

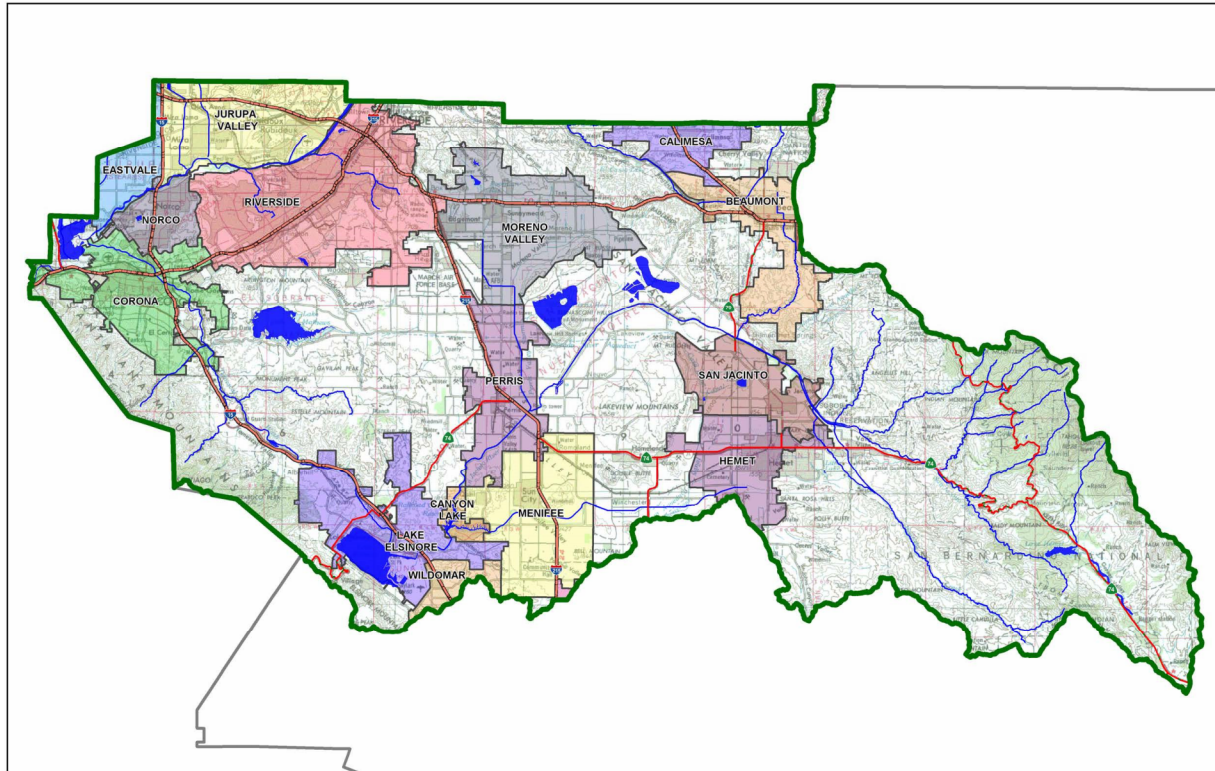
# Project Specific Water Quality Management Plan

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

**Project Title:** Case & Goetz

**Development No:**

**Design Review/Case No:**



- Preliminary
- Final

**Original Date Prepared:** November 21, 2023

**Revision Date(s):**

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

**Template revised June 30, 2016**

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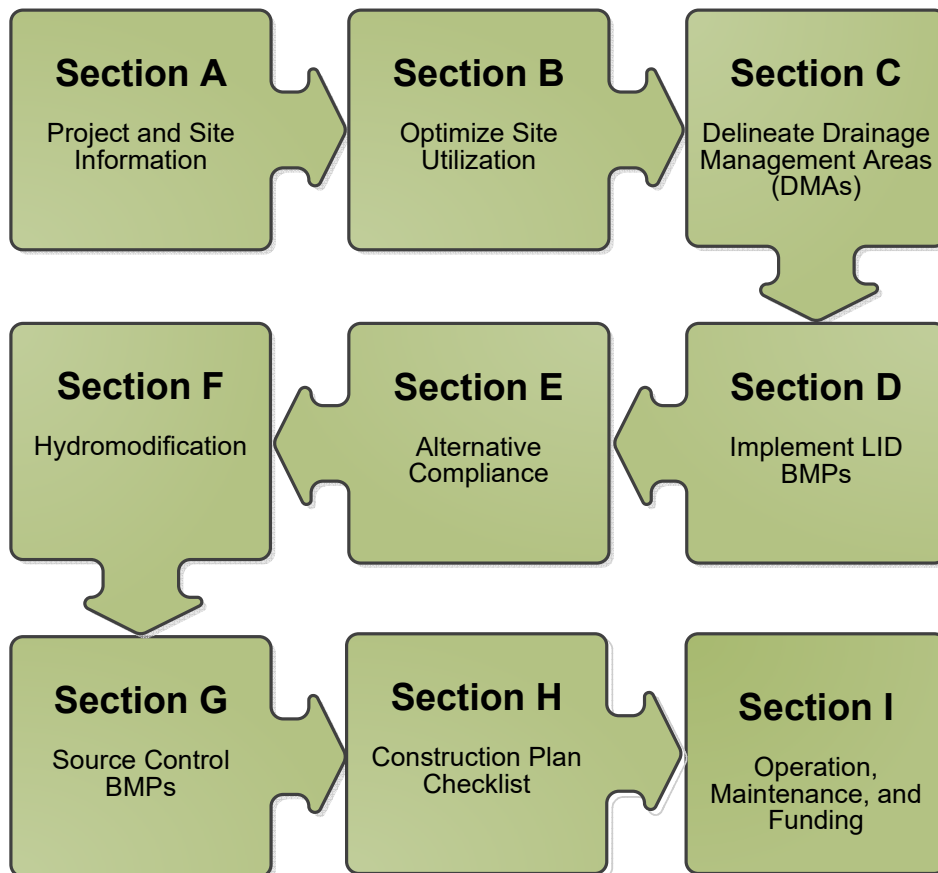
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## A Brief Introduction

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



## OWNER'S CERTIFICATION

This Project-Specific Water Quality Management Plan (WQMP) has been prepared for Alabbasi Construction & Engineering by ADKAN Engineers for the Case & Goetz project.

This WQMP is intended to comply with the requirements of City of Perris for 14.22.090 which includes the requirement for the preparation and implementation of a Project-Specific WQMP.

The undersigned, while owning the property/project described in the preceding paragraph, shall be responsible for the implementation and funding of this WQMP and will ensure that this WQMP is amended as appropriate to reflect up-to-date conditions on the site. In addition, the property owner accepts responsibility for interim operation and maintenance of Stormwater BMPs until such time as this responsibility is formally transferred to a subsequent owner. This WQMP will be reviewed with the facility operator, facility supervisors, employees, tenants, maintenance and service contractors, or any other party (or parties) having responsibility for implementing portions of this WQMP. At least one copy of this WQMP will be maintained at the project site or project office in perpetuity. The undersigned is authorized to certify and to approve implementation of this WQMP. The undersigned is aware that implementation of this WQMP is enforceable under City of Perris Water Quality Ordinance (Municipal Code Section 14.22.090).

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

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

\_\_\_\_\_  
Date

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

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

## PREPARER'S CERTIFICATION

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

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

\_\_\_\_\_  
Date

Micheal R. Brendecke  
\_\_\_\_\_  
Preparer's Printed Name

Senior Projec Manager  
\_\_\_\_\_  
Preparer's Title/Position

Preparer's Licensure:

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## Section A: Project and Site Information

PROJECT INFORMATION	
Type of Project:	Commercial
Planning Area:	N/A
Community Name:	N/A
Development Name:	N/A
PROJECT LOCATION	
Latitude & Longitude (DMS): 33°46'22.39", 117°13'22.16"	
Project Watershed and Sub-Watershed: Santa Ana Watershed	
Gross Acres: 80.47	
APN(s): 310-150-012, 310-160-070	
Map Book and Page No.: T4SR3W SEC 32 W	
PROJECT CHARACTERISTICS	
Proposed or Potential Land Use(s)	Commercial
Proposed or Potential SIC Code(s)	4225 & 5541
Area of Impervious Project Footprint (SF)	
Total Area of <u>proposed</u> Impervious Surfaces within the Project Footprint (SF)/or Replacement	
Does the project consist of offsite road improvements?	<input type="checkbox"/> Y <input checked="" type="checkbox"/> N
Does the project propose to construct unpaved roads?	<input type="checkbox"/> Y <input checked="" type="checkbox"/> N
Is the project part of a larger common plan of development (phased project)?	<input type="checkbox"/> Y <input checked="" type="checkbox"/> N
EXISTING SITE CHARACTERISTICS	
Total area of <u>existing</u> Impervious Surfaces within the Project limits Footprint (SF)	
Is the project located within any MSHCP Criteria Cell?	<input type="checkbox"/> Y <input checked="" type="checkbox"/> N
If so, identify the Cell number:	
Are there any natural hydrologic features on the project site?	<input type="checkbox"/> Y <input checked="" type="checkbox"/> N
Is a Geotechnical Report attached?	<input checked="" type="checkbox"/> Y <input type="checkbox"/> N
If no Geotech. Report, list the NRCS soils type(s) present on the site (A, B, C and/or D)	
What is the Water Quality Design Storm Depth for the project?	

### A.1 Maps and Site Plans

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

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

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

## 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
San Jacinto River Reach 3	None	MUN, AGR, GWR, REC1, REC2, WARM, WILD	1.1 Miles
Canyon Lake	Pathogens, Nutrients	MUN, AGR, GWR, REC1, REC2, WARM, WILD	5.5 Miles
Lak Elsinore	Nutrients, Organic Enrichment/ Low Dissolved Oxygen	REC1, REC2, WARM, WILD, RARE	12 Miles
Temescal Creek Reach 6-4	None	MUN, AGR, GWR, REC1, REC2, WARM, WILD, RARE	19 Miles
Temescal Creek Reach 2	None	MUN, AGR, GWR, REC1, REC2, WARM, SPWN	25 Miles
Temescal Creek Reach 1B-1A	None	AGR, GWR, REC1, REC2, WARM, WILD	33 Miles
Prado Basin Management Zone	None	GWR, REC1, REC2, WARM, WILD, RARE	40 Miles
Santa Ana River (Reach 2-1)	Lead, Metals, Indicator Bacteria, Pathogens	GWR, REC1, REC2, WARM, SPWN	70 Miles
Pacific Ocean	N/A	N/A	N/A

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

**Table A.2 Other Applicable Permits**

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

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

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

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

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

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

### Site Optimization

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

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

*The existing drainage flows to.....*

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

*The existing vegetation consist of native weeds that will be removed for the development.*

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

**The existing infiltration rates as per the soils report “PRELIMINARY GEOTECHNICAL EVALUATION AND INFILTRATION STUDY PROPOSED GAS STATION, RETAIL AND STORAGE FACILITY APNS 310-150-012 AND 310-160-070-4 PERRIS, RIVERSIDE COUNTY, CALIFORNIA” the highest infiltration rate available is 0.33 in/hr which is less than the minimum required rate of 1.6 in/hr. Therefore, we will not be proposing infiltration BMP’s.**

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

**There is .....**

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

**There is .....**

## Section C: Delineate Drainage Management Areas (DMAs)

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

**Table C.1 DMA Classifications**

DMA Name or ID	Surface Type(s) <sup>12</sup>	Area (Sq. Ft.)	DMA Type
D1.1 LANDSCAPE	ORNAMENTAL LANDSCAPE	70,879	D
D1.2 PAVEMENT	CONCRETE/ASPHALT	193,838	D
D1.3 ROOF	ROOF	98,654	D

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

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

**Table C.2 Type ‘A’, Self-Treating Areas**

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

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

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

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

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]	

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

DMA Name or ID	BMP Name or ID

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

## Section D: Implement LID BMPs

### D.1 Infiltration Applicability

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

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

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

#### Geotechnical Report

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

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

#### Infiltration Feasibility

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

**Table D.1 Infiltration Feasibility**

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

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

## D.2 Harvest and Use Assessment

Please check what applies:

- Reclaimed water will be used for the non-potable water demands for the project.
- Downstream water rights may be impacted by Harvest and Use as approved by the Regional Board (verify with the 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:*

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

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:*

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

*Enter your EIATIA factor:*

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:*

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).

<b>Minimum required irrigated area (Step 4)</b>	<b>Available Irrigated Landscape (Step 1)</b>

## Toilet Use Feasibility

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

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

*Projected Number of Daily Toilet Users:*

*Project Type:*

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:*

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

*Enter your TUTIA factor:*

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:*

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

**Minimum required Toilet Users (Step 4)**

**Projected number of toilet users (Step 1)**

## Other Non-Potable Use Feasibility

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

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

*Average Daily Demand:*

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

*Total Area of Impervious Surfaces:*

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

*Enter the factor from Table 2-4:*

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

*Minimum required use:*

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

<b>Minimum required non-potable use (Step 4)</b>	<b>Projected average daily use (Step 1)</b>

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

### **D.3 Bioretention and Biotreatment Assessment**

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

*Select one of the following:*

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

## D.4 Feasibility Assessment Summaries

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

Table D.2 LID Prioritization Summary Matrix

DMA Name/ID	LID BMP Hierarchy				No LID (Alternative Compliance)
	1. Infiltration	2. Harvest and use	3. Bioretention	4. Biotreatment	
D1.1	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D1.2	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
D1.3	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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

## D.5 LID BMP Sizing

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

**Table D.3** DCV Calculations for LID BMPs

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, $I_f$	DMA Runoff Factor	DMA Areas $\times$ Runoff Factor	Enter BMP Name / Identifier Here		
	[A]		[B]	[C]	[A] $\times$ [C]			
<b>D1.1</b>	70,879	ORNAMENTAL LANDSCAPE	0.1	0.11	7829.2	Design Storm Depth (in)	Design Capture Volume, $V_{BMP}$ (cubic feet)	Proposed Volume on Plans (cubic feet)
<b>D1.2</b>	193,838	CONCRETE/ASPHALT	1.0	0.89	172903.5			
<b>D1.3</b>	98,654	ROOF	1	0.89	87999.4			
	363,371				268,732.1	0.60	134,436.6	

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

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

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

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

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

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

- Or -

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

## E.1 Identify Pollutants of Concern

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

Table E.1 Potential Pollutants by Land Use Type

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

P = Potential

N = Not Potential

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

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

<sup>(3)</sup> A potential Pollutant is land use involving animal waste

<sup>(4)</sup> Specifically petroleum hydrocarbons

<sup>(5)</sup> Specifically solvents

<sup>(6)</sup> Bacterial indicators are routinely detected in pavement runoff

## E.2 Stormwater Credits

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

Table E.2 Water Quality Credits

Qualifying Project Categories	Credit Percentage <sup>2</sup>
<i>Total Credit Percentage<sup>1</sup></i>	

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

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

## E.3 Sizing Criteria

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

Table E.3 Treatment Control BMP Sizing

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I <sub>r</sub>	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)
	$\frac{A_T}{\Sigma[A]}$			$\Sigma = [D]$	[E]	$[F] = \frac{[D] \times [E]}{[G]}$	$[F] \times (1-[H])$	[I]	

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

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

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

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

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

## E.4 Treatment Control BMP Selection

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

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

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

**Table E.4 Treatment Control BMP Selection**

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

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

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

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

# Section F: Hydromodification

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

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

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

Does the project qualify for this HCOC Exemption?       Y     N

If Yes, HCOC criteria do not apply.

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

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

Does the project qualify for this HCOC Exemption?       Y     N

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

**Table F.1 Hydrologic Conditions of Concern Summary**

	2 year – 24 hour		
	Pre-condition	Post-condition	% Difference
<b>Time of Concentration</b>			
<b>Volume (Cubic Feet)</b>			

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

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

Does the project qualify for this HCOC Exemption?       Y     N

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

## F.2 HCOC Mitigation

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

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

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

## Section G: Source Control BMPs

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

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

**Table G.1** Permanent and Operational Source Control Measures

Potential Sources of Runoff pollutants	Permanent Structural Source Control BMPs	Operational Source Control BMPs

## Section H: Construction Plan Checklist

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

Table H.1 Construction Plan Cross-reference

BMP No. or ID	BMP Identifier and Description	Corresponding Plan Sheet(s)	BMP Location (Lat/Long)

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

## Section I: Operation, Maintenance and Funding

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

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

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

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

**Maintenance Mechanism:**      Insert text here.

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

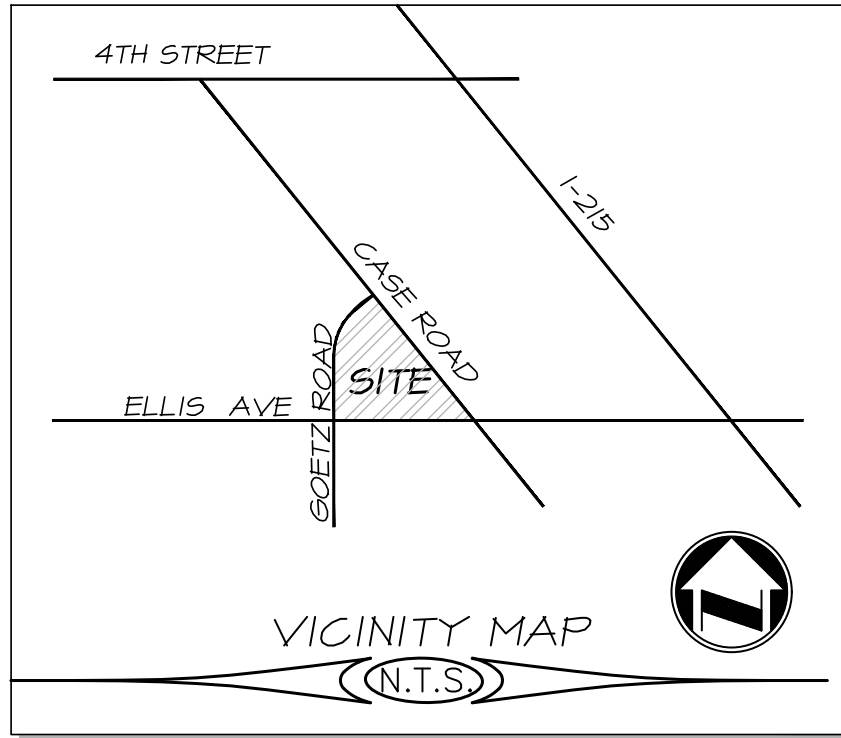
Y       N

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

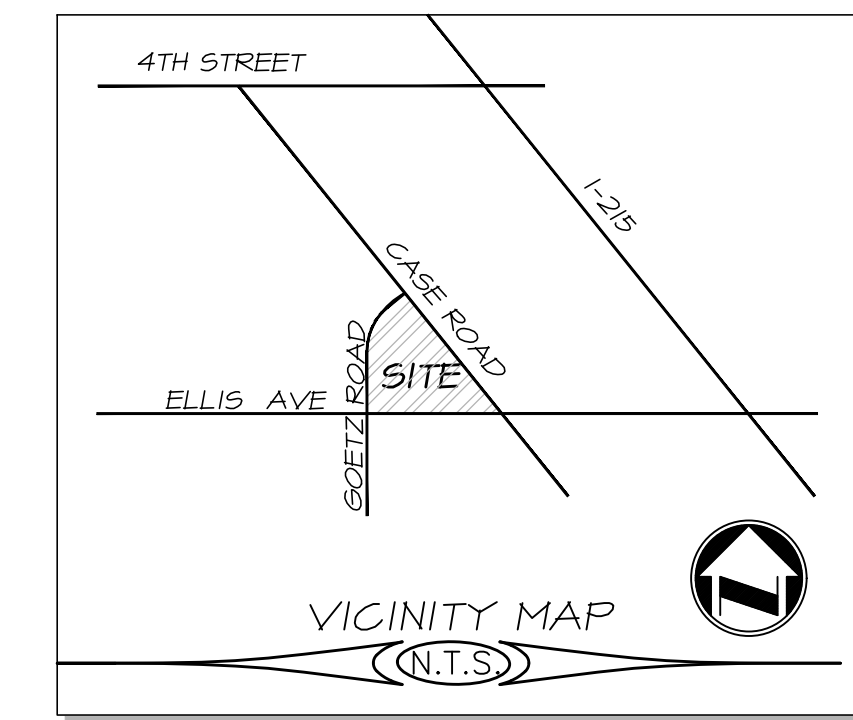
# Appendix 1: Maps and Site Plans

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

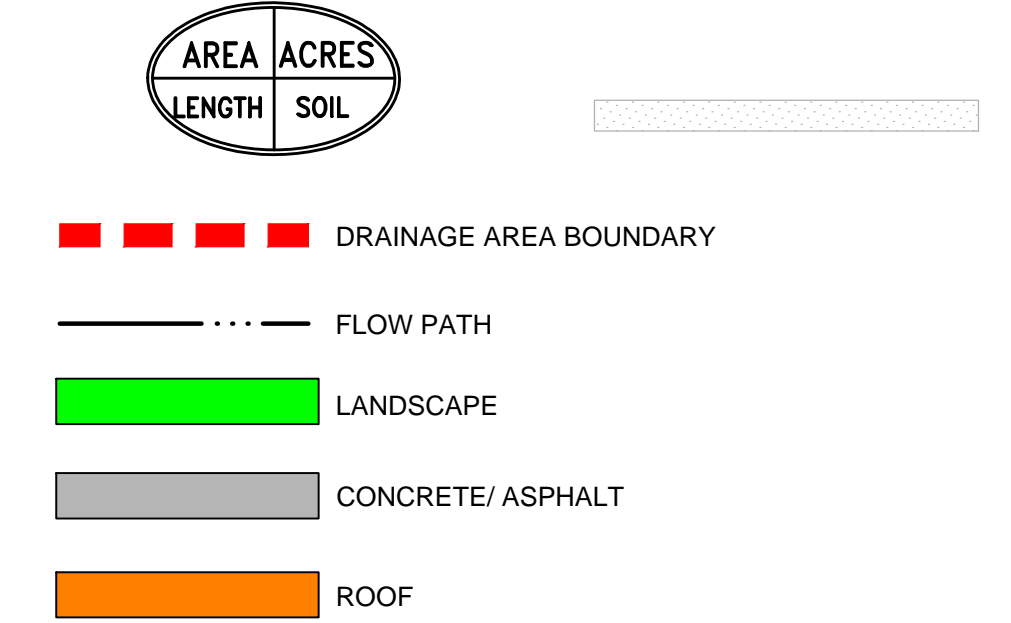
LOCATION MAP



# BMP MAP CASE & GOETZ



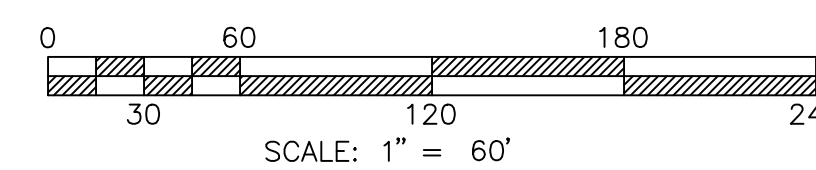
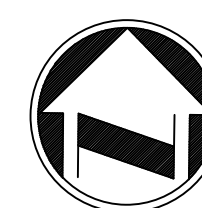
## LEGEND



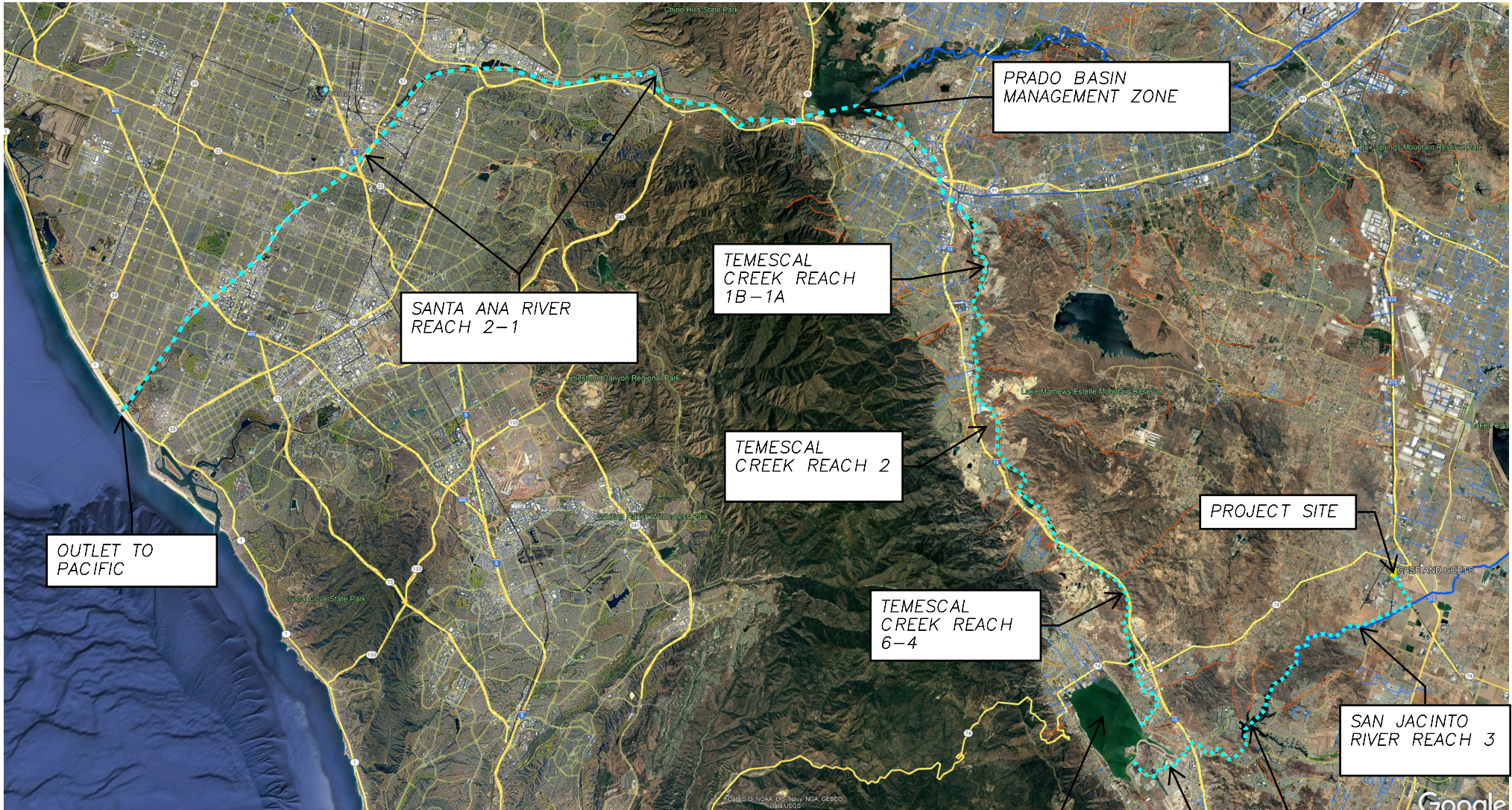
BMP DATA				
DMA	DMA CLASSIFICATION	SURFACE TYPE	AREA (SF)	AREA (AC)
D1.1	D	LANDSCAPE	70,879	1.63
D1.2	D	CONCRETE/ASPHALT	193,838	4.45
D1.3	D	ROOF	98,654	2.26
TOTAL			363,371	8.34



SOURCE CONTROLS		
NAME	TYPE	CASQA
BMP 1	BIO RETENTION	TC-32



# RECEIVING WATER MAP: CASE & GOETZ



RW FLOW PATH

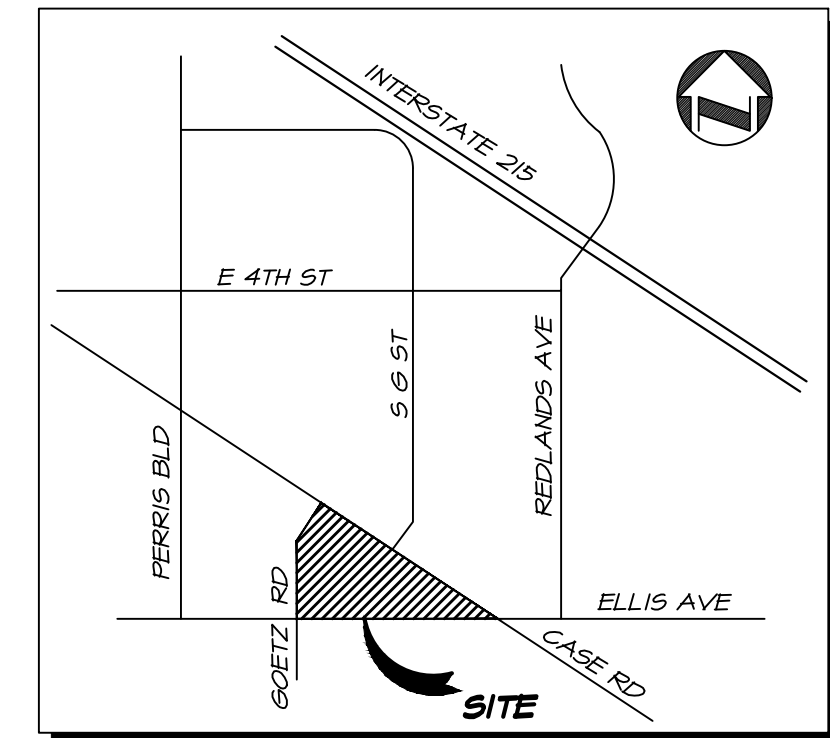


# Appendix 2: Construction Plans

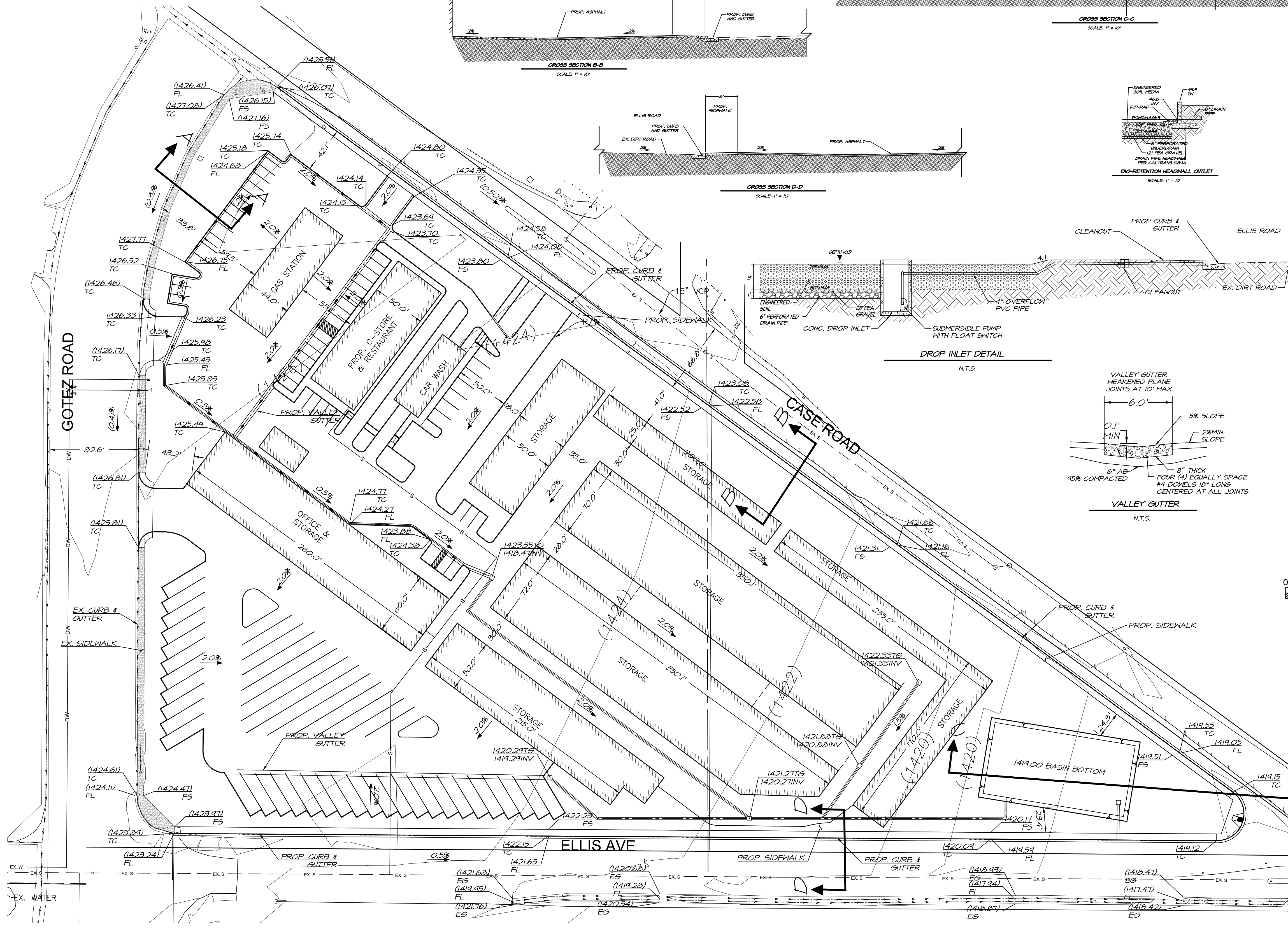
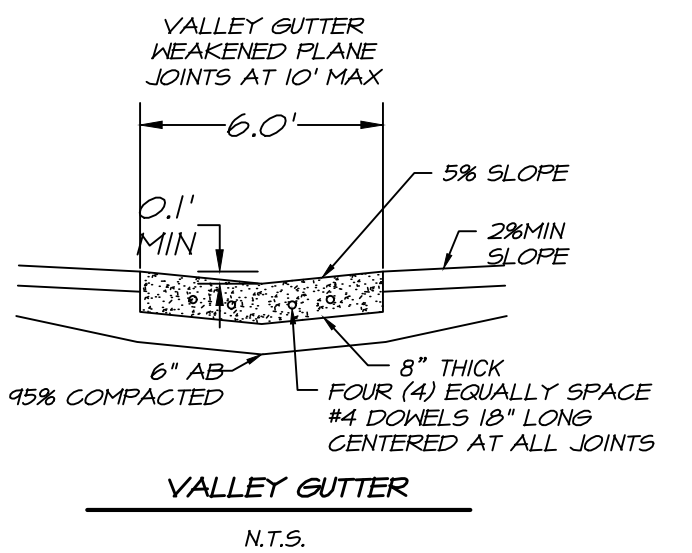
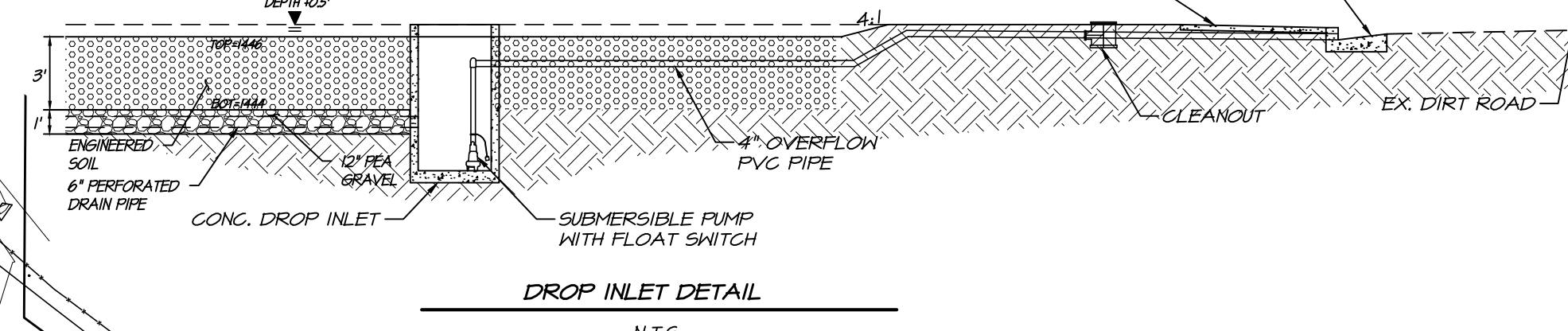
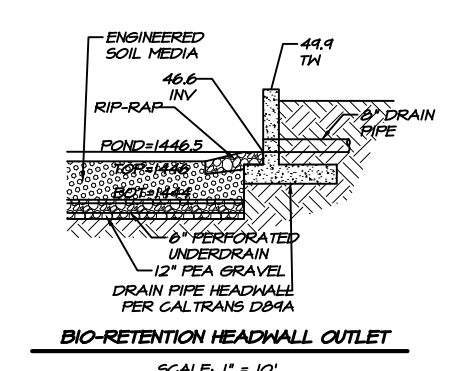
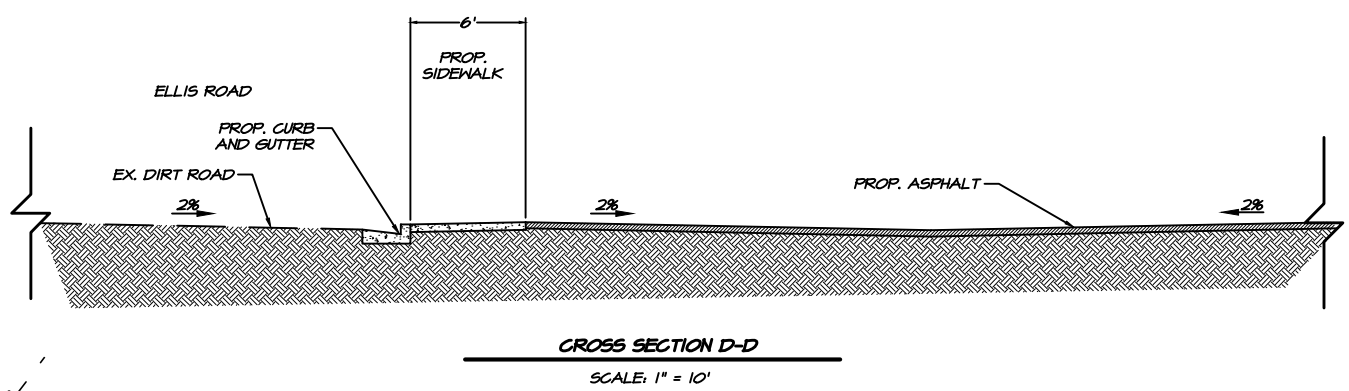
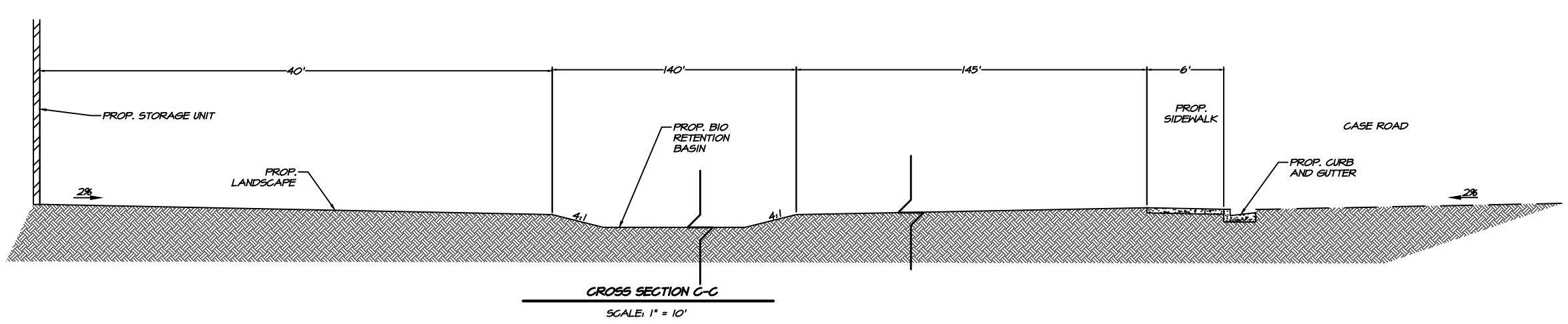
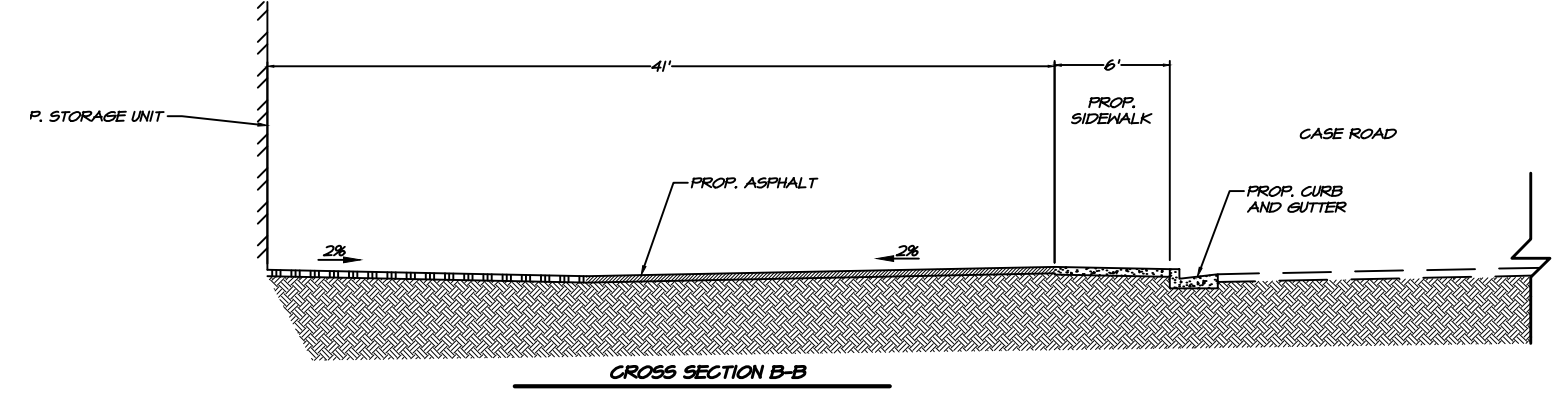
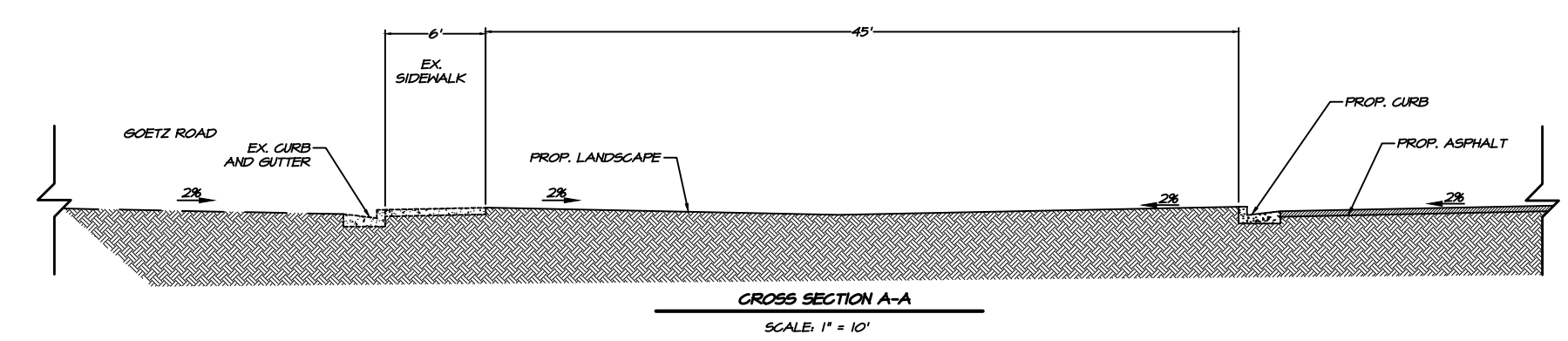
*Grading and Drainage Plans*

# IN THE CITY OF PERRIS, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA SITE PLAN AND CONCEPTUAL GRADING PLAN CASE AND GOETZ

THOMAS BRO. GUIDE PG. 807 GRID: H4



**VICINITY MAP**  
(N.T.S.)  
T4S R3W SEC 32 W



**OWNER/APPLICANT**  
ALABBASSI CONSTRUCTION & ENGINEERING  
164 W. RAMONA EXPRESSWAY SUITE C,  
PERRIS, CA 92571

**ENGINEER**  
ADKAN ENGINEERS  
6879 AIRPORT DRIVE  
RIVERSIDE, CA 92504  
CONTACT: MICHAEL BRENDENCKE  
OFFICE: (951) 688-0241  
FAX: (951) 688-0631  
EMAIL: MBRENDENCKE@ADKAN.COM

**APN**  
310-150-012  
310-160-070

**UTILITIES**  
WATER: EASTERN MUNICIPAL WATER DISTRICT 951-428-3771  
SEWER: EASTERN MUNICIPAL WATER DISTRICT 951-428-3771  
PHONE: VERIZON 1-800-837-4966  
PHONE: SUNDAY'S (TELEPHONE) 1-855-493-4237  
ELECTRIC: MORENO VALLEY ELECTRIC 951-413-3000  
GAS: SOCIAL GAS 1-877-238-0042  
CABLE: TIME WARNER 1-855-707-7328

**LAND USE AND ZONING**

CURRENT GENERAL PLAN	DT SP
CURRENT ZONING	DTSP EP
PROPOSED ZONING	DTSP EP
EXISTING LAND USE	VACANT
PROPOSED LAND USE	COMMERCIAL

**LEGAL DESCRIPTION**

REAL PROPERTY IN THE CITY OF PERRIS, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA, DESCRIBED AS FOLLOWS:

PARCEL 1: APN: 310-150-012  
THAT PORTION OF THE SOUTHWEST QUARTER OF THE SOUTHWEST QUARTER OF SECTION 32, TOWNSHIP 4 SOUTH, RANGE 3 WEST, SAN BERNARDINO BASE AND MERIDIAN, ACCORDING TO UNITED STATES GOVERNMENT SURVEY THEREOF, LYING SOUTHWESTERLY OF THE SOUTHWESTERLY LINE OF THE CALIFORNIA CENTRAL RAILWAY, AND LYING EASTERLY OF THE EASTERLY LINE OF GOETZ ROAD AS CONVEYED TO THE CITY OF PERRIS, BY DEED RECORDED MARCH 14, 1952 IN BOOK 1350 PAGE 454 OF OFFICIAL RECORDS OF RIVERSIDE COUNTY, CALIFORNIA.

EXCEPTING THEREFROM THE NORTHEASTERLY 40.00 FEET THEREOF, LYING WITHIN CASE ROAD.

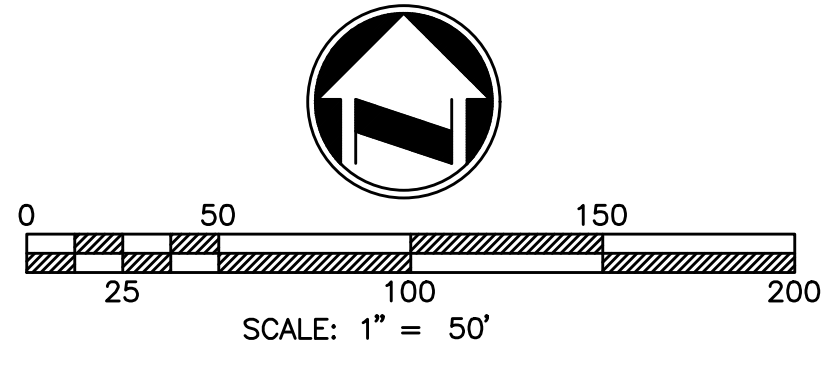
ALSO EXCEPTING THEREFROM THAT PORTION AS CONVEYED TO THE CITY OF PERRIS, BY DEED RECORDED OCTOBER 13, 1989 AS INSTRUMENT NO. 89-355953 OF OFFICIAL RECORDS OF RIVERSIDE COUNTY, CALIFORNIA.

ALSO EXCEPTING THE SOUTHERLY 30.00 FEET THEREOF, LYING WITHIN ELLIS AVENUE.

ALSO EXCEPTING THEREFROM THAT PORTION AS CONVEYED TO THE CITY OF PERRIS, BY DEED RECORDED NOVEMBER 16, 2017 AS INSTRUMENT NO. 2017-0480242 OF OFFICIAL RECORDS OF RIVERSIDE COUNTY, CALIFORNIA.

PARCEL 2: (APN: 301-160-070)  
BLOCK 6 OF WALKER'S SUBDIVISION, AS SHOWN BY MAP ON FILE IN BOOK 10 PAGE 493 OF MAPS, RECORDS OF SAN DIEGO COUNTY, CALIFORNIA.

TOGETHER WITH THAT PORTION OF JOHNSON STREET AS VACATED AND CLOSED TO PUBLIC USE BY RESOLUTION NO. 1861, RECORDED AUGUST 14, 1990 AS INSTRUMENT NO. 40-300819 OF OFFICIAL RECORDS OF RIVERSIDE COUNTY, CALIFORNIA, LYING NORTHERLY OF THE WESTERLY PROLONGATION OF THE SOUTHERLY LINE OF SAID BLOCK 6 AND SOUTHERLY OF THE NORTHWESTERLY PROLONGATION OF THE NORTHEASTERLY LINE OF SAID BLOCK 6.



**LEGEND**

PROP DOMESTIC WATER	DW
PROPOSED RECLAIMED WATER	RW
PROPOSED SEWER	S
PROPOSED STORM DRAIN	SD
EXISTING EDGE OF PAVEMENT	---
PROPOSED PADS	---
PROPOSED LOT LINES	---
PROPOSED EASEMENTS	---
TRACT BOUNDARY	---
RIGHT OF WAY	---

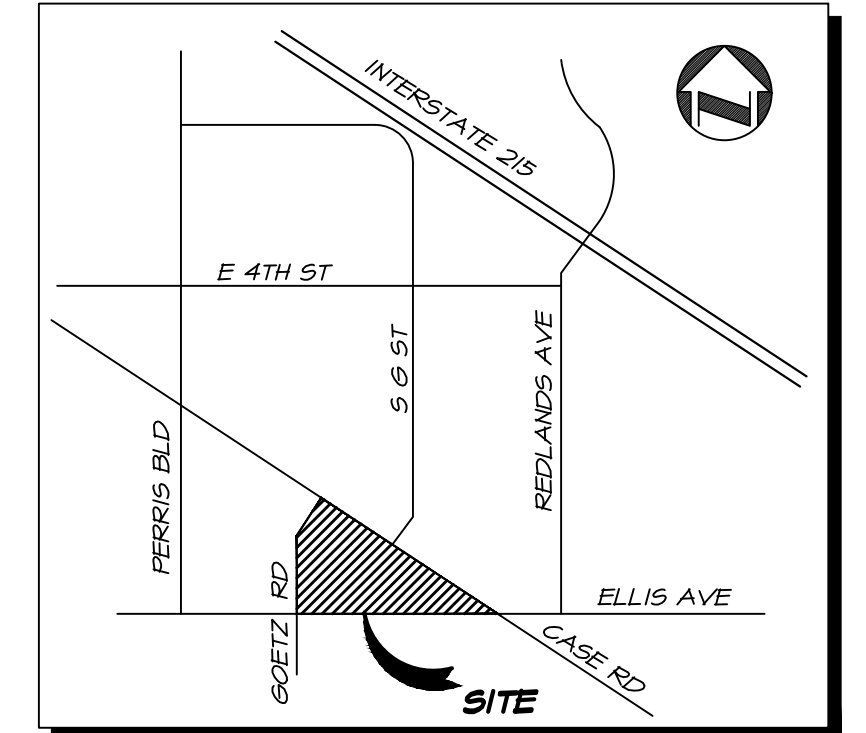
  

SD = STORM DRAIN	PROP = PROPOSED
TC = TOP OF CURB	EVG = END OF VERTICAL CURVE
FS = FINISH SURFACE	SNR = BEGINNING OF VERTICAL CURVE
SNR = SENIOR	TF = TOP OF FOOTING
TF = TOP OF FOOTING	TW = TOP OF WALL
TW = TOP OF WALL	CL = CENTER LINE
CL = CENTER LINE	FG = FINISHED GROUND
FG = FINISHED GROUND	SH = SIDEWALK
SH = SIDEWALK	EP = EDGE OF PAVEMENT
EP = EDGE OF PAVEMENT	C&G = CURB AND GUTTER
C&G = CURB AND GUTTER	S.F. = SQUARE FEET
S.F. = SQUARE FEET	O.S. = OPEN SPACE
O.S. = OPEN SPACE	EX = EXISTING
EX = EXISTING	

Plot Date: 11/20/2023 U:\Projects\alabbassi\10519\ENGINEERING\Conceptual\Precise\Grade\10519\_CG01.dwg

IN THE CITY OF PERRIS, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA  
**CONCEPTUAL UTILITY PLAN**  
**CASE AND GOETZ**

THOMAS BRO. GUIDE PG. 807 GRID: H4



**VICINITY MAP**  
 (N.T.S.)  
**T4S R3W SEC 32 W**

**OWNER/APPLICANT**

ALABASSI CONSTRUCTION & ENGINEERING  
 764 N. RAMONA EXPRESSWAY SUITE C,  
 PERRIS, CA 92571

**ENGINEER**

ADKAN ENGINEERS  
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**APN**

310-150-012  
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 GAS: SOCAL GAS 1-877-238-0092  
 CABLE: TIME WARNER 1-855-707-1328

**LAND USE AND ZONING**

CURRENT GENERAL PLAN DT SP  
 CURRENT ZONING DTSP EP  
 PROPOSED ZONING DTSP EP  
 EXISTING LAND USE VACANT  
 PROPOSED LAND USE COMMERCIAL

**WATER CONSTRUCTION NOTES - BY CONTRACTOR**

- ① INSTALL 2" SERVICE (B-344A).....1 EA.
- ② INSTALL 8" DOMESTIC WATERLINE.....1 EA.

**SEWER CONSTRUCTION NOTES- BY CONTRACTOR**

- ⑪ INSTALL 8" SEWER.....1 EA.

**CITY FORCES INSTALLATIONS**

- ⑩ INSTALL 8" SEWER LATERAL PER EMWD STD. SB-ITT (PRIVATE).....3 EA.
- ⑫ INSTALL 6" FIRE SERVICE PER R.P.U. STD. DWS, CHD-615.....1 EA.

**LEGAL DESCRIPTION**

REAL PROPERTY IN THE CITY OF PERRIS, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA, DESCRIBED AS FOLLOWS:

PARCEL 1: APN: 310-150-012  
 THAT PORTION OF THE SOUTHWEST QUARTER OF THE SOUTHWEST QUARTER OF SECTION 32, TOWNSHIP 4 SOUTH, RANGE 3 WEST, SAN BERNARDINO BASE AND MERIDIAN, ACCORDING TO UNITED STATES GOVERNMENT SURVEY THEREOF, LYING SOUTHWESTERLY OF THE SOUTHWESTERLY LINE OF THE CALIFORNIA CENTRAL RAILWAY, AND LYING EASTERLY OF THE EASTERLY LINE OF GOETZ ROAD AS CONVEYED TO THE CITY OF PERRIS, BY DEED RECORDED MARCH 14, 1952 IN BOOK 1350 PAGE 454 OF OFFICIAL RECORDS OF RIVERSIDE COUNTY, CALIFORNIA.

EXCEPTING THEREFROM THE NORTHEASTERLY 40.00 FEET THEREOF, LYING WITHIN CASE ROAD.

ALSO EXCEPTING THEREFROM THAT PORTION AS CONVEYED TO THE CITY OF PERRIS, BY DEED RECORDED OCTOBER 13, 1989 AS INSTRUMENT NO. 84-355953 OF OFFICIAL RECORDS OF RIVERSIDE COUNTY, CALIFORNIA.

ALSO EXCEPTING THE SOUTHERLY 30.00 FEET THEREOF, LYING WITHIN ELLIS AVENUE.

ALSO EXCEPTING THEREFROM THAT PORTION AS CONVEYED TO THE CITY OF PERRIS, BY DEED RECORDED NOVEMBER 16, 2011 AS INSTRUMENT NO. 2011-0480242 OF OFFICIAL RECORDS OF RIVERSIDE COUNTY, CALIFORNIA.

PARCEL 2: (APN: 301-160-070)  
 BLOCK 6 OF WALKER'S SUBDIVISION, AS SHOWN BY MAP ON FILE IN BOOK 10 PAGE 493 OF MAPS, RECORDS OF SAN DIEGO COUNTY, CALIFORNIA.

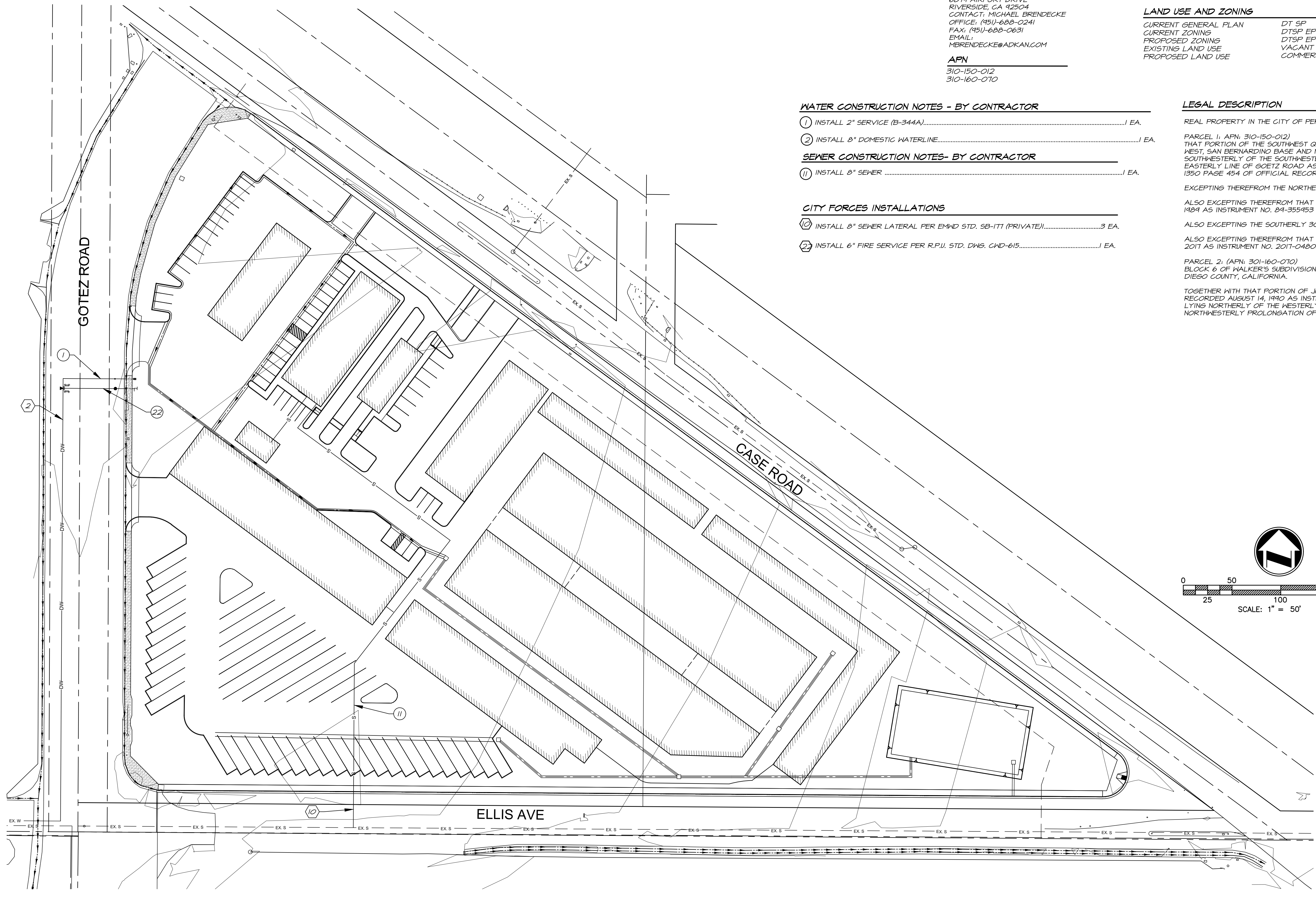
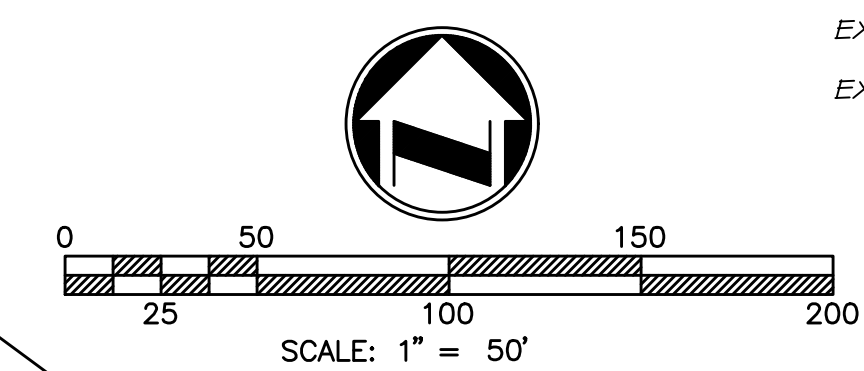
TOGETHER WITH THAT PORTION OF JOHNSON STREET AS VACATED AND CLOSED TO PUBLIC USE BY RESOLUTION NO. 1061, RECORDED AUGUST 14, 1990 AS INSTRUMENT NO. 90-300819 OF OFFICIAL RECORDS OF RIVERSIDE COUNTY, CALIFORNIA, LYING NORTHERLY OF THE WESTERLY PROLONGATION OF THE SOUTHERLY LINE OF SAID BLOCK 6 AND SOUTHERLY OF THE NORTHWESTERLY PROLONGATION OF THE NORTHEASTERLY LINE OF SAID BLOCK 6.

**LEGEND**

PROP DOMESTIC WATER	DW
PROPOSED RECLAIMED WATER	RW
PROPOSED SEWER	S
PROPOSED STORM DRAIN	SD
EXISTING EDGE OF PAVEMENT	---
PROPOSED PADS	---
PROPOSED LOT LINES	---
PROPOSED EASEMENTS	---
TRACT BOUNDARY	---
RIGHT OF WAY	---
EXISTING SEWER	---
EXISTING WATER	---
EXISTING GAS	---

SD = STORM DRAIN  
 TC = TOP OF CURB  
 FS = FINISH SURFACE  
 SWR = SEWER  
 TF = TOP OF FOOTING  
 TW = TOP OF WALL  
 CL = CENTER LINE  
 FG = FINISHED GROUND  
 WTR = WATER  
 EP = EDGE OF PAVEMENT  
 P/L = PROPERTY LINE  
 R/W = RIGHT OF WAY  
 O.S. = OPEN SPACE  
 EX. = EXISTING

PROP. = PROPOSED  
 EVG = END OF VERTICAL CURVE  
 BVC = BEGINNING OF VERTICAL CURVE  
 A.R. = A.D.A ACCESS RAMP  
 SW = SIDEWALK  
 ( ) = EXISTING ELEVATION  
 C&G = CURB AND GUTTER  
 S.F. = SQUARE FEET  
 F.S. = FINISH SURFACE  
 FH = FIRE HYDRANT



Plot Date: 11/21/2023 U:\Projects\labbas\10519\ENGINEERING\Conceptual Utility\10519 UTILITY\_01.dwg

# Appendix 3: Soils Information

*Geotechnical Study and Other Infiltration Testing Data*

**PRELIMINARY GEOTECHNICAL EVALUATION AND INFILTRATION STUDY  
PROPOSED GAS STATION, RETAIL AND STORAGE FACILITY  
APNs 310-150-012-1 AND 310-160-070-4  
PERRIS, RIVERSIDE COUNTY, CALIFORNIA**

**PREPARED FOR**

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

**PREPARED BY**

**GEO TEK, INC.  
1548 NORTH MAPLE STREET  
CORONA, CALIFORNIA 92878**

**PROJECT No. 2582-CR**

**JANUARY 18, 2021**

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**GeoTek, Inc.**

1548 North Maple Street, Corona, California 92878  
(951) 710-1160 Office (951) 710-1167 Fax [www.geotekusa.com](http://www.geotekusa.com)

January 18, 2021  
Project No. 2582-CR

**Alabbasi Construction & Engineering**

764 W. Ramona Expressway, Suite C  
Perris, California 92571

Attention: Ms. Corinne Mostad

Subject: Preliminary Geotechnical Evaluation and Infiltration Study  
Proposed Gas Station, Retail and Storage Facility  
Assessor's Parcel Numbers (APNs) 310-150-012-1 and 310-160-070-4  
Perris, Riverside County, California

Dear Ms. Mostad:

We are pleased to provide the results of our preliminary geotechnical evaluation and infiltration study for the subject project located in the Perris area of Riverside County, California. This report presents the results of our evaluation and discussion of our findings.

Based on the results of our evaluation, development of the property appears feasible from a geotechnical viewpoint provided that the recommendations presented in this report and in future reports are incorporated into design and construction.

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

Respectfully submitted,  
**GeoTek, Inc.**



Edward H. LaMont  
CEG 1892, Exp. 07/31/22  
Principal Geologist



Noelle C. Toney  
PE 84700, Exp. 03/31/22  
Project Engineer



Distribution: (1) Addressee via email

G:\Projects\2551 to 2600\2582CR Alabbasi Construction & Engineering Intersection of Goatz Rd, Case Rd & Ellis Ave. Perris\Geo\2582CR Alabbasi Construction & Engineering Commercial Devt Perris\_Prelim Geo Evaluation and Infiltration Study.docx

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### ENCLOSURES

Figure 1 – Site Location and General Topography Map

Figure 2 – Exploration Location Map

Appendix A – Logs of Exploratory Borings

Appendix B – Laboratory Test Results

Appendix C – Infiltration Test Data

Appendix D – Liquefaction Analysis

Appendix E – General Grading Guidelines

## **I. PURPOSE AND SCOPE OF SERVICES**

The purpose of this study was to evaluate the geotechnical conditions for the proposed development. Services provided for this study included the following:

- Research and review of available geologic and geotechnical data, and general information pertinent to the site,
- Site exploration consisting of the excavation, logging, and sampling of four exploratory hollow-stem auger borings; and logging and infiltration testing of two hollow-stem auger borings,
- Collection of relatively undisturbed and bulk samples of the on-site materials,
- Laboratory testing of the samples obtained from the site,
- Review and evaluation of site seismicity, including seismic settlement analysis, and
- Compilation of this geotechnical report which presents our findings and a general summary of pertinent geotechnical conditions relevant for site development.

The intent of this report is to aid in the evaluation of the site for future development from a geotechnical perspective. The professional opinions and geotechnical information contained in this report will likely need to be updated based on our review of final site development plans. These should be provided to GeoTek for review when available.

## **2. SITE DESCRIPTION AND PROPOSED DEVELOPMENT**

### **2.1 SITE DESCRIPTION**

The triangular-shaped site is located in the city of Perris, Riverside County, California. The site consists of approximately 11-acres and is comprised of one parcel identified with Riverside County Assessor's Parcel Numbers (APNs) 310-150-012-1 and 310-160-070-4. The approximate location of the site is noted on the attached Figure 1, Site Location and General Topography Map.

Based on a review of available maps, observations at the time of our site reconnaissance and field exploration, the currently proposed development will be located in the area of a currently vacant site area with no visual indication of previous structural improvements. The subject property is

bounded to the south by the Ellis Avenue extension (unpaved) a row of trees, vacant land and Perris Valley Airport beyond; to the north/northeast by Commercial Street/Case Road, vacant land and commercial developments beyond; and to the west by Goetz Road and single-family residential homes beyond. The G Street extension (unpaved) traverses the central portion of the subject site in a north-south direction. The subject site is located in an area characterized by single-family homes and commercial buildings. Site topography is relatively planar and slopes gently down to the southeast with surface drainage generally directed towards the southeast. Total relief across the site is on the order of eight feet.

## **2.2 PROPOSED DEVELOPMENT**

It is our understanding that the proposed site improvements will consist of a gas station, retail and storage facility. Associated parking, drive aisles, underground utilities (including gas storage tanks), concrete flatwork and landscaping are also anticipated for development. It is anticipated that on-site storm water disposal may be planned, although location of the system is not yet known.

Specific structural loading was not provided to us; however, it is anticipated that the structures will be single-story, of wood-framed construction, will be supported by conventional shallow foundations and will include concrete slab-on-grade floors. For the purpose of this evaluation, we have assumed maximum column and wall loads of 100 kips and 4 kips per foot, respectively.

Improvement plans have not been reviewed by GeoTek in the preparation of this report. As site development planning progresses and plans become available, the plans should be provided to GeoTek for review and comment. Additional engineering analyses may be necessary in order to provide specific earthwork recommendations and geotechnical design parameters for actual site development.

## **3. GEOTECHNICAL WORK**

### **3.1 FIELD EXPLORATION**

Our geotechnical field exploration was conducted on December 18, 2020. An engineer from GeoTek logged four exploratory hollow-stem auger borings excavated by a truck-mounted hollow-stem auger drill. In addition, two percolation test borings were excavated and infiltration testing subsequently performed within the test borings. The borings were located throughout the site (see Exploration Location Map, Figure 2). Logs of the exploratory borings are included

in Appendix A. Samples of on-site soils encountered in the excavations were returned to the laboratory for testing and evaluation.

### **3.2 LABORATORY TESTING**

Laboratory testing was performed on selected soil samples collected during the field exploration. The purpose of the laboratory testing was to help confirm the field classification of the soil materials encountered and to evaluate their physical and chemical properties for use in engineering design and analysis. Results of the laboratory testing program along with a brief description and relevant information regarding testing procedures are included in Appendix B.

## **4. GEOLOGIC AND SOILS CONDITIONS**

### **4.1 REGIONAL SETTING**

The subject property is situated in the Peninsular Ranges geomorphic province. The Peninsular Ranges province is one of the largest geomorphic units in western North America. It extends from the point of contact with the Transverse Ranges geomorphic province, southerly to the tip of Baja California. This province varies in width from about 30 to 100 miles. It is bounded on the west by the Pacific Ocean, on the south by the Gulf of California and on the east by the Colorado Desert Province.

The Peninsular Ranges are essentially a series of northwest-southeast oriented fault blocks. Several major fault zones are found in this province. The Elsinore Fault zone and the San Jacinto Fault zone trend northwest-southeast and are mostly found near the middle of the province. The San Andreas Fault zone borders the northeasterly margin of the province, and the San Jacinto fault borders the province adjacent the Colorado Desert province.

More specific to the subject property, the site is located in an area geologically mapped to be underlain by older alluvium (Dibblee, T.W. and Minch, J.A., 2003). No active faults are shown in the immediate site vicinity on the maps reviewed for the site and site area.

### **4.2 EARTH MATERIALS**

A brief description of the earth materials encountered during our explorations is presented in the following sections.

#### **4.2.1 Undocumented Fill**

Undocumented fill was not encountered in any of the explorations excavated on-site. Undocumented fill may be present within areas of the site that were not explored. Expansion index testing reveals that the near-surface soils exhibit a “very low” expansion potential.

#### **4.2.2 Older Alluvium**

Alluvial materials underlying the undocumented fill was encountered in all of the borings excavated on the site. In general, the alluvial materials typically consist of sand with varying amounts of silt and clay, and silt and clay with varying amounts of sand. Expansion index testing reveals that the near-surface soils exhibit a “very low” expansion potential.

### **4.3 SURFACE WATER AND GROUNDWATER**

#### **4.3.1 Surface Water**

Surface water was not observed during our site reconnaissance or investigation. If encountered during earthwork construction, surface water on this site is the result of precipitation or possibly some minor surface run-off from immediately surrounding properties. Overall site area drainage is generally in a southeast direction, as directed by site topography. Provisions for surface drainage should be accounted for by the project civil engineer.

#### **4.3.2 Groundwater**

Groundwater was encountered within one of our exploratory borings (Boring B-3) at a depth of approximately 29 feet bgs. Based on a review of information contained within the State of California Geotracker website (<https://geotracker.waterboards.ca.gov/>), groundwater was recently reported at a depth of approximately 40 feet bgs at a location 0.7-mile to the north-northwest of the subject site. The depth to groundwater is expected to vary seasonally and localized perched groundwater conditions could be encountered. Groundwater is not anticipated to impact the planned development with the exception of the planned underground gas tanks and infiltration chambers.

### **4.4 INFILTRATION STUDY**

Two percolation test borings were set up within the southeast corner of the site where stormwater naturally drains due to site topography. The borings were excavated with a truck-mounted hollow-stem auger drill rig and were approximately eight inches in diameter. Test borings I-1 and I-2 were excavated to a depth of approximately five feet bgs. A three-inch diameter perforated PVC pipe encapsulated in filter sock was inserted into each of the

percolation test holes. The annular space between the test hole sidewalls and PVC pipe was filled with gravel to prevent caving. The locations of the test borings are presented on Figure 1.

The soils encountered in our borings generally consisted of silty sand. The boring logs are presented in Appendix A.

Subsequent to pre-soaking the test holes in general conformance with the referenced document (Riverside County, 2011), percolation testing was performed in the bottom 20 inches in test borings I-1 and I-2 by a representative from our firm. The percolation testing was conducted in general conformance with the referenced document from Riverside County. The percolation rate was converted to an infiltration rate utilizing the Porchet Method.

The infiltration rates for the borings are presented in the following table, after the water level had stabilized.

<b>Boring No.</b>	<b>Infiltration Rate (inches per hour)</b>	<b>Depth of Boring (feet)</b>
Boring I-1	0.09	5
Boring I-2	0.33	5

Copies of the percolation data and infiltration conversions (Porchet Method) are included in Appendix C. The reported infiltration rates are the measured rates without any factor of safety applied. Over the lifetime of the infiltration areas, the infiltration rates may be affected by silt build up and biological activities, as well as local variations in near surface soil conditions. A suitable factor of safety should be applied to the field rate in designing the infiltration system.

It should be noted that the infiltration rates provided above were performed in relatively undisturbed on-site soils. Infiltration rates will vary and are mostly dependent on the underlying consistency of the site soils and relative density. Infiltration rates may be impacted by weight of equipment travelling over the soils, placement of engineered fill and other various factors. GeoTek assumes no responsibility or liability for the ultimate design or performance of the storm water facility.

#### **4.5 FAULTING AND SEISMICITY**

The geologic structure of the entire southern California area is dominated mainly by northwest-trending faults associated with the San Andreas system. The site is in a seismically active region. No active or potentially active fault is known to exist at this site nor is the site situated within a State of California designated "Alquist-Priolo" Earthquake Fault Zone (Bryant and Hart, 2007). The nearest zoned faults are the Elsinore Fault, approximately nine miles to the southwest, and the



San Jacinto Fault, approximately 11 miles to the northeast. The project site has not been evaluated by the State of California for liquefaction or landslide potential. The County of Riverside has designated the site as “not in fault zone, “not in a fault line,” has “low” potential for liquefaction and is “susceptible” to subsidence.

#### **4.5.1 Seismic Design Parameters**

The site is located at approximately 33.7728 Latitude and -117.2219 Longitude. Site spectral accelerations ( $S_a$  and  $S_1$ ), for 0.2 and 1.0 second periods for a Class “D” site, was determined from the SEAOC/OSHPD web interface that utilizes the USGS web services and retrieves the seismic design data and presents that information in a report format. Using the ASCE 7-16 option on the SEAOC/OSHPD website results in the values for  $S_{M1}$  and  $S_{D1}$  reported as “null-See Section 11.4.8” (of ASCE 7-16). As noted in ASCE 7-16, Section 11.4.8, a site-specific ground motion procedure is recommended for Site Class D when the value  $S_1$  exceeds 0.2. The value  $S_1$  for the subject site exceeds 0.2.

For a site Class D, an exception to performing a site-specific ground motion analysis is allowed in ASCE 7-16 where  $S_1$  exceeds 0.2 provided the value of the seismic response coefficient,  $C_s$ , is conservatively calculated by Eq 12.8-2 of ASCE 7-16 for values of  $T \leq 1.5T_L$  and taken as equal to 1.5 times the value computed in accordance with either Eq. 12.8-3 for  $T_L \geq T > 1.5T_L$  or Eq. 12.8-4 for  $T > T_L$ .

The results, based on the 2015 NEHRP and the 2019 CBC, are presented in the following table and we have assumed that the exception as allowed in ASCE 7-16 is applicable. If the exception is deemed not appropriate, a site-specific ground motion analysis will be required.

<b>SITE SEISMIC PARAMETERS</b>	
Mapped 0.2 sec Period Spectral Acceleration, $S_s$	1.448g
Mapped 1.0 sec Period Spectral Acceleration, $S_1$	0.535g
Site Coefficient for Site Class "D," $F_a$	1.0
Site Coefficient for Site Class "D," $F_v$	1.765 (See Section 11.4.7 of ASCE 7-16)
Maximum Considered Earthquake Spectral Response Acceleration for 0.2 Second, $S_{MS}$	1.448g
Maximum Considered Earthquake Spectral Response Acceleration for 1.0 Second, $S_{M1}$	0.945g (See Section 11.4.7 of ASCE 7-16)
5% Damped Design Spectral Response Acceleration Parameter at 0.2 Second, $S_{DS}$	0.965g
5% Damped Design Spectral Response Acceleration Parameter at 1 second, $S_{D1}$	0.63g (See Section 11.4.7 of ASCE 7-16)
Seismic Design Category	D

Final selection of the appropriate seismic design coefficients should be made by the project structural engineer based upon the local practices and ordinances, expected building response and desired level of conservatism.

#### **4.5.2 Surface Fault Rupture**

The site is in a seismically active region; however, no active or potentially active fault is known to exist at this site nor is the site situated within an "Alquist-Priolo" Earthquake Fault Zone (Bryant and Hart, 2007; State of California, 1993). The nearest known active fault is located approximately nine miles to the southwest. Therefore, the potential for surface rupture at the site is considered to be nil.

#### **4.5.3 Liquefaction Analysis**

Liquefaction describes a phenomenon in which cyclic stresses, produced by earthquake-induced ground motion, create excess pore pressures in relatively cohesionless soils. These soils may acquire a high degree of mobility which can lead to lateral movement, sliding, settlement of loose sediments, sand boils and other damaging deformations. This phenomenon occurs only below the water table, but, after liquefaction has developed, the effects can propagate upward into overlying non-saturated soil as excess pore water dissipates.

The factors known to influence liquefaction potential include soil type and grain size, relative density, groundwater level, confining pressures, and both intensity and duration of ground shaking. In general, materials that are susceptible to liquefaction are loose, saturated granular soils having low fines content under low confining pressures. The site is designated as having

“low” potential for liquefaction by Riverside County. Groundwater was encountered at a depth of 29 feet bgs in our exploratory Boring B-3.

It is anticipated that major earthquake ground shaking will occur during the lifetime of the proposed development from the seismically active San Jacinto Fault and Elsinore Fault. These are the known faults are likely to create the most significant earthshaking event at the subject site.

Due to the potential for significant ground shaking, we evaluated the potential for liquefaction induced settlement resulting from seismic activity. For this analysis we utilized a ground acceleration ( $PGA_M$ ) value 0.55g and a mean earthquake magnitude of 6.87. The ground acceleration and earthquake magnitude values were obtained from the USGS websites. GeoTek evaluated the liquefaction induced settlement potential at the site using the computer program LiquefyPro Version 5.8n and the soil profile of Boring B-3.

Our analysis revealed an estimated seismic-induced settlement potential of approximately 0.14-inch in Boring B-3. We estimate a seismic differential settlement of about 0.07-inch over a 40-foot span. Based on these seismic settlement estimates, it is our opinion that special mitigation is not needed. The results of this evaluation are shown in Appendix D.

#### **4.5.4 Other Seismic Hazards**

The potential for secondary seismic hazards such as seiche and tsunami is considered to be remote due to site elevation and distance from an open body of water. Due to the absence of a nearby free-face and the low liquefaction hazard, the potential for lateral spreading is considered to be nil.

## **5. CONCLUSIONS AND RECOMMENDATIONS**

### **5.1 GENERAL**

Development of the site appears feasible from a geotechnical viewpoint. Specific recommendations for site development provided in this report will need to be further evaluated when development plans are provided for our review. The following sections present general recommendations. More specific geotechnical recommendations for site development can be provided when more finalized site development plans are available for review.

## **5.2 EARTHWORK CONSIDERATIONS**

### **5.2.1 General**

Earthwork and grading should be performed in accordance with the applicable grading ordinances of Riverside County, the 2019 California Building Code (CBC) and recommendations contained in this report. The General Grading Guidelines included in Appendix E outline general procedures and do not anticipate all site-specific situations. In the event of conflict, the recommendations presented in the text of this report should supersede those contained in Appendix E.

### **5.2.2 Site Clearing and Demolition**

Site preparation should start with removal of existing deleterious materials and vegetation within the planned development areas of the site. All deleterious materials should be properly disposed of off-site.

### **5.2.3 Removals and Overexcavations**

All existing undocumented fill, if encountered, should be removed and replaced with engineered fill. Removals should extend down to competent alluvium. Competent alluvium is defined as native materials that are visually relatively non-porous and having a relative compaction of at least 85 percent of the soil's maximum dry density as determined per ASTM D 1557. In areas of the proposed buildings and improvements, a minimum of two feet of engineered fill below the bottom of the proposed footings and floor-slabs should be provided. A minimum of two feet of fill should be provided beneath the pavement subgrade.

In cut areas, overexcavation should extend down to a depth such that a minimum of two feet of engineered fill is provided below the bottom of the deepest proposed foundation.

In transition areas (requiring cut and fill), a minimum of two feet of engineered fill should be provided below the bottom of the deepest proposed foundation. To mitigate the potential of excessive differential settlement associated with variable depths of engineered fill, overexcavation should extend down to a depth of one-half the maximum fill depth.

As a minimum, removals should extend down and away from foundation elements at a 1:1 (h:v) projection to the recommended removal depth, or a minimum of five feet laterally.

All undocumented fill should be also removed beneath flatwork improvement areas. A minimum of 12 inches of engineered fill should be provided below asphaltic concrete pavement and

Portland cement concrete hardscape areas. The horizontal extent of removals should extend at least two feet beyond the edge of hardscape.

Development plans should be reviewed by this firm when available. Depending on actual field conditions encountered during grading, locally deeper areas of removal may be recommended.

The bottom of all removals should be scarified to a minimum depth of six inches, brought to at least the optimum moisture content, and then recompacted to at least 90 percent of the soil's maximum dry density (ASTM D 1557). The bottoms of removals should be observed by a GeoTek representative prior to scarification.

#### **5.2.4 Engineered Fill**

The on-site soils are generally considered suitable for reuse as engineered fill provided that they are free from vegetation, debris and other deleterious material. The undercut areas should be brought to final subgrade elevations with fill materials that are placed and compacted in general accordance with minimum project standards. Engineered fill should be placed in six-inch to eight-inch loose lifts, moisture conditioned to at least the optimum moisture content and compacted to a minimum relative compaction of 90 percent as determined by ASTM D 1557.

#### **5.2.5 Excavation Characteristics**

The anticipated excavations in the on-site alluvial materials should be readily accomplished with heavy-duty earthmoving or excavating equipment in good operating condition.

#### **5.2.6 Trench Excavations and Backfill**

Trench excavations should conform to Cal-OSHA regulations. The contractor should have a competent person, per OSHA requirements, on site during construction to observe conditions and to make the appropriate recommendations.

Utility trench backfill should be compacted to at least 90 percent relative compaction (as determined per ASTM D 1557). Under-slab trenches should also be compacted to project specifications. Where applicable, based on jurisdictional requirements, the upper 12 inches of backfill below subgrade for road pavements should be compacted to at least 95 percent relative compaction. On-site materials may not be suitable for use as bedding material but should be suitable as backfill provided particles larger than six inches are removed.

Compaction should be achieved with a mechanical compaction device. Ponding or jetting of trench backfill is not recommended. If backfill soils have dried out, they should be thoroughly moisture conditioned prior to placement in trenches.

### **5.2.7 Shrinkage and Subsidence**

For planning purposes, a shrinkage factor from 10 to 15 percent may be considered for the materials requiring removal and/or recompaction. A subsidence value of up to 0.1 may be anticipated for the underlying soils.

Several factors will impact earthwork balancing on the site, including shrinkage, trench spoil from utilities and footing excavations, as well as the accuracy of topography. Shrinkage and bulking are primarily dependent upon the degree of compactive effort achieved during construction, depth of fill and underlying site conditions.

Site balance areas should be available in order to adjust project grades, depending on actual field conditions at the conclusion of earthwork construction.

## **5.3 DESIGN RECOMMENDATIONS**

### **5.3.1 Foundation Design Criteria**

Foundation design criteria for a conventional foundation system, in general conformance with the 2019 CBC, are presented in this section. These are typical design criteria and are not intended to supersede the design by the structural engineer. If desirable, preliminary design recommendations for post-tension foundation systems can be provided upon request.

Based on the results of this investigation and laboratory testing previously performed at this site, GeoTek anticipates that the majority of the on-site soils to be encountered during grading may be classified as having “very low” ( $0 \leq e_i \leq 20$ ) expansion potential per ASTM D 4829. Additional laboratory testing should be performed at the completion of site grading to verify the expansion potential of the near-surface soils.

A summary of our preliminary foundation design recommendations is presented in the table below:

**GEOTECHNICAL RECOMMENDATIONS FOR FOUNDATION DESIGN**

<b>MINIMUM DESIGN REQUIREMENTS FOR CONVENTIONALLY REINFORCED FOUNDATIONS</b>	
<b>Design Parameter</b>	<b>“Very Low” Expansion Potential</b>
Foundation Depth or Minimum Perimeter Beam Depth (inches below lowest adjacent grade)	One-Story – 12
Minimum Foundation Width (Inches)*	One-Story – 12
Minimum Slab Thickness (actual)	4 – Actual
Minimum Slab Reinforcing	No. 3 rebar 24 inches on-center, each way, placed in middle of slab
Minimum Footing Reinforcement	Two No. 4 reinforcing bars, one placed near the top and one near the bottom
Presaturation of Subgrade Soil (Percent of Optimum)	Minimum of 100% of the optimum moisture content to a depth of at least 12 inches prior to placing concrete

\* Code minimums per Table 1809.7 of the 2019 CBC.

It should be noted that the criteria provided are based on soil support characteristics only. The structural engineer should design the slab and beam reinforcement based on actual loading conditions.

The following criteria for design of foundations are preliminary and should be re-evaluated based on the results additional laboratory testing of samples obtained at/near finish pad grade.

5.3.1.1 An allowable bearing capacity of 2,000 pounds per square foot (psf) may be used for design of continuous footings 12 inches deep and 12 inches wide, and pad footings 12 inches square and 12 inches deep. This value may be increased by 500 psf for each additional 12 inches in depth and 300 psf for each additional 12 inches in width to a maximum value of 3,500 psf. An increase of one-third may be applied when considering short-term live loads (e.g. seismic and wind loads).

5.3.1.2 Structural foundations should be designed in accordance with the 2019 CBC, and to withstand a total estimated static settlement of less than 1 inch and a maximum differential static settlement of one-half of the total settlement over a horizontal distance of 40 feet.

5.3.1.3 The passive earth pressure may be computed as an equivalent fluid having a density of 200 psf per foot of depth, to a maximum earth pressure of 3,500 psf for footings founded on engineered fill. A coefficient of friction between soil and concrete of 0.35 may be



used with dead load forces. When combining passive pressure and frictional resistance, the passive pressure component should be reduced by one-third.

- 5.3.1.4 A grade beam, a minimum of 12 inches wide and 18 inches deep, should be utilized across large entrances. The base of the grade beam should be at the same elevation as the bottom of the adjoining footings.
- 5.3.1.5 A moisture and vapor retarding system should be placed below slabs-on-grade where moisture migration through the slab is undesirable. Guidelines for these are provided in the 2019 California Green Building Standards Code (CALGreen) Section 4.505.2, the 2019 CBC Section 1907.1 and ACI 360R-10. The vapor retarder design and construction should also meet the requirements of ASTM E 1643. A portion of the vapor retarder design should be the implementation of a moisture vapor retardant membrane.

It should be realized that the effectiveness of the vapor retarding membrane can be adversely impacted as a result of construction related punctures (e.g. stake penetrations, tears, punctures from walking on the vapor retarder placed atop the underlying aggregate layer, etc.). These occurrences should be limited as much as possible during construction. Thicker membranes are generally more resistant to accidental puncture than thinner ones. Products specifically designed for use as moisture/vapor retarders may also be more puncture resistant. Although the CBC specifies a 6-mil vapor retarder membrane, it is GeoTek's opinion that a minimum 10-mil thick membrane with joints properly overlapped and sealed should be considered, unless otherwise specified by the slab design professional. The membrane should consist of Stego wrap or the equivalent.

Moisture and vapor retarding systems are intended to provide a certain level of resistance to vapor and moisture transmission through the concrete, but do not eliminate it. The acceptable level of moisture transmission through the slab is to a large extent based on the type of flooring used and environmental conditions. Ultimately, the vapor retarding system should be comprised of suitable elements to limited migration of water and reduce transmission of water vapor through the slab to acceptable levels. The selected elements should have suitable properties (i.e. thickness, composition, strength, and permeability) to achieve the desired performance level.

Moisture retarders can reduce, but not eliminate, moisture vapor rise from the underlying soils up through the slab. Moisture retarder systems should be designed and constructed in accordance with applicable American Concrete Institute, Portland

Cement Association, Post-Tensioning Concrete Institute, ASTM, California Building Code and Cal Green requirements and guidelines.

GeoTek recommends that a qualified person, such as the flooring contractor, structural engineer, architect, and/or other experts specializing in moisture control within the building be consulted to evaluate the general and specific moisture and vapor transmission paths and associated potential impact on the proposed construction. That person (or persons) should provide recommendations relative to the slab moisture and vapor retarder systems and for migration of potential adverse impact of moisture vapor transmission on various components of the structures, as deemed appropriate.

In addition, the recommendations in this report and our services in general are not intended to address mold prevention; since we, along with geotechnical consultants in general, do not practice in the area of mold prevention. If specific recommendations addressing potential mold issues are desired, then a professional mold prevention consultant should be contacted.

- 5.3.1.6 We recommend that control joints be placed in two directions spaced approximately 24 to 36 times the thickness of the slab in inches. These joints are a widely accepted means to control cracks and should be reviewed by the project structural engineer.

### **5.3.2 Miscellaneous Foundation Recommendations**

- 5.3.2.1 To minimize moisture penetration beneath the slab-on-grade areas, utility trenches should be backfilled with engineered fill, lean concrete or concrete slurry where they intercept the perimeter footing or thickened slab edge.
- 5.3.2.2 Soils from the footing excavations should not be placed in the slab-on-grade areas unless properly compacted and tested. The excavations should be free of loose/sloughed materials and be neatly trimmed at the time of concrete placement.
- 5.3.2.3 Unsuitable soil removals along the property lines will likely be restricted due to adjacent improvements. Special considerations will be required for foundation elements in these areas. Such considerations may include deepening of foundations, reduced bearing

capacity, or other measures. This issue should be further evaluated once site plans become available.

### **5.3.3 Foundation Set Backs**

5.3.3.1 Where applicable, the following setbacks should apply to all foundations. Any improvements not conforming to these setbacks may be subject to lateral movements and/or differential settlements:

5.3.3.2 The outside bottom edge of all footings should be set back a minimum of  $H/3$  (where  $H$  is the slope height) from the face of any descending slope. The setback should be at least seven feet and need not exceed 40 feet.

5.3.3.3 The bottom of all footings for structures near retaining walls should be deepened so as to extend below a 1:1 projection upward from the bottom inside edge of the wall stem. This applies to the existing retaining walls along the perimeter, if they are to remain.

The bottom of any proposed foundations for structures should be deepened so as to extend below a 1:1 projection upward from the bottom of the nearest excavation.

## **5.4 RETAINING WALL DESIGN AND CONSTRUCTION**

### **5.4.1 General Design Criteria**

Recommendations presented may apply to typical masonry or concrete vertical retaining walls to a maximum height of six feet. Additional review and recommendations should be requested for higher walls.

The passive earth pressure may be computed as an equivalent fluid having a density of 200 psf per foot of depth, to a maximum earth pressure of 3,500 psf. A coefficient of friction between soil and concrete of 0.35 may be used with dead load forces. When combining passive pressure and frictional resistance, the passive pressure component should be reduced by one-third.

An equivalent fluid pressure approach may be used to compute the horizontal active pressure against the wall. The appropriate fluid unit weights are given in the table below for specific slope gradients of retained materials.

Surface Slope of Retained Materials (H:V)	Equivalent Fluid Pressure (PCF) Select Backfill*
Level	35
2:1	55

\*Select backfill should consist of imported sand other approved materials with an expansion index less than or equal to 20.

The above equivalent fluid weights do not include superimposed loading conditions such as expansive soils, vehicular traffic, structures, seismic conditions or adverse geologic conditions.

#### **5.4.2 Wall Backfill and Drainage**

Wall backfill should include a minimum one-foot wide section of  $\frac{3}{4}$ - to 1-inch clean crushed rock (or approved equivalent). The rock should be placed immediately adjacent to the back of the wall and extend up from the backdrain to within approximately 12 inches of finish grade. The upper 12 inches should consist of compacted on-site materials. If the walls are designed using the “select” backfill design parameters, then the “select” materials shall be placed within the active zone as defined by a 1:1 (H:V) projection from the back of the retaining wall footing up to the retained surface behind the wall. The presence of other materials might necessitate revision to the parameters provided and modification of wall designs.

The backfill materials should be placed in lifts no greater than eight inches in thickness and compacted to a minimum of 90 percent relative compaction in accordance with ASTM D 1557. Proper surface drainage needs to be provided and maintained. Water should not be allowed to pond behind retaining walls. Waterproofing of site walls should be performed where moisture migration through the walls is undesirable.

Retaining walls should be provided with an adequate pipe and gravel back drain system to reduce the potential for hydrostatic pressures to develop. A 4-inch diameter perforated collector pipe (Schedule 40 PVC, or approved equivalent) in a minimum of one cubic foot per linear foot of  $\frac{3}{4}$ - inch or one-inch clean crushed rock or equivalent, wrapped in filter fabric should be placed near the bottom of the backfill and be directed (via a solid outlet pipe) to an appropriate disposal area.

Walls from two to four feet in height may be drained using localized gravel packs behind weep holes at 10 feet maximum spacing (e.g. approximately 1.5 cubic feet of gravel in a woven plastic bag). Weep holes should be provided or the head joints omitted in the first course of block

extended above the ground surface. However, nuisance water may still collect in front of the wall.

Drain outlets should be maintained over the life of the project and should not be obstructed or plugged by adjacent improvements.

### **5.4.3 Restrained Retaining Walls**

Any retaining wall that will be restrained prior to placing backfill or walls that have male or reentrant corners should be designed for at-rest soil conditions using an equivalent fluid pressure of 60 pcf (select backfill), plus any applicable surcharge loading. For areas having male or reentrant corners, the restrained wall design should extend a minimum distance equal to twice the height of the wall laterally from the corner, or as otherwise determined by the structural engineer.

#### **5.4.3.1 Other Design Considerations**

- Retaining and garden wall foundation elements should be designed in accordance with building code setback requirements. A minimum horizontal setback distance of five feet as measured from the bottom outside edge of the footing to a sloped face is recommended.
- Wall design should consider the additional surcharge loads from superjacent slopes and/or footings, where appropriate.
- No backfill should be placed against concrete until minimum design strengths are evident by compression tests of cylinders.
- The retaining wall footing excavations, backcuts and backfill materials should be approved by the project geotechnical engineer or their authorized representative.
- Positive separations should be provided in garden walls at horizontal distances not exceeding 20 feet.

## **5.5 PAVEMENT DESIGN AND CONSTRUCTION**

### **5.5.1 Asphaltic Concrete Pavement**

GeoTek utilized a bulk sample obtained from the field investigation for R-Value testing. The testing (by others) indicated an R-Value of 45. The R-Value test results are included in Appendix B.

Traffic Indices (TI) of 5.5 and 7.0 were assumed for preliminary pavement design for parking lot and drive aisle areas. The traffic indices selected to determine the pavement section should be reviewed by a design engineer when truck traffic loading is known. The table below provides the roadway area, TI, and two options for the recommended minimum structural pavement sections.

**MINIMUM RECOMMENDED ASPHALT CONCRETE PAVEMENT SECTIONS**

Location	Assumed Traffic Index	Design R-Value	Asphaltic Concrete (inches)	Aggregate Base (inches)
Light Vehicular Traffic Areas (including parking stalls and drive aisles not subject to heavy truck traffic)	5.5	45	3.0	4.5
			3.5	3.5
Heavy Truck Traffic Areas (including fire lanes, trash dumpster pads and approaches)	7.0	45	4.0	6.0
			4.5	5.0

The pavement sections recommended are subject to review by the City of Perris or the County of Riverside. Performance of the pavement sections will ultimately be based largely on construction methods, traffic loading and subgrade performance.

Additional laboratory testing should be completed during earthwork construction when pavement subgrade elevations are reached to confirm the sections presented above.

**5.5.2 Portland Cement Concrete Pavement for Heavy Truck Traffic Areas**

It is anticipated that heavy truck traffic will be exerting loads within heavy truck traffic areas paved with Portland Cement Concrete (PCC) pavement.

The table below provides the street area/usage, associated TI, and the recommended minimum concrete pavement section for the subject project. An R-Value of 45 was correlated to a modulus of subgrade reaction, k-Value, of approximately 210 for design purposes.



**MINIMUM RECOMMENDED CONCRETE PAVEMENT SECTIONS**

<b>Location</b>	<b>Assumed Traffic Category*</b>	<b>Design k-Value</b>	<b>PCC (inches)</b>	<b>Aggregate Base (inches)</b>
Heavy Truck Traffic Areas  (including dock aprons, fire lanes, trash dumpster pads and approaches)	D	210	7.0	4.0

\*Reference: *Guide for the Design and Construction of Concrete Parking Lots*, Reported by ACI Committee 330, ACI 330R-08, 2008.

The PCC pavement sections should incorporate appropriate steel reinforcement as designed by the project structural engineer. Crack control joints should be provided in the transverse direction spaced at horizontal intervals with a maximum spacing of 15 feet. The actual design should also be in accordance with design criteria specified by the governing jurisdiction.

The concrete should have a minimum modulus of rupture of 500 pounds per square inch (psi), and a minimum 28-day compressive strength of 2,500 psi. Concrete should incorporate one-inch maximum size aggregate and should be proportioned to achieve a maximum slump of four inches. Instead of increasing the water content, a plasticizing admixture may be utilized to increase the workability of the concrete. The concrete should be properly cured after placement. Concrete should not be placed during hot and windy weather.

The concrete pavement section is subject to the review and approval by the City of Perris or the County of Riverside. Performance of the pavement sections will ultimately be based largely on construction methods, traffic loading and subgrade performance.

**5.5.3 Pavement Construction**

All pavement installation, including preparation and compaction of subgrade, compaction of base material, placement of concrete and rolling of asphaltic concrete, should be done in accordance with the City of Perris or the County of Riverside specifications and under the observation and testing of GeoTek and a City or County inspector where required.

The aggregate base should consist of crushed rock with an R-Value and gradation in accordance with Crushed Aggregate Base (Section 200-2 of the “Greenbook”). Asphaltic concrete materials and construction should conform to Section 203 of the Greenbook. Minimum compaction requirements should be 95 percent for the upper three feet of subgrade and 95 percent for aggregate base, as per ASTM D 1557. The upper 12 inches of subgrade should be moisture



conditioned to at least the optimum moisture content. Jurisdictional minimum compaction requirements in excess of the aforementioned minimums may govern.

#### **5.5.4 Soil Corrosivity**

The soil corrosivity at this site was tested in the laboratory on one sample collected by our firm. The results of the testing indicate that the soil samples were considered “moderately corrosive” to buried ferrous metals. This corrosion classification is obtained from “Handbook of Corrosion Engineering,” by Pierre R. Roberge, 2<sup>nd</sup> Edition, 2000. Recommendations for protection of buried ferrous metal should be provided by a corrosion engineer. The laboratory test results are provided in Appendix B.

#### **5.5.5 Soil Sulfate Content**

The sulfate content was determined in the laboratory for one representative soil sample collected by our firm. The results indicate that the water-soluble sulfate for the tested samples was less than 0.1 percent by weight, which is considered “not applicable” (i.e. negligible) as per Table 4.2.1 of ACI 318. Based upon the test results, no special concrete mix design is required for sulfate attack resistance. The laboratory test results are provided in Appendix B.

#### **5.5.6 Import Soils**

Import soils should have expansion characteristics similar to the on-site soils. GeoTek also recommends that the proposed import soils be tested for expansion and sulfate potential. GeoTek should be notified a minimum of 72 hours prior to importing so that appropriate sampling and laboratory testing can be performed.

### **5.6 CONCRETE CONSTRUCTION**

#### **5.6.1 General**

Concrete construction should follow the 2019 CBC and ACI guidelines regarding design, mix placement and curing of the concrete. If desired, we could provide quality control testing of the concrete during construction.

#### **5.6.2 Concrete Flatwork**

Exterior concrete slabs, sidewalks and driveways should be designed using a four-inch minimum thickness. No specific reinforcement is required from a geotechnical perspective. However, some shrinkage and cracking of the concrete should be anticipated as a result of typical mix designs and curing practices commonly utilized in industrial construction. Sidewalks and driveways may be under the jurisdiction of the governing agency. If so, jurisdictional design and

construction criteria would apply, if more restrictive than the recommendations presented in this report.

Subgrade soils should be pre-moistened prior to placing concrete. The subgrade soils below exterior slabs, sidewalks, driveways, etc. should be pre-saturated to a minimum of 100 percent of the optimum moisture content to a depth of 12 inches.

All concrete installation, including preparation and compaction of subgrade, should be done in accordance with the City of Perris or County of Riverside specifications, and under the observation and testing of GeoTek and a City or County inspector, if necessary.

### **5.6.3 Concrete Performance**

Concrete cracks should be expected. These cracks can vary from sizes that are essentially unnoticeable to more than 1/8 inch in width. Most cracks in concrete while unsightly do not significantly impact long-term performance. While it is possible to take measures (proper concrete mix, placement, curing, control joints, etc.) to reduce the extent and size of cracks that occur, some cracking will occur despite the best efforts to minimize it. Concrete undergoes chemical processes that are dependent on a wide range of variables, which are difficult, at best, to control. Concrete, while seemingly a stable material, is subject to internal expansion and contraction due to external changes over time.

One of the simplest means to control cracking is to provide weakened control joints for cracking to occur along. These do not prevent cracks from developing; they simply provide a relief point for the stresses that develop. These joints are a widely accepted means to control cracks but are not always effective. Control joints are more effective the more closely spaced they are. GeoTek suggests that control joints be placed in two directions and located a distance apart approximately equal to 24 to 36 times the slab thickness.

Exterior concrete flatwork (patios, walkways, driveways, etc.) is often some of the most visible aspects of site development. They are typically given the least level of quality control, being considered “non-structural” components. We suggest that the same standards of care be applied to these features as to the structures themselves.

## **5.7 POST CONSTRUCTION CONSIDERATIONS**

### **5.7.1 Landscape Maintenance and Planting**

Water has been shown to weaken the inherent strength of soil, and slope stability is significantly reduced by overly wet conditions. Positive surface drainage away from graded slopes should be maintained and only the amount of irrigation necessary to sustain plant life should be provided for planted slopes. Controlling surface drainage and runoff and maintaining a suitable vegetation cover can minimize erosion. Plants selected for landscaping should be lightweight, deep-rooted types that require little water and are capable of surviving the prevailing climate.

Overwatering should be avoided. Care should be taken when adding soil amendments to avoid excessive watering. Leaching as a method of soil preparation prior to planting is not recommended. An abatement program to control ground-burrowing rodents should be implemented and maintained. This is critical as burrowing rodents can decreased the long-term performance of slopes.

It is common for planting to be placed adjacent to structures in planter or lawn areas. This will result in the introduction of water into the ground adjacent to the foundations. This type of landscaping should be avoided. Planters within 30 feet of the buildings should be above ground and underlain by a concrete slab. Waterproofing of the foundation and/or subdrains may be warranted and advisable. We could discuss these issues, if desired, when plans are made available.

### **5.7.2 Drainage**

The need to maintain proper surface drainage and subsurface systems cannot be overly emphasized. Positive site drainage should be 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 adjacent to the footings and floor-slabs. Pad drainage should be directed toward approved areas and not be blocked by other improvements.

Roof gutters should be installed that will direct the collected water at least 20 feet from the buildings.

It is the owner's responsibility to maintain and clean drainage devices on or contiguous to their lot. In order to be effective, maintenance should be conducted on a regular and routine schedule and necessary corrections made prior to each rainy season.

## **5.8 PLAN REVIEW AND CONSTRUCTION OBSERVATIONS**

We recommend that site grading, specifications, retaining wall/shoring plans and foundation plans be reviewed by this office prior to construction to check for conformance with the recommendations of this report. Additional recommendations may be necessary based on these reviews. We also recommend that GeoTek representatives be present during site grading and foundation construction to check for proper implementation of the geotechnical recommendations. The owner/developer should have GeoTek's representative perform at least the following duties:

- Observe site clearing and grubbing operations for proper removal of unsuitable materials.
- Observe and test bottom of removals prior to fill placement.
- Evaluate the suitability of on-site and import materials for fill placement and collect soil samples for laboratory testing when necessary.
- Observe the fill for uniformity during placement including utility trenches.
- Test the fill for field density and relative compaction.
- Test the near-surface soils to verify proper moisture content.
- Observe and probe foundation excavations to confirm suitability of bearing materials.

If requested, a construction observation and compaction report can be provided by GeoTek, which can comply with the requirements of the governmental agencies having jurisdiction over the project. We recommend that these agencies be notified prior to commencement of construction so that necessary grading permits can be obtained.

## **6. LIMITATIONS**

This evaluation does not and should in no way be construed to encompass any areas beyond the specific area of proposed construction as indicated to us by the client. Further, no evaluation of any existing site improvements is included. The scope is based on our understanding of the project and the client's needs, our proposal (Proposal No. P-1103720-CR) dated November 16, 2020 and geotechnical engineering standards normally used on similar projects in this region.

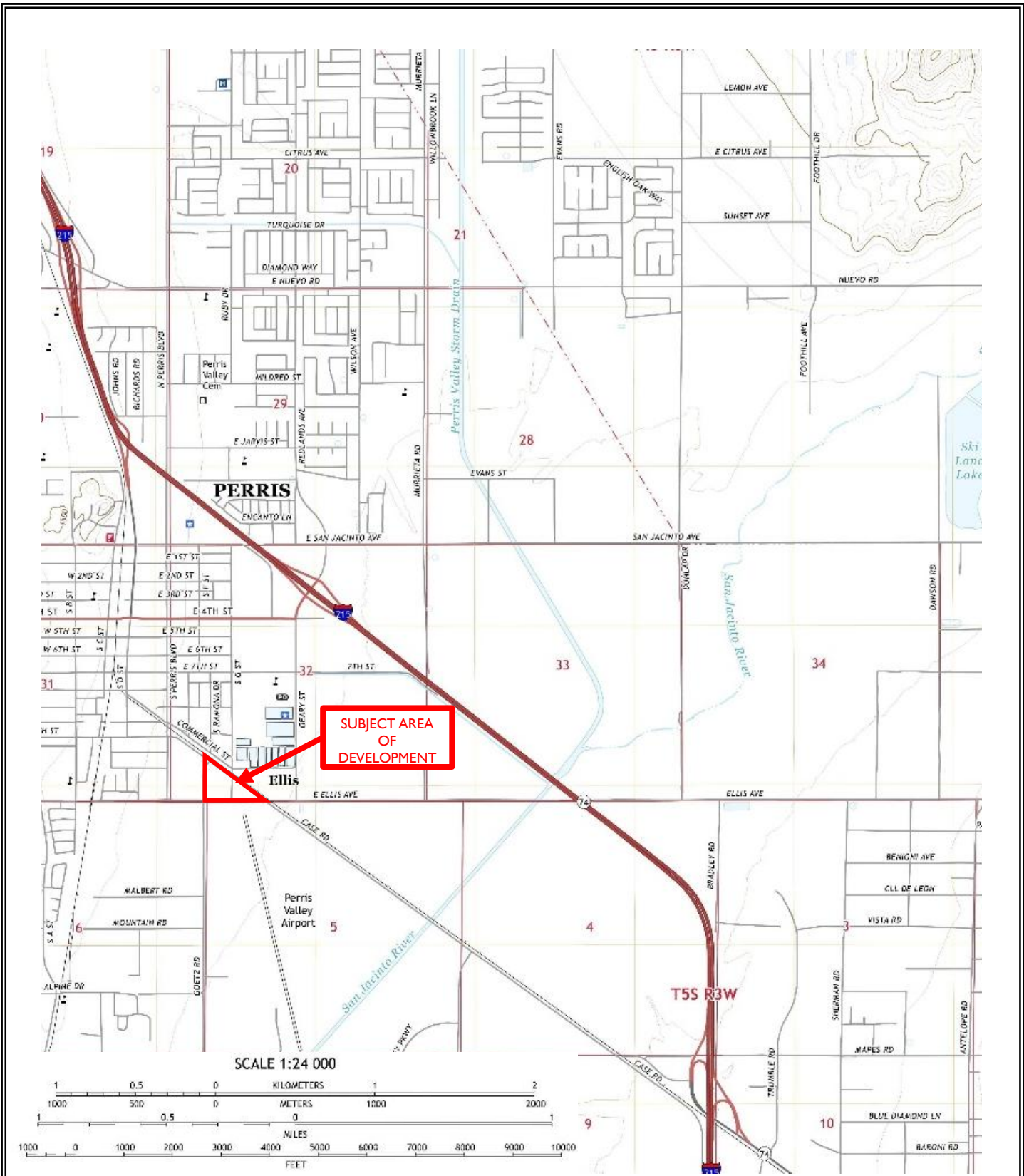
The materials observed on the project site appear to be representative of the area; however, soil and bedrock materials vary in character between excavations and natural outcrops or conditions exposed during site construction. Site conditions may vary due to seasonal changes or other factors. GeoTek, Inc. assumes no responsibility or liability for work, testing or recommendations performed or provided by others.



Since our recommendations are based on the site conditions observed and encountered, and laboratory testing, our conclusions and recommendations are professional opinions that are limited to the extent of the available data. Observations during construction are important to allow for any change in recommendations found to be warranted. These opinions have been derived in accordance with current standards of practice and no warranty is expressed or implied. Standards of practice are subject to change with time.

## **7. SELECTED REFERENCES**

- American Concrete Institute, 2008, "Guide for the Design and Construction of Concrete Parking Lots," Reported by ACI Committee 330, ACI-330R-08.
- American Society of Civil Engineers (ASCE), 2016, "Minimum Design Loads for Buildings and Other Structures," ASCE/SEI 7-16, Errata Incorporated through January 2020.
- Bowles, J. E., 1977, "Foundation Analysis and Design," Second Edition
- Bryant, W.A., and Hart, E.W., 2007, "Fault Rupture Hazard Zones in California, Alquist-Priolo Earthquake Fault Zoning Act with Index to Earthquake Fault Zones Maps," California Geological Survey: Special Publication 42.
- California Code of Regulations, Title 24, 2019 "California Building Code," 2 volumes.
- California Geological Survey (CGS, formerly referred to as the California Division of Mines and Geology), 1977, "Geologic Map of California."
- Dibblee, T.W., and Minch, J.A, 2003, "Geologic Map of the Perris Quadrangle, Riverside County, California," Dibblee Foundation Map DF-112, scale 1:24,000.
- GeoTek, Inc., In-house proprietary information.
- Riverside County, 2020, "Riverside County Parcel Report, APN(s) 310150012, 310160070," accessed November 13, 2020 (<http://rivcoparcelreport.rivcoca.org>).
- Riverside County Flood Control and Water Conservation District, 2011, "Design Handbook for Low Impact Development Best Management Practices, Appendix A – Infiltration Testing Guidelines," effective September 2011.
- Roberge, P.R., 1984, "Corrosion Basics An Introduction."
- SEA/OSHPD web service, "Seismic Design Maps" (<https://seismicmaps.org>).
- Terzaghi, K. and Peck, R. B., 1967, "Soil Mechanics in Engineering Practice," Second Edition.



**Alabbasi Construction & Engineering**  
 Proposed Gas Station, Retail and Storage Facility  
 APNs 310-150-012-1 and 310-160-070-4  
 Perris, Riverside County, California

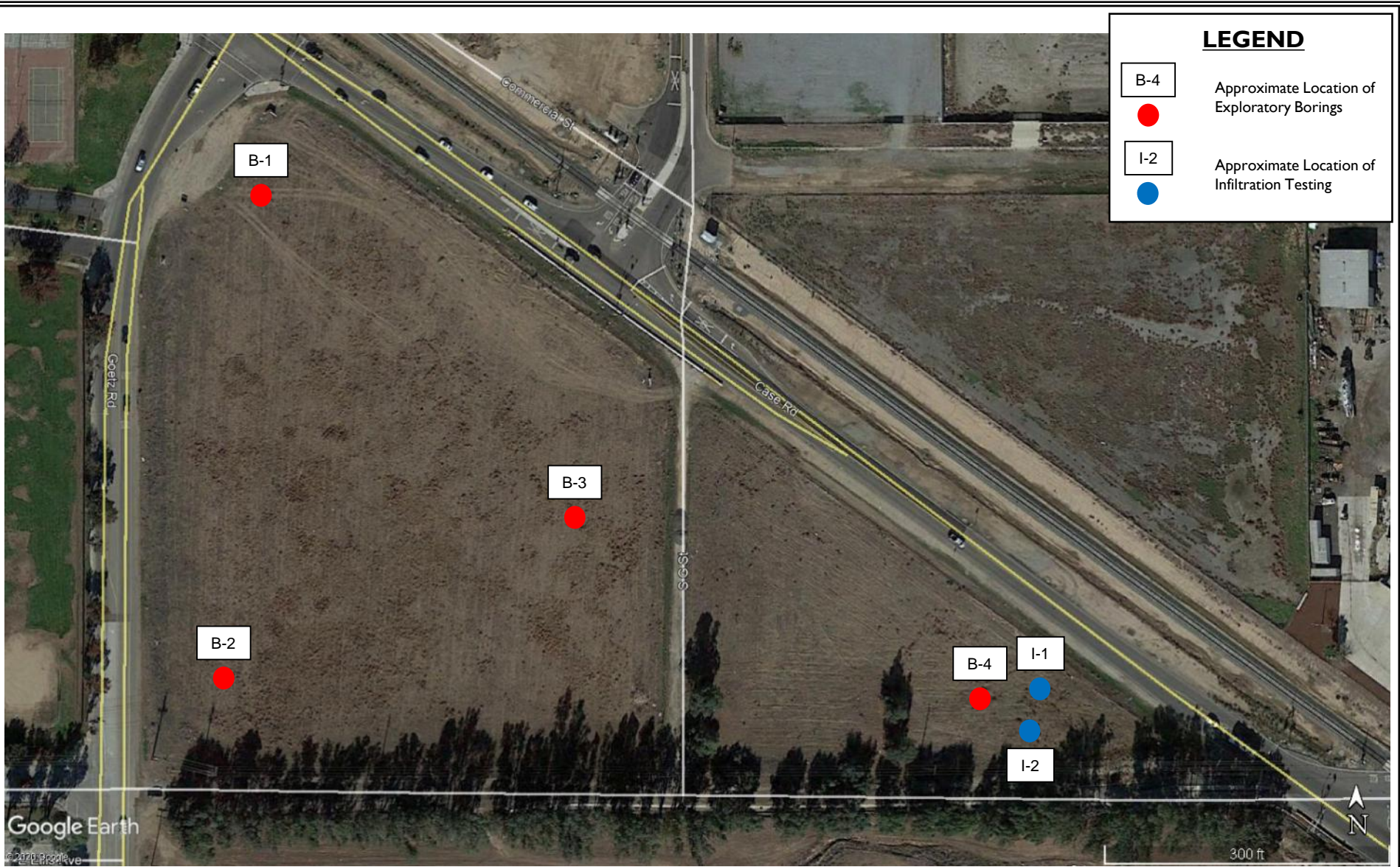
GeoTek Project No. 2582-CR



Modified from USGS  
 7.5-minute  
 Perris Quadrangle  
 Topographic Map

**Figure I**  
**Site Location and**  
**General**  
**Topography**  
**Map**





**Alabbasi Construction & Engineering**  
 Proposed Gas Station, Retail and Storage Facility  
 APNs 310-150-012-1 and 310-160-070-4  
 Perris, Riverside County, California

GeoTek Project No. 2582-CR



**Figure 2**  
**Exploration**  
**Location**  
**Map**



# **APPENDIX A**

## **LOGS OF EXPLORATORY BORINGS**

**Proposed Gas Station, Retail and Storage Facility**

**APNs 310-150-012-1 and 310-160-070-4**

**Perris, Riverside County, California**

**Project No. 2582-CR**



## **A - FIELD TESTING AND SAMPLING PROCEDURES**

### The Modified Split-Barrel Sampler (Ring)

The Ring sampler is driven into the ground in accordance with ASTM Test Method D 3550. The sampler, with an external diameter of 3.0 inches, is lined with 1-inch long, thin brass rings with inside diameters of approximately 2.4 inches. The sampler is typically driven into the ground 12 or 18 inches with a 140-pound hammer free falling from a height of 30 inches. Blow counts are recorded for every 6 inches of penetration as indicated on the log of boring. The samples are removed from the sample barrel in the brass rings, sealed, and transported to the laboratory for testing.

### Bulk Samples (Large)

These samples are normally large bags of representative earth materials over 20 pounds in weight collected from the field by means of hand digging or exploratory cuttings.

### Bulk Samples (Small)

These are plastic bag samples which are normally airtight and contain less than 5 pounds in weight of representative earth materials collected from the field by means of hand digging or exploratory cuttings. These samples are primarily used for determining natural moisture content and classification indices.

## **B – BORING/TRENCH LOG LEGEND**

The following abbreviations and symbols often appear in the classification and description of soil and rock on the logs of borings/trenches:

### SOILS

USCS	Unified Soil Classification System
f-c	Fine to coarse
f-m	Fine to medium

### GEOLOGIC

B: Attitudes	Bedding: strike/dip
J: Attitudes	Joint: strike/dip
C:	Contact line
.....	Dashed line denotes USCS material change
————	Solid Line denotes unit / formational change
————	Thick solid line denotes end of boring

(Additional denotations and symbols are provided on the log of boring)

**GeoTek, Inc.**  
**LOG OF EXPLORATORY BORING**



**CLIENT:** Alabbasi Construction & Engineering  
**PROJECT NAME:** Goetz Road, Case Road, and Ellis Ave  
**PROJECT NO.:** 2582-CR  
**LOCATION:** See Exploration Location Map

**DRILLER:** 2R  
**DRILL METHOD:** Hollow-Stem Auger  
**HAMMER:** 140 lbs, 30 in.

**LOGGED BY:** JE  
**OPERATOR:** Adrian  
**RIG TYPE:** CME 75  
**DATE:** 12/18/2020

Depth (ft)	SAMPLES			USCS Symbol	BORING NO.: B-1 MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing			
	Sample Type	Blows/ 6 in	Sample Number			Water Content (%)	Dry Density (pcf)	Others	
5		12 20 37		SM	Older Alluvium Silty f-m SAND, light brown, slightly moist, dense	4.2	120.5		
		27 50/5"			Becomes very dense at 4'	4.6	122.9		
10		29 50/5"		SM	F-m SAND with silt, light brown to brown, slightly moist, very dense	6.8	116.8		
		26 50/4"				8.1	130.0		
15		12 21 30		SC	Clayey SAND, brown to dark brown, slightly moist to moist, dense				
		16 38 50			Becomes very dense at 16'				
20		11 23 32			Becomes dense at 19'				
	<b>BORING TERMINATED AT 20.5'</b>								
25	No groundwater encountered Boring backfilled with soil cuttings								
30									

<b>LEGEND</b>	<b>Sample type:</b>	---Ring	---SPT	---Small Bulk	---Large Bulk	---No Recovery	---Water Table	
	<b>Lab testing:</b>	AL = Atterberg Limits	SR = Sulfate/Resistivity Test	EI = Expansion Index	SH = Shear Test	SA = Sieve Analysis	HC = Consolidation	RV = R-Value Test

**GeoTek, Inc.**  
**LOG OF EXPLORATORY BORING**



**CLIENT:** Alabasi Construction & Engineering  
**PROJECT NAME:** Goetz Road, Case Road, and Ellis Ave  
**PROJECT NO.:** 2582-CR  
**LOCATION:** See Exploration Location Map

**DRILLER:** 2R  
**DRILL METHOD:** Hollow-Stem Auger  
**HAMMER:** 140 lbs, 30 in.

**LOGGED BY:** JE  
**OPERATOR:** Adrian  
**RIG TYPE:** CME 75  
**DATE:** 12/18/2020

Depth (ft)	SAMPLES			USCS Symbol	BORING NO.: B-2  MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing		
	Sample Type	Blows/ 6 in	Sample Number			Water Content (%)	Dry Density (pcf)	Others
5		8 9 40		SM-ML	Silty f-m SAND to sandy SILT, light brown, slightly moist, medium dense, some rootlets	4.0	118.8	
5		25 50/4"			Becomes very dense at 5'	4.2	120.2	
10		16 50/5"		SM	Silty f-m SAND, light brown to brown, slightly moist, very dense	7.2	117.2	
10		16 20 23			Becomes medium dense with some gravel at 11'			
15		19 50		SM	Silty f-c SAND, brown, slightly moist to moist, some gravel, dense			
15		50/5"			Becomes very dense at 17'			
20		4 10 12		ML	F-m sandy SILT to clayey SILT, brown, slightly moist, stiff			
<b>BORING TERMINATED AT 21.5'</b>								
25					No groundwater encountered Boring backfilled with soil cuttings			
30								

<b>LEGEND</b>	<b>Sample type:</b>		---Ring		---SPT		---Small Bulk		---Large Bulk		---No Recovery		---Water Table
	<b>Lab testing:</b>	AL = Atterberg Limits	SR = Sulfate/Resistivity Test	EI = Expansion Index	SH = Shear Test	SA = Sieve Analysis	HC = Consolidation	RV = R-Value Test	MD = Maximum Density				

**GeoTek, Inc.**  
**LOG OF EXPLORATORY BORING**



**CLIENT:** Alabbasi Construction & Engineering  
**PROJECT NAME:** Goetz Road, Case Road, and Ellis Ave  
**PROJECT NO.:** 2582-CR  
**LOCATION:** See Exploration Location Map

**DRILLER:** 2R  
**DRILL METHOD:** Hollow-Stem Auger  
**HAMMER:** 140 lbs, 30 in.

**LOGGED BY:** JE  
**OPERATOR:** Adrian  
**RIG TYPE:** CME 75  
**DATE:** 12/18/2020

Depth (ft)	SAMPLES			USCS Symbol	BORING NO.: B-3 MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing		
	Sample Type	Blows/ 6 in	Sample Number			Water Content (%)	Dry Density (pcf)	Others
0 - 5					<b>Older Alluvium</b>			
5 - 5.5	SM-ML	24 50/5"			Silty f-m SAND to sandy SILT, light brown, slightly moist, medium dense, some rootlets	4.8	122.6	MD, EI, SR, SH
5.5 - 6.5	SM	24 50/4"			Silty f-c SAND, brown, slightly moist, very dense	6.9	124.7	
6.5 - 10		15 50/5"			Becomes dense at 9'	13.8	120.7	
10 - 15		45 50/4"			Silty f-m SAND, light brown to brown, slightly moist, very dense			-#200 = 43.4%
15 - 16		10			Becomes grayish brown, medium dense and f-c grained at 15'			-#200 = 40.2%
16 - 17		10						
17 - 18		10						
18 - 19		19						
19 - 20		20						
20 - 21		8			Becomes dense at 21'			
21 - 22		21						
22 - 23		33						
23 - 25	SP	18 26 30			F-c SAND, gray to grayish brown, slightly moist, dense			
25 - 29					Groundwater encountered at 29'			
29 - 30	SP	7 14 20			F-c SAND, gray to grayish brown, wet, dense			

<b>LEGEND</b>	<b>Sample type:</b>	---Ring	---SPT	---Small Bulk	---Large Bulk	---No Recovery	---Water Table	
	<b>Lab testing:</b>	AL = Atterberg Limits	SR = Sulfate/Resistivity Test	EI = Expansion Index	SH = Shear Test	SA = Sieve Analysis	HC = Consolidation	RV = R-Value Test

**GeoTek, Inc.**  
**LOG OF EXPLORATORY BORING**



**CLIENT:** Alabbasi Construction & Engineering  
**PROJECT NAME:** Goetz Road, Case Road, and Ellis Ave  
**PROJECT NO.:** 2582-CR  
**LOCATION:** See Exploration Location Map

**DRILLER:** 2R  
**DRILL METHOD:** Hollow-Stem Auger  
**HAMMER:** 140 lbs, 30 in.

**LOGGED BY:** JE  
**OPERATOR:** Adrian  
**RIG TYPE:** CME 75  
**DATE:** 12/18/2020

Depth (ft)	SAMPLES			USCS Symbol	BORING NO.: B-3 cont.  MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing		
	Sample Type	Blows/ 6 in	Sample Number			Water Content (%)	Dry Density (pcf)	Others
35		10 14 26		SP	F-c SAND, gray to grayish brown, wet, dense			
40		17 26 33			Becomes very dense at 40'			
45		14 24 42			Becomes f-m grained at 45'			
50		5 17 33		SM	F-m SAND with silt, brown, wet, very dense			
<b>BORING TERMINATED AT 51.5'</b>								
55					Groundwater encountered at 29' Boring backfilled with soil cuttings			
60								

<b>LEGEND</b>	<b>Sample type:</b>		---Ring		---SPT		---Small Bulk		---Large Bulk		---No Recovery		---Water Table
	<b>Lab testing:</b>	AL = Atterberg Limits	SR = Sulfate/Resistivity Test	EI = Expansion Index	SH = Shear Test	SA = Sieve Analysis	HC = Consolidation	RV = R-Value Test	MD = Maximum Density				

**GeoTek, Inc.**  
**LOG OF EXPLORATORY BORING**



**CLIENT:** Alabbasi Construction & Engineering  
**PROJECT NAME:** Goetz Road, Case Road, and Ellis Ave  
**PROJECT NO.:** 2582-CR  
**LOCATION:** See Exploration Location Map

**DRILLER:** 2R  
**DRILL METHOD:** Hollow-Stem Auger  
**HAMMER:** 140 lbs, 30 in.

**LOGGED BY:** JE  
**OPERATOR:** Adrian  
**RIG TYPE:** CME 75  
**DATE:** 12/18/2020

Depth (ft)	SAMPLES			USCS Symbol	BORING NO.: B-4  MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing		
	Sample Type	Blows/ 6 in	Sample Number			Water Content (%)	Dry Density (pcf)	Others
5	6	50/5"		SM	Older Alluvium Silty f-m SAND, light brown, slightly moist, very dense	4.4	110.0	
5	15	37		SM	Silty f-m SAND with a trace of clay, light brown, moist, very dense	19.4	109.4	
	7	10			Becomes medium dense at 7'	21.7	101.2	
10	7	13		ML	Sandy SILT, grayish brown, slightly moist, stiff	11.8	102.2	
	2	4		CL	Silty CLAY, light brown to grayish brown, moist, stiff	28.9	95.6	
	9	13			Becomes very stiff at 16'			
20	3	6			Becomes stiff at 20'			
					<b>BORING TERMINATED AT 21.5'</b>			
					No groundwater encountered Boring backfilled with soil cuttings			
25								
30								

<b>LEGEND</b>	<b>Sample type:</b>	---Ring	---SPT	---Small Bulk	---Large Bulk	---No Recovery	---Water Table	
	<b>Lab testing:</b>	AL = Atterberg Limits	SR = Sulfate/Resistivity Test	EI = Expansion Index	SH = Shear Test	SA = Sieve Analysis	HC = Consolidation	RV = R-Value Test





# **APPENDIX B**

## **LABORATORY TEST RESULTS**

**Proposed Gas Station, Retail and Storage Facility**

**APNs 310-150-012-1 and 310-160-070-4**

**Perris, Riverside County, California**

**Project No. 2582-CR**



## SUMMARY OF LABORATORY TESTING

### Classification

Soils were classified visually in general accordance to the Unified Soil Classification System (ASTM D 2487). The soil classifications are shown on the logs of exploratory borings in Appendix A.

### In-Situ Moisture Content and Unit Weight

The field moisture content was measured in the laboratory on selected samples collected during the field investigation. The field moisture content is determined as a percentage of the dry unit weight. The dry density was measured in the laboratory on selected ring samples. The results are shown on the logs of exploratory borings in Appendix A.

### Moisture-Density Relationship

Laboratory testing was performed on representative site samples collected during the recent subsurface exploration. The laboratory maximum dry density and optimum moisture content for the samples tested were determined in general accordance with test method ASTM D 1557. The results are presented below.

Boring No.	Depth (ft.)	Description	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
B-3	0-5	Silty f-m sand to sandy silt	132.5	7.5

### Materials Finer Than the No. 200 Sieve

A No. 200 sieve wash was performed on selected samples of the soils according to ASTM D 1140. The results of this testing are presented on the boring logs in Appendix A.

### Direct Shear

Direct shear testing was performed on a remolded sample of the surficial soils according to ASTM D 3080. The results of these tests are presented in Appendix B.

### Expansion Index

The expansion potential of the soils was determined by performing expansion index tests on soil samples obtained from the site in general accordance with ASTM D 4829. The results of these tests are presented below.

Boring No.	Depth (ft.)	Soil Type	Expansion Index	Classification
B-3	0-5	Silty f-m sand to sandy silt	0	Very Low

### R-Value

Testing to determine the resistance value for pavement design was performed by others in accordance with California Test Method 301, on a sample collected during the subsurface exploration. The results are presented in Appendix B.

**Sulfate Content, Resistivity and Chloride Content**

Testing to determine the water-soluble sulfate content was performed by others in general accordance with ASTM D4327. Resistivity testing was completed by others in general accordance with ASTM G187. Testing to determine the chloride content was performed by others in general accordance with ASTM D4327. pH testing was completed by others in general accordance with ASTM D4972. The results of the testing are provided below.

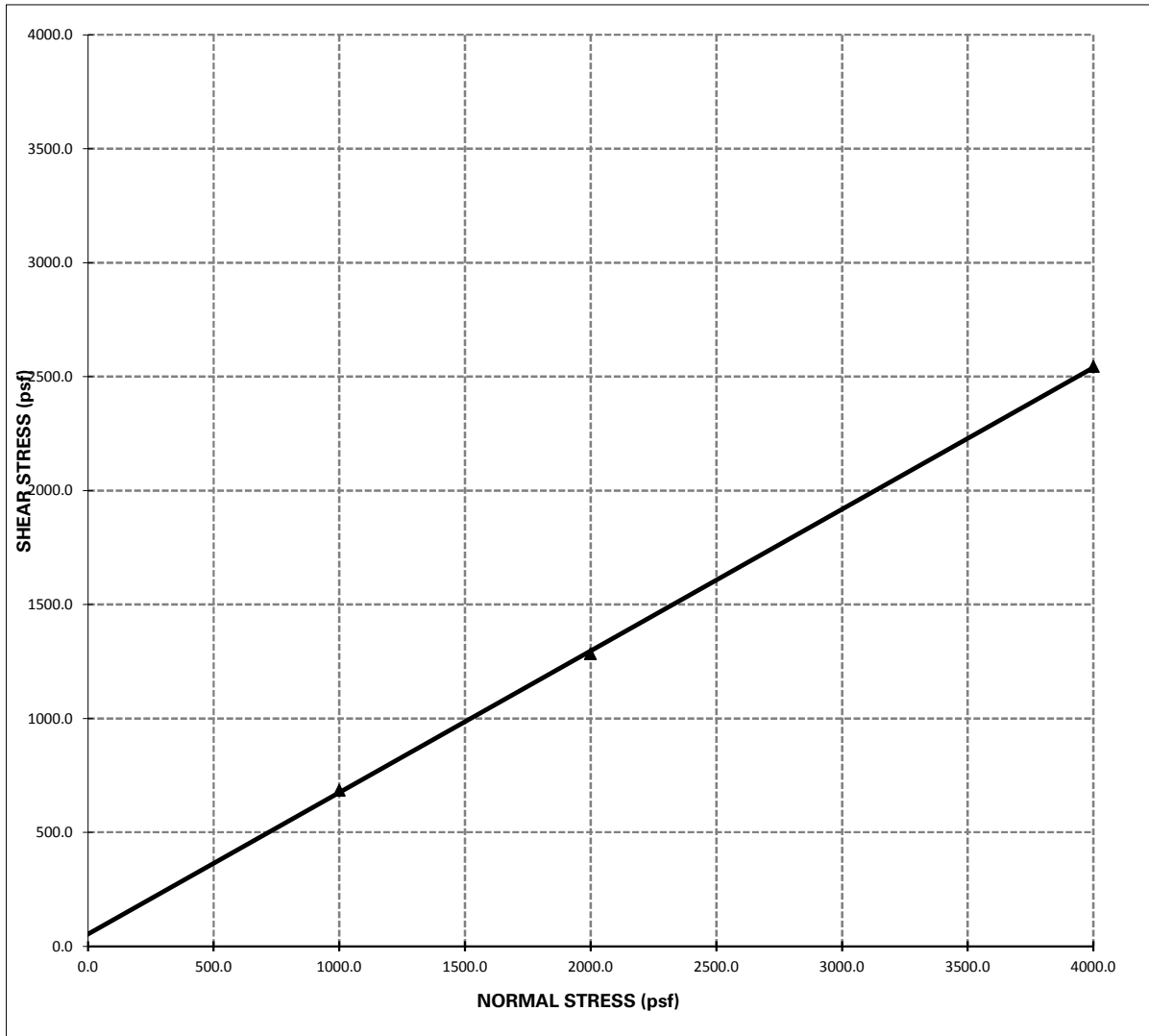
Boring No.	Depth (ft.)	pH ASTM D4972	Chloride ASTM D4327 (ppm)	Sulfates ASTM D4327 (% by weight)	Resistivity ASTM G187 (ohm-cm)
B-3	0-5	8.3	9.7	0.0026	8,710



## DIRECT SHEAR TEST

**Project Name:** Alabbasi Const. & Eng.  
**Project Number:** 2582-CR

**Sample Location:** B-3 @ 0-5 feet  
**Date Tested:** 1/5/2020



**Shear Strength:**  $\Phi = 31.9^\circ$   $C = 54.00$  psf

- Notes:**
- 1 - The soil specimen used in the shear box was a ring sample remolded to approximately 90% relative compaction from a bulk sample collected during the field investigation.
  - 2 - The above reflect direct shear strength at saturated conditions.
  - 3 - The tests were run at a shear rate of 0.035 in/min.

December 30, 2020

**Ms. Anna Scott**

**GeoTek Inc.**

1548 North Maple Street  
Corona, California 92880

Project No. 46794

Attention Ms. Scott:

Laboratory testing of the bulk soil sample delivered to our laboratory on 12/29/2020 has been completed.

Reference: W.O. # 2582-CR  
Project: Commercial Development, Perris, Alabbasi Construction & Engineering  
Sample: B-4 @ 0'-5'

Data sheets are transmitted herewith for your use and information. Any untested portion of the samples will be retained for a period of sixty (60) days prior to disposal. The opportunity to be of service is appreciated, and should you have any questions, kindly call.

Very truly yours,



**Steven R. Marvin**  
**RCE 30659**

SRM:tw  
Enclosures



# R - VALUE DATA SHEET

PROJECT No. 46794

DATE: 12/30/2020

BORING NO. B-4 @ 0'-5'

Alibbasi Construction Eng., Commercial Dev., Perris


W.O.# 2582-CR

SAMPLE DESCRIPTION: Brown Fine Sandy Silt

R-VALUE TESTING DATA   CA TEST 301			
	SPECIMEN ID		
	a	b	c
Mold ID Number	7	8	9
Water added, grams	57	38	32
Initial Test Water, %	11.3	9.4	8.8
Compact Gage Pressure,psi	45	145	290
Exudation Pressure, psi	158	302	439
Height Sample, Inches	2.54	2.49	2.42
Gross Weight Mold, grams	3102	3075	2890
Tare Weight Mold, grams	1953	1948	1772
Sample Wet Weight, grams	1149	1127	1118
Expansion, Inches x 10exp-4	0	24	28
Stability 2,000 lbs (160psi)	42 / 88	20 / 41	17 / 32
Turns Displacement	5.51	4.77	4.35
R-Value Uncorrected	27	60	70
R-Value Corrected	27	60	69
Dry Density, pcf	123.2	125.3	128.6

### DESIGN CALCULATION DATA

Traffic Index	Assumed:	4.0	4.0	4.0
G.E. by Stability		0.75	0.41	0.32
G. E. by Expansion		0.00	0.80	0.93

<b>Equilibrium R-Value</b>	<b>45</b> by <b>EXPANSION</b>	Examined & Checked: 12 /30/ 20
REMARKS:	Gf = <u>1.25</u> 0.0% Retained on the <u>3/4" Sieve.</u>	 Steven R. Marvin, RCE 30659

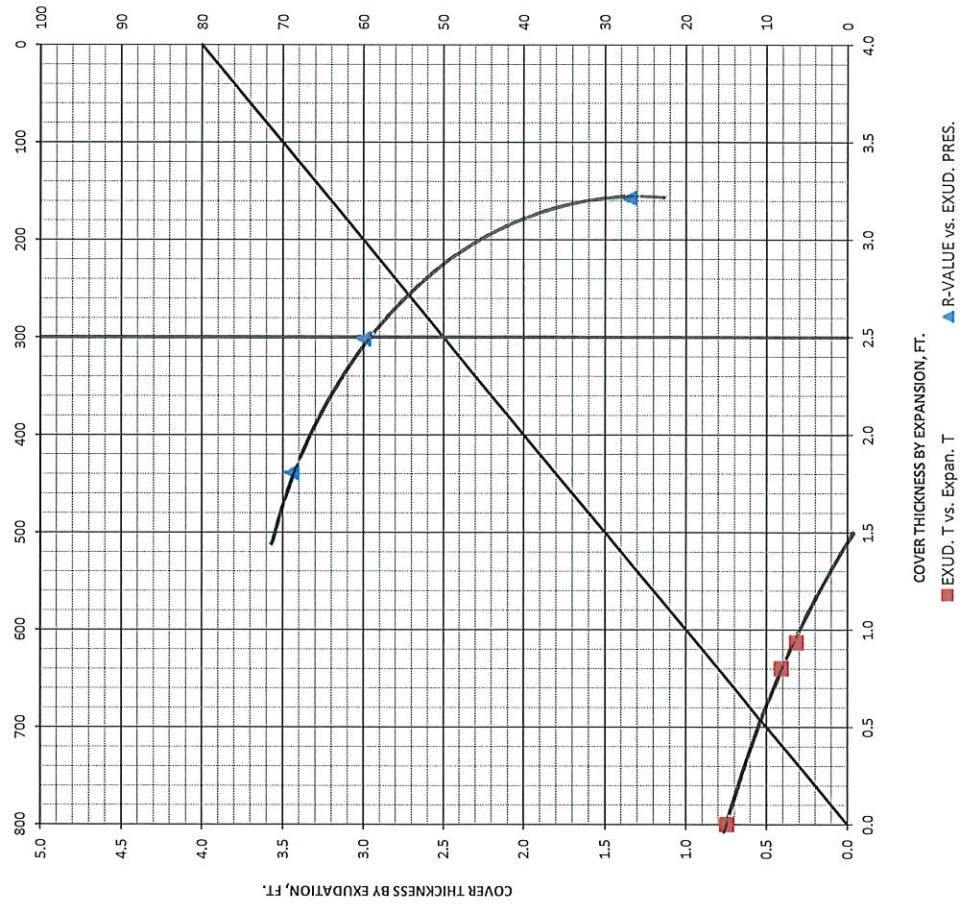
The data above is based upon processing and testing samples as received from the field. Test procedures in accordance with latest revisions to Department of Transportation, State of California, Materials & Research Test Method No. 301.



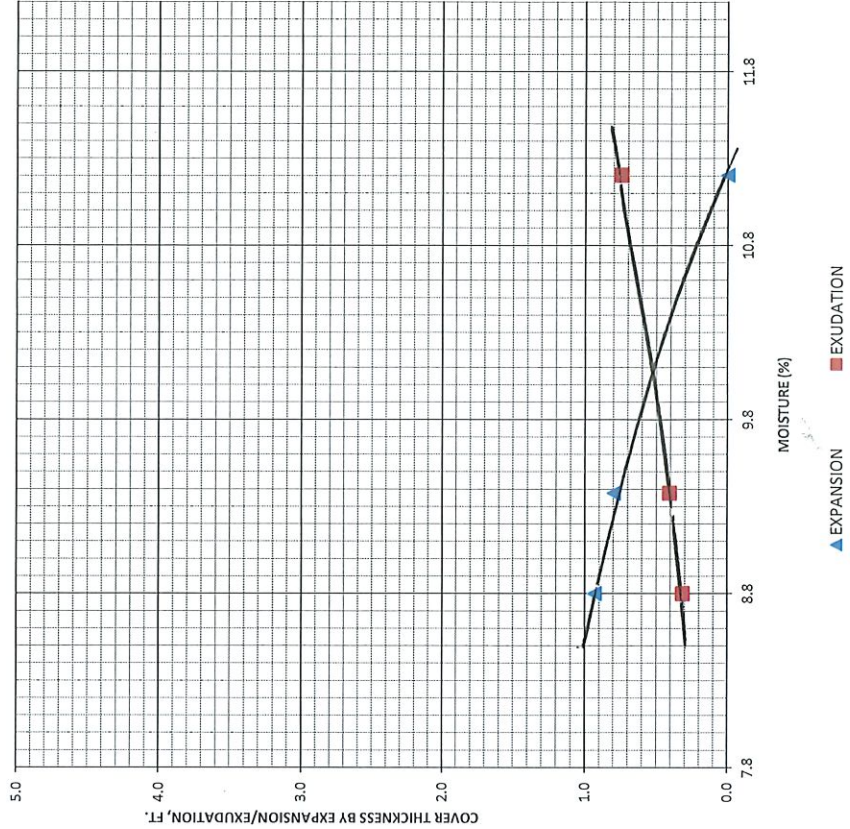
# R-VALUE GRAPHICAL PRESENTATION

PROJECT NO. 46794      REMARKS: \_\_\_\_\_  
 DATE: 12 /30/ 2020      \_\_\_\_\_  
 BORING NO. B-4 @ 0'-5'      \_\_\_\_\_  
Alibasi Construction Eng., Commercial Dev., Perris  
W.O.# 2582-CR

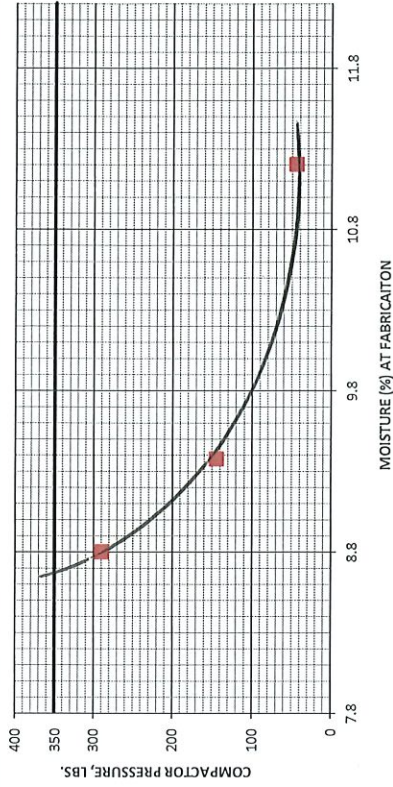
## COVER THICKNESS BY EXUDATION vs COVER THICKNESS BY EXPANSION



## COVER THICKNESS vs MOISTURE %



## COMPACTOR PRESSURE vs MOISTURE %



# **APPENDIX C**

## **INFILTRATION TEST DATA**

**Proposed Gas Station, Retail and Storage Facility  
APNs 310-150-012-1 and 310-160-070-4  
Perris, Riverside County, California  
Project No. 2582-CR**



GeoTek, Inc.  
**PERCOLATION TESTING**

**Shallow Percolation Test**

Depth of Hole (D<sub>i</sub>) in.

60

Boring Radius, in.

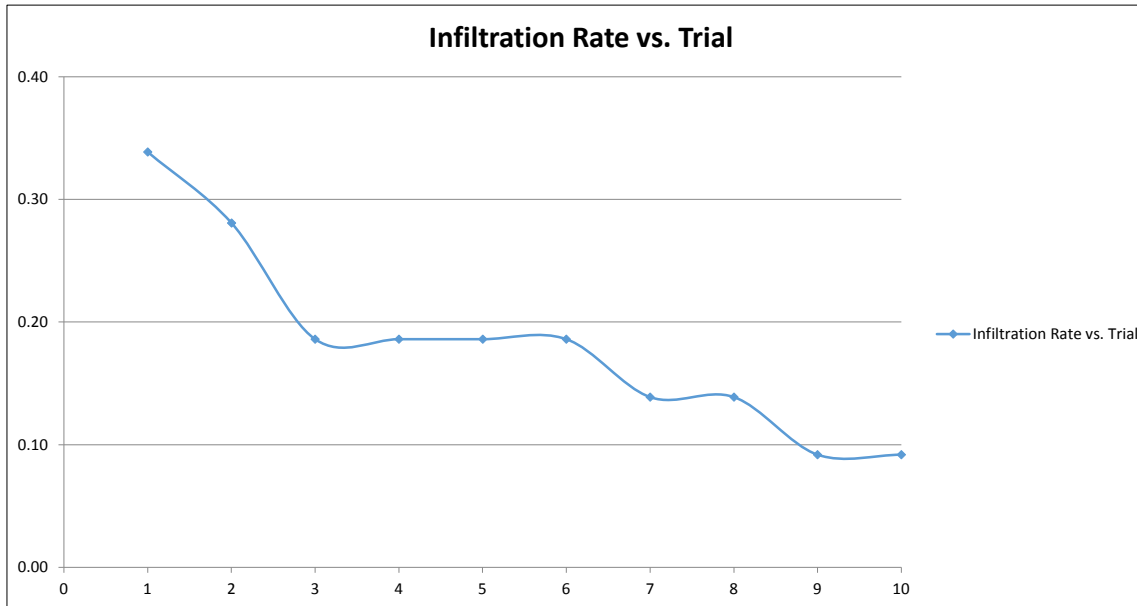
4

Test No. I-1

2582-CR

Trial No.	Time Interval (ΔT) Min.	Initial Depth (D <sub>i</sub> ) in.	Final Depth (D <sub>f</sub> ) in.	Change In Level (ΔD) in.	Perc Rate (min/in)	Infiltration Rate (in/hr)
Sandy Soil Trial 1	25	40.00	41.50	1.50	0.06	0.34
Sandy Soil Trial 2	25	40.00	41.25	1.25	0.05	0.28
1	30	40.00	41.00	1.00	0.20	0.19
2	30	40.00	41.00	1.00	0.20	0.19
3	30	40.00	41.00	1.00	0.20	0.19
4	30	40.00	41.00	1.00	0.20	0.19
5	30	40.00	40.75	0.75	0.15	0.14
6	30	40.00	40.75	0.75	0.15	0.14
7	30	40.00	40.50	0.50	0.10	0.09
8	30	40.00	40.50	0.50	0.10	0.09
9	30	40.00	40.50	0.50	0.10	0.09
10	30	40.00	40.50	0.50	0.10	0.09

Initial Height (H <sub>i</sub> )	Final Height (H <sub>f</sub> )	Height Change (ΔH)	Height Average (H <sub>avg</sub> )
20	18.5	1.5	19.25
20	18.75	1.25	19.375
20	19	1	19.5
20	19	1	19.5
20	19	1	19.5
20	19	1	19.5
20	19.25	0.75	19.625
20	19.25	0.75	19.625
20	19.50	0.5	19.75
20	19.50	0.5	19.75
20	19.50	0.5	19.75
20	19.50	0.5	19.75



**GeoTek, Inc.**  
**PERCOLATION TESTING**

**Shallow Percolation Test**

Depth of Hole (D<sub>i</sub>) in.

60

Boring Radius, in.

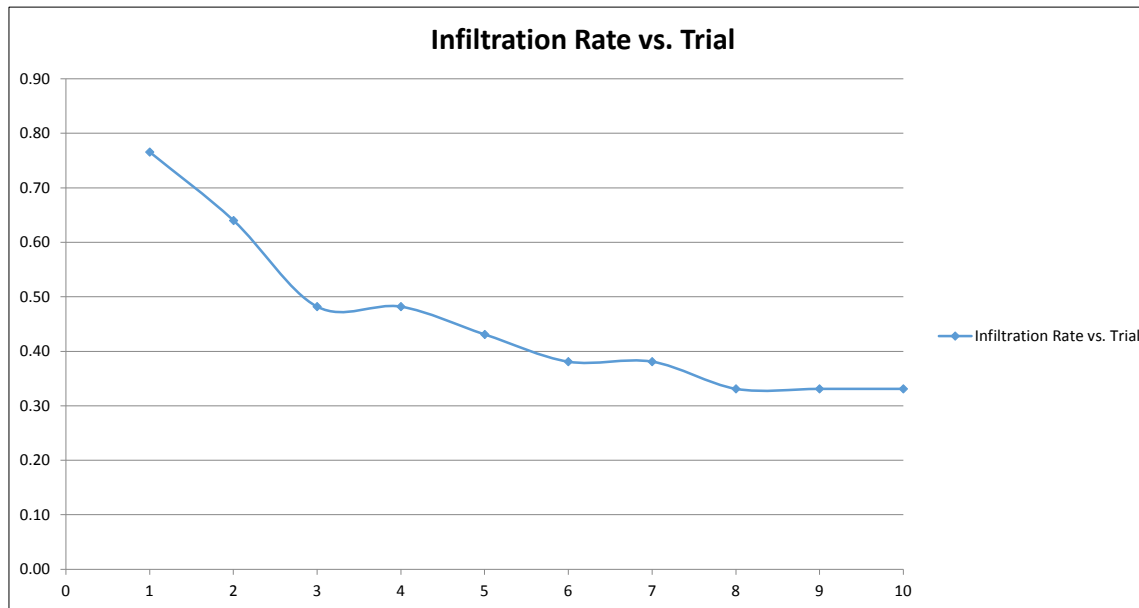
4

Test No. I-2

2582-CR

Trial No.	Time Interval (ΔT) Min.	Initial Depth (D <sub>i</sub> ) in.	Final Depth (D <sub>f</sub> ) in.	Change In Level (ΔD) in.	Perc Rate (min/in)	Infiltration Rate (in/hr)
Sandy Soil Trial 1	25	40.00	43.25	3.25	0.13	0.77
Sandy Soil Trial 2	25	40.00	42.75	2.75	0.11	0.64
1	30	40.00	42.50	2.50	0.50	0.48
2	30	40.00	42.50	2.50	0.50	0.48
3	30	40.00	42.25	2.25	0.45	0.43
4	30	40.00	42.00	2.00	0.40	0.38
5	30	40.00	42.00	2.00	0.40	0.38
6	30	40.00	41.75	1.75	0.35	0.33
7	30	40.00	41.75	1.75	0.35	0.33
8	30	40.00	41.75	1.75	0.35	0.33
9	30	40.00	41.75	1.75	0.35	0.33
10	30	40.00	41.75	1.75	0.35	0.33

Initial Height (H <sub>i</sub> )	Final Height (H <sub>f</sub> )	Height Change (ΔH)	Height Average (H <sub>avg</sub> )
20	16.75	3.25	18.375
20	17.25	2.75	18.625
20	17.5	2.5	18.75
20	17.5	2.5	18.75
20	17.75	2.25	18.875
20	18	2	19
20	18	2	19
20	18.25	1.75	19.125
20	18.25	1.75	19.125
20	18.25	1.75	19.125
20	18.25	1.75	19.125
20	18.25	1.75	19.125



# **APPENDIX D**

## **LIQUEFACTION ANALYSIS**

**Proposed Gas Station, Retail and Storage Facility  
APNs 310-150-012-1 and 310-160-070-4  
Perris, Riverside County, California  
Project No. 2582-CR**

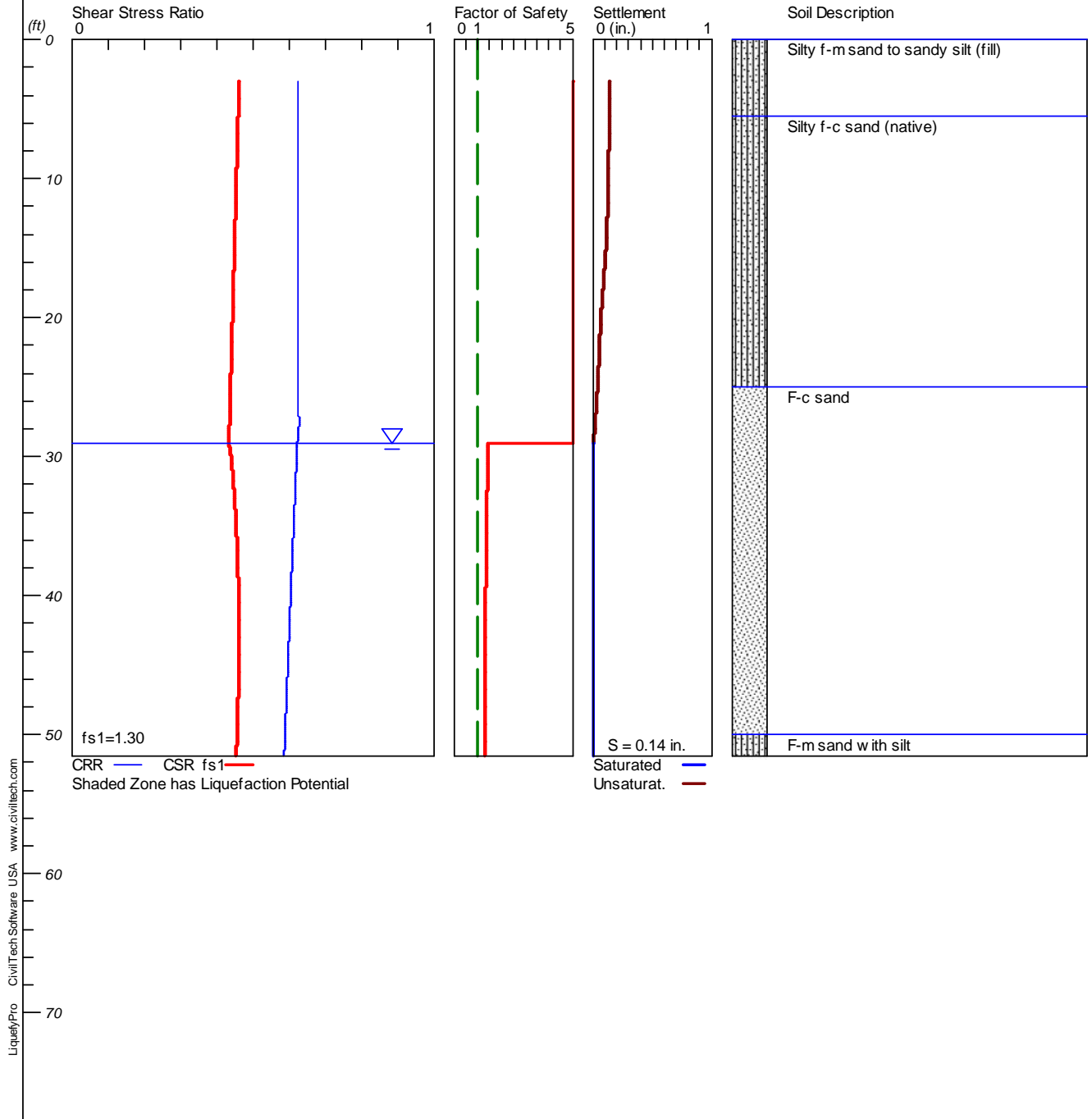


# LIQUEFACTION ANALYSIS

## 2582-CR APNs 310-150-012-1 and 310-160-070-4

Hole No.=B-3 Water Depth=29 ft

Magnitude=6.87  
Acceleration=0.55g



LiquefyPro CivilTech Software USA www.civiltech.com



Perris, Riverside County, California

# **APPENDIX E**

## **GENERAL GRADING GUIDELINES**

**Proposed Gas Station, Retail and Storage Facility  
APNs 310-150-012-1 and 310-160-070-4  
Perris, Riverside County, California  
Project No. 2582-CR**



## **GENERAL GRADING GUIDELINES**

Guidelines presented herein are intended to address general construction procedures for earthwork construction. Specific situations and conditions often arise which cannot reasonably be discussed in general guidelines, when anticipated these are discussed in the text of the report. Often unanticipated conditions are encountered which may necessitate modification or changes to these guidelines. It is our hope that these will assist the contractor to more efficiently complete the project by providing a reasonable understanding of the procedures that would be expected during earthwork and the testing and observation used to evaluate those procedures.

### **General**

Grading should be performed to at least the minimum requirements of governing agencies, Chapters 18 and 33 of the California Building Code, CBC (2016) and the guidelines presented below.

### **Preconstruction Meeting**

A preconstruction meeting should be held prior to site earthwork. Any questions the contractor has regarding our recommendations, general site conditions, apparent discrepancies between reported and actual conditions and/or differences in procedures the contractor intends to use should be brought up at that meeting. The contractor (including the main onsite representative) should review our report and these guidelines in advance of the meeting. Any comments the contractor may have regarding these guidelines should be brought up at that meeting.

### **Grading Observation and Testing**

1. Observation of the fill placement should be provided by our representative during grading. Verbal communication during the course of each day will be used to inform the contractor of test results. The contractor should receive a copy of the "Daily Field Report" indicating results of field density tests that day. If our representative does not provide the contractor with these reports, our office should be notified.
2. Testing and observation procedures are, by their nature, specific to the work or area observed and location of the tests taken, variability may occur in other locations. The contractor is responsible for the uniformity of the grading operations; our observations and test results are intended to evaluate the contractor's overall level of efforts during grading. The contractor's personnel are the only individuals participating in all aspect of site work. Compaction testing and observation should not be considered as relieving the contractor's responsibility to properly compact the fill.
3. Cleanouts, processed ground to receive fill, key excavations, and subdrains should be observed by our representative prior to placing any fill. It will be the contractor's responsibility to notify our representative or office when such areas are ready for observation.
4. Density tests may be made on the surface material to receive fill, as considered warranted by this firm.
5. In general, density tests would be made at maximum intervals of two feet of fill height or every 1,000 cubic yards of fill placed. Criteria will vary depending on soil conditions and size of the fill. More frequent testing may be performed. In any case, an adequate number of field density tests should be made to evaluate the required compaction and moisture content is generally being obtained.

6. Laboratory testing to support field test procedures will be performed, as considered warranted, based on conditions encountered (e.g. change of material sources, types, etc.) Every effort will be made to process samples in the laboratory as quickly as possible and in progress construction projects are our first priority. However, laboratory workloads may cause in delays and some soils may require a **minimum of 48 to 72 hours to complete test procedures**. Whenever possible, our representative(s) should be informed in advance of operational changes that might result in different source areas for materials.
7. Procedures for testing of fill slopes are as follows:
  - a) Density tests should be taken periodically during grading on the flat surface of the fill, three to five feet horizontally from the face of the slope.
  - b) If a method other than over building and cutting back to the compacted core is to be employed, slope compaction testing during construction should include testing the outer six inches to three feet in the slope face to determine if the required compaction is being achieved.
8. Finish grade testing of slopes and pad surfaces should be performed after construction is complete.

### **Site Clearing**

1. All vegetation, and other deleterious materials, should be removed from the site. If material is not immediately removed from the site it should be stockpiled in a designated area(s) well outside of all current work areas and delineated with flagging or other means. Site clearing should be performed in advance of any grading in a specific area.
2. Efforts should be made by the contractor to remove all organic or other deleterious material from the fill, as even the most diligent efforts may result in the incorporation of some materials. This is especially important when grading is occurring near the natural grade. All equipment operators should be aware of these efforts. Laborers may be required as root pickers.
3. Nonorganic debris or concrete may be placed in deeper fill areas provided the procedures used are observed and found acceptable by our representative.

### **Treatment of Existing Ground**

1. Following site clearing, all surficial deposits of alluvium and colluvium as well as weathered or creep effected bedrock, should be removed unless otherwise specifically indicated in the text of this report.
2. In some cases, removal may be recommended to a specified depth (e.g. flat sites where partial alluvial removals may be sufficient). The contractor should not exceed these depths unless directed otherwise by our representative.
3. Groundwater existing in alluvial areas may make excavation difficult. Deeper removals than indicated in the text of the report may be necessary due to saturation during winter months.
4. Subsequent to removals, the natural ground should be processed to a depth of six inches, moistened to near optimum moisture conditions and compacted to fill standards.
5. Exploratory back hoe or dozer trenches still remaining after site removal should be excavated and filled with compacted fill if they can be located.

### **Fill Placement**

1. Unless otherwise indicated, all site soil and bedrock may be reused for compacted fill; however, some special processing or handling may be required (see text of report).



2. Material used in the compacting process should be evenly spread, moisture conditioned, processed, and compacted in thin lifts six (6) to eight (8) inches in compacted thickness to obtain a uniformly dense layer. The fill should be placed and compacted on a nearly horizontal plane, unless otherwise found acceptable by our representative.
3. If the moisture content or relative density varies from that recommended by this firm, the contractor should rework the fill until it is in accordance with the following:
  - a) Moisture content of the fill should be at or above optimum moisture. Moisture should be evenly distributed without wet and dry pockets. Pre-watering of cut or removal areas should be considered in addition to watering during fill placement, particularly in clay or dry surficial soils. The ability of the contractor to obtain the proper moisture content will control production rates.
  - b) Each six-inch layer should be compacted to at least 90 percent of the maximum dry density in compliance with the testing method specified by the controlling governmental agency. In most cases, the testing method is ASTM Test Designation D 1557.
4. Rock fragments less than eight inches in diameter may be utilized in the fill, provided:
  - a) They are not placed in concentrated pockets;
  - b) There is a sufficient percentage of fine-grained material to surround the rocks;
  - c) The distribution of the rocks is observed by, and acceptable to, our representative.
5. Rocks exceeding eight (8) inches in diameter should be taken off site, broken into smaller fragments, or placed in accordance with recommendations of this firm in areas designated suitable for rock disposal. On projects where significant large quantities of oversized materials are anticipated, alternate guidelines for placement may be included. If significant oversize materials are encountered during construction, these guidelines should be requested.
6. In clay soil, dry or large chunks or blocks are common. If in excess of eight (8) inches minimum dimension, then they are considered as oversized. Sheepsfoot compactors or other suitable methods should be used to break up blocks. When dry, they should be moisture conditioned to provide a uniform condition with the surrounding fill.

### **Slope Construction**

1. The contractor should obtain a minimum relative compaction of 90 percent out to the finished slope face of fill slopes. This may be achieved by either overbuilding the slope and cutting back to the compacted core, or by direct compaction of the slope face with suitable equipment.
2. Slopes trimmed to the compacted core should be overbuilt by at least three (3) feet with compaction efforts out to the edge of the false slope. Failure to properly compact the outer edge results in trimming not exposing the compacted core and additional compaction after trimming may be necessary.
3. If fill slopes are built "at grade" using direct compaction methods, then the slope construction should be performed so that a constant gradient is maintained throughout construction. Soil should not be "spilled" over the slope face nor should slopes be "pushed out" to obtain grades. Compaction equipment should compact each lift along the immediate top of slope. Slopes should be back rolled or otherwise compacted at approximately every 4 feet vertically as the slope is built.
4. Corners and bends in slopes should have special attention during construction as these are the most difficult areas to obtain proper compaction.
5. Cut slopes should be cut to the finished surface. Excessive undercutting and smoothing of the face with fill may necessitate stabilization.

## **UTILITY TRENCH CONSTRUCTION AND BACKFILL**

Utility trench excavation and backfill is the contractor's responsibility. The geotechnical consultant typically provides periodic observation and testing of these operations. While efforts are made to make sufficient observations and tests to verify that the contractor's methods and procedures are adequate to achieve proper compaction, it is typically impractical to observe all backfill procedures. As such, it is critical that the contractor use consistent backfill procedures.

Compaction methods vary for trench compaction and experience indicates many methods can be successful. However, procedures that "worked" on previous projects may or may not prove effective on a given site. The contractor(s) should outline the procedures proposed, so that we may discuss them **prior** to construction. We will offer comments based on our knowledge of site conditions and experience.

1. Utility trench backfill in slopes, structural areas, in streets and beneath flat work or hardscape should be brought to at least optimum moisture and compacted to at least 90 percent of the laboratory standard. Soil should be moisture conditioned prior to placing in the trench.
2. Flooding and jetting are not typically recommended or acceptable for native soils. Flooding or jetting may be used with select sand having a Sand Equivalent (SE) of 30 or higher. This is typically limited to the following uses:
  - a) shallow (12 + inches) under slab interior trenches and,
  - b) as bedding in pipe zone.

The water should be allowed to dissipate prior to pouring slabs or completing trench compaction.

3. Care should be taken not to place soils at high moisture content within the upper three feet of the trench backfill in street areas, as overly wet soils may impact subgrade preparation. Moisture may be reduced to 2% below optimum moisture in areas to be paved within the upper three feet below sub grade.
4. Sand backfill should not be allowed in exterior trenches adjacent to and within an area extending below a 1:1 projection from the outside bottom edge of a footing, unless it is similar to the surrounding soil.
5. Trench compaction testing is generally at the discretion of the geotechnical consultant. Testing frequency will be based on trench depth and the contractor's procedures. A probing rod would be used to assess the consistency of compaction between tested areas and untested areas. If zones are found that are considered less compact than other areas, this would be brought to the contractor's attention.

## **JOB SAFETY**

### **General**

Personnel safety is a primary concern on all job sites. The following summaries are safety considerations for use by all our employees on multi-employer construction sites. On ground personnel are at highest risk of injury and possible fatality on grading construction projects. The company recognizes that construction activities will vary on each site and that job site safety is the contractor's responsibility. However, it is imperative that all personnel be safety conscious to avoid accidents and potential injury.



In an effort to minimize risks associated with geotechnical testing and observation, the following precautions are to be implemented for the safety of our field personnel on grading and construction projects.

1. Safety Meetings: Our field personnel are directed to attend the contractor's regularly scheduled safety meetings.
2. Safety Vests: Safety vests are provided for and are to be worn by our personnel while on the job site.
3. Safety Flags: Safety flags are provided to our 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.

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.

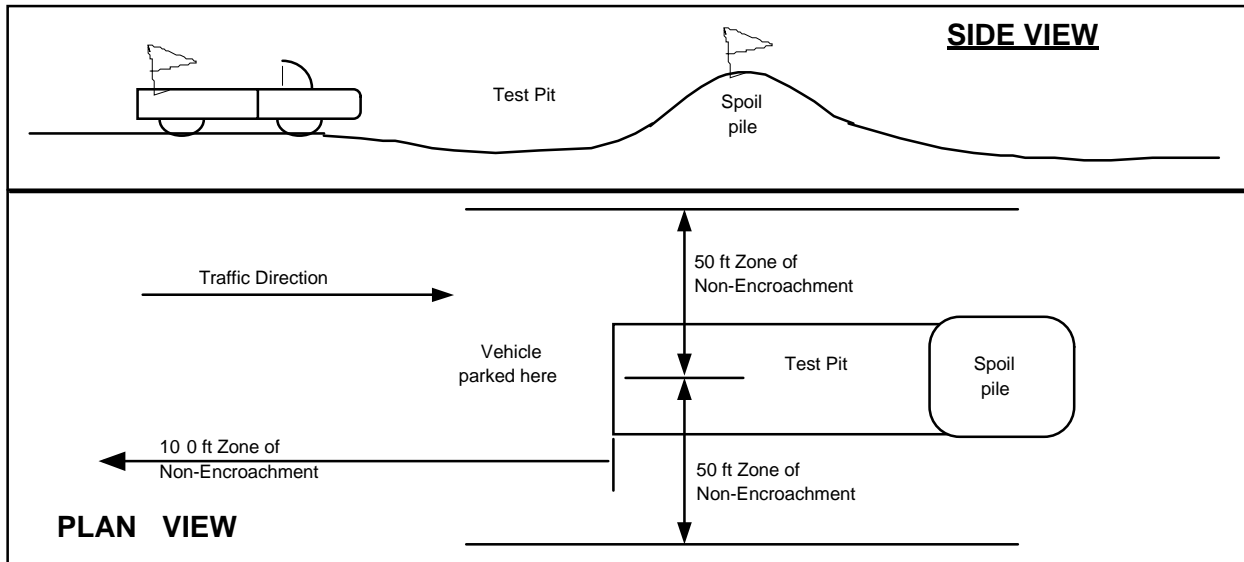
### **Test Pits Location, Orientation and Clearance**

The technician is responsible for selecting test pit locations. The primary concern is the technician's safety. However, it is necessary to take sufficient tests at various locations to obtain a representative sampling of the fill. As such, efforts will be made to coordinate locations with the grading contractors authorized representatives (e.g. dump man, operator, supervisor, grade checker, etc.), and to select locations following or behind the established traffic pattern, preferably outside of current traffic. The contractors authorized representative should direct excavation of the pit and safety during the test period. Again, safety is the paramount concern.

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

A zone of non-encroachment should be established for all test pits (see diagram below). No grading equipment should enter this zone during the test procedure. The zone should extend outward to the sides approximately 50 feet from the center of the test pit and 100 feet in the direction of traffic flow. This zone is established both for safety and to avoid excessive ground vibration, which typically decreases test results.

### TEST PIT SAFETY PLAN



#### Slope Tests

When taking slope tests, the technician should park their vehicle directly above or below the test location on the slope. The contractor's representative should effectively keep all equipment at a safe operation distance (e.g. 50 feet) away from the slope during 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.

#### Trench Safety

It is the contractor's responsibility to provide safe access into trenches where compaction testing is needed. Trenches for all utilities should be excavated in accordance with CAL-OSHA and any other applicable safety standards. Safe conditions will be required to enable compaction testing of the trench backfill.

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

Our personnel are directed not to enter any excavation which;

1. is 5 feet or deeper unless shored or laid back,
2. exit points or ladders are not provided,
3. displays any evidence of instability, has any loose rock or other debris which could fall into the trench, or
4. displays any other evidence of any unsafe conditions regardless of depth.

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

### **Procedures**

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 directed to inform both the developer's and contractor's representatives. If the condition is not rectified, the technician is required, by company policy, to immediately withdraw and notify their supervisor. The contractor's representative will then be contacted in an effort to effect a solution. No further testing will be performed until the situation is rectified. Any fill placed in the interim 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 technicians attention and notify our project manager or office. Effective communication and coordination between the contractors' representative and the field technician(s) is strongly encouraged in order to implement the above safety program and safety in general.

The safety procedures outlined above should be discussed at the contractor's safety meetings. This will serve to inform and remind equipment operators of these safety procedures particularly the zone of non-encroachment.

The safety procedures outlined above should be discussed at the contractor's safety meetings. This will serve to inform and remind equipment operators of these safety procedures particularly the zone of non-encroachment.

# ALTERNATES

Finish Grade

Original Ground

Loose Surface Materials

4 feet typical

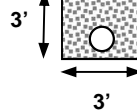
Suitable Material

Construct Benches where slope exceeds 5:1

Slope to Drain

Suitable Material

Bottom of Cleanout to Be At Least 1.5 Times the Width of Compaction Equipment



6" Perforated Pipe in 9 cubic feet per Lineal Foot Clean Gravel Wrapped in Filter Fabric

Finish Grade

Original Ground

Loose Surface Materials

4 feet typical

Construct Benches where slope exceeds 5:1

Slope to Drain

Suitable Material

Bottom of Cleanout to Be At Least 1.5 Times the Width of Compaction Equipment



6" Perforated Pipe in 9 cubic feet per Lineal Foot Clean Gravel Wrapped in Filter Fabric



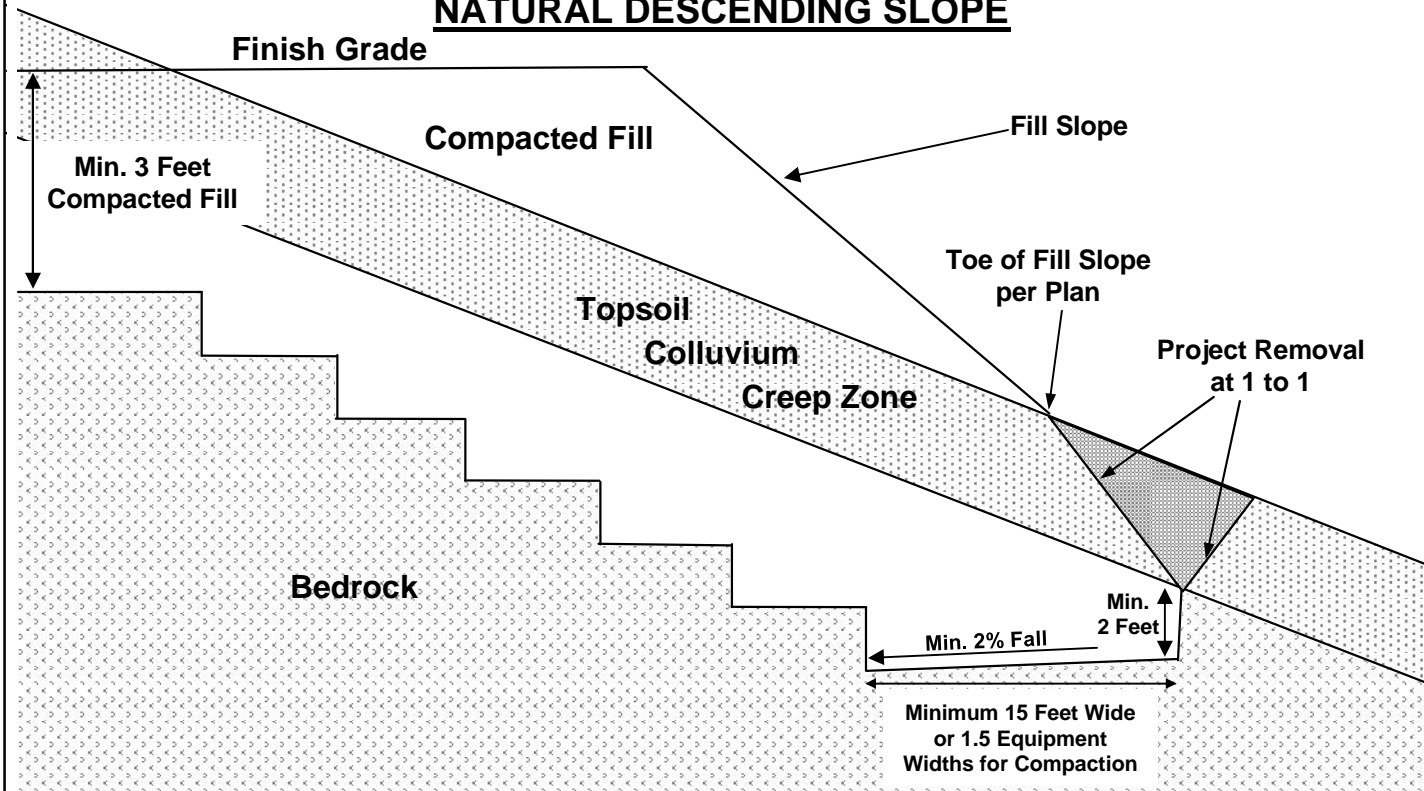
1548 North Maple Street  
Corona, California 92880

TYPICAL CANYON  
CLEANOUT

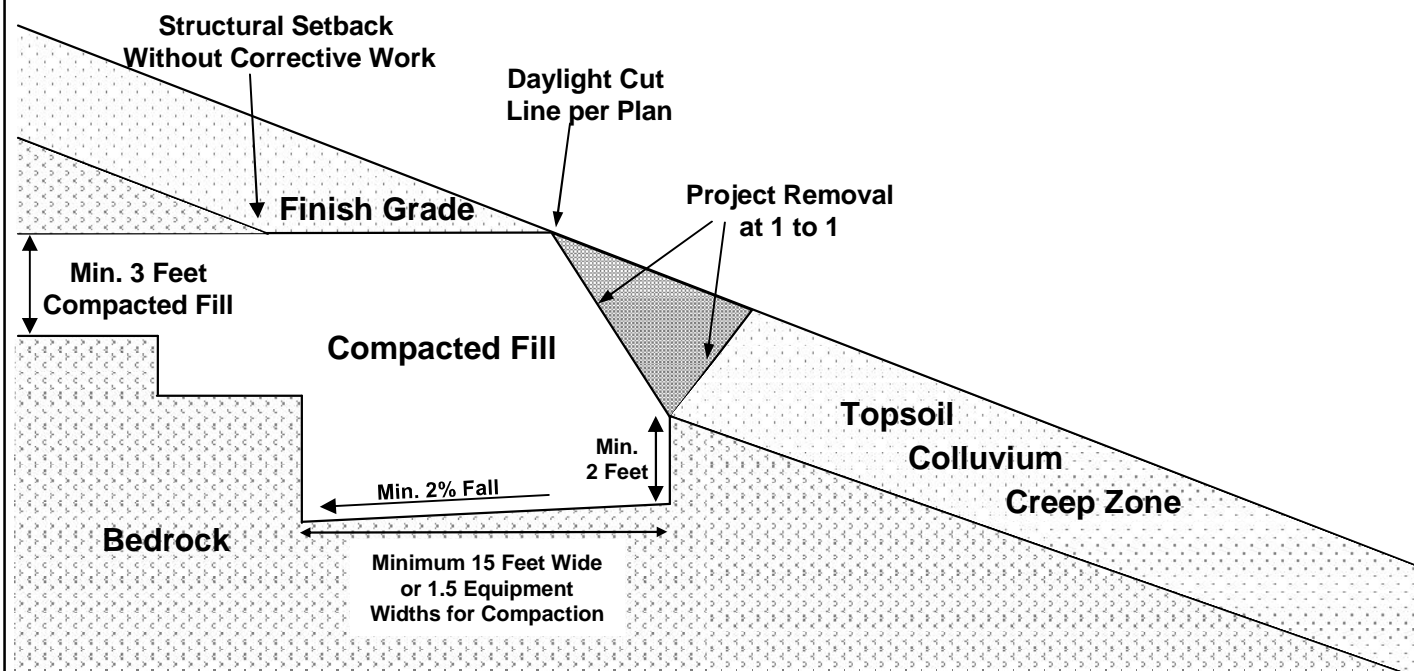
STANDARD GRADING  
GUIDELINES

PLATE G-I

## TYPICAL FILL SLOPE OVER NATURAL DESCENDING SLOPE



## DAYLIGHT CUT AREA OVER NATURAL DESCENDING SLOPE



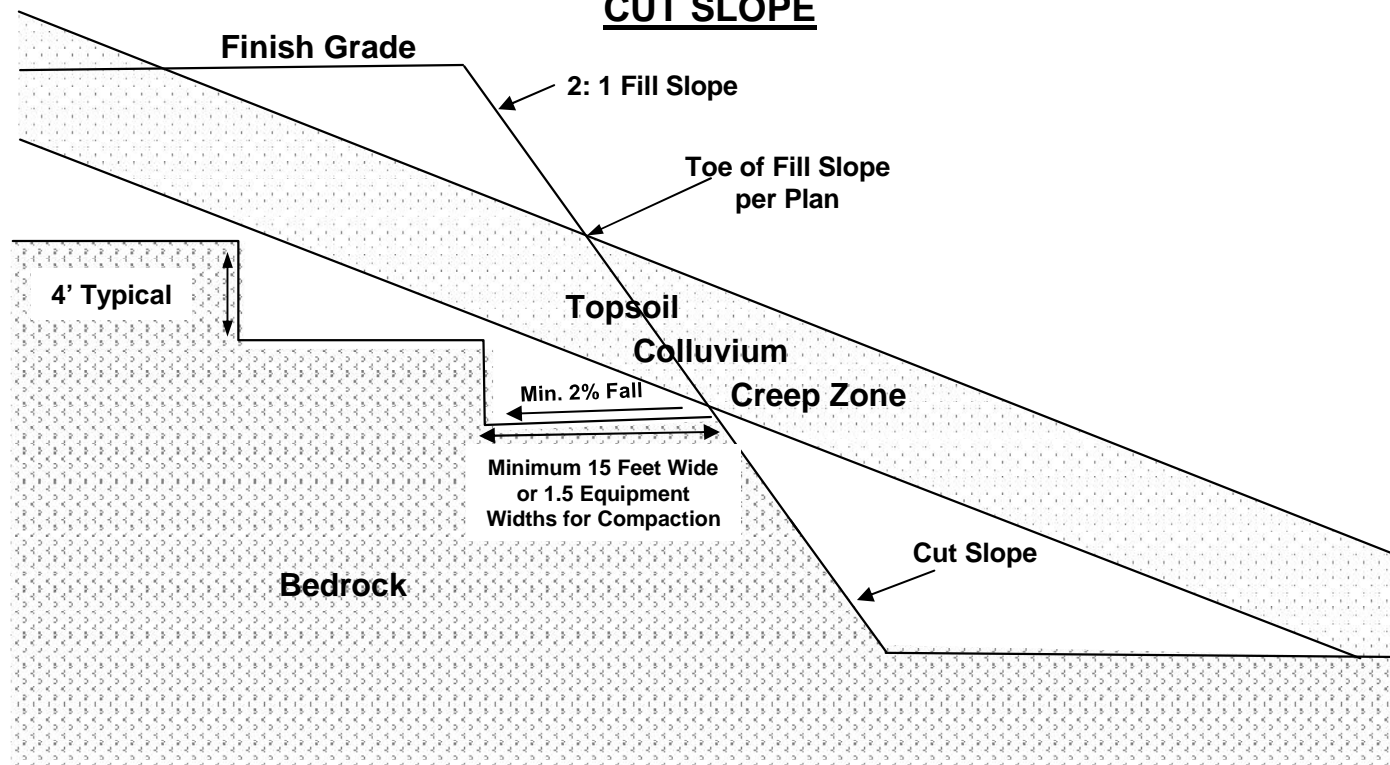
1548 North Maple Street  
Corona, California 92880

TREATMENT ABOVE  
NATURAL SLOPES

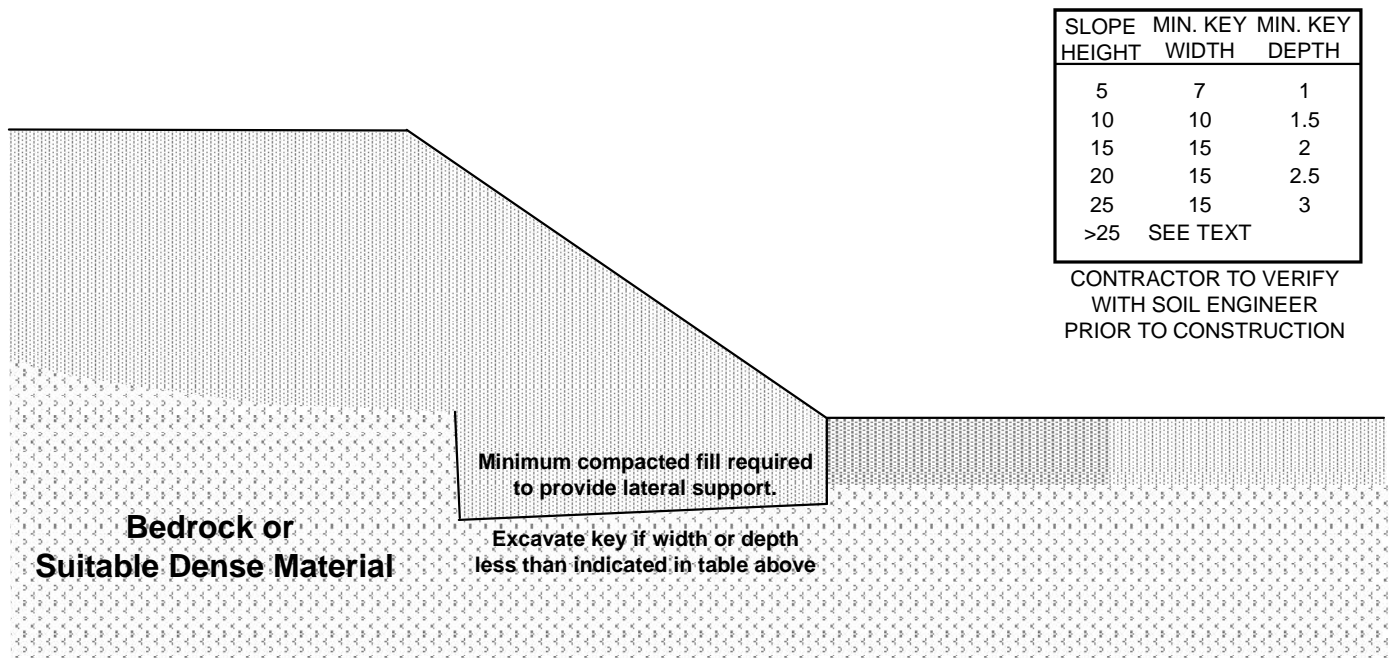
STANDARD GRADING  
GUIDELINES

PLATE G-2

## TYPICAL FILL SLOPE OVER CUT SLOPE



## TYPICAL FILL SLOPE



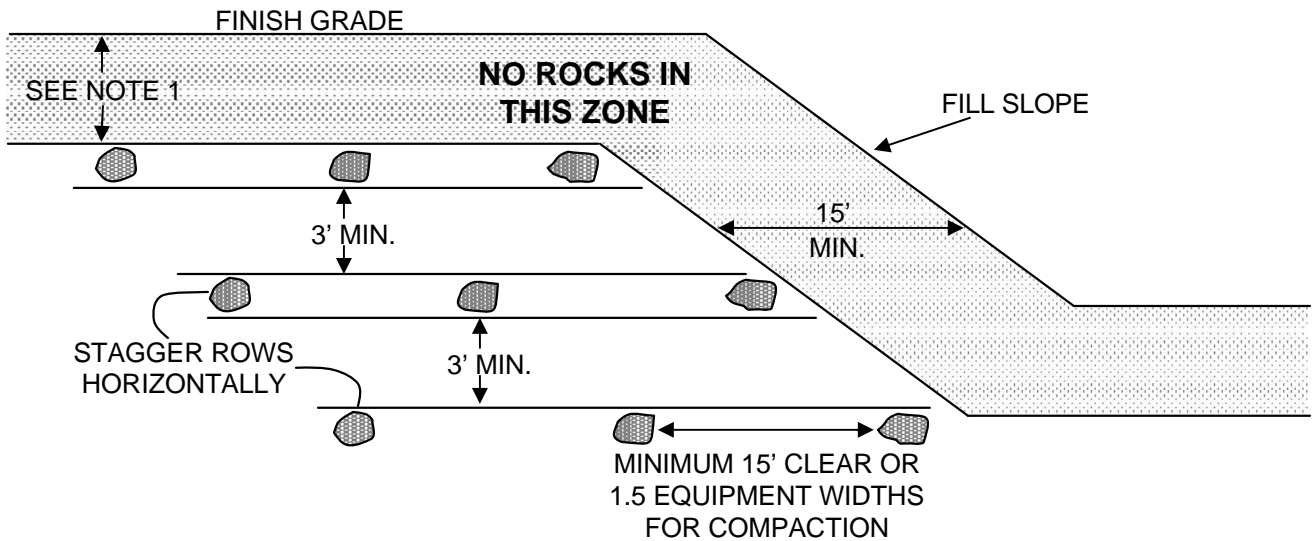
1548 North Maple Street  
Corona, California 92880

COMMON FILL  
SLOPE KEYS

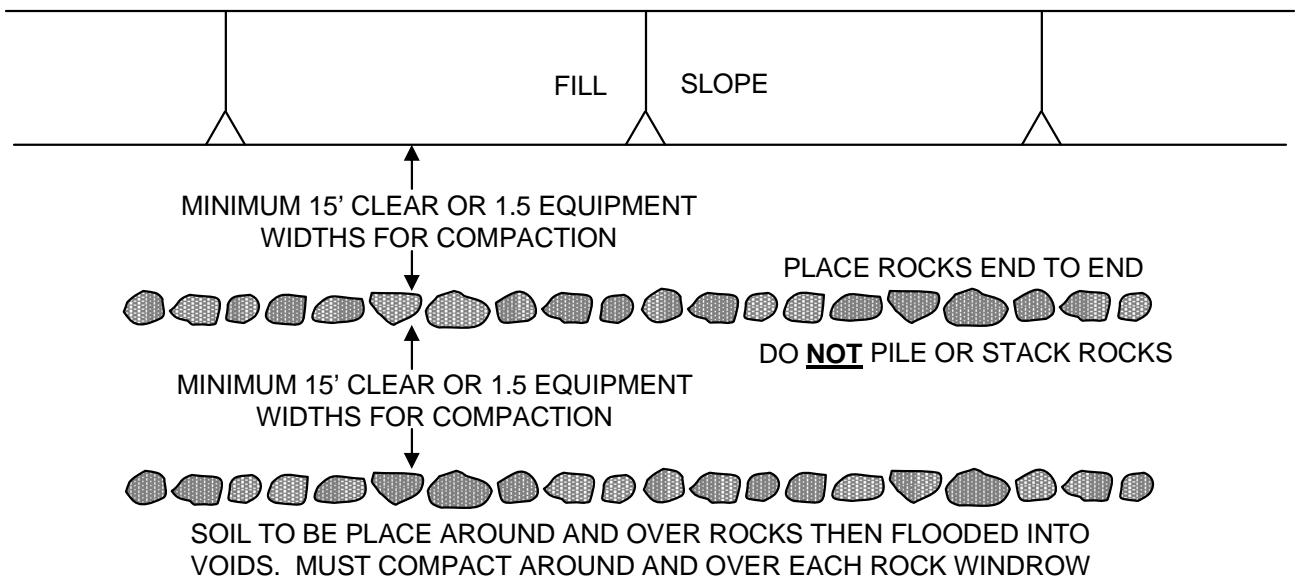
STANDARD GRADING  
GUIDELINES

PLATE G-3

# CROSS SECTIONAL VIEW



# PLAN VIEW



**NOTES:**

- 1) SOIL FILL OVER WINDROW SHOULD BE 7 FEET OR PER JURISDICTIONAL STANDARDS AND SUFFICIENT FOR FUTURE EXCAVATIONS TO AVOID ROCKS
- 2) MAXIMUM ROCK SIZE IN WINDROWS IS 4 FEET IN DIAMETER
- 3) SOIL AROUND WINDROWS TO BE SANDY MATERIAL SUBJECT TO SOIL ENGINEER ACCEPTANCE
- 4) SPACING AND CLEARANCES MUST BE SUFFICIENT TO ALLOW FOR PROPER COMPACTION
- 5) INDIVIDUAL LARGE ROCKS MAY BE BURIED IN PITS.

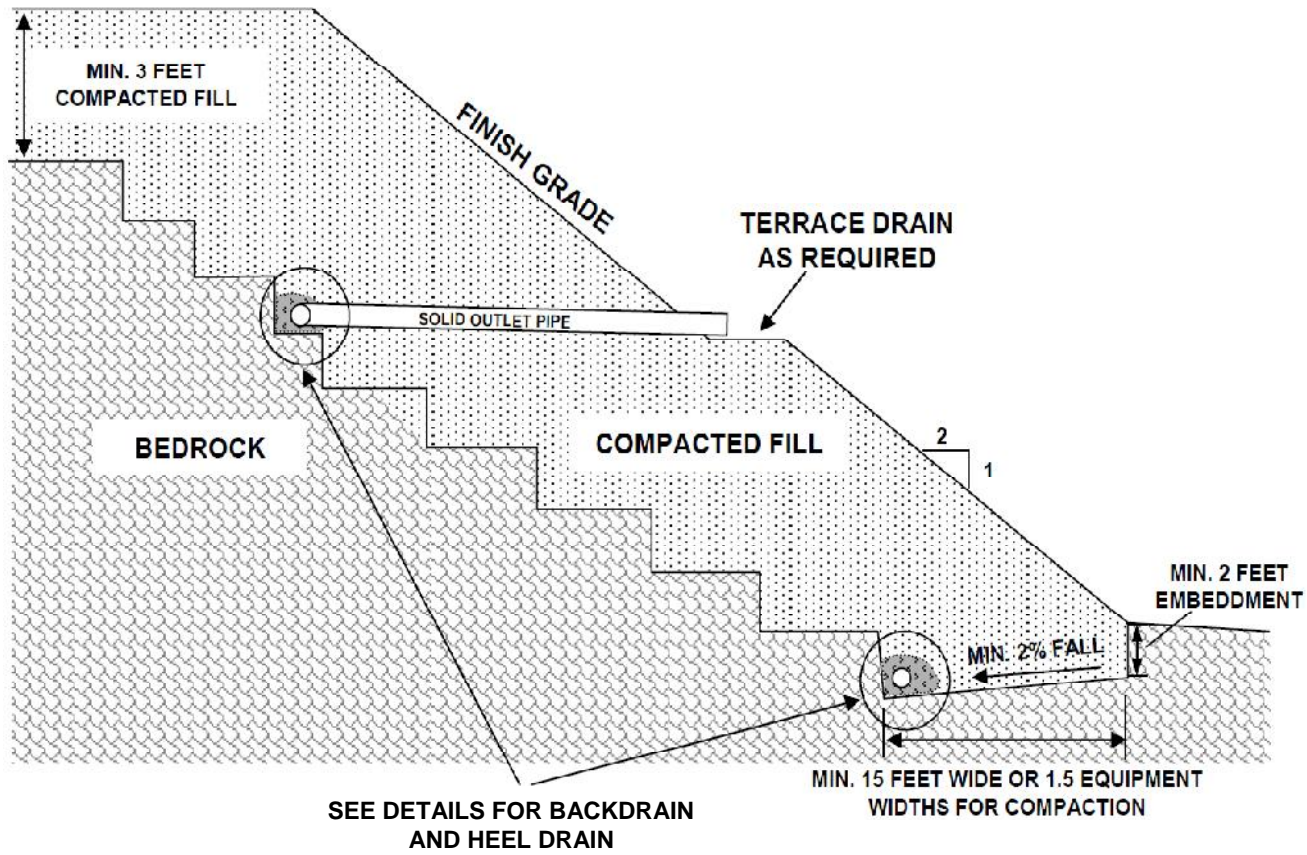


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Corona, California 92880

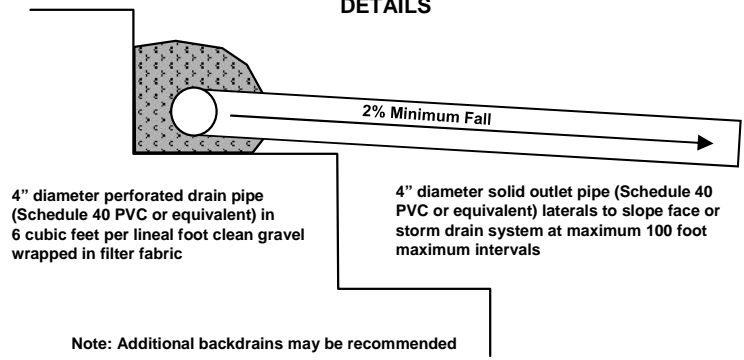
ROCK BURIAL DETAILS

STANDARD GRADING  
GUIDELINES

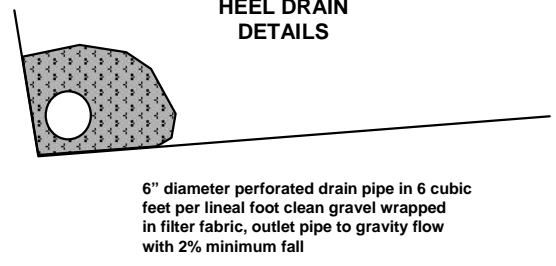
PLATE G-4



**BACKDRAIN DETAILS**



**HEEL DRAIN DETAILS**



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Corona, California 92880

**TYPICAL BUTTRESS AND STABILIZATION FILL**

**STANDARD GRADING GUIDELINES**

**PLATE G-5**

## Appendix 4: Historical Site Conditions

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

N/A

## Appendix 5: LID Infeasibility

*LID Technical Infeasibility Analysis*

N/A

# Appendix 6: BMP Design Details

*BMP Sizing, Design Details and other Supporting Documentation*

## Santa Ana Watershed

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

These worksheets are to be used to determine the required

Design Capture Volume ( $V_{BMP}$ )

or the

Design Flow Rate ( $Q_{BMP}$ )

for BMPs in the Santa Ana Watershed

To verify which watershed your project is located within, visit

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

and use the 'Locate my Watershed' tool

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

Do not use these worksheets! Instead visit

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

To access worksheets applicable to your watershed

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

## Effective Impervious Fraction

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

Mixed Surface Types

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



Bioretention Facility - Design Procedure		BMP ID BMP 1	Legend:	Required Entries	
				Calculated Cells	
Company Name:	ADKAN ENGINEERS		Date: 10/3/2023		
Designed by:	SERGIO FLORES		County/City Case No.:		
Design Volume					
Enter the area tributary to this feature			$A_T =$	8.34	acres
Enter $V_{BMP}$ determined from Section 2.1 of this Handbook			$V_{BMP} =$	13,437	ft <sup>3</sup>
Type of Bioretention Facility Design					
<input checked="" type="radio"/> Side slopes required (parallel to parking spaces or adjacent to walkways) <input type="radio"/> No side slopes required (perpendicular to parking space or Planter Boxes)					
Bioretention Facility Surface Area					
Depth of Soil Filter Media Layer			$d_S =$	3.0	ft
Top Width of Bioretention Facility, excluding curb			$w_T =$	66.0	ft
Total Effective Depth, $d_E$ $d_E = (0.3) \times d_S + (0.4) \times 1 - (0.7/w_T) + 0.5$			$d_E =$	1.79	ft
Minimum Surface Area, $A_m$ $A_M (ft^2) = \frac{V_{BMP} (ft^3)}{d_E (ft)}$			$A_M =$	7,510	ft <sup>2</sup>
Proposed Surface Area			$A =$	8,833	ft <sup>2</sup>
Bioretention Facility Properties					
Side Slopes in Bioretention Facility			$z =$	4	:1
Diameter of Underdrain				6	inches
Longitudinal Slope of Site (3% maximum)				1	%
6" Check Dam Spacing				25	feet
Describe Vegetation:			Natural Grasses		
Notes:	CASE & GOETZ				

## Appendix 7: Hydromodification

*Supporting Detail Relating to Hydrologic Conditions of Concern*

N/A

# 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.1 on page 23 of this WQMP Template. Describe your specific BMPs in an accompanying narrative, and explain any special conditions or situations that required omitting BMPs or substituting alternative BMPs for those shown here.

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

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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

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
<input type="checkbox"/> H. Industrial processes.	<input type="checkbox"/> Show process area.	<input type="checkbox"/> If industrial processes are to be located on site, state: “All process activities to be performed indoors. No processes to drain to exterior or to storm drain system.”	<input type="checkbox"/> See Fact Sheet SC-10, “Non-Stormwater Discharges” in the CASQA Stormwater Quality Handbooks at <a href="http://www.cabmphandbooks.com">www.cabmphandbooks.com</a>  See the brochure “Industrial & Commercial Facilities Best Management Practices for: Industrial, Commercial Facilities” at <a href="http://rcflood.org/stormwater/">http://rcflood.org/stormwater/</a>

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 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
<input type="checkbox"/> I. Outdoor storage of equipment or materials. (See rows J and K for source control measures for vehicle cleaning, repair, and maintenance.)	<input type="checkbox"/> Show any outdoor storage areas, including how materials will be covered. Show how areas will be graded and bermed to prevent run-on or run-off from area. <input type="checkbox"/> Storage of non-hazardous liquids shall be covered by a roof and/or drain to the sanitary sewer system, and be contained by berms, dikes, liners, or vaults. <input type="checkbox"/> Storage of hazardous materials and wastes must be in compliance with the local hazardous materials ordinance and a Hazardous Materials Management Plan for the site.	<p>Include a detailed description of materials to be stored, storage areas, and structural features to prevent pollutants from entering storm drains.</p> <p>Where appropriate, reference documentation of compliance with the requirements of Hazardous Materials Programs for:</p> <ul style="list-style-type: none"> <li>▪ Hazardous Waste Generation</li> <li>▪ Hazardous Materials Release Response and Inventory</li> <li>▪ California Accidental Release (CalARP)</li> <li>▪ Aboveground Storage Tank</li> <li>▪ Uniform Fire Code Article 80 Section 103(b) &amp; (c) 1991</li> <li>▪ Underground Storage Tank</li> </ul> <p><a href="http://www.cchealth.org/groups/hazmat/">www.cchealth.org/groups/hazmat/</a></p>	<input type="checkbox"/> See the Fact Sheets SC-31, “Outdoor Liquid Container Storage” and SC-33, “Outdoor Storage of Raw Materials ” in the CASQA Stormwater Quality Handbooks at <a href="http://www.cabmphandbooks.com">www.cabmphandbooks.com</a>

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><input type="checkbox"/> <b>J. Vehicle and Equipment Cleaning</b></p>	<p><input type="checkbox"/> <b>Show on drawings as appropriate:</b></p> <p>(1) Commercial/industrial facilities having vehicle/equipment cleaning needs shall either provide a covered, bermed area for washing activities or discourage vehicle/equipment washing by removing hose bibs and installing signs prohibiting such uses.</p> <p>(2) Multi-dwelling complexes shall have a paved, bermed, and covered car wash area (unless car washing is prohibited on-site and hoses are provided with an automatic shut-off to discourage such use).</p> <p>(3) Washing areas for cars, vehicles, and equipment shall be paved, designed to prevent run-on to or runoff from the area, and plumbed to drain to the sanitary sewer.</p> <p>(4) Commercial car wash facilities shall be designed such that no runoff from the facility is discharged to the storm drain system. Wastewater from the facility shall discharge to the sanitary sewer, or a wastewater reclamation system shall be installed.</p>	<p><input type="checkbox"/> <b>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.</b></p>	<p><b>Describe operational measures to implement the following (if applicable):</b></p> <p><input type="checkbox"/> <b>Washwater from vehicle and equipment washing operations shall not be discharged to the storm drain system.</b> Refer to “Outdoor Cleaning Activities and Professional Mobile Service Providers” for many of the Potential Sources of Runoff Pollutants categories below. Brochure can be found at <a href="http://rcflood.org/stormwater/">http://rcflood.org/stormwater/</a></p> <p><input type="checkbox"/> <b>Car dealerships and similar may rinse cars with water only.</b></p>

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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

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

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 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
<input type="checkbox"/> N. Fire Sprinkler Test Water		<input type="checkbox"/> Provide a means to drain fire sprinkler test water to the sanitary sewer.	<input type="checkbox"/> See the note in Fact Sheet SC-41, “Building and Grounds Maintenance,” in the CASQA Stormwater Quality Handbooks at <a href="http://www.cabmphandbooks.com">www.cabmphandbooks.com</a>
<p>O. Miscellaneous Drain or Wash Water or Other Sources</p> <input type="checkbox"/> Boiler drain lines <input checked="" type="checkbox"/> Condensate drain lines <input type="checkbox"/> Rooftop equipment <input type="checkbox"/> Drainage sumps <input checked="" type="checkbox"/> Roofing, gutters, and trim. <input type="checkbox"/> Other sources		<input type="checkbox"/> Boiler drain lines shall be directly or indirectly connected to the sanitary sewer system and may not discharge to the storm drain system. <input checked="" type="checkbox"/> Condensate drain lines may discharge to landscaped areas if the flow is small enough that runoff will not occur. Condensate drain lines may not discharge to the storm drain system. <input type="checkbox"/> Rooftop equipment with potential to produce pollutants shall be roofed and/or have secondary containment. <input type="checkbox"/> Any drainage sumps on-site shall feature a sediment sump to reduce the quantity of sediment in pumped water. <input checked="" type="checkbox"/> 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
<input checked="" type="checkbox"/> P. Plazas, sidewalks, and parking lots.			<input checked="" type="checkbox"/> Sweep plazas, sidewalks, and parking lots regularly to prevent accumulation of litter and debris. Collect debris from pressure washing to prevent entry into the storm drain system. Collect washwater containing any cleaning agent or degreaser and discharge to the sanitary sewer not to a storm drain.

## Appendix 9: O&M

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

## **Operations & Maintenance Responsibility for Treatment Control BMP's**

The planned development will consist of 109 lot single-family residences, street improvements, onsite stormwater treatment areas (Extended Detention Basin) in the southwest corner near Brodiaea Avenue and Landon Road. All onsite runoff will flow to the southwest as per the existing drainage path.

<b>BMP Required Maintenance</b>	<b>Frequency</b>	<b>Maintenance Requirements</b>	<b>Responsibility</b>	<b>Est. Annual (\$)**</b>
Roof Drains/ Gutters	Before wet season, or significant rain event, or when needed	Roof Gutters shall be visually inspected for defects and possible leakage. Damage or defects found shall be corrected as soon as possible. Owners should avoid use of gutters, roofing, and trim made of copper so as to prevent the metal from leaching into runoff.	Owners	TBD
Self-Retaining/ Landscape Areas	Bi-Weekly	Mow, weed, trim and remove accumulation of trash debris and/or sediment. Retaining areas should be mowed at 4-6 inches in height if grass is proposed. Maintain landscaping using minimal pesticides	Owners	\$3,132
Bio Retention	Ongoing including just before annual storm seasons & following rainfall events.	<ul style="list-style-type: none"> <li>• Maintain vegetation as needed. Use of fertilizers, pesticides and herbicides should be strongly avoided to ensure they don't contribute to water pollution. If appropriate native plant selections and other IPM methods are used, such products shouldn't be needed. If such projects are used: Care should be taken to avoid contact with the low-flow or other trenches, and the media filter in the bottom stage. Products shall be applied in accordance with their labeling, especially in relation to application to water, and in areas subjected to flooding. Fertilizers should not be applied within 15 days before, after, or during the rainy season. No ponded water should be present for more than 72 hours to avoid nuisance or vector problems. No algae formation should be visible. Correct problems as needed</li> </ul>	Owners	
	Annually. If possible, schedule These inspections before the beginning of the rain season to allow for any repairs to occur before rains occur	<ul style="list-style-type: none"> <li>Remove debris and litter from the entire basin</li> <li>• Inspect hydraulic and structural facilities. Examine the outlet for clogging, the embankment and spillway integrity, as well as damage to any structural element.</li> <li>• Check for erosion, slumping and overgrowth. Repair as needed.</li> <li>• Inspect sand media at the filter drain to verify it is allowing acceptable infiltration. Scarify top 3 inches by raking the filter drain's sand surface annually.</li> <li>• Check the media filter underdrains (via the cleanout) for damage or clogging. Repair as needed.</li> <li>• Remove accumulated sediment and debris from the forebay, and ensure that the notch weir is clear and will allow proper drainage.</li> <li>• Check gravel filled low flow and collector trenches for sediment buildup and repair as needed.</li> </ul>	Owners	
	Every 5 years or sooner (depending on whether observed drain times to empty the basin are less than 72 hours)	Remove the top 3 inches of sand from the filter drain and backfill with 3 inches of new sand to return the sand layer to its original depth. When scarification or removal of the top 3 inches of sand is no longer effective, remove and replace sand filter layer.	Owners	

**Water Quality Management Plan (WQMP)  
CASE AND GOETZ**

	Whenever substantial sediment accumulation has occurred.	Remove accumulated sediment from the bottom of the basin. Removal should extend to original basin depth.	Owners	
On-site Storm Drain inlets	During every scheduled maintenance check (per below), and as needed at other times following rainfall events.	Regular inspections and maintenance will be required to prevent the inlets from becoming more than 40% full. Two-person teams may be required to clean catch basins with vactor trucks. Arrangements must be made for proper disposal of collected wastes. Technical staff are required to detect and investigate illegal/illicit dumping violations.	Owners	\$1,600
Street Sweeping	Bi-weekly	Street sweeping will be conducted, to remove all debris from streets to prevent any clogging of site storm drains.	Owners	\$3,700

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

\*\*Estimated Annual Fees taken from the Project's Budget Worksheet (DRAFT) for the State of California – Department of Real Estate prepared by Seabreeze Management Company, Inc. - Contact: Brandon Tryon and California Stormwater BMP Handbook January 2003 Extended Detention Basin TC-22

## **Funding**

***Funding for Ongoing Maintenance will be provided by:***

***Owners***







**Water Quality Management Plan (WQMP)  
CASE GOETZ**

**Operations & Maintenance Responsibility for Treatment Control BMP's**

	<b>BMP Required Maintenance</b>	<b>Frequency</b>	<b>Maintenance Requirements</b>	<b>Responsibility</b>
Source Control	Refuse Areas	Weekly	- Collect and dispose of trash and debris	Property Owner
	Trash, Street Sweeping	Weekly	- Collect and dispose trash, debris and sediment by street sweeping and other approved County of Riverside's method.	Property Owner
Structural BMP	TC-32 Bioretention	Periodic maintenance that is required of any landscaped area	<ul style="list-style-type: none"> <li>- Inspect infiltration chamber for sediment or trash</li> <li>- Maintain the treatment area's appearance it may be necessary to prune and weed.</li> <li>- Mulch replacement is suggested when erosion is evident or when the site begins to look unattractive.</li> <li>- Entire area may require mulch replacement every two to three years, although spot mulching may be sufficient when there are random void areas.</li> </ul> <p>Mulch replacement should be done prior to the start of the wet season.</p>	Property Owner

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

# Appendix 10: Educational Materials

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



## Design Considerations

- Soil for Infiltration
- Tributary Area
- Slope
- Aesthetics
- Environmental Side-effects

## Description

The bioretention best management practice (BMP) functions as a soil and plant-based filtration device that removes pollutants through a variety of physical, biological, and chemical treatment processes. These facilities normally consist of a grass buffer strip, sand bed, ponding area, organic layer or mulch layer, planting soil, and plants. The runoff's velocity is reduced by passing over or through buffer strip and subsequently distributed evenly along a ponding area. Exfiltration of the stored water in the bioretention area planting soil into the underlying soils occurs over a period of days.

## California Experience

None documented. Bioretention has been used as a stormwater BMP since 1992. In addition to Prince George's County, MD and Alexandria, VA, bioretention has been used successfully at urban and suburban areas in Montgomery County, MD; Baltimore County, MD; Chesterfield County, VA; Prince William County, VA; Smith Mountain Lake State Park, VA; and Cary, NC.

## Advantages

- Bioretention provides stormwater treatment that enhances the quality of downstream water bodies by temporarily storing runoff in the BMP and releasing it over a period of four days to the receiving water (EPA, 1999).
- The vegetation provides shade and wind breaks, absorbs noise, and improves an area's landscape.

## Limitations

- The bioretention BMP is not recommended for areas with slopes greater than 20% or where mature tree removal would

## Targeted Constituents

<input checked="" type="checkbox"/>	Sediment	■
<input checked="" type="checkbox"/>	Nutrients	▲
<input checked="" type="checkbox"/>	Trash	■
<input checked="" type="checkbox"/>	Metals	■
<input checked="" type="checkbox"/>	Bacteria	■
<input checked="" type="checkbox"/>	Oil and Grease	■
<input checked="" type="checkbox"/>	Organics	■

Legend (*Removal Effectiveness*)

- Low
- High
- ▲ Medium



be required since clogging may result, particularly if the BMP receives runoff with high sediment loads (EPA, 1999).

- Bioretention is not a suitable BMP at locations where the water table is within 6 feet of the ground surface and where the surrounding soil stratum is unstable.
- By design, bioretention BMPs have the potential to create very attractive habitats for mosquitoes and other vectors because of highly organic, often heavily vegetated areas mixed with shallow water.
- In cold climates the soil may freeze, preventing runoff from infiltrating into the planting soil.

### **Design and Sizing Guidelines**

- The bioretention area should be sized to capture the design storm runoff.
- In areas where the native soil permeability is less than 0.5 in/hr an underdrain should be provided.
- Recommended minimum dimensions are 15 feet by 40 feet, although the preferred width is 25 feet. Excavated depth should be 4 feet.
- Area should drain completely within 72 hours.
- Approximately 1 tree or shrub per 50 ft<sup>2</sup> of bioretention area should be included.
- Cover area with about 3 inches of mulch.

### ***Construction/Inspection Considerations***

Bioretention area should not be established until contributing watershed is stabilized.

### **Performance**

Bioretention removes stormwater pollutants through physical and biological processes, including adsorption, filtration, plant uptake, microbial activity, decomposition, sedimentation and volatilization (EPA, 1999). Adsorption is the process whereby particulate pollutants attach to soil (e.g., clay) or vegetation surfaces. Adequate contact time between the surface and pollutant must be provided for in the design of the system for this removal process to occur. Thus, the infiltration rate of the soils must not exceed those specified in the design criteria or pollutant removal may decrease. Pollutants removed by adsorption include metals, phosphorus, and hydrocarbons. Filtration occurs as runoff passes through the bioretention area media, such as the sand bed, ground cover, and planting soil.

Common particulates removed from stormwater include particulate organic matter, phosphorus, and suspended solids. Biological processes that occur in wetlands result in pollutant uptake by plants and microorganisms in the soil. Plant growth is sustained by the uptake of nutrients from the soils, with woody plants locking up these nutrients through the seasons. Microbial activity within the soil also contributes to the removal of nitrogen and organic matter. Nitrogen is removed by nitrifying and denitrifying bacteria, while aerobic bacteria are responsible for the decomposition of the organic matter. Microbial processes require oxygen and can result in depleted oxygen levels if the bioretention area is not adequately

aerated. Sedimentation occurs in the swale or ponding area as the velocity slows and solids fall out of suspension.

The removal effectiveness of bioretention has been studied during field and laboratory studies conducted by the University of Maryland (Davis et al, 1998). During these experiments, synthetic stormwater runoff was pumped through several laboratory and field bioretention areas to simulate typical storm events in Prince George's County, MD. Removal rates for heavy metals and nutrients are shown in Table 1.

<b>Pollutant</b>	<b>Removal Rate</b>
Total Phosphorus	70-83%
Metals (Cu, Zn, Pb)	93-98%
TKN	68-80%
Total Suspended Solids	90%
Organics	90%
Bacteria	90%

Results for both the laboratory and field experiments were similar for each of the pollutants analyzed. Doubling or halving the influent pollutant levels had little effect on the effluent pollutants concentrations (Davis et al, 1998).

The microbial activity and plant uptake occurring in the bioretention area will likely result in higher removal rates than those determined for infiltration BMPs.

### **Siting Criteria**

Bioretention BMPs are generally used to treat stormwater from impervious surfaces at commercial, residential, and industrial areas (EPA, 1999). Implementation of bioretention for stormwater management is ideal for median strips, parking lot islands, and swales. Moreover, the runoff in these areas can be designed to either divert directly into the bioretention area or convey into the bioretention area by a curb and gutter collection system.

The best location for bioretention areas is upland from inlets that receive sheet flow from graded areas and at areas that will be excavated (EPA, 1999). In order to maximize treatment effectiveness, the site must be graded in such a way that minimizes erosive conditions as sheet flow is conveyed to the treatment area. Locations where a bioretention area can be readily incorporated into the site plan without further environmental damage are preferred. Furthermore, to effectively minimize sediment loading in the treatment area, bioretention only should be used in stabilized drainage areas.

**Additional Design Guidelines**

The layout of the bioretention area is determined after site constraints such as location of utilities, underlying soils, existing vegetation, and drainage are considered (EPA, 1999). Sites with loamy sand soils are especially appropriate for bioretention because the excavated soil can be backfilled and used as the planting soil, thus eliminating the cost of importing planting soil.

The use of bioretention may not be feasible given an unstable surrounding soil stratum, soils with clay content greater than 25 percent, a site with slopes greater than 20 percent, and/or a site with mature trees that would be removed during construction of the BMP.

Bioretention can be designed to be off-line or on-line of the existing drainage system (EPA, 1999). The drainage area for a bioretention area should be between 0.1 and 0.4 hectares (0.25 and 1.0 acres). Larger drainage areas may require multiple bioretention areas. Furthermore, the maximum drainage area for a bioretention area is determined by the expected rainfall intensity and runoff rate. Stabilized areas may erode when velocities are greater than 5 feet per second (1.5 meter per second). The designer should determine the potential for erosive conditions at the site.

The size of the bioretention area, which is a function of the drainage area and the runoff generated from the area is sized to capture the water quality volume.

The recommended minimum dimensions of the bioretention area are 15 feet (4.6 meters) wide by 40 feet (12.2 meters) long, where the minimum width allows enough space for a dense, randomly-distributed area of trees and shrubs to become established. Thus replicating a natural forest and creating a microclimate, thereby enabling the bioretention area to tolerate the effects of heat stress, acid rain, runoff pollutants, and insect and disease infestations which landscaped areas in urban settings typically are unable to tolerate. The preferred width is 25 feet (7.6 meters), with a length of twice the width. Essentially, any facilities wider than 20 feet (6.1 meters) should be twice as long as they are wide, which promotes the distribution of flow and decreases the chances of concentrated flow.

In order to provide adequate storage and prevent water from standing for excessive periods of time the ponding depth of the bioretention area should not exceed 6 inches (15 centimeters). Water should not be left to stand for more than 72 hours. A restriction on the type of plants that can be used may be necessary due to some plants' water intolerance. Furthermore, if water is left standing for longer than 72 hours mosquitoes and other insects may start to breed.

The appropriate planting soil should be backfilled into the excavated bioretention area. Planting soils should be sandy loam, loamy sand, or loam texture with a clay content ranging from 10 to 25 percent.

Generally the soil should have infiltration rates greater than 0.5 inches (1.25 centimeters) per hour, which is typical of sandy loams, loamy sands, or loams. The pH of the soil should range between 5.5 and 6.5, where pollutants such as organic nitrogen and phosphorus can be adsorbed by the soil and microbial activity can flourish. Additional requirements for the planting soil include a 1.5 to 3 percent organic content and a maximum 500 ppm concentration of soluble salts.

Soil tests should be performed for every 500 cubic yards (382 cubic meters) of planting soil, with the exception of pH and organic content tests, which are required only once per bioretention area (EPA, 1999). Planting soil should be 4 inches (10.1 centimeters) deeper than the bottom of the largest root ball and 4 feet (1.2 meters) altogether. This depth will provide adequate soil for the plants' root systems to become established, prevent plant damage due to severe wind, and provide adequate moisture capacity. Most sites will require excavation in order to obtain the recommended depth.

Planting soil depths of greater than 4 feet (1.2 meters) may require additional construction practices such as shoring measures (EPA, 1999). Planting soil should be placed in 18 inches or greater lifts and lightly compacted until the desired depth is reached. Since high canopy trees may be destroyed during maintenance the bioretention area should be vegetated to resemble a terrestrial forest community ecosystem that is dominated by understory trees. Three species each of both trees and shrubs are recommended to be planted at a rate of 2500 trees and shrubs per hectare (1000 per acre). For instance, a 15 foot (4.6 meter) by 40 foot (12.2 meter) bioretention area (600 square feet or 55.75 square meters) would require 14 trees and shrubs. The shrub-to-tree ratio should be 2:1 to 3:1.

Trees and shrubs should be planted when conditions are favorable. Vegetation should be watered at the end of each day for fourteen days following its planting. Plant species tolerant of pollutant loads and varying wet and dry conditions should be used in the bioretention area.

The designer should assess aesthetics, site layout, and maintenance requirements when selecting plant species. Adjacent non-native invasive species should be identified and the designer should take measures, such as providing a soil breach to eliminate the threat of these species invading the bioretention area. Regional landscaping manuals should be consulted to ensure that the planting of the bioretention area meets the landscaping requirements established by the local authorities. The designers should evaluate the best placement of vegetation within the bioretention area. Plants should be placed at irregular intervals to replicate a natural forest. Trees should be placed on the perimeter of the area to provide shade and shelter from the wind. Trees and shrubs can be sheltered from damaging flows if they are placed away from the path of the incoming runoff. In cold climates, species that are more tolerant to cold winds, such as evergreens, should be placed in windier areas of the site.

Following placement of the trees and shrubs, the ground cover and/or mulch should be established. Ground cover such as grasses or legumes can be planted at the beginning of the growing season. Mulch should be placed immediately after trees and shrubs are planted. Two to 3 inches (5 to 7.6 cm) of commercially-available fine shredded hardwood mulch or shredded hardwood chips should be applied to the bioretention area to protect from erosion.

## Maintenance

The primary maintenance requirement for bioretention areas is that of inspection and repair or replacement of the treatment area's components. Generally, this involves nothing more than the routine periodic maintenance that is required of any landscaped area. Plants that are appropriate for the site, climatic, and watering conditions should be selected for use in the bioretention cell. Appropriately selected plants will aide in reducing fertilizer, pesticide, water, and overall maintenance requirements. Bioretention system components should blend over time through plant and root growth, organic decomposition, and the development of a natural

soil horizon. These biologic and physical processes over time will lengthen the facility's life span and reduce the need for extensive maintenance.

Routine maintenance should include a biannual health evaluation of the trees and shrubs and subsequent removal of any dead or diseased vegetation (EPA, 1999). Diseased vegetation should be treated as needed using preventative and low-toxic measures to the extent possible. BMPs have the potential to create very attractive habitats for mosquitoes and other vectors because of highly organic, often heavily vegetated areas mixed with shallow water. Routine inspections for areas of standing water within the BMP and corrective measures to restore proper infiltration rates are necessary to prevent creating mosquito and other vector habitat. In addition, bioretention BMPs are susceptible to invasion by aggressive plant species such as cattails, which increase the chances of water standing and subsequent vector production if not routinely maintained.

In order to maintain the treatment area's appearance it may be necessary to prune and weed. Furthermore, mulch replacement is suggested when erosion is evident or when the site begins to look unattractive. Specifically, the entire area may require mulch replacement every two to three years, although spot mulching may be sufficient when there are random void areas. Mulch replacement should be done prior to the start of the wet season.

New Jersey's Department of Environmental Protection states in their bioretention systems standards that accumulated sediment and debris removal (especially at the inflow point) will normally be the primary maintenance function. Other potential tasks include replacement of dead vegetation, soil pH regulation, erosion repair at inflow points, mulch replenishment, unclogging the underdrain, and repairing overflow structures. There is also the possibility that the cation exchange capacity of the soils in the cell will be significantly reduced over time. Depending on pollutant loads, soils may need to be replaced within 5-10 years of construction (LID, 2000).

## Cost

### ***Construction Cost***

Construction cost estimates for a bioretention area are slightly greater than those for the required landscaping for a new development (EPA, 1999). A general rule of thumb (Coffman, 1999) is that residential bioretention areas average about \$3 to \$4 per square foot, depending on soil conditions and the density and types of plants used. Commercial, industrial and institutional site costs can range between \$10 to \$40 per square foot, based on the need for control structures, curbing, storm drains and underdrains.

Retrofitting a site typically costs more, averaging \$6,500 per bioretention area. The higher costs are attributed to the demolition of existing concrete, asphalt, and existing structures and the replacement of fill material with planting soil. The costs of retrofitting a commercial site in Maryland, Kettering Development, with 15 bioretention areas were estimated at \$111,600.

In any bioretention area design, the cost of plants varies substantially and can account for a significant portion of the expenditures. While these cost estimates are slightly greater than those of typical landscaping treatment (due to the increased number of plantings, additional soil excavation, backfill material, use of underdrains etc.), those landscaping expenses that would be required regardless of the bioretention installation should be subtracted when determining the net cost.

Perhaps of most importance, however, the cost savings compared to the use of traditional structural stormwater conveyance systems makes bioretention areas quite attractive financially. For example, the use of bioretention can decrease the cost required for constructing stormwater conveyance systems at a site. A medical office building in Maryland was able to reduce the amount of storm drain pipe that was needed from 800 to 230 feet - a cost savings of \$24,000 (PGDER, 1993). And a new residential development spent a total of approximately \$100,000 using bioretention cells on each lot instead of nearly \$400,000 for the traditional stormwater ponds that were originally planned (Rappahanock, ). Also, in residential areas, stormwater management controls become a part of each property owner's landscape, reducing the public burden to maintain large centralized facilities.

### ***Maintenance Cost***

The operation and maintenance costs for a bioretention facility will be comparable to those of typical landscaping required for a site. Costs beyond the normal landscaping fees will include the cost for testing the soils and may include costs for a sand bed and planting soil.

### **References and Sources of Additional Information**

Coffman, L.S., R. Goo and R. Frederick, 1999: Low impact development: an innovative alternative approach to stormwater management. Proceedings of the 26th Annual Water Resources Planning and Management Conference ASCE, June 6-9, Tempe, Arizona.

Davis, A.P., Shokouhian, M., Sharma, H. and Minami, C., "Laboratory Study of Biological Retention (Bioretention) for Urban Stormwater Management," *Water Environ. Res.*, 73(1), 5-14 (2001).

Davis, A.P., Shokouhian, M., Sharma, H., Minami, C., and Winogradoff, D. "Water Quality Improvement through Bioretention: Lead, Copper, and Zinc," *Water Environ. Res.*, accepted for publication, August 2002.

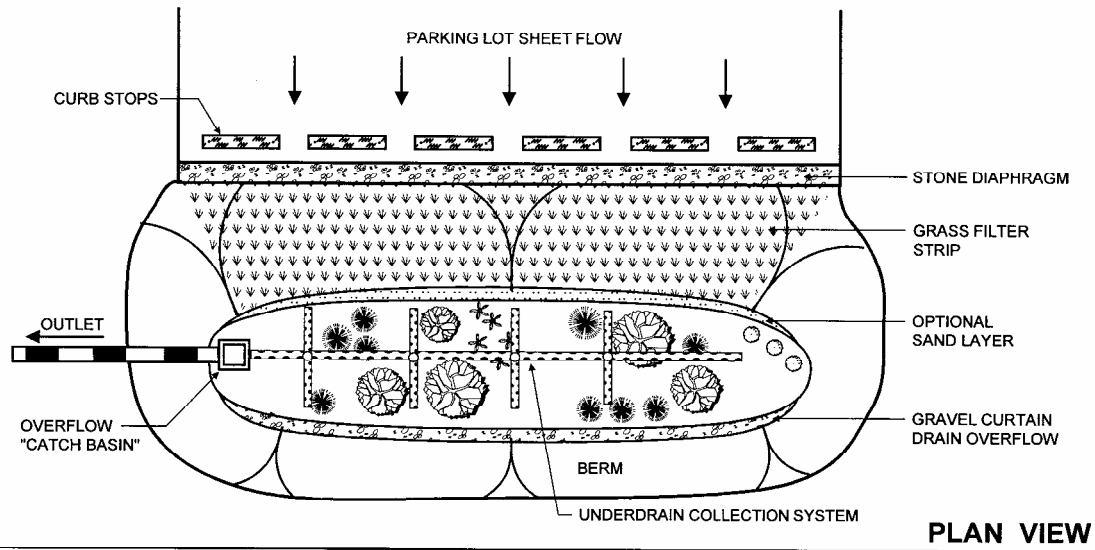
Kim, H., Seagren, E.A., and Davis, A.P., "Engineered Bioretention for Removal of Nitrate from Stormwater Runoff," *WEFTEC 2000 Conference Proceedings on CDROM Research Symposium, Nitrogen Removal*, Session 19, Anaheim CA, October 2000.

Hsieh, C.-h. and Davis, A.P. "Engineering Bioretention for Treatment of Urban Stormwater Runoff," *Watersheds 2002, Proceedings on CDROM Research Symposium*, Session 15, Ft. Lauderdale, FL, Feb. 2002.

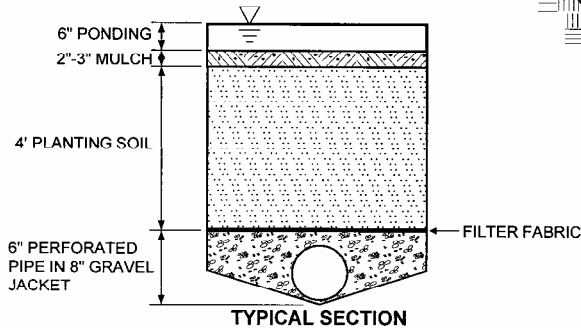
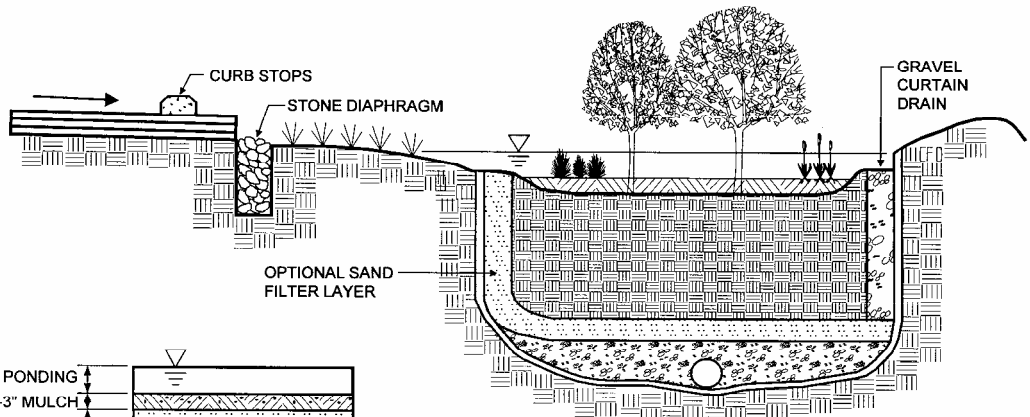
Prince George's County Department of Environmental Resources (PGDER), 1993. Design Manual for Use of *Bioretention in Stormwater Management*. Division of Environmental Management, Watershed Protection Branch. Landover, MD.

U.S. EPA Office of Water, 1999. Stormwater Technology Fact Sheet: Bioretention. EPA 832-F-99-012.

Weinstein, N. Davis, A.P. and Veeramachaneni, R. "Low Impact Development (LID) Stormwater Management Approach for the Control of Diffuse Pollution from Urban Roadways," *5th International Conference Diffuse/Nonpoint Pollution and Watershed Management Proceedings*, C.S. Melching and Emre Alp, Eds. 2001 International Water Association



PLAN VIEW



TYPICAL SECTION

PROFILE

Schematic of a Bioretention Facility (MDE, 2000)