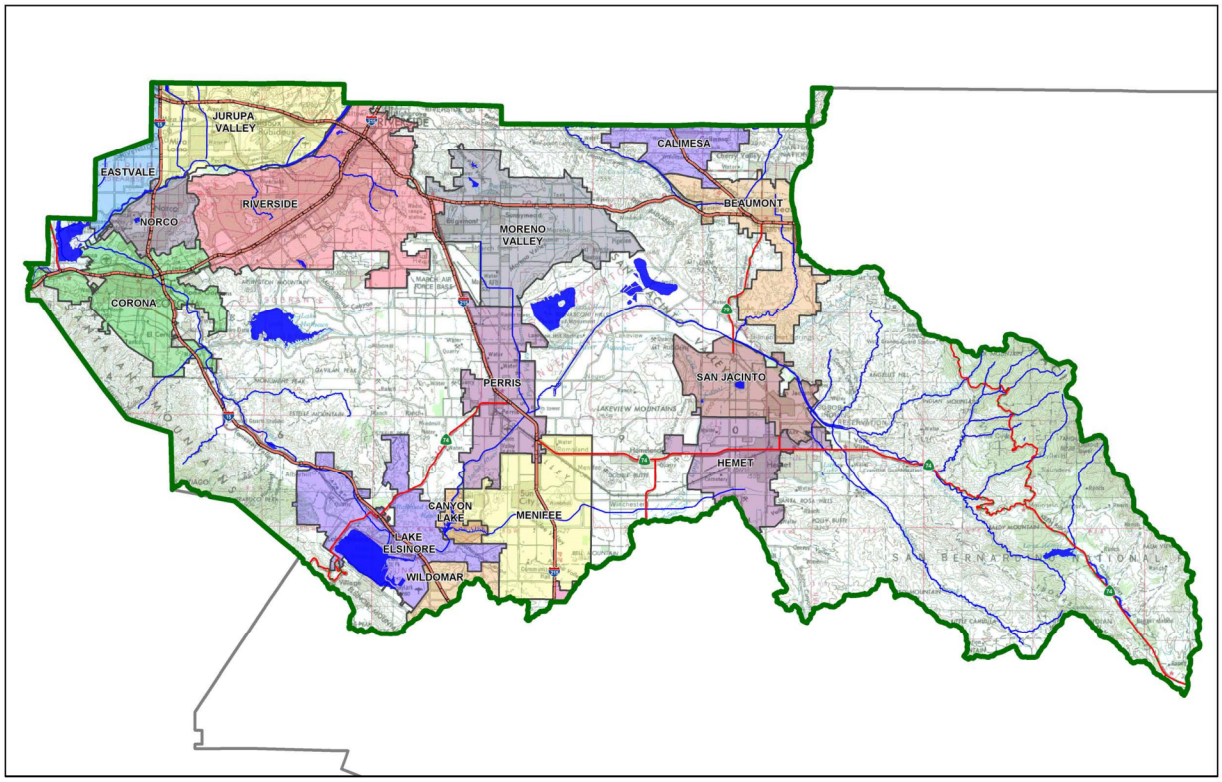
Project Specific Water Quality Management Plan

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

Project Title: Perris Mixed Use

Development No:

Design Review/Case No:



☒ **Preliminary**
☐ **Final**

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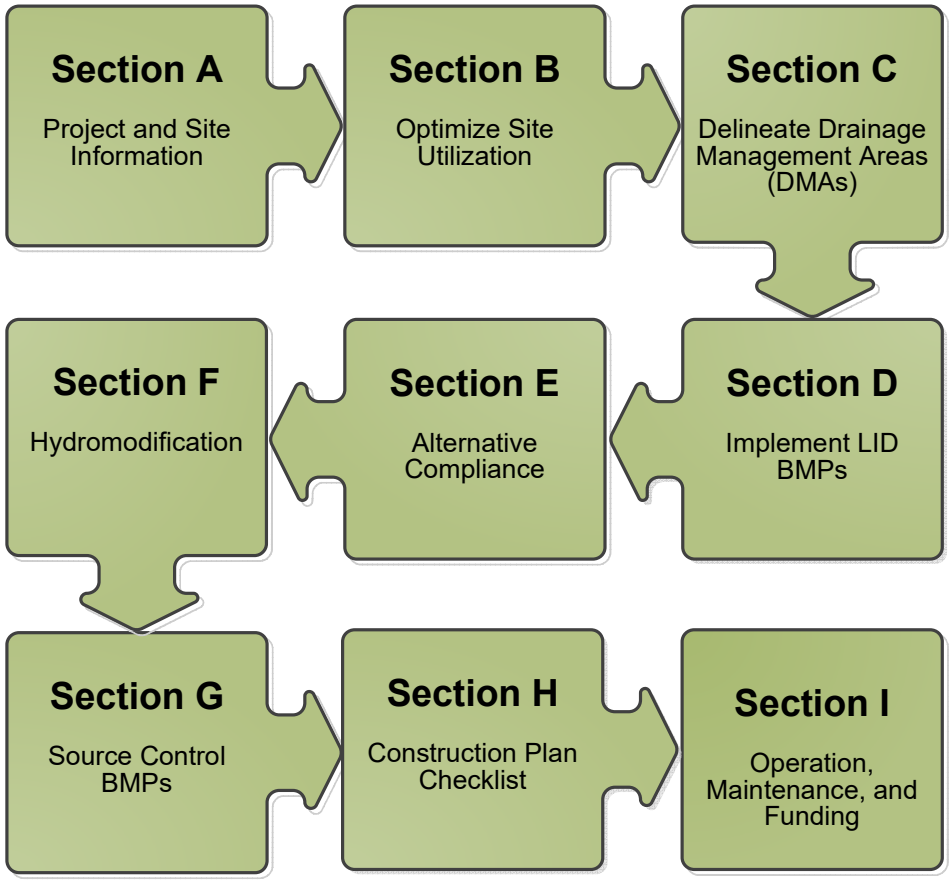
A Brief Introduction

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



OWNER'S CERTIFICATION

This Project-Specific Water Quality Management Plan (PWQMP) has been prepared for Alabbasi Construction & Engineering by R.A. SMITH INC. for the PERRIS MIXED USE project.

This PWQMP is intended to comply with the requirements of City of Perris for Perris Quality Ordinance 1194 which includes the requirement for the preparation and implementation of a Project-Specific PWQMP.

The undersigned, while owning the property/project described in the preceding paragraph, shall be responsible for the implementation and funding of this PWQMP and will ensure that this PWQMP 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 PWQMP 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 PWQMP. At least one copy of this PWQMP will be maintained at the project site or project office in perpetuity. The undersigned is authorized to certify and to approve implementation of this PWQMP. The undersigned is aware that implementation of this PWQMP is enforceable under City of Perris Water Quality Ordinance 1194 (Municipal Code Section14.22).

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

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

PREPARER'S CERTIFICATION

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

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

Preparer's Licensure:

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Section A: Project and Site Information

PROJECT INFORMATION	
Type of Project:	MIXED USE COMMERCIAL AND WEREHOUSE
Planning Area:	Perris Valley Commerce Center
Community Name:	Perris Valley Commerce Center
Development Name:	E. Dawes Street & Painted Canyon Road
PROJECT LOCATION	
Latitude & Longitude (DMS): LAT = 33.842680, LONG = -117.220690	
Project Watershed and Sub-Watershed: Santa Ana; San Jacinto River Reach 3	
Gross Acres: 748,543 sq-ft or 17.18 acres APN(s): 303-100-012, 303-100-014 Map Book and Page No.: Book 14 Page 668	
PROJECT CHARACTERISTICS	
Proposed or Potential Land Use(s)	Restaurant, Hotel, Industrial Warehouse
Proposed or Potential SIC Code(s)	5812, 7011, 4225
Area of Impervious Project Footprint (SF)	674,544
Total Area of proposed Impervious Surfaces within the Project Footprint (SF)/or Replacement	674,544
Does the project consist of offsite road improvements?	☒ Y ☐ N
Does the project propose to construct unpaved roads?	☐ Y ☒ N
Is the project part of a larger common plan of development (phased project)?	☐ Y ☒ N
EXISTING SITE CHARACTERISTICS	
Total area of existing Impervious Surfaces within the Project limits Footprint (SF)	0
Is the project located within any MSHCP Criteria Cell?	☐ Y ☒ N
If so, identify the Cell number:	N/A
Are there any natural hydrologic features on the project site?	☐ Y ☒ N
Is a Geotechnical Report attached?	☒ Y ☐ N
If no Geotech. Report, list the NRCS soils type(s) present on the site (A, B, C and/or D)	N/A
What is the Water Quality Design Storm Depth for the project?	0.64

A.1 Maps and Site Plans

When completing your Project-Specific PWQMP, 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 PWQMP Site Plan should include the following:

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

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

A.2 Identify Receiving Waters

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

Table A.1 Identification of Receiving Waters

Receiving Waters	EPA Approved 303(d) List Impairments	Designated Beneficial Uses	Proximity to RARE Beneficial Use
Perris Valley Channel	N/A	Groundwater recharge	0.40 miles
San Jacinto River, Reach 3	None		
Canyon Lake	Nutrients		
San Jacinto River , Reach 1	None		
Elsinore, Lake	DDT, Nutrients, Organic Enrichment/Low Dissolved Oxygen, Toxicity		

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 Perris 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 PWQMP.

Section B: Optimize Site Utilization (LID Principles)

Site Optimization

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

The existing drainage patterns are generally maintained to the extent feasible. The existing site sheet flows from Northwest to Southeast in to the curb and gutter along East Dawes Street, which ultimately discharges to Lake Elsinore. The proposed site is divided into a north and south DMA's. Both areas flow via gutter and storm drain to underground cisterns that will then be pumped up to biofiltration facilities. After the water is treated through the biofiltration systems it will be pumped up and discharged into the curb and gutter in East Dawes Street. In large storms once the rainwater cisterns are full the stormwater will overflow to the curb in East Dawes Street, to Perris Valley Channel, to San Jacinto River Reach 3, to Canyon Lake, to San Jacinto River Reach 1, to Lake Elsinore.

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

The site is a fallow farm field, No Vegetation to protect

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

Infiltration test show that infiltration is not feasable

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

Landscaping areas have been maximized

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

Runoff is captured in underground cistern, treated in a bioretention basin and then released to the adjacent roadway curbs.

Section C: Delineate Drainage Management Areas (DMAs)

Utilizing the procedure in Section 3.3 of the PWQMP 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
DMA-1	Impervious Roof, Impervious Pavement, Landscaping Areas	199,667	Type D
DMA-2	Impervious Roof, Impervious Pavement, Landscaping Areas	548,875	Type D

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

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

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

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

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

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

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

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

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

DMA Name or ID	BMP Name or ID
DMA-1	Bioretention (BIO-1)
DMA-2	Bioretention (BIO-2)

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 PWQMP 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 PWQMP 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 PWQMP 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 PWQMP 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: DMA-1, DMA-2		
…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: 1.70 (Acres)

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

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

Total Area of Impervious Surfaces: 17.18 (Acres)

Step 3: Cross reference the Design Storm depth for the project site (see Exhibit A of the PWQMP 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: EIATIA Factor = 1.05

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

Minimum required irrigated area: 18.04 (Acres)

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

Minimum required irrigated area (Step 4)	Available Irrigated Landscape (Step 1)
18.04 (Acres)	1.70 (Acres)

Toilet Use Feasibility

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

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

Projected Number of Daily Toilet Users: 676

Project Type: Mixed Use; Industrial Warhouse, Hotel, Commercial

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

Total Area of Impervious Surfaces: 1.70 (Acres)

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

Enter your TUTIA factor: 128

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: 1,982

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)
1,982	676

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: Projected Average Daily Use (gpd)

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: Insert Area (Acres)

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: Enter Value

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: Minimum use required (gpd)

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)**
Minimum use required (gpd)	Projected Average Daily Use (gpd)

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 PWQMP Guidance Document.

D.3 Bioretention and Biotreatment Assessment

Other LID Bioretention and Biotreatment BMPs as described in Chapter 2.4.7 of the PWQMP 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 PWQMP 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	
DMA-1	☐	☐	☒	☐	☐
DMA-2	☐	☐	☒	☐	☐
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐

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.

Insert narrative description here.

D.5 LID BMP Sizing

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	*Enter BMP Name / Identifier Here*		
	[A]		[B]	[C]	[A] x [C]			
DMA-1								
Roof, Paving	*166,336*	*Roofs, Concrete or Asphalt*	*1*	*0 .89*	*148,066*			
Pervious	*33,331*	*Ornamental Landscaping*	*0 .1*	*0.11*	*3,666*			
						Design Storm Depth (in)	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
	A_T = 199,667				Σ= 151,732	0.64	8,092	8,422

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

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

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

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Enter BMP Name / Identifier Here*		
	[A]		[B]	[C]	[A] x [C]			
DMA-2								
Roof, Paving	*508,208*	*Roofs, Concrete or Asphalt*	*1*	*0.89*	*452,305*			
Pervious	*40,667*	*Ornamental Landscaping*	*0.1*	*0.11*	*4,473*			
						Design Storm Depth (in)	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
	A_T = 548,875				Σ= 456,778	0.64	24,361	24,565

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

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

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

	2 year – 24 hour						
	Storage Tank design volume Required cu-ft	Storage Tank design volume Provided cu-ft	Bioretention surface area Sq-ft	Pump rate gpm	Pump rate Sq-ft/hr	Infiltration rate needed In/hr	Infiltration rate Provided In/Hr
DMA 1	8,092	8,422	847	22	175.5	2.5	5.0
DMA 2	24,361	24,565	2,326	64	512	2.6	5.0

Section E: Alternative Compliance (LID Waiver Program)

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

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

- *Or* -

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

E.1 Identify Pollutants of Concern

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

Table E.1 Potential Pollutants by Land Use Type

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

P = Potential

N = Not Potential

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

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

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

(4) Specifically petroleum hydrocarbons

(5) Specifically solvents

(6) Bacterial indicators are routinely detected in pavement runoff

E.2 Stormwater Credits

Projects that cannot implement LID BMPs but nevertheless implement smart growth principles are potentially eligible for Stormwater Credits. Utilize Table 3-8 within the PWQMP 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 PWQMP 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 PWQMP 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 PWQMP 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 PWQMP 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 PWQMP Guidance Document, must be included in Appendix 6. In addition, ensure that proposed Treatment Control BMPs are properly identified on the PWQMP 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 PWQMP 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 PWQMP 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	INSERT VALUE	INSERT VALUE
Volume (Cubic Feet)	INSERT VALUE	INSERT VALUE	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 PWQMP 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 PWQMP 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

Section H: Construction Plan Checklist

Table H.1 Construction Plan Cross-reference

BMP No. or ID	BMP Identifier and Description	Corresponding Plan Sheet(s)	BMP Location (Lat/Long)
DMA-1	BIORETENTION 1 (BIO-1)	GP-1, WQ-1	33.844242° / -117.219724°
DMA-2	BIORETENTION 2 (BIO-2)	GP-1, WQ-1	33.841269° / -117.219939°

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 PWQMP:

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 PWQMP Guidance. Include a brief description of typical landscape maintenance for these areas.

See Appendix 9 for a detailed Stormwater BMP Operation and Maintenance Plan that sets forth a maintenance schedule for each of the Stormwater BMPs built on site, and an agreement assigning responsibility for maintenance and providing for inspections and certification.

Maintenance Mechanism: Property Owner

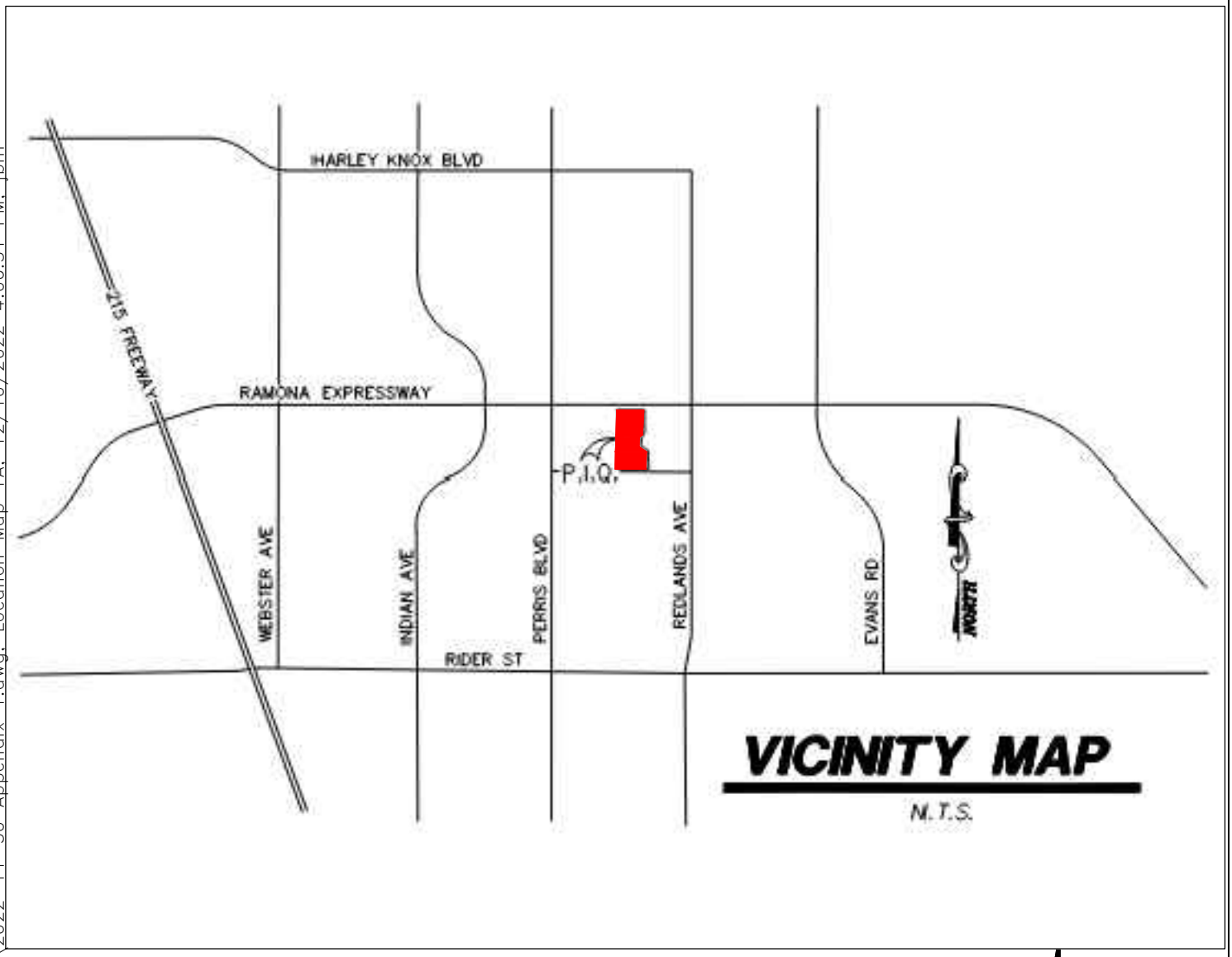
Will the proposed BMPs be maintained by a Home Owners' Association (HOA) or Property Owners Association (POA)?

☐ 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 PWQMP in Appendix 10.

Appendix 1: Maps and Site Plans

Location Map, PWQMP Site Plan and Receiving Waters Map



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Irvine, CA 92618-4237
(949) 872-2378
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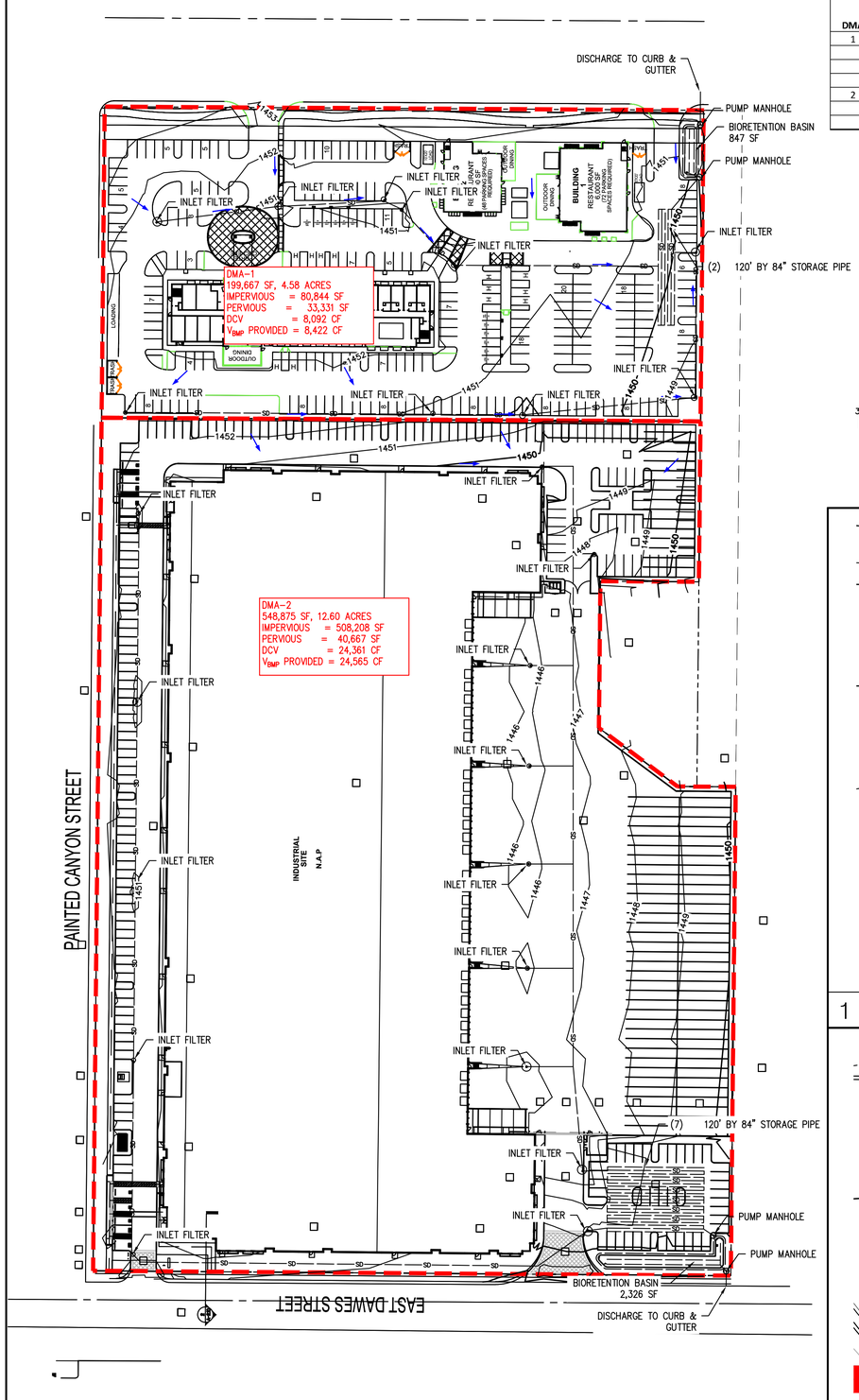
PERRIS MIXED USE
RAMONA EXPRESSWAY PERRIS, CA

LOCATION MAP

DATE: MM/DD/YY
SCALE: 1" = 20'
JOB NO. 3220220
PROJECT MANAGER: ERIC A. ROBLES

SHEET NUMBER
WQMP-1A



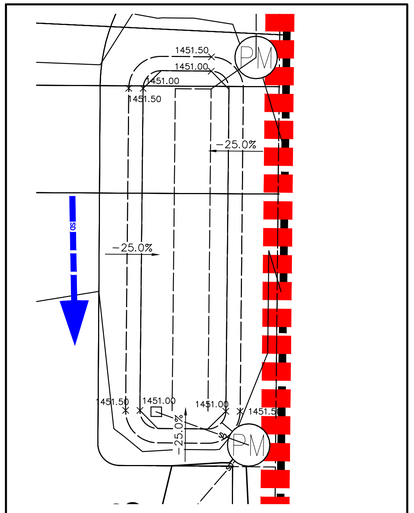
DMA	SURFACE TYPE	DMA TYPE	AREA (SF)	PERVIOUS AREA (SF)	IMPERVIOUS AREA (SF)	% PERVIOUS	% IMPERVIOUS	EFFECTIVE IMPERVIOUS FRACTION	DMA RUNOFF FACTOR	V BMP (CF)	BIORETENTION AREA	STORAGE VOLUME REQUIRED (CF)	STORAGE VOLUME PROVIDED (CF)	BMP TYPE
1	IMPERVIOUS	D	199,667	0	199,667	0.00%	100.00%	1	0.89					BIORETENTION WITH
	LANDSCAPE AREAS	D	33,331	33,331	0	100.00%	0.00%	0.1	0.11	8,092.0	847	8,092.0	8,422.00	UPSTREAM STORAGE
	TOTAL		**232,998**											
2	IMPERVIOUS	D	508,208	0	508,208	0.00%	100.00%	1	0.89					BIORETENTION WITH
	LANDSCAPE AREAS	D	40,667	40,667	0	100.00%	0.00%	0.1	0.11	24,361.0	2,326	24,361.0	24,565.00	UPSTREAM STORAGE
	TOTAL		**548,875**											

GRAPHIC SCALE
35 0 17.5 35 70 140
(IN FEET)
1 inch = 70 ft.

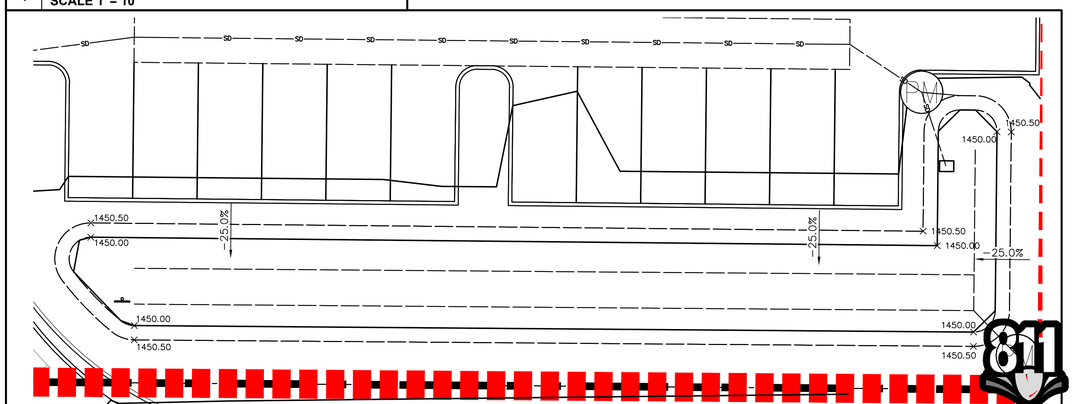
[1] CMP VOLUME = π x RADIUS^2 x LENGTH
= π x (3.5FT)^2 x 240 FT = 9,236 CF
– TOP 1' OF PIPE.
=$R^2\cos^{-1}((R-h)/R) - (R-h)\sqrt{(2Rh-h^2)}$
= 814 CF
= TOTAL STORAGE 8,422 cf

[2] CMP VOLUME = π x RADIUS^2 x LENGTH
= π x (3.5FT)^2 x 700 FT = 26,939 CF
– TOP 1' OF PIPE.
=$R^2\cos^{-1}((R-h)/R) - (R-h)\sqrt{(2Rh-h^2)}$
= 2,374 CF
= TOTAL STORAGE 24,565 CF

	2 year – 24 hour						
	Storage Tank design volume Required cu-ft	Storage Tank design volume Provided cu-ft	Bioretention surface area Sq-ft	Pump rate gpm	Pump rate Sq-ft/hr	Infiltration rate needed In/hr	Infiltration rate Provided In/Hr
DMA 1	8,092	8,422	847	22	175.5	2.5	5.0
DMA 2	24,361	24,565	2,326	64	512	2.6	5.0



1 NORTH STORM BIORETENTION BASIN DETAIL
SCALE 1"= 10'



2 SOUTH STORM BIORETENTION BASIN DETAIL
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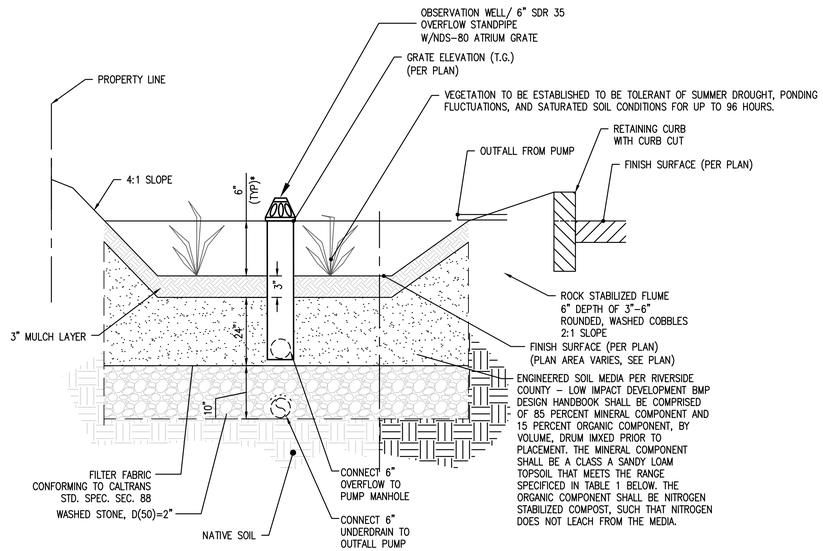

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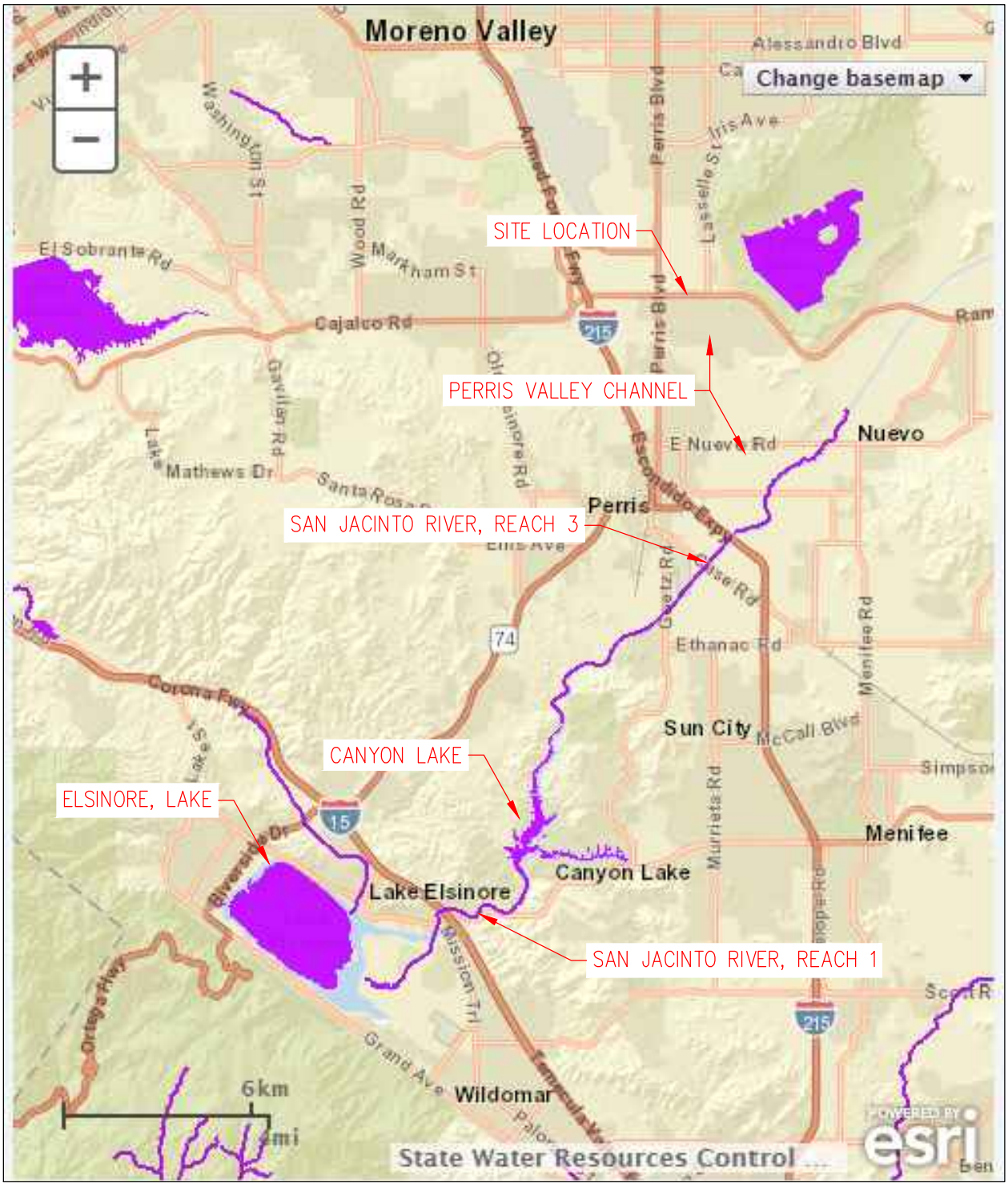
PERRIS MIXED USE
SOUTH OF RAMONA EXPRESSWAY AND NORTH OF DAWES SREET, PEERIS,CA

WQMP EXHIBIT

LICENSED PROFESSIONAL ENGINEER
ERIC A. ROBLES
C89866
EXP.6/30/23
CIVIL
STATE OF CALIFORNIA
DATE_____

DATE: 12/16/22
SCALE: 1" = 70'
JOB NO. 3220220
PROJECT MANAGER: ERIC A. ROBLES
DESIGNED BY:
CHECKED BY: EAR

SHEET NUMBER
WQMP–1B



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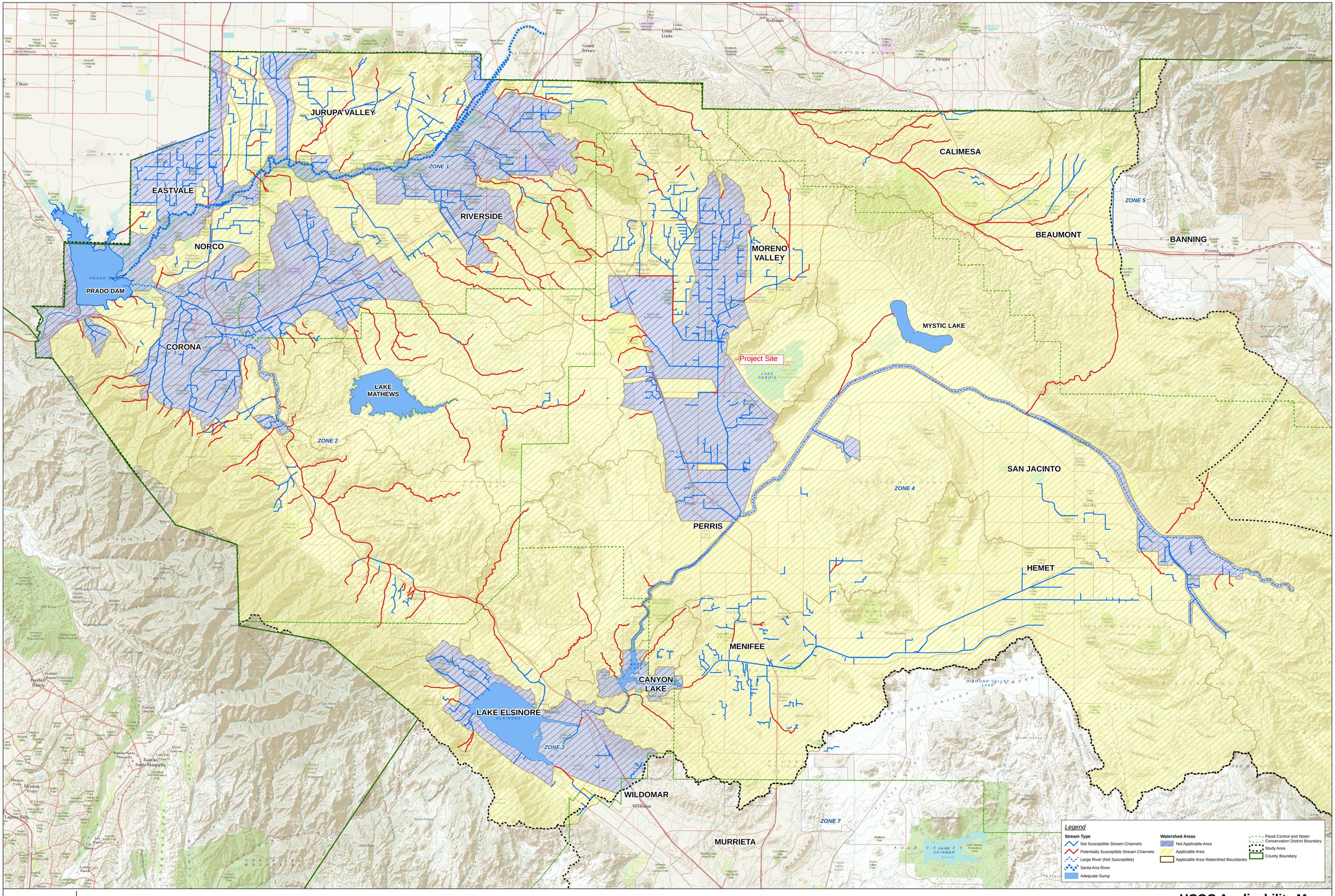
PERRIS MIXED USE
RAMONA EXPRESSWAY PERRIS, CA

RECIEVING WATERS

DATE: 12/16/22
SCALE: NTS
JOB NO. 3220220
PROJECT MANAGER: ERIC A. ROBLES

SHEET NUMBER
WQMP-1C



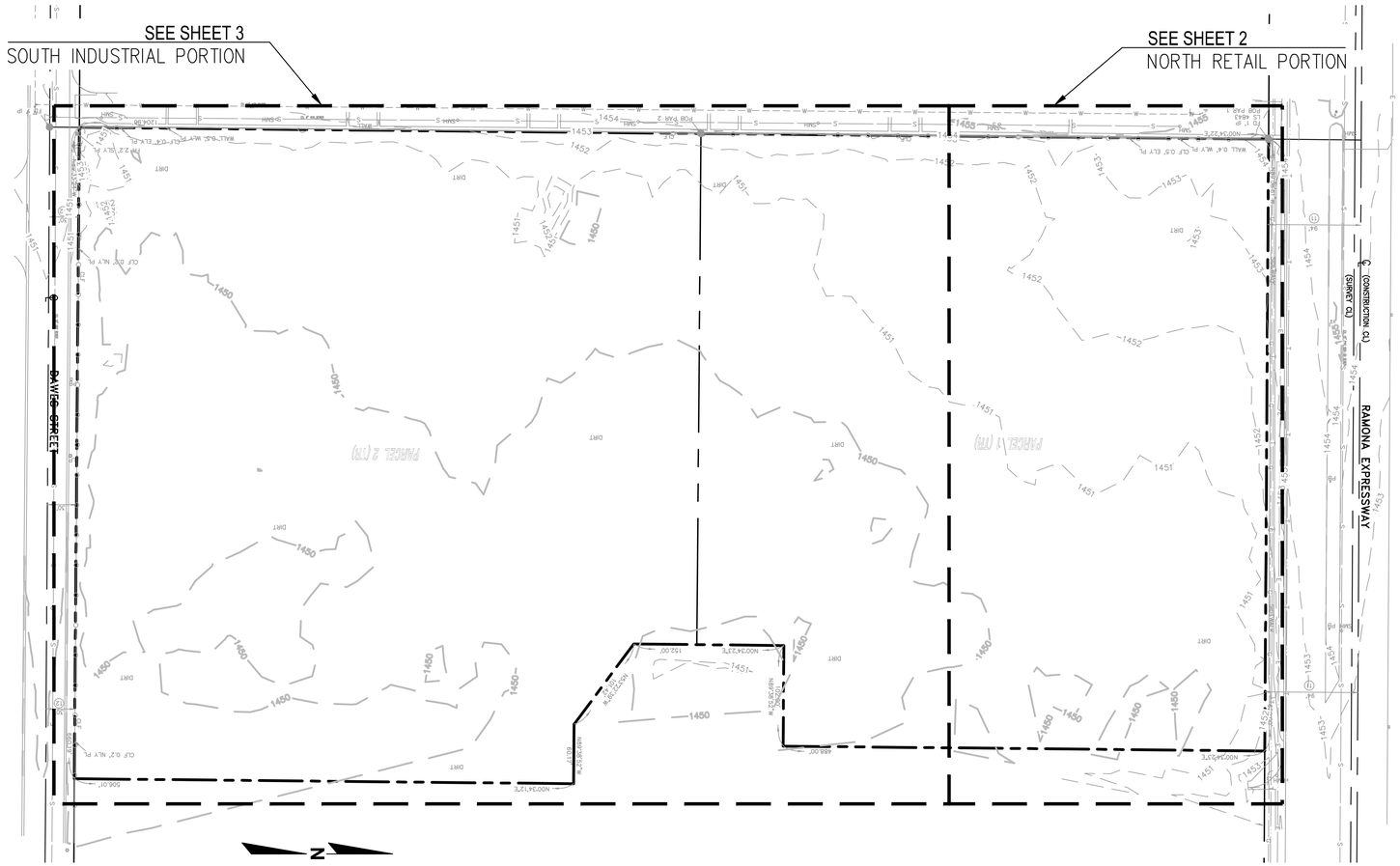
HCOC Applicability Map

Hydromodification Susceptibility Documentation Report and Mapping
Riverside County Flood Control and Water Conservation District

Map 2

Appendix 2: Construction Plans

Grading and Drainage Plans



GRAPHIC SCALE

35 0 17.5 35 70 140

(IN FEET)

1 inch = 70 ft.

CIVIL PLAN INDEX

SHEET NO.	DESCRIPTION
1	EXISTING CONDITIONS
2	PRELIMINARY GRADING AND UTILITY PLAN (NORTH)
3	PRELIMINARY GRADING AND UTILITY PLAN (SOUTH)
4	INDUSTRIAL CROSS SECTIONS
5	RETAIL CROSS SECTIONS

LOCATION MAP

NOT TO SCALE

LEGAL DESCRIPTION

BASED UPON PRELIMINARY REPORT NO. NCS-1119554-ONT1, DATED MARCH 14, 2022, PREPARED BY FIRST AMERICAN TITLE COMPANY.

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

PARCEL A:

PARCEL 1 AS SHOWN ON CERTIFICATE OF COMPLIANCE FOR LOT LINE ADJUSTMENT #012-87 AS EVIDENCED BY DOCUMENT RECORDED SEPTEMBER 17, 1987 AS INSTRUMENT NO. 1987-270637 OF OFFICIAL RECORDS, BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

THAT PORTION OF LOT 2 IN BLOCK 14 OF THE RIVERSIDE TRACT, IN THE CITY OF PERRIS, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA, AS PER MAP RECORDED IN BOOK 14, PAGE(S) 668 OF MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAN DIEGO COUNTY, DESCRIBED AS FOLLOWS:

BEGINNING A THE INTERSECTION OF THE WEST LINE OF SAID LOT 2 WITH THE SOUTH LINE OF THE RAMONA EXPRESSWAY AS CONVEYED TO THE COUNTY OF RIVERSIDE, RECORDED NOVEMBER 7, 1958 AS INSTRUMENT NO. 80353 OF OFFICIAL RECORDS;

THENCE SOUTH 89° 38' 51" EAST, ALONG THE SOUTH LINE OF SAID RAMONA EXPRESSWAY, A DISTANCE OF 620.00 FEET;

THENCE SOUTH 0° 34' 24" WEST, PARALLEL WITH THE WEST LINE OF LOT 2, A DISTANCE OF 488.00 FEET;

THENCE NORTH 89° 38' 51" WEST, PARALLEL WITH THE SOUTH LINE OF SAID RAMONA EXPRESSWAY, A DISTANCE OF 102.00 FEET;

THENCE SOUTH 0° 34' 24" WEST, PARALLEL WITH THE WEST LINE OF LOT 2, A DISTANCE OF 88.08 FEET TO A POINT ON THE SOUTH LINE OF LOT 2;

THENCE NORTH 89° 32' 24" WEST, ALONG SAID SOUTH LINE, A DISTANCE OF 518.00 FEET TO THE SOUTHWEST CORNER OF LOT 2;

THENCE NORTH 0° 34' 24" EAST, ALONG THE WEST LINE OF LOT 2, A DISTANCE OF 575.11 FEET TO THE POINT OF BEGINNING.

PARCEL B:

PARCEL 2 AS SHOWN ON CERTIFICATE OF COMPLIANCE FOR LOT LINE ADJUSTMENT #012-87 AS EVIDENCED BY DOCUMENT RECORDED SEPTEMBER 17, 1987 AS INSTRUMENT NO. 1987-270637 OF OFFICIAL RECORDS, BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS::

THAT PORTION OF LOT 7 IN BLOCK 14 OF THE RIVERSIDE TRACT, IN THE CITY OF PERRIS, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA, AS PER MAP RECORDED IN BOOK 14, PAGE(S) 668 OF MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAN DIEGO COUNTY, DESCRIBED AS FOLLOWS:

BEGINNING AT THE NORTHWEST CORNER OF LOT 7;

THENCE SOUTH 89° 32' 24" EAST, ALONG THE NORTH LINE OF LOT 7, A DISTANCE OF 518.00 FEET;

THENCE SOUTH 0° 34' 24" WEST, PARALLEL WITH THE WEST LINE OF LOT 7, A DISTANCE OF 63.92 FEET TO A POINT ON A LINE PARALLEL WITH AND 640.00 FEET SOUTH OF THE SOUTH LINE OF RAMONA EXPRESSWAY AS CONVEYED TO THE COUNTY OF RIVERSIDE, RECORDED NOVEMBER 7, 1958 AS INSTRUMENT NO. 80353 OF OFFICIAL RECORDS, SAID 640.00 FEET AS MEASURED PARALLEL WITH THE WEST LINE OF LOT 7;

THENCE SOUTH 53° 22' 38" EAST, A DISTANCE OF 101.42 FEET;

THENCE SOUTH 89° 38' 51" EAST, PARALLEL WITH THE SOUTH LINE OF SAID RAMONA EXPRESSWAY, 60.17 FEET TO A POINT ON THE EAST LINE OF LOT 7;

THENCE SOUTH 0° 34' 13" WEST, ALONG SAID EAST LINE, 506.01 FEET SOUTHEAST CORNER OF LOT 7, SAID SOUTHEAST CORNER BEING 30.00 FEET NORTH OF THE CENTERLINE OF DAWES STREET;

THENCE NORTH 89° 33' 23" WEST, ALONG THE SOUTH LINE OF LOT 7, A DISTANCE OF 660.19 FEET TO THE SOUTHWEST CORNER OF LOT 7;

THENCE NORTH 0° 34' 24" EAST, ALONG THE WEST LINE OF LOT 7, A DISTANCE OF 629.85 FEET TO THE POINT OF BEGINNING.

FOR CONVEYANCING PURPOSES ONLY: APN 303-100-012 (AFFECTS PORTION OF PARCEL A) 303-100-014 (AFFECTS PARCEL B AND PORTION OF PARCEL A)

FLOOD ZONE

THE PROPERTY LIES WITHIN ZONE "X" AND ZONE "AE" OF THE FLOOD INSURANCE RATE MAP 06065C1430H BEARING AN EFFECTIVE DATE OF AUGUST 18, 2014.

ZONING

NO ZONING REPORT WAS PROVIDED.

THE PROPERTY IS ZONED: PVCC SP (PERRIS VALLEY COMMERCE CENTER SPECIFIC PLAN)

BASIS OF BEARINGS

THE BASIS OF BEARINGS FOR THIS SURVEY IS THE CENTERLINE OF RAMONA EXPRESSWAY BEING NORTH 89°38'51" WEST PER TRACT NO. 21771 FILED IN BOOK 175, PAGES 60 THROUGH 66, RECORDS OF RIVERSIDE COUNTY.

811 Know what's **below.** **Call** before you dig.

DATE	DESCRIPTION
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PERRIS MIXED USE
SOUTH OF RAMONA EXPRESSWAY AND NORTH OF DAWES SREET, PEERIS,CA

EXISTING CONDITIONS

LICENSED PROFESSIONAL ENGINEER
ERIC A. ROBLES
C89866
EXP.6/30/23
CIVIL
STATE OF CALIFORNIA

DATE 12/16/22

DATE: 12/16/22

SCALE: 1" = 70'

JOB NO. 3220220

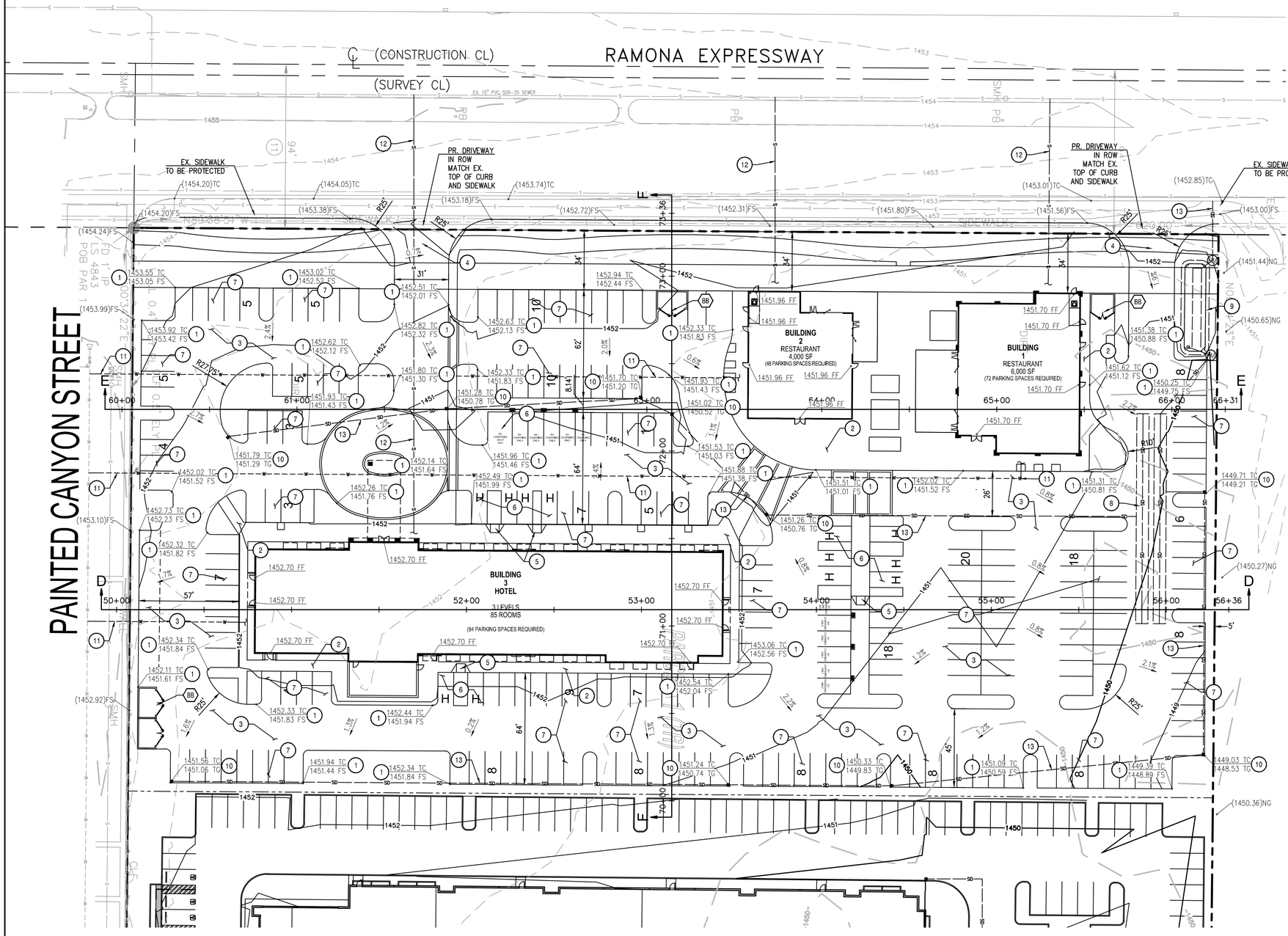
PROJECT MANAGER:
ERIC A. ROBLES

DESIGNED BY: EAR

CHECKED BY: EAR

SHEET NUMBER

1



CIVIL PLANNING NOTES:

1. PROPOSED CURB AND/OR CURB & GUTTER PER CITY STDS.
2. PROPOSED SIDEWALK PER CITY STDS.
3. PROPOSED AC PAVEMENT PER CITY STDS.
4. PROPOSED DRIVEWAY PER CITY STDS.
5. PROPOSED ADA RAMP WITH TRUNCATED DOMES.
6. PROPOSED ADA STRIPING AND SIGNAGE.
7. PROPOSED WHITE PARKING STRIPING.
8. PROPOSED CONTECH CMP DETENTION PIPE.
9. PROPOSED BIOTREATMENT AREA.
10. PROPOSED STORM DRAIN INLET.
11. PROPOSED WATER SERVICE.
12. PROPOSED SANITARY SEWER.
13. PROPOSED STORM DRAIN.

PER SEPARATE PLAN:

- AA, BB, CC — CMU SCREEN WALL, TRASH ENCLOSURE, STAIRS

LEGEND:

- PROPERTY LINE
- EXISTING WATER LINE
- PROPOSED WATERLINE
- EXISTING SANITARY SEWER LINE
- PROPOSED SANITARY SEWER LINE
- EXISTING STORM DRAIN LINE
- PROPOSED STORM DRAIN

Know what's below. Call before you dig.

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DATE	DESCRIPTION
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Irvine, CA 92618-4237
(949) 872-2378
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raSmith
CREATIVITY BEYOND ENGINEERING

PERRIS MIXED USE
SOUTH OF RAMONA EXPRESSWAY AND NORTH OF DAWES SREET, PEERIS,CA

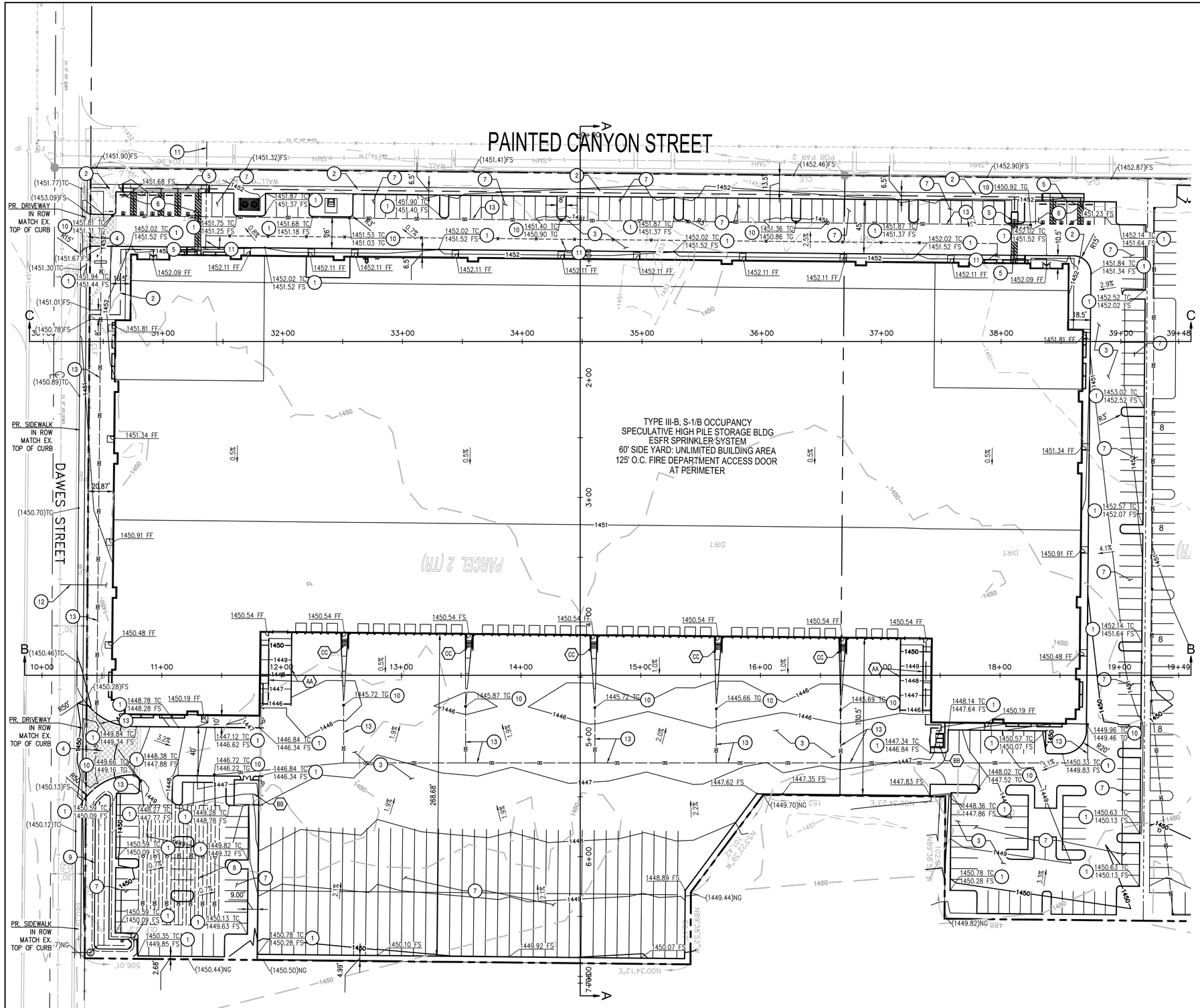
PRELIMINARY GRADING AND UTILITY PLAN (NORTH)

LICENSED PROFESSIONAL ENGINEER — ERIC A. ROBLES — C89866 EXP.6/30/23 — CIVIL — STATE OF CALIFORNIA

DATE 12/16/22

DATE: 12/16/22
SCALE: 1" = 30'
JOB NO. 3220220
PROJECT MANAGER: ERIC A. ROBLES
DESIGNED BY: EAR
CHECKED BY: EAR

SHEET NUMBER
2



CIVIL PLANNING NOTES:

1. PROPOSED CURB AND/OR CURB & GUTTER PER CITY STDS.
2. PROPOSED SIDEWALK PER CITY STDS.
3. PROPOSED AC PAVEMENT PER CITY STDS.
4. PROPOSED DRIVEWAY PER CITY STDS.
5. PROPOSED ADA RAMP WITH TRUNCATED DOMES.
6. PROPOSED ADA STRIPING AND SIGNAGE.
7. PROPOSED WHITE PARKING STRIPING.
8. PROPOSED CONTECH CMP DETENTION PIPE.
9. PROPOSED BIOTREATMENT AREA.
10. PROPOSED STORM DRAIN INLET.
11. PROPOSED WATER SERVICE.
12. PROPOSED SANITARY SEWER.
13. PROPOSED STORM DRAIN.

DESCRIPTION	DATE
---	---

PER SEPARATE PLAN:

- AA — CMU SCREEN WALL
- BB — TRASH ENCLOSURE
- CC — STAIRS

LEGEND:

- PROPERTY LINE
- EXISTING WATER LINE
- PROPOSED WATERLINE
- EXISTING SANITARY SEWER LINE
- PROPOSED SANITARY SEWER LINE
- EXISTING STORM DRAIN LINE
- PROPOSED STORM DRAIN

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PERRIS MIXED USE
SOUTH OF RAMONA EXPRESSWAY AND NORTH OF DAWES SREET, PEERIS,CA

PRELIMINARY GRADING AND UTILITY PLAN (SOUTH)

LICENSED PROFESSIONAL ENGINEER
ERIC A. ROBLES
C89866
EXP.6/30/23
CIVIL
STATE OF CALIFORNIA
DATE 12/16/22

DATE: 12/16/22
SCALE: 1" = 40'
JOB NO. 3220220
PROJECT MANAGER: ERIC A. ROBLES
DESIGNED BY: EAR
CHECKED BY: EAR

SHEET NUMBER
3

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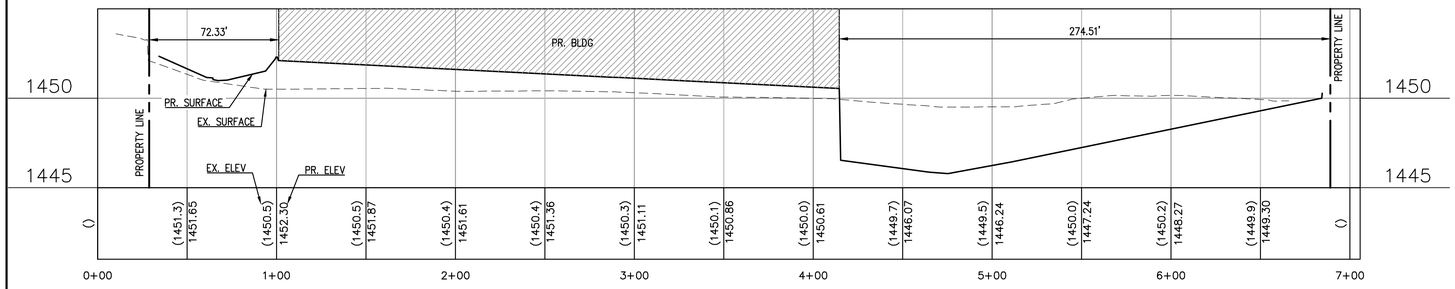

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SECTION A-A
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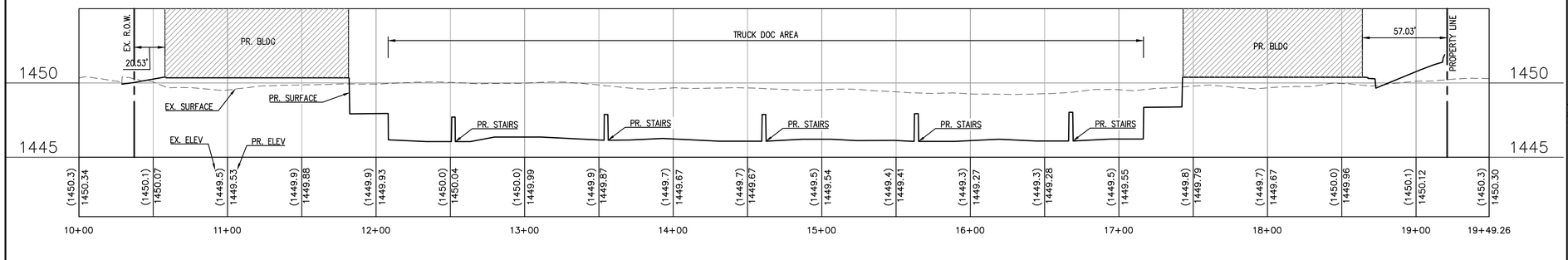
HORIZ: 1" = 40'



B | INDUSTRIAL PORTION
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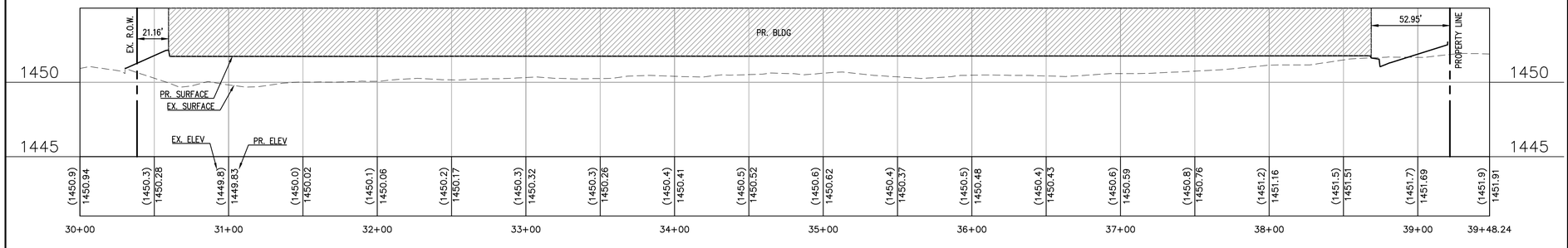
HORIZ: 1" = 40'



C | INDUSTRIAL PORTION
SECTION C-C
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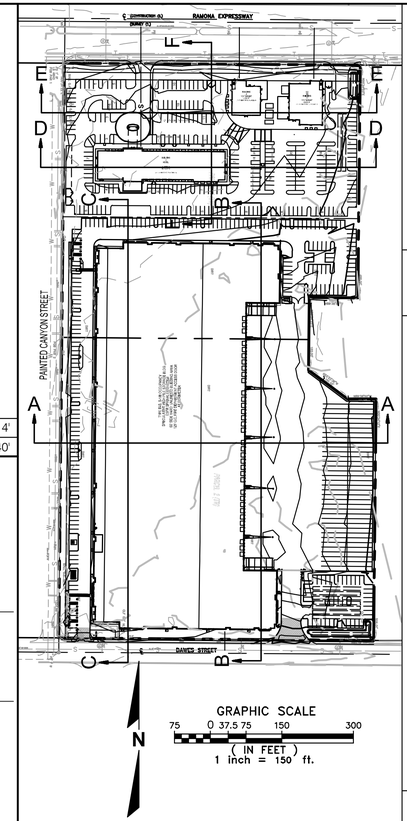
HORIZ: 1" = 40'



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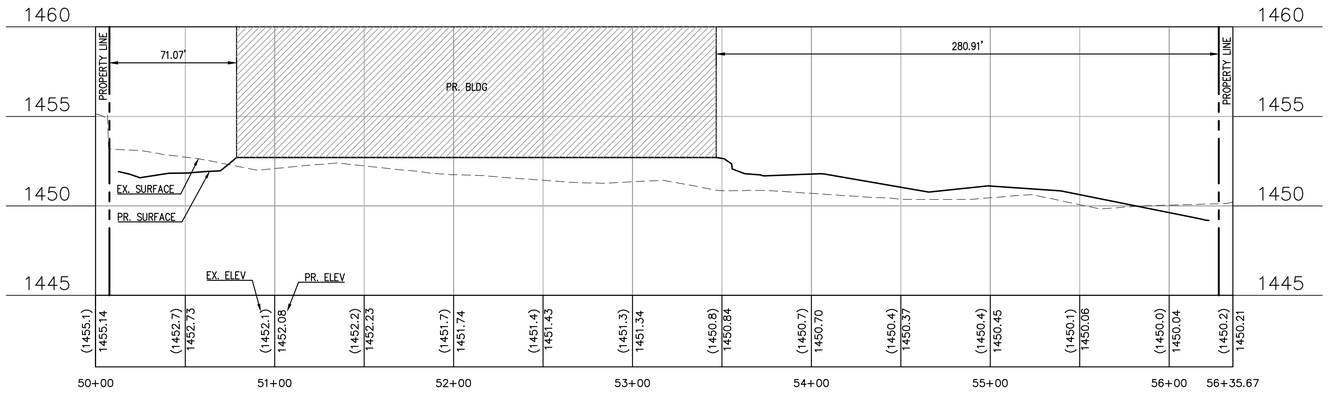
PERRIS MIXED USE
SOUTH OF RAMONA EXPRESSWAY AND NORTH OF DAWES SREET, PEERIS,CA

INDUSTRIAL CROSS SECTIONS

LICENSED PROFESSIONAL ENGINEER
ERIC A. ROBLES
C89866
EXP.6/30/23
CIVIL
STATE OF CALIFORNIA
DATE 12/16/22

DATE: 12/16/22
SCALE: AS SHOWN
JOB NO. 3220220
PROJECT MANAGER: ERIC A. ROBLES
DESIGNED BY: EAR
CHECKED BY: EAR

SHEET NUMBER
4



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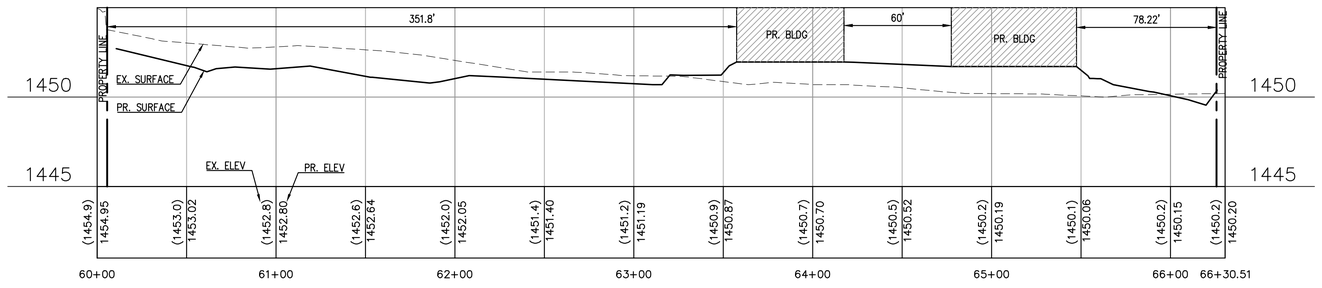
SECTION D-D — HORIZ: 1" = 40'



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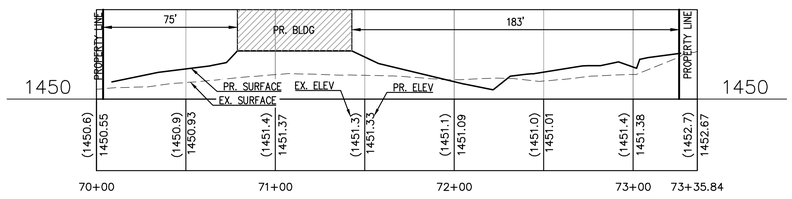
SECTION E-E — HORIZ: 1" = 40'



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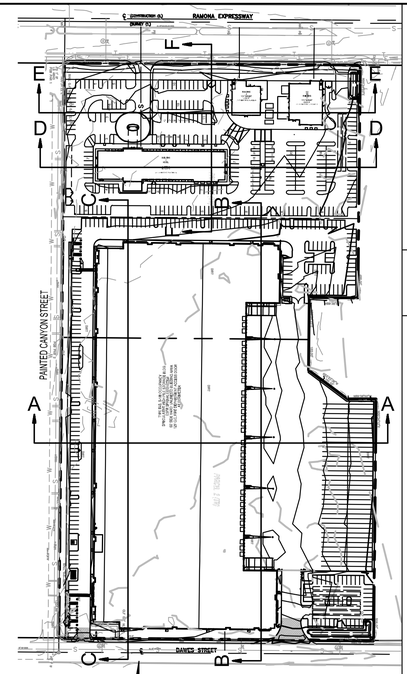
SECTION F-F — HORIZ: 1" = 40'



DESCRIPTION	DATE
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PERRIS MIXED USE
SOUTH OF RAMONA EXPRESSWAY AND NORTH OF DAWES SREET, PEERIS,CA

RETAIL CROSS SECTIONS

LICENSED PROFESSIONAL ENGINEER
ERIC A. ROBLES
C89866
EXP.6/30/23
CIVIL
STATE OF CALIFORNIA
DATE 12/16/22

DATE: 12/16/22
SCALE: AS SHOWN
JOB NO. 3220220
PROJECT MANAGER: ERIC A. ROBLES
DESIGNED BY: EAR
CHECKED BY: EAR

SHEET NUMBER
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Appendix 3: Soils Information

Geotechnical Study and Other Infiltration Testing Data

PRELIMINARY GEOTECHNICAL INVESTIGATION
AND INFILTRATION FEASIBILITY TESTING
PROPOSED 17.64-ACRE INDUSTRIAL/COMMERCIAL SITE
NEC PAINTED CANYON STREET AND EAST DAWES STREET
CITY OF PERRIS, RIVERSIDE COUNTY, CALIFORNIA
(APNS 303-100-012 AND -014)

FOR

ALABBASI CONSTRUCTION & ENGINEERING
764 RAMONA EXPRESSWAY, SUITE C
PERRIS, CALIFORNIA 92571

W.O. 8448-A-SC OCTOBER 14, 2022

GeoSoils, Inc.

Geotechnical • Geologic • Coastal • Environmental

18451 Collier Avenue, Suite A • Lake Elsinore, California 92530 • (951) 471-0700 • FAX (951) 471-0702 • www.geosoilsinc.com

October 14, 2022

W.O. 8448-A-SC

Alabbasi Construction & Engineering
764 Ramona Expressway, Suite C
Perris, California 92571

Attention: Ms. Corinne Mostad

Subject: Preliminary Geotechnical Investigation and Infiltration Feasibility Testing, Proposed 17.64-Acre Industrial/Commercial Site, NEC Painted Canyon Street and East Dawes Street, City of Perris, Riverside County, California (APNs 303-100-012 and -014)

Dear Ms. Mostad:

In accordance with your request and authorization, GeoSoils, Inc. (GSI) is presenting the results of our preliminary geotechnical investigation and infiltration feasibility testing for the proposed 17.64-acre industrial/commercial site located at the northeast corner of Painted Canyon Street and East Dawes Street in the City of Perris, Riverside County, California. The primary purpose of this study was to evaluate the onsite soils and geologic conditions and their effects on the proposed industrial/commercial development of the 17.64-acre site, from a geotechnical point of view. A secondary purpose of this study was to provide infiltration feasibility testing for proposed stormwater Best Management Practices (BMP) designs by the civil engineer of record, general earthwork and grading guidelines, and development criteria in light of proposed industrial/commercial development and site geologic conditions.

EXECUTIVE SUMMARY

Based on our review of readily available data, our recent subsurface investigation and infiltration feasibility testing, associated laboratory testing, and geologic and engineering analyses, the proposed development of the project site appears suitable for its intended industrial/commercial development from a geotechnical viewpoint, provided the recommendations presented in the text of this report are properly implemented. The primary developmental considerations are summarized below:

- Based on our subsurface investigation, and published geologic mapping by Morton (2003), the site is underlain by early Pleistocene-age very old alluvial-fan deposits (Qvof). These surficial alluvial deposits are described as well-indurated reddish brown sand deposits.

- As encountered during our recent field work, the site is locally mantled by up to approximately 3 to 5 feet of undifferentiated tilled topsoil and colluvial soils. Due to the relatively low density and lack of uniformity, all near-surface colluvium is considered unsuitable for the support of settlement-sensitive improvements or additional engineered fill, and will need to be removed and recompacted. Additional discussions of remedial site grading and fill placement are provided within following sections of this report.

- Our review indicates no known active faults are crossing the site, and the site is not located within an Alquist-Priolo Earthquake Fault Zone (California Department of Conservation, California Geological Survey [CGS], 2018). In addition, the site is not located within a County of Riverside fault zone. Based on our review of the Riverside County Information Technology website (RCIT, 2022), the site is located within a zone of "low" liquefaction potential, and is characterized as being potentially susceptible to subsidence (RCIT, 2021). Further discussions of the potentials for liquefaction and subsidence are provided within following sections of this report.

- Our review of the City of Perris general plan safety element (2021) indicates the site is located within a dam inundation zone associated with the nearby Perris reservoir (Lake Perris). As such, the potential for flooding should be further evaluated by the design civil engineer for the project.

- An evaluation of storm water infiltration feasibility testing indicates a moderate to relatively low infiltration potential at the project site. Further discussions of the test procedures used, onsite USDA soil groups, general infiltration system siting requirements and limitations, along with the converted infiltration rates obtained are presented herein.

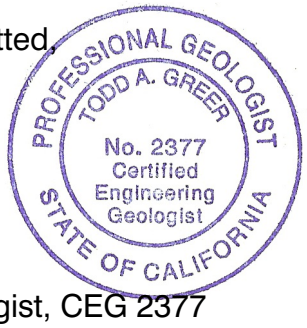
- Adverse geologic features that would preclude project feasibility (e.g., shallow regional groundwater, liquefaction, subsidence, active faulting, etc.) were not encountered.

- The recommendations presented in this report should be incorporated into preliminary planning, design, and construction considerations of the project.

The opportunity to be of service is sincerely appreciated. If you should have any questions, please do not hesitate to contact our office.

Respectfully submitted,

GeoSoils, Inc.



Todd A. Greer
Engineering Geologist, CEG 2377

Stephen J. Coover
Geotechnical Engineer, GE 2057

MAM/TAG/JPF/SJC/sh

Distribution: (1) Addressee (via email PDF)

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PRELIMINARY GEOTECHNICAL INVESTIGATION
AND INFILTRATION FEASIBILITY TESTING
PROPOSED 17.64-ACRE INDUSTRIAL/COMMERCIAL SITE
NEC PAINTED CANYON STREET AND EAST DAWES STREET
CITY OF PERRIS, RIVERSIDE COUNTY, CALIFORNIA
(APNS 303-100-012 AND -014)

SCOPE OF SERVICES

The scope of our services has included the following:

1. Review of online and in-house geologic maps and literature for the site, review of the City of Perris general plan safety element (2021), and review of aerial photographs provided by Google Earth Pro (GEP, 2022) and the United States Department of Agricultural (USDA, 1980, see Appendix A).

2. Geologic site reconnaissance and geologic mapping of significant surficial deposits.

3. The advancement of 6 exploratory borings across the site for geotechnical logging and soil sample collection, and to evaluate subsurface conditions onsite. In addition, two (2) relatively shallow borings were advanced for infiltration feasibility testing. The borings were advanced on September 15, 2022 using a hollow-stem drill rig (Appendix B).

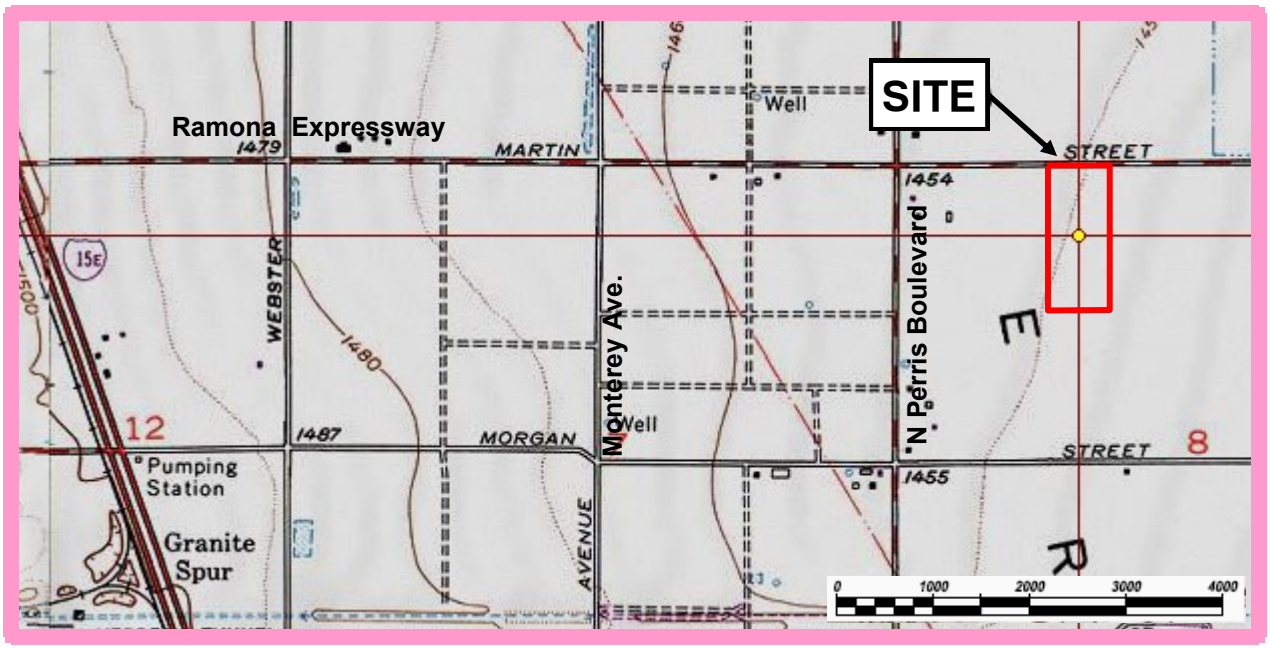
4. General areal seismicity evaluation (Appendix C).

5. Pertinent laboratory testing of representative soil samples collected during our subsurface exploration program. Testing included in-situ moisture and density, maximum density testing, expansion index, sulfate/corrosion, remolded shear, and R-value testing of the materials encountered during our field study. Results of our laboratory testing are provided in Appendix D.

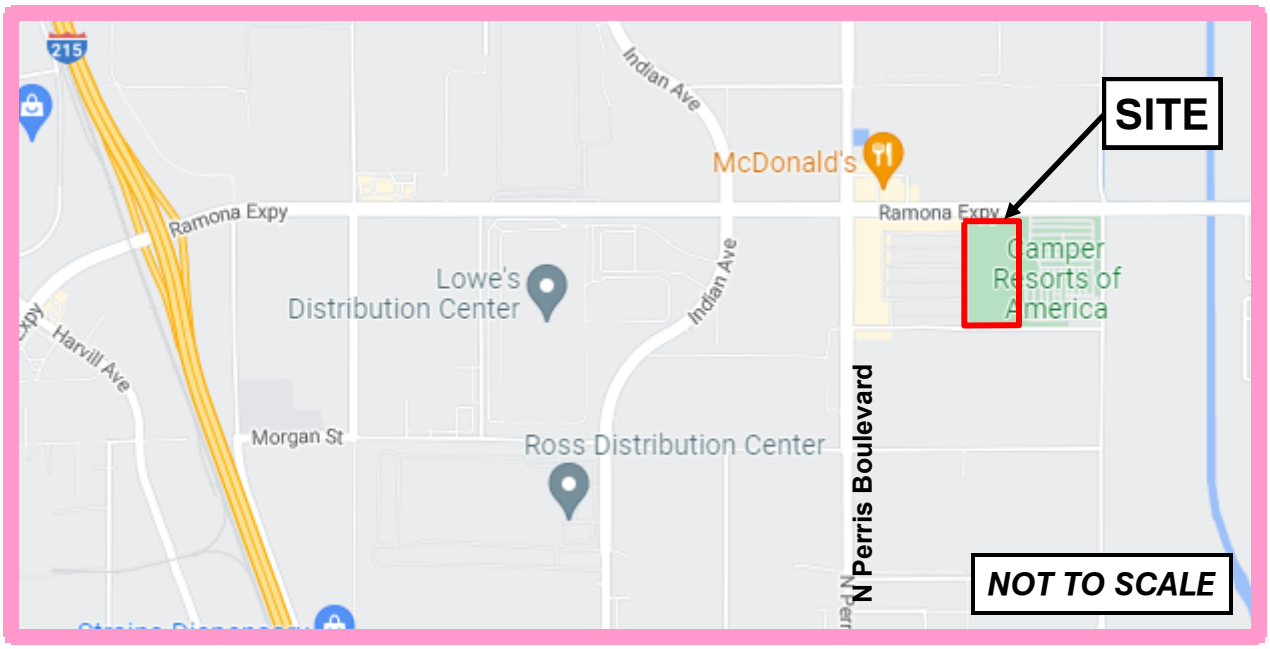
6. Appropriate engineering and geologic analyses of data collected and preparation of this report and accompaniments.

SITE LOCATION

The subject 17.64-acre property (APNs 303-100-012 and -014) is located on the NEC of Painted Canyon Street and East Dawes Street (South of Ramona Expressway) in the City of Perris, Riverside County, California (see Figure 1, Site Location Map). Based on our review, the site is generally vacant and undeveloped. Topographically, the property consists of flat-lying terrain that varies in elevation from approximately 1,454 feet MSL (Mean Sea Level) near the northwest corner of the site to approximately 1,449 feet MSL near the middle of the property to approximately 1,451 feet MSL near the southeast corner of the site. Therefore, overall relief is on the order of 3 to 5 feet. Based on our review, the



Base Map: TOPO! Copyright 2003 National Geographic, USGS Perris Quadrangle, California -- Riverside Co., 7.5 Minute, dated 1967.



Base Map: Google Maps, Copyright 2022, Map Data Copyright 2022 Google

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GeoSoils, Inc.

W.O.

8448-A-SC

SITE LOCATION MAP

Figure 1

site is underlain by early Pleistocene-age very old alluvial-fan deposits. The site is currently covered with a moderate growth of native brush and grasses, as well as scattered deleterious materials. The site has been previously tilled for weed abatement purposes.

PROPOSED DEVELOPMENT

Based on the site plan provided by Alabbasi Construction & Engineering (ACE, 2022) it is our understanding that the proposed development of the project would consist of the construction of one (1) 300,000 sq/ft industrial warehouse structure, two (2) 4,000 to 6,000 sq/ft restaurant structures, as well as one (1) 15,000 sq/ft hotel structure within the 17.64-acre property. Development of the project would also include the installation of underground utilities, site infrastructure, and street/parking improvements. We assume that the proposed industrial/commercial structures will be one- or two-stories, and will use continuous footings and slab-on-grade floors, or mat foundations, using wood-frame, masonry block, or tilt-up type of construction. Building loads are assumed to be typical for these types of light industrial/commercial structures. Sewage disposal is to be accommodated by tying into the regional municipal disposal system. The development is also anticipated to include water quality BMP storm water systems.

FIELD STUDIES

Field studies conducted during our evaluation of the property for this investigation consisted of geologic reconnaissance mapping, the advancement of a total of 6 exploratory borings across the property for evaluation of near-surface soil and geologic conditions, sample collection, and 2 borings for infiltration feasibility testing. Field exploration was performed on September 15, 2022, with the associated infiltration feasibility testing conducted on September 16, 2022. The borings were observed and logged by a staff geologist from our firm who also collected representative soil samples for appropriate laboratory testing. The logs of the borings are presented in Appendix B. The approximate locations of the exploratory borings and infiltration feasibility test locations conducted for this study are presented on Plate 1 (Geotechnical Map), which uses the site plan provided by ACE (2022) as a base map.

GEOLOGY

Regional Geologic Setting

The property lies within the Perris Block, a relatively stable area located between the Elsinore and San Jacinto fault zones, in a prominent natural geomorphic province in southwestern California known as the Peninsular Ranges. The Peninsular Ranges are characterized by steep, elongated ranges and valleys that trend northwesterly. This province is typified by plutonic and metamorphic rocks (bedrock) which comprise the

majority of the mountain masses, with relatively thin volcanic and sedimentary deposits discontinuously overlying the bedrock, and with Plio/Pleistocene-age to older Quaternary-age alluvial-fan deposits filling in the valleys and younger alluvium filling in the incised drainages. The alluvial deposits are derived from the water borne deposition of the products of weathering and erosion of the bedrock. Colluvium is derived from weathering of the sediments essentially in-place, to form a residual soil imprinted on those sediments.

Site Geology

Based on our recent subsurface investigation, and published geologic mapping by Morton (2003), the site is underlain by early Pleistocene-age very old alluvial-fan deposits (Qvof). Based on our subsurface investigation and geologic reconnaissance mapping, the very old alluvial-fan deposits are locally mantled by up to approximately 3 to 5 feet of native tilled topsoil materials.

Site Earth Materials

As discussed above, the earth materials encountered during our subsurface investigation included tilled topsoil and early Pleistocene-age very old alluvial-fan deposits (Morton, 2003). Mappable geologic units are shown on Plate 1 (Geotechnical Map), and the units are described as follows, from youngest to oldest:

Tilled Topsoil/Colluvium (Unmapped)

As encountered during our recent field work, the site is mantled by approximately 3 to 5 feet of undifferentiated tilled topsoil and colluvial soils (colluvium). These surficial soils were observed to consist primarily of light brownish gray to pale brown silty sands. The colluvium was generally dry to damp, with a loose consistency near the surface becoming medium dense with depth, likely due to previous surficial tilling for weed abatement purposes. These soils typically have a very low expansion potential. However, locally low expansive soils cannot be precluded from occurring onsite. Due to the relatively low density and lack of uniformity, the colluvium throughout the site is deemed unsuitable for the support of new structures or additional fill placement, and will require complete removal and recompaction during rough grading. The colluvial soils may be reused for compacted fills, provided that they have been cleansed of deleterious materials (i.e., trash, debris, weeds, grasses, and concentrations of organic matter) prior to placement onsite as engineered fill.

Quaternary - Very Old Alluvial-Fan Deposits (Map Symbol - Qvof)

As observed onsite, the very old alluvial-fan deposits generally consisted of pale brown to brown, silty, fine- to coarse-grained sands, interbedded with light yellowish brown to reddish brown clayey, fine- to medium- grained sands. The alluvial sediments varied from damp to locally saturated, and were generally medium dense to very dense with depth.

Expansion index (E.I.) testing performed on a representative sample of the very old alluvial-fan deposits indicates very low expansive soil conditions (E.I. 0-20) across the majority of the site, on a preliminary basis. However, at the conclusion of site grading, low expansive soils (E.I. 21-50) may not be precluded from occurring. The near-surface weathered very old alluvial-fan deposits (upper 1 foot) are locally dry and porous and should be ripped, moisture conditioned, and processed in-place during rough grading. The very old alluvial-fan deposits may be reused for compacted fills, provided that they have been cleansed of deleterious materials (i.e., weeds, grasses, and concentrations of organic matter), prior to placement onsite as engineered fill.

GROUNDWATER/SURFACE WATER

Groundwater was encountered in one (1) of the geotechnical borings (Boring B-1) advanced during our field investigation at a depth of 40½ feet below the ground surface (bgs). Based upon our review of the California Department of Water Resources, Water Data Library (2022), two (2) groundwater wells were located within the site vicinity and reported groundwater depths ranging between 43.6 feet (Station No. 338371N1172274W001, measured March 14, 2022), to 55.9 feet bgs (Station No. 338464N1172319W001, measured November 30, 2020). However, the possibility of localized perched groundwater within drainage areas or along the interface between compacted fills and the underlying very old alluvial-fan deposits cannot be discounted. Seepage may also occur locally (due to heavy precipitation or irrigation) in areas where thin soils overlie less permeable materials. Thus, perched groundwater conditions may occur in the future, and should be anticipated. Additionally, our review of the City of Perris, General Plan (CP, 2016), indicates the site is located within the Lake Perris dam inundation zone. The site is also located within flood Zone X to the south, a low risk, "500 Year Flood Area," and partially within Zone AE to the north, a higher risk, "100 Year Flood Area" (CP, 2016). As such, the potential for flooding and dam inundation should be further evaluated by the design civil engineer.

FAULTING AND REGIONAL SEISMICITY

Local and Regional Faults

Our review indicates that there are no known active faults crossing this site, and the site is not within an Alquist-Priolo Earthquake Fault Zone (California Geological Survey [CGS], 2018). However, the site is situated in a region subject to strong earthquakes occurring along active faults. These faults include, but are not limited to, the local San Jacinto fault systems, the Glen Ivy segment of the Elsinore Fault, and the San Andreas Fault.

According to Blake (2000a), the closest known active fault to the site is the San Jacinto Valley/Casa Loma segment of the San Jacinto Fault Zone, and is located approximately 8 miles (12.8 km) northeast of the site. The San Jacinto Valley/Casa Loma segment of the San Jacinto Fault zone has demonstrated movement in the Holocene Epoch (i.e., last 11,700 years), and therefore, is considered active and is located within an Alquist-Priolo Earthquake Fault Zone (CGS, 2018). Cao, et al. (2003) indicates that the San Jacinto Valley/Casa Loma segment of the San Jacinto Fault zone is an "A" fault and is capable of producing a maximum magnitude (M_w) 6.9 earthquake. The possibility of ground acceleration, or shaking at the site, may be considered as approximately similar to the Southern California region as a whole.

Seismicity

The acceleration-attenuation relations of Bozorgnia, Campbell, and Niazi (1999), have been incorporated into EQFAULT (Blake, 2000a). For this study, peak horizontal ground accelerations anticipated at the site were determined based on the mean plus 1 - sigma attenuation curves developed by those authors. The EQFAULT computer program performs deterministic seismic hazard analyses using digitized California faults as earthquake sources. The program estimates the closest distance between each fault and a given site. If a fault is found to be within a user-selected radius, the program estimates peak horizontal ground acceleration that may occur at the site from an upper bound ("maximum credible") earthquake on that fault. Site acceleration (g) is computed by user-selected acceleration-attenuation relations that are contained in EQFAULT. Based on the EQFAULT program, peak horizontal ground accelerations (deterministic acceleration values) from an upper bound event at the site may be on the order of 0.4203g.

Historical Site Acceleration

Historical site seismicity was evaluated with the acceleration-attenuation relations of Bozorgnia, Campbell, and Niazi (1999) and the computer program EQSEARCH (Blake, 2000b). This program was used to perform a search of historical earthquake records for magnitude 5.0 to 9.0 seismic events within a 100 km radius, between the years 1800 to May 8, 2021. Based on the selected acceleration-attenuation relation, a peak horizontal ground acceleration has been estimated, which may have affected the site during the specific seismic events in the past. Based on the available data and attenuation relationship used, the estimated maximum (peak) site acceleration during the period of 1800 to May 8, 2021, was 0.411g. In addition, a seismic recurrence curve is also estimated/generated from the historical data (see Appendix C).

Seismic Design Parameters

Based on the site conditions, the following table summarizes the site-specific design criteria obtained from the 2019 CBC (CBSC, 2019a), Chapter 16 Structural Design, Section 1613, Earthquake Loads. The computer program "Seismic Design Maps,"

provided by the California Office of Statewide Health Planning and Development (OSHPD, 2022) was used to aid in the design (https://seismicmaps.org/). The short spectral response uses a period of 0.2 seconds.

2019 CBC SEISMIC DESIGN PARAMETERS		
PARAMETER	**SITE-SPECIFIC DESIGN VALUE PER ASCE 7-16**	**2019 CBC or REFERENCE**
Risk Category[1]	I, II, or III	Table 1604.5
Site Class	D	Section 1613.2.2/Chap. 20 ASCE 7-16 (p. 203-204)
Spectral Response - (0.2 sec), S_s	0.882 g	Section 1613.2.1 Figure 1613.2.1(1)
Spectral Response - (1 sec), S_1	0.666 g	Section 1613.2.1 Figure 1613.2.1(2)
Site Coefficient, F_a	1.0[2]	Table 1613.2.3(1)
Site Coefficient, F_v	2.5[3] (Section 21.3)	Table 1613.2.3(2)
Maximum Considered Earthquake Spectral Response Acceleration (0.2 sec), S_{MS}	1.321 g[4] (Section 21.4)	Section 1613.2.3 (Eqn 16-36)
Maximum Considered Earthquake Spectral Response Acceleration (1 sec),S_{M1}	1.067 g[5] (Section 21.4)	Section 1613.2.3 (Eqn 16-37)
5% Damped Design Spectral Response Acceleration (0.2 sec), S_{DS}	0.881 g[6]	Section 1613.2.4 (Eqn 16-38)
5% Damped Design Spectral Response Acceleration (1 sec), S_{D1}	0.712 g[7] (Section 21.4)	Section 1613.2.4 (Eqn 16-39)
PGA_M - Probabilistic Vertical Ground Acceleration may be assumed as about 50% of these values.	0.586 g	ASCE 7-16 (Eqn 11.8.1)
Seismic Design Category	D[8] (Section 11.6)	Section 1613.2.5/ASCE 7-16 (p. 85: Table 11.6-1 or 11.6-2)

1. Risk Category to be confirmed by the Project Architect or Structural Engineer.
2. Per Table 11.4-1 of ASCE 7-16
3. Per Section 21.3 of ASCE 7-16, if $S_1 \geq 0.2$ then F_v is taken as 2.5.
4. Per Section 21.4 of ASCE 7-16, $S_{MS} = (1.5)(S_{DS}) = (1.5)(0.881\ g) = 1.321\ g$
5. Per Section 21.4 of ASCE 7-16, $S_{M1} = (1.5)(S_{D1}) = (1.5)(0.712\ g) = 1.067\ g$
6. Per Section 21.4 of ASCE 7-16, S_{DS} shall be taken as 90 percent of the maximum spectral acceleration (S_a) obtained from the site-specific spectrum at any period within the range from 0.2 to 5 seconds, inclusive.
7. Per Section 21.4 of ASCE 7-16, S_{D1} shall be taken as the maximum value of the product TS_a obtained from the site-specific spectrum from the period within the range of 1 to 5 seconds, inclusive.
8. Per Tables 11.6-1 and 11.6-2 of ASCE 7-16, Mapped S_1 (0.583 g) $\leq$ 0.75 . Thus, the seismic design category is "D".

GENERAL SEISMIC PARAMETERS	
PARAMETER	**VALUE**
Distance to Seismic Source (San Jacinto Valley Fault)	8.0 mi (12.8 km)[1]
Upper Bound Earthquake (San Jacinto Valley Fault)	M_w = 6.9[2]
[1] - Blake (2000a) [2] - Cao, et al. (2003)	

Conformance to the criteria above for seismic design does not constitute any kind of guarantee or assurance that significant structural damage or ground failure will not occur in the event of a large earthquake. The primary goal of seismic design is to protect life, not to eliminate all damage, since such design may be economically prohibitive. Cumulative effects of seismic events are not addressed in the 2019 CBC (CBSC, 2019a) and regular maintenance and repair following locally significant seismic events (i.e., M_w5.5) will likely be necessary, as is the case in all of Southern California.

In the event of a maximum probable or credible earthquake occurring on any of the nearby major faults, strong ground shaking would occur in the subject site's general area. Potential damage to any structure(s) would likely be greatest from the vibrations and impelling force caused by the inertia of a structure's mass. This potential would be no greater than that for other existing structures and improvements in the immediate vicinity.

SECONDARY SEISMIC HAZARDS

The following list includes other geologic/seismic related hazards that have been considered during our evaluation of the site. The hazards listed are considered negligible or mitigated as a result of site location, soil characteristics, recommended remedial site grading, civil engineering, and typical site development procedures:

- Liquefaction
- Lateral Spreading
- Subsidence
- Ground Lurching or Shallow Ground Rupture
- Dam Inundation
- Tsunami
- Seiche

A review of the Riverside County Information Technology (RCIT, 2022), or “Map My County v10,” indicates that the site is not located within a County of Riverside fault zone. However, based on our review, the site is located within a zone of “low” liquefaction potential, and is characterized as being potentially susceptible to subsidence (RCIT, 2022). However, our general liquefaction screening evaluation (pursuant to Special Publication 117 [CGS, 2008

SP117]) indicates that the potential for liquefaction and associated adverse effects within the site is considered low, based on the medium dense to very dense very old alluvial-fan deposits which underlie the site at shallow depths, the materials induration (cementation), and anticipated removal of near-surface potentially compressible soils during site grading activities.

In addition, the effects of areal subsidence generally occur at the transition or boundaries between low-lying areas and adjacent hillside terrain, where materials of substantially different engineering properties (i.e., thick alluvium vs. bedrock) are present, or in areas of overdraft owing to groundwater withdrawal, usually where bounded by Neogene faults. Our review of available data, as well as stereoscopic aerial photographs (USDA, 1980), showed no features generally associated with areal subsidence (i.e., radially-directed drainages flowing into a depression(s), linearity of depressions associated with mountain fronts, etc.), directly on the project site. In view of the nature of the underlying very old alluvial-fan deposits, and lack of onsite faulting and adjacent hillside terrain, the potential for this phenomena to affect the site is considered very low.

Furthermore, ground fissures are generally associated with excessive groundwater withdrawal and associated subsidence, or active faulting. Our review did not reveal any information that active faulting or excessive groundwater withdrawal, ground fissures, or hydroconsolidation in the specific site location, is occurring at this time. Therefore, the potential for ground fissures is also considered low.

MASS WASTING/LANDSLIDE SUSCEPTIBILITY

Mass wasting refers to the various processes by which earth materials are moved down slope in response to the force of gravity. Examples of these processes include slope creep, surficial failures, and deep-seated landslides. Creep is the slowest form of mass wasting and generally involves the outer 5 to 10 feet of a slope surface. During heavy rains, such as those in El Niño years, creep-affected materials may become saturated, resulting in a more rapid form of downslope movement (i.e., landslides or surficial failures). For this relatively low relief (flat-lying) site, geomorphic expressions indicative of past mass wasting events (i.e., scarps and hummocky terrain) were not observed on the property during our field studies, nor in our review of regional geologic mapping. Further, no adverse geologic structures were encountered during our subsurface exploration. Regional geologic maps do not indicate the presence of landslides on the property. However, based on the locally sandy and non-cohesive nature of some of the onsite earth materials, the onsite soils are considered erosive. Therefore, slopes composed of these materials may be subject to rilling, gullying, and sloughing, depending on rainfall severity, surface drainage, and landscape practices. Such risks can be minimized through properly designed and regularly and periodically maintained surface drainage, and proper landscape cover.

LABORATORY TESTING

Classification

Soils were classified visually according to the Unified Soils Classification System (Sowers and Sowers (1979). The soil classifications are shown on the Boring Logs presented in Appendix B. The Laboratory Test Results are discussed below and presented in Appendix D.

Moisture-Density

The field moisture contents and dry unit weights were determined for undisturbed ring samples for the soils encountered in the exploratory borings. The dry unit weight was determined in pounds per cubic foot (pcf) and the field moisture content was determined as a percentage of the dry unit weight. The results of these tests are shown on the Boring Logs (Appendix B).

Laboratory Standard

The maximum dry density and optimum moisture content was determined for the major soil types encountered within the exploratory borings. The laboratory standard used was ASTM D 1557. The moisture-density relationships obtained are shown below:

SOIL TYPE	BORING AND DEPTH (ft.)	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)
Silty SAND, Yellowish Brown	B-2 @ 0-5	129.6	9.0

Expansion Potential

Expansion index (E.I.) testing was performed on a representative sample of site earth materials. E.I. test results are presented in the following table. Additional E.I. testing should be conducted at the conclusion of site grading to further evaluate the preliminary test results obtained.

SOIL TYPE	LOCATION & DEPTH (FT)	EXPANSION INDEX (E.I.)	EXPANSION POTENTIAL
Silty SAND, Yellowish Brown	B-2 @ 0-5	15	Very Low

Soluble Sulfates/Corrosion

A representative sample of site soil was analyzed for soluble sulfates, chloride, pH, and resistivity. The soluble sulfate and corrosion potential results are presented in the following Table, and in Appendix D. Additional sulfate/corrosion testing should be conducted at the conclusion of site grading to further evaluate the preliminary test results obtained.

LOCATION AND DEPTH (FT.)	SOLUBLE SULFATES (PERCENTAGE BY WEIGHT)	CHLORIDE (PPM)	pH	RESISTIVITY (OHMS-CM)
B-2 @ 0-5	< 0.003	11	8.0	3,500

For preliminary planning purposes, based upon the soluble sulfate test results obtained, and the latest edition of the 2019 CBC (CBSC, 2019a), the soluble sulfate content is considered Class "S0" per the ACI 318-14 (0.00 to 0.10 soil percentage by weight is considered Class "S0"). As such, sulfate-resistant concrete is currently not anticipated. Based on the results of the resistivity and pH testing, the onsite soils are generally considered moderately alkaline (a pH of 7.9 to 8.4 is considered moderately alkaline), and are considered moderately corrosive to ferrous metals in a saturated state (2,000 to 10,000 ohm-cm is considered moderately corrosive). Chlorides are generally low.

Although the site soils are categorized as moderately corrosive to ferrous metals, other than Exposure Classes S0, W0, and C1, no exposure conditions indicated in Table 19.3.1.1 of the ACI (2014a) were considered warranted based on our preliminary laboratory testing, as the footings would likely be exposed to moisture. It is our understanding that ferrous metals embedded in properly poured and formed concrete with the proper mix should be adequately protected from these conditions. Based upon the preliminary laboratory test results obtained, a consulting corrosion engineer should be retained to provide specific recommendations for foundations, utility piping, etc, as warranted.

Direct Shear Tests

Shear testing was performed on a remolded sample of site earth materials collected from the borings in general accordance with ASTM D 3080. The shear testing results are provided in the following table, and in Appendix D.

SAMPLE LOCATION AND DEPTH (FT)	PRIMARY		RESIDUAL	
	COHESION (PSF)	FRICTION ANGLE (DEGREES)	COHESION (PSF)	FRICTION ANGLE (DEGREES)
B-2 @ 0-5	16	36	7	35

Resistance Value

Resistance value, or R-Value testing, was performed on representative soil samples in accordance with CalTrans Test Method 301, and yielded a test result of R=19. The results of R-Value testing are presented in Appendix D.

PERCOLATION/INFILTRATION TESTING

In general accordance with guidelines of the Riverside County Flood Control (RCFC, 2011) Design Handbook for Low Impact Development Best Management Practices, and errata (RCFC, 2016), two (2) percolation/infiltration tests were conducted within the proposed water quality BMP locations onsite (see Geotechnical Map, Plate 1), area, as provided by the Client. The percolation testing was conducted at a depth of approximately 5 feet at each test location. The percolation/infiltration testing was performed to further evaluate site conditions with respect to the proposed water quality BMP systems that will retain and filter onsite storm water. The percolation testing was performed in general conformance with the RCFC (2011 and 2016) and CASQA (2003) design handbooks for such testing. The field percolation testing and geologic logging were performed by a staff geologist from our firm. Logs of the borings advanced for this study are included in Appendix B. The field percolation data sheets from our study are presented in Appendix E. Procedures for testing are outlined briefly below:

Percolation Test Procedures

Test Borings:

1. Diameter - 8 inches.
2. After the removal of loose materials, 2 inches of gravel was placed on the bottom of each test boring.
3. A perforated pipe was then installed at each test location to facilitate accurate field measurements and prevent caving during the pre-soak period and testing periods.

Pre-Soaking: After the installation of the perforated pipes, the boring was filled with clear water to a depth of approximately 25 inches. The pre-soak period for the percolation tests continued overnight, as all the water did not seep away while the tester was present.

Sandy Soil Test: During the sandy soil test period, two (2) consecutive measurements were conducted at each test location at intervals of approximately 25 minutes. More than 6 inches of water seeped away during each of the two (2) measurements at test location P-1, therefore sandy soils testing began at that location. Less than 6 inches of water seeped away during each of the two (2) measurements at test location P-2, therefore, non-sandy soils testing methods began at that location.

Testing: After required pre-soak period and sandy soil test periods, percolation testing measurements were made. A column of clear water was re-established at each of the test locations. The drop in water level was measured from a fixed reference point, refilling after each test measurement. For test location P-1, a series of test measurements were taken for an additional hour, at time intervals of approximately 10 minutes. For test location P-2, a series of test measurements were taken for an additional six hours, at time intervals of approximately 30 minutes.

Accuracy: All test measurements were read to the nearest ¼-inch.

Test Results: Calculations from our field testing indicate percolation rates of 6.67 minutes/inch at test location P-1 and 7.06 minutes/inch at test location P-2. Per the RCFC (2011) guidelines, the percolation rates obtained were then converted to infiltration rates using the "Porchet Method," to be used by the design engineer for appropriate sizing of the water quality BMP system. The converted infiltration rates obtained varied between 0.62 inches/hour at test location P-1, and 0.70 inches/hour at test location P-2, with an average of 0.66 inches/hour. Typically, the lowest infiltration rate obtained is applied to the design. The converted infiltration rates, along with the formulas used are presented on Figure 2.

USDA Site Soil Groups, Soil Units, Ksat Values

Our review of the United States Department of Agriculture (USDA, 2022) Web Soil Survey (https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm), indicates two (2) major soil units underlie the project site. The Domino silt loam (Dv), is distributed throughout the north- northeast quarter of the site. The Exeter sandy loam(EpA) is distributed throughout the southwestern three quarters of the site, and is in the vicinity of both the potential locations of the proposed water quality BMP systems. Based on our review USDA (1971), the Domino silt loam belongs to Hydrologic Soil Group (HSG) "C," with the capacity of the most limiting soil layer to transmit water classified as "low." The "K_{sat}" value (i.e., hydraulic conductivity or infiltration rate) for the soil type onsite was evaluated by the USDA to range from 0.63 to 2.00 inches per hour. The more extensive Exeter sandy loam also belongs to HSG "C," with the capacity of the most limiting soil layer to transmit water also classified as "very low." The "K_{sat}" value (i.e., hydraulic conductivity or infiltration rate) for the soil type onsite was also evaluated by the USDA to range from 0.63 to 2.00 inches per hour. The results of site specific infiltration testing (this study) are within the general data sets presented in the USDA soil web survey.

Percolation Rate to Infiltration Rate Conversion

* Infiltration Rate (I_t) = $\dfrac{\Delta H\ \pi r^2\ 60}{\Delta t(\pi r^2 + 2\pi r H_{avg})} = \dfrac{\Delta H\ 60\ r}{\Delta t(r+2H_{avg})}$

Where:
- I_t = tested infiltration rate, inches/hour
- ΔH = change in head over the time interval, inches
- Δt = time interval, minutes
- r = effective radius of test hole
- H_{avg} = average head over the time interval, inches

		Δt	Init Level	Fnl Level	ΔH	H_{avg}	I_t	
Infiltration Test Numbers	P-1 @ 5.5 ft.	10	28	26 1/2	1 1/2	27 1/4	0.62	
	P-2 @ 5 ft.	30	24 1/2	20 1/4	4 1/4	22 3/8	0.70	
								Low = 0.70
								Average = 0.66
								**DIR = 0.62

* Conversion per the "Porchet Method" (RCFC, 2011)

** DIR = Design Infiltration Rate

Infiltration Basin Siting Requirements

Our review of the general infiltration basin siting requirements and limitations (CASQA, 2003), indicates sites characterized as belonging to Hydrologic Soil Group "A," "B," and "C" may be suitable for infiltration, requiring a minimum soil infiltration rate of 0.5 inches/hour (CASQA, 2003). Based on our review of historic regional groundwater levels and recent onsite subsurface investigation, a minimum 10-foot vertical separation from the bottom of the BMP system to the top of historic high groundwater levels should be maintained, provided shallow (i.e., $\leq$ 5 feet) BMP systems are used.

The design engineer will need to review basin siting requirements by CASQA (2003) and the converted infiltration rates obtained during this study with respect to the proposed water quality BMP systems. An appropriate factor of safety (FOS), per the RCFC (2011) BMP design handbook, should be applied by the design engineer, as warranted.

Onsite Storm Water Quality Best Management Practice (BMP) Systems

It is our understanding that infiltration-runoff retention systems (OIRRS) are planned for Best Management Practices (BMP's) or Low Impact Development (LID) principles for the project. Therefore, certain guidelines must be followed in the planning, design, and construction of such systems. Such systems, if improperly designed or implemented without consideration of the geotechnical aspects of site conditions, can contribute to flooding, saturation of bearing materials beneath site improvements, slope instability, and possible concentration and contribution of pollutants into the groundwater, storm drain system, or utility trench systems.

A key factor in these systems is the infiltration rate (often referred to as the percolation rate) which can be ascribed to, or determined for, the earth materials within which these systems are installed. Additionally, the infiltration rate of the designed system (which may include gravel, sand, mulch/topsoil, or other amendments, etc.) will need to be considered. The project infiltration testing is very site specific, any changes to the location of the proposed OIRRS or estimated size of the OIRRS, may require additional infiltration testing. Locally, relatively impermeable formations include: clayey surficial soils, igneous and metamorphic bedrock, as well as future fine grained fill soils.

Some of the methods which are used for onsite infiltration include percolation basins, dry wells, bio-swale/bio-retention, permeable pavers/pavement, infiltration trenches, filter boxes and subsurface infiltration galleries/chambers. Some of these systems are constructed using native and import soils, perforated piping, and filter fabrics while others employ structural components such as stormwater infiltration chambers and filters/separators. Every site will have characteristics which should lend themselves to one or more of these methods, but not every site is suitable for OIRRS. In practice, OIRRS are usually initially designed by the project design civil engineer. Selection of methods should include (but should not be limited to) review by licensed professionals including the

geotechnical engineer, hydrogeologist, engineering geologist, project civil engineer, landscape architect, and environmental professional. Applicable governing agency requirements should be reviewed and included in design considerations.

The following geotechnical guidelines should be considered when designing onsite infiltration-runoff retention systems:

1. It is not good engineering practice to allow water to saturate soils, especially near slopes or improvements; however, the controlling agency/authority is now requiring this for OIRRS purposes on many projects.

2. Impermeable liners used in conjunction with basins should consist of a 30-mil polyvinyl chloride (PVC) membrane that is covered by a minimum of 12 inches of clean soil, free from rocks and debris, at a maximum inclination of 3:1 (h:v), and meets the following minimum specifications:

   Specific Gravity (ASTM D792): 1.2 (g/cc [min.]); Tensile (ASTM D882): 73 (lb/in-width [min.]); Elongation at Break (ASTM D882): 380 (% [min.]); Modulus (ASTM D882): 30 (lb/in-width [min.]); and Tear Strength (ASTM D1004): 8 (lbs [min.]); Seam Shear Strength (ASTM D882) 58.4 (lb/in [min.]); Seam Peel Strength (ASTM D882) 15 (lb/in [min]).

3. The landscape architect should be notified of the location of the proposed OIRRS. If landscaping is proposed within the OIRRS, consideration should be given to the type of vegetation chosen and their potential effect upon subsurface improvements (i.e., some trees/shrubs will have an effect on subsurface improvements with their extensive root systems). Over-watering landscape areas above, or adjacent to, the proposed OIRRS could adversely affect performance of the system.

4. Areas adjacent to, or within, the OIRRS that are subject to inundation should be properly protected against scouring, undermining, and erosion, in accordance with the recommendations of the design engineer.

5. Infiltrations systems should not be installed within 8 feet of building foundations utility trenches, and walls/retaining walls, or a 1:1 (horizontal to vertical [h:v]) slope (down and away) from the bottom elements of these improvements. Alternatively, deepened foundations or pile/pier supported improvements may be used.

6. Infiltrations systems should not be installed adjacent to pavement or hardscape improvements. Alternatively, deepened/thickened edges and curbs or impermeable liners may be used in areas adjoining the OIRRS.

7. As with any OIRRS, localized ponding and groundwater seepage should be anticipated. The potential for seepage or perched groundwater to occur after site development should be disclosed to all interested/affected parties.

8. Installation of infiltrations systems should avoid expansive soils (Expansion Index [E.I.] $\geq$ 51) or soils with a relatively high plasticity index (P.I. > 20).

9. Infiltration systems should not be installed where the vertical separation of the groundwater level is less than 10 feet from the base of the system.

10. Where permeable pavements are planned as part of the system, the site Traffic Index (T.I.) Should be less than 25,000 Average Daily Traffic (ADT), as recommended in Allen, et al. (2011).

11. Infiltration systems should be designed using a suitable factor of safety (FOS) to account for uncertainties in the known infiltration rates (as generally required by the controlling authorities), and reduction in performance over time.

12. As with any OIRRS, proper care will need to provided. Best management practices should be followed at all times, especially during inclement weather. Provisions for the management of any siltation, debris within the OIRRS, or overgrown vegetation (including root systems) should be considered. An appropriate inspection schedule will need to adopted and provided to all interested/affected parties.

13. Any designed system will require regular and periodic maintenance, which may include rehabilitation or complete replacement of the filter media (e.g., sand, gravel, filter fabrics, topsoils, mulch, etc.) or other components used in construction, so that the design life exceeds 15 years. Due to the potential for piping and adverse seepage conditions, a burrowing rodent control program should also be implemented onsite.

14. Newly established vegetation/landscaping (including phreatophytes) may have root systems that will influence the performance of the OIRRS or nearby LID systems.

15. The potential for surface flooding, in the case of system blockage, should be evaluated by the design engineer.

16. Any proposed utility backfill materials (i.e., inlet/outlet piping or other subsurface utilities) located within or near the proposed area of the OIRRS may become saturated. This is due to the potential for piping, water migration, or seepage along the utility trench line backfill. If utility trenches cross or are proposed near the OIRRS, cut-off walls or other water barriers will need to be installed to mitigate the potential for piping and excess water entering the utility backfill materials. Planned or existing utilities may also be subject to piping of fines into open-graded gravel backfill or pipe bedding layers unless separated from overlying or adjoining OIRRS by geotextiles or slurry backfill. Slurry backfill is recommended.

17. The use of OIRRS above existing utilities that might degrade/corrode with the introduction of water/seepage should be avoided.

PRELIMINARY CONCLUSIONS AND RECOMMENDATIONS

Based on our field exploration, laboratory testing, and geotechnical engineering analysis, it is our opinion that the subject site is suitable for the proposed industrial/commercial development from a geotechnical engineering and geologic viewpoint, provided that the recommendations presented in the following sections are incorporated into the design and construction phases of site development. The primary geotechnical concerns with respect to the proposed development and improvements are:

- Earth materials characteristics and depth to competent bearing material.
- On-going expansion and corrosion potential for site soils.
- Erosiveness of site earth materials.
- Potential for perched water during and following site development.
- Regional seismic activity.

The recommendations presented herein consider these as well as other aspects of the site. The engineering analyses performed concerning site preparation and the recommendations presented herein have been completed using the information provided and obtained during our field work.

If any significant changes are made to proposed site development, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the recommendations of this report verified or modified in writing by this office. Foundation design parameters are considered preliminary until the foundation design, layout, and structural loads are provided to this office for review.

EARTHWORK CONSTRUCTION RECOMMENDATIONS

General

All earthwork should conform to the guidelines presented in the 2019 CBC (CBSC, 2019a), the requirements of the City of Perris and County of Riverside, and the General Earthwork and Grading Guidelines presented in Appendix F, except where specifically superceded in the text of this report. Prior to earthwork, a GSI representative should be present at the preconstruction meeting to provide additional earthwork guidelines, if needed, and review the rough grading and earthwork schedules. This office should be notified in advance of any fill placement, supplemental regrading of the site, or backfilling underground utility trenches and retaining walls after rough earthwork has been completed. This includes grading for driveway approaches, driveways, and exterior hardscape improvements.

During earthwork construction, all site preparation and the general grading procedures of the contractor should be observed and the fill selectively tested by a representative(s) of GSI. If unusual or unexpected conditions are exposed in the field, they should be reviewed by this office and, if warranted, modified or additional recommendations will be offered. All applicable requirements of local and national construction and general industry safety orders, the Occupational Safety and Health Act (OSHA, 2011), and the Construction Safety Act should be met. It is the onsite general contractor's and individual subcontractors' responsibility to provide a safe working environment for our field staff who are onsite. GSI does not consult in the area of safety engineering.

1. Soils engineering and compaction testing services should be provided during grading operations to assist the contractor in removing unsuitable soils and in his effort to compact the fill.

2. Geologic observations should be performed during grading to document or further evaluate geologic conditions. Although unlikely, if adverse geologic structures are encountered, supplemental recommendations and earthwork may be warranted.

3. In general, and based upon the available data to date, regional groundwater does not appear to be a factor in site development or underground utility installation. However, seepage may be encountered along fill/native contacts or throughout the site along with seasonal perched water. Seepage and a transient perched water table can also develop along, or near, the contact between near surface fills and the underlying native soil, most likely after heavy rains, due to irrigation practices, BMP systems, or other factors not evident at the time of our review. This may occur after development. Although generally not anticipated, the need for localized subdrainage systems for the control of seepage and perched water may be necessary.

4. Based upon the proposed development planned and our field exploration, the very old alluvial-fan deposits throughout the site should be readily rippable with conventional earthwork equipment, in good working order.

5. Due to the non-cohesive and locally dry nature of some of the onsite materials, caving and sloughing should be anticipated in all subsurface excavations and trenching. Therefore, current local and state/federal safety ordinances for subsurface trenching should be enforced.

6. General earthwork, grading guidelines, and preliminary criteria are provided at the end of this report as Appendix F. Specific recommendations are provided below.

Demolition/Grubbing

1. Any existing surficial/subsurface structures (i.e., wells, foundations, septic systems, etc.), trees and major vegetation, bushes, and any miscellaneous debris should be removed from the areas of proposed grading and disposed offsite.

2. The project geotechnical consultant should be notified of any previous foundation, irrigation lines, septic tanks, leach fields, or other subsurface structures that are uncovered during the recommended removals, so that appropriate remedial recommendations can be provided.

3. Cavities or loose soils remaining after demolition and site clearance should be cleaned out, observed by the soils engineer, processed, and replaced with fill that has been moisture conditioned to at least optimum moisture content and compacted to at least 90 percent of the laboratory standard (ASTM D 1557), if not removed by proposed cuts.

Treatment of Existing Ground

1. All surficial tilled topsoil materials and low density near surface very old alluvial fan deposits (upper 3 to 5 feet, with an average of approximately 4 feet) should be removed to competent very old alluvial-fan deposits (i.e., greater than or equal to 85 percent compaction, or greater than or equal to 105 pcf for in-place native materials), if not removed by proposed excavation within areas proposed for settlement-sensitive improvements. For preliminary planning purposes, removal depths are estimated to be approximately 3 to 5 feet across the site, with the potential for localized deeper removals. However, a minimum of 2 feet of compacted fill should underlie proposed building foundations. Actual depths of removals will be evaluated in the field during grading by the geotechnical consultant.

2. After the above removals, the upper 6 inches of the exposed subsoils should be scarified, brought to at least optimum moisture content, and recompacted to a minimum relative compaction of 90 percent of the laboratory standard.

3. The existing site soils may be reused as compacted fill provided that any significant concentrations of vegetation and miscellaneous trash/debris are removed prior to or during fill placement.

4. Localized deeper removal may be necessary due to localized undocumented artificial fills or dry porous materials. The project geotechnical consultant/geologist should observe all removal areas during the grading.

Fill Placement

1. Fill materials should be cleansed of significant vegetation and debris prior to fill placement.

2. Fill materials should be brought to at least optimum moisture, placed in thin 6- to 8-inch lifts and mechanically compacted to obtain a minimum relative compaction of 90 percent of the laboratory standard (ASTM D 1557).

3. Any import materials should be observed and determined suitable by the soils engineer prior to placement on the site. Foundation designs may be altered if import materials have a greater expansion or sulfate values than the onsite materials encountered during our preliminary investigation.

Transition and Overexcavation Areas

Although generally not anticipated based on the flay-lying nature of the project site, in order to reduce the potential for possible differential settlements between cut and fill materials or materials of differing engineering properties, the entire cut portion of cut/fill transitions should be overexcavated to a minimum depth of 3 feet below finish grade, or a maximum ratio of fill thickness of 3:1 (maximum to minimum), and replaced with compacted fill. In addition, building pads located entirely in cut areas, if any, should be overexcavated and capped with at least 3 feet of fill, or 2 feet below the bottom of proposed footings, whichever is greater.

Subdrains

The possibility that local seepage may be encountered at the subject site is considered moderate. As such, the need for subdrainage systems for the control of localized groundwater seepage cannot be precluded. If required, subdrainage for slopes and embankments should adhere to the specifications in Appendix F, which should be incorporated into the project plans and construction documents.

Preliminary Earthwork Factors

Preliminary earthwork factors (shrinkage and bulking) for the subject property have been estimated based upon our field and laboratory testing, visual site observations, and experience in the site area. It is apparent that shrinkage would vary with depth and with areal extent over the site. Variables include surficial blow-sands and low density soils, vegetation, and previous filling or exploring. However, all these factors are difficult to define in a three-dimensional fashion.

Therefore, the information presented below represents an average shrinkage/bulking value:

Tilled Topsoil	15% to 25% shrinkage
Very Old Alluvial Fan Deposits	5% to 8% shrinkage

An additional shrinkage factor item would include the removal of root systems of individual large plants or trees. These plants and trees vary in size, but when pulled, may result in a loss of ½ to 1 cubic yard, to locally greater than 1 cubic yard of volume, respectively. The above facts indicate that earthwork balance for the site may be difficult to define and flexibility in design is essential to achieve a balanced end product. Subsidence due to equipment loadings (dynamic compaction) may be on the order of up to 0.10 feet, but will depend on haul routes, etc.

PRELIMINARY RECOMMENDATIONS - FOUNDATIONS

General

Preliminary recommendations for foundation design and construction are provided in the following sections. These preliminary recommendations have been developed from our understanding of the currently planned site development, site observations, subsurface exploration, laboratory testing, and engineering analyses. Foundation design should be re-evaluated at the conclusion of site grading/remedial earthwork for the as-graded soil conditions. Although not anticipated, revisions to these recommendations may be necessary.

The information and recommendations presented in this section are not meant to supercede design by the project structural engineer or civil engineer specializing in structural design. Upon request, GSI could provide additional input/consultation regarding soil parameters, as related to foundation design.

Expansive/Corrosive Soils

The laboratory testing conducted for this study indicates that the onsite soils do not meet the criteria of detrimentally expansive soils as defined in Section 1803.5.3 of the 2019 CBC. With recommended site grading, the overall expansive character of site soils is anticipated to be very low expansive.

Preliminary testing indicates that site soils present a negligible sulfate exposure (exposure Class “S0” (per Table 19.3.2.1 of ACI 318R-14) to concrete. However, reinforced concrete mix design for foundations, slab-on-grade floors, and pavements should also conform to Exposure Classes “S0”, “W0”, and “C1” in Table 19.3.1.1 of ACI 318R-14, as concrete would likely be exposed to moisture.

PRELIMINARY FOUNDATION DESIGN FOR INDUSTRIAL/COMMERCIAL STRUCTURES

We anticipate average and maximum static column loads of 50 and 150 kips, respectively for the proposed industrial/commercial structures. Maximum wall loads are anticipated to be on the order of 2 to 5 kips per lineal foot. Static differential settlement is estimated at 1 inch in 50 feet, and seismic differential settlement is estimated at ½ inch in 50 feet. Based on the above, we have considered the following:

- Conventional spread/continuous footings for very low expansive soils, with design to accommodate the differential settlement provided herein.

The preliminary foundation design and construction recommendations provided herein are based on laboratory testing and engineering analysis of onsite earth materials by GSI. Recommendations for footings/foundation systems and associated design parameters are provided in the following sections. The foundation systems may be used to support the proposed industrial/commercial structures, provided they are founded in competent bearing materials. As discussed previously, conventional spread/continuous footings may be used; however, they will need to consider static and seismic settlement. Mat-type foundation systems may also be used. The site structural engineer should be informed of this to aid in preliminary foundation designs. The proposed foundation systems should also be designed and constructed in accordance with other applicable guidelines contained in the 2019 CBC (CBSC, 2019a).

Isolated Spread and Continuous Footings

1. Based on the anticipated foundation loads and preliminary design information, it is our opinion that the proposed structure(s) can favorably be supported on recompacted fill soils. Building loads may be supported on continuous or isolated spread footings (typically 18 to 30 inches below planned grades) designed in accordance with the following recommendations.

ALLOWABLE BEARING VALUES FOR FOOTINGS		
DEPTH BELOW LOWEST ADJACENT FINISHED GRADE (INCHES)	ALLOWABLE BEARING CAPACITY FOR INTERIOR SPREAD FOOTINGS (MINIMUM WIDTH = 4 FEET)	ALLOWABLE BEARING CAPACITY FOR CONTINUOUS WALL FOOTINGS (MINIMUM WIDTH = 2 FEET)
18	1.5 ksf	1.5 ksf
24	2.0 ksf	2.0 ksf
30	2.5 ksf	2.5 ksf

The above values are for dead plus live loads and may be increased by one-third for short-term wind or seismic loads. Where column or wall spacings are less than twice the width of the footing, some reduction in bearing capacity may be necessary to compensate for the effects of group action. Reinforcement should be designed in accordance with local codes and structural considerations.

The recommended allowable bearing capacity is generally based on maximum total and differential settlements indicated herein for building areas. Actual settlement can be estimated on the basis that settlement is roughly proportional to the net contact bearing pressure. The majority of the settlement should occur during construction. Since settlement is a function of footing size and contact bearing pressure, some differential settlement can be expected between adjacent columns or walls where a large differential loading condition exists. However, for most cases, static differential settlements are considered unlikely to exceed those indicated herein. With increased footing depth/width ratios, differential settlement should be less, provided a minimum fill cap is maintained beneath all footings. GSI should review foundation plans and evaluate foundation specific load patterns.

2. For lateral sliding resistance, a 0.35 coefficient of friction may be used for a concrete to soil contact when multiplied by the dead load.

3. Passive earth pressure may be computed as an equivalent fluid having a density of 250 pounds per cubic foot (pcf) with a maximum lateral earth pressure of 2,500 pounds per square foot (psf).

4. When combining passive pressure and frictional resistance, the passive pressure component should be reduced by one-third.

5. Due to the anticipated granular nature of the site fill, i.e., native soils, as well as the potential for seismic loading, all footings should maintain a minimum 7-foot horizontal distance from the base of the footing to any adjacent descending slope, and minimally comply with the guidelines depicted on Figure 1808.7.1 of the 2019 CBC (CBSC, 2019a).

Preliminary Construction Recommendations for Industrial/Commercial Structures

The following foundation construction recommendations are presented as a minimum criteria from a soils engineering viewpoint. The expansion potential of onsite soils is considered very low. Accordingly, the following preliminary foundation construction recommendations are for soils in the upper 7 feet from finish grade, which may have a very low expansion potential. For foundation design, the project's design-structural engineer or architect, may exceed the geotechnical consultants recommendations and should take precedence over the following minimum requirements.

1. Conventional continuous footings should be founded at a minimum depth of 18 to 30 inches (depending on the allowable bearing value from the previous section) below the lowest adjacent ground surface for typical industrial/commercial building loads. Interior footings may be founded at a minimum depth of 18 to 30 inches below the lowest adjacent ground surface. The entire foundation should be supported by at least 2 feet of compacted fill. Footings should have a minimum width of 24 inches. All continuous footings should be reinforced with a minimum of four No. 5 reinforcing bars, two at the top and two No. 5 reinforcing bars at the bottom.

2. Isolated exterior pier and column footings should be constructed 24 inches square by 24 inches deep, and tied to the main foundation in at least one direction with a grade beam. Isolated footing reinforcement should be designed by the project structural engineer.

3. A grade beam, reinforced as above and at least 18 inches deep (minimum of 12 inches square), should be provided across garages, large, or wide entrances. The base of the reinforced grade beam should be at the same elevation as the adjoining footings.

4. Concrete slabs should be constructed and underlain with a vapor retarder and slab underlayment as indicated in the “Soil Moisture Transmission Considerations” section of this report.

5. A minimum slab thickness of 5 inches is recommended, and the slab subgrade should be free of loose and uncompacted material prior to placing concrete. The design engineer should determine the actual thickness of concrete slabs based upon proposed loading and use.

6. Concrete slabs should be reinforced with No. 3 reinforcement bars (per the CBC 2019), placed on 18-inch centers, in two horizontally perpendicular directions (i.e., long axis and short axis).

7. All slab reinforcement should be supported to ensure proper mid-slab height positioning during placement of the concrete. "Hooking" of reinforcement is not an acceptable method of positioning.

8. Specific presaturation is not required for very low expansive soil conditions; however, the moisture content of the subgrade soils should be equal to, or greater than, optimum moisture to a depth of 18 to 30 inches below the adjacent ground grade in the slab areas for very low expansive soils, or the depth of the foundation. This should be evaluated by the geotechnical consultant within 72 hours of the vapor retarder and steel reenforcement placement.

9. Foundations near the top of slope should be deepened to conform to the latest edition of the 2019 CBC (CBSC, 2019) and provide a minimum of 7 feet horizontal distance from the slope face. Rigid block wall designs, located along the top of slope, should be reviewed by a geotechnical consultant.

PRELIMINARY FLOOR SLAB DESIGN RECOMMENDATIONS - ISOLATED SPREAD AND CONTINUOUS FOOTING FOUNDATION SYSTEMS

General

Concrete slab-on-grade floor construction is anticipated. The following are presented as minimum design parameters for the slab, but they are in no way intended to supercede design by the structural engineer. Design parameters do not account for concentrated loads (e.g., fork lifts, heavy rack loads, other machinery, etc.) or the use of freezers or heating boxes. These recommendations are meant as minimums. The project architect or structural engineer should review and verify that the minimum recommendations presented herein are considered adequate with respect to anticipated uses.

Light Load Floor Slabs

The slabs in areas that will receive relatively light live loads (i.e., office space, less than 50 psf) should be a minimum of 5 inches thick and be reinforced with No. 3 reinforcing bar on 18-inch centers in two horizontally perpendicular directions. Reinforcing should be properly supported to ensure placement near the vertical midpoint of the slab. "Hooking" of the reinforcement is not considered an acceptable method of positioning the steel.

The project structural engineer should consider the use of transverse and longitudinal control joints to help control slab cracking due to concrete shrinkage or expansion. Two of the best ways to control this movement are: 1) add a sufficient amount of reinforcing steel to increase the tensile strength of the slab; and 2) provide an adequate amount of control or expansion joints to accommodate anticipated concrete shrinkage and expansion. Transverse and longitudinal crack control joints should be spaced no more than 12 feet on center and constructed to a minimum depth of T/4, where "T" equals the slab thickness in inches.

Heavy Load Floor Slabs

The project structural engineer should design the slabs in areas subject to high loads (machinery, forklifts, storage racks, etc.). The Modulus of subgrade reaction (k_S-value) may be used in the design of the floor slab supporting heavy truck traffic, fork lifts, machine foundations, and heavy storage areas. A k_S-value of 100 pounds per square inch per inch (pci) would be prudent to use for preliminary slab design. An R-value test or plate load test may be used to verify the k_S-value on near-surface fill soils.

Concrete slabs should be at least 6 inches thick and reinforced with No. 5 reinforcing bars placed 12 inches on center in two horizontally perpendicular directions. Selection of slab thickness compatibility with anticipated loads should be provided by the structural engineer.

Transverse and longitudinal crack control joints should be spaced no more than 14 feet on center and constructed to a minimum depth of T/4, where "T" equals the slab thickness in inches. The use of expansion joints in the slab should be considered. Spacing of expansion or crack control joints should be modified based on the footprint of the area to be heavily loaded.

Slab Subgrade Preparation

Subgrade material should be compacted to a minimum of 90 percent of the maximum laboratory dry density (ASTM D 1557). Prior to placement of concrete, the subgrade soils should be moisture conditioned to 18 to 30 inches below grade (depending on the footing depth used) to at least the soils' optimum moisture content, for very low to low expansive soils.

After moisture conditioning, the subgrade soils should be evaluated by a field representative of GSI prior to vapor retarder placement, and prior to and within 72 hours of concrete placement. Alternative methods, including sealing the subgrade surface with select sand/base and periodic moisture conditioning, may also be considered, as long as the minimum recommended soil moisture content is achieved. In summary:

EXPANSION INDEX	PAD SOIL MOISTURE	CONSTRUCTION METHOD	SOIL MOISTURE RETENTION
Very Low (0-20)	Upper 18 to 30 inches of pad at or above soil optimum moisture	Wetting or reprocessing	Periodically wet or cover with plastic after trenching. Evaluation 72 hours prior to placement of concrete.

PRELIMINARY MAT FOUNDATION DESIGN RECOMMENDATIONS

Mat Foundations

In lieu of using a conventional foundation system, the Client may consider a mat foundation which uses steel bar reinforcement. The structural engineer may supercede the following recommendations based on the planned building loads and use. Wire Reinforcement Institute (WRI, 2016) methodologies for design may be used.

Mat Foundation Design

The design of mat foundations should incorporate the vertical modulus of subgrade reaction. This value is a unit value for a 1-foot square footing and should be reduced in accordance with the following equation when used with the design of larger foundations. This assumes that the bearing soils will consist of engineered fills with an average relative compaction of 90 percent of the laboratory (ASTM D 1557).

$$K_R = K_S \left[\frac{B+1}{2B} \right]^2$$

where: K_S = unit subgrade modulus
K_R = reduced subgrade modulus
B = foundation width (in feet)

The modulus of subgrade reaction (K_S) and effective plasticity index (PI) to be used in mat foundation design for various expansive soil conditions are presented in the following table:

VERY LOW TO LOW EXPANSION (E.I. = 0-50)
K_S =100 pci/inch, PI < 15

Reinforcement bar sizing and spacing for mat slab foundations should be provided by the structural engineer. Mat slabs may be uniform thickness foundations (UTF) or may incorporate the use of edge footings for moisture cut-off barriers as recommended herein. The bottom of the edge footing should be designed to resist tension, using reinforcement per the structural engineer. The need and arrangement of interior grade beams (stiffening beams) will be in accordance with the structural consultant's recommendations. The recommendations for a mat type of foundation assume that the soils below the slab are compacted fill. The parameters herein are to mitigate the effects of total and differential settlements provided herein.

Confirmation Testing for Final Foundation Design

Following the completion of site grading, the expansion index, subgrade modulus, and corrosion potential of soils exposed near finish pad grades should be re-evaluated. Although not anticipated, the results of the recommended testing may require amendments to these preliminary recommendations.

SOIL MOISTURE TRANSMISSION CONSIDERATIONS

GSI has evaluated the potential for vapor or water transmission through the concrete floor slab, in light of typical floor coverings and improvements. Please note that slab moisture emission rates range from about 2 to 27 lbs/24 hours/1,000 square feet from a typical slab (Kanare, 2005), while floor covering manufacturers generally recommend about 3 lbs/24 hours as an upper limit. The recommendations in this section are not intended to preclude the transmission of water or vapor through the foundation or slabs. Foundation systems and slabs shall not allow water or water vapor to enter into the structure so as to cause damage to another building component or to limit the installation of the type of flooring materials typically used for the particular application (State of California, 2022). These recommendations may be exceeded or supplemented by a water "proofing" specialist, project architect, or structural consultant. Thus, the client will need to evaluate the following in light of a cost versus benefit analysis (owner expectations and repairs/replacement), along with disclosure to all interested/affected parties.

Vapor transmission will occur in new slab-on-grade floors as a result of chemical reactions taking place within the curing concrete. Vapor transmission through concrete floor slabs as a result of concrete curing has the potential to adversely affect sensitive floor coverings depending on the thickness of the concrete floor slab and the duration of time between the placement of concrete and the floor covering. It is possible that a slab moisture sealant may be needed prior to the placement of sensitive floor coverings if a thick slab-on-grade floor is used and the time frame between concrete and floor covering placement is relatively short.

Considering the E.I. test results presented herein, and known soil conditions in the region, the anticipated typical water vapor transmission rates, floor coverings, and improvements (to be chosen by the Client or project architect) that can tolerate vapor transmission rates without significant distress, the following alternatives are provided:

- Concrete slab-on-grade floors should be thicker.

- Concrete slab underlayment should consist of a 15-mil vapor retarder, or equivalent, with all laps sealed per the 2019 CBC and the manufacturer's recommendation. The vapor retarder should comply with the ASTM E 1745 - Class A criteria, and be installed in accordance with ACI 302.1R-04 and ASTM E 1643.

- The 15-mil vapor retarder (ASTM E 1745 - Class A) shall be installed per the recommendations of the manufacturer, including all penetrations (i.e., pipe, ducting, rebar, etc.).

- Concrete slabs, including garages, should be underlain by 2 inches of clean sand (S.E. $\geq$ 30) above a 15-mil vapor retarder (ASTM E 1745 - Class A, per Engineering Bulletin 119 [Kanare, 2005]). The vapor retarder should in-turn, be underlain by

2 inches of sand (S.E. $\geq$ 30) placed directly on the prepared, moisture conditioned, subgrade. The vapor retarder should be sealed to provide a continuous retarder under the entire slab and should be installed per the recommendations of the manufacturer, including all penetrations (i.e., pipe, ducting, rebar, etc.). The manufacturer should provide instructions for lap sealing, including minimum width of lap, method of sealing, and either supply or specify suitable products for lap sealing (ASTM E 1745), and per Code.

ACI 302.1R-04 (2004) states "If a cushion or sand layer is desired between the vapor retarder and the slab, care must be taken to protect the sand layer from taking on additional water from a source such as rain, curing, cutting, or cleaning. Wet cushion or sand layer has been directly linked in the past to significant lengthening of time required for a slab to reach an acceptable level of dryness for floor covering applications." Therefore, additional observation or testing will be necessary for the cushion or sand layer for moisture content, and relatively uniform thicknesses, prior to the placement of concrete.

- Additional concrete mix design recommendations should be provided by the structural consultant or waterproofing specialist. Concrete finishing and workability should be addressed by the structural consultant and a waterproofing specialist.

- Where concrete admixtures are used, the structural consultant should also make changes to the concrete in the grade beams and footings in kind, so that the concrete used in the foundation and slabs are designed or treated for more uniform moisture protection.

- The owner(s) should be specifically advised which areas are suitable for tile flooring, vinyl flooring, or other types of water/vapor-sensitive flooring and which are not suitable. In all planned floor areas, flooring shall be installed per the manufacturer's recommendations.

- Additional recommendations regarding water or vapor transmission should be provided by the architect/structural engineer/slab or foundation designer and should be consistent with the specified floor coverings indicated by the architect.

Regardless of the mitigation, some limited moisture/moisture vapor transmission through the slab should be anticipated. Construction crews may require special training for installation of certain product(s), as well as concrete finishing techniques. The use of specialized product(s) should be approved by the slab designer and water-proofing consultant. A technical representative of the flooring contractor should review the slab and moisture retarder plans and provide comment prior to the construction of the foundations or improvements.

PRELIMINARY WALL DESIGN PARAMETERS

General

Recommendations for the design and construction of conventional masonry retaining walls are provided below. Recommendations for specialty walls (i.e., crib, earthstone, mechanically stabilized earth [MSE], gravity, etc.) can be provided upon request, and would be based on site specific conditions.

Conventional Retaining Walls

The design parameters provided below assume that either very low expansive soils (typically Class 2 permeable filter material or Class 3 aggregate base) or native onsite materials with an expansion index up to 50 are used to backfill any retaining wall. The type of backfill (i.e., select or native), should be specified by the wall designer, and clearly shown on the plans. Building walls, below grade, should be water-proofed. Waterproofing should also be provided for site retaining walls in order to reduce the potential for efflorescence staining.

Preliminary Retaining Wall Foundation Design

Preliminary foundation design for retaining walls should incorporate the following recommendations:

Minimum Footing Embedment - 18 inches below the lowest adjacent grade (excluding landscape layer [upper 6 inches]).

Minimum Footing Width - 24 inches.

Allowable Bearing Pressure - An allowable bearing pressure of 2,500 pcf may be used in the preliminary design of retaining wall foundations provided that the footing maintains a minimum width of 24 inches and extends at least 18 inches into approved engineered fill overlying dense formational materials. This pressure may be increased by one-third for short-term wind or seismic loads.

Passive Earth Pressure - A passive earth pressure of 250 pcf with a maximum earth pressure of 2,500 psf may be used in the preliminary design of retaining wall foundations provided the foundation is embedded into properly compacted silty to clayey sand fill.

Lateral Sliding Resistance - A 0.35 coefficient of friction may be used for a concrete to soil contact when multiplied by the dead load. When combining passive pressure and frictional resistance, the passive pressure component should be reduced by one-third.

Backfill Soil Density - Soil densities ranging between 125 pcf and 135 pcf may be used in the design of retaining wall foundations. This assumes an average engineered fill compaction of at least 90 percent of the laboratory standard (ASTM D 1557).

Any retaining wall footings near the perimeter of the site will likely need to be deepened into unweathered native deposits for adequate vertical and lateral bearing support. All retaining wall footing setbacks from slopes should comply with Figure 1808.7.1 of the 2019 CBC. GSI recommends a minimum horizontal setback distance of 7 feet as measured from the bottom, outboard edge of the footing to the slope face.

Restrained Walls

Any retaining walls that will be restrained prior to placing and compacting backfill material or that have re-entrant or male corners, should be designed for an at-rest equivalent fluid pressure (EFP) of 55 pcf and 65 pcf for select and very low expansive native backfill, respectively. The design should include any applicable surcharge loading. For areas of male or re-entrant corners, the restrained wall design should extend a minimum distance of twice the height of the wall (2H) laterally from the corner.

Cantilevered Walls

The recommendations presented below are for cantilevered retaining walls up to 10 feet high. Design parameters for walls less than 3 feet in height may be superceded by City or County standard design. Active earth pressure may be used for retaining wall design, provided the top of the wall is not restrained from minor deflections. An equivalent fluid pressure approach may be used to compute the horizontal pressure against the wall. Appropriate fluid unit weights are given below for specific slope gradients of the retained material. These do not include other superimposed loading conditions due to traffic, structures, seismic events or adverse geologic conditions. When wall configurations are finalized, the appropriate loading conditions for superimposed loads can be provided upon request.

For preliminary planning purposes, the structural consultant/wall designer should incorporate the surcharge of traffic on the back of retaining walls where vehicular traffic could occur within horizontal distance “H” from the back of the retaining wall (where “H” equals the wall height). The traffic surcharge may be taken as 100 psf/ft in the upper 5 feet of backfill for light truck and cars traffic. This does not include the surcharge of parked vehicles which should be evaluated at a higher surcharge to account for the effects of seismic loading. Equivalent fluid pressures for the design of cantilevered retaining walls are provided in the following table:

SURFACE SLOPE OF RETAINED MATERIAL (HORIZONTAL:VERTICAL)	EQUIVALENT FLUID WEIGHT P.C.F. (SELECT BACKFILL)[2]	EQUIVALENT FLUID WEIGHT P.C.F. (NATIVE BACKFILL)[3]
Level[1]	38	50
2 to 1	55	65

[1] Level backfill behind a retaining wall is defined as compacted earth materials, properly drained, without a slope for a distance of 2H behind the wall, where H is the height of the wall.
[2] SE > 30, P.I. < 15, E.I. < 21, and < 10% passing No. 200 sieve.
[3] E.I. = 0 to 50, SE > 30, P.I. < 15, E.I. < 21, and < 15% passing No. 200 sieve.

Seismic Surcharge

For engineered retaining walls with more than 6 feet of retained materials, as measured vertically from the bottom of the wall footing at the heel to daylight , GSI recommends that the walls be evaluated for a seismic surcharge (in general accordance with 2019 CBC requirements). The site walls in this category should maintain an overturning factor-of-safety (FOS) of approximately 1.25 when the seismic surcharge (increment), is applied. For restrained walls, the seismic surcharge should be applied as a uniform surcharge load from the bottom of the footing (excluding shear keys) to the top of the backfill at the heel of the wall footing. This seismic surcharge pressure (seismic increment) may be taken as 15H where "H" for retained walls is the dimension previously noted as the height of the backfill to the bottom of the footing. The resultant force should be applied at a distance 0.6 H up from the bottom of the footing. For the evaluation of the seismic surcharge, the bearing pressure may exceed the static value by one-third, considering the transient nature of this surcharge. For cantilevered walls, the pressure should be applied as an inverted triangular distribution using 15H. For restrained walls, the pressure should be applied as a rectangular distribution. Please note this is for local wall stability only.

The 15H is derived from a Mononobe-Okabe solution for both restrained cantilever walls. This accounts for the increased lateral pressure due to shakedown or movement of the sand fill soil in the zone of influence from the wall or roughly a 45° - ϕ/2 plane away from the back of the wall. The 15H seismic surcharge is derived from the formula:

$$P_h = \tfrac{3}{8} \bullet a_h \bullet \gamma_t H$$

Where:
- P_h = Seismic increment.
- a_h = Probabilistic horizontal site acceleration with a percentage of "g."
- γ_t = total unit weight (125 to 135 pcf for site soils @ 90% relative compaction).
- H = Height of the wall from the bottom of the footing or point of pile fixity.

Retaining Wall Backfill and Drainage

Positive drainage must be provided behind all retaining walls in the form of gravel wrapped in geofabric and outlets. A backdrain system is considered necessary for retaining walls that are 2 feet or greater in height. Details 1, 2, and 3, present the backdrainage options discussed below. Backdrains should consist of a 4-inch diameter perforated PVC or ABS pipe encased in either Class 2 permeable filter material or ¾-inch to 1½-inch gravel wrapped in approved filter fabric (Mirafi 140 or equivalent). For select backfill, the filter material should extend a minimum of 1 horizontal foot behind the base of the walls and upward at least 1 foot. For native backfill that has up to E.I. = 20, continuous Class 2 permeable drain materials should be used behind the wall. This material should be laterally continuous behind the wall, and it should be constructed in accordance with the enclosed Detail 1 (Typical Retaining Wall Backfill and Drainage Detail). For limited access and confined areas, (panel) drainage behind the wall may be constructed in accordance with Detail 2 (Retaining Wall Backfill and Subdrain Detail Geotextile Drain). Materials with an expansion index (E.I.) potential of greater than 50 should not be used as backfill for retaining walls. Retaining wall backfill materials should be moisture conditioned and mixed to achieve the soil's optimum moisture content, placed in relatively thin lifts (6 to 10 inches), and compacted to at least 90 percent relative compaction. For more onerous expansive situations, backfill and drainage behind the retaining wall should conform with Detail 3 (Retaining Wall And Subdrain Detail Clean Sand Backfill).

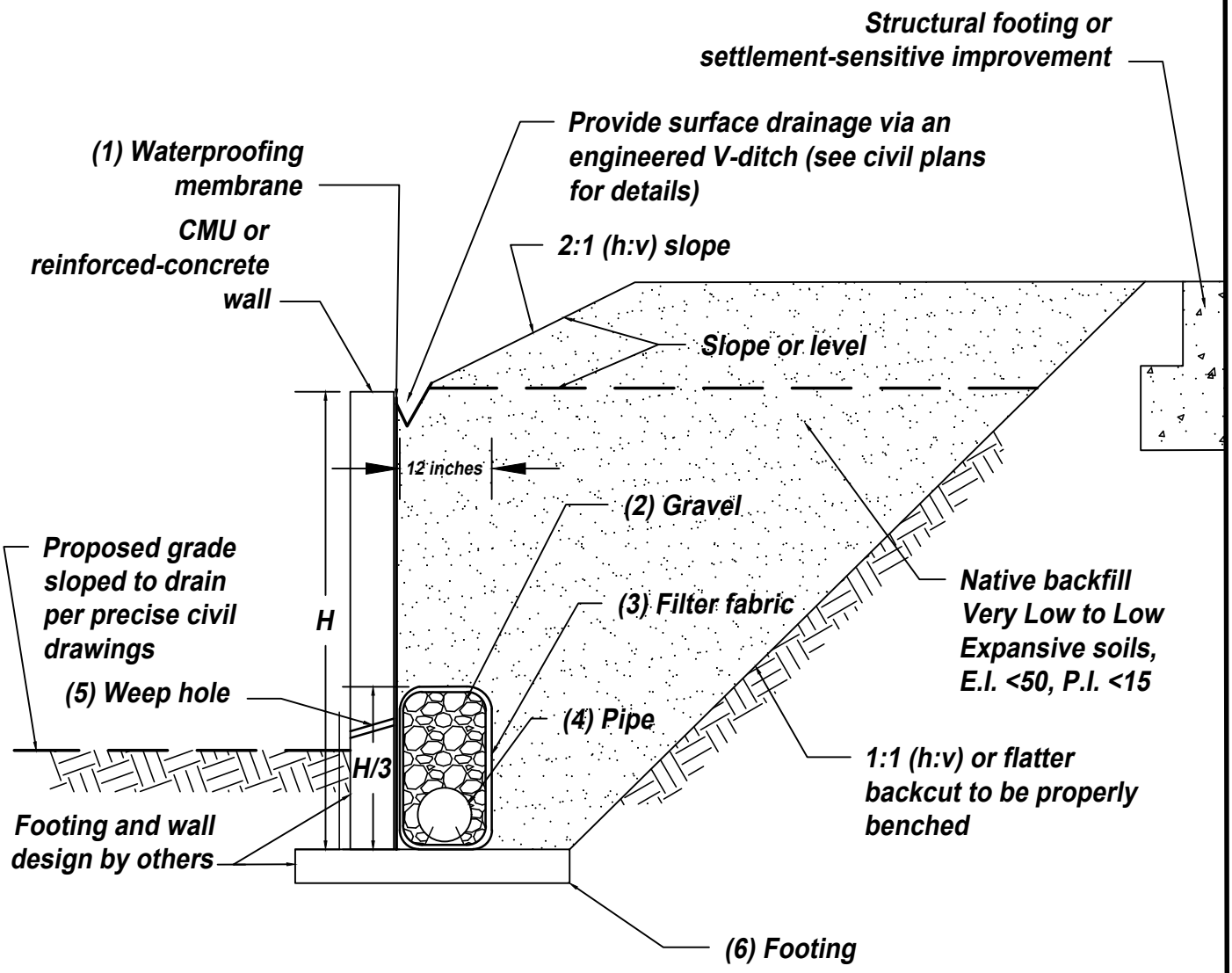
Outlets should consist of a 4-inch diameter solid PVC or ABS pipe spaced no greater than 100 feet apart, with a minimum of two outlets, one on each end. The use of weep holes, only, in walls higher than 2 feet, is not recommended. The surface of the backfill should be sealed by pavement or the top 18 inches compacted with native soil (E.I. $\leq$ 50). Proper surface drainage should also be provided. For additional mitigation, consideration should be given to applying a water-proof membrane to the back of all retaining structures. The use of a waterstop should be considered for all concrete and masonry joints.

Wall/Retaining Wall Footing Transitions

Site walls are anticipated to be founded on footings designed in accordance with the recommendations in this report. Should wall footings transition from cut to fill, the structural consultant/wall designer may specify either:

a) A minimum of a 2-foot overexcavation and recompaction of cut materials for a distance of 2H, from the point of transition.

b) Increase of the amount of reinforcing steel and wall detailing (i.e., expansion joints or crack control joints) such that a angular distortion of 1/360 for a distance of 2H on either side of the transition may be accommodated. Expansion joints should be placed no greater than 20 feet on-center, in accordance with the structural engineer's/wall designer's recommendations, regardless of whether or not transition conditions exist. Expansion joints should be sealed with a flexible, non-shrink grout.



(1) Waterproofing membrane.

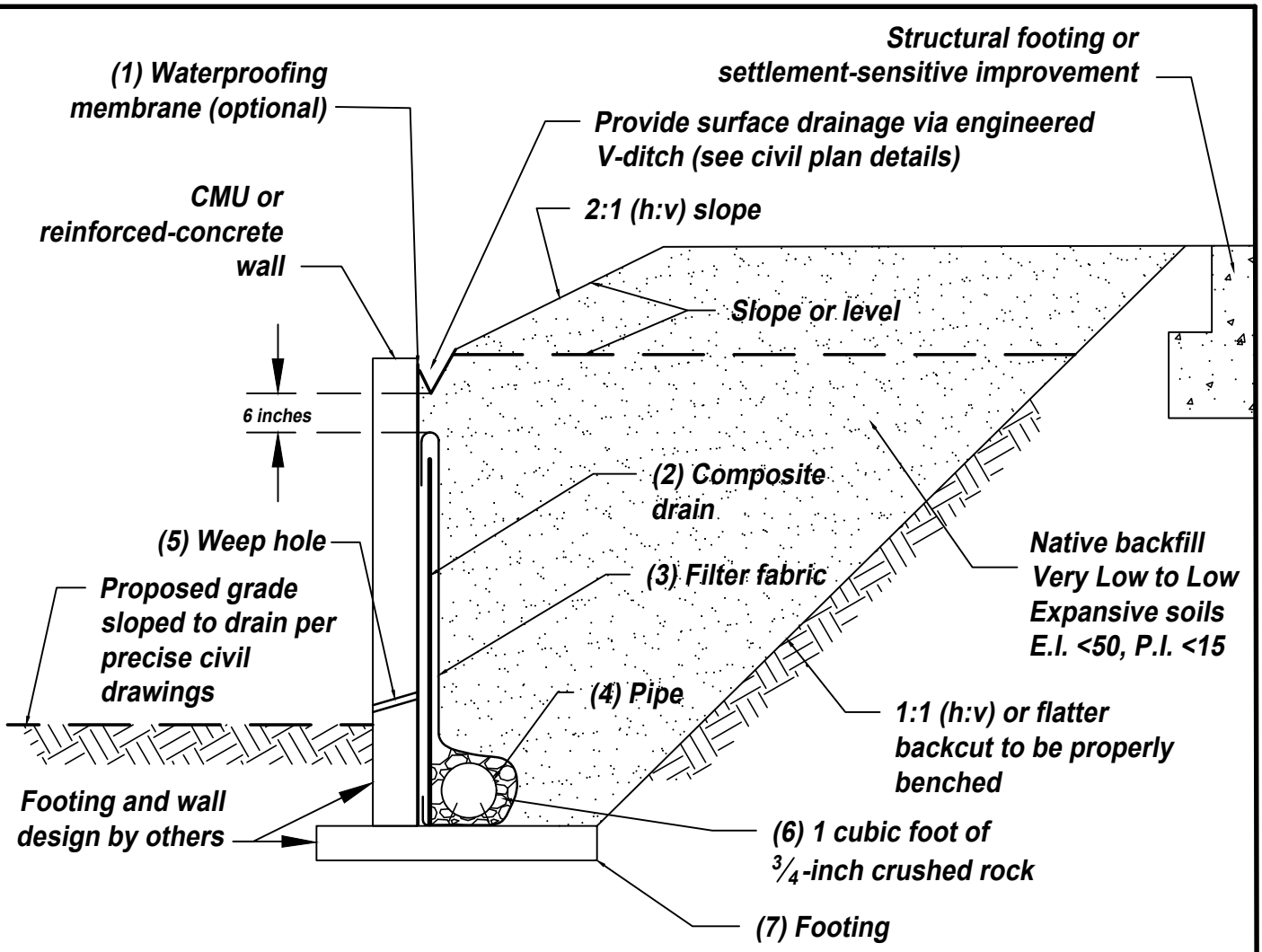
(2) Gravel: Clean, crushed, ¾ to 1½ inch.

(3) Filter fabric: Mirafi 140N or approved equivalent.

(4) Pipe: 4-inch-diameter perforated PVC, Schedule 40, or approved alternative with minimum of 1 percent gradient sloped to suitable, approved outlet point (perforations down).

(5) Weep holes: For CMU walls, Omit grout every other block, at or slightly above finished surface. For reinforced concrete walls, minimum 2-inch diameter weep holesspaced at 20 foot centers along the wall and placed 3 inches above finished surface. Design civil engineer to provide drainage at toe of wall. No weep holes for below-grade walls.

(6) Footing: If bench is created behind the footing greater than the footing width using level fill or cut natural earth materials, an additional "heel" drain will likely be required by geotechnical consultant.



(1) Waterproofing membrane (optional): Liquid boot or approved mastic equivalent.

(2) Drain: Miradrain 6000 or J-drain 200 or equivalent for non-waterproofed walls; Miradrain 6200 or J-drain 200 or equivalent for waterproofed walls (all perforations down).

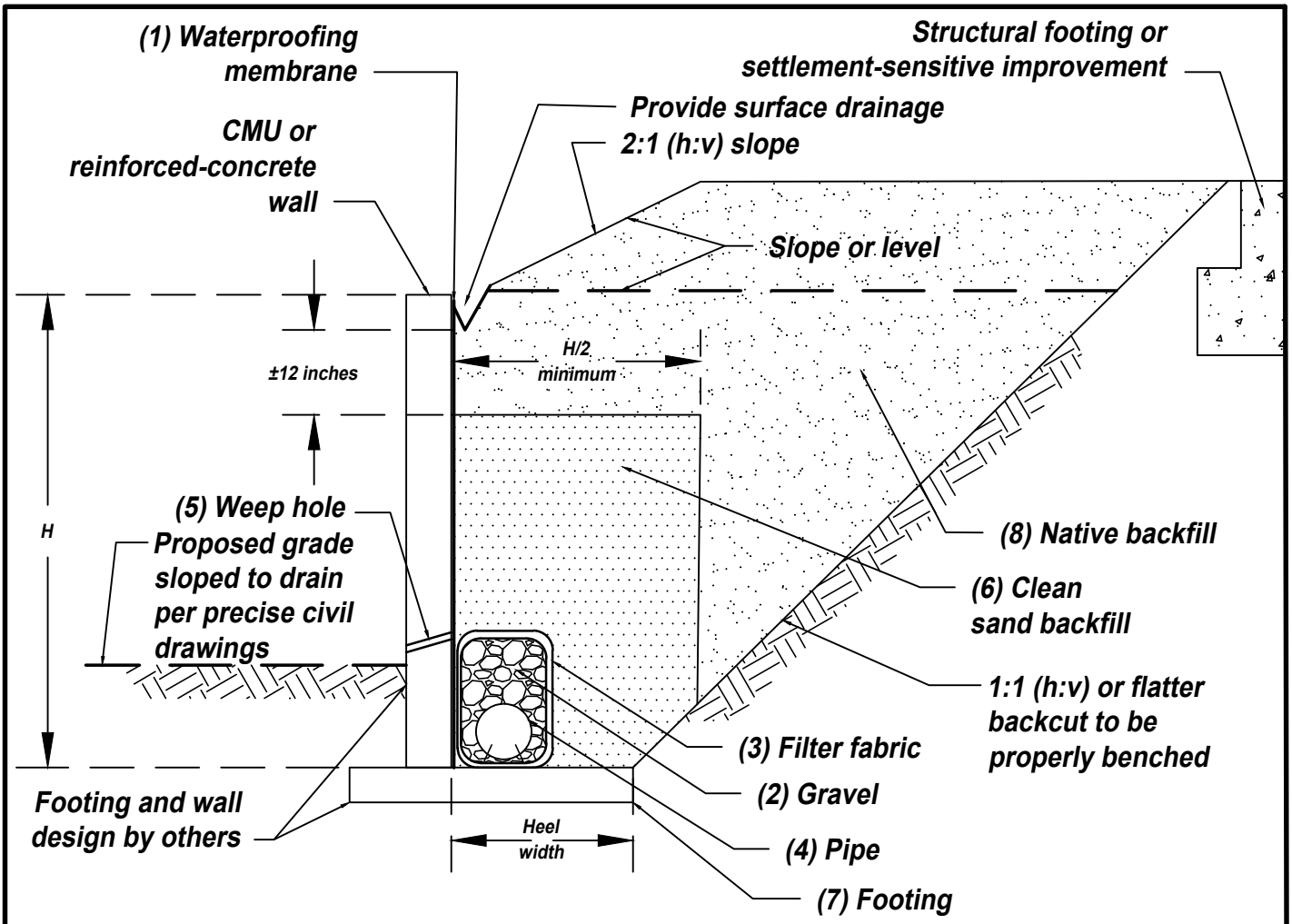
(3) Filter fabric: Mirafi 140N or approved equivalent; place fabric flap behind core.

(4) Pipe: 4-inch-diameter perforated PVC, Schedule 40, or approved alternative with minimum of 1 percent gradient to proper outlet point (perforations down).

(5) Weep holes: For CMU walls, Omit grout every other block, at or slightly above finished surface. For reinforced concrete walls, minimum 2-inch diameter weep holesspaced at 20 foot centers along the wall and placed 3 inches above finished surface. Design civil engineer to provide drainage at toe of wall. No weep holes for below-grade walls.

(6) Gravel: Clean, crushed, ¾ to 1½ inch.

(7) Footing: If bench is created behind the footing greater than the footing width using level fill or cut natural earth materials, an additional "heel" drain will likely be required by geotechnical consultant.



(1) Waterproofing membrane: Liquid boot or approved masticequivalent.

(2) Gravel: Clean, crushed, ¾ to 1½ inch.

(3) Filter fabric: Mirafi 140N or approved equivalent.

(4) Pipe: 4-inch-diameter perforated PVC, Schedule 40, or approved alternative with minimum of 1 percent gradient to proper outlet point (perforations down).

(5) Weep hole: For CMU walls, Omit grout every other block, at or slightly above finished surface. For reinforced concrete walls, minimum 2-inch diameter weep holesspaced at 20 foot centers along the wall and placed 3 inches above finished surface. Design civil engineer to provide drainage at toe of wall. No weep holes for below-grade walls.

(6) Clean sand backfill: Must have sand equivalent value (S.E.) of 35 or greater; can be densified by water jetting upon approval by geotechnical engineer.

(7) Footing: If bench is created behind the footing greater than the footing width using level fill or cut natural earth materials, an additional "heel" drain will likely be required by geotechnical consultant.

(8) Native backfill: If E.I. <21 and S.E. ≥35 then all sand requirements also may not be required and will be reviewed by the geotechnical consultant.

c) Embed the footings entirely into native formational material (i.e., deepened footings).

If transitions from cut to fill transect the wall footing alignment at an angle of less than 45 degrees (plan view), then the designer should follow recommendation "a" (above) and until such transition is between 45 and 90 degrees to the wall alignment.

PRELIMINARY PAVEMENT DESIGN AND CONSTRUCTION

General

The governing agency may retain the authority to approve the final structural design sections after subgrade elevations and actual resistance values (R-values) have been obtained at the conclusion of earthwork. Based on a general review of pavement designs for other nearby projects, and for estimation and bidding purposes, the pavement sections provided herein should be considered for preliminary design. Typically, actual pavement sections will likely vary, therefore final pavement sections should be based on actual R-value testing performed during, or shortly after, roadway grading for any proposed street and driveway/parking area improvements.

Asphaltic Concrete (AC) Pavements

The preliminary design for Asphaltic Concrete (AC), and Portland Cement Concrete Pavement (PCCP) was evaluated based on a R-value of 19, and the use of concrete shoulders (curb or gutter) at the edge of PCC pavement. GSI does not recommend the use of an ADTT value of less than 25 for any pavement section, unless the ADTT significantly less than 25 is certified by a civil engineer specializing in traffic engineering.

Pavement Design

The preliminary pavement sections presented in the following table are based on the preliminary R-value test results obtained, the minimum paving thickness provided by the County of Riverside (Standard Details Nos. 103, 111 and 114) for a local street, a collector (road), an industrial collector street, and the guidelines presented in the latest revision to the California Department of Transportation (Caltrans, 2020) "Highway Design Manual" seventh edition. It is our understanding that the traffic index (TI) value for a local street is 5.5, and the minimum pavement section required by the County of Riverside 3.0 inches of AC (asphaltic concrete) on 6.0 inches of Class 2 aggregate base. Based on the R-value of 19 obtained (i.e., R=19), the minimum asphalt concrete and base thickness are presented below. Applicable sections of City and/or County ordinances should be followed during design of public roads, fire access lanes, etc.

Asphaltic Concrete Pavement (ACP)

Preliminary asphaltic concrete (AC) pavement sections are presented in the following table:

STREET CLASSIFICATION	TRAFFIC INDEX (T.I.)[1]	STANDARD PAVEMENT DESIGNS		
		R-VALUE	AC INCHES	CLASS 2 BASE ROCK[2] INCHES
Local Street	5.5	19	3.0*	9.0
Collector (Road)	7.0	19	4.0*	12.0
Industrial Collector Street	8.0	19	4.7*	14.0

[1] T.I.s provided in the County of Riverside Standard Details (Standard Detail No. 114).
[2] Denotes standard Caltrans Class 2 aggregate base rock ® $\geq$ 78, SE $\geq$ 25).
* Denotes County of Riverside minimum asphaltic concrete or aggregate base.

The preliminary pavement sections provided above are intended as a minimum guideline. If thinner or highly variable pavement sections are constructed, increased maintenance and repair could be expected. If the ADT (average daily traffic) or ADTT (average daily truck traffic) increases beyond that intended, increased maintenance and repair could be required for the pavement section. Consideration should be given to the increased potential for distress from overuse of paved street areas by heavy equipment or construction related heavy traffic (e.g., concrete trucks, loaded supply trucks, etc.), particularly when the final section is not in place (i.e., topcoat). Best management construction practices should be followed at all times, especially during inclement weather.

Portland Concrete Cement (PCC) Pavement

The preliminary design for Portland Cement Concrete Pavement (PCCP) was evaluated using a subgrade R-value of 19, a modulus of rupture (MR) of 420 and 500 psi. GSI does not recommend the use of an ADTT value of less than 25 for any pavement section, unless the ADTT significantly less than 25 is certified by a civil engineer specializing in traffic engineering. The preliminary PCCP sections are provided in the following table:

PORTLAND CONCRETE CEMENT PAVEMENTS (PCCP)*					
TRAFFIC AREAS	CONCRETE TYPE	PCCP THICKNESS (INCHES)	TRAFFIC AREAS	CONCRETE TYPE	PCCP THICKNESS (INCHES)
Light Vehicles	520-C-2500	6.0	Dumpster Aprons (Trash Service)	520-C-2500	8.0
	560-C-3250	5.0		560-C-3250	7.0

NOTE: All PCCP is designed as un-reinforced and bearing directly on compacted subgrade. However, a 4-inch thick leveling course of compacted aggregate base, or crushed rock may be considered to improve performance. All PCCP should be properly detailed (jointing, etc.) per the industry standard. Pavements may be additionally reinforced with #4 reinforcing bars, placed 18 inches on center, each way, for improved performance.
* To be re-evaluated based on exposed field conditions and R-values obtained following rough grading.

The transition of the pavement from parking to traffic lanes should be made over a distance of 24 inches with crack control joints (weaken plane) or contact joints at the end of the transition. A minimum 4-inch layer of base rock in traffic and bus stop areas should be considered to improve traffic lane performance. Base rock may consist of either ¾-inch crushed rock or Caltrans Class 2 aggregate base. Crushed rock may be compacted by vibratory methods. Aggregate base should be compacted to a minimum relative compaction of 95 percent.

Weakened Plane Joints

Transverse and longitudinal weakened plane joints may be constructed per Greenbook Standard Specifications (2021), Section 302-6.5, or the structural/civil engineer. Transverse weakened plane joints should be spaced no farther than 15 feet apart and no closer than 5 feet. Longitudinal weakened plane joints should be spaced no farther than 20 feet apart, but not less than 5 feet.

Expansion Joints and Contact Joints

Transverse expansion joints should be constructed at 120-foot spacings, or in accordance with City standards. Transverse and longitudinal contact joints should be constructed in accordance with the recommendations of the design engineer. Within large slab areas, joint spacings should be no greater than 20 feet.

Slab Reinforcement

The preliminary PCC Pavements for this project are designed as unreinforced and should perform adequately, assuming proper construction. If additional control of internal slab stresses (i.e., curing shrinkage, thermal expansion and contraction) is desired, then the use of No. 4 reinforcing bars, 18 inches on center each way, should be considered.

Subgrade should be compacted to a minimum relative compaction of 95 percent. Aggregate base compaction should be 95 percent of the maximum dry density (ASTM D 1557). If adverse conditions (i.e., saturated ground, etc.) are encountered during preparation of subgrade, special construction methods may need to be employed. These recommendations should be considered preliminary. R-value testing and pavement design analysis should be performed upon completion of grading for the project.

Concrete/Pervious Pavers

Concrete pavers should be underlain by a minimum of 8 inches of aggregate base, overlain by a leveling-course of sand, or per the manufacturers guidelines. Manufacturer's guidelines should be reviewed for concordance with the intent of the geotechnical report and the underlying soil conditions. Prior to aggregate base placement the subgrade soils should be compacted to a minimum relative compaction of 95 percent. Aggregate base

compaction should also be 95 percent of the maximum dry density (ASTM D-1557), and follow the pavement grading recommendations provided below, as warranted.

PAVEMENT GRADING RECOMMENDATIONS

General

All section changes should be properly transitioned. If adverse conditions are encountered during the preparation of subgrade materials, special construction methods may need to be employed. A GSI representative should be present for the preparation of subgrade, aggregate base rock, and asphalt concrete.

Subgrade

Within roadways, access drives and parking areas, all surficial deposits of loose soil material should be removed and recompacted as recommended. After the loose soils are removed, the bottom is to be scarified to a depth of at least 6 inches, moisture conditioned as necessary and compacted to 95 percent of the maximum laboratory density or the County minimum, as evaluated by ASTM Test Method D 1557.

Deleterious material, excessively wet or dry pockets, concentrated zones of oversized rock fragments, and any other unsuitable materials encountered during grading should be removed. The compacted fill material should then be brought to the elevation of the proposed subgrade for the pavement. The subgrade should be proof-rolled in order to ensure a uniform firm and unyielding surface. All grading and fill placement should be observed by the project geotechnical consultant or his representative.

Aggregate Base Rock

Compaction tests are required for the recommended base section. Minimum relative compaction required will be 95 percent of the laboratory maximum density as evaluated by ASTM Test Designation D 1557. Base aggregate should be in accordance to the Caltrans Class 2 base rock (minimum R-value=78).

Drainage

Positive drainage should be provided for all surface water to drain towards the area swale, curb and gutter, catch basin, or to an approved drainage channel. Positive site drainage should be maintained at all times. Water should not be allowed to pond or seep into the ground. If planters or landscaping are adjacent to paved areas, measures should be taken to minimize the potential for water to enter the pavement section, such as thickened edges, enclosed planters, etc.

Additional Considerations

To mitigate perched groundwater, consideration should be given to installation of subgrade separators (cut-offs) between pavement subgrade and landscape areas (such as planting strips in parkways), although this is not a requirement from a geotechnical standpoint. Cut-offs, if used, should be 6 inches wide and at least 12 inches below the pavement/subgrade contact or 12 inches below the aggregate base rock, if used.

DRIVEWAYS, CONCRETE APRONS, FLATWORK, AND OTHER IMPROVEMENTS

Based on the very low expansive soil materials on the site, the following recommendations are presented for all exterior flatwork:

1. The subgrade area for sidewalk slabs should be compacted to achieve a minimum 90 percent relative compaction, the subgrade area for access drive slabs and concrete aprons should be compacted to achieve a minimum 95 percent relative compaction, and then be presoaked to 2 to 3 percentage points above (or 125 percent of) the soils' optimum moisture content, to a depth of 18 inches below subgrade elevation. If very low expansive soils are present, only optimum moisture content, or greater, is required and specific presoaking is not warranted. The moisture content of the subgrade should be proof tested within 72 hours prior to concrete placement.

2. Exterior concrete slabs should be cast over a non-yielding surface, consisting of a 4-inch layer of Class 2 base, crushed rock, gravel, or clean sand (or City minimum, whichever is greater), that should be compacted and level prior to placement of concrete. If very low expansive soils are present, the base, rock, gravel, or sand may be deleted. The layer or subgrade should be wet-down completely prior to placement of concrete, to minimize loss of concrete moisture to the surrounding earth materials.

3. Exterior sidewalk slabs should be a minimum of 4 inches thick. Access drive slabs should be a minimum of 5 inches thick. Slabs and approaches should additionally have a thickened edge (12 inches) adjacent to all landscape areas, to help impede infiltration of landscape water under the slab. Trash disposal (dumpster) area aprons should be a minimum of 6 inches thick and meet minimum City standards, as necessary.

4. Curbs next to slopes should have a thickened edge similar to drives and approaches.

5. The use of transverse and longitudinal control joints are recommended to help control slab cracking due to concrete shrinkage or thermal expansion. Two ways

to mitigate such cracking are: a) add a sufficient amount of reinforcing steel, increasing tensile strength of the slab; and, b) provide an adequate amount of control or expansion joints to accommodate anticipated concrete shrinkage and thermal expansion.

In order to reduce the potential for unsightly cracks, slabs should be reinforced at mid-height with a minimum of No. 3 bars placed at 18 inches on center, in each direction. If subgrade soils within the top 7 feet from finish grade are very low expansive soils (i.e., E.I. $\leq$ 20), then 6x6-W1.4xW1.4 welded-wire mesh may be substituted for the rebar, provided the reinforcement is placed on chairs, at slab mid-height. The exterior slabs should be scored or saw cut, ½ to ⅜ inches deep, often enough so that no section is greater than 10 feet by 10 feet. For sidewalks or narrow slabs, control joints should be provided at intervals of every 6 feet. The slabs should be separated from the foundations and sidewalks with expansion joint filler material. Presoaking, as indicated earlier, is recommended for slab subsoils.

6. No traffic should be allowed upon the newly placed concrete slabs until they have been properly cured to within 75 percent of design strength. Concrete compression strength should be a minimum of 2,500 psi.

7. Access drives, sidewalks, and patio/exterior slabs adjacent to the structure should be separated from the structure with thick expansion joint filler material. In areas directly adjacent to a continuous source of moisture (i.e., irrigation, planters, etc.), all joints should be additionally sealed with flexible mastic.

8. Planters and walls (sound walls or retaining walls) should not be tied to the structure.

9. Overhang structures should be supported on the slabs, or structurally designed with continuous footings tied in at least one direction for very low expansive soils.

10. Any masonry landscape or sound walls that are to be constructed throughout the property should be grouted and articulated in segments no more than 20 feet long. These segments should be keyed or doweled together.

11. Utilities may be enclosed within a closed utilidor (vault) or designed with flexible connections to accommodate differential settlement and thermal expansion conditions.

12. Positive site drainage should be maintained at all times. Finish grade on the building pad should provide a minimum of 1 to 2 percent fall to the street, as indicated herein. Drainage reversals could occur, including post-construction settlement, if relatively flat drainage gradients are not periodically maintained by the owner or interested/affected parties.

13. Air conditioning (A/C) units should be supported by slabs that are incorporated into the building foundation or constructed on a rigid slab with flexible couplings for plumbing and electrical lines. A/C waste water lines should be drained to a suitable non-erosive outlet.

14. Shrinkage cracks could become excessive if proper finishing and curing practices are not followed. Finishing and curing practices should be performed per the Portland Cement Association (PCA) guidelines. Mix design should incorporate rate of curing for climate and time of year, sulfate content of soils, corrosion potential of soils, and fertilizers used on site.

DEVELOPMENT CRITERIA

Slope Maintenance and Planting

Water has been shown to weaken the inherent strength of all earth materials. Slope stability is significantly reduced by overly wet conditions. Positive surface drainage away from slopes should be maintained and only the amount of irrigation necessary to sustain plant life should be provided for planted slopes. Over-watering should be avoided as it adversely affects site improvements, and causes perched groundwater conditions. Based on the non-cohesive soils encountered onsite, graded slopes constructed using onsite materials would be highly erosive. Eroded debris may be minimized and surficial slope stability enhanced by establishing and maintaining a suitable vegetation cover soon after construction. Compaction to the face of fill slopes would tend to minimize short-term erosion until vegetation is established. Plants selected for landscaping should be light weight, deep rooted types that require little water and are capable of surviving the prevailing climate. Jute-type matting or other fibrous covers may aid in allowing the establishment of a sparse plant cover. Using plants other than those recommended above will increase the potential for perched water, staining, mold, etc., to develop. A rodent control program to prevent burrowing should be implemented. Irrigation of natural (ungraded) slope areas is generally not recommended. These recommendations regarding plant type, irrigation practices, and rodent control should be provided to all interested/affected parties. Over-steepening of slopes should be avoided during building construction activities and landscaping.

Drainage

Adequate lot surface drainage is a very important factor in reducing the likelihood of adverse performance of foundations, hardscape, and slopes. Surface drainage should be sufficient to prevent ponding of water anywhere on a lot, and especially near structures and tops of slopes. Lot surface drainage should be carefully taken into consideration during fine grading, landscaping, and building construction. Therefore, care should be taken that future landscaping or construction activities do not create adverse drainage conditions.

Positive site drainage within lots and common areas should be provided and maintained at all times. Drainage should not flow uncontrolled down any descending slope. Water should be directed away from foundations and not allowed to pond or seep into the ground. In general, the area within 5 feet around a structure should slope away from the structure. We recommend that unpaved lawn and landscape areas have a minimum gradient of 1 percent sloping away from structures, and whenever possible, should be above adjacent paved areas. Consideration should be given to avoiding construction of planters adjacent to structures (buildings, retaining walls, etc.). Pad drainage should be directed toward the street or other approved area(s). Although not a geotechnical requirement, roof gutters, downspouts, or other appropriate, means may be used to control roof drainage. Downspouts, or drainage devices, should outlet a minimum of 5 feet from structures or into a subsurface drainage system. Areas of seepage may develop due to irrigation or heavy rainfall, and should be anticipated. Minimizing irrigation will lessen this potential. If areas of seepage develop, recommendations for minimizing this effect could be provided upon request.

Erosion Control

Cut and fill slopes will be subject to surficial erosion during and after grading. Onsite earth materials have a high erosion potential. Consideration should be given to providing hay bales and silt fences for the temporary control of surface water, from a geotechnical viewpoint.

Landscape Maintenance

Only the amount of irrigation necessary to sustain plant life should be provided. Over-watering the landscape areas will adversely affect proposed site improvements. We would recommend that any proposed open-bottom planters adjacent to proposed structures be eliminated for a minimum distance of 10 feet. As an alternative, closed-bottom type planters could be used. An outlet placed in the bottom of the planter, could be installed to direct drainage away from structures or any exterior concrete flatwork. If planters are constructed adjacent to structures, the sides and bottom of the planter should be provided with a moisture barrier to prevent penetration of irrigation water into the subgrade. Provisions should be made to drain the excess irrigation water from the planters without saturating the subgrade below or adjacent to the planters. Graded slope areas should be planted with drought resistant vegetation. Consideration should be given to the type of vegetation chosen and their potential effect upon surface improvements (i.e., some trees will have an effect on concrete flatwork with their extensive root systems). From a geotechnical standpoint leaching is not recommended for establishing landscaping. If the surface soils are processed for the purpose of adding amendments, they should be recompacted to 90 percent minimum relative compaction.

Subsurface and Surface Water

Subsurface and surface water are not generally anticipated to affect site development, provided that the recommendations contained in this report are incorporated into final design and construction and that prudent surface and subsurface drainage practices are incorporated into the construction plans. Perched groundwater conditions along zones of contrasting permeabilities may not be precluded from occurring in the future due to site irrigation, poor drainage conditions, or damaged utilities, and should be anticipated. Should perched groundwater conditions develop, this office could assess the affected area(s) and provide the appropriate recommendations to mitigate the observed groundwater conditions. Groundwater conditions may change with the introduction of irrigation, rainfall, or other factors.

Site Improvements

If any additional improvements (e.g., trash enclosures, walls, etc.) are planned for the site, recommendations concerning the geological or geotechnical aspects of design and construction of said improvements could be provided upon request. This office should be notified in advance of any fill placement, grading of the site, or trench backfilling after rough grading has been completed. This includes any grading, utility trench and retaining wall backfills, flatwork, etc.

Tile Flooring

Tile flooring can crack, reflecting cracks in the concrete slab below the tile, although small cracks in a conventional slab may not be significant. Therefore, the designer should consider additional steel reinforcement for concrete slabs-on-grade where tile will be placed. The tile installer should consider installation methods that reduce possible cracking of the tile such as slipsheets. Slipsheets or a vinyl crack isolation membrane (approved by the Tile Council of America/Ceramic Tile Institute) are recommended between tile and concrete slabs on grade.

Additional Grading

This office should be notified in advance of any fill placement, supplemental regrading of the site, or trench backfilling after rough grading has been completed. This includes completion of grading in the street, driveway approaches, driveways, parking areas, and utility trench and retaining wall backfills.

Footing Trench Excavation

All footing excavations should be observed by a representative of this firm after to trenching and prior to concrete form and reinforcement placement. The purpose of the observations is to evaluate that the excavations have been made into the recommended

bearing material and to the minimum widths and depths recommended for construction. If loose or compressible materials are exposed within the footing excavation, a deeper footing or removal and recompaction of the subgrade materials would be recommended at that time. Footing trench spoil and any excess soils generated from utility trench excavations should be compacted to a minimum relative compaction of 90 percent, if not removed from the site.

Trenching/Temporary Construction Backcuts

Considering the nature of the onsite earth materials, it should be anticipated that caving or sloughing could be a factor in subsurface excavations and trenching. Shoring or excavating the trench walls/backcuts at the angle of repose (typically 25 to 45 degrees [except as specifically superceded within the text of this report]), should be anticipated. All excavations should be observed by an engineering geologist or soil engineer from GSI, prior to workers entering the excavation or trench, and minimally conform to CAL-OSHA, state, and local safety codes. Given the potentially erosive nature of the low expansive (low cohesive) soils, poor drainage or heavy rain events could destabilize trenches. Should adverse conditions exist, appropriate recommendations would be offered at that time. The above recommendations should be provided to any contractors or subcontractors, or owners, etc., that may perform such work.

Utility Trench Backfill

1. All interior utility trench backfill should be brought to at least 2 percent above optimum moisture content and then compacted to obtain a minimum relative compaction of 90 percent of the laboratory standard. As an alternative for shallow (12-inch to 18-inch) under-slab trenches, sand having a sand equivalent value of 30 or greater may be used and jetted or flooded into place. Observation, probing and testing should be provided to evaluate the desired results.

2. Exterior trenches adjacent to, and within areas extending below a 1:1 plane projected from the outside bottom edge of the footing, and all trenches beneath hardscape features and in slopes, should be compacted to at least 90 percent of the laboratory standard. Sand backfill, unless excavated from the trench, should not be used in these backfill areas. Compaction testing and observations, along with probing, should be accomplished to evaluate the desired results.

3. All trench excavations should conform to CAL-OSHA, state, and local safety codes.

4. Utilities crossing grade beams, perimeter beams, or footings should either pass below the footing or grade beam using a hardened collar or foam spacer, or pass through the footing or grade beam in accordance with the recommendations of the structural engineer.

SUMMARY OF RECOMMENDATIONS REGARDING GEOTECHNICAL OBSERVATION AND TESTING

We recommend that observation or testing be performed by GSI at each of the following construction stages:

- During grading/recertification.
- During excavation.
- During placement of subdrains, toe drains, or other subdrainage devices, prior to placing fill or backfill.
- After excavation of building footings, retaining wall footings, and free standing walls footings, prior to the placement of reinforcing steel or concrete.
- Prior to pouring any slabs or flatwork, after presoaking/presaturation of building pads and other flatwork subgrade, before the placement of concrete, reinforcing steel, capillary break (i.e., sand, pea-gravel, etc.), or vapor barriers (i.e., Stego Wrap, Husky Guard, etc.).
- During retaining wall subdrain installation, prior to backfill placement.
- During placement of backfill for area drain, interior plumbing, utility line trenches, and retaining wall backfill.
- During slope construction/repair.
- When any unusual soil conditions are encountered during any construction operations, after to the issuance of this report.
- When any developer or owner improvements, such as flatwork, walls, etc., are constructed, prior to construction.
- A report of geotechnical observation and testing should be provided at the conclusion of each of the above stages, in order to provide concise and clear documentation of site work, or to comply with code requirements.
- GSI should review project sales documents to owners/owners associations for geotechnical aspects, including irrigation practices, the conditions outlined above, etc., prior to any sales. At that stage, GSI will provide owners maintenance guidelines which should be incorporated into such documents.

OTHER DESIGN PROFESSIONALS/CONSULTANTS

The design civil engineer, structural engineer, foundation designer, architect, landscape architect, wall designer, etc., should review the recommendations provided herein, incorporate those recommendations into all their respective plans, and by explicit reference, make this report part of their project plans. This report presents minimum design criteria for the design of slabs, foundations and other elements possibly applicable to the project. These criteria should not be considered as substitutes for actual designs by the structural engineer/designer. Please note that the recommendations contained herein are not intended to preclude the transmission of water or vapor through the slab or foundation. The structural engineer/foundation or slab designer should provide recommendations to not allow water or vapor to enter into the structure so as to cause damage to another building component, or so as to limit the installation of the type of flooring materials typically used for the particular application.

The structural engineer/designer should analyze actual soil-structure interaction and consider, as needed, bearing, expansive soil influence, and strength, stiffness and deflections in the various slab, foundation, and other elements in order to develop appropriate, design-specific details. As conditions dictate, it is possible that other influences will also have to be considered. The structural engineer/designer should consider all applicable codes and authoritative sources where needed. If analyses by the structural engineer/designer result in less critical details than are provided herein as minimums, the minimums presented herein should be adopted. It is considered likely that some, more restrictive details will be required.

If the structural engineer/designer has any questions or requires further assistance, they should not hesitate to call or otherwise transmit their requests to GSI. In order to mitigate potential distress, the foundation or improvement's designer should confirm to GSI and the governing agency, in writing, that the proposed foundations or improvements can tolerate the amount of differential settlement or expansion characteristics and other design criteria specified herein.

PLAN REVIEW

Final project plans (grading, precise grading, foundation, retaining wall, landscaping, etc.), should be reviewed by this office prior to construction, so that construction is in accordance with the conclusions and recommendations of this report. Based on our review, supplemental recommendations or further geotechnical studies may be warranted.

LIMITATIONS

The materials encountered on the project site and used for our analysis are believed representative of the area; however, soil and bedrock materials vary in character between excavations and natural outcrops or conditions exposed during mass grading. Site conditions may vary due to seasonal changes or other factors.

The findings of this study 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 addition, changes in applicable or inappropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this study may be invalidated wholly or partially by changes outside our control. Therefore, this study and the recommendations contained herein are subject to review and should not be relied upon after a period of three years.

Inasmuch as our study is based upon our review and engineering analyses and laboratory data, the conclusions and recommendations are professional opinions. These opinions have been derived in accordance with current standards of practice, and no warranty, either express or implied, is given. Standards of practice are subject to change with time. GSI assumes no responsibility or liability for work or testing performed by others, or their inaction; or work performed when GSI is not requested to be onsite, to evaluate if our recommendations have been properly implemented. Use of this report constitutes an agreement and consent by the user to all the limitations outlined above, notwithstanding any other agreements that may be in place. In addition, this report may be subject to review by the controlling authorities. Thus, this report brings to completion our scope of services for this portion of the project. All samples will be disposed of after 30 days, unless specifically requested by the client, in writing.

APPENDIX A

REFERENCES

APPENDIX A

REFERENCES

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APPENDIX B

BORING LOGS

UNIFIED SOIL CLASSIFICATION SYSTEM

Major Divisions			Group Symbols	Typical Names
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels 50% or more of coarse fraction retained on No. 4 sieve	Clean Gravels	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		Gravel with	GM	Silty gravels gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	Sands more than 50% of coarse fraction passes No. 4 sieve	Clean Sands	SW	Well-graded sands and gravelly sands, little or no fines
			SP	Poorly graded sands and gravelly sands, little or no fines
		Sands with Fines	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
Fine-Grained Soils 50% or more passes No. 200 sieve	Silts and Clays Liquid limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic silts and organic silty clays of low plasticity
	Silts and Clays Liquid limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity
Highly Organic Soils			PT	Peat, mucic, and other highly organic soils

CONSISTENCY OR RELATIVE DENSITY

CRITERIA

Standard Penetration Test

Penetration Resistance N (blows/ft)	Relative Density
0 - 4	Very loose
4 - 10	Loose
10 - 30	Medium
30 - 50	Dense
> 50	Very dense

Standard Penetration Test

Penetration Resistance N (blows/ft)	Consistency	Unconfined Compressive Strength (tons/ft^2)
<2	Very Soft	<0.25
2 - 4	Soft	0.25 - .050
4 - 8	Medium	0.50 - 1.00
8 - 15	Stiff	1.00 - 2.00
15 - 30	Very Stiff	2.00 - 4.00
>30	Hard	>4.00

3" 3/4" #4 #10 #40 #200 U.S. Standard Sieve

Unified Soil Classification	Cobbles	Gravel		Sand			Silt or Clay
		coarse	fine	coarse	medium	fine	

MOISTURE CONDITIONS

Dry	Absence of moisture: dusty, dry to the touch
Slightly Moist	Below optimum moisture content for compaction
Moist	Near optimum moisture content
Very Moist	Above optimum moisture content
Wet	Visible free water; below water table

MATERIAL QUANTITY

trace	0 - 5 %
few	5 - 10 %
little	10 - 25 %
some	25 - 45 %

OTHER SYMBOLS

C Core Sample
S SPT Sample
B Bulk Sample
__ Groundwater
Qp Pocket Penetrometer

BASIC LOG FORMAT:
Group name, Group symbol, (grain size), color, moisture, consistency or relative density. Additional comments: odor, presence of roots, mica, gypsum, coarse grained particles, etc.

EXAMPLE:
Sand (SP), fine to medium grained, brown, moist, loose, trace silt, little fine gravel, few cobbles up to 4" in size, some hair roots and rootlets.

File:Mgr: c;\SoilClassif.wpd

PLATE B-1

GeoSoils, Inc.

BORING LOG

PROJECT: ALABASSI - PERRIS COMMERCIAL

W.O. 8448-A-SC *BORING* B-1 *SHEET* 1 *OF* 2

DATE EXCAVATED 9-15-22 *LOGGED BY:* MAM *APPROX. ELEV.:* 1449'

SAMPLE METHOD: 8" HSA-140 lb @ 30" Drop, Cal Sampler&SPT

Depth (ft.)	Sample: Bulk	Sample: Undisturbed	Sample: Blows/Ft.	USCS Symbol	Dry Unit Wt. (pcf)	Moisture (%)	Saturation (%)	Material Description
0				SM				**TILLED TOPSOIL/COLLUVIUM:**
			47	SM	112.3	7.0	39.0	@ 0', SILTY SAND, light brownish gray to pale brown, dry to damp, medium dense; fine to coarse SAND, organics at surface.
				SM				@ 2.5', SILTY SAND, brown, damp, dense; fine to coarse SAND, contains calcium carbonate.
5			61	SM	122.9	5.4	41.3	**QUATERNARY VERY OLD ALLUVIAL FAN DEPOSITS (Qvof):** @ 3', SILTY SAND, brown, damp, dense; fine to coarse SAND. @ 5, SILTY SAND, brown, damp, very dense; fine to coarse SAND.
			23	SM	108.3	9.6	48.3	@ 7.5', SILTY SAND, pale brown, damp, medium dense; fine to medium SAND.
10			31	SM	114.0	5.5	32.3	@ 10', As per 7.5', yellowish brown, damp.
15			15	SC-SM		12.3		@ 15', SILTY CLAYEY SAND, pale brown, wet, medium dense.
								@ 17', Rig chatter, operator added water.
20			26	SC	113.6	16.0	93.1	@ 20', CLAYEY SAND, light yellowish brown, wet, medium dense; fine to medium SAND.
25			21	SC		18.0		@ 25', As per 20'.
30			36	SC	123.1	12.0	93.6	@ 30', As per 25', reddish brown, wet.

▼ *Standard Penetration Test*

⌶ *Undisturbed, Ring Sample*

▽ *Groundwater*

♀ *Seepage*

GeoSoils, Inc.

PLATE B-2

GeoSoils, Inc.

BORING LOG

PROJECT: ALABASSI - PERRIS COMMERCIAL

W.O. 8448-A-SC *BORING* B-1 *SHEET* 2 *OF* 2

DATE EXCAVATED 9-15-22 *LOGGED BY:* MAM *APPROX. ELEV.:* 1449'

SAMPLE METHOD: 8" HSA-140 lb @ 30" Drop, Cal Sampler&SPT

Depth (ft.)	Sample: Bulk	Sample: Undisturbed	Sample: Blows/Ft.	USCS Symbol	Dry Unit Wt. (pcf)	Moisture (%)	Saturation (%)	Material Description
35			24	SC		13.2		@ 35', As per 30'; water added by operator.
40			50/5	SC	129.3	9.2	87.4	@ 40', As per 35', wet, very dense; fine to coarse SAND.
45			28	SC		16.2		@ 45', As per 40', wet, medium dense.
50			50/4.5	SC	121.9	11.7	87.1	@ 50', As per 40'.
								@ 51.5', SILTY SAND, reddish brown, wet, very dense; fine to coarse SAND, driller terminated boring at target depth, very difficult drilling.
								Total Depth = 51.5'.
								Groundwater Encountered at 40.5'.
								No Caving.
								Backfilled 9-15-22.
55								
60								
65								

Standard Penetration Test
Undisturbed, Ring Sample
Groundwater
Seepage

GeoSoils, Inc.

PLATE B-3

GeoSoils, Inc.

BORING LOG

PROJECT: ALABASSI - PERRIS COMMERCIAL

W.O. 8448-A-SC *BORING* B-2 *SHEET* 1 *OF* 1

DATE EXCAVATED 9-15-22 *LOGGED BY:* MAM *APPROX. ELEV.:* 1449'

SAMPLE METHOD: 8" HSA-140 lb @ 30" Drop, Cal Sampler&SPT

Depth (ft.)	Sample: Bulk	Sample: Undisturbed	Sample: Blows/Ft.	USCS Symbol	Dry Unit Wt. (pcf)	Moisture (%)	Saturation (%)	Material Description
0				SM				**TILLED TOPSOIL/COLLUVIUM:** @ 0', SILTY SAND, light brownish gray to pale brown, dry to damp, medium dense; fine to coarse SAND, organics at surface.
5			85	SM	116.8	4.5	28.5	**QUARTERNARY VERY OLD ALLUVIAL FAN DEPOSITS (Qvof):** @ 5', SILTY SAND, brown, damp, very dense; fine to coarse SAND.
10			17	SM		6.4		@ 10', As per 5'; more fine SAND, medium dense.
15			29	SC-SM	102.3	23.0	99.4	@ 15', SILTY CLAYEY SAND, brown, saturated, medium dense; fine to medium SAND.
20			17	SM		17.0		@ 20', SILTY SAND, grayish brown, wet, medium dense; fine to medium SAND.
								Total Depth - 21.5' No Groundwater Encountered. No Caving. Backfilled 9-15-22.
25								
30								

Standard Penetration Test
Undisturbed, Ring Sample
Groundwater
Seepage

GeoSoils, Inc.

PLATE B-4

GeoSoils, Inc.

BORING LOG

PROJECT: ALABASSI - PERRIS COMMERCIAL

W.O. 8448-A-SC *BORING* B-3 *SHEET* 1 *OF* 1

DATE EXCAVATED 9-15-22 *LOGGED BY:* MAM *APPROX. ELEV.:* 1450'

SAMPLE METHOD: 8" HSA-140 lb @ 30" Drop, Cal Sampler&SPT

Depth (ft.)	Sample: Bulk	Sample: Undisturbed	Sample: Blows/Ft.	USCS Symbol	Dry Unit Wt. (pcf)	Moisture (%)	Saturation (%)	Material Description
0				SM				**TILLED TOPSOIL/COLLUVIUM:** @ 0', SILTY SAND, light brownish gray to pale brown, dry to damp, medium dense; fine to coarse SAND, organics at surface.
5			25	SM	87.9	17.1	51.3	**QUATERNARY VERY OLD ALLUVIAL FAN DEPOSITS (Qvof):** @ 5', SILTY SAND, brown to yellowish brown, moist, medium dense; fine to coarse SAND, trace calcium carbonate inclusions.
10			15	SM		14.9		@ 10', As per 5'; no calcium carbonate.
15			48	SM	120.3	10.3	72.8	@ 15', As per 10'.
20			19	SC-SM		12.0		@ 20', SILTY CLAYEY SAND, yellowish brown, moist, medium dense; fine to medium and trace coarse SAND.
25								Total Depth = 21.5' No Groundwater Encountered. No Caving. Backfilled 9-15-22.
30								

Standard Penetration Test

Undisturbed, Ring Sample

Groundwater

Seepage

GeoSoils, Inc.

PLATE B-5

GeoSoils, Inc.

BORING LOG

PROJECT: ALABASSI - PERRIS COMMERCIAL

W.O. 8448-A-SC *BORING* B-4 *SHEET* 1 *OF* 1

DATE EXCAVATED 9-15-22 *LOGGED BY:* MAM *APPROX. ELEV.:* 1451'

SAMPLE METHOD: 8" HSA-140 lb @ 30" Drop, Cal Sampler&SPT

Depth (ft.)	Sample: Bulk	Sample: Undisturbed	Sample: Blows/Ft.	USCS Symbol	Dry Unit Wt. (pcf)	Moisture (%)	Saturation (%)	Material Description
0				SM				**TILLED TOPSOIL/COLLUVIUM:** @ 0', SILTY SAND, pale brown, dry, medium dense; fine to coarse SAND, organics at surface.
5		▼	45	SM		10.4		**QUARTERNARY VERY OLD ALLUVIAL FAN DEPOSITS (Qvof):** @ 3', SILTY SAND, brown, damp, medium dense. @ 5', SILTY SAND, brown, moist, dense; fine to coarse SAND.
10		⌶	30	SM	117.0	10.3	65.9	@ 10', As per 5', medium dense.
15		▼	14	SC		22.0		@ 15', CLAYEY SAND, brown, moist to wet, medium dense; fine to medium SAND, trace coarse SAND. @ 17', Rig chatter.
20		⌶	39	SC	109.4	16.0	80.5	@ 20', As per 15', wet, dense.
25								Total Depth - 21.5' No Groundwater Encountered. No Caving. Backfilled 9-15-22.
30								

▼ *Standard Penetration Test*
⌶ *Undisturbed, Ring Sample*
▽ *Groundwater*
♀ *Seepage*

GeoSoils, Inc.

PLATE B-6

GeoSoils, Inc.

BORING LOG

PROJECT: ALABASSI - PERRIS COMMERCIAL

W.O. 8448-A-SC *BORING* B-5 *SHEET* 1 *OF* 1

DATE EXCAVATED 9-15-22 *LOGGED BY:* MAM *APPROX. ELEV.:* 1451'

SAMPLE METHOD: 8" HSA-140 lb @ 30" Drop, Cal Sampler&SPT

Depth (ft.)	Sample: Bulk	Sample: Undisturbed	Sample: Blows/Ft.	USCS Symbol	Dry Unit Wt. (pcf)	Moisture (%)	Saturation (%)	Material Description
0				SM				**TILLED TOPSOIL/COLLUVIUM:** @ 0', SILTY SAND, pale brown, dry, loose; fine to coarse SAND, organics at surface.
				SM				**QUARTERNARY VERY OLD ALLUVIAL FAN DEPOSITS (Qvof):** @ 3', As per 0', medium to light brown; no organics.
5			78	SM	127.9	4.3	38.7	@ 5', SILTY SAND, pale brown to brown, damp, very dense; fine to coarse SAND.
10			6	SC-SM		25.1		@ 10', SILTY CLAYEY SAND, brownish yellow to pale brown, wet, loose; fine to medium SAND.
15			45	SC-SM	122.8	10.8	82.2	@ 15', As per 10', brownish yellow, dense.
20			16	SC-SM		11.9		@ 20', As per 15', medium dense.
								Total Depth - 21.5' No Groundwater Encountered. No Caving. Backfilled 9-15-22.
25								
30								

▼ *Standard Penetration Test*

⌶ *Undisturbed, Ring Sample*

Groundwater

Seepage

GeoSoils, Inc.

PLATE B-7

GeoSoils, Inc.

BORING LOG

PROJECT: ALABASSI - PERRIS COMMERCIAL

W.O. 8448-A-SC *BORING* B-6 *SHEET* 1 *OF* 1

DATE EXCAVATED 9-15-22 *LOGGED BY:* MAM *APPROX. ELEV.:* 1451'

SAMPLE METHOD: 8" HSA-140 lb @ 30" Drop, Cal Sampler&SPT

Depth (ft.)	Sample: Bulk	Sample: Undisturbed	Sample: Blows/Ft.	USCS Symbol	Dry Unit Wt. (pcf)	Moisture (%)	Saturation (%)	Material Description
0				SM				**TILLED TOPSOIL/COLLUVIUM:** @ 0', SILTY SAND, pale brown, dry, medium dense; fine to coarse SAND, organics at surface.
				SM				**QUARTERNARY VERY OLD ALLUVIAL FAN DEPOSITS (Qvof):** @ 3', SILTY SAND, brown, damp, loose; fine to coarse SAND.
5		▼	10	SM		8.7		@ 5', SILTY SAND, pale brown to brown, damp, loose; fine to coarse SAND.
10			31	SC-SM	103.4	20.4	90.5	@ 10', SILTY CLAYEY SAND, brownish yellow to pale brown, wet, medium dense; fine to medium SAND.
15		▼	15	SC-SM		15.0		@ 15', As per 10'.
20			53	SP-SM	116.1	6.0	36.2	@ 20', Poorly graded SAND with SILT, very pale brown, damp, dense; fine to coarse SAND.
								Total Depth - 21.5' No Groundwater Encountered. No Caving. Backfilled 9-15-22.
25								
30								

▼ *Standard Penetration Test*

⌶ *Undisturbed, Ring Sample*

Groundwater

Seepage

GeoSoils, Inc.

PLATE B-8

GeoSoils, Inc.

BORING LOG

PROJECT: ALABASSI - PERRIS COMMERCIAL

W.O. 8448-A-SC *BORING* P-1 *SHEET* 1 *OF* 1

DATE EXCAVATED 9-15-22 *LOGGED BY:* MAM *APPROX. ELEV.:* 1450'

SAMPLE METHOD: 8" HSA

Depth (ft.)	Sample: Bulk	Sample: Undisturbed	Sample: Blows/Ft.	USCS Symbol	Dry Unit Wt. (pcf)	Moisture (%)	Saturation (%)	Material Description
0				SM				**TILLED TOPSOIL/COLLUVIUM:**
								@ 0', SILTY SAND, light brownish gray to pale brown, dry to damp, medium dense to loose; fine to coarse SAND.
5								@ 4', As per 0', brown, medium dense.
								Total Depth = 5'
								No Groundwater Encountered.
								No Caving.
								Gravel and Pipe Placed.
								Presoaked @ 11:34 AM.
10								Backfilled 9-16-22.
15								
20								
25								
30								

▼ *Standard Penetration Test*
⌶ *Undisturbed, Ring Sample*
▽ *Groundwater*
♀ *Seepage*

GeoSoils, Inc.

BORING LOG

PROJECT: ALABASSI - PERRIS COMMERCIAL

W.O. 8448-A-SC *BORING* P-2 *SHEET* 1 *OF* 1

DATE EXCAVATED 9-15-22 *LOGGED BY:* MAM *APPROX. ELEV.:* 1449'

SAMPLE METHOD: 8" HSA

Depth (ft.)	Sample: Bulk	Sample: Undisturbed	Sample: Blows/Ft.	USCS Symbol	Dry Unit Wt. (pcf)	Moisture (%)	Saturation (%)	Material Description
0				SM				**TILLED TOPSOIL/COLLUVIUM:** @ 0', SILTY SAND, pale brown, dry, medium dense; fine to coarse SAND.
5								Total Depth = 5' No Groundwater Encountered. No Caving. Gravel and Pipe Placed. Presoaked @ 12:16 PM. Backfilled 9-16-22
10								
15								
20								
25								
30								

▼ *Standard Penetration Test*
⌶ *Undisturbed, Ring Sample*
▽ *Groundwater*
♀ *Seepage*

GeoSoils, Inc.

PLATE B-10

APPENDIX C

SEISMIC DATA

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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: 8448-A-SC

DATE: 09-30-2022

JOB NAME: Perris Commercial Site

CALCULATION NAME: Test Run Analysis

FAULT-DATA-FILE NAME: C:\Program Files\EQFAULT1\CGSFLTErev.DAT

SITE COORDINATES:
SITE LATITUDE: 33.8428
SITE LONGITUDE: 117.2208

SEARCH RADIUS: 62.2 mi

ATTENUATION RELATION: 11) Bozorgnia Campbell Niazi (1999) Hor.-Pleist. Soil-Cor.
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: C:\Program Files\EQFAULT1\CGSFLTErev.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.
SAN JACINTO-SAN J.VLY-CASA LOMA	8.0(12.8)	6.9	0.420	X
SAN JACINTO-SAN BERNARDINO	12.2(19.7)	6.7	0.258	IX
ELSINORE (GLEN IVY)	15.3(24.6)	6.8	0.221	IX
ELSINORE (TEMECULA)	15.7(25.3)	6.8	0.215	VIII
SAN JACINTO-ANZA	18.9(30.4)	7.2	0.233	IX
SAN ANDREAS - SB-Coach. M-2b	19.4(31.3)	7.7	0.314	IX
SAN ANDREAS - Whole M-1a	19.4(31.3)	8.0	0.378	IX
SAN ANDREAS - San Bernardino M-1	19.4(31.3)	7.5	0.276	IX
SAN ANDREAS - SB-Coach. M-1b-2	19.4(31.3)	7.7	0.314	IX
CHINO-CENTRAL AVE. (Elsinore)	20.8(33.5)	6.7	0.215	VIII
WHITTIER	23.8(38.3)	6.8	0.142	VIII
NORTH FRONTAL FAULT ZONE (West)	27.8(44.7)	7.2	0.224	IX
CUCAMONGA	28.5(45.8)	6.9	0.178	VIII
CLEGHORN	30.0(48.2)	6.5	0.092	VII
PINTO MOUNTAIN	32.3(52.0)	7.2	0.136	VIII
SAN JOAQUIN HILLS	32.6(52.4)	6.6	0.128	VIII
SAN JOSE	33.4(53.7)	6.4	0.108	VII
ELSINORE (JULIAN)	34.4(55.3)	7.1	0.119	VII
SAN ANDREAS - 1857 Rupture M-2a	34.8(56.0)	7.8	0.193	VIII
SAN ANDREAS - Cho-Moj M-1b-1	34.8(56.0)	7.8	0.193	VIII
SAN ANDREAS - Mojave M-1c-3	34.8(56.0)	7.4	0.145	VIII
NORTH FRONTAL FAULT ZONE (East)	36.0(58.0)	6.7	0.122	VII
SIERRA MADRE	36.0(58.0)	7.2	0.172	VIII
PUENTE HILLS BLIND THRUST	37.7(60.6)	7.1	0.154	VIII
NEWPORT-INGLEWOOD (Offshore)	40.3(64.8)	7.1	0.101	VII
HELENDALE - S. LOCKHARDT	41.7(67.1)	7.3	0.112	VII
SAN ANDREAS - Coachella M-1c-5	43.5(70.0)	7.2	0.100	VII
NEWPORT-INGLEWOOD (L.A.Basin)	43.6(70.2)	7.1	0.093	VII
CLAMSHELL-SAWPIT	46.9(75.5)	6.5	0.081	VII
BURNT MTN.	48.1(77.4)	6.5	0.056	VI
LENWOOD-LOCKHART-OLD WOMAN SPRGS	48.8(78.5)	7.5	0.110	VII
SAN JACINTO-COYOTE CREEK	48.8(78.6)	6.6	0.059	VI
RAYMOND	49.7(80.0)	6.5	0.076	VII
LANDERS	50.7(81.6)	7.3	0.092	VII
ROSE CANYON	51.1(82.3)	7.2	0.085	VII
EUREKA PEAK	51.1(82.3)	6.4	0.049	VI
UPPER ELYSIAN PARK BLIND THRUST	52.8(85.0)	6.4	0.067	VI
JOHNSON VALLEY (Northern)	54.6(87.8)	6.7	0.056	VI
PALOS VERDES	55.1(88.7)	7.3	0.084	VII
VERDUGO	56.4(90.7)	6.9	0.087	VII

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.
CORONADO BANK	56.7(91.3)	7.6	0.101	VII
EARTHQUAKE VALLEY	58.6(94.3)	6.5	0.045	VI
EMERSON So. - COPPER MTN.	60.8(97.9)	7.0	0.061	VI
HOLLYWOOD	61.3(98.7)	6.4	0.057	VI

****

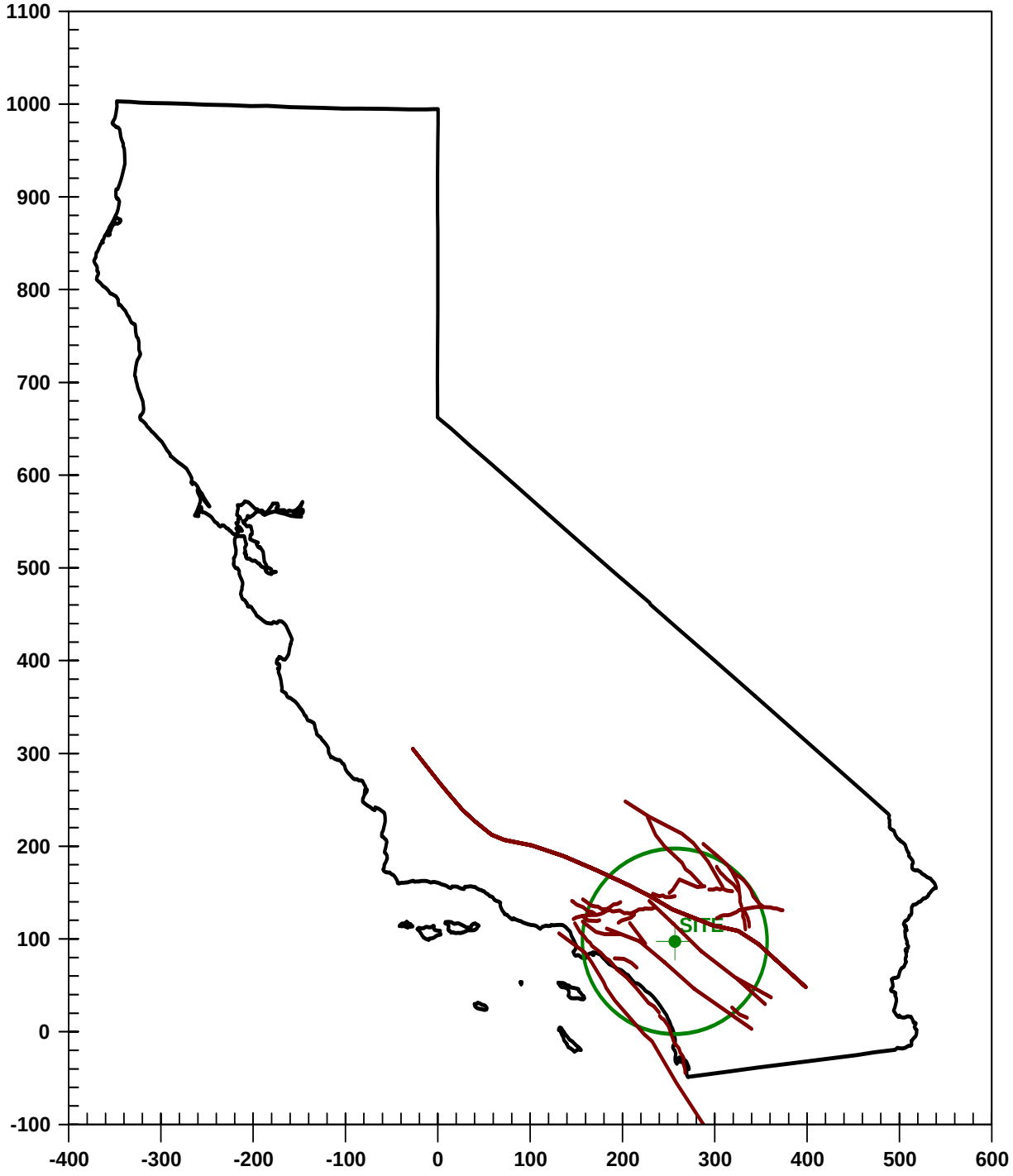
-END OF SEARCH- 44 FAULTS FOUND WITHIN THE SPECIFIED SEARCH RADIUS.

THE SAN JACINTO-SAN J.VLY-CASA LOMA FAULT IS CLOSEST TO THE SITE.
IT IS ABOUT 8.0 MILES (12.8 km) AWAY.

LARGEST MAXIMUM-EARTHQUAKE SITE ACCELERATION: 0.4203 g

CALIFORNIA FAULT MAP

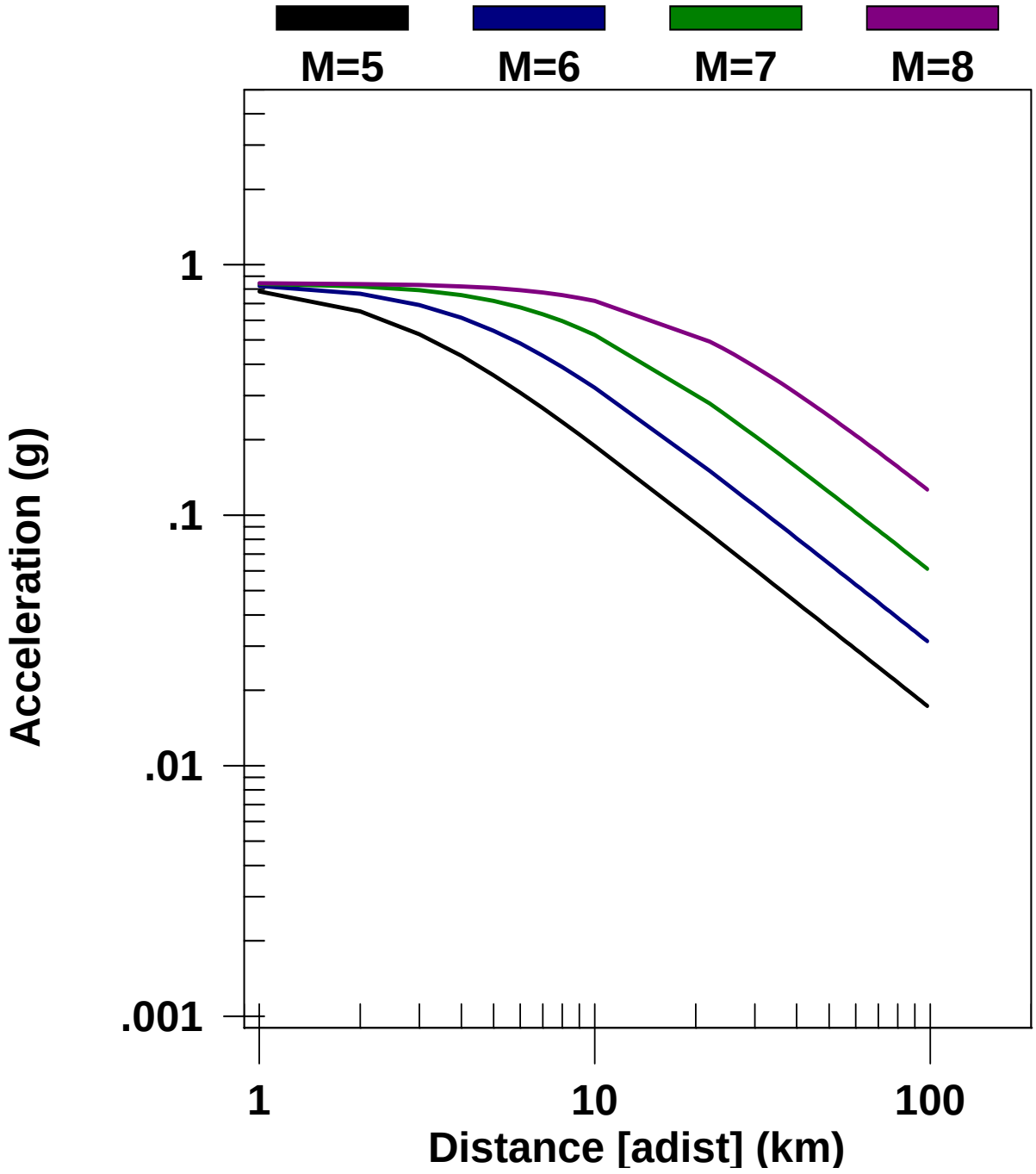
Perris Commercial Site



W.O. 8448-A-SC
PLATE C-3

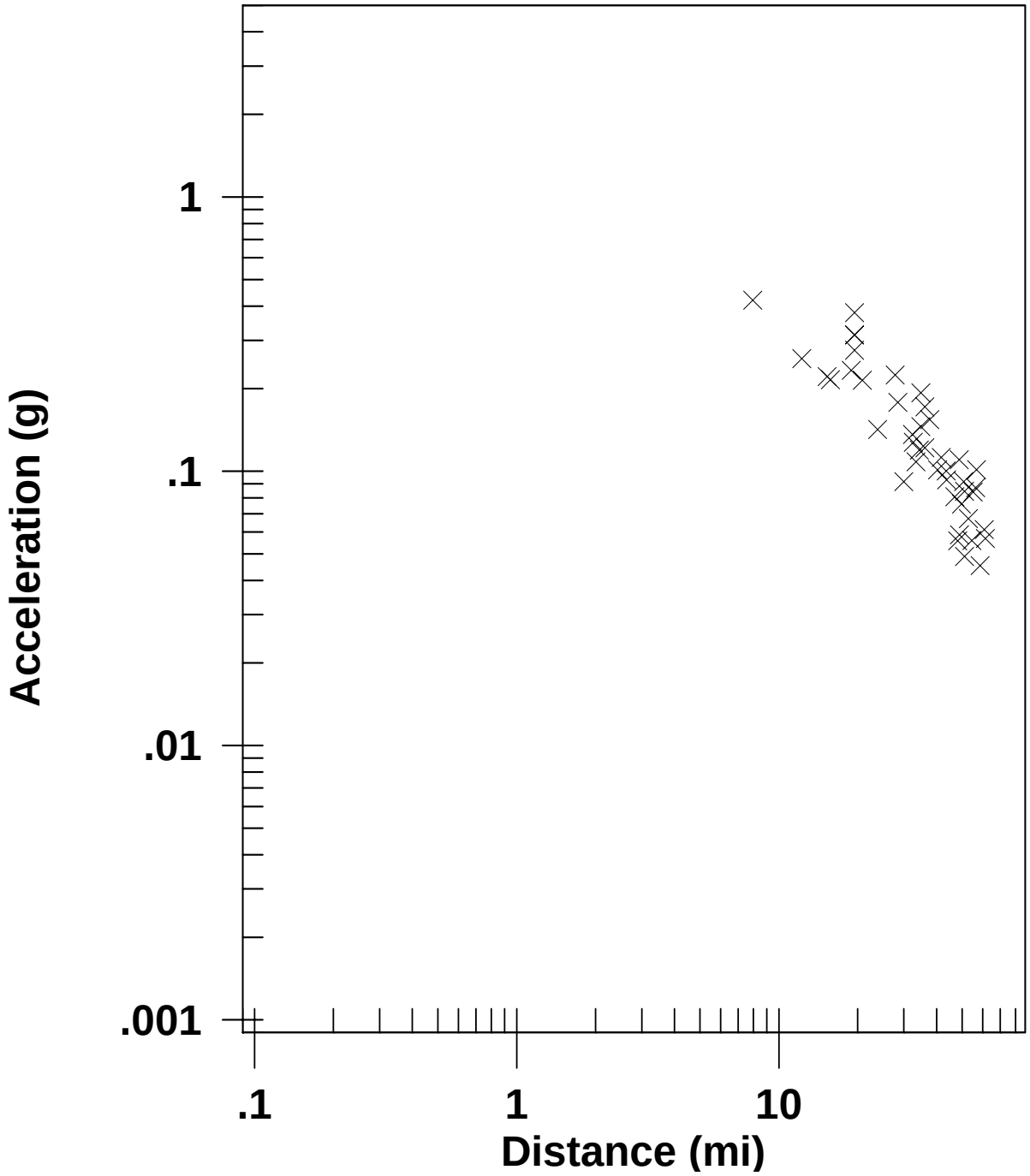
STRIKE-SLIP FAULTS

11) Bozorgnia Campbell Niazi (1999) Hor.-Pleist. Soil-Cor.



MAXIMUM EARTHQUAKES

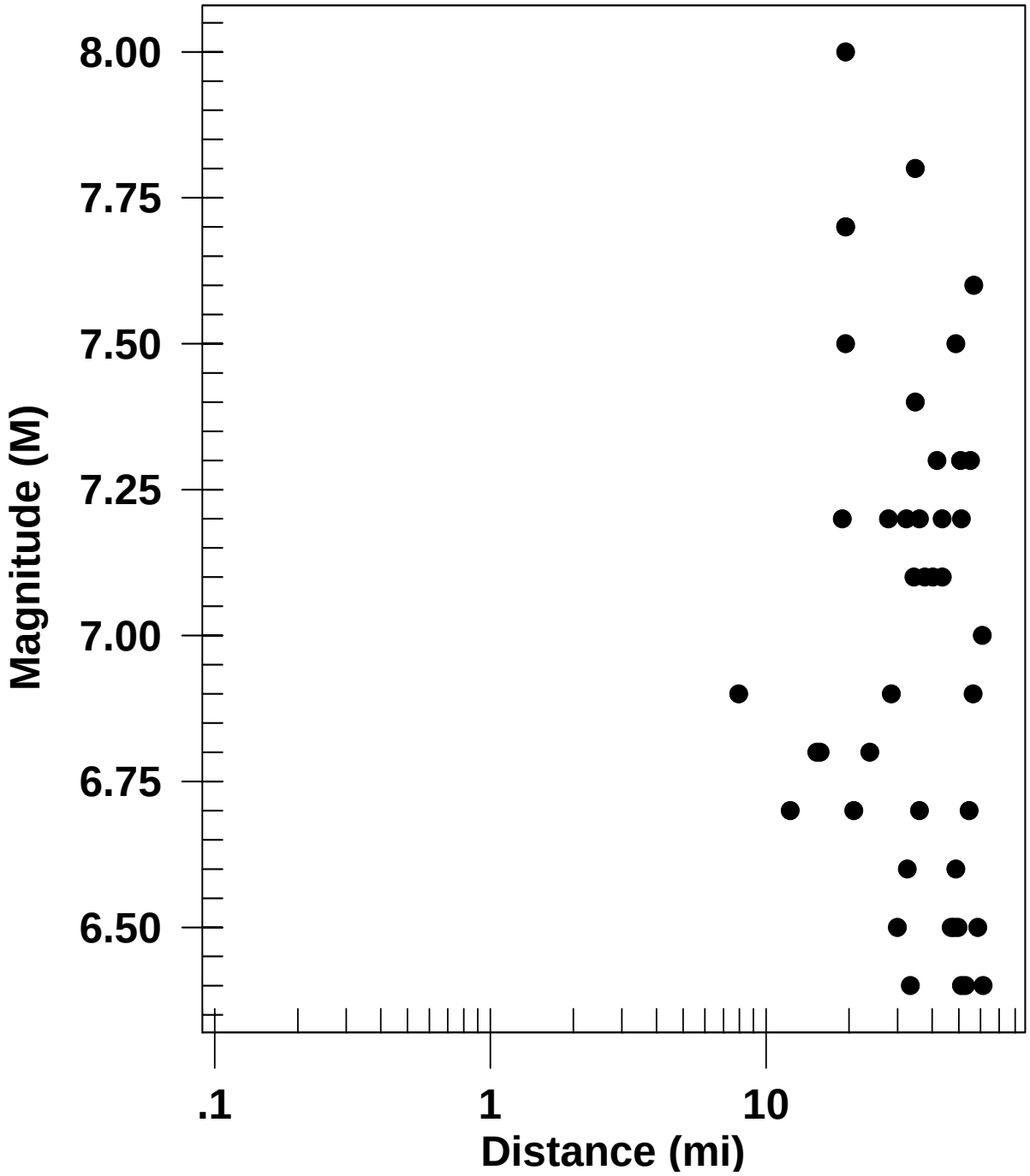
Perris Commercial Site



W.O. 8448-A-SC
PLATE C-5

EARTHQUAKE MAGNITUDES & DISTANCES

Perris Commercial Site



W.O. 8448-A-SC
PLATE C-6

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*                      *
*    E Q S E A R C H   *
*                      *
*     Version 3.00     *
*                      *
************************

      ESTIMATION OF
   PEAK ACCELERATION FROM
CALIFORNIA EARTHQUAKE CATALOGS


JOB NUMBER: 8448-A-SC
                                                DATE: 09-30-2022

JOB NAME: Perris Commercial Site

EARTHQUAKE-CATALOG-FILE NAME: ALLQUAKE.DAT


MAGNITUDE RANGE:
   MINIMUM MAGNITUDE:  5.00
   MAXIMUM MAGNITUDE:  9.00

SITE COORDINATES:
   SITE LATITUDE:  33.8428
   SITE LONGITUDE:  117.2208

SEARCH DATES:
           START DATE:   1800
           END DATE:   2021

SEARCH RADIUS:
           62.2 mi
           100.1 km

ATTENUATION RELATION:  11) Bozorgnia Campbell Niazi (1999) Hor.-Pleist. Soil-Cor.
   UNCERTAINTY (M=Median, S=Sigma): S       Number of Sigmas:  1.0
   ASSUMED SOURCE TYPE:  SS [SS=Strike-slip, DS=Reverse-slip, BT=Blind-thrust]
   SCOND:   0  Depth Source:  A
   Basement Depth:  5.00 km     Campbell SSR:  0     Campbell SHR:  0
   COMPUTE PEAK HORIZONTAL ACCELERATION

MINIMUM DEPTH VALUE (km):  3.0
```

FILE CODE	LAT. NORTH	LONG. WEST	DATE	TIME (UTC) H M Sec	DEPTH (km)	QUAKE MAG.	SITE ACC. g	SITE MM INT.	APPROX. DISTANCE mi [km]
DMG	33.9000	117.2000	12/19/1880	0 0 0.0	0.0	6.00	0.411	X	4.1(6.6)
DMG	34.0000	117.2500	07/23/1923	73026.0	0.0	6.25	0.215	VIII	11.0(17.7)
DMG	33.8000	117.0000	12/25/1899	1225 0.0	0.0	6.40	0.200	VIII	13.0(20.9)
DMG	33.7500	117.0000	04/21/1918	223225.0	0.0	6.80	0.236	IX	14.2(22.8)
DMG	33.7500	117.0000	06/06/1918	2232 0.0	0.0	5.00	0.077	VII	14.2(22.8)
DMG	33.7000	117.4000	05/15/1910	1547 0.0	0.0	6.00	0.143	VIII	14.2(22.9)
DMG	33.7000	117.4000	04/11/1910	757 0.0	0.0	5.00	0.077	VII	14.2(22.9)
DMG	33.7000	117.4000	05/13/1910	620 0.0	0.0	5.00	0.077	VII	14.2(22.9)
MGI	34.1000	117.3000	07/15/1905	2041 0.0	0.0	5.30	0.071	VI	18.3(29.5)
DMG	33.7100	116.9250	09/23/1963	144152.6	16.5	5.00	0.057	VI	19.3(31.0)
MGI	34.0000	117.5000	12/16/1858	10 0 0.0	0.0	7.00	0.199	VIII	19.3(31.1)
DMG	33.6990	117.5110	05/31/1938	83455.4	10.0	5.50	0.076	VII	19.4(31.2)
MGI	33.8000	117.6000	04/22/1918	2115 0.0	0.0	5.00	0.050	VI	21.9(35.3)
DMG	33.9500	116.8500	09/28/1946	719 9.0	0.0	5.00	0.049	VI	22.5(36.2)
DMG	34.2000	117.1000	09/20/1907	154 0.0	0.0	6.00	0.078	VII	25.6(41.2)
DMG	34.2000	117.4000	07/22/1899	046 0.0	0.0	5.50	0.055	VI	26.7(43.0)
DMG	34.1800	116.9200	01/16/1930	034 3.6	0.0	5.10	0.040	V	29.0(46.6)
DMG	34.1800	116.9200	01/16/1930	02433.9	0.0	5.20	0.042	VI	29.0(46.6)
DMG	34.1000	116.8000	10/24/1935	1448 7.6	0.0	5.10	0.038	V	29.9(48.2)
DMG	33.9760	116.7210	06/12/1944	104534.7	10.0	5.10	0.038	V	30.1(48.4)
GSP	34.1630	116.8550	06/28/1992	144321.0	6.0	5.30	0.042	VI	30.4(49.0)
DMG	33.9940	116.7120	06/12/1944	111636.0	10.0	5.30	0.042	VI	31.0(49.8)
GSP	34.1950	116.8620	08/17/1992	204152.1	11.0	5.30	0.041	V	31.8(51.2)
GSG	33.9530	117.7610	07/29/2008	184215.7	14.0	5.30	0.040	V	31.9(51.3)
DMG	34.2670	116.9670	08/29/1943	34513.0	0.0	5.50	0.044	VI	32.7(52.6)
GSN	34.2030	116.8270	06/28/1992	150530.7	5.0	6.70	0.093	VII	33.6(54.0)
GSP	34.1400	117.7000	02/28/1990	234336.6	5.0	5.20	0.035	V	34.3(55.1)
GSP	34.2900	116.9460	02/10/2001	210505.8	9.0	5.10	0.033	V	34.6(55.7)
DMG	34.2700	117.5400	09/12/1970	143053.0	8.0	5.40	0.039	V	34.7(55.8)
DMG	34.1000	116.7000	02/07/1889	520 0.0	0.0	5.30	0.037	V	34.7(55.8)
GSP	34.2390	116.8370	07/09/1992	014357.6	0.0	5.30	0.037	V	35.1(56.4)
DMG	34.3000	117.5000	07/22/1899	2032 0.0	0.0	6.50	0.077	VII	35.4(56.9)
PAS	33.9980	116.6060	07/08/1986	92044.5	11.7	5.60	0.042	VI	36.8(59.2)
DMG	34.3000	117.6000	07/30/1894	512 0.0	0.0	6.00	0.051	VI	38.3(61.6)
GSG	34.3100	116.8480	02/22/2003	121910.6	1.0	5.20	0.031	V	38.7(62.2)
GSP	34.3400	116.9000	11/27/1992	160057.5	1.0	5.30	0.033	V	38.9(62.6)
GSP	33.9325	117.9158	03/29/2014	040942.2	5.1	5.10	0.028	V	40.3(64.9)
GSP	34.3690	116.8970	12/04/1992	020857.5	3.0	5.30	0.031	V	40.8(65.6)
DMG	34.0170	116.5000	07/24/1947	221046.0	0.0	5.50	0.033	V	43.0(69.2)
DMG	34.0170	116.5000	07/26/1947	24941.0	0.0	5.10	0.026	V	43.0(69.2)
DMG	34.0170	116.5000	07/25/1947	61949.0	0.0	5.20	0.028	V	43.0(69.2)
DMG	34.0170	116.5000	07/25/1947	04631.0	0.0	5.00	0.025	V	43.0(69.2)
GSP	33.5290	116.5720	06/12/2005	154146.5	14.0	5.20	0.028	V	43.1(69.4)
DMG	34.3700	117.6500	12/08/1812	15 0 0.0	0.0	7.00	0.086	VII	43.9(70.6)
DMG	33.6170	117.9670	03/11/1933	154 7.8	0.0	6.30	0.052	VI	45.6(73.4)
MGI	34.0000	118.0000	12/25/1903	1745 0.0	0.0	5.00	0.023	IV	45.9(73.9)
DMG	34.2000	117.9000	08/28/1889	215 0.0	0.0	5.50	0.031	V	46.0(74.1)
GSP	33.5080	116.5140	10/31/2001	075616.6	15.0	5.10	0.024	V	46.7(75.2)
PAS	33.5010	116.5130	02/25/1980	104738.5	13.6	5.50	0.030	V	47.0(75.7)
DMG	33.5750	117.9830	03/11/1933	518 4.0	0.0	5.20	0.025	V	47.5(76.5)
DMG	33.5000	116.5000	09/30/1916	211 0.0	0.0	5.00	0.022	IV	47.7(76.8)
DMG	33.6170	118.0170	03/14/1933	19 150.0	0.0	5.10	0.023	IV	48.3(77.7)
DMG	33.9330	116.3830	12/04/1948	234317.0	0.0	6.50	0.055	VI	48.4(77.9)

EARTHQUAKE SEARCH RESULTS

FILE CODE	LAT. NORTH	LONG. WEST	DATE	TIME (UTC) H M Sec	DEPTH (km)	QUAKE MAG.	SITE ACC. g	SITE MM INT.	APPROX. DISTANCE mi [km]
DMG	33.6830	118.0500	03/11/1933	658 3.0	0.0	5.50	0.029	V	48.9(78.6)
DMG	33.7000	118.0670	03/11/1933	51022.0	0.0	5.10	0.023	IV	49.6(79.7)

DMG	33.7000	118.0670	03/11/1933	85457.0	0.0	5.10	0.023	IV	49.6(79.7)
GSP	34.1390	116.4310	06/28/1992	123640.6	10.0	5.10	0.023	IV	49.6(79.9)
DMG	33.7500	118.0830	03/11/1933	230 0.0	0.0	5.10	0.023	IV	49.9(80.3)
DMG	33.7500	118.0830	03/11/1933	910 0.0	0.0	5.10	0.023	IV	49.9(80.3)
DMG	33.7500	118.0830	03/11/1933	2 9 0.0	0.0	5.00	0.021	IV	49.9(80.3)
DMG	33.7500	118.0830	03/13/1933	131828.0	0.0	5.30	0.025	V	49.9(80.3)
DMG	33.7500	118.0830	03/11/1933	323 0.0	0.0	5.00	0.021	IV	49.9(80.3)
GSP	34.1080	116.4040	06/29/1992	141338.8	9.0	5.40	0.027	V	50.2(80.8)
GSG	33.4200	116.4890	07/07/2010	235333.5	14.0	5.50	0.028	V	51.2(82.4)
GSN	34.2010	116.4360	06/28/1992	115734.1	1.0	7.60	0.112	VII	51.3(82.5)
PAS	34.0610	118.0790	10/01/1987	144220.0	9.5	5.90	0.035	V	51.4(82.7)
GSP	34.0640	116.3610	09/15/1992	084711.3	9.0	5.20	0.023	IV	51.6(83.0)
GSP	33.9610	116.3180	04/23/1992	045023.0	12.0	6.10	0.039	V	52.4(84.3)
GSP	34.3410	116.5290	06/28/1992	124053.5	6.0	5.20	0.023	IV	52.4(84.4)
DMG	33.7830	118.1330	10/02/1933	91017.6	0.0	5.40	0.025	V	52.5(84.5)
PAS	34.0730	118.0980	10/04/1987	105938.2	8.2	5.30	0.024	V	52.7(84.8)
GSP	33.4315	116.4427	06/10/2016	080438.7	12.3	5.19	0.022	IV	53.0(85.3)
GSP	34.0290	116.3210	08/21/1993	014638.4	9.0	5.00	0.020	IV	53.1(85.5)
DMG	34.0670	116.3330	05/18/1940	55120.2	0.0	5.20	0.022	IV	53.1(85.5)
DMG	34.0670	116.3330	05/18/1940	72132.7	0.0	5.00	0.020	IV	53.1(85.5)
GSP	34.2620	118.0020	06/28/1991	144354.5	11.0	5.40	0.025	V	53.2(85.7)
MGI	34.1000	118.1000	07/11/1855	415 0.0	0.0	6.30	0.044	VI	53.4(85.9)
DMG	33.2000	116.7000	01/01/1920	235 0.0	0.0	5.00	0.020	IV	53.6(86.2)
GSP	33.9020	116.2840	07/24/1992	181436.2	9.0	5.00	0.020	IV	53.9(86.7)
GSP	33.8760	116.2670	06/29/1992	160142.8	1.0	5.20	0.022	IV	54.7(88.1)
GSP	34.3320	116.4620	07/01/1992	074029.9	9.0	5.40	0.024	V	55.0(88.5)
DMG	34.0830	116.3000	05/18/1940	5 358.5	0.0	5.40	0.024	V	55.3(88.9)
GSP	34.2680	116.4020	06/16/1994	162427.5	3.0	5.00	0.019	IV	55.3(89.0)
PAS	34.3270	116.4450	03/15/1979	21 716.5	2.5	5.20	0.021	IV	55.5(89.4)
MGI	33.2000	116.6000	10/12/1920	1748 0.0	0.0	5.30	0.022	IV	57.0(91.7)
DMG	33.0000	117.3000	11/22/1800	2130 0.0	0.0	6.50	0.045	VI	58.4(93.9)
DMG	33.7830	118.2500	11/14/1941	84136.3	0.0	5.40	0.022	IV	59.2(95.2)
MGI	33.0000	117.0000	09/21/1856	730 0.0	0.0	5.00	0.018	IV	59.6(95.9)
T-A	34.0000	118.2500	01/10/1856	0 0 0.0	0.0	5.00	0.018	IV	60.0(96.5)
T-A	34.0000	118.2500	03/26/1860	0 0 0.0	0.0	5.00	0.018	IV	60.0(96.5)
T-A	34.0000	118.2500	09/23/1827	0 0 0.0	0.0	5.00	0.018	IV	60.0(96.5)
DMG	33.8500	118.2670	03/11/1933	1425 0.0	0.0	5.00	0.018	IV	60.0(96.5)
DMG	33.3430	116.3460	04/28/1969	232042.9	20.0	5.80	0.028	V	61.0(98.2)
DMG	33.4000	116.3000	02/09/1890	12 6 0.0	0.0	6.30	0.038	V	61.1(98.4)
MGI	34.0800	118.2600	07/16/1920	18 8 0.0	0.0	5.00	0.017	IV	61.7(99.3)

****

-END OF SEARCH- 95 EARTHQUAKES FOUND WITHIN THE SPECIFIED SEARCH AREA.

TIME PERIOD OF SEARCH: 1800 TO 2021

LENGTH OF SEARCH TIME: 222 years

THE EARTHQUAKE CLOSEST TO THE SITE IS ABOUT 4.1 MILES (6.6 km) AWAY.

LARGEST EARTHQUAKE MAGNITUDE FOUND IN THE SEARCH RADIUS: 7.6

LARGEST EARTHQUAKE SITE ACCELERATION FROM THIS SEARCH: 0.411 g

COEFFICIENTS FOR GUTENBERG & RICHTER RECURRENCE RELATION:
a-value= 1.344
b-value= 0.392
beta-value= 0.903

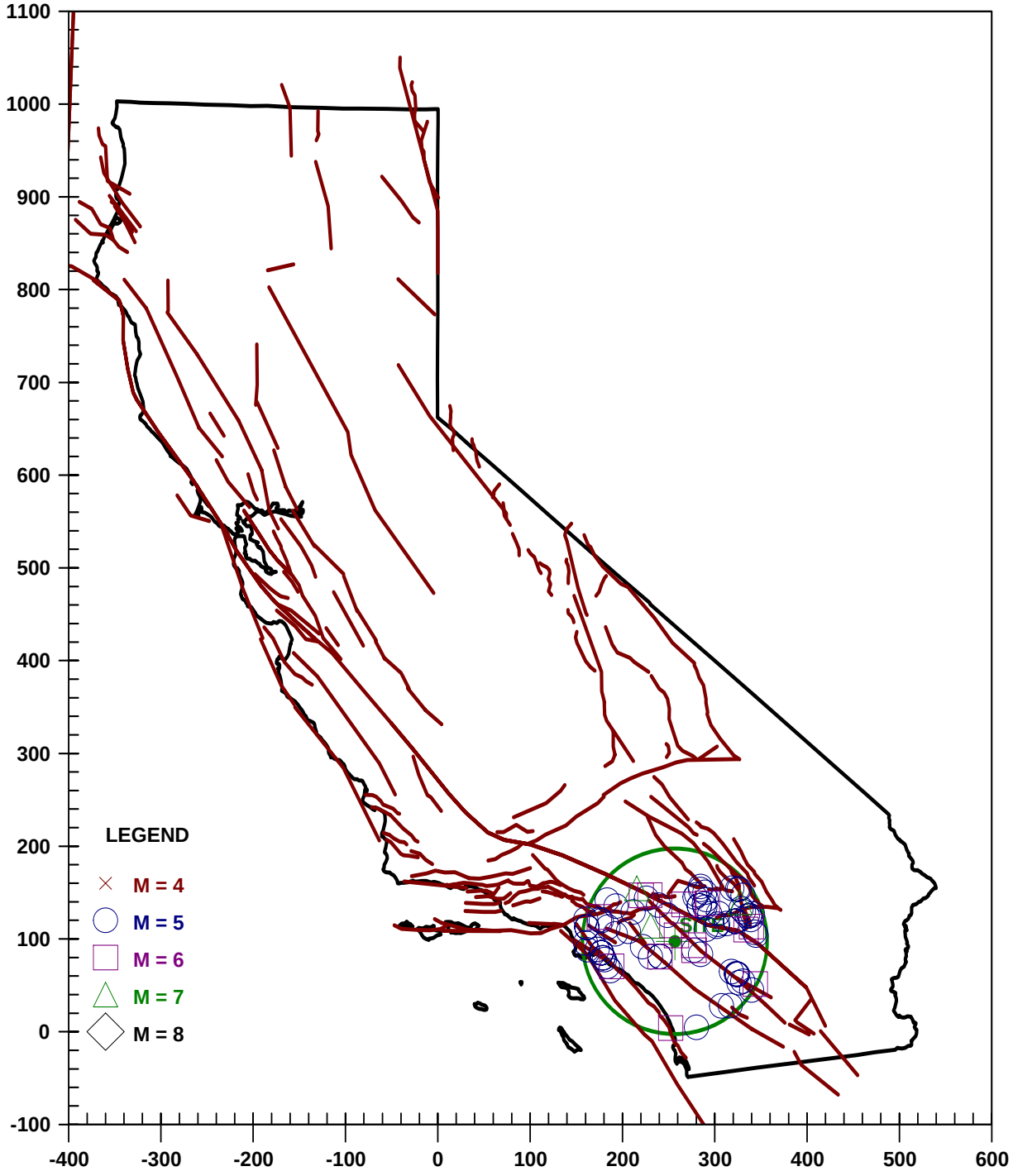
TABLE OF MAGNITUDES AND EXCEEDANCES:

Earthquake Magnitude	Number of Times Exceeded	Cumulative No. / Year

4.0	95	0.42793
4.5	95	0.42793
5.0	95	0.42793
5.5	29	0.13063
6.0	18	0.08108
6.5	8	0.03604
7.0	3	0.01351
7.5	1	0.00450

EARTHQUAKE EPICENTER MAP

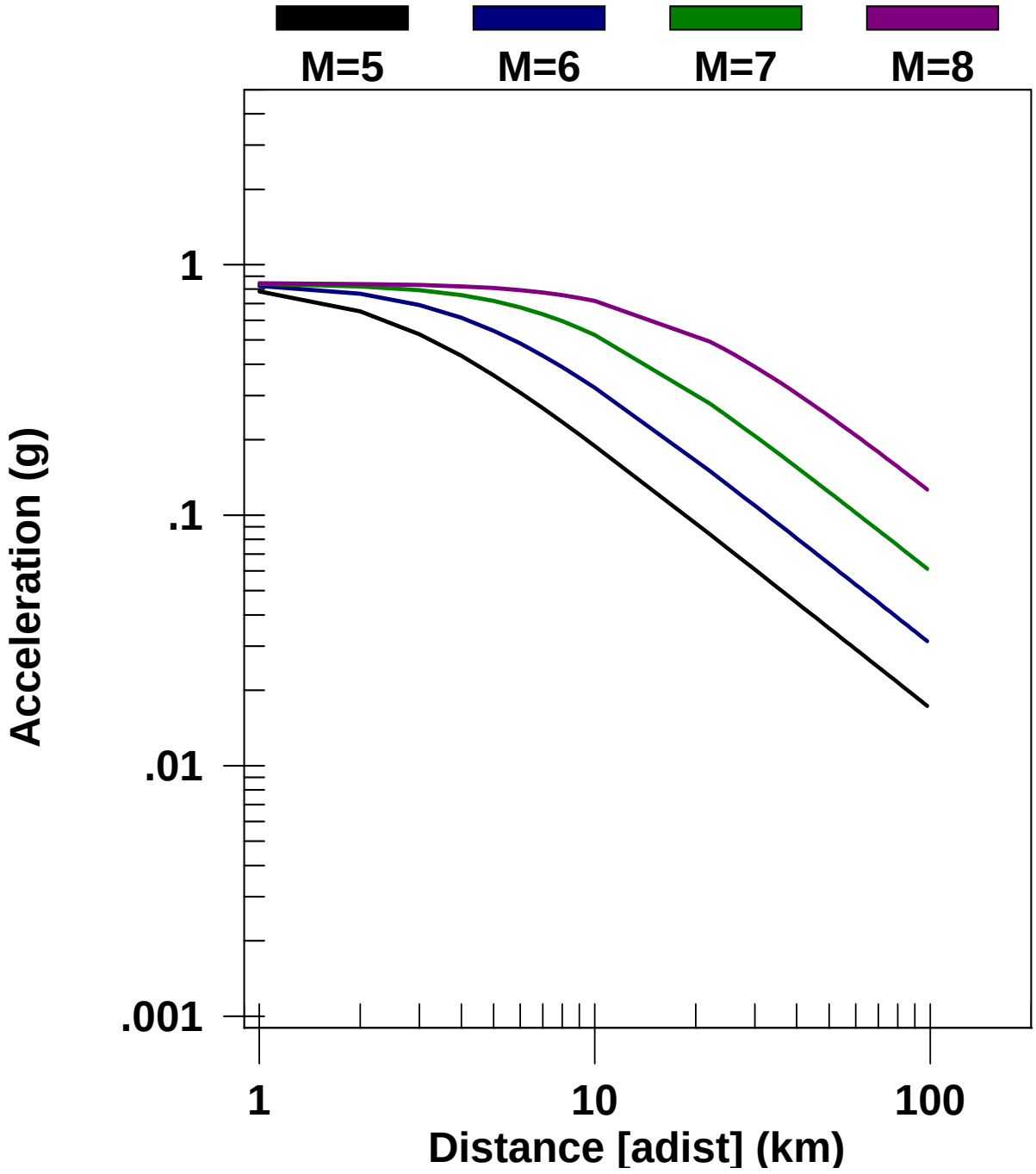
Perris Commercial Site



W.O. 8448-A-SC
PLATE C-11

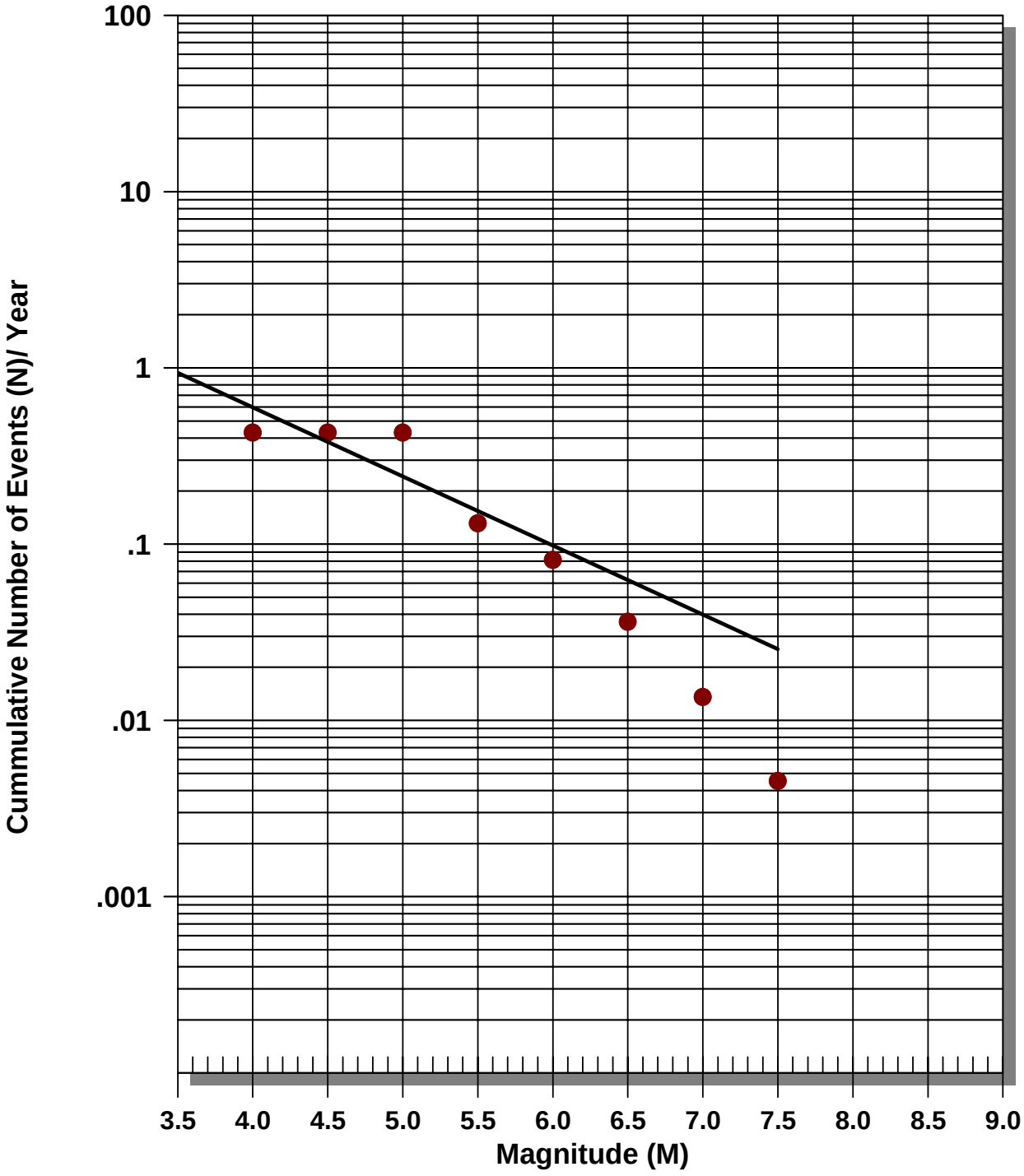
STRIKE-SLIP FAULTS

11) Bozorgnia Campbell Niazi (1999) Hor.-Pleist. Soil-Cor.



EARTHQUAKE RECURRENCE CURVE

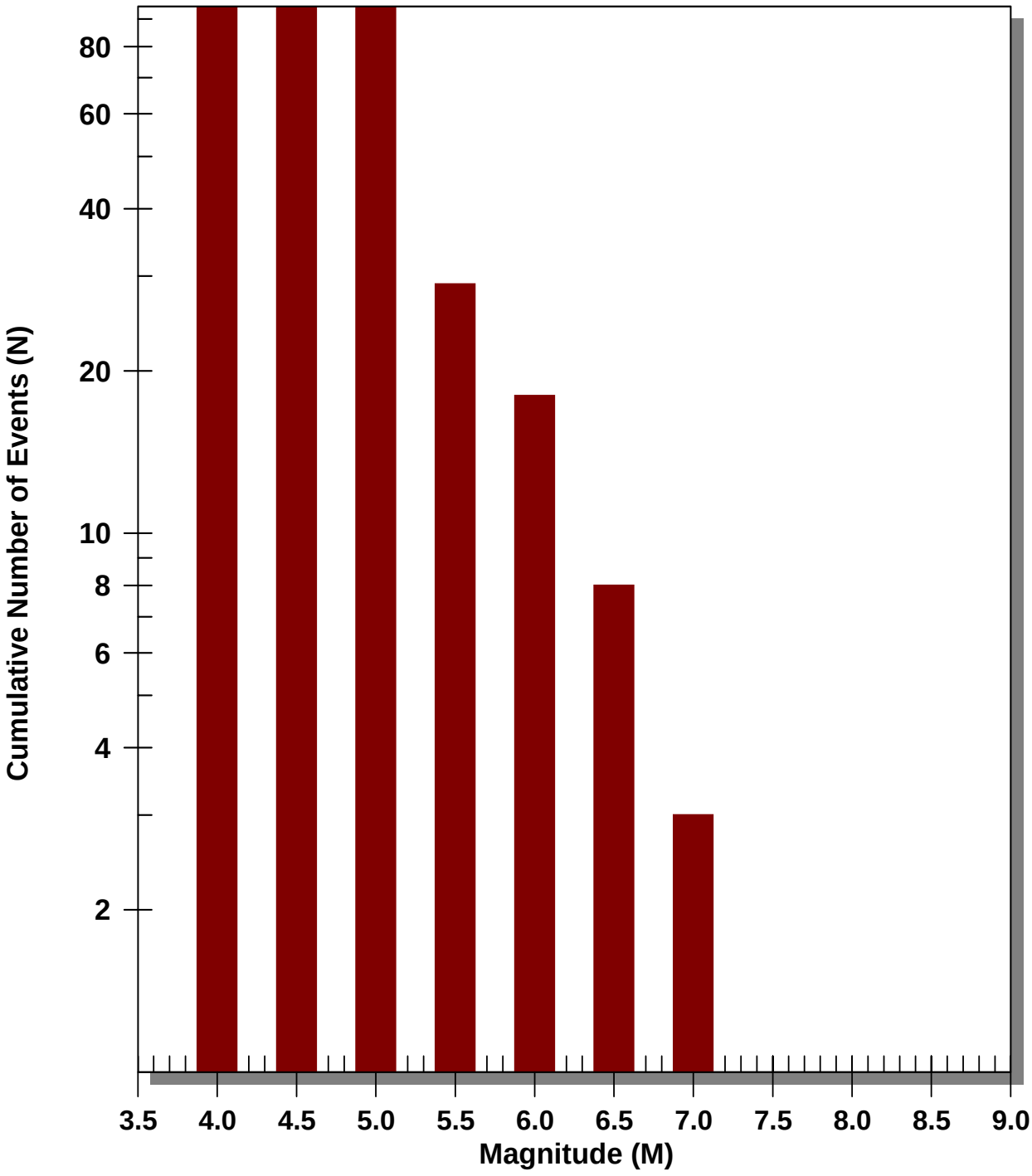
Perris Commercial Site



W.O. 8448-A-SC
PLATE C-13

Number of Earthquakes (N) Above Magnitude (M)

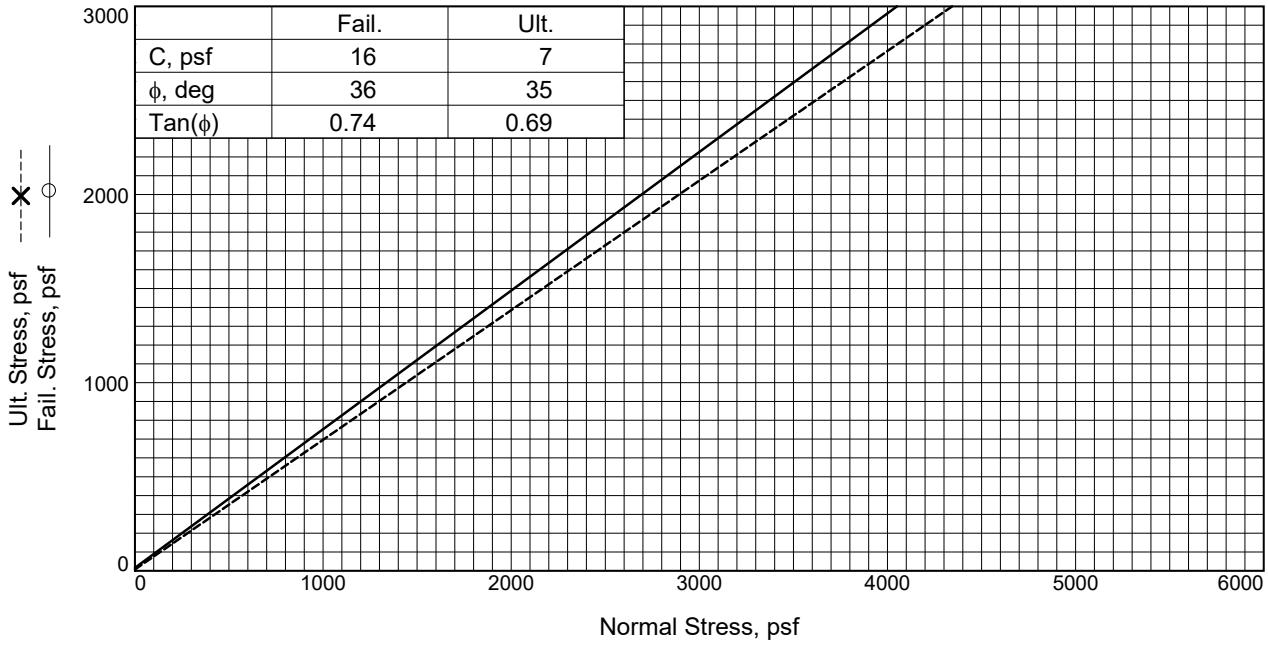
Perris Commercial Site

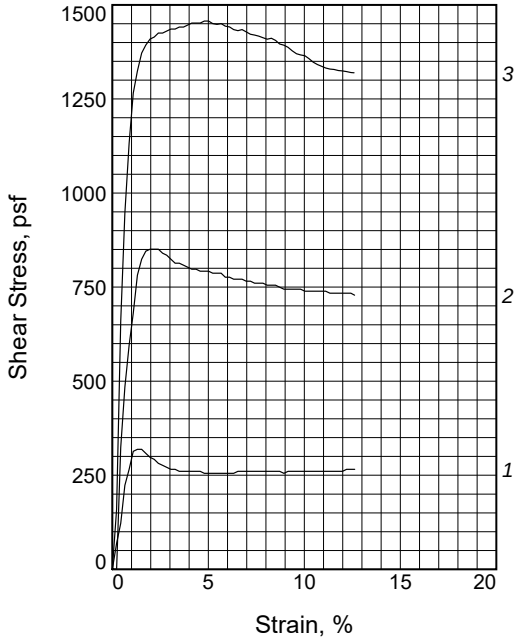


W.O. 8448-A-SC
PLATE C-14

APPENDIX D

LABORATORY TEST RESULTS





Sample No.		1	2	3
Initial	Water Content, %	9.0	9.0	9.0
	Dry Density, pcf	117.4	117.3	117.1
	Saturation, %	58.3	58.1	57.7
	Void Ratio	0.4092	0.4102	0.4130
	Diameter, in.	2.38	2.38	2.38
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	15.0	14.7	14.9
	Dry Density, pcf	117.6	118.3	118.5
	Saturation, %	97.9	98.0	99.5
	Void Ratio	0.4064	0.3989	0.3961
	Diameter, in.	2.38	2.38	2.38
	Height, in.	1.00	0.99	0.99
Normal Stress, psf		500	1000	2000
Fail. Stress, psf		319	851	1457
Strain, %		1.3	2.0	5.0
Ult. Stress, psf		255	739	1332
Strain, %		4.8	10.0	11.1
Strain rate, in./min.		0.004	0.004	0.004

Sample Type: Remolded
Description: Yellowish Brown Silty Sand

Specific Gravity= 2.65
Remarks:

Plate _____

Client: Alabassi

Project: Commercial - Perris

Source of Sample: B-2 **Depth:** 0-5
Sample Number: B-2
Proj. No.: 8448-A-SC **Date Sampled:**

GeoSoils, Inc.

Tested By: TR **Checked By:** TR

W.O. 8448-A-SC
PLATE D-1

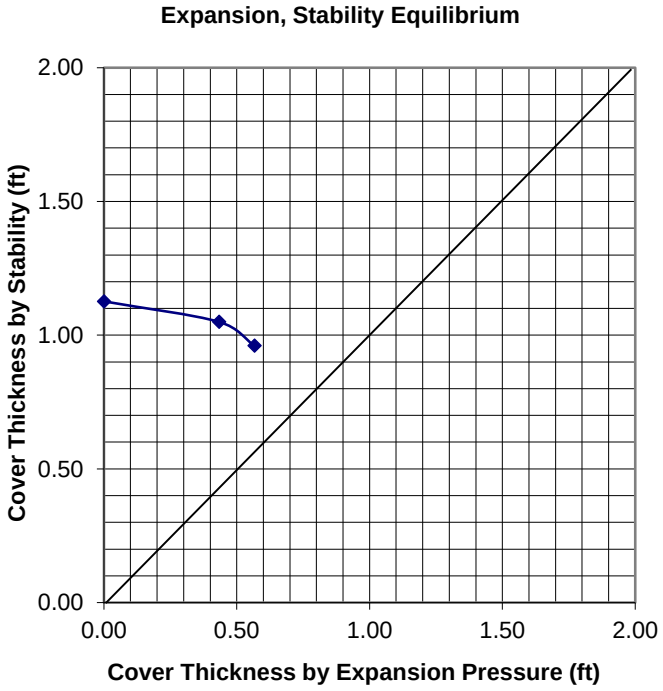
TEST SPECIMEN		A	B	C	D
Compactor air pressure	PSI	210	180	85	
Water added	%	3.5	4.4	6.3	
Moisture at compaction	%	12.2	13.1	15.0	
Height of sample	IN	2.54	2.6	2.65	
Dry density	PCF	124.1	121.0	117.0	
R-Value by exudation		25	18	12	
R-Value by exudation, corrected		25	19	12	
Exudation pressure	PSI	418	305	132	
Stability thickness	FT	0.96	1.05	1.13	
Expansion pressure thickness	FT	0.57	0.43	0.00	

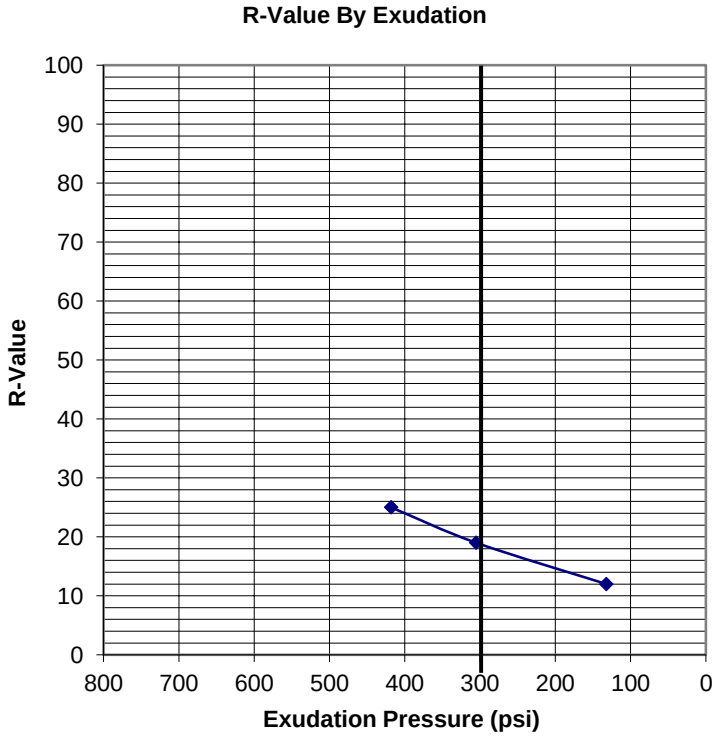
DESIGN CALCULATION DATA

Traffic index, assumed	5.0
Gravel equivalent factor, assumed	1.25
Expansion, stability equilibrium	0
R-Value by expansion	NA
R-Value by exudation	19
R-Value at equilibrium	**19**

SAMPLE INFORMATION

Sample Location:	B-2, 0-5ft
Sample Description:	Yellowish Brown Silty Sand
Notes:	-
	0% Retained on 3/4 inch sieve
Test Method:	Cal-Trans Test 301





GeoSoils, Inc.
5741 Palmer Way
Carlsbad, CA 92008
Telephone: (760) 438-3155
Fax: (760) 931-0915

9/2/2010

R - VALUE TEST RESULTS

Project: Alabassi

Number: 8448-A-SC

Date: September 2022

W.O. 8448-A-SC

PLATE D-2

GeoSoils, Inc.
5741 Palmer Way, Carlsbad CA 92010
Phone (760) 438-3155

CORROSION REPORT SUMMARY

Project No: **8448-A-SC**
Project Name: **Alabassi**
Report Date: **October 4, 2022**

SAMPLE ID	pH (H+)	Minimum Resistivity (ohm/cm)	Sulfate Content (wt%)	Chloride Content (mg/kg)
B-2, 0-5ft	8.0	3500	<0.003	11

Samples testing in accordance with: pH - CTM 643, Resistivity - CTM 643
Sulfate - CTM 417, Chloride - CTM 422

Remarks: _____

APPENDIX E

FIELD PERCOLATION DATA SHEETS

Leach Line Percolation Data Sheet

Project: Abbassi – Perris Commercial		W.O. Number: 8448-A	
Test Hole No.: P-1		Date Excavated: 9/15/2022	
Depth of Test Hole: 5' 7"		Soil Classification: SM	
Check for Sandy Soil Criteria Tested by: Madison M.		Date: 9/15/2022	Presoak: yes
Actual Percolation Tested by: Madison M.		Date: 9/16/2022	

Sandy Soil Criteria Test

Trial No.	Time	Time Interval (Min.)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ in Water Level (Inches)
1	8:55 9:20	25	28.5	18.25	10.25
2	9:23 9:48	25	27.5	18.75	8.75

Use: Normal Sandy (Circle One) Soil Criteria

	Time	Time Interval (min)	Total Elapsed Time (Min.)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ in Water Level (Inches)	Percolation Rate (min/inch)
First Hour	9:51 10:01	10	10	28.0	25.0	3.0	$3.3\overline{3}$
	10:02 10:12	10	20	28.0	25	3.0	$3.3\overline{3}$
Second Hour	10:13 10:23	10	30	28	25.25	2.75	3.64
	10:25 10:35	10	40	28.25	26.5	1.75	5.71
Third Hour	10:37 10:47	10	50	28	26	2.0	5.0
	10:47 10:57	10	60	28	26.5	1.5	6.67
Fourth Hour							
Fifth Hour							
Sixth Hour							

Plate No. E-1

Leach Line Percolation Data Sheet

Project: Albassi - Perris - Commercial		W.O. Number: 8448-A-SC	
Test Hole No.: P-2		Date Excavated: 9/15/2022	
Depth of Test Hole: 5'2"		Soil Classification: SM	
Check for Sandy Soil Criteria Tested by:		Date: 9/15/2022	Presoak: yes
Actual Percolation Tested by: Madison M.		Date: 9/16/2022	

Sandy Soil Criteria Test

Trial No.	Time	Time Interval (Min.)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ in Water Level (Inches)
1	8:18 8:43	25	24.5	22.5	5.75
2	8:43 9:08	25	24.5	19.5	5.0

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

	Time	Time Interval (min)	Total Elapsed Time (Min.)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ in Water Level (Inches)	Percolation Rate (min/inch)
First Hour	9:11 9:41	30	30	25	20	5.0	6.0
	9:45 10:15	30	60	25	20	5.0	6.0
Second Hour	10:18 10:48	30	90	25	20.25	4.75	6.32
	10:51 11:21	30	120	24.5	19.75	4.75	6.32
Third Hour	11:23 11:53	30	150	24.75	20	4.75	6.32
	11:55 12:25	30	180	24.5	19.75	4.75	6.32
Fourth Hour	12:27 12:57	30	210	24.75	20	4.75	6.32
	12:59 1:29	30	240	25	20.25	4.75	6.32
Fifth Hour	1:31 2:01	30	270	25	20.5	4.5	6.67
	2:03 2:33	30	300	24.5	20	4.5	6.67
Sixth Hour	2:35 3:05	30	330	24.75	20.25	4.5	6.67
	3:07 3:37	30	360	24.5	20.25	4.25	7.06

Plate No. E-2

APPENDIX F

GENERAL EARTHWORK AND GRADING GUIDELINES

GENERAL EARTHWORK AND GRADING GUIDELINES

General

These guidelines present general procedures and requirements for earthwork and grading as shown on the approved grading plans, including preparation of areas to be filled, placement of fill, installation of subdrains, excavations, and appurtenant structures or flatwork. The recommendations contained in the geotechnical report are part of these earthwork and grading guidelines and would supercede the provisions contained hereafter in the case of conflict. Evaluations performed by the consultant during the course of grading may result in new or revised recommendations which could supercede these guidelines or the recommendations contained in the geotechnical report. Generalized details follow this text.

The contractor is responsible for the satisfactory completion of all earthwork in accordance with provisions of the project plans and specifications and latest adopted Code. In the case of conflict, the most onerous provisions shall prevail. The project geotechnical engineer and engineering geologist (geotechnical consultant), or their representatives, should provide observation and testing services, and geotechnical consultation during the duration of the project.

EARTHWORK OBSERVATIONS AND TESTING

Geotechnical Consultant

Prior to the commencement of grading, a qualified geotechnical consultant (soil engineer and engineering geologist) should be employed for the purpose of observing earthwork procedures and testing the fills for general conformance with the recommendations of the geotechnical report(s), the approved grading plans, and applicable grading codes and ordinances.

The geotechnical consultant should provide testing and observation so that an evaluation may be made that the work is being accomplished as specified. It is the responsibility of the contractor to assist the consultants and keep them apprised of anticipated work schedules and changes, so that they may schedule their personnel accordingly.

All remedial removals, clean-outs, prepared ground to receive fill, key excavations, and subdrain installation should be observed and documented by the geotechnical consultant prior to placing any fill. It is the contractor's responsibility to notify the geotechnical consultant when such areas are ready for observation.

Laboratory and Field Tests

Maximum dry density tests to determine the degree of compaction should be performed in accordance with American Standard Testing Materials test method ASTM designation D-1557. Random or representative field compaction tests should be performed in

accordance with test methods ASTM designation D-1556, D-2937 or D-2922, and D-3017, at intervals of approximately 2 feet of fill height or approximately every 1,000 cubic yards placed. These criteria would vary depending on the soil conditions and the size of the project. The location and frequency of testing would be at the discretion of the geotechnical consultant.

Contractor's Responsibility

All clearing, site preparation, and earthwork performed on the project should be conducted by the contractor, with observation by a geotechnical consultant, and staged approval by the governing agencies, as applicable. It is the contractor's responsibility to prepare the ground surface to receive the fill, to the satisfaction of the geotechnical consultant, and to place, spread, moisture condition, mix, and compact the fill in accordance with the recommendations of the geotechnical consultant. The contractor should also remove all non-earth material considered unsatisfactory by the geotechnical consultant.

Notwithstanding the services provided by the geotechnical consultant, it is the sole responsibility of the contractor to provide adequate equipment and methods to accomplish the earthwork in strict accordance with applicable grading guidelines, latest adopted Code or agency ordinances, geotechnical report(s), and approved grading plans. Sufficient watering apparatus and compaction equipment should be provided by the contractor with due consideration for the fill material, rate of placement, and climatic conditions. If, in the opinion of the geotechnical consultant, unsatisfactory conditions such as questionable weather, excessive oversized rock or deleterious material, insufficient support equipment, etc., are resulting in a quality of work that is not acceptable, the consultant will inform the contractor, and the contractor is expected to rectify the conditions, and if necessary, stop work until conditions are satisfactory.

During construction, the contractor shall properly grade all surfaces to maintain good drainage and prevent ponding of water. The contractor shall take remedial measures to control surface water and to prevent erosion of graded areas until such time as permanent drainage and erosion control measures have been installed.

SITE PREPARATION

All major vegetation, including brush, trees, thick grasses, organic debris, and other deleterious material, should be removed and disposed of off-site. These removals must be concluded prior to placing fill. In-place existing alluvium or rock materials, as evaluated by the geotechnical consultant as being unsuitable, should be removed and recompacted prior to any fill placement. Depending upon the soil conditions, these materials may be reused as compacted fills. Any materials incorporated as part of the compacted fills should be approved by the geotechnical consultant.

Any underground structures such as cesspools, cisterns, mining shafts, tunnels, septic tanks, wells, pipelines, or other structures not located prior to grading, are to be removed or treated in a manner recommended by the geotechnical consultant. Soft, dry, spongy, highly fractured, or otherwise unsuitable ground, extending to such a depth that surface processing cannot adequately improve the condition, should be overexcavated down to firm ground and approved by the geotechnical consultant before compaction and filling operations continue. Overexcavated and processed soils, which have been properly mixed and moisture conditioned, should be re-compacted to the minimum relative compaction as specified in these guidelines.

Existing ground, which is determined to be satisfactory for support of the fills, should be scarified (ripped) to a minimum depth of 6 to 8 inches, or as directed by the geotechnical consultant. After the scarified ground is brought to optimum moisture content, or greater and mixed, the materials should be compacted as specified herein. If the scarified zone is greater than 6 to 8 inches in depth, it may be necessary to remove the excess and place the material in lifts restricted to about 6 to 8 inches in compacted thickness. Scarification, disc harrowing, or other acceptable forms of mixing should continue until the soils are broken down and free of large lumps or clods, until the working surface is reasonably uniform and free from ruts, hollows, hummocks, mounds, or other uneven features, which would inhibit compaction as described previously.

Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical [h:v]), the ground should be stepped or benched. The lowest bench, which will act as a key, should be a minimum of 15 feet wide and should be at least 2 feet deep into firm material, and approved by the geotechnical consultant. In fill-over-cut slope conditions, the recommended minimum width of the lowest bench or key is also 15 feet, with the key founded on firm material, as designated by the geotechnical consultant. As a general rule, unless specifically recommended otherwise by the geotechnical consultant, the minimum width of fill keys should be equal to ½ the height of the slope.

Standard benching is generally 4 feet (minimum) vertically, exposing firm, acceptable material. Benching may be used to remove unsuitable materials, although it is understood that the vertical height of the bench may exceed 4 feet. Pre-stripping may be considered for unsuitable materials in excess of 4 feet in thickness.

All areas to receive fill, including processed areas, removal areas, and the toes of fill benches, should be observed and approved by the geotechnical consultant prior to placement of fill. Fills may then be properly placed and compacted until design grades (elevations) are attained.

COMPACTED FILLS

Any earth materials imported or excavated on the property may be used in the fill provided that each material has been evaluated to be suitable by the geotechnical consultant.

These materials should be free of roots, tree branches, other organic matter, or other deleterious materials. All unsuitable materials should be removed from the fill as directed by the geotechnical consultant. Soils of poor gradation, undesirable expansion potential, or substandard strength characteristics may be designated by the consultant as unsuitable and may require blending with other soils to serve as a satisfactory fill material.

Fill materials derived from benching operations should be dispersed throughout the fill area and blended with other approved material. Benching operations should not result in the benched material being placed only within a single equipment width away from the fill/bedrock contact.

Oversized materials defined as rock, or other irreducible materials, with a maximum dimension greater than 12 inches, should not be buried or placed in fills unless the location of materials and disposal methods are specifically approved by the geotechnical consultant. Oversized material should be taken offsite, or placed in accordance with recommendations of the geotechnical consultant in areas designated as suitable for rock disposal. GSI anticipates that soils to be used as fill material for the subject project may contain some rock. Appropriately, the need for rock disposal may be necessary during grading operations on the site. From a geotechnical standpoint, the depth of any rocks, rock fills, or rock blankets, should be a sufficient distance from finish grade. This depth is generally the same as any overexcavation due to cut-fill transitions in hard rock areas, and generally facilitates the excavation of structural footings and substructures. Should deeper excavations be proposed (i.e., deepened footings, utility trenching, etc.), the developer may consider increasing the hold-down depth of any rocky fills to be placed, as appropriate. In addition, some agencies/jurisdictions mandate a specific hold-down depth for oversize materials placed in fills. The hold-down depth, and potential to encounter oversize rock, both within fills, and occurring in cut or natural areas, would need to be disclosed to all interested/affected parties. Once approved by the governing agency, the hold-down depth for oversized rock (i.e., greater than 12 inches) in fills on this project is provided as 10 feet, unless specified differently in the text of this report. The governing agency may require that these materials need to be deeper, crushed, or reduced to less than 12 inches in maximum dimension, at their discretion.

To facilitate future trenching, rock (or oversized material), should not be placed within the hold-down depth feet from finish grade, the range of foundation excavations, future utilities, or underground construction unless specifically approved by the governing agency, the geotechnical consultant, or the developer's representative.

If import material is required for grading, representative samples of the materials to be used as compacted fill should be analyzed in the laboratory by the geotechnical consultant to evaluate it's physical properties and suitability for use onsite. Such testing should be performed three (3) days prior to importation. If any material other than that previously tested is encountered during grading, an appropriate analysis of this material should be conducted by the geotechnical consultant as soon as possible.

Approved fill material should be placed in areas prepared to receive fill in near horizontal layers, that when compacted, should not exceed about 6 to 8 inches in thickness. The geotechnical consultant may approve thick lifts if testing indicates the grading procedures are such that adequate compaction is being achieved with lifts of greater thickness. Each layer should be spread evenly and blended to attain uniformity of material and moisture suitable for compaction.

Fill layers at a moisture content less than optimum should be watered and mixed, and wet fill layers should be aerated by scarification, or should be blended with drier material. Moisture conditioning, blending, and mixing of the fill layer should continue until the fill materials have a uniform moisture content at, or above, optimum moisture.

After each layer has been evenly spread, moisture conditioned, and mixed, it should be uniformly compacted to a minimum of 90 percent of the maximum density as evaluated by ASTM test designation D-1557, or as otherwise recommended by the geotechnical consultant. Compaction equipment should be adequately sized and should be specifically designed for soil compaction, or of proven reliability to efficiently achieve the specified degree of compaction.

Where tests indicate that the density of any layer of fill, or portion thereof, is below the required relative compaction, or improper moisture is in evidence, the particular layer or portion shall be re-worked until the required density or moisture content has been attained. No additional fill shall be placed in an area until the last placed lift of fill has been tested and found to meet the density and moisture requirements, and is approved by the geotechnical consultant.

In general, per the latest adopted Code, fill slopes should be designed and constructed at a gradient of 2:1 (h:v), or flatter. Compaction of slopes should be accomplished by over-building a minimum of 3 feet horizontally, and after trimming back to the design slope configuration. Testing shall be performed as the fill is elevated to evaluate compaction as the fill core is being developed. Special efforts may be necessary to attain the specified compaction in the fill slope zone. Final slope shaping should be performed by trimming and removing loose materials with appropriate equipment. A final evaluation of fill slope compaction should be based on observation or testing of the finished slope face. Where compacted fill slopes are designed steeper than 2:1 (h:v), prior approval from the governing agency, specific material types, a higher minimum relative compaction, special reinforcement, and special grading procedures will be recommended.

If an alternative to over-building and cutting back the compacted fill slopes is selected, then special effort should be made to achieve the required compaction in the outer 10 feet of each lift of fill by undertaking the following:

1. An extra piece of equipment consisting of a heavy, short-shanked sheepsfoot should be used to roll (horizontal) parallel to the slopes continuously as fill is placed. The sheepsfoot roller should also be used to roll perpendicular to the

slopes, and extend out over the slope to provide adequate compaction to the face of the slope.

2. Loose fill should not be spilled out over the face of the slope as each lift is compacted. Any loose fill spilled over a previously completed slope face should be trimmed off or be subject to re-rolling.

3. Field compaction tests will be made in the outer (horizontal) 2 to 8 feet of the slope at appropriate vertical intervals, after compaction operations.

4. After completion of the slope, the slope face should be shaped with a small tractor and then re-rolled with a sheepsfoot to achieve compaction to near the slope face. After testing to evaluate compaction, the slopes should be grid-rolled to achieve compaction to the slope face. Final testing should be used to evaluate compaction after grid rolling.

5. Where testing indicates less than adequate compaction, the contractor will be responsible to rip, water, mix, and recompact the slope material as necessary to achieve compaction. Additional testing should be performed to evaluate compaction.

SUBDRAIN INSTALLATION

Subdrains should be installed in approved ground in accordance with the approximate alignment and details indicated by the geotechnical consultant. Subdrain locations or materials should not be changed or modified without approval of the geotechnical consultant. The geotechnical consultant may recommend and direct changes in subdrain line, grade, and drain material in the field, pending exposed conditions. The location of constructed subdrains, especially the outlets, should be recorded/surveyed by the project civil engineer. Drainage at the subdrain outlets should be provided by the project civil engineer.

EXCAVATIONS

Excavations and cut slopes should be examined during grading by the geotechnical consultant. If directed by the geotechnical consultant, further excavations or overexcavation and refilling of cut areas should be performed, or remedial grading of cut slopes should be performed. When fill-over-cut slopes are to be graded, unless otherwise approved, the cut portion of the slope should be observed by the geotechnical consultant prior to placement of materials for construction of the fill portion of the slope. The geotechnical consultant should observe all cut slopes, and should be notified by the contractor when excavation of cut slopes commence.

If, during the course of grading, unforeseen adverse or potentially adverse geologic conditions are encountered, the geotechnical consultant should investigate, evaluate, and make appropriate recommendations for mitigation of these conditions. The need for cut slope buttressing or stabilizing should be based on in-grading evaluation by the geotechnical consultant, whether anticipated or not.

Unless otherwise specified in geotechnical and geological report(s), no cut slopes should be excavated higher or steeper than that allowed by the ordinances of controlling governmental agencies. Additionally, short-term stability of temporary cut slopes is the contractor's responsibility.

Erosion control and drainage devices should be designed by the project civil engineer and should be constructed in compliance with the ordinances of the controlling governmental agencies, or in accordance with the recommendations of the geotechnical consultant.

COMPLETION

Observation, testing, and consultation by the geotechnical consultant should be conducted during the grading operations in order to state an opinion that all cut and fill areas are graded in accordance with the approved project specifications. After completion of grading, and after the geotechnical consultant has finished observations of the work, final reports should be submitted, and may be subject to review by the controlling governmental agencies. No further excavation or filling should be undertaken without prior notification of the geotechnical consultant or approved plans.

All finished cut and fill slopes should be protected from erosion or be planted in accordance with the project specifications or as recommended by a landscape architect. Such protection or planning should be undertaken as soon as practical after completion of grading.

JOB SAFETY

General

At GSI, getting the job done safely is of primary concern. The following is the company's safety considerations for use by all employees on multi-employer construction sites. On-ground personnel are at highest risk of injury, and possible fatality, on grading and construction projects. GSI recognizes that construction activities will vary on each site, and that site safety is the prime responsibility of the contractor; however, everyone must be safety conscious and responsible at all times. To achieve our goal of avoiding accidents, cooperation between the client, the contractor, and GSI personnel must be maintained. In an effort to minimize risks associated with geotechnical testing and observation, the following precautions are to be implemented for the safety of field personnel on grading and construction projects:

Safety Meetings: GSI field personnel are directed to attend contractor's regularly scheduled and documented safety meetings.

Safety Vests: Safety vests are provided for, and are to be worn by GSI personnel, at all times, when they are working in the field.

Safety Flags: Two safety flags are provided to GSI field technicians; one is to be affixed to the vehicle when on site, the other is to be placed atop the spoil pile on all test pits.

Flashing Lights: All vehicles stationary in the grading area shall use rotating or flashing amber beacons, or strobe lights, on the vehicle during all field testing. While operating a vehicle in the grading area, the emergency flasher on the vehicle shall be activated.

In the event that the contractor's representative observes any of our personnel not following the above, we request that it be brought to the attention of our office.

Test Pits Location, Orientation, and Clearance

The technician is responsible for selecting test pit locations. A primary concern should be the technician's safety. Efforts will be made to coordinate locations with the grading contractor's authorized representative, and to select locations following or behind the established traffic pattern, preferably outside of current traffic. The contractor's authorized representative (supervisor, grade checker, dump man, operator, etc.) should direct excavation of the pit and safety during the test period. Of paramount concern should be the soil technician's safety, and obtaining enough tests to represent the fill.

Test pits should be excavated so that the spoil pile is placed away from oncoming traffic, whenever possible. The technician's vehicle is to be placed next to the test pit, opposite the spoil pile. This necessitates the fill be maintained in a driveable condition. Alternatively, the contractor may wish to park a piece of equipment in front of the test holes, particularly in small fill areas or those with limited access.

A zone of non-encroachment should be established for all test pits. No grading equipment should enter this zone during the testing procedure. The zone should extend approximately 50 feet outward from the center of the test pit. This zone is established for safety and to avoid excessive ground vibration, which typically decreases test results.

When taking slope tests, the technician should park the vehicle directly above or below the test location. If this is not possible, a prominent flag should be placed at the top of the slope. The contractor's representative should effectively keep all equipment at a safe operational distance (e.g., 50 feet) away from the slope during this testing.

The technician is directed to withdraw from the active portion of the fill as soon as possible following testing. The technician's vehicle should be parked at the perimeter of the fill in a highly visible location, well away from the equipment traffic pattern. The contractor should inform our personnel of all changes to haul roads, cut and fill areas or other factors that may affect site access and site safety.

In the event that the technician's safety is jeopardized or compromised as a result of the contractor's failure to comply with any of the above, the technician is required, by company policy, to immediately withdraw and notify his/her supervisor. The grading contractor's representative will be contacted in an effort to affect a solution. However, in the interim, no further testing will be performed until the situation is rectified. Any fill placed can be considered unacceptable and subject to reprocessing, recompaction, or removal.

In the event that the soil technician does not comply with the above or other established safety guidelines, we request that the contractor bring this to the technician's attention and notify this office. Effective communication and coordination between the contractor's representative and the soil technician is strongly encouraged in order to implement the above safety plan.

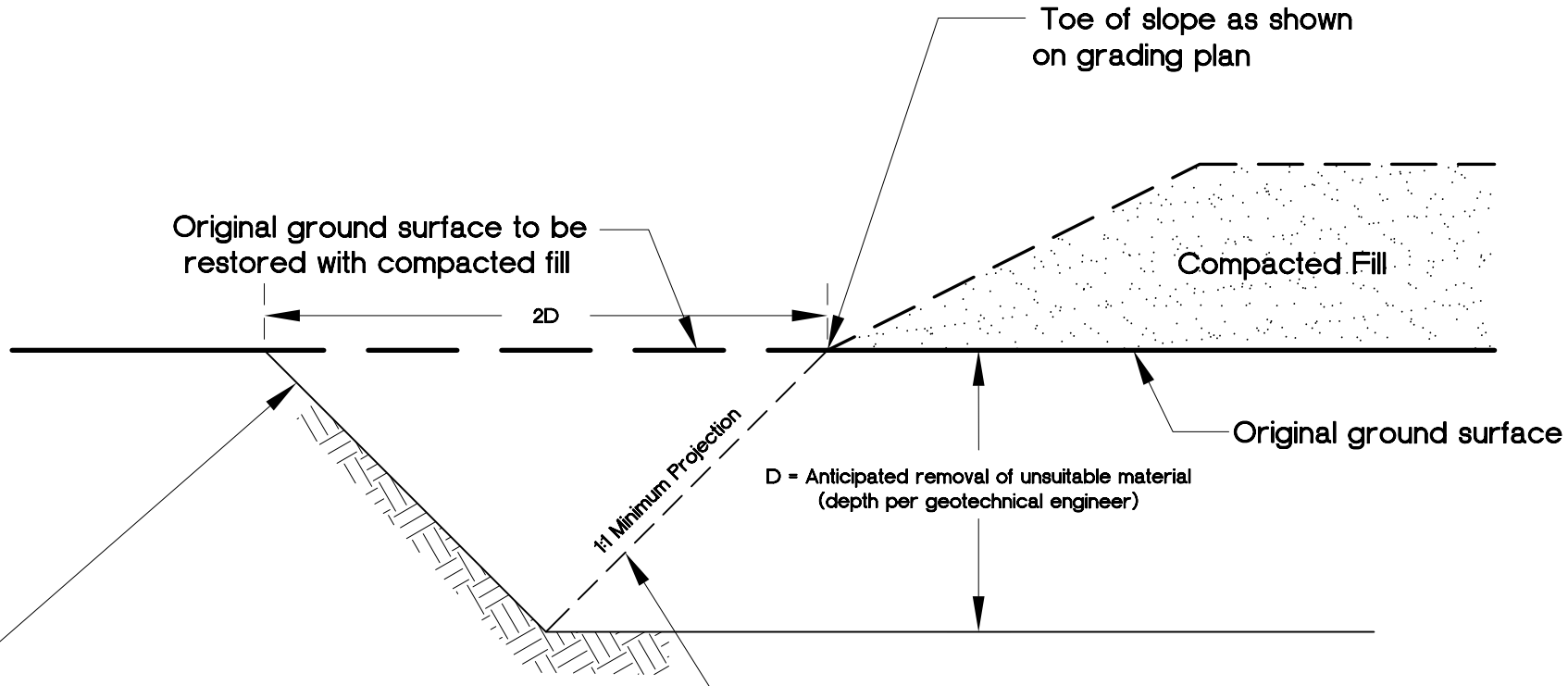
Trench and Vertical Excavation

It is the contractor's responsibility to provide safe access into trenches where compaction testing is needed. Our personnel are directed not to enter any excavation or vertical cut which: 1) is 5 feet or deeper unless shored or laid back; 2) displays any evidence of instability, has any loose rock or other debris which could fall into the trench; or 3) displays any other evidence of any unsafe conditions regardless of depth.

All trench excavations or vertical cuts in excess of 5 feet deep, which any person enters, should be shored or laid back. Trench access should be provided in accordance with Cal/OSHA or state and local standards. Our personnel are directed not to enter any trench by being lowered or "riding down" on the equipment.

If the contractor fails to provide safe access to trenches for compaction testing, our company policy requires that the soil technician withdraw and notify his/her supervisor. The contractor's representative will be contacted in an effort to affect a solution. All backfill not tested due to safety concerns or other reasons could be subject to reprocessing or removal.

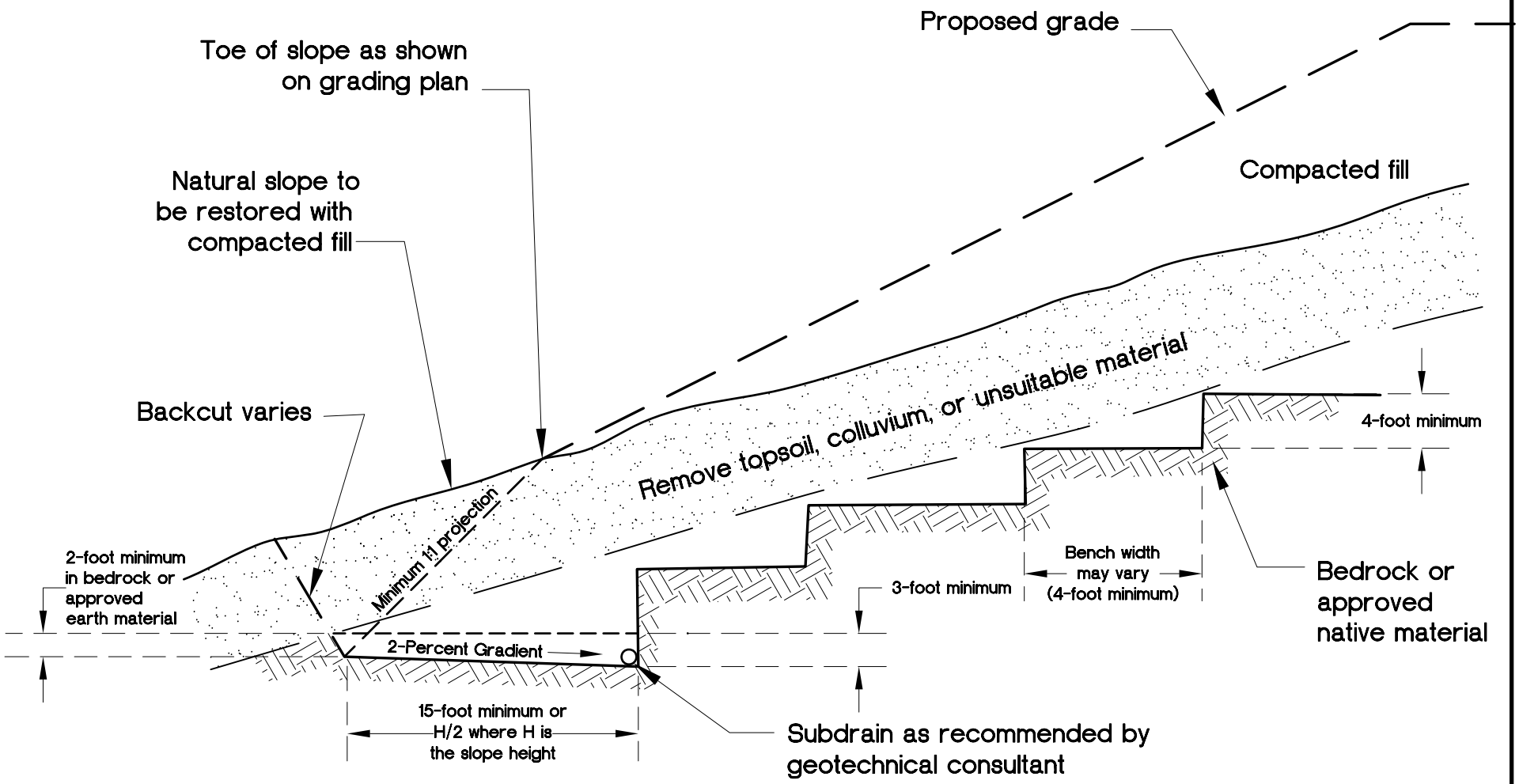
If GSI personnel become aware of anyone working beneath an unsafe trench wall or vertical excavation, we have a legal obligation to put the contractor and owner/developer on notice to immediately correct the situation. If corrective steps are not taken, GSI then has an obligation to notify Cal/OSHA or the proper controlling authorities.



GeoSoils, Inc.

FILL SLOPE TOEING OUT ON FLAT ALLUVIATED CANYON DETAIL

Plate F-3

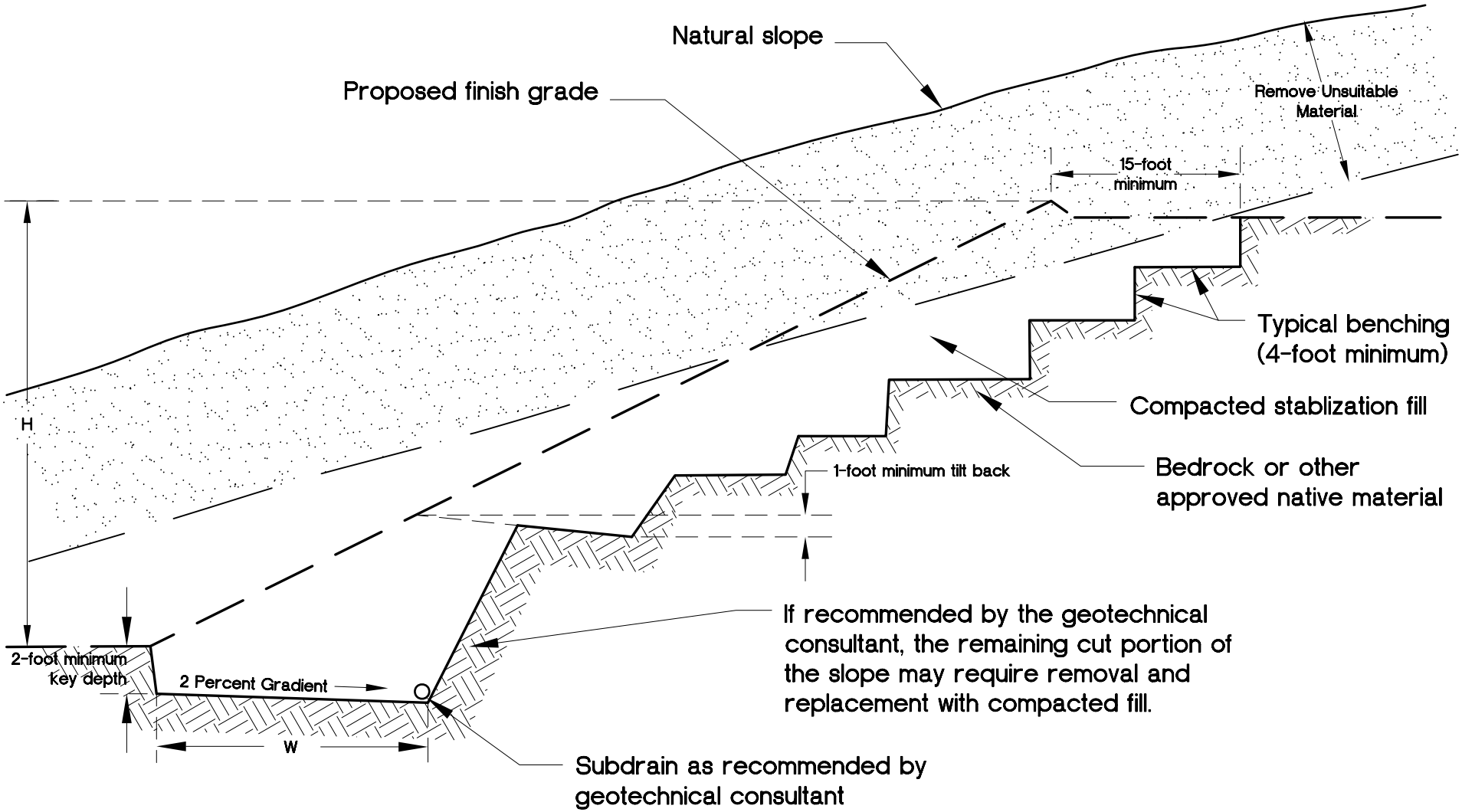


NOTES:

1. Where the natural slope approaches or exceeds the design slope ratio, special recommendations would be provided by the geotechnical consultant.

2. The need for and disposition of drains should be evaluated by the geotechnical consultant, based upon exposed conditions.

GeoSoils, Inc.	FILL OVER NATURAL (SIDEHILL FILL) DETAIL	Plate F-7

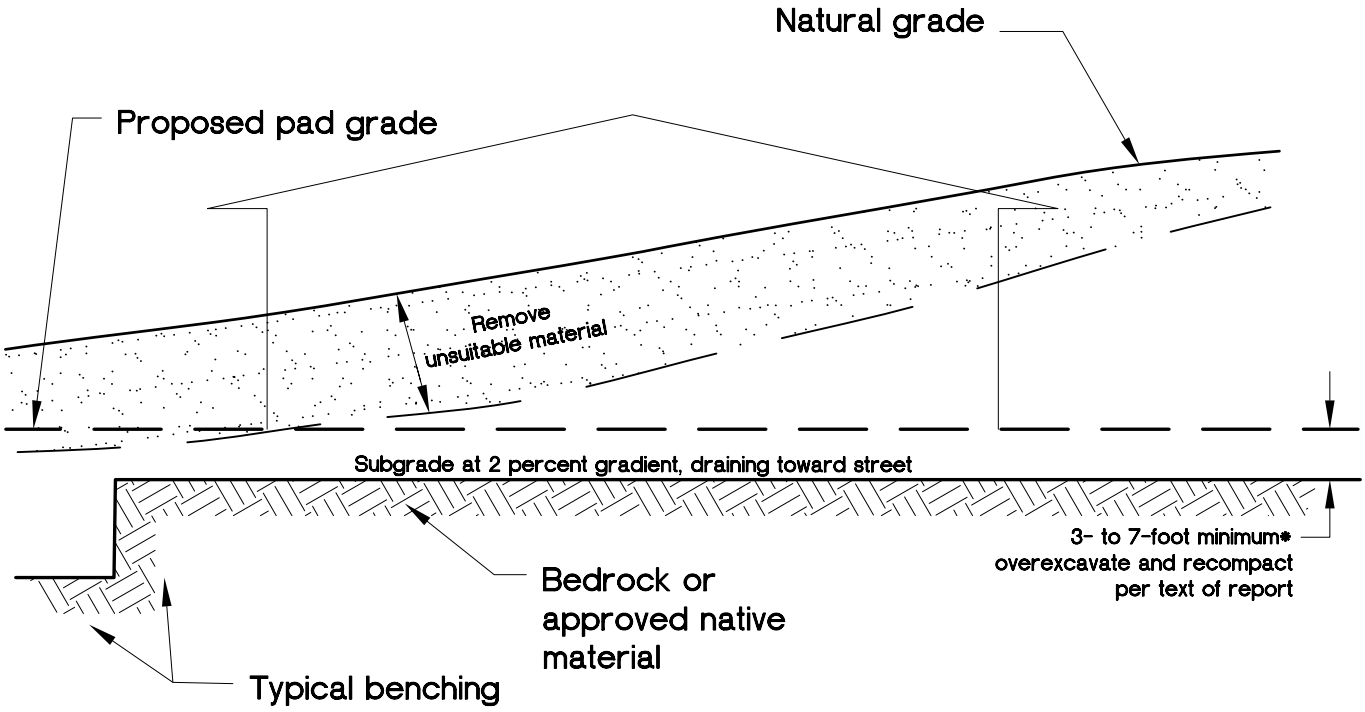


NOTES:

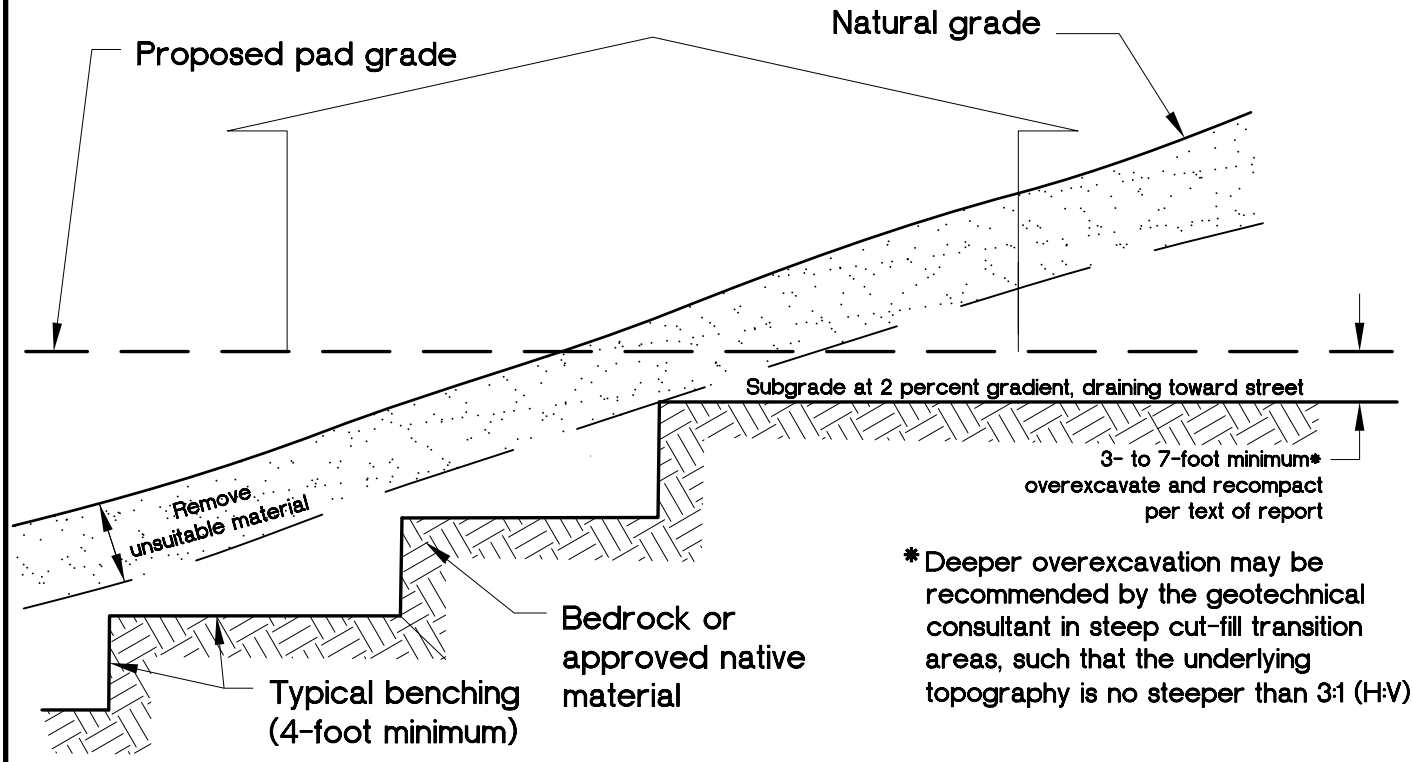
1. Subdrains may be required as specified by the geotechnical consultant.

2. W shall be equipment width (15 feet) for slope heights less than 25 feet. For slopes greater than 25 feet, W shall be evaluated by the geotechnical consultant. At no time, shall W be less than H/2, where H is the height of the slope.

GeoSoils, Inc.	STABLIZATION FILL FOR UNSTABLE MATERIAL EXPOSED IN CUT SLOPE DETAIL	Plate F-9

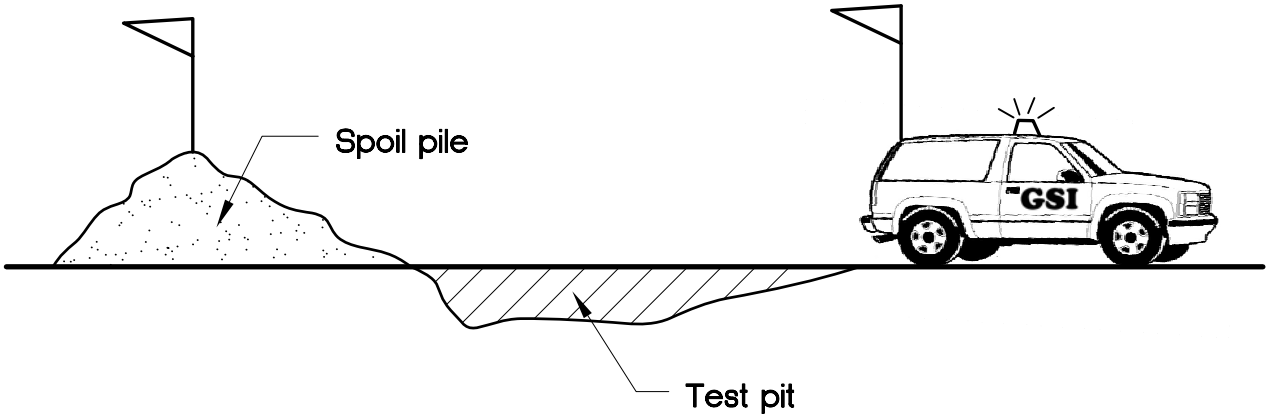


CUT LOT OR MATERIAL-TYPE TRANSITION

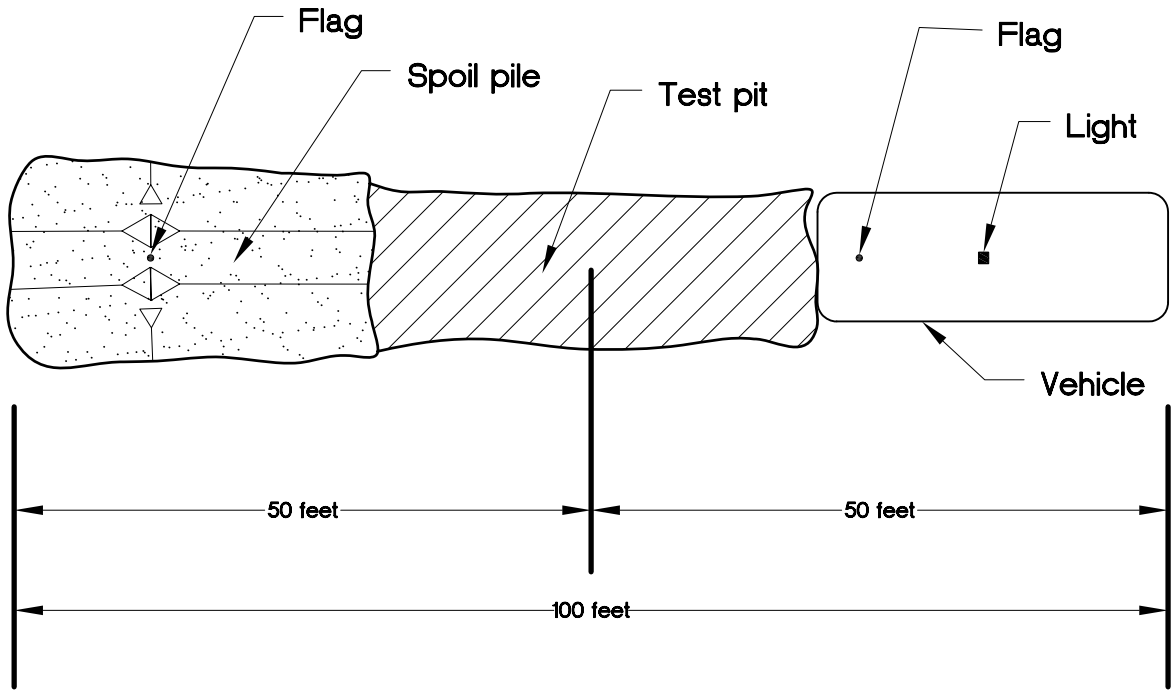


CUT-FILL LOT (DAYLIGHT TRANSITION)

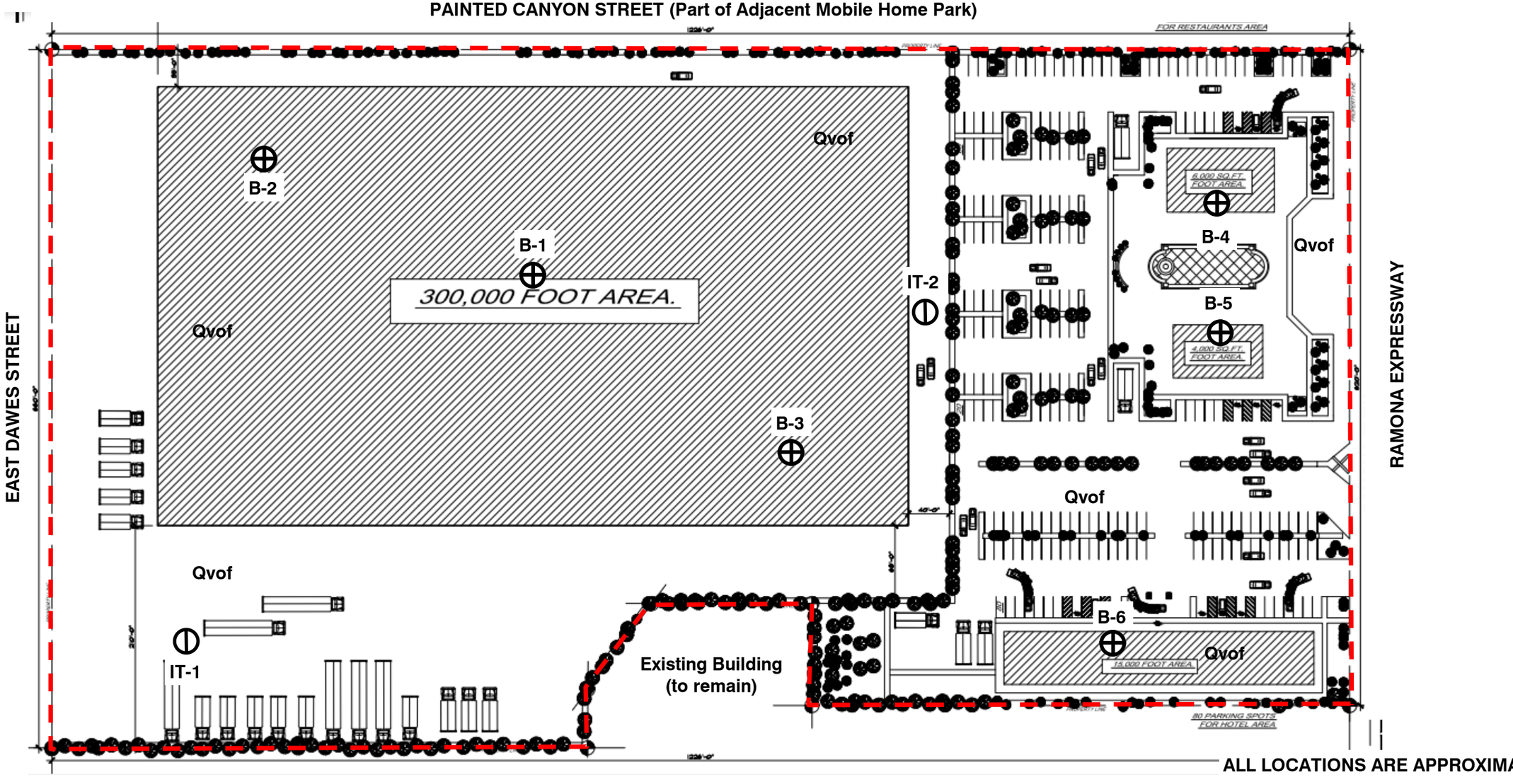
SIDE VIEW



TOP VIEW



GeoSoils, Inc.	TEST PIT SAFETY DIAGRAM	Plate F-20

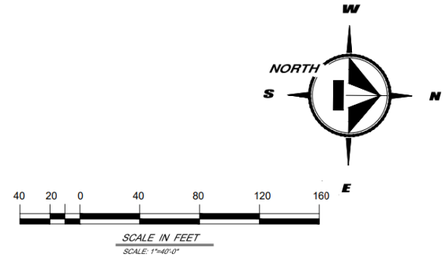


ALL LOCATIONS ARE APPROXIMATE

This document or e-file is not part of the Construction Documents and should not be relied upon as being an accurate depiction of design.

GSI LEGEND

⊕ B-6	Approximate Location of Exploratory Boring.
⊖ IT-2	Approximate Location of Percolation/ Infiltration Test Boring
Qvof	Quaternary Very Old Alluvial Fan Deposits
– – –	Approximate Boundary of Property Under the Purview of this Report.



GeoSoils, Inc.

Plate 1

GEOTECHNICAL MAP

W.O. 8448-A-SC	DATE: 10/22	SCALE: See Scale

Appendix 4: Historical Site Conditions

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

The site has not been developed before. The site has only been used for agricultural purposes.

D1 Infiltration.

Infiltration on the site ranges from 0.62 to 0.70 inches per hour per the soils report in Appendix 3

Infiltration is less than 1.6 inches. Infiltration is infeasible.

D2 Harvest and Reuse

TUTIA Using Table 2-2 Harvest and Data for Toilet Use

DMA-1 Retail and Office Commercial 3.81 ac, 106 toilet users/ impervious acre

DMA-2 Industrial Warehouse 11.67 ac, 135 toilet users/ impervious acre

Combined 15.48 acres, 128 toilet users/ impervious acre

15.48 acres X 128 toilet users/ impervious acre = 1,982

For a Design Storm Capture Depth of 0.65" 128 Employees are required per acre of impervious. With 15.48 acres of impervious that would require an onsite work force of 1,982 people. There are far fewer than 629 people proposed to work on this site Bio-filtration is considered more efficient.

IRRIGATION Using Table 2.3 Harvest and Use Data for Irrigation Use

For a design Storm Capture depth of 0.65" 1.05 acres of irrigated Acres per acre of per 1.00 Acre of Impervious. With 17.18 acres of impervious 18.04 irrigated acres would be required. There is not 18.04 acres of impervious on site to be irrigated. Capture and reuse is not feasible.

D3 Bioretention

This LID was chosen.

Appendix 6: BMP Design Details

BMP Sizing, Design Details and other Supporting Documentation

Bioretention Facility - Design Procedure	BMP ID	Legend:	Required Entries	
	BIO-1		Calculated Cells	

Company Name: RA Smith — Date: 12/16/2022

Designed by: Bradford Meyer — County/City Case No.:

Design Volume

Enter the area tributary to this feature — A_T = 4.58 acres

Enter V_{BMP} determined from Section 2.1 of this Handbook — V_{BMP} = 8,092 ft^3

Type of Bioretention Facility Design

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

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

Bioretention Facility Surface Area

Depth of Soil Filter Media Layer — d_S = 2 ft

Top Width of Bioretention Facility, excluding curb — w_T = 16.0 ft

Total Effective Depth, d_E

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

$0.6 + (0.4 \times .96) + 0.5$

$0.6 + 0.38 + 0.5$

d_E = 1.48 ft

Minimum Surface Area, A_m

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

8,092 /1.48

A_M = 5,468 ft^2

Proposed Surface Area — A= 847 ft^2

Bioretention Facility Properties

Side Slopes in Bioretention Facility — z = 4 :1

Diameter of Underdrain — 6 inches

Longitudinal Slope of Site (3% maximum) — 0 %

6" Check Dam Spacing — NONE feet

Describe Vegetation: DROUGHT TOLERANT

Notes: DUE TO THE BIORETENTION ONLY BEING A TREATMENT DEVICE AND NOT A CAPTURE AND TREATMENT DEVICE THE SURFACE AREA HAS BEEN SIZED TO ACCOMODATE THE PUMP FLOW FROM THE UNDERGROUND CISTERN.

Bioretention Facility - Design Procedure	BMP ID	Legend:	Required Entries	
	BIO-2		Calculated Cells	

Company Name: RA Smith — Date: 12/16/2022

Designed by: Bradford Meyer — County/City Case No.:

Design Volume

Enter the area tributary to this feature — A_T = 12.6 acres

Enter V_{BMP} determined from Section 2.1 of this Handbook — V_{BMP} = 24,361 ft^3

Type of Bioretention Facility Design

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

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

Bioretention Facility Surface Area

Depth of Soil Filter Media Layer — d_S = 2 ft

Top Width of Bioretention Facility, excluding curb — w_T = 16.5 ft

Total Effective Depth, d_E

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

$0.6 + (0.4 \times .96) + 0.5$

$0.6 + 0.38 + 0.5$

d_E = 1.48 ft

Minimum Surface Area, A_m

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

24,361 / 1.48

A_M = 16,460.0 ft^2

Proposed Surface Area — A= 461.5 ft^2

Bioretention Facility Properties

Side Slopes in Bioretention Facility — z = 4 :1

Diameter of Underdrain — 6 inches

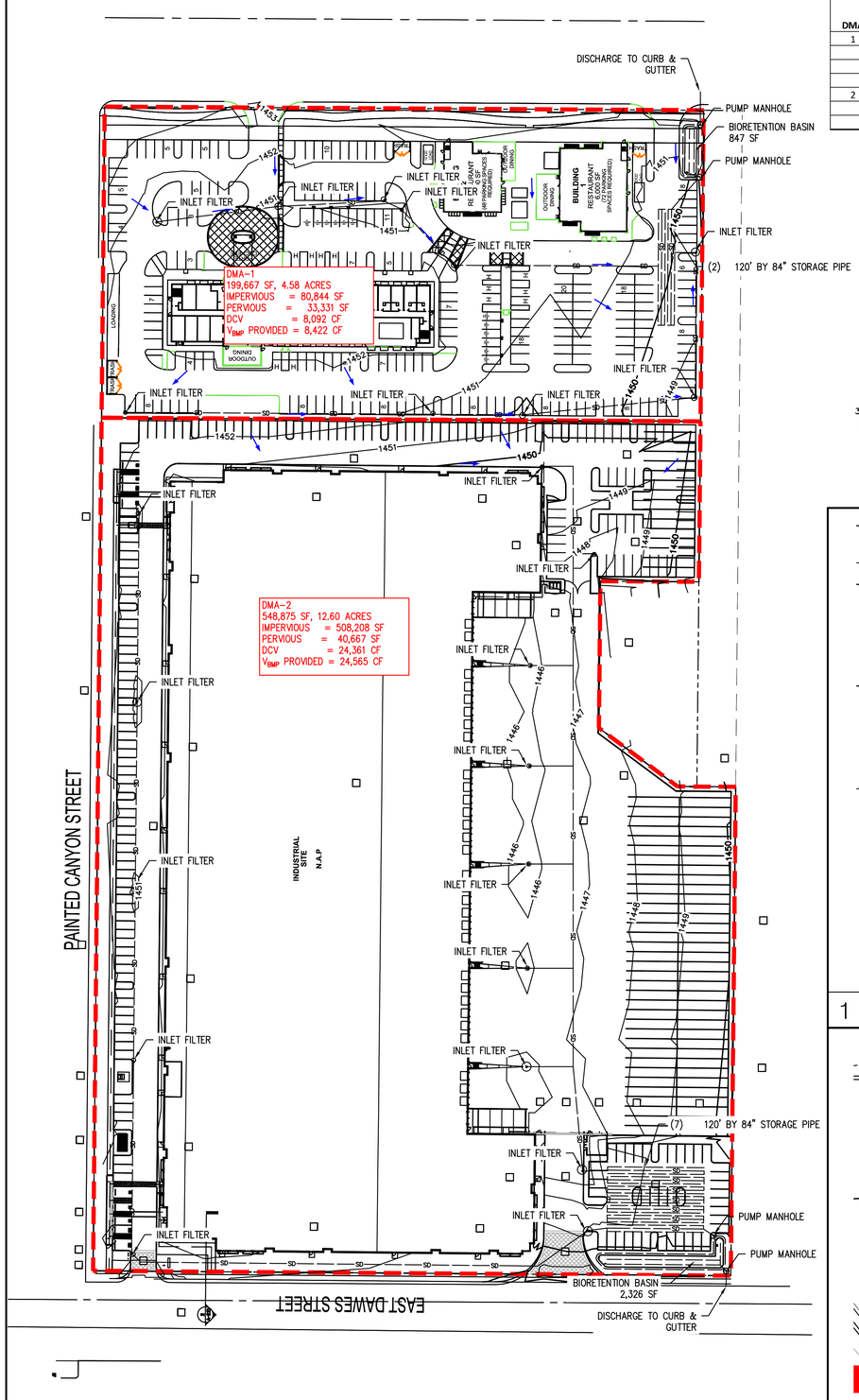
Longitudinal Slope of Site (3% maximum) — 0 %

6" Check Dam Spacing — NONE feet

Describe Vegetation: DROUGHT TOLERANT

Notes: DUE TO THE BIORETENTION ONLY BEING A TREATMENT DEVICE AND NOT A CAPTURE AND TREATMENT DEVICE THE SURFACE AREA HAS BEEN SIZED TO ACCOMODATE THE PUMP FLOW FROM THE UNDERGROUND CISTERN.

	2 year – 24 hour						
	Storage Tank design volume Required cu-ft	Storage Tank design volume Provided cu-ft	Bioretention surface area Sq-ft	Pump rate gpm	Pump rate Sq-ft/hr	Infiltration rate needed In/hr	Infiltration rate Provided In/Hr
DMA 1	8,092	8,422	847	22	175.5	2.5	5.0
DMA 2	24,361	24,565	2,326	64	512	2.6	5.0



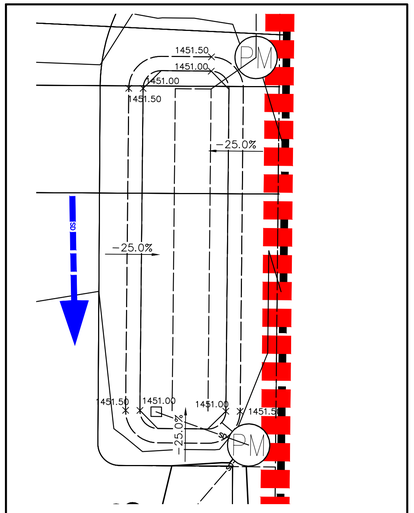
DMA	SURFACE TYPE	DMA TYPE	AREA (SF)	PERVIOUS AREA (SF)	IMPERVIOUS AREA (SF)	% PERVIOUS	% IMPERVIOUS	EFFECTIVE IMPERVIOUS FRACTION	DMA RUNOFF FACTOR	V BMP (CF)	BIORETENTION AREA	STORAGE VOLUME REQUIRED (CF)	STORAGE VOLUME PROVIDED (CF)	BMP TYPE
1	IMPERVIOUS	D	199,667	0	199,667	0.00%	100.00%	1	0.89					BIORETENTION WITH
	LANDSCAPE AREAS	D	33,331	33,331	0	100.00%	0.00%	0.1	0.11	8,092.0	847	8,092.0	8,422.00	UPSTREAM STORAGE
	TOTAL		**232,998**											
2	IMPERVIOUS	D	508,208	0	508,208	0.00%	100.00%	1	0.89					BIORETENTION WITH
	LANDSCAPE AREAS	D	40,667	40,667	0	100.00%	0.00%	0.1	0.11	24,361.0	2,326	24,361.0	24,565.00	UPSTREAM STORAGE
	TOTAL		**548,875**											

GRAPHIC SCALE
35 0 17.5 35 70 140
(IN FEET)
1 inch = 70 ft.

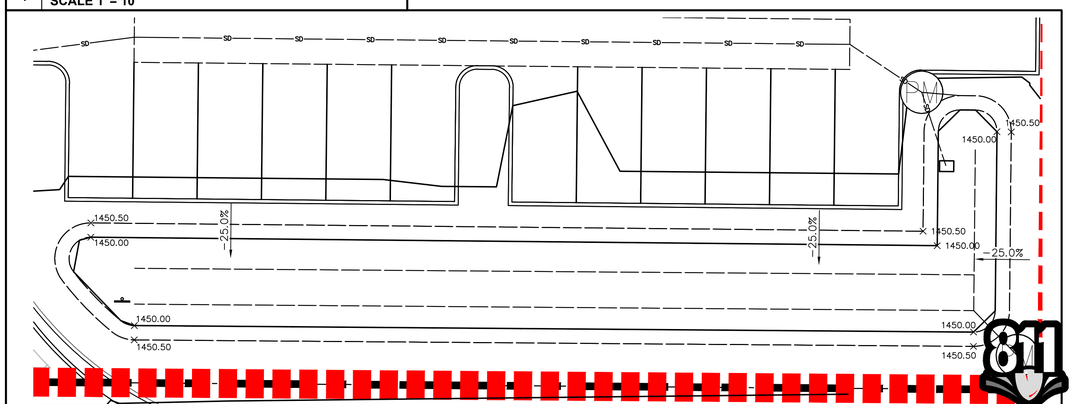
[1] CMP VOLUME = π x RADIUS^2 x LENGTH
= π x (3.5FT)^2 x 240 FT = 9,236 CF
– TOP 1' OF PIPE.
=$R^2\cos^{-1}((R-h)/R) - (R-h)\sqrt{(2Rh-h^2)}$
= 814 CF
= TOTAL STORAGE 8,422 cf

[2] CMP VOLUME = π x RADIUS^2 x LENGTH
= π x (3.5FT)^2 x 700 FT = 26,939 CF
– TOP 1' OF PIPE.
=$R^2\cos^{-1}((R-h)/R) - (R-h)\sqrt{(2Rh-h^2)}$
= 2,374 CF
= TOTAL STORAGE 24,565 CF

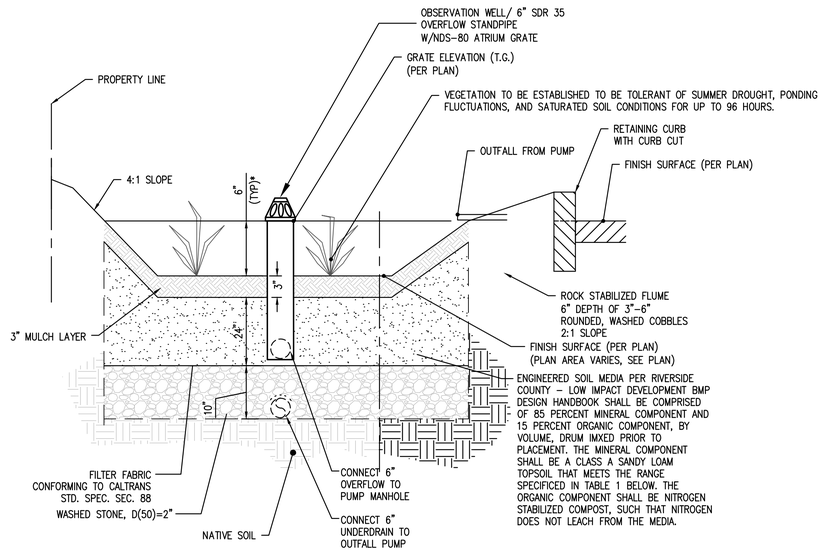
	2 year – 24 hour						
	Storage Tank design volume Required cu-ft	Storage Tank design volume Provided cu-ft	Bioretention surface area Sq-ft	Pump rate gpm	Pump rate Sq-ft/hr	Infiltration rate needed In/hr	Infiltration rate Provided In/Hr
DMA 1	8,092	8,422	847	22	175.5	2.5	5.0
DMA 2	24,361	24,565	2,326	64	512	2.6	5.0



1 NORTH STORM BIORETENTION BASIN DETAIL
SCALE 1"= 10'



2 SOUTH STORM BIORETENTION BASIN DETAIL
SCALE 1"= 10'



Know what's **below.**
Call before you dig.

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DATE	DESCRIPTION
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raSmith
CREATIVITY BEYOND ENGINEERING
8911 Research Drive
Irvine, CA 92618-4237
(949) 872-2378
rasmith.com

PERRIS MIXED USE
SOUTH OF RAMONA EXPRESSWAY AND NORTH OF DAWES SREET, PEERIS,CA

WQMP EXHIBIT

LICENSED PROFESSIONAL ENGINEER
ERIC A. ROBLES
C89866
EXP.6/30/23
CIVIL
STATE OF CALIFORNIA
DATE_____

DATE: 12/16/22
SCALE: 1" = 70'
JOB NO. 3220220
PROJECT MANAGER: ERIC A. ROBLES
DESIGNED BY:
CHECKED BY: EAR

SHEET NUMBER
WQMP–1B

Appendix 7: Hydromodification

Supporting Detail Relating to Hydrologic Conditions of Concern

HCOC Mitigation

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.

2yr-24hr Peak Flow Pre =

2yr-24hr Peak Flow Post =

This was accomplished by capturing the Design Volume in an underground Cistern and then treating it by pumping it through a Bio-retention Basin.

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

WQMP
Operation & Maintenance (O&M) Plan

Peris Mixed Use

South of Ramona Expressway and North of Dawes Street
Perris, CA

Prepared for:
Alabbasi Construction & Engineering
764 Ramona Expressway, Suite C
PERRIS, CA 92571
???-???-????

Prepared on:
12/16/2022

This O&M Plan describes the designated responsible party for implementation of this WQMP, including: operation and maintenance of all the structural BMP(s), conducting the training/educational program and duties, and any other necessary activities. The O&M Plan includes detailed inspection and maintenance requirements for all structural BMPs, including copies of any maintenance contract agreements, manufacturer's maintenance requirements, permits, etc.

8.1.1 Project Information

APN: 303-100-012 & 014
Address: South of Ramona Expressway and North of Dawes Street, Perris, CA
Site Size: 17.64 ACRES
List Structural BMPs, (2) Bioretention Basins, (2) underground rainwater cisterns, (14) Inlet filters .
1 Commercial tenant, Hotel Tenant, 2 Restaurant Tenants etc.
10% pervious

The North and South drainage areas drains to inlets that then discharge to underground rainwater cisterns. The water is then pumped up to the Bioretention basins that will treat the runoff. It is then collected by the underdrains at the bottom of the Bioretention Basins. It is then pumped back up to the surface to discharge into the gutter in East Dawes Street.

8.1.2 Responsible Party

The responsible party for implementation and financing of this WQMP is:

Ms. Corinne Mostad
Director of Land Development
Alabbasi Construction & Engineering
764 Ramona Expressway, Suite C
Perris, CA 92571
Phone #
24-Hour Emergency Contact #: ???????
Email: ????????

8.1.3 Record Keeping

Parties responsible for the O&M plan shall retain records for at least 5 years.

All training and educational activities and BMP operation and maintenance shall be documented to verify compliance with this O&M Plan. A sample Training Log and Inspection and Maintenance Log are included in Appendix C of this document.

The **WQMP Verification Form** (Appendix D) shall be completed accurately and submitted, with associated documentation, to the City of Riverside by September 30 of each year, or as requested by the City. **Failure to complete and submit the verification form will result in a noncompliance and enforcement actions may be taken.**

8.1.4 Electronic Data Submittal

This document along with the Site Plan and Attachments shall be provided in PDF format. Autocad files and/or GIS coordinates of BMPs shall also be submitted to the City.

8.1.5 Vector Control

Standing water which exists for longer than 72 hours may contribute to mosquito breeding areas. Best Management Practices (BMPs) shall be inspected for standing water on a regular basis. Standing water may indicate that the BMP is not functioning properly and proper action to remedy the situation shall be taken in a timely manner.

Elimination of standing water and managing garbage, lawn clippings, and pet droppings, can help decrease the presence of mosquitoes and flies in the area.

The Riverside County Flood Control District may be contacted for more information and support at 951-955-1200

Required Permits

No Additional permits are required for this project.

8.1.6 Inspections

The City may conduct a site inspection to evaluate compliance with the Project WQMP, at any time, in accordance with The City of Riverside Municipal Code Section 14.12.315, Storm Water/Surface Runoff Water Quality.

8.1.7 Monitoring Plan

The City or other agencies may require a monitoring plan. Details regarding monitoring plan, such as parameters to be tested, frequency, testing locations, laboratory, etc. shall be included as appropriate.

No monitoring plan required

8.1.8 Operation and Maintenance Requirements

BMP	Implementation, Inspection and Maintenance Requirements	Frequency
N1. Education for Property Owners, Tenants and Occupants	RP will insure that all owners & tenants will be given a copy of the recorded CC&R's which will contain a section outlining the environmental awareness education materials at the close of escrow. RP shall distribute appropriate materials to owners, tenants and/or occupants via contract language, mailings, website or meeting. Brochures can be requested or downloaded from www.ocwatersheds.com. Brochures and educational articles for RP distribution can also be requested from City Water Quality Engineer.	Information to be initially provided to owners & tenants upon sale or lease agreement. Educational materials will be provided to owners and/or tenants annually, thereafter.
N2. Activity Restriction	Within the CC&R's or lease agreement, the following activity restrictions shall be enforced:	Continuous
N3. Common Area Landscape Management & Efficient Landscape Design	Landscape Management Includes: • Mitigation of the potential dangers of fertilizer and pesticide usage through the incorporation of an Integrated Pest Management Program (IPM). • Monitor for runoff and efficiency regularly. • Implementation of a water budget. • Irrigation systems shall be automatically controlled and designed, installed, and maintained so as to minimize overspray and runoff onto streets, sidewalks, driveways, structures, windows, walls, and fences. • Use of native and drought tolerant species when replanting	Inspected once a week
N11. Common Area Litter Control	Weekly sweeping and trash pick up as necessary within all project areas and common landscape areas. Daily inspection of trash receptacles to ensure that lids are closed and pick up any excess trash on the ground, noting trash disposal violations by homeowners and reporting the violations to the HOA/RP for investigation.	Daily inspection and weekly sweeping and clean-up or as needed

N12. Contractor/Employee Training	All contractors shall be trained and made aware of this WQMP and operation and maintenance requirements of BMPs.	At first hire and annually thereafter for HOA personnel and employees, to include the educational materials contained in the approved Water Quality Management Plan.
N13. Housekeeping of Loading Docks	See SD-31	

BMP	Implementation, Inspection and Maintenance Requirements	Frequency
N14. Common Area Catch Basin Inspection	Catch basins will be owned, inspected and maintained by the HOA/RP. Catch basins will be inspected at a minimum on a yearly basis, and prior to the storm season, no later than October 1st of each year.	At a minimum, basins will be inspected and cleaned around October 1ST of each year, prior to "first flush" storm, or as necessary after large storm events to clear inlets of trash, debris and silt.
N15. Street Sweeping Private Streets and Parking Lots	Vacuum street sweeping will occur on a weekly basis.	Streets will be vacuum swept on a weekly basis.
SD-13 Provide Storm Drain System Stenciling and Signage	All catch basins where applicable in paved areas, will be marked or stenciled with "No Dumping - Drains to Ocean, No Descargue Basura" language. This will be done in a location that can be clearly seen by all and will be routinely inspected and relabeled, as necessary. Thereafter, the owner/operator shall routinely inspect and re-label the catch basins, as necessary.	Catch basin labels will be inspected once annually and relabeled as necessary to maintain legibility.
SD-34 Design and Construct Outdoor Material Storage Areas to Reduce Pollutant Introduction		
SD-32 Design and Construct Trash and Waste Storage Areas to Reduce Pollutant Introduction	Trash will be removed by the local private solid waste management contractor on a weekly basis for proper disposal of the trash to landfill; with recyclable materials and greenwastes to be processed offsite.	Trash dumpster shall be kept in a non-leaking condition.

SD-31 Loading Docks	Loading docks typically found at large retail and warehouse-type commercial and industrial facilities should be kept in a clean and orderly condition through a regular program of sweeping and litter control and immediate cleanup of spills and broken containers. Cleanup procedures should minimize or eliminate the use of water if plumed to the storm sewer. If wash water is used, it must be disposed of in an approved manner and not discharged to the storm drain system. If there are no other alternatives, discharge of non-stormwater flow to the sanitary sewer must be at an acceptable discharge point such as a cleanout, oil/water separator, grease interceptor, or industrial sewer connection. All sewer discharges shall be in accordance with the Orange County Sanitation District‟s Wastewater Discharge Regulations and/or Washwater Disposal Guidelines.	<u>Inspection</u> • Inspect the loading dock area daily for loose trash/litter and sweep biweekly. <u>Maintenance</u> • Pick up loose trash/litter and place in trash receptacles. • Daily

BMP	Implementation, Inspection and Maintenance Requirements	Frequency
Hydromod/LID/Treatment BMP # 1 **DMA-1 BioRetention Basin** **DMA-2 BioRetention Basin**	Remove obstructions, debris and trash from bioretention area and	Monthly, or as needed after storm events
	Remove sediment	As needed after storm
	Re-mulch Void Areas	As needed after storm
	Remove and replace all dead and diseased	Semi-annually, or as needed
	Inspect inlets for channels, soil exposure or other evidence of erosion. Clear	Semi-annually, or as needed
	Repair outflow structures	As needed
	Unclog Underdrains	Semi-annually, or as
	Add Mulch	Annually
	Replace Mulch	2-3 years, or as needed
	Inspect Bioretention Facility to ensure that it drains between storms and within 48 hours	Monthly, or as needed after storm events

	Maintain vegetation and the irrigation system. Prune and weed to keep Bioretention Facility neat	Before wet season begins, or as needed
	Check that mulch is at appropriate depth (2-3 inches per LID BMP Design Handbook) and replenish as	Monthly
	Inspect Bioretention Facility using the attached inspection checklist.	Monthly, or after large storm events, and after removal of accumulated debris or material
Hydromod/LID/Treatment BMP # 2 **DMA-1 Rainwater Cistern** **DMA-2 Rainwater Cistern**	• Remove Trash from Underground Storage Tank, Every 6 to 12 months • Remove sediment from Underground Storage Tank once Depth reaches 4 inches.	Every 6 to 12 months
Hydromod/LID/Treatment BMP # 2 **Inlet Filters**	• Remove Trash from Screening Device, • As determined necessary during inspection. Cleaning shall take place prior to the onset of the rainy season (generally accepted as October 1st through April 30th).	Quarterly

Appendix A

BMP SITE PLAN

Appendix B

EDUCATIONAL MATERIALS

The following is a selection of Educational Materials for Homeowners, Contractors and employees that address BMPS and water quality issues. Many are available in English and Spanish.

To meet the educational requirements of this O&M Plan, educational brochures can be downloaded or requested at no charge at www.casqa.org for inclusion on a website, in a newsletter or mailed to property owners, tenants and/or contractors. Property owners, tenants, staff and/or contractors must receive education/training at least once per year.

Brochure	Pollutant(s) Addressed	Activities Addressed
"The Ocean Begins At Your Front Door" – English, Spanish, Vietnamese	Household hazardous waste, trash, motor oil, chlorine, overwatering, green waste, dirt, pesticides/fertilizer, pet waste	Household maintenance and activities (i.e. hosing driveway), automotive maintenance and washing, pool maintenance, landscape and gardening, trash disposal, pet care
Homeowners Guide for Sustainable Water Use Pamphlet	Household hazardous waste, trash, motor oil, chlorine, overwatering, green waste, dirt, pesticides/fertilizer, pet waste	Preventing urban runoff through low impact development in residential properties, water conservation, use of IPM techniques and California-friendly landscaping, general water pollution prevention methods
"Help Prevent Ocean Pollution: Your Local Used Oil Collection Center" - South– English, Spanish, Vietnamese	Motor Oil	Automotive Maintenance, Disposal of Used Motor Oil
"Help Prevent Ocean Pollution: Tips for Pool Maintenance" – English, Spanish	Chlorine, runoff	Pool Drainage/Maintenance
"Help Prevent Ocean Pollution: Tips for Landscape and Gardening" – English, Spanish	Fertilizer, pesticide, dirt, overwatering, green waste	Landscape maintenance, pesticide/fertilizer application, proper disposal of household hazardous waste and green waste
"Help Prevent Ocean Pollution: Tips for Pet Care" – English, Spanish	Surfactants, chemicals, pet waste	Proper disposal of pet waste, proper pet bathing techniques
"Help Prevent Ocean Pollution: Household Tips" – English, Spanish	Household hazardous waste, pet waste, pesticides/fertilizers, overwatering, green waste, surfactants, motor oil, trash	Household maintenance and activities (i.e. hosing driveway), automotive maintenance and washing, pool maintenance, landscape and gardening, trash disposal, pet care

"Help Prevent Ocean Pollution: Proper Disposal of Household Hazardous Materials" – English, Spanish, Vietnamese	Household hazardous wastes	Proper identification and disposal of household hazardous wastes

Brochure	Pollutant(s) Addressed	Activities Addressed
"Help Prevent Ocean Pollution: Maintenance Practices for Your Business" – English, Spanish	Fertilizer, pesticides, green waste, overwatering, trash, toxic substances	Landscape maintenance, proper application of pesticides and fertilizers, trash management, proper storage of materials
"Help Prevent Ocean Pollution: Tips for Using Concrete and Mortar" – English, Spanish	Concrete and mortar, slurry	Proper preparation, use, clean up and disposal of concrete and mortar
"Responsible Pest Control"	Pesticides	Proper identification of pests, selection of least toxic chemical, proper pesticide application, spill prevention and proper storage and disposal of pesticides (use of Integrated Pest Management (IPM) techniques)
"Help Prevent Ocean Pollution: Residential Pool, Landscape and Hardscape Drains" – English, Spanish	Chlorine, chemicals, pet waste, green waste, overwatering, motor oil and vehicle fluids	Pool maintenance, spill prevention, proper disposal of household hazardous waste, proper disposal of pet waste, proper use of pesticides and fertilizers, proper vehicle maintenance
"Help Prevent Ocean Pollution: Proper Use and Disposal of Paint" – English, Spanish	Paint, chemicals	Proper use, storage and disposal of paint
"Help Prevent Ocean Pollution: Tips for Home Improvement Projects" – English, Spanish	Construction debris, concrete, paint, household hazardous waste, sediment	Proper storage of construction materials, recycling of construction materials, proper disposal of household hazardous waste, proper erosion and spill control
"Help Prevent Ocean Pollution: Children's Coloring & Activity Book"	Trash, pet waste, motor oil, green waste	Litter control, proper disposal of pet waste, proper spill clean up (e.g. use of cat litter)
"Help Prevent Ocean Pollution: Tips for the Automotive Industry" – English, Spanish	Motor oil, metals, surfactants, toxic substances, dirt	Proper maintenance and washing practices for automobiles, proper storage and disposal of automotive liquids and materials
"Help Prevent Ocean Pollution: Tips for the Home Mechanic"	Motor oil, metals, surfactants, toxic substances	Proper maintenance and washing practices for automobiles and automotive detailing materials, proper storage and disposal of automotive liquids and materials, use of used oil collection centers

"Compliance Best Management Practices for Mobile Businesses"	Surfactants, toxic substances, dirt, metals	Mobile car washing and detailing, proper high pressure cleaning, proper storage and disposal of washwater from mobile automotive detailing, washing and carpet and fabric cleaning
Brochure	**Pollutant(s) Addressed**	**Activities Addressed**
"Help Prevent Ocean Pollution: A Guide for Food Service Facilities" – English, Spanish, Vietnamese	Grease, food waste, trash	Proper food waste disposal, proper grease and oil disposal, proper procedures for spill cleanup, proper maintenance of trash dumpsters, proper floor mat cleaning, proper wastewater disposal

Regulatory Information

1. City of Riverside Municipal Code Section 14.12.315. Storm Water/Surface Runoff Water Quality

Both of the above Code Chapters are available on the City's website at:
https://library.municode.com/ca/riverside/codes/code_of_ordinances

Appendix C

BMP OPERATION & MAINTENANCE AND TRAINING LOGS

Table 1 Routine Maintenance Activities for Bioretention Facilities		
No.	**Maintenance Task**	**Frequency of Task**
1	Remove obstructions, debris and trash from bioretention area and dispose of properly.	Monthly, or as needed after storm events
2	Remove sediment	As needed after storm events
3	Re-mulch Void Areas	As needed after storm events
4	Remove and replace all dead and diseased vegetation.	Semi-annually, or as needed
5	Inspect inlets for channels, soil exposure or other evidence of erosion. Clear obstructions	Semi-annually, or as needed
6	Repair outflow structures	As needed
7	Unclog Underdrains	Semi-annually, or as needed
8	Add Mulch	Annually
9	Replace Mulch	2-3 years, or as needed
10	Inspect Bioretention Facility to ensure that it drains between storms and within 48 hours after rainfall	Monthly, or as needed after storm events
11	Maintain vegetation and the irrigation system. Prune and weed to keep Bioretention Facility neat and orderly in appearance.	Before wet season begins, or as needed
12	Check that mulch is at appropriate depth (2-3 inches per LID BMP Design Handbook) and replenish as necessary before wet season begins.	Monthly
13	Inspect Bioretention Facility using the attached inspection checklist.	Monthly, or after large storm events, and after removal of accumulated debris or material

ALSO INCLUDE MANFACTURER'S MAINTENANCE GUIDELINES & CHECKLISTS HERE

BMP OPERATION & MAINTENANCE LOG
Perris Mixed Use Project

Today's Date: _____

Name of Person Performing Activity (Printed): _____

Signature: _____

BMP Name (As Shown in O&M Plan)	Brief Description of Implementation, Maintenance, and Inspection Activity Performed

TRAINING / EDUCATIONAL LOG

Date of Training/Educational Activity: _____

Name of Person Performing Activity (Printed): _____

Signature: _____

Topic of Training/Educational Activity: _____

_____

Name of Participant	Signature of Participant

For newsletter or mailer educational activities, please include the following information:

- **Date of mailing**
- **Number distributed**
- **Method of distribution**
- **Topics addressed**

If a newsletter article was distributed, please include a copy of it.

APPENDIX D

CITY OF RIVERSIDE
WATER QUALITY MANAGEMENT PLAN (WQMP) VERIFICATION SURVEY

Project Name/Site Address: __Perris Mixed Use

Responsible Party : ___Corinne Mostad Alabbasi Construction & Engineering_____

Contact Phone: 951-436-5155_____ Contact Email: _____

1. **Have your contractors (landscape, maintenance, etc.) been educated regarding the applicable requirements to prevent pollution as outlined in the WQMP?**

   ☐ **Yes** ☐ **No** Name of Landscape/Maintenance Contractor:
   _____

   Method of education (contract language, Copy of O&M, educational brochures, etc.):
   _____

2. **Have the storm drains and inlets been inspected and maintained, at a minimum, annually prior to Oct 1?**

   ☐ **Yes** ☐ **No** Date of Last Inspection/Maintenance:
   _____

   Maintenance conducted by:
   _____

3. **Have you observed any runoff from the irrigation system?**

   ☐ **Yes** ☐ **No** If yes, how was the problem resolved?:
   _____

   _____

4. **What type of Integrated Pest Management (IPM) practices are used on site?**

   _____

5. **Are native and/or drought tolerant plants established and considered for any new landscaping?**

   ☐ **Yes** ☐ **No**

6. **Have the storm drain stencils been inspected annually for legibility prior to Oct. 1?**

   ☐ **Yes** ☐ **No** Total number of stencils on site: _____

   How many inlets required restenciling / date of restenciling? _____ /_____

7. **Have education materials been distributed to the residents/tenants/contractors within the past year?**

   ☐ **Yes** ☐ **No** Topic / Date of Distribution: _____ / _____

   Method of Distribution: newsletter, billing insert, etc.: _____

8. **Is street sweeping conducted weekly?**

   ☐ **Yes** ☐ **No** **Contractor:** _____

9. **Are trash areas in common area inspected daily?**

   ☐ **Yes** ☐ **No**

10. **Have any vector concerns been observed (standing water, mosquito larvae, etc.). if yes, please contact City of Riverside Vector Control Department at 951-340-9792.**

    ☐ **Yes** ☐ **No**

11. **Have the Bioretention Basins and Rainwater Cisterns been inspected and maintained per Manufacturer instructions? (attach invoices and inspection/maintenance forms).**

    ☐ **Yes** ☐ **No**

12. **Have there been any issues with operation and maintenance of the Bioretention Basins and Rainwater Cisterns units?**

    _____

I certify that the above information is correct and that the BMPs for this project have been implemented and operated and maintained in accordance with the Operation and Maintenance (O&M) Plan on site and on file at the City.

_____

Print Name of Responsible Party

_____

_____

Signature (required) Date

STORMWATER SOLUTIONS

STORAGE SYSTEMS INSPECTION & MAINTENANCE MANUAL

10244 Freeman Avenue | Santa Fe Springs, CA 90670 | 562-777-9724
santafewinwater.com

STORMWATER SYSTEM - INSPECTION & MAINTENANCE

Inspection and maintenance of the underground detention, retention, or infiltration system is vital for the performance and life cycle of the stormwater management system. All local, state, and federal permits and regulations must be followed for system compliance. Manway access locations are provided on each system for ease of ingress and egress for routine inspection and maintenance activities. Stormwater regulations require that all BMPs be inspected and maintained to ensure they are operating as designed and providing protection to receiving water bodies. It is recommended that inspections be performed multiple times during the first year to assess the site-specific conditions. Inspection after the first significant rainfall event and at quarterly intervals is typical. This is recommended because pollutant loading and pollutant characteristics can vary greatly from site to site. Variables such as nearby soil erosion or construction sites, winter sanding on roads, amount of daily traffic and land use can increase pollutant loading on the system. The first year of inspections can be used to set inspection and maintenance intervals for subsequent years to ensure appropriate maintenance is provided. Without appropriate maintenance, a BMP can exceed its storage capacity, become blocked, or damaged, which can negatively affect its continued performance.

Inspection Equipment

Following is a list of equipment to allow for simple and effective inspection of the underground detention, retention, or infiltration system:

- Santa Fe WinWater Inspection and Maintenance Report Form
- Flashlight
- Manhole hook or appropriate tools to access hatches and covers
- Appropriate traffic control signage and procedures
- Measuring pole and/or tape measure
- Protective clothing and eye protection
- Note: Entering a confined space requires appropriate safety and certification. It is generally not required for routine inspections of the system.

Inspection Steps

The key to any successful stormwater BMP maintenance program is routine inspections. The inspection steps required on the underground detention, retention, or infiltration system are quick and easy. As mentioned above, the first year should be seen as the maintenance interval establishment phase. During the first year more frequent inspections should occur in order

to gather loading data and maintenance requirements for that specific site. This information can be used to establish a base for long term inspection and maintenance interval requirements.

The underground detention, retention, or infiltration system can be inspected though visual observation without entry into the system. All necessary pre-inspection steps must be carried out before inspection occurs, especially traffic control and other safety measures to protect the inspector and nearby pedestrians from any dangers associated with an open access hatch or manhole. Once these access covers have been safely opened the inspection process can proceed:

- Prepare the inspection form by writing in the necessary information including project name, location, date & time, unit number and other information (see inspection form).
- Observe the upstream drainage area and look for sources of pollution, sediment, trash and debris.
- Observe the inside of the system through the access manholes. If minimal light is available and vision into the unit is impaired, utilize a flashlight to see inside the system and all of its modules.
- Look for any out of the ordinary obstructions in the inflow and outflow pipes. Check pipes for movement or leakage. Write down any observations on the inspection form.
- Observe any evidence of differential settling between modules.
- Observe tank walls for signs of deterioration.
- In detention and retention systems inspect for any signs of leakage.
- In infiltration systems inspect for any signs of blockage or reasons that the soils are not infiltrating.
- Through observation and/or digital photographs, estimate the amount of floatable debris accumulated in the system. Record this information on the inspection form. Next, utilizing a tape measure or measuring stick, estimate the amount of sediment accumulated in the system. Sediment depth may vary throughout the system, depending on the flow path. Record this depth on the inspection form.
- Finalize inspection report for analysis by the maintenance manager to determine if maintenance is required.

Maintenance Indicators

Based upon observations made during inspection, maintenance of the system may be required based on the following indicators:

- Damaged inlet and outlet pipes.
- Obstructions in the system or its inlet or outlet.
- Excessive accumulation of floatables.

- Excessive accumulation of sediment of more than 6" in depth.
- Damaged joint sealant.

Maintenance Equipment

While maintenance can be done fully by hand, it is recommended that a vacuum truck be utilized to minimize time required to maintain the underground detention, retention, or infiltration system:

- Santa Fe WinWater Inspection and Maintenance Report Form
- Flashlight
- Manhole hook or appropriate tools to access hatches and covers
- Appropriate traffic control signage and procedures
- Measuring pole and/or tape measure
- Protective clothing and eye protection
- Vacuum truck
- Trash can
- Pressure washer
- Note: Entering a confined space requires appropriate safety and certification. It is generally not required for routine inspections of the system. Entry into the system will be required if maintenance is required.

Maintenance Procedures

It is recommended that maintenance occurs at least three days after the most recent rain event to allow for drain down of the system and any upstream detention systems designed to drain down over an extended period of time. Maintaining the system while flows are still entering it will increase the time and complexity required for maintenance. Once all safety measures have been set up cleaning of the system can proceed as follows:

- Using an extension on a boom on the vacuum truck, position the hose over the opened manway and lower into the system. Remove all floating debris, standing water (as needed) and sediment from the system. A power washer can be used to assist if sediments have become hardened and stuck to the walls and columns. Repeat the same procedure at each manway until the system has been fully maintained. Be sure not to pressure wash the infiltration area as it may scour.

If maintenance requires entry into the vault:

- Following rules for confined space entry use a gas meter to detect the presence of any hazardous gases. If hazardous gases are present do not enter the vault. Follow appropriate confined space procedures, such as utilizing venting system, to address the hazard. Once it is determined to be safe, enter utilizing appropriate entry

equipment such as a ladder and tripod with harness.

- The last step is to close up and replace all manhole covers and removeall traffic control.
- All removed debris and pollutants shall be disposed of following local and state requirements.

For Maintenance Services please contact Santa Fe WinWater at 562-777-9724 for assistance in finding an authorized service provider.

Inspection and Maintenance Report
Underground Detention, Retention, or Infiltration

For Office Use Only
(Reviewed By)
(Date) Office personnel to complete section to the left.

Project Name _____

Project Address _____ _____
[Street Number, Street Name (or Cross-Streets), City, Zip Code]

Owner / Management Company _____

Contact _____ Phone ( ) –

Inspector Name _____ Date ____/____/____ Time _____ AM / PM

Type of Inspection ☐ Routine ☐ Follow Up ☐ Complaint ☐ Storm Storm Event in Last 72-hours? ☐ No ☐ Yes

Weather Condition _____ Additional Notes _____

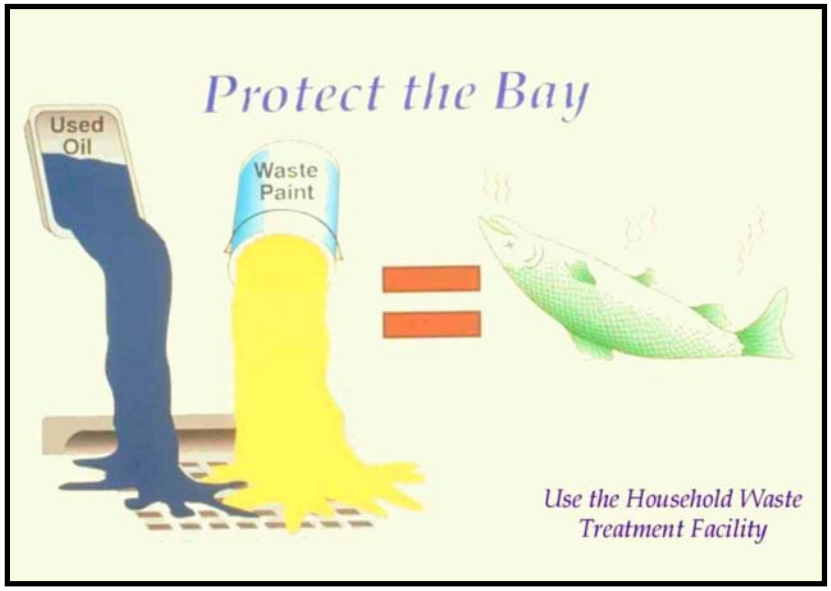
Site Map #	GPS Coordinates	Model #	Inspection of Inlet and Outlet Pipes, Joints, and Connections Between Modules	Trash or Sediment Accumulation (lbs) & Depth (inches)	Structural Notes	Operational Per Manufacturer's Specifications (If not, why?)
	Lat: Long:					
	Lat: Long:					
	Lat: Long:					

Comments:

Appendix 10: Educational Materials

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

Non-Stormwater Discharges SC-10



Objectives

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

Description

Non-stormwater discharges are those flows that do not consist entirely of stormwater. Some non-stormwater discharges do not include pollutants and may be discharged to the storm drain. These include uncontaminated groundwater and natural springs. There are also some non-stormwater discharges that typically do not contain pollutants and may be discharged to the storm drain with conditions. These include car washing, air conditioner condensate, etc. However there are certain non-stormwater discharges that pose environmental concern. These discharges may originate from illegal dumping or from internal floor drains, appliances, industrial processes, sinks, and toilets that are connected to the nearby storm drainage system. These discharges (which may include: process waste waters, cooling waters, wash waters, and sanitary wastewater) can carry substances such as paint, oil, fuel and other automotive fluids, chemicals and other pollutants into storm drains. They can generally be detected through a combination of detection and elimination. The ultimate goal is to effectively eliminate non-stormwater discharges to the stormwater drainage system through implementation of measures to detect, correct, and enforce against illicit connections and illegal discharges of pollutants on streets and into the storm drain system and creeks.

Targeted Constituents

Sediment	
Nutrients	✓
Trash	
Metals	✓
Bacteria	✓
Oil and Grease	✓
Organics	✓

Approach

Initially the industry must make an assessment of non-stormwater discharges to determine which types must be eliminated or addressed through BMPs. The focus of the following approach is in the elimination of non-stormwater discharges.

CASQA California Stormwater Quality Association

Pollution Prevention

- Ensure that used oil, used antifreeze, and hazardous chemical recycling programs are being implemented. Encourage litter control.

Suggested Protocols

Recommended Complaint Investigation Equipment

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

General

- Develop clear protocols and lines of communication for effectively prohibiting non-stormwater discharges, especially those that are not classified as hazardous. These are often not responded to as effectively as they need to be.
- Stencil or demarcate storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as “Dump No Waste Drains to Stream” stenciled or demarcated next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.

- See SC44 Stormwater Drainage System Maintenance for additional information.

Illicit Connections

- Locate discharges from the industrial storm drainage system to the municipal storm drain system through review of "as-built" piping schematics.
- Isolate problem areas and plug illicit discharge points.
- Locate and evaluate all discharges to the industrial storm drain system.

Visual Inspection and Inventory

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

Review Infield Piping

- A review of the "as-built" piping schematic is a way to determine if there are any connections to the stormwater collection system.
- Inspect the path of floor drains in older buildings.

Smoke Testing

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

Dye Testing

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

TV Inspection of Drainage System

- TV Cameras can be employed to visually identify illicit connections to the industrial storm drainage system.

Illegal Dumping

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- On paved surfaces, clean up spills with as little water as possible. Use a rag for small spills, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste.

- Never hose down or bury dry material spills. Sweep up the material and dispose of properly.
- Use adsorbent materials on small spills rather than hosing down the spill. Remove the adsorbent materials promptly and dispose of properly.
- For larger spills, a private spill cleanup company or Hazmat team may be necessary.

Once a site has been cleaned:

- Post "No Dumping" signs with a phone number for reporting dumping and disposal.
- Landscaping and beautification efforts of hot spots may also discourage future dumping, as well as provide open space and increase property values.
- Lighting or barriers may also be needed to discourage future dumping.
- See fact sheet SC11 Spill Prevention, Control, and Cleanup.

Inspection

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- Conduct field investigations of the industrial storm drain system for potential sources of non-stormwater discharges.
- Pro-actively conduct investigations of high priority areas. Based on historical data, prioritize specific geographic areas and/or incident type for pro-active investigations.

Reporting

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

Training

- Training of technical staff in identifying and documenting illegal dumping incidents is required.
- Consider posting the quick reference table near storm drains to reinforce training.
- Train employees to identify non-stormwater discharges and report discharges to the appropriate departments.

- Educate employees about spill prevention and cleanup.
- Well-trained employees can reduce human errors that lead to accidental releases or spills. The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur. Employees should be familiar with the Spill Prevention Control and Countermeasure Plan.
- Determine and implement appropriate outreach efforts to reduce non-permissible non-stormwater discharges.
- Conduct spill response drills annually (if no events occurred to evaluate your plan) in cooperation with other industries.
- When a responsible party is identified, educate the party on the impacts of his or her actions.

Spill Response and Prevention

- See SC11 Spill Prevention Control and Cleanup.

Other Considerations

- Many facilities do not have accurate, up-to-date schematic drawings.

Requirements

Costs (including capital and operation & maintenance)

- The primary cost is for staff time and depends on how aggressively a program is implemented.
- Cost for containment and disposal is borne by the discharger.
- Illicit connections can be difficult to locate especially if there is groundwater infiltration.
- Indoor floor drains may require re-plumbing if cross-connections to storm drains are detected.

Maintenance (including administrative and staffing)

- Illegal dumping and illicit connection violations requires technical staff to detect and investigate them.

Supplemental Information

Further Detail of the BMP

Illegal Dumping

- Substances illegally dumped on streets and into the storm drain systems and creeks include paints, used oil and other automotive fluids, construction debris, chemicals, fresh concrete, leaves, grass clippings, and pet wastes. All of these wastes cause stormwater and receiving water quality problems as well as clog the storm drain system itself.
- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Illegal dumping hot spots

- Types and quantities (in some cases) of wastes
- Patterns in time of occurrence (time of day/night, month, or year)
- Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)
- Responsible parties

One of the keys to success of reducing or eliminating illegal dumping is increasing the number of people at the facility who are aware of the problem and who have the tools to at least identify the incident, if not correct it. Therefore, train field staff to recognize and report the incidents.

What constitutes a "non-stormwater" discharge?

- Non-stormwater discharges to the stormwater collection system may include any water used directly in the manufacturing process (process wastewater), air conditioning condensate and coolant, non-contact cooling water, cooling equipment condensate, outdoor secondary containment water, vehicle and equipment wash water, sink and drinking fountain wastewater, sanitary wastes, or other wastewaters.

Permit Requirements

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

Performance Evaluation

- Review annually internal investigation results; assess whether goals were met and what changes or improvements are necessary.
- Obtain feedback from personnel assigned to respond to, or inspect for, illicit connections and illegal dumping incidents.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Spill Prevention, Control & Cleanup SC-11

Photo Credit: Geoff Brosseau

Objectives

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

Description

Many activities that occur at an industrial or commercial site have the potential to cause accidental or illegal spills. Preparation for accidental or illegal spills, with proper training and reporting systems implemented, can minimize the discharge of pollutants to the environment.

Spills and leaks are one of the largest contributors of stormwater pollutants. Spill prevention and control plans are applicable to any site at which hazardous materials are stored or used. An effective plan should have spill prevention and response procedures that identify potential spill areas, specify material handling procedures, describe spill response procedures, and provide spill clean-up equipment. The plan should take steps to identify and characterize potential spills, eliminate and reduce spill potential, respond to spills when they occur in an effort to prevent pollutants from entering the stormwater drainage system, and train personnel to prevent and control future spills.

Targeted Constituents

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

Approach

Pollution Prevention

- Develop procedures to prevent/mitigate spills to storm drain systems. Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures.

- Develop a Spill Prevention Control and Countermeasure (SPCC) Plan. The plan should include:

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- Description of the facility, owner and address, activities and chemicals present
- Facility map
- Notification and evacuation procedures
- Cleanup instructions
- Identification of responsible departments
- Identify key spill response personnel

- Recycle, reclaim, or reuse materials whenever possible. This will reduce the amount of process materials that are brought into the facility.

Suggested Protocols (including equipment needs)

Spill Prevention

- Develop procedures to prevent/mitigate spills to storm drain systems. Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures.

- If consistent illegal dumping is observed at the facility:
  - Post "No Dumping" signs with a phone number for reporting illegal dumping and disposal. Signs should also indicate fines and penalties applicable for illegal dumping.
  - Landscaping and beautification efforts may also discourage illegal dumping.
  - Bright lighting and/or entrance barriers may also be needed to discourage illegal dumping.

- Store and contain liquid materials in such a manner that if the tank is ruptured, the contents will not discharge, flow, or be washed into the storm drainage system, surface waters, or groundwater.

- If the liquid is oil, gas, or other material that separates from and floats on water, install a spill control device (such as a tee section) in the catch basins that collects runoff from the storage tank area.

- Routine maintenance:
  - Place drip pans or absorbent materials beneath all mounted taps, and at all potential drip and spill locations during filling and unloading of tanks. Any collected liquids or soiled absorbent materials must be reused/recycled or properly disposed.
  - Store and maintain appropriate spill cleanup materials in a location known to all near the tank storage area; and ensure that employees are familiar with the site's spill control plan and/or proper spill cleanup procedures.
  - Sweep and clean the storage area monthly if it is paved, *do not hose down the area to a storm drain.*

  - Check tanks (and any containment sumps) daily for leaks and spills. Replace tanks that are leaking, corroded, or otherwise deteriorating with tanks in good condition. Collect all spilled liquids and properly dispose of them.

- Label all containers according to their contents (e.g., solvent, gasoline).
- Label hazardous substances regarding the potential hazard (corrosive, radioactive, flammable, explosive, poisonous).
- Prominently display required labels on transported hazardous and toxic materials (per US DOT regulations).
- Identify key spill response personnel.

Spill Control and Cleanup Activities

- Follow the Spill Prevention Control and Countermeasure Plan.
- Clean up leaks and spills immediately.
- Place a stockpile of spill cleanup materials where it will be readily accessible (e.g., near storage and maintenance areas).
- On paved surfaces, clean up spills with as little water as possible. Use a rag for small spills, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste. Physical methods for the cleanup of dry chemicals include the use of brooms, shovels, sweepers, or plows.
- Never hose down or bury dry material spills. Sweep up the material and dispose of properly.
- Chemical cleanups of material can be achieved with the use of adsorbents, gels, and foams. Use adsorbent materials on small spills rather than hosing down the spill. Remove the adsorbent materials promptly and dispose of properly.
- For larger spills, a private spill cleanup company or Hazmat team may be necessary.

Reporting

- Report spills that pose an immediate threat to human health or the environment to the Regional Water Quality Control Board.
- Federal regulations require that any oil spill into a water body or onto an adjoining shoreline be reported to the National Response Center (NRC) at 800-424-8802 (24 hour).
- Report spills to local agencies, such as the fire department; they can assist in cleanup.
- Establish a system for tracking incidents. The system should be designed to identify the following:

  - Types and quantities (in some cases) of wastes

  - Patterns in time of occurrence (time of day/night, month, or year)

- Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)

- Responsible parties

Training

- Educate employees about spill prevention and cleanup.

- Well-trained employees can reduce human errors that lead to accidental releases or spills:

  - The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur.

  - Employees should be familiar with the Spill Prevention Control and Countermeasure Plan.

- Employees should be educated about aboveground storage tank requirements. Employees responsible for aboveground storage tanks and liquid transfers should be thoroughly familiar with the Spill Prevention Control and Countermeasure Plan and the plan should be readily available.

- Train employees to recognize and report illegal dumping incidents.

Other Considerations (Limitations and Regulations)

- A Spill Prevention Control and Countermeasure Plan (SPCC) is required for facilities that are subject to the oil pollution regulations specified in Part 112 of Title 40 of the Code of Federal Regulations or if they have a storage capacity of 10,000 gallons or more of petroleum. (Health and Safety Code 6.67)

- State regulations also exist for storage of hazardous materials (Health & Safety Code Chapter 6.95), including the preparation of area and business plans for emergency response to the releases or threatened releases.

- Consider requiring smaller secondary containment areas (less than 200 sq. ft.) to be connected to the sanitary sewer, prohibiting any hard connections to the storm drain.

Requirements

Costs (including capital and operation & maintenance)

- Will vary depending on the size of the facility and the necessary controls.

- Prevention of leaks and spills is inexpensive. Treatment and/or disposal of contaminated soil or water can be quite expensive.

Maintenance (including administrative and staffing)

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

Supplemental Information

Further Detail of the BMP

Reporting

Record keeping and internal reporting represent good operating practices because they can increase the efficiency of the facility and the effectiveness of BMPs. A good record keeping system helps the facility minimize incident recurrence, correctly respond with appropriate cleanup activities, and comply with legal requirements. A record keeping and reporting system should be set up for documenting spills, leaks, and other discharges, including discharges of hazardous substances in reportable quantities. Incident records describe the quality and quantity of non-stormwater discharges to the storm sewer. These records should contain the following information:

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

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

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

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

Aboveground Tank Leak and Spill Control

Accidental releases of materials from aboveground liquid storage tanks present the potential for contaminating stormwater with many different pollutants. Materials spilled, leaked, or lost from

tanks may accumulate in soils or on impervious surfaces and be carried away by stormwater runoff.

The most common causes of unintentional releases are:

- Installation problems
- Failure of piping systems (pipes, pumps, flanges, couplings, hoses, and valves)
- External corrosion and structural failure
- Spills and overfills due to operator error
- Leaks during pumping of liquids or gases from truck or rail car to a storage tank or vice versa

Storage of reactive, ignitable, or flammable liquids should comply with the Uniform Fire Code and the National Electric Code. Practices listed below should be employed to enhance the code requirements:

- Tanks should be placed in a designated area.
- Tanks located in areas where firearms are discharged should be encapsulated in concrete or the equivalent.
- Designated areas should be impervious and paved with Portland cement concrete, free of cracks and gaps, in order to contain leaks and spills.
- Liquid materials should be stored in UL approved double walled tanks or surrounded by a curb or dike to provide the volume to contain 10 percent of the volume of all of the containers or 110 percent of the volume of the largest container, whichever is greater. The area inside the curb should slope to a drain.
- For used oil or dangerous waste, a dead-end sump should be installed in the drain.
- All other liquids should be drained to the sanitary sewer if available. The drain must have a positive control such as a lock, valve, or plug to prevent release of contaminated liquids.
- Accumulated stormwater in petroleum storage areas should be passed through an oil/water separator.

Maintenance is critical to preventing leaks and spills. Conduct routine inspections and:

- Check for external corrosion and structural failure.
- Check for spills and overfills due to operator error.
- Check for failure of piping system (pipes, pumps, flanger, coupling, hoses, and valves).
- Check for leaks or spills during pumping of liquids or gases from truck or rail car to a storage facility or vice versa.

- Visually inspect new tank or container installation for loose fittings, poor welding, and improper or poorly fitted gaskets.
- Inspect tank foundations, connections, coatings, and tank walls and piping system. Look for corrosion, leaks, cracks, scratches, and other physical damage that may weaken the tank or container system.
- Frequently relocate accumulated stormwater during the wet season.
- Periodically conduct integrity testing by a qualified professional.

Vehicle Leak and Spill Control

Major spills on roadways and other public areas are generally handled by highly trained Hazmat teams from local fire departments or environmental health departments. The measures listed below pertain to leaks and smaller spills at vehicle maintenance shops.

In addition to implementing the spill prevention, control, and clean up practices above, use the following measures related to specific activities:

Vehicle and Equipment Maintenance

- Perform all vehicle fluid removal or changing inside or under cover to prevent the run-on of stormwater and the runoff of spills.
- Regularly inspect vehicles and equipment for leaks, and repair immediately.
- Check incoming vehicles and equipment (including delivery trucks, and employee and subcontractor vehicles) for leaking oil and fluids. Do not allow leaking vehicles or equipment onsite.
- Always use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
- Immediately drain all fluids from wrecked vehicles.
- Store wrecked vehicles or damaged equipment under cover.
- Place drip pans or absorbent materials under heavy equipment when not in use.
- Use adsorbent materials on small spills rather than hosing down the spill.
- Remove the adsorbent materials promptly and dispose of properly.
- Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around.
- Oil filters disposed of in trashcans or dumpsters can leak oil and contaminate stormwater. Place the oil filter in a funnel over a waste oil recycling drum to drain excess oil before disposal. Oil filters can also be recycled. Ask your oil supplier or recycler about recycling oil filters.

- Store cracked batteries in a non-leaking secondary container. Do this with all cracked batteries, even if you think all the acid has drained out. If you drop a battery, treat it as if it is cracked. Put it into the containment area until you are sure it is not leaking.

Vehicle and Equipment Fueling

- Design the fueling area to prevent the run-on of stormwater and the runoff of spills:
  - Cover fueling area if possible.
  - Use a perimeter drain or slope pavement inward with drainage to a sump.
  - Pave fueling area with concrete rather than asphalt.
- If dead-end sump is not used to collect spills, install an oil/water separator.
- Install vapor recovery nozzles to help control drips as well as air pollution.
- Discourage "topping-off' of fuel tanks.
- Use secondary containment when transferring fuel from the tank truck to the fuel tank.
- Use adsorbent materials on small spills and general cleaning rather than hosing down the area. Remove the adsorbent materials promptly.
- Carry out all Federal and State requirements regarding underground storage tanks, or install above ground tanks.
- Do not use mobile fueling of mobile industrial equipment around the facility; rather, transport the equipment to designated fueling areas.
- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Train employees in proper fueling and cleanup procedures.

Industrial Spill Prevention Response

For the purposes of developing a spill prevention and response program to meet the stormwater regulations, facility managers should use information provided in this fact sheet and the spill prevention/response portions of the fact sheets in this handbook, for specific activities. The program should:

- Integrate with existing emergency response/hazardous materials programs (e.g., Fire Department)
- Develop procedures to prevent/mitigate spills to storm drain systems
- Identify responsible departments
- Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures
- Address spills at municipal facilities, as well as public areas

- Provide training concerning spill prevention, response and cleanup to all appropriate personnel

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Stormwater Managers Resource Center http://www.stormwatercenter.net/

Building & Grounds Maintenance SC-41

Objectives

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

Targeted Constituents

Sediment	✓
Nutrients	✓
Trash	
Metals	✓
Bacteria	✓
Oil and Grease	
Organics	

Description

Stormwater runoff from building and grounds maintenance activities can be contaminated with toxic hydrocarbons in solvents, fertilizers and pesticides, suspended solids, heavy metals, abnormal pH, and oils and greases. Utilizing the protocols in this fact sheet will prevent or reduce the discharge of pollutants to stormwater from building and grounds maintenance activities by washing and cleaning up with as little water as possible, following good landscape management practices, preventing and cleaning up spills immediately, keeping debris from entering the storm drains, and maintaining the stormwater collection system.

Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Switch to non-toxic chemicals for maintenance when possible.
- Choose cleaning agents that can be recycled.
- Encourage proper lawn management and landscaping, including use of native vegetation.

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- Encourage use of Integrated Pest Management techniques for pest control.
- Encourage proper onsite recycling of yard trimmings.
- Recycle residual paints, solvents, lumber, and other material as much as possible.

Suggested Protocols

Pressure Washing of Buildings, Rooftops, and Other Large Objects

- In situations where soaps or detergents are used and the surrounding area is paved, pressure washers must use a water collection device that enables collection of wash water and associated solids. A sump pump, wet vacuum or similarly effective device must be used to collect the runoff and loose materials. The collected runoff and solids must be disposed of properly.
- If soaps or detergents are not used, and the surrounding area is paved, wash runoff does not have to be collected but must be screened. Pressure washers must use filter fabric or some other type of screen on the ground and/or in the catch basin to trap the particles in wash water runoff.
- If you are pressure washing on a grassed area (with or without soap), runoff must be dispersed as sheet flow as much as possible, rather than as a concentrated stream. The wash runoff must remain on the grass and not drain to pavement.

Landscaping Activities

- Dispose of grass clippings, leaves, sticks, or other collected vegetation as garbage, or by composting. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures on exposed soils.

Building Repair, Remodeling, and Construction

- Do not dump any toxic substance or liquid waste on the pavement, the ground, or toward a storm drain.
- Use ground or drop cloths underneath outdoor painting, scraping, and sandblasting work, and properly dispose of collected material daily.
- Use a ground cloth or oversized tub for activities such as paint mixing and tool cleaning.
- Clean paintbrushes and tools covered with water-based paints in sinks connected to sanitary sewers or in portable containers that can be dumped into a sanitary sewer drain. Brushes and tools covered with non-water-based paints, finishes, or other materials must be cleaned in a manner that enables collection of used solvents (e.g., paint thinner, turpentine, etc.) for recycling or proper disposal.
- Use a storm drain cover, filter fabric, or similarly effective runoff control mechanism if dust, grit, wash water, or other pollutants may escape the work area and enter a catch basin. This is particularly necessary on rainy days. The containment device(s) must be in place at the beginning of the work day, and accumulated dirty runoff and solids must be collected and disposed of before removing the containment device(s) at the end of the work day.

- If you need to de-water an excavation site, you may need to filter the water before discharging to a catch basin or off-site. If directed off-site, you should direct the water through hay bales and filter fabric or use other sediment filters or traps.
- Store toxic material under cover during precipitation events and when not in use. A cover would include tarps or other temporary cover material.

Mowing, Trimming, and Planting

- Dispose of leaves, sticks, or other collected vegetation as garbage, by composting or at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures when soils are exposed.
- Place temporarily stockpiled material away from watercourses and drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.
- Consider an alternative approach when bailing out muddy water: do not put it in the storm drain; pour over landscaped areas.
- Use hand weeding where practical.

Fertilizer and Pesticide Management

- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.
- Use less toxic pesticides that will do the job when applicable. Avoid use of copper-based pesticides if possible.
- Do not use pesticides if rain is expected.
- Do not mix or prepare pesticides for application near storm drains.
- Use the minimum amount needed for the job.
- Calibrate fertilizer distributors to avoid excessive application.
- Employ techniques to minimize off-target application (e.g., spray drift) of pesticides, including consideration of alternative application techniques.
- Apply pesticides only when wind speeds are low.
- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
- Irrigate slowly to prevent runoff and then only as much as is needed.
- Clean pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Dispose of empty pesticide containers according to the instructions on the container label.

- Use up the pesticides. Rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Implement storage requirements for pesticide products with guidance from the local fire department and County Agricultural Commissioner. Provide secondary containment for pesticides.

Inspection

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering and repair leaks in the irrigation system as soon as they are observed.

Training

- Educate and train employees on pesticide use and in pesticide application techniques to prevent pollution.
- Train employees and contractors in proper techniques for spill containment and cleanup.
- Be sure the frequency of training takes into account the complexity of the operations and the nature of the staff.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials, such as brooms, dustpans, and vacuum sweepers (if desired) near the storage area where it will be readily accessible.
- Have employees trained in spill containment and cleanup present during the loading/unloading of dangerous wastes, liquid chemicals, or other materials.
- Familiarize employees with the Spill Prevention Control and Countermeasure Plan.
- Clean up spills immediately.

Other Considerations

Alternative pest/weed controls may not be available, suitable, or effective in many cases.

Requirements

Costs

- Cost will vary depending on the type and size of facility.
- Overall costs should be low in comparison to other BMPs.

Maintenance

Sweep paved areas regularly to collect loose particles. Wipe up spills with rags and other absorbent material immediately, do not hose down the area to a storm drain.

Supplemental Information

Further Detail of the BMP

Fire Sprinkler Line Flushing

Building fire sprinkler line flushing may be a source of non-stormwater runoff pollution. The water entering the system is usually potable water, though in some areas it may be non-potable reclaimed wastewater. There are subsequent factors that may drastically reduce the quality of the water in such systems. Black iron pipe is usually used since it is cheaper than potable piping, but it is subject to rusting and results in lower quality water. Initially, the black iron pipe has an oil coating to protect it from rusting between manufacture and installation; this will contaminate the water from the first flush but not from subsequent flushes. Nitrates, poly-phosphates and other corrosion inhibitors, as well as fire suppressants and antifreeze may be added to the sprinkler water system. Water generally remains in the sprinkler system a long time (typically a year) and between flushes may accumulate iron, manganese, lead, copper, nickel, and zinc. The water generally becomes anoxic and contains living and dead bacteria and breakdown products from chlorination. This may result in a significant BOD problem and the water often smells. Consequently dispose fire sprinkler line flush water into the sanitary sewer. Do not allow discharge to storm drain or infiltration due to potential high levels of pollutants in fire sprinkler line water.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Mobile Cleaners Pilot Program: Final Report. 1997. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Building Repair and Construction SC-42

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Recycle

Targeted Constituents

Sediment	✓
Nutrients	
Trash	✓
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

Description

Modifications are common particularly at large industrial sites. The activity may vary from minor and normal building repair to major remodeling, or the construction of new facilities. These activities can generate pollutants including solvents, paints, paint and varnish removers, finishing residues, spent thinners, soap cleaners, kerosene, asphalt and concrete materials, adhesive residues, and old asbestos installation. Protocols in this fact sheet are intended to prevent or reduce the discharge of pollutants to stormwater from building repair, remodeling, and construction by using soil erosion controls, enclosing or covering building material storage areas, using good housekeeping practices, using safer alternative products, and training employees.

Approach

Pollution Prevention

- Recycle residual paints, solvents, lumber, and other materials to the maximum extent practical.
- Buy recycled products to the maximum extent practical.
- Inform on-site contractors of company policy on these matters and include appropriate provisions in their contract to ensure certain proper housekeeping and disposal practices are implemented.

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- Make sure that nearby storm drains are well marked to minimize the chance of inadvertent disposal of residual paints and other liquids.

Suggested Protocols

Repair & Remodeling

- Follow BMPs identified in Construction BMP Handbook.
- Maintain good housekeeping practices while work is underway.
- Keep the work site clean and orderly. Remove debris in a timely fashion. Sweep the area.
- Cover materials of particular concern that must be left outside, particularly during the rainy season.
- Do not dump waste liquids down the storm drain.
- Dispose of wash water, sweepings, and sediments properly.
- Store materials properly that are normally used in repair and remodeling such as paints and solvents.
- Sweep out the gutter or wash the gutter and trap the particles at the outlet of the downspout if when repairing roofs, small particles have accumulated in the gutter. A sock or geofabric placed over the outlet may effectively trap the materials. If the downspout is tight lined, place a temporary plug at the first convenient point in the storm drain and pump out the water with a vactor truck, and clean the catch basin sump where you placed the plug.
- Properly store and dispose waste materials generated from construction activities. See Construction BMP Handbook.
- Clean the storm drain system in the immediate vicinity of the construction activity after it is completed.

Painting

- Enclose painting operations consistent with local air quality regulations and OSHA.
- Local air pollution regulations may, in many areas of the state, specify painting procedures which if properly carried out are usually sufficient to protect water quality.
- Develop paint handling procedures for proper use, storage, and disposal of paints.
- Transport paint and materials to and from job sites in containers with secure lids and tied down to the transport vehicle.
- Test and inspect spray equipment prior to starting to paint. Tighten all hoses and connections and do not overfill paint containers.
- Mix paint indoors before using so that any spill will not be exposed to rain. Do so even during dry weather because cleanup of a spill will never be 100% effective.
- Transfer and load paint and hot thermoplastic away from storm drain inlets.

- Do not transfer or load paint near storm drain inlets.
- Plug nearby storm drain inlets prior to starting painting and remove plugs when job is complete when there is significant risk of a spill reaching storm drains.
- Cover nearby storm drain inlets prior to starting work if sand blasting is used to remove paint.
- Use a ground cloth to collect the chips if painting requires scraping or sand blasting of the existing surface. Dispose the residue properly.
- Cover or enclose painting operations properly to avoid drift.
- Clean the application equipment in a sink that is connected to the sanitary sewer if using water based paints.
- Capture all cleanup-water and dispose of properly.
- Dispose of paints containing lead or tributyl tin and considered a hazardous waste properly.
- Store leftover paints if they are to be kept for the next job properly, or dispose properly.
- Recycle paint when possible. Dispose of paint at an appropriate household hazardous waste facility.

Training

Proper education of off-site contractors is often overlooked. The conscientious efforts of well trained employees can be lost by unknowing off-site contractors, so make sure they are well informed about what they are expected to do.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials where it will be readily accessible.
- Clean up spills immediately.
- Excavate and remove the contaminated (stained) soil if a spill occurs on dirt.

Limitations

- This BMP is for minor construction only. The State's General Construction Activity Stormwater Permit has more requirements for larger projects. The companion "Construction Best Management Practice Handbook" contains specific guidance and best management practices for larger-scale projects.
- Hazardous waste that cannot be reused or recycled must be disposed of by a licensed hazardous waste hauler.
- Be certain that actions to help stormwater quality are consistent with Cal- and Fed-OSHA and air quality regulations.

SC-42 Building Repair and Construction

Requirements

Costs

These BMPs are generally low to modest in cost.

Maintenance

N/A

Supplemental Information

Further Detail of the BMP

Soil/Erosion Control

If the work involves exposing large areas of soil, employ the appropriate soil erosion and control techniques. See the Construction Best Management Practice Handbook. If old buildings are being torn down and not replaced in the near future, stabilize the site using measures described in SC-40 Contaminated or Erodible Areas.

If a building is to be placed over an open area with a storm drainage system, make sure the storm inlets within the building are covered or removed, or the storm line is connected to the sanitary sewer. If because of the remodeling a new drainage system is to be installed or the existing system is to be modified, consider installing catch basins as they serve as effective "in-line" treatment devices. See Treatment Control Fact Sheet TC-20 Wet Pond/Basin in Section 5 of the New Development and Redevelopment Handbook regarding design criteria. Include in the catch basin a "turn-down" elbow or similar device to trap floatables.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Parking/Storage Area Maintenance SC-43

Objectives

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

Targeted Constituents

Sediment	✓
Nutrients	
Trash	✓
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

Description

Parking lots and storage areas can contribute a number of substances, such as trash, suspended solids, hydrocarbons, oil and grease, and heavy metals that can enter receiving waters through stormwater runoff or non-stormwater discharges. The protocols in this fact sheet are intended to prevent or reduce the discharge of pollutants from parking/storage areas and include using good housekeeping practices, following appropriate cleaning BMPs, and training employees.

Approach

The goal of this program is to ensure stormwater pollution prevention practices are considered when conducting activities on or around parking areas and storage areas to reduce potential for pollutant discharge to receiving waters. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Encourage alternative designs and maintenance strategies for impervious parking lots. (See New Development and Redevelopment BMP Handbook)
- Keep accurate maintenance logs to evaluate BMP implementation.

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SC-43 Parking/Storage Area Maintenance

Suggested Protocols

General

- Keep the parking and storage areas clean and orderly. Remove debris in a timely fashion.
- Allow sheet runoff to flow into biofilters (vegetated strip and swale) and/or infiltration devices.
- Utilize sand filters or oleophilic collectors for oily waste in low quantities.
- Arrange rooftop drains to prevent drainage directly onto paved surfaces.
- Design lot to include semi-permeable hardscape.
- Discharge soapy water remaining in mop or wash buckets to the sanitary sewer through a sink, toilet, clean-out, or wash area with drain.

Controlling Litter

- Post "No Littering" signs and enforce anti-litter laws.
- Provide an adequate number of litter receptacles.
- Clean out and cover litter receptacles frequently to prevent spillage.
- Provide trash receptacles in parking lots to discourage litter.
- Routinely sweep, shovel, and dispose of litter in the trash.

Surface Cleaning

- Use dry cleaning methods (e.g., sweeping, vacuuming) to prevent the discharge of pollutants into the stormwater conveyance system if possible.
- Establish frequency of public parking lot sweeping based on usage and field observations of waste accumulation.
- Sweep all parking lots at least once before the onset of the wet season.
- Follow the procedures below if water is used to clean surfaces:
  - Block the storm drain or contain runoff.
  - Collect and pump wash water to the sanitary sewer or discharge to a pervious surface. Do not allow wash water to enter storm drains.
  - Dispose of parking lot sweeping debris and dirt at a landfill.
- Follow the procedures below when cleaning heavy oily deposits:
  - Clean oily spots with absorbent materials.
  - Use a screen or filter fabric over inlet, then wash surfaces.

- Do not allow discharges to the storm drain.
- Vacuum/pump discharges to a tank or discharge to sanitary sewer.
- Appropriately dispose of spilled materials and absorbents.

Surface Repair

- Preheat, transfer or load hot bituminous material away from storm drain inlets.
- Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff.
- Cover and seal nearby storm drain inlets where applicable (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal.
- Use only as much water as necessary for dust control, to avoid runoff.
- Catch drips from paving equipment that is not in use with pans or absorbent material placed under the machines. Dispose of collected material and absorbents properly.

Inspection

- Have designated personnel conduct inspections of parking facilities and stormwater conveyance systems associated with parking facilities on a regular basis.
- Inspect cleaning equipment/sweepers for leaks on a regular basis.

Training

- Provide regular training to field employees and/or contractors regarding cleaning of paved areas and proper operation of equipment.
- Train employees and contractors in proper techniques for spill containment and cleanup.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials where it will be readily accessible or at a central location.
- Clean up fluid spills immediately with absorbent rags or material.
- Dispose of spilled material and absorbents properly.

Other Considerations

Limitations related to sweeping activities at large parking facilities may include high equipment costs, the need for sweeper operator training, and the inability of current sweeper technology to remove oil and grease.

SC-43 Parking/Storage Area Maintenance

Requirements

Costs

Cleaning/sweeping costs can be quite large. Construction and maintenance of stormwater structural controls can be quite expensive as well.

Maintenance

- Sweep parking lot regularly to minimize cleaning with water.
- Clean out oil/water/sand separators regularly, especially after heavy storms.
- Clean parking facilities regularly to prevent accumulated wastes and pollutants from being discharged into conveyance systems during rainy conditions.

Supplemental Information

Further Detail of the BMP

Surface Repair

Apply concrete, asphalt, and seal coat during dry weather to prevent contamination from contacting stormwater runoff. Where applicable, cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal. Only use only as much water as is necessary for dust control to avoid runoff.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Drainage System Maintenance SC-44

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize

Description

As a consequence of its function, the stormwater conveyance system collects and transports urban runoff and stormwater that may contain certain pollutants. The protocols in this fact sheet are intended to reduce pollutants reaching receiving waters through proper conveyance system operation and maintenance.

Targeted Constituents

Sediment	✓
Nutrients	
Trash	✓
Metals	
Bacteria	✓
Oil and Grease	
Organics	

Approach

Pollution Prevention

Maintain catch basins, stormwater inlets, and other stormwater conveyance structures on a regular basis to remove pollutants, reduce high pollutant concentrations during the first flush of storms, prevent clogging of the downstream conveyance system, restore catch basins' sediment trapping capacity, and ensure the system functions properly hydraulically to avoid flooding.

Suggested Protocols

Catch Basins/Inlet Structures

- Staff should regularly inspect facilities to ensure compliance with the following:
  - Immediate repair of any deterioration threatening structural integrity.
  - Cleaning before the sump is 40% full. Catch basins should be cleaned as frequently as needed to meet this standard.
  - Stenciling of catch basins and inlets (see SC34 Waste Handling and Disposal).

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- Clean catch basins, storm drain inlets, and other conveyance structures before the wet season to remove sediments and debris accumulated during the summer.
- Conduct inspections more frequently during the wet season for problem areas where sediment or trash accumulates more often. Clean and repair as needed.
- Keep accurate logs of the number of catch basins cleaned.
- Store wastes collected from cleaning activities of the drainage system in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain.
- Dewater the wastes if necessary with outflow into the sanitary sewer if permitted. Water should be treated with an appropriate filtering device prior to discharge to the sanitary sewer. If discharge to the sanitary sewer is not allowed, water should be pumped or vacuumed to a tank and properly disposed. Do not dewater near a storm drain or stream.

Storm Drain Conveyance System

- Locate reaches of storm drain with deposit problems and develop a flushing schedule that keeps the pipe clear of excessive buildup.
- Collect and pump flushed effluent to the sanitary sewer for treatment whenever possible.

Pump Stations

- Clean all storm drain pump stations prior to the wet season to remove silt and trash.
- Do not allow discharge to reach the storm drain system when cleaning a storm drain pump station or other facility.
- Conduct routine maintenance at each pump station.
- Inspect, clean, and repair as necessary all outlet structures prior to the wet season.

Open Channel

- Modify storm channel characteristics to improve channel hydraulics, increase pollutant removals, and enhance channel/creek aesthetic and habitat value.
- Conduct channel modification/improvement in accordance with existing laws. Any person, government agency, or public utility proposing an activity that will change the natural (emphasis added) state of any river, stream, or lake in California, must enter into a Steam or Lake Alteration Agreement with the Department of Fish and Game. The developer-applicant should also contact local governments (city, county, special districts), other state agencies (SWRCB, RWQCB, Department of Forestry, Department of Water Resources), and Federal Corps of Engineers and USFWS.

Illicit Connections and Discharges

- Look for evidence of illegal discharges or illicit connections during routine maintenance of conveyance system and drainage structures:
  - Is there evidence of spills such as paints, discoloring, etc?

- Are there any odors associated with the drainage system?
- Record locations of apparent illegal discharges/illicit connections?
- Track flows back to potential dischargers and conduct aboveground inspections. This can be done through visual inspection of upgradient manholes or alternate techniques including zinc chloride smoke testing, fluorometric dye testing, physical inspection testing, or television camera inspection.
- Eliminate the discharge once the origin of flow is established.

- Stencil or demarcate storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste Drains to Stream" stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Illegal Dumping

- Inspect and clean up hot spots and other storm drainage areas regularly where illegal dumping and disposal occurs.
- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Illegal dumping hot spots
  - Types and quantities (in some cases) of wastes
  - Patterns in time of occurrence (time of day/night, month, or year)
  - Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)
  - Responsible parties
- Post "No Dumping" signs in problem areas with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Training

- Train crews in proper maintenance activities, including record keeping and disposal.
- Allow only properly trained individuals to handle hazardous materials/wastes.
- Have staff involved in detection and removal of illicit connections trained in the following:
  - OSHA-required Health and Safety Training (29 CFR 1910.120) plus annual refresher training (as needed).

- OSHA Confined Space Entry training (Cal-OSHA Confined Space, Title 8 and Federal OSHA 29 CFR 1910.146).

- Procedural training (field screening, sampling, smoke/dye testing, TV inspection).

Spill Response and Prevention

- Investigate all reports of spills, leaks, and/or illegal dumping promptly.
- Clean up all spills and leaks using "dry" methods (with absorbent materials and/or rags) or dig up, remove, and properly dispose of contaminated soil.
- Refer to fact sheet SC-11 Spill Prevention, Control, and Cleanup.

Other Considerations (Limitations and Regulations)

- Clean-up activities may create a slight disturbance for local aquatic species. Access to items and material on private property may be limited. Trade-offs may exist between channel hydraulics and water quality/riparian habitat. If storm channels or basins are recognized as wetlands, many activities, including maintenance, may be subject to regulation and permitting.
- Storm drain flushing is most effective in small diameter pipes (36-inch diameter pipe or less, depending on water supply and sediment collection capacity). Other considerations associated with storm drain flushing may include the availability of a water source, finding a downstream area to collect sediments, liquid/sediment disposal, and prohibition against disposal of flushed effluent to sanitary sewer in some areas.
- Regulations may include adoption of substantial penalties for illegal dumping and disposal.
- Local municipal codes may include sections prohibiting discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.

Requirements

Costs

- An aggressive catch basin cleaning program could require a significant capital and O&M budget.
- The elimination of illegal dumping is dependent on the availability, convenience, and cost of alternative means of disposal. The primary cost is for staff time. Cost depends on how aggressively a program is implemented. Other cost considerations for an illegal dumping program include:

  - Purchase and installation of signs.

  - Rental of vehicle(s) to haul illegally-disposed items and material to landfills.

  - Rental of heavy equipment to remove larger items (e.g., car bodies) from channels.

  - Purchase of landfill space to dispose of illegally-dumped items and material.

- Methods used for illicit connection detection (smoke testing, dye testing, visual inspection, and flow monitoring) can be costly and time-consuming. Site-specific factors, such as the level of impervious area, the density and ages of buildings, and type of land use will determine the level of investigation necessary.

Maintenance

- Two-person teams may be required to clean catch basins with vactor trucks.
- Teams of at least two people plus administrative personnel are required to identify illicit discharges, depending on the complexity of the storm sewer system.
- Arrangements must be made for proper disposal of collected wastes.
- Technical staff are required to detect and investigate illegal dumping violations.

Supplemental Information

Further Detail of the BMP

Storm Drain Flushing

Flushing is a common maintenance activity used to improve pipe hydraulics and to remove pollutants in storm drainage systems. Flushing may be designed to hydraulically convey accumulated material to strategic locations, such as an open channel, another point where flushing will be initiated, or the sanitary sewer and the treatment facilities, thus preventing resuspension and overflow of a portion of the solids during storm events. Flushing prevents "plug flow" discharges of concentrated pollutant loadings and sediments. Deposits can hinder the designed conveyance capacity of the storm drain system and potentially cause backwater conditions in severe cases of clogging.

Storm drain flushing usually takes place along segments of pipe with grades that are too flat to maintain adequate velocity to keep particles in suspension. An upstream manhole is selected to place an inflatable device that temporarily plugs the pipe. Further upstream, water is pumped into the line to create a flushing wave. When the upstream reach of pipe is sufficiently full to cause a flushing wave, the inflated device is rapidly deflated with the assistance of a vacuum pump, thereby releasing the backed up water and resulting in the cleaning of the storm drain segment.

To further reduce impacts of stormwater pollution, a second inflatable device placed well downstream may be used to recollect the water after the force of the flushing wave has dissipated. A pump may then be used to transfer the water and accumulated material to the sanitary sewer for treatment. In some cases, an interceptor structure may be more practical or required to recollect the flushed waters.

It has been found that cleansing efficiency of periodic flush waves is dependent upon flush volume, flush discharge rate, sewer slope, sewer length, sewer flow rate, sewer diameter, and population density. As a rule of thumb, the length of line to be flushed should not exceed 700 feet. At this maximum recommended length, the percent removal efficiency ranges between 65-75% for organics and 55-65% for dry weather grit/inorganic material. The percent removal efficiency drops rapidly beyond that. Water is commonly supplied by a water truck, but fire hydrants can also supply water. To make the best use of water, it is recommended that reclaimed water be used or that fire hydrant line flushing coincide with storm sewer flushing.

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

Ferguson, B.K. 1991. Urban Stream Reclamation, p. 324-322, Journal of Soil and Water Conservation.

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Storm Water Managers Resource Center http://www.stormwatercenter.net

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Storm Drain System Cleaning. On line:
http://www.epa.gov/npdes/menuofbmps/poll_16.htm

Housekeeping Practices SC-60

Description

Promote efficient and safe housekeeping practices (storage, use, and cleanup) when handling potentially harmful materials such as fertilizers, pesticides, cleaning solutions, paint products, automotive products, and swimming pool chemicals. Related information is provided in BMP fact sheets SC-11 Spill Prevention, Control & Cleanup and SC-34 Waste Handling & Disposal.

Approach

Pollution Prevention

- Purchase only the amount of material that will be needed for foreseeable use. In most cases this will result in cost savings in both purchasing and disposal. See SC-61 Safer Alternative Products for additional information.
- Be aware of new products that may do the same job with less environmental risk and for less or the equivalent cost. Total cost must be used here; this includes purchase price, transportation costs, storage costs, use related costs, clean up costs and disposal costs.

Suggested Protocols

General

- Keep work sites clean and orderly. Remove debris in a timely fashion. Sweep the area.
- Dispose of wash water, sweepings, and sediments, properly.
- Recycle or dispose of fluids properly.
- Establish a daily checklist of office, yard and plant areas to confirm cleanliness and adherence to proper storage and security. Specific employees should be assigned specific inspection responsibilities and given the authority to remedy any problems found.
- Post waste disposal charts in appropriate locations detailing for each waste its hazardous nature (poison, corrosive, flammable), prohibitions on its disposal (dumpster, drain, sewer) and the recommended disposal method (recycle, sewer, burn, storage, landfill).
- Summarize the chosen BMPs applicable to your operation and post them in appropriate conspicuous places.

Objectives

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

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	☑
Bacteria	☑
Oil and Grease	☑
Organics	☑
Oxygen Demanding	☑

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- Require a signed checklist from every user of any hazardous material detailing amount taken, amount used, amount returned and disposal of spent material.
- Do a before audit of your site to establish baseline conditions and regular subsequent audits to note any changes and whether conditions are improving or deteriorating.
- Keep records of water, air and solid waste quantities and quality tests and their disposition.
- Maintain a mass balance of incoming, outgoing and on hand materials so you know when there are unknown losses that need to be tracked down and accounted for.
- Use and reward employee suggestions related to BMPs, hazards, pollution reduction, work place safety, cost reduction, alternative materials and procedures, recycling and disposal.
- Have, and review regularly, a contingency plan for spills, leaks, weather extremes etc. Make sure all employees know about it and what their role is so that it comes into force automatically.

Training

- Train all employees, management, office, yard, manufacturing, field and clerical in BMPs and pollution prevention and make them accountable.
- Train municipal employees who handle potentially harmful materials in good housekeeping practices.
- Train personnel who use pesticides in the proper use of the pesticides. The California Department of Pesticide Regulation license pesticide dealers, certify pesticide applicators and conduct onsite inspections.
- Train employees and contractors in proper techniques for spill containment and cleanup. The employee should have the tools and knowledge to immediately begin cleaning up a spill if one should occur.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Keep your Spill Prevention Control and Countermeasure (SPCC) plant up-to-date, and implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- There are no major limitations to this best management practice.
- There are no regulatory requirements to this BMP. Existing regulations already require municipalities to properly store, use, and dispose of hazardous materials

Requirements

Costs

- Minimal cost associated with this BMP. Implementation of good housekeeping practices may result in cost savings as these procedures may reduce the need for more costly BMPs.

Maintenance

- Ongoing maintenance required to keep a clean site. Level of effort is a function of site size and type of activities.

Supplemental Information

Further Detail of the BMP

- The California Integrated Waste Management Board's Recycling Hotline, 1-800-553-2962, provides information on household hazardous waste collection programs and facilities.

Examples

There are a number of communities with effective programs. The most pro-active include Santa Clara County and the City of Palo Alto, the City and County of San Francisco, and the Municipality of Metropolitan Seattle (Metro).

References and Resources

British Columbia Lake Stewardship Society. Best Management Practices to Protect Water Quality from Non-Point Source Pollution. March 2000.
http://www.nalms.org/bclss/bmphome.html#bmp

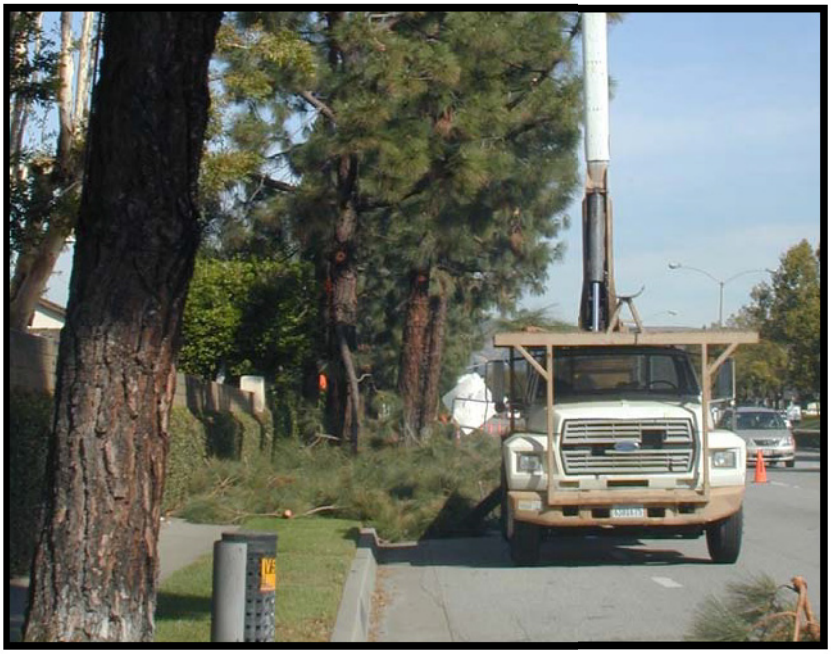
King County Stormwater Pollution Control Manual - http://dnr.metrokc.gov/wlr/dss/spcm.htm

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities, Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality Control Board. July, 1998, Revised by California Coastal Commission, February 2002.

Orange County Stormwater Program
http://www.ocwatersheds.com/stormwater/swp_introduction.asp

San Mateo STOPPP - (http://stoppp.tripod.com/bmp.html)

Landscape Maintenance SC-73



Objectives

- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	
Bacteria	
Oil and Grease	
Organics	
Oxygen Demanding	☑

Description

Landscape maintenance activities include vegetation removal; herbicide and insecticide application; fertilizer application; watering; and other gardening and lawn care practices. Vegetation control typically involves a combination of chemical (herbicide) application and mechanical methods. All of these maintenance practices have the potential to contribute pollutants to the storm drain system. The major objectives of this BMP are to minimize the discharge of pesticides, herbicides and fertilizers to the storm drain system and receiving waters; prevent the disposal of landscape waste into the storm drain system by collecting and properly disposing of clippings and cuttings, and educating employees and the public.

Approach

Pollution Prevention

- Implement an integrated pest management (IPM) program. IPM is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools.
- Choose low water using flowers, trees, shrubs, and groundcover.
- Consider alternative landscaping techniques such as naturescaping and xeriscaping.
- Conduct appropriate maintenance (i.e. properly timed fertilizing, weeding, pest control, and pruning) to help preserve the landscapes water efficiency.

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- Consider grass cycling (grass cycling is the natural recycling of grass by leaving the clippings on the lawn when mowing. Grass clippings decompose quickly and release valuable nutrients back into the lawn).

Suggested Protocols

Mowing, Trimming, and Weeding

- Whenever possible use mechanical methods of vegetation removal (e.g mowing with tractor-type or push mowers, hand cutting with gas or electric powered weed trimmers) rather than applying herbicides. Use hand weeding where practical.
- Avoid loosening the soil when conducting mechanical or manual weed control, this could lead to erosion. Use mulch or other erosion control measures when soils are exposed.
- Performing mowing at optimal times. Mowing should not be performed if significant rain events are predicted.
- Mulching mowers may be recommended for certain flat areas. Other techniques may be employed to minimize mowing such as selective vegetative planting using low maintenance grasses and shrubs.
- Collect lawn and garden clippings, pruning waste, tree trimmings, and weeds. Chip if necessary, and compost or dispose of at a landfill (see waste management section of this fact sheet).
- Place temporarily stockpiled material away from watercourses, and berm or cover stockpiles to prevent material releases to storm drains.

Planting

- Determine existing native vegetation features (location, species, size, function, importance) and consider the feasibility of protecting them. Consider elements such as their effect on drainage and erosion, hardiness, maintenance requirements, and possible conflicts between preserving vegetation and the resulting maintenance needs.
- Retain and/or plant selected native vegetation whose features are determined to be beneficial, where feasible. Native vegetation usually requires less maintenance (e.g., irrigation, fertilizer) than planting new vegetation.
- Consider using low water use groundcovers when planting or replanting.

Waste Management

- Compost leaves, sticks, or other collected vegetation or dispose of at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Place temporarily stockpiled material away from watercourses and storm drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.
- Reduce the use of high nitrogen fertilizers that produce excess growth requiring more frequent mowing or trimming.

- Avoid landscape wastes in and around storm drain inlets by either using bagging equipment or by manually picking up the material.

Irrigation

- Where practical, use automatic timers to minimize runoff.
- Use popup sprinkler heads in areas with a lot of activity or where there is a chance the pipes may be broken. Consider the use of mechanisms that reduce water flow to sprinkler heads if broken.
- Ensure that there is no runoff from the landscaped area(s) if re-claimed water is used for irrigation.
- If bailing of muddy water is required (e.g. when repairing a water line leak), do not put it in the storm drain; pour over landscaped areas.
- Irrigate slowly or pulse irrigate to prevent runoff and then only irrigate as much as is needed.
- Apply water at rates that do not exceed the infiltration rate of the soil.

Fertilizer and Pesticide Management

- Utilize a comprehensive management system that incorporates integrated pest management (IPM) techniques. There are many methods and types of IPM, including the following:
  - Mulching can be used to prevent weeds where turf is absent, fencing installed to keep rodents out, and netting used to keep birds and insects away from leaves and fruit.
  - Visible insects can be removed by hand (with gloves or tweezers) and placed in soapy water or vegetable oil. Alternatively, insects can be sprayed off the plant with water or in some cases vacuumed off of larger plants.
  - Store-bought traps, such as species-specific, pheromone-based traps or colored sticky cards, can be used.
  - Slugs can be trapped in small cups filled with beer that are set in the ground so the slugs can get in easily.
  - In cases where microscopic parasites, such as bacteria and fungi, are causing damage to plants, the affected plant material can be removed and disposed of (pruning equipment should be disinfected with bleach to prevent spreading the disease organism).
  - Small mammals and birds can be excluded using fences, netting, tree trunk guards.
  - Beneficial organisms, such as bats, birds, green lacewings, ladybugs, praying mantis, ground beetles, parasitic nematodes, trichogramma wasps, seed head weevils, and spiders that prey on detrimental pest species can be promoted.
- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.

- Use pesticides only if there is an actual pest problem (not on a regular preventative schedule).
- Do not use pesticides if rain is expected. Apply pesticides only when wind speeds are low (less than 5 mph).
- Do not mix or prepare pesticides for application near storm drains.
- Prepare the minimum amount of pesticide needed for the job and use the lowest rate that will effectively control the pest.
- Employ techniques to minimize off-target application (e.g. spray drift) of pesticides, including consideration of alternative application techniques.
- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
- Calibrate fertilizer and pesticide application equipment to avoid excessive application.
- Periodically test soils for determining proper fertilizer use.
- Sweep pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Purchase only the amount of pesticide that you can reasonably use in a given time period (month or year depending on the product).
- Triple rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Dispose of empty pesticide containers according to the instructions on the container label.

Inspection

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering, and repair leaks in the irrigation system as soon as they are observed.
- Inspect pesticide/fertilizer equipment and transportation vehicles daily.

Training

- Educate and train employees on use of pesticides and in pesticide application techniques to prevent pollution. Pesticide application must be under the supervision of a California qualified pesticide applicator.
- Train/encourage municipal maintenance crews to use IPM techniques for managing public green areas.
- Annually train employees within departments responsible for pesticide application on the appropriate portions of the agency's IPM Policy, SOPs, and BMPs, and the latest IPM techniques.

- Employees who are not authorized and trained to apply pesticides should be periodically (at least annually) informed that they cannot use over-the-counter pesticides in or around the workplace.
- Use a training log or similar method to document training.

Spill Response and Prevention

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

Other Considerations

- The Federal Pesticide, Fungicide, and Rodenticide Act and California Title 3, Division 6, Pesticides and Pest Control Operations place strict controls over pesticide application and handling and specify training, annual refresher, and testing requirements. The regulations generally cover: a list of approved pesticides and selected uses, updated regularly; general application information; equipment use and maintenance procedures; and record keeping. The California Department of Pesticide Regulations and the County Agricultural Commission coordinate and maintain the licensing and certification programs. All public agency employees who apply pesticides and herbicides in "agricultural use" areas such as parks, golf courses, rights-of-way and recreation areas should be properly certified in accordance with state regulations. Contracts for landscape maintenance should include similar requirements.
- All employees who handle pesticides should be familiar with the most recent material safety data sheet (MSDS) files.
- Municipalities do not have the authority to regulate the use of pesticides by school districts, however the California Healthy Schools Act of 2000 (AB 2260) has imposed requirements on California school districts regarding pesticide use in schools. Posting of notification prior to the application of pesticides is now required, and IPM is stated as the preferred approach to pest management in schools.

Requirements

Costs

Additional training of municipal employees will be required to address IPM techniques and BMPs. IPM methods will likely increase labor cost for pest control which may be offset by lower chemical costs.

Maintenance

Not applicable

Supplemental Information

Further Detail of the BMP

Waste Management

Composting is one of the better disposal alternatives if locally available. Most municipalities either have or are planning yard waste composting facilities as a means of reducing the amount of waste going to the landfill. Lawn clippings from municipal maintenance programs as well as private sources would probably be compatible with most composting facilities

Contractors and Other Pesticide Users

Municipal agencies should develop and implement a process to ensure that any contractor employed to conduct pest control and pesticide application on municipal property engages in pest control methods consistent with the IPM Policy adopted by the agency. Specifically, municipalities should require contractors to follow the agency's IPM policy, SOPs, and BMPs; provide evidence to the agency of having received training on current IPM techniques when feasible; provide documentation of pesticide use on agency property to the agency in a timely manner.

References and Resources

King County Stormwater Pollution Control Manual. Best Management Practices for Businesses. 1995. King County Surface Water Management. July. On-line: http://dnr.metrokc.gov/wlr/dss/spcm.htm

Los Angeles County Stormwater Quality Model Programs. Public Agency Activities http://ladpw.org/wmd/npdes/model_links.cfm

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities. Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality Control Board. July. 1998.

Orange County Stormwater Program http://www.ocwatersheds.com/StormWater/swp_introduction.asp

Santa Clara Valley Urban Runoff Pollution Prevention Program. 1997 Urban Runoff Management Plan. September 1997, updated October 2000.

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Landscaping and Lawn Care. Office of Water. Office of Wastewater Management. On-line: http://www.epa.gov/npdes/menuofbmps/poll_8.htm

Site Design & Landscape Planning SD-10

Design Objectives

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

Description

Each project site possesses unique topographic, hydrologic, and vegetative features, some of which are more suitable for development than others. Integrating and incorporating appropriate landscape planning methodologies into the project design is the most effective action that can be done to minimize surface and groundwater contamination from stormwater.

Approach

Landscape planning should couple consideration of land suitability for urban uses with consideration of community goals and projected growth. Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Suitable Applications

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

Design Considerations

Design requirements for site design and landscapes planning should conform to applicable standards and specifications of agencies with jurisdiction and be consistent with applicable General Plan and Local Area Plan policies.

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Designing New Installations

Begin the development of a plan for the landscape unit with attention to the following general principles:

- Formulate the plan on the basis of clearly articulated community goals. Carefully identify conflicts and choices between retaining and protecting desired resources and community growth.
- Map and assess land suitability for urban uses. Include the following landscape features in the assessment: wooded land, open unwooded land, steep slopes, erosion-prone soils, foundation suitability, soil suitability for waste disposal, aquifers, aquifer recharge areas, wetlands, floodplains, surface waters, agricultural lands, and various categories of urban land use. When appropriate, the assessment can highlight outstanding local or regional resources that the community determines should be protected (e.g., a scenic area, recreational area, threatened species habitat, farmland, fish run). Mapping and assessment should recognize not only these resources but also additional areas needed for their sustenance.

Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Conserve Natural Areas during Landscape Planning

If applicable, the following items are required and must be implemented in the site layout during the subdivision design and approval process, consistent with applicable General Plan and Local Area Plan policies:

- Cluster development on least-sensitive portions of a site while leaving the remaining land in a natural undisturbed condition.
- Limit clearing and grading of native vegetation at a site to the minimum amount needed to build lots, allow access, and provide fire protection.
- Maximize trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought tolerant plants.
- Promote natural vegetation by using parking lot islands and other landscaped areas.
- Preserve riparian areas and wetlands.

Maximize Natural Water Storage and Infiltration Opportunities Within the Landscape Unit

- Promote the conservation of forest cover. Building on land that is already deforested affects basin hydrology to a lesser extent than converting forested land. Loss of forest cover reduces interception storage, detention in the organic forest floor layer, and water losses by evapotranspiration, resulting in large peak runoff increases and either their negative effects or the expense of countering them with structural solutions.
- Maintain natural storage reservoirs and drainage corridors, including depressions, areas of permeable soils, swales, and intermittent streams. Develop and implement policies and

regulations to discourage the clearing, filling, and channelization of these features. Utilize them in drainage networks in preference to pipes, culverts, and engineered ditches.

- Evaluating infiltration opportunities by referring to the stormwater management manual for the jurisdiction and pay particular attention to the selection criteria for avoiding groundwater contamination, poor soils, and hydrogeological conditions that cause these facilities to fail. If necessary, locate developments with large amounts of impervious surfaces or a potential to produce relatively contaminated runoff away from groundwater recharge areas.

Protection of Slopes and Channels during Landscape Design

- Convey runoff safely from the tops of slopes.
- Avoid disturbing steep or unstable slopes.
- Avoid disturbing natural channels.
- Stabilize disturbed slopes as quickly as possible.
- Vegetate slopes with native or drought tolerant vegetation.
- Control and treat flows in landscaping and/or other controls prior to reaching existing natural drainage systems.
- Stabilize temporary and permanent channel crossings as quickly as possible, and ensure that increases in run-off velocity and frequency caused by the project do not erode the channel.
- Install energy dissipaters, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined channels in accordance with applicable specifications to minimize erosion. Energy dissipaters shall be installed in such a way as to minimize impacts to receiving waters.
- Line on-site conveyance channels where appropriate, to reduce erosion caused by increased flow velocity due to increases in tributary impervious area. The first choice for linings should be grass or some other vegetative surface, since these materials not only reduce runoff velocities, but also provide water quality benefits from filtration and infiltration. If velocities in the channel are high enough to erode grass or other vegetative linings, riprap, concrete, soil cement, or geo-grid stabilization are other alternatives.
- Consider other design principles that are comparable and equally effective.

Redeveloping Existing Installations

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

Redevelopment may present significant opportunity to add features which had not previously been implemented. Examples include incorporation of depressions, areas of permeable soils, and swales in newly redeveloped areas. While some site constraints may exist due to the status of already existing infrastructure, opportunities should not be missed to maximize infiltration, slow runoff, reduce impervious areas, disconnect directly connected impervious areas.

Other Resources

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

Stormwater Management Manual for Western Washington, Washington State Department of Ecology, August 2001.

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

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

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

Roof Runoff Controls SD-11

Rain Garden

Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

Designing New Installations

Cisterns or Rain Barrels

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

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

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

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

Dry wells and Infiltration Trenches

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

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

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

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

Pop-up Drainage Emitter

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

Foundation Planting

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

Redeveloping Existing Installations

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

Supplemental Information

Examples

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

Other Resources

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

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

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

Efficient Irrigation SD-12

Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

Designing New Installations

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

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

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

Redeveloping Existing Installations

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

Other Resources

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

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

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

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

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

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– 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.

Trash Storage Areas SD-32

Description

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

Approach

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

Design Objectives

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

Suitable Applications

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

Design Considerations

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

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

Designing New Installations

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

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

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Maintenance Bays & Docks SD-31

Design Objectives

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

Description

Several measures can be taken to prevent operations at maintenance bays and loading docks from contributing a variety of toxic compounds, oil and grease, heavy metals, nutrients, suspended solids, and other pollutants to the stormwater conveyance system.

Approach

In designs for maintenance bays and loading docks, containment is encouraged. Preventative measures include overflow containment structures and dead-end sumps. However, in the case of loading docks from grocery stores and warehouse/distribution centers, engineered infiltration systems may be considered.

Suitable Applications

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

Design Considerations

Design requirements for vehicle maintenance and repair are governed by Building and Fire Codes, and by current local agency ordinances, and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code requirements.

Designing New Installations

Designs of maintenance bays should consider the following:

- Repair/maintenance bays and vehicle parts with fluids should be indoors; or designed to preclude urban run-on and runoff.
- Repair/maintenance floor areas should be paved with Portland cement concrete (or equivalent smooth impervious surface).

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- Repair/maintenance bays should be designed to capture all wash water leaks and spills. Provide impermeable berms, drop inlets, trench catch basins, or overflow containment structures around repair bays to prevent spilled materials and wash-down waters form entering the storm drain system. Connect drains to a sump for collection and disposal. Direct connection of the repair/maintenance bays to the storm drain system is prohibited. If required by local jurisdiction, obtain an Industrial Waste Discharge Permit.
- Other features may be comparable and equally effective.

The following designs of loading/unloading dock areas should be considered:

- Loading dock areas should be covered, or drainage should be designed to preclude urban run-on and runoff.
- Direct connections into storm drains from depressed loading docks (truck wells) are prohibited.
- Below-grade loading docks from grocery stores and warehouse/distribution centers of fresh food items should drain through water quality inlets, or to an engineered infiltration system, or an equally effective alternative. Pre-treatment may also be required.
- Other features may be 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.

Additional Information

Stormwater and non-stormwater will accumulate in containment areas and sumps with impervious surfaces. Contaminated accumulated water must be disposed of in accordance with applicable laws and cannot be discharged directly to the storm drain or sanitary sewer system without the appropriate permit.

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.

BG-30 Food Service Facilities

Photo Credit: Geoff Brosseau

Description

This category includes:

- Restaurants
- Food truck commissaries
- Institutional cafeterias
- Grocery stores, bakeries, and delicatessens
- Any facility requiring a Health Department permit for food preparation

Pollutant Sources

The following are sources of pollutants:

- Cleaning of equipment
- Grease handling and disposal
- Spills
- Surface cleaning
- Cooling and refrigeration equipment maintenance
- Landscaping and grounds maintenance
- Dumpster and loading dock area
- Parking lots
- Illicit connections to storm drain system

Pollutants can include:

- Organic materials (food wastes)

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- Oil and grease
- Toxic chemicals in cleaning products, disinfectants, and pesticides

Approach

Minimize exposure of rain and runoff to outdoor cleaning and storage areas by using cover and containment. In and around these areas, use good housekeeping to minimize the generation of pollutants. Make stormwater pollution prevention BMPs a part of standard operating procedures and the employee training program. Provide employee education materials in the first language of employees.

Source Control BMPs

The best management practices are listed by activity or area in the following table.

Dumpster and Loading Dock Areas	☐ Store and transfer all solid and liquid wastes, such as tallow, in watertight covered containers. ☐ Keep litter from accumulating around loading docks by providing trash receptacles and encouraging employees to use them. ☐ Bag and seal food waste before putting it in the dumpster. Do not place uncontained liquids, or leaking containers or garbage bags into a dumpster. ☐ Keep dumpster lids closed to keep out rainwater and to prevent trash from spilling out. ☐ If the dumpster regularly overflows, get a bigger one or arrange for more frequent collection. If the dumpster is shared with other tenants, speak with the property/lease manager about scheduling more frequent trash pickups or a larger dumpster. ☐ Don't hose out dumpsters. Apply absorbent over any fluids spilled in dumpster. Absorbent will usually be knocked out when the dumpster is emptied. ☐ Have the dumpster leasing company repair or replace leaky dumpsters and compactors, and have them clean out dirty dumpsters. ☐ Install a spill cleanup kit near the dumpster and loading dock areas. ☐ Post employee reminder signs such as "Keep lid closed" near tallow bins and dumpsters. ☐ Consider enclosing the dumpster in a roofed and bermed area to prevent exposure to rainwater, and draining the area to the sanitary sewer. Contact the local wastewater treatment plant or the county environmental health department for guidance. ☐ Keep dumpsters or the dumpster enclosure locked to prevent illegal dumping. ☐ For more information on cleaning dumpster areas see the Mobile Cleaning - Food Service Business-related business guide sheet in this series.

BG-30 Food Service Facilities

Equipment and Outdoor Cleaning	☐ Make sure all discharges from cooling equipment go to the sanitary sewer and not the street, gutter, or storm drain. ☐ Clean floor mats, filters, and garbage cans in a mop sink, floor drain, or proper outside area connected to the sanitary sewer with an oil and water separator. Don't wash them in a parking lot, alley, sidewalk, or street. ☐ Consider installing anti-slip floors when you remodel. ☐ Consider cleaning filters in the dishwasher. Contact the local wastewater treatment plant or the county environmental health department for guidance. ☐ Pour wash water into a janitorial or mop sink. Don't pour it out onto a parking lot, alley, sidewalk, or street. ☐ For outdoor cleaning, have employees or contractors follow the instructions in the following business guide sheet in this series: ✓ Mobile Cleaning - Food Service Business-related ✓ Mobile Cleaning – Surface cleaning ☐ For more information in general on cleaning floor mats, equipment, exhaust filters, and outdoor surfaces see the Mobile Cleaning - Food Service Business-related business guide sheet in this series.
Spill Cleanup	☐ Prepare a spill cleanup plan that includes: ✓ Procedures for different types of spills ✓ Schedule for initial and annual training of employees ✓ Cleanup kits in well-marked, accessible areas ✓ Designation of key employee who monitors cleanup ✓ Posting the plan in the work area ☐ If a spill occurs, immediately stop the spill at its source. ☐ Keep the spill from entering the street, gutter, or storm drain. ☐ Use dry methods for spill cleanup (sweeping, cat litter, etc.). Don't hose down spills. ☐ If wet cleaning (including high-temperature or high pressure washing) is required, dry clean first and then mop (or if it is absolutely necessary, wash) and collect the water. Dispose of water in sink or other indoor drain, not in the street, gutter, or storm drain. ☐ If a final rinse is necessary for health reasons, collect the rinsewater and dispose it to the sink or indoor floor drain. If outdoors, block the storm drain before applying water. Mop up or wet-vacuum water, and dispose it to a sink or indoor drain. ☐ Do not use bleach or disinfectants if there is a possibility that rinsewater could flow to a street, gutter, or storm drain.

	☐ For more information on cleaning outdoor surfaces see the Mobile Cleaning - Surface Cleaning business guide sheet in this series.
Recycling and Disposal	☐ Separate wastes. Keep your recyclable wastes in separate containers according to the type of material. They are easier to recycle if separated. ☐ Recycle the following materials: ✓ Food waste (non-greasy, non-animal food waste can be composted). Donate leftover, edible food whenever possible to local food banks. ✓ Paper and cardboard ✓ Container glass, aluminum, and tin ✓ Pallets and drums ☐ Dispose of toxic waste properly. Toxic waste includes used cleaners, and rags (soaked with solvents, floor cleaners, and detergents).
Grease Handling and Disposal	☐ Never pour oil, grease, or large quantities of oily liquids such as sauces or salad dressings or waste grease down a sink, floor drain, storm drain, or into a dumpster. ☐ Install screens and solid traps in sink and floor drains to catch larger solids. Clean these screens and traps frequently. ☐ Don't try to "dissolve" grease by adding hot water or emulsifying chemicals – it will only move the grease further down the building's sewer line and make it harder to remove later. ☐ Recycle grease and oil. Don't pour it into sinks, floor drains, or onto a parking lot or street. Look in the phone book for "Renderers" or call the local recycling or household hazardous waste information line. ☐ Use tallow bins or sealed containers with tamper-proof lids. Keep the exterior of the container clean. Check for leaks. Ask the recycler for a leak-free tallow bin and replace any leaky grease containers. If grease is stored outside, keep it under a roof, if possible. ☐ Do not contaminate the recyclable oils and grease in the tallow bin with the waste grease from the grease trap or grease interceptor. ☐ Inspect and clean all waste grease removal devices (grease trap or grease interceptor) often enough to keep them functioning properly and efficiently. ☐ For disposal of waste grease from the grease trap or grease interceptor, see "Grease Traps" or "Septic Tanks" in the phone book.

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Land-scaping and Grounds Mainte-nance	☐ Never dispose of leftover pesticides in the gutter, street, or storm drain. Leftover pesticides must be either used up or disposed of as hazardous waste. ☐ Do not blow or rake leaves, grass, or garden clippings into the street, gutter, or storm drain. ☐ If pesticides are used, do not over apply or apply when rain is forecast. ☐ Do not use copper-based algaecides in pools or fountains. Control algae with chlorine or other alternatives to copper-based products.
Pest Control	Food Sources ☐ Keep the kitchen free of food scraps. ☐ Take out garbage each night in a closed container. ☐ Refrigerate all food or store in pest-proof containers each night. ☐ Keep ventilation system working properly to keep greasy residue off walls. Appliances ☐ Keep dishwasher area clean. Check the trap nightly. ☐ Where possible, elevate appliances at least 6 inches off the floor. ☐ Clean under appliances nightly. ☐ Steam clean or wash appliances weekly. ☐ Remember to clean under the counter, under the sink, and the refrigerator vent. Drains and Trash Cans ☐ Steam clean or scrub floor drains with a brush to help eliminate fruit flies. ☐ Keep dumpster area clean – inside and out. ☐ Wash garbage cans regularly. Supplies and Entry Points ☐ Check for pests before bringing supplies in to the kitchen. Roaches like corrugated boxes. ☐ Don't store boxes in the kitchen – take boxes away or store in a refrigerated area. ☐ Seal any gaps below doors. Reduce Habitat ☐ Inspect the entire establishment – inside and out. ☐ Suggest physical modifications that may help to eliminate pest behavior.

	☐ Suggest changes in food storage or cleanup practices to eliminate food sources for pests. ☐ Place boric acid powder in wall voids. ☐ Seal cracks and crevices. Monitor for Pests ☐ Use sticky traps to monitor how well the pest control program is working. Pests caught in the traps warn of a possible problem. ☐ When hiring a pest control service, look for a company that provides Integrated Pest Management (IPM) services. Use Baits First ☐ Use baits for controlling pests. Remove bait when pests are gone, or else the bait may attract more pests. ☐ Use chemicals only as a last resort. If absolutely necessary, choose less-toxic chemicals, and ask the pest service to provide label information. ☐ Apply pesticides only if necessary, not on a regular schedule. Follow label directions. Do not apply pesticides around floor drains, sinks, or food. Purchasing ☐ Use non-disposable products. Serve food on ceramic dishware rather than paper, plastic or Styrofoam, and use cloth napkins rather than paper ones. If you must use disposable products, use paper instead of Styrofoam. ☐ Buy the least toxic products available: ✓ Look for "non-toxic," "non-petroleum based," "free of ammonia, phosphates, dye, or perfume," or "readily biodegradable" on the label. Don't assume biodegradable products are safe. Biodegradable means the product will eventually break down, but it may harm the environment in the meantime. ✓ Avoid chlorinated compounds, petroleum distillates, phenols, formaldehyde, and caustic or acidic products. ✓ Use water-based products. ✓ Look for and purchase "recycled" and "recyclable" containers. By doing so, you help ensure a use for the recyclable materials that people collect and recycle.
Education and Training	☐ Employees can help prevent pollution when urban runoff training is included in employee orientations and reviews. ☐ Train all employees upon hiring and annually thereafter. ☐ Use a training log to document employee training.

	☐ Post information about or labels for BMPs where employees and customers can see them. ☐ Remember the facility is liable for the behavior of contractors. Be sure all contractors hired to clean inside or outside are aware of and implement these BMPs. ☐ Explain BMPs to other food businesses through your business associations or chambers of commerce.

Treatment Control BMPs

If treatment controls are installed at the facility, see Section 4 of this Handbook for information on inspecting and maintaining the BMPs.

For information on designing treatment controls, see Section 5 of the Development and Redevelopment Handbook.

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