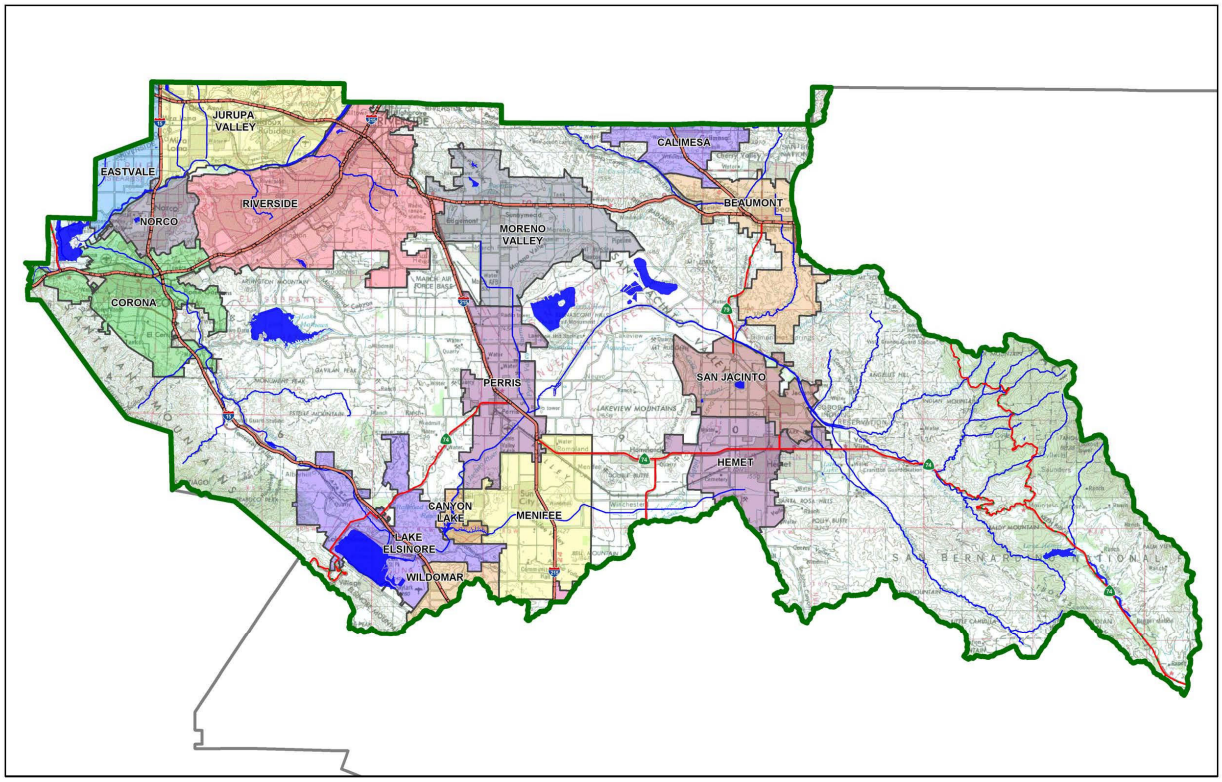
Project Specific Water Quality Management Plan

*A Template for Projects located within the **Santa Ana Watershed** Region of Riverside County*

Project Title: Boulders Menifee Mixed Use Development

Development No: PLN20-0167PP

Design Review/Case No: WQ20-0243



☒ **Preliminary**
☐ **Final**

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Contact Information:

Prepared for:
TMC Holding, LLC
15916 Bernardo Center Drive
San Diego, CA 92127
760-489-9563

Prepared by:

KOLIBRIEN

John Johnson, P.E.
27919 Jefferson Ave., Ste. 201
Temecula, CA 92590
951-252-1034

OWNER'S CERTIFICATION

This Project-Specific Water Quality Management Plan (WQMP) has been prepared for TMC Holding, LLC by Kolibrien Engineering for the Boulders Menifee Mixed Use Development project.

This WQMP is intended to comply with the requirements of Menifee for Ordinance No. 457 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 Menifee Water Quality Ordinance (Municipal Code Section 457).

"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	10-19-2020 Date
John Johnson, P.E. Preparer's Printed Name	Professional Engineer Preparer's Title/Position

Preparer's Licensure:

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Section A: Project and Site Information

PROJECT INFORMATION	
Type of Project:	Mixed Use - Commercial and Residential
Planning Area:	Not in a Specific Plan
Community Name:	Menifee
Development Name:	Boulders Menifee Mixed Use Development

PROJECT LOCATION
Latitude & Longitude (DMS): LAT 33.6859 / LONG -117.2137
Project Watershed and Sub-Watershed: Santa Ana
Gross Acres: 9.92
APN(s): 339-200-080-5
Map Book and Page No.: Thomas Brothers Page 867

PROJECT CHARACTERISTICS	
Proposed or Potential Land Use(s)	Mixed use - Commercial and Residential
Proposed or Potential SIC Code(s)	I-P
Area of Impervious Project Footprint (SF)	413,268
Total Area of proposed Impervious Surfaces within the Project Footprint (SF)/or Replacement	329129
Does the project consist of offsite road improvements?	☒ Y ☐ N
Does the project propose to construct unpaved roads?	☐ Y ☒ N
Is the project part of a larger common plan of development (phased project)?	☐ Y ☒ N

EXISTING SITE CHARACTERISTICS	
Total area of existing Impervious Surfaces within the Project limits Footprint (SF)	0
Is the project located within any MSHCP Criteria Cell?	☐ Y ☒ N
If so, identify the Cell number:	N/A
Are there any natural hydrologic features on the project site?	☐ Y ☒ N
Is a Geotechnical Report attached?	☒ Y ☐ N
If no Geotech. Report, list the NRCS soils type(s) present on the site (A, B, C and/or D)	
What is the Water Quality Design Storm Depth for the project?	0.6 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)

The proposed project is a mixed-use development, which includes multi-family residential, a daycare, office building, and a club house. Two driveways are proposed on Berea Road to give access to the site and one driveway on Normandy Road. The proposed drainage discharges from the site in the northeast corner following the pattern of the existing condition. A portion also drains to the south west corner of the site to a culvert in Berea Road. The site development includes pretreatment forebays in various areas to treat flow prior to entering the storm drain system. All drainage on the site is routed to these forebays through surface flow and then through the pipe system to a large retention/detention chamber system which includes a retention depth for the VBMP. The chamber includes an irrigation pump for the retained water to be used for harvest and reuse. Any flows that exceed the retention capacity will flow through the detention chamber outlet structure, which then flows to northwest corner of the site where flow from the site is discharged in the existing condition.

A.2 Identify Receiving Waters

Table A.1 Identification of Receiving Waters

Receiving Waters	EPA Approved 303(d) List Impairments	Designated Beneficial Uses	Proximity to RARE Beneficial Use
Canyon Lake and Salt Creek HU#802.11 & 802.12	Nutrients and Pathogens	MUN, AGR, GWR, REC1, REC2, WARM, WILD	Not designated as RARE
Lake Elsinore HU#802.31	Nutrients, Organic Enrichment, Low Dissolved Oxygen, Sedimentation, Siltation, Unknown Toxicity, PCB's	REC1, REC2, WARM, WILD	Not designated as RARE

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	☐ Y	☒ N
State Water Resources Control Board, Clean Water Act (CWA) Section 401 Water Quality Cert.	☐ Y	☒ N
US Army Corps of Engineers, CWA Section 404 Permit	☐ Y	☒ N
US Fish and Wildlife, Endangered Species Act Section 7 Biological Opinion	☐ Y	☒ N
Statewide Construction General Permit Coverage	☒ Y	☐ N
Statewide Industrial General Permit Coverage	☐ Y	☒ N
Western Riverside MSHCP Consistency Approval (e.g., JPR, DBESP)	☐ Y	☒ N
Other *(please list in the space below as required)*	☐ Y	☐ N

Section B: Optimize Site Utilization (LID Principles)

Site Optimization

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

Yes, existing drainage flows north and west and the site drainage areas preserve those patterns.

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

The site only has brush. The project will have landscaping throughout.

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

Yes, LID is being implemented through a large detention chamber, which includes a retention volume with harvest and reuse. Additionally, Forebays are included prior to any flow entering the storm drain system to the detention chamber. Landscaped areas will be minimally compacted.

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

Yes, there are minimum requirements for parking and circulation on this site and it was kept to a minimum to decrease new impervious areas.

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

Yes, all of the impervious areas flow to landscaped areas and the pervious forebays.

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)[1][2]	Area (Sq. Ft.)	DMA Type
DMA1-D1	Ornamental Landscape, Concrete, Asphalt, Roof	413269	Drains to BMP

[1]*Reference Table 2-1 in the WQMP Guidance Document to populate this column*
[2]*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) [A]	Storm Depth (inches) [B]	DMA Name / ID	[C] from Table C.4 = [C]	Required Retention Depth (inches) [D]
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
DMA1-D1	B1-D1

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 Copermittee 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?		X
If Yes, list affected DMAs:		
…have any DMAs located within 100 feet of a water supply well?		X
If Yes, list affected DMAs:		
…have any areas identified by the geotechnical report as posing a public safety risk where infiltration of stormwater could have a negative impact?		X
If Yes, list affected DMAs:		
…have measured in-situ infiltration rates of less than 1.6 inches / hour?		X
If Yes, list affected DMAs:		
…have significant cut and/or fill conditions that would preclude in-situ testing of infiltration rates at the final infiltration surface?		X
If Yes, list affected DMAs:		
…geotechnical report identify other site-specific factors that would preclude effective and safe infiltration?	X	
Describe here: Geotechnical engineer has determined that the site does not have adequate infiltration rates.		

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 Copermittee).

☐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: 2.36 Acres

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: 7.13 Acres

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: 0.79

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: 5.63 Acres

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)
5.63 Acres	2.36 Acres

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: 500

Project Type: Residential and Commercial

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: 7.13 Acres

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 or toilet users per tributary impervious acre (TUTIA).

Enter your TUTIA factor: 101

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: 720

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)
720	500

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: N/A

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: N/A

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: N/A

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: N/A

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)**
N/A	N/A

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	
DMA1-D1	☐	☒	☐	☒	☐
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐

D.5 LID BMP Sizing

Each LID BMP must be designed to ensure that the Design Capture Volume will be addressed by the selected BMPs. First**,** calculate the Design Capture Volume 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 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**	***B1-D1***		
	[A]		[B]	[C]	[A] x [C]			
DMA1-D1	*137267.2*	Roof	*1*	*0.89*	*122442.3*			
	191861.8	Concrete, Asphalt	*1*	*0.89*	*171140.7*	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
	84139.8	Ornamental Landscape	*0.1*	*0.11*	*9293.9*			
	413268.8				302876.9	0.6	15194.3	21511

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.

N/A

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
☐ Detached Residential Development	P	N	P	P	N	P	P	P
☒ Attached Residential Development	P	N	P	P	N	P	P	P(2)
☒ Commercial/Industrial Development	P(3)	P	P(1)	P(1)	P(5)	P(1)	P	P
☐ Automotive Repair Shops	N	P	N	N	P(4, 5)	N	P	P
☐ Restaurants (>5,000 ft^2)	P	N	N	N	N	N	P	P
☐ Hillside Development (>5,000 ft^2)	P	N	P	P	N	P	P	P
☐ Parking Lots (>5,000 ft^2)	P(6)	P	P(1)	P(1)	P(4)	P(1)	P	P
☐ Retail Gasoline Outlets	N	P	N	N	P	N	P	P
Project Priority Pollutant(s) of Concern	☒	☒	☒	☒	☐	☒	☐	☐

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[2]
N/A	
Total Credit Percentage[1]	

[1]*Cannot Exceed 50%*
[2]*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 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**		***Enter BMP Name / Identifier Here***		
	[A]		[B]	[C]	[A] x [C]				
						Design Storm Depth (in)	*Minimum Design Capture Volume or Design Flow Rate (cubic feet or cfs)*	*Total Storm Water Credit % Reduction*	*Proposed Volume or Flow on Plans (cubic feet or cfs)*
	A_T = Σ[A]				Σ= [D]	[E]	$[F] = \frac{[D]x[E]}{[G]}$	[F] X (1-[H])	[I]

[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[1]	Priority Pollutant(s) of Concern to Mitigate[2]	Removal Efficiency Percentage[3]
N/A		

[1] *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.*
[2] *Cross Reference Table E.1 above to populate this column.*
[3] *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 Copermittee 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[1] 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			
Volume (Cubic Feet)			

[1] 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:

Area flows to Canyon Lake and Lake Elsinore.

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.

Section G: Source Control BMPs

Table G.1 Permanent and Operational Source Control Measures

Potential Sources of Runoff pollutants	Permanent Structural Source Control BMPs	Operational Source Control BMPs
On-site storm drain inlets	Mark all inlets with "Only Rian Down the Storm Drain."	Maintain and periodically repaint or replace markings. Provide stormwater pollution prevention information to owners, lessees, or operators. See Fact Sheet SC-44. 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."**
Interior floor drains and elevator shaft sump pumps	Floor drains and elevator sumps shall go to sewer.	Inspect and maintain drains to prevent blockages and overflow.
Landscape/ Outdoor Pesticide Use	Preserve existing to the maximum extent. Minimize irrigation. BMP areas shall have plants that can tolerate saturation. Pest resistant plans will be used as practicable. Landscape architect shall select appropriate plans for the area.	Maintain landscaping using minimum or no pesticides. Follow "Landscape and Gardening" guidance from RCFCWCD. Provide IPM information to new owners, lessees and operators.
Refuse areas	Refuse areas will be enclosed and have a roof structure. Signs will be posted to say "Do not dump hazardous materials here."	See Fact Sheet SD-34.
Fire Sprinkler Test Water	Provide a means to drain fire sprinkler test water to sewer.	See Fact Sheet SC-41.
Rooftop equipment	Pollutant sources shall have roof or secondary containment.	
Roofing, gutters, and trim.	Materials will not be copper.	
Plazas, sidewalks, and parking lots.		Sweep areas and collect litter and debris regularly.

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)
B1-D1	Detention/Retention Chamber		

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.

Will complete in Final 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: Owner will provide contracted maintenance.

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

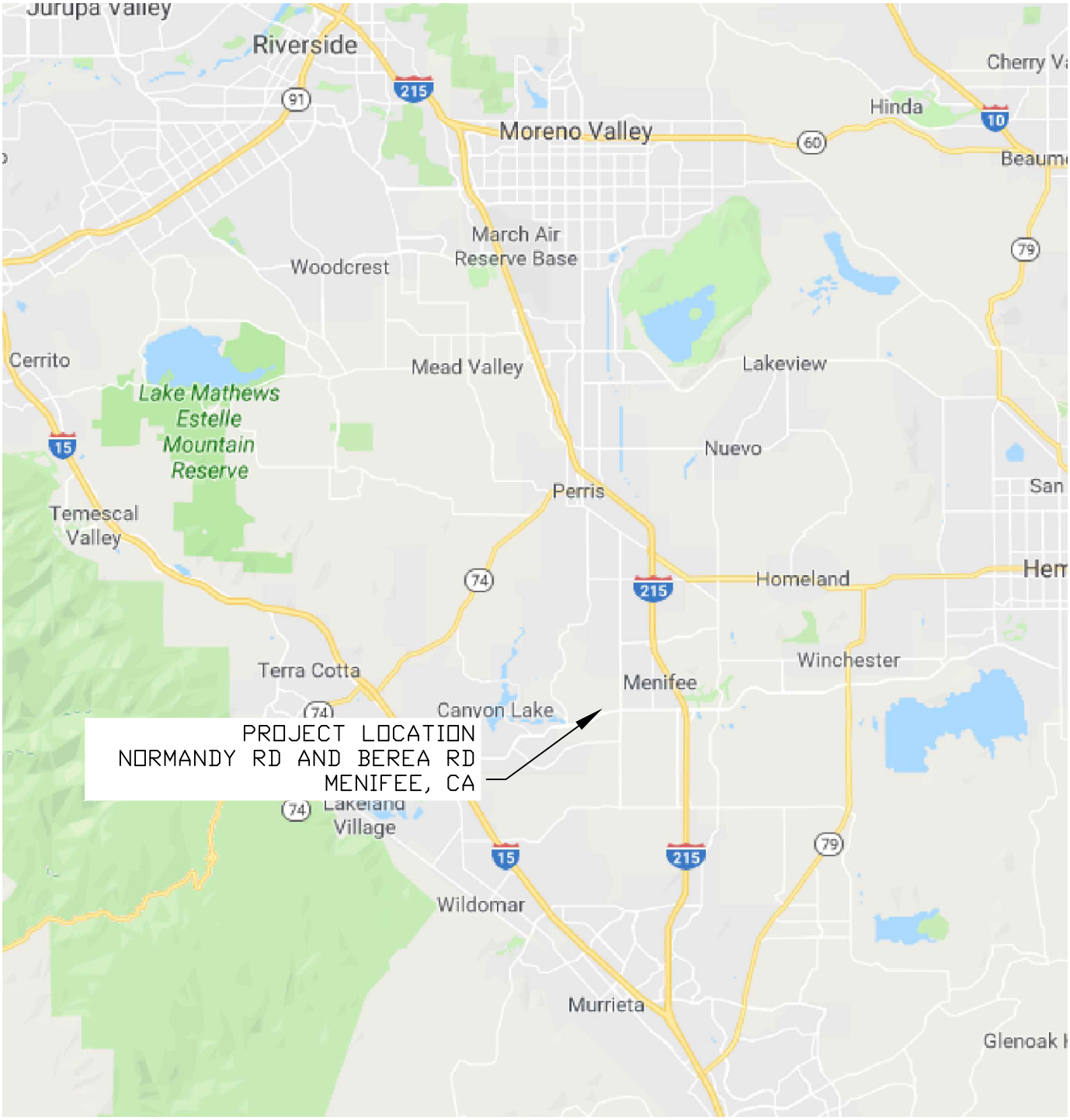
☐ Y ☒ N

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.

To be provided in Final Engineering.

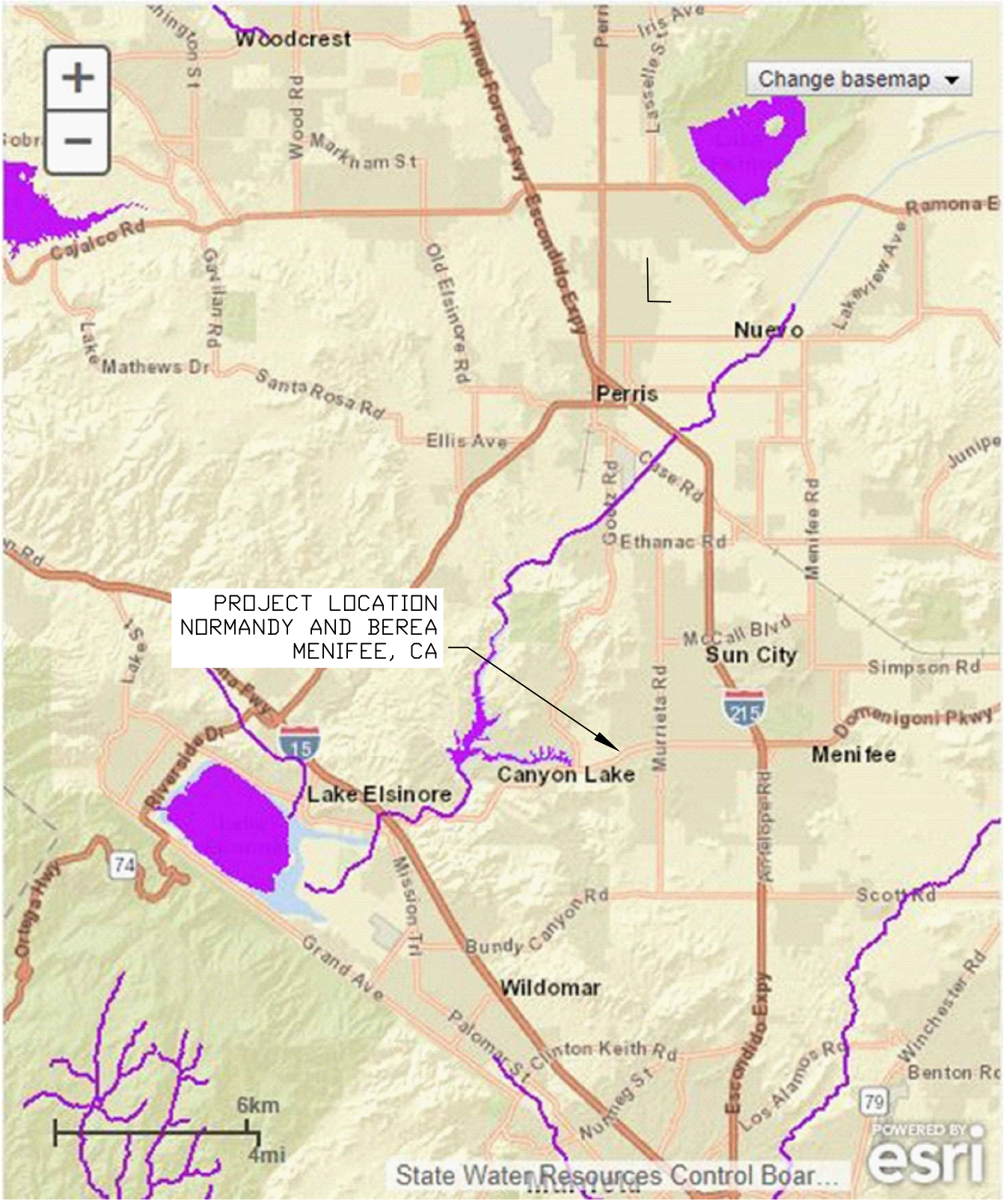
Appendix 1: Maps and Site Plans

Location Map, WQMP Site Plan and Receiving Waters Map



VICINITY MAP

NO SCALE



RECEIVING WATERS MAP

NO SCALE

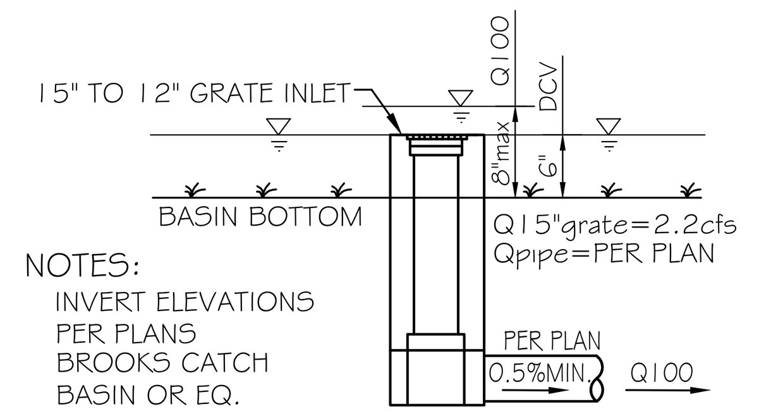
LEGEND

- DRAINAGE PATH FROM SITE
- RECEIVING WATERS
- RECEIVING WATER BODIES

IN THE CITY OF MENIFEE, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA

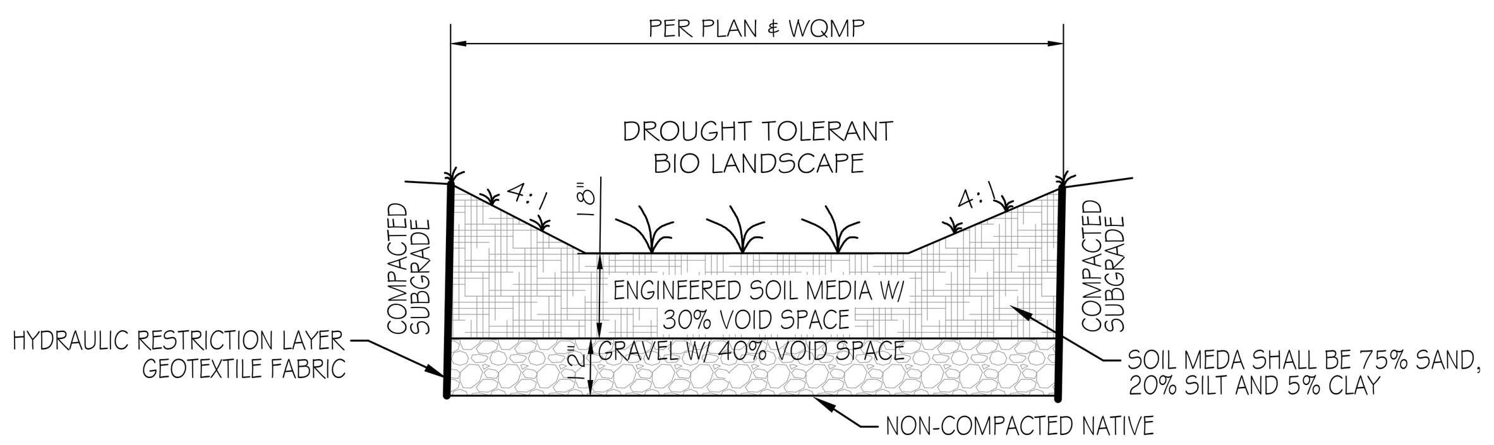
BOULDER MENIFEE MIXED USE DEVELOPMENT

PRELIMINARY WATER QUALITY MANAGEMENT PLAN

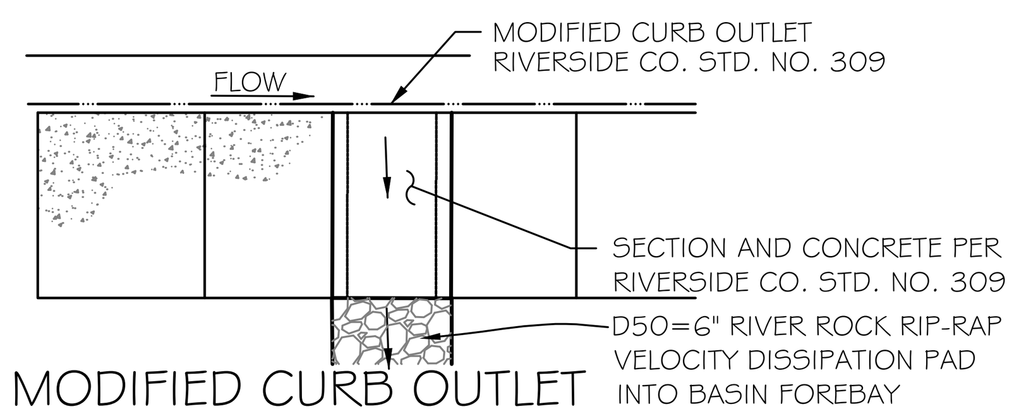


FOREBAY DRAINAGE OUTLET

N.T.S.

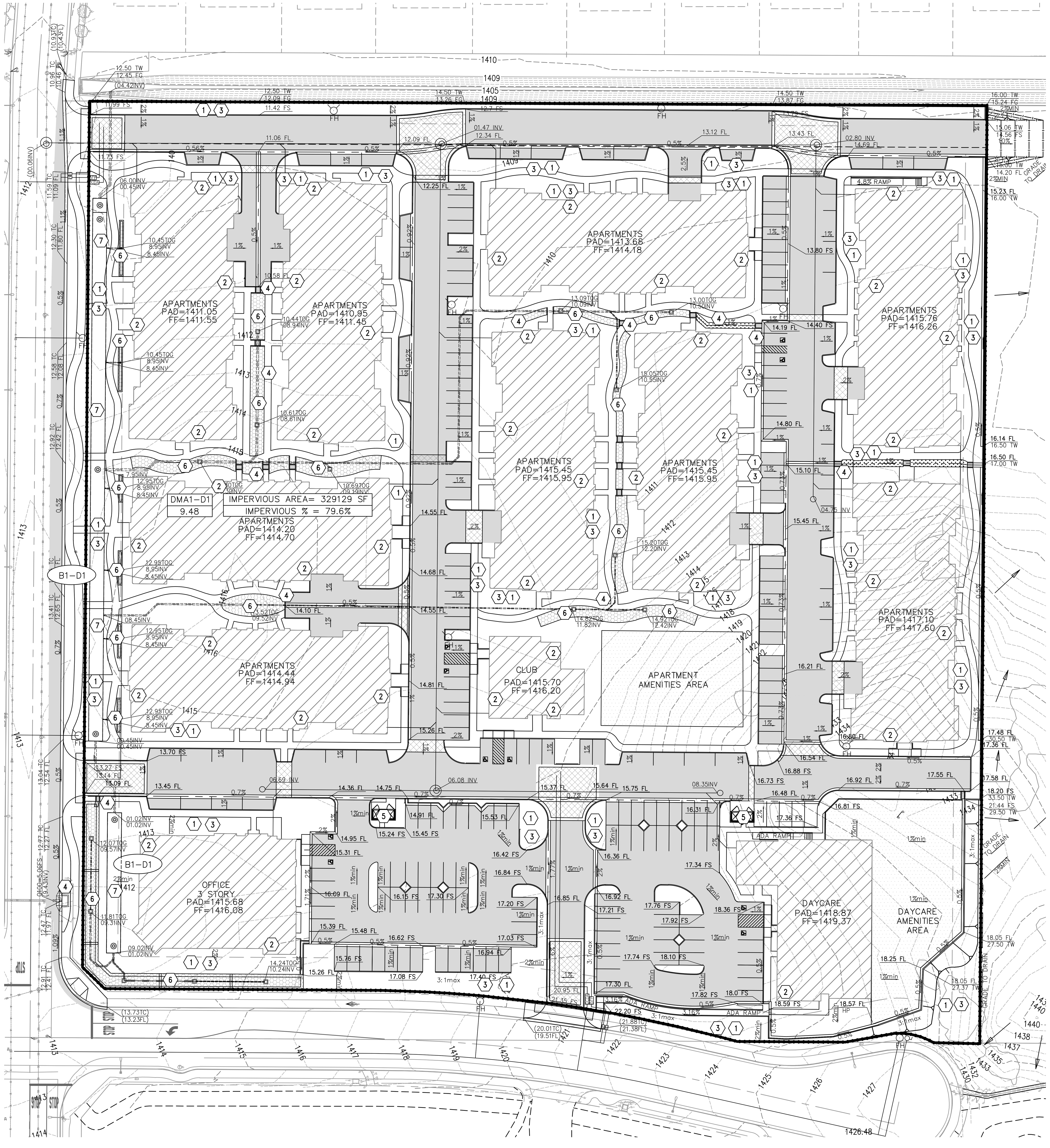


TYPICAL FOREBAY SECTION



MODIFIED CURB OUTLET

N.T.S



BMP SUMMARY TABLE

DMA	BMP	TYPE	VBMP (CF)	BIORETENTION BASIN VOLUME (CF)
DMA-D1	B1-D1	DETENTION/RETENTION CHAMBER	15194	21511

BMP NOTES

1. PER SD-10 DROUGHT TOLERANT LANDSCAPING AREA PER LANDSCAPE PLANS
2. PER SD-11 ROOF RUNOFF CONTROLS, ROOF RUNOFF DIRECTED TO DOWNSPOUTS
3. PER SD-12 EFFICIENT IRRIGATION PER LANDSCAPE ARCHITECTURE PLANS
4. PER SD-13 STORM DRAIN SIGNAGE AND CITY OF MENIFEE SPECIFICATIONS
5. PER SD-32 TRASH ENCLOSURES, AND CITY OF MENIFEE STANDARDS
6. PER TC-22 DETENTION BASIN FOREBAY
7. PER TC-22 DETENTION BASIN - UNDERGROUND CHAMBER (SEE DETAIL SHEET 2) INCLUDES IRRIGATION PUMP FOR HARVEST AND REUSE

PROPOSED LEGEND

- STREET LIGHT
- SEWER MANHOLE
- STORMDRAIN CLEANOUT
- STORMDRAIN MANHOLE
- FIRE HYDRANT
- 7' WIDE CATCH BASIN
- STORMDRAIN BASIN OUTLET STRUCTURE
- STORMDRAIN BASIN INLET STRUCTURE
- 6" SEWER LATERAL
- 2" WATER LATERAL & BFP
- 4" FIRE LATERAL, DCDA, PIV & FCA
- 8" SANITARY SEWER LINE
- 2" IRRIGATION WATER LINE
- 8" WATER LINE
- STORM DRAIN LINE (SIZE/TYPE PER PLAN)
- BLOCK WALL
- 6" CURB
- 6" CURB & GUTTER
- 4' WIDE VALLEY GUTTER
- PROPERTY LINE
- RIGHT-OF-WAY LINE
- STREET CENTERLINE
- BUILDING
- FOREBAY AREAS
- LANDSCAPING
- DETENTION CHAMBER

BMP LEGEND:

- DMA1-A1 / 7.50 — INDICATES DRAINAGE MANAGEMENT AREA ID / INDICATES AREA IN ACRES
- BR 1-A1 — INDICATES BMP ID
- INDICATES SITE TRIBUTARY AREA BOUNDARY

GRAPHIC SCALE

40 0 20 40 80 120

(IN FEET)
1 inch =40 ft.

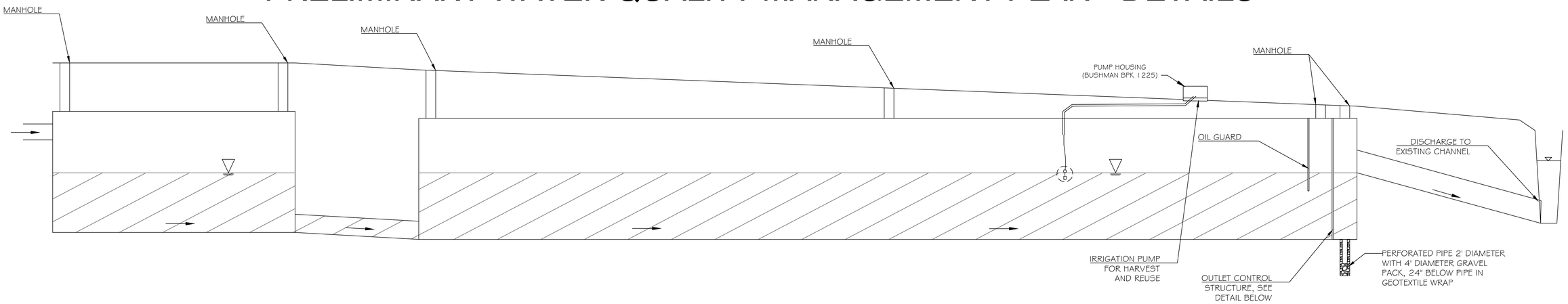
KOLIBRIEN
CIVIL / STRUCTURAL / SURVEYING
27919 JEFFERSON AVE., STE. 201, TEMECULA CA, 92590
Phone: (951) 252-1034 Web: WWW.KOLIBRIEN.BIZ

File: C02001

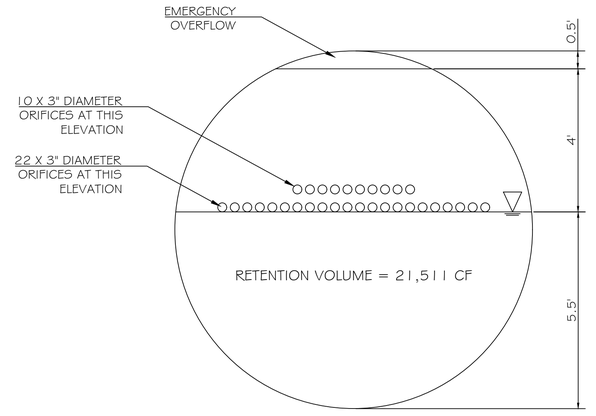
IN THE CITY OF MENIFEE, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA

BOULDER MENIFEE MIXED USE DEVELOPMENT

PRELIMINARY WATER QUALITY MANAGEMENT PLAN - DETAILS



DETENTION/RETENTION SYSTEM DETAILS



OUTLET STRUCTURE DETAIL

KOLIBRIEN
CIVIL / STRUCTURAL / SURVEYING
27919 JEFFERSON AVE., STE. 201, TEMECULA CA, 92590
Phone: (951) 252-1034 Web: WWW.KOLIBRIEN.BIZ

WQMP Project Report

County of Riverside Stormwater Program

Santa Ana River Watershed Geodatabase

Friday, January 31, 2020

Note: The information provided in this report and on the Stormwater Geodatabase for the County of Riverside Stormwater Program is intended to provide basic guidance in the preparation of the applicant's Water Quality Management Plan (WQMP) and should not be relied upon without independent verification.

Project Site Parcel Number(s):	RW, 339200080, 358090049, RW, RW, 339200013, RW, 339190005, 339304011, 339293010, RW, 358090050
Latitude/Longitude:	33.6859, -117.2136
Thomas Brothers Page:	
Project Site Acreage:	10.78
Watershed(s):	SANTA ANA
This Project Site Resides in the following Hydrologic Unit(s) (HUC):	**HUC Name** - HUC Number **Menifee Valley** - 180702020303
The HUCs Contribute stormwater to the following 303d listed water bodies and TMDLs which may include drainage from your proposed Project Site:	**WBID Name** - WBID Number **Canyon Lake (Railroad Canyon Reservoir)** - CAL8021100019990208151525 **Elsinore, Lake** - CAL8023100019990208151100
These 303d listed Water bodies and TMDLs have the following Pollutants of Concern (POC):	**Bacterial Indicators** - Pathogens **Nutrients** - Nutrients, Organic Enrichment/Low Dissolved Oxygen **Other Organics** - PCBs (Polychlorinated biphenyls) **Toxicity** - Sediment Toxicity, Unknown Toxicity
Is the Site subject to Hydromodification:	Yes
Limitations on Infiltration:	**Project Site Onsite Soils Group(s)** - A, B, C, D **Known Groundwater Contamination Plumes within 1000'** - No **Adjacent Water Supply Wells(s)** - No information available please contact your local water agency for more information. Your local contact agency is EASTERN MUNICIPAL W.D.. Your local wholesaler contact agency is METROPOLITAN WATER DISTRICT.
Environmentally Sensitive Areas within 200'(Fish and Wildlife Habitat/Species):	None

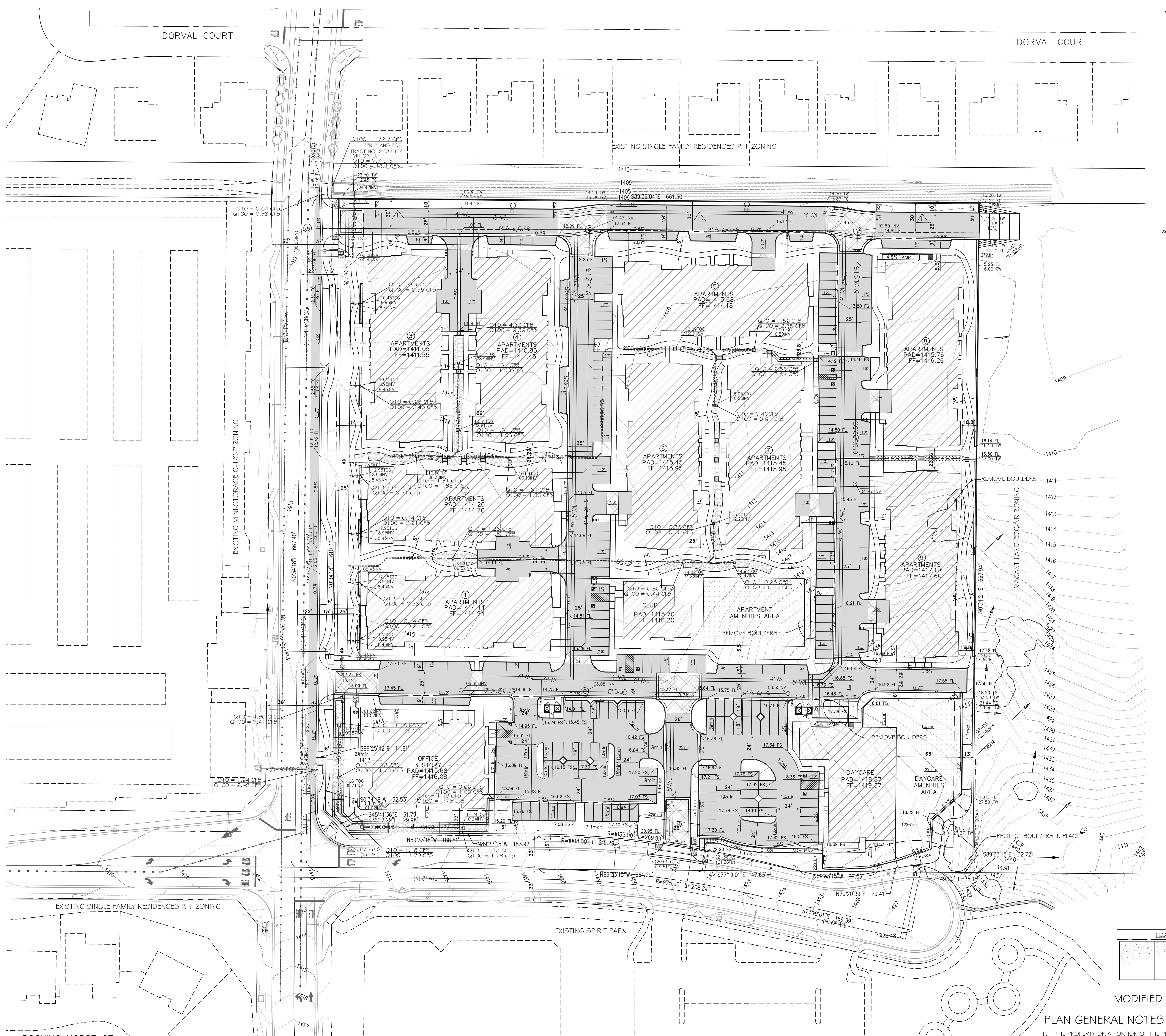
Environmentally Sensitive Areas within 200'(CVMSHCP):	None
Environmentally Sensitive Areas within 200'(WRMSHCP):	Burrowing Owl Survey Required Area,Narrow Endemic Plants Survey Req. - Area 3
Groundwater elevation from Mean Sea Level:	No Data
85th Percentile Design Storm Depth (in):	0.602
Groundwater Basin:	Perris-South
MSHCP/CVMSHCP Criteria Cell (s):	No Data
Retention Ordinance Information:	No Data
Studies and Reports Related to Project Site:	Comprehensive Nutrient Reduction Plan IBI Scores - Southern Cal bulletin118_4-sc water_fact_3_7.11 8039-SAR-Hydromodification West San Jacinto GW Basin Management Plan

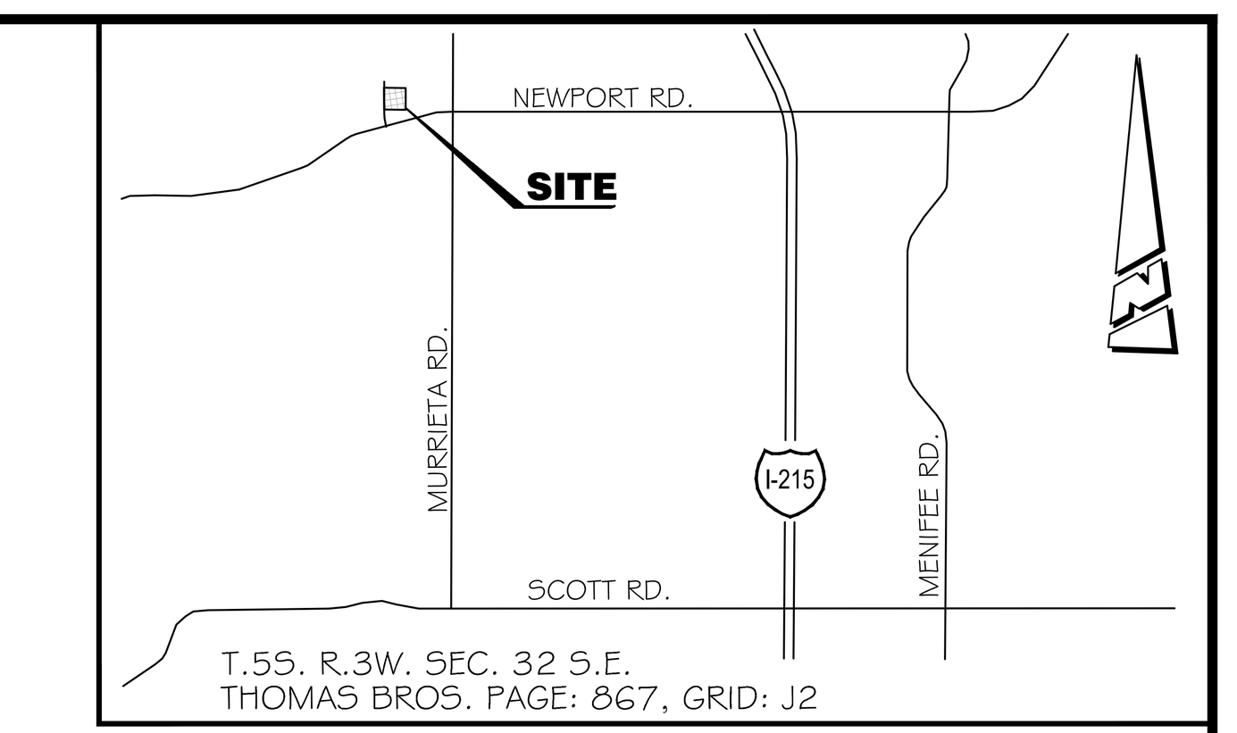
Appendix 2: Construction Plans

Grading and Drainage Plans

#	DATE	REVISION
#	10/01/20	REVISIONS PER 1ST SUBMITTAL CITY COMMENTS

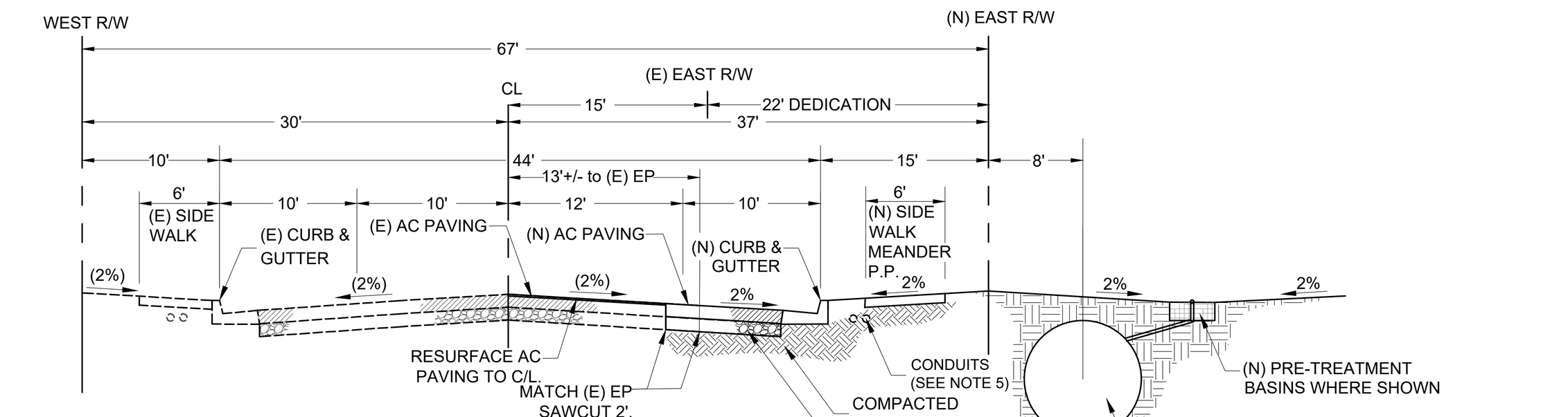
CONCEPTUAL GRADING, DRAINAGE & UTILITY PLAN FOR CUP PLN20-016
BOULDERS MENIFEE - A MIXED USE DEVELOPMENT





VICINITY MAP
NOT TO SCALE

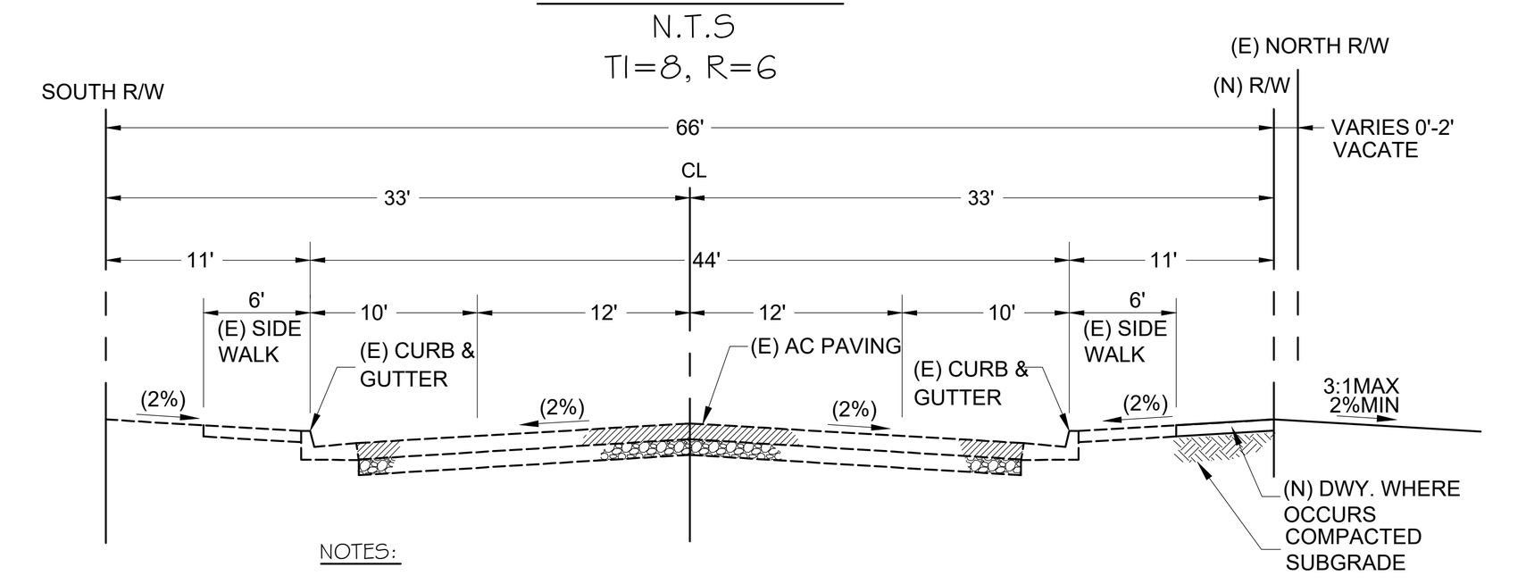
SECTIONS & DETAILS:



NOTES:

1. THICKNESS OF BASE AND PAVING TO BE DETERMINED BY GEOTECHNICAL TEST AT TIME OF GRADING OPERATIONS.
2. MINIMUM THICKNESS FOR A.C. IS 5"; FOR AGGREGATE BASE IS 6".
3. CURB AND GUTTER TO BE "TYPE 6" UNLESS OTHERWISE SPECIFIED.
4. PROVIDE MIN. 48" CLEAR FROM BACK OF SIDEWALK TO ANY ABOVE GRADE OBJECTS SUCH AS STREET LIGHTS, FIRE HYDRANTS, POWER POLES, ETC. SEE STANDARD 402 TO WIDEN SIDEWALK AROUND OBSTRUCTIONS.
5. INSTALL TWO SCH. 80 PVC CONDUITS PER STANDARD 1005.
6. NOTE THAT THE PROJECT IS RESPONSIBLE FOR STREET IMPROVEMENTS TO THE CENTERLINE PLUS 12-FEET.

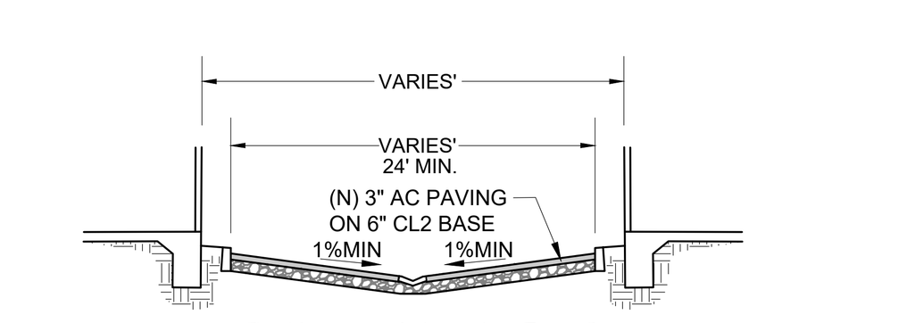
TYPICAL STREET SECTION
BEREA ROAD
N.T.S
TI=8, R=6



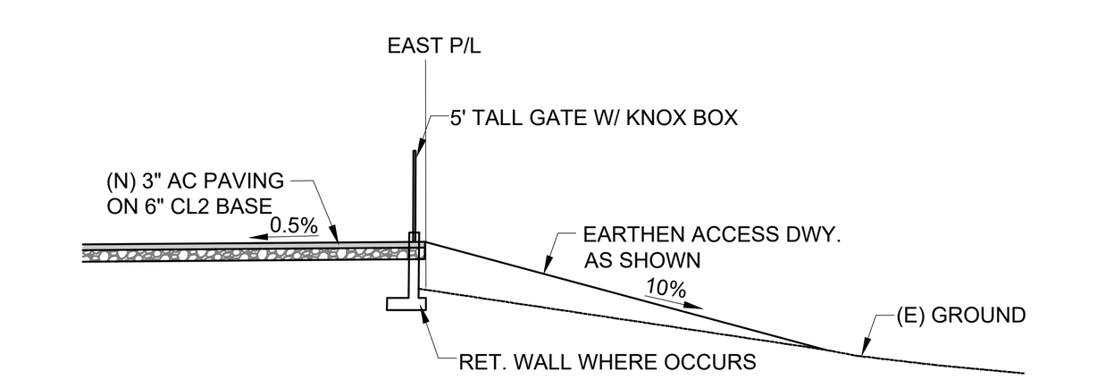
NOTES:

1. THICKNESS OF BASE AND PAVING TO BE DETERMINED BY SOIL TEST AT TIME OF GRADING OPERATIONS.
2. MINIMUM THICKNESS FOR A.C. IS 5"; FOR AGGREGATE BASE IS 6".
3. CURB AND GUTTER TO BE "TYPE 6" UNLESS OTHERWISE SPECIFIED.
4. PROVIDE MIN. 48" CLEAR FROM BACK OF SIDEWALK TO ANY ABOVE GRADE OBJECTS SUCH AS STREET LIGHTS, FIRE HYDRANTS, POWER POLES, ETC. SEE STANDARD 402 TO WIDEN SIDEWALK AROUND OBSTRUCTIONS.

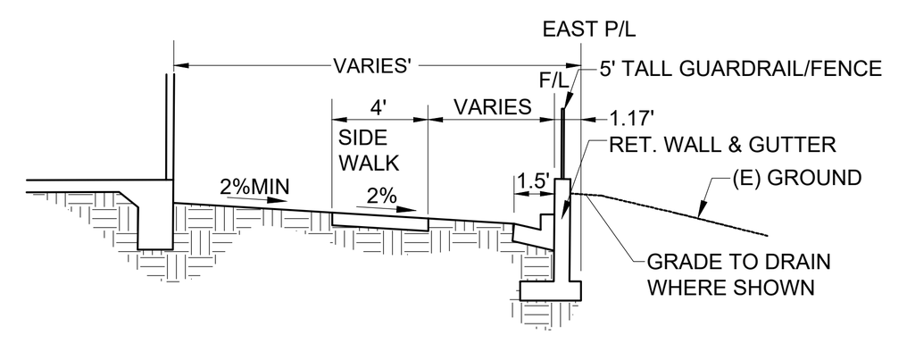
TYPICAL STREET SECTION
NORMANDY ROAD
N.T.S
TI=8, R=6



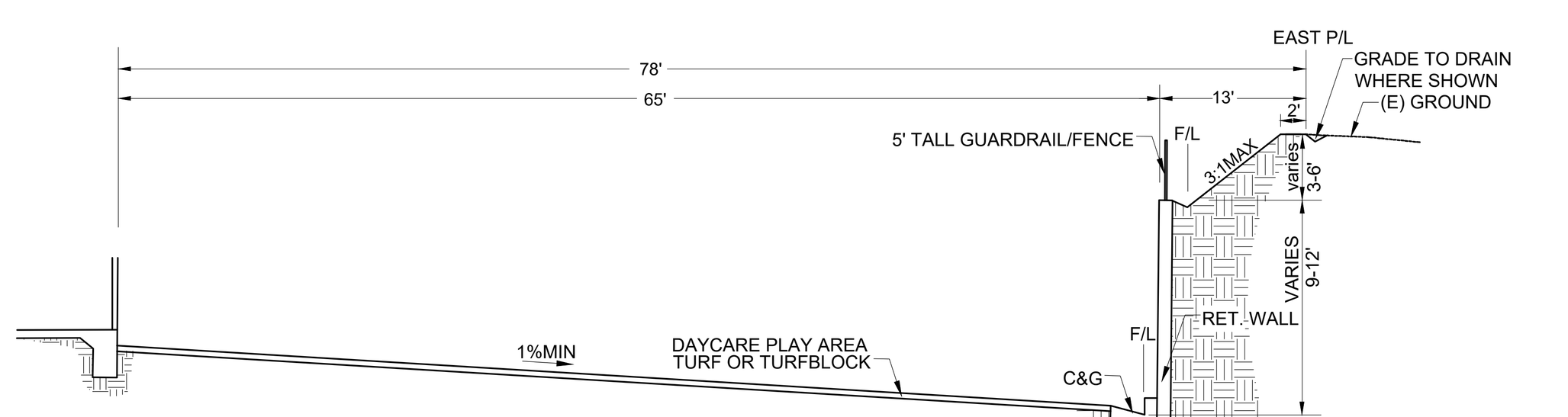
TYP. DWY AISLE
N.T.S



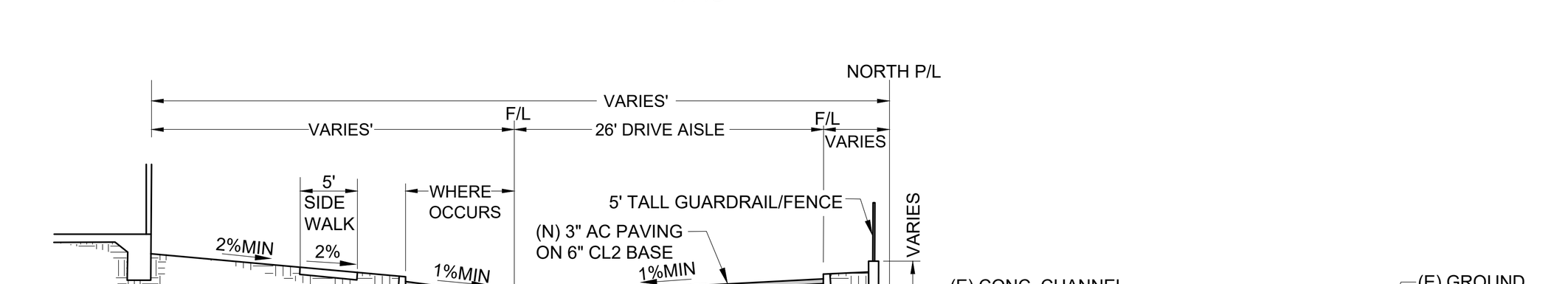
EAST P/L - NORTHERLY SECTION
N.T.S



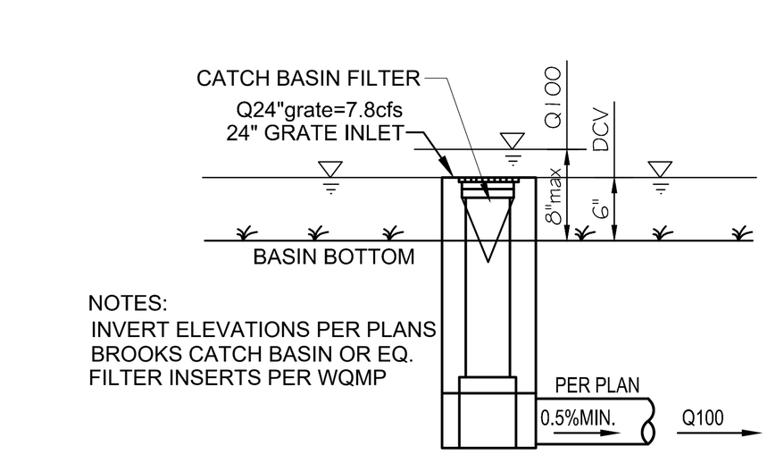
EAST P/L - CENTRAL SECTION
N.T.S



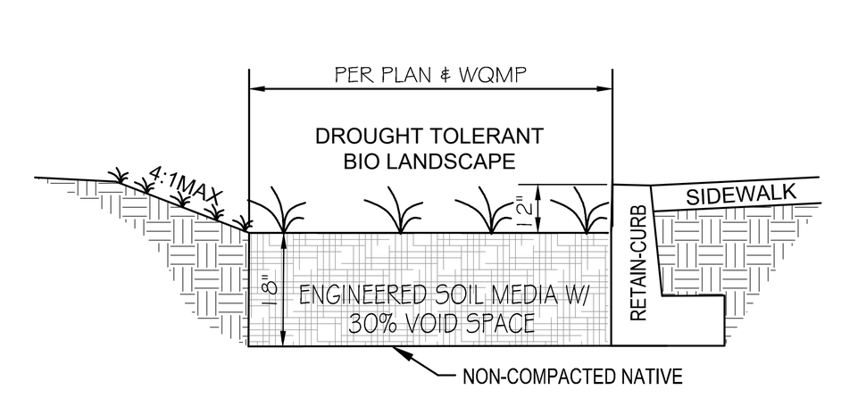
EAST P/L - SOUTHERLY SECTION
N.T.S



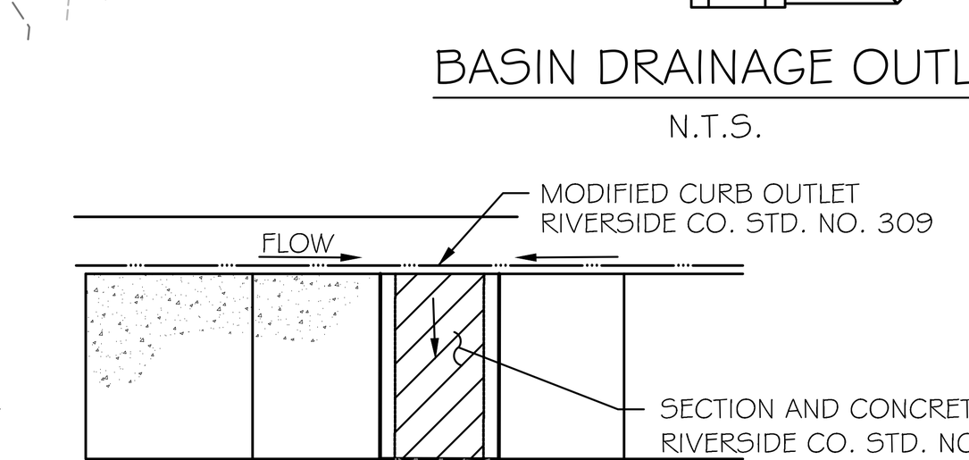
NORTH P/L - SECTION
N.T.S



BASIN DRAINAGE OUTLET
N.T.S.



PRE-TREATMENT SEDIMENT & FILTRATION BASINS
N.T.S



MODIFIED CURB OUTLET
N.T.S

SITE ADDRESS:
VACANT LAND, BEREA ROAD, MENIFEE, CA 92584

ASSESSOR'S PARCEL NO.S:
339-200-080-5

OWNER:
TMC HOLDING, LLC
15916 BERNARDO CENTER DRIVE,
SAN DIEGO, CA. 92127
CONTACT: RICH WILSON
PH: (760) 489-9563
E: RICH@JMWTRUSS.COM

APPLICANT / DEVELOPER:
TRADEMARK CONSTRUCTION CO. INC
15916 BERNARDO CENTER DRIVE,
SAN DIEGO, CA. 92127
CONTACT: RICH WILSON
PH: (760) 489-9563
E: RICH@JMWTRUSS.COM

ENGINEER / SURVEYOR:
KOLIBRIEN CORP. - JOHN JOHNSON, PE, PLS
27919 JEFFERSON AVE., STE. 201
TEMECULA, CA 92590
PHONE: (951) 252-1034
EMAIL: INFO@KOLIBRIEN.BIZ
WEBSITE: WWW.KOLIBRIEN.BIZ

PASSION. PERFORMANCE. EXCELLENCE.

BASIS OF BEARINGS:
THE WESTERLY HALF OF THE SOUTHWESTERLY LINE OF SECTION 32, T.5S., R.3W., SAN BERNARDINO BASE & MERIDIAN AS N89°35'15"W AS SHOWN ON PARCEL MAP 22745 ON FILE MAP IN BOOK PM 155 / 71-74, RECORDS OF RIVERSIDE COUNTY.

BENCHMARK:
RIVERSIDE COUNTY 600 25 68, 54 FT. NORTH-EAST OF POWER POLE 16193, 29 FT. EAST OF MURRIETA RD. AND 2 FT. ABOVE THE ROAD, 2 FT. SOUTH-WEST OF THE NORTH-WEST CORNER OF A 4 FT. CHAIN LINK FENCE, 2 FT. NORTH OF A WATER METER, 2 FT. SOUTH OF A MARKER POST, A BRASS DISK IN A CONCRETE POST.; ELEVATION = 1498.4, NAVD88.

FLOOD ZONE DESIGNATION:
A PORTION OF THE PROPERTY FOR THE PROPOSED DEVELOPMENT IS IN FLOODWAY AREA ZONE X, PARTIALLY WITHIN THE 0.2% ANNUAL CHANCE FLOODPLAIN, AS IS SHOWN ON FLOOD INSURANCE RATE MAPS FOR THE COUNTY OF RIVERSIDE, CALIFORNIA, SHOWN ON COMMUNITY PANEL NUMBER 06065C2062H. ADJACENT DEVELOPMENT PER EFFECTIVE LOMR 13-09-037GP SHOWS THE OPEN IMPROVEMENT TO THE NORTH MITIGATED/REMOVED ORIGINAL FLOODPLAIN PRIOR TO DEVELOPMENT.

ZONE AND USE INFORMATION:
EX. ZONE = R-1 - SINGLE FAMILY DWELLINGS
EX. LAND USE = EDC - ECONOMIC DEVELOPMENT CORRIDOR
SPA: NOT IN A SPECIFIC PLAN

CIRCULATION ELEMENT: 74 FOOT WIDE R.O.W. REQUIRED FOR BEREA ROAD, COLLECTOR. PROPOSED 22 FOOT WIDE DEDICATION PROPOSED ALONG WESTERLY P/L.
66 FOOT WIDE R.O.W. NORMANDY ROAD, ENHANCED LOCAL; NO CHANGE PROPOSED, PARTIAL QUITCLAIM/VACATION PROPOSED APPROXIMATELY 2 FOOT WIDE ALONG NORTHERLY NORMANDY R/W LINE.

LEGAL DESCRIPTION:
THE LAND REFERRED TO HEREIN BELOW IS SITUATED IN THE CITY OF MENIFEE, IN THE COUNTY OF RIVERSIDE, STATE OF CALIFORNIA, AND IS DESCRIBED AS FOLLOWS:

THE WEST HALF OF THE WEST HALF OF THE EAST HALF OF THE SOUTH HALF OF THE SOUTH HALF OF THE SOUTH HALF OF SECTION 32, TOWNSHIP 5 SOUTH, RANGE 3 WEST, SAN BERNARDINO MERIDIAN, IN THE CITY OF MENIFEE, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF.

EXCEPT THOSE PORTIONS CONVEYED TO THE COUNTY OF RIVERSIDE BY DEEDS RECORDED APRIL 9, 1903 IN BOOK 154 PAGE(S) 274 OF DEEDS, RECORDS OF RIVERSIDE COUNTY, CALIFORNIA, AND RECORDED SEPTEMBER 27, 1950 AS INSTRUMENT NO. 3428, IN BOOK 1207 PAGE(S) 269, OFFICIAL RECORDS OF RIVERSIDE COUNTY, CALIFORNIA.

UTILITY PURVEYORS & SCHOOLS:

WATER/ SEWER SERVICE:	EASTERN MUNICIPAL WATER DISTRICT
SEWER SERVICE:	EASTERN MUNICIPAL WATER DISTRICT
GAS:	SOUTHER CALIFORNIA GAS COMPANY
ELECTRICITY:	SOUTHERN CALIFORNIA EDISON
TEL./ CABLE:	AT&T/ FRONTIER COMMUNICATIONS
SCHOOL DISTRICT:	MENIFEE UNION/ PERRIS UNION

EXISTING EASEMENTS:
1. EASEMENT FOR FOR THE PURPOSE OF INGRESS AND EGRESS FOR ROAD AND UTILITY AND RIGHTS INCIDENTAL THERETO AS RESERVED IN A DOCUMENT BY USE INVESTMENT CORPORATION, RECORDED DECEMBER 31, 1968, NO: 127245, OFFICIAL RECORDS.
2. EASEMENT FOR THE THE PURPOSE OF PUBLIC ROAD AND DRAINAGE, INCLUDING PUBLIC UTILITY AND PUBLIC SERVICES PURPOSES AND RIGHTS INCIDENTAL THERETO, AS GRANTED IN A DOCUMENT TO THE COUNTY OF RIVERSIDE, A POLITICAL SUBDIVISION, RECORDED JANUARY 25, 2007, NO: 2007-0057488, OFFICIAL RECORDS.

PROPOSED EASEMENTS:
A. EASEMENT FOR RECIPROCAL ACCESS, DRAINAGE AND UTILITY PURPOSES.

PRELIMINARY EARTHWORK:
APPROXIMATE RAW CUT = 20,600 C.Y.
APPROXIMATE RAW FILL = 20,600 C.Y.

SURVEYOR'S NOTES:
1. THIS SURVEY WAS COMPLETED BY KOLIBRIEN CORP. FROM JANUARY 15TH THROUGH FEBRUARY 17TH, 2019.
2. THIS PROPOSED PROJECT SITE AREA CONTAINS 10.14 GROSS ACRES AND 9.51 NET ACRES.
3. IMPROVEMENTS WITHIN OFF-SITE EASEMENTS OR SERVITUDE BENEFITING THE PROPERTY ARE SHOWN ON THE FIELD TOPOGRAPHY.
4. NOT ALL UTILITIES LINES ARE SHOWN FOR CLARITY, I.E. TELEPHONE, CABLE AND GAS.
5. UTILITIES SHOWN ARE COMPRISED OF RECORD DATA AND FIELD SURVEY MEASUREMENTS.
6. RECORD DATA FOR SEWER AND WATER LINES WAS FOUND ON RECORD DRAWINGS D-1741, D-11675, D-11722, D-11723, D-29927, D-34057, D-34072, RECORDS OF EASTERN MUNICIPAL WATER DISTRICT.
7. RECORD DATA FOR STORM DRAIN LINES WAS FOUND ON RIVERSIDE COUNTY DRAWINGS BGR030936, CUP3286, AND RCFC&WCD DRAWING DWG 4-0547.
8. RECORD DATA FOR PROPERTY BOUNDARIES AND CENTERLINE MONUMENTS WAS FOUND ON RECORD DRAWINGS PM175/71-74, MB436/78-83,MB221/13-24, MB226/5-14, RS90/67, 2007-0057488, RECORDS OF RIVERSIDE COUNTY.
9. ALL ADJACENT RECORD BOUNDARY DATA SHOWN HAS BEEN ADJUSTED TO THE SAME BASIS OF BEARING AS THIS MAP.
10. WITH EXCEPTION TO MEASURED DISTANCE BETWEEN FOUND SURVEY MONUMENTS, ALL ALL PARCEL AND LOT LINES ARE SHOWN PER RECORD MAPS REFERENCED ABOVE.

MAINTENANCE:
ALL EXISTING AND PROPOSED MAINTENANCE SHALL BE THE RESPONSIBILITY OF THE PROPERTY OWNER. SPECIFIC MAINTENANCE REQUIREMENTS FOR WATER QUALITY BASINS AND RAINWATER HARVEST STORAGE RESERVOIRS IS OUTLINED IN THE PRELIMINARY WATER QUALITY MANAGEMENT PLAN AND SHALL BE FINALIZED BY AGREEMENT WITH CITY AT TIME OF WQMP APPROVAL. ALL ONSITE LANDSCAPE AND PRIVATE UTILITY MAINTENANCE SHALL BE THE RESPONSIBILITY OF THE OWNER. LOT 108 SHOWN ALONG NORMANDY IS ALREADY MAINTAINED BY CITY CFD AND IS OWNED BY ASSOCIATION. IF OWNER OF THIS PROJECT ACQUIRED LOT 108, 108 SHALL BE MAINTAINED BY OWNER.

ENGINEER'S NOTES:
1. ALL GUTTER FLOWLINE SLOPES SHALL BE 0.5% MINIMUM SLOPE AND DRAIN AS NOTED.
2. ALL PROPOSED CURB FACES SHALL BE 6" TALL PER CITY STANDARDS.
3. CURB ELEVATIONS HAVE BEEN OMITTED FOR CLARITY.
4. ALL FINISHED SURFACE GRADES SHALL GRADE TO DRAIN AT 1% MINIMUM.
5. MAXIMUM SITE FINISHED SURFACE SLOPES SHALL BE 4.9% UNLESS OTHERWISE NOTED.
6. EMBANKMENT SLOPES SHALL BE AS NOTED AND 2:1MAX.
7. ALL BLOCK/RETAINING WALLS SHOWN SHALL HAVE A FOOTING DEPTH OF 6" MIN. BELOW THE LOWEST ADJACENT FINISHED SURFACE OR FINISHED GROUND AS NOTED ON THE PLAN.
8. ONSITE PRIVATE FIRE WATER LOOPS SHALL BE 8" PVC C-900 PIPE AND RESTRAINED MECHANICAL JOINT DI FITTINGS.
9. ONSITE PRIVATE POTABLE WATER LOOP SHALL BE 3" PVC C-900 AND RESTRAINED MECHANICAL JOINT DI FITTINGS.
10. ONSITE PRIVATE IRRIGATION WATER MAIN SHALL BE 3" PVC SCHEDULE 40 PIPE AND FITTINGS.
8. ONSITE PRIVATE SEWER LINES SHALL BE 8" PVC SDR-35 PIPE AND FITTINGS WITH A GRADE OF 0.5% UNLESS OTHERWISE NOTED.
9. ONSITE SEWER MANHOLES SHALL BE PER EMWD STANDARDS AND AS NOTED.
12. ONSITE PRIVATE STORM DRAIN LINE SHALL BE PVC SDR-35 PIPE AND FITTINGS SIZED AS NOTED WITH CLEAN OUTS AS SHOWN WITH CIRCLE SYMBOLS.
13. ONSITE STORM DRAIN MANHOLES AND CATCH BASINS SHALL BE PER CITY & PER RCFC&WCD STANDARDS, AND AS NOTED.
14. ALL ONSITE STORMDRAIN PIPING SHALL BE DESIGNED TO CONVEY THE 100 YEAR STORM PEAK FLOWRATES AND SHALL HAVE A MINIMUM SLOPE OF 0.50% UNLESS OTHERWISE NOTED.
15. PROPOSED INCREASE IN STORMWATER VOLUME AND RUNOFF SHALL BE MITIGATED BY ADDITIONAL INFILTRATION/BIO-RETENTION PRETREATMENT BASINS, RAINWATER HARVEST STORAGE AND STORMWATER BMPS AS PROPOSED.
16. OFFSITE TRIBUTARY DRAINAGE SHALL BE COLLECTED AND CONVEYED THROUGH STORM DRAIN FACILITIES AS NOTED.
17. ALL OPEN SPACE AND LANDSCAPE AREAS SHALL DRAIN AT 1% MINIMUM TO LOWEST ADJACENT SPOT ELEVATIONS SHOWN.
18. YARD DRAINS ADJACENT TO PROPOSED BUILDINGS SHALL BE A MINIMUM OF 0.3' LOWER THAN THE ADJACENT BUILDING PAD ELEVATION.
19. EACH SELF TREATING DMA SHALL BE GRADED SUCH THAT RUNOFF FROM THE ENTIRE AREA IS DIRECTED TO THE AREA DRAIN AND NOT ALLOWED TO FLOW OFF TO THE ADJACENT SIDEWALK, AND NO RUNOFF FROM ANY ADJACENT IMPERVIOUS AREAS FROM OTHER DMAS SHALL BE ALLOWED TO FLOW TO SELF-TREATING DMA.
20. RETAINING CURBS SHALL BE PROVIDED AROUND BUILDING PERIMETERS WHERE THE ADJACENT FINISHED GRADES ARE HIGHER THAN THE BUILDING PAD ELEVATIONS AS NOTED ON THE PLANS AND SECTIONS.
21. A LICENSED PLUMBING ENGINEER SHALL DESIGN THE ROOF DRAINAGE SYSTEM WITH ROOF GUTTERS AND DOWNSPOUTS SUCH THAT ALL ROOF RUNOFF IS CAPTURED AND CONVEYED INTO THE PROPOSED PRETREATMENT SYSTEMS AND RAINWATER HARVEST AND REUSE TANKS; AND AS NOTED IN THE WQMP.

PLAN GENERAL NOTES:
1. THE PROPERTY OR A PORTION OF THE PROPERTY IS NOT WITHIN A HIGH FIRE HAZARD SEVERITY ZONE, AS DETERMINED BY THE DEPARTMENT OF FORESTRY AND FIRE PROTECTION PURSUANT TO SECTION 51178.
2. THE PROPERTY OR A PORTION OF THE PROPERTY IS NOT WITHIN ANY WETLANDS, AS DEFINED IN THE UNITED STATES FISH AND WILDLIFE SERVICES MANUAL, PART 660 FW 2 (JUNE 21, 1993).
3. ALL EXISTING AND PROPOSED FIRE HYDRANTS WITHIN 300 FEET OF THE PROPERTY ARE SHOWN.
4. NO KNOWN SPECIES OF SPECIAL CONCERN KNOWN OCCUR ON THE PROPERTY.
5. PROPERTY IS NOT WITHIN A COUNTY SERVICE AREA BUT IS WITHIN CFD 92-1 AND HAS A PENDING ASSESSMENT FOR COMMUNITY FACILITIES DISTRICT NO. 07-1 (NEWPORT / I-215 INTERCHANGE).
6. PROPERTY OR PORTION OF THE PROPERTY IS NOT WITHIN A HAZARDOUS WASTE SITE THAT IS LISTED PURSUANT TO SECTION 65962.5 OR A HAZARDOUS WASTE SITE DESIGNATED BY THE DEPARTMENT OF TOXIC SUBSTANCES CONTROL PURSUANT TO SECTION 25356 OF THE HEALTH AND SAFETY CODE.
7. NO SUBSURFACE SEPTIC SEWER DISPOSAL IS PROPOSED.
8. PROPERTY IS SUBJECT TO A LOW LIQUEFACTION POTENTIAL AND IS NOT IT WITHIN A SPECIAL STUDIES ZONE.
9. PORTION OF THE PROPERTY WAS WITHIN A SPECIAL FLOOD HAZARD AREA SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD (100-YEAR FLOOD) AS DETERMINED BY THE FEDERAL EMERGENCY MANAGEMENT AGENCY IN ANY OFFICIAL MAPS PUBLISHED BY THE FEDERAL EMERGENCY MANAGEMENT AGENCY. EFFECTIVE LOMR 13-09-037GP SHOWS DRAINAGE CHANNEL MITIGATION OF 100 YEAR FLOODPLAIN.
10. FEMA MAPPED FLOODPLAIN AND FLOODWAY LIMITS INCLUDING ZONE DESIGNATION SHOWN ON PLAN.
11. PROPERTY OR PORTION OF THE PROPERTY IS NOT WITHIN A DELINEATED EARTHQUAKE FAULT ZONE.
12. PROPERTY OR PORTION OF THE PROPERTY IS NOT WITHIN A STREAM OR OTHER RESOURCE THAT MAY BE SUBJECT TO A STREAMBED ALTERATION AGREEMENT PURSUANT TO CHAPTER 6 (COMMENCING WITH SECTION 1600) OF DIVISION 2 OF THE FISH AND GAME CODE.
13. HISTORIC OR CULTURAL RESOURCES KNOWN TO EXIST ON THE PROPERTY ARE SHOWN ON THE PLAN.
14. LOCATION AND DIMENSIONS OF EXISTING AND PROPOSED INGRESS AND EGRESS, AND METHODS OF VEHICLE CIRCULATION SHOWN ON PLAN.
15. WATER QUALITY FEATURES SHOWN ON PLAN. SEE PWQMP FOR ADDITIONAL INFORMATION.
16. NO PROPOSED POINT SOURCES OF AIR OR WATER POLLUTANTS OTHER THAN TYPICAL SHOWN IN PWQMP.

HYDROLOGY & WATER QUALITY SUMMARY:
SEE DRAINAGE STUDY AND PRELIMINARY WATER QUALITY MANAGEMENT PLAN FOR ADDITIONAL INFO.

UNIT HYDROGRAPH AND FLOOD ROUTING SUMMARY

STORM EVENT	DURATION	EXISTING PEAK FLOW (CFS)	EXISTING VOLUME (CF)	PROPOSED PEAK FLOW (CFS)	PROPOSED VOLUME (CF)	ROUTED PEAK FLOW (CFS)
10	3	11.51	39160	11.51	39645	7.7
	6	10.82	52955	9.55	50812	7.01
	24	3.54	61591	3.46	83057	3.27
100	3	19.29	74162	19.28	72439	13.1
	6	16.01	94300	15.92	90982	11.31
	24	6.57	149894	6.43	151510	6.14

RAINWATER HARVEST / STORMWATER RETENTION SUMMARY

STORM	VOLUME REQUIRED FOR BMP MITIGATION	VOLUME PROVIDED THROUGH RAINWATER HARVEST / RETENTION TANKS (CF)
ANY	15,194	21,511

EXISTING RATIONAL HYDROLOGY DATA

AREA ID	10 YEAR Q	100 YEAR Q
A1	8.67 CFS	13.67 CFS
B1	3.48 CFS	5.47 CFS
OA1	1.68 CFS	2.54 CFS
OB1	0.63 CFS	0.95 CFS

PROPOSED RATIONAL HYDROLOGY DATA

AREA ID	10 YEAR Q	100 YEAR Q
A1	5.92 CFS	8.94 CFS
A2	1.32 CFS	2.02 CFS
CONFLUENCE A1 AND A2	6.84 CFS	10.35 CFS
A3	2.19 CFS	3.23 CFS
CONFLUENCE WITH A3	8.92 CFS	13.41 CFS
A4	3.53 CFS	5.31 CFS
A5	5.25 CFS	7.71 CFS
CONFLUENCE A4 AND A5	8.34 CFS	12.29 CFS
CONFLUENCE TO NODE 12	16.55 CFS	24.54 CFS
OA1	1.64 CFS	2.49 CFS
OB1	0.64 CFS	0.93 CFS

LEGEND:

	POWER POLE	AV	AIR VALVE ASSEMBLY
	WATER METER		BLOCK/RETAINING WALL
	GUY ANCHOR	(XXXX)	MINOR CONTOUR 1 FT. INTERVAL
	VALVE	(XXXX)	MAJOR CONTOUR 5 FT. INTERVAL
	STREET LIGHT		FENCE
	STREET SIGN	SS	SANITARY SEWER LINE
	SEWER MANHOLE	W	WATER LINE
	SEWER CLEANOUT	SD	STORM DRAIN LINE
	STORM DRAIN MANHOLE		EDGE OF ASPHALT PAVEMENT
	UTILITY MANHOLE		(E) CONCRETE SURFACE
FH	FIRE HYDRANT		BUILDING
	CATCH BASIN		ROCK OUTCROPPING
	8" SEWER LINE		TREE
	WATER LINE AS NOTED		OPEN SPACE / LANDSCAPING
	FIRE LATERAL; PIV & FCA		BIO-RETENTION BASIN

GRAPHIC SCALE
40 0 20 40 80 120
(IN FEET)
1 inch = 40 ft.

PREPARED BY:

JOHN H. JOHNSON R.C.E. 83934 06/15/20 DATE PREPARED
MY REGISTRATION EXPIRES ON 09/30/2021

REGISTERED PROFESSIONAL ENGINEER JOHN H. JOHNSON No. 83934 CIVIL STATE OF CALIFORNIA

LICENSED LAND SURVEYOR JOHN H. JOHNSON No. 9457 STATE OF CALIFORNIA

KOLIBRIEN
LAND SURVEYING - CIVIL ENGINEERING - STRUCTURAL ENGINEERING

SHEET 1 OF 1
File: T05001

Appendix 3: Soils Information

Geotechnical Study and Other Infiltration Testing Data

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Western Riverside Area, California

October 18, 2020

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:1,590 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 20 40 80 120

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Western Riverside Area, California
Survey Area Data: Version 13, May 27, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 25, 2019—Jun 25, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
CkF2	Cieneba rocky sandy loam, 15 to 50 percent slopes, eroded	2.2	21.7%
Dv	Domino silt loam, saline-alkali	4.4	43.8%
GyD2	Greenfield sandy loam, 8 to 15 percent slopes, eroded	0.0	0.1%
MmB	Monserate sandy loam, 0 to 5 percent slopes	2.4	23.6%
VsC	Vista coarse sandy loam, 2 to 8 percent slopes	1.1	10.8%
Totals for Area of Interest		**10.0**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Western Riverside Area, California

CkF2—Cieneba rocky sandy loam, 15 to 50 percent slopes, eroded

Map Unit Setting

National map unit symbol: hcsf
Elevation: 500 to 4,000 feet
Mean annual precipitation: 12 to 35 inches
Mean annual air temperature: 57 to 64 degrees F
Frost-free period: 200 to 300 days
Farmland classification: Not prime farmland

Map Unit Composition

Cieneba and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cieneba

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Residuum weathered from igneous rock

Typical profile

H1 - 0 to 14 inches: sandy loam
H2 - 14 to 22 inches: weathered bedrock

Properties and qualities

Slope: 15 to 50 percent
Depth to restrictive feature: 14 to 22 inches to paralithic bedrock
Drainage class: Somewhat excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 1.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Ecological site: R019XD060CA - SHALLOW LOAMY (1975)
Hydric soil rating: No

Minor Components

Rock outcrop

Percent of map unit: 10 percent
Hydric soil rating: No

Unnamed
Percent of map unit: 3 percent
Hydric soil rating: No

Friant
Percent of map unit: 3 percent
Hydric soil rating: No

Escondido
Percent of map unit: 3 percent
Hydric soil rating: No

Vista
Percent of map unit: 3 percent
Hydric soil rating: No

Fallbrook
Percent of map unit: 3 percent
Hydric soil rating: No

Dv—Domino silt loam, saline-alkali

Map Unit Setting
National map unit symbol: hct8
Elevation: 1,000 to 1,800 feet
Mean annual precipitation: 12 inches
Mean annual air temperature: 63 degrees F
Frost-free period: 230 to 280 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Domino and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Domino

Setting
Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile
H1 - 0 to 14 inches: silt loam
H2 - 14 to 27 inches: silt loam
H3 - 27 to 36 inches: cemented
H4 - 36 to 63 inches: loam, sandy loam
H4 - 36 to 63 inches:

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 20 to 40 inches to duripan
Drainage class: Moderately well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Available water capacity: Very low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: D
Ecological site: R019XD068CA - SILTY BASIN
Hydric soil rating: No

Minor Components

Chino

Percent of map unit: 10 percent
Hydric soil rating: No

Willows

Percent of map unit: 4 percent
Hydric soil rating: No

Unnamed

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

GyD2—Greenfield sandy loam, 8 to 15 percent slopes, eroded

Map Unit Setting

National map unit symbol: hcvx
Elevation: 100 to 3,500 feet
Mean annual precipitation: 9 to 20 inches
Mean annual air temperature: 63 degrees F
Frost-free period: 200 to 300 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Greenfield and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Greenfield

Setting

Landform: Alluvial fans, terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

H1 - 0 to 26 inches: sandy loam
H2 - 26 to 43 inches: fine sandy loam
H3 - 43 to 60 inches: loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 8.3 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: A
Ecological site: R019XD029CA
Hydric soil rating: No

Minor Components

Hanford

Percent of map unit: 5 percent
Hydric soil rating: No

Arlington

Percent of map unit: 5 percent
Hydric soil rating: No

Pachappa

Percent of map unit: 5 percent
Hydric soil rating: No

MmB—Monserate sandy loam, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: hcx4

Elevation: 700 to 2,500 feet
Mean annual precipitation: 10 to 18 inches
Mean annual air temperature: 63 to 64 degrees F
Frost-free period: 220 to 280 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Monserate and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Monserate

Setting

Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

H1 - 0 to 10 inches: sandy loam
H2 - 10 to 28 inches: sandy clay loam
H3 - 28 to 45 inches: indurated
H4 - 45 to 57 inches: cemented
H5 - 57 to 70 inches: loamy coarse sand, coarse sandy loam
H5 - 57 to 70 inches:

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: 20 to 39 inches to duripan
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: R019XD029CA
Hydric soil rating: No

Minor Components

Greenfield

Percent of map unit: 5 percent
Hydric soil rating: No

Hanford

Percent of map unit: 5 percent
Hydric soil rating: No

Tujunga
Percent of map unit: 5 percent
Hydric soil rating: No

VsC—Vista coarse sandy loam, 2 to 8 percent slopes

Map Unit Setting
National map unit symbol: hczx
Elevation: 400 to 3,900 feet
Mean annual precipitation: 10 to 18 inches
Mean annual air temperature: 59 to 64 degrees F
Frost-free period: 210 to 300 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Vista and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Vista

Setting
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from granite and/or residuum weathered from granodiorite

Typical profile
H1 - 0 to 15 inches: coarse sandy loam
H2 - 15 to 24 inches: coarse sandy loam
H3 - 24 to 30 inches: weathered bedrock

Properties and qualities
Slope: 2 to 8 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.4 inches)

Interpretive groups
Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e

Hydrologic Soil Group: B
Ecological site: R019XD029CA
Hydric soil rating: No

Minor Components

Bonsall
Percent of map unit: 5 percent
Hydric soil rating: No

Fallbrook
Percent of map unit: 5 percent
Hydric soil rating: No

Cieneba
Percent of map unit: 5 percent
Hydric soil rating: No

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South Shore Testing & Environmental

23811 Washington Ave, Suite C110, #112, Murrieta, CA 92562 E-mail: ss.testing@aol.com
Phone: (951) 239-3008 FAX: (951) 239-3122

February 24, 2020

Mr. Rich Wilson
Trademark Construction Co., Inc.
15916 Bernardo Center Drive
San Diego, CA 92127

SUBJECT: **ONSITE STORMWATER INFILTRATION SYSTEM INVESTIGATION**
Proposed Multi-Family Residential Development
APN: 339-200-080, 9.92-Acres
NE Corner of Berea and Normandy Roads
City of Menifee, Riverside County, California
Work Order No. 4722002.01

Dear Mr. Wilson:

In accordance with your authorization, we have conducted percolation testing for the infiltration system for the proposed multi-family residential development. The purpose of our investigation was to provide infiltration rates for proposed infiltration systems. The proposed infiltration test areas were designated on a 40-scale Conceptual Site Plan (Summa Architecture, 2019) by the project civil engineer, Kolibrien Civil, Structural, and Surveying of Temecula, California.

Site Description

The subject site is a nearly square-shaped, 9.92-acre parcel of land located the northeast corner of Brea and Normandy Roads in the city of Menifee, Riverside County, California. The site is bordered on the north by a flood control channel and an existing single-family residential tract, on the west by Berea Road and a mini-storage facility, on the south by Normandy Road and a park, and on the east by vacant undeveloped land.

Topographically on the subject site, for the most part, consists of low rolling gently sloping terrain with natural gradients of less than 5 percent. The southeast corner of the site consists of a small hill with numerous large unweathered granitic boulders up to 20-ft in diameter. Natural gradients on the hill are approximately 15 percent. Drainage is accomplished by sheetflow to the northwest toward Berea Road and the flood control channel. Vegetation onsite generally consists of a sparse to moderate low dried growth of annual weeds and grasses.

Proposed Development

The proposed development consists of the construction of a multi-family residential development with interior parking and driveways, a 3-story commercial building, a fitness building, a clubhouse, a recreation area, and landscape area. The Conceptual Site Plan (Summa, 2019) depicts the extreme southeast corner of the site, which is underlain by numerous granitic boulders, is to remain vacant and in a relatively natural condition.

Percolation Investigation

Percolation testing was conducted on January 31, 2020 at locations designated by the project civil engineer. Six (6) tests were performed within the onsite late to middle Pleistocene-age Old alluvial fan deposits (Morton, 2003) on the northerly portion of the subject site. Six (6) exploratory trenches were advanced to a depth of 3-ft below the ground surface (bgs) with an infiltration test performed at the bottom of each trench. The Old alluvial fan deposits, for the most part, consisted of silty Sand (Unified Soil Classification – SM) that can generally be described as red to orange brown, fine to coarse grained, minor gravel size, abundant fines, dry (top 1-ft) to slightly moist, loose(top 2-ft) to medium dense to very dense and excavated with slight difficulty. Approximately 0.5 to 1-ft of undocumented fills were observed overlying the Old alluvial fan deposits in most areas. Infiltration test pits were advanced to a depth of 36-ft bgs utilizing a Case No. 590 extenda-backhoe equipped with a 18-inch bucket. Our field personnel logged the exploratory trenches and a copies of our Exploratory Trench Logs are presented in **Appendix B**.

GROUNDWATER

Groundwater was not encountered to the maximum depth explored of 16.2-ft below the ground surface (bgs) previously excavated on the northerly portion of the subject site (T.H.E., 2003). Based on historic regional groundwater information (DWR, 1978), regional high groundwater is at least 100-ft bgs on the lower elevations of the subject site. Minor fluctuations can and will likely occur in moisture or free water content of the soil owing to rainfall and irrigation over time.

SUMMARY OF TEST PROCEDURES

The testing procedure was performed in accordance with Riverside County Department of Environmental Health's "Local Management Program for Onsite Wastewater Treatment Systems", which became effective October 5, 2016 and the resulting perc rates were converted to infiltration rates utilizing the Porchet Method as outlined in the Riverside County Flood Control and Water Conservation District, "Design Handbook for Low Impact Development Best Management Practices" dated September 2011. The percolation tests were performed at a depth of 3-ft bgs (per

the project civil engineer). Owing to the mostly moderately fast rates the procedures for **Normal** soils were followed (see percolation test sheets).

Conclusion

Testing indicated infiltration rates at 3-ft below existing grade within the native soils obtained fast to moderately fast rates of 6.0 to 13.3-min/inch percolation rate. The percolation rates were converted to infiltration rate utilizing the Porchet Method. The converted infiltration rates varied from 1.1 to 3.5-inches/hr. The rate provided does not include a safety factor. The test locations are presented on our Infiltration Test Location Map, **Plate 1**.

PERCOLATION TEST NO.	DEPTH OF TEST BELOW GRADE (In Feet)	PERCOLATION RATE (Min/Inch	INFILTRATION RATE (In/Hr)
1	3	7.1	4.3
2	3	13.3	2.2
3	3	12.0	3.1
4	3	15.0	2.7
5	3	6.0	7.0
6	3	7.5	5.3

CLOSURE

It should be noted that infiltration rates determined by testing are ultimate rates based on short-duration field test results utilizing clear water. Infiltration rates can be affected by silt build-up, debris, degree of soil saturation, and other factors. An appropriate safety factor should be applied prior to use in design to account for subsoil inconsistencies, possible compaction related to site grading, and potential silting of the percolating soils. The safety factor should also be determined with consideration to other factors in the system design, particularly storm water volume estimates and the safety factors associated with those design components.

LIMITATIONS

The tested rates are representative for the areas and soil types tested. Should the systems be moved, or the exposed soil types are found to different within the proposed systems, the approved infiltration rates may not apply. Our investigation was performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable Geotechnical Engineers and Geologists practicing in this or similar localities. No other warranty, expressed or implied, is made as to the conclusions and professional advice included in this report.

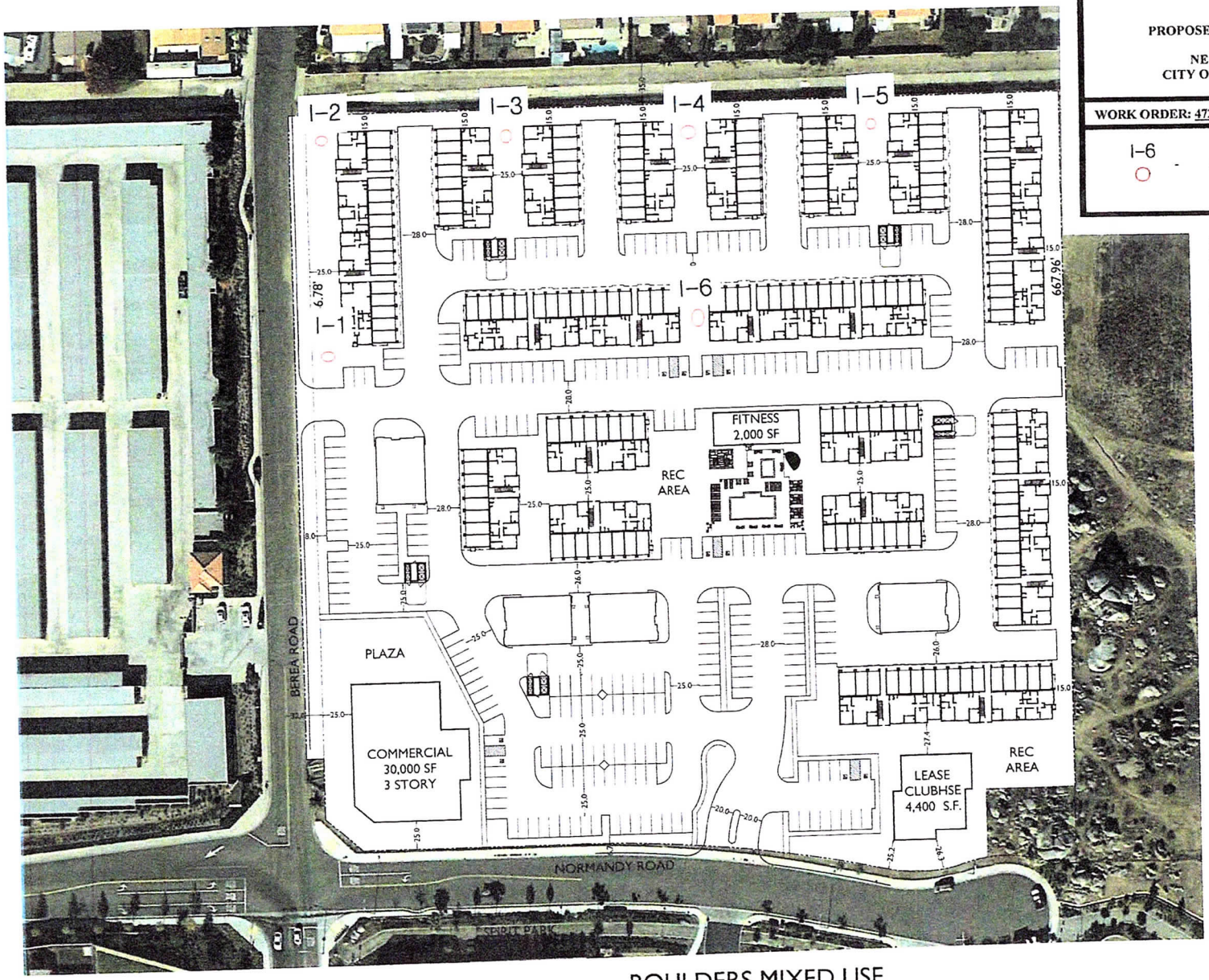
The report is issued with the understanding that it is used only by the owner and it is the sole responsibility of the owner or their representative to ensure that the information and

SOUTH SHORE TESTING & ENVIRONMENTAL

INFILTRATION TEST LOCATION MAP
PROPOSED MULTI-FAMILY RESIDENTIAL DEVELOPMENT
APN: 339-200-080, 9.92-ACRES
NE CORNER OF BEREA & NORMANDY ROADS
CITY OF MENIFEE, RIVERSIDE COUNTY, CALIFORNIA

WORK ORDER: 4722002.011 **DATE:** FEB. 2020 **PLATE:** 1 OF 1

I-6 ○ - APPROXIMATE LOCATION OF INFILTRATION TESTS



265 OPEN/CARPORT STALLS
490 TOTAL STALLS PROVIDED

96 1 BDRM UNITS @ 1.0 ST/UNIT =	96 STALLS
116 2 BDRM UNITS @ 1.5 ST/UNIT =	174 STALLS
26 3 BDRM UNITS @ 2.5 ST/UNIT =	65 STALLS
GUEST STALLS (1 PER 10 UNITS) =	24 STALLS
TOTAL RESID. PARKING REQ'D =	359 STALLS
COMMERCIAL STALLS REQ'D (3:1000) =	90 STALLS
TOTAL STALLS REQUIRED	449 STALLS

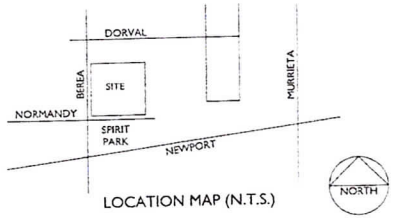
DWELLING UNIT SUMMARY

PLAN 1	1BD/1BA	700 SF	96 UNITS	12.5%
PLAN 2	2BD/2BA	980 SF	116 UNITS	20.1%
PLAN 3	3BD/2BA	1,200 SF	26 UNITS	9.8%

SITE AREA	432,115 SF
RESIDENTIAL AREA	260,000 SF (0.59 FAR)
RESIDENTIAL GARAGES	52,800 SF (0.11 FAR)
COMMERCIAL AREA	30,000 SF (0.07 FAR)
TOTAL BUILDING AREA	342,800 SF
F.A.R.	0.8 (1.0 ALLOWED)

STATEMENT OF OPERATIONS

HORIZONTAL MIXED USE WITH WALK-UP TYPE APARTMENTS. COMMERCIAL SPACE TO CONSIST OF OFFICE SPACE AND CHILD CARE FACILITIES. EMPLOYEES AND USERS TO BE DETERMINED PER SCHEMATIC DESIGN..



LOCATION MAP (N.T.S.)

MENIFEE, CA

BOULDERS MIXED USE

CONCEPTUAL SITE PLAN

TRADEMARK CONSTRUCTION
15916 BERNARDO CENTER DRIVE
SAN DIEGO, CA 92127
(760) 489-9563

Scale 0 40 80 120

JAN 13, 2019

SUMMA ARCHITECTURE
5256 S. MISSION ROAD STE. 404
BONSALL, CA. 92003
760.724.1198

SP

1/13/2020 4:57:36 PM

recommendations contained herein are brought to the attention of the architect, engineer, and appropriate jurisdictional agency for the project and incorporated into the plans; and the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations contained herein during construction and in the field.

The samples taken and used for testing and the observations made are believed representative; however, soil and geologic conditions can vary significantly between test locations. The evaluation or identification of the potential presence of hazardous or corrosive materials was not part of the scope of services provided by **South Shore Testing & Environmental**, or its assigns.

The findings of this report are valid as of the present date. However, changes in the condition of a property can occur with the passage of time, whether due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and revision as changed conditions are identified. The firm that performed the geotechnical investigation for this project should be retained to provide testing observation services during construction to maintain continuity of geotechnical interpretation and to check that the recommendations presented herein are implemented during construction of improvements.

If another geotechnical firm is selected to perform the testing and observation services during construction operations, that firm should prepare a letter indicating their intent to assume the responsibilities of project geotechnical engineer of record. Selection of another firm to perform any of the recommended activities or failure to retain the undersigned to perform the recommended activities wholly absolves **South Shore Testing & Environmental**, the undersigned, and its assigns from any and all liability arising directly or indirectly from any aspects of this project.

We appreciate the opportunity to be of service. Limitations and conditions contained in reference documents are considered in full force and applicable. If you have any questions, please do not hesitate to call our office.

Respectfully Submitted,

South Shore Testing & Environmental

John P. Frey
Project Manager

William C. Hobbs, RCE 42265
Civil Engineer

ATTACHMENTS

Plate 1 – Infiltration Test Location Map
Appendix A –References
Appendix B – Exploratory Trench Logs
Appendix C - Percolation Test Data

APPENDIX A

References

REFERENCES

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APPENDIX B

Exploratory Trench Logs

LOGGED BY: JPF

METHOD OF EXCAVATION: CASE #580 N BACKHOE EQUIPPED W/ 18" BUCKET

ELEVATION: ±

DATE OBSERVED: 1/30/2020

LOCATION: SEE PLATE 1

DEPTH (FEET)	CLASSIFICATION	BLOWS/FOOT	UNDISTURBED SAMPLE	BULK SAMPLE	MOISTURE CONTENT(%)	INPLACE DRY DENSITY (PCF)	TEST PIT NO.__1__ DESCRIPTION	SOIL TEST
							UNDOCUMENTED FILL	
							SILTY SAND (SM): DARK BROWN, FINE TO COARSE GRAINED, MINOR GRAVEL, LOOSE	
							POROUS	INFILTRATION TEST
							OLD ALLUVIAL DEPOSITS	
5							SILTY SAND (SM): RED BROWN, FINE TO COARSE GRAINED, ABUNDANT FINES, MINOR	
							PINPOINT PORES IN UPPER 1 -FT, MINOR GRAVEL SIZE, DENSITY INCREASES W/ DEPTH	
							SLIGHTLY MOIST	
							TOTAL DEPTH=10.2FT	
10							**NO GROUNDWATER**	
							NO CAVING	
15								
20								
25								
30								
35								
40								

JOB NO: 4722002.00

LOG OF TEST PIT

FIGURE: T-1

OGGED BY: JPF

METHOD OF EXCAVATION: CASE #580 N BACKHOE EQUIPPED W/ 18" BUCKET

ELEVATION: ±

DATE OBSERVED: 1/30/2020

LOCATION: SEE PLATE 1

DEPTH (FEET)	CLASSIFICATION	BLOWS/FOOT	UNDISTURBED SAMPLE	BULK SAMPLE	MOISTURE CONTENT(%)	INPLACE DRY DENSITY (PCF)

TEST PIT NO.__2__

DESCRIPTION

UNDOCUMENTED FILL

SANDY SILT (ML): DARK BROWN, MINOR SAND, LOOSE, POROUS

OLD ALLUVIAL DEPOSITS

SILTY SAND (SM): REDDISH BROWN, FINE TO COARSE GRAINED, NUMEROUS PINPOINT PORES AND FINE ROOTS IN TOP 1 FT, MINOR GRAVEL SZ, SLIGHTLY MOIST, INCREASING IN DENSITY WITH DEPTH

TOTAL DEPTH=10.2FT

NO GROUNDWATER

NO CAVING

SOIL TEST

INFILTRATION TEST

JOB NO: 4722002.00

LOG OF TEST PIT

FIGURE: T-2

LOGGED BY: JPF

METHOD OF EXCAVATION: CASE #580 N BACKHOE EQUIPPED W/ 18" BUCKET

ELEVATION: ±

DATE OBSERVED: 1/30/2020

LOCATION: SEE PLATE 1

DEPTH (FEET)	CLASSIFICATION	BLOWS/FOOT	UNDISTURBED SAMPLE	BULK SAMPLE	MOISTURE CONTENT(%)	INPLACE DRY DENSITY (PCF)

TEST PIT NO.__3__

DESCRIPTION

SOIL TEST

UNDOCUMENTED FILL

ALLUVIAL FAN DEPOSITS

SILTY SAND (SM): DARK RED BROWN, FINE TO MEDIUM GRAINED, MINOR COARSE, MODERATELY SORTED, SLIGHTLY MOIST, NUMEROUS PINPOINT PORES IN UPPER 1-2 FT

INFILTRATION TEST

TOTAL DEPTH=3.0FT

NO GROUNDWATER

NO CAVING

5

10

15

20

25

30

35

40

JOB NO: 4722002.00

LOG OF TEST PIT

FIGURE: T-3

OGGED BY: JPF

METHOD OF EXCAVATION: CASE #580 N BACKHOE EQUIPPED W/ 18" BUCKET

ELEVATION: ±

DATE OBSERVED: 1/30/2020

LOCATION: SEE PLATE 1

DEPTH (FEET)	CLASSIFICATION	BLOWS/FOOT	UNDISTURBED SAMPLE	BULK SAMPLE	MOISTURE CONTENT(%)	INPLACE DRY DENSITY (PCF)

TEST PIT NO.__4__

DESCRIPTION

SOIL TEST

UNDOCUMENTED FILL

SILTY SAND (SM): DARK BROWN, FINE TO MEDIUM GRAINED, MINOR COARSE, LOOSE, POROUS

INFILTRATION TEST

OLD ALLUVIAL FAN DEPOSITS

SILTY SAND (SM): DARK RED BROWN, FINE TO COARSE GRAINED, MODERATELY SORTED, LOOSE TO MEDIUM DENSE, MINOR GRAVEL SIZE

TOTAL DEPTH 3.0FT

NO GROUNDWATER

NO CAVING

5

10

15

20

25

30

35

40

JOB NO: 4722002.00

LOG OF TEST PIT

FIGURE: T-4

LOGGED BY: JPF	METHOD OF EXCAVATION: CASE #580 N BACKHOE EQUIPPED W/ 18" BUCKET ELEVATION: ±	DATE OBSERVED: 1/30/2020 LOCATION: SEE PLATE 1

DEPTH (FEET)	CLASSIFICATION	BLOWS/FOOT	UNDISTURBED SAMPLE	BULK SAMPLE	MOISTURE CONTENT(%)	INPLACE DRY DENSITY (PCF)	TEST PIT NO. 5 DESCRIPTION	SOIL TEST
							UNDOCUMENTED FILL SANDY SILT (ML) DARK BROWN, DRY, LOOSE, POROUS, MINOR CONSTRUCTION DEBRIS POROUS	INFILTRATION TEST
5							**OLD ALLUVIAL FAN DEPOSITS** SILTY SAND (SM): DARK RED BROWN, FINE TO COARSE GRAINED, MINOR GRAVEL SIZE, MODERATELY SORTED, SLIGHTLY MOIST, DENSITY INCREASING WITH DEPTH	
10							**TOTAL DEPTH 3.0FT** **NO GROUNDWATER** **NO CAVING**	
15								
20								
25								
30								
35								
40								

JOB NO: 4722002.00	LOG OF TEST PIT	FIGURE: T-5

LOGGED BY: JPF	METHOD OF EXCAVATION: CASE #580 N BACKHOE EQUIPPED W/ 18" BUCKET ELEVATION: ±	DATE OBSERVED: 1/30/2020 LOCATION: SEE PLATE 1

DEPTH (FEET)	CLASSIFICATION	BLOWS/FOOT	UNDISTURBED SAMPLE	BULK SAMPLE	MOISTURE CONTENT(%)	INPLACE DRY DENSITY (PCF)	TEST PIT NO. 6 DESCRIPTION	SOIL TEST
							UNDOCUMENTED FILL	
							GRAVELLY SANDY SILT(ML): DARK BROWN, SANDY IN PART, DRY, LOOSE, MINOR CONSTRUCTION DEBRIS	INFILTRATION TEST
5							**OLD ALLUVIAL FAN DEPOSITS**	
							SILTY SAND (SM): DARK RED BROWN, FINE TO COARSE GRAINED, LOOSE IN UPPER 2-FT, SLIGHTLY MOIST, INCREASING IN DENSITY WITH DEPTH	
10							**TOTAL DEPTH 3.0FT** **NO GROUNDWATER** **NO CAVING**	
15								
20								
25								
30								
35								
40								

JOB NO: 4722002.00	LOG OF TEST PIT	FIGURE: T-6

APPENDIX C

Percolation Test Results

Appendix 4

Leach Line Percolation Data Sheet

Project Trademark	Job No. 472002.01	
Test Hole No. I-1	Date Excavated: 1-30-2020	
Depth of Test Hole: 36"	Soil Classification SM-ML	
Check for Sandy Soil Criteria Tested by: JPF	Date:	Presoak: 1-30-2020
Actual Percolation Tested by: JPF	Date:	1-31-2020

Sandy Soil Criteria Test

Trial No.	Time	Time Interval (Min)	Initial Water Level (Inches)	Final Water Level (Inches)	▲in Water Level (Inches)
1	8:30 / 8:55	25	6"	0.25	5 3/4
2					

Use(Normal) Sandy (Circle One) Soil Criteria

Time	Time Interval (Min)	Total Elapsed Time (Min)	Initial Water Level (Inches)	Final Water Level (Inches)	▲in Water Level (Inches)	Percolation Rate (Min/Inch)
9:48 / 10:18	30	30	6"	1.0	5"	6.0
10:18 / 10:48	30	60	6"	1 1/2	4 1/2	6.7
10:48 / 11:18	30	90	6"	1 3/4	4 1/4	7.1
11:18 / 11:48	30	120	6"	1 3/4	4 1/4	7.1
11:48 / 12:18	30	150	6"	1 3/4	4 1/4	7.1
12:18 / 12:48	30	180	6"	1 3/4	4 1/4	7.1
12:48 / 1:18	30	240	6"	1 3/4	4 1/4	7.1

Appendix 4

Leach Line Percolation Data Sheet

Project Trademark	Job No. 472002.01	
Test Hole No. I-2	Date Excavated: 1-30-2020	
Depth of Test Hole: 36"	Soil Classification SM-ML	
Check for Sandy Soil Criteria Tested by: JPF	Date:	Presoak: 1-30-2020
Actual Percolation Tested by: JPF	Date:	1-31-2020

Sandy Soil Criteria Test

Trial No.	Time	Time Interval (Min)	Initial Water Level (Inches)	Final Water Level (Inches)	▲in Water Level (Inches)
1	8:32 / 8:57	25	6 5/16	2 1/4	3 3/4
2					

Use: Normal Sandy (Circle One) Soil Criteria

Time	Time Interval (Min)	Total Elapsed Time (Min)	Initial Water Level (Inches)	Final Water Level (Inches)	▲in Water Level (Inches)	Percolation Rate (Min/Inch)
9:51 / 10:21	30	30	6"	2.5	3.5	8.6
10:21 / 10:51	30	60	6"	2.75	3 1/4	9.2
10:51 / 11:21	30	90	6"	3"	3"	10
11:21 / 11:51	30	120	6"	3 1/2	2 1/2	12
11:51 / 12:21	30	150	6"	3 3/4	2 1/4	13.3
12:21 / 12:51	30	180	6"	3 3/4	2 1/4	13.3
12:51 / 1:21	30	240	6"	3 3/4	2 1/4	13.3

Appendix 4

Leach Line Percolation Data Sheet

Project Trademark	Job No. 472.2002.01	
Test Hole No. I-3	Date Excavated: 1-30-2020	
Depth of Test Hole: 36"	Soil Classification SM-ML	
Check for Sandy Soil Criteria Tested by: JPF	Date:	Presoak: 1-30-2020
Actual Percolation Tested by: JPF	Date:	1-31-2020

Sandy Soil Criteria Test

Trial No.	Time	Time Interval (Min)	Initial Water Level (Inches)	Final Water Level (Inches)	▲in Water Level (Inches)
1	8:34 / 8:59	25	6	2.75	3 1/4
2					

Use (Normal) Sandy (Circle One) Soil Criteria

Time	Time Interval (Min)	Total Elapsed Time (Min)	Initial Water Level (Inches)	Final Water Level (Inches)	▲in Water Level (Inches)	Percolation Rate (Min/Inch)
9:52 / 10:22	30	30	6 0/16	2.5	3 1/2	8.6
10:22 / 10:52	30	60	6 0/16	3.0	3.0	10
10:52 / 11:22	30	90	6 0/16	3.0	3.0	10
11:22 / 11:52	30	120	6 0/16	3 1/4	2 3/4	10.9
11:52 / 12:22	30	150	6 0/16	3 1/4	2 3/4	10.9
12:22 / 12:52	30	180	6 0/16	3 1/4	2 1/2	12
12:52 / 1:22	30	240	6 0/16	3 1/4	2 1/2	12

Appendix 4

Leach Line Percolation Data Sheet

Project Trademark	Job No. 472.2002.01	
Test Hole No. I-4	Date Excavated: 1-30-2020	
Depth of Test Hole: 36"	Soil Classification SM-ML	
Check for Sandy Soil Criteria Tested by: JPF	Date:	Presoak: 1-30-2020
Actual Percolation Tested by: JPF	Date:	1-31-2020

Sandy Soil Criteria Test

Trial No.	Time	Time Interval (Min)	Initial Water Level (Inches)	Final Water Level (Inches)	▲in Water Level (Inches)
1	8:36 / 9:01	25	6"	2 3/4	3 1/4
2					

Use: Normal Sandy (Circle One) Soil Criteria

Time	Time Interval (Min)	Total Elapsed Time (Min)	Initial Water Level (Inches)	Final Water Level (Inches)	▲in Water Level (Inches)	Percolation Rate (Min/Inch)
9:55 / 10:25	30	30	6 5/16	3"	3"	10
10:25 / 10:55	30	60	6"	3 1/2	2 1/2	12
10:55 / 11:25	30	90	6"	3 3/4	2 1/4	13.3
11:25 / 11:55	30	120	6"	3 3/4	2 1/4	13.3
11:55 / 12:25	30	150	6"	4"	2"	15
12:25 / 12:55	30	180	6"	4"	2"	15
12:55 / 11:25	30	240	6"	4,0	2"	15

Appendix 4

Leach Line Percolation Data Sheet

Project Trademark	Job No. 472002.01	
Test Hole No. I-5	Date Excavated: 1-30-2020	
Depth of Test Hole: 36"	Soil Classification SM-ML	
Check for Sandy Soil Criteria Tested by: JPF	Date:	Presoak: 1-30-2020
Actual Percolation Tested by: JPF	Date:	1-31-2020

Sandy Soil Criteria Test

Trial No.	Time	Time Interval (Min)	Initial Water Level (Inches)	Final Water Level (Inches)	▲in Water Level (Inches)
1	8:39 / 9:04	25	6 1/16	1/4	5 3/4
2					

Use (Normal) Sandy (Circle One) Soil Criteria

Time	Time Interval (Min)	Total Elapsed Time (Min)	Initial Water Level (Inches)	Final Water Level (Inches)	▲in Water Level (Inches)	Percolation Rate (Min/Inch)
11:00 / 11:30	30	30	6"	1/2	5 1/2	5.5
11:30 / 12:00	30	60	6"	1/2	5 1/2	5.5
12:00 / 12:30	30	90	6"	3/4	5 1/4	5.7
12:30 / 1:00	30	120	6"	1"	5"	6"
1:00 / 1:30	30	150	6"	1"	5"	6"
1:30 / 2:00	30	180	6"	1"	5"	6"
2:00 / 2:30	30	240	6"	1"	5"	6"

Appendix 4

Leach Line Percolation Data Sheet

Project Trademark	Job No. 472.2002.01	
Test Hole No. I-6	Date Excavated: 1-30-2020	
Depth of Test Hole: 36"	Soil Classification SM-ML	
Check for Sandy Soil Criteria Tested by: JPF	Date:	Presoak: 1-30-2020
Actual Percolation Tested by: JPF	Date:	1-31-2020

Sandy Soil Criteria Test

Trial No.	Time	Time Interval (Min)	Initial Water Level (Inches)	Final Water Level (Inches)	▲in Water Level (Inches)
1	8:42 / 9:07	25	6 1/16	1 1/2	4 1/2
2					

Use: (Normal) Sandy (Circle One) Soil Criteria

Time	Time Interval (Min)	Total Elapsed Time (Min)	Initial Water Level (Inches)	Final Water Level (Inches)	▲in Water Level (Inches)	Percolation Rate (Min/Inch)
11:05 / 11:35	30	30	6"	1 3/4	4 1/4	7.1
11:35 / 12:05	30	60	6"	1 3/4	4 1/4	7.1
12:05 / 12:35	30	90	6"	2"	4"	7.5
12:35 / 1:05	30	120	6"	2"	4"	7.5
1:05 / 1:35	30	150	6"	2"	4"	7.5
1:35 / 2:05	30	180	6"	2"	4"	7.5
2:05 / 2:35	30	240	6"	2"	4"	7.5

Appendix 4: Historical Site Conditions

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

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

(Rev. 10-2011)

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 KOLIBRIEN CORP. Date 10/22/2020

Designed by JJ Case No 1

Company Project Number/Name Boulder Mixed Use Project

BMP Identification

BMP NAME / ID DMA1-D1 - DETENTION CHAMBER WITH HARVEST AND REUSE

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}= 0.60 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 Impervious 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)*
DMA1-D1	*137267.2*	*Roofs*	*1*	*0.89*	*122442.3*			
	191861.8	*Concrete or Asphalt*	*1*	*0.89*	*171140.7*			
	84139.8	*Ornamental Landscaping*	*0.1*	*0.11*	*9293.9*			
	413268.8	***Total***			**302876.9**	**0.60**	**15194.3**	**21511**

Notes:

DETENTION CHAMBER HYDRAULICS (Stage vs. Discharge)

V = Volume at depth d	V	ft³
D = Depth of basin ponding	d	ft
Elevation of weir crest	10	ft
Height of weir above the crest	0.5	ft
Horizontal weir length	0.5	ft
Number of Oriface Openings	1	
Oriface Diameter	0.5	in
Number of Oriface Openings	22	
Oriface Diameter	3	in
Number of Oriface Openings	10	
Oriface Diameter	3	in

3

Basin Outlet is 24" HDPE with 1% slope (see pipe hydraulics)

			Oriface @ 0"	Oriface @ 5.5'	Oriface @ 6'	Weir @ 9.5'	Total Outflow
Stage	**Storage**	**Storage**	**Discharge**	**Discharge**	**Discharge**	**Discharge**	**Discharge**
d (ft)	**V (ft³)**	**V (acre-ft)**	**Qout (ft³/s)**	**Qout (ft³/s)**	**Qout (ft³/s)**	**Qout (ft³/s)**	**Q (ft³/s)**
0.00	0.00	0.0000	0.00			0.00	0.00
0.50	713.52	0.0164	0.00			0.00	0.00
1.00	1986.54	0.0456	0.01			0.00	0.01
1.50	3590.31	0.0824	0.01			0.00	0.01
2.00	5434.64	0.1248	0.01			0.00	0.01
2.50	7462.35	0.1713	0.01			0.00	0.01
3.00	9630.98	0.2211	0.01			0.00	0.01
3.50	11906.05	0.2733	0.01			0.00	0.01
4.00	14257.77	0.3273	0.01			0.00	0.01
4.50	16659.23	0.3824	0.01			0.00	0.01
5.00	19085.18	0.4381	0.01			0.00	0.01
5.50	21511.12	0.4938	0.02	0.00		0.00	0.02
6.00	23912.58	0.5490	0.02	3.18	0.00	0.00	3.20
6.50	26264.30	0.6029	0.02	4.86	1.45	0.00	6.33
7.00	28539.37	0.6552	0.02	6.10	1.87	0.00	7.98
7.50	30708.00	0.7050	0.02	7.12	2.51	0.00	9.64
8.00	32735.71	0.7515	0.02	8.01	3.01	0.00	11.04
8.50	34580.04	0.7938	0.02	8.82	3.45	0.00	12.28
9.00	36183.81	0.8307	0.02	9.55	3.83	0.00	13.40
9.50	37456.83	0.8599	0.02	10.24	4.18	0.00	14.43
10.00	38170.35	0.8763	0.02	10.88	4.50	0.00	15.40

Adjusted 100 Year Storm Peak Flow Time of Concentration

$$Q = C_o A_o (2gH_o)^{0.5}$$

Q = the orifice Flow rate, m^3/s (ft^3/s)
C_o = discharge coefficient (0.40 - 0.60)
Ao = area of orifice, m^2 (ft^2)
H_o = effective head on the orifice measured from the centroid of the opening, m (ft)
g = gravitational acceleration, 9.81 m/s^2 (32.2 ft/s^2 for English units)

$$Q = C_{scw} L H^{1.5}$$

Q = discharge, m^3/s (ft^3/s)
L = horizontal weir length, m (ft)
H = head above weir crest excluding velocity head, m (ft)
C_{SCW} = 1.81 + 0.22 (H/H_c) [3.27 + 0.4 (H/H_c) in English units]

Completed by:	**RJD**
Checked by:	**JHJ**
Date:	**10/24/2020**
Sheet:	**1 of 1**

Appendix 5: LID Infeasibility

LID Technical Infeasibility Analysis

Appendix 6: BMP Design Details

BMP Sizing, Design Details and other Supporting Documentation

Appendix 7: Hydromodification

Supporting Detail Relating to Hydrologic Conditions of Concern

Appendix 8: Source Control

Pollutant Sources/Source Control Checklist

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.1on 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 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ A. **On-site storm drain inlets**	❑ **Locations of inlets.**	❑ **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.**	❑ **Maintain and periodically repaint or replace inlet markings.** ❑ **Provide stormwater pollution prevention information to new site owners, lessees, or operators.** ❑ **See applicable operational BMPs in Fact Sheet SC-44, "Drainage System Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com** ❑ **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."**
❑ B. **Interior floor drains and elevator shaft sump pumps**		❑ **State that interior floor drains and elevator shaft sump pumps will be plumbed to sanitary sewer.**	❑ **Inspect and maintain drains to prevent blockages and overflow.**
❑ C. **Interior parking garages**		❑ **State that parking garage floor drains will be plumbed to the sanitary sewer.**	❑ **Inspect and maintain drains to prevent blockages and overflow.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☑ D1. **Need for future indoor & structural pest control**		☐ **Note building design features that discourage entry of pests.**	☑ **Provide Integrated Pest Management information to owners, lessees, and operators.**
☑ D2. **Landscape/ Outdoor Pesticide Use**	☐ **Show locations of native trees or areas of shrubs and ground cover to be undisturbed and retained.** ☐ **Show self-retaining landscape areas, if any.** ☐ **Show stormwater treatment and hydrograph modification management BMPs. (See instructions in Chapter 3, Step 5 and guidance in Chapter 5.)**	**State that final landscape plans will accomplish all of the following.** ☐ **Preserve existing native trees, shrubs, and ground cover to the maximum extent possible.** ☑ ☐ **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.** **Where landscaped areas are used to retain or detain stormwater, specify plants that are tolerant of saturated soil conditions.** ☐ **Consider using pest-resistant plants, especially adjacent to hardscape.** ☑ ☐ **To insure successful establishment, select plants appropriate to site soils, slopes, climate, sun, wind, rain, land use, air movement, ecological consistency, and plant interactions.**	☑ **Maintain landscaping using minimum or no pesticides.** ☑ **See applicable operational BMPs in "What you should know for…..Landscape and Gardening"** at http://rcflood.org/stormwater/**Error! Hyperlink reference not valid.** ☐ **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 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☐ E. **Pools, spas, ponds, decorative fountains, and other water features.**	☐ **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.**	☐ **See applicable operational BMPs in** "Guidelines for Maintaining Your Swimming Pool, Jacuzzi and Garden Fountain" at http://rcflood.org/stormwater/
☐ F. **Food service**	☐ **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.** ☐ **On the drawing, show a note that this drain will be connected to a grease interceptor before discharging to the sanitary sewer.**	☐ **Describe the location and features of the designated cleaning area.** ☐ **Describe the items to be cleaned in this facility and how it has been sized to insure that the largest items can be accommodated.**	☐ **See the brochure, "**The Food Service Industry Best Management Practices for: Restaurants, Grocery Stores, Delicatessens and Bakeries" at http://rcflood.org/stormwater/ **Provide this brochure to new site owners, lessees, and operators.**
☑ G. **Refuse areas**	☑ **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.** ☑ **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.** ☐ **Any drains from dumpsters, compactors, and tallow bin areas shall be connected to a grease removal device before discharge to sanitary sewer.**	☑ **State how site refuse will be handled and provide supporting detail to what is shown on plans.** ☑ **State that signs will be posted on or near dumpsters with the words "Do not dump hazardous materials here" or similar.**	☑ **State how the following will be implemented:** **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 www.cabmphandbooks.com**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ H. **Industrial processes.**	❑ **Show process area.**	❑ **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."**	❑ **See Fact Sheet SC-10, "Non-Stormwater Discharges" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com** See the brochure "Industrial & Commercial Facilities Best Management Practices for: Industrial, Commercial Facilities" at http://rcflood.org/stormwater/

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ I. **Outdoor storage of equipment or materials. (See rows J and K for source control measures for vehicle cleaning, repair, and maintenance.)**	❑ **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.** ❑ **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.** ❑ **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.**	**Include a detailed description of materials to be stored, storage areas, and structural features to prevent pollutants from entering storm drains.** **Where appropriate, reference documentation of compliance with the requirements of Hazardous Materials Programs for:** ▪ **Hazardous Waste Generation** ▪ **Hazardous Materials Release Response and Inventory** ▪ **California Accidental Release (CalARP)** ▪ **Aboveground Storage Tank** ▪ **Uniform Fire Code Article 80 Section 103(b) & (c) 1991** ▪ **Underground Storage Tank** **www.cchealth.org/groups/hazmat/**	❑ **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 www.cabmphandbooks.com**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ J. **Vehicle and Equipment Cleaning**	❑ **Show on drawings as appropriate:** **(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.** **(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).** **(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.** **(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.**	❑ **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.**	**Describe operational measures to implement the following (if applicable):** ❑ **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 http://rcflood.org/stormwater/ ❑ **Car dealerships and similar may rinse cars with water only.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ K. **Vehicle/Equipment Repair and Maintenance**	❑ **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.** ❑ **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.** ❑ **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.**	❑ **State that no vehicle repair or maintenance will be done outdoors, or else describe the required features of the outdoor work area.** ❑ **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.** ❑ **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.**	**In the Stormwater Control Plan, note that all of the following restrictions apply to use the site:** ❑ **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.** ❑ **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.** ❑ **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.** Refer to "Automotive Maintenance & 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 http://rcflood.org/stormwater/ 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 http://rcflood.org/stormwater/

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ L. **Fuel Dispensing Areas**	❑ **Fueling areas[6] 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.** ❑ **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[1].] The canopy [or cover] shall not drain onto the fueling area.**		❑ **The property owner shall dry sweep the fueling area routinely.** ❑ **See the Fact Sheet SD-30 , "Fueling Areas" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

[6] **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.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ M. **Loading Docks**	❑ **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.** ❑ **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.** ❑ **Provide a roof overhang over the loading area or install door skirts (cowling) at each bay that enclose the end of the trailer.**		❑ **Move loaded and unloaded items indoors as soon as possible.** ❑ **See Fact Sheet SC-30, "Outdoor Loading and Unloading," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☑ N. **Fire Sprinkler Test Water**		☑ **Provide a means to drain fire sprinkler test water to the sanitary sewer.**	☑ **See the note in Fact Sheet SC-41, "Building and Grounds Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**
O. **Miscellaneous Drain or Wash Water or Other Sources** ☐ **Boiler drain lines** ☐ **Condensate drain lines** ☐ **Rooftop equipment** ☐ **Drainage sumps** ☐ **Roofing, gutters, and trim.** ☐ **Other sources**		☐ **Boiler drain lines shall be directly or indirectly connected to the sanitary sewer system and may not discharge to the storm drain system.** ☐ **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.** ☐ **Rooftop equipment with potential to produce pollutants shall be roofed and/or have secondary containment.** ☐ **Any drainage sumps on-site shall feature a sediment sump to reduce the quantity of sediment in pumped water.** ☐ **Avoid roofing, gutters, and trim made of copper or other unprotected metals that may leach into runoff.** **Include controls for other sources as specified by local reviewer.**	

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 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☑ P. **Plazas, sidewalks, and parking lots.**			☑ **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

Stormwater BMP Operation & Maintenance Plan

I. Inspection Log

Site Inspection Log

Maintenance Engineer/Company:	
Date:	
Reason for Inspection:	

Inspection Item	A	M	U	N/A	Corrective Action Required
I. Landscaping					
Are grounds in good condition, clean and free of debris?					
Are lawn areas mowed and trimmed?					
Are plant beds and/or planter boxes well maintained?					
Are shrubs trimmed and maintained?					
Are dead trees or shrubs evident?					
Are lawn sprinkler systems operable?					
Are areas around trash receptacles clean?					
Do a sufficient quantity of receptacles exist?					
II. Hardscape					
Are sidewalks and trails in good condition, clean, and free of debris?					
III. Storm Drain System					
Are all stencils in good condition, visible and legible?					
Are all drains clean and free of obstructions?					
IV. Forebay BMPs					
Is the BMP in good condition, clean and free of debris?					
Is the BMP free of burrows?					
Is the BMP free of sediment accumulation?					
Is the BMP free of standing water					
V. Detention Chambers					
Is the BMP free of trash and debris?					
Is the BMP free of sediment accumulation?					
Is the pump and irrigation system functioning?					

Comments:

A Acceptable M Marginal U Unacceptable N/A Not Applicable

II. Updates, Revisions, Errata

Revision No.	Date	Brief Description of Revision, include section and page number	Prepared and Approved By:
			Name: Title:
			Name: Title:
			Name: Title:
			Name: Title:
			Name: Title:
			Name: Title:
			Name: Title:

III. Introduction

The proposed project is a mixed-use development, which includes multi-family residential, a daycare, office building, and a club house. Two driveways are proposed on Berea Road to give access to the site and one driveway on Normandy Road. The proposed drainage discharges from the site in the northeast corner following the pattern of the existing condition. A portion also drains to the south west corner of the site to a culvert in Berea Road. The site development includes pretreatment forebays in various areas to treat flow prior to entering the storm drain system. All drainage on the site is routed to these forebays through surface flow and then through the pipe system to a large retention/detention chamber system which includes a retention depth for the VBMP. The chamber includes an irrigation pump for the retained water to be used for harvest and reuse. Any flows that exceed the retention capacity will flow through the detention chamber outlet structure, which then flows to northwest corner of the site where flow from the site is discharged in the existing condition.

IV. Responsibility for Maintenance and Funding

A. General

1) Responsible Party during Construction

Identify the parties responsible for maintenance during construction phase of BMPs identified and source controls specified.

Developer's Name	TMC Holding LLC		
Address	15916 Bernardo Center Drive		
	San Diego	State: CA	Zip: 92127
Email Address			
Phone Number	760-489-9563		
Engineer of Work	Kolibrien Corp.		
Engineer's Phone Number	(951) 252-1034		

2) Responsible Party for Ongoing Maintenance

Owner Responsible for Negotiating and Executing Contracts Responsible for Maintenance

Owner's Name			
Address			
	City:	State:	Zip:
Email Address			
Phone Number			

Supervisor Responsible for Responding to problems with Stormwater BMPs

Supervisor's Name	TBD		
Address			
	City:	State:	Zip:
Email Address			
Phone Number			

3) Employees or Contractors Responsible for conducting Stormwater BMP Operation and Maintenance

Employees	
Name	TBD
Title	
Phone	
Email	
Contractors	
Company	TBD
Employee	
Title	
Phone	
Email	

4) Funding

Funding for installation, operation, and maintenance of all stormwater BMPs will be the responsibility of the property owner. Funding for stormwater facility maintenance shall be paid for from ordinary incomes generated from the apartment complex. Any future owners will be required to maintain BMPs as per manufacturer's specifications.

Budget for Maintenance will be determined by property owner/management.

B. Training

Training of employees responsible for BMP maintenance procedures will be provided by the owner and the type of training will be at the discretion of the owner. Any contractors will be trained by their respective company and this will not be the property owner's responsibility.

C. Records

Insert maintenance records here.

Storm Water BMP Maintenance Log

Maintenance Engineer/ Company	Maintenance Type	Date	Comments

D. Safety

Insert Company's Safety Training Documentation here.

Employee Training Log

Training Type: _____

_____

Instructor: _____ **Date:** _____

Company: _____

Attendees

Name	Signature	Name	Signature

V. Summary of Drainage Management Areas and Stormwater BMPs

A. Drainage Areas

This site includes landscaping. These areas will not require specialized O&M or inspections, but will require typical landscape maintenance. Landscape maintenance activities are described in Section VII. Maintenance Schedule.

The site is a large DMA that drains to the detention chamber system. Stormwater runoff from the areas are directed to the forebays. When the forebays overflow, runoff flows to the detention/retention chambers. The VBMP is captured in the chamber and is used for irrigation.

B. Structural Post-Construction BMPs

VI. Stormwater BMP Design Documentation

These BMPs will be "As Built" by a licensed civil/geotechnical engineer registered in the state of California and submitted to the Co-Permittee.

VII. Maintenance Schedule or Matrix

A. Maintenance Schedule

BMP	Responsible Party	Maintenance Activity	Inspection/Maintenance Frequency
Self-Treating Areas			
Landscape Maintenance	Property Owner	Inspect landscape areas for litter and debris daily. Weekly preform landscape area inspections and preform required landscape maintenance activities when it is needed. These maintenance activities include irrigating, weeding, applying fertilizers and pesticides in minimum required quantities, remulching, trimming vegetation, raking leaves, removing detritus, and replacing diseased or dead plants.	Continuous, as needed
Source Control BMPs {Structural and Nonstructural)			
Education for Property Owner	Property Owner	Education program as it would apply to future tenants and maintenance staff. The owner shall prepare manual{s) for tenants and maintenance staff.	Continuous. Provide regular training to field employees regarding all the BMPs proposed in this document.
Activity Restriction	Property Owner	No sidewalk or driveway washing.	Continuous
Common Area Landscape Maintenance	Property Owner	Manage landscaping in accordance with: the City Regulations, and with management guidelines for use of fertilizers and pesticides and with the County of Riverside.	Monthly during regular maintenance.
BMP Maintenance	Property Owner	The maintenance staff and tenants will be instructed in environmental procedures regarding contamination and cleanup.	Per established maintenance BMP schedule.
Common Area Litter Control/ Refuse	Property Owner	A contract for trash management and litter control and landscaped maintenance will be made with outside contractors as necessary.	Daily, during regular maintenance. Litter patrol and emptying trash receptacles.
Employee Training	Property Owner	Educational materials.	When maintenance staff are hired or for new tenants, and once every six months.

Common catch basin Inspection	Property Owner	Inspect inlet for debris and clean with required.	Monthly, after rain events and prior to October 1st each year.
Private Street Sweeping	Property Owner	Post "No Littering" signs and enforce anti-litter laws. A contract for street sweeping and litter control will be mad with outside contractors as necessary. The contractor will clean out and cover litter receptacles frequently to prevent spillage. The contractor will routinely sweep, shovel, and dispose of litter in the trash. The contractor will use dry cleaning methods to prevent the discharge of pollutants into the stormwater conveyance system. A contract for oil and petroleum hydrocarbons removal will be made with cleaning services contractor.	Sweep private alleys and parking lots weekly and prior to the storm season. Remove oil and petroleum hydrocarbons if any at the drive-way once every 6 months.
Storm Drain System Stenciling and Signage	Property Owner	Inspect for re-stenciling needs and re-stencil as necessary.	Once every 6 months.
Efficient Irrigation System	Property Owner	Verify that the runoff minimizing landscape design continues to function by checking that water sensors are functioning properly, that irrigation heads are adjusted properly to eliminate overspray to landscape areas, and to verify that irrigation timing and cycle lengths are adjusted in accordance with water demands, given time of day or night time temperatures.	Once a week with maintenance activities.

BMP Maintenance			
Forebays	Property Owner	Inspection Activities • Inspect soil and repair eroded areas. • Inspect for erosion or damage to vegetation, preferably at the end of the wet season to schedule summer maintenance and before major fall runoff to be sure the strips are ready for winter. However, additional inspection after periods of heavy runoff is desirable. • Inspect to ensure grass is well established. If not, either prepare soil and reseed or replace with alternative species. Install erosion control blanket. • Check for debris and litter, and areas of sediment accumulation. • Inspect health of trees and shrubs. Maintenance Activities • Water plants daily for 2 weeks after project completion. • Remove litter and debris monthly. • Remove sediment as needed. • Remulch void areas as needed. • Treat diseased trees and shrubs as needed. • Mow turf areas as needed. • Repair erosion at inflow points as needed. • Repair outflow structures as needed. • Unclog underdrain as needed. • Regulate soil pH regulation as needed. • Remove and replace dead and diseased vegetation semi-annually.	Monthly, after rain events and prior to October 1st each year.

B. Service Agreement Information

Insert Service Agreement here.

Appendix 10: Educational Materials

BMP Fact Sheets, Maintenance Guidelines and Other End-User BMP Information

After the Storm

A Citizen's Guide to Understanding Stormwater

EPA 833-B-03-002

January 2003

Internet Address (URL) • HTTP://www.epa.gov
Recycled/Recyclable • Printed With Vegetable Oil Based Inks on 100% Postconsumer, Process Chlorine Free Recycled Paper

For more information contact:

or visit
www.epa.gov/npdes/stormwater
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.

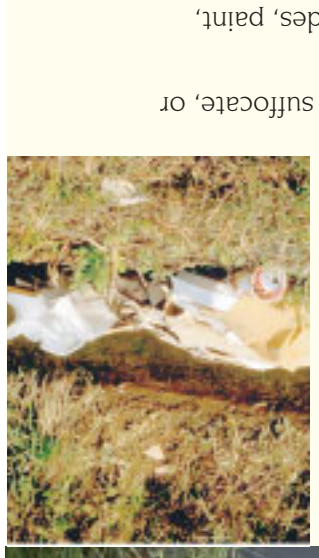
Stormwater can pick up debris, chemicals, dirt, and other pollutants and flow into a storm sewer system or directly to a lake, stream, river, wetland, or coastal water. Anything that enters a storm sewer system is discharged untreated into the waterbodies we use for swimming, fishing, and providing drinking water.

Why is stormwater runoff a problem?

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

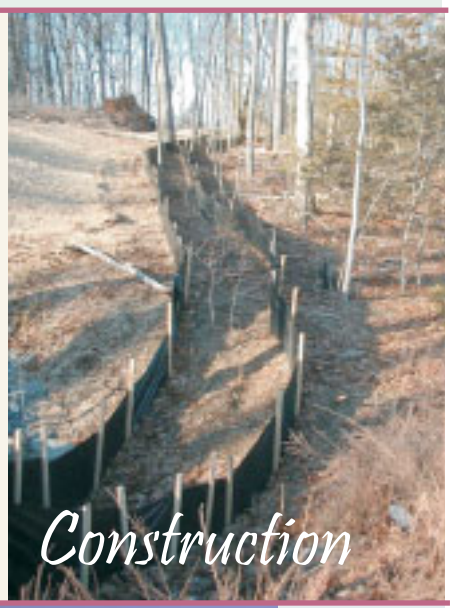
Dirt, oil, and debris that collect in parking lots and paved areas can be washed into the storm sewer system and eventually enter local waterbodies.

- 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.

Construction

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.



Agriculture

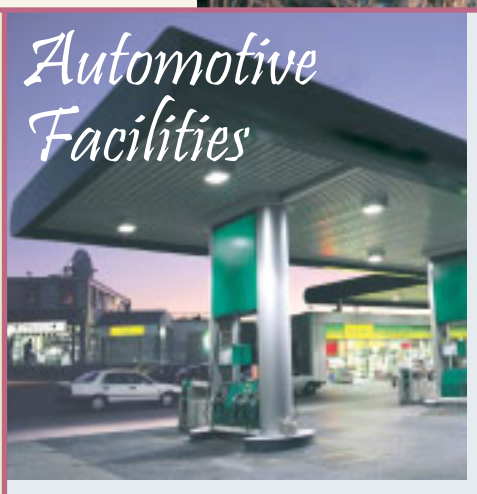
Lack of vegetation on streambanks can lead to erosion. Overgrazed pastures can also contribute excessive amounts of sediment to local waterbodies. Excess fertilizers and pesticides can poison aquatic animals and lead to destructive algae blooms. Livestock in streams can contaminate waterways with bacteria, 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.

For Information:

For more information on the General Industrial Storm Water Permit contact:

State Water Resources Control Board (SWRCB)
(916) 657-1146 or www.swrcb.ca.gov/ or, at your Regional Water Quality Control Board (RWQCB).

Santa Ana Region (8)
California Tower
3737 Main Street, Ste. 500
Riverside, CA 92501-3339
(909) 782-4130

San Diego Region (9)
9771 Clairemont Mesa Blvd., Ste. A
San Diego, CA 92124
(619) 467-2952

Colorado River Basin Region (7)
73-720 Fred Waring Dr., Ste. 100
Palm Desert, CA 92260
(760) 346-7491

SPILL RESPONSE AGENCY:
HAZ-MAT: (909) 358-5055
HAZARDOUS WASTE DISPOSAL: (909) 358-5055
RECYCLING INFORMATION: 1-800-366-SAVE
TO REPORT ILLEGAL DUMPING OR A CLOGGED STORM DRAIN: 1-800-506-2555

To order additional brochures or to obtain information on other pollution prevention activities, call: (909) 955-1111.

StormWater CleanWater PROTECTION PROGRAM

Riverside County gratefully acknowledges the State Water Quality Control Board and the American Public Works Association, Storm Water Quality Task Force for the information provided in this brochure.

DID YOU KNOW . . .

YOUR FACILITY MAY NEED A STORM WATER PERMIT?

Many industrial facilities and manufacturing operations must obtain coverage under the Industrial Activities Storm Water General Permit

FIND OUT
IF YOUR FACILITY MUST OBTAIN A PERMIT

StormWater Pollution . . . What you should know

Riverside County has two drainage systems - sanitary sewers and storm drains. The storm drain system is designed to help prevent flooding by carrying excess rainwater away from streets. Since the storm drain system does not provide for water treatment, it also serves the *unintended* function of transporting pollutants directly to our waterways.

Unlike sanitary sewers, storm drains are not connected to a treatment plant - they flow directly to our local streams, rivers and lakes.

In recent years, awareness of the need to protect water quality has increased. As a result, federal, state, and local programs have been established to reduce polluted stormwater discharges to our waterways. The emphasis of these programs is to prevent stormwater pollution since it's much easier, and less costly, than cleaning up "after the fact."

National Pollutant Discharge Elimination System (NPDES)

In 1987, the Federal Clean Water Act was amended to establish a framework for regulating industrial stormwater discharges under the NPDES permit program. In California, NPDES permits are issued by the State Water Resources Control Board (SWRCB) and the nine (9) Regional Water Quality Control Boards (RWQCB). In general, certain industrial facilities and manufacturing operations must obtain coverage under the Industrial Activities Storm Water General Permit if the type of facilities or operations falls into one of the several categories described in this brochure.

How Do I Know If I Need A Permit?

Following are ***general descriptions*** of the industry categories types that are regulated by the Industrial Activities Storm Water General Permit. Contact your local Region Water Quality Control Board to determine if your facility/operation requires coverage under the Permit.

➜ Facilities such as cement manufacturing; feedlots; fertilizer manufacturing; petroleum refining; phosphate manufacturing; steam electric power generation; coal mining; mineral mining and processing; ore mining and dressing; and asphalt emulsion;

➜ Facilities classified as lumber and wood products (except wood kitchen cabinets); pulp, paper, and paperboard mills; chemical producers (except some pharmaceutical and biological products); petroleum and coal products; leather production and products; stone, clay and glass products; primary metal industries; fabricated structural metal; ship and boat building and repairing;

➜ Active or inactive mining operations and oil and gas exploration, production, processing, or treatment operations;

➜ Hazardous waste treatment, storage, or disposal facilities;

➜ Landfills, land application sites and open dumps that receive or have received any industrial waste; unless there is a new overlying land use such as a golf course, park, etc., and there is no discharge associated with the landfill;

➜ Facilities involved in the recycling of materials, including metal scrap yards, battery reclaimers, salvage yards, and automobile junkyards;

➜ Steam electric power generating facilities, facilities that generate steam for electric power by combustion;

➜ Transportation facilities that have vehicle maintenance shops, fueling facilities, equipment cleaning operations, or airport deicing operations. This includes school bus maintenance facilities operated by a school district;

➜ Sewage treatment facilities;

➜ Facilities that have areas where material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, or industrial machinery are exposed to storm water.

How do I obtain coverage under the Industrial Activities Storm Water General Permit?

Obtain a permit application package from your local Regional Water Quality Control Board listed on the back of this brochure or the State Water Resources Control Board (SWRCB). Submit a completed Notice of Intent (NOI) form, site map and the appropriate fee ($250 or $500) to the SWRCB. Facilities must submit an NOI thirty (30) days prior to beginning operation. Once you submit the NOI, the State Board will send you a letter acknowledging receipt of your NOI and will assign your facility a waste discharge identification number (WDID No.). You will also receive an annual fee billing. These billings should roughly coincide with the date the State Board processed your original NOI submittal.

What are the requirements of the Industrial Activities Storm Water General Permit?

The basic requirements of the Permit are:

1. The facility must eliminate any non-stormwater discharges or obtain a separate permit for such discharges.

2. The facility must develop and implement a Storm Water Pollution Prevention Plan (SWPPP). The SWPPP must identify sources of pollutants that may be exposed to stormwater. Once the sources of pollutants have been identified, the facility operator must develop and implement Best Management Practices (BMPs) to minimize or prevent polluted runoff.

   Guidance in preparing a SWPPP is available from a document prepared by the California Storm Water Quality Task Force called the California Storm Water Best Management Practice Handbook.

3. The facility must develop and implement a Monitoring Program that includes conducting visual observations and collecting samples of the facility's storm water discharges associated with industrial activity. The General Permit requires that the analysis be conducted by a laboratory that is certified by the State of California.

4. The facility must submit to the Regional Board, every July 1, an annual report that includes the results of its monitoring program.

A Non-Storm Water Discharge is... *any discharge to a storm drain system that is not composed entirely of storm water. The following non-storm water discharges are authorized by the General Permit: fire hydrant flushing; potable water sources, including potable water related to the operation, maintenance, or testing of potable water systems; drinking fountain water; atmospheric condensates including refrigeration, air conditioning, and compressor condensate; irrigation drainage; landscape watering; springs; non-contaminated ground water; foundation or footing drainage; and sea water infiltration where the sea waters are discharged back into the sea water source.*

A BMP is . . . *a technique, process, activity, or structure used to reduce the pollutant content of a storm water discharge. BMPs may include simple, non-structural methods such as good housekeeping, staff training and preventive maintenance. Additionally, BMPs may include structural modifications such as the installation of berms, canopies or treatment control (e.g. setting basins, oil/water separators, etc.)*

WARNING*: There are significant penalties for non-compliance: a minimum fine of $5,000 for failing to obtain permit coverage, and, up to $10,000 per day, per violation plus $10 per gallon of discharge in excess of 1,000 gallons.*

Stormwater Pollution

What you should know for...

Industrial & Commercial Facilities

Best Management Practices (BMPS) for:

- Industrial Facilities
- Commercial Facilities

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

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.

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, 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.

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

- Riverside County Flood Control and Water Conservation District
  www.rcflood.org

Online resources include:

- California Storm Water Quality Association
  www.casqa.org
- State Water Resources Control Board
  www.waterboards.ca.gov
- Power Washers of North America
  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

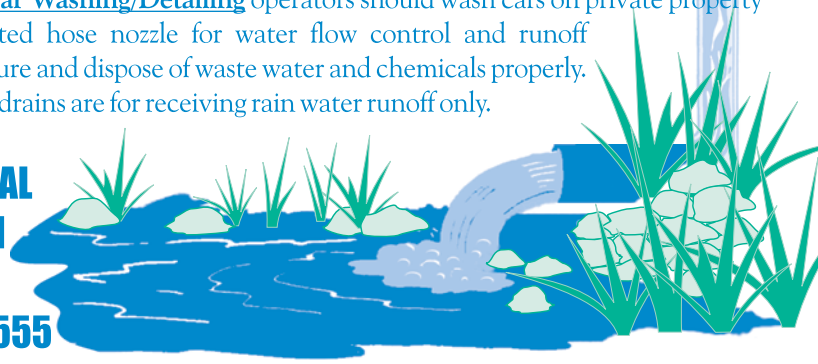
Do you know where street flows actually go?

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

Did 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.

Site Design & Landscape Planning SD-10

Design Objectives

- ☑ 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.

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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

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.

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.

Roof Runoff Controls SD-11

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

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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 ¼ to ½ 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

Low Impact Urban Design Tools, Low Impact Development Design Center, Beltsville, MD. www.lid-stormwater.net

Start at the Source, Bay Area Stormwater Management Agencies Association, 1999 Edition

Efficient Irrigation SD-12

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.

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- 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.

Trash Storage Areas SD-32

Description

Trash storage areas are areas where a trash receptacle (s) are located for use as a repository for solid wastes. Stormwater runoff from areas where trash is stored or disposed of can be polluted. In addition, loose trash and debris can be easily transported by water or wind into nearby storm drain inlets, channels, and/or creeks. Waste handling operations that may be sources of stormwater pollution include dumpsters, litter control, and waste piles.

Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- ☑ Contain Pollutants
- Collect and Convey

Approach

This fact sheet contains details on the specific measures required to prevent or reduce pollutants in stormwater runoff associated with trash storage and handling. Preventative measures including enclosures, containment structures, and impervious pavements to mitigate spills, should be used to reduce the likelihood of contamination.

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

Design requirements for waste handling areas are governed by Building and Fire Codes, and by current local agency ordinances and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code and ordinance requirements. Hazardous waste should be handled in accordance with legal requirements established in Title 22, California Code of Regulation.

Wastes from commercial and industrial sites are typically hauled by either public or commercial carriers that may have design or access requirements for waste storage areas. The design criteria in this fact sheet are recommendations and are not intended to be in conflict with requirements established by the waste hauler. The waste hauler should be contacted prior to the design of your site trash collection areas. Conflicts or issues should be discussed with the local agency.

Designing New Installations

Trash storage areas should be designed to consider the following structural or treatment control BMPs:

- Design trash container areas so that drainage from adjoining roofs and pavement is diverted around the area(s) to avoid run-on. This might include berming or grading the waste handling area to prevent run-on of stormwater.
- Make sure trash container areas are screened or walled to prevent off-site transport of trash.

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- Use lined bins or dumpsters to reduce leaking of liquid waste.
- Provide roofs, awnings, or attached lids on all trash containers to minimize direct precipitation and prevent rainfall from entering containers.
- Pave trash storage areas with an impervious surface to mitigate spills.
- Do not locate storm drains in immediate vicinity of the trash storage area.
- Post signs on all dumpsters informing users that hazardous materials are not to be disposed of therein.

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.

Additional Information

Maintenance Considerations

The integrity of structural elements that are subject to damage (i.e., screens, covers, and signs) must be maintained by the owner/operator. Maintenance agreements between the local agency and the owner/operator may be required. Some agencies will require maintenance deed restrictions to be recorded of the property title. If required by the local agency, maintenance agreements or deed restrictions must be executed by the owner/operator before improvement plans are approved.

Other Resources

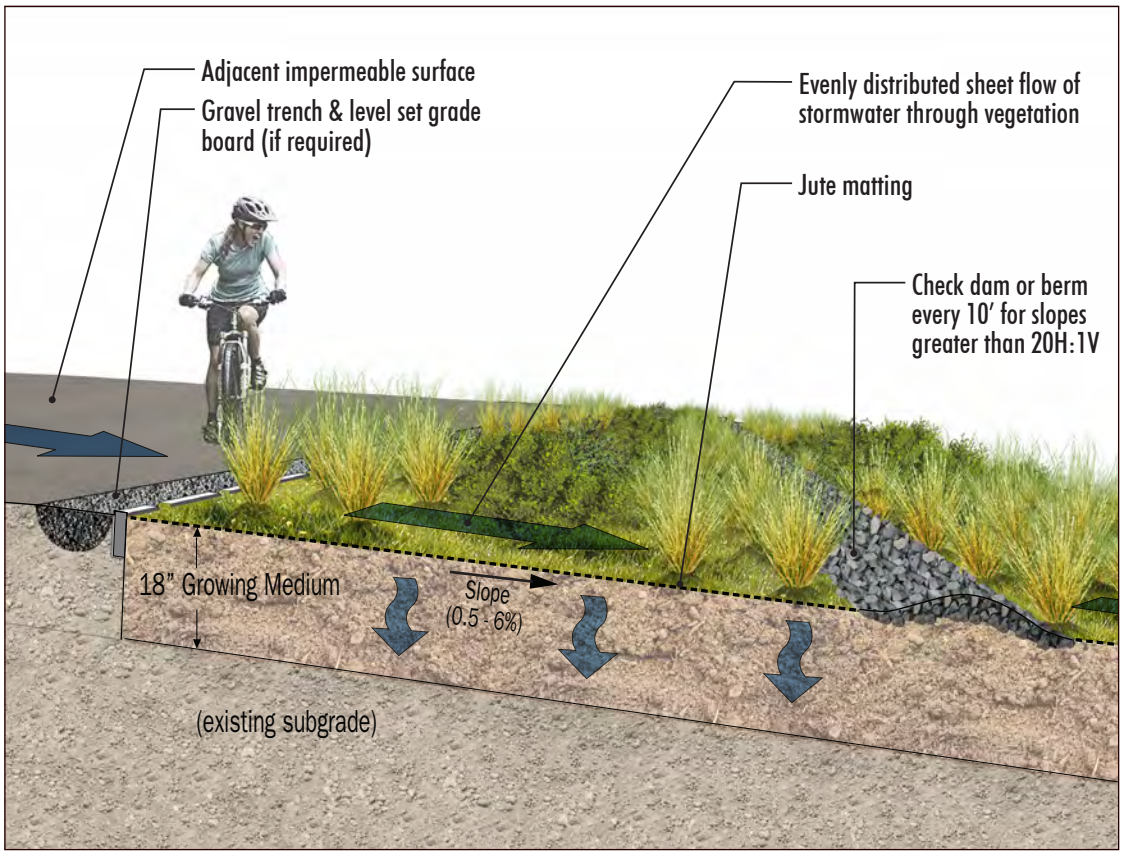
A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

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.

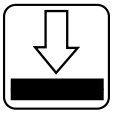
Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Vegetated Filter Strip




parking areas & impermeable landscape


impermeable soils


permeable soils

Description

Vegetated filter strips are gently sloped areas designed to receive sheet flows from adjacent impervious surfaces. Filter strips are vegetated with grasses and groundcovers that filter and reduce the velocity of stormwater. Peak stormwater flows are attenuated as stormwater travels across the filter strip and infiltrates or is stored temporarily in the soils below.

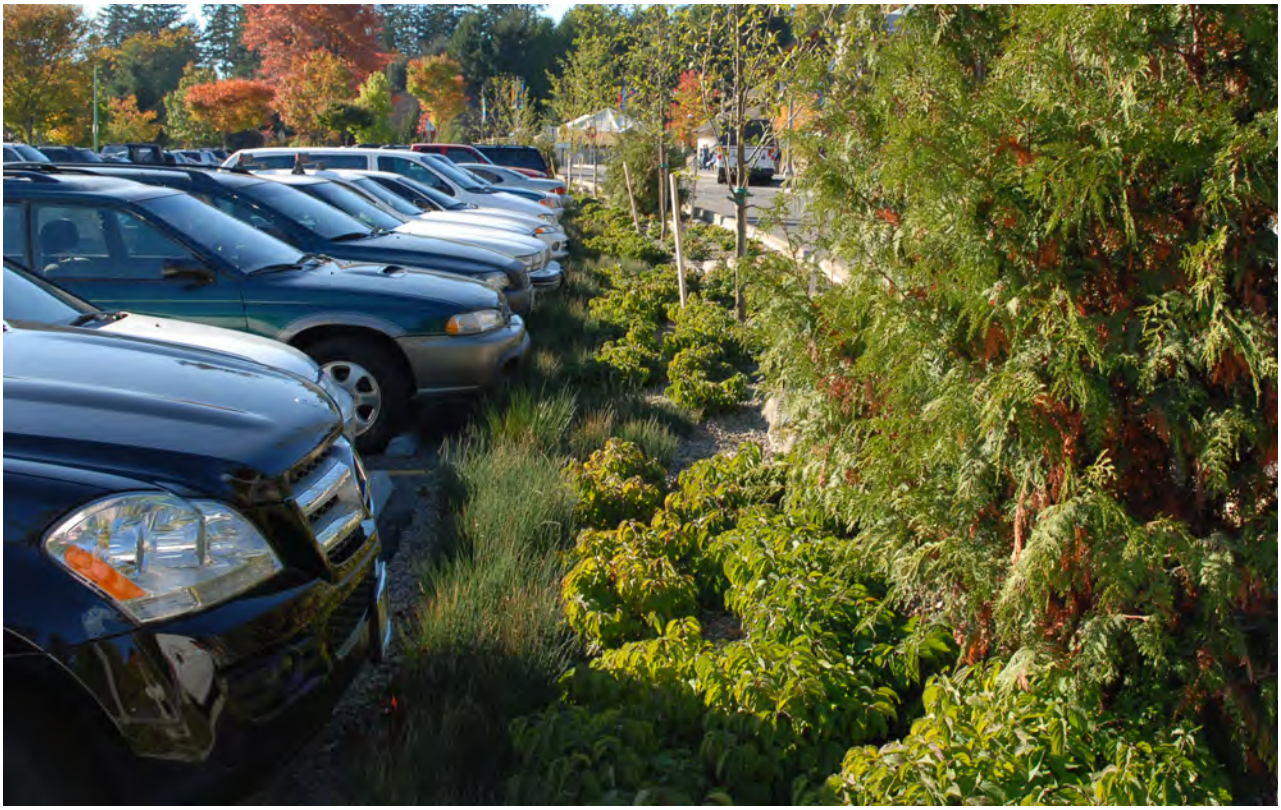
For residential driveways, center filter strips typically are 3 feet wide between two 3-foot wide paved sections. The strip treats and infiltrates stormwater only from the impervious area of the drive aisles which slope toward the center filter strip. The driveway center filter strip must be maintained to the design requirements for vegetated filter strips.

Application & Limitations

Vegetated filter strips should be integrated into the overall site design and may help fulfill a site's landscaping area requirement. Vegetated filter strips can be used to manage stormwater runoff from a variety of impervious surfaces such as walkways and driveways on private property and within the public right-of-way. Check with the local jurisdiction if proposing to use a vegetated filter strip in the public right-of-way.

Oregon Zoo parking lot, Portland

Vegetated Filter Strip



Oregon Zoo parking lot

Design Factors

Sizing
Vegetated filter strips are appropriate for all soil types and have 18" depth of growing medium. The size of the filter strip will depend upon the infiltration rate of existing soils. A sizing factor of 0.06 assumes that the site has an infiltration rate less than 2 in/hr.

For example, a facility managing 1,500 square feet of total impervious area would require a 90 sq ft filter strip (1,500 x 0.06).

Size may be decreased if:
- Demonstrated infiltration rate is greater than 2 in/hr using ASTM D3395-09 method; or
- Amended soil depth is increased

Geometry/Slopes
The minimum width of a vegetated filter strip is 5 feet measured in the direction of stormwater flow. The slope is between 0.5 and 6%, and the slope of the impervious area draining to the strip is less than 6%.
Check dams may be required to maintain shallow slopes if the existing site slopes exceed 5%. Typically, check dams are 3 to 5 inches high and are placed every 10 feet where slopes exceed 5%. If a level spreader such as a grade board or sand/gravel trench is required to disperse runoff evenly across the filter strip, the top must be horizontal and at an appropriate height to direct sheet flow to the soil without scour. Grade boards may be any material that withstands weather and solar degradation but should not be old railroad ties, used utility poles, or other pollutant source.

Piping for Vegetated Filter Strips
Non-infiltrated flows/overflows from the vegetated filter strip are collected and conveyed to an approved system or outlet structure.

Setbacks
Check with local building department to confirm site-specific requirements.

Soil Amendment/Mulch
Amended soils with appropriate compost and sand provide numerous benefits: infiltration; detention; retention; better plant establishment and growth; reduced summer irrigation needs; reduced fertilizer need; increased physical/chemical/microbial pollution reduction; and, reduced erosion potential. Primary treatment will occur in the top 18 inches of the vegetated filter strip. Amended soil in the treatment area is composed of organic compost, gravelly sand and topsoil. Compost is weed-free, decomposed, non-woody plant material; animal waste is not allowed. Check with the local jurisdiction or Clean Water Services for Seal of Testing Approval Program (STA) Compost provider.

To avoid erosion, use approved erosion control BMPs for vegetated filter strip.

Vegetated Filter Strip

Arata Creek School, Troutdale

Design Factors (continued)

Vegetation

Herbs, shrubs and grasses can provide the vegetation needed to remove sediment and pollutants. The vegetated filter strip is planted or seeded with a mix of grasses, wildflowers, and groundcovers well-suited to moist-to-dry soil conditions. All vegetation should be self-sustaining and drought tolerant.

Native plants are encouraged, but non-invasive ornamentals that add aesthetic and functional value are acceptable. For a complete list of allowable plants refer to page 76.

Trees are not required for vegetated filter strips, but are encouraged where applicable. Tree species should be selected by their adaptability to moist-to-dry conditions and full size at maturity. The filter strip conveys evenly-distributed sheet flows of water through vegetation for treatment. Because unplanted areas may decrease stormwater treatment, the entire filter strip must have 100% vegetation coverage to ensure proper hydrologic function.

If check dams are required, plants suited to wet-to-moist planting conditions may be supplemented on the upslope side of the check dam where occasional inundation and pooling of water may occur.

Required Maintenance Period

- Water-efficient irrigation should be applied for the first two years after construction of the facility, particularly during the dry summer months, while plantings become established. Irrigation after these two years is at the discretion of the owner.
- If public, the permittee is responsible for the maintenance of the vegetated filter strip for a minimum of two years following construction and acceptance of the facility.

Long Term Maintenance

If private, the property owner will be responsible for ongoing maintenance per a recorded maintenance agreement (see page 88 for example maintenance agreement).

For Detailed Operation and Maintenance Plans Refer to page 91 for maintenance .

All publicly maintained facilities not located in the public right-of-way must have a public easement to ensure access for maintenance.

References

Clean Water Services Design and Construction Standards

Vegetated Buffer Strip Factsheet

1.0 General Description

Figure 1. Vegetated Buffer Strip (Caltrans)

Potential Treatment Mechanisms								
I	ET	FA	B	RH	S	F	P	T
✓	✓	✓	✓		✓		✓	

Legend:
I = Infiltration
ET = Evapotranspiration
FA = Filtration and/or Adsorption
B = Biochemical Transformation
RH = Rainfall and Runoff Harvest
S = Sedimentation
F = Floatation
P = Plant Uptake
T = Trash Capture

Vegetated buffer strips are gently sloped, relatively flat vegetated surfaces over which runoff is treated as sheet flow. In conventional vegetated buffer strips, the plants slow the flow, which enhances sedimentation, filtration, and infiltration. In some cases, the soil underlying the strip is amended with compost or replaced with a permeable soil/compost mix. This allows more runoff to infiltrate into the ground, thus reducing runoff volumes. A schematic of a basic vegetated buffer strip is shown in Figure 2.

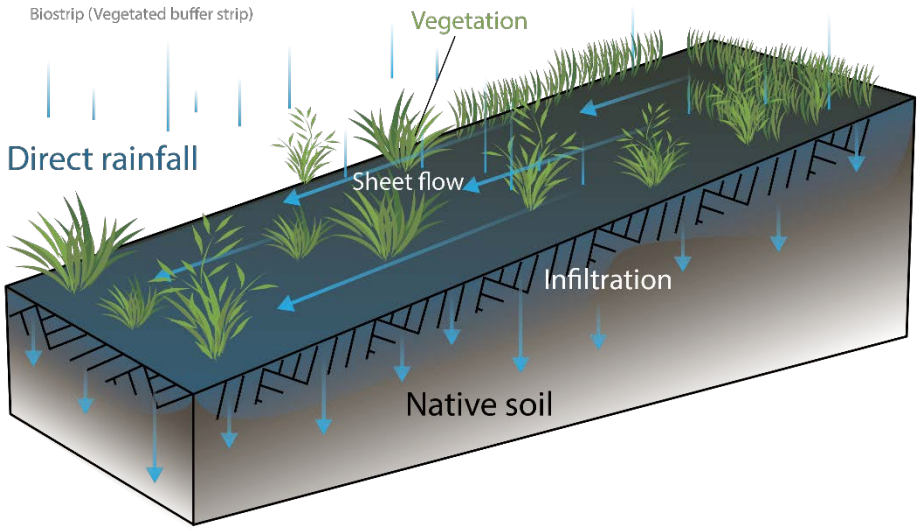


Figure 2. Schematic of a basic vegetated buffer strip

1.1 Variations and Alternative Names

- Strips
- Buffers
- Buffer strips
- Biostrips

2.0 Advantages & Limitations

2.1 Advantages

✓ Usually vegetated with grasses or other low maintenance plants, these strips often require little maintenance.
✓ When done well, strips can be both inexpensive and add aesthetic appeal.
✓ If sized correctly, strips provide adequate drainage and removal of particulate pollutants.

2.2 Limitations

- Prone to erosion and channelization if vegetative cover is not properly established.
- One strip is not suitable for large treatment areas or areas with concentrated runoff.

3.0 Siting

According to the California Stormwater Quality Association and the Sacramento Stormwater Quality Partnership, one strip is limited to treating only a few acres of contributing drainage area (CASQA 2003, SSQP 2018).

4.0 Design Considerations

When designing a vegetated buffer strip, the following parameters should be considered:

- ❑ Contributing drainage area
- ❑ Hydraulic residence time
- ❑ Slope in flow direction (longitudinal slope)
- ❑ Flat perpendicular to flow direction (no lateral slope)
- ❑ Flow depth (less than plant height)
- ❑ Length and width of strip (for estimating infiltration)
- ❑ Vegetation type and height (cool season grasses can reduce dry season watering needs)

5.0 Construction Considerations

- ❑ Install during a time of year when it is likely that the vegetation will receive sufficient watering from rainfall to become established without irrigation
  - o Irrigation should only be applied if incidental rainfall is insufficient for plant establishment
- ❑ Divert runoff until plants are established

6.0 Maintenance

- ❑ Plant management
  - o mowing grass
  - o pruning non-grasses
  - o removing woody vegetation
  - o removing weeds (if desired for aesthetics)
- ❑ Inspections for erosion with additional inspections after major rainfall events
- ❑ Litter removal (for areas prone to litter)
- ❑ Inspections for standing water to prevent mosquitos and other vector breeding

7.0 References

California Stormwater Quality Association (CASQA 2003). *Stormwater Best Management Practice Handbook: New Development and Redevelopment*. January 2003.

California Stormwater Quality Association (CASQA 2017). *Draft Stormwater Best Management Practice Handbook: New Development and Redevelopment*. April 2017.

County of Placer, City of Roseville, City of Auburn, City of Lincoln, and Town of Loomis (County of Placer et al. 2016). *West Placer Storm Water Quality Design Manual*. April 2016.

Sacramento Stormwater Quality Partnership (SSQP 2018). *Stormwater Quality Design Manual*. July 2018.

Vegetated Swale TC-30

Design Considerations

- Tributary Area
- Area Required
- Slope
- Water Availability

Description

Vegetated swales are open, shallow channels with vegetation covering the side slopes and bottom that collect and slowly convey runoff flow to downstream discharge points. They are designed to treat runoff through filtering by the vegetation in the channel, filtering through a subsoil matrix, and/or infiltration into the underlying soils. Swales can be natural or manmade. They trap particulate pollutants (suspended solids and trace metals), promote infiltration, and reduce the flow velocity of stormwater runoff. Vegetated swales can serve as part of a stormwater drainage system and can replace curbs, gutters and storm sewer systems.

Targeted Constituents

☑	Sediment	▲
☑	Nutrients	●
☑	Trash	●
☑	Metals	▲
☑	Bacteria	●
☑	Oil and Grease	▲
☑	Organics	▲

Legend ***(Removal Effectiveness)***

● Low ■ High

▲ Medium

California Experience

Caltrans constructed and monitored six vegetated swales in southern California. These swales were generally effective in reducing the volume and mass of pollutants in runoff. Even in the areas where the annual rainfall was only about 10 inches/yr, the vegetation did not require additional irrigation. One factor that strongly affected performance was the presence of large numbers of gophers at most of the sites. The gophers created earthen mounds, destroyed vegetation, and generally reduced the effectiveness of the controls for TSS reduction.

Advantages

- If properly designed, vegetated, and operated, swales can serve as an aesthetic, potentially inexpensive urban development or roadway drainage conveyance measure with significant collateral water quality benefits.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Roadside ditches should be regarded as significant potential swale/buffer strip sites and should be utilized for this purpose whenever possible.

Limitations

- Can be difficult to avoid channelization.
- May not be appropriate for industrial sites or locations where spills may occur
- Grassed swales cannot treat a very large drainage area. Large areas may be divided and treated using multiple swales.
- A thick vegetative cover is needed for these practices to function properly.
- They are impractical in areas with steep topography.
- They are not effective and may even erode when flow velocities are high, if the grass cover is not properly maintained.
- In some places, their use is restricted by law: many local municipalities require curb and gutter systems in residential areas.
- Swales are mores susceptible to failure if not properly maintained than other treatment BMPs.

Design and Sizing Guidelines

- Flow rate based design determined by local requirements or sized so that 85% of the annual runoff volume is discharged at less than the design rainfall intensity.
- Swale should be designed so that the water level does not exceed 2/3rds the height of the grass or 4 inches, which ever is less, at the design treatment rate.
- Longitudinal slopes should not exceed 2.5%
- Trapezoidal channels are normally recommended but other configurations, such as parabolic, can also provide substantial water quality improvement and may be easier to mow than designs with sharp breaks in slope.
- Swales constructed in cut are preferred, or in fill areas that are far enough from an adjacent slope to minimize the potential for gopher damage. Do not use side slopes constructed of fill, which are prone to structural damage by gophers and other burrowing animals.
- A diverse selection of low growing, plants that thrive under the specific site, climatic, and watering conditions should be specified. Vegetation whose growing season corresponds to the wet season are preferred. Drought tolerant vegetation should be considered especially for swales that are not part of a regularly irrigated landscaped area.
- The width of the swale should be determined using Manning's Equation using a value of 0.25 for Manning's n.

Construction/Inspection Considerations

- Include directions in the specifications for use of appropriate fertilizer and soil amendments based on soil properties determined through testing and compared to the needs of the vegetation requirements.
- Install swales at the time of the year when there is a reasonable chance of successful establishment without irrigation; however, it is recognized that rainfall in a given year may not be sufficient and temporary irrigation may be used.
- If sod tiles must be used, they should be placed so that there are no gaps between the tiles; stagger the ends of the tiles to prevent the formation of channels along the swale or strip.
- Use a roller on the sod to ensure that no air pockets form between the sod and the soil.
- Where seeds are used, erosion controls will be necessary to protect seeds for at least 75 days after the first rainfall of the season.

Performance

The literature suggests that vegetated swales represent a practical and potentially effective technique for controlling urban runoff quality. While limited quantitative performance data exists for vegetated swales, it is known that check dams, slight slopes, permeable soils, dense grass cover, increased contact time, and small storm events all contribute to successful pollutant removal by the swale system. Factors decreasing the effectiveness of swales include compacted soils, short runoff contact time, large storm events, frozen ground, short grass heights, steep slopes, and high runoff velocities and discharge rates.

Conventional vegetated swale designs have achieved mixed results in removing particulate pollutants. A study performed by the Nationwide Urban Runoff Program (NURP) monitored three grass swales in the Washington, D.C., area and found no significant improvement in urban runoff quality for the pollutants analyzed. However, the weak performance of these swales was attributed to the high flow velocities in the swales, soil compaction, steep slopes, and short grass height.

Another project in Durham, NC, monitored the performance of a carefully designed artificial swale that received runoff from a commercial parking lot. The project tracked 11 storms and concluded that particulate concentrations of heavy metals (Cu, Pb, Zn, and Cd) were reduced by approximately 50 percent. However, the swale proved largely ineffective for removing soluble nutrients.

The effectiveness of vegetated swales can be enhanced by adding check dams at approximately 17 meter (50 foot) increments along their length (See Figure 1). These dams maximize the retention time within the swale, decrease flow velocities, and promote particulate settling. Finally, the incorporation of vegetated filter strips parallel to the top of the channel banks can help to treat sheet flows entering the swale.

Only 9 studies have been conducted on all grassed channels designed for water quality (Table 1). The data suggest relatively high removal rates for some pollutants, but negative removals for some bacteria, and fair performance for phosphorus.

Table 1 Grassed swale pollutant removal efficiency data							
	Removal Efficiencies (% Removal)						
Study	TSS	TP	TN	NO_3	Metals	Bacteria	Type
Caltrans 2002	77	8	67	66	83-90	-33	dry swales
Goldberg 1993	67.8	4.5	-	31.4	42–62	-100	grassed channel
Seattle Metro and Washington Department of Ecology 1992	60	45	-	-25	2–16	-25	grassed channel
Seattle Metro and Washington Department of Ecology, 1992	83	29	-	-25	46–73	-25	grassed channel
Wang et al., 1981	80	-	-	-	70–80	-	dry swale
Dorman et al., 1989	98	18	-	45	37–81	-	dry swale
Harper, 1988	87	83	84	80	88–90	-	dry swale
Kercher et al., 1983	99	99	99	99	99	-	dry swale
Harper, 1988.	81	17	40	52	37–69	-	wet swale
Koon, 1995	67	39	-	9	-35 to 6	-	wet swale

While it is difficult to distinguish between different designs based on the small amount of available data, grassed channels generally have poorer removal rates than wet and dry swales, although some swales appear to export soluble phosphorus (Harper, 1988; Koon, 1995). It is not clear why swales export bacteria. One explanation is that bacteria thrive in the warm swale soils.

Siting Criteria

The suitability of a swale at a site will depend on land use, size of the area serviced, soil type, slope, imperviousness of the contributing watershed, and dimensions and slope of the swale system (Schueler et al., 1992). In general, swales can be used to serve areas of less than 10 acres, with slopes no greater than 5 %. Use of natural topographic lows is encouraged and natural drainage courses should be regarded as significant local resources to be kept in use (Young et al., 1996).

Selection Criteria (NCTCOG, 1993)

- Comparable performance to wet basins
- Limited to treating a few acres
- Availability of water during dry periods to maintain vegetation
- Sufficient available land area

Research in the Austin area indicates that vegetated controls are effective at removing pollutants even when dormant. Therefore, irrigation is not required to maintain growth during dry periods, but may be necessary only to prevent the vegetation from dying.

The topography of the site should permit the design of a channel with appropriate slope and cross-sectional area. Site topography may also dictate a need for additional structural controls. Recommendations for longitudinal slopes range between 2 and 6 percent. Flatter slopes can be used, if sufficient to provide adequate conveyance. Steep slopes increase flow velocity, decrease detention time, and may require energy dissipating and grade check. Steep slopes also can be managed using a series of check dams to terrace the swale and reduce the slope to within acceptable limits. The use of check dams with swales also promotes infiltration.

Additional Design Guidelines

Most of the design guidelines adopted for swale design specify a minimum hydraulic residence time of 9 minutes. This criterion is based on the results of a single study conducted in Seattle, Washington (Seattle Metro and Washington Department of Ecology, 1992), and is not well supported. Analysis of the data collected in that study indicates that pollutant removal at a residence time of 5 minutes was not significantly different, although there is more variability in that data. Therefore, additional research in the design criteria for swales is needed. Substantial pollutant removal has also been observed for vegetated controls designed solely for conveyance (Barrett et al, 1998); consequently, some flexibility in the design is warranted.

Many design guidelines recommend that grass be frequently mowed to maintain dense coverage near the ground surface. Recent research (Colwell et al., 2000) has shown mowing frequency or grass height has little or no effect on pollutant removal.

Summary of Design Recommendations

1) The swale should have a length that provides a minimum hydraulic residence time of at least 10 minutes. The maximum bottom width should not exceed 10 feet unless a dividing berm is provided. The depth of flow should not exceed 2/3rds the height of the grass at the peak of the water quality design storm intensity. The channel slope should not exceed 2.5%.

2) A design grass height of 6 inches is recommended.

3) Regardless of the recommended detention time, the swale should be not less than 100 feet in length.

4) The width of the swale should be determined using Manning's Equation, at the peak of the design storm, using a Manning's n of 0.25.

5) The swale can be sized as both a treatment facility for the design storm and as a conveyance system to pass the peak hydraulic flows of the 100-year storm if it is located "on-line." The side slopes should be no steeper than 3:1 (H:V).

6) Roadside ditches should be regarded as significant potential swale/buffer strip sites and should be utilized for this purpose whenever possible. If flow is to be introduced through curb cuts, place pavement slightly above the elevation of the vegetated areas. Curb cuts should be at least 12 inches wide to prevent clogging.

7) Swales must be vegetated in order to provide adequate treatment of runoff. It is important to maximize water contact with vegetation and the soil surface. For general purposes, select fine, close-growing, water-resistant grasses. If possible, divert runoff (other than necessary irrigation) during the period of vegetation

establishment. Where runoff diversion is not possible, cover graded and seeded areas with suitable erosion control materials.

Maintenance

The useful life of a vegetated swale system is directly proportional to its maintenance frequency. If properly designed and regularly maintained, vegetated swales can last indefinitely. The maintenance objectives for vegetated swale systems include keeping up the hydraulic and removal efficiency of the channel and maintaining a dense, healthy grass cover.

Maintenance activities should include periodic mowing (with grass never cut shorter than the design flow depth), weed control, watering during drought conditions, reseeding of bare areas, and clearing of debris and blockages. Cuttings should be removed from the channel and disposed in a local composting facility. Accumulated sediment should also be removed manually to avoid concentrated flows in the swale. The application of fertilizers and pesticides should be minimal.

Another aspect of a good maintenance plan is repairing damaged areas within a channel. For example, if the channel develops ruts or holes, it should be repaired utilizing a suitable soil that is properly tamped and seeded. The grass cover should be thick; if it is not, reseed as necessary. Any standing water removed during the maintenance operation must be disposed to a sanitary sewer at an approved discharge location. Residuals (e.g., silt, grass cuttings) must be disposed in accordance with local or State requirements. Maintenance of grassed swales mostly involves maintenance of the grass or wetland plant cover. Typical maintenance activities are summarized below:

- Inspect swales at least twice annually for erosion, damage to vegetation, and sediment and debris accumulation preferably at the end of the wet season to schedule summer maintenance and before major fall runoff to be sure the swale is ready for winter. However, additional inspection after periods of heavy runoff is desirable. The swale should be checked for debris and litter, and areas of sediment accumulation.

- Grass height and mowing frequency may not have a large impact on pollutant removal. Consequently, mowing may only be necessary once or twice a year for safety or aesthetics or to suppress weeds and woody vegetation.

- Trash tends to accumulate in swale areas, particularly along highways. The need for litter removal is determined through periodic inspection, but litter should always be removed prior to mowing.

- Sediment accumulating near culverts and in channels should be removed when it builds up to 75 mm (3 in.) at any spot, or covers vegetation.

- Regularly inspect swales for pools of standing water. Swales can become a nuisance due to mosquito breeding in standing water if obstructions develop (e.g. debris accumulation, invasive vegetation) and/or if proper drainage slopes are not implemented and maintained.

Cost

Construction Cost

Little data is available to estimate the difference in cost between various swale designs. One study (SWRPC, 1991) estimated the construction cost of grassed channels at approximately $0.25 per ft². This price does not include design costs or contingencies. Brown and Schueler (1997) estimate these costs at approximately 32 percent of construction costs for most stormwater management practices. For swales, however, these costs would probably be significantly higher since the construction costs are so low compared with other practices. A more realistic estimate would be a total cost of approximately $0.50 per ft², which compares favorably with other stormwater management practices.

Table 2 Swale Cost Estimate (SEWRPC, 1991)

Component	Unit	Extent	Unit Cost			Total Cost		
			Low	Moderate	High	Low	Moderate	High
Mobilization / Demobilization-Light	Swale	1	$107	$274	$441	$107	$274	$441
Site Preparation								
Clearing[b]	Acre	0.5	$2,200	$3,800	$5,400	$1,100	$1,900	$2,700
Grubbing[c]	Acre	0.25	$3,800	$5,200	$6,600	$950	$1,300	$1,650
General Excavation[d]	Yd^3	372	$2.10	$3.70	$5.30	$781	$1,376	$1,972
Level and Till[e]	Yd^2	1,210	$0.20	$0.35	$0.50	$242	$424	$605
Sites Development								
Salvaged Topsoil Seed, and Mulch[f]	Yd^2	1,210	$0.40	$1.00	$1.60	$484	$1,210	$1,936
Sod[g]	Yd^2	1,210	$1.20	$2.40	$3.60	$1,452	$2,904	$4,356
Subtotal	--	--	--	--	--	$5,116	$9,388	$13,660
Contingencies	Swale	1	25%	25%	25%	$1,279	$2,347	$3,415
Total	--	--	--	--	--	$6,395	$11,735	$17,075

Source: (SEWRPC, 1991)

Note: Mobilization/demobilization refers to the organization and planning involved in establishing a vegetative swale.

[a] Swale has a bottom width of 1.0 foot, a top width of 10 feet with 1:3 side slopes, and a 1,000-foot length.

[b] Area cleared = (top width + 10 feet) x swale length.

[c] Area grubbed = (top width x swale length).

[d] Volume excavated = (0.67 x top width x swale depth) x swale length (parabolic cross-section).

[e] Area tilled = $\left(\text{top width} + \frac{8(\text{swale depth}^2)}{3(\text{top width})}\right) \times$ swale length (parabolic cross-section).

[f] Area seeded = area cleared x 0.5.

[g] Area sodded = area cleared x 0.5.

Table 3 Estimated Maintenance Costs (SEWRPC, 1991)

Component	Unit Cost	Swale Size (Depth and Top Width)		Comment
		1.5 Foot Depth, One-Foot Bottom Width, 10-Foot Top Width	3-Foot Depth, 3-Foot Bottom Width, 21-Foot Top Width	
Lawn Mowing	\$0.85 / 1,000 ft^2/ mowing	\$0.14 / linear foot	\$0.21 / linear foot	Lawn maintenance area=(top width + 10 feet) x length. Mow eight times per year
General Lawn Care	\$9.00 / 1,000 ft^2/ year	\$0.18 / linear foot	\$0.28 / linear foot	Lawn maintenance area = (top width + 10 feet) x length
Swale Debris and Litter Removal	\$0.10 / linear foot / year	\$0.10 / linear foot	\$0.10 / linear foot	--
Grass Reseeding with Mulch and Fertilizer	\$0.30 / yd^2	\$0.01 / linear foot	\$0.01 / linear foot	Area revegetated equals 1% of lawn maintenance area per year
Program Administration and Swale Inspection	\$0.15 / linear foot / year, plus \$25 / inspection	\$0.15 / linear foot	\$0.15 / linear foot	Inspect four times per year
Total	--	**\$0.58 / linear foot**	**\$ 0.75 / linear foot**	--

Maintenance Cost

Caltrans (2002) estimated the expected annual maintenance cost for a swale with a tributary area of approximately 2 ha at approximately $2,700. Since almost all maintenance consists of mowing, the cost is fundamentally a function of the mowing frequency. Unit costs developed by SEWRPC are shown in Table 3. In many cases vegetated channels would be used to convey runoff and would require periodic mowing as well, so there may be little additional cost for the water quality component. Since essentially all the activities are related to vegetation management, no special training is required for maintenance personnel.

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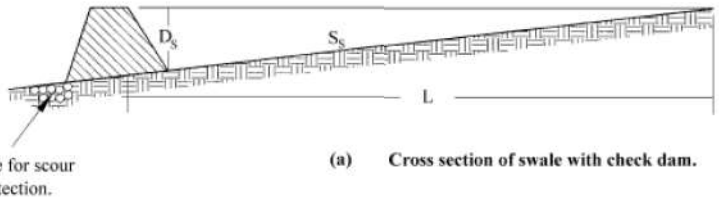
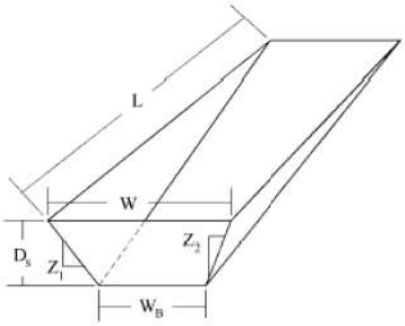


(a) Cross section of swale with check dam.



(b) Dimensional view of swale impoundment area.

Notation:
L = Length of swale impoundment area per check dam (ft)
D_S = Depth of check dam (ft)
S_S = Bottom slpe of swale (ft/ft)
W = Top width of check dam (ft)
W_B = Bottom width of check dam (ft)
$Z_{1\&2}$ = Ratio of horizontal to vertical change in swale side slope (ft/ft)

FACT SHEET- RAINWATER HARVESTING

Universal BMP

RAINWATER HARVESTING

Also know as: Rain Barrel, Cistern, and Rainwater Collection

DESCRIPTION

Rainwater harvesting is the practice of collecting and using rainwater from impervious surfaces such as roofs and patios. Rain barrels, or cisterns, are containers or tanks that are typically designed to capture rainwater runoff for irrigation. Rain barrels are inexpensive, easy to install and maintain, and well suited for small-scale residential sites. Cisterns are larger can be installed above or below ground depending upon design requirements and site conditions.

ADVANTAGES

- Can provide volume capture if collected water is used for irrigation or allowed to infiltrate.
- Attenuates peak flow and provides hydromodification benefits.
- Can be used as part of a treatment train with other BMPs.
- Low maintenance requirements (for above ground installations).
- Good for sites where infiltration is limited.
- Provides another source for irrigation water.

FACT SHEET- RAINWATER HARVESTING

- Prioritized as a “Universal LID feature.”

LIMITATIONS

- Limited storage capacity.
- Does not provide water quality treatment.
- May require infrastructure (pumps or valves) to use stored water.
- Inadequate maintenance can result in mosquito breeding and/or algae production.
- May require building permits. Contact the governing agency for requirements.

KEY DESIGN FEATURES

- Roof surfaces and downspouts shall not include copper or materials treated with fungicides or herbicides.
- Gutters, if present, must be fully screened and installed at continuous grade.
- Storage containers, tank liners, and tank coatings must be listed as food grade, or be approved for potable water storage.
- Containers must be opaque, water tight, vented, completely covered and screened.
- Screen all openings.
- For above-ground systems, spigot and/or hose bib for drawing water must be at least 2 inches from the bottom and must be labeled “NONPOTABLE”.
- Overflow device must be equal in size to the total of all inlets and must lead to an approved discharge location with approved air gap.
- First flush diverter must be automatic self-draining with a clean out.
- Safety labels (non-potable, vector hazard, drowning hazard icons) should be included as applicable.
- Outdoor spigots must have an atmospheric vacuum breaker attached.

- Prior to installation, roofs must be cleaned, and downspouts disconnected from the storm drain system.
- All municipal water service lines to facilities with rainwater harvesting systems require the installation of an approved backflow prevention device. This condition may be met if the backflow prevention was installed as part of the fire sprinkler system.
- Not permitted within the front yard setback.
- Tanks up to 8 feet in height are permitted within the rear and side yard setbacks.
- Tanks in excess of 8 feet in height, shall be subject to the same setbacks as a detached residential accessory structure.
- Both rain barrels and above-ground cisterns must be sited in a stable, flat area. Rain barrels and cisterns may not block the path of travel for fire safety access.

- Overflow locations, such as rain gardens, swales, or the downstream storm drain system, must be designed to both direct outflow away from building foundations and prevent nuisance flows to adjacent properties.
- Overflow may not discharge water across a public right-of-way.
- Regular use of the water stored in systems between rain events is critical to ensure that storage is available for the next storm event.

FACT SHEET- RAINWATER HARVESTING

SIZING DESIGN GOALS AND REQUIREMENTS

- ***For projects that increase the amount of impervious surface, but create or replace less than a total of one acre:*** The **Delta Volume Capture** component requires that any increase in volume due to development for the water quality design storm must be infiltrated and/or reused on site. Further discussion of the Treatment and Delta Volume Capture requirements and the accompanying formulas can be found in Chapter 6.
- ***For projects that create or replace one acre or more of impervious surface*****:** These larger projects must mitigate their impacts by meeting the **Hydromodification Requirement** by capturing 100% of the post development volume generated by the water quality rain event.
- All calculations shall be completed using the "Storm Water Calculator" available at www.srcity.org/stormwaterLID.

INSPECTION AND MAINTENANCE REQUIREMENTS

A maintenance plan shall be provided with the Final SWLID Submittal. The maintenance plan shall include recommended maintenance practices, state the parties responsible for maintenance and upkeep, specify the funding source for ongoing maintenance with provisions for full replacement when necessary and provide site specific inspection checklist. At a minimum maintenance shall include the following:

- Inspect twice annually to confirm that all the parts are operable and not leaking.
- Debris and clear all screens to prevent mosquitoes and other vectors from breeding.
- Test all backflow prevention assemblies annually by the system owner using an approved certified tester.
- Regular use of the water stored in systems between rain events is critical to ensure that storage is available for the next storm event.
- Clear roof gutter screens and first flush diverters.

Extended Detention Basin TC-22

Design Considerations

- Tributary Area
- Area Required
- Hydraulic Head

Description

Dry extended detention ponds (a.k.a. dry ponds, extended detention basins, detention ponds, extended detention ponds) are basins whose outlets have been designed to detain the stormwater runoff from a water quality design storm for some minimum time (e.g., 48 hours) to allow particles and associated pollutants to settle. Unlike wet ponds, these facilities do not have a large permanent pool. They can also be used to provide flood control by including additional flood detention storage.

Targeted Constituents

☑	Sediment	▲
☑	Nutrients	●
☑	Trash	■
☑	Metals	▲
☑	Bacteria	▲
☑	Oil and Grease	▲
☑	Organics	▲

Legend ***(Removal Effectiveness)***

● Low ■ High

▲ Medium

California Experience

Caltrans constructed and monitored 5 extended detention basins in southern California with design drain times of 72 hours. Four of the basins were earthen, less costly and had substantially better load reduction because of infiltration that occurred, than the concrete basin. The Caltrans study reaffirmed the flexibility and performance of this conventional technology. The small headloss and few siting constraints suggest that these devices are one of the most applicable technologies for stormwater treatment.

Advantages

- Due to the simplicity of design, extended detention basins are relatively easy and inexpensive to construct and operate.
- Extended detention basins can provide substantial capture of sediment and the toxics fraction associated with particulates.
- Widespread application with sufficient capture volume can provide significant control of channel erosion and enlargement caused by changes to flow frequency

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relationships resulting from the increase of impervious cover in a watershed.

Limitations

- Limitation of the diameter of the orifice may not allow use of extended detention in watersheds of less than 5 acres (would require an orifice with a diameter of less than 0.5 inches that would be prone to clogging).
- Dry extended detention ponds have only moderate pollutant removal when compared to some other structural stormwater practices, and they are relatively ineffective at removing soluble pollutants.
- Although wet ponds can increase property values, dry ponds can actually detract from the value of a home due to the adverse aesthetics of dry, bare areas and inlet and outlet structures.

Design and Sizing Guidelines

- Capture volume determined by local requirements or sized to treat 85% of the annual runoff volume.
- Outlet designed to discharge the capture volume over a period of hours.
- Length to width ratio of at least 1.5:1 where feasible.
- Basin depths optimally range from 2 to 5 feet.
- Include energy dissipation in the inlet design to reduce resuspension of accumulated sediment.
- A maintenance ramp and perimeter access should be included in the design to facilitate access to the basin for maintenance activities and for vector surveillance and control.
- Use a draw down time of 48 hours in most areas of California. Draw down times in excess of 48 hours may result in vector breeding, and should be used only after coordination with local vector control authorities. Draw down times of less than 48 hours should be limited to BMP drainage areas with coarse soils that readily settle and to watersheds where warming may be determined to downstream fisheries.

Construction/Inspection Considerations

- Inspect facility after first large to storm to determine whether the desired residence time has been achieved.
- When constructed with small tributary area, orifice sizing is critical and inspection should verify that flow through additional openings such as bolt holes does not occur.

Performance

One objective of stormwater management practices can be to reduce the flood hazard associated with large storm events by reducing the peak flow associated with these storms. Dry extended detention basins can easily be designed for flood control, and this is actually the primary purpose of most detention ponds.

Dry extended detention basins provide moderate pollutant removal, provided that the recommended design features are incorporated. Although they can be effective at removing some pollutants through settling, they are less effective at removing soluble pollutants because of the absence of a permanent pool. Several studies are available on the effectiveness of dry extended detention ponds including one recently concluded by Caltrans (2002).

The load reduction is greater than the concentration reduction because of the substantial infiltration that occurs. Although the infiltration of stormwater is clearly beneficial to surface receiving waters, there is the potential for groundwater contamination. Previous research on the effects of incidental infiltration on groundwater quality indicated that the risk of contamination is minimal.

There were substantial differences in the amount of infiltration that were observed in the earthen basins during the Caltrans study. On average, approximately 40 percent of the runoff entering the unlined basins infiltrated and was not discharged. The percentage ranged from a high of about 60 percent to a low of only about 8 percent for the different facilities. Climatic conditions and local water table elevation are likely the principal causes of this difference. The least infiltration occurred at a site located on the coast where humidity is higher and the basin invert is within a few meters of sea level. Conversely, the most infiltration occurred at a facility located well inland in Los Angeles County where the climate is much warmer and the humidity is less, resulting in lower soil moisture content in the basin floor at the beginning of storms.

Vegetated detention basins appear to have greater pollutant removal than concrete basins. In the Caltrans study, the concrete basin exported sediment and associated pollutants during a number of storms. Export was not as common in the earthen basins, where the vegetation appeared to help stabilize the retained sediment.

Siting Criteria

Dry extended detention ponds are among the most widely applicable stormwater management practices and are especially useful in retrofit situations where their low hydraulic head requirements allow them to be sited within the constraints of the existing storm drain system. In addition, many communities have detention basins designed for flood control. It is possible to modify these facilities to incorporate features that provide water quality treatment and/or channel protection. Although dry extended detention ponds can be applied rather broadly, designers need to ensure that they are feasible at the site in question. This section provides basic guidelines for siting dry extended detention ponds.

In general, dry extended detention ponds should be used on sites with a minimum area of 5 acres. With this size catchment area, the orifice size can be on the order of 0.5 inches. On smaller sites, it can be challenging to provide channel or water quality control because the orifice diameter at the outlet needed to control relatively small storms becomes very small and thus prone to clogging. In addition, it is generally more cost-effective to control larger drainage areas due to the economies of scale.

Extended detention basins can be used with almost all soils and geology, with minor design adjustments for regions of rapidly percolating soils such as sand. In these areas, extended detention ponds may need an impermeable liner to prevent ground water contamination.

The base of the extended detention facility should not intersect the water table. A permanently wet bottom may become a mosquito breeding ground. Research in Southwest Florida (Santana et al., 1994) demonstrated that intermittently flooded systems, such as dry extended detention ponds, produce more mosquitoes than other pond systems, particularly when the facilities remained wet for more than 3 days following heavy rainfall.

A study in Prince George's County, Maryland, found that stormwater management practices can increase stream temperatures (Galli, 1990). Overall, dry extended detention ponds increased temperature by about 5°F. In cold water streams, dry ponds should be designed to detain stormwater for a relatively short time (i.e., 24 hours) to minimize the amount of warming that occurs in the basin.

Additional Design Guidelines

In order to enhance the effectiveness of extended detention basins, the dimensions of the basin must be sized appropriately. Merely providing the required storage volume will not ensure maximum constituent removal. By effectively configuring the basin, the designer will create a long flow path, promote the establishment of low velocities, and avoid having stagnant areas of the basin. To promote settling and to attain an appealing environment, the design of the basin should consider the length to width ratio, cross-sectional areas, basin slopes and pond configuration, and aesthetics (Young et al., 1996).

Energy dissipation structures should be included for the basin inlet to prevent resuspension of accumulated sediment. The use of stilling basins for this purpose should be avoided because the standing water provides a breeding area for mosquitoes.

Extended detention facilities should be sized to completely capture the water quality volume. A micropool is often recommended for inclusion in the design and one is shown in the schematic diagram. These small permanent pools greatly increase the potential for mosquito breeding and complicate maintenance activities; consequently, they are not recommended for use in California.

A large aspect ratio may improve the performance of detention basins; consequently, the outlets should be placed to maximize the flowpath through the facility. The ratio of flowpath length to width from the inlet to the outlet should be at least 1.5:1 (L:W) where feasible. Basin depths optimally range from 2 to 5 feet.

The facility's drawdown time should be regulated by an orifice or weir. In general, the outflow structure should have a trash rack or other acceptable means of preventing clogging at the entrance to the outflow pipes. The outlet design implemented by Caltrans in the facilities constructed in San Diego County used an outlet riser with orifices

Figure 1
Example of Extended Detention Outlet Structure

sized to discharge the water quality volume, and the riser overflow height was set to the design storm elevation. A stainless steel screen was placed around the outlet riser to ensure that the orifices would not become clogged with debris. Sites either used a separate riser or broad crested weir for overflow of runoff for the 25 and greater year storms. A picture of a typical outlet is presented in Figure 1.

The outflow structure should be sized to allow for complete drawdown of the water quality volume in 72 hours. No more than 50% of the water quality volume should drain from the facility within the first 24 hours. The outflow structure can be fitted with a valve so that discharge from the basin can be halted in case of an accidental spill in the watershed.

Summary of Design Recommendations

(1) Facility Sizing - The required water quality volume is determined by local regulations or the basin should be sized to capture and treat 85% of the annual runoff volume. See Section 5.5.1 of the handbook for a discussion of volume-based design.

Basin Configuration – A high aspect ratio may improve the performance of detention basins; consequently, the outlets should be placed to maximize the flowpath through the facility. The ratio of flowpath length to width from the inlet to the outlet should be at least 1.5:1 (L:W). The flowpath length is defined as the distance from the inlet to the outlet as measured at the surface. The width is defined as the mean width of the basin. Basin depths optimally range from 2 to 5 feet. The basin may include a sediment forebay to provide the opportunity for larger particles to settle out.

A micropool should not be incorporated in the design because of vector concerns. For online facilities, the principal and emergency spillways must be sized to provide 1.0 foot of freeboard during the 25-year event and to safely pass the flow from 100-year storm.

(2) Pond Side Slopes - Side slopes of the pond should be 3:1 (H:V) or flatter for grass stabilized slopes. Slopes steeper than 3:1 (H:V) must be stabilized with an appropriate slope stabilization practice.

(3) Basin Lining – Basins must be constructed to prevent possible contamination of groundwater below the facility.

(4) Basin Inlet – Energy dissipation is required at the basin inlet to reduce resuspension of accumulated sediment and to reduce the tendency for short-circuiting.

(5) Outflow Structure - The facility's drawdown time should be regulated by a gate valve or orifice plate. In general, the outflow structure should have a trash rack or other acceptable means of preventing clogging at the entrance to the outflow pipes.

The outflow structure should be sized to allow for complete drawdown of the water quality volume in 72 hours. No more than 50% of the water quality volume should drain from the facility within the first 24 hours. The outflow structure should be fitted with a valve so that discharge from the basin can be halted in case of an accidental spill in the watershed. This same valve also can be used to regulate the rate of discharge from the basin.

The discharge through a control orifice is calculated from:

$$Q = CA(2gH-H_o)^{0.5}$$

where: Q = discharge (ft^3/s)
C = orifice coefficient
A = area of the orifice (ft^2)
g = gravitational constant (32.2)
H = water surface elevation (ft)
H_o= orifice elevation (ft)

Recommended values for C are 0.66 for thin materials and 0.80 when the material is thicker than the orifice diameter. This equation can be implemented in spreadsheet form with the pond stage/volume relationship to calculate drain time. To do this, use the initial height of the water above the orifice for the water quality volume. Calculate the discharge and assume that it remains constant for approximately 10 minutes. Based on that discharge, estimate the total discharge during that interval and the new elevation based on the stage volume relationship. Continue to iterate until H is approximately equal to H_o. When using multiple orifices the discharge from each is summed.

(6) Splitter Box - When the pond is designed as an offline facility, a splitter structure is used to isolate the water quality volume. The splitter box, or other flow diverting approach, should be designed to convey the 25-year storm event while providing at least 1.0 foot of freeboard along pond side slopes.

(7) Erosion Protection at the Outfall - For online facilities, special consideration should be given to the facility's outfall location. Flared pipe end sections that discharge at or near the stream invert are preferred. The channel immediately below the pond outfall should be modified to conform to natural dimensions, and lined with large stone riprap placed over filter cloth. Energy dissipation may be required to reduce flow velocities from the primary spillway to non-erosive velocities.

(8) Safety Considerations - Safety is provided either by fencing of the facility or by managing the contours of the pond to eliminate dropoffs and other hazards. Earthen side slopes should not exceed 3:1 (H:V) and should terminate on a flat safety bench area. Landscaping can be used to impede access to the facility. The primary spillway opening must not permit access by small children. Outfall pipes above 48 inches in diameter should be fenced.

Maintenance

Routine maintenance activity is often thought to consist mostly of sediment and trash and debris removal; however, these activities often constitute only a small fraction of the maintenance hours. During a recent study by Caltrans, 72 hours of maintenance was performed annually, but only a little over 7 hours was spent on sediment and trash removal. The largest recurring activity was vegetation management, routine mowing. The largest absolute number of hours was associated with vector control because of mosquito breeding that occurred in the stilling basins (example of standing water to be avoided) installed as energy dissipaters. In most cases, basic housekeeping practices such as removal of debris accumulations and vegetation

management to ensure that the basin dewaters completely in 48-72 hours is sufficient to prevent creating mosquito and other vector habitats.

Consequently, maintenance costs should be estimated based primarily on the mowing frequency and the time required. Mowing should be done at least annually to avoid establishment of woody vegetation, but may need to be performed much more frequently if aesthetics are an important consideration.

Typical activities and frequencies include:

- Schedule semiannual inspection for the beginning and end of the wet season for standing water, slope stability, sediment accumulation, trash and debris, and presence of burrows.
- Remove accumulated trash and debris in the basin and around the riser pipe during the semiannual inspections. The frequency of this activity may be altered to meet specific site conditions.
- Trim vegetation at the beginning and end of the wet season and inspect monthly to prevent establishment of woody vegetation and for aesthetic and vector reasons.
- Remove accumulated sediment and regrade about every 10 years or when the accumulated sediment volume exceeds 10 percent of the basin volume. Inspect the basin each year for accumulated sediment volume.

Cost

Construction Cost

The construction costs associated with extended detention basins vary considerably. One recent study evaluated the cost of all pond systems (Brown and Schueler, 1997). Adjusting for inflation, the cost of dry extended detention ponds can be estimated with the equation:

$$C = 12.4V^{0.760}$$

where: C = Construction, design, and permitting cost, and
V = Volume (ft^3).

Using this equation, typical construction costs are:

$ 41,600 for a 1 acre-foot pond

$ 239,000 for a 10 acre-foot pond

$ 1,380,000 for a 100 acre-foot pond

Interestingly, these costs are generally slightly higher than the predicted cost of wet ponds (according to Brown and Schueler, 1997) on a cost per total volume basis, which highlights the difficulty of developing reasonably accurate construction estimates. In addition, a typical facility constructed by Caltrans cost about $160,000 with a capture volume of only 0.3 ac-ft.

An economic concern associated with dry ponds is that they might detract slightly from the value of adjacent properties. One study found that dry ponds can actually detract from the

perceived value of homes adjacent to a dry pond by between 3 and 10 percent (Emmerling-Dinovo, 1995).

Maintenance Cost

For ponds, the annual cost of routine maintenance is typically estimated at about 3 to 5 percent of the construction cost (EPA website). Alternatively, a community can estimate the cost of the maintenance activities outlined in the maintenance section. Table 1 presents the maintenance costs estimated by Caltrans based on their experience with five basins located in southern California. Again, it should be emphasized that the vast majority of hours are related to vegetation management (mowing).

Table 1 Estimated Average Annual Maintenance Effort

Activity	Labor Hours	Equipment & Material ($)	Cost
Inspections	4	7	183
Maintenance	49	126	2282
Vector Control	0	0	0
Administration	3	0	132
Materials	-	535	535
Total	**56**	**$668**	**$3,132**

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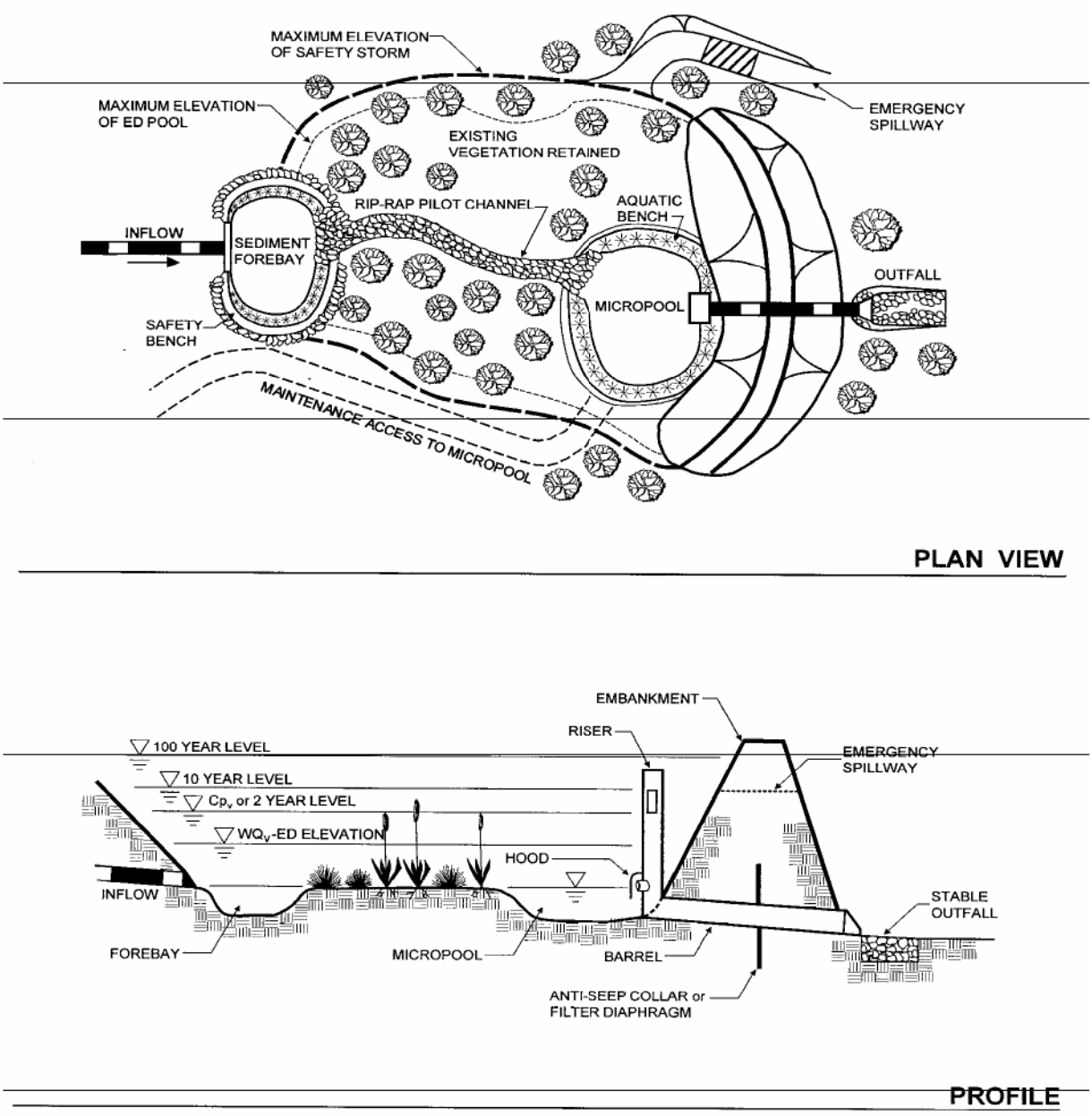

Schematic of an Extended Detention Basin (MDE, 2000)