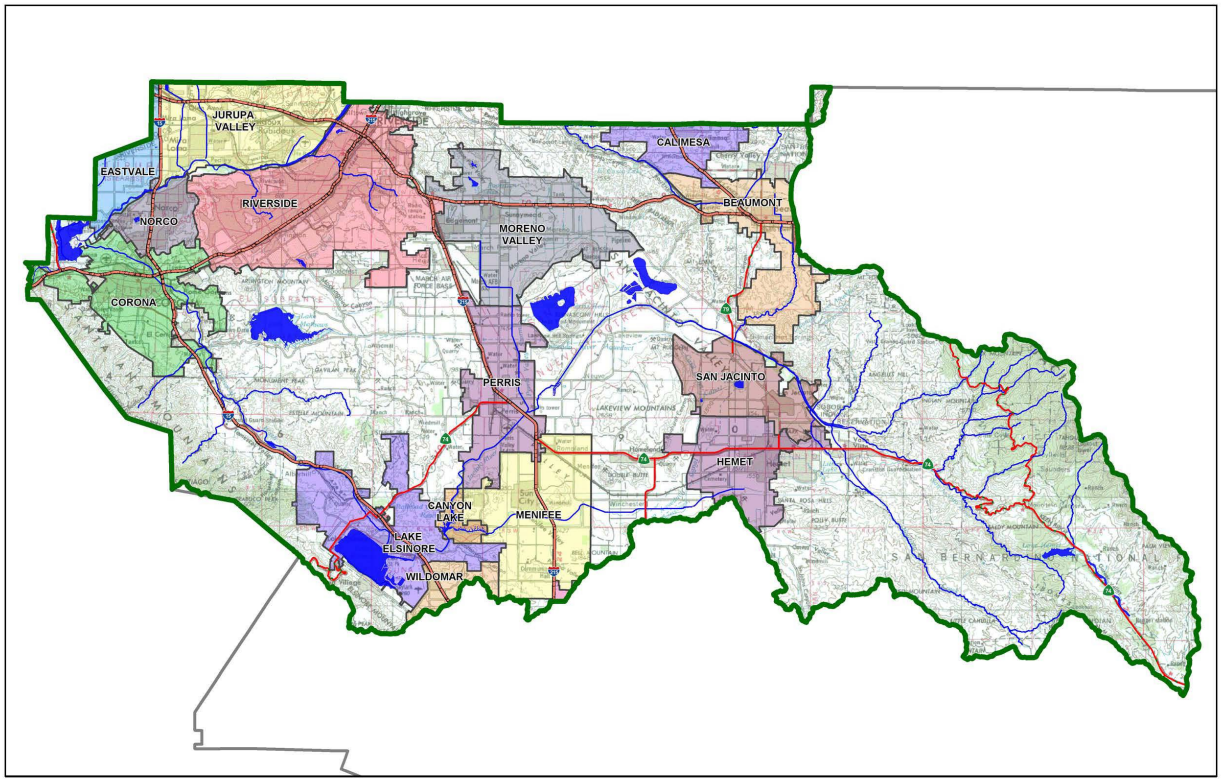
Project Specific Water Quality Management Plan

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

Project Title: Arroyo Vista

Development No:

Design Review/Case No: TTM38510



☒ **Preliminary**
☐ **Final**

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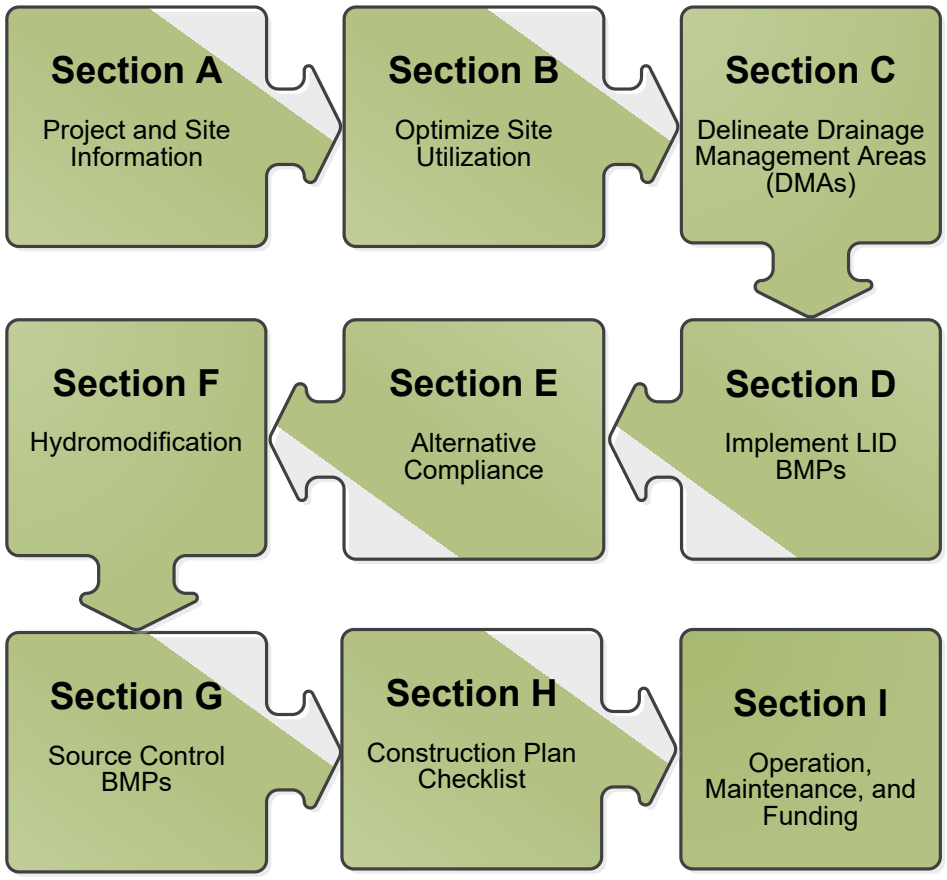
A Brief Introduction

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 TTLC Riverside Chicago by Rick Engineering Company for the Chicago Ave. project.

This WQMP is intended to comply with the requirements of unincorporated Riverside County ORDER NO. R8-2010-0033 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 unincorporated Riverside County= Water Quality Ordinance (Municipal Code Section ORDER NO. R8-2010-0033).

"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	May 13, 2024 Date
Brendan Hastie Preparer's Printed Name	Principal Preparer's Title/Position

Preparer's Licensure:

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Section A: Project and Site Information

This WQMP presents preliminary DMA and BMP analyses for the proposed Chicago Ave. project (herein referred to as "the project"). The approximately 148-acre Specific Plan site consists of single-family residential homes on lots sized 11,000 square feet to one acre. The project site has 3 BMPs. Two are centrally located and one is in the northwest corner of the project site. Refer to Appendix 1 for a Vicinity Map of the project.

PROJECT INFORMATION	
Type of Project: Single Family Residential	
Planning Area: Chicago and Iris Ave.	
Community Name:	
Development Name: TTM38510	
PROJECT LOCATION	
Latitude & Longitude (DMS): 33°53'29.26"N 117°21'3.80"W	
Project Watershed and Sub-Watershed: Santa Ana, Arlington	
Gross Acres: 148	
APN(s): 245300001, 245300004	
Map Book and Page No.: Thomas Bros. pg. 746	
PROJECT CHARACTERISTICS	
Proposed or Potential Land Use(s)	R-1, RC
Proposed or Potential SIC Code(s)	13000,10500,8500,7000
Area of Impervious Project Footprint (SF)	2,973,250
Total Area of proposed Impervious Surfaces within the Project Footprint (SF)/or Replacement	2,973,250
Does the project consist of offsite road improvements?	☒ Y ☐ N
Does the project propose to construct unpaved roads?	☐ Y ☒ N
Is the project part of a larger common plan of development (phased project)?	☐ Y ☒ N
EXISTING SITE CHARACTERISTICS	
Total area of existing Impervious Surfaces within the Project limits Footprint (SF)	0
Is the project located within any MSHCP Criteria Cell?	☐ Y ☒ N
If so, identify the Cell number:	N/A
Are there any natural hydrologic features on the project site?	☒ Y ☐ N
Is a Geotechnical Report attached?	☒ Y ☐ N
If no Geotech. Report, list the NRCS soils type(s) present on the site (A, B, C and/or D)	B,C,D
What is the Water Quality Design Storm Depth for the project?	.53"

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
Goldenstar Creek	Indicator Bacteria	REC1	Approximately 0 miles from site
Local Drainage to Riverside Canal			Approximately 2 miles from site
Riverside Canal			Approximately 5 miles from site
Temescal Creek Reach 1	PH, Acidity, Caustic Conditions	REC1,REC2,WARM,WILD	Approximately 14 miles from site
Santa Ana River Reach 3	Lead, Copper, Pathogens	AGR,GWR,REC1,REC2,WARM,WILD,RARE,SPWN	Approximately 16 miles from site A RARE water body.
Santa Ana River Reach 2	Pathogens	AGR,GWR,REC1,REC2,WARM,WILD,RARE	Approximately 34 miles from site A RARE water body.
Santa Ana River Reach 1		Intermittent Beneficial Use; WARM,WILD Present Beneficial Use; Rec1,Rec2,	Approximately 41 miles from site
Pacific Ocean		IND,NAV,REC1,REC2,COMM,FIOL,WILD,RARE,SPWN,MAR,SHEL	Approximately 44 miles from site A RARE water body.

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

Table A.2 Other Applicable Permits

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

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?

Existing drainage patterns have been identified and will generally remain the same in the post project condition.

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

A large portion of the project site is to remain undeveloped, so existing vegetation in these areas will be left undisturbed.

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

A large portion of the project site is to remain undeveloped, and natural infiltration will be preserved in these areas.

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

A large portion of the project site is to remain undeveloped, minimizing overall impervious areas within the project boundary.

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

Multiple areas of the project site have been identified and are to remain undeveloped allowing for natural infiltration. It is anticipated that runoff from the future homes will be dispersed on surrounding pervious landscaping prior to collection by the proposed storm drain system.

Section C: Delineate Drainage Management Areas (DMAs)

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

Table C.1 DMA Classifications

DMA Name or ID	Surface Type(s)[1][2]	Area (Sq. Ft.)	DMA Type
DMA 1.1	DETACHED RESIDENTIAL	906,955	D
DMA 1.2	ROAD SURFACE/SIDEWALK	342,254	D
DMA 1.3	ORNAMENTAL LANDSCAPING	23,248	D
DMA 1.4	BMP WQ SURFACE	17,683	D
DMA 1.5	VEGETATED SLOPE	25,822	A
DMA 1.6	DECOMPOSED GRANITE	26,509	A
DMA 2.1	DETACHED RESIDENTIAL	642,705	D
DMA 2.2	ROAD SURFACE/SIDEWALK	186,243	D
DMA 2.3	ORNAMENTAL LANDSCAPING	60,152	D
DMA 2.4	BMP WQ SURFACE	14,541	D
DMA 2.5	VEGETATED SLOPE	13,789	A
DMA 3.1	DETACHED RESIDENTIAL	1,749,449	D
DMA 3.2	ROAD SURFACE/SIDEWALK	547,759	D
DMA 3.3	ORNAMENTAL LANDSCAPING	103,694	D
DMA 3.4	BMP WQ SURFACE	30,760	D
DMA 3.5	VEGETATED SLOPE	469,592	A
DMA 3.6.1	DECOMPOSED GRANITE	26,135	A
DMA 3.6.2	DECOMPOSED GRANITE	1,967	D

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

[2]If multi-surface provide back-up

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

DMA Name or ID	Area (Sq. Ft.)	Stabilization Type	Irrigation Type (if any)
DMA 1.5	25,822	Vegetated Slope	
DMA 1.6	26,509	Decomposed Granite	
DMA 2.5	13,789	Vegetated Slope	
DMA 3.5	469,592	Vegetated Slope	
DMA 3.6.1	26,135	Decomposed Granite	
DMA 3.6.2	13789	Decomposed Granite	

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

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

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

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			
	[A]		[B]	[C] = [A] x [B]	DMA name /ID	[D]	[C]/[D]

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

DMA Name or ID	BMP Name or ID
DMA 1.1	BMP 1
DMA 1.2	BMP 1
DMA 1.3	BMP 1
DMA 1.4	BMP 1
DMA 2.1	BMP 2
DMA 2.2	BMP 2
DMA 2.3	BMP 2
DMA 2.4	BMP 2
DMA 3.1	BMP 3
DMA 3.2	BMP 3
DMA 3.3	BMP 3
DMA 3.4	BMP 3
DMA 3.6.2	BMP 3

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

Section D: Implement LID BMPs

D.1 Infiltration Applicability

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

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

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

Geotechnical Report

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

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

Infiltration Feasibility

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

Table D.1 Infiltration Feasibility

Does the project site…	YES	NO
…have any DMAs with a seasonal high groundwater mark shallower than 10 feet?	X	
If Yes, list affected DMAs:	DMA 1	
…have any DMAs located within 100 feet of a water supply well?		X
If Yes, list affected DMAs:		
…have any areas identified by the geotechnical report as posing a public safety risk where infiltration of stormwater could have a negative impact?		X
If Yes, list affected DMAs:		
…have measured in-situ infiltration rates of less than 1.6 inches / hour?	X SEE NOTE	
If Yes, list affected DMAs: DMAs 1, 2, & 3		
…have significant cut and/or fill conditions that would preclude in-situ testing of infiltration rates at the final infiltration surface?		X
If Yes, list affected DMAs:		
…geotechnical report identify other site-specific factors that would preclude effective and safe infiltration?		X
Describe here:		

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

Note: Infiltration testing has not yet been performed for the project. Due to the proximity of water quality basins to shallow rock features, and the fact that there are no Hydrologic Type 'A' soils in thew project area, infiltration is not anticipated to be feasible.

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: ~17.4

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

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

Total Area of Impervious Surfaces: 69.4 acres

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

Enter your EIATIA factor: .39

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: 27.1

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

Minimum required irrigated area (Step 4)	Available Irrigated Landscape (Step 1)
27.1	~17.4

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: ~592 (148 houses*4 people/household)*

Project Type: Residential

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

Total Area of Impervious Surfaces: 69.4

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

Enter your TUTIA factor: 89

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: 6177

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)**
6177	~592

Other Non-Potable Use Feasibility

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

N/A

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

Average Daily Demand: Projected Average Daily Use (gpd)

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

Total Area of Impervious Surfaces: Insert Area (Acres)

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

Enter the factor from Table 2-4: 825

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

Minimum required use: Minimum use required (gpd)

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

Minimum required non-potable use (Step 4)	**Projected average daily use (Step 1)**
Minimum use required (gpd)	Projected Average Daily Use (gpd)

If Irrigation, Toilet and Other Use feasibility anticipated demands are less than the applicable minimum values, Harvest and Use BMPs are not required and you should proceed to utilize LID Bioretention and Biotreatment per Section 3.4.2 of the 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	
DMA 1	☐	☐	☒	☐	☐
DMA 2	☐	☐	☒	☐	☐
DMA 3	☐	☐	☒	☐	☐
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐

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

Insert narrative description here.

D.5 LID BMP Sizing

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.3.1 DCV Calculations for LID BMPs

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Enter BMP Name / Identifier Here* **BMP 1**		
	[A]		[B][1]	[C]	[A] x [C]			
DMA 1.1	906,955	Mixed Surface Types	0.55	*.37*	*337,840.5*			
DMA 1.2	342,254	Concrete or Asphalt	1	*.89*	*305,290.6*			
DMA 1.3	23,248	Ornamental Landscaping	0.1	*.37*	*2,567.9*	*Design Storm Depth (in)*	*Design Capture Volume,* V_{BMP} *(cubic feet)*	*Proposed Volume on Plans (cubic feet)*
DMA 1.4	17,683	BMP WQ Surface	1	*.89*	*15,773.2*			
	A_T = Σ[A] 1,290,140				*Σ= [D] 661,472*	*[E] .53*	*[F] = ([D]x[E])/12 29,215*	*[G] 136,562*

[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

Note 1. Effective fraction for mixed type surfaces was calculated from plate D5.6 of the Riverside County Hydrology Manual, dated April 1978, using the most conservative recommended value for impervious cover for single family residential housing. Plate D5.6 has been provided for reference in Appendix 6.

Table D.4.2 DCV Calculations for LID BMPs

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Enter BMP Name / Identifier Here* **BMP 2**		
	[A]		[B][1]	[C]	[A] x [C]			
DMA 2.1	642,705	Mixed Surface Types	0.55	*.37*	*239,407.5*	*Design Storm Depth*	*Design Capture Volume,*	*Proposed Volume on Plans*

DMA 2.2	186,243	Concrete or Asphalt	1	*.89*	*166,128.8*	*(in)*	**V_{BMP}** *(cubic feet)*	*(cubic feet)*
DMA 2.3	60,152	Ornamental Landscaping	0.1	*.11*	*6,644.3*			
DMA 2.4	14,541	BMP WQ Surface	1	*.89*	12,970.6			
	A_T = Σ[A] 903,641				*Σ= [D] 45151.2*	*[E] .53*	*[F] = ([D]x[E])/12 18,777.5*	*[G] 114,440*

[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

Note 1. Effective fraction for mixed type surfaces was calculated from plate D5.6 of the Riverside County Hydrology Manual, dated April 1978, using the most conservative recommended value for impervious cover for single family residential housing.

Table D.5.3 DCV Calculations for LID BMPs

DMA Type/ID	**DMA Area (square feet)**	**Post-Project Surface Type**	**Effective Impervious Fraction, I_f**	**DMA Runoff Factor**	**DMA Areas x Runoff Factor**	***Enter BMP Name / Identifier Here*** ***BMP 2***		
	[A]		[B][1]	[C]	[A] x [C]			
DMA 3.1	1,749,449	Mixed Surface Types	0.55	*.37*	*651,669.3*			
DMA 3.2	547,759	Concrete or Asphalt	1	*.89*	*488,601*			
DMA 3.3	103,694	Ornamental Landscaping	0.1	*.11*	*11,453.8*			
DMA 3.4	30,760	BMP WQ Surface	1	*.89*	27,437.9	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
DMA 3.6.1	1,967	Decomposed Granite	0.4	*.28*	550.2			
	A_T = Σ[A] 2433629				*Σ= [D] 1,179,712.2*	*[E] .53*	*[F] = ([D]x[E])/12 52,104*	*[G] 221,195*

[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

Note 1. Effective fraction for mixed type surfaces was calculated from plate D5.6 of the Riverside County Hydrology Manual, dated April 1978, using the most conservative recommended value for impervious cover for single family residential housing.

Section E: Alternative Compliance (LID Waiver Program)

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

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

- *Or* -

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

E.1 Identify Pollutants of Concern

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

Table E.1 Potential Pollutants by Land Use Type

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

P = Potential

N = Not Potential

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

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

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

(4) Specifically petroleum hydrocarbons

(5) Specifically solvents

(6) Bacterial indicators are routinely detected in pavement runoff

E.2 Stormwater Credits

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

Table E.2 Water Quality Credits

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

[1]*Cannot Exceed 50%*
[2]*Obtain corresponding data from Table 3-8 in the WQMP Guidance Document*

E.3 Sizing Criteria

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

Table E.3 Treatment Control BMP Sizing

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

[B], [C] is obtained as described in Section 2.3.1 from the WQMP Guidance Document
[E] is for Flow-Based Treatment Control BMPs [E] = .2, for Volume-Based Control Treatment BMPs, [E] obtained from Exhibit A in the WQMP Guidance Document
[G] is for Flow-Based Treatment Control BMPs [G] = 43,560, for Volume-Based Control Treatment BMPs, [G] = 12
[H] is from the Total Credit Percentage as Calculated from Table E.2 above
[I] as obtained from a design procedure sheet from the BMP manufacturer and should be included in Appendix 6

E.4 Treatment Control BMP Selection

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

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

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

Table E.4 Treatment Control BMP Selection

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

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

[2] Cross Reference Table E.1 above to populate this column.

[3] As documented in a Co-Permittee Approved Study and provided in Appendix 6.

Section F: Hydromodification

F.1 Hydrologic Conditions of Concern (HCOC) Analysis

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

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

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

If Yes, HCOC criteria do not apply.

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

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

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

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

Table F.1 Hydrologic Conditions of Concern Summary

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

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

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

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

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

INSERT TEXT HERE

F.2 HCOC Mitigation

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

a. Additional LID BMPS are implemented onsite or offsite to mitigate potential erosion or habitat impacts as a result of HCOCs. This can be conducted by an evaluation of site-specific conditions utilizing accepted professional methodologies published by entities such as the California Stormwater Quality Association (CASQA), the Southern California Coastal Water Research Project (SCCRWP), or other Co-Permittee approved methodologies for site-specific HCOC analysis.

b. The project is developed consistent with an approved Watershed Action Plan that addresses HCOC in Receiving Waters.

c. Mimicking the pre-development hydrograph with the post-development hydrograph, for a 2-year return frequency storm. Generally, the hydrologic conditions of concern are not significant, if the post-development hydrograph is no more than 10% greater than pre-development hydrograph. In cases where excess volume cannot be infiltrated or captured and reused, discharge from the site must be limited to a flow rate no greater than 110% of the pre-development 2-year peak flow.

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

Hydromodification analysis supporting item C is provided with 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: Riverside County CFD

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

R 07 W R 06 W R 05 W R 04 W R 03 W R 02 W R 01 W R 01 E R 02 E R 03 E R 04 E R 05 E

T 01 S
T 02 S
T 03 S
T 04 S
T 05 S
T 06 S
T 07 S
T 08 S

Approximate Chicago Ave. Site location ~.53

0.85 MiraLoma
0.61 RiversideNorth
0.54 RiversideSouth
0.88 PradoDam
0.51 Woodcrest
0.50 LakeMathews
0.68 PigeonPass
0.66 MorenoEast
0.68 PerrisReservoir
0.85 Beaumont
0.70 SanJacintoNWS
0.87 VistaGrandeGS
1.18 Idyllwild
0.90 HurkeyCreek
0.58 SunCity
0.68 Winchester
0.70 ElsinoreNWS
1.11 ElCarisoStation
0.77 WildomarLaCresta
0.52 SkinnerLake
0.77 SantaRosaPlateau
1.00 TemeculaNWS
0.64 AguangaValley
0.65 Anza

Santa Ana River Watershed
Santa Margarita Watershed

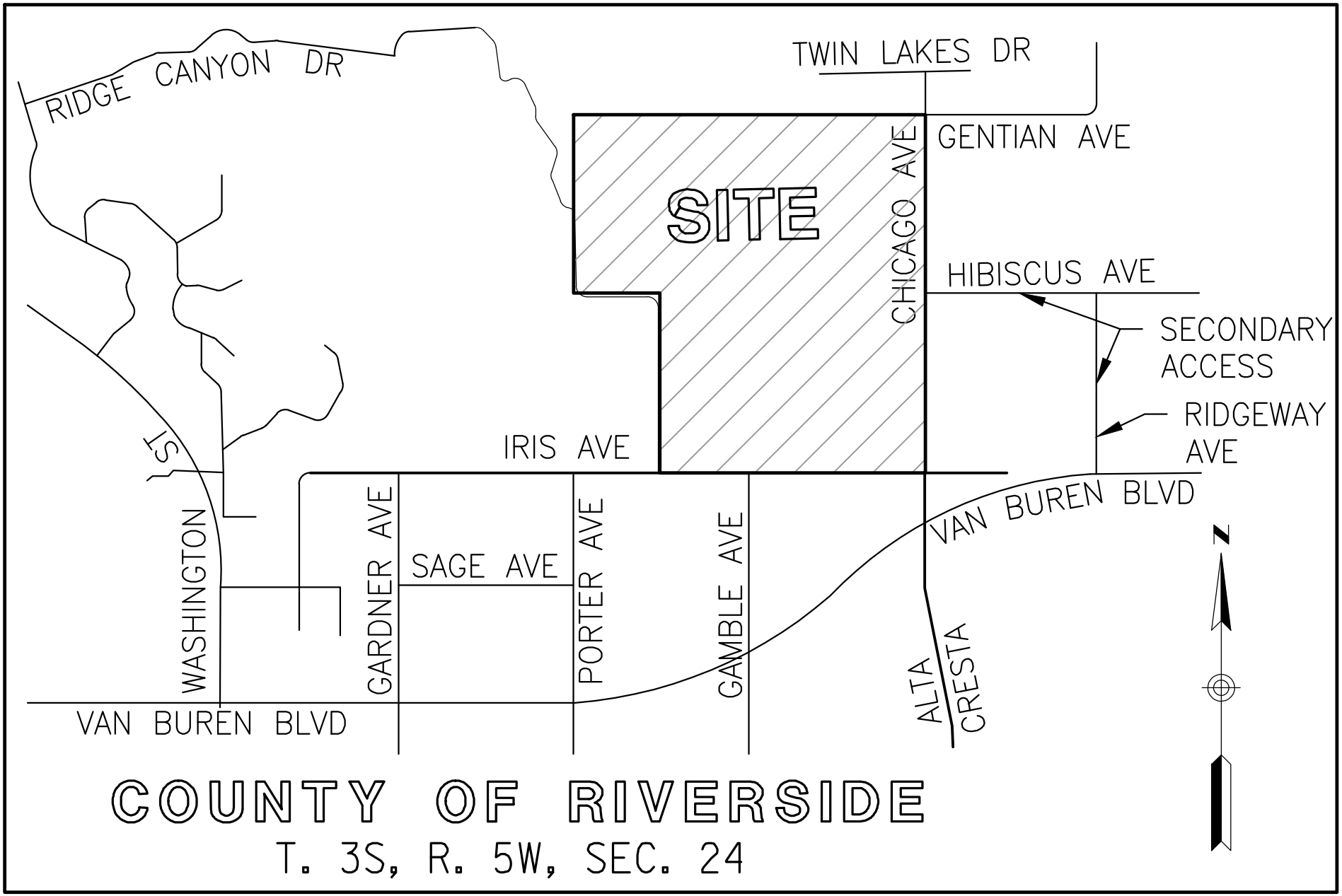
JURUPA VALLEY, EASTVALE, NORCO, CORONA, RIVERSIDE, MORENO VALLEY, CALIMESA, BEAUMONT, SAN JACINTO, PERRIS, HEMET, CANYON LAKE, LAKE ELSINORE, WILDOMAR, MENIFEE, MURRIETA, TEMECULA

Rain Gage Locations

RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

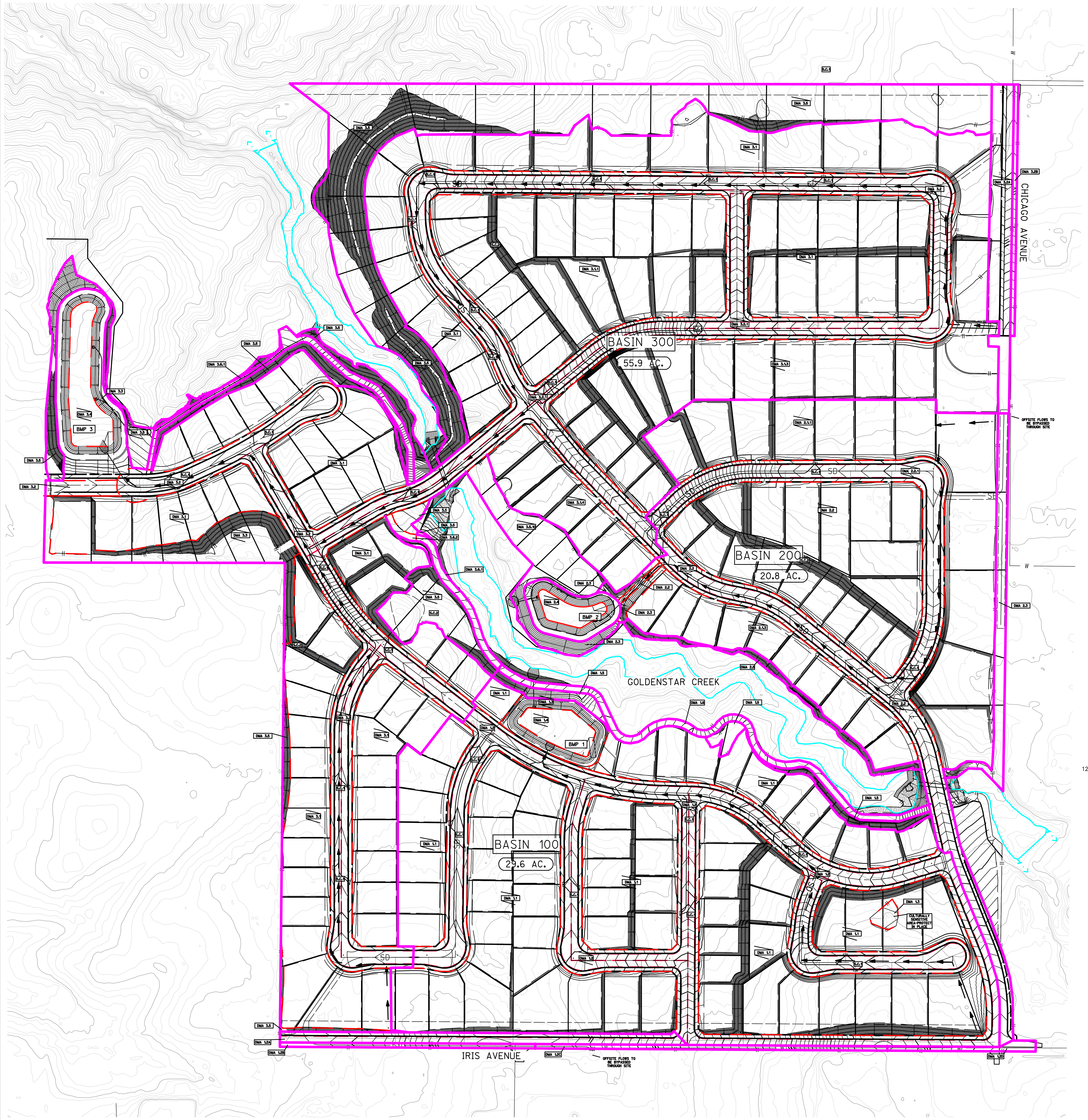
Isohyetal Map for the 85th Percentile 24 hour Storm Event

July 2011



Vicinity Map

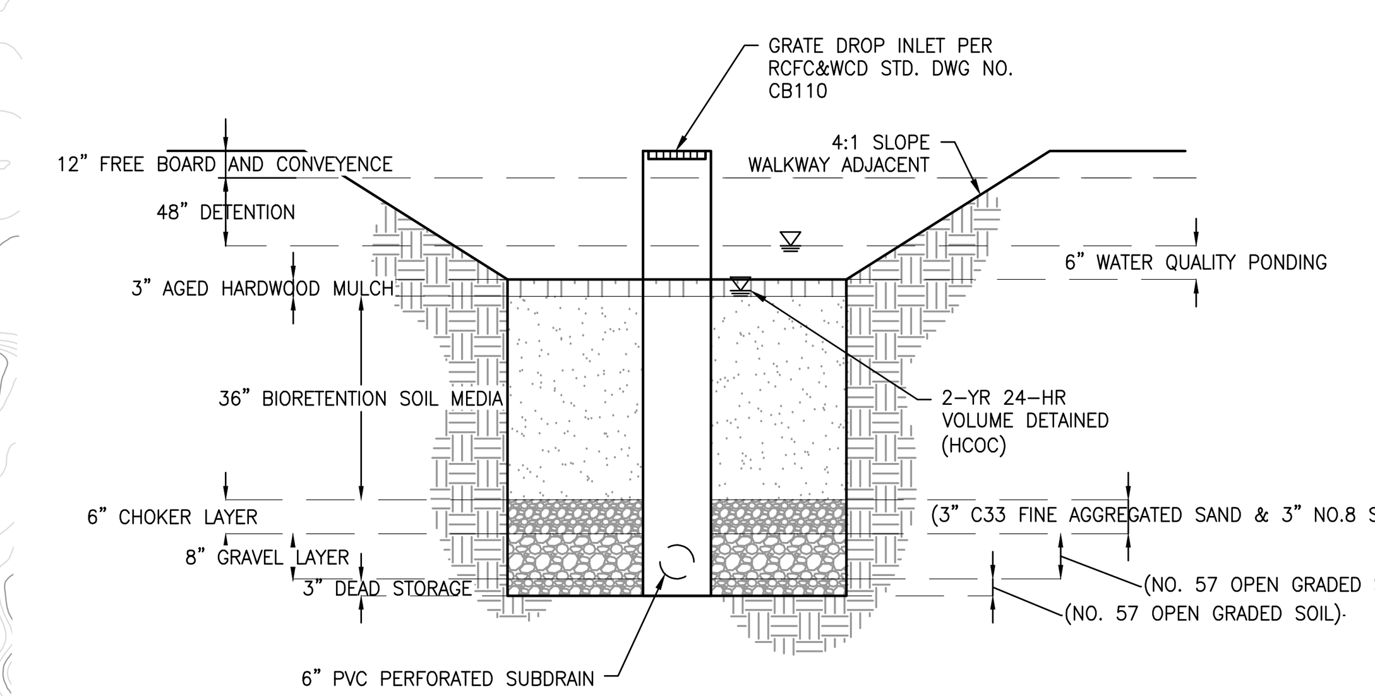
Not to scale



SOURCE CONTROL ID (S.C.)	SOURCE CONTROL
S.C. 1	ON-SITE STORM DRAIN INLETS
S.C. 2	LANDSCAPE/OUTDOOR PESTCIDE USE

DMA	AREA (SF)	AREA (AC)	LANDUSE/SURFACE TYPES	%IMPERVIOUS	IMPERVIOUS AREA DRAINING TO BMP (SF)	IMPERVIOUS AREA DRAINING TO BMP (AC)	PERVIOUS AREA DRAINING TO BMP (SF)	PERVIOUS AREA DRAINING TO BMP (AC)	AREA DRAINING TO BMP (AC)
1.1	906,955	20.8	DETACHED RESIDENTIAL	55%	498,825	11.5	408,130	9.4	20.8
1.2	342,254	7.9	ROAD SURFACE/SIDEWALK	100%	342,254	7.9	0	0.0	7.9
1.3	23,248	0.5	ORNAMENTAL LANDSCAPING	10%	2,325	0.1	20,923	0.5	0.5
1.4	17,683	0.4	BMP WQ	100%	17,683	0.4	0	0	0.4
1.5	25,822	0.6	VEGETATED SLOPE	SELF-TREATING	-	-	-	-	-
1.6	26,509	0.6	DECOMPOSED GRANITE	SELF-TREATING	-	-	-	-	-
DMA 1 TOTALS	1,342,471	30.8	-	64%	861,087	19.8	429,053	9.8	29.6
2.1	642,705	14.8	DETACHED RESIDENTIAL	55%	353,488	8.1	289,217	6.6	14.8
2.2	186,243	4.3	ROAD SURFACE/SIDEWALK	100%	186,243	4.3	0	0.0	4.3
2.3	60,152	1.4	ORNAMENTAL LANDSCAPING	10%	6,015	0.1	54,137	1.2	1.4
2.4	14,541	0.3	BMP WQ	100%	14,541	0.3	0	0.0	0.3
2.5	13,789	0.3	VEGETATED SLOPE	SELF-TREATING	-	-	-	-	-
DMA 2 TOTALS	917,430	21.1	-	61%	560,287	12.9	343,354	7.9	20.8
3.1	1,749,449	40.2	DETACHED RESIDENTIAL	55%	962,197	22.1	787,252	18.1	40.2
3.2	547,759	12.6	ROAD SURFACE/SIDEWALK	100%	547,759	12.6	0	0.0	12.6
3.3	103,694	2.4	ORNAMENTAL LANDSCAPING	10%	10,369	0.2	93,325	2.1	2.4
3.4	30,760	0.7	BMP WQ SURFACE	100%	30,760	0.7	0	0.0	0.7
3.5	469,592	10.8	VEGETATED SLOPE	SELF-TREATING	-	-	-	-	-
3.6.1	26,135	0.6	DECOMPOSED GRANITE	SELF-TREATING	-	-	-	-	-
3.6.2	1,967	0.0	DECOMPOSED GRANITE	40%	787	0.0	1,180	0.0	0.0
DMA 3 TOTALS	2,929,356	67.2	-	53%	1,551,872	35.6	881,757	20.2	55.9
TOTALS =	5,189,257	119.1	-	57%	2,973,246	68.3	1,654,164	38.0	106.3

TYPICAL BMP SECTION
(REFER TO SHEET 4 OF TTM FOR LOCATION SPECIFIC SECTIONS)



BIORETENTION BASIN DETAIL
N.T.S.

NOTES

1. GOLDENSTAR CREEK AND ADJACENT SLOPES ARE CONSIDERED SELF-TREATING AREA.
2. IRIS AVENUE STREET IMPROVEMENTS INCLUDING DMA 1.2A, 1.2B, 1.2C, AND 1.2D DO NOT DRAIN TO BMP 1. HOWEVER, BMP 1 HAS BEEN SIZED FOR ADDITIONAL AREA EQUAL TO THE DMA 1.2A, 1.2B, 1.2C, AND 1.2D AREA PER DISCUSSION WITH COUNTY OF RIVERSIDE ON APRIL 6, 2023.
3. CHICAGO AVENUE STREET IMPROVEMENTS INCLUDING DMA 3.2A AND 3.2B DO NOT DRAIN TO BMP 3. HOWEVER, BMP 3 HAS BEEN SIZED FOR ADDITIONAL AREA EQUAL TO THE DMA 3.2A, AND 3.2B AREA PER DISCUSSION WITH COUNTY OF RIVERSIDE ON APRIL 6, 2023.
4. THIS SITE PLAN IS PRELIMINARY IN NATURE. FINAL DESIGN ELEMENTS OF BASIN SUCH AS OVERFLOWS, FENCING, ETC. TO BE INCLUDED WITH THE FINAL DESIGN EFFORT. EXCESS TREATMENT AREA AND VOLUME IS PROVIDED IN THE PROPOSED BMPS TO ACCOMMODATE MINOR CHANGES FOR SETBACKS AND RAMPS WITH THE FINAL DESIGN EFFORT IF NECESSARY.

LEGEND

BASIN ID	BASIN 200
MAJOR DMA BOUNDARY	
MINOR DMA BOUNDARY	
DMA AREA	5.6 AC.
DMA LABEL	DMA 2.1
BMP LABEL	BMP 2
PROPOSED 100-YEAR WATER SURFACE ELEVATION	
FLOWPATH	

150 75 0 150 300 450
GRAPHIC SCALE: 1"=150'

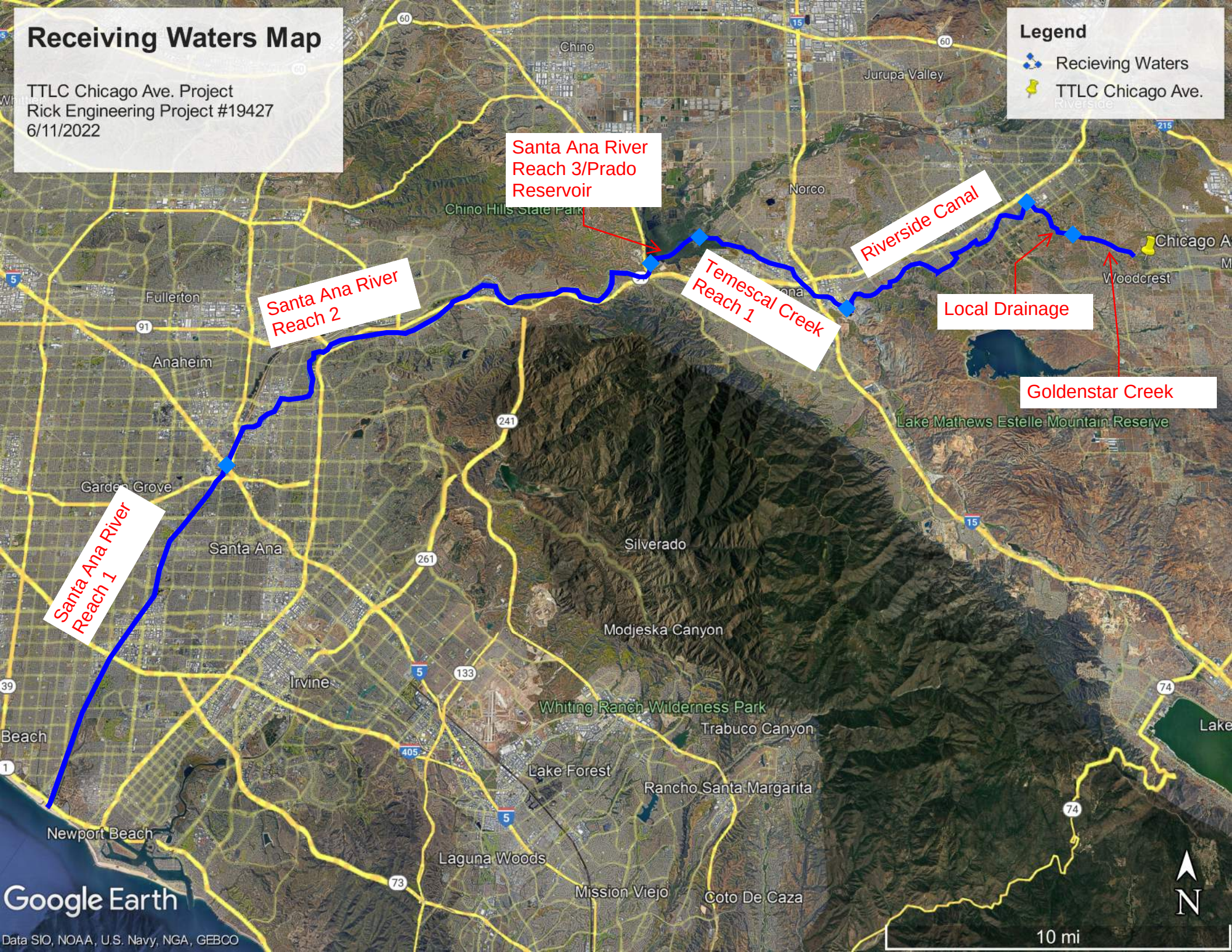
RICK ENGINEERING COMPANY
1770 IOWA AVE, SUITE 100
RIVERSIDE, CA 92507
951.782.0707
rickengineering.com

WATER QUALITY MANAGEMENT PLAN
EXHIBIT FOR
ARROYO VISTA
TTM 38510
PRELIMINARY ENGINEERING

SHEET 1 OF 1
J-19427

DATE: 07/11/2022
REVISED: 12/23/2023
REVISED: 05/08/2024

NOT FOR CONSTRUCTION – EXHIBIT FOR WATER QUALITY MANAGEMENT PLAN REPORT ONLY


Receiving Waters Map
TTLC Chicago Ave. Project
Rick Engineering Project #19427
6/11/2022
Legend
Recieving Waters
TTLC Chicago Ave.
Santa Ana River Reach 3/Prado Reservoir
Riverside Canal
Temescal Creek Reach 1
Santa Ana River Reach 2
Local Drainage
Goldenstar Creek
Santa Ana River Reach 1
Chino
Jurupa Valley
Norco
Chino Hills State Park
Chicago A
Woodcrest
Fullerton
Anaheim
Lake Mathews Estelle Mountain Reserve
Garden Grove
Santa Ana
Silverado
Modjeska Canyon
Irvine
Whiting Ranch Wilderness Park
Trabuco Canyon
Lake Forest
Rancho Santa Margarita
Newport Beach
Laguna Woods
Mission Viejo
Coto De Caza
Google Earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
N
10 mi

Appendix 2: Construction Plans

Grading and Drainage Plans

Appendix 3: Soils Information

Geotechnical Study and Other Infiltration Testing Data

UPDATED GEOTECHNICAL EVALUATION
PROPOSED SINGLE-FAMILY RESIDENTIAL DEVELOPMENT
APNS 245-300-001 AND -004
NORTHWEST OF IRIS AVENUE AND CHICAGO AVENUE
WOODCREST AREA OF RIVERSIDE COUNTY, CALIFORNIA

PREPARED FOR

TTLC MANAGEMENT, INC., AN ARIZONA CORPORATION
2942 CENTURY PLACE, SUITE 121
COSTA MESA, CALIFORNIA 92626

PREPARED BY

GEOTEK, INC.
1548 NORTH MAPLE STREET
CORONA, CALIFORNIA 92878

PROJECT NO. 2855-CR **SEPTEMBER 21, 2021**

GEOTEK

GeoTek, Inc.
1548 North Maple Street, Corona, California 92878
(951) 710-1160 Office (951) 710-1167 Fax www.geotekusa.com

September 21, 2021
Project No. 2855-CR

TTLC Management, Inc., an Arizona Corporation
2942 Century Place, Suite 121
Costa Mesa, California 92626

Attention: Mr. Michael Torres

Subject: Updated Geotechnical Evaluation
Proposed Single-Family Residential Development
APN 245-300-001 and -004
Northwest of Iris Avenue and Chicago Avenue
Woodcrest Area of Riverside County, California

Dear Mr. Torres:

GeoTek, Inc. (GeoTek) is pleased to provide the results of this updated geotechnical evaluation for the subject project located north of Iris Avenue and west of Chicago Avenue, in the Woodcrest area of Riverside County, California. This report presents the results of GeoTek's evaluation and discussion of findings.

Based upon review, it is GeoTek's opinion that site development appears feasible from a geotechnical viewpoint. Final site development and grading plans should be reviewed by this firm as they become available, as it will be necessary to provide appropriate recommendations for intended specific site development as those plans become refined.

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

Respectfully submitted,
GeoTek, Inc.

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1. PURPOSE AND SCOPE OF SERVICES

The purpose of this study was to evaluate the general geotechnical conditions on the site and provide updated geotechnical recommendations as deemed appropriate. Services for this study included the following:

- Research and review of available geologic and geotechnical data, and past reports pertinent to the site,
- Perform a reconnaissance of the site,
- Excavation of eleven (11) exploratory trenches to assess the general subsurface soil and bedrock conditions and rock hardness at the property,
- A seismic refraction survey, performed by a subconsultant, to further evaluate rock excavatability,
- Collection of bulk samples of the onsite materials for laboratory testing,
- Laboratory testing,
- Review and evaluation of site seismicity, and
- Compilation of this updated geotechnical evaluation report which presents GeoTek's findings, conclusions, and recommendations for the 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 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 project site consists of two parcels of land identified as Riverside County Assessor's Parcel Numbers (APNs) 245-300-001 (119.0-acres) and 245-300-001 (19.99-acres) (See Figure 1). The site is located at the northwest corner of Iris Avenue and Chicago Avenue, in the Woodcrest area of Riverside County, California. The majority of the property is currently

gently-rolling vacant land that was previously utilized as an agricultural orchard. The orchard trees, including visible tree stumps, appeared to have been removed at the time of the field exploration. In addition, there currently is a single-family residence and three outbuildings in the east-central portion of the site. The northwest portion of the subject site is hillside terrain that is currently vacant and does not appear to have been utilized as an agricultural orchard.

There is an existing incised drainage course trending southeast to northwest that meanders through the central portion of the site. Furthermore, several granitic bedrock outcrops were visible throughout the central and northwest portions of the property.

The subject site is bounded by residential development and vacant land to the north; Chicago Avenue, followed by residential development to the east; Iris Avenue, followed by residential development to the south; and vacant land to the west.

2.2 PROPOSED DEVELOPMENT

The *Master Plan*, prepared by Urban Arena and dated August 10, 2021 ("Chicago 139"), indicates that the site development will consist of the construction of 276 single-family residences, a neighborhood park, open spaces, interior streets, and underground utilities. In addition, a pedestrian bridge over the drainage course and multi-purposes trails are proposed. The existing drainage channel will remain undeveloped and will act as a natural drainage course (see Figure 2).

It is anticipated that the residential structures will be one and/or two stories in height utilizing conventional shallow footings with slab-on-grade. Sewage disposal is to be by a public sewer system.

The inclusion and/or location of water quality basins are not known at this time. As such, infiltration testing was not included in this evaluation.

If site development differs from the assumptions made herein, the recommendations included in this report should be subject to further review and evaluation. Final site development plans should be reviewed by GeoTek when they become available. Additional geotechnical field exploration, analyses, and recommendations may be necessary upon review of site development plans.

3. REPORT REVIEW

On April 27, 2015, Earth-Strata, Inc. (Earth-Strata) issued a *Revised Preliminary Geotechnical Interpretive Report* (Earth-Strata, 2015a) for a portion of the subject site. Earth-Strata's report pertained exclusively to APN 245-300-001 (See Figure 1). Earth-Strata's subsurface investigation consisted of the excavation of eight (8) hollow-stem auger borings to a maximum depth of 10 feet. Additionally, a backhoe was utilized to excavate 18 test pits to a maximum depth of 6 feet throughout the development areas. Earth-Strata indicated that their explorations encountered "surficial" deposits (topsoil), quaternary-age alluvium and Cretaceous-age Tonalite bedrock of the Val Verde Formation within the proposed site development area. The alluvium was encountered to the maximum depth explored and generally consisted of silty sand (SM soil type based upon the Unified Soil Classification System). The tonalite bedrock was generally found to be moderately hard to very hard and typically weathered in the upper 1 to 4 feet.

Earth-Strata concluded that there are no known faults that project through the site and the site is not located within an Alquist-Priolo Earthquake Fault Zone. No landslides were identified on the site by Earth-Strata.

Earth-Strata concluded that the subject property is considered suitable for the proposed development and offered numerous earthwork recommendations. The consultant stated that the near surface earth materials except in areas of rock outcrops will be readily excavated with conventional earth moving equipment. However, the consultant noted that sewer lines may be in excess of 25 feet deep on the west portion of the site and should be further investigated with seismic refraction lines.

Groundwater was not encountered by Earth-Strata during their subsurface exploration. However, water was noted within the drainage channel that trends through the middle of the project site.

Earth-Strata recommended the removal of topsoil, alluvial materials and artificial fill down to competent bedrock. Removals were anticipated to be about 2 to 4 feet deep across much of the site, with localized areas up to 6 to 8 feet within the orchard areas. Properly constructed fill slopes and cut slopes up to 20 feet high with inclinations of 2:1 (horizontal:vertical) are considered to be grossly stable.

The evaluation estimated a shrinkage factor of 5 to 10 percent for the artificial fill and 0 to 5 percent for the bedrock. No shrinkage values were given for the alluvial materials. Earth-Strata stated the subsidence is estimated to be negligible to 0.01 feet.
The Earth Strata report estimated that the on-site materials have a "very low" to "low" expansion index and recommended confirmation after grading. Soils were encountered to have "negligible" soluble sulfate contents and to be "corrosive" to "very corrosive" to common metallic components. Earth-Strata recommended that additional corrosion testing be conducted at the completion of the site grading.

Earth-Strata provided geotechnical parameters for design of both conventionally reinforced shallow foundations and post-tensioned slab systems for soils having "very low" to "low" expansion index potential.

Copies of the excavation logs, seismic refraction lines, and laboratory test results by Earth-Strata are included in Appendix A. The locations of Earth-Strata's excavations are shown on Figure 2.

On June 8, 2015, Earth-Strata issued a *Seismic Refraction Survey* (Earth-Strata, 2015b) for a portion of the subject site. Earth-Strata's report pertained exclusively to APN 245-300-001 (See Figure 1). Earth-Strata completed a total of four (4) seismic refraction survey lines each totaling 150 feet in length. The seismic line locations are shown on Figure 2.

Earth-Strata concluded that minor excavation difficulties are to be expected in the uppermost 2 feet to 10 feet. However, areas of surficial bedrock outcropping may require more significant excavation techniques. Within the areas of seismic line 1, areas as shallow as 2 feet to 5 feet and as deep as 40 feet are expected to be excavated with moderately difficult conditions utilizing appropriately sized good working equipment.

Earth-Strata concluded that locally areas referred to as "floaters" and/or "corestones" should be expected and will likely cause difficult excavation conditions. Placement of infrastructure within these areas may require some breaking and/or light blasting to obtain desired grades. Additionally, Earth-Strata concluded that areas with seismic velocities less than 6,800 feet per second (fps) are generally noted to be within the threshold for conventional ripping.

Copies of the seismic refraction survey data by Earth-Strata are included in Appendix A.

4. FIELD EXPLORATION AND LABORATORY TESTING

4.1 FIELD EXPLORATION

To supplement the existing subsurface exploration by Earth-Strata and to assess previously unexplored areas of the proposed development, GeoTek excavated nine (9) exploratory trenches on August 30, 2021. The trenches extended to depths ranging from about 5 to 14 feet below existing grades and were excavated to log the subsurface materials and examine the rippability and/or hardness of localized areas throughout the site. The trenches were excavated by a backhoe.

A seismic refraction survey was conducted on August 12, 2021 by a subconsultant (Subsurface Surveys & Associates, Inc.). The seismic refraction survey involved the recording and measuring of man-made energy waves from seven (7) seismic refraction and tomography lines placed in site areas where deep excavations are proposed, as discussed with the project civil engineer. The seismic survey summary report is included in Appendix D of this report.

The approximate locations of GeoTek's site explorations are shown on the Exploration Location Map, Figure 2. Logs of the explorations by Earth Strata, in addition to the trenches and seismic refraction lines by GeoTek, are provided in Appendices A and B, respectively.

4.2 LABORATORY TESTING

Laboratory testing was performed on selected bulk and relatively undisturbed soil and bedrock samples collected during the field exploration. The purpose of the laboratory testing was to confirm the field classification of the subsurface materials encountered and to evaluate the soil/bedrock physical properties for use in the engineering design and analysis. GeoTek's test results along with a brief description and relevant information regarding testing procedures are included in Appendix C.

5. GEOLOGIC AND SOILS CONDITIONS

5.1 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 within a large structural mass known as the Perris Block of the Peninsula Ranges providence. The Perris Block is a relatively stable mass of granitic bedrock that in places is overlain by alluvium and thin sedimentary and volcanic units. After formation of granitic rocks, the Perris Block experienced vertical movements that produced nearly flat erosional surfaces. Sediments emanating from the elevated portions of the Perris Block filled low lying areas of the region. The project area is in an area geologically mapped by others to be underlain by granitic bedrock (tonalite, Dibblee, T.W. and Minch, J.A., 2004).

No active faults are shown in the immediate site vicinity on the maps reviewed for the area. The site is not located within an Earthquake Fault Zone (Alquist-Priolo) as designated by the State of California. The Riverside County website (https://gis.countyofriverside.us/) has designated the site as "not in a fault zone", "not in a fault line", "not in a liquefaction area", and "not in a subsidence area".

5.2 EARTH MATERIALS

A brief description of the earth materials reported to be on the site by Earth-Strata (2015) and encountered in GeoTek's explorations is presented in the following sections.

5.2.1 Disturbed Soil/Undocumented Fill/Topsoils

Earth-Strata and GeoTek observations noted the presence of topsoil and disturbed soil/undocumented fill ("surficial") soils throughout the site. The surficial soils generally consist of silty and clayey sands and sandy silts (SM, SC, and ML soil types based upon the Unified Soil Classification System) which are predominately brown in color and loose/very soft to medium dense/stiff in consistency. The thickness of the surficial soils ranged from about 1 to 3 feet. However, the composition and thickness of the on-site surficial soils could be highly variable.

5.2.2 Quaternary Alluvium

Quaternary-aged alluvium was encountered in most of the Earth-Strata and GeoTek explorations. These alluvial deposits consist predominately of brown, fine to coarse-grained sands, silty sands, clayey sands and sandy silts (SP, SM, SC and ML soil types). These deposits were found to be in a loose/soft to medium dense/stiff state. The thickness of the alluvium ranged up to approximately 7 feet near the toes of slopes and 8 feet in the drainage courses.

5.2.3 Cretaceous Val Verde Tonalite

The Val Verde Tonalite was mapped within the site and underlies the surficial and alluvial deposits. Tonalite has a similar chemical composition to gabbro but includes a higher percentage of quartz. The Val Verde Tonalite was generally noted to be light gray to yellowish tan and was found to be in a moderately hard to very hard state. The bedrock was generally massive and lacks significant structural planes. Typically, the upper approximate three to four feet of the bedrock was found to be moderately to severely weathered and not as hard. The weathered granitic material consisted of massive, slightly friable fine to very coarse-grained sand when excavated ("Decomposed Granite" (DG)). The bedrock becomes less weathered with depth. Most of GeoTek's trench excavations were terminated due to refusal in the tonalite.

As part of GeoTek's services for this report, a seismic refraction survey was performed by Subsurface Surveys & Associates, Inc. on the site. As part of this survey, seven (7) seismic lines were recorded at various site locations. The results of the seismic refraction survey are presented in Appendix D.

GeoTek's seismic refraction survey performed within planned deep cut areas or areas with deep utilities proposed, as shown on Figure 2, identified three layers of subsurface materials. The uppermost zone comprises alluvial soil (colluvium) and is estimated to extend up to 10 feet below grade. The middle layer was noted to correspond to weathered bedrock with velocities ranging from 3,027 to 4,408 feet per second (fps). The bottom layer was noted to comprise slightly weathered to unweathered bedrock. Results of the seismic refraction survey are provided in Appendix C.

Earth-Strata's seismic refraction survey was performed within APN 245-300-001, as shown on Figure 2, identified three major layers of subsurface materials. The uppermost zone comprises alluvial and colluvium and/or completely weathered bedrock and was estimated to extend up to 10 feet below grade. This layer was estimated to be excavatable with only minor difficulties. However, localized boulders should be anticipated based on surficial exposures which may require more significant excavation techniques.

The middle layer, which starts as shallow as 2 to 5 feet and extended in excess of 40 feet below existing grade, consists of slightly to highly weathered bedrock. This layer is expected to be excavated with moderate conditions, assuming appropriately sized good working equipment. Isolated floaters (i.e., boulders, corestones, etc.) should be expected to be present within this second layer which could produce somewhat difficult conditions locally. Placement of infrastructure within this layer may require some breaking and/or light blasting to obtain desired grades.

The third layer starts at depths of 2 to 30 feet below existing grade, consists of moderately to unweathered bedrock. Placement of infrastructure within this layer may require some localized blasting to obtain desired grades. Results of Earth-Strata's seismic refraction survey are provided in Appendix A.

Based on the results of laboratory testing by Earth-Strata and GeoTek, the surficial soils are considered to have a "very low" (0-20) to "low" (21-50) expansion potential (ASTM D 4829). Based on the laboratory test results, the near surface soils have a soluble sulfate content of less than 0.1 percent (ASTM D 4327). The test results are provided in Appendix A (Earth-Strata) and Appendix C (GeoTek).

Detailed logs of the subsurface conditions of the site are presented in Appendix A (Earth-Strata) and Appendix B (GeoTek).

5.3 SURFACE WATER AND GROUNDWATER

5.3.1 Surface Water

Surface water was not noted during GeoTek's field investigation. However, water was observed within the drainages during Earth Strata's field exploration. 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 to the north/northwest, as directed by site topography. As previously

discussed, a "blue-line" drainage trends northwest through the central portion of the site. Provisions for surface drainage will need to be accounted for by the project civil engineer.

5.3.2 Groundwater

Groundwater was encountered at a depth of approximately 6.5 feet below the existing ground surface in Trench T-5 at the time of exploration. This groundwater appears to be the result of a perched condition. Groundwater was not encountered in any other trenches excavated by GeoTek for this project. Groundwater was not encountered by Earth Strata (2015a) to an explored depth of 10 feet. The California Department of Water Resources, Water Data Library indicates that the presence of various groundwater wells within a one-mile radius from the site. Records for these wells show depths to groundwater in excess of 100 feet. Based on the above, groundwater is not anticipated to be a factor during the site grading. However, seasonal perched groundwater may be encountered during grading within portions of the site.

5.4 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; CGS, 1986).

The County of Riverside has designated the site as "not in a fault zone" and "not in a fault line." The nearest known active faults are the Elsinore fault zone and the San Jacinto fault zone located approximately 11.4 and 11.2 miles to the southwest and northeast of the site, respectively.

5.4.1 Seismic Design Parameters

The site is located at approximately 33.8902 North Latitude and -117.3516 West Longitude. A Site Class "C" is considered appropriate due to the presence of shallow bedrock across the site. Site spectral accelerations (S_a and S_1), for 0.2 and 1.0 second periods for a Class "C" site, were 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. The results are presented in the following table:

SITE SEISMIC PARAMETERS	
Mapped 0.2 sec Period Spectral Acceleration, S_S	1.5g
Mapped 1.0 sec Period Spectral Acceleration, S_1	0.562g
Site Coefficient for Site Class "C", F_a	1.2
Site Coefficient for Site Class "C", F_v	1.438
Maximum Considered Earthquake Spectral Response Acceleration for 0.2 Second, S_{MS}	1.8g
Maximum Considered Earthquake Spectral Response Acceleration for 1.0 Second, S_{M1}	0.809g
5% Damped Design Spectral Response Acceleration Parameter at 0.2 Second, S_{DS}	1.2g
5% Damped Design Spectral Response Acceleration Parameter at 1 second, S_{D1}	0.539g
Site Modified Peak Ground Acceleration, PGA_M	0.6g

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.

5.4.2 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). No faults are identified on geologic maps readily available and reviewed by this firm for the immediate study area. The nearest known active faults are the Elsinore fault zone and the San Jacinto fault zone located approximately 11.4 and 11.2 miles to the southwest and northeast of the site, respectively.

5.4.3 Liquefaction and Seismically Induced Settlement

The County of Riverside has designated the site as being "not in a liquefaction area" and "not in a subsidence area".

Liquefaction is not considered to be a hazard at the subject site due the lack of a true groundwater level within the site, presence of shallow bedrock, and proposed remedial grading. Also, the potential for seismically induced settlement at the property is considered to be nil to very low due to the presence of shallow bedrock and proposed remedial grading.

5.4.4 Other Seismic Hazards

Evidence of ancient landslides or slope instabilities at this site was not observed during the field investigation. Thus, the potential for landslides is considered negligible.

The potential for secondary seismic hazards such as a seiche or tsunami is considered negligible due to site elevation and distance to an open body of water.

As previously discussed, bedrock (tonalite) outcrops are present on portions of the site. As previously noted, the tonalite is generally massive and lacks significant structural planes. In addition, the site topography is relatively gentle with a moderate slope to the north/northwest. Based upon this condition, the rock fall hazard at the site is not a design consideration for this project.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 GENERAL

Development of the site appears feasible from a geotechnical viewpoint. The following recommendations should be incorporated into the design and construction phases of development.

6.2 EARTHWORK CONSIDERATIONS

6.2.1 General

Earthwork and grading should be performed in accordance with the applicable grading ordinances of the County of Riverside, 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.

Final site grading plans should be reviewed by this office when they become available. Additional recommendations will likely be offered subsequent to review of these plans.

6.2.2 Site Clearing

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

6.2.3 Remedial Grading

The trenches excavated during this evaluation and likely the previous trenches performed by Earth Strata were backfilled without compaction effort. All trench backfill should be entirely removed and replaced with engineered compacted fill.

All topsoil, disturbed soil/undocumented fill ("surficial") soils, loose alluvium, and highly weathered bedrock should be removed to expose competent native materials. Competent native materials are defined as either relatively dense alluvium, which is relatively uniform, not visibly porous, and having an in-place compaction of at least 85 percent of the soil's maximum dry density (per ASTM D 1557 test procedures) or firm, unyielding bedrock. Estimated removal depths are anticipated to range from 2 to 4 feet within "bedrock" areas and 6 to 8 feet within "alluvial" areas.

Actual depths of removals should be determined in the field based on observation and in-place density testing. A representative of this firm should observe and approve the bottom of all excavations. As a minimum, removals should extend down and away from foundation elements at a 1:1 (horizontal:vertical) projection to the recommended removal depth, or a minimum of five feet laterally, whichever is greater. The bottom of the removals should be graded to drain toward the front of the lot at a gradient of at least two percent.

Project rough grading will create fill, cut/fill transition and cut building pads. All pads in fill should be overexcavated such that the pads are underlain by at least five feet of engineered fill and over-excavation bottoms should slope to drain to the adjacent street of suitable direction so ponding of water is not likely. In addition, the minimum fill thickness should be at least one-half of the maximum fill thickness under the pad, up to a maximum of 15 feet. The lateral extent of this recommendation should include an area of at least 5 feet beyond the building limits.

The cut portions of transition (i.e., cut/fill) pads should be overexcavated a minimum of five feet below proposed grades or to a depth of one-half the maximum fill thickness.

All building pads in cut areas exposing tonalite bedrock should be overexcavated to a minimum depth of three feet below proposed grade and replaced with engineered fill.

The base of all project footings should be underlain by at least 24 inches of engineered compacted fill.

In order to facilitate footing excavation and installation of house services, consideration should be given to over-excavating cut lots to a minimum depth of five feet below proposed finished grades. It is recommended that the entire lot be over-excavated. It is also recommended that utility alignments be over-excavated to at least one foot below the depth of the lowest underground utility.

To prevent potential differential settlement, the cut portions of transition (i.e., cut/fill) lots should be over-excavated a minimum of five feet below proposed grades or to a depth of one-half of the maximum fill thickness on the lot, whichever is greater. The horizontal extent of over-excavation could comprise the entire lot or extend at least five feet outside the structural area, or a distance equal to the depth of over-excavation below the bottom of the structural elements, whichever is greater. Over-excavation bottoms should be graded to drain toward the front of the lot (two percent minimum).

The approved removal/over-excavation bottom exposed should then be scarified to a depth of about six inches, be moisture conditioned to slightly above the soil's optimum moisture content and then be compacted to at least 90 percent of the soil's maximum dry density as determined by ASTM D 1557 test procedures. Compaction should be confirmed by testing.

6.2.4 Excavation Characteristics

As previously discussed, excavation up to approximately 25 feet or less will be needed for localized areas of infrastructure (sewer line) construction. Based upon results of GeoTek's and Earth Strata's exploration, backhoe and drill rigs met shallow refusal in bedrock. In addition, bedrock outcrops were present on portions of the site.

As part of GeoTek's services for this report, a seismic refraction survey was performed by Subsurface Surveys & Associates, Inc. on the site. As part of this survey, seven (7) seismic lines were recorded at various site locations. The results of the seismic refraction survey are presented in Appendix D. Earth-Strata's seismic refraction survey was performed within APN 245-300-001, as shown on Figure 2. The results of Earth Strata's seismic refraction survey are presented in Appendix A.

A brief discussion of the results of the seismic refraction surveys performed by Earth Strata and GeoTek was provided in Section 5.2.3. of this report. Much of the rock at the site is extremely hard and relatively unfractured, with bedrock outcrops present on the site. Some blasting or special excavation techniques will likely be required to complete the proposed project grading and infrastructure construction.

The above evaluation of rock hardness is based on review of previous studies performed for the site and the recently performed seismic refraction survey. It should be realized that the ability of any particular contractor to excavate the materials encountered will vary based on factors that may or may not be considered in the evaluation. All methods available to evaluate rock hardness and associated rippability are interpretive to some extent. As such, experience and judgment are primary factors in such evaluations.

Utility excavation is expected to be challenging due to the presence of hard rock. Extensive blasting or special excavation techniques should be anticipated to perform the utility infrastructure of this project. It is recommended that utility corridors within streets be over-excavated to at least 1 foot below the deepest utility and backfilling with compacted soil. Oversized rocks (>6 inches) should be anticipated on this site and hard floaters/corestones may be encountered at varying depths during grading and/or blasting operations. A caving or loosening of bedrock often known as "overbreak" of utility trench excavations is expected in excavations into the tonalite bedrock.

Overexcavation of street areas underlain by bedrock during rough grading should be considered to prevent significant trenching difficulties associated with utility installations. The overexcavation should extend to a depth of at least one foot below the deepest planned utility and then be backfilled with properly compacted fill.

Excavation of alluvial deposits to the design elevations is expected to be feasible with heavy-duty grading equipment in good operating condition. All temporary excavations for grading purposes and installation of underground utilities should be constructed in accordance with local and Cal-OSHA guidelines. Temporary excavations within the on-site materials should be stable at 1:1 (horizontal:vertical) inclinations for cuts less than ten feet in height.

Based on the soils encountered in the various site explorations, site earth materials can be categorized as OSHA Soil Type C. It is recommended that temporary slopes greater than four feet in height not be constructed at inclinations steeper than 1:1 (horizontal:vertical). Flatter inclinations may be needed depending on the field conditions. Temporary construction slopes should be periodically examined by a competent person, per OSHA requirements, to look of evidence of instability.

6.2.5 Canyon Subdrains

Subdrains are recommended within the bottom of the existing major drainage swales/canyons in areas where the depth of fill will exceed 10 feet in thickness. The subdrains should consist of 6-inch diameter (subdrain length less than 500 feet) or 8-inch diameter (lengths greater than

500 feet) Schedule 40 perforated PVC pipe encapsulated within 9 cubic feet of suitable drainage material (¾ inch open graded rock, or equivalent) surrounded by a filter fabric, such as Mirafi 140N, or equivalent. Where possible, the subdrains should be installed within the bottom of the canyon cleanouts. The subdrains should be installed with a minimum 1 percent gradient sloping to an approved outlet. The final 10 feet of pipe, where connecting to an outlet, should consist of solid PVC pipe. A subdrain detail is shown on Plate E-1 in Appendix E.

6.2.6 Slope Construction

Cut slopes constructed in bedrock at maximum gradients of 2:1 (horizontal:vertical), in accordance with industry standards, are anticipated to be both grossly and surficially stable. Cut slopes constructed at maximum gradients of 2:1 (horizontal:vertical) in suitable alluvial soils, in accordance with industry standards, are anticipated to be both grossly and surficially stable. An engineering geologist should observe all cut slopes. Cut slopes should expose competent bedrock (defined as tonalite) or suitable alluvium. If adverse structure or incompetent materials are exposed and identified in the cut slopes, stabilization fills may be recommended. Where alluvial soils are present over bedrock in the cut slope, the alluvial portion of the slope should be reconstructed as a surficial stability fill.

Swales should be constructed at the top of all cut slopes to collect and divert drainage away from the slope face. Drainage should be directed to an approved drainage discharge location. Swales should be constructed with concrete, shotcrete or approved non-erosive material. Swales should be cleaned of loose soil and debris on an on-going basis.

Fill slopes constructed at maximum gradients of 2:1 (horizontal:vertical), in accordance with industry standards, are anticipated to be both grossly and surficially stable. Where fill is to be placed against sloping terrain with gradients of 5:1 (horizontal:vertical) or steeper, the sloping ground surface should be benched to remove loose and disturbed surface soil to assure that the new fill is placed in direct contact with competent bedrock and to provide horizontal surfaces for fill placement. A 10- to 15-foot-wide keyway should be constructed at the toe of the fill slope areas extending at least 2 to 3 feet vertically into competent natural material.

The base of the keyways and benches should be sloped back into the hillside at a gradient of at least two percent. The base of the benches should be evaluated by a representative of GeoTek prior to processing. Upon approval, the exposed materials should be moistened to at least the optimum moisture content and densified to a relative compaction of at least 90 percent of maximum dry density as determined by ASTM D 1557 test procedures.

Fill slopes should be overfilled during construction and then cut back to expose fully compacted soil. A suitable alternative would be to compact the slopes during construction and then roll the final slope to provide a dense, erosion resistant surface.

Berms should be constructed and maintained at the top of all slopes to divert drainage away from the slope faces. An abatement program to control ground-burrowing rodents should be implemented and maintained. Burrowing rodents can decrease the long-term performance of slopes.

6.2.7 Engineered Fill

The onsite materials are considered suitable for reuse as engineered fill provided the materials are free from vegetation, roots, and rock/hard lumps greater than six inches in maximum dimension.

Prior to placing fill, the approved exposed subgrade should then be scarified to a depth of about 12 inches, be moisture conditioned to slightly above the soil's optimum moisture content and then be compacted to at least 90 percent of maximum dry density as determined by ASTM D 1557 test procedures.

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- to eight-inch loose lifts, moisture conditioned to slightly above optimum moisture content, and compacted to a minimum relative compaction of 90 percent as determined by ASTM D 1557 test procedures. If engineered fill depths exceed 50 feet, the engineered fill below a depth of 50 feet from finish grade should be compacted to a minimum relative compaction of 95 percent as determined by ASTM D 1557. Fills deeper than 30 feet from finish grade should be compacted to a minimum relative compaction of 93 percent. Placement of engineered fill should be observed and tested on a full-time basis by a GeoTek representative during grading activities.

The site excavations noted that the bedrock generally breaks down to sand and gravel with trace of boulders and cobbles up to 2 feet in maximum dimension. Occasional cobbles and boulders were also encountered in the deeper portions of the alluvium. Oversized materials (greater than six inches) should be placed scattered (windrows) on site as detailed in Appendix E and Figure E-4. Alternatively, oversized rock could be disposed of offsite or stockpiled on site and crushed for future use.

6.2.8 Trench Excavations and Backfill

Temporary trench excavations within the on-site materials should be stable at 1:1 (h:v) inclinations for short durations during construction and where cuts do not exceed ten feet in height. It is anticipated that temporary cuts to a maximum height of four feet can be excavated vertically.

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 test procedures). Under-slab trenches should also be compacted to project specifications. Where applicable, based on jurisdictional requirements, the top 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.

6.2.9 Shrinkage and Bulking

Several factors will impact earthwork balancing on the site, including shrinkage, subsidence, trench spoil from utilities and footing excavations, as well as the accuracy of topography.

Shrinkage is primarily dependent upon the degree of compactive effort achieved during construction. For planning purposes, a shrinkage factor of 5 to 10 percent may be considered for the alluvium. Bedrock materials may bulk up to 10 percent or possibly more. Site balance areas should be available in order to adjust project grades, depending on actual field conditions at the conclusion of site earthwork construction.

Due to the presence of relatively shallow bedrock across the site, subsidence is expected to be negligible.

6.3 DESIGN RECOMMENDATIONS

6.3.1 Foundation Design Criteria

Foundation design criteria for a conventional foundation system, in general conformance with the 2019 CBC, are presented herein. These are typical design criteria and are not intended to supersede the design by the structural engineer.

Based on the results of laboratory testing (GeoTek and Earth Strata, 2015a), the on-site materials are classified as having "very low" (0≤EI≤20) to "low" (21≤EI≤50) 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.

The foundation elements for the proposed structures should bear entirely in engineered fill soils as recommended in this report. Foundations should be designed in accordance with the *2019 California Building Code* (CBC). A summary of the foundation design recommendations is presented in the following table:

MINIMUM DESIGN REQUIREMENTS FOR CONVENTIONALLY REINFORCED FOUNDATIONS		
Design Parameter	"Very Low" Expansion Potential (0≤EI≤20)	"Low" Expansion Potential (21≤EI≤50)
Foundation Depth or Minimum Perimeter Beam Depth (inches below lowest adjacent grade)	One- and two-story – 12	One- and two-story - 12
Minimum Foundation Width (Inches)*	One-and two-story – 12	One- and two-story – 15
Minimum Slab Thickness (Inches)	4 - Actual	4 - Actual
Minimum Slab Reinforcing	6" x 6" – W1.4/W1.4 welded wire fabric placed in middle of slab	6" x 6" – W2.9/W2.9 welded wire fabric or No. 3 reinforcing bars placed at 18 o.c. each way placed in middle of slab
Minimum Reinforcement for Continuous Footings, Grade Beams, and Retailing Wall Footings	Two No. 4 reinforcing bars, one placed near the top and one near the bottom	Two No. 4 reinforcing bars, one placed near the top and one near the bottom
Effective Plasticity Index**	0 – design value	35 – design value
Presaturation of Subgrade Soil (Percent of Optimum/Depth in Inches)	Minimum 100% of the optimum moisture content to a depth of at least 12 inches prior to placing concrete	Minimum of 110% 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 2016 CBC
**Effective plasticity index should be verified at the completion of remedial grading

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.

An allowable bearing capacity of 2,000 pounds per square foot (psf) may be used for design of continuous and perimeter footings 12 inches deep and 12 inches wide, and pad footings 24 inches square and 12 inches deep. This value may be increased by 300 psf for each additional 12 inches in depth and by 300 psf for each additional 12 inches in width to a maximum value of 3,500 psf. Additionally, an increase of one-third may be applied when considering short-term live loads (e.g., seismic and wind loads).

The recommended allowable bearing capacity is based on an estimated maximum post-construction settlement of 1-inch. Differential settlement of about one-half of the total settlement over a horizontal distance of 40 feet could result. Seismically induced settlement is expected to be negligible. The project structural engineer, foundation engineer, and earth retention structure designer should incorporate these settlement estimates into the design, as appropriate.

The passive earth pressure may be computed as an equivalent fluid having a density of 300 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.

A grade beam, a minimum of 12 inches wide and 12 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.

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 the result of construction related punctures (e.g., stake penetrations, tears, punctures from walking on the 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. It is GeoTek's opinion that a minimum ten mil thick membrane with joints properly overlapped and sealed should be considered, unless otherwise specified by the slab design professional. 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 atmospheric conditions.

Ultimately, the vapor retarding system should be comprised of suitable elements to limit 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 permeance) to achieve the desired performance level. Consideration should be given to consulting with an individual possessing specific expertise in this area for additional evaluation.

It is recommended 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.

6.3.2 Miscellaneous Foundation Recommendations

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.

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.

6.3.3 Foundation Setbacks

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:

- 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 5 feet and need not exceed 40 feet.

- The outside bottom edge of all footings should be set back a minimum of H/2 (where H is the slope height) from the face of any ascending slope. The setback should be at least 7 feet and need not to exceed 15 feet. Where a retaining wall is constructed at the toe of the slope, the height of the slope should be measured from top of the wall to the top of the slope.
- The bottom of all footings for structures near retaining walls should be deepened so as to extend below a 1:1 (h:v) projection upward from the bottom inside edge of the wall footing.
- The bottom of any proposed foundations for structures should be deepened so as to extend below a 1:1 (h:v) projection upward from the bottom of the nearest excavation.

6.4 RETAINING WALL DESIGN AND SITE CONSTRUCTION

6.4.1 General Design Criteria

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

Retaining wall foundations embedded a minimum of 12 inches below the lowest adjacent grade and should rest on at least 24 inches of compacted fill. Wall footings should be designed using an allowable bearing capacity of 2,000 psf. An increase of one-third may be applied when considering short-term live loads (e.g., seismic and wind loads). The passive earth pressure may be computed as an equivalent fluid having a density of 300 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.

ACTIVE EARTH PRESSURES	
Surface Slope of Retained Materials (H:V)	Equivalent Fluid Pressure (PCF) Native Materials*
Level	42
2:1	65

*The design pressures assume the native backfill material has an expansion index less than or equal to 20. Backfill zone includes area between the back of the wall and footing to a plane (1:1 h:v) up from the bottom of the wall foundation to the ground surface.

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

For walls with more than 6 feet of compacted backfill, a seismic force must also be included into the wall design. For proposed earth retention structures an earthquake-induced equivalent fluid pressure of 15 pcf should be included into the wall design. This earthquake pressure was determined using the Seed and Whitman method. This seismic pressure can be assumed to be a conventional triangular distribution.

6.4.2 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 65 pcf, 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.

6.4.3 Wall Backfill and Drainage

Retaining wall backfill should be free of deleterious and/or oversized materials and should have and expansion index of less than 20. Retaining walls should be provided with an adequate pipe and gravel back drain system to help prevent buildup of hydrostatic pressures. Backdrains should consist of a four-inch diameter perforated collector pipe (Schedule 40, SDR 35, or approved equivalent) embedded in a minimum of one-cubic foot per linear foot of ¾- to 1-inch clean crushed rock or an approved equivalent, wrapped in filter fabric (Mirafi 140N or an approved equivalent). The drain system should be connected to a suitable outlet. Waterproofing of site walls should be performed where moisture migration through the wall is undesirable.

Retaining wall backfill should be placed in lifts no greater than eight inches in thickness and compacted to a minimum of 90 percent relative compaction as determined by ASTM D 1557 test procedures. The wall backfill should also include a minimum one-foot wide section of ¾- to 1-inch clean crushed rock (or an approved equivalent). The rock should be placed immediately adjacent to the back of the wall and extend up from a back drain to within approximately 24 inches of the finish grade. The rock should be separated from the earth with filter fabric. The upper 24 inches should consist of compacted on-site soil.

As an alternative to the drain rock and fabric, Miradrain 2000, or approved equivalent, may be used behind the retaining wall. The Miradrain 2000 should extend from the base of the wall to within two feet of the ground surface. The subdrain should be placed at the base of the wall in direct contact with the Miradrain 2000.

The presence of other materials might necessitate revision to the parameters provided and modification of the wall designs. Proper surface drainage needs to be provided and maintained. Walls from two to four feet in height may be drained using localized gravel packs behind weep holes at eight 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.

6.4.3.1 Other Design Considerations

- 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.

6.4.4 Pavement Design Considerations

No on-site earth material has been tested to determine a preliminary R-Value for pavement design. A R-Value of 40 is assumed for the determination of preliminary pavement sections for

this report. The final design should be based on R-Value testing of the soil subgrade following completion of rough grading operations. Project streets should be designed in accordance with County of Riverside requirements when final Traffic Indices and R-Value test results of the subgrade soil are completed.

Pavement design for proposed on-site and off-site street improvements was conducted per Caltrans *Highway Design Manual* guidelines for flexible pavements. Based on traffic indices (TIs) generally associated with this type of project and using a design R-value of 40, the following preliminary sections were calculated:

PRELIMINARY PAVEMENT SECTIONS			
TI	R-Value	Thickness of Asphalt Concrete (inches)	Thickness of Aggregate Base (inches)
5.5 (Access Road and Local Street)	40	3*	6
6.5 (Enhanced Local Street at School or Park)		4*	6*
7.0 (Collector)		4*	8
8.5 (Secondary Highway)		5*	9
9.0 (Major Highway)		5*	10

*Minimum pavement structural section per County of Riverside Standards

The TIs used in the above pavement analysis and design were designated by Riverside County for the indicated street types and should provide a pavement life of approximately 20 years with a normal amount of flexible pavement maintenance. Irrigation adjacent to pavements, without a deep curb or other cutoff to separate landscaping from the paving may result in premature pavement failure. Traffic parameters used for design were selected based upon engineering judgment and not upon information furnished to us such as an equivalent wheel load analysis or a traffic study.

The recommended pavement sections provided are intended as a minimum guideline and final selection of pavement cross section parameters should be made by the project civil engineer, based upon the local laws and ordinates, expected subgrade and pavement response, and desired level of conservatism. If thinner or highly variable pavement sections are constructed, increased maintenance and repair could be expected. Final pavement design should be checked by testing of soils exposed at subgrade (the upper 12 inches) after final grading has been completed.

Asphalt concrete and aggregate base should conform to current Caltrans Standard Specifications Section 39 and 26-1.02, respectively. As an alternative, asphalt concrete can conform to Section 203-6 of the current Standard Specifications for Public Work (Green Book). Crushed aggregate base or crushed miscellaneous base can conform to Section 200-2.2 and 200-2.4 of the Green Book, respectively. Pavement base should be compacted to at least 95 percent of the ASTM D1557 laboratory maximum dry density (modified proctor).

All pavement installation, including preparation and compaction of subgrade, compaction of base material, placement and rolling of asphaltic concrete, should be done in accordance with County of Riverside specifications, and under the observation and testing of GeoTek and a County Inspector where required. Jurisdictional minimum compaction requirements in excess of the aforementioned minimums may govern.

Deleterious material, excessive wet or dry pockets, oversized rock fragments, and other unsuitable yielding materials encountered during grading should be removed. Once existing compacted fill are brought to the proposed pavement subgrade elevations, the subgrade should be proof rolled in order to check for a uniform and unyielding surface. The upper 12 inches of pavement subgrade soils should be scarified, moisture conditioned at or near optimum moisture content, and recompacted to at least 95 percent of the laboratory maximum dry density as determined by ASTM D1557 test procedures. If loose or yielding materials are encountered during construction, additional evaluation of these areas should be carried out by GeoTek. All pavement section changes should be properly transitioned.

6.4.5 Soil Corrosivity

The soil resistivity at this site was tested in the laboratory on two samples collected during the field investigation. The results of the testing indicate that the on-site soils are considered "extremely corrosive" (804 ohm-cm) (Roberge, 2000) to buried ferrous metal in accordance with current standards used by corrosion engineers. It is recommended that a corrosion engineer be consulted to provide recommendations for the protection of buried ferrous metal at this site.

6.4.6 Soil Sulfate Content

The sulfate content was determined in the laboratory on two samples collected during the field investigation. The results indicate that the water-soluble sulfate results are less than 0.1 percent by weight, which is considered "negligible" as per ACI 318. Based on the test results and Table 4.3.1 of ACI 318, no special recommendations for concrete are required for this project due to soil sulfate exposure.

Additional soil sampling, laboratory testing and analysis regarding soil corrosion and soil sulfate content should be conducted following completion of the project rough grading operation.

6.4.7 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.

6.4.8 Concrete Flatwork

6.4.8.1 Exterior Concrete Slabs, Sidewalks, and Driveways

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 flatwork with "very low" expansive soils should be pre-saturated to a minimum of 100 percent of optimum moisture content or 110 percent of optimum moisture for "low" expansive soils to a depth of at least 12 inches.

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

6.4.8.2 Concrete Performance

Concrete cracks should be expected. These cracks can vary from sizes that are hairline 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 can also undergo chemical processes that are dependent upon 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 orthogonal directions and located a distance apart approximately equal to 24 to 36 times the slab thickness.

6.5 POST CONSTRUCTION CONSIDERATIONS

6.5.1 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. Due to the presence of high expansive soils, irrigation should be minimized adjacent to the buildings. 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.

6.5.2 Drainage

The need to maintain proper surface drainage and subsurface systems cannot be overly emphasized. Positive site drainage should be maintained at all times, as directed by the project civil engineer. 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.

6.6 PLAN REVIEW AND CONSTRUCTION OBSERVATIONS

It is recommended 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 contained in this report. Additional recommendations may be necessary based on these reviews. It is also recommended 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. It is recommended that these agencies be notified prior to commencement of construction so that necessary grading permits can be obtained.

7. 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 of this report is based on GeoTek's understanding of the project and the client's needs, GeoTek's proposal (Proposal No. P-0705721-CR) dated July 21, 2021 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 the recommendations contained in this report are based on the site conditions observed and encountered, and laboratory testing, GeoTek's 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.

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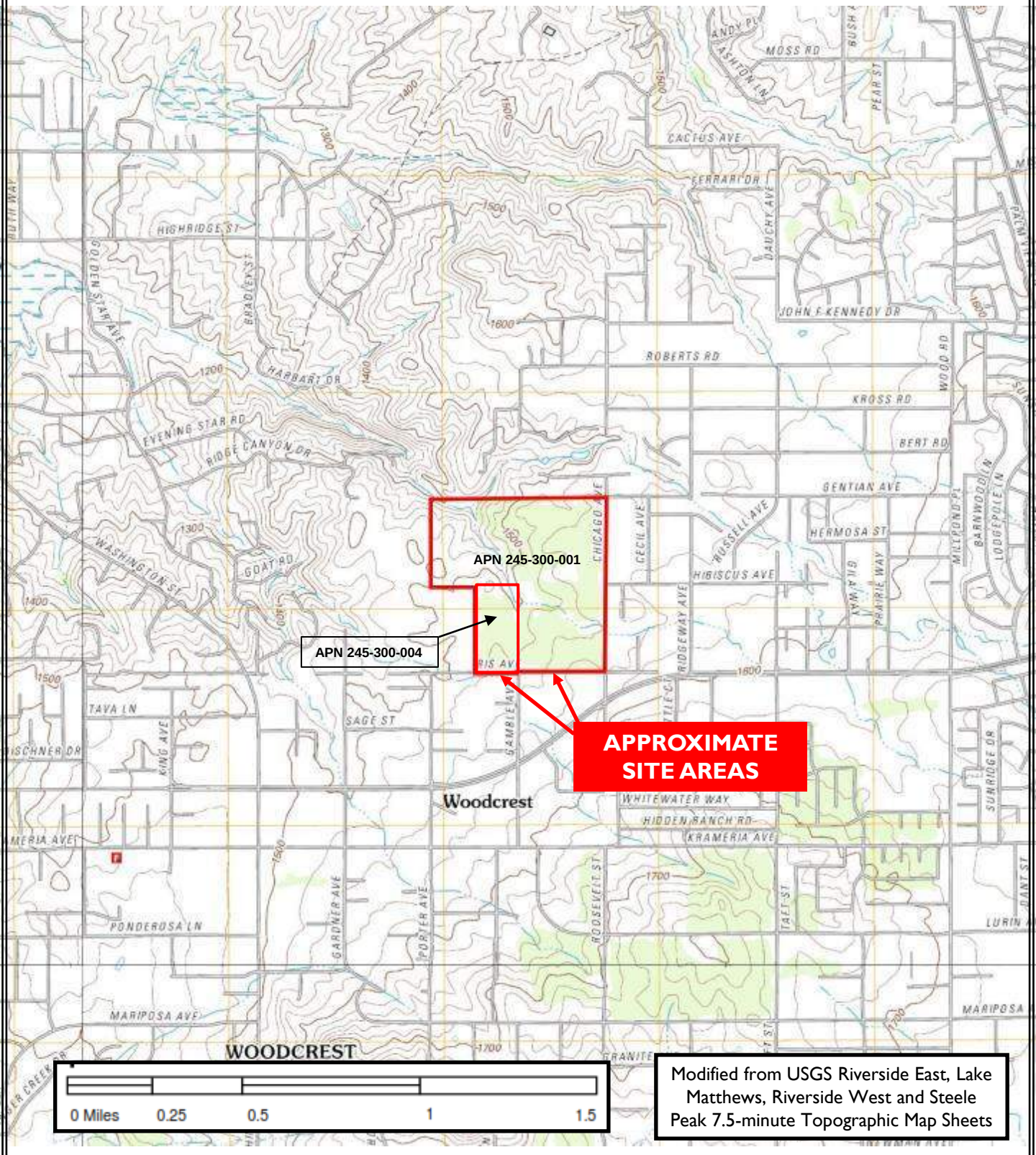

Modified from USGS Riverside East, Lake Matthews, Riverside West and Steele Peak 7.5-minute Topographic Map Sheets

TTLC Management an Arizona Corp.
Assessor's Parcel Numbers 245-300-001 and -004
Woodcrest Area of Riverside County, California

Project No. 2855-CR

NORTH

Figure 1

Site Location Map

GEOTEK

TTLC Management an Arizona Corp.
Proposed Single-Family Residential Development
NW of Iris Avenue and Chicago Avenue
Woodcrest Area of Riverside County, California

GeoTek Project No. 2855-CR

NORTH

200 ft.
SCALE

Figure 2

Exploration Location Map

GEOTEK

APPENDIX A

EXPLORATION LOGS, LABORATORY TEST RESULTS AND SEISMIC REFRACTION SURVEY DATA BY EARTH-STRATA (2015a)

Updated Geotechnical Evaluation
Proposed Single-Family Residential Development
Woodcrest, Riverside County, California
Project No. 2855-CR

GEOTEK

Geotechnical Boring Log B-1

Date: March 25, 2015	**Project Name: P& F Prpoerty** **Page: 1 of 1**
Project Number: 15735-10A	**Logged By: GWG**
Drilling Company: Drilling It	**Type of Rig: CME 45B**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft):	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Number	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Topsoil:**
					SM	Silty SAND; light orange brown, dry to slightly moist, medium dense
	70	1	105.1	10.3		**Cretaceous Val Verde Tonalite (Kvt)**
					SC	Clayey Sandstone; light tan brown, moist, hard to very hard
5	50/4"	2	81.4	19.6	SC	Clayey SAND; light grey, moist, grainitic bedrock
						Dark grey, moist, coarse, very hard
10						End of Boring at 10 feet
						No Groundwater
15						
20						
25						
30						

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Geotechnical Boring Log B-2

Date: March 25, 2015	**Project Name: P& F Prpoerty** **Page: 1 of 1**
Project Number: 15735-10A	**Logged By: GWG**
Drilling Company: Drilling It	**Type of Rig: CME 45B**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft):	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Number	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Topsoil:**
					SC	Clayey SAND; reddish brown, dry
						Cretaceous Val Verde Tonalite (Kvt)
	68	1	118.6	8.9	SC	Clayey Sandstone; light tan brown, moist, hard to very hard
5	50/8"	2	91.6	4.6		
10						End of Boring at 10 feet
						No Groundwater
15						
20						
25						
30						

Geotechnical Boring Log B-3

Date: March 31, 2015	**Project Name: P& F Prpoerty** **Page: 1 of 1**
Project Number: 15735-10A	**Logged By: GWG**
Drilling Company: Drilling It	**Type of Rig: CME 45B**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft):	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Number	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Topsoil:**
					ML	Sandy SILT; light brown, dense
						Cretaceous Val Verde Tonalite (Kvt)
5					SC	Clayey Sandstone; light tan brown, moist, hard to very hard
						End of Boring at 5.5 feet
						No Groundwater
10						
15						
20						
25						
30						

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Geotechnical Boring Log B-4

Date: March 31, 2015	**Project Name: P& F Prpoerty** **Page: 1 of 1**
Project Number: 15735-10A	**Logged By: GWG**
Drilling Company: Drilling It	**Type of Rig: CME 45B**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft):	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Number	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Topsoil:**
						Sandy SILT; light brown, dense
	88/10"	1				**Cretaceous Val Verde Tonalite (Kvt)**
					SC	Clayey Sandstone; light tan brown, moist, hard to very hard
5						
10						End of Boring at 10 feet
						No Groundwater
15						
20						
25						
30						

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Geotechnical Boring Log B-5

Date: March 31, 2015	**Project Name: P& F Prpoerty** **Page: 1 of 1**
Project Number: 15735-10A	**Logged By: GWG**
Drilling Company: Drilling It	**Type of Rig: CME 45B**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft):	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Number	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Topsoil:**
						Sandy SILT; light brown, dense
						Cretaceous Val Verde Tonalite (Kvt)
	96/8"	1			SC	Clayey Sandstone; light tan brown, moist, hard to very hard
5						
						End of Boring at 7.5
						No Groundwater
10						
15						
20						
25						
30						

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Geotechnical Boring Log B-6

Date: March 31, 2015	**Project Name: P& F Prpoerty** **Page: 1 of 1**
Project Number: 15735-10A	**Logged By: GWG**
Drilling Company: Drilling It	**Type of Rig: CME 45B**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft):	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Number	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Topsoil:**
					ML	Sandy SILT; light brown, dense
						Cretaceous Val Verde Tonalite (Kvt)
	110/3"	1			SC	Clayey Sandstone; light tan brown, moist, hard to very hard
5						
	50/1"	2				
						End of Boring at 6 feet
						No Groundwater
10						
15						
20						
25						
30						

Geotechnical Boring Log B-7

Date: March 31, 2015	**Project Name: P& F Prpoerty** **Page: 1 of 1**
Project Number: 15735-10A	**Logged By: GWG**
Drilling Company: Drilling It	**Type of Rig: CME 45B**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft):	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Number	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Topsoil:**
						Sandy SILT; light brown, dense
						Cretaceous Val Verde Tonalite (Kvt)
	50/4"	1			SM	Silty SAND (weathered bedrock);
5						
10						End of Boring at 10 feet
						No Groundwater
15						
20						
25						
30						

Geotechnical Boring Log B-8

Date: March 31, 2015	**Project Name: P& F Prpoerty** **Page: 1 of 1**
Project Number: 15735-10A	**Logged By: DV**
Drilling Company: Drilling It	**Type of Rig: CME 45B**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft):	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Number	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Topsoil:**
						Sandy SILT; reddish brown, dense
						Cretaceous Val Verde Tonalite (Kvt)
	50/2"	1			SC	Clayey Sandstone; light tan brown, moist, hard to very hard
5						
						End of Boring at 6 feet
						No Groundwater
10						
15						
20						
25						
30						

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Geotechnical Boring Log TP-1

Date: March 27, 2015	**Project Name: P & F Properties** **Page: 1 of 1**
Project Number: 15735-10A	**Logged By: SMP**
Drilling Company: Drilling It	**Type of Rig: Mini Excavator**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft):	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Number	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Topsoil:**
					SM	Silty SAND; reddish brown, slightly moist, with weathered rock
						Tonalite (Kvt):
5					SP	Sand with SILT and weathered rock, gravel size; grey and light brown
						End of Boring at 6 feet
						No Groundwater
						`
10						
15						
20						
25						
30						

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Geotechnical Boring Log TP-2

Date: March 28, 2015	**Project Name: P & F Properties** **Page: 1 of 1**
Project Number: 15735-10A	**Logged By: SMP**
Drilling Company: Drilling It	**Type of Rig: Mini Excavator**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft):	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Number	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Topsoil:**
					SM	Silty SAND; reddish brown, dry, medium dense
						Tonalite (Kvt):
					SP	SAND with fine GRAVEL (weathered rock); light grey
5						End of Boring at 4.9 feet
						No Groundwater
10						
15						
20						
25						
30						

Geotechnical Boring Log TP-3

Date: March 28, 2015	**Project Name: P & F Properties** **Page: 1 of 1**
Project Number: 15735-10A	**Logged By: SMP**
Drilling Company: Drilling It	**Type of Rig: Mini Excavator**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft):	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Number	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Topsoil**
					SM	Silty SAND; reddish brown, dry, medium dense
						Tonalite (Kvt):
					SP	Sand with fine GRAVEL; light grey, dry, weatherd bedrock
						End of Boring at 4 feet
5						No Groundwater
10						
15						
20						
25						
30						

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Geotechnical Boring Log TP-4

Date: March 28, 2015	**Project Name: P & F Properties** **Page: 1 of 1**
Project Number: 15735-10A	**Logged By: SMP**
Drilling Company: Drilling It	**Type of Rig: Mini Excavator**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft):	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Number	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Topsoil:**
					SM	Silty SAND; reddish brown, dry, medium dense
						Tonalite (Kvt):
5					SP	SAND with SILT; reddish brown, dry, medium dense
						End of Boring at 6 feet
						No Groundwater
10						
15						
20						
25						
30						

Geotechnical Boring Log TP-5

Date: March 27, 2015	**Project Name: P & F Properties** **Page: 1 of 1**
Project Number: 15735-10A	**Logged By: SMP**
Drilling Company: Drilling It	**Type of Rig: Mini Excavator**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft):	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Number	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Topsoil:**
					SM	Silty SAND; reddish brown, dry, loose to medium dense
						Tonalite (Kvt):
					SP	SAND (weathered bedrock); light grey with black spots, very dense
5						End of Boring at 4.7 feet
						No Groundwater
10						
15						
20						
25						
30						

Geotechnical Boring Log TP-6

Date: March 27, 2015	**Project Name: P & F Properties** **Page: 1 of 1**
Project Number: 15735-10A	**Logged By: SMP**
Drilling Company: Drilling It	**Type of Rig: Mini Excavator**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft):	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Number	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Topsoil:**
					SM	Silty SAND; reddish brown, dry, loose
						Tonalite (Kvt):
					SP	SAND (weathered bedrock); light grey, dry, very dense
5						End of Boring 5 feet
						No Groundwater
10						
15						
20						
25						
30						

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Geotechnical Boring Log TP-7

Date: March 27, 2015	**Project Name: P & F Properties** **Page: 1 of 1**
Project Number: 15735-10A	**Logged By: SMP**
Drilling Company: Drilling It	**Type of Rig: Mini Excavator**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft):	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Number	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Topsoil:**
					SM	Silty SAND; brown, dry, medium dense
						Tonalite (Kvt):
					SP	SAND (weathered bedrock) with gravel; light grey, very dense
						End of Boring at 2.5 feet
5						No Groundwater
10						
15						
20						
25						
30						

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Geotechnical Boring Log TP-8

Date: April 7, 2015	**Project Name: P & F Properties** **Page: 1 of 1**
Project Number: 15735-10A	**Logged By: SMP**
Drilling Company: Drilling It	**Type of Rig: Backhoe**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft):	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Number	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Topsoil:**
					SM	Silty SAND; Reddish brown, dry, loose
5						**Tonalite (Kvt):**
					SP	SAND (weathered bedrock); light grey, dry, very dense
						End of Boring at 5.1 feet
						No Groundwater
10						
15						
20						
25						
30						

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Geotechnical Boring Log TP-9

Date: April 7, 2015	**Project Name: P & F Properties** **Page: 1 of 1**
Project Number: 15735-10A	**Logged By: SMP**
Drilling Company: Drilling It	**Type of Rig: Backhoe**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft):	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Number	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Topsoil:**
					SM	Silty SAND; reddish brown, dry, loose
5						**Tonalite (Kvt):**
					SP	SAND (weathered bedrock); light grey, hard, dry, very dense
						End of Boring at 6 feet
						No Groundwater
10						
15						
20						
25						
30						

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Geotechnical Boring Log TP-10

Date: April 7, 2015	**Project Name: P & F Properties** **Page: 1 of 1**
Project Number: 15735-10A	**Logged By: SMP**
Drilling Company: Drilling It	**Type of Rig: Backhoe**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft):	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Number	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Topsoil:**
					SM	Silty SAND; reddish brown, dry, loose
						Tonalite (Kvt):
5					SP	SAND (wethered bedrock); light grey, hard, dry, very dense
						End of Boring at 5 feet
						No Groundwater
10						
15						
20						
25						
30						

Geotechnical Boring Log TP-11

Date: April 7, 2015	**Project Name: P & F Properties** **Page: 1 of 1**
Project Number: 15735-10A	**Logged By: SMP**
Drilling Company: Drilling It	**Type of Rig: Backhoe**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft):	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Number	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Topsoil:**
					SM	Silty SAND; reddish brown, dry, loose
						Tonalite (Kvt):
					SP	SAND (wethered bedrock); light grey, hard, dry, very dense
						End of Boring at 2.1 feet
5						No Groundwater
10						
15						
20						
25						
30						

Geotechnical Boring Log TP-12

Date: April 7, 2015	**Project Name: P & F Properties** **Page: 1 of 1**
Project Number: 15735-10A	**Logged By: SMP**
Drilling Company: Drilling It	**Type of Rig: Backhoe**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft):	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Number	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Topsoil:**
					SM	Silty SAND; reddish brown, loose, moist
						Tonalite (Kvt):
5					SP	SAND (weathered bedrock); light grey, moist, very dense
						End of Boring at 5 feet
						No Groundwater
10						
15						
20						
25						
30						

Geotechnical Boring Log TP-13

Date: April 7, 2015	**Project Name: P & F Properties** **Page: 1 of 1**
Project Number: 15735-10A	**Logged By: SMP**
Drilling Company: Drilling It	**Type of Rig: Backhoe**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft):	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Number	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Topsoil:**
					SM	Silty SAND; reddish brown, dry, loose
						Tonalite (Kvt):
					SP	SAND (weathered bedrock); light grey, moist, very dense
						End of Boring at 3.8 feet
5						No Groundwater
10						
15						
20						
25						
30						

Geotechnical Boring Log TP-14A

Date: April 7, 2015	**Project Name: P & F Properties** **Page: 1 of 1**
Project Number: 15735-10A	**Logged By: SMP**
Drilling Company: Drilling It	**Type of Rig: Backhoe**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft):	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Number	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Topsoil:**
					SM	Silty SAND; brown, dry, hard, medium-dense
					SP	**Tonalite (Kvt):**
						SAND (weathered bedrock); brown, dry, very dense
5						End of Boring at 3 feet
						No Groundwater
10						
15						
20						
25						
30						

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Geotechnical Boring Log TP-14

Date: April 7, 2015	**Project Name: P & F Properties** **Page: 1 of 1**
Project Number: 15735-10A	**Logged By: SMP**
Drilling Company: Drilling It	**Type of Rig: Backhoe**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft):	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Number	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Topsoil:**
					SM	Silty SAND; reddish brown, dry, loose
						Tonalite (Kvt):
5					SP	SAND (weathered bedrock); light grey, hard, dry, very dense
						End of Boring at 6 feet
						No Groundwater
10						
15						
20						
25						
30						

Geotechnical Boring Log TP-15

Date: April 7, 2015	**Project Name: P & F Properties** **Page: 1 of 1**
Project Number: 15735-10A	**Logged By: SMP**
Drilling Company: Drilling It	**Type of Rig: Backhoe**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft):	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Number	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Topsoil:**
					SM	Silty SAND; reddish brown, dry, loose
						Tonalite (Kvt):
					SP	SAND (weathered bedrock); light grey, hard, dry, very dense
5						End of Boring at 5 feet
						No Groundwater
10						
15						
20						
25						
30						

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Geotechnical Boring Log TP-16

Date: April 7, 2015	**Project Name: P & F Properties** **Page: 1 of 1**
Project Number: 15735-10A	**Logged By: SMP**
Drilling Company: Drilling It	**Type of Rig: Backhoe**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft):	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Number	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Topsoil:**
					SM	Silty SAND; reddish brown, dry, loose
						Tonalite (Kvt):
					SP	SAND (weathered bedrock); light grey, hard, dry, very dense
5						End of Boring at 3.2 feet
						No Groundwater
10						
15						
20						
25						
30						

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Geotechnical Boring Log TP-17

Date: April 7, 2015	**Project Name: P & F Properties** **Page: 1 of 1**
Project Number: 15735-10A	**Logged By: SMP**
Drilling Company: Drilling It	**Type of Rig: Backhoe**
Drive Weight (lbs): 140	**Drop (in): 30** **Hole Diameter (in): 8**
Top of Hole Elevation (ft):	**Hole Location: See Geotechnical Map**

Depth (ft)	Blow Count Per Foot	Sample Number	Dry Density (pcf)	Moisture (%)	Classification Symbol	MATERIAL DESCRIPTION
0						**Topsoil:**
					SM	Silty SAND; reddish brown, dry, loose
5						**Tonalite (Kvt):**
					SP	SAND (weathered bedrock); light grey, hard, dry, very dense
						End of Boring at 5.2 feet
						No Groundwater
10						
15						
20						
25						
30						

APPENDIX C

LABORATORY PROCEDURES AND TEST RESULTS

APPENDIX C

Laboratory Procedures and Test Results

Laboratory testing provided quantitative and qualitative data involving the relevant engineering properties of the representative earth materials selected for testing. The representative samples were tested in general accordance with American Society for Testing and Materials (ASTM) procedures and/or California Test Methods (CTM).

Soil Classification: Earth materials encountered during exploration were classified and logged in general accordance with the Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) of ASTM D 2488. Upon completion of laboratory testing, exploratory logs and sample descriptions were reconciled to reflect laboratory test results with regard to ASTM D 2487.

Moisture and Density Tests: For select samples moisture content was determined using the guidelines of ASTM D 2216 and dry density determinations were made using the guidelines of ASTM D 2937. These tests were performed on relatively undisturbed samples and the test results are presented on the exploratory logs.

Maximum Density Tests: The maximum dry density and optimum moisture content of representative samples were determined using the guidelines of ASTM D 1557. The test results are presented in the table below.

SAMPLE LOCATION	MATERIAL DESCRIPTION	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (%)
B-1 @ 0 to 2 feet	Olive Brown SAND with SILT	133.0	7.5
B-2 @ 0 to 2 feet	Dark Yellowish Brown Silty SAND with trace CLAY	127.0	8.0
TP-1 @ 0 to 3 feet	Dark Brown Silty SAND	125.0	11.5
TP-1 @ 4 to 5 feet	Olive Brown Silty SAND	108.5	10.0

Expansion Index: The expansion potential of representative samples was evaluated using the guidelines of ASTM D 4829. The test results are presented in the table below.

SAMPLE LOCATION	MATERIAL DESCRIPTION	EXPANSION INDEX	EXPANSION POTENTIAL
B-1 @ 0 to 2 feet	Olive Brown SAND with SILT	0	Very Low
B-2 @ 0to 2 feet	Dark Yellowish Brown Silty SAND with trace CLAY	7	Very Low
TP-1 @ 0 to 3 feet	Dark Brown Silty SAND	29	Low
TP-1 @ 4 to 5 feet	Olive Brown Silty SAND	7	Very Low

Minimum Resistivity and pH Tests: Minimum resistivity and pH Tests of select samples were performed using the guidelines of CTM 643. The test results are presented in the table below.

SAMPLE LOCATION	MATERIAL DESCRIPTION	pH	MINIMUM RESISTIVITY (ohm-cm)
B-1 @ 0 to 2 feet	Olive Brown SAND with SILT	7.3	1,000
B-2 @ 0 to 2 feet	Dark Yellowish Brown Silty SAND with trace CLAY	7.1	440
TP-1 @ 0 to 3 feet	Dark Brown Silty SAND	7.2	400
TP-1 @ 4 to 5 feet	Olive Brown Silty SAND	7.8	1,100

Soluble Sulfate: The soluble sulfate content of select samples was determined using the guidelines of CTM 417. The test results are presented in the table below.

SAMPLE LOCATION	MATERIAL DESCRIPTION	SULFATE CONTENT (% by weight)	SULFATE EXPOSURE
B-1 @ 0 to 2 feet	Olive Brown SAND with SILT	0.002	Negigible
B-2 @ 0 to 2 feet	Dark Yellowish Brown Silty SAND with trace CLAY	0.029	Negigible
TP-1 @ 0 to 3	Dark Brown Silty SAND	0.002	Negigible
TP-1 @ 4 to 5 feet	Olive Brown Silty SAND	0.002	Negigible

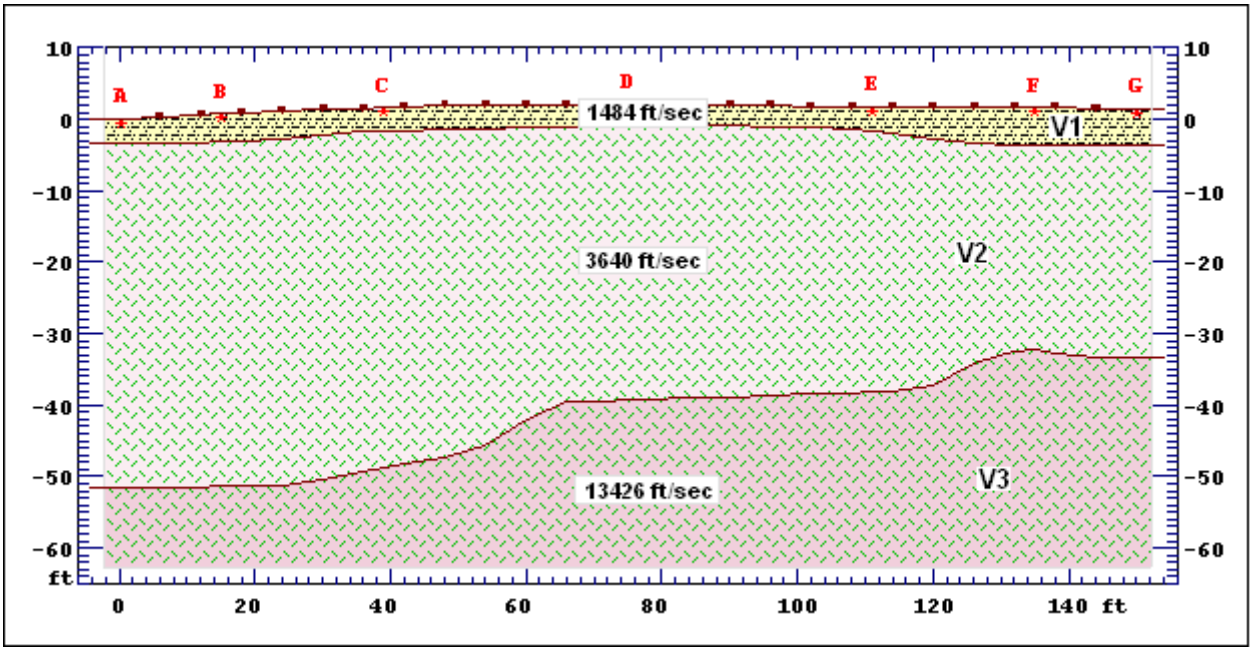
Chloride Content: Chloride content of select samples was determined using the guidelines of CTM 422. The test results are presented in the table below.

SAMPLE LOCATION	MATERIAL DESCRIPTION	CHLORIDE CONTENT (ppm)
B-1 @ 0 to 2 feet	Olive Brown SAND with SILT	50
B-2 @ 0 to 2 feet	Dark Yellowish Brown Silty SAND with trace CLAY	70
TP-1 @ 0 to 3 feet	Dark Brown Silty SAND	60
TP-1 @ 4 to 5 feet	Olive Brown Silty SAND	20

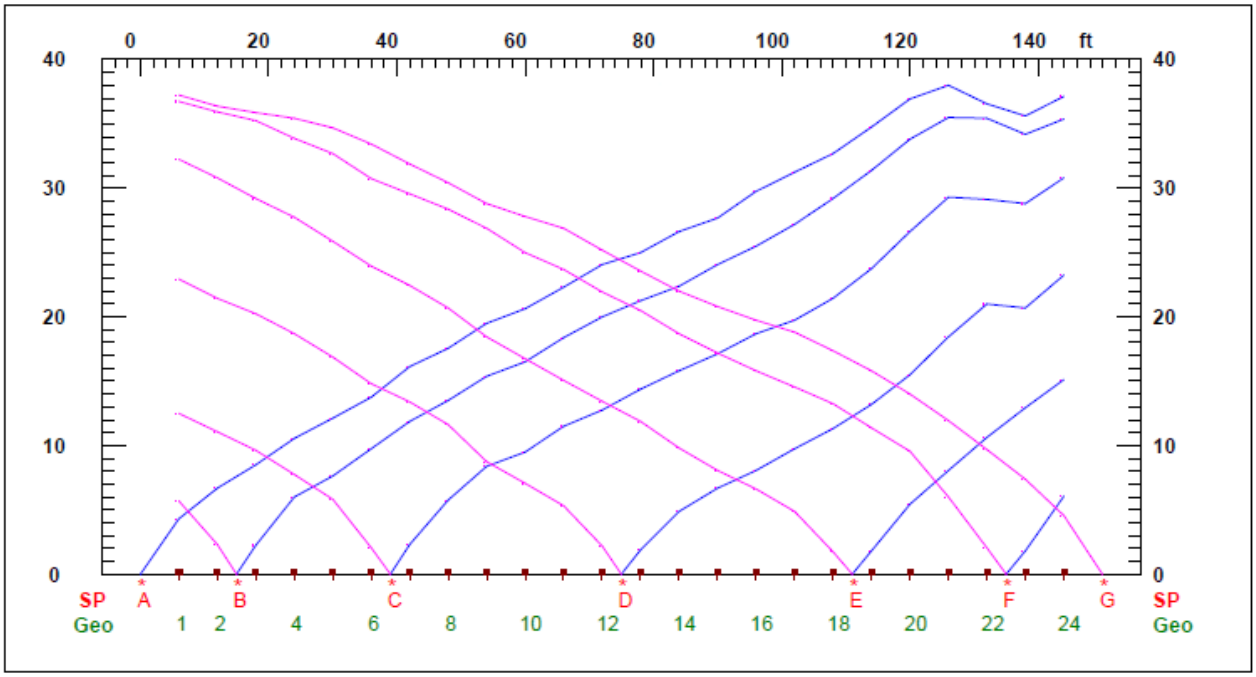
SEISMIC LINE S-1

< South - North >

LAYER VELOCITY MODEL



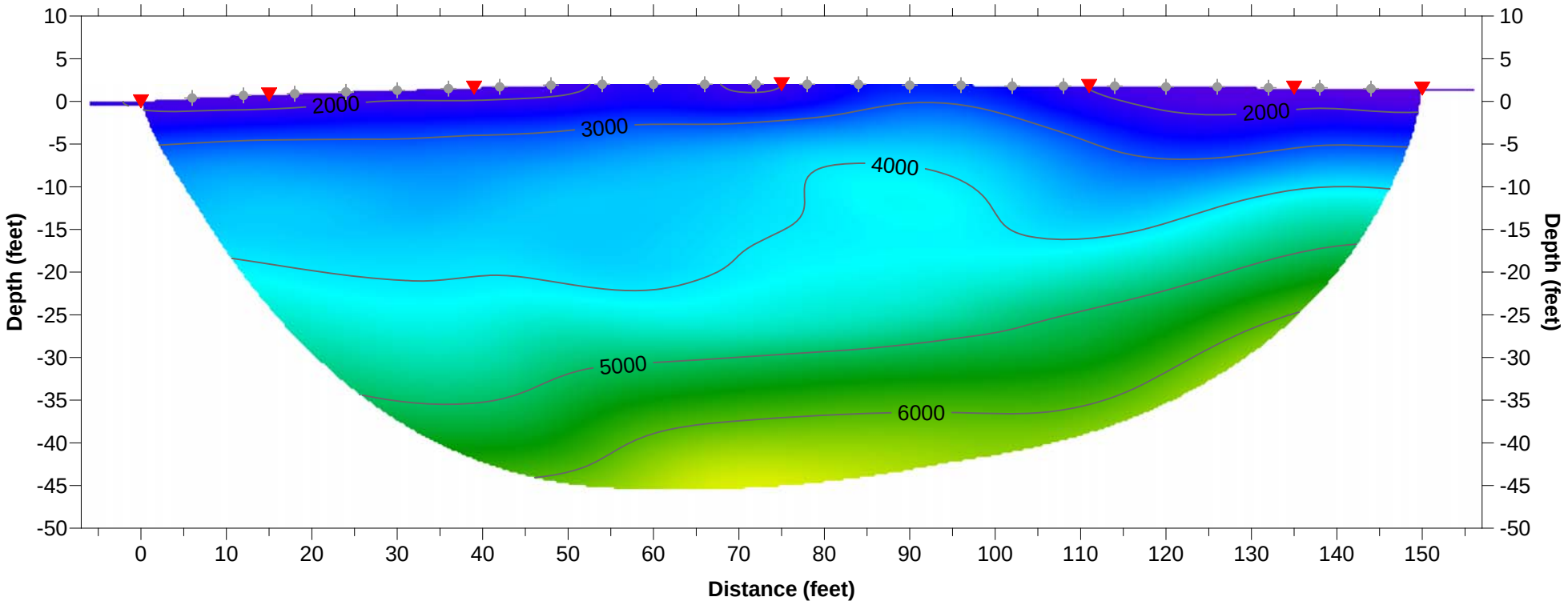
TIME-DISTANCE PLOT



SEISMIC LINE S-1

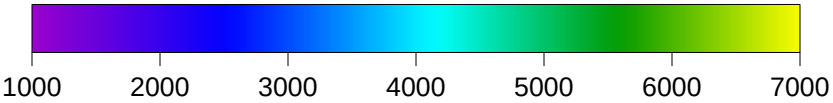
← South - North →

REFRACTION TOMOGRAPHIC MODEL



Seismic Source

Geophone Receiver



P-Wave Velocity (feet/second)

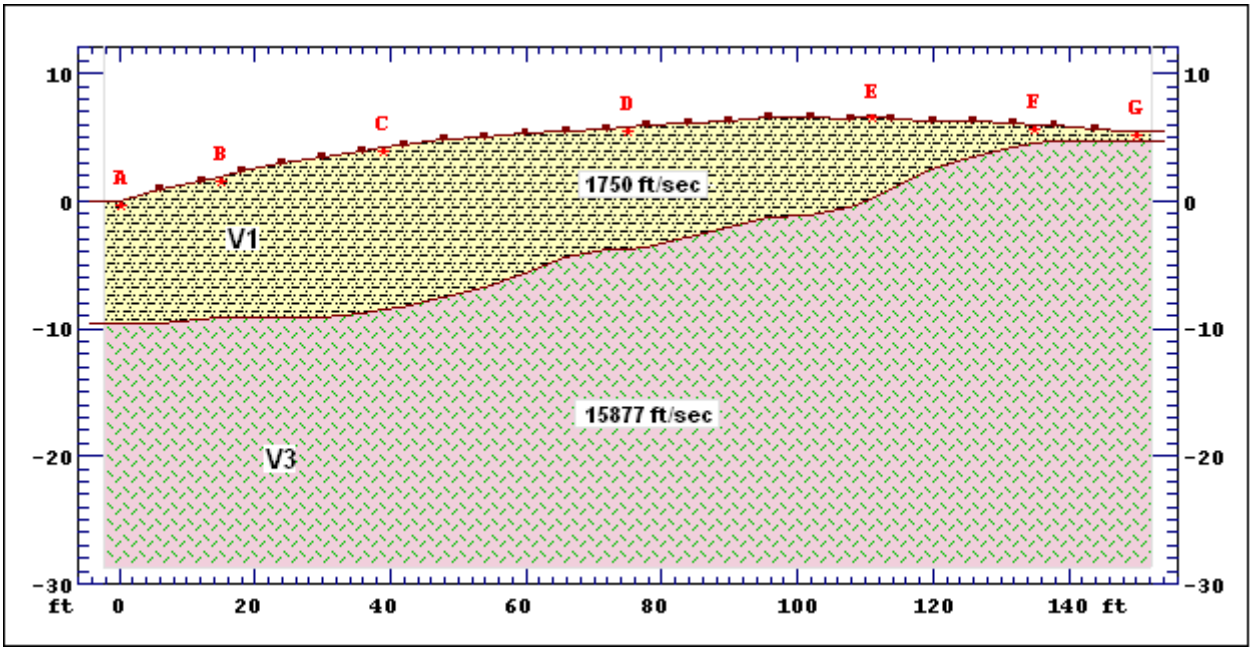
SCALE: 1" = 18' (Horizontal & Vertical)

RMS error 1.4 %, Rayfract Version 3.33

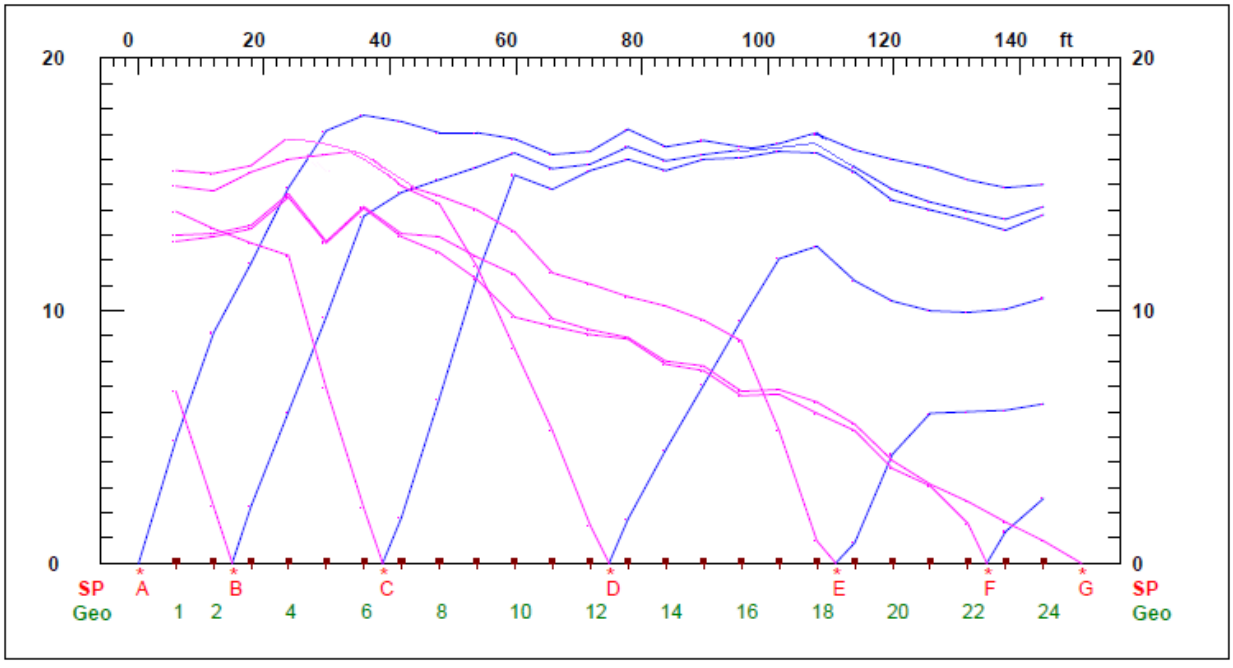
SEISMIC LINE S-2

< South - North >

LAYER VELOCITY MODEL

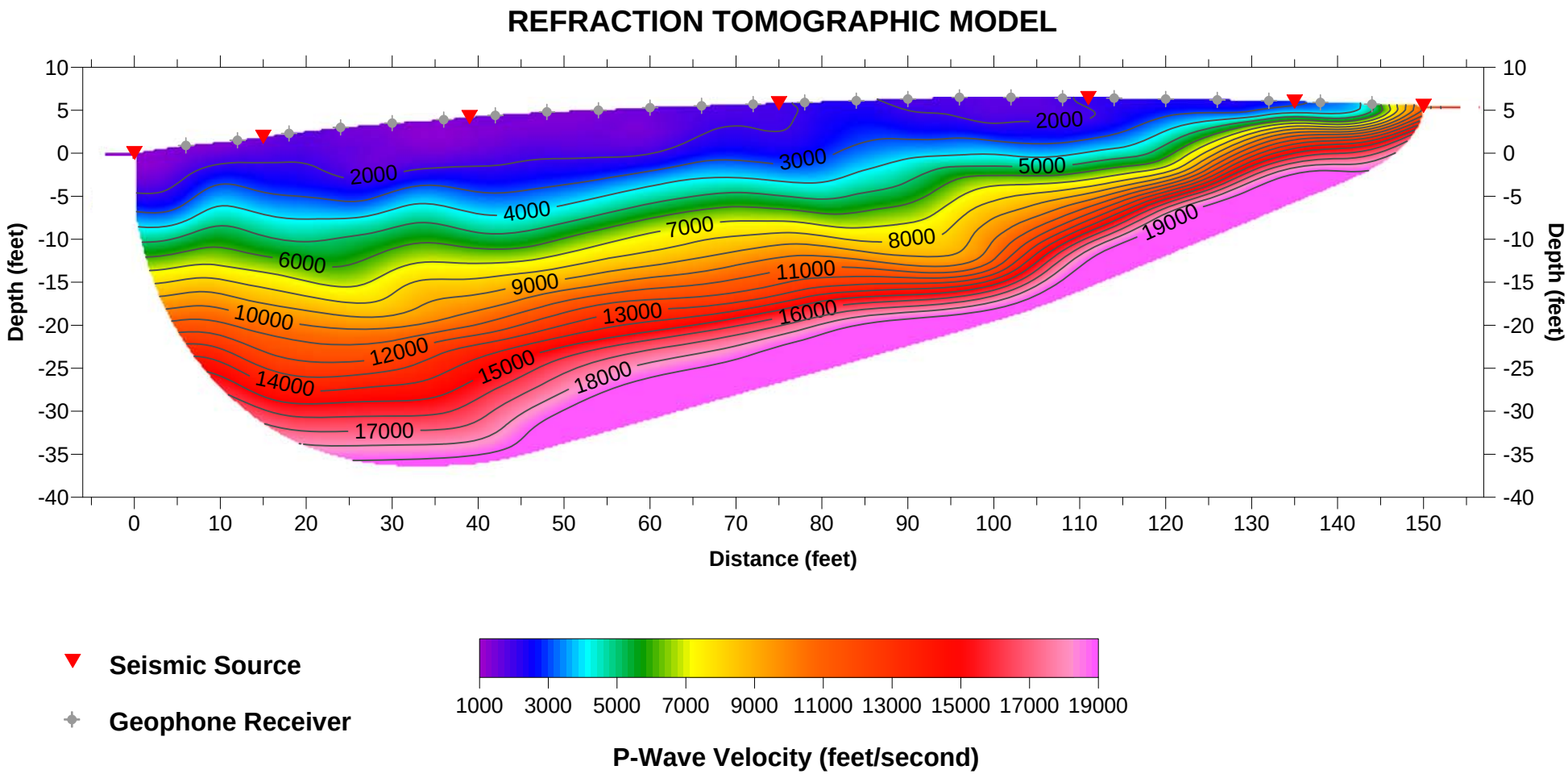


TIME-DISTANCE PLOT



SEISMIC LINE S-2

← South - North →



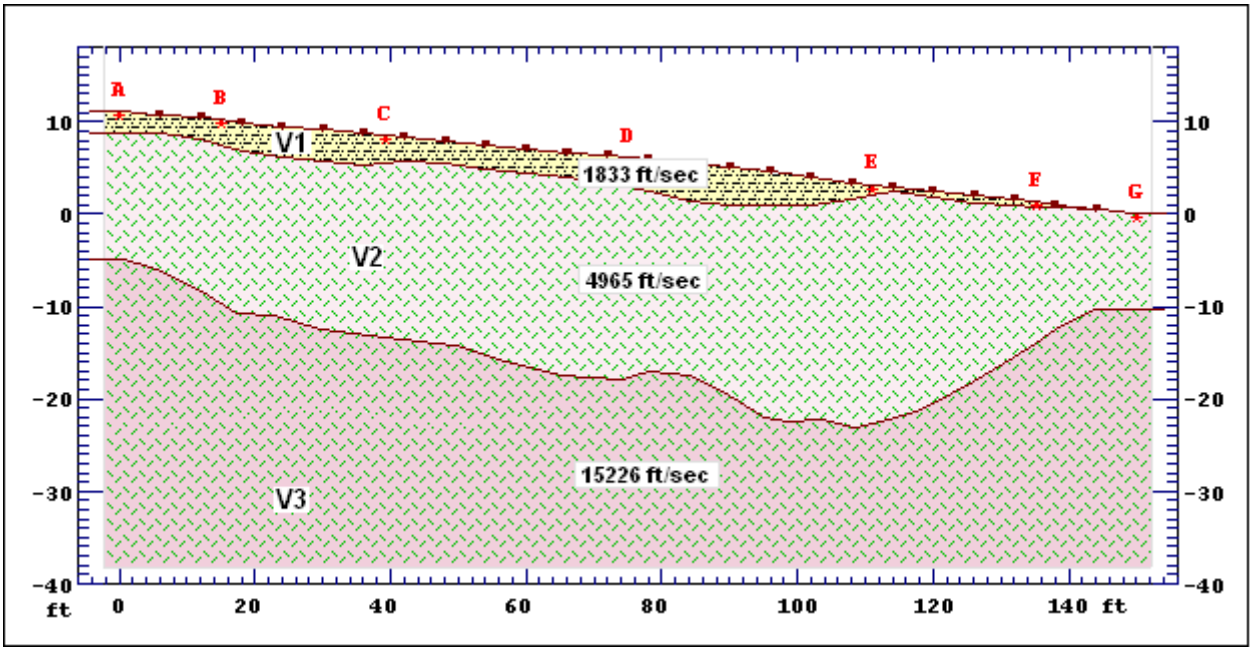
SCALE: 1" = 18' (Horizontal & Vertical)

RMS error 2.9 %, Rayfract Version 3.33

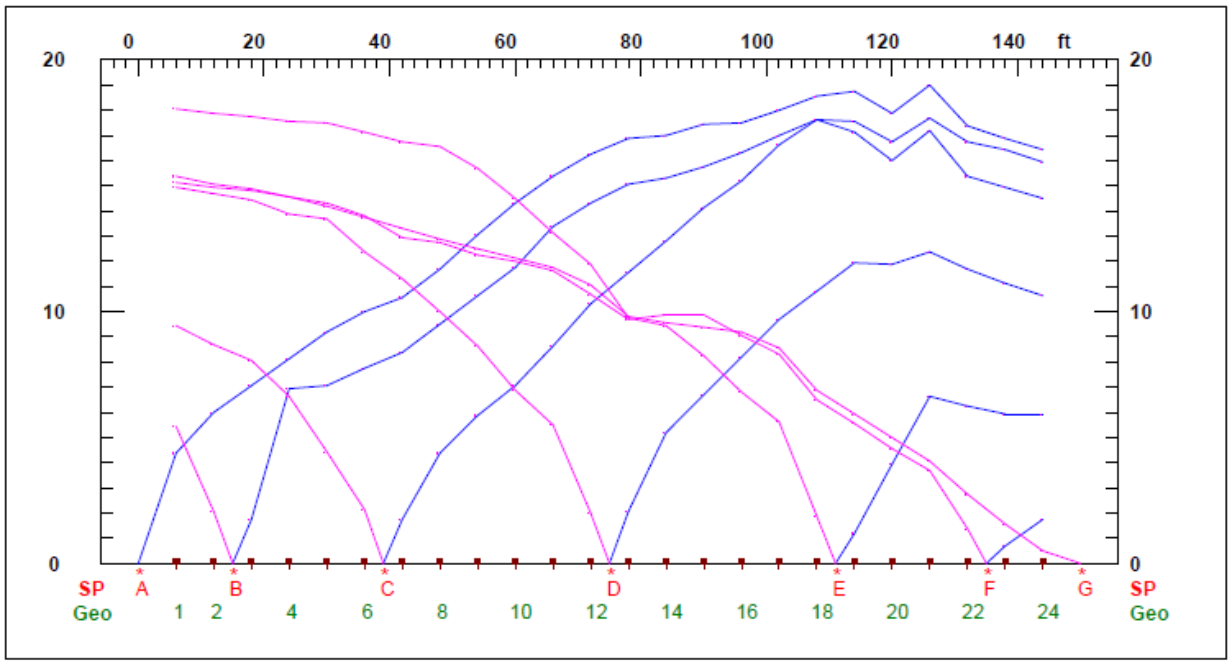
SEISMIC LINE S-3

< South - North >

LAYER VELOCITY MODEL



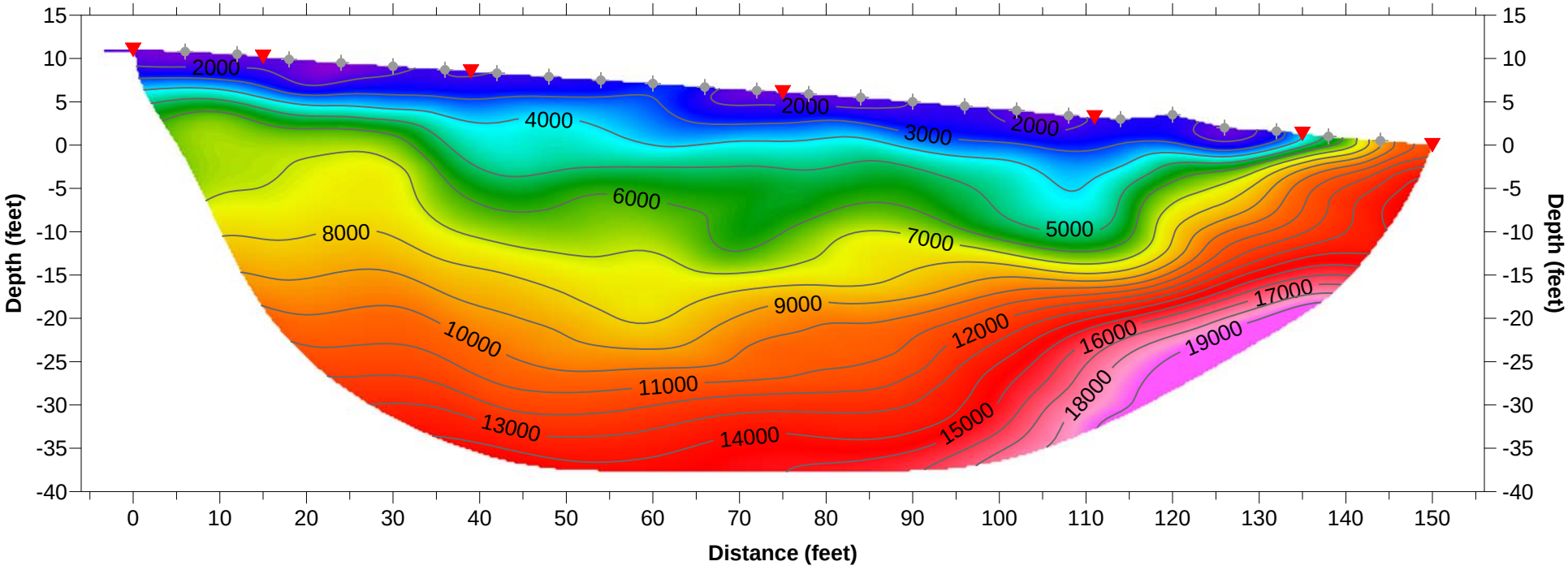
TIME-DISTANCE PLOT



SEISMIC LINE S-3

← South - North →

REFRACTION TOMOGRAPHIC MODEL



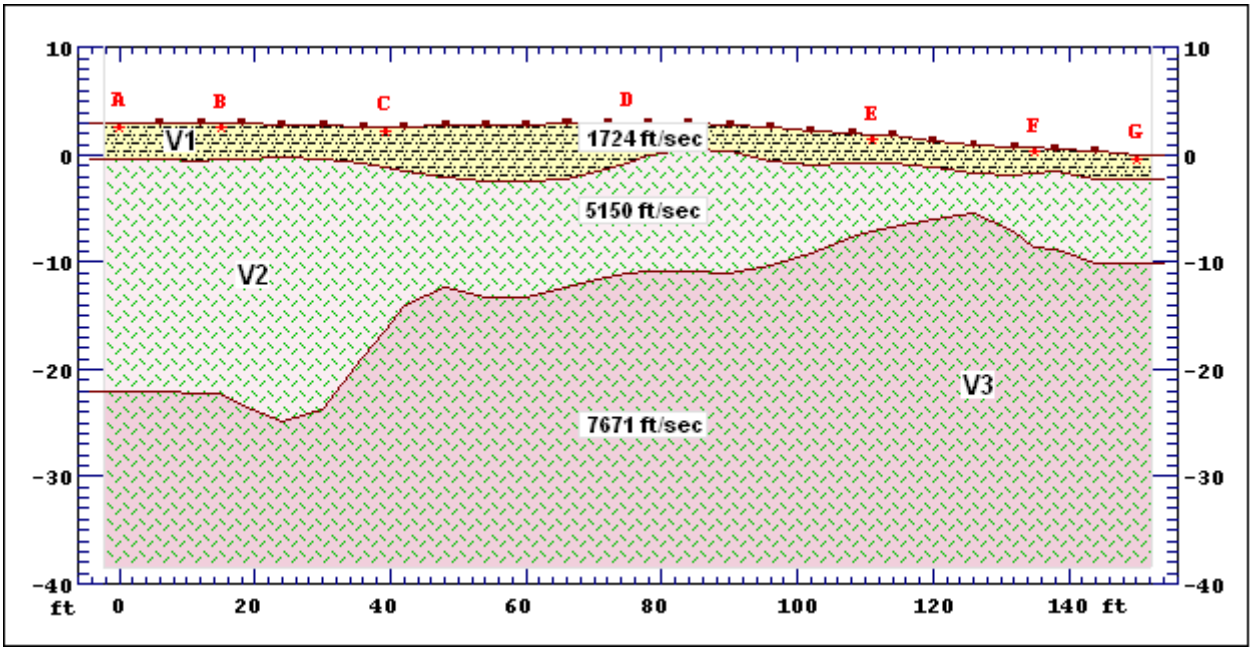
SCALE: 1" = 18' (Horizontal & Vertical)

RMS error 2.4 %, Rayfract Version 3.33

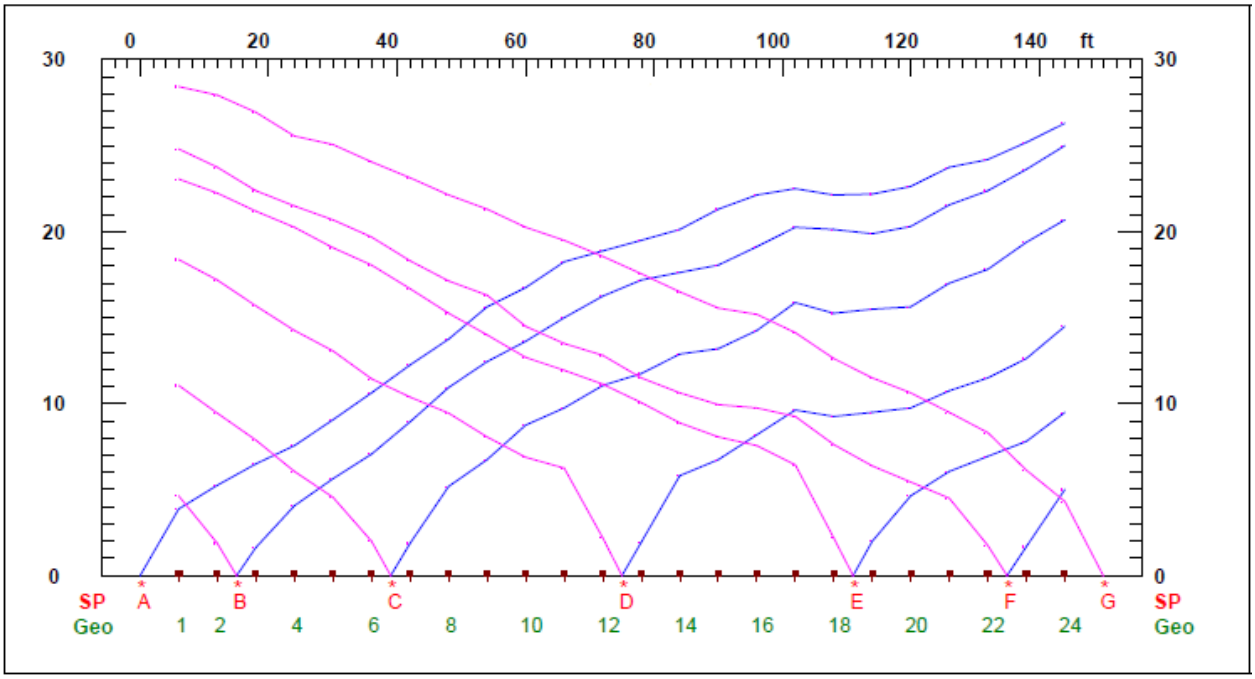
SEISMIC LINE S-4

< West - East >

LAYER VELOCITY MODEL



TIME-DISTANCE PLOT



Additionally, as presented below on Figure 1, the Caterpillar D9R Ripper Performance Chart (Caterpillar, 2012) has been provided for reference.

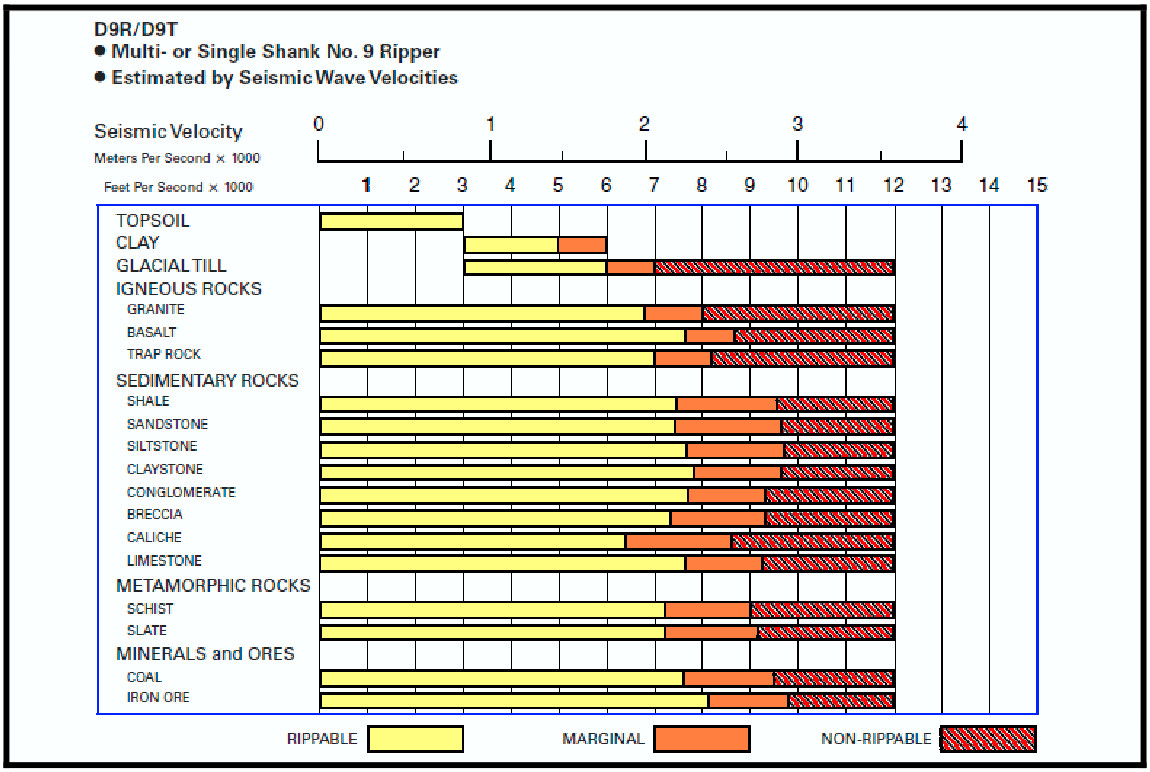
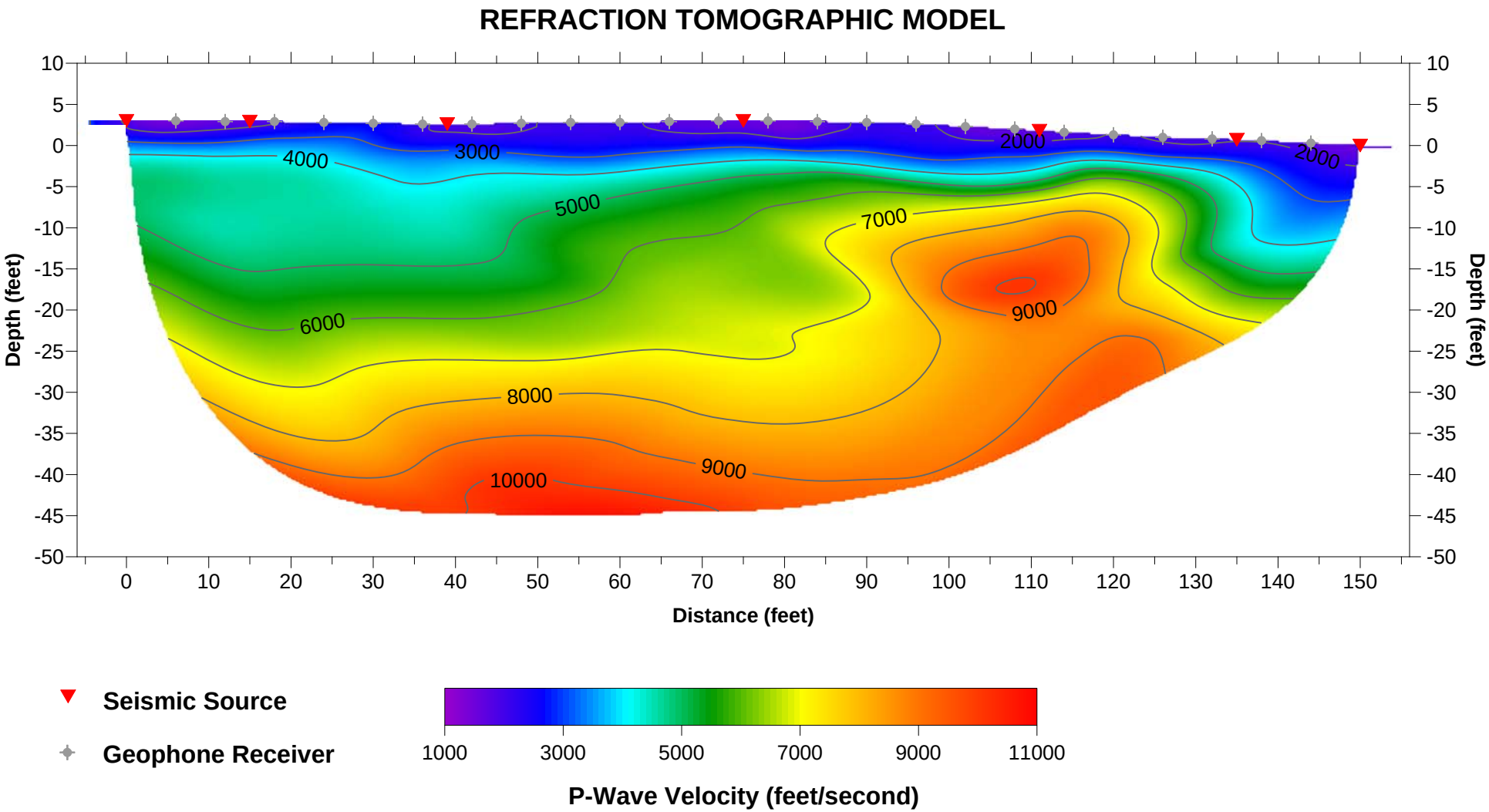


FIGURE 1- Caterpillar D9R Ripper Performance Chart

SEISMIC LINE S-4

← East - West →



SCALE: 1" = 18' (Horizontal & Vertical)

RMS error 1.5 %, Rayfract Version 3.33

APPENDIX B

Generalized Rippability Characteristic of Bedrock

GENERALIZED RIPPABILITY CHARACTERISTICS OF BEDROCK

A summary of the generalized rippability characteristics of bedrock based on a compilation of rippability performance charts prepared by Caterpillar, Inc. (2004), Caltrans (Stephens, 1978), and Santi (2006), has been provided to aid in evaluating potential excavation difficulties with respect to the seismic velocities obtained along the local areas surveyed. These seismic velocity ranges and rippability potentials have been tabulated below for reference.

TABLE 1- CATERPILLAR RIPPABILITY CHART (D9 Ripper)

Granitic Rock Velocity	Rippability
< 6,800	Rippable
6,800 – 8,000	Moderately Rippable
> 8,000	Non-Rippable

Additionally, we have provided the Caltrans Rippability Chart as presented below within Table 2 for comparison. These values are from published Caltrans studies (Stephens, 1978) that are based on their experience which are more conservative than Caterpillar's rippability charts. It should be noted that the type of bedrock was not indicated.

TABLE 2- STANDARD CALTRANS RIPPABILITY CHART

Velocity (feet/sec ±)	Rippability
< 3,500	Easily Ripped
3,500 – 5,000	Moderately Difficult
5,000 – 6,600	Difficult Ripping / Light Blasting
> 6,600	Blasting Required

Table 3 is partially modified from the "Engineering Behavior from Weathering Grade" as presented by Santi (2006), which also provides velocity ranges with respect to rippability potentials, along with other rock engineering properties that may be pertinent.

TABLE 3- SUMMARY OF ROCK ENGINEERING PROPERTIES

ENGINEERING PROPERTY:	Slightly Weathered	Moderately Weathered	Highly Weathered	Completely Weathered
Excavatability	Blasting necessary	Blasting to rippable	Generally rippable	Rippable
Slope Stability	½ :1 to 1:1 (H:V)	1:1 (H:V)	1:1 to 1.5:1 (H:V)	1.5:1 to 2:1 (H:V)
Schmidt Hammer Value	51 – 56	37 – 48	12 – 21	5 – 20
Seismic Velocity (fps)	8,200 – 13,125	5,000 – 10,000	3,300 – 6,600	1,650 – 3,300

APPENDIX B

LOGS OF EXPLORATORY TRENCHES BY GEOTEK

Updated Geotechnical Evaluation
Proposed Single-Family Residential Development
Woodcrest, Riverside County, California
Project No. 2855-CR

GEOTEK

A - FIELD TESTING AND SAMPLING PROCEDURES

Bulk Samples (Large)
These samples are normally large bags of 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 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 – TRENCH LOG LEGEND

The following abbreviations and symbols often appear in the classification and description of soil and rock on the logs of 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 the trench

(Additional denotations and symbols are provided on the logs of trenches)

GeoTek, Inc.

LOG OF EXPLORATORY TRENCH

CLIENT:	TTLC Management Inc., An Arizona Corp.	**LOGGED BY:**	DA
PROJECT NAME:	Proposed Single-Family Residential Development	**EQUIPMENT:**	Backhoe
PROJECT NO.:	2855-CR	**DATE:**	8/30/2021
LOCATION:	Woodcrest, CA		

Depth (ft)	SAMPLES: Sample Type	SAMPLES: DCP Blow Count	USCS Symbol	**TRENCH NO.: T-1** / MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)	Rel. Comp. (%)	Others
				Disturbed Soil/Undocumented Fill				
			SM	Silty m-c SAND with some clay, light brown, slightly moist				
				Alluvium				
			SC	Clayey m-c SAND, red-brown, very moist				
5				**Granitic Bedrock** Tonalite, red-yellow, slightly moist, relatively easy to excavate - Becomes hard to excavate, 2-3 scratches for 1/4 bucket				
10				**TRENCH TERMINATED AT 10 FEET DUE TO REFUSAL** No groundwater encountered Trench backfilled with soil cuttings				
15								

LEGEND

Sample type: ---Ring ---Large Bulk ---Water Table

Lab testing: ND = Nuclear Density Test; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY TRENCH

CLIENT:	TTLC Management Inc., An Arizona Corp.	**LOGGED BY:**	DA
PROJECT NAME:	Proposed Single-Family Residential Development	**EQUIPMENT:**	Backhoe
PROJECT NO.:	2855-CR	**DATE:**	8/30/2021
LOCATION:	Woodcrest, CA		

Depth (ft)	SAMPLES: Sample Type	SAMPLES: DCP Blow Count	USCS Symbol	TRENCH NO.: T-2 / MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)	Rel. Comp. (%)	Others
				Disturbed Soil/Undocumented Fill				
			SM	Silty m-c SAND with some clay, light brown, slightly moist, some pvc pipe				
				Alluvium				
			SM	Silty m-c SAND with some clay, light brown, moist, some granite fragments				
				Granitic Bedrock				
				Tonalite, excavates as m-c SAND, moist, yellowish tan, relatively easy to excavate				
5				-Becomes gray @ 5.0 feet				
10								
				TRENCH TERMINATED AT 13 FEET				
				No groundwater encountered				
15				Trench backfilled with soil cuttings				

LEGEND

Sample type: ---Ring ---Large Bulk ---Water Table

Lab testing: ND = Nuclear Density Test; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.
LOG OF EXPLORATORY TRENCH

CLIENT:	TTLC Management Inc., An Arizona Corp.	**LOGGED BY:**	DA
PROJECT NAME:	Proposed Single-Family Residential Development	**EQUIPMENT:**	Backhoe
PROJECT NO.:	2855-CR	**DATE:**	8/30/2021
LOCATION:	Woodcrest, CA		

TRENCH NO.: T-3

Depth (ft)	SAMPLES: Sample Type	SAMPLES: DCP Blow Count	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Rel. Comp. (%)	Laboratory Testing: Others
				Disturbed Soil/Undocumented Fill				
			SM	Silty f SAND, light brown, slightly moist, loose, some rootlets				
	X			**Alluvium**				Expansion Index = 17
			ML	Sandy SILT with some clay, red-brown, moist to very moist				Corrosion Testing
								Remolded Shear Test
								Maximum Density Test
				Granitic Bedrock				
				Tonalite, excavates as m-c sand, yellowish tan, relatively easy to excavate				
5								
				- Becomes medium hard to excavate, 2-3 scratches for 1/2 bucket				
10								
				TRENCH TERMINATED AT 10.5 FEET				
				No groundwater encountered				
				Trench backfilled with soil cuttings				
15								

LEGEND

Sample type: ---Ring; ---Large Bulk; ---Water Table

Lab testing: ND = Nuclear Density Test; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.
LOG OF EXPLORATORY TRENCH

CLIENT:	TTLC Management Inc., An Arizona Corp.	**LOGGED BY:**	DA
PROJECT NAME:	Proposed Single-Family Residential Development	**EQUIPMENT:**	Backhoe
PROJECT NO.:	2855-CR	**DATE:**	8/30/2021
LOCATION:	Woodcrest, CA		

TRENCH NO.: T-4

Depth (ft)	SAMPLES: Sample Type	SAMPLES: DCP Blow Count	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Rel. Comp. (%)	Laboratory Testing: Others
				Disturbed Soil/Undocumented Fill				
			SM	Silty f SAND, light brown, dry to slightly moist, loose, some rootlets				
				Alluvium				
			SM	Silty f SAND, brown, moist, some rootlets				
				Granitic Bedrock				
				Tonalite, excavates as m-c sand, orange black, easy to medium hard to excavate				
5								
10								
				TRENCH TERMINATED AT 14.0 FEET				
15				No groundwater encountered Trench backfilled with soil cuttings				

LEGEND

Sample type: ---Ring ---Large Bulk ---Water Table

Lab testing: ND = Nuclear Density Test; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.
LOG OF EXPLORATORY TRENCH

CLIENT:	TTLC Management Inc., An Arizona Corp.	**LOGGED BY:**	DA
PROJECT NAME:	Proposed Single-Family Residential Development	**EQUIPMENT:**	Backhoe
PROJECT NO.:	2855-CR	**DATE:**	8/30/2021
LOCATION:	Woodcrest, CA		

Depth (ft)	SAMPLES: Sample Type	SAMPLES: DCP Blow Count	USCS Symbol	TRENCH NO.: T-5 / MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)	Rel. Comp. (%)	Others
				Disturbed Soil/Undocumented Fill				
			SM	Silty f SAND, light brown, dry to slightly moist, loose, some rootlets				
				Alluvium				
			SM	Silty f SAND, brown, moist, some rootlets				
			SP	F-m SAND with some silt and clay, moderate brown, very moist				
5		▽		**Granitic Bedrock** Tonalite, excavates as m-c sand, black-gray, Relatively easy to excavate				
10				**TRENCH TERMINATED AT 8.0 FEET** Groundwater encountered at 6.5 feet Trench backfilled with soil cuttings				
15								

LEGEND

Sample type: ---Ring ---Large Bulk ▽ ---Water Table

Lab testing: ND = Nuclear Density Test; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY TRENCH

CLIENT:	TTLC Management Inc., An Arizona Corp.	**LOGGED BY:**	DA
PROJECT NAME:	Proposed Single-Family Residential Development	**EQUIPMENT:**	Backhoe
PROJECT NO.:	2855-CR	**DATE:**	8/30/2021
LOCATION:	Woodcrest, CA		

Depth (ft)	SAMPLES: Sample Type	SAMPLES: DCP Blow Count	USCS Symbol	TRENCH NO.: T-6 / MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Rel. Comp. (%)	Laboratory Testing: Others
				Disturbed Soil/Undocumented Fill				
			SM	Silty f-m SAND with some clay, light brown, slightly moist, some rootlets				
				Alluvium				
			SM	Silty f-m SAND with some clay, brown, moist, some rootlets				
			SC	Clayey m-c SAND with some granitic fragments, red-brown, moist				
5				**Granitic Bedrock**				
				Tonalite, red-brown, moist, very hard to excavate				
				TRENCH TERMINATED AT 5 FEET DUE TO REFUSAL				
				No groundwater encountered				
				Trench backfilled with soil cuttings				
10								
15								

LEGEND

Sample type: ---Ring ---Large Bulk ---Water Table

Lab testing: ND = Nuclear Density Test; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.
LOG OF EXPLORATORY TRENCH

CLIENT:	TTLC Management Inc., An Arizona Corp.	**LOGGED BY:**	DA
PROJECT NAME:	Proposed Single-Family Residential Development	**EQUIPMENT:**	Backhoe
PROJECT NO.:	2855-CR	**DATE:**	8/30/2021
LOCATION:	Woodcrest, CA		

Depth (ft)	SAMPLES: Sample Type	SAMPLES: DCP Blow Count	USCS Symbol	TRENCH NO.: T-7 / MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Rel. Comp. (%)	Laboratory Testing: Others
				Disturbed Soil/Undocumented Fill				
			SM	Silty f-m SAND with some clay, light brown, slightly moist, some rootlets				
				Alluvium				
			SM	Silty f-m SAND with some clay and granite fragments, brown, moist, some rootlets and cobbles				Expansion Index = 0
	X		SC	Clayey m-c SAND, red-brown, very moist				Corrosion Testing
								Remolded Shear Test
								Maximum Density Test
				-Becomes yellowish red-brown				
5				**Granitic Bedrock**				
				Tonalite, yellow-tan, moist, easy to excavate				
				- Becomes hard to excavate, 3 scratches for 1/4 bucket				
10				**TRENCH TERMINATED AT 10.5 FEET**				
				No groundwater encountered				
				Trench backfilled with soil cuttings				
15								

LEGEND

Sample type: ---Ring ---Large Bulk ---Water Table

Lab testing: ND = Nuclear Density Test; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.
LOG OF EXPLORATORY TRENCH

CLIENT:	TTLC Management Inc., An Arizona Corp.	**LOGGED BY:**	DA
PROJECT NAME:	Proposed Single-Family Residential Development	**EQUIPMENT:**	Backhoe
PROJECT NO.:	2855-CR	**DATE:**	8/30/2021
LOCATION:	Woodcrest, CA		

TRENCH NO.: T-8

Depth (ft)	SAMPLES: Sample Type	SAMPLES: DCP Blow Count	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Rel. Comp. (%)	Laboratory Testing: Others
				Disturbed Soil/Undocumented Fill				
			SM	Silty f SAND, light brown, dry to slightly moist, loose, some rootlets				
				Alluvium				
			SC	Clayey f-m SAND with some silt, red-brown, moist				
				Granitic Bedrock				
				Tonalite, excavates as m-c sand, yellowish tan, easy to excavate				
5				- Becomes hard to excavate, 2-3 scratches for 1/4 bucket				
				TRENCH TERMINATED AT 7.0 FEET DUE TO REFUSAL				
				No groundwater encountered				
				Trench backfilled with soil cuttings				
10								
15								

LEGEND

Sample type: ---Ring ---Large Bulk ---Water Table

Lab testing: ND = Nuclear Density Test; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

GeoTek, Inc.
LOG OF EXPLORATORY TRENCH

CLIENT:	TTLC Management Inc., An Arizona Corp.	**LOGGED BY:**	DA
PROJECT NAME:	Proposed Single-Family Residential Development	**EQUIPMENT:**	Backhoe
PROJECT NO.:	2855-CR	**DATE:**	8/30/2021
LOCATION:	Woodcrest, CA		

Depth (ft)	SAMPLES: Sample Type	SAMPLES: DCP Blow Count	USCS Symbol	TRENCH NO.: T-9 / MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)	Rel. Comp. (%)	Others
				Disturbed Soil/Undocumented Fill				
			SM	Silty f SAND, light brown, dry to slightly moist, loose, some rootlets				
				Alluvium				
			SM-SC	Silty f SAND with clay, red-brown, moist				
				Granitic Bedrock				
				Tonalite, excavates as m-c sand, black-orange, easy to excavate				
5								
10				**TRENCH TERMINATED AT 10.0 FEET**				
				No groundwater encountered				
				Trench backfilled with soil cuttings				
15								

LEGEND

Sample type: ---Ring ---Large Bulk ---Water Table

Lab testing: ND = Nuclear Density Test; EI = Expansion Index; SA = Sieve Analysis; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; HC= Consolidation; MD = Maximum Density

APPENDIX C

LABORATORY TEST RESULTS BY GEOTEK

Updated Geotechnical Evaluation
Proposed Single-Family Residential Development
Woodcrest, Riverside County, California
Project No. 2855-CR

GEOTEK

SUMMARY OF LABORATORY TESTING

Direct Shear
Shear testing was performed in a direct shear machine of the strain-control type in general accordance with ASTM D 3080 test procedures. The rate of deformation was approximately 0.035 inch per minute. The sample was sheared under varying confining loads in order to determine the coulomb shear strength parameters, angle of internal friction and cohesion. The tests were performed on soil samples remolded to approximately 90 percent of maximum dry density as determined by ASTM D 1557 test procedures. The shear test results are presented in Appendix C.

Expansion Index
Expansion Index testing was performed on two soil samples. Testing was performed in general accordance with ASTM Test Method D 4829. The results of the testing are provided below and in Appendix C.

Trench No.	Depth (ft.)	Description	Expansion Index	Classification
T-3	1-2	Sandy Silt with Clay	17	Very Low
T-7	2-3	Silty Sand with Clay	0	Very Low

Moisture-Density Relationship
Laboratory testing was performed on two samples collected during the subsurface exploration. The laboratory maximum dry density and optimum moisture content for the soil type was determined in general accordance with ASTM Test D 1557 test procedures. The results of the testing are provided in Appendix C.

Sulfate Content, Resistivity and Chloride Content
Testing to determine the water-soluble sulfate content was performed by others in general accordance with ASTM D4327 test procedures. Resistivity testing was completed by others in general accordance with ASTM G187 test procedures. Testing to determine the chloride content was performed by others in general accordance with ASTM D4327 test procedures. The results of the testing are provided below and in Appendix B.

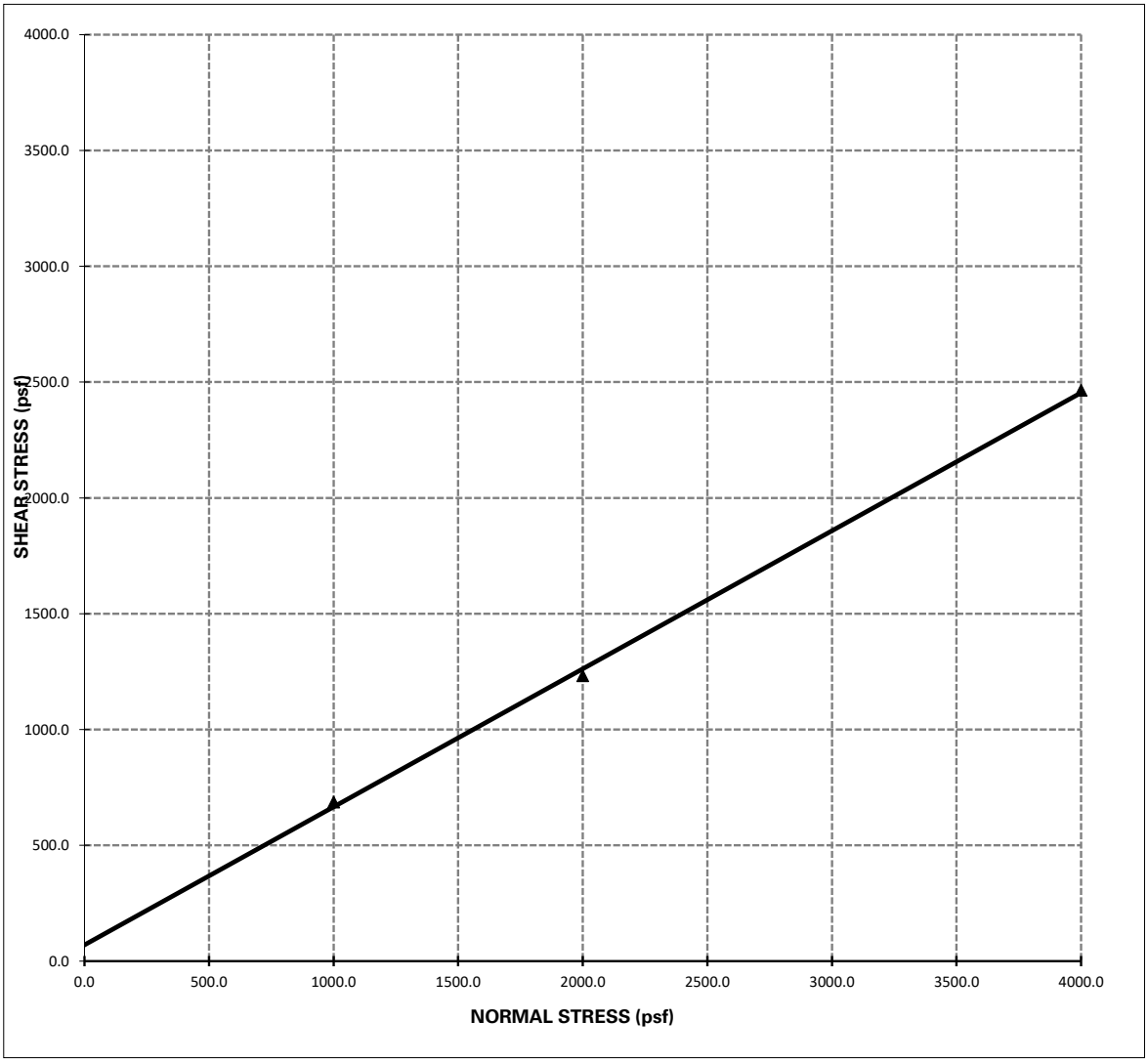
Trench No.	Depth (ft.)	pH ASTM D4972	Chloride ASTM D4327 (mg/kg)	Sulfate ASTM D4327 (% by weight)	Resistivity ASTM G187 (ohm-cm)
T-3	1-2	7.7	135.9	0.0278	804
T-7	2-3	8.3	15.5	0.0047	3,685

GEOTEK

DIRECT SHEAR TEST

Project Name:	The True Life Comapanies	***Sample Location:***	T3 @ 1-2'
Project Number:	2855-CR	***Date Tested:***	9/15/2021

PEAK VALUE



Shear Strength: **Φ = 31 °** , **C = 70 psf**

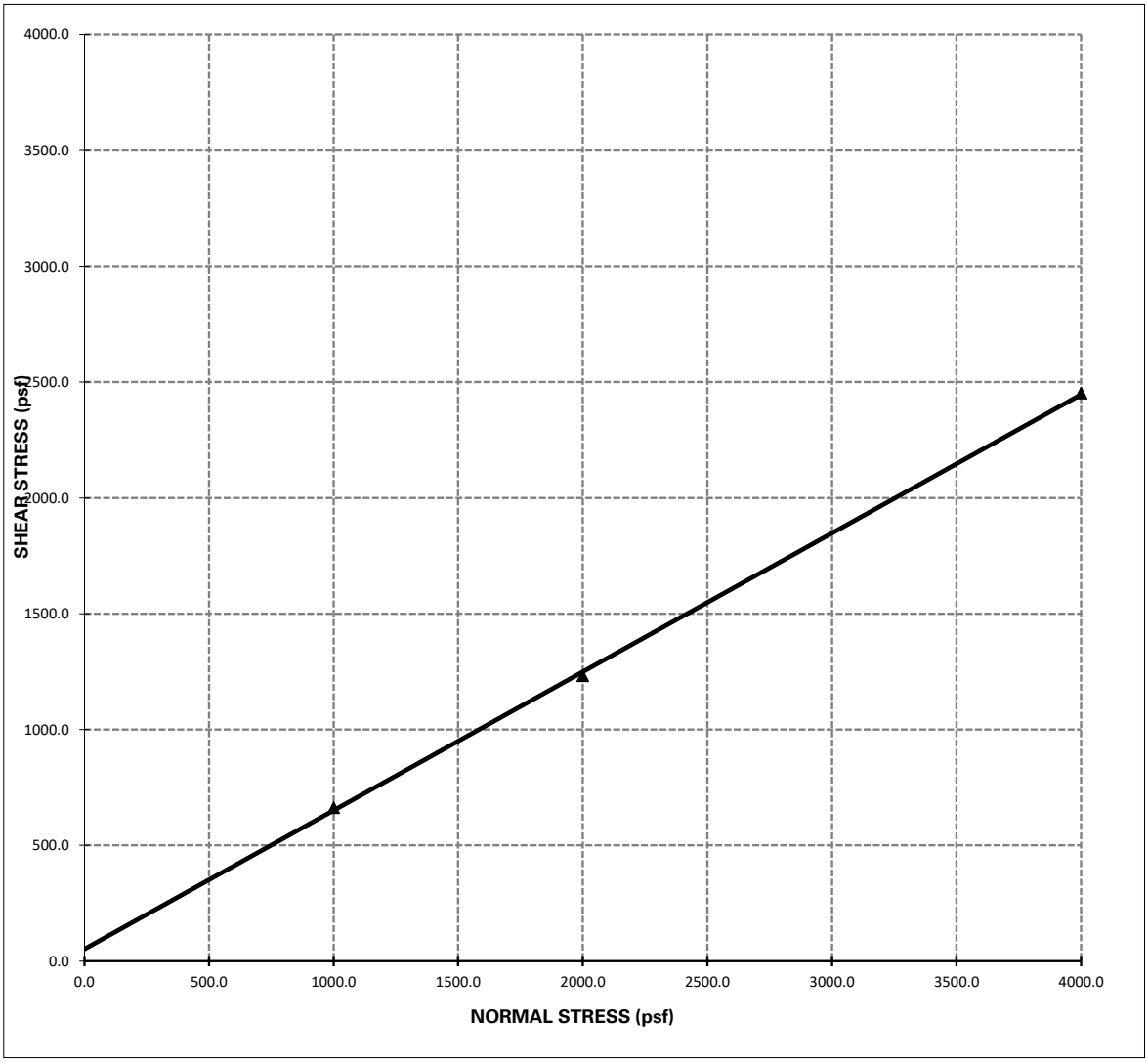
Notes: 1 - The soil specimen used in the shear box was a ring sample remolded to approximately 90% relative compaction from a bulk sample collected during the field investigation.

2 - The above reflect direct shear strength at saturated conditions.

3 - The tests were run at a shear rate of 0.035 in/min.

DIRECT SHEAR TEST

Project Name:	The True Life Comapanies	***Sample Location:***	T3 @ 1-2'
Project Number:	2855-CR	***Date Tested:***	9/15/2021



Shear Strength: Φ = **31°** **C = 52 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.

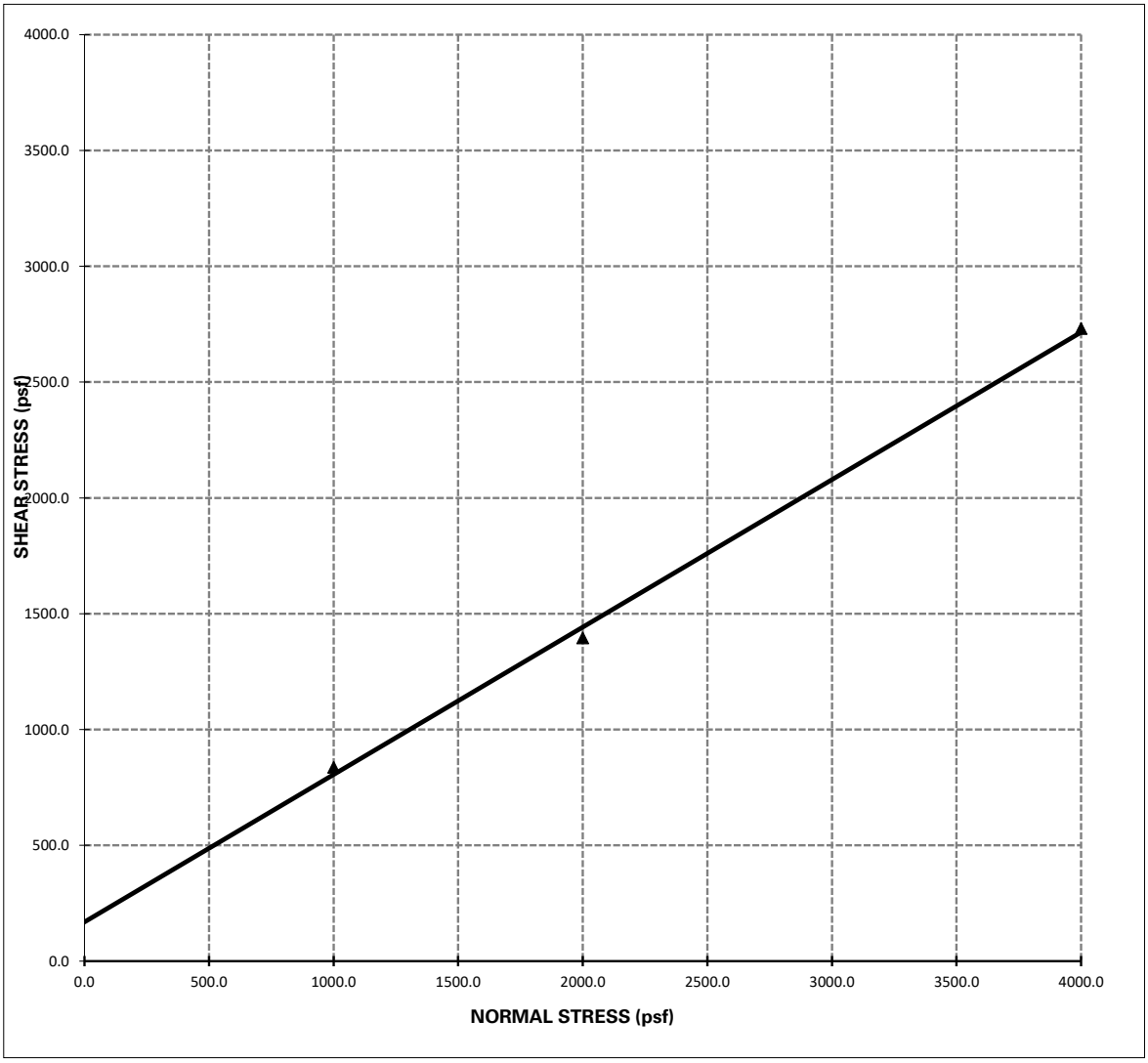
2 - The above reflect direct shear strength at saturated conditions.

3 - The tests were run at a shear rate of 0.035 in/min.

DIRECT SHEAR TEST

Project Name:	The True Life Comapanies	***Sample Location:***	T7 @ 2-3'
Project Number:	2855-CR	***Date Tested:***	9/15/2021

PEAK VALUE



Shear Strength: Φ = **32** ° , **C = 169 psf**

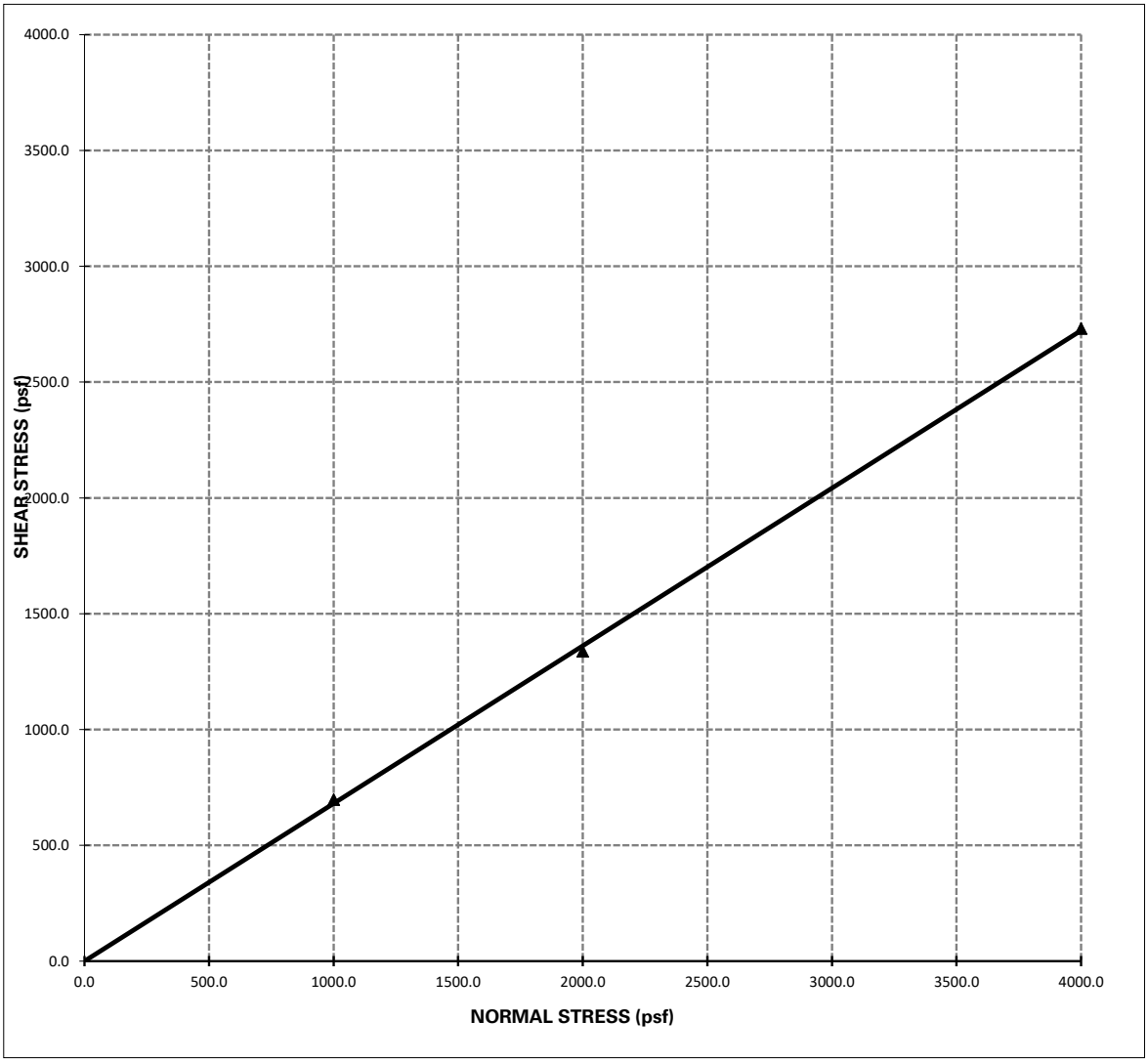
Notes: 1 - The soil specimen used in the shear box was a ring sample remolded to approximately 90% relative compaction from a bulk sample collected during the field investigation.

2 - The above reflect direct shear strength at saturated conditions.

3 - The tests were run at a shear rate of 0.035 in/min.

DIRECT SHEAR TEST

Project Name:	The True Life Comapanies	***Sample Location:***	T7 @ 2-3'
Project Number:	2855-CR	***Date Tested:***	9/15/2021



Shear Strength: Φ = **34** ° , **C = 0 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.

GEOTEK

EXPANSION INDEX TEST

(ASTM D4829)

Client:	The True Life Companies	***Tested/ Checked By:***	EB Lab No Corona
Project Number:	2855-CR	***Date Tested:***	9/9/2021
Project Location:	NW Iris Ave & Chicago Ave, Woodcrest	***Sample Source:***	T3 @ 1-2
		Sample Description:	

Ring #:_____ Ring Dia. : 4.01" Ring Ht.:1"

DENSITY DETERMINATION

A	Weight of compacted sample & ring (gm)	773.7
B	Weight of ring (gm)	363.8
C	Net weight of sample (gm)	**409.9**
D	Wet Density, lb / ft3 (C*0.3016)	**123.6**
E	Dry Density, lb / ft3 (D/1.F)	**113.5**

SATURATION DETERMINATION

F	Moisture Content, %	8.9
G	Specific Gravity, assumed	**2.70**
H	Unit Wt. of Water @ 20°C, (pcf)	**62.4**
I	% Saturation	**49.6**

READINGS

DATE	TIME	READING	
9/9/2021		0.2070	Initial
9/9/2021		0.2070	10 min/Dry
9/10/2021		0.2240	Final

FINAL MOISTURE

Final Weight of wet sample & tare	% Moisture
803.9	**16.3**

EXPANSION INDEX = 17

GEOTEK

EXPANSION INDEX TEST

(ASTM D4829)

Client:	The True Life Companies	***Tested/ Checked By:***	RL Lab No Corona
Project Number:	2855-CR	***Date Tested:***	9/9/2021
Project Location:	NW Iris Ave & Chicago Ave, Woodcrest	***Sample Source:***	T3 @ 1-2
		Sample Description:	

Ring #:_____ Ring Dia. : 4.01" Ring Ht.:1"

DENSITY DETERMINATION

A	Weight of compacted sample & ring (gm)	770.9
B	Weight of ring (gm)	363.0
C	Net weight of sample (gm)	**407.9**
D	Wet Density, lb / ft3 (C*0.3016)	**123.0**
E	Dry Density, lb / ft3 (D/1.F)	**112.9**

SATURATION DETERMINATION

F	Moisture Content, %	9.0
G	Specific Gravity, assumed	**2.70**
H	Unit Wt. of Water @ 20°C, (pcf)	**62.4**
I	% Saturation	**49.3**

READINGS

DATE	TIME	READING	
9/9/2021		0.6110	Initial
9/9/2021		0.6130	10 min/Dry
9/10/2021		0.6130	Final

FINAL MOISTURE

Final Weight of wet sample & tare	% Moisture
776.2	**10.3**

EXPANSION INDEX = 0

GEOTEK

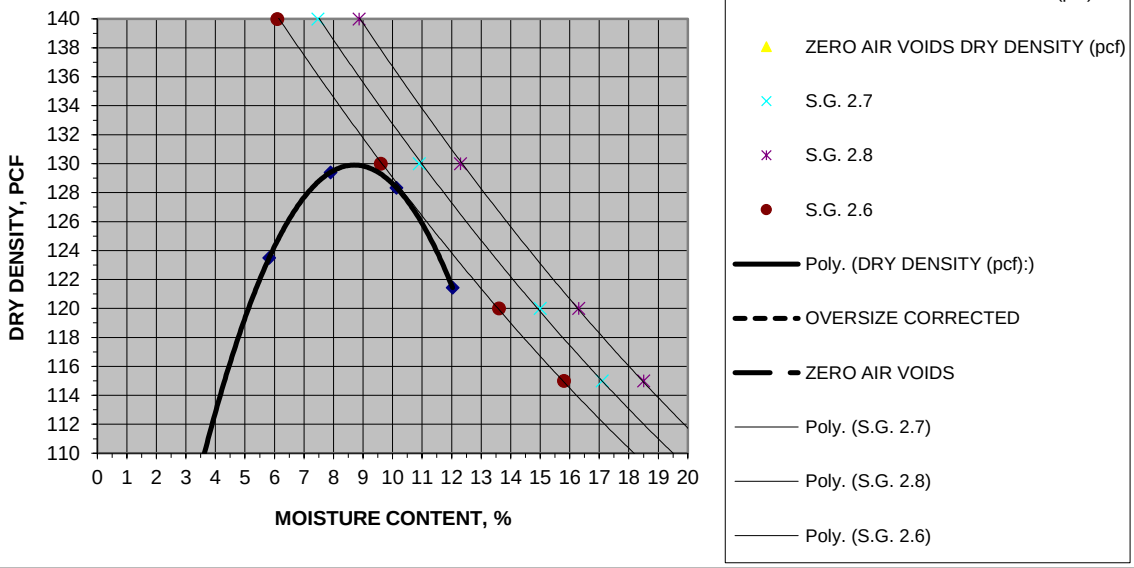
MOISTURE/DENSITY RELATIONSHIP

Client:	The True Life Companies	**Job No.:**	2855-CR
Project:	NW Iris Ave. & Chicago Ave.	**Lab No.:**	Corona
Location:	Woodcrest		
Material Type:	Reddish Brown Silty Sand		
Material Supplier:	-		
Material Source:	-		
Sample Location:	T3 @ 1-2'		
	-		
Sampled By:	DA	**Date Sampled:**	8/31/2021
Received By:	RJ	**Date Received:**	8/31/2021
Tested By:	AD	**Date Tested:**	9/14/2021
Reviewed By:	RJ	**Date Reviewed:**	9/14/2021

Test Procedure: ASTM D1557 **Method:** A

Oversized Material (%): 0.1 **Correction Required:** [ ] yes [x] no

MOISTURE/DENSITY RELATIONSHIP CURVE



MOISTURE DENSITY RELATIONSHIP VALUES

Maximum Dry Density, pcf	130.0	**@ Optimum Moisture, %**	8.5
Corrected Maximum Dry Density, pcf		**@ Optimum Moisture, %**	

MATERIAL DESCRIPTION

Grain Size Distribution:

	% Gravel (retained on No. 4)
	% Sand (Passing No. 4, Retained on No. 200)
	% Silt and Clay (Passing No. 200)

Atterberg Limits:

	Liquid Limit, %
	Plastic Limit, %
	Plasticity Index, %

Classification:

Unified Soils Classification:

AASHTO Soils Classification:

GEOTEK

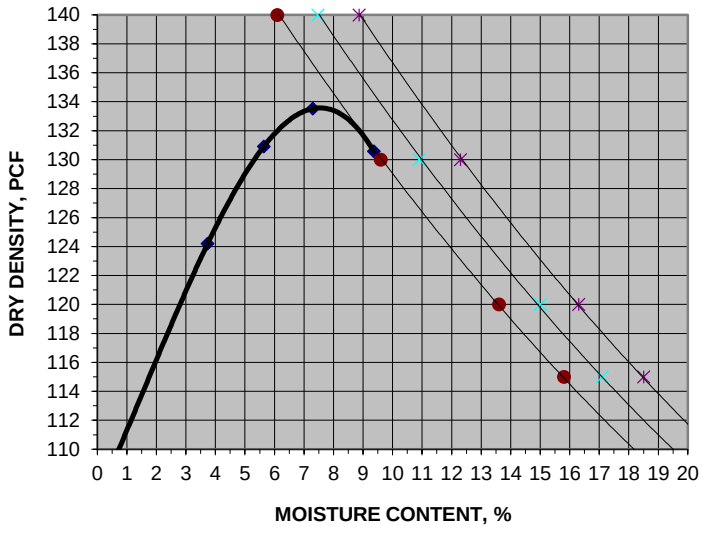
MOISTURE/DENSITY RELATIONSHIP

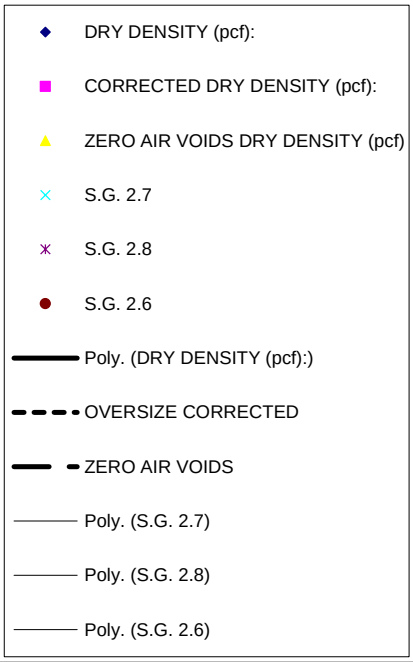
Client:	The True Life Companies	**Job No.:**	2855-CR
Project:	NW Iris Ave. & Chicago Ave.	**Lab No.:**	Corona
Location:	Woodcrest		
Material Type:	Reddish Brown Silty Sand		
Material Supplier:	-		
Material Source:	-		
Sample Location:	T7 @ 2-3'		
	-		
Sampled By:	DA	**Date Sampled:**	8/31/2021
Received By:	RJ	**Date Received:**	8/31/2021
Tested By:	AD	**Date Tested:**	9/14/2021
Reviewed By:	RJ	**Date Reviewed:**	9/15/2021

Test Procedure: ASTM D1557 **Method:** A

Oversized Material (%): 0.3 **Correction Required:** [ ] yes [x] no

MOISTURE/DENSITY RELATIONSHIP CURVE





MOISTURE DENSITY RELATIONSHIP VALUES

Maximum Dry Density, pcf	133.5	**@ Optimum Moisture, %**	7.5
Corrected Maximum Dry Density, pcf		**@ Optimum Moisture, %**	

MATERIAL DESCRIPTION

Grain Size Distribution:

	% Gravel (retained on No. 4)
	% Sand (Passing No. 4, Retained on No. 200)
	% Silt and Clay (Passing No. 200)

Atterberg Limits:

	Liquid Limit, %
	Plastic Limit, %
	Plasticity Index, %

Classification:

Unified Soils Classification:

AASHTO Soils Classification:

Results Only Soil Testing for NW of Iris Ave Chicago Ave, Woodcrest

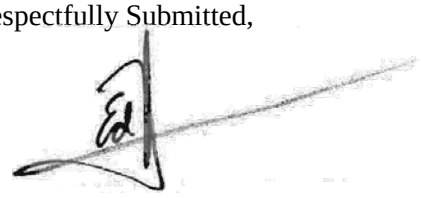
September 9, 2021

Prepared for:

Kyle McHargue
GeoTek, Inc.
1548 North Maple Street
Corona, CA 92280
kmchargue@geotekusa.com

Project X Job#: S210908G
Client Job or PO#: 2855-CR The True Life Companies

Respectfully Submitted,



Eduardo Hernandez, M.Sc., P.E.
Sr. Corrosion Consultant
NACE Corrosion Technologist #16592
Professional Engineer
California No. M37102
ehernandez@projectxcorrosion.com

Soil Analysis Lab Results

Client: GeoTek, Inc.
Job Name: NW of Iris Ave Chicago Ave, Woodcrest
Client Job Number: 2855-CR The True Life Companies
Project X Job Number: S210908G
September 9, 2021

	Method	ASTM D4327		ASTM D4327		ASTM G187		ASTM D4972	ASTM G200	ASTM D4658	ASTM D4327	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D4327	ASTM D4327
Bore# / Description	**Depth**	**Sulfates** SO_4^{2-}		**Chlorides** Cl^-		**Resistivity** As Rec'd | Minimum		**pH**	**Redox**	**Sulfide** S^{2-}	**Nitrate** NO_3^-	**Ammonium** NH_4^+	**Lithium** Li^+	**Sodium** Na^+	**Potassium** K^+	**Magnesium** Mg^{2+}	**Calcium** Ca^{2+}	**Fluoride** F_2^{--}	**Phosphate** PO_4^{3-}
	(ft)	(mg/kg)	(wt%)	(mg/kg)	(wt%)	(Ohm-cm)	(Ohm-cm)		(mV)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
2855-CR T3	1-2	277.8	0.0278	135.9	0.0136	4,221	804	7.7	164	<0.01	404.9	9.1	0.07	229.0	1.2	40.7	148.7	4.8	2.9
2855-CR T7	2-3	46.7	0.0047	15.5	0.0015	9,380	3,685	8.3	116	0.01	35.0	2.6	ND	66.6	1.5	25.2	53.4	2.3	14.9

Cations and Anions, except Sulfide and Bicarbonate, tested with Ion Chromatography
mg/kg = milligrams per kilogram (parts per million) of dry soil weight
ND = 0 = Not Detected | NT = Not Tested | Unk = Unknown
Chemical Analysis performed on 1:3 Soil-To-Water extract
PPM = mg/kg (soil) = mg/L (Liquid)

Project X
Corrosion Engineering
Corrosion Control - Soil, Water, and Metallurgy Lab

Lab Request Sheet Chain of Custody
Phone: (213) 928-7213 · Fax (951) 226-1720 · www.projectxcorrosion.com

Ship Samples To: 29990 Technology Dr, Suite 13, Murrieta, CA 92563

Project X Job Number: S210908G Geotek 2855-CR NW of Iris Ave 2 Full

IMPORTANT: Please complete Project and Sample Identification Data as you would like it to appear in report & include this form with samples.

Company Name:	Geotek USA	**Contact Name:**	Kyle McHargue
Mailing Address:	1548 N. Maple St. Corona, CA 92880	**Phone No:**	951-206-5443
Accounting Contact:		**Contact Email:**	KmcHargue@geotekusa.com
Client Project No:	The True Life Companies	**Invoice Email:**	
P.O. #:		**Project Name:**	NW of Iris Ave. Chicago Ave., Woodcrest

(Business Days) Turn Around Time: 3-5 Day Standard [X] | 3 Day Guarantee 50% mark-up [ ] | 24 Hr RUSH 100% mark-up [ ]

Results By: ☐ Phone ☐ Fax ☒ Email

Date & Received by : 09/08/21

Special Instructions:

ANALYSIS REQUESTED (Please circle)

Default Method: ASTM G187 | ASTM G51 | ASTM D4327 | ASTM D4327 | ASTM G200

Full Corrosion Series

Geo Quad

	SAMPLE ID - BORE #	DESCRIPTION	DEPTH (ft)	DATE COLLECTED
59	1	2855-CR	T3	1-2	BULK
60	2	2855-CR	T7	2-3	BULK
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	10				
	11				
	12				
	13				
	14				
	15				

Geo Quad: Soil Resistivity (ASTM G187) | pH (ASTM G51) | Sulfate (ASTM D4327) | Chloride (ASTM D4327)

Full Corrosion Series: Redox Potential (ASTM D4327) | Sulfide (ASTM D6919) | Ammonia (ASTM D6919) | Nitrate (ASTM D4327) | Flouride (ASTM D4327) | Phosphate (ASTM D4327) | Lithium (ASTM D6919) | Sodium (ASTM D6919) | Potassium (ASTM D6919) | Magnesium (ASTM D6919) | Calcium (ASTM D6919) | BiCarbonate (SM 2320B)

Full Corrosion Series: ✓ ✓

Reports: Soil Corrosivity Evaluation Report | Water Corrosivity Mini Report

*Req: Min. 3 Samples, site map, and groundwater info

Moisture Content (ASTM D2216) | Total Alkalinity (SM 2320B) | Thermal Resistivity | Metallurgical Analysis | Langelier Index | Puckorius Index | XRF Elemental Analysis | Water Hardness

APPENDIX D

SEISMIC REFRACTION SURVEY RESULTS BY GEOTEK

Updated Geotechnical Evaluation
Proposed Single-Family Residential Development
Woodcrest, Riverside County, California
Project No. 2855-CR

GEOTEK

Subsurface Surveys & Associates, Inc.
2075 Corte Del Nogal, Suite W Carlsbad, CA 92011
Phone: (760) 476-0492 Fax: (760) 476-0493

GeoTek. Inc.
1548 North Maple Street
Corona, CA 92880

August 23, 2021

Attn: Kyle McHargue

Re: Seismic Survey Summary Report
Woodcrest Project, Riverside County

This report covers the results of a seismic refraction survey performed at the Woodcrest Project Site, located northwest of the intersection of Iris Ave and Chicago Ave, in Riverside County, California. The purpose of the survey was to measure the compressional wave velocity of bedrock for rippability assessment and to provide cross sections showing thickness of the weathered zone and depth to the unweathered interface. This should be useful for planning cuts, grading, and other earthwork.

The field work was conducted on August 12, 2021. Seven seismic lines were recorded at locations selected by GeoTek. A survey location map is provided on Figure 1 that shows the position and orientation of the traverses.

GEOLOGIC SETTING

A review of the "Geologic Map of the San Bernardino and Santa Ana 30' x 60' quadrangles, California ", (USGS Open File Report 2006-1217, 2006) indicates the survey area is underlain by Val Verde tonalite (Kvt) of Cretaceous age. This rock unit is described as relatively homogeneous and massive to well foliated.

DATA ACQUISITION AND FIELD METHODS

Seismic refraction data were recorded with a Bison 9024 signal enhancement seismograph and 28 Hz geophones. The standard spread layout used 24 geophones with a 7-foot spacing which provided a line length of 168 feet. Each spread used five shotpoints, one off each end (5-foot offset) and three within the interior of the spread. Depth of investigation was approximately 40-45 feet.

Compressional wave energy was created by sledge hammer impacts on a metal plate. The signal enhancement feature of the seismograph allowed returns from repeated hits to be stacked, thus improving the signal. Each record was stored digitally on an internal hard disk and printed copies of each seismogram were made in the field on thermal paper. Example field records are shown on Figure 2.

Relative elevations of all shotpoints and geophones were determined by differential leveling with a hand level. Geophone 1 (distance = 0 ft.) at the beginning of each line was assigned a elevation value of 0.0 feet. This datum point served as the reference elevation for all other measurements.

Labeled wooden stakes were placed at the beginning and end of each spread and a Garmin handheld GPS receiver was used to record the latitude and longitude coordinates of the stakes. The coordinates were used to make the location map shown on Figure 1.

SEISMIC REFRACTION METHOD

The refraction method involves measuring the total time for compressional waves to travel from a shotpoint through the subsurface to a set of geophones placed linearly along the ground. Based on Snell's Law, when two or more layers are present with increasingly higher acoustic velocity, waves become critically refracted across the layer boundaries and begin traveling at the speed of the underlying layer. The advancing waves then generate new wavefronts back to the ground surface. The first surge of energy hitting the geophone is termed the "first arrival" and is depicted on the seismogram as a high angle deflection along each trace.

Recognition of direct wave arrivals (non-refracted) verses refracted waves is a key element of refraction interpretation. To assist this process, the first arrival times measured from the seismic records are plotted on graphs of time verses distance called Time-Distance graphs. An example T-D graph from Line 1 is shown on Figure 3. Based on changes in slope on the graphs, a preliminary layer number (i.e. 1, 2, 3) is assigned to each segment of the graph. The layer assignments together with time, distance and elevation data are input to a computer for additional processing.

DATA REDUCTION AND VELOCITY DETERMINATION

Processing and interpretation of this data set was accomplished with “SIPT2", an interactive inversion modeling program developed by James Scott for the U.S. Bureau of Mines. The inversion algorithm uses the delay time method to construct a first pass depth model. The model is then adjusted by an iterative ray tracing process that attempts to minimize the discrepancies between the total travel times calculated along ray paths and the observed travel times measured in the field.

This program calculates refractor velocity in two ways. First, apparent velocities from each shot are determined by the inverse slope of a best fit (least squares) line through datum-corrected travel times. True velocity is estimated from the apparent velocities by using the following equation:

$$Vt = 2(Vu \times Vd)/(Vu + Vd)$$

where Vt = true velocity
Vu = apparent up dip velocity
Vd = apparent down dip velocity

The second method uses a more sophisticated set of equations (the Hobson-Overton formula) developed by the Canadian Geological Survey. The final velocity assigned to the refractor is a weighted average of the results of the two methods. The weighting is based on the number of arrival times used in the computations.

SUMMARY OF RESULTS

Results from refraction analysis show a three layer solution beneath all lines (see Figures 5-11). Velocities posted on the cross sections represent averages as described in the previous section. Therefore, minor localized changes in velocity may occur along any profile. A description of the layers is provided below and a cross section summary is shown in Table 1.

Layer 1 - is mostly colluvium with rock fragments and alluvium in low lying areas. Thickness is generally less than 10 feet.

Layer 2 - is interpreted to be weathered bedrock. The velocity range is 3027-4408 ft/sec. Based on the Cat rippability chart shown on Figure 4, this range is considered easily rippable with a D-9 Cat.

Layer 3 - represents slightly weathered to unweathered bedrock.

Table 1. Cross Section Summary Velocity in (ft/sec), Depth in (feet)

Line	Velocity Layer 1	Velocity Layer 2	Velocity Layer 3	Depth Range Layer 2/3 Interface
1	1370	3199	8634	20 - 29
2	1490	4408	12494	5 - 26
3	1699	4345	14636	5 - 13
4	1334	3027	8423	29 - 40
5	1345	3273	10696	13 - 22
6	1471	4018	7011	26 - 37
7	1424	4265	8568	20 - 28

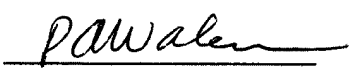
Weathering tends to be gradational for most granitic rock types and usually produces a gradual increase in velocity with depth. Consequently, variation of $\pm$ 10% from the posted averages may occur between the top and bottom of Layer 2.

Figure 4 presents a rippability chart (courtesy of Caterpillar Tractor Co.) for a D9R Ripper. Bar graphs show the relationship between seismic compressional wave velocity and ripper

performance for various rock types in three categories: rippable, marginal, and non-rippable. Granitic rocks are listed as marginally rippable at approximately 6800 ft/sec and are considered non-rippable above 8000 ft/sec. This chart is provided only as a guide and should not be considered absolute. Other geologic factors that may influence bedrock rippability at this site include changes in composition of the bedrock and the presence of fractures and joints.

All data acquired during this survey is considered confidential and is available for review by your staff at any time. We appreciate the opportunity to participate in this project.

Please call if there are any questions.



Phillip A. Walen
Senior Geophysicist
CA Registration No. GP917

Seismic Survey Location Map

Woodcrest Area -- Riverside County

All seismic lines are
168 feet in length.

Figure 1

Example Seismic Field Records

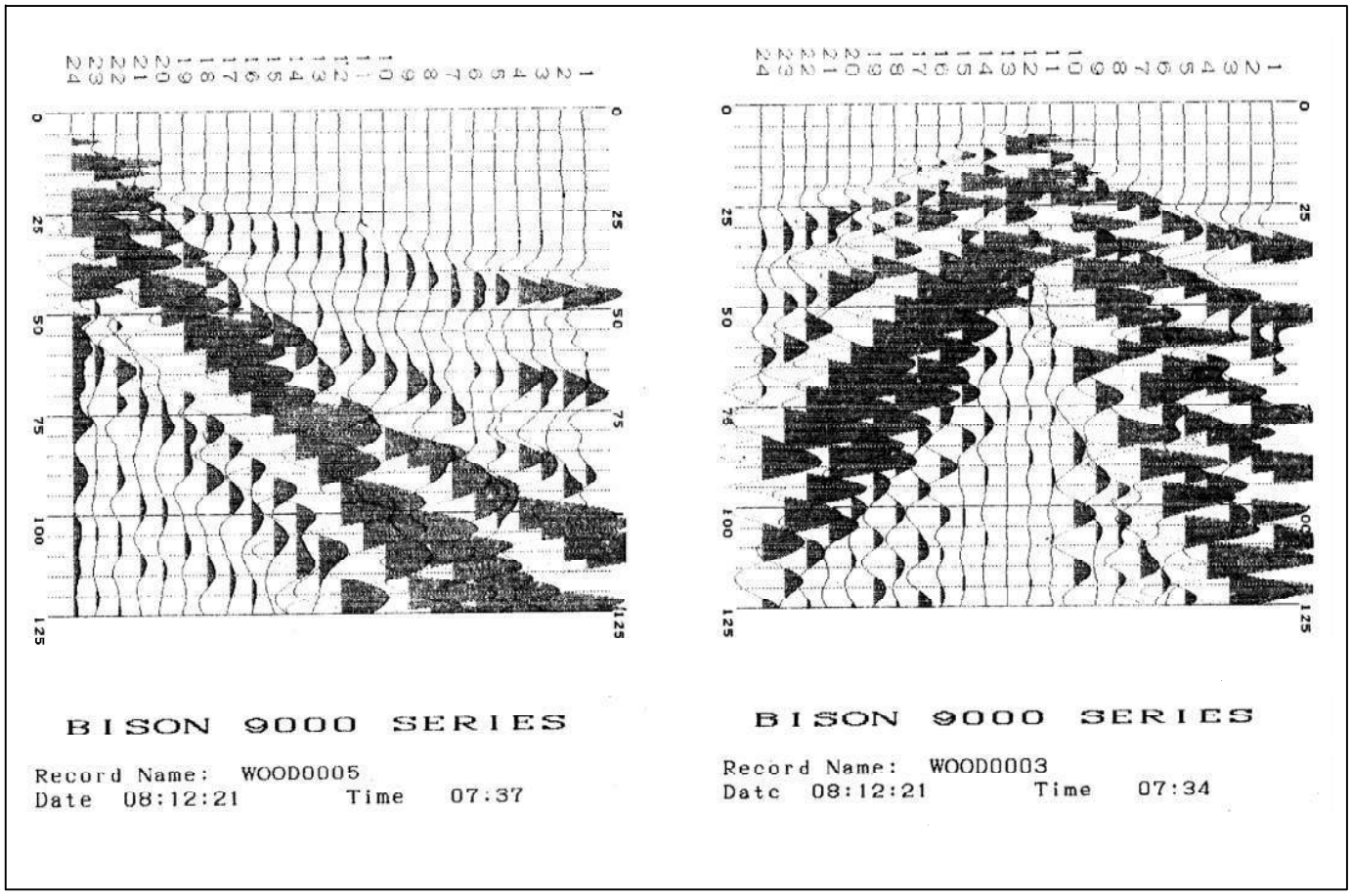


Figure 2

Example Time-Distance Graph -- Line 1

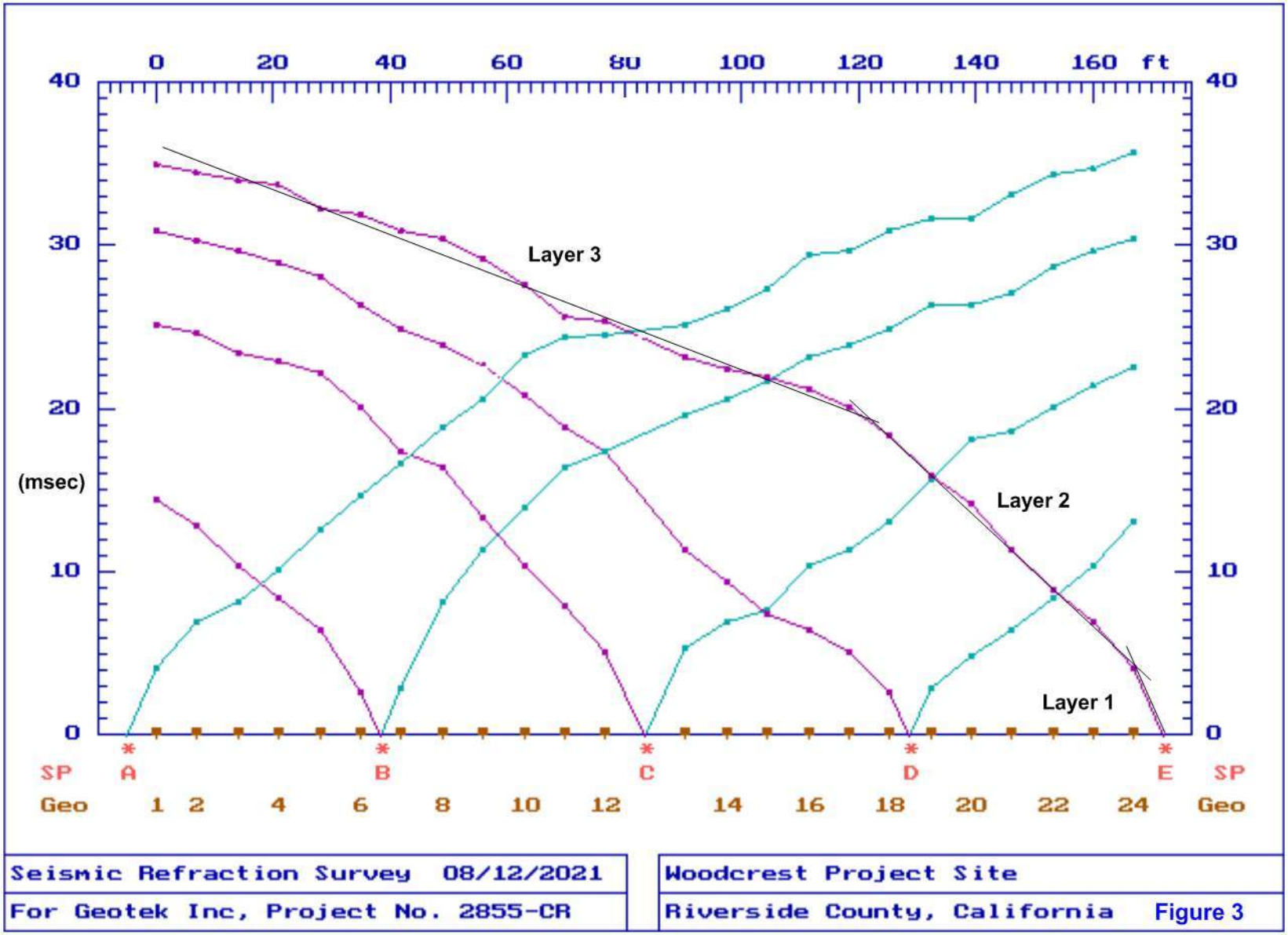


Figure 3

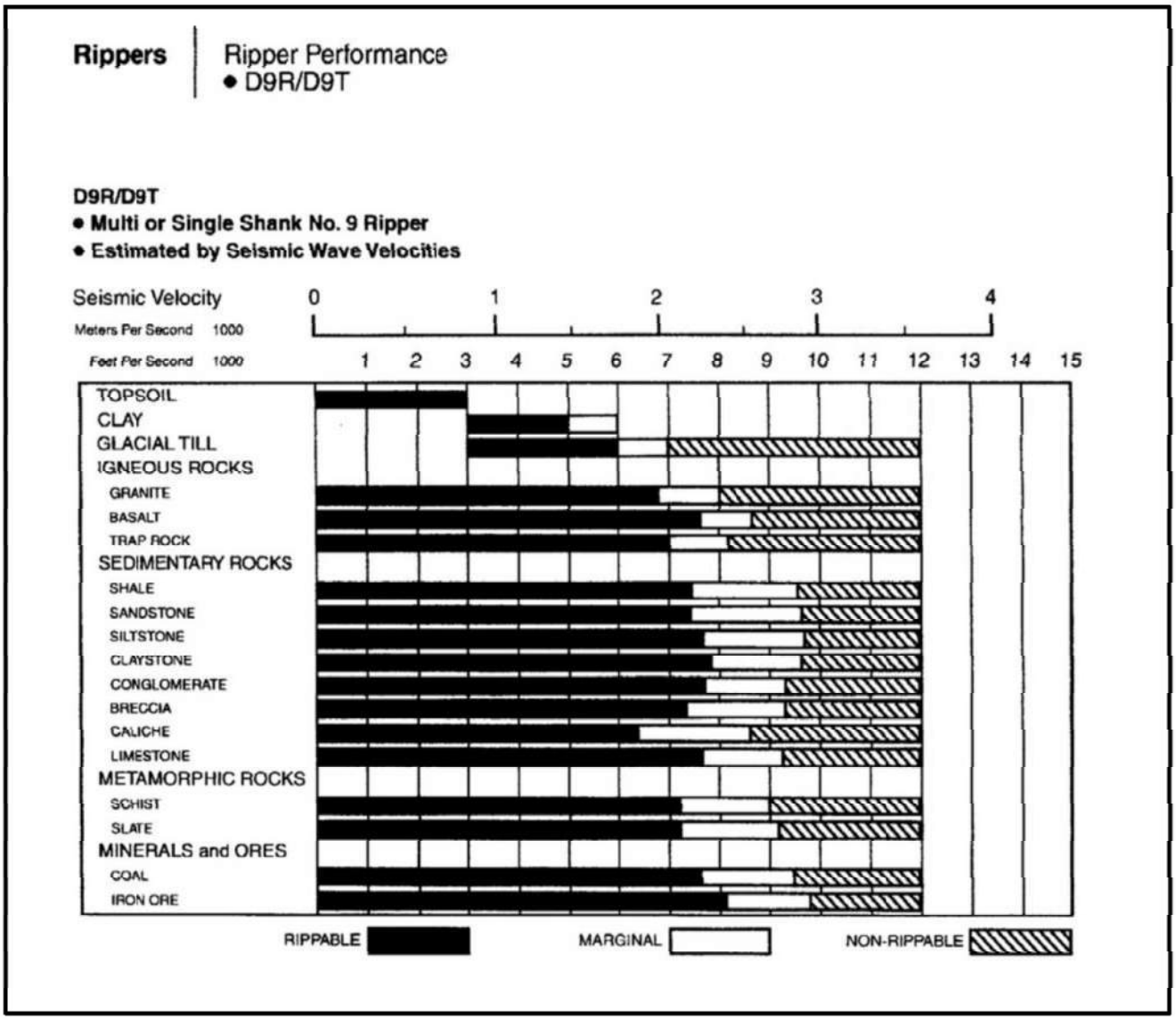
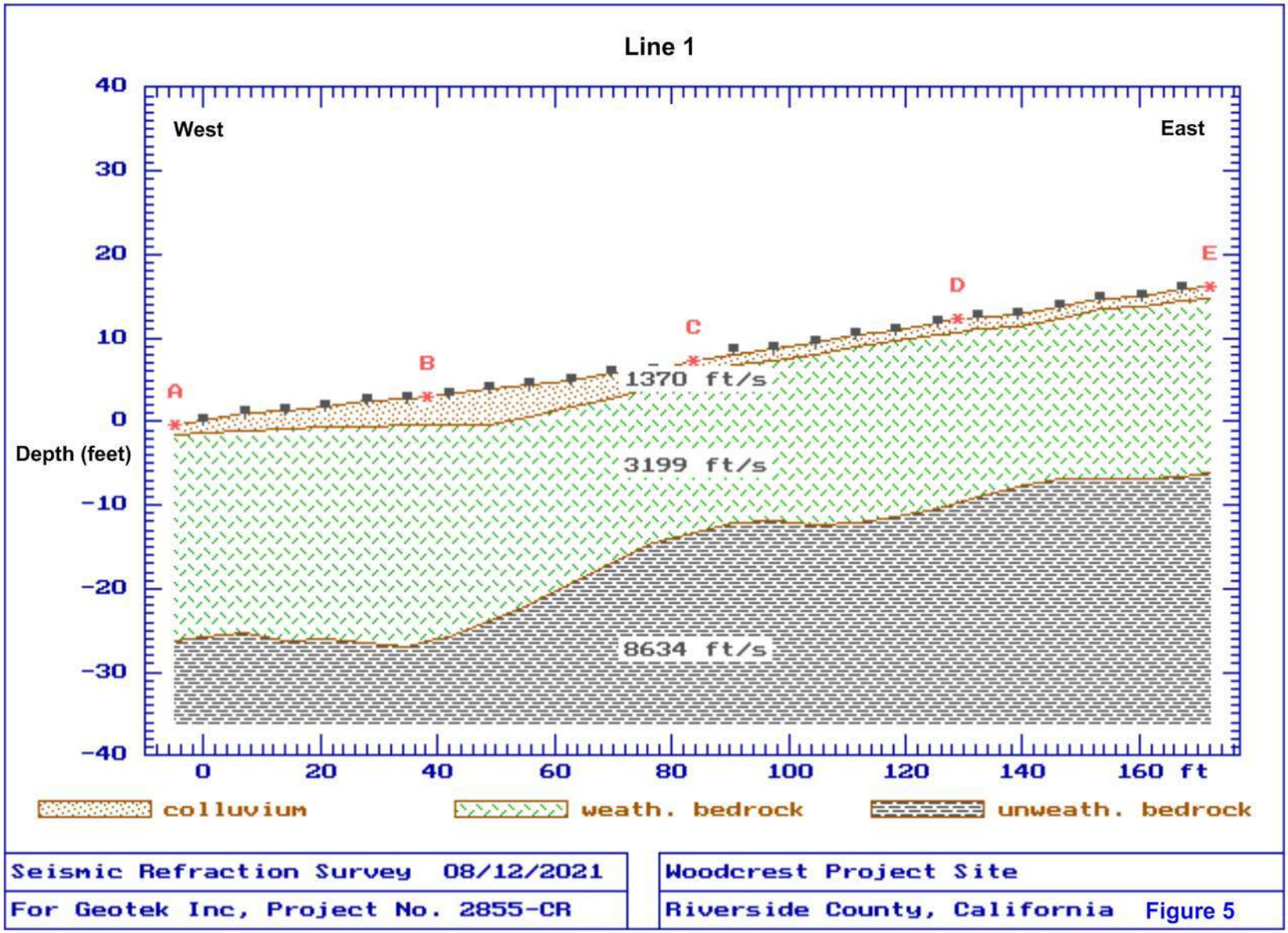
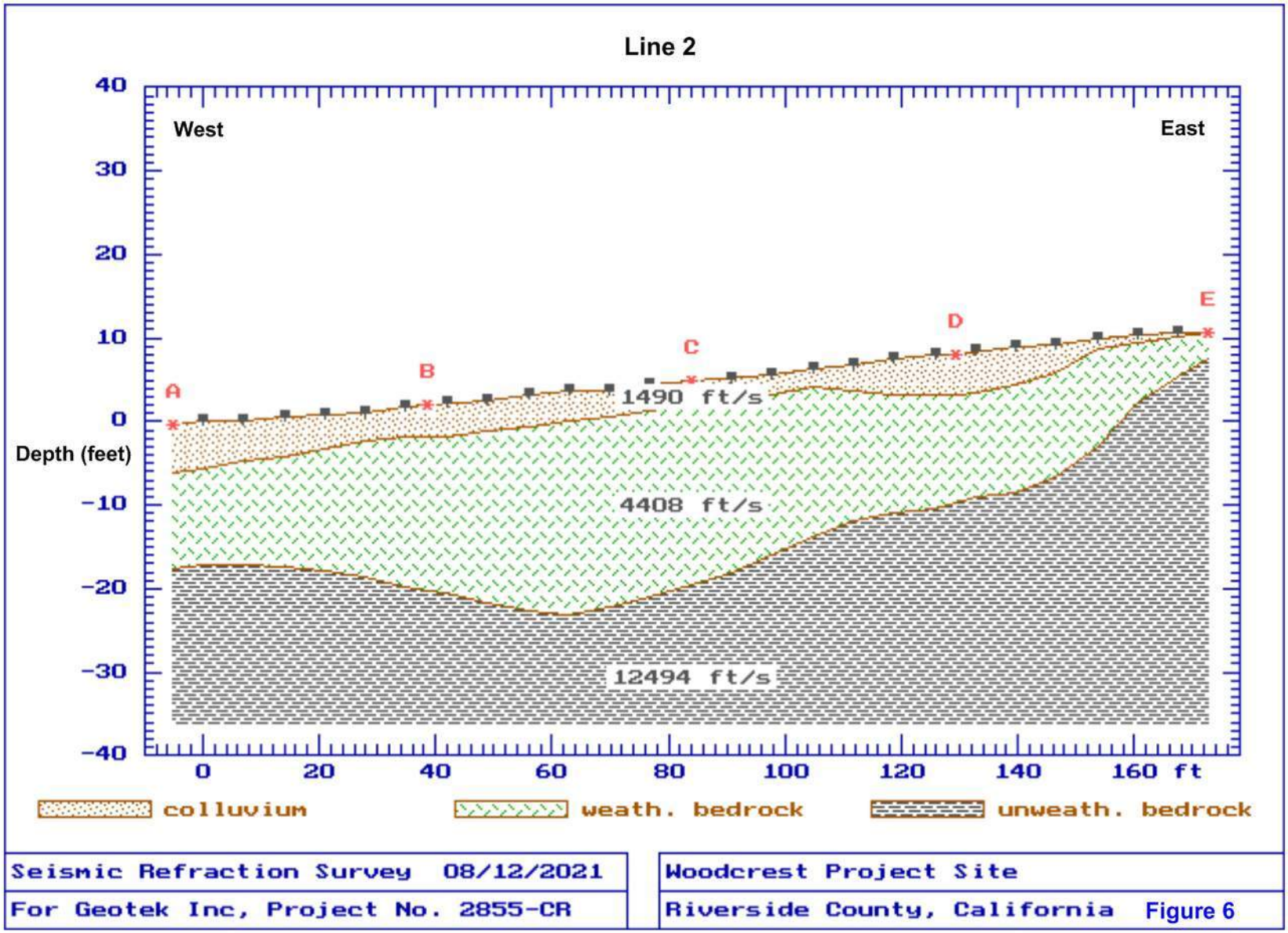
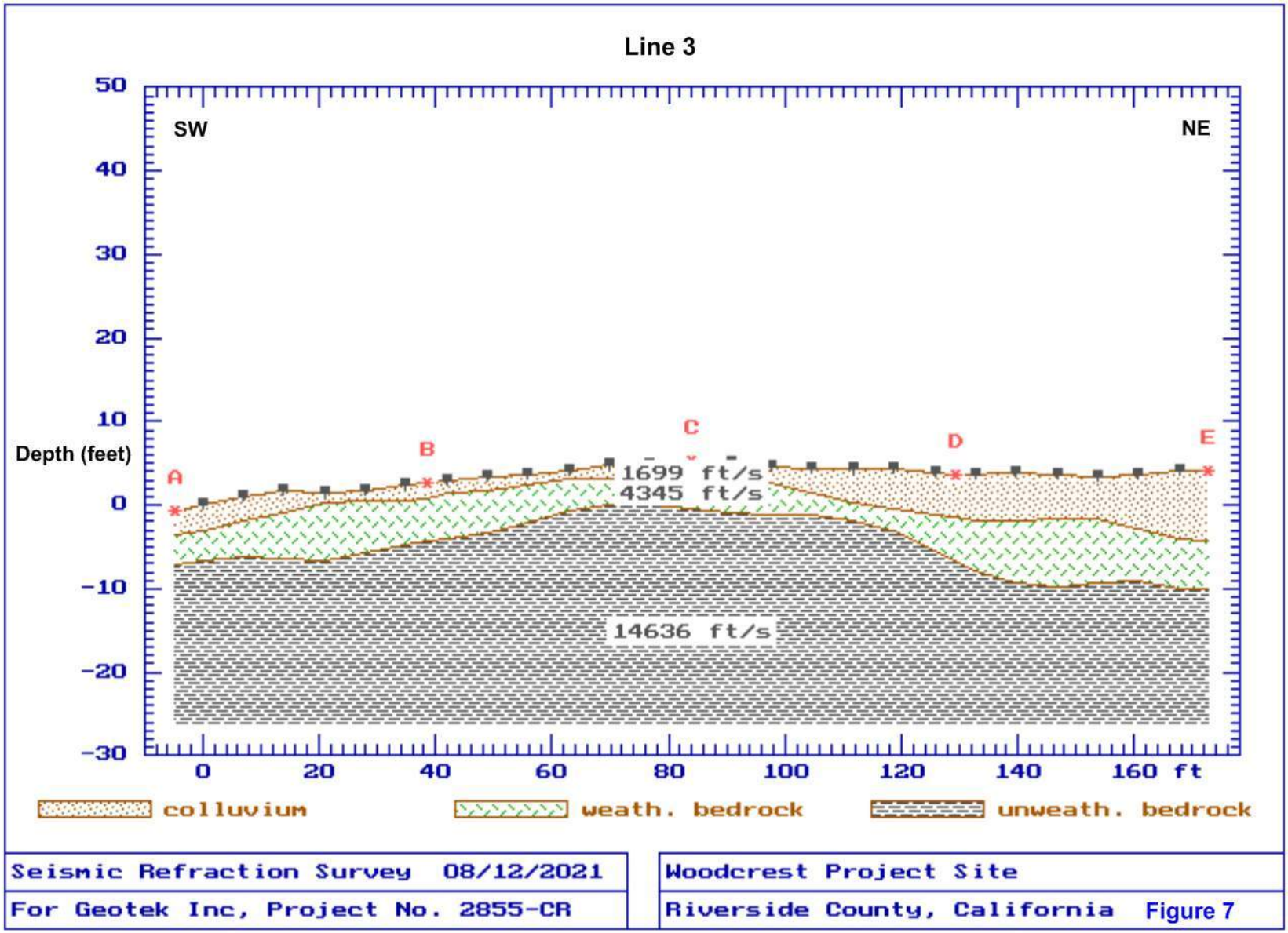

Rippers
Ripper Performance
• D9R/D9T
D9R/D9T
• Multi or Single Shank No. 9 Ripper
• Estimated by Seismic Wave Velocities
Seismic Velocity
Meters Per Second 1000
Feet Per Second 1000
0 1 2 3 4
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
TOPSOIL
CLAY
GLACIAL TILL
IGNEOUS ROCKS
GRANITE
BASALT
TRAP ROCK
SEDIMENTARY ROCKS
SHALE
SANDSTONE
SILTSTONE
CLAYSTONE
CONGLOMERATE
BRECCIA
CALICHE
LIMESTONE
METAMORPHIC ROCKS
SCHIST
SLATE
MINERALS and ORES
COAL
IRON ORE
RIPPABLE
MARGINAL
NON-RIPPABLE

Figure 4


Line 1
West
East
Depth (feet)
40
30
20
10
0
-10
-20
-30
-40
0
20
40
60
80
100
120
140
160 ft
A
B
C
D
E
1370 ft/s
3199 ft/s
8634 ft/s
colluvium
weath. bedrock
unweath. bedrock
Seismic Refraction Survey 08/12/2021
For Geotek Inc, Project No. 2855-CR
Woodcrest Project Site
Riverside County, California
Figure 5


Line 2
West
East
Depth (feet)
40
30
20
10
0
-10
-20
-30
-40
0
20
40
60
80
100
120
140
160 ft
A
B
C
D
E
1490 ft/s
4408 ft/s
12494 ft/s
colluvium
weath. bedrock
unweath. bedrock
Seismic Refraction Survey 08/12/2021
For Geotek Inc, Project No. 2855-CR
Woodcrest Project Site
Riverside County, California
Figure 6

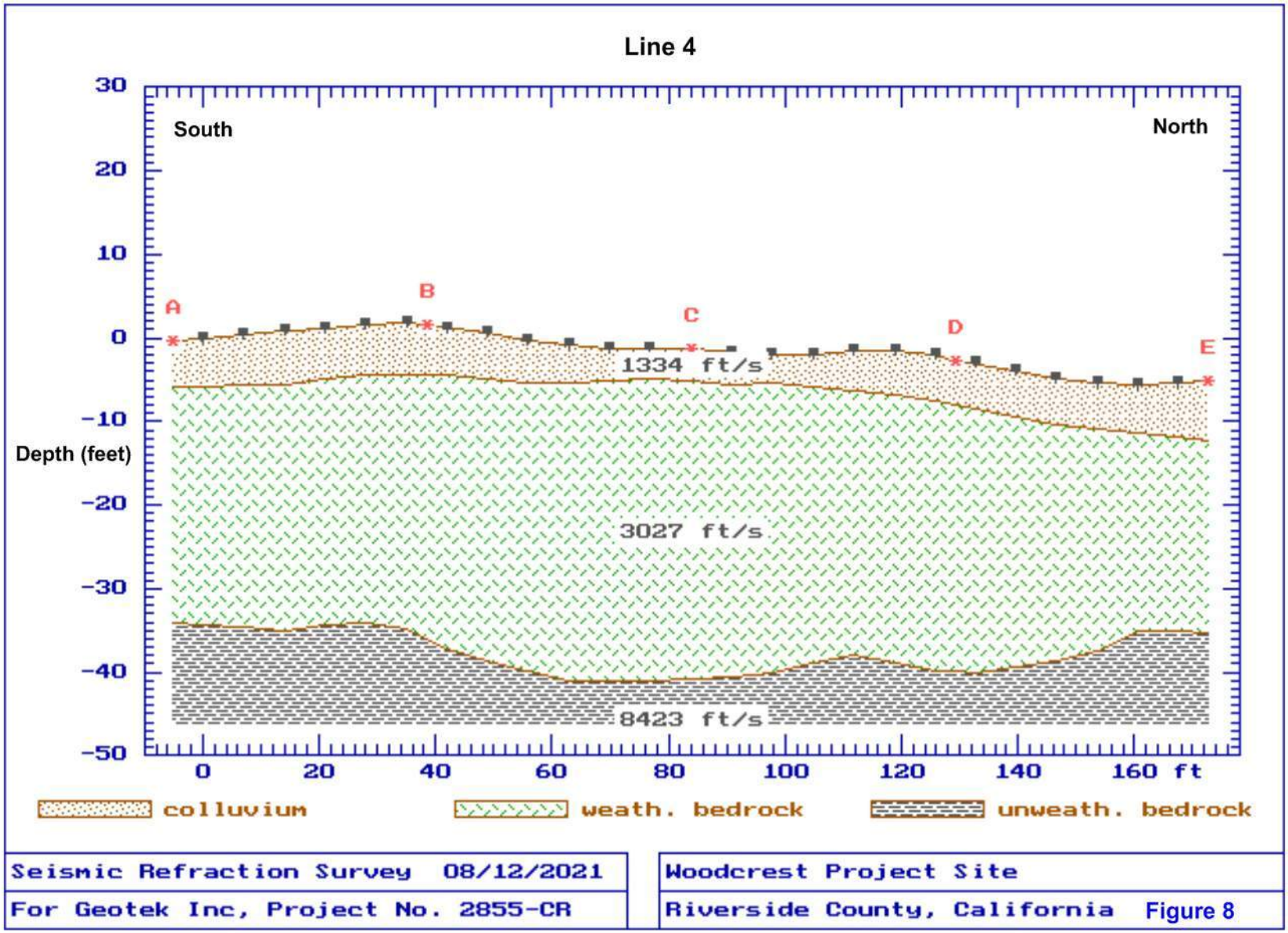


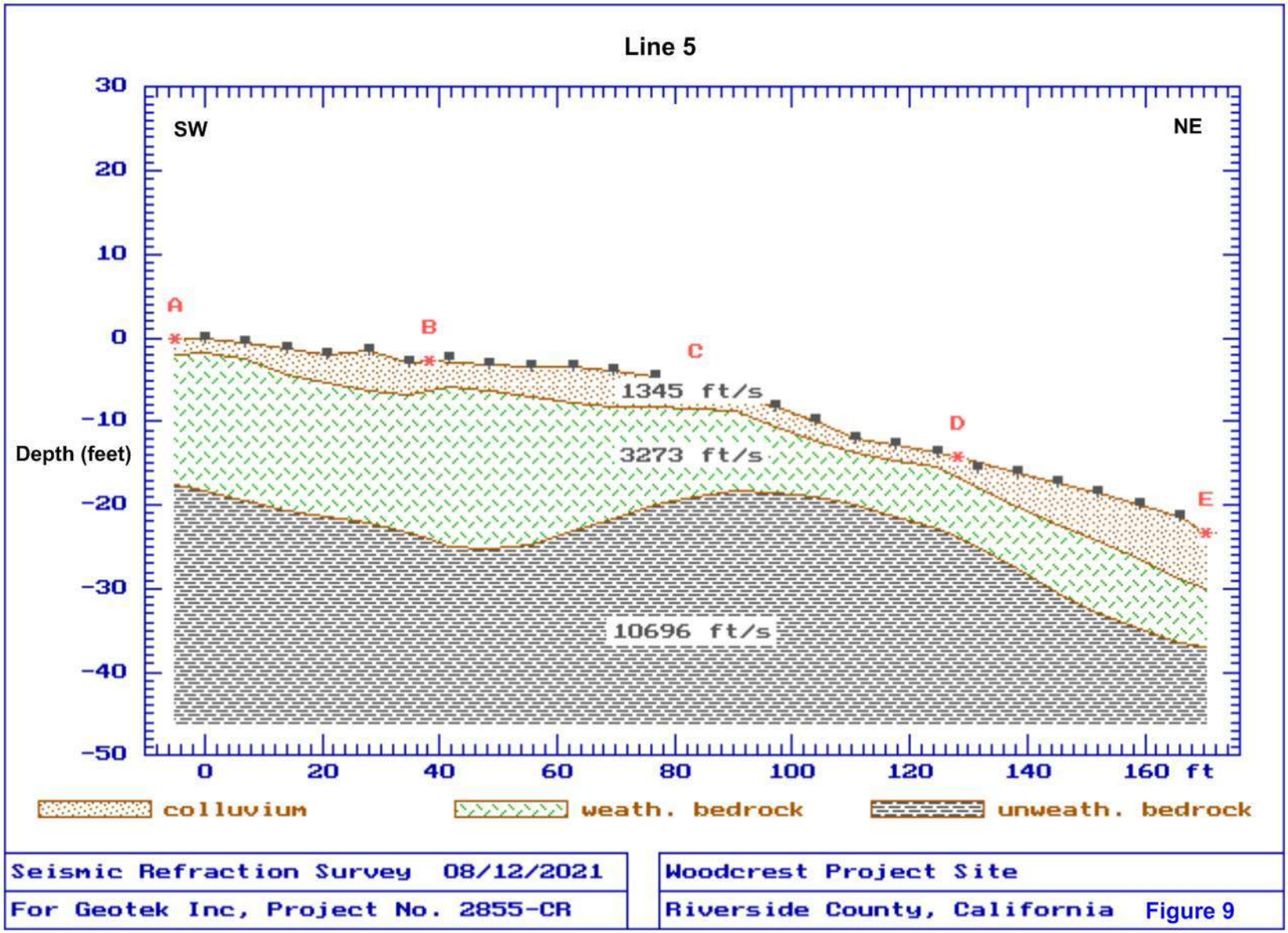
Seismic Refraction Survey 08/12/2021

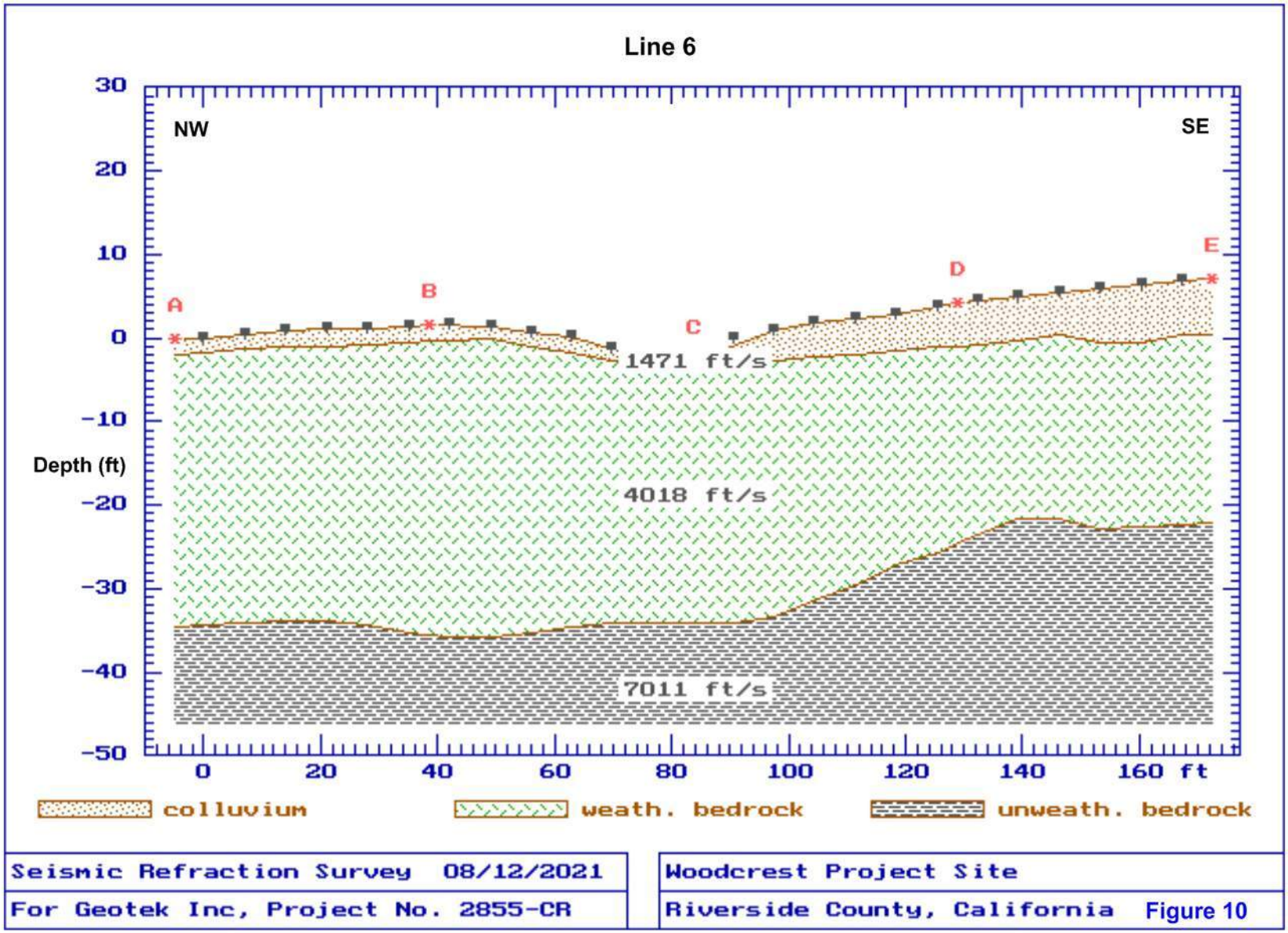
For Geotek Inc, Project No. 2855-CR

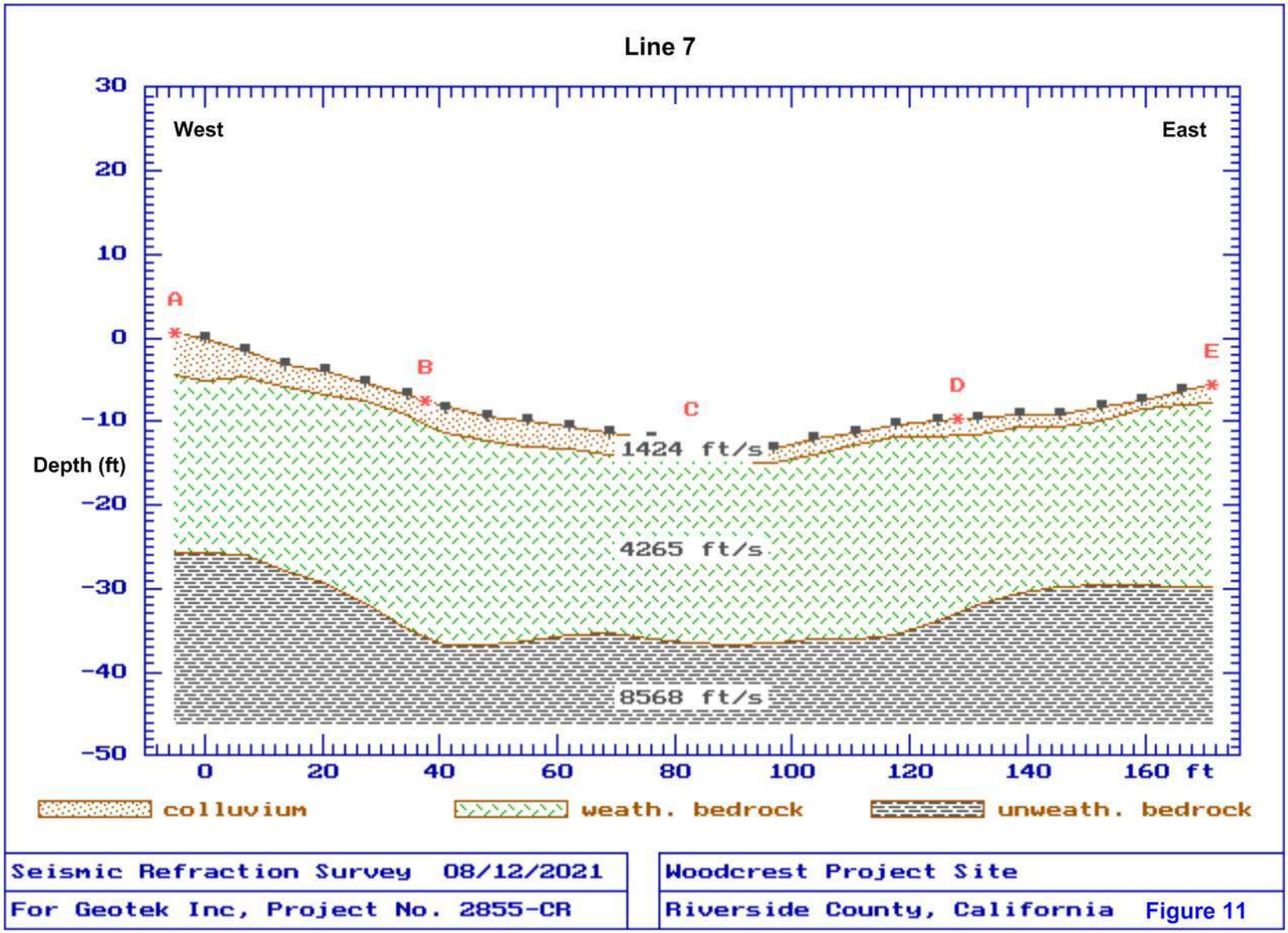
Woodcrest Project Site

Riverside County, California Figure 7


Line 4
South
North
A
B
C
D
E
1334 ft/s
3027 ft/s
8423 ft/s
Depth (feet)
30
20
10
0
-10
-20
-30
-40
-50
0
20
40
60
80
100
120
140
160 ft
colluvium
weath. bedrock
unweath. bedrock
Seismic Refraction Survey 08/12/2021
For Geotek Inc, Project No. 2855-CR
Woodcrest Project Site
Riverside County, California
Figure 8


Line 5
SW
NE
A
B
C
D
E
1345 ft/s
3273 ft/s
10696 ft/s
Depth (feet)
30
20
10
0
-10
-20
-30
-40
-50
0
20
40
60
80
100
120
140
160 ft
colluvium
weath. bedrock
unweath. bedrock
Seismic Refraction Survey 08/12/2021
For Geotek Inc, Project No. 2855-CR
Woodcrest Project Site
Riverside County, California
Figure 9


Line 6
NW
SE
A
B
C
D
E
1471 ft/s
4018 ft/s
7011 ft/s
Depth (ft)
30
20
10
0
-10
-20
-30
-40
-50
0
20
40
60
80
100
120
140
160 ft
colluvium
weath. bedrock
unweath. bedrock
Seismic Refraction Survey 08/12/2021
For Geotek Inc, Project No. 2855-CR
Woodcrest Project Site
Riverside County, California
Figure 10


Line 7
West
East
A
B
C
D
E
1424 ft/s
4265 ft/s
8568 ft/s
Depth (ft)
30
20
10
0
-10
-20
-30
-40
-50
0
20
40
60
80
100
120
140
160 ft
colluvium
weath. bedrock
unweath. bedrock
Seismic Refraction Survey 08/12/2021
For Geotek Inc, Project No. 2855-CR
Woodcrest Project Site
Riverside County, California
Figure 11

APPENDIX E

GENERAL GRADING GUIDELINES

Updated Geotechnical Evaluation
Proposed Single-Family Residential Development
Woodcrest, Riverside County, California
Project No. 2855-CR

GEOTEK

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 (2019) 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 topsoil, 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 contractors 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 contractors' 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 contractors 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 contractors 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.

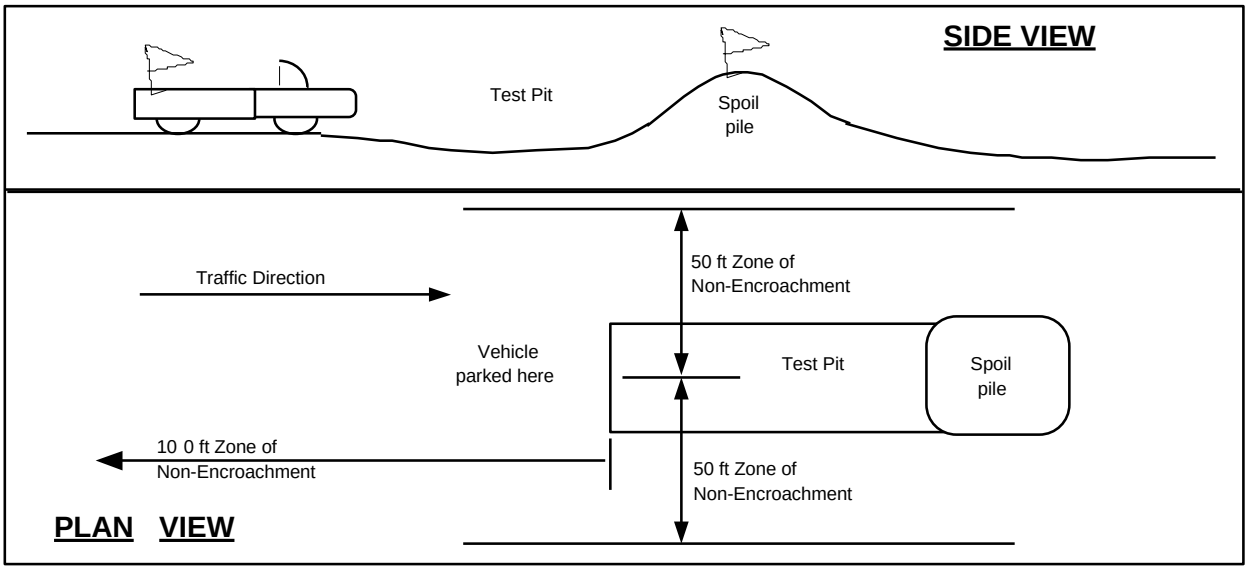
Test Pits Location, Orientation and Clearance

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 contractors 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

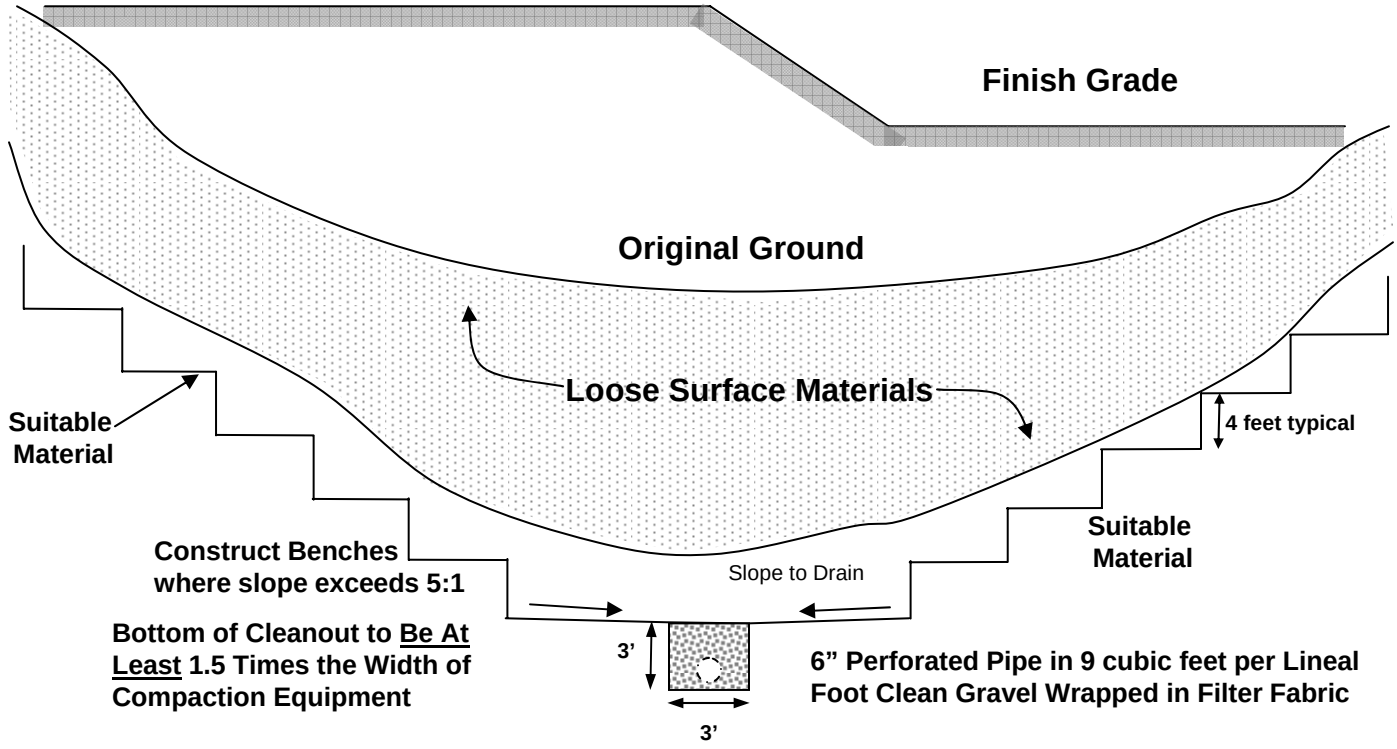
In the event that the technician's safety is jeopardized or compromised as a result of the contractor's failure to comply with any of the above, the technician is directed to inform both the developer's and contractor's representatives. If the condition is not rectified, the technician is required, by 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.

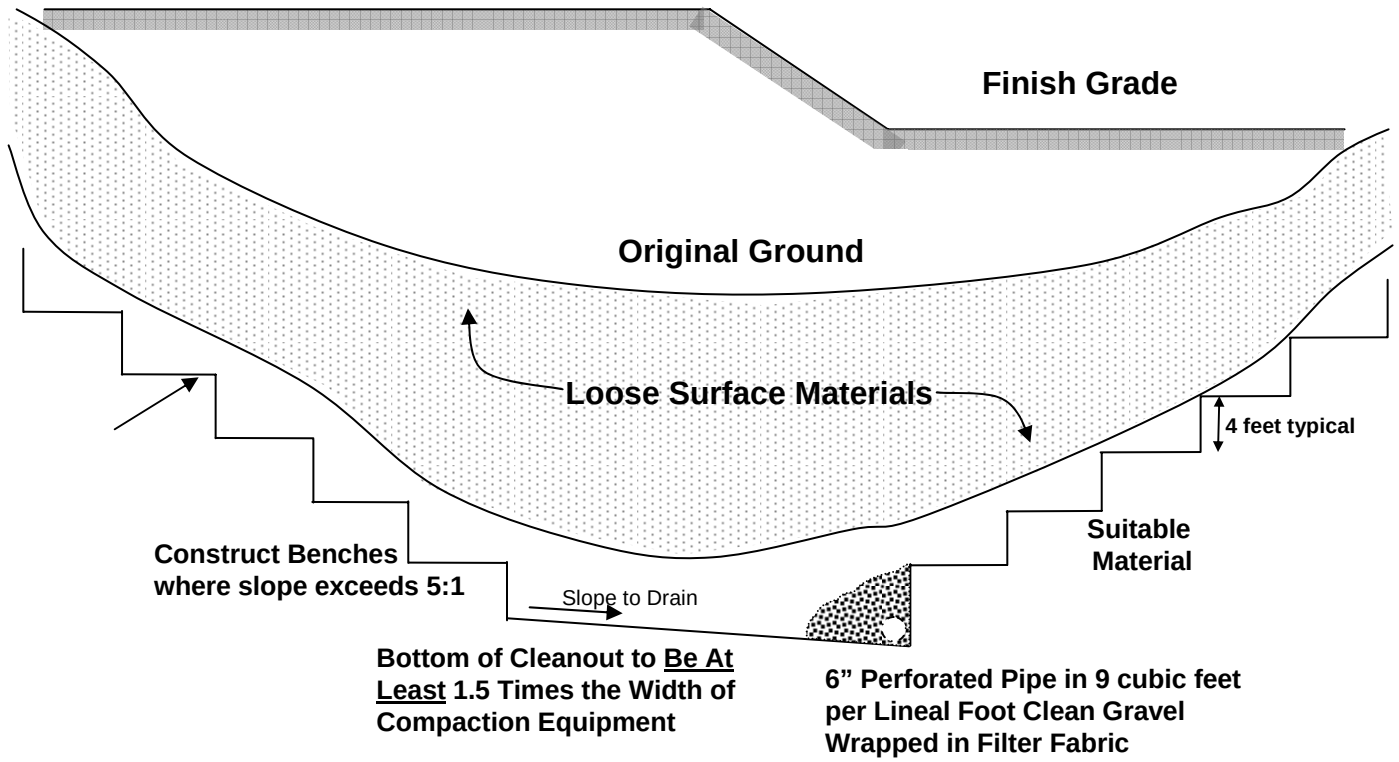
In the event that the soil technician does not comply with the above or other established safety guidelines, we request that the contractor bring this to technicians attention and notify our project manager or office. Effective communication and coordination between the contractors' representative and 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





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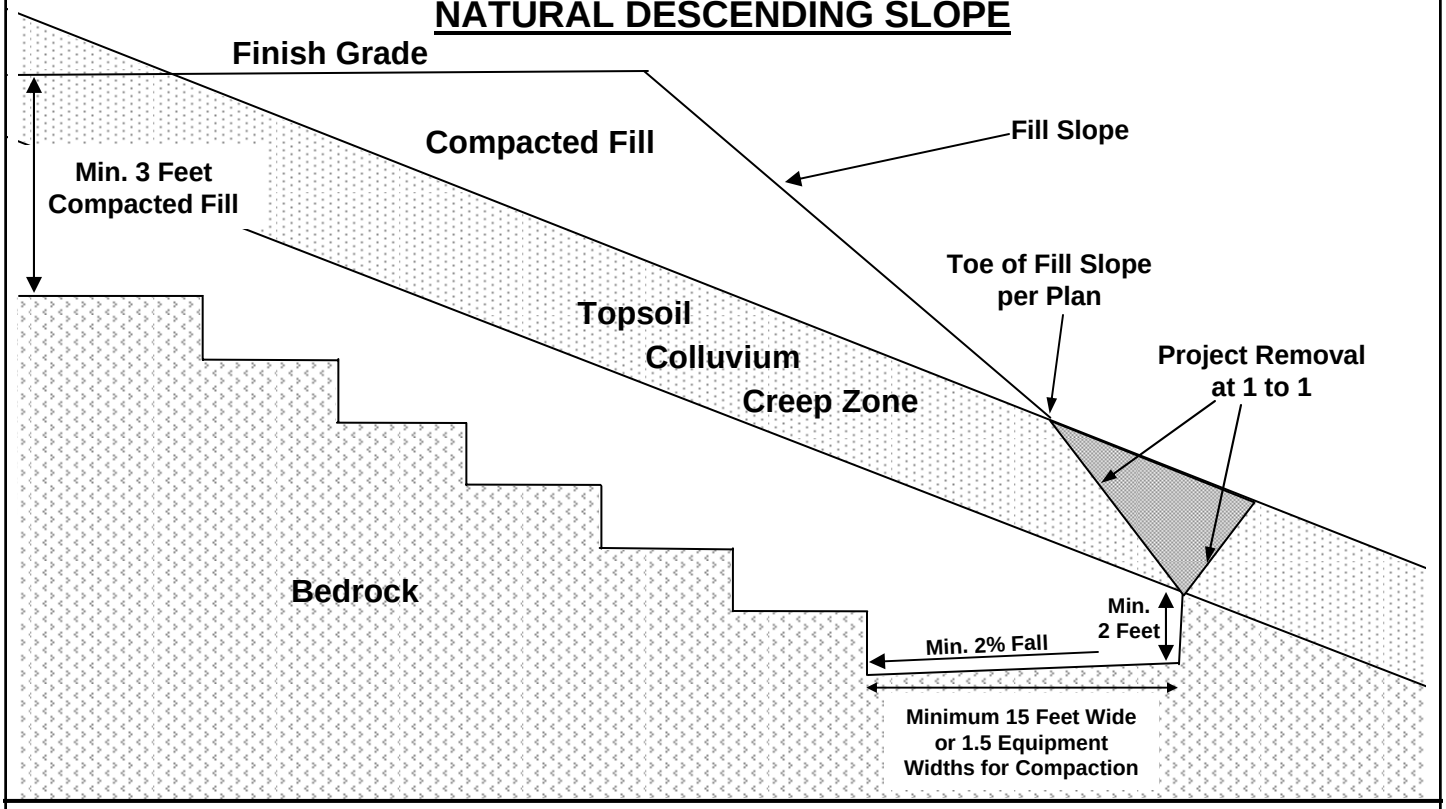
TYPICAL CANYON CLEANOUT

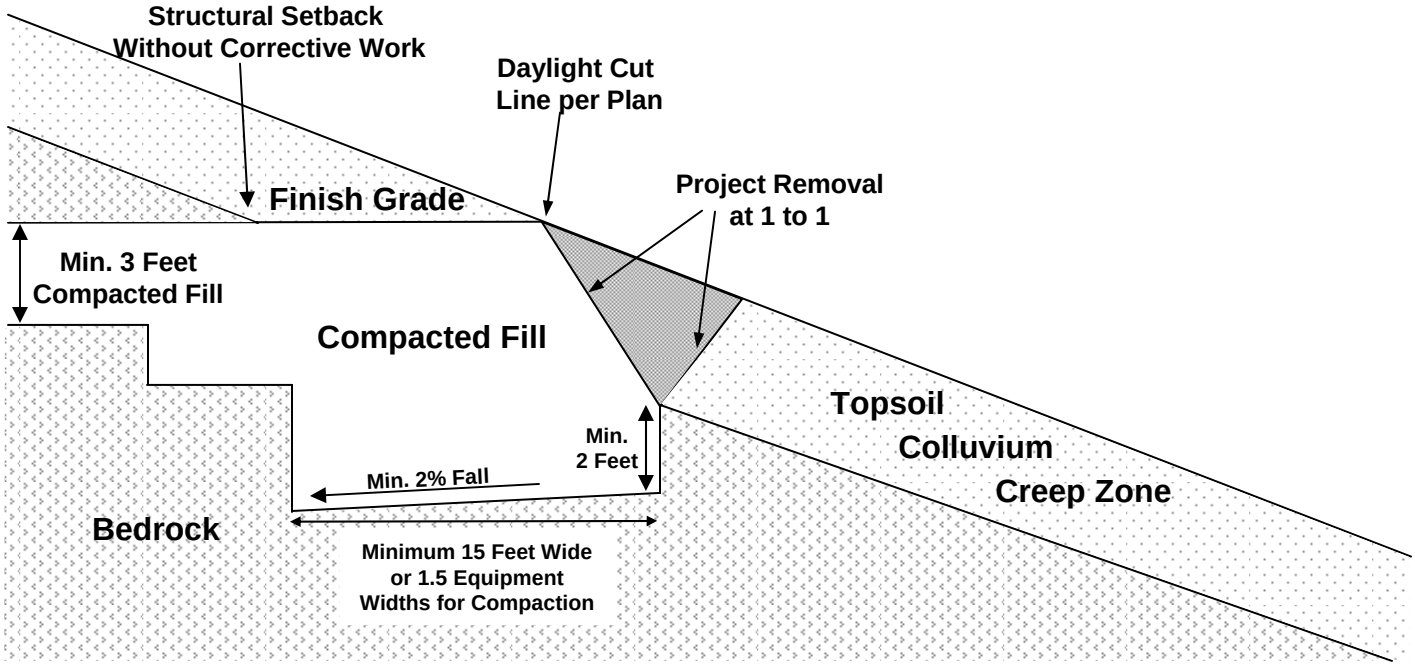
STANDARD GRADING GUIDELINES

PLATE G-1

TYPICAL FILL SLOPE OVER NATURAL DESCENDING SLOPE



DAYLIGHT CUT AREA OVER NATURAL DESCENDING SLOPE



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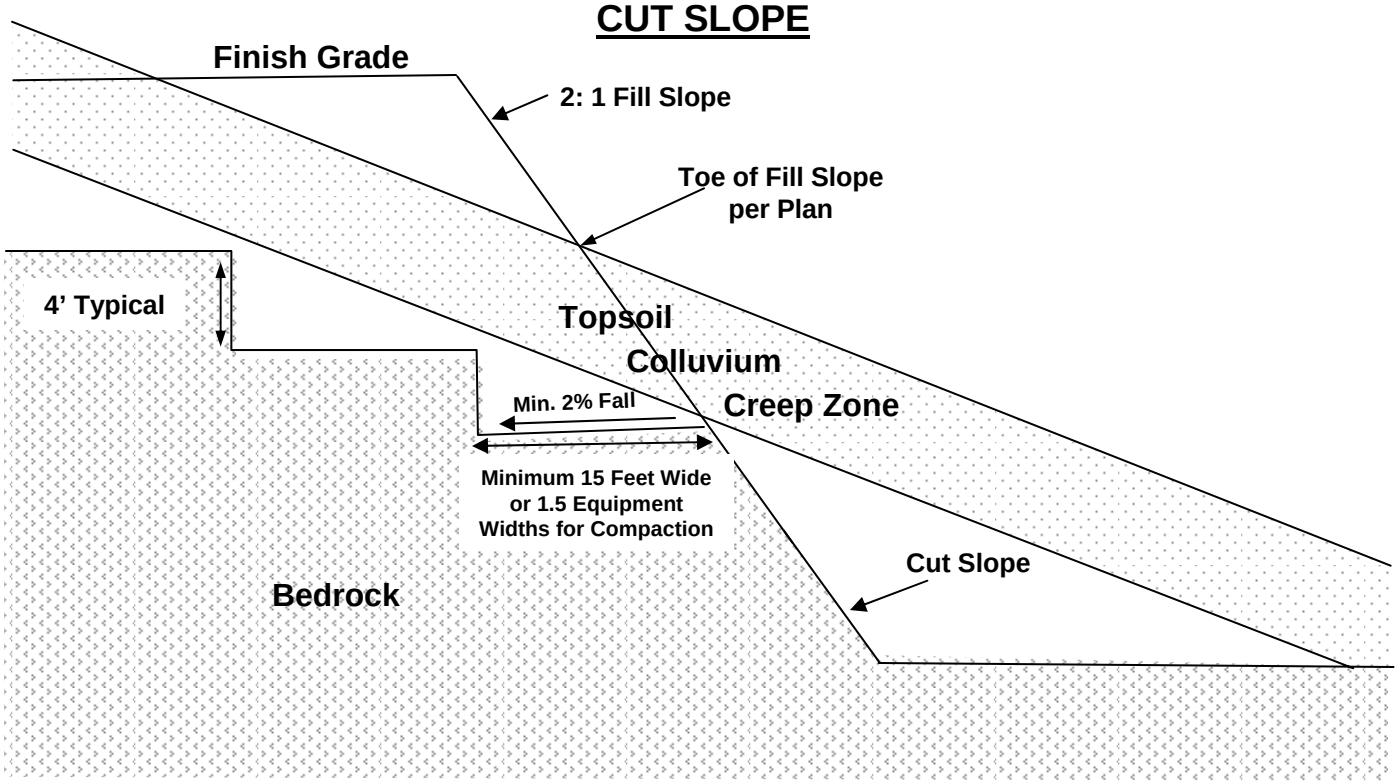
TREATMENT ABOVE NATURAL SLOPES

STANDARD GRADING GUIDELINES

PLATE G-2

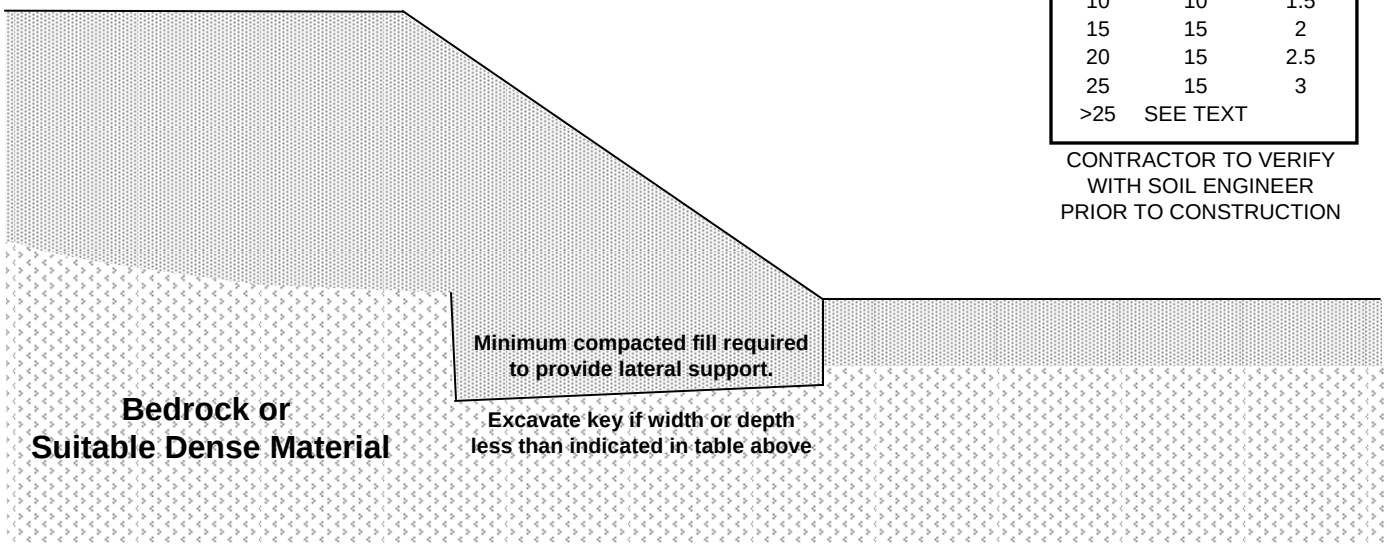
TYPICAL FILL SLOPE OVER CUT SLOPE



TYPICAL FILL SLOPE

SLOPE HEIGHT	MIN. KEY WIDTH	MIN. KEY DEPTH
5	7	1
10	10	1.5
15	15	2
20	15	2.5
25	15	3
>25	SEE TEXT	

CONTRACTOR TO VERIFY WITH SOIL ENGINEER PRIOR TO CONSTRUCTION



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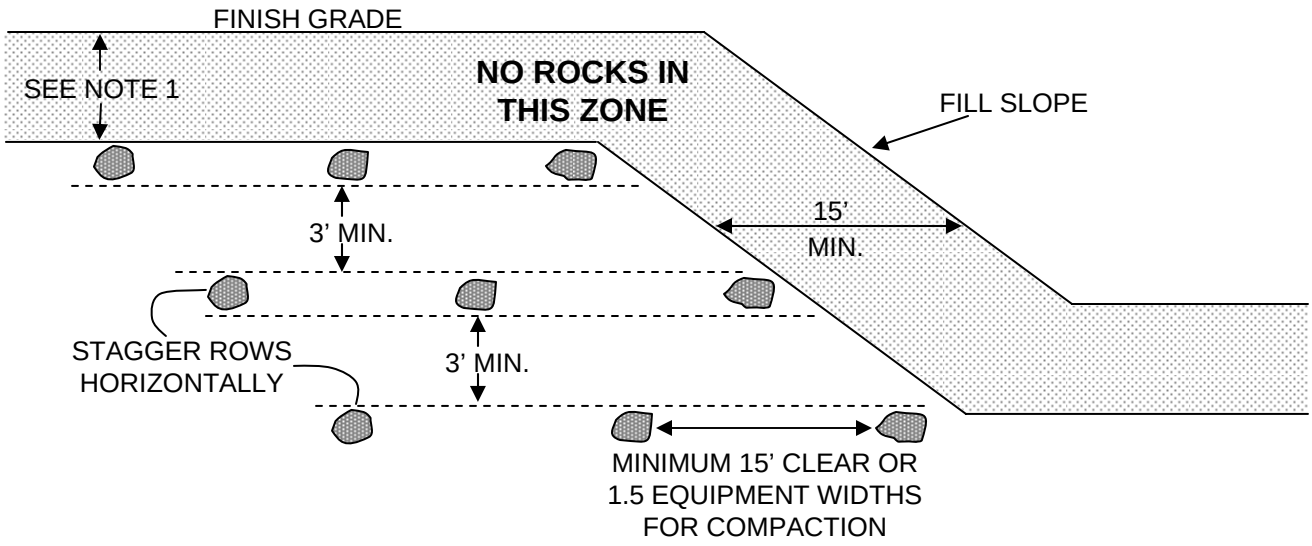
COMMON FILL SLOPE KEYS

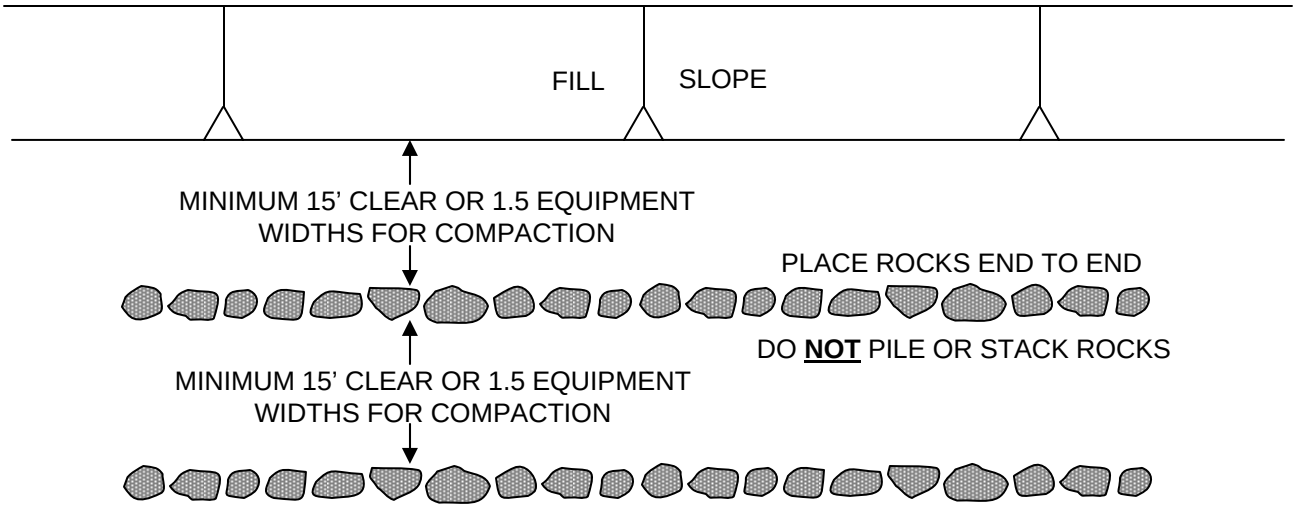
STANDARD GRADING GUIDELINES

PLATE G-3

CROSS SECTIONAL VIEW



PLAN VIEW



NOTES:

1) SOIL FILL OVER WINDROW SHOULE BE 7 FEET OR PER JURISDUICTIONAL 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) INDIVDUAL LARGE ROCKS MAY BE BURIED IN PITS.

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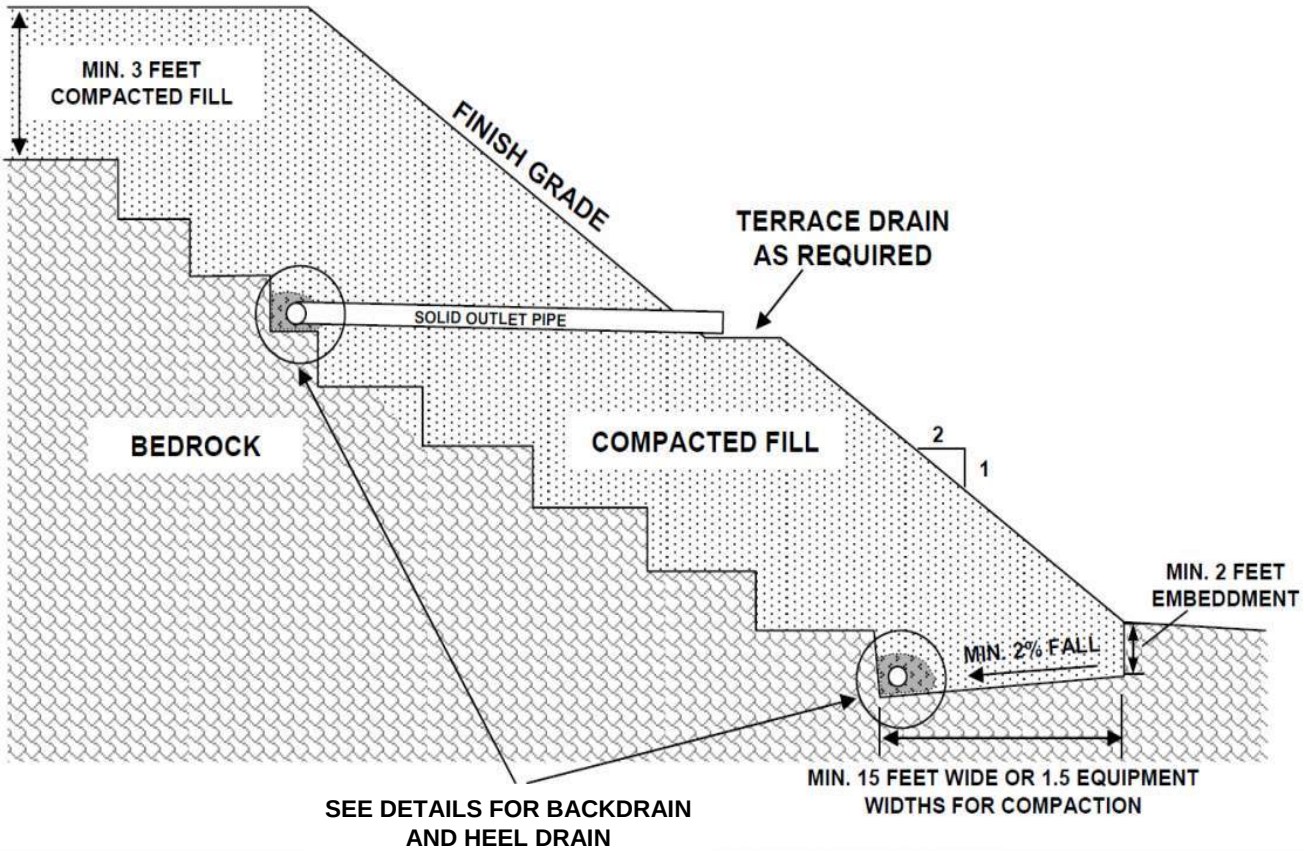
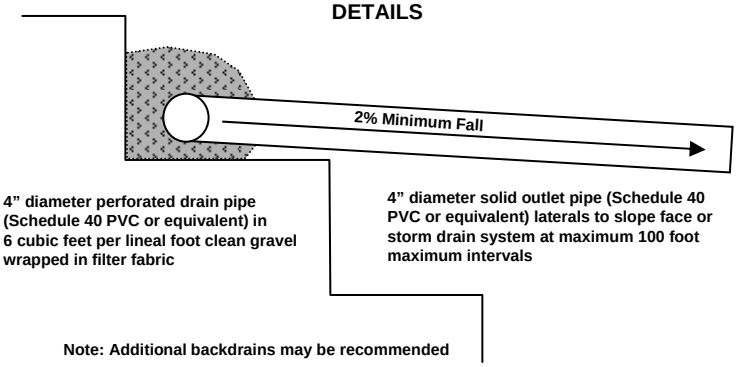
ROCK BURIAL DETAILS

STANDARD GRADING GUIDELINES

PLATE G-4



BACKDRAIN DETAILS



4" diameter perforated drain pipe (Schedule 40 PVC or equivalent) in 6 cubic feet per lineal foot clean gravel wrapped in filter fabric

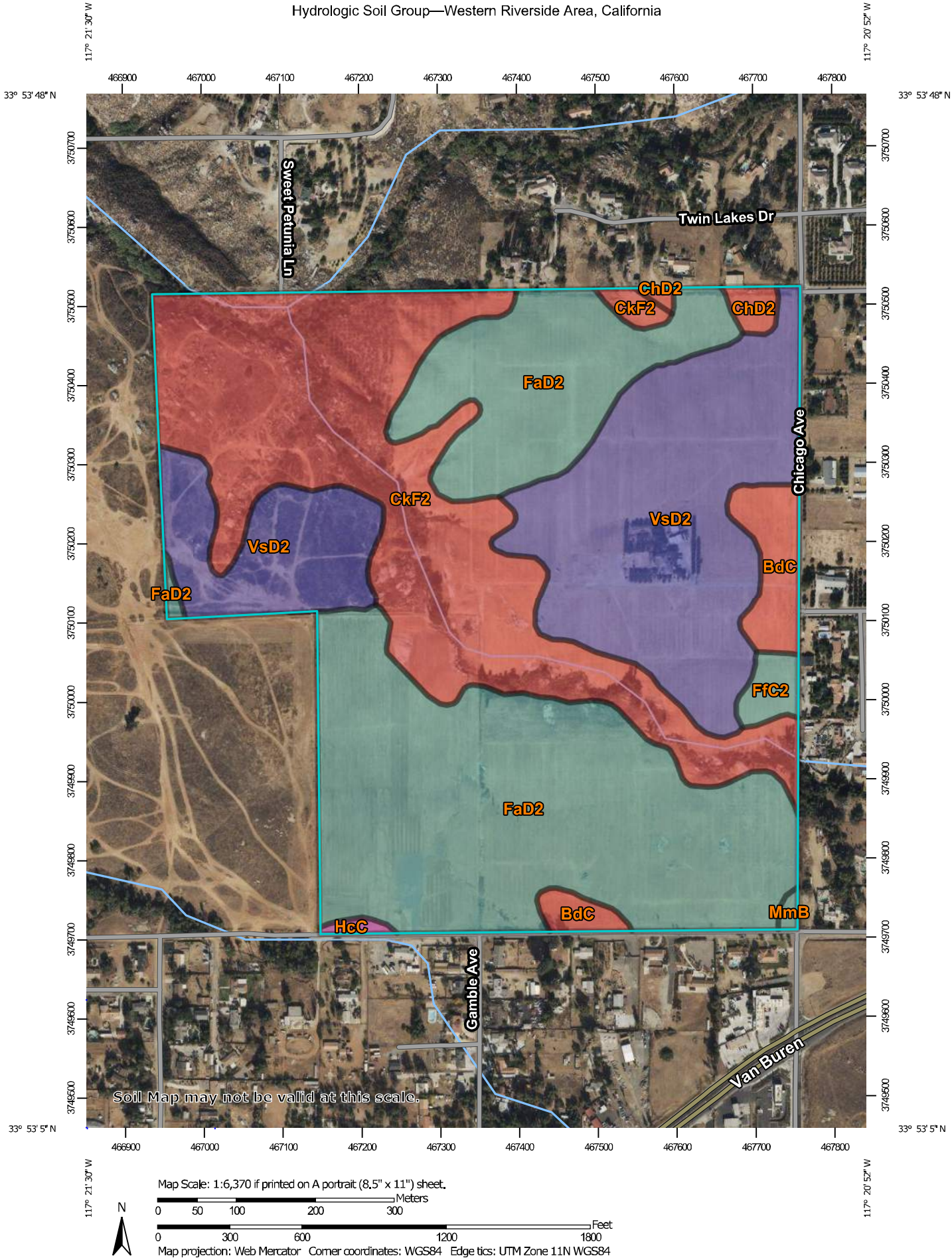
4" diameter solid outlet pipe (Schedule 40 PVC or equivalent) laterals to slope face or storm drain system at maximum 100 foot maximum intervals

Note: Additional backdrains may be recommended

HEEL DRAIN DETAILS

6" diameter perforated drain pipe in 6 cubic feet per lineal foot clean gravel wrapped in filter fabric, outlet pipe to gravity flow with 2% minimum fall

GEOTEK	1548 North Maple Street Corona, California 92880	TYPICAL BUTTRESS AND STABILIZATION FILL	STANDARD GRADING GUIDELINES PLATE G-5



Map Scale: 1:6,370 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 300 600 1200 1800

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

MAP LEGEND

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

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Western Riverside Area, California
Survey Area Data: Version 14, Sep 13, 2021

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

Date(s) aerial images were photographed: Nov 15, 2020—Feb 6, 2021

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BdC	Bonsall fine sandy loam, 2 to 8 percent slopes	D	4.5	3.2%
ChD2	Cieneba sandy loam, 8 to 15 percent slopes, eroded	D	1.0	0.7%
CkF2	Cieneba rocky sandy loam, 15 to 50 percent slopes, eroded	D	40.5	28.3%
FaD2	Fallbrook sandy loam, 8 to 15 percent slopes, eroded	C	56.7	39.7%
FfC2	Fallbrook fine sandy loam, 2 to 8 percent slopes, eroded	C	1.4	1.0%
HcC	Hanford coarse sandy loam, 2 to 8 percent slopes	A	0.4	0.2%
MmB	Monserate sandy loam, 0 to 5 percent slopes	C	0.3	0.2%
VsD2	Vista coarse sandy loam, 8 to 15 percent slopes, eroded	B	38.2	26.7%
Totals for Area of Interest			**143.1**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Appendix 4: Historical Site Conditions

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

Appendix 5: LID Infeasibility

LID Technical Infeasibility Analysis

Appendix 6: BMP Design Details

BMP Sizing, Design Details and other Supporting Documentation

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

(Rev. 10-2011)

Legend: Required Entries / Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name: Rick Engineering — Date: 4/10/2023

Designed by: TR — Case No:

Company Project Number/Name: 19427

BMP Identification

BMP NAME / ID: DMA 1

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

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

D_{85}= 0.53 inches

Drainage Management Area Tabulation

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

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	Design Storm Depth (in)	Design Capture Volume, V_{BMP} (cubic feet)	Proposed Volume on Plans (cubic feet)
DMA 1.1	906955	Mixed Surface Types	0.55	0.37	337840.5			
DMA 1.2	342254	Concrete or Asphalt	1	0.89	305290.6			
DMA 1.3	23248	Ornamental Landscaping	0.1	0.11	2567.9			
DMA 1.4	17683	BMP WQ Surface	1	0.89	15773.2			
	1290140	Total			661472.2	0.53	29215	136562

Notes:

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

Company Name: Rick Engineering — Date: 4/10/2023

Designed by: TR — County/City Case No.:

Design Volume

Enter the area tributary to this feature — A_T = 29.6 acres

Enter V_{BMP} determined from Section 2.1 of this Handbook — V_{BMP} = 29,215 ft^3

Type of Bioretention Facility Design

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

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

Bioretention Facility Surface Area

Depth of Soil Filter Media Layer — d_S = 3.0 ft

Top Width of Bioretention Facility, excluding curb — w_T = 67.0 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 = 16,326 ft^2

Proposed Surface Area — A= 17,683 ft^2

Bioretention Facility Properties

Side Slopes in Bioretention Facility — z = 4 :1

Diameter of Underdrain — 6 inches

Longitudinal Slope of Site (3% maximum) — 0.5 %

6" Check Dam Spacing — 0 feet

Describe Vegetation:

Notes: Basin designed for a tributary area larger than 10 acres per fact sheet 3.7 "Guidance for Larger Bioretention/Biofiltration BMP Facilities" per discussion with county staff on 4/6/2023.

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

(Rev. 10-2011)

Legend: Required Entries / Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name: Rick Engineering | Date: 12/23/2022

Designed by: TR | Case No: 19427

Company Project Number/Name: Chicago Ave

BMP Identification

BMP NAME / ID: 200

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

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

D_{85}= 0.53 inches

Drainage Management Area Tabulation

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

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
DMA 2.1	*642705*	*Mixed Surface Types*	*0.55*	*0.37*	*239407.5*			
DMA 2.2	*186243*	*Concrete or Asphalt*	*1*	*0.89*	*166128.8*			
DMA 2.3	*60152*	*Ornamental Landscaping*	*0.1*	*0.11*	*6644.3*			
DMA 2.4	*14541*	*BMP WQ Surface*	*1*	*0.89*	*12970.6*			
	903641	***Total***			**425151.2**	**0.53**	***18777.5***	***114440***

Notes:

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

Company Name:	Rick Engineering	Date:	4/10/2023
Designed by:	TR	County/City Case No.:	

Design Volume

Enter the area tributary to this feature	A_T=	20.8	acres
Enter V_{BMP} determined from Section 2.1 of this Handbook	V_{BMP}=	18,610	ft^3

Type of Bioretention Facility Design

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

Bioretention Facility Surface Area

Depth of Soil Filter Media Layer	d_S =	3.0	ft
Top Width of Bioretention Facility, excluding curb	w_T =	110.0	ft

Total Effective Depth, d_E

$d_E = [(0.3) \times d_S + (0.4) \times 1] + 0.583$ → d_E = 1.88 ft

Minimum Surface Area, A_m

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

A_M = 9,881 ft^2

Proposed Surface Area	A=	10,247	ft^2
Minimum Required Length of Bioretention Facility, L	L =	94.0	ft

Bioretention Facility Properties

Side Slopes in Bioretention Facility	z =	4	:1
Diameter of Underdrain		6	inches
Longitudinal Slope of Site (3% maximum)		0.5	%
6" Check Dam Spacing		0	feet

Describe Vegetation:

Notes: 7" of WQ Ponding to be used, De = 1.88, Min Surface Area = 9,881 ft^2

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

(Rev. 10-2011)

Legend: Required Entries / Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name: Rick Engineering — Date: 4/10/2023

Designed by: TR — Case No:

Company Project Number/Name:

BMP Identification

BMP NAME / ID: 300

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

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

D_{85}= 0.53 inches

Drainage Management Area Tabulation

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

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	Design Storm Depth (in)	Design Capture Volume, V_{BMP} (cubic feet)	Proposed Volume on Plans (cubic feet)
DMA 3.1	1749449	Mixed Surface Types	0.55	0.37	651669.3			
DMA 3.2	547759	Concrete or Asphalt	1	0.89	488601			
DMA 3.3	103694	Ornamental Landscaping	0.1	0.11	11453.8			
DMA 3.4	30760	BMP WQ Surface	1	0.89	27437.9			
DMA 3.6.1	1967	Decomposed Granite	0.4	0.28	550.2			
	2433629	Total			1179712.2	0.53	52104	221195

Notes:

Bioretention Facility - Design Procedure	BMP ID 3	Legend:	Required Entries / Calculated Cells

Company Name:	Rick Engineering	Date:	4/10/2023
Designed by:	TR	County/City Case No.:	

Design Volume

Enter the area tributary to this feature	A_T=	55.9	acres
Enter V_{BMP} determined from Section 2.1 of this Handbook	V_{BMP}=	52,104	ft^3

Type of Bioretention Facility Design

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

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

Bioretention Facility Surface Area

Depth of Soil Filter Media Layer	d_S =	3.0	ft
Top Width of Bioretention Facility, excluding curb	w_T =	75.0	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 =	29,098	ft^2
Proposed Surface Area	A=	29,500	ft^2

Bioretention Facility Properties

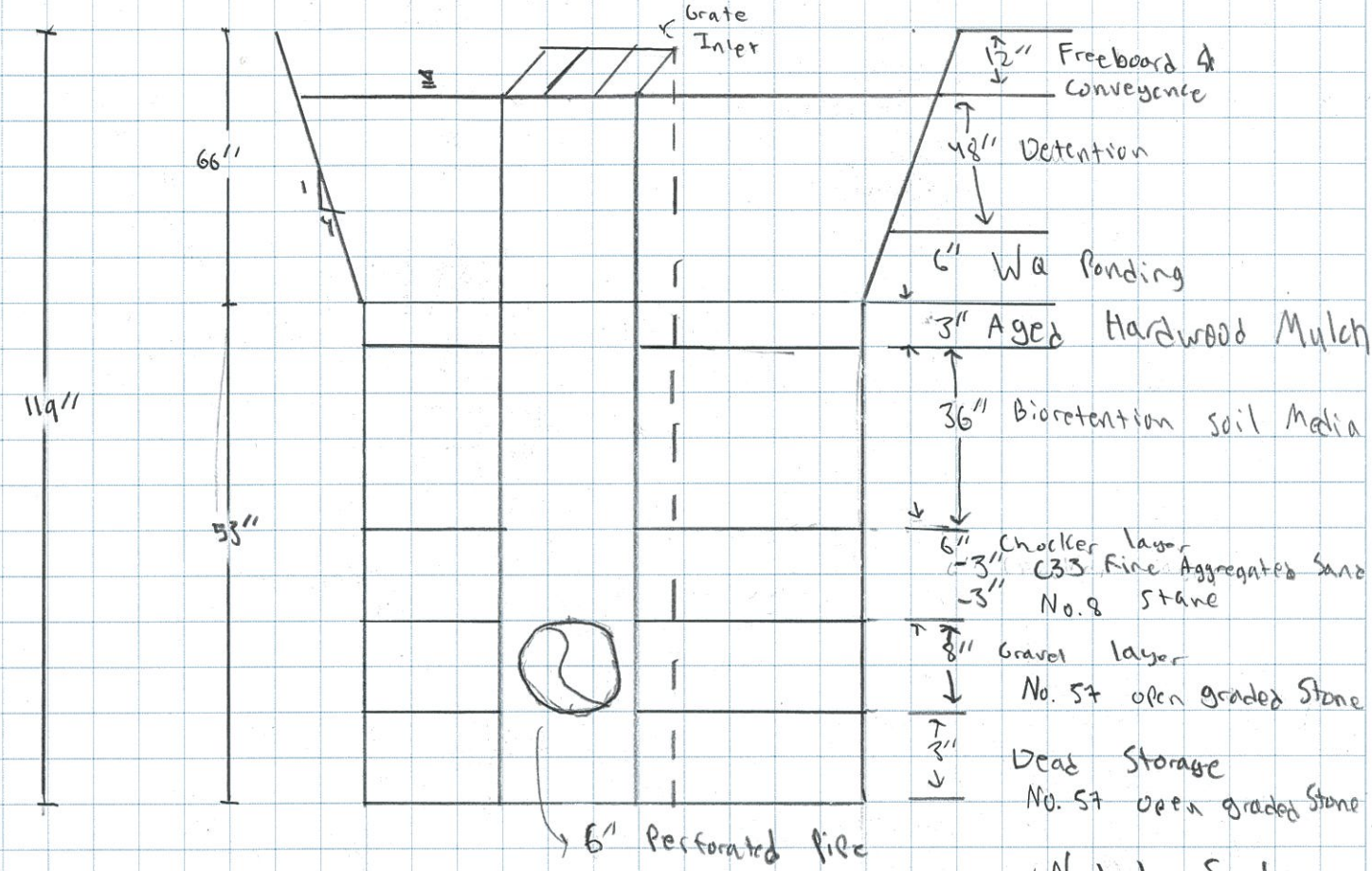
Side Slopes in Bioretention Facility	z =	4	:1
Diameter of Underdrain		6	inches
Longitudinal Slope of Site (3% maximum)		0.5	%
6" Check Dam Spacing		0	feet
Describe Vegetation:			

Notes: Basin designed for a tributary area larger than 10 acres per fact sheet 3.7 "Guidance for Larger Bioretention/Biofiltration BMP Facilities" per discussion with county staff on 4/6/2023.

RICK ENGINEERING COMPANY™
5620 Friars Road
San Diego, CA 92110-2596
Tel: (619) 291-0707
Fax: (619) 291-4165

Date 12/08/2022
Job No. 19427
Page
Done By TR
Checked By

Chicago Avenue Typical Bioretention BMP Cross Section



* Not to Scale
* Working Copy
* Not for Construction

BMP 1 - South of creek
Min Req Volume: 30,000 ft³
Min Req Bottom Surface Area: 16500 ft²
At 4:1 side slopes, typical required top footprint: 20400 ft²

BMP 2 - North of Creek
Min Req Volume: 18900 ft³
Min Req Bottom Surface Area: 10,800 ft²
At 4:1 side slopes typical required top footprint: 12800 ft²

BMP 3 - New Basin to Northeast
Min Req. Volume: 5300 ft³
Min. Req. Bottom Surface Area: 29,500 ft²
At 4:1 side slopes, typical required top footprint: 33,900 ft²

ACTUAL IMPERVIOUS COVER

Land Use (1)	Range-Percent	Recommended Value For Average Conditions-Percent(2)
Natural or Agriculture	0 - 10	0
Single Family Residential: (3)		
40,000 S. F. (1 Acre) Lots	10 - 25	20
20,000 S. F. (½ Acre) Lots	30 - 45	40
7,200 - 10,000 S. F. Lots	45 - 55	50
Multiple Family Residential:		
Condominiums	45 - 70	65
Apartments	65 - 90	80
Mobile Home Park	60 - 85	75
Commercial, Downtown Business or Industrial	80 -100	90

Notes:

1. Land use should be based on ultimate development of the watershed. Long range master plans for the County and incorporated cities should be reviewed to insure reasonable land use assumptions.

2. Recommended values are based on average conditions which may not apply to a particular study area. The percentage impervious may vary greatly even on comparable sized lots due to differences in dwelling size, improvements, etc. Landscape practices should also be considered as it is common in some areas to use ornamental gravels underlain by impervious plastic materials in place of lawns and shrubs. A field investigation of a study area should always be made, and a review of aerial photos, where available may assist in estimating the percentage of impervious cover in developed areas.

3. For typical horse ranch subdivisions increase impervious area 5 percent over the values recommended in the table above.

RCFC & WCD
HYDROLOGY MANUAL

IMPERVIOUS COVER FOR DEVELOPED AREAS

PLATE D-5.6

Note provided: “Basin designed for a tributary area larger than 10 acres per fact sheet 3.7 “Guidance for Large Bioretention/Biofiltration BMP Facilities” per discussion with County staff on 4/6/2023”

3.7 Guidance for Large Bioretention/Biofiltration BMP Facilities

No BMP worksheet is provided. For use, include designs on the WQMP site map with a cross section. Adequate details on the grading plans are required to demonstrate the project design incorporates all of the applicable design criteria.

Applicability	Large sites, multi-parcel sites, BMPs treating greater than 5 acres This fact sheet is intended to be used in combination with Fact Sheet 3.4, 3.5, or 3.6 to provide guidance for how to scale up the design of small scale features to larger scale basins
LID BMPs	Bioretention, Biofiltration with Partial Infiltration, and Biofiltration with No Infiltration

Limits on Use and Applicability

This fact sheet provides guidance for the design, installation, and maintenance of regional scale bioretention/biofiltration Best Management Practices (BMPs) for large multi-parcel projects. The requirements included in this fact sheet are in addition to, those specified in the LID BMP Handbook Fact Sheets for Bioretention (3.4), Biofiltration with Partial Infiltration (3.5), and Biofiltration with No Infiltration (3.6). The user will still need to refer to those fact sheets. This fact sheet then provides additional or overriding criteria for facilities that are designed at a larger scale. These additional criteria are necessary to address unique design challenges associated with larger facilities.

Use of regional scale facilities is at the discretion of the Copermittee. Before continuing with design of regional scale facilities, PDPs shall consult with the Copermittee with jurisdiction over the project site.

Categories of Regional Bioretention/Biofiltration Facilities

The same categories of regional bioretention/biofiltration facilities apply at a regional scale and need to be selected based on the feasibility criteria at the location.

- Bioretention (full infiltration) – Fact Sheet 3.4
- Biofiltration with partial infiltration – Fact Sheet 3.5
- Biofiltration (no infiltration/limited infiltration) – Fact Sheet 3.6

Using a regional facility does not preclude the requirement to evaluate infiltration feasibility criteria. Large facilities require a thorough and detailed assessment of the sites underlying infiltration rates and geotechnical environment. Refer to the Santa Margarita Watershed WQMP for complete feasibility analysis requirements.

Basic Design Requirements and Provisions

Basin Guidelines

All regional facilities shall be designed in accordance with the “Basin Guidelines” included in Appendix C of the LID BMP Handbook. Section 1 of the “Basin Guidelines” presents guidelines

and standards for the design and maintenance of water quality basins used within Riverside County including provisions for:

- General Criteria
- Geotechnical Reports
- Basin Grading Parameters
- Setbacks
- Outlet Structures and Spillways
- Maintenance Access
- Landscaping
- Fencing, and
- Additional Requirements

Site Geotechnical Investigation

A site-specific geotechnical investigation is required to determine subsurface conditions, infiltration rates, the seasonal high ground water elevation (SHGWE), and impacts to site environs as listed in the Feasibility Criteria. The investigation must be conducted by or under direct supervision of a State of California-licensed engineering geologist, geotechnical engineer, or civil engineer with experience in geotechnical engineering, and in compliance with the *SMR WQMP*. The Geotechnical Report shall meet the minimum requirements of the "Basin Guidelines" and provide the following additional information:

- Infiltration rates (in accordance with the "Infiltration Testing Guidelines" included in Appendix A)
- Seasonal high groundwater levels
- Potential for groundwater mounding below the facility or down gradient
- Geotechnical hazards
- Other impacts to site environs, such as water balance impacts on biological resources
- Utilities

Summary of BMP Design Parameters

The BMP design parameters contained in the respective fact sheets for Bioretention, Biofiltration with Partial Infiltration, and Biofiltration with No Infiltration apply to the design of large scale facilities of the same type; however, additional criteria also apply. Table 1 below provides a summary of the standard and augmented design components required for large scale facilities. Where augmented components are specified, additional design criteria are provided in this fact sheet to augment the criteria in the standard fact sheets.

Table 1. Design Requirements for BMP Components

Component	Design Requirements
Pretreatment	Augmented
Cross Section Geometry	Augmented
Overflow	Augmented
Engineered Soil Media	Standard
Subsurface Storage Layer	Standard
Underdrain	Augmented
Energy Dissipation	Augmented
Internal Flow Distribution	Augmented
Media Properties and Outlet Control	Augmented
Landscaping	Standard
Vector Control	Standard
Maintenance Access	Augmented
Construction Considerations	Augmented
Sizing	Standard

Augmented Design Requirements for Regional Scale Facilities

This section contains the augmented design parameters and requirements that are unique to Large Bioretention/Biofiltration Facilities. These provisions help to maintain BMP function and performance in larger facilities and provide additional storage and routing options that are not applicable to smaller scale facilities.

Cross Section Geometry

The following design parameters for regional scale facilities shall be used in place of the corresponding parameters for standard facilities:

- The ponding depth above the engineered soil media shall not exceed 3 feet or the maximum depth that can be drained in 72 hours. A shorter drawdown time may be specified if necessary to support the selected vegetation.
- The engineered soil media shall be a minimum of 2 feet deep.
- Side slopes shall conform to the Basin Guidelines in Appendix C.

Pretreatment

Pretreatment shall be provided in order to reduce the sediment load entering the facility and to maintain the infiltration/filtration rate of the basin. This is more critical for regional facilities as they tend to be deeper and therefore have a larger sediment load per unit area of media.

Where feasible, the following pre-treatment approach is recommended:

- Stabilization or bypass of all exposed soil areas in the watershed.

- Use of a manufactured pre-treatment system with a GULD certification for "pre-treatment" or "basic treatment" per Washington State TAPE Program. Currently approved products: are here: http://www.ecy.wa.gov/programs/wq/stormwater/newtech/technologies.html. Use Internet Explorer for this web page.

The minimum pretreatment mechanism shall be a sedimentation basin or forebay with a volume equivalent to 20 percent of the BMP volume and shall be separated by a berm with a height of at least half of the total ponding depth of the facility.

Overflow

Regional facilities shall conform to the requirements included in the "Basin Guidelines" (Appendix C). These guidelines provide guidance for the design of outlet structures and spillways.

Underdrain

Hydraulic calculations shall be used to determine necessary size of underdrains. It should not be assumed that the 6-inch diameter default for smaller systems will be adequate for larger systems. Subdrains shall be sloped with positive drainage of at least 0.5%.

Rigid non-perforated observation pipes with a diameter equal to the underdrain diameter shall be connected to the underdrain every 50 feet to provide a clean-out port as well as an observation well to monitor dewatering rates.

- The wells/cleanouts shall be connected to the underdrain with the appropriate manufactured connections.
- The wells/cleanouts shall extend 6 inches above the top elevation of the bioretention facility mulch, and shall be capped with a lockable screw cap. Cleanouts may be integrated with vents, in which case the vent should extend above the facility high water line.
- The ends of underdrain pipes not terminating in an observation well/cleanout shall be capped.

Energy Dissipation

Energy dissipation must be provided to prevent erosion of the engineered soil media layer. Internal erosion is a greater risk for larger BMPs due to the higher flow rates and velocities routed to them. Energy dissipation is required meeting the following provisions:

1. All significant inlets shall enter the sediment forebay, if a sediment forebay is provided as the required pretreatment device. Significant inlets include any piped, channeled or conveyed inlets. If a forebay is not provided, a stilling well is recommended.
2. Energy dissipation shall be provided at each inlet to the facility (including curb-cuts) and shall be engineered to control the velocity of inflows to less than 2 feet per second to prevent scour of the media bed.

3. Woody plants (trees, shrubs, etc.) shall not be placed directly in the entrance flow path, but may be used in other portions of the regional facility.

Side Slope Erosion Control

Side slopes of regional facilities can contribute large sediment loads if not full stabilized prior to commissioning of the system. The design and construction phasing shall demonstrate how side slopes will be stabilized to minimize erosion. Example design approaches include:

- Revegetation with dense grass, including irrigation
- Flexible soil armoring grid products combined with revegetation

Flow Distribution System

An internal flow distribution system should be considered to convey pre-treated inflows more evenly across the media bed. This helps avoid scour caused by concentrated flow of water over the media surface near the inlet. It is also desirable to avoid short circuiting[1]. Example design approaches for flow distribution include:

- Design a distribution channel or perforated pipe around a portion of the perimeter (1/2 to 2/3 of the perimeter of the system) and internal to the facility, where needed, to distribute flows within the facility.
- A distribution channel could consist of shallow swale (3 to 6 inches deep) in the media bed, armored with turf reinforcement matting, other geotextile, or cobbles, to withstand higher velocities.
- The distribution system should be designed to drain completely between storm events.

Media Bed Hydraulics and Outlet Control

The following design approach for media outlet control should be considered to help improve filtration processes and media longevity for systems that are designed as biofiltration (with or without partial infiltration)

1. An outlet-controlled underdrain system, consisting of an orifice or other flow control device that controls the rate at which water discharges from the system underdrain.[2]

---

[1] Short-circuiting of flows refers to a disproportionately high fraction of the total filtration occurring in the immediate vicinity of the inlet. These conditions are undesirable as this can overwhelm biological functions and treatment processes in the areas receiving the majority of the flow and result in lower treatment performance on average.

[2] When an outlet-controlled underdrain is used, the rate of flow through the media is controlled by the rate that water can discharge from the underdrain orifice rather than the filtration rate of the media. The filtration rate of the media may vary spatially and will change with time. The use of an outlet controlled underdrain promotes more uniform infiltration across the media bed and longer average contact time with the biofiltration media. It also allows

2. When an outlet control is used, the initial media permeability may be higher (20 to 80 in/hr).

3. The outlet control is then designed such that the average infiltration rate through the media (i.e., the rate at which water passes through the media; as controlled by the outlet, not by the saturated hydraulic conductivity of the media) is approximately 2.5 to 5 in/hr.

4. The facility must drain freely to an acceptable discharge point.

5. If the design configuration has potential for trapped air in the underdrain system to interfere with infiltration through the media bed (i.e., an "airlock"), it may be necessary to vent at an elevation above the high water line.

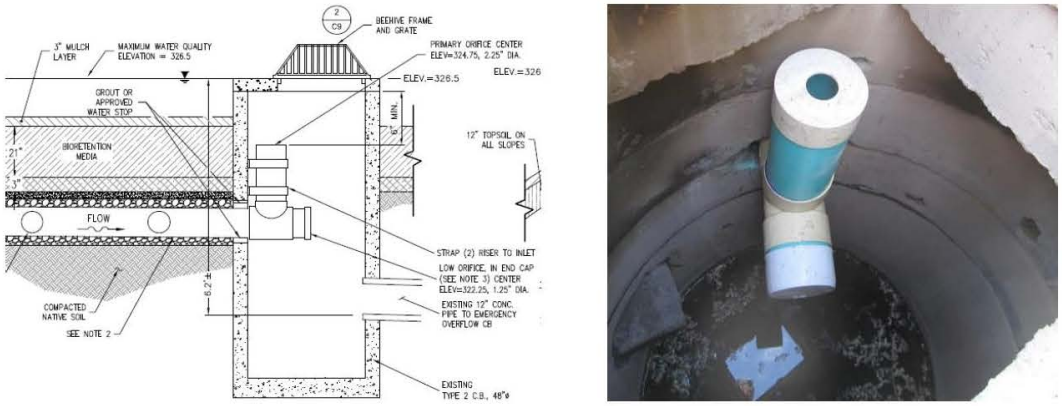


Figure 1. Example Outlet Control Structure

Design for LID and Hydromodification Control

Large bioretention/biofiltration basins can be designed for both LID and hydromodification control. Figure 2 shows schematics of how LID and hydromodification designs can be integrated.

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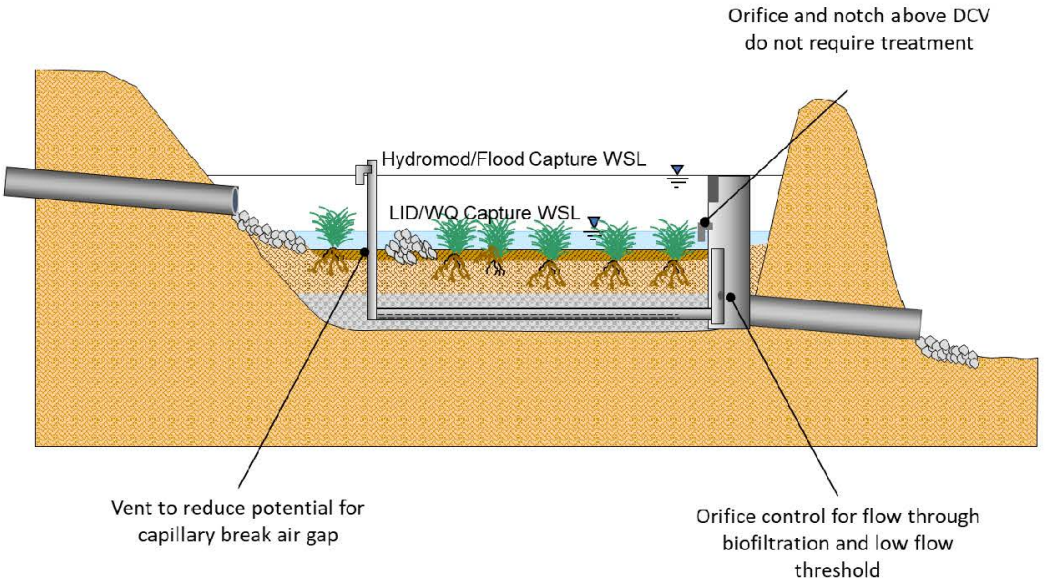
the biofiltration media to be designed with a higher initial saturated hydraulic conductivity, such that a greater degree of clogging can occur before maintenance of the media bed is required.



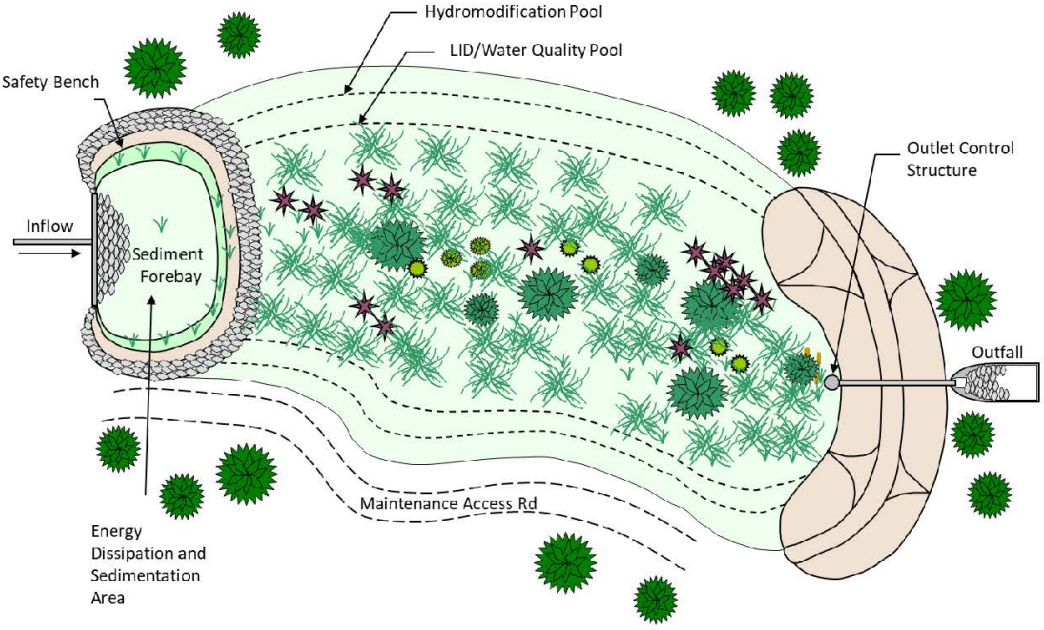
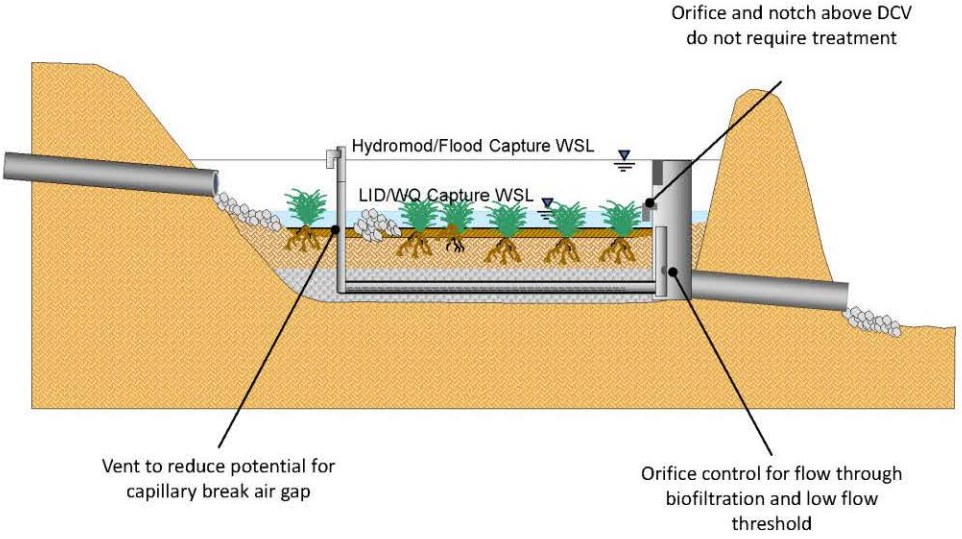
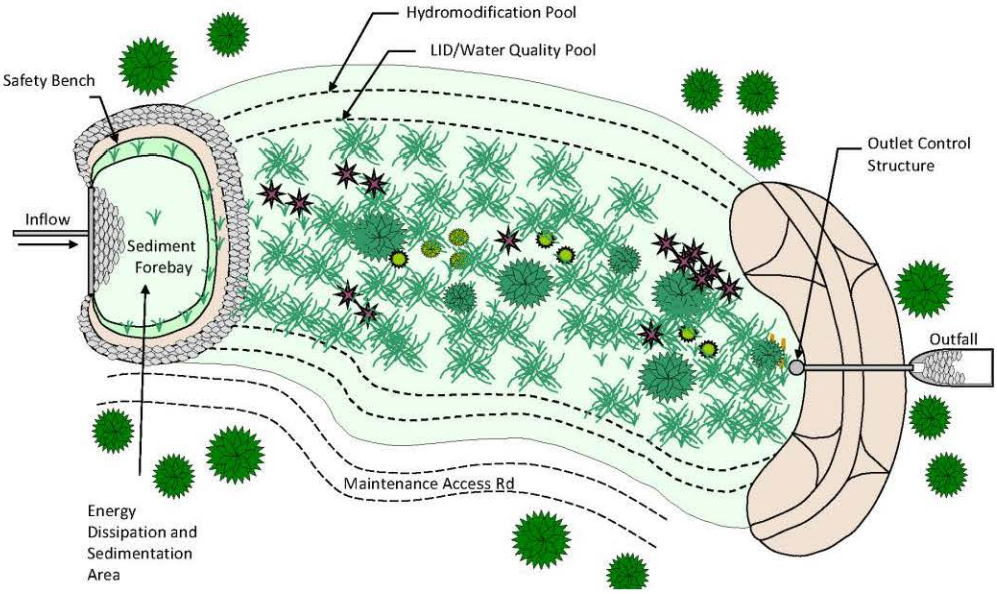


Figure 2. Example Schematic of Combination LID/Hydromodification Basin

Maintenance Access

Access for maintenance activities shall be provided as outlined in the "Basin Guidelines."

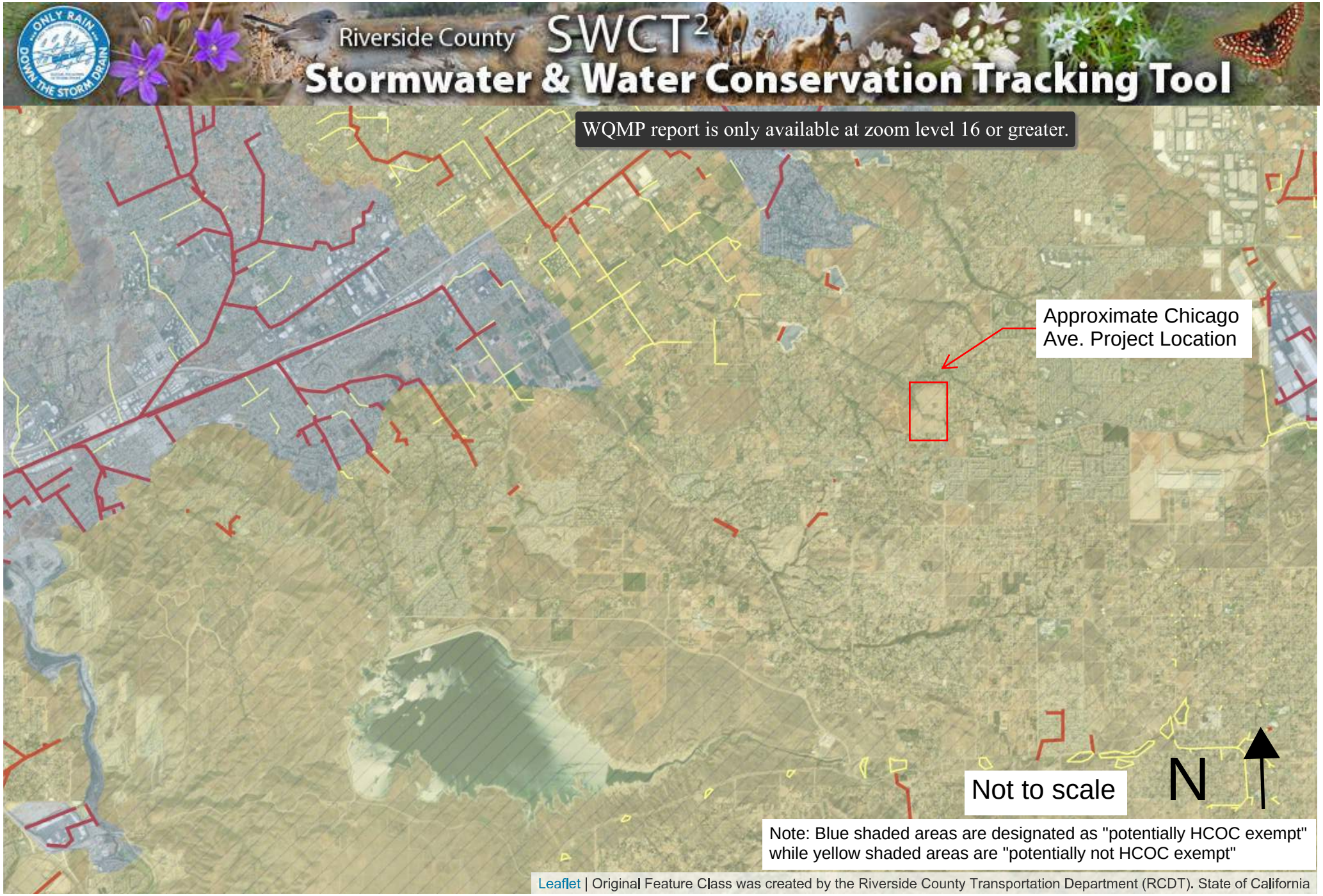

Orifice and notch above DCV
do not require treatment
Hydromod/Flood Capture WSL
LID/WQ Capture WSL
Vent to reduce potential for
capillary break air gap
Orifice control for flow through
biofiltration and low flow
threshold


Hydromodification Pool
LID/Water Quality Pool
Safety Bench
Outlet Control
Structure
Inflow
Sediment
Forebay
Outfall
Maintenance Access Rd
Energy
Dissipation and
Sedimentation
Area

2

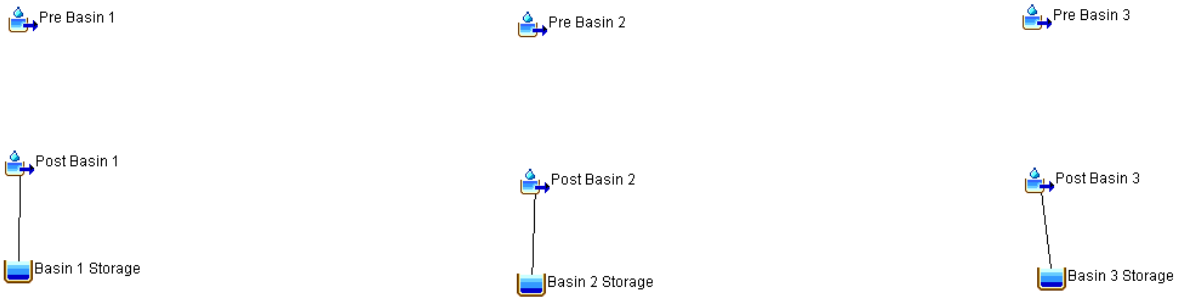
Appendix 7: Hydromodification

Supporting Detail Relating to Hydrologic Conditions of Concern



Arroyo Vista JN-19427 HEC-HMS Detention Results 5/7/2024

HEC-HMS Basin Configuration



10-Year 24 Hour Storm Event

Global Summary

Global Summary Results for Run "3 Basin 10yr 24hr"

Project: ChicagoAve_updated Simulation Run: 3 Basin 10yr 24hr

Start of Run: 01Jan2000, 00:00
End of Run: 04Jan2000, 00:00
Compute Time: DATA CHANGED, RECOMPUTE

Basin Model: Routed 3 Basins
Meteorologic Model: 3 Basin 10yr 24hr Post
Control Specifications: 72 hr

Show Elements: All Elements Volume Units: IN ACRE-FT Sorting: Hydrologic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (ACRE-FT)
Pre Basin 1	0.0462	4.2	01Jan2000, 13:30	0.98
Pre Basin 2	0.0312	2.8	01Jan2000, 13:30	0.66
Pre Basin 3	0.0855	7.7	01Jan2000, 13:30	1.82
Post Basin 1	0.0462	6.5	01Jan2000, 13:30	1.81
Basin 1 Storage	0.0462	4.0	01Jan2000, 15:00	1.81
Post Basin 2	0.0312	4.3	01Jan2000, 13:30	1.22
Basin 2 Storage	0.0312	2.8	01Jan2000, 14:50	1.22
Post Basin 3	0.0855	11.4	01Jan2000, 13:30	3.34
Basin 3 Storage	0.0855	7.0	01Jan2000, 15:20	3.34

Basin 100 Results

Summary Results for Reservoir "Basin 1 Storage"

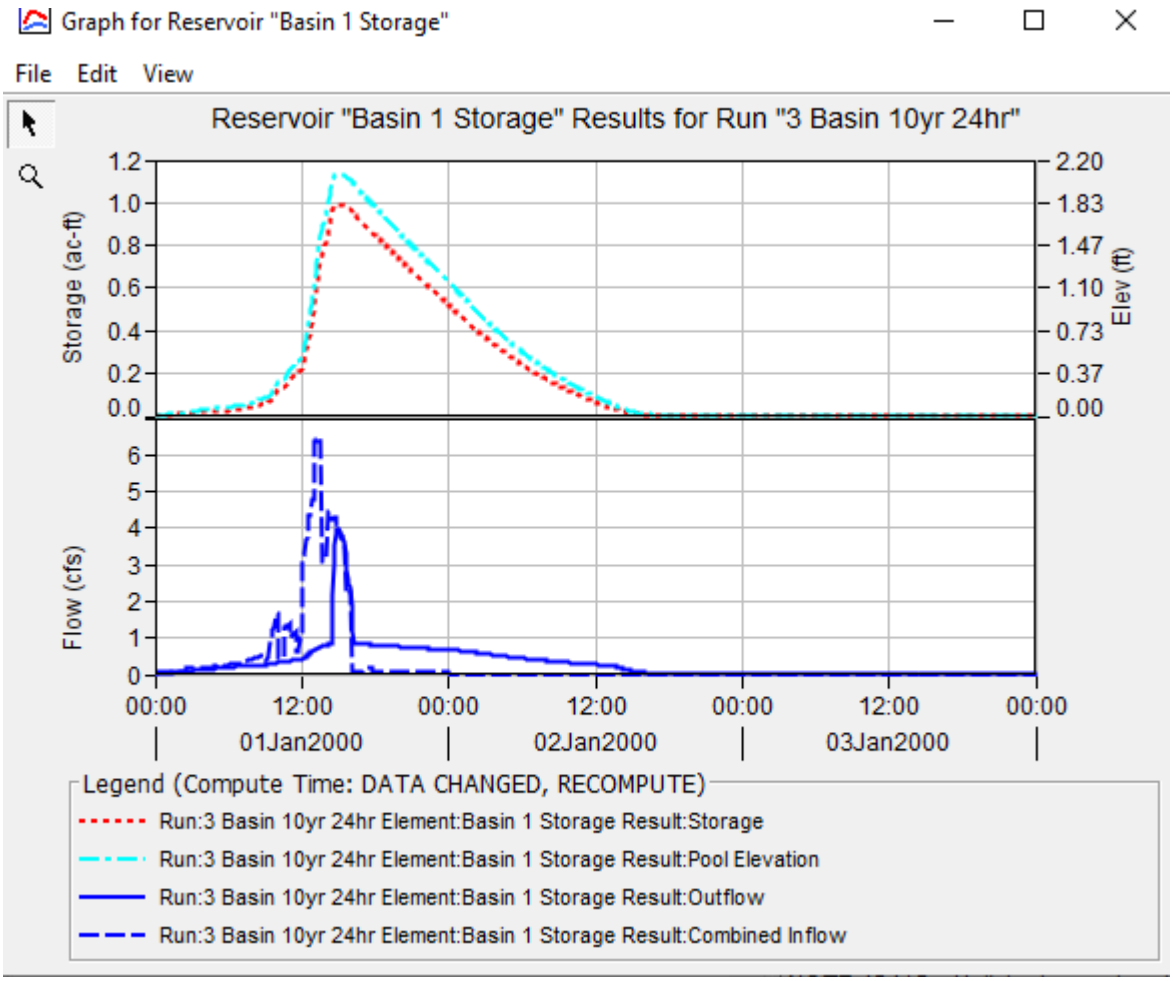
Project: ChicagoAve_updated Simulation Run: 3 Basin 10yr 24hr
Reservoir: Basin 1 Storage

Start of Run:	01Jan2000, 00:00	Basin Model:	Routed 3 Basins
End of Run:	04Jan2000, 00:00	Meteorologic Model:	3 Basin 10yr 24hr Post
Compute Time:	DATA CHANGED, RECOMPUTE	Control Specifications:	72 hr

Volume Units: ○ IN ◉ ACRE-FT

Computed Results

Peak Inflow:	6.5 (CFS)	Date/Time of Peak Inflow:	01Jan2000, 13:30
Peak Discharge:	4.0 (CFS)	Date/Time of Peak Discharge:	01Jan2000, 15:00
Inflow Volume:	1.81 (ACRE-FT)	Peak Storage:	0.99 (ACRE-FT)
Discharge Volume:	1.81 (ACRE-FT)	Peak Elevation:	2.1 (FT)



Basin 200 Results

Summary Results for Reservoir "Basin 2 Storage"

Project: ChicagoAve_updated Simulation Run: 3 Basin 10yr 24hr
Reservoir: Basin 2 Storage

Start of Run:	01Jan2000, 00:00	Basin Model:	Routed 3 Basins
End of Run:	04Jan2000, 00:00	Meteorologic Model:	3 Basin 10yr 24hr Post
Compute Time:	DATA CHANGED, RECOMPUTE	Control Specifications:	72 hr

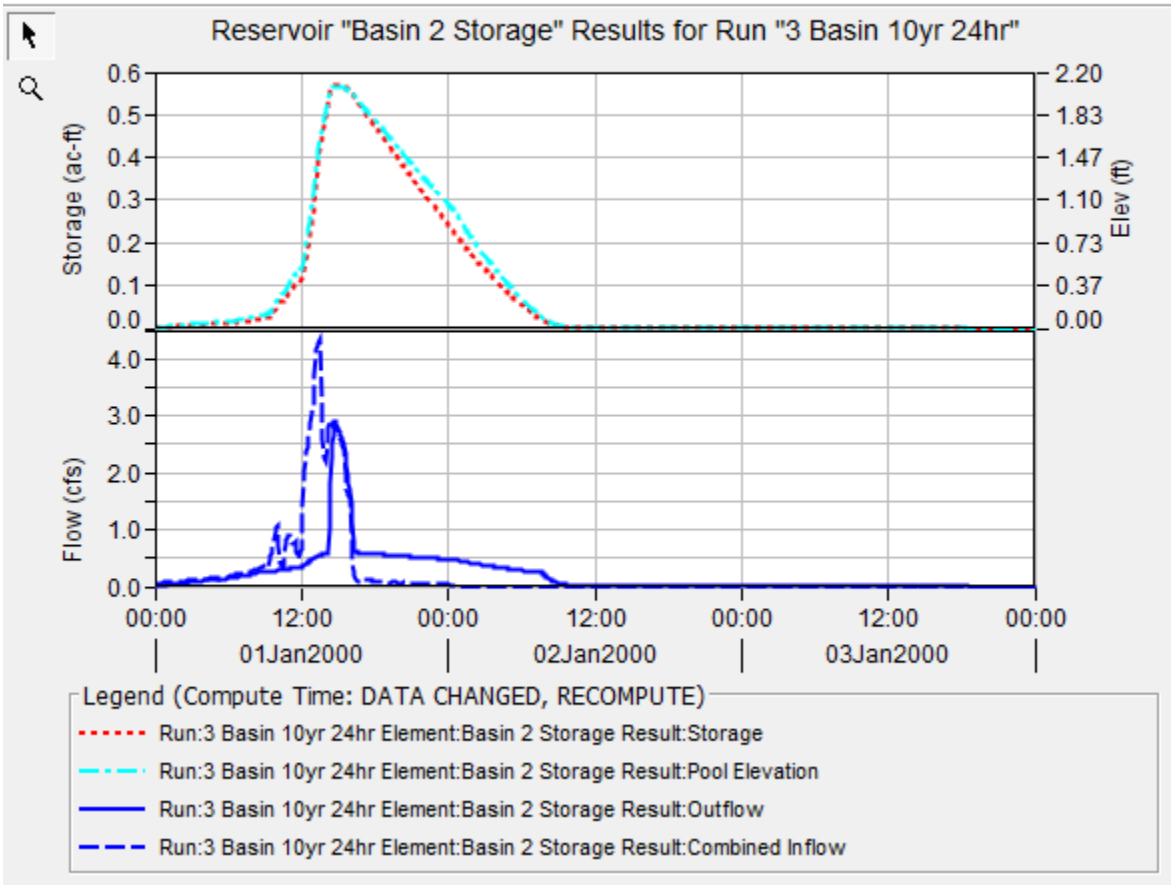
Volume Units: ○ IN ◉ ACRE-FT

Computed Results

Peak Inflow:	4.3 (CFS)	Date/Time of Peak Inflow:	01Jan2000, 13:30
Peak Discharge:	2.8 (CFS)	Date/Time of Peak Discharge:	01Jan2000, 14:50
Inflow Volume:	1.22 (ACRE-FT)	Peak Storage:	0.57 (ACRE-FT)
Discharge Volume:	1.22 (ACRE-FT)	Peak Elevation:	2.1 (FT)

Graph for Reservoir "Basin 2 Storage"

File Edit View



Basin 300 Results

Summary Results for Reservoir "Basin 3 Storage"

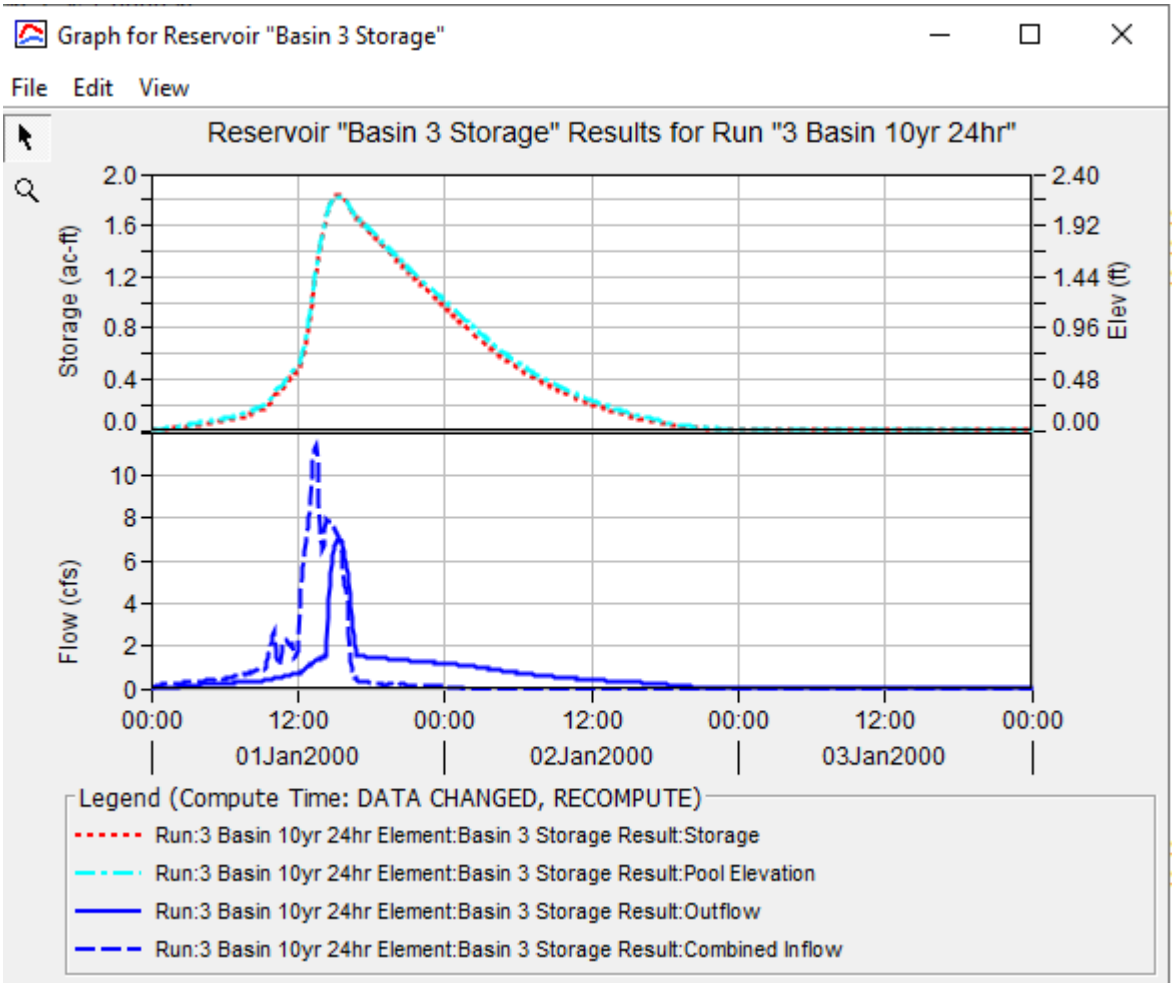
Project: ChicagoAve_updated Simulation Run: 3 Basin 10yr 24hr
Reservoir: Basin 3 Storage

Start of Run:	01Jan2000, 00:00	Basin Model:	Routed 3 Basins
End of Run:	04Jan2000, 00:00	Meteorologic Model:	3 Basin 10yr 24hr Post
Compute Time:	DATA CHANGED, RECOMPUTE	Control Specifications:	72 hr

Volume Units: ○ IN ◉ ACRE-FT

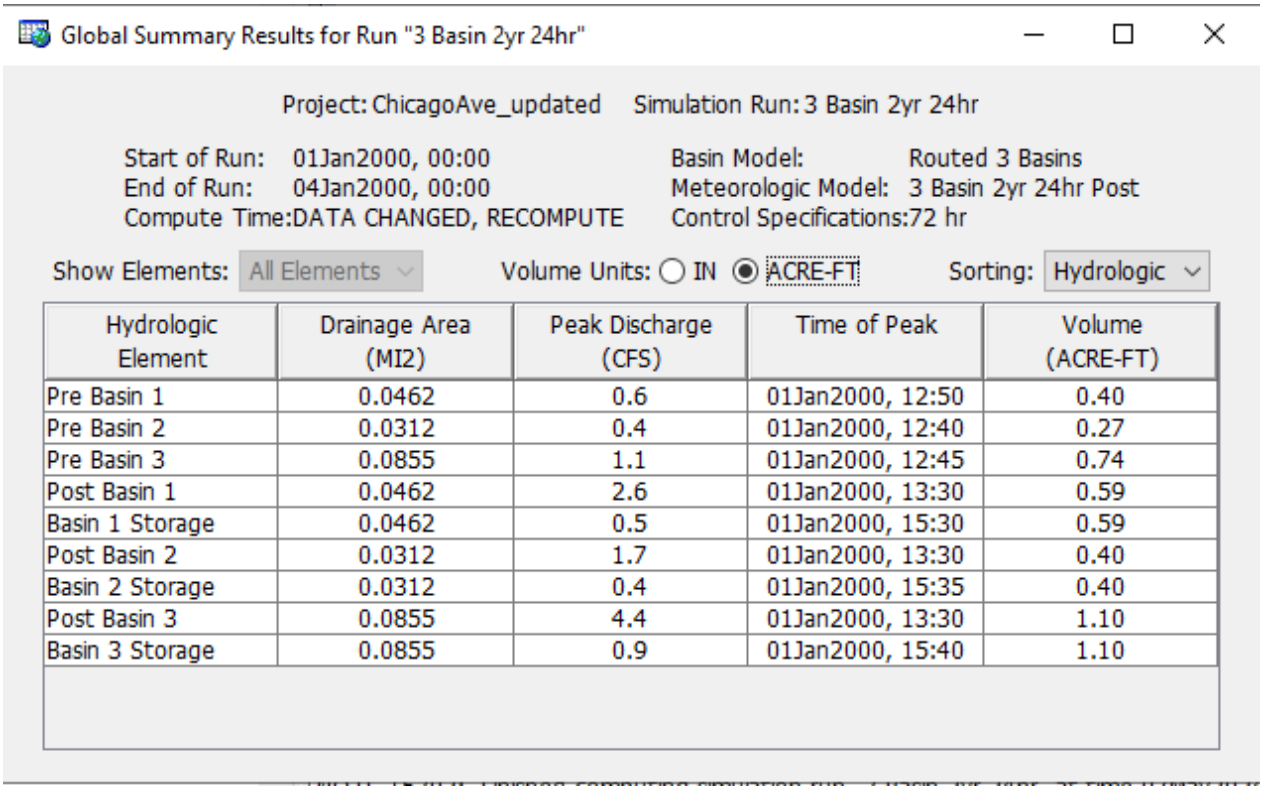
Computed Results

Peak Inflow:	11.4 (CFS)	Date/Time of Peak Inflow:	01Jan2000, 13:30
Peak Discharge:	7.0 (CFS)	Date/Time of Peak Discharge:	01Jan2000, 15:20
Inflow Volume:	3.34 (ACRE-FT)	Peak Storage:	1.83 (ACRE-FT)
Discharge Volume:	3.34 (ACRE-FT)	Peak Elevation:	2.2 (FT)



2 Year Storm Event

Global Summary



Global Summary Results for Run "3 Basin 2yr 24hr"

Project: ChicagoAve_updated Simulation Run: 3 Basin 2yr 24hr

Start of Run: 01Jan2000, 00:00
End of Run: 04Jan2000, 00:00
Compute Time: DATA CHANGED, RECOMPUTE

Basin Model: Routed 3 Basins
Meteorologic Model: 3 Basin 2yr 24hr Post
Control Specifications: 72 hr

Show Elements: All Elements | Volume Units: IN / ACRE-FT | Sorting: Hydrologic

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (ACRE-FT)
Pre Basin 1	0.0462	0.6	01Jan2000, 12:50	0.40
Pre Basin 2	0.0312	0.4	01Jan2000, 12:40	0.27
Pre Basin 3	0.0855	1.1	01Jan2000, 12:45	0.74
Post Basin 1	0.0462	2.6	01Jan2000, 13:30	0.59
Basin 1 Storage	0.0462	0.5	01Jan2000, 15:30	0.59
Post Basin 2	0.0312	1.7	01Jan2000, 13:30	0.40
Basin 2 Storage	0.0312	0.4	01Jan2000, 15:35	0.40
Post Basin 3	0.0855	4.4	01Jan2000, 13:30	1.10
Basin 3 Storage	0.0855	0.9	01Jan2000, 15:40	1.10

Basin 100 Results

Summary Results for Reservoir "Basin 1 Storage"

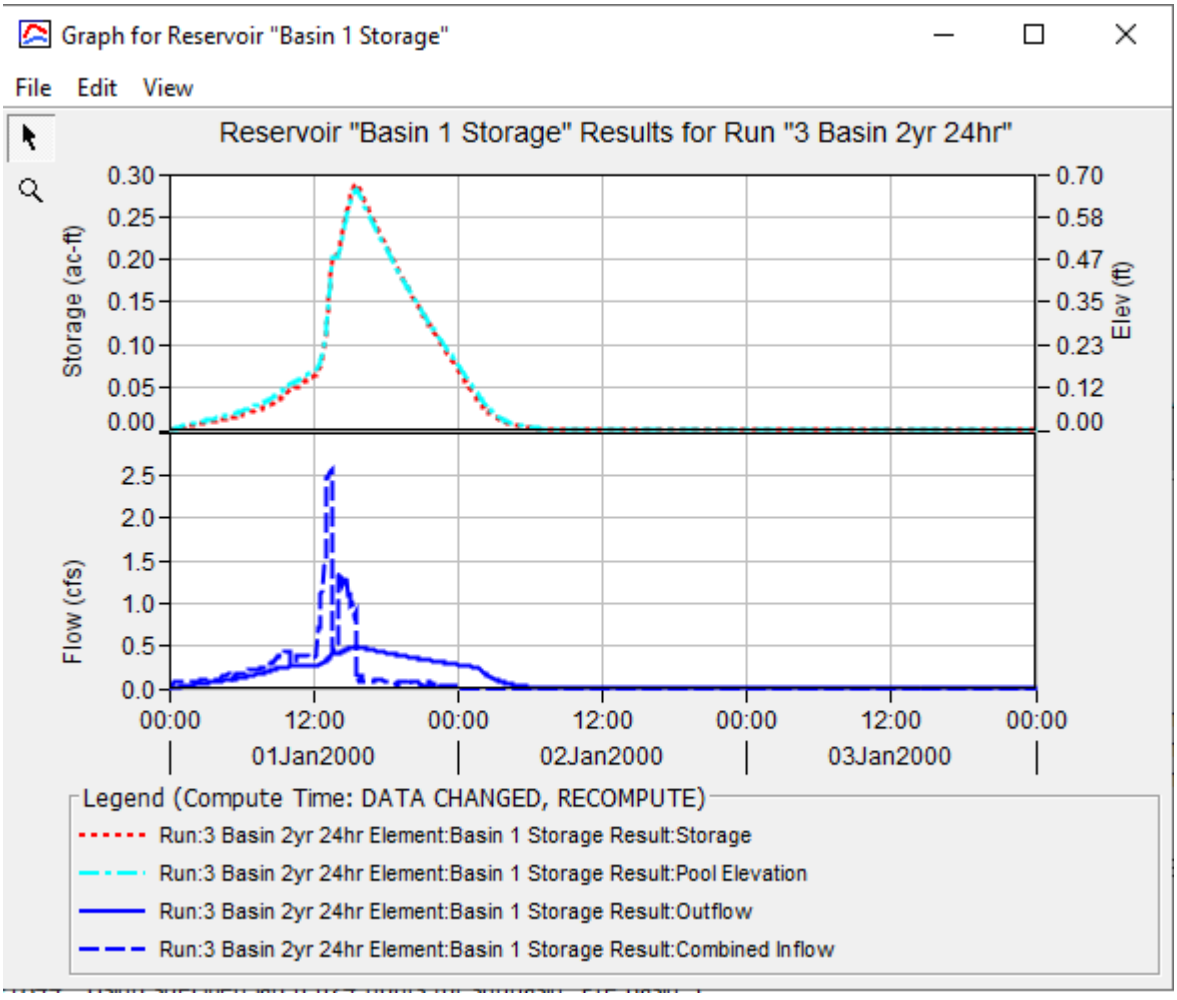
Project: ChicagoAve_updated Simulation Run: 3 Basin 2yr 24hr
Reservoir: Basin 1 Storage

Start of Run:	01Jan2000, 00:00	Basin Model:	Routed 3 Basins
End of Run:	04Jan2000, 00:00	Meteorologic Model:	3 Basin 2yr 24hr Post
Compute Time:	DATA CHANGED, RECOMPUTE	Control Specifications:	72 hr

Volume Units: ○ IN ◉ ACRE-FT

Computed Results

Peak Inflow:	2.6 (CFS)	Date/Time of Peak Inflow:	01Jan2000, 13:30
Peak Discharge:	0.5 (CFS)	Date/Time of Peak Discharge:	01Jan2000, 15:30
Inflow Volume:	0.59 (ACRE-FT)	Peak Storage:	0.29 (ACRE-FT)
Discharge Volume:	0.59 (ACRE-FT)	Peak Elevation:	0.7 (FT)



Basin 200 Results

Summary Results for Reservoir "Basin 2 Storage"

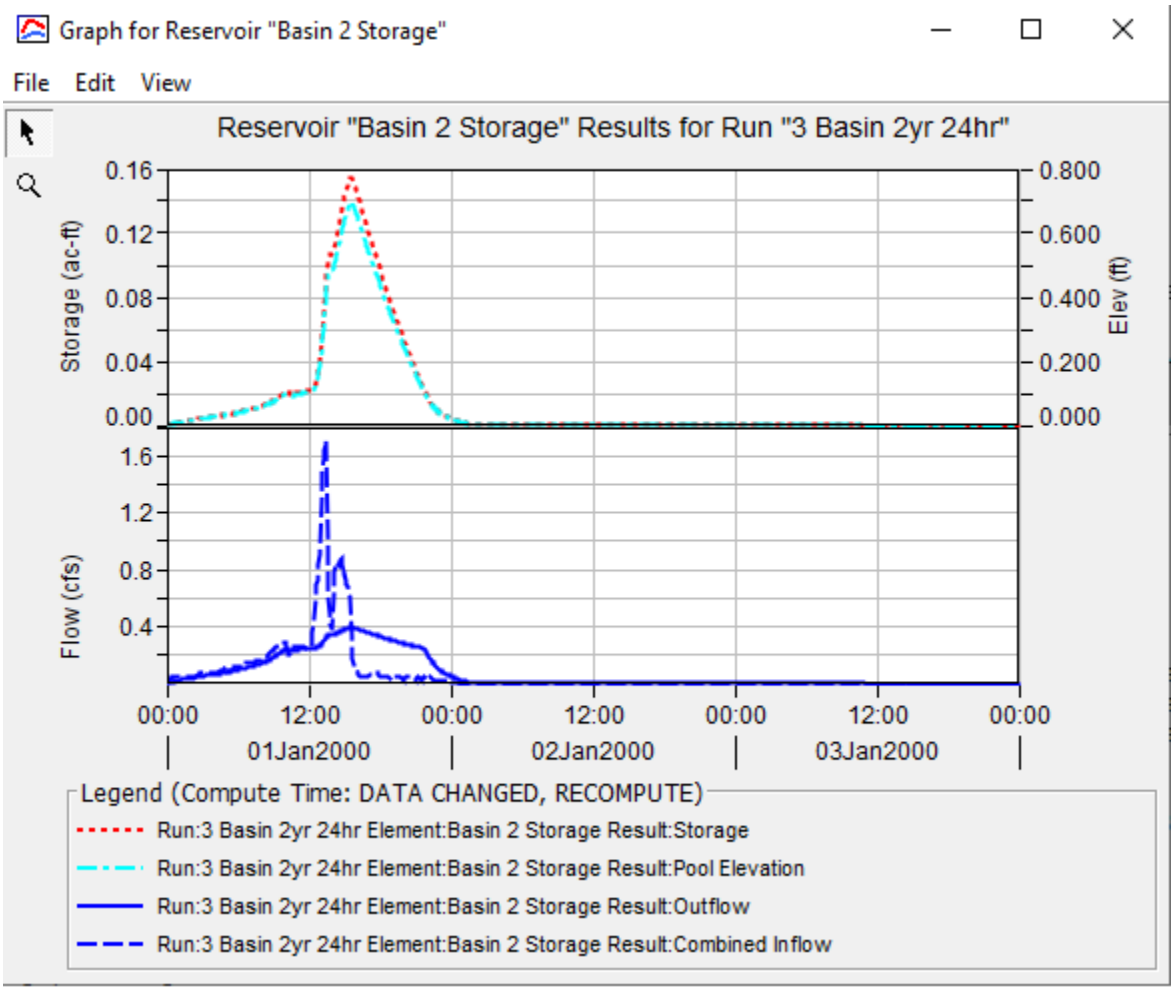
Project: ChicagoAve_updated Simulation Run: 3 Basin 2yr 24hr
Reservoir: Basin 2 Storage

Start of Run:	01Jan2000, 00:00	Basin Model:	Routed 3 Basins
End of Run:	04Jan2000, 00:00	Meteorologic Model:	3 Basin 2yr 24hr Post
Compute Time:	DATA CHANGED, RECOMPUTE	Control Specifications:	72 hr

Volume Units: ○ IN ◉ ACRE-FT

Computed Results

Peak Inflow:	1.7 (CFS)	Date/Time of Peak Inflow:	01Jan2000, 13:30
Peak Discharge:	0.4 (CFS)	Date/Time of Peak Discharge:	01Jan2000, 15:35
Inflow Volume:	0.40 (ACRE-FT)	Peak Storage:	0.15 (ACRE-FT)
Discharge Volume:	0.40 (ACRE-FT)	Peak Elevation:	0.7 (FT)



Basin 300 Results

Summary Results for Reservoir "Basin 3 Storage"

Project: ChicagoAve_updated Simulation Run: 3 Basin 2yr 24hr
Reservoir: Basin 3 Storage

Start of Run:	01Jan2000, 00:00	Basin Model:	Routed 3 Basins
End of Run:	04Jan2000, 00:00	Meteorologic Model:	3 Basin 2yr 24hr Post
Compute Time:	DATA CHANGED, RECOMPUTE	Control Specifications:	72 hr

Volume Units: ○ IN ◉ ACRE-FT

Computed Results

Peak Inflow:	4.4 (CFS)	Date/Time of Peak Inflow:	01Jan2000, 13:30
Peak Discharge:	0.9 (CFS)	Date/Time of Peak Discharge:	01Jan2000, 15:40
Inflow Volume:	1.10 (ACRE-FT)	Peak Storage:	0.61 (ACRE-FT)
Discharge Volume:	1.10 (ACRE-FT)	Peak Elevation:	0.8 (FT)

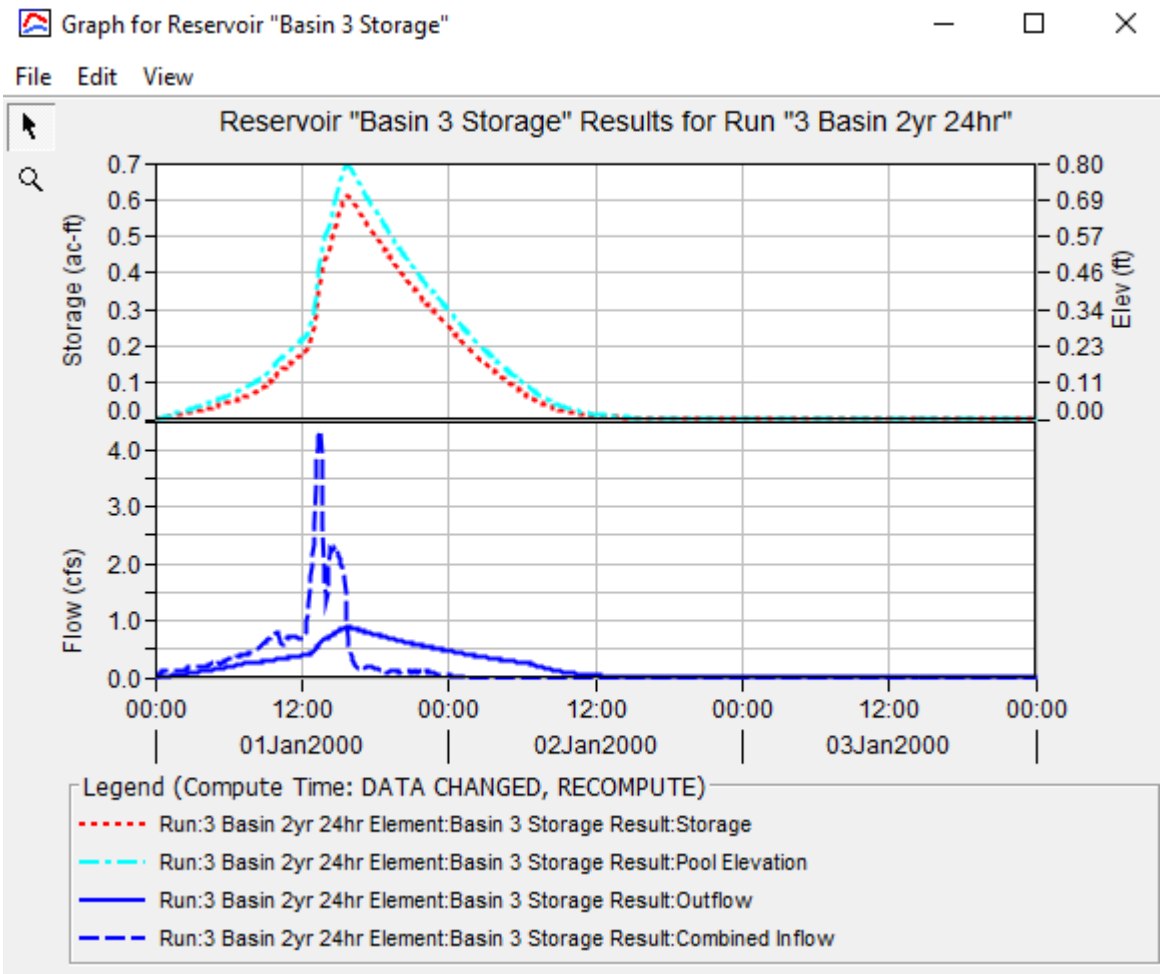


Table 4.1 - Detention Summary for the 10-Year and 2-year 24 Hour Storm Events

		Pre-Project Flow Rate (cfs)	Post-Project Flow Rate (Undetained) (cfs)	Post-Project Flow Rate (Detained) (cfs)	Post-Project Peak Storage (acre-feet)
Basin 100	2YR	0.6	2.6	0.5	0.29
	10 YR	4.2	6.5	4.0	0.99
Basin 200	2 YR	0.4	1.7	0.4	0.15
	10 YR	2.8	4.3	2.8	0.57
Basin 300	2 YR	1.1	4.4	0.9	0.61
	10 YR	7.7	11.4	7.0	1.83

Notes:

1. Peak Storages obtained from HEC-HMS. Outputs and RCFC Preprocessor inputs provided in appendix D.

A summary of the proposed basin storage is summarized in table 4.2 below.

Table 4.2 - Proposed Basin Summary

	Tributary Area (acre)	Minimum volume from 2-year, 24-hour storm event (Acre-feet)	Minimum volume from 10-year, 24-hour storm event (Acre-feet)	Provided Detention Volume (acre-feet)[1]
Basin 100	28.6	0.40	0.98	2.13
Basin 200	19.9	0.27	0.66	1.34
Basin 300	56.6	0.74	1.82	3.69

Notes:

1. Provided Detention Volume is calculated reserving 1 foot of freeboard depth within the proposed basin footprint.

Appendix 8: Source Control

Pollutant Sources/Source Control Checklist

STORMWATER POLLUTANT SOURCES / SOURCE CONTROL CHECKLIST

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

STORMWATER POLLUTANT SOURCES / SOURCE CONTROL CHECKLIST

1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Shown on WQMP Drawings	3 Permanent Controls—Listed in WQMP Table and Narrative	4 Operational BMPs—Included in WQMP Table and Narrative
☐ **D1. Need for future indoor & structural pest control**		☐ **Note building design features that discourage entry of pests.**	☐ **Provide Integrated Pest Management information to owners, lessees, and operators.**
☑ **D2. Landscape/ Outdoor Pesticide Use**	☐ **Show locations of native trees or areas of shrubs and ground cover to be undisturbed and retained.** ☐ **Show self-retaining landscape areas, if any.** ☐ **Show stormwater treatment and hydrograph modification management BMPs. (See instructions in Chapter 3, Step 5 and guidance in Chapter 5.)**	☑ **State that final landscape plans will accomplish all of the following.** ☑ **Preserve existing native trees, shrubs, and ground cover to the maximum extent possible.** ☑ **Design landscaping to minimize irrigation and runoff, to promote surface infiltration where appropriate, and to minimize the use of fertilizers and pesticides that can contribute to stormwater pollution.** ☑ **Where landscaped areas are used to retain or detain stormwater, specify plants that are tolerant of saturated soil conditions.** ☑ **Consider using pest-resistant plants, especially adjacent to hardscape.** ☑ **To insure successful establishment, select plants appropriate to site soils, slopes, climate, sun, wind, rain, land use, air movement, ecological consistency, and plant interactions.**	☑ **Maintain landscaping using minimum or no pesticides.** ☑ **See applicable operational BMPs in "What you should know for…..Landscape and Gardening" at http://rcflood.org/stormwater/Downloads/LandscapeGardenBrochure.pdf** ☑ **Provide IPM information to new owners, lessees and operators.**

STORMWATER POLLUTANT SOURCES / SOURCE CONTROL CHECKLIST

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

STORMWATER POLLUTANT SOURCES / SOURCE CONTROL CHECKLIST

1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Shown on WQMP Drawings	3 Permanent Controls—Listed in WQMP Table and Narrative	4 Operational BMPs—Included in WQMP Table and Narrative
☐ H. Industrial processes.	☐ Show process area.	☐ If industrial processes are to be located on site, state: "All process activities to be performed indoors. No processes to drain to exterior or to storm drain system."	☐ See Fact Sheet SC-10, "Non-Stormwater Discharges" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com See the brochure "Industrial & Commercial Facilities Best Management Practices for: Industrial, Commercial Facilities" at http://rcflood.org/stormwater/

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

STORMWATER POLLUTANT SOURCES / SOURCE CONTROL CHECKLIST

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

STORMWATER POLLUTANT SOURCES / SOURCE CONTROL CHECKLIST

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

STORMWATER POLLUTANT SOURCES / SOURCE CONTROL CHECKLIST

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

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

STORMWATER POLLUTANT SOURCES / SOURCE CONTROL CHECKLIST

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

STORMWATER POLLUTANT SOURCES / SOURCE CONTROL CHECKLIST

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

STORMWATER POLLUTANT SOURCES / SOURCE CONTROL CHECKLIST

1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Shown on WQMP Drawings	3 Permanent Controls—Listed in WQMP Table and Narrative	4 Operational BMPs—Included in WQMP Table and Narrative
☑ P. Plazas, sidewalks, and parking lots.			☑ Sweep plazas, sidewalks, and parking lots regularly to prevent accumulation of litter and debris. Collect debris from pressure washing to prevent entry into the storm drain system. Collect washwater containing any cleaning agent or degreaser and discharge to the sanitary sewer not to a storm drain.

Appendix 9: O&M

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

Not Applicable for Preliminary WQMP

Appendix 10: Educational Materials

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

3.5 Bioretention Facility

Type of BMP	LID – Bioretention
Treatment Mechanisms	Infiltration, Evapotranspiration, Evaporation, Biofiltration
Maximum Drainage Area	This BMP is intended to be integrated into a project's landscaped area in a distributed manner. Typically, contributing drainage areas to Bioretention Facilities range from less than 1 acre to a maximum of around 10 acres.
Other Names	Rain Garden, Bioretention Cell, Bioretention Basin, Biofiltration Basin, Landscaped Filter Basin, Porous Landscape Detention

Description

Bioretention Facilities are shallow, vegetated basins underlain by an engineered soil media. Healthy plant and biological activity in the root zone maintain and renew the macro-pore space in the soil and maximize plant uptake of pollutants and runoff. This keeps the Best Management Practice (BMP) from becoming clogged and allows more of the soil column to function as both a sponge (retaining water) and a highly effective and self-maintaining biofilter. In most cases, the bottom of a Bioretention Facility is unlined, which also provides an opportunity for infiltration to the extent the underlying onsite soil can accommodate. When the infiltration rate of the underlying soil is exceeded, fully biotreated flows are discharged via underdrains. Bioretention Facilities therefore will inherently achieve the maximum feasible level of infiltration and evapotranspiration and achieve the minimum feasible (but highly biotreated) discharge to the storm drain system.

Siting Considerations

These facilities work best when they are designed in a relatively level area. Unlike other BMPs, Bioretention Facilities can be used in smaller landscaped spaces on the site, such as:

- ✓ Parking islands
- ✓ Medians
- ✓ Site entrances

Landscaped areas on the site (such as may otherwise be required through minimum landscaping ordinances), can often be designed as Bioretention Facilities. This can be accomplished by:

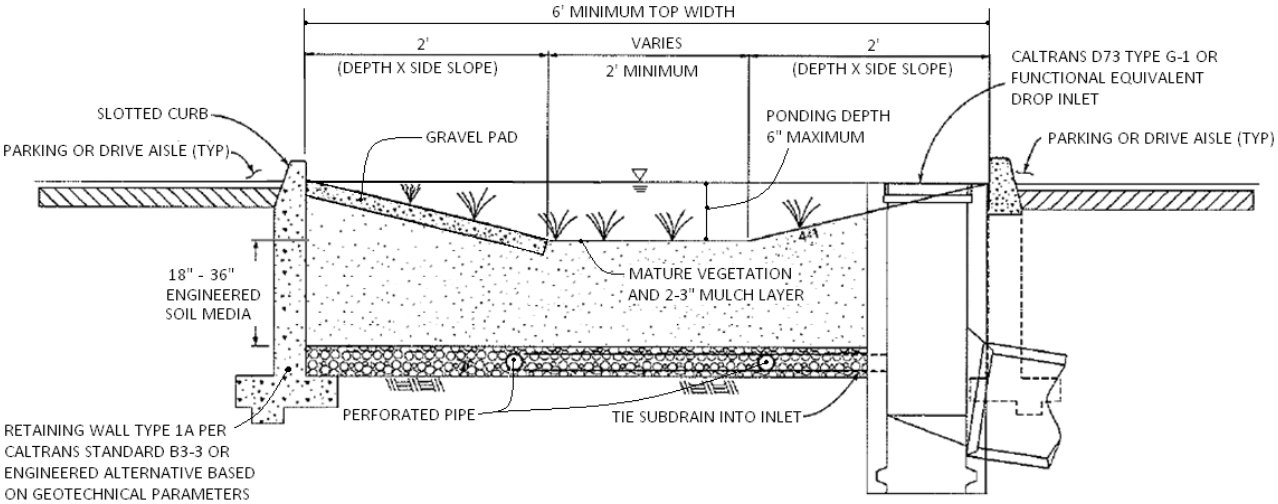
- *Depressing* landscaped areas below adjacent impervious surfaces, rather than elevating those areas
- Grading the site to direct runoff from those impervious surfaces *into* the Bioretention Facility, rather than away from the landscaping
- Sizing and designing the depressed landscaped area as a Bioretention Facility as described in this Fact Sheet

Bioretention Facilities should however not be used downstream of areas where large amounts of sediment can clog the system. Placing a Bioretention Facility at the toe of a steep slope should also be avoided due to the potential for clogging the engineered soil media with erosion from the slope, as well as the potential for damaging the vegetation.

Design and Sizing Criteria

The recommended cross section necessary for a Bioretention Facility includes:

- Vegetated area
- 18' minimum depth of engineered soil media
- 12' minimum gravel layer depth with 6' perforated pipes (added flow control features such as orifice plates may be required to mitigate for HCOC conditions)



While the 18-inch minimum engineered soil media depth can be used in some cases, it is recommended to use 24 inches or a preferred 36 inches to provide an adequate root zone for the chosen plant palate. Such a design also provides for improved removal effectiveness for nutrients. The recommended ponding depth inside of a Bioretention Facility is 6 inches; measured from the flat bottom surface to the top of the water surface as shown in Figure 1.

Because this BMP is filled with an engineered soil media, pore space in the soil and gravel layer is assumed to provide storage volume. However, several considerations must be noted:

- Surcharge storage above the soil surface (6 inches) is important to assure that design flows do not bypass the BMP when runoff exceeds the soil's absorption rate.
- In cases where the Bioretention Facility contains engineered soil media deeper than 36 inches, the pore space within the engineered soil media can only be counted to the 36-inch depth.
- A maximum of 30 percent pore space can be used for the soil media whereas a maximum of 40 percent pore space can be use for the gravel layer.

Figure 1: Standard Layout for a Bioretention Facility

Engineered Soil Media Requirements

The engineered soil media shall be comprised of 85 percent mineral component and 15 percent organic component, by volume, drum mixed prior to placement. The mineral component shall be a Class A sandy loam topsoil that meets the range specified in Table 1 below. The organic component shall be nitrogen stabilized compost[1], such that nitrogen does not leach from the media.

Table 1: Mineral Component Range Requirements

Percent Range	Component
70-80	Sand
15-20	Silt
5-10	Clay

The trip ticket, or certificate of compliance, shall be made available to the inspector to prove the engineered mix meets this specification.

Vegetation Requirements

Vegetative cover is important to minimize erosion and ensure that treatment occurs in the Bioretention Facility. The area should be designed for at least 70 percent mature coverage throughout the Bioretention Facility. To prevent the BMP from being used as walkways, Bioretention Facilities shall be planted with a combination of small trees, densely planted shrubs, and natural grasses. Grasses shall be native or ornamental; preferably ones that do not need to be mowed. The application of fertilizers and pesticides should be minimal. To maintain oxygen levels for the vegetation and promote biodegradation, it is important that vegetation not be completely submerged for any extended period of time. Therefore, a maximum of 6 inches of ponded water shall be used in the design to ensure that plants within the Bioretention Facility remain healthy.

A 2 to 3-inch layer of standard shredded aged hardwood mulch shall be placed as the top layer inside the Bioretention Facility. The 6-inch ponding depth shown in Figure 1 above shall be measured from the top surface of the 2 to 3-inch mulch layer.

Curb Cuts

To allow water to flow into the Bioretention Facility, 1-foot-wide (minimum) curb cuts should be placed approximately every 10 feet around the perimeter of the Bioretention Facility. Figure 2 shows a curb cut in a Bioretention Facility. Curb cut flow lines must be at or above the V_{BMP} water surface level.

[1] For more information on compost, visit the US Composting Council website at: http://compostingcouncil.org/

Figure 2: Curb Cut located in a Bioretention Facility

To reduce erosion, a gravel pad shall be placed at each inlet point to the Bioretention Facility. The gravel should be 1- to 1.5-inch diameter in size. The gravel should overlap the curb cut opening a minimum of 6 inches. The gravel pad inside the Bioretention Facility should be flush with the finished surface at the curb cut and extend to the bottom of the slope.

In addition, place an apron of stone or concrete, a foot square or larger, inside each inlet to prevent vegetation from growing up and blocking the inlet. See Figure 3.

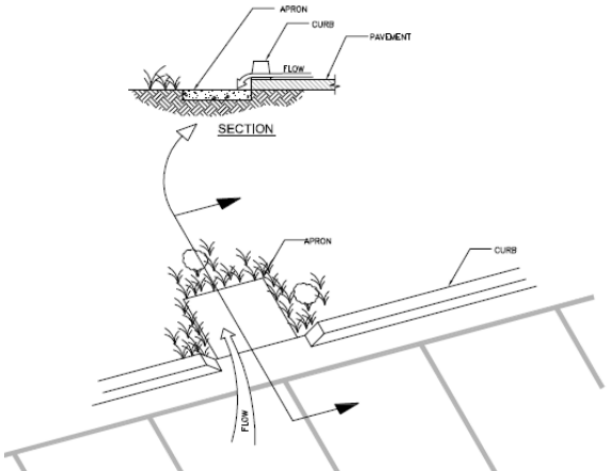


Figure 3: Apron located in a Bioretention Facility

Terracing the Landscaped Filter Basin

It is recommended that Bioretention Facilities be level. In the event the facility site slopes and lacks proper design, water would fill the lowest point of the BMP and then discharge from the basin without being treated. To ensure that the water will be held within the Bioretention Facility on sloped sites, the BMP must be terraced with nonporous check dams to provide the required storage and treatment capacity.

The terraced version of this BMP shall be used on non-flat sites with no more than a 3 percent slope. The surcharge depth cannot exceed 0.5 feet, and side slopes shall not exceed 4:1. Table 2 below shows the spacing of the check dams, and slopes shall be rounded up (i.e., 2.5 percent slope shall use 10' spacing for check dams).

Table 2: Check Dam Spacing

6" Check Dam Spacing	
Slope	**Spacing**
1%	*25'*
2%	*15'*
3%	*10'*

Roof Runoff

Roof downspouts may be directed towards Bioretention Facilities. However, the downspouts must discharge onto a concrete splash block to protect the Bioretention Facility from erosion.

Retaining Walls

It is recommended that Retaining Wall Type 1A, per Caltrans Standard B3-3 or equivalent, be constructed around the entire perimeter of the Bioretention Facility. This practice will protect the sides of the Bioretention Facility from collapsing during construction and maintenance or from high service loads adjacent to the BMP. Where such service loads would not exist adjacent to the BMP, an engineered alternative may be used if signed by a licensed civil engineer.

Side Slope Requirements

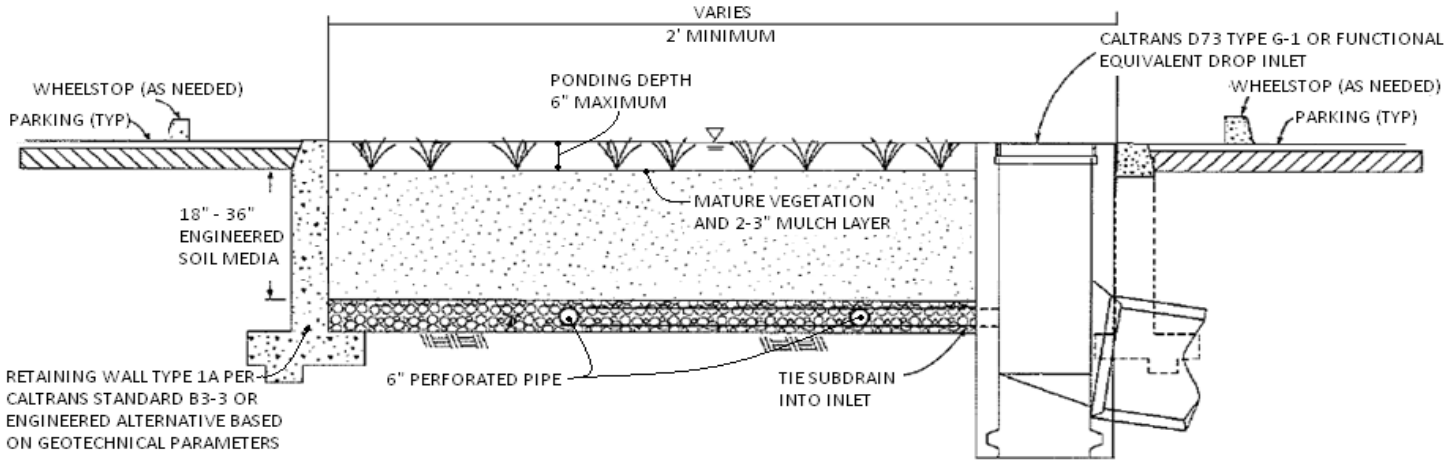
Bioretention Facilities Requiring Side Slopes

The design should assure that the Bioretention Facility does not present a tripping hazard. Bioretention Facilities proposed near pedestrian areas, such as areas parallel to parking spaces or along a walkway, must have a gentle slope to the bottom of the facility. Side slopes inside of a Bioretention Facility shall be 4:1. A typical cross section for the Bioretention Facility is shown in Figure 1.

Bioretention Facilities Not Requiring Side Slopes

Where cars park perpendicular to the Bioretention Facility, side slopes are not required. A 6-inch maximum drop may be used, and the Bioretention Facility must be planted with trees and shrubs to prevent pedestrian access. In this case, a curb is not placed around the Bioretention Facility,

but wheel stops shall be used to prevent vehicles from entering the Bioretention Facility, as shown in Figure 4.



Planter Boxes

Bioretention Facilities can also be placed above ground as planter boxes. Planter boxes must have a minimum width of 2 feet, a maximum surcharge depth of 6 inches, and no side slopes are necessary. Planter boxes must be constructed so as to ensure that the top surface of the engineered soil media will remain level. This option may be constructed of concrete, brick, stone or other stable materials that will not warp or bend. Chemically treated wood or galvanized steel, which has the ability to contaminate stormwater, should not be used. Planter boxes must be lined with an impermeable liner on all sides, including the bottom. Due to the impermeable liner, the inside bottom of the planter box shall be designed and constructed with a cross fall, directing treated flows within the subdrain layer toward the point where subdrain exits the planter box, and subdrains shall be oriented with drain holes oriented down. These provisions will help avoid excessive stagnant water within the gravel underdrain layer. Similar to the in-ground Bioretention Facility versions, this BMP benefits from healthy plants and biological activity in the root zone. Planter boxes should be planted with appropriately selected vegetation.

Figure 5: Planter Box
Source: LA Team Effort

Overflow

An overflow route is needed in the Bioretention Facility design to bypass stored runoff from storm events larger than V_{BMP} or in the event of facility or subdrain clogging. Overflow systems must connect to an acceptable discharge point, such as a downstream conveyance system as shown in Figure 1 and Figure 4. The inlet to the overflow structure shall be elevated inside the Bioretention Facility to be flush with the ponding surface for the design capture volume (V_{BMP}) as shown in Figure 4. This will allow the design capture volume to be fully treated by the Bioretention Facility, and for larger events to safely be conveyed to downstream systems. The overflow inlet shall **not** be located in the entrance of a Bioretention Facility, as shown in Figure 6.

Underdrain Gravel and Pipes

An underdrain gravel layer and pipes shall be provided in accordance with Appendix B – Underdrains.

Figure 6: Incorrect Placement of an Overflow Inlet.

Inspection and Maintenance Schedule

The Bioretention Facility area shall be inspected for erosion, dead vegetation, soggy soils, or standing water. The use of fertilizers and pesticides on the plants inside the Bioretention Facility should be minimized.

Schedule	Activity
Ongoing	• Keep adjacent landscape areas maintained. Remove clippings from landscape maintenance activities. • Remove trash and debris • Replace damaged grass and/or plants • Replace surface mulch layer as needed to maintain a 2-3 inch soil cover.
After storm events	• Inspect areas for ponding
Annually	• Inspect/clean inlets and outlets

Bioretention Facility Design Procedure

1) Enter the area tributary, A_T, to the Bioretention Facility.

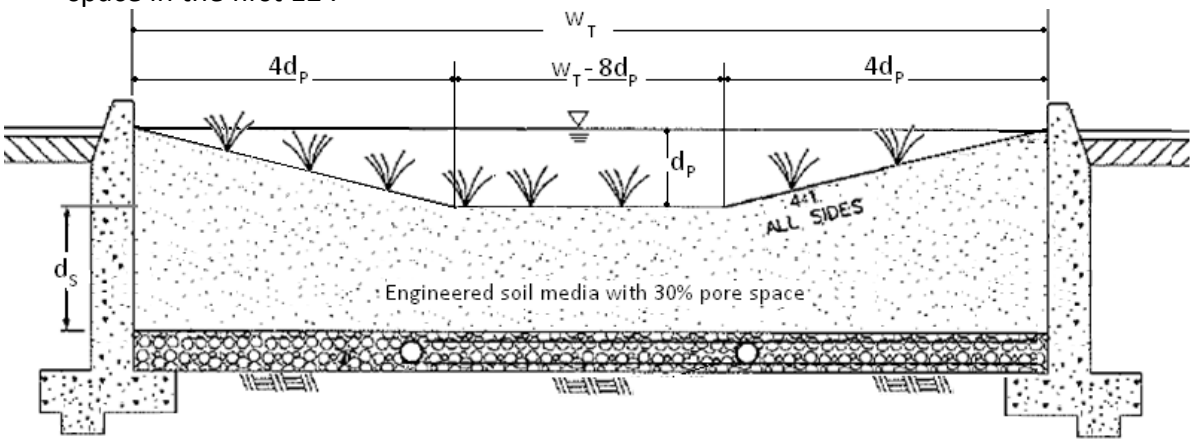
2) Enter the Design Volume, $V_{BMP,}$ determined from Section 2.1 of this Handbook.

3) Select the type of design used. There are two types of Bioretention Facility designs: the standard design used for most project sites that include side slopes, and the modified design used when the BMP is located perpendicular to the parking spaces or with planter boxes that do not use side slopes.

4) Enter the depth of the engineered soil media, d_S. The minimum depth for the engineered soil media can be 18' in limited cases, but it is recommended to use 24' or a preferred 36' to provide an adequate root zone for the chosen plant palette. Engineered soil media deeper than 36' will only get credit for the pore space in the first 36'.

5) Enter the top width of the Bioretention Facility.

6) Calculate the total effective depth, d_E, within the Bioretention Facility. The maximum allowable pore space of the soil media is 30% while the maximum allowable pore space for the gravel layer is 40%. Gravel layer deeper than 12' will only get credit for the pore space in the first 12'.



a. For the design with side slopes the following equation shall be used to determine the total effective depth. Where, d_P is the depth of ponding within the basin.

$$d_E(\text{ft}) = \frac{0.3 \times \left[\left(w_T(\text{ft}) \times d_S(\text{ft})\right) + 4\left(d_P(\text{ft})\right)^2\right] + 0.4 \times 1(\text{ft}) + d_P(\text{ft})\left[4d_P(\text{ft}) + \left(w_T(\text{ft}) - 8d_P(\text{ft})\right)\right]}{w_T(\text{ft})}$$

This above equation can be simplified if the maximum ponding depth of 0.5' is used. The equation below is used on the worksheet to find the minimum area required for the Bioretention Facility:

$$d_E(\text{ft}) = (0.3 \times d_S(\text{ft}) + 0.4 \text{ x } 1(\text{ft})) - \left(\frac{0.7\ (\text{ft}^2)}{w_T(\text{ft})}\right) + 0.5(\text{ft})$$

b. For the design without side slopes the following equation shall be used to determine the total effective depth:

$$d_E(\text{ft}) = d_P(\text{ft}) + [(0.3) \times d_S(\text{ft}) + (0.4) \times 1(\text{ft})]$$

The equation below, using the maximum ponding depth of 0.5', is used on the worksheet to find the minimum area required for the Bioretention Facility:

$$d_E(\text{ft}) = 0.5\ (\text{ft}) + [(0.3) \times d_S(\text{ft}) + (0.4) \times 1(\text{ft})]$$

7) Calculate the minimum surface area, A_M, required for the Bioretention Facility. This does not include the curb surrounding the Bioretention Facility or side slopes.

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

8) Enter the proposed surface area. This area shall not be less than the minimum required surface area.

9) Verify that side slopes are no steeper than 4:1 in the standard design, and are not required in the modified design.

10) Provide the diameter, minimum 6 inches, of the perforated underdrain used in the Bioretention Facility. See Appendix B for specific information regarding perforated pipes.

11) Provide the slope of the site around the Bioretention Facility, if used. The maximum slope is 3 percent for a standard design.

12) Provide the check dam spacing, if the site around the Bioretention Facility is sloped.

13) Describe the vegetation used within the Bioretention Facility.

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Plaza and Sidewalk Cleaning SC-71

Objectives

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

Targeted Constituents

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

Description

Pollutants on sidewalks and other pedestrian traffic areas and plazas are typically due to littering and vehicle use. This fact sheet describes good housekeeping practices that can be incorporated into the municipality's existing cleaning and maintenance program.

Approach

Pollution Prevention

- Use dry cleaning methods whenever practical for surface cleaning activities.
- Use the least toxic materials available (e.g. water based paints, gels or sprays for graffiti removal).

Suggested Protocols

Surface Cleaning

- Regularly broom (dry) sweep sidewalk, plaza and parking lot areas to minimize cleaning with water.
- Dry cleanup first (sweep, collect, and dispose of debris and trash) when cleaning sidewalks or plazas, then wash with or without soap.
- Block the storm drain or contain runoff when cleaning with water. Discharge wash water to landscaping or collect water and pump to a tank or discharge to sanitary sewer if allowed. (Permission may be required from local sanitation district.)

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- Block the storm drain or contain runoff when washing parking areas, driveways or drive-throughs. Use absorbents to pick up oil; then dry sweep. Clean with or without soap. Collect water and pump to a tank or discharge to sanitary sewer if allowed. Street Repair and Maintenance.

Graffiti Removal

- Avoid graffiti abatement activities during rain events.
- Implement the procedures under Painting and Paint Removal in SC-70 Roads, Streets, and Highway Operation and Maintenance fact sheet when graffiti is removed by painting over.
- Direct runoff from sand blasting and high pressure washing (with no cleaning agents) into a dirt or landscaped area after treating with an appropriate filtering device.
- Plug nearby storm drain inlets and vacuum/pump wash water to the sanitary sewer if authorized to do so if a graffiti abatement method generates wash water containing a cleaning compound (such as high pressure washing with a cleaning compound). Ensure that a non-hazardous cleaning compound is used or dispose as hazardous waste, as appropriate.

Surface Removal and Repair

- Schedule surface removal activities for dry weather if possible.
- Avoid creating excess dust when breaking asphalt or concrete.
- Take measures to protect nearby storm drain inlets prior to breaking up asphalt or concrete (e.g. place hay bales or sand bags around inlets). Clean afterwards by sweeping up as much material as possible.
- Designate an area for clean up and proper disposal of excess materials.
- Remove and recycle as much of the broken pavement as possible to avoid contact with rainfall and stormwater runoff.
- When making saw cuts in pavement, use as little water as possible. Cover each storm drain inlet completely with filter fabric during the sawing operation and contain the slurry by placing straw bales, sandbags, or gravel dams around the inlets. After the liquid drains or evaporates, shovel or vacuum the slurry residue from the pavement or gutter and remove from site.
- Always dry sweep first to clean up tracked dirt. Use a street sweeper or vacuum truck. Do not dump vacuumed liquid in storm drains. Once dry sweeping is complete, the area may be hosed down if needed. Wash water should be directed to landscaping or collected and pumped to the sanitary sewer if allowed.

Concrete Installation and Repair

- Schedule asphalt and concrete activities for dry weather.

- Take measures to protect any nearby storm drain inlets and adjacent watercourses, prior to breaking up asphalt or concrete (e.g. place san bags around inlets or work areas).
- Limit the amount of fresh concrete or cement mortar mixed, mix only what is needed for the job.
- Store concrete materials under cover, away from drainage areas. Secure bags of cement after they are open. Be sure to keep wind-blown cement powder away from streets, gutters, storm drains, rainfall, and runoff.
- Return leftover materials to the transit mixer. Dispose of small amounts of hardened excess concrete, grout, and mortar in the trash.
- Do not wash sweepings from exposed aggregate concrete into the street or storm drain. Collect and return sweepings to aggregate base stockpile, or dispose in the trash.
- Protect applications of fresh concrete from rainfall and runoff until the material has dried.
- Do not allow excess concrete to be dumped onsite, except in designated areas.
- Wash concrete trucks off site or in designated areas on site designed to preclude discharge of wash water to drainage system.

Controlling Litter

- Post "No Littering" signs and enforce anti-litter laws.
- Provide litter receptacles in busy, high pedestrian traffic areas of the community, at recreational facilities, and at community events.
- Cover litter receptacles and clean out frequently to prevent leaking/spillage or overflow.
- Clean parking lots on a regular basis with a street sweeper.

Training

- Provide regular training to field employees and/or contractors regarding surface cleaning and proper operation of equipment.
- Train employee and contractors in proper techniques for spill containment and cleanup.
- Use a training log or similar method to document training.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- Limitations related to sweeping activities at large parking facilities may include current sweeper technology to remove oil and grease.
- Surface cleaning activities that require discharges to the local sewering agency will require coordination with the agency.
- Arrangements for disposal of the swept material collected must be made, as well as accurate tracking of the areas swept and the frequency of sweeping.

Requirements

Costs

- The largest expenditures for sweeping and cleaning of sidewalks, plazas, and parking lots are in staffing and equipment. Sweeping of these areas should be incorporated into street sweeping programs to reduce costs.

Maintenance

Not applicable

Supplemental Information

Further Detail of the BMP

Community education, such as informing residents about their options for recycling and waste disposal, as well as the consequences of littering, can instill a sense of citizen responsibility and potentially reduce the amount of maintenance required by the municipality.

Additional BMPs that should be considered for parking lot areas include:

- Allow sheet runoff to flow into biofilters (vegetated strip and swale) and infiltration devices.
- Utilize sand filters or oleophilic collectors for oily waste in low concentrations.
- Arrange rooftop drains to prevent drainage directly onto paved surfaces.
- Design lot to include semi-permeable hardscape.
- Structural BMPs such as storm drain inlet filters can be very effective in reducing the amount of pollutants discharged from parking facilities during periods of rain.

References and Resources

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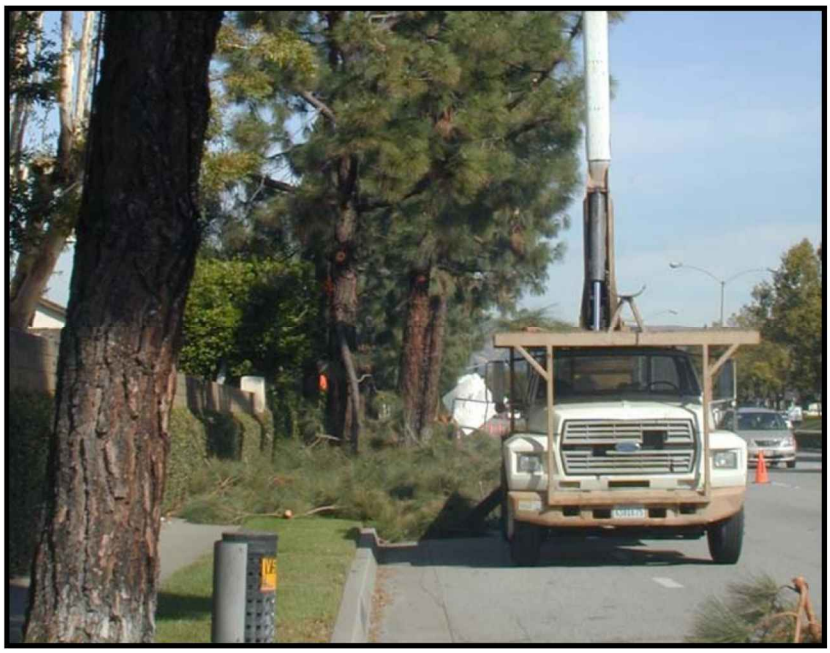
Landscape Maintenance SC-73



Objectives

- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

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

Description

Landscape maintenance activities include vegetation removal; herbicide and insecticide application; fertilizer application; watering; and other gardening and lawn care practices. Vegetation control typically involves a combination of chemical (herbicide) application and mechanical methods. All of these maintenance practices have the potential to contribute pollutants to the storm drain system. The major objectives of this BMP are to minimize the discharge of pesticides, herbicides and fertilizers to the storm drain system and receiving waters; prevent the disposal of landscape waste into the storm drain system by collecting and properly disposing of clippings and cuttings, and educating employees and the public.

Approach

Pollution Prevention

- Implement an integrated pest management (IPM) program. IPM is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools.
- Choose low water using flowers, trees, shrubs, and groundcover.
- Consider alternative landscaping techniques such as naturescaping and xeriscaping.
- Conduct appropriate maintenance (i.e. properly timed fertilizing, weeding, pest control, and pruning) to help preserve the landscapes water efficiency.

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- Consider grass cycling (grass cycling is the natural recycling of grass by leaving the clippings on the lawn when mowing. Grass clippings decompose quickly and release valuable nutrients back into the lawn).

Suggested Protocols

Mowing, Trimming, and Weeding

- Whenever possible use mechanical methods of vegetation removal (e.g mowing with tractor-type or push mowers, hand cutting with gas or electric powered weed trimmers) rather than applying herbicides. Use hand weeding where practical.
- Avoid loosening the soil when conducting mechanical or manual weed control, this could lead to erosion. Use mulch or other erosion control measures when soils are exposed.
- Performing mowing at optimal times. Mowing should not be performed if significant rain events are predicted.
- Mulching mowers may be recommended for certain flat areas. Other techniques may be employed to minimize mowing such as selective vegetative planting using low maintenance grasses and shrubs.
- Collect lawn and garden clippings, pruning waste, tree trimmings, and weeds. Chip if necessary, and compost or dispose of at a landfill (see waste management section of this fact sheet).
- Place temporarily stockpiled material away from watercourses, and berm or cover stockpiles to prevent material releases to storm drains.

Planting

- Determine existing native vegetation features (location, species, size, function, importance) and consider the feasibility of protecting them. Consider elements such as their effect on drainage and erosion, hardiness, maintenance requirements, and possible conflicts between preserving vegetation and the resulting maintenance needs.
- Retain and/or plant selected native vegetation whose features are determined to be beneficial, where feasible. Native vegetation usually requires less maintenance (e.g., irrigation, fertilizer) than planting new vegetation.
- Consider using low water use groundcovers when planting or replanting.

Waste Management

- Compost leaves, sticks, or other collected vegetation or dispose of at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Place temporarily stockpiled material away from watercourses and storm drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.
- Reduce the use of high nitrogen fertilizers that produce excess growth requiring more frequent mowing or trimming.

- Avoid landscape wastes in and around storm drain inlets by either using bagging equipment or by manually picking up the material.

Irrigation

- Where practical, use automatic timers to minimize runoff.
- Use popup sprinkler heads in areas with a lot of activity or where there is a chance the pipes may be broken. Consider the use of mechanisms that reduce water flow to sprinkler heads if broken.
- Ensure that there is no runoff from the landscaped area(s) if re-claimed water is used for irrigation.
- If bailing of muddy water is required (e.g. when repairing a water line leak), do not put it in the storm drain; pour over landscaped areas.
- Irrigate slowly or pulse irrigate to prevent runoff and then only irrigate as much as is needed.
- Apply water at rates that do not exceed the infiltration rate of the soil.

Fertilizer and Pesticide Management

- Utilize a comprehensive management system that incorporates integrated pest management (IPM) techniques. There are many methods and types of IPM, including the following:
  - Mulching can be used to prevent weeds where turf is absent, fencing installed to keep rodents out, and netting used to keep birds and insects away from leaves and fruit.
  - Visible insects can be removed by hand (with gloves or tweezers) and placed in soapy water or vegetable oil. Alternatively, insects can be sprayed off the plant with water or in some cases vacuumed off of larger plants.
  - Store-bought traps, such as species-specific, pheromone-based traps or colored sticky cards, can be used.
  - Slugs can be trapped in small cups filled with beer that are set in the ground so the slugs can get in easily.
  - In cases where microscopic parasites, such as bacteria and fungi, are causing damage to plants, the affected plant material can be removed and disposed of (pruning equipment should be disinfected with bleach to prevent spreading the disease organism).
  - Small mammals and birds can be excluded using fences, netting, tree trunk guards.
  - Beneficial organisms, such as bats, birds, green lacewings, ladybugs, praying mantis, ground beetles, parasitic nematodes, trichogramma wasps, seed head weevils, and spiders that prey on detrimental pest species can be promoted.
- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.

- Use pesticides only if there is an actual pest problem (not on a regular preventative schedule).
- Do not use pesticides if rain is expected. Apply pesticides only when wind speeds are low (less than 5 mph).
- Do not mix or prepare pesticides for application near storm drains.
- Prepare the minimum amount of pesticide needed for the job and use the lowest rate that will effectively control the pest.
- Employ techniques to minimize off-target application (e.g. spray drift) of pesticides, including consideration of alternative application techniques.
- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
- Calibrate fertilizer and pesticide application equipment to avoid excessive application.
- Periodically test soils for determining proper fertilizer use.
- Sweep pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Purchase only the amount of pesticide that you can reasonably use in a given time period (month or year depending on the product).
- Triple rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Dispose of empty pesticide containers according to the instructions on the container label.

Inspection

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering, and repair leaks in the irrigation system as soon as they are observed.
- Inspect pesticide/fertilizer equipment and transportation vehicles daily.

Training

- Educate and train employees on use of pesticides and in pesticide application techniques to prevent pollution. Pesticide application must be under the supervision of a California qualified pesticide applicator.
- Train/encourage municipal maintenance crews to use IPM techniques for managing public green areas.
- Annually train employees within departments responsible for pesticide application on the appropriate portions of the agency's IPM Policy, SOPs, and BMPs, and the latest IPM techniques.

- Employees who are not authorized and trained to apply pesticides should be periodically (at least annually) informed that they cannot use over-the-counter pesticides in or around the workplace.
- Use a training log or similar method to document training.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup
- Have spill cleanup materials readily available and in a know in location
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- The Federal Pesticide, Fungicide, and Rodenticide Act and California Title 3, Division 6, Pesticides and Pest Control Operations place strict controls over pesticide application and handling and specify training, annual refresher, and testing requirements. The regulations generally cover: a list of approved pesticides and selected uses, updated regularly; general application information; equipment use and maintenance procedures; and record keeping. The California Department of Pesticide Regulations and the County Agricultural Commission coordinate and maintain the licensing and certification programs. All public agency employees who apply pesticides and herbicides in "agricultural use" areas such as parks, golf courses, rights-of-way and recreation areas should be properly certified in accordance with state regulations. Contracts for landscape maintenance should include similar requirements.
- All employees who handle pesticides should be familiar with the most recent material safety data sheet (MSDS) files.
- Municipalities do not have the authority to regulate the use of pesticides by school districts, however the California Healthy Schools Act of 2000 (AB 2260) has imposed requirements on California school districts regarding pesticide use in schools. Posting of notification prior to the application of pesticides is now required, and IPM is stated as the preferred approach to pest management in schools.

Requirements

Costs

Additional training of municipal employees will be required to address IPM techniques and BMPs. IPM methods will likely increase labor cost for pest control which may be offset by lower chemical costs.

Maintenance

Not applicable

Supplemental Information

Further Detail of the BMP

Waste Management

Composting is one of the better disposal alternatives if locally available. Most municipalities either have or are planning yard waste composting facilities as a means of reducing the amount of waste going to the landfill. Lawn clippings from municipal maintenance programs as well as private sources would probably be compatible with most composting facilities

Contractors and Other Pesticide Users

Municipal agencies should develop and implement a process to ensure that any contractor employed to conduct pest control and pesticide application on municipal property engages in pest control methods consistent with the IPM Policy adopted by the agency. Specifically, municipalities should require contractors to follow the agency's IPM policy, SOPs, and BMPs; provide evidence to the agency of having received training on current IPM techniques when feasible; provide documentation of pesticide use on agency property to the agency in a timely manner.

References and Resources

King County Stormwater Pollution Control Manual. Best Management Practices for Businesses. 1995. King County Surface Water Management. July. On-line: http://dnr.metrokc.gov/wlr/dss/spcm.htm

Los Angeles County Stormwater Quality Model Programs. Public Agency Activities http://ladpw.org/wmd/npdes/model_links.cfm

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities. Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality Control Board. July. 1998.

Orange County Stormwater Program http://www.ocwatersheds.com/StormWater/swp_introduction.asp

Santa Clara Valley Urban Runoff Pollution Prevention Program. 1997 Urban Runoff Management Plan. September 1997, updated October 2000.

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Landscaping and Lawn Care. Office of Water. Office of Wastewater Management. On-line: http://www.epa.gov/npdes/menuofbmps/poll_8.htm