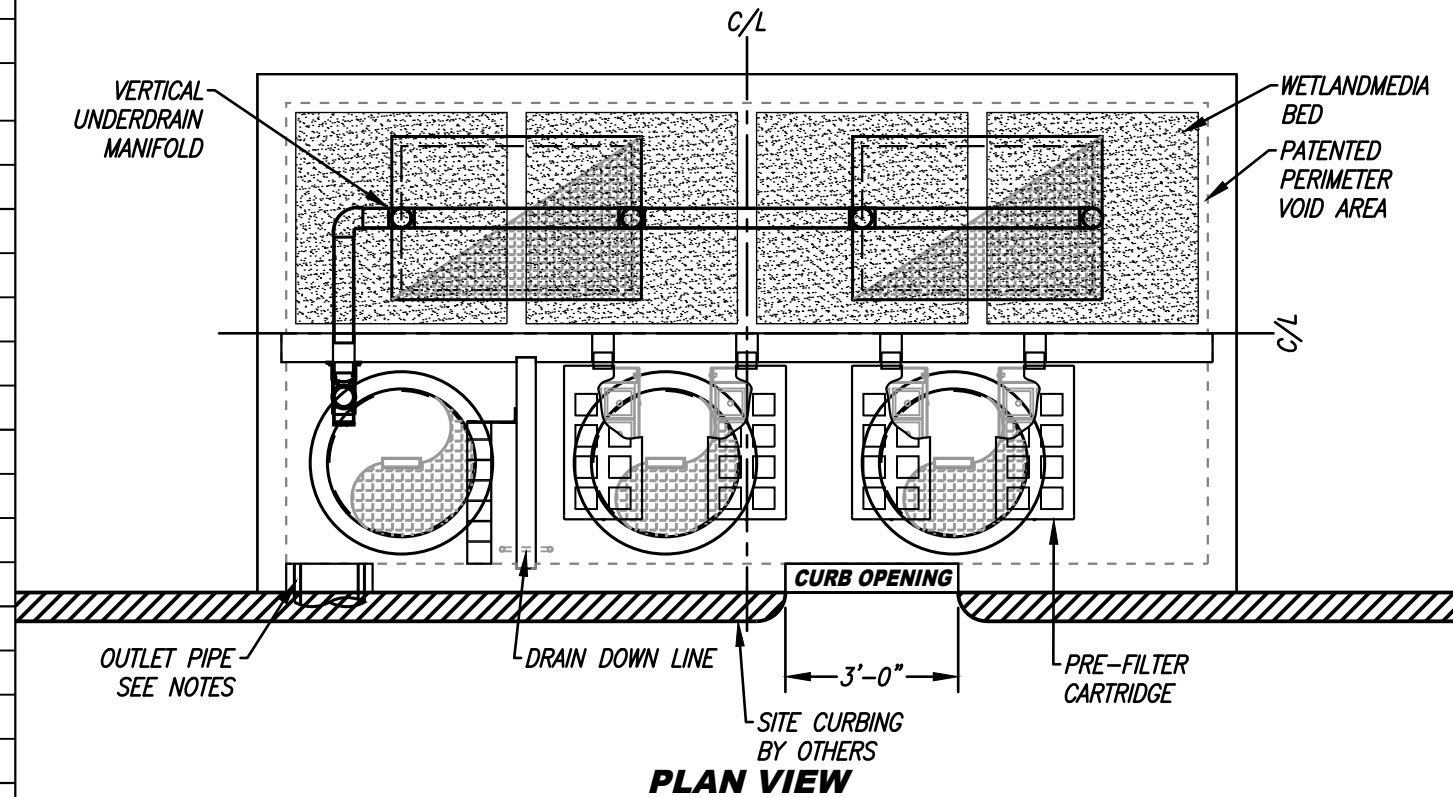
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**MWS-L-8-16-4'-4"-C-UG**  
**STORMWATER BIOFILTRATION SYSTEM**  
**STANDARD DETAIL**

Z15/22GSHIPPER

| SITE SPECIFIC DATA                         |                                  |               |            |
|--|----------------------------------|---------------|------------|
| PROJECT NUMBER                             | 15516                            |               |            |
| PROJECT NAME                               | MORENO VALLEY MALL REDEVELOPMENT |               |            |
| PROJECT LOCATION                           | MORENO VALLEY, CA                |               |            |
| STRUCTURE ID                               | BMP 5 - UNIT 2 OF 2              |               |            |
| TREATMENT REQUIRED                         |                                  |               |            |
| VOLUME BASED (CF)                          | FLOW BASED (CFS)                 |               |            |
| 10,045                                     | 0.9 (TWO UNITS REQUIRED)         |               |            |
| TREATMENT HGL AVAILABLE (FT)               | N/K                              |               |            |
| PEAK BYPASS REQUIRED (CFS) - IF APPLICABLE | 5.6                              |               |            |
| PIPE DATA                                  | I.E.                             | MATERIAL      | DIAMETER   |
| INLET PIPE 1                               | N/A                              | N/A           | N/A        |
| INLET PIPE 2                               | N/A                              | N/A           | N/A        |
| OUTLET PIPE                                | 1603.55                          | PVC           | 12"        |
|  | PRETREATMENT                     | BIOFILTRATION | DISCHARGE  |
| RIM ELEVATION                              | 1608.97                          | 1608.97       | 1608.97    |
| SURFACE LOAD                               | PEDESTRIAN                       | PEDESTRIAN    | PEDESTRIAN |
| FRAME & COVER                              | 2EA $\phi$ 30"                   | 2EA 30" X 48" | $\phi$ 30" |
| WETLANDMEDIA VOLUME (CY)                   | 7.61                             |               |            |
| ORIFICE SIZE (DIA. INCHES)                 | $\phi$ 3.07"                     |               |            |
| NOTES: PRELIMINARY NOT FOR CONSTRUCTION.   |                                  |               |            |

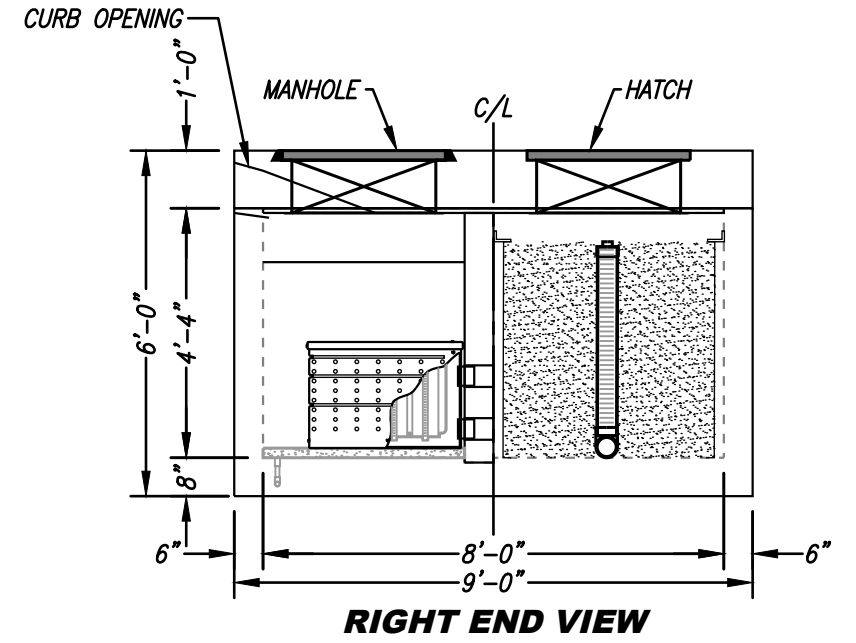
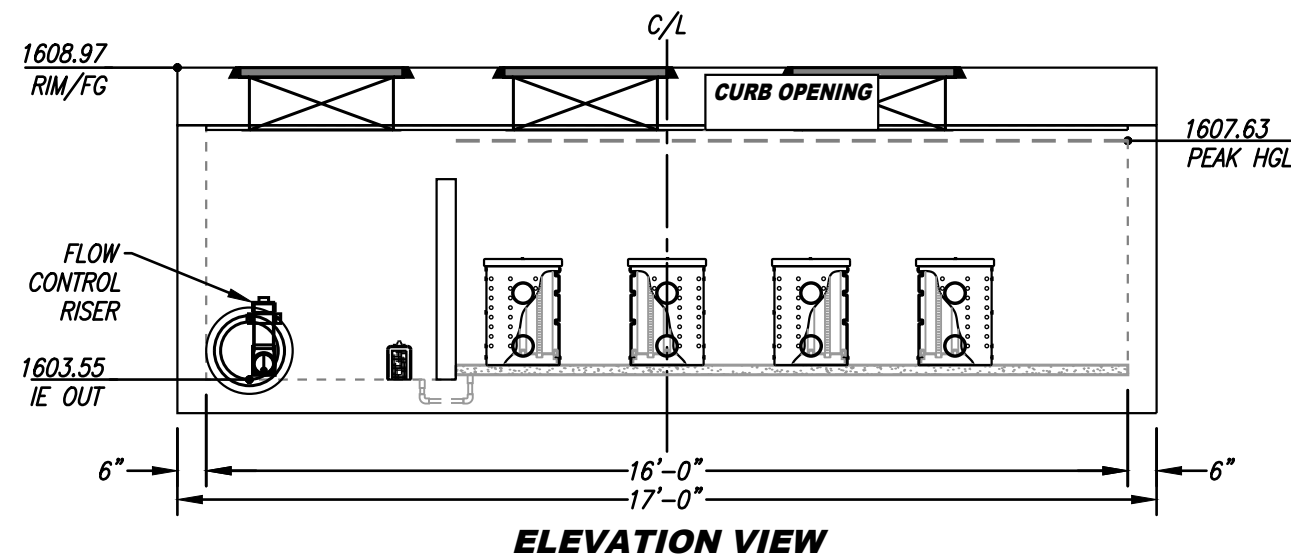


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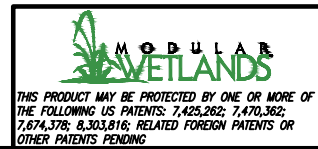


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|                                     |       |
|-------------------------------------|-------|
| TREATMENT FLOW (CFS)                | 0.462 |
| TREATMENT VOLUME (CF)               | 5023  |
| DRAINDOWN DURATION (HOURS)          | 3.0   |
| OPERATING HEAD (FT)                 | 3.4   |
| PRETREATMENT LOADING RATE (GPM/SF)  | 2.0   |
| WETLAND MEDIA LOADING RATE (GPM/SF) | 1.0   |



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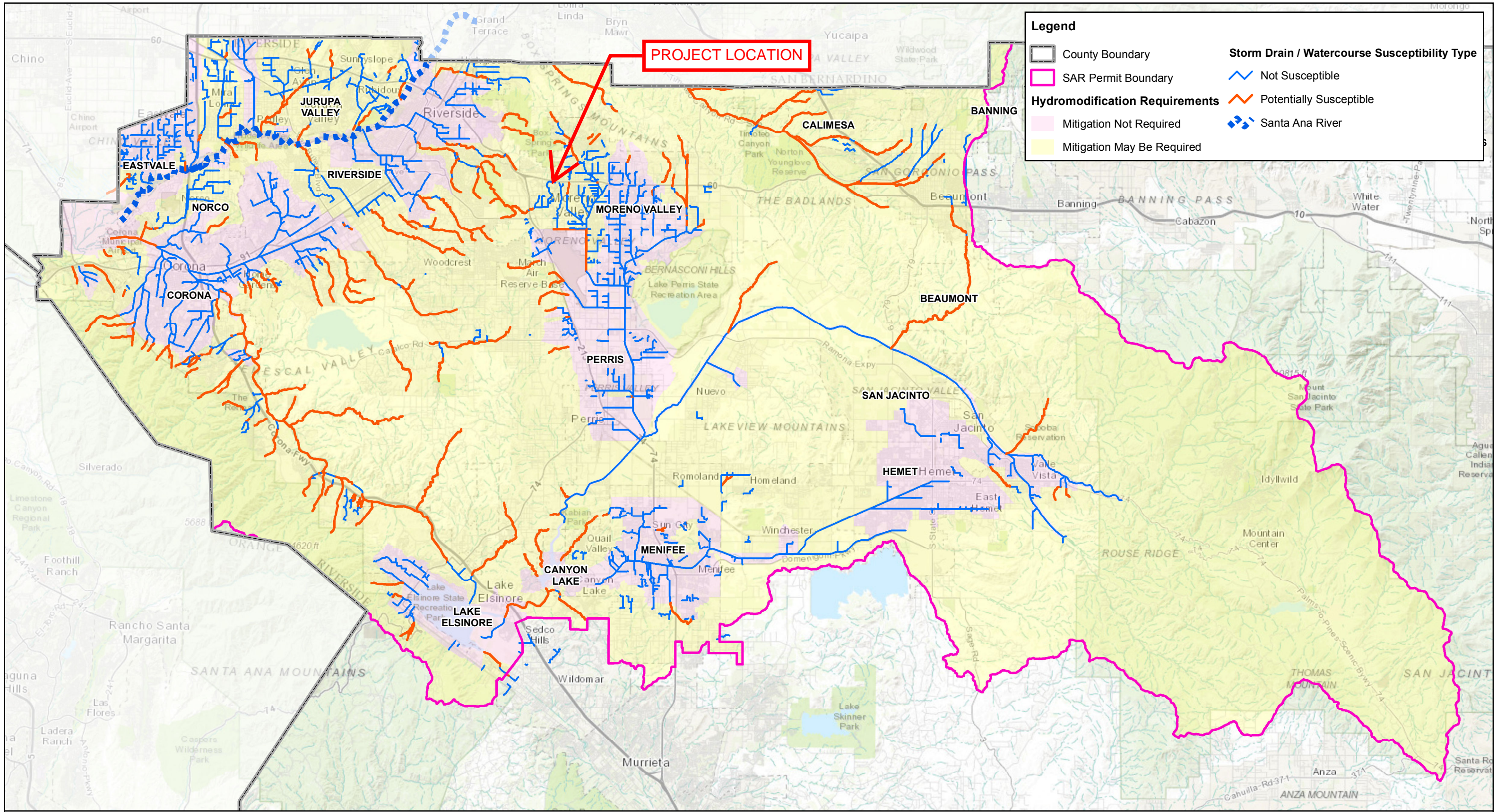
**MWS-L-8-16-4'-4"-C-UG**  
**STORMWATER BIOFILTRATION SYSTEM**  
**STANDARD DETAIL**

Z15/22GSHIPPER



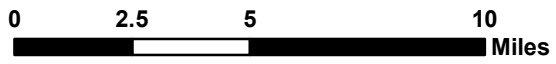
# Appendix 7: Hydromodification

*NOT APPLICABLE – PROJECT IS HCOC EXEMPT.*



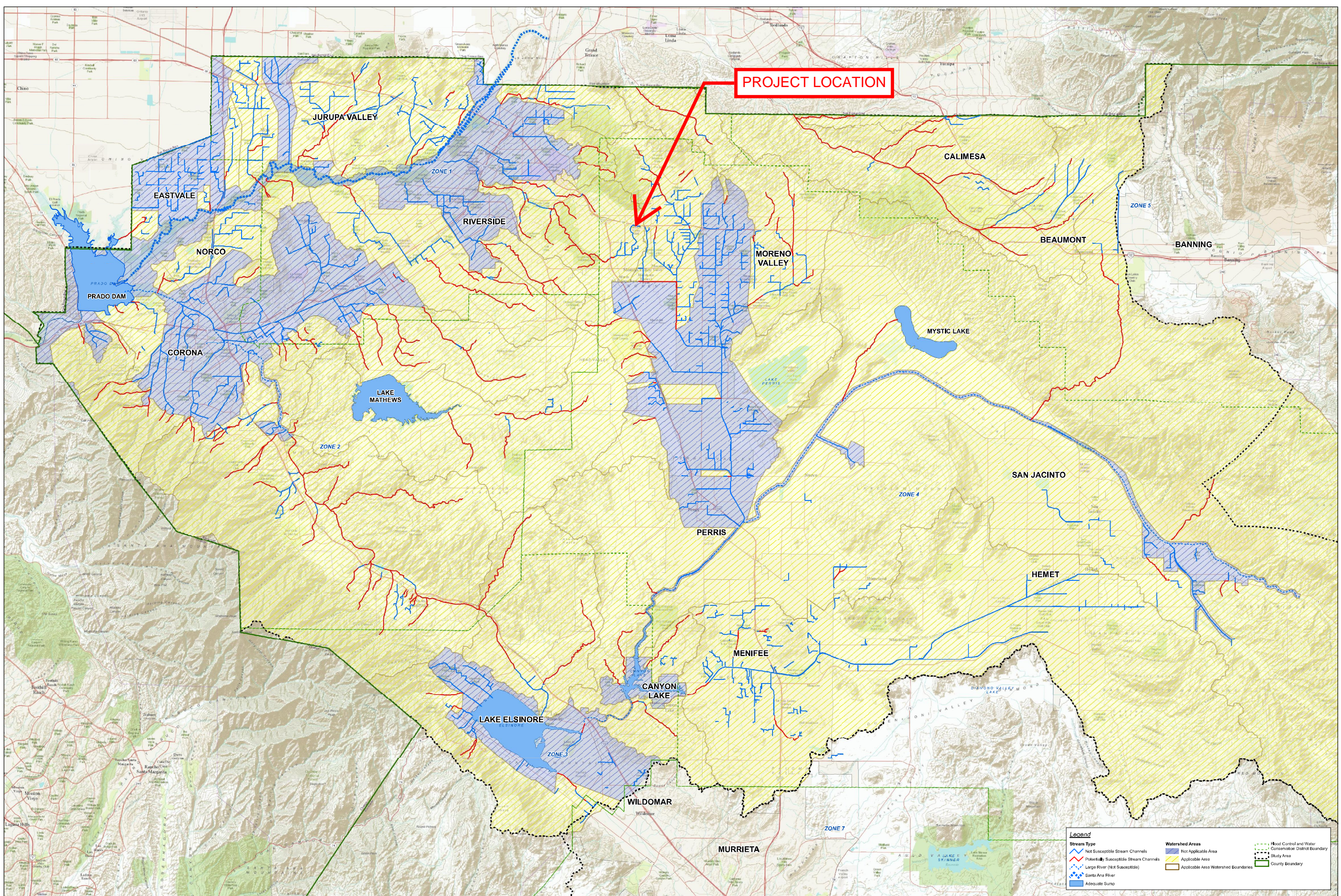
**Legend**

|                                       |  |
|---------------------------------------|--|
| County Boundary                       | <b>Storm Drain / Watercourse Susceptibility Type</b> |
| SAR Permit Boundary                   | Not Susceptible                                      |
| <b>Hydromodification Requirements</b> | Potentially Susceptible                              |
| Mitigation Not Required               | Santa Ana River                                      |
| Mitigation May Be Required            |  |



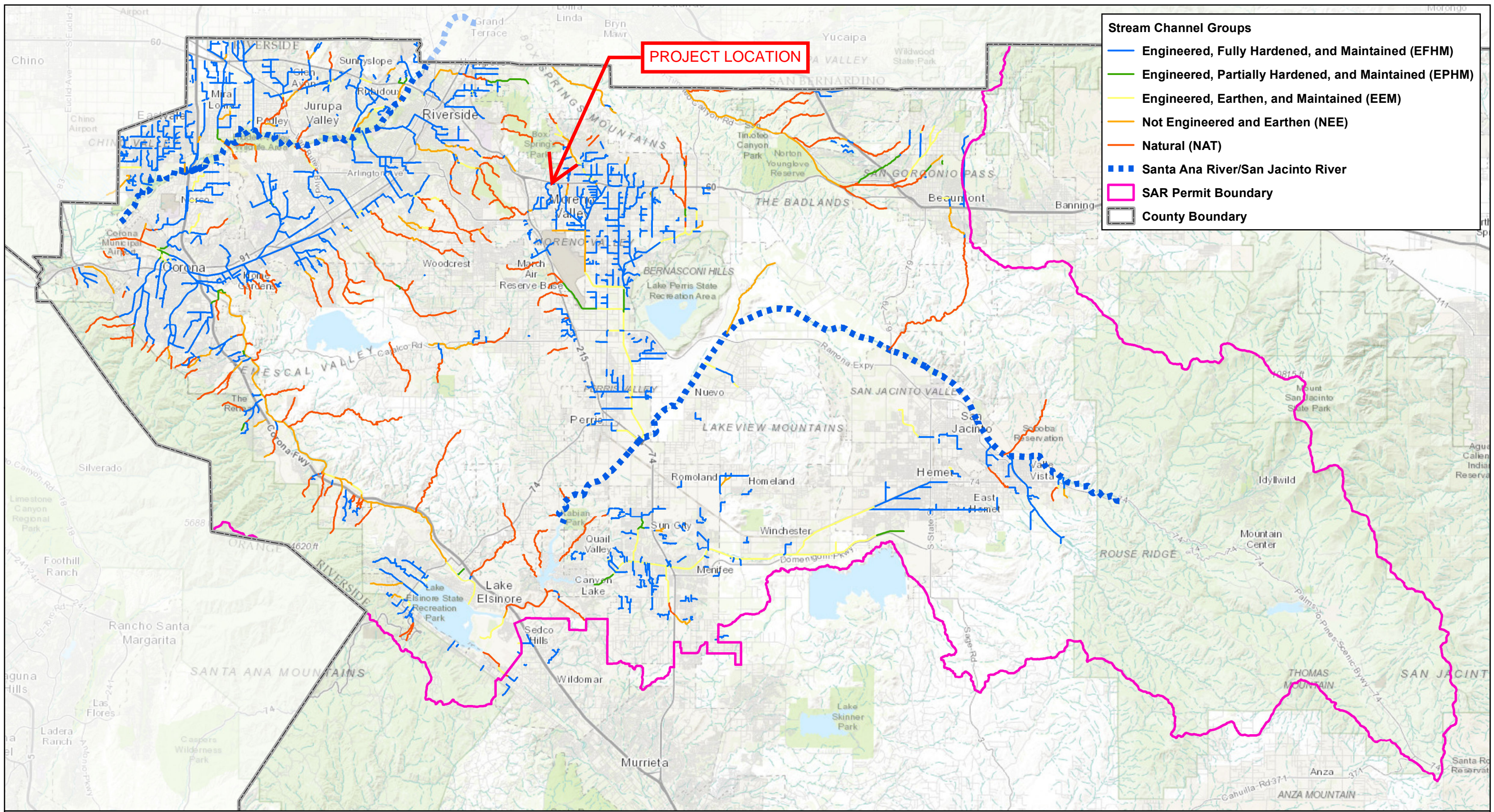
Updated February 2017

**HCOC Applicability Map  
SAR Permittees**



**PROJECT LOCATION**

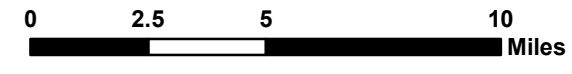
| Legend |  |
|--------|--|
|        | Stream Type  |
|        | Not Susceptible Stream Channels                        |
|        | Potentially Susceptible Stream Channels                |
|        | Large River (Not Susceptible)                          |
|        | Santa Ana River  |
|        | Adequate Sump  |
|        | Watershed Areas  |
|        | Not Applicable Area                                    |
|        | Applicable Area  |
|        | Applicable Area Watershed Boundaries                   |
|        | Flood Control and Water Conservation District Boundary |
|        | Conservation District Boundary                         |
|        | Study Area   |
|        | County Boundary  |



**Stream Channel Groups**

- Engineered, Fully Hardened, and Maintained (EFHM)
- Engineered, Partially Hardened, and Maintained (EPHM)
- Engineered, Earthen, and Maintained (EEM)
- Not Engineered and Earthen (NEE)
- Natural (NAT)
- - - Santa Ana River/San Jacinto River
- SAR Permit Boundary
- County Boundary

**PROJECT LOCATION**



Revised February 2017

**Existing Storm Drain / Watercourse Delineation Map  
SAR Permittees**

\*\*\*\*\*

RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM BASED ON  
RIVERSIDE COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT  
(RCFC&WCD) 1978 HYDROLOGY MANUAL  
(c) Copyright 1982-2011 Advanced Engineering Software (aes)  
(Rational Tabling Version 18.0)  
Release Date: 07/01/2011 License ID 1499

Analysis prepared by:

Kimley-Horn and Associates, Inc.  
765 The City Drive  
Suite 200  
Orange, CA 92868

\*\*\*\*\* DESCRIPTION OF STUDY \*\*\*\*\*  
\* MORENO VALLEY MALL REDEVELOPMENT \*  
\* EXISTING 2 YEAR HYDROLOGY \*  
\* \*  
\*\*\*\*\*

FILE NAME: MOVAL2.DAT  
TIME/DATE OF STUDY: 16:54 05/31/2022

-----  
USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:  
-----

USER SPECIFIED STORM EVENT(YEAR) = 2.00  
SPECIFIED MINIMUM PIPE SIZE(INCH) = 12.00  
SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95  
10-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) = 1.640  
10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 0.737  
100-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) = 2.660  
100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 1.190  
SLOPE OF 10-YEAR INTENSITY-DURATION CURVE = 0.4464123  
SLOPE OF 100-YEAR INTENSITY-DURATION CURVE = 0.4489289  
COMPUTED RAINFALL INTENSITY DATA:

STORM EVENT = 2.00 1-HOUR INTENSITY(INCH/HOUR) = 0.420  
SLOPE OF INTENSITY DURATION CURVE = 0.4464

SPECIFIED CONSTANT RUNOFF COEFFICIENT = 0.900

NOTE: COMPUTE CONFLUENCE VALUES ACCORDING TO RCFC&WCD HYDROLOGY MANUAL  
AND IGNORE OTHER CONFLUENCE COMBINATIONS FOR DOWNSTREAM ANALYSES

\*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL\*

| NO. | WIDTH<br>(FT) | CROWN TO<br>CROSSFALL<br>(FT) | STREET-CROSSFALL<br>IN- / OUT- / PARK-<br>SIDE / SIDE / WAY | CURB<br>HEIGHT<br>(FT) | GUTTER-GEOMETRIES<br>WIDTH<br>(FT) | LIP<br>(FT) | HIKE<br>(FT) | MANNING<br>FACTOR<br>(n) |
|-----|---------------|-------------------------------|---|------------------------|------------------------------------|-------------|--------------|--------------------------|
| 1   | 30.0          | 20.0                          | 0.018/0.018/0.020   | 0.67                   | 2.00                               | 0.0313      | 0.167        | 0.0150                   |

GLOBAL STREET FLOW-DEPTH CONSTRAINTS:

1. Relative Flow-Depth = 0.00 FEET  
as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
2. (Depth)\*(Velocity) Constraint = 6.0 (FT\*FT/S)

\*SIZE PIPE WITH A FLOW CAPACITY GREATER THAN  
OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.\*

\*\*\*\*\*  
FLOW PROCESS FROM NODE 100.00 TO NODE 101.00 IS CODE = 21  
-----

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<

=====

ASSUMED INITIAL SUBAREA UNIFORM  
DEVELOPMENT IS COMMERCIAL

TC = K\*[(LENGTH\*\*3)/(ELEVATION CHANGE)]\*\*.2  
INITIAL SUBAREA FLOW-LENGTH(FEET) = 100.00  
UPSTREAM ELEVATION(FEET) = 1612.48  
DOWNSTREAM ELEVATION(FEET) = 1611.80  
ELEVATION DIFFERENCE(FEET) = 0.68  
TC = 0.303\*[(100.00\*\*3)/(0.68)]\*\*.2 = 5.189  
2 YEAR RAINFALL INTENSITY(INCH/HOUR) = 1.254  
\*USER SPECIFIED(GLOBAL):  
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000  
SUBAREA RUNOFF(CFS) = 0.11  
TOTAL AREA(ACRES) = 0.10 TOTAL RUNOFF(CFS) = 0.11

\*\*\*\*\*  
FLOW PROCESS FROM NODE 101.00 TO NODE 102.00 IS CODE = 51  
-----

>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<  
>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<

=====

ELEVATION DATA: UPSTREAM(FEET) = 1611.80 DOWNSTREAM(FEET) = 1607.85  
CHANNEL LENGTH THRU SUBAREA(FEET) = 281.38 CHANNEL SLOPE = 0.0140  
CHANNEL BASE(FEET) = 0.00 "Z" FACTOR = 99.000  
MANNING'S FACTOR = 0.015 MAXIMUM DEPTH(FEET) = 0.50  
2 YEAR RAINFALL INTENSITY(INCH/HOUR) = 1.019  
\*USER SPECIFIED(GLOBAL):  
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000  
TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) = 1.58  
TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) = 1.53  
AVERAGE FLOW DEPTH(FEET) = 0.10 TRAVEL TIME(MIN.) = 3.06  
Tc(MIN.) = 8.25  
SUBAREA AREA(ACRES) = 3.13 SUBAREA RUNOFF(CFS) = 2.87  
TOTAL AREA(ACRES) = 3.2 PEAK FLOW RATE(CFS) = 2.98

END OF SUBAREA CHANNEL FLOW HYDRAULICS:  
DEPTH(FEET) = 0.13 FLOW VELOCITY(FEET/SEC.) = 1.87  
LONGEST FLOWPATH FROM NODE 100.00 TO NODE 102.00 = 381.38 FEET.

\*\*\*\*\*  
FLOW PROCESS FROM NODE 102.00 TO NODE 102.00 IS CODE = 81  
-----

>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

=====

2 YEAR RAINFALL INTENSITY(INCH/HOUR) = 1.019  
\*USER SPECIFIED(GLOBAL):  
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000  
SUBAREA AREA(ACRES) = 3.13 SUBAREA RUNOFF(CFS) = 2.87  
TOTAL AREA(ACRES) = 6.4 TOTAL RUNOFF(CFS) = 5.86  
TC(MIN.) = 8.25

\*\*\*\*\*  
FLOW PROCESS FROM NODE 102.00 TO NODE 103.00 IS CODE = 31  
-----

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<  
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

=====

ELEVATION DATA: UPSTREAM(FEET) = 1602.50 DOWNSTREAM(FEET) = 1602.00  
FLOW LENGTH(FEET) = 51.80 MANNING'S N = 0.013  
DEPTH OF FLOW IN 15.0 INCH PIPE IS 11.6 INCHES  
PIPE-FLOW VELOCITY(FEET/SEC.) = 5.74  
ESTIMATED PIPE DIAMETER(INCH) = 15.00 NUMBER OF PIPES = 1  
PIPE-FLOW(CFS) = 5.86  
PIPE TRAVEL TIME(MIN.) = 0.15 Tc(MIN.) = 8.40  
LONGEST FLOWPATH FROM NODE 100.00 TO NODE 103.00 = 433.18 FEET.

```

*****
FLOW PROCESS FROM NODE    103.00 TO NODE    104.00 IS CODE = 31
-----
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 1602.00  DOWNSTREAM(FEET) = 1598.58
FLOW LENGTH(FEET) = 397.87  MANNING'S N = 0.013
DEPTH OF FLOW IN 18.0 INCH PIPE IS 10.2 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 5.65
ESTIMATED PIPE DIAMETER(INCH) = 18.00  NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 5.86
PIPE TRAVEL TIME(MIN.) = 1.17  Tc(MIN.) = 9.57
LONGEST FLOWPATH FROM NODE    100.00 TO NODE    104.00 = 831.05 FEET.

*****
FLOW PROCESS FROM NODE    104.00 TO NODE    104.00 IS CODE = 81
-----
>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<
=====
2 YEAR RAINFALL INTENSITY(INCH/HOUR) = 0.954
*USER SPECIFIED(GLOBAL):
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000
SUBAREA AREA(ACRES) = 8.61  SUBAREA RUNOFF(CFS) = 7.39
TOTAL AREA(ACRES) = 15.0  TOTAL RUNOFF(CFS) = 13.25
TC(MIN.) = 9.57

*****
FLOW PROCESS FROM NODE    104.00 TO NODE    105.00 IS CODE = 31
-----
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 1598.58  DOWNSTREAM(FEET) = 1597.00
FLOW LENGTH(FEET) = 502.90  MANNING'S N = 0.013
DEPTH OF FLOW IN 27.0 INCH PIPE IS 18.0 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 4.71
ESTIMATED PIPE DIAMETER(INCH) = 27.00  NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 13.25
PIPE TRAVEL TIME(MIN.) = 1.78  Tc(MIN.) = 11.35
LONGEST FLOWPATH FROM NODE    100.00 TO NODE    105.00 = 1333.95 FEET.

*****
FLOW PROCESS FROM NODE    105.00 TO NODE    105.00 IS CODE = 81
-----
>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<
=====
2 YEAR RAINFALL INTENSITY(INCH/HOUR) = 0.884
*USER SPECIFIED(GLOBAL):
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000
SUBAREA AREA(ACRES) = 0.52  SUBAREA RUNOFF(CFS) = 0.41
TOTAL AREA(ACRES) = 15.5  TOTAL RUNOFF(CFS) = 13.66
TC(MIN.) = 11.35

*****
FLOW PROCESS FROM NODE    105.00 TO NODE    106.00 IS CODE = 31
-----
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 1597.00  DOWNSTREAM(FEET) = 1595.98
FLOW LENGTH(FEET) = 454.12  MANNING'S N = 0.013
DEPTH OF FLOW IN 27.0 INCH PIPE IS 21.1 INCHES

```

PIPE-FLOW VELOCITY(FEET/SEC.) = 4.10  
ESTIMATED PIPE DIAMETER(INCH) = 27.00 NUMBER OF PIPES = 1  
PIPE-FLOW(CFS) = 13.66  
PIPE TRAVEL TIME(MIN.) = 1.85 Tc(MIN.) = 13.20  
LONGEST FLOWPATH FROM NODE 100.00 TO NODE 106.00 = 1788.07 FEET.

\*\*\*\*\*  
FLOW PROCESS FROM NODE 106.00 TO NODE 106.00 IS CODE = 81  
-----

>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

=====

2 YEAR RAINFALL INTENSITY(INCH/HOUR) = 0.826  
\*USER SPECIFIED(GLOBAL):  
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000  
SUBAREA AREA(ACRES) = 4.63 SUBAREA RUNOFF(CFS) = 3.44  
TOTAL AREA(ACRES) = 20.1 TOTAL RUNOFF(CFS) = 17.10  
TC(MIN.) = 13.20

\*\*\*\*\*  
FLOW PROCESS FROM NODE 106.00 TO NODE 107.00 IS CODE = 31  
-----

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<  
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

=====

ELEVATION DATA: UPSTREAM(FEET) = 1595.98 DOWNSTREAM(FEET) = 1595.89  
FLOW LENGTH(FEET) = 506.94 MANNING'S N = 0.013  
DEPTH OF FLOW IN 48.0 INCH PIPE IS 36.2 INCHES  
PIPE-FLOW VELOCITY(FEET/SEC.) = 1.68  
ESTIMATED PIPE DIAMETER(INCH) = 48.00 NUMBER OF PIPES = 1  
PIPE-FLOW(CFS) = 17.10  
PIPE TRAVEL TIME(MIN.) = 5.02 Tc(MIN.) = 18.22  
LONGEST FLOWPATH FROM NODE 100.00 TO NODE 107.00 = 2295.01 FEET.

\*\*\*\*\*  
FLOW PROCESS FROM NODE 107.00 TO NODE 107.00 IS CODE = 81  
-----

>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

=====

2 YEAR RAINFALL INTENSITY(INCH/HOUR) = 0.716  
\*USER SPECIFIED(GLOBAL):  
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000  
SUBAREA AREA(ACRES) = 1.90 SUBAREA RUNOFF(CFS) = 1.22  
TOTAL AREA(ACRES) = 22.0 TOTAL RUNOFF(CFS) = 18.33  
TC(MIN.) = 18.22

\*\*\*\*\*  
FLOW PROCESS FROM NODE 107.00 TO NODE 108.00 IS CODE = 31  
-----

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<  
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

=====

ELEVATION DATA: UPSTREAM(FEET) = 1595.89 DOWNSTREAM(FEET) = 1593.80  
FLOW LENGTH(FEET) = 397.71 MANNING'S N = 0.013  
DEPTH OF FLOW IN 27.0 INCH PIPE IS 18.9 INCHES  
PIPE-FLOW VELOCITY(FEET/SEC.) = 6.16  
ESTIMATED PIPE DIAMETER(INCH) = 27.00 NUMBER OF PIPES = 1  
PIPE-FLOW(CFS) = 18.33  
PIPE TRAVEL TIME(MIN.) = 1.08 Tc(MIN.) = 19.29  
LONGEST FLOWPATH FROM NODE 100.00 TO NODE 108.00 = 2692.72 FEET.

\*\*\*\*\*  
FLOW PROCESS FROM NODE 108.00 TO NODE 108.00 IS CODE = 81  
-----



```

>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<
=====
      2 YEAR RAINFALL INTENSITY(INCH/HOUR) = 0.698
*USER SPECIFIED(GLOBAL):
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000
SUBAREA AREA(ACRES) =      2.82  SUBAREA RUNOFF(CFS) =      1.77
TOTAL AREA(ACRES) =      24.8  TOTAL RUNOFF(CFS) =      20.10
TC(MIN.) =      19.29

*****
FLOW PROCESS FROM NODE      108.00 TO NODE      109.00 IS CODE = 31
-----
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 1593.80  DOWNSTREAM(FEET) = 1591.60
FLOW LENGTH(FEET) = 482.30  MANNING'S N = 0.013
DEPTH OF FLOW IN 27.0 INCH PIPE IS 21.8 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 5.84
ESTIMATED PIPE DIAMETER(INCH) = 27.00  NUMBER OF PIPES = 1
PIPE-FLOW(CFS) =      20.10
PIPE TRAVEL TIME(MIN.) = 1.38  Tc(MIN.) = 20.67
LONGEST FLOWPATH FROM NODE      100.00 TO NODE      109.00 =      3175.02 FEET.

*****
FLOW PROCESS FROM NODE      109.00 TO NODE      109.00 IS CODE = 81
-----
>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<
=====
      2 YEAR RAINFALL INTENSITY(INCH/HOUR) = 0.676
*USER SPECIFIED(GLOBAL):
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000
SUBAREA AREA(ACRES) =      16.45  SUBAREA RUNOFF(CFS) =      10.01
TOTAL AREA(ACRES) =      41.3  TOTAL RUNOFF(CFS) =      30.11
TC(MIN.) =      20.67

*****
FLOW PROCESS FROM NODE      109.00 TO NODE      110.00 IS CODE = 31
-----
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 1591.60  DOWNSTREAM(FEET) = 1590.20
FLOW LENGTH(FEET) = 501.47  MANNING'S N = 0.013
DEPTH OF FLOW IN 36.0 INCH PIPE IS 26.1 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 5.48
ESTIMATED PIPE DIAMETER(INCH) = 36.00  NUMBER OF PIPES = 1
PIPE-FLOW(CFS) =      30.11
PIPE TRAVEL TIME(MIN.) = 1.53  Tc(MIN.) = 22.20
LONGEST FLOWPATH FROM NODE      100.00 TO NODE      110.00 =      3676.49 FEET.

*****
FLOW PROCESS FROM NODE      110.00 TO NODE      110.00 IS CODE = 81
-----
>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<
=====
      2 YEAR RAINFALL INTENSITY(INCH/HOUR) = 0.655
*USER SPECIFIED(GLOBAL):
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000
SUBAREA AREA(ACRES) =      6.10  SUBAREA RUNOFF(CFS) =      3.60
TOTAL AREA(ACRES) =      47.4  TOTAL RUNOFF(CFS) =      33.71
TC(MIN.) =      22.20

```

```

*****
FLOW PROCESS FROM NODE    110.00 TO NODE    111.00 IS CODE = 31
-----
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 1590.20  DOWNSTREAM(FEET) = 1588.44
FLOW LENGTH(FEET) = 494.26  MANNING'S N = 0.013
DEPTH OF FLOW IN 36.0 INCH PIPE IS 25.9 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 6.18
ESTIMATED PIPE DIAMETER(INCH) = 36.00  NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 33.71
PIPE TRAVEL TIME(MIN.) = 1.33  Tc(MIN.) = 23.53
LONGEST FLOWPATH FROM NODE 100.00 TO NODE 111.00 = 4170.75 FEET.

*****
FLOW PROCESS FROM NODE    111.00 TO NODE    111.00 IS CODE = 81
-----
>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<
=====
2 YEAR RAINFALL INTENSITY(INCH/HOUR) = 0.638
*USER SPECIFIED(GLOBAL):
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000
SUBAREA AREA(ACRES) = 9.01  SUBAREA RUNOFF(CFS) = 5.18
TOTAL AREA(ACRES) = 56.4  TOTAL RUNOFF(CFS) = 38.89
TC(MIN.) = 23.53

*****
FLOW PROCESS FROM NODE    111.00 TO NODE    112.00 IS CODE = 31
-----
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 1588.44  DOWNSTREAM(FEET) = 1586.08
FLOW LENGTH(FEET) = 410.44  MANNING'S N = 0.013
DEPTH OF FLOW IN 33.0 INCH PIPE IS 26.9 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 7.50
ESTIMATED PIPE DIAMETER(INCH) = 33.00  NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 38.89
PIPE TRAVEL TIME(MIN.) = 0.91  Tc(MIN.) = 24.44
LONGEST FLOWPATH FROM NODE 100.00 TO NODE 112.00 = 4581.19 FEET.

*****
FLOW PROCESS FROM NODE    112.00 TO NODE    112.00 IS CODE = 1
-----
>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<
=====
TOTAL NUMBER OF STREAMS = 2
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 1 ARE:
TIME OF CONCENTRATION(MIN.) = 24.44
RAINFALL INTENSITY(INCH/HR) = 0.63
TOTAL STREAM AREA(ACRES) = 56.40
PEAK FLOW RATE(CFS) AT CONFLUENCE = 38.89

*****
FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE = 21
-----
>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<
=====
ASSUMED INITIAL SUBAREA UNIFORM
DEVELOPMENT IS COMMERCIAL
TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
INITIAL SUBAREA FLOW-LENGTH(FEET) = 100.00

```

UPSTREAM ELEVATION(FEET) = 1612.37  
DOWNSTREAM ELEVATION(FEET) = 1611.24  
ELEVATION DIFFERENCE(FEET) = 1.13  
TC = 0.303\*[( 100.00\*\*3)/( 1.13)]\*\*.2 = 4.688  
COMPUTED TIME OF CONCENTRATION INCREASED TO 5 MIN.  
2 YEAR RAINFALL INTENSITY(INCH/HOUR) = 1.275  
\*USER SPECIFIED(GLOBAL):  
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000  
SUBAREA RUNOFF(CFS) = 0.11  
TOTAL AREA(ACRES) = 0.10 TOTAL RUNOFF(CFS) = 0.11

\*\*\*\*\*  
FLOW PROCESS FROM NODE 201.00 TO NODE 202.00 IS CODE = 51  
-----

>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<  
>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<

=====

ELEVATION DATA: UPSTREAM(FEET) = 1611.24 DOWNSTREAM(FEET) = 1607.90  
CHANNEL LENGTH THRU SUBAREA(FEET) = 232.00 CHANNEL SLOPE = 0.0144  
CHANNEL BASE(FEET) = 0.00 "Z" FACTOR = 99.000  
MANNING'S FACTOR = 0.015 MAXIMUM DEPTH(FEET) = 0.50  
2 YEAR RAINFALL INTENSITY(INCH/HOUR) = 1.067

\*USER SPECIFIED(GLOBAL):  
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000  
TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) = 1.63  
TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) = 1.58  
AVERAGE FLOW DEPTH(FEET) = 0.10 TRAVEL TIME(MIN.) = 2.45  
Tc(MIN.) = 7.45  
SUBAREA AREA(ACRES) = 3.14 SUBAREA RUNOFF(CFS) = 3.01  
TOTAL AREA(ACRES) = 3.2 PEAK FLOW RATE(CFS) = 3.13

END OF SUBAREA CHANNEL FLOW HYDRAULICS:  
DEPTH(FEET) = 0.13 FLOW VELOCITY(FEET/SEC.) = 1.96  
LONGEST FLOWPATH FROM NODE 200.00 TO NODE 202.00 = 332.00 FEET.

\*\*\*\*\*  
FLOW PROCESS FROM NODE 202.00 TO NODE 202.00 IS CODE = 81  
-----

>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

=====

2 YEAR RAINFALL INTENSITY(INCH/HOUR) = 1.067  
\*USER SPECIFIED(GLOBAL):  
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000  
SUBAREA AREA(ACRES) = 3.14 SUBAREA RUNOFF(CFS) = 3.01  
TOTAL AREA(ACRES) = 6.4 TOTAL RUNOFF(CFS) = 6.14  
TC(MIN.) = 7.45

\*\*\*\*\*  
FLOW PROCESS FROM NODE 202.00 TO NODE 203.00 IS CODE = 31  
-----

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<  
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

=====

ELEVATION DATA: UPSTREAM(FEET) = 1601.75 DOWNSTREAM(FEET) = 1601.50  
FLOW LENGTH(FEET) = 247.00 MANNING'S N = 0.013  
DEPTH OF FLOW IN 24.0 INCH PIPE IS 17.4 INCHES  
PIPE-FLOW VELOCITY(FEET/SEC.) = 2.52  
ESTIMATED PIPE DIAMETER(INCH) = 24.00 NUMBER OF PIPES = 1  
PIPE-FLOW(CFS) = 6.14  
PIPE TRAVEL TIME(MIN.) = 1.64 Tc(MIN.) = 9.09  
LONGEST FLOWPATH FROM NODE 200.00 TO NODE 203.00 = 579.00 FEET.

\*\*\*\*\*

FLOW PROCESS FROM NODE 203.00 TO NODE 204.00 IS CODE = 31

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<  
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<

ELEVATION DATA: UPSTREAM(FEET) = 1601.50 DOWNSTREAM(FEET) = 1598.78  
FLOW LENGTH(FEET) = 1147.74 MANNING'S N = 0.013  
DEPTH OF FLOW IN 21.0 INCH PIPE IS 14.4 INCHES  
PIPE-FLOW VELOCITY(FEET/SEC.) = 3.49  
ESTIMATED PIPE DIAMETER(INCH) = 21.00 NUMBER OF PIPES = 1  
PIPE-FLOW(CFS) = 6.14  
PIPE TRAVEL TIME(MIN.) = 5.49 Tc(MIN.) = 14.57  
LONGEST FLOWPATH FROM NODE 200.00 TO NODE 204.00 = 1726.74 FEET.

\*\*\*\*\*  
FLOW PROCESS FROM NODE 204.00 TO NODE 204.00 IS CODE = 81

>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<

2 YEAR RAINFALL INTENSITY(INCH/HOUR) = 0.791  
\*USER SPECIFIED(GLOBAL):  
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000  
SUBAREA AREA(ACRES) = 11.72 SUBAREA RUNOFF(CFS) = 8.34  
TOTAL AREA(ACRES) = 18.1 TOTAL RUNOFF(CFS) = 14.48  
TC(MIN.) = 14.57

\*\*\*\*\*  
FLOW PROCESS FROM NODE 204.00 TO NODE 205.00 IS CODE = 31

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<  
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<

ELEVATION DATA: UPSTREAM(FEET) = 1598.78 DOWNSTREAM(FEET) = 1597.90  
FLOW LENGTH(FEET) = 206.68 MANNING'S N = 0.013  
DEPTH OF FLOW IN 27.0 INCH PIPE IS 17.2 INCHES  
PIPE-FLOW VELOCITY(FEET/SEC.) = 5.41  
ESTIMATED PIPE DIAMETER(INCH) = 27.00 NUMBER OF PIPES = 1  
PIPE-FLOW(CFS) = 14.48  
PIPE TRAVEL TIME(MIN.) = 0.64 Tc(MIN.) = 15.21  
LONGEST FLOWPATH FROM NODE 200.00 TO NODE 205.00 = 1933.42 FEET.

\*\*\*\*\*  
FLOW PROCESS FROM NODE 205.00 TO NODE 205.00 IS CODE = 81

>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<

2 YEAR RAINFALL INTENSITY(INCH/HOUR) = 0.776  
\*USER SPECIFIED(GLOBAL):  
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000  
SUBAREA AREA(ACRES) = 1.96 SUBAREA RUNOFF(CFS) = 1.37  
TOTAL AREA(ACRES) = 20.1 TOTAL RUNOFF(CFS) = 15.85  
TC(MIN.) = 15.21

\*\*\*\*\*  
FLOW PROCESS FROM NODE 205.00 TO NODE 206.00 IS CODE = 31

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<  
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<

ELEVATION DATA: UPSTREAM(FEET) = 1597.90 DOWNSTREAM(FEET) = 1596.70  
FLOW LENGTH(FEET) = 237.58 MANNING'S N = 0.013  
DEPTH OF FLOW IN 27.0 INCH PIPE IS 17.3 INCHES  
PIPE-FLOW VELOCITY(FEET/SEC.) = 5.90

ESTIMATED PIPE DIAMETER(INCH) = 27.00 NUMBER OF PIPES = 1  
PIPE-FLOW(CFS) = 15.85  
PIPE TRAVEL TIME(MIN.) = 0.67 Tc(MIN.) = 15.88  
LONGEST FLOWPATH FROM NODE 200.00 TO NODE 206.00 = 2171.00 FEET.

\*\*\*\*\*  
FLOW PROCESS FROM NODE 206.00 TO NODE 206.00 IS CODE = 81

-----  
>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<

=====

2 YEAR RAINFALL INTENSITY(INCH/HOUR) = 0.761  
\*USER SPECIFIED(GLOBAL):  
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000  
SUBAREA AREA(ACRES) = 0.38 SUBAREA RUNOFF(CFS) = 0.26  
TOTAL AREA(ACRES) = 20.4 TOTAL RUNOFF(CFS) = 16.11  
TC(MIN.) = 15.88

\*\*\*\*\*  
FLOW PROCESS FROM NODE 206.00 TO NODE 207.00 IS CODE = 31

-----  
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<  
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<

=====

ELEVATION DATA: UPSTREAM(FEET) = 1596.70 DOWNSTREAM(FEET) = 1594.00  
FLOW LENGTH(FEET) = 393.08 MANNING'S N = 0.013  
DEPTH OF FLOW IN 24.0 INCH PIPE IS 17.5 INCHES  
PIPE-FLOW VELOCITY(FEET/SEC.) = 6.57  
ESTIMATED PIPE DIAMETER(INCH) = 24.00 NUMBER OF PIPES = 1  
PIPE-FLOW(CFS) = 16.11  
PIPE TRAVEL TIME(MIN.) = 1.00 Tc(MIN.) = 16.88  
LONGEST FLOWPATH FROM NODE 200.00 TO NODE 207.00 = 2564.08 FEET.

\*\*\*\*\*  
FLOW PROCESS FROM NODE 207.00 TO NODE 207.00 IS CODE = 81

-----  
>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<

=====

2 YEAR RAINFALL INTENSITY(INCH/HOUR) = 0.740  
\*USER SPECIFIED(GLOBAL):  
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000  
SUBAREA AREA(ACRES) = 6.86 SUBAREA RUNOFF(CFS) = 4.57  
TOTAL AREA(ACRES) = 27.3 TOTAL RUNOFF(CFS) = 20.68  
TC(MIN.) = 16.88

\*\*\*\*\*  
FLOW PROCESS FROM NODE 207.00 TO NODE 208.00 IS CODE = 31

-----  
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<  
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<

=====

ELEVATION DATA: UPSTREAM(FEET) = 1594.00 DOWNSTREAM(FEET) = 1590.45  
FLOW LENGTH(FEET) = 548.29 MANNING'S N = 0.013  
DEPTH OF FLOW IN 27.0 INCH PIPE IS 19.1 INCHES  
PIPE-FLOW VELOCITY(FEET/SEC.) = 6.86  
ESTIMATED PIPE DIAMETER(INCH) = 27.00 NUMBER OF PIPES = 1  
PIPE-FLOW(CFS) = 20.68  
PIPE TRAVEL TIME(MIN.) = 1.33 Tc(MIN.) = 18.21  
LONGEST FLOWPATH FROM NODE 200.00 TO NODE 208.00 = 3112.37 FEET.

\*\*\*\*\*  
FLOW PROCESS FROM NODE 208.00 TO NODE 208.00 IS CODE = 81

-----  
>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<

```

=====
      2 YEAR RAINFALL INTENSITY(INCH/HOUR) = 0.716
*USER SPECIFIED(GLOBAL):
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000
SUBAREA AREA(ACRES) = 5.41 SUBAREA RUNOFF(CFS) = 3.49
TOTAL AREA(ACRES) = 32.7 TOTAL RUNOFF(CFS) = 24.17
TC(MIN.) = 18.21

*****
FLOW PROCESS FROM NODE 208.00 TO NODE 209.00 IS CODE = 31
-----
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
-----
ELEVATION DATA: UPSTREAM(FEET) = 1590.45 DOWNSTREAM(FEET) = 1586.08
FLOW LENGTH(FEET) = 292.02 MANNING'S N = 0.013
DEPTH OF FLOW IN 24.0 INCH PIPE IS 17.7 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 9.71
ESTIMATED PIPE DIAMETER(INCH) = 24.00 NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 24.17
PIPE TRAVEL TIME(MIN.) = 0.50 Tc(MIN.) = 18.71
LONGEST FLOWPATH FROM NODE 200.00 TO NODE 209.00 = 3404.39 FEET.

*****
FLOW PROCESS FROM NODE 209.00 TO NODE 209.00 IS CODE = 1
-----
>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
-----
TOTAL NUMBER OF STREAMS = 2
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:
TIME OF CONCENTRATION(MIN.) = 18.71
RAINFALL INTENSITY(INCH/HR) = 0.71
TOTAL STREAM AREA(ACRES) = 32.71
PEAK FLOW RATE(CFS) AT CONFLUENCE = 24.17

** CONFLUENCE DATA **
STREAM RUNOFF Tc INTENSITY AREA
NUMBER (CFS) (MIN.) (INCH/HOUR) (ACRE)
1 38.89 24.44 0.628 56.40
2 24.17 18.71 0.707 32.71

*****WARNING*****
IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED
ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA
WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.
*****

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
CONFLUENCE FORMULA USED FOR 2 STREAMS.

** PEAK FLOW RATE TABLE **
STREAM RUNOFF Tc INTENSITY
NUMBER (CFS) (MIN.) (INCH/HOUR)
1 53.94 18.71 0.707
2 60.34 24.44 0.628

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) = 60.34 Tc(MIN.) = 24.44
TOTAL AREA(ACRES) = 89.1
LONGEST FLOWPATH FROM NODE 100.00 TO NODE 209.00 = 4581.19 FEET.
=====
END OF STUDY SUMMARY:

```

TOTAL AREA(ACRES) = 89.1 TC(MIN.) = 24.44  
PEAK FLOW RATE(CFS) = 60.34

=====  
=====

END OF RATIONAL METHOD ANALYSIS

\*\*\*\*\*

RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM BASED ON  
RIVERSIDE COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT  
(RCFC&WCD) 1978 HYDROLOGY MANUAL  
(c) Copyright 1982-2011 Advanced Engineering Software (aes)  
(Rational Tabling Version 18.0)  
Release Date: 07/01/2011 License ID 1499

Analysis prepared by:

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\*\*\*\*\* DESCRIPTION OF STUDY \*\*\*\*\*  
\* MORENO VALLEY MALL REDEVELOPMENT \*  
\* PROPOSED 2 YEAR \*  
\* \*  
\*\*\*\*\*

FILE NAME: MOVAL4.DAT  
TIME/DATE OF STUDY: 17:32 05/31/2022

-----  
USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:  
-----

USER SPECIFIED STORM EVENT(YEAR) = 2.00  
SPECIFIED MINIMUM PIPE SIZE(INCH) = 12.00  
SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95  
10-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) = 1.640  
10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 0.737  
100-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) = 2.660  
100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) = 1.190  
SLOPE OF 10-YEAR INTENSITY-DURATION CURVE = 0.4464123  
SLOPE OF 100-YEAR INTENSITY-DURATION CURVE = 0.4489289  
COMPUTED RAINFALL INTENSITY DATA:

STORM EVENT = 2.00 1-HOUR INTENSITY(INCH/HOUR) = 0.420  
SLOPE OF INTENSITY DURATION CURVE = 0.4464  
SPECIFIED CONSTANT RUNOFF COEFFICIENT = 0.900

NOTE: COMPUTE CONFLUENCE VALUES ACCORDING TO RCFC&WCD HYDROLOGY MANUAL  
AND IGNORE OTHER CONFLUENCE COMBINATIONS FOR DOWNSTREAM ANALYSES

\*USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL\*

| NO. | WIDTH<br>(FT) | CROSSFALL<br>(FT) | IN- /<br>SIDE /   | OUT- /<br>SIDE / | PARK-<br>WAY | HEIGHT<br>(FT) | CURB<br>WIDTH<br>(FT) | GUTTER-<br>LIP<br>(FT) | GEOMETRIES:<br>HIKE<br>(FT) | MANNING<br>FACTOR<br>(n) |
|-----|---------------|-------------------|-------------------|------------------|--------------|----------------|-----------------------|------------------------|-----------------------------|--------------------------|
| 1   | 30.0          | 20.0              | 0.018/0.018/0.020 |                  |              | 0.67           | 2.00                  | 0.0313                 | 0.167                       | 0.0150                   |

GLOBAL STREET FLOW-DEPTH CONSTRAINTS:

1. Relative Flow-Depth = 0.00 FEET  
as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
  2. (Depth)\*(Velocity) Constraint = 6.0 (FT\*FT/S)
- \*SIZE PIPE WITH A FLOW CAPACITY GREATER THAN  
OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.\*

\*\*\*\*\*  
FLOW PROCESS FROM NODE 97.00 TO NODE 98.00 IS CODE = 21  
-----

>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<

=====

ASSUMED INITIAL SUBAREA UNIFORM  
DEVELOPMENT IS COMMERCIAL



```

TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
INITIAL SUBAREA FLOW-LENGTH(FEET) = 100.00
UPSTREAM ELEVATION(FEET) = 1636.67
DOWNSTREAM ELEVATION(FEET) = 1633.33
ELEVATION DIFFERENCE(FEET) = 3.34
TC = 0.303*[(100.00**3)/(3.34)]**.2 = 3.774
COMPUTED TIME OF CONCENTRATION INCREASED TO 5 MIN.
2 YEAR RAINFALL INTENSITY(INCH/HOUR) = 1.275
*USER SPECIFIED(GLOBAL):
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000
SUBAREA RUNOFF(CFS) = 0.11
TOTAL AREA(ACRES) = 0.10 TOTAL RUNOFF(CFS) = 0.11

```

```

*****
FLOW PROCESS FROM NODE 98.00 TO NODE 99.00 IS CODE = 51
-----

```

```

>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<
>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 1633.33 DOWNSTREAM(FEET) = 1607.27
CHANNEL LENGTH THRU SUBAREA(FEET) = 737.50 CHANNEL SLOPE = 0.0353
CHANNEL BASE(FEET) = 0.00 "Z" FACTOR = 99.000
MANNING'S FACTOR = 0.015 MAXIMUM DEPTH(FEET) = 0.50
2 YEAR RAINFALL INTENSITY(INCH/HOUR) = 0.847
*USER SPECIFIED(GLOBAL):
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000
TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) = 0.30
TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) = 1.64
AVERAGE FLOW DEPTH(FEET) = 0.04 TRAVEL TIME(MIN.) = 7.49
Tc(MIN.) = 12.49
SUBAREA AREA(ACRES) = 0.49 SUBAREA RUNOFF(CFS) = 0.37
TOTAL AREA(ACRES) = 0.6 PEAK FLOW RATE(CFS) = 0.49

```

```

END OF SUBAREA CHANNEL FLOW HYDRAULICS:
DEPTH(FEET) = 0.06 FLOW VELOCITY(FEET/SEC.) = 1.56
LONGEST FLOWPATH FROM NODE 97.00 TO NODE 99.00 = 837.50 FEET.

```

```

*****
FLOW PROCESS FROM NODE 99.00 TO NODE 99.00 IS CODE = 81
-----

```

```

>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<
=====
2 YEAR RAINFALL INTENSITY(INCH/HOUR) = 0.847
*USER SPECIFIED(GLOBAL):
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000
SUBAREA AREA(ACRES) = 0.49 SUBAREA RUNOFF(CFS) = 0.37
TOTAL AREA(ACRES) = 1.1 TOTAL RUNOFF(CFS) = 0.86
TC(MIN.) = 12.49

```

```

*****
FLOW PROCESS FROM NODE 99.00 TO NODE 103.00 IS CODE = 31
-----

```

```

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 1603.27 DOWNSTREAM(FEET) = 1601.49
FLOW LENGTH(FEET) = 50.00 MANNING'S N = 0.013
ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000
DEPTH OF FLOW IN 12.0 INCH PIPE IS 2.9 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 5.78
ESTIMATED PIPE DIAMETER(INCH) = 12.00 NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 0.86
PIPE TRAVEL TIME(MIN.) = 0.14 Tc(MIN.) = 12.64

```

```

LONGEST FLOWPATH FROM NODE      97.00 TO NODE      103.00 =      887.50 FEET.
*****
FLOW PROCESS FROM NODE      103.00 TO NODE      103.00 IS CODE =   1
-----
>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<
=====
TOTAL NUMBER OF STREAMS = 2
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 1 ARE:
TIME OF CONCENTRATION(MIN.) = 12.64
RAINFALL INTENSITY(INCH/HR) = 0.84
TOTAL STREAM AREA(ACRES) = 1.08
PEAK FLOW RATE(CFS) AT CONFLUENCE = 0.86
*****
FLOW PROCESS FROM NODE      100.00 TO NODE      101.00 IS CODE =  21
-----
>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<
=====
      ASSUMED INITIAL SUBAREA UNIFORM
      DEVELOPMENT IS COMMERCIAL
TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
INITIAL SUBAREA FLOW-LENGTH(FEET) = 100.00
UPSTREAM ELEVATION(FEET) = 1612.71
DOWNSTREAM ELEVATION(FEET) = 1611.93
ELEVATION DIFFERENCE(FEET) = 0.78
TC = 0.303*[( 100.00**3)/( 0.78)]**.2 = 5.049
  2 YEAR RAINFALL INTENSITY(INCH/HOUR) = 1.269
*USER SPECIFIED(GLOBAL):
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000
SUBAREA RUNOFF(CFS) = 0.11
TOTAL AREA(ACRES) = 0.10 TOTAL RUNOFF(CFS) = 0.11
*****
FLOW PROCESS FROM NODE      101.00 TO NODE      102.00 IS CODE =  51
-----
>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<
>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 1611.93 DOWNSTREAM(FEET) = 1609.90
CHANNEL LENGTH THRU SUBAREA(FEET) = 384.69 CHANNEL SLOPE = 0.0053
CHANNEL BASE(FEET) = 0.00 "Z" FACTOR = 99.000
MANNING'S FACTOR = 0.015 MAXIMUM DEPTH(FEET) = 0.50
  2 YEAR RAINFALL INTENSITY(INCH/HOUR) = 0.890
*USER SPECIFIED(GLOBAL):
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000
TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) = 1.42
TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) = 1.04
AVERAGE FLOW DEPTH(FEET) = 0.12 TRAVEL TIME(MIN.) = 6.14
Tc(MIN.) = 11.19
SUBAREA AREA(ACRES) = 3.16 SUBAREA RUNOFF(CFS) = 2.53
TOTAL AREA(ACRES) = 3.3 PEAK FLOW RATE(CFS) = 2.64

END OF SUBAREA CHANNEL FLOW HYDRAULICS:
DEPTH(FEET) = 0.15 FLOW VELOCITY(FEET/SEC.) = 1.22
LONGEST FLOWPATH FROM NODE      100.00 TO NODE      102.00 =      484.69 FEET.
*****
FLOW PROCESS FROM NODE      102.00 TO NODE      102.00 IS CODE =  81
-----
>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<
=====
      2 YEAR RAINFALL INTENSITY(INCH/HOUR) = 0.890

```

\*USER SPECIFIED(GLOBAL):  
 COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000  
 SUBAREA AREA(ACRES) = 3.16 SUBAREA RUNOFF(CFS) = 2.53  
 TOTAL AREA(ACRES) = 6.4 TOTAL RUNOFF(CFS) = 5.18  
 TC(MIN.) = 11.19

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 102.00 TO NODE 103.00 IS CODE = 31  
 -----

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<  
 >>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<  
 =====  
 ELEVATION DATA: UPSTREAM(FEET) = 1604.90 DOWNSTREAM(FEET) = 1601.49  
 FLOW LENGTH(FEET) = 27.50 MANNING'S N = 0.013  
 ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 12.000  
 DEPTH OF FLOW IN 12.0 INCH PIPE IS 5.4 INCHES  
 PIPE-FLOW VELOCITY(FEET/SEC.) = 14.92  
 ESTIMATED PIPE DIAMETER(INCH) = 12.00 NUMBER OF PIPES = 1  
 PIPE-FLOW(CFS) = 5.18  
 PIPE TRAVEL TIME(MIN.) = 0.03 Tc(MIN.) = 11.22  
 LONGEST FLOWPATH FROM NODE 100.00 TO NODE 103.00 = 512.19 FEET.

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 103.00 TO NODE 103.00 IS CODE = 1  
 -----

>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<  
 >>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<  
 =====  
 TOTAL NUMBER OF STREAMS = 2  
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:  
 TIME OF CONCENTRATION(MIN.) = 11.22  
 RAINFALL INTENSITY(INCH/HR) = 0.89  
 TOTAL STREAM AREA(ACRES) = 6.42  
 PEAK FLOW RATE(CFS) AT CONFLUENCE = 5.18

\*\* CONFLUENCE DATA \*\*

| STREAM NUMBER | RUNOFF (CFS) | Tc (MIN.) | INTENSITY (INCH/HOUR) | AREA (ACRE) |
|---------------|--------------|-----------|-----------------------|-------------|
| 1             | 0.86         | 12.64     | 0.843                 | 1.08        |
| 2             | 5.18         | 11.22     | 0.889                 | 6.42        |

\*\*\*\*\*WARNING\*\*\*\*\*  
 IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED  
 ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA  
 WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.  
 \*\*\*\*\*

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO  
 CONFLUENCE FORMULA USED FOR 2 STREAMS.

\*\* PEAK FLOW RATE TABLE \*\*

| STREAM NUMBER | RUNOFF (CFS) | Tc (MIN.) | INTENSITY (INCH/HOUR) |
|---------------|--------------|-----------|-----------------------|
| 1             | 5.94         | 11.22     | 0.889                 |
| 2             | 5.77         | 12.64     | 0.843                 |

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:  
 PEAK FLOW RATE(CFS) = 5.94 Tc(MIN.) = 11.22  
 TOTAL AREA(ACRES) = 7.5  
 LONGEST FLOWPATH FROM NODE 97.00 TO NODE 103.00 = 887.50 FEET.

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 103.00 TO NODE 104.00 IS CODE = 31  
 -----

-----  
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<  
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<  
=====

|                                    |             |                    |                        |
|------------------------------------|-------------|--------------------|------------------------|
| ELEVATION DATA: UPSTREAM(FEET) =   | 1601.49     | DOWNSTREAM(FEET) = | 1598.58                |
| FLOW LENGTH(FEET) =                | 305.34      | MANNING'S N =      | 0.013                  |
| DEPTH OF FLOW IN 15.0 INCH PIPE IS | 11.9 INCHES |                    |                        |
| PIPE-FLOW VELOCITY(FEET/SEC.) =    | 5.71        |                    |                        |
| ESTIMATED PIPE DIAMETER(INCH) =    | 15.00       | NUMBER OF PIPES =  | 1                      |
| PIPE-FLOW(CFS) =                   | 5.94        |                    |                        |
| PIPE TRAVEL TIME(MIN.) =           | 0.89        | Tc(MIN.) =         | 12.11                  |
| LONGEST FLOWPATH FROM NODE         | 97.00       | TO NODE            | 104.00 = 1192.84 FEET. |

\*\*\*\*\*  
FLOW PROCESS FROM NODE 104.00 TO NODE 104.00 IS CODE = 81  
-----

>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<  
=====

|   |       |                       |      |
|---|-------|-----------------------|------|
| 2 YEAR RAINFALL INTENSITY(INCH/HOUR) =      | 0.859 |                       |      |
| *USER SPECIFIED(GLOBAL):                    |       |                       |      |
| COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = | .9000 |                       |      |
| SUBAREA AREA(ACRES) =                       | 1.39  | SUBAREA RUNOFF(CFS) = | 1.07 |
| TOTAL AREA(ACRES) =                         | 8.9   | TOTAL RUNOFF(CFS) =   | 7.01 |
| TC(MIN.) =                                  | 12.11 |                       |      |

\*\*\*\*\*  
FLOW PROCESS FROM NODE 104.00 TO NODE 105.00 IS CODE = 31  
-----

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<  
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<  
=====

|                                    |             |                    |                        |
|------------------------------------|-------------|--------------------|------------------------|
| ELEVATION DATA: UPSTREAM(FEET) =   | 1598.58     | DOWNSTREAM(FEET) = | 1598.11                |
| FLOW LENGTH(FEET) =                | 149.00      | MANNING'S N =      | 0.013                  |
| DEPTH OF FLOW IN 21.0 INCH PIPE IS | 14.3 INCHES |                    |                        |
| PIPE-FLOW VELOCITY(FEET/SEC.) =    | 4.01        |                    |                        |
| ESTIMATED PIPE DIAMETER(INCH) =    | 21.00       | NUMBER OF PIPES =  | 1                      |
| PIPE-FLOW(CFS) =                   | 7.01        |                    |                        |
| PIPE TRAVEL TIME(MIN.) =           | 0.62        | Tc(MIN.) =         | 12.73                  |
| LONGEST FLOWPATH FROM NODE         | 97.00       | TO NODE            | 105.00 = 1341.84 FEET. |

\*\*\*\*\*  
FLOW PROCESS FROM NODE 105.00 TO NODE 105.00 IS CODE = 81  
-----

>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<  
=====

|   |       |                       |       |
|---|-------|-----------------------|-------|
| 2 YEAR RAINFALL INTENSITY(INCH/HOUR) =      | 0.840 |                       |       |
| *USER SPECIFIED(GLOBAL):                    |       |                       |       |
| COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = | .9000 |                       |       |
| SUBAREA AREA(ACRES) =                       | 7.60  | SUBAREA RUNOFF(CFS) = | 5.75  |
| TOTAL AREA(ACRES) =                         | 16.5  | TOTAL RUNOFF(CFS) =   | 12.76 |
| TC(MIN.) =                                  | 12.73 |                       |       |

\*\*\*\*\*  
FLOW PROCESS FROM NODE 105.00 TO NODE 106.00 IS CODE = 31  
-----

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<  
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<  
=====

|                                    |             |                    |         |
|------------------------------------|-------------|--------------------|---------|
| ELEVATION DATA: UPSTREAM(FEET) =   | 1598.11     | DOWNSTREAM(FEET) = | 1597.00 |
| FLOW LENGTH(FEET) =                | 353.89      | MANNING'S N =      | 0.013   |
| DEPTH OF FLOW IN 27.0 INCH PIPE IS | 17.5 INCHES |                    |         |
| PIPE-FLOW VELOCITY(FEET/SEC.) =    | 4.67        |                    |         |
| ESTIMATED PIPE DIAMETER(INCH) =    | 27.00       | NUMBER OF PIPES =  | 1       |

```

PIPE-FLOW(CFS) =          12.76
PIPE TRAVEL TIME(MIN.) =  1.26    Tc(MIN.) =  13.99
LONGEST FLOWPATH FROM NODE    97.00 TO NODE    106.00 =  1695.73 FEET.

*****
FLOW PROCESS FROM NODE    106.00 TO NODE    106.00 IS CODE =  81
-----
>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<
=====
      2 YEAR RAINFALL INTENSITY(INCH/HOUR) =  0.805
*USER SPECIFIED(GLOBAL):
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000
SUBAREA AREA(ACRES) =    0.52    SUBAREA RUNOFF(CFS) =    0.38
TOTAL AREA(ACRES) =    17.0    TOTAL RUNOFF(CFS) =    13.14
TC(MIN.) =    13.99

*****
FLOW PROCESS FROM NODE    106.00 TO NODE    107.00 IS CODE =  31
-----
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 1597.00 DOWNSTREAM(FEET) = 1595.98
FLOW LENGTH(FEET) =  454.12    MANNING'S N =  0.013
DEPTH OF FLOW IN 27.0 INCH PIPE IS 20.4 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) =  4.08
ESTIMATED PIPE DIAMETER(INCH) = 27.00    NUMBER OF PIPES =  1
PIPE-FLOW(CFS) =    13.14
PIPE TRAVEL TIME(MIN.) =  1.85    Tc(MIN.) =  15.84
LONGEST FLOWPATH FROM NODE    97.00 TO NODE    107.00 =  2149.85 FEET.

*****
FLOW PROCESS FROM NODE    107.00 TO NODE    107.00 IS CODE =  81
-----
>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<
=====
      2 YEAR RAINFALL INTENSITY(INCH/HOUR) =  0.762
*USER SPECIFIED(GLOBAL):
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000
SUBAREA AREA(ACRES) =    0.47    SUBAREA RUNOFF(CFS) =    0.32
TOTAL AREA(ACRES) =    17.5    TOTAL RUNOFF(CFS) =    13.46
TC(MIN.) =    15.84

*****
FLOW PROCESS FROM NODE    107.00 TO NODE    108.00 IS CODE =  31
-----
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 1595.98 DOWNSTREAM(FEET) = 1595.89
FLOW LENGTH(FEET) =  498.74    MANNING'S N =  0.013
DEPTH OF FLOW IN 45.0 INCH PIPE IS 31.9 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) =  1.61
ESTIMATED PIPE DIAMETER(INCH) = 45.00    NUMBER OF PIPES =  1
PIPE-FLOW(CFS) =    13.46
PIPE TRAVEL TIME(MIN.) =  5.16    Tc(MIN.) =  21.01
LONGEST FLOWPATH FROM NODE    97.00 TO NODE    108.00 =  2648.59 FEET.

*****
FLOW PROCESS FROM NODE    108.00 TO NODE    108.00 IS CODE =  81
-----
>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<
=====

```

2 YEAR RAINFALL INTENSITY(INCH/HOUR) = 0.672  
\*USER SPECIFIED(GLOBAL):  
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000  
SUBAREA AREA(ACRES) = 0.47 SUBAREA RUNOFF(CFS) = 0.28  
TOTAL AREA(ACRES) = 17.9 TOTAL RUNOFF(CFS) = 13.74  
TC(MIN.) = 21.01

\*\*\*\*\*  
FLOW PROCESS FROM NODE 108.00 TO NODE 109.00 IS CODE = 31

-----  
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<  
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<  
=====

|                                    |               |                      |               |
|------------------------------------|---------------|----------------------|---------------|
| ELEVATION DATA: UPSTREAM( FEET ) = | 1595.89       | DOWNSTREAM( FEET ) = | 1593.80       |
| FLOW LENGTH( FEET ) =              | 506.94        | MANNING'S N =        | 0.013         |
| DEPTH OF FLOW IN 24.0 INCH PIPE IS | 19.1 INCHES   |                      |               |
| PIPE-FLOW VELOCITY( FEET/SEC. ) =  | 5.14          |                      |               |
| ESTIMATED PIPE DIAMETER( INCH ) =  | 24.00         | NUMBER OF PIPES =    | 1             |
| PIPE-FLOW( CFS ) =                 | 13.74         |                      |               |
| PIPE TRAVEL TIME( MIN. ) =         | 1.65          | Tc( MIN. ) =         | 22.65         |
| LONGEST FLOWPATH FROM NODE         | 97.00 TO NODE | 109.00 =             | 3155.53 FEET. |

\*\*\*\*\*  
FLOW PROCESS FROM NODE 109.00 TO NODE 109.00 IS CODE = 81

-----  
>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<  
=====

|   |       |                       |       |
|---|-------|-----------------------|-------|
| 2 YEAR RAINFALL INTENSITY(INCH/HOUR) =      | 0.649 |                       |       |
| *USER SPECIFIED(GLOBAL):                    |       |                       |       |
| COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = | .9000 |                       |       |
| SUBAREA AREA(ACRES) =                       | 0.72  | SUBAREA RUNOFF(CFS) = | 0.42  |
| TOTAL AREA(ACRES) =                         | 18.7  | TOTAL RUNOFF(CFS) =   | 14.16 |
| TC(MIN.) =                                  | 22.65 |                       |       |

\*\*\*\*\*  
FLOW PROCESS FROM NODE 109.00 TO NODE 110.00 IS CODE = 31

-----  
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<  
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<  
=====

|                                    |               |                      |               |
|------------------------------------|---------------|----------------------|---------------|
| ELEVATION DATA: UPSTREAM( FEET ) = | 1593.80       | DOWNSTREAM( FEET ) = | 1591.60       |
| FLOW LENGTH( FEET ) =              | 390.78        | MANNING'S N =        | 0.013         |
| DEPTH OF FLOW IN 24.0 INCH PIPE IS | 17.1 INCHES   |                      |               |
| PIPE-FLOW VELOCITY( FEET/SEC. ) =  | 5.92          |                      |               |
| ESTIMATED PIPE DIAMETER( INCH ) =  | 24.00         | NUMBER OF PIPES =    | 1             |
| PIPE-FLOW( CFS ) =                 | 14.16         |                      |               |
| PIPE TRAVEL TIME( MIN. ) =         | 1.10          | Tc( MIN. ) =         | 23.76         |
| LONGEST FLOWPATH FROM NODE         | 97.00 TO NODE | 110.00 =             | 3546.31 FEET. |

\*\*\*\*\*  
FLOW PROCESS FROM NODE 110.00 TO NODE 110.00 IS CODE = 81

-----  
>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<  
=====

|   |       |                       |       |
|---|-------|-----------------------|-------|
| 2 YEAR RAINFALL INTENSITY(INCH/HOUR) =      | 0.636 |                       |       |
| *USER SPECIFIED(GLOBAL):                    |       |                       |       |
| COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = | .9000 |                       |       |
| SUBAREA AREA(ACRES) =                       | 3.96  | SUBAREA RUNOFF(CFS) = | 2.27  |
| TOTAL AREA(ACRES) =                         | 22.6  | TOTAL RUNOFF(CFS) =   | 16.43 |
| TC(MIN.) =                                  | 23.76 |                       |       |

\*\*\*\*\*  
FLOW PROCESS FROM NODE 110.00 TO NODE 111.00 IS CODE = 31

-----  
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<  
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<  
=====

|                                    |             |                    |                        |
|------------------------------------|-------------|--------------------|------------------------|
| ELEVATION DATA: UPSTREAM(FEET) =   | 1591.60     | DOWNSTREAM(FEET) = | 1591.27                |
| FLOW LENGTH(FEET) =                | 118.33      | MANNING'S N =      | 0.013                  |
| DEPTH OF FLOW IN 30.0 INCH PIPE IS | 19.9 INCHES |                    |                        |
| PIPE-FLOW VELOCITY(FEET/SEC.) =    | 4.75        |                    |                        |
| ESTIMATED PIPE DIAMETER(INCH) =    | 30.00       | NUMBER OF PIPES =  | 1                      |
| PIPE-FLOW(CFS) =                   | 16.43       |                    |                        |
| PIPE TRAVEL TIME(MIN.) =           | 0.41        | Tc(MIN.) =         | 24.17                  |
| LONGEST FLOWPATH FROM NODE         | 97.00       | TO NODE            | 111.00 = 3664.64 FEET. |

\*\*\*\*\*  
FLOW PROCESS FROM NODE 111.00 TO NODE 111.00 IS CODE = 81  
-----

>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<  
=====

|   |       |                       |       |
|---|-------|-----------------------|-------|
| 2 YEAR RAINFALL INTENSITY(INCH/HOUR) =      | 0.631 |                       |       |
| *USER SPECIFIED(GLOBAL):                    |       |                       |       |
| COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = | .9000 |                       |       |
| SUBAREA AREA(ACRES) =                       | 18.46 | SUBAREA RUNOFF(CFS) = | 10.48 |
| TOTAL AREA(ACRES) =                         | 41.1  | TOTAL RUNOFF(CFS) =   | 26.91 |
| TC(MIN.) =                                  | 24.17 |                       |       |

\*\*\*\*\*  
FLOW PROCESS FROM NODE 111.00 TO NODE 112.00 IS CODE = 31  
-----

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<  
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<  
=====

|                                    |             |                    |                        |
|------------------------------------|-------------|--------------------|------------------------|
| ELEVATION DATA: UPSTREAM(FEET) =   | 1591.27     | DOWNSTREAM(FEET) = | 1590.20                |
| FLOW LENGTH(FEET) =                | 380.42      | MANNING'S N =      | 0.013                  |
| DEPTH OF FLOW IN 33.0 INCH PIPE IS | 26.6 INCHES |                    |                        |
| PIPE-FLOW VELOCITY(FEET/SEC.) =    | 5.25        |                    |                        |
| ESTIMATED PIPE DIAMETER(INCH) =    | 33.00       | NUMBER OF PIPES =  | 1                      |
| PIPE-FLOW(CFS) =                   | 26.91       |                    |                        |
| PIPE TRAVEL TIME(MIN.) =           | 1.21        | Tc(MIN.) =         | 25.38                  |
| LONGEST FLOWPATH FROM NODE         | 97.00       | TO NODE            | 112.00 = 4045.06 FEET. |

\*\*\*\*\*  
FLOW PROCESS FROM NODE 112.00 TO NODE 112.00 IS CODE = 81  
-----

>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<  
=====

|   |       |                       |       |
|---|-------|-----------------------|-------|
| 2 YEAR RAINFALL INTENSITY(INCH/HOUR) =      | 0.617 |                       |       |
| *USER SPECIFIED(GLOBAL):                    |       |                       |       |
| COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = | .9000 |                       |       |
| SUBAREA AREA(ACRES) =                       | 6.23  | SUBAREA RUNOFF(CFS) = | 3.46  |
| TOTAL AREA(ACRES) =                         | 47.3  | TOTAL RUNOFF(CFS) =   | 30.37 |
| TC(MIN.) =                                  | 25.38 |                       |       |

\*\*\*\*\*  
FLOW PROCESS FROM NODE 112.00 TO NODE 113.00 IS CODE = 31  
-----

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<  
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<  
=====

|                                    |             |                    |         |
|------------------------------------|-------------|--------------------|---------|
| ELEVATION DATA: UPSTREAM(FEET) =   | 1590.20     | DOWNSTREAM(FEET) = | 1588.44 |
| FLOW LENGTH(FEET) =                | 494.26      | MANNING'S N =      | 0.013   |
| DEPTH OF FLOW IN 33.0 INCH PIPE IS | 26.7 INCHES |                    |         |
| PIPE-FLOW VELOCITY(FEET/SEC.) =    | 5.90        |                    |         |

```

ESTIMATED PIPE DIAMETER(INCH) = 33.00    NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 30.37
PIPE TRAVEL TIME(MIN.) = 1.40    Tc(MIN.) = 26.77
LONGEST FLOWPATH FROM NODE 97.00 TO NODE 113.00 = 4539.32 FEET.

*****
FLOW PROCESS FROM NODE 113.00 TO NODE 113.00 IS CODE = 81
-----
>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<
=====
2 YEAR RAINFALL INTENSITY(INCH/HOUR) = 0.603
*USER SPECIFIED(GLOBAL):
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000
SUBAREA AREA(ACRES) = 9.01    SUBAREA RUNOFF(CFS) = 4.89
TOTAL AREA(ACRES) = 56.3    TOTAL RUNOFF(CFS) = 35.26
TC(MIN.) = 26.77

*****
FLOW PROCESS FROM NODE 113.00 TO NODE 114.00 IS CODE = 31
-----
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 1588.44    DOWNSTREAM(FEET) = 1586.08
FLOW LENGTH(FEET) = 410.44    MANNING'S N = 0.013
DEPTH OF FLOW IN 33.0 INCH PIPE IS 24.5 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 7.45
ESTIMATED PIPE DIAMETER(INCH) = 33.00    NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 35.26
PIPE TRAVEL TIME(MIN.) = 0.92    Tc(MIN.) = 27.69
LONGEST FLOWPATH FROM NODE 97.00 TO NODE 114.00 = 4949.76 FEET.

*****
FLOW PROCESS FROM NODE 114.00 TO NODE 114.00 IS CODE = 1
-----
>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<
=====
TOTAL NUMBER OF STREAMS = 2
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 1 ARE:
TIME OF CONCENTRATION(MIN.) = 27.69
RAINFALL INTENSITY(INCH/HR) = 0.59
TOTAL STREAM AREA(ACRES) = 56.33
PEAK FLOW RATE(CFS) AT CONFLUENCE = 35.26

*****
FLOW PROCESS FROM NODE 200.00 TO NODE 201.00 IS CODE = 21
-----
>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<
=====
ASSUMED INITIAL SUBAREA UNIFORM
DEVELOPMENT IS COMMERCIAL
TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
INITIAL SUBAREA FLOW-LENGTH(FEET) = 100.00
UPSTREAM ELEVATION(FEET) = 1612.17
DOWNSTREAM ELEVATION(FEET) = 1611.46
ELEVATION DIFFERENCE(FEET) = 0.71
TC = 0.303*[(100.00**3)/(0.71)]**.2 = 5.144
2 YEAR RAINFALL INTENSITY(INCH/HOUR) = 1.259
*USER SPECIFIED(GLOBAL):
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000
SUBAREA RUNOFF(CFS) = 0.11
TOTAL AREA(ACRES) = 0.10    TOTAL RUNOFF(CFS) = 0.11

```



\*\*\*\*\*  
FLOW PROCESS FROM NODE 201.00 TO NODE 202.00 IS CODE = 51

-----  
>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<  
>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<

=====

|  |         |                       |         |
|--|---------|-----------------------|---------|
| ELEVATION DATA: UPSTREAM(FEET) =       | 1611.76 | DOWNSTREAM(FEET) =    | 1608.81 |
| CHANNEL LENGTH THRU SUBAREA(FEET) =    | 412.00  | CHANNEL SLOPE =       | 0.0072  |
| CHANNEL BASE(FEET) =                   | 0.00    | "Z" FACTOR =          | 99.000  |
| MANNING'S FACTOR =                     | 0.015   | MAXIMUM DEPTH(FEET) = | 0.50    |
| 2 YEAR RAINFALL INTENSITY(INCH/HOUR) = | 0.905   |                       |         |

\*USER SPECIFIED(GLOBAL):

|   |       |                       |      |
|---|-------|-----------------------|------|
| COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT =             | .9000 |                       |      |
| TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =        |       | 1.51                  |      |
| TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) = |       | 1.22                  |      |
| AVERAGE FLOW DEPTH(FEET) =                              | 0.11  | TRAVEL TIME(MIN.) =   | 5.61 |
| Tc(MIN.) =  | 10.76 |                       |      |
| SUBAREA AREA(ACRES) =                                   | 3.37  | SUBAREA RUNOFF(CFS) = | 2.75 |
| TOTAL AREA(ACRES) =                                     | 3.5   | PEAK FLOW RATE(CFS) = | 2.86 |

END OF SUBAREA CHANNEL FLOW HYDRAULICS:  
DEPTH(FEET) = 0.14 FLOW VELOCITY(FEET/SEC.) = 1.43  
LONGEST FLOWPATH FROM NODE 200.00 TO NODE 202.00 = 512.00 FEET.

\*\*\*\*\*  
FLOW PROCESS FROM NODE 202.00 TO NODE 202.00 IS CODE = 81

-----  
>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<

=====

|  |       |  |  |
|--|-------|--|--|
| 2 YEAR RAINFALL INTENSITY(INCH/HOUR) = | 0.905 |  |  |
|--|-------|--|--|

\*USER SPECIFIED(GLOBAL):

|   |       |                       |      |
|---|-------|-----------------------|------|
| COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = | .9000 |                       |      |
| SUBAREA AREA(ACRES) =                       | 3.37  | SUBAREA RUNOFF(CFS) = | 2.75 |
| TOTAL AREA(ACRES) =                         | 6.8   | TOTAL RUNOFF(CFS) =   | 5.61 |
| TC(MIN.) =                                  | 10.76 |                       |      |

\*\*\*\*\*  
FLOW PROCESS FROM NODE 202.00 TO NODE 203.00 IS CODE = 31

-----  
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<  
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

=====

|  |            |                    |              |
|--|------------|--------------------|--------------|
| ELEVATION DATA: UPSTREAM(FEET) =                   | 1604.81    | DOWNSTREAM(FEET) = | 1601.60      |
| FLOW LENGTH(FEET) =                                | 23.00      | MANNING'S N =      | 0.013        |
| ESTIMATED PIPE DIAMETER(INCH) INCREASED TO         | 12.000     |                    |              |
| DEPTH OF FLOW IN 12.0 INCH PIPE IS                 | 5.5 INCHES |                    |              |
| PIPE-FLOW VELOCITY(FEET/SEC.) =                    | 15.92      |                    |              |
| ESTIMATED PIPE DIAMETER(INCH) =                    | 12.00      | NUMBER OF PIPES =  | 1            |
| PIPE-FLOW(CFS) =                                   | 5.61       |                    |              |
| PIPE TRAVEL TIME(MIN.) =                           | 0.02       | Tc(MIN.) =         | 10.78        |
| LONGEST FLOWPATH FROM NODE 200.00 TO NODE 203.00 = |            |                    | 535.00 FEET. |

\*\*\*\*\*  
FLOW PROCESS FROM NODE 203.00 TO NODE 204.00 IS CODE = 31

-----  
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<  
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<

=====

|                                    |             |                    |         |
|------------------------------------|-------------|--------------------|---------|
| ELEVATION DATA: UPSTREAM(FEET) =   | 1601.60     | DOWNSTREAM(FEET) = | 1601.50 |
| FLOW LENGTH(FEET) =                | 33.46       | MANNING'S N =      | 0.013   |
| DEPTH OF FLOW IN 21.0 INCH PIPE IS | 12.5 INCHES |                    |         |
| PIPE-FLOW VELOCITY(FEET/SEC.) =    | 3.76        |                    |         |
| ESTIMATED PIPE DIAMETER(INCH) =    | 21.00       | NUMBER OF PIPES =  | 1       |

```

PIPE-FLOW(CFS) =          5.61
PIPE TRAVEL TIME(MIN.) =  0.15      Tc(MIN.) =  10.93
LONGEST FLOWPATH FROM NODE 200.00 TO NODE 204.00 = 568.46 FEET.
*****
FLOW PROCESS FROM NODE 204.00 TO NODE 204.00 IS CODE = 81
-----
>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<
=====
      2 YEAR RAINFALL INTENSITY(INCH/HOUR) = 0.899
*USER SPECIFIED(GLOBAL):
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000
SUBAREA AREA(ACRES) = 0.95      SUBAREA RUNOFF(CFS) = 0.77
TOTAL AREA(ACRES) = 7.8      TOTAL RUNOFF(CFS) = 6.37
TC(MIN.) = 10.93
*****
FLOW PROCESS FROM NODE 204.00 TO NODE 205.00 IS CODE = 31
-----
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 1601.50 DOWNSTREAM(FEET) = 1599.84
FLOW LENGTH(FEET) = 705.54 MANNING'S N = 0.013
DEPTH OF FLOW IN 21.0 INCH PIPE IS 14.9 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 3.50
ESTIMATED PIPE DIAMETER(INCH) = 21.00      NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 6.37
PIPE TRAVEL TIME(MIN.) = 3.36      Tc(MIN.) = 14.29
LONGEST FLOWPATH FROM NODE 200.00 TO NODE 205.00 = 1274.00 FEET.
*****
FLOW PROCESS FROM NODE 205.00 TO NODE 205.00 IS CODE = 81
-----
>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<
=====
      2 YEAR RAINFALL INTENSITY(INCH/HOUR) = 0.798
*USER SPECIFIED(GLOBAL):
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000
SUBAREA AREA(ACRES) = 2.48      SUBAREA RUNOFF(CFS) = 1.78
TOTAL AREA(ACRES) = 10.3      TOTAL RUNOFF(CFS) = 8.15
TC(MIN.) = 14.29
*****
FLOW PROCESS FROM NODE 205.00 TO NODE 206.00 IS CODE = 31
-----
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<
=====
ELEVATION DATA: UPSTREAM(FEET) = 1599.84 DOWNSTREAM(FEET) = 1598.78
FLOW LENGTH(FEET) = 444.00 MANNING'S N = 0.013
DEPTH OF FLOW IN 24.0 INCH PIPE IS 15.6 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) = 3.77
ESTIMATED PIPE DIAMETER(INCH) = 24.00      NUMBER OF PIPES = 1
PIPE-FLOW(CFS) = 8.15
PIPE TRAVEL TIME(MIN.) = 1.96      Tc(MIN.) = 16.26
LONGEST FLOWPATH FROM NODE 200.00 TO NODE 206.00 = 1718.00 FEET.
*****
FLOW PROCESS FROM NODE 206.00 TO NODE 206.00 IS CODE = 81
-----
>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<
=====

```

2 YEAR RAINFALL INTENSITY(INCH/HOUR) = 0.753  
\*USER SPECIFIED(GLOBAL):  
COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .9000  
SUBAREA AREA(ACRES) = 8.02 SUBAREA RUNOFF(CFS) = 5.44  
TOTAL AREA(ACRES) = 18.3 TOTAL RUNOFF(CFS) = 13.59  
TC(MIN.) = 16.26

\*\*\*\*\*  
FLOW PROCESS FROM NODE 206.00 TO NODE 207.00 IS CODE = 31  
-----

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<  
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<  
=====

|                                    |                |                    |               |
|------------------------------------|----------------|--------------------|---------------|
| ELEVATION DATA: UPSTREAM(FEET) =   | 1598.78        | DOWNSTREAM(FEET) = | 1597.90       |
| FLOW LENGTH(FEET) =                | 206.68         | MANNING'S N =      | 0.013         |
| DEPTH OF FLOW IN 24.0 INCH PIPE IS | 18.6 INCHES    |                    |               |
| PIPE-FLOW VELOCITY(FEET/SEC.) =    | 5.21           |                    |               |
| ESTIMATED PIPE DIAMETER(INCH) =    | 24.00          | NUMBER OF PIPES =  | 1             |
| PIPE-FLOW(CFS) =                   | 13.59          |                    |               |
| PIPE TRAVEL TIME(MIN.) =           | 0.66           | Tc(MIN.) =         | 16.92         |
| LONGEST FLOWPATH FROM NODE         | 200.00 TO NODE | 207.00 =           | 1924.68 FEET. |

\*\*\*\*\*  
FLOW PROCESS FROM NODE 207.00 TO NODE 207.00 IS CODE = 81  
-----

>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<  
=====

|   |       |                       |       |
|---|-------|-----------------------|-------|
| 2 YEAR RAINFALL INTENSITY(INCH/HOUR) =      | 0.740 |                       |       |
| *USER SPECIFIED(GLOBAL):                    |       |                       |       |
| COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = | .9000 |                       |       |
| SUBAREA AREA(ACRES) =                       | 1.96  | SUBAREA RUNOFF(CFS) = | 1.30  |
| TOTAL AREA(ACRES) =                         | 20.2  | TOTAL RUNOFF(CFS) =   | 14.89 |
| TC(MIN.) =                                  | 16.92 |                       |       |

\*\*\*\*\*  
FLOW PROCESS FROM NODE 207.00 TO NODE 208.00 IS CODE = 31  
-----

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<  
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<  
=====

|                                    |                |                    |               |
|------------------------------------|----------------|--------------------|---------------|
| ELEVATION DATA: UPSTREAM(FEET) =   | 1597.90        | DOWNSTREAM(FEET) = | 1596.70       |
| FLOW LENGTH(FEET) =                | 237.58         | MANNING'S N =      | 0.013         |
| DEPTH OF FLOW IN 24.0 INCH PIPE IS | 18.7 INCHES    |                    |               |
| PIPE-FLOW VELOCITY(FEET/SEC.) =    | 5.68           |                    |               |
| ESTIMATED PIPE DIAMETER(INCH) =    | 24.00          | NUMBER OF PIPES =  | 1             |
| PIPE-FLOW(CFS) =                   | 14.89          |                    |               |
| PIPE TRAVEL TIME(MIN.) =           | 0.70           | Tc(MIN.) =         | 17.61         |
| LONGEST FLOWPATH FROM NODE         | 200.00 TO NODE | 208.00 =           | 2162.26 FEET. |

\*\*\*\*\*  
FLOW PROCESS FROM NODE 208.00 TO NODE 208.00 IS CODE = 81  
-----

>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<  
=====

|   |       |                       |       |
|---|-------|-----------------------|-------|
| 2 YEAR RAINFALL INTENSITY(INCH/HOUR) =      | 0.727 |                       |       |
| *USER SPECIFIED(GLOBAL):                    |       |                       |       |
| COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = | .9000 |                       |       |
| SUBAREA AREA(ACRES) =                       | 0.39  | SUBAREA RUNOFF(CFS) = | 0.26  |
| TOTAL AREA(ACRES) =                         | 20.6  | TOTAL RUNOFF(CFS) =   | 15.15 |
| TC(MIN.) =                                  | 17.61 |                       |       |

\*\*\*\*\*  
FLOW PROCESS FROM NODE 208.00 TO NODE 209.00 IS CODE = 31

-----  
>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<  
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<  
=====

|                                    |             |                    |                        |
|------------------------------------|-------------|--------------------|------------------------|
| ELEVATION DATA: UPSTREAM(FEET) =   | 1596.70     | DOWNSTREAM(FEET) = | 1594.00                |
| FLOW LENGTH(FEET) =                | 393.08      | MANNING'S N =      | 0.013                  |
| DEPTH OF FLOW IN 24.0 INCH PIPE IS | 16.7 INCHES |                    |                        |
| PIPE-FLOW VELOCITY(FEET/SEC.) =    | 6.50        |                    |                        |
| ESTIMATED PIPE DIAMETER(INCH) =    | 24.00       | NUMBER OF PIPES =  | 1                      |
| PIPE-FLOW(CFS) =                   | 15.15       |                    |                        |
| PIPE TRAVEL TIME(MIN.) =           | 1.01        | Tc(MIN.) =         | 18.62                  |
| LONGEST FLOWPATH FROM NODE         | 200.00      | TO NODE            | 209.00 = 2555.34 FEET. |

\*\*\*\*\*  
FLOW PROCESS FROM NODE 209.00 TO NODE 209.00 IS CODE = 81  
-----

>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<  
=====

|   |       |                       |       |
|---|-------|-----------------------|-------|
| 2 YEAR RAINFALL INTENSITY(INCH/HOUR) =      | 0.709 |                       |       |
| *USER SPECIFIED(GLOBAL):                    |       |                       |       |
| COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = | .9000 |                       |       |
| SUBAREA AREA(ACRES) =                       | 6.86  | SUBAREA RUNOFF(CFS) = | 4.38  |
| TOTAL AREA(ACRES) =                         | 27.5  | TOTAL RUNOFF(CFS) =   | 19.52 |
| TC(MIN.) =                                  | 18.62 |                       |       |

\*\*\*\*\*  
FLOW PROCESS FROM NODE 209.00 TO NODE 210.00 IS CODE = 31  
-----

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<  
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<  
=====

|                                    |             |                    |                        |
|------------------------------------|-------------|--------------------|------------------------|
| ELEVATION DATA: UPSTREAM(FEET) =   | 1594.00     | DOWNSTREAM(FEET) = | 1590.45                |
| FLOW LENGTH(FEET) =                | 548.29      | MANNING'S N =      | 0.013                  |
| DEPTH OF FLOW IN 27.0 INCH PIPE IS | 18.3 INCHES |                    |                        |
| PIPE-FLOW VELOCITY(FEET/SEC.) =    | 6.79        |                    |                        |
| ESTIMATED PIPE DIAMETER(INCH) =    | 27.00       | NUMBER OF PIPES =  | 1                      |
| PIPE-FLOW(CFS) =                   | 19.52       |                    |                        |
| PIPE TRAVEL TIME(MIN.) =           | 1.35        | Tc(MIN.) =         | 19.97                  |
| LONGEST FLOWPATH FROM NODE         | 200.00      | TO NODE            | 210.00 = 3103.63 FEET. |

\*\*\*\*\*  
FLOW PROCESS FROM NODE 210.00 TO NODE 210.00 IS CODE = 81  
-----

>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<  
=====

|   |       |                       |       |
|---|-------|-----------------------|-------|
| 2 YEAR RAINFALL INTENSITY(INCH/HOUR) =      | 0.687 |                       |       |
| *USER SPECIFIED(GLOBAL):                    |       |                       |       |
| COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = | .9000 |                       |       |
| SUBAREA AREA(ACRES) =                       | 5.41  | SUBAREA RUNOFF(CFS) = | 3.34  |
| TOTAL AREA(ACRES) =                         | 32.9  | TOTAL RUNOFF(CFS) =   | 22.87 |
| TC(MIN.) =                                  | 19.97 |                       |       |

\*\*\*\*\*  
FLOW PROCESS FROM NODE 210.00 TO NODE 211.00 IS CODE = 31  
-----

>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<  
>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<  
=====

|                                    |             |                    |         |
|------------------------------------|-------------|--------------------|---------|
| ELEVATION DATA: UPSTREAM(FEET) =   | 1590.45     | DOWNSTREAM(FEET) = | 1586.08 |
| FLOW LENGTH(FEET) =                | 292.02      | MANNING'S N =      | 0.013   |
| DEPTH OF FLOW IN 24.0 INCH PIPE IS | 17.0 INCHES |                    |         |
| PIPE-FLOW VELOCITY(FEET/SEC.) =    | 9.63        |                    |         |
| ESTIMATED PIPE DIAMETER(INCH) =    | 24.00       | NUMBER OF PIPES =  | 1       |

PIPE-FLOW(CFS) = 22.87  
 PIPE TRAVEL TIME(MIN.) = 0.51 Tc(MIN.) = 20.47  
 LONGEST FLOWPATH FROM NODE 200.00 TO NODE 211.00 = 3395.65 FEET.

\*\*\*\*\*  
 FLOW PROCESS FROM NODE 211.00 TO NODE 211.00 IS CODE = 1  
 -----

>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<  
 >>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<

=====

TOTAL NUMBER OF STREAMS = 2  
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:  
 TIME OF CONCENTRATION(MIN.) = 20.47  
 RAINFALL INTENSITY(INCH/HR) = 0.68  
 TOTAL STREAM AREA(ACRES) = 32.91  
 PEAK FLOW RATE(CFS) AT CONFLUENCE = 22.87

\*\* CONFLUENCE DATA \*\*

| STREAM NUMBER | RUNOFF (CFS) | Tc (MIN.) | INTENSITY (INCH/HOUR) | AREA (ACRE) |
|---------------|--------------|-----------|-----------------------|-------------|
| 1             | 35.26        | 27.69     | 0.594                 | 56.33       |
| 2             | 22.87        | 20.47     | 0.679                 | 32.91       |

\*\*\*\*\*WARNING\*\*\*\*\*  
 IN THIS COMPUTER PROGRAM, THE CONFLUENCE VALUE USED IS BASED  
 ON THE RCFC&WCD FORMULA OF PLATE D-1 AS DEFAULT VALUE. THIS FORMULA  
 WILL NOT NECESSARILY RESULT IN THE MAXIMUM VALUE OF PEAK FLOW.  
 \*\*\*\*\*

RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO  
 CONFLUENCE FORMULA USED FOR 2 STREAMS.

\*\* PEAK FLOW RATE TABLE \*\*

| STREAM NUMBER | RUNOFF (CFS) | Tc (MIN.) | INTENSITY (INCH/HOUR) |
|---------------|--------------|-----------|-----------------------|
| 1             | 48.93        | 20.47     | 0.679                 |
| 2             | 55.24        | 27.69     | 0.594                 |

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:  
 PEAK FLOW RATE(CFS) = 55.24 Tc(MIN.) = 27.69  
 TOTAL AREA(ACRES) = 89.2  
 LONGEST FLOWPATH FROM NODE 97.00 TO NODE 211.00 = 4949.76 FEET.

=====

END OF STUDY SUMMARY:  
 TOTAL AREA(ACRES) = 89.2 TC(MIN.) = 27.69  
 PEAK FLOW RATE(CFS) = 55.24

=====

END OF RATIONAL METHOD ANALYSIS

=====  
 \*\*\* NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)  
 AND LOW LOSS FRACTION ESTIMATIONS FOR AMC II:

TOTAL 24-HOUR DURATION RAINFALL DEPTH = 1.91 (i nches)

| SOIL-COVER TYPE | AREA (Acres) | PERCENT OF PERVIOUS AREA | SCS CURVE NUMBER | LOSS RATE Fp(i n. /hr.) | YIELD |
|-----------------|--------------|--------------------------|------------------|-------------------------|-------|
| 1               | 89.10        | 10.00                    | 98.              | 0.000                   | 0.882 |

TOTAL AREA (Acres) = 89.10

AREA-AVERAGED LOSS RATE,  $\bar{F}_m$  (i n. /hr.) = 0.000

AREA-AVERAGED LOW LOSS FRACTION,  $\bar{Y}$  = 0.118

=====

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RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90  
 TOTAL CATCHMENT AREA(ACRES) = 89.10  
 SOIL-LOSS RATE,  $F_m$ , (INCH/HR) = 0.000  
 LOW LOSS FRACTION = 0.118  
 TIME OF CONCENTRATION(MIN.) = 24.44  
 SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA  
 USER SPECIFIED RAINFALL VALUES ARE USED  
 RETURN FREQUENCY(YEARS) = 2  
 5-MINUTE POINT RAINFALL VALUE(INCHES) = 0.12  
 30-MINUTE POINT RAINFALL VALUE(INCHES) = 0.32  
 1-HOUR POINT RAINFALL VALUE(INCHES) = 0.46  
 3-HOUR POINT RAINFALL VALUE(INCHES) = 0.80  
 6-HOUR POINT RAINFALL VALUE(INCHES) = 1.09  
 24-HOUR POINT RAINFALL VALUE(INCHES) = 1.91

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TOTAL CATCHMENT RUNOFF VOLUME(ACRE-FEET) = 12.67  
 TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) = 1.52

\*\*\*\*\*

| TIME (HOURS) | VOLUME (AF) | Q (CFS) | 0. | 15.0 | 30.0 | 45.0 | 60.0 |
|--------------|-------------|---------|----|------|------|------|------|
| 0.11         | 0.0000      | 0.00    | Q  | .    | .    | .    | .    |
| 0.52         | 0.0437      | 2.59    | .Q | .    | .    | .    | .    |
| 0.93         | 0.1319      | 2.65    | .Q | .    | .    | .    | .    |
| 1.34         | 0.2215      | 2.68    | .Q | .    | .    | .    | .    |
| 1.74         | 0.3126      | 2.73    | .Q | .    | .    | .    | .    |
| 2.15         | 0.4052      | 2.77    | .Q | .    | .    | .    | .    |
| 2.56         | 0.4994      | 2.83    | .Q | .    | .    | .    | .    |

|        |          |        |     |   |   |   |   |
|--------|----------|--------|-----|---|---|---|---|
| 2. 97  | 0. 5952  | 2. 86  | . Q | . | . | . | . |
| 3. 37  | 0. 6928  | 2. 94  | . Q | . | . | . | . |
| 3. 78  | 0. 7923  | 2. 97  | . Q | . | . | . | . |
| 4. 19  | 0. 8937  | 3. 05  | . Q | . | . | . | . |
| 4. 59  | 0. 9972  | 3. 09  | . Q | . | . | . | . |
| 5. 00  | 1. 1028  | 3. 18  | . Q | . | . | . | . |
| 5. 41  | 1. 2107  | 3. 23  | . Q | . | . | . | . |
| 5. 82  | 1. 3210  | 3. 33  | . Q | . | . | . | . |
| 6. 22  | 1. 4339  | 3. 38  | . Q | . | . | . | . |
| 6. 63  | 1. 5495  | 3. 49  | . Q | . | . | . | . |
| 7. 04  | 1. 6681  | 3. 55  | . Q | . | . | . | . |
| 7. 45  | 1. 7898  | 3. 68  | . Q | . | . | . | . |
| 7. 85  | 1. 9148  | 3. 75  | . Q | . | . | . | . |
| 8. 26  | 2. 0435  | 3. 90  | . Q | . | . | . | . |
| 8. 67  | 2. 1761  | 3. 98  | . Q | . | . | . | . |
| 9. 08  | 2. 3131  | 4. 16  | . Q | . | . | . | . |
| 9. 48  | 2. 4546  | 4. 25  | . Q | . | . | . | . |
| 9. 89  | 2. 6013  | 4. 46  | . Q | . | . | . | . |
| 10. 30 | 2. 7535  | 4. 58  | . Q | . | . | . | . |
| 10. 70 | 2. 9121  | 4. 84  | . Q | . | . | . | . |
| 11. 11 | 3. 0776  | 4. 99  | . Q | . | . | . | . |
| 11. 52 | 3. 2511  | 5. 32  | . Q | . | . | . | . |
| 11. 93 | 3. 4334  | 5. 51  | . Q | . | . | . | . |
| 12. 33 | 3. 6351  | 6. 47  | . Q | . | . | . | . |
| 12. 74 | 3. 8607  | 6. 93  | . Q | . | . | . | . |
| 13. 15 | 4. 1047  | 7. 57  | . Q | . | . | . | . |
| 13. 56 | 4. 3658  | 7. 95  | . Q | . | . | . | . |
| 13. 96 | 4. 6499  | 8. 93  | . Q | . | . | . | . |
| 14. 37 | 4. 9663  | 9. 87  | . Q | . | . | . | . |
| 14. 78 | 5. 3374  | 12. 18 | . Q | . | . | . | . |
| 15. 19 | 5. 7695  | 13. 49 | . Q | . | . | . | . |
| 15. 59 | 6. 3136  | 18. 83 | . Q | . | . | . | . |
| 16. 00 | 7. 0569  | 25. 33 | . Q | . | . | . | . |
| 16. 41 | 8. 4336  | 56. 47 | .   | . | . | . | . |
| 16. 81 | 9. 6422  | 15. 34 | . Q | . | . | . | . |
| 17. 22 | 10. 0888 | 11. 19 | . Q | . | . | . | . |
| 17. 63 | 10. 4185 | 8. 40  | . Q | . | . | . | . |
| 18. 04 | 10. 6815 | 7. 23  | . Q | . | . | . | . |
| 18. 44 | 10. 8994 | 5. 72  | . Q | . | . | . | . |
| 18. 85 | 11. 0823 | 5. 15  | . Q | . | . | . | . |
| 19. 26 | 11. 2482 | 4. 71  | . Q | . | . | . | . |
| 19. 67 | 11. 4007 | 4. 35  | . Q | . | . | . | . |
| 20. 07 | 11. 5424 | 4. 06  | . Q | . | . | . | . |
| 20. 48 | 11. 6752 | 3. 82  | . Q | . | . | . | . |
| 20. 89 | 11. 8003 | 3. 61  | . Q | . | . | . | . |
| 21. 30 | 11. 9190 | 3. 43  | . Q | . | . | . | . |
| 21. 70 | 12. 0319 | 3. 28  | . Q | . | . | . | . |
| 22. 11 | 12. 1399 | 3. 14  | . Q | . | . | . | . |
| 22. 52 | 12. 2433 | 3. 01  | . Q | . | . | . | . |
| 22. 92 | 12. 3428 | 2. 90  | . Q | . | . | . | . |
| 23. 33 | 12. 4387 | 2. 80  | . Q | . | . | . | . |

|       |         |      |    |   |   |   |   |
|-------|---------|------|----|---|---|---|---|
| 23.74 | 12.5314 | 2.70 | .0 | . | . | . | . |
| 24.15 | 12.6210 | 2.62 | .0 | . | . | . | . |
| 24.55 | 12.6651 | 0.00 | 0  | . | . | . | . |

---

TIME DURATION(mi nutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:  
 (Note: 100% of Peak Flow Rate estimate assumed to have  
 an instantaneous time duration)

| Percentile of Estimated<br>Peak Flow Rate | Duration<br>(mi nutes) |
|---|------------------------|
| =====                                     | =====                  |
| 0%  | 1442.0                 |
| 10%                                       | 391.0                  |
| 20%                                       | 146.6                  |
| 30%                                       | 73.3                   |
| 40%                                       | 48.9                   |
| 50%                                       | 24.4                   |
| 60%                                       | 24.4                   |
| 70%                                       | 24.4                   |
| 80%                                       | 24.4                   |
| 90%                                       | 24.4                   |



=====  
 \*\*\* NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)  
 AND LOW LOSS FRACTION ESTIMATIONS FOR AMC II:

TOTAL 24-HOUR DURATION RAINFALL DEPTH = 1.91 (i nches)

| SOIL-COVER TYPE | AREA (Acres) | PERCENT OF PERVIOUS AREA | SCS CURVE NUMBER | LOSS RATE Fp(i n. /hr.) | YIELD |
|-----------------|--------------|--------------------------|------------------|-------------------------|-------|
| 1               | 89.10        | 10.00                    | 98.              | 0.000                   | 0.882 |

TOTAL AREA (Acres) = 89.10

AREA-AVERAGED LOSS RATE,  $\bar{F}_m$  (i n. /hr.) = 0.000

AREA-AVERAGED LOW LOSS FRACTION,  $\bar{Y}$  = 0.118

=====

RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90  
 TOTAL CATCHMENT AREA(ACRES) = 89.20  
 SOIL-LOSS RATE,  $F_m$ , (INCH/HR) = 0.000  
 LOW LOSS FRACTION = 0.118  
 TIME OF CONCENTRATION(MIN. ) = 27.69  
 SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA  
 USER SPECIFIED RAINFALL VALUES ARE USED  
 RETURN FREQUENCY(YEARS) = 2  
 5-MINUTE POINT RAINFALL VALUE(INCHES) = 0.12  
 30-MINUTE POINT RAINFALL VALUE(INCHES) = 0.32  
 1-HOUR POINT RAINFALL VALUE(INCHES) = 0.46  
 3-HOUR POINT RAINFALL VALUE(INCHES) = 0.77  
 6-HOUR POINT RAINFALL VALUE(INCHES) = 1.09  
 24-HOUR POINT RAINFALL VALUE(INCHES) = 1.91

-----  
 TOTAL CATCHMENT RUNOFF VOLUME(ACRE-FEET) = 12.77  
 TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) = 1.43

\*\*\*\*\*

| TIME (HOURS) | VOLUME (AF) | Q (CFS) | 0. | 15.0 | 30.0 | 45.0 | 60.0 |
|--------------|-------------|---------|----|------|------|------|------|
| 0.31         | 0.0493      | 2.58    | .0 | .    | .    | .    | .    |
| 0.77         | 0.1488      | 2.63    | .0 | .    | .    | .    | .    |
| 1.23         | 0.2497      | 2.66    | .0 | .    | .    | .    | .    |
| 1.69         | 0.3525      | 2.73    | .0 | .    | .    | .    | .    |
| 2.15         | 0.4572      | 2.76    | .0 | .    | .    | .    | .    |
| 2.62         | 0.5640      | 2.84    | .0 | .    | .    | .    | .    |
| 3.08         | 0.6729      | 2.88    | .0 | .    | .    | .    | .    |
| 3.54         | 0.7841      | 2.96    | .0 | .    | .    | .    | .    |

|       |         |       |    |    |   |    |   |
|-------|---------|-------|----|----|---|----|---|
| 4.00  | 0.8977  | 3.00  | .Q | .  | . | .  | . |
| 4.46  | 1.0139  | 3.09  | .Q | .  | . | .  | . |
| 4.92  | 1.1328  | 3.14  | .Q | .  | . | .  | . |
| 5.39  | 1.2546  | 3.24  | .Q | .  | . | .  | . |
| 5.85  | 1.3794  | 3.30  | .Q | .  | . | .  | . |
| 6.31  | 1.5076  | 3.42  | .Q | .  | . | .  | . |
| 6.77  | 1.6392  | 3.48  | .Q | .  | . | .  | . |
| 7.23  | 1.7748  | 3.62  | .Q | .  | . | .  | . |
| 7.69  | 1.9144  | 3.70  | .Q | .  | . | .  | . |
| 8.15  | 2.0586  | 3.86  | .Q | .  | . | .  | . |
| 8.62  | 2.2076  | 3.95  | .Q | .  | . | .  | . |
| 9.08  | 2.3621  | 4.15  | .Q | .  | . | .  | . |
| 9.54  | 2.5224  | 4.26  | .Q | .  | . | .  | . |
| 10.00 | 2.6894  | 4.50  | .Q | .  | . | .  | . |
| 10.46 | 2.8636  | 4.64  | .Q | .  | . | .  | . |
| 10.92 | 3.0463  | 4.94  | .Q | .  | . | .  | . |
| 11.38 | 3.2383  | 5.12  | .Q | .  | . | .  | . |
| 11.85 | 3.4414  | 5.53  | .Q | .  | . | .  | . |
| 12.31 | 3.6570  | 5.77  | .Q | .  | . | .  | . |
| 12.77 | 3.9159  | 7.80  | .Q | .  | . | .  | . |
| 13.23 | 4.2204  | 8.16  | .Q | .  | . | .  | . |
| 13.69 | 4.5490  | 9.07  | .Q | .  | . | .  | . |
| 14.15 | 4.9060  | 9.65  | .Q | .  | . | .  | . |
| 14.62 | 5.2886  | 10.41 | .Q | .  | . | .  | . |
| 15.08 | 5.7084  | 11.60 | .Q | .  | . | .  | . |
| 15.54 | 6.2424  | 16.40 | .Q | .  | . | .  | . |
| 16.00 | 7.0083  | 23.77 | .  | .Q | . | .  | . |
| 16.46 | 8.4805  | 53.44 | .  | .  | . | .Q | . |
| 16.92 | 9.7532  | 13.30 | .Q | .  | . | .  | . |
| 17.38 | 10.1963 | 9.94  | .Q | .  | . | .  | . |
| 17.85 | 10.5495 | 8.58  | .Q | .  | . | .  | . |
| 18.31 | 10.8558 | 7.49  | .Q | .  | . | .  | . |
| 18.77 | 11.1000 | 5.32  | .Q | .  | . | .  | . |
| 19.23 | 11.2926 | 4.78  | .Q | .  | . | .  | . |
| 19.69 | 11.4672 | 4.37  | .Q | .  | . | .  | . |
| 20.15 | 11.6278 | 4.05  | .Q | .  | . | .  | . |
| 20.61 | 11.7770 | 3.78  | .Q | .  | . | .  | . |
| 21.08 | 11.9168 | 3.55  | .Q | .  | . | .  | . |
| 21.54 | 12.0486 | 3.36  | .Q | .  | . | .  | . |
| 22.00 | 12.1735 | 3.19  | .Q | .  | . | .  | . |
| 22.46 | 12.2925 | 3.05  | .Q | .  | . | .  | . |
| 22.92 | 12.4061 | 2.92  | .Q | .  | . | .  | . |
| 23.38 | 12.5151 | 2.80  | .Q | .  | . | .  | . |
| 23.85 | 12.6199 | 2.69  | .Q | .  | . | .  | . |
| 24.31 | 12.7209 | 2.60  | .Q | .  | . | .  | . |
| 24.77 | 12.7705 | 0.00  | .Q | .  | . | .  | . |

-----

TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:  
 (Note: 100% of Peak Flow Rate estimate assumed to have  
 an instantaneous time duration)

Percentile of Estimated  
Peak Flow Rate

Duration  
(minutes)

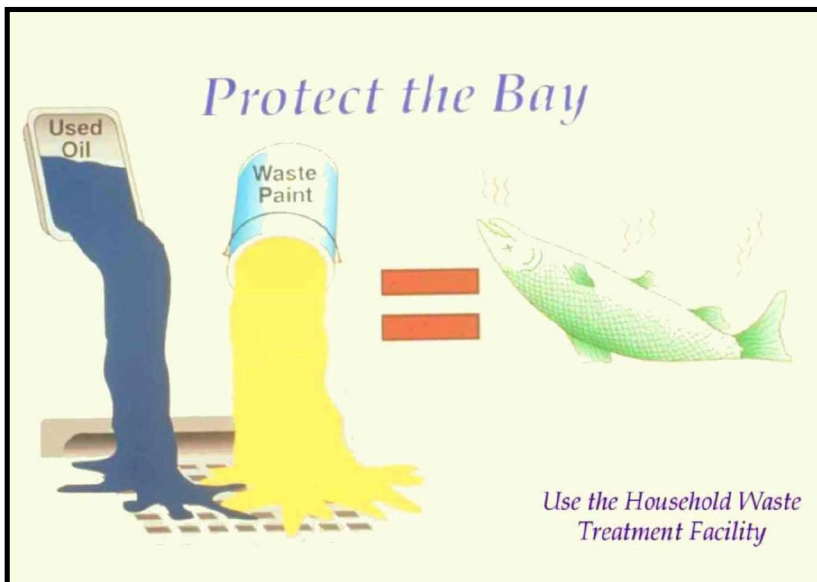
=====

=====

|     |        |
|-----|--------|
| 0%  | 1467.6 |
| 10% | 415.4  |
| 20% | 138.4  |
| 30% | 83.1   |
| 40% | 55.4   |
| 50% | 27.7   |
| 60% | 27.7   |
| 70% | 27.7   |
| 80% | 27.7   |
| 90% | 27.7   |

# Appendix 8: Source Control

*Pollutant Sources/Source Control Checklist*



Graphic by: Margie Winter

## Description

Non-stormwater discharges are those flows that do not consist entirely of stormwater. For municipalities non-stormwater discharges present themselves in two situations. One is from fixed facilities owned and/or operated by the municipality. The other situation is non-stormwater discharges that are discovered during the normal operation of a field program. Some non-stormwater discharges do not include pollutants and may be discharged to the storm drain. These include uncontaminated groundwater and natural springs. There are also some non-stormwater discharges that typically do not contain pollutants and may be discharged to the storm drain with conditions. These include car washing, and surface cleaning. However, there are certain non-stormwater discharges that pose environmental concern. These discharges may originate from illegal dumping or from internal floor drains, appliances, industrial processes, sinks, and toilets that are connected to the nearby storm drainage system. These discharges (which may include: process waste waters, cooling waters, wash waters, and sanitary wastewater) can carry substances (such as paint, oil, fuel and other automotive fluids, chemicals and other pollutants) into storm drains. The ultimate goal is to effectively eliminate non-stormwater discharges to the stormwater drainage system through implementation of measures to detect, correct, and enforce against illicit connections and illegal discharges.

## Approach

The municipality must address non-stormwater discharges from its fixed facilities by assessing the types of non-stormwater discharges and implementing BMPs for the discharges determined to pose environmental concern. For field programs the field staff must be

## Objectives

- Contain
- Educate
- Reduce/Minimize

## Targeted Constituents

|                  |   |
|------------------|---|
| Sediment         | ✓ |
| Nutrients        | ✓ |
| Trash            | ✓ |
| Metals           | ✓ |
| Bacteria         | ✓ |
| Oil and Grease   | ✓ |
| Organics         | ✓ |
| Oxygen Demanding | ✓ |



trained to now what to look for regarding non-stormwater discharges and the procedures to follow in investigating the detected discharges.

## ***Suggested Protocols***

### **Fixed Facility**

#### *General*

- Post “No Dumping” signs with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.
- Stencil storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as “Dump No Waste Drains to Stream” stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.
- Landscaping and beautification efforts of hot spots might also discourage future dumping, as well as provide open space and increase property values.
- Lighting or barriers may also be needed to discourage future dumping.

#### *Illicit Connections*

- Locate discharges from the fixed facility drainage system to the municipal storm drain system through review of “as-built” piping schematics.
- Use techniques such as smoke testing, dye testing and television camera inspection (as noted below) to verify physical connections.
- Isolate problem areas and plug illicit discharge points.

#### *Visual Inspection and Inventory*

- Inventory and inspect each discharge point during dry weather.
- Keep in mind that drainage from a storm event can continue for several days following the end of a storm and groundwater may infiltrate the underground stormwater collection system. Also, non-stormwater discharges are often intermittent and may require periodic inspections.

#### *Review Infield Piping*

- Review the “as-built” piping schematic as a way to determine if there are any connections to the stormwater collection system.
- Inspect the path of floor drains in older buildings.

#### *Smoke Testing*

- Smoke testing of wastewater and stormwater collection systems is used to detect connections between the two systems.

- During dry weather the stormwater collection system is filled with smoke and then traced to sources. The appearance of smoke at the base of a toilet indicates that there may be a connection between the sanitary and the stormwater system.

### *Dye Testing*

- A dye test can be performed by simply releasing a dye into either your sanitary or process wastewater system and examining the discharge points from the stormwater collection system for discoloration.

### *TV Inspection of Storm Sewer*

- TV Cameras can be employed to visually identify illicit connections to the fixed facility storm drain system.

### *Illegal Dumping*

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- Clean up spills on paved surfaces with as little water as possible. Use a rag for small spills, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste.
- Never hose down or bury dry material spills. Sweep up the material and dispose of properly.
- Use adsorbent materials on small spills rather than hosing down the spill. Remove the adsorbent materials promptly and dispose of properly.
- For larger spills, a private spill cleanup company or Hazmat team may be necessary.
- See fact sheet SC-11 Spill Prevention, Control, and Clean Up.

## **Field Program**

### *General*

- Develop clear protocols and lines of communication for effectively prohibiting non-stormwater discharges, especially ones that involve more than one jurisdiction and those that are not classified as hazardous, which are often not responded to as effectively as they need to be.
- Stencil storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as “Dump No Waste Drains to Stream” stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.
- See SC-74 Stormwater Drainage System Maintenance for additional information.

## *Field Inspection*

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- During routine field program maintenance field staff should look for evidence of illegal discharges or illicit connection:
  - Is there evidence of spills such as paints, discoloring, etc.
  - Are there any odors associated with the drainage system
  - Record locations of apparent illegal discharges/illicit connections and notify appropriate investigating agency.
- If trained, conduct field investigation of non-stormwater discharges to determine whether they pose a threat to water quality.

## *Recommended Complaint Investigation Equipment*

- Field Screening Analysis
  - pH paper or meter
  - Commercial stormwater pollutant screening kit that can detect for reactive phosphorus, nitrate nitrogen, ammonium nitrogen, specific conductance, and turbidity
  - Sample jars
  - Sample collection pole
  - A tool to remove access hole covers
- Laboratory Analysis
  - Sample cooler
  - Ice
  - Sample jars and labels
  - Chain of custody forms.
- Documentation
  - Camera
  - Notebook
  - Pens
  - Notice of Violation forms



- Educational materials

## *Reporting*

- A database is useful for defining and tracking the magnitude and location of the problem.
- Report prohibited non-stormwater discharges observed during the course of normal daily activities so they can be investigated, contained and cleaned up or eliminated.
- Document that non-stormwater discharges have been eliminated by recording tests performed, methods used, dates of testing, and any onsite drainage points observed.
- Maintain documentation of illicit connection and illegal dumping incidents, including significant conditionally exempt discharges that are not properly managed.

## *Enforcement*

- Educate the responsible party if identified on the impacts of their actions, explain the stormwater requirements, and provide information regarding Best Management Practices (BMP), as appropriate. Initiate follow-up and/or enforcement procedures.
- If an illegal discharge is traced to a commercial, residential or industrial source, conduct the following activities or coordinate the following activities with the appropriate agency:
  - Contact the responsible party to discuss methods of eliminating the non-stormwater discharge, including disposal options, recycling, and possible discharge to the sanitary sewer (if within POTW limits).
  - Provide information regarding BMPs to the responsible party, where appropriate.
  - Begin enforcement procedures, if appropriate.
  - Continue inspection and follow-up activities until the illicit discharge activity has ceased.
- If an illegal discharge is traced to a commercial or industrial activity, coordinate information on the discharge with the jurisdiction's commercial and industrial facility inspection program.

## *Training*

- Train technical staff to identify and document illegal dumping incidents.
- Well-trained employees can reduce human errors that lead to accidental releases or spills. The employee should have the tools and knowledge to immediately begin cleaning up a spill if one should occur. Employees should be familiar with the Spill Prevention Control and Countermeasure Plan.
- Train employees to identify non-stormwater discharges and report them to the appropriate departments.
- Train staff who have the authority to conduct surveillance and inspections, and write citations for those caught illegally dumping.

- Train municipal staff responsible for surveillance and inspection in the following:
  - OSHA-required Health and Safety Training (29 CFR 1910.120) plus annual refresher training (as needed).
  - OSHA Confined Space Entry training (Cal-OSHA Confined Space, Title 8 and federal OSHA 29 CFR 1910.146).
  - Procedural training (field screening, sampling, smoke/dye testing, TV inspection).
- Educate the identified responsible party on the impacts of his or her actions.

***Spill Response and Prevention***

- See SC-11 Spill Prevention Control and Clean Up

***Other Considerations***

- The elimination of illegal dumping is dependent on the availability, convenience, and cost of alternative means of disposal. The cost of fees for dumping at a proper waste disposal facility are often more than the fine for an illegal dumping offense, thereby discouraging people from complying with the law. The absence of routine or affordable pickup service for trash and recyclables in some communities also encourages illegal dumping. A lack of understanding regarding applicable laws or the inadequacy of existing laws may also contribute to the problem.
- Municipal codes should include sections prohibiting the discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.
- Many facilities do not have accurate, up-to-date schematic drawings.
- Can be difficult to locate illicit connections especially if there is groundwater infiltration.

**Requirements*****Costs***

- Eliminating illicit connections can be expensive especially if structural modifications are required such re-plumbing cross connections under an existing slab.
- Minor cost to train field crews regarding the identification of non-stormwater discharges. The primary cost is for a fully integrated program to identify and eliminate illicit connections and illegal dumping. However, by combining with other municipal programs (i.e. pretreatment program) cost may be lowered.
- Municipal cost for containment and disposal may be borne by the discharger.

***Maintenance***

Not applicable

## Supplemental Information

### *Further Detail of the BMP*

*What constitutes a “non-stormwater” discharge?*

- Non-stormwater discharges are discharges not made up entirely of stormwater and include water used directly in the manufacturing process (process wastewater), air conditioning condensate and coolant, non-contact cooling water, cooling equipment condensate, outdoor secondary containment water, vehicle and equipment wash water, landscape irrigation, sink and drinking fountain wastewater, sanitary wastes, or other wastewaters.

### *Permit Requirements*

- Current municipal NPDES permits require municipalities to effectively prohibit non-stormwater discharges unless authorized by a separate NPDES permit or allowed in accordance with the current NPDES permit conditions. Typically the current permits allow certain non-stormwater discharges in the storm drain system as long as the discharges are not significant sources of pollutants. In this context the following non-stormwater discharges are typically allowed:
  - Diverted stream flows;
  - Rising found waters;
  - Uncontaminated ground water infiltration (as defined at 40 CFR 35.2005(20));
  - Uncontaminated pumped ground water;
  - Foundation drains;
  - Springs;
  - Water from crawl space pumps;
  - Footing drains;
  - Air conditioning condensation;
  - Flows from riparian habitats and wetlands;
  - Water line and hydrant flushing ;
  - Landscape irrigation;
  - Planned and unplanned discharges from potable water sources;
  - Irrigation water;
  - Individual residential car washing; and
  - Lawn watering.

Municipal facilities subject to industrial general permit requirements must include a certification that the stormwater collection system has been tested or evaluated for the presence of non-stormwater discharges. The state's General Industrial Stormwater Permit requires that non-stormwater discharges be eliminated prior to implementation of the facility's SWPPP.

### *Illegal Dumping*

- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Illegal dumping hot spots
  - Types and quantities (in some cases) of wastes
  - Patterns in time of occurrence (time of day/night, month, or year)
  - Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)
  - Responsible parties

### *Outreach*

One of the keys to success of reducing or eliminating illegal dumping is increasing the number of people on the street who are aware of the problem and who have the tools to at least identify the incident, if not correct it. There are a number of ways of accomplishing this:

- Train municipal staff from all departments (public works, utilities, street cleaning, parks and recreation, industrial waste inspection, hazardous waste inspection, sewer maintenance) to recognize and report the incidents.
- Deputize municipal staff who may come into contact with illegal dumping with the authority to write illegal dumping tickets for offenders caught in the act (see below).
- Educate the public. As many as 3 out of 4 people do not understand that in most communities the storm drain does not go to the wastewater treatment plant. Unfortunately, with the heavy emphasis in recent years on public education about solid waste management, including recycling and household hazardous waste, the sewer system (both storm and sanitary) has been the likely recipient of cross-media transfers of waste.
- Provide the public with a mechanism for reporting incidents such as a hot line and/or door hanger (see below).
- Help areas where incidents occur more frequently set up environmental watch programs (like crime watch programs).
- Train volunteers to notice and report the presence and suspected source of an observed pollutant to the appropriate public agency.

*What constitutes a “non-stormwater” discharge?*

- Non-stormwater discharges are discharges not made up entirely of stormwater and include water used directly in the manufacturing process (process wastewater), air conditioning condensate and coolant, non-contact cooling water, cooling equipment condensate, outdoor secondary containment water, vehicle and equipment wash water, landscape irrigation, sink and drinking fountain wastewater, sanitary wastes, or other wastewaters.

*Permit Requirements*

- Current municipal NPDES permits require municipalities to effectively prohibit non-stormwater discharges unless authorized by a separate NPDES permit or allowed in accordance with the current NPDES permit conditions. Typically the current permits allow certain non-stormwater discharges in the storm drain system as long as the discharges are not significant sources of pollutants. In this context the following non-stormwater discharges are typically allowed:
  - Diverted stream flows;
  - Rising found waters;
  - Uncontaminated ground water infiltration (as defined at 40 CFR 35.2005(20));
  - Uncontaminated pumped ground water;
  - Foundation drains;
  - Springs;
  - Water from crawl space pumps;
  - Footing drains;
  - Air conditioning condensation;
  - Flows from riparian habitats and wetlands;
  - Water line and hydrant flushing ;
  - Landscape irrigation;
  - Planned and unplanned discharges from potable water sources;
  - Irrigation water;
  - Individual residential car washing; and
  - Lawn watering.

Municipal facilities subject to industrial general permit requirements must include a certification that the stormwater collection system has been tested or evaluated for the presence of non-stormwater discharges. The state's General Industrial Stormwater Permit requires that non-stormwater discharges be eliminated prior to implementation of the facility's SWPPP.

#### *Storm Drain Stenciling*

- Stencil storm drain inlets with a message to prohibit illegal dumpings, especially in areas with waste handling facilities.
- Encourage public reporting of improper waste disposal by a HOTLINE number stenciled onto the storm drain inlet.
- See Supplemental Information section of this fact sheet for further detail on stenciling program approach.

#### *Oil Recycling*

- Contract collection and hauling of used oil to a private licensed used oil hauler/recycler.
- Comply with all applicable state and federal regulations regarding storage, handling, and transport of petroleum products.
- Create procedures for collection such as; collection locations and schedule, acceptable containers, and maximum amounts accepted.
- The California Integrated Waste Management Board has a Recycling Hotline, (800) 553-2962, that provides information and recycling locations for used oil.

#### ***Household Hazardous Waste***

- Provide household hazardous waste (HHW) collection facilities. Several types of collection approaches are available including permanent, periodic, or mobile centers, curbside collection, or a combination of these systems.

#### ***Training***

- Train municipal employees and contractors in proper and consistent methods for waste disposal.
- Train municipal employees to recognize and report illegal dumping.
- Train employees and subcontractors in proper hazardous waste management.

#### ***Spill Response and Prevention***

- Refer to SC-11, Spill Prevention, Control & Cleanup
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

## ***Other Considerations***

- Federal Regulations (RCRA, SARA, CERCLA) and state regulations exist regarding the disposal of hazardous waste.
- Municipalities are required to have a used oil recycling and a HHW element within their integrate waste management plan.
- Significant liability issues are involved with the collection, handling, and disposal of HHW.

## ***Examples***

The City of Palo Alto has developed a public participation program for reporting dumping violations. When a concerned citizen or public employee encounters evidence of illegal dumping, a door hanger (similar in format to hotel “Do Not Disturb” signs) is placed on the front doors in the neighborhood. The door hanger notes that a violation has occurred in the neighborhood, informs the reader why illegal dumping is a problem, and notes that illegal dumping carries a significant financial penalty. Information is also provided on what citizens can do as well as contact numbers for more information or to report a violation.

The Port of Long Beach has a state of the art database incorporating storm drain infrastructure, potential pollutant sources, facility management practices, and a pollutant tracking system.

The State Department of Fish and Game has a hotline for reporting violations called CalTIP (1-800-952-5400). The phone number may be used to report any violation of a Fish and Game code (illegal dumping, poaching, etc.).

The California Department of Toxic Substances Control’s Waste Alert Hotline, 1-800-69TOXIC, can be used to report hazardous waste violations.

## **References and Resources**

<http://www.stormwatercenter.net/>

California’s Nonpoint Source Program Plan <http://www.co.clark.wa.us/pubworks/bmpman.pdf>

King County Stormwater Pollution Control Manual - <http://dnr.metrokc.gov/wlr/dss/spcm.htm>

Orange County Stormwater Program,  
[http://www.ocwatersheds.com/stormwater/swp\\_introduction.asp](http://www.ocwatersheds.com/stormwater/swp_introduction.asp)

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program  
(<http://www.projectcleanwater.org>)

Santa Clara Valley Urban Runoff Pollution Prevention Program  
[http://www.scvurppp-w2k.com/pdf%20documents/PS\\_ICID.PDF](http://www.scvurppp-w2k.com/pdf%20documents/PS_ICID.PDF)

# Spill Prevention, Control & Cleanup SC-11



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## Objectives

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- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

## Description

Spills and leaks, if not properly controlled, can adversely impact the storm drain system and receiving waters. Due to the type of work or the materials involved, many activities that occur either at a municipal facility or as a part of municipal field programs have the potential for accidental spills and leaks. Proper spill response planning and preparation can enable municipal employees to effectively respond to problems when they occur and minimize the discharge of pollutants to the environment.

## Approach

- An effective spill response and control plan should include:
  - Spill/leak prevention measures;
  - Spill response procedures;
  - Spill cleanup procedures;
  - Reporting; and
  - Training
- A well thought out and implemented plan can prevent pollutants from entering the storm drainage system and can be used as a tool for training personnel to prevent and control future spills as well.

## Pollution Prevention

- Develop and implement a Spill Prevention Control and Response Plan. The plan should include:

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## Targeted Constituents

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|                  |   |
|------------------|---|
| Sediment         |   |
| Nutrients        | ✓ |
| Trash            |   |
| Metals           | ✓ |
| Bacteria         |   |
| Oil and Grease   | ✓ |
| Organics         | ✓ |
| Oxygen Demanding | ✓ |





# **SC-11 Spill Prevention, Control & Cleanup**

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- A description of the facility, the address, activities and materials involved
- Identification of key spill response personnel
- Identification of the potential spill areas or operations prone to spills/leaks
- Identification of which areas should be or are bermed to contain spills/leaks
- Facility map identifying the key locations of areas, activities, materials, structural BMPs, etc.
- Material handling procedures
- Spill response procedures including:
  - Assessment of the site and potential impacts
  - Containment of the material
  - Notification of the proper personnel and evacuation procedures
  - Clean up of the site
  - Disposal of the waste material and
  - Proper record keeping
- Product substitution – use less toxic materials (i.e. use water based paints instead of oil based paints)
- Recycle, reclaim, or reuse materials whenever possible. This will reduce the amount of materials that are brought into the facility or into the field.

## ***Suggested Protocols***

### *Spill/Leak Prevention Measures*

- If possible, move material handling indoors, under cover, or away from storm drains or sensitive water bodies.
- Properly label all containers so that the contents are easily identifiable.
- Berm storage areas so that if a spill or leak occurs, the material is contained.
- Cover outside storage areas either with a permanent structure or with a seasonal one such as a tarp so that rain can not come into contact with the materials.
- Check containers (and any containment sumps) often for leaks and spills. Replace containers that are leaking, corroded, or otherwise deteriorating with containers in good condition. Collect all spilled liquids and properly dispose of them.

# **Spill Prevention, Control & Cleanup SC-11**

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- Store, contain and transfer liquid materials in such a manner that if the container is ruptured or the contents spilled, they will not discharge, flow or be washed into the storm drainage system, surface waters, or groundwater.
- Place drip pans or absorbent materials beneath all mounted taps and at all potential drip and spill locations during the filling and unloading of containers. Any collected liquids or soiled absorbent materials should be reused/recycled or properly disposed of.
- For field programs, only transport the minimum amount of material needed for the daily activities and transfer materials between containers at a municipal yard where leaks and spill are easier to control.
- If paved, sweep and clean storage areas monthly, do not use water to hose down the area unless all of the water will be collected and disposed of properly.
- Install a spill control device (such as a tee section) in any catch basins that collect runoff from any storage areas if the materials stored are oil, gas, or other materials that separate from and float on water. This will allow for easier cleanup if a spill occurs.
- If necessary, protect catch basins while conducting field activities so that if a spill occurs, the material will be contained.

## ***Training***

- Educate employees about spill prevention, spill response and cleanup on a routine basis.
- Well-trained employees can reduce human errors that lead to accidental releases or spills:
  - The employees should have the tools and knowledge to immediately begin cleaning up a spill if one should occur.
  - Employees should be familiar with the Spill Prevention Control and Countermeasure Plan if one is available.
- Training of staff from all municipal departments should focus on recognizing and reporting potential or current spills/leaks and who they should contact.
- Employees responsible for aboveground storage tanks and liquid transfers for large bulk containers should be thoroughly familiar with the Spill Prevention Control and Countermeasure Plan and the plan should be readily available.

## ***Spill Response and Prevention***

- Identify key spill response personnel and train employees on who they are.
- Store and maintain appropriate spill cleanup materials in a clearly marked location near storage areas; and train employees to ensure familiarity with the site's spill control plan and/or proper spill cleanup procedures.
- Locate spill cleanup materials, such as absorbents, where they will be readily accessible (e.g. near storage and maintenance areas, on field trucks).

# **SC-11 Spill Prevention, Control & Cleanup**

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- Follow the Spill Prevention Control and Countermeasure Plan if one is available.
- If a spill occurs, notify the key spill response personnel immediately. If the material is unknown or hazardous, the local fire department may also need to be contacted.
- If safe to do so, attempt to contain the material and block the nearby storm drains so that the area impacted is minimized. If the material is unknown or hazardous wait for properly trained personnel to contain the materials.
- Perform an assessment of the area where the spill occurred and the downstream area that it could impact. Relay this information to the key spill response and clean up personnel.

## *Spill Cleanup Procedures*

- Small non-hazardous spills
  - Use a rag, damp cloth or absorbent materials for general clean up of liquids
  - Use brooms or shovels for the general clean up of dry materials
  - If water is used, it must be collected and properly disposed of. The wash water can not be allowed to enter the storm drain.
  - Dispose of any waste materials properly
  - Clean or dispose of any equipment used to clean up the spill properly
- Large non-hazardous spills
  - Use absorbent materials for general clean up of liquids
  - Use brooms, shovels or street sweepers for the general clean up of dry materials
  - If water is used, it must be collected and properly disposed of. The wash water can not be allowed to enter the storm drain.
  - Dispose of any waste materials properly
  - Clean or dispose of any equipment used to clean up the spill properly
- For hazardous or very large spills, a private cleanup company or Hazmat team may need to be contacted to assess the situation and conduct the cleanup and disposal of the materials.
- Chemical cleanups of material can be achieved with the use of absorbents, gels, and foams. Remove the adsorbent materials promptly and dispose of according to regulations.
- If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste.

## *Reporting*

- Report any spills immediately to the identified key municipal spill response personnel.

# Spill Prevention, Control & Cleanup SC-11

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- Report spills in accordance with applicable reporting laws. Spills that pose an immediate threat to human health or the environment must be reported immediately to the Office of Emergency Service (OES)
- Spills that pose an immediate threat to human health or the environment may also need to be reported within 24 hours to the Regional Water Quality Control Board.
- Federal regulations require that any oil spill into a water body or onto an adjoining shoreline be reported to the National Response Center (NRC) at 800-424-8802 (24 hour)
- After the spill has been contained and cleaned up, a detailed report about the incident should be generated and kept on file (see the section on Reporting below). The incident may also be used in briefing staff about proper procedures

## ***Other Considerations***

- State regulations exist for facilities with a storage capacity of 10,000 gallons or more of petroleum to prepare a Spill Prevention Control and Countermeasure Plan (SPCC) Plan (Health & Safety Code Chapter 6.67).
- State regulations also exist for storage of hazardous materials (Health & Safety Code Chapter 6.95), including the preparation of area and business plans for emergency response to the releases or threatened releases.
- Consider requiring smaller secondary containment areas (less than 200 sq. ft.) to be connected to the sanitary sewer, if permitted to do so, prohibiting any hard connections to the storm drain.

## **Requirements**

### ***Costs***

- Will vary depending on the size of the facility and the necessary controls.
- Prevention of leaks and spills is inexpensive. Treatment and/or disposal of wastes, contaminated soil and water is very expensive

### ***Maintenance***

- This BMP has no major administrative or staffing requirements. However, extra time is needed to properly handle and dispose of spills, which results in increased labor costs

## **Supplemental Information**

### ***Further Detail of the BMP***

#### ***Reporting***

Record keeping and internal reporting represent good operating practices because they can increase the efficiency of the response and containment of a spill. A good record keeping system helps the municipality minimize incident recurrence, correctly respond with appropriate containment and cleanup activities, and comply with legal requirements.

# **SC-11 Spill Prevention, Control & Cleanup**

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A record keeping and reporting system should be set up for documenting spills, leaks, and other discharges, including discharges of hazardous substances in reportable quantities. Incident records describe the quality and quantity of non-stormwater discharges to the storm drain.

These records should contain the following information:

- Date and time of the incident
- Weather conditions
- Duration of the spill/leak/discharge
- Cause of the spill/leak/discharge
- Response procedures implemented
- Persons notified
- Environmental problems associated with the spill/leak/discharge

Separate record keeping systems should be established to document housekeeping and preventive maintenance inspections, and training activities. All housekeeping and preventive maintenance inspections should be documented. Inspection documentation should contain the following information:

- The date and time the inspection was performed
- Name of the inspector
- Items inspected
- Problems noted
- Corrective action required
- Date corrective action was taken

Other means to document and record inspection results are field notes, timed and dated photographs, videotapes, and drawings and maps.

## ***Examples***

The City of Palo Alto includes spill prevention and control as a major element of its highly effective program for municipal vehicle maintenance shops.

## **References and Resources**

King County Stormwater Pollution Control Manual - <http://dnr.metrokc.gov/wlr/dss/spcm.htm>

Orange County Stormwater Program

[http://www.ocwatersheds.com/stormwater/swp\\_introduction.asp](http://www.ocwatersheds.com/stormwater/swp_introduction.asp)

# **Spill Prevention, Control & Cleanup SC-11**

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program  
(URMP)

<http://www.projectcleanwater.org/pdf/Model%20Program%20Municipal%20Facilities.pdf>



## Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

## Description

The loading/unloading of materials usually takes place outside on docks or terminals; therefore, materials spilled, leaked, or lost during loading/unloading may collect in the soil or on other surfaces and have the potential to be carried away by stormwater runoff or when the area is cleaned. Additionally, rainfall may wash pollutants from machinery used to unload or move materials. Loading and unloading of material may include package products, barrels, and bulk products. Implementation of the following protocols will prevent or reduce the discharge of pollutants to stormwater from outdoor loading/unloading of materials.

## Approach

### *Pollution Prevention*

- Keep accurate maintenance logs to evaluate materials removed and improvements made.
- Park tank trucks or delivery vehicles in designated areas so that spills or leaks can be contained.
- Limit exposure of materials with the potential to contaminate stormwater.
- Prevent stormwater runoff.
- Regularly check equipment for leaks.

## Targeted Constituents

|                  |   |
|------------------|---|
| Sediment         | ✓ |
| Nutrients        | ✓ |
| Trash            |   |
| Metals           | ✓ |
| Bacteria         |   |
| Oil and Grease   | ✓ |
| Organics         | ✓ |
| Oxygen Demanding | ✓ |



***Suggested Protocols******Loading and Unloading – General Guidelines***

- Develop an operations plan that describes procedures for loading and/or unloading.
- Do not conduct loading and unloading during wet weather, whenever possible.
- Cover designated loading/unloading areas to reduce exposure of materials to rain.
- A seal or door skirt between delivery vehicles and building can reduce or prevent exposure to rain.
- Design loading/unloading area to prevent stormwater runoff which would include grading or berming the area, and positioning roof downspouts so they direct stormwater away from the loading/unloading areas.
- If feasible, load and unload all materials and equipment in covered areas such as building overhangs at loading docks.
- Load/unload only at designated loading areas.
- Use drip pans underneath hose and pipe connections and other leak-prone spots during liquid transfer operations, and when making and breaking connections. Several drip pans should be stored in a covered location near the liquid transfer area so that they are always available, yet protected from precipitation when not in use. Drip pans can be made specifically for railroad tracks. Drip pans must be cleaned periodically, and drip collected materials must be disposed of properly.
- Pave loading areas with concrete instead of asphalt.
- Avoid placing storm drains in the area.
- Grade and/or berm the loading/ unloading area to a drain that is connected to a dead-end sump.

***Inspection***

- Check loading and unloading equipment regularly for leaks, including valves, pumps, flanges and connections.
- Look for dust or fumes during loading or unloading operations.

***Training***

- Train employees (e.g. fork lift operators) and contractors on proper spill containment and cleanup.
- Employees trained in spill containment and cleanup should be present during the loading/unloading.
- Train employees in proper handling techniques during liquid transfers to avoid spills.



- Make sure forklift operators are properly trained on loading and unloading procedures.

## ***Spill Response and Prevention***

- Refer to SC-11, Spill Prevention, Control & Cleanup
- Keep your spill prevention Control and countermeasure (SPCC) Plan up-to-date, and implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

## ***Other Considerations***

- Space, material characteristics and/or time limitations may preclude all transfers from being performed indoors or under cover.

## **Requirements**

### ***Costs***

- Should be low except when covering a large loading/unloading area.

### ***Maintenance***

- Conduct regular inspections and make repairs as necessary. The frequency of repairs will depend on the age of the facility.
- Check loading and unloading equipment regularly for leaks.
- Regular broom dry-sweeping of area.
- Conduct major clean-out of loading and unloading area and sump prior to October 1 of each year.

## **Supplemental Information**

### ***Further Detail of the BMP***

#### ***Special Circumstances for Indoor Loading/Unloading of Materials***

As appropriate loading or unloading of liquids should occur indoors so that any spills that are not completely retained can be discharged to the sanitary sewer, treatment plant, or treated in a manner consistent with local sewer authorities and permit requirements.

- For loading and unloading tank trucks to above and below ground storage tanks, the following procedures should be used:
  - The area where the transfer takes place should be paved. If the liquid is reactive with the asphalt, Portland cement should be used to pave the area.
  - Transfer area should be designed to prevent runoff of stormwater from adjacent areas. Sloping the pad and using a curb, like a speed bump, around the uphill side of the transfer area should reduce run-on.

- Transfer area should be designed to prevent runoff of spilled liquids from the area. Sloping the area to a drain should prevent runoff. The drain should be connected to a dead-end sump or to the sanitary sewer (if allowed). A positive control valve should be installed on the drain.
- For transfer from rail cars to storage tanks that must occur outside, use the following procedures:
  - Drip pans should be placed at locations where spillage may occur, such as hose connections, hose reels, and filler nozzles, Use drip pans when making and breaking connections.
  - Drip pan systems should be installed between the rails to collect spillage from tank cars.

**References and Resources**

<http://www.stormwatercenter.net/>

King County - <ftp://dnr.metrokc.gov/wlr/dss/spcm/Chapter%203.PDF>

Orange County Stormwater Program

[http://www.ocwatersheds.com/StormWater/swp\\_introduction.asp](http://www.ocwatersheds.com/StormWater/swp_introduction.asp)

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program (URMP) -

<http://www.projectcleanwater.org/pdf/Model%20Program%20Municipal%20Facilities.pdf>



## Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

## Description

Improper storage and handling of solid wastes can allow toxic compounds, oils and greases, heavy metals, nutrients, suspended solids, and other pollutants to enter stormwater runoff. The discharge of pollutants to stormwater from waste handling and disposal can be prevented and reduced by tracking waste generation, storage, and disposal; reducing waste generation and disposal through source reduction, re-use, and recycling; and preventing runoff and runoff.

## Approach

### *Pollution Prevention*

- Reduction in the amount of waste generated can be accomplished using the following source controls such as:
  - Production planning and sequencing
  - Process or equipment modification
  - Raw material substitution or elimination
  - Loss prevention and housekeeping
  - Waste segregation and separation
  - Close loop recycling
- Establish a material tracking system to increase awareness about material usage. This may reduce spills and minimize contamination, thus reducing the amount of waste produced.
- Recycle materials whenever possible.

## Targeted Constituents

|                  |   |
|------------------|---|
| Sediment         | ✓ |
| Nutrients        | ✓ |
| Trash            | ✓ |
| Metals           | ✓ |
| Bacteria         | ✓ |
| Oil and Grease   | ✓ |
| Organics         | ✓ |
| Oxygen Demanding | ✓ |



***Suggested Protocols****General*

- Cover storage containers with leak proof lids or some other means. If waste is not in containers, cover all waste piles (plastic tarps are acceptable coverage) and prevent stormwater runoff and runoff with a berm. The waste containers or piles must be covered except when in use.
- Use drip pans or absorbent materials whenever grease containers are emptied by vacuum trucks or other means. Grease cannot be left on the ground. Collected grease must be properly disposed of as garbage.
- Check storage containers weekly for leaks and to ensure that lids are on tightly. Replace any that are leaking, corroded, or otherwise deteriorating.
- Sweep and clean the storage area regularly. If it is paved, do not hose down the area to a storm drain.
- Dispose of rinse and wash water from cleaning waste containers into a sanitary sewer if allowed by the local sewer authority. Do not discharge wash water to the street or storm drain.
- Transfer waste from damaged containers into safe containers.
- Take special care when loading or unloading wastes to minimize losses. Loading systems can be used to minimize spills and fugitive emission losses such as dust or mist. Vacuum transfer systems can minimize waste loss.

*Controlling Litter*

- Post “No Littering” signs and enforce anti-litter laws.
- Provide a sufficient number of litter receptacles for the facility.
- Clean out and cover litter receptacles frequently to prevent spillage.

*Waste Collection*

- Keep waste collection areas clean.
- Inspect solid waste containers for structural damage or leaks regularly. Repair or replace damaged containers as necessary.
- Secure solid waste containers; containers must be closed tightly when not in use.
- Place waste containers under cover if possible.
- Do not fill waste containers with washout water or any other liquid.
- Ensure that only appropriate solid wastes are added to the solid waste container. Certain wastes such as hazardous wastes, appliances, fluorescent lamps, pesticides, etc. may not be

disposed of in solid waste containers (see chemical/ hazardous waste collection section below).

- Do not mix wastes; this can cause chemical reactions, make recycling impossible, and complicate disposal.

## *Good Housekeeping*

- Use all of the product before disposing of the container.
- Keep the waste management area clean at all times by sweeping and cleaning up spills immediately.
- Use dry methods when possible (e.g. sweeping, use of absorbents) when cleaning around restaurant/food handling dumpster areas. If water must be used after sweeping/using absorbents, collect water and discharge through grease interceptor to the sewer.
- Stencil storm drains on the facility's property with prohibitive message regarding waste disposal.

## *Chemical/Hazardous Wastes*

- Select designated hazardous waste collection areas on-site.
- Store hazardous materials and wastes in covered containers protected from vandalism, and in compliance with fire and hazardous waste codes.
- Place hazardous waste containers in secondary containment.
- Make sure that hazardous waste is collected, removed, and disposed of only at authorized disposal areas.

## *Runon/Runoff Prevention*

- Prevent stormwater runon from entering the waste management area by enclosing the area or building a berm around the area.
- Prevent the waste materials from directly contacting rain.
- Cover waste piles with temporary covering material such as reinforced tarpaulin, polyethylene, polyurethane, polypropylene or hypalon.
- Cover the area with a permanent roof if feasible.
- Cover dumpsters to prevent rain from washing waste out of holes or cracks in the bottom of the dumpster.
- Move the activity indoor after ensuring all safety concerns such as fire hazard and ventilation are addressed.

## *Inspection*

- Inspect and replace faulty pumps or hoses regularly to minimize the potential of releases and spills.
- Check waste management areas for leaking containers or spills.
- Repair leaking equipment including valves, lines, seals, or pumps promptly.

***Training***

- Train staff pollution prevention measures and proper disposal methods.
- Train employees and contractors proper spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill if one should occur.
- Train employees and subcontractors in proper hazardous waste management.

***Spill Response and Prevention***

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Keep your Spill Prevention Control and countermeasure (SPCC) plan up-to-date, and implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.
- Vehicles transporting waste should have spill prevention equipment that can prevent spills during transport. The spill prevention equipment includes:
  - Vehicles equipped with baffles for liquid waste
  - Trucks with sealed gates and spill guards for solid waste

***Other Considerations***

- Hazardous waste cannot be re-used or recycled; it must be disposed of by a licensed hazardous waste hauler.

**Requirements*****Costs***

- Capital and operation and maintenance costs will vary substantially depending on the size of the facility and the types of waste handled. Costs should be low if there is an inventory program in place.

***Maintenance***

- None except for maintaining equipment for material tracking program.

## Supplemental Information

### *Further Detail of the BMP*

#### *Land Treatment System*

- Minimize the runoff of polluted stormwater from land application of municipal waste on-site by:
  - Choosing a site where slopes are under 6%, the soil is permeable, there is a low water table, it is located away from wetlands or marshes, there is a closed drainage system.
  - Avoiding application of waste to the site when it is raining or when the ground is saturated with water.
  - Growing vegetation on land disposal areas to stabilize soils and reduce the volume of surface water runoff from the site.
  - Maintaining adequate barriers between the land application site and the receiving waters. Planted strips are particularly good.
  - Using erosion control techniques such as mulching and matting, filter fences, straw bales, diversion terracing, and sediment basins.
  - Performing routine maintenance to ensure the erosion control or site stabilization measures are working.

## References and Resources

King County Stormwater Pollution Control Manual - <http://dnr.metrokc.gov/wlr/dss/spcm.htm>

Orange County Stormwater Program

[http://www.ocwatersheds.com/StormWater/swp\\_introduction.asp](http://www.ocwatersheds.com/StormWater/swp_introduction.asp)

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Associations (BASMAA). On-line: <http://www.basmaa.org>



## Description

Stormwater runoff from building and grounds maintenance activities can be contaminated with toxic hydrocarbons in solvents, fertilizers and pesticides, suspended solids, heavy metals, and abnormal pH. Utilizing the following protocols will prevent or reduce the discharge of pollutants to stormwater from building and grounds maintenance activities by washing and cleaning up with as little water as possible, following good landscape management practices, preventing and cleaning up spills immediately, keeping debris from entering the storm drains, and maintaining the stormwater collection system.

## Approach

### *Pollution Prevention*

- Switch to non-toxic chemicals for maintenance when possible.
- Choose cleaning agents that can be recycled.
- Encourage proper lawn management and landscaping, including use of native vegetation.
- Encourage use of Integrated Pest Management techniques for pest control.
- Encourage proper onsite recycling of yard trimmings.
- Recycle residual paints, solvents, lumber, and other material as much as possible.

## Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

## Targeted Constituents

|                  |   |
|------------------|---|
| Sediment         | ✓ |
| Nutrients        | ✓ |
| Trash            | ✓ |
| Metals           | ✓ |
| Bacteria         | ✓ |
| Oil and Grease   | ✓ |
| Organics         | ✓ |
| Oxygen Demanding | ✓ |





# SC-41 Building & Grounds Maintenance

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## *Suggested Protocols*

### *Pressure Washing of Buildings, Rooftops, and Other Large Objects*

- In situations where soaps or detergents are used and the surrounding area is paved, pressure washers must use a waste water collection device that enables collection of wash water and associated solids. A sump pump, wet vacuum or similarly effective device must be used to collect the runoff and loose materials. The collected runoff and solids must be disposed of properly.
- If soaps or detergents are not used, and the surrounding area is paved, wash water runoff does not have to be collected but must be screened. Pressure washers must use filter fabric or some other type of screen on the ground and/or in the catch basin to trap the particles in wash water runoff.
- If you are pressure washing on a grassed area (with or without soap), runoff must be dispersed as sheet flow as much as possible, rather than as a concentrated stream. The wash runoff must remain on the grass and not drain to pavement. Ensure that this practice does not kill grass.

### *Landscaping Activities*

- Do not apply any chemicals (insecticide, herbicide, or fertilizer) directly to surface waters, unless the application is approved and permitted by the state.
- Dispose of grass clippings, leaves, sticks, or other collected vegetation as garbage, or by composting. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures on exposed soils.
- Check irrigation schedules so pesticides will not be washed away and to minimize non-stormwater discharge.

### *Building Repair, Remodeling, and Construction*

- Do not dump any toxic substance or liquid waste on the pavement, the ground, or toward a storm drain.
- Use ground or drop cloths underneath outdoor painting, scraping, and sandblasting work, and properly dispose of collected material daily.
- Use a ground cloth or oversized tub for activities such as paint mixing and tool cleaning.
- Clean paint brushes and tools covered with water-based paints in sinks connected to sanitary sewers or in portable containers that can be dumped into a sanitary sewer drain. Brushes and tools covered with non-water-based paints, finishes, or other materials must be cleaned in a manner that enables collection of used solvents (e.g., paint thinner, turpentine, etc.) for recycling or proper disposal.

- Use a storm drain cover, filter fabric, or similarly effective runoff control mechanism if dust, grit, wash water, or other pollutants may escape the work area and enter a catch basin. The containment device(s) must be in place at the beginning of the work day, and accumulated dirty runoff and solids must be collected and disposed of before removing the containment device(s) at the end of the work day.
- If you need to de-water an excavation site, you may need to filter the water before discharging to a catch basin or off-site. In which case you should direct the water through hay bales and filter fabric or use other sediment filters or traps.
- Store toxic material under cover with secondary containment during precipitation events and when not in use. A cover would include tarps or other temporary cover material.

### *Mowing, Trimming, and Planting*

- Dispose of leaves, sticks, or other collected vegetation as garbage, by composting or at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures when soils are exposed.
- Place temporarily stockpiled material away from watercourses and drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.
- Consider an alternative approach when bailing out muddy water; do not put it in the storm drain, pour over landscaped areas.
- Use hand or mechanical weeding where practical.

### *Fertilizer and Pesticide Management*

- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.
- Follow manufacturers' recommendations and label directions. Pesticides must never be applied if precipitation is occurring or predicted. Do not apply insecticides within 100 feet of surface waters such as lakes, ponds, wetlands, and streams.
- Use less toxic pesticides that will do the job, whenever possible. Avoid use of copper-based pesticides if possible.
- Do not use pesticides if rain is expected.
- Do not mix or prepare pesticides for application near storm drains.
- Use the minimum amount needed for the job.
- Calibrate fertilizer distributors to avoid excessive application.
- Employ techniques to minimize off-target application (e.g. spray drift) of pesticides, including consideration of alternative application techniques.

# SC-41 Building & Grounds Maintenance

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- Apply pesticides only when wind speeds are low.
- Work fertilizers into the soil rather than dumping or broadcasting them onto the surface.
- Irrigate slowly to prevent runoff and then only as much as is needed.
- Clean pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Dispose of empty pesticide containers according to the instructions on the container label.
- Use up the pesticides. Rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Implement storage requirements for pesticide products with guidance from the local fire department and County Agricultural Commissioner. Provide secondary containment for pesticides.

## *Inspection*

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering, and repair leaks in the irrigation system as soon as they are observed.

## *Training*

- Educate and train employees on use of pesticides and in pesticide application techniques to prevent pollution.
- Train employees and contractors in proper techniques for spill containment and cleanup.
- Be sure the frequency of training takes into account the complexity of the operations and the nature of the staff.

## *Spill Response and Prevention*

- Refer to SC-11, Spill Prevention, Control & Cleanup
- Keep your Spill Prevention Control and countermeasure (SPCC) plan up-to-date, and implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

## *Other Considerations*

- Alternative pest/weed controls may not be available, suitable, or effective in many cases.

## **Requirements**

### **Costs**

- Overall costs should be low in comparison to other BMPs.

### **Maintenance**

- Sweep paved areas regularly to collect loose particles, and wipe up spills with rags and other absorbent material immediately, do not hose down the area to a storm drain.

## **Supplemental Information**

### **Further Detail of the BMP**

#### *Fire Sprinkler Line Flushing*

Building fire sprinkler line flushing may be a source of non-stormwater runoff pollution. The water entering the system is usually potable water though in some areas it may be non-potable reclaimed wastewater. There are subsequent factors that may drastically reduce the quality of the water in such systems. Black iron pipe is usually used since it is cheaper than potable piping but it is subject to rusting and results in lower quality water. Initially the black iron pipe has an oil coating to protect it from rusting between manufacture and installation; this will contaminate the water from the first flush but not from subsequent flushes. Nitrates, poly-phosphates and other corrosion inhibitors, as well as fire suppressants and antifreeze may be added to the sprinkler water system. Water generally remains in the sprinkler system a long time, typically a year, between flushes and may accumulate iron, manganese, lead, copper, nickel and zinc. The water generally becomes anoxic and contains living and dead bacteria and breakdown products from chlorination. This may result in a significant BOD problem and the water often smells. Consequently dispose fire sprinkler line flush water into the sanitary sewer. Do not allow discharge to storm drain or infiltration due to potential high levels of pollutants in fire sprinkler line water.

## **References and Resources**

California's Nonpoint Source Program Plan <http://www.swrcb.ca.gov/nps/index.html>

King County - <ftp://dnr.metrokc.gov/wlr/dss/spcm/Chapter%203.PDF>

Orange County Stormwater Program

[http://www.ocwatersheds.com/StormWater/swp\\_introduction.asp](http://www.ocwatersheds.com/StormWater/swp_introduction.asp)

Mobile Cleaners Pilot Program: Final Report. 1997. Bay Area Stormwater Management Agencies Association (BASSMA) <http://www.basmaa.org/>

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA) <http://www.basmaa.org/>

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program (URMP) -

<http://www.projectcleanwater.org/pdf/Model%20Program%20Municipal%20Facilities.pdf>

# Parking/Storage Area Maintenance SC-43



## Description

Parking lots and storage areas can contribute a number of substances, such as trash, suspended solids, hydrocarbons, oil and grease, and heavy metals that can enter receiving waters through stormwater runoff or non-stormwater discharges. The following protocols are intended to prevent or reduce the discharge of pollutants from parking/storage areas and include using good housekeeping practices, following appropriate cleaning BMPs, and training employees.

## Approach

### *Pollution Prevention*

- Encourage alternative designs and maintenance strategies for impervious parking lots. (See New Development and Redevelopment BMP Handbook).
- Keep accurate maintenance logs to evaluate BMP implementation.

### *Suggested Protocols*

#### *General*

- Keep the parking and storage areas clean and orderly. Remove debris in a timely fashion.
- Allow sheet runoff to flow into biofilters (vegetated strip and swale) and/or infiltration devices.
- Utilize sand filters or oleophilic collectors for oily waste in low concentrations.

## Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

## Targeted Constituents

|                  |   |
|------------------|---|
| Sediment         | ✓ |
| Nutrients        | ✓ |
| Trash            | ✓ |
| Metals           | ✓ |
| Bacteria         | ✓ |
| Oil and Grease   | ✓ |
| Organics         | ✓ |
| Oxygen Demanding | ✓ |



# **SC-43 Parking/Storage Area Maintenance**

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- Arrange rooftop drains to prevent drainage directly onto paved surfaces.
- Design lot to include semi-permeable hardscape.

## *Controlling Litter*

- Post “No Littering” signs and enforce anti-litter laws.
- Provide an adequate number of litter receptacles.
- Clean out and cover litter receptacles frequently to prevent spillage.
- Provide trash receptacles in parking lots to discourage litter.
- Routinely sweep, shovel and dispose of litter in the trash.

## *Surface cleaning*

- Use dry cleaning methods (e.g. sweeping or vacuuming) to prevent the discharge of pollutants into the stormwater conveyance system.
- Establish frequency of public parking lot sweeping based on usage and field observations of waste accumulation.
- Sweep all parking lots at least once before the onset of the wet season.
- If water is used follow the procedures below:
  - Block the storm drain or contain runoff.
  - Wash water should be collected and pumped to the sanitary sewer or discharged to a pervious surface, do not allow wash water to enter storm drains.
  - Dispose of parking lot sweeping debris and dirt at a landfill.
- When cleaning heavy oily deposits:
  - Use absorbent materials on oily spots prior to sweeping or washing.
  - Dispose of used absorbents appropriately.

## *Surface Repair*

- Pre-heat, transfer or load hot bituminous material away from storm drain inlets.
- Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff.
- Cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc., where applicable. Leave covers in place until job is complete and until all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal.

# **Parking/Storage Area Maintenance SC-43**

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- Use only as much water as necessary for dust control, to avoid runoff.
- Catch drips from paving equipment that is not in use with pans or absorbent material placed under the machines. Dispose of collected material and absorbents properly.

## *Inspection*

- Have designated personnel conduct inspections of the parking facilities and stormwater conveyance systems associated with them on a regular basis.
- Inspect cleaning equipment/sweepers for leaks on a regular basis.

## *Training*

- Provide regular training to field employees and/or contractors regarding cleaning of paved areas and proper operation of equipment.
- Train employees and contractors in proper techniques for spill containment and cleanup.

## *Spill Response and Prevention*

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Keep your Spill Prevention Control and countermeasure (SPCC) plan up-to-date, and implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

## *Other Considerations*

- Limitations related to sweeping activities at large parking facilities may include high equipment costs, the need for sweeper operator training, and the inability of current sweeper technology to remove oil and grease.

## **Requirements**

### **Costs**

Cleaning/sweeping costs can be quite large, construction and maintenance of stormwater structural controls can be quite expensive as well.

### **Maintenance**

- Sweep parking lot to minimize cleaning with water.
- Clean out oil/water/sand separators regularly, especially after heavy storms.
- Clean parking facilities on a regular basis to prevent accumulated wastes and pollutants from being discharged into conveyance systems during rainy conditions.

# **SC-43 Parking/Storage Area Maintenance**

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## **Supplemental Information**

### ***Further Detail of the BMP***

#### *Surface Repair*

Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff. Where applicable, cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and until all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal. Use only as much water as necessary for dust control, to avoid runoff.

## **References and Resources**

<http://www.stormwatercenter.net/>

California's Nonpoint Source Program Plan <http://www.swrcb.ca.gov/nps/index.html>

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities. Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality control Board. July 1998 (Revised February 2002 by the California Coastal Commission).

Orange County Stormwater Program

[http://www.ocwatersheds.com/StormWater/swp\\_introduction.asp](http://www.ocwatersheds.com/StormWater/swp_introduction.asp)

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA) <http://www.basma.org>

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program (URMP)

<http://www.projectcleanwater.org/pdf/Model%20Program%20Municipal%20Facilities.pdf>



## Description

Promote efficient and safe housekeeping practices (storage, use, and cleanup) when handling potentially harmful materials such as fertilizers, pesticides, cleaning solutions, paint products, automotive products, and swimming pool chemicals. Related information is provided in BMP fact sheets SC-11 Spill Prevention, Control & Cleanup and SC-34 Waste Handling & Disposal.

## Approach

### *Pollution Prevention*

- Purchase only the amount of material that will be needed for foreseeable use. In most cases this will result in cost savings in both purchasing and disposal. See SC-61 Safer Alternative Products for additional information.
- Be aware of new products that may do the same job with less environmental risk and for less or the equivalent cost. Total cost must be used here; this includes purchase price, transportation costs, storage costs, use related costs, clean up costs and disposal costs.

### *Suggested Protocols*

#### *General*

- Keep work sites clean and orderly. Remove debris in a timely fashion. Sweep the area.
- Dispose of wash water, sweepings, and sediments, properly.
- Recycle or dispose of fluids properly.
- Establish a daily checklist of office, yard and plant areas to confirm cleanliness and adherence to proper storage and security. Specific employees should be assigned specific inspection responsibilities and given the authority to remedy any problems found.
- Post waste disposal charts in appropriate locations detailing for each waste its hazardous nature (poison, corrosive, flammable), prohibitions on its disposal (dumpster, drain, sewer) and the recommended disposal method (recycle, sewer, burn, storage, landfill).
- Summarize the chosen BMPs applicable to your operation and post them in appropriate conspicuous places.

## Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

## Targeted Constituents

|                  |                                     |
|------------------|-------------------------------------|
| Sediment         | <input checked="" type="checkbox"/> |
| Nutrients        | <input checked="" type="checkbox"/> |
| Trash            | <input checked="" type="checkbox"/> |
| Metals           | <input checked="" type="checkbox"/> |
| Bacteria         | <input checked="" type="checkbox"/> |
| Oil and Grease   | <input checked="" type="checkbox"/> |
| Organics         | <input checked="" type="checkbox"/> |
| Oxygen Demanding | <input checked="" type="checkbox"/> |



- Require a signed checklist from every user of any hazardous material detailing amount taken, amount used, amount returned and disposal of spent material.
- Do a before audit of your site to establish baseline conditions and regular subsequent audits to note any changes and whether conditions are improving or deteriorating.
- Keep records of water, air and solid waste quantities and quality tests and their disposition.
- Maintain a mass balance of incoming, outgoing and on hand materials so you know when there are unknown losses that need to be tracked down and accounted for.
- Use and reward employee suggestions related to BMPs, hazards, pollution reduction, work place safety, cost reduction, alternative materials and procedures, recycling and disposal.
- Have, and review regularly, a contingency plan for spills, leaks, weather extremes etc. Make sure all employees know about it and what their role is so that it comes into force automatically.

#### *Training*

- Train all employees, management, office, yard, manufacturing, field and clerical in BMPs and pollution prevention and make them accountable.
- Train municipal employees who handle potentially harmful materials in good housekeeping practices.
- Train personnel who use pesticides in the proper use of the pesticides. The California Department of Pesticide Regulation license pesticide dealers, certify pesticide applicators and conduct onsite inspections.
- Train employees and contractors in proper techniques for spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill if one should occur.

#### *Spill Response and Prevention*

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Keep your Spill Prevention Control and Countermeasure (SPCC) plan up-to-date, and implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

#### *Other Considerations*

- There are no major limitations to this best management practice.
- There are no regulatory requirements to this BMP. Existing regulations already require municipalities to properly store, use, and dispose of hazardous materials

## Requirements

### *Costs*

- Minimal cost associated with this BMP. Implementation of good housekeeping practices may result in cost savings as these procedures may reduce the need for more costly BMPs.

### *Maintenance*

- Ongoing maintenance required to keep a clean site. Level of effort is a function of site size and type of activities.

## Supplemental Information

### *Further Detail of the BMP*

- The California Integrated Waste Management Board's Recycling Hotline, 1-800-553-2962, provides information on household hazardous waste collection programs and facilities.

### *Examples*

There are a number of communities with effective programs. The most pro-active include Santa Clara County and the City of Palo Alto, the City and County of San Francisco, and the Municipality of Metropolitan Seattle (Metro).

## References and Resources

British Columbia Lake Stewardship Society. Best Management Practices to Protect Water Quality from Non-Point Source Pollution. March 2000.

<http://www.nalms.org/bclss/bmphome.html#bmp>

King County Stormwater Pollution Control Manual - <http://dnr.metrokc.gov/wlr/dss/spcm.htm>

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities, Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality Control Board. July, 1998, Revised by California Coastal Commission, February 2002.

Orange County Stormwater Program

[http://www.ocwatersheds.com/stormwater/swp\\_introduction.asp](http://www.ocwatersheds.com/stormwater/swp_introduction.asp)

San Mateo STOPPP - (<http://stoppp.tripod.com/bmp.html>)



## Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

## Targeted Constituents

|                  |                                     |
|------------------|-------------------------------------|
| Sediment         | <input checked="" type="checkbox"/> |
| Nutrients        | <input checked="" type="checkbox"/> |
| Trash            | <input checked="" type="checkbox"/> |
| Metals           | <input checked="" type="checkbox"/> |
| Bacteria         | <input checked="" type="checkbox"/> |
| Oil and Grease   | <input checked="" type="checkbox"/> |
| Organics         | <input checked="" type="checkbox"/> |
| Oxygen Demanding | <input checked="" type="checkbox"/> |

## Description

Pollutants on sidewalks and other pedestrian traffic areas and plazas are typically due to littering and vehicle use. This fact sheet describes good housekeeping practices that can be incorporated into the municipality's existing cleaning and maintenance program.

## Approach

### *Pollution Prevention*

- Use dry cleaning methods whenever practical for surface cleaning activities.
- Use the least toxic materials available (e.g. water based paints, gels or sprays for graffiti removal).

### *Suggested Protocols*

#### *Surface Cleaning*

- Regularly broom (dry) sweep sidewalk, plaza and parking lot areas to minimize cleaning with water.
- Dry cleanup first (sweep, collect, and dispose of debris and trash) when cleaning sidewalks or plazas, then wash with or without soap.
- Block the storm drain or contain runoff when cleaning with water. Discharge wash water to landscaping or collect water and pump to a tank or discharge to sanitary sewer if allowed. (Permission may be required from local sanitation district.)



- Block the storm drain or contain runoff when washing parking areas, driveways or drive-throughs. Use absorbents to pick up oil; then dry sweep. Clean with or without soap. Collect water and pump to a tank or discharge to sanitary sewer if allowed. Street Repair and Maintenance.

#### *Graffiti Removal*

- Avoid graffiti abatement activities during rain events.
- Implement the procedures under Painting and Paint Removal in SC-70 Roads, Streets, and Highway Operation and Maintenance fact sheet when graffiti is removed by painting over.
- Direct runoff from sand blasting and high pressure washing (with no cleaning agents) into a dirt or landscaped area after treating with an appropriate filtering device.
- Plug nearby storm drain inlets and vacuum/pump wash water to the sanitary sewer if authorized to do so if a graffiti abatement method generates wash water containing a cleaning compound (such as high pressure washing with a cleaning compound). Ensure that a non-hazardous cleaning compound is used or dispose as hazardous waste, as appropriate.

#### *Surface Removal and Repair*

- Schedule surface removal activities for dry weather if possible.
- Avoid creating excess dust when breaking asphalt or concrete.
- Take measures to protect nearby storm drain inlets prior to breaking up asphalt or concrete (e.g. place hay bales or sand bags around inlets). Clean afterwards by sweeping up as much material as possible.
- Designate an area for clean up and proper disposal of excess materials.
- Remove and recycle as much of the broken pavement as possible to avoid contact with rainfall and stormwater runoff.
- When making saw cuts in pavement, use as little water as possible. Cover each storm drain inlet completely with filter fabric during the sawing operation and contain the slurry by placing straw bales, sandbags, or gravel dams around the inlets. After the liquid drains or evaporates, shovel or vacuum the slurry residue from the pavement or gutter and remove from site.
- Always dry sweep first to clean up tracked dirt. Use a street sweeper or vacuum truck. Do not dump vacuumed liquid in storm drains. Once dry sweeping is complete, the area may be hosed down if needed. Wash water should be directed to landscaping or collected and pumped to the sanitary sewer if allowed.

#### *Concrete Installation and Repair*

- Schedule asphalt and concrete activities for dry weather.

- Take measures to protect any nearby storm drain inlets and adjacent watercourses, prior to breaking up asphalt or concrete (e.g. place sand bags around inlets or work areas).
- Limit the amount of fresh concrete or cement mortar mixed, mix only what is needed for the job.
- Store concrete materials under cover, away from drainage areas. Secure bags of cement after they are open. Be sure to keep wind-blown cement powder away from streets, gutters, storm drains, rainfall, and runoff.
- Return leftover materials to the transit mixer. Dispose of small amounts of hardened excess concrete, grout, and mortar in the trash.
- Do not wash sweepings from exposed aggregate concrete into the street or storm drain. Collect and return sweepings to aggregate base stockpile, or dispose in the trash.
- Protect applications of fresh concrete from rainfall and runoff until the material has dried.
- Do not allow excess concrete to be dumped onsite, except in designated areas.
- Wash concrete trucks off site or in designated areas on site designed to preclude discharge of wash water to drainage system.

## *Controlling Litter*

- Post "No Littering" signs and enforce anti-litter laws.
- Provide litter receptacles in busy, high pedestrian traffic areas of the community, at recreational facilities, and at community events.
- Cover litter receptacles and clean out frequently to prevent leaking/spillage or overflow.
- Clean parking lots on a regular basis with a street sweeper.

## *Training*

- Provide regular training to field employees and/or contractors regarding surface cleaning and proper operation of equipment.
- Train employee and contractors in proper techniques for spill containment and cleanup.
- Use a training log or similar method to document training.

## *Spill Response and Prevention*

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

*Other Considerations*

- Limitations related to sweeping activities at large parking facilities may include current sweeper technology to remove oil and grease.
- Surface cleaning activities that require discharges to the local sewerage agency will require coordination with the agency.
- Arrangements for disposal of the swept material collected must be made, as well as accurate tracking of the areas swept and the frequency of sweeping.

## Requirements

*Costs*

- The largest expenditures for sweeping and cleaning of sidewalks, plazas, and parking lots are in staffing and equipment. Sweeping of these areas should be incorporated into street sweeping programs to reduce costs.

*Maintenance*

Not applicable

## Supplemental Information

*Further Detail of the BMP*

Community education, such as informing residents about their options for recycling and waste disposal, as well as the consequences of littering, can instill a sense of citizen responsibility and potentially reduce the amount of maintenance required by the municipality.

Additional BMPs that should be considered for parking lot areas include:

- Allow sheet runoff to flow into biofilters (vegetated strip and swale) and infiltration devices.
- Utilize sand filters or oleophilic collectors for oily waste in low concentrations.
- Arrange rooftop drains to prevent drainage directly onto paved surfaces.
- Design lot to include semi-permeable hardscape.
- Structural BMPs such as storm drain inlet filters can be very effective in reducing the amount of pollutants discharged from parking facilities during periods of rain.

## References and Resources

Bay Area Stormwater Management Agencies Association (BASMAA). 1996. Pollution From Surface Cleaning Folder <http://www.basmaa.org>

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities. Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality Control Board. July. 1998.

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Orange County Stormwater Program

[http://www.ocwatersheds.com/stormwater/swp\\_introduction.asp](http://www.ocwatersheds.com/stormwater/swp_introduction.asp)

Santa Clara Valley Urban Runoff Pollution Prevention Program. 1997 Urban Runoff Management Plan. September 1997, updated October 2000.

Santa Clara Valley Urban Runoff Pollution Prevention Program. Maintenance Best Management Practices for the Construction Industry. Brochures: Landscaping, Gardening, and Pool; Roadwork and Paving; and Fresh Concrete and Mortar Application. June 2001.

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Plan. 2001. Municipal Activities Model Program Guidance. November.





## Description

Landscape maintenance activities include vegetation removal; herbicide and insecticide application; fertilizer application; watering; and other gardening and lawn care practices. Vegetation control typically involves a combination of chemical (herbicide) application and mechanical methods. All of these maintenance practices have the potential to contribute pollutants to the storm drain system. The major objectives of this BMP are to minimize the discharge of pesticides, herbicides and fertilizers to the storm drain system and receiving waters; prevent the disposal of landscape waste into the storm drain system by collecting and properly disposing of clippings and cuttings, and educating employees and the public.

## Approach

### *Pollution Prevention*

- Implement an integrated pest management (IPM) program. IPM is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools.
- Choose low water using flowers, trees, shrubs, and groundcover.
- Consider alternative landscaping techniques such as naturescaping and xeriscaping.
- Conduct appropriate maintenance (i.e. properly timed fertilizing, weeding, pest control, and pruning) to help preserve the landscapes water efficiency.

## Objectives

- Contain
- Educate
- Reduce/Minimize
- Product Substitution

## Targeted Constituents

|                  |                                     |
|------------------|-------------------------------------|
| Sediment         | <input checked="" type="checkbox"/> |
| Nutrients        | <input checked="" type="checkbox"/> |
| Trash            | <input checked="" type="checkbox"/> |
| Metals           |                                     |
| Bacteria         |                                     |
| Oil and Grease   |                                     |
| Organics         |                                     |
| Oxygen Demanding | <input checked="" type="checkbox"/> |



- Consider grass cycling (grass cycling is the natural recycling of grass by leaving the clippings on the lawn when mowing. Grass clippings decompose quickly and release valuable nutrients back into the lawn).

#### *Suggested Protocols*

##### *Mowing, Trimming, and Weeding*

- Whenever possible use mechanical methods of vegetation removal (e.g mowing with tractor-type or push mowers, hand cutting with gas or electric powered weed trimmers) rather than applying herbicides. Use hand weeding where practical.
- Avoid loosening the soil when conducting mechanical or manual weed control, this could lead to erosion. Use mulch or other erosion control measures when soils are exposed.
- Performing mowing at optimal times. Mowing should not be performed if significant rain events are predicted.
- Mulching mowers may be recommended for certain flat areas. Other techniques may be employed to minimize mowing such as selective vegetative planting using low maintenance grasses and shrubs.
- Collect lawn and garden clippings, pruning waste, tree trimmings, and weeds. Chip if necessary, and compost or dispose of at a landfill (see waste management section of this fact sheet).
- Place temporarily stockpiled material away from watercourses, and berm or cover stockpiles to prevent material releases to storm drains.

##### *Planting*

- Determine existing native vegetation features (location, species, size, function, importance) and consider the feasibility of protecting them. Consider elements such as their effect on drainage and erosion, hardiness, maintenance requirements, and possible conflicts between preserving vegetation and the resulting maintenance needs.
- Retain and/or plant selected native vegetation whose features are determined to be beneficial, where feasible. Native vegetation usually requires less maintenance (e.g., irrigation, fertilizer) than planting new vegetation.
- Consider using low water use groundcovers when planting or replanting.

##### *Waste Management*

- Compost leaves, sticks, or other collected vegetation or dispose of at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Place temporarily stockpiled material away from watercourses and storm drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.
- Reduce the use of high nitrogen fertilizers that produce excess growth requiring more frequent mowing or trimming.

- Avoid landscape wastes in and around storm drain inlets by either using bagging equipment or by manually picking up the material.

## *Irrigation*

- Where practical, use automatic timers to minimize runoff.
- Use popup sprinkler heads in areas with a lot of activity or where there is a chance the pipes may be broken. Consider the use of mechanisms that reduce water flow to sprinkler heads if broken.
- Ensure that there is no runoff from the landscaped area(s) if re-claimed water is used for irrigation.
- If bailing of muddy water is required (e.g. when repairing a water line leak), do not put it in the storm drain; pour over landscaped areas.
- Irrigate slowly or pulse irrigate to prevent runoff and then only irrigate as much as is needed.
- Apply water at rates that do not exceed the infiltration rate of the soil.

## *Fertilizer and Pesticide Management*

- Utilize a comprehensive management system that incorporates integrated pest management (IPM) techniques. There are many methods and types of IPM, including the following:
  - Mulching can be used to prevent weeds where turf is absent, fencing installed to keep rodents out, and netting used to keep birds and insects away from leaves and fruit.
  - Visible insects can be removed by hand (with gloves or tweezers) and placed in soapy water or vegetable oil. Alternatively, insects can be sprayed off the plant with water or in some cases vacuumed off of larger plants.
  - Store-bought traps, such as species-specific, pheromone-based traps or colored sticky cards, can be used.
  - Slugs can be trapped in small cups filled with beer that are set in the ground so the slugs can get in easily.
  - In cases where microscopic parasites, such as bacteria and fungi, are causing damage to plants, the affected plant material can be removed and disposed of (pruning equipment should be disinfected with bleach to prevent spreading the disease organism).
  - Small mammals and birds can be excluded using fences, netting, tree trunk guards.
  - Beneficial organisms, such as bats, birds, green lacewings, ladybugs, praying mantis, ground beetles, parasitic nematodes, trichogramma wasps, seed head weevils, and spiders that prey on detrimental pest species can be promoted.
- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.

- Use pesticides only if there is an actual pest problem (not on a regular preventative schedule).
- Do not use pesticides if rain is expected. Apply pesticides only when wind speeds are low (less than 5 mph).
- Do not mix or prepare pesticides for application near storm drains.
- Prepare the minimum amount of pesticide needed for the job and use the lowest rate that will effectively control the pest.
- Employ techniques to minimize off-target application (e.g. spray drift) of pesticides, including consideration of alternative application techniques.
- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
- Calibrate fertilizer and pesticide application equipment to avoid excessive application.
- Periodically test soils for determining proper fertilizer use.
- Sweep pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Purchase only the amount of pesticide that you can reasonably use in a given time period (month or year depending on the product).
- Triple rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Dispose of empty pesticide containers according to the instructions on the container label.

### *Inspection*

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering, and repair leaks in the irrigation system as soon as they are observed.
- Inspect pesticide/fertilizer equipment and transportation vehicles daily.

### *Training*

- Educate and train employees on use of pesticides and in pesticide application techniques to prevent pollution. Pesticide application must be under the supervision of a California qualified pesticide applicator.
- Train/encourage municipal maintenance crews to use IPM techniques for managing public green areas.
- Annually train employees within departments responsible for pesticide application on the appropriate portions of the agency's IPM Policy, SOPs, and BMPs, and the latest IPM techniques.

- Employees who are not authorized and trained to apply pesticides should be periodically (at least annually) informed that they cannot use over-the-counter pesticides in or around the workplace.
- Use a training log or similar method to document training.

### *Spill Response and Prevention*

- Refer to SC-11, Spill Prevention, Control & Cleanup
- Have spill cleanup materials readily available and in a known location
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

### *Other Considerations*

- The Federal Pesticide, Fungicide, and Rodenticide Act and California Title 3, Division 6, Pesticides and Pest Control Operations place strict controls over pesticide application and handling and specify training, annual refresher, and testing requirements. The regulations generally cover: a list of approved pesticides and selected uses, updated regularly; general application information; equipment use and maintenance procedures; and record keeping. The California Department of Pesticide Regulations and the County Agricultural Commission coordinate and maintain the licensing and certification programs. All public agency employees who apply pesticides and herbicides in "agricultural use" areas such as parks, golf courses, rights-of-way and recreation areas should be properly certified in accordance with state regulations. Contracts for landscape maintenance should include similar requirements.
- All employees who handle pesticides should be familiar with the most recent material safety data sheet (MSDS) files.
- Municipalities do not have the authority to regulate the use of pesticides by school districts, however the California Healthy Schools Act of 2000 (AB 2260) has imposed requirements on California school districts regarding pesticide use in schools. Posting of notification prior to the application of pesticides is now required, and IPM is stated as the preferred approach to pest management in schools.

### Requirements

#### *Costs*

Additional training of municipal employees will be required to address IPM techniques and BMPs. IPM methods will likely increase labor cost for pest control which may be offset by lower chemical costs.

#### *Maintenance*

Not applicable

## Supplemental Information

*Further Detail of the BMP**Waste Management*

Composting is one of the better disposal alternatives if locally available. Most municipalities either have or are planning yard waste composting facilities as a means of reducing the amount of waste going to the landfill. Lawn clippings from municipal maintenance programs as well as private sources would probably be compatible with most composting facilities

*Contractors and Other Pesticide Users*

Municipal agencies should develop and implement a process to ensure that any contractor employed to conduct pest control and pesticide application on municipal property engages in pest control methods consistent with the IPM Policy adopted by the agency. Specifically, municipalities should require contractors to follow the agency's IPM policy, SOPs, and BMPs; provide evidence to the agency of having received training on current IPM techniques when feasible; provide documentation of pesticide use on agency property to the agency in a timely manner.

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## Orange County Stormwater Program

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United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Landscaping and Lawn Care. Office of Water. Office of Wastewater Management. On-line: [http://www.epa.gov/npdes/menuofbmps/poll\\_8.htm](http://www.epa.gov/npdes/menuofbmps/poll_8.htm)



Photo Credit: Geoff Brosseau

## Objectives

- Contain
- Educate
- Reduce/Minimize

## Description

As a consequence of its function, the stormwater conveyance system collects and transports urban runoff that may contain certain pollutants. Maintaining catch basins, stormwater inlets, and other stormwater conveyance structures on a regular basis will remove pollutants, prevent clogging of the downstream conveyance system, restore catch basins' sediment trapping capacity, and ensure the system functions properly hydraulically to avoid flooding.

## Approach

### *Suggested Protocols*

#### *Catch Basins/Inlet Structures*

- Municipal staff should regularly inspect facilities to ensure the following:
  - Immediate repair of any deterioration threatening structural integrity.
  - Cleaning before the sump is 40% full. Catch basins should be cleaned as frequently as needed to meet this standard.
  - Stenciling of catch basins and inlets (see SC-75 Waste Handling and Disposal).
- Clean catch basins, storm drain inlets, and other conveyance structures in high pollutant load areas just before the wet season to remove sediments and debris accumulated during the summer.

## Targeted Constituents

|                  |                                     |
|------------------|-------------------------------------|
| Sediment         | <input checked="" type="checkbox"/> |
| Nutrients        | <input checked="" type="checkbox"/> |
| Trash            | <input checked="" type="checkbox"/> |
| Metals           | <input checked="" type="checkbox"/> |
| Bacteria         | <input checked="" type="checkbox"/> |
| Oil and Grease   | <input checked="" type="checkbox"/> |
| Organics         | <input checked="" type="checkbox"/> |
| Oxygen Demanding | <input checked="" type="checkbox"/> |



- Conduct inspections more frequently during the wet season for problem areas where sediment or trash accumulates more often. Clean and repair as needed.
- Keep accurate logs of the number of catch basins cleaned.
- Record the amount of waste collected.
- Store wastes collected from cleaning activities of the drainage system in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain.
- Dewater the wastes with outflow into the sanitary sewer if permitted. Water should be treated with an appropriate filtering device prior to discharge to the sanitary sewer. If discharge to the sanitary sewer is not allowed, water should be pumped or vacuumed to a tank and properly disposed of. Do not dewater near a storm drain or stream.
- Except for small communities with relatively few catch basins that may be cleaned manually, most municipalities will require mechanical cleaners such as eductors, vacuums, or bucket loaders.

#### *Storm Drain Conveyance System*

- Locate reaches of storm drain with deposit problems and develop a flushing schedule that keeps the pipe clear of excessive buildup.
- Collect flushed effluent and pump to the sanitary sewer for treatment.

#### *Pump Stations*

- Clean all storm drain pump stations prior to the wet season to remove silt and trash.
- Do not allow discharge from cleaning a storm drain pump station or other facility to reach the storm drain system.
- Conduct quarterly routine maintenance at each pump station.
- Inspect, clean, and repair as necessary all outlet structures prior to the wet season.
- Sample collected sediments to determine if landfill disposal is possible, or illegal discharges in the watershed are occurring.

#### *Open Channel*

- Consider modification of storm channel characteristics to improve channel hydraulics, to increase pollutant removals, and to enhance channel/creek aesthetic and habitat value.
- Conduct channel modification/improvement in accordance with existing laws. Any person, government agency, or public utility proposing an activity that will change the natural (emphasis added) state of any river, stream, or lake in California, must enter into a stream or Lake Alteration Agreement with the Department of Fish and Game. The developer-applicant should also contact local governments (city, county, special districts), other state agencies



(SWRCB, RWQCB, Department of Forestry, Department of Water Resources), and Federal Corps of Engineers and USFWS

## *Illicit Connections and Discharges*

- During routine maintenance of conveyance system and drainage structures field staff should look for evidence of illegal discharges or illicit connections:
  - Is there evidence of spills such as paints, discoloring, etc.
  - Are there any odors associated with the drainage system
  - Record locations of apparent illegal discharges/illicit connections
  - Track flows back to potential dischargers and conduct aboveground inspections. This can be done through visual inspection of up gradient manholes or alternate techniques including zinc chloride smoke testing, fluorometric dye testing, physical inspection testing, or television camera inspection.
  - Once the origin of flow is established, require illicit discharger to eliminate the discharge.
- Stencil storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste Drains to Stream" stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

## *Illegal Dumping*

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Illegal dumping hot spots
  - Types and quantities (in some cases) of wastes
  - Patterns in time of occurrence (time of day/night, month, or year)
  - Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)
  - Responsible parties
- Post "No Dumping" signs in problem areas with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

- The State Department of Fish and Game has a hotline for reporting violations called Cal TIP (1-800-952-5400). The phone number may be used to report any violation of a Fish and Game code (illegal dumping, poaching, etc.).
- The California Department of Toxic Substances Control's Waste Alert Hotline, 1-800-69TOXIC, can be used to report hazardous waste violations.

#### *Training*

- Train crews in proper maintenance activities, including record keeping and disposal.
- Only properly trained individuals are allowed to handle hazardous materials/wastes.
- Train municipal employees from all departments (public works, utilities, street cleaning, parks and recreation, industrial waste inspection, hazardous waste inspection, sewer maintenance) to recognize and report illegal dumping.
- Train municipal employees and educate businesses, contractors, and the general public in proper and consistent methods for disposal.
- Train municipal staff regarding non-stormwater discharges (See SC-10 Non-Stormwater Discharges).

#### *Spill Response and Prevention*

- Refer to SC-11, Prevention, Control & Cleanup
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

#### *Other Considerations*

- Cleanup activities may create a slight disturbance for local aquatic species. Access to items and material on private property may be limited. Trade-offs may exist between channel hydraulics and water quality/riparian habitat. If storm channels or basins are recognized as wetlands, many activities, including maintenance, may be subject to regulation and permitting.
- Storm drain flushing is most effective in small diameter pipes (36-inch diameter pipe or less, depending on water supply and sediment collection capacity). Other considerations associated with storm drain flushing may include the availability of a water source, finding a downstream area to collect sediments, liquid/sediment disposal, and disposal of flushed effluent to sanitary sewer may be prohibited in some areas.
- Regulations may include adoption of substantial penalties for illegal dumping and disposal.
- Municipal codes should include sections prohibiting the discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.
- Private property access rights may be needed to track illegal discharges up gradient.

- Requirements of municipal ordinance authority for suspected source verification testing for illicit connections necessary for guaranteed rights of entry.

## Requirements

### *Costs*

- An aggressive catch basin cleaning program could require a significant capital and O&M budget. A careful study of cleaning effectiveness should be undertaken before increased cleaning is implemented. Catch basin cleaning costs are less expensive if vacuum street sweepers are available; cleaning catch basins manually can cost approximately twice as much as cleaning the basins with a vacuum attached to a sweeper.
- Methods used for illicit connection detection (smoke testing, dye testing, visual inspection, and flow monitoring) can be costly and time-consuming. Site-specific factors, such as the level of impervious area, the density and ages of buildings, and type of land use will determine the level of investigation necessary. Encouraging reporting of illicit discharges by employees can offset costs by saving expense on inspectors and directing resources more efficiently. Some programs have used funds available from “environmental fees” or special assessment districts to fund their illicit connection elimination programs.

### *Maintenance*

- Two-person teams may be required to clean catch basins with vactor trucks.
- Identifying illicit discharges requires teams of at least two people (volunteers can be used), plus administrative personnel, depending on the complexity of the storm sewer system.
- Arrangements must be made for proper disposal of collected wastes.
- Requires technical staff to detect and investigate illegal dumping violations, and to coordinate public education.

## Supplemental Information

### *Further Detail of the BMP*

#### *Storm Drain flushing*

Sanitary sewer flushing is a common maintenance activity used to improve pipe hydraulics and to remove pollutants in sanitary sewer systems. The same principles that make sanitary sewer flushing effective can be used to flush storm drains. Flushing may be designed to hydraulically convey accumulated material to strategic locations, such as to an open channel, to another point where flushing will be initiated, or over to the sanitary sewer and on to the treatment facilities, thus preventing re-suspension and overflow of a portion of the solids during storm events. Flushing prevents “plug flow” discharges of concentrated pollutant loadings and sediments. The deposits can hinder the designed conveyance capacity of the storm drain system and potentially cause backwater conditions in severe cases of clogging.

Storm drain flushing usually takes place along segments of pipe with grades that are too flat to maintain adequate velocity to keep particles in suspension. An upstream manhole is selected to place an inflatable device that temporarily plugs the pipe. Further upstream, water is pumped into the line to create a flushing wave. When the upstream reach of pipe is sufficiently full to

cause a flushing wave, the inflated device is rapidly deflated with the assistance of a vacuum pump, releasing the backed up water and resulting in the cleaning of the storm drain segment.

To further reduce the impacts of stormwater pollution, a second inflatable device, placed well downstream, may be used to re-collect the water after the force of the flushing wave has dissipated. A pump may then be used to transfer the water and accumulated material to the sanitary sewer for treatment. In some cases, an interceptor structure may be more practical or required to re-collect the flushed waters.

It has been found that cleansing efficiency of periodic flush waves is dependent upon flush volume, flush discharge rate, sewer slope, sewer length, sewer flow rate, sewer diameter, and population density. As a rule of thumb, the length of line to be flushed should not exceed 700 feet. At this maximum recommended length, the percent removal efficiency ranges between 65-75 percent for organics and 55-65 percent for dry weather grit/inorganic material. The percent removal efficiency drops rapidly beyond that. Water is commonly supplied by a water truck, but fire hydrants can also supply water. To make the best use of water, it is recommended that reclaimed water be used or that fire hydrant line flushing coincide with storm drain flushing.

#### *Flow Management*

Flow management has been one of the principal motivations for designing urban stream corridors in the past. Such needs may or may not be compatible with the stormwater quality goals in the stream corridor.

Downstream flood peaks can be suppressed by reducing through flow velocity. This can be accomplished by reducing gradient with grade control structures or increasing roughness with boulders, dense vegetation, or complex banks forms. Reducing velocity correspondingly increases flood height, so all such measures have a natural association with floodplain open space. Flood elevations laterally adjacent to the stream can be lowered by increasing through flow velocity.

However, increasing velocity increases flooding downstream and inherently conflicts with channel stability and human safety. Where topography permits, another way to lower flood elevation is to lower the level of the floodway with drop structures into a large but subtly excavated bowl where flood flows we allowed to spread out.

#### *Stream Corridor Planning*

Urban streams receive and convey stormwater flows from developed or developing watersheds. Planning of stream corridors thus interacts with urban stormwater management programs. If local programs are intended to control or protect downstream environments by managing flows delivered to the channels, then it is logical that such programs should be supplemented by management of the materials, forms, and uses of the downstream riparian corridor. Any proposal for steam alteration or management should be investigated for its potential flow and stability effects on upstream, downstream, and laterally adjacent areas. The timing and rate of flow from various tributaries can combine in complex ways to alter flood hazards. Each section of channel is unique, influenced by its own distribution of roughness elements, management activities, and stream responses.

Flexibility to adapt to stream features and behaviors as they evolve must be included in stream reclamation planning. The amenity and ecology of streams may be enhanced through the landscape design options of 1) corridor reservation, 2) bank treatment, 3) geomorphic restoration, and 4) grade control.

Corridor reservation - Reserving stream corridors and valleys to accommodate natural stream meandering, aggradation, degradation, and over bank flows allows streams to find their own form and generate less ongoing erosion. In California, open stream corridors in recent urban developments have produced recreational open space, irrigation of streamside plantings, and the aesthetic amenity of flowing water.

Bank treatment - The use of armoring, vegetative cover, and flow deflection may be used to influence a channel's form, stability, and biotic habitat. To prevent bank erosion, armoring can be done with rigid construction materials, such as concrete, masonry, wood planks and logs, riprap, and gabions. Concrete linings have been criticized because of their lack of provision of biotic habitat. In contrast, riprap and gabions make relatively porous and flexible linings. Boulders, placed in the bed reduce velocity and erosive power.

Riparian vegetation can stabilize the banks of streams that are at or near a condition of equilibrium. Binding networks of roots increase bank shear strength. During flood flows, resilient vegetation is forced into erosion-inhibiting mats. The roughness of vegetation leads to lower velocity, further reducing erosive effects. Structural flow deflection can protect banks from erosion or alter fish habitat. By concentrating flow, a deflector causes a pool to be scoured in the bed.

Geomorphic restoration – Restoration refers to alteration of disturbed streams so their form and behavior emulate those of undisturbed streams. Natural meanders are retained, with grading to gentle slopes on the inside of curves to allow point bars and riffle-pool sequences to develop. Trees are retained to provide scenic quality, biotic productivity, and roots for bank stabilization, supplemented by plantings where necessary.

A restorative approach can be successful where the stream is already approaching equilibrium. However, if upstream urbanization continues new flow regimes will be generated that could disrupt the equilibrium of the treated system.

Grade Control - A grade control structure is a level shelf of a permanent material, such as stone, masonry, or concrete, over which stream water flows. A grade control structure is called a sill, weir, or drop structure, depending on the relation of its invert elevation to upstream and downstream channels.

A sill is installed at the preexisting channel bed elevation to prevent upstream migration of nick points. It establishes a firm base level below which the upstream channel can not erode.

A weir or check dam is installed with invert above the preexisting bed elevation. A weir raises the local base level of the stream and causes aggradation upstream. The gradient, velocity, and erosive potential of the stream channel are reduced. A drop structure lowers the downstream invert below its preexisting elevation, reducing downstream gradient and velocity. Weirs and drop structure control erosion by dissipating energy and reducing slope velocity.

When carefully applied, grade control structures can be highly versatile in establishing human and environmental benefits in stabilized channels. To be successful, application of grade control structures should be guided by analysis of the stream system both upstream and downstream from the area to be reclaimed.

### *Examples*

The California Department of Water Resources began the Urban Stream Restoration Program in 1985. The program provides grant funds to municipalities and community groups to implement stream restoration projects. The projects reduce damages from streambank and watershed instability and floods while restoring streams' aesthetic, recreational, and fish and wildlife values.

In Buena Vista Park, upper floodway slopes are gentle and grassed to achieve continuity of usable park land across the channel of small boulders at the base of the slopes.

The San Diego River is a large, vegetative lined channel, which was planted in a variety of species to support riparian wildlife while stabilizing the steep banks of the floodway.

### References and Resources

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Orange County Stormwater Program

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## Description

It is important to control litter to eliminate trash and other materials in stormwater runoff. Waste reduction is a major component of waste management and should be encouraged through training and public outreach. Management of waste once it is collected may involve reuse, recycling, or proper disposal.

## Approach

### *Pollution Prevention*

- Reuse products when possible.
- Encourage recycling programs with recycling bins, used oil collection, etc.

### *Suggested Protocols*

#### *Solid Waste Collection*

- Implement procedures, where applicable, to collect, transport, and dispose of solid waste at appropriate disposal facilities in accordance with applicable federal, state, and local laws and regulations.
- Include properly designed trash storage areas. If feasible provide cover over trash storage areas.
- Regularly inspect solid waste containers for structural damage. Repair or replace damaged containers as necessary.

## Objectives

- Cover
- Contain
- Educate
- Reduce/Reuse

## Targeted Constituents

|                  |                                     |
|------------------|-------------------------------------|
| Sediment         | <input checked="" type="checkbox"/> |
| Nutrients        | <input checked="" type="checkbox"/> |
| Trash            | <input checked="" type="checkbox"/> |
| Metals           | <input checked="" type="checkbox"/> |
| Bacteria         | <input checked="" type="checkbox"/> |
| Oil and Grease   | <input checked="" type="checkbox"/> |
| Organics         | <input checked="" type="checkbox"/> |
| Oxygen Demanding | <input checked="" type="checkbox"/> |





- Secure solid waste containers; containers must be closed tightly when not in use.
- Do not fill waste containers with washout water or any other liquid.
- Ensure that only appropriate solid wastes are added to the solid waste container. Certain wastes such as hazardous wastes, appliances, fluorescent lamps, pesticides, etc. may not be disposed of in solid waste containers (see chemical/ hazardous waste collection section below).
- Do not mix wastes; this can cause chemical reactions, make recycling impossible, and complicate disposal.
- Refer to SC-34 Waste Handling and Disposal for more information regarding solid waste facilities.

#### *Waste Reduction and Recycling*

- Recycle wastes whenever possible. Many types of waste can be recycled, recycling options for each waste type are limited. All gasoline, antifreeze, waste oil, and lead-acid batteries can be recycled. Latex and oil-based paint can be reused, as well as recycled. Materials that cannot be reused or recycled should either be incinerated or disposed of at a properly permitted landfill.
- Recycling is always preferable to disposal of unwanted materials.
- Recycling bins for glass, metal, newspaper, plastic bottles and other recyclable household solid wastes should be provided at public facilities and/or for residential curbside collection.

#### *Controlling Litter*

- Post "No Littering" signs and enforce anti-litter laws.
- Provide litter receptacles in busy, high pedestrian traffic areas of the community, at recreational facilities, and at community events.
- Clean out and cover litter receptacles frequently to prevent spillage.

#### *Illegal Dumping*

Substances illegally dumped on streets and into the storm drain system and creeks include paints, used oil and other automotive fluids, construction debris, chemicals, fresh concrete, leaves, grass clipping, and pet wastes.

- Post "No Dumping" signs with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.
- Landscaping and beautification efforts of hot spots might also discourage future dumping.
- See SC-74 Drainage System Maintenance, and SC-10 Non-Stormwater Discharges.

## Requirements

### *Costs*

- The costs for a solid waste source control program vary depending on the type of method. The cost of a community education program or a plan to increase the number of trash receptacles can be very minimal. Costs for structural controls such as trash racks, bar screens, and silt traps can be quite costly ranging from \$250,000 to \$900,000.
- A collection facility or curbside collection for used oil may result in significant costs. Commercial locations (automobile service stations, quick oil change centers, etc.) as collection points eliminate hauling and recycling costs.
- Collection and disposal of hazardous waste can be very expensive and requires trained operators; laboratory and detection equipment; and extensive record keeping including dates, types, and quantities.
- Use of volunteer work forces can lower storm drain stenciling program costs. Stenciling kits require procurement of durable/disposable items. The stenciling program can aid in the cataloging of the storm drain system. One municipality from the state of Washington has estimated that stenciling kits cost approximately \$50 each. Stencils may cost about \$8 each including the die cost on an order of 1,000. Re-orders cost about \$1/stencil. Stencil designs may be available from other communities. Stencil kits should be provided on a loan basis to volunteer groups free of charge with the understanding that kit remnants are to be returned.

### *Maintenance*

- The primary staff demand for stenciling programs is for program setup to provide marketing and training. Ongoing/follow-up staff time is minimal because of volunteer services.
- Staffing requirements are minimal for oil recycling programs if collection/recycling is contracted out to a used oil hauler/recycler or required at commercial locations.
- Staff requirements for maintaining good housekeeping BMPs at waste handling sites is minimal.

## Supplemental Information

### *Further Detail of the BMP*

#### *Waste Reduction*

An approach to reduce stormwater pollution from waste handling and disposal is to assess activities and reduce waste generation. The assessment is designed to find situations where waste can be eliminated or reduced and emissions and environmental damage can be minimized. The assessment involves collecting process specific information, setting pollution prevention targets, and developing, screening and selecting waste reduction options for further study. Starting a waste reduction program is economically beneficial because of reduced raw material purchases and lower waste disposal fees.

#### References and Resources

Best Management Practices Program for Pollution Prevention, City and County of San Francisco, Uribe & Associates, Oakland, California, 1990.

Harvard University. 2002. Solid Waste Container Best Management Practices – Fact Sheet On-Line Resources – Environmental Health and Safety.

Model Urban Runoff Program: A How-To-Guide for Developing Urban Runoff Programs for Small Municipalities. Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality Control Board. July 1998. (Revised February 2002 by the California Coastal Commission).

Orange County Stormwater Program

[http://www.ocwatersheds.com/StormWater/swp\\_introduction.asp](http://www.ocwatersheds.com/StormWater/swp_introduction.asp).

Santa Clara Valley Urban Runoff Pollution Prevention Program. 1997 Urban Runoff Management Plan. September 1997, updated October 2000.

# Water & Sewer Utility Maintenance SC-76



## Objectives

- Contain
- Educate
- Reduce/Minimize

## Description

Although the operation and maintenance of public utilities are not considered chronic sources of stormwater pollution, some activities and accidents can result in the discharge of pollutants that can pose a threat to both human health and the quality of receiving waters if they enter the storm drain system. Sewage incident response and investigation may involve a coordinated effort between staff from a number of different departments/agencies. Cities that do not provide maintenance of water and sewer utilities must coordinate with the contracting agency responsible for these activities and ensure that these model procedures are followed.

## Approach

### *Pollution Prevention*

Inspect potential non-stormwater discharge flow paths and clear/cleanup any debris or pollutants found (i.e. remove trash, leaves, sediment, and wipe up liquids, including oil spills).

### *Suggested Protocols*

#### *Water Line Maintenance and Cleaning*

Procedures can be employed to reduce pollutants from discharges associated with water utility operation and maintenance activities. Planned discharges may include fire hydrant testing, flushing water supply mains after new construction, flushing lines due to complaints of taste and odor, dewatering mains for maintenance work. Unplanned discharges from treated, recycled water, raw water, and groundwater systems operation and maintenance activities can occur from water main

## Targeted Constituents

|                  |                                     |
|------------------|-------------------------------------|
| Sediment         | <input checked="" type="checkbox"/> |
| Nutrients        | <input checked="" type="checkbox"/> |
| Trash            |                                     |
| Metals           |                                     |
| Bacteria         | <input checked="" type="checkbox"/> |
| Oil and Grease   | <input checked="" type="checkbox"/> |
| Organics         | <input checked="" type="checkbox"/> |
| Oxygen Demanding | <input checked="" type="checkbox"/> |



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breaks, sheared fire hydrants, equipment malfunction, and operator error.

## *Planned discharges*

- Identify a suitable discharge option in the following order of preference:
  - Apply to the land.
  - Reuse water for dust suppression, irrigation, or construction compaction.
  - Discharge to a sanitary sewer system with approval.
  - Discharge to the storm drain system using applicable pollution control measures. (Only available to clean water discharges such as water main/ water storage tank/water hydrant flushing).
- If water is discharged to a storm drain, control measures must be put in place to control potential pollutants (i.e. sediment, chlorine, etc.). Examples of some storm drain protection options include:
  - Silt fence – appropriate where the inlet drains a relatively flat area.
  - Gravel and wire mesh sediment filter – Appropriate where concentrated flows are expected.
  - Wooden weir and fabric – use at curb inlets where a compact installation is desired.
- Prior to discharge, inspect discharge flow path and clear/cleanup any debris or pollutants found (i.e. remove trash, leaves, sediment, and wipe up liquids, including oil spills).
- General Design considerations for inlet protection devices include the following:
  - The device should be constructed such that cleaning and disposal of trapped sediment is made easy, while minimizing interference with discharge activities.
  - Devices should be constructed so that any standing water resulting from the discharge will not cause excessive inconvenience or flooding/damage to adjacent land or structures.
- The effectiveness of control devices must be monitored during the discharge period and any necessary repairs or modifications made.

## *Unplanned Discharges*

- Stop the discharge as quickly as possible.
- Inspect flow path of the discharged water:
  - Identify erodible areas which may need to be repaired or protected during subsequent repairs or corrective actions

# Water & Sewer Utility Maintenance SC-76

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- Identify the potential for pollutants to be washed into the waterway
- If repairs or corrective action will cause additional discharges of water, select the appropriate procedures for erosion control, chlorine residual, turbidity, and chemical additives. Prevent potential pollutants from entering the flow path.

## *Sanitary Sewer Maintenance*

Applicable to municipalities who own and operated a sewage collection system. Facilities that are covered under this program include sanitary sewer pipes and pump stations owned and operated by a municipality. The owner of the sanitary sewer facilities is the entity responsible for carrying out this prevention and response program.

- Clean sewer lines on a regular basis to remove grease, grit, and other debris that may lead to sewer backups.
- Establish routine maintenance program. Cleaning should be conducted at an established minimum frequency and more frequently for problem areas such as restaurants that are identified
- Cleaning activities may require removal of tree roots and other identified obstructions.
- During routine maintenance and inspection note the condition of sanitary sewer structures and identify areas that need repair or maintenance. Items to note may include the following:
  - Cracked/deteriorating pipes
  - Leaking joints/seals at manhole
  - Frequent line plugs
  - Line generally flows at or near capacity
  - Suspected infiltration or exfiltration.
- Prioritize repairs based on the nature and severity of the problem. Immediate clearing of blockage or repair is required where an overflow is currently occurring or for urgent problems that may cause an imminent overflow (e.g. pump station failures, sewer line ruptures, sewer line blockages). These repairs may be temporary until scheduled or capital improvements can be completed.
- Review previous sewer maintenance records to help identify "hot spots" or areas with frequent maintenance problems and locations of potential system failure.

## *Spills and Overflows*

- Identify and track sanitary sewer discharges. Identify dry weather infiltration and inflow first. Wet weather overflow connections are very difficult to locate.

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- Locate wet weather overflows and leaking sanitary sewers using conventional source identification techniques such as monitoring and field screening. Techniques used to identify other illicit connection sources can also be used for sewer system evaluation surveys (see SC74 Drainage System Operation and Maintenance).
- Implement community awareness programs for monitoring sanitary sewer wet weather overflows. A citizen's hotline for reporting observed overflow conditions should be established to supplement field screening efforts.
- Establish lead department/agency responsible for spill response and containment. Provide coordination within departments.
- When a spill, leak, and/or overflow occurs and when disinfecting a sewage contaminated area, take every effort to ensure that the sewage, disinfectant and/or sewage treated with the disinfectant is not discharged to the storm drain system or receiving waters. Methods may include:
  - Blocking storm drain inlets and catch basins
  - Containing and diverting sewage and disinfectant away from open channels and other storm drain fixtures (using sandbags, inflatable dams, etc.)
  - Removing the material with vacuum equipment
- Record required information at the spill site.
- Perform field tests as necessary to determine the source of the spill.
- Develop notification procedures regarding spill reporting.

## *Septic Systems*

- Ensure that homeowners, installers, and inspectors are educated in proper maintenance of septic systems. This may require coordination with staff from other departments. Outreach to homeowners should include inspection reminders informing them that inspection and perhaps maintenance is due for their systems. Recommend that the system be inspected annually and pumped-out regularly.
- Programs which seek to address failing septic systems should consider using field screening to pinpoint areas where more detailed onsite inspection surveys are warranted.

## *Training*

- Conduct annual training of water utility personnel and service contractors. (field screening, sampling, smoke/dye testing, TV inspection).
- OSHA-required Health and Safety Training 29 CFR 1910.120 plus annual Refresher Training (as needed).
- OSHA Confined Space Entry training (Cal-OSHA Confined Space, Title 8 and federal OSHA 29 CFR 1910.146).

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## *Spill Response and Prevention*

- See previous section regarding spills and overflows.
- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

## *Other Considerations*

- Enact ordinance granting “right-of-entry” to locate potentially responsible parties for sewer overflows.
- Reliance on individual onsite inspection to detect failed septic systems can be a major limitation. The individual onsite inspection is very labor-intensive and requires access to private property to pinpoint the exact location of the failing system.
- A significant limitation to correcting failing septic systems is the lack of techniques available for detecting individual failed septic systems.

## Requirements

### *Costs*

- Departmental cooperation recommended for sharing or borrowing staff resources and equipment from municipal wastewater department.
- Infiltration, inflow, and wet weather overflows from sanitary sewers are very labor and equipment intensive to locate.
- The costs associated with detecting and correcting septic system failures are subject to a number of factors, including availability of trained personnel, cost of materials, and the level of follow-up required to fix the system problems.

### *Maintenance*

- Minimum 2-person teams to perform field screening and associated sampling.
- Larger teams required for implementing other techniques (i.e. zinc chloride smoke testing, fluorometric dye testing, television camera inspection and physical inspection with confined space entry) to identify sewer system leaks.
- Program coordination required for handling emergencies, record keeping, etc.
- Many of the problems associated with improper use of septic systems may be attributed to lack of user knowledge on operation and maintenance. Educational materials for homeowners and training courses for installers and inspectors can reduce the incidence of pollution from these widespread and commonly used pollution control devices.



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## Supplemental Information

### *Further Detail of the BMP*

### *Onsite Sewage Disposal Systems*

New onsite sewage disposal systems should be designed, located, and installed away from open waterbodies and sensitive resources such as wetlands and floodplains. A protective separation between the OSDS and groundwater should also be established. OSDSs should be operated and maintained to prevent surface water discharges and reduce pollutant loadings to groundwater. Inspection of OSDSs should occur regularly and repairs made immediately. New or replacement plumbing fixtures should be of the high efficiency type.

### *Typical Sanitary Sewer Problems*

- Old and deteriorated main and lateral pipes - Sewers range in age from 30 to 100 years with an average age of 50 years.
- Cracked sewer pipes - Existing sewers are mostly clay pipes which can crack as they deteriorate with age and also by earth movement.
- Misaligned and open pipe joints - Most of the mortar used to seal the joints between sections of clay pipe has deteriorated.
- Undersized sewer pipe - The existing sewer system is overloaded due to new sewer hook-ups, underground water infiltration, and illegal roof and/or yard drain connections.
- Defective manholes - Old manholes are made of bricks. Typical problems associated with brick manholes are loose bricks, missing bricks, and misaligned manholes.
- Missing and/or unrecorded sewer pipes and manholes - This problem is typical in the easement/backline sewer. Sewer pipe locations shown on the sewer record map are different from the actual sewer location.
- Sewer main under houses and other improvements - Complaints of sewer main alignment crossing the house and other improvements. A solution to this problem requires an agreement with the property owner for a new sewer easement at a relocated line.

### *Causes of Sanitary Sewer Backups*

- Root infiltration - Tree roots are a major cause of backups.
- Water inflow/infiltration - Rain water entering the sewer pipe causes overflows.
- Solids - Typical solids that buildup in the pipe and cause backups are grease, dirt, bones, tampons, paper towels, diapers, broken dishware, garbage, concrete, and debris.
- Structural defects in pipes and manholes - Sags in the line, cracks, holes, protruding laterals, misaligned pipe, offset joints are all possible causes of backups.

# Water & Sewer Utility Maintenance SC-76

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## *Design Considerations*

Sanitary sewer overflows can often be reduced or eliminated by a number of practices, in addition to sewer system cleaning and maintenance, including the following:

- Reducing infiltration and inflow through rehabilitation and repair of broken or leaking sewer lines.
- Enlarging or upgrading the capacity of sewer lines, pump stations, or sewage treatment plants.
- Constructing wet weather storage and treatment facilities to treat excess flows.
- Addressing SSOs during sewer system master planning and facilities planning.

## *Septic Systems*

Two field screening techniques that have been used with success at identifying possible locations of failing septic systems are the brightener test and color infrared (CIR) aerial photography. The first involves the use of specific phosphorus-based elements found in many laundry products, often called brighteners, as an indicator of the presence of failing onsite wastewater systems. The second technique uses color infrared (CIR) aerial photography to characterize the performance of septic systems. This method has been found to be a quick and cost-effective method for assessing the potential impacts of failing systems and uses variations in vegetative growth or stress patterns over septic system field lines to identify those systems that may potentially be malfunctioning. Then a more detailed onsite visual and physical inspection will confirm whether the system has truly failed and the extent of the repairs needed. These inspections may be carried out by county health departments or other authorized personnel.

## References and Resources

Alameda Countywide Clean Water Program on-line  
<http://www.ci.berkeley.ca.us/pw/Storm/stormala.html>

Los Angeles County Stormwater Quality. Public Agency Activities Model Program. On-line:  
[http://ladpw.org/wmd/npdes/public\\_TC.cfm](http://ladpw.org/wmd/npdes/public_TC.cfm)

Orange County Stormwater Program  
[http://www.ocwatersheds.com/StormWater/swp\\_introduction.asp](http://www.ocwatersheds.com/StormWater/swp_introduction.asp)

Santa Clara Valley Urban Runoff Pollution Prevention Program. 1997 Urban Runoff Management Plan. September 1997, updated October 2000.

Santa Clara Valley Urban Runoff Pollution Prevention Program. 1998. Water Utility Operation and Maintenance Discharge Pollution Prevention Plan. June

United States Environmental Protection Agency (USEPA). 2001. Illicit Discharge Detection and Elimination. On-line: [http://cfpub.epa.gov/npdes/stormwater/menuofbmps/illi\\_1.cfm](http://cfpub.epa.gov/npdes/stormwater/menuofbmps/illi_1.cfm)

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United States Environmental Protection Agency (USEPA). 2001. Pollution Prevention/Good Housekeeping for Municipal Operators Septic System Controls. On-line:  
[http://www.epa.gov/npdes/menuofbmps/poll\\_14.htm](http://www.epa.gov/npdes/menuofbmps/poll_14.htm)

## STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

How to use this worksheet (also see instructions in Section G of the WQMP Template):

1. Review Column 1 and identify which of these potential sources of stormwater pollutants apply to your site. Check each box that applies.
2. Review Column 2 and incorporate all of the corresponding applicable BMPs in your WQMP Exhibit.
3. Review Columns 3 and 4 and incorporate all of the corresponding applicable permanent controls and operational BMPs in your WQMP. Use the format shown in Table G.1 on page 23 of this WQMP Template. Describe your specific BMPs in an accompanying narrative, and explain any special conditions or situations that required omitting BMPs or substituting alternative BMPs for those shown here.

| IF THESE SOURCES WILL BE ON THE PROJECT SITE ...                                | ... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE |  |   |
|---|--|--|---|
| 1<br>Potential Sources of Runoff Pollutants                                     | 2<br>Permanent Controls—Show on WQMP Drawings                              | 3<br>Permanent Controls—List in WQMP Table and Narrative   | 4<br>Operational BMPs—Include in WQMP Table and Narrative   |
| <input checked="" type="checkbox"/> A. On-site storm drain inlets               | <input checked="" type="checkbox"/> Locations of inlets.                   | <input checked="" type="checkbox"/> Mark all inlets with the words “Only Rain Down the Storm Drain” or similar. Catch Basin Markers may be available from the Riverside County Flood Control and Water Conservation District, call 951.955.1200 to verify. | <input checked="" type="checkbox"/> Maintain and periodically repaint or replace inlet markings.<br><input checked="" type="checkbox"/> Provide stormwater pollution prevention information to new site owners, lessees, or operators.<br><input checked="" type="checkbox"/> See applicable operational BMPs in Fact Sheet SC-44, “Drainage System Maintenance,” in the CASQA Stormwater Quality Handbooks at <a href="http://www.cabmphandbooks.com">www.cabmphandbooks.com</a><br><input checked="" type="checkbox"/> Include the following in lease agreements: “Tenant shall not allow anyone to discharge anything to storm drains or to store or deposit materials so as to create a potential discharge to storm drains.” |
| <input type="checkbox"/> B. Interior floor drains and elevator shaft sump pumps |  | <input type="checkbox"/> State that interior floor drains and elevator shaft sump pumps will be plumbed to sanitary sewer.   | <input type="checkbox"/> Inspect and maintain drains to prevent blockages and overflow.   |
| <input checked="" type="checkbox"/> C. Interior parking garages                 |  | <input checked="" type="checkbox"/> State that parking garage floor drains will be plumbed to the sanitary sewer.  | <input checked="" type="checkbox"/> Inspect and maintain drains to prevent blockages and overflow.  |

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

| IF THESE SOURCES WILL BE ON THE PROJECT SITE ...                              | ... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE  |   |   |
|---|---|---|---|
| 1<br>Potential Sources of Runoff Pollutants                                   | 2<br>Permanent Controls—Show on WQMP Drawings   | 3<br>Permanent Controls—List in WQMP Table and Narrative  | 4<br>Operational BMPs—Include in WQMP Table and Narrative   |
| <input type="checkbox"/> D1. Need for future indoor & structural pest control |   | <input type="checkbox"/> Note building design features that discourage entry of pests.  | <input type="checkbox"/> Provide Integrated Pest Management information to owners, lessees, and operators.  |
| <input checked="" type="checkbox"/> D2. Landscape/ Outdoor Pesticide Use      | <input checked="" type="checkbox"/> Show locations of native trees or areas of shrubs and ground cover to be undisturbed and retained.<br><input checked="" type="checkbox"/> Show self-retaining landscape areas, if any.<br><input checked="" type="checkbox"/> Show stormwater treatment and hydrograph modification management BMPs. (See instructions in Chapter 3, Step 5 and guidance in Chapter 5.) | <p>State that final landscape plans will accomplish all of the following.</p> <input checked="" type="checkbox"/> Preserve existing native trees, shrubs, and ground cover to the maximum extent possible.<br><input checked="" type="checkbox"/> Design landscaping to minimize irrigation and runoff, to promote surface infiltration where appropriate, and to minimize the use of fertilizers and pesticides that can contribute to stormwater pollution.<br><input checked="" type="checkbox"/> Where landscaped areas are used to retain or detain stormwater, specify plants that are tolerant of saturated soil conditions.<br><input checked="" type="checkbox"/> Consider using pest-resistant plants, especially adjacent to hardscape.<br><p>To insure successful establishment, select plants appropriate to site soils, slopes, climate, sun, wind, rain, land use, air movement, ecological consistency, and plant interactions.</p> | <input checked="" type="checkbox"/> Maintain landscaping using minimum or no pesticides.<br><input checked="" type="checkbox"/> See applicable operational BMPs in “What you should know for.....Landscape and Gardening” at <a href="http://rcflood.org/stormwater/Error!">http://rcflood.org/stormwater/Error!</a> <small>Hyperlink reference not valid.</small><br><input checked="" type="checkbox"/> Provide IPM information to new owners, lessees and operators. |

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

| IF THESE SOURCES WILL BE ON THE PROJECT SITE ...   | ... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE  |  |  |
|--|---|--|--|
| 1<br>Potential Sources of Runoff Pollutants  | 2<br>Permanent Controls—Show on WQMP Drawings   | 3<br>Permanent Controls—List in WQMP Table and Narrative   | 4<br>Operational BMPs—Include in WQMP Table and Narrative  |
| <input checked="" type="checkbox"/> E. Pools, spas, ponds, decorative fountains, and other water features. | <input checked="" type="checkbox"/> Show location of water feature and a sanitary sewer cleanout in an accessible area within 10 feet. (Exception: Public pools must be plumbed according to County Department of Environmental Health Guidelines.)   | If the Co-Permittee requires pools to be plumbed to the sanitary sewer, place a note on the plans and state in the narrative that this connection will be made according to local requirements.  | <input checked="" type="checkbox"/> See applicable operational BMPs in “Guidelines for Maintaining Your Swimming Pool, Jacuzzi and Garden Fountain” at <a href="http://rcflood.org/stormwater/">http://rcflood.org/stormwater/</a>   |
| <input checked="" type="checkbox"/> F. Food service  | <input checked="" type="checkbox"/> For restaurants, grocery stores, and other food service operations, show location (indoors or in a covered area outdoors) of a floor sink or other area for cleaning floor mats, containers, and equipment.<br><br><input checked="" type="checkbox"/> On the drawing, show a note that this drain will be connected to a grease interceptor before discharging to the sanitary sewer.  | <input checked="" type="checkbox"/> Describe the location and features of the designated cleaning area.<br><br><input checked="" type="checkbox"/> Describe the items to be cleaned in this facility and how it has been sized to insure that the largest items can be accommodated.                 | <input checked="" type="checkbox"/> See the brochure, “The Food Service Industry Best Management Practices for: Restaurants, Grocery Stores, Delicatessens and Bakeries” at <a href="http://rcflood.org/stormwater/">http://rcflood.org/stormwater/</a><br><br>Provide this brochure to new site owners, lessees, and operators.   |
| <input checked="" type="checkbox"/> G. Refuse areas  | <input checked="" type="checkbox"/> Show where site refuse and recycled materials will be handled and stored for pickup. See local municipal requirements for sizes and other details of refuse areas.<br><br><input checked="" type="checkbox"/> If dumpsters or other receptacles are outdoors, show how the designated area will be covered, graded, and paved to prevent run-on and show locations of berms to prevent runoff from the area.<br><br><input checked="" type="checkbox"/> Any drains from dumpsters, compactors, and tallow bin areas shall be connected to a grease removal device before discharge to sanitary sewer. | <input checked="" type="checkbox"/> State how site refuse will be handled and provide supporting detail to what is shown on plans.<br><br><input checked="" type="checkbox"/> State that signs will be posted on or near dumpsters with the words “Do not dump hazardous materials here” or similar. | <input checked="" type="checkbox"/> State how the following will be implemented:<br><br>Provide adequate number of receptacles. Inspect receptacles regularly; repair or replace leaky receptacles. Keep receptacles covered. Prohibit/prevent dumping of liquid or hazardous wastes. Post “no hazardous materials” signs. Inspect and pick up litter daily and clean up spills immediately. Keep spill control materials available on-site. See Fact Sheet SC-34, “Waste Handling and Disposal” in the CASQA Stormwater Quality Handbooks at <a href="http://www.cabmphandbooks.com">www.cabmphandbooks.com</a> |

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

| IF THESE SOURCES WILL BE ON THE PROJECT SITE ...  | ... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE |  |   |
|---|--|--|---|
| 1<br>Potential Sources of Runoff Pollutants       | 2<br>Permanent Controls—Show on WQMP Drawings                              | 3<br>Permanent Controls—List in WQMP Table and Narrative   | 4<br>Operational BMPs—Include in WQMP Table and Narrative   |
| <input type="checkbox"/> H. Industrial processes. | <input type="checkbox"/> Show process area.                                | <input type="checkbox"/> If industrial processes are to be located on site, state: “All process activities to be performed indoors. No processes to drain to exterior or to storm drain system.” | <input type="checkbox"/> See Fact Sheet SC-10, “Non-Stormwater Discharges” in the CASQA Stormwater Quality Handbooks at <a href="http://www.cabmphandbooks.com">www.cabmphandbooks.com</a><br><br>See the brochure “Industrial & Commercial Facilities Best Management Practices for: Industrial, Commercial Facilities” at <a href="http://rcflood.org/stormwater/">http://rcflood.org/stormwater/</a> |

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

| IF THESE SOURCES WILL BE ON THE PROJECT SITE ...  | ... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE   |   |  |
|---|--|---|--|
| 1<br>Potential Sources of Runoff Pollutants   | 2<br>Permanent Controls—Show on WQMP Drawings  | 3<br>Permanent Controls—List in WQMP Table and Narrative  | 4<br>Operational BMPs—Include in WQMP Table and Narrative  |
| <p><input type="checkbox"/> I. Outdoor storage of equipment or materials. (See rows J and K for source control measures for vehicle cleaning, repair, and maintenance.)</p> | <p><input type="checkbox"/> Show any outdoor storage areas, including how materials will be covered. Show how areas will be graded and bermed to prevent run-on or run-off from area.</p> <p><input type="checkbox"/> Storage of non-hazardous liquids shall be covered by a roof and/or drain to the sanitary sewer system, and be contained by berms, dikes, liners, or vaults.</p> <p><input type="checkbox"/> Storage of hazardous materials and wastes must be in compliance with the local hazardous materials ordinance and a Hazardous Materials Management Plan for the site.</p> | <p>Include a detailed description of materials to be stored, storage areas, and structural features to prevent pollutants from entering storm drains.</p> <p>Where appropriate, reference documentation of compliance with the requirements of Hazardous Materials Programs for:</p> <ul style="list-style-type: none"> <li>▪ Hazardous Waste Generation</li> <li>▪ Hazardous Materials Release Response and Inventory</li> <li>▪ California Accidental Release (CalARP)</li> <li>▪ Aboveground Storage Tank</li> <li>▪ Uniform Fire Code Article 80 Section 103(b) &amp; (c) 1991</li> <li>▪ Underground Storage Tank</li> </ul> <p><a href="http://www.cchealth.org/groups/hazmat/">www.cchealth.org/groups/hazmat/</a></p> | <p><input type="checkbox"/> See the Fact Sheets SC-31, “Outdoor Liquid Container Storage” and SC-33, “Outdoor Storage of Raw Materials ” in the CASQA Stormwater Quality Handbooks at <a href="http://www.cabmphandbooks.com">www.cabmphandbooks.com</a></p> |



STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

| IF THESE SOURCES WILL BE ON THE PROJECT SITE ...                  | ... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE   |   |  |
|---|--|---|--|
| 1<br>Potential Sources of Runoff Pollutants                       | 2<br>Permanent Controls—Show on WQMP Drawings  | 3<br>Permanent Controls—List in WQMP Table and Narrative  | 4<br>Operational BMPs—Include in WQMP Table and Narrative  |
| <p><input type="checkbox"/> J. Vehicle and Equipment Cleaning</p> | <p><input type="checkbox"/> Show on drawings as appropriate:</p> <p>(1) Commercial/industrial facilities having vehicle/equipment cleaning needs shall either provide a covered, bermed area for washing activities or discourage vehicle/equipment washing by removing hose bibs and installing signs prohibiting such uses.</p> <p>(2) Multi-dwelling complexes shall have a paved, bermed, and covered car wash area (unless car washing is prohibited on-site and hoses are provided with an automatic shut-off to discourage such use).</p> <p>(3) Washing areas for cars, vehicles, and equipment shall be paved, designed to prevent run-on to or runoff from the area, and plumbed to drain to the sanitary sewer.</p> <p>(4) Commercial car wash facilities shall be designed such that no runoff from the facility is discharged to the storm drain system. Wastewater from the facility shall discharge to the sanitary sewer, or a wastewater reclamation system shall be installed.</p> | <p><input type="checkbox"/> If a car wash area is not provided, describe any measures taken to discourage on-site car washing and explain how these will be enforced.</p> | <p>Describe operational measures to implement the following (if applicable):</p> <p><input type="checkbox"/> Washwater from vehicle and equipment washing operations shall not be discharged to the storm drain system. Refer to “Outdoor Cleaning Activities and Professional Mobile Service Providers” for many of the Potential Sources of Runoff Pollutants categories below. Brochure can be found at <a href="http://rcflood.org/stormwater/">http://rcflood.org/stormwater/</a></p> <p><input type="checkbox"/> Car dealerships and similar may rinse cars with water only.</p> |

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

| IF THESE SOURCES WILL BE ON THE PROJECT SITE ...                                   | ... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE  |  |   |
|--|---|--|---|
| 1<br>Potential Sources of Runoff Pollutants  | 2<br>Permanent Controls—Show on WQMP Drawings   | 3<br>Permanent Controls—List in WQMP Table and Narrative   | 4<br>Operational BMPs—Include in WQMP Table and Narrative   |
| <p><input type="checkbox"/> <b>K. Vehicle/Equipment Repair and Maintenance</b></p> | <p><input type="checkbox"/> Accommodate all vehicle equipment repair and maintenance indoors. Or designate an outdoor work area and design the area to prevent run-on and runoff of stormwater.</p> <p><input type="checkbox"/> Show secondary containment for exterior work areas where motor oil, brake fluid, gasoline, diesel fuel, radiator fluid, acid-containing batteries or other hazardous materials or hazardous wastes are used or stored. Drains shall not be installed within the secondary containment areas.</p> <p><input type="checkbox"/> Add a note on the plans that states either (1) there are no floor drains, or (2) floor drains are connected to wastewater pretreatment systems prior to discharge to the sanitary sewer and an industrial waste discharge permit will be obtained.</p> | <p><input type="checkbox"/> State that no vehicle repair or maintenance will be done outdoors, or else describe the required features of the outdoor work area.</p> <p><input type="checkbox"/> State that there are no floor drains or if there are floor drains, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency’s requirements.</p> <p><input type="checkbox"/> State that there are no tanks, containers or sinks to be used for parts cleaning or rinsing or, if there are, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency’s requirements.</p> | <p>In the Stormwater Control Plan, note that all of the following restrictions apply to use the site:</p> <p><input type="checkbox"/> No person shall dispose of, nor permit the disposal, directly or indirectly of vehicle fluids, hazardous materials, or rinsewater from parts cleaning into storm drains.</p> <p><input type="checkbox"/> No vehicle fluid removal shall be performed outside a building, nor on asphalt or ground surfaces, whether inside or outside a building, except in such a manner as to ensure that any spilled fluid will be in an area of secondary containment. Leaking vehicle fluids shall be contained or drained from the vehicle immediately.</p> <p><input type="checkbox"/> No person shall leave unattended drip parts or other open containers containing vehicle fluid, unless such containers are in use or in an area of secondary containment.</p> <p>Refer to “Automotive Maintenance &amp; Car Care Best Management Practices for Auto Body Shops, Auto Repair Shops, Car Dealerships, Gas Stations and Fleet Service Operations”. Brochure can be found at <a href="http://rcflood.org/stormwater/">http://rcflood.org/stormwater/</a></p> <p>Refer to Outdoor Cleaning Activities and Professional Mobile Service Providers for many of the Potential Sources of Runoff Pollutants categories below. Brochure can be found at <a href="http://rcflood.org/stormwater/">http://rcflood.org/stormwater/</a></p> |

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

| IF THESE SOURCES WILL BE ON THE PROJECT SITE ...  | ... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE  |  |  |
|---|---|--|--|
| 1<br>Potential Sources of Runoff Pollutants       | 2<br>Permanent Controls—Show on WQMP Drawings   | 3<br>Permanent Controls—List in WQMP Table and Narrative | 4<br>Operational BMPs—Include in WQMP Table and Narrative  |
| <input type="checkbox"/> L. Fuel Dispensing Areas | <input type="checkbox"/> Fueling areas <sup>6</sup> shall have impermeable floors (i.e., portland cement concrete or equivalent smooth impervious surface) that are: a) graded at the minimum slope necessary to prevent ponding; and b) separated from the rest of the site by a grade break that prevents run-on of stormwater to the maximum extent practicable.<br><br><input type="checkbox"/> Fueling areas shall be covered by a canopy that extends a minimum of ten feet in each direction from each pump. [Alternative: The fueling area must be covered and the cover's minimum dimensions must be equal to or greater than the area within the grade break or fuel dispensing area <sup>1</sup> .] The canopy [or cover] shall not drain onto the fueling area. |  | <input type="checkbox"/> The property owner shall dry sweep the fueling area routinely.<br><input type="checkbox"/> See the Fact Sheet SD-30 , “Fueling Areas” in the CASQA Stormwater Quality Handbooks at <a href="http://www.cabmphandbooks.com">www.cabmphandbooks.com</a> |

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<sup>6</sup> The fueling area shall be defined as the area extending a minimum of 6.5 feet from the corner of each fuel dispenser or the length at which the hose and nozzle assembly may be operated plus a minimum of one foot, whichever is greater.

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

| IF THESE SOURCES WILL BE ON THE PROJECT SITE ...     | ... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE   |  |   |
|--|--|--|---|
| 1<br>Potential Sources of Runoff Pollutants          | 2<br>Permanent Controls—Show on WQMP Drawings  | 3<br>Permanent Controls—List in WQMP Table and Narrative | 4<br>Operational BMPs—Include in WQMP Table and Narrative   |
| <input checked="" type="checkbox"/> M. Loading Docks | <input checked="" type="checkbox"/> Show a preliminary design for the loading dock area, including roofing and drainage. Loading docks shall be covered and/or graded to minimize run-on to and runoff from the loading area. Roof downspouts shall be positioned to direct stormwater away from the loading area. Water from loading dock areas shall be drained to the sanitary sewer, or diverted and collected for ultimate discharge to the sanitary sewer.<br><br><input checked="" type="checkbox"/> Loading dock areas draining directly to the sanitary sewer shall be equipped with a spill control valve or equivalent device, which shall be kept closed during periods of operation.<br><br><input checked="" type="checkbox"/> Provide a roof overhang over the loading area or install door skirts (cowling) at each bay that enclose the end of the trailer. |  | <input checked="" type="checkbox"/> Move loaded and unloaded items indoors as soon as possible.<br><br><input checked="" type="checkbox"/> See Fact Sheet SC-30, “Outdoor Loading and Unloading,” in the CASQA Stormwater Quality Handbooks at <a href="http://www.cabmphandbooks.com">www.cabmphandbooks.com</a> |

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

| IF THESE SOURCES WILL BE ON THE PROJECT SITE ...   | ... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE |  |   |
|--|--|--|---|
| 1<br>Potential Sources of Runoff Pollutants  | 2<br>Permanent Controls—Show on WQMP Drawings                              | 3<br>Permanent Controls—List in WQMP Table and Narrative   | 4<br>Operational BMPs—Include in WQMP Table and Narrative   |
| <input checked="" type="checkbox"/> N. Fire Sprinkler Test Water   |  | <input checked="" type="checkbox"/> Provide a means to drain fire sprinkler test water to the sanitary sewer.  | <input checked="" type="checkbox"/> See the note in Fact Sheet SC-41, “Building and Grounds Maintenance,” in the CASQA Stormwater Quality Handbooks at <a href="http://www.cabmphandbooks.com">www.cabmphandbooks.com</a> |
| <p>O. Miscellaneous Drain or Wash Water or Other Sources</p> <input checked="" type="checkbox"/> Boiler drain lines<br><input checked="" type="checkbox"/> Condensate drain lines<br><input checked="" type="checkbox"/> Rooftop equipment<br><input checked="" type="checkbox"/> Drainage sumps<br><input checked="" type="checkbox"/> Roofing, gutters, and trim.<br><input checked="" type="checkbox"/> Other sources |  | <input checked="" type="checkbox"/> Boiler drain lines shall be directly or indirectly connected to the sanitary sewer system and may not discharge to the storm drain system.<br><input checked="" type="checkbox"/> Condensate drain lines may discharge to landscaped areas if the flow is small enough that runoff will not occur. Condensate drain lines may not discharge to the storm drain system.<br><input checked="" type="checkbox"/> Rooftop equipment with potential to produce pollutants shall be roofed and/or have secondary containment.<br><input checked="" type="checkbox"/> Any drainage sumps on-site shall feature a sediment sump to reduce the quantity of sediment in pumped water.<br><input checked="" type="checkbox"/> Avoid roofing, gutters, and trim made of copper or other unprotected metals that may leach into runoff.<br>Include controls for other sources as specified by local reviewer. |   |

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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|---|--|--|---|
| 1<br>Potential Sources of Runoff Pollutants                                 | 2<br>Permanent Controls—Show on WQMP Drawings                              | 3<br>Permanent Controls—List in WQMP Table and Narrative | 4<br>Operational BMPs—Include in WQMP Table and Narrative   |
| <input checked="" type="checkbox"/> P. Plazas, sidewalks, and parking lots. |  |  | <input checked="" type="checkbox"/> Sweep plazas, sidewalks, and parking lots regularly to prevent accumulation of litter and debris. Collect debris from pressure washing to prevent entry into the storm drain system. Collect washwater containing any cleaning agent or degreaser and discharge to the sanitary sewer not to a storm drain. |

# Appendix 9: O&M

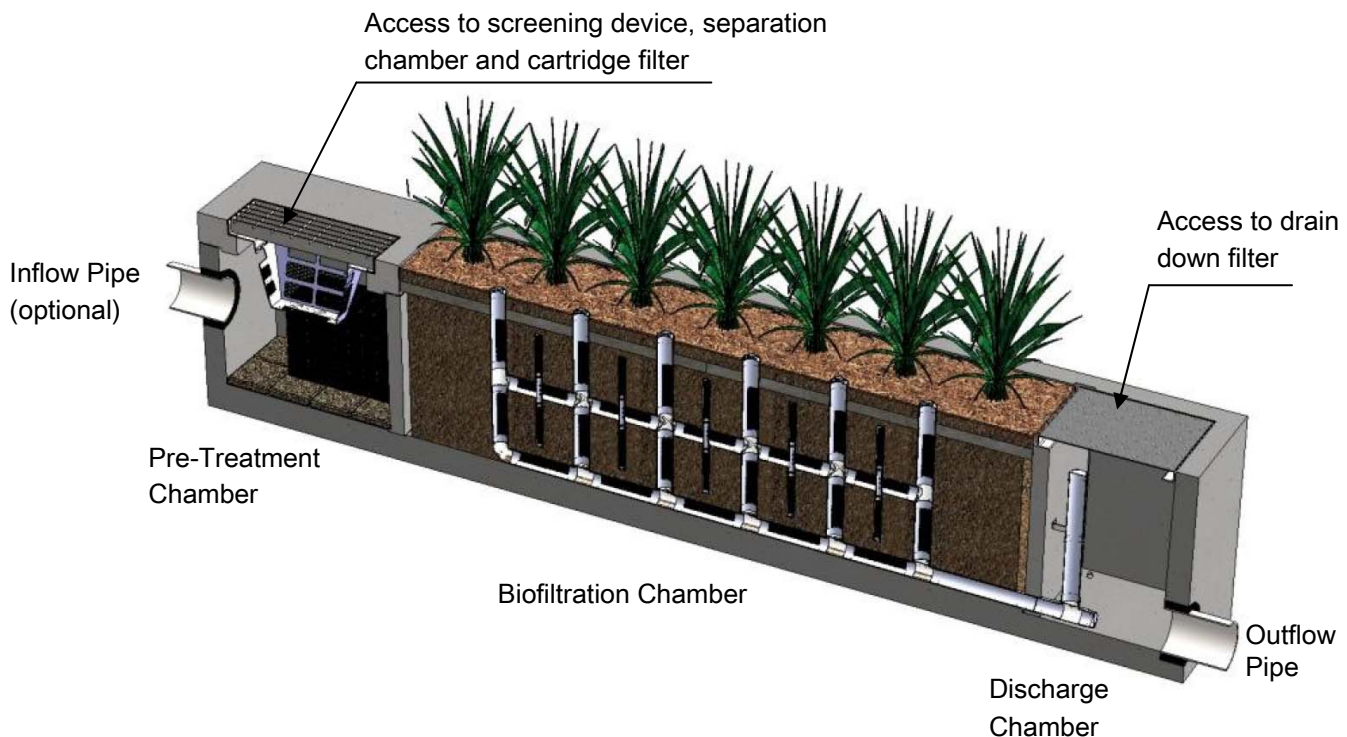
*Operation and Maintenance Plan and Documentation of Finance, Maintenance and Recording Mechanisms*

## Maintenance Guidelines for Modular Wetland System - Linear

### Maintenance Summary

- Remove Trash from Screening Device – average maintenance interval is 6 to 12 months.
  - *(5 minute average service time).*
- Remove Sediment from Separation Chamber – average maintenance interval is 12 to 24 months.
  - *(10 minute average service time).*
- Replace Cartridge Filter Media – average maintenance interval 12 to 24 months.
  - *(10-15 minute per cartridge average service time).*
- Replace Drain Down Filter Media – average maintenance interval is 12 to 24 months.
  - *(5 minute average service time).*
- Trim Vegetation – average maintenance interval is 6 to 12 months.
  - *(Service time varies).*

### System Diagram





# Maintenance Procedures

## Screening Device

1. Remove grate or manhole cover to gain access to the screening device in the Pre-Treatment Chamber. Vault type units do not have screening device. Maintenance can be performed without entry.
2. Remove all pollutants collected by the screening device. Removal can be done manually or with the use of a vacuum truck. The hose of the vacuum truck will not damage the screening device.
3. Screening device can easily be removed from the Pre-Treatment Chamber to gain access to separation chamber and media filters below. Replace grate or manhole cover when completed.

## Separation Chamber

1. Perform maintenance procedures of screening device listed above before maintaining the separation chamber.
2. With a pressure washer spray down pollutants accumulated on walls and cartridge filters.
3. Vacuum out Separation Chamber and remove all accumulated pollutants. Replace screening device, grate or manhole cover when completed.

## Cartridge Filters

1. Perform maintenance procedures on screening device and separation chamber before maintaining cartridge filters.
2. Enter separation chamber.
3. Unscrew the two bolts holding the lid on each cartridge filter and remove lid.
4. Remove each of 4 to 8 media cages holding the media in place.
5. Spray down the cartridge filter to remove any accumulated pollutants.
6. Vacuum out old media and accumulated pollutants.
7. Reinstall media cages and fill with new media from manufacturer or outside supplier. Manufacturer will provide specification of media and sources to purchase.
8. Replace the lid and tighten down bolts. Replace screening device, grate or manhole cover when completed.

## Drain Down Filter

1. Remove hatch or manhole cover over discharge chamber and enter chamber.
2. Unlock and lift drain down filter housing and remove old media block. Replace with new media block. Lower drain down filter housing and lock into place.
3. Exit chamber and replace hatch or manhole cover.



## Maintenance Notes

1. Following maintenance and/or inspection, it is recommended the maintenance operator prepare a maintenance/inspection record. The record should include any maintenance activities performed, amount and description of debris collected, and condition of the system and its various filter mechanisms.
2. The owner should keep maintenance/inspection record(s) for a minimum of five years from the date of maintenance. These records should be made available to the governing municipality for inspection upon request at any time.
3. Transport all debris, trash, organics and sediments to approved facility for disposal in accordance with local and state requirements.
4. Entry into chambers may require confined space training based on state and local regulations.
5. No fertilizer shall be used in the Biofiltration Chamber.
6. Irrigation should be provided as recommended by manufacturer and/or landscape architect. Amount of irrigation required is dependent on plant species. Some plants may require irrigation.

## Maintenance Procedure Illustration

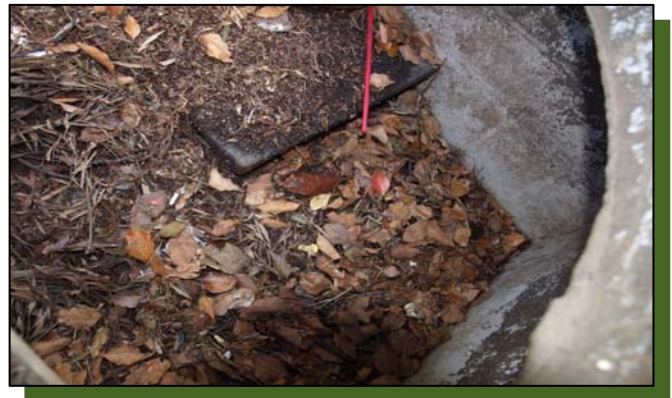
### Screening Device

The screening device is located directly under the manhole or grate over the Pre-Treatment Chamber. It's mounted directly underneath for easy access and cleaning. Device can be cleaned by hand or with a vacuum truck.



### Separation Chamber

The separation chamber is located directly beneath the screening device. It can be quickly cleaned using a vacuum truck or by hand. A pressure washer is useful to assist in the cleaning process.



### **Cartridge Filters**

The cartridge filters are located in the Pre-Treatment chamber connected to the wall adjacent to the biofiltration chamber. The cartridges have removable tops to access the individual media filters. Once the cartridge is open media can be easily removed and replaced by hand or a vacuum truck.



### **Drain Down Filter**

The drain down filter is located in the Discharge Chamber. The drain filter unlocks from the wall mount and hinges up. Remove filter block and replace with new block.



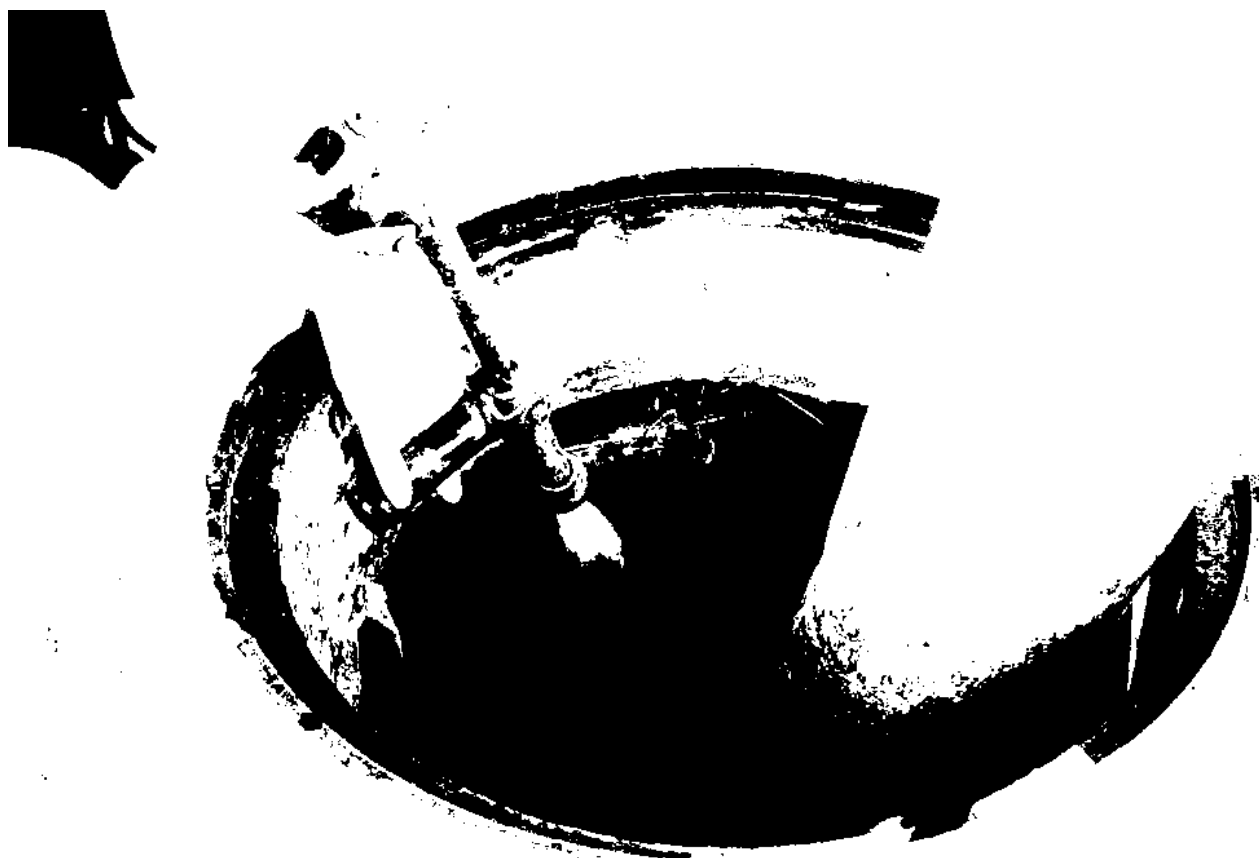
### Trim Vegetation

Vegetation should be maintained in the same manner as surrounding vegetation and trimmed as needed. No fertilizer shall be used on the plants. Irrigation per the recommendation of the manufacturer and or landscape architect. Different types of vegetation requires different amounts of irrigation.





## Inspection Form



Modular Wetland System, Inc.

P. 760.433-7640

F. 760-433-3176

E. [Info@modularwetlands.com](mailto:Info@modularwetlands.com)

[www.modularwetlands.com](http://www.modularwetlands.com)



# Inspection Report Modular Wetlands System



Project Name \_\_\_\_\_

Project Address \_\_\_\_\_ (city) (Zip Code)

Owner / Management Company \_\_\_\_\_

Contact \_\_\_\_\_

Phone ( ) -

Inspector Name \_\_\_\_\_

Date \_\_\_\_ / \_\_\_\_ / \_\_\_\_

Time \_\_\_\_\_ AM / PM

Type of Inspection  Routine  Follow Up  Complaint

Storm

Storm Event in Last 72-hours?  No  Yes

Weather Condition \_\_\_\_\_

Additional Notes \_\_\_\_\_

For Office Use Only

(Reviewed By)

(Date)  
Office personnel to complete section to the left.

## Inspection Checklist

Modular Wetland System Type (Curb, Grate or UG Vault): \_\_\_\_\_ Size (22', 14' or etc.): \_\_\_\_\_

| Structural Integrity:   | Yes | No | Comments |
|---|-----|----|----------|
| Damage to pre-treatment access cover (manhole cover/grate) or cannot be opened using normal lifting pressure?   |     |    |          |
| Damage to discharge chamber access cover (manhole cover/grate) or cannot be opened using normal lifting pressure?   |     |    |          |
| Does the MWS unit show signs of structural deterioration (cracks in the wall, damage to frame)?   |     |    |          |
| Is the inlet/outlet pipe or drain down pipe damaged or otherwise not functioning properly?  |     |    |          |
| <b>Working Condition:</b>   |     |    |          |
| Is there evidence of illicit discharge or excessive oil, grease, or other automobile fluids entering and clogging the unit?   |     |    |          |
| Is there standing water in inappropriate areas after a dry period?  |     |    |          |
| Is the filter insert (if applicable) at capacity and/or is there an accumulation of debris/trash on the shelf system?   |     |    |          |
| Does the depth of sediment/trash/debris suggest a blockage of the inflow pipe, bypass or cartridge filter? If yes, specify which one in the comments section. Note depth of accumulation in in pre-treatment chamber. |     |    | Depth:   |
| Does the cartridge filter media need replacement in pre-treatment chamber and/or discharge chamber?   |     |    | Chamber: |
| Any signs of improper functioning in the discharge chamber? Note issues in comments section.  |     |    |          |
| <b>Other Inspection Items:</b>  |     |    |          |
| Is there an accumulation of sediment/trash/debris in the wetland media (if applicable)?   |     |    |          |
| Is it evident that the plants are alive and healthy (if applicable)? Please note Plant Information below.   |     |    |          |
| Is there a septic or foul odor coming from inside the system?   |     |    |          |

| Waste:                         | Yes | No |
|--------------------------------|-----|----|
| Sediment / Silt / Clay         |     |    |
| Trash / Bags / Bottles         |     |    |
| Green Waste / Leaves / Foliage |     |    |

| Recommended Maintenance         |  |
|---------------------------------|--|
| No Cleaning Needed              |  |
| Schedule Maintenance as Planned |  |
| Needs Immediate Maintenance     |  |

| Plant Information |  |
|-------------------|--|
| Damage to Plants  |  |
| Plant Replacement |  |
| Plant Trimming    |  |

Additional Notes: \_\_\_\_\_

## Maintenance Report



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E. [Info@modularwetlands.com](mailto:Info@modularwetlands.com)

[www.modularwetlands.com](http://www.modularwetlands.com)





# Cleaning and Maintenance Report Modular Wetlands System



Project Name \_\_\_\_\_

Project Address \_\_\_\_\_  
(city) (Zip Code)

Owner / Management Company \_\_\_\_\_

Contact \_\_\_\_\_ Phone (      )      -

Inspector Name \_\_\_\_\_ Date \_\_\_\_ / \_\_\_\_ / \_\_\_\_ Time \_\_\_\_\_ AM / PM

Type of Inspection     Routine     Follow Up     Complaint     Storm    Storm Event in Last 72-hours?     No     Yes

Weather Condition \_\_\_\_\_ Additional Notes \_\_\_\_\_

For Office Use Only

---

(Reviewed By) \_\_\_\_\_

---

(Date) \_\_\_\_\_  
 Office personnel to complete section to the left.

| Site Map # | GPS Coordinates of Insert | Manufacturer / Description / Sizing | Trash Accumulation | Foliage Accumulation | Sediment Accumulation | Total Debris Accumulation | Condition of Media 25/50/75/100 (will be changed @ 75%) | Operational Per Manufactures' Specifications (If not, why?) |
|------------|---------------------------|-------------------------------------|--------------------|----------------------|-----------------------|---------------------------|---|---|
|            | Lat: _____<br>Long: _____ | MWS Catch Basins                    |                    |                      |                       |                           |   |   |
|            |                           | MWS Sedimentation Basin             |                    |                      |                       |                           |   |   |
|            |                           | Media Filter Condition              |                    |                      |                       |                           |   |   |
|            |                           | Plant Condition                     |                    |                      |                       |                           |   |   |
|            |                           | Drain Down Media Condition          |                    |                      |                       |                           |   |   |
|            |                           | Discharge Chamber Condition         |                    |                      |                       |                           |   |   |
|            |                           | Drain Down Pipe Condition           |                    |                      |                       |                           |   |   |
|            |                           | Inlet and Outlet Pipe Condition     |                    |                      |                       |                           |   |   |

Comments:

---



---

## Stormwater BMP Inspection and Maintenance Log

|               |          |
|---------------|----------|
| Facility Name |          |
| Address       |          |
| Begin Date    | End Date |

| Date | BMP ID# | BMP Description | Inspected by: | Cause for Inspection | Exceptions Noted | Comments and Actions Taken |
|------|---------|-----------------|---------------|----------------------|------------------|----------------------------|
|      |         |                 |               |                      |                  |                            |
|      |         |                 |               |                      |                  |                            |
|      |         |                 |               |                      |                  |                            |
|      |         |                 |               |                      |                  |                            |
|      |         |                 |               |                      |                  |                            |
|      |         |                 |               |                      |                  |                            |
|      |         |                 |               |                      |                  |                            |
|      |         |                 |               |                      |                  |                            |
|      |         |                 |               |                      |                  |                            |
|      |         |                 |               |                      |                  |                            |

**Instructions:** Record all inspections and maintenance for all treatment BMPs on this form. Use additional log sheets and/or attach extended comments or documentation as necessary. Submit a copy of the completed log with the annual independent inspectors’ report to the municipality, and start a new log at that time.

- BMP ID# — Always use ID# from the Operation and Maintenance Manual.
- Inspected by — Note all inspections and maintenance on this form, including the required independent annual inspection.
- Cause for inspection — Note if the inspection is routine, pre-rainy-season, post-storm, annual, or in response to a noted problem or complaint.
- Exceptions noted — Note any condition that requires correction or indicates a need for maintenance.
- Comments and actions taken — Describe any maintenance done and need for follow-up.

# Appendix 10: Educational Materials

*BMP Fact Sheets, Maintenance Guidelines and Other End-User BMP Information*

# Trained Contractor and Personnel Log

## Stormwater Management Training Log and Documentation

Project Name: \_

WDID #: \_\_\_\_\_

Stormwater Management Topic: (check as appropriate)

- |  |   |
|--|---|
| <input type="checkbox"/> Erosion Control           | <input type="checkbox"/> Sediment Control                                 |
| <input type="checkbox"/> Wind Erosion Control      | <input type="checkbox"/> Tracking Control                                 |
| <input type="checkbox"/> Non-Stormwater Management | <input type="checkbox"/> Waste Management and Materials Pollution Control |
| <input type="checkbox"/> Stormwater Sampling       | <input type="checkbox"/> Other (explain)                                  |

Specific Training Objective: \_\_\_\_\_

Location: \_\_\_\_\_ Date: \_\_\_\_

Instructor: \_\_\_\_\_ Telephone: \_\_\_\_

Course Length (hours):

**Attendee Roster (Attach additional forms if necessary)**

| Name | Company | Phone |
|------|---------|-------|
|      |         |       |
|      |         |       |
|      |         |       |
|      |         |       |
|      |         |       |
|      |         |       |

As needed, add proof of external training (e.g., course completion certificates, credentials for QSP, QSD).

# A Menu of Activities . . . to Keep Our Water Clean

## Cleanin' It Right . . .

Pour mop and wash water into the mop sink or down floor drains . . . not into gutters, alleys, parking lots or a storm drain. Wash greasy equipment only in designated wash areas which are properly connected to the sewer system with an appropriate oil/water separator. Also, avoid washing kitchen mats, garbage containers, and other items in areas where wastewater is likely to flow into a storm drain.



## Watch Out For Spills . . .

Use dry methods for spill cleanup. Don't hose down outside spills. Use rags or absorbents such as cat litter and then dispose of in the garbage, or handle as hazardous waste as appropriate. If necessary, mop the area with a minimum amount of water.



## Proper Storage and Disposal . . .

General cleaners, floor cleaners, solvents, and detergents often contain toxic substances. Read labels carefully and store and dispose of these products properly.

REMEMBER: Don't throw toxic waste into the trash or into a storm drain. To report toxic spill call 911. For information on hazardous waste pick-up call (909) 358-5055.



## Grease and Oil . . .

Handle and dispose of grease properly. Save used cooking grease and oil for recycling in tallow bins or sealed containers. Never pour grease into a sink, floor drain, dumpster or storm drain. Watch out for, and report to management, overflowing grease interceptors. Call (909) 358-5172 for disposal information.



## How 'Bout That Dumpster . . .

Keep dumpster and loading dock areas clean. Control litter by sweeping - don't hose down the area. Replace leaky dumpsters and keep lids closed to keep out rainwater.



## Use Water-Friendly Products . . .

Whenever possible, purchase water-based cleaning products. Look for products labeled "non-toxic," "non-petroleum based," "ammonia-free," "phosphate-free," and "perfume-free," or "readily biodegradable."



## Outdoor/Sidewalk Areas . . .

Sweep up food particles, cigarette butts, and trash from outdoor dining areas before rinsing or steam cleaning. Don't use toxic bleaches or detergents when you pressure wash outdoor dining areas, entrances or surrounding sidewalk areas.



*You may be already implementing many of the BMPs prescribed in this brochure. However, if you discover any potential problem areas, please consider using one or more of the recommended BMPs.*

*Also, please note that the Riverside County Environmental Health Department will monitor potential sources of stormwater pollution activities during regularly scheduled inspections of food service facilities. If Health Department staff observe activities which may be contributing to stormwater pollution, suggestions will be provided and/or use of prescribed BMPs listed in this brochure will be offered.*

**Please remember:**



**Everyone contributes a little to the problem of stormwater pollution. Now it's time for all of us to become part of the solution!**



# A Citizen's Guide to Understanding Stormwater



EPA  
United States Environmental Protection Agency

EPA 833-B-03-002

January 2003

Internet Address (URL): <http://www.epa.gov>  
Oil Based Inks on 100% Postconsumer Recycled Paper • Printed with Vegetable Process Chlorine Free Recycled Paper



## After the Storm

For more information contact:  
[www.epa.gov/nps/stormwater](http://www.epa.gov/nps/stormwater)  
or visit  
[www.epa.gov/nps](http://www.epa.gov/nps)



## What is stormwater runoff?



Stormwater runoff occurs when precipitation from rain or snowmelt flows over the ground. Impervious surfaces like driveways, sidewalks, and streets prevent stormwater from naturally soaking into the ground.

## Why is stormwater runoff a problem?



Stormwater can pick up debris, chemicals, dirt, and other pollutants and flow into a storm sewer system or directly to a lake, stream, river, wetland, or coastal water. Anything that enters a storm sewer system is discharged untreated into the waterbodies we use for swimming, fishing, and providing drinking water.

## The effects of pollution

Polluted stormwater runoff can have many adverse effects on plants, fish, animals, and people.

- ◆ Sediment can cloud the water and make it difficult or impossible for aquatic plants to grow. Sediment also can destroy aquatic habitats.
- ◆ Excess nutrients can cause algae blooms. When algae die, they sink to the bottom and decompose in a process that removes oxygen from the water. Fish and other aquatic organisms can't exist in water with low dissolved oxygen levels.
- ◆ Bacteria and other pathogens can wash into swimming areas and create health hazards, often making beach closures necessary.
- ◆ Debris—plastic bags, six-pack rings, bottles, and cigarette butts—washed into waterbodies can choke, suffocate, or disable aquatic life like ducks, fish, turtles, and birds.
- ◆ Household hazardous wastes like insecticides, pesticides, paint, solvents, used motor oil, and other auto fluids can poison aquatic life. Land animals and people can become sick or die from eating diseased fish and shellfish or ingesting polluted water.



- ◆ Polluted stormwater often affects drinking water sources. This, in turn, can affect human health and increase drinking water treatment costs.

# Stormwater Pollution Solutions

## Residential

Recycle or properly dispose of household products that contain chemicals, such as insecticides, pesticides, paint, solvents, and used motor oil and other auto fluids. Don't pour them onto the ground or into storm drains.

### Lawn care

Excess fertilizers and pesticides applied to lawns and gardens wash off and pollute streams. In addition, yard clippings and leaves can wash into storm drains and contribute nutrients and organic matter to streams.



- ◆ Don't overwater your lawn. Consider using a soaker hose instead of a sprinkler.
- ◆ Use pesticides and fertilizers sparingly. When use is necessary, use these chemicals in the recommended amounts. Use organic mulch or safer pest control methods whenever possible.
- ◆ Compost or mulch yard waste. Don't leave it in the street or sweep it into storm drains or streams.
- ◆ Cover piles of dirt or mulch being used in landscaping projects.

### Septic systems

Leaking and poorly maintained septic systems release nutrients and pathogens (bacteria and viruses) that can be picked up by stormwater and discharged into nearby waterbodies. Pathogens can cause public health problems and environmental concerns.



- ◆ Inspect your system every 3 years and pump your tank as necessary (every 3 to 5 years).
- ◆ Don't dispose of household hazardous waste in sinks or toilets.

### Auto care

Washing your car and degreasing auto parts at home can send detergents and other contaminants through the storm sewer system. Dumping automotive fluids into storm drains has the same result as dumping the materials directly into a waterbody.



- ◆ Use a commercial car wash that treats or recycles its wastewater, or wash your car on your yard so the water infiltrates into the ground.
- ◆ Repair leaks and dispose of used auto fluids and batteries at designated drop-off or recycling locations.

### Pet waste

Pet waste can be a major source of bacteria and excess nutrients in local waters.



- ◆ When walking your pet, remember to pick up the waste and dispose of it properly. Flushing pet waste is the best disposal method. Leaving pet waste on the ground increases public health risks by allowing harmful bacteria and nutrients to wash into the storm drain and eventually into local waterbodies.



Education is essential to changing people's behavior. Signs and markers near storm drains warn residents that pollutants entering the drains will be carried untreated into a local waterbody.

## Residential landscaping

**Permeable Pavement**—Traditional concrete and asphalt don't allow water to soak into the ground. Instead these surfaces rely on storm drains to divert unwanted water. Permeable pavement systems allow rain and snowmelt to soak through, decreasing stormwater runoff.

**Rain Barrels**—You can collect rainwater from rooftops in mosquito-proof containers. The water can be used later on lawn or garden areas.



**Rain Gardens and Grassy Swales**—Specially designed areas planted with native plants can provide natural places for rainwater to collect and soak into the ground. Rain from rooftop areas or paved areas can be diverted into these areas rather than into storm drains.



**Vegetated Filter Strips**—Filter strips are areas of native grass or plants created along roadways or streams. They trap the pollutants stormwater picks up as it flows across driveways and streets.



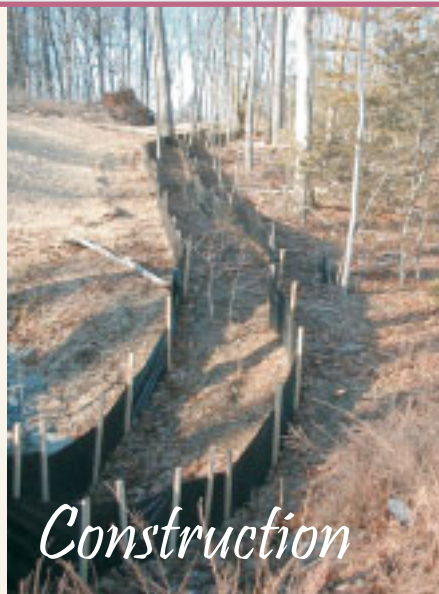
## Commercial

Dirt, oil, and debris that collect in parking lots and paved areas can be washed into the storm sewer system and eventually enter local waterbodies.

- ◆ Sweep up litter and debris from sidewalks, driveways and parking lots, especially around storm drains.
- ◆ Cover grease storage and dumpsters and keep them clean to avoid leaks.
- ◆ Report any chemical spill to the local hazardous waste cleanup team. They'll know the best way to keep spills from harming the environment.

Erosion controls that aren't maintained can cause excessive amounts of sediment and debris to be carried into the stormwater system. Construction vehicles can leak fuel, oil, and other harmful fluids that can be picked up by stormwater and deposited into local waterbodies.

- ◆ Divert stormwater away from disturbed or exposed areas of the construction site.
- ◆ Install silt fences, vehicle mud removal areas, vegetative cover, and other sediment and erosion controls and properly maintain them, especially after rainstorms.
- ◆ Prevent soil erosion by minimizing disturbed areas during construction projects, and seed and mulch bare areas as soon as possible.



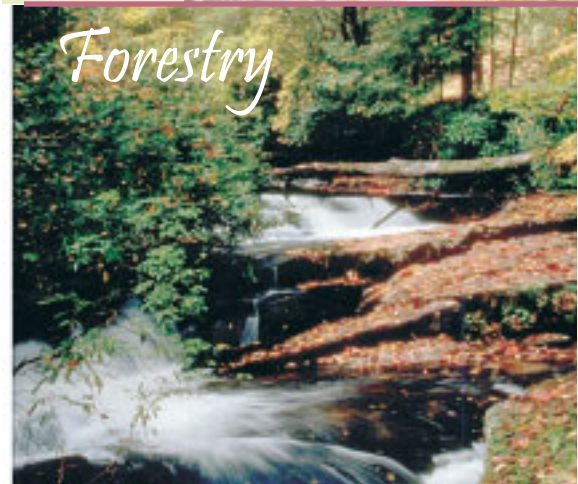
## Construction



## Agriculture

Lack of vegetation on streambanks can lead to erosion. Overgrazed pastures can also contribute excessive amounts of sediment to local waterbodies. Excess fertilizers and pesticides can poison aquatic animals and lead to destructive algae blooms. Livestock in streams can contaminate waterways with bacteria, making them unsafe for human contact.

- ◆ Keep livestock away from streambanks and provide them a water source away from waterbodies.
- ◆ Store and apply manure away from waterbodies and in accordance with a nutrient management plan.
- ◆ Vegetate riparian areas along waterways.
- ◆ Rotate animal grazing to prevent soil erosion in fields.
- ◆ Apply fertilizers and pesticides according to label instructions to save money and minimize pollution.

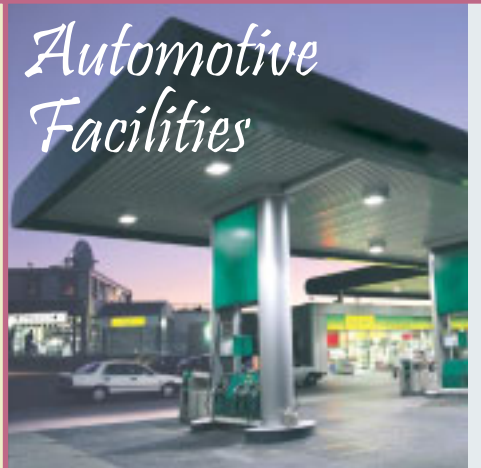


## Forestry

Improperly managed logging operations can result in erosion and sedimentation.

- ◆ Conduct preharvest planning to prevent erosion and lower costs.
- ◆ Use logging methods and equipment that minimize soil disturbance.
- ◆ Plan and design skid trails, yard areas, and truck access roads to minimize stream crossings and avoid disturbing the forest floor.
- ◆ Construct stream crossings so that they minimize erosion and physical changes to streams.
- ◆ Expedite revegetation of cleared areas.

## Automotive Facilities



Uncovered fueling stations allow spills to be washed into storm drains. Cars waiting to be repaired can leak fuel, oil, and other harmful fluids that can be picked up by stormwater.

- ◆ Clean up spills immediately and properly dispose of cleanup materials.
- ◆ Provide cover over fueling stations and design or retrofit facilities for spill containment.
- ◆ Properly maintain fleet vehicles to prevent oil, gas, and other discharges from being washed into local waterbodies.
- ◆ Install and maintain oil/water separators.



## Riverside County Stormwater Program Members

City of Banning  
(951) 922-3105

City of Beaumont  
(951) 769-8520

City of Calimesa  
(909) 795-9801

City of Canyon Lake  
(951) 244-2955

City of Cathedral City  
(760) 770-0340

City of Coachella  
(760) 398-3502

City of Corona  
(951) 736-2447

City of Desert Hot Springs  
(760) 329-6411

City of Eastvale  
(951) 361-0900

City of Hemet  
(951) 765-2300

City of Indian Wells  
(760) 346-2489

City of Indio  
(760) 391-4000

City of Jurupa Valley  
(951) 332-6464

City of Lake Elsinore  
(951) 674-3124

City of La Quinta  
(760) 777-7000

City of Menifee  
(951) 672-6777

City of Moreno Valley  
(951) 413-3000

City of Murrieta  
(951) 304-2489

City of Norco  
(951) 270-5607

City of Palm Desert  
(760) 346-0611

City of Palm Springs  
(760) 323-8299

City of Perris  
(951) 943-6100

City of Rancho Mirage  
(760) 324-4511

City of Riverside  
(951) 826-5311

City of San Jacinto  
(951) 487-7330

City of Temecula  
(951) 694-6444

City of Wildomar  
(951) 677-7751

Coachella Valley Water District  
(760) 398-2651

County of Riverside  
(951) 955-1000

Riverside County Flood Control District  
(951) 955-1200

# Stormwater Pollution

*What you should know for...*

## Industrial & Commercial Facilities

Best Management Practices (BMPs) for:

- Industrial Facilities
- Commercial Facilities





# YOU can prevent Stormwater Pollution following these practices...

## Industrial and Commercial Facilities

The Riverside County Stormwater Program has identified a number of Best Management Practices (BMPs) for Industrial and Commercial Facilities. These BMPs control and reduce stormwater pollutants from reaching our storm drain system and ultimately our local water bodies. City and County ordinances require businesses to use these BMPs to protect our water quality. Local cities and the County are required to verify implementation of these BMPs by performing regular facility inspections.

### Prohibited Discharges

Discontinue all non-stormwater discharges to the storm drain system. It is *prohibited* to discharge any chemicals, paints, debris, wastes or wastewater into the gutter, street or storm drain.

### Outdoor Storage BMPs

- Install covers and secondary containment areas for all hazardous materials and wastes stored outdoors in accordance with County and/or City standards.
- Keep all temporary waste containers covered, at all times when not in use.
- Sweep outdoor areas instead of using a hose or pressure washer.
- Move all process operations including vehicle/equipment maintenance inside of the building or under a covered and contained area.
- Wash equipment and vehicles in a contained and covered wash bay which is closed-loop or connected to a clarifier sized to local standards and discharged to a sanitary sewer or take them to a commercial car wash.



### Spills and Clean Up BMPs

- Keep the work site clean and orderly. Remove debris in a timely fashion. Sweep up the area.
- Clean up spills immediately when they occur, using dry clean up methods such as absorbent materials or sweep followed by proper disposal of materials.

- Always have a spill kit available near chemical loading dock doors and vehicle maintenance and fueling areas.
- Follow your Business Emergency Plan, as filed with the local Fire Department.
- Report all prohibited discharges and non-implementation of BMPs to your local Stormwater Coordinator as listed on the back of this pamphlet.
- Report hazardous materials spills to 951-358-5055 or call after hours to 951-782-2973 or, if an emergency, call the Fire Department's Haz Mat Team at 911.



## Plastic Manufacturing Facilities BMPs

AB 258 requires plastic product manufacturers to use BMPs, such as safe storage and clean-up procedures to prevent plastic pellets (nurdles) from entering the waterway. The plastic pellets are released into the environment during transporting, packaging and processing and migrate to waterways through the storm drain system. AB 258 will help protect fish and wildlife from the hazards of plastic pollution.

### Training BMPs

As prescribed by your City and County Stormwater Ordinance(s), train employees in spill procedures and prohibit non-stormwater discharges to the storm drain system. Applicable BMP examples can be found at [www.cabmphandbooks.com](http://www.cabmphandbooks.com).

### Permitting

Stormwater discharges associated with specific categories for industrial facilities are regulated by the State Water Resources Control Board through an Industrial Stormwater General Permit. A copy of this General Permit and application forms are available at: [www.waterboards.ca.gov](http://www.waterboards.ca.gov), select stormwater then the industrial quick link.

To report illegal dumping or for more information on stormwater pollution prevention call: 1-800-506-2555 or e-mail us at: [fcnpdes@rcflood.org](mailto:fcnpdes@rcflood.org).



**L**andscaping and garden maintenance activities can be major contributors to water pollution. Soils, yard wastes, over-watering and garden chemicals become part of the urban runoff mix that winds its way through streets, gutters and storm drains before entering lakes, rivers, streams, etc. Urban runoff pollution contaminates water and harms aquatic life!

In Riverside County, report illegal discharges into the storm drain, call  
1-800-506-2555  
“Only Rain Down the Storm Drain”

**Important Links:**

Riverside County Household Hazardous Waste Collection Information  
1-800-304-2226 or [www.rivcowm.org](http://www.rivcowm.org)

Riverside County Backyard Composting Program  
1-800-366-SAVE

Integrated Pest Management (IPM) Solutions  
[www.ipm.ucdavis.edu](http://www.ipm.ucdavis.edu)

California Master Gardener Programs  
[www.mastergardeners.org](http://www.mastergardeners.org)  
[www.camastergardeners.ucdavis.edu](http://www.camastergardeners.ucdavis.edu)

California Native Plant Society  
[www.cnps.org](http://www.cnps.org)

The Riverside County “Only Rain Down the Storm Drain” Pollution Prevention Program gratefully acknowledges Orange County's Storm Water Program for their contribution to this brochure.



## ...Only Rain Down ...the Storm Drain

*What you should know for...  
Landscape and Gardening*

Best Management tips for:

- Professionals
- Novices
- Landscapers
- Gardeners
- Cultivators



# Tips for Landscape & Gardening

This brochure will help you to get the most of your lawn and gardening efforts and keep our waterways clean. Clean waterways provide recreation, establish thriving fish habitats, secure safe sanctuaries for wildlife, and add beauty to our communities. NEVER allow gardening products or waste water to enter the street, gutter or storm drain.

## General Landscaping Tips

- Protect stockpiles and materials from wind and rain by storing them under tarps or secured plastic sheeting.
- Prevent erosion of slopes by planting fast-growing, dense ground covering plants. These will shield and bind the soil.
- Plant native vegetation to reduce the amount of water, fertilizers and pesticides applied to the landscape.
- Never apply pesticides or fertilizers when rain is predicted within the next 48 hours.



## Garden & Lawn Maintenance

- Do not overwater. Use irrigation practices such as drip irrigation, soaker hoses or micro-spray systems. Periodically inspect and fix leaks and misdirected sprinklers.

- Do not rake or blow leaves, clippings or pruning waste into the street, gutter or storm drain. Instead, dispose of green waste by composting, hauling it to a permitted landfill, or recycling it through your city's program.



- Consider recycling your green waste and adding “nature’s own fertilizer” to your lawn or garden.
- Read labels and use only as directed. Do not over-apply pesticides or fertilizers. Apply to spots as needed, rather than blanketing an entire area.
- Store pesticides, fertilizers and other chemicals in a dry covered area to prevent exposure that may result in the deterioration of containers and packaging.
- Rinse empty pesticide containers and re-use rinse water as you would use the product. Do not dump rinse water down storm drains or sewers. Dispose of empty containers in the trash.
- When available, use non-toxic alternatives to traditional pesticides, and use pesticides specifically designed to control the pest you are targeting.

- Try natural long-term common sense solutions first. Integrated Pest Management (IPM) can provide landscaping guidance and solutions, such as:

- ◆ **Physical Controls** - Try hand picking, barriers, traps or caulking holes to control weeds and pests.
- ◆ **Biological Controls** - Use predatory insects to control harmful pests.
- ◆ **Chemical Controls** - Check out [www.ipm.ucdavis.edu](http://www.ipm.ucdavis.edu) before using chemicals. Remember, all chemicals should be used cautiously and in moderation.

- If fertilizer is spilled, sweep up the spill before irrigating. If the spill is liquid, apply an absorbent material such as cat litter, and then sweep it up and dispose of it in the trash.
- Take unwanted pesticides to a Household Waste Collection Center to be recycled.
- *Dumping toxics into the street, gutter or storm drain is illegal!*

[www.bewaterwise.com](http://www.bewaterwise.com) Great water conservation tips and drought tolerant garden designs.

[www.ourwaterourworld.com](http://www.ourwaterourworld.com) Learn how to safely manage home and garden pests.

Additional information can also be found on the back of this brochure.

## Helpful telephone numbers and links:

### Riverside County Stormwater Protection Partners

|                            |                |
|----------------------------|----------------|
| Flood Control District     | (951) 955-1200 |
| County of Riverside        | (951) 955-1000 |
| City of Banning            | (951) 922-3105 |
| City of Beaumont           | (951) 769-8520 |
| City of Calimesa           | (909) 795-9801 |
| City of Canyon Lake        | (951) 244-2955 |
| Cathedral City             | (760) 770-0327 |
| City of Coachella          | (760) 398-4978 |
| City of Corona             | (951) 736-2447 |
| City of Desert Hot Springs | (760) 329-6411 |
| City of Eastvale           | (951) 361-0900 |
| City of Hemet              | (951) 765-2300 |
| City of Indian Wells       | (760) 346-2489 |
| City of Indio              | (760) 391-4000 |
| City of Lake Elsinore      | (951) 674-3124 |
| City of La Quinta          | (760) 777-7000 |
| City of Menifee            | (951) 672-6777 |
| City of Moreno Valley      | (951) 413-3000 |
| City of Murrieta           | (951) 304-2489 |
| City of Norco              | (951) 270-5607 |
| City of Palm Desert        | (760) 346-0611 |
| City of Palm Springs       | (760) 323-8299 |
| City of Perris             | (951) 943-6100 |
| City of Rancho Mirage      | (760) 324-4511 |
| City of Riverside          | (951) 361-0900 |
| City of San Jacinto        | (951) 654-7337 |
| City of Temecula           | (951) 694-6444 |
| City of Wildomar           | (951) 677-7751 |

### REPORT ILLEGAL STORM DRAIN DISPOSAL

1-800-506-2555 or e-mail us at  
[fcnpdes@rcflood.org](mailto:fcnpdes@rcflood.org)

- Riverside County Flood Control and Water Conservation District  
[www.rcflood.org](http://www.rcflood.org)

#### Online resources include:

- California Storm Water Quality Association  
[www.casqa.org](http://www.casqa.org)
- State Water Resources Control Board  
[www.waterboards.ca.gov](http://www.waterboards.ca.gov)
- Power Washers of North America  
[www.thepwna.org](http://www.thepwna.org)

# Stormwater Pollution

What you should know for...

## Outdoor Cleaning Activities and Professional Mobile Service Providers



### Storm drain pollution prevention information for:

- Car Washing / Mobile Detailers
- Window and Carpet Cleaners
- Power Washers
- Waterproofers / Street Sweepers
- Equipment cleaners or degreasers and all mobile service providers

Do you know where street flows actually go?

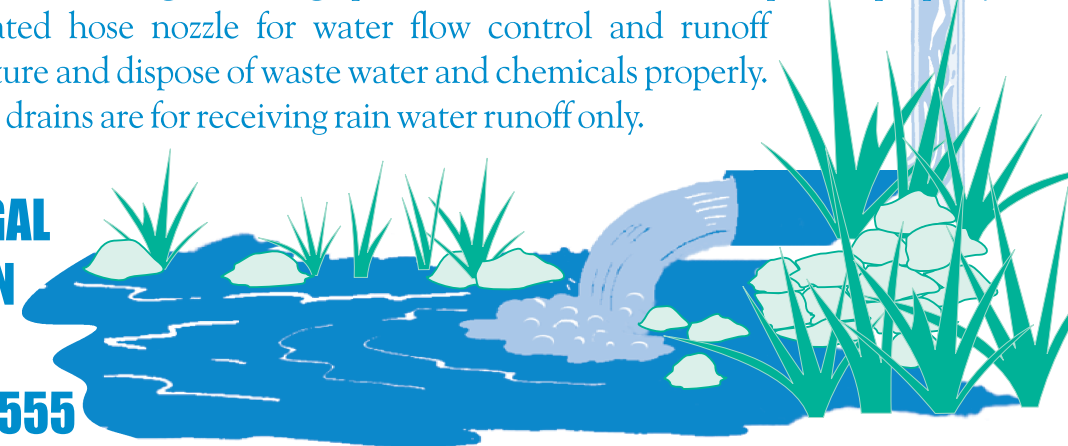
## Storm drains are NOT connected to sanitary sewer systems and treatment plants!



The primary purpose of storm drains is to carry *rain* water away from developed areas to prevent flooding. Pollutants discharged to storm drains are transported directly into rivers, lakes and streams. Soaps, degreasers, automotive fluids, litter and a host of materials are washed off buildings, sidewalks, plazas and parking areas. Vehicles and equipment must be properly managed to prevent the pollution of local waterways.

Unintentional spills by mobile service operators can flow into storm drains and pollute our waterways. **Avoid mishaps.** Always have a **Spill Response Kit** on hand to clean up unintentional spills. Only emergency **Mechanical** repairs should be done in City streets, using drip pans for spills. **Plumbing** should be done on private property. Always store chemicals in a leak-proof container and keep covered when not in use. **Window/Power Washing** waste water shouldn't be released into the streets, but should be disposed of in a sanitary sewer, landscaped area or in the soil. Soiled **Carpet Cleaning** wash water should be filtered before being discharged into the sanitary sewer. Dispose of all filter debris properly. **Car Washing/Detailing** operators should wash cars on private property and use a regulated hose nozzle for water flow control and runoff prevention. Capture and dispose of waste water and chemicals properly. Remember, storm drains are for receiving rain water runoff only.

**REPORT ILLEGAL  
STORM DRAIN  
DISPOSAL  
1-800-506-2555**



# Help Protect Our Waterways!

Use these guidelines for Outdoor Cleaning Activities and Wash Water Disposal

**D**id you know that disposing of pollutants into the street, gutter, storm drain or body of water is **PROHIBITED** by law and can result in stiff penalties?

## Best Management Practices

Waste wash water from Mechanics, Plumbers, Window/Power Washers, Carpet Cleaners, Car Washing and Mobile Detailing activities may contain significant quantities of motor oil, grease, chemicals, dirt, detergents, brake pad dust, litter and other materials.

Best Management Practices, or BMPs as they are known, are guides to prevent pollutants from entering the storm drains. *Each of us* can do our part to keep stormwater clean by using the suggested BMPs below:

## Simple solutions for both light and heavy duty jobs:

**Do...**consider dry cleaning methods first such as a mop, broom, rag or wire brush. Always keep a spill response kit on site.

**Do...**prepare the work area before power cleaning by using sand bags, rubber mats, vacuum booms, containment pads or temporary berms to keep wash water away from the gutters and storm drains.

**Do...**use vacuums or other machines to remove and collect loose debris or litter before applying water.

**Do...**obtain the property owner's permission to dispose of *small amounts* of power washing waste water on to landscaped, gravel or unpaved surfaces.

**Do...**check your local sanitary sewer agency's policies on wash water disposal regulations before disposing of wash water into the sewer. (See list on reverse side)

**Do...**be aware that if discharging to landscape areas, soapy wash water may damage landscaping. Residual wash water may remain on paved surfaces to evaporate. Sweep up solid residuals and dispose of properly. Vacuum booms are another option for capturing and collecting wash water.

**Do...**check to see if local ordinances prevent certain activities.

**Do not let...**wash or waste water from sidewalk, plaza or building cleaning go into a street or storm drain.



Report illegal storm drain disposal  
Call Toll Free  
**1-800-506-2555**

## Using Cleaning Agents

Try using biodegradable/phosphate-free products. They are easier on the environment, but don't confuse them with being toxic free. Soapy water entering the storm drain system can impact the delicate aquatic environment.



When cleaning surfaces with a *high-pressure washer* or *steam cleaner*, additional precautions should be taken to prevent the discharge of pollutants into the storm drain system. These two methods of surface cleaning can loosen additional material that can contaminate local waterways.

## Think Water Conservation

Minimize water use by using high pressure, low volume nozzles. Be sure to check all hoses for leaks. Water is a precious resource, don't let it flow freely and be sure to shut it off in between uses.

## Screening Wash Water

Conduct thorough dry cleanup before washing exterior surfaces, such as buildings and decks **with loose paint**, sidewalks or plaza areas. Keep debris from entering the storm drain after cleaning by first passing the wash water through a "20 mesh" or finer screen to catch the solid materials, then dispose of the mesh in a refuse container. Do not let the remaining wash water enter a street, gutter or storm drain.

## Drain Inlet Protection & Collection of Wash Water

- Prior to any washing, block all storm drains with an impervious barrier such as sandbags or berms, or seal the storm drain with plugs or other appropriate materials.
- Create a containment area with berms and traps or take advantage of a low spot to keep wash water contained.
- Wash vehicles and equipment on grassy or gravel areas so that the wash water can seep into the ground.
- Pump or vacuum up all wash water in the contained area.

## Concrete/Coring/Saw Cutting and Drilling Projects

Protect any down-gradient inlets by using dry activity techniques whenever possible. If water is used, minimize the amount of water used during the coring/drilling or saw cutting process. Place a barrier of sandbags and/or absorbent berms to protect the storm drain inlet or watercourse. Use a shovel or wet vacuum to remove the residue from the pavement. Do not wash residue or particulate matter into a storm drain inlet or watercourse.



## Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

## Description

Improper storage and handling of solid wastes can allow toxic compounds, oils and greases, heavy metals, nutrients, suspended solids, and other pollutants to enter stormwater runoff. The discharge of pollutants to stormwater from waste handling and disposal can be prevented and reduced by tracking waste generation, storage, and disposal; reducing waste generation and disposal through source reduction, re-use, and recycling; and preventing runoff and runoff.

## Approach

### *Pollution Prevention*

- Reduction in the amount of waste generated can be accomplished using the following source controls such as:
  - Production planning and sequencing
  - Process or equipment modification
  - Raw material substitution or elimination
  - Loss prevention and housekeeping
  - Waste segregation and separation
  - Close loop recycling
- Establish a material tracking system to increase awareness about material usage. This may reduce spills and minimize contamination, thus reducing the amount of waste produced.
- Recycle materials whenever possible.

## Targeted Constituents

|                  |   |
|------------------|---|
| Sediment         | ✓ |
| Nutrients        | ✓ |
| Trash            | ✓ |
| Metals           | ✓ |
| Bacteria         | ✓ |
| Oil and Grease   | ✓ |
| Organics         | ✓ |
| Oxygen Demanding | ✓ |



***Suggested Protocols****General*

- Cover storage containers with leak proof lids or some other means. If waste is not in containers, cover all waste piles (plastic tarps are acceptable coverage) and prevent stormwater runoff and runoff with a berm. The waste containers or piles must be covered except when in use.
- Use drip pans or absorbent materials whenever grease containers are emptied by vacuum trucks or other means. Grease cannot be left on the ground. Collected grease must be properly disposed of as garbage.
- Check storage containers weekly for leaks and to ensure that lids are on tightly. Replace any that are leaking, corroded, or otherwise deteriorating.
- Sweep and clean the storage area regularly. If it is paved, do not hose down the area to a storm drain.
- Dispose of rinse and wash water from cleaning waste containers into a sanitary sewer if allowed by the local sewer authority. Do not discharge wash water to the street or storm drain.
- Transfer waste from damaged containers into safe containers.
- Take special care when loading or unloading wastes to minimize losses. Loading systems can be used to minimize spills and fugitive emission losses such as dust or mist. Vacuum transfer systems can minimize waste loss.

*Controlling Litter*

- Post “No Littering” signs and enforce anti-litter laws.
- Provide a sufficient number of litter receptacles for the facility.
- Clean out and cover litter receptacles frequently to prevent spillage.

*Waste Collection*

- Keep waste collection areas clean.
- Inspect solid waste containers for structural damage or leaks regularly. Repair or replace damaged containers as necessary.
- Secure solid waste containers; containers must be closed tightly when not in use.
- Place waste containers under cover if possible.
- Do not fill waste containers with washout water or any other liquid.
- Ensure that only appropriate solid wastes are added to the solid waste container. Certain wastes such as hazardous wastes, appliances, fluorescent lamps, pesticides, etc. may not be

disposed of in solid waste containers (see chemical/ hazardous waste collection section below).

- Do not mix wastes; this can cause chemical reactions, make recycling impossible, and complicate disposal.

### *Good Housekeeping*

- Use all of the product before disposing of the container.
- Keep the waste management area clean at all times by sweeping and cleaning up spills immediately.
- Use dry methods when possible (e.g. sweeping, use of absorbents) when cleaning around restaurant/food handling dumpster areas. If water must be used after sweeping/using absorbents, collect water and discharge through grease interceptor to the sewer.
- Stencil storm drains on the facility's property with prohibitive message regarding waste disposal.

### *Chemical/Hazardous Wastes*

- Select designated hazardous waste collection areas on-site.
- Store hazardous materials and wastes in covered containers protected from vandalism, and in compliance with fire and hazardous waste codes.
- Place hazardous waste containers in secondary containment.
- Make sure that hazardous waste is collected, removed, and disposed of only at authorized disposal areas.

### *Runon/Runoff Prevention*

- Prevent stormwater runon from entering the waste management area by enclosing the area or building a berm around the area.
- Prevent the waste materials from directly contacting rain.
- Cover waste piles with temporary covering material such as reinforced tarpaulin, polyethylene, polyurethane, polypropylene or hypalon.
- Cover the area with a permanent roof if feasible.
- Cover dumpsters to prevent rain from washing waste out of holes or cracks in the bottom of the dumpster.
- Move the activity indoor after ensuring all safety concerns such as fire hazard and ventilation are addressed.

### *Inspection*



- Inspect and replace faulty pumps or hoses regularly to minimize the potential of releases and spills.
- Check waste management areas for leaking containers or spills.
- Repair leaking equipment including valves, lines, seals, or pumps promptly.

***Training***

- Train staff pollution prevention measures and proper disposal methods.
- Train employees and contractors proper spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill if one should occur.
- Train employees and subcontractors in proper hazardous waste management.

***Spill Response and Prevention***

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Keep your Spill Prevention Control and countermeasure (SPCC) plan up-to-date, and implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.
- Vehicles transporting waste should have spill prevention equipment that can prevent spills during transport. The spill prevention equipment includes:
  - Vehicles equipped with baffles for liquid waste
  - Trucks with sealed gates and spill guards for solid waste

***Other Considerations***

- Hazardous waste cannot be re-used or recycled; it must be disposed of by a licensed hazardous waste hauler.

**Requirements*****Costs***

- Capital and operation and maintenance costs will vary substantially depending on the size of the facility and the types of waste handled. Costs should be low if there is an inventory program in place.

***Maintenance***

- None except for maintaining equipment for material tracking program.

## Supplemental Information

### *Further Detail of the BMP*

#### *Land Treatment System*

- Minimize the runoff of polluted stormwater from land application of municipal waste on-site by:
  - Choosing a site where slopes are under 6%, the soil is permeable, there is a low water table, it is located away from wetlands or marshes, there is a closed drainage system.
  - Avoiding application of waste to the site when it is raining or when the ground is saturated with water.
  - Growing vegetation on land disposal areas to stabilize soils and reduce the volume of surface water runoff from the site.
  - Maintaining adequate barriers between the land application site and the receiving waters. Planted strips are particularly good.
  - Using erosion control techniques such as mulching and matting, filter fences, straw bales, diversion terracing, and sediment basins.
  - Performing routine maintenance to ensure the erosion control or site stabilization measures are working.

## References and Resources

King County Stormwater Pollution Control Manual - <http://dnr.metrokc.gov/wlr/dss/spcm.htm>

Orange County Stormwater Program

[http://www.ocwatersheds.com/StormWater/swp\\_introduction.asp](http://www.ocwatersheds.com/StormWater/swp_introduction.asp)

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Associations (BASMAA). On-line: <http://www.basmaa.org>



Photo Credit: Geoff Brosseau

## Objectives

- Contain
- Educate
- Reduce/Minimize

## Description

As a consequence of its function, the stormwater conveyance system collects and transports urban runoff that may contain certain pollutants. Maintaining catch basins, stormwater inlets, and other stormwater conveyance structures on a regular basis will remove pollutants, prevent clogging of the downstream conveyance system, restore catch basins' sediment trapping capacity, and ensure the system functions properly hydraulically to avoid flooding.

## Approach

### ***Suggested Protocols***

#### *Catch Basins/Inlet Structures*

- Municipal staff should regularly inspect facilities to ensure the following:
  - Immediate repair of any deterioration threatening structural integrity.
  - Cleaning before the sump is 40% full. Catch basins should be cleaned as frequently as needed to meet this standard.
  - Stenciling of catch basins and inlets (see SC-75 Waste Handling and Disposal).
- Clean catch basins, storm drain inlets, and other conveyance structures in high pollutant load areas just before the wet season to remove sediments and debris accumulated during the summer.

## Targeted Constituents

|                  |                                     |
|------------------|-------------------------------------|
| Sediment         | <input checked="" type="checkbox"/> |
| Nutrients        | <input checked="" type="checkbox"/> |
| Trash            | <input checked="" type="checkbox"/> |
| Metals           | <input checked="" type="checkbox"/> |
| Bacteria         | <input checked="" type="checkbox"/> |
| Oil and Grease   | <input checked="" type="checkbox"/> |
| Organics         | <input checked="" type="checkbox"/> |
| Oxygen Demanding | <input checked="" type="checkbox"/> |



- Conduct inspections more frequently during the wet season for problem areas where sediment or trash accumulates more often. Clean and repair as needed.
- Keep accurate logs of the number of catch basins cleaned.
- Record the amount of waste collected.
- Store wastes collected from cleaning activities of the drainage system in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain.
- Dewater the wastes with outflow into the sanitary sewer if permitted. Water should be treated with an appropriate filtering device prior to discharge to the sanitary sewer. If discharge to the sanitary sewer is not allowed, water should be pumped or vacuumed to a tank and properly disposed of. Do not dewater near a storm drain or stream.
- Except for small communities with relatively few catch basins that may be cleaned manually, most municipalities will require mechanical cleaners such as eductors, vacuums, or bucket loaders.

### *Storm Drain Conveyance System*

- Locate reaches of storm drain with deposit problems and develop a flushing schedule that keeps the pipe clear of excessive buildup.
- Collect flushed effluent and pump to the sanitary sewer for treatment.

### *Pump Stations*

- Clean all storm drain pump stations prior to the wet season to remove silt and trash.
- Do not allow discharge from cleaning a storm drain pump station or other facility to reach the storm drain system.
- Conduct quarterly routine maintenance at each pump station.
- Inspect, clean, and repair as necessary all outlet structures prior to the wet season.
- Sample collected sediments to determine if landfill disposal is possible, or illegal discharges in the watershed are occurring.

### *Open Channel*

- Consider modification of storm channel characteristics to improve channel hydraulics, to increase pollutant removals, and to enhance channel/creek aesthetic and habitat value.
- Conduct channel modification/improvement in accordance with existing laws. Any person, government agency, or public utility proposing an activity that will change the natural (emphasis added) state of any river, stream, or lake in California, must enter into a stream or Lake Alteration Agreement with the Department of Fish and Game. The developer-applicant should also contact local governments (city, county, special districts), other state agencies

(SWRCB, RWQCB, Department of Forestry, Department of Water Resources), and Federal Corps of Engineers and USFWS

## *Illicit Connections and Discharges*

- During routine maintenance of conveyance system and drainage structures field staff should look for evidence of illegal discharges or illicit connections:
  - Is there evidence of spills such as paints, discoloring, etc.
  - Are there any odors associated with the drainage system
  - Record locations of apparent illegal discharges/illicit connections
  - Track flows back to potential dischargers and conduct aboveground inspections. This can be done through visual inspection of up gradient manholes or alternate techniques including zinc chloride smoke testing, fluorometric dye testing, physical inspection testing, or television camera inspection.
  - Once the origin of flow is established, require illicit discharger to eliminate the discharge.
- Stencil storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as “Dump No Waste Drains to Stream” stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

## *Illegal Dumping*

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Illegal dumping hot spots
  - Types and quantities (in some cases) of wastes
  - Patterns in time of occurrence (time of day/night, month, or year)
  - Mode of dumping (abandoned containers, “midnight dumping” from moving vehicles, direct dumping of materials, accidents/spills)
  - Responsible parties
- Post “No Dumping” signs in problem areas with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

- The State Department of Fish and Game has a hotline for reporting violations called Cal TIP (1-800-952-5400). The phone number may be used to report any violation of a Fish and Game code (illegal dumping, poaching, etc.).
- The California Department of Toxic Substances Control's Waste Alert Hotline, 1-800-69TOXIC, can be used to report hazardous waste violations.

***Training***

- Train crews in proper maintenance activities, including record keeping and disposal.
- Only properly trained individuals are allowed to handle hazardous materials/wastes.
- Train municipal employees from all departments (public works, utilities, street cleaning, parks and recreation, industrial waste inspection, hazardous waste inspection, sewer maintenance) to recognize and report illegal dumping.
- Train municipal employees and educate businesses, contractors, and the general public in proper and consistent methods for disposal.
- Train municipal staff regarding non-stormwater discharges (See SC-10 Non-Stormwater Discharges).

***Spill Response and Prevention***

- Refer to SC-11, Prevention, Control & Cleanup
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

***Other Considerations***

- Cleanup activities may create a slight disturbance for local aquatic species. Access to items and material on private property may be limited. Trade-offs may exist between channel hydraulics and water quality/riparian habitat. If storm channels or basins are recognized as wetlands, many activities, including maintenance, may be subject to regulation and permitting.
- Storm drain flushing is most effective in small diameter pipes (36-inch diameter pipe or less, depending on water supply and sediment collection capacity). Other considerations associated with storm drain flushing may include the availability of a water source, finding a downstream area to collect sediments, liquid/sediment disposal, and disposal of flushed effluent to sanitary sewer may be prohibited in some areas.
- Regulations may include adoption of substantial penalties for illegal dumping and disposal.
- Municipal codes should include sections prohibiting the discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.
- Private property access rights may be needed to track illegal discharges up gradient.

- Requirements of municipal ordinance authority for suspected source verification testing for illicit connections necessary for guaranteed rights of entry.

## Requirements

### **Costs**

- An aggressive catch basin cleaning program could require a significant capital and O&M budget. A careful study of cleaning effectiveness should be undertaken before increased cleaning is implemented. Catch basin cleaning costs are less expensive if vacuum street sweepers are available; cleaning catch basins manually can cost approximately twice as much as cleaning the basins with a vacuum attached to a sweeper.
- Methods used for illicit connection detection (smoke testing, dye testing, visual inspection, and flow monitoring) can be costly and time-consuming. Site-specific factors, such as the level of impervious area, the density and ages of buildings, and type of land use will determine the level of investigation necessary. Encouraging reporting of illicit discharges by employees can offset costs by saving expense on inspectors and directing resources more efficiently. Some programs have used funds available from “environmental fees” or special assessment districts to fund their illicit connection elimination programs.

### **Maintenance**

- Two-person teams may be required to clean catch basins with vector trucks.
- Identifying illicit discharges requires teams of at least two people (volunteers can be used), plus administrative personnel, depending on the complexity of the storm sewer system.
- Arrangements must be made for proper disposal of collected wastes.
- Requires technical staff to detect and investigate illegal dumping violations, and to coordinate public education.

## Supplemental Information

### **Further Detail of the BMP**

#### *Storm Drain flushing*

Sanitary sewer flushing is a common maintenance activity used to improve pipe hydraulics and to remove pollutants in sanitary sewer systems. The same principles that make sanitary sewer flushing effective can be used to flush storm drains. Flushing may be designed to hydraulically convey accumulated material to strategic locations, such as to an open channel, to another point where flushing will be initiated, or over to the sanitary sewer and on to the treatment facilities, thus preventing re-suspension and overflow of a portion of the solids during storm events. Flushing prevents “plug flow” discharges of concentrated pollutant loadings and sediments. The deposits can hinder the designed conveyance capacity of the storm drain system and potentially cause backwater conditions in severe cases of clogging.

Storm drain flushing usually takes place along segments of pipe with grades that are too flat to maintain adequate velocity to keep particles in suspension. An upstream manhole is selected to place an inflatable device that temporarily plugs the pipe. Further upstream, water is pumped into the line to create a flushing wave. When the upstream reach of pipe is sufficiently full to

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cause a flushing wave, the inflated device is rapidly deflated with the assistance of a vacuum pump, releasing the backed up water and resulting in the cleaning of the storm drain segment.

To further reduce the impacts of stormwater pollution, a second inflatable device, placed well downstream, may be used to re-collect the water after the force of the flushing wave has dissipated. A pump may then be used to transfer the water and accumulated material to the sanitary sewer for treatment. In some cases, an interceptor structure may be more practical or required to re-collect the flushed waters.

It has been found that cleansing efficiency of periodic flush waves is dependent upon flush volume, flush discharge rate, sewer slope, sewer length, sewer flow rate, sewer diameter, and population density. As a rule of thumb, the length of line to be flushed should not exceed 700 feet. At this maximum recommended length, the percent removal efficiency ranges between 65-75 percent for organics and 55-65 percent for dry weather grit/inorganic material. The percent removal efficiency drops rapidly beyond that. Water is commonly supplied by a water truck, but fire hydrants can also supply water. To make the best use of water, it is recommended that reclaimed water be used or that fire hydrant line flushing coincide with storm drain flushing.

## *Flow Management*

Flow management has been one of the principal motivations for designing urban stream corridors in the past. Such needs may or may not be compatible with the stormwater quality goals in the stream corridor.

Downstream flood peaks can be suppressed by reducing through flow velocity. This can be accomplished by reducing gradient with grade control structures or increasing roughness with boulders, dense vegetation, or complex banks forms. Reducing velocity correspondingly increases flood height, so all such measures have a natural association with floodplain open space. Flood elevations laterally adjacent to the stream can be lowered by increasing through flow velocity.

However, increasing velocity increases flooding downstream and inherently conflicts with channel stability and human safety. Where topography permits, another way to lower flood elevation is to lower the level of the floodway with drop structures into a large but subtly excavated bowl where flood flows we allowed to spread out.

## *Stream Corridor Planning*

Urban streams receive and convey stormwater flows from developed or developing watersheds. Planning of stream corridors thus interacts with urban stormwater management programs. If local programs are intended to control or protect downstream environments by managing flows delivered to the channels, then it is logical that such programs should be supplemented by management of the materials, forms, and uses of the downstream riparian corridor. Any proposal for steam alteration or management should be investigated for its potential flow and stability effects on upstream, downstream, and laterally adjacent areas. The timing and rate of flow from various tributaries can combine in complex ways to alter flood hazards. Each section of channel is unique, influenced by its own distribution of roughness elements, management activities, and stream responses.



Flexibility to adapt to stream features and behaviors as they evolve must be included in stream reclamation planning. The amenity and ecology of streams may be enhanced through the landscape design options of 1) corridor reservation, 2) bank treatment, 3) geomorphic restoration, and 4) grade control.

**Corridor reservation** - Reserving stream corridors and valleys to accommodate natural stream meandering, aggradation, degradation, and over bank flows allows streams to find their own form and generate less ongoing erosion. In California, open stream corridors in recent urban developments have produced recreational open space, irrigation of streamside plantings, and the aesthetic amenity of flowing water.

**Bank treatment** - The use of armoring, vegetative cover, and flow deflection may be used to influence a channel's form, stability, and biotic habitat. To prevent bank erosion, armoring can be done with rigid construction materials, such as concrete, masonry, wood planks and logs, riprap, and gabions. Concrete linings have been criticized because of their lack of provision of biotic habitat. In contrast, riprap and gabions make relatively porous and flexible linings. Boulders, placed in the bed reduce velocity and erosive power.

Riparian vegetation can stabilize the banks of streams that are at or near a condition of equilibrium. Binding networks of roots increase bank shear strength. During flood flows, resilient vegetation is forced into erosion-inhibiting mats. The roughness of vegetation leads to lower velocity, further reducing erosive effects. Structural flow deflection can protect banks from erosion or alter fish habitat. By concentrating flow, a deflector causes a pool to be scoured in the bed.

**Geomorphic restoration** – Restoration refers to alteration of disturbed streams so their form and behavior emulate those of undisturbed streams. Natural meanders are retained, with grading to gentle slopes on the inside of curves to allow point bars and riffle-pool sequences to develop. Trees are retained to provide scenic quality, biotic productivity, and roots for bank stabilization, supplemented by plantings where necessary.

A restorative approach can be successful where the stream is already approaching equilibrium. However, if upstream urbanization continues new flow regimes will be generated that could disrupt the equilibrium of the treated system.

**Grade Control** - A grade control structure is a level shelf of a permanent material, such as stone, masonry, or concrete, over which stream water flows. A grade control structure is called a sill, weir, or drop structure, depending on the relation of its invert elevation to upstream and downstream channels.

A sill is installed at the preexisting channel bed elevation to prevent upstream migration of nick points. It establishes a firm base level below which the upstream channel can not erode.

A weir or check dam is installed with invert above the preexisting bed elevation. A weir raises the local base level of the stream and causes aggradation upstream. The gradient, velocity, and erosive potential of the stream channel are reduced. A drop structure lowers the downstream invert below its preexisting elevation, reducing downstream gradient and velocity. Weirs and drop structure control erosion by dissipating energy and reducing slope velocity.

When carefully applied, grade control structures can be highly versatile in establishing human and environmental benefits in stabilized channels. To be successful, application of grade control structures should be guided by analysis of the stream system both upstream and downstream from the area to be reclaimed.

**Examples**

The California Department of Water Resources began the Urban Stream Restoration Program in 1985. The program provides grant funds to municipalities and community groups to implement stream restoration projects. The projects reduce damages from streambank and watershed instability and floods while restoring streams' aesthetic, recreational, and fish and wildlife values.

In Buena Vista Park, upper floodway slopes are gentle and grassed to achieve continuity of usable park land across the channel of small boulders at the base of the slopes.

The San Diego River is a large, vegetative lined channel, which was planted in a variety of species to support riparian wildlife while stabilizing the steep banks of the floodway.

**References and Resources**

Ferguson, B.K. 1991. Urban Stream Reclamation, p. 324-322, *Journal of Soil and Water Conservation*.

Los Angeles County Stormwater Quality. Public Agency Activities Model Program. On-line: [http://ladpw.org/wmd/npdes/public\\_TC.cfm](http://ladpw.org/wmd/npdes/public_TC.cfm)

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities. Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality Control Board. July, 1998.

Orange County Stormwater Program

[http://www.ocwatersheds.com/StormWater/swp\\_introduction.asp](http://www.ocwatersheds.com/StormWater/swp_introduction.asp)

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San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program (URMP) Municipal Activities Model Program Guidance. 2001. Project Clean Water. November.

United States Environmental Protection Agency (USEPA). 1999. Stormwater Management Fact Sheet Non-stormwater Discharges to Storm Sewers. EPA 832-F-99-022. Office of Water, Washington, D.C. September.

United States Environmental Protection Agency (USEPA). 1999. Stormwater O&M Fact Sheet Catch Basin Cleaning. EPA 832-F-99-011. Office of Water, Washington, D.C. September.

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Illegal Dumping Control. On line:  
[http://www.epa.gov/npdes/menuofbmps/poll\\_7.htm](http://www.epa.gov/npdes/menuofbmps/poll_7.htm)

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Storm Drain System Cleaning. On line:  
[http://www.epa.gov/npdes/menuofbmps/poll\\_16.htm](http://www.epa.gov/npdes/menuofbmps/poll_16.htm)

# Site Design & Landscape Planning SD-10



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## Design Objectives

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- Maximize Infiltration
  - Provide Retention
  - Slow Runoff
  - Minimize Impervious Land Coverage
  - Prohibit Dumping of Improper Materials
  - Contain Pollutants
  - Collect and Convey
- 

## Description

Each project site possesses unique topographic, hydrologic, and vegetative features, some of which are more suitable for development than others. Integrating and incorporating appropriate landscape planning methodologies into the project design is the most effective action that can be done to minimize surface and groundwater contamination from stormwater.

## Approach

Landscape planning should couple consideration of land suitability for urban uses with consideration of community goals and projected growth. Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

## Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

## Design Considerations

Design requirements for site design and landscapes planning should conform to applicable standards and specifications of agencies with jurisdiction and be consistent with applicable General Plan and Local Area Plan policies.



# SD-10 Site Design & Landscape Planning

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## *Designing New Installations*

Begin the development of a plan for the landscape unit with attention to the following general principles:

- Formulate the plan on the basis of clearly articulated community goals. Carefully identify conflicts and choices between retaining and protecting desired resources and community growth.
- Map and assess land suitability for urban uses. Include the following landscape features in the assessment: wooded land, open unwooded land, steep slopes, erosion-prone soils, foundation suitability, soil suitability for waste disposal, aquifers, aquifer recharge areas, wetlands, floodplains, surface waters, agricultural lands, and various categories of urban land use. When appropriate, the assessment can highlight outstanding local or regional resources that the community determines should be protected (e.g., a scenic area, recreational area, threatened species habitat, farmland, fish run). Mapping and assessment should recognize not only these resources but also additional areas needed for their sustenance.

Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

## *Conserve Natural Areas during Landscape Planning*

If applicable, the following items are required and must be implemented in the site layout during the subdivision design and approval process, consistent with applicable General Plan and Local Area Plan policies:

- Cluster development on least-sensitive portions of a site while leaving the remaining land in a natural undisturbed condition.
- Limit clearing and grading of native vegetation at a site to the minimum amount needed to build lots, allow access, and provide fire protection.
- Maximize trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought tolerant plants.
- Promote natural vegetation by using parking lot islands and other landscaped areas.
- Preserve riparian areas and wetlands.

## *Maximize Natural Water Storage and Infiltration Opportunities Within the Landscape Unit*

- Promote the conservation of forest cover. Building on land that is already deforested affects basin hydrology to a lesser extent than converting forested land. Loss of forest cover reduces interception storage, detention in the organic forest floor layer, and water losses by evapotranspiration, resulting in large peak runoff increases and either their negative effects or the expense of countering them with structural solutions.
- Maintain natural storage reservoirs and drainage corridors, including depressions, areas of permeable soils, swales, and intermittent streams. Develop and implement policies and

# Site Design & Landscape Planning SD-10

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regulations to discourage the clearing, filling, and channelization of these features. Utilize them in drainage networks in preference to pipes, culverts, and engineered ditches.

- Evaluating infiltration opportunities by referring to the stormwater management manual for the jurisdiction and pay particular attention to the selection criteria for avoiding groundwater contamination, poor soils, and hydrogeological conditions that cause these facilities to fail. If necessary, locate developments with large amounts of impervious surfaces or a potential to produce relatively contaminated runoff away from groundwater recharge areas.

## *Protection of Slopes and Channels during Landscape Design*

- Convey runoff safely from the tops of slopes.
- Avoid disturbing steep or unstable slopes.
- Avoid disturbing natural channels.
- Stabilize disturbed slopes as quickly as possible.
- Vegetate slopes with native or drought tolerant vegetation.
- Control and treat flows in landscaping and/or other controls prior to reaching existing natural drainage systems.
- Stabilize temporary and permanent channel crossings as quickly as possible, and ensure that increases in run-off velocity and frequency caused by the project do not erode the channel.
- Install energy dissipaters, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined channels in accordance with applicable specifications to minimize erosion. Energy dissipaters shall be installed in such a way as to minimize impacts to receiving waters.
- Line on-site conveyance channels where appropriate, to reduce erosion caused by increased flow velocity due to increases in tributary impervious area. The first choice for linings should be grass or some other vegetative surface, since these materials not only reduce runoff velocities, but also provide water quality benefits from filtration and infiltration. If velocities in the channel are high enough to erode grass or other vegetative linings, riprap, concrete, soil cement, or geo-grid stabilization are other alternatives.
- Consider other design principles that are comparable and equally effective.

## ***Redeveloping Existing Installations***

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define “redevelopment” in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of “redevelopment” must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under “designing new installations” above should be followed.

# **SD-10 Site Design & Landscape Planning**

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Redevelopment may present significant opportunity to add features which had not previously been implemented. Examples include incorporation of depressions, areas of permeable soils, and swales in newly redeveloped areas. While some site constraints may exist due to the status of already existing infrastructure, opportunities should not be missed to maximize infiltration, slow runoff, reduce impervious areas, disconnect directly connected impervious areas.

## **Other Resources**

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Stormwater Management Manual for Western Washington, Washington State Department of Ecology, August 2001.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.



Rain Garden

## Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

## Description

Various roof runoff controls are available to address stormwater that drains off rooftops. The objective is to reduce the total volume and rate of runoff from individual lots, and retain the pollutants on site that may be picked up from roofing materials and atmospheric deposition. Roof runoff controls consist of directing the roof runoff away from paved areas and mitigating flow to the storm drain system through one of several general approaches: cisterns or rain barrels; dry wells or infiltration trenches; pop-up emitters, and foundation planting. The first three approaches require the roof runoff to be contained in a gutter and downspout system. Foundation planting provides a vegetated strip under the drip line of the roof.

## Approach

Design of individual lots for single-family homes as well as lots for higher density residential and commercial structures should consider site design provisions for containing and infiltrating roof runoff or directing roof runoff to vegetative swales or buffer areas. Retained water can be reused for watering gardens, lawns, and trees. Benefits to the environment include reduced demand for potable water used for irrigation, improved stormwater quality, increased groundwater recharge, decreased runoff volume and peak flows, and decreased flooding potential.

## Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

## Design Considerations

### ***Designing New Installations***

#### *Cisterns or Rain Barrels*

One method of addressing roof runoff is to direct roof downspouts to cisterns or rain barrels. A cistern is an above ground storage vessel with either a manually operated valve or a permanently open outlet. Roof runoff is temporarily stored and then released for irrigation or infiltration between storms. The number of rain





barrels needed is a function of the rooftop area. Some low impact developers recommend that every house have at least 2 rain barrels, with a minimum storage capacity of 1000 liters. Roof barrels serve several purposes including mitigating the first flush from the roof which has a high volume, amount of contaminants, and thermal load. Several types of rain barrels are commercially available. Consideration must be given to selecting rain barrels that are vector proof and childproof. In addition, some barrels are designed with a bypass valve that filters out grit and other contaminants and routes overflow to a soak-away pit or rain garden.

If the cistern has an operable valve, the valve can be closed to store stormwater for irrigation or infiltration between storms. This system requires continual monitoring by the resident or grounds crews, but provides greater flexibility in water storage and metering. If a cistern is provided with an operable valve and water is stored inside for long periods, the cistern must be covered to prevent mosquitoes from breeding.

A cistern system with a permanently open outlet can also provide for metering stormwater runoff. If the cistern outlet is significantly smaller than the size of the downspout inlet (say  $\frac{1}{4}$  to  $\frac{1}{2}$  inch diameter), runoff will build up inside the cistern during storms, and will empty out slowly after peak intensities subside. This is a feasible way to mitigate the peak flow increases caused by rooftop impervious land coverage, especially for the frequent, small storms.

#### *Dry wells and Infiltration Trenches*

Roof downspouts can be directed to dry wells or infiltration trenches. A dry well is constructed by excavating a hole in the ground and filling it with an open graded aggregate, and allowing the water to fill the dry well and infiltrate after the storm event. An underground connection from the downspout conveys water into the dry well, allowing it to be stored in the voids. To minimize sedimentation from lateral soil movement, the sides and top of the stone storage matrix can be wrapped in a permeable filter fabric, though the bottom may remain open. A perforated observation pipe can be inserted vertically into the dry well to allow for inspection and maintenance.

In practice, dry wells receiving runoff from single roof downspouts have been successful over long periods because they contain very little sediment. They must be sized according to the amount of rooftop runoff received, but are typically 4 to 5 feet square, and 2 to 3 feet deep, with a minimum of 1-foot soil cover over the top (maximum depth of 10 feet).

To protect the foundation, dry wells must be set away from the building at least 10 feet. They must be installed in solids that accommodate infiltration. In poorly drained soils, dry wells have very limited feasibility.

Infiltration trenches function in a similar manner and would be particularly effective for larger roof areas. An infiltration trench is a long, narrow, rock-filled trench with no outlet that receives stormwater runoff. These are described under Treatment Controls.

#### *Pop-up Drainage Emitter*

Roof downspouts can be directed to an underground pipe that daylights some distance from the building foundation, releasing the roof runoff through a pop-up emitter. Similar to a pop-up irrigation head, the emitter only opens when there is flow from the roof. The emitter remains flush to the ground during dry periods, for ease of lawn or landscape maintenance.

## *Foundation Planting*

Landscape planting can be provided around the base to allow increased opportunities for stormwater infiltration and protect the soil from erosion caused by concentrated sheet flow coming off the roof. Foundation plantings can reduce the physical impact of water on the soil and provide a subsurface matrix of roots that encourage infiltration. These plantings must be sturdy enough to tolerate the heavy runoff sheet flows, and periodic soil saturation.

## ***Redeveloping Existing Installations***

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define “redevelopment” in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of “redevelopment” must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under “designing new installations” above should be followed.

## **Supplemental Information**

### ***Examples***

- City of Ottawa’s Water Links Surface –Water Quality Protection Program
- City of Toronto Downspout Disconnection Program
- City of Boston, MA, Rain Barrel Demonstration Program

### **Other Resources**

Hager, Marty Catherine, Stormwater, “Low-Impact Development”, January/February 2003.  
[www.stormh2o.com](http://www.stormh2o.com)

Low Impact Urban Design Tools, Low Impact Development Design Center, Beltsville, MD.  
[www.lid-stormwater.net](http://www.lid-stormwater.net)

Start at the Source, Bay Area Stormwater Management Agencies Association, 1999 Edition



## Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

## Description

Irrigation water provided to landscaped areas may result in excess irrigation water being conveyed into stormwater drainage systems.

## Approach

Project plan designs for development and redevelopment should include application methods of irrigation water that minimize runoff of excess irrigation water into the stormwater conveyance system.

## Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

## Design Considerations

### ***Designing New Installations***

The following methods to reduce excessive irrigation runoff should be considered, and incorporated and implemented where determined applicable and feasible by the Permittee:

- Employ rain-triggered shutoff devices to prevent irrigation after precipitation.
- Design irrigation systems to each landscape area's specific water requirements.
- Include design featuring flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.
- Implement landscape plans consistent with County or City water conservation resolutions, which may include provision of water sensors, programmable irrigation times (for short cycles), etc.



- Design timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the storm water drainage system.
- Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species). Consider design features such as:
  - Using mulches (such as wood chips or bar) in planter areas without ground cover to minimize sediment in runoff
  - Installing appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant materials where possible and/or as recommended by the landscape architect
  - Leaving a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible
  - Choosing plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth
- Employ other comparable, equally effective methods to reduce irrigation water runoff.

### ***Redeveloping Existing Installations***

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define “redevelopment” in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of “redevelopment” must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under “designing new installations” above should be followed.

### **Other Resources**

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.



## Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

## Description

Waste materials dumped into storm drain inlets can have severe impacts on receiving and ground waters. Posting notices regarding discharge prohibitions at storm drain inlets can prevent waste dumping. Storm drain signs and stencils are highly visible source controls that are typically placed directly adjacent to storm drain inlets.

## Approach

The stencil or affixed sign contains a brief statement that prohibits dumping of improper materials into the urban runoff conveyance system. Storm drain messages have become a popular method of alerting the public about the effects of and the prohibitions against waste disposal.

## Suitable Applications

Stencils and signs alert the public to the destination of pollutants discharged to the storm drain. Signs are appropriate in residential, commercial, and industrial areas, as well as any other area where contributions or dumping to storm drains is likely.

## Design Considerations

Storm drain message markers or placards are recommended at all storm drain inlets within the boundary of a development project. The marker should be placed in clear sight facing toward anyone approaching the inlet from either side. All storm drain inlet locations should be identified on the development site map.

## *Designing New Installations*

The following methods should be considered for inclusion in the project design and show on project plans:

- Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with prohibitive language. Examples include “NO DUMPING



– DRAINS TO OCEAN” and/or other graphical icons to discourage illegal dumping.

- Post signs with prohibitive language and/or graphical icons, which prohibit illegal dumping at public access points along channels and creeks within the project area.

Note - Some local agencies have approved specific signage and/or storm drain message placards for use. Consult local agency stormwater staff to determine specific requirements for placard types and methods of application.

### ***Redeveloping Existing Installations***

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define “redevelopment” in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. If the project meets the definition of “redevelopment”, then the requirements stated under “designing new installations” above should be included in all project design plans.

### **Additional Information**

#### ***Maintenance Considerations***

- Legibility of markers and signs should be maintained. If required by the agency with jurisdiction over the project, the owner/operator or homeowner’s association should enter into a maintenance agreement with the agency or record a deed restriction upon the property title to maintain the legibility of placards or signs.

#### ***Placement***

- Signage on top of curbs tends to weather and fade.
- Signage on face of curbs tends to be worn by contact with vehicle tires and sweeper brooms.

### **Supplemental Information**

#### ***Examples***

- Most MS4 programs have storm drain signage programs. Some MS4 programs will provide stencils, or arrange for volunteers to stencil storm drains as part of their outreach program.

### **Other Resources**

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

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## Design Objectives

- Maximize Infiltration
- Provide Retention
- Source Control
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutant
- Collect and Convey

## Description

Alternative building materials are selected instead of conventional materials for new construction and renovation. These materials reduce potential sources of pollutants in stormwater runoff by eliminating compounds that can leach into runoff, reducing the need for pesticide application, reducing the need for painting and other maintenance, or by reducing the volume of runoff.

## Approach

Alternative building materials are available for use as lumber for decking, roofing materials, home siding, and paving for driveways, decks, and sidewalks.

## Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

## Design Considerations

### ***Designing New Installations***

#### *Decking*

One of the most common materials for construction of decks and other outdoor construction has traditionally been pressure treated wood, which is now being phased out. The standard treatment is called CCA, for chromated copper arsenate. The key ingredients are arsenic (which kills termites, carpenter ants and other insects), copper (which kills the fungi that cause wood to rot) and chromium (which reacts with the other ingredients to bind them to the wood). The amount of arsenic is far from trivial. A deck just 8 feet x 10 feet contains more than 1 1/3 pounds of this highly potent poison. Replacement materials include a new type of pressure treated wood, plastic and composite lumber.



There are currently over 20 products in the market consisting of plastic or plastic-wood composites. Plastic lumber is made from 100% recycled plastic, # 2 HDPE and polyethylene plastic milk jugs and soap bottles. Plastic-wood composites are a combination of plastic and wood fibers or sawdust. These materials are a long lasting exterior weather, insect, and chemical resistant wood lumber replacement for non structural applications. Use it for decks, docks, raised garden beds and planter boxes, pallets, hand railings, outdoor furniture, animal pens, boat decks, etc.

New pressure treated wood uses a much safer recipe, ACQ, which stands for ammoniacal copper quaternary. It contains no arsenic and no chromium. Yet the American Wood Preservers Association has found it to be just as effective as the standard formula. ACQ is common in Japan and Europe.

### *Roofing*

Several studies have indicated that metal used as roofing material, flashing, or gutters can leach metals into the environment. The leaching occurs because rainfall is slightly acidic and slowly dissolved the exposed metals. Common traditional applications include copper sheathing and galvanized (zinc) gutters.

Coated metal products are available for both roofing and gutter applications. These products eliminate contact of bare metal with rainfall, eliminating one source of metals in runoff. There are also roofing materials made of recycled rubber and plastic that resemble traditional materials.

A less traditional approach is the use of green roofs. These roofs are not just green, they're alive. Planted with grasses and succulents, low- profile green roofs reduce the urban heat island effect, stormwater runoff, and cooling costs, while providing wildlife habitat and a connection to nature for building occupants. These roofs are widely used on industrial facilities in Europe and have been established as experimental installations in several locations in the US, including Portland, Oregon. Their feasibility is questionable in areas of California with prolonged, dry, hot weather.

### *Paved Areas*

Traditionally, concrete is used for construction of patios, sidewalks, and driveways. Although it is non-toxic, these paved areas reduce stormwater infiltration and increase the volume and rate of runoff. This increase in the amount of runoff is the leading cause of stream channel degradation in urban areas.

There are a number of alternative materials that can be used in these applications, including porous concrete and asphalt, modular blocks, and crushed granite. These materials, especially modular paving blocks, are widely available and a well established method to reduce stormwater runoff.

### *Building Siding*

Wood siding is commonly used on the exterior of residential construction. This material weathers fairly rapidly and requires repeated painting to prevent rotting. Alternative "new" products for this application include cement-fiber and vinyl. Cement-fiber siding is a masonry product made from Portland cement, sand, and cellulose and will not burn, cup, swell, or shrink.



## Pesticide Reduction

A common use of powerful pesticides is for the control of termites. Chlordane was used for many years for this purpose and is now found in urban streams and lakes nationwide. There are a number of physical barriers that can be installed during construction to help reduce the use of pesticides.

Sand barriers for subterranean termites are a physical deterrent because the termites cannot tunnel through it. Sand barriers can be applied in crawl spaces under pier and beam foundations, under slab foundations, and between the foundation and concrete porches, terraces, patios and steps. Other possible locations include under fence posts, underground electrical cables, water and gas lines, telephone and electrical poles, inside hollow tile cells and against retaining walls.

Metal termite shields are physical barriers to termites which prevent them from building invisible tunnels. In reality, metal shields function as a helpful termite detection device, forcing them to build tunnels on the outside of the shields which are easily seen. Metal termite shields also help prevent dampness from wicking to adjoining wood members which can result in rot, thus making the material more attractive to termites and other pests. Metal flashing and metal plates can also be used as a barrier between piers and beams of structures such as decks, which are particularly vulnerable to termite attack.

## ***Redeveloping Existing Installations***

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define “redevelopment” in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of “redevelopment” must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under “designing new installations” above should be followed.

## **Other Resources**

There are no good, independent, comprehensive sources of information on alternative building materials for use in minimizing the impacts of stormwater runoff. Most websites or other references to “green” or “alternative” building materials focus on indoor applications, such as formaldehyde free plywood and low VOC paints, carpets, and pads. Some supplemental information on alternative materials is available from the manufacturers.

Fires are a source of concern in many areas of California. Information on the flammability of alternative decking materials is available from the University of California Forest Product Laboratory (UCFPL) website at: <http://www.ucfpl.ucop.edu/WDDeckIntro.htm>