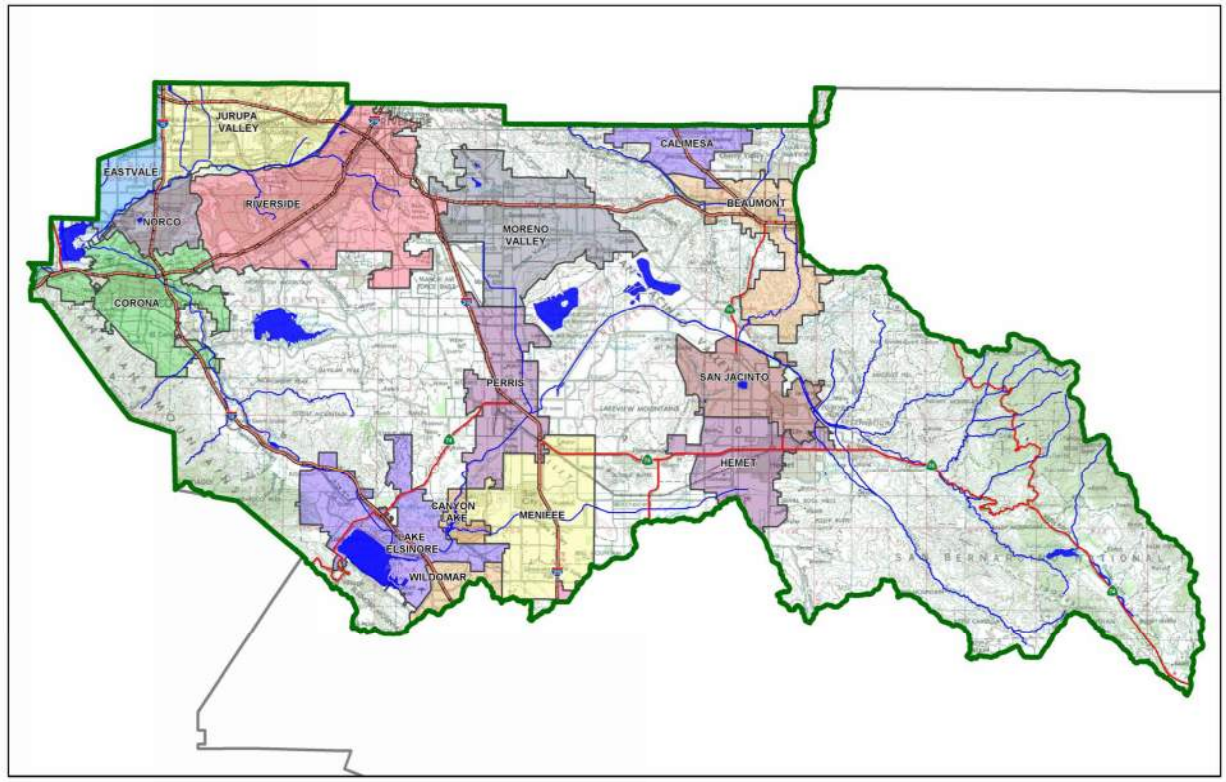
Project Specific Water Quality Management Plan

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

Project Title: TRACT 38921

Development No: P24-XXXX

Design Review/Case No: DP-2023-01293



☒ **Preliminary**
☐ **Final**

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OWNER'S CERTIFICATION

This Project-Specific Water Quality Management Plan (WQMP) has been prepared for La Sierra Victoria Development LLC by Adkan Engineers for the Tract 38921, located on southeast corner of Victoria Avenue and La Sierra Avenue.

This WQMP is intended to comply with the requirements of City of Riverside for Tentative tract map. Planning Case No. DP-2023-01293 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 riverside Water Quality Ordinance (Municipal Code Section 14.12.315).

"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
Michael Brendecke	Senior Project Manager
Preparer's Printed Name	Preparer's Title/Position

Preparer's Licensure:

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Section A: Project and Site Information

PROJECT INFORMATION		
Type of Project:	Residential	
Planning Area:	La Sierra South	
Community Name:	La Sierra South	
Development Name:	TRACT 38921	
PROJECT LOCATION		
Latitude & Longitude (DMS): 33°88'76"N 117°27'43"W		
Project Watershed and Sub-Watershed: Prado Basin/Temescal Creek, Reach 1		
Gross Acres: 10.8 APN(s): 136-220-016		
Map Book and Page No.: Thomas Guide 2008 Edition, Page 744, Grid G-3		
PROJECT CHARACTERISTICS		
Proposed or Potential Land Use(s)	Residential	
Proposed or Potential SIC Code(s)	1521	
Area of Impervious Project Footprint (SF)	341,993	
Total Area of proposed Impervious Surfaces within the Project Footprint (SF)/or Replacement	341,993	
Does the project consist of offsite road improvements?	☒ Y	☐ N
Does the project propose to construct unpaved roads?	☐ Y	☒ N
Is the project part of a larger common plan of development (phased project)?	☐ Y	☒ N
EXISTING SITE CHARACTERISTICS		
Total area of existing Impervious Surfaces within the Project limits Footprint (SF)	4943	
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?	0.56 in	

A.1 Maps and Site Plans

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

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

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
Arizona Channel			8.8 mi
Arlington Channel			7.5 mi
Temescal Creek, Reach 1	pH	REC1. REC2. WARM, WILD	2.7 mi
Prado Creek Basin	Nutrients, Pathogens, TSS	REC1. REC2. WARM, WILD, RARE	

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

Table A.2 Other Applicable Permits

Agency	Permit Required	
State Department of Fish and Game, 1602 Streambed Alteration Agreement	☐ Y	☒ N
State Water Resources Control Board, Clean Water Act (CWA) Section 401 Water Quality Cert.	☐ Y	☒ N
US Army Corps of Engineers, CWA Section 404 Permit	☐ Y	☒ N
US Fish and Wildlife, Endangered Species Act Section 7 Biological Opinion	☐ Y	☒ N
Statewide Construction General Permit Coverage	☐ Y	☒ N
Statewide Industrial General Permit Coverage	☐ Y	☒ N
Western Riverside MSHCP Consistency Approval (e.g., JPR, DBESP)	☐ Y	☒ N
Other *(please list in the space below as required)* City of Riverside Building permit City of Riverside Grading permit City of Riverside Construction Permit	☒ 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)

Site Optimization

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

Yes, the grading design preserves the historic drainage patterns north to Victoria Avenue.

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

Some, where possible. The project site is currently orange groves which will need to be removed in order to develop the site. The orange groves will be preserved at the northerly edge of site along Victoria Ave up to 100' from the edge of roadway in accordance with the Victoria Ave policy.

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

Natural infiltration capacity was preserved with the implementation of an onsite infiltration basin.

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

Impervious areas were minimized to the maximum extent practicable. Landscaping is being incorporated into the site in all feasible areas.

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

Onsite drainage will be conveyed to a proposed infiltration basin at the north east corner of the site via surface drainage and a storm drain system.

Section C: Delineate Drainage Management Areas (DMAs)

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

Table C.1 DMA Classifications

DMA Name or ID	Surface Type(s)[1][2]	Area (Sq. Ft.)	DMA Type
C1	Roofs	132,538	C
C2	Streets	65,141	C
C3	Landscaping	111,239	C
B1	Natural A Soil (infiltration basin)	3,674	B

[1]Reference Table 2-1 in the WQMP Guidance Document to populate this column
[2]If multi-surface provide back-up

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

DMA Name or ID	Area (Sq. Ft.)	Stabilization Type	Irrigation Type (if any)
A1	29,400	Existing orange groves	

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

Self-Retaining Area				**Type 'C' DMAs that are draining to the Self-Retaining Area**		
DMA Name/ ID	Post-project surface type	Area (square feet) [A]	Storm Depth (inches) [B]	DMA Name / ID	[C] from Table C.4 = [C]	Required Retention Depth (inches) [D]
B1	Natural A Soil (infiltration basin)	3674	0.56	C1	132538	11.3
				C2	65141	5.6
				C3	11123.9	0.9

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

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

DMA					Receiving Self-Retaining DMA		
DMA Name/ ID	Area (square feet)	Post-project surface type	Impervious fraction	Product		Area (square feet)	Ratio
	[A]		[B]	[C] = [A] x [B]	DMA name /ID	[D]	[C]/[D]
C1	132538	Roofs	1.00	132538	B1	3674	36.07
C2	65141	Concrete/Asphalt	1.00	65141	B1	3674	17.73
C3	11139	Ornamental Landscaping	0.10	11123.9	B1	3674	3.03

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

DMA Name or ID	BMP Name or ID

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

Section D: Implement LID BMPs

D.1 Infiltration Applicability

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

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

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

Geotechnical Report

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

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

Infiltration Feasibility

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

Table D.1 Infiltration Feasibility

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

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

D.2 Harvest and Use Assessment

Please check what applies*:*

☐ Reclaimed water will be used for the non-potable water demands for the project.

☐Downstream water rights may be impacted by Harvest and Use as approved by the Regional Board (verify with the Copermittee).

☐The Design Capture Volume will be addressed using Infiltration Only BMPs. In such a case, Harvest and Use BMPs are still encouraged, but it would not be required if the Design Capture Volume will be infiltrated or evapotranspired.

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

Irrigation Use Feasibility

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

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

***Total Area of Irrigated Landscape*: n/a**

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:* n/a**

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*: n/a**

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

***Minimum required irrigated area*: n/a**

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)
n/a	**n/a**

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: n/a

Project Type: Residential

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

Total Area of Impervious Surfaces: n/a

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

Enter your TUTIA factor: n/a

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

Minimum number of toilet users: n/a

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)**

Other Non-Potable Use Feasibility

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

N/A

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

Average Daily Demand: N/A

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

Total Area of Impervious Surfaces: N/A

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

Enter the factor from Table 2-4: N/A

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

Minimum required use: N/A

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

Minimum required non-potable use (Step 4)	**Projected average daily use (Step 1)**
N/A	N/A

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

D.3 Bioretention and Biotreatment Assessment

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

Select one of the following:

☐ LID Bioretention/Biotreatment BMPs will be used for some or all DMAs of the project as noted below in Section D.4 (note the requirements of Section 3.4.2 in the WQMP Guidance Document).

☐ A site-specific analysis demonstrating the technical infeasibility of all LID BMPs has been performed and is included in Appendix 5. If you plan to submit an analysis demonstrating the technical infeasibility of LID BMPs, request a pre-submittal meeting with the Copermittee to discuss this option. Proceed to Section E to document your alternative compliance measures.

D.4 Feasibility Assessment Summaries

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

Table D.2 LID Prioritization Summary Matrix

DMA Name/ID	LID BMP Hierarchy				No LID (Alternative Compliance)
	1. Infiltration	2. Harvest and use	3. Bioretention	4. Biotreatment	
B1	☒	☐	☐	☐	☐
C1	☒	☐	☐	☐	☐
C2	☒	☐	☐	☐	☐
C3	☒	☐	☐	☐	☐
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐

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

N/A

D.5 LID BMP Sizing

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

Table D.3 DCV Calculations for LID BMPs

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*B1: Infiltration Basin*		
	[A]		[B]	[C]	[A] x [C]			
C1	*132538*	*ROOFS*	*1.00*	*0.89*	*118223.9*	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
C2	*65141*	*CONCRETE OR ASPHALT*	*1.00*	*0.89*	*58105.8*			
C3	*111239*	*ORNAMENTAL LANDSCAPING*	*0.10*	*0.11*	*12287.2*			
B1	*3674*	*NATURAL (A SOIL)*	*0.03*	*0.06*	*229.8*			
	312592				188846.7	0.56	8812.8	***9177.5***

[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.

List DMAs here.

E.1 Identify Pollutants of Concern

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

Table E.1 Potential Pollutants by Land Use Type

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

P = Potential

N = Not Potential

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

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

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

(4) Specifically petroleum hydrocarbons

(5) Specifically solvents

(6) Bacterial indicators are routinely detected in pavement runoff

E.2 Stormwater Credits

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

Table E.2 Water Quality Credits

Qualifying Project Categories	Credit Percentage[2]
Total Credit Percentage[1]	

[1]Cannot Exceed 50%

[2]Obtain corresponding data from Table 3-8 in the WQMP Guidance Document

E.3 Sizing Criteria

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

Table E.3 Treatment Control BMP Sizing

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I_f	DMA Runoff Factor	DMA Area x Runoff Factor		*Enter BMP Name / Identifier Here*		
	[A]		[B]	[C]	[A] x [C]				
						Design Storm Depth (in)	*Minimum Design Capture Volume or Design Flow Rate (cubic feet or cfs)*	*Total Storm Water Credit % Reduction*	*Proposed Volume or Flow on Plans (cubic feet or cfs)*
	A_T = Σ[A]				Σ= [D]	[E]	$[F] = \frac{[D]x[E]}{[G]}$	[F] X (1-[H])	[I]

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

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

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

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

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

E.4 Treatment Control BMP Selection

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

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

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

Table E.4 Treatment Control BMP Selection

Selected Treatment Control BMP Name or ID[1]	Priority Pollutant(s) of Concern to Mitigate[2]	Removal Efficiency Percentage[3]

[1] Treatment Control BMPs must not be constructed within Receiving Waters. In addition, a proposed Treatment Control BMP may be listed more than once if they possess more than one qualifying pollutant removal efficiency.
[2] Cross Reference Table E.1 above to populate this column.
[3] As documented in a Co-Permittee Approved Study and provided in Appendix 6.

Section F: Hydromodification

F.1 Hydrologic Conditions of Concern (HCOC) Analysis

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

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

Does the project qualify for this HCOC Exemption? ☐ Y ☒ N

If Yes, HCOC criteria do not apply.

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

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

Does the project qualify for this HCOC Exemption? ☐ Y ☒ N

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

Table F.1 Hydrologic Conditions of Concern Summary

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

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

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

Does the project qualify for this HCOC Exemption? ☐ Y ☒ N

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

INSERT TEXT HERE

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
Onsite storm drains inlets	• Mark all inlet with the words "only rain down storm drain" or similar. Catch basin markers may be available from the Riverside County Flood Control and Water Conservation District, call 951.55.1200 to verify	• Maintain and periodically repaint or replace inlet markings • Provide Stormwater pollution prevention information to new site owners, lessees, or operators. • See applicable optional 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."
Landscape/Outdoor Pesticide Us	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 to 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	• 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/. • Provide IPM information to new owners, lessees and operators
Roofing, gutters and trim	• Avoid roofing, gutters, and trim made of copper or other unprotected metals that may leach into runoff.	• See applicable operational BMPs in "Guidelines for Maintaining Your Swimming Pool, Jacuzzi and Garden Fountain" at http://rcflood.org/stormwater

Section H: Construction Plan Checklist

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

Table H.1 Construction Plan Cross-reference

BMP No. or ID	BMP Identifier and Description	Corresponding Plan Sheet(s)	BMP Location (Lat/Long)
INFIL	INFILTRATION BASIN	CONCEPTUAL GRADE PLAN SHEET 1	33°88'76" North 117°27'43" West

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: Insert text here.

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

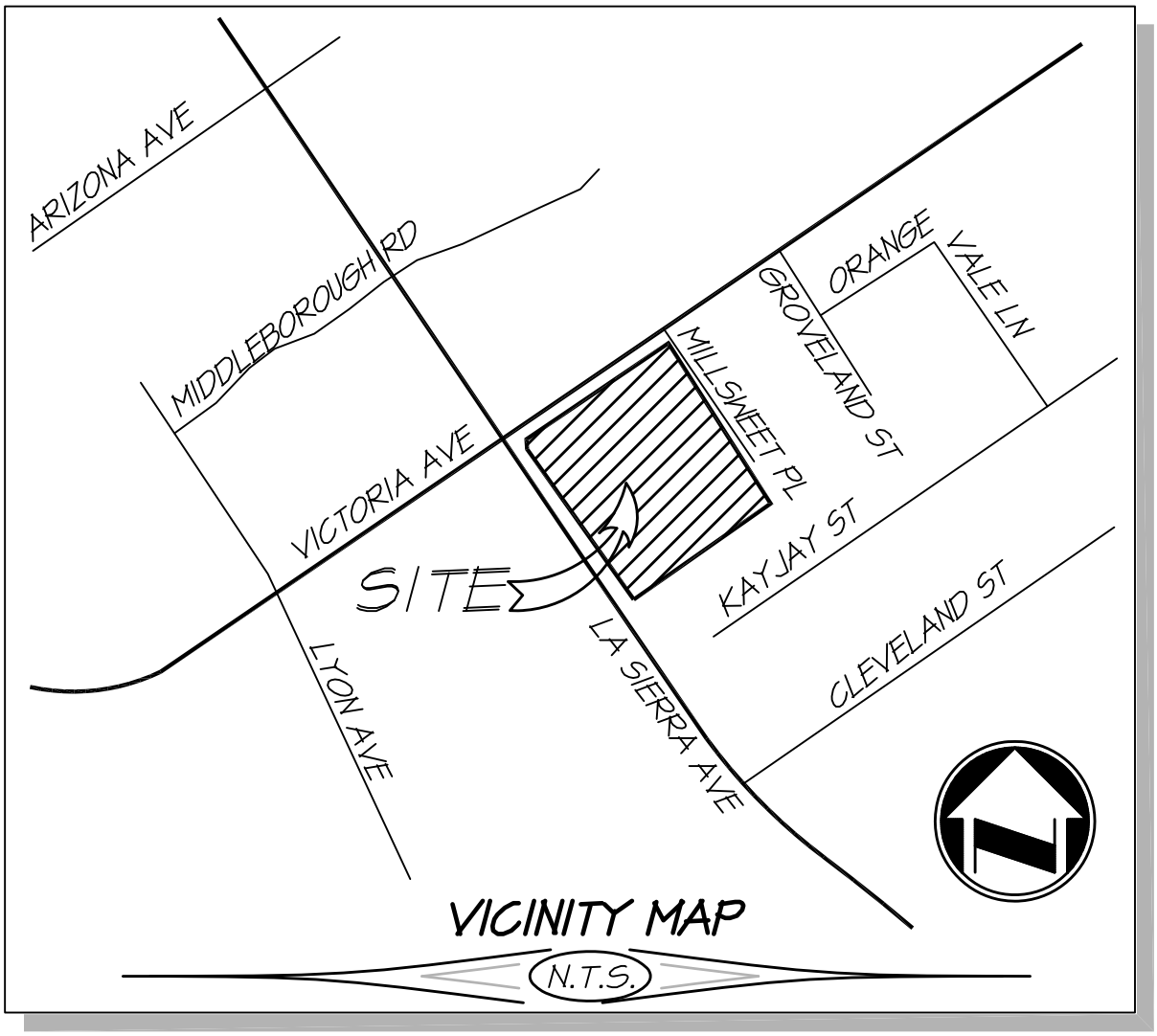
☒ Y ☐ N

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

Appendix 1: Maps and Site Plans

Location Map, WQMP Site Plan and Receiving Waters Map

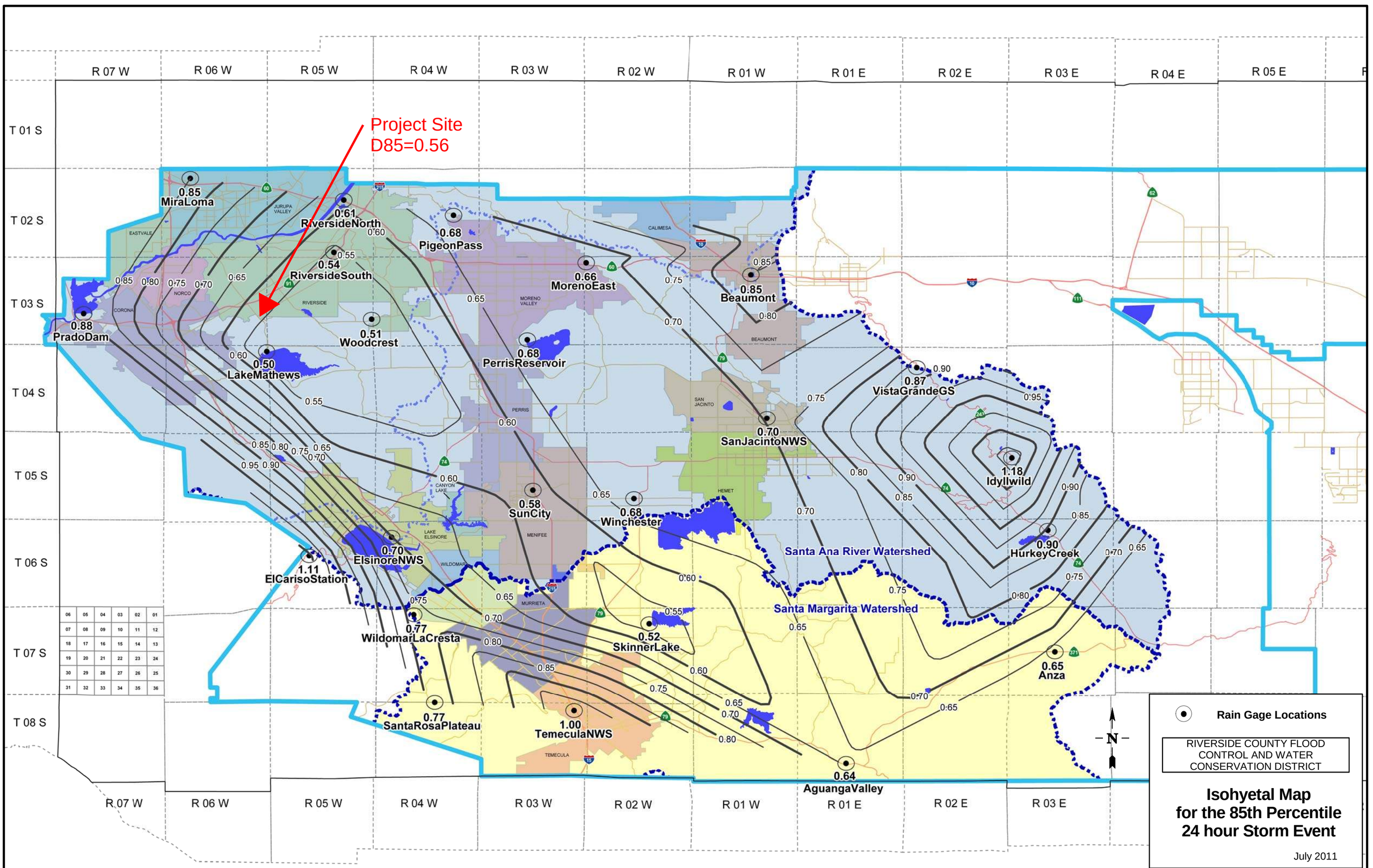
THOMAS BROS. MAP PG 744 GRID G-3

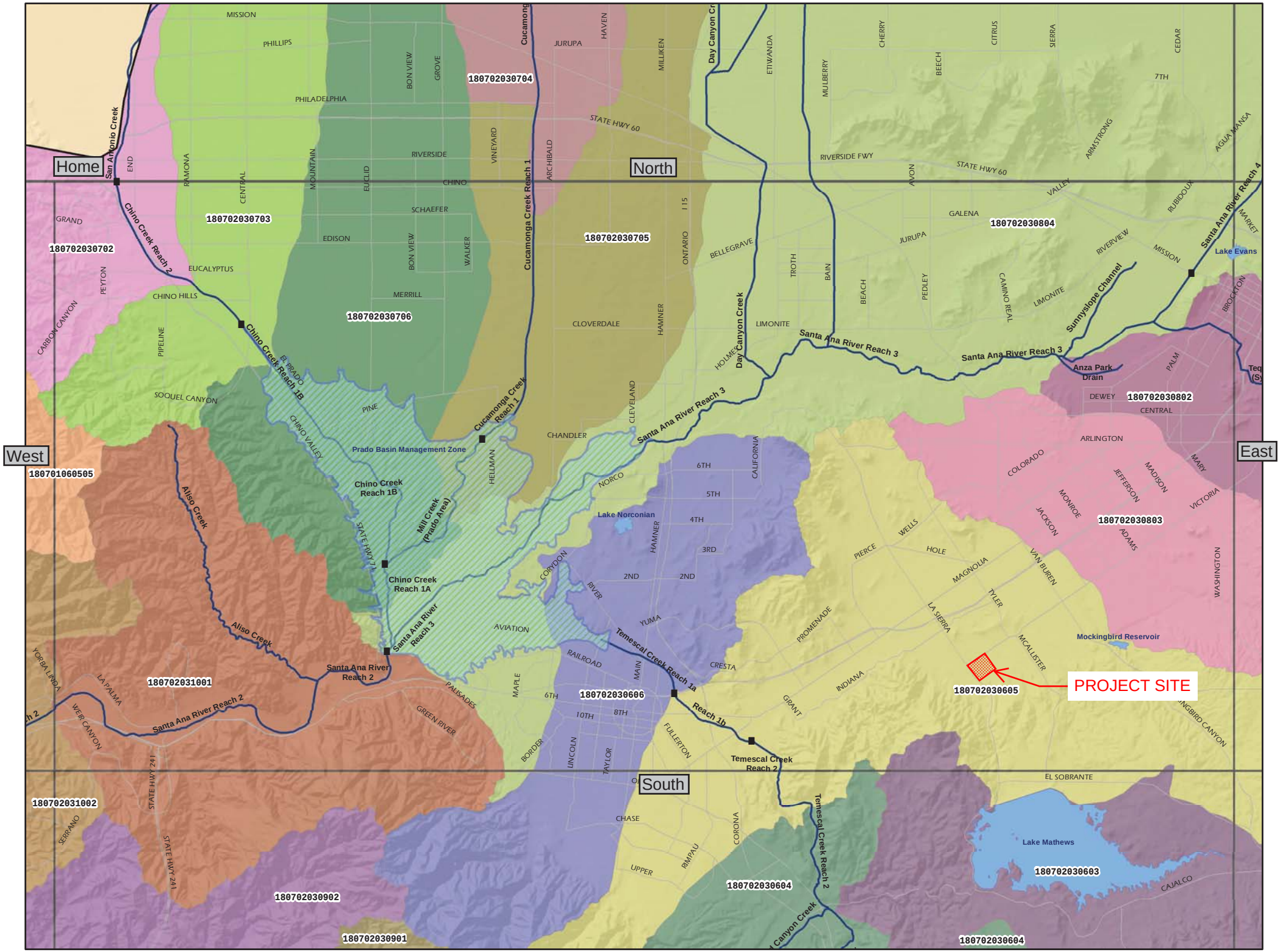


VICINITY MAP

N.T.S.

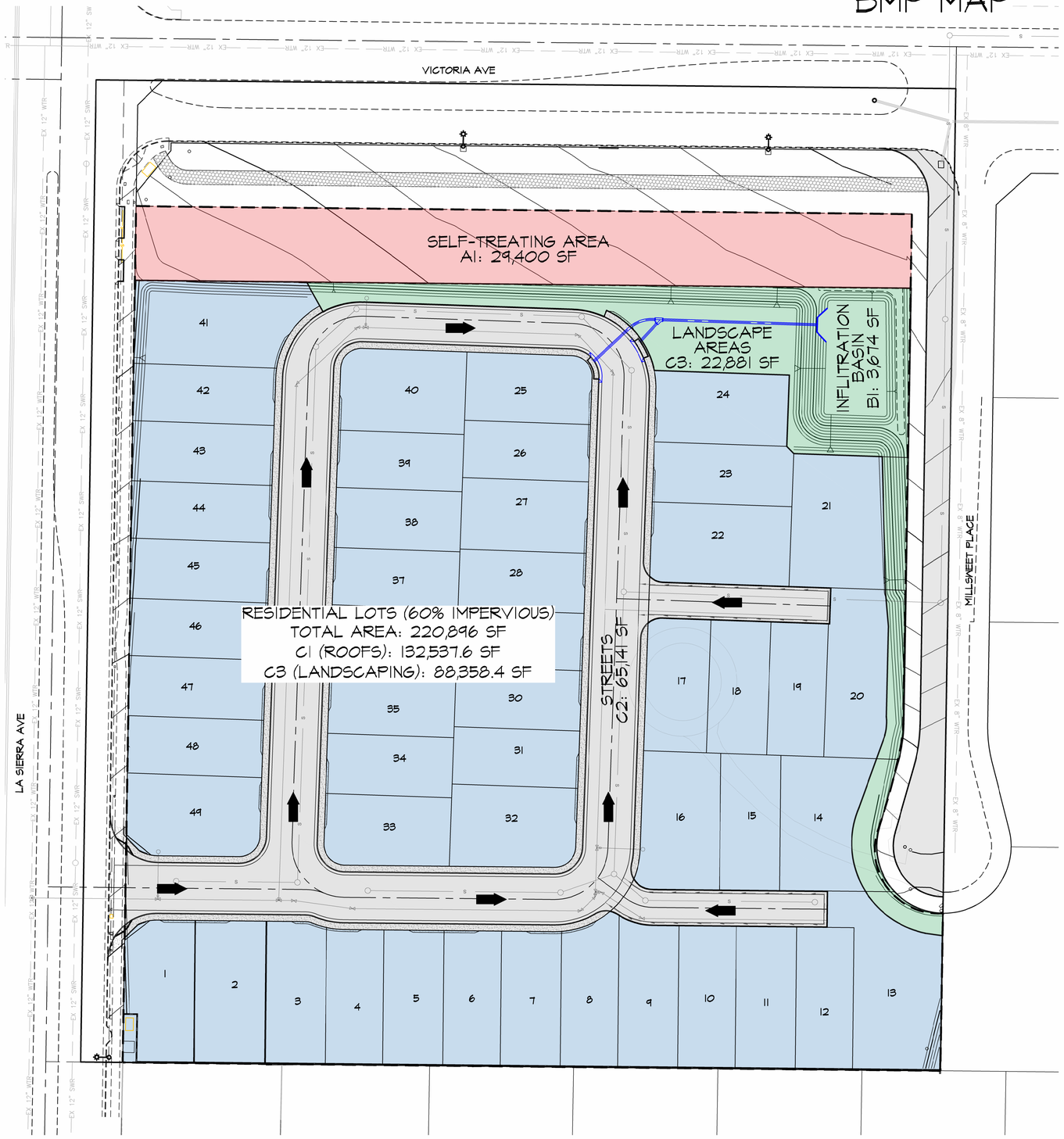
SEC. 24 T.3S. R.6W

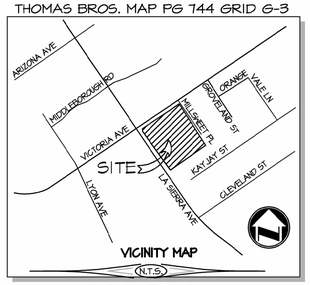

Project Site
D85=0.56
R 07 W
R 06 W
R 05 W
R 04 W
R 03 W
R 02 W
R 01 W
R 01 E
R 02 E
R 03 E
R 04 E
R 05 E
T 01 S
T 02 S
T 03 S
T 04 S
T 05 S
T 06 S
T 07 S
T 08 S
0.85 MiraLoma
0.61 RiversideNorth
0.54 RiversideSouth
0.68 PigeonPass
0.66 MorenoEast
0.85 Beaumont
0.88 PradoDam
0.51 Woodcrest
0.50 LakeMathews
0.68 PerrisReservoir
0.87 VistaGrandeGS
0.70 SanJacintoNWS
1.18 Idyllwild
0.58 SunCity
0.68 Winchester
0.70 ElsinoreNWS
1.11 ElCarisoStation
0.90 HurkeyCreek
0.77 WildomarLaCresta
0.52 SkinnerLake
0.65 Anza
0.77 SantaRosaPlateau
1.00 TemeculaNWS
0.64 AguangaValley
Santa Ana River Watershed
Santa Margarita Watershed
JURUPA VALLEY
EASTVALE
NORCO
CORONA
RIVERSIDE
MORENO VALLEY
CALIMESA
BEAUMONT
SAN JACINTO
PERRIS
HEMET
CANYON LAKE
LAKE ELSINORE
MENIFEE
WILDOMAR
MURRIETA
TEMECULA
Rain Gage Locations
RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
Isohyetal Map for the 85th Percentile 24 hour Storm Event
July 2011
N


Home
North
West
East
South
PROJECT SITE
180702030704
180702030703
180702030702
180702030705
180702030804
180702030706
180702030802
180701060505
180702030803
180702031001
180702030606
180702030605
180702031002
180702030902
180702030901
180702030604
180702030603
Santa Ana River Reach 4
Santa Ana River Reach 3
Santa Ana River Reach 2
Chino Creek Reach 2
Chino Creek Reach 1B
Chino Creek Reach 1A
Cucamonga Creek Reach 1
Temescal Creek Reach 1a
Reach 1b
Temescal Creek Reach 2
Day Canyon Creek
Aliso Creek
Mill Creek (Prado Area)
Sunnyslope Channel
Anza Park Drain
Prado Basin Management Zone
Lake Norconian
Lake Evans
Mockingbird Reservoir
Lake Mathews
San Antonio Creek
MISSION
PHILLIPS
PHILADELPHIA
JURUPA
RIVERSIDE
CHINO
SCHAEFER
EDISON
EUCALYPTUS
MERRILL
CHINO HILLS
CLOVERDALE
LIMONITE
GALENA
CHANDLER
NORCO
AVIATION
CRESTA
FULLERTON
CHASE
EL SOBRANTE
ARLINGTON
CENTRAL
DEWEY
STATE HWY 60
STATE HWY 71
STATE HWY 241
RIVERSIDE FWY

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

TENTATIVE TRACT 38921
BMP MAP





SEC. 24 T.3S. R.6W

ENGINEER
ADKAN ENGINEERS
6879 AIRPORT DRIVE
RIVERSIDE, CA 92504
TELEPHONE: (951) 688-0241
LSAGLIA@ADKAN.COM

OWNER
LA SIERRA VICTORIA DEVELOPMENT LLC
19215 WILD MUSTANG COURT
APPLE VALLEY, CA 92307

ASSESSORS PARCEL NUMBERS
136-220-016

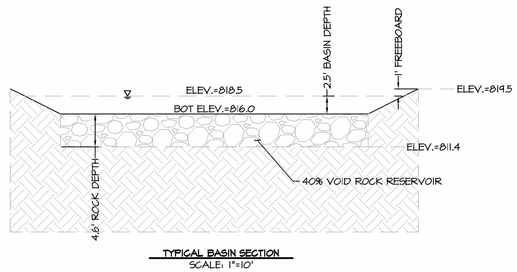
APPLICANT
WARMINGTON RESIDENTIAL
3090 PULLMAN ST
COSTA MESA, CA 92626
CONTACT: MATTHEW ESQUIVEL
EMAIL: MESQUIVEL@WARMINGTONGROUP.COM

LEGEND

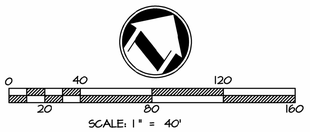
- DRAINAGE FLOWS
- DMA BOUNDARY
- PROP. MAJOR CONTOUR
- PROP. MINOR CONTOUR
- PROP. STORM DRAIN
- PROP. WATER
- PROP. SEWER
- HOMESITES
- LANDSCAPE
- STREETS
- SELF-TREATING AREA

AC	ACRES
CB	CATCH BASIN
CFS	CUBIC FEET PER SECOND
DA	DRAINAGE AREA
DMA	DRAINAGE MANAGEMENT AREA
EX.	EXISTING
PROP.	PROPOSED
SF	SQUARE FEET

DMA 1			
DMA	NAME	SURFACE TYPE	AREA (SF)
A1	EXISTING	SELF-TREATING	29,400
B1	INFILTRATION BASIN	NATURAL A SOIL	3,674
C1	HOMES	ROOF/LANDSCAPE 60% IMPERVIOUS	132,538
C2	STREETS	ASPHALT/CONCRETE	65,141
C3	LANDSCAPING	ORNAMENTAL LANDSCAPING	111,239
TOTAL			341,992



TYPICAL BASIN SECTION
SCALE: 1"=10'



SCALE: 1" = 40'

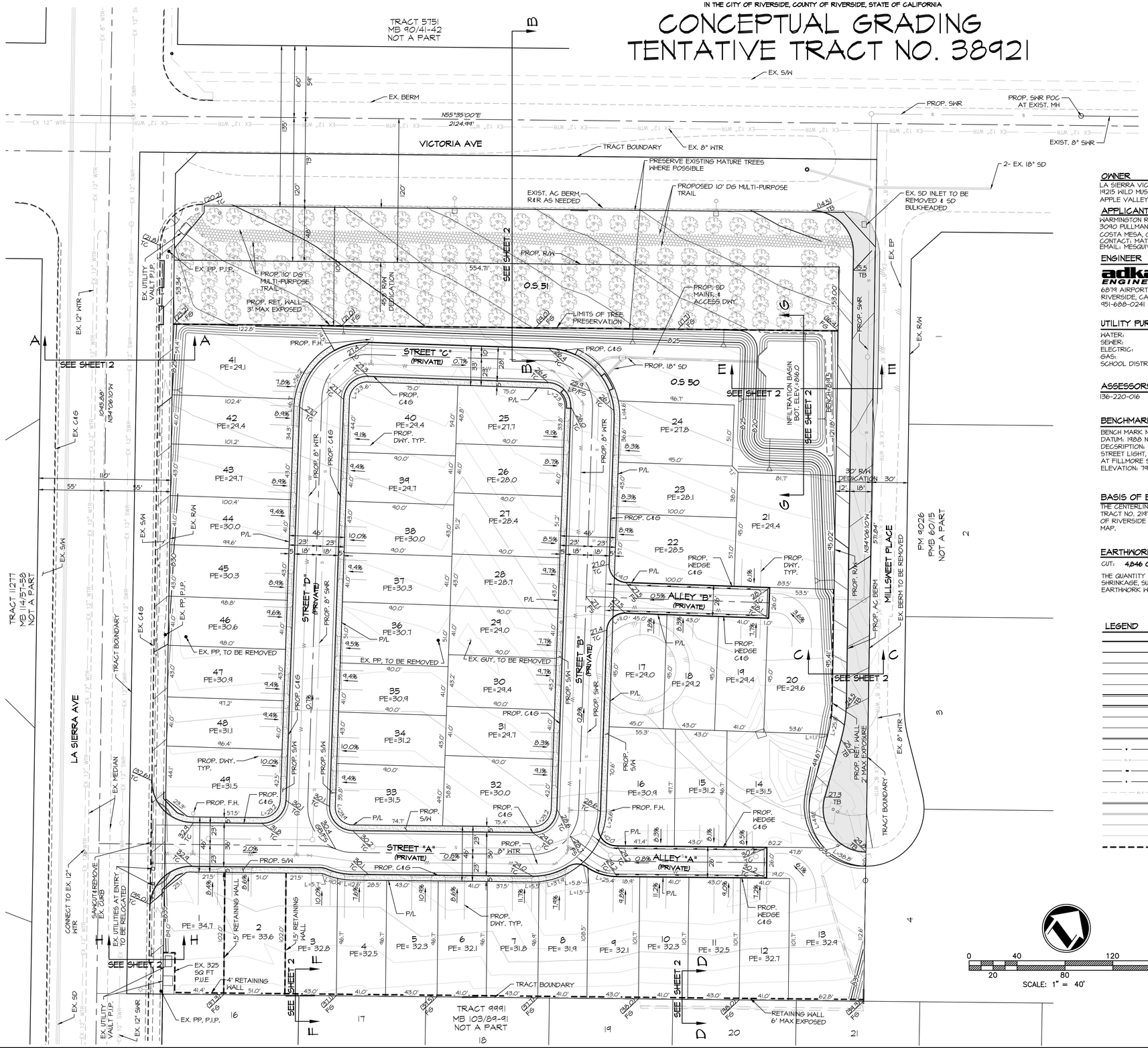
PLANS PREPARED BY:
adkan ENGINEERS
Civil Engineering · Surveying · Planning
6879 Airport Drive, Riverside, CA 92504
Tel:(951) 688-0241 · Fax:(951) 688-0599

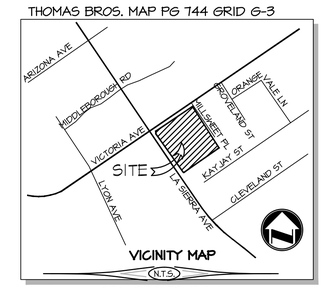
Appendix 2: Construction Plans

Grading and Drainage Plans

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

CONCEPTUAL GRADING
TENTATIVE TRACT NO. 38921





SEC. 24 T.3S. R.6W

OWNER
LA SIERRA VICTORIA DEVELOPMENT LLC
19215 WILD MUSTANG COURT
APPLE VALLEY, CA 92307

APPLICANT
WARMINGTON RESIDENTIAL
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EMAIL: MESQUIVEL@WARMINGTONGROUP.COM

ENGINEER
adkan ENGINEERS
6879 AIRPORT DRIVE
RIVERSIDE, CA. 92504
951-688-0241

UTILITY PURVEYORS

WATER:	RIVERSIDE PUBLIC UTILITIES
SEWER:	RIVERSIDE PUBLIC WORKS
ELECTRIC:	*RIVERSIDE PUBLIC UTILITIES*
GAS:	SO. CAL. GAS COMPANY
SCHOOL DISTRICT:	RIVERSIDE UNIFIED SCHOOL DISTRICT

ASSESSORS PARCEL NUMBER
136-220-016

BENCHMARK
BENCH MARK NO. D3-E3
DATUM: 1988 NAVD
DECSRIPTION: P.K. NAIL AND CITY ENGINEER TAG IN CONCRETE BASE OF A STREET LIGHT, 2 FEET NORTHWESTERLY OF THE NORTHERLY CURB RETURN AT FILLMORE STREET AND ARIZONA AVENUE FORMERLY D3-D RESET.
ELEVATION: 743.147

BASIS OF BEARING
THE CENTERLINE OF VICTORIA AVENUE BEING NORTH 55°35'00" EAST PER TRACT NO. 21974, FILED IN BOOK 175 MAPS, AT PAGES 46 AND 47, RECORDS OF RIVERSIDE COUNTY, WAS HELD AS THE BASIS OF BEARINGS FOR THIS MAP.

EARTHWORK QUANTITIES

CUT: **4846 CY** FILL: **30,491 CY** NET: **24346 CY (FILL)**

THE QUANTITY SHOWN ABOVE IS FOR DISCUSSION PURPOSES ONLY. SHRINKAGE, SUBSIDENCE AND SURFACE LOSS FACTORS ARE NOT INCLUDED. EARTHWORK WILL BE BALANCED ON SITE DURING FINAL ENGINEERING.

LEGEND

BOUNDARY	EX. EXISTING
RIGHT OF WAY	PROP. PROPOSED
CENTERLINE	S/W SIDEWALK
PROPERTY LINE	R/W RIGHT OF WAY
EASEMENT	R&R REPLACE AND REPAIR
PROP. CURB & GUTTER	P/L PROPERTY LINE
EX. CURB & GUTTER	C&G CURB & GUTTER
PROP. SIDEWALK	O.S. OPEN SPACE
EX. SIDEWALK	EVA EMERGENCY VEHICLE ACCESS
UNDERGROUND STORAGE	SWR SEWER
PROP. DOMESTIC WATER	WTR WATER
EX. DOMESTIC WATER	SD STORM DRAIN
PROP. RECYCLED WATER	CB CATCH BASIN
PROP. SEWER	TBR TO BE REMOVED
EX. SEWER	TYP. TYPICAL
PROP. STORM DRAIN	DWY DRIVEWAY
EX. STORM DRAIN	
EX. MAJOR CONTOUR	
EX. MINOR CONTOUR	
PROP. RETAINING WALL	

LEGAL DESCRIPTION
LOT 6 IN BLOCK 12 OF THE RESUBDIVISION OF LANDS OF J. F. MOULTON AND H. B. PRAED, AS SHOWN BY MAP ON FILE IN BOOK 1 PAGES 44 AND 50 OF MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF THE COUNTY OF RIVERSIDE

PROJECT NOTES
1. TOTAL GROSS AREA: 10.8 AC, 470,448 SQ.FT
2. NET PROJECT SIZE: 7.85 AC, 341,946 SQ.FT
3. NO. OF RESIDENTIAL LOTS: 44
4. NO. OF O.S. LOTS: 2
5. PROPOSED DENSITY: 4.5 DU/AC (GROSS), 6.24 DU/AC (NET)
6. DRIVEWAY SLOPE: 15% MAX
7. BLDG SETBACKS:
   FRONT-
   HOUSE = 10 FT
   GARAGE FACE = 18 FT
   SIDEYARD = 4' TYP., 10' STREET SIDE
   REAR YARD-15' MIN
8. THOMAS BROS. COORDINATES: 2006 RIV. CO. (PAGE 744, GRID G-3)
9. THIS MAP DOES INCLUDE ALL OF THE LAND DIVIDERS CONTIGUOUS PROPERTY.
10. THE PROJECT IS NOT SUBJECT TO OVERFLOW, INNUNDATION, OR FLOOD HAZARDS.
11. THIS PROJECT DOES NOT LIE WITHIN THE AIRPORT INFLUENCE AREA
12. ALL CONTOURS ARE SHOWN AT 1' INTERVALS

TOPOGRAPHY SOURCE
FIELD SURVEY PERFORMED BY ADKAN ENGINEERS 12/01/2023

0 40 120
20 80 160
SCALE: 1" = 40'

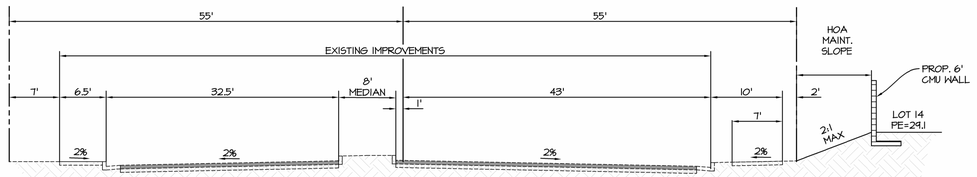
REVISIONS	
DELTA	DESCRIPTION

PAGE 1 OF 2
TENTATIVE TRACT NO. 38921
CONCEPTUAL GRADING DETAILS
PREPARATION DATE: FEBRUARY 2024

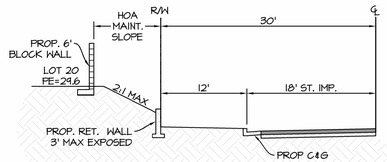
adkan ENGINEERS
Civil Engineering · Surveying · Planning
6879 Airport Drive, Riverside, CA 92504
Tel:(951) 688-0241 Fax:(951) 688-0599

U:\PROJECTS\WARMINGTON\05714\ENGINEERING\CONCEPTUAL GRADING\05714 CG_OLD.DWG

PLOT DATE: 2/23/2024 2:26 PM



SCALE: 1"=10' — SECTION A-A



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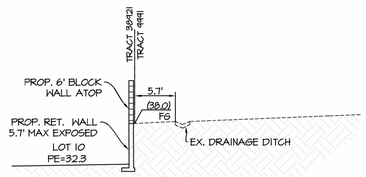
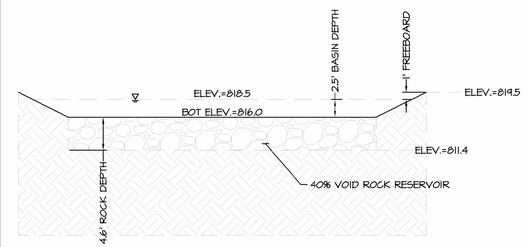


SCALE: 1"=10' — SECTION D-D



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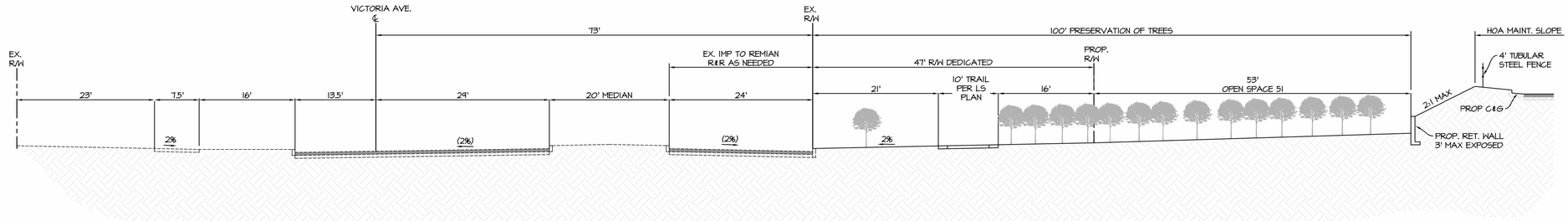

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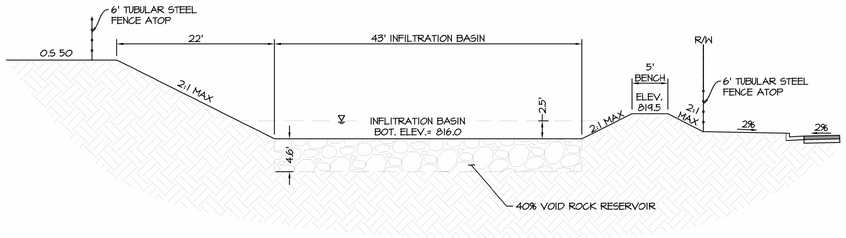

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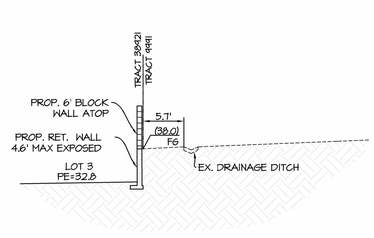

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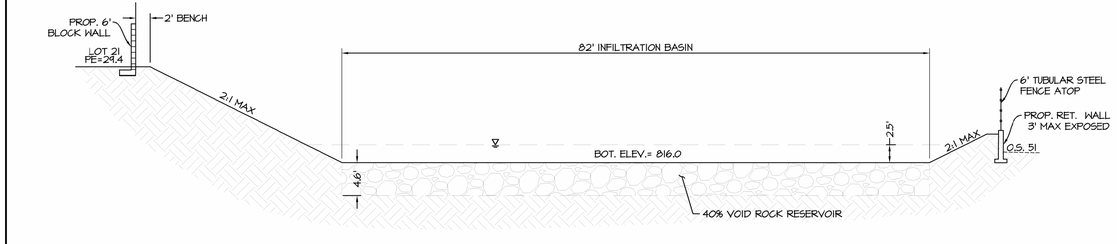

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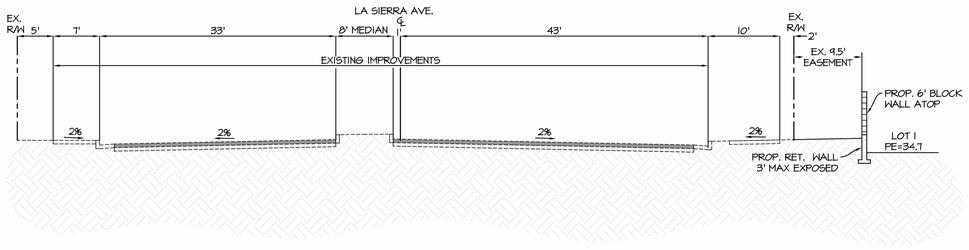

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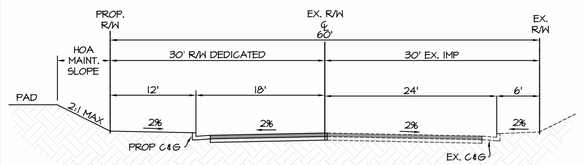

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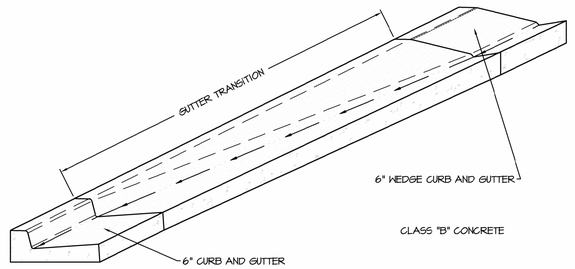
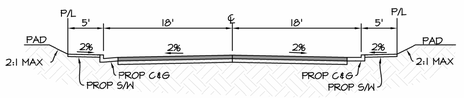


N.T.S. — CURB TRANSITION DETAIL



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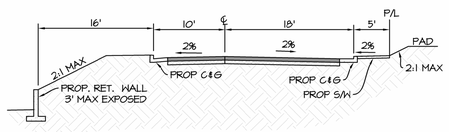

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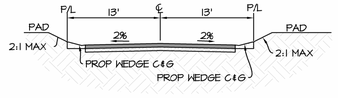
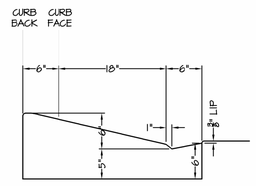


SCALE: 1"=10' — TYPICAL ALLEY



N.T.S. — WEDGE CURB DETAIL

PAGE 2 OF 2
TENTATIVE TRACT NO. 38421
CONCEPTUAL GRADING DETAILS
PREPARATION DATE: FEBRUARY 2024

adkan ENGINEERS
Civil Engineering · Surveying · Planning
6879 Airport Drive, Riverside, CA 92504
Tel:(951) 688-0241 Fax:(951) 688-0599

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PLOT DATE: 2/26/2024 9:56 AM

Appendix 3: Soils Information

Geotechnical Study and Other Infiltration Testing Data

December 14, 2023
J.N. 23-341

WARMINGTON RESIDENTIAL
3090 Pullman Street
Costa Mesa, California 92626

Attention: Mr. Bret Ilich

Subject: **Feasibility/Due-Diligence Desktop Geotechnical Review, *Proposed 48 Lot Residential Project,* Assessor's Parcel Number 136-220-016, 7.9-Acre Site at SEC of Victoria and La Sierra Avenues, City of Riverside, Riverside County California**

Dear Mr. Ilich

In accordance with your request, **Petra Geosciences, Inc. (Petra)** is providing this desktop feasibility/due-diligence geotechnical review for proposed 48-lot development in the city of Riverside, California. This report presents our findings and professional opinions with respect to the geotechnical feasibility of the proposed development, geotechnical constraints that should be taken into consideration during development of the site, and potential mitigation measures to bring the site to compliance from a geotechnical engineering viewpoint.

> *It must be emphasized that that this desktop review report is intended as a feasibility-level geotechnical assessment only and is based solely on a review of the referenced geotechnical literature, a site reconnaissance and updated engineering analysis. As such, the contents of this report are not suitable for submittal to regulatory agencies, nor should the findings or conclusions provided herein be relied upon for earthwork, quantity calculation or procedure, or final structural engineering design. It should be further noted that this geotechnical evaluation does not necessarily address soil contamination or other environmental issues affecting the property.*

SITE GENERAL OVERVIEW

The project site is essentially square-shaped and approximately 8.8-acres in size, of which 7.9 acres are proposed for development. The site is situated southeasterly of Victoria Avenue, southwesterly of Millsweet Place and northeasterly of La Sierra Avenue. Existing residences are located to the southeast and the site is currently utilized as an orange grove with the exception of the eastern quadrant that appears to have been more recently developed as a park or recreation feature. Site access is at a driveway at the end of Millsweet Place, although a locked gate is present off Victoria Avenue.

DUE DILIGENCE ASSESSMENT

Geotechnical Literature Review and Site Reconnaissance

We have reviewed the existing geotechnical report, code update letter and supporting data for subject property by Soil Exploration Company, Inc. (SEC, 2014, 2019), as well as available published and unpublished geologic maps, data and reports, online aerial imagery and historic phots. We also performed a recent site reconnaissance to observe the surface conditions.

FINDINGS

Proposed Development

The current proposed development concept, Plan Option 3g by KTGY Architecture, will consist of 48 residential lots, a water quality basin and in-tract streets. A new site entrance will be constructed off La Sierra Avenue and Millsweet Place will be improved. The exiting orange grove along Victoria Avenue will remain as a 100-foot wide easement along with a trail. Other ancillary site improvements are expected to consist of underground utility lines (sewer, water, storm drain and dry utilities), perimeter masonry block screen walls, concrete sidewalks and landscaping. No grading plans are currently available; therefore, the preliminary grading quantities are currently unknown. Based on the low gradient of the site, significant fill slopes, cut slopes, nor retaining walls are currently anticipated.

Aerial Photograph Review

Based on aerial photographs reviewed, the subject site appears to have been utilized as an orange grove since at least 1931. Victoria and La Sierra Avenues were also present since that time and the surrounding properties were developed for residential use during the 1980's. The grove operations have continued from at least 1931 to the present time with the exception of the southeasterly quadrant of the site. During 2002, portions of the grove in this local area was cleared and some localized construction appeared to be taking place by 2004. By 2007 the park and/or recreation facilities included an asphalt-paved driveway and several sheds had been constructed. This area appears to no longer be in use, with the exception of parking for contractor vehicles/trailers.

Site Reconnaissance

A representative of Petra performed a site reconnaissance and photo documentation on December 4, 2023. Current access is via an asphalt driveway off Millsweet Place near the southeastern corner and a locked gate is also present at Victoria Avenue. Wire and/or chain link fencing surrounds the site. The majority of

the site is covered by an active orange grove with other miscellaneous mature trees located in other areas, with the exception of the southeasterly quadrant which has been partially improved with an asphalt driveway, a few sheds and miscellaneous playground-related equipment. These recreation facilities no longer appear to be in use; however, several contractor trailers and vehicles were currently parked within the site. A windmill structure is present near the center of the site along with overhead power poles for electricity. Overhead power lines are also located along the southwestern property line with La Sierra Avenue.

Underground irrigation lines are present throughout the property and although not observed, a water well may also be present. Two electric vaults were observed at the south corner and storm drain facilities are located at the north corner. The southeastern property edge appears to have undergone some minor grading, as evidenced by a noteworthy break in grade, and is clear of vegetation that may be related to an easement. In addition to the various trees, site vegetation consists of a variable growth of weeds, grasses and shrubs, and miscellaneous debris was randomly observed on the surface of the site. The site descends at relatively low grading to the northwest.

Literature Review

As noted, Petra has reviewed the preliminary geotechnical report and code update letter by Soil Exploration Company, Inc. for the subject property, as well as geologic and geotechnical maps and data it the nearby area. The most pertinent geotechnical findings made from reviewing the report are paraphrased herein with any commentary/discussion by Petra in parenthesis and italics.

SEC Geotechnical Investigation and Update Letter (2014, 2019)

- The field investigation included 4 hollow-stem auger borings to depths ranging from 15 to 25 feet and performing 3 infiltration tests at a depth of 2 feet. *(Petra: Due to limited access from the existing grove, the borings are primarily located in the middle portion of the site. The boring location map and logs are included as Appendix A herein for reference.)*

- In general, the site is underlain by alluvial soils consisting of silty sand, sandy silt and silty clay. The soils are loose near the surface and become dense to very dense and stiff below. Bedrock was encountered at depths of 15 to 20 feet. *(Petra: Based on the 4 borings logs, the alluvial soils are loose to at least 10 feet in depth and mainly consist of silty sand soil type. No consolidation or collapse tests were performed in the loose alluvium.)*

- Basic laboratory testing was performed for natural moisture content and dry density and sieve analysis. Based on observation of the soils, the expansion potential of near-surface soils is expected to be very low (*Petra: One sand equivalent test was performed in addition to two sieve tests. No tests were performed for soil expansion or corrosion potentials. Based on the lab data, site soils have appreciable fines content and soil expansion could also be in the low range.)*

- No groundwater was encountered in the borings. Historic groundwater is indicated to be at a depth of 10± feet and a well in the vicinity of the site indicated a depth to groundwater was 4.7 feet in 1974. (*Petra: One boring was advanced to the maximum explored depth of 25 feet in January of 2014 did not encounter groundwater.)*

- The site in an area of potential liquefaction, however considering the depth to bedrock at 15 and 20 feet, the potential for liquefaction at the site is low. The potential for seismically induced dynamic settlement would be mitigated by overexcavation and recompaction of near surface sandy soils. (*Petra: Based on current standards of practice, we have performed a supplemental liquefaction/dynamic settlement as described further below.)*

- The grading areas should be cleared of all vegetation, irrigation lines, roots, debris and deleterious materials which should be hauled offsite. Subsequent to site clearance and debris removal, the building areas should be overexcavated to a depth of at least 4 feet below ground or proposed grade, whichever is deeper, to expose underlying firm soils. Locally deeper overexcavation should not be precluded to expose competent soils. All foundations should be provided with at least 3 feet of compacted fill mat below the bottom of the footings. After overexcavation the exposed soils should be further scarified to a depth of at least 12 inches, watered and recompacted to at least 90 percent of the maximum dry density. (*Petra: Based on the data in the borings logs, the alluvial silty sand soils appear to be loose to about 10 feet below ground surface. Based on a lack of geotechnical engineering test data, we recommend a minimum removal or overexcavation depth of 6 to 7 feet below existing grades, as well as processing the exposed removal bottom in-place at least one foot in depth. Alternatively, additional exploratory borings and laboratory testing may be performed to confirm these preliminary recommendation depths.)*

- The use of shallow spread footings is feasible for proposed structures. The expansion potential of the onsite sandy soils is anticipated to be very low, however this should be verified subsequent to completion of site preparation. The soluble sulfate content of the foundation soils should also be determined subsequent to complete of grading. (*Petra: Based on the boring logs and reported lab data, site soils have appreciable fines content and soil expansion could also be in the low range. We also recommend corrosion screening laboratory testing for presence of sulfates, chlorides and corrosion to metallic elements.)*

- Three 8-inch diameter and two-feet deep test holes were excavated, and the soils were classified as silty sand. The field tests indicated an infiltration rate of 2.8, 4.5 and 17.9 inches per hour with no factor of safety applied. (*Petra: SEC test IT-1 is in the vicinity of the proposed water quality basin which had a test rate of 2.8 inches/hour at a depth of 2 feet below grade. Depending on the depth of the proposed basin, additional field infiltration testing may be warranted.)*

- The 2019 letter proved updated seismic parameters related to the 2016 CBC. (*Petra: We have provided updated seismic design parameters for the current 2022 CBC as included in Appendix B herein.)*

Local Area Geology and Soil Conditions

The subject property is situated on the medial portion of a broad alluvial fan descending at a moderate gradient northwesterly from the nearby El Sobrante mountain just to the south. The general area is underlain predominantly by young surficial alluvial deposits further underlain by dense older alluvial fan deposits.

Topsoil and Artificial Fill – A presumed topsoil horizon and/or localized surficial artificial fill mantels the site to an anticipated depth of approximately 1 or 2 feet across the surface of the property. These materials generally consist of dry and very loose silty sand with organic material.

Younger Alluvium – Recent or young alluvium appears to be present beneath the topsoil horizon and these alluvial soils mainly consist of dry to moist, loose to medium dense, silty sands and occasional sandy silt. These soils appear to be loose to a depth of approximately 10 feet.

Older Alluvium – Older alluvium appears to be present beneath the upper young alluvium at depths of approximately 10 to 15 feet below surface grades. These soils mainly consist of moist, firm to stiff, sandy silts and sandy clays.

Granitic Bedrock – Bedrock, mostly likely weathered granite, were encountered within 3 of the borings at depths of 15, 18.5 and 20 feet below surface grades. The upper 5 feet of the bedrock was readily excavated with the B-61 mobile hollow-stem auger drill utilized. Blow counts indicated medium dense to very dense conditions.

Groundwater

Groundwater levels in the nearby area have been reported to range from approximately 4.7 to 10± feet below surface grades in 1974 and on historic high groundwater maps respectively. Groundwater was not encountered within the borings advanced to a maximum depth of 25 feet below grade during January 2014 exploration. Free groundwater is not expected to be encountered during remedial grading at the present time.

Compressible Soils

Based on our field observations and the data on the SCE borings logs, the existing soils including all topsoils and the upper portions of low-density alluvial deposits, are deemed to be potentially compressible. As such, these materials are considered unsuitable for support of proposed fills, structures, pavement or other improvements and should be removed to expose the underlying competent alluvium or alluvial fan deposits. The removal soils may be subsequently placed as engineered (compacted) fill. The recommended remedial removal of natural alluvial soils us estimated to be at depths of approximately 6 to 7 feet below the existing ground surface along with processing the exposed removal bottom to a depth of one foot in-place. Localized areas of deeper excavation/removal of unsuitable soils could be necessary based on field observations during the course of grading and contingencies for such deeper should be planned considering past use within the site.

Strong Ground Motions

The site is located in a seismically active area of southern California and will likely be subjected to very strong seismic-related ground shaking during the anticipated life span of the project. Structures within the site should therefore be designed and constructed to resist the effects of strong ground motion in accordance with the provisions of the 2022 California Building Code (2022 CBC).

Updated Liquefaction/Dynamic Settlement Potential

General

Based on a review of the Riverside County Land Information System the site is mapped as having a moderate to high potential for liquefaction. Accordingly, Petra has performed an updated liquefaction analyses using the data provided in SEC, 2014 report to determine the liquefaction settlement potential in accordance with 2022 CBC requirements within the site.

Seismically Induced Settlement

Petra has reanalyzed the boring data with respect to potential for liquefaction and dry sand settlement within the site development. The analysis was performed following the guidelines contained in Special Publication 117A published by the California Geological Survey (1997, Revised 2008) and those in the 2022 California Building Code (2022 CBC). Considering the sandy nature of some of the onsite deposits, seismically induced settlement within the site is calculated to be on the order of 1 to 1 ½ inches across the site.

Based on our calculations, the differential settlement between various locations within the site is not expected to exceed 1 inch in 40 feet, which is considered well within tolerable limits for seismic differential settlement.

PRELIMINARY CONCLUSIONS AND RECOMMENDATIONS

Based on our recent reconnaissance and review of existing preliminary SCE report and data, development of the subject project site is considered feasible from a geotechnical engineering standpoint. It is recommended that the following geotechnical issues be considered by the Client during this due diligence period.

Primary Geotechnical Issues

Our professional opinion, from a geotechnical engineering viewpoint, regarding various aspects of the site existing conditions and the proposed development is presented within this letter report. The following

presents the salient features of our due diligence assessment that we recommend being considered for future site development.

- Rough Grading Plan Review and/or Updated Geotechnical Design Report: The city of Riverside may request a geotechnical update report during project approvals as well as review and signing of the future rough grading plans. The geotechnical report should include updated recommendations for site remedial and rough grading, post-grading improvements and *preliminary* building foundation design based on the current 2022 California Building Code. Minor modified recommendations could be warranted based on proposed slopes and/or retaining wall designs.

- Demolition of Improvements, Clearing and Grubbing: All existing trees and vegetation, and existing site improvements, such as power lines, a windmill structure, foundations or buried irrigation lines will need to be cleared or demolished and removed from the site. Other buried utility lines could be present within or along the boundaries of the site. All other dumped debris and/or other deleterious materials found within the site will also require clearing and hauling offsite. Based on the past site usage, we further recommend that the grading contractor provide a dedicated crew to removing all trees roots, irrigation pipes and/or debris encountered during grading and fill operations.

- Removal of Unsuitable Soil Materials: The existing topsoil and upper portions of young alluvium will require removal and replacement as compacted fill. Based on Petra's review of the existing boring data, we recommend an the upper 6 to 7 feet of existing soils should be removed to competent alluvial soils and replaced as compacted fill, however this should also be confirmed during grading by in-situ density testing of the removal bottoms, exhibiting a minimum of 85 percent relative compaction. Deeper removals are always possible depending on the exposed natural soils, and contingencies should be considered as with any large grading operation.

- Suitability of Onsite Soils for Fill: Onsite soils are considered suitable for use in engineering fill provided they are free of organics/roots or other deleterious materials. The shallow subsurface sandy soils may be in a dry condition to a depth of several feet and pre-watering of the site is highly recommended prior to site grading. As noted above, based on the historical site usage, the grading contractor should provide a dedicated crew to removing all organics, tree roots, debris or other deleterious materials encountered during remedial grading and fill placement operations.

- Importing of Fill: Preliminary grading calculations should account for remedial alluvial removal and overexcavation depths, as well as for soil shrinkage when recompacted as fill. Based on the loose alluvial soils, shrinkage when replaced as compacted fill could be on the order of 15± percent, however that is a qualitative estimate and not based on any calculations. In the event imported soil material is needed to complete the project, all potential import source(s) should be evaluated at least one week prior to confirm that non-expansive, low corrosive soils that are free of deleterious materials or environmental contaminants will be imported.

- Liquefaction and Dynamic Settlement Potential: Based on Riverside County hazard maps, the site is located in a high zone for liquefaction potential most likely due to historic high groundwater depths many decades ago. Based on the report and analysis by SEC liquefaction settlement was considered low due the presence of hard bedrock at 15 to 20 feet below the surface.

  Based on our updated analysis, the potential for seismically induced settlement is on the order of 1 to 1½ inches under the unlikely scenario of high groundwater level of 5 feet below ground surface.

- Soil Expansion and Corrosion Potential and Building Foundation Design: Local area soils are expected to have a very low expansion potential; however, low expansive soils could potentially be encountered during site grading. Supplemental sampling and testing of site soils for expansion and corrosion is recommended during the next phase of geotechnical report submittals.

- Foundation Design: The seismic and foundation design recommendations for the residential buildings should be provided in accordance with the current 2022 California Building Code (2022 CBC). Conventional foundations are feasible, and Appendix B contains preliminary foundation design based on the assumed future very low expansion as-graded soil conditions. Modifications may be warranted depending on the soil types placed at finish pad grades follow site grading.

- Infiltration Design: SEC reported infiltration rates of 2.8, 4.5 and 17.9 inches/hour at a test depth of 2 foot below grade within the site. Depending on the proposed infiltration basin depths, additional testing may be needed.

- Preliminary Pavement Design: Based on the observed soil types, moderate R-values are expected which will allow for a City of Riverside minimum pavement design presumably 4 inches of asphalt over 6 inches of base material for the interior streets. Final pavement design should be performed at the completion of street rough grading with final R-value testing.

REPORT LIMITATIONS

This report is based on the existing observed surficial conditions and the geotechnical document review for the subject site. The conclusions and opinions contained in this report are based on the results of the described geotechnical evaluations, primarily the 4 borings performed near the center of the site, very limited laboratory testing and our professional judgment. This report has been prepared consistent with that level of care being provided by other professionals providing similar services at the same locale and in the same time period. The contents of this report are professional opinions and as such, are not to be considered a guaranty or warranty.

This report should be reviewed and updated after a period of one year or if the site ownership or project concept changes from that described herein. This report has not been prepared for use by parties or projects other than those named or described herein. This report may not contain sufficient information for other parties or other purposes.

This opportunity to be of service is sincerely appreciated. If you have any additional questions or concerns, please feel free contact this office.

Respectfully submitted,

PETRA GEOSCIENCES, INC.

12/14/23

Douglass Johnston
Senior Associate Geologist
CEG 2477

Siamak Jafroudi, PhD
Senior Principal Engineer
GE 2024

DJ/SJ/kb

Attachments: References
Appendix A – SEC Exploration Map and Boring Logs
Appendix B – Tentative Preliminary Foundation Design Recommendations and Seismic Parameters

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APPENDIX A

SEC EXPLORATION MAP AND BORING LOGS


VICTORIA AVENUE
WIRE FENCE
B-1
I-1
WIRE FENCE
I-2
B-2
MILLSPORT PLACE
WIRE FENCE
B-3
B-4
I-3
N
LA SIERRA AVENUE
WIRE FENCE
EXPLORATORY BORING &
INFILTRATION TEST LOCATION MAP
PLATE 1
LEGEND
B-4 ● Approximate Location of Boring
I-3 ▲ Approximate Location of Infiltration Test
Soil Exploration Co., Inc.
Project No. 13167-01
January 24, 2014
Base Map: Provided by Client

GEOTECHNICAL BORING LOGS

Drill Hole No. B-1

Date: January 17, 2014
Drilling Company: WDI
Hole Diameter: 8" **Drive Weight:** 140 lbs. **Drop:** 30"

Project No. 13167-01
Type of Rig: B-61
Elevation: 816±

DEPTH (feet)	TYPE OF TEST	SAMPLE TEST	BLOWS PER 6 INCH	DRY DENSITY (%)	MOISTURE (%)	SOIL CLASSIFICATION USCS	GEOTECHNICAL DESCRIPTION LOGGED BY: GL SAMPLED BY: GL
1	Alluvium					SM	**SILTY SAND:** Light brown, fine to coarse grained, dry, medium dense
2							
3							
4		■	4/8/10	108.4	3.4		Dry, medium dense, micaceous % Passing No. 200 Sieve = 43 SE = 18
5							
6		X	3/4/4	-	-		Slightly moist, loose
7							
8							
9							
10							
11		X	3/6/4	-	-		Medium dense
12							
13							
14							
15							
16		X	7/9/11	-	-	ML	**SANDY SILT:** Light brown, slightly moist, stiff
17							
18							
19							
20							
21	Bedrock	X	15/37/50	-	-	SM	**SILTY SAND:** Light brown, fine to coarse grained, very dense
22							
23							Very dense
24							TOTAL DEPTH = 25 FEET NO GROUNDWATER
25		X	19/39/50				NO CAVING BORING BACKFILLED

GEOTECHNICAL BORING LOGS

Drill Hole No. B-2

Date: January 17, 2014
Drilling Company: WDI
Hole Diameter: 8" **Drive Weight:** 140 lbs. **Drop:** 30"

Project No. 13167-01
Type of Rig: B-61
Elevation: 818.5±

DEPTH (feet)	TYPE OF TEST	SAMPLE TEST	BLOWS PER 6 INCH	DRY DENSITY (%)	MOISTURE (%)	SOIL CLASSIFICATION USCS	GEOTECHNICAL DESCRIPTION LOGGED BY: GL SAMPLED BY: GL
1	Alluvium					SM	**SILTY SAND:** Light brown, fine to medium grained, slightly moist, loose, micaceous
2							
3							
4		X	2/2/2	-	-		Loose SE = 29
5							
6		■	3/4/4	113.3	13.1	ML	**SANDY SILT:** Light brown, moist, loose, micaceous % Passing No. 200 Sieve = 59
7							
8							
9							
10							
11		X	2/3/3	-	-		Loose
12							
13							
14						CL-ML	**SILTY CLAY:** Light brown, moist, stiff
15		X	7/9/13	-	-		
16							TOTAL DEPTH = 15 FEET NO GROUNDWATER NO CAVING BORING BACKFILLED
17							
18							
19							
20							
21							
22							
23							
24							
25							

GEOTECHNICAL BORING LOGS

Drill Hole No. B-3

Date: January 17, 2014
Drilling Company: WDI
Hole Diameter: 8" **Drive Weight:** 140 lbs. **Drop:** 30"

Project No. 13167-01
Type of Rig: B-61
Elevation: 822.5±

DEPTH (feet)	TYPE OF TEST	SAMPLE TEST	BLOWS PER 6 INCH	DRY DENSITY (%)	MOISTURE (%)	SOIL CLASSIFICATION USCS	GEOTECHNICAL DESCRIPTION LOGGED BY: GL SAMPLED BY: GL
1	Alluvium					SM	**SILTY SAND:** Light brown, fine to medium grained, dry, loose
2							
3							
4							
5							
6		X	3/4/4	-	-		
7							
8							
9							
10							
11		X	5/6/7	-	-	ML	**SANDY SILT:** Light brown, moist, stiff
12							
13							
14							
15							
16	Bedrock	X	7/9/13	-	-	SM	**SILTY SAND:** Light gray, weathered, medium dense
17							
18							
19							
20		X	9/17/22	-	-		
21							TOTAL DEPTH = 20 FEET NO GROUNDWATER NO CAVING BORING BACKFILLED
22							
23							
24							
25							

GEOTECHNICAL BORING LOGS

Drill Hole No. B-4

Date: January 17, 2014
Drilling Company: WDI
Hole Diameter: 8" **Drive Weight:** 140 lbs. **Drop:** 30"

Project No. 13167-01
Type of Rig: B-61
Elevation: 824±

DEPTH (feet)	TYPE OF TEST	SAMPLE TEST	BLOWS PER 6 INCH	DRY DENSITY (%)	MOISTURE (%)	SOIL CLASSIFICATION USCS	GEOTECHNICAL DESCRIPTION LOGGED BY: GL SAMPLED BY: GL
1	Alluvium					SM	**SILTY SAND:** Light brown, fine to medium grained, slightly moist, loose
2							
3							
4							
5							
6		X	3/4/5	-	-		Loose
7							
8							
9							
10							
11		X	5/5/5	-	-		Medium dense
12							
13							
14							
15							
16		X	5/8/11	-	-	ML	**SANDY SILT:** Light brown, slightly moist, stiff
17							
18							
19							
20	Bedrock	X	27/33/39	-	-	SM	**SILTY SAND:** Light brown, fine to coarse grained, very dense
21							TOTAL DEPTH = 20 FEET NO GROUNDWATER NO CAVING BORING BACKFILLED
22							
23							
24							
25							

APPENDIX B

TENTATIVE PRELIMINARY FOUNDATION DESIGN RECOMMENDATIONS AND SEISMIC PARAMETERS

Tentative Preliminary Foundation Design Recommendations

Foundation System

Based on the expectation that very low expansion potential soils will be present at finish pads grades following site grading, a conventional slab-on-ground foundation is recommended for the proposed residual buildings. This should be confirmed by additional testing at the completion of site grading.

Allowable Soil Bearing Capacities

Pad Footings

An allowable soil bearing capacity of 1,500 pounds per square foot may be utilized for design of isolated 24-inch-square footings founded at a minimum depth of 12 inches below the lowest adjacent final grade for pad footings that are not a part of the slab system and are used for support of such features as roof overhang, second-story decks, patio covers, etc. This value may be increased by 20 percent for each additional foot of depth and by 10 percent for each additional foot of width, to a maximum value of 2,500 pounds per square foot. The recommended allowable bearing value includes both dead and live loads, and may be increased by one-third for short duration wind and seismic forces.

Continuous Footings

An allowable soil bearing capacity of 1,500 pounds per square foot may be utilized for design of continuous footings founded at a minimum depth of 12 inches below the lowest adjacent final grade. This value may be increased by 20 percent for each additional foot of depth and by 10 percent for each additional foot of width, to a maximum value of 2,500 pounds per square foot. The recommended allowable bearing value includes both dead and live loads and may be increased by one-third for short duration wind and seismic forces.

For foundations to be located adjacent to property lines where complete removal and re-compaction of unsuitable surficial soil materials below the proposed foundations can be performed but the *horizontal* limits of remedial grading are restricted due to perimeter constraints, a maximum allowable bearing value of 1,200 pounds per square foot should be used. These conditions may affect foundations for retaining and landscape walls to be located along the tract boundaries if remedial grading cannot encroach into the adjacent properties. The need for special foundation design for these structures should be evaluated during grading based on the actual limits of remedial removals achieved by the grading contractor.

Estimated Footing Settlement

Based on the allowable bearing values provided above, total static settlement of the footings under the anticipated loads is expected to be less than ¾ inch. Differential settlement is expected to be less than ½ inch over a horizontal span of 30 feet. The majority of settlement is likely to take place as footing loads are applied or shortly thereafter.

Lateral Resistance

A passive earth pressure increasing at a rate of 250 pounds per square foot per foot of depth, to a maximum value of 2,500 pounds per square foot, may be used to determine lateral bearing resistance for footings. In addition, a coefficient of friction of 0.40 times the dead load forces may be used between concrete and the supporting soils to determine lateral sliding resistance.

Lateral bearing and lateral sliding resistance may be combined without reduction. In addition, an increase of one-third of the above values may be used when designing for short duration wind and seismic forces.

The above values are based on footings placed directly against compacted fill. In the case where footing sides are formed, all backfill placed against the footings should be compacted to at least 90 percent of maximum dry density.

For foundations to be located adjacent to tract boundaries where complete removal and recompaction of unsuitable surficial soil materials *below* the proposed foundations can be performed but the *horizontal* limits of remedial grading are restricted due to perimeter constraints, a passive pressure of 150 pounds per square foot, per foot of depth, to a maximum value of 1,500 pounds per square foot, should be used to determine the lateral bearing.

Guidelines for Footings and Slabs on-Grade Design and Construction

Soils within the site are anticipated to exhibit expansion potential that is within the Very Low range (Expansion Index from 0 to 20). As indicated in Section 1803.5.3 of 2022 California Building Code (2022 CBC), these soils are considered non-expansive and, as such, the design of slabs on-grade is considered to be exempt from the procedures outlined in Sections 1808.6.2 of the 2022 CBC and may be performed using any method deemed rational and appropriate by the project structural engineer. However, the following minimum recommendations are presented herein for conditions where the project design team may require geotechnical engineering guidelines for design and construction of footings and slabs on-grade the project site.

The design and construction guidelines that follow are based on the above soil conditions and may be considered for reducing the effects of variability in fabric, composition and, therefore, the detrimental behavior of the site soils such as excessive short- and long-term total and differential settlements. These guidelines have been developed on the basis of the previous experience of this firm on projects with similar soil conditions. Although construction performed in accordance with these guidelines has been found to reduce post-construction movement and/or distress, they generally do not positively eliminate all potential effects of variability in soils characteristics and future settlement.

It should also be noted that the suggestions for dimension and reinforcement provided herein are performance-based and intended only as preliminary guidelines to achieve adequate performance under the anticipated soil conditions. However, they should not be construed as replacement for structural engineering analyses, experience and judgment. The project structural engineer, architect and/or civil engineer should make appropriate adjustments to slab and footing dimensions, and reinforcement type, size and spacing to account for internal concrete forces (e.g., thermal, shrinkage and expansion), as well as external forces (e.g., applied loads) as deemed necessary. Consideration should also be given to minimum design criteria as dictated by local building code requirements.

Conventional Slabs on-Grade System

Given the very low expansion potential by onsite soils expected to be present at finish pad grades, we recommend that footings and floor slabs be designed and constructed in accordance with the following minimum criteria.

Footings

1. Exterior continuous footings supporting one- and two-story structures should be founded at a minimum depth of 12 inches below the lowest adjacent final grade, respectively. Interior continuous footings may be founded at a minimum depth of 10 inches below the top of the adjacent finish floor slabs.

2. In accordance with Table 1809.7 of 2022 CBC for light-frame construction, all continuous footings should have minimum widths of 12 inches for one- and two-story construction. We recommend all continuous footings should be reinforced with a minimum of two No. 4 bars, one top and one bottom.

3. A minimum 12-inch-wide grade beam founded at the same depth as adjacent footings should be provided across garage entrances or similar openings (such as large doors or bay windows). The grade beam should be reinforced with a similar manner as provided above.

4. Interior isolated pad footings, if required, should be a minimum of 24 inches square and founded at a minimum depth of 12 inches below the bottoms of the adjacent floor slabs. Pad footings should be reinforced with No. 4 bars spaced a maximum of 18 inches on centers, both ways, placed near the bottoms of the footings.

5. Exterior isolated pad footings intended for support of roof overhangs such as second-story decks, patio covers, and similar construction should be a minimum of 24 inches square and founded at a minimum depth of 18 inches below the lowest adjacent final grade. The pad footings should be reinforced with No. 4 bars spaced a maximum of 18 inches on centers, both ways, placed near the bottoms of the footings. Exterior isolated pad footings may need to be connected to adjacent pad and/or continuous footings via tie beams at the discretion of the project structural engineer.

6. The minimum footing dimensions and reinforcement recommended herein may be modified (increased or decreased subject to the constraints of Chapter 18 of the 2022 CBC) by the structural engineer responsible for foundation design based on his/her calculations, engineering experience and judgment.

Building Floor Slabs

1. Concrete floor slabs should be a minimum 4 inches thick and reinforced with No. 3 bars spaced a maximum of 24 inches on centers, both ways. Alternatively, the structural engineer may recommend the use of prefabricated welded wire mesh for slab reinforcement. For this condition, the welded wire mesh should be of sheet type (not rolled) and should consist of 6x6/W2.9xW2.9 (per the Wire Reinforcement Institute, WRI, designation) or stronger. All slab reinforcement should be supported on concrete chairs or brick to ensure the desired placement near mid-depth. Care should be exercised to prevent warping of the welded wire mesh between the chairs in order to ensure its placement at the desired mid-slab position.

2. Living area concrete floor slabs and areas to receive moisture sensitive floor covering should be underlain with a moisture vapor retarder consisting of a minimum 10-mil-thick polyethylene or polyolefin membrane that meets the minimum requirements of ASTM E96 and ASTM E1745 for vapor retarders (such as Husky Yellow Guard®, Stego® Wrap, or equivalent). All laps within the membrane should be sealed, and at least 2 inches of clean sand should be placed over the membrane to promote uniform curing of the concrete. To reduce the potential for punctures, the membrane should be placed on a pad surface that has been graded smooth without any sharp protrusions. If a smooth surface cannot be achieved by grading, consideration should be given to lowering the pad finished grade an additional inch and then placing a 1-inch-thick leveling course of sand across the pad surface prior to the placement of the membrane.

   At the present time, some slab designers, geotechnical professionals and concrete experts view the sand layer below the slab (blotting sand) as a place for entrapment of excess moisture that could adversely impact moisture-sensitive floor coverings. As a preventive measure, the potential for moisture intrusion into the concrete slab could be reduced if the concrete is placed directly on the vapor retarder. However, if this sand layer is omitted, appropriate curing methods must be implemented to ensure that the concrete slab cures uniformly. A qualified materials engineer with experience in slab design and construction should provide recommendations for alternative methods of curing and supervise the construction process to ensure uniform slab curing. Additional steps would also need to be taken to prevent puncturing of the vapor retarder during concrete placement.

3. Garage floor slabs should be a minimum 4 inches thick and reinforced in a similar manner as living area floor slabs. Garage slabs should also be poured separately from adjacent wall footings with a

positive separation maintained using ¾-inch-minimum felt expansion joint material. To control the propagation of shrinkage cracks, garage floor slabs should be quartered with weakened plane joints. Consideration should be given to placement of a moisture vapor retarder below the garage slab, similar to that provided in Item 2 above, should the garage slab be overlain with moisture sensitive floor covering.

4. Presaturation of the subgrade below floor slabs will not be required; however, prior to placing concrete, the subgrade below all dwelling and garage floor slab areas should be thoroughly moistened to achieve a moisture content that is at least equal to or slightly greater than optimum moisture content. This moisture content should penetrate to a minimum depth of 12 inches below the bottoms of the slabs.

5. The minimum dimensions and reinforcement recommended herein for building floor slabs may be modified (increased or decreased subject to the constraints of Chapter 18 of the 2022 CBC) by the structural engineer responsible for foundation design based on his/her calculations, engineering experience and judgment.

SOIL
EXPLORATION
COMPANY, INC.

Soil Engineering, Environmental Engineering, Materials Testing, Geology

January 24, 2014

Project No. 13167-01

TO: Adkan Engineers
6879 Airport Dr.
Riverside, CA 92504

ATTENTION: Charissa Leach, P.E.

SUBJECT: Preliminary Geotechnical Investigation/Liquefaction Evaluation/Infiltration Tests Report, Proposed 8.8± Acre, 14 Lot Residential Subdivision, SEC of Victoria Avenue and La Sierra Avenue (APN 136-220-016), City of Riverside, California

Introduction

In accordance with your authorization, Soil Exploration Co., Inc. has conducted a preliminary soil investigation and liquefaction analysis for the subject site (see Figure 1, Site Location Map). The accompanying report presents a summary of our findings, conclusions, recommendations and limitations of our work for the site development.

Scope of Work

- Review soils, geologic, seismic, groundwater data, maps and nearby site reports in our files.
- Perform exploration of the site by means of three or four borings varying in depth from 15 to 25 feet below existing ground surface at readily accessible locations.
- Field engineer for logging, sampling of select soils, observation of excavation resistance, record SPT blow counts, and water seepage (if any).
- Perform basic laboratory testing of select soil samples, including moisture, density, sieve analysis and expansion index.
- Perform three shallow infiltration tests at readily accessible locations.
- Perform digitized search of known faults within a 50-mile radius of the site.
- Determine CBC (2010) seismic parameters.
- Consult with project design engineer.
- Prepare a report of our findings, conclusions and recommendations for site preparation, including overexcavation/removal depth, liquefaction evaluation, allowable bearing value, foundation recommendations, footings/slab-on-grade depth/thickness, excavation characteristics, lateral earth pressures for retaining walls design, general earthwork and grading specifications, Cal/OSHA classification of soils, California Building Code (2010) seismic design coefficients and infiltration rate in inches/hour.

Site Conditions

The square shaped, 8.8± acre, flat site is located on the southeast corner of Victoria Avenue and La Sierra Avenue in the City of Riverside, California. Victoria Avenue is a paved road with AC curbs and La Sierra Avenue is a paved road with curbs, gutters and sidewalks. The site is bordered by a wire fence. Access to the site is from southeast corner via a driveway leading from cleared area on Millsweet Place. Vegetation throughout the site consists of small to medium size orange trees.

The approximate locations of some of the above features are shown on the Exploratory Boring and Infiltration Test Location Map (Plate 1).

Proposed Development

We understand that the 8.8± acre site is proposed for a 14 lot, single family residential development. The structures will be of wood frame construction with concrete floor slabs supported on prepared subgrade. Based on the flat topography of the site, modest cut and fill grading and no significant cut or fill slopes are proposed.

Field Work

Four exploratory borings were drilled at the site on January 17, 2014, to a maximum depth of 25 feet below existing ground surface utilizing a B-61 mobile drill rig equipped with 8-inch diameter hollow stem auger. Standard Penetration Test (SPT) blow counts were recorded at regular intervals and utilized in determining the compactness/consistency of the earth materials.

In general, these borings revealed that the site is underlain by alluvial soils consisting of silty sand, sandy silt and silty clay (USCS "SM", "ML" and "CL-ML"). The soils are loose near the surface and become dense to very dense and stiff below. Bedrock was encountered at depths of 15 to 20 feet in Borings B-1, B-3 and B-4. Based on USGS Geologic Map, the site is underlain with alluvial fan deposits (see Figure 2). Envicom Plate VA shows the site is underlain with thin Pleistocene alluvium (10 feet to 200 feet thick).

Laboratory Testing

Basic laboratory tests were performed for select soil samples. The tests consisted primarily of natural moisture contents, dry densities and sieve analysis. Laboratory test results are presented in Appendix C and with Geotechnical Boring Logs (Appendix B).

Groundwater/Liquefaction

No groundwater was encountered in our exploratory borings at the time this work was performed. Based on referenced Carson & Matti map, the minimum historic groundwater is indicated to be at a depth of 10± feet. Well No. 679 in the vicinity of the site indicates the minimum depth to groundwater in 1974 was 4.7 feet.

Liquefaction occurs when loose, poorly graded, cohesionless soils are subject to ground shaking during an earthquake of large magnitude. The liquefaction potential is relatively higher when groundwater depths are less than 30 feet below ground surface. Based on referenced Envicom Map (Plate VA) and TLMA 1600-scale map dated September 26, 1997, the site is in an area of potential liquefaction.

Considering the depth to bedrock at 15 to 20 feet, the potential for liquefaction at the site is low.

Seismicity/Faulting

A computer search of all known Quarternary major faults within 50 miles of the site is presented in Appendix D. The computer search was performed by EQFAULT (Version 3.00) software. Please note that it is probable that not all-active or potentially active faults in the region have been identified. Furthermore, seismic potential of the smaller and less notable faults is not sufficiently developed for assignment of maximum magnitudes and associated levels of ground shaking that might occur at the site due to these faults.

Conclusions

- Vegetable matter, trees, roots, existing structures, old foundations, underground structures, old fills, buried utilities/irrigation lines, etc. and deleterious materials would require removal from the proposed improvement areas.

- Overexcavation and recompaction of surficial soils in building areas should be anticipated to provide adequate and uniform support for the proposed structures.

- The earth materials encountered during our exploration can be excavated with normal grading equipment in good working condition.

- The onsite soils, exclusive of deleterious material, debris, roots, etc., may be used as compacted fill materials.

- Based on observation and soil classification, the expansion potential of the near-surface soils at the site is expected to be very low (EI<20).

- The use of shallow foundations is feasible for the proposed light weight, residential construction.

- Site is located approximately 8.5 and 8.6 miles from the Chino-Central Ave. (Elsinore) and Elsinore-Glen Ivy faults, respectively. The site is located in a region of generally high seismicity, as is all of Southern California. During its design life, the site is expected to experience moderate to strong ground motions from earthquakes on regional and/or nearby causative faults.

- There is a 10 percent probability in 50 years that ground acceleration at the site will exceed 0.425g (see Appendix D).

- Based on referenced Envicom Map (Plate VA) and County of Riverside TLMA Geotechnical/Liquefaction Map, dated September 26, 1997, the site is in an area of potential liquefaction. Based on the bedrock at shallow depth and dense to very dense earth materials, the liquefaction potential at the site is low.

- The potential for seismically induced dynamic settlement of the near surface sandy soils during earthquake would be mitigated by overexcavation and recompaction as recommended below in the report.

- Based on Envicom Safety Element Map (Plate VB), the site is not in 100-year flood plain. However flood potential should be evaluated and considered in planning and design by civil engineering consultant.

- Groundwater was not encountered during subsurface investigation. However our experience indicates that surface or near-surface groundwater conditions can develop in areas where groundwater conditions did not exist prior to site development, especially in areas where a substantial increase in surface water infiltration results from landscape irrigation. We therefore recommend that local landscape irrigation and landscape irrigation from surrounding areas be kept to the minimum necessary to maintain plant vigor and that any leaking pipes/sprinklers, etc. should be promptly repaired. We have no way of predicting depth to the groundwater or perched water, which may fluctuate with seasonal changes and from one year to the next.

Recommendations

Site Preparation/Overexcavation

All grading and backfills should be performed in accordance with the attached General Earthwork and Grading Specifications (Appendix E) except as modified in the text of this report.

The building/grading areas should be cleared of all vegetation, irrigation lines, roots, debris and deleterious materials which should be hauled offsite. Subsequent to site clearance and debris removal, the building area, extending at least 5 feet beyond building lines in plan (including any canopies/exterior footings), should be overexcavated to a depth of at least 4 feet below existing ground or proposed grade (whichever is deeper) to remove loose soils and roots and expose underlying firm soils. Locally deeper overexcavations should not be precluded specially to remove roots and expose competent soils. Vegetation roots should be traced and completely removed if encountered in bottom of the overexcavated areas. Root pickers may be required for this purpose. After any overexcavation, the exposed surfaces should be further scarified to a depth of at least 12-inches, watered and recompacted to at least 90 percent of the maximum dry density, as determined by ASTM D1557-09 Test Method, prior to placement of fill. All fills should be compacted to at least 90 percent of the maximum dry density.

Foundation Design

Following site preparation, the use of shallow spread footings supported on compacted fill is feasible for proposed structures. A net allowable bearing value of 1500 psf is recommended for foundations extending at least 12 inches into the compacted fill. This bearing value may be increased by one third for temporary (wind or seismic) loads. Reinforcement and other recommendations for residential structures are presented on Plate 2 and may be designed for very low expansion category. All foundations should be designed by a qualified structural engineer in accordance with the latest applicable building codes and structural considerations may govern. All foundations should be provided with at least 3 feet of compacted fill mat below bottom of footings. Please note foundation design is under the purview of structural engineer and structural engineer may have more stringent requirements.

Residential slabs-on-grade should be at least 4 inches thick, and should be reinforced with at least No. 3 bars at 18-inches on-center both ways, properly centered in mid-thickness of slabs. Slabs-on-grade should be underlain by a 10-mil Visqueen moisture barrier placed over two inches of clean rolled sand and overlain by two-inch layer of clean rolled sand to aid in concrete curing. Other additional recommendations for residential structures are presented on Plate 2.

Special Considerations

Slab-on-grade thickness and reinforcement should be evaluated by the structural engineer and designed in compliance with applicable codes. Excess soils generated from foundation excavations should not be placed on building pads and driveway without proper moisture and compaction. All slab subgrades should be verified to contain 1.2 times the soil optimum moisture content to a depth of 6 inches prior to placement of slab building materials. Moisture content should be tested in the field by the soil engineer. Slabs subgrade should be kept moist and the surface should not be allowed to desiccate.

The addition of fiber mesh in the concrete and careful control of water/cement ratios may lessen the potential for slab cracking. In hot or windy weather, the contractor must take appropriate curing precautions after the placement of concrete. The use of mechanically compacted/dense low slump concrete (not exceeding 4 inches at the time of placement) is recommended. We recommend that a slipsheet (or equivalent) be utilized if grouted tiles or other crack sensitive flooring (such as marble tiles) is planned directly on concrete slabs.

Retaining Walls/Lateral Earth Pressures

The following lateral earth pressures and soil parameters, in conjunction with the above-recommended bearing value of 1500 psf, may be used for design of retaining walls with free draining compacted backfills. If passive earth pressure and friction are combined to provide required resistance to lateral forces, the value of the passive pressure should be reduced to two-thirds the following recommendations.

Active Earth Pressure with level backfill (P_a)	35 psf (EFP), drained, yielding
At Rest Pressure (P_0)	50 psf (EFP), drained, non-yielding (part of building wall)
Passive Earth Pressure (P_p)	300 psf (EFP), drained, maximum of 3000 psf
Horizontal Coefficient of Friction (μ)	0.30
Unit Soil Weight (γ_t)	120 pcf

We recommend drainage for retaining walls to be provided in accordance with Plate 3 of this report. Maximum precautions should be taken when placing drainage materials and during backfilling. All wall backfills should be properly compacted to at least 90 percent relative compaction. Any waterproofing of the walls must be evaluated by the project architect and considered during planning and construction.

Expansion Index/Soluble Sulfates

Based on observation and soil classification, the expansion potential of the onsite sandy soils is anticipated to be very low (EI<20). However, we recommend that expansion potential of the soils should be verified subsequent to completion of site preparation. Soluble sulfate content of the foundation soils should also be determined subsequent to completion of grading/prior to start of construction. Tentatively we recommend Type II cement and concrete slump not exceeding 4 inches at the time of placement. If critical, these should be further verified by your structural and/or a corrosion engineer.

Seismic Design

The site is approximately 8.5 and 8.6 miles from the Chino-Central Ave. (Elsinore) and Elsinore-Glen Ivy faults, respectively. Moderate to strong ground shaking can be expected and there is a 10 percent probability in 50 years that ground acceleration will exceed 0.425g at the site. A soil profile, site class D (stiff soil), has been considered for the site. The structural engineer should consider City/County local codes, California Building Code (CBC) 2010, seismic data presented in this report (Appendix D), the latest requirements of the Structural Engineers Association, and any other pertinent data in selecting design parameters.

Drainage

Positive drainage must be provided and maintained for the life of the project around the perimeter of the structure and all foundations toward streets or approved drainage devices to minimize water infiltrating into the underlying natural and engineered fill soils. In addition, finish subgrade adjacent to exterior footings should be sloped down and away to facilitate surface drainage. Roof drainage should be collected and directed away from foundations via nonerosive devices. Water, either natural or by irrigation, should not be permitted to pond or saturate the foundation soils.

Infiltration Test Procedure

Three 8-inch diameter, two-feet deep test holes (I-1, I-2 and I-3) were excavated at the randomly selected locations. The soil at the test locations was visually classified as silty sand (USCS "SM"). To mitigate any possible caving or sloughing of the test hole, an 8-inch diameter perforated canister was placed in the hole.

The testing was conducted after presoaking. Water level was adjusted to 6 inches above the bottom of the test hole. Consecutive measurements were taken at 30 minute intervals on test holes I-1 and I-2 and 10 minute intervals on test hole I-3, until a stabilized rate of drop was obtained. The drop that occurred during the final reading was used for design purposes.

Infiltration Tests/Tabulated Results

Test No.	Depth of Test (feet)	Earth Material	Infiltration Rate (in/hr)
I-1	2	Silty Sand ("SM")	2.82
I-2	2	Silty Sand ("SM")	4.56
I-3	2	Silty Sand ("SM")	17.9

We recommend that a suitable factor of safety should be applied to the rate in design of the system.

Cal/OSHA Classification/Trench Excavations/Backfills

In general Cal/OSHA classification of onsite soils appears to be Type B.

Temporary trench excavations deeper than 5 feet should be shored or sloped at 1:1 or flatter in compliance with Cal/OSHA requirements. All utility trenches and wall backfills should be mechanically compacted to the minimum requirements of at least 90 percent relative compaction. No jetting, ponding, or flooding should be permitted within the building area or where trenches are in zone of influence of footing loads. Excavated material from footing trenches should not be placed in slab-on-grade and driveways areas unless properly compacted and tested.

Foundation Plan Review/Observations and Testing

The recommendations provided in this report are based on preliminary design information and subsurface conditions as interpreted from limited exploratory work. Our conclusions and recommendations should also be reviewed, verified during grading and construction, and revised as necessary. Soil Exploration Co., Inc. should review the foundation plan and observe and/or test at the following stages of construction:

- During all overexcavations, site preparation and grading.
- Following footing excavations and prior to placement of footing materials.
- During wetting of slab subgrade (1.2 optimum moisture to a depth of 6 inches) and prior to placement of slab materials.
- During all trench backfills and pavements subgrade/base compaction.
- When any unusual conditions are encountered.

Final Compaction Report

A final report of compaction control should be prepared subsequent to the completion of site preparation. The report should include a summary of work performed, laboratory test results, and the results, locations and elevations of field density tests performed during rough grading.

Limitation of Investigation

Our investigation was performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable Geotechnical Engineers practicing in this or similar locations. No other warranty, expressed or implied, is made as to the conclusions and professional advice included in this report. The field and laboratory test data are believed representative of the project site; however, soil conditions can vary significantly. As in most projects, conditions revealed during grading may be at variance with preliminary findings. If this condition occurs, the possible variations must be evaluated by the Project Geotechnical Engineer and adjusted as required or alternate design recommended. This report is issued with the understanding that it is the responsibility of the owner, or his representative, to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project and incorporated into the plans, and the necessary steps are taken to see that the

contractor and subcontractor carry out such recommendations in the field. This firm does not practice or consult in the field of safety engineering. We do not direct the contractor's operations, and we cannot be responsible for other than our own personnel on the site; therefore, the safety of others is the responsibility of the contractor. The contractor should notify the owner if he considers any of the recommended actions presented herein to be unsafe. The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether they be due to natural processes or the works of man on this or adjacent properties. In additions, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge.

This report was prepared for the client based on client's needs, directions and requirements at the time. This report is not authorized for use by and is not to be relied upon by any party except the client with whom Soil Exploration Co., Inc. contracted for the work. Use of, or reliance on, this report by any other party is at that party's risk. Unauthorized use of or reliance on this report constitutes an agreement to defend and indemnify Soil Exploration Co., Inc. from and against any liability which may arise as a result of such use or reliance, regardless of any fault, negligence, or strict liability of Soil Exploration Co., Inc.

Closure

If you should have any questions regarding this report, please do not hesitate to call our office. We appreciate this opportunity to be of service.

Very truly yours,
Soil Exploration Co., Inc.

REGISTERED PROFESSIONAL ENGINEER
GENE KINH-TOAN LUU
C 053417
EXP. 6/30/15
CIVIL
STATE OF CALIFORNIA

Gene K. Luu, PE 53417
Project Engineer

Distribution: [3] Addressee

Attachments:

Figure 1	Site Location Map
Figure 2	USGS Geologic Map
Plate 1	Exploratory Boring & Infiltration Test Location Map
Plate 2	Minimum Foundation and Slab Recommendations for Expansive Soils
Plate 3	Retaining Wall Backfill and Subdrain Detail
Appendix A	References
Appendix B	Exploratory Boring Logs
Appendix C	Laboratory Test Results
Appendix D	Deterministic and CBC (2010) Seismic Parameters
Appendix E	General Earthwork and Grading Specifications

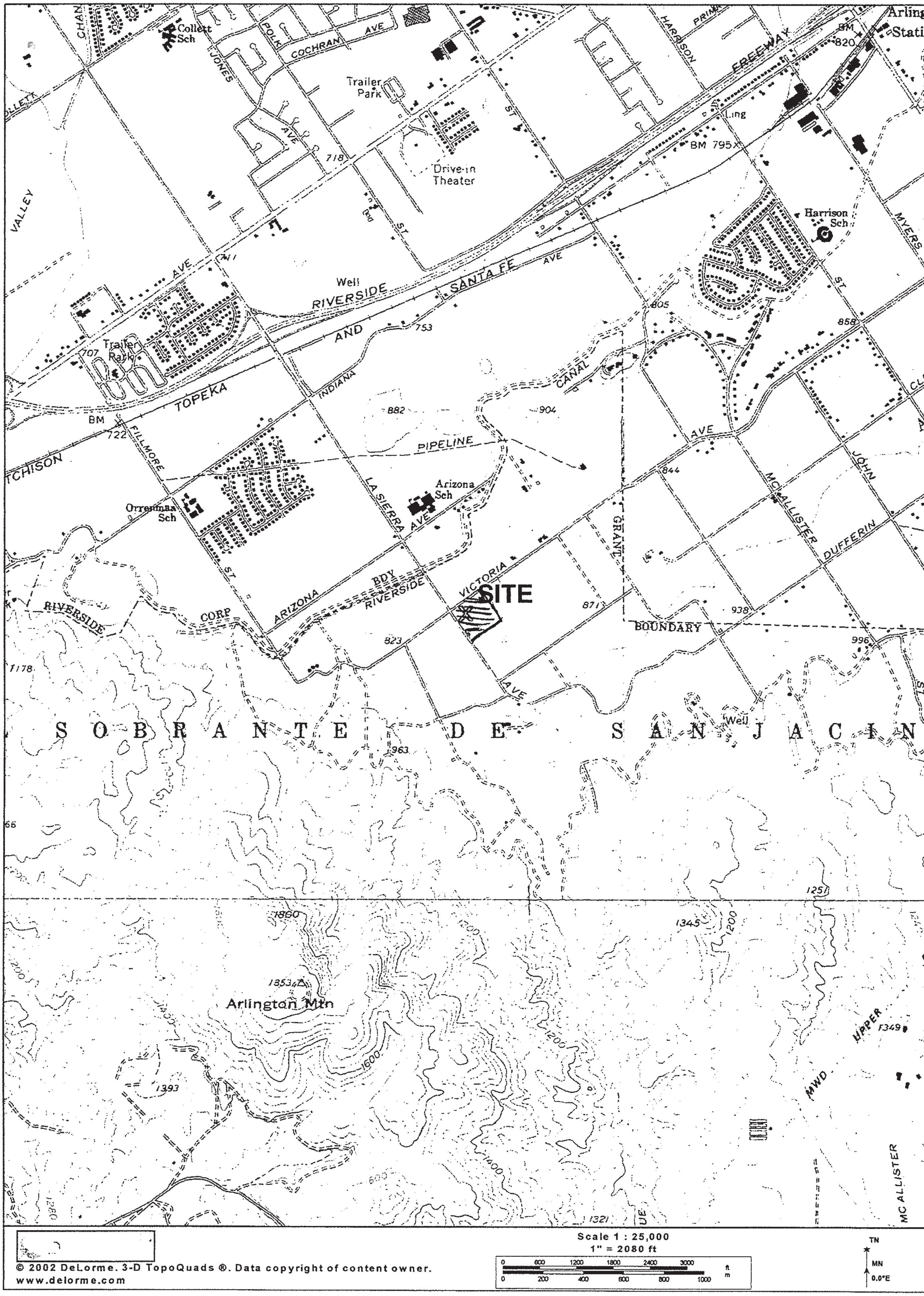
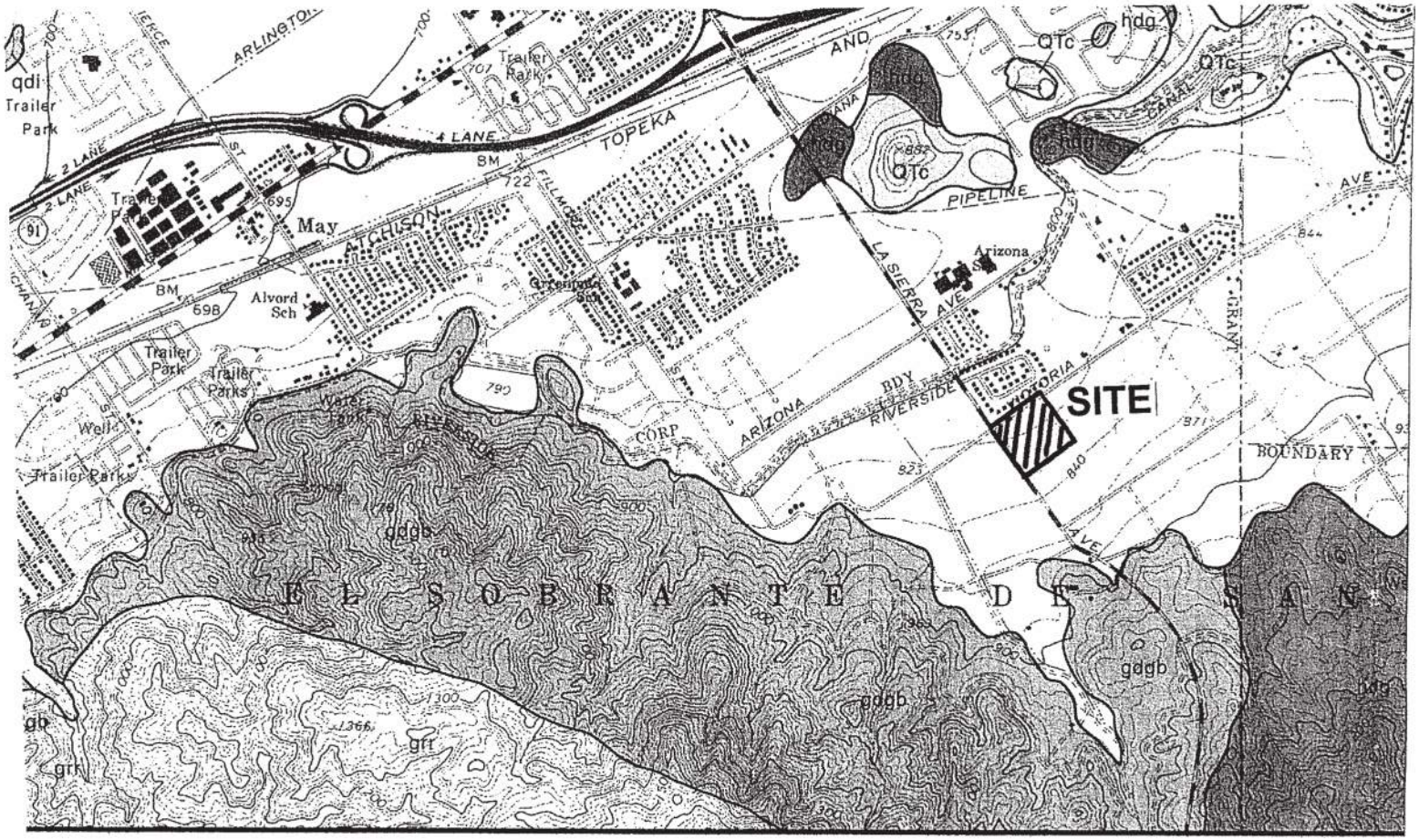

SITE
RIVERSIDE AVE
SANTA FE
TOPEKA
AND
FREEWAY
LA SIERRA AVE
ARIZONA AVE
VICTORIA AVE
INDIANA
FILLMORE ST
MC ALLISTER
DUFFERIN
JOHN
GRANT
BOUNDARY
RIVERSIDE CORP BDY
CANAL
PIPELINE
Arizona Sch
Harrison Sch
Collett Sch
Trailer Park
Drive-in Theater
Well
S O B R A N T E D E S A N J A C I N
Arlington Mtn
COCHRAN AVE
POLK
JONES
HARRISON
MYERS
VALLEY
Scale 1 : 25,000
1" = 2080 ft
© 2002 DeLorme. 3-D TopoQuads ®. Data copyright of content owner.
www.delorme.com

Figure 1



Base Map: Geologic Map of the Riverside West/South ½ of Fontana Quadrangles, San Bernardino and Riverside County, California, By Thomas W. Dibblee, Jr., 2004.

LEGEND:

Qoa: Alluvial fan deposits of sand, minor gravel, tan to light reddish brown.

SEC of Victoria Avenue and La Sierra Avenue **(APN 136-220-016)** **City of Riverside, California**	**Soil Exploration Co., Inc.** **Project No.:** 13167-01 **Date:** January 24, 2014 **Figure:** 2


VICTORIA AVENUE
WIRE FENCE
B-1
I-1
WIRE FENCE
I-2
B-2
MILLSPORT PLACE
WIRE FENCE
B-3
B-4
I-3
N
LA SIERRA AVENUE
WIRE FENCE
EXPLORATORY BORING &
INFILTRATION TEST LOCATION MAP
PLATE 1
LEGEND
B-4 ● Approximate Location of Boring
I-3 ▲ Approximate Location of Infiltration Test
Soil Exploration Co., Inc.
Project No. 13167-01
January 24, 2014
Base Map: Provided by Client

	EXPANSION INDEX (ASTM D 4829) 0-20 VERY LOW EXPANSION
1-Story Footings (See Note 1)	All footings 12" deep. Reinforcement for continuous footings: two No. 4 bars top and two No. 4 bars at bottom
2-Story Footings (See Note 1)	All footings at least 18" deep. Reinforcement for continuous footings: Two No. 4 bars top and two No. 4 bars at bottom
Minimum Footing Width	Continuous: 12" for 1-story Continuous: 15" for 2-story
Pad Footings	Isolated column: 24" wide and 24" deep, tied to continuous footings in two directions
Garage Door Grade Beam (See Note 2)	A grade beam 12" deep for 1-story and 18" deep for 2-story by 12" wide for 1-story and 15" wide for 2-story should be provided across the garage entrance and other openings.
Living Area Floor Slabs (See Notes 3, 4 and 5)	4" thick slab. No. 3 rebar at 18 inches on-center reinforcement at mid-height, 10-mil Visqueen moisture barrier above 2" sand base with 2" sand above Visqueen
Garage Floor Slabs (See Notes 4 and 6)	4" thick slab. No. 3 rebar at 18 inches on-center with 2" sand base above and below a 10-mil Visqueen moisture barrier. Garage slabs should be quarter-sawn
Presoaking of Living Areas & Garage Slabs Subgrade*	(1.2) times optimum moisture to a depth of at least 6"

The Above Are Minimum Recommendations.
All Work Should Comply with Applicable/Governing Agency Codes and Requirements

*Presoaking of living areas and garage slabs should be observed and tested by the project geotechnical engineer.

NOTES:
1. Depth of interior or exterior footings to be measured from lowest adjacent finish grade.
2. The base of the grade beam should be at the same elevation as that of the adjoining footings.
3. Living areas slabs may be tied to the footings as directed by the structural engineer.
4. We recommend the use of at least No. 3 bars at 18 inches on-center, each way, for all slabs.
5. 10-mil Visqueen sheeting welded at laps has proved successful. Equivalents are acceptable.
6. Garage slabs should be isolated from stem wall footings with a minimum 3/8" felt expansion joint.
7. Sand base should have a Sand Equivalent (SE) of 30 or greater (e.g., washed concrete sand).

Post-Tensioned Slabs

As an alternative to conventional foundations, building may be supported on post-tensioned slabs, to be designed by a structural engineer in consultation with the geotechnical consultant. In addition, a post-tensioned slab is also recommended for VERY HIGH expansion potential (Expansion Index greater than 130), if encountered. Post-tensioned slabs should have perimeter footings embedded a minimum of 12 inches below the adjacent grade. The slabs should be designed such that they can be deformed approximately 1-inch vertically over a width of 30 feet without distress in the event of shrinkage or swelling of the supporting soils. Living area slabs should be underlain by a 10-mil Visqueen moisture barrier covered by a 2-inch layer of sand. Presoaking is recommended for post tensioned slabs: (1.2) x optimum to a depth of 12 inches, (1.3) x optimum to a depth of 18 inches, and (1.4) x optimum to a depth of 24 inches for LOW, MEDIUM, and HIGH expansion potential soils, respectively. LOW and MEDIUM expansive soil lots using conventional foundation should comply with 2010 CBC. For very high expansion potential (Expansion Index greater than 130), specific recommendations by the geotechnical consultant will be required. Placement of 4 inches of sand base is also suggested for post-tensioned slab systems. Unless stated in the attached report, for EI=21-50 use PI-25, and EI=51-90 use PI=35.

Minimum Foundation and Slab Recommendations For Expansive Soils

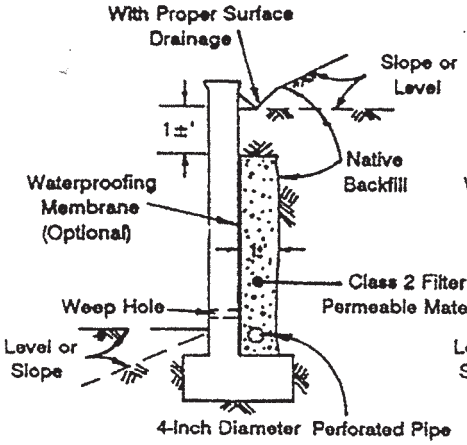
ONE- AND TWO-STORY RESIDENTIAL BUILDINGS

Soil Exploration Co. Inc.

Plate: 2

SUBDRAIN OPTIONS FOR NATIVE MATERIAL BACKFILL

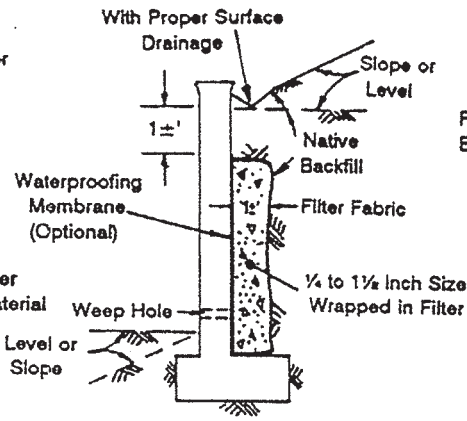
OPTION N2: Pipe Surrounded with Class 2 Material



Class 2 Filter Permeable Material Grading Per Caltrans Specifications

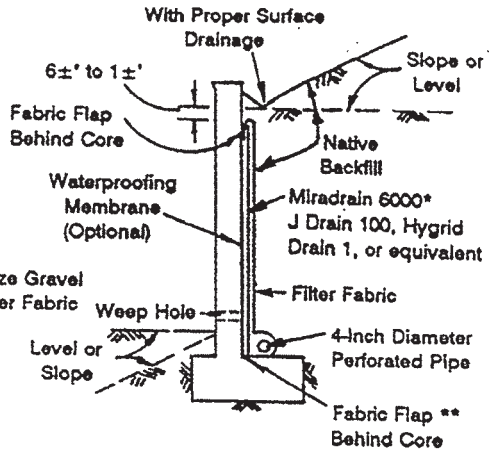
Sieve Size	Percent Passing
1"	100
3/4"	90-100
3/8"	40-100
No. 4	25-40
No. 8	18-33
No. 30	5-15
No. 50	0-7
No. 200	0-3

OPTION N1: Gravel Wrapped in Filter Fabric



Proper Outlet Should be Provided for Gravel Subdrain (See Notes)

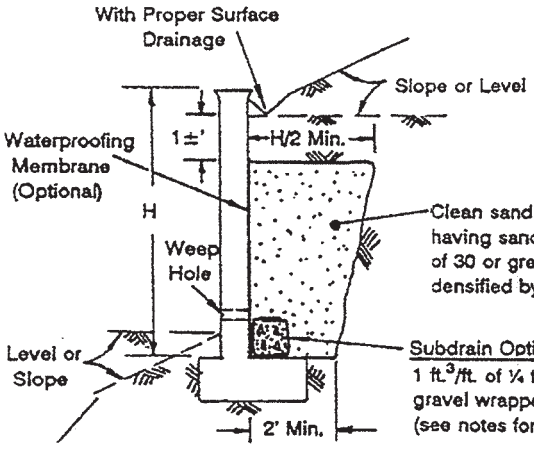
OPTION N3: Geotextile Drain

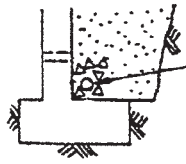


*Miradrain 6000 or J Drain 100 for non-waterproofed walls; Miradrain 6200 or J Drain 200 for completed waterproofed walls

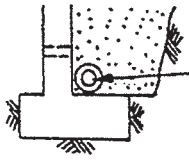
**Peel back the bottom fabric flap, place pipe next to core, wrap fabric around pipe and tuck behind core.

SUBDRAIN OPTIONS FOR CLEAN SAND BACKFILL





Subdrain Option S2:
4" diameter perforated pipe surrounded with 1 ft.³/ft. of Class 2 filter material per Caltrans specifications as above



Subdrain Option S3:
4" diameter perforated pipe wrapped in filter fabric

Notes:

- Pipe type should be ASTM D1527 Acrylonitrile Butediene Styrene (ABS) SDR35 or ASTM D1785 Polyvinyl Chloride plastic (PVC), Schedule 40, Armco A2000 PVC, or approved equivalent. Pipe should be installed with perforations down.
- Filter fabric should be Mirafi 140N, 140NS, Supac 4NP, Amoco 4545, Trevira 1114, or approved equivalent.
- All drains should have a gradient of 1 percent minimum.
- Outlet portion for gravel subdrain should have a 4"-diameter pipe with the perforated portion inserted into the gravel approximately 2' minimum and the nonperforated portion extending approximately 1' outside the gravel. Proper sealing should be provided at the pipe insertion enabling water to run from the gravel portion into rather than outside the pipe.
- Waterproofing membrane may be required for a specific retaining wall such as a stucco or basement wall.
- Weephole should be 2" minimum diameter and provided at 25' minimum in length of wall. If exposure is permitted, weephole should be located at 3±" above finished grade. If exposure is not permitted such as for a wall adjacent to a sidewalk/curb, a pipe under the sidewalk to discharge through the curb face or equivalent should be provided, or for a basement-type wall, a proper subdrain outlet system should be provided. Open vertical masonry joints (i.e., omit mortar from joints of first course above finished grade) at 32" maximum intervals may be substituted for weepholes. Screening such as with a filter fabric should be provided for weepholes/open joints to prevent earth materials from entering the holes/joints.

RETAINING WALL BACKFILL AND SUBDRAIN DETAIL

Soil Exploration Co. Inc.

Plate: 3

APPENDIX A

REFERENCES

- Envicom, 1976, Seismic Hazards Map, City of Riverside Area, Plate VA, Dated September 1976.
- Envicom, 1976, Safety Element Map, City of Riverside Area, Plate VB, Dated September 1976.
- Department of the Interior, U.S. Geological Survey, Contour Map Showing Minimum Depth to Ground Water, Upper Santa Ana River Valley, California 1973-1979 (Sheet 2 of 2), By Scott E. Carson and Jonathan C. Matti, Dated 1985.
- U.S. Department of the Interior, U.S. Geological Survey, Geologic Map of the Riverside West Quadrangle, Riverside County, California, Dated 1994.
- TLMA, County of Riverside, Geotechnical/Liquefaction Map, Dated September 26, 1997.
- CDMG, Maps of Known Active Fault Near-Source Zones in California and Adjacent Portions of Nevada, Dated February 1998.

APPENDIX B

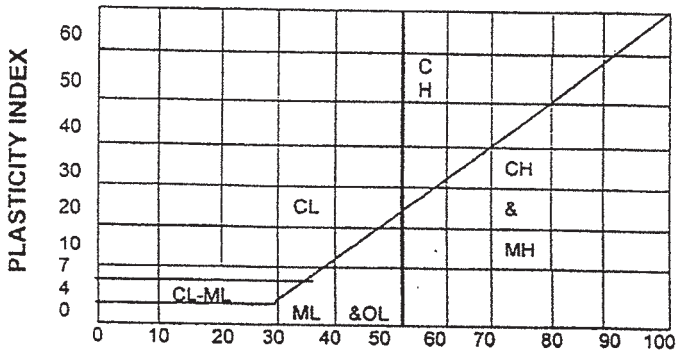
MAJOR DIVISIONS		SYMBOLS		TYPICAL NAMES
COARSE-GRAINED SOILS (More than ½ of soil < No. 200 sieve)	GRAVELS (More than ½ of coarse fraction > No. 4 sieve size)	GW		Well-graded gravels or gravel-sand mixtures, little or no fines
		GP		Poorly graded gravels or gravel-sand mixtures, little or no fines
		GM		Silty gravels, gravel-sand-silt mixtures
		GC		Clayey gravels, gravel-sand-clay mixtures
	SANDS (More than ½ of coarse fraction < No. 4 sieve size)	SW		Well-graded sands or gravely sands, little or no fines
		SP		Poorly graded sands or gravelly sands, little or no fines
		SM		Silty sands, sand-salt mixtures
		SC		Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (More than ½ of soil < No. 200 sieve)	SILTS & CLAYS LL < 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 & CLAYS LL > 50	MH		Inorganic silts, caceous or diatonaceous fine sandy or silty soils, elastic silts
		CH		Inorganic clays of medium to high plasticity, organic silty clays, organic silts
		OH		Organic clays of medium to high plasticity, organic silty clays, organic silts
	HIGHLY ORGANIC SOILS	Pt		Peat and other highly organic soils

CLASSIFICATION CHART

(UNIFIED SOIL CLASSIFICATION SYSTEM)

CLASSIFICATION	RANGE OF GRAIN SIZES	
	U.S. Standard Sieve Size	Grain Size in Millimeters
BOULDER	ABOVE 12"	ABOVE 305
COBBLES	3" to 12"	305 to 76.2
GRAVEL	3" to No. 4	762 to 4.76
COARSE	3" TO ¾"	76.2 to 19.1
FINE	¾"to No. 4	19.1 to 4.76
SAND	No. 4 to 200	4.76 to 0.074
COARSE	No. 4 to 10	4.76 to 2.00
MEDIUM	No. 10 to 40	2.00 to 0.420
FINE	No. 40 to 200	0.420 to 0.074
SILT & CLAY	BELOW No. 200	BELOW 0.074

GRAIN SIZE CHART



PLASTICITY CHART

Ring Sample	Bag Sample	NR No Recovery
SPT Sample	= Seepage	

Classification in accordance with ASTM D2487
Description and visual observation in accordance with ASTM D2488
All Sieve Sizes shown are US Standard
SPT Refusal is defined as one of the following:
10 blows for no apparent displacement
50 blows for less than 6 inches advancement
100 blows for 6 to 18 inches advancement

GEOTECHNICAL BORING LOGS

Drill Hole No. B-1

Date: January 17, 2014
Drilling Company: WDI
Hole Diameter: 8" **Drive Weight:** 140 lbs. **Drop:** 30"

Project No. 13167-01
Type of Rig: B-61
Elevation: 816±

DEPTH (feet)	TYPE OF TEST	SAMPLE TEST	BLOWS PER 6 INCH	DRY DENSITY (%)	MOISTURE (%)	SOIL CLASSIFICATION USCS	GEOTECHNICAL DESCRIPTION LOGGED BY: GL SAMPLED BY: GL
1	Alluvium					SM	**SILTY SAND:** Light brown, fine to coarse grained, dry, medium dense
2							
3							
4		■	4/8/10	108.4	3.4		Dry, medium dense, micaceous % Passing No. 200 Sieve = 43 SE = 18
5							
6		X	3/4/4	-	-		Slightly moist, loose
7							
8							
9							
10							
11		X	3/6/4	-	-		Medium dense
12							
13							
14							
15							
16		X	7/9/11	-	-	ML	**SANDY SILT:** Light brown, slightly moist, stiff
17							
18							
19							
20							
21	Bedrock	X	15/37/50	-	-	SM	**SILTY SAND:** Light brown, fine to coarse grained, very dense
22							
23							Very dense
24							TOTAL DEPTH = 25 FEET NO GROUNDWATER
25		X	19/39/50				NO CAVING BORING BACKFILLED

GEOTECHNICAL BORING LOGS

Drill Hole No. B-2

Date: January 17, 2014
Drilling Company: WDI
Hole Diameter: 8" **Drive Weight:** 140 lbs. **Drop:** 30"

Project No. 13167-01
Type of Rig: B-61
Elevation: 818.5±

DEPTH (feet)	TYPE OF TEST	SAMPLE TEST	BLOWS PER 6 INCH	DRY DENSITY (%)	MOISTURE (%)	SOIL CLASSIFICATION USCS	GEOTECHNICAL DESCRIPTION LOGGED BY: GL SAMPLED BY: GL
1	Alluvium					SM	**SILTY SAND:** Light brown, fine to medium grained, slightly moist, loose, micaceous
2							
3							
4		X	2/2/2	-	-		Loose SE = 29
5							
6		■	3/4/4	113.3	13.1	ML	**SANDY SILT:** Light brown, moist, loose, micaceous % Passing No. 200 Sieve = 59
7							
8							
9							
10							
11		X	2/3/3	-	-		Loose
12							
13							
14						CL-ML	**SILTY CLAY:** Light brown, moist, stiff
15		X	7/9/13	-	-		
16							TOTAL DEPTH = 15 FEET NO GROUNDWATER NO CAVING BORING BACKFILLED
17							
18							
19							
20							
21							
22							
23							
24							
25							

GEOTECHNICAL BORING LOGS

Drill Hole No. B-3

Date: January 17, 2014
Drilling Company: WDI
Hole Diameter: 8" **Drive Weight:** 140 lbs. **Drop:** 30"

Project No. 13167-01
Type of Rig: B-61
Elevation: 822.5±

DEPTH (feet)	TYPE OF TEST	SAMPLE TEST	BLOWS PER 6 INCH	DRY DENSITY (%)	MOISTURE (%)	SOIL CLASSIFICATION USCS	GEOTECHNICAL DESCRIPTION LOGGED BY: GL SAMPLED BY: GL
1	Alluvium					SM	**SILTY SAND:** Light brown, fine to medium grained, dry, loose
2							
3							
4							
5							
6		X	3/4/4	-	-		
7							
8							
9							
10							
11		X	5/6/7	-	-	ML	**SANDY SILT:** Light brown, moist, stiff
12							
13							
14							
15							
16	Bedrock	X	7/9/13	-	-	SM	**SILTY SAND:** Light gray, weathered, medium dense
17							
18							
19							
20		X	9/17/22	-	-		
21							TOTAL DEPTH = 20 FEET NO GROUNDWATER NO CAVING BORING BACKFILLED
22							
23							
24							
25							

GEOTECHNICAL BORING LOGS

Drill Hole No. B-4

Date: January 17, 2014
Drilling Company: WDI
Hole Diameter: 8" **Drive Weight:** 140 lbs. **Drop:** 30"

Project No. 13167-01
Type of Rig: B-61
Elevation: 824±

DEPTH (feet)	TYPE OF TEST	SAMPLE TEST	BLOWS PER 6 INCH	DRY DENSITY (%)	MOISTURE (%)	SOIL CLASSIFICATION USCS	GEOTECHNICAL DESCRIPTION LOGGED BY: GL SAMPLED BY: GL
1	Alluvium					SM	**SILTY SAND:** Light brown, fine to medium grained, slightly moist, loose
2							
3							
4							
5							
6		X	3/4/5	-	-		Loose
7							
8							
9							
10							
11		X	5/5/5	-	-		Medium dense
12							
13							
14							
15							
16		X	5/8/11	-	-	ML	**SANDY SILT:** Light brown, slightly moist, stiff
17							
18							
19							
20	Bedrock	X	27/33/39	-	-	SM	**SILTY SAND:** Light brown, fine to coarse grained, very dense
21							TOTAL DEPTH = 20 FEET NO GROUNDWATER NO CAVING BORING BACKFILLED
22							
23							
24							
25							

APPENDIX C

LABORATORY TEST RESULTS

SEC of Victoria Avenue and La Sierra Avenue
City of Riverside, California

SIEVE SIZE	B-1 @ 2.5' % PASSING	B-2 @ 5' % PASSING
3/8"	100	-
No. 4	99.5	100
No. 8	98	98
No. 16	93	91
No. 30	86	83
No. 50	78	77
No. 100	65	69
No. 200	43	59
SIEVE ANALYSIS TEST DATA		

B-1 @ 2.5'	B-2 @ 2.5'
18	29
SAND EQUIVALENT TEST DATA	

APPENDIX D

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**********
*        *
*  E Q F A U L T  *
*        *
*  Version 3.00  *
*        *
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DETERMINISTIC ESTIMATION OF
PEAK ACCELERATION FROM DIGITIZED FAULTS

JOB NUMBER: 13167-01

DATE: 12-30-2013

JOB NAME: Adkan Engineers
CALCULATION NAME: Test Run Analysis
FAULT-DATA-FILE NAME: CDMGFLTE.DAT
SITE COORDINATES:
SITE LATITUDE: 33.8875
SITE LONGITUDE: 117.4619
SEARCH RADIUS: 50 mi
ATTENUATION RELATION: 14) Campbell & Bozorgnia (1997 Rev.) - Alluvium
UNCERTAINTY (M=Median, S=Sigma): S Number of Sigmas: 1.0
DISTANCE MEASURE: cdist
SCOND: 0
Basement Depth: 5.00 km Campbell SSR: 0 Campbell SHR: 0
COMPUTE PEAK HORIZONTAL ACCELERATION
FAULT-DATA FILE USED: CDMGFLTE.DAT
MINIMUM DEPTH VALUE (km): 3.0

EQFAULT SUMMARY

DETERMINISTIC SITE PARAMETERS

ABBREVIATED FAULT NAME	APPROXIMATE DISTANCE mi	(km)	ESTIMATED MAX. EARTHQUAKE EVENT: MAXIMUM EARTHQUAKE MAG.(Mw)	PEAK SITE ACCEL. g	EST. SITE INTENSITY MOD.MERC.
CHINO-CENTRAL AVE. (Elsinore)	8.5	(13.6)	6.7	0.501	X
ELSINORE-GLEN IVY	8.6	(13.8)	6.8	0.431	X
WHITTIER	10.5	(16.9)	6.8	0.366	IX
SAN JACINTO-SAN BERNARDINO	15.1	(24.3)	6.7	0.248	IX
SAN JACINTO-SAN JACINTO VALLEY	15.8	(25.4)	6.9	0.270	IX
ELSINORE-TEMECULA	18.2	(29.3)	6.8	0.221	IX
SAN JOSE	21.0	(33.8)	6.5	0.171	VIII
CUCAMONGA	21.9	(35.3)	7.0	0.221	IX
SAN ANDREAS - Southern	23.7	(38.1)	7.4	0.255	IX
SAN ANDREAS - San Bernardino	23.7	(38.1)	7.3	0.239	IX
SIERRA MADRE	23.7	(38.2)	7.0	0.203	VIII
ELYSIAN PARK THRUST	23.7	(38.2)	6.7	0.168	VIII
CLEGHORN	27.9	(44.9)	6.5	0.114	VII
SAN ANDREAS - 1857 Rupture	29.6	(47.6)	7.8	0.268	IX
SAN ANDREAS - Mojave	29.6	(47.6)	7.1	0.167	VIII
NORTH FRONTAL FAULT ZONE (West)	30.1	(48.4)	7.0	0.155	VIII
COMPTON THRUST	30.6	(49.3)	6.8	0.134	VIII
NEWPORT-INGLEWOOD (Offshore)	32.5	(52.3)	6.9	0.131	VIII
NEWPORT-INGLEWOOD (L.A.Basin)	32.9	(53.0)	6.9	0.129	VIII
SAN JACINTO-ANZA	32.9	(53.0)	7.2	0.160	VIII
CLAMSHELL-SAWPIT	34.7	(55.9)	6.5	0.091	VII
RAYMOND	37.2	(59.8)	6.5	0.083	VII
VERDUGO	42.8	(68.8)	6.7	0.079	VII
ELSINORE-JULIAN	43.7	(70.3)	7.1	0.109	VII
PINTO MOUNTAIN	44.1	(70.9)	7.0	0.098	VII
PALOS VERDES	44.6	(71.7)	7.1	0.106	VII
NORTH FRONTAL FAULT ZONE (East)	44.7	(71.9)	6.7	0.075	VII
HOLLYWOOD	47.2	(76.0)	6.4	0.054	VI
HELENDALE - S. LOCKHARDT	47.7	(76.7)	7.1	0.097	VII

-END OF SEARCH- 29 FAULTS FOUND WITHIN THE SPECIFIED SEARCH RADIUS.
THE CHINO-CENTRAL AVE. (Elsinore) FAULT IS CLOSEST TO THE SITE. IT IS ABOUT 8.5 MILES (13.6 km) AWAY. LARGEST MAXIMUM-EARTHQUAKE SITE ACCELERATION: 0.5006 g

-/-

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*        *
*  E Q F A U L T  *
*        *
*  Version 3.00  *
*        *
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DETERMINISTIC ESTIMATION OF
PEAK ACCELERATION FROM DIGITIZED FAULTS

JOB NUMBER: 13167-01

DATE: 12-30-2013

JOB NAME: Adkan Engineers
CALCULATION NAME: Test Run Analysis
FAULT-DATA-FILE NAME: CDMGFLTE.DAT
SITE COORDINATES:
SITE LATITUDE: 33.8875
SITE LONGITUDE: 117.4619
SEARCH RADIUS: 50 mi
ATTENUATION RELATION: 14) Campbell & Bozorgnia (1997 Rev.) - Alluvium
UNCERTAINTY (M=Median, S=Sigma): M Number of Sigmas: 0.0
DISTANCE MEASURE: cdist
SCOND: 0
Basement Depth: 5.00 km Campbell SSR: 0 Campbell SHR: 0
COMPUTE PEAK HORIZONTAL ACCELERATION
FAULT-DATA FILE USED: CDMGFLTE.DAT
MINIMUM DEPTH VALUE (km): 3.0

EQFAULT SUMMARY

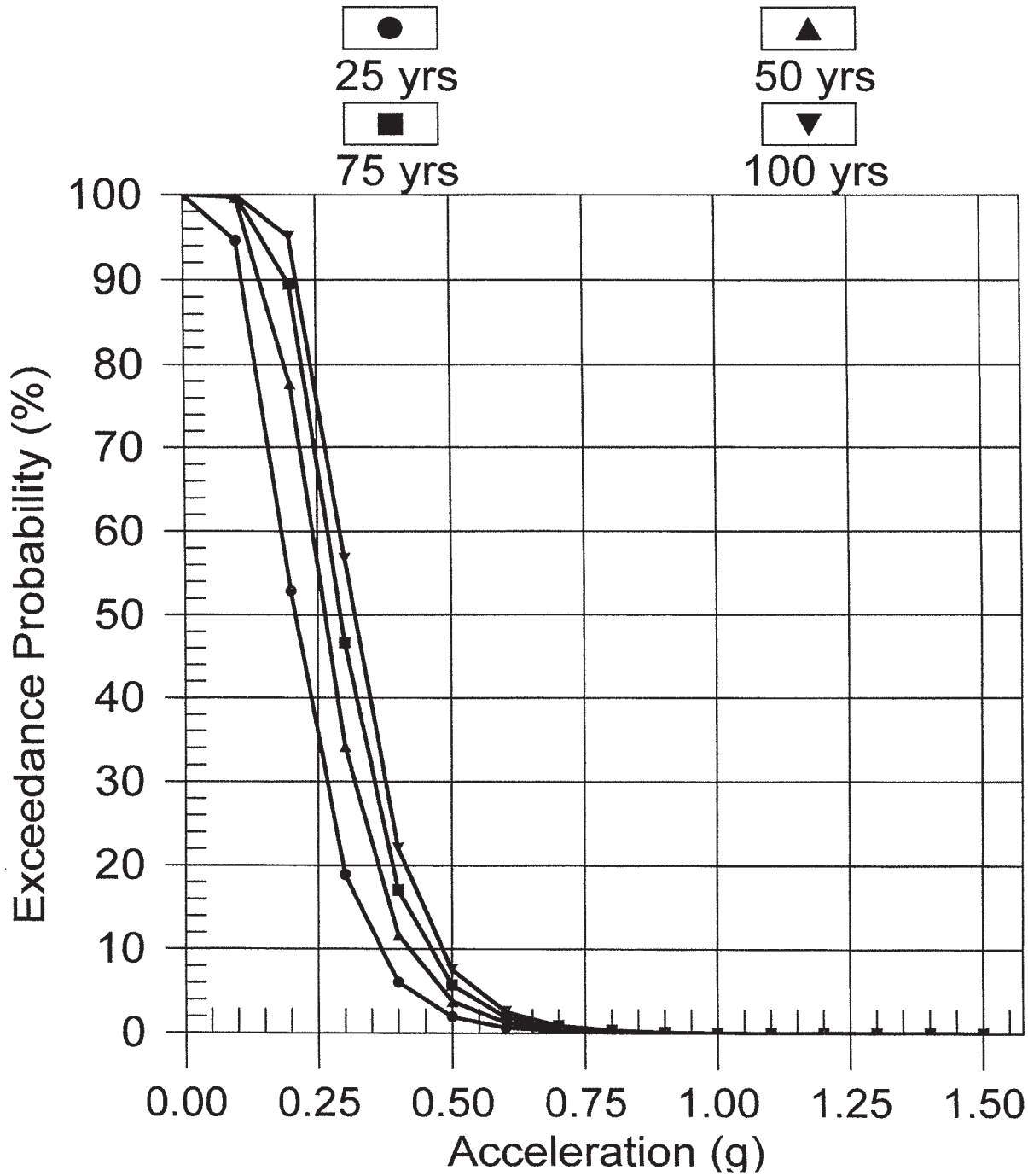
DETERMINISTIC SITE PARAMETERS

ABBREVIATED FAULT NAME	APPROXIMATE DISTANCE mi	APPROXIMATE DISTANCE (km)	ESTIMATED MAX. EARTHQUAKE EVENT MAXIMUM EARTHQUAKE MAG.(Mw)	ESTIMATED MAX. EARTHQUAKE EVENT PEAK SITE ACCEL. g	ESTIMATED MAX. EARTHQUAKE EVENT EST. SITE INTENSITY MOD.MERC.
CHINO-CENTRAL AVE. (Elsinore)	8.5	13.6	6.7	0.339	IX
ELSINORE-GLEN IVY	8.6	13.8	6.8	0.292	IX
WHITTIER	10.5	16.9	6.8	0.248	IX
SAN JACINTO-SAN BERNARDINO	15.1	24.3	6.7	0.161	VIII
SAN JACINTO-SAN JACINTO VALLEY	15.8	25.4	6.9	0.178	VIII
ELSINORE-TEMECULA	18.2	29.3	6.8	0.142	VIII
SAN JOSE	21.0	33.8	6.5	0.105	VII
CUCAMONGA	21.9	35.3	7.0	0.141	VIII
SAN ANDREAS - Southern	23.7	38.1	7.4	0.167	VIII
SAN ANDREAS - San Bernardino	23.7	38.1	7.3	0.155	VIII
SIERRA MADRE	23.7	38.2	7.0	0.128	VIII
ELYSIAN PARK THRUST	23.7	38.2	6.7	0.103	VII
CLEGHORN	27.9	44.9	6.5	0.066	VI
SAN ANDREAS - 1857 Rupture	29.6	47.6	7.8	0.177	VIII
SAN ANDREAS - Mojave	29.6	47.6	7.1	0.102	VII
NORTH FRONTAL FAULT ZONE (West)	30.1	48.4	7.0	0.094	VII
COMPTON THRUST	30.6	49.3	6.8	0.079	VII
NEWPORT-INGLEWOOD (Offshore)	32.5	52.3	6.9	0.077	VII
NEWPORT-INGLEWOOD (L.A.Basin)	32.9	53.0	6.9	0.075	VII
SAN JACINTO-ANZA	32.9	53.0	7.2	0.097	VII
CLAMSHELL-SAWPIT	34.7	55.9	6.5	0.052	VI
RAYMOND	37.2	59.8	6.5	0.048	VI
VERDUGO	42.8	68.8	6.7	0.046	VI
ELSINORE-JULIAN	43.7	70.3	7.1	0.063	VI
PINTO MOUNTAIN	44.1	70.9	7.0	0.057	VI
PALOS VERDES	44.6	71.7	7.1	0.061	VI
NORTH FRONTAL FAULT ZONE (East)	44.7	71.9	6.7	0.043	VI
HOLLYWOOD	47.2	76.0	6.4	0.031	V
HELENDALE - S. LOCKHARDT	47.7	76.7	7.1	0.056	VI

-END OF SEARCH- 29 FAULTS FOUND WITHIN THE SPECIFIED SEARCH RADIUS.
THE CHINO-CENTRAL AVE. (Elsinore) FAULT IS CLOSEST TO THE SITE. IT IS ABOUT 8.5 MILES (13.6 km) AWAY. LARGEST MAXIMUM-EARTHQUAKE SITE ACCELERATION: 0.3390 g

PROBABILITY OF EXCEEDANCE

CAMP. & BOZ. (1997 Rev.) AL 1



2010 CBC – SEISMIC PARAMETERS		
Mapped Spectral Response Acceleration	**S_S = 1.50**	**S_1 = 0.60**
Site Coefficients (Class "D")	**F_a = 1.00**	**F_v = 1.50**
Maximum Considered Earthquake (MCE) Spectral Response Acceleration	**S_{MS} = 1.500**	**S_{M1} = 0.900**
Design Spectral Response Acceleration Parameters	**S_{DS} = 1.000**	**S_{D1} = 0.600**
Seismic Design Category	**D**	

References:

- Earthquake.usgs.gov/research/hazmaps/design
- 2010 California Building Code, California Code of Regulations, Title 24, Part 2, Volume 2 of 2, Section 1613, Earthquake Loads

APPENDIX E

GENERAL EARTHWORK AND GRADING SPECIFICATIONS

1.0 GENERAL INTENT

These specifications present general procedures and requirements for grading and earthwork as shown on the approved grading plans, including preparation of areas to be filled, placement of fill, installations of subdrains, and excavations. The recommendations contained in the geotechnical report are a part of the earthwork and grading specifications and shall supersede the provisions contained hereinafter in the case of conflict. Evaluations performed by the consultant during the course of grading may result in new recommendations which could supersede these specifications or the recommendations of the geotechnical report.

2.0 EARTHWORK OBSERVATIONS AND TESTING

Prior to the commencement of grading, a qualified geotechnical consultant (soils engineer and engineering geologist, and their representatives) shall be employed for the purpose of observing earthwork procedures and testing the fills for conformance with the recommendations of the geotechnical report and these specifications. It will be necessary that the consultant provide adequate testing and observations so that he may determine that the work was accomplished as specified. It shall be the responsibility of the contractor to assist the consultant and keep him apprised of work schedules and changes so that he may schedule his personnel accordingly.

It shall be the sole responsibility of the contractor to provide adequate equipment and methods to accomplish the work in accordance with applicable grading codes or agency ordinances, these specifications and approved grading plans. If, in the opinion of the consultant, unsatisfactory conditions, such as questionable soil, poor moisture conditions, inadequate compaction, adverse weather, etc., are resulting in a quality of work less than required in these specifications, the consultant will be empowered to reject the work and recommend that construction be stopped until the unsatisfactory conditions are rectified.

Maximum dry density tests used to determine the degree of compaction will be performed in accordance with the American Society of Testing and Materials, test method ASTM D1557-09.

3.0 PREPARATION OF AREAS TO BE FILLED

3.1 Clearing and Grubbing

All brush, vegetation, and debris shall be removed or piled and otherwise disposed of.

3.2 Processing

The existing ground which is determined to be satisfactory for support of fill shall be scarified to a minimum depth of 6 inches. Existing ground which is not satisfactory shall be overexcavated as specified in the following section. Scarification shall continue until the soils are broken down and free of large clay lumps or clods and until the working surface is reasonably uniform and free of uneven features which would inhibit uniform compaction.

3.3 Overexcavation

Soft, dry, spongy, highly fractured or otherwise unsuitable ground, extending to such depth that surface processing cannot adequately improve the condition, shall be overexcavated down to firm ground, approved by the consultant.

3.4 Moisture Conditioning

Overexcavated and processed soils shall be watered, dried-back, blended, and/or mixed, as required to attain a uniform moisture content near optimum.

3.5 Recompaction

Overexcavation and processed soils which have been properly mixed and moisture-conditioned shall be recompacted to a minimum relative compaction of 90 percent.

3.6 *Benching*

Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal : vertical), the ground shall be stepped or benched. The lowest bench shall be a minimum of 15 feet wide, shall be at least 2 feet deep, shall expose firm materials, and shall be approved by the consultant. Other benches shall be excavated in firm materials for a minimum width of 4 feet. Ground sloping flatter than 5:1 (horizontal : vertical) shall be benched or otherwise overexcavated when considered necessary by the consultant.

3.7 *Approval*

All areas to receive fill, including processed areas, removal areas and toe-of-fill benches shall be approved by the consultant prior to fill placement.

4.0 FILL MATERIAL

4.1 *General*

Material to be placed as fill shall be free of organic matter and other deleterious substances, and shall be approved by the consultant. Soils of poor gradation, expansion, or strength characteristics shall be placed in areas designated by consultant or shall be mixed with other soils to serve as satisfactory fill material.

4.2 *Oversize*

Oversize materials defined as rock, or other irreducible material with maximum dimension greater than 12 inches, shall not be buried or placed in fills, unless the location, materials, and disposal methods are specifically approved by the consultant. Oversize disposal operations shall be such that nesting of oversize material does not occur, and such that the oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 feet vertically of finish grade or within the range of future utilities or underground construction, unless specifically approved by the consultant.

4.3 *Import*

If importing of fill material is required for grading, the import material shall meet the requirements of Section 4.1.

5.0 FILL PLACEMENT and COMPACTION

5.1 *Fill Lifts*

Approved fill material shall be placed in areas prepared to receive fill in near-horizontal layers not exceeding 6 inches in compacted thickness. The consultant may approve thicker lifts if testing indicates the grading procedures are such that adequate compaction is being achieved with lifts of greater thickness. Each layer shall be spread evenly and shall be thoroughly mixed during spreading to attain uniformity of material and moisture in each layer.

5.2 *Fill Moisture*

Fill layers at a moisture content less than optimum shall be watered and mixed, and wet fill layers shall be aerated by scarification or shall be blended with drier material. Moisture conditioning and mixing of fill layers shall continue until the fill material is at a uniform moisture content at or near optimum.

5.3 *Compaction of Fill*

After each layer has been evenly spread, moisture-conditioned, and mixed, it shall be uniformly compacted to not less than 90 percent of maximum dry density. Compaction equipment shall be adequately sized and shall be either specifically designed for soil compaction or of proven reliability, to efficiently achieve the specified degree of compaction.

5.4 Fill Slopes

Compacting of slopes shall be accomplished, in addition to normal compacting procedures, by backrolling of slopes with sheepsfoot rollers at frequent increments of 2 to 3 feet in fill elevation gain, or by other methods producing satisfactory results. At the completion of grading, the relative compaction of the slope out to the slope face shall be at least 90 percent.

5.5 Compaction Testing

Field-tests to check the fill moisture and degree of compaction will be performed by the consultant. The location and frequency of tests shall be at the consultant's discretion. In general, the tests will be taken at intervals not exceeding 2 feet in vertical rise and/or 1,000 cubic yards of embankment.

6.0 SUBDRAIN INSTALLATION

Subdrain systems, if required, shall be installed in approved ground to conform to the approximate alignment and details shown on the plans or herein. The subdrain location or materials shall not be changed or modified without the approval of the consultant. The consultant, however, may recommend and upon approval, direct changes in subdrain line, grade or material. All subdrains should be surveyed for line and grade after installation and sufficient time shall be allowed for the surveys, prior to commencement of filling over the subdrain.

7.0 EXCAVATION

Excavations and cut slopes will be examined during grading. If directed by the consultant, further excavation or overexcavation and refilling of cut areas shall be performed, and/or remedial grading of cut slopes shall be performed. Where fill-over-cut slopes are to be graded, unless otherwise approved, the cut portion of the slope shall be made and approved by the consultant prior to placement of materials for construction of the fill portion of the slope.

8.0 TRENCH BACKFILLS

Trench excavations for utility pipes shall be backfilled under engineering supervision.

After the utility pipe has been laid, the space under and around the pipe shall be backfilled with clean sand or approved granular soil to a depth of at least one foot over the top of the pipe. The sand backfill shall be uniformly jetted into place before the controlled backfill is placed over the sand.

The onsite materials, or other soils approved by the soil engineer, shall be watered and mixed as necessary prior to placement in lifts over the sand backfill.

The controlled backfill shall be compacted to at least 90 percent of the maximum dry density as determined by the ASTM D1557-09 test method.

Field density tests and inspection of the backfill procedures shall be made by the soil engineer during backfilling to see that proper moisture content and uniform compaction is being maintained. The contractor shall provide test holes and exploratory pits as required by the soil engineer to enable sampling and testing.

SOIL
EXPLORATION
COMPANY, INC.

Soil Engineering, Environmental Engineering, Materials Testing, Geology

December 16, 2019

Project No. 13167-01

TO: West Coast Hotels Group LLC
19215 Wild Mustang Ct.
Apple Valley, CA 92307

ATTENTION: Hitesh Patel

SUBJECT: California Building Code (CBC) 2016 Seismic Update, Proposed 8.8±Acre, 14 Lot Residential Subdivision, SEC Victoria Avenue and La Sierra Avenue, City of Riverside, California

REFERENCES: Soil Exploration Co., Inc., "Preliminary Geotechnical Investigation/Liquefaction Evaluation/Infiltration Tests Report, Proposed 8.8± Acre, 14 Lot Residential Subdivision, SEC of Victoria Avenue and La Sierra Avenue (APN 136-220-016), City of Riverside, California", Dated January 24, 2014 (Project No. 13167-01).

Introduction

As requested, we have prepared the following updated seismic parameters for the subject site.

CBC 2016 Seismic Parameters

The CBC (2016) seismic parameters for the site are tabulated below:

2016 CBC – SEISMIC PARAMETERS		
	Latitude	**Longitude**
Site Coordinates	**33.8875**	**-117.4619**
Mapped Spectral Response Acceleration	S_s = 1.500	S_1 = 0.600
Site Coefficients (Class "D")	F_a = 1.00	F_v = 1.50
Maximum Considered Earthquake (MCE) Spectral Response Acceleration	S_{MS} = 1.500	S_{M1} = 0.900
Design Spectral Response Acceleration Parameters	S_{DS} = 1.000	S_{D1} = 0.600
Seismic Design Category	D	
Peak Ground Acceleration (PGA)	0.514g	

References:

- Earthquake.usgs.gov/research/hazmaps/design
- 2016 California Building Code, California Code of Regulations, Title 24, Part 2, Volume 2 of 2, Section 1613, Earthquake Loads

7535 Jurupa Ave., Unit C • Riverside, CA 92504 • Tel: (951) 688-7200 • Fax: (951) 688-7100
soilexploration@yahoo.com • www.soilexp.com

Foundation Plan Review/Additional Observations and Testing

Soil Exploration Co., Inc. should review the foundation plans and observe and/or test at the following stages of construction:

- During any additional grading or fill placement.
- Following footings excavation and prior to placement of footing materials.
- During all utility trench backfills and street subgrade/base compaction.
- Following wetting of slab subgrade (1.2X optimum to a depth of at least 6") and prior to placement of slab materials.
- When any unusual conditions are encountered.

Limitation

Soil Exploration Co., Inc. has striven to perform our services within the limits prescribed by our client, and in a manner consistent with the usual thoroughness and competence of reputable soils engineers practicing under similar circumstances. No other representation, express or implied, and no warranty or guarantee is included or intended by virtue of the services performed or reports, opinion, documents, or otherwise supplied.

Closure

If you should have any questions regarding this report, please do not hesitate to contact our office. We appreciate this opportunity to be of service.

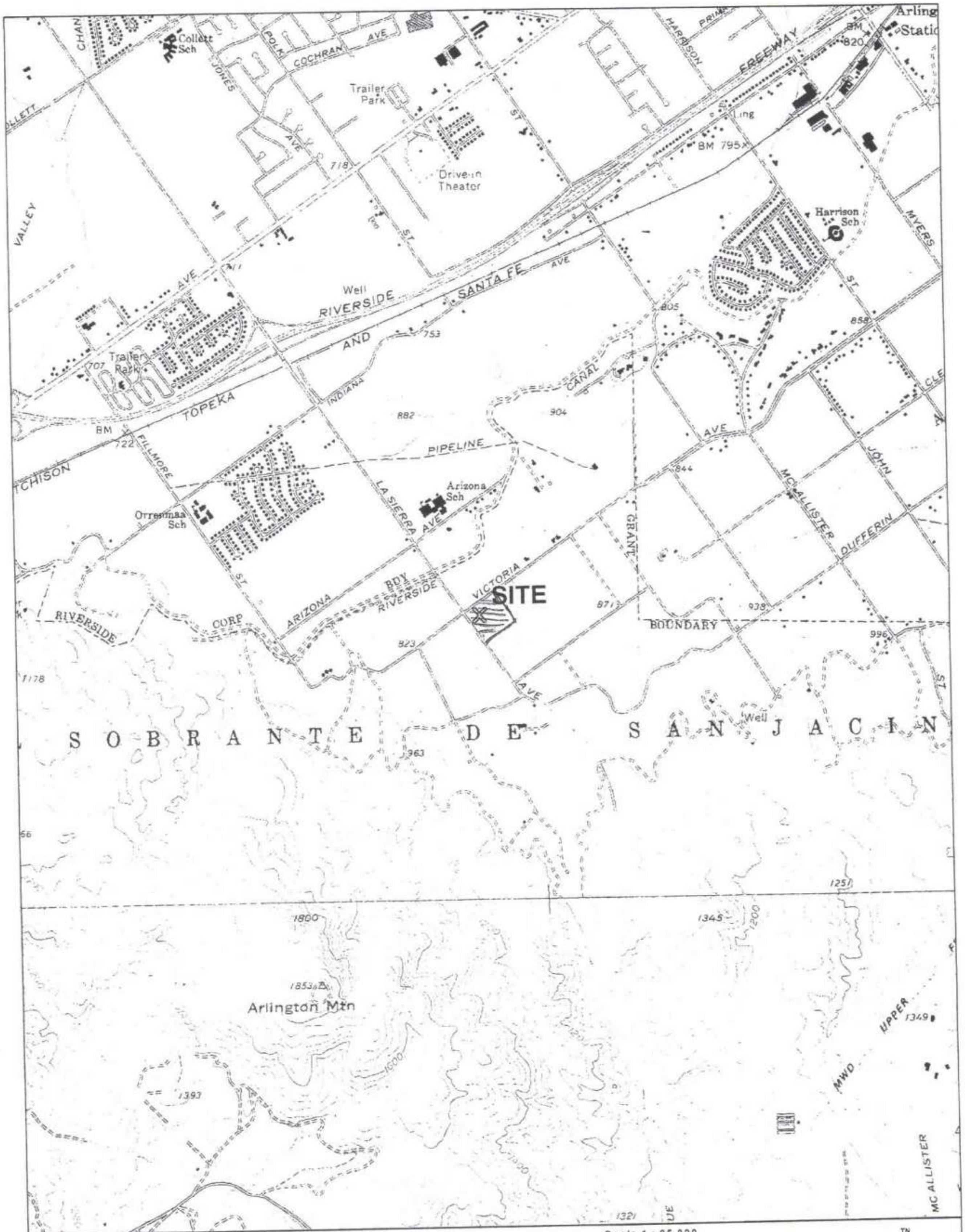
Very truly yours,
Soil Exploration Co., Inc.

REGISTERED PROFESSIONAL ENGINEER
GENE KINH-TOAN LUU
C 53417
EXP. 6/30/21
CIVIL
STATE OF CALIFORNIA

Gene K. Luu, PE 53417
Project Engineer

Distribution: [1] Addressee (hitesh@westcoasthotelsgroup.com)

Attachments: Figure 1 Site Location Map


SITE
Collett Sch
COCHRAN AVE
POLK
JONES
Trailer Park
Drive-in Theater
HARRISON
FREEWAY
BM 820
BM 795
Harrison Sch
MYERS
VALLEY
RIVERSIDE AVE
SANTA FE
AND
TOPEKA
ATCHISON
Well
753
Trailer Park
707
BM 722
FILLMORE
INDIANA
882
904
CANAL
PIPELINE
Arizona Sch
LA SIERRA AVE
Orrenmaa Sch
GRANT
844
MC ALLISTER
JOHN
DUFFERIN
ARIZONA
RIVERSIDE BDY
VICTORIA
871
938
BOUNDARY
996
823
RIVERSIDE CORP
1178
S O B R A N T E D E S A N J A C I N
963
1251
1800
1345
1853
Arlington Mtn
UPPER
MWD
1349
1393
1321
MC ALLISTER
Scale 1 : 25,000
1" = 2080 ft
TN
MN
0.0°E
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www.delorme.com

Figure 1

Appendix 4: Historical Site Conditions

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

Appendix 5: LID Infeasibility

LID Technical Infeasibility Analysis

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	Adkan Engineers	Date	1/31/2022
Designed by	Israel Duque	Case No	
Company Project Number/Name	Warmington- Tract 36713		

BMP Identification

BMP NAME / ID: Inflitration basin

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}= 0.56 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)*
C1	*132538*	*Roofs*	*1.00*	*0.89*	*118223.9*			
C2	*65141*	*Concrete or Asphalt*	*1.00*	*0.89*	*58105.8*			
C3	*111239*	*Ornamental Landscaping*	*0.1*	*0.11*	*12287.2*			
B1	*3674*	*Natural (A Soil)*	*0.03*	*0.06*	*229.8*			
	312592	***Total***			**188846.7**	**0.56**	***8812.8***	***9177.5***

Notes:

Infiltration Basin - Design Procedure (Rev. 03-2012)	BMP ID	Legend:	Required Entries / Calculated Cells
Company Name: Adkan Engineers			Date:
Designed by: ISRAEL DUQUE			County/City Case No.:

Design Volume

a) Tributary area (BMP subarea)	A_T =	7.4	acres
b) Enter V_{BMP} determined from Section 2.1 of this Handbook	V_{BMP}=	8,832	ft^3

Maximum Depth

a) Infiltration rate	I =	2.85	in/hr
b) Factor of Safety (See Table 1, Appendix A: "Infiltration Testing" from this BMP Handbook)	FS =	3	
c) Calculate D_1 $D_1 = \frac{I\ (in/hr) \times 72\ hrs}{12\ (in/ft) \times FS}$	D_1 =	5.7	ft
d) Enter the depth of freeboard (at least 1 ft)		1	ft
e) Enter depth to historic high ground water (measured from **top** of basin)		15	ft
f) Enter depth to top of bedrock or impermeable layer (measured from **top** of basin)		15	ft
g) D_2 is the smaller of: Depth to groundwater - (10 ft + freeboard) and Depth to impermeable layer - (5 ft + freeboard)	D_2 =	4.0	ft
h) D_{MAX} is the smaller value of D_1 and D_2 but shall not exceed 5 feet	D_{MAX} =	4.0	ft

Basin Geometry

a) Basin side slopes (no steeper than 4:1)	Slope no steeper than 4:1	z =	2	:1
b) Proposed basin depth (excluding freeboard)		d_B =	2.5	ft
c) Minimum bottom surface area of basin ($A_S = V_{BMP}/d_B$)		A_S =	3533	ft^2
d) Proposed Design Surface Area		A_D =	3,671	ft^2

Forebay

a) Forebay volume (minimum 0.5% V_{BMP})	Volume =	44	ft^3
b) Forebay depth (height of berm/splashwall. 1 foot min.)	Depth =	1	ft
c) Forebay surface area (minimum)	Area =	44	ft^2
d) Full height notch-type weir	Width (W) =	36.0	in

Notes:

Appendix 7: Hydromodification

Supporting Detail Relating to Hydrologic Conditions of Concern

Basin Storage Volume Calculations	
Infiltration Basin Bottom Area (sf)	3674
Basin Top Area (sf)	4899
Depth of Basin (ft)	2.5
Open Basin Volume Provided (cf)	10716
Rock Storage depth (ft)	4.6
Rock Storage Volume (40% void) (cf)	6755
Total Flood Volume Stored	**17472**
Ex. 2-yr 24-hr Storm Volume (cf)	8233
Prop. 2-yr 24-hr Storm Volume (cf)	26528
Allowable 2-yr 24-hr Storm Volume (mitigated to 110% of existing) (cf)	**9056**
Prop. 2-yr 24-hr Storm Volume (cf)	26528
Total Flood Volume Stored	17472
Remaining Storm Volume	**9056**

U n i t H y d r o g r a p h A n a l y s i s

Study date 02/22/24 File: EX2YR242.out

++

Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 5006

English (in-lb) Input Units Used
English Rainfall Data (Inches) Input Values Used

English Units used in output format

Drainage Area = 7.00(Ac.) = 0.011 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 7.00(Ac.) = 0.011 Sq. Mi.
Length along longest watercourse = 596.00(Ft.)
Length along longest watercourse measured to centroid = 300.00(Ft.)
Length along longest watercourse = 0.113 Mi.
Length along longest watercourse measured to centroid = 0.057 Mi.
Difference in elevation = 26.00(Ft.)
Slope along watercourse = 230.3356 Ft./Mi.
Average Manning's 'N' = 0.030
Lag time = 0.038 Hr.
Lag time = 2.26 Min.
25% of lag time = 0.56 Min.
40% of lag time = 0.90 Min.
Unit time = 5.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow = 0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
7.00	1.80	12.60

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
7.00	6.00	42.00

STORM EVENT (YEAR) = 2.00
Area Averaged 2-Year Rainfall = 1.800(In)
Area Averaged 100-Year Rainfall = 6.000(In)

Point rain (area averaged) = 1.800(In)
Areal adjustment factor = 100.00 %
Adjusted average point rain = 1.800(In)

Sub-Area Data:

Area(Ac.)	Runoff Index	Impervious %
7.000	72.00	0.100

Total Area Entered = 7.00(Ac.)

RI AMC2	RI AMC-1	Infil. Rate (In/Hr)	Impervious (Dec.%)	Adj. Infil. Rate (In/Hr)	Area% (Dec.)	F (In/Hr)
72.0	53.4	0.537	0.100	0.489	1.000	0.489
					Sum (F) =	0.489

Area averaged mean soil loss (F) (In/Hr) = 0.489
Minimum soil loss rate ((In/Hr)) = 0.244
(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.820

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)	Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)

1	0.083	221.634	46.905	3.309
2	0.167	443.269	41.886	2.955
3	0.250	664.903	7.981	0.563
4	0.333	886.537	3.228	0.228
			Sum = 100.000 Sum=	7.055

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	0.07	0.014	(0.867)	0.012	0.003
2	0.17	0.07	0.014	(0.863)	0.012	0.003
3	0.25	0.07	0.014	(0.860)	0.012	0.003
4	0.33	0.10	0.022	(0.857)	0.018	0.004
5	0.42	0.10	0.022	(0.853)	0.018	0.004
6	0.50	0.10	0.022	(0.850)	0.018	0.004
7	0.58	0.10	0.022	(0.847)	0.018	0.004
8	0.67	0.10	0.022	(0.843)	0.018	0.004
9	0.75	0.10	0.022	(0.840)	0.018	0.004
10	0.83	0.13	0.029	(0.837)	0.024	0.005
11	0.92	0.13	0.029	(0.834)	0.024	0.005
12	1.00	0.13	0.029	(0.830)	0.024	0.005
13	1.08	0.10	0.022	(0.827)	0.018	0.004
14	1.17	0.10	0.022	(0.824)	0.018	0.004
15	1.25	0.10	0.022	(0.820)	0.018	0.004
16	1.33	0.10	0.022	(0.817)	0.018	0.004
17	1.42	0.10	0.022	(0.814)	0.018	0.004
18	1.50	0.10	0.022	(0.811)	0.018	0.004
19	1.58	0.10	0.022	(0.807)	0.018	0.004
20	1.67	0.10	0.022	(0.804)	0.018	0.004
21	1.75	0.10	0.022	(0.801)	0.018	0.004
22	1.83	0.13	0.029	(0.798)	0.024	0.005
23	1.92	0.13	0.029	(0.795)	0.024	0.005
24	2.00	0.13	0.029	(0.791)	0.024	0.005
25	2.08	0.13	0.029	(0.788)	0.024	0.005
26	2.17	0.13	0.029	(0.785)	0.024	0.005
27	2.25	0.13	0.029	(0.782)	0.024	0.005
28	2.33	0.13	0.029	(0.779)	0.024	0.005
29	2.42	0.13	0.029	(0.775)	0.024	0.005
30	2.50	0.13	0.029	(0.772)	0.024	0.005
31	2.58	0.17	0.036	(0.769)	0.030	0.006
32	2.67	0.17	0.036	(0.766)	0.030	0.006
33	2.75	0.17	0.036	(0.763)	0.030	0.006
34	2.83	0.17	0.036	(0.760)	0.030	0.006
35	2.92	0.17	0.036	(0.756)	0.030	0.006
36	3.00	0.17	0.036	(0.753)	0.030	0.006
37	3.08	0.17	0.036	(0.750)	0.030	0.006
38	3.17	0.17	0.036	(0.747)	0.030	0.006
39	3.25	0.17	0.036	(0.744)	0.030	0.006
40	3.33	0.17	0.036	(0.741)	0.030	0.006
41	3.42	0.17	0.036	(0.738)	0.030	0.006
42	3.50	0.17	0.036	(0.735)	0.030	0.006
43	3.58	0.17	0.036	(0.732)	0.030	0.006
44	3.67	0.17	0.036	(0.729)	0.030	0.006
45	3.75	0.17	0.036	(0.726)	0.030	0.006
46	3.83	0.20	0.043	(0.722)	0.035	0.008
47	3.92	0.20	0.043	(0.719)	0.035	0.008
48	4.00	0.20	0.043	(0.716)	0.035	0.008
49	4.08	0.20	0.043	(0.713)	0.035	0.008
50	4.17	0.20	0.043	(0.710)	0.035	0.008
51	4.25	0.20	0.043	(0.707)	0.035	0.008
52	4.33	0.23	0.050	(0.704)	0.041	0.009
53	4.42	0.23	0.050	(0.701)	0.041	0.009
54	4.50	0.23	0.050	(0.698)	0.041	0.009
55	4.58	0.23	0.050	(0.695)	0.041	0.009
56	4.67	0.23	0.050	(0.692)	0.041	0.009
57	4.75	0.23	0.050	(0.689)	0.041	0.009
58	4.83	0.27	0.058	(0.686)	0.047	0.010
59	4.92	0.27	0.058	(0.683)	0.047	0.010
60	5.00	0.27	0.058	(0.680)	0.047	0.010
61	5.08	0.20	0.043	(0.677)	0.035	0.008
62	5.17	0.20	0.043	(0.674)	0.035	0.008
63	5.25	0.20	0.043	(0.672)	0.035	0.008
64	5.33	0.23	0.050	(0.669)	0.041	0.009
65	5.42	0.23	0.050	(0.666)	0.041	0.009
66	5.50	0.23	0.050	(0.663)	0.041	0.009
67	5.58	0.27	0.058	(0.660)	0.047	0.010
68	5.67	0.27	0.058	(0.657)	0.047	0.010
69	5.75	0.27	0.058	(0.654)	0.047	0.010
70	5.83	0.27	0.058	(0.651)	0.047	0.010
71	5.92	0.27	0.058	(0.648)	0.047	0.010
72	6.00	0.27	0.058	(0.645)	0.047	0.010

73	6.08	0.30	0.065	(0.643)	0.053	0.012
74	6.17	0.30	0.065	(0.640)	0.053	0.012
75	6.25	0.30	0.065	(0.637)	0.053	0.012
76	6.33	0.30	0.065	(0.634)	0.053	0.012
77	6.42	0.30	0.065	(0.631)	0.053	0.012
78	6.50	0.30	0.065	(0.628)	0.053	0.012
79	6.58	0.33	0.072	(0.626)	0.059	0.013
80	6.67	0.33	0.072	(0.623)	0.059	0.013
81	6.75	0.33	0.072	(0.620)	0.059	0.013
82	6.83	0.33	0.072	(0.617)	0.059	0.013
83	6.92	0.33	0.072	(0.614)	0.059	0.013
84	7.00	0.33	0.072	(0.612)	0.059	0.013
85	7.08	0.33	0.072	(0.609)	0.059	0.013
86	7.17	0.33	0.072	(0.606)	0.059	0.013
87	7.25	0.33	0.072	(0.603)	0.059	0.013
88	7.33	0.37	0.079	(0.600)	0.065	0.014
89	7.42	0.37	0.079	(0.598)	0.065	0.014
90	7.50	0.37	0.079	(0.595)	0.065	0.014
91	7.58	0.40	0.086	(0.592)	0.071	0.016
92	7.67	0.40	0.086	(0.589)	0.071	0.016
93	7.75	0.40	0.086	(0.587)	0.071	0.016
94	7.83	0.43	0.094	(0.584)	0.077	0.017
95	7.92	0.43	0.094	(0.581)	0.077	0.017
96	8.00	0.43	0.094	(0.579)	0.077	0.017
97	8.08	0.50	0.108	(0.576)	0.089	0.019
98	8.17	0.50	0.108	(0.573)	0.089	0.019
99	8.25	0.50	0.108	(0.571)	0.089	0.019
100	8.33	0.50	0.108	(0.568)	0.089	0.019
101	8.42	0.50	0.108	(0.565)	0.089	0.019
102	8.50	0.50	0.108	(0.563)	0.089	0.019
103	8.58	0.53	0.115	(0.560)	0.094	0.021
104	8.67	0.53	0.115	(0.557)	0.094	0.021
105	8.75	0.53	0.115	(0.555)	0.094	0.021
106	8.83	0.57	0.122	(0.552)	0.100	0.022
107	8.92	0.57	0.122	(0.550)	0.100	0.022
108	9.00	0.57	0.122	(0.547)	0.100	0.022
109	9.08	0.63	0.137	(0.544)	0.112	0.025
110	9.17	0.63	0.137	(0.542)	0.112	0.025
111	9.25	0.63	0.137	(0.539)	0.112	0.025
112	9.33	0.67	0.144	(0.537)	0.118	0.026
113	9.42	0.67	0.144	(0.534)	0.118	0.026
114	9.50	0.67	0.144	(0.531)	0.118	0.026
115	9.58	0.70	0.151	(0.529)	0.124	0.027
116	9.67	0.70	0.151	(0.526)	0.124	0.027
117	9.75	0.70	0.151	(0.524)	0.124	0.027
118	9.83	0.73	0.158	(0.521)	0.130	0.029
119	9.92	0.73	0.158	(0.519)	0.130	0.029
120	10.00	0.73	0.158	(0.516)	0.130	0.029
121	10.08	0.50	0.108	(0.514)	0.089	0.019
122	10.17	0.50	0.108	(0.511)	0.089	0.019
123	10.25	0.50	0.108	(0.509)	0.089	0.019
124	10.33	0.50	0.108	(0.506)	0.089	0.019
125	10.42	0.50	0.108	(0.504)	0.089	0.019
126	10.50	0.50	0.108	(0.501)	0.089	0.019
127	10.58	0.67	0.144	(0.499)	0.118	0.026
128	10.67	0.67	0.144	(0.497)	0.118	0.026
129	10.75	0.67	0.144	(0.494)	0.118	0.026
130	10.83	0.67	0.144	(0.492)	0.118	0.026
131	10.92	0.67	0.144	(0.489)	0.118	0.026
132	11.00	0.67	0.144	(0.487)	0.118	0.026
133	11.08	0.63	0.137	(0.485)	0.112	0.025
134	11.17	0.63	0.137	(0.482)	0.112	0.025
135	11.25	0.63	0.137	(0.480)	0.112	0.025
136	11.33	0.63	0.137	(0.477)	0.112	0.025
137	11.42	0.63	0.137	(0.475)	0.112	0.025
138	11.50	0.63	0.137	(0.473)	0.112	0.025
139	11.58	0.57	0.122	(0.470)	0.100	0.022
140	11.67	0.57	0.122	(0.468)	0.100	0.022
141	11.75	0.57	0.122	(0.466)	0.100	0.022
142	11.83	0.60	0.130	(0.463)	0.106	0.023
143	11.92	0.60	0.130	(0.461)	0.106	0.023
144	12.00	0.60	0.130	(0.459)	0.106	0.023
145	12.08	0.83	0.180	(0.456)	0.148	0.032
146	12.17	0.83	0.180	(0.454)	0.148	0.032
147	12.25	0.83	0.180	(0.452)	0.148	0.032
148	12.33	0.87	0.187	(0.450)	0.154	0.034
149	12.42	0.87	0.187	(0.447)	0.154	0.034
150	12.50	0.87	0.187	(0.445)	0.154	0.034
151	12.58	0.93	0.202	(0.443)	0.165	0.036
152	12.67	0.93	0.202	(0.441)	0.165	0.036
153	12.75	0.93	0.202	(0.438)	0.165	0.036
154	12.83	0.97	0.209	(0.436)	0.171	0.038
155	12.92	0.97	0.209	(0.434)	0.171	0.038
156	13.00	0.97	0.209	(0.432)	0.171	0.038
157	13.08	1.13	0.245	(0.430)	0.201	0.044
158	13.17	1.13	0.245	(0.427)	0.201	0.044

159	13.25	1.13	0.245	(0.425)	0.201	0.044
160	13.33	1.13	0.245	(0.423)	0.201	0.044
161	13.42	1.13	0.245	(0.421)	0.201	0.044
162	13.50	1.13	0.245	(0.419)	0.201	0.044
163	13.58	0.77	0.166	(0.417)	0.136	0.030
164	13.67	0.77	0.166	(0.415)	0.136	0.030
165	13.75	0.77	0.166	(0.412)	0.136	0.030
166	13.83	0.77	0.166	(0.410)	0.136	0.030
167	13.92	0.77	0.166	(0.408)	0.136	0.030
168	14.00	0.77	0.166	(0.406)	0.136	0.030
169	14.08	0.90	0.194	(0.404)	0.159	0.035
170	14.17	0.90	0.194	(0.402)	0.159	0.035
171	14.25	0.90	0.194	(0.400)	0.159	0.035
172	14.33	0.87	0.187	(0.398)	0.154	0.034
173	14.42	0.87	0.187	(0.396)	0.154	0.034
174	14.50	0.87	0.187	(0.394)	0.154	0.034
175	14.58	0.87	0.187	(0.392)	0.154	0.034
176	14.67	0.87	0.187	(0.390)	0.154	0.034
177	14.75	0.87	0.187	(0.388)	0.154	0.034
178	14.83	0.83	0.180	(0.386)	0.148	0.032
179	14.92	0.83	0.180	(0.384)	0.148	0.032
180	15.00	0.83	0.180	(0.382)	0.148	0.032
181	15.08	0.80	0.173	(0.380)	0.142	0.031
182	15.17	0.80	0.173	(0.378)	0.142	0.031
183	15.25	0.80	0.173	(0.376)	0.142	0.031
184	15.33	0.77	0.166	(0.374)	0.136	0.030
185	15.42	0.77	0.166	(0.372)	0.136	0.030
186	15.50	0.77	0.166	(0.370)	0.136	0.030
187	15.58	0.63	0.137	(0.368)	0.112	0.025
188	15.67	0.63	0.137	(0.367)	0.112	0.025
189	15.75	0.63	0.137	(0.365)	0.112	0.025
190	15.83	0.63	0.137	(0.363)	0.112	0.025
191	15.92	0.63	0.137	(0.361)	0.112	0.025
192	16.00	0.63	0.137	(0.359)	0.112	0.025
193	16.08	0.13	0.029	(0.357)	0.024	0.005
194	16.17	0.13	0.029	(0.355)	0.024	0.005
195	16.25	0.13	0.029	(0.354)	0.024	0.005
196	16.33	0.13	0.029	(0.352)	0.024	0.005
197	16.42	0.13	0.029	(0.350)	0.024	0.005
198	16.50	0.13	0.029	(0.348)	0.024	0.005
199	16.58	0.10	0.022	(0.346)	0.018	0.004
200	16.67	0.10	0.022	(0.345)	0.018	0.004
201	16.75	0.10	0.022	(0.343)	0.018	0.004
202	16.83	0.10	0.022	(0.341)	0.018	0.004
203	16.92	0.10	0.022	(0.339)	0.018	0.004
204	17.00	0.10	0.022	(0.338)	0.018	0.004
205	17.08	0.17	0.036	(0.336)	0.030	0.006
206	17.17	0.17	0.036	(0.334)	0.030	0.006
207	17.25	0.17	0.036	(0.333)	0.030	0.006
208	17.33	0.17	0.036	(0.331)	0.030	0.006
209	17.42	0.17	0.036	(0.329)	0.030	0.006
210	17.50	0.17	0.036	(0.328)	0.030	0.006
211	17.58	0.17	0.036	(0.326)	0.030	0.006
212	17.67	0.17	0.036	(0.324)	0.030	0.006
213	17.75	0.17	0.036	(0.323)	0.030	0.006
214	17.83	0.13	0.029	(0.321)	0.024	0.005
215	17.92	0.13	0.029	(0.320)	0.024	0.005
216	18.00	0.13	0.029	(0.318)	0.024	0.005
217	18.08	0.13	0.029	(0.316)	0.024	0.005
218	18.17	0.13	0.029	(0.315)	0.024	0.005
219	18.25	0.13	0.029	(0.313)	0.024	0.005
220	18.33	0.13	0.029	(0.312)	0.024	0.005
221	18.42	0.13	0.029	(0.310)	0.024	0.005
222	18.50	0.13	0.029	(0.309)	0.024	0.005
223	18.58	0.10	0.022	(0.307)	0.018	0.004
224	18.67	0.10	0.022	(0.306)	0.018	0.004
225	18.75	0.10	0.022	(0.304)	0.018	0.004
226	18.83	0.07	0.014	(0.303)	0.012	0.003
227	18.92	0.07	0.014	(0.301)	0.012	0.003
228	19.00	0.07	0.014	(0.300)	0.012	0.003
229	19.08	0.10	0.022	(0.299)	0.018	0.004
230	19.17	0.10	0.022	(0.297)	0.018	0.004
231	19.25	0.10	0.022	(0.296)	0.018	0.004
232	19.33	0.13	0.029	(0.294)	0.024	0.005
233	19.42	0.13	0.029	(0.293)	0.024	0.005
234	19.50	0.13	0.029	(0.292)	0.024	0.005
235	19.58	0.10	0.022	(0.290)	0.018	0.004
236	19.67	0.10	0.022	(0.289)	0.018	0.004
237	19.75	0.10	0.022	(0.288)	0.018	0.004
238	19.83	0.07	0.014	(0.286)	0.012	0.003
239	19.92	0.07	0.014	(0.285)	0.012	0.003
240	20.00	0.07	0.014	(0.284)	0.012	0.003
241	20.08	0.10	0.022	(0.283)	0.018	0.004
242	20.17	0.10	0.022	(0.281)	0.018	0.004
243	20.25	0.10	0.022	(0.280)	0.018	0.004
244	20.33	0.10	0.022	(0.279)	0.018	0.004

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245  20.42     0.10      0.022       (  0.278)       0.018        0.004
246  20.50     0.10      0.022       (  0.277)       0.018        0.004
247  20.58     0.10      0.022       (  0.275)       0.018        0.004
248  20.67     0.10      0.022       (  0.274)       0.018        0.004
249  20.75     0.10      0.022       (  0.273)       0.018        0.004
250  20.83     0.07      0.014       (  0.272)       0.012        0.003
251  20.92     0.07      0.014       (  0.271)       0.012        0.003
252  21.00     0.07      0.014       (  0.270)       0.012        0.003
253  21.08     0.10      0.022       (  0.269)       0.018        0.004
254  21.17     0.10      0.022       (  0.268)       0.018        0.004
255  21.25     0.10      0.022       (  0.267)       0.018        0.004
256  21.33     0.07      0.014       (  0.266)       0.012        0.003
257  21.42     0.07      0.014       (  0.265)       0.012        0.003
258  21.50     0.07      0.014       (  0.264)       0.012        0.003
259  21.58     0.10      0.022       (  0.263)       0.018        0.004
260  21.67     0.10      0.022       (  0.262)       0.018        0.004
261  21.75     0.10      0.022       (  0.261)       0.018        0.004
262  21.83     0.07      0.014       (  0.260)       0.012        0.003
263  21.92     0.07      0.014       (  0.259)       0.012        0.003
264  22.00     0.07      0.014       (  0.258)       0.012        0.003
265  22.08     0.10      0.022       (  0.257)       0.018        0.004
266  22.17     0.10      0.022       (  0.256)       0.018        0.004
267  22.25     0.10      0.022       (  0.256)       0.018        0.004
268  22.33     0.07      0.014       (  0.255)       0.012        0.003
269  22.42     0.07      0.014       (  0.254)       0.012        0.003
270  22.50     0.07      0.014       (  0.253)       0.012        0.003
271  22.58     0.07      0.014       (  0.253)       0.012        0.003
272  22.67     0.07      0.014       (  0.252)       0.012        0.003
273  22.75     0.07      0.014       (  0.251)       0.012        0.003
274  22.83     0.07      0.014       (  0.251)       0.012        0.003
275  22.92     0.07      0.014       (  0.250)       0.012        0.003
276  23.00     0.07      0.014       (  0.249)       0.012        0.003
277  23.08     0.07      0.014       (  0.249)       0.012        0.003
278  23.17     0.07      0.014       (  0.248)       0.012        0.003
279  23.25     0.07      0.014       (  0.248)       0.012        0.003
280  23.33     0.07      0.014       (  0.247)       0.012        0.003
281  23.42     0.07      0.014       (  0.247)       0.012        0.003
282  23.50     0.07      0.014       (  0.246)       0.012        0.003
283  23.58     0.07      0.014       (  0.246)       0.012        0.003
284  23.67     0.07      0.014       (  0.245)       0.012        0.003
285  23.75     0.07      0.014       (  0.245)       0.012        0.003
286  23.83     0.07      0.014       (  0.245)       0.012        0.003
287  23.92     0.07      0.014       (  0.245)       0.012        0.003
288  24.00     0.07      0.014       (  0.245)       0.012        0.003
                (Loss Rate Not Used)
    Sum =     100.0                                  Sum =      3.9
      Flood volume = Effective rainfall      0.32(In)
       times area       7.0(Ac.)/[(In)/(Ft.)] =       0.2(Ac.Ft)
      Total soil loss =      1.48(In)
      Total soil loss =     0.861(Ac.Ft)
      Total rainfall =      1.80(In)
      Flood volume =        8232.7 Cubic Feet
      Total soil loss =       37504.6 Cubic Feet
      ---------------------------------------------------------------------
       Peak flow rate of this hydrograph =      0.311(CFS)
      ---------------------------------------------------------------------
      +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                          24 - H O U R    S T O R M
                     R u n o f f      H y d r o g r a p h
      ---------------------------------------------------------------------
                  Hydrograph in   5   Minute intervals ((CFS))

      ---------------------------------------------------------------------
 Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
 ---------------------------------------------------------------------------
   0+ 5       0.0001      0.01  Q          |         |         |         |
   0+10       0.0002      0.02  Q          |         |         |         |
   0+15       0.0003      0.02  Q          |         |         |         |
   0+20       0.0004      0.02  Q          |         |         |         |
   0+25       0.0006      0.03  Q          |         |         |         |
   0+30       0.0008      0.03  Q          |         |         |         |
   0+35       0.0010      0.03  Q          |         |         |         |
   0+40       0.0012      0.03  Q          |         |         |         |
   0+45       0.0014      0.03  Q          |         |         |         |
   0+50       0.0016      0.03  Q          |         |         |         |
   0+55       0.0018      0.04  Q          |         |         |         |
   1+ 0       0.0021      0.04  Q          |         |         |         |
   1+ 5       0.0023      0.03  Q          |         |         |         |
   1+10       0.0025      0.03  Q          |         |         |         |
   1+15       0.0027      0.03  Q          |         |         |         |
   1+20       0.0029      0.03  Q          |         |         |         |
   1+25       0.0031      0.03  Q          |         |         |         |
   1+30       0.0033      0.03  Q          |         |         |         |
   1+35       0.0035      0.03  Q          |         |         |         |
   1+40       0.0037      0.03  Q          |         |         |         |
   1+45       0.0038      0.03  Q          |         |         |         |
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1+50      0.0041      0.03  Q          |          |          |          |
1+55      0.0043      0.04  Q          |          |          |          |
2+ 0      0.0046      0.04  Q          |          |          |          |
2+ 5      0.0048      0.04  QV         |          |          |          |
2+10      0.0051      0.04  QV         |          |          |          |
2+15      0.0053      0.04  QV         |          |          |          |
2+20      0.0056      0.04  QV         |          |          |          |
2+25      0.0058      0.04  QV         |          |          |          |
2+30      0.0061      0.04  QV         |          |          |          |
2+35      0.0063      0.04  QV         |          |          |          |
2+40      0.0067      0.04  QV         |          |          |          |
2+45      0.0070      0.05  QV         |          |          |          |
2+50      0.0073      0.05  QV         |          |          |          |
2+55      0.0076      0.05  QV         |          |          |          |
3+ 0      0.0079      0.05  QV         |          |          |          |
3+ 5      0.0082      0.05  QV         |          |          |          |
3+10      0.0085      0.05  QV         |          |          |          |
3+15      0.0089      0.05  QV         |          |          |          |
3+20      0.0092      0.05  QV         |          |          |          |
3+25      0.0095      0.05  Q V        |          |          |          |
3+30      0.0098      0.05  Q V        |          |          |          |
3+35      0.0101      0.05  Q V        |          |          |          |
3+40      0.0104      0.05  Q V        |          |          |          |
3+45      0.0107      0.05  Q V        |          |          |          |
3+50      0.0111      0.05  Q V        |          |          |          |
3+55      0.0115      0.05  Q V        |          |          |          |
4+ 0      0.0118      0.05  Q V        |          |          |          |
4+ 5      0.0122      0.05  Q V        |          |          |          |
4+10      0.0126      0.05  Q V        |          |          |          |
4+15      0.0130      0.05  Q V        |          |          |          |
4+20      0.0134      0.06  Q V        |          |          |          |
4+25      0.0138      0.06  Q V        |          |          |          |
4+30      0.0143      0.06  Q  V       |          |          |          |
4+35      0.0147      0.06  Q  V       |          |          |          |
4+40      0.0151      0.06  Q  V       |          |          |          |
4+45      0.0156      0.06  Q  V       |          |          |          |
4+50      0.0160      0.07  Q  V       |          |          |          |
4+55      0.0165      0.07  Q  V       |          |          |          |
5+ 0      0.0170      0.07  Q  V       |          |          |          |
5+ 5      0.0175      0.06  Q  V       |          |          |          |
5+10      0.0179      0.06  Q  V       |          |          |          |
5+15      0.0183      0.06  Q  V       |          |          |          |
5+20      0.0187      0.06  Q  V       |          |          |          |
5+25      0.0191      0.06  Q   V      |          |          |          |
5+30      0.0195      0.06  Q   V      |          |          |          |
5+35      0.0200      0.07  Q   V      |          |          |          |
5+40      0.0205      0.07  Q   V      |          |          |          |
5+45      0.0210      0.07  Q   V      |          |          |          |
5+50      0.0215      0.07  Q   V      |          |          |          |
5+55      0.0220      0.07  Q   V      |          |          |          |
6+ 0      0.0225      0.07  Q   V      |          |          |          |
6+ 5      0.0231      0.08  Q   V      |          |          |          |
6+10      0.0236      0.08  Q   V      |          |          |          |
6+15      0.0242      0.08  Q    V     |          |          |          |
6+20      0.0248      0.08  Q    V     |          |          |          |
6+25      0.0253      0.08  Q    V     |          |          |          |
6+30      0.0259      0.08  Q    V     |          |          |          |
6+35      0.0265      0.09  Q    V     |          |          |          |
6+40      0.0271      0.09  Q    V     |          |          |          |
6+45      0.0277      0.09  Q    V     |          |          |          |
6+50      0.0284      0.09  Q     V    |          |          |          |
6+55      0.0290      0.09  Q     V    |          |          |          |
7+ 0      0.0296      0.09  Q     V    |          |          |          |
7+ 5      0.0303      0.09  Q     V    |          |          |          |
7+10      0.0309      0.09  Q     V    |          |          |          |
7+15      0.0315      0.09  Q     V    |          |          |          |
7+20      0.0322      0.10  Q     V    |          |          |          |
7+25      0.0329      0.10  Q     V    |          |          |          |
7+30      0.0336      0.10  Q      V   |          |          |          |
7+35      0.0343      0.10  Q      V   |          |          |          |
7+40      0.0350      0.11  Q      V   |          |          |          |
7+45      0.0358      0.11  Q      V   |          |          |          |
7+50      0.0366      0.11  Q      V   |          |          |          |
7+55      0.0374      0.12  Q      V   |          |          |          |
8+ 0      0.0382      0.12  Q       V  |          |          |          |
8+ 5      0.0391      0.13  Q       V  |          |          |          |
8+10      0.0400      0.14  Q       V  |          |          |          |
8+15      0.0409      0.14  Q       V  |          |          |          |
8+20      0.0419      0.14  Q       V  |          |          |          |
8+25      0.0428      0.14  Q        V |          |          |          |
8+30      0.0438      0.14  Q        V |          |          |          |
8+35      0.0448      0.14  Q        V |          |          |          |
8+40      0.0458      0.15  Q        V |          |          |          |
8+45      0.0468      0.15  Q        V |          |          |          |
8+50      0.0478      0.15  Q         V          |          |          |
8+55      0.0489      0.15  Q         V          |          |          |
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9+ 0	0.0499	0.16	Q	
9+ 5	0.0511	0.16	Q	
9+10	0.0522	0.17	Q	
9+15	0.0534	0.17	Q	
9+20	0.0547	0.18	Q	
9+25	0.0559	0.18	Q	
9+30	0.0572	0.18	Q	
9+35	0.0585	0.19	Q	
9+40	0.0598	0.19	Q	
9+45	0.0611	0.19	Q	
9+50	0.0625	0.20	Q	
9+55	0.0638	0.20	Q	
10+ 0	0.0652	0.20	Q	
10+ 5	0.0664	0.17	Q	
10+10	0.0674	0.14	Q	
10+15	0.0683	0.14	Q	
10+20	0.0693	0.14	Q	
10+25	0.0702	0.14	Q	
10+30	0.0712	0.14	Q	
10+35	0.0723	0.16	Q	
10+40	0.0735	0.18	Q	
10+45	0.0747	0.18	Q	
10+50	0.0760	0.18	Q	
10+55	0.0773	0.18	Q	
11+ 0	0.0785	0.18	Q	
11+ 5	0.0798	0.18	Q	
11+10	0.0810	0.17	Q	
11+15	0.0822	0.17	Q	
11+20	0.0834	0.17	Q	
11+25	0.0846	0.17	Q	
11+30	0.0858	0.17	Q	
11+35	0.0869	0.17	Q	
11+40	0.0880	0.16	Q	
11+45	0.0891	0.16	Q	
11+50	0.0902	0.16	Q	
11+55	0.0913	0.16	Q	
12+ 0	0.0924	0.16	Q	
12+ 5	0.0938	0.19	Q	
12+10	0.0953	0.22	Q	
12+15	0.0968	0.23	Q	
12+20	0.0984	0.23	Q	
12+25	0.1001	0.24	Q	
12+30	0.1017	0.24	Q	
12+35	0.1034	0.25	Q	
12+40	0.1052	0.25	Q	
12+45	0.1069	0.26	Q	
12+50	0.1087	0.26	Q	
12+55	0.1105	0.26	Q	
13+ 0	0.1124	0.26	Q	
13+ 5	0.1143	0.29	Q	
13+10	0.1164	0.31	Q	
13+15	0.1186	0.31	Q	
13+20	0.1207	0.31	Q	
13+25	0.1229	0.31	Q	
13+30	0.1250	0.31	Q	
13+35	0.1268	0.26	Q	
13+40	0.1283	0.22	Q	
13+45	0.1298	0.21	Q	
13+50	0.1313	0.21	Q	
13+55	0.1327	0.21	Q	
14+ 0	0.1342	0.21	Q	
14+ 5	0.1357	0.23	Q	
14+10	0.1374	0.24	Q	
14+15	0.1391	0.25	Q	
14+20	0.1408	0.24	Q	
14+25	0.1424	0.24	Q	
14+30	0.1440	0.24	Q	
14+35	0.1457	0.24	Q	
14+40	0.1473	0.24	Q	
14+45	0.1490	0.24	Q	
14+50	0.1506	0.23	Q	
14+55	0.1521	0.23	Q	
15+ 0	0.1537	0.23	Q	
15+ 5	0.1553	0.22	Q	
15+10	0.1568	0.22	Q	
15+15	0.1583	0.22	Q	
15+20	0.1598	0.22	Q	
15+25	0.1612	0.21	Q	
15+30	0.1627	0.21	Q	
15+35	0.1640	0.19	Q	
15+40	0.1652	0.18	Q	
15+45	0.1665	0.17	Q	
15+50	0.1677	0.17	Q	
15+55	0.1688	0.17	Q	
16+ 0	0.1700	0.17	Q	
16+ 5	0.1708	0.11	Q	

16+10	0.1712	0.05	Q	|	|	|	V |
16+15	0.1714	0.04	Q	|	|	|	V |
16+20	0.1717	0.04	Q	|	|	|	V |
16+25	0.1719	0.04	Q	|	|	|	V |
16+30	0.1722	0.04	Q	|	|	|	V |
16+35	0.1724	0.03	Q	|	|	|	V |
16+40	0.1726	0.03	Q	|	|	|	V |
16+45	0.1728	0.03	Q	|	|	|	V |
16+50	0.1730	0.03	Q	|	|	|	V |
16+55	0.1732	0.03	Q	|	|	|	V |
17+ 0	0.1734	0.03	Q	|	|	|	V |
17+ 5	0.1736	0.04	Q	|	|	|	V |
17+10	0.1739	0.04	Q	|	|	|	V |
17+15	0.1742	0.05	Q	|	|	|	V |
17+20	0.1745	0.05	Q	|	|	|	V |
17+25	0.1749	0.05	Q	|	|	|	V |
17+30	0.1752	0.05	Q	|	|	|	V |
17+35	0.1755	0.05	Q	|	|	|	V |
17+40	0.1758	0.05	Q	|	|	|	V |
17+45	0.1761	0.05	Q	|	|	|	V |
17+50	0.1764	0.04	Q	|	|	|	V |
17+55	0.1767	0.04	Q	|	|	|	V |
18+ 0	0.1769	0.04	Q	|	|	|	V |
18+ 5	0.1772	0.04	Q	|	|	|	V |
18+10	0.1774	0.04	Q	|	|	|	V |
18+15	0.1777	0.04	Q	|	|	|	V |
18+20	0.1779	0.04	Q	|	|	|	V |
18+25	0.1782	0.04	Q	|	|	|	V |
18+30	0.1784	0.04	Q	|	|	|	V |
18+35	0.1787	0.03	Q	|	|	|	V |
18+40	0.1789	0.03	Q	|	|	|	V |
18+45	0.1790	0.03	Q	|	|	|	V |
18+50	0.1792	0.02	Q	|	|	|	V |
18+55	0.1793	0.02	Q	|	|	|	V |
19+ 0	0.1795	0.02	Q	|	|	|	V |
19+ 5	0.1796	0.02	Q	|	|	|	V |
19+10	0.1798	0.03	Q	|	|	|	V |
19+15	0.1800	0.03	Q	|	|	|	V |
19+20	0.1802	0.03	Q	|	|	|	V |
19+25	0.1805	0.04	Q	|	|	|	V |
19+30	0.1807	0.04	Q	|	|	|	V |
19+35	0.1809	0.03	Q	|	|	|	V |
19+40	0.1811	0.03	Q	|	|	|	V |
19+45	0.1813	0.03	Q	|	|	|	V |
19+50	0.1815	0.02	Q	|	|	|	V |
19+55	0.1816	0.02	Q	|	|	|	V |
20+ 0	0.1817	0.02	Q	|	|	|	V |
20+ 5	0.1819	0.02	Q	|	|	|	V |
20+10	0.1821	0.03	Q	|	|	|	V |
20+15	0.1823	0.03	Q	|	|	|	V |
20+20	0.1824	0.03	Q	|	|	|	V |
20+25	0.1826	0.03	Q	|	|	|	V |
20+30	0.1828	0.03	Q	|	|	|	V |
20+35	0.1830	0.03	Q	|	|	|	V |
20+40	0.1832	0.03	Q	|	|	|	V |
20+45	0.1834	0.03	Q	|	|	|	V |
20+50	0.1835	0.02	Q	|	|	|	V |
20+55	0.1837	0.02	Q	|	|	|	V |
21+ 0	0.1838	0.02	Q	|	|	|	V |
21+ 5	0.1840	0.02	Q	|	|	|	V |
21+10	0.1841	0.03	Q	|	|	|	V |
21+15	0.1843	0.03	Q	|	|	|	V|
21+20	0.1845	0.02	Q	|	|	|	V|
21+25	0.1846	0.02	Q	|	|	|	V|
21+30	0.1848	0.02	Q	|	|	|	V|
21+35	0.1849	0.02	Q	|	|	|	V|
21+40	0.1851	0.03	Q	|	|	|	V|
21+45	0.1853	0.03	Q	|	|	|	V|
21+50	0.1854	0.02	Q	|	|	|	V|
21+55	0.1856	0.02	Q	|	|	|	V|
22+ 0	0.1857	0.02	Q	|	|	|	V|
22+ 5	0.1859	0.02	Q	|	|	|	V|
22+10	0.1860	0.03	Q	|	|	|	V|
22+15	0.1862	0.03	Q	|	|	|	V|
22+20	0.1864	0.02	Q	|	|	|	V|
22+25	0.1865	0.02	Q	|	|	|	V|
22+30	0.1866	0.02	Q	|	|	|	V|
22+35	0.1868	0.02	Q	|	|	|	V|
22+40	0.1869	0.02	Q	|	|	|	V|
22+45	0.1870	0.02	Q	|	|	|	V|
22+50	0.1871	0.02	Q	|	|	|	V|
22+55	0.1873	0.02	Q	|	|	|	V|
23+ 0	0.1874	0.02	Q	|	|	|	V|
23+ 5	0.1875	0.02	Q	|	|	|	V|
23+10	0.1877	0.02	Q	|	|	|	V|
23+15	0.1878	0.02	Q	|	|	|	V|

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   23+20       0.1879      0.02  Q          |          |          |          v|
   23+25       0.1880      0.02  Q          |          |          |          v|
   23+30       0.1882      0.02  Q          |          |          |          v|
   23+35       0.1883      0.02  Q          |          |          |          v|
   23+40       0.1884      0.02  Q          |          |          |          v|
   23+45       0.1885      0.02  Q          |          |          |          v|
   23+50       0.1887      0.02  Q          |          |          |          v|
   23+55       0.1888      0.02  Q          |          |          |          v|
   24+ 0       0.1889      0.02  Q          |          |          |          v|
   24+ 5       0.1890      0.01  Q          |          |          |          v|
   24+10       0.1890      0.00  Q          |          |          |          v|
   24+15       0.1890      0.00  Q          |          |          |          v|
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U n i t H y d r o g r a p h A n a l y s i s

Study date 02/22/24 File: 2YR242.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978

Program License Serial Number 5006

English (in-lb) Input Units Used
English Rainfall Data (Inches) Input Values Used

English Units used in output format

Drainage Area = 7.00(Ac.) = 0.011 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 7.00(Ac.) = 0.011 Sq. Mi.
Length along longest watercourse = 861.00(Ft.)
Length along longest watercourse measured to centroid = 430.00(Ft.)
Length along longest watercourse = 0.163 Mi.
Length along longest watercourse measured to centroid = 0.081 Mi.
Difference in elevation = 16.90(Ft.)
Slope along watercourse = 103.6376 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time = 0.029 Hr.
Lag time = 1.73 Min.
25% of lag time = 0.43 Min.
40% of lag time = 0.69 Min.
Unit time = 5.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow = 0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
7.00	1.80	12.60

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
7.00	6.00	42.00

STORM EVENT (YEAR) = 2.00
Area Averaged 2-Year Rainfall = 1.800(In)
Area Averaged 100-Year Rainfall = 6.000(In)

Point rain (area averaged) = 1.800(In)
Areal adjustment factor = 100.00 %
Adjusted average point rain = 1.800(In)

Sub-Area Data:

Area(Ac.)	Runoff Index	Impervious %
7.000	69.00	0.600

Total Area Entered = 7.00(Ac.)

RI AMC2	RI AMC-1	Infil. Rate (In/Hr)	Impervious (Dec.%)	Adj. Infil. Rate (In/Hr)	Area% (Dec.)	F (In/Hr)
69.0	49.8	0.574	0.600	0.264	1.000	0.264
					Sum (F) =	0.264

Area averaged mean soil loss (F) (In/Hr) = 0.264
Minimum soil loss rate ((In/Hr)) = 0.132
(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.420

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)	Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)

1	0.083	288.833	55.504	3.916
2	0.167	577.666	37.752	2.663
3	0.250	866.500	6.744	0.476
			Sum = 100.000 Sum=	7.055

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	0.07	0.014	(0.468)	0.006	0.008
2	0.17	0.07	0.014	(0.466)	0.006	0.008
3	0.25	0.07	0.014	(0.464)	0.006	0.008
4	0.33	0.10	0.022	(0.463)	0.009	0.013
5	0.42	0.10	0.022	(0.461)	0.009	0.013
6	0.50	0.10	0.022	(0.459)	0.009	0.013
7	0.58	0.10	0.022	(0.457)	0.009	0.013
8	0.67	0.10	0.022	(0.455)	0.009	0.013
9	0.75	0.10	0.022	(0.454)	0.009	0.013
10	0.83	0.13	0.029	(0.452)	0.012	0.017
11	0.92	0.13	0.029	(0.450)	0.012	0.017
12	1.00	0.13	0.029	(0.448)	0.012	0.017
13	1.08	0.10	0.022	(0.447)	0.009	0.013
14	1.17	0.10	0.022	(0.445)	0.009	0.013
15	1.25	0.10	0.022	(0.443)	0.009	0.013
16	1.33	0.10	0.022	(0.441)	0.009	0.013
17	1.42	0.10	0.022	(0.439)	0.009	0.013
18	1.50	0.10	0.022	(0.438)	0.009	0.013
19	1.58	0.10	0.022	(0.436)	0.009	0.013
20	1.67	0.10	0.022	(0.434)	0.009	0.013
21	1.75	0.10	0.022	(0.433)	0.009	0.013
22	1.83	0.13	0.029	(0.431)	0.012	0.017
23	1.92	0.13	0.029	(0.429)	0.012	0.017
24	2.00	0.13	0.029	(0.427)	0.012	0.017
25	2.08	0.13	0.029	(0.426)	0.012	0.017
26	2.17	0.13	0.029	(0.424)	0.012	0.017
27	2.25	0.13	0.029	(0.422)	0.012	0.017
28	2.33	0.13	0.029	(0.420)	0.012	0.017
29	2.42	0.13	0.029	(0.419)	0.012	0.017
30	2.50	0.13	0.029	(0.417)	0.012	0.017
31	2.58	0.17	0.036	(0.415)	0.015	0.021
32	2.67	0.17	0.036	(0.414)	0.015	0.021
33	2.75	0.17	0.036	(0.412)	0.015	0.021
34	2.83	0.17	0.036	(0.410)	0.015	0.021
35	2.92	0.17	0.036	(0.408)	0.015	0.021
36	3.00	0.17	0.036	(0.407)	0.015	0.021
37	3.08	0.17	0.036	(0.405)	0.015	0.021
38	3.17	0.17	0.036	(0.403)	0.015	0.021
39	3.25	0.17	0.036	(0.402)	0.015	0.021
40	3.33	0.17	0.036	(0.400)	0.015	0.021
41	3.42	0.17	0.036	(0.398)	0.015	0.021
42	3.50	0.17	0.036	(0.397)	0.015	0.021
43	3.58	0.17	0.036	(0.395)	0.015	0.021
44	3.67	0.17	0.036	(0.393)	0.015	0.021
45	3.75	0.17	0.036	(0.392)	0.015	0.021
46	3.83	0.20	0.043	(0.390)	0.018	0.025
47	3.92	0.20	0.043	(0.388)	0.018	0.025
48	4.00	0.20	0.043	(0.387)	0.018	0.025
49	4.08	0.20	0.043	(0.385)	0.018	0.025
50	4.17	0.20	0.043	(0.384)	0.018	0.025
51	4.25	0.20	0.043	(0.382)	0.018	0.025
52	4.33	0.23	0.050	(0.380)	0.021	0.029
53	4.42	0.23	0.050	(0.379)	0.021	0.029
54	4.50	0.23	0.050	(0.377)	0.021	0.029
55	4.58	0.23	0.050	(0.375)	0.021	0.029
56	4.67	0.23	0.050	(0.374)	0.021	0.029
57	4.75	0.23	0.050	(0.372)	0.021	0.029
58	4.83	0.27	0.058	(0.371)	0.024	0.033
59	4.92	0.27	0.058	(0.369)	0.024	0.033
60	5.00	0.27	0.058	(0.367)	0.024	0.033
61	5.08	0.20	0.043	(0.366)	0.018	0.025
62	5.17	0.20	0.043	(0.364)	0.018	0.025
63	5.25	0.20	0.043	(0.363)	0.018	0.025
64	5.33	0.23	0.050	(0.361)	0.021	0.029
65	5.42	0.23	0.050	(0.359)	0.021	0.029
66	5.50	0.23	0.050	(0.358)	0.021	0.029
67	5.58	0.27	0.058	(0.356)	0.024	0.033
68	5.67	0.27	0.058	(0.355)	0.024	0.033
69	5.75	0.27	0.058	(0.353)	0.024	0.033
70	5.83	0.27	0.058	(0.352)	0.024	0.033
71	5.92	0.27	0.058	(0.350)	0.024	0.033
72	6.00	0.27	0.058	(0.349)	0.024	0.033
73	6.08	0.30	0.065	(0.347)	0.027	0.038

74	6.17	0.30	0.065	(0.345)	0.027	0.038
75	6.25	0.30	0.065	(0.344)	0.027	0.038
76	6.33	0.30	0.065	(0.342)	0.027	0.038
77	6.42	0.30	0.065	(0.341)	0.027	0.038
78	6.50	0.30	0.065	(0.339)	0.027	0.038
79	6.58	0.33	0.072	(0.338)	0.030	0.042
80	6.67	0.33	0.072	(0.336)	0.030	0.042
81	6.75	0.33	0.072	(0.335)	0.030	0.042
82	6.83	0.33	0.072	(0.333)	0.030	0.042
83	6.92	0.33	0.072	(0.332)	0.030	0.042
84	7.00	0.33	0.072	(0.330)	0.030	0.042
85	7.08	0.33	0.072	(0.329)	0.030	0.042
86	7.17	0.33	0.072	(0.327)	0.030	0.042
87	7.25	0.33	0.072	(0.326)	0.030	0.042
88	7.33	0.37	0.079	(0.324)	0.033	0.046
89	7.42	0.37	0.079	(0.323)	0.033	0.046
90	7.50	0.37	0.079	(0.321)	0.033	0.046
91	7.58	0.40	0.086	(0.320)	0.036	0.050
92	7.67	0.40	0.086	(0.318)	0.036	0.050
93	7.75	0.40	0.086	(0.317)	0.036	0.050
94	7.83	0.43	0.094	(0.315)	0.039	0.054
95	7.92	0.43	0.094	(0.314)	0.039	0.054
96	8.00	0.43	0.094	(0.312)	0.039	0.054
97	8.08	0.50	0.108	(0.311)	0.045	0.063
98	8.17	0.50	0.108	(0.310)	0.045	0.063
99	8.25	0.50	0.108	(0.308)	0.045	0.063
100	8.33	0.50	0.108	(0.307)	0.045	0.063
101	8.42	0.50	0.108	(0.305)	0.045	0.063
102	8.50	0.50	0.108	(0.304)	0.045	0.063
103	8.58	0.53	0.115	(0.302)	0.048	0.067
104	8.67	0.53	0.115	(0.301)	0.048	0.067
105	8.75	0.53	0.115	(0.300)	0.048	0.067
106	8.83	0.57	0.122	(0.298)	0.051	0.071
107	8.92	0.57	0.122	(0.297)	0.051	0.071
108	9.00	0.57	0.122	(0.295)	0.051	0.071
109	9.08	0.63	0.137	(0.294)	0.057	0.079
110	9.17	0.63	0.137	(0.293)	0.057	0.079
111	9.25	0.63	0.137	(0.291)	0.057	0.079
112	9.33	0.67	0.144	(0.290)	0.060	0.084
113	9.42	0.67	0.144	(0.288)	0.060	0.084
114	9.50	0.67	0.144	(0.287)	0.060	0.084
115	9.58	0.70	0.151	(0.286)	0.064	0.088
116	9.67	0.70	0.151	(0.284)	0.064	0.088
117	9.75	0.70	0.151	(0.283)	0.064	0.088
118	9.83	0.73	0.158	(0.282)	0.067	0.092
119	9.92	0.73	0.158	(0.280)	0.067	0.092
120	10.00	0.73	0.158	(0.279)	0.067	0.092
121	10.08	0.50	0.108	(0.277)	0.045	0.063
122	10.17	0.50	0.108	(0.276)	0.045	0.063
123	10.25	0.50	0.108	(0.275)	0.045	0.063
124	10.33	0.50	0.108	(0.273)	0.045	0.063
125	10.42	0.50	0.108	(0.272)	0.045	0.063
126	10.50	0.50	0.108	(0.271)	0.045	0.063
127	10.58	0.67	0.144	(0.269)	0.060	0.084
128	10.67	0.67	0.144	(0.268)	0.060	0.084
129	10.75	0.67	0.144	(0.267)	0.060	0.084
130	10.83	0.67	0.144	(0.266)	0.060	0.084
131	10.92	0.67	0.144	(0.264)	0.060	0.084
132	11.00	0.67	0.144	(0.263)	0.060	0.084
133	11.08	0.63	0.137	(0.262)	0.057	0.079
134	11.17	0.63	0.137	(0.260)	0.057	0.079
135	11.25	0.63	0.137	(0.259)	0.057	0.079
136	11.33	0.63	0.137	(0.258)	0.057	0.079
137	11.42	0.63	0.137	(0.256)	0.057	0.079
138	11.50	0.63	0.137	(0.255)	0.057	0.079
139	11.58	0.57	0.122	(0.254)	0.051	0.071
140	11.67	0.57	0.122	(0.253)	0.051	0.071
141	11.75	0.57	0.122	(0.251)	0.051	0.071
142	11.83	0.60	0.130	(0.250)	0.054	0.075
143	11.92	0.60	0.130	(0.249)	0.054	0.075
144	12.00	0.60	0.130	(0.248)	0.054	0.075
145	12.08	0.83	0.180	(0.246)	0.076	0.104
146	12.17	0.83	0.180	(0.245)	0.076	0.104
147	12.25	0.83	0.180	(0.244)	0.076	0.104
148	12.33	0.87	0.187	(0.243)	0.079	0.109
149	12.42	0.87	0.187	(0.242)	0.079	0.109
150	12.50	0.87	0.187	(0.240)	0.079	0.109
151	12.58	0.93	0.202	(0.239)	0.085	0.117
152	12.67	0.93	0.202	(0.238)	0.085	0.117
153	12.75	0.93	0.202	(0.237)	0.085	0.117
154	12.83	0.97	0.209	(0.236)	0.088	0.121
155	12.92	0.97	0.209	(0.234)	0.088	0.121
156	13.00	0.97	0.209	(0.233)	0.088	0.121
157	13.08	1.13	0.245	(0.232)	0.103	0.142
158	13.17	1.13	0.245	(0.231)	0.103	0.142
159	13.25	1.13	0.245	(0.230)	0.103	0.142

160	13.33	1.13	0.245	(0.228)	0.103	0.142
161	13.42	1.13	0.245	(0.227)	0.103	0.142
162	13.50	1.13	0.245	(0.226)	0.103	0.142
163	13.58	0.77	0.166	(0.225)	0.070	0.096
164	13.67	0.77	0.166	(0.224)	0.070	0.096
165	13.75	0.77	0.166	(0.223)	0.070	0.096
166	13.83	0.77	0.166	(0.222)	0.070	0.096
167	13.92	0.77	0.166	(0.220)	0.070	0.096
168	14.00	0.77	0.166	(0.219)	0.070	0.096
169	14.08	0.90	0.194	(0.218)	0.082	0.113
170	14.17	0.90	0.194	(0.217)	0.082	0.113
171	14.25	0.90	0.194	(0.216)	0.082	0.113
172	14.33	0.87	0.187	(0.215)	0.079	0.109
173	14.42	0.87	0.187	(0.214)	0.079	0.109
174	14.50	0.87	0.187	(0.213)	0.079	0.109
175	14.58	0.87	0.187	(0.212)	0.079	0.109
176	14.67	0.87	0.187	(0.210)	0.079	0.109
177	14.75	0.87	0.187	(0.209)	0.079	0.109
178	14.83	0.83	0.180	(0.208)	0.076	0.104
179	14.92	0.83	0.180	(0.207)	0.076	0.104
180	15.00	0.83	0.180	(0.206)	0.076	0.104
181	15.08	0.80	0.173	(0.205)	0.073	0.100
182	15.17	0.80	0.173	(0.204)	0.073	0.100
183	15.25	0.80	0.173	(0.203)	0.073	0.100
184	15.33	0.77	0.166	(0.202)	0.070	0.096
185	15.42	0.77	0.166	(0.201)	0.070	0.096
186	15.50	0.77	0.166	(0.200)	0.070	0.096
187	15.58	0.63	0.137	(0.199)	0.057	0.079
188	15.67	0.63	0.137	(0.198)	0.057	0.079
189	15.75	0.63	0.137	(0.197)	0.057	0.079
190	15.83	0.63	0.137	(0.196)	0.057	0.079
191	15.92	0.63	0.137	(0.195)	0.057	0.079
192	16.00	0.63	0.137	(0.194)	0.057	0.079
193	16.08	0.13	0.029	(0.193)	0.012	0.017
194	16.17	0.13	0.029	(0.192)	0.012	0.017
195	16.25	0.13	0.029	(0.191)	0.012	0.017
196	16.33	0.13	0.029	(0.190)	0.012	0.017
197	16.42	0.13	0.029	(0.189)	0.012	0.017
198	16.50	0.13	0.029	(0.188)	0.012	0.017
199	16.58	0.10	0.022	(0.187)	0.009	0.013
200	16.67	0.10	0.022	(0.186)	0.009	0.013
201	16.75	0.10	0.022	(0.185)	0.009	0.013
202	16.83	0.10	0.022	(0.184)	0.009	0.013
203	16.92	0.10	0.022	(0.183)	0.009	0.013
204	17.00	0.10	0.022	(0.182)	0.009	0.013
205	17.08	0.17	0.036	(0.181)	0.015	0.021
206	17.17	0.17	0.036	(0.181)	0.015	0.021
207	17.25	0.17	0.036	(0.180)	0.015	0.021
208	17.33	0.17	0.036	(0.179)	0.015	0.021
209	17.42	0.17	0.036	(0.178)	0.015	0.021
210	17.50	0.17	0.036	(0.177)	0.015	0.021
211	17.58	0.17	0.036	(0.176)	0.015	0.021
212	17.67	0.17	0.036	(0.175)	0.015	0.021
213	17.75	0.17	0.036	(0.174)	0.015	0.021
214	17.83	0.13	0.029	(0.173)	0.012	0.017
215	17.92	0.13	0.029	(0.173)	0.012	0.017
216	18.00	0.13	0.029	(0.172)	0.012	0.017
217	18.08	0.13	0.029	(0.171)	0.012	0.017
218	18.17	0.13	0.029	(0.170)	0.012	0.017
219	18.25	0.13	0.029	(0.169)	0.012	0.017
220	18.33	0.13	0.029	(0.168)	0.012	0.017
221	18.42	0.13	0.029	(0.168)	0.012	0.017
222	18.50	0.13	0.029	(0.167)	0.012	0.017
223	18.58	0.10	0.022	(0.166)	0.009	0.013
224	18.67	0.10	0.022	(0.165)	0.009	0.013
225	18.75	0.10	0.022	(0.164)	0.009	0.013
226	18.83	0.07	0.014	(0.164)	0.006	0.008
227	18.92	0.07	0.014	(0.163)	0.006	0.008
228	19.00	0.07	0.014	(0.162)	0.006	0.008
229	19.08	0.10	0.022	(0.161)	0.009	0.013
230	19.17	0.10	0.022	(0.160)	0.009	0.013
231	19.25	0.10	0.022	(0.160)	0.009	0.013
232	19.33	0.13	0.029	(0.159)	0.012	0.017
233	19.42	0.13	0.029	(0.158)	0.012	0.017
234	19.50	0.13	0.029	(0.158)	0.012	0.017
235	19.58	0.10	0.022	(0.157)	0.009	0.013
236	19.67	0.10	0.022	(0.156)	0.009	0.013
237	19.75	0.10	0.022	(0.155)	0.009	0.013
238	19.83	0.07	0.014	(0.155)	0.006	0.008
239	19.92	0.07	0.014	(0.154)	0.006	0.008
240	20.00	0.07	0.014	(0.153)	0.006	0.008
241	20.08	0.10	0.022	(0.153)	0.009	0.013
242	20.17	0.10	0.022	(0.152)	0.009	0.013
243	20.25	0.10	0.022	(0.151)	0.009	0.013
244	20.33	0.10	0.022	(0.151)	0.009	0.013
245	20.42	0.10	0.022	(0.150)	0.009	0.013

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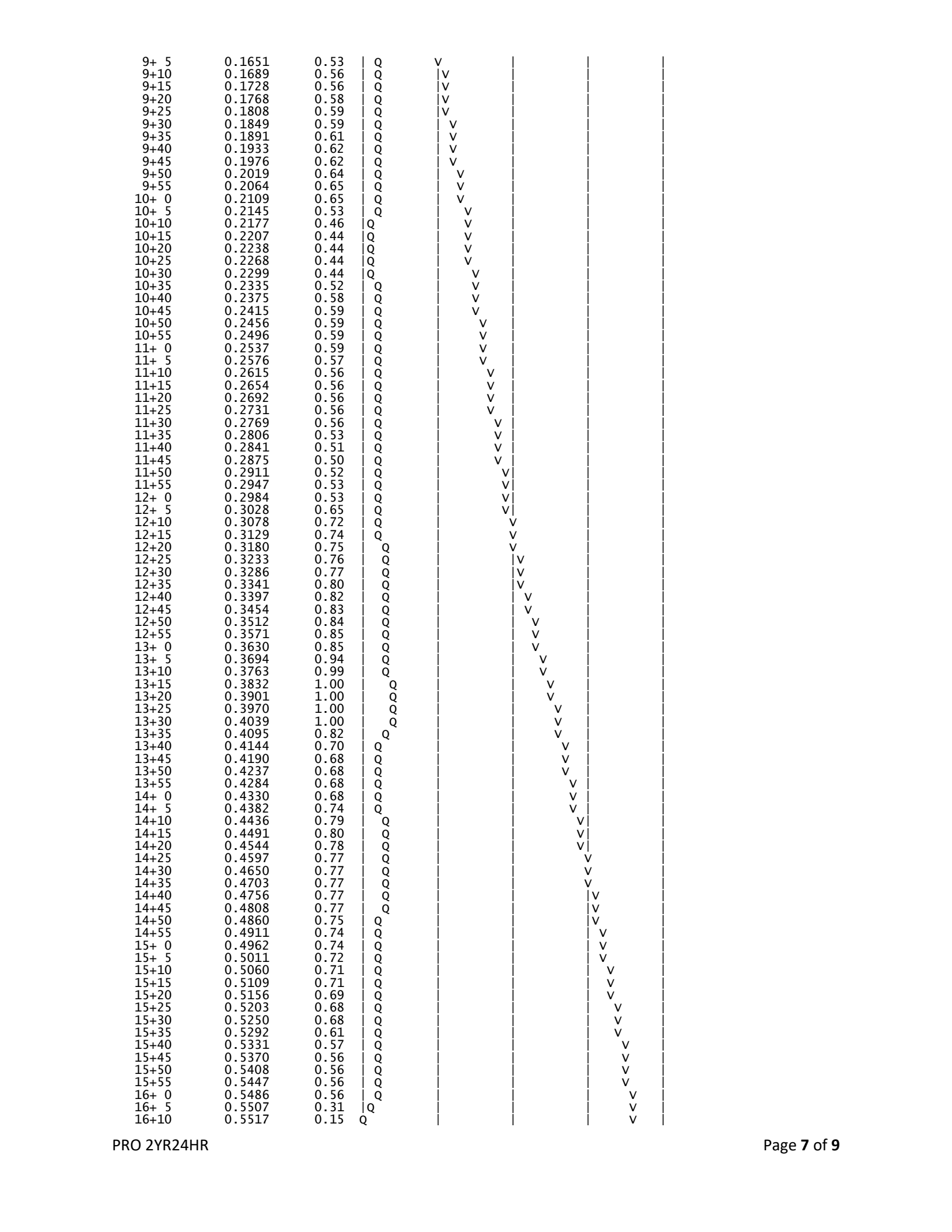
246  20.50     0.10      0.022       (  0.149)       0.009        0.013
247  20.58     0.10      0.022       (  0.149)       0.009        0.013
248  20.67     0.10      0.022       (  0.148)       0.009        0.013
249  20.75     0.10      0.022       (  0.148)       0.009        0.013
250  20.83     0.07      0.014       (  0.147)       0.006        0.008
251  20.92     0.07      0.014       (  0.146)       0.006        0.008
252  21.00     0.07      0.014       (  0.146)       0.006        0.008
253  21.08     0.10      0.022       (  0.145)       0.009        0.013
254  21.17     0.10      0.022       (  0.145)       0.009        0.013
255  21.25     0.10      0.022       (  0.144)       0.009        0.013
256  21.33     0.07      0.014       (  0.143)       0.006        0.008
257  21.42     0.07      0.014       (  0.143)       0.006        0.008
258  21.50     0.07      0.014       (  0.142)       0.006        0.008
259  21.58     0.10      0.022       (  0.142)       0.009        0.013
260  21.67     0.10      0.022       (  0.141)       0.009        0.013
261  21.75     0.10      0.022       (  0.141)       0.009        0.013
262  21.83     0.07      0.014       (  0.140)       0.006        0.008
263  21.92     0.07      0.014       (  0.140)       0.006        0.008
264  22.00     0.07      0.014       (  0.139)       0.006        0.008
265  22.08     0.10      0.022       (  0.139)       0.009        0.013
266  22.17     0.10      0.022       (  0.138)       0.009        0.013
267  22.25     0.10      0.022       (  0.138)       0.009        0.013
268  22.33     0.07      0.014       (  0.138)       0.006        0.008
269  22.42     0.07      0.014       (  0.137)       0.006        0.008
270  22.50     0.07      0.014       (  0.137)       0.006        0.008
271  22.58     0.07      0.014       (  0.136)       0.006        0.008
272  22.67     0.07      0.014       (  0.136)       0.006        0.008
273  22.75     0.07      0.014       (  0.136)       0.006        0.008
274  22.83     0.07      0.014       (  0.135)       0.006        0.008
275  22.92     0.07      0.014       (  0.135)       0.006        0.008
276  23.00     0.07      0.014       (  0.135)       0.006        0.008
277  23.08     0.07      0.014       (  0.134)       0.006        0.008
278  23.17     0.07      0.014       (  0.134)       0.006        0.008
279  23.25     0.07      0.014       (  0.134)       0.006        0.008
280  23.33     0.07      0.014       (  0.133)       0.006        0.008
281  23.42     0.07      0.014       (  0.133)       0.006        0.008
282  23.50     0.07      0.014       (  0.133)       0.006        0.008
283  23.58     0.07      0.014       (  0.133)       0.006        0.008
284  23.67     0.07      0.014       (  0.133)       0.006        0.008
285  23.75     0.07      0.014       (  0.132)       0.006        0.008
286  23.83     0.07      0.014       (  0.132)       0.006        0.008
287  23.92     0.07      0.014       (  0.132)       0.006        0.008
288  24.00     0.07      0.014       (  0.132)       0.006        0.008
              (Loss Rate Not Used)
    Sum =     100.0                                  Sum =    12.5
      Flood volume = Effective rainfall      1.04(In)
       times area       7.0(Ac.)/[(In)/(Ft.)] =       0.6(Ac.Ft)
      Total soil loss =      0.76(In)
      Total soil loss =     0.441(Ac.Ft)
      Total rainfall =      1.80(In)
      Flood volume =       26527.7 Cubic Feet
      Total soil loss =       19209.7 Cubic Feet
      ---------------------------------------------------------------------
       Peak flow rate of this hydrograph =      1.002(CFS)
      ---------------------------------------------------------------------
      +++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                        24 - H O U R    S T O R M
                    R u n o f f      H y d r o g r a p h
      ---------------------------------------------------------------------
                 Hydrograph in   5   Minute intervals ((CFS))

      ---------------------------------------------------------------------
 Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
 ---------------------------------------------------------------------------
   0+ 5       0.0002      0.03  Q          |         |         |         |
   0+10       0.0006      0.05  Q          |         |         |         |
   0+15       0.0010      0.06  Q          |         |         |         |
   0+20       0.0015      0.08  Q          |         |         |         |
   0+25       0.0021      0.09  Q          |         |         |         |
   0+30       0.0027      0.09  Q          |         |         |         |
   0+35       0.0033      0.09  Q          |         |         |         |
   0+40       0.0040      0.09  Q          |         |         |         |
   0+45       0.0046      0.09  Q          |         |         |         |
   0+50       0.0053      0.10  Q          |         |         |         |
   0+55       0.0061      0.12  Q          |         |         |         |
   1+ 0       0.0069      0.12  Q          |         |         |         |
   1+ 5       0.0076      0.10  Q          |         |         |         |
   1+10       0.0082      0.09  Q          |         |         |         |
   1+15       0.0088      0.09  Q          |         |         |         |
   1+20       0.0094      0.09  Q          |         |         |         |
   1+25       0.0100      0.09  Q          |         |         |         |
   1+30       0.0106      0.09  Q          |         |         |         |
   1+35       0.0113      0.09  Q          |         |         |         |
   1+40       0.0119      0.09  Q          |         |         |         |
   1+45       0.0125      0.09  Q          |         |         |         |
   1+50       0.0132      0.10  Q          |         |         |         |
```

```
1+55    0.0140    0.12  Q          |          |          |          |
2+ 0    0.0148    0.12  Q          |          |          |          |
2+ 5    0.0156    0.12  QV         |          |          |          |
2+10    0.0164    0.12  QV         |          |          |          |
2+15    0.0172    0.12  QV         |          |          |          |
2+20    0.0181    0.12  QV         |          |          |          |
2+25    0.0189    0.12  QV         |          |          |          |
2+30    0.0197    0.12  QV         |          |          |          |
2+35    0.0206    0.13  QV         |          |          |          |
2+40    0.0216    0.15  QV         |          |          |          |
2+45    0.0226    0.15  QV         |          |          |          |
2+50    0.0236    0.15  QV         |          |          |          |
2+55    0.0247    0.15  QV         |          |          |          |
3+ 0    0.0257    0.15  QV         |          |          |          |
3+ 5    0.0267    0.15  QV         |          |          |          |
3+10    0.0277    0.15  QV         |          |          |          |
3+15    0.0287    0.15  QV         |          |          |          |
3+20    0.0297    0.15  QV         |          |          |          |
3+25    0.0307    0.15  Q V        |          |          |          |
3+30    0.0318    0.15  Q V        |          |          |          |
3+35    0.0328    0.15  Q V        |          |          |          |
3+40    0.0338    0.15  Q V        |          |          |          |
3+45    0.0348    0.15  Q V        |          |          |          |
3+50    0.0359    0.16  Q V        |          |          |          |
3+55    0.0371    0.17  Q V        |          |          |          |
4+ 0    0.0384    0.18  Q V        |          |          |          |
4+ 5    0.0396    0.18  Q V        |          |          |          |
4+10    0.0408    0.18  Q V        |          |          |          |
4+15    0.0420    0.18  Q V        |          |          |          |
4+20    0.0433    0.19  Q V        |          |          |          |
4+25    0.0447    0.20  Q V        |          |          |          |
4+30    0.0462    0.21  Q  V       |          |          |          |
4+35    0.0476    0.21  Q  V       |          |          |          |
4+40    0.0490    0.21  Q  V       |          |          |          |
4+45    0.0504    0.21  Q  V       |          |          |          |
4+50    0.0520    0.22  Q  V       |          |          |          |
4+55    0.0536    0.23  Q  V       |          |          |          |
5+ 0    0.0552    0.24  Q  V       |          |          |          |
5+ 5    0.0566    0.20  Q  V       |          |          |          |
5+10    0.0578    0.18  Q  V       |          |          |          |
5+15    0.0591    0.18  Q  V       |          |          |          |
5+20    0.0604    0.19  Q  V       |          |          |          |
5+25    0.0618    0.20  Q   V      |          |          |          |
5+30    0.0632    0.21  Q   V      |          |          |          |
5+35    0.0647    0.22  Q   V      |          |          |          |
5+40    0.0664    0.23  Q   V      |          |          |          |
5+45    0.0680    0.24  Q   V      |          |          |          |
5+50    0.0696    0.24  Q   V      |          |          |          |
5+55    0.0712    0.24  Q   V      |          |          |          |
6+ 0    0.0729    0.24  Q   V      |          |          |          |
6+ 5    0.0746    0.25  |Q  V      |          |          |          |
6+10    0.0764    0.26  |Q   V     |          |          |          |
6+15    0.0782    0.27  |Q   V     |          |          |          |
6+20    0.0801    0.27  |Q   V     |          |          |          |
6+25    0.0819    0.27  |Q   V     |          |          |          |
6+30    0.0837    0.27  |Q   V     |          |          |          |
6+35    0.0857    0.28  |Q   V     |          |          |          |
6+40    0.0877    0.29  |Q   V     |          |          |          |
6+45    0.0897    0.29  |Q   V     |          |          |          |
6+50    0.0917    0.29  |Q    V    |          |          |          |
6+55    0.0938    0.29  |Q    V    |          |          |          |
7+ 0    0.0958    0.29  |Q    V    |          |          |          |
7+ 5    0.0978    0.29  |Q    V    |          |          |          |
7+10    0.0998    0.29  |Q    V    |          |          |          |
7+15    0.1019    0.29  |Q    V    |          |          |          |
7+20    0.1040    0.31  |Q    V    |          |          |          |
7+25    0.1062    0.32  |Q    V    |          |          |          |
7+30    0.1085    0.32  |Q     V   |          |          |          |
7+35    0.1108    0.34  |Q     V   |          |          |          |
7+40    0.1132    0.35  |Q     V   |          |          |          |
7+45    0.1157    0.35  |Q     V   |          |          |          |
7+50    0.1182    0.37  |Q     V   |          |          |          |
7+55    0.1209    0.38  |Q     V   |          |          |          |
8+ 0    0.1235    0.38  |Q      V  |          |          |          |
8+ 5    0.1264    0.42  |Q      V  |          |          |          |
8+10    0.1294    0.44  |Q      V  |          |          |          |
8+15    0.1324    0.44  |Q      V  |          |          |          |
8+20    0.1355    0.44  |Q      V  |          |          |          |
8+25    0.1385    0.44  |Q       V |          |          |          |
8+30    0.1416    0.44  |Q       V |          |          |          |
8+35    0.1447    0.46  |Q       V |          |          |          |
8+40    0.1479    0.47  |Q       V |          |          |          |
8+45    0.1512    0.47  |Q       V |          |          |          |
8+50    0.1546    0.49  |Q        V |          |          |          |
8+55    0.1580    0.50  |Q        V |          |          |          |
9+ 0    0.1614    0.50  | Q       V |          |          |          |
```



9+ 5	0.1651	0.53	Q V
9+10	0.1689	0.56	Q V
9+15	0.1728	0.56	Q V
9+20	0.1768	0.58	Q V
9+25	0.1808	0.59	Q V
9+30	0.1849	0.59	Q V
9+35	0.1891	0.61	Q V
9+40	0.1933	0.62	Q V
9+45	0.1976	0.62	Q V
9+50	0.2019	0.64	Q V
9+55	0.2064	0.65	Q V
10+ 0	0.2109	0.65	Q V
10+ 5	0.2145	0.53	Q V
10+10	0.2177	0.46	Q V
10+15	0.2207	0.44	Q V
10+20	0.2238	0.44	Q V
10+25	0.2268	0.44	Q V
10+30	0.2299	0.44	Q V
10+35	0.2335	0.52	Q V
10+40	0.2375	0.58	Q V
10+45	0.2415	0.59	Q V
10+50	0.2456	0.59	Q V
10+55	0.2496	0.59	Q V
11+ 0	0.2537	0.59	Q V
11+ 5	0.2576	0.57	Q V
11+10	0.2615	0.56	Q V
11+15	0.2654	0.56	Q V
11+20	0.2692	0.56	Q V
11+25	0.2731	0.56	Q V
11+30	0.2769	0.56	Q V
11+35	0.2806	0.53	Q V
11+40	0.2841	0.51	Q V
11+45	0.2875	0.50	Q V
11+50	0.2911	0.52	Q V
11+55	0.2947	0.53	Q V
12+ 0	0.2984	0.53	Q V
12+ 5	0.3028	0.65	Q V
12+10	0.3078	0.72	Q V
12+15	0.3129	0.74	Q V
12+20	0.3180	0.75	Q V
12+25	0.3233	0.76	Q V
12+30	0.3286	0.77	Q V
12+35	0.3341	0.80	Q V
12+40	0.3397	0.82	Q V
12+45	0.3454	0.83	Q V
12+50	0.3512	0.84	Q V
12+55	0.3571	0.85	Q V
13+ 0	0.3630	0.85	Q V
13+ 5	0.3694	0.94	Q V
13+10	0.3763	0.99	Q V
13+15	0.3832	1.00	Q V
13+20	0.3901	1.00	Q V
13+25	0.3970	1.00	Q V
13+30	0.4039	1.00	Q V
13+35	0.4095	0.82	Q V
13+40	0.4144	0.70	Q V
13+45	0.4190	0.68	Q V
13+50	0.4237	0.68	Q V
13+55	0.4284	0.68	Q V
14+ 0	0.4330	0.68	Q V
14+ 5	0.4382	0.74	Q V
14+10	0.4436	0.79	Q V
14+15	0.4491	0.80	Q V
14+20	0.4544	0.78	Q V
14+25	0.4597	0.77	Q V
14+30	0.4650	0.77	Q V
14+35	0.4703	0.77	Q V
14+40	0.4756	0.77	Q V
14+45	0.4808	0.77	Q V
14+50	0.4860	0.75	Q V
14+55	0.4911	0.74	Q V
15+ 0	0.4962	0.74	Q V
15+ 5	0.5011	0.72	Q V
15+10	0.5060	0.71	Q V
15+15	0.5109	0.71	Q V
15+20	0.5156	0.69	Q V
15+25	0.5203	0.68	Q V
15+30	0.5250	0.68	Q V
15+35	0.5292	0.61	Q V
15+40	0.5331	0.57	Q V
15+45	0.5370	0.56	Q V
15+50	0.5408	0.56	Q V
15+55	0.5447	0.56	Q V
16+ 0	0.5486	0.56	Q V
16+ 5	0.5507	0.31	Q V
16+10	0.5517	0.15	Q V

16+15	0.5525	0.12	Q	|	|	|	V |
16+20	0.5534	0.12	Q	|	|	|	V |
16+25	0.5542	0.12	Q	|	|	|	V |
16+30	0.5550	0.12	Q	|	|	|	V |
16+35	0.5557	0.10	Q	|	|	|	V |
16+40	0.5563	0.09	Q	|	|	|	V |
16+45	0.5569	0.09	Q	|	|	|	V |
16+50	0.5575	0.09	Q	|	|	|	V |
16+55	0.5581	0.09	Q	|	|	|	V |
17+ 0	0.5587	0.09	Q	|	|	|	V |
17+ 5	0.5596	0.12	Q	|	|	|	V |
17+10	0.5606	0.14	Q	|	|	|	V |
17+15	0.5616	0.15	Q	|	|	|	V |
17+20	0.5626	0.15	Q	|	|	|	V |
17+25	0.5636	0.15	Q	|	|	|	V |
17+30	0.5646	0.15	Q	|	|	|	V |
17+35	0.5656	0.15	Q	|	|	|	V |
17+40	0.5667	0.15	Q	|	|	|	V |
17+45	0.5677	0.15	Q	|	|	|	V |
17+50	0.5686	0.13	Q	|	|	|	V |
17+55	0.5694	0.12	Q	|	|	|	V |
18+ 0	0.5702	0.12	Q	|	|	|	V |
18+ 5	0.5710	0.12	Q	|	|	|	V |
18+10	0.5718	0.12	Q	|	|	|	V |
18+15	0.5726	0.12	Q	|	|	|	V |
18+20	0.5735	0.12	Q	|	|	|	V |
18+25	0.5743	0.12	Q	|	|	|	V |
18+30	0.5751	0.12	Q	|	|	|	V |
18+35	0.5758	0.10	Q	|	|	|	V |
18+40	0.5764	0.09	Q	|	|	|	V |
18+45	0.5770	0.09	Q	|	|	|	V |
18+50	0.5775	0.07	Q	|	|	|	V |
18+55	0.5779	0.06	Q	|	|	|	V |
19+ 0	0.5783	0.06	Q	|	|	|	V |
19+ 5	0.5789	0.08	Q	|	|	|	V |
19+10	0.5794	0.09	Q	|	|	|	V |
19+15	0.5801	0.09	Q	|	|	|	V |
19+20	0.5808	0.10	Q	|	|	|	V |
19+25	0.5816	0.12	Q	|	|	|	V |
19+30	0.5824	0.12	Q	|	|	|	V |
19+35	0.5831	0.10	Q	|	|	|	V |
19+40	0.5837	0.09	Q	|	|	|	V |
19+45	0.5843	0.09	Q	|	|	|	V |
19+50	0.5848	0.07	Q	|	|	|	V |
19+55	0.5852	0.06	Q	|	|	|	V |
20+ 0	0.5856	0.06	Q	|	|	|	V |
20+ 5	0.5862	0.08	Q	|	|	|	V |
20+10	0.5868	0.09	Q	|	|	|	V |
20+15	0.5874	0.09	Q	|	|	|	V |
20+20	0.5880	0.09	Q	|	|	|	V |
20+25	0.5886	0.09	Q	|	|	|	V |
20+30	0.5892	0.09	Q	|	|	|	V |
20+35	0.5898	0.09	Q	|	|	|	V |
20+40	0.5904	0.09	Q	|	|	|	V |
20+45	0.5910	0.09	Q	|	|	|	V |
20+50	0.5915	0.07	Q	|	|	|	V |
20+55	0.5919	0.06	Q	|	|	|	V |
21+ 0	0.5923	0.06	Q	|	|	|	V |
21+ 5	0.5929	0.08	Q	|	|	|	V |
21+10	0.5935	0.09	Q	|	|	|	V |
21+15	0.5941	0.09	Q	|	|	|	V|
21+20	0.5946	0.07	Q	|	|	|	V|
21+25	0.5950	0.06	Q	|	|	|	V|
21+30	0.5954	0.06	Q	|	|	|	V|
21+35	0.5959	0.08	Q	|	|	|	V|
21+40	0.5965	0.09	Q	|	|	|	V|
21+45	0.5971	0.09	Q	|	|	|	V|
21+50	0.5976	0.07	Q	|	|	|	V|
21+55	0.5980	0.06	Q	|	|	|	V|
22+ 0	0.5984	0.06	Q	|	|	|	V|
22+ 5	0.5989	0.08	Q	|	|	|	V|
22+10	0.5995	0.09	Q	|	|	|	V|
22+15	0.6002	0.09	Q	|	|	|	V|
22+20	0.6007	0.07	Q	|	|	|	V|
22+25	0.6011	0.06	Q	|	|	|	V|
22+30	0.6015	0.06	Q	|	|	|	V|
22+35	0.6019	0.06	Q	|	|	|	V|
22+40	0.6023	0.06	Q	|	|	|	V|
22+45	0.6027	0.06	Q	|	|	|	V|
22+50	0.6031	0.06	Q	|	|	|	V|
22+55	0.6035	0.06	Q	|	|	|	V|
23+ 0	0.6039	0.06	Q	|	|	|	V|
23+ 5	0.6043	0.06	Q	|	|	|	V|
23+10	0.6047	0.06	Q	|	|	|	V|
23+15	0.6051	0.06	Q	|	|	|	V|
23+20	0.6055	0.06	Q	|	|	|	V|

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   23+25       0.6059      0.06  Q          |          |          |         v|
   23+30       0.6063      0.06  Q          |          |          |         v|
   23+35       0.6068      0.06  Q          |          |          |         v|
   23+40       0.6072      0.06  Q          |          |          |         v|
   23+45       0.6076      0.06  Q          |          |          |         v|
   23+50       0.6080      0.06  Q          |          |          |         v|
   23+55       0.6084      0.06  Q          |          |          |         v|
   24+ 0       0.6088      0.06  Q          |          |          |         v|
   24+ 5       0.6090      0.03  Q          |          |          |         v|
   24+10       0.6090      0.00  Q          |          |          |         v|
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Appendix 8: Source Control

Pollutant Sources/Source Control Checklist

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

How to use this worksheet (also see instructions in Section G of the WQMP Template):

1. Review Column 1 and identify which of these potential sources of stormwater pollutants apply to your site. Check each box that applies.
2. Review Column 2 and incorporate all of the corresponding applicable BMPs in your WQMP Exhibit.
3. Review Columns 3 and 4 and incorporate all of the corresponding applicable permanent controls and operational BMPs in your WQMP. Use the format shown in Table G.1on page 23 of this WQMP Template. Describe your specific BMPs in an accompanying narrative, and explain any special conditions or situations that required omitting BMPs or substituting alternative BMPs for those shown here.

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☒ A. **On-site storm drain inlets**	☒ **Locations of inlets.**	☒ **Mark all inlets with the words "Only Rain Down the Storm Drain" or similar. Catch Basin Markers may be available from the Riverside County Flood Control and Water Conservation District, call 951.955.1200 to verify.**	☒ **Maintain and periodically repaint or replace inlet markings.** ☒ **Provide stormwater pollution prevention information to new site owners, lessees, or operators.** ☒ **See applicable operational BMPs in Fact Sheet SC-44, "Drainage System Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com** ☒ **Include the following in lease agreements: "Tenant shall not allow anyone to discharge anything to storm drains or to store or deposit materials so as to create a potential discharge to storm drains."**
☐ B. **Interior floor drains and elevator shaft sump pumps**		☐ **State that interior floor drains and elevator shaft sump pumps will be plumbed to sanitary sewer.**	☐ **Inspect and maintain drains to prevent blockages and overflow.**
☐ C. **Interior parking garages**		☐ **State that parking garage floor drains will be plumbed to the sanitary sewer.**	☐ **Inspect and maintain drains to prevent blockages and overflow.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☐ D1. **Need for future indoor & structural pest control**		☐ **Note building design features that discourage entry of pests.**	☐ **Provide Integrated Pest Management information to owners, lessees, and operators.**
☒ D2. **Landscape/ Outdoor Pesticide Use**	☐ **Show locations of native trees or areas of shrubs and ground cover to be undisturbed and retained.** ☒ **Show self-retaining landscape areas, if any.** ☒ **Show stormwater treatment and hydrograph modification management BMPs. (See instructions in Chapter 3, Step 5 and guidance in Chapter 5.)**	**State that final landscape plans will accomplish all of the following.** ☐ **Preserve existing native trees, shrubs, and ground cover to the maximum extent possible.** ☒ **Design landscaping to minimize irrigation and runoff, to promote surface infiltration where appropriate, and to minimize the use of fertilizers and pesticides that can contribute to stormwater pollution.** **Where landscaped areas are used to retain or detain stormwater, specify plants that are tolerant of saturated** ☒ **soil conditions.** **Consider using pest-resistant** ☒ **plants, especially adjacent to hardscape.** **To insure successful establishment, select plants appropriate to site soils, slopes, climate, sun, wind, rain, land use, air movement, ecological consistency, and plant interactions.**	☒ **Maintain landscaping using minimum or no pesticides.** ☒ **See applicable operational BMPs in "What you should know for…..Landscape and Gardening"** at http://rcflood.org/stormwater/**Error! Hyperlink reference not valid.** **Provide IPM information to new** ☒ **owners, lessees and operators.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ E. **Pools, spas, ponds, decorative fountains, and other water features.**	❑ **Show location of water feature and a sanitary sewer cleanout in an accessible area within 10 feet. (Exception: Public pools must be plumbed according to County Department of Environmental Health Guidelines.)**	**If the Co-Permittee requires pools to be plumbed to the sanitary sewer, place a note on the plans and state in the narrative that this connection will be made according to local requirements.**	❑ **See applicable operational BMPs in** "Guidelines for Maintaining Your Swimming Pool, Jacuzzi and Garden Fountain" at http://rcflood.org/stormwater/
❑ F. **Food service**	❑ **For restaurants, grocery stores, and other food service operations, show location (indoors or in a covered area outdoors) of a floor sink or other area for cleaning floor mats, containers, and equipment.** ❑ **On the drawing, show a note that this drain will be connected to a grease interceptor before discharging to the sanitary sewer.**	❑ **Describe the location and features of the designated cleaning area.** ❑ **Describe the items to be cleaned in this facility and how it has been sized to insure that the largest items can be accommodated.**	❑ **See the brochure, "**The Food Service Industry Best Management Practices for: Restaurants, Grocery Stores, Delicatessens and Bakeries" at http://rcflood.org/stormwater/ **Provide this brochure to new site owners, lessees, and operators.**
❑ G. **Refuse areas**	❑ **Show where site refuse and recycled materials will be handled and stored for pickup. See local municipal requirements for sizes and other details of refuse areas.** ❑ **If dumpsters or other receptacles are outdoors, show how the designated area will be covered, graded, and paved to prevent run-on and show locations of berms to prevent runoff from the area.** ❑ **Any drains from dumpsters, compactors, and tallow bin areas shall be connected to a grease removal device before discharge to sanitary sewer.**	❑ **State how site refuse will be handled and provide supporting detail to what is shown on plans.** ❑ **State that signs will be posted on or near dumpsters with the words "Do not dump hazardous materials here" or similar.**	❑ **State how the following will be implemented:** **Provide adequate number of receptacles. Inspect receptacles regularly; repair or replace leaky receptacles. Keep receptacles covered. Prohibit/prevent dumping of liquid or hazardous wastes. Post "no hazardous materials" signs. Inspect and pick up litter daily and clean up spills immediately. Keep spill control materials available on-site. See Fact Sheet SC-34, "Waste Handling and Disposal" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ H. **Industrial processes.**	❑ **Show process area.**	❑ **If industrial processes are to be located on site, state: "All process activities to be performed indoors. No processes to drain to exterior or to storm drain system."**	❑ **See Fact Sheet SC-10, "Non-Stormwater Discharges" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com** See the brochure "Industrial & Commercial Facilities Best Management Practices for: Industrial, Commercial Facilities" at http://rcflood.org/stormwater/

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ I. **Outdoor storage of equipment or materials. (See rows J and K for source control measures for vehicle cleaning, repair, and maintenance.)**	❑ **Show any outdoor storage areas, including how materials will be covered. Show how areas will be graded and bermed to prevent run-on or run-off from area.** ❑ **Storage of non-hazardous liquids shall be covered by a roof and/or drain to the sanitary sewer system, and be contained by berms, dikes, liners, or vaults.** ❑ **Storage of hazardous materials and wastes must be in compliance with the local hazardous materials ordinance and a Hazardous Materials Management Plan for the site.**	**Include a detailed description of materials to be stored, storage areas, and structural features to prevent pollutants from entering storm drains.** **Where appropriate, reference documentation of compliance with the requirements of Hazardous Materials Programs for:** ▪ **Hazardous Waste Generation** ▪ **Hazardous Materials Release Response and Inventory** ▪ **California Accidental Release (CalARP)** ▪ **Aboveground Storage Tank** ▪ **Uniform Fire Code Article 80 Section 103(b) & (c) 1991** ▪ **Underground Storage Tank** **www.cchealth.org/groups/hazmat/**	❑ **See the Fact Sheets SC-31, "Outdoor Liquid Container Storage" and SC-33, "Outdoor Storage of Raw Materials " in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ J. **Vehicle and Equipment Cleaning**	❑ **Show on drawings as appropriate:** **(1) Commercial/industrial facilities having vehicle/equipment cleaning needs shall either provide a covered, bermed area for washing activities or discourage vehicle/equipment washing by removing hose bibs and installing signs prohibiting such uses.** **(2) Multi-dwelling complexes shall have a paved, bermed, and covered car wash area (unless car washing is prohibited on-site and hoses are provided with an automatic shut-off to discourage such use).** **(3) Washing areas for cars, vehicles, and equipment shall be paved, designed to prevent run-on to or runoff from the area, and plumbed to drain to the sanitary sewer.** **(4) Commercial car wash facilities shall be designed such that no runoff from the facility is discharged to the storm drain system. Wastewater from the facility shall discharge to the sanitary sewer, or a wastewater reclamation system shall be installed.**	❑ **If a car wash area is not provided, describe any measures taken to discourage on-site car washing and explain how these will be enforced.**	**Describe operational measures to implement the following (if applicable):** ❑ **Washwater from vehicle and equipment washing operations shall not be discharged to the storm drain system.** Refer to "Outdoor Cleaning Activities and Professional Mobile Service Providers" for many of the Potential Sources of Runoff Pollutants categories below. Brochure can be found at http://rcflood.org/stormwater/ ❑ **Car dealerships and similar may rinse cars with water only.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ K. **Vehicle/Equipment Repair and Maintenance**	❑ **Accommodate all vehicle equipment repair and maintenance indoors. Or designate an outdoor work area and design the area to prevent run-on and runoff of stormwater.** ❑ **Show secondary containment for exterior work areas where motor oil, brake fluid, gasoline, diesel fuel, radiator fluid, acid-containing batteries or other hazardous materials or hazardous wastes are used or stored. Drains shall not be installed within the secondary containment areas.** ❑ **Add a note on the plans that states either (1) there are no floor drains, or (2) floor drains are connected to wastewater pretreatment systems prior to discharge to the sanitary sewer and an industrial waste discharge permit will be obtained.**	❑ **State that no vehicle repair or maintenance will be done outdoors, or else describe the required features of the outdoor work area.** ❑ **State that there are no floor drains or if there are floor drains, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements.** ❑ **State that there are no tanks, containers or sinks to be used for parts cleaning or rinsing or, if there are, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements.**	**In the Stormwater Control Plan, note that all of the following restrictions apply to use the site:** ❑ **No person shall dispose of, nor permit the disposal, directly or indirectly of vehicle fluids, hazardous materials, or rinsewater from parts cleaning into storm drains.** ❑ **No vehicle fluid removal shall be performed outside a building, nor on asphalt or ground surfaces, whether inside or outside a building, except in such a manner as to ensure that any spilled fluid will be in an area of secondary containment. Leaking vehicle fluids shall be contained or drained from the vehicle immediately.** ❑ **No person shall leave unattended drip parts or other open containers containing vehicle fluid, unless such containers are in use or in an area of secondary containment.** Refer to "Automotive Maintenance & Car Care Best Management Practices for Auto Body Shops, Auto Repair Shops, Car Dealerships, Gas Stations and Fleet Service Operations". Brochure can be found at http://rcflood.org/stormwater/ Refer to Outdoor Cleaning Activities and Professional Mobile Service Providers for many of the Potential Sources of Runoff Pollutants categories below. Brochure can be found at http://rcflood.org/stormwater/

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ L. **Fuel Dispensing Areas**	❑ **Fueling areas[6] shall have impermeable floors (i.e., portland cement concrete or equivalent smooth impervious surface) that are: a) graded at the minimum slope necessary to prevent ponding; and b) separated from the rest of the site by a grade break that prevents run-on of stormwater to the maximum extent practicable.** ❑ **Fueling areas shall be covered by a canopy that extends a minimum of ten feet in each direction from each pump. [Alternative: The fueling area must be covered and the cover's minimum dimensions must be equal to or greater than the area within the grade break or fuel dispensing area[1].] The canopy [or cover] shall not drain onto the fueling area.**		❑ **The property owner shall dry sweep the fueling area routinely.** ❑ **See the Fact Sheet SD-30 , "Fueling Areas" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

[6] **The fueling area shall be defined as the area extending a minimum of 6.5 feet from the corner of each fuel dispenser or the length at which the hose and nozzle assembly may be operated plus a minimum of one foot, whichever is greater.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ M. **Loading Docks**	❑ **Show a preliminary design for the loading dock area, including roofing and drainage. Loading docks shall be covered and/or graded to minimize run-on to and runoff from the loading area. Roof downspouts shall be positioned to direct stormwater away from the loading area. Water from loading dock areas shall be drained to the sanitary sewer, or diverted and collected for ultimate discharge to the sanitary sewer.** ❑ **Loading dock areas draining directly to the sanitary sewer shall be equipped with a spill control valve or equivalent device, which shall be kept closed during periods of operation.** ❑ **Provide a roof overhang over the loading area or install door skirts (cowling) at each bay that enclose the end of the trailer.**		❑ **Move loaded and unloaded items indoors as soon as possible.** ❑ **See Fact Sheet SC-30, "Outdoor Loading and Unloading," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

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

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☒ P. **Plazas, sidewalks, and parking lots.**			☒ **Sweep plazas, sidewalks, and parking lots regularly to prevent accumulation of litter and debris. Collect debris from pressure washing to prevent entry into the storm drain system. Collect washwater containing any cleaning agent or degreaser and discharge to the sanitary sewer not to a storm drain.**

Appendix 9: O&M

Operation and Maintenance Plan and Documentation of Finance, Maintenance and Recording Mechanisms

Operations & Maintenance Responsibility for Treatment Control BMP's

BMP Required Maintenance	Frequency	Maintenance Requirements	Responsibility
Trash	Weekly	Empty Dumpsters	Property Owner
Roof Drains/ Gutters	Before wet season, or significant rain event, or when needed	Roof Gutters shall be visually inspected for defects and possible leakage. Damage or defects found shall be corrected as soon as possible. Owners should avoid use of gutters, roofing, and trim made of copper so as to prevent the metal from leaching into runoff.	Property Owner
INFILTRATION BASIN	Bi-Weekly Semi-Annual Annually As Needed	Mow, weed, trim and remove accumulation of trash debris and/or sediment. Routine inspections for areas of standing water within the BMP and corrective measures to restore proper infiltration rates are necessary. Trim Vegetation at the beginning and end of the wet season to prevent establishment of woody vegetation. Replant eroded or barren spots to prevent erosion and accumulation of sediment. Per Condition of Approval 90.FLOODRI all BMPs are to be inspected, and if required, cleaned no later than October 15 each year Stabilize eroded banks, repair undercut and eroded areas at inflow and outflow areas, maintain access to the basin for regular maintenance, mow as appropriate for vegetative cover species, monitor health of vegetation and replace as necessary, control mosquitos as necessary, remove liter and debris. Mulch replacement may be necessary on an occasional basis to fill in voids, mulching should be done prior to the wet season. Unclog underdrain, and regulate soil pH. **For additional maintenance information please see Appendix 10 of the WQMP** **Grading Plans and BMP Map provided in WQMP document provide additional information on location of Bio-retention facility and tributary areas.**	Home Owners Association
Self-Retaining/ Landscape Areas	Bi-Weekly	Mow, weed, trim and remove accumulation of trash debris and/or sediment. Retaining areas should be mowed at 4-6 inches in height if grass is proposed. **Maintain landscaping using minimal pesticides**	Home Owners Association

BMP's should start and be inspected prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.

Funding

Funding for Ongoing Maintenance will be provided by the Home Owner's Association.

Basin Site Maintenance Summary Form

Date:	**Inspector Name:**	**Basin:**
Maintenance Performed:		
Date:	**Inspector Name:**	**Basin:**
Maintenance Performed:		
Date:	**Inspector Name:**	**Basin:**
Maintenance Performed:		
Date:	**Inspector Name:**	**Basin:**
Maintenance Performed:		
Date:	**Inspector Name:**	**Basin:**
Maintenance Performed:		
Date:	**Inspector Name:**	**Basin:**
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Date:	**Inspector Name:**	**Basin:**
Maintenance Performed:		
Date:	**Inspector Name:**	**Basin:**
Maintenance Performed:		
Date:	**Inspector Name:**	**Basin:**
Maintenance Performed:		

WHEN RECORDED MAIL TO:

City Clerk
City of Riverside
City Hall, 3900 Main Street
Riverside, CA 92522

Planning Case: P__-____

For Recorder's Office Use Only

COVENANT AND AGREEMENT
ESTABLISHING NOTIFICATION PROCESS AND RESPONSIBILITY FOR
WATER QUALITY MANAGEMENT PLAN IMPLEMENTATION AND MAINTENANCE

THIS COVENANT AND AGREEMENT FOR WATER QUALITY MANAGEMENT PLAN IMPLEMENTATION AND MAINTENANCE is made and entered into this _____ day of _____, 20__, by LA SIERRA VICTORIA DEVELOPMENT LLC _____("Declarant"), with reference to the following facts:

A. Declarant is the fee owner of the real property (the "Property") situated in the City of Riverside, County of Riverside, State of California, and legally described in Exhibit "A", which is attached hereto and incorporated within by reference.

B. Declarant has applied to the City of Riverside ("City") for _____ _____ TRACT 38921 DP-2023-01293 _____ _____.

C. As a condition of approval and prior to the map recordation and/or issuance of any permits, the City is requiring Declarant to execute and record an agreement stating that the future property owners shall be informed of the requirements to implement and maintain the Best Management Practices ("BMPs") as described in the approved project specific Water Quality Management Plan.

D. Declarant intends by this document to comply with the conditions imposed by the City and to impose upon the Property mutually beneficial restrictions, conditions, covenants and agreements for the benefit of Property.

NOW, THEREFORE, for the purposes of complying with the conditions imposed by the City of Riverside for the approval of Planning Case P__-____, Declarant hereby declares that the Property is and hereafter shall be held, conveyed, transferred, mortgaged, encumbered, leased, rented, used, occupied, sold and improved subject to the following declarations, limitations, covenants, conditions, restrictions and easements, all of which are imposed as

equitable servitudes pursuant to a general plan for the development of the Property for the purpose of enhancing and protecting the value and attractiveness of the Property, and each Parcel thereof, in accordance with the plan for the improvement of the Property, and to comply with certain conditions imposed by the City for the approval of P__-____, and shall be binding and inure to the benefit of each successor and assignee in interest of each such party. Any conveyance, transfer, sale, assignment, lease or sublease made by Declarant of a Parcel of the Property shall be and hereby is deemed to incorporate by reference all the provisions of the Covenant and Agreement including, but not limited to, all the covenants, conditions, restrictions, limitations, grants of easement, rights, rights-of-way, and equitable servitude contained herein.

1. This Covenant and Agreement hereby establishes a notification process for future individual property owners to ensure they are subject to and adhere to the Water Quality Management Plan implementation measures and that it shall be the responsibility of the Declarant, its heirs, successors and assigns to implement and maintain all Best Management Practices (BMPs) in good working order.

2. Declarant shall use its best efforts to diligently implement and maintain all BMPs in a manner assuring peak performance at all times. All reasonable precautions shall be exercised by Declarant, its heirs, successors and assigns, in the removal and extraction of any material(s) from the BMPs and the ultimate disposal of the material(s) in a manner consistent with all relevant laws and regulations in effect at the time. As may be requested from time to time by the City, Declarant, its heirs, successors and assigns shall provide the City with documentation identifying the material(s) removed, the quantity, and disposal destination.

3. In the event Declarant, or its heirs, successors or assigns, fails to undertake the maintenance contemplated by this Covenant and Agreement within twenty-one (21) days of being given written notice by the City, or fails to complete any maintenance contemplated by this Covenant and Agreement with reasonable diligence, the City is hereby authorized to cause any maintenance necessary to be completed and charge the entire cost and expense to the Declarant or Declarant's successors or assigns, including administrative costs, reasonable attorneys fees and interest thereon at the maximum rate authorized by the Civil Code from the date of the notice of expense until paid in full. As an additional remedy, the Public Works Director may withdraw any previous urban runoff-related approval with respect to the Property on which BMPs have been installed and/or implemented until such time as Declarant, its heirs, successors or assigns, repays to City its reasonable costs incurred in accordance with this paragraph.

4. Any person who now or hereafter owns or acquires any right, title or interest in or to any parcel of the Property shall be deemed to have consented and agreed to every covenant, condition, restriction and easement contained herein.

5. In addition, each of the provisions hereof shall operate as covenants running with the land for the benefit of the Property and each Parcel thereof and shall inure to the benefit of all owners of the Parcels thereof, their successors and assigns in interest, and shall apply to and bind each successive owner of each Parcel, their successors and assigns in interest.

6. The terms of this Covenant and Agreement may be enforced by the City, its successors or assigns, and by any owner, lessee or tenant of the Parcels of the Property. Should the City or any owner, lessee or tenant bring an action to enforce any of the terms of this Covenant and Agreement, the prevailing party shall be entitled to costs of suit including reasonable attorneys' fees.

7. Subject to the prior written approval of the City by its Public Works Director, any provision contained herein may be terminated, modified or amended as to all of the Property or any portion thereof. No such termination, modification or amendment shall be effective until there shall have been executed, acknowledged and recorded in the Office of the Recorder of Riverside County, California, an appropriate instrument evidencing the same including the consent thereto by the City.

IN WITNESS WHEREOF, Declarant has caused this Covenant and Agreement to be executed as of the day and year first written above.

LA SIERRA VICTORIA DEVELOPMENT LLC

_____
Name:
Title:

_____
Name:
Title:

APPROVED AS TO FORM:

_____
Name:
Deputy City Attorney

APPROVED AS TO CONTENT

_____
Name:
Public Works Department:

STATE OF)
)
COUNTY OF)

On _____, before me, _____, Notary Public, personally appeared _____, who proved to me on the basis of satisfactory evidence, to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of _____ that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

_____ (SEAL)
Notary Public Signature

STATE OF)
)
COUNTY OF)

On _____, before me, _____, Notary Public, personally appeared _____, who proved to me on the basis of satisfactory evidence, to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of _____ that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

_____ (SEAL)
Notary Public Signature

EXHIBIT A
(Legal Description)

EXHIBIT B
(Map/Illustration)

Appendix 10: Educational Materials

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

Infiltration Basin TC-11

Design Considerations

- Soil for Infiltration
- Slope
- Aesthetics

Targeted Constituent	Removal
Sediment	High
Nutrients	High
Trash	High
Metals	High
Bacteria	High
Oil and Grease	High
Organics	High
Flow Control	High

Description

An infiltration basin is a relatively large impoundment that is designed to infiltrate stormwater. Infiltration basins use the natural filtering ability of the soil to remove pollutants in stormwater runoff. Infiltration facilities store runoff until it gradually exfiltrates through the soil and eventually into the water table. This practice removes surface flow and associated pollutants through infiltration and can also help recharge groundwater, thus helping to maintain low flows in stream systems. Infiltration basins can be challenging to apply on many sites, however, because of soils requirements. In addition, some studies have shown relatively high failure rates compared with other management practices.

California Experience

Infiltration basins have a long history of use in California, especially in the Central Valley. Basins located in Fresno were among those initially evaluated in the National Urban Runoff Program and were found to be effective at reducing the volume of runoff, while posing little long-term threat to groundwater quality (EPA, 1983; Schroeder, 1995). Proper siting of these devices is crucial as underscored by the experience of Caltrans in siting two basins in Southern California. The basin with marginal separation from groundwater and soil permeability failed immediately and could never be rehabilitated. The Water Augmentatoin Study (LASGRWC 2010) perfomred in the Los Angeles region showed no negative impact to ground water from infiltrating stormwater through infiltration practices treating stormwater from sites ranging from 0.5 acres to 7.4 acres.

Infiltration basins have been shown to be effective at reducing many of the pollutants regulated by the State and Regional Water Boards. Additionally, the Water Boards have determined that

infiltration basins can qualify as a "Full Capture System (FCS)[1]" for trash. Accordingly, in addition to providing general specifications, this fact sheet includes trash-specific information to assist with upgrading either an existing BMP or the design of a planned BMP to meet the FCS definition. See the "**Full Trash Capture Compliance**" section and "***Trash FCS***" subsections in this fact sheet for more information.

Advantages

- Provides stormwater treatment and can be designed to meet hydromodification management requirements and the full capture system definition for trash control.
- 100% reduction in the load discharged to surface waters.
- Can achieve pre-development hydrology by infiltrating a significant portion of the average annual rainfall runoff.

Limitations

- Have a high failure rate if soil and subsurface conditions are not suitable.
- May not be appropriate for industrial sites or locations where spills may occur.
- Infiltration basins require a minimum soil infiltration rate of 0.5 inches/hour, not appropriate at sites with Hydrologic Soil Types C or D.

Performance

As water migrates through porous soil and rock, pollutant attenuation mechanisms include precipitation, sorption, physical filtration, and bacterial degradation (Table 1). Vegetation establishment may improve water quality performance and decrease residence time (i.e., increase water losses). If functioning properly, this approach is presumed to have high removal efficiencies for particulate pollutants and moderate removal of soluble pollutants. Actual pollutant removal in the subsurface would be expected to vary depending upon site-specific soil types. This technology eliminates discharge to surface waters except for the very largest storms; consequently, complete removal of all stormwater constituents can be assumed.

Table 1. Typical pollutant removal for constituents and removal processes

Pollutant	Typical Removal	Median Effluent Concentration[1]	Removal Processes	Treatment Depth	References
Sediment	High (90%)	9.9 mg/l	Settling, filtration and sedimentation in top 2 to 8 inches of media.	1.5 feet	Geosyntec Consultants and Wright Water Engineering 2012; Hatt et al. 2008; Hunt et al. 2012; Li and Davis 2008; Stander and Borst 2010; Maniquiz, 2010; Scholes, 2007

[1] Full Capture System (FCS): A treatment control, or series of treatment controls, including but not limited to, a multi-benefit projector a low impact development control that traps all particles that are 5 mm or greater, and has a design treatment capacity that is either: a) of not less than the peak flow rate, Q, resulting from a one-year, one-hour, storm in the subdrainage area, or b) appropriately sized to, and designed to carry at least the same flows as, the corresponding storm drain.

Pollutant	Typical Removal	Median Effluent Concentration[1]	Removal Processes	Treatment Depth	References
Metals	High	TCd: 0.07 µg/L, TCr: 0.35 µg/L, TCu: 5.33 µg/L, *TFe: 1027 µg/L,* TPb: 0.19 µg/L, *TNi: 4.53 µg/L,* TZn: 12.0 µg/L	Settling with sediment and sorption to organic matter and clay in media.	2 feet	Geosyntec Consultants and Wright Water Engineering 2012; Hsieh and Davis 2005; Hunt et al. 2012; Maniquiz, 2010
Hydro-carbons	High (90-97%)	N/A	Volatilization, sorption, and degradation in mulch layer.	1 foot	Hong et al. 2006; Hunt et al. 2012; Barraud et al 1999; Dierkes and Geiger, 1999; Mikkelsen et al. 1997; Hong et al. 2006. Hsieh and Davis 2005; Pitt et al. 1999
Total phosphorus	High (-240% to 99%)	*0.240 mg/l*	Settling with sediment, sorption to organic matter and clay in media, and plant uptake. Poor removal efficiency can result from media containing high organic matter or with high background concentrations of phosphorus.	2 feet	Clark and Pitt 2009; Davis 2007; Geosyntec Consultants and Wright Water Engineering 2012; Hsieh and Davis 2005; Hunt et al. 2006; Hunt and Lord 2006; Li et al. 2010; Maniquiz 2010
Total nitrogen	High (TKN: -5% to 64%, Nitrate: 1% to 80%)	TN: 0.92 mg/l, TKN: 1.34 mg/l, $NO_{2,3}$-N: 0.37 mg/l	Sorption and settling (TKN), denitrification in IWS (nitrate), and plant uptake. Poor removal efficiency can result from media containing high organic matter.	3 feet	Barrett et al. 2013; Clark and Pitt 2009; Geosyntec Consultants and Wright Water Engineering 2012; Hunt et al. 2006; Hunt et al. 2012; Kim et al. 2003; Li et al. 2010; Passeport et al. 2009; Maniquiz, 2010; Winiarski et al. 2006

Pollutant	Typical Removal	Median Effluent Concentration[1]	Removal Processes	Treatment Depth	References
Bacteria	High	*Enterococcus*: 235 MPN/ 100 mL, *E.coli*: 101 MPN/100 mL	Sedimentation, filtration, sorption, desiccation, predation, and photolysis in mulch layer and media.	2 feet	Geosyntec Consultants and Wright Water Engineering 2012; Hathaway et al. 2009; Hathaway et al. 2011; Hunt and Lord 2006; Hunt et al. 2008; Hunt et al. 2012; Jones and Hunt 2010
Trash	High	*N/A*	Filtration	1.5 feet of media	Barrett et al. 2013

[1] Concentrations are based on bioretention performance data. Underlined effluent concentrations were (statistically) significantly lower than influent concentrations, as determined by statistical hypothesis testing on the available sampled data. Effluent concentrations displayed in *italics* were (statistically) significantly higher than influent concentrations.

Groundwater contamination concerns exists for infiltration basins (Lind and Karro, 1995; Datry et al., 2004; Pitt, 1999) but pollutant concentrations in the soil column have been shown to decrease rapidly with depth (within the first 6 to 18 inches) (Dechesne, M. et al., 2004; Dierkes and Geiger, 1999; Mikkelsen et al., 1997; Datry et al., 2004). However, pollutant concentrations can be of concern as deep as 10 feet, preferential flow pathways are suspected as the means of transport in some geologic settings (Winiarski et al. 2006). These observations warrant a 10 foot minimum between infiltration basin bottom and seasonal high water table.

Trash FCS

The Trash Amendments adopted by the State Water Board in April 2015 provide a performance standard for treatment of stormwater for trash in the form of the definition of FCS, which infiltration basin meets (see Section 5.6.1 for FCS details).

Suitability and Design

The use of infiltration basins may be limited by a number of factors, including type of native soils, climate, and location of groundwater table. Site characteristics, such as excessive slope of the drainage area, fine-grained soil types, and proximate location of the water table and bedrock, can also preclude the use of infiltration basins. The constraints of each site dictate the appropriate siting and footprint. Fundamental infiltration basin design components are as follows:

- Infiltration rate assessed on-site by a licensed geotechnical engineer or soil scientist.
- Unsuitable if known soil contamination is present, or if upstream drainage area uses or store chemicals or hazardous materials that could drain to the basin.
- 10 feet of separation between bottom of the basin and seasonal high water table.

- Drainage area that has been fully stabilized, plus use of a pretreatment BMP (e.g. grassed swales, gravity separator) at the entry point to ensure longevity.
- 10-ft setback from foundations, 100-ft from septic fields and water supply wells, and 50-ft from steep slopes.

Basin design is highly dependent on the constraints of the considered site. Costs will vary in accordance with the design. Table 2 details a number of core construction components and corresponding design considerations.

Table 2. Cost of design components and associated considerations

Component	Cost	Design Consideration
Excavation		Requires infiltration rate > 0.5 in/hr. When excavating ensure that subgrade compaction is minimized. Design for 6 to 18 inches average ponding depth. Basin should contain entire upstream WQV. After final grading, till the infiltration surface deeply
Without underdrains	$2.75–$5.00/ft^2	
With underdrains	$3.90–$6.15/ft^2	
Soil Media		1.5–4 feet (deeper for better pollutant removal, hydrologic benefits, and rooting depths) at minimum 5 in/hr infiltration. Total phosphorus < 15 ppm, pH 6–8, CEC > 5 meq/100 g soil. Organic Matter Content < 5% by weight. 65% sand, 20% sandy loam, and 15% compost (from vegetation-based feedstock) by volume.
Recommended mix	$2.90–$4.30/ft^2	
With engineered media	$3.60–$5.40/ft^2	
Soil Media Barrier		When incorporating an underdrain, separate media from native soil with a geotextile layer, 2 to 4 inches of washed sand (ASTM C-33), followed by 2 inches of choking stone (ASTM No. 8) over a 1.5 ft envelope of ASTM No. 57 stone.
Geotextile	$0.45/ft^2	
Washed sand (2-inch layer)	$0.20/ft^2	
No. 8 aggregate (min 2 inches thick)	$0.28/ft^2	
No. 57 stone (1.5 + feet)	$2.49/ft^2	
Hydraulic Restriction Layer		May use hydraulic restriction layer on vertical surfaces to restrict lateral flows to adjacent subgrades, foundations, or utilities.
Filter fabric	$0.45/ft^2	
Clay	$0.65/ft^2	
30-mil liner	$0.35/ft^2	
Concrete barrier	$12.00/ft^2	

Subsurface Option (Figure 1) Excavation, Installation, and Backfill Concrete Unit	 $9.20/ft^2 $59.93/ft^2	Constructing a subsurface facility includes excavating to depth, installing concrete unit, overdig, and backfill. Concrete unit height assumed here: 11' 4". *Requires* pretreatment BMP to capture trash and debris.
Landscape	$0.20–$3.50/ft^2	Armor surface with cobble or vegetation. If planted (optional), install native, deep rooting, and drought tolerant plants.

Ensure that adequate head is available to operate flow splitter structures (to allow the basin to be offline) without ponding in the splitter structure or creating backwater upstream of the splitter.

Basin invert area should be determined by the equation. Where:

$$A = \frac{WQV}{kt}$$

A = Basin invert area (m^2)

WQV = water quality volume (m^3)

k = 0.5 times the lowest field-measured hydraulic Conductivity (m/hr)

t = drawdown time (48 hr)

Design Variations

When traditional surface basins are infeasible because of land constraints, subsurface extended detention basin are ideal (Figure 1). Open space parks (e.g., baseball fields, etc.) are an example of where a subsurface infiltration basin is ideal because the park's purpose as a recreational area is not compromised. Additionally, recreational areas typical lack large structures, therefore the issue of overhead weight over the subsurface unit is not a concern.

Full Trash Capture Compliance

This section provides trash-specific information to assist with upgrading either an existing BMP or the design of a planned BMP to meet the FCS definition. In addition to developing and adopting the Trash Amendments, the State Water Board provides implementation information on its Trash Implementation web page: https://www.waterboards.ca.gov/water_issues/programs/stormwater/trash_implementation.html.

The web page includes information on best management practices or Full Capture Systems, including lists of State-certified Multi-Benefit Trash Treatment Systems. So, when selecting BMPs for trash control, fact sheet users should refer to both this BMP fact sheet and the State Water Board's Trash Implementation web page.

Design Modifications to Prevent Trash Migration, Sustain Capacity, and Prevent Reduced Functionality

The infiltration basin must be configured to allow trash to enter the system and for trash to remain in the basin until it can be collected and removed. To meet the requirement, inlets must be designed to pass the peak flow produced by the one-year, one-hour design storm or the same flows as the capacity of the inlet storm drain and solids that would be retained by a 5 mm screen or mesh, must remain in the system.

Inlets

There are a multitude of inlet configurations that will allow trash to enter and be captured in an infiltration basin. An open inlet with a forebay is recommended.

Pretreatment

Pretreatment is beneficial to increase and consolidate trash capture while managing maintenance requirements. A forebay with mortared cobble is one example of incorporating pretreatment in the inlet (Figure 2). This configuration can slow flow and allow trash and gross solids to settle out while consolidating at the edge of the infiltration basin to make it easier for maintenance crews to collect and remove.

Trash Containment

Once trash has been captured in an infiltration basin it must be contained so trash does not escape the infiltration basin. Containment may be provided by one or more of these features:

- an external design feature or up-gradient structure designed to bypass flows exceeding the region-specific one-year, one-hour storm event; or
- the BMP having sufficient capacity to trap particles from flows exceeding those generated by the one-year, one-hour storm event; or
- the BMP having sufficient capacity to treat either the design flows or volumes through media filtration or infiltration into native or amended soils; or
- use of a maximum 5 mm mesh screen on all outlets.

Maintenance

A considerable cost concern associated with infiltration practices is the maintenance burden and longevity. If improperly maintained, infiltration basins have a high failure rate. Thus, it may be necessary to replace the basin with a different technology after a relatively short period of time. To mitigate failure, ensure particulate loading of the stormwater is minimal, or is reduced with an adjacent pretreatment (i.e. vegetated buffer strip). Reducing the particulate loading enables the soils infiltrative capacity to stay high and functional.

Clogged infiltration basins reduced water quality performance but can also enable standing water to become a nuisance due to mosquito breeding. If the basin takes more than 48 hours to drain, then the rock fill should be removed and all dimensions of the basin should be increased by 2 inches to provide a fresh surface for infiltration. To mitigate failure, ensure particulate loading of the stormwater is minimal, or is reduced with an adjacent pretreatment (Figure 2). Reducing particulate loading enables the soil's infiltrative capacity to remain high and functional. Table 3 provides maintenance activity details, frequency, and costs.

Table 3. Typical maintenance activities and associated costs and frequency

Frequency	Cost	Activity
Routine Maintenance (required monthly to every 2 years)		
Routine (small)	$7.62/ft^2	Remove excess sediment, trash, and debris across the surface, inlet, and outlet. Check for and stabilize erosion. Pruning and mowing overgrown

Frequency	Cost	Activity
Routine (medium)	$1.91/ft^2	vegetation that interferes with access, or safety (if applicable).
Routine (large)	$1.91/ft^2	
End of Life Replacement (service life of 20 years)		Excavate to the depth of soil media. Test soil for excessive soil contamination of common stormwater pollutants (e.g. metals, nutrients). Continue to remove underlying soil if pollutants exceed standard for contaminated soil. Replace with clean soil.
Replacement (small)	$10.52/ft^2	
Replacement (medium)	$10.17/ft^2	
Replacement (large)	$10.11/ft^2	
Note: Small System = 500 ft^2; Medium System = 2000 ft^2; Large System = 4000 ft^2 Underlined statement indicates that the activity may be required more frequently than shown in the table to meet the State Water Board maintenance criteria for Multi-Benefit Treatment Systems to be qualified as Full Capture Systems.		

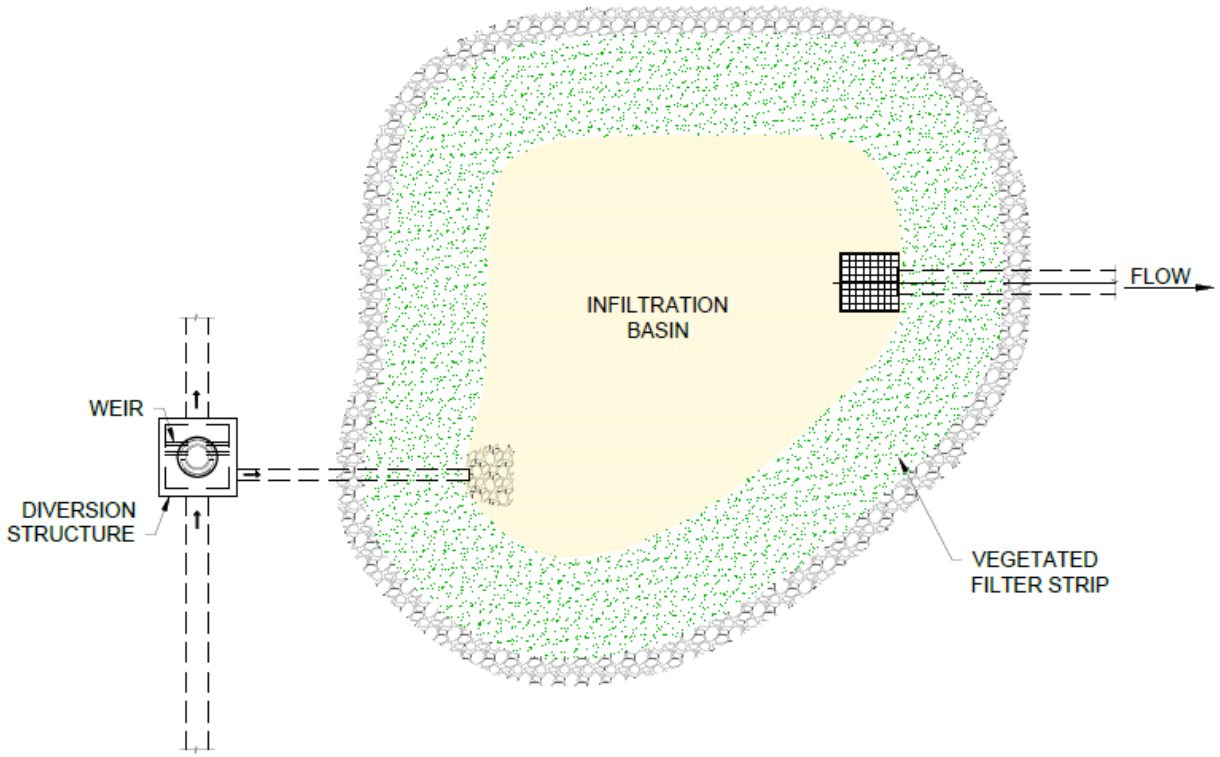
Trash FCS

Maintenance to Prevent Trash Migration, Sustain Capacity, and Prevent Reduced Functionality

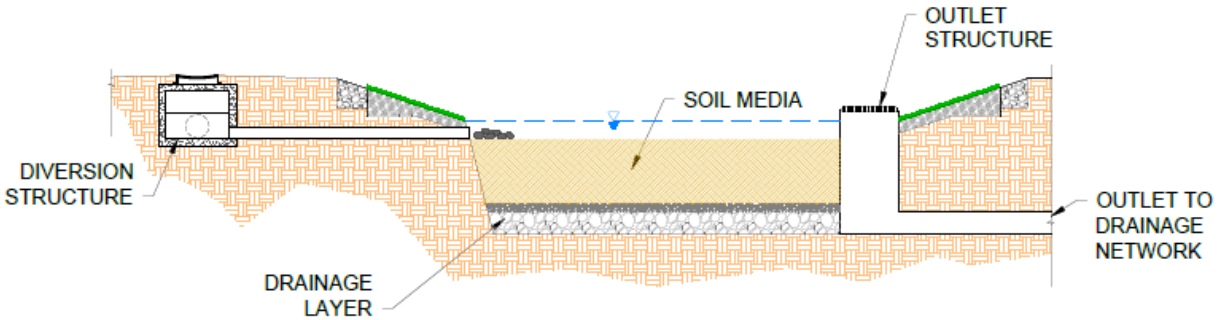
For Multi-Benefit Treatment Systems to be qualified as Full Capture Systems, the State Water Board requires regular maintenance to maintain adequate trash capture capacity and to ensure that trapped trash does not migrate offsite. Additionally, the State Water Board requires the BMP owner to establish a maintenance schedule based on site-specific factors, including the design trash capacity of the Infiltration Basin Multi-Benefit Trash Treatment System, storm frequency, and estimated or measured trash loading from the drainage area. To meet those criteria, it is likely that the frequency of trash and debris removal will have to be increased above the recommended monthly interval during the wet season to prevent trash from being blown from the BMP or being washed out of the infiltration basin in the subsequent rain events (see Table 3). Depending on the frequency and size of storms, and upstream pollutant characteristics, trash and debris removal can be as frequent as before and after every wet weather event. The optimum maintenance frequency is best determined by site observation over an average water year.

Trash maintenance not only plays a role in the functionality of the infiltration basin but also in the aesthetics and public perception of the infiltration basin (and of all BMPs). Part of maintaining positive perception among the public is the visibility of a well-maintained BMP. This positive perception can self-perpetuate further support for integrated stormwater management practices and therefore further investment in regular maintenance.

Schematic



A - INFILTRATION BASIN - PLAN VIEW
NOT TO SCALE



A - INFILTRATION BASIN - SECTION
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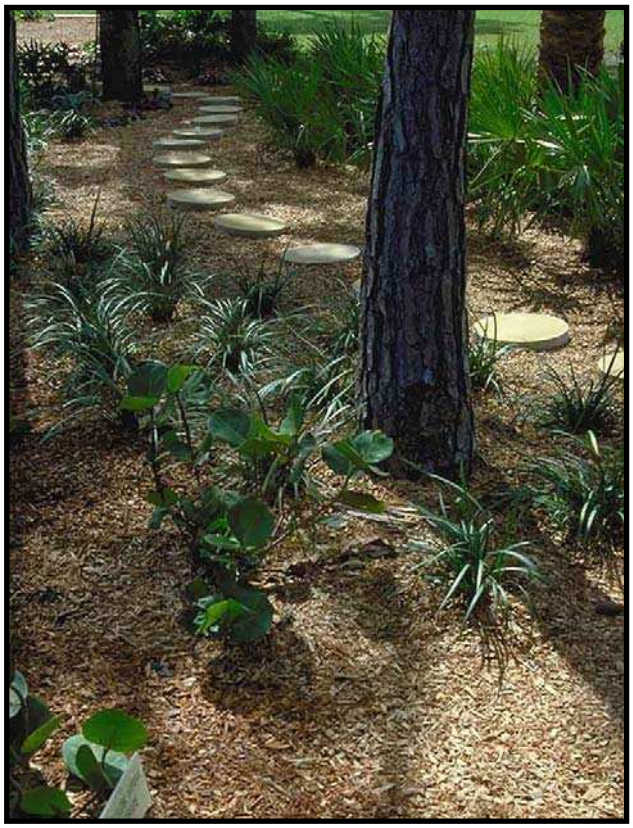
Site Design & Landscape Planning SD-10



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.

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.

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

Roof Runoff Controls SD-11

Rain Garden

Design Objectives

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

Description

Various roof runoff controls are available to address stormwater that drains off rooftops. The objective is to reduce the total volume and rate of runoff from individual lots, and retain the pollutants on site that may be picked up from roofing materials and atmospheric deposition. Roof runoff controls consist of directing the roof runoff away from paved areas and mitigating flow to the storm drain system through one of several general approaches: cisterns or rain barrels; dry wells or infiltration trenches; pop-up emitters, and foundation planting. The first three approaches require the roof runoff to be contained in a gutter and downspout system. Foundation planting provides a vegetated strip under the drip line of the roof.

Approach

Design of individual lots for single-family homes as well as lots for higher density residential and commercial structures should consider site design provisions for containing and infiltrating roof runoff or directing roof runoff to vegetative swales or buffer areas. Retained water can be reused for watering gardens, lawns, and trees. Benefits to the environment include reduced demand for potable water used for irrigation, improved stormwater quality, increased groundwater recharge, decreased runoff volume and peak flows, and decreased flooding potential.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Designing New Installations

Cisterns or Rain Barrels

One method of addressing roof runoff is to direct roof downspouts to cisterns or rain barrels. A cistern is an above ground storage vessel with either a manually operated valve or a permanently open outlet. Roof runoff is temporarily stored and then released for irrigation or infiltration between storms. The number of rain

barrels needed is a function of the rooftop area. Some low impact developers recommend that every house have at least 2 rain barrels, with a minimum storage capacity of 1000 liters. Roof barrels serve several purposes including mitigating the first flush from the roof which has a high volume, amount of contaminants, and thermal load. Several types of rain barrels are commercially available. Consideration must be given to selecting rain barrels that are vector proof and childproof. In addition, some barrels are designed with a bypass valve that filters out grit and other contaminants and routes overflow to a soak-away pit or rain garden.

If the cistern has an operable valve, the valve can be closed to store stormwater for irrigation or infiltration between storms. This system requires continual monitoring by the resident or grounds crews, but provides greater flexibility in water storage and metering. If a cistern is provided with an operable valve and water is stored inside for long periods, the cistern must be covered to prevent mosquitoes from breeding.

A cistern system with a permanently open outlet can also provide for metering stormwater runoff. If the cistern outlet is significantly smaller than the size of the downspout inlet (say ¼ to ½ inch diameter), runoff will build up inside the cistern during storms, and will empty out slowly after peak intensities subside. This is a feasible way to mitigate the peak flow increases caused by rooftop impervious land coverage, especially for the frequent, small storms.

Dry wells and Infiltration Trenches

Roof downspouts can be directed to dry wells or infiltration trenches. A dry well is constructed by excavating a hole in the ground and filling it with an open graded aggregate, and allowing the water to fill the dry well and infiltrate after the storm event. An underground connection from the downspout conveys water into the dry well, allowing it to be stored in the voids. To minimize sedimentation from lateral soil movement, the sides and top of the stone storage matrix can be wrapped in a permeable filter fabric, though the bottom may remain open. A perforated observation pipe can be inserted vertically into the dry well to allow for inspection and maintenance.

In practice, dry wells receiving runoff from single roof downspouts have been successful over long periods because they contain very little sediment. They must be sized according to the amount of rooftop runoff received, but are typically 4 to 5 feet square, and 2 to 3 feet deep, with a minimum of 1-foot soil cover over the top (maximum depth of 10 feet).

To protect the foundation, dry wells must be set away from the building at least 10 feet. They must be installed in solids that accommodate infiltration. In poorly drained soils, dry wells have very limited feasibility.

Infiltration trenches function in a similar manner and would be particularly effective for larger roof areas. An infiltration trench is a long, narrow, rock-filled trench with no outlet that receives stormwater runoff. These are described under Treatment Controls.

Pop-up Drainage Emitter

Roof downspouts can be directed to an underground pipe that daylights some distance from the building foundation, releasing the roof runoff through a pop-up emitter. Similar to a pop-up irrigation head, the emitter only opens when there is flow from the roof. The emitter remains flush to the ground during dry periods, for ease of lawn or landscape maintenance.

Foundation Planting

Landscape planting can be provided around the base to allow increased opportunities for stormwater infiltration and protect the soil from erosion caused by concentrated sheet flow coming off the roof. Foundation plantings can reduce the physical impact of water on the soil and provide a subsurface matrix of roots that encourage infiltration. These plantings must be sturdy enough to tolerate the heavy runoff sheet flows, and periodic soil saturation.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Supplemental Information

Examples

- City of Ottawa's Water Links Surface –Water Quality Protection Program
- City of Toronto Downspout Disconnection Program
- City of Boston, MA, Rain Barrel Demonstration Program

Other Resources

Hager, Marty Catherine, Stormwater, "Low-Impact Development", January/February 2003. www.stormh2o.com

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

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

Efficient Irrigation SD-12

Design Objectives

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

Description

Irrigation water provided to landscaped areas may result in excess irrigation water being conveyed into stormwater drainage systems.

Approach

Project plan designs for development and redevelopment should include application methods of irrigation water that minimize runoff of excess irrigation water into the stormwater conveyance system.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Designing New Installations

The following methods to reduce excessive irrigation runoff should be considered, and incorporated and implemented where determined applicable and feasible by the Permittee:

- Employ rain-triggered shutoff devices to prevent irrigation after precipitation.
- Design irrigation systems to each landscape area's specific water requirements.
- Include design featuring flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.
- Implement landscape plans consistent with County or City water conservation resolutions, which may include provision of water sensors, programmable irrigation times (for short cycles), etc.

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- Design timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the storm water drainage system.
- Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species). Consider design features such as:
  - Using mulches (such as wood chips or bar) in planter areas without ground cover to minimize sediment in runoff
  - Installing appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant materials where possible and/or as recommended by the landscape architect
  - Leaving a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible
  - Choosing plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth
- Employ other comparable, equally effective methods to reduce irrigation water runoff.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Other Resources

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

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

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

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

Storm Drain Signage SD-13

Design Objectives

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

Description

Waste materials dumped into storm drain inlets can have severe impacts on receiving and ground waters. Posting notices regarding discharge prohibitions at storm drain inlets can prevent waste dumping. Storm drain signs and stencils are highly visible source controls that are typically placed directly adjacent to storm drain inlets.

Approach

The stencil or affixed sign contains a brief statement that prohibits dumping of improper materials into the urban runoff conveyance system. Storm drain messages have become a popular method of alerting the public about the effects of and the prohibitions against waste disposal.

Suitable Applications

Stencils and signs alert the public to the destination of pollutants discharged to the storm drain. Signs are appropriate in residential, commercial, and industrial areas, as well as any other area where contributions or dumping to storm drains is likely.

Design Considerations

Storm drain message markers or placards are recommended at all storm drain inlets within the boundary of a development project. The marker should be placed in clear sight facing toward anyone approaching the inlet from either side. All storm drain inlet locations should be identified on the development site map.

Designing New Installations

The following methods should be considered for inclusion in the project design and show on project plans:

- Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with prohibitive language. Examples include “NO DUMPING

– DRAINS TO OCEAN" and/or other graphical icons to discourage illegal dumping.

- Post signs with prohibitive language and/or graphical icons, which prohibit illegal dumping at public access points along channels and creeks within the project area.

Note - Some local agencies have approved specific signage and/or storm drain message placards for use. Consult local agency stormwater staff to determine specific requirements for placard types and methods of application.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. If the project meets the definition of "redevelopment", then the requirements stated under " designing new installations" above should be included in all project design plans.

Additional Information

Maintenance Considerations

- Legibility of markers and signs should be maintained. If required by the agency with jurisdiction over the project, the owner/operator or homeowner's association should enter into a maintenance agreement with the agency or record a deed restriction upon the property title to maintain the legibility of placards or signs.

Placement

- Signage on top of curbs tends to weather and fade.

- Signage on face of curbs tends to be worn by contact with vehicle tires and sweeper brooms.

Supplemental Information

Examples

- Most MS4 programs have storm drain signage programs. Some MS4 programs will provide stencils, or arrange for volunteers to stencil storm drains as part of their outreach program.

Other Resources

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

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

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.