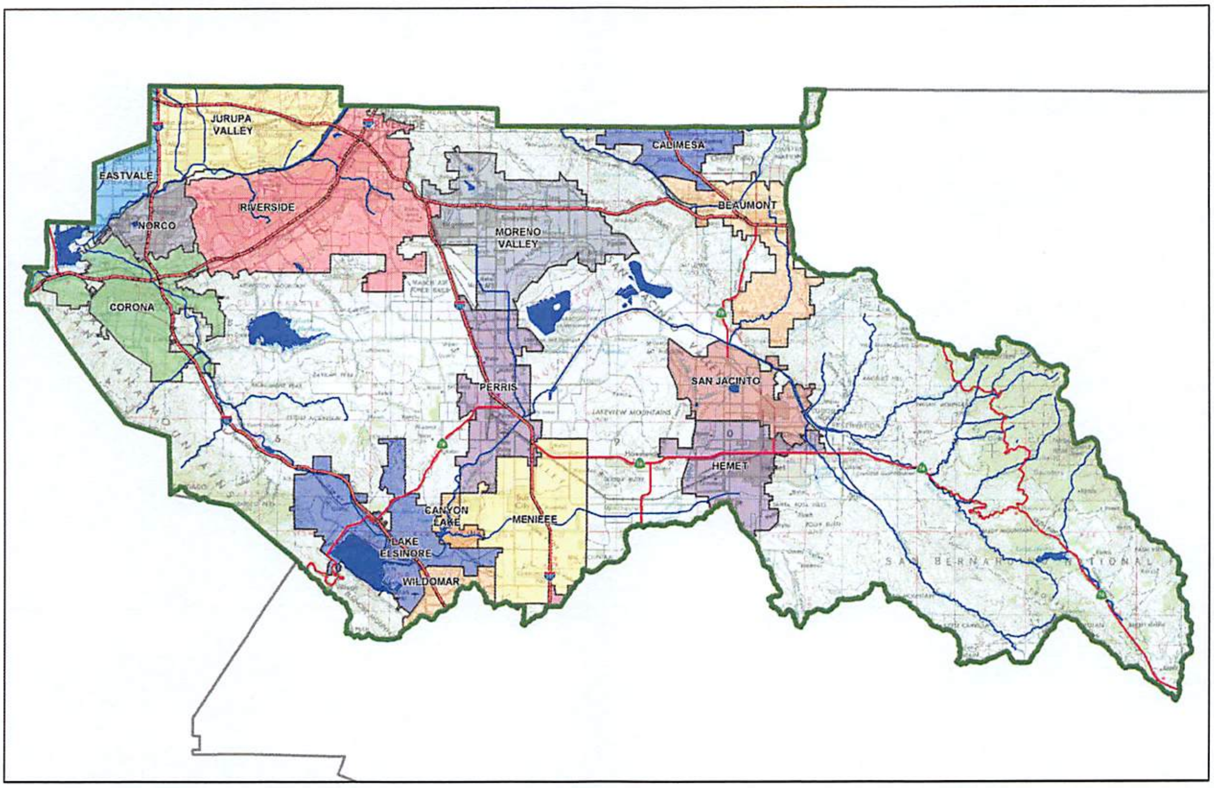
Project Specific Water Quality Management Plan

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

Project Title: Compass Danbe Centerpointe, Proposed Industrial Warehouse Facility, South side of Alessandro Blvd. between Frederick Street and Graham Street, City of Moreno Valley

Development No: PM 37944 PEN 20-0120/0121

Design Review/Case No: LWQ 20--0018



☒ **Preliminary**
☐ **Final**

Original Date Prepared10/5/2020

Revision Date(s):

Prepared for Compliance with
Regional Board Order No. **R8-2010-0033**

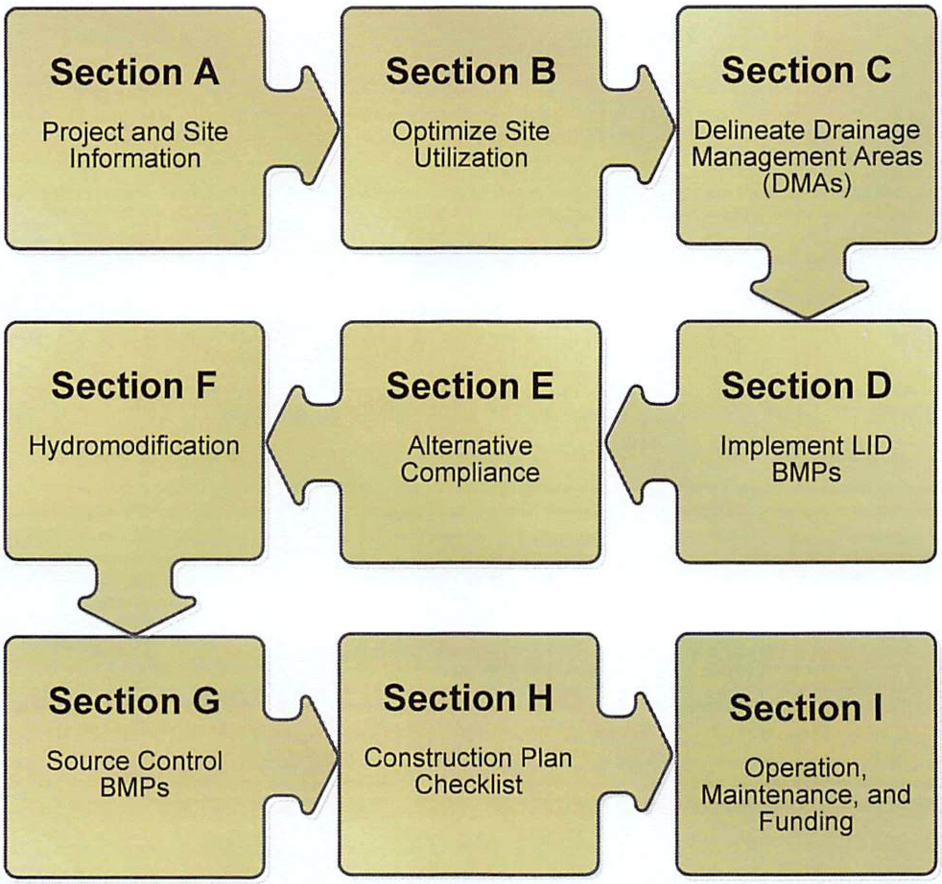
Contact Information:

Prepared for:
CDRE HOLDINGS 17 LLC
Attn: Mark Bachli
523 Main Street
El Segundo, CA 90245
(310) 428-3302

Prepared by:
Thatcher Engineering and Associates, Inc.
1461 Ford Street Suite 105
Redlands, CA 92373
(909) 748-7777

A Brief Introduction

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



OWNER'S CERTIFICATION

This Project-Specific Water Quality Management Plan (WQMP) has been prepared for CDRE HOLDINGS 17 LLC by Thatcher Engineering and Associates, Inc. for Compass Danbe Centerpointe.

This WQMP is intended to comply with the requirements of City of Moreno Valley for Water Quality Ordinance (Municipal code Section 9.10.080) which includes the requirement for the preparation and implementation of a Project-Specific WQMP.

The undersigned, while owning the property/project described in the preceding paragraph, shall be responsible for the implementation and funding of this WQMP and will ensure that this WQMP is amended as appropriate to reflect up-to-date conditions on the site. In addition, the property owner accepts responsibility for interim operation and maintenance of Stormwater BMPs until such time as this responsibility is formally transferred to a subsequent owner. This WQMP will be reviewed with the facility operator, facility supervisors, employees, tenants, maintenance and service contractors, or any other party (or parties) having responsibility for implementing portions of this WQMP. At least one copy of this WQMP will be maintained at the project site or project office in perpetuity. The undersigned is authorized to certify and to approve implementation of this WQMP. The undersigned is aware that implementation of this WQMP is enforceable under City of Moreno Valley Water Quality Ordinance (Municipal Code Section9.10.080).

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

Owner's Signature	Date
Owner's Printed Name	Owner's Title/Position

PREPARER'S CERTIFICATION

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

Preparer's Signature	Date
Patrick C. Flanagan Jr.	Professional Engineer
Preparer's Printed Name	Preparer's Title/Position

Preparer's Licensure:

Table of Contents

List of Tables

List of Appendices

Section A: Project and Site Information

PROJECT INFORMATION	
Type of Project:	Industrial Warehouse Facility
Planning Area:	N/A
Community Name:	N/A
Development Name:	Compass Danbe Centerpointe, Proposed Industrial Warehouse Facility, South side of Alessandro Blvd. between Frederick Street and Graham Street, City of Moreno Valley
PROJECT LOCATION	
Latitude & Longitude (DMS): 33.916171, -117.256090	
Project Watershed and Sub-Watershed: San Jacinto River/ Lake Elsinore	
APN(s): 297-170-002 and 003	
Map Book and Page No.: Book 11, Page 10	
PROJECT CHARACTERISTICS	
Proposed or Potential Land Use(s)	Industrial Warehouse
Proposed or Potential SIC Code(s)	1541
Area of Project Footprint (SF)	995,188
Total Area of proposed Impervious Surfaces within the Project Limits (SF)/or Replacement	793,767 SF
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 (SF)	47,725 (Alessandro Blvd)
Is the project located within any MSHCP Criteria Cell?	☐ Y ☒ N
If so, identify the Cell number:	
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?	0.67

The project site is currently vacant, and consists of two parcels. The site is located on the south side of Alessandro Blvd. between Frederick Street and Graham Street in the City of Moreno Valley. The site generally drains from north to south.

The project proposes to develop the site as an industrial warehouse facility with related access from Alessandro Blvd. and landscape improvements. The development will also include street improvements along Alessandro Boulevard.

The total existing net area of the site is approximately 17.67 acres. After dedication for public right of way, the proposed net area of the site is approximately 17.65 acres. The project area, including proposed offsite improvements and vacant area runon, and existing offsite improvements tributary to the project's BMPs is 995,188 SF.

Drainage Area 1 includes Parcel 1 onsite areas and offsite tributary runon totaling 558,536 SF. Flows generated onsite from Parcel 1 and offsite tributary runon will be directed to an underground detention tank. From here the required treatment volume will be pumped to Biotreatment Device 1 (a Modular Wetland). Treated flows will discharge (gravity flow) to the City of Moreno Valley's storm drain system. Flows from larger storms in excess of water quality treatment volume will be pumped out at rates less than pre-development rates from the detention tank to the storm drain. From here, flows continue via City of Moreno Valley Storm Drain to Perris Valley Channel and Canyon Lake as they do historically.

Drainage Area 2 includes Parcel 2 onsite areas and offsite tributary runon totaling 346,029 SF. Flows generated onsite from Parcel 2 and offsite tributary runon will be directed to an underground detention tank. From here the required treatment volume will be pumped to Biotreatment Device 2 (a Modular Wetland). Treated flows will discharge (gravity flow) to the City of Moreno Valley's storm drain system. Flows from larger storms in excess of water quality treatment volume will be pumped out at rates less than pre-development rates from the detention tank to the storm drain. From here, flows continue via City of Moreno Valley Storm Drain to Perris Valley Channel and Canyon Lake as they do historically.

Drainage Area 3 includes the westerly portion of the Alessandro frontage, adjacent and adjacent parkway totaling 27,680 SF. Bioretention Swale 3 is proposed to provide treatment of the area. Runoff from Alessandro Boulevard will be directed to the swale via curb openings. Once treated in the soil media, runoff will enter an underdrain, ultimately directing flows to a proposed catch basin and into a City of Moreno Valley storm drain which is proposed to be routed through the site. From here, flows continue via City of Moreno Valley Storm Drain to Perris Valley Channel and Canyon Lake as they do historically.

Drainage Area 4 includes the center portion of the Alessandro frontage, adjacent and adjacent parkway totaling 27,994 SF. Bioretention Swale 4 is proposed to provide treatment of the area. Runoff from Alessandro Boulevard will be directed to the swale via curb openings. Once treated in the soil media, runoff will enter an underdrain, ultimately directing flows to a proposed catch basin and into a City of Moreno Valley storm drain which is proposed to be routed through the site. From here, flows continue via City of Moreno Valley Storm Drain to Perris Valley Channel and Canyon Lake as they do historically.

Drainage Area 5 includes the easterly portion of the Alessandro frontage, adjacent and adjacent parkway totaling 34,949 SF. Bioretention Swale 5 is proposed to provide treatment of the area. Runoff from Alessandro Boulevard will be directed to the swale via curb openings. Once treated in the soil media, runoff will enter an underdrain, ultimately directing flows to a proposed catch basin and into a City of Moreno Valley storm drain which is proposed to be routed through the site. From here, flows continue via City of Moreno Valley Storm Drain to Perris Valley Channel and Canyon Lake as they do historically.

The Owner will maintain all BMPs including onsite biotreatment devices and offsite bioretention swales.

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

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

A.2 Identify Receiving Waters

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

Table A.1 Identification of Receiving Waters

Receiving Waters	EPA Approved 303(d) List Impairments	Designated Beneficial Uses	Proximity to RARE Beneficial Use
Perris Valley Channel	None	None	N/A
San Jacinto River (Reach 3)	None	MUN-AGR-GWR-REC1-REC2-WARM-WILD-RARE	11.6 Miles
Canyon Lake (aka San Jacinto River Reach 2)	Nutrients	MUN-AGR-GWR-REC1-REC2-WARM-WILD	N/A
San Jacinto River (Reach 1)	None	MUN-AGR-GWR-REC1-REC2-WARM-WILD-RARE	18.8 Miles
Lake Elsinore	Nutrients, DDT, PCBs, Organic Enrichment/Low Dissolved Oxygen	REC1-REC2-WARM-WILD	N/A
Temescal Creek (Reach 5)	None	AGR-GWR-REC1-REC2-WARM-WILD-RARE	24.4 Miles
Temescal Creek (Reach 4)	None	AGR-GWR-REC1-REC2-WARM-WILD-RARE	37.3 Miles
Temescal Creek (Reach 3)	None	AGR-IND-GWR-REC1-REC2-WARM-WILD	N/A
Temescal Creek (Reach 2)	None	AGR-IND-GWR-REC1-REC2-WARM-LWRM	N/A
Temescal Creek (Reach 1)	pH	REC1-REC2-WARM-WILD	N/A
Santa Ana River (Reach 3)	Copper, Lead, Pathogens	AGR-GWR-REC1-REC2-WARM-WILD-RARE-SPWN	60.7 Miles
Prado Basin Management Zone	pH	REC1-REC2-WARM-WILD-RARE	46.3 Miles
Santa Ana River (Reach 2)	None	AGR-GWR-REC1-REC2-WARM-WILD-RARE	65.7 Miles
Santa Ana River (Reach 1)	None	REC1-REC2-WARM-WILD	N/A
Tidal Prism of Santa Ana River (to within 1000' of Victoria Street) and Newport Slough	None	None	N/A

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)* City of Moreno Valley Permits	☒ Y	☐ N

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

Section B: Optimize Site Utilization (LID Principles)

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

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

Site Optimization

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

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

No. The entire site will be mass graded. Runoff from onsite areas is directed to one of the biotreatment devices for treatment, prior to exiting the site to the City storm drain as it does historically.

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

No. The entire site will be mass graded to accommodate the development, so it is not feasible to protect existing vegetation.

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

No. The measured infiltration rates were too low to allow for the use of an infiltration BMP. Instead, biotreatment BMPs are proposed.

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

Yes. Impervious areas are limited to required streets, sidewalks and buildings. No decorative hardscape is proposed.

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

Yes. Alessandro Boulevard runoff will be directed to bioretention swales for treatment.

Section C: Delineate Drainage Management Areas (DMAs)

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

Table C.1 DMA Classifications

DMA Name or ID	Surface Type(s)[1]	Area (Sq. Ft.)	DMA Type
1A	Concrete /Asphalt/ Roof	502,471	Type D
1B	Ornamental Landscaping	40,593	Type D
1C	Natural	15,472	Type D
2A	Concrete /Asphalt/ Roof	221,281	Type D
2B	Ornamental Landscaping	24,599	Type D
2C	Natural	100,149	Type D
3A	Concrete /Asphalt	21,819	Type D
3B	Ornamental Landscaping	5,861	Type D
4A	Concrete /Asphalt	21,407	Type D
4B	Ornamental Landscaping	6,587	Type D
5A	Concrete /Asphalt	26,789	Type D
5B	Ornamental Landscaping	8,160	Type D

[1] *Reference Table 2-1 in the WQMP Guidance Document to populate this column*

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

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

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

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

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

DMA Name or ID	BMP Name or ID
1A and 1B	Underground Detention and Biotreatment Device 1
2A and 2B	Underground Detention and Biotreatment Device 2
3A and 3B	Bioretention Swale 3
4A and 4B	Bioretention Swale 4
5A and 5B	Bioretention Swale 5

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

Section D: Implement LID BMPs

D.1 Infiltration Applicability

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

If yes has been checked, Infiltration BMPs shall not be used for the site. 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: ALL		
...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:		

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: None of the below apply. Therefore, Harvest and Use has been assessed.

☐ 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 neither 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: 2.01 acres

Type of Landscaping (Conservation Design or Active Turf): Conservation 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: 18.22 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: 1.158

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: 21.10

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)
21.10	2.01

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:

Project Type: Industrial

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: 18.22 acres

Step 3: Enter the Design Storm depth for the project site (see Exhibit A) into the left column of Table 2-1 in Chapter 2 to determine the minimum number or toilet users per tributary impervious acre (TUTIA).

Enter your TUTIA factor: 190

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: 3,462

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)
3,462	914

Other Non-Potable Use Feasibility

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

N/A

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

Average Daily Demand:

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

Total Area of Impervious Surfaces:

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

Enter the factor from Table 2-3:

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

Minimum required use:

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

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

If Irrigation, Toilet and Other Use feasibility anticipated demands are less than the applicable minimum values, Harvest and Use BMPs are not required and you should proceed to utilize LID Bioretention and Biotreatment, unless a site-specific analysis has been completed that demonstrates technical infeasibility as noted in D.3 below.

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	
1A	☐	☐	☐	☒	☐
1B	☐	☐	☐	☒	☐
2A	☐	☐	☐	☒	☐
2B	☐	☐	☐	☒	☐
3A	☐	☐	☒	☐	☐
3B	☐	☐	☒	☐	☐
4A	☐	☐	☒	☐	☐
4B	☐	☐	☒	☐	☐
5A	☐	☐	☒	☐	☐
5B	☐	☐	☒	☐	☐

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

All DMAs are treated using a LID BMP. No alternative compliance is required or proposed.

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)** [A]	**Post-Project Surface Type**	**Effective Impervious Fraction, I_f** [B]	**DMA Runoff Factor** [C]	**DMA Areas x Runoff Factor** [A] x [C]	***Bioretention Device 1***		
1A	*502471*	*Asphalt*	*1*	*0.89*	*448204.1*			
1B	*40593*	*Landscaping*	*0.1*	*0.11*	*4483.8*			
1C	*15472*	*Natural*	*0.3*	*0.23*	*3483.8*			
						Design Storm Depth (in)	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
	$A_T = \Sigma$	***558536***			**Σ= 456171.7**	***0.67***	***25469.6***	***25470***

DMA Type/ID	**DMA Area (square feet)** [A]	**Post-Project Surface Type**	**Effective Impervious Fraction, I_f** [B]	**DMA Runoff Factor** [C]	**DMA Areas x Runoff Factor** [A] x [C]	***Bioretention Device 2***		
2A	*221281*	*Asphalt*	*1*	*0.89*	*197382.7*			
2B	*24599*	*Landscaping*	*0.1*	*0.11*	*2717.2*			
2C	*100149*	*Natural*	*0.3*	*0.23*	*22550.1*			
						Design Storm Depth (in)	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
	$A_T = \Sigma$	***346029***			**Σ=222650.0**	***0.67***	***12431.3***	***12432***

DMA Type/ID	DMA Area (square feet) [A]	Post-Project Surface Type	Effective Impervious Fraction, I_f [B]	DMA Runoff Factor [C]	DMA Areas x Runoff Factor [A] x [C]	*Bioretention Swale 3*		
3A	*21819*	*Asphalt*	*1*	*0.89*	*19462.5*			
3B	*5861*	*Landscaping*	*0.1*	*0.11*	*647.4*			
						Design Storm Depth (in)	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
	$A_T = \Sigma$	***27680***			Σ= **20109.9**	***0.67***	***1122.8***	***1123***

DMA Type/ID	DMA Area (square feet) [A]	Post-Project Surface Type	Effective Impervious Fraction, I_f [B]	DMA Runoff Factor [C]	DMA Areas x Runoff Factor [A] x [C]	*Bioretention Swale 4*		
4A	*21407*	*Asphalt*	*1*	*0.89*	*19095*			
4B	*6587*	*Landscaping*	*0.1*	*0.11*	*727.6*			
						Design Storm Depth (in)	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
	$A_T = \Sigma$	***27994***			Σ= ***19822.6***	***0.67***	***1106.8***	***1107***

DMA Type/ID	DMA Area (square feet) [A]	Post-Project Surface Type	Effective Impervious Fraction, I_f [B]	DMA Runoff Factor [C]	DMA Areas x Runoff Factor [A] x [C]	*Bioretention Swale 5*		
5A	*26789*	*Asphalt*	*1*	*0.89*	*23895.8*			
5B	*8160*	*Landscaping*	*0.1*	*0.11*	*901.3*			
						Design Storm Depth (in)	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
	$A_T = \Sigma$	***34949***			Σ= ***24797.1***	***0.67***	***1384.5***	***1385***

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

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

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

Section E: Alternative Compliance (LID Waiver Program)

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

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

- *Or* -

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

E.1 Identify Pollutants of Concern

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

Table E.1 Potential Pollutants by Land Use Type

Priority Development Project Categories and/or Project Features (check those that apply)	**General Pollutant Categories**							
	Bacterial Indicators	**Metals**	**Nutrients**	**Pesticides**	**Toxic Organic Compounds**	**Sediments**	**Trash & Debris**	**Oil & Grease**
☐ 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.

N/A

Table E.2 Water Quality Credits

Qualifying Project Categories	Credit Percentage[2]
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.

N/A

Table E.3 Treatment Control BMP Sizing

DMA Type/ID	**DMA Area (square feet)** [A]	**Post-Project Surface Type**	**Effective Impervious Fraction, I_f** [B]	**DMA Runoff Factor** [C]	**DMA Area x Runoff Factor** [A] x [C]		***Enter BMP Name / Identifier Here***		
						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 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.

N/A

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]

[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 (DA 1)

	2 year – 24 hour		
	Pre-condition	**Post-condition**	**% Difference**
Time of Concentration			
Volume (Cubic Feet)			

Table F.2 Hydrologic Conditions of Concern Summary (DA 2)

	2 year – 24 hour		
	Pre-condition	**Post-condition**	**% Difference**
Time of Concentration			
Volume (Cubic Feet)			

Table F.3 Hydrologic Conditions of Concern Summary (DA 3)

	2 year – 24 hour		
	Pre-condition	**Post-condition**	**% Difference**
Time of Concentration			
Volume (Cubic Feet)			

Table F.4 Hydrologic Conditions of Concern Summary (DA 4)

	2 year – 24 hour		
	Pre-condition	**Post-condition**	**% Difference**
Time of Concentration			
Volume (Cubic Feet)			

Table F.5 Hydrologic Conditions of Concern Summary (DA 5)

	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 Sensitivity 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:

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

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

1. ***Identify Pollutant Sources*:** Review Column 1 in the Pollutant Sources/Source Control Checklist. Check off the potential sources of Pollutants that apply to your site.

2. ***Note Locations on Project-Specific WQMP Exhibit*:** Note the corresponding requirements listed in Column 2 of the Pollutant Sources/Source Control Checklist. Show the location of each Pollutant source and each permanent Source Control BMP in your Project-Specific WQMP Exhibit located in Appendix 1.

3. ***Prepare a Table and Narrative*:** Check off the corresponding requirements listed in Column 3 in the Pollutant Sources/Source Control Checklist. In the left column of Table G.1 below, list each potential source of runoff Pollutants on your site (from those that you checked in the Pollutant Sources/Source Control Checklist). In the middle column, list the corresponding permanent, Structural Source Control BMPs (from Columns 2 and 3 of the Pollutant Sources/Source Control Checklist) used to prevent Pollutants from entering runoff. **Add additional narrative** in this column that explains any special features, materials or methods of construction that will be used to implement these permanent, Structural Source Control BMPs.

4. ***Identify Operational Source Control BMPs:*** To complete your table, refer once again to the Pollutant Sources/Source Control Checklist. List in the right column of your table the Operational BMPs that should be implemented as long as the anticipated activities continue at the site. Copermittee stormwater ordinances require that applicable Source Control BMPs be implemented; the same BMPs may also be required as a condition of a use permit or other revocable Discretionary Approval for use of the site.

Table G.1 Permanent and Operational Source Control Measures

Potential Sources of Runoff pollutants	Permanent Structural Source Control BMPs	Operational Source Control BMPs
Landscape/Outdoor Pesticide Use	Project plan designs maximize natural water storage and infiltration opportunities, and protect slopes and channels. Plants are grouped with similar water requirements in order to reduce excess irrigation runoff and promote surface infiltration. Landscaping correlates to the climate,	Landscape maintenance will begin upon construction completion and will occur on a monthly basis (or more frequently if desired) for all common areas. The Owners will be responsible for servicing all site landscaping and irrigation in common areas. Site trees

	soil, related natural resources and existing vegetation of the site, as well as the type of development proposed. Irrigation methods will be utilized to minimize runoff of excess irrigation water across impervious surfaces. Such measures will include employing rain-triggered shutoff devises to eliminate or reduce irrigation during and immediately after precipitation, using mulches (such as wood chips) to minimize sediment in runoff and to maintain soil infiltration capacity, and coordinating design of the irrigation system and landscape to minimize overspray and runoff. Irrigation systems will use flow reducers or shutoff valves triggered by pressure drop to control water loss in the event of broken sprinkler heads or water supply lines. Water conservation devices such as programmable irrigation timers will be used.	and shrubs are to be trimmed as necessary and all wastes disposed of offsite. Wood mulch that has been disturbed is to be replaced. Ongoing maintenance shall be consistent with local guidelines, and fertilizer and pesticide usage shall be consistent with the instructions contained on product labels and with the regulations administered by the State Department of Pesticide Regulation. Clippings and yard waste shall be composted. Any adjustments to ensure that sprinklers are not overspraying should be made in a timely manner. Any breaks or leaks in piping must be repaired within 5 business days of report to the landscaper. Scrap pipe and extra materials shall be recycled if possible. All non-recyclable wastes shall be landfilled. Hazardous wastes shall be disposed of per County hazardous material disposal regulations.
Refuse Area	Drainage is not directed to the trash enclosures but away from it. The enclosures will be roofed.	This BMP will begin upon construction completion and will occur on a monthly basis or more frequently as dictated by volume of trash. The Owners will be responsible for having staff or contracting with a landscape maintenance service that will be responsible for litter control. They are to ensure that the entire site is trash free. Trash is to be removed and placed in bins. "No hazardous materials" signs will be posted in the trash enclosure areas.
Loading Docks	Loading docks drain to the biotreatment devices for treatment which will include pre-treatment.	Items shall be unloaded and loaded from docks as quickly as possible.

Sweeping of Sidewalks and Parking Lots		This BMP will begin upon construction completion and will occur on a bi-annual basis. The Owners will contract with a sweeping service to sweep the lot every every six months.
Roofing, Gutters, Trim	Roofing, gutters and trim made of copper or other unprotected metals will not be used.	
On-site Storm Drain Inlets	Stenciling adjacent to drop inlets will be provided.	This BMP will begin upon construction completion. Inspections will be done by Owner's staff after the first storm of the rainy season and bi-monthly thereafter for the duration of the rainy season. The inspector is also required to clean the facility as needed or when filled to 25% capacity. Cleaning can be by pump or chopvac or by hand. Debris and trash shall be placed inside bins.Stenciling shall be reflreshed as needed . The Owners shall provide stormwater pollution prevention information to new site owners, lessees and operators, and shall include the following language on the lease agreement: "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."

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)
1	Bioretention Device 1	Conceptual Grading Plan
2	Bioretention Device 2	Conceptual Grading Plan
3	Bioretention Swale 3	Conceptual Grading Plan
4	Bioretention Swale 4	Conceptual Grading Plan
5	Bioretention Swale 5	Conceptual Grading Plan

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

Section I: Operation, Maintenance and Funding

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

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

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

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

Maintenance Mechanism: The Owners will maintain all BMPs including the offsite bioretention swales and onsite biotreatment devices.

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.

Operation and Maintenance Plan and Maintenance Mechanism will be provided in the Final WQMP.

Appendix 1: Maps and Site Plans

WQMP Site Plan (includes Location Map) and Receiving Waters Map

PRELIMINARY WATER QUALITY MANAGEMENT PLAN

COMPASS DANBE CENTERPOINTE - PROPOSED INDUSTRIAL WAREHOUSE FACILITY

SOUTH SIDE OF ALESSANDRO BOULEVARD

APN 297-170-002 & 003 - CITY OF MORENO VALLEY

LEGAL DESCRIPTION

PARCEL 1:

LOT 2, BLOCK 242 OF MAP NO. 1, BEAR VALLEY AND ALESSANDRO DEVELOPMENT CO., AS SHOWN BY MAP ON FILE IN BOOK 11 PAGE 10 OF MAPS, RECORDS OF SAN BERNARDINO COUNTY, CALIFORNIA; EXCEPTING THEREFROM THAT PORTION OF ALESSANDRO BOULEVARD AS CONVEYED TO THE COUNTY OF RIVERSIDE BY DOCUMENT RECORDED NOVEMBER 28, 1972 AS INSTRUMENT NO. 157190, OFFICIAL RECORDS.

PARCEL 2:

LOT 3, BLOCK 242 OF MAP NO. 1, BEAR VALLEY AND ALESSANDRO DEVELOPMENT CO., AS SHOWN BY MAP ON FILE IN BOOK 11, PAGE 10 OF MAPS, RECORDS OF SAN BERNARDINO COUNTY, CALIFORNIA; EXCEPTING THEREFROM THAT PORTION DESCRIBED IN THE DEED TO THE COUNTY OF RIVERSIDE DOCUMENT RECORDED MAY 30, 1972 AS INSTRUMENT NO. 69766, OFFICIAL RECORDS.

Table D.3 DCV Calculations for LID BMPs

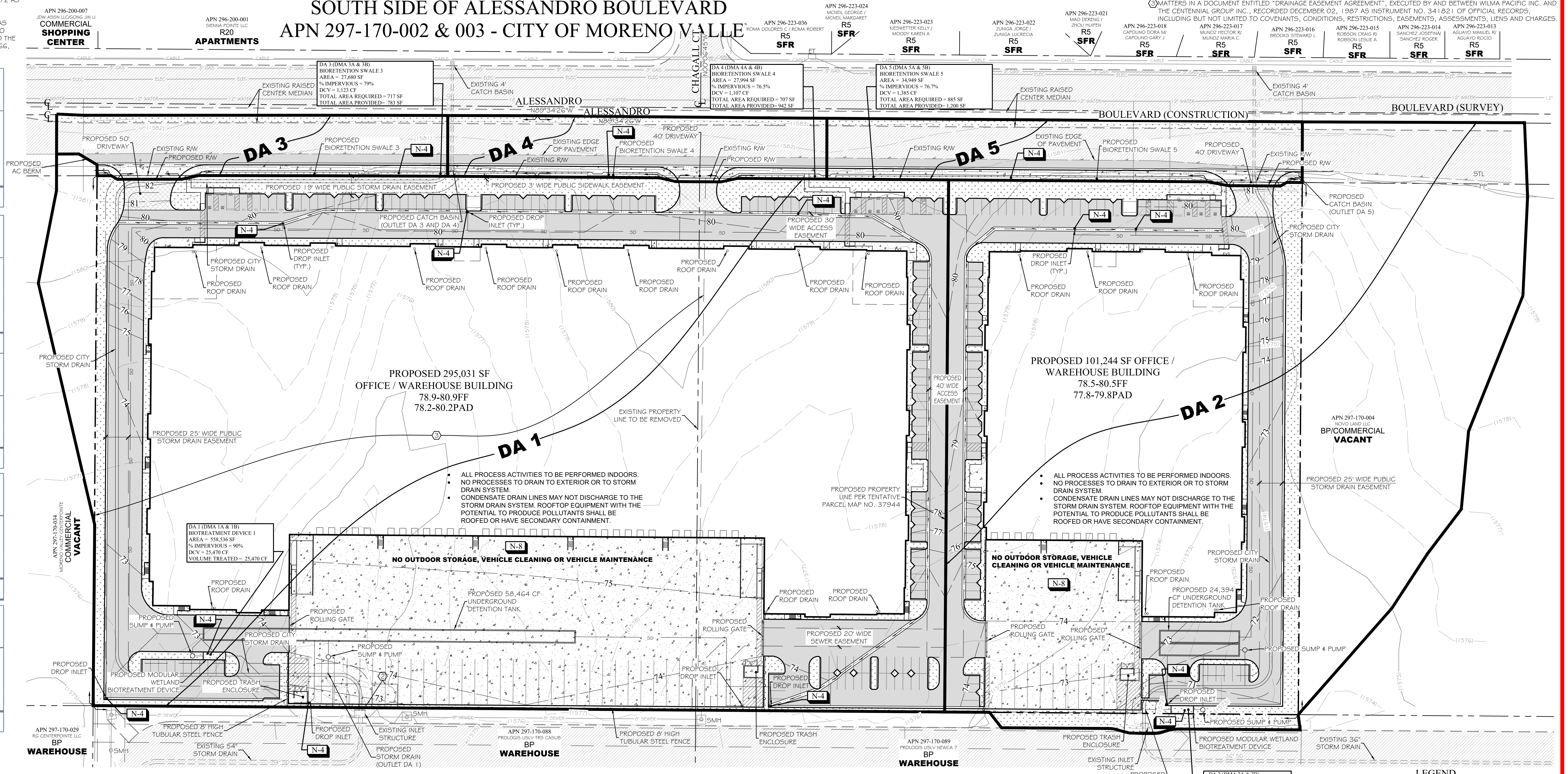
DMA Type/ID	DMA Area (square feet) [A]	Post-Project Surface Type	Effective Impervious Fraction, I_f [B]	DMA Runoff Factor [C]	DMA Areas x Runoff Factor [A] x [C]	*Bioretention Device 1*		
1A	502471	Asphalt	1	0.89	448204.1			
1B	40593	Landscaping	0.1	0.11	4483.8			
1C	15472	Natural	0.3	0.23	3483.8			
						Design Storm Depth (in)	Design Capture Volume, V_{BMP} (cubic feet)	Proposed Volume on Plans (cubic feet)
	$A_T = \Sigma$	558536			Σ= 456171.7	0.67	25469.6	25470

DMA Type/ID	DMA Area (square feet) [A]	Post-Project Surface Type	Effective Impervious Fraction, I_f [B]	DMA Runoff Factor [C]	DMA Areas x Runoff Factor [A] x [C]	*Bioretention Device 2*		
2A	221281	Asphalt	1	0.89	197382.7			
2B	24599	Landscaping	0.1	0.11	2717.2			
2C	100149	Natural	0.3	0.23	22550.1			
						Design Storm Depth (in)	Design Capture Volume, V_{BMP} (cubic feet)	Proposed Volume on Plans (cubic feet)
	$A_T = \Sigma$	346029			Σ=222650.0	0.67	12431.3	12432

DMA Type/ID	DMA Area (square feet) [A]	Post-Project Surface Type	Effective Impervious Fraction, I_f [B]	DMA Runoff Factor [C]	DMA Areas x Runoff Factor [A] x [C]	*Bioretention Swale 3*		
3A	21819	Asphalt	1	0.89	19462.5			
3B	5861	Landscaping	0.1	0.11	647.4			
						Design Storm Depth (in)	Design Capture Volume, V_{BMP} (cubic feet)	Proposed Volume on Plans (cubic feet)
	$A_T = \Sigma$	27680			Σ= 20109.9	0.67	1122.8	1123

DMA Type/ID	DMA Area (square feet) [A]	Post-Project Surface Type	Effective Impervious Fraction, I_f [B]	DMA Runoff Factor [C]	DMA Areas x Runoff Factor [A] x [C]	*Bioretention Swale 4*		
4A	21407	Asphalt	1	0.89	19095			
4B	6587	Landscaping	0.1	0.11	727.6			
						Design Storm Depth (in)	Design Capture Volume, V_{BMP} (cubic feet)	Proposed Volume on Plans (cubic feet)
	$A_T = \Sigma$	27994			Σ= 19822.6	0.67	1106.8	1107

DMA Type/ID	DMA Area (square feet) [A]	Post-Project Surface Type	Effective Impervious Fraction, I_f [B]	DMA Runoff Factor [C]	DMA Areas x Runoff Factor [A] x [C]	*Bioretention Swale 5*		
5A	26789	Asphalt	1	0.89	23895.8			
5B	8160	Landscaping	0.1	0.11	901.3			
						Design Storm Depth (in)	Design Capture Volume, V_{BMP} (cubic feet)	Proposed Volume on Plans (cubic feet)
	$A_T = \Sigma$	34949			Σ= 24797.1	0.67	1384.5	1385



DA 3 (DMA 3A & 3B)
BIORETENTION SWALE 3
AREA = 27,680 SF
% IMPERVIOUS = 79%
DCV = 1,123 CF
TOTAL AREA REQUIRED = 717 SF
TOTAL AREA PROVIDED= 783 SF

DA 4 (DMA 4A & 4B)
BIORETENTION SWALE 4
AREA = 27,994 SF
% IMPERVIOUS = 76.5%
DCV = 1,107 CF
TOTAL AREA REQUIRED = 707 SF
TOTAL AREA PROVIDED= 942 SF

DA 5 (DMA 5A & 5B)
BIORETENTION SWALE 5
AREA = 34,949 SF
% IMPERVIOUS = 76.7%
DCV = 1,385 CF
TOTAL AREA REQUIRED = 885 SF
TOTAL AREA PROVIDED= 1,200 SF

DA 1 (DMA 1A & 1B)
BIOTREATMENT DEVICE 1
AREA = 558,536 SF
% IMPERVIOUS = 90%
DCV = 25,470 CF
VOLUME TREATED = 25,470 CF

DA 2 (DMA 2A & 2B)
BIOTREATMENT DEVICE 2
AREA = 346,029 SF
% IMPERVIOUS = 64%
DCV = 12,432 CF
VOLUME TREATED = 12,432 CF

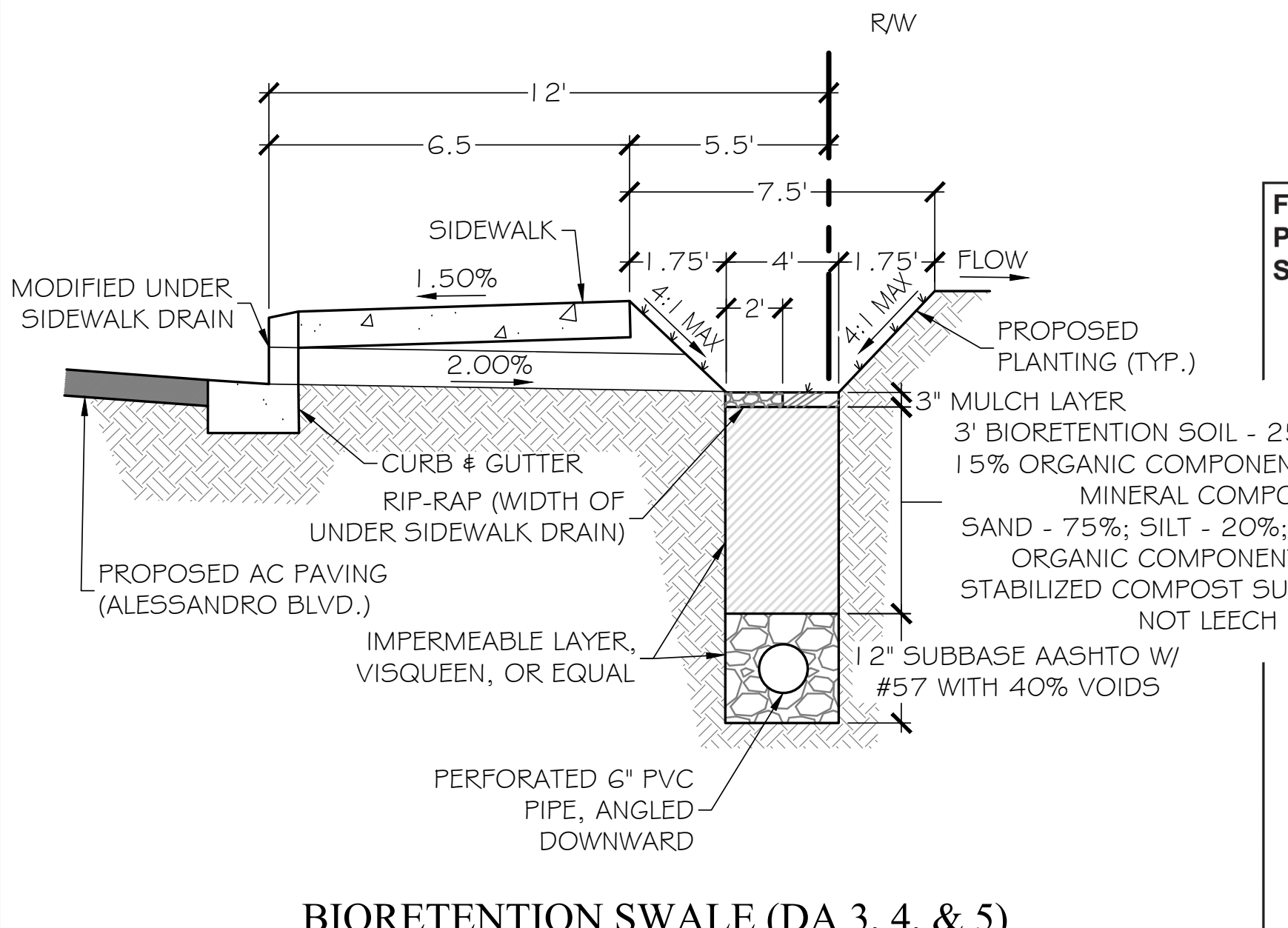
- ALL PROCESS ACTIVITIES TO BE PERFORMED INDOORS.
- NO PROCESSES TO DRAIN TO EXTERIOR OR TO STORM DRAIN SYSTEM.
- CONDENSATE DRAIN LINES MAY NOT DISCHARGE TO THE STORM DRAIN SYSTEM. ROOFTOP EQUIPMENT WITH THE POTENTIAL TO PRODUCE POLLUTANTS SHALL BE ROOFED OR HAVE SECONDARY CONTAINMENT.

EASEMENTS

1 THE TERMS, PROVISIONS AND EASEMENT(S) CONTAINED IN THE DOCUMENT ENTITLED "TEMPORARY DECLARATION OF EASEMENT FOR ACCEPTANCE OF DRAINAGE WATERS" RECORDED JANUARY 22, 2009 AS INSTRUMENT NO. 2009-0029343 OF OFFICIAL RECORDS. PER THE PROVISIONS OF THE EASEMENT DOCUMENT, SAID EASEMENT WILL BE ABANDONED UPON THE DEVELOPMENT OF THE PROPERTY.

2 AN OFFER OF DEDICATION FOR FLOOD CONTROL AND DRAINAGE AND INCIDENTAL PURPOSES, IN FAVOR OF RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT, RECORDED DECEMBER 23, 2009 AS INSTRUMENT NO. 2009-0657601 OF OFFICIAL RECORDS.

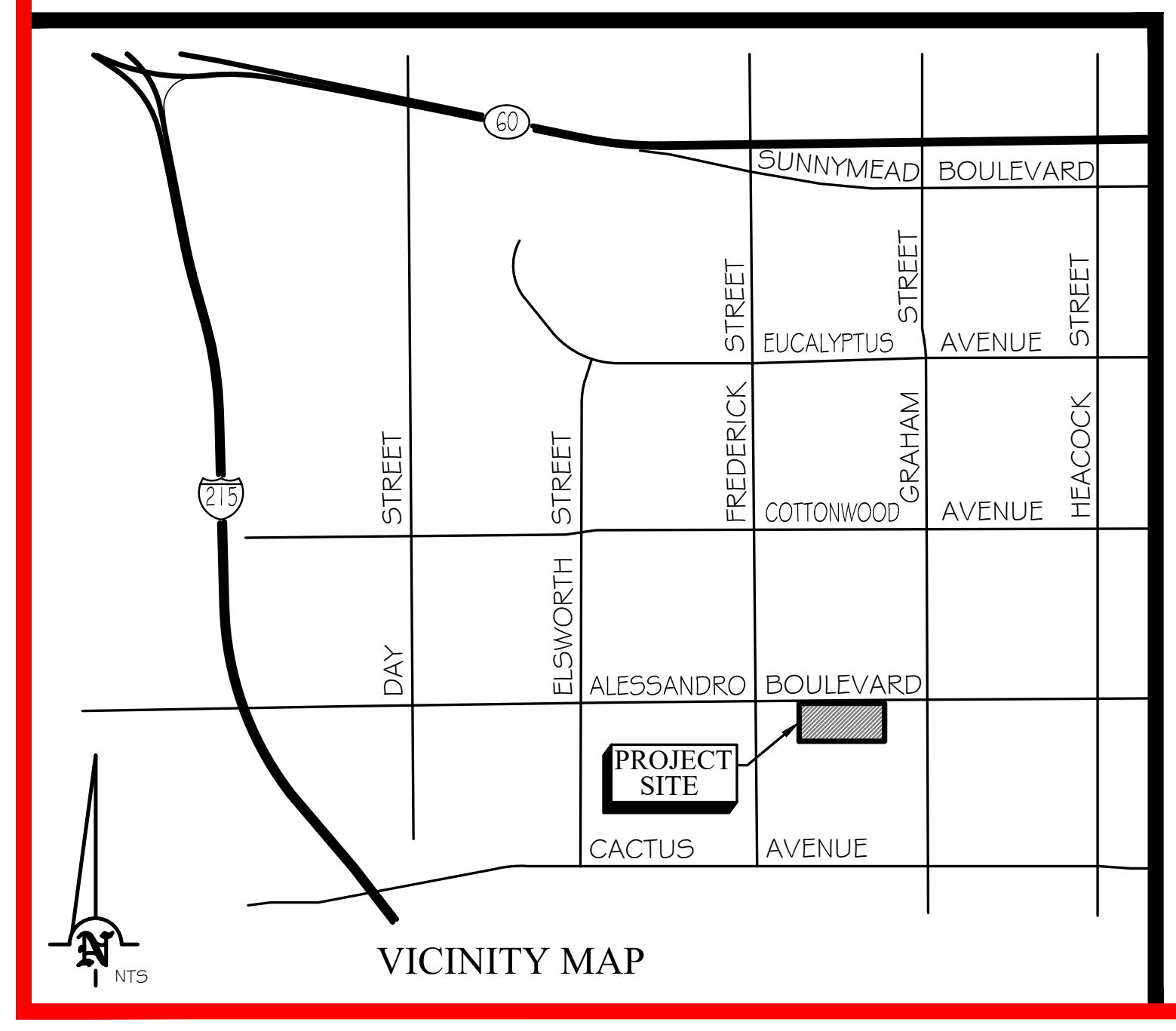
3 MATTERS IN A DOCUMENT ENTITLED "DRAINAGE EASEMENT AGREEMENT", EXECUTED BY AND BETWEEN WILMA PACIFIC INC. AND THE CENTENNIAL GROUP INC., RECORDED DECEMBER 02, 1987 AS INSTRUMENT NO. 341821 OF OFFICIAL RECORDS, INCLUDING BUT NOT LIMITED TO COVENANTS, CONDITIONS, RESTRICTIONS, EASEMENTS, ASSESSMENTS, LIENS AND CHARGES.



3' BIORETENTION SOIL - 25% MINERAL COMPONENT; 15% ORGANIC COMPONENT (SANDY LOAM TOPSOIL) MINERAL COMPONENT SHALL BE: SAND - 75%; SILT - 20%; CLAY - 5%; (30% VOIDS) ORGANIC COMPONENT SHALL BE NITROGEN STABILIZED COMPOST SUCH THAT NITROGEN DOES NOT LEECH INTO MEDIA

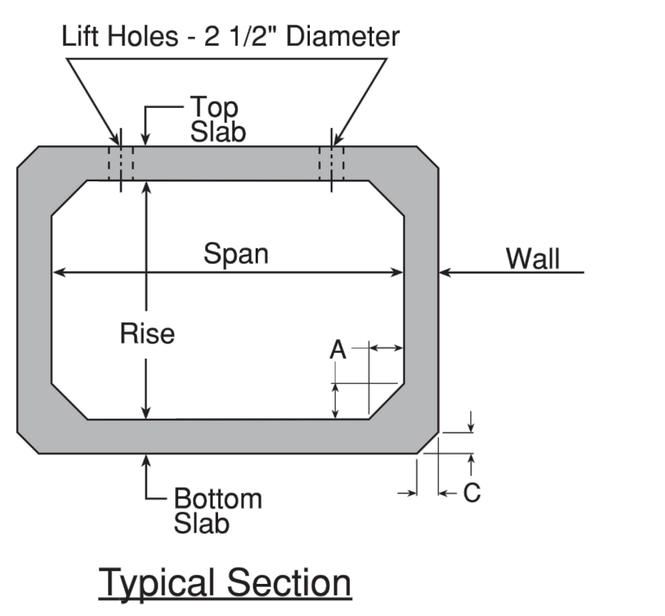
BIORETENTION SWALE (DA 3, 4, & 5)

NTS



VICINITY MAP

FastCast™ Drycast
PreGasketed
Stormwater Storage



Typical Section

Standard Box Dimensions					
Span (Ft.)	Rise (Ft.)	Top Slab (In.)	Bottom Slab (In.)	Wall (In.)	Weight (Lbs./ft.)
3	2	7	6	4	848
3	3	7	6	4	952
4	2	7 1/2	6	5	1146
4	3	7 1/2	6	5	1276
4	4	7 1/2	6	5	1405
5	2	8	7	6	1541
5	3	8	7	6	1696
5	4	8	7	6	1851
5	5	8	7	6	2006
6	2	8	7	7	1821
6	3	8	7	7	2002
6	4	8	7	7	2183
6	5	8	7	7	2364
6	6	8	7	7	2545
7	2	8	8	8	2238
7	3	8	8	8	2446
7	4	8	8	8	2652
7	5	8	8	8	2859
7	6	8	8	8	3066
7	7	8	8	8	3272

Standard Box Dimensions					
Span (Ft.)	Rise (Ft.)	Top Slab (In.)	Bottom Slab (In.)	Wall (In.)	Weight (Lbs./ft.)
8	3	8	8	8	2652
8	4	8	8	8	2859
8	5	8	8	8	3066
8	6	8	8	8	3272
8	7	8	8	8	3479
8	8	8	8	8	3686
9	4	9	9	9	3511
9	5	9	9	9	3744
9	6	9	9	9	3976
9	7	9	9	9	4209
9	8	9	9	9	4441
9	9	9	9	9	4674
10	4	10	10	10	4228
10	5	10	10	10	4486
10	6	10	10	10	4745
10	7	10	10	10	5003
10	8	10	10	10	5261
10	9	10	10	10	5520
10	10	10	10	10	5778

Standard Box Dimensions					
Span (Ft.)	Rise (Ft.)	Top Slab (In.)	Bottom Slab (In.)	Wall (In.)	Weight (Lbs./ft.)
11	4	11	11	11	5010
11	5	11	11	11	5294
11	6	11	11	11	5578
11	7	11	11	11	5862
11	8	11	11	11	6146
11	9	11	11	11	6430
11	10	11	11	11	6715
11	11	11	11	11	6999
12	4	12	12	12	5856
12	5	12	12	12	6166
12	6	12	12	12	6476
12	7	12	12	12	6786
12	8	12	12	12	7096
12	9	12	12	12	7406
12	10	12	12	12	7716
12	11	12	12	12	8026
12	12	12	12	12	8336

Note:
- A = Wall thickness
- C = 2" for 4", 5" and 6" wall
- C = 4" for 7" and greater wall
- Contact manufacturer for standard joint lengths.

-No Scale-
All dimensions subject to allowable specification tolerances.

TITLE	PLANT	STATE	SECTION.PAGE	DATE	
Reinforced Concrete Precast Box Section	Grand Prairie Houston	TX	4.1	11-12-15	Bio Clean A Forterra Company

STORMWATER DETENTION DETAIL

N.T.S.

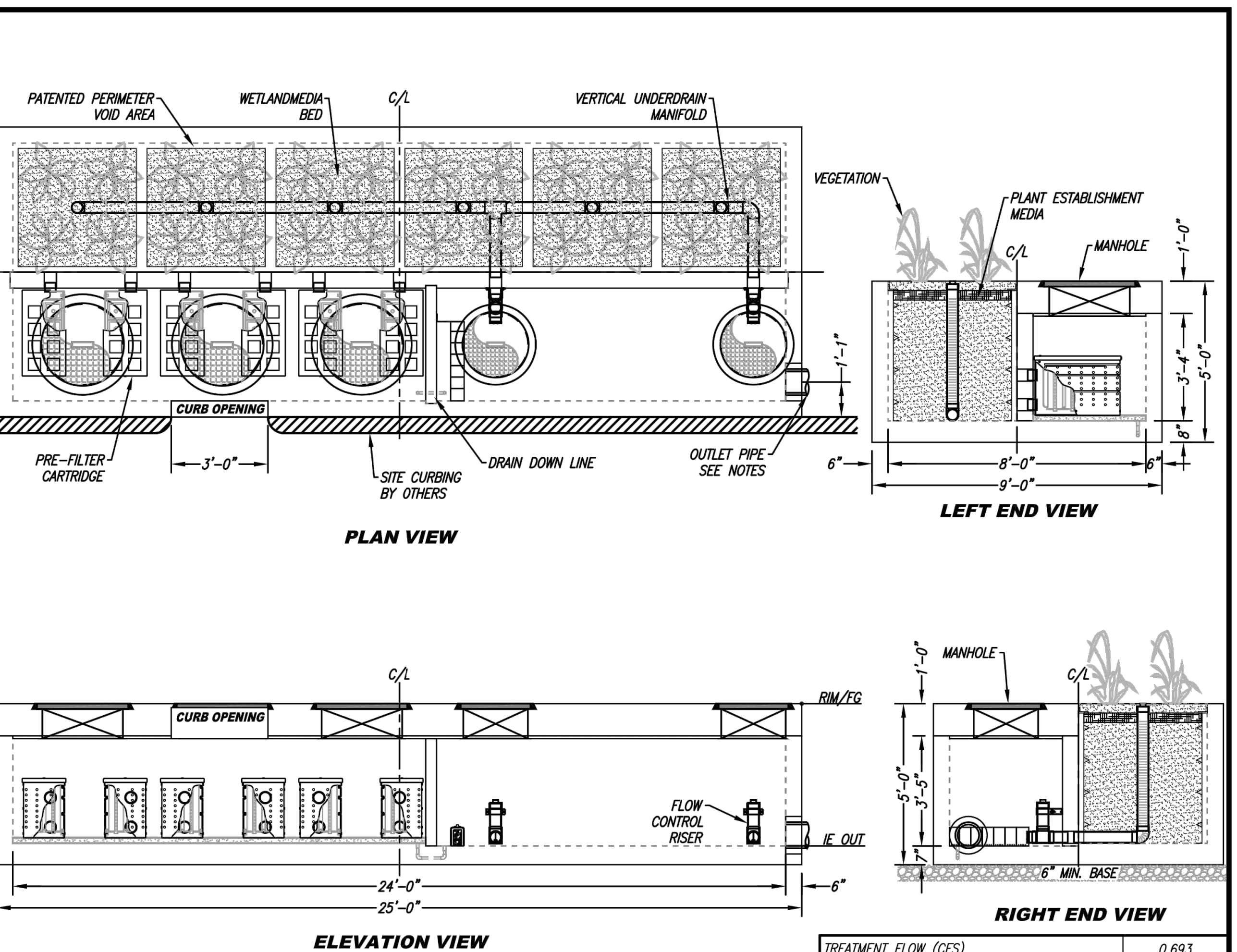
SITE SPECIFIC DATA			
PROJECT NUMBER			
ORDER NUMBER			
PROJECT NAME			
PROJECT LOCATION			
STRUCTURE ID			
TREATMENT REQUIRED			
VOLUME BASED (CF)		FLOW BASED (CFS)	
TREATMENT HGL AVAILABLE (FT)			
PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE			
PIPE DATA	I.E.	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			
	PRETREATMENT	BIOFILTRATION	DISCHARGE
RIM ELEVATION			
SURFACE LOAD	PEDESTRIAN	OPEN PLANTER	PEDESTRIAN
FRAME & COVER	3 EA ø30"	N/A	2 EA ø24"
WETLANDMEDIA VOLUME (CY)			TBD
ORIFICE SIZE (DIA. INCHES)			TBD
NOTES: PRELIMINARY NOT FOR CONSTRUCTION.			

INSTALLATION NOTES

1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURERS SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURERS CONTRACT.
2. UNIT MUST BE INSTALLED ON LEVEL BASE. MANUFACTURER RECOMMENDS A MINIMUM 6" LEVEL ROCK BASE UNLESS SPECIFIED BY THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE TO VERIFY PROJECT ENGINEERS RECOMMENDED BASE SPECIFICATIONS.
3. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE. (PIPES CANNOT INTRUDE BEYOND FLUSH). INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR. ALL GAPS AROUND PIPES SHALL BE SEALED WATER TIGHT WITH A NON-SHRINK GROUT PER MANUFACTURERS STANDARD CONNECTION DETAIL AND SHALL MEET OR EXCEED REGIONAL PIPE CONNECTION STANDARDS.
4. CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES.
5. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL RISERS, MANHOLES, AND HATCHES. CONTRACTOR TO GROUT ALL MANHOLES AND HATCHES TO MATCH FINISHED SURFACE UNLESS SPECIFIED OTHERWISE.
6. DRIP OR SPRAY IRRIGATION REQUIRED ON ALL UNITS WITH VEGETATION.
7. CONTRACTOR RESPONSIBLE FOR CONTACTING MODULAR WETLANDS FOR ACTIVATION OF UNIT. MANUFACTURES WARRANTY IS VOID WITH OUT PROPER ACTIVATION BY A MODULAR WETLANDS REPRESENTATIVE.

GENERAL NOTES

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



TREATMENT FLOW (CFS)	0.693
OPERATING HEAD (FT)	3.4
PRETREATMENT LOADING RATE (GPM/SF)	2.0
WETLAND MEDIA LOADING RATE (GPM/SF)	1.0

MODULAR WETLANDS

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING US PATENTS: 7,425,262; 7,470,362; 7,674,378; 8,303,816; RELATED FOREIGN PATENTS OR OTHER PATENTS PENDING

PROPRIETARY AND CONFIDENTIAL:

THE INFORMATION CONTAINED IN THIS DOCUMENT IS THE SOLE PROPERTY OF FORTERRA AND ITS COMPANIES. THIS DOCUMENT, NOR ANY PART THEREOF, MAY BE USED, REPRODUCED OR MODIFIED IN ANY MANNER WITH OUT THE WRITTEN CONSENT OF FORTERRA.

Bio Clean
A Forterra Company

MWS-L-8-24-C
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL

MODULAR WETLANDS STANDARD DETAIL

N.T.S.

SITE WIDE BMP'S

N-1
N-2
N-3
N-5
N-6
N-7
N-8

KEY NOTES:

BMP SYMBOL	DESCRIPTION	RESPONSIBLE PARTY
N-1	EDUCATION OF PROPERTY OWNERS, OPERATORS, TENANTS OCCUPANTS, OR EMPLOYEES	DEVELOPER/OWNERS
N-2	IRRIGATION AND LANDSCAPE MAINTENANCE	OWNERS
N-3	COMMON AREA LITTER CONTROL	OWNERS
N-4	DRAINAGE FACILITY INSPECTION AND MAINTENANCE	OWNERS
N-5	LANDSCAPE AND IRRIGATION SYSTEM DESIGN	DEVELOPER
N-6	LANDSCAPE/OUTDOOR PESTICIDE USE	OWNERS
N-7	ROOFING, GUTTERS, TRIM	DEVELOPER
N-8	SWEEPING OF PARKING LOT	OWNERS

Table C.1 DMA Classifications

DMA Name or ID	Surface Type(s)[1]	Area (Sq. Ft.)	DMA Type
1A	Concrete /Asphalt/ Roof	502,471	Type D
1B	Ornamental Landscaping	40,593	Type D
1C	Natural	15,472	Type D
2A	Concrete /Asphalt/ Roof	221,281	Type D
2B	Ornamental Landscaping	24,599	Type D
2C	Natural	100,149	Type D
3A	Concrete /Asphalt	21,819	Type D
3B	Ornamental Landscaping	5,861	Type D
4A	Concrete /Asphalt	21,407	Type D
4B	Ornamental Landscaping	6,587	Type D
5A	Concrete /Asphalt	26,789	Type D
5B	Ornamental Landscaping	8,160	Type D

PROPERTY OWNER:

MORENO VALLEY CENTERPOINTE
C/O CDRE HOLDINGS 17 LLC
ATTN: MARK BACHLI
523 MAIN STREET
EL SEGUNDO, CA 90245
(310) 428-3302

PREPARED FOR/APPLICANT:

CDRE HOLDINGS 17 LLC
ATTN: MARK BACHLI
523 MAIN STREET
EL SEGUNDO, CA 90245
(310) 428-3302

SOIL ENGINEER

REPORT DATED JANUARY 31, 2020
PROJECT NO. 21631-20
AS CONDUCTED BY
NORCAL ENGINEERING
10641 HUMBOLT STREET
LOS ALAMITOS, CA 90720
PHONE: (562) 799-9469
FAX: (562) 799-9459

LEGEND

AC	ASPHALT CONCRETE
ET	ELECTRIC TRANSFORMER
PB	PULL BOX
PCC	PORTLAND CEMENT CONCRETE
PL	PROPERTY LINE
PP	EX. POWER POLE
R/W	RIGHT-OF-WAY
SMH	SEWER MANHOLE
STL	EX. STREET LIGHT

SOURCE OF SURVEY

TOPOGRAPHIC SURVEY
DATED DECEMBER 2019
AS CONDUCTED BY
PARTNER ENGINEERING AND SCIENCE, INC.
1761 EAST GARRY AVENUE
SANTA ANA, CA 92705
PHONE: (714) 477-8657

PAVING LEGEND

▨	PROPOSED LANDSCAPING
▨	PROPOSED AC PAVING
▨	PROPOSED PCC PAVING
▨	PROPOSED DECORATIVE PAVING
▨	EXISTING AC PAVING
━	DRAINAGE AREA TRIBUTARY BOUNDARY

SCALE: 1"=50'

0 50 100 150

PEN20-0120
PEN20-0121

TPM NO. 37944

PRELIMINARY WATER
QUALITY MANAGEMENT PLAN
APN 297-170-002 & 003
COMPASS DANBE CENTERPOINTE
SOUTH SIDE OF ALESSANDRO BOULEVARD
CITY OF MORENO VALLEY

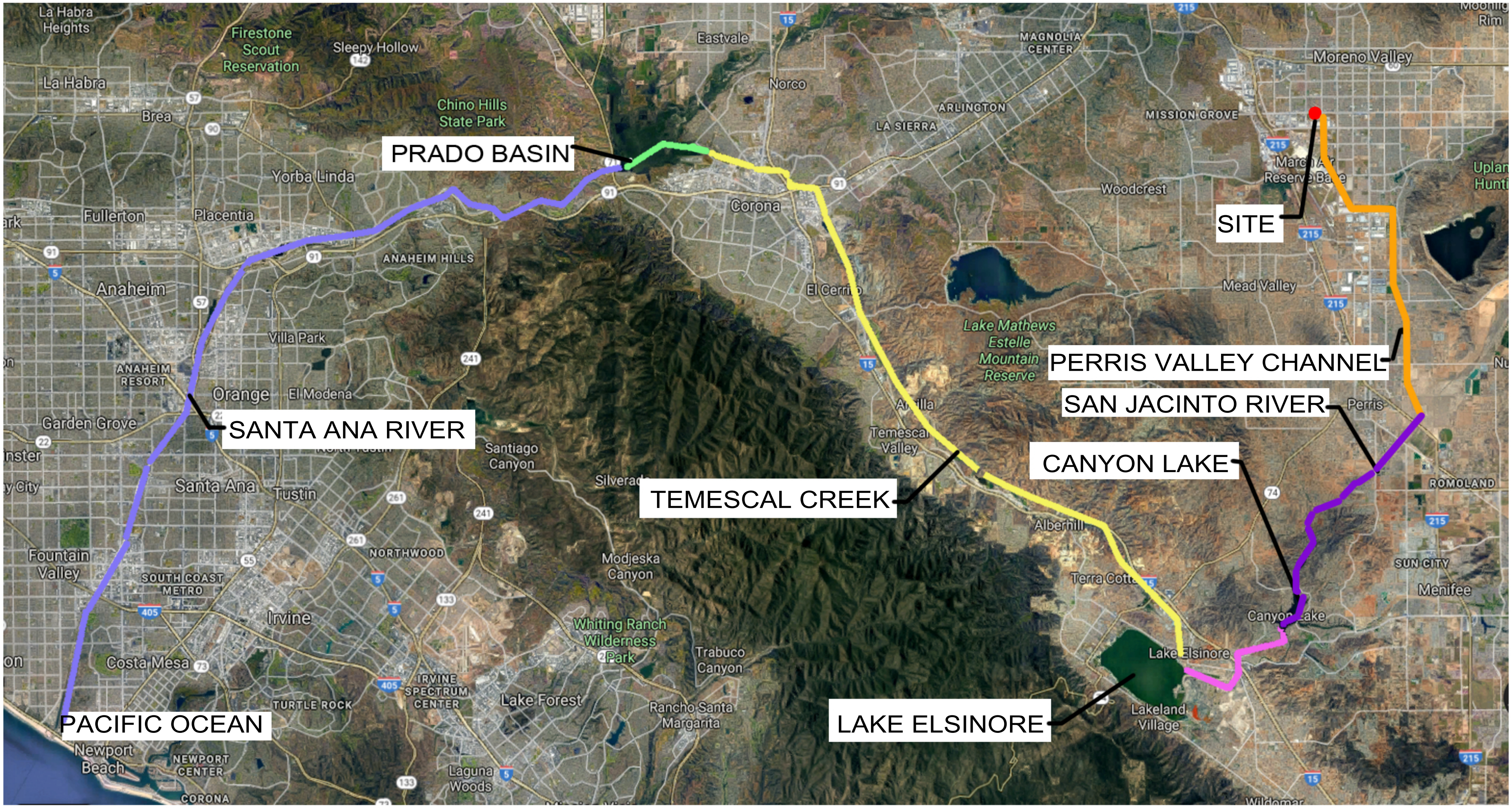
- land planning
- civil engineering
- landscape architecture

phone 909.748.7777
fax 909.748.7776
est. 1989
thatcher engineering & associates, inc.
1461 ford street, suite 105, redlands, ca 92373

PATRICK C. FLANAGAN, JR.
No. 86046
Exp. 9/30/22
CIVIL

Patrick C. Flanagan, Jr. R.C.E. 86046 Exp. Sep 30, 2020

Job Number:	Date Prepared:	Drawn By:	Reference Number:
162012	10/6/20	RL	162012PWQMP



RECEIVING WATER BODIES EXHIBIT

N.T.S.

Appendix 2: Construction Plans

Conceptual Grading Plan

CALIFORNIA STATE WATER RESOURCES CONTROL BOARD
DIVISION OF WATER QUALITY- MUNICIPAL STORM WATER UNIT
TRASH IMPLEMENTATION PROGRAM

EXECUTIVE DIRECTOR DESIGNEE CERTIFICATION of TRASH FULL CAPTURE SYSTEMS

The Executive Director Designee of the State Water Resources Control Board certified[1] the initial Full Capture Systems List of Trash Treatment Control Devices on:	**April 27, 2017**
The Executive Director Designee of the State Water Resources Control Board certified the following: • AquaShield was added to the Certified Full Capture Systems List of Trash Treatment Control Devices; and • The new Certified Trash Full Capture Systems List of Multi-Benefit Treatment Systems on:	**August 4, 2017**
The Executive Director Designee of the State Water Resources Control Board certified the following new Full Capture System Devices: • Inventive Resources - Water Decontaminator (WD) • ADS FlexStorm - Full Capture Inserts • Bio Clean - Inlet and Grate Inlet Filters • Jensen Stormwater Systems - Jensen Deflective Separator (JDS) • Bio Clean - Debris Separating Baffle Box (DSBB) • CleanWay - Curb Inlet Filtration System • CleanWay - Drop Inlet Device • StormTrap - SiteSaver	**March 15, 2018**
The Executive Director Designee of the State Water Resources Control Board certified the following new Full Capture System Devices: • Hydro International - Hydro DryScreen • Hydro International - Up-Flo Filter • Revel Environmental Manufacturing Inc. - Triton CPS-FTC • Revel Environmental Manufacturing Inc. - Triton PERF-FTC Insert Cartridge • Hydro International - Downstream Defender • BioClean - Modular Wetland System	**July 10, 2018**

In accordance with the Trash Amendments[2], I do hereby certify that the Trash Treatment Control Devices/Systems in the Certified Full Capture Systems lists of Trash Treatment Control Devices and of Multi-Benefit Treatment Systems meet the Full Capture System definition, provided the device or system meets the conditions stated within these lists.

Karen Mog

Karen Mogus, Deputy Director of Water Quality
Executive Director Designee

---

[1] Prior to installation, Full Capture Systems must be certified by the Executive Director, or designee, of the State Water Board. (See definition of Full Capture System in Trash Amendments Glossary)

[2] Amendment to the Water Quality Control Plan for Ocean Waters of California to Control Trash (Ocean Plan) and Part 1 Trash Provisions of the Water Quality Control Plan for Inland Surface Waters, Enclosed Bays, And Estuaries Of California (ISWEBE Plan) adopted by the State Water Board.

CONCEPTUAL GRADING PLAN

COMPASS DANBE CENTERPOINTE - PROPOSED INDUSTRIAL WAREHOUSE FACILITY
SOUTH SIDE OF ALESSANDRO BOULEVARD
APN 297-170-002 & 003 - CITY OF MORENO VALLEY

LEGAL DESCRIPTION

PARCEL 1:
LOT 2, BLOCK 242 OF MAP NO. 1, BEAR VALLEY AND ALESSANDRO DEVELOPMENT CO., AS SHOWN BY MAP ON FILE IN BOOK 11 PAGE 10 OF MAPS, RECORDS OF SAN BERNARDINO COUNTY, CALIFORNIA; EXCEPTING THEREFROM THAT PORTION OF ALESSANDRO BOULEVARD AS CONVEYED TO THE COUNTY OF RIVERSIDE BY DOCUMENT RECORDED NOVEMBER 28, 1972 AS INSTRUMENT NO. 157190, OFFICIAL RECORDS.
PARCEL 2:
LOT 3, BLOCK 242 OF MAP NO. 1, BEAR VALLEY AND ALESSANDRO DEVELOPMENT CO., AS SHOWN BY MAP ON FILE IN BOOK 11, PAGE 10 OF MAPS, RECORDS OF SAN BERNARDINO COUNTY, CALIFORNIA; EXCEPTING THEREFROM THAT PORTION DESCRIBED IN THE DEED TO THE COUNTY OF RIVERSIDE DOCUMENT RECORDED MAY 30, 1972 AS INSTRUMENT NO. 69766, OFFICIAL RECORDS.

EASEMENTS

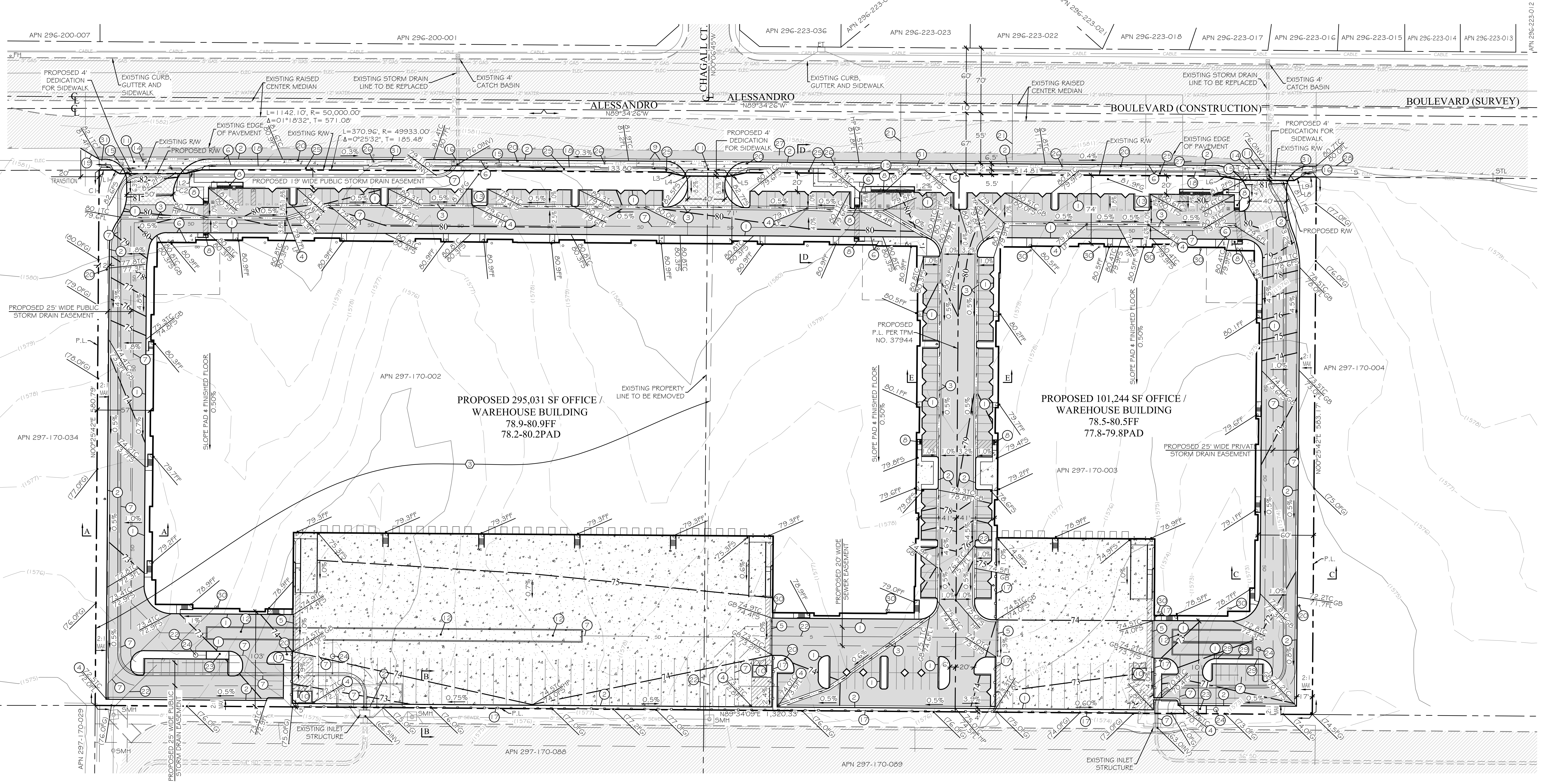
1 THE TERMS, PROVISIONS AND EASEMENT(S) CONTAINED IN THE DOCUMENT ENTITLED "TEMPORARY DECLARATION OF EASEMENT FOR ACCEPTANCE OF DRAINAGE WATERS" RECORDED JANUARY 22, 2009 AS INSTRUMENT NO. 2009-0029343 OF OFFICIAL RECORDS. PER THE PROVISIONS OF THE EASEMENT DOCUMENT, SAID EASEMENT WILL BE ABANDONED UPON THE DEVELOPMENT OF THE PROPERTY.

2 AN OFFER OF DEDICATION FOR FLOOD CONTROL AND DRAINAGE AND INCIDENTAL PURPOSES, IN FAVOR OF RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT, RECORDED DECEMBER 23, 2009 AS INSTRUMENT NO. 2009-0657601 OF OFFICIAL RECORDS.

3 MATTERS IN A DOCUMENT ENTITLED "DRAINAGE EASEMENT AGREEMENT", EXECUTED BY AND BETWEEN WILMA PACIFIC INC. AND THE CENTENNIAL GROUP INC., RECORDED DECEMBER 02, 1987 AS INSTRUMENT NO. 341821 OF OFFICIAL RECORDS, INCLUDING BUT NOT LIMITED TO COVENANTS, CONDITIONS, RESTRICTIONS, EASEMENTS, ASSESSMENTS, LIENS AND CHARGES.

NOTES

1. EXISTING GROSS AREA: 871,608 SF = 20.01 AC
2. EXISTING NET AREA: 769,571 SF = 17.67 AC
3. PROPOSED DEDICATION: 890 SF = 0.02 AC
4. PROPOSED NET AREA: 768,681 SF = 17.65 AC
5. PROJECT SITE IS LOCATED WITHIN ZONE 'X' (AREA OF MINIMAL FLOOD HAZARD PER FIRM MAP NO. 06065C0745G DATED AUGUST 28, 2008)
6. SEE SITE PLAN FOR PARKING STALL DIMENSIONS.
7. EXISTING FEATURES ARE TO REMAIN UNLESS OTHERWISE NOTED.



PROPOSED FEATURES

1. PROPOSED CURB
2. PROPOSED CURB & GUTTER
3. PROPOSED RIBBON GUTTER
4. PROPOSED DROP INLET
5. PROPOSED ROLLING GATE
6. PROPOSED SIDEWALK
7. PROPOSED STORM DRAIN
8. PROPOSED ADA RAMP
9. EXISTING BUS STOP TO BE REMOVED
10. PROPOSED TRASH ENCLOSURE
11. PROPOSED DRIVEWAY
12. PROPOSED UNDERGROUND DETENTION TANK
13. PROPOSED TRANSFORMER
14. EXISTING POWER POLE/STREET LIGHT TO BE RELOCATED
15. EXISTING PULLBOX TO BE RELOCATED
16. PROPOSED CATCH BASIN
17. PROPOSED 8' HIGH TUBULAR STEEL FENCE
18. PROPOSED COMMUNICATION CONDUIT PER CITY STANDARDS
19. PROPOSED AC BERM
20. PROPOSED FIRE HYDRANT
21. PROPOSED WATER SERVICE
22. PROPOSED SEWER SERVICE
23. PROPOSED MODULAR WETLAND BIOTREATMENT DEVICE
24. PROPOSED SUMP AND PUMP
25. PROPOSED BIORETENTION SWALE
26. EXISTING POWER POLE/STREET LIGHT TO REMAIN
27. EXISTING SIGN BE RELOCATED
28. PROPOSED EDGE OF PAVEMENT
29. PROPOSED CURB OPENING
30. PROPOSED ROOF DRAIN
31. OVERHEAD UTILITIES AND ELECTRICAL LINES LESS THAN 115KV TO BE UNDERGROUNDED

NOTE

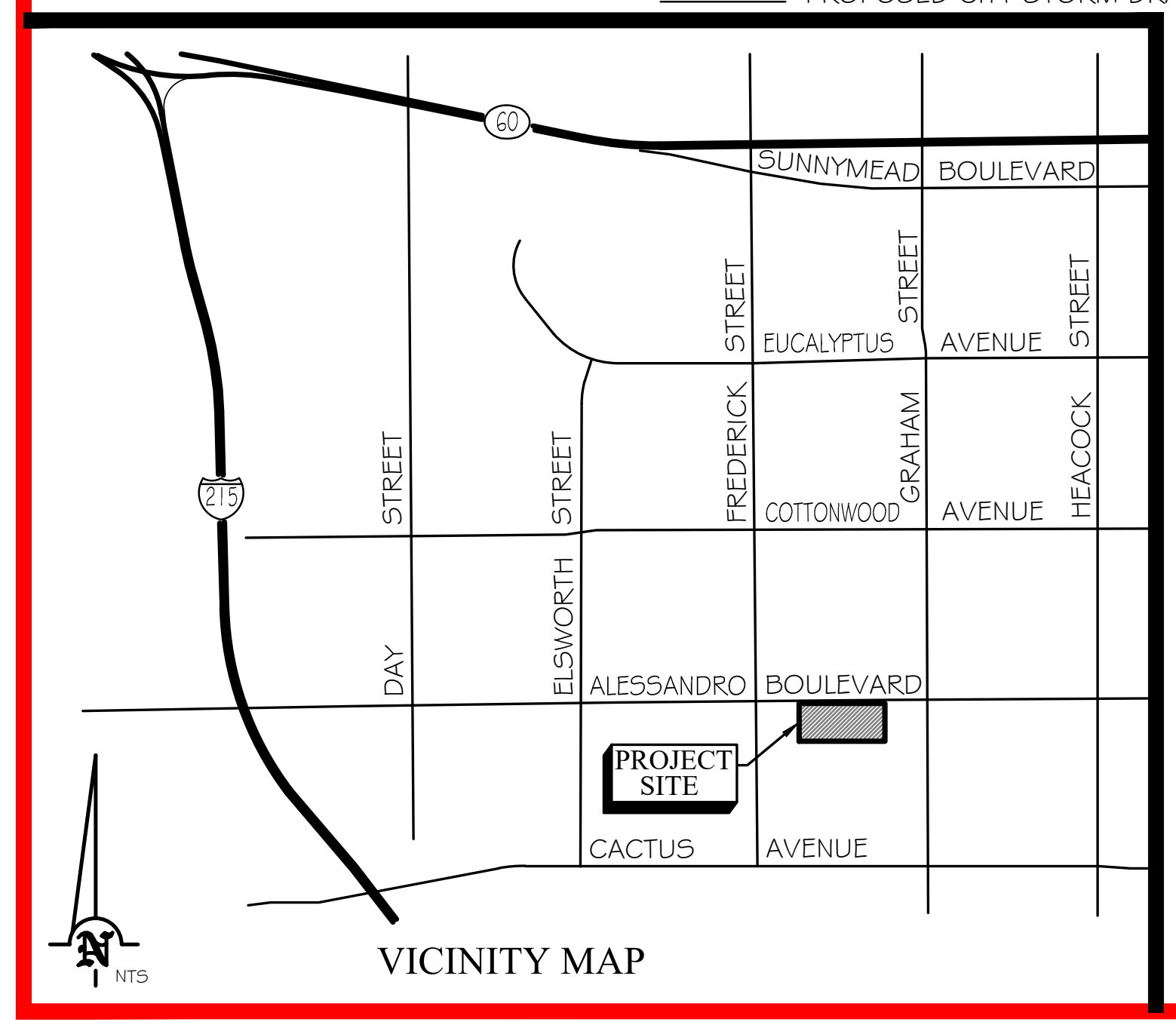
THE CITY ENGINEER MAY REQUIRE THE REMOVAL AND REPLACEMENT OF THE STRUCTURAL SECTION FOR PAVEMENT TO HALF-STREET WIDTHS PLUS 18' OR PROVIDE CORE TEST RESULTS CONFIRMING THAT THE EXISTING PAVEMENT SECTION IS PER CURRENT CITY STANDARD.

LEGEND

AC	ASPHALT CONCRETE
CF	CURB FACE
ET	ELECTRIC TRANSFORMER
FF	FINISHED FLOOR
FG	FINISHED GROUND
FH	EXISTING FIRE HYDRANT
FL	FLOWLINE
FS	FINISHED SURFACE
GB	GRADEBREAK
INV	INVERT ELEVATION
PB	EXISTING PULL BOX
PCC	PORTLAND CEMENT CONCRETE
PL	PROPERTY LINE
PP	EXISTING POWER POLE
RET	RETAINING
R/W	RIGHT-OF-WAY
SMH	EXISTING SEWER MANHOLE
STL	EXISTING STREET LIGHT
TC	TOP OF CURB
TG	TOP OF GRATE
═ ═	EXISTING CURB & GUTTER
═══	PROPOSED CURB & GUTTER
—(1200)	EXISTING CONTOURS
— · · · —	FLOWLINES
— - —	CENTERLINE
— - - —	EXISTING R/W
━ ━ ━	PROPERTY LINES
—2" GAS—	EXISTING UTILITY LINE
━━━	PROPOSED BUILDING FOOTPRINT
—SD—	PROPOSED PRIVATE STORM DRAIN
══ - ══	PROPOSED CITY STORM DRAIN

PAVING LEGEND

▒	PROPOSED AC PAVING
░	PROPOSED PCC PAVING
▩	PROPOSED DECORATIVE PAVING
▨	EXISTING AC PAVING



VICINITY MAP

CURVE DATA

	Δ	R	T	L
C1	00°01'04"	49933.00'	7.71'	15.41'
C2	00°04'51"	49929.00'	35.23'	70.46'

LINE DATA

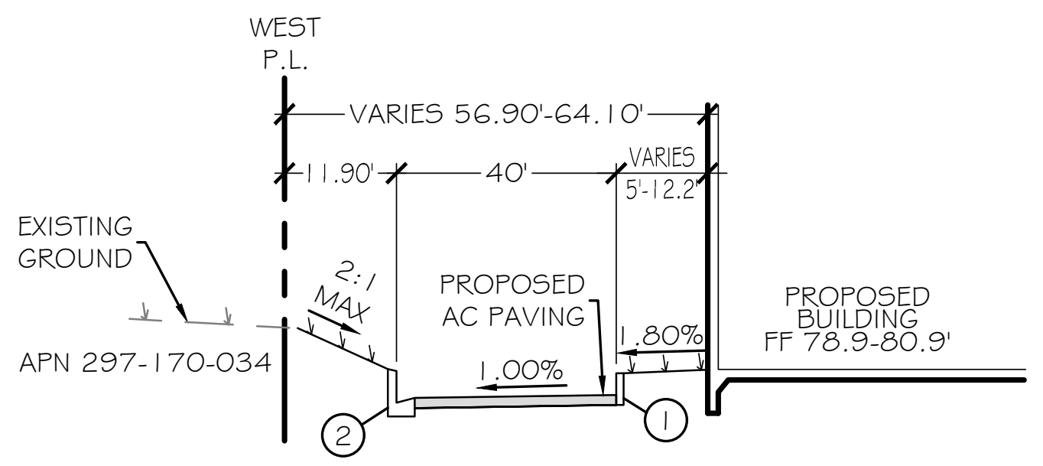
	BEARING	DISTANCE
L1	N59°38'55"W	7.89'
L2	N77°40'08"E	18.75'
L3	N77°12'47"W	18.69'
L4	N89°34'26"W	49.33'
L5	N78°03'57"E	18.69'
L6	N79°46'02"E	23.49'
L7	N89°34'26"W	56.75'
L8	N60°53'25"E	8.11'
L9	N89°34'26"W	16.97'

BENCHMARK

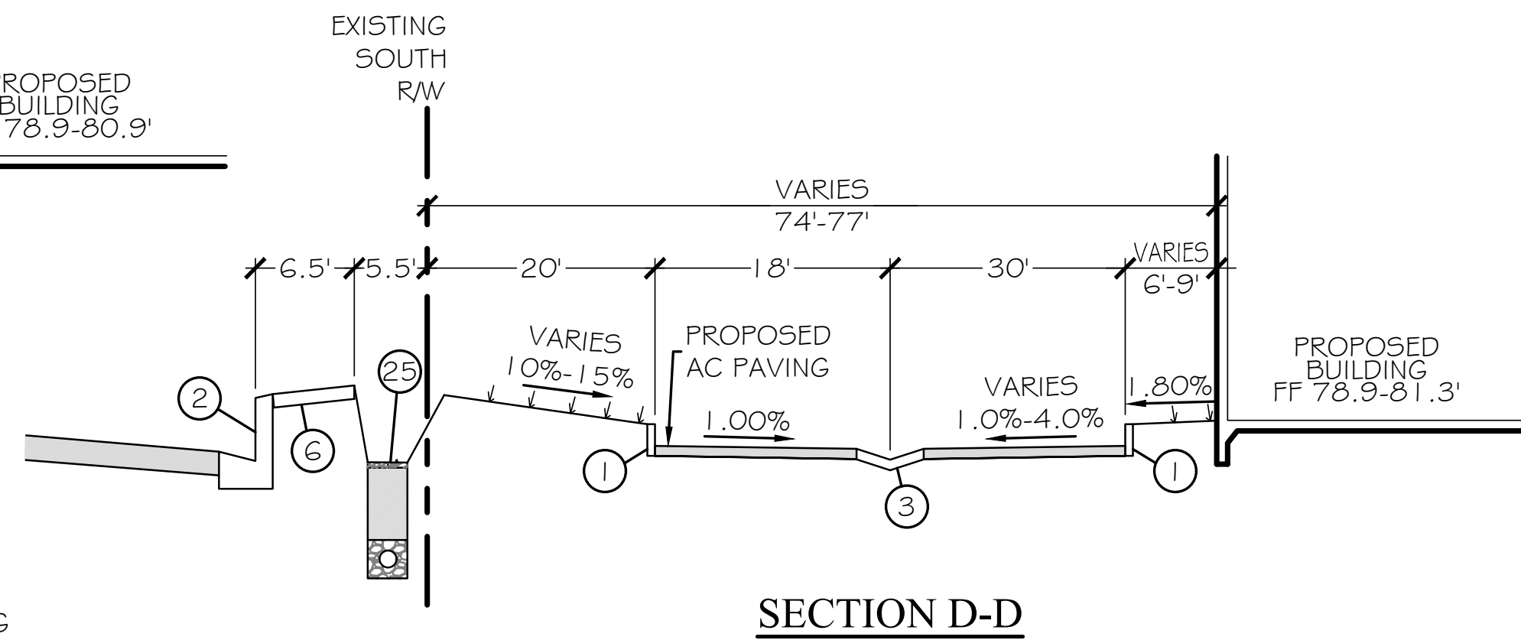
TOP OF CONCRETE STORM DRAINAGE BASIN 288.58' N88°21'35"W FROM THE SOUTHWEST CORNER OF THE PROPERTY.
ELEVATION = 1574.20'

BASIS OF BEARING

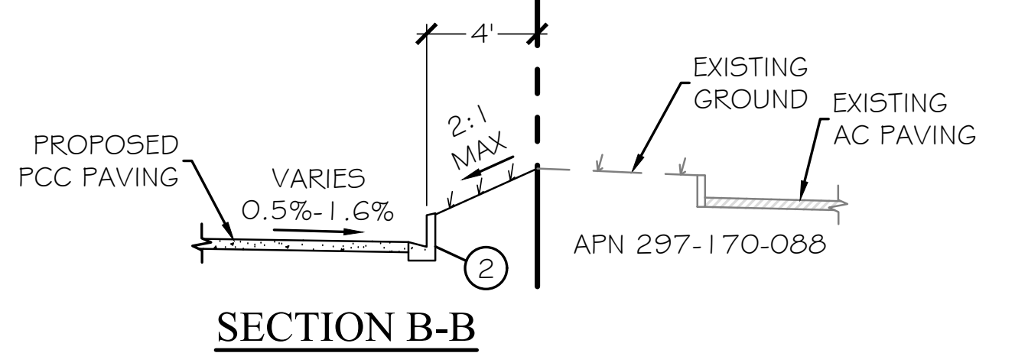
BASIS OF BEARINGS IS THE CENTER LINE OF BRODIAEA AVENUE, KNOWN AS N89°34'09"W, AS DESCRIBED IN PARCEL MAP NO. 36463, BOOK 238 PAGE 43, OF OFFICIAL RECORDS IN RIVERSIDE COUNTY, DATED DECEMBER 19, 2014.



SECTION A-A
FACING NORTH
NTS



SECTION D-D
FACING EAST
NTS



SECTION B-B
FACING EAST
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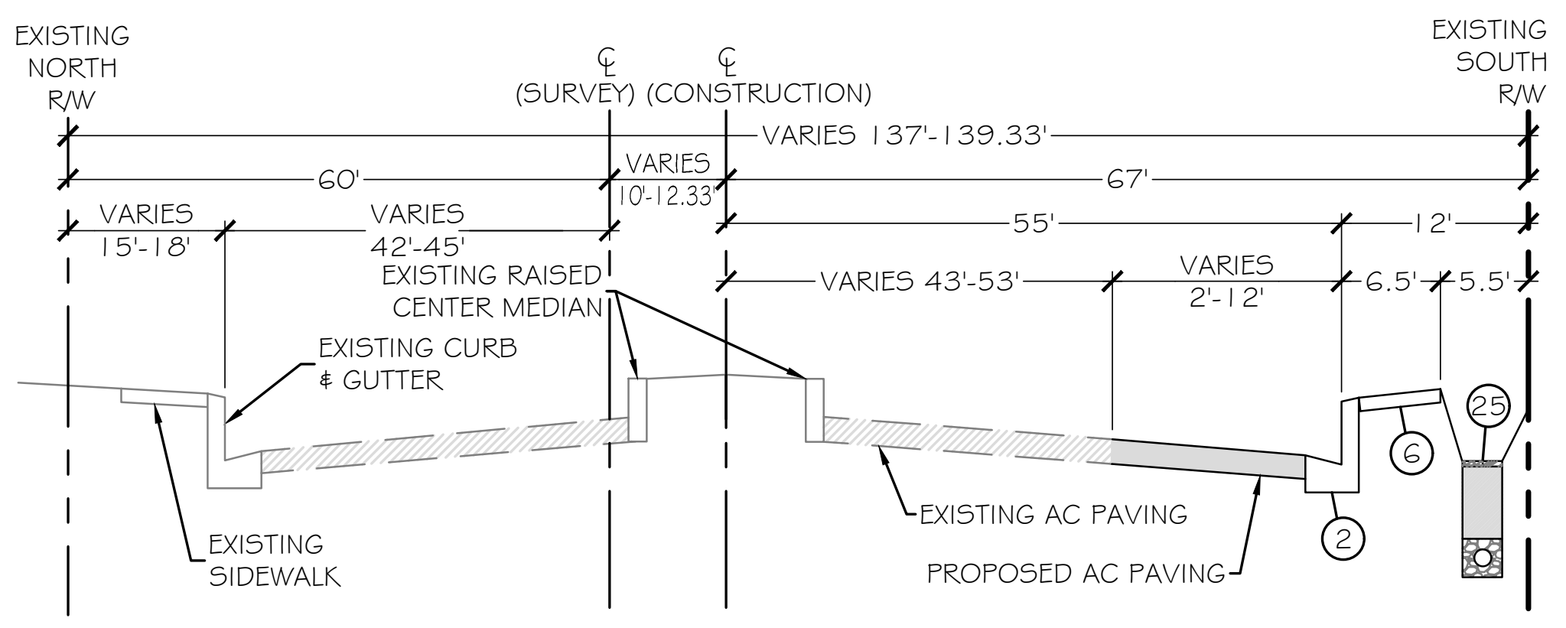

TYPICAL SECTION
DIVIDED MAJOR ARTERIAL
(STANDARD MVSI-101A-0)
ALESSANDRO BLVD. - FACING EAST
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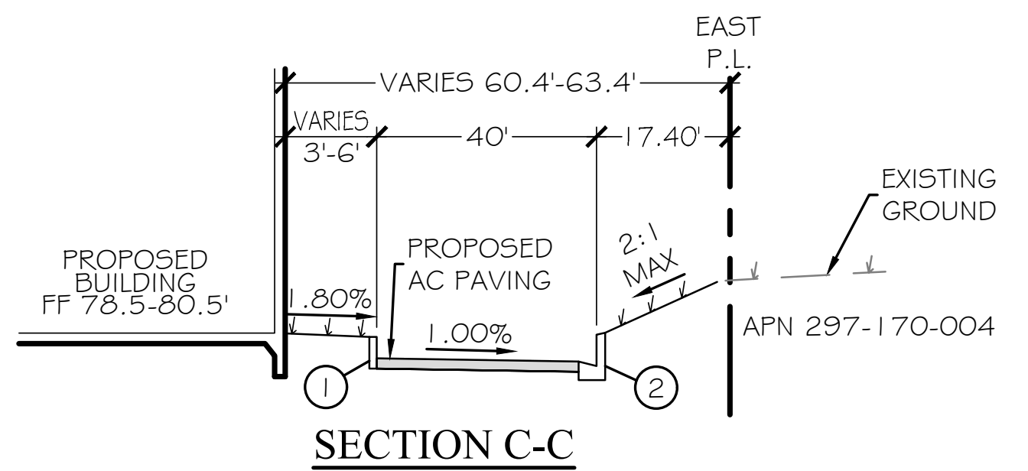

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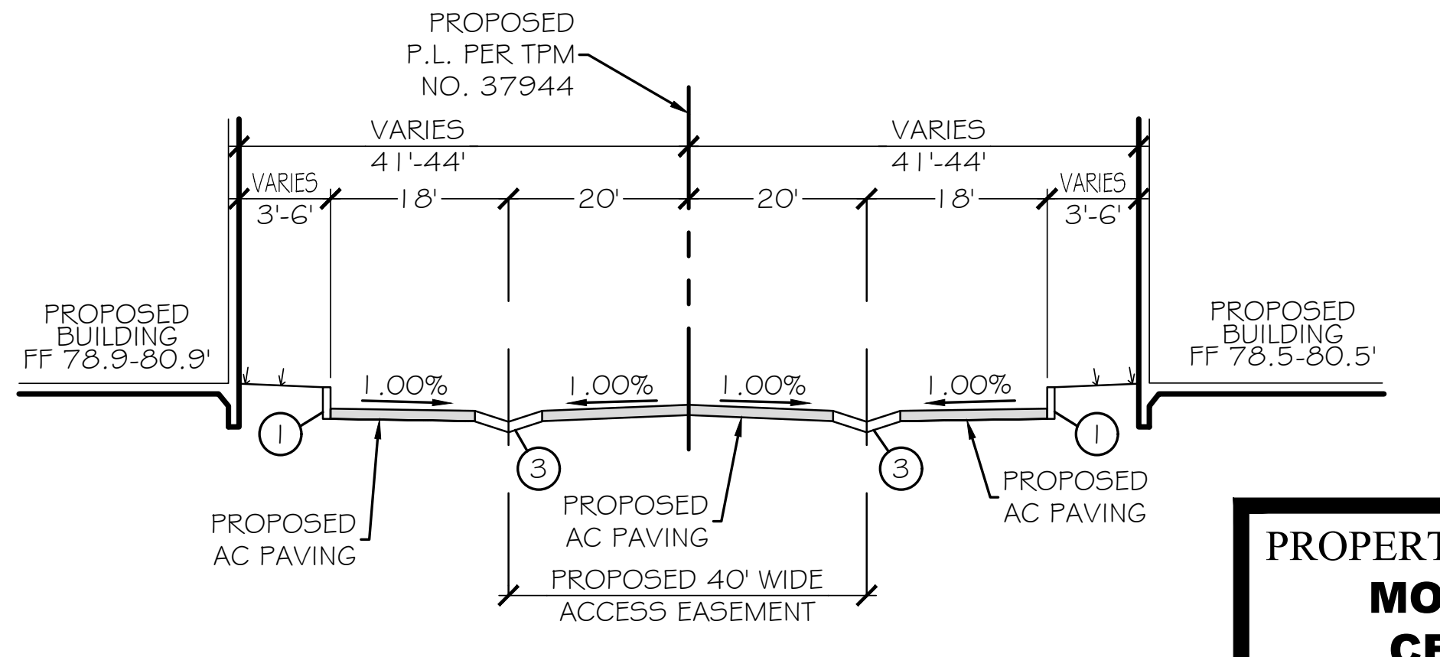

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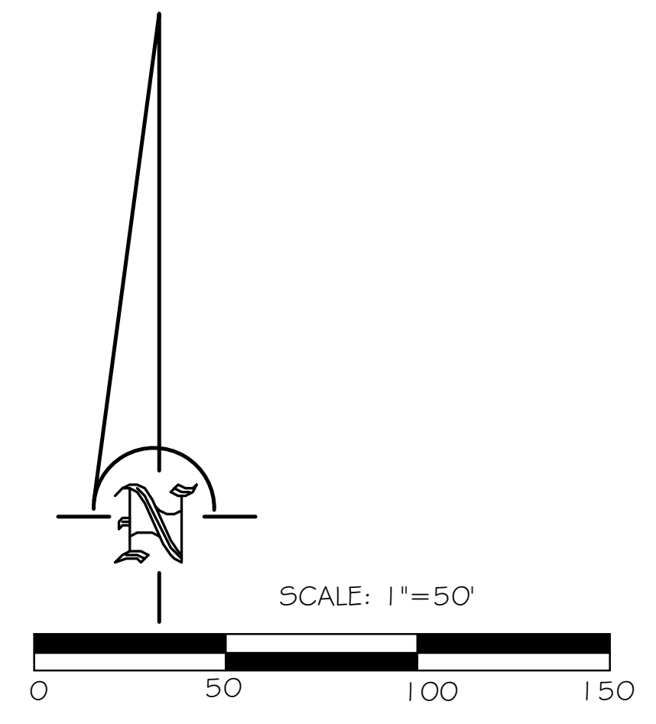


SCHOOL DISTRICT

MORENO VALLEY
UNIFIED SCHOOL DISTRICT:
26634 ALESSANDRO BOULEVARD
MORENO VALLEY, CA 92553
(951) 571-7500

UTILITIES

ELECTRIC:
SOUTHERN CALIFORNIA
EDISON COMPANY
26100 MENIFEE ROAD
ROMOLAND, CA 92585
(951) 928-8334

WATER:
EASTERN MUNICIPAL
WATER DISTRICT
2270 TRUMBLE ROAD
PERRIS, CA 92570
(951) 928-3777

SEWER:
EASTERN MUNICIPAL
WATER DISTRICT
2270 TRUMBLE ROAD
PERRIS, CA 92570
(951)928-3777

GAS:
SOUTHERN CALIFORNIA
GAS COMPANY
1981 WEST LUGONIA AVENUE
REDLANDS, CA 92373
(909) 335-7837

TELECOMMUNICATIONS:
CHARTER COMMUNICATIONS
7337 CENTRAL AVE.
RIVERSIDE, CA 92504
(951) 406-1666

FRONTIER COMMUNICATIONS
9 S. 4TH STREET
REDLANDS, CA 92373
(909) 748-6676

AT&T
3939 E. CORONADO ST.
2ND FLOOR
ANAHEIM, CA 92807
(714) 507-3526

SOURCE OF SURVEY

TOPOGRAPHIC SURVEY
DATED JUNE 2020
AS CONDUCTED BY
PARTNER ENGINEERING
AND SCIENCE, INC.
1761 EAST GARRY AVENUE
SANTA ANA, CA 92705
PHONE: (714) 477-8657

SOILS ENGINEER

REPORT DATED JANUARY 31, 2020
PROJECT NO. 21631-20
AS CONDUCTED BY
NORCAL ENGINEERING
10641 HUMBOLT STREET
LOS ALAMITOS, CA 90720
PHONE: (562) 799-9469
FAX: (562) 799-9459

PEN20-0120
TPM NO. 37944
PEN20-0121 - PLOT PLAN

PRELIMINARY EARTHWORK QUANTITIES

CUT	30,500 CY	(RAW/UNADJUSTED)
FILL	26,000 CY	(SITE EXPECTED TO BALANCE AFTER LOSSES)

NOTE: THE PROPOSED GRADING ON THIS PLAN IS STRICTLY CONCEPTUAL AND SHOULD ONLY BE USED FOR PLANNING PURPOSES.

PROPERTY OWNER:
MORENO VALLEY
CENTERPOINTE
C/O CDRE HOLDINGS 17 LLC
ATTN: MARK BACHLI
523 MAIN STREET
EL SEGUNDO, CA 90245
(310) 428-3302

PREPARED FOR/APPLICANT:
CDRE HOLDINGS 17 LLC
ATTN: MARK BACHLI
523 MAIN STREET
EL SEGUNDO, CA 90245
(310) 428-3302

CONCEPTUAL GRADING PLAN
APN 297-170-002 & 003
COMPASS DANBE CENTERPOINTE
PROPOSED INDUSTRIAL WAREHOUSE FACILITY
SOUTH SIDE OF ALESSANDRO BOULEVARD
CITY OF MORENO VALLEY

- land planning
- civil engineering
- landscape architecture

phone 909.748.7777
fax 909.748.7776
est. 1989
thatcher engineering & associates, inc.
1461 ford street, suite 105, redlands, ca 92373

Job Number:	Date Prepared:	Drawn By:	Reference Number:	Sheet Number:
162012	10/5/20	RL	162012CGP	CG-1

Appendix 3: Soils Information

Geotechnical Study and Other Infiltration Testing Data

NorCal Engineering
Soils and Geotechnical Consultants
Los Alamitos, California 90720
(562)799-9469 Fax (562)799-9459

September 22, 2020 Project Number 21631-20

CDREP LLC
523 Main Street
El Segundo, California 90245

Attn: Mr. Mark Bachli

RE: **Evaluation of Soils Infiltration Study** - Proposed Industrial Warehouse Development - Located at the Southeast and Southwest Corners of Allessandro Boulevard and Chagall Court, in the City of Moreno Valley, California

Dear Mr. Bachli:
Pursuant to your request, this firm has performed an evaluation of our soil infiltration study at the above referenced project. Based upon the results of our field testing as described in our Updated Soils Infiltration Study dated April 27, 2020, the soils have infiltration rates less than 0.8 in/hr in 7 of 8 pits, as listed below.

Test No.	Depth	Minimum Field Percolation Rate (in/hr)	Design Infiltration Rate (in/hr)
1	5'	4.72	1.57
2	2'	0.16	0.05
3	5'	0.16	0.05
4	3'	0.63	0.21
5	6'	0.79	0.26
6	7'	0.16	0.05
7	7'	0.16	0.05
8	4'	0.32	0.11

The actual water drop verses time was plotted by this firm for eight (8) percolation tests with the results shown in Appendix A. The minimum field percolation rate was computed based on the lowest water drop over a 3 hour testing period. For field percolation tests up to 6 hours long, lower percolation rates would typically occur. Since 7 out of 8 tests yield very low percolation rates, our final design recommendations are these fine-grained soils should not be used for percolation pits.

Based on a safety factor of 3.0, the subsurface soils encountered in the proposed on-site drainage disposal system have a design infiltration rate of less than 0.3 in/hr in 7 of 8 pits. Thus, these fine grained soils are not acceptable for percolation pits at the site.

Our Test No. 1 encountered an isolated area of sandy soil which did provide a favorable infiltration rate. It is our professional opinion, that the proposed on-site drainage disposal system shall not be utilized based on the predominately very stiff clayey conditions.

We appreciate this opportunity to be of service to you. If you have any further questions, please do not hesitate to contact the undersigned.

Respectfully submitted,
NORCAL ENGINEERING

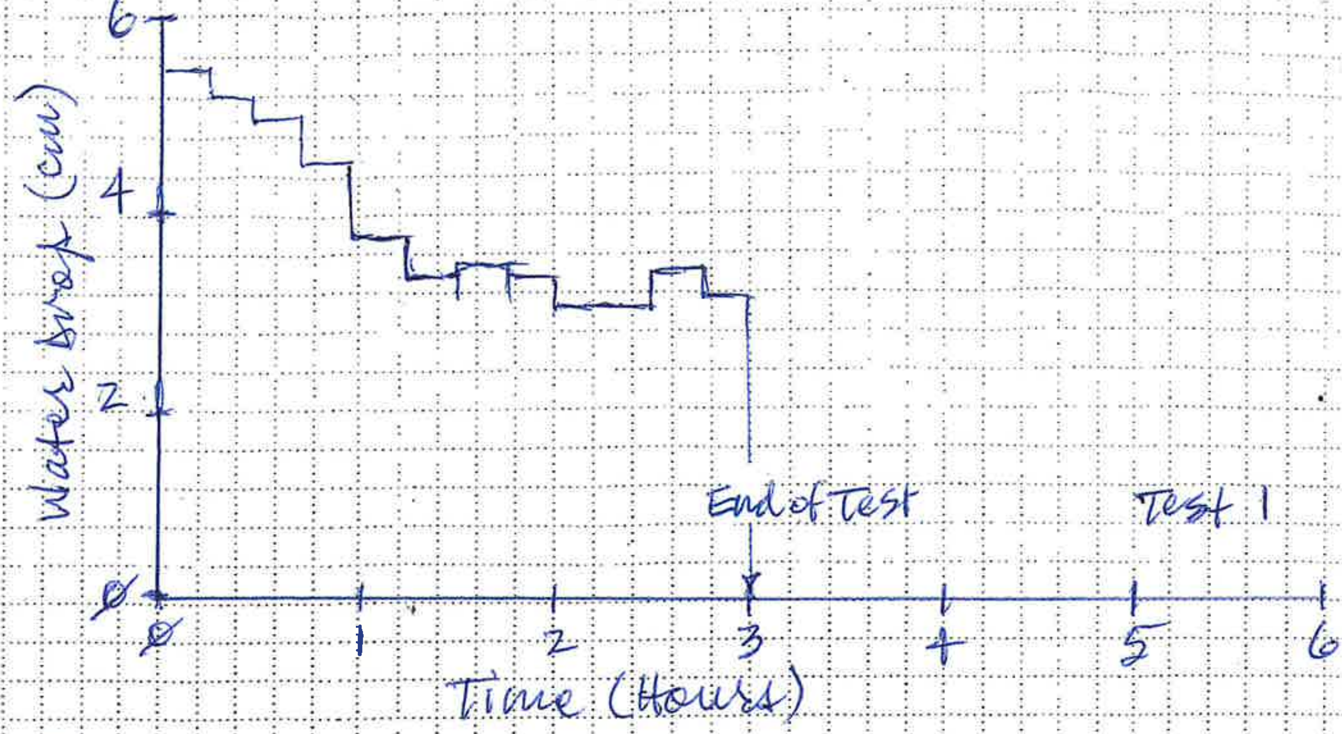
Keith D Tucker

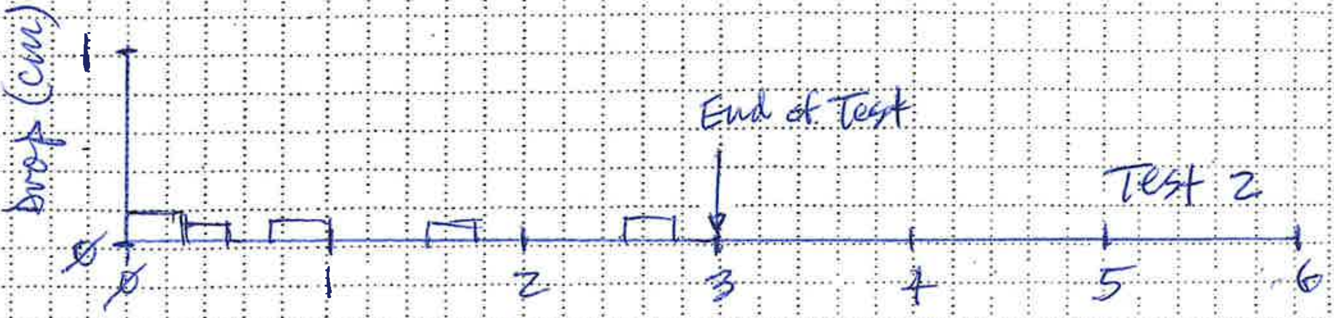
REGISTERED PROFESSIONAL ENGINEER
KEITH D. TUCKER
No. 841
Exp. 12/31/2020
GEOTECHNICAL
STATE OF CALIFORNIA

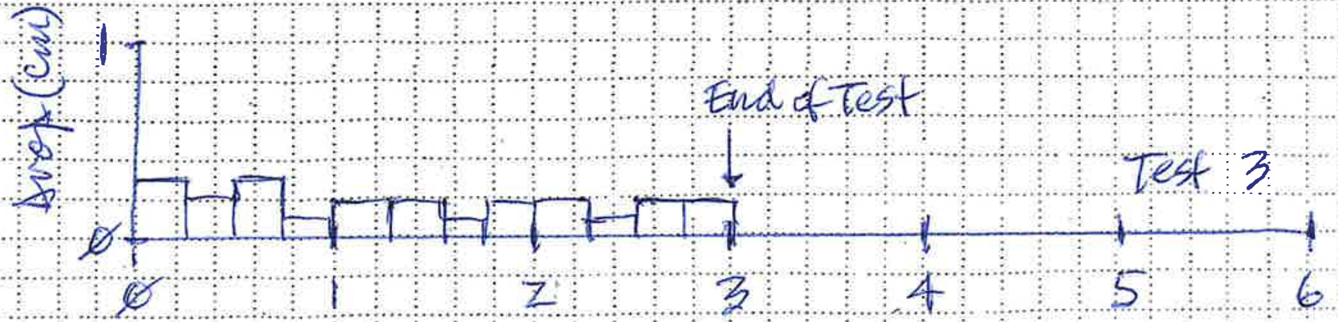
Keith D. Tucker
Project Engineer
R.G.E. 841

Scott D. Spensiero
Project Manager

Appendix A

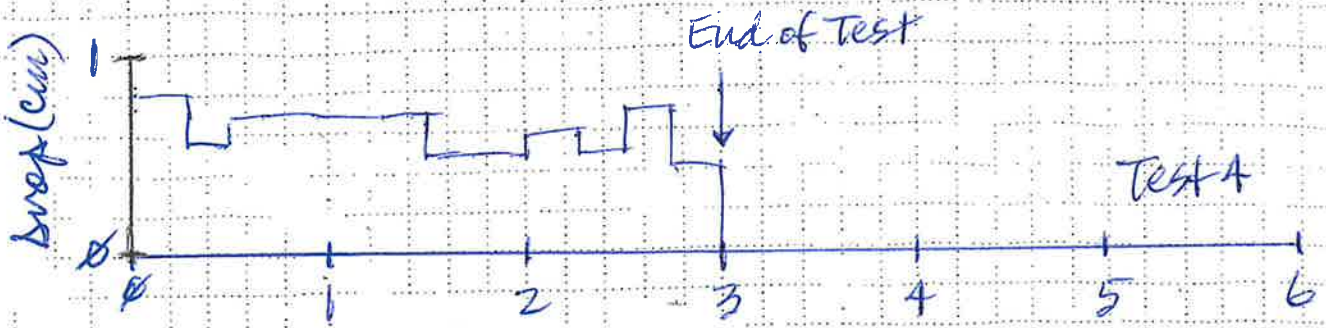


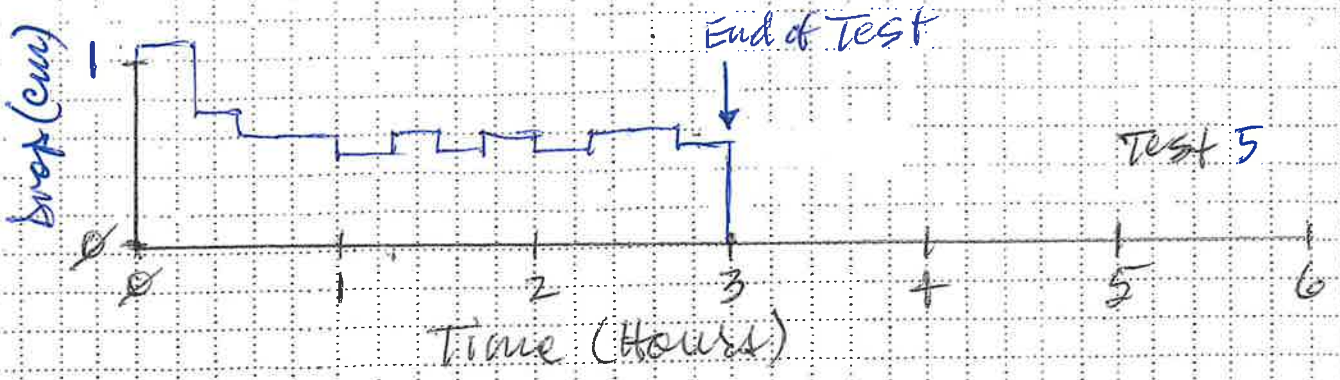


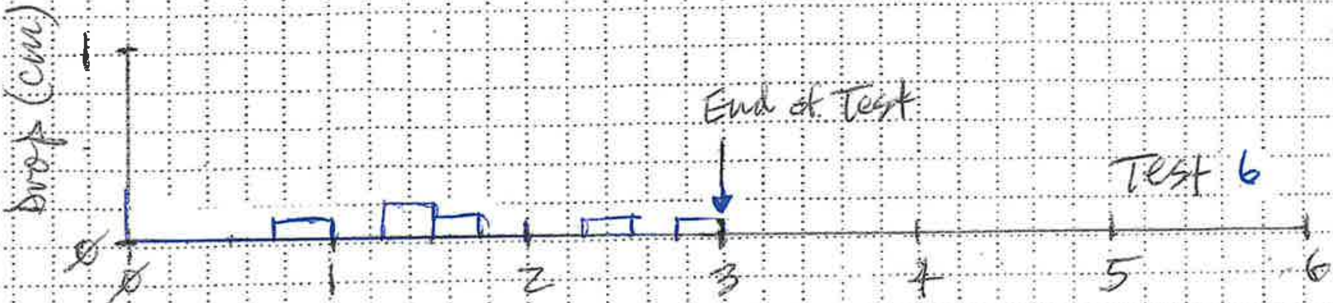


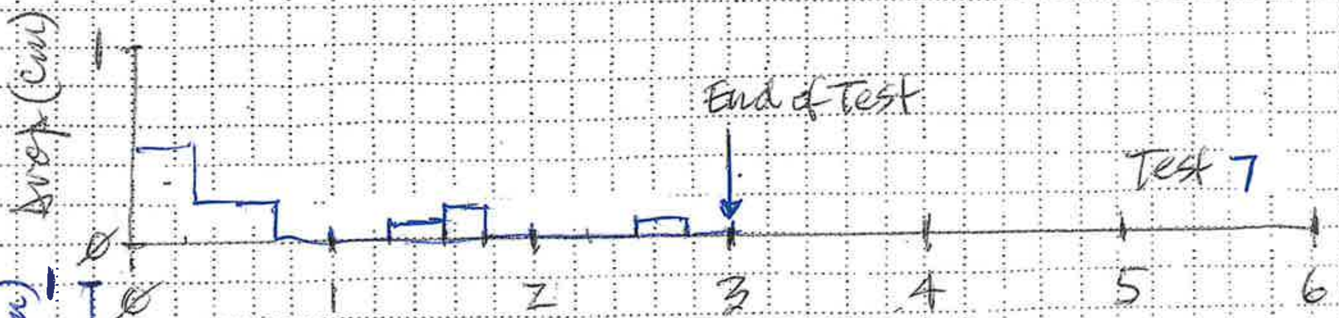
NorCal Engineering
SOILS AND GEOTECHNICAL CONSULTANTS

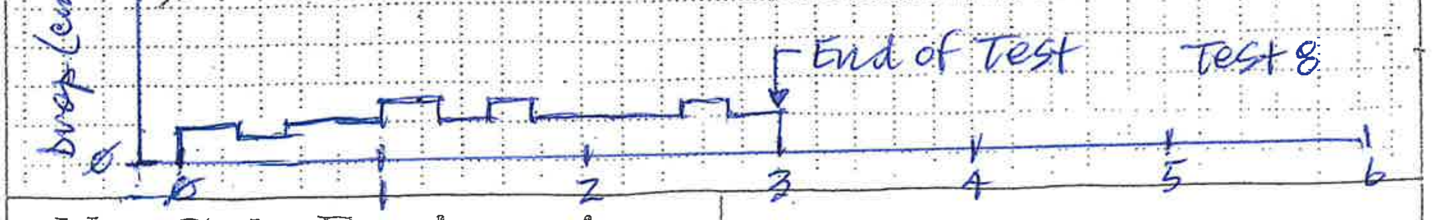
DATE











NorCal Engineering
SOILS AND GEOTECHNICAL CONSULTANTS

DATE

Geotechnical Engineering Investigation

Proposed Industrial Warehouse Development
SE and SW Corners of Allessandro Blvd and Chagall Ct
Moreno Valley, California

CDREP LLC
523 Main Street
El Segundo, California 90245

Attn: Mr. Mark Bachli

Project Number 21631-20
January 31, 2019

NorCal Engineering

NorCal Engineering
Soils and Geotechnical Consultants
10641 Humbolt Street Los Alamitos, CA 90720
(562) 799-9469 Fax (562) 799-9459

January 31, 2020

Project Number 21631-20

CDREP LLC
523 Main Street
El Segundo, California 90245

Attn: Mr. Mark Bachli

RE: **Geotechnical Engineering Investigation** - Proposed Industrial Warehouse Development - Located at the Southeast and Southwest Corners of Allessandro Boulevard and Chagall Court, in the City of Moreno Valley, California

Dear Mr. Bachli:

Pursuant to your request, this firm has performed a Geotechnical Engineering Investigation for the above referenced project in accordance with your approval of our proposal dated January 13, 2020. The purpose of this investigation is to evaluate the geotechnical conditions of the subject site and to provide recommendations for the proposed industrial warehouse development.

The scope of work included the following: 1) site reconnaissance; 2) subsurface geotechnical exploration and sampling; 3) laboratory testing; 4) soil infiltration testing; 5) engineering analysis of field and laboratory data; 5) preparation of a geotechnical engineering report. It is the opinion of this firm that the proposed development is feasible from a geotechnical standpoint provided that the recommendations presented in this report are followed in the design and construction of the project.

1.0 Project Description

It is proposed to construct an industrial warehouse development consisting of a 102,669 and 295,470 square feet buildings as shown on the attached Site Plan by Herdman Architecture + Design dated December 18, 2019. The proposed concrete tilt-up buildings will be supported by a conventional slab-on-grade foundation system with perimeter-spread footings and isolated interior footings. Other improvements will include asphalt and concrete pavement areas, hardscape and landscaping.

It is assumed that the proposed grading for the development will include cut and fill procedures on the order of a few feet to achieve finished grade elevations. Final building plans shall be reviewed by this firm prior to submittal for city approval to determine the need for any additional study and revised recommendations pertinent to the proposed development, if necessary.

2.0 Site Description

The 18.05-acre subject property is located at the southeast and southwest corners of Allessandro Boulevard and Chagall Court, in the City of Moreno Valley. The generally rectangular-shaped parcel is elongated in an east to west direction with topography of the relatively level descending slightly from a north to south direction on the order of a few feet. The site is undeveloped parcel covered with a low vegetation growth of natural grasses and weeds.

3.0 Site Exploration

The investigation consisted of the placement of ten (10) subsurface exploratory trenches by a backhoe to depths ranging between 5 and 15 feet and two (2) exploratory borings by a truck mounted drill rig both to a depth of 50 feet below current ground elevations. The explorations were visually classified and logged by a field engineer with locations of the subsurface explorations shown on the attached plan. The exploratory trenches/borings revealed the existing earth materials to consist of fill and natural soil. Detailed descriptions of the subsurface conditions are listed on the trench and boring logs in Appendix A.

It should be noted that the transition from one soil type to another as shown on the trench logs is approximate and may in fact be a gradual transition. The soils encountered are described as follows:

Fill: A fill soil classifying as a brown, fine to medium grained, silty to clayey SAND was encountered across the site to depths ranging from 1 to 1½ feet below ground surface. These soils were noted to be loose and moist.

Natural: A natural undisturbed soil classifying as a brown, fine to medium grained, clayey to silty SAND to sandy CLAY was encountered beneath the upper fill soils. The native soils as encountered were observed to be dense/stiff to very dense/stiff and moist.

The overall engineering characteristics of the earth material were relatively uniform with each excavation. Groundwater was encountered to the depth of 33 and 39 feet ground surface in Borings B-1 and B-2 respectively, and no caving occurred.

4.0 Laboratory Tests

Relatively undisturbed samples of the subsurface soils were obtained to perform laboratory testing and analysis for direct shear, consolidation tests, and to determine in-place moisture/densities. These relatively undisturbed ring samples were obtained by driving a thin-walled steel sampler lined with one-inch long brass rings with an inside diameter of 2.42 inches into the undisturbed soils. Bulk bag samples were obtained in the upper soils for expansion index tests and maximum density tests. All test results are included in Appendix B, unless otherwise noted.

4.1 **Field Moisture Content** (ASTM: D 2216) and the dry density of the ring samples were determined in the laboratory. This data is listed on the logs of explorations.

4.2 **Maximum Density tests** (ASTM: D 1557) were performed on typical samples of the upper soils. Results of these tests are shown on Table I.

4.3 **Expansion Index tests** (ASTM: D 4829) were performed on remolded samples of the upper soils to determine expansive characteristics. Results of these tests are provided on Table II.

4.4 **Atterberg Limits** (ASTM: D 4318) consisting of liquid limit, plastic limit and plasticity index were performed on representative soil samples. Results are shown on Table III.

4.5 **Corrosion tests** consisting of sulfate, pH, resistivity and chloride analysis to determine potential corrosive effects of soils on concrete and underground utilities. Test results are provided on Table IV.

4.6 **R-Value test** per California Test Method 301 was performed on a representative sample, which may be anticipated to be near subgrade to determine pavement design. Results are provided within the pavement design section of the report.

4.7 **Direct Shear tests** (ASTM: D 3080) were performed on undisturbed and/or remolded samples of the subsurface soils. The test is performed under saturated conditions at loads of 1,000 lbs./sq.ft., 2,000 lbs./sq.ft., and 3,000 lbs./sq.ft. with results shown on Plates A and B.

4.8 **Consolidation tests** (ASTM: D 2435) were performed on undisturbed samples to determine the differential and total settlement which may be anticipated based upon the proposed loads. Water was added to the samples at a surcharge of one KSF and the settlement curves are plotted on Plates C to E.

5.0 Seismicity Evaluation

The proposed development lies outside of any Alquist Priolo Special Studies Zone and the potential for damage due to direct fault rupture is considered unlikely. The site is situated in an area of high regional seismicity and the San Jacinto (San Jacinto Valley) fault is located about 6 kilometers from the site. Ground shaking originating from earthquakes along other active faults in the region is expected to induce lower horizontal accelerations due to smaller anticipated earthquakes and/or greater distances to other faults.

The seismic design parameters are provided below and are based on the 2019 California Building Code (CBC) Standard ASCE/SEI 7-16. The data was obtained from the American Society of Civil Engineers (ASCE) website, https://asce7hazardtool.online/. The ASCE 7 Hazards Report is attached in Appendix C.

Seismic Design Acceleration Parameters

Latitude	33.916
Longitude	-117.257
Site Class	D
Risk Category	I/II/III
Mapped Spectral Response Acceleration	S_S = 1.500 S_1 = 0.600
Adjusted Maximum Acceleration	S_{MS} = 1.500
Design Spectral Response Acceleration Parameters	S_{DS} = 1.000
Peak Ground Acceleration	PGA_M = 0.674

6.0 Liquefaction Evaluation

The site is expected to experience ground shaking and earthquake activity that is typical of Southern California area. It is during severe ground shaking that loose, granular soils below the groundwater table can liquefy. A review of the exploratory boring log and the laboratory test results on selected soil samples obtained indicate the following soil classifications, field blowcounts and amounts of fines passing through the No. 200 sieve.

Field Blowcount and Gradation Data

Boring No.	Classification	Blowcounts (blows/ft)	Relative Density	% Passing No. 200 Sieve
B-1 @ 5’	SC	>50	Very Dense	47
B-1 @ 10’	ML/CL	>50	Very Stiff	62
B-1 @ 15’	SC	82	Very Dense	45
B-1 @ 20’	SC	76	Very Dense	44
B-1 @ 25’	SC	>50	Very Dense	42
B-1 @ 30’	SC	34	Dense	42
B-1 @ 35’	SM	32	Dense	37
B-1 @ 40’	CL	65	Very Stiff	60
B-1 @ 45’	CL	42	Dense	61
B-1 @ 50’	CL	36	Stiff	56

Boring No.	Classification	Blowcounts (blows/ft)	Relative Density	% Passing No. 200 Sieve
B-2 @ 5'	SM	>50	Very Dense	21
B-2 @ 10'	SC	36	Very Dense	47
B-2 @ 15'	SM	52	Very Dense	33
B-2 @ 20'	SM	30	Dense	14
B-2 @ 25'	SC	>50	Very Dense	46
B-2 @ 30'	SC	41	Very Dense	45
B-2 @ 35'	SC	42	Very Dense	40
B-2 @ 40'	SC	56	Very Dense	48
B-2 @ 45'	SC	46	Very Dense	47
B-2 @ 50'	SM	37	Dense	29

The analysis indicates the potential for liquefaction at this site to be low based on the density of the subsurface soils. The associated seismic-induced settlements would be on the order of less than 3/4 inch and would occur rather uniformly across the site. Differential settlements would be on the order of ½ inch over a 50-foot (horizontal) distance. Thus, the design of the proposed construction in conformance with the latest Building Code provisions for earthquake design is expected to provide mitigation of ground shaking hazards that are typical to Southern California.

7.0 Infiltration Characteristics

Infiltration tests within the site were performed to provide preliminary infiltration rates for the purpose of planning and design of an on-site water disposal system. The infiltration tests consisted of the double ring infiltration test per ASTM Method D 3385. The field infiltration rate was computed using a reduction factor – R_f based on the field measurements with our calculations given in Appendix D. Based upon the results of our testing, the soils encountered in the planned on-site drainage disposal system area exhibit the following infiltration rates.

Test No.	Depth	Soil Classification	Infiltration Rate
T-1	5'	Silty SAND	26.8 in/hr
T-2	7.5'	Sandy CLAY	0.1 in/hr
T-3	10'	Sandy CLAY	0.7 in/hr

The correction factors CFt, CFv and CFs are given below based on soils at 5 to 10 feet from our field tests.

a) CFt = Rf =1.0 for our double ring infiltration test holes.

b) CFv = 1.0 based on uniform soils encountered in three (3) trenches for infiltration tests.

c) CFs = 3.0 for long-term siltation, plugging and maintenance. The subsurface soils are likely to have some plugging and regular maintenance of storm water discharge devices is required.

Based on the results of our field testing, the subsurface soils encountered in the proposed on-site drainage disposal system at 5 feet below ground surface and into sandy soils shall utilize a design infiltration rate of 8 in/hr. The infiltration rate at a depth below 5 feet to 10 feet indicates the very stiff fine-grained clayey soils which are not suitable for seepage pits at the site. All systems must meet the latest county specifications and the California Regional Water Quality Control Board (CRWQCB) requirements.

It is recommended that foundations shall be setback a minimum distance of 10 feet from the drainage disposal system and the bottom of footing shall be a minimum of 10 feet from the expected zone of saturation. The boundary of the zone of saturation may be assumed to project downward from the top of the permeable portion of the disposal system at an inclination of 1 to 1 or flatter, as determined by the geotechnical engineer.

8.0 Conclusions and Recommendations

Based upon our evaluations, the proposed development is acceptable from a geotechnical engineering standpoint. By following the recommendations and guidelines set forth in our report, the structures will be safe from excessive settlements under the anticipated design loadings and conditions. The proposed development shall meet all requirements of the City Building Ordinance and will not impose any adverse effect on existing adjacent structures.

The following recommendations are based upon soil conditions encountered in our field investigation; these near-surface soil conditions could vary across the site. Variations in the soil conditions may not become evident until the commencement of grading operations for the proposed development and revised recommendations from the soils engineer may be necessary based upon the conditions encountered.

It is recommended that site inspections be performed by a representative of this firm during all grading and construction of the development to verify the findings and recommendations documented in this report. Any unusual conditions which may be encountered in the course of the project development may require the need for additional study and revised recommendations.

8.1 Site Grading Recommendations

Any vegetation and/or demolition debris shall be removed and hauled from proposed grading areas prior to the start of grading operations. Existing vegetation shall not be mixed or disced into the soils. Any removed soils may be reutilized as compacted fill once any deleterious material or oversized materials (in excess of eight inches) is removed. Grading operations shall be performed in accordance with the attached *Specifications for Placement of Compacted Fill*.

8.1.1 Removal and Recompaction Recommendations

All disturbed soils and/or fill (about 1 to 1½ feet below ground surface) shall be removed to competent native material, the exposed surface scarified to a depth of 12 inches, brought to within 2% of optimum moisture content and compacted to a minimum of 90% of the laboratory standard (ASTM: D 1557) prior to placement of any additional compacted fill soils, foundations, slabs-on-grade and pavement. Grading shall extend a minimum of five horizontal feet outside the edges of foundations or equidistant to the depth of fill placed, whichever is greater.

It is possible that isolated areas of undiscovered fill not described in this report are present on site; if found, these areas should be treated as discussed earlier. A diligent search shall also be conducted during grading operations in an effort to uncover any underground structures, irrigation or utility lines. If encountered, these structures and lines shall be either removed or properly abandoned prior to the proposed construction.

Any imported fill material should be preferably soil similar to the upper soils encountered at the subject site. All soils shall be approved by this firm prior to importing at the site and will be subjected to additional laboratory testing to assure concurrence with the recommendations stated in this report.

If placement of slabs-on-grade and pavement is not completed immediately upon completion of grading operations, additional testing and grading of the areas may be necessary prior to continuation of construction operations. Likewise, if adverse weather conditions occur which may damage the subgrade soils, additional assessment by the soils engineer as to the suitability of the supporting soils may be needed.

Care should be taken to provide or maintain adequate lateral support for all adjacent improvements and structures at all times during the grading operations and construction phase. Adequate drainage away from the structures, pavement and slopes should be provided at all times.

8.1.2 Fill Blanket Recommendations

Due to the potential for differential settlement of foundations placed on compacted fill and native materials, it is recommended that all foundations including floor slab areas be underlain by a uniform compacted fill blanket at least two feet in thickness. This fill blanket shall extend a minimum of five horizontal feet outside the edges of foundations or equidistant to the depth of fill placed, whichever is greater.

8.2 Shrinkage and Subsidence

Results of our in-place density tests reveal that the soil shrinkage will be less than 5% due to excavation and recompaction, based upon the assumption that the fill is compacted to 92% of the maximum dry density per ASTM standards. Subsidence should be 0.2 feet die to earthwork operations. The volume change does not include any allowance for vegetation or organic stripping, removal of subsurface improvements, or topographic approximations.

Although these values are only approximate, they represent our best estimate of lost yardage, which will likely occur during grading. If more accurate shrinkage and subsidence factors are needed, it is recommended that field testing the actual equipment and grading techniques should be conducted.

8.3 Temporary Excavations

Temporary unsurcharged excavations in the existing site materials may be made at vertical inclinations up to 4 feet in height unless cohesionless soils are encountered. In areas where soils with little or no binder are encountered, where adverse geological conditions are exposed, or where excavations are adjacent to existing structures, shoring or flatter excavations may be required. The temporary cut slope gradients given above do not preclude local raveling and sloughing. All excavations shall be made in accordance with the requirements of the soils engineer, CAL-OSHA and other public agencies having jurisdiction. Care should be taken to provide or maintain adequate lateral support for all adjacent improvements and structures at all times during the grading operations and construction phase.

8.4 Foundation Design

All foundations may be designed utilizing the following allowable bearing capacities for an embedded depth of 24 inches into approved engineered fill with the corresponding widths:

Allowable Bearing Capacity (psf)		
Width (feet)	Continuous Foundation	Isolated Foundation
1.5	2000	2500
2.0	2075	2575
4.0	2375	2875
6.0	2500	3000

The bearing value may be increased by 500 psf for each additional foot of depth in excess of the 18-inch minimum depth, up to a maximum of 4,000 psf. A one-third increase may be used when considering short-term loading and seismic forces. Any foundations located along property line may utilize an allowable bearing capacity of 1,500 psf and embedded into competent native soils. All foundations shall be reinforced a minimum of one, No. 4 bar, top and bottom. A representative of this firm shall inspect all foundation excavations prior to pouring concrete.

8.5 Settlement Analysis

Resultant pressure curves for the consolidation tests are shown on Plates C and D. Computations utilizing these curves and the recommended allowable soil bearing capacities reveal that the foundations will experience settlements on the order of ¾ inch and differential settlements of less than ¼ inch.

8.6 Lateral Resistance

The following values may be utilized in resisting lateral loads imposed on the structure. Requirements of the California Building Code should be adhered to when the coefficient of friction and passive pressures are combined.

Coefficient of Friction - 0.35

Equivalent Passive Fluid Pressure = 200 lbs./cu.ft.

Maximum Passive Pressure = 2,000 lbs./cu.ft.

The passive pressure recommendations are valid only for approved compacted fill soils or competent native materials.

8.7 Retaining Wall Design Parameters

Active earth pressures against retaining walls will be equal to the pressures developed by the following fluid densities. These values are for **approved granular backfill material** placed behind the walls at various ground slopes above the walls.

Surface Slope of Retained Materials (Horizontal to Vertical	Equivalent Fluid Density (lb./cu.ft.)
Level	30
5 to 1	35
4 to 1	38
3 to 1	40
2 to 1	45

Any applicable short-term construction surcharges and seismic forces should be added to the above lateral pressure values. An equivalent fluid pressure of 45 pcf may be utilized for the restrained wall condition with a level grade behind the wall.

The seismic-induced lateral soil pressure for walls greater than 6 feet may be computed using a triangular pressure distribution with the maximum value at the top of the wall. The maximum lateral pressure of (20 pcf) H where H is the height of the retained soils above the wall footing should be used in final design of retaining walls. Sliding resistance values and passive fluid pressure values may be increased by 1/3 during short-term wind and seismic loading conditions.

All walls shall be waterproofed as needed and protected from hydrostatic pressure by a reliable permanent subdrain system. The granular backfill to be utilized immediately adjacent to retaining walls shall consist of an approved select granular soil with a sand equivalency greater than 30. This backfill zone of free draining material shall consist of a wedge beginning a minimum of one horizontal foot from the base of the wall extending upward at an inclination of no less than ¾ to 1 (horizontal to vertical).

8.8 Slab Design

All concrete slabs shall be a minimum of six inches in thickness in the proposed warehouse areas and four inches in office and hardscape both reinforced a minimum of No. 3 bars, sixteen inches in each direction and positioned in the center of slab and placed on approved subgrade soils. Additional reinforcement requirements and an increase in thickness of the slabs-on-grade may be necessary based upon soils expansion potential and proposed loading conditions in the structures and should be evaluated further by the project engineers and/or architect. All subgrade soils shall be moisture conditioned to 3% over optimum moisture content to a depth eighteen inches.

A vapor retarder (10-mil minimum thickness) should be utilized in areas which would be sensitive to the infiltration of moisture. This retarder shall meet requirements of ASTM E 96, *Water Vapor Transmission of Materials* and ASTM E 1745, *Standard Specification for Water Vapor Retarders used in Contact with Soil or Granular Fill Under Concrete Slabs.* The vapor retarder shall be installed in accordance with procedures stated in ASTM E 1643, *Standard practice for Installation of Water Vapor Retarders used in Contact with Earth or Granular Fill Under Concrete Slabs.*

The moisture retarder may be placed directly upon compacted subgrade soils conditioned to near optimum moisture levels, although one to two inches of sand beneath the membrane is desirable. The subgrade upon which the retarder is placed shall be smooth and free of rocks, gravel or other protrusions which may damage the retarder. Use of sand above the retarder is under the purview of the structural engineer; if sand is used over the retarder, it should be placed in a dry condition.

8.9 Pavement Section Design

The table on the following page provides a preliminary pavement design based upon an R-Value of 16 for the subgrade soils for the proposed pavement areas. Final pavement design may need to be based on R-Value testing of the subgrade soils near the conclusion of site grading to assure that these soils are consistent with those assumed in this preliminary design.

The recommendations are based upon estimated traffic loads. Client should submit any other anticipated traffic loadings to the geotechnical engineer, if necessary, so that pavement sections may be reviewed to determine adequacy to support the proposed loadings.

Type of Traffic	Traffic Index	Asphalt (in.)	Base Material (in.)
Automobile Parking Stalls	4.0	3.0	6.0
Light Vehicle Circulation Areas	5.5	3.5	9.5
Heavy Truck Access Areas	7.0	4.0	14.0

Any concrete slab-on-grade in pavement areas shall be a minimum of seven inches in thickness and may be placed on approved subgrade soils. All pavement areas shall have positive drainage toward an approved outlet from the site. Drain lines behind curbs and/or adjacent to landscape areas should be considered by client and the appropriate design engineers to prevent water from infiltrating beneath pavement. If such infiltration occurs, damage to pavement, curbs and flow lines, especially on sites with expansive soils, may occur during the life of the project.

Any approved base material shall consist of a Class II aggregate or equivalent and should be compacted to a minimum of 95% relative compaction. All pavement materials shall conform to the requirements set forth by the City of Moreno Valley. The base material; and asphaltic concrete should be tested prior to delivery to the site and during placement to determine conformance with the project specifications. A pavement engineer shall designate the specific asphalt mix design to meet the required project specifications.

8.10 Utility Trench and Excavation Backfill

Trenches from installation of utility lines and other excavations may be backfilled with on-site soils or approved imported soils compacted to a minimum of 90% relative compaction. All utility lines shall be properly bedded with clean sand having a sand equivalency rating of 30 or more. This bedding material shall be thoroughly water jetted around the pipe structure prior to placement of compacted backfill soils.

8.11 Corrosion Design Criteria

Representative samples of the surficial soils, typical of the subgrade soils expected to be encountered within foundation excavations and underground utilities were tested for corrosion potential. The minimum resistivity value obtained for the samples tested is representative of an environment that may be severely corrosive to metals. The soil pH value was considered mildly alkaline and may not have a significant effect on soil corrosivity. Consideration should be given to corrosion protection systems for buried metal such as protective coatings, wrappings or the use of PVC where permitted by local building codes.

According to Table 4.3.1 of ACI 318 Building Code and Commentary, these contents revealed negligible sulfate concentrations. Therefore, a Type II cement according to latest CBC specifications may be utilized for building foundations at this time. It is recommended that additional sulfate tests be performed at the completion of site grading to assure that the as graded conditions are consistent with the recommendations stated in this design. Corrosion test results may be found on the attached Table IV.

8.12 Expansive Soil

Since expansive soils were encountered, special attention should be given to the project design and maintenance. The attached *Expansive Soil Guidelines* should be reviewed by the engineers, architects, owner, maintenance personnel and other interested parties and considered during the design of the project and future property maintenance.

9.0 Closure

The recommendations and conclusions contained in this report are based upon the soil conditions uncovered in our test excavations. No warranty of the soil condition between our excavations is implied. NorCal Engineering should be notified for possible further recommendations if unexpected to unfavorable conditions are encountered during construction phase. It is the responsibility of the owner to ensure that all information within this report is submitted to the Architect and appropriate Engineers for the project.

A preconstruction conference should be held between the developer, general contractor, grading contractor, city inspector, architect, and geotechnical engineer to clarify any questions relating to the grading operations and subsequent construction. Our representative should be present during the grading operations and construction phase to certify that such recommendations are complied within the field.

This geotechnical investigation has been conducted in a manner consistent with the level of care and skill exercised by members of our profession currently practicing under similar conditions in the Southern California area. No other warranty, expressed or implied is made.

We appreciate this opportunity to be of service to you. If you have any further questions, please do not hesitate to contact the undersigned.

Respectfully submitted,
NORCAL ENGINEERING

Keith D Tucker

Keith D. Tucker
Project Engineer
R.G.E. 841

REGISTERED PROFESSIONAL ENGINEER
KEITH D. TUCKER
No. 841
Exp. 12/31/2020
GEOTECHNICAL
STATE OF CALIFORNIA

Scott D. Spensiero
Project Manager

SPECIFICATIONS FOR PLACEMENT OF COMPACTED FILL

Excavation

Any existing low-density soils and/or saturated soils shall be removed to competent natural soil under the inspection of the Geotechnical Engineering Firm. After the exposed surface has been cleansed of debris and/or vegetation, it shall be scarified until it is uniform in consistency, brought to the proper moisture content and compacted to a minimum of 90% relative compaction (in accordance with ASTM: D 1557).

In any area where a transition between fill and native soil or between bedrock and soil are encountered, additional excavation beneath foundations and slabs will be necessary in order to provide uniform support and avoid differential settlement of the structure.

Material for Fill

The on-site soils or approved import soils may be utilized for the compacted fill provided they are free of any deleterious materials and shall not contain any rocks, brick, asphaltic concrete, concrete or other hard materials greater than eight inches in maximum dimensions. Any import soil must be approved by the Geotechnical Engineering firm a minimum of 72 hours prior to importation of site.

Placement of Compacted Fill Soils

The approved fill soils shall be placed in layers not excess of six inches in thickness. Each lift shall be uniform in thickness and thoroughly blended. The fill soils shall be brought to within 2% of the optimum moisture content, unless otherwise specified by the Soils Engineering firm. Each lift shall be compacted to a minimum of 90% relative compaction (in accordance with ASTM: D 1557) and approved prior to the placement of the next layer of soil. Compaction tests shall be obtained at the discretion of the Geotechnical Engineering firm but to a minimum of one test for every 500 cubic yards placed and/or for every 2 feet of compacted fill placed.

The minimum relative compaction shall be obtained in accordance with accepted methods in the construction industry. The final grade of the structural areas shall be in a dense and smooth condition prior to placement of slabs-on-grade or pavement areas. No fill soils shall be placed, spread or compacted during unfavorable weather conditions. When the grading is interrupted by heavy rains, compaction operations shall not be resumed until approved by the Geotechnical Engineering firm.

Grading Observations

The controlling governmental agencies should be notified prior to commencement of any grading operations. This firm recommends that the grading operations be conducted under the observation of a Soils Engineering firm as deemed necessary. A 24-hour notice must be provided to this firm prior to the time of our initial inspection.

Observation shall include the clearing and grubbing operations to assure that all unsuitable materials have been properly removed; approve the exposed subgrade in areas to receive fill and in areas where excavation has resulted in the desired finished grade and designate areas of overexcavation; and perform field compaction tests to determine relative compaction achieved during fill placement. In addition, all foundation excavations shall be observed by the Geotechnical Engineering firm to confirm that appropriate bearing materials are present at the design grades and recommend any modifications to construct footings.

EXPANSIVE SOIL GUIDELINES

The following expansive soil guidelines are provided for your project. The intent of these guidelines is to inform you, the client, of the importance of proper design and maintenance of projects supported on expansive soils. ***You, as the owner or other interested party, should be warned that you have a duty to provide the information contained in the soil report including these guidelines to your design engineers, architects, landscapers and other design parties in order to enable them to provide a design that takes into consideration expansive soils.***

In addition, you should provide the soil report with these guidelines to any property manager, lessee, property purchaser or other interested party that will have or assume the responsibility of maintaining the development in the future.

Expansive soils are fine-grained silts and clays which are subject to swelling and contracting. The amount of this swelling and contracting is subject to the amount of fine-grained clay materials present in the soils and the amount of moisture either introduced or extracted from the soils. Expansive soils are divided into five categories ranging from "very low" to "very high". Expansion indices are assigned to each classification and are included in the laboratory testing section of this report. *If the expansion index of the soils on your site, as stated in this report, is 21 or higher, you have expansive soils.* The classifications of expansive soils are as follows:

Classification of Expansive Soil*

Expansion Index	Potential Expansion
0-20	Very Low
21-50	Low
51-90	Medium
91-130	High
Above 130	Very High

*From Table 18A-I-B of California Building Code (1988)

When expansive soils are compacted during site grading operations, care is taken to place the materials at or slightly above optimum moisture levels and perform proper compaction operations. Any subsequent excessive wetting and/or drying of expansive soils will cause the soil materials to expand and/or contract. These actions are likely to cause distress of foundations, structures, slabs-on-grade, sidewalks and pavement over the life of the structure. ***It is therefore imperative that even after construction of improvements, the moisture contents are maintained at relatively constant levels, allowing neither excessive wetting or drying of soils.***

Evidence of excessive wetting of expansive soils may be seen in concrete slabs, both interior and exterior. Slabs may lift at construction joints producing a trip hazard or may crack from the pressure of soil expansion. Wet clays in foundation areas may result in lifting of the structure causing difficulty in the opening and closing of doors and windows, as well as cracking in exterior and interior wall surfaces. In extreme wetting of soils to depth, settlement of the structure may eventually result. Excessive wetting of soils in landscape areas adjacent to concrete or asphaltic pavement areas may also result in expansion of soils beneath pavement and resultant distress to the pavement surface.

Excessive drying of expansive soils is initially evidenced by cracking in the surface of the soils due to contraction. Settlement of structures and on-grade slabs may also eventually result along with problems in the operation of doors and windows.

Projects located in areas of expansive clay soils will be subject to more movement and "hairline" cracking of walls and slabs than similar projects situated on non-expansive sandy soils. There are, however, measures that developers and property owners may take to reduce the amount of movement over the life the development. The following guidelines are provided to assist you in both design and maintenance of projects on expansive soils:

- Drainage away from structures and pavement is essential to prevent excessive wetting of expansive soils. Grades should be designed to the latest building code and maintained to allow flow of irrigation and rain water to approved drainage devices or to the street. Any "ponding" of water adjacent to buildings, slabs and pavement after rains is evidence of poor drainage; the installation of drainage devices or regrading of the area may be required to assure proper drainage. Installation of rain gutters is also recommended to control the introduction of moisture next to buildings. Gutters should discharge into a drainage device or onto pavement which drains to roadways.

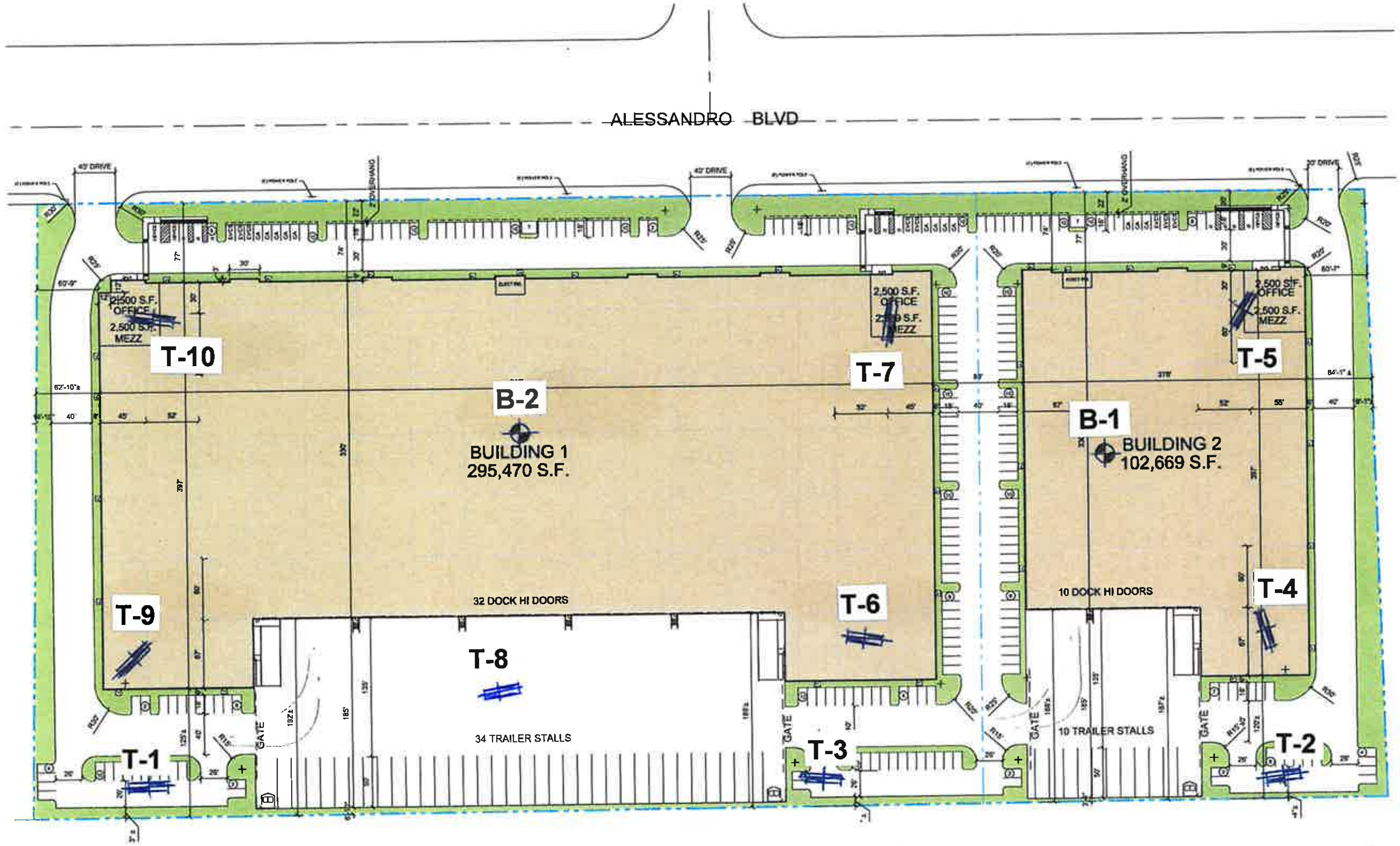
- Irrigation should be strictly controlled around building foundations, slabs and pavement and may need to be adjusted depending upon season. This control is essential to maintain a relatively uniform moisture content in the expansive soils and to prevent swelling and contracting. Over-watering adjacent to improvements may result in damage to those improvements. NorCal Engineering makes no specific recommendations regarding landscape irrigation schedules.

- Planting schemes for landscaping around structures and pavement should be analyzed carefully. Plants (including sod) requiring high amounts of water may result in excessive wetting of soils. Trees and large shrubs may actually extract moisture from the expansive soils, thus causing contraction of the fine-grained soils.

- Thickened edges on exterior slabs will assist in keeping excessive moisture from entering directly beneath the concrete. A six-inch thick or greater deepened edge on slabs may be considered. Underlying interior and exterior slabs with 6 to 12 inches or more of non-expansive soils and providing presaturation of the underlying clayey soils as recommended in the soil report will improve the overall performance of on-grade slabs.

- Increase the amount of steel reinforcing in concrete slabs, foundations and other structures to resist the forces of expansive soils. The precise amount of reinforcing should be determined by the appropriate design engineers and/or architects.

- Recommendations of the soil report should always be followed in the development of the project. Any recommendations regarding presaturation of the upper subgrade soils in slab areas should be performed in the field and verified by the Soil Engineer.



NorCal Engineering
SOILS AND GEOTECHNICAL CONSULTANTS

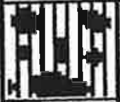
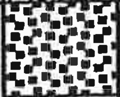
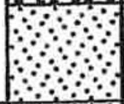
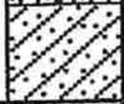
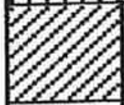
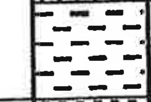
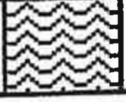
PROJECT 21631-20 | **DATE** FEBRUARY 2020

SITE PLAN

List of Appendices

(in order of appearance)

Appendix A

MAJOR DIVISION			GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL, SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SAND (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVEL-LY SANDS, LITTLE OR NO FINES
		SANDS WITH FINE (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

UNIFIED SOIL CLASSIFICATION SYSTEM

NorCal Engineering

KEY:

■	Indicates 2.5-inch Inside Diameter. Ring Sample.
☒	Indicates 2-inch OD Split Spoon Sample (SPT).
⧅	Indicates Shelby Tube Sample.
◫	Indicates No Recovery.
◧	Indicates SPT with 140# Hammer 30 in. Drop.
🖂	Indicates Bulk Sample.
◩	Indicates Small Bag Sample.
◨	Indicates Non-Standard
⧗	Indicates Core Run.

COMPONENT PROPORTIONS

DESCRIPTIVE TERMS	RANGE OF PROPORTION
Trace	1 - 5%
Few	5 - 10%
Little	10 - 20%
Some	20 - 35%
And	35 - 50%

COMPONENT DEFINITIONS

COMPONENT	SIZE RANGE
Boulders	Larger than 12 in
Cobbles	3 in to 12 in
Gravel	3 in to No 4 (4.5mm)
Coarse gravel	3 in to 3/4 in
Fine gravel	3/4 in to No 4 (4.5mm)
Sand	No. 4 (4.5mm) to No. 200 (0.074mm)
Coarse sand	No. 4 (4.5 mm) to No. 10 (2.0 mm)
Medium sand	No. 10 (2.0 mm) to No. 40 (0.42 mm)
Fine sand	No. 40 (0.42 mm) to No. 200 (0.074 mm)
Silt and Clay	Smaller than No. 200 (0.074 mm)

MOISTURE CONTENT

DRY	Absence of moisture, dusty, dry to the touch.
DAMP	Some perceptible moisture; below optimum
MOIST	No visible water; near optimum moisture content
WET	Visible free water, usually soil is below water table.

RELATIVE DENSITY OR CONSISTENCY VERSUS SPT N -VALUE

COHESIONLESS SOILS		COHESIVE SOILS		
Density	N (blows/ft)	Consistency	N (blows/ft)	Approximate Undrained Shear Strength (psf)
Very Loose	0 to 4	Very Soft	0 to 2	< 250
Loose	4 to 10	Soft	2 to 4	250 - 500
Medium Dense	10 to 30	Medium Stiff	4 to 8	500 - 1000
Dense	30 to 50	Stiff	8 to 15	1000 - 2000
Very Dense	over 50	Very Stiff	15 to 30	2000 - 4000
		Hard	over 30	> 4000

CDREP
21631-20

Log of Trench T-1

Boring Location: Alessandro & Chagall Ct, Moreno Valley

Date of Drilling: 1/20/2020
Groundwater Depth: None Encountered

Drilling Method: Backhoe

Hammer Weight:
Drop:

Surface Elevation: Not Measured

Depth (feet)	Lith-ology		Material Description	Samples		Laboratory		
				Type	Blow Counts	Moisture	Dry Density	Fines Content %
0	▨	GWT not encountered	FILL Silty SAND Brown, loose, moist					
	▨		NATURAL Silty SAND Brown, dense to very dense, moist					
5			Trench completed at depth of 5'					
10								
15								
20								
25								
30								
35								

CDREP
21631-20

Log of Trench T-2

Boring Location: Alessandro & Chagall Ct, Moreno Valley

Date of Drilling: 1/20/2020 | **Groundwater Depth:** None Encountered

Drilling Method: Backhoe

Hammer Weight: | **Drop:**

Surface Elevation: Not Measured

Depth (feet)	Lith-ology		Material Description	Samples Type	Samples Blow Counts	Laboratory Moisture	Laboratory Dry Density	Laboratory Fines Content %
0		GWT not encountered	FILL Clayey SAND Brown, loose, moist					
			NATURAL Clayey SAND to Sandy CLAY Brown, dense to very dense, moist					
5								
			Trench completed at depth of 7.5'					
10								
15								
20								
25								
30								
35								

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NorCal Engineering

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21631-20

Log of Trench T-3

Boring Location: Alessandro & Chagall Ct, Moreno Valley

Date of Drilling: 1/20/2020

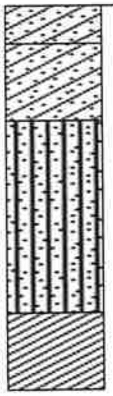
Groundwater Depth: None Encountered

Drilling Method: Backhoe

Hammer Weight:

Drop:

Surface Elevation: Not Measured



GWT not encountered

Depth (feet)	Lith-ology	Material Description	Samples		Laboratory		
			Type	Blow Counts	Moisture	Dry Density	Fines Content %
0		FILL Clayey SAND Brown, loose, moist					
		NATURAL Clayey SAND Brown, dense, moist					
5		Silty SAND Brown, dense, moist					
		Sandy CLAY Brown, stiff, moist					
10		Trench completed at depth of 10'					
15							
20							
25							
30							
35							

CDREP
21631-20

Log of Trench T-4

Boring Location: Alessandro & Chagall Ct, Moreno Valley

Date of Drilling: 1/20/2020

Groundwater Depth: None Encountered

Drilling Method: Backhoe

Hammer Weight:

Drop:

Surface Elevation: Not Measured

Depth (feet)	Lith- ology		Material Description	Samples Type	Samples Blow Counts	Laboratory Moisture	Laboratory Dry Density	Laboratory Fines Content %
0	▨	GWT not encountered	FILL Clayey SAND Brown, loose, moist	■ ☒		11.6	119.0	
	▥		NATURAL Silty SAND Brown, dense to very dense, moist	■		13.2	117.6	
5	▥		Silty (fine to coarse grained) SAND Brown, dense, moist	■		9.7	118.8	
10			Trench completed at depth of 10'					
15								
20								
25								
30								
35								

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NorCal Engineering

CDREP
21631-20

Log of Trench T-5

Boring Location: Alessandro & Chagall Ct, Moreno Valley

Date of Drilling: 1/20/2020

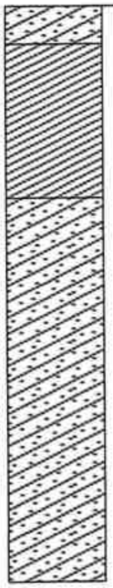
Groundwater Depth: None Encountered

Drilling Method: Backhoe

Hammer Weight:

Drop:

Surface Elevation: Not Measured



GWT not encountered

Depth (feet)	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0	FILL Clayey SAND Brown, loose, moist					
2	NATURAL Sandy CLAY Brown, stiff, moist	■ ▽		12.1	117.2	
5	Clayey SAND Brown, very dense, moist	■		11.7	120.4	
10		■		9.4	122.6	
15	Trench completed at depth of 15'	■		10.3	119.6	

CDREP
21631-20

Log of Trench T-6

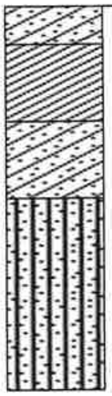
Boring Location: Alessandro & Chagall Ct, Moreno Valley

Date of Drilling: 1/20/2020 | **Groundwater Depth:** None Encountered

Drilling Method: Backhoe

Hammer Weight: | **Drop:**

Surface Elevation: Not Measured



Depth (feet)	Lith- ology		Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0		GWT not encountered	FILL Clayey SAND Brown, loose, moist					
			NATURAL Sandy CLAY Brown, stiff, moist	■		8.4	115.7	
5			Clayey SAND Brown, dense, moist					
			Silty SAND Brown, dense, moist	■		7.0	117.8	
10			Trench completed at depth of 10'					
15								
20								
25								
30								
35								

SuperLog CivilTech Software, USA www.civiltech.com File: C:\Superlog4\PROJECT\21631-20.log Date: 2/3/2020

NorCal Engineering

CDREP
21631-20

Log of Trench T-7

Boring Location: Alessandro & Chagall Ct, Moreno Valley

Date of Drilling: 1/20/2020

Groundwater Depth: None Encountered

Drilling Method: Backhoe

Hammer Weight:

Drop:

Surface Elevation: Not Measured

Depth (feet)	Lith- ology		Material Description	Samples		Laboratory		
				Type	Blow Counts	Moisture	Dry Density	Fines Content %
0	▨	GWT not encountered	FILL Clayey SAND Brown, loose, moist	■		7.4	115.9	
	▨		NATURAL Clayey SAND Brown, dense to very dense, moist	■		8.3	117.8	
5	▨							
10			Trench completed at depth of 10'	■		11.0	118.8	
15								
20								
25								
30								
35								

NorCal Engineering

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21631-20

Log of Trench T-8

Boring Location: Alessandro & Chagall Ct, Moreno Valley

Date of Drilling: 1/20/2020

Groundwater Depth: None Encountered

Drilling Method: Backhoe

Hammer Weight:

Drop:

Surface Elevation: Not Measured

Depth (feet)	Lith-ology		Material Description	Samples		Laboratory		
				Type	Blow Counts	Moisture	Dry Density	Fines Content %
0		GWT not encountered	FILL Clayey SAND Brown, loose, moist	■		11.0	117.5	
			NATURAL Sandy CLAY Brown, stiff, moist					
5			Clayey SAND Brown, dense, moist					
			Trench completed at depth of 4.5'					
10								
15								
20								
25								
30								
35								

CDREP

21631-20

Log of Trench T-9

Boring Location: Alessandro & Chagall Ct, Moreno Valley

Date of Drilling: 1/20/2020

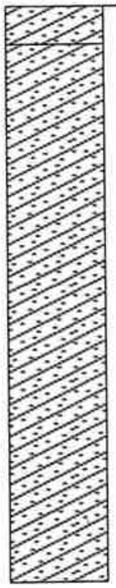
Groundwater Depth: None Encountered

Drilling Method: Backhoe

Hammer Weight:

Drop:

Surface Elevation: Not Measured



GWT not encountered

Depth (feet)	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0	FILL Clayey SAND Brown, loose, moist					
		■ ▽		10.6	115.5	
	NATURAL Clayey SAND Brown, dense to very dense, moist					
5		■		11.1	119.5	
10		■		9.8	116.1	
15	Trench completed at depth of 15'	■		11.4	116.8	
20						
25						
30						
35						

SuperLog CivilTech Software, USA www.civiltech.com File: C:\Superlog4\PROJECT\21631-20.log Date: 2/3/2020

CDREP

21631-20

Log of Trench T-10

Boring Location: Alessandro & Chagall Ct, Moreno Valley

Date of Drilling: 1/20/2020

Groundwater Depth: None Encountered

Drilling Method: Backhoe

Hammer Weight:

Drop:

Surface Elevation: Not Measured

Depth (feet)	Lith-ology	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0	▨	FILL Silty SAND Brown, loose, moist					
	▨	NATURAL Silty SAND Brown, dense to very dense, moist					
			■		6.1	114.2	
5							
			■		7.4	117.0	
10		Trench completed at depth of 10'					
15							
20							
25							
30							
35							

GWT not encountered

SuperLog CivilTech Software, USA www.civiltech.com File: C:\Superlog4\PROJECT\21631-20.log Date: 2/3/2020

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CDREP
21631-20

Log of Boring B-1

Boring Location: Alessandro & Chagall Ct, Moreno Valley

Date of Drilling: 1/22/2020

Groundwater Depth: 39'

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation: Not Measured

Depth (feet)	Lith-ology	Material Description	Samples		Laboratory		
			Type	Blow Counts	Moisture	Dry Density	Fines Content %
0	▨	FILL Clayey SAND Brown, loose, moist					
	▨	NATURAL Clayey SAND Brown, dense to very dense, moist					
5	▨		☒	32/50-4"	12.3		47
	▥	Sandy SILT Brown, very stiff, moist					
10	▥		☒	19/50-5"	11.8		62
	▨	Clayey (fine to coarse grained) SAND Red-brown, very dense, moist					
15	▨		☒	24/37/45	14.0		45
20	▨		☒	17/26/50	14.5		44
25	▨		☒	23/50-5"	14.7		42
30	▨		☒	15/18/16	18.3		42
	▦	Silty SAND Brown, dense, moist					
35							

NorCal Engineering

CDREP
21631-20

Log of Boring B-1

Boring Location: Alessandro & Chagall Ct, Moreno Valley

Date of Drilling: 1/22/2020

Groundwater Depth: 39'

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation: Not Measured

Depth (feet)	Lith-ology	Material Description	Samples		Laboratory		
			Type	Blow Counts	Moisture	Dry Density	Fines Content %
35	▦	Silty SAND Brown, dense, moist	☒	10/15/17	19.6		37
	▨ ▽	Sandy CLAY Red-brown, stiff, wet					
40	▨		☒	18/27/38	21.0		60
45	▨		☒	13/19/23	20.0		61
50	▨		☒	10/13/23	19.3		56
		Boring completed at depth of 51.5'					
55							
60							
65							
70							

CDREP
21631-20

Log of Boring B-2

Boring Location: Alessandro & Chagall Ct, Moreno Valley

Date of Drilling: 1/22/2020

Groundwater Depth: 33'

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs

Drop: 30"

Surface Elevation: Not Measured

Depth (feet)	Lith- ology	Material Description	Samples		Laboratory		
			Type	Blow Counts	Moisture	Dry Density	Fines Content %
0		FILL Silty SAND Brown, loose, moist					
		NATURAL Silty SAND Brown, dense to very dense, moist					
5			☒	38/50-5"	11.9		21
		Clayey (fine to coarse grained) SAND Red-brown, very dense, moist					
10			☒	8/17/19	8.2		47
		Silty SAND Brown, dense, wet					
15			☒	10/17/35	12.9		33
20			☒	10/11/19	6.0		14
		Clayey SAND Brown, dense, wet					
25			☒	25/50-4"	11.3		46
30			☒	18/21/20	15.2		45
	▽						
35							

NorCal Engineering

CDREP

21631-20

Log of Boring B-2

Boring Location: Alessandro & Chagall Ct, Moreno Valley

Date of Drilling: 1/22/2020 | **Groundwater Depth:** 33'

Drilling Method: Simco 2800HS

Hammer Weight: 140 lbs | **Drop:** 30"

Surface Elevation: Not Measured

Depth (feet)	Lith-ology	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
35	▨	Clayey SAND Brown, dense, wet	☒	14/16/26	16.2		40
40	▨		☒	18/25/31	19.5		48
45	▨		☒	13/21/25	16.7		47
	▥	Silty SAND Brown, dense, wet					
50	▥		☒	10/15/22	13.8		29
		Boring completed at depth of 51.5'					
55							
60							
65							
70							

Appendix B

TABLE I
MAXIMUM DENSITY TESTS

Sample	Classification	Optimum Moisture (%)	Maximum Dry Density (lbs/cu.ft)
T-4 @ 2'	Silty SAND	9.0	130.0
T-5 @ 2'	Sandy CLAY	13.5	125.0
T-9 @ 2'	Clayey SAND	12.0	128.0

TABLE II
EXPANSION TESTS

Sample	Classification	Expansion Index
T-4 @ 2'	Silty SAND	3
T-5 @ 2'	Sandy CLAY	65
T-9 @ 2'	Clayey SAND	25

TABLE III
ATTERBERG LIMITS

Sample	Liquid Limit	Plastic Limit	Plasticity Index
T-5 @ 2-5'	32	19	13
T-5 @ 8-10'	25	19	6

TABLE IV
CORROSION TESTS

Sample	pH	Electrical Resistivity	Sulfate (%)	Chloride (ppm)
T-5 @ 2'	7.2	1,820	0.008	257
T-9 @ 2'	7.1	2,540	0.007	285

% by weight
ppm – mg/kg

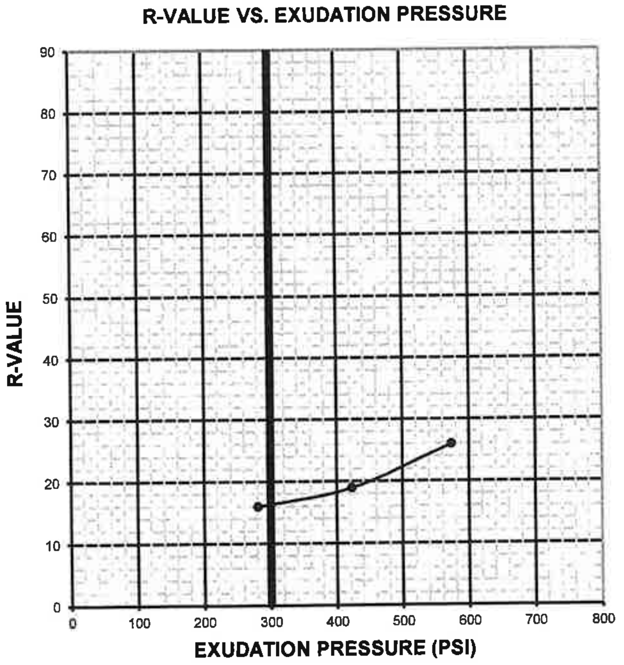
GMU

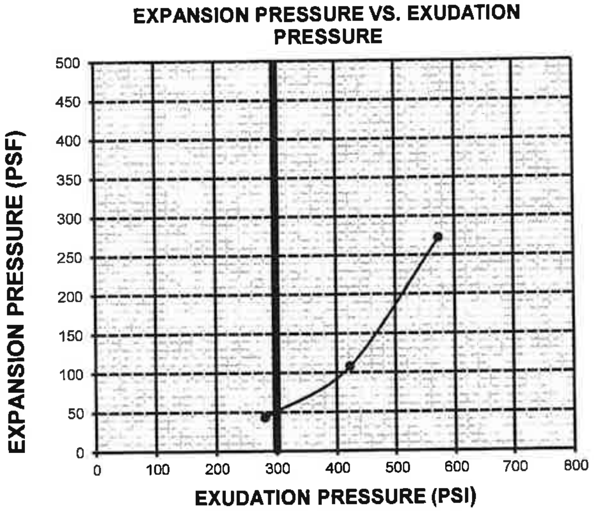
R-VALUE TEST REPORT

☑ CT-301 ☐ ASTM-D2844

PROJECT NAME: Norcal (CDREP LLC)
PROJECT NUMBER: L-200101
SAMPLE LOCATION: SEC of SWC of Alessandro Blvd and Chega II CT. Moreno Valley
SAMPLE NUMBER: T3
SAMPLE DESCRIPTION: Sandy Lean Clay (CL-CH)
SAMPLE DEPTH: 1.0'
SAMPLED BY: Norcal
TESTED BY: CC/ER
DATE TESTED: 1/24/2020

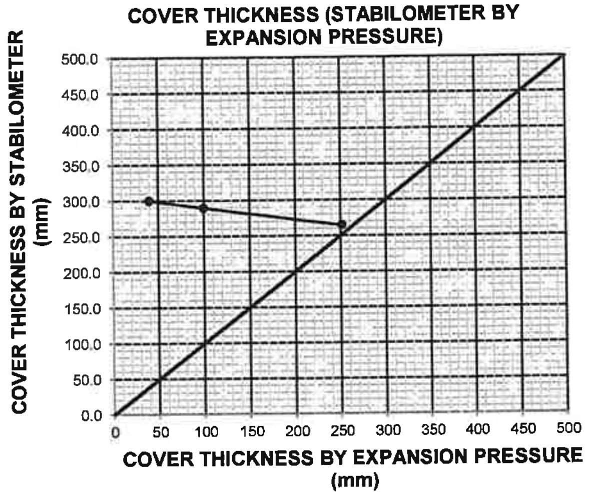
TEST SPECIMEN	A	B	C
MOISTURE AT COMPACTION %	14.4	15.5	16.9
WEIGHT OF SAMPLE, grams	1117	1191	1227
HEIGHT OF SAMPLE, Inches	2.30	2.48	2.67
DRY DENSITY, pcf	128.7	126.1	119.3
COMPACTOR AIR PRESSURE, psi	250	200	100
EXUDATION PRESSURE, psi	573	423	281
EXPANSION, Inches x 10exp-4	63	25	10
STABILITY Ph 2,000 lbs (160 psi)	100	119	125
TURNS DISPLACEMENT	3.51	3.76	4.19
R-VALUE UNCORRECTED	30	19	14
R-VALUE CORRECTED	26	19	16
EXPANSION PRESSURE (psf)	272.2	108.0	43.2





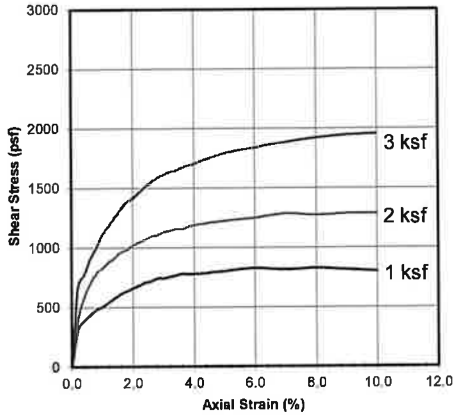
R-VALUE AT EQUILIBRIUM:	16

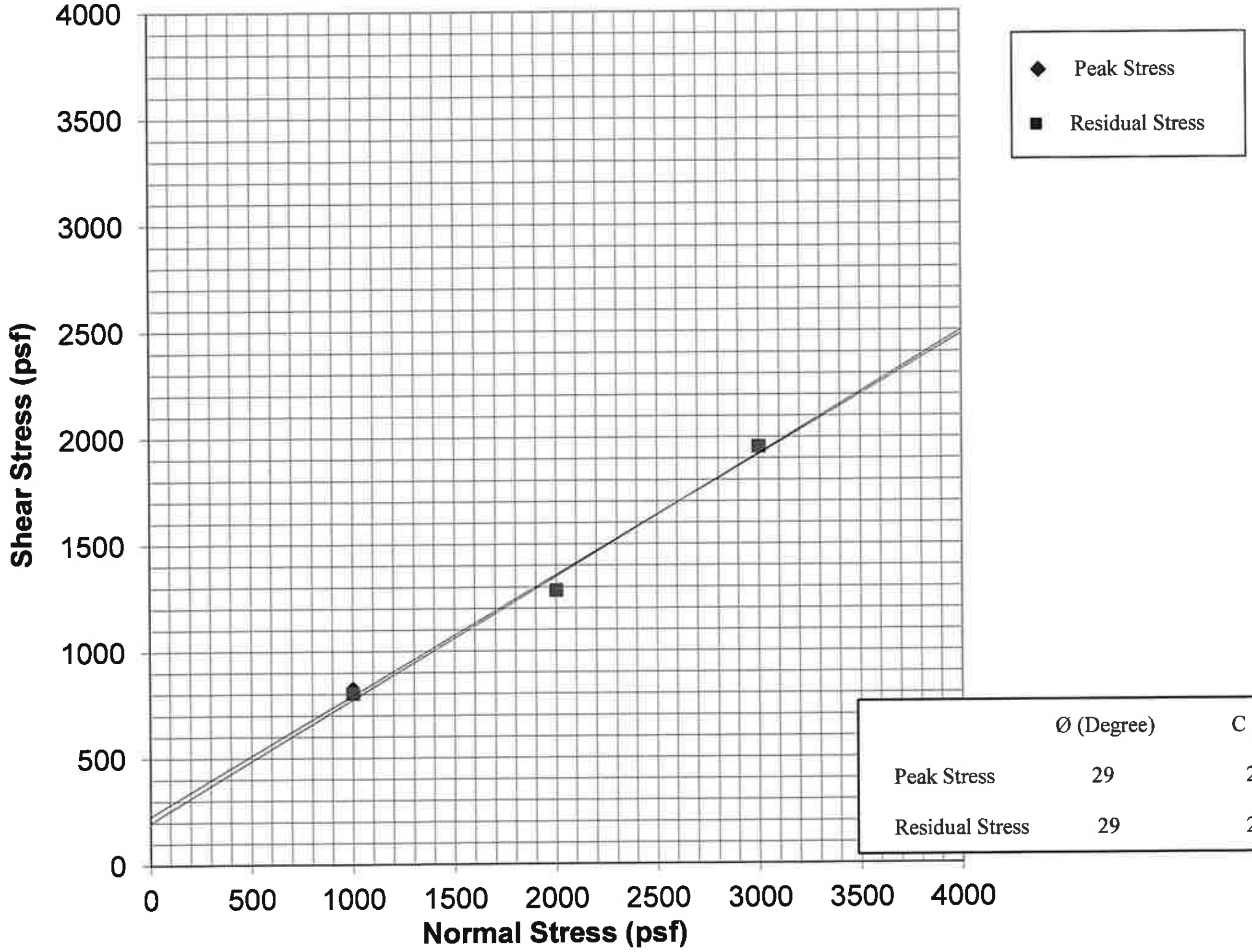
R-VALUE BY EXUDATION PRESSURE:	16
R-VALUE BY EXPANSION PRESSURE:	N.A.
EXPANSION PRESSURE AT 300 PSI EXUDATION:	52
TRAFFIC INDEX (Assumed):	5.5
GRAVEL FACTOR (Assumed):	1.5
UNIT MASS OF COVER MATERIAL, kg/m^3 (Assumed):	2100.0



Sample No.	T5@2'
Sample Type:	Undisturbed/Saturated
Soil Description:	Silty Clay

		1	2	3
Normal Stress	(psf)	1000	2000	3000
Peak Stress	(psf)	828	1284	1956
Displacement	(in)	0.150	0.175	0.250
Residual Stress	(psf)	804	1284	1956
Displacement	(in.)	0.250	0.250	0.250
In Situ Dry Density	(pcf)	117.2	117.2	117.2
In Situ Water Content	(%)	12.1	12.1	12.1
Saturated Water Content	(%)	16.1	16.1	16.1
Strain Rate	(in/min)	0.020	0.020	0.020





	Ø (Degree)	C (psf)
Peak Stress	29	230
Residual Stress	29	200

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SOILS AND GEOTECHNICAL CONSULTANTS

CDREP, LLC

PROJECT NUMBER: 21631-20 DATE: 1/30/2020

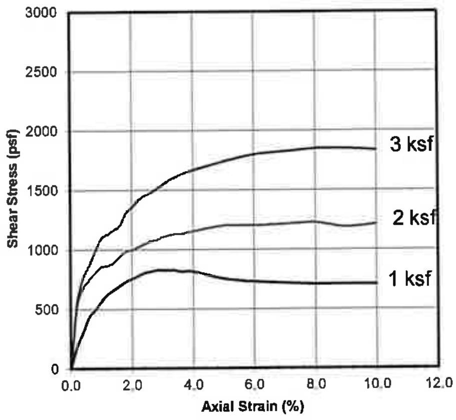
DIRECT SHEAR TEST

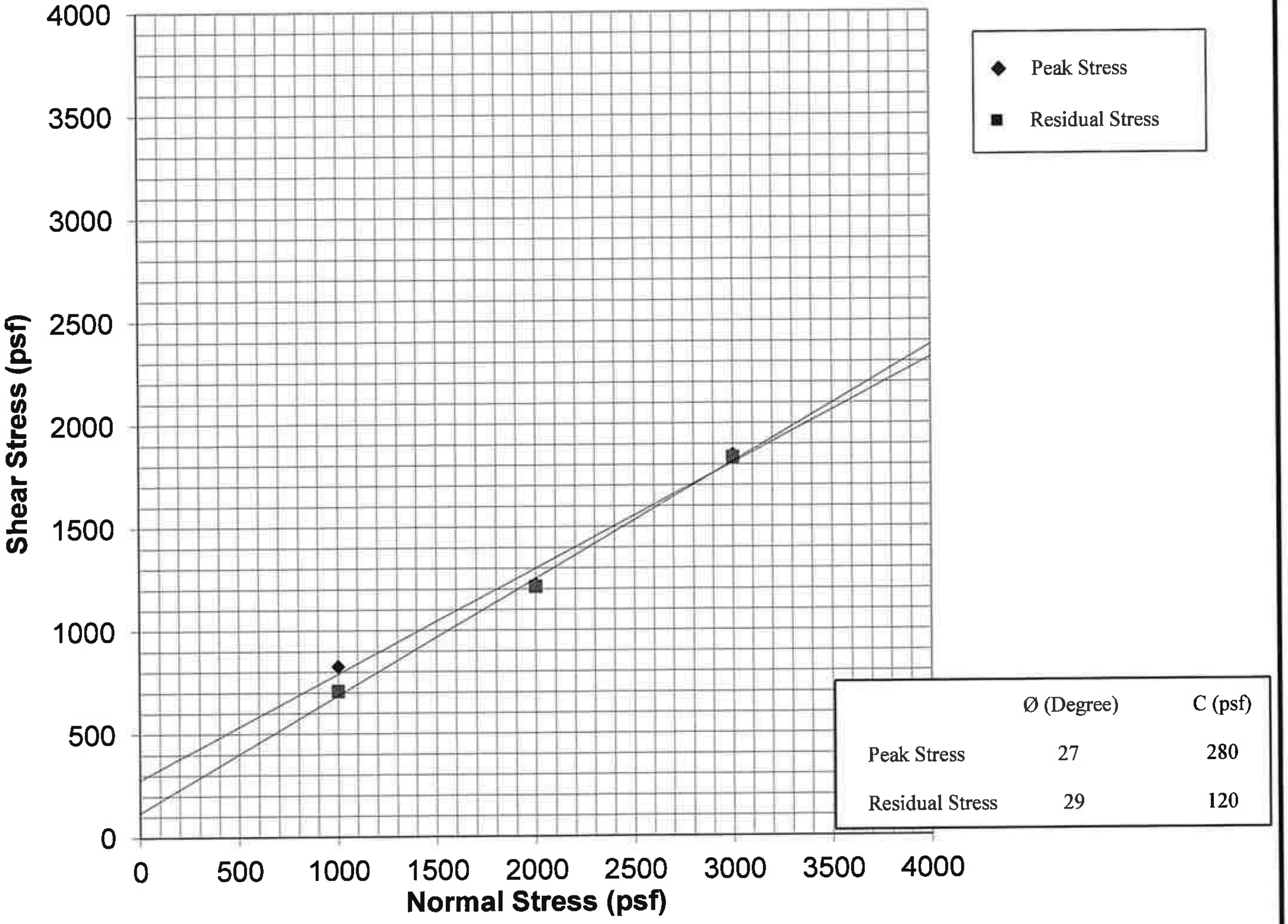
ASTM D3080

Plate A

Sample No. T9@2'
Sample Type: Undisturbed/Saturated
Soil Description: Silty Clay w/ Some Sand

		1	2	3
Normal Stress	(psf)	1000	2000	3000
Peak Stress	(psf)	828	1224	1848
Displacement	(in.)	0.070	0.200	0.200
Residual Stress	(psf)	708	1212	1836
Displacement	(in.)	0.250	0.250	0.250
In Situ Dry Density	(pcf)	115.5	115.5	115.5
In Situ Water Content	(%)	10.6	10.6	10.6
Saturated Water Content	(%)	16.9	16.9	16.9
Strain Rate	(in/min)	0.020	0.020	0.020





	Ø (Degree)	C (psf)
Peak Stress	27	280
Residual Stress	29	120

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SOILS AND GEOTECHNICAL CONSULTANTS

CDREP, LLC

PROJECT NUMBER: 21631-20 DATE: 1/30/2020

DIRECT SHEAR TEST

ASTM D3080

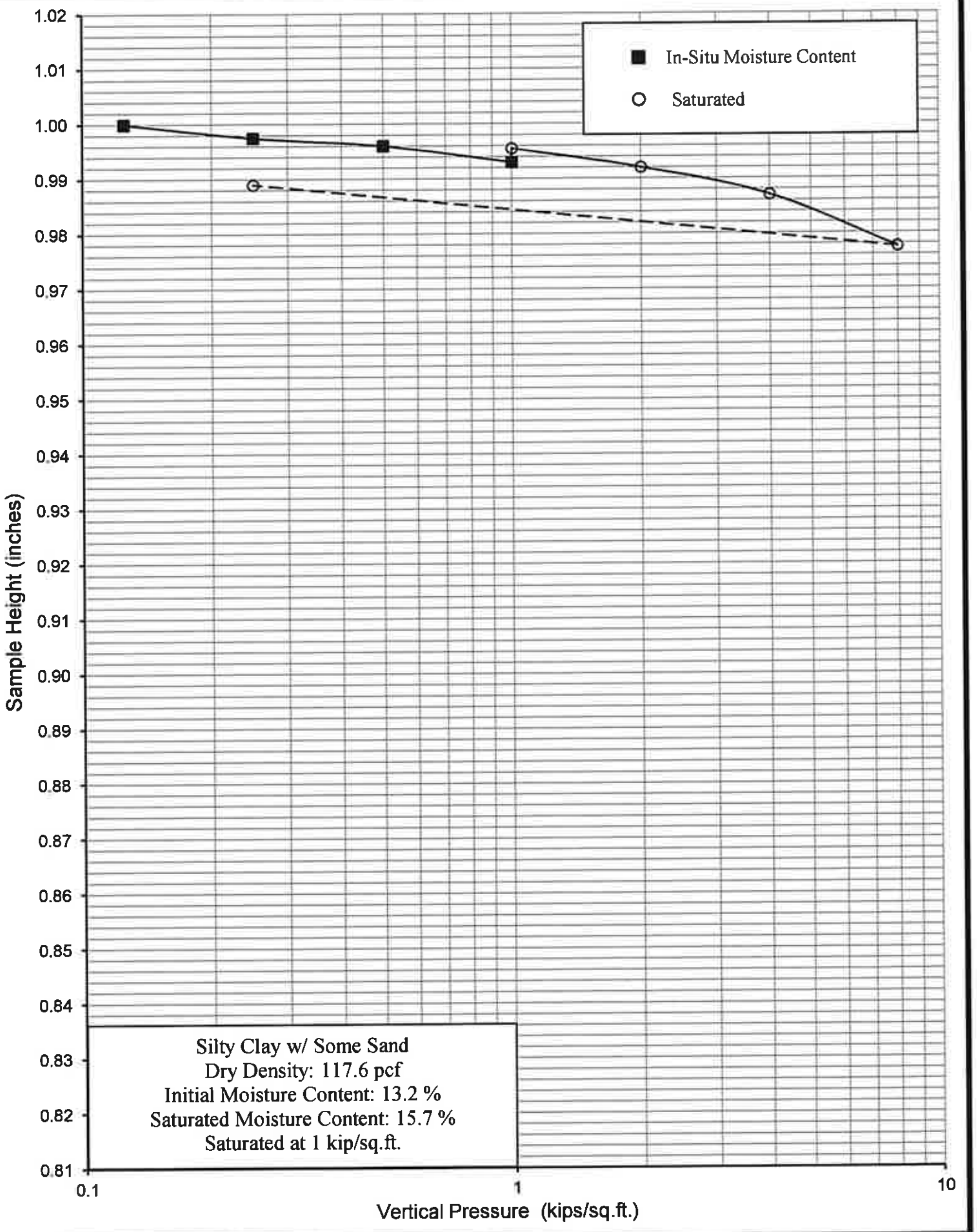
Plate B

Sample No. T4 | Depth 4' | Date 1/30/2020

Vertical Pressure (kips/sq.ft.)	Sample Height (inches)	Consolidation (percent)
0.125	1.0000	0.0
0.25	0.9975	0.2
0.5	0.9960	0.4
1	0.9930	0.7
1	0.9955	0.4
2	0.9920	0.8
4	0.9870	1.3
8	0.9775	2.3
0.25	0.9890	1.1

Saturated

Date Tested: 1/29/2020
Sample: T4
Depth: 4'



Silty Clay w/ Some Sand
Dry Density: 117.6 pcf
Initial Moisture Content: 13.2 %
Saturated Moisture Content: 15.7 %
Saturated at 1 kip/sq.ft.

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SOILS AND GEOTECHNICAL CONSULTANTS

CDREP, LLC

PROJECT NUMBER: 21631-20 DATE: 1/30/2020

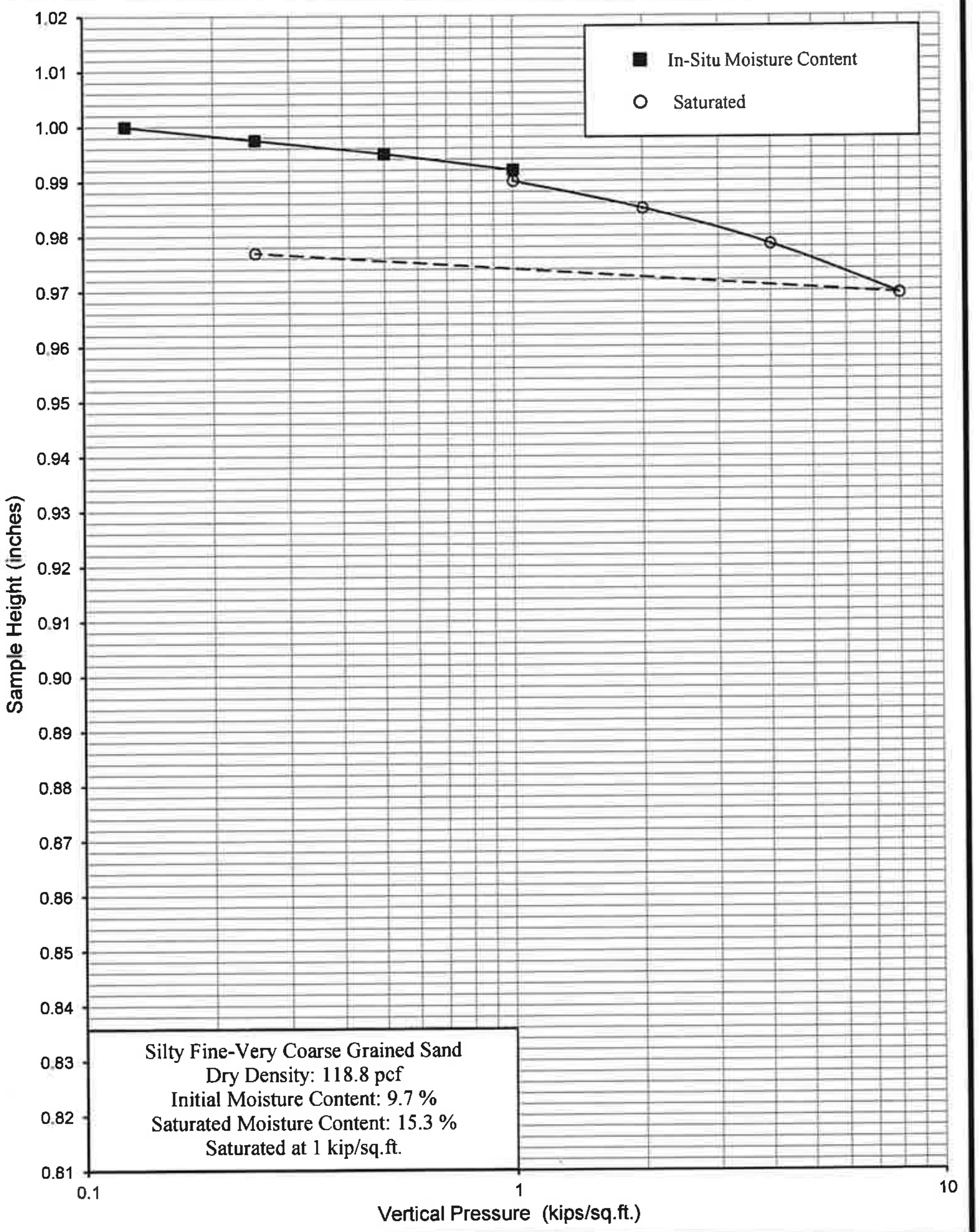
CONSOLIDATION TEST
ASTM D2435
Plate C

Vertical Pressure (kips/sq.ft.)	Sample Height (inches)	Consolidation (percent)	Sample No.	T4	Depth	8'	Date	1/30/2020

0.125	1.0000	0.0
0.25	0.9975	0.2
0.5	0.9950	0.5
1	0.9920	0.8
1	0.9900	1.0
2	0.9850	1.5
4	0.9785	2.2
8	0.9695	3.1
0.25	0.9770	2.3

Saturated

Date Tested: 1/29/2020
Sample: T4
Depth: 8'



Silty Fine-Very Coarse Grained Sand
Dry Density: 118.8 pcf
Initial Moisture Content: 9.7 %
Saturated Moisture Content: 15.3 %
Saturated at 1 kip/sq.ft.

NorCal Engineering

SOILS AND GEOTECHNICAL CONSULTANTS

CDREP, LLC

PROJECT NUMBER: 21631-20 DATE: 1/30/2020

CONSOLIDATION TEST

ASTM D2435

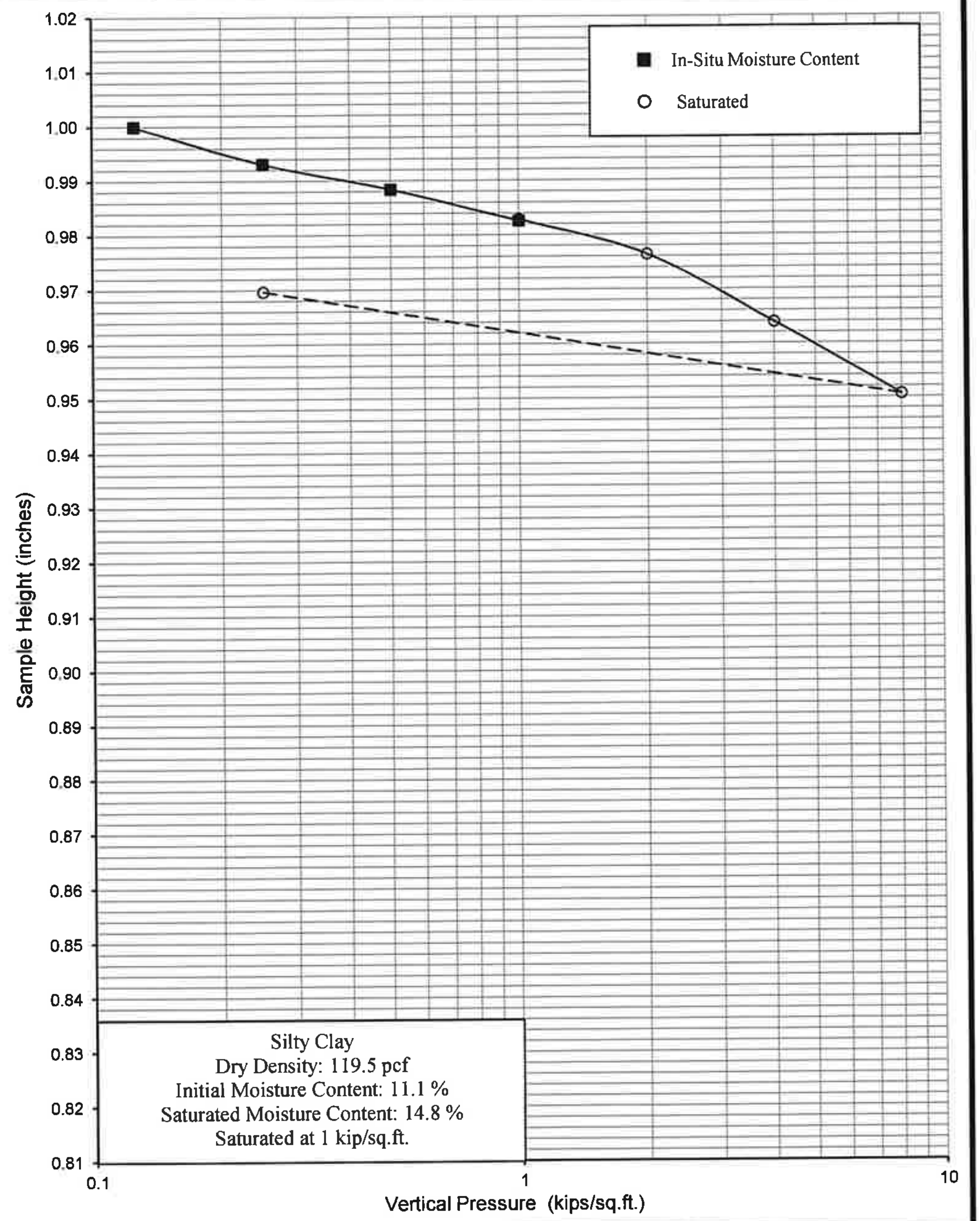
Plate D

Vertical Pressure (kips/sq.ft.)	Sample Height (inches)	Consolidation (percent)	Sample No.	T9	Depth	5'	Date	1/30/2020

Vertical Pressure (kips/sq.ft.)	Sample Height (inches)	Consolidation (percent)
0.125	1.0000	0.0
0.25	0.9931	0.7
0.5	0.9884	1.2
1	0.9826	1.7
1	0.9829	1.7
2	0.9764	2.4
4	0.9639	3.6
8	0.9506	4.9
0.25	0.9697	3.0

Saturated

Date Tested: 1/29/2020
Sample: T9
Depth: 5'



Silty Clay
Dry Density: 119.5 pcf
Initial Moisture Content: 11.1 %
Saturated Moisture Content: 14.8 %
Saturated at 1 kip/sq.ft.

NorCal Engineering

SOILS AND GEOTECHNICAL CONSULTANTS

CDREP, LLC

PROJECT NUMBER: 21631-20 DATE: 1/30/2020

CONSOLIDATION TEST

ASTM D2435

Plate E

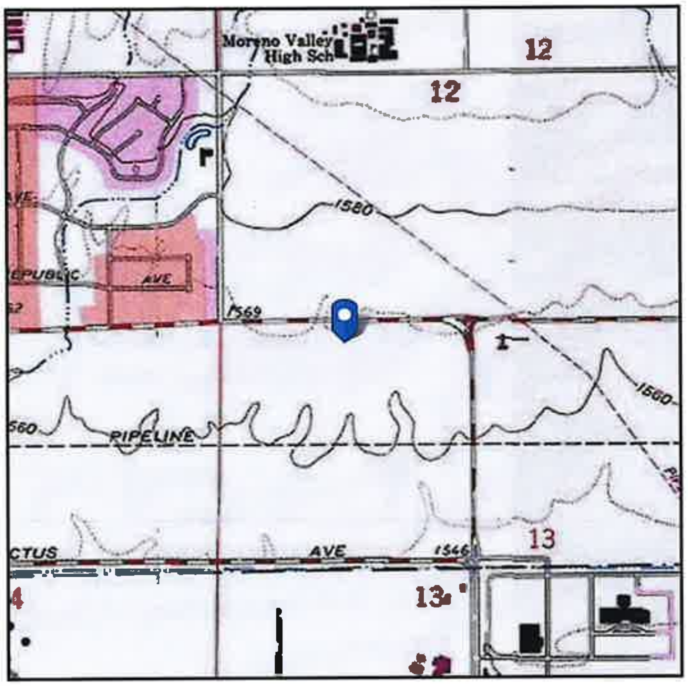
Appendix C

ASCE 7 Hazards Report

Address:
No Address at This Location

Standard: ASCE/SEI 7-16
Risk Category: III
Soil Class: D - Stiff Soil

Elevation: 1570.6 ft (NAVD 88)
Latitude: 33.916457
Longitude: -117.256778



Seismic

Site Soil Class: D - Stiff Soil

Results:

S_S :	1.5	S_{D1} :	N/A
S_1 :	0.6	T_L :	8
F_a :	1	PGA :	0.612
F_v :	N/A	PGA_M :	0.674
S_{MS} :	1.5	F_{PGA} :	1.1
S_{M1} :	N/A	I_e :	1.25
S_{DS} :	1	C_v :	1.4

Ground motion hazard analysis may be required. See ASCE/SEI 7-16 Section 11.4.8.

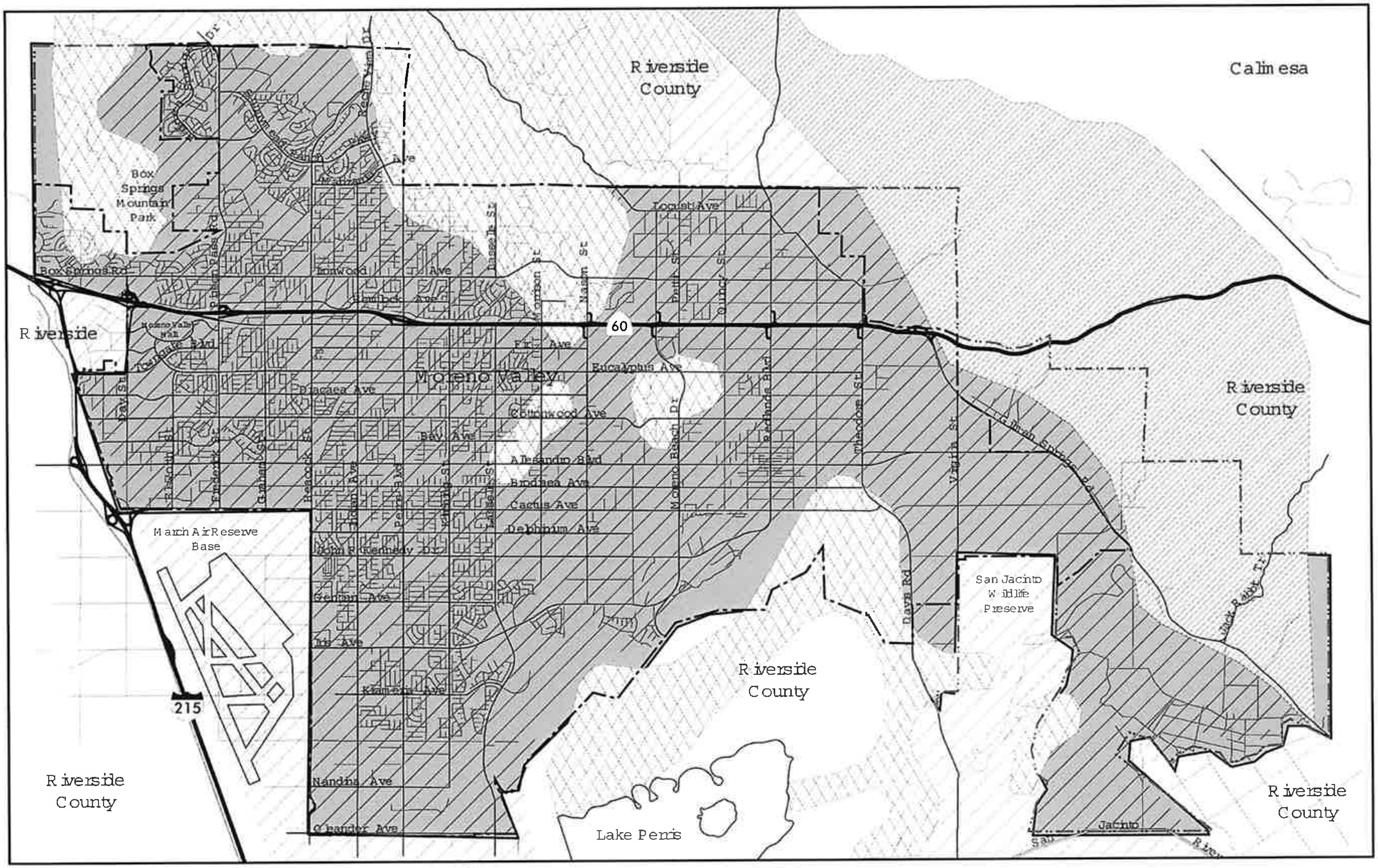
Data Accessed: Tue Jan 28 2020

Date Source: USGS Seismic Design Maps

The ASCE 7 Hazard Tool is provided for your convenience, for informational purposes only, and is provided "as is" and without warranties of any kind. The location data included herein has been obtained from information developed, produced, and maintained by third party providers; or has been extrapolated from maps incorporated in the ASCE 7 standard. While ASCE has made every effort to use data obtained from reliable sources or methodologies, ASCE does not make any representations or warranties as to the accuracy, completeness, reliability, currency, or quality of any data provided herein. Any third-party links provided by this Tool should not be construed as an endorsement, affiliation, relationship, or sponsorship of such third-party content by or from ASCE.

ASCE does not intend, nor should anyone interpret, the results provided by this Tool to replace the sound judgment of a competent professional, having knowledge and experience in the appropriate field(s) of practice, nor to substitute for the standard of care required of such professionals in interpreting and applying the contents of this Tool or the ASCE 7 standard.

In using this Tool, you expressly assume all risks associated with your use. Under no circumstances shall ASCE or its officers, directors, employees, members, affiliates, or agents be liable to you or any other person for any direct, indirect, special, incidental, or consequential damages arising from or related to your use of, or reliance on, the Tool or any information obtained therein. To the fullest extent permitted by law, you agree to release and hold harmless ASCE from any and all liability of any nature arising out of or resulting from any use of data provided by the ASCE 7 Hazard Tool.



Source: *Generalized Geologic Map of Part of the Northern Peninsular Ranges, 1985.* University of California Riverside, Campus Museum Contributions No. 1, page 64.

Note: This map is not a substitute for detailed Alquist-Priolo Special Studies Maps or Riverside County Hazard Management Zone Maps. For Accurate sitings refer to California State and Riverside County Geologists.

▨ Perris Bedrock

▨ Quarternary Alluvium

☐ Semi Consolidated Sandstone, Siltstone and beds of gravel

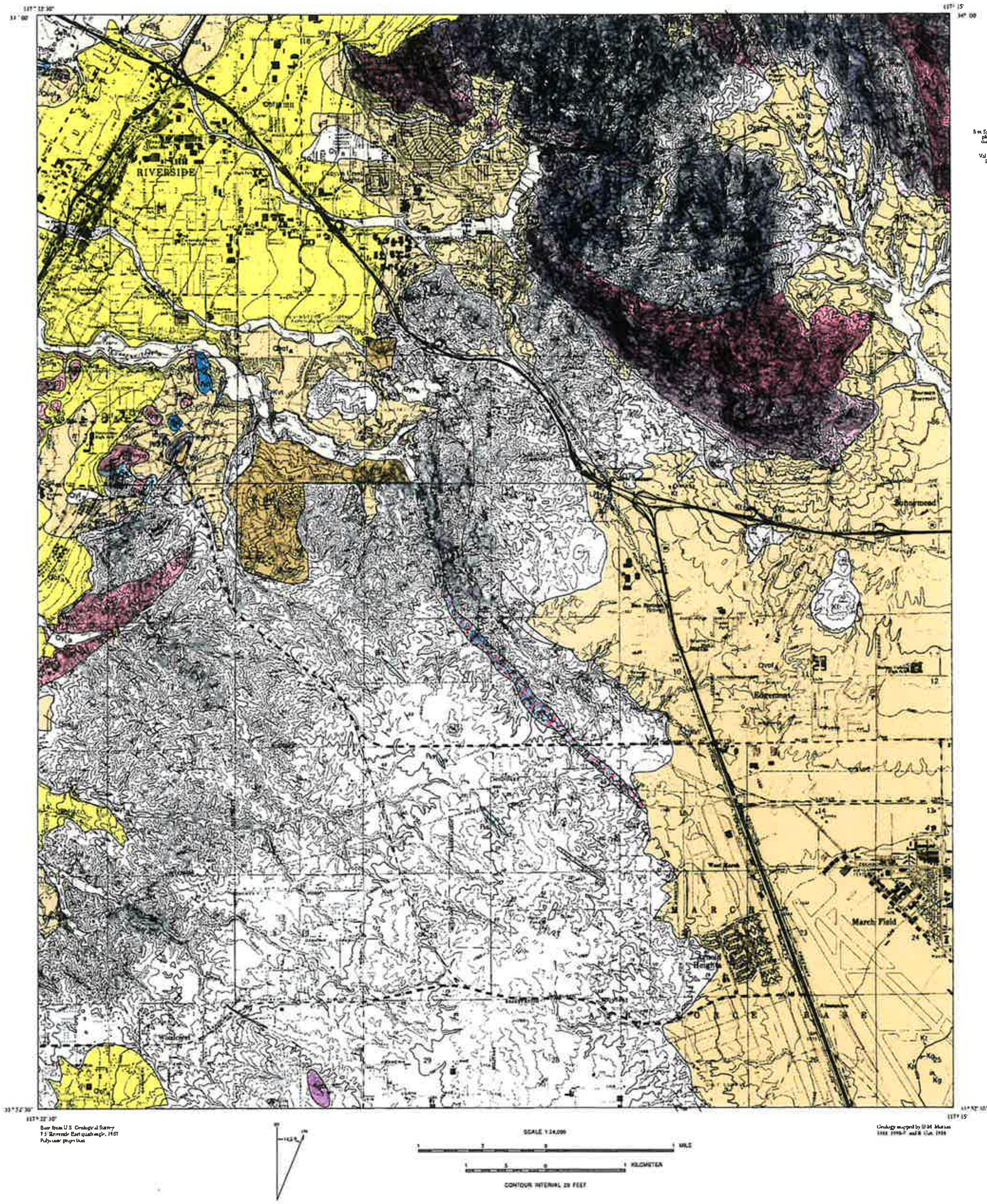
▨ Granite Rocks of the Southern California Batholith

Figure 5.6-1
Geology

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

Prepared in cooperation with the
CALIFORNIA DIVISION OF MINES AND GEOLOGY
and
UNITED STATES AIR FORCE

OPEN-FILE REPORT 01-452



Base from U.S. Geological Survey
7.5' Riverside East quadrangle, 1967
Polyconic projection

Geology mapped by D.M. Morton
1988, 1998-9 and B. Cox, 1998

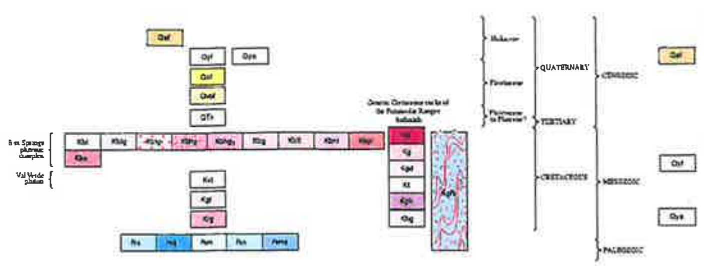
GEOLOGIC MAP OF THE RIVERSIDE EAST 7.5' QUADRANGLE, RIVERSIDE COUNTY, CALIFORNIA

Version 1.0

By

Douglas M. Morton[1] and Brett Cox[2]

CORRELATION OF MAP UNITS



On some SCAMP geologic map plots, including the Riverside East 7.5' quadrangle, characteristic grain size information is displayed using subscripted alpha characters (e.g. Qyf_g, Qor_s), where the characters conform to the following definitions:

- a - arenaceous (very coarse sand through very fine sand)
- b - boulder gravel (>25mm)
- g - gravel (cobble through granule gravel)
- s - silty
- c - clayey
- m - marl
- p - peat

In the Description of Map Units, the Ma following U/Pb ages has an attached subscript, Ma_d for isotope dilution analyses, and Ma_p for ion probe analyses.

Contact—Generally located within ±15 meters

Fault—High angle. Strike-slip component on all faults is right-lateral; dip-slip component is unknown, but probably reflects valley-highland relations. Dashed where located within ±30 meters; dotted where concealed. Arrow and number indicate measured dip of fault plane that was exposed in trench.

Strike and dip of igneous foliation

- Inclined
- Vertical

Strike and dip of metamorphic foliation

- Inclined
- Vertical

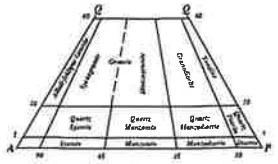
Strike and dip of joints in igneous rocks

- Inclined
- Vertical

Bearing and plunge of linear features

- Inclined

SURROUNDING 7.5' QUADRANGLES



Classification of plutonic rock types (from IUGA, 1973, and Streckeisen, 1973). A, alkali feldspar; P, plagioclase feldspar; Q, quartz

This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards or with the North American Stratigraphic Code. Any use of trade, firm, or product names in this publication is for descriptive purposes only and does not imply endorsement by the U.S. Government.

This map was printed on an electronic plotter directly from digital files. Dimensional calibration may vary between electronic plotters and between X and Y directions on the same plotter, and paper may change size due to atmospheric conditions; therefore, scale and proportions may not be true on plots of this map.

Digital files available on World Wide Web at http://geopubs.wr.usgs.gov

DESCRIPTION OF MAP UNITS

VERY YOUNG SURFICIAL DEPOSITS—Sediment recently transported and deposited in channels and washes, on surfaces of alluvial fans and alluvial plains, and on hillslopes. Soil-profile development is non-existent. Includes:

Qaf **Artificial fill (late Holocene)**—Deposits of fill resulting from human construction or mining activities; restricted to large area of regrading related to residential development in west central part of quadrangle and several smaller areas nearby

YOUNG SURFICIAL DEPOSITS—Sedimentary units that are slightly consolidated to cemented and slightly to moderately dissected. Alluvial fan deposits (Qyf series) typically have high coarse:fine clast ratios. Younger surficial units have upper surfaces that are capped by slight to moderately developed pedogenic-soil profiles (A/C to $A/AC/B_{cambric}C_{ox}$ profiles). Includes:

Qyf **Young alluvial fan deposits (Holocene and late Pleistocene)**—Gray-hued sand and cobble- and gravel-sand deposits derived chiefly from rocks of Peninsular Ranges batholith. Found in restricted drainages along west edge of quadrangle, but contiguous with much more extensively developed deposits west of quadrangle

Qya **Young axial channel deposits (Holocene and late Pleistocene)**—Gray, unconsolidated alluvium consisting of medium- to fine-grained sand and lesser silt flooring several low relief valleys and their tributaries in northwestern and northeastern part of quadrangle. Includes sediments in Tequesquite Arroyo and Pigeon Pass Valley

OLD SURFICIAL DEPOSITS—Sedimentary units that are moderately consolidated and slightly to moderately dissected. Older surficial deposits have upper surfaces that are capped by moderately to well-developed pedogenic soils ($A/AB/B/C_{ox}$ profiles and Bt horizons as much as 1 to 2 m thick and maximum hues in the range of 10YR 5/4 and 6/4 through 7.5YR 6/4 to 4/4 and mature Bt horizons reaching 5YR 5/6). Includes:

Qof **Old alluvial fan deposits (late to middle Pleistocene)**—Indurated, sandy alluvial fan deposits developed extensively in western part of quadrangle. Most of unit is slightly to moderately dissected and reddish-brown. Some Qof includes thin, discontinuous surface layer of Holocene alluvial fan material

VERY OLD SURFICIAL DEPOSITS—Sediments that are slightly to well consolidated to indurated, and moderately to well dissected. Upper surfaces are capped by moderate to well developed pedogenic soils ($A/AB/B/C_{ox}$ profiles having Bt horizons as much as 2 to 3 m thick and maximum hues in the range 7.5YR 6/4 and 4/4 to 2.5YR 5/6)

Qvof **Very old alluvial fan deposits (early Pleistocene)**—Mostly well-dissected, well-indurated, reddish-brown sand deposits. Commonly contains duripans and locally silcretes. Forms large area in southeastern part of quadrangle in area of March Air Force Base, and numerous smaller areas in northern part of quadrangle. Derived chiefly from rocks of southern California batholith

QTs **Unnamed late Cenozoic sedimentary rocks in Riverside and Corona areas (early Pleistocene to late Pliocene?)**—Lithologically diverse, moderately indurated, gray to brown, coarse-grained sandstone, pebbly sandstone, and conglomerate. Restricted to two small areas near southeast end of Box Springs Canyon. In the Riverside West 7.5' quadrangle, most clasts in unit were derived from San Bernardino Mountains. In Riverside East 7.5' quadrangle, appears to be derived from units found in Santa Ana River drainage. Southeast of Riverside clasts are locally derived from Peninsular Ranges sources

Box Springs plutonic complex (Cretaceous)—Box Springs plutonic complex is an elliptical, horizontally-floored basin-shaped granitic complex centered on Box Springs Mountains, apparently lower part of granitic diapir. Layering and foliation in granitic rocks is primary. Complex consists of essentially massive to indistinctly primary layered biotite tonalite in core, surrounded by layer of foliated biotite granodiorite to tonalite. Further outward in complex is discontinuous layer of foliated, heterogeneous, porphyritic granodiorite, succeeded by uniform porphyritic granodiorite. Other compositionally and texturally diverse granitic rocks also occur within complex, but in relatively small amounts. All rocks of complex were included in Perris quartz diorite by Dudley (1935) and in Bonsall tonalite by Larsen (1948). Except for dike rocks, units are described in general order from core outward. Includes:

Kbt **Biotite tonalite**—Massive, fine- to medium-grained, equigranular biotite tonalite. Much has faintly to moderately developed, very regular compositional layering. Rocks contain about 35 to 40 percent quartz and 6 to 12 percent biotite. Hornblende is absent and potassium feldspar ranges from 1 to 4 percent. Mineral alignment is poorly developed or absent, but much of rock has incipient to well-developed primary layering defined by mineral concentrations. Unit contains sparse equant- to elliptical-shaped, fine-grained, mesocratic inclusions; some have relatively mafic rims. Inclusions tend to be aligned parallel to compositional layering. Zircon ages of rock are 98.6 Ma_d and 100.4 Ma_p

Kbfg **Biotite granodiorite and tonalite**—Light gray, medium- to coarse-grained, foliated biotite granodiorite and tonalite. Contains 25 to 35 percent quartz, 8 to 15 percent biotite, and minor hornblende. Potassium feldspar occurs as small interstitial grains and sparse, subhedral phenocrysts up to 1.5 cm in diameter. Potassium feldspar content appears to decrease progressively inward, tonalite most abundant in inner part. Mesocratic discoidal inclusions oriented parallel to foliation are common, but not abundant. Grades into biotite tonalite unit (Kbt)

Kbfgi **Biotite granodiorite and tonalite containing abundant inclusions**—Biotite granodiorite and tonalite that contains abundant discoidal, mafic inclusions; restricted to east side of complex

Kbhg **Heterogeneous porphyritic granodiorite**—Heterogeneous porphyritic granodiorite and subordinate tonalite. In most places surrounds biotite granodiorite and tonalite unit (Kbfg). Pinches out along west side of complex. Medium- to coarse-grained, light gray, foliated, and porphyritic. Quartz ranges from 25 to 35 percent; mafic minerals, biotite and subordinate hornblende, from 10 to 15 percent. Mafic minerals unevenly distributed imparting heterogeneous appearance to rock. Subhedral potassium feldspar crystals are up to 2.5 cm in length. Widespread discoidal mesocratic inclusions oriented parallel to foliation. Cut by numerous dikes of leucocratic granite and pegmatite

Kbhgl **Layered heterogeneous porphyritic granodiorite**—Heterogeneous porphyritic granodiorite having pronounced layering that is defined chiefly by variations in grain size. Restricted to single mass west of Sugarloaf Mtn in north-central part of quadrangle

Kbg **Porphyritic granodiorite**—Coarse-grained, light gray, foliated, porphyritic biotite granodiorite and subordinate tonalite. In most places grades into heterogeneous porphyritic granodiorite unit (Kbhg). Groundmass is plagioclase, quartz (30 to 40 percent), and mafic minerals (5 to 10 percent). Mafic minerals are biotite and sparse hornblende, which are more evenly distributed than in heterogeneous granodiorite (Kbhg). Subhedral potassium feldspar phenocrysts are up to 2.5 cm in length. Discoidal mesocratic inclusions are oriented parallel to foliation

Kbt **Biotite-hornblende tonalite**—Light to medium gray, medium- to coarse-grained, foliated tonalite. Forms discontinuous, pod-shaped masses surrounding, but not in contact with, biotite tonalite (Kbt). Contains 20 to 25 percent quartz and about 25 percent biotite and hornblende in subequal amounts. Hornblende and biotite occur as ragged crystals. Potassium feldspar present, but very sparse. Anhedral, interstitial sphene is conspicuous accessory mineral. Contains abundant, fine-grained, mesocratic, ellipsoidal- to discoidal-shaped mafic inclusions aligned parallel to foliation

Kbht **Heterogeneous biotite tonalite**—Light-gray, inequigranular, medium- to coarse-grained, foliated biotite tonalite; restricted to northwestern Box Springs Mountains. Leucocratic, containing 1 to 4 percent biotite, which occurs as thin, subhedral plates, irregularly concentrated and aligned to produce wispy, swirled foliation. Leucocratic tonalite encloses pods and lenses of tonalite containing about 15 percent biotite as large ragged plates. Both types of tonalite contain abundant quartz (30 to 40 percent) and very sparse potassium feldspar (1 percent or less). Contains dispersed mesocratic discoidal inclusions. Granitic pegmatite dikes are abundant

Kbgt **Heterogeneous granodiorite and tonalite**—Light- to medium-gray, medium- to coarse-grained, texturally heterogeneous, foliated, hornblende-biotite tonalite and granodiorite; restricted to northern Box Springs Mountains near Pigeon Pass. Common discoidal, mesocratic inclusions oriented parallel to foliation

Kba **Amphibolitic gabbro**—Dark-gray to black, fine- to medium-grained, foliated, hornblende-rich amphibolitic gabbro forming lenses and elongate masses within biotite granodiorite and tonalite (Kbfg). Foliation is parallel to foliation in that unit

Val Verde pluton (Cretaceous)—Relatively uniform pluton composed of biotite-hornblende tonalite. Termed Perris quartz diorite by Dudley (1935), Val Verde tonalite by Osborn (1939), and included within Bonsall tonalite by Larsen (1948). Name Val Verde adopted by Morton (1999) based on detailed study of Osborn (1939) near Val Verde, a former settlement and railway siding midway between Perris and Riverside. Apparently steep-walled Val Verde pluton is eroded to mid-pluton level. Emplacement age of the pluton is 105.7 Ma_d. $^{40}Ar/^{39}Ar$ age of hornblende is 100 Ma, biotite 95 Ma and potassium feldspar 89.5 Ma. Includes:

Kvt **Val Verde tonalite**—Gray-weathering, relatively homogeneous, massive- to well-foliated, medium- to coarse-grained, hypautomorphic-granular biotite-hornblende tonalite; principal rock type of Val Verde pluton. Contains subequal biotite and hornblende, quartz and plagioclase. Potassium feldspar generally less than two percent of rock. Where present, foliation typically strikes northwest and dips moderately to steeply northeast. Northern part of pluton contains younger, intermittently developed, northeast-striking foliation. In central part of pluton, tonalite is mostly massive, and contains few segregational masses of mesocratic to melanocratic tonalite. Elliptical- to pancake-shaped, meso-to melanocratic inclusions are common.

Krg **Granite of the Riverside area (Cretaceous)**—Medium- to coarse-grained, massive- to faintly-foliated, leucocratic biotite granite. Contains about 1 to 3 percent biotite. Inclusions are sparse or absent except locally in western part of body, west of quadrangle, where rock contains 2 to 8 percent biotite and sparse to abundant inclusions of quartz diorite, granodiorite, and fine-grained mafic rock. At Mount Rubidoux, west of quadrangle, rocks contain sparse hypersthene and fayalitic olivine and moderately abundant equant inclusions of dark-gray fine-grained rock

Generic Cretaceous granitic rocks of the Peninsular Ranges batholith

Kp **Granitic pegmatite dikes (Cretaceous)**—Leucocratic, mostly tabular, pegmatitic-textured granitic dikes. Most dikes range in thickness from a few centimeters to over a meter. Larger dikes are typically zoned compositionally and texturally, having a border and wall zone consisting of coarse-grained biotite, quartz, and alkali feldspars. Intermediate zone consists of large to giant crystals of quartz and alkali feldspars, and commonly contain muscovite, schorl and garnet. Core zone consists of quartz and alkali feldspars. Line-rock layering is rare

Kg **Granitic dikes (Cretaceous)**—Includes texturally diverse group of leucocratic granitic dikes composed mainly of quartz and alkali feldspars. Dikes range in thickness from few centimeters to over a meter and are up to several hundred meters in length. Most are tabular, some are texturally and compositionally unzoned, irregular-shaped bodies. Some dike rock has a foliated or gneissoid fabric. Textures are mostly coarse grained and equigranular granitic, but range from aplitic to pegmatitic. Accessory minerals include biotite, muscovite, and garnet

Kgd **Granodiorite, undifferentiated (Cretaceous)**—Intermediate composition granitic rocks, mainly biotite-hornblende and biotite granodiorite; most is massive and medium grained. Restricted to single area just east of Sycamore Canyon

Kt **Tonalite, undifferentiated (Cretaceous)**—Mainly biotite-hornblende tonalite not associated with specific plutons. Gray, medium-grained, typically foliated. Forms relatively large mass on south side of Box Springs Mountains

Kgb **Gabbro (Cretaceous)**—Mainly hornblende gabbro. Typically brown-weathering, medium-to very coarse-grained hornblende gabbro. Very large poikilitic hornblende crystals in some rocks; locally pegmatitic. Commonly heterogeneous in composition and texture. Includes noritic and dioritic composition rocks. Exposed in southern part of quadrangle and as small masses in biotite granodiorite and tonalite (Kbfg)

Khg **Heterogeneous granitic rocks (Cretaceous)**—Includes heterogeneous compositionally diverse granitic rocks mostly of tonalite and granodiorite composition, but includes some monzogranite and gabbro. Mapped in and east of Sycamore Canyon, and near west edge of quadrangle

End rocks of Peninsular Ranges batholith

Intermixed Paleozoic(?) schist and gneiss and Cretaceous granitic rocks (Cretaceous and Paleozoic?)—Intermixed Paleozoic(?) schist and gneiss and Cretaceous granitic rocks, mostly tonalite and granodiorite. Forms elongate mass within Val Verde tonalite (Kvt) west of Sycamore Canyon and small mass south of Tequesquite Arroyo

Pzs **Biotite Schist (Paleozoic?)**—Medium-to dark-gray, fine-grained biotite schist and biotite-quartz-feldspar schist. Locally contains sillimanite and andalusite. Commonly includes minor amounts of quartzite and calc-silicate hornfels. Limited exposures in hills south of Tequesquite Arroyo, and as pendants in Val Verde tonalite

Pzq **Impure quartzite (Paleozoic?)**—Quartzite, impure, light-gray to light-greenish-gray, fine-to medium-grained, layered to massive. Limited exposures in hills south of Tequesquite Arroyo

Pzm **Marble (Paleozoic?)**—Marble, white to light-gray, locally bluish-gray and blue, coarse to extremely coarse grained

Pzc **Calc-silicate rocks (Paleozoic?)**—Heterogeneous, massive to well-layered calc-silicate rocks

Pzms **Marble and schist, undifferentiated (Paleozoic?)**—Intermixed marble, calc-silicate rock, and biotite schist. Mapped on North Hill in northwestern part of quadrangle

GEOLOGIC SUMMARY

The Riverside East quadrangle is located in the northern part of the Peninsular Ranges Province within the central part of the Perris block, a relatively stable, rectangular in plan area located between the Elsinore and San Jacinto fault zones.

The quadrangle is underlain predominantly by Cretaceous plutonic rocks which are part of the composite Peninsular Ranges batholith. Within the quadrangle, the batholithic rocks represent a wide variety of mafic to intermediate composition granitic rocks ranging in composition from monzogranite to gabbro, but tonalite predominates. Most of the granitic rocks are faintly to intensely foliated. Many are heterogeneous and contain varying amounts of meso-and melanocratic discoidal-shaped inclusions. Some rock is composed almost wholly of inclusion material and some are migmatitic. Included within these granitic rocks are a few septa of Paleozoic(?) biotite schist, marble, and calc-silicate rock of upper amphibolite metamorphic grade.

Metamorphic rocks of Paleozoic(?) age occur primarily in the northwest part of the quadrangle. These rocks include coarse-grained marble bodies that have been quarried in the past. North Hill, at the northwest corner of the quadrangle is the site of the 'Old City' quarry, where tonalite intrudes marble producing pyroxene-hornfels grade garnet-pyroxene skarn. South of Riverside several disconnected bodies of marble, impure quartzite, and calc-silicate rock were quarried at the 'New City' (Victoria Ave) quarry. There the thicker of the two marble bodies was quarried exposing skarn developed at a contact between the marble and intrusive biotite-hornblende tonalite. The composition of the skarn is highly varied and includes pyroxene-garnet, idocrase, scapolite-pyroxene, and magnetite-pargasite skarns.

Biotite-hornblende tonalite of the relatively large Val Verde pluton dominates the quadrangle west of Interstate 215. In most places this tonalite has a northwest oriented crude to well developed planar fabric produced by oriented biotite and hornblende. In the northern part of the pluton northeast striking planar fabric dominates. Schlieren and massive clots of mafic tonalite occur locally. Discoidal to pancake-shaped mafic inclusions are widespread and are oriented in the plane of the biotite and hornblende. Typically, the planar fabric dips moderately to the northeast, but is locally horizontal to subhorizontal or grades to an isotropic fabric.

Granitic rocks in the northeastern part of the quadrangle are part of the Box Springs plutonic complex. This composite intrusion is an elliptical, flat-floored granitic complex centered on the Box Springs Mountains. The exposed part of the complex is apparently the lowest part of a granitic diapir. In the center of the complex massive to indistinctly primarily layered biotite tonalite grades outward into well foliated biotite tonalite. Further outward the rocks are a heterogeneous assemblage of primarily granodioritic plutonic rocks.

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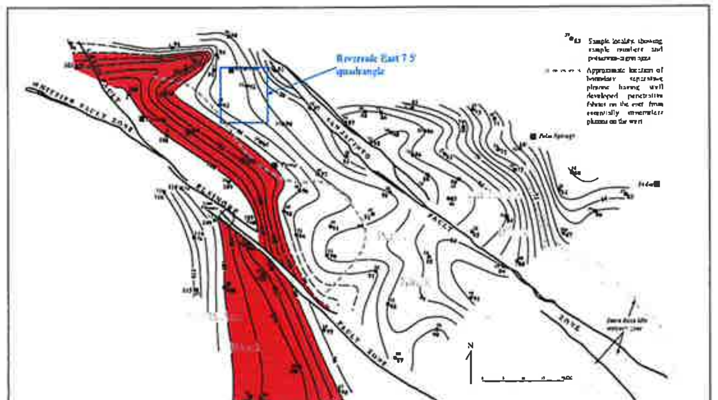
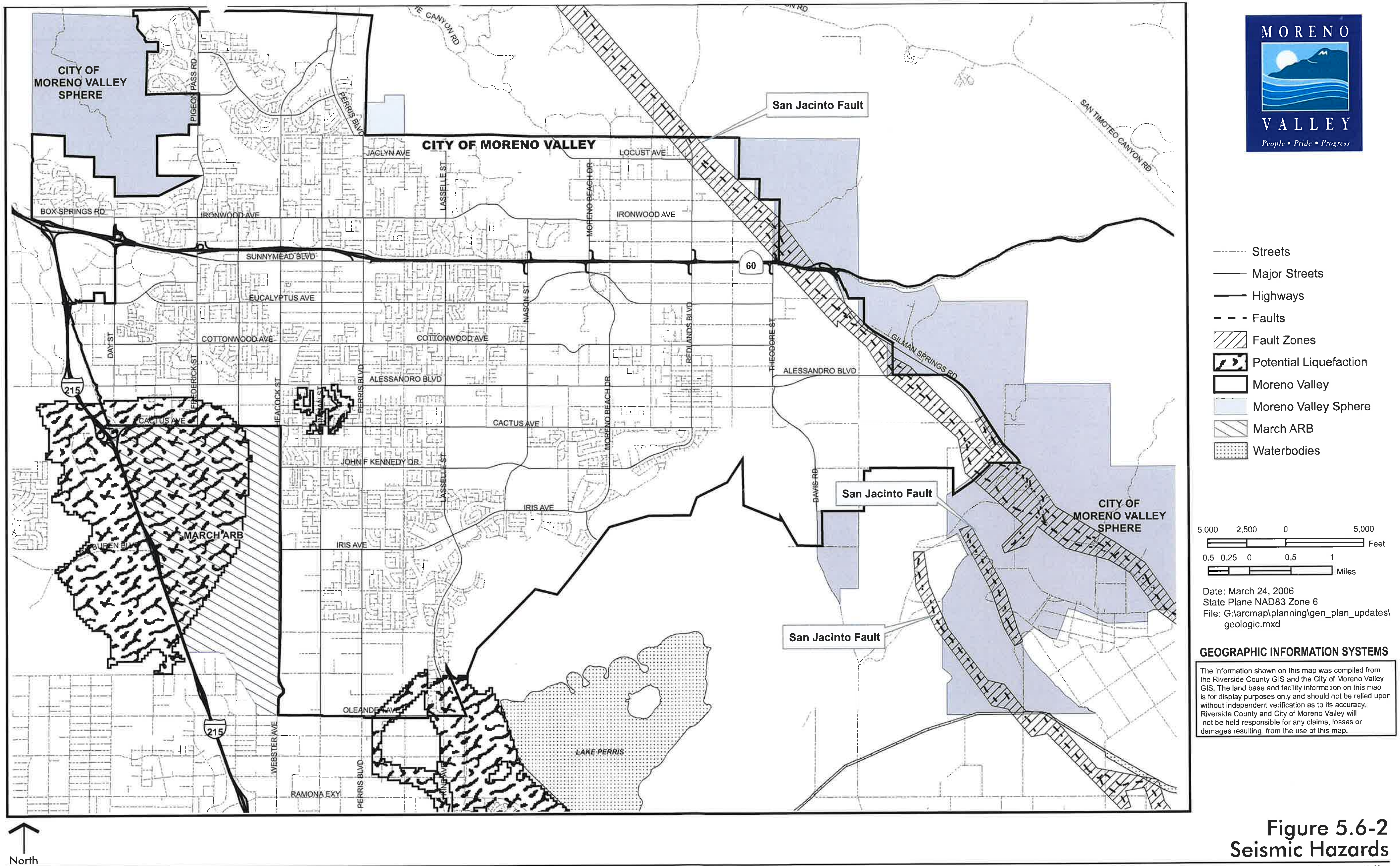


Sample locality showing sample numbers and potassium-argon ages

Approximate location of boundary separating plutons having well developed penetrative fabric on the east from essentially nonpenetrative plutons on the west

Location of Riverside East quadrangle relative to major structural blocks of the northern Peninsular Ranges batholith. Contoured potassium-argon biotite ages of Cretaceous granitic rocks are ... and are considered to reflect the cooling history of the batholith rather than representing ages of emplacement. Contouring of ages in each of the three structural blocks separated by the Elsinore and San Jacinto fault zones, was done independently of ages in adjacent blocks. Red band shows offset of 75 to 100 contours across Elsinore fault zone. Faults as shown are simplified from Rogers, 1965



Date: March 24, 2006
State Plane NAD83 Zone 6
File: G:\arcmap\planning\gen_plan_updates\geologic.mxd

GEOGRAPHIC INFORMATION SYSTEMS

The information shown on this map was compiled from the Riverside County GIS and the City of Moreno Valley GIS. The land base and facility information on this map is for display purposes only and should not be relied upon without independent verification as to its accuracy. Riverside County and City of Moreno Valley will not be held responsible for any claims, losses or damages resulting from the use of this map.

Figure 5.6-2
Seismic Hazards

Appendix D

Project: CDREP, LLC
Project No.: 21631-20
Date: 1/20/2020
Test No. 1
Depth: 5'
Tested By: J.S. Jr.

TIME (hr/min)	CHANGE TIME (min)	CUMULATIVE TIME (min)	INNER RING READING (cm)	INNER RING CHANGE	INNER RING FLOW (cc)	OUTER RING READING (cm)	OUTER RING CHANGE	OUTER RING FLOW (cc)	INNER RING INF RATE (cm/hr)	OUTER RING INF RATE (cm/hr)	INNER RING INF RATE (ft/hr)
7:10			105.3			46.4					
7:15	5	5	111.5	6.2		52.8	6.4				
7:15			100.3			41.2					
7:20	5	10	106.4	6.1		47.3	6.1				
7:20			102.6			43.5					
7:25	5	15	108.6	6.0		49.7	6.2				
7:25			103.2			44.2					
7:30	5	20	109.1	5.9		50.3	6.1				
7:30			104.4			45.1					
7:35	5	25	110.4	6.0		51.2	6.1				
7:35			104.1			44.3					
7:40	5	30	109.9	5.8		50.3	6.0				
7:40			103.8			43.9					
7:45	5	35	109.8	6.0		49.9	6.0		72.0	72.0	
7:45			104.3			45.5					
7:50	5	40	110.1	5.8		51.0	5.5		69.6	66.0	
7:50			103.6			44.7					
7:55	5	45	109.3	5.7		50.3	5.6		68.4	67.2	
7:55			103.3			44.1					
8:00	5	50	108.5	5.2		49.4	5.3		62.4	63.6	
8:00			103.1			44.2					
8:05	5	55	108.6	5.5		47.8	5.6		66.0	67.2	
8:05			102.9			43.2					
8:10	5	60	108.2	5.3		48.7	5.5		63.6	66.0	

Average = 67.0 / 67.0 cm/hr

Project: CDREP, LLC
Project No.: 21631-20
Date: 1/20/2020
Test No. 2
Depth: 7.5'
Tested By: J.S. Jr.

TIME (hr/min)	CHANGE TIME (min)	CUMULATIVE TIME (min)	INNER RING READING (cm)	INNER RING CHANGE	INNER RING FLOW (cc)	OUTER RING READING (cm)	OUTER RING CHANGE	OUTER RING FLOW (cc)	INNER RING INF RATE (cm/hr)	OUTER RING INF RATE (cm/hr)	INNER RING INF RATE (ft/hr)
8:15			73.0			45.6					
8:30	15	15	74.4	1.4		46.6	1.0				
8:30			74.4			46.6					
8:45	15	30	75.2	0.8		46.6	0.0				
8:45			75.2			46.6					
9:00	15	45	75.7	0.5		46.7	0.1				
9:00			75.7			46.7					
9:15	15	60	76.1	0.4		46.7	0.0				
9:15			76.1			46.7					
9:30	15	75	76.2	0.1		46.7	0.0				
9:30			76.2			46.7					
9:45	15	90	76.3	0.1		46.8	0.1		0.4	0.4	
9:45			76.3			46.8					
10:00	15	105	76.3	0.0		46.8	0.0		0.0	0.0	
10:00			76.3			46.8					
10:15	15	120	76.3	0.0		46.8	0.0		0.0	0.0	
10:15			76.3			46.8					
10:30	15	135	76.3	0.0		46.8	0.0		0.0	0.0	
10:30			76.3			46.8					
10:45	15	150	76.4	0.1		46.8	0.0		0.4	0.0	
10:45			76.4			46.8					
11:00	15	165	76.5	0.1		46.9	0.1		0.4	0.4	
11:00			76.5			46.9					
11:15	15	180	76.5	0.0		46.9	0.0		0.0	0.0	

Average = 0.17 / 0.11 cm/hr

NORCAL
ENGINEERING

SOILS AND GEOTECHNICAL CONSULTANTS

Project: CDREP, LLC
Project No.: 21631-20
Date: 1/20/2020
Test No. 3
Depth: 10'
Tested By: D.L.

TIME (hr/min)	CHANGE TIME (min)	CUMULATIVE TIME (min)	INNER RING READING (cm)	INNER RING CHANGE	INNER RING FLOW (cc)	OUTER RING READING (cm)	OUTER RING CHANGE	OUTER RING FLOW (cc)	INNER RING INF RATE (cm/hr)	OUTER RING INF RATE (cm/hr)	INNER RING INF RATE (ft/hr)
9:06			100.0			42.5					
9:16	10	10	101.2	1.2		46.4	3.9				
9:16			99.9			37.9					
9:26	10	20	100.5	0.6		39.2	1.3				
9:26			100.5			39.2					
9:36	10	30	101.0	0.5		40.3	1.1				
9:36			101.0			40.3					
9:46	10	40	101.7	0.7		41.4	1.1				
9:46			101.7			41.4					
9:56	10	50	102.1	0.4		42.1	0.7				
9:56			102.1			42.1					
10:06	10	60	102.6	0.5		42.8	0.7				
10:06			102.6			42.8					
10:16	10	70	102.8	0.2		43.5	0.7		1.2	4.2	
10:16			102.8			43.5					
10:26	10	80	103.0	0.2		44.5	1.0		1.2	6.0	
10:26			103.0			44.5					
10:36	10	90	103.4	0.4		45.2	0.7		2.4	4.2	
10:36			103.4			45.2					
10:46	10	100	103.8	0.4		45.7	0.5		2.4	3.0	
10:46			103.8			45.7					
10:56	10	110	104.2	0.4		46.3	0.6		2.4	3.6	
10:56			104.2			46.3					
11:06	10	120	104.4	0.2		46.7	0.4		1.2	2.4	

Average = 1.8 / 3.9 cm/hr

SITE LOCATION: ______
GEOTECHNICAL REPORT: ______
GEOLOGY REPORT: ______

DEPTH TO WATER TABLE = 30'
EARTHQUAKE MAGNITUDE = 7.0
PEAK GROUND ACCELERATION = 0.67g

DEPTH BELOW FINAL GRADE (FEET)	MOIST DENSITY (PCF)	σ_o TOTAL STRESS (PSF)	$\bar{\sigma}_o$ EFFECTIVE STRESS (PSF)	$\sigma_o/\bar{\sigma}_o$ (-)	r_d (-)	① $\tau_h/\bar{\sigma}_o$ (-)	N VALUE (BLOWS/FT)	RELATIVE DENSITY (%)	C_N (-)	C_E (-)	C_B (-)	C_R (-)	C_S (-)	$(N_1)_{60}$ (Blows/ft)	FINES (%)	CRR M=7.5	MSF (-)	CRR M=7.0	LIQ. F.S.
5	120	600	Same	1.00	0.99	0.44	>50	>90	>1.6	1.00	1.05	0.70	1.20	>70	21	>0.50	1.25	>0.63	>1.4
10	125	1225	↓	↓	0.96	0.42	36	↓	1.2	↓	↓	0.75	↓	41	47	↓	↓	↓	>1.5
15	130	1875			0.92	0.40	52		1.0			0.85		56	33				>1.6
20	↓	2525			0.87	0.38	30	85	0.9			0.90		31	14				>1.6
25		3175			0.80	0.35	>50	>90	0.82			0.95		49	46				>1.6
30		3825			0.74	0.32	41	85	0.77			1.00		40	45				>1.5
35		4475	4163	1.07	0.68	0.32	42	85	0.74			↓		39	40				>1.5
40		5125	4501	1.14	0.64	0.32	56	>90	0.71					50	48				>1.5
45		5775	4839	1.19	0.61	0.32	46	85	0.68					39	47				>1.5
50		6425	5177	1.24	0.58	0.32	37	70	0.65					30	29				>1.5

① INDUCED CYCLIC STRESS RATIO = $\tau_{ave}/\bar{\sigma}_o = 0.65 \cdot \frac{a_{max}}{g} \cdot \frac{\sigma_o}{\bar{\sigma}_o} \cdot r_d$

- C_E = Corr. - Energy Ratio = Energy Ratio/60%
- C_B = Corr. - Borehole Dia. = 1.15 for 8" dia. borehole
- C_R = Corr. - Rod Length
- C_S = Corr. - Sampling Method

Actual Energy Ratio = 0.67-1.17 (Safety Hammer)
= 0.50-1.00 (Donut Hammer)

Sampling Method = 1.0 Standard sampler
= 1.2 Sampler W/o liners

NorCal Engineering
SOILS AND GEOTECHNICAL CONSULTANTS

EVALUATION OF LIQUEFACTION POTENTIAL

PROJECT ______ DATE ______

NorCal Engineering
Soils and Geotechnical Consultants
10641 Humbolt Street Los Alamitos, CA 90720
(562) 799-9469 Fax (562) 799-9459

April 27, 2020 Project Number 21631-20

CDREP LLC
523 Main Street
El Segundo, California 90245

Attn: Mr. Mark Bachli

RE: **Updated Soils Infiltration Study** - Proposed Industrial Warehouse Development - Located at the Southeast and Southwest Corners of Allessandro Boulevard and Chagall Court, in the City of Moreno Valley, California

Dear Mr. Bachli:

Pursuant to your request, this firm has performed an Updated Soils Infiltration Study in accordance with our proposal dated April 10, 2020 for the above referenced project. The purpose of this study is to provide additional testing to evaluate the feasibility of an on-site water disposal system for the proposed industrial development. The scope of work included the following: 1) site reconnaissance; 2) subsurface geotechnical exploration; 3) soil infiltration testing; 4) engineering analysis of field and laboratory data; and 5) preparation of a report.

The 18.05-acre subject property is located at the southeast and southwest corners of Allessandro Boulevard and Chagall Court, in the City of Moreno Valley. The generally rectangular-shaped parcel is elongated in an east to west direction with topography of the relatively level descending slightly from a north to south direction on the order of a few feet. The site is undeveloped parcel covered with a low vegetation growth of natural grasses and weeds.

It is proposed to construct an industrial warehouse development consisting of a 102,669 and 295,470 square feet building as shown on the plan by Herdman Architecture + Design dated December 18, 2019. The proposed concrete tilt-up building will be supported by a conventional slab-on-grade foundation system with perimeter-spread footings and isolated interior footings. Other improvements will include asphalt and concrete pavement areas, hardscape and landscaping.

It is assumed that the proposed grading for the development will include cut and fill procedures on the order of a few feet to achieve finished grade elevations. Final building plans shall be reviewed by this firm prior to submittal for city approval to determine the need for any additional study and revised recommendations pertinent to the proposed development, if necessary.

Field Exploration and Testing

The field exploration consisted of eight (8) additional exploratory trenches by a backhoe to depths ranging between 2 and 7 feet below ground surface (bgs) to determine the subsurface soil conditions. The explorations were visually classified and logged by a field engineer with locations of the subsurface explorations shown on the attached Site Plan. The exploratory trenches revealed the existing earth materials to consist of fill and natural soil. Detailed descriptions of the subsurface conditions are listed on the trench logs in Appendix A. It should be noted that the transition from one soil type to another as shown on the trench logs is approximate and may in fact be a gradual transition. The soils encountered are described as follows:

Fill: A fill soil classifying as a brown, fine to medium grained, silty to clayey SAND was encountered across the site to depths ranging from 1 to 2 feet below ground surface. These soils were noted to be loose and moist.

Natural: A natural undisturbed soil classifying as a brown, fine to medium grained, clayey to silty SAND to sandy CLAY was encountered beneath the upper fill soils. The native soils as encountered were observed to be dense/stiff to very dense/very stiff and moist.

The overall engineering characteristics of the earth material were relatively uniform with each trench and no caving occurred. Groundwater was encountered at a depth of 33 and 39 feet ground surface as encountered from our deep borings in our "Geotechnical Engineering Investigation" report dated January 31, 2020.

Results of Field Infiltration Tests

Infiltration tests within the site were performed to provide preliminary infiltration rates for the purpose of planning and design of an on-site water disposal system. The infiltration tests consisted of the double ring infiltration test per ASTM Method D 3385. The field infiltration rate was computed using a reduction factor – R_f based on the field measurements with our calculations given in Appendix D. Based upon the results of our testing, the soils encountered in the planned on-site drainage disposal system area exhibit the following infiltration rates.

Test No.	Depth	Soil Classification	Field Infiltration Rate	Design Rate
T-1	5'	Silty Sand	5.12 in/hr	1.707
T-2	2'	Sandy Clay	0.05 in/hr	0.017
T-3	5'	Sandy Clay	0.26 in/hr	0.087
T-4	3'	Clayey Sand	0.83 in/hr	0.277
T-5	6'	Clayey Sand	0.87 in/hr	0.290
T-6	7'	Sandy Clay	0.08 in/hr	0.027
T-7	7'	Sandy Clay	0.08 in/hr	0.027
T-8	4'	Sandy Clay	0.35 in/hr	0.117

The correction factors CF_t, CF_v and CF_s are given below based on soils from 2 to 7 feet from our field tests.

a) $CF_t = Rf = 1.0$ for our double ring infiltration test holes.

b) $CF_v = 1.0$ based on uniform soils encountered in eight trenches.

c) $CF_s = 3.0$ for long-term siltation, plugging and maintenance. The subsurface soils are likely to have some plugging and regular maintenance of storm water discharge devices is required.

Based on the results of our field testing, the subsurface soils encountered in the proposed on-site drainage disposal system shall utilize the design infiltration rates based on the County of Riverside safety factor. These infiltration rates were found to be low representing very stiff fine-grained clayey soils which may not suitable for seepage at the site. Our referenced preliminary geotechnical report stated that deeper soils were clayey soils with increasing density with depth, indicating unfavorable conditions for infiltration. All systems must meet the latest county specifications and the California Regional Water Quality Control Board (CRWQCB) requirements.

It is recommended that foundations shall be setback a minimum distance of 10 feet from the drainage disposal system and the bottom of footing shall be a minimum of 10 feet from the expected zone of saturation. The boundary of the zone of saturation may be assumed to project downward from the top of the permeable portion of the disposal system at an inclination of 1 to 1 or flatter, as determined by the geotechnical engineer.

Closure

The recommendations and conclusions contained in this report are based upon the soil conditions uncovered in our test excavation. No warranty of the soil condition between our excavations is implied. NorCal Engineering should be notified for possible further recommendations if unexpected to unfavorable conditions are encountered during construction phase.

This firm should have the opportunity to review the final plans to verify that all our recommendations are incorporated. This report and all conclusions are subject to the review of the controlling authorities for the project. Our representative should be present during the grading operations and construction phase to certify that such recommendations are complied within the field.

This geotechnical investigation has been conducted in a manner consistent with the level of care and skill exercised by members of our profession currently practicing under similar conditions in the Southern California area. No other warranty, expressed or implied is made.

We appreciate this opportunity to be of service to you. If you have any further questions, please do not hesitate to contact the undersigned.

Respectfully submitted,
NORCAL ENGINEERING

Keith D Tucker

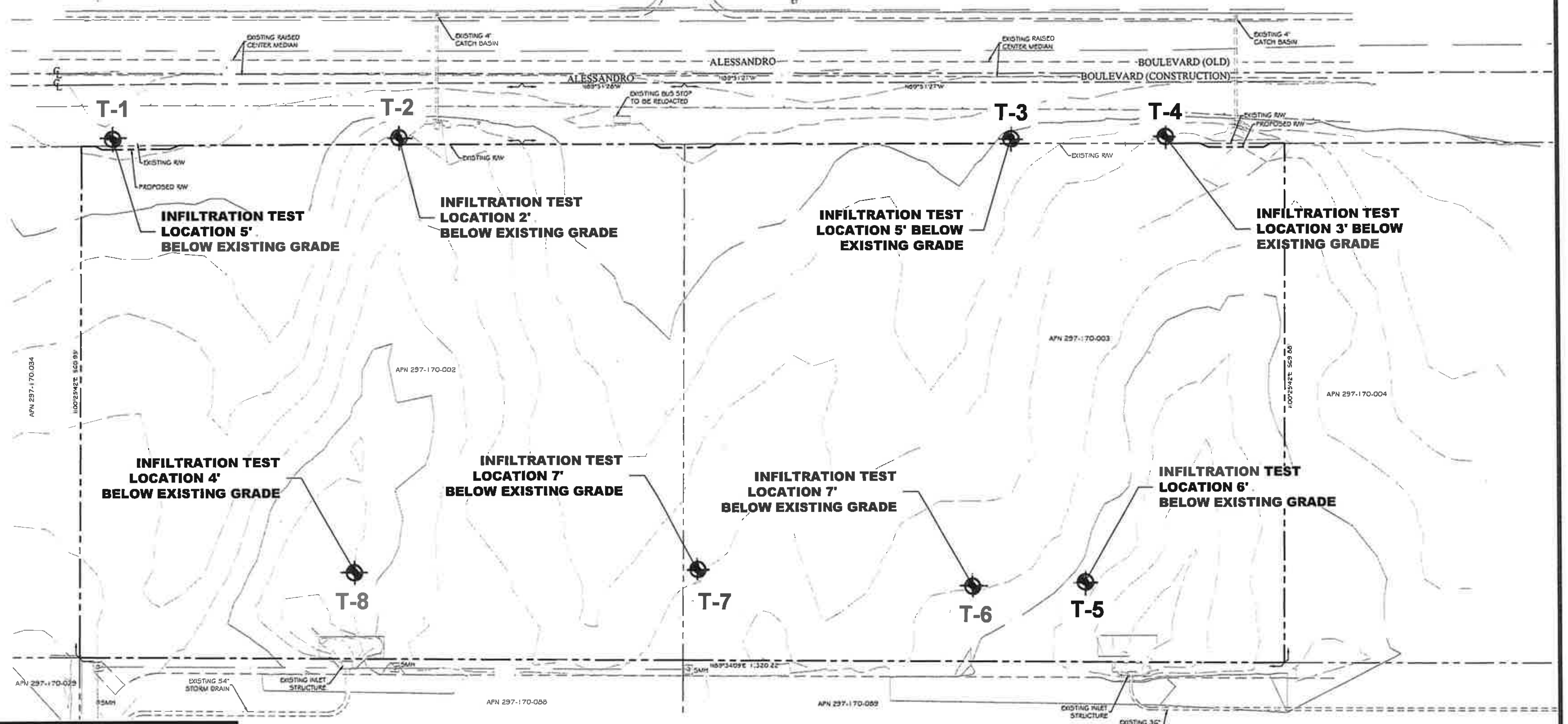
Keith D. Tucker
Project Engineer
R.G.E. 841

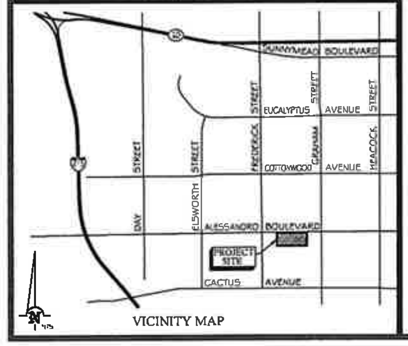
REGISTERED PROFESSIONAL ENGINEER
KEITH D. TUCKER
No. 841
Exp. 12/31/2020
GEOTECHNICAL
STATE OF CALIFORNIA

Scott D. Spensiero
Project Manager

INFILTRATION TEST LOCATION EXHIBIT

APN 297-170-002 & 003
CITY OF MORENO VALLEY





VICINITY MAP

LEGEND

AC	ASPHALT CONCRETE
CF	CURB FACE
ET	ELECTRIC TRANSFORMER
FF	FINISHED FLOOR
FG	FINISHED GROUND
FL	FLOWLINE
FS	FINISHED SURFACE
GB	GRADEBREAK
INV	INVERT ELEVATION
PB	PULL BOX
PCC	PORTLAND CEMENT CONCRETE
PL	PROPERTY LINE
PP	EX. POWER POLE
R/W	RIGHT-OF-WAY
SMH	SEWER MANHOLE
STL	EX. STREET LIGHT
TC	TOP OF CURB
TG	TOP OF GRATE

SOURCE OF SURVEY
TOPOGRAPHIC SURVEY
DATED DECEMBER 2019
AS CONDUCTED BY
PARTNER ENGINEERING AND SCIENCE, INC.
1761 EAST GARRY AVENUE
SANTA ANA, CA 92705
PHONE: (714) 477-8657

SOIL ENGINEER
REPORT DATED JANUARY 31, 2020
PROJECT NO. 21631-20
AS CONDUCTED BY
NORCAL ENGINEERING
10641 HUMBOLT STREET
LOS ALAMITOS, CA 90720
PHONE: (562) 799-9469
FAX: (562) 799-9459

N
0 50 100 150

1 INCH = 150 FEET

PROPERTY OWNER
MORENO VALLEY CENTERPOINTE
C/O CDRE HOLDINGS 14 LLC
ATTN: MARK BACHU
523 MAIN STREET
EL SEGUNDO, CA 90245
(310) 428-3302

PREPARED FOR/APPLICANT:
CDRE HOLDINGS 14 LLC
ATTN: MARK BACHU
523 MAIN STREET
EL SEGUNDO, CA 90245
(310) 428-3302

INFILTRATION TEST LOCATION EXHIBIT
APN 297-170-002 & 003
SOUTH SIDE OF ALESSANDRO BOULEVARD
CITY OF MORENO VALLEY

- land planning
- civil engineering
- landscape architecture

phone 909.748.7777
fax 909.748.7776
thatcher engineering & associates, inc.
1461 ford street, suite 105, redlands, ca 92373

PATRICK C. FLANAGAN, JR. No. 86046 Exp. 9/30/20 CIVIL

Patrick C. Flanagan, Jr. R.C.E. 86046 Exp. Sep 30, 2020

Job Number:	Date Prepared:	Drawn By:	Reference Number:
162012	3/25/20	RL	162012TAM

162012TAM

NorCal Engineering
SOILS AND GEOTECHNICAL CONSULTANTS

PROJECT

DATE APRIL 2020

SITE PLAN

List of Appendices

(in order of appearance)

Appendix A

MAJOR DIVISION			GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)	○	GW	WELL-GRADED GRAVELS, GRAVEL, SAND MIXTURES, LITTLE OR NO FINES
			●	GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)	▥	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
			▨	GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SAND (LITTLE OR NO FINES)	▦	SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			⁘	SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINE (APPRECIABLE AMOUNT OF FINES)	▥	SM	SILTY SANDS, SAND-SILT MIXTURES
			▨	SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50	▥	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			▨	CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			┅	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50	▥	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
			▨	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			▨	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			≈	PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

UNIFIED SOIL CLASSIFICATION SYSTEM

KEY:

■	Indicates 2.5-inch Inside Diameter. Ring Sample.
☒	Indicates 2-inch OD Split Spoon Sample (SPT).
⧅	Indicates Shelby Tube Sample.
◫	Indicates No Recovery.
◧	Indicates SPT with 140# Hammer 30 in. Drop.
🖂	Indicates Bulk Sample.
◩	Indicates Small Bag Sample.
◨	Indicates Non-Standard
⊠	Indicates Core Run.

COMPONENT PROPORTIONS

DESCRIPTIVE TERMS	RANGE OF PROPORTION
Trace	1 - 5%
Few	5 - 10%
Little	10 - 20%
Some	20 - 35%
And	35 - 50%

COMPONENT DEFINITIONS

COMPONENT	SIZE RANGE
Boulders	Larger than 12 in
Cobbles	3 in to 12 in
Gravel	3 in to No 4 (4.5mm)
Coarse gravel	3 in to 3/4 in
Fine gravel	3/4 in to No 4 (4.5mm)
Sand	No. 4 (4.5mm) to No. 200 (0.074mm)
Coarse sand	No. 4 (4.5 mm) to No. 10 (2.0 mm)
Medium sand	No. 10 (2.0 mm) to No. 40 (0.42 mm)
Fine sand	No. 40 (0.42 mm) to No. 200 (0.074 mm)
Silt and Clay	Smaller than No. 200 (0.074 mm)

MOISTURE CONTENT

DRY	Absence of moisture, dusty, dry to the touch.
DAMP	Some perceptible moisture; below optimum
MOIST	No visible water; near optimum moisture content
WET	Visible free water, usually soil is below water table.

RELATIVE DENSITY OR CONSISTENCY VERSUS SPT N -VALUE

COHESIONLESS SOILS		COHESIVE SOILS		
Density	N (blows/ft)	Consistency	N (blows/ft)	Approximate Undrained Shear Strength (psf)
Very Loose	0 to 4	Very Soft	0 to 2	< 250
Loose	4 to 10	Soft	2 to 4	250 - 500
Medium Dense	10 to 30	Medium Stiff	4 to 8	500 - 1000
Dense	30 to 50	Stiff	8 to 15	1000 - 2000
Very Dense	over 50	Very Stiff	15 to 30	2000 - 4000
		Hard	over 30	> 4000

CDREP, LLC
21631-20

Log of Trench T-1

Boring Location: Allessandro & Chagall, Moreno Valley

Date of Drilling: 4/21/2020

Groundwater Depth: None Encountered

Drilling Method: Backhoe

Hammer Weight:

Drop:

Surface Elevation: Not Measured

Depth (feet)	Lith- ology		Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0		GWT not encountered	FILL Silty SAND Brown, loose, moist					
			NATURAL Silty SAND Brown, dense, moist					
5			Trench completed at depth of 5'					
10								
15								
20								
25								
30								
35								

SuperLog CivilTech Software, USA www.civiltech.com File: C:\Superlog4\PROJECT\2163120-1.log Date: 4/24/2020

CDREP, LLC
21631-20

Log of Trench T-2

Boring Location: Allessandro & Chagall, Moreno Valley

Date of Drilling: 4/21/2020 **Groundwater Depth: None Encountered**

Drilling Method: Backhoe

Hammer Weight: **Drop:**

Surface Elevation: Not Measured

Depth (feet)	Lith- ology		Material Description	Samples		Laboratory		
				Type	Blow Counts	Moisture	Dry Density	Fines Content %
0	▦	GWT not encountered	FILL Silty SAND Brown, loose, moist					
	▨		NATURAL Sandy CLAY Brown, stiff, moist					
5			Trench completed at depth of 2'					
10								
15								
20								
25								
30								
35								

SuperLog CivilTech Software, USA www.civiltech.com File: C:\Superlog4\PROJECT\2163120-1.log Date: 4/24/2020

NorCal Engineering

CDREP, LLC
21631-20

Log of Trench T-3

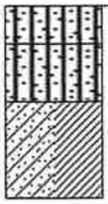
Boring Location: Allessandro & Chagall, Moreno Valley

Date of Drilling: 4/21/2020 **Groundwater Depth: None Encountered**

Drilling Method: Backhoe

Hammer Weight: **Drop:**

Surface Elevation: Not Measured

Depth (feet)	Lith- ology	Material Description	Samples		Laboratory		
			Type	Blow Counts	Moisture	Dry Density	Fines Content %
0	 GWT not encountered	FILL Silty SAND Brown, loose, moist					
		NATURAL Silty SAND Brown, dense to very dense, moist					
5		Clayey SAND to Sandy CLAY Brown, dense to stiff, damp					
		Trench completed at depth of 5'					
10							
15							
20							
25							
30							
35							

NorCal Engineering

CDREP, LLC
21631-20

Log of Trench T-4

Boring Location: Allessandro & Chagall, Moreno Valley

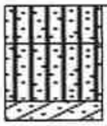
Date of Drilling: 4/21/2020 | **Groundwater Depth: None Encountered**

Drilling Method: Backhoe

Hammer Weight: | **Drop:**

Surface Elevation: Not Measured

Depth (feet)	Lith- ology	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0		FILL Silty SAND Brown, loose, moist					
		NATURAL Silty SAND Brown, dense to very dense, moist					
5		Clayey SAND Brown, very dense, damp					
		Trench completed at depth of 3'					
10							
15							
20							
25							
30							
35							



GWT not encountered

NorCal Engineering

CDREP, LLC
21631-20

Log of Trench T-5

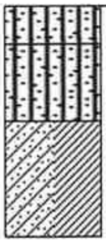
Boring Location: Allessandro & Chagall, Moreno Valley

Date of Drilling: 4/21/2020 | **Groundwater Depth:** None Encountered

Drilling Method: Backhoe

Hammer Weight: | **Drop:**

Surface Elevation: Not Measured



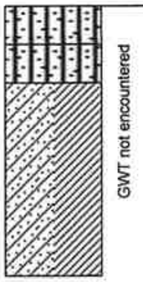
GWT not encountered

Depth (feet)	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0	FILL Silty SAND Brown, loose, moist					
	NATURAL Silty SAND Brown, dense, moist					
5	Clayey SAND to Sandy CLAY Brown, dense to very stiff, moist					
	Trench completed at depth of 6'					
10						
15						
20						
25						
30						
35						

CDREP, LLC
21631-20

Log of Trench T-6

Boring Location: Allessandro & Chagall, Moreno Valley
Date of Drilling: 4/21/2020
Groundwater Depth: None Encountered
Drilling Method: Backhoe
Hammer Weight:
Drop:
Surface Elevation: Not Measured



Depth (feet)	Lith-ology	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0		FILL Silty SAND Brown, loose, moist					
		NATURAL Silty SAND Brown, dense, moist					
5		Clayey SAND to Sandy CLAY Brown, dense to very stiff, moist to damp					
		Trench completed at depth of 7'					
10							
15							
20							
25							
30							
35							

CDREP, LLC
21631-20

Log of Trench T-7

Boring Location: Allessandro & Chagall, Moreno Valley

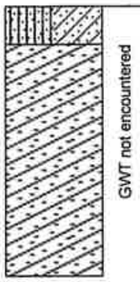
Date of Drilling: 4/21/2020 | **Groundwater Depth: None Encountered**

Drilling Method: Backhoe

Hammer Weight: | **Drop:**

Surface Elevation: Not Measured

Depth (feet)	Lith- ology	Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0		FILL Silty to Clayey SAND Brown, loose, moist					
		NATURAL Clayey SAND Brown, dense to very dense, moist to damp					
5							
		Boring completed at depth of 7'					
10							
15							
20							
25							
30							
35							



NorCal Engineering

CDREP, LLC
21631-20

Log of Trench T-8

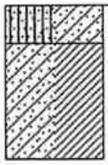
Boring Location: Allessandro & Chagall, Moreno Valley

Date of Drilling: 4/21/2020 | **Groundwater Depth: None Encountered**

Drilling Method: Backhoe

Hammer Weight: | **Drop:**

Surface Elevation: Not Measured

Depth (feet)	Lith-ology		Material Description	Samples: Type	Samples: Blow Counts	Laboratory: Moisture	Laboratory: Dry Density	Laboratory: Fines Content %
0		GWT not encountered	FILL Silty to Clayey SAND Brown, loose, moist					
			NATURAL Clayey SAND to Sandy CLAY Brown, dense to very stiff, moist					
5			Trench completed at depth of 4'					
10								
15								
20								
25								
30								
35								

Appendix B

Project: CDREP, LLC
Project No.: 21631-20
Date: 4/21/2020
Test No. 1
Depth: 5'
Tested By: J.S. Jr.

TIME (hr/min)	CHANGE TIME (min)	CUMULATIVE TIME (min)	INNER RING READING (cm)	INNER RING CHANGE	INNER RING FLOW (cc)	OUTER RING READING (cm)	OUTER RING CHANGE	OUTER RING FLOW (cc)	INNER RING INF RATE (cm/hr)	OUTER RING INF RATE (cm/hr)	INNER RING INF RATE (ft/hr)
7:05			100.5			41.6					
7:20	15	15	106.0	5.5		46.6	5.0				
7:20			97.0			37.3					
7:35	15	30	102.2	5.2		42.2	4.9				
7:35			97.0			37.0					
7:50	15	45	102.0	5.0		41.8	4.8				
7:50			102.0			41.8					
8:05	15	60	106.5	4.5		45.7	3.9				
8:05			99.1			38.5					
8:20	15	75	102.8	3.7		42.7	4.2				
8:20			102.8			42.7					
8:35	15	90	106.1	3.3		46.3	3.6				
8:35			106.1			46.3					
8:50	15	105	109.5	3.4		49.5	3.2		13.6	12.8	
8:50			98.1			38.2					
9:05	15	120	101.4	3.3		41.6	3.4		13.2	13.6	
9:05			101.4			41.6					
9:20	15	135	104.5	3.1		45.3	3.7		12.4	14.8	
9:20			104.5			45.3					
9:35	15	150	107.6	3.1		48.6	3.3		12.4	13.2	
9:35			98.6			40.2					
9:50	15	165	102.0	3.4		43.5	3.3		13.6	13.2	
9:50			102.0			43.5					
10:05	15	180	105.2	3.2		46.6	3.1		12.8	12.4	

Average = 13.0 / 13.3 cm/hr

NORCAL
ENGINEERING
SOILS AND GEOTECHNICAL CONSULTANTS

Project: CDREP, LLC
Project No.: 21631-20
Date: 4/21/2020
Test No. 2
Depth: 2'
Tested By: J.S. Jr.

TIME (hr/min)	CHANGE TIME (min)	CUMULATIVE TIME (min)	INNER RING READING (cm)	INNER RING CHANGE	INNER RING FLOW (cc)	OUTER RING READING (cm)	OUTER RING CHANGE	OUTER RING FLOW (cc)	INNER RING INF RATE (cm/hr)	OUTER RING INF RATE (cm/hr)	INNER RING INF RATE (ft/hr)
6:38			72.2			38.8					
6:53	15	15	72.4	0.2		39.0	0.2				
6:53			72.4			39.0					
7:08	15	30	72.5	0.1		39.1	0.1				
7:08			72.5			39.1					
7:23	15	45	72.5	0.0		39.1	0.0				
7:23			72.5			39.1					
7:38	15	60	72.6	0.1		39.2	0.1				
7:38			72.6			39.2					
7:53	15	75	72.6	0.0		39.3	0.1				
7:53			72.6			39.3					
8:08	15	90	72.6	0.0		39.3	0.0				
8:08			72.6			39.3					
8:23	15	105	72.7	0.1		39.4	0.1		0.4	0.4	
8:23			72.7			39.4					
8:38	15	120	72.7	0.0		39.4	0.0		0.0	0.0	
8:38			72.7			39.4					
8:53	15	135	72.7	0.0		39.4	0.0		0.0	0.0	
8:53			72.7			39.4					
9:08	15	150	72.7	0.0		39.4	0.0		0.0	0.0	
9:08			72.7			39.4					
9:23	15	165	72.8	0.1		39.5	0.1		0.4	0.4	
9:23			72.8			39.5					
9:38	15	180	72.8	0.0		39.5	0.0		0.0	0.0	

Average = 0.13 / 0.13 cm/hr

NORCAL ENGINEERING

SOILS AND GEOTECHNICAL CONSULTANTS

Project: CDREP, LLC
Project No.: 21631-20
Date: 4/21/2020
Test No. 3
Depth: 5'
Tested By: J.S. Jr.

TIME (hr/min)	CHANGE TIME (min)	CUMULATIVE TIME (min)	INNER RING READING (cm)	INNER RING CHANGE	INNER RING FLOW (cc)	OUTER RING READING (cm)	OUTER RING CHANGE	OUTER RING FLOW (cc)	INNER RING INF RATE (cm/hr)	OUTER RING INF RATE (cm/hr)	INNER RING INF RATE (ft/hr)
9:14			76.2			42.7					
9:29	15	15	76.5	0.3		43.0	0.3				
9:29			76.5			43.0					
9:44	15	30	76.7	0.2		43.2	0.2				
9:44			76.7			43.2					
9:59	15	45	77.0	0.3		43.5	0.3				
9:59			77.0			43.5					
10:14	15	60	77.1	0.1		43.7	0.2				
10:14			77.1			43.7					
10:29	15	75	77.3	0.2		43.9	0.2				
10:29			77.3			43.9					
10:44	15	90	77.5	0.2		44.1	0.2				
10:44			77.5			44.1					
10:59	15	105	77.6	0.1		44.2	0.1		0.4	0.4	
10:59			77.6			44.2					
11:14	15	120	77.8	0.2		44.3	0.1		0.8	0.4	
11:14			77.8			44.3					
11:29	15	135	78.0	0.2		44.5	0.2		0.8	0.8	
11:29			78.0			44.5					
11:44	15	150	78.1	0.1		44.6	0.1		0.4	0.4	
11:44			78.1			44.6					
11:59	15	165	78.3	0.2		44.8	0.2		0.8	0.8	
11:59			78.3			44.8					
12:14	15	180	80.3	0.2		45.0	0.2		0.8	0.8	

Average = 0.67 / 0.60 cm/hr

NORCAL
ENGINEERING
SOILS AND GEOTECHNICAL CONSULTANTS

Project: CDREP, LLC
Project No.: 21631-20
Date: 4/21/2020
Test No. 4
Depth: 3'
Tested By: J.S. Jr.

TIME (hr/min)	CHANGE TIME (min)	CUMULATIVE TIME (min)	INNER RING READING (cm)	INNER RING CHANGE	INNER RING FLOW (cc)	OUTER RING READING (cm)	OUTER RING CHANGE	OUTER RING FLOW (cc)	INNER RING INF RATE (cm/hr)	OUTER RING INF RATE (cm/hr)	INNER RING INF RATE (ft/hr)
10:15			98.0			38.7					
10:30	15	15	98.8	0.8		39.3	0.6				
10:30			98.8			39.3					
10:45	15	30	99.4	0.6		40.1	0.8				
10:45			99.4			40.1					
11:00	15	45	100.1	0.7		10.7	0.6				
11:00			100.1			10.7					
11:15	15	60	100.8	0.7		41.2	0.5				
11:15			100.8			41.2					
11:30	15	75	101.5	0.7		41.9	0.7				
11:30			101.5			41.9					
11:45	15	90	102.2	0.7		42.6	0.7				
11:45			102.2			42.6					
12:00	15	105	102.7	0.5		43.2	0.6		2.0	2.4	
12:00			102.7			43.2					
12:15	15	120	103.2	0.5		43.8	0.6		2.0	2.4	
12:15			103.2			43.8					
12:30	15	135	103.8	0.6		44.2	0.4		2.4	1.6	
12:30			103.8			44.2					
12:45	15	150	104.5	0.5		44.7	0.5		2.0	2.0	
12:45			104.5			44.7					
1:00	15	165	105.2	0.7		45.1	0.4		2.8	1.6	
1:00			105.2			45.1					
1:15	15	180	105.6	0.4		45.5	0.4		1.6	1.6	

Average = 2.1 / 1.9 cm/hr

Project: CDREP, LLC
Project No.: 21631-20
Date: 4/21/2020
Test No. 5
Depth: 6’
Tested By: J.S. Jr.

TIME (hr/min)	CHANGE TIME (min)	CUMULATIVE TIME (min)	INNER RING READING (cm)	INNER RING CHANGE	INNER RING FLOW (cc)	OUTER RING READING (cm)	OUTER RING CHANGE	OUTER RING FLOW (cc)	INNER RING INF RATE (cm/hr)	OUTER RING INF RATE (cm/hr)	INNER RING INF RATE (ft/hr)
6:11			68.0			37.0					
6:26	15	15	69.1	1.1		37.6	0.6				
6:26			69.1			37.6					
6:41	15	30	69.8	0.7		38.0	0.4				
6:41			69.8			38.0					
6:56	15	45	70.4	0.6		38.3	0.3				
6:56			70.4			38.3					
7:11	15	60	71.0	0.6		38.6	0.3				
7:11			71.0			38.6					
7:26	15	75	71.5	0.5		39.0	0.4				
7:26			71.5			39.0					
7:41	15	90	72.1	0.6		39.4	0.4				
7:41			72.1			39.4					
7:56	15	105	72.6	0.5		39.7	0.3		2.0	1.2	
7:56			72.6			39.7					
8:11	15	120	73.2	0.6		40.0	0.3		2.4	1.2	
8:11			73.2			40.0					
8:26	15	135	73.7	0.5		40.3	0.3		2.0	1.2	
8:26			73.7			40.3					
8:41	15	150	74.3	0.6		40.6	0.3		2.4	1.2	
8:41			74.3			40.6					
8:56	15	165	74.9	0.6		40.9	0.3		2.4	1.2	
8:56			74.9			40.9					
9:11	15	180	75.4	0.5		41.1	0.2		2.0	0.8	

Average = 2.2 / 1.1 cm/hr

Project: CDREP, LLC
Project No.: 21631-20
Date: 4/21/2020
Test No. 6
Depth: 7'
Tested By: J.S. Jr.

TIME (hr/min)	CHANGE TIME (min)	CUMULATIVE TIME (min)	INNER RING READING (cm)	INNER RING CHANGE	INNER RING FLOW (cc)	OUTER RING READING (cm)	OUTER RING CHANGE	OUTER RING FLOW (cc)	INNER RING INF RATE (cm/hr)	OUTER RING INF RATE (cm/hr)	INNER RING INF RATE (ft/hr)
6:15			101.2			42.0					
6:30	15	15	101.2	0.0		42.1	0.1				
6:30			101.2			42.1					
6:45	15	30	101.2	0.0		42.1	0.0				
6:45			101.2			42.1					
7:00	15	45	101.3	0.0		42.1	0.1				
7:00			101.3			42.1					
7:15	15	60	101.4	0.1		42.3	0.2				
7:15			101.4			42.3					
7:30	15	75	101.4	0.0		42.3	0.0				
7:30			101.4			42.3					
7:45	15	90	101.6	0.2		42.3	0.0				
7:45			101.6			42.3					
8:00	15	105	101.7	0.1		42.4	0.1		0.4	0.4	
8:00			101.7			42.4					
8:15	15	120	101.7	0.0		42.4	0.0		0.0	0.0	
8:15			101.7			42.4					
8:30	15	135	101.7	0.0		42.4	0.0		0.0	0.0	
8:30			101.7			42.4					
8:45	15	150	101.8	0.1		42.6	0.2		0.4	0.8	
8:45			101.8			42.6					
9:00	15	165	101.8	0.0		42.6	0.0		0.0	0.0	
9:00			108.8			42.6					
9:15	15	180	108.9	0.1		42.7	0.1		0.4	0.4	

Average = 0.2 / 0.3 cm/hr

NORCAL ENGINEERING

SOILS AND GEOTECHNICAL CONSULTANTS

Project: CDREP, LLC
Project No.: 21631-20
Date: 4/21/2020
Test No. 7
Depth: 7'
Tested By: J.S. Jr.

TIME (hr/min)	CHANGE TIME (min)	CUMULATIVE TIME (min)	INNER RING READING (cm)	INNER RING CHANGE	INNER RING FLOW (cc)	OUTER RING READING (cm)	OUTER RING CHANGE	OUTER RING FLOW (cc)	INNER RING INF RATE (cm/hr)	OUTER RING INF RATE (cm/hr)	INNER RING INF RATE (ft/hr)
9:50			79.5			48.8					
10:05	15	15	80.0	0.5		49.0	0.2				
10:05			80.0			49.0					
10:20	15	30	80.2	0.2		49.4	0.4				
10:20			80.2			49.4					
10:35	15	45	80.4	0.2		49.5	0.1				
10:35			80.4			49.5					
10:50	15	60	80.4	0.0		49.6	0.1				
10:50			80.4			49.6					
11:05	15	75	80.4	0.0		49.6	0.0				
11:05			80.4			49.6					
11:20	15	90	80.5	0.1		49.7	0.1		0.4	0.4	
11:20			80.5			49.7					
11:35	15	105	80.7	0.2		49.9	0.2		0.8	0.8	
11:35			80.7			49.9					
11:50	15	120	80.7	0.0		49.9	0.0		0.0	0.0	
11:50			80.7			49.9					
12:05	15	135	80.7	0.0		49.9	0.0		0.0	0.0	
12:05			80.7			49.9					
12:20	15	150	80.7	0.0		49.9	0.0		0.0	0.0	
12:20			80.7			49.9					
12:35	15	165	80.8	0.1		50.0	0.1		0.4	0.4	
12:35			80.8			50.0					
12:50	15	180	80.8	0.0		50.0	0.0		0.0	0.0	

Average = 0.2 / 0.2 cm/hr

NORCAL
ENGINEERING
SOILS AND GEOTECHNICAL CONSULTANTS

Project: CDREP, LLC
Project No.: 21631-20
Date: 4/21/2020
Test No. 8
Depth: 4'
Tested By: D.L.

TIME (hr/min)	CHANGE TIME (min)	CUMULATIVE TIME (min)	INNER RING READING (cm)	INNER RING CHANGE	INNER RING FLOW (cc)	OUTER RING READING (cm)	OUTER RING CHANGE	OUTER RING FLOW (cc)	INNER RING INF RATE (cm/hr)	OUTER RING INF RATE (cm/hr)	INNER RING INF RATE (ft/hr)
9:23			100.8			41.5					
9:38	15	15	101.0	0.2		41.8	0.3				
9:38			101.0			41.8					
9:53	15	30	101.1	0.1		41.8	0.0				
9:53			101.1			41.8					
10:08	15	45	101.3	0.2		41.9	0.1				
10:08			101.3			41.9					
10:23	15	60	101.5	0.2		42.1	0.2				
10:23			101.5			42.1					
10:38	15	75	101.8	0.3		42.4	0.3				
10:38			101.8			42.4					
10:53	15	90	102.0	0.2		42.6	0.2		0.8	0.8	
10:53			102.0			42.6					
11:08	15	105	102.3	0.3		42.9	0.3		1.2	1.2	
11:08			102.3			42.9					
11:23	15	120	102.5	0.2		43.1	0.2		0.8	0.8	
11:23			102.5			43.1					
11:38	15	135	102.8	0.2		43.4	0.3		0.8	1.2	
11:38			102.8			43.4					
11:53	15	150	103.0	0.2		43.7	0.3		0.8	1.2	
11:53			103.0			43.7					
12:08	15	165	103.3	0.3		43.9	0.2		1.2	0.8	
12:08			103.3			43.9					
12:23	15	180	103.5	0.2		44.1	0.2		0.8	0.8	

Average = 0.9 / 1.0 cm/hr

Appendix 4: Historical Site Conditions

Not applicable

Appendix 5: LID Infeasibility

Not applicable

Appendix 6: BMP Design Details

BMP Sizing, Design Details and other Supporting Documentation

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 Thatcher Engineering
Date 10/5/2020
Designed by Kristin Tissot
Case No
Company Project Number/Name Industrial Warehouse Facility, Alessandro Blvd. Moreno Valley

BMP Identification

BMP NAME / ID Area 1

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

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

D_{85}= 0.67 inches

Drainage Management Area Tabulation

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

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
1a	*502471*	*Roofs*	*1*	*0.89*	*448204.1*			
1b	*40593*	*Ornamental Landscaping*	*0.1*	*0.11*	*4483.8*			
1c	*15472*	*Natural (C Soil)*	*0.3*	*0.23*	*3483.8*			
	558536	***Total***			**456171.7**	**0.67**	***25469.6***	***25470***

Notes:

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 Thatcher Engineering
Date 10/5/2020
Designed by Kristin Tissot
Case No
Company Project Number/Name Industrial Warehouse Facility, Alessandro Blvd. Moreno Valley

BMP Identification

BMP NAME / ID Area 2: Biotreatment Device 2

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

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

D_{85}= 0.67 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 Imperious 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)*
2a	*221,281*	*Roofs*	*1*	*0.89*	*197382.7*			
2b	*24,599*	*Ornamental Landscaping*	*0.1*	*0.11*	*2717.2*			
2c	*100149*	*Natural (C Soil)*	*0.3*	*0.23*	*22550.1*			
	346029	***Total***			**222650**	**0.67**	***12431.3***	***12432***

Notes:

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 Thatcher Engineering

Date 7/14/2020

Designed by Kristin Tissot

Case No

Company Project Number/Name Industrial Warehouse Facility, Alessandro Blvd. Moreno Valley

BMP Identification

BMP NAME / ID Area 3 Bioretention Swale 3

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}= 0.67 inches

Drainage Management Area Tabulation

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

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
3a	*21,819*	*Concrete or Asphalt*	*1*	*0.89*	*19462.5*			
3b	*5861*	*Ornamental Landscaping*	*0.1*	*0.11*	*647.4*			
	27680		***Total***		**20109.9**	**0.67**	***1122.8***	***1123***

Notes:

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 Thatcher Engineering
Date 7/14/2020
Designed by Kristin Tissot
Case No
Company Project Number/Name Industrial Warehouse Facility, Alessandro, Moreno Valley

BMP Identification

BMP NAME / ID Area 4 Bioretention Swale 4

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

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

D_{85}= 0.67 inches

Drainage Management Area Tabulation

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

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
4a	*21407*	*Concrete or Asphalt*	*1*	*0.89*	*19095*			
4b	*6587*	*Ornamental Landscaping*	*0.1*	*0.11*	*727.6*			
	27994		*Total*		19822.6	0.67	*1106.8*	*1107*

Notes:

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 Thatcher Engineering
Date 7/14/2020
Designed by Kristin Tissot
Case No
Company Project Number/Name Industrial Warehouse Facility, Alessandro Blvd. Moreno Valley

BMP Identification

BMP NAME / ID Area 5 Bioretention Swale 5

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

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

D_{85}= 0.67 inches

Drainage Management Area Tabulation

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

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
5a	*26789*	*Concrete or Asphalt*	*1*	*0.89*	*23895.8*			
5b	*8160*	*Ornamental Landscaping*	*0.1*	*0.11*	*901.3*			
	34949	***Total***			**24797.1**	**0.67**	*1384.5*	*1385*

Notes:

Bioretention Facility - Design Procedure	BMP ID	Legend:	Required Entries	🟦
	Bio Swale 3		Calculated Cells	▨

Company Name: Thatcher Engineering
Date: 10/5/2020
Designed by: Kristin Tissot
County/City Case No.:

Design Volume

Enter the area tributary to this feature $A_T =$ 0.64 acres

Enter V_{BMP} determined from Section 2.1 of this Handbook $V_{BMP} =$ 1,123 ft^3

Type of Bioretention Facility Design

● Side slopes required (parallel to parking spaces or adjacent to walkways)

○ No side slopes required (perpendicular to parking space or Planter Boxes)

Bioretention Facility Surface Area

Depth of Soil Filter Media Layer $d_S =$ 3.0 ft

Top Width of Bioretention Facility, excluding curb $w_T =$ 4.0 ft

ERROR, the minimum width for the Bioretention Facility design selected has not been met

Total Effective Depth, d_E

$d_E = (0.3) \text{ x } d_S + (0.4) \text{ x } 1 - (0.7/w_T) + 0.5$ $d_E =$ 1.63 ft

Minimum Surface Area, A_m

$$A_M (ft^2) = \frac{V_{BMP} (ft^3)}{d_E (ft)}$$

$A_M =$ 692 ft^2

Proposed Surface Area $A =$ 783 ft^2

Bioretention Facility Properties

Side Slopes in Bioretention Facility $z =$ 4 :1

Diameter of Underdrain 6 inches

Longitudinal Slope of Site (3% maximum) 0.3 %

6" Check Dam Spacing 0 feet

Describe Vegetation:

Notes:

Bioretention Facility - Design Procedure

BMP ID: Bio Swale 4

Legend:	
Required Entries	🟦
Calculated Cells	▨

Company Name: Thatcher Engineering

Date: 10/5/2020

Designed by: Kristin Tissot

County/City Case No.:

Design Volume

Enter the area tributary to this feature $A_T=$ 0.64 acres

Enter V_{BMP} determined from Section 2.1 of this Handbook $V_{BMP}=$ 1,107 ft^3

Type of Bioretention Facility Design

● Side slopes required (parallel to parking spaces or adjacent to walkways)

○ No side slopes required (perpendicular to parking space or Planter Boxes)

Bioretention Facility Surface Area

Depth of Soil Filter Media Layer $d_S=$ 3.0 ft

Top Width of Bioretention Facility, excluding curb $w_T=$ 4.0 ft

ERROR, the minimum width for the Bioretention Facility design selected has not been met

Total Effective Depth, d_E

$d_E = (0.3) \times d_S + (0.4) \times 1 - (0.7/w_T) + 0.5$ $d_E=$ 1.63 ft

Minimum Surface Area, A_m

$$A_M\ (ft^2) = \frac{V_{BMP}\ (ft^3)}{d_E\ (ft)}$$

$A_M=$ 682 ft^2

Proposed Surface Area $A=$ 942 ft^2

Bioretention Facility Properties

Side Slopes in Bioretention Facility $z=$ 4 :1

Diameter of Underdrain 6 inches

Longitudinal Slope of Site (3% maximum) 0.3 %

6" Check Dam Spacing 0 feet

Describe Vegetation:

Notes:

Bioretention Facility - Design Procedure	BMP ID	Legend:	Required Entries	🟦
	Bio Swale 5		Calculated Cells	▨

Company Name: Thatcher Engineering
Date: 10/5/2020
Designed by: Kristin Tissot
County/City Case No.:

Design Volume

Enter the area tributary to this feature $A_T =$ 0.8 acres

Enter V_{BMP} determined from Section 2.1 of this Handbook $V_{BMP} =$ 1,385 ft^3

Type of Bioretention Facility Design

● Side slopes required (parallel to parking spaces or adjacent to walkways)
○ No side slopes required (perpendicular to parking space or Planter Boxes)

Bioretention Facility Surface Area

Depth of Soil Filter Media Layer $d_S =$ 3.0 ft

Top Width of Bioretention Facility, excluding curb $w_T =$ 4.0 ft

ERROR, the minimum width for the Bioretention Facility design selected has not been met

Total Effective Depth, d_E

$d_E = (0.3) \times d_S + (0.4) \times 1 - (0.7/w_T) + 0.5$ $d_E =$ 1.63 ft

Minimum Surface Area, A_m

$$A_M\ (ft^2) = \frac{V_{BMP}\ (ft^3)}{d_E\ (ft)}$$

$A_M =$ 853 ft^2

Proposed Surface Area $A =$ 1,200 ft^2

Bioretention Facility Properties

Side Slopes in Bioretention Facility $z =$ 4 :1

Diameter of Underdrain 6 inches

Longitudinal Slope of Site (3% maximum) 0.4 %

6" Check Dam Spacing 0 feet

Describe Vegetation:

Notes:

MWS Linear 2.0 Volume Based Sizing Calculations - *All States*

	Model #	Physical Depth of Model from TC, FS, TC to INVERT OUT	Wetland Perimiter (ft)	**Wetland Chamber Max HGL Height (ft)	Wetland Surface Area (sq ft)	Treatment Capacity (cu ft) for Volume Based Design **VOLUME DESIGN**	
						24 Hour Drain Down	**48 Hour Drain Down**
	MWS-L-4-4	4.13'	6.7	3.40	22.78	**1139.96**	**2279.93**
	MWS-L-4-6	4.13'	9.4	3.40	31.96	**1599.35**	**3198.71**
	MWS-L-4-8	4.13'	14.8	3.40	50.32	**2518.13**	**5036.26**
	MWS-L-4-13	4.13'	18.4	3.40	62.56	**3130.65**	**6261.30**
	MWS-L-4-15	4.13'	22.4	3.40	76.16	**3811.22**	**7622.45**
	MWS-L-4-17	4.13'	26.4	3.40	89.76	**4491.80**	**8983.60**
	MWS-L-4-19	4.13'	30.4	3.40	103.36	**5172.37**	**10344.75**
	MWS-L-4-21	4.13'	34.4	3.40	116.96	**5852.95**	**11705.90**
DA 2	MWS-L-8-12	4.13'	44.4	3.40	150.96	**7554.39**	**15108.78**
	MWS-L-8-16	4.13'	59.2	3.40	201.28	**10072.52**	**20145.04**
	MWS-L-8-20	4.13'	74.0	3.40	251.60	**12590.65**	**25181.30**
DA 1	MWS-L-8-24	4.13'	88.8	3.40	301.92	**15108.78**	**30217.56**

Shallow or Deeper Units Available. Change in Height Will Affect Treatment Capacity

** Not the physical height of the unit but the max HGL in the system at peak treatment flow rate

Based on loading rate of 25 in/hr or 0.26 gpm/sq ft

Appendix 7: Hydromodification

Supporting Detail Relating to Hydrologic Conditions of Concern

HCOC Narrative

Compass Danbe Centerpointe
Proposed Industrial Warehouse Facility
APN 297-170-002 & 003
South Side of Alessandro Boulevard
City of Moreno Valley
October 6, 2020
PEN20-0120 & PEN20-0121

Alessandro Boulevard is currently a partially improved roadway with a paved roadway, curb, gutter, and sidewalk along the north side. The street is divided by an existing raised center median. The south side of the street, adjacent to the project site, is currently unimproved. Flows from the south side of Alessandro Boulevard currently drain south onto the subject site, and these tributary flows are included in this study. The development proposes to improve Alessandro Boulevard across the project frontage with curb, gutter, and sidewalk. The improvements will nearly mirror the improvements on the north side of the street, which contains two separate catch basins. The improvements will include modified under sidewalk drains, which will allow street flows to enter a proposed bioretention swale sized for water quality treatment purposes. The proposed bioretention swales will discharge treated flows to two proposed catch basins connected to the city's storm drain system, which will be extended as part of this development. The two proposed catch basins will also act as an overflow for the bioretention swale.

The proposed development of the site includes the construction of two industrial warehouse buildings with related parking, paved access, and landscaping. Post-development flows from the property will be directed via sheet flow, ribbon gutter, curb and gutter, and an underground storm drain system to one of two proposed underground detention tanks onsite. A proposed sump and pump will pump flows from the detention tank to a proposed Modular Wetland biotreatment unit for water quality treatment. The Modular Wetland biotreatment units will discharge treated flows into the city's storm drain system that is being installed as part of this development. Each of the two parcels will have its own Modular Wetlands unit and detention tank, and both are located on the south side of the proposed buildings. A separate proposed sump and pump will discharge flows in excess of water quality volumes from the detention tank to the city's storm drain system. There will be no increase in flows or intensity from historic storm events.

```
****************************************************************************
          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM BASED ON
       RIVERSIDE COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT
                 (RCFC&WCD)  1978 HYDROLOGY MANUAL
      (c) Copyright 1982-2016 Advanced Engineering Software (aes)
                  (Rational Tabling Version 23.0)
              Release Date: 07/01/2016  License ID 1533

                       Analysis prepared by:

             THATCHER ENGINEERING & ASSOCIATES, INC.
                   1461 FORD STREET, SUITE 105
                        REDLANDS, CA 92373
            PHONE: (909) 748-7777   FAX: (909) 748-7776

 ************************* DESCRIPTION OF STUDY *************************
 * APN 297-170-002 & 003                                                *
 * PRE DEVELOPMENT HCOC                                                 *
 * 2-YEAR STORM EVENT                                                   *
 ************************************************************************

  FILE NAME: 162012HC.DAT
  TIME/DATE OF STUDY: 11:29 07/13/2020
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   3.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  10-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  1.650
  10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  0.734
  100-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.720
  100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  1.210
  SLOPE OF 10-YEAR INTENSITY-DURATION CURVE =  0.4520815
  SLOPE OF 100-YEAR INTENSITY-DURATION CURVE =  0.4520759
  COMPUTED RAINFALL INTENSITY DATA:
  STORM EVENT =    2.00   1-HOUR INTENSITY(INCH/HOUR) =   0.401
  SLOPE OF INTENSITY DURATION CURVE = 0.4521
  RCFC&WCD HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: COMPUTE CONFLUENCE VALUES ACCORDING TO RCFC&WCD HYDROLOGY MANUAL
        AND IGNORE OTHER CONFLUENCE COMBINATIONS FOR DOWNSTREAM ANALYSES
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:  CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.  (FT)     (FT)     SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
 1   30.0     20.0     0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
```

```
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE      2.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS: UNDEVELOPED WITH POOR COVER
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    60.00
  UPSTREAM ELEVATION(FEET) =     82.50
  DOWNSTREAM ELEVATION(FEET) =     78.00
  ELEVATION DIFFERENCE(FEET) =      4.50
  TC = 0.533*[(   60.00**3)/(     4.50)]**.2 =    4.599
  COMPUTED TIME OF CONCENTRATION INCREASED TO 5 MIN.
     2 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.234
  UNDEVELOPED WATERSHED RUNOFF COEFFICIENT = .6059
  SOIL CLASSIFICATION IS "C"
  SUBAREA RUNOFF(CFS) =      0.48
  TOTAL AREA(ACRES) =      0.64   TOTAL RUNOFF(CFS) =      0.48

****************************************************************************
  FLOW PROCESS FROM NODE      3.00 TO NODE      4.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS: UNDEVELOPED WITH POOR COVER
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    62.00
  UPSTREAM ELEVATION(FEET) =     82.50
  DOWNSTREAM ELEVATION(FEET) =     80.20
  ELEVATION DIFFERENCE(FEET) =      2.30
  TC = 0.533*[(   62.00**3)/(     2.30)]**.2 =    5.364
     2 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.195
  UNDEVELOPED WATERSHED RUNOFF COEFFICIENT = .5996
  SOIL CLASSIFICATION IS "C"
  SUBAREA RUNOFF(CFS) =      0.46
  TOTAL AREA(ACRES) =      0.64   TOTAL RUNOFF(CFS) =      0.46

****************************************************************************
  FLOW PROCESS FROM NODE      5.00 TO NODE      6.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS: UNDEVELOPED WITH POOR COVER
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =    62.00
  UPSTREAM ELEVATION(FEET) =     82.50
  DOWNSTREAM ELEVATION(FEET) =     78.50
  ELEVATION DIFFERENCE(FEET) =      4.00
  TC = 0.533*[(   62.00**3)/(     4.00)]**.2 =    4.802
```

```
  COMPUTED TIME OF CONCENTRATION INCREASED TO 5 MIN.
     2 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.234
  UNDEVELOPED WATERSHED RUNOFF COEFFICIENT = .6059
  SOIL CLASSIFICATION IS "C"
  SUBAREA RUNOFF(CFS) =      0.60
  TOTAL AREA(ACRES) =      0.80   TOTAL RUNOFF(CFS) =      0.60

****************************************************************************
  FLOW PROCESS FROM NODE      7.00 TO NODE      8.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS: UNDEVELOPED WITH FAIR COVER
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   598.00
  UPSTREAM ELEVATION(FEET) =     78.00
  DOWNSTREAM ELEVATION(FEET) =     72.00
  ELEVATION DIFFERENCE(FEET) =      6.00
  TC = 0.709*[(  598.00**3)/(     6.00)]**.2 =   22.976
     2 YEAR RAINFALL INTENSITY(INCH/HOUR) =  0.619
  UNDEVELOPED WATERSHED RUNOFF COEFFICIENT = .4575
  SOIL CLASSIFICATION IS "C"
  SUBAREA RUNOFF(CFS) =      3.63
  TOTAL AREA(ACRES) =     12.82   TOTAL RUNOFF(CFS) =      3.63

****************************************************************************
  FLOW PROCESS FROM NODE      9.00 TO NODE     10.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS: UNDEVELOPED WITH FAIR COVER
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   607.00
  UPSTREAM ELEVATION(FEET) =     78.50
  DOWNSTREAM ELEVATION(FEET) =     71.80
  ELEVATION DIFFERENCE(FEET) =      6.70
  TC = 0.709*[(  607.00**3)/(     6.70)]**.2 =   22.677
     2 YEAR RAINFALL INTENSITY(INCH/HOUR) =  0.623
  UNDEVELOPED WATERSHED RUNOFF COEFFICIENT = .4588
  SOIL CLASSIFICATION IS "C"
  SUBAREA RUNOFF(CFS) =      2.27
  TOTAL AREA(ACRES) =      7.94   TOTAL RUNOFF(CFS) =      2.27
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        7.9  TC(MIN.) =     22.68
  PEAK FLOW RATE(CFS)   =       2.27
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
____________________________________________________________________________
****************************************************************************
          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM BASED ON
      RIVERSIDE COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT
                  (RCFC&WCD)  1978 HYDROLOGY MANUAL
        (c) Copyright 1982-2016 Advanced Engineering Software (aes)
                   (Rational Tabling Version 23.0)
               Release Date: 07/01/2016  License ID 1533

                         Analysis prepared by:

                THATCHER ENGINEERING & ASSOCIATES, INC.
                      1461 FORD STREET, SUITE 105
                          REDLANDS, CA 92373
              PHONE: (909) 748-7777    FAX: (909) 748-7776

 ************************** DESCRIPTION OF STUDY **************************
* APN 297-170-002 & 003                                                    *
* POST-DEVELOPMENT DRAINAGE STUDY                                          *
* 2-YEAR STORM EVENT                                                       *
 **************************************************************************

  FILE NAME: 162012PO.DAT
  TIME/DATE OF STUDY: 11:37 07/13/2020
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   3.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  10-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  1.650
  10-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  0.734
  100-YEAR STORM 10-MINUTE INTENSITY(INCH/HOUR) =  2.720
  100-YEAR STORM 60-MINUTE INTENSITY(INCH/HOUR) =  1.210
  SLOPE OF 10-YEAR INTENSITY-DURATION CURVE =  0.4520815
  SLOPE OF 100-YEAR INTENSITY-DURATION CURVE =  0.4520759
  COMPUTED RAINFALL INTENSITY DATA:
  STORM EVENT =    2.00   1-HOUR INTENSITY(INCH/HOUR) =   0.401
  SLOPE OF INTENSITY DURATION CURVE = 0.4521
  RCFC&WCD HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: COMPUTE CONFLUENCE VALUES ACCORDING TO RCFC&WCD HYDROLOGY MANUAL
        AND IGNORE OTHER CONFLUENCE COMBINATIONS FOR DOWNSTREAM ANALYSES
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:  CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK- HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY   (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================= ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020  0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
```

```
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

****************************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE      2.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   427.00
  UPSTREAM ELEVATION(FEET) =     83.00
  DOWNSTREAM ELEVATION(FEET) =     80.80
  ELEVATION DIFFERENCE(FEET) =      2.20
  TC = 0.303*[(  427.00**3)/(     2.20)]**.2 =    9.803
     2 YEAR RAINFALL INTENSITY(INCH/HOUR) =  0.910
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8643
  SOIL CLASSIFICATION IS "C"
  SUBAREA RUNOFF(CFS) =      0.50
  TOTAL AREA(ACRES) =      0.64   TOTAL RUNOFF(CFS) =      0.50

****************************************************************************
  FLOW PROCESS FROM NODE      2.00 TO NODE      2.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    9.80
  RAINFALL INTENSITY(INCH/HR) =   0.91
  TOTAL STREAM AREA(ACRES) =     0.64
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.50

****************************************************************************
  FLOW PROCESS FROM NODE      3.00 TO NODE      2.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   443.00
  UPSTREAM ELEVATION(FEET) =     83.00
  DOWNSTREAM ELEVATION(FEET) =     80.80
  ELEVATION DIFFERENCE(FEET) =      2.20
  TC = 0.303*[(  443.00**3)/(     2.20)]**.2 =   10.022
     2 YEAR RAINFALL INTENSITY(INCH/HOUR) =  0.901
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8641
  SOIL CLASSIFICATION IS "C"
  SUBAREA RUNOFF(CFS) =      0.50
  TOTAL AREA(ACRES) =      0.64   TOTAL RUNOFF(CFS) =      0.50

****************************************************************************
  FLOW PROCESS FROM NODE      2.00 TO NODE      2.00 IS CODE =   1
```

```
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.02
  RAINFALL INTENSITY(INCH/HR) =   0.90
  TOTAL STREAM AREA(ACRES) =     0.64
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.50

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
     1         0.50      9.80        0.910         0.64
     2         0.50     10.02        0.901         0.64

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

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

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF       Tc      INTENSITY
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)
     1         0.99      9.80       0.910
     2         1.00     10.02       0.901

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       0.99   Tc(MIN.) =    9.80
  TOTAL AREA(ACRES) =        1.3
  LONGEST FLOWPATH FROM NODE      3.00 TO NODE      2.00 =     443.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.00 TO NODE      5.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   551.00
  UPSTREAM ELEVATION(FEET) =     83.00
  DOWNSTREAM ELEVATION(FEET) =     80.00
  ELEVATION DIFFERENCE(FEET) =      3.00
  TC = 0.303*[(  551.00**3)/(     3.00)]**.2 =   10.736
     2 YEAR RAINFALL INTENSITY(INCH/HOUR) =  0.874
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8634
  SOIL CLASSIFICATION IS "C"
  SUBAREA RUNOFF(CFS) =      0.60
```

```
  TOTAL AREA(ACRES) =      0.80   TOTAL RUNOFF(CFS) =      0.60

****************************************************************************
  FLOW PROCESS FROM NODE      6.00 TO NODE      7.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   622.00
  UPSTREAM ELEVATION(FEET) =     82.20
  DOWNSTREAM ELEVATION(FEET) =     72.00
  ELEVATION DIFFERENCE(FEET) =     10.20
  TC = 0.303*[(  622.00**3)/(    10.20)]**.2 =    9.039
     2 YEAR RAINFALL INTENSITY(INCH/HOUR) =  0.944
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8651
  SOIL CLASSIFICATION IS "C"
  SUBAREA RUNOFF(CFS) =      5.46
  TOTAL AREA(ACRES) =      6.68   TOTAL RUNOFF(CFS) =      5.46

****************************************************************************
  FLOW PROCESS FROM NODE      7.00 TO NODE      7.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    9.04
  RAINFALL INTENSITY(INCH/HR) =   0.94
  TOTAL STREAM AREA(ACRES) =     6.68
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      5.46

****************************************************************************
  FLOW PROCESS FROM NODE      8.00 TO NODE      7.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   637.00
  UPSTREAM ELEVATION(FEET) =     80.50
  DOWNSTREAM ELEVATION(FEET) =     73.50
  ELEVATION DIFFERENCE(FEET) =      7.00
  TC = 0.303*[(  637.00**3)/(     7.00)]**.2 =    9.887
     2 YEAR RAINFALL INTENSITY(INCH/HOUR) =  0.907
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8642
  SOIL CLASSIFICATION IS "C"
  SUBAREA RUNOFF(CFS) =      4.81
  TOTAL AREA(ACRES) =      6.14   TOTAL RUNOFF(CFS) =      4.81

****************************************************************************
  FLOW PROCESS FROM NODE      7.00 TO NODE      7.00 IS CODE =   1
```

```
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    9.89
  RAINFALL INTENSITY(INCH/HR) =   0.91
  TOTAL STREAM AREA(ACRES) =    6.14
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      4.81

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        5.46      9.04        0.944          6.68
      2        4.81      9.89        0.907          6.14

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

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

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF       Tc      INTENSITY
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)
      1        9.86      9.04       0.944
      2       10.05      9.89       0.907

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       9.86   Tc(MIN.) =    9.04
  TOTAL AREA(ACRES) =      12.8
  LONGEST FLOWPATH FROM NODE      8.00 TO NODE      7.00 =     637.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      9.00 TO NODE     10.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
        ASSUMED INITIAL SUBAREA UNIFORM
        DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   704.00
  UPSTREAM ELEVATION(FEET) =     80.20
  DOWNSTREAM ELEVATION(FEET) =     71.80
  ELEVATION DIFFERENCE(FEET) =      8.40
  TC = 0.303*[(  704.00**3)/(     8.40)]**.2 =   10.122
     2 YEAR RAINFALL INTENSITY(INCH/HOUR) =  0.897
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8640
  SOIL CLASSIFICATION IS "C"
  SUBAREA RUNOFF(CFS) =      2.28
```

```
  TOTAL AREA(ACRES) =      2.94   TOTAL RUNOFF(CFS) =      2.28

****************************************************************************
  FLOW PROCESS FROM NODE     10.00 TO NODE     10.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.12
  RAINFALL INTENSITY(INCH/HR) =   0.90
  TOTAL STREAM AREA(ACRES) =     2.94
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.28

****************************************************************************
  FLOW PROCESS FROM NODE     11.00 TO NODE     10.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS COMMERCIAL
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   705.00
  UPSTREAM ELEVATION(FEET) =     81.20
  DOWNSTREAM ELEVATION(FEET) =     10.10
  ELEVATION DIFFERENCE(FEET) =     71.10
  TC = 0.303*[(  705.00**3)/(    71.10)]**.2 =    6.609
     2 YEAR RAINFALL INTENSITY(INCH/HOUR) =  1.088
  COMMERCIAL DEVELOPMENT RUNOFF COEFFICIENT = .8680
  SOIL CLASSIFICATION IS "C"
  SUBAREA RUNOFF(CFS) =     2.01
  TOTAL AREA(ACRES) =      2.13   TOTAL RUNOFF(CFS) =      2.01

****************************************************************************
  FLOW PROCESS FROM NODE     10.00 TO NODE     10.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    6.61
  RAINFALL INTENSITY(INCH/HR) =   1.09
  TOTAL STREAM AREA(ACRES) =     2.13
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      2.01

****************************************************************************
  FLOW PROCESS FROM NODE     12.00 TO NODE     10.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
         ASSUMED INITIAL SUBAREA UNIFORM
         DEVELOPMENT IS: UNDEVELOPED WITH FAIR COVER
  TC = K*[(LENGTH**3)/(ELEVATION CHANGE)]**.2
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   695.00
```

```
  UPSTREAM ELEVATION(FEET) =     81.50
  DOWNSTREAM ELEVATION(FEET) =     71.20
  ELEVATION DIFFERENCE(FEET) =     10.30
  TC = 0.709*[(  695.00**3)/(    10.30)]**.2 =   22.569
     2 YEAR RAINFALL INTENSITY(INCH/HOUR) =  0.624
  UNDEVELOPED WATERSHED RUNOFF COEFFICIENT = .4593
  SOIL CLASSIFICATION IS "C"
  SUBAREA RUNOFF(CFS) =      0.81
  TOTAL AREA(ACRES) =      2.84   TOTAL RUNOFF(CFS) =      0.81

****************************************************************************
  FLOW PROCESS FROM NODE     10.00 TO NODE     10.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  3 ARE:
  TIME OF CONCENTRATION(MIN.) =   22.57
  RAINFALL INTENSITY(INCH/HR) =   0.62
  TOTAL STREAM AREA(ACRES) =     2.84
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      0.81

  ** CONFLUENCE DATA **
  STREAM     RUNOFF       Tc      INTENSITY      AREA
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)    (ACRE)
      1        2.28    10.12        0.897          2.94
      2        2.01     6.61        1.088          2.13
      3        0.81    22.57        0.624          2.84

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

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  3 STREAMS.

  ** PEAK FLOW RATE TABLE **
  STREAM     RUNOFF       Tc      INTENSITY
  NUMBER      (CFS)     (MIN.)   (INCH/HOUR)
      1        3.74     6.61       1.088
      2        4.30    10.12       0.897
      3        3.55    22.57       0.624

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =        4.30   Tc(MIN.) =   10.12
  TOTAL AREA(ACRES) =        7.9
  LONGEST FLOWPATH FROM NODE     11.00 TO NODE     10.00 =     705.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)      =        7.9  TC(MIN.) =     10.12
  PEAK FLOW RATE(CFS)    =       4.30
```

```
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
        NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                 AND LOW LOSS FRACTION ESTIMATIONS
============================================================================
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                       Analysis prepared by:

             THATCHER ENGINEERING & ASSOCIATES, INC.
                   1461 FORD STREET, SUITE 105
                        REDLANDS, CA 92373
           PHONE: (909) 748-7777   FAX: (909) 748-7776

****************************************************************************
----------------------------------------------------------------------------

 Problem Descriptions:
  APN 297-170-002 & 003
  PRE-DEVELOPMENT DA1
  2-YEAR STORM EVENT
============================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC I:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     1.83 (inches)

    SOIL-COVER     AREA      PERCENT OF    SCS CURVE    LOSS RATE
       TYPE      (Acres)   PERVIOUS AREA    NUMBER    Fp(in./hr.)    YIELD
        1         12.82       100.00       79.(AMC II)     0.648       0.030

    TOTAL AREA (Acres) =     12.82

    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.648

    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.970
============================================================================
```

```
****************************************************************************
        NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                  AND LOW LOSS FRACTION ESTIMATIONS
============================================================================
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                      1461 FORD STREET, SUITE 105
                           REDLANDS, CA 92373
              PHONE: (909) 748-7777   FAX: (909) 748-7776

****************************************************************************
----------------------------------------------------------------------------

 Problem Descriptions:
  APN 297-170-002 & 003
  PRE-DEVELOPMENT DA2
  2-YEAR STORM EVENT
============================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC I:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     1.83 (inches)

    SOIL-COVER     AREA     PERCENT OF    SCS CURVE    LOSS RATE
       TYPE      (Acres)  PERVIOUS AREA    NUMBER    Fp(in./hr.)     YIELD
        1          0.28        0.00       98.(AMC II)    0.000        0.878
        2          7.66      100.00       79.(AMC II)    0.648        0.030

    TOTAL AREA (Acres) =       7.94

    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.625

    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.940
============================================================================
```

```
****************************************************************************
          NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                    AND LOW LOSS FRACTION ESTIMATIONS
============================================================================
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                     1461 FORD STREET, SUITE 105
                          REDLANDS, CA 92373
              PHONE: (909) 748-7777   FAX: (909) 748-7776

****************************************************************************
----------------------------------------------------------------------------

 Problem Descriptions:
  APN 297-170-002 & 003
  PRE-DEVELOPMENT DA3
  2-YEAR STORM EVENT
============================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC I:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     1.83 (inches)

    SOIL-COVER     AREA      PERCENT OF    SCS CURVE    LOSS RATE
       TYPE      (Acres)   PERVIOUS AREA    NUMBER    Fp(in./hr.)     YIELD
         1          0.30      100.00       91.(AMC II)     0.370        0.252
         2          0.34        0.00       98.(AMC II)     0.000        0.878

    TOTAL AREA (Acres) =      0.64

    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.173

    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.415
============================================================================
```

```
****************************************************************************
       NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                 AND LOW LOSS FRACTION ESTIMATIONS
============================================================================
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                      1461 FORD STREET, SUITE 105
                           REDLANDS, CA 92373
              PHONE: (909) 748-7777   FAX: (909) 748-7776

****************************************************************************
----------------------------------------------------------------------------

 Problem Descriptions:
  APN 297-170-002 & 003
  PRE-DEVELOPMENT DA4
  2-YEAR STORM EVENT
============================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC I:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     1.83 (inches)

    SOIL-COVER     AREA      PERCENT OF    SCS CURVE    LOSS RATE
       TYPE       (Acres)   PERVIOUS AREA   NUMBER    Fp(in./hr.)     YIELD
         1          0.31      100.00      91.(AMC II)     0.370        0.252
         2          0.33        0.00      98.(AMC II)     0.000        0.878

    TOTAL AREA (Acres) =      0.64

    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.179

    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.425
============================================================================
```

```
****************************************************************************
           NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                     AND LOW LOSS FRACTION ESTIMATIONS
============================================================================
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                             REDLANDS, CA 92373
                PHONE: (909) 748-7777   FAX: (909) 748-7776

****************************************************************************
----------------------------------------------------------------------------

 Problem Descriptions:
  APN 297-170-002 & 003
  PRE-DEVELOPMENT DA5
  2-YEAR STORM EVENT
============================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC I:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     1.83 (inches)

    SOIL-COVER     AREA      PERCENT OF    SCS CURVE    LOSS RATE
       TYPE      (Acres)   PERVIOUS AREA    NUMBER    Fp(in./hr.)     YIELD
         1          0.36      100.00       91.(AMC II)     0.370       0.252
         2          0.44        0.00       98.(AMC II)     0.000       0.878

    TOTAL AREA (Acres) =       0.80
                             _
    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.167
                                     _
    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.404
============================================================================
```

```
****************************************************************************
                      SMALL AREA UNIT HYDROGRAPH MODEL
============================================================================
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                           Analysis prepared by:

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                       1461 FORD STREET, SUITE 105
                            REDLANDS, CA 92373
               PHONE: (909) 748-7777   FAX: (909) 748-7776

****************************************************************************
----------------------------------------------------------------------------

 Problem Descriptions:
  APN 297-170-002 & 003
  PRE-DEVELOPMENT DA1
  2-YEAR STORM EVENT
----------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
    TOTAL CATCHMENT AREA(ACRES) =   12.82
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.648
    LOW LOSS FRACTION = 0.970
    TIME OF CONCENTRATION(MIN.) = 22.98
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    USER SPECIFIED RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =   2
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.12
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.32
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.45
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  0.78
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.07
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  1.83

----------------------------------------------------------------------------

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     0.07
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     1.88

****************************************************************************
  TIME     VOLUME      Q    0.        2.5       5.0       7.5      10.0
 (HOURS)    (AF)     (CFS)
----------------------------------------------------------------------------
  0.30     0.0001     0.01  Q         .         .         .         .
  0.68     0.0005     0.01  Q         .         .         .         .
  1.06     0.0008     0.01  Q         .         .         .         .
  1.45     0.0011     0.01  Q         .         .         .         .
  1.83     0.0015     0.01  Q         .         .         .         .
  2.21     0.0018     0.01  Q         .         .         .         .
  2.60     0.0022     0.01  Q         .         .         .         .
  2.98     0.0025     0.01  Q         .         .         .         .
  3.36     0.0029     0.01  Q         .         .         .         .
```

```
      3.74        0.0033       0.01  Q          .          .          .          .
      4.13        0.0036       0.01  Q          .          .          .          .
      4.51        0.0040       0.01  Q          .          .          .          .
      4.89        0.0044       0.01  Q          .          .          .          .
      5.28        0.0048       0.01  Q          .          .          .          .
      5.66        0.0052       0.01  Q          .          .          .          .
      6.04        0.0056       0.01  Q          .          .          .          .
      6.43        0.0061       0.01  Q          .          .          .          .
      6.81        0.0065       0.01  Q          .          .          .          .
      7.19        0.0070       0.01  Q          .          .          .          .
      7.57        0.0074       0.01  Q          .          .          .          .
      7.96        0.0079       0.02  Q          .          .          .          .
      8.34        0.0084       0.02  Q          .          .          .          .
      8.72        0.0089       0.02  Q          .          .          .          .
      9.11        0.0094       0.02  Q          .          .          .          .
      9.49        0.0099       0.02  Q          .          .          .          .
      9.87        0.0105       0.02  Q          .          .          .          .
     10.26        0.0111       0.02  Q          .          .          .          .
     10.64        0.0117       0.02  Q          .          .          .          .
     11.02        0.0123       0.02  Q          .          .          .          .
     11.40        0.0129       0.02  Q          .          .          .          .
     11.79        0.0136       0.02  Q          .          .          .          .
     12.17        0.0144       0.02  Q          .          .          .          .
     12.55        0.0152       0.03  Q          .          .          .          .
     12.94        0.0161       0.03  Q          .          .          .          .
     13.32        0.0171       0.03  Q          .          .          .          .
     13.70        0.0182       0.04  Q          .          .          .          .
     14.09        0.0194       0.04  Q          .          .          .          .
     14.47        0.0207       0.05  Q          .          .          .          .
     14.85        0.0223       0.05  Q          .          .          .          .
     15.23        0.0241       0.06  Q          .          .          .          .
     15.62        0.0263       0.08  Q          .          .          .          .
     16.00        0.0292       0.11  Q          .          .          .          .
     16.38        0.0445       0.85  .   Q      .          .          .          .
     16.77        0.0591       0.07  Q          .          .          .          .
     17.15        0.0609       0.05  Q          .          .          .          .
     17.53        0.0623       0.04  Q          .          .          .          .
     17.92        0.0634       0.03  Q          .          .          .          .
     18.30        0.0643       0.03  Q          .          .          .          .
     18.68        0.0651       0.02  Q          .          .          .          .
     19.06        0.0657       0.02  Q          .          .          .          .
     19.45        0.0663       0.02  Q          .          .          .          .
     19.83        0.0669       0.02  Q          .          .          .          .
     20.21        0.0674       0.02  Q          .          .          .          .
     20.60        0.0679       0.01  Q          .          .          .          .
     20.98        0.0683       0.01  Q          .          .          .          .
     21.36        0.0688       0.01  Q          .          .          .          .
     21.74        0.0692       0.01  Q          .          .          .          .
     22.13        0.0696       0.01  Q          .          .          .          .
     22.51        0.0700       0.01  Q          .          .          .          .
     22.89        0.0704       0.01  Q          .          .          .          .
     23.28        0.0707       0.01  Q          .          .          .          .
     23.66        0.0711       0.01  Q          .          .          .          .
     24.04        0.0714       0.01  Q          .          .          .          .
     24.43        0.0716       0.00  Q          .          .          .          .
  -----------------------------------------------------------------------------
-------------------------------------------------------------------------------
```

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

Percentile of Estimated                 Duration
    Peak Flow Rate                      (minutes)
=======================                 =========
          0%                             1447.7
         10%                               46.0
         20%                               23.0
         30%                               23.0
         40%                               23.0
         50%                               23.0
         60%                               23.0
         70%                               23.0
         80%                               23.0
         90%                               23.0
```

```
******************************************************************************
                      SMALL AREA UNIT HYDROGRAPH MODEL
==============================================================================
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                         Analysis prepared by:

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                      1461 FORD STREET, SUITE 105
                           REDLANDS, CA 92373
              PHONE: (909) 748-7777   FAX: (909) 748-7776

******************************************************************************
------------------------------------------------------------------------------

 Problem Descriptions:
  APN 297-170-002 & 003
  PRE-DEVELOPMENT DA2
  2-YEAR STORM EVENT
------------------------------------------------------------------------------


   RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
   TOTAL CATCHMENT AREA(ACRES) =    7.94
   SOIL-LOSS RATE, Fm,(INCH/HR) =  0.625
   LOW LOSS FRACTION = 0.940
   TIME OF CONCENTRATION(MIN.) = 22.68
   SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
   USER SPECIFIED RAINFALL VALUES ARE USED
   RETURN FREQUENCY(YEARS) =   2
      5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.12
     30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.32
      1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.45
      3-HOUR   POINT RAINFALL VALUE(INCHES) =  0.78
      6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.07
     24-HOUR   POINT RAINFALL VALUE(INCHES) =  1.83

------------------------------------------------------------------------------

   TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     0.08
   TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     1.13

******************************************************************************
  TIME     VOLUME       Q   0.        2.5       5.0       7.5      10.0
 (HOURS)    (AF)      (CFS)
------------------------------------------------------------------------------
  0.12     0.0000      0.00  Q         .         .         .         .
  0.50     0.0002      0.01  Q         .         .         .         .
  0.88     0.0006      0.01  Q         .         .         .         .
  1.26     0.0010      0.01  Q         .         .         .         .
  1.64     0.0014      0.01  Q         .         .         .         .
  2.01     0.0018      0.01  Q         .         .         .         .
  2.39     0.0023      0.01  Q         .         .         .         .
  2.77     0.0027      0.01  Q         .         .         .         .
  3.15     0.0031      0.01  Q         .         .         .         .
```

```
   3.53      0.0036      0.01  Q         .         .         .         .
   3.90      0.0041      0.01  Q         .         .         .         .
   4.28      0.0045      0.02  Q         .         .         .         .
   4.66      0.0050      0.02  Q         .         .         .         .
   5.04      0.0055      0.02  Q         .         .         .         .
   5.42      0.0060      0.02  Q         .         .         .         .
   5.79      0.0065      0.02  Q         .         .         .         .
   6.17      0.0070      0.02  Q         .         .         .         .
   6.55      0.0075      0.02  Q         .         .         .         .
   6.93      0.0081      0.02  Q         .         .         .         .
   7.31      0.0086      0.02  Q         .         .         .         .
   7.68      0.0092      0.02  Q         .         .         .         .
   8.06      0.0098      0.02  Q         .         .         .         .
   8.44      0.0104      0.02  Q         .         .         .         .
   8.82      0.0110      0.02  Q         .         .         .         .
   9.20      0.0116      0.02  Q         .         .         .         .
   9.57      0.0123      0.02  Q         .         .         .         .
   9.95      0.0130      0.02  Q         .         .         .         .
  10.33      0.0137      0.02  Q         .         .         .         .
  10.71      0.0144      0.02  Q         .         .         .         .
  11.09      0.0152      0.03  Q         .         .         .         .
  11.46      0.0160      0.03  Q         .         .         .         .
  11.84      0.0168      0.03  Q         .         .         .         .
  12.22      0.0177      0.03  Q         .         .         .         .
  12.60      0.0188      0.04  Q         .         .         .         .
  12.98      0.0199      0.04  Q         .         .         .         .
  13.35      0.0212      0.04  Q         .         .         .         .
  13.73      0.0225      0.04  Q         .         .         .         .
  14.11      0.0239      0.05  Q         .         .         .         .
  14.49      0.0256      0.06  Q         .         .         .         .
  14.87      0.0275      0.07  Q         .         .         .         .
  15.24      0.0298      0.07  Q         .         .         .         .
  15.62      0.0325      0.10  Q         .         .         .         .
  16.00      0.0361      0.13  Q         .         .         .         .
  16.38      0.0495      0.72  . Q       .         .         .         .
  16.76      0.0621      0.08  Q         .         .         .         .
  17.13      0.0644      0.06  Q         .         .         .         .
  17.51      0.0661      0.05  Q         .         .         .         .
  17.89      0.0674      0.04  Q         .         .         .         .
  18.27      0.0686      0.03  Q         .         .         .         .
  18.65      0.0695      0.03  Q         .         .         .         .
  19.02      0.0703      0.02  Q         .         .         .         .
  19.40      0.0711      0.02  Q         .         .         .         .
  19.78      0.0718      0.02  Q         .         .         .         .
  20.16      0.0724      0.02  Q         .         .         .         .
  20.54      0.0730      0.02  Q         .         .         .         .
  20.91      0.0736      0.02  Q         .         .         .         .
  21.29      0.0741      0.02  Q         .         .         .         .
  21.67      0.0746      0.02  Q         .         .         .         .
  22.05      0.0751      0.02  Q         .         .         .         .
  22.43      0.0756      0.01  Q         .         .         .         .
  22.80      0.0761      0.01  Q         .         .         .         .
  23.18      0.0765      0.01  Q         .         .         .         .
  23.56      0.0769      0.01  Q         .         .         .         .
  23.94      0.0773      0.01  Q         .         .         .         .
  24.32      0.0777      0.01  Q         .         .         .         .
  24.69      0.0779      0.00  Q         .         .         .         .
```

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

    Percentile of Estimated                  Duration
        Peak Flow Rate                       (minutes)
    =======================                  =========
               0%                             1451.5
              10%                              113.4
              20%                               22.7
              30%                               22.7
              40%                               22.7
              50%                               22.7
              60%                               22.7
              70%                               22.7
              80%                               22.7
              90%                               22.7
```

```
****************************************************************************
                    SMALL AREA UNIT HYDROGRAPH MODEL
============================================================================
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             Ver. 23.0  Release Date: 07/01/2016  License ID 1533

                          Analysis prepared by:

                 THATCHER ENGINEERING & ASSOCIATES, INC.
                       1461 FORD STREET, SUITE 105
                            REDLANDS, CA 92373
                PHONE: (909) 748-7777   FAX: (909) 748-7776

****************************************************************************
----------------------------------------------------------------------------

 Problem Descriptions:
  APN 297-170-002 & 003
  PRE-DEVELOPMENT DA3
  2-YEAR STORM EVENT
----------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
    TOTAL CATCHMENT AREA(ACRES) =    0.64
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.173
    LOW LOSS FRACTION = 0.415
    TIME OF CONCENTRATION(MIN.) =  5.00
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    USER SPECIFIED RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =   2
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.12
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.32
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.45
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  0.78
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.07
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  1.83

----------------------------------------------------------------------------

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     0.05
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.04

****************************************************************************
  TIME     VOLUME       Q    0.         2.5        5.0        7.5       10.0
 (HOURS)    (AF)      (CFS)
----------------------------------------------------------------------------
  0.08     0.0000      0.01  Q          .          .          .          .
  0.17     0.0001      0.01  Q          .          .          .          .
  0.25     0.0002      0.01  Q          .          .          .          .
  0.33     0.0002      0.01  Q          .          .          .          .
  0.42     0.0003      0.01  Q          .          .          .          .
  0.50     0.0004      0.01  Q          .          .          .          .
  0.58     0.0004      0.01  Q          .          .          .          .
  0.67     0.0005      0.01  Q          .          .          .          .
  0.75     0.0006      0.01  Q          .          .          .          .
```

```
0.83      0.0007      0.01  Q          .         .         .         .
0.92      0.0007      0.01  Q          .         .         .         .
1.00      0.0008      0.01  Q          .         .         .         .
1.08      0.0009      0.01  Q          .         .         .         .
1.17      0.0009      0.01  Q          .         .         .         .
1.25      0.0010      0.01  Q          .         .         .         .
1.33      0.0011      0.01  Q          .         .         .         .
1.42      0.0012      0.01  Q          .         .         .         .
1.50      0.0012      0.01  Q          .         .         .         .
1.58      0.0013      0.01  Q          .         .         .         .
1.67      0.0014      0.01  Q          .         .         .         .
1.75      0.0015      0.01  Q          .         .         .         .
1.83      0.0015      0.01  Q          .         .         .         .
1.92      0.0016      0.01  Q          .         .         .         .
2.00      0.0017      0.01  Q          .         .         .         .
2.08      0.0017      0.01  Q          .         .         .         .
2.17      0.0018      0.01  Q          .         .         .         .
2.25      0.0019      0.01  Q          .         .         .         .
2.33      0.0020      0.01  Q          .         .         .         .
2.42      0.0020      0.01  Q          .         .         .         .
2.50      0.0021      0.01  Q          .         .         .         .
2.58      0.0022      0.01  Q          .         .         .         .
2.67      0.0023      0.01  Q          .         .         .         .
2.75      0.0024      0.01  Q          .         .         .         .
2.83      0.0024      0.01  Q          .         .         .         .
2.92      0.0025      0.01  Q          .         .         .         .
3.00      0.0026      0.01  Q          .         .         .         .
3.08      0.0027      0.01  Q          .         .         .         .
3.17      0.0027      0.01  Q          .         .         .         .
3.25      0.0028      0.01  Q          .         .         .         .
3.33      0.0029      0.01  Q          .         .         .         .
3.42      0.0030      0.01  Q          .         .         .         .
3.50      0.0031      0.01  Q          .         .         .         .
3.58      0.0031      0.01  Q          .         .         .         .
3.67      0.0032      0.01  Q          .         .         .         .
3.75      0.0033      0.01  Q          .         .         .         .
3.83      0.0034      0.01  Q          .         .         .         .
3.92      0.0035      0.01  Q          .         .         .         .
4.00      0.0035      0.01  Q          .         .         .         .
4.08      0.0036      0.01  Q          .         .         .         .
4.17      0.0037      0.01  Q          .         .         .         .
4.25      0.0038      0.01  Q          .         .         .         .
4.33      0.0039      0.01  Q          .         .         .         .
4.42      0.0039      0.01  Q          .         .         .         .
4.50      0.0040      0.01  Q          .         .         .         .
4.58      0.0041      0.01  Q          .         .         .         .
4.67      0.0042      0.01  Q          .         .         .         .
4.75      0.0043      0.01  Q          .         .         .         .
4.83      0.0044      0.01  Q          .         .         .         .
4.92      0.0045      0.01  Q          .         .         .         .
5.00      0.0045      0.01  Q          .         .         .         .
5.08      0.0046      0.01  Q          .         .         .         .
5.17      0.0047      0.01  Q          .         .         .         .
5.25      0.0048      0.01  Q          .         .         .         .
5.33      0.0049      0.01  Q          .         .         .         .
5.42      0.0050      0.01  Q          .         .         .         .
5.50      0.0051      0.01  Q          .         .         .         .
```

```
   5.58        0.0051       0.01  Q          .          .          .          .
   5.67        0.0052       0.01  Q          .          .          .          .
   5.75        0.0053       0.01  Q          .          .          .          .
   5.83        0.0054       0.01  Q          .          .          .          .
   5.92        0.0055       0.01  Q          .          .          .          .
   6.00        0.0056       0.01  Q          .          .          .          .
   6.08        0.0057       0.01  Q          .          .          .          .
   6.17        0.0058       0.01  Q          .          .          .          .
   6.25        0.0059       0.01  Q          .          .          .          .
   6.33        0.0060       0.01  Q          .          .          .          .
   6.42        0.0061       0.01  Q          .          .          .          .
   6.50        0.0062       0.01  Q          .          .          .          .
   6.58        0.0062       0.01  Q          .          .          .          .
   6.67        0.0063       0.01  Q          .          .          .          .
   6.75        0.0064       0.01  Q          .          .          .          .
   6.83        0.0065       0.01  Q          .          .          .          .
   6.92        0.0066       0.01  Q          .          .          .          .
   7.00        0.0067       0.01  Q          .          .          .          .
   7.08        0.0068       0.01  Q          .          .          .          .
   7.17        0.0069       0.01  Q          .          .          .          .
   7.25        0.0070       0.01  Q          .          .          .          .
   7.33        0.0071       0.01  Q          .          .          .          .
   7.42        0.0072       0.01  Q          .          .          .          .
   7.50        0.0073       0.01  Q          .          .          .          .
   7.58        0.0074       0.01  Q          .          .          .          .
   7.67        0.0075       0.01  Q          .          .          .          .
   7.75        0.0076       0.01  Q          .          .          .          .
   7.83        0.0077       0.01  Q          .          .          .          .
   7.92        0.0078       0.02  Q          .          .          .          .
   8.00        0.0079       0.02  Q          .          .          .          .
   8.08        0.0080       0.02  Q          .          .          .          .
   8.17        0.0081       0.02  Q          .          .          .          .
   8.25        0.0082       0.02  Q          .          .          .          .
   8.33        0.0084       0.02  Q          .          .          .          .
   8.42        0.0085       0.02  Q          .          .          .          .
   8.50        0.0086       0.02  Q          .          .          .          .
   8.58        0.0087       0.02  Q          .          .          .          .
   8.67        0.0088       0.02  Q          .          .          .          .
   8.75        0.0089       0.02  Q          .          .          .          .
   8.83        0.0090       0.02  Q          .          .          .          .
   8.92        0.0091       0.02  Q          .          .          .          .
   9.00        0.0092       0.02  Q          .          .          .          .
   9.08        0.0093       0.02  Q          .          .          .          .
   9.17        0.0095       0.02  Q          .          .          .          .
   9.25        0.0096       0.02  Q          .          .          .          .
   9.33        0.0097       0.02  Q          .          .          .          .
   9.42        0.0098       0.02  Q          .          .          .          .
   9.50        0.0099       0.02  Q          .          .          .          .
   9.58        0.0100       0.02  Q          .          .          .          .
   9.67        0.0102       0.02  Q          .          .          .          .
   9.75        0.0103       0.02  Q          .          .          .          .
   9.83        0.0104       0.02  Q          .          .          .          .
   9.92        0.0105       0.02  Q          .          .          .          .
  10.00        0.0107       0.02  Q          .          .          .          .
  10.08        0.0108       0.02  Q          .          .          .          .
  10.17        0.0109       0.02  Q          .          .          .          .
  10.25        0.0110       0.02  Q          .          .          .          .
```

```
 10.33        0.0112      0.02  Q         .         .         .         .
 10.42        0.0113      0.02  Q         .         .         .         .
 10.50        0.0114      0.02  Q         .         .         .         .
 10.58        0.0115      0.02  Q         .         .         .         .
 10.67        0.0117      0.02  Q         .         .         .         .
 10.75        0.0118      0.02  Q         .         .         .         .
 10.83        0.0120      0.02  Q         .         .         .         .
 10.92        0.0121      0.02  Q         .         .         .         .
 11.00        0.0122      0.02  Q         .         .         .         .
 11.08        0.0124      0.02  Q         .         .         .         .
 11.17        0.0125      0.02  Q         .         .         .         .
 11.25        0.0126      0.02  Q         .         .         .         .
 11.33        0.0128      0.02  Q         .         .         .         .
 11.42        0.0129      0.02  Q         .         .         .         .
 11.50        0.0131      0.02  Q         .         .         .         .
 11.58        0.0132      0.02  Q         .         .         .         .
 11.67        0.0134      0.02  Q         .         .         .         .
 11.75        0.0135      0.02  Q         .         .         .         .
 11.83        0.0137      0.02  Q         .         .         .         .
 11.92        0.0138      0.02  Q         .         .         .         .
 12.00        0.0140      0.02  Q         .         .         .         .
 12.08        0.0142      0.03  Q         .         .         .         .
 12.17        0.0144      0.03  Q         .         .         .         .
 12.25        0.0146      0.03  Q         .         .         .         .
 12.33        0.0148      0.03  Q         .         .         .         .
 12.42        0.0150      0.03  Q         .         .         .         .
 12.50        0.0152      0.03  Q         .         .         .         .
 12.58        0.0154      0.03  Q         .         .         .         .
 12.67        0.0156      0.03  Q         .         .         .         .
 12.75        0.0158      0.03  Q         .         .         .         .
 12.83        0.0160      0.03  Q         .         .         .         .
 12.92        0.0162      0.03  Q         .         .         .         .
 13.00        0.0164      0.03  Q         .         .         .         .
 13.08        0.0167      0.03  Q         .         .         .         .
 13.17        0.0169      0.03  Q         .         .         .         .
 13.25        0.0171      0.03  Q         .         .         .         .
 13.33        0.0173      0.03  Q         .         .         .         .
 13.42        0.0176      0.03  Q         .         .         .         .
 13.50        0.0178      0.04  Q         .         .         .         .
 13.58        0.0181      0.04  Q         .         .         .         .
 13.67        0.0183      0.04  Q         .         .         .         .
 13.75        0.0186      0.04  Q         .         .         .         .
 13.83        0.0188      0.04  Q         .         .         .         .
 13.92        0.0191      0.04  Q         .         .         .         .
 14.00        0.0194      0.04  Q         .         .         .         .
 14.08        0.0197      0.04  Q         .         .         .         .
 14.17        0.0200      0.04  Q         .         .         .         .
 14.25        0.0203      0.05  Q         .         .         .         .
 14.33        0.0206      0.05  Q         .         .         .         .
 14.42        0.0209      0.05  Q         .         .         .         .
 14.50        0.0212      0.05  Q         .         .         .         .
 14.58        0.0216      0.05  Q         .         .         .         .
 14.67        0.0219      0.05  Q         .         .         .         .
 14.75        0.0223      0.05  Q         .         .         .         .
 14.83        0.0227      0.05  Q         .         .         .         .
 14.92        0.0231      0.06  Q         .         .         .         .
 15.00        0.0235      0.06  Q         .         .         .         .
```

```
  15.08        0.0239        0.06  Q          .          .          .          .
  15.17        0.0243        0.06  Q          .          .          .          .
  15.25        0.0248        0.07  Q          .          .          .          .
  15.33        0.0253        0.07  Q          .          .          .          .
  15.42        0.0258        0.08  Q          .          .          .          .
  15.50        0.0263        0.08  Q          .          .          .          .
  15.58        0.0269        0.09  Q          .          .          .          .
  15.67        0.0275        0.09  Q          .          .          .          .
  15.75        0.0283        0.13  Q          .          .          .          .
  15.83        0.0292        0.14  Q          .          .          .          .
  15.92        0.0304        0.20  Q          .          .          .          .
  16.00        0.0320        0.28  .Q         .          .          .          .
  16.08        0.0355        0.71  . Q        .          .          .          .
  16.17        0.0384        0.16  Q          .          .          .          .
  16.25        0.0394        0.10  Q          .          .          .          .
  16.33        0.0400        0.08  Q          .          .          .          .
  16.42        0.0405        0.07  Q          .          .          .          .
  16.50        0.0410        0.07  Q          .          .          .          .
  16.58        0.0415        0.06  Q          .          .          .          .
  16.67        0.0419        0.06  Q          .          .          .          .
  16.75        0.0422        0.05  Q          .          .          .          .
  16.83        0.0426        0.05  Q          .          .          .          .
  16.92        0.0429        0.05  Q          .          .          .          .
  17.00        0.0432        0.05  Q          .          .          .          .
  17.08        0.0435        0.04  Q          .          .          .          .
  17.17        0.0438        0.04  Q          .          .          .          .
  17.25        0.0441        0.04  Q          .          .          .          .
  17.33        0.0443        0.04  Q          .          .          .          .
  17.42        0.0446        0.03  Q          .          .          .          .
  17.50        0.0448        0.03  Q          .          .          .          .
  17.58        0.0450        0.03  Q          .          .          .          .
  17.67        0.0452        0.03  Q          .          .          .          .
  17.75        0.0454        0.03  Q          .          .          .          .
  17.83        0.0457        0.03  Q          .          .          .          .
  17.92        0.0459        0.03  Q          .          .          .          .
  18.00        0.0461        0.03  Q          .          .          .          .
  18.08        0.0462        0.02  Q          .          .          .          .
  18.17        0.0464        0.02  Q          .          .          .          .
  18.25        0.0465        0.02  Q          .          .          .          .
  18.33        0.0467        0.02  Q          .          .          .          .
  18.42        0.0468        0.02  Q          .          .          .          .
  18.50        0.0470        0.02  Q          .          .          .          .
  18.58        0.0471        0.02  Q          .          .          .          .
  18.67        0.0473        0.02  Q          .          .          .          .
  18.75        0.0474        0.02  Q          .          .          .          .
  18.83        0.0475        0.02  Q          .          .          .          .
  18.92        0.0477        0.02  Q          .          .          .          .
  19.00        0.0478        0.02  Q          .          .          .          .
  19.08        0.0479        0.02  Q          .          .          .          .
  19.17        0.0480        0.02  Q          .          .          .          .
  19.25        0.0482        0.02  Q          .          .          .          .
  19.33        0.0483        0.02  Q          .          .          .          .
  19.42        0.0484        0.02  Q          .          .          .          .
  19.50        0.0485        0.02  Q          .          .          .          .
  19.58        0.0486        0.02  Q          .          .          .          .
  19.67        0.0487        0.02  Q          .          .          .          .
  19.75        0.0489        0.02  Q          .          .          .          .
```

```
  19.83      0.0490      0.02  Q          .          .          .          .
  19.92      0.0491      0.02  Q          .          .          .          .
  20.00      0.0492      0.02  Q          .          .          .          .
  20.08      0.0493      0.02  Q          .          .          .          .
  20.17      0.0494      0.01  Q          .          .          .          .
  20.25      0.0495      0.01  Q          .          .          .          .
  20.33      0.0496      0.01  Q          .          .          .          .
  20.42      0.0497      0.01  Q          .          .          .          .
  20.50      0.0498      0.01  Q          .          .          .          .
  20.58      0.0499      0.01  Q          .          .          .          .
  20.67      0.0500      0.01  Q          .          .          .          .
  20.75      0.0501      0.01  Q          .          .          .          .
  20.83      0.0502      0.01  Q          .          .          .          .
  20.92      0.0503      0.01  Q          .          .          .          .
  21.00      0.0504      0.01  Q          .          .          .          .
  21.08      0.0505      0.01  Q          .          .          .          .
  21.17      0.0505      0.01  Q          .          .          .          .
  21.25      0.0506      0.01  Q          .          .          .          .
  21.33      0.0507      0.01  Q          .          .          .          .
  21.42      0.0508      0.01  Q          .          .          .          .
  21.50      0.0509      0.01  Q          .          .          .          .
  21.58      0.0510      0.01  Q          .          .          .          .
  21.67      0.0511      0.01  Q          .          .          .          .
  21.75      0.0512      0.01  Q          .          .          .          .
  21.83      0.0512      0.01  Q          .          .          .          .
  21.92      0.0513      0.01  Q          .          .          .          .
  22.00      0.0514      0.01  Q          .          .          .          .
  22.08      0.0515      0.01  Q          .          .          .          .
  22.17      0.0516      0.01  Q          .          .          .          .
  22.25      0.0516      0.01  Q          .          .          .          .
  22.33      0.0517      0.01  Q          .          .          .          .
  22.42      0.0518      0.01  Q          .          .          .          .
  22.50      0.0519      0.01  Q          .          .          .          .
  22.58      0.0520      0.01  Q          .          .          .          .
  22.67      0.0520      0.01  Q          .          .          .          .
  22.75      0.0521      0.01  Q          .          .          .          .
  22.83      0.0522      0.01  Q          .          .          .          .
  22.92      0.0523      0.01  Q          .          .          .          .
  23.00      0.0523      0.01  Q          .          .          .          .
  23.08      0.0524      0.01  Q          .          .          .          .
  23.17      0.0525      0.01  Q          .          .          .          .
  23.25      0.0526      0.01  Q          .          .          .          .
  23.33      0.0526      0.01  Q          .          .          .          .
  23.42      0.0527      0.01  Q          .          .          .          .
  23.50      0.0528      0.01  Q          .          .          .          .
  23.58      0.0529      0.01  Q          .          .          .          .
  23.67      0.0529      0.01  Q          .          .          .          .
  23.75      0.0530      0.01  Q          .          .          .          .
  23.83      0.0531      0.01  Q          .          .          .          .
  23.92      0.0531      0.01  Q          .          .          .          .
  24.00      0.0532      0.01  Q          .          .          .          .
  24.08      0.0532      0.00  Q          .          .          .          .
 -------------------------------------------------------------------------------
----------------------------------------------------------------------------------
    TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
    (Note: 100% of Peak Flow Rate estimate assumed to have
    an instantaneous time duration)
```

Percentile of Estimated Peak Flow Rate	Duration (minutes)
0%	1440.0
10%	70.0
20%	20.0
30%	10.0
40%	10.0
50%	5.0
60%	5.0
70%	5.0
80%	5.0
90%	5.0

```
****************************************************************************
                    SMALL AREA UNIT HYDROGRAPH MODEL
============================================================================
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            Ver. 23.0  Release Date: 07/01/2016  License ID 1533

                         Analysis prepared by:

                 THATCHER ENGINEERING & ASSOCIATES, INC.
                       1461 FORD STREET, SUITE 105
                            REDLANDS, CA 92373
               PHONE: (909) 748-7777   FAX: (909) 748-7776

****************************************************************************
----------------------------------------------------------------------------

 Problem Descriptions:
  APN 297-170-002 & 003
  PRE-DEVELOPMENT DA4
  2-YEAR STORM EVENT
----------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
    TOTAL CATCHMENT AREA(ACRES) =    0.64
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.179
    LOW LOSS FRACTION = 0.425
    TIME OF CONCENTRATION(MIN.) =  5.36
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    USER SPECIFIED RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =   2
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.12
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.32
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.45
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  0.78
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.07
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  1.83

----------------------------------------------------------------------------

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     0.05
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.05

****************************************************************************
  TIME     VOLUME       Q    0.        2.5       5.0       7.5      10.0
 (HOURS)    (AF)      (CFS)
----------------------------------------------------------------------------
  0.01     0.0000      0.00  Q          .         .         .         .
  0.10     0.0000      0.01  Q          .         .         .         .
  0.19     0.0001      0.01  Q          .         .         .         .
  0.28     0.0002      0.01  Q          .         .         .         .
  0.37     0.0003      0.01  Q          .         .         .         .
  0.46     0.0003      0.01  Q          .         .         .         .
  0.55     0.0004      0.01  Q          .         .         .         .
  0.63     0.0005      0.01  Q          .         .         .         .
  0.72     0.0005      0.01  Q          .         .         .         .
```

```
  0.81      0.0006      0.01  Q          .          .          .          .
  0.90      0.0007      0.01  Q          .          .          .          .
  0.99      0.0008      0.01  Q          .          .          .          .
  1.08      0.0008      0.01  Q          .          .          .          .
  1.17      0.0009      0.01  Q          .          .          .          .
  1.26      0.0010      0.01  Q          .          .          .          .
  1.35      0.0011      0.01  Q          .          .          .          .
  1.44      0.0011      0.01  Q          .          .          .          .
  1.53      0.0012      0.01  Q          .          .          .          .
  1.62      0.0013      0.01  Q          .          .          .          .
  1.71      0.0014      0.01  Q          .          .          .          .
  1.80      0.0015      0.01  Q          .          .          .          .
  1.89      0.0015      0.01  Q          .          .          .          .
  1.97      0.0016      0.01  Q          .          .          .          .
  2.06      0.0017      0.01  Q          .          .          .          .
  2.15      0.0018      0.01  Q          .          .          .          .
  2.24      0.0018      0.01  Q          .          .          .          .
  2.33      0.0019      0.01  Q          .          .          .          .
  2.42      0.0020      0.01  Q          .          .          .          .
  2.51      0.0021      0.01  Q          .          .          .          .
  2.60      0.0022      0.01  Q          .          .          .          .
  2.69      0.0022      0.01  Q          .          .          .          .
  2.78      0.0023      0.01  Q          .          .          .          .
  2.87      0.0024      0.01  Q          .          .          .          .
  2.96      0.0025      0.01  Q          .          .          .          .
  3.05      0.0026      0.01  Q          .          .          .          .
  3.14      0.0027      0.01  Q          .          .          .          .
  3.23      0.0027      0.01  Q          .          .          .          .
  3.31      0.0028      0.01  Q          .          .          .          .
  3.40      0.0029      0.01  Q          .          .          .          .
  3.49      0.0030      0.01  Q          .          .          .          .
  3.58      0.0031      0.01  Q          .          .          .          .
  3.67      0.0032      0.01  Q          .          .          .          .
  3.76      0.0032      0.01  Q          .          .          .          .
  3.85      0.0033      0.01  Q          .          .          .          .
  3.94      0.0034      0.01  Q          .          .          .          .
  4.03      0.0035      0.01  Q          .          .          .          .
  4.12      0.0036      0.01  Q          .          .          .          .
  4.21      0.0037      0.01  Q          .          .          .          .
  4.30      0.0038      0.01  Q          .          .          .          .
  4.39      0.0038      0.01  Q          .          .          .          .
  4.48      0.0039      0.01  Q          .          .          .          .
  4.57      0.0040      0.01  Q          .          .          .          .
  4.65      0.0041      0.01  Q          .          .          .          .
  4.74      0.0042      0.01  Q          .          .          .          .
  4.83      0.0043      0.01  Q          .          .          .          .
  4.92      0.0044      0.01  Q          .          .          .          .
  5.01      0.0045      0.01  Q          .          .          .          .
  5.10      0.0046      0.01  Q          .          .          .          .
  5.19      0.0046      0.01  Q          .          .          .          .
  5.28      0.0047      0.01  Q          .          .          .          .
  5.37      0.0048      0.01  Q          .          .          .          .
  5.46      0.0049      0.01  Q          .          .          .          .
  5.55      0.0050      0.01  Q          .          .          .          .
  5.64      0.0051      0.01  Q          .          .          .          .
  5.73      0.0052      0.01  Q          .          .          .          .
  5.82      0.0053      0.01  Q          .          .          .          .
```

```
  5.91      0.0054      0.01  Q      .       .       .       .
  5.99      0.0055      0.01  Q      .       .       .       .
  6.08      0.0056      0.01  Q      .       .       .       .
  6.17      0.0057      0.01  Q      .       .       .       .
  6.26      0.0058      0.01  Q      .       .       .       .
  6.35      0.0059      0.01  Q      .       .       .       .
  6.44      0.0060      0.01  Q      .       .       .       .
  6.53      0.0061      0.01  Q      .       .       .       .
  6.62      0.0062      0.01  Q      .       .       .       .
  6.71      0.0063      0.01  Q      .       .       .       .
  6.80      0.0064      0.01  Q      .       .       .       .
  6.89      0.0065      0.01  Q      .       .       .       .
  6.98      0.0066      0.01  Q      .       .       .       .
  7.07      0.0067      0.01  Q      .       .       .       .
  7.16      0.0068      0.01  Q      .       .       .       .
  7.25      0.0069      0.01  Q      .       .       .       .
  7.33      0.0070      0.01  Q      .       .       .       .
  7.42      0.0071      0.01  Q      .       .       .       .
  7.51      0.0072      0.01  Q      .       .       .       .
  7.60      0.0073      0.01  Q      .       .       .       .
  7.69      0.0074      0.01  Q      .       .       .       .
  7.78      0.0075      0.01  Q      .       .       .       .
  7.87      0.0076      0.01  Q      .       .       .       .
  7.96      0.0077      0.01  Q      .       .       .       .
  8.05      0.0078      0.01  Q      .       .       .       .
  8.14      0.0080      0.02  Q      .       .       .       .
  8.23      0.0081      0.02  Q      .       .       .       .
  8.32      0.0082      0.02  Q      .       .       .       .
  8.41      0.0083      0.02  Q      .       .       .       .
  8.50      0.0084      0.02  Q      .       .       .       .
  8.59      0.0085      0.02  Q      .       .       .       .
  8.67      0.0086      0.02  Q      .       .       .       .
  8.76      0.0088      0.02  Q      .       .       .       .
  8.85      0.0089      0.02  Q      .       .       .       .
  8.94      0.0090      0.02  Q      .       .       .       .
  9.03      0.0091      0.02  Q      .       .       .       .
  9.12      0.0092      0.02  Q      .       .       .       .
  9.21      0.0093      0.02  Q      .       .       .       .
  9.30      0.0095      0.02  Q      .       .       .       .
  9.39      0.0096      0.02  Q      .       .       .       .
  9.48      0.0097      0.02  Q      .       .       .       .
  9.57      0.0098      0.02  Q      .       .       .       .
  9.66      0.0100      0.02  Q      .       .       .       .
  9.75      0.0101      0.02  Q      .       .       .       .
  9.84      0.0102      0.02  Q      .       .       .       .
  9.93      0.0103      0.02  Q      .       .       .       .
 10.01      0.0105      0.02  Q      .       .       .       .
 10.10      0.0106      0.02  Q      .       .       .       .
 10.19      0.0107      0.02  Q      .       .       .       .
 10.28      0.0109      0.02  Q      .       .       .       .
 10.37      0.0110      0.02  Q      .       .       .       .
 10.46      0.0111      0.02  Q      .       .       .       .
 10.55      0.0113      0.02  Q      .       .       .       .
 10.64      0.0114      0.02  Q      .       .       .       .
 10.73      0.0116      0.02  Q      .       .       .       .
 10.82      0.0117      0.02  Q      .       .       .       .
 10.91      0.0119      0.02  Q      .       .       .       .
```

```
  11.00      0.0120      0.02  Q        .        .        .        .
  11.09      0.0121      0.02  Q        .        .        .        .
  11.18      0.0123      0.02  Q        .        .        .        .
  11.27      0.0124      0.02  Q        .        .        .        .
  11.35      0.0126      0.02  Q        .        .        .        .
  11.44      0.0127      0.02  Q        .        .        .        .
  11.53      0.0129      0.02  Q        .        .        .        .
  11.62      0.0131      0.02  Q        .        .        .        .
  11.71      0.0132      0.02  Q        .        .        .        .
  11.80      0.0134      0.02  Q        .        .        .        .
  11.89      0.0135      0.02  Q        .        .        .        .
  11.98      0.0137      0.02  Q        .        .        .        .
  12.07      0.0139      0.02  Q        .        .        .        .
  12.16      0.0141      0.03  Q        .        .        .        .
  12.25      0.0143      0.03  Q        .        .        .        .
  12.34      0.0145      0.03  Q        .        .        .        .
  12.43      0.0147      0.03  Q        .        .        .        .
  12.52      0.0149      0.03  Q        .        .        .        .
  12.61      0.0151      0.03  Q        .        .        .        .
  12.69      0.0153      0.03  Q        .        .        .        .
  12.78      0.0155      0.03  Q        .        .        .        .
  12.87      0.0158      0.03  Q        .        .        .        .
  12.96      0.0160      0.03  Q        .        .        .        .
  13.05      0.0162      0.03  Q        .        .        .        .
  13.14      0.0165      0.03  Q        .        .        .        .
  13.23      0.0167      0.03  Q        .        .        .        .
  13.32      0.0169      0.03  Q        .        .        .        .
  13.41      0.0172      0.03  Q        .        .        .        .
  13.50      0.0174      0.03  Q        .        .        .        .
  13.59      0.0177      0.04  Q        .        .        .        .
  13.68      0.0179      0.04  Q        .        .        .        .
  13.77      0.0182      0.04  Q        .        .        .        .
  13.86      0.0185      0.04  Q        .        .        .        .
  13.95      0.0188      0.04  Q        .        .        .        .
  14.03      0.0190      0.04  Q        .        .        .        .
  14.12      0.0193      0.04  Q        .        .        .        .
  14.21      0.0197      0.04  Q        .        .        .        .
  14.30      0.0200      0.05  Q        .        .        .        .
  14.39      0.0203      0.05  Q        .        .        .        .
  14.48      0.0207      0.05  Q        .        .        .        .
  14.57      0.0211      0.05  Q        .        .        .        .
  14.66      0.0214      0.05  Q        .        .        .        .
  14.75      0.0218      0.05  Q        .        .        .        .
  14.84      0.0222      0.06  Q        .        .        .        .
  14.93      0.0226      0.06  Q        .        .        .        .
  15.02      0.0231      0.06  Q        .        .        .        .
  15.11      0.0235      0.06  Q        .        .        .        .
  15.20      0.0240      0.07  Q        .        .        .        .
  15.29      0.0245      0.07  Q        .        .        .        .
  15.37      0.0250      0.07  Q        .        .        .        .
  15.46      0.0255      0.08  Q        .        .        .        .
  15.55      0.0261      0.08  Q        .        .        .        .
  15.64      0.0268      0.09  Q        .        .        .        .
  15.73      0.0275      0.11  Q        .        .        .        .
  15.82      0.0284      0.13  Q        .        .        .        .
  15.91      0.0296      0.19  Q        .        .        .        .
  16.00      0.0313      0.27  .Q       .        .        .        .
```

```
 16.09        0.0348       0.70  . Q       .         .         .         .
 16.18        0.0380       0.15  Q         .         .         .         .
 16.27        0.0389       0.10  Q         .         .         .         .
 16.36        0.0395       0.08  Q         .         .         .         .
 16.45        0.0401       0.07  Q         .         .         .         .
 16.54        0.0406       0.06  Q         .         .         .         .
 16.63        0.0410       0.06  Q         .         .         .         .
 16.71        0.0414       0.05  Q         .         .         .         .
 16.80        0.0418       0.05  Q         .         .         .         .
 16.89        0.0422       0.05  Q         .         .         .         .
 16.98        0.0425       0.05  Q         .         .         .         .
 17.07        0.0428       0.04  Q         .         .         .         .
 17.16        0.0431       0.04  Q         .         .         .         .
 17.25        0.0434       0.04  Q         .         .         .         .
 17.34        0.0437       0.03  Q         .         .         .         .
 17.43        0.0439       0.03  Q         .         .         .         .
 17.52        0.0442       0.03  Q         .         .         .         .
 17.61        0.0444       0.03  Q         .         .         .         .
 17.70        0.0446       0.03  Q         .         .         .         .
 17.79        0.0448       0.03  Q         .         .         .         .
 17.88        0.0451       0.03  Q         .         .         .         .
 17.97        0.0453       0.03  Q         .         .         .         .
 18.05        0.0455       0.03  Q         .         .         .         .
 18.14        0.0456       0.02  Q         .         .         .         .
 18.23        0.0458       0.02  Q         .         .         .         .
 18.32        0.0460       0.02  Q         .         .         .         .
 18.41        0.0461       0.02  Q         .         .         .         .
 18.50        0.0463       0.02  Q         .         .         .         .
 18.59        0.0464       0.02  Q         .         .         .         .
 18.68        0.0466       0.02  Q         .         .         .         .
 18.77        0.0467       0.02  Q         .         .         .         .
 18.86        0.0468       0.02  Q         .         .         .         .
 18.95        0.0470       0.02  Q         .         .         .         .
 19.04        0.0471       0.02  Q         .         .         .         .
 19.13        0.0473       0.02  Q         .         .         .         .
 19.22        0.0474       0.02  Q         .         .         .         .
 19.31        0.0475       0.02  Q         .         .         .         .
 19.39        0.0476       0.02  Q         .         .         .         .
 19.48        0.0478       0.02  Q         .         .         .         .
 19.57        0.0479       0.02  Q         .         .         .         .
 19.66        0.0480       0.02  Q         .         .         .         .
 19.75        0.0481       0.02  Q         .         .         .         .
 19.84        0.0482       0.02  Q         .         .         .         .
 19.93        0.0483       0.02  Q         .         .         .         .
 20.02        0.0485       0.02  Q         .         .         .         .
 20.11        0.0486       0.01  Q         .         .         .         .
 20.20        0.0487       0.01  Q         .         .         .         .
 20.29        0.0488       0.01  Q         .         .         .         .
 20.38        0.0489       0.01  Q         .         .         .         .
 20.47        0.0490       0.01  Q         .         .         .         .
 20.56        0.0491       0.01  Q         .         .         .         .
 20.65        0.0492       0.01  Q         .         .         .         .
 20.73        0.0493       0.01  Q         .         .         .         .
 20.82        0.0494       0.01  Q         .         .         .         .
 20.91        0.0495       0.01  Q         .         .         .         .
 21.00        0.0496       0.01  Q         .         .         .         .
 21.09        0.0497       0.01  Q         .         .         .         .
```

```
  21.18      0.0498      0.01  Q         .         .         .         .
  21.27      0.0499      0.01  Q         .         .         .         .
  21.36      0.0500      0.01  Q         .         .         .         .
  21.45      0.0501      0.01  Q         .         .         .         .
  21.54      0.0502      0.01  Q         .         .         .         .
  21.63      0.0502      0.01  Q         .         .         .         .
  21.72      0.0503      0.01  Q         .         .         .         .
  21.81      0.0504      0.01  Q         .         .         .         .
  21.90      0.0505      0.01  Q         .         .         .         .
  21.99      0.0506      0.01  Q         .         .         .         .
  22.07      0.0507      0.01  Q         .         .         .         .
  22.16      0.0508      0.01  Q         .         .         .         .
  22.25      0.0509      0.01  Q         .         .         .         .
  22.34      0.0509      0.01  Q         .         .         .         .
  22.43      0.0510      0.01  Q         .         .         .         .
  22.52      0.0511      0.01  Q         .         .         .         .
  22.61      0.0512      0.01  Q         .         .         .         .
  22.70      0.0513      0.01  Q         .         .         .         .
  22.79      0.0514      0.01  Q         .         .         .         .
  22.88      0.0514      0.01  Q         .         .         .         .
  22.97      0.0515      0.01  Q         .         .         .         .
  23.06      0.0516      0.01  Q         .         .         .         .
  23.15      0.0517      0.01  Q         .         .         .         .
  23.24      0.0517      0.01  Q         .         .         .         .
  23.33      0.0518      0.01  Q         .         .         .         .
  23.41      0.0519      0.01  Q         .         .         .         .
  23.50      0.0520      0.01  Q         .         .         .         .
  23.59      0.0521      0.01  Q         .         .         .         .
  23.68      0.0521      0.01  Q         .         .         .         .
  23.77      0.0522      0.01  Q         .         .         .         .
  23.86      0.0523      0.01  Q         .         .         .         .
  23.95      0.0523      0.01  Q         .         .         .         .
  24.04      0.0524      0.01  Q         .         .         .         .
  24.13      0.0525      0.00  Q         .         .         .         .
 ----------------------------------------------------------------------------
--------------------------------------------------------------------------------
    TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
    (Note: 100% of Peak Flow Rate estimate assumed to have
    an instantaneous time duration)

    Percentile of Estimated                 Duration
        Peak Flow Rate                      (minutes)
    =======================                 =========
               0%                            1441.8
              10%                              69.7
              20%                              21.4
              30%                              10.7
              40%                               5.4
              50%                               5.4
              60%                               5.4
              70%                               5.4
              80%                               5.4
              90%                               5.4
```

```
*****************************************************************************
                      SMALL AREA UNIT HYDROGRAPH MODEL
=============================================================================
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             Ver. 23.0  Release Date: 07/01/2016  License ID 1533

                           Analysis prepared by:

                  THATCHER ENGINEERING & ASSOCIATES, INC.
                        1461 FORD STREET, SUITE 105
                             REDLANDS, CA 92373
                PHONE: (909) 748-7777   FAX: (909) 748-7776

*****************************************************************************
-----------------------------------------------------------------------------

 Problem Descriptions:
  APN 297-170-002 & 003
  PRE-DEVELOPMENT DA5
  2-YEAR STORM EVENT
-----------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
    TOTAL CATCHMENT AREA(ACRES) =    0.80
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.167
    LOW LOSS FRACTION = 0.404
    TIME OF CONCENTRATION(MIN.) =  5.00
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    USER SPECIFIED RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =   2
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.12
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.32
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.45
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  0.78
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.07
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  1.83

-----------------------------------------------------------------------------

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     0.07
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.05

*****************************************************************************
  TIME     VOLUME       Q    0.        2.5       5.0       7.5      10.0
 (HOURS)    (AF)      (CFS)
-----------------------------------------------------------------------------
  0.08      0.0000      0.01  Q         .         .         .         .
  0.17      0.0001      0.01  Q         .         .         .         .
  0.25      0.0002      0.01  Q         .         .         .         .
  0.33      0.0003      0.01  Q         .         .         .         .
  0.42      0.0004      0.01  Q         .         .         .         .
  0.50      0.0005      0.01  Q         .         .         .         .
  0.58      0.0006      0.01  Q         .         .         .         .
  0.67      0.0007      0.01  Q         .         .         .         .
  0.75      0.0008      0.01  Q         .         .         .         .
```

```
 0.83        0.0008       0.01  Q         .         .         .         .
 0.92        0.0009       0.01  Q         .         .         .         .
 1.00        0.0010       0.01  Q         .         .         .         .
 1.08        0.0011       0.01  Q         .         .         .         .
 1.17        0.0012       0.01  Q         .         .         .         .
 1.25        0.0013       0.01  Q         .         .         .         .
 1.33        0.0014       0.01  Q         .         .         .         .
 1.42        0.0015       0.01  Q         .         .         .         .
 1.50        0.0016       0.01  Q         .         .         .         .
 1.58        0.0017       0.01  Q         .         .         .         .
 1.67        0.0018       0.01  Q         .         .         .         .
 1.75        0.0018       0.01  Q         .         .         .         .
 1.83        0.0019       0.01  Q         .         .         .         .
 1.92        0.0020       0.01  Q         .         .         .         .
 2.00        0.0021       0.01  Q         .         .         .         .
 2.08        0.0022       0.01  Q         .         .         .         .
 2.17        0.0023       0.01  Q         .         .         .         .
 2.25        0.0024       0.01  Q         .         .         .         .
 2.33        0.0025       0.01  Q         .         .         .         .
 2.42        0.0026       0.01  Q         .         .         .         .
 2.50        0.0027       0.01  Q         .         .         .         .
 2.58        0.0028       0.01  Q         .         .         .         .
 2.67        0.0029       0.01  Q         .         .         .         .
 2.75        0.0030       0.01  Q         .         .         .         .
 2.83        0.0031       0.01  Q         .         .         .         .
 2.92        0.0032       0.01  Q         .         .         .         .
 3.00        0.0033       0.01  Q         .         .         .         .
 3.08        0.0034       0.01  Q         .         .         .         .
 3.17        0.0035       0.01  Q         .         .         .         .
 3.25        0.0036       0.01  Q         .         .         .         .
 3.33        0.0037       0.01  Q         .         .         .         .
 3.42        0.0038       0.01  Q         .         .         .         .
 3.50        0.0039       0.01  Q         .         .         .         .
 3.58        0.0040       0.01  Q         .         .         .         .
 3.67        0.0041       0.01  Q         .         .         .         .
 3.75        0.0042       0.01  Q         .         .         .         .
 3.83        0.0043       0.01  Q         .         .         .         .
 3.92        0.0044       0.02  Q         .         .         .         .
 4.00        0.0045       0.02  Q         .         .         .         .
 4.08        0.0046       0.02  Q         .         .         .         .
 4.17        0.0047       0.02  Q         .         .         .         .
 4.25        0.0048       0.02  Q         .         .         .         .
 4.33        0.0049       0.02  Q         .         .         .         .
 4.42        0.0050       0.02  Q         .         .         .         .
 4.50        0.0051       0.02  Q         .         .         .         .
 4.58        0.0052       0.02  Q         .         .         .         .
 4.67        0.0053       0.02  Q         .         .         .         .
 4.75        0.0055       0.02  Q         .         .         .         .
 4.83        0.0056       0.02  Q         .         .         .         .
 4.92        0.0057       0.02  Q         .         .         .         .
 5.00        0.0058       0.02  Q         .         .         .         .
 5.08        0.0059       0.02  Q         .         .         .         .
 5.17        0.0060       0.02  Q         .         .         .         .
 5.25        0.0061       0.02  Q         .         .         .         .
 5.33        0.0062       0.02  Q         .         .         .         .
 5.42        0.0063       0.02  Q         .         .         .         .
 5.50        0.0064       0.02  Q         .         .         .         .
```

```
   5.58       0.0066       0.02  Q         .         .         .         .
   5.67       0.0067       0.02  Q         .         .         .         .
   5.75       0.0068       0.02  Q         .         .         .         .
   5.83       0.0069       0.02  Q         .         .         .         .
   5.92       0.0070       0.02  Q         .         .         .         .
   6.00       0.0071       0.02  Q         .         .         .         .
   6.08       0.0072       0.02  Q         .         .         .         .
   6.17       0.0074       0.02  Q         .         .         .         .
   6.25       0.0075       0.02  Q         .         .         .         .
   6.33       0.0076       0.02  Q         .         .         .         .
   6.42       0.0077       0.02  Q         .         .         .         .
   6.50       0.0078       0.02  Q         .         .         .         .
   6.58       0.0080       0.02  Q         .         .         .         .
   6.67       0.0081       0.02  Q         .         .         .         .
   6.75       0.0082       0.02  Q         .         .         .         .
   6.83       0.0083       0.02  Q         .         .         .         .
   6.92       0.0084       0.02  Q         .         .         .         .
   7.00       0.0086       0.02  Q         .         .         .         .
   7.08       0.0087       0.02  Q         .         .         .         .
   7.17       0.0088       0.02  Q         .         .         .         .
   7.25       0.0089       0.02  Q         .         .         .         .
   7.33       0.0091       0.02  Q         .         .         .         .
   7.42       0.0092       0.02  Q         .         .         .         .
   7.50       0.0093       0.02  Q         .         .         .         .
   7.58       0.0094       0.02  Q         .         .         .         .
   7.67       0.0096       0.02  Q         .         .         .         .
   7.75       0.0097       0.02  Q         .         .         .         .
   7.83       0.0098       0.02  Q         .         .         .         .
   7.92       0.0100       0.02  Q         .         .         .         .
   8.00       0.0101       0.02  Q         .         .         .         .
   8.08       0.0102       0.02  Q         .         .         .         .
   8.17       0.0104       0.02  Q         .         .         .         .
   8.25       0.0105       0.02  Q         .         .         .         .
   8.33       0.0106       0.02  Q         .         .         .         .
   8.42       0.0108       0.02  Q         .         .         .         .
   8.50       0.0109       0.02  Q         .         .         .         .
   8.58       0.0111       0.02  Q         .         .         .         .
   8.67       0.0112       0.02  Q         .         .         .         .
   8.75       0.0113       0.02  Q         .         .         .         .
   8.83       0.0115       0.02  Q         .         .         .         .
   8.92       0.0116       0.02  Q         .         .         .         .
   9.00       0.0118       0.02  Q         .         .         .         .
   9.08       0.0119       0.02  Q         .         .         .         .
   9.17       0.0120       0.02  Q         .         .         .         .
   9.25       0.0122       0.02  Q         .         .         .         .
   9.33       0.0123       0.02  Q         .         .         .         .
   9.42       0.0125       0.02  Q         .         .         .         .
   9.50       0.0126       0.02  Q         .         .         .         .
   9.58       0.0128       0.02  Q         .         .         .         .
   9.67       0.0129       0.02  Q         .         .         .         .
   9.75       0.0131       0.02  Q         .         .         .         .
   9.83       0.0133       0.02  Q         .         .         .         .
   9.92       0.0134       0.02  Q         .         .         .         .
  10.00       0.0136       0.02  Q         .         .         .         .
  10.08       0.0137       0.02  Q         .         .         .         .
  10.17       0.0139       0.02  Q         .         .         .         .
  10.25       0.0140       0.02  Q         .         .         .         .
```

```
 10.33       0.0142       0.02  Q         .         .         .         .
 10.42       0.0144       0.02  Q         .         .         .         .
 10.50       0.0145       0.02  Q         .         .         .         .
 10.58       0.0147       0.02  Q         .         .         .         .
 10.67       0.0149       0.02  Q         .         .         .         .
 10.75       0.0150       0.02  Q         .         .         .         .
 10.83       0.0152       0.03  Q         .         .         .         .
 10.92       0.0154       0.03  Q         .         .         .         .
 11.00       0.0156       0.03  Q         .         .         .         .
 11.08       0.0157       0.03  Q         .         .         .         .
 11.17       0.0159       0.03  Q         .         .         .         .
 11.25       0.0161       0.03  Q         .         .         .         .
 11.33       0.0163       0.03  Q         .         .         .         .
 11.42       0.0165       0.03  Q         .         .         .         .
 11.50       0.0167       0.03  Q         .         .         .         .
 11.58       0.0168       0.03  Q         .         .         .         .
 11.67       0.0170       0.03  Q         .         .         .         .
 11.75       0.0172       0.03  Q         .         .         .         .
 11.83       0.0174       0.03  Q         .         .         .         .
 11.92       0.0176       0.03  Q         .         .         .         .
 12.00       0.0178       0.03  Q         .         .         .         .
 12.08       0.0181       0.04  Q         .         .         .         .
 12.17       0.0183       0.04  Q         .         .         .         .
 12.25       0.0185       0.04  Q         .         .         .         .
 12.33       0.0188       0.04  Q         .         .         .         .
 12.42       0.0190       0.04  Q         .         .         .         .
 12.50       0.0193       0.04  Q         .         .         .         .
 12.58       0.0195       0.04  Q         .         .         .         .
 12.67       0.0198       0.04  Q         .         .         .         .
 12.75       0.0201       0.04  Q         .         .         .         .
 12.83       0.0203       0.04  Q         .         .         .         .
 12.92       0.0206       0.04  Q         .         .         .         .
 13.00       0.0209       0.04  Q         .         .         .         .
 13.08       0.0212       0.04  Q         .         .         .         .
 13.17       0.0215       0.04  Q         .         .         .         .
 13.25       0.0217       0.04  Q         .         .         .         .
 13.33       0.0220       0.04  Q         .         .         .         .
 13.42       0.0223       0.04  Q         .         .         .         .
 13.50       0.0226       0.04  Q         .         .         .         .
 13.58       0.0229       0.05  Q         .         .         .         .
 13.67       0.0233       0.05  Q         .         .         .         .
 13.75       0.0236       0.05  Q         .         .         .         .
 13.83       0.0239       0.05  Q         .         .         .         .
 13.92       0.0242       0.05  Q         .         .         .         .
 14.00       0.0246       0.05  Q         .         .         .         .
 14.08       0.0249       0.06  Q         .         .         .         .
 14.17       0.0253       0.06  Q         .         .         .         .
 14.25       0.0257       0.06  Q         .         .         .         .
 14.33       0.0261       0.06  Q         .         .         .         .
 14.42       0.0266       0.06  Q         .         .         .         .
 14.50       0.0270       0.06  Q         .         .         .         .
 14.58       0.0274       0.07  Q         .         .         .         .
 14.67       0.0279       0.07  Q         .         .         .         .
 14.75       0.0283       0.07  Q         .         .         .         .
 14.83       0.0288       0.07  Q         .         .         .         .
 14.92       0.0293       0.07  Q         .         .         .         .
 15.00       0.0298       0.08  Q         .         .         .         .
```

```
15.08      0.0304      0.08  Q          .         .         .         .
15.17      0.0309      0.08  Q          .         .         .         .
15.25      0.0315      0.09  Q          .         .         .         .
15.33      0.0321      0.09  Q          .         .         .         .
15.42      0.0328      0.10  Q          .         .         .         .
15.50      0.0335      0.10  Q          .         .         .         .
15.58      0.0342      0.11  Q          .         .         .         .
15.67      0.0350      0.12  Q          .         .         .         .
15.75      0.0360      0.16  Q          .         .         .         .
15.83      0.0371      0.17  Q          .         .         .         .
15.92      0.0386      0.26  .Q         .         .         .         .
16.00      0.0407      0.36  .Q         .         .         .         .
16.08      0.0451      0.92  .   Q      .         .         .         .
16.17      0.0489      0.20  Q          .         .         .         .
16.25      0.0501      0.13  Q          .         .         .         .
16.33      0.0509      0.11  Q          .         .         .         .
16.42      0.0516      0.09  Q          .         .         .         .
16.50      0.0522      0.09  Q          .         .         .         .
16.58      0.0528      0.08  Q          .         .         .         .
16.67      0.0533      0.07  Q          .         .         .         .
16.75      0.0538      0.07  Q          .         .         .         .
16.83      0.0542      0.06  Q          .         .         .         .
16.92      0.0547      0.06  Q          .         .         .         .
17.00      0.0551      0.06  Q          .         .         .         .
17.08      0.0554      0.05  Q          .         .         .         .
17.17      0.0558      0.05  Q          .         .         .         .
17.25      0.0561      0.05  Q          .         .         .         .
17.33      0.0564      0.04  Q          .         .         .         .
17.42      0.0567      0.04  Q          .         .         .         .
17.50      0.0570      0.04  Q          .         .         .         .
17.58      0.0573      0.04  Q          .         .         .         .
17.67      0.0576      0.04  Q          .         .         .         .
17.75      0.0578      0.04  Q          .         .         .         .
17.83      0.0581      0.04  Q          .         .         .         .
17.92      0.0584      0.04  Q          .         .         .         .
18.00      0.0586      0.04  Q          .         .         .         .
18.08      0.0588      0.03  Q          .         .         .         .
18.17      0.0590      0.03  Q          .         .         .         .
18.25      0.0592      0.03  Q          .         .         .         .
18.33      0.0594      0.03  Q          .         .         .         .
18.42      0.0596      0.03  Q          .         .         .         .
18.50      0.0598      0.03  Q          .         .         .         .
18.58      0.0600      0.03  Q          .         .         .         .
18.67      0.0601      0.03  Q          .         .         .         .
18.75      0.0603      0.02  Q          .         .         .         .
18.83      0.0605      0.02  Q          .         .         .         .
18.92      0.0606      0.02  Q          .         .         .         .
19.00      0.0608      0.02  Q          .         .         .         .
19.08      0.0610      0.02  Q          .         .         .         .
19.17      0.0611      0.02  Q          .         .         .         .
19.25      0.0613      0.02  Q          .         .         .         .
19.33      0.0614      0.02  Q          .         .         .         .
19.42      0.0616      0.02  Q          .         .         .         .
19.50      0.0617      0.02  Q          .         .         .         .
19.58      0.0619      0.02  Q          .         .         .         .
19.67      0.0620      0.02  Q          .         .         .         .
19.75      0.0622      0.02  Q          .         .         .         .
```

```
  19.83      0.0623      0.02  Q         .         .         .         .
  19.92      0.0624      0.02  Q         .         .         .         .
  20.00      0.0626      0.02  Q         .         .         .         .
  20.08      0.0627      0.02  Q         .         .         .         .
  20.17      0.0628      0.02  Q         .         .         .         .
  20.25      0.0630      0.02  Q         .         .         .         .
  20.33      0.0631      0.02  Q         .         .         .         .
  20.42      0.0632      0.02  Q         .         .         .         .
  20.50      0.0634      0.02  Q         .         .         .         .
  20.58      0.0635      0.02  Q         .         .         .         .
  20.67      0.0636      0.02  Q         .         .         .         .
  20.75      0.0637      0.02  Q         .         .         .         .
  20.83      0.0638      0.02  Q         .         .         .         .
  20.92      0.0640      0.02  Q         .         .         .         .
  21.00      0.0641      0.02  Q         .         .         .         .
  21.08      0.0642      0.02  Q         .         .         .         .
  21.17      0.0643      0.02  Q         .         .         .         .
  21.25      0.0644      0.02  Q         .         .         .         .
  21.33      0.0645      0.02  Q         .         .         .         .
  21.42      0.0647      0.02  Q         .         .         .         .
  21.50      0.0648      0.02  Q         .         .         .         .
  21.58      0.0649      0.02  Q         .         .         .         .
  21.67      0.0650      0.02  Q         .         .         .         .
  21.75      0.0651      0.02  Q         .         .         .         .
  21.83      0.0652      0.02  Q         .         .         .         .
  21.92      0.0653      0.02  Q         .         .         .         .
  22.00      0.0654      0.02  Q         .         .         .         .
  22.08      0.0655      0.02  Q         .         .         .         .
  22.17      0.0656      0.01  Q         .         .         .         .
  22.25      0.0657      0.01  Q         .         .         .         .
  22.33      0.0658      0.01  Q         .         .         .         .
  22.42      0.0659      0.01  Q         .         .         .         .
  22.50      0.0660      0.01  Q         .         .         .         .
  22.58      0.0661      0.01  Q         .         .         .         .
  22.67      0.0662      0.01  Q         .         .         .         .
  22.75      0.0663      0.01  Q         .         .         .         .
  22.83      0.0664      0.01  Q         .         .         .         .
  22.92      0.0665      0.01  Q         .         .         .         .
  23.00      0.0666      0.01  Q         .         .         .         .
  23.08      0.0667      0.01  Q         .         .         .         .
  23.17      0.0668      0.01  Q         .         .         .         .
  23.25      0.0669      0.01  Q         .         .         .         .
  23.33      0.0670      0.01  Q         .         .         .         .
  23.42      0.0671      0.01  Q         .         .         .         .
  23.50      0.0672      0.01  Q         .         .         .         .
  23.58      0.0673      0.01  Q         .         .         .         .
  23.67      0.0673      0.01  Q         .         .         .         .
  23.75      0.0674      0.01  Q         .         .         .         .
  23.83      0.0675      0.01  Q         .         .         .         .
  23.92      0.0676      0.01  Q         .         .         .         .
  24.00      0.0677      0.01  Q         .         .         .         .
  24.08      0.0677      0.00  Q         .         .         .         .
-----------------------------------------------------------------------
----------------------------------------------------------------------------
   TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
   (Note: 100% of Peak Flow Rate estimate assumed to have
   an instantaneous time duration)
```

Percentile of Estimated Peak Flow Rate	Duration (minutes)
0%	1440.0
10%	65.0
20%	20.0
30%	10.0
40%	5.0
50%	5.0
60%	5.0
70%	5.0
80%	5.0
90%	5.0

```
****************************************************************************
           NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                     AND LOW LOSS FRACTION ESTIMATIONS
============================================================================
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                           Analysis prepared by:

                  THATCHER ENGINEERING & ASSOCIATES, INC.
                        1461 FORD STREET, SUITE 105
                             REDLANDS, CA 92373
                PHONE: (909) 748-7777   FAX: (909) 748-7776

****************************************************************************
----------------------------------------------------------------------------

 Problem Descriptions:
  APN 297-170-002 & 003
  POST DEVELOPMENT DA1
  2-YEAR STORM EVENT
============================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC I:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     1.83 (inches)

    SOIL-COVER     AREA      PERCENT OF    SCS CURVE    LOSS RATE
       TYPE      (Acres)   PERVIOUS AREA    NUMBER    Fp(in./hr.)    YIELD
        1          1.28      100.00        69.(AMC II)     0.812        0.000
        2         11.54        0.00        98.(AMC II)     0.000        0.878

    TOTAL AREA (Acres) =     12.82

    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.081

    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.210
============================================================================
```

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****************************************************************************
          NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                    AND LOW LOSS FRACTION ESTIMATIONS
============================================================================
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                     1461 FORD STREET, SUITE 105
                          REDLANDS, CA 92373
              PHONE: (909) 748-7777   FAX: (909) 748-7776

****************************************************************************
----------------------------------------------------------------------------

 Problem Descriptions:
  APN 297-170-002 & 003
  POST-DEVELOPMENT DA2
  2-YEAR STORM EVENT
============================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC I:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     1.83 (inches)

    SOIL-COVER     AREA      PERCENT OF     SCS CURVE    LOSS RATE
       TYPE      (Acres)   PERVIOUS AREA     NUMBER    Fp(in./hr.)     YIELD
        1          2.67       100.00       79.(AMC II)     0.648        0.030
        2          0.27       100.00       69.(AMC II)     0.812        0.000
        3          5.00         0.00       98.(AMC II)     0.000        0.878

    TOTAL AREA (Acres) =      7.94

    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.246

    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.437
============================================================================
```

```
****************************************************************************
         NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                   AND LOW LOSS FRACTION ESTIMATIONS
============================================================================
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                         Analysis prepared by:

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                       1461 FORD STREET, SUITE 105
                            REDLANDS, CA 92373
                PHONE: (909) 748-7777   FAX: (909) 748-7776

****************************************************************************
----------------------------------------------------------------------------

 Problem Descriptions:
  APN 297-170-002 & 003
  POST-DEVELOPMENT DA3
  2-YEAR STORM EVENT
============================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC I:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     1.83 (inches)

    SOIL-COVER     AREA      PERCENT OF    SCS CURVE    LOSS RATE
       TYPE      (Acres)   PERVIOUS AREA    NUMBER    Fp(in./hr.)     YIELD
         1         0.13       100.00       69.(AMC II)     0.812       0.000
         2         0.51         0.00       98.(AMC II)     0.000       0.878

    TOTAL AREA (Acres) =      0.64

    AREA-AVERAGED LOSS RATE, F̅m (in./hr.) =  0.165

    AREA-AVERAGED LOW LOSS FRACTION, Y̅ = 0.301
============================================================================
```

```
****************************************************************************
         NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                   AND LOW LOSS FRACTION ESTIMATIONS
============================================================================
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                     1461 FORD STREET, SUITE 105
                          REDLANDS, CA 92373
              PHONE: (909) 748-7777   FAX: (909) 748-7776

****************************************************************************
----------------------------------------------------------------------------

 Problem Descriptions:
  APN 297-170-002 & 003
  POST-DEVELOPMENT DA4
  2-YEAR STORM EVENT
============================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC I:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     1.83 (inches)

    SOIL-COVER     AREA      PERCENT OF    SCS CURVE    LOSS RATE
       TYPE      (Acres)   PERVIOUS AREA    NUMBER    Fp(in./hr.)    YIELD
         1          0.15     100.00       69.(AMC II)     0.812      0.000
         2          0.49       0.00       98.(AMC II)     0.000      0.878

    TOTAL AREA (Acres) =      0.64

    AREA-AVERAGED LOSS RATE, F̅m (in./hr.) =  0.190

    AREA-AVERAGED LOW LOSS FRACTION, Y̅ = 0.328
============================================================================
```

```
****************************************************************************
        NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                  AND LOW LOSS FRACTION ESTIMATIONS
============================================================================
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                        Analysis prepared by:

             THATCHER ENGINEERING & ASSOCIATES, INC.
                   1461 FORD STREET, SUITE 105
                        REDLANDS, CA 92373
            PHONE: (909) 748-7777   FAX: (909) 748-7776

****************************************************************************
----------------------------------------------------------------------------

 Problem Descriptions:
  APN 297-170-002 & 003
  POST-DEVELOPMENT DA5
  2-YEAR STORM EVENT
============================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC I:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     1.83 (inches)

    SOIL-COVER     AREA      PERCENT OF     SCS CURVE    LOSS RATE
       TYPE       (Acres)   PERVIOUS AREA    NUMBER    Fp(in./hr.)     YIELD
        1           0.19      100.00       69.(AMC II)     0.812       0.000
        2           0.61        0.00       98.(AMC II)     0.000       0.878

    TOTAL AREA (Acres) =       0.80

    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.193

    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.331
============================================================================
```

```
****************************************************************************
                      SMALL AREA UNIT HYDROGRAPH MODEL
============================================================================
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                           Analysis prepared by:

                  THATCHER ENGINEERING & ASSOCIATES, INC.
                        1461 FORD STREET, SUITE 105
                             REDLANDS, CA 92373
                PHONE: (909) 748-7777   FAX: (909) 748-7776

****************************************************************************
----------------------------------------------------------------------------

 Problem Descriptions:
  APN 297-170-002 & 003
  POST-DEVELOPMENT DA1
  2-YEAR STORM EVENT
----------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
    TOTAL CATCHMENT AREA(ACRES) =   12.82
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.081
    LOW LOSS FRACTION = 0.210
    TIME OF CONCENTRATION(MIN.) =  9.04
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    USER SPECIFIED RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =   2
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.12
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.32
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.45
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  0.78
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.07
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  1.83

----------------------------------------------------------------------------

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     1.41
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.55

****************************************************************************
  TIME      VOLUME        Q    0.        5.0      10.0      15.0      20.0
 (HOURS)     (AF)       (CFS)
----------------------------------------------------------------------------
  0.03      0.0000      0.00 Q         .         .         .         .
  0.18      0.0017      0.27 Q         .         .         .         .
  0.33      0.0050      0.27 Q         .         .         .         .
  0.48      0.0084      0.27 Q         .         .         .         .
  0.63      0.0118      0.27 Q         .         .         .         .
  0.78      0.0153      0.28 Q         .         .         .         .
  0.93      0.0187      0.28 Q         .         .         .         .
  1.08      0.0222      0.28 Q         .         .         .         .
  1.23      0.0257      0.28 Q         .         .         .         .
```

```
  1.39      0.0292      0.28  Q         .         .         .         .
  1.54      0.0327      0.28  Q         .         .         .         .
  1.69      0.0363      0.29  Q         .         .         .         .
  1.84      0.0399      0.29  Q         .         .         .         .
  1.99      0.0435      0.29  Q         .         .         .         .
  2.14      0.0471      0.29  Q         .         .         .         .
  2.29      0.0507      0.29  Q         .         .         .         .
  2.44      0.0544      0.30  Q         .         .         .         .
  2.59      0.0581      0.30  Q         .         .         .         .
  2.74      0.0618      0.30  Q         .         .         .         .
  2.89      0.0656      0.30  Q         .         .         .         .
  3.04      0.0694      0.30  Q         .         .         .         .
  3.19      0.0732      0.31  Q         .         .         .         .
  3.34      0.0770      0.31  Q         .         .         .         .
  3.49      0.0809      0.31  Q         .         .         .         .
  3.65      0.0847      0.31  Q         .         .         .         .
  3.80      0.0887      0.32  Q         .         .         .         .
  3.95      0.0926      0.32  Q         .         .         .         .
  4.10      0.0966      0.32  Q         .         .         .         .
  4.25      0.1006      0.32  Q         .         .         .         .
  4.40      0.1046      0.33  Q         .         .         .         .
  4.55      0.1087      0.33  Q         .         .         .         .
  4.70      0.1128      0.33  Q         .         .         .         .
  4.85      0.1169      0.33  Q         .         .         .         .
  5.00      0.1211      0.34  Q         .         .         .         .
  5.15      0.1253      0.34  Q         .         .         .         .
  5.30      0.1295      0.34  Q         .         .         .         .
  5.45      0.1338      0.34  Q         .         .         .         .
  5.60      0.1381      0.35  Q         .         .         .         .
  5.75      0.1425      0.35  Q         .         .         .         .
  5.91      0.1469      0.35  Q         .         .         .         .
  6.06      0.1513      0.36  Q         .         .         .         .
  6.21      0.1558      0.36  Q         .         .         .         .
  6.36      0.1603      0.36  Q         .         .         .         .
  6.51      0.1648      0.37  Q         .         .         .         .
  6.66      0.1694      0.37  Q         .         .         .         .
  6.81      0.1741      0.38  Q         .         .         .         .
  6.96      0.1788      0.38  Q         .         .         .         .
  7.11      0.1835      0.38  Q         .         .         .         .
  7.26      0.1883      0.39  Q         .         .         .         .
  7.41      0.1931      0.39  Q         .         .         .         .
  7.56      0.1980      0.39  Q         .         .         .         .
  7.71      0.2030      0.40  Q         .         .         .         .
  7.86      0.2080      0.40  Q         .         .         .         .
  8.01      0.2130      0.41  Q         .         .         .         .
  8.17      0.2181      0.41  Q         .         .         .         .
  8.32      0.2233      0.42  Q         .         .         .         .
  8.47      0.2285      0.42  Q         .         .         .         .
  8.62      0.2338      0.43  Q         .         .         .         .
  8.77      0.2392      0.43  Q         .         .         .         .
  8.92      0.2446      0.44  Q         .         .         .         .
  9.07      0.2501      0.44  Q         .         .         .         .
  9.22      0.2557      0.45  Q         .         .         .         .
  9.37      0.2613      0.46  Q         .         .         .         .
  9.52      0.2670      0.46  Q         .         .         .         .
  9.67      0.2728      0.47  Q         .         .         .         .
  9.82      0.2787      0.48  Q         .         .         .         .
```

```
 9.97      0.2847      0.48  Q         .         .         .         .
10.12      0.2908      0.49  Q         .         .         .         .
10.27      0.2969      0.50  Q         .         .         .         .
10.43      0.3032      0.51  .Q        .         .         .         .
10.58      0.3095      0.51  .Q        .         .         .         .
10.73      0.3160      0.53  .Q        .         .         .         .
10.88      0.3226      0.53  .Q        .         .         .         .
11.03      0.3293      0.54  .Q        .         .         .         .
11.18      0.3361      0.55  .Q        .         .         .         .
11.33      0.3430      0.56  .Q        .         .         .         .
11.48      0.3501      0.57  .Q        .         .         .         .
11.63      0.3573      0.59  .Q        .         .         .         .
11.78      0.3647      0.60  .Q        .         .         .         .
11.93      0.3722      0.61  .Q        .         .         .         .
12.08      0.3799      0.62  .Q        .         .         .         .
12.23      0.3885      0.76  .Q        .         .         .         .
12.38      0.3980      0.77  .Q        .         .         .         .
12.53      0.4077      0.79  .Q        .         .         .         .
12.69      0.4176      0.80  .Q        .         .         .         .
12.84      0.4277      0.83  .Q        .         .         .         .
12.99      0.4381      0.84  .Q        .         .         .         .
13.14      0.4488      0.87  .Q        .         .         .         .
13.29      0.4598      0.89  .Q        .         .         .         .
13.44      0.4711      0.93  .Q        .         .         .         .
13.59      0.4827      0.94  .Q        .         .         .         .
13.74      0.4947      0.99  .Q        .         .         .         .
13.89      0.5072      1.01  . Q       .         .         .         .
14.04      0.5201      1.06  . Q       .         .         .         .
14.19      0.5341      1.19  . Q       .         .         .         .
14.34      0.5494      1.27  . Q       .         .         .         .
14.49      0.5654      1.30  . Q       .         .         .         .
14.64      0.5822      1.39  . Q       .         .         .         .
14.79      0.5998      1.44  . Q       .         .         .         .
14.95      0.6185      1.56  .  Q      .         .         .         .
15.10      0.6384      1.63  .  Q      .         .         .         .
15.25      0.6599      1.82  .  Q      .         .         .         .
15.40      0.6832      1.93  .  Q      .         .         .         .
15.55      0.7091      2.22  .   Q     .         .         .         .
15.70      0.7382      2.46  .   Q     .         .         .         .
15.85      0.7765      3.68  .      Q  .         .         .         .
16.00      0.8301      4.93  .        Q.         .         .         .
16.15      0.9341     11.77  .         .         .  Q      .         .
16.30      1.0255      2.90  .    Q    .         .         .         .
16.45      1.0563      2.05  .   Q     .         .         .         .
16.60      1.0798      1.72  .  Q      .         .         .         .
16.75      1.0998      1.50  . Q       .         .         .         .
16.90      1.1175      1.34  . Q       .         .         .         .
17.05      1.1336      1.23  . Q       .         .         .         .
17.21      1.1477      1.04  . Q       .         .         .         .
17.36      1.1601      0.97  .Q        .         .         .         .
17.51      1.1718      0.91  .Q        .         .         .         .
17.66      1.1828      0.86  .Q        .         .         .         .
17.81      1.1932      0.81  .Q        .         .         .         .
17.96      1.2031      0.78  .Q        .         .         .         .
18.11      1.2125      0.72  .Q        .         .         .         .
18.26      1.2207      0.60  .Q        .         .         .         .
18.41      1.2281      0.58  .Q        .         .         .         .
```

```
  18.56      1.2352      0.56  .Q         .         .         .         .
  18.71      1.2420      0.54  .Q         .         .         .         .
  18.86      1.2486      0.52  .Q         .         .         .         .
  19.01      1.2549      0.50  .Q         .         .         .         .
  19.16      1.2611      0.49  Q          .         .         .         .
  19.31      1.2671      0.47  Q          .         .         .         .
  19.47      1.2729      0.46  Q          .         .         .         .
  19.62      1.2785      0.45  Q          .         .         .         .
  19.77      1.2840      0.44  Q          .         .         .         .
  19.92      1.2894      0.43  Q          .         .         .         .
  20.07      1.2946      0.42  Q          .         .         .         .
  20.22      1.2997      0.41  Q          .         .         .         .
  20.37      1.3047      0.40  Q          .         .         .         .
  20.52      1.3096      0.39  Q          .         .         .         .
  20.67      1.3144      0.38  Q          .         .         .         .
  20.82      1.3191      0.37  Q          .         .         .         .
  20.97      1.3237      0.37  Q          .         .         .         .
  21.12      1.3282      0.36  Q          .         .         .         .
  21.27      1.3326      0.35  Q          .         .         .         .
  21.42      1.3370      0.35  Q          .         .         .         .
  21.57      1.3413      0.34  Q          .         .         .         .
  21.73      1.3455      0.33  Q          .         .         .         .
  21.88      1.3496      0.33  Q          .         .         .         .
  22.03      1.3537      0.32  Q          .         .         .         .
  22.18      1.3577      0.32  Q          .         .         .         .
  22.33      1.3616      0.31  Q          .         .         .         .
  22.48      1.3655      0.31  Q          .         .         .         .
  22.63      1.3693      0.31  Q          .         .         .         .
  22.78      1.3731      0.30  Q          .         .         .         .
  22.93      1.3768      0.30  Q          .         .         .         .
  23.08      1.3805      0.29  Q          .         .         .         .
  23.23      1.3841      0.29  Q          .         .         .         .
  23.38      1.3877      0.29  Q          .         .         .         .
  23.53      1.3913      0.28  Q          .         .         .         .
  23.68      1.3947      0.28  Q          .         .         .         .
  23.83      1.3982      0.28  Q          .         .         .         .
  23.99      1.4016      0.27  Q          .         .         .         .
  24.14      1.4050      0.27  Q          .         .         .         .
  24.29      1.4066      0.00  Q          .         .         .         .
 -----------------------------------------------------------------------------
---------------------------------------------------------------------------------
    TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
    (Note: 100% of Peak Flow Rate estimate assumed to have
    an instantaneous time duration)
    Percentile of Estimated                  Duration
        Peak Flow Rate                       (minutes)
    =======================                  =========
               0%                             1446.4
              10%                              180.8
              20%                               45.2
              30%                               27.1
              40%                               18.1
              50%                                9.0
              60%                                9.0
              70%                                9.0
              80%                                9.0
              90%                                9.0
```

```
****************************************************************************
                      SMALL AREA UNIT HYDROGRAPH MODEL
============================================================================
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                           Analysis prepared by:

                  THATCHER ENGINEERING & ASSOCIATES, INC.
                        1461 FORD STREET, SUITE 105
                             REDLANDS, CA 92373
                PHONE: (909) 748-7777   FAX: (909) 748-7776

****************************************************************************
----------------------------------------------------------------------------

 Problem Descriptions:
  APN 297-107-002 & 003
  POST-DEVELOPMENT DA2
  2-YEAR STORM EVENT
----------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
    TOTAL CATCHMENT AREA(ACRES) =    7.94
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.246
    LOW LOSS FRACTION = 0.437
    TIME OF CONCENTRATION(MIN.) = 10.12
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    USER SPECIFIED RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =   2
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.12
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.32
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.45
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  0.78
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.07
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  1.83

----------------------------------------------------------------------------

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     0.63
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.58

****************************************************************************
  TIME     VOLUME       Q    0.        2.5       5.0       7.5      10.0
 (HOURS)    (AF)      (CFS)
----------------------------------------------------------------------------
  0.15     0.0008      0.12  Q         .         .         .         .
  0.31     0.0025      0.12  Q         .         .         .         .
  0.48     0.0042      0.12  Q         .         .         .         .
  0.65     0.0058      0.12  Q         .         .         .         .
  0.82     0.0075      0.12  Q         .         .         .         .
  0.99     0.0092      0.12  Q         .         .         .         .
  1.16     0.0110      0.12  Q         .         .         .         .
  1.33     0.0127      0.12  Q         .         .         .         .
  1.49     0.0144      0.13  Q         .         .         .         .
```

```
  1.66      0.0162      0.13  Q         .         .         .         .
  1.83      0.0180      0.13  Q         .         .         .         .
  2.00      0.0197      0.13  Q         .         .         .         .
  2.17      0.0215      0.13  Q         .         .         .         .
  2.34      0.0233      0.13  Q         .         .         .         .
  2.51      0.0251      0.13  Q         .         .         .         .
  2.68      0.0270      0.13  Q         .         .         .         .
  2.84      0.0288      0.13  Q         .         .         .         .
  3.01      0.0307      0.13  Q         .         .         .         .
  3.18      0.0326      0.13  Q         .         .         .         .
  3.35      0.0345      0.14  Q         .         .         .         .
  3.52      0.0364      0.14  Q         .         .         .         .
  3.69      0.0383      0.14  Q         .         .         .         .
  3.86      0.0402      0.14  Q         .         .         .         .
  4.02      0.0422      0.14  Q         .         .         .         .
  4.19      0.0442      0.14  Q         .         .         .         .
  4.36      0.0461      0.14  Q         .         .         .         .
  4.53      0.0481      0.14  Q         .         .         .         .
  4.70      0.0502      0.15  Q         .         .         .         .
  4.87      0.0522      0.15  Q         .         .         .         .
  5.04      0.0543      0.15  Q         .         .         .         .
  5.21      0.0564      0.15  Q         .         .         .         .
  5.37      0.0585      0.15  Q         .         .         .         .
  5.54      0.0606      0.15  Q         .         .         .         .
  5.71      0.0627      0.15  Q         .         .         .         .
  5.88      0.0649      0.16  Q         .         .         .         .
  6.05      0.0671      0.16  Q         .         .         .         .
  6.22      0.0693      0.16  Q         .         .         .         .
  6.39      0.0715      0.16  Q         .         .         .         .
  6.55      0.0738      0.16  Q         .         .         .         .
  6.72      0.0760      0.16  Q         .         .         .         .
  6.89      0.0783      0.17  Q         .         .         .         .
  7.06      0.0807      0.17  Q         .         .         .         .
  7.23      0.0830      0.17  Q         .         .         .         .
  7.40      0.0854      0.17  Q         .         .         .         .
  7.57      0.0878      0.17  Q         .         .         .         .
  7.74      0.0903      0.18  Q         .         .         .         .
  7.90      0.0927      0.18  Q         .         .         .         .
  8.07      0.0952      0.18  Q         .         .         .         .
  8.24      0.0978      0.18  Q         .         .         .         .
  8.41      0.1003      0.19  Q         .         .         .         .
  8.58      0.1029      0.19  Q         .         .         .         .
  8.75      0.1056      0.19  Q         .         .         .         .
  8.92      0.1083      0.19  Q         .         .         .         .
  9.08      0.1110      0.20  Q         .         .         .         .
  9.25      0.1137      0.20  Q         .         .         .         .
  9.42      0.1165      0.20  Q         .         .         .         .
  9.59      0.1194      0.20  Q         .         .         .         .
  9.76      0.1222      0.21  Q         .         .         .         .
  9.93      0.1252      0.21  Q         .         .         .         .
 10.10      0.1282      0.22  Q         .         .         .         .
 10.27      0.1312      0.22  Q         .         .         .         .
 10.43      0.1343      0.22  Q         .         .         .         .
 10.60      0.1374      0.23  Q         .         .         .         .
 10.77      0.1406      0.23  Q         .         .         .         .
 10.94      0.1439      0.24  Q         .         .         .         .
 11.11      0.1472      0.24  Q         .         .         .         .
```

```
11.28      0.1506      0.25  Q         .         .         .         .
11.45      0.1541      0.25  .Q        .         .         .         .
11.61      0.1576      0.26  .Q        .         .         .         .
11.78      0.1613      0.26  .Q        .         .         .         .
11.95      0.1650      0.27  .Q        .         .         .         .
12.12      0.1690      0.31  .Q        .         .         .         .
12.29      0.1735      0.33  .Q        .         .         .         .
12.46      0.1782      0.34  .Q        .         .         .         .
12.63      0.1830      0.35  .Q        .         .         .         .
12.80      0.1880      0.36  .Q        .         .         .         .
12.96      0.1931      0.37  .Q        .         .         .         .
13.13      0.1983      0.38  .Q        .         .         .         .
13.30      0.2037      0.39  .Q        .         .         .         .
13.47      0.2093      0.41  .Q        .         .         .         .
13.64      0.2151      0.42  .Q        .         .         .         .
13.81      0.2211      0.44  .Q        .         .         .         .
13.98      0.2273      0.45  .Q        .         .         .         .
14.14      0.2341      0.52  . Q       .         .         .         .
14.31      0.2415      0.54  . Q       .         .         .         .
14.48      0.2493      0.58  . Q       .         .         .         .
14.65      0.2576      0.60  . Q       .         .         .         .
14.82      0.2663      0.65  . Q       .         .         .         .
14.99      0.2756      0.68  . Q       .         .         .         .
15.16      0.2856      0.76  .  Q      .         .         .         .
15.33      0.2965      0.81  .  Q      .         .         .         .
15.49      0.3086      0.93  .  Q      .         .         .         .
15.66      0.3222      1.03  .   Q     .         .         .         .
15.83      0.3400      1.52  .     Q   .         .         .         .
16.00      0.3642      1.94  .      Q  .         .         .         .
16.17      0.4176      5.72  .         .         . Q       .         .
16.34      0.4656      1.17  .   Q     .         .         .         .
16.51      0.4798      0.87  .  Q      .         .         .         .
16.67      0.4908      0.72  . Q       .         .         .         .
16.84      0.5001      0.62  . Q       .         .         .         .
17.01      0.5084      0.56  . Q       .         .         .         .
17.18      0.5156      0.47  .Q        .         .         .         .
17.35      0.5218      0.43  .Q        .         .         .         .
17.52      0.5276      0.40  .Q        .         .         .         .
17.69      0.5330      0.38  .Q        .         .         .         .
17.86      0.5381      0.36  .Q        .         .         .         .
18.02      0.5430      0.34  .Q        .         .         .         .
18.19      0.5472      0.27  .Q        .         .         .         .
18.36      0.5510      0.26  .Q        .         .         .         .
18.53      0.5545      0.25  Q         .         .         .         .
18.70      0.5579      0.24  Q         .         .         .         .
18.87      0.5612      0.23  Q         .         .         .         .
19.04      0.5643      0.22  Q         .         .         .         .
19.20      0.5674      0.21  Q         .         .         .         .
19.37      0.5703      0.21  Q         .         .         .         .
19.54      0.5731      0.20  Q         .         .         .         .
19.71      0.5759      0.19  Q         .         .         .         .
19.88      0.5786      0.19  Q         .         .         .         .
20.05      0.5812      0.18  Q         .         .         .         .
20.22      0.5837      0.18  Q         .         .         .         .
20.39      0.5862      0.18  Q         .         .         .         .
20.55      0.5886      0.17  Q         .         .         .         .
20.72      0.5909      0.17  Q         .         .         .         .
```

```
  20.89      0.5932      0.16  Q         .         .         .         .
  21.06      0.5955      0.16  Q         .         .         .         .
  21.23      0.5977      0.16  Q         .         .         .         .
  21.40      0.5999      0.15  Q         .         .         .         .
  21.57      0.6020      0.15  Q         .         .         .         .
  21.73      0.6041      0.15  Q         .         .         .         .
  21.90      0.6061      0.15  Q         .         .         .         .
  22.07      0.6081      0.14  Q         .         .         .         .
  22.24      0.6101      0.14  Q         .         .         .         .
  22.41      0.6120      0.14  Q         .         .         .         .
  22.58      0.6139      0.14  Q         .         .         .         .
  22.75      0.6158      0.13  Q         .         .         .         .
  22.92      0.6177      0.13  Q         .         .         .         .
  23.08      0.6195      0.13  Q         .         .         .         .
  23.25      0.6213      0.13  Q         .         .         .         .
  23.42      0.6230      0.13  Q         .         .         .         .
  23.59      0.6248      0.12  Q         .         .         .         .
  23.76      0.6265      0.12  Q         .         .         .         .
  23.93      0.6282      0.12  Q         .         .         .         .
  24.10      0.6299      0.12  Q         .         .         .         .
  24.26      0.6307      0.00  Q         .         .         .         .
 -----------------------------------------------------------------------------
--------------------------------------------------------------------------------
    TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
    (Note: 100% of Peak Flow Rate estimate assumed to have
    an instantaneous time duration)

    Percentile of Estimated                 Duration
        Peak Flow Rate                      (minutes)
    =======================                 =========
               0%                            1447.2
              10%                             151.8
              20%                              40.5
              30%                              20.2
              40%                              10.1
              50%                              10.1
              60%                              10.1
              70%                              10.1
              80%                              10.1
              90%                              10.1
```

```
****************************************************************************
                    SMALL AREA UNIT HYDROGRAPH MODEL
============================================================================
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            Ver. 23.0  Release Date: 07/01/2016  License ID 1533

                          Analysis prepared by:

                THATCHER ENGINEERING & ASSOCIATES, INC.
                      1461 FORD STREET, SUITE 105
                           REDLANDS, CA 92373
              PHONE: (909) 748-7777   FAX: (909) 748-7776

****************************************************************************
----------------------------------------------------------------------------

 Problem Descriptions:
  APN 297-170-002 & 003
  POST-DEVELOPMENT DA3
  2-YEAR STORM EVENT
----------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
    TOTAL CATCHMENT AREA(ACRES) =    0.64
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.165
    LOW LOSS FRACTION = 0.301
    TIME OF CONCENTRATION(MIN.) =  9.81
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    USER SPECIFIED RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =   2
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.12
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.32
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.45
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  0.78
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.07
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  1.83

----------------------------------------------------------------------------

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     0.06
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.04

****************************************************************************
  TIME     VOLUME        Q    0.        2.5        5.0        7.5       10.0
 (HOURS)    (AF)       (CFS)
----------------------------------------------------------------------------
  0.14      0.0001      0.01  Q          .          .          .          .
  0.30      0.0002      0.01  Q          .          .          .          .
  0.47      0.0004      0.01  Q          .          .          .          .
  0.63      0.0006      0.01  Q          .          .          .          .
  0.79      0.0007      0.01  Q          .          .          .          .
  0.96      0.0009      0.01  Q          .          .          .          .
  1.12      0.0011      0.01  Q          .          .          .          .
  1.28      0.0012      0.01  Q          .          .          .          .
  1.45      0.0014      0.01  Q          .          .          .          .
```

```
    1.61      0.0016      0.01  Q         .         .         .         .
    1.78      0.0017      0.01  Q         .         .         .         .
    1.94      0.0019      0.01  Q         .         .         .         .
    2.10      0.0021      0.01  Q         .         .         .         .
    2.27      0.0022      0.01  Q         .         .         .         .
    2.43      0.0024      0.01  Q         .         .         .         .
    2.59      0.0026      0.01  Q         .         .         .         .
    2.76      0.0028      0.01  Q         .         .         .         .
    2.92      0.0030      0.01  Q         .         .         .         .
    3.08      0.0031      0.01  Q         .         .         .         .
    3.25      0.0033      0.01  Q         .         .         .         .
    3.41      0.0035      0.01  Q         .         .         .         .
    3.57      0.0037      0.01  Q         .         .         .         .
    3.74      0.0039      0.01  Q         .         .         .         .
    3.90      0.0041      0.01  Q         .         .         .         .
    4.06      0.0043      0.01  Q         .         .         .         .
    4.23      0.0045      0.01  Q         .         .         .         .
    4.39      0.0046      0.01  Q         .         .         .         .
    4.55      0.0048      0.01  Q         .         .         .         .
    4.72      0.0050      0.01  Q         .         .         .         .
    4.88      0.0052      0.01  Q         .         .         .         .
    5.05      0.0054      0.01  Q         .         .         .         .
    5.21      0.0056      0.01  Q         .         .         .         .
    5.37      0.0058      0.02  Q         .         .         .         .
    5.54      0.0060      0.02  Q         .         .         .         .
    5.70      0.0063      0.02  Q         .         .         .         .
    5.86      0.0065      0.02  Q         .         .         .         .
    6.03      0.0067      0.02  Q         .         .         .         .
    6.19      0.0069      0.02  Q         .         .         .         .
    6.35      0.0071      0.02  Q         .         .         .         .
    6.52      0.0073      0.02  Q         .         .         .         .
    6.68      0.0075      0.02  Q         .         .         .         .
    6.84      0.0078      0.02  Q         .         .         .         .
    7.01      0.0080      0.02  Q         .         .         .         .
    7.17      0.0082      0.02  Q         .         .         .         .
    7.33      0.0084      0.02  Q         .         .         .         .
    7.50      0.0087      0.02  Q         .         .         .         .
    7.66      0.0089      0.02  Q         .         .         .         .
    7.82      0.0092      0.02  Q         .         .         .         .
    7.99      0.0094      0.02  Q         .         .         .         .
    8.15      0.0096      0.02  Q         .         .         .         .
    8.32      0.0099      0.02  Q         .         .         .         .
    8.48      0.0101      0.02  Q         .         .         .         .
    8.64      0.0104      0.02  Q         .         .         .         .
    8.81      0.0107      0.02  Q         .         .         .         .
    8.97      0.0109      0.02  Q         .         .         .         .
    9.13      0.0112      0.02  Q         .         .         .         .
    9.30      0.0114      0.02  Q         .         .         .         .
    9.46      0.0117      0.02  Q         .         .         .         .
    9.62      0.0120      0.02  Q         .         .         .         .
    9.79      0.0123      0.02  Q         .         .         .         .
    9.95      0.0126      0.02  Q         .         .         .         .
   10.11      0.0129      0.02  Q         .         .         .         .
   10.28      0.0131      0.02  Q         .         .         .         .
   10.44      0.0134      0.02  Q         .         .         .         .
   10.60      0.0138      0.02  Q         .         .         .         .
   10.77      0.0141      0.02  Q         .         .         .         .
```

```
10.93      0.0144      0.02  Q          .         .         .         .
11.10      0.0147      0.02  Q          .         .         .         .
11.26      0.0150      0.02  Q          .         .         .         .
11.42      0.0154      0.03  Q          .         .         .         .
11.59      0.0157      0.03  Q          .         .         .         .
11.75      0.0161      0.03  Q          .         .         .         .
11.91      0.0164      0.03  Q          .         .         .         .
12.08      0.0168      0.03  Q          .         .         .         .
12.24      0.0172      0.03  Q          .         .         .         .
12.40      0.0177      0.03  Q          .         .         .         .
12.57      0.0181      0.04  Q          .         .         .         .
12.73      0.0186      0.04  Q          .         .         .         .
12.89      0.0191      0.04  Q          .         .         .         .
13.06      0.0196      0.04  Q          .         .         .         .
13.22      0.0202      0.04  Q          .         .         .         .
13.38      0.0207      0.04  Q          .         .         .         .
13.55      0.0213      0.04  Q          .         .         .         .
13.71      0.0218      0.04  Q          .         .         .         .
13.87      0.0224      0.05  Q          .         .         .         .
14.04      0.0231      0.05  Q          .         .         .         .
14.20      0.0237      0.05  Q          .         .         .         .
14.37      0.0245      0.05  Q          .         .         .         .
14.53      0.0252      0.06  Q          .         .         .         .
14.69      0.0260      0.06  Q          .         .         .         .
14.86      0.0269      0.07  Q          .         .         .         .
15.02      0.0278      0.07  Q          .         .         .         .
15.18      0.0288      0.08  Q          .         .         .         .
15.35      0.0298      0.08  Q          .         .         .         .
15.51      0.0310      0.09  Q          .         .         .         .
15.67      0.0324      0.10  Q          .         .         .         .
15.84      0.0341      0.16  Q          .         .         .         .
16.00      0.0365      0.20  Q          .         .         .         .
16.16      0.0413      0.51  . Q        .         .         .         .
16.33      0.0455      0.12  Q          .         .         .         .
16.49      0.0469      0.09  Q          .         .         .         .
16.65      0.0480      0.07  Q          .         .         .         .
16.82      0.0489      0.06  Q          .         .         .         .
16.98      0.0497      0.06  Q          .         .         .         .
17.14      0.0504      0.05  Q          .         .         .         .
17.31      0.0511      0.04  Q          .         .         .         .
17.47      0.0516      0.04  Q          .         .         .         .
17.64      0.0522      0.04  Q          .         .         .         .
17.80      0.0527      0.04  Q          .         .         .         .
17.96      0.0532      0.03  Q          .         .         .         .
18.13      0.0536      0.03  Q          .         .         .         .
18.29      0.0540      0.03  Q          .         .         .         .
18.45      0.0544      0.03  Q          .         .         .         .
18.62      0.0547      0.02  Q          .         .         .         .
18.78      0.0550      0.02  Q          .         .         .         .
18.94      0.0554      0.02  Q          .         .         .         .
19.11      0.0557      0.02  Q          .         .         .         .
19.27      0.0559      0.02  Q          .         .         .         .
19.43      0.0562      0.02  Q          .         .         .         .
19.60      0.0565      0.02  Q          .         .         .         .
19.76      0.0568      0.02  Q          .         .         .         .
19.92      0.0570      0.02  Q          .         .         .         .
20.09      0.0573      0.02  Q          .         .         .         .
```

```
 20.25       0.0575      0.02  Q         .         .         .         .
 20.41       0.0578      0.02  Q         .         .         .         .
 20.58       0.0580      0.02  Q         .         .         .         .
 20.74       0.0582      0.02  Q         .         .         .         .
 20.91       0.0584      0.02  Q         .         .         .         .
 21.07       0.0587      0.02  Q         .         .         .         .
 21.23       0.0589      0.02  Q         .         .         .         .
 21.40       0.0591      0.02  Q         .         .         .         .
 21.56       0.0593      0.02  Q         .         .         .         .
 21.72       0.0595      0.01  Q         .         .         .         .
 21.89       0.0597      0.01  Q         .         .         .         .
 22.05       0.0599      0.01  Q         .         .         .         .
 22.21       0.0601      0.01  Q         .         .         .         .
 22.38       0.0603      0.01  Q         .         .         .         .
 22.54       0.0604      0.01  Q         .         .         .         .
 22.70       0.0606      0.01  Q         .         .         .         .
 22.87       0.0608      0.01  Q         .         .         .         .
 23.03       0.0610      0.01  Q         .         .         .         .
 23.19       0.0612      0.01  Q         .         .         .         .
 23.36       0.0613      0.01  Q         .         .         .         .
 23.52       0.0615      0.01  Q         .         .         .         .
 23.68       0.0617      0.01  Q         .         .         .         .
 23.85       0.0618      0.01  Q         .         .         .         .
 24.01       0.0620      0.01  Q         .         .         .         .
 24.18       0.0621      0.00  Q         .         .         .         .
----------------------------------------------------------------------------
--------------------------------------------------------------------------------
    TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
    (Note: 100% of Peak Flow Rate estimate assumed to have
    an instantaneous time duration)

    Percentile of Estimated                 Duration
        Peak Flow Rate                      (minutes)
    =======================                 =========
              0%                             1442.1
             10%                              176.6
             20%                               49.1
             30%                               29.4
             40%                                9.8
             50%                                9.8
             60%                                9.8
             70%                                9.8
             80%                                9.8
             90%                                9.8
```

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****************************************************************************
                      SMALL AREA UNIT HYDROGRAPH MODEL
============================================================================
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                          Analysis prepared by:

                THATCHER ENGINEERING & ASSOCIATES, INC.
                      1461 FORD STREET, SUITE 105
                           REDLANDS, CA 92373
              PHONE: (909) 748-7777   FAX: (909) 748-7776

****************************************************************************
----------------------------------------------------------------------------

 Problem Descriptions:
  APN 297-170-002 & 003
  POST-DEVELOPMENT DA4
  2-YEAR STORM EVENT
----------------------------------------------------------------------------


   RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
   TOTAL CATCHMENT AREA(ACRES) =    0.64
   SOIL-LOSS RATE, Fm,(INCH/HR) =  0.190
   LOW LOSS FRACTION = 0.328
   TIME OF CONCENTRATION(MIN.) = 10.02
   SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
   USER SPECIFIED RAINFALL VALUES ARE USED
   RETURN FREQUENCY(YEARS) =   2
      5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.12
     30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.32
      1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.45
      3-HOUR   POINT RAINFALL VALUE(INCHES) =  0.78
      6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.07
     24-HOUR   POINT RAINFALL VALUE(INCHES) =  1.83

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   TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     0.06
   TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.04

****************************************************************************
  TIME     VOLUME       Q    0.         2.5        5.0        7.5       10.0
 (HOURS)    (AF)      (CFS)
----------------------------------------------------------------------------
  0.13     0.0001     0.01  Q          .          .          .          .
  0.30     0.0002     0.01  Q          .          .          .          .
  0.47     0.0004     0.01  Q          .          .          .          .
  0.64     0.0005     0.01  Q          .          .          .          .
  0.80     0.0007     0.01  Q          .          .          .          .
  0.97     0.0009     0.01  Q          .          .          .          .
  1.14     0.0010     0.01  Q          .          .          .          .
  1.30     0.0012     0.01  Q          .          .          .          .
  1.47     0.0014     0.01  Q          .          .          .          .
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```
  1.64        0.0015        0.01  Q        .         .         .         .
  1.80        0.0017        0.01  Q        .         .         .         .
  1.97        0.0019        0.01  Q        .         .         .         .
  2.14        0.0020        0.01  Q        .         .         .         .
  2.31        0.0022        0.01  Q        .         .         .         .
  2.47        0.0024        0.01  Q        .         .         .         .
  2.64        0.0026        0.01  Q        .         .         .         .
  2.81        0.0027        0.01  Q        .         .         .         .
  2.97        0.0029        0.01  Q        .         .         .         .
  3.14        0.0031        0.01  Q        .         .         .         .
  3.31        0.0033        0.01  Q        .         .         .         .
  3.47        0.0034        0.01  Q        .         .         .         .
  3.64        0.0036        0.01  Q        .         .         .         .
  3.81        0.0038        0.01  Q        .         .         .         .
  3.98        0.0040        0.01  Q        .         .         .         .
  4.14        0.0042        0.01  Q        .         .         .         .
  4.31        0.0044        0.01  Q        .         .         .         .
  4.48        0.0046        0.01  Q        .         .         .         .
  4.64        0.0048        0.01  Q        .         .         .         .
  4.81        0.0050        0.01  Q        .         .         .         .
  4.98        0.0051        0.01  Q        .         .         .         .
  5.14        0.0053        0.01  Q        .         .         .         .
  5.31        0.0055        0.01  Q        .         .         .         .
  5.48        0.0057        0.01  Q        .         .         .         .
  5.65        0.0059        0.01  Q        .         .         .         .
  5.81        0.0062        0.01  Q        .         .         .         .
  5.98        0.0064        0.02  Q        .         .         .         .
  6.15        0.0066        0.02  Q        .         .         .         .
  6.31        0.0068        0.02  Q        .         .         .         .
  6.48        0.0070        0.02  Q        .         .         .         .
  6.65        0.0072        0.02  Q        .         .         .         .
  6.81        0.0074        0.02  Q        .         .         .         .
  6.98        0.0077        0.02  Q        .         .         .         .
  7.15        0.0079        0.02  Q        .         .         .         .
  7.32        0.0081        0.02  Q        .         .         .         .
  7.48        0.0083        0.02  Q        .         .         .         .
  7.65        0.0086        0.02  Q        .         .         .         .
  7.82        0.0088        0.02  Q        .         .         .         .
  7.98        0.0090        0.02  Q        .         .         .         .
  8.15        0.0093        0.02  Q        .         .         .         .
  8.32        0.0095        0.02  Q        .         .         .         .
  8.48        0.0098        0.02  Q        .         .         .         .
  8.65        0.0100        0.02  Q        .         .         .         .
  8.82        0.0103        0.02  Q        .         .         .         .
  8.99        0.0105        0.02  Q        .         .         .         .
  9.15        0.0108        0.02  Q        .         .         .         .
  9.32        0.0110        0.02  Q        .         .         .         .
  9.49        0.0113        0.02  Q        .         .         .         .
  9.65        0.0116        0.02  Q        .         .         .         .
  9.82        0.0119        0.02  Q        .         .         .         .
  9.99        0.0121        0.02  Q        .         .         .         .
 10.15        0.0124        0.02  Q        .         .         .         .
 10.32        0.0127        0.02  Q        .         .         .         .
 10.49        0.0130        0.02  Q        .         .         .         .
 10.66        0.0133        0.02  Q        .         .         .         .
 10.82        0.0136        0.02  Q        .         .         .         .
 10.99        0.0139        0.02  Q        .         .         .         .
```

```
 11.16        0.0143       0.02  Q            .            .            .            .
 11.32        0.0146       0.02  Q            .            .            .            .
 11.49        0.0149       0.02  Q            .            .            .            .
 11.66        0.0153       0.02  Q            .            .            .            .
 11.82        0.0156       0.03  Q            .            .            .            .
 11.99        0.0160       0.03  Q            .            .            .            .
 12.16        0.0164       0.03  Q            .            .            .            .
 12.33        0.0168       0.03  Q            .            .            .            .
 12.49        0.0172       0.03  Q            .            .            .            .
 12.66        0.0177       0.03  Q            .            .            .            .
 12.83        0.0182       0.04  Q            .            .            .            .
 12.99        0.0187       0.04  Q            .            .            .            .
 13.16        0.0192       0.04  Q            .            .            .            .
 13.33        0.0197       0.04  Q            .            .            .            .
 13.49        0.0202       0.04  Q            .            .            .            .
 13.66        0.0208       0.04  Q            .            .            .            .
 13.83        0.0214       0.04  Q            .            .            .            .
 14.00        0.0220       0.04  Q            .            .            .            .
 14.16        0.0226       0.05  Q            .            .            .            .
 14.33        0.0233       0.05  Q            .            .            .            .
 14.50        0.0241       0.06  Q            .            .            .            .
 14.66        0.0249       0.06  Q            .            .            .            .
 14.83        0.0257       0.06  Q            .            .            .            .
 15.00        0.0266       0.07  Q            .            .            .            .
 15.16        0.0275       0.07  Q            .            .            .            .
 15.33        0.0286       0.08  Q            .            .            .            .
 15.50        0.0297       0.09  Q            .            .            .            .
 15.67        0.0310       0.10  Q            .            .            .            .
 15.83        0.0327       0.15  Q            .            .            .            .
 16.00        0.0351       0.19  Q            .            .            .            .
 16.17        0.0398       0.50  .Q           .            .            .            .
 16.33        0.0440       0.11  Q            .            .            .            .
 16.50        0.0453       0.08  Q            .            .            .            .
 16.67        0.0464       0.07  Q            .            .            .            .
 16.83        0.0473       0.06  Q            .            .            .            .
 17.00        0.0481       0.05  Q            .            .            .            .
 17.17        0.0488       0.05  Q            .            .            .            .
 17.34        0.0494       0.04  Q            .            .            .            .
 17.50        0.0499       0.04  Q            .            .            .            .
 17.67        0.0504       0.04  Q            .            .            .            .
 17.84        0.0509       0.03  Q            .            .            .            .
 18.00        0.0514       0.03  Q            .            .            .            .
 18.17        0.0518       0.03  Q            .            .            .            .
 18.34        0.0522       0.03  Q            .            .            .            .
 18.51        0.0525       0.02  Q            .            .            .            .
 18.67        0.0528       0.02  Q            .            .            .            .
 18.84        0.0531       0.02  Q            .            .            .            .
 19.01        0.0534       0.02  Q            .            .            .            .
 19.17        0.0537       0.02  Q            .            .            .            .
 19.34        0.0540       0.02  Q            .            .            .            .
 19.51        0.0543       0.02  Q            .            .            .            .
 19.67        0.0545       0.02  Q            .            .            .            .
 19.84        0.0548       0.02  Q            .            .            .            .
 20.01        0.0551       0.02  Q            .            .            .            .
 20.17        0.0553       0.02  Q            .            .            .            .
 20.34        0.0555       0.02  Q            .            .            .            .
 20.51        0.0558       0.02  Q            .            .            .            .
```

```
  20.68      0.0560      0.02  Q         .         .         .         .
  20.84      0.0562      0.02  Q         .         .         .         .
  21.01      0.0564      0.02  Q         .         .         .         .
  21.18      0.0566      0.02  Q         .         .         .         .
  21.34      0.0568      0.01  Q         .         .         .         .
  21.51      0.0571      0.01  Q         .         .         .         .
  21.68      0.0573      0.01  Q         .         .         .         .
  21.85      0.0574      0.01  Q         .         .         .         .
  22.01      0.0576      0.01  Q         .         .         .         .
  22.18      0.0578      0.01  Q         .         .         .         .
  22.35      0.0580      0.01  Q         .         .         .         .
  22.51      0.0582      0.01  Q         .         .         .         .
  22.68      0.0584      0.01  Q         .         .         .         .
  22.85      0.0586      0.01  Q         .         .         .         .
  23.01      0.0587      0.01  Q         .         .         .         .
  23.18      0.0589      0.01  Q         .         .         .         .
  23.35      0.0591      0.01  Q         .         .         .         .
  23.52      0.0592      0.01  Q         .         .         .         .
  23.68      0.0594      0.01  Q         .         .         .         .
  23.85      0.0596      0.01  Q         .         .         .         .
  24.02      0.0597      0.01  Q         .         .         .         .
  24.18      0.0598      0.00  Q         .         .         .         .
 -----------------------------------------------------------------------------
-------------------------------------------------------------------------------
    TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
    (Note: 100% of Peak Flow Rate estimate assumed to have
    an instantaneous time duration)

    Percentile of Estimated                Duration
        Peak Flow Rate                     (minutes)
    =======================                =========
              0%                            1442.9
             10%                             180.4
             20%                              40.1
             30%                              20.0
             40%                              10.0
             50%                              10.0
             60%                              10.0
             70%                              10.0
             80%                              10.0
             90%                              10.0
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                             Analysis prepared by:

                    THATCHER ENGINEERING & ASSOCIATES, INC.
                          1461 FORD STREET, SUITE 105
                               REDLANDS, CA 92373
                  PHONE: (909) 748-7777   FAX: (909) 748-7776

****************************************************************************
----------------------------------------------------------------------------

 Problem Descriptions:
  APN 297-170-002 & 003
  POST-DEVELOPMENT DA5
  2-YEAR STORM EVENT
----------------------------------------------------------------------------


   RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
   TOTAL CATCHMENT AREA(ACRES) =     0.80
   SOIL-LOSS RATE, Fm,(INCH/HR) =  0.193
   LOW LOSS FRACTION = 0.331
   TIME OF CONCENTRATION(MIN.) = 10.74
   SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
   USER SPECIFIED RAINFALL VALUES ARE USED
   RETURN FREQUENCY(YEARS) =   2
      5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.12
     30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.32
      1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.45
      3-HOUR   POINT RAINFALL VALUE(INCHES) =  0.78
      6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.07
     24-HOUR   POINT RAINFALL VALUE(INCHES) =  1.83

----------------------------------------------------------------------------

   TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     0.07
   TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     0.05

****************************************************************************
  TIME      VOLUME       Q    0.        2.5       5.0       7.5      10.0
 (HOURS)     (AF)      (CFS)
----------------------------------------------------------------------------
  0.07      0.0000     0.01  Q         .         .         .         .
  0.25      0.0003     0.01  Q         .         .         .         .
  0.43      0.0005     0.01  Q         .         .         .         .
  0.61      0.0007     0.01  Q         .         .         .         .
  0.79      0.0009     0.01  Q         .         .         .         .
  0.96      0.0011     0.01  Q         .         .         .         .
  1.14      0.0013     0.01  Q         .         .         .         .
  1.32      0.0015     0.01  Q         .         .         .         .
  1.50      0.0018     0.02  Q         .         .         .         .
```

```
   1.68        0.0020        0.02  Q          .          .          .          .
   1.86        0.0022        0.02  Q          .          .          .          .
   2.04        0.0024        0.02  Q          .          .          .          .
   2.22        0.0027        0.02  Q          .          .          .          .
   2.40        0.0029        0.02  Q          .          .          .          .
   2.58        0.0031        0.02  Q          .          .          .          .
   2.75        0.0034        0.02  Q          .          .          .          .
   2.93        0.0036        0.02  Q          .          .          .          .
   3.11        0.0038        0.02  Q          .          .          .          .
   3.29        0.0041        0.02  Q          .          .          .          .
   3.47        0.0043        0.02  Q          .          .          .          .
   3.65        0.0046        0.02  Q          .          .          .          .
   3.83        0.0048        0.02  Q          .          .          .          .
   4.01        0.0051        0.02  Q          .          .          .          .
   4.19        0.0053        0.02  Q          .          .          .          .
   4.37        0.0056        0.02  Q          .          .          .          .
   4.54        0.0058        0.02  Q          .          .          .          .
   4.72        0.0061        0.02  Q          .          .          .          .
   4.90        0.0063        0.02  Q          .          .          .          .
   5.08        0.0066        0.02  Q          .          .          .          .
   5.26        0.0069        0.02  Q          .          .          .          .
   5.44        0.0071        0.02  Q          .          .          .          .
   5.62        0.0074        0.02  Q          .          .          .          .
   5.80        0.0077        0.02  Q          .          .          .          .
   5.98        0.0079        0.02  Q          .          .          .          .
   6.16        0.0082        0.02  Q          .          .          .          .
   6.33        0.0085        0.02  Q          .          .          .          .
   6.51        0.0088        0.02  Q          .          .          .          .
   6.69        0.0091        0.02  Q          .          .          .          .
   6.87        0.0094        0.02  Q          .          .          .          .
   7.05        0.0097        0.02  Q          .          .          .          .
   7.23        0.0100        0.02  Q          .          .          .          .
   7.41        0.0103        0.02  Q          .          .          .          .
   7.59        0.0106        0.02  Q          .          .          .          .
   7.77        0.0109        0.02  Q          .          .          .          .
   7.95        0.0112        0.02  Q          .          .          .          .
   8.12        0.0115        0.02  Q          .          .          .          .
   8.30        0.0118        0.02  Q          .          .          .          .
   8.48        0.0122        0.02  Q          .          .          .          .
   8.66        0.0125        0.02  Q          .          .          .          .
   8.84        0.0128        0.02  Q          .          .          .          .
   9.02        0.0132        0.02  Q          .          .          .          .
   9.20        0.0135        0.02  Q          .          .          .          .
   9.38        0.0139        0.02  Q          .          .          .          .
   9.56        0.0142        0.02  Q          .          .          .          .
   9.74        0.0146        0.02  Q          .          .          .          .
   9.91        0.0150        0.03  Q          .          .          .          .
  10.09        0.0154        0.03  Q          .          .          .          .
  10.27        0.0157        0.03  Q          .          .          .          .
  10.45        0.0161        0.03  Q          .          .          .          .
  10.63        0.0165        0.03  Q          .          .          .          .
  10.81        0.0169        0.03  Q          .          .          .          .
  10.99        0.0174        0.03  Q          .          .          .          .
  11.17        0.0178        0.03  Q          .          .          .          .
  11.35        0.0182        0.03  Q          .          .          .          .
  11.52        0.0187        0.03  Q          .          .          .          .
  11.70        0.0191        0.03  Q          .          .          .          .
```

```
 11.88        0.0196       0.03  Q         .         .         .         .
 12.06        0.0201       0.03  Q         .         .         .         .
 12.24        0.0206       0.04  Q         .         .         .         .
 12.42        0.0212       0.04  Q         .         .         .         .
 12.60        0.0218       0.04  Q         .         .         .         .
 12.78        0.0224       0.04  Q         .         .         .         .
 12.96        0.0231       0.04  Q         .         .         .         .
 13.14        0.0237       0.05  Q         .         .         .         .
 13.32        0.0244       0.05  Q         .         .         .         .
 13.49        0.0251       0.05  Q         .         .         .         .
 13.67        0.0259       0.05  Q         .         .         .         .
 13.85        0.0267       0.05  Q         .         .         .         .
 14.03        0.0275       0.06  Q         .         .         .         .
 14.21        0.0283       0.06  Q         .         .         .         .
 14.39        0.0293       0.07  Q         .         .         .         .
 14.57        0.0303       0.07  Q         .         .         .         .
 14.75        0.0314       0.08  Q         .         .         .         .
 14.93        0.0325       0.08  Q         .         .         .         .
 15.10        0.0338       0.09  Q         .         .         .         .
 15.28        0.0351       0.09  Q         .         .         .         .
 15.46        0.0366       0.11  Q         .         .         .         .
 15.64        0.0383       0.12  Q         .         .         .         .
 15.82        0.0405       0.17  Q         .         .         .         .
 16.00        0.0434       0.23  Q         .         .         .         .
 16.18        0.0495       0.59  . Q       .         .         .         .
 16.36        0.0549       0.14  Q         .         .         .         .
 16.54        0.0566       0.10  Q         .         .         .         .
 16.72        0.0580       0.08  Q         .         .         .         .
 16.90        0.0592       0.07  Q         .         .         .         .
 17.07        0.0602       0.07  Q         .         .         .         .
 17.25        0.0611       0.05  Q         .         .         .         .
 17.43        0.0618       0.05  Q         .         .         .         .
 17.61        0.0625       0.05  Q         .         .         .         .
 17.79        0.0632       0.04  Q         .         .         .         .
 17.97        0.0638       0.04  Q         .         .         .         .
 18.15        0.0644       0.04  Q         .         .         .         .
 18.33        0.0649       0.03  Q         .         .         .         .
 18.51        0.0654       0.03  Q         .         .         .         .
 18.68        0.0658       0.03  Q         .         .         .         .
 18.86        0.0662       0.03  Q         .         .         .         .
 19.04        0.0666       0.03  Q         .         .         .         .
 19.22        0.0670       0.03  Q         .         .         .         .
 19.40        0.0674       0.02  Q         .         .         .         .
 19.58        0.0677       0.02  Q         .         .         .         .
 19.76        0.0681       0.02  Q         .         .         .         .
 19.94        0.0684       0.02  Q         .         .         .         .
 20.12        0.0687       0.02  Q         .         .         .         .
 20.30        0.0691       0.02  Q         .         .         .         .
 20.48        0.0694       0.02  Q         .         .         .         .
 20.65        0.0697       0.02  Q         .         .         .         .
 20.83        0.0700       0.02  Q         .         .         .         .
 21.01        0.0703       0.02  Q         .         .         .         .
 21.19        0.0705       0.02  Q         .         .         .         .
 21.37        0.0708       0.02  Q         .         .         .         .
 21.55        0.0711       0.02  Q         .         .         .         .
 21.73        0.0714       0.02  Q         .         .         .         .
 21.91        0.0716       0.02  Q         .         .         .         .
```

```
   22.09       0.0719      0.02  Q         .         .         .         .
   22.27       0.0721      0.02  Q         .         .         .         .
   22.44       0.0724      0.02  Q         .         .         .         .
   22.62       0.0726      0.02  Q         .         .         .         .
   22.80       0.0728      0.02  Q         .         .         .         .
   22.98       0.0731      0.02  Q         .         .         .         .
   23.16       0.0733      0.02  Q         .         .         .         .
   23.34       0.0735      0.02  Q         .         .         .         .
   23.52       0.0738      0.01  Q         .         .         .         .
   23.70       0.0740      0.01  Q         .         .         .         .
   23.88       0.0742      0.01  Q         .         .         .         .
   24.06       0.0744      0.01  Q         .         .         .         .
   24.23       0.0745      0.00  Q         .         .         .         .
  ----------------------------------------------------------------------------
-------------------------------------------------------------------------------
    TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
    (Note: 100% of Peak Flow Rate estimate assumed to have
    an instantaneous time duration)

    Percentile of Estimated                   Duration
        Peak Flow Rate                        (minutes)
    =======================                   =========
               0%                              1449.9
              10%                               182.6
              20%                                53.7
              30%                                21.5
              40%                                10.7
              50%                                10.7
              60%                                10.7
              70%                                10.7
              80%                                10.7
              90%                                10.7
```

NOAA Atlas 14, Volume 6, Version 2
Location name: Moreno Valley, California, USA*
Latitude: 33.9165°, Longitude: -117.2566°
Elevation: 1570.47 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.088** (0.073-0.106)	**0.117** (0.098-0.142)	**0.157** (0.131-0.191)	**0.191** (0.157-0.234)	**0.238** (0.189-0.302)	**0.276** (0.215-0.357)	**0.315** (0.239-0.419)	**0.357** (0.263-0.488)	**0.415** (0.294-0.594)	**0.463** (0.316-0.686)
10-min	**0.126** (0.105-0.153)	**0.168** (0.140-0.204)	**0.226** (0.188-0.274)	**0.274** (0.226-0.335)	**0.341** (0.272-0.433)	**0.395** (0.308-0.512)	**0.451** (0.343-0.600)	**0.511** (0.377-0.700)	**0.596** (0.421-0.851)	**0.663** (0.452-0.983)
15-min	**0.152** (0.127-0.184)	**0.204** (0.170-0.247)	**0.273** (0.227-0.331)	**0.331** (0.273-0.405)	**0.413** (0.328-0.523)	**0.478** (0.372-0.619)	**0.546** (0.414-0.726)	**0.618** (0.456-0.847)	**0.720** (0.509-1.03)	**0.802** (0.547-1.19)
30-min	**0.239** (0.199-0.289)	**0.319** (0.266-0.386)	**0.427** (0.355-0.519)	**0.518** (0.427-0.635)	**0.646** (0.514-0.820)	**0.748** (0.583-0.970)	**0.855** (0.649-1.14)	**0.968** (0.714-1.33)	**1.13** (0.797-1.61)	**1.26** (0.857-1.86)
60-min	**0.336** (0.281-0.407)	**0.449** (0.374-0.544)	**0.601** (0.500-0.731)	**0.730** (0.601-0.894)	**0.910** (0.724-1.15)	**1.05** (0.820-1.37)	**1.20** (0.914-1.60)	**1.36** (1.01-1.87)	**1.59** (1.12-2.27)	**1.77** (1.21-2.62)
2-hr	**0.490** (0.409-0.593)	**0.639** (0.532-0.774)	**0.836** (0.695-1.02)	**0.999** (0.824-1.23)	**1.23** (0.976-1.56)	**1.40** (1.09-1.82)	**1.58** (1.20-2.11)	**1.77** (1.31-2.43)	**2.04** (1.44-2.91)	**2.24** (1.53-3.32)
3-hr	**0.601** (0.501-0.727)	**0.776** (0.647-0.940)	**1.01** (0.838-1.22)	**1.20** (0.988-1.47)	**1.46** (1.16-1.85)	**1.66** (1.30-2.16)	**1.87** (1.42-2.49)	**2.09** (1.54-2.86)	**2.38** (1.68-3.41)	**2.62** (1.78-3.88)
6-hr	**0.829** (0.692-1.00)	**1.07** (0.888-1.29)	**1.38** (1.14-1.67)	**1.63** (1.34-2.00)	**1.97** (1.57-2.50)	**2.24** (1.74-2.90)	**2.51** (1.91-3.34)	**2.79** (2.06-3.82)	**3.17** (2.24-4.52)	**3.46** (2.36-5.12)
12-hr	**1.07** (0.896-1.30)	**1.39** (1.16-1.69)	**1.81** (1.50-2.20)	**2.15** (1.77-2.63)	**2.61** (2.08-3.31)	**2.96** (2.31-3.84)	**3.32** (2.52-4.41)	**3.68** (2.72-5.05)	**4.18** (2.95-5.97)	**4.56** (3.11-6.76)
24-hr	**1.39** (1.23-1.60)	**1.83** (1.62-2.12)	**2.41** (2.13-2.79)	**2.88** (2.52-3.37)	**3.52** (2.98-4.25)	**4.01** (3.33-4.94)	**4.51** (3.65-5.68)	**5.02** (3.96-6.50)	**5.71** (4.32-7.69)	**6.24** (4.57-8.70)
2-day	**1.64** (1.45-1.89)	**2.20** (1.94-2.54)	**2.93** (2.58-3.39)	**3.53** (3.09-4.12)	**4.35** (3.68-5.24)	**4.97** (4.13-6.12)	**5.61** (4.55-7.07)	**6.27** (4.94-8.11)	**7.16** (5.42-9.65)	**7.84** (5.74-10.9)
3-day	**1.74** (1.54-2.01)	**2.37** (2.09-2.73)	**3.20** (2.82-3.70)	**3.87** (3.39-4.52)	**4.80** (4.06-5.78)	**5.51** (4.57-6.78)	**6.24** (5.05-7.86)	**6.99** (5.51-9.05)	**8.02** (6.07-10.8)	**8.81** (6.45-12.3)
4-day	**1.88** (1.67-2.17)	**2.58** (2.28-2.98)	**3.51** (3.09-4.06)	**4.27** (3.74-4.98)	**5.31** (4.50-6.40)	**6.12** (5.08-7.53)	**6.95** (5.63-8.75)	**7.81** (6.15-10.1)	**8.98** (6.80-12.1)	**9.89** (7.24-13.8)
7-day	**2.10** (1.86-2.42)	**2.92** (2.58-3.38)	**4.02** (3.55-4.66)	**4.93** (4.31-5.75)	**6.18** (5.23-7.45)	**7.15** (5.93-8.79)	**8.15** (6.60-10.3)	**9.18** (7.24-11.9)	**10.6** (8.03-14.3)	**11.7** (8.57-16.3)
10-day	**2.21** (1.95-2.54)	**3.10** (2.74-3.58)	**4.30** (3.79-4.97)	**5.29** (4.63-6.18)	**6.67** (5.65-8.04)	**7.75** (6.43-9.53)	**8.85** (7.17-11.1)	**10.0** (7.89-13.0)	**11.6** (8.78-15.6)	**12.8** (9.40-17.9)
20-day	**2.58** (2.28-2.98)	**3.68** (3.25-4.24)	**5.17** (4.56-5.98)	**6.42** (5.62-7.49)	**8.19** (6.93-9.86)	**9.58** (7.95-11.8)	**11.0** (8.94-13.9)	**12.6** (9.91-16.3)	**14.7** (11.1-19.8)	**16.4** (12.0-22.8)
30-day	**3.01** (2.66-3.47)	**4.28** (3.79-4.95)	**6.04** (5.33-6.99)	**7.54** (6.59-8.79)	**9.66** (8.18-11.6)	**11.4** (9.42-14.0)	**13.1** (10.6-16.5)	**15.0** (11.8-19.4)	**17.7** (13.4-23.8)	**19.8** (14.5-27.6)
45-day	**3.54** (3.13-4.08)	**4.99** (4.41-5.76)	**7.03** (6.19-8.13)	**8.78** (7.67-10.2)	**11.3** (9.56-13.6)	**13.3** (11.1-16.4)	**15.5** (12.6-19.5)	**17.8** (14.0-23.0)	**21.1** (16.0-28.4)	**23.7** (17.3-33.0)
60-day	**4.07** (3.60-4.69)	**5.67** (5.01-6.55)	**7.94** (7.00-9.19)	**9.90** (8.66-11.6)	**12.8** (10.8-15.4)	**15.1** (12.5-18.6)	**17.6** (14.2-22.1)	**20.2** (16.0-26.2)	**24.1** (18.2-32.4)	**27.2** (19.9-37.9)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

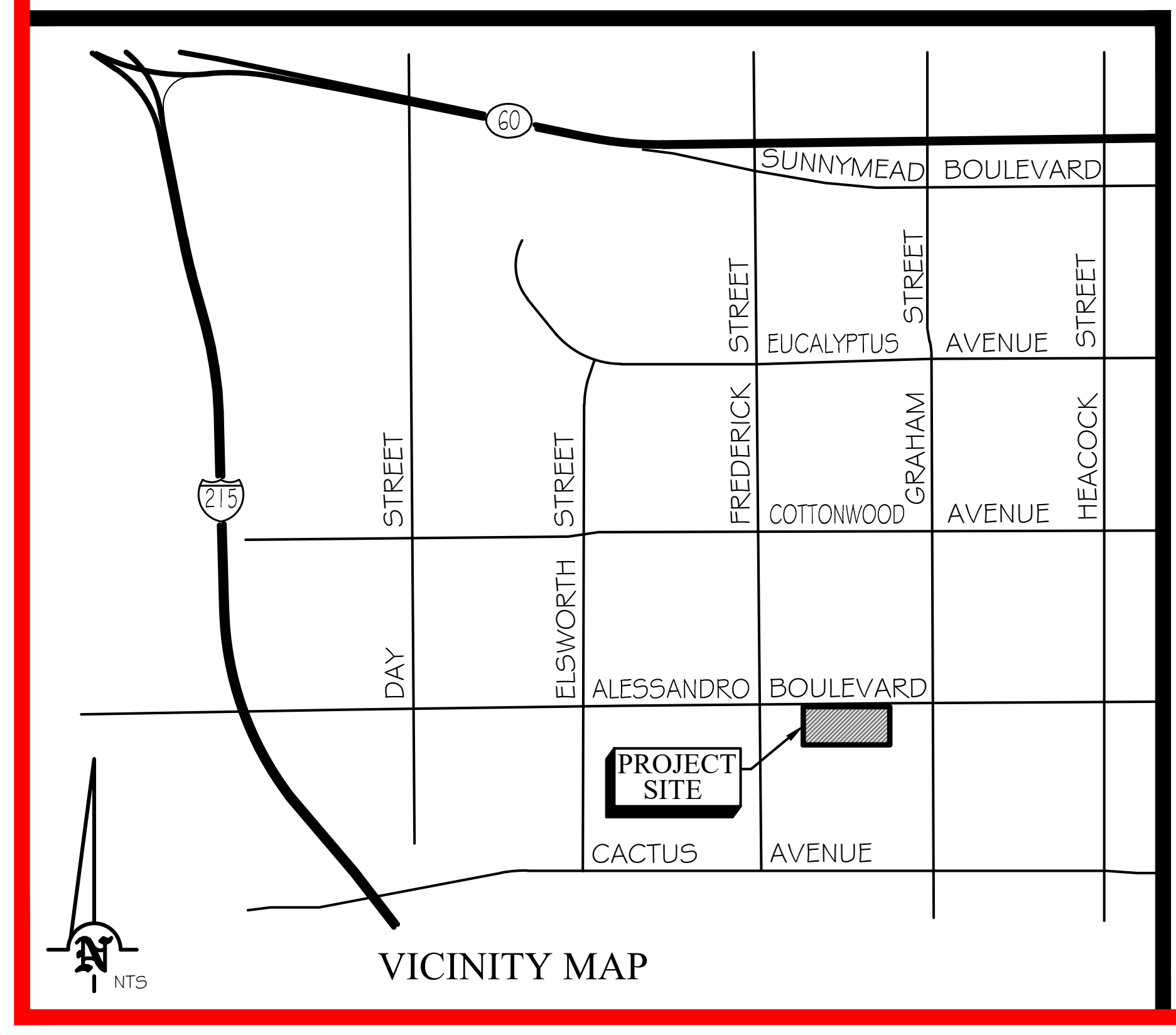
Back to Top

PF graphical

HCOC TRIBUTARY AREA MAP

PRE-DEVELOPMENT - COMPASS DANBE CENTERPOINTE - PROPOSED INDUSTRIAL WAREHOUSE FACILITY, PEN20-0120/TPM 37944

SOUTH SIDE OF ALESSANDRO BOULEVARD - APN 297-170-002 & 003 - CITY OF MORENO VALLEY



VICINITY MAP

PAVING LEGEND

▨	EXISTING PCC PAVING
▨	EXISTING AC PAVING

LEGEND

AC	ASPHALT CONCRETE
CF	CURB FACE
ET	ELECTRIC TRANSFORMER
FF	FINISHED FLOOR
FG	FINISHED GROUND
FL	FLOWLINE
FS	FINISHED SURFACE
GB	GRADEBREAK
INV	INVERT ELEVATION
PB	PULL BOX
PCC	PORTLAND CEMENT CONCRETE
PL	PROPERTY LINE
PP	EX. POWER POLE
R/W	RIGHT-OF-WAY
SMH	SEWER MANHOLE
STL	EX. STREET LIGHT
TC	TOP OF CURB
TG	TOP OF GRATE

LINE DATA

	BEARING	DISTANCE
L1	N59°38'55"W	7.89'
L2	N77°40'08"E	18.75'
L3	N77°12'47"W	18.69'
L4	N89°34'26"W	49.33'
L5	N78°03'57"E	18.69'
L6	N79°46'02"E	23.49'
L7	N89°34'26"W	56.75'
L8	N60°53'25"E	8.11'
L9	N89°34'26"W	16.97'

CURVE DATA

	Δ	R	T	L
C1	00°01'04"	49933.00'	7.71'	15.41'
C2	00°04'51"	49929.00'	35.23'	70.46'

SOURCE OF SURVEY

TOPOGRAPHIC SURVEY
DATED DECEMBER 2019
AS CONDUCTED BY
PARTNER ENGINEERING AND SCIENCE, INC.
1761 EAST GARRY AVENUE
SANTA ANA, CA 92705
PHONE: (714) 477-8657

SOIL ENGINEER

REPORT DATED JANUARY 31, 2020
PROJECT NO. 21631-20
AS CONDUCTED BY
NORCAL ENGINEERING
10641 HUMBOLT STREET
LOS ALAMITOS, CA 90720
PHONE: (562) 799-9469
FAX: (562) 799-9459

SCALE: 1"=50'
0 50 100 150

LEGEND

① ELEV.	NODE # & ELEV.
L=165'	FLOWLINE LENGTH
A=1.44 AC	SUB AREA
—·—··—◄—	FLOWLINE
▬▬	TRIBUTARY BOUNDARY

PROPERTY OWNER:
MORENO VALLEY CENTERPOINTE
C/O CDRE HOLDINGS 17 LLC
ATTN: MARK BACHLI
523 MAIN STREET
EL SEGUNDO, CA 90245
(310) 428-3302

PREPARED FOR/APPLICANT:
CDRE HOLDINGS 17 LLC
ATTN: MARK BACHLI
523 MAIN STREET
EL SEGUNDO, CA 90245
(310) 428-3302

HCOC TRIBUTARY AREA MAP
PEN20-0120/TPM37944
PRE-DEVELOPMENT - APN 297-170-002 & 003
COMPASS DANBE CENTERPOINTE
PROPOSED INDUSTRIAL WAREHOUSE FACILITY
SOUTH SIDE OF ALESSANDRO BOULEVARD
CITY OF MORENO VALLEY

- land planning
- civil engineering
- landscape architecture

est. 1989
phone 909.748.7777
fax 909.748.7776
thatcher engineering & associates, inc.
1461 ford street, suite 105, redlands, ca 92373

PATRICK C. FLANAGAN, JR.
No. 86046
Exp. 9/30/22
CIVIL

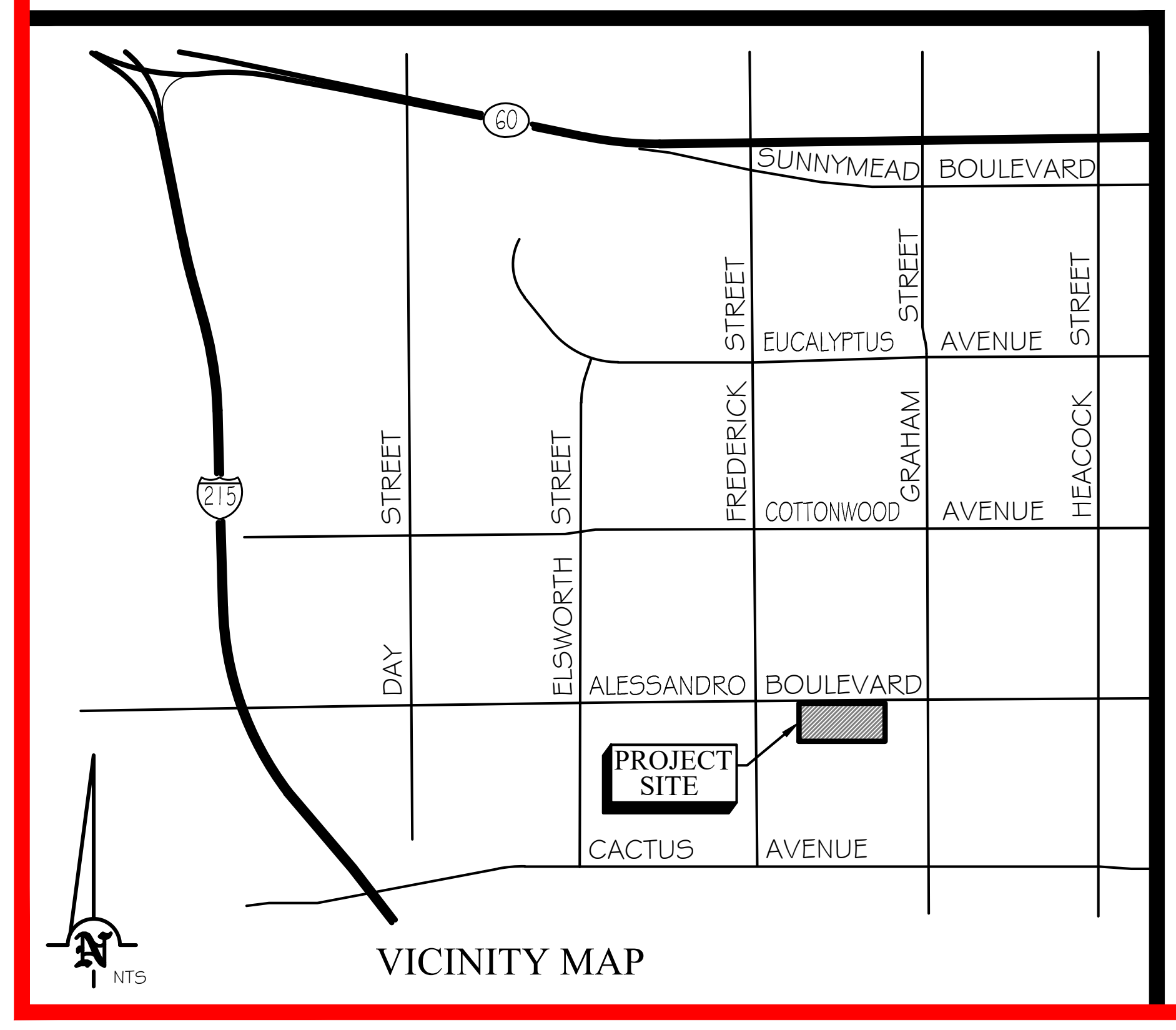
Patrick C. Flanagan, Jr. R.C.E. 86046 Exp. Sep 30, 2022

Job Number:	Date Prepared:	Drawn By:	Reference Number:
162012	10/6/20	RL	162012HCOC

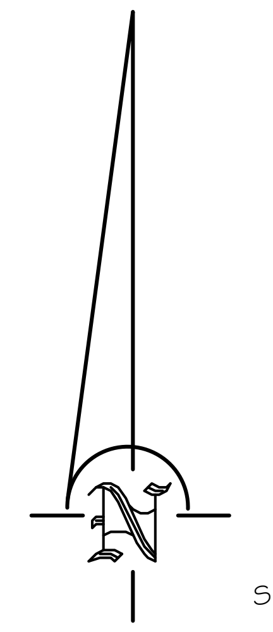
HCOC TRIBUTARY AREA MAP

POST-DEVELOPMENT - COMPASS DANBE CENTERPOINTE - PROPOSED INDUSTRIAL WAREHOUSE FACILITY, PEN20-0120/TPM 37944

SOUTH SIDE OF ALESSANDRO BOULEVARD - APN 297-170-002 & 003 - CITY OF MORENO VALLEY



VICINITY MAP



SCALE: 1"=50'

0 50 100 150

LINE DATA

	BEARING	DISTANCE
L1	N59°38'55"W	7.89'
L2	N77°40'08"E	18.75'
L3	N77°12'47"W	18.69'
L4	N89°34'26"W	49.33'
L5	N78°03'57"E	18.69'
L6	N79°46'02"E	23.49'
L7	N89°34'26"W	56.75'
L8	N60°53'25"E	8.11'
L9	N89°34'26"W	16.97'

CURVE DATA

	Δ	R	T	L
C1	00°01'04"	49933.00'	7.71'	15.41'
C2	00°04'51"	49929.00'	35.23'	70.46'

PAVING LEGEND

▨	PROPOSED/EXISTING LANDSCAPE
▨	PROPOSED AC PAVING
▨	PROPOSED PCC PAVING
▨	PROPOSED DECORATIVE PAVING
▨	EXISTING AC PAVING

LEGEND

AC	ASPHALT CONCRETE
CF	CURB FACE
DIA	DIAMETER
ET	ELECTRIC TRANSFORMER
FF	FINISHED FLOOR
FG	FINISHED GROUND
FL	FLOWLINE
FS	FINISHED SURFACE
PB	PULL BOX
PCC	PORTLAND CEMENT CONCRETE
PL	PROPERTY LINE
PP	EX. POWER POLE
R/W	RIGHT-OF-WAY
SMH	SEWER MANHOLE
STL	EX. STREET LIGHT
TC	TOP OF CURB
TG	TOP OF GRATE

LEGEND

① ELEV.	NODE # & ELEV.
L=165'	FLOWLINE LENGTH
A=1.44 AC	SUB AREA
—···◄—···◄	FLOWLINE
▬	TRIBUTARY BOUNDARY

SOURCE OF SURVEY

TOPOGRAPHIC SURVEY
DATED DECEMBER 2019
AS CONDUCTED BY
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AND SCIENCE, INC.
1761 EAST GARRY AVENUE
SANTA ANA, CA 92705
PHONE: (714) 477-8657

SOIL ENGINEER

REPORT DATED JANUARY 31, 2020
PROJECT NO. 21631-20
AS CONDUCTED BY
NORCAL ENGINEERING
10641 HUMBOLT STREET
LOS ALAMITOS, CA 90720
PHONE: (562) 799-9469
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PROPERTY OWNER:

MORENO VALLEY
CENTERPOINTE
C/O CDRE HOLDINGS 17 LLC
ATTN: MARK BACHLI
523 MAIN STREET
EL SEGUNDO, CA 90245
(310) 428-3302

PREPARED FOR/APPLICANT:

CDRE HOLDINGS 17 LLC
ATTN: MARK BACHLI
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HCOC TRIBUTARY AREA MAP
PEN20-0120/TPM37944
POST-DEVELOPMENT - APN 297-170-002 & 003
COMPASS DANBE CENTERPOINTE
PROPOSED INDUSTRIAL WAREHOUSE FACILITY
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Job Number:	Date Prepared:	Drawn By:	Reference Number:
162012	10/6/20	RL	162012HCOC

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.

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**
☐ **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 <u>www.cabmphandbooks.com</u>

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**
☒ **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/

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**
☐ **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

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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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.

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**
☐ **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/

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**		
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☐ 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

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[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.

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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☒ 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

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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☒ **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

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☒ **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.

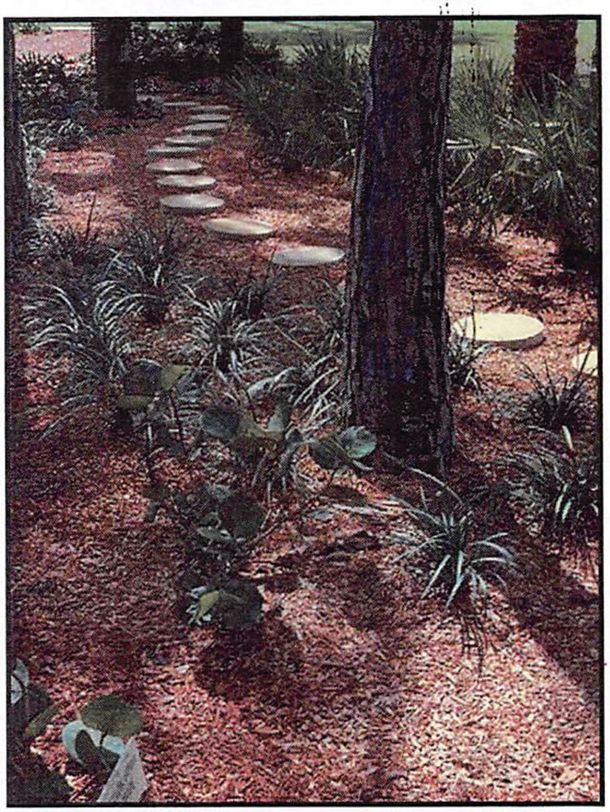
Appendix 9: O&M

Not applicable for Preliminary WQMP

Appendix 10: Educational Materials

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

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.

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

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.

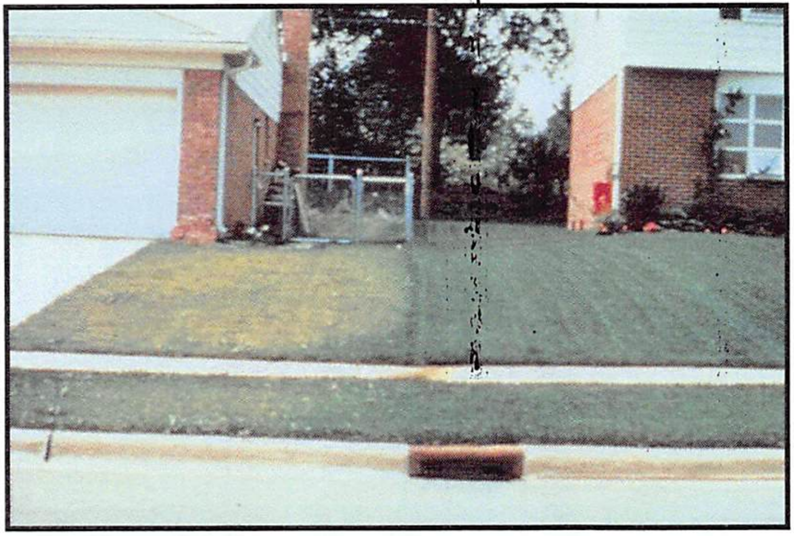
Stormwater Management Manual for Western Washington, Washington State Department of Ecology, August 2001.

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.

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.

- 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

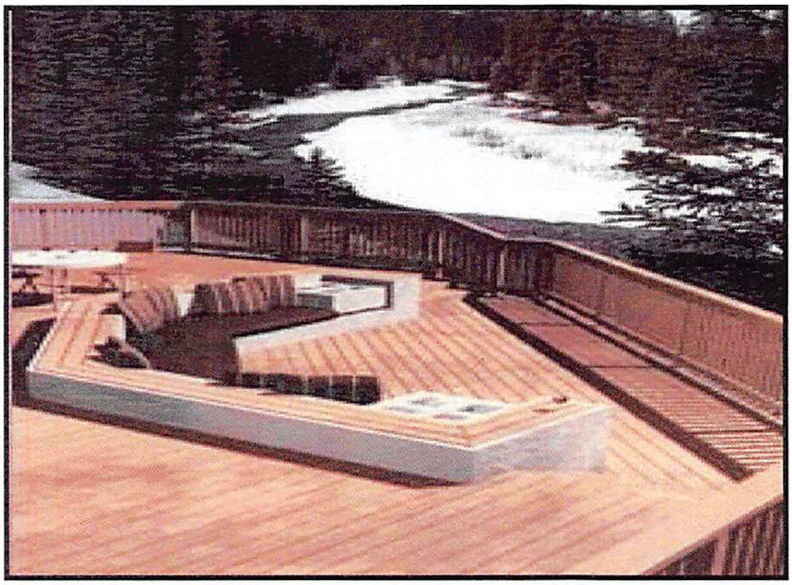
A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

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.

Alternative Building Materials SD-21



Design Objectives

☑ Maximize Infiltration

☑ Provide Retention

☑ Source Control

Minimize Impervious Land Coverage

Prohibit Dumping of Improper Materials

Contain Pollutant

Collect and Convey

Description

Alternative building materials are selected instead of conventional materials for new construction and renovation. These materials reduce potential sources of pollutants in stormwater runoff by eliminating compounds that can leach into runoff, reducing the need for pesticide application, reducing the need for painting and other maintenance, or by reducing the volume of runoff.

Approach

Alternative building materials are available for use as lumber for decking, roofing materials, home siding, and paving for driveways, decks, and sidewalks.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Designing New Installations

Decking

One of the most common materials for construction of decks and other outdoor construction has traditionally been pressure treated wood, which is now being phased out. The standard treatment is called CCA, for chromated copper arsenate. The key ingredients are arsenic (which kills termites, carpenter ants and other insects), copper (which kills the fungi that cause wood to rot) and chromium (which reacts with the other ingredients to bind them to the wood). The amount of arsenic is far from trivial. A deck just 8 feet x 10 feet contains more than 1 1/3 pounds of this highly potent poison. Replacement materials include a new type of pressure treated wood, plastic and composite lumber.

There are currently over 20 products in the market consisting of plastic or plastic-wood composites. Plastic lumber is made from 100% recycled plastic, # 2 HDPE and polyethylene plastic milk jugs and soap bottles. Plastic-wood composites are a combination of plastic and wood fibers or sawdust. These materials are a long lasting exterior weather, insect, and chemical resistant wood lumber replacement for non structural applications. Use it for decks, docks, raised garden beds and planter boxes, pallets, hand railings, outdoor furniture, animal pens, boat decks, etc.

New pressure treated wood uses a much safer recipe, ACQ, which stands for ammoniacal copper quartenary. It contains no arsenic and no chromium. Yet the American Wood Preservers Association has found it to be just as effective as the standard formula. ACQ is common in Japan and Europe.

Roofing

Several studies have indicated that metal used as roofing material, flashing, or gutters can leach metals into the environment. The leaching occurs because rainfall is slightly acidic and slowly dissolved the exposed metals. Common traditional applications include copper sheathing and galvanized (zinc) gutters.

Coated metal products are available for both roofing and gutter applications. These products eliminate contact of bare metal with rainfall, eliminating one source of metals in runoff. There are also roofing materials made of recycled rubber and plastic that resemble traditional materials.

A less traditional approach is the use of green roofs. These roofs are not just green, they're alive.. Planted with grasses and succulents, low- profile green roofs reduce the urban heat island effect, stormwater runoff, and cooling costs, while providing wildlife habitat and a connection to nature for building occupants. These roofs are widely used on industrial facilities in Europe and have been established as experimental installations in several locations in the US, including Portland, Oregon. Their feasibility is questionable in areas of California with prolonged, dry, hot weather.

Paved Areas

Traditionally, concrete is used for construction of patios, sidewalks, and driveways. Although it is non-toxic, these paved areas reduce stormwater infiltration and increase the volume and rate of runoff. This increase in the amount of runoff is the leading cause of stream channel degradation in urban areas.

There are a number of alternative materials that can be used in these applications, including porous concrete and asphalt, modular blocks, and crushed granite. These materials, especially modular paving blocks, are widely available and a well established method to reduce stormwater runoff.

Building Siding

Wood siding is commonly used on the exterior of residential construction. This material weathers fairly rapidly and requires repeated painting to prevent rotting. Alternative "new" products for this application include cement-fiber and vinyl. Cement-fiber siding is a masonry product made from Portland cement, sand, and cellulose and will not burn, cup, swell, or shrink.

Pesticide Reduction
A common use of powerful pesticides is for the control of termites. Chlordane was used for many years for this purpose and is now found in urban streams and lakes nationwide. There are a number of physical barriers that can be installed during construction to help reduce the use of pesticides.

Sand barriers for subterranean termites are a physical deterrent because the termites cannot tunnel through it. Sand barriers can be applied in crawl spaces under pier and beam foundations, under slab foundations, and between the foundation and concrete porches, terraces, patios and steps. Other possible locations include under fence posts, underground electrical cables, water and gas lines, telephone and electrical poles, inside hollow tile cells and against retaining walls.

Metal termite shields are physical barriers to termites which prevent them from building invisible tunnels. In reality, metal shields function as a helpful termite detection device, forcing them to build tunnels on the outside of the shields which are easily seen. Metal termite shields also help prevent dampness from wicking to adjoining wood members which can result in rot, thus making the material more attractive to termites and other pests. Metal flashing and metal plates can also be used as a barrier between piers and beams of structures such as decks, which are particularly vulnerable to termite attack.

Redeveloping Existing Installations

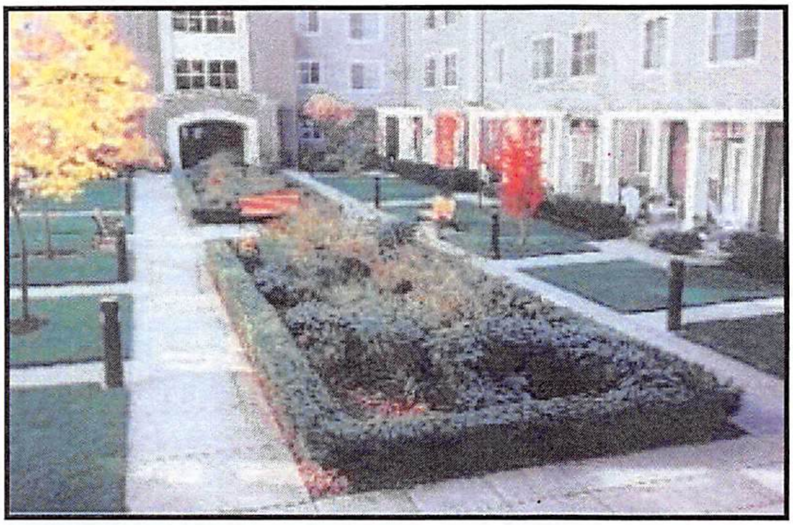
Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of "redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Other Resources

There are no good, independent, comprehensive sources of information on alternative building materials for use in minimizing the impacts of stormwater runoff. Most websites or other references to "green" or "alternative" building materials focus on indoor applications, such as formaldehyde free plywood and low VOC paints, carpets, and pads. Some supplemental information on alternative materials is available from the manufacturers.

Fires are a source of concern in many areas of California. Information on the flammability of alternative decking materials is available from the University of California Forest Product Laboratory (UCFPL) website at: http://www.ucfpl.ucop.edu/WDDeckIntro.htm

Bioretention TC-32



Design Considerations

- Soil for Infiltration
- Tributary Area
- Slope
- Aesthetics
- Environmental Side-effects

Description

The bioretention best management practice (BMP) functions as a soil and plant-based filtration device that removes pollutants through a variety of physical, biological, and chemical treatment processes. These facilities normally consist of a grass buffer strip, sand bed, ponding area, organic layer or mulch layer, planting soil, and plants. The runoff's velocity is reduced by passing over or through buffer strip and subsequently distributed evenly along a ponding area. Exfiltration of the stored water in the bioretention area planting soil into the underlying soils occurs over a period of days.

California Experience

None documented. Bioretention has been used as a stormwater BMP since 1992. In addition to Prince George's County, MD and Alexandria, VA, bioretention has been used successfully at urban and suburban areas in Montgomery County, MD; Baltimore County, MD; Chesterfield County, VA; Prince William County, VA; Smith Mountain Lake State Park, VA; and Cary, NC.

Advantages

- Bioretention provides stormwater treatment that enhances the quality of downstream water bodies by temporarily storing runoff in the BMP and releasing it over a period of four days to the receiving water (EPA, 1999).

- The vegetation provides shade and wind breaks, absorbs noise, and improves an area's landscape.

Limitations

- The bioretention BMP is not recommended for areas with slopes greater than 20% or where mature tree removal would

Targeted Constituents

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

Legend ***(Removal Effectiveness)***

● Low ■ High

▲ Medium

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be required since clogging may result, particularly if the BMP receives runoff with high sediment loads (EPA, 1999).

- Bioretention is not a suitable BMP at locations where the water table is within 6 feet of the ground surface and where the surrounding soil stratum is unstable.
- By design, bioretention BMPs have the potential to create very attractive habitats for mosquitoes and other vectors because of highly organic, often heavily vegetated areas mixed with shallow water.
- In cold climates the soil may freeze, preventing runoff from infiltrating into the planting soil.

Design and Sizing Guidelines

- The bioretention area should be sized to capture the design storm runoff.
- In areas where the native soil permeability is less than 0.5 in/hr an underdrain should be provided.
- Recommended minimum dimensions are 15 feet by 40 feet, although the preferred width is 25 feet. Excavated depth should be 4 feet.
- Area should drain completely within 72 hours.
- Approximately 1 tree or shrub per 50 ft^2 of bioretention area should be included.
- Cover area with about 3 inches of mulch.

Construction/Inspection Considerations

Bioretention area should not be established until contributing watershed is stabilized.

Performance

Bioretention removes stormwater pollutants through physical and biological processes, including adsorption, filtration, plant uptake, microbial activity, decomposition, sedimentation and volatilization (EPA, 1999). Adsorption is the process whereby particulate pollutants attach to soil (e.g., clay) or vegetation surfaces. Adequate contact time between the surface and pollutant must be provided for in the design of the system for this removal process to occur. Thus, the infiltration rate of the soils must not exceed those specified in the design criteria or pollutant removal may decrease. Pollutants removed by adsorption include metals, phosphorus, and hydrocarbons. Filtration occurs as runoff passes through the bioretention area media, such as the sand bed, ground cover, and planting soil.

Common particulates removed from stormwater include particulate organic matter, phosphorus, and suspended solids. Biological processes that occur in wetlands result in pollutant uptake by plants and microorganisms in the soil. Plant growth is sustained by the uptake of nutrients from the soils, with woody plants locking up these nutrients through the seasons. Microbial activity within the soil also contributes to the removal of nitrogen and organic matter. Nitrogen is removed by nitrifying and denitrifying bacteria, while aerobic bacteria are responsible for the decomposition of the organic matter. Microbial processes require oxygen and can result in depleted oxygen levels if the bioretention area is not adequately aerated. Sedimentation occurs in the swale or ponding area as the velocity slows and solids fall out of suspension.

The removal effectiveness of bioretention has been studied during field and laboratory studies conducted by the University of Maryland (Davis et al, 1998). During these experiments, synthetic stormwater runoff was pumped through several laboratory and field bioretention areas to simulate typical storm events in Prince George's County, MD. Removal rates for heavy metals and nutrients are shown in Table 1.

Table 1 Laboratory and Estimated Bioretention Davis et al. (1998); PGDER (1993)

Pollutant	Removal Rate
Total Phosphorus	70-83%
Metals (Cu, Zn, Pb)	93-98%
TKN	68-80%
Total Suspended Solids	90%
Organics	90%
Bacteria	90%

Results for both the laboratory and field experiments were similar for each of the pollutants analyzed. Doubling or halving the influent pollutant levels had little effect on the effluent pollutants concentrations (Davis et al, 1998).

The microbial activity and plant uptake occurring in the bioretention area will likely result in higher removal rates than those determined for infiltration BMPs.

Siting Criteria

Bioretention BMPs are generally used to treat stormwater from impervious surfaces at commercial, residential, and industrial areas (EPA, 1999). Implementation of bioretention for stormwater management is ideal for median strips, parking lot islands, and swales. Moreover, the runoff in these areas can be designed to either divert directly into the bioretention area or convey into the bioretention area by a curb and gutter collection system.

The best location for bioretention areas is upland from inlets that receive sheet flow from graded areas and at areas that will be excavated (EPA, 1999). In order to maximize treatment effectiveness, the site must be graded in such a way that minimizes erosive conditions as sheet flow is conveyed to the treatment area. Locations where a bioretention area can be readily incorporated into the site plan without further environmental damage are preferred. Furthermore, to effectively minimize sediment loading in the treatment area, bioretention only should be used in stabilized drainage areas.

Additional Design Guidelines

The layout of the bioretention area is determined after site constraints such as location of utilities, underlying soils, existing vegetation, and drainage are considered (EPA, 1999). Sites with loamy sand soils are especially appropriate for bioretention because the excavated soil can be backfilled and used as the planting soil, thus eliminating the cost of importing planting soil.

The use of bioretention may not be feasible given an unstable surrounding soil stratum, soils with clay content greater than 25 percent, a site with slopes greater than 20 percent, and/or a site with mature trees that would be removed during construction of the BMP.

Bioretention can be designed to be off-line or on-line of the existing drainage system (EPA, 1999). The drainage area for a bioretention area should be between 0.1 and 0.4 hectares (0.25 and 1.0 acres). Larger drainage areas may require multiple bioretention areas. Furthermore, the maximum drainage area for a bioretention area is determined by the expected rainfall intensity and runoff rate. Stabilized areas may erode when velocities are greater than 5 feet per second (1.5 meter per second). The designer should determine the potential for erosive conditions at the site.

The size of the bioretention area, which is a function of the drainage area and the runoff generated from the area is sized to capture the water quality volume.

The recommended minimum dimensions of the bioretention area are 15 feet (4.6 meters) wide by 40 feet (12.2 meters) long, where the minimum width allows enough space for a dense, randomly-distributed area of trees and shrubs to become established. Thus replicating a natural forest and creating a microclimate, thereby enabling the bioretention area to tolerate the effects of heat stress, acid rain, runoff pollutants, and insect and disease infestations which landscaped areas in urban settings typically are unable to tolerate. The preferred width is 25 feet (7.6 meters), with a length of twice the width. Essentially, any facilities wider than 20 feet (6.1 meters) should be twice as long as they are wide, which promotes the distribution of flow and decreases the chances of concentrated flow.

In order to provide adequate storage and prevent water from standing for excessive periods of time the ponding depth of the bioretention area should not exceed 6 inches (15 centimeters). Water should not be left to stand for more than 72 hours. A restriction on the type of plants that can be used may be necessary due to some plants' water intolerance. Furthermore, if water is left standing for longer than 72 hours mosquitoes and other insects may start to breed.

The appropriate planting soil should be backfilled into the excavated bioretention area. Planting soils should be sandy loam, loamy sand, or loam texture with a clay content ranging from 10 to 25 percent.

Generally the soil should have infiltration rates greater than 0.5 inches (1.25 centimeters) per hour, which is typical of sandy loams, loamy sands, or loams. The pH of the soil should range between 5.5 and 6.5, where pollutants such as organic nitrogen and phosphorus can be adsorbed by the soil and microbial activity can flourish. Additional requirements for the planting soil include a 1.5 to 3 percent organic content and a maximum 500 ppm concentration of soluble salts.

Soil tests should be performed for every 500 cubic yards (382 cubic meters) of planting soil, with the exception of pH and organic content tests, which are required only once per bioretention area (EPA, 1999). Planting soil should be 4 inches (10.1 centimeters) deeper than the bottom of the largest root ball and 4 feet (1.2 meters) altogether. This depth will provide adequate soil for the plants' root systems to become established, prevent plant damage due to severe wind, and provide adequate moisture capacity. Most sites will require excavation in order to obtain the recommended depth.

Planting soil depths of greater than 4 feet (1.2 meters) may require additional construction practices such as shoring measures (EPA, 1999). Planting soil should be placed in 18 inches or greater lifts and lightly compacted until the desired depth is reached. Since high canopy trees may be destroyed during maintenance the bioretention area should be vegetated to resemble a terrestrial forest community ecosystem that is dominated by understory trees. Three species each of both trees and shrubs are recommended to be planted at a rate of 2500 trees and shrubs per hectare (1000 per acre). For instance, a 15 foot (4.6 meter) by 40 foot (12.2 meter) bioretention area (600 square feet or 55.75 square meters) would require 14 trees and shrubs. The shrub-to-tree ratio should be 2:1 to 3:1.

Trees and shrubs should be planted when conditions are favorable. Vegetation should be watered at the end of each day for fourteen days following its planting. Plant species tolerant of pollutant loads and varying wet and dry conditions should be used in the bioretention area.

The designer should assess aesthetics, site layout, and maintenance requirements when selecting plant species. Adjacent non-native invasive species should be identified and the designer should take measures, such as providing a soil breach to eliminate the threat of these species invading the bioretention area. Regional landscaping manuals should be consulted to ensure that the planting of the bioretention area meets the landscaping requirements established by the local authorities. The designers should evaluate the best placement of vegetation within the bioretention area. Plants should be placed at irregular intervals to replicate a natural forest. Trees should be placed on the perimeter of the area to provide shade and shelter from the wind. Trees and shrubs can be sheltered from damaging flows if they are placed away from the path of the incoming runoff. In cold climates, species that are more tolerant to cold winds, such as evergreens, should be placed in windier areas of the site.

Following placement of the trees and shrubs, the ground cover and/or mulch should be established. Ground cover such as grasses or legumes can be planted at the beginning of the growing season. Mulch should be placed immediately after trees and shrubs are planted. Two to 3 inches (5 to 7.6 cm) of commercially-available fine shredded hardwood mulch or shredded hardwood chips should be applied to the bioretention area to protect from erosion.

Maintenance

The primary maintenance requirement for bioretention areas is that of inspection and repair or replacement of the treatment area's components. Generally, this involves nothing more than the routine periodic maintenance that is required of any landscaped area. Plants that are appropriate for the site, climatic, and watering conditions should be selected for use in the bioretention cell. Appropriately selected plants will aide in reducing fertilizer, pesticide, water, and overall maintenance requirements. Bioretention system components should blend over time through plant and root growth, organic decomposition, and the development of a natural soil horizon. These biologic and physical processes over time will lengthen the facility's life span and reduce the need for extensive maintenance.

Routine maintenance should include a biannual health evaluation of the trees and shrubs and subsequent removal of any dead or diseased vegetation (EPA, 1999). Diseased vegetation should be treated as needed using preventative and low-toxic measures to the extent possible. BMPs have the potential to create very attractive habitats for mosquitoes and other vectors because of highly organic, often heavily vegetated areas mixed with shallow water. Routine inspections for areas of standing water within the BMP and corrective measures to restore proper infiltration rates are necessary to prevent creating mosquito and other vector habitat. In addition, bioretention BMPs are susceptible to invasion by aggressive plant species such as cattails, which increase the chances of water standing and subsequent vector production if not routinely maintained.

In order to maintain the treatment area's appearance it may be necessary to prune and weed. Furthermore, mulch replacement is suggested when erosion is evident or when the site begins to look unattractive. Specifically, the entire area may require mulch replacement every two to three years, although spot mulching may be sufficient when there are random void areas. Mulch replacement should be done prior to the start of the wet season.

New Jersey's Department of Environmental Protection states in their bioretention systems standards that accumulated sediment and debris removal (especially at the inflow point) will normally be the primary maintenance function. Other potential tasks include replacement of dead vegetation, soil pH regulation, erosion repair at inflow points, mulch replenishment, unclogging the underdrain, and repairing overflow structures. There is also the possibility that the cation exchange capacity of the soils in the cell will be significantly reduced over time. Depending on pollutant loads, soils may need to be replaced within 5-10 years of construction (LID, 2000).

Cost

Construction Cost

Construction cost estimates for a bioretention area are slightly greater than those for the required landscaping for a new development (EPA, 1999). A general rule of thumb (Coffman, 1999) is that residential bioretention areas average about $3 to $4 per square foot, depending on soil conditions and the density and types of plants used. Commercial, industrial and institutional site costs can range between $10 to $40 per square foot, based on the need for control structures, curbing, storm drains and underdrains.

Retrofitting a site typically costs more, averaging $6,500 per bioretention area. The higher costs are attributed to the demolition of existing concrete, asphalt, and existing structures and the replacement of fill material with planting soil. The costs of retrofitting a commercial site in Maryland, Kettering Development, with 15 bioretention areas were estimated at $111,600.

In any bioretention area design, the cost of plants varies substantially and can account for a significant portion of the expenditures. While these cost estimates are slightly greater than those of typical landscaping treatment (due to the increased number of plantings, additional soil excavation, backfill material, use of underdrains etc.), those landscaping expenses that would be required regardless of the bioretention installation should be subtracted when determining the net cost.

Perhaps of most importance, however, the cost savings compared to the use of traditional structural stormwater conveyance systems makes bioretention areas quite attractive financially. For example, the use of bioretention can decrease the cost required for constructing stormwater conveyance systems at a site. A medical office building in Maryland was able to reduce the amount of storm drain pipe that was needed from 800 to 230 feet - a cost savings of $24,000 (PGDER, 1993). And a new residential development spent a total of approximately $100,000 using bioretention cells on each lot instead of nearly $400,000 for the traditional stormwater ponds that were originally planned (Rappahanock,). Also, in residential areas, stormwater management controls become a part of each property owner's landscape, reducing the public burden to maintain large centralized facilities.

Maintenance Cost

The operation and maintenance costs for a bioretention facility will be comparable to those of typical landscaping required for a site. Costs beyond the normal landscaping fees will include the cost for testing the soils and may include costs for a sand bed and planting soil.

References and Sources of Additional Information

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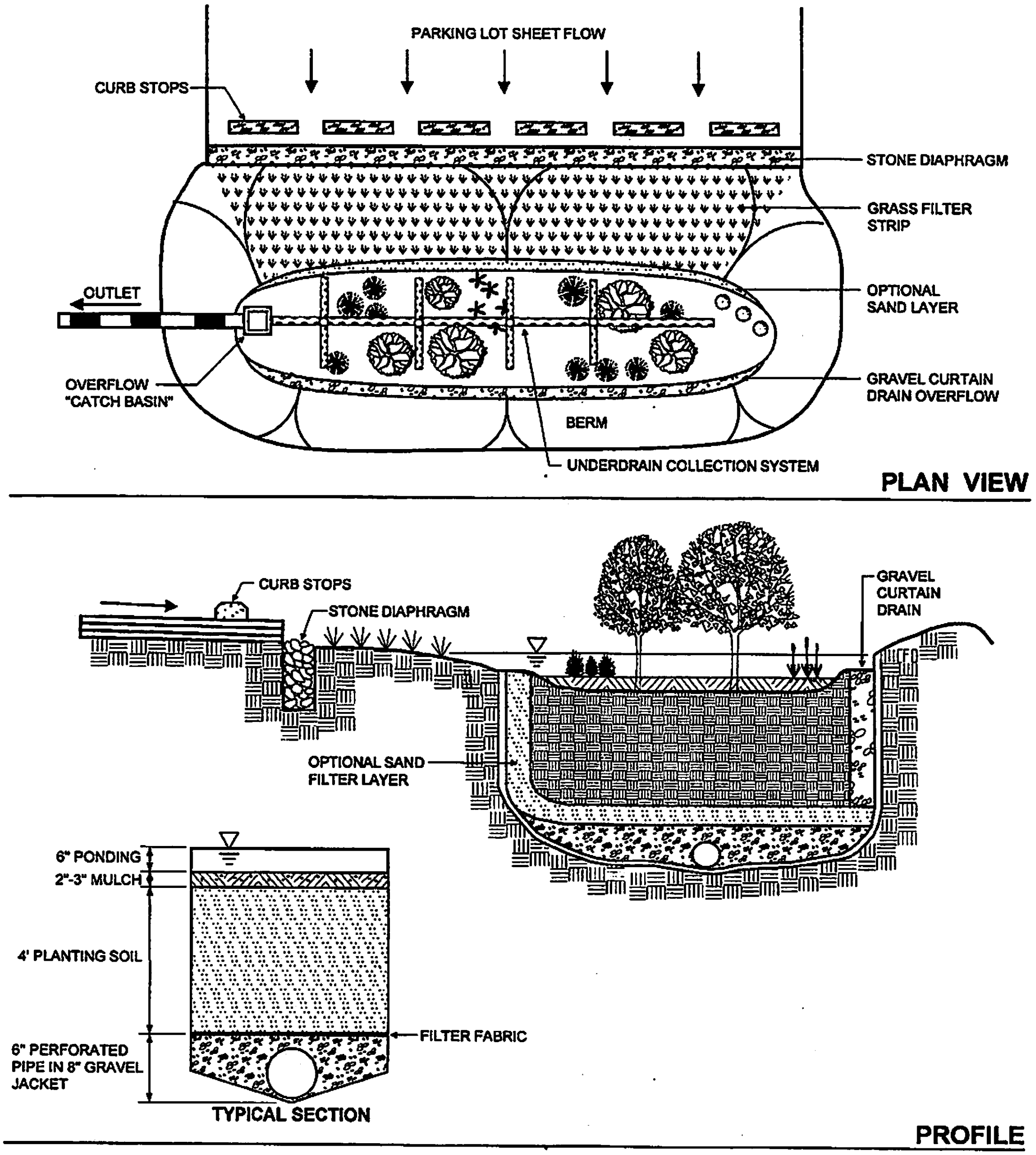
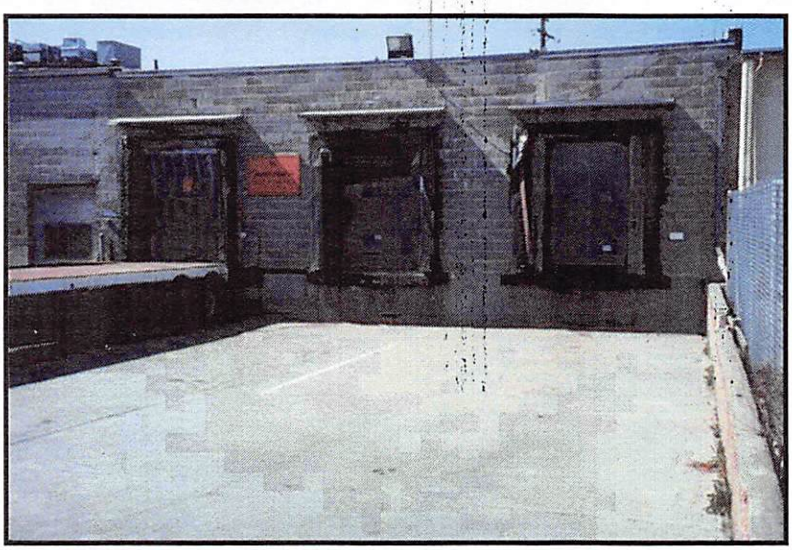


Schematic of a Bioretention Facility (MDE, 2000)

Outdoor Loading/Unloading SC-30



Objectives

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

Targeted Constituents

Sediment	✓
Nutrients	✓
Trash	
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

Description

The loading/unloading of materials usually takes place outside on docks or terminals; therefore, materials spilled, leaked, or lost during loading/unloading may collect in the soil or on other surfaces and have the potential to be carried away by stormwater runoff or when the area is cleaned. Additionally, rainfall may wash pollutants from machinery used to unload or move materials. Implementation of the following protocols will prevent or reduce the discharge of pollutants to stormwater from outdoor loading/unloading of materials.

Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Keep accurate maintenance logs to evaluate materials removed and improvements made.
- Park tank trucks or delivery vehicles in designated areas so that spills or leaks can be contained.
- Limit exposure of material to rainfall whenever possible.
- Prevent stormwater run-on.
- Check equipment regularly for leaks.

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Suggested Protocols

Loading and Unloading – General Guidelines

- Develop an operations plan that describes procedures for loading and/or unloading.
- Conduct loading and unloading in dry weather if possible.
- Cover designated loading/unloading areas to reduce exposure of materials to rain.
- Consider placing a seal or door skirt between delivery vehicles and building to prevent exposure to rain.
- Design loading/unloading area to prevent stormwater run-on, which would include grading or berming the area, and position roof downspouts so they direct stormwater away from the loading/unloading areas.
- Have employees load and unload all materials and equipment in covered areas such as building overhangs at loading docks if feasible.
- Load/unload only at designated loading areas.
- Use drip pans underneath hose and pipe connections and other leak-prone spots during liquid transfer operations, and when making and breaking connections. Several drip pans should be stored in a covered location near the liquid transfer area so that they are always available, yet protected from precipitation when not in use. Drip pans can be made specifically for railroad tracks. Drip pans must be cleaned periodically, and drip collected materials must be disposed of properly.
- Pave loading areas with concrete instead of asphalt.
- Avoid placing storm drains in the area.
- Grade and/or berm the loading/unloading area to a drain that is connected to a deadend.

Inspection

- Check loading and unloading equipment regularly for leaks, including valves, pumps, flanges and connections.
- Look for dust or fumes during loading or unloading operations.

Training

- Train employees (e.g., fork lift operators) and contractors on proper spill containment and cleanup.
- Have employees trained in spill containment and cleanup present during loading/unloading.
- Train employees in proper handling techniques during liquid transfers to avoid spills.
- Make sure forklift operators are properly trained on loading and unloading procedures.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Contain leaks during transfer.
- Store and maintain appropriate spill cleanup materials in a location that is readily accessible and known to all and ensure that employees are familiar with the site's spill control plan and proper spill cleanup procedures.
- Have an emergency spill cleanup plan readily available.
- Use drip pans or comparable devices when transferring oils, solvents, and paints.

Other Considerations (Limitations and Regulations)

- Space and time limitations may preclude all transfers from being performed indoors or under cover.
- It may not be possible to conduct transfers only during dry weather.

Requirements

Costs

Costs should be low except when covering a large loading/unloading area.

Maintenance

- Conduct regular inspections and make repairs as necessary. The frequency of repairs will depend on the age of the facility.
- Check loading and unloading equipment regularly for leaks.
- Conduct regular broom dry-sweeping of area.

Supplemental Information

Further Detail of the BMP

Special Circumstances for Indoor Loading/Unloading of Materials

Loading or unloading of liquids should occur in the manufacturing building so that any spills that are not completely retained can be discharged to the sanitary sewer, treatment plant, or treated in a manner consistent with local sewer authorities and permit requirements.

- For loading and unloading tank trucks to above and below ground storage tanks, the following procedures should be used:
    - The area where the transfer takes place should be paved. If the liquid is reactive with the asphalt, Portland cement should be used to pave the area.
    - The transfer area should be designed to prevent run-on of stormwater from adjacent areas. Sloping the pad and using a curb, like a speed bump, around the uphill side of the transfer area should reduce run-on.

  - The transfer area should be designed to prevent runoff of spilled liquids from the area. Sloping the area to a drain should prevent runoff. The drain should be connected to a dead-end sump or to the sanitary sewer. A positive control valve should be installed on the drain.

- For transfer from rail cars to storage tanks that must occur outside, use the following procedures:
  - Drip pans should be placed at locations where spillage may occur, such as hose connections, hose reels, and filler nozzles. Use drip pans when making and breaking connections.
  - Drip pan systems should be installed between the rails to collect spillage from tank cars.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Parking/Storage Area Maintenance SC-43

Objectives

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

Targeted Constituents

Sediment	✓
Nutrients	
Trash	✓
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

Description

Parking lots and storage areas can contribute a number of substances, such as trash, suspended solids, hydrocarbons, oil and grease, and heavy metals that can enter receiving waters through stormwater runoff or non-stormwater discharges. The protocols in this fact sheet are intended to prevent or reduce the discharge of pollutants from parking/storage areas and include using good housekeeping practices, following appropriate cleaning BMPs, and training employees.

Approach

The goal of this program is to ensure stormwater pollution prevention practices are considered when conducting activities on or around parking areas and storage areas to reduce potential for pollutant discharge to receiving waters. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Encourage alternative designs and maintenance strategies for impervious parking lots. (See New Development and Redevelopment BMP Handbook)

- Keep accurate maintenance logs to evaluate BMP implementation.

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SC-43 Parking/Storage Area Maintenance

Suggested Protocols

General

- Keep the parking and storage areas clean and orderly. Remove debris in a timely fashion.
- Allow sheet runoff to flow into biofilters (vegetated strip and swale) and/or infiltration devices.
- Utilize sand filters or oleophilic collectors for oily waste in low quantities.
- Arrange rooftop drains to prevent drainage directly onto paved surfaces.
- Design lot to include semi-permeable hardscape.
- Discharge soapy water remaining in mop or wash buckets to the sanitary sewer through a sink, toilet, clean-out, or wash area with drain.

Controlling Litter

- Post "No Littering" signs and enforce anti-litter laws.
- Provide an adequate number of litter receptacles.
- Clean out and cover litter receptacles frequently to prevent spillage.
- Provide trash receptacles in parking lots to discourage litter.
- Routinely sweep, shovel, and dispose of litter in the trash.

Surface Cleaning

- Use dry cleaning methods (e.g., sweeping, vacuuming) to prevent the discharge of pollutants into the stormwater conveyance system if possible.
- Establish frequency of public parking lot sweeping based on usage and field observations of waste accumulation.
- Sweep all parking lots at least once before the onset of the wet season.
- Follow the procedures below if water is used to clean surfaces:
  - Block the storm drain or contain runoff.
  - Collect and pump wash water to the sanitary sewer or discharge to a pervious surface. Do not allow wash water to enter storm drains.
  - Dispose of parking lot sweeping debris and dirt at a landfill.
- Follow the procedures below when cleaning heavy oily deposits:
  - Clean oily spots with absorbent materials.
  - Use a screen or filter fabric over inlet, then wash surfaces.

  - Do not allow discharges to the storm drain.
  - Vacuum/pump discharges to a tank or discharge to sanitary sewer.
  - Appropriately dispose of spilled materials and absorbents.

Surface Repair

- Preheat, transfer or load hot bituminous material away from storm drain inlets.
- Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff.
- Cover and seal nearby storm drain inlets where applicable (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal.
- Use only as much water as necessary for dust control, to avoid runoff.
- Catch drips from paving equipment that is not in use with pans or absorbent material placed under the machines. Dispose of collected material and absorbents properly.

Inspection

- Have designated personnel conduct inspections of parking facilities and stormwater conveyance systems associated with parking facilities on a regular basis.
- Inspect cleaning equipment/sweepers for leaks on a regular basis.

Training

- Provide regular training to field employees and/or contractors regarding cleaning of paved areas and proper operation of equipment.
- Train employees and contractors in proper techniques for spill containment and cleanup.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials where it will be readily accessible or at a central location.
- Clean up fluid spills immediately with absorbent rags or material.
- Dispose of spilled material and absorbents properly.

Other Considerations

Limitations related to sweeping activities at large parking facilities may include high equipment costs, the need for sweeper operator training, and the inability of current sweeper technology to remove oil and grease.

SC-43 Parking/Storage Area Maintenance

Requirements

Costs

Cleaning/sweeping costs can be quite large. Construction and maintenance of stormwater structural controls can be quite expensive as well.

Maintenance

- Sweep parking lot regularly to minimize cleaning with water.
- Clean out oil/water/sand separators regularly, especially after heavy storms.
- Clean parking facilities regularly to prevent accumulated wastes and pollutants from being discharged into conveyance systems during rainy conditions.

Supplemental Information

Further Detail of the BMP

Surface Repair

Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff. Where applicable, cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal. Only use only as much water as is necessary for dust control to avoid runoff.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual http://www.co.clark.wa.us/pubworks/bmpman.pdf

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Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Drainage System Maintenance SC-44

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize

Targeted Constituents

Sediment	✓
Nutrients	
Trash	✓
Metals	
Bacteria	✓
Oil and Grease	
Organics	

Description

As a consequence of its function, the stormwater conveyance system collects and transports urban runoff and stormwater that may contain certain pollutants. The protocols in this fact sheet are intended to reduce pollutants reaching receiving waters through proper conveyance system operation and maintenance.

Approach

Pollution Prevention

Maintain catch basins, stormwater inlets, and other stormwater conveyance structures on a regular basis to remove pollutants, reduce high pollutant concentrations during the first flush of storms, prevent clogging of the downstream conveyance system, restore catch basins' sediment trapping capacity, and ensure the system functions properly hydraulically to avoid flooding.

Suggested Protocols

Catch Basins/Inlet Structures

- Staff should regularly inspect facilities to ensure compliance with the following:

  - Immediate repair of any deterioration threatening structural integrity.

  - Cleaning before the sump is 40% full. Catch basins should be cleaned as frequently as needed to meet this standard.

  - Stenciling of catch basins and inlets (see SC34 Waste Handling and Disposal).

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- Clean catch basins, storm drain inlets, and other conveyance structures before the wet season to remove sediments and debris accumulated during the summer.
- Conduct inspections more frequently during the wet season for problem areas where sediment or trash accumulates more often. Clean and repair as needed.
- Keep accurate logs of the number of catch basins cleaned.
- Store wastes collected from cleaning activities of the drainage system in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain.
- Dewater the wastes if necessary with outflow into the sanitary sewer if permitted. Water should be treated with an appropriate filtering device prior to discharge to the sanitary sewer. If discharge to the sanitary sewer is not allowed, water should be pumped or vacuumed to a tank and properly disposed. Do not dewater near a storm drain or stream.

Storm Drain Conveyance System

- Locate reaches of storm drain with deposit problems and develop a flushing schedule that keeps the pipe clear of excessive buildup.
- Collect and pump flushed effluent to the sanitary sewer for treatment whenever possible.

Pump Stations

- Clean all storm drain pump stations prior to the wet season to remove silt and trash.
- Do not allow discharge to reach the storm drain system when cleaning a storm drain pump station or other facility.
- Conduct routine maintenance at each pump station.
- Inspect, clean, and repair as necessary all outlet structures prior to the wet season.

Open Channel

- Modify storm channel characteristics to improve channel hydraulics, increase pollutant removals, and enhance channel/creek aesthetic and habitat value.
- Conduct channel modification/improvement in accordance with existing laws. Any person, government agency, or public utility proposing an activity that will change the natural (emphasis added) state of any river, stream, or lake in California, must enter into a Steam or Lake Alteration Agreement with the Department of Fish and Game. The developer-applicant should also contact local governments (city, county, special districts), other state agencies (SWRCB, RWQCB, Department of Forestry, Department of Water Resources), and Federal Corps of Engineers and USFWS.

Illicit Connections and Discharges

- Look for evidence of illegal discharges or illicit connections during routine maintenance of conveyance system and drainage structures:
    - Is there evidence of spills such as paints, discoloring, etc?

  - Are there any odors associated with the drainage system?
  - Record locations of apparent illegal discharges/illicit connections?
  - Track flows back to potential dischargers and conduct aboveground inspections. This can be done through visual inspection of upgradient manholes or alternate techniques including zinc chloride smoke testing, fluorometric dye testing, physical inspection testing, or television camera inspection.
  - Eliminate the discharge once the origin of flow is established.

- Stencil or demarcate storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste Drains to Stream" stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Illegal Dumping

- Inspect and clean up hot spots and other storm drainage areas regularly where illegal dumping and disposal occurs.
- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Illegal dumping hot spots
  - Types and quantities (in some cases) of wastes
  - Patterns in time of occurrence (time of day/night, month, or year)
  - Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)
  - Responsible parties
- Post "No Dumping" signs in problem areas with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Training

- Train crews in proper maintenance activities, including record keeping and disposal.
- Allow only properly trained individuals to handle hazardous materials/wastes.
- Have staff involved in detection and removal of illicit connections trained in the following:
  - OSHA-required Health and Safety Training (29 CFR 1910.120) plus annual refresher training (as needed).

  - OSHA Confined Space Entry training (Cal-OSHA Confined Space, Title 8 and Federal OSHA 29 CFR 1910.146).
  - Procedural training (field screening, sampling, smoke/dye testing, TV inspection).

Spill Response and Prevention

- Investigate all reports of spills, leaks, and/or illegal dumping promptly.
- Clean up all spills and leaks using "dry" methods (with absorbent materials and/or rags) or dig up, remove, and properly dispose of contaminated soil.
- Refer to fact sheet SC-11 Spill Prevention, Control, and Cleanup.

Other Considerations (Limitations and Regulations)

- Clean-up activities may create a slight disturbance for local aquatic species. Access to items and material on private property may be limited. Trade-offs may exist between channel hydraulics and water quality/riparian habitat. If storm channels or basins are recognized as wetlands, many activities, including maintenance, may be subject to regulation and permitting.
- Storm drain flushing is most effective in small diameter pipes (36-inch diameter pipe or less, depending on water supply and sediment collection capacity). Other considerations associated with storm drain flushing may include the availability of a water source, finding a downstream area to collect sediments, liquid/sediment disposal, and prohibition against disposal of flushed effluent to sanitary sewer in some areas.
- Regulations may include adoption of substantial penalties for illegal dumping and disposal.
- Local municipal codes may include sections prohibiting discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.

Requirements

Costs

- An aggressive catch basin cleaning program could require a significant capital and O&M budget.
- The elimination of illegal dumping is dependent on the availability, convenience, and cost of alternative means of disposal. The primary cost is for staff time. Cost depends on how aggressively a program is implemented. Other cost considerations for an illegal dumping program include:
  - Purchase and installation of signs.
  - Rental of vehicle(s) to haul illegally-disposed items and material to landfills.
  - Rental of heavy equipment to remove larger items (e.g., car bodies) from channels.
  - Purchase of landfill space to dispose of illegally-dumped items and material.

- Methods used for illicit connection detection (smoke testing, dye testing, visual inspection, and flow monitoring) can be costly and time-consuming. Site-specific factors, such as the level of impervious area, the density and ages of buildings, and type of land use will determine the level of investigation necessary.

Maintenance

- Two-person teams may be required to clean catch basins with vactor trucks.
- Teams of at least two people plus administrative personnel are required to identify illicit discharges, depending on the complexity of the storm sewer system.
- Arrangements must be made for proper disposal of collected wastes.
- Technical staff are required to detect and investigate illegal dumping violations.

Supplemental Information

Further Detail of the BMP

Storm Drain Flushing

Flushing is a common maintenance activity used to improve pipe hydraulics and to remove pollutants in storm drainage systems. Flushing may be designed to hydraulically convey accumulated material to strategic locations, such as an open channel, another point where flushing will be initiated, or the sanitary sewer and the treatment facilities, thus preventing resuspension and overflow of a portion of the solids during storm events. Flushing prevents "plug flow" discharges of concentrated pollutant loadings and sediments. Deposits can hinder the designed conveyance capacity of the storm drain system and potentially cause backwater conditions in severe cases of clogging.

Storm drain flushing usually takes place along segments of pipe with grades that are too flat to maintain adequate velocity to keep particles in suspension. An upstream manhole is selected to place an inflatable device that temporarily plugs the pipe. Further upstream, water is pumped into the line to create a flushing wave. When the upstream reach of pipe is sufficiently full to cause a flushing wave, the inflated device is rapidly deflated with the assistance of a vacuum pump, thereby releasing the backed up water and resulting in the cleaning of the storm drain segment.

To further reduce impacts of stormwater pollution, a second inflatable device placed well downstream may be used to recollect the water after the force of the flushing wave has dissipated. A pump may then be used to transfer the water and accumulated material to the sanitary sewer for treatment. In some cases, an interceptor structure may be more practical or required to recollect the flushed waters.

It has been found that cleansing efficiency of periodic flush waves is dependent upon flush volume, flush discharge rate, sewer slope, sewer length, sewer flow rate, sewer diameter, and population density. As a rule of thumb, the length of line to be flushed should not exceed 700 feet. At this maximum recommended length, the percent removal efficiency ranges between 65-75% for organics and 55-65% for dry weather grit/inorganic material. The percent removal efficiency drops rapidly beyond that. Water is commonly supplied by a water truck, but fire hydrants can also supply water. To make the best use of water, it is recommended that reclaimed water be used or that fire hydrant line flushing coincide with storm sewer flushing.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

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The Storm Water Managers Resource Center http://www.stormwatercenter.net

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Storm Drain System Cleaning. On line:
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