

Appendix “B”

Site Specific Preliminary Water Quality Management Plan Tract 39011

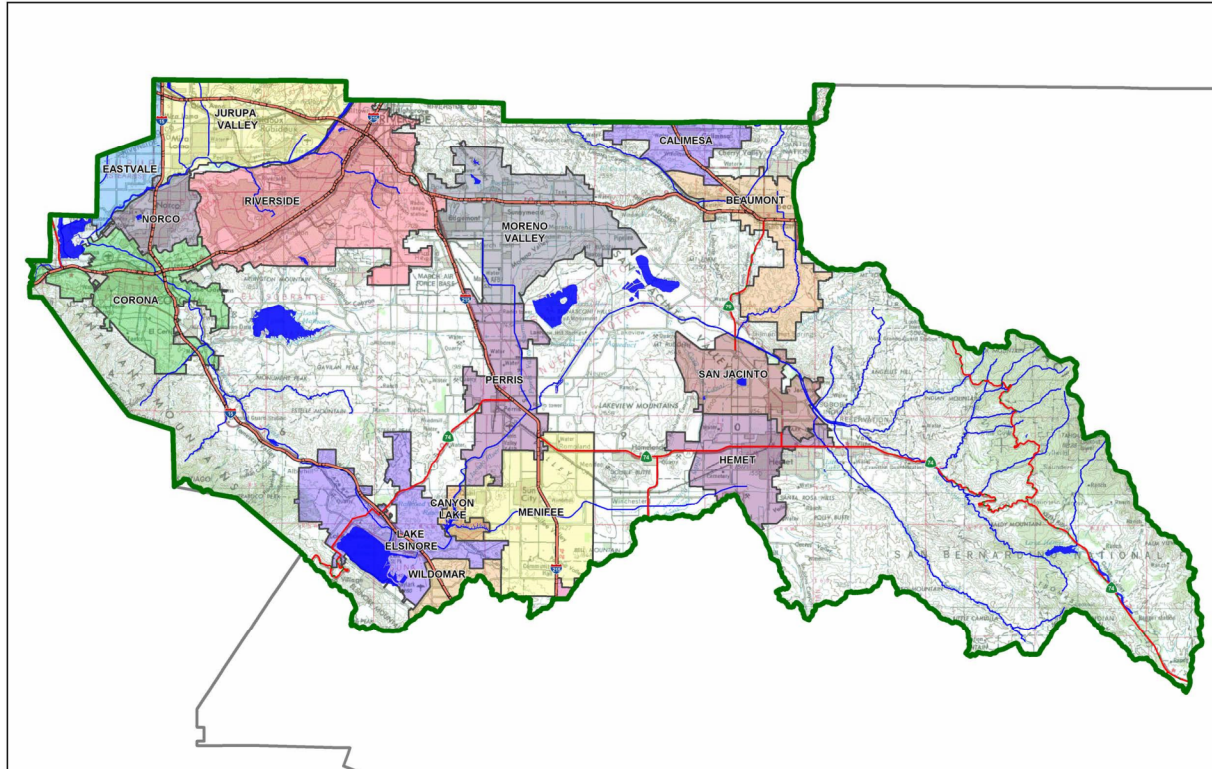
Project Specific Water Quality Management Plan

Project located within the **Santa Ana Watershed** Region of Riverside County

Project Title: Tract 39011

Development No:

Design Review/Case No: TTM 39011



Contact Information:

Prepared for:

Green Willow Ranch, LLC
6879 Airport Drive
Riverside, CA 92504
Email: madkison@adkan.com

Prepared by:

Adkan Engineers
Mitch Adkison
6879 Airport Drive
Riverside, CA 92504
Tel: (951) 688-0241
Email: madkison@adkan.com

- ☒ Preliminary
☐ Final

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Prepared for Compliance with

*Regional Board Order No. **R8-2010-0033***

OWNER'S CERTIFICATION

This Project-Specific Water Quality Management Plan (WQMP) for the TTM 39011 Project has been prepared for **Green Willow Ranch**, and prepared by Adkan Engineers, Mitch Adkison, Managing Member.

This WQMP is intended to comply with the requirements of the unincorporated area of the County of Riverside 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 the County of Riverside Water Quality Ordinance.

"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."

Signature

Steve Waddell

Owner

Date

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

Mitch Adkison

Preparer's Printed Name

Date

Senior Project Manager

Preparer's Title/Position

Preparer's Licensure:

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Section A: Project and Site Information

PROJECT INFORMATION	
Type of Project:	Residential
Planning Area:	Lake Matthews/Woodcrest Area Plan
Community Name:	TRACT 39011
Development Name:	TRACT 39011
PROJECT LOCATION	
Latitude & Longitude (DMS): 33° 51' 54.17" N - 117° 25' 30.08" W	
Project Watershed and Sub-Watershed: Temescal Creek Reach 1 to Santa Ana River Reach 3 – Via Arlington Channel	
APN(s): 270-160-006, 270-160-008	
Map Book and Page No.: TB Page: 745 – Grid: B6, C6	
*Note: Project drains to Temescal Creek Reach 1B to Temescal Creek Reach 1A.	
PROJECT CHARACTERISTICS	
Proposed or Potential Land Use(s)	RC-LDR, RC-VLDR
Proposed or Potential SIC Code(s)	1521 SFR
Area of Impervious Project Footprint (SF)	719,341 SF
Total Area of <u>proposed</u> Impervious Surfaces within the Project Limits (SF)/or Replacement	719,341 SF
Does the project consist of offsite road improvements?	☐ Y ☒ N
Does the project propose to construct unpaved roads?	☐ Y ☒ N
Is the project part of a larger common plan of development (phased project)?	☒ Y ☐ N
EXISTING SITE CHARACTERISTICS	
Total area of <u>existing</u> Impervious Surfaces within the project limits (SF)	0
Is the project located within any MSHCP Criteria Cell?	☒ Y ☐ N
If so, identify the Cell number:	Cells H & I
Are there any natural hydrologic features on the project site?	☒ Y ☐ N
Is a Geotechnical Report attached?	☒ Y ☐ N
If no Geotech. Report, list the NRCS soils type(s) present on the site (A, B, C and/or D)	
What is the Water Quality Design Storm Depth for the project?	0.55

A.1 Maps and Site Plans

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

- Drainage Management Areas
- Proposed Structural BMPs
- Drainage Path
- Drainage Infrastructure, Inlets, Overflows
- Source Control BMPs
- Buildings, Roof Lines, Downspouts
- Impervious Surfaces
- Standard Labeling

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

A.2 Identify Receiving Waters

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

Table A.1 Identification of Receiving Waters

Receiving Waters	EPA Approved 303(d) List Impairments	Designated Beneficial Uses	Proximity to RARE Beneficial Use
On-site Storm Drain System (HU #801.26)	N/A	N/A	Start
Temescal Creek – Reach 1 (HU #801.25) Via Arlington Channel	N/A	N/A	2.92 mi
Santa Ana River – Reach 3 (HU #801.21/801.25)	Copper, Lead, Indicator Bacteria	Warm Fresh Water Habitat, Water Contact Recreation	RARE
Prado Basin (HU #801.21)	Ph	Warm Fresh Water Habitat	RARE
Additional Downstream Reaches to Pacific Ocean (outside of “proximate” project influence) *Note: Project drains to Temescal Creek Reach 1B to Temescal Creek Reach 1A.			

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

Table A.2 Other Applicable Permits

Agency	Permit Required	
State Department of Fish and Wildlife, 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)

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

Site Optimization

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

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

Yes, the sites historic existing drainage patterns will be preserved. All proposed runoff from the site will drain southwest corner of the site.

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

Yes, the surrounding existing vegetation as seen on the WQMP site map has been identified and protected as open space areas. It is an inherent design concept seen throughout the Master Planned Community in an effort to preserve open space and sensitive plant habitats.

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

Yes, a large amount of natural open space areas have primarily been preserved. As such, the "natural infiltration" characteristics and capacity of these areas is considered "preserved."

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

Yes, within the development envelope, street widths were minimized to the acceptable County standards and many of the sidewalks are reduced in width based on a planted parkway between the sidewalk and curb face (sidewalks without landscaped parkways and adjacent to curbs are wider for public safety purposes). Additionally, landscaped parkways between the sidewalks and curb allows for runoff across the sidewalks to be slowed and partially infiltrated when introduced to vegetated landscaped parkways.

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

Yes, homes drain to side yard swales, sidewalks have green belt parkways between them and the street, a large portion of the site drains to biotreatment BMP prior to discharge from the site. Including various pervious areas throughout the site allows for the overarching water quality concept to "slow" the flows, "spread" them out and "soak" them in.

Section C: Delineate Drainage Management Areas (DMAs)

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

Table C.1 DMA Classifications

DMA Name or ID	Surface Type(s) ¹	Area (Sq. Ft.)	DMA Type
1-1	Concrete/Asphalt	256,192	D
1-2	Roofs	913,504	D
1-3	Landscaping	63,96	D

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

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

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

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	Runoff factor	Product	DMA name /ID	Area (square feet)	Ratio
	[A]		[B]	[C] = [A] x [B]		[D]	[C]/[D]

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

DMA Name or ID	BMP Name or ID
1-1	Extended Detention Basin 1
1-2	Extended Detention Basin 1
1-3	Extended Detention Basin 1

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

Section D: Implement LID BMPs

D.1 Infiltration Applicability

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

If yes has been checked, Infiltration BMPs shall not be used for the site. If no, continue working through this section to implement your LID BMPs. It is recommended that you contact your Co-Permittee to verify whether or not your project discharges to an approved downstream 'Highest and Best Use' feature.

Geotechnical Report

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

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

Infiltration Feasibility

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

Table D.1 Infiltration Feasibility

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

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

D.2 Harvest and Use Assessment

Please check what applies:

- ☒ Reclaimed water will be used for the non-potable water demands for the project.
- ☐ Downstream water rights may be impacted by Harvest and Use as approved by the Regional Board (verify with the Committee).
- ☐ The Design Capture Volume will be addressed using Infiltration Only BMPs. In such a case, Harvest and Use BMPs are still encouraged, but it would not be required if the Design Capture Volume will be infiltrated or evapotranspired.

If any of the above boxes have been checked, Harvest and Use BMPs need not be assessed for the site. If neither of the above criteria applies, follow the steps below to assess the feasibility of irrigation use, toilet use and other non-potable uses (e.g., industrial use).

Reclaimed water will be used in the park sites and landscaped areas which lessen the demand for harvest rainwater, therefore harvest and use will not be used on this project.

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 Committee 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	
D 1.1	☐	☐	☐	☒	☐
D 1.2	☐	☐	☐	☒	☐
D 1.3	☐	☐	☐	☒	☐

It should be noted that biotreatment is being utilized in lieu of bioretention because of the overall acreage of the project. Bioretention would typically be utilized in area where infiltration is not feasible, however bioretention DMA's are limited to 10 acres for their effectivity. Additionally, the HCOC's required for the project require mitigation of the 100 year storm events (1, 3, 6, and 24 hour) as required by Riverside County Flood Control to eliminate any potential impacts to the downstream Harrison Dam. Utilizing a bioretention system as a detention facility for a project with a large tributary drainage acreage requires ponding in excess of 6" and results in increased maintenance and concerns of damage to the bioretention facilities given the large storm volumes and flow rates expected. Extended Detention Basins (EDBS), utilizing biotreatment are being proposed for this project as the most effective BMP available for treatment given the inability to infiltrate, having DMA's in excess of 10

acres, being able to utilizing the BMP to mitigate the HCOC's, and to reduce the overall number of BMP's in turn reducing overall maintenance and repair costs burdened by CFD for the perpetuity of the project.

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 Committee. Utilize the worksheets found in the LID BMP Design Handbook or consult with your Committee to assist you in correctly sizing your LID BMPs. Complete Table D.3 below to document the Design Capture Volume and the Proposed Volume for each LID BMP. Provide the completed design procedure sheets for each LID BMP in Appendix 6. You may add additional rows to the table below as needed.

Table D.3 DCV Calculations for LID BMPs

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	<i>Extended Detention Basin 1</i>		
	[A]		[B]	[C]	[A] x [C]			
1-1	256,192	Concrete/Asphalt	1.00	0.89	228,523.30	Design Storm Depth (in)	Design Capture Volume, V_{BMP} (cubic feet)	Proposed Volume on Plans (cubic feet)
1-2	913,504	Roofs	0.50	0.34	309,906.20			
1-3	63,966	Landscaping	0.10	0.11	7,065.60			
	1,233,662	total			545,495.10	0.55	25,001.90	25,002

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

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

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

Section E: Alternative Compliance (LID Waiver Program)

LID BMPs are expected to be feasible on virtually all projects. Where LID BMPs have been demonstrated to be infeasible as documented in Section D, other Treatment Control BMPs must be used (subject to LID waiver approval by the Committee). 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 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.2 Treatment Control BMP Selection

Selected Treatment Control BMP Name or ID ¹	Priority Pollutant(s) of Concern to Mitigate ²	Removal Efficiency Percentage ³
Extended Detention Basins	Bacteria, viruses, pathogens, nutrients, and metals in park parking lot.	High (H)

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 Committee 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 concentration¹ 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.

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

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

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

F.2 HCOC Mitigation

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

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

Condition C is being met. The project site is mimicking the pre-development hydrograph with the post-development hydrograph. It should be noted the project site has the inability to infiltration given the soil condition being dense and mostly of granitic bedrock. Given the inability to infiltrate, excess volume generated by the additional impervious area will be released downstream and cannot be contained on-site. Prior to the release of the excess volume the expected storm flows will be detained within the proposed extended detention basin and release at a rate that does not exceed the pre-development condition. Concerns raised by Riverside County Flood Control of the downstream facilities require the mitigation of the 2-,5-,10-, and 100-year storm events for the 1-,3-,6- and 24-year hour durations. The post-development flow rates were mitigated to not exceed 110% of the pre-development flow rate. The results of the 2-year storm event are shown below, the other remaining storms flows, hydrographs, and detention routings are shown within Appendix 7.

Table F.1 Hydrologic Conditions of Concern Summary

DMA	SPECIFICATIONS						
	Existing Runoff Volume (ac.ft.)	Existing 2-year Peak Flow (cfs)	Proposed Runoff Volume (ac.ft.)	Volume Difference (ac.ft.)	BMP Volume (ac.ft.)	Proposed 2-year Peak Flow (cfs)	Incremental Increase Mitigated?
EDB 1	0.4342	0.948	3.509	2.1321	1.456	1.019	Yes

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

Section G: Source Control BMPs

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

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

Table G.1 Permanent and Operational Source Control Measures

Potential Sources of Runoff pollutants	Permanent Structural Source Control BMPs	Operational Source Control BMPs
Onsite storm drains inlets	Mark with “Only rain in the drain”	Maintain regularly, provide educational materials to residents (good practices and discharge prohibitions)
Landscape/outdoor pesticide use	Landscaping plans to include: preservation of native trees, design for minimal irrigation, fertilizers & pesticides	Maintenance staff education and prohibitions
Sidewalks & Streets	n/a	Sweep regularly and prevent litter from accumulating (no cleaning agents or degreasers discharging to storm drain system).

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)
EDB 1	Extended Detention Basin 1	TTM 39011

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 Committee will periodically verify that Stormwater BMPs on your site are maintained and continue to operate as designed. To make this possible, your Committee 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:

**Community Facilities District (Operated by Riverside County
Transportation Department)**

Riverside County Flood Control District

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

☐ Y

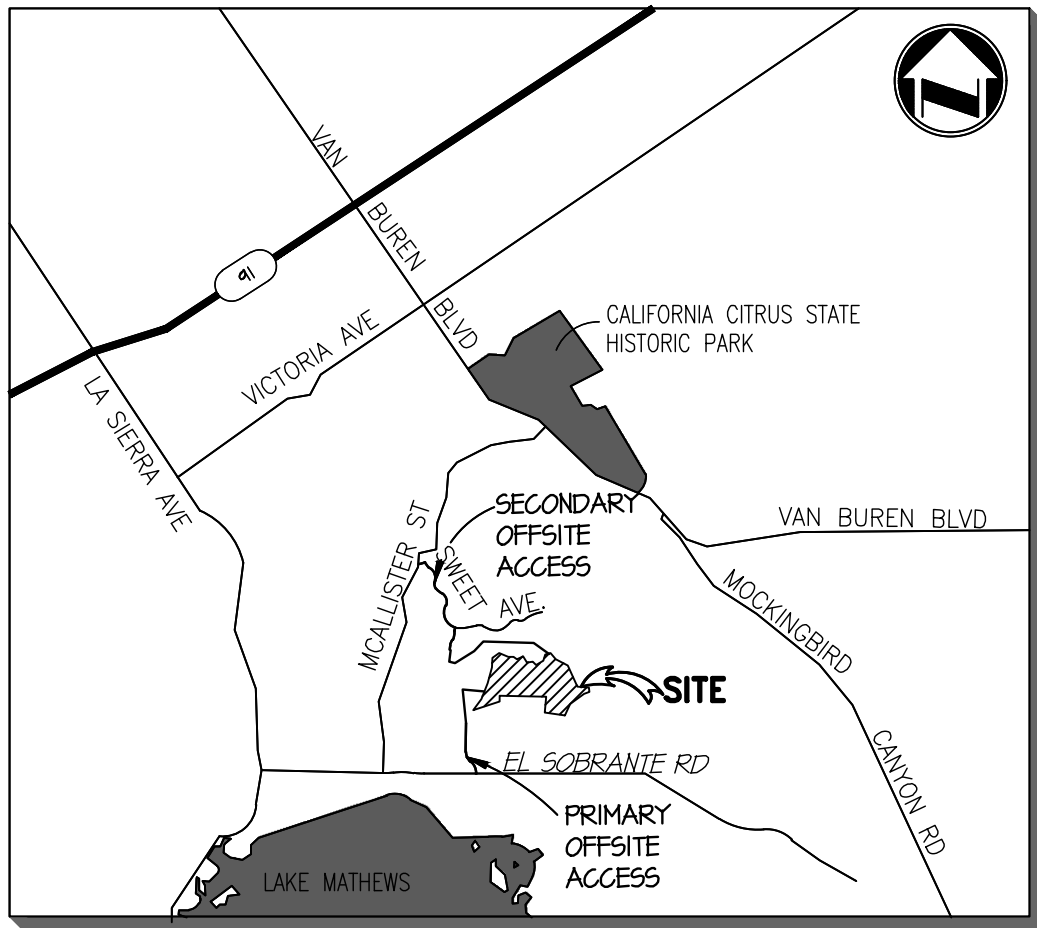
☒ N

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

Appendix 1: Maps and Site Plans

Location Map, WQMP Site Plan and Receiving Waters Map

THOMAS BROS. GUIDE PAGE 745, GRID B6, C6

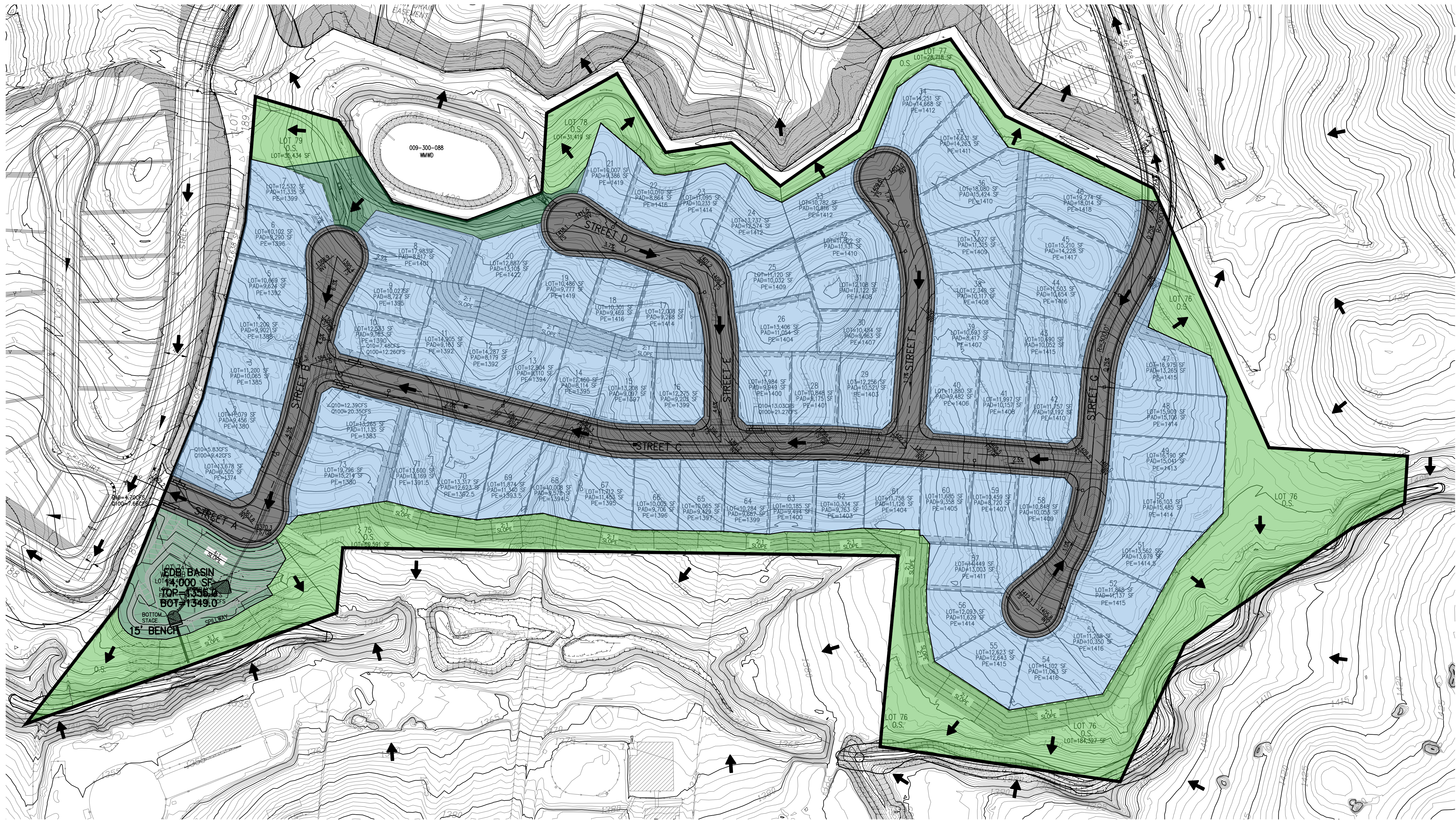


VICINITY MAP

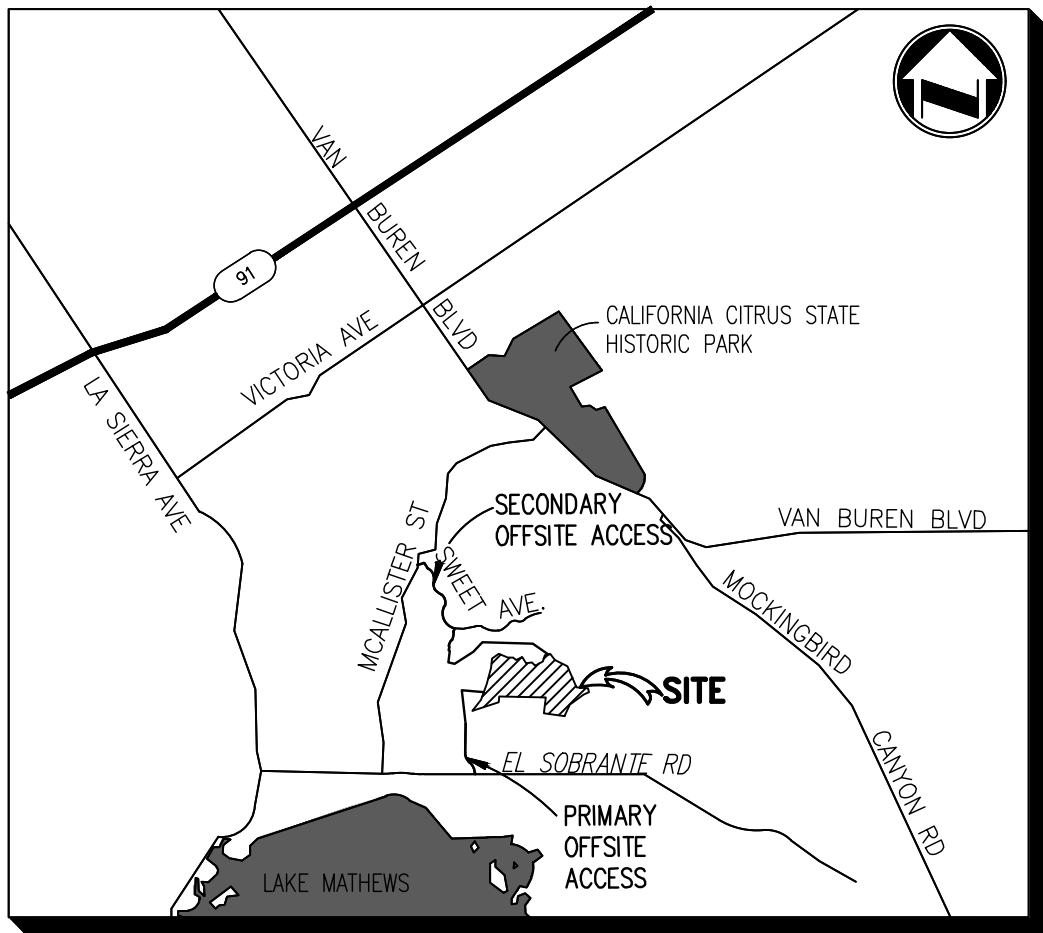
(N.T.S.)

SEC.32 NE T.3S. R.5W

TTM 39011 – HG5
BMP MAP



THOMAS BROS. GUIDE PAGE 745, GRID B6, C6



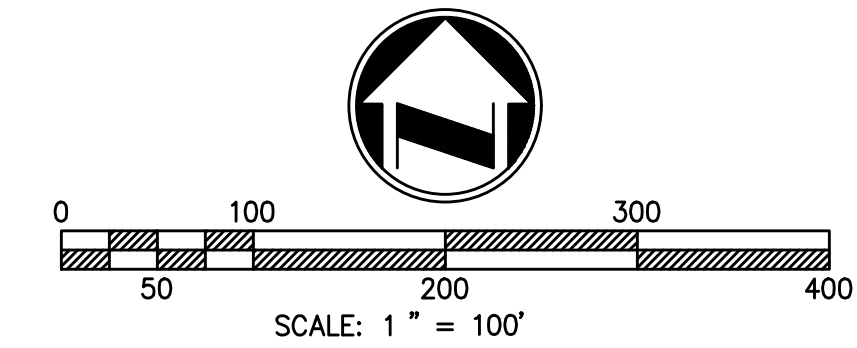
VICINITY MAP
SEC.32 NE T.3S. R.5W

LEGEND

- STREETS
- HOMESITES
60% IMPERVIOUS (ROOFS)
40% PERVIOUS (LANDSCAPING)
- ONSITE OPEN SPACE
- OFFSITE OPEN SPACE
- DRAINAGE PATH
- TRACT BOUNDARY
- DMA BOUNDARY

DMA DATA

DMA ID	SURFACE TYPE	AREA (SF)
1-1	CONCRETE/ASPHALT	256,192
1-2	ROOFS	913,504
1-3	LANDSCAPING	63,966
TOTAL DMA AREA		1,233,662



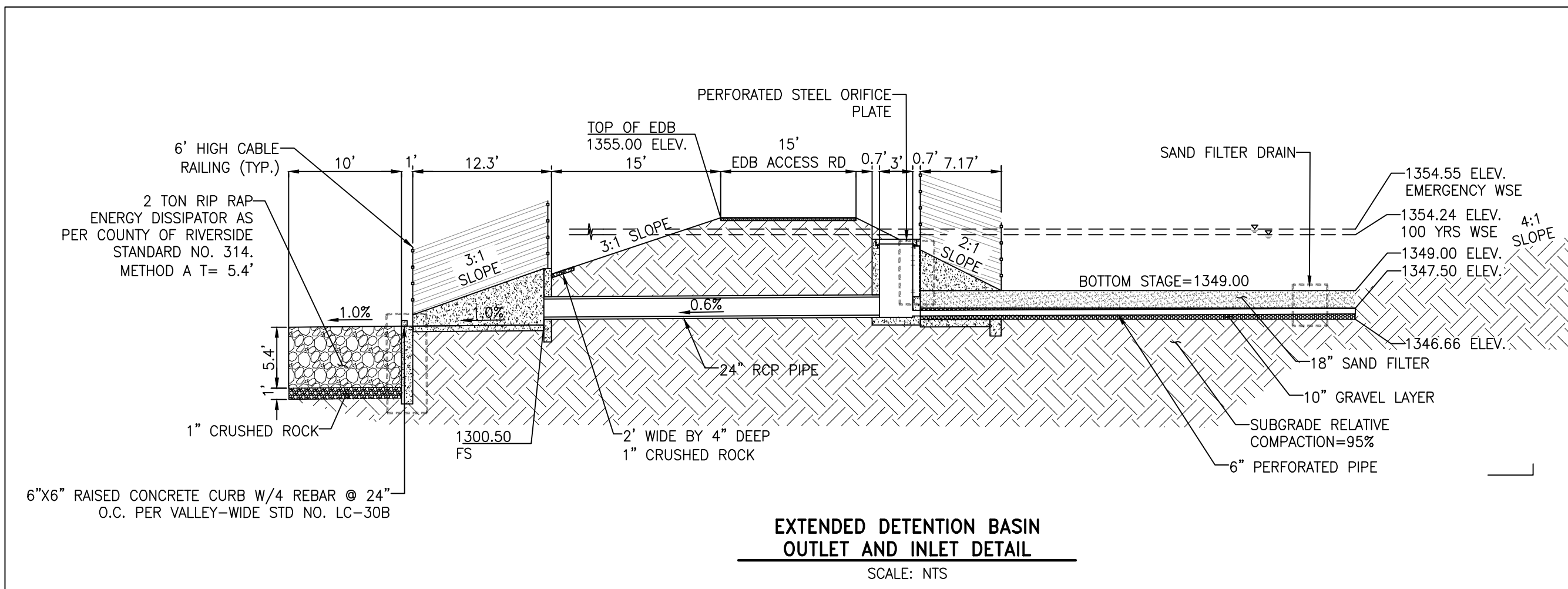
OWNER/APPLICANT
DMB SAN JUAN
28811 ORTEGA HIGHWAY
SAN JUAN CAPISTRANO, CA 92675

RJ EL SOBRANTE
PO BOX 9
SAN JUAN CAPISTRANO, CA 92693

ENGINEER/REPRESENTATIVE
adkan
ENGINEERS
6879 AIRPORT DRIVE
RIVERSIDE, CA 92504
TEL: 951-688-0241

ASSESSORS PARCEL NUMBERS
270-160-008
270-160-008

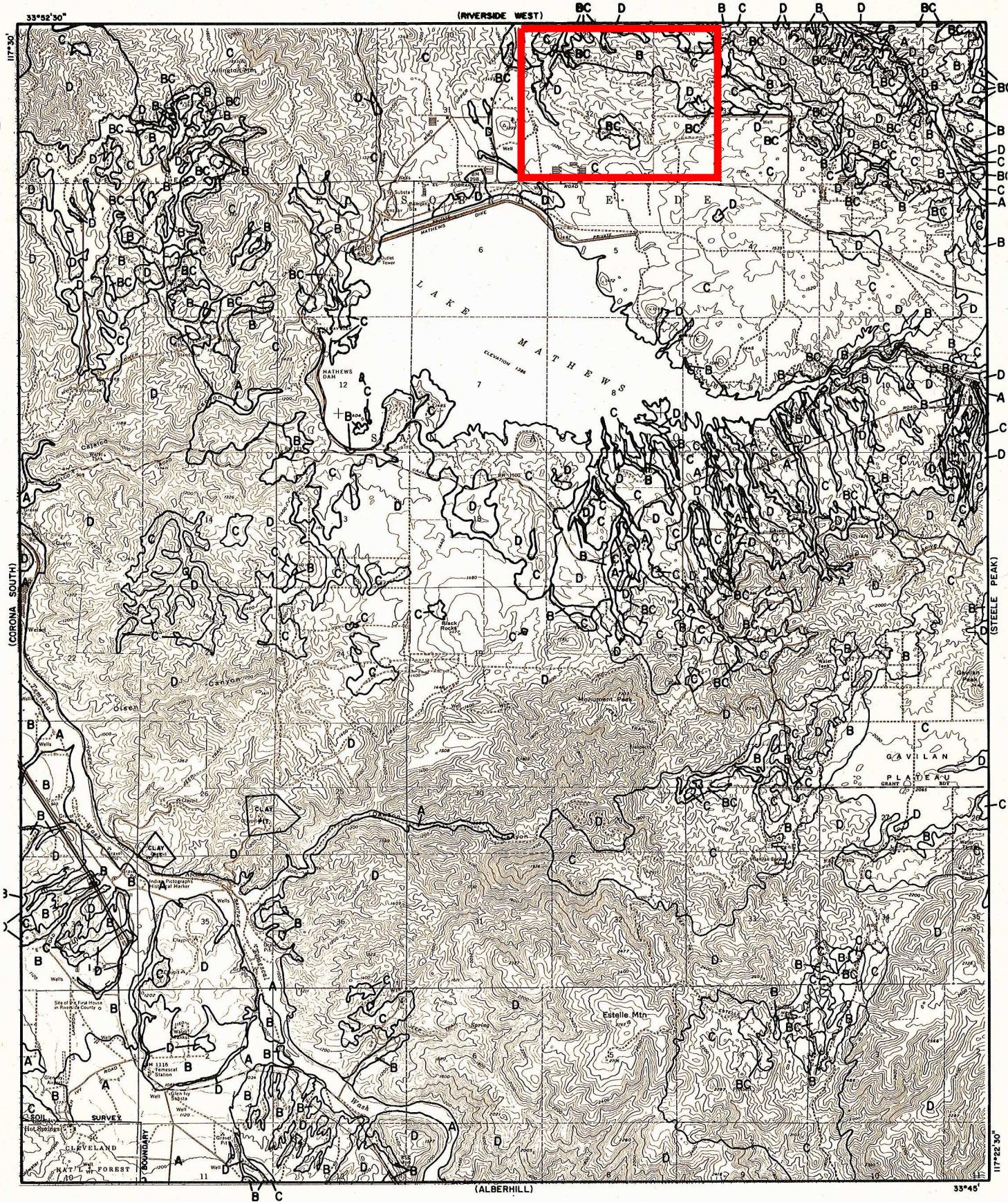
ZONING/LAND USE
EXISTING ZONING: A-1-10
PROPOSED ZONING: R-1-10,000
EXISTING LAND USE: RC-LDR, RC-VLDR
PROPOSED LAND USE: RC-LDR, RC-VLDR

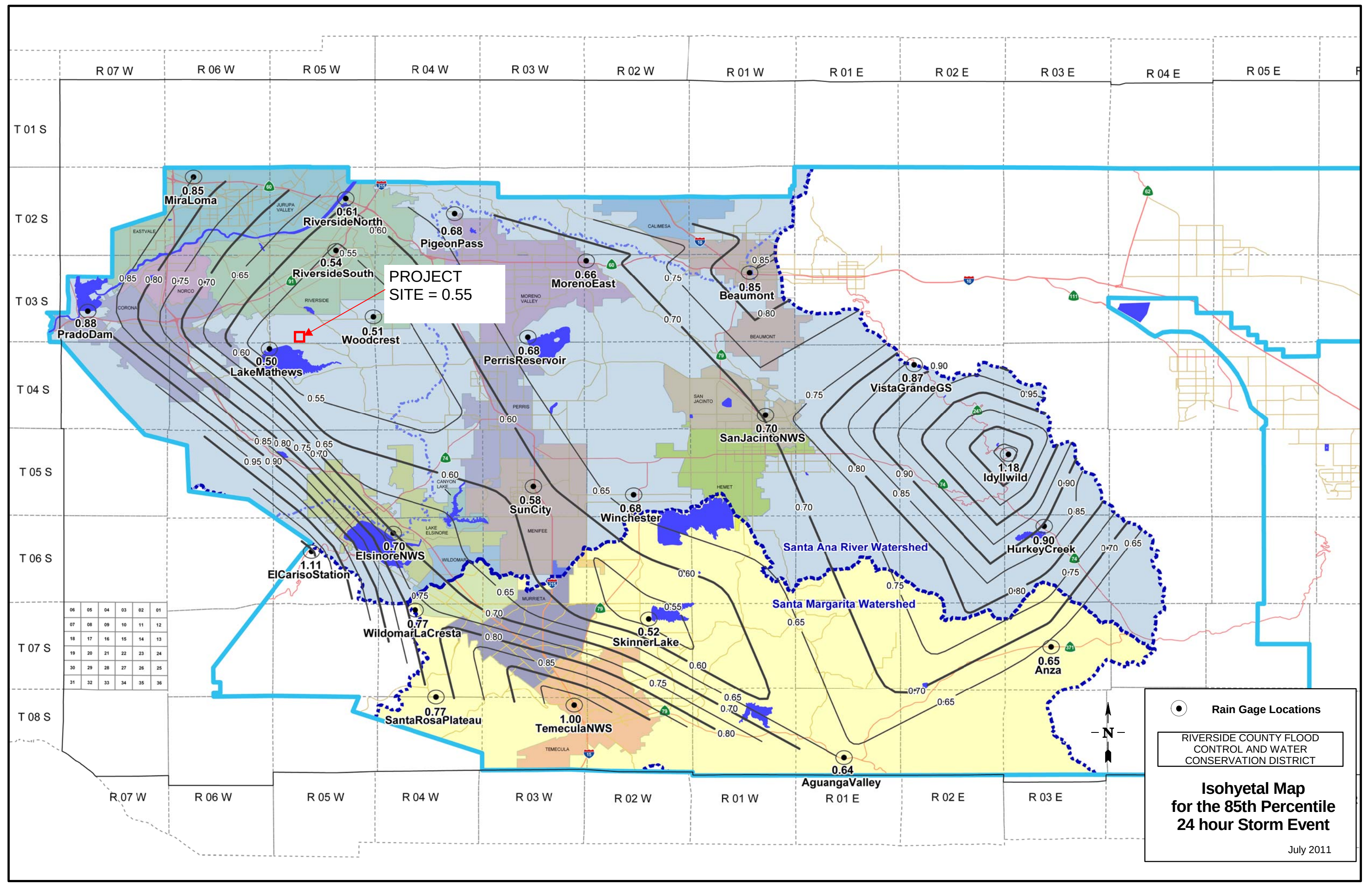


TTM 39011 – HG5
BMP MAP

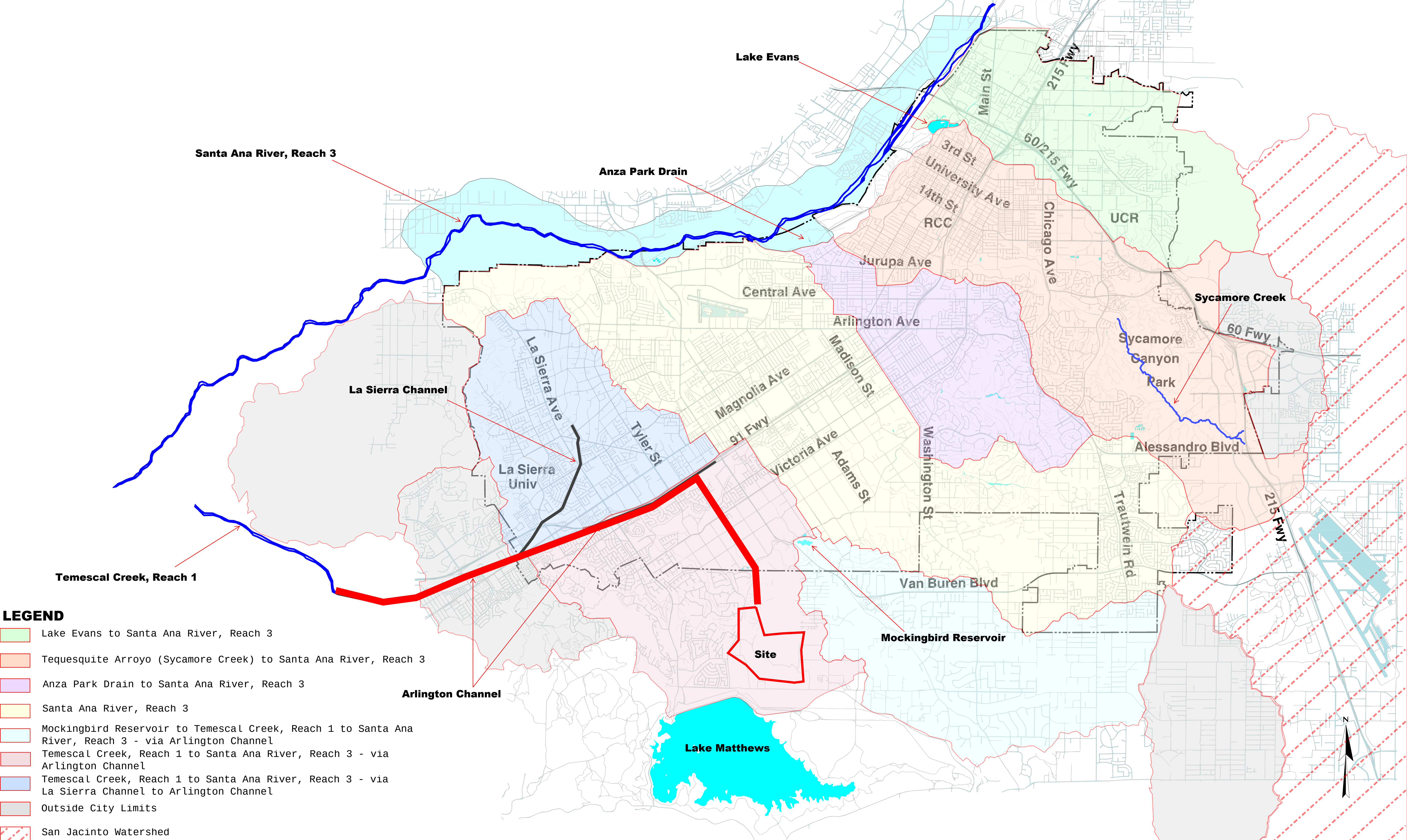
PLANS PREPARED BY:
adkan
ENGINEERS
Civil Engineering • Surveying • Planning
6879 Airport Drive, Riverside, CA 92504
Tel: (951) 688-0241 • Fax: (951) 688-0599

PLOT DATE: 5/7/2025 2:41 PM





RECEIVING WATERS MAP

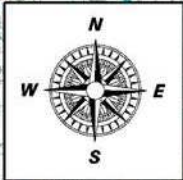


- LEGEND**
- Lake Evans to Santa Ana River, Reach 3
 - Tequesquite Arroyo (Sycamore Creek) to Santa Ana River, Reach 3
 - Anza Park Drain to Santa Ana River, Reach 3
 - Santa Ana River, Reach 3
 - Mockingbird Reservoir to Temescal Creek, Reach 1 to Santa Ana River, Reach 3 - via Arlington Channel
 - Temescal Creek, Reach 1 to Santa Ana River, Reach 3 - via Arlington Channel
 - Temescal Creek, Reach 1 to Santa Ana River, Reach 3 - via La Sierra Channel to Arlington Channel
 - Outside City Limits
 - San Jacinto Watershed

PROJECT SITE - REGIONALLY
IMPAIRED FOR "BACTERIA &
VIRUSES". TEMESCAL CREEK NOT
INDICATED AS 303(d) LIST IMPAIRED.



This map is intended for developments in Riverside County only



LEGEND

 Hydrology	 Nutrients
 2006 303(d) listed Impaired Waters	 Bacteria & Viruses
 Riverside County Boundary	 Nutrients/Bacteria & Viruses
 Santa Ana Region Boundary	 Nutrients/Bacteria&Viruses/Turbidity

The graphical and tabular information shown on this document may be derived from a variety of public agency and/or private commercial sources such as Riverside County Transportation and Land Management Agency, Thomas Brothers Mapping, the Stephen P. Teale Data Center, GIS Technology Center, State of California, the United States Geologic Survey and the United States National Atlas. These sources may possess varying levels of accuracy and precision and this product is meant only as a guide to the relative position and scale of the depicted features. This GIS document is in no case to be interpreted as fundamental or decisive for purposes of land surveying, field engineering, plan drafting, code enforcement, land boundary determination and/or land acquisition.

Revised: April 2009

Appendix 2: Construction Plans

Grading and Drainage Plans

Appendix 3: Soils Information

Geotechnical Study and Other Infiltration Testing Data

September 25, 2024

Project No: 24174-01

Mr. Joe Martin
Trumark Homes
450 Newport Center Drive, Suite 300
Newport Beach, CA 92660

Subject: Geotechnical Due Diligence Subsurface Evaluation and Review of Proposed Residential Development, Tentative Tract Map 39011, North of El Sobrante Road, County of Riverside, California

Introduction

In accordance with your request, LGC Geotechnical, Inc. has prepared this geotechnical due diligence subsurface evaluation and review for the proposed residential development, Tentative Tract Map 39011, located north of El Sobrante Road in the County of Riverside, California.

The purpose of our study was to form an opinion on the anticipated geotechnical conditions and provide preliminary geotechnical conclusions and recommendations relative to the geotechnical feasibility of the site for development. This report is based on our review of the referenced geotechnical reports (by others), preliminary site plans, readily available geotechnical information, and a limited field evaluation consisting of excavating test pits, seismic refraction lines, and performing laboratory testing.

Project Description

The approximately 37-acre site is bound to the north by proposed HG3 Tract 38605, to the east and south by moderately developed farmland and to the west by proposed HG2 Tract 38901 (see Figure 1 – Site Location Map). Existing grades vary from elevations of approximately 1325 to 1440 feet.

The undeveloped site consists of gentle to steeply sloped hillside land and is generally lightly vegetated with trails throughout. Based on review of historic aerial photographs, it appears that the site was previously used for agricultural farming from prior to 1959 up to 2009. Refer to the attached Site Photos for existing conditions (Figure 2).

The proposed residential development includes the construction of 68 single-family residential lots. Planned residential buildings are anticipated to be at-grade relatively light weight wood-framed structures with on-grade parking. Other planned improvements include open space, water quality basins, streets, and other associated improvements. Planned design cuts and fills are expected to be a maximum of approximately 40 and 22 feet, respectively. Additionally, cut slopes and fill slopes are

planned to be constructed at a maximum inclination of 2:1 (horizontal to vertical) and are expected to be a maximum of approximately 30 feet in height.

Subsurface Geotechnical Evaluation

LGC Geotechnical performed a subsurface geotechnical evaluation of the site consisting of the excavation of thirteen test pits and completion of seven seismic refraction lines to evaluate onsite geotechnical conditions.

Thirteen exploratory test pits (TP-1 through TP-13) were excavated utilizing a standard backhoe with a 2-foot bucket to estimate remedial grading depths and obtain samples for laboratory testing. A geologist observed the operation, logged the geotechnical test pits, and collected the soil samples. Subsequent to logging, the test pits were backfilled with native soils and wheel rolled for densification. Some settlement of the backfill should be expected.

The seven seismic refraction lines (S-1 through S-7) were performed to assess the general seismic velocities of the underlying bedrock materials that can then be correlated with excavation characteristics (rippability). The seismic refraction lines were generally placed in areas of maximum design cut within the hard bedrock areas. Lengths of the seismic refraction lines were up to approximately 200 feet, resulting in maximum explored depths of approximately 20 to 55 feet below the existing ground surface. Please note that seismic refraction lines only characterize the subsurface conditions at the locations where they are performed, and locations were determined based on available plans and our understanding of potential future development of the site. If substantial changes to the current plans or site layout are made in the future, additional subsurface exploration may be needed.

The approximate locations of our subsurface explorations and subsurface explorations performed by others are provided on the Geotechnical Map (Sheet 1). Our test pit and seismic refraction logs as well as exploration logs by others are provided in Appendix B.

Laboratory Testing

Representative bulk samples were obtained for laboratory testing during our field evaluation. Laboratory testing included in-situ moisture content, fines content, expansion index, direct shear, laboratory compaction, R-value and corrosion (sulfate, chloride, pH and minimum resistivity).

The following is a summary of the laboratory test results:

- Field moisture contents ranged from approximately 2.5 to 6.7 percent, with an average of approximately 4.4 percent.
- Four fines content tests were performed and indicated a fines content (passing No. 200 sieve) of approximately 8, 22, 27 and 48 percent. Based on the Unified Soils Classification System (USCS), the tested samples would be classified as "coarse -grained."
- Two remolded direct shear tests were performed. The plots are provided in Appendix C.
- Two laboratory compaction tests of near surface samples indicated a maximum dry density of 130.5 and 132.5 pcf with an optimum moisture content of 9.5 and 9.0 percent.
- Three Expansion potential tests were performed and indicated an expansion index value of 1, 13

and 19, corresponding to “Very Low” expansion potential.

- Corrosion testing indicated soluble sulfate contents less than 0.01 percent, chloride contents of 60 and 120 parts per million (ppm), pH of 8.44 and 8.29, and minimum resistivity of 1800 and 2900 ohm-centimeters.

A summary of the laboratory test results is presented in Appendix C. The moisture content results are presented on the test pit logs in Appendix B.

Summary of Geotechnical Reports by Others (Adjacent Site to the North and West)

Summary and Findings of AGS, 2018

Advanced Geotechnical Solutions (AGS, 2018) performed a preliminary geotechnical investigation of the site to the north and west of the subject site. Their evaluation consisted of the excavation of 32 backhoe test pits, 19 excavator test pits, 16 air-track borings and 10 seismic refraction lines. Laboratory testing included in-situ moisture and density, maximum density and optimum moisture content, fines content, expansion index, corrosion testing, and R-value. Based on the subsurface data and laboratory test results, AGS (2018) provided the following major conclusions and recommendations regarding development of their subject site. Of the field data obtained as part of the AGS evaluation (2018), only 4 of the excavator test pits were excavated within the subject site (TTM 39011) and all other field work was performed in areas outside the limits of the subject site to the north and west.

Groundwater

- Groundwater was not encountered in any of the exploratory borings/test pits throughout the site. Due to geologic conditions groundwater is expected to be greater than 100 feet deep.

Faulting and Seismic Hazards

- No active faults or fault zones have been mapped within the site or site vicinity.
- The site was characterized using the now outdated 2016 California Building Code (CBC).
- Due to the dense nature of the granitic bedrock, relatively thin veneer of dense granular soils, lack of shallow groundwater and proposed remedial grading, the subject site is not considered to be susceptible to liquefaction.

Expansion Potential

- Based on preliminary observations and laboratory testing for the subject site, the expansion potential of the onsite soil materials is considered to be “Very Low”.

Earthwork

- From a geotechnical perspective, the existing onsite soils appear to be suitable material for use as fill, provided they are relatively free of oversize material (greater than 8 inches in maximum dimension), construction debris, trash, and organic material.

- AGS recommended near surface soils including undocumented artificial fill, topsoil, alluvium, and weathered portions of older alluvium and bedrock are considered unsuitable for support of the proposed improvements and should be temporarily removed to expose competent underlying materials.
- Rippability was assessed by AGS based on their seismic refraction lines and air track borings and they determined that blasting will be expected in portions of the granitic bedrock near our subject site at a depth ranging from approximately 5 to 30 feet below existing grade. AGS suggests that street/utility overexcavation be performed by heavy equipment in open excavation to 2 feet below lowest utility and 3 feet below pad grade.
 - *Refer to the discussion in "Preliminary Findings and Recommendations" Section of this report for updated rippability recommendations.*
- During rough grading, generation of oversize rock (greater than 8 inches) is anticipated.
 - *Refer to the discussion in "Preliminary Findings and Recommendations" Section of this report for updated oversized handling recommendations.*
- AGS recommended that cut and fill slopes be constructed at an inclination no steeper than 2:1 (horizontal to vertical) and that keyways be constructed at the toe of all fill slopes and the need for stabilization fill for cut slopes will be determined in the field during grading.
- AGS concluded that slope stability was not considered an issue at this site.

LGC Geotechnical's Preliminary Conclusions

The following general conclusions for development of the proposed site are provided for consideration. From a geotechnical perspective, the site appears to be feasible for construction of the proposed residential development. However, there are some geotechnical items that should be considered, please refer to our preliminary conclusions provided below and our preliminary findings and recommendations in the subsequent section.

- In general, the site consists of near surface soils including topsoil, alluvium, and older alluvium underlain by very dense/hard granitic bedrock (locally as shallow as 6 inches below existing grade).
- The site is not located in a State of California Alquist-Priolo Earthquake Fault Zone or County of Riverside Fault Zone.
- Groundwater was not encountered to a maximum depth of approximately 9.5 feet below existing grade during our subsurface geotechnical evaluation or AGS's geotechnical evaluation (2018).
 - *Groundwater is not expected to be a constraint during construction; however, perched groundwater may be encountered at the contact between existing alluvial soils and bedrock materials.*
- Based on our review of the Riverside County mapping portal for liquefaction potential, the site is not located within a zone of liquefaction potential. Subsurface data suggest the soils are generally very dense sands and very stiff to hard fine-grained soils that are not susceptible to liquefaction.
- In order to provide a relatively uniform bearing condition for the planned building structures we recommend the near surface site soils be temporarily removed and recompacted. Compressible near surface soils shall be removed to suitable, competent native materials prior to re-placement as compacted fill to design grade.
 - *Refer to our "Preliminary Findings and Recommendations" Section and Sheet 1 for updated remedial grading recommendations.*
- The largest slopes at the subject site consists of both 30-foot-high cut and fill slopes inclined at approximately 2:1 (horizontal to vertical) ratio.
 - *We recommend design level slope stability analysis should be performed during a 40-scale grading plan review. Cut and fill slopes are expected to be globally stable.*
 - *It should be noted that cut slopes left with very dense/hard bedrock on the slope face may be difficult to plant and may be prone to increased localized erosion potential. We recommend stabilization fills (replacement slopes) be constructed for cut slopes greater than 5 feet in height to help reduce erosion potential, to promote plantability, to help control subsurface water and seepage, and to improve the cosmetic aspects of the cut slopes.*
- Preliminary laboratory testing indicates site soils were found to have "Very Low" expansion potential. Therefore, building foundations may be constructed with conventional or post-tensioned foundation systems designed in accordance with the California Building Code. We recommend expansion index testing be performed on finish grade pad soils at the completion of grading to confirm the preliminary findings and recommendations.
 - *Refer to our "Preliminary Findings and Recommendations" Section for updated preliminary foundation recommendations.*
- Corrosion testing should be performed on actual subgrade material at the completion of grading.
 - *Refer to our "Preliminary Findings and Recommendations" Section for updated preliminary soil corrosion recommendations.*
- We recommend any proposed import soils match the characteristics of the existing onsite soils (i.e., expansion index, corrosion characteristics, etc.).

- Foundations should be setback from top and toe of slopes in accordance with the County of Riverside grading code or Chapter 18 of the 2022 California Building Code, whichever is more conservative.
- R-value testing indicated a preliminary R-value of 40. These results suggest that the soils are likely to have moderate to favorable subgrade conditions for the proposed street construction. This will result in average street section thicknesses for the region.
- Based on the relatively dense nature of the underlying soils, the presence of some fine-grained soils, hillside nature of the site, and relatively shallow dense bedrock at depth, the subsurface soil conditions are not expected to be conducive to infiltration. We do not recommend intentional infiltration of stormwater. The following should be considered for design of any required water quality system.
 - *We recommend WQMP systems be setback a minimum of 15 feet from structures, and that building footings are designed to be embedded outside a 1:1 (horizontal to vertical) projection up from the bottom of the WQMP system. Deepened footings or repositioning of the infiltration system may be considered if there is conflict. Additionally, the County recommended minimum setback should be incorporated into the design of the unlined systems.*
 - *Due to the hillside nature of the subject site, it is recommended that water quality detention systems/basins be constructed with a liner to reduce the impact of concentrated subsurface water destabilizing slopes or adjacent properties at lower elevations.*
- Protecting existing offsite improvements during grading construction is critical and should be anticipated by the contractor.
 - *We recommend a preconstruction survey be performed to document the existing conditions of the adjacent structures, walls, and improvements prior to initiation of grading and construction activities.*
- Prior to construction, LGC Geotechnical should be provided with the proposed improvement plans for review and/or revision (if necessary).

LGC Geotechnical's Preliminary Findings and Recommendations

The following findings and recommendations are based on review of the provided geotechnical reports as well as the limited field work and laboratory testing performed as part of this due diligence evaluation. These recommendations are to be considered preliminary and should be updated as part of a 40-scale geotechnical grading plan review evaluation and confirmed upon completion of grading and earthwork operations. In addition, they should be considered minimal from a geotechnical viewpoint, as there may be more restrictive requirements from the architect, structural engineer, building codes, governing agencies, or the owner.

Geologic Conditions

The subject site is located within an area known as the Perris Block, a relatively seismically stable zone in Riverside County. The Perris Block is generally a broad area of ancient crystalline bedrock that is bounded by the large regional faults including the Elsinore Fault to the west and the San Jacinto Fault to the east; the site itself is located in an area with no known active faults. The site is specifically located within the low hills north of Lake Mathews that generally consist of granitic rock of the Cretaceous- age Cajalco Pluton. The rock in the area has been eroded significantly to the current levels of low hilly relief (Morton & Weber, 2001). A stream passes just south of the site that runs from east to west (locally dammed by placement of older fill), then turns north past the site. A reservoir constructed prior to 1967 is located just north of the site, presumably constructed to irrigate the orchard agricultural uses at the site and/or surrounding areas over the decades (Historic Aerials, 2024).

The geologic formation that underlies the site is Cretaceous Granodiorite and Gabbro, Undifferentiated (Map Symbol: Kcgb). The rock unit is generally medium to coarse grained crystalline bedrock with a weak foliation (alignment of crystals that creates a parting surface). Several prominent rocky knobs appear to be the darker gabbro rock that reportedly intruded into the lighter brown granodiorite material. The bedrock materials in general are anticipated to become increasingly dense and more likely to produce oversize rock with depth, to the point of very difficult excavation within the unweathered/fresh bedrock that may be encountered within the deepest excavations. The hard rock materials are expected to have random corestones or "floaters," defined as zones that are denser and resist weathering and excavation.

The granitic bedrock is mantled within the lower elevations by a relatively thin layer of older alluvial fan deposits, up to about 6 feet in thickness where evaluated (Map Symbol: Qoa). Where observed, the material was a reddish brown, sand to silty sand, dry to slightly moist, loose to medium dense. Relatively thin younger alluvial deposits are present within the few incised drainages that dissect the site (Map Symbol: Qal). Approximate limits of site materials are presented on the Geotechnical Map (Sheet 1). Logs of test pits and results of seismic refraction line testing are presented in Appendix B and Figure 3a-3g, respectively.

Groundwater

Groundwater was not encountered to a maximum depth of approximately 9.5 feet below existing grade during our subsurface geotechnical evaluation or AGS's geotechnical evaluation (2018). Groundwater is not expected to be a constraint during construction; however, perched

groundwater may be encountered at the contact between existing alluvial soils and bedrock materials.

Seismic

The site seismic characteristics were evaluated per the guidelines set forth in Chapter 16, Section 1613 of the 2022 California Building Code (CBC) and applicable portions of ASCE 7-16 which has been adopted by the CBC. **Please note that the following seismic parameters are only applicable for code-based acceleration response spectra and are not applicable for where site-specific ground motion procedures are required by ASCE 7-16.** Representative site coordinates of latitude 33.861573 degrees north and longitude -117.424832 degrees west were utilized in our analyses. The maximum considered earthquake (MCE) spectral response accelerations (S_{MS} and S_{M1}) and adjusted design spectral response acceleration parameters (S_{DS} and S_{D1}) for Site Class C are provided in Table 1 on the following page. The structural designer should contact the geotechnical consultant if structural conditions (e.g., number of stories, seismically isolated structures, etc.) require site-specific ground motions.

A deaggregation of the PGA based on a 2,475-year average return period (MCE) indicates that an earthquake magnitude of 6.77 at a distance of approximately 13.87 km from the site would contribute the most to this ground motion. A deaggregation of the PGA based on a 475-year average return period (Design Earthquake) indicates that an earthquake magnitude of 6.73 at a distance of approximately 15.82 km from the site would contribute the most to this ground motion (USGS, 2014).

Section 1803.5.12 of the 2022 CBC (per Section 11.8.3 of ASCE 7) states that the maximum considered earthquake geometric mean (MCE_G) Peak Ground Acceleration (PGA) should be used for liquefaction potential. The PGA_M for the site is equal to 0.670g (SEAOC, 2024). The design PGA is equal to 0.447g ($2/3\ PGA_M$).

TABLE 1**Seismic Design Parameters**

Selected Parameters from 2022 CBC, Section 1613 - Earthquake Loads	Seismic Design Values	Notes/Exceptions
Distance to applicable faults classifies the site as a "Near-Fault" site.		Section 11.4.1 of ASCE 7
Site Class	C	Chapter 20 of ASCE 7
S _s (Risk-Targeted Spectral Acceleration for Short Periods)	1.500g	From SEAOC, 2024
S ₁ (Risk-Targeted Spectral Accelerations for 1-Second Periods)	0.593g	From SEAOC, 2024
F _a (per Table 1613.2.3(1))	1.200	For Simplified Design Procedure of Section 12.14 of ASCE 7, F _a shall be taken as 1.4 (Section 12.14.8.1)
F _v (per Table 1613.2.3(2))	1.407	-
S _{MS} for Site Class C [Note: S _{MS} = F _a S _s]	1.800g	-
S _{M1} for Site Class C [Note: S _{M1} = F _v S ₁]	0.835g	-
S _{DS} for Site Class C [Note: S _{DS} = (2/3) S _{MS}]	1.200g	-
S _{D1} for Site Class C [Note: S _{D1} = (2/3) S _{M1}]	0.556g	-
C _{RS} (Mapped Risk Coefficient at 0.2 sec)	0.939	ASCE 7 Chapter 22
C _{R1} (Mapped Risk Coefficient at 1 sec)	0.919	ASCE 7 Chapter 22

Faulting

Prompted by damaging earthquakes in Northern and Southern California, State legislation and policies concerning the classification and land-use criteria associated with faults have been developed. Their purpose was to prevent the construction of urban developments across the trace of active faults, resulting in the Alquist-Priolo Earthquake Fault Zoning Act. Earthquake Fault Zones have been delineated along the traces of active faults within California. Where developments for human occupation are proposed within these zones, the state requires detailed fault evaluations be performed so that engineering geologists can mitigate the hazards associated with active faulting by identifying the location of active faults and allowing for a setback from the zone of previous ground rupture.

The subject site is not located within a State of California Earthquake Fault Zone (Alquist-Priolo) and no faults were identified on the site during our site evaluation (CGS, 2018 & CGS,

2024). The possibility of damage due to ground rupture is considered low since no active faults are known to cross the site. The closest known active faults to the subject site are the San Jacinto Fault Zone located about 14 miles east of the site, and the Elsinore Fault Zone located about 7 miles west of the site (Riverside County, 2024 & CGS, 2024).

Secondary effects of seismic shaking resulting from large earthquakes on the major faults in the Southern California region, which may affect the site, include ground lurching and shallow ground rupture, soil liquefaction, and dynamic settlement. These secondary effects of seismic shaking are a possibility throughout the Southern California region and are dependent on the distance between the site and causative fault and the onsite geology. A discussion of these secondary effects is provided in the following sections.

Liquefaction

Liquefaction is a seismic phenomenon in which loose, saturated, granular soils behave similarly to a fluid when subject to high-intensity ground shaking. Liquefaction occurs when three general conditions coexist: 1) shallow groundwater; 2) low density non-cohesive (granular) soils; and 3) high-intensity ground motion. Studies indicate that saturated, loose near-surface cohesionless soils exhibit the highest liquefaction potential, while dry, dense, cohesionless soils and cohesive soils exhibit low to negligible liquefaction potential. In general, cohesive soils are not considered susceptible to liquefaction, depending on their plasticity and moisture content. Effects of liquefaction on level ground include settlement, sand boils, and bearing capacity failures below structures. Dynamic settlement of dry loose sands can occur as the sand particles tend to settle and densify as a result of a seismic event.

The subject site is not located within a County of Riverside Seismic Hazard Zone for liquefaction potential (County, 2024b). Groundwater is not anticipated to be present in the upper 50 feet and the site is expected to consist of compacted fill over very hard bedrock. Therefore, liquefaction potential is considered very low.

Lateral Spread

Lateral spreading is a type of liquefaction-induced ground failure associated with the lateral displacement of surficial blocks of sediment resulting from liquefaction in a subsurface layer. Once liquefaction transforms the subsurface layer into a fluid mass, gravity plus the earthquake inertial forces may cause the mass to move downslope towards a free face (such as a river channel or an embankment). Lateral spreading may cause large horizontal displacements, and such movement typically damages pipelines, utilities, bridges, and structures.

Due to the depth to groundwater and very low potential for liquefaction, the potential for lateral spreading is considered very low.

Preliminary Rippability Findings

Preliminary seismic refraction line rippability study was performed as part of this evaluation. This data was used to make preliminary conclusions regarding the rippability of onsite materials. It may be necessary to perform a design level rippability evaluation in the future based on the 40-scale grading plans once available. Additional field work including seismic refraction lines, air track excavations, etc. may be considered.

In general, the topsoil, older fill, alluvium, and older alluvial deposits are anticipated to be easily to moderately rippable utilizing conventional heavy-duty earth moving equipment (Caterpillar D9 or equivalent). A preliminary rippability study of the hard bedrock unit described in the “Site Geology and Generalized Subsurface Conditions” Section was conducted as part of this evaluation using seven seismic refraction lines.

In general, the subsurface data collected indicates that the bedrock materials can be classified into three zones of rippability (rippable, marginally rippable, and non-rippable). Seismic refraction data is summarized below and presented in Appendix B. Refer to the Geotechnical Map (Sheet 1) for seismic refraction line locations. Table 2 presents generalized rippability classifications and velocity ranges based on readily available rippability charts (Caterpillar, 2019) and our local experience with similar nearby projects. These seismic velocities are utilized in estimating the effort required in excavating the onsite crystalline (hard rock) bedrock materials.

TABLE 2

Generalized Rippability Summary of Crystalline Bedrock

Rippability Classification	Approximate Seismic Velocity (Feet per Second)
Moderate Rippability	< 4,000
Difficult to Very Difficult Rippability	4,000 to 5,500
Non-Rippable (Blasting Recommended)	> 5,500

Based on the geologic characteristics of the onsite hard bedrock and our local experience, we estimate that a seismic velocity of approximately 5,500 feet per second represents the boundary between a very difficult rippability and non-rippable classification. A seismic velocity of 5,500 feet per second is slightly more conservative than what is presented on the referenced rippability charts, however, it is based on our experience with similar local hard rock grading projects. Please note that the velocity ranges of these classifications (Table 2) are approximate and that rock characteristics, including jointing and fracturing spacing and orientation, are a major factor in determining rippability.

Estimated depths of the difficulty of rippability utilizing large, heavy-duty equipment (Caterpillar D-9 or equivalent) for each of the seven subject seismic refraction lines are presented in Table 3 below. These depth estimates are based on the seismic refraction line data obtained as part of this preliminary evaluation (Appendix B). Figures 3a through 3g (rear of text) present a cross-sectional view of the proposed finish grades and estimated over-excavation limits overlain on the seismic line tomographic plots. Each layer depicts the average velocity for that specific layer of soil/rock.

TABLE 3

Summary of Seismic Line Velocity vs. Rippability (D-9 or Equivalent)

Seismic Line	Approximate Depth (in feet) to <u>Difficult Ripping</u> (Approx. Seismic Velocity 4,000 ft/sec)	Approximate Depth (in feet) to <u>Non-rippable Bedrock</u> (Approx. Seismic Velocity 5,500 ft./sec or Greater)
S-1	2 - 10	>20
S-2	5 - 20	15 - 25
S-3	2 - 10	15 - 25
S-4	2 - 10	15 - 30
S-5	10 - 35	>40
S-6	0 - 15	5 - 40
S-7	10 - 20	>30

In general, the onsite seismic refraction data suggests that the proposed design cuts (plus the underlying overexcavations for pads and underground utilities) within the bedrock formation will be moderately rippable to non-rippable with heavy equipment. Blasting should be expected at depths ranging from approximately 10 to 30 feet below existing grade in the bedrock cut areas. Localized zones of potentially non-rippable bedrock should be anticipated to be encountered above the estimated non-rippable bedrock depths. Furthermore, areas of core stones or “floaters” and rock outcrops will likely require very difficult ripping to possible blasting, especially for utilities (i.e., “line shooting”). Based on seismic refraction lines, the excavation difficulty of the bedrock materials generally increases with depth. Once a 40-scale grading plan is made available, a more in-depth study should be conducted to evaluate rippability as it pertains to proposed cuts across the site.

Please note that different earthmoving equipment (excavators, smaller dozers, backhoes, etc.) will not correlate exactly with the velocity ranges and rippability classifications presented above. In general, an excavator typically utilized for underground utility installation will generally encounter difficult ripping conditions in materials having a seismic velocity of approximately 4,000 to 4,500 feet per second. Therefore, any future underground utilities proposed in the area of crystalline bedrock will require over-excavation during rough grading with the larger/heavy duty grading equipment. Areas of proposed underground utilities in hard rock conditions should be overexcavated a minimum depth of 2 feet below the deepest utility during grading operations to facilitate installation after grading is complete. LGC

Geotechnical should review the wet utility plans once available to confirm the street overexcavation depths.

Performing blasting at lower seismic velocities (4,500 to 5,500 feet per second) may be determined to be more economical or beneficial for construction scheduling. This is highly dependent on anticipated production rates of the grading contractor based on the equipment used for ripping/excavation. It is recommended that the grading contractor review the provided subsurface data and independently determine the potential non-rippable/blasting depths, lateral extents, quantities, production rates, etc. based on their experience and final project plans.

Specialized equipment should be anticipated to handle the difficult rippable to non-rippable materials. This equipment may include heavy breakers, large ripper teeth, line-blasting (if allowed), chemical splitting, rock trucks to move materials, and localized core stone blasting (if allowed).

It should be noted that the proposed project is near existing residential developments. Agency approval to perform blasting, if needed, should be determined prior to the start of grading.

Oversized Material Handling

General fill should be relatively free of organics and other deleterious materials and should have a maximum particle size less than 8 inches. Oversized materials (greater than 8 inches in maximum dimension) should be anticipated to be generated during excavation of the hard crystalline bedrock and core stones. Generation of oversized materials as a result of heavy ripping, breaking, or blasting the very dense bedrock should also be expected. These materials will require special handling during grading which may include oversized burial, offsite disposal, or crushing/breaking to meet project requirements.

Recommendations for appropriate handling of oversized materials should be determined prior to the start of grading. If feasible, crushing oversized materials onsite, incorporating oversized materials into “rock fills” or “windrows,” or exporting oversized material from the site may be considered. For preliminary planning purposes, oversized materials should be buried a minimum of 10 feet below finish grades, should be buried a minimum of 2 feet below the deepest utility in the street areas, and should not be buried within 15 feet of slopes, which will limit the available areas that can accommodate oversized materials. Based on our preliminary review of the tentative tract map (Adkan, 2024), the pad areas onsite with fills greater than 10 feet are limited. We estimate approximately 10 to 15 lots will contain fills deep enough to accept the placement of oversized materials. These lots are generally located in the southern and western portions of the site. Additional recommendations are provided for appropriate handling of oversized materials in General Earthwork & Grading Specifications (Appendix D).

Detailed oversized handling recommendations should be provided as part of a comprehensive 40-scale grading plan review evaluation.

Expansion

Based on the results of our laboratory testing and laboratory testing by others, the site soils are anticipated to have a “Very Low” expansion potential. Final expansion potential of site soils should be determined at the completion of grading. Results of expansion testing at finish grades will be utilized to confirm final foundation design.

Site Earthwork

We anticipate that earthwork at the site will consist of required earthwork removals and over excavations, subgrade preparation, placement of fill, precise grading, and construction of the proposed new improvements, including the residential structures, neighborhood amenities, subsurface utilities and interior streets.

We recommend that earthwork onsite be performed in accordance with the following recommendations, future grading plan review evaluation reports, the 2022 CBC, the County of Riverside grading requirements, and the General Earthwork and Grading Specifications included in Appendix D. In case of conflict, the following recommendations shall supersede those included in Appendix D. The following recommendations should be considered preliminary and may be revised based upon future evaluation and review of the project plans and/or based on the actual conditions encountered during site grading/construction.

Additional and/or revised earthwork recommendations should be provided in a comprehensive grading plan review geotechnical evaluation report. The recommendations provided herein are for preliminary planning purposes only.

Site Preparation

Prior to grading of areas to receive structural fill or engineered improvements, the areas should be cleared of any existing structures, asphalt, surface obstructions, and debris. Vegetation and debris should be removed and properly disposed of off-site. Holes resulting from the removal of buried obstructions, which extend below proposed finish grades, should be replaced with suitable compacted fill material. Any abandoned sewer or storm drain lines should be completely removed and replaced with properly placed compacted fill.

If cesspools or septic systems are encountered, they should be removed in their entirety. The resulting excavation should be backfilled with properly compacted fill soils. As an alternative, cesspools can be backfilled with lean sand-cement slurry. Any encountered wells should be properly abandoned in accordance with regulatory requirements. At the conclusion of the clearing operations, a representative of LGC Geotechnical should observe and accept the site prior to further grading.

Removal and Recomaction

The majority of the site is underlain by very dense bedrock, very old alluvial deposits and potentially compressible younger alluvium. The depth of potentially compressible materials recommended for removal and recompaction during site remedial grading are estimated to be on the order of approximately 3 to 8 feet below existing grade. Preliminary removal and recompaction depth recommendations are presented on the Geotechnical Map (Sheet 1).

For preliminary planning purposes, design cut pad overexcavation should be assumed at a depth of 4 feet below finish pad grades. A maximum 3:1 differential fill thickness, up to a maximum over-excavation depth of 10 feet, underneath individual lots should be maintained in order to reduce the potential for future differential settlement. In order to avoid difficult excavation during utility installation with smaller equipment (e.g., excavators, backhoes, etc.), streets in design cut areas should be over-excavated to a depth equivalent to 2-feet below the lowest utility during rough grading. Extending the street over-excavation to 2-feet below the deepest utility will help mitigate potential hard rock excavation difficulties during underground utility installation; core stones (very hard zones) may be present in areas of utility trenches within design cut areas.

The preliminary overexcavation guidance provided above has been simplified and portrayed on the Seismic Refraction Line Figures (Figures 3a through 3g). A pad overexcavation of 4 feet below finish pad grades and an assumed overexcavation of 10 feet below street grades is shown on the Figures, for preliminary planning purposes.

Remedial grading and overexcavation recommendations should be further evaluated at the 40-scale grading plan review phase of the project in order to provide design-level geotechnical recommendations. Additional subsurface evaluation; including excavator test pits, borings, or air track testing can be performed to refine remedial grading recommendations.

Local conditions may be encountered during excavation that could require additional over-excavation beyond the above noted minimum in order to obtain an acceptable subgrade. The actual depths and lateral extents of grading will be determined by the geotechnical consultant, based on subsurface conditions encountered during grading. Removal areas and areas to be over-excavated should be accurately staked in the field by the Project Surveyor.

Temporary Excavations

Temporary excavations should be performed in accordance with project plans, specifications, and all Occupational Safety and Health Administration (OSHA) requirements. Excavations should be laid back or shored in accordance with OSHA requirements before personnel or equipment are allowed to enter. Based on our field evaluation and review of the existing geotechnical data, the majority of site soils are anticipated to be OSHA Type "B" soils (refer to the attached test pit logs). Sandy soils are present and should be considered susceptible to caving. Soil conditions should be regularly evaluated during construction to verify conditions are as anticipated. The

contractor shall be responsible for providing the “competent person” required by OSHA standards to evaluate soil conditions. Close coordination with the geotechnical consultant should be maintained to facilitate construction while providing safe excavations. Excavation safety is the sole responsibility of the contractor.

Where proposed building structures will be adjacent to property lines, the potential for impacting existing offsite improvements may be reduced by performing “ABC” slot cuts. Slot cuts should be backfilled immediately with properly placed compacted fill to finish grade prior to excavation of adjacent slots. Sandy soils are present and should be considered susceptible to caving. Recommendations for ABC slot cuts including dimensions should be provided during grading based on the conditions encountered. Protection of the existing offsite improvements during grading is the responsibility of the contractor.

Vehicular traffic, stockpiles, and equipment storage should be set back from the perimeter of excavations a minimum distance equivalent to a 1:1 projection from the bottom of the excavation or 5 feet, whichever is greater. Once an excavation has been initiated, it should be backfilled as soon as practical. Prolonged exposure of temporary excavations may result in some localized instability. Excavations should be planned so that they are not initiated without sufficient time to shore/fill them prior to weekends, holidays, or forecasted rain.

It should be noted that any excavation that extends below a 1:1 (horizontal to vertical) projection of an existing foundation will remove existing support of the structure foundation. If requested, temporary shoring parameters will be provided.

Removal Bottoms and Subgrade Preparation

In general, removal bottoms, over-excavation bottoms and areas to receive compacted fill should be scarified to a minimum depth of 6 inches, brought to a near-optimum moisture condition (generally within optimum and 2 percent above optimum moisture content), and re-compacted per project recommendations.

Removal bottoms, over-excavation bottoms and areas to receive fill should be observed and accepted by the geotechnical consultant prior to subsequent fill placement.

Material for Fill

From a geotechnical perspective, the onsite soils are generally considered suitable for use as general compacted fill, provided they are screened of organic materials, construction debris and oversized material (8 inches in greatest dimension).

From a geotechnical viewpoint, any required import soils for general fill (i.e., non-retaining wall backfill) should consist of soils of “Very Low” expansion potential (expansion index 20 or less based on American Society for Testing and Materials [ASTM] D 4829), and free of organic materials, construction debris and any material greater than 3 inches in maximum dimension. Import for any required retaining wall backfill should

meet the criteria outlined in the following paragraph. Source samples should be provided to the geotechnical consultant for laboratory testing a minimum of four working days prior to any planned importation.

Retaining wall backfill should consist of imported sandy soils with a maximum of 35 percent fines (passing the No. 200 sieve) per ASTM Test Method D1140 (or ASTM D6913/D422) and a "Very Low" expansion potential (EI of 20 or less per ASTM D4829). Soils should also be screened of organic materials, construction debris, and any material greater than 3 inches in maximum dimension. A majority of the site contains soils that are suitable for retaining wall backfill based on their fines content and expansion potential; therefore, either selective grading of on-site sandy soils or import of soils will be required by the contractor for obtaining suitable retaining wall backfill soil.

Aggregate base (crushed aggregate base or crushed miscellaneous base) should conform to the requirements of Section 200-2 of the most recent version of the Standard Specifications for Public Works Construction ("Greenbook") for untreated base materials (except processed miscellaneous base) and/or County of Riverside requirements.

Placement and Compaction of Fills

Material to be placed as fill should be brought to near-optimum moisture content (generally within optimum and 2 percent above optimum moisture content) and recompacted to at least 90 percent relative compaction (per ASTM D1557). Moisture conditioning of site soils will be required in order to achieve adequate compaction. Drying and/or mixing the very moist soils will be required prior to reusing the materials in compacted fills. Soils are also present that will require additional moisture in order to achieve the required compaction.

The optimum lift thickness to produce a uniformly compacted fill will depend on the type and size of compaction equipment used. In general, fill should be placed in uniform lifts not exceeding 8 inches in compacted thickness. Each lift should be thoroughly compacted and accepted prior to subsequent lifts. Generally, placement and compaction of fill should be performed in accordance with local grading ordinances and with observation and testing by LGC Geotechnical. Oversized material as previously defined should be removed from site fills.

During backfill of excavations, the fill should be properly benched into firm and competent soils of temporary backcut slopes as it is placed in lifts.

Aggregate base material should be compacted to a minimum of 95 percent relative compaction at or slightly above optimum moisture content per ASTM D1557. Subgrade below aggregate base should be compacted to a minimum of 90 percent relative compaction per ASTM D1557 at near-optimum moisture content (generally within optimum and 2 percent above optimum moisture content).

If gap-graded ¾-inch rock is used for backfill (around storm drain storage chambers, retaining wall backfill, etc.) it will require compaction. Rock shall be placed in thin lifts (typically not exceeding 6 inches) and mechanically compacted with observation by

geotechnical consultant. Backfill rock shall meet the requirements of ASTM D2321. Gap-graded rock is required to be wrapped in filter fabric (Mirafi 140N or approved alternative) to prevent the migration of fines into the rock backfill or at a minimum separated vertically from the trench backfill with filter fabric.

Trench and Retaining Wall Backfill and Compaction

Bedding material used within the pipe zone should conform to the requirements of the current Greenbook and the pipe manufacturer. Where applicable, sand having a sand equivalent (SE) of 30 or greater (per Caltrans Test Method [CTM] 217) may be used to bed and shade the pipes within the bedding zone. Sand backfill should be densified by jetting or flooding and then tamped to ensure adequate compaction. Bedding sand should be from a natural source with a rounded shape, manufactured sand from recycled material is not suitable for jetting/flooding as the grains are typically angular in shape and do not densify well enough with these methods. The onsite soils may generally be considered suitable as trench backfill (zone defined as 12 inches above the pipe to subgrade), provided the soils are screened of rocks greater than 6 inches in maximum dimension, construction debris and organic material. Trench backfill should be compacted in uniform lifts (as outlined above in Section "Material for Fill") by mechanical means to at least 90 percent relative compaction (per ASTM D1557). If gap-graded rock is used for trench backfill, refer to the above Section.

Retaining wall backfill should consist of sandy soils as outlined in preceding "Material for Fill" Section. The limits of select sandy backfill should extend at minimum $\frac{1}{2}$ the height of the retaining wall or the width of the heel (if applicable), whichever is greater. Retaining wall backfill soils should be compacted in relatively uniform thin lifts to at least 90 percent relative compaction (per ASTM D1557). Jetting or flooding of retaining wall backfill materials should not be permitted.

In backfill areas where mechanical compaction of soil backfill is impractical due to space constraints, typically sand-cement slurry may be substituted for compacted backfill. The slurry should contain about one sack of cement per cubic yard. When set, such a mix typically has the consistency of compacted soil. Sand cement slurry placed near the surface within landscape areas should be evaluated for potential impacts on planned improvements.

A representative from LGC Geotechnical should observe, probe, and test the backfill to verify compliance with the project recommendations.

Feasibility Level Shrinkage and Bulking Estimate

Volumetric changes in earth quantities will occur when excavated onsite earth materials are replaced as properly compacted fill. The following is a preliminary feasibility level estimate of shrinkage and bulking factors for the various geologic units found onsite. These estimates are based on limited in-place densities of the various materials and on the estimated average degree of relative compaction that

will be achieved during grading. These estimates are preliminary and should be updated as part of a 40-scale grading plan review evaluation.

TABLE 4

Feasibility Level Shrinkage and Bulking Estimations

Soil Type	Allowance	Estimated Range
Topsoil, Older Fill, and Alluvium	Shrinkage	10 to 20%
Older Alluvium	Shrinkage	0 to 10%
Granodiorite and Gabbro (Weathered Rippable Zone)	Bulking	5 to 15%
Granodiorite and Gabbro / Core Stones (Blasting Zone)	Bulking	15 to 25%

Subsidence due to earthwork equipment is expected to be on the order of 0.1 feet. It should be stressed that these values are only estimates and that actual shrinkage factors are extremely difficult to predict. The effective shrinkage of onsite soils will depend primarily on the type of compaction equipment and method of compaction used onsite by the contractor. Additionally, the geology onsite varies; therefore, the estimates provided above are generalized groupings of similar lithologies and should be expected to vary across the site laterally and with depth. The above shrinkage estimates are intended as an aid for others in determining preliminary earthwork quantities. However, these estimates should be used with some caution since they are not absolute values.

Preliminary Foundation Recommendations

Provided that the remedial grading recommendations provided herein are implemented, the site may be considered suitable for the support of the residential structures using a conventional or post-tensioned foundation system. Laboratory testing indicates that the site soils have a “Very Low” expansion potential (EI of 20 or less per ASTM D4829), however, the foundation designer should take into consideration the total and differential settlement in their design. Please note that the following foundation recommendations are preliminary and must be confirmed by LGC Geotechnical at the completion of grading.

Provisional Conventional Foundation Design Parameters

Due to the very low expansion potential of the onsite soils, the foundation/structural engineer may design a conventional foundation system that is tied together based upon the anticipated dead and live loads (wind, seismic) that will be imparted by the structure. The recommendations provided in the “Soil Bearing and Lateral Resistance” section may be utilized in the design of a rigid slab-on-grade conventional foundation designed in accordance with Section 1808 of the 2022 C.B.C. The moisture content of near surface fill soils should be kept at optimum moisture content to a minimum depth of 12 inches prior to trenching and concrete placement.

Provisional Post-Tensioned Foundation Design Parameters

The foundation designer may use a modulus of vertical subgrade reaction (k) of 200 pounds per cubic inch (pounds per square inch per inch of deflection). This value is for a 1-foot by 1-foot square loaded area and should be adjusted by the structural designer for the area of the proposed footing using the following formula:

$$k = 200 \times [(B+1)/2B]^2$$

k = modulus of vertical subgrade reaction, pounds per cubic inch (pci)

B = foundation width (feet)

The moisture content of near surface fill soils should be kept at optimum moisture content to a minimum depth of 12 inches prior to trenching and concrete placement.

Foundation Subgrade Preparation and Maintenance

The geotechnical parameters provided herein assume that if the areas adjacent to the foundation are planted and irrigated, these areas will be designed with proper drainage and adequately maintained so that ponding, which causes significant moisture changes below the foundation, does not occur. Our recommendations do not account for excessive irrigation and/or incorrect landscape design. Plants should only be provided with sufficient irrigation for life and not overwatered to saturate subgrade soils. Sunken planters placed adjacent to the foundation should either be designed with an efficient drainage system or liners to prevent moisture infiltration below the foundation. Some lifting of the perimeter foundation beam should be expected even with properly constructed planters.

In addition to the factors mentioned above, future owners/property management personnel should be made aware of the potential negative influences of trees and/or other large vegetation. Roots that extend near the vicinity of foundations can cause distress to foundations. Future owners (and the owner's landscape architect) should not plant trees/large shrubs closer to the foundations than a distance equal to half the mature height of the tree or 20 feet, whichever is more conservative unless specifically provided with root barriers to prevent root growth below the building foundation.

It is the owner's responsibility to perform periodic maintenance during hot and dry periods to ensure that adequate watering has been provided to keep soil from separating or pulling back from the foundation. Future owners and property management personnel should be informed and educated regarding the importance of maintaining a constant level of soil-moisture. The owners should be made aware of the potential negative consequences of both excessive watering, as well as allowing potentially expansive soils to become too dry. Expansive soils can undergo shrinkage during drying, and swelling during the rainy winter season, or when irrigation is resumed. This can result in distress to building structures and hardscape improvements. The builder should provide these recommendations to future owners and property management personnel.

Slab Underlayment Guidelines

The following recommendations are for informational purposes since they are unrelated to the geotechnical performance of the foundation. Some post-construction moisture migration should be expected below the foundation; the foundation engineer must assume soil moisture to be present below the slab. The following recommendations may be superseded by the foundation engineer and/or owner.

In general, interior floor slabs with moisture sensitive floor coverings should be underlain by a minimum 10-15 mil thick vapor retarder, which has a water vapor transmission rate (permeance) of less than 0.3 perms, as determined by ASTM E 96, and meets the applicable code requirements (ASTM E 1745).

It is the responsibility of the contractor to ensure that the moisture/vapor retarder systems are properly installed in accordance with the project plans and manufacturer's specifications, and that the moisture/vapor retarder materials are free of tears and punctures prior to and as a result of concrete placement. Additional moisture reduction and/or prevention measures may be needed, depending on the performance requirements of future interior floor coverings.

The foundation engineer/architect should determine whether the use of a capillary break (sand or gravel layer) in conjunction with the vapor retarder is necessary or required by code. Sand layer thickness and location (above and/or below vapor retarder) should also be determined by the foundation engineer/architect. However, we often observe the membrane to be sandwiched between a layer of sand, 1-inch above and 1-inch below. Sand layers should be installed, where applicable, in accordance with ACI Publication 302 – "Guide for Concrete Floor and Slab Construction.

Soil Bearing and Lateral Resistance

Provided our earthwork recommendations are implemented, an allowable soil bearing pressure of 2,000 pounds per square foot (psf) may be used for the design of footings having a minimum width of 12 inches and minimum embedment of 12 inches below lowest adjacent ground surface. This value may be increased by 400 psf for each additional foot of embedment and 200 psf for each additional foot of foundation width to a maximum value of 3,000 psf. A post-tensioned mat foundation a minimum of 6 inches below lowest adjacent grade may be designed for an allowable soil bearing pressure of 1,200 psf. These allowable bearing pressures are applicable for level (ground slope equal to or flatter than 5H:1V) conditions only. Bearing values indicated are for total dead loads and frequently applied live loads and may be increased by $\frac{1}{3}$ for short duration loading (i.e., wind or seismic loads).

In utilizing the above-mentioned allowable bearing capacity and provided our earthwork recommendations are implemented, foundation settlement due to consolidation and structural loads is anticipated to be on the order of 1-inch. Differential static settlement may be taken as half of the total settlement (i.e., $\frac{1}{2}$ -inch over a horizontal span of 40 feet due to structural loads).

Resistance to lateral loads can be provided by friction acting at the base of foundations and by passive earth pressure. For concrete/soil frictional resistance, an allowable coefficient of friction

of 0.35 may be assumed with dead-load forces. For slabs constructed over a moisture retarder, the allowable friction coefficient should be provided by the manufacturer. An allowable passive lateral earth pressure of 300 psf per foot of depth (or pcf) to a maximum of 3,000 psf may be used for the sides of footings poured against properly compacted fill. Allowable passive pressure may be increased to 400 pcf (maximum of 4,000 psf) for short duration seismic loading. This passive pressure is applicable for level (ground slope equal to or flatter than 5H:1V) conditions. Frictional resistance and passive pressure may be used in combination without reduction. We recommend that the upper foot of passive resistance be neglected if finished grade will not be covered with concrete or asphalt. The provided allowable passive pressures are based on a factor of safety of 1.5 and 1.1 for static and seismic loading conditions, respectively.

Soil Corrosivity

Although not corrosion engineers (LGC Geotechnical is not a corrosion consultant), several governing agencies in Southern California require the geotechnical consultant to determine the corrosion potential of soils to buried concrete and metal facilities. We therefore present the results of our testing with regard to corrosion for the use of the client and other consultants, as they determine necessary.

Preliminary corrosion testing of near-surface bulk samples from a nearby site indicated soluble sulfate contents less than 0.01 percent, chloride contents ranging from 60 to 120 parts per million (ppm), pH values ranging from 8.29 to 8.44, and minimum resistivities ranging from 1,800 to 2,900 ohm-centimeters. Based on Caltrans Corrosion Guidelines (Caltrans, 2021), soils are considered corrosive to structural elements if the pH is 5.5 or less, or the chloride concentration is 500 ppm or greater, or the sulfate concentration is 1,500 ppm (0.15 percent) or greater. Based on the preliminary test results, soils are not considered corrosive using Caltrans criteria. Note that based on minimum resistivity the soils are considered corrosive to metallic improvements. If improvements that may be susceptible to corrosion are proposed, it is recommended that further evaluation by a corrosion engineer be performed.

Based on preliminary laboratory sulfate test results, the near surface soils are designated to a class "S0" per ACI 318, Table 19.3.1.1 with respect to sulfates. Concrete in direct contact with the onsite soils can be designed according to ACI 318, Table 19.3.2.1 using the "S0" sulfate classification.

Laboratory testing may need to be performed at the completion of grading by the project corrosion engineer to further evaluate the as-graded soil corrosivity characteristics. Accordingly, revision of the corrosion potential may be needed, should future test results differ substantially from the conditions reported herein. The client and/or other members of the development team should consider this during the design and planning phase of the project and formulate an appropriate course of action.

Future Geotechnical Evaluation

Final design level recommendations (e.g., earthwork, foundation, retaining wall, pavement, flatwork, etc.) pertaining to the 40-scale rough grading plans should be provided as part of a comprehensive 40-

scale grading plan review geotechnical report. The site should be evaluated to the 2022 California Building Code (CBC) standard, including the characterization of seismic design criteria.

Closure

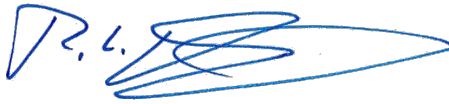
Please note, this letter is based on our review of the referenced reports and our limited due diligence field evaluation. Our proposed services were performed to the general standard of care of geotechnical consulting in Southern California; no other warranty is expressed or implied. This geotechnical due-diligence report has been prepared for the sole use of Trumark, its subsidiaries and affiliates may be relied upon by any of same.

The findings of this report are valid as of the present date. However, changes in the conditions of a property can and do occur with the passage of time, whether they be due to natural processes or the works of man on this or adjacent properties. Therefore, the findings, conclusions, and recommendations presented in this report can be relied upon only if LGC Geotechnical has the opportunity to observe the subsurface conditions during grading and construction of the project, in order to confirm that our preliminary findings are representative for the site.

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

Sincerely,

LGC Geotechnical, Inc.



Ryan Douglas, PE, GE 3147
Vice President of Engineering



Katie Maes, CEG 2216
Director of Geology

RLD/KTM/BPP/ala

Attachments: Figure 1 – Site Location Map (Rear of Text)
Figure 2 – Site Photos (Rear of Text)
Figures 3a through 3g – Seismic Line Tomographic Plots (Rear of Text)
Appendix A – References
Appendix B – Field Exploration Logs
Appendix C – Laboratory Testing Results
Appendix D – General Earthwork and Grading Specifications for Rough Grading
Sheet 1 – Geotechnical Map

Distribution: (1) Addressee (electronic copy)



FIGURE 1
Site Location Map

PROJECT NAME	Trumark - HG5 Riverside
PROJECT NO.	24174-01
ENG. / GEOL.	RLD / KTM
SCALE	Not to Scale
DATE	September 2024



Photo 1 - Southern Portion of Site Looking North



Photo 2 - Southern Portion of Site Looking Southwest



Photo 3 - Northwest Portion of Site Looking East

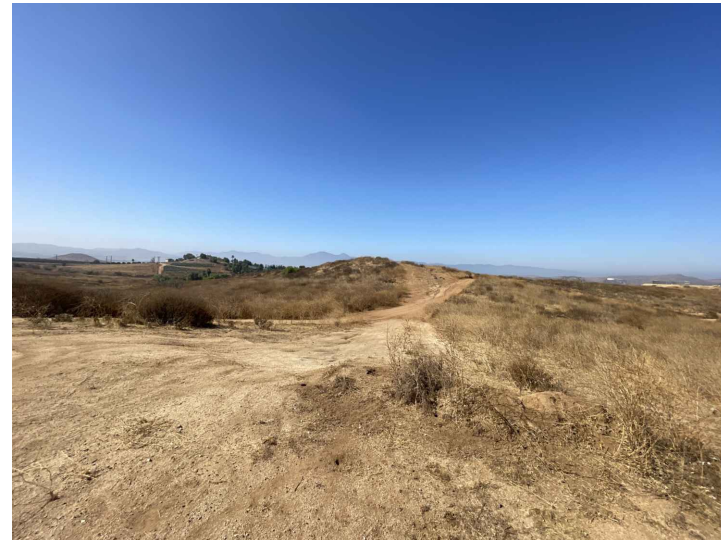


Photo 4 - Northern Portion of Site Looking Southwest



FIGURE 2
Site Photos

PROJECT NAME	Trumark - HG5, Riverside
PROJECT NO.	24174-01
ENG. / GEOL.	RLD / KTM
SCALE	Not to Scale
DATE	September 2024

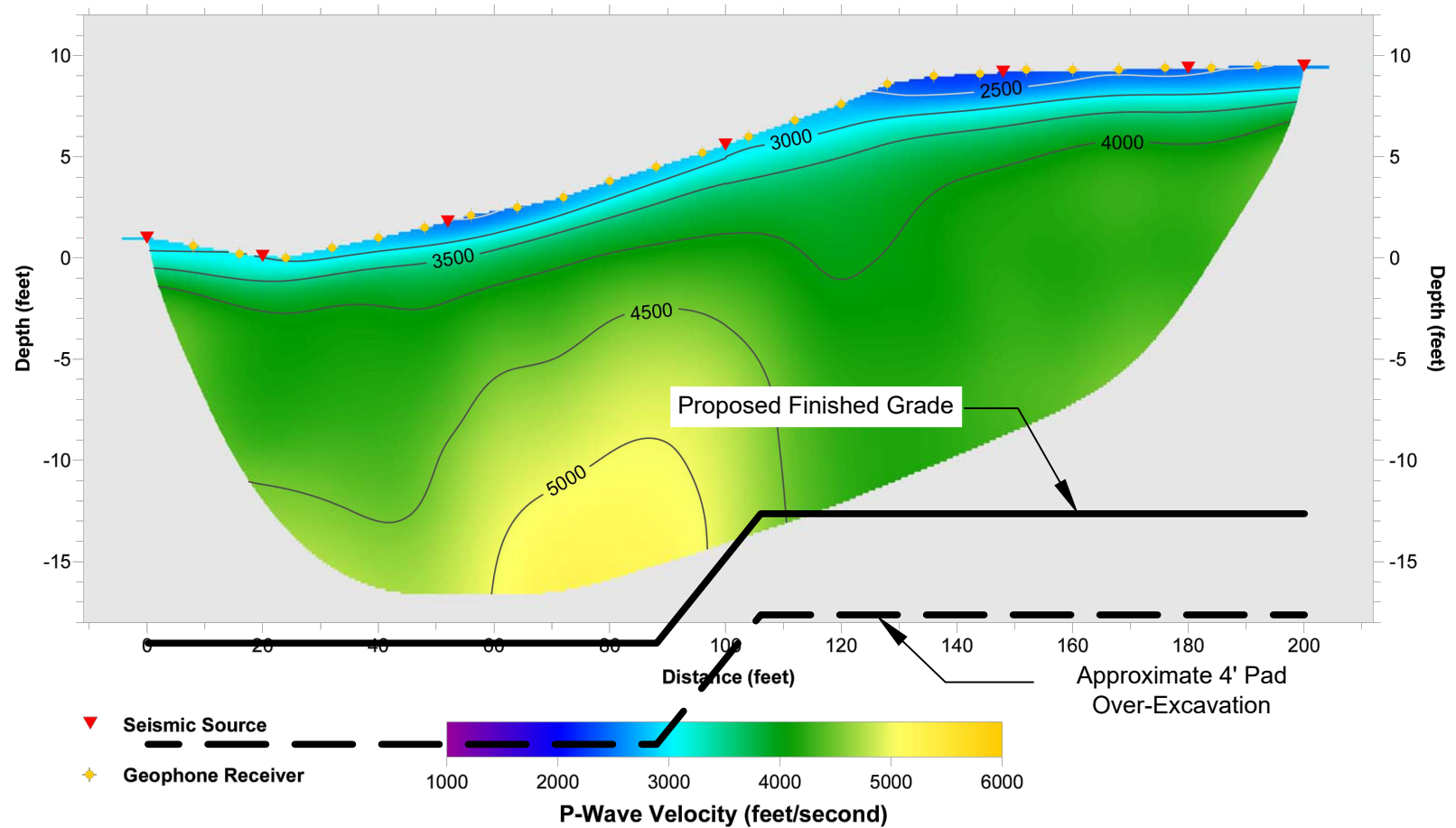
SEISMIC LINE S-1

South 64° East →

SCALE: 1"=30'



REFRACTION TOMOGRAPHIC MODEL



SCALE: Vertical Exaggeration 3.5X

RMS error 2.4; Rayfract Version 4.06



FIGURE 3a
Seismic Line Tomographic Plots
Seismic Line 1

PROJECT NAME	Trumark - HG5, Riverside
PROJECT NO.	24174-01
ENG. / GEOL.	RLD / KTM
SCALE	1" = 30'
DATE	September 2024

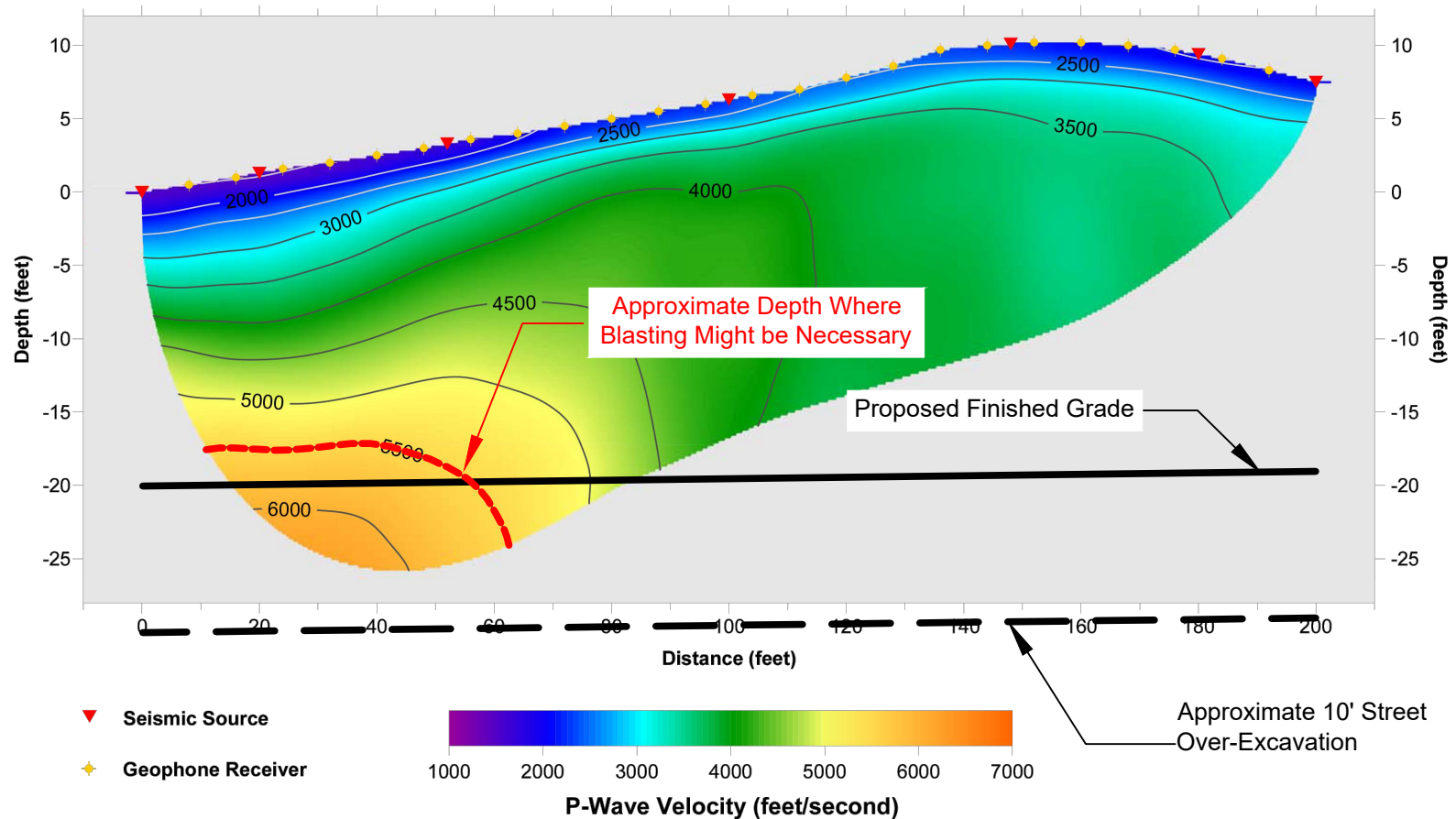
SEISMIC LINE S-2

North 5° East →

SCALE: 1"=30'



REFRACTION TOMOGRAPHIC MODEL



SCALE: Vertical Exaggeration 2.5X

RMS error 1.8; Rayfract Version 4.06



FIGURE 3b
Seismic Line Tomographic Plots
Seismic Line 2

PROJECT NAME	Trumark - HG5, Riverside
PROJECT NO.	24174-01
ENG. / GEOL.	RLD / KTM
SCALE	1" = 30'
DATE	September 2024

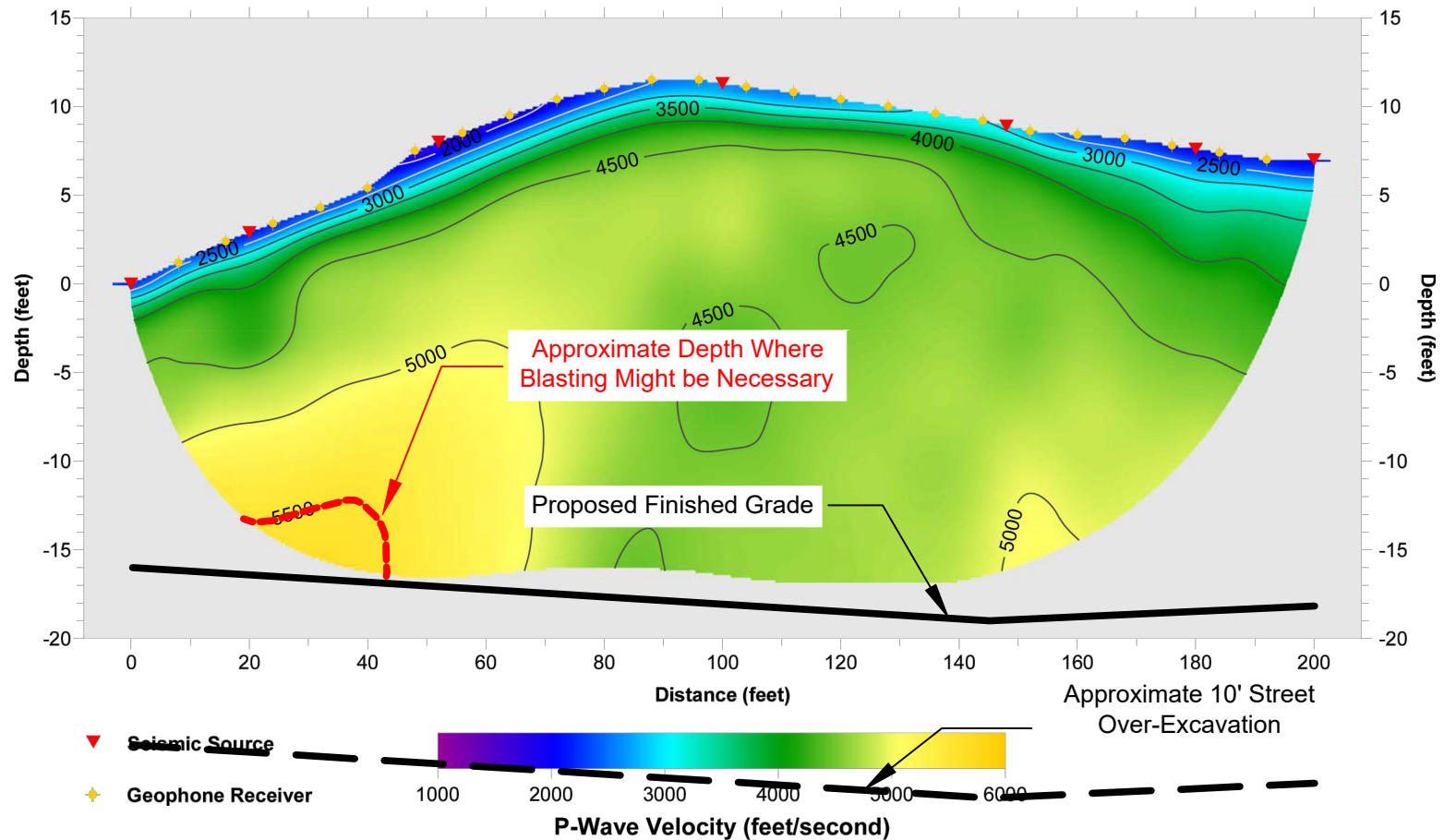
SEISMIC LINE S-3

North 5° East →

SCALE: 1"=30'



REFRACTION TOMOGRAPHIC MODEL



SCALE: Vertical Exaggeration 3X

RMS error 1.5; Rayfract Version 4.06

FIGURE 3c
Seismic Line Tomographic Plots
Seismic Line 3



PROJECT NAME	Trumark - HG5, Riverside
PROJECT NO.	24174-01
ENG. / GEOL.	RLD / KTM
SCALE	1" = 30'
DATE	September 2024

SEISMIC LINE S-4

North 2° East →

REFRACTION TOMOGRAPHIC MODEL

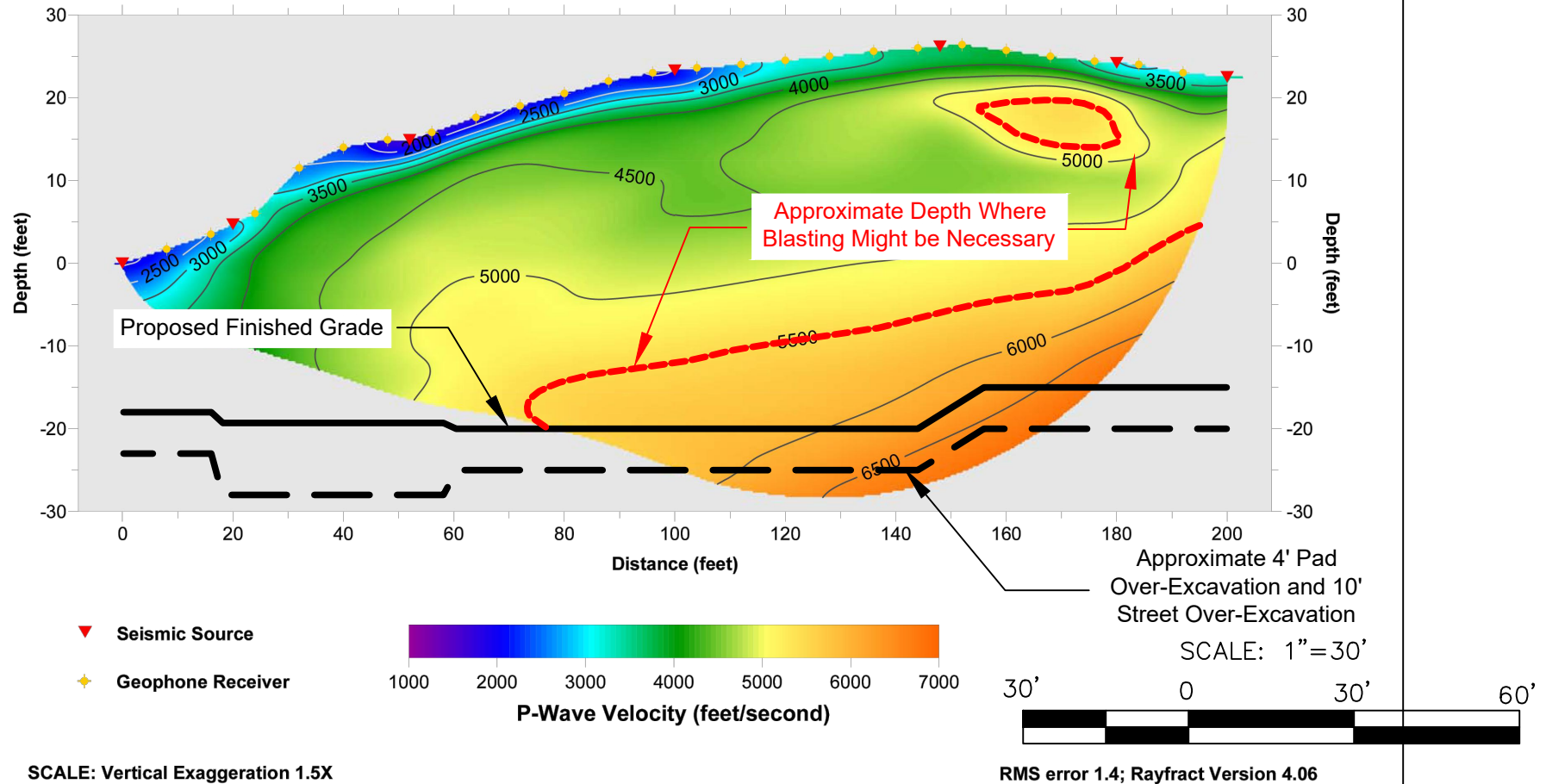


FIGURE 3d
Seismic Line Tomographic Plots
Seismic Line 4

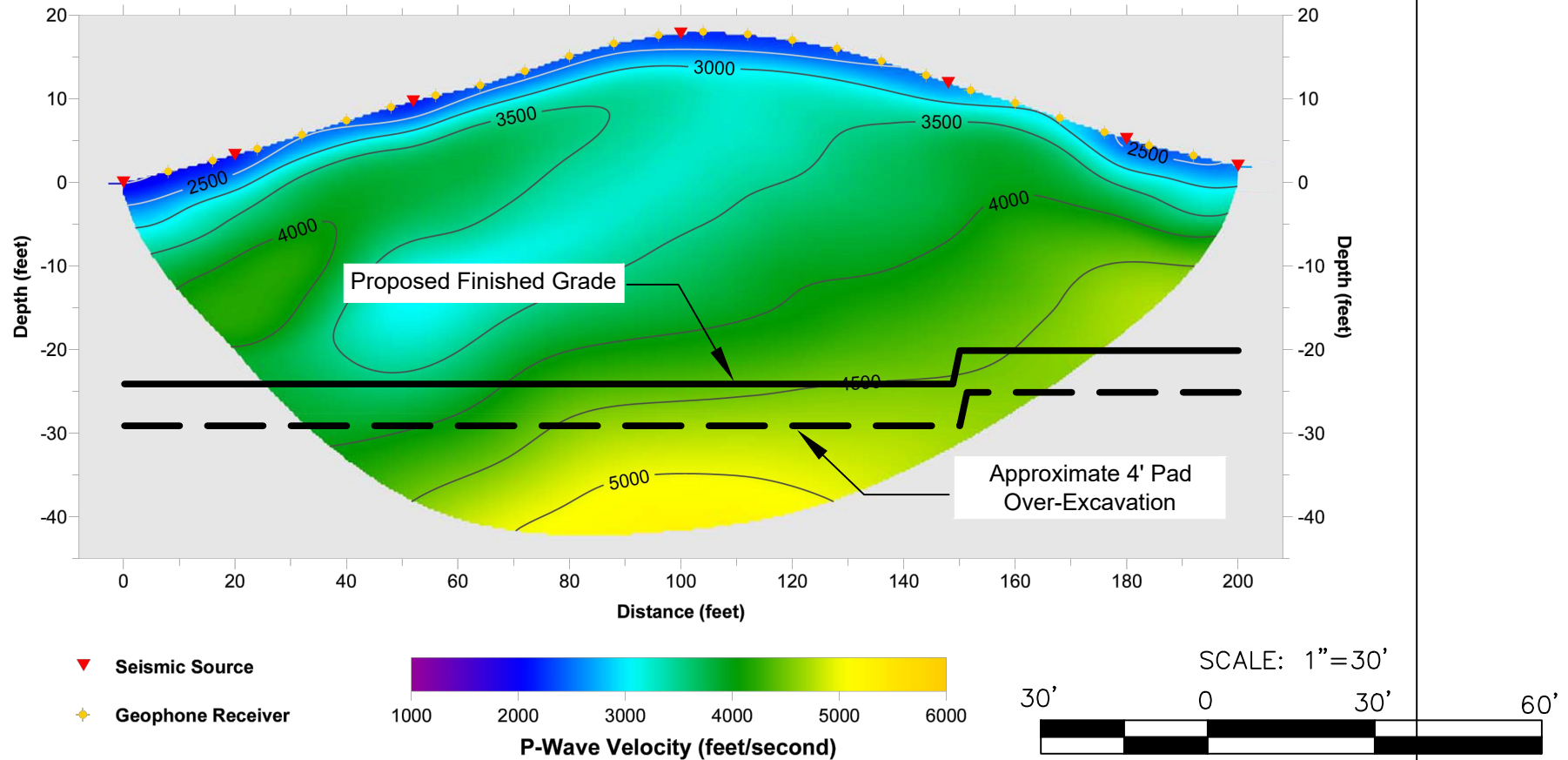


PROJECT NAME	Trumark - HG5, Riverside
PROJECT NO.	24174-01
ENG. / GEOL.	RLD / KTM
SCALE	1" = 30'
DATE	September 2024

SEISMIC LINE S-5

South 87° East →

REFRACTION TOMOGRAPHIC MODEL



SCALE: Vertical Exaggeration 1.5X

RMS error 1.9; Rayfract Version 4.06

FIGURE 3e
Seismic Line Tomographic Plots
Seismic Line 5

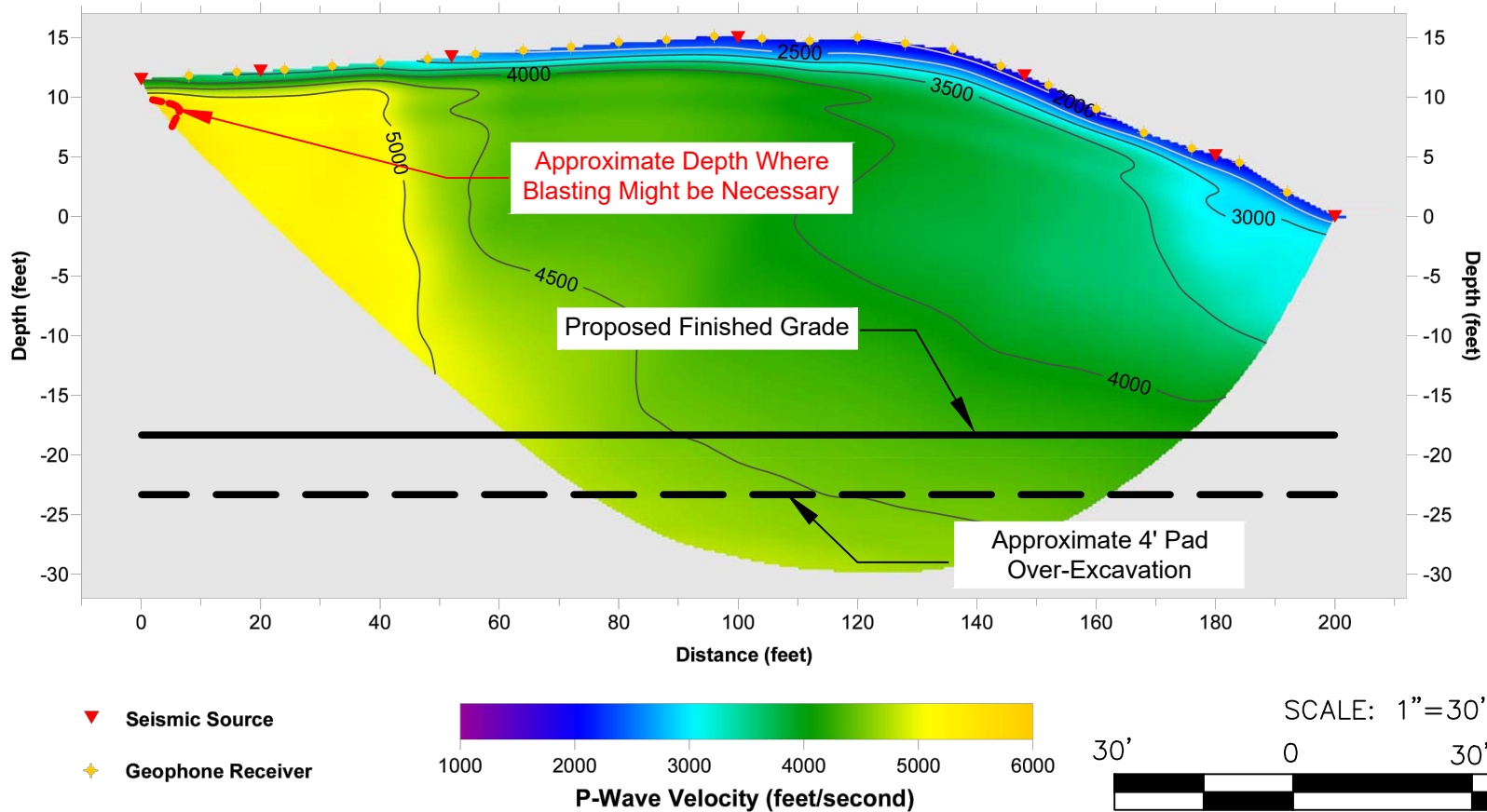


PROJECT NAME	Trumark - HG5, Riverside
PROJECT NO.	24174-01
ENG. / GEOL.	RLD / KTM
SCALE	1" = 30'
DATE	September 2024

SEISMIC LINE S-6

North 60° East →

REFRACTION TOMOGRAPHIC MODEL



SCALE: Vertical Exaggeration 2X

RMS error 2.8; Rayfract Version 4.06

FIGURE 3f
Seismic Line Tomographic Plots
Seismic Line 6



PROJECT NAME	Trumark - HG5, Riverside
PROJECT NO.	24174-01
ENG. / GEOL.	RLD / KTM
SCALE	1" = 30'
DATE	September 2024

SEISMIC LINE S-7

South 63° East →

REFRACTION TOMOGRAPHIC MODEL

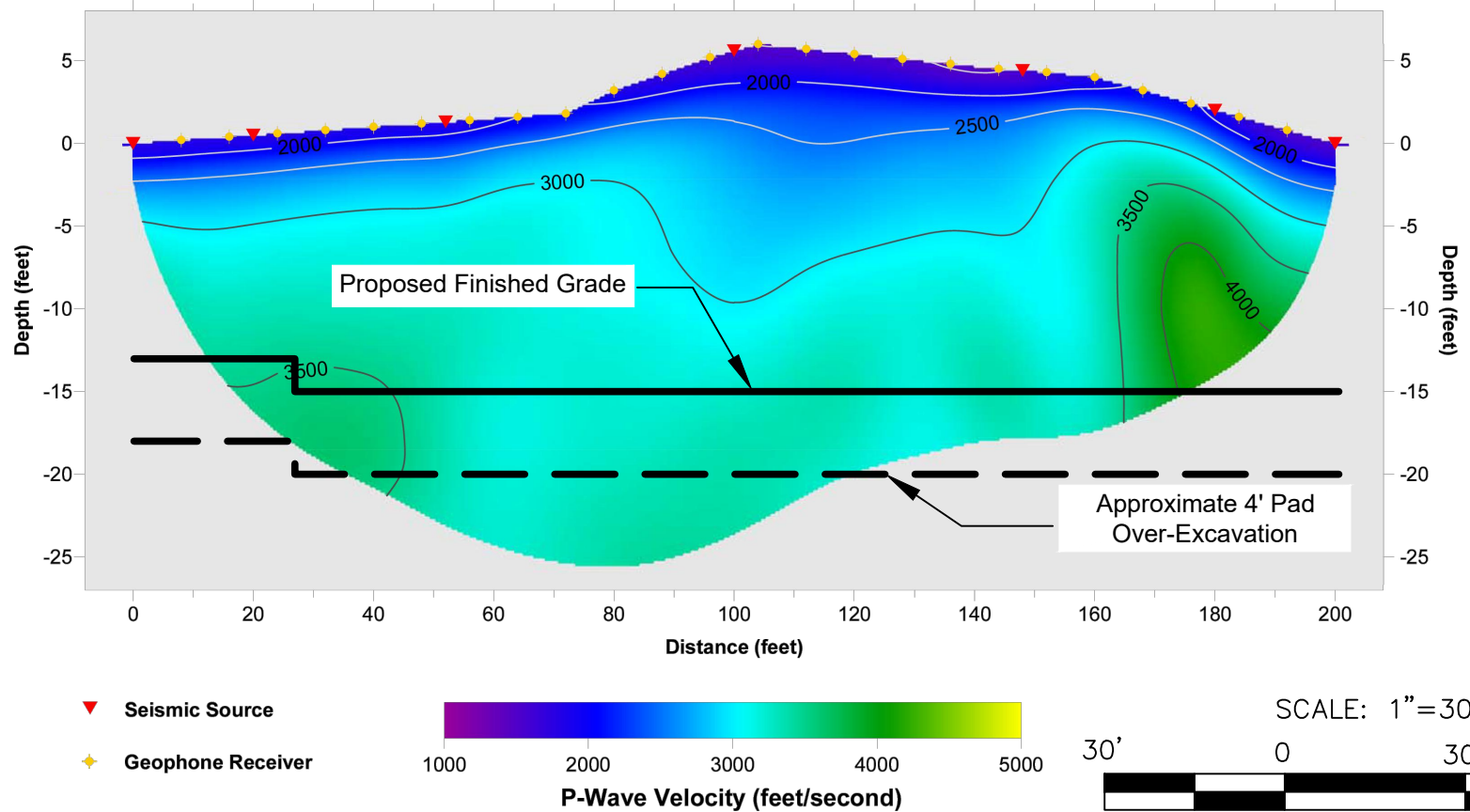


FIGURE 3g
Seismic Line Tomographic Plots
Seismic Line 7

PROJECT NAME	Trumark - HG5, Riverside
PROJECT NO.	24174-01
ENG. / GEOL.	RLD / KTM
SCALE	1" = 30'
DATE	September 2024

Appendix A

References

Appendix A

References

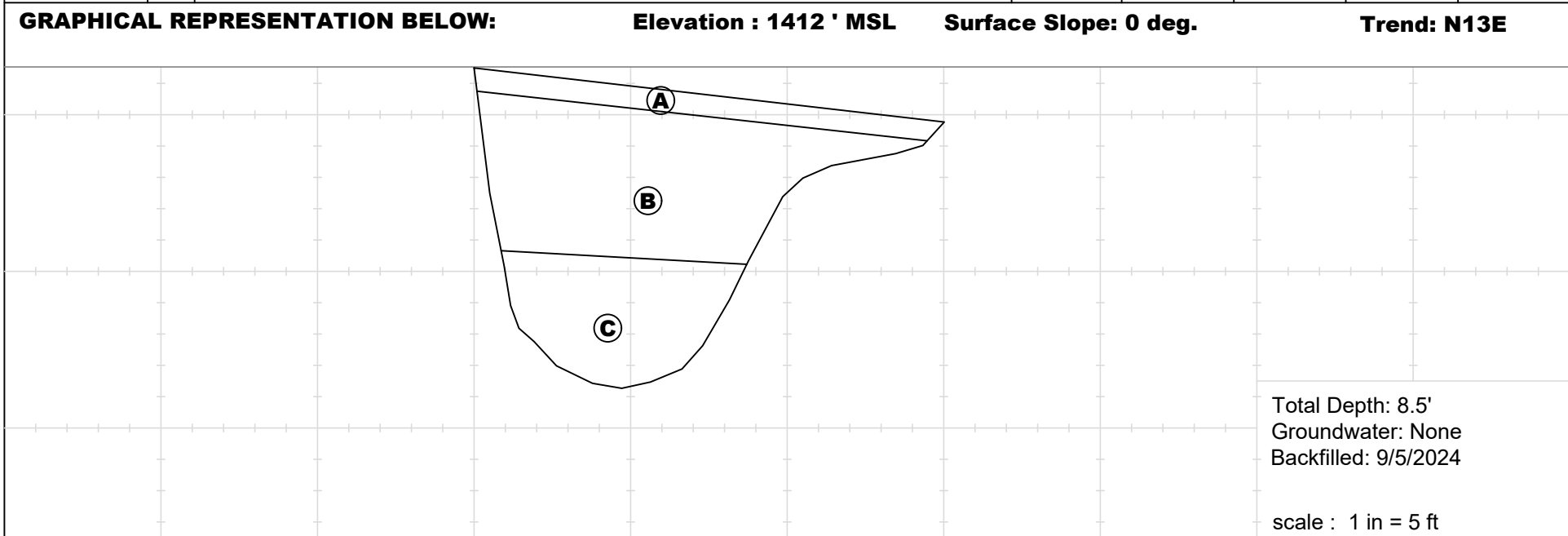
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Appendix B
Field Exploration Logs

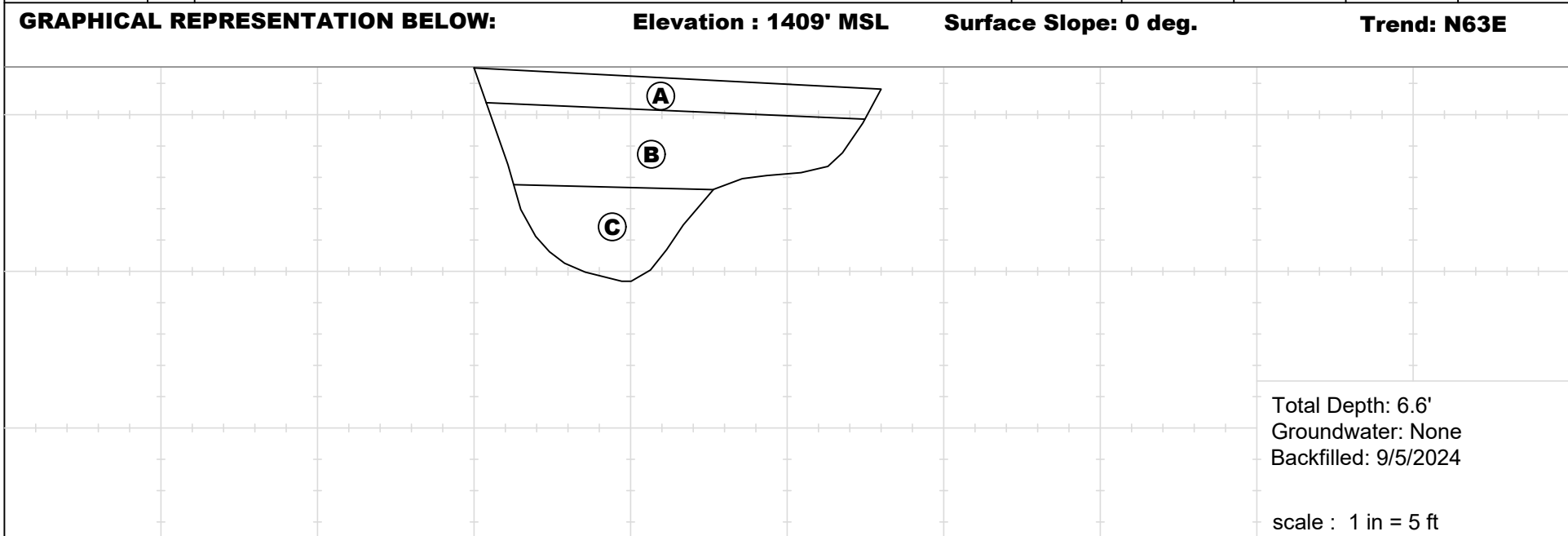
Project Name: Trumark - HG5 Riverside	Logged By: HPB	Trench No: TP-1	
Project Number : 24174-01	Date : 9/5/2024	Engineering Properties:	
Equipment: Backhoe	Location: See Geotechnical Map		

Geologic Attitudes	Unit	SOIL DESCRIPTION:	GEOLOGIC UNIT	USCS	SAMPLE No	MOISTURE (%)	DRY DENSITY (PCF)
	A	0' to 6" - Topsoil Clayey SILT with organics: brown to light brown, dry, soft, vegetation, roots.	Qoa Kcgb	SM	B-1	6.7	
	B	6" to 5.6' - <u>Quaternary Older Alluvium (Qoa)</u> Silty SAND, reddish brown, dry to slightly moist, loose to slightly dense, fine to medium grained sand, roots & rootlets in upper 3'.					
	C	5.6' to T.D. - <u>Granodiorite and Gabbro, Undifferentiated (Kcgb)</u> Granitic rock, light yellow to grayish brown, slightly moist, very dense, decomposed or weathered in upper 2.9'.					



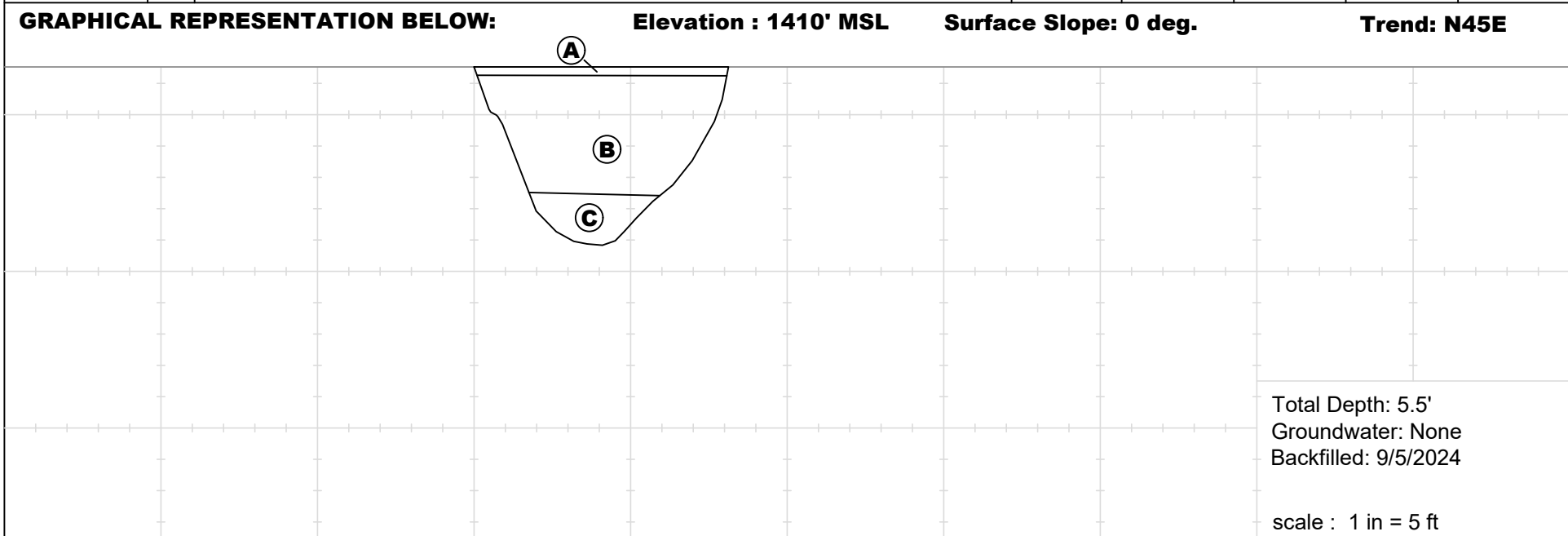
Project Name: Trumark - HG5 Riverside	Logged By: HPB	Trench No: TP-2	
Project Number : 24174-01	Date : 9/5/2024	Engineering Properties:	
Equipment: Backhoe	Location: See Geotechnical Map		

Geologic Attitudes	Unit	SOIL DESCRIPTION:	GEOLOGIC UNIT	USCS	SAMPLE No	MOISTURE (%)	DRY DENSITY (PCF)
	A	0' to 1' - Topsoil Clayey SILT with organics: light brown to brown, dry, soft, vegetation, roots.	Qoa	SP-SM	B-1	3.5	
	B	1' to 3.5' - <u>Quaternary Older Alluvium (Qoa)</u> SAND with Silt, reddish brown, slightly moist, medium dense, fine to coarse grained sand, visibly porous & rootlets in upper 1.5'.					
	C	3.5' to T.D. - <u>Granodiorite and Gabbro, Undifferentiated (Kcgb)</u> Granitic rock, reddish brown to yellowish brown, dry to slightly moist, dense, decomposed or weathered in upper 3'.	Kcgb				



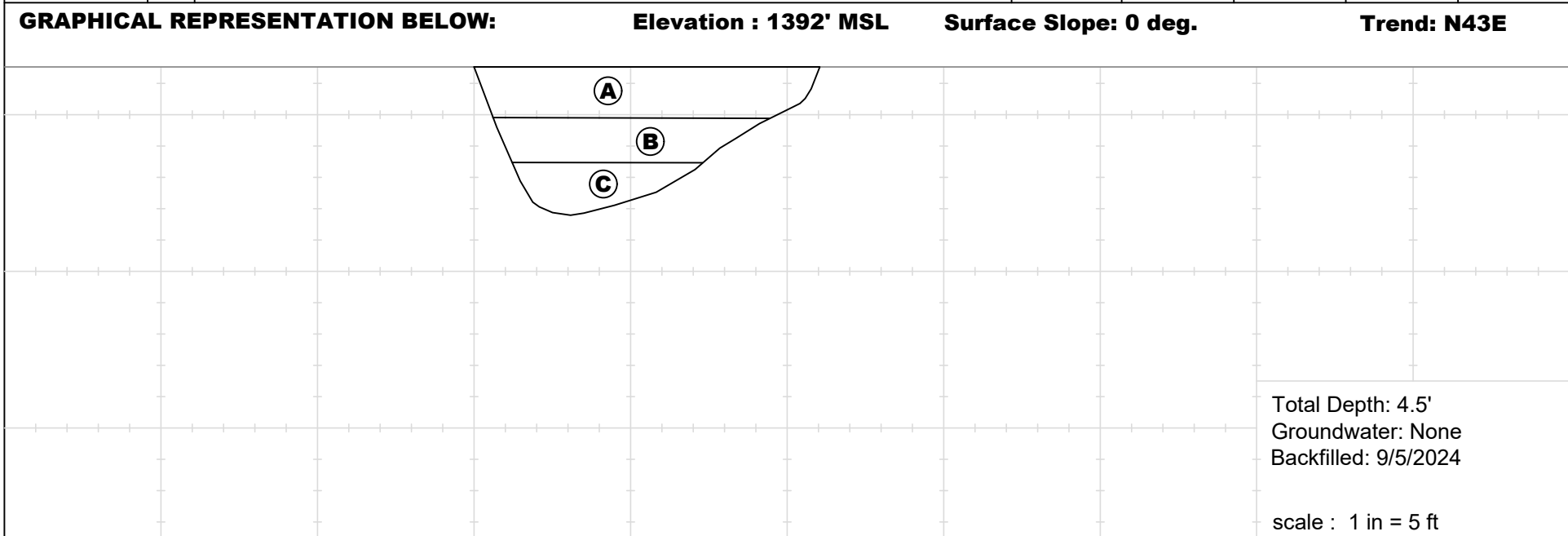
Project Name: Trumark - HG5 Riverside	Logged By: HPB	Trench No: TP-3	
Project Number : 24174-01	Date : 9/5/2024	Engineering Properties:	
Equipment: Backhoe	Location: See Geotechnical Map		

Geologic Attitudes	Unit	SOIL DESCRIPTION:	GEOLOGIC UNIT	USCS	SAMPLE No	MOISTURE (%)	DRY DENSITY (PCF)
	A	0' to 3" - <u>Topsoil</u> Clayey SILT with Sand: brown, dry, soft, vegetation, roots porous.	Qoa Kcgb	SC	B-1	4.9	
	B	3" to 4' - <u>Quaternary Older Alluvium (Qoa)</u> Clayey SAND, reddish brown, dry to slightly moist, medium dense to dense, medium to coarse grained sand, porous & rootlets in upper 1.5'.					
	C	4' to T.D. - <u>Granodiorite and Gabbro, Undifferentiated (Kcgb)</u> Granitic rock, yellowish brown to light brown, dry, very dense, decomposed or weathered in upper 1'.					
Note: abandoned 8" cement irrigation pipe 1.5' deep.							



Project Name: Trumark - HG5 Riverside	Logged By: HPB	Trench No: TP-4	
Project Number : 24174-01	Date : 9/5/2024	Engineering Properties:	
Equipment: Backhoe	Location: See Geotechnical Map		

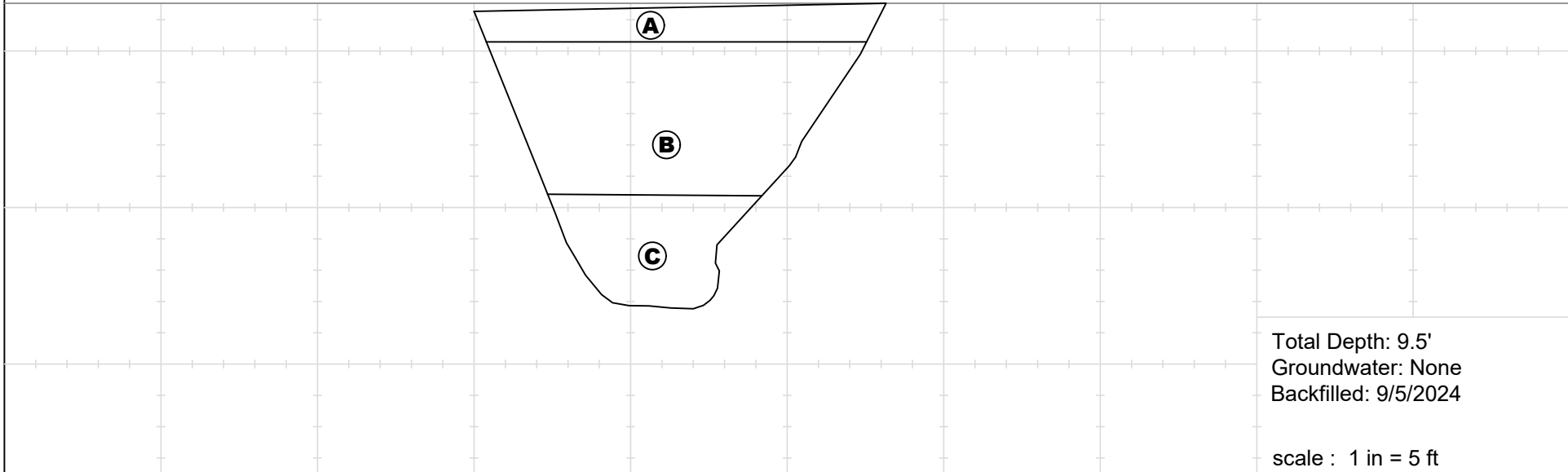
Geologic Attitudes	Unit	SOIL DESCRIPTION:	GEOLOGIC UNIT	USCS	SAMPLE No	MOISTURE (%)	DRY DENSITY (PCF)
	A	0' to 1.5' - Topsoil Clayey SILT with Sand: light brown to brown, dry, soft, vegetation, roots.	Qoa	SC	B-1	3.2	
	B	1.5' to 3' - Quaternary Older Alluvium (Qoa) Clayey SAND, reddish brown, dry to slightly moist, medium dense, fine to coarse grained sand, porous & rootlets.					
	C	3' to T.D. - Granodiorite and Gabbro, Undifferentiated (Kcgb) Granitic rock, brown, dry, very dense to hard, shallow refusal.	Kcgb				



Project Name: Trumark - HG5 Riverside	Logged By: HPB	Trench No: TP-5	
Project Number : 24174-01	Date : 9/5/2024	Engineering Properties:	
Equipment: Backhoe	Location: See Geotechnical Map		

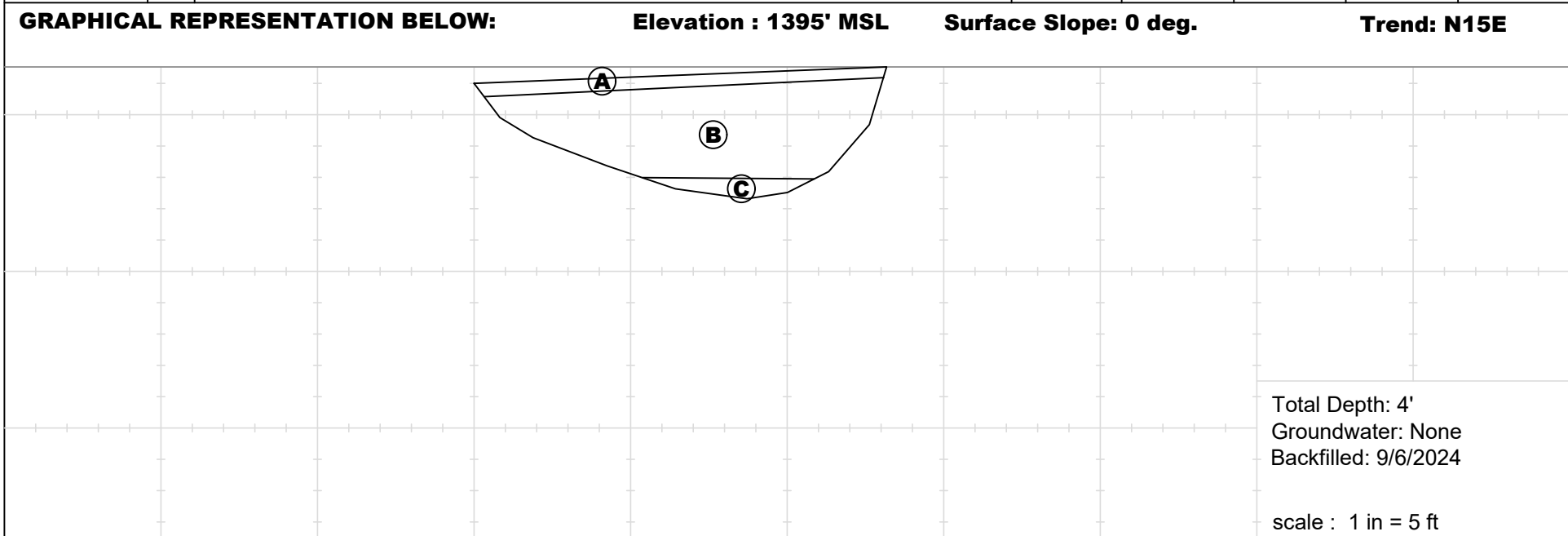
Geologic Attitudes	Unit	SOIL DESCRIPTION:	GEOLOGIC UNIT	USCS	SAMPLE No	MOISTURE (%)	DRY DENSITY (PCF)
	A	0' to 1' - Topsoil					
	B	1' to 6' - Quaternary Older Alluvium (Qoa)	Qoa	SP-SM	B-1	3.1	
	C	6' to T.D. - Granodiorite and Gabbro, Undifferentiated (Kcgb)	Kcgb				

GRAPHICAL REPRESENTATION BELOW: **Elevation : 1398' MSL** **Surface Slope: 0 deg.** **Trend: N41W**



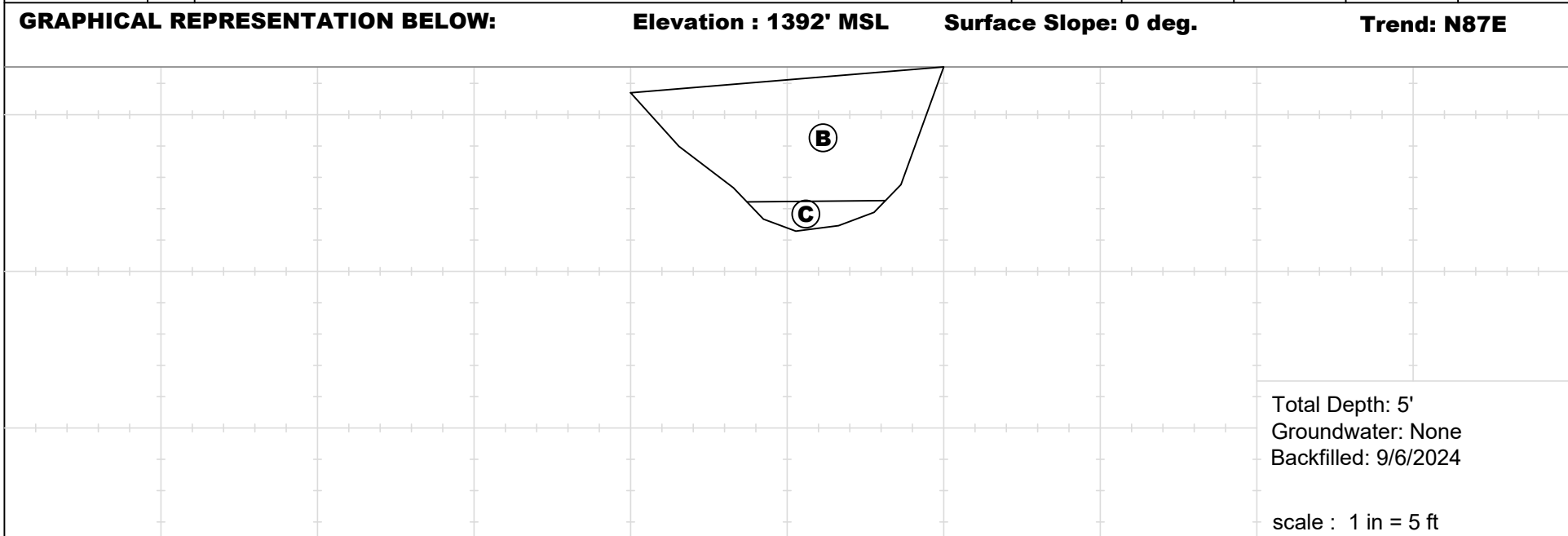
Project Name: Trumark - HG5 Riverside	Logged By: HPB	Trench No: TP-6	
Project Number : 24174-01	Date : 9/6/2024	Engineering Properties:	
Equipment: Backhoe	Location: See Geotechnical Map		

Geologic Attitudes	Unit	SOIL DESCRIPTION:	GEOLOGIC UNIT	USCS	SAMPLE No	MOISTURE (%)	DRY DENSITY (PCF)
	A	0' to 3" - Topsoil Clayey SILT with Sand: brown, dry, soft, vegetation, roots.	Qoa Kcgb	SM	B-1	3.4	
	B	3" to 3.5' - Quaternary Older Alluvium (Qoa) Silty SAND, reddish brown, dry to slightly moist, dense, fine to medium grained sand, porous, rootlets.					
	C	3.5' to T.D. - Granodiorite and Gabbro, Undifferentiated (Kcgb) Granitic rock, reddish brown, dry, very dense to hard, decomposed or weathered in upper 6".					



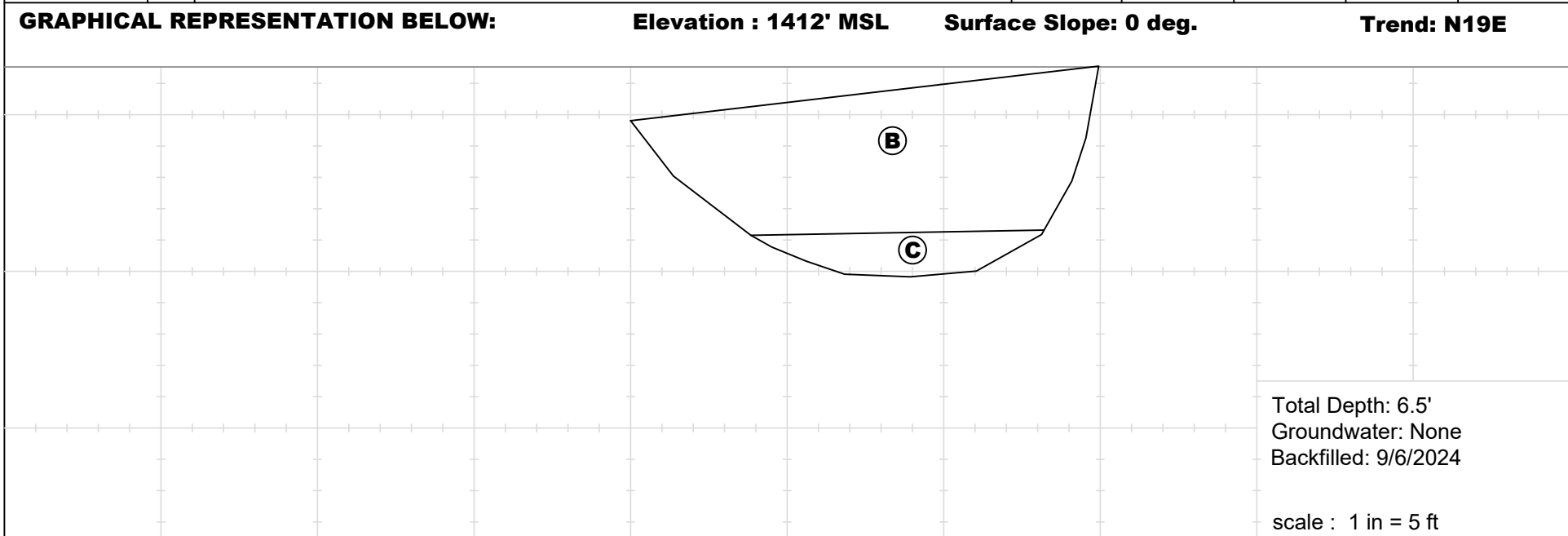
Project Name: Trumark - HG5 Riverside	Logged By: HPB	Trench No: TP-7	
Project Number : 24174-01	Date : 9/6/2024	Engineering Properties:	
Equipment: Backhoe	Location: See Geotechnical Map		

Geologic Attitudes	Unit	SOIL DESCRIPTION:	GEOLOGIC UNIT	USCS	SAMPLE No	MOISTURE (%)	DRY DENSITY (PCF)
	B	0' to 4' - Quaternary Older Alluvium (Qoa) Sandy CLAY to Sandy SILT, reddish brown to brown, dry, medium dense, fine to medium grained sand, porous, rootlets, vegetation and roots in upper 3".	Qoa	CL/ML	B-1	4.8	
	C	4' to T.D. - Granodiorite and Gabbro, Undifferentiated (Kcgb) Granitic rock, yellowish brown to brown, dry, very dense to hard, decomposed or weathered in upper 8".	Kcgb				



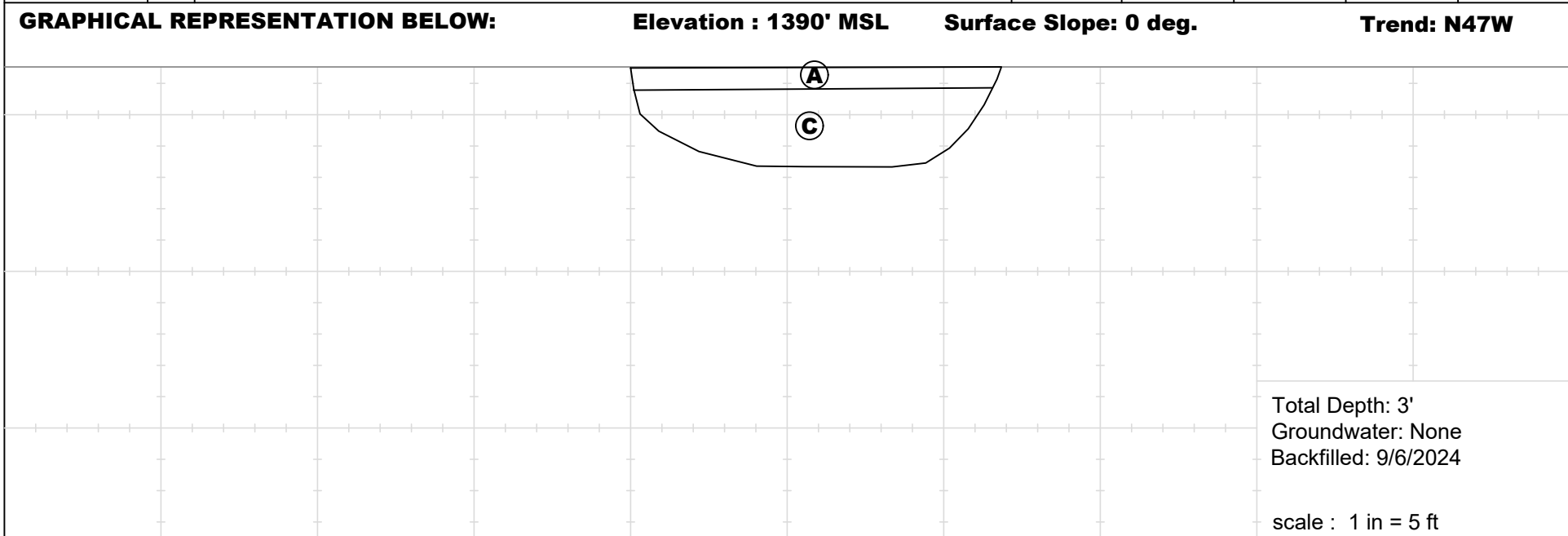
Project Name: Trumark - HG5 Riverside	Logged By: HPB	Trench No: TP-8	
Project Number : 24174-01	Date : 9/6/2024	Engineering Properties:	
Equipment: Backhoe	Location: See Geotechnical Map		

Geologic Attitudes	Unit	SOIL DESCRIPTION:	GEOLOGIC UNIT	USCS	SAMPLE No	MOISTURE (%)	DRY DENSITY (PCF)
	B	0' to 5' - <u>Quaternary Older Alluvium (Qoa)</u> Clayey Silty SAND, reddish brown to brown, dry, medium dense, fine to medium grained sand, porous, rootlets, vegetation and roots in upper 3".	Qoa	SC/SM	B-1	4.3	
	C	5' to T.D. - <u>Granodiorite and Gabbro, Undifferentiated (Kcgb)</u> Granitic rock, reddish brown to light brown, dry, very dense to hard, decomposed or weathered in upper 6".	Kcgb				



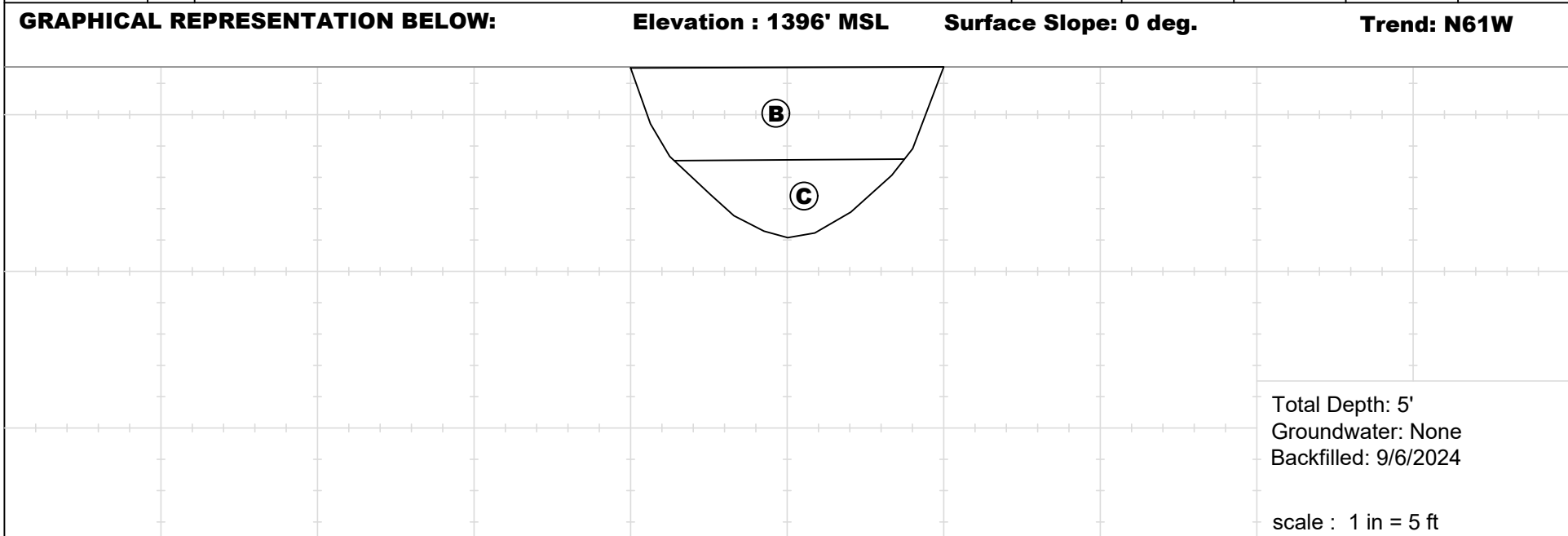
Project Name: Trumark - HG5 Riverside	Logged By: HPB	Trench No: TP-9	
Project Number : 24174-01	Date : 9/6/2024	Engineering Properties:	
Equipment: Backhoe	Location: See Geotechnical Map		

Geologic Attitudes	Unit	SOIL DESCRIPTION:	GEOLOGIC UNIT	USCS	SAMPLE No	MOISTURE (%)	DRY DENSITY (PCF)
	A	0' to 6" - <u>Topsoil</u>	Kcgb	SM	B-1	5.6	
	C	Sandy SILT, brown, dry, soft, vegetation and roots. 6" to T.D. - <u>Granodiorite and Gabbro, Undifferentiated (Kcgb)</u> Granitic rock, reddish brown to light gray, dry, dense to hard, decomposed or weathered in upper 2.5'.					



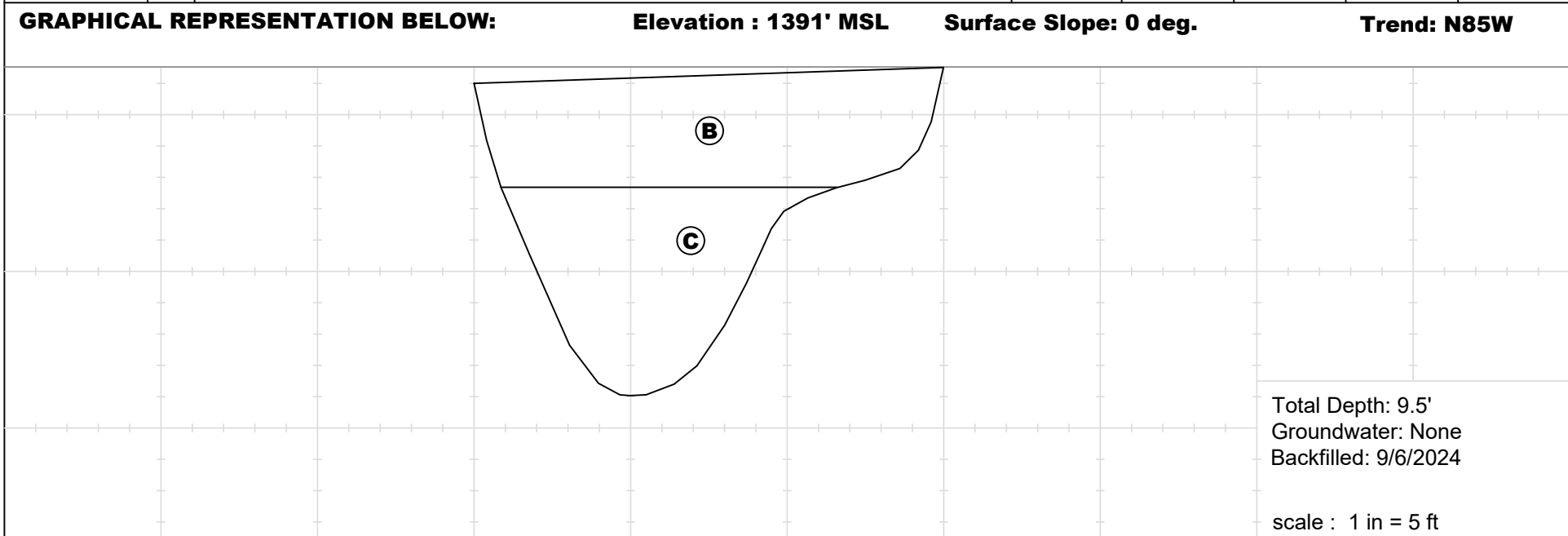
Project Name: Trumark - HG5 Riverside	Logged By: HPB	Trench No: TP-10	
Project Number : 24174-01	Date : 9/6/2024	Engineering Properties:	
Equipment: Backhoe	Location: See Geotechnical Map		

Geologic Attitudes	Unit	SOIL DESCRIPTION:	GEOLOGIC UNIT	USCS	SAMPLE No	MOISTURE (%)	DRY DENSITY (PCF)
	B	0' to 3' - Quaternary Older Alluvium (Qoa) Sandy SILT to Silty SAND, reddish brown, dry, medium dense or medium stiff, porous, rootlets.	Qoa	SM	B-1	4.8	
	C	3' to T.D. - Granodiorite and Gabbro, Undifferentiated (Kcgb) Granitic rock, yellowish brown, dry, hard, decomposed or weathered in upper 1.5'.	Kcgb				



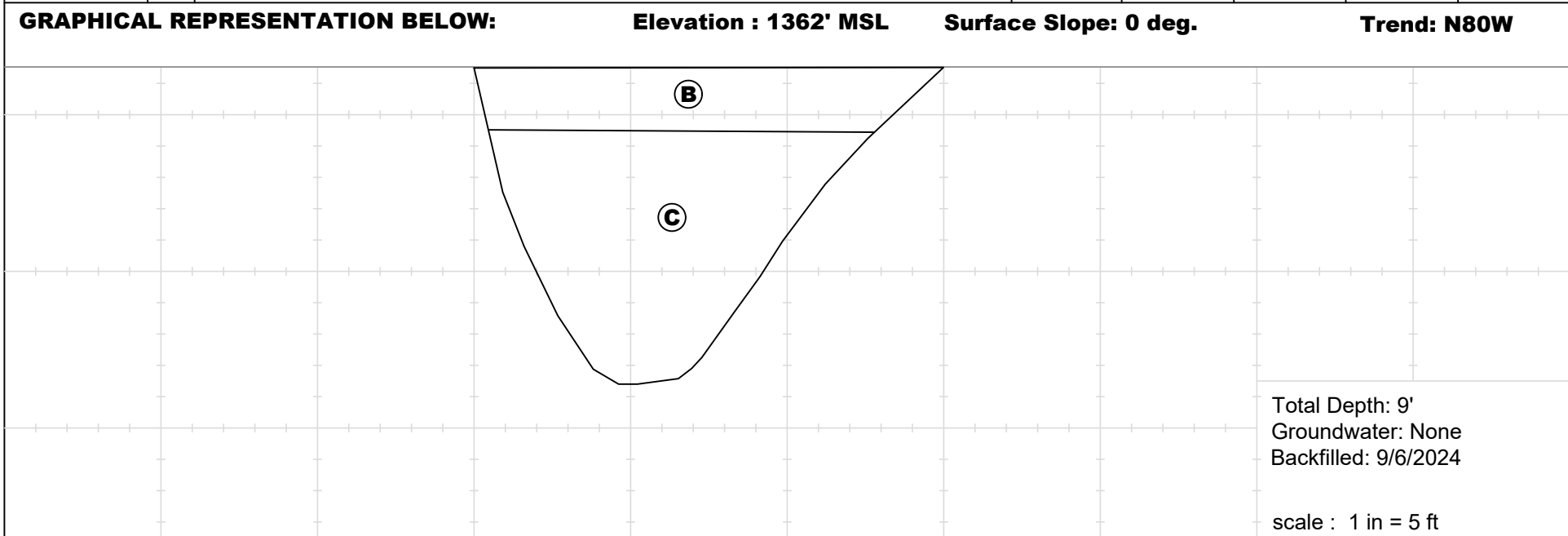
Project Name: Trumark - HG5 Riverside	Logged By: HPB	Trench No: TP-11	
Project Number : 24174-01	Date : 9/6/2024	Engineering Properties:	
Equipment: Backhoe	Location: See Geotechnical Map		

Geologic Attitudes	Unit	SOIL DESCRIPTION:	GEOLOGIC UNIT	USCS	SAMPLE No	MOISTURE (%)	DRY DENSITY (PCF)
	B	0' to 3.5' - Quaternary Older Alluvium (Qoa) Clayey SAND, reddish brown to brownish red, dry, medium stiff.	Qoa	SC	B-1	6.6	
	C	3' to T.D. - Granodiorite and Gabbro, Undifferentiated (Kcgb) Granitic rock, pale yellowish brown to light gray, dry, loose to very dense with depth, decomposed or weathered in upper 5.5'.	Kcgb	SM	B-2	2.5	



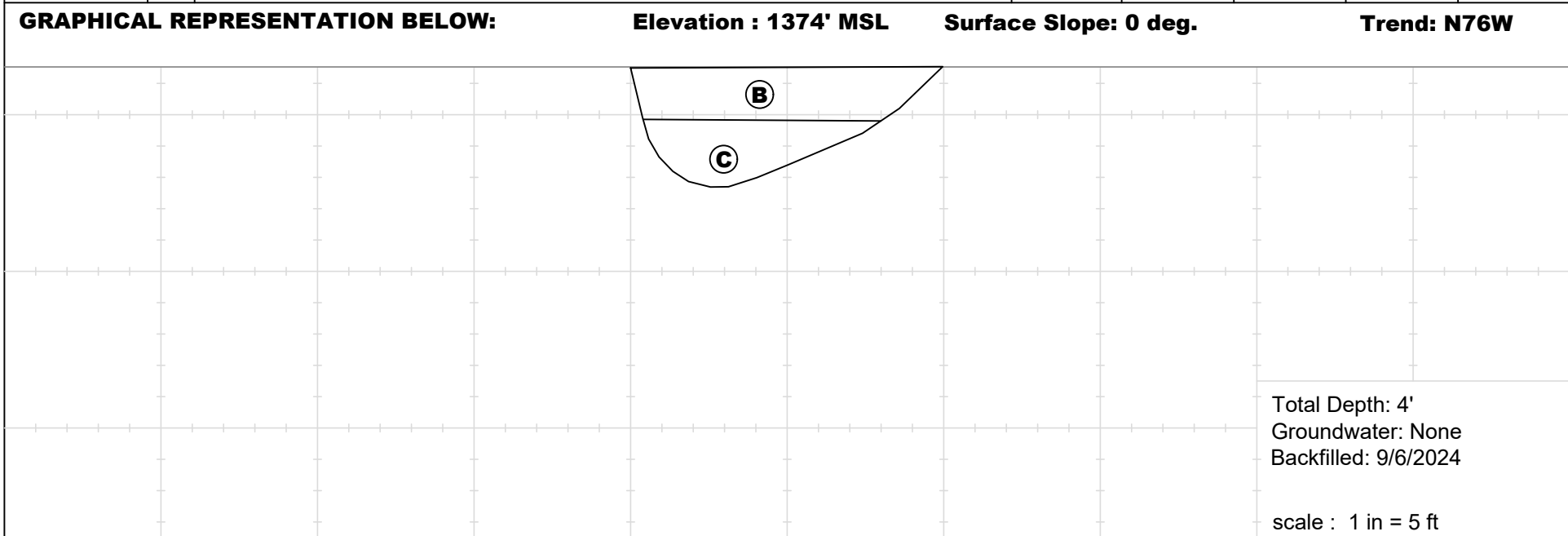
Project Name: Trumark - HG5 Riverside	Logged By: HPB	Trench No: TP-12	
Project Number : 24174-01	Date : 9/6/2024	Engineering Properties:	
Equipment: Backhoe	Location: See Geotechnical Map		

Geologic Attitudes	Unit	SOIL DESCRIPTION:	GEOLOGIC UNIT	USCS	SAMPLE No	MOISTURE (%)	DRY DENSITY (PCF)
	B	0' to 2' - Quaternary Older Alluvium (Qoa) Sandy SILT, brownish red, dry, soft to medium stiff, roots and vegetation in upper 1'.	Qoa				
	C	2' to T.D. - Granodiorite and Gabbro, Undifferentiated (Kcgb) Granitic rock, reddish brown to grayish brown, dry then moist at 5', medium dense to hard, decomposed or weathered in upper 6.5'.	Kcgb	SM	B-1	3.9	



Project Name: Trumark - HG5 Riverside	Logged By: HPB	Trench No: TP-13	
Project Number : 24174-01	Date : 9/6/2024	Engineering Properties:	
Equipment: Backhoe	Location: See Geotechnical Map		

Geologic Attitudes	Unit	SOIL DESCRIPTION:	GEOLOGIC UNIT	USCS	SAMPLE No	MOISTURE (%)	DRY DENSITY (PCF)
	B	0' to 1.5' - Quaternary Older Alluvium (Qoa) Sandy SILT to Silty SAND, brownish red, dry, soft or loose, roots and vegetation in upper 6".	Qoa	SM	B-1	4.3	
	C	1.5' to T.D. - Granodiorite and Gabbro, Undifferentiated (Kcgb) Granitic rock, reddish brown, dry, hard, decomposed or weathered in upper 6".	Kcgb				



Date Excavated 8/28/2015

Test Pit No.	Depth (ft.)	USCS	Description
EX-9	0.0 – 2.0	SM	<u>Artificial Fill - undocumented:</u> SILTY SAND; brown, moist, loose, fine to coarse grained.
	2.0 – 20.0		<u>Granodiorite/Gabbro undifferentiated (Kcgb):</u> Red, dry, soft, fine to medium grained, highly weathered to clayey sand, abundant secondary clays. @ 4 ft. brownish gray, moderately soft, breaks into clayey sand. @ 6 ft. breaks into fine to coarse grained sand, some silt and clay. @ 7 ft. Some ½ inch thick pegmatite dikes. @ 11 ft. gray, large crystal size/coarse grained. @ 15 ft. moderately hard. @ 16 ft. light gray, breaks into fine to coarse grained sand, (SE 30+) @ 20 ft. still rippable. TOTAL DEPTH 20 FT. NO WATER, NO CAVING



Test

Pit No.	Depth (ft.)	USCS	Description
EX-10	0.0 – 2.0	SM	<u>Artificial Fill - undocumented:</u> SILTY SAND; reddish brown and brown, slightly moist, loose, fine to coarse grained.
	2.0 – 20.5		<u>Granodiorite/Gabbro undifferentiated (Kcgb):</u> Yellowish brown and gray, dry, moderately hard, coarse grained, moderately weathered, breaks into fine to coarse grained sand with some silt and clay. Steeply dipping clay-lined joints, approximately 8-inch spacing. @ 7 ft. N32E, 82SE - Joint @ 7 ft. N33W, 85N - Joint @ 10 ft. moderately hard. @ 16 ft. gray with trace of iron oxide, moderately hard to hard. @ 19 ft. bluish gray, hard, very slow digging. @ 20.5 ft. still rippable. TOTAL DEPTH 20.5 FT. NO WATER, NO CAVING



Test

Pit No.	Depth (ft.)	USCS	Description
EX-11	0.0 – 1.0	SM	<u>Topsoil:</u> SILTY SAND; reddish brown, dry, loose, fine to coarse grained, some angular granitic gravel.
	1.0 – 20.0		<u>Granodiorite/Gabbro undifferentiated (Kcgb):</u> Red, dry, soft, fine to medium grained, highly weathered, densely fractured, abundant secondary clays. @ 2.5 ft. gray to dark gray (Gabbro), hard, some flat-lying to shallowly dipping fine fractures with iron oxide. @ 5 ft. N20W, 55NE – parallel joints. @ 18 ft. very slow digging. @ 20 ft. still rippable. TOTAL DEPTH 20 FT. NO WATER, NO CAVING



Test			
Pit No.	Depth (ft.)	USCS	Description
EX-14	0.0 – 16.5		<u>Granodiorite/Gabbro - undifferentiated (Kcgb):</u> Brownish red, slightly moist, moderately soft, fine to coarse grained, highly to moderately weathered. @4 ft. light yellowish brown, moderately hard, breaks-up to fine to coarse grained sand. @ 5 ft. gray, hard, slow digging. @ 6 ft. N60E, Vertical - Joint @ 6 ft. N40W, 80NE - Joint @ 12 ft. gray, very slow digging. @ 16.5 ft. Practical Refusal. TOTAL DEPTH 16.5 FT NO WATER, NO CAVING

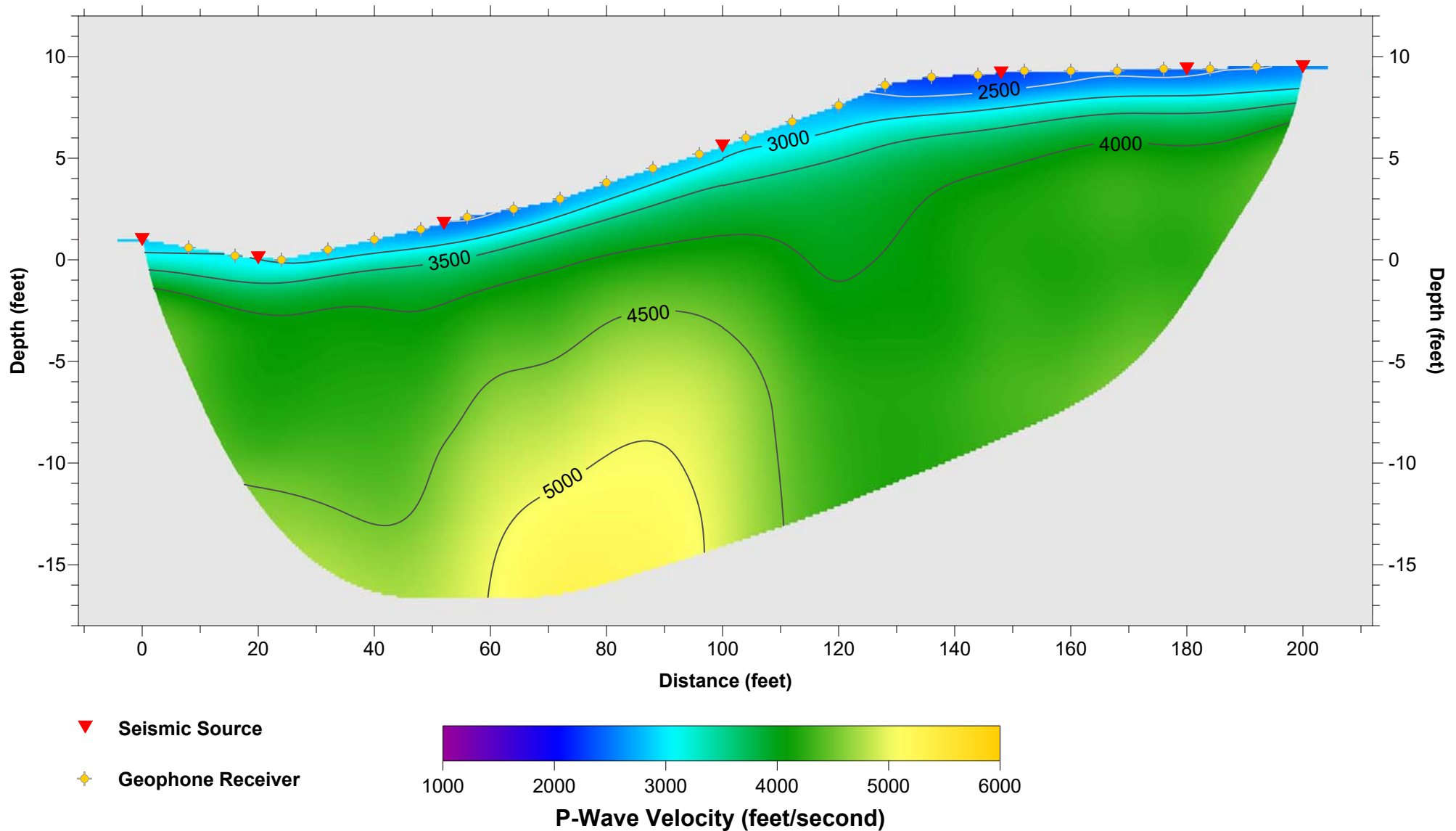




SEISMIC LINE S-1

South 64° East →

REFRACTION TOMOGRAPHIC MODEL



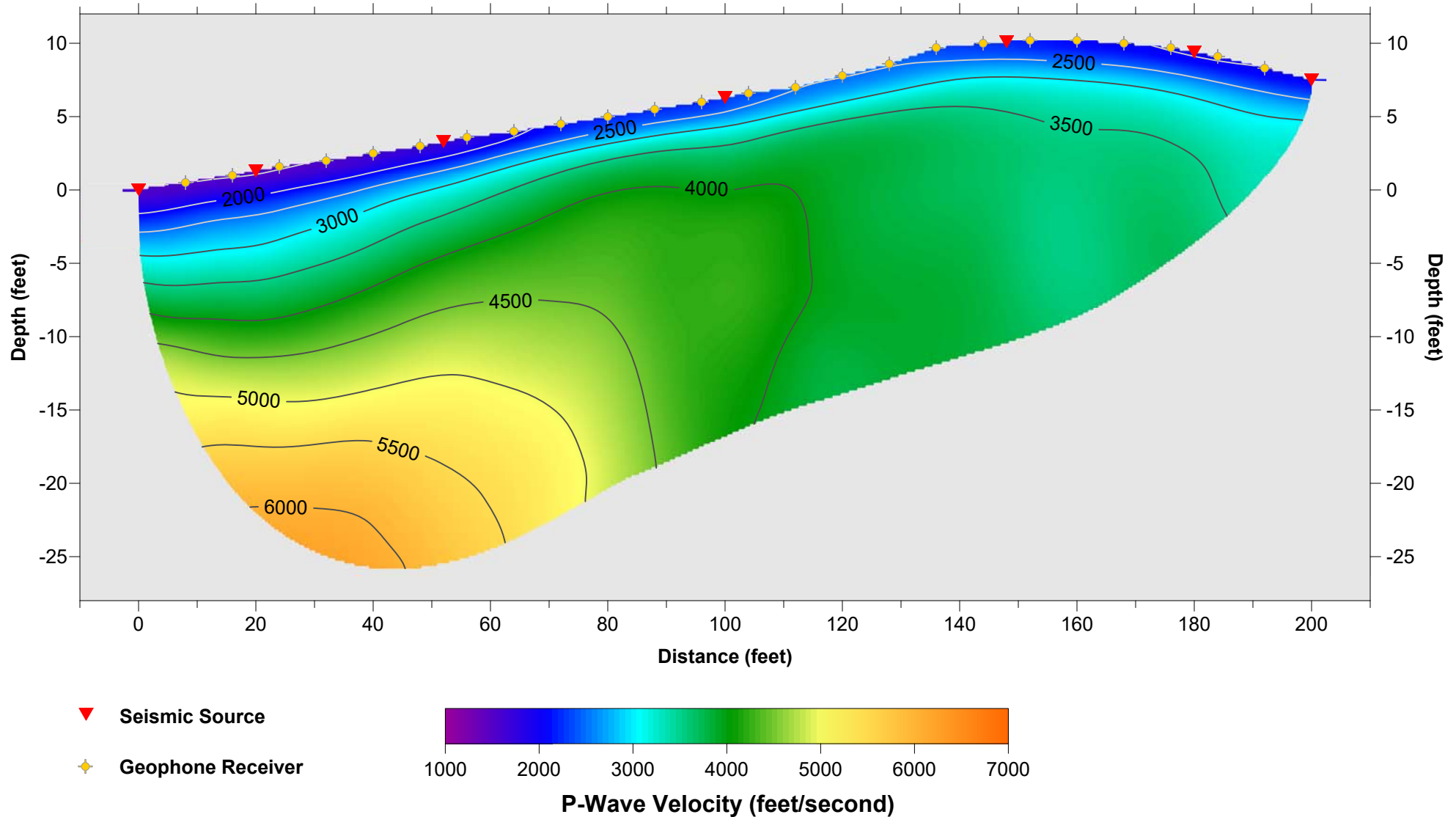
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RMS error 2.4; Rayfract Version 4.06

SEISMIC LINE S-2

North 5° East →

REFRACTION TOMOGRAPHIC MODEL



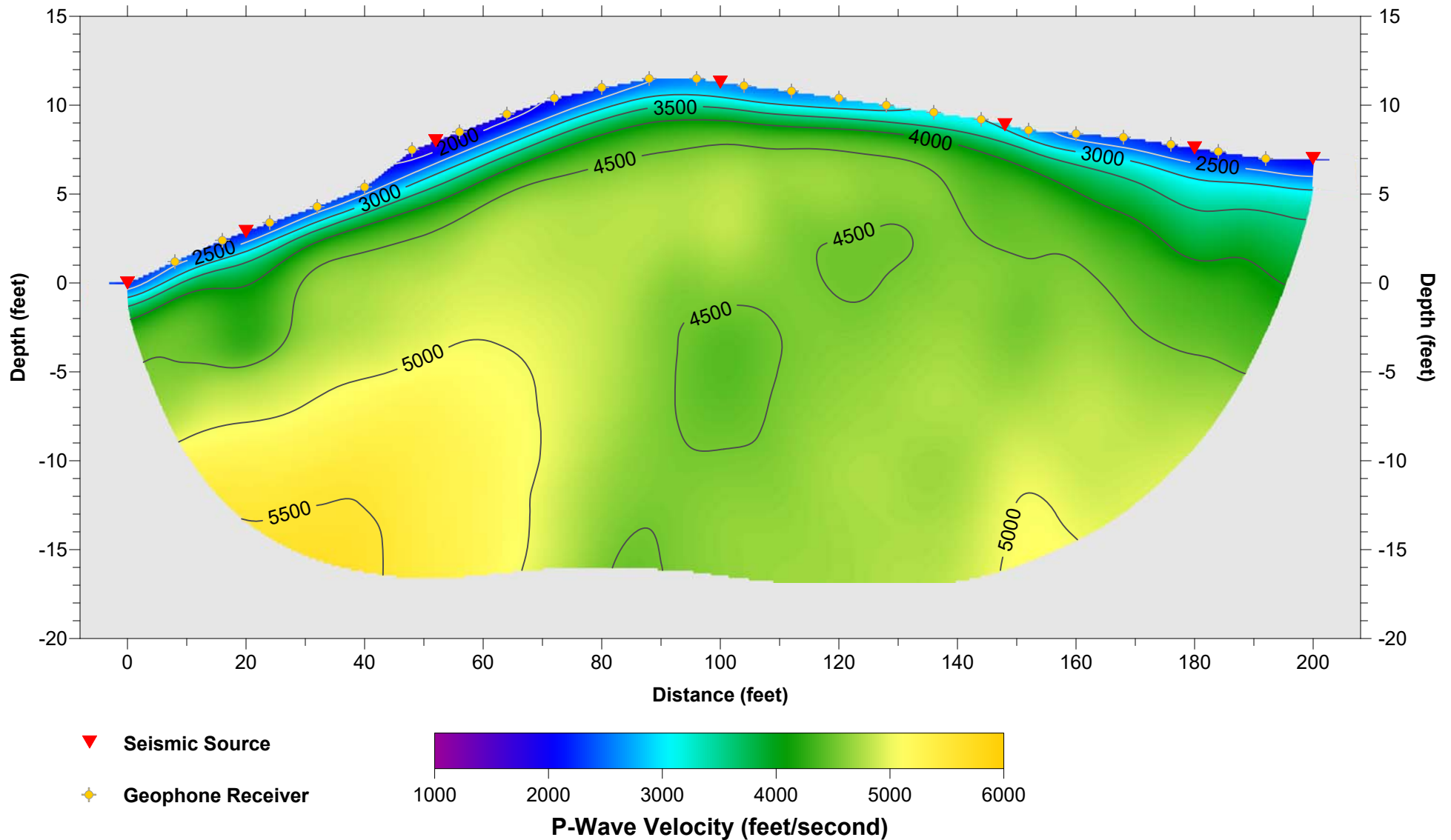
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RMS error 1.8; Rayfract Version 4.06

SEISMIC LINE S-3

North 5° East →

REFRACTION TOMOGRAPHIC MODEL



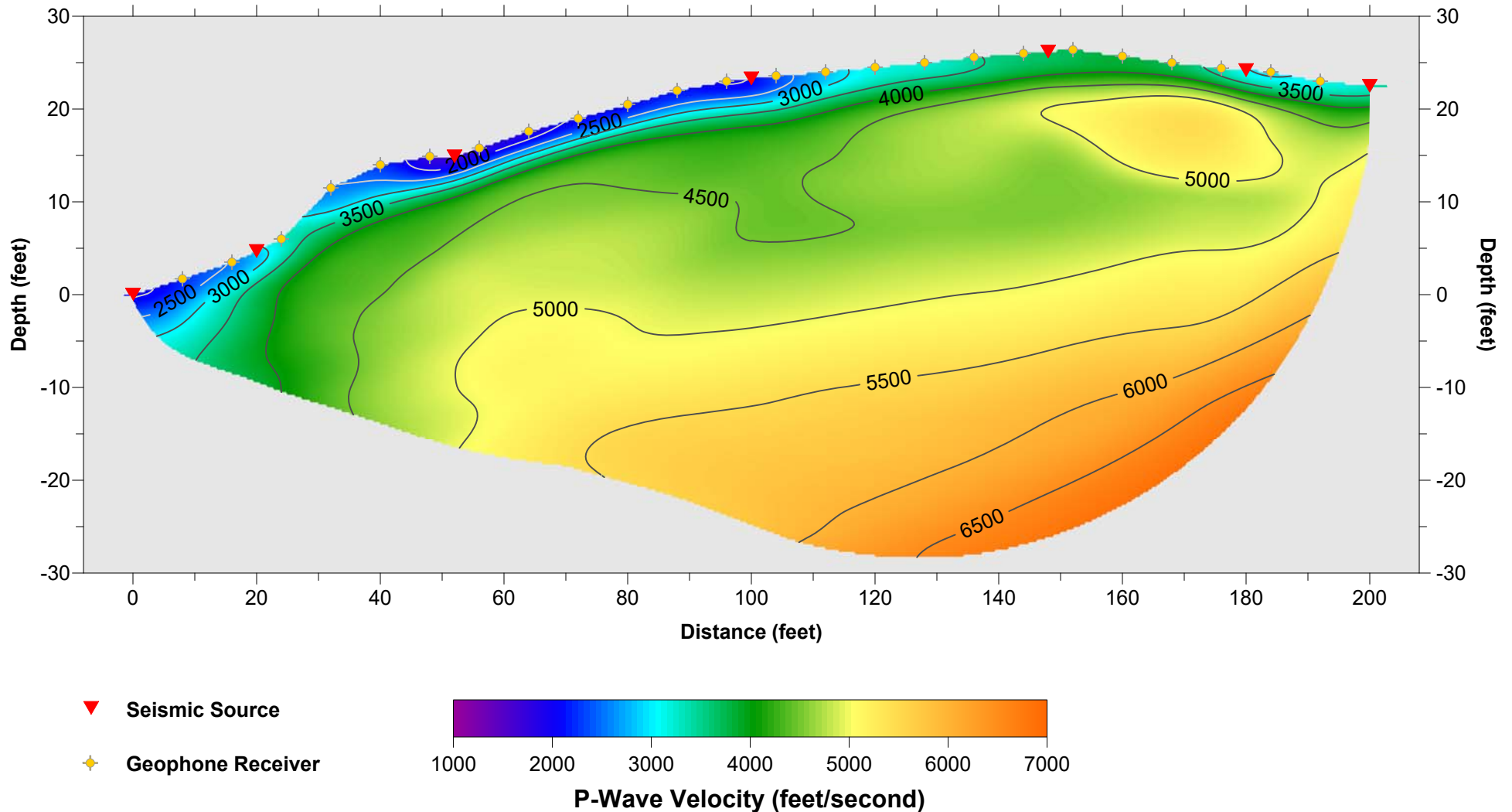
SCALE: Vertical Exaggeration 3X

RMS error 1.5; Rayfract Version 4.06

SEISMIC LINE S-4

North 2° East →

REFRACTION TOMOGRAPHIC MODEL



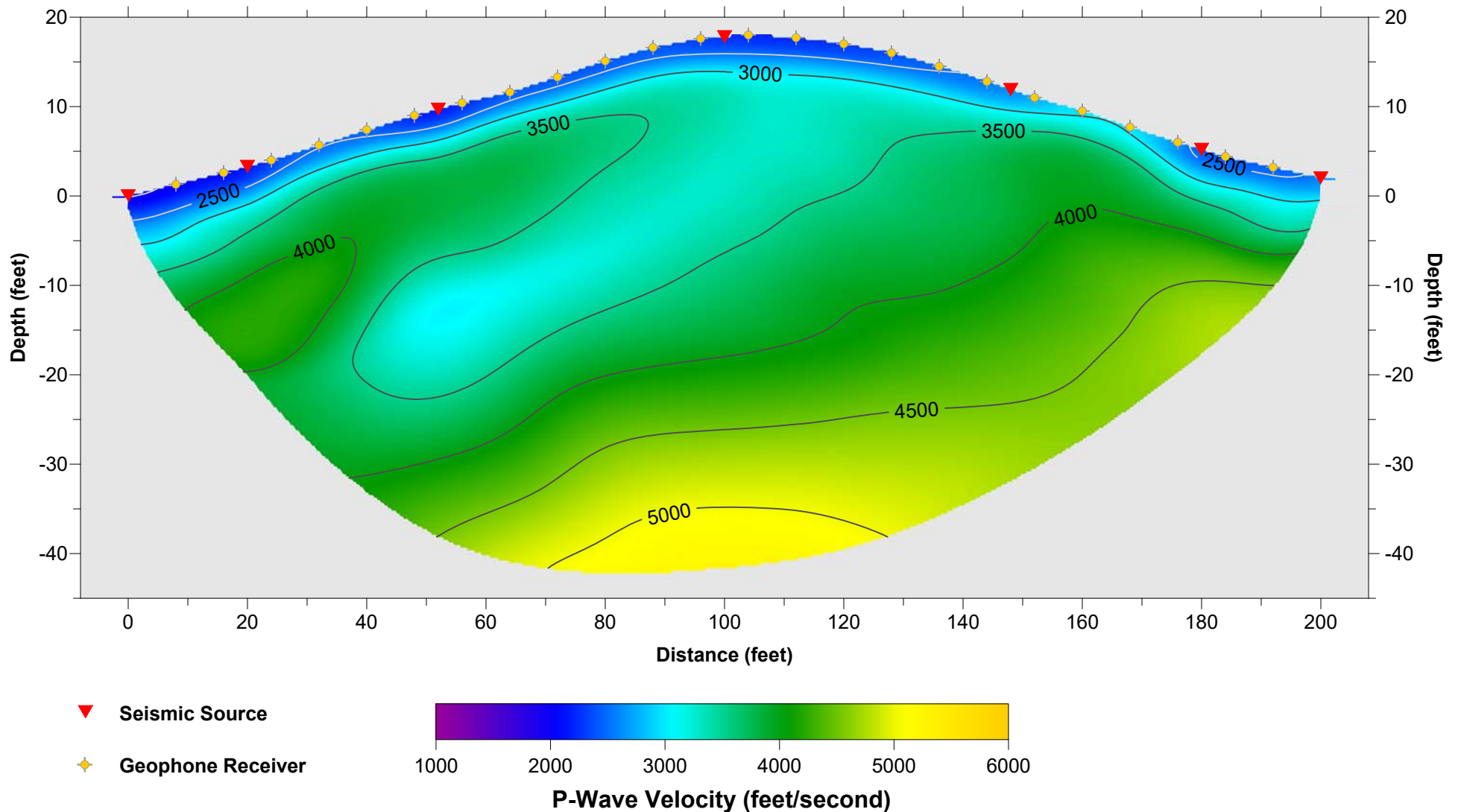
SCALE: Vertical Exaggeration 1.5X

RMS error 1.4; Rayfract Version 4.06

SEISMIC LINE S-5

South 87° East →

REFRACTION TOMOGRAPHIC MODEL



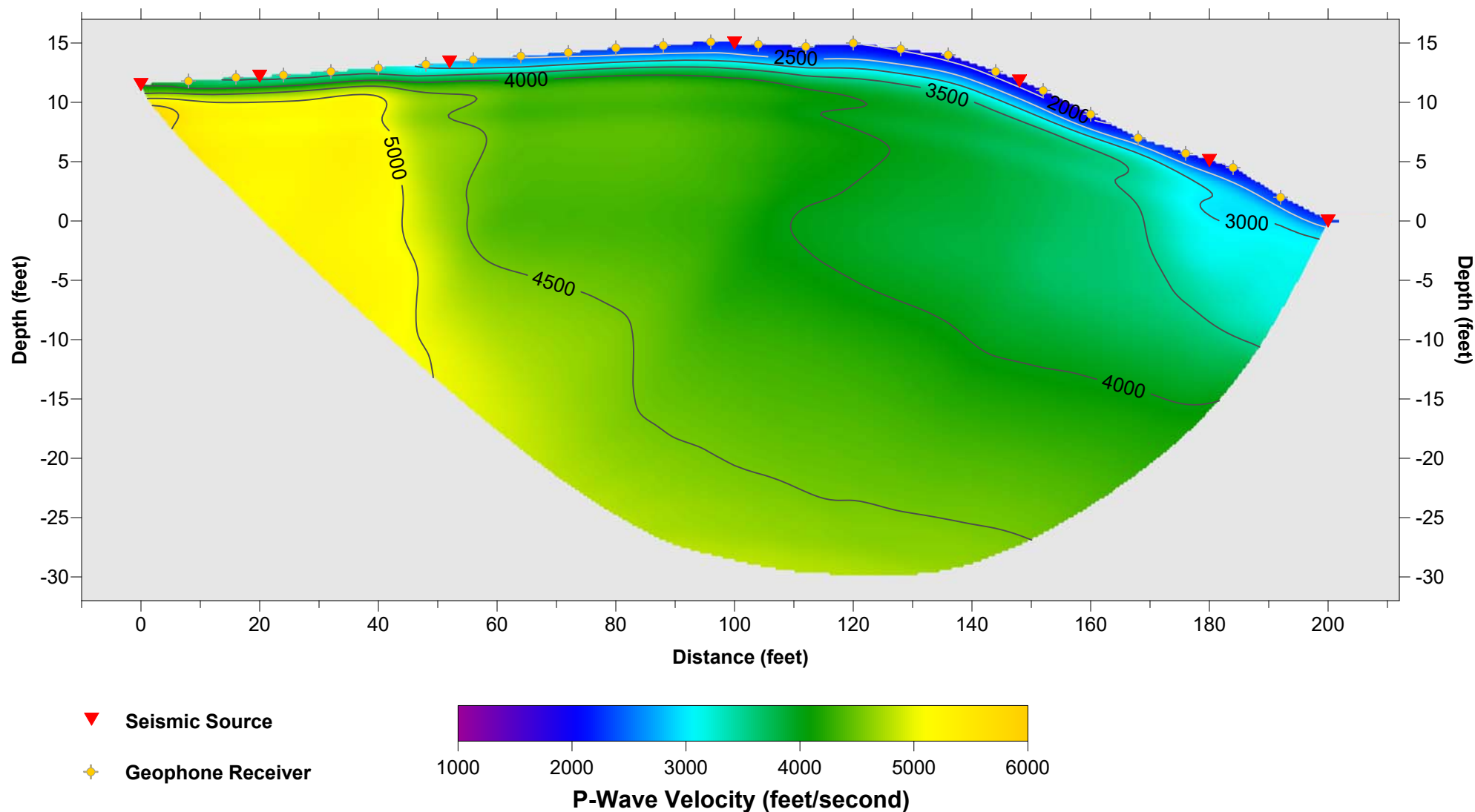
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RMS error 1.9; Rayfract Version 4.06

SEISMIC LINE S-6

North 60° East →

REFRACTION TOMOGRAPHIC MODEL



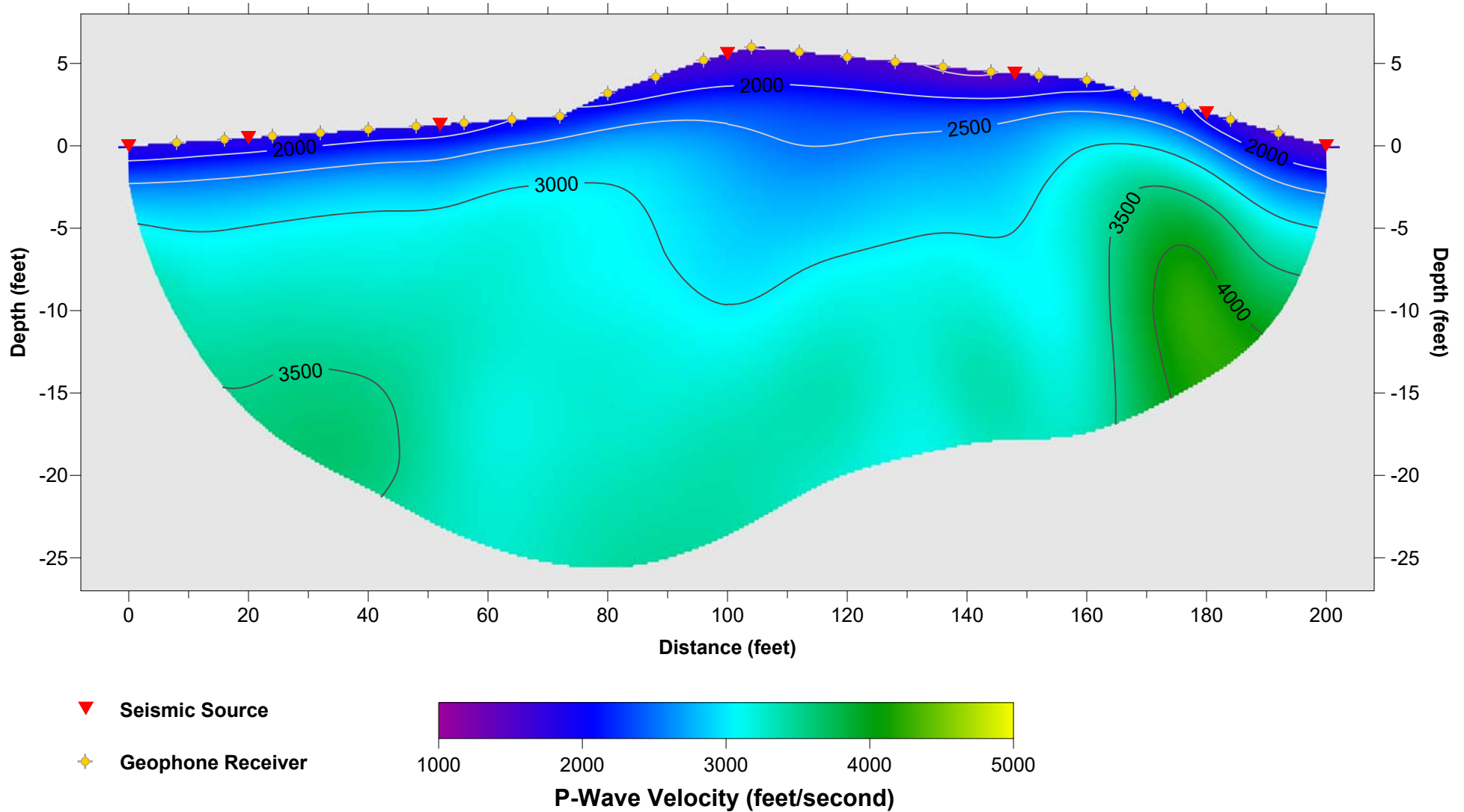
SCALE: Vertical Exaggeration 2X

RMS error 2.8; Rayfract Version 4.06

SEISMIC LINE S-7

South 63° East →

REFRACTION TOMOGRAPHIC MODEL



SCALE: Vertical Exaggeration 2.75X

RMS error 1.8; Rayfract Version 4.06

Appendix C
Laboratory Test Results

APPENDIX C

Laboratory Testing Procedures and Test Results

The laboratory testing program was formulated towards providing data relating to the relevant engineering properties of the soils with respect to residential construction. Samples considered representative of site conditions were tested in general accordance with American Society for Testing and Materials (ASTM) procedure and/or California Test Methods (CTM), where applicable. The following summary is a brief outline of the test type and a table summarizing the test results.

Moisture Determination Tests: Moisture content (ASTM D2216) was performed on relatively undisturbed samples obtained from the trenches. The results of these tests are presented in the test pit logs (Appendix B). Where applicable, only moisture content was determined from undisturbed or disturbed samples.

Maximum Density Tests: The maximum dry density and optimum moisture content of typical materials were determined in accordance with ASTM D1557. The results of these tests are presented in the table below:

Sample Location	Sample Description	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
TP-2 @ 1-3 feet	Orangish Brown Sand with Silt	130.5	9.5
TP-10 @ 0-5 feet	Light Brown Silty Sand	132.5	9.0

Grain Size Distribution: Representative samples were dried, weighed, and soaked in water until individual soil particles were separated (per ASTM D421) and then washed on a No. 200 sieve. The portion retained on the No. 200 sieve was dried and then sieved on a U.S. Standard brass sieve set in accordance with ASTM D422 (CTM 202). Where an appreciable amount of fines were encountered (greater than 20 percent passing the No. 200 sieve) a hydrometer analysis was done to determine the distribution of soil particles passing the No. 200 sieve.

Sample Location	Description	% Passing # 200 Sieve
TP-2 @ 1-3 feet	Sand with Silt	8
TP-4 @ 0-4.5 feet	Clayey Sand	22
TP-10 @ 0-5 feet	Silty Sand	27
TP-11 @ 0-3.5 feet	Clayey Sand	48

APPENDIX C (Cont'd)

Laboratory Testing Procedures and Test Results

Expansion Index: The expansion potential of selected samples was evaluated by the Expansion Index Test, Standard ASTM D4829. Specimens are molded under a set compactive effort to approximately the optimum moisture content and approximately 50 percent saturation or approximately 90 percent relative compaction. The prepared 1-inch-thick by 4-inch-diameter specimens are loaded to an equivalent 144 psf surcharge and are inundated with tap water until volumetric equilibrium is reached. The results of these tests are presented in the table below.

Sample Location	Expansion Index	Expansion Potential*
TP-4 @ 0-4.5 feet	1	Very Low
TP-10 @ 0-5 feet	13	Very Low
TP-11 @ 0-3.5 feet	19	Very Low

Direct Shear: Two direct shear tests were performed on a selected remolded sample, which was soaked for a minimum of 24 hours under a surcharge equal to the applied normal force during testing. After transfer of the sample to the shear box, and reloading the sample, pore pressures set up in the sample due to the transfer were allowed to dissipate for a period of approximately 1 hour prior to application of shearing force. The samples were tested under various normal loads, a motor-driven, strain-controlled, direct-shear testing apparatus at a strain rate of less than 0.05 inch per minute (for sandy soil). The results of this test are presented in this Appendix.

Chloride Content: Chloride content was tested in accordance with Caltrans Test Method (CTM) 422. The results are presented below.

Sample Location	Chloride Content, ppm
TP-4 @ 0-4.5 feet	60
TP-10 @ 0-5 feet	120

Soluble Sulfates: The soluble sulfate contents of selected samples were determined by standard geochemical methods (CTM 417). The soluble sulfate content is used to determine the appropriate cement type and maximum water-cement ratios. The test results are presented in the table below.

Sample Location	Sulfate Content (ppm)	Sulfate Exposure Class *
TP-4 @ 0-4.5 feet	95	S0
TP-10 @ 0-5 feet	29	S0

*Based on ACI 318R-14, Table 19.3.1.1

APPENDIX C (Cont'd)

Laboratory Testing Procedures and Test Results

Minimum Resistivity and pH Tests: Minimum resistivity and pH tests were performed in general accordance with CTM 643 and standard geochemical methods. The results are presented in the table below.

Sample Location	pH	Minimum Resistivity (ohms-cm)
TP-4 @ 0-4.5 feet	8.44	1,800
TP-10 @ 0-5 feet	8.29	2,900

R-value Test: R-value test was performed in general accordance with California Test Method 301. The plot is attached.

Sample No.	R-Value
TP-11 @ 0-3.5 feet	40

DIRECT SHEAR TEST

Consolidated Drained - ASTM D 3080

Project Name: [HG5 Riverside](#)

Project No.: [24174-01](#)

Boring No.: [TP-2](#)

Sample No.: [B-1](#)

Soil Identification: [Orangish brown silty sand \(SM\)](#)

Tested By: [G. Bathala](#)

Checked By: [J. Ward](#)

Sample Type: [90% Remold](#)

Depth (ft.): [N/A](#)

Date: [09/12/24](#)

Date: [09/17/24](#)

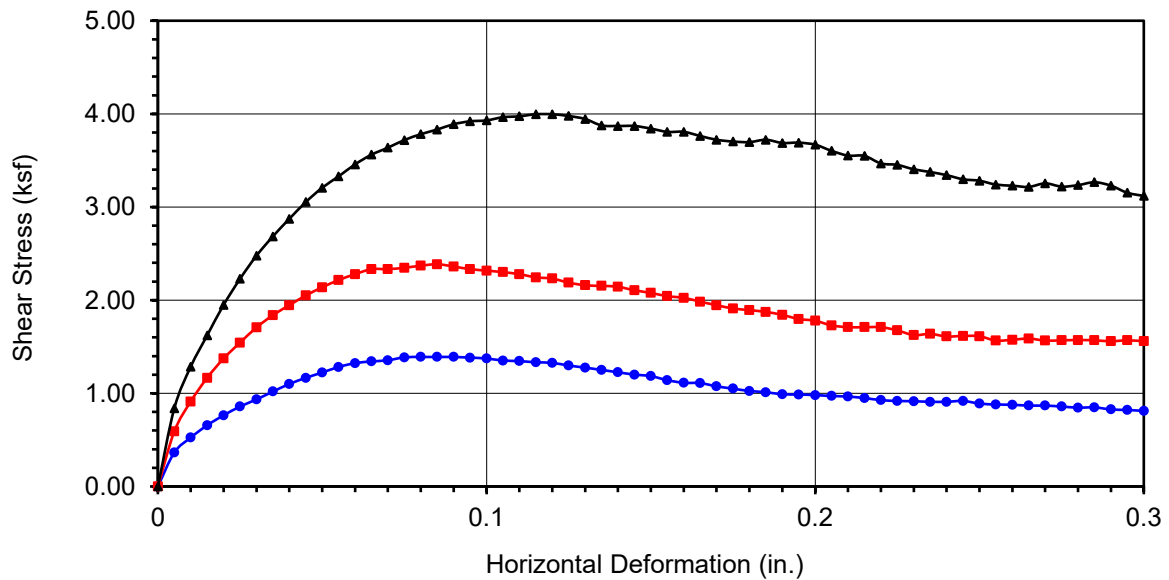
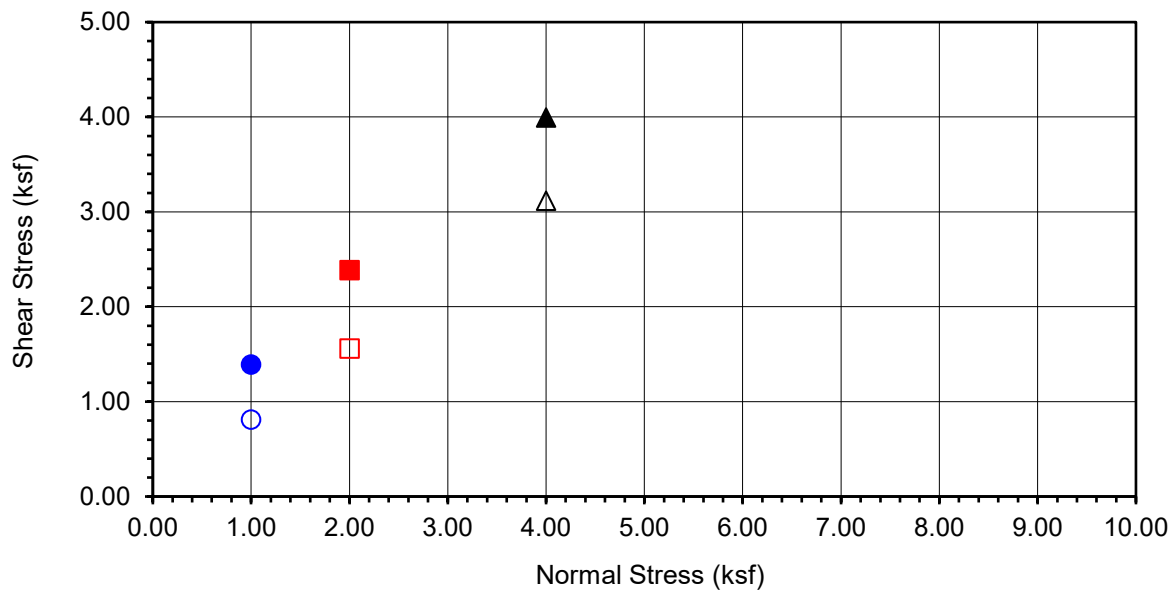
Sample Diameter(in):	2.415	2.415	2.415
Sample Thickness(in.):	1.000	1.000	1.000
Weight of Sample + ring(gm):	200.22	197.47	199.65
Weight of Ring(gm):	45.21	42.40	44.32

Before Shearing

Weight of Wet Sample+Cont.(gm):	177.00	177.00	177.00
Weight of Dry Sample+Cont.(gm):	165.27	165.27	165.27
Weight of Container(gm):	39.00	39.00	39.00
Vertical Rdg.(in): Initial	0.0000	0.2618	0.2519
Vertical Rdg.(in): Final	-0.0102	0.2755	0.2754

After Shearing

Weight of Wet Sample+Cont.(gm):	226.62	215.42	221.94
Weight of Dry Sample+Cont.(gm):	207.19	196.27	203.37
Weight of Container(gm):	68.90	57.87	64.65
Specific Gravity (Assumed):	2.70	2.70	2.70
Water Density(pcf):	62.43	62.43	62.43



Boring No.	TP-2
Sample No.	B-1
Depth (ft)	N/A
<u>Sample Type:</u>	
90% Remold	
<u>Soil Identification:</u>	
Orangish brown silty sand (SM)	

Normal Stress (kip/ft ²)	1.000	2.000	4.000
Peak Shear Stress (kip/ft ²)	● 1.390	■ 2.386	▲ 3.996
Shear Stress @ End of Test (ksf)	○ 0.811	□ 1.559	△ 3.119
Deformation Rate (in./min.)	0.0033	0.0033	0.0033
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	9.29	9.29	9.29
Dry Density (pcf)	118.0	118.0	118.2
Saturation (%)	58.5	58.5	58.9
Soil Height Before Shearing (in.)	0.9898	0.9863	0.9765
Final Moisture Content (%)	14.1	13.8	13.4

DIRECT SHEAR TEST RESULTS
Consolidated Drained - ASTM D 3080

Project No.: 24174-01

HG5 Riverside

09-24

DIRECT SHEAR TEST

Consolidated Drained - ASTM D 3080

Project Name: [HG5 Riverside](#)

Project No.: [24174-01](#)

Boring No.: [TP-10](#)

Sample No.: [B-1](#)

Soil Identification: [Light brown silty sand \(SM\)](#)

Tested By: [G. Bathala](#)

Checked By: [J. Ward](#)

Sample Type: [90% Remold](#)

Depth (ft.): [N/A](#)

Date: [09/12/24](#)

Date: [09/17/24](#)

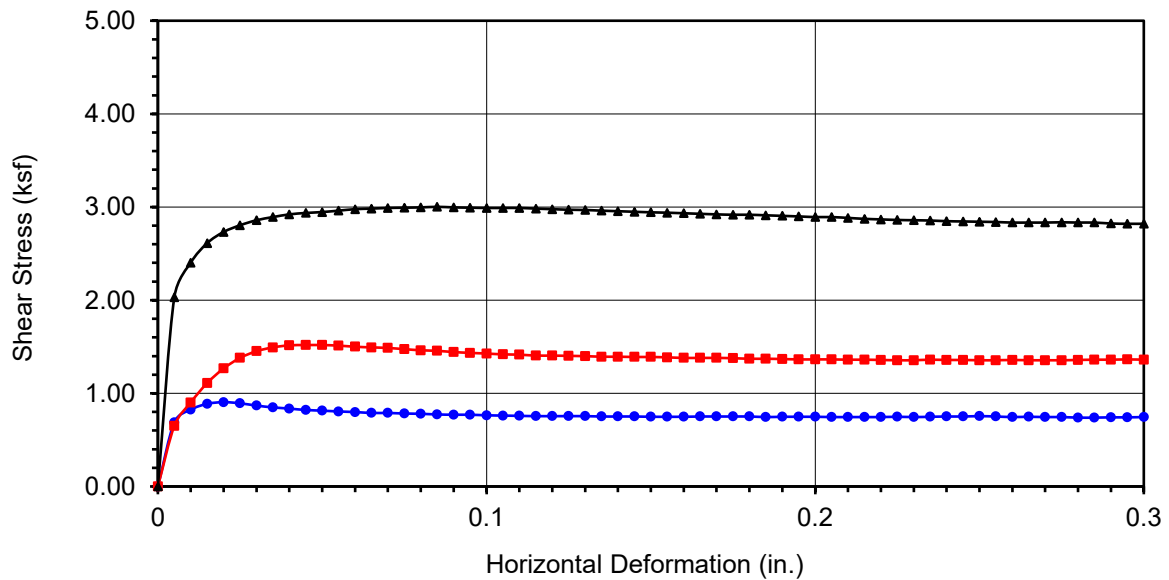
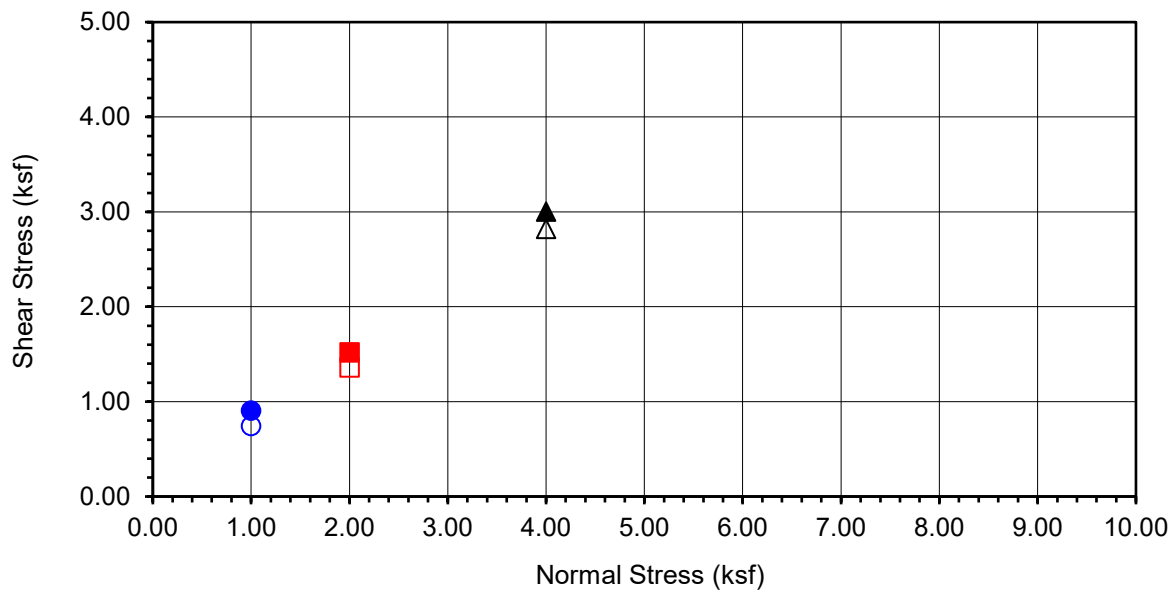
Sample Diameter(in):	2.415	2.415	2.415
Sample Thickness(in.):	1.000	1.000	1.000
Weight of Sample + ring(gm):	199.22	201.18	202.12
Weight of Ring(gm):	42.39	44.30	45.20

Before Shearing

Weight of Wet Sample+Cont.(gm):	172.58	172.58	172.58
Weight of Dry Sample+Cont.(gm):	163.29	163.29	163.29
Weight of Container(gm):	60.37	60.37	60.37
Vertical Rdg.(in): Initial	0.0000	0.2774	0.2590
Vertical Rdg.(in): Final	-0.0084	0.2891	0.2733

After Shearing

Weight of Wet Sample+Cont.(gm):	203.80	228.05	230.18
Weight of Dry Sample+Cont.(gm):	182.07	206.50	209.39
Weight of Container(gm):	40.03	64.79	67.12
Specific Gravity (Assumed):	2.70	2.70	2.70
Water Density(pcf):	62.43	62.43	62.43



Boring No.	TP-10
Sample No.	B-1
Depth (ft)	N/A
<u>Sample Type:</u>	
90% Remold	
<u>Soil Identification:</u>	
Light brown silty sand (SM)	

Normal Stress (kip/ft ²)	1.000	2.000	4.000
Peak Shear Stress (kip/ft ²)	● 0.905	■ 1.518	▲ 3.002
Shear Stress @ End of Test (ksf)	○ 0.745	□ 1.361	△ 2.820
Deformation Rate (in./min.)	0.0025	0.0025	0.0025
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	9.03	9.03	9.03
Dry Density (pcf)	119.6	119.7	119.7
Saturation (%)	59.6	59.7	59.7
Soil Height Before Shearing (in.)	0.9916	0.9883	0.9857
Final Moisture Content (%)	15.3	15.2	14.6

DIRECT SHEAR TEST RESULTS
Consolidated Drained - ASTM D 3080

Project No.: 24174-01

HG5 Riverside

09-24

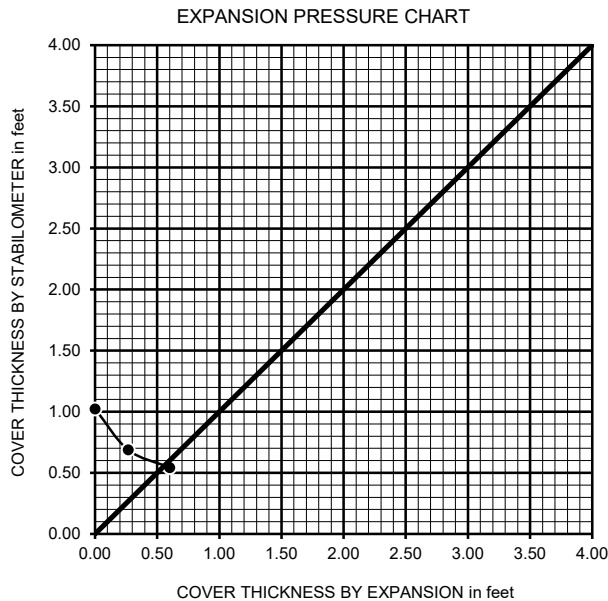
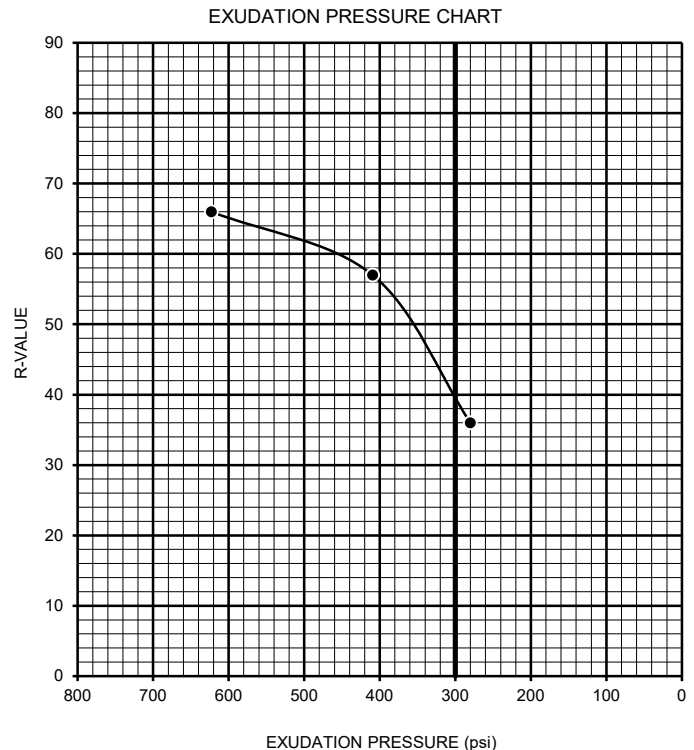
R-VALUE TEST RESULTS

DOT CA Test 301

PROJECT NAME:	HG5 Riverside	PROJECT NUMBER:	24174-01
BORING NUMBER:	TP-11	DEPTH (FT.):	N/A
SAMPLE NUMBER:	B-1	TECHNICIAN:	O. Figueroa
SAMPLE DESCRIPTION:	Reddish brown silty, clayey sand (SC-SM)	DATE COMPLETED:	09/12/24

TEST SPECIMEN	a	b	c
MOISTURE AT COMPACTION %	9.5	10.2	11.3
HEIGHT OF SAMPLE, Inches	2.40	2.47	2.55
DRY DENSITY, pcf	130.7	129.4	128.1
COMPACTOR PRESSURE, psi	250	150	70
EXUDATION PRESSURE, psi	623	410	280
EXPANSION, Inches x 10 ^{exp-4}	18	8	0
STABILITY Ph 2,000 lbs (160 psi)	34	45	76
TURNS DISPLACEMENT	4.45	4.80	4.95
R-VALUE UNCORRECTED	68	57	36
R-VALUE CORRECTED	66	57	36

DESIGN CALCULATION DATA	a	b	c
GRAVEL EQUIVALENT FACTOR	1.0	1.0	1.0
TRAFFIC INDEX	5.0	5.0	5.0
STABILOMETER THICKNESS, ft.	0.54	0.69	1.02
EXPANSION PRESSURE THICKNESS, ft.	0.60	0.27	0.00



R-VALUE BY EXPANSION:	66
R-VALUE BY EXUDATION:	40
EQUILIBRIUM R-VALUE:	40

Appendix D
General Earthwork and Grading Specifications
for Rough Grading

General Earthwork and Grading Specifications for Rough Grading

1.0 General

1.1 Intent

These General Earthwork and Grading Specifications are for the grading and earthwork shown on the approved grading plan(s) and/or indicated in the geotechnical report(s). These Specifications are a part of the recommendations contained in the geotechnical report(s). In case of conflict, the specific recommendations in the geotechnical report shall supersede these more general Specifications. Observations of the earthwork by the project Geotechnical Consultant during the course of grading may result in new or revised recommendations that could supersede these specifications or the recommendations in the geotechnical report(s).

1.2 The Geotechnical Consultant of Record

Prior to commencement of work, the owner shall employ a qualified Geotechnical Consultant of Record (Geotechnical Consultant). The Geotechnical Consultant shall be responsible for reviewing the approved geotechnical report(s) and accepting the adequacy of the preliminary geotechnical findings, conclusions, and recommendations prior to the commencement of the grading.

Prior to commencement of grading, the Geotechnical Consultant shall review the "work plan" prepared by the Earthwork Contractor (Contractor) and schedule sufficient personnel to perform the appropriate level of observation, mapping, and compaction testing.

During the grading and earthwork operations, the Geotechnical Consultant shall observe, map, and document the subsurface exposures to verify the geotechnical design assumptions. If the observed conditions are found to be significantly different than the interpreted assumptions during the design phase, the Geotechnical Consultant shall inform the owner, recommend appropriate changes in design to accommodate the observed conditions, and notify the review agency where required.

The Geotechnical Consultant shall observe the moisture-conditioning and processing of the subgrade and fill materials and perform relative compaction testing of fill to confirm that the attained level of compaction is being accomplished as specified. The Geotechnical Consultant shall provide the test results to the owner and the Contractor on a routine and frequent basis.

1.3 The Earthwork Contractor

The Earthwork Contractor (Contractor) shall be qualified, experienced, and knowledgeable in earthwork logistics, preparation and processing of ground to receive fill, moisture-conditioning and processing of fill, and compacting fill. The Contractor shall review and accept the plans, geotechnical report(s), and these Specifications prior to commencement of grading. The Contractor shall be solely responsible for performing the grading in accordance with the project plans and specifications. The Contractor shall prepare and submit to the owner and the Geotechnical Consultant a work plan that indicates the sequence of earthwork grading, the number of "equipment" of work and the estimated quantities of daily earthwork

contemplated for the site prior to commencement of grading. The Contractor shall inform the owner and the Geotechnical Consultant of changes in work schedules and updates to the work plan at least 24 hours in advance of such changes so that appropriate personnel will be available for observation and testing. The Contractor shall not assume that the Geotechnical Consultant is aware of all grading operations.

The Contractor shall have the sole responsibility to provide adequate equipment and methods to accomplish the earthwork in accordance with the applicable grading codes and agency ordinances, these Specifications, and the recommendations in the approved geotechnical report(s) and grading plan(s). If, in the opinion of the Geotechnical Consultant, unsatisfactory conditions, such as unsuitable soil, improper moisture condition, inadequate compaction, insufficient buttress key size, adverse weather, etc., are resulting in a quality of work less than required in these specifications, the Geotechnical Consultant shall reject the work and may recommend to the owner that construction be stopped until the conditions are rectified. It is the contractor's sole responsibility to provide proper fill compaction.

2.0 Preparation of Areas to be Filled

2.1 Clearing and Grubbing

Vegetation, such as brush, grass, roots, and other deleterious material shall be sufficiently removed and properly disposed of in a method acceptable to the owner, governing agencies, and the Geotechnical Consultant.

The Geotechnical Consultant shall evaluate the extent of these removals depending on specific site conditions. Earth fill material shall not contain more than 1 percent of organic materials (by volume). Nesting of the organic materials shall not be allowed.

If potentially hazardous materials are encountered, the Contractor shall stop work in the affected area, and a hazardous material specialist shall be informed immediately for proper evaluation and handling of these materials prior to continuing to work in that area.

As presently defined by the State of California, most refined petroleum products (gasoline, diesel fuel, motor oil, grease, coolant, etc.) have chemical constituents that are considered to be hazardous waste. As such, the indiscriminate dumping or spillage of these fluids onto the ground may constitute a misdemeanor, punishable by fines and/or imprisonment, and shall not be allowed. The contractor is responsible for all hazardous waste relating to his work. The Geotechnical Consultant does not have expertise in this area. If hazardous waste is a concern, then the Client should acquire the services of a qualified environmental assessor.

2.2 Processing

Existing ground that has been declared satisfactory for support of fill by the Geotechnical Consultant shall be scarified to a minimum depth of 6 inches. Existing ground that is not satisfactory shall be over-excavated as specified in the following section. Scarification shall continue until soils are broken down and free of oversize material and the working surface is reasonably uniform, flat, and free of uneven features that would inhibit uniform compaction.

2.3 Over-excavation

In addition to removals and over-excavations recommended in the approved geotechnical report(s) and the grading plan, soft, loose, dry, saturated, spongy, organic-rich, highly fractured or otherwise unsuitable ground shall be over-excavated to competent ground as evaluated by the Geotechnical Consultant during grading.

2.4 Benching

Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical units), the ground shall be stepped or benched. Please see the Standard Details for a graphic illustration. The lowest bench or key shall be a minimum of 15 feet wide and at least 2 feet deep, into competent material as evaluated by the Geotechnical Consultant. Other benches shall be excavated a minimum height of 4 feet into competent material or as otherwise recommended by the Geotechnical Consultant. Fill placed on ground sloping flatter than 5:1 shall also be benched or otherwise over-excavated to provide a flat subgrade for the fill.

2.5 Evaluation/Acceptance of Fill Areas

All areas to receive fill, including removal and processed areas, key bottoms, and benches, shall be observed, mapped, elevations recorded, and/or tested prior to being accepted by the Geotechnical Consultant as suitable to receive fill. The Contractor shall obtain a written acceptance from the Geotechnical Consultant prior to fill placement. A licensed surveyor shall provide the survey control for determining elevations of processed areas, keys, and benches.

3.0 Fill Material

3.1 General

Material to be used as fill shall be essentially free of organic matter and other deleterious substances evaluated and accepted by the Geotechnical Consultant prior to placement. Soils of poor quality, such as those with unacceptable gradation, high expansion potential, or low strength shall be placed in areas acceptable to the Geotechnical Consultant or mixed with other soils to achieve satisfactory fill material.

3.2 Oversize

Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 8 inches, shall not be buried or placed in fill unless location, materials, and placement methods are specifically accepted by the Geotechnical Consultant. Placement operations shall be such that nesting of oversized material does not occur and such that oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 vertical feet of finish grade or within 2 feet of future utilities or underground construction.

3.3 Import

If importing of fill material is required for grading, proposed import material shall meet the requirements of the geotechnical consultant. The potential import source shall be given to the Geotechnical Consultant at least 48 hours (2 working days) before importing begins so that its suitability can be determined and appropriate tests performed.

4.0 Fill Placement and Compaction

4.1 Fill Layers

Approved fill material shall be placed in areas prepared to receive fill (per Section 3.0) in near-horizontal layers not exceeding 8 inches in loose thickness. The Geotechnical Consultant may accept thicker layers if testing indicates the grading procedures can adequately compact the thicker layers. Each layer shall be spread evenly and mixed thoroughly to attain relative uniformity of material and moisture throughout.

4.2 Fill Moisture Conditioning

Fill soils shall be watered, dried back, blended, and/or mixed, as necessary to attain a relatively uniform moisture content at or slightly over optimum. Maximum density and optimum soil moisture content tests shall be performed in accordance with the American Society of Testing and Materials (ASTM Test Method D1557).

4.3 Compaction of Fill

After each layer has been moisture-conditioned, mixed, and evenly spread, it shall be uniformly compacted to not less than 90 percent of maximum dry density (ASTM Test Method D1557). Compaction equipment shall be adequately sized and be either specifically designed for soil compaction or of proven reliability to efficiently achieve the specified level of compaction with uniformity.

4.4 Compaction of Fill Slopes

In addition to normal compaction procedures specified above, compaction of slopes shall be accomplished by backrolling of slopes with sheepfoot rollers at increments of 3 to 4 feet in fill elevation, or by other methods producing satisfactory results acceptable to the Geotechnical Consultant. Upon completion of grading, relative compaction of the fill, out to the slope face, shall be at least 90 percent of maximum density per ASTM Test Method D1557.

4.5 Compaction Testing

Field tests for moisture content and relative compaction of the fill soils shall be performed by the Geotechnical Consultant. Location and frequency of tests shall be at the Consultant's discretion based on field conditions encountered. Compaction test locations will not necessarily be selected on a random basis. Test locations shall be selected to verify adequacy of compaction levels in areas that are judged to be prone to inadequate compaction (such as close to slope faces and at the fill/bedrock benches).

4.6 Frequency of Compaction Testing

Tests shall be taken at intervals not exceeding 2 feet in vertical rise and/or 1,000 cubic yards of compacted fill soils embankment. In addition, as a guideline, at least one test shall be taken on slope faces for each 5,000 square feet of slope face and/or each 10 feet of vertical height of slope. The Contractor shall assure that fill construction is such that the testing schedule can be accomplished by the Geotechnical Consultant. The Contractor shall stop or slow down the earthwork construction if these minimum standards are not met.

4.7 Compaction Test Locations

The Geotechnical Consultant shall document the approximate elevation and horizontal coordinates of each test location. The Contractor shall coordinate with the project surveyor to assure that sufficient grade stakes are established so that the Geotechnical Consultant can determine the test locations with sufficient accuracy. At a minimum, two grade stakes within a horizontal distance of 100 feet and vertically less than 5 feet apart from potential test locations shall be provided.

5.0 Subdrain Installation

Subdrain systems shall be installed in accordance with the approved geotechnical report(s), the grading plan, and the Standard Details. The Geotechnical Consultant may recommend additional subdrains and/or changes in subdrain extent, location, grade, or material depending on conditions encountered during grading. All subdrains shall be surveyed by a land surveyor/civil engineer for line and grade after installation and prior to burial. Sufficient time should be allowed by the Contractor for these surveys.

6.0 Excavation

Excavations, as well as over-excavation for remedial purposes, shall be evaluated by the Geotechnical Consultant during grading. Remedial removal depths shown on geotechnical plans are estimates only. The actual extent of removal shall be determined by the Geotechnical Consultant based on the field evaluation of exposed conditions during grading. Where fill-over-cut slopes are to be graded, the cut portion of the slope shall be made, evaluated, and accepted by the Geotechnical Consultant prior to placement of materials for construction of the fill portion of the slope, unless otherwise recommended by the Geotechnical Consultant.

7.0 Trench Backfills

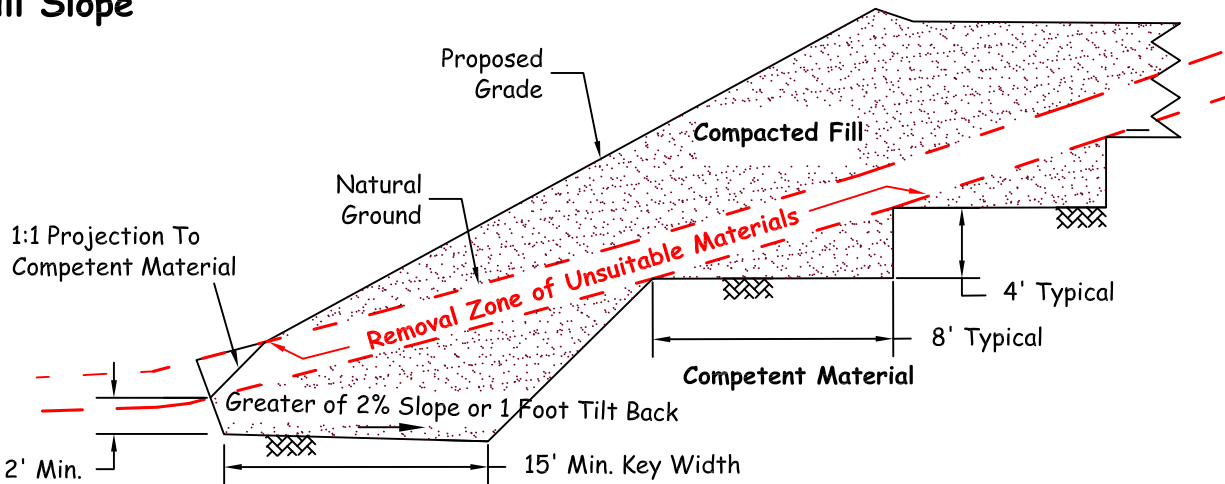
7.1 The Contractor shall follow all OHSA and Cal/OSHA requirements for safety of trench excavations.

7.2 All bedding and backfill of utility trenches shall be done in accordance with the applicable provisions of Standard Specifications of Public Works Construction. Bedding material shall have a Sand Equivalent greater than 30 (SE>30). The bedding shall be placed to 1 foot over

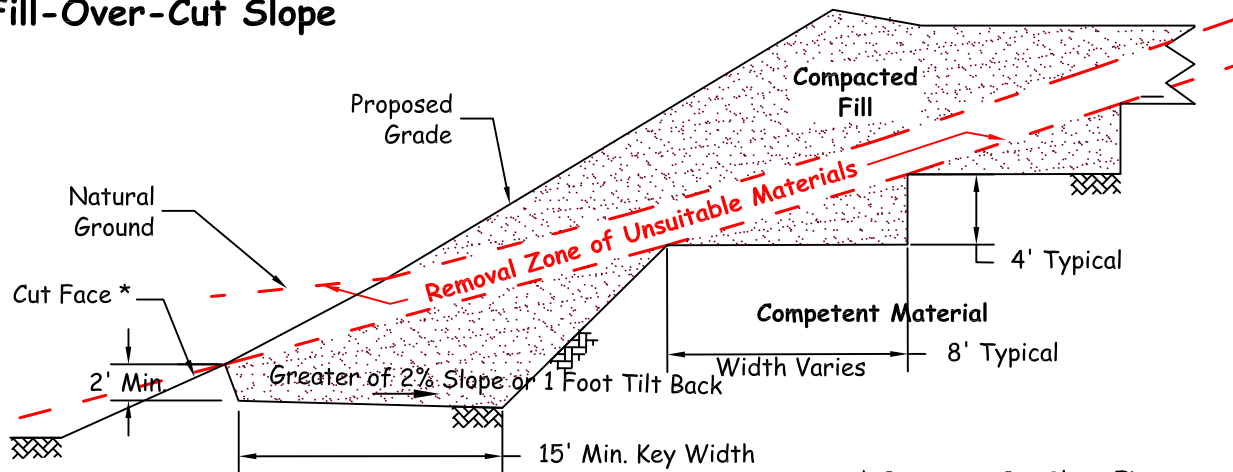
the top of the conduit and densified by jetting. Backfill shall be placed and densified to a minimum of 90 percent of maximum from 1 foot above the top of the conduit to the surface.

- 7.3** The jetting of the bedding around the conduits shall be observed by the Geotechnical Consultant.
- 7.4** The Geotechnical Consultant shall test the trench backfill for relative compaction. At least one test should be made for every 300 feet of trench and 2 feet of fill.
- 7.5** Lift thickness of trench backfill shall not exceed those allowed in the Standard Specifications of Public Works Construction unless the Contractor can demonstrate to the Geotechnical Consultant that the fill lift can be compacted to the minimum relative compaction by his alternative equipment and method.

Fill Slope

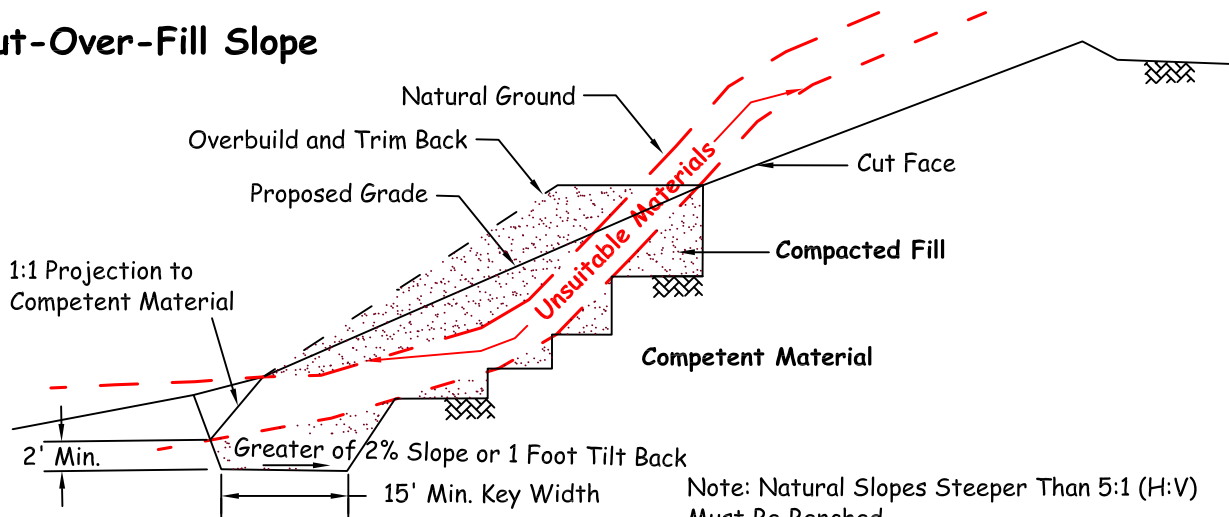


Fill-Over-Cut Slope

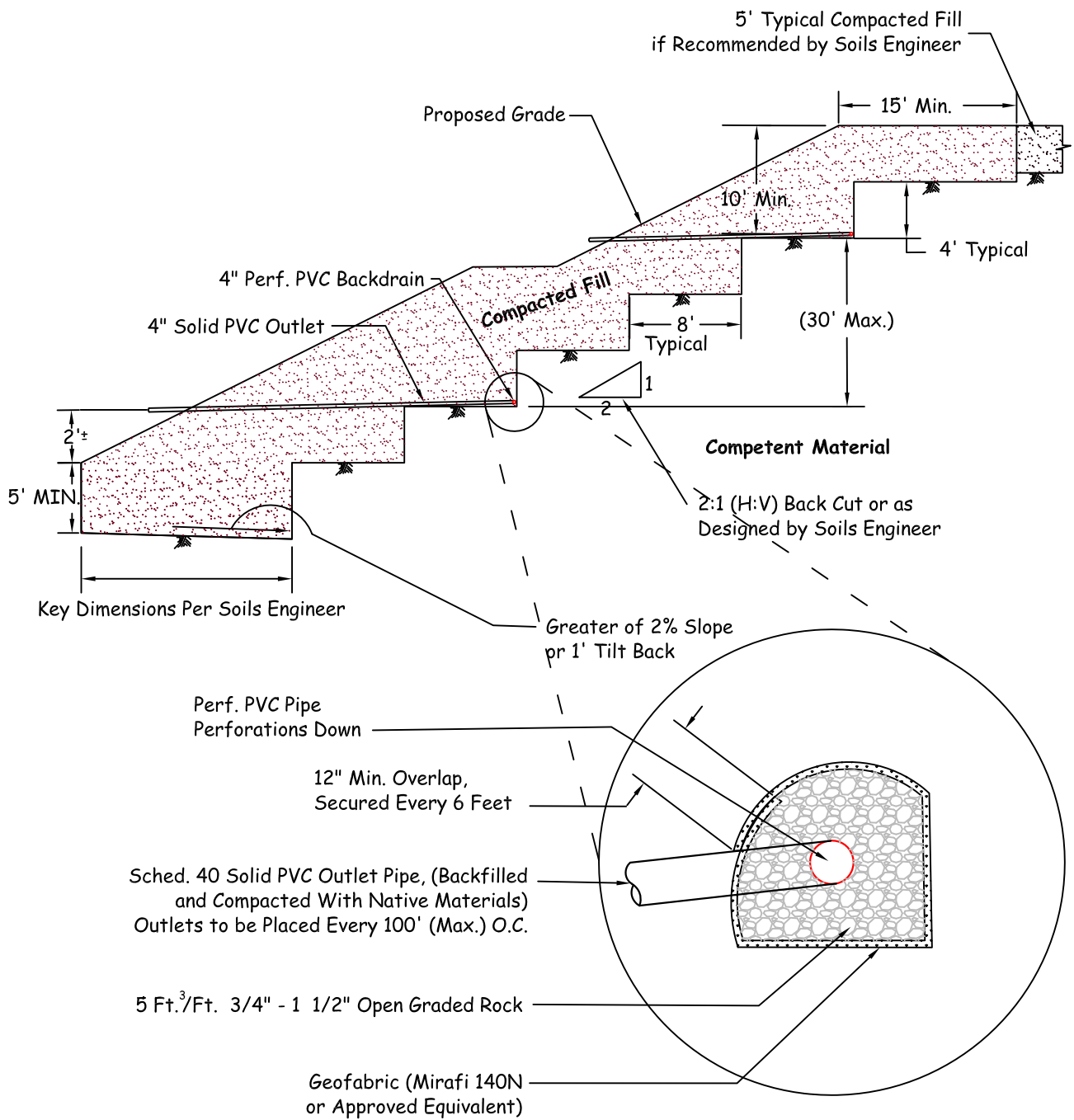


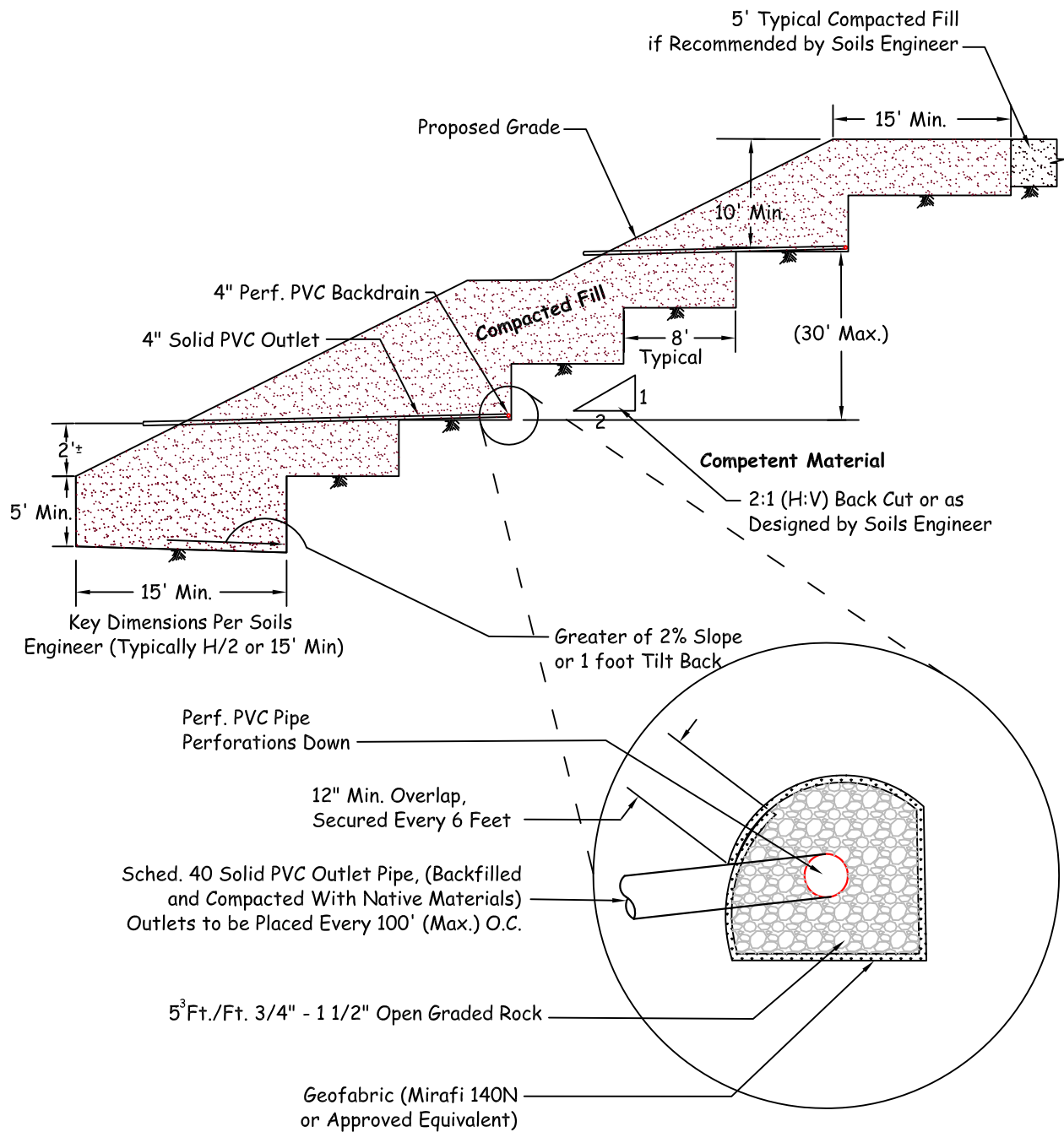
* Construct Cut Slope First

Cut-Over-Fill Slope

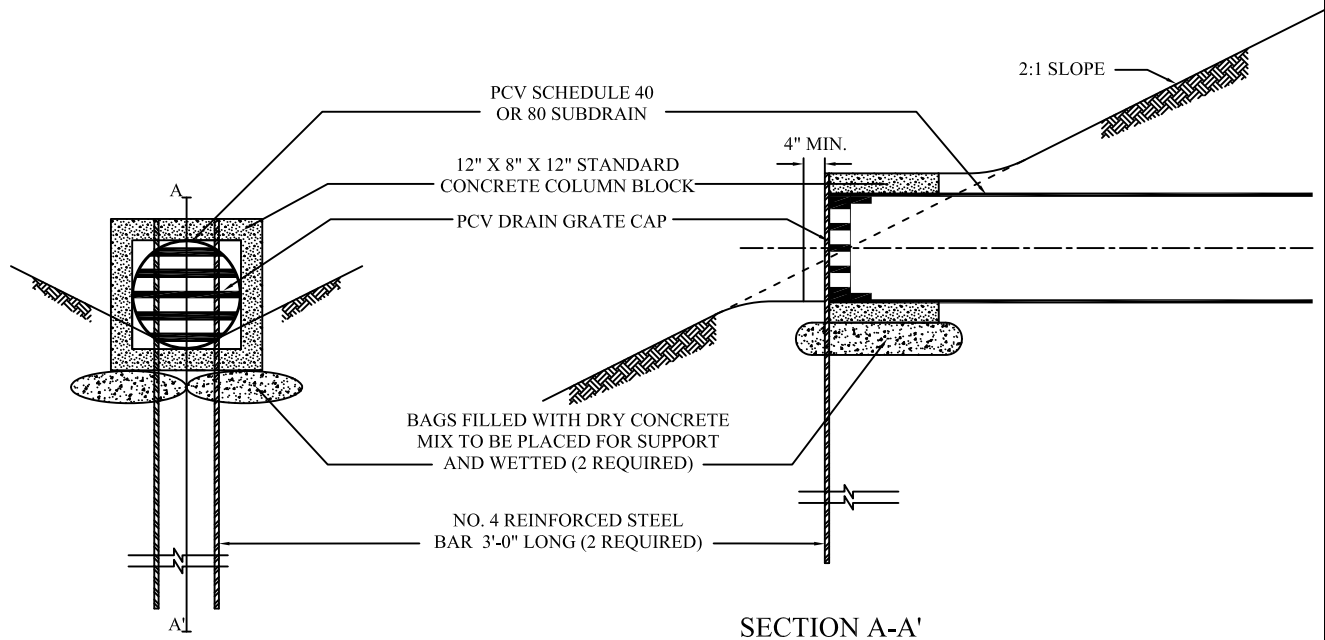


Note: Natural Slopes Steeper Than 5:1 (H:V) Must Be Benched.

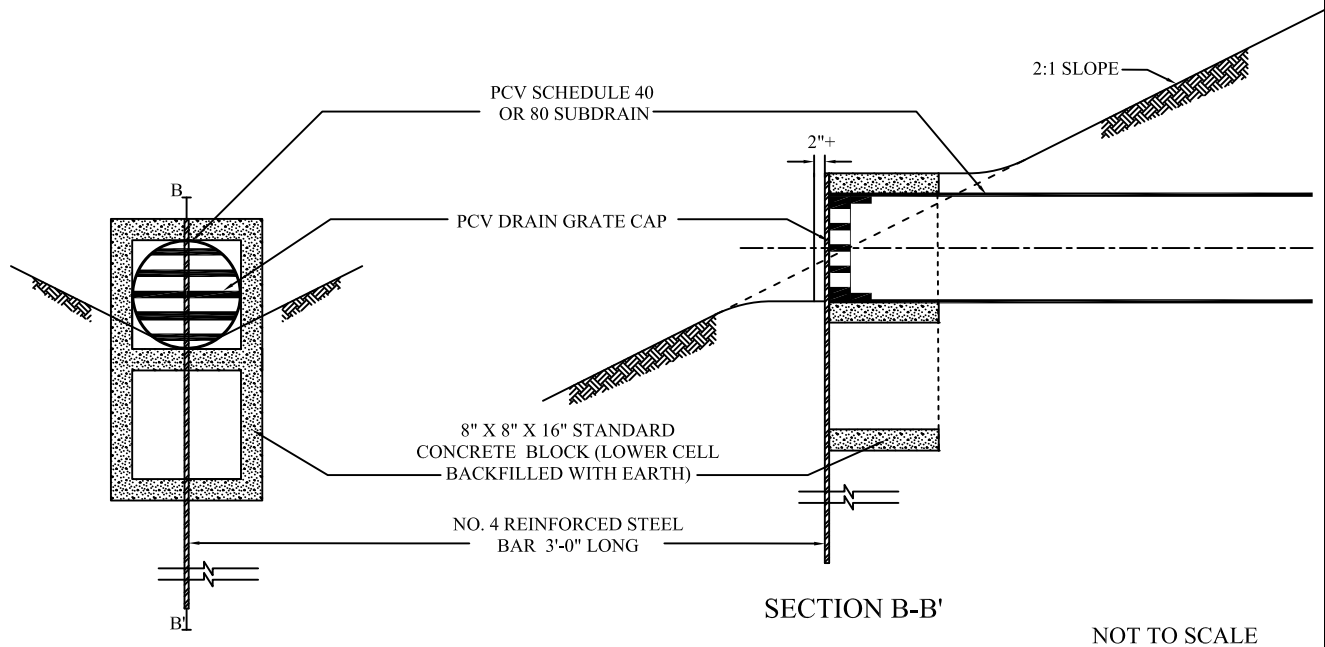




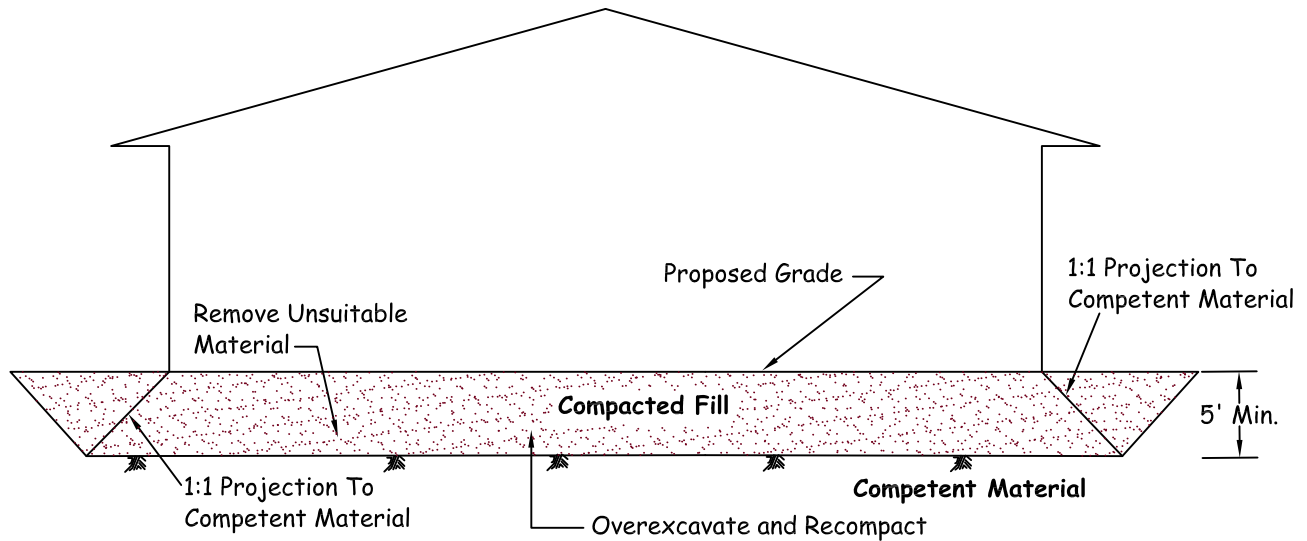
SUBDRAIN OUTLET MARKER -6" & 8" PIPE



SUBDRAIN OUTLET MARKER -4" PIPE



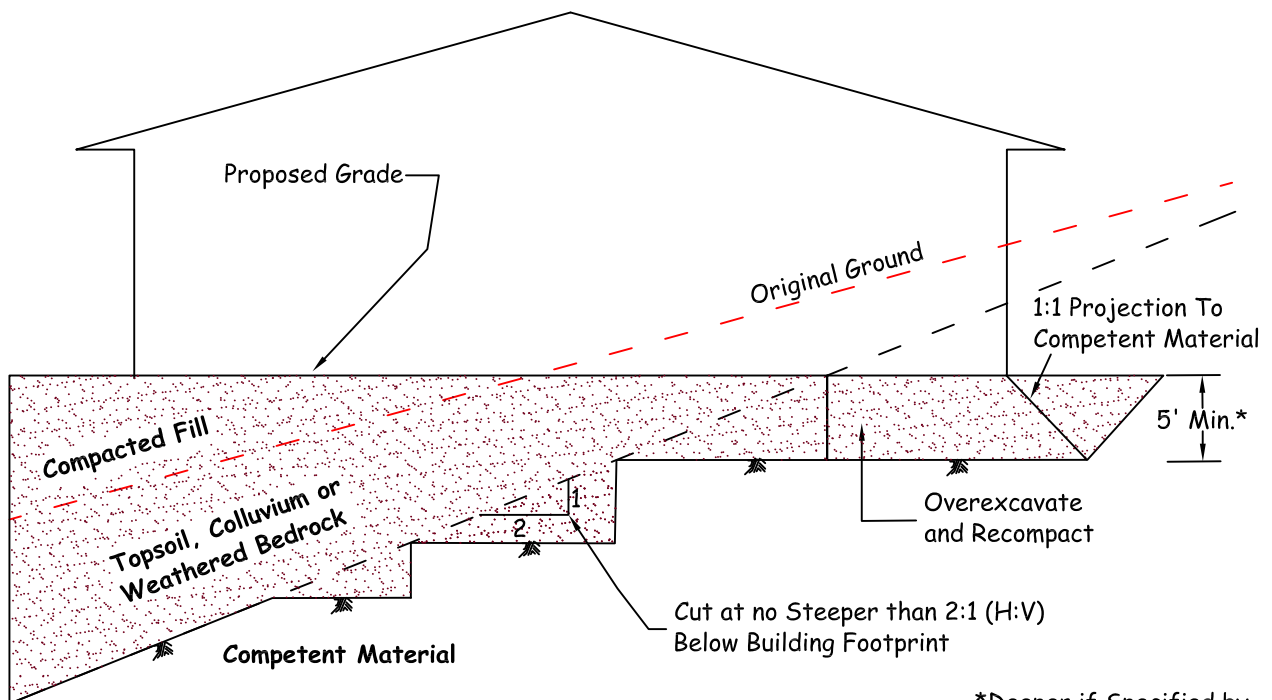
Cut Lot (Exposing Unsuitable Soils at Design Grade)



Note 1: Removal Bottom Should be Graded With Minimum 2% Fall Towards Street or Other Suitable Area (as Determined by Soils Engineer) to Avoid Ponding Below Building

Note 2: Where Design Cut Lots are Excavated Entirely Into Competent Material, Overexcavation May Still be Required for Hard-Rock Conditions or for Materials With Variable Expansion Characteristics.

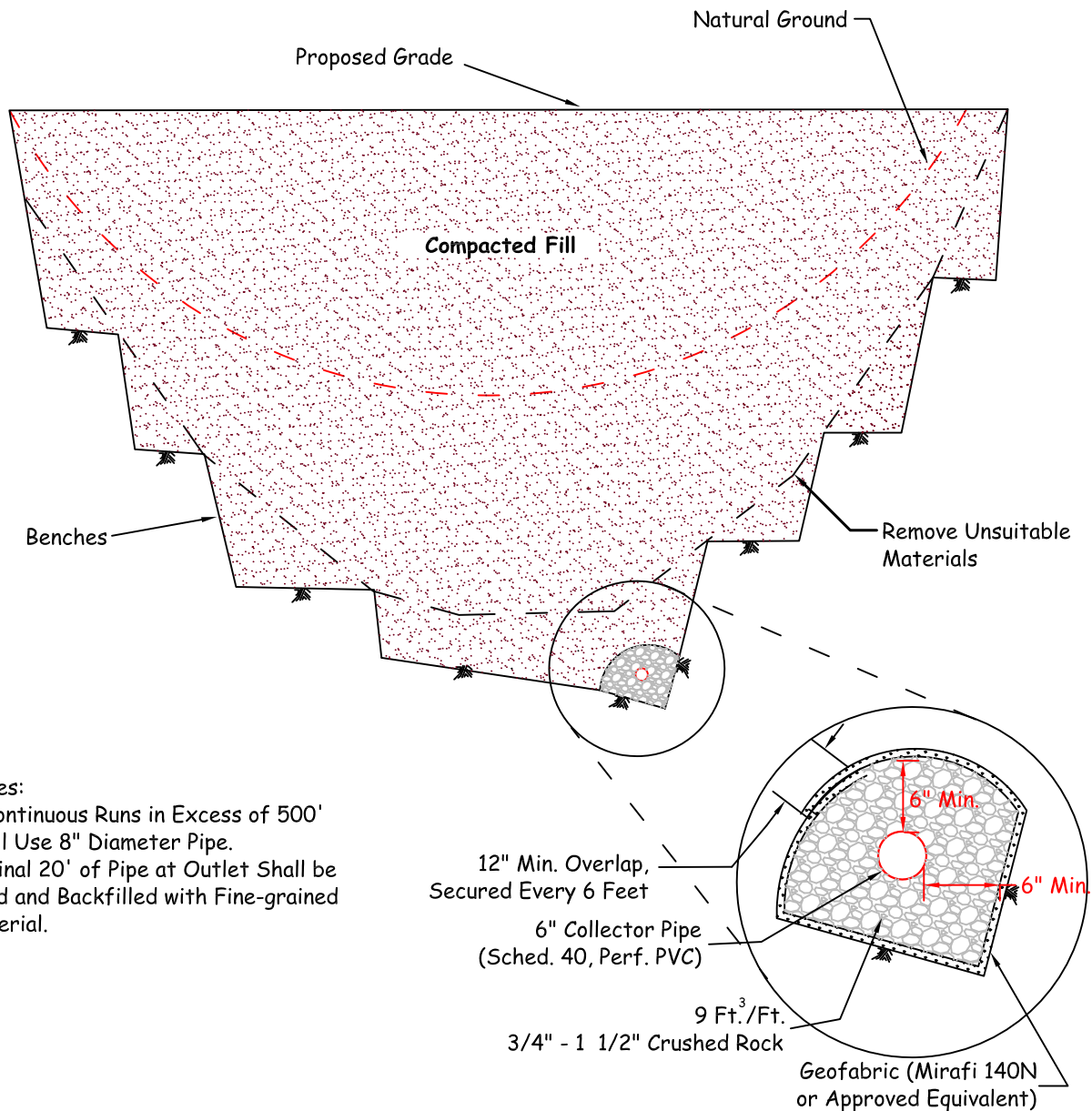
Cut/Fill Transition Lot



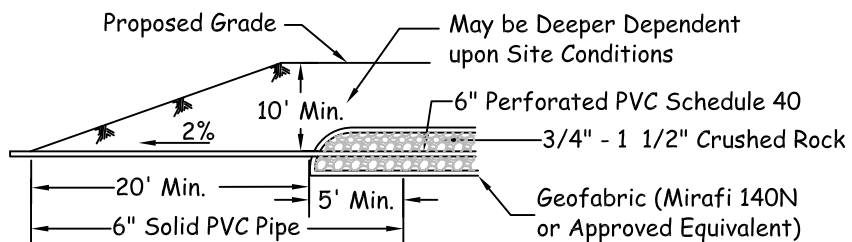
*Deeper if Specified by Soils Engineer

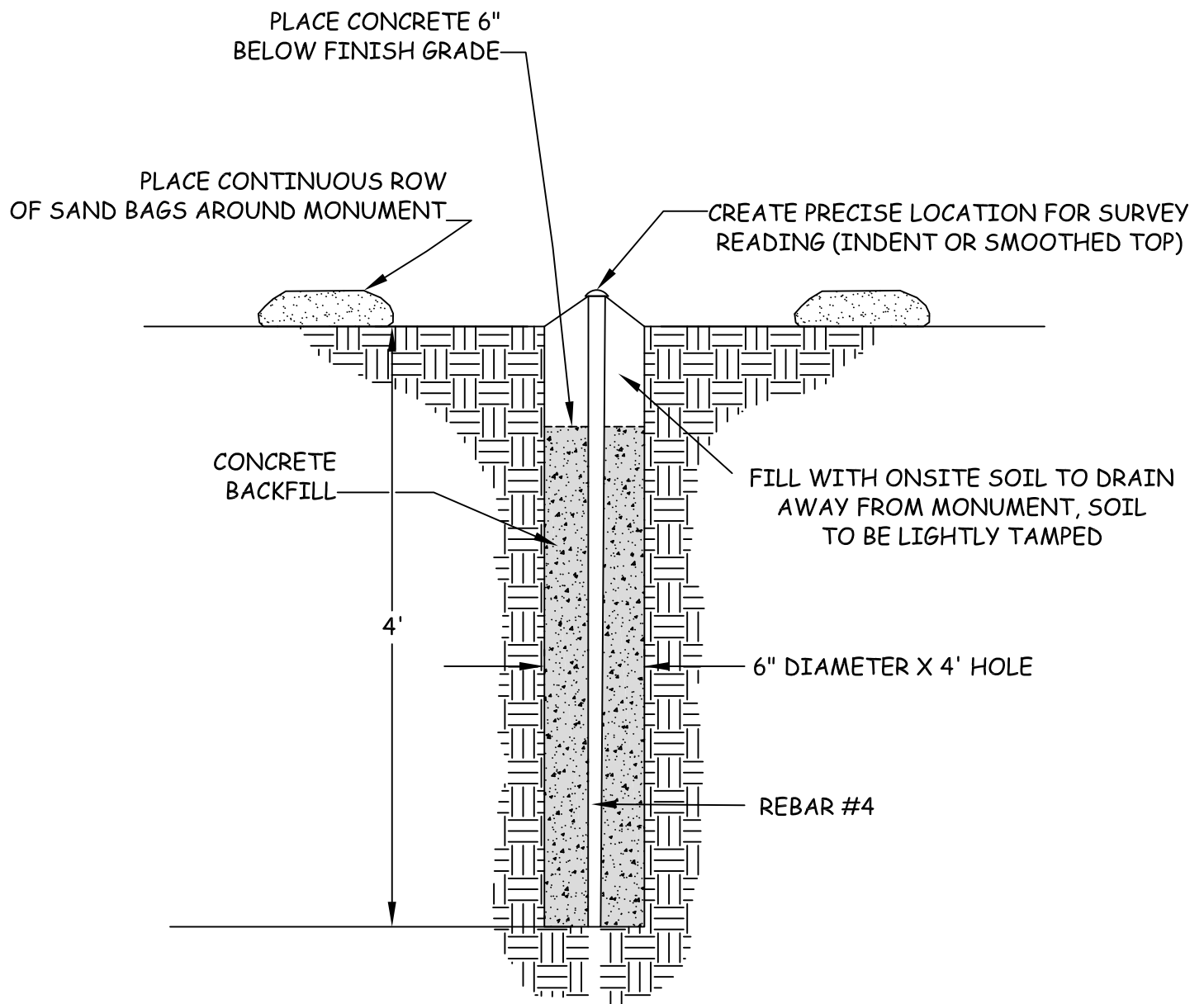


CUT AND TRANSITION LOT OVEREXCAVATION DETAIL



Proposed Outlet Detail

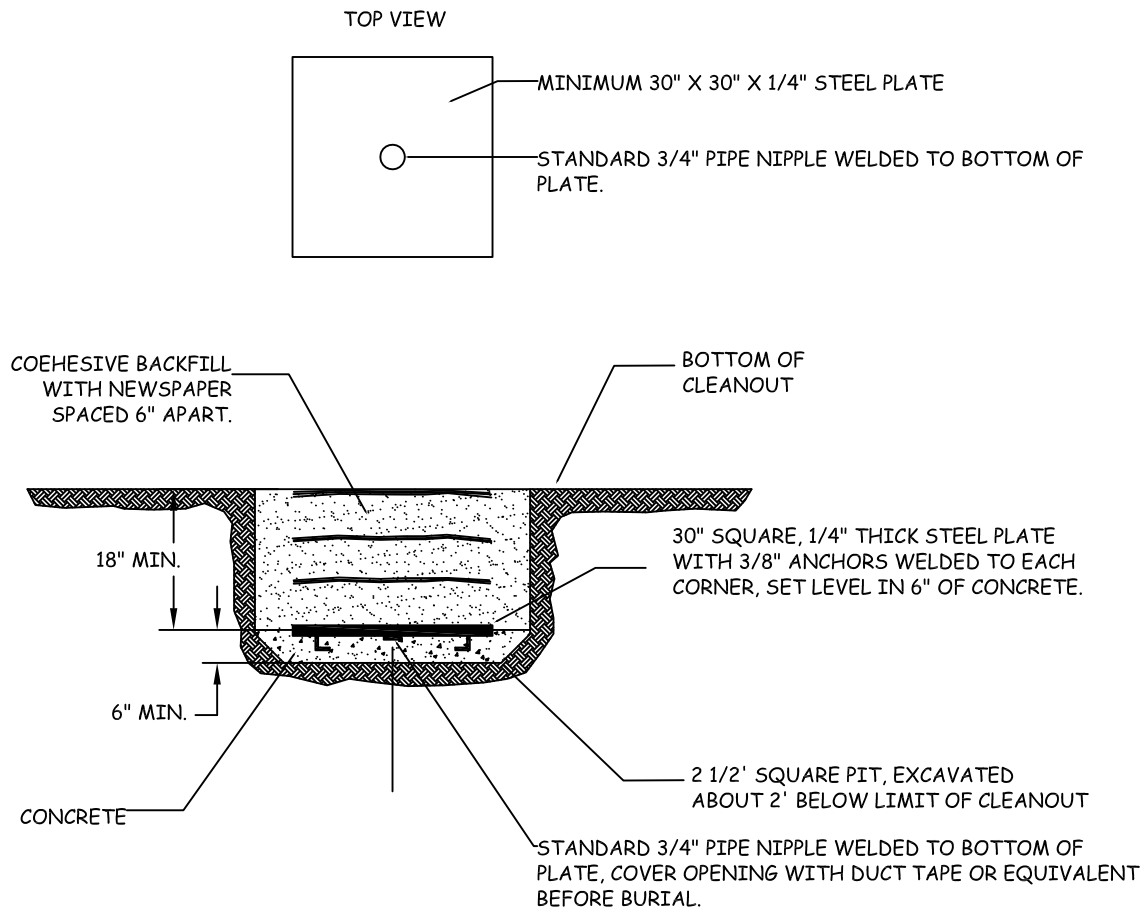




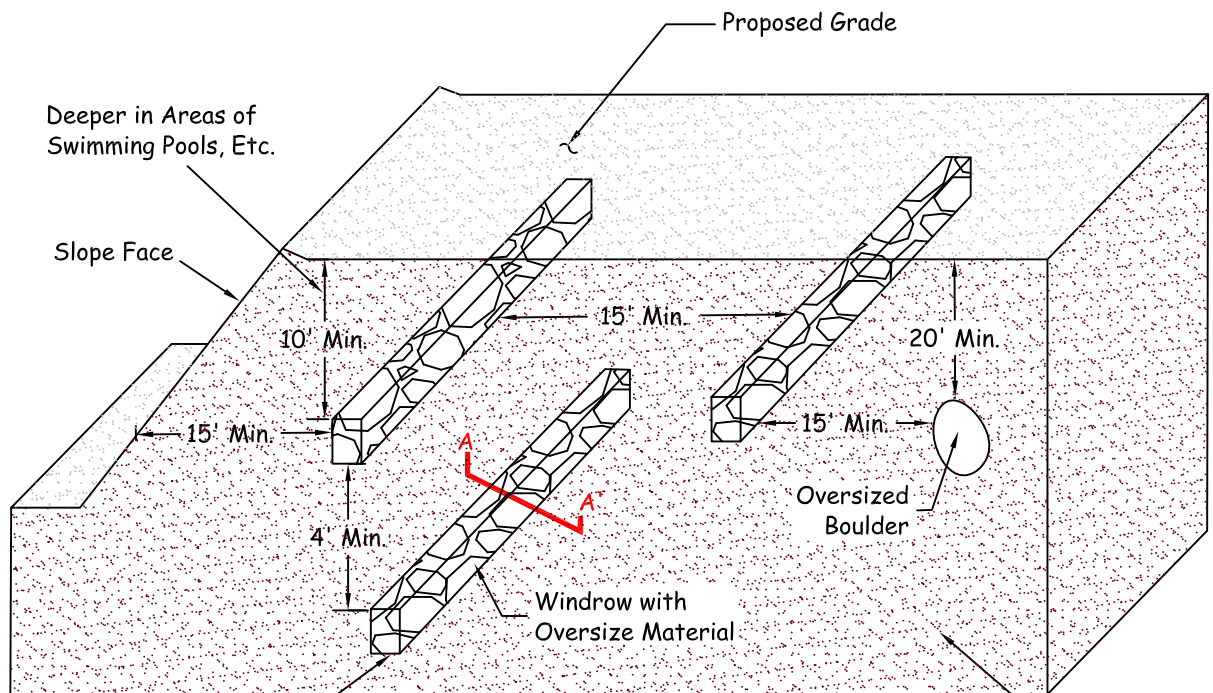
NO CONSTRUCTION EQUIPMENT WITHIN 25 FEET
OF ANY INSTALLED SETTLEMENT MONUMENTS



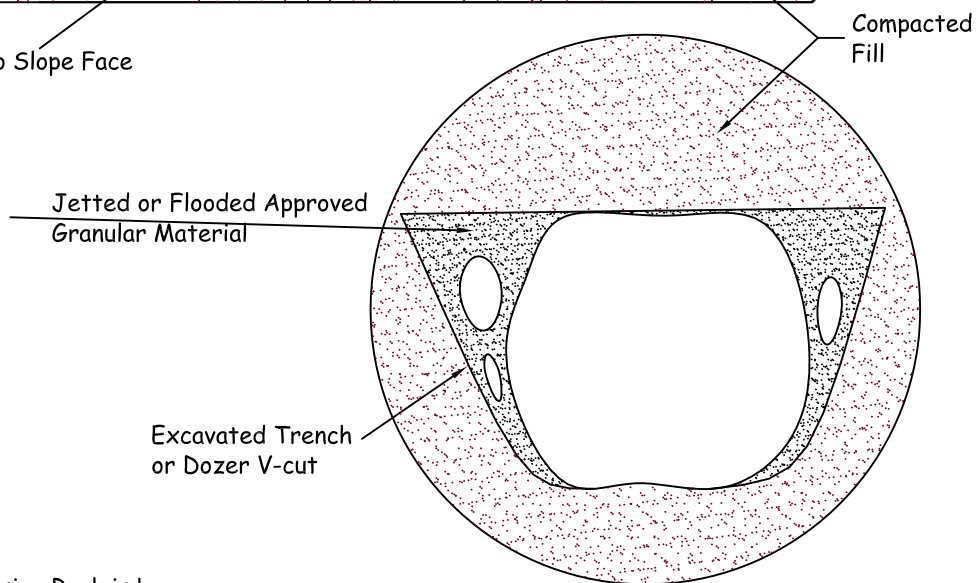
TYPICAL SURFACE SETTLEMENT MONUMENT



1. SURVEY FOR HORIZONTAL AND VERTICAL LOCATION TO NEAREST .01 INCH PRIOR TO BACKFILL USING KNOW LOCATIONS THAT WILL REMAIN INTACT DURING THE DURATION OF THE MONITORING PROGRAM. KNOW POINTS EXPLICITLY NOT ALLOWED ARE THOSE LOCATED ON FILL OR THAT WILL BE DESTROYED DURING GRADING.
2. IN THE EVENT OF DAMAGE TO SETTLEMENT PLATE DURING GRADING, CONTRACTOR SHALL IMMEDIATELY NOTIFY THE GEOTECHNICAL ENGINEER AND SHALL BE RESPONSIBLE FOR RESTORING THE SETTLEMENT PLATES TO WORKING ORDER.
3. DRILL TO RECOVER AND ATTACH RISER PIPE.



Windrow Parallel to Slope Face



Note: Oversize Rock is Larger than 8" in Maximum Dimension.

Section A-A'

TP-13

EX-14

S-7

afo

Qal

Qoa

Kcgb

Approximate Location of Geologic Contact

Approximate Depth of Remedial Measures, in Feet

LEGEND

Approximate Location of Exploratory Test Pit by LGC Geotechnical

Approximate Location of Excavator Test Pit by Others (AGS, 2017)

Approximate Location of Seismic Refraction Line by LGC Geotechnical

Older Artificial Fill by Others

Quaternary Alluvium

Quaternary Older Alluvium

Cretaceous Granodiorite and Gabbro, Undifferentiated

LGC Geotechnical, Inc.

131 Calle Iglesia, Ste. 200

San Clemente, CA 92672

TEL (949) 369-6141 FAX (949) 369-6142

Geotechnical Map

PROJECT NAME	Trumark - HG5 Riverside		
PROJECT NO.	24174-01		
ENG. / GEOL.	RLD / KTM		
SCALE	1" = 100'		
DATE	September 2024		

SHEET

1 of 1

Appendix 4: Historical Site Conditions

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

Not Applicable

Appendix 5: LID Infeasibility

LID Technical Infeasibility Analysis

Not Applicable

Appendix 6: BMP Design Details

BMP Sizing, Design Details and other Supporting Documentation

Extended Detention Basin Design Procedure

BMP Subarea
No. EDB

Legend:

Required Entries

Calculated Cells

Company Name:

ADKAN ENGINEERS

Date: #####

Designed by:

Casanova Matulionis

County/City Case No.:

Design Volume

Tributary Area (BMP Subarea)

$A_T = 28.32$ acres

Enter V_{BMP} , determined from Section 2.1 of this Handbook

$V_{BMP} = 25,002$ ft³

Basin Footprint

Overall Geometry

Length at Basin Bottom Surface

Length = 153 ft

Width at Basin Bottom Surface

Width = 102 ft

Meets 1.5 : 1 requirement?



Side Slopes per "Basin Guidelines", Sect. 1.2

$z = 4$:1

Proposed Basin Depth (with no freeboard)

$D_B = 5.00$ ft

Depth of freeboard (if used)

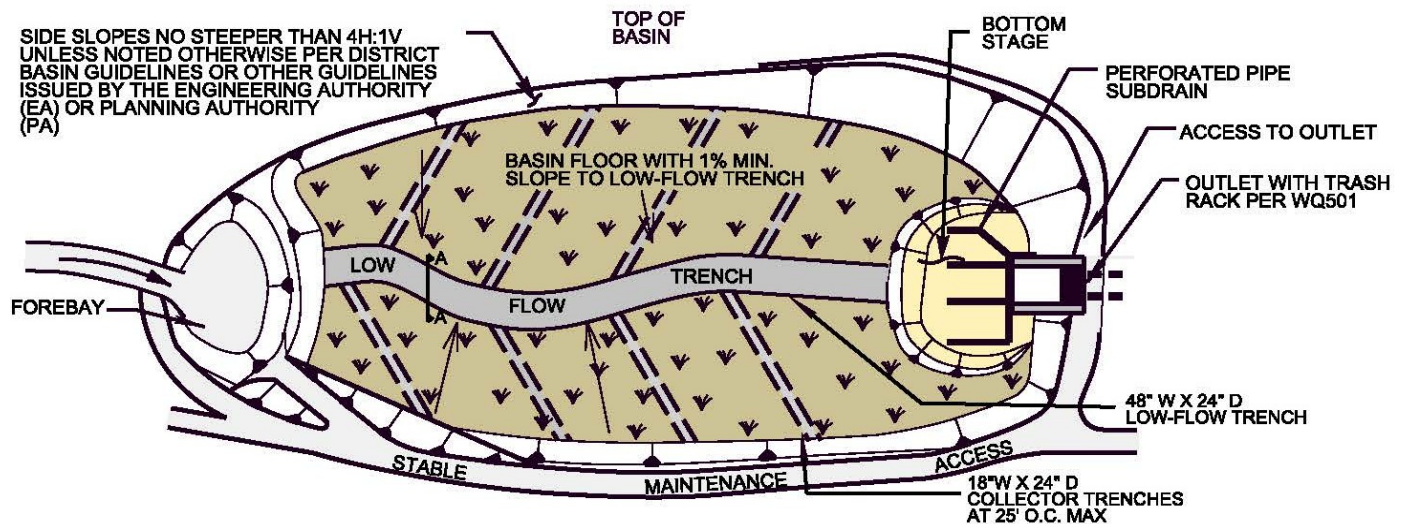
$D_{FB} = 1.00$ ft

Minimum Required Allowance for Total Depth (including proposed basin depth, freeboard, minimum depth of bottom stage ($D_{BS}=0.33'$) and minimum filter depth ($D_{FD}=2.33'$))

$D_{REQ} = 8.7$ ft

Depth from design water surface elevation to lowest orifice

$D_O = 5.0$ ft



Basin Design

Basin Design

Proposed Total Basin Depth (proposed depth plus freeboard)

$D_{TOT} = 6.00$ ft

Basin Invert Longitudinal Slope

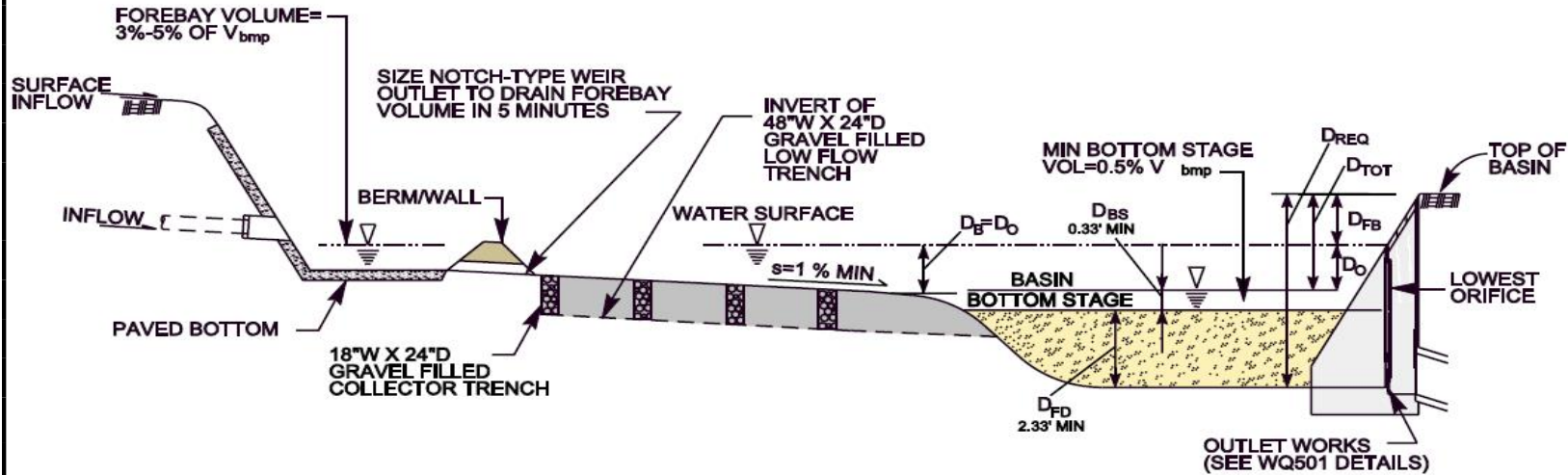
Slope = 1.00 %

Basin Invert Transverse Slope (1% min)

Slope = 1 %

Basin Volume

$V_{Basin} = 94011$ ft³



Forebay Design

Forebay Volume (3 - 5% V_{BMP})

$V_{FB} = 751$ ft³

Forebay Depth (height of berm)

$D_{FBY} = 1$ ft

Minimum Forebay Surface Area

$A_{FB} = 751$ ft²

Rectangular weir (notch)

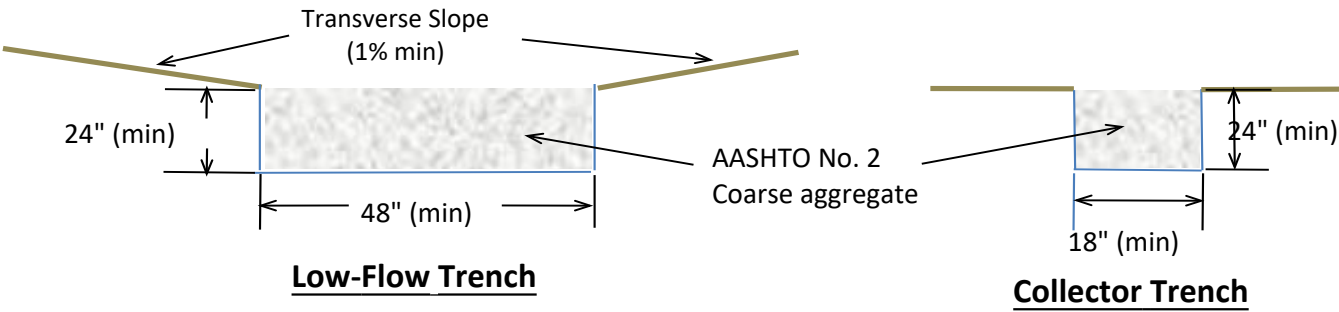
$W = 18.00$ in

Low-Flow Trench (see graphic below)

Depth (24 inches minimum, gravel filled)	Depth = <div><div></div>24</div> inches
Width (48 inches minimum)	Width = <div><div></div>48</div> inches
Trench Invert Longitudinal Slope	Slope = <div><div></div>1</div> %

Collector Trenches (see graphic below)

Depth (24 inches minimum)	Depth = <div><div></div>24</div> inches
Width (18 inches minimum)	Width = <div><div></div>18</div> inches
Trench Invert Longitudinal Slope	Slope = <div><div></div>1</div> %
Spacing (25 feet on center maximum)	S = <div><div></div>25</div> feet

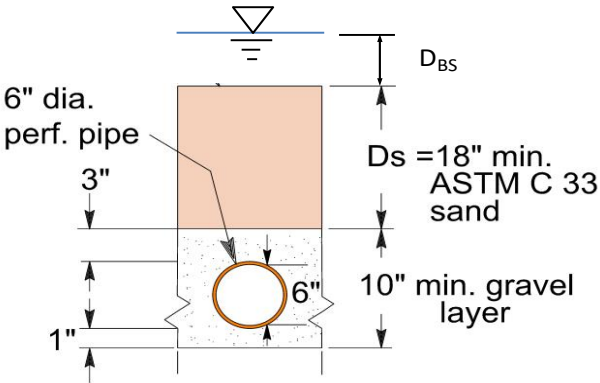


Bottom Stage (Sand Filter) Design

Depth of the Bottom Stage (4" minimum ponding)	D_{BS} = <div><div></div>4</div> in
Surface Area of Bottom Stage	A_{BS} = <div><div></div>405</div> ft ²
Dry Weather Poned Volume (above sand layer)	V_{BS} = <div><div></div>135</div> ft ³
Is V_{BS} no less than 0.5% V_{BMP} ? <div>OK</div>	

Depth of ASTM-C33 sand (18 inch minimum)

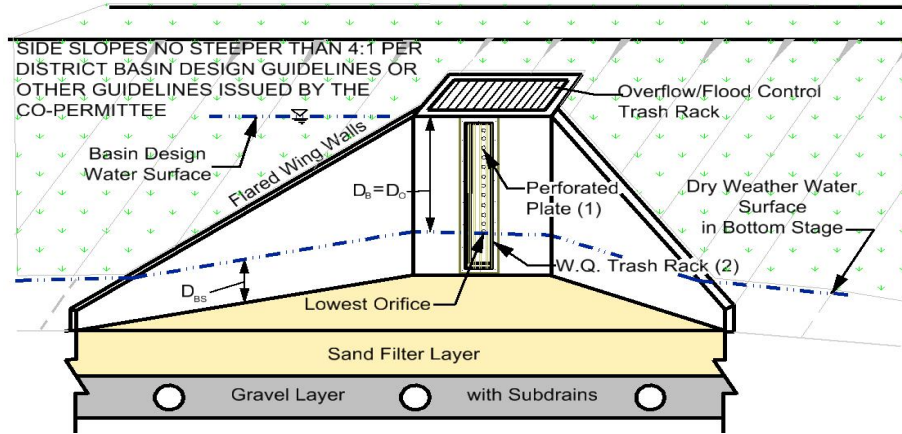
D_s = <div><div></div>18</div> inches	
Diameter of Subdrains	Subdrain Spacing
ϕ = <div><div></div>6</div> in	s = <div><div></div>6</div> ft. on center



Basin Outlet Design

Outlet Design

Assume an orifice area. Based on the information provided above, the spreadsheet provides discharge vs. stage data. Enter the volume vs. stage data for each interval. This information is used to route the volume through the basin. The size of the orifice is acceptable when the data shows that less than 50% of V_{BMP} has drained in 24 hours, and that 100% drawdown occurs within 72 hours.



Flow Rate, Q (cfs)

$$Q = CA[2g(H-H_o)]^{0.5}$$

Discharge Coefficient,

Default, C = 0.66

Other, C = 0.66

Orifice Area (ft²)

Orifice Diameter, d; number of orifices per row, n; and number of orifice rows, N (from the bottom up).

d = 2.2 inches

n = 1 per row

N = 1 rows

A_{eff} = 0.026 ft² per row

or

A_{eff} = 3.799 in² per row

From outflow hydrograph, the time where 50% of V_{BMP} has drained from the basin (24 hour minimum):

Time (50%) = 24.64 hrs

OK

From outflow hydrograph, the time where 100% V_{BMP} has drained from the basin (within 72 hours):

Time (100 %) = 71.41 hrs

OK

Headwater Elev. / Stage (ft)	Discharge (cfs)	Volume (acre-ft)	Δt (hrs.)
0	0.0000	0.0000	
0.33	0.0806	0.085	25.51
0.67	0.1141	0.171	10.64
1.00	0.1397	0.256	8.14
1.33	0.1613	0.353	7.80
1.67	0.1804	0.451	6.91
2.00	0.1976	0.549	6.30
2.33	0.2135	0.653	6.12
2.67	0.2282	0.757	
3.00	0.2420	0.881	
3.33	0.2551	1.007	
3.67	0.2676	1.133	
4.00	0.2795	1.259	
4.33	0.2909	1.400	
4.67	0.3019	1.541	
5.00	0.3125	1.684	
5.33			
5.67			
6.00			
6.33			
6.67			
7.00			
7.33			
7.67			
8.00			
8.33			
8.67			
9.00			
9.33			
9.67			
10.00			
Σ =			71.41

Appendix 7: Hydromodification

Supporting Detail Relating to Hydrologic Conditions of Concern

Unit Hydrograph Analysis

Copyright (C) CIVILCADD/CIVILDESIGN, 1989 - 2008, Version 8.1
Study date 12/17/24 File: EX2242.out

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

Program License Serial Number 5006

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

Drainage Area = 28.43(Ac.) = 0.044 Sq. Mi.
Drainage Area for Depth-Area Area Adjustment = 28.43(Ac.) = 0.044 Sq. Mi.
Length along longest watercourse = 691.00(Ft.)
Length along longest watercourse measured to centroid = 346.00(Ft.)
Length along longest watercourse = 0.131 Mi.
Length along longest watercourse measured to centroid = 0.066 Mi.
Difference in elevation = 73.00(Ft.)
Slope along watercourse = 557.8003 Ft./Mi.
Average Manning's 'N' = 0.030
Lag time = 0.035 Hr.
Lag time = 2.13 Min.
25% of lag time = 0.53 Min.
40% of lag time = 0.85 Min.
Unit time = 5.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow = 0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	weighting[1*2]
28.43	1.80	51.17

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	weighting[1*2]
28.43	5.00	142.15

STORM EVENT (YEAR) = 2.00
Area Averaged 2-Year Rainfall = 1.800(In)
Area Averaged 100-Year Rainfall = 5.000(In)

Point rain (area averaged) = 1.800(In)
Areal adjustment factor = 99.99 %
Adjusted average point rain = 1.800(In)

Sub-Area Data:
Area(Ac.) Runoff Index Impervious %
28.430 91.00 0.000
Total Area Entered = 28.43(Ac.)

RI	RI	Infil. Rate	Impervious	Adj. Infil. Rate	Area%	F
AMC2	AMC-1	(In/Hr)	(Dec.%)	(In/Hr)	(Dec.)	(In/Hr)
91.0	79.8	0.246	0.000	0.246	1.000	0.246
					Sum (F) =	0.246

Area averaged mean soil loss (F) (In/Hr) = 0.246
Minimum soil loss rate ((In/Hr)) = 0.123
(for 24 hour storm duration)
Soil loss rate (decimal) = 0.900

Unit Hydrograph VALLEY S-Curve

Unit Hydrograph Data

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

1	0.083	234.784	48.832	13.991
2	0.167	469.568	41.016	11.752
3	0.250	704.352	7.528	2.157
4	0.333	939.136	2.624	0.752
Sum = 100.000			Sum=	28.652

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

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr)		Effective (In/Hr)
				Max	Low	
1	0.08	0.07	0.014	(0.437)	0.013	0.001
2	0.17	0.07	0.014	(0.435)	0.013	0.001
3	0.25	0.07	0.014	(0.433)	0.013	0.001
4	0.33	0.10	0.022	(0.432)	0.019	0.002
5	0.42	0.10	0.022	(0.430)	0.019	0.002
6	0.50	0.10	0.022	(0.428)	0.019	0.002
7	0.58	0.10	0.022	(0.427)	0.019	0.002
8	0.67	0.10	0.022	(0.425)	0.019	0.002
9	0.75	0.10	0.022	(0.423)	0.019	0.002
10	0.83	0.13	0.029	(0.422)	0.026	0.003
11	0.92	0.13	0.029	(0.420)	0.026	0.003
12	1.00	0.13	0.029	(0.418)	0.026	0.003
13	1.08	0.10	0.022	(0.417)	0.019	0.002
14	1.17	0.10	0.022	(0.415)	0.019	0.002
15	1.25	0.10	0.022	(0.413)	0.019	0.002
16	1.33	0.10	0.022	(0.412)	0.019	0.002
17	1.42	0.10	0.022	(0.410)	0.019	0.002
18	1.50	0.10	0.022	(0.408)	0.019	0.002
19	1.58	0.10	0.022	(0.407)	0.019	0.002
20	1.67	0.10	0.022	(0.405)	0.019	0.002
21	1.75	0.10	0.022	(0.404)	0.019	0.002
22	1.83	0.13	0.029	(0.402)	0.026	0.003
23	1.92	0.13	0.029	(0.400)	0.026	0.003
24	2.00	0.13	0.029	(0.399)	0.026	0.003
25	2.08	0.13	0.029	(0.397)	0.026	0.003
26	2.17	0.13	0.029	(0.395)	0.026	0.003
27	2.25	0.13	0.029	(0.394)	0.026	0.003
28	2.33	0.13	0.029	(0.392)	0.026	0.003
29	2.42	0.13	0.029	(0.391)	0.026	0.003
30	2.50	0.13	0.029	(0.389)	0.026	0.003
31	2.58	0.17	0.036	(0.387)	0.032	0.004
32	2.67	0.17	0.036	(0.386)	0.032	0.004
33	2.75	0.17	0.036	(0.384)	0.032	0.004
34	2.83	0.17	0.036	(0.383)	0.032	0.004
35	2.92	0.17	0.036	(0.381)	0.032	0.004
36	3.00	0.17	0.036	(0.380)	0.032	0.004
37	3.08	0.17	0.036	(0.378)	0.032	0.004
38	3.17	0.17	0.036	(0.376)	0.032	0.004
39	3.25	0.17	0.036	(0.375)	0.032	0.004
40	3.33	0.17	0.036	(0.373)	0.032	0.004
41	3.42	0.17	0.036	(0.372)	0.032	0.004
42	3.50	0.17	0.036	(0.370)	0.032	0.004
43	3.58	0.17	0.036	(0.369)	0.032	0.004
44	3.67	0.17	0.036	(0.367)	0.032	0.004
45	3.75	0.17	0.036	(0.366)	0.032	0.004
46	3.83	0.20	0.043	(0.364)	0.039	0.004
47	3.92	0.20	0.043	(0.362)	0.039	0.004
48	4.00	0.20	0.043	(0.361)	0.039	0.004
49	4.08	0.20	0.043	(0.359)	0.039	0.004
50	4.17	0.20	0.043	(0.358)	0.039	0.004
51	4.25	0.20	0.043	(0.356)	0.039	0.004
52	4.33	0.23	0.050	(0.355)	0.045	0.005
53	4.42	0.23	0.050	(0.353)	0.045	0.005
54	4.50	0.23	0.050	(0.352)	0.045	0.005
55	4.58	0.23	0.050	(0.350)	0.045	0.005
56	4.67	0.23	0.050	(0.349)	0.045	0.005
57	4.75	0.23	0.050	(0.347)	0.045	0.005
58	4.83	0.27	0.058	(0.346)	0.052	0.006
59	4.92	0.27	0.058	(0.344)	0.052	0.006
60	5.00	0.27	0.058	(0.343)	0.052	0.006
61	5.08	0.20	0.043	(0.341)	0.039	0.004
62	5.17	0.20	0.043	(0.340)	0.039	0.004
63	5.25	0.20	0.043	(0.338)	0.039	0.004
64	5.33	0.23	0.050	(0.337)	0.045	0.005
65	5.42	0.23	0.050	(0.335)	0.045	0.005
66	5.50	0.23	0.050	(0.334)	0.045	0.005
67	5.58	0.27	0.058	(0.332)	0.052	0.006
68	5.67	0.27	0.058	(0.331)	0.052	0.006
69	5.75	0.27	0.058	(0.330)	0.052	0.006
70	5.83	0.27	0.058	(0.328)	0.052	0.006
71	5.92	0.27	0.058	(0.327)	0.052	0.006
72	6.00	0.27	0.058	(0.325)	0.052	0.006

73	6.08	0.30	0.065	(0.324)	0.058	0.006
74	6.17	0.30	0.065	(0.322)	0.058	0.006
75	6.25	0.30	0.065	(0.321)	0.058	0.006
76	6.33	0.30	0.065	(0.319)	0.058	0.006
77	6.42	0.30	0.065	(0.318)	0.058	0.006
78	6.50	0.30	0.065	(0.317)	0.058	0.006
79	6.58	0.33	0.072	(0.315)	0.065	0.007
80	6.67	0.33	0.072	(0.314)	0.065	0.007
81	6.75	0.33	0.072	(0.312)	0.065	0.007
82	6.83	0.33	0.072	(0.311)	0.065	0.007
83	6.92	0.33	0.072	(0.310)	0.065	0.007
84	7.00	0.33	0.072	(0.308)	0.065	0.007
85	7.08	0.33	0.072	(0.307)	0.065	0.007
86	7.17	0.33	0.072	(0.305)	0.065	0.007
87	7.25	0.33	0.072	(0.304)	0.065	0.007
88	7.33	0.37	0.079	(0.303)	0.071	0.008
89	7.42	0.37	0.079	(0.301)	0.071	0.008
90	7.50	0.37	0.079	(0.300)	0.071	0.008
91	7.58	0.40	0.086	(0.298)	0.078	0.009
92	7.67	0.40	0.086	(0.297)	0.078	0.009
93	7.75	0.40	0.086	(0.296)	0.078	0.009
94	7.83	0.43	0.094	(0.294)	0.084	0.009
95	7.92	0.43	0.094	(0.293)	0.084	0.009
96	8.00	0.43	0.094	(0.292)	0.084	0.009
97	8.08	0.50	0.108	(0.290)	0.097	0.011
98	8.17	0.50	0.108	(0.289)	0.097	0.011
99	8.25	0.50	0.108	(0.288)	0.097	0.011
100	8.33	0.50	0.108	(0.286)	0.097	0.011
101	8.42	0.50	0.108	(0.285)	0.097	0.011
102	8.50	0.50	0.108	(0.283)	0.097	0.011
103	8.58	0.53	0.115	(0.282)	0.104	0.012
104	8.67	0.53	0.115	(0.281)	0.104	0.012
105	8.75	0.53	0.115	(0.280)	0.104	0.012
106	8.83	0.57	0.122	(0.278)	0.110	0.012
107	8.92	0.57	0.122	(0.277)	0.110	0.012
108	9.00	0.57	0.122	(0.276)	0.110	0.012
109	9.08	0.63	0.137	(0.274)	0.123	0.014
110	9.17	0.63	0.137	(0.273)	0.123	0.014
111	9.25	0.63	0.137	(0.272)	0.123	0.014
112	9.33	0.67	0.144	(0.270)	0.130	0.014
113	9.42	0.67	0.144	(0.269)	0.130	0.014
114	9.50	0.67	0.144	(0.268)	0.130	0.014
115	9.58	0.70	0.151	(0.267)	0.136	0.015
116	9.67	0.70	0.151	(0.265)	0.136	0.015
117	9.75	0.70	0.151	(0.264)	0.136	0.015
118	9.83	0.73	0.158	(0.263)	0.143	0.016
119	9.92	0.73	0.158	(0.261)	0.143	0.016
120	10.00	0.73	0.158	(0.260)	0.143	0.016
121	10.08	0.50	0.108	(0.259)	0.097	0.011
122	10.17	0.50	0.108	(0.258)	0.097	0.011
123	10.25	0.50	0.108	(0.256)	0.097	0.011
124	10.33	0.50	0.108	(0.255)	0.097	0.011
125	10.42	0.50	0.108	(0.254)	0.097	0.011
126	10.50	0.50	0.108	(0.253)	0.097	0.011
127	10.58	0.67	0.144	(0.251)	0.130	0.014
128	10.67	0.67	0.144	(0.250)	0.130	0.014
129	10.75	0.67	0.144	(0.249)	0.130	0.014
130	10.83	0.67	0.144	(0.248)	0.130	0.014
131	10.92	0.67	0.144	(0.247)	0.130	0.014
132	11.00	0.67	0.144	(0.245)	0.130	0.014
133	11.08	0.63	0.137	(0.244)	0.123	0.014
134	11.17	0.63	0.137	(0.243)	0.123	0.014
135	11.25	0.63	0.137	(0.242)	0.123	0.014
136	11.33	0.63	0.137	(0.241)	0.123	0.014
137	11.42	0.63	0.137	(0.239)	0.123	0.014
138	11.50	0.63	0.137	(0.238)	0.123	0.014
139	11.58	0.57	0.122	(0.237)	0.110	0.012
140	11.67	0.57	0.122	(0.236)	0.110	0.012
141	11.75	0.57	0.122	(0.235)	0.110	0.012
142	11.83	0.60	0.130	(0.233)	0.117	0.013
143	11.92	0.60	0.130	(0.232)	0.117	0.013
144	12.00	0.60	0.130	(0.231)	0.117	0.013
145	12.08	0.83	0.180	(0.230)	0.162	0.018
146	12.17	0.83	0.180	(0.229)	0.162	0.018
147	12.25	0.83	0.180	(0.228)	0.162	0.018
148	12.33	0.87	0.187	(0.227)	0.168	0.019
149	12.42	0.87	0.187	(0.225)	0.168	0.019
150	12.50	0.87	0.187	(0.224)	0.168	0.019
151	12.58	0.93	0.202	(0.223)	0.181	0.020
152	12.67	0.93	0.202	(0.222)	0.181	0.020
153	12.75	0.93	0.202	(0.221)	0.181	0.020
154	12.83	0.97	0.209	(0.220)	0.188	0.021
155	12.92	0.97	0.209	(0.219)	0.188	0.021
156	13.00	0.97	0.209	(0.218)	0.188	0.021
157	13.08	1.13	0.245	0.216 (0.220)		0.028
158	13.17	1.13	0.245	0.215 (0.220)		0.029

159	13.25	1.13	0.245	0.214	(0.220)	0.031
160	13.33	1.13	0.245	0.213	(0.220)	0.032
161	13.42	1.13	0.245	0.212	(0.220)	0.033
162	13.50	1.13	0.245	0.211	(0.220)	0.034
163	13.58	0.77	0.166	(0.210)	0.149	0.017
164	13.67	0.77	0.166	(0.209)	0.149	0.017
165	13.75	0.77	0.166	(0.208)	0.149	0.017
166	13.83	0.77	0.166	(0.207)	0.149	0.017
167	13.92	0.77	0.166	(0.206)	0.149	0.017
168	14.00	0.77	0.166	(0.205)	0.149	0.017
169	14.08	0.90	0.194	(0.204)	0.175	0.019
170	14.17	0.90	0.194	(0.203)	0.175	0.019
171	14.25	0.90	0.194	(0.202)	0.175	0.019
172	14.33	0.87	0.187	(0.200)	0.168	0.019
173	14.42	0.87	0.187	(0.199)	0.168	0.019
174	14.50	0.87	0.187	(0.198)	0.168	0.019
175	14.58	0.87	0.187	(0.197)	0.168	0.019
176	14.67	0.87	0.187	(0.196)	0.168	0.019
177	14.75	0.87	0.187	(0.195)	0.168	0.019
178	14.83	0.83	0.180	(0.194)	0.162	0.018
179	14.92	0.83	0.180	(0.193)	0.162	0.018
180	15.00	0.83	0.180	(0.192)	0.162	0.018
181	15.08	0.80	0.173	(0.191)	0.156	0.017
182	15.17	0.80	0.173	(0.190)	0.156	0.017
183	15.25	0.80	0.173	(0.189)	0.156	0.017
184	15.33	0.77	0.166	(0.188)	0.149	0.017
185	15.42	0.77	0.166	(0.188)	0.149	0.017
186	15.50	0.77	0.166	(0.187)	0.149	0.017
187	15.58	0.63	0.137	(0.186)	0.123	0.014
188	15.67	0.63	0.137	(0.185)	0.123	0.014
189	15.75	0.63	0.137	(0.184)	0.123	0.014
190	15.83	0.63	0.137	(0.183)	0.123	0.014
191	15.92	0.63	0.137	(0.182)	0.123	0.014
192	16.00	0.63	0.137	(0.181)	0.123	0.014
193	16.08	0.13	0.029	(0.180)	0.026	0.003
194	16.17	0.13	0.029	(0.179)	0.026	0.003
195	16.25	0.13	0.029	(0.178)	0.026	0.003
196	16.33	0.13	0.029	(0.177)	0.026	0.003
197	16.42	0.13	0.029	(0.176)	0.026	0.003
198	16.50	0.13	0.029	(0.175)	0.026	0.003
199	16.58	0.10	0.022	(0.175)	0.019	0.002
200	16.67	0.10	0.022	(0.174)	0.019	0.002
201	16.75	0.10	0.022	(0.173)	0.019	0.002
202	16.83	0.10	0.022	(0.172)	0.019	0.002
203	16.92	0.10	0.022	(0.171)	0.019	0.002
204	17.00	0.10	0.022	(0.170)	0.019	0.002
205	17.08	0.17	0.036	(0.169)	0.032	0.004
206	17.17	0.17	0.036	(0.168)	0.032	0.004
207	17.25	0.17	0.036	(0.168)	0.032	0.004
208	17.33	0.17	0.036	(0.167)	0.032	0.004
209	17.42	0.17	0.036	(0.166)	0.032	0.004
210	17.50	0.17	0.036	(0.165)	0.032	0.004
211	17.58	0.17	0.036	(0.164)	0.032	0.004
212	17.67	0.17	0.036	(0.163)	0.032	0.004
213	17.75	0.17	0.036	(0.163)	0.032	0.004
214	17.83	0.13	0.029	(0.162)	0.026	0.003
215	17.92	0.13	0.029	(0.161)	0.026	0.003
216	18.00	0.13	0.029	(0.160)	0.026	0.003
217	18.08	0.13	0.029	(0.159)	0.026	0.003
218	18.17	0.13	0.029	(0.159)	0.026	0.003
219	18.25	0.13	0.029	(0.158)	0.026	0.003
220	18.33	0.13	0.029	(0.157)	0.026	0.003
221	18.42	0.13	0.029	(0.156)	0.026	0.003
222	18.50	0.13	0.029	(0.156)	0.026	0.003
223	18.58	0.10	0.022	(0.155)	0.019	0.002
224	18.67	0.10	0.022	(0.154)	0.019	0.002
225	18.75	0.10	0.022	(0.153)	0.019	0.002
226	18.83	0.07	0.014	(0.153)	0.013	0.001
227	18.92	0.07	0.014	(0.152)	0.013	0.001
228	19.00	0.07	0.014	(0.151)	0.013	0.001
229	19.08	0.10	0.022	(0.150)	0.019	0.002
230	19.17	0.10	0.022	(0.150)	0.019	0.002
231	19.25	0.10	0.022	(0.149)	0.019	0.002
232	19.33	0.13	0.029	(0.148)	0.026	0.003
233	19.42	0.13	0.029	(0.148)	0.026	0.003
234	19.50	0.13	0.029	(0.147)	0.026	0.003
235	19.58	0.10	0.022	(0.146)	0.019	0.002
236	19.67	0.10	0.022	(0.146)	0.019	0.002
237	19.75	0.10	0.022	(0.145)	0.019	0.002
238	19.83	0.07	0.014	(0.144)	0.013	0.001
239	19.92	0.07	0.014	(0.144)	0.013	0.001
240	20.00	0.07	0.014	(0.143)	0.013	0.001
241	20.08	0.10	0.022	(0.142)	0.019	0.002
242	20.17	0.10	0.022	(0.142)	0.019	0.002
243	20.25	0.10	0.022	(0.141)	0.019	0.002
244	20.33	0.10	0.022	(0.141)	0.019	0.002

245	20.42	0.10	0.022	(0.140)	0.019	0.002
246	20.50	0.10	0.022	(0.139)	0.019	0.002
247	20.58	0.10	0.022	(0.139)	0.019	0.002
248	20.67	0.10	0.022	(0.138)	0.019	0.002
249	20.75	0.10	0.022	(0.138)	0.019	0.002
250	20.83	0.07	0.014	(0.137)	0.013	0.001
251	20.92	0.07	0.014	(0.137)	0.013	0.001
252	21.00	0.07	0.014	(0.136)	0.013	0.001
253	21.08	0.10	0.022	(0.135)	0.019	0.002
254	21.17	0.10	0.022	(0.135)	0.019	0.002
255	21.25	0.10	0.022	(0.134)	0.019	0.002
256	21.33	0.07	0.014	(0.134)	0.013	0.001
257	21.42	0.07	0.014	(0.133)	0.013	0.001
258	21.50	0.07	0.014	(0.133)	0.013	0.001
259	21.58	0.10	0.022	(0.132)	0.019	0.002
260	21.67	0.10	0.022	(0.132)	0.019	0.002
261	21.75	0.10	0.022	(0.131)	0.019	0.002
262	21.83	0.07	0.014	(0.131)	0.013	0.001
263	21.92	0.07	0.014	(0.131)	0.013	0.001
264	22.00	0.07	0.014	(0.130)	0.013	0.001
265	22.08	0.10	0.022	(0.130)	0.019	0.002
266	22.17	0.10	0.022	(0.129)	0.019	0.002
267	22.25	0.10	0.022	(0.129)	0.019	0.002
268	22.33	0.07	0.014	(0.128)	0.013	0.001
269	22.42	0.07	0.014	(0.128)	0.013	0.001
270	22.50	0.07	0.014	(0.128)	0.013	0.001
271	22.58	0.07	0.014	(0.127)	0.013	0.001
272	22.67	0.07	0.014	(0.127)	0.013	0.001
273	22.75	0.07	0.014	(0.127)	0.013	0.001
274	22.83	0.07	0.014	(0.126)	0.013	0.001
275	22.92	0.07	0.014	(0.126)	0.013	0.001
276	23.00	0.07	0.014	(0.126)	0.013	0.001
277	23.08	0.07	0.014	(0.125)	0.013	0.001
278	23.17	0.07	0.014	(0.125)	0.013	0.001
279	23.25	0.07	0.014	(0.125)	0.013	0.001
280	23.33	0.07	0.014	(0.125)	0.013	0.001
281	23.42	0.07	0.014	(0.124)	0.013	0.001
282	23.50	0.07	0.014	(0.124)	0.013	0.001
283	23.58	0.07	0.014	(0.124)	0.013	0.001
284	23.67	0.07	0.014	(0.124)	0.013	0.001
285	23.75	0.07	0.014	(0.124)	0.013	0.001
286	23.83	0.07	0.014	(0.123)	0.013	0.001
287	23.92	0.07	0.014	(0.123)	0.013	0.001
288	24.00	0.07	0.014	(0.123)	0.013	0.001

(Loss Rate Not Used)

Sum =	100.0		Sum =	2.2
Flood volume =	Effective rainfall	0.18(In)		
times area	28.4(Ac.)/[(In)/(Ft.)]	=	0.4(Ac.Ft)	
Total soil loss =	1.62(In)			
Total soil loss =	3.830(Ac.Ft)			
Total rainfall =	1.80(In)			
Flood volume =	18914.8 Cubic Feet			
Total soil loss =	166836.5 Cubic Feet			

Peak flow rate of this hydrograph = 0.948(CFS)

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24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	2.5	5.0	7.5	10.0
0+ 5	0.0001	0.02	Q				
0+10	0.0004	0.04	Q				
0+15	0.0007	0.04	Q				
0+20	0.0010	0.05	Q				
0+25	0.0014	0.06	Q				
0+30	0.0019	0.06	Q				
0+35	0.0023	0.06	Q				
0+40	0.0027	0.06	Q				
0+45	0.0031	0.06	Q				
0+50	0.0036	0.07	Q				
0+55	0.0042	0.08	Q				
1+ 0	0.0048	0.08	Q				
1+ 5	0.0053	0.07	Q				
1+10	0.0057	0.06	Q				
1+15	0.0061	0.06	Q				
1+20	0.0066	0.06	Q				
1+25	0.0070	0.06	Q				
1+30	0.0074	0.06	Q				
1+35	0.0078	0.06	Q				
1+40	0.0083	0.06	Q				
1+45	0.0087	0.06	Q				

1+50	0.0092	0.07	Q				
1+55	0.0097	0.08	Q				
2+ 0	0.0103	0.08	Q				
2+ 5	0.0109	0.08	QV				
2+10	0.0114	0.08	QV				
2+15	0.0120	0.08	QV				
2+20	0.0126	0.08	QV				
2+25	0.0131	0.08	QV				
2+30	0.0137	0.08	QV				
2+35	0.0143	0.09	QV				
2+40	0.0150	0.10	QV				
2+45	0.0157	0.10	QV				
2+50	0.0165	0.10	QV				
2+55	0.0172	0.10	QV				
3+ 0	0.0179	0.10	QV				
3+ 5	0.0186	0.10	QV				
3+10	0.0193	0.10	QV				
3+15	0.0200	0.10	QV				
3+20	0.0207	0.10	QV				
3+25	0.0214	0.10	QV				
3+30	0.0221	0.10	Q V				
3+35	0.0229	0.10	Q V				
3+40	0.0236	0.10	Q V				
3+45	0.0243	0.10	Q V				
3+50	0.0251	0.11	Q V				
3+55	0.0259	0.12	Q V				
4+ 0	0.0267	0.12	Q V				
4+ 5	0.0276	0.12	Q V				
4+10	0.0285	0.12	Q V				
4+15	0.0293	0.12	Q V				
4+20	0.0302	0.13	Q V				
4+25	0.0312	0.14	Q V				
4+30	0.0322	0.14	Q V				
4+35	0.0332	0.14	Q V				
4+40	0.0342	0.14	Q V				
4+45	0.0352	0.14	Q V				
4+50	0.0362	0.15	Q V				
4+55	0.0374	0.16	Q V				
5+ 0	0.0385	0.16	Q V				
5+ 5	0.0395	0.14	Q V				
5+10	0.0404	0.13	Q V				
5+15	0.0412	0.12	Q V				
5+20	0.0422	0.13	Q V				
5+25	0.0431	0.14	Q V				
5+30	0.0441	0.14	Q V				
5+35	0.0452	0.15	Q V				
5+40	0.0463	0.16	Q V				
5+45	0.0475	0.16	Q V				
5+50	0.0486	0.17	Q V				
5+55	0.0497	0.17	Q V				
6+ 0	0.0509	0.17	Q V				
6+ 5	0.0521	0.18	Q V				
6+10	0.0533	0.18	Q V				
6+15	0.0546	0.19	Q V				
6+20	0.0559	0.19	Q V				
6+25	0.0572	0.19	Q V				
6+30	0.0585	0.19	Q V				
6+35	0.0598	0.20	Q V				
6+40	0.0612	0.20	Q V				
6+45	0.0626	0.21	Q V				
6+50	0.0641	0.21	Q V				
6+55	0.0655	0.21	Q V				
7+ 0	0.0669	0.21	Q V				
7+ 5	0.0683	0.21	Q V				
7+10	0.0697	0.21	Q V				
7+15	0.0712	0.21	Q V				
7+20	0.0726	0.22	Q V				
7+25	0.0742	0.22	Q V				
7+30	0.0758	0.23	Q V				
7+35	0.0774	0.24	Q V				
7+40	0.0791	0.25	Q V				
7+45	0.0808	0.25	Q V				
7+50	0.0826	0.26	Q V				
7+55	0.0844	0.27	Q V				
8+ 0	0.0862	0.27	Q V				
8+ 5	0.0882	0.29	Q V				
8+10	0.0903	0.31	Q V				
8+15	0.0925	0.31	Q V				
8+20	0.0946	0.31	Q V				
8+25	0.0967	0.31	Q V				
8+30	0.0988	0.31	Q V				
8+35	0.1010	0.32	Q V				
8+40	0.1033	0.33	Q V				
8+45	0.1056	0.33	Q V				
8+50	0.1079	0.34	Q V				
8+55	0.1103	0.35	Q V				

9+ 0	0.1127	0.35	Q	V			
9+ 5	0.1153	0.37	Q	V			
9+10	0.1180	0.39	Q	V			
9+15	0.1207	0.39	Q	V			
9+20	0.1234	0.40	Q	V			
9+25	0.1263	0.41	Q	V			
9+30	0.1291	0.41	Q	V			
9+35	0.1320	0.42	Q	V			
9+40	0.1350	0.43	Q	V			
9+45	0.1380	0.43	Q	V			
9+50	0.1410	0.44	Q	V			
9+55	0.1441	0.45	Q	V			
10+ 0	0.1472	0.45	Q	V			
10+ 5	0.1499	0.38	Q	V			
10+10	0.1521	0.32	Q	V			
10+15	0.1543	0.31	Q	V			
10+20	0.1564	0.31	Q	V			
10+25	0.1585	0.31	Q	V			
10+30	0.1607	0.31	Q	V			
10+35	0.1632	0.36	Q	V			
10+40	0.1659	0.40	Q	V			
10+45	0.1688	0.41	Q	V			
10+50	0.1716	0.41	Q	V			
10+55	0.1744	0.41	Q	V			
11+ 0	0.1773	0.41	Q	V			
11+ 5	0.1801	0.40	Q	V			
11+10	0.1828	0.39	Q	V			
11+15	0.1855	0.39	Q	V			
11+20	0.1882	0.39	Q	V			
11+25	0.1909	0.39	Q	V			
11+30	0.1936	0.39	Q	V			
11+35	0.1961	0.37	Q	V			
11+40	0.1986	0.36	Q	V			
11+45	0.2010	0.35	Q	V			
11+50	0.2035	0.36	Q	V			
11+55	0.2060	0.37	Q	V			
12+ 0	0.2086	0.37	Q	V			
12+ 5	0.2116	0.44	Q	V			
12+10	0.2151	0.50	Q	V			
12+15	0.2186	0.51	Q	V			
12+20	0.2222	0.53	Q	V			
12+25	0.2259	0.53	Q	V			
12+30	0.2296	0.54	Q	V			
12+35	0.2334	0.56	Q	V			
12+40	0.2374	0.57	Q	V			
12+45	0.2414	0.58	Q	V			
12+50	0.2454	0.59	Q	V			
12+55	0.2495	0.60	Q	V			
13+ 0	0.2536	0.60	Q	V			
13+ 5	0.2585	0.70	Q	V			
13+10	0.2640	0.81	Q	V			
13+15	0.2699	0.85	Q	V			
13+20	0.2760	0.89	Q	V			
13+25	0.2823	0.92	Q	V			
13+30	0.2888	0.95	Q	V			
13+35	0.2938	0.72	Q	V			
13+40	0.2974	0.52	Q	V			
13+45	0.3008	0.49	Q	V			
13+50	0.3041	0.47	Q	V			
13+55	0.3073	0.47	Q	V			
14+ 0	0.3106	0.47	Q	V			
14+ 5	0.3141	0.52	Q	V			
14+10	0.3179	0.55	Q	V			
14+15	0.3218	0.56	Q	V			
14+20	0.3255	0.55	Q	V			
14+25	0.3292	0.54	Q	V			
14+30	0.3329	0.54	Q	V			
14+35	0.3366	0.54	Q	V			
14+40	0.3403	0.54	Q	V			
14+45	0.3440	0.54	Q	V			
14+50	0.3476	0.53	Q	V			
14+55	0.3512	0.52	Q	V			
15+ 0	0.3548	0.52	Q	V			
15+ 5	0.3583	0.51	Q	V			
15+10	0.3617	0.50	Q	V			
15+15	0.3651	0.50	Q	V			
15+20	0.3684	0.49	Q	V			
15+25	0.3717	0.48	Q	V			
15+30	0.3750	0.48	Q	V			
15+35	0.3780	0.43	Q	V			
15+40	0.3807	0.40	Q	V			
15+45	0.3835	0.39	Q	V			
15+50	0.3862	0.39	Q	V			
15+55	0.3889	0.39	Q	V			
16+ 0	0.3916	0.39	Q	V			
16+ 5	0.3932	0.24	Q	V			

16+10	0.3940	0.11	Q				V
16+15	0.3946	0.09	Q				V
16+20	0.3952	0.08	Q				V
16+25	0.3958	0.08	Q				V
16+30	0.3963	0.08	Q				V
16+35	0.3968	0.07	Q				V
16+40	0.3973	0.06	Q				V
16+45	0.3977	0.06	Q				V
16+50	0.3981	0.06	Q				V
16+55	0.3986	0.06	Q				V
17+ 0	0.3990	0.06	Q				V
17+ 5	0.3996	0.08	Q				V
17+10	0.4002	0.10	Q				V
17+15	0.4009	0.10	Q				V
17+20	0.4016	0.10	Q				V
17+25	0.4024	0.10	Q				V
17+30	0.4031	0.10	Q				V
17+35	0.4038	0.10	Q				V
17+40	0.4045	0.10	Q				V
17+45	0.4052	0.10	Q				V
17+50	0.4058	0.09	Q				V
17+55	0.4064	0.08	Q				V
18+ 0	0.4070	0.08	Q				V
18+ 5	0.4076	0.08	Q				V
18+10	0.4081	0.08	Q				V
18+15	0.4087	0.08	Q				V
18+20	0.4093	0.08	Q				V
18+25	0.4098	0.08	Q				V
18+30	0.4104	0.08	Q				V
18+35	0.4109	0.07	Q				V
18+40	0.4113	0.06	Q				V
18+45	0.4118	0.06	Q				V
18+50	0.4121	0.05	Q				V
18+55	0.4124	0.04	Q				V
19+ 0	0.4127	0.04	Q				V
19+ 5	0.4131	0.05	Q				V
19+10	0.4135	0.06	Q				V
19+15	0.4139	0.06	Q				V
19+20	0.4144	0.07	Q				V
19+25	0.4150	0.08	Q				V
19+30	0.4155	0.08	Q				V
19+35	0.4160	0.07	Q				V
19+40	0.4165	0.06	Q				V
19+45	0.4169	0.06	Q				V
19+50	0.4173	0.05	Q				V
19+55	0.4176	0.04	Q				V
20+ 0	0.4178	0.04	Q				V
20+ 5	0.4182	0.05	Q				V
20+10	0.4186	0.06	Q				V
20+15	0.4190	0.06	Q				V
20+20	0.4195	0.06	Q				V
20+25	0.4199	0.06	Q				V
20+30	0.4203	0.06	Q				V
20+35	0.4207	0.06	Q				V
20+40	0.4212	0.06	Q				V
20+45	0.4216	0.06	Q				V
20+50	0.4219	0.05	Q				V
20+55	0.4222	0.04	Q				V
21+ 0	0.4225	0.04	Q				V
21+ 5	0.4229	0.05	Q				V
21+10	0.4233	0.06	Q				V
21+15	0.4237	0.06	Q				V
21+20	0.4241	0.05	Q				V
21+25	0.4244	0.04	Q				V
21+30	0.4247	0.04	Q				V
21+35	0.4250	0.05	Q				V
21+40	0.4254	0.06	Q				V
21+45	0.4258	0.06	Q				V
21+50	0.4262	0.05	Q				V
21+55	0.4265	0.04	Q				V
22+ 0	0.4268	0.04	Q				V
22+ 5	0.4271	0.05	Q				V
22+10	0.4276	0.06	Q				V
22+15	0.4280	0.06	Q				V
22+20	0.4283	0.05	Q				V
22+25	0.4286	0.04	Q				V
22+30	0.4289	0.04	Q				V
22+35	0.4292	0.04	Q				V
22+40	0.4295	0.04	Q				V
22+45	0.4298	0.04	Q				V
22+50	0.4301	0.04	Q				V
22+55	0.4303	0.04	Q				V
23+ 0	0.4306	0.04	Q				V
23+ 5	0.4309	0.04	Q				V
23+10	0.4312	0.04	Q				V
23+15	0.4315	0.04	Q				V

23+20	0.4318	0.04	Q				V
23+25	0.4321	0.04	Q				V
23+30	0.4323	0.04	Q				V
23+35	0.4326	0.04	Q				V
23+40	0.4329	0.04	Q				V
23+45	0.4332	0.04	Q				V
23+50	0.4335	0.04	Q				V
23+55	0.4338	0.04	Q				V
24+ 0	0.4340	0.04	Q				V
24+ 5	0.4342	0.02	Q				V
24+10	0.4342	0.00	Q				V
24+15	0.4342	0.00	Q				V

Unit Hydrograph Analysis

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Study date 12/17/24 File: pro2242.out

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

Program License Serial Number 5006

English (in-lb) Input Units Used
English Rainfall Data (Inches) Input values Used
English Units used in output format

Drainage Area = 28.43(Ac.) = 0.044 Sq. Mi.
Drainage Area for Depth-Area Area Adjustment = 28.43(Ac.) = 0.044 Sq. Mi.
Length along longest watercourse = 2325.00(Ft.)
Length along longest watercourse measured to centroid = 1172.00(Ft.)
Length along longest watercourse = 0.440 Mi.
Length along longest watercourse measured to centroid = 0.222 Mi.
Difference in elevation = 62.00(Ft.)
Slope along watercourse = 140.8000 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time = 0.058 Hr.
Lag time = 3.49 Min.
25% of lag time = 0.87 Min.
40% of lag time = 1.39 Min.
Unit time = 5.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow = 0.00(CFS)

2 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	weighting[1*2]
28.43	1.80	51.17

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	weighting[1*2]
28.43	5.00	142.15

STORM EVENT (YEAR) = 2.00
Area Averaged 2-Year Rainfall = 1.800(In)
Area Averaged 100-Year Rainfall = 5.000(In)

Point rain (area averaged) = 1.800(In)
Areal adjustment factor = 99.99 %
Adjusted average point rain = 1.800(In)

Sub-Area Data:
Area(Ac.) Runoff Index Impervious %
28.430 69.00 0.500
Total Area Entered = 28.43(Ac.)

RI	RI	Infil. Rate	Impervious	Adj. Infil. Rate	Area%	F
AMC2	AMC-1	(In/Hr)	(Dec.)	(In/Hr)	(Dec.)	(In/Hr)
69.0	49.8	0.574	0.500	0.316	1.000	0.316
					Sum (F) =	0.316

Area averaged mean soil loss (F) (In/Hr) = 0.316
Minimum soil loss rate ((In/Hr)) = 0.158
(for 24 hour storm duration)
Soil loss rate (decimal) = 0.500

Unit Hydrograph VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)	Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
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1	0.083	143.390	31.542	9.037
2	0.167	286.780	47.479	13.604
3	0.250	430.170	11.584	3.319
4	0.333	573.561	5.090	1.458
5	0.417	716.951	2.667	0.764
6	0.500	860.341	1.639	0.470
Sum = 100.000			Sum=	28.652

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

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr)		Effective (In/Hr)
				Max	Low	
1	0.08	0.07	0.014	(0.560)	0.007	0.007
2	0.17	0.07	0.014	(0.557)	0.007	0.007
3	0.25	0.07	0.014	(0.555)	0.007	0.007
4	0.33	0.10	0.022	(0.553)	0.011	0.011
5	0.42	0.10	0.022	(0.551)	0.011	0.011
6	0.50	0.10	0.022	(0.549)	0.011	0.011
7	0.58	0.10	0.022	(0.547)	0.011	0.011
8	0.67	0.10	0.022	(0.545)	0.011	0.011
9	0.75	0.10	0.022	(0.542)	0.011	0.011
10	0.83	0.13	0.029	(0.540)	0.014	0.014
11	0.92	0.13	0.029	(0.538)	0.014	0.014
12	1.00	0.13	0.029	(0.536)	0.014	0.014
13	1.08	0.10	0.022	(0.534)	0.011	0.011
14	1.17	0.10	0.022	(0.532)	0.011	0.011
15	1.25	0.10	0.022	(0.530)	0.011	0.011
16	1.33	0.10	0.022	(0.528)	0.011	0.011
17	1.42	0.10	0.022	(0.525)	0.011	0.011
18	1.50	0.10	0.022	(0.523)	0.011	0.011
19	1.58	0.10	0.022	(0.521)	0.011	0.011
20	1.67	0.10	0.022	(0.519)	0.011	0.011
21	1.75	0.10	0.022	(0.517)	0.011	0.011
22	1.83	0.13	0.029	(0.515)	0.014	0.014
23	1.92	0.13	0.029	(0.513)	0.014	0.014
24	2.00	0.13	0.029	(0.511)	0.014	0.014
25	2.08	0.13	0.029	(0.509)	0.014	0.014
26	2.17	0.13	0.029	(0.507)	0.014	0.014
27	2.25	0.13	0.029	(0.505)	0.014	0.014
28	2.33	0.13	0.029	(0.503)	0.014	0.014
29	2.42	0.13	0.029	(0.501)	0.014	0.014
30	2.50	0.13	0.029	(0.499)	0.014	0.014
31	2.58	0.17	0.036	(0.497)	0.018	0.018
32	2.67	0.17	0.036	(0.494)	0.018	0.018
33	2.75	0.17	0.036	(0.492)	0.018	0.018
34	2.83	0.17	0.036	(0.490)	0.018	0.018
35	2.92	0.17	0.036	(0.488)	0.018	0.018
36	3.00	0.17	0.036	(0.486)	0.018	0.018
37	3.08	0.17	0.036	(0.484)	0.018	0.018
38	3.17	0.17	0.036	(0.482)	0.018	0.018
39	3.25	0.17	0.036	(0.480)	0.018	0.018
40	3.33	0.17	0.036	(0.478)	0.018	0.018
41	3.42	0.17	0.036	(0.476)	0.018	0.018
42	3.50	0.17	0.036	(0.474)	0.018	0.018
43	3.58	0.17	0.036	(0.472)	0.018	0.018
44	3.67	0.17	0.036	(0.470)	0.018	0.018
45	3.75	0.17	0.036	(0.468)	0.018	0.018
46	3.83	0.20	0.043	(0.466)	0.022	0.022
47	3.92	0.20	0.043	(0.464)	0.022	0.022
48	4.00	0.20	0.043	(0.463)	0.022	0.022
49	4.08	0.20	0.043	(0.461)	0.022	0.022
50	4.17	0.20	0.043	(0.459)	0.022	0.022
51	4.25	0.20	0.043	(0.457)	0.022	0.022
52	4.33	0.23	0.050	(0.455)	0.025	0.025
53	4.42	0.23	0.050	(0.453)	0.025	0.025
54	4.50	0.23	0.050	(0.451)	0.025	0.025
55	4.58	0.23	0.050	(0.449)	0.025	0.025
56	4.67	0.23	0.050	(0.447)	0.025	0.025
57	4.75	0.23	0.050	(0.445)	0.025	0.025
58	4.83	0.27	0.058	(0.443)	0.029	0.029
59	4.92	0.27	0.058	(0.441)	0.029	0.029
60	5.00	0.27	0.058	(0.439)	0.029	0.029
61	5.08	0.20	0.043	(0.437)	0.022	0.022
62	5.17	0.20	0.043	(0.435)	0.022	0.022
63	5.25	0.20	0.043	(0.434)	0.022	0.022
64	5.33	0.23	0.050	(0.432)	0.025	0.025
65	5.42	0.23	0.050	(0.430)	0.025	0.025
66	5.50	0.23	0.050	(0.428)	0.025	0.025
67	5.58	0.27	0.058	(0.426)	0.029	0.029
68	5.67	0.27	0.058	(0.424)	0.029	0.029
69	5.75	0.27	0.058	(0.422)	0.029	0.029
70	5.83	0.27	0.058	(0.420)	0.029	0.029

71	5.92	0.27	0.058	(0.419)	0.029	0.029
72	6.00	0.27	0.058	(0.417)	0.029	0.029
73	6.08	0.30	0.065	(0.415)	0.032	0.032
74	6.17	0.30	0.065	(0.413)	0.032	0.032
75	6.25	0.30	0.065	(0.411)	0.032	0.032
76	6.33	0.30	0.065	(0.409)	0.032	0.032
77	6.42	0.30	0.065	(0.407)	0.032	0.032
78	6.50	0.30	0.065	(0.406)	0.032	0.032
79	6.58	0.33	0.072	(0.404)	0.036	0.036
80	6.67	0.33	0.072	(0.402)	0.036	0.036
81	6.75	0.33	0.072	(0.400)	0.036	0.036
82	6.83	0.33	0.072	(0.398)	0.036	0.036
83	6.92	0.33	0.072	(0.397)	0.036	0.036
84	7.00	0.33	0.072	(0.395)	0.036	0.036
85	7.08	0.33	0.072	(0.393)	0.036	0.036
86	7.17	0.33	0.072	(0.391)	0.036	0.036
87	7.25	0.33	0.072	(0.389)	0.036	0.036
88	7.33	0.37	0.079	(0.388)	0.040	0.040
89	7.42	0.37	0.079	(0.386)	0.040	0.040
90	7.50	0.37	0.079	(0.384)	0.040	0.040
91	7.58	0.40	0.086	(0.382)	0.043	0.043
92	7.67	0.40	0.086	(0.381)	0.043	0.043
93	7.75	0.40	0.086	(0.379)	0.043	0.043
94	7.83	0.43	0.094	(0.377)	0.047	0.047
95	7.92	0.43	0.094	(0.375)	0.047	0.047
96	8.00	0.43	0.094	(0.374)	0.047	0.047
97	8.08	0.50	0.108	(0.372)	0.054	0.054
98	8.17	0.50	0.108	(0.370)	0.054	0.054
99	8.25	0.50	0.108	(0.368)	0.054	0.054
100	8.33	0.50	0.108	(0.367)	0.054	0.054
101	8.42	0.50	0.108	(0.365)	0.054	0.054
102	8.50	0.50	0.108	(0.363)	0.054	0.054
103	8.58	0.53	0.115	(0.362)	0.058	0.058
104	8.67	0.53	0.115	(0.360)	0.058	0.058
105	8.75	0.53	0.115	(0.358)	0.058	0.058
106	8.83	0.57	0.122	(0.356)	0.061	0.061
107	8.92	0.57	0.122	(0.355)	0.061	0.061
108	9.00	0.57	0.122	(0.353)	0.061	0.061
109	9.08	0.63	0.137	(0.351)	0.068	0.068
110	9.17	0.63	0.137	(0.350)	0.068	0.068
111	9.25	0.63	0.137	(0.348)	0.068	0.068
112	9.33	0.67	0.144	(0.346)	0.072	0.072
113	9.42	0.67	0.144	(0.345)	0.072	0.072
114	9.50	0.67	0.144	(0.343)	0.072	0.072
115	9.58	0.70	0.151	(0.341)	0.076	0.076
116	9.67	0.70	0.151	(0.340)	0.076	0.076
117	9.75	0.70	0.151	(0.338)	0.076	0.076
118	9.83	0.73	0.158	(0.337)	0.079	0.079
119	9.92	0.73	0.158	(0.335)	0.079	0.079
120	10.00	0.73	0.158	(0.333)	0.079	0.079
121	10.08	0.50	0.108	(0.332)	0.054	0.054
122	10.17	0.50	0.108	(0.330)	0.054	0.054
123	10.25	0.50	0.108	(0.329)	0.054	0.054
124	10.33	0.50	0.108	(0.327)	0.054	0.054
125	10.42	0.50	0.108	(0.325)	0.054	0.054
126	10.50	0.50	0.108	(0.324)	0.054	0.054
127	10.58	0.67	0.144	(0.322)	0.072	0.072
128	10.67	0.67	0.144	(0.321)	0.072	0.072
129	10.75	0.67	0.144	(0.319)	0.072	0.072
130	10.83	0.67	0.144	(0.317)	0.072	0.072
131	10.92	0.67	0.144	(0.316)	0.072	0.072
132	11.00	0.67	0.144	(0.314)	0.072	0.072
133	11.08	0.63	0.137	(0.313)	0.068	0.068
134	11.17	0.63	0.137	(0.311)	0.068	0.068
135	11.25	0.63	0.137	(0.310)	0.068	0.068
136	11.33	0.63	0.137	(0.308)	0.068	0.068
137	11.42	0.63	0.137	(0.307)	0.068	0.068
138	11.50	0.63	0.137	(0.305)	0.068	0.068
139	11.58	0.57	0.122	(0.304)	0.061	0.061
140	11.67	0.57	0.122	(0.302)	0.061	0.061
141	11.75	0.57	0.122	(0.301)	0.061	0.061
142	11.83	0.60	0.130	(0.299)	0.065	0.065
143	11.92	0.60	0.130	(0.298)	0.065	0.065
144	12.00	0.60	0.130	(0.296)	0.065	0.065
145	12.08	0.83	0.180	(0.295)	0.090	0.090
146	12.17	0.83	0.180	(0.293)	0.090	0.090
147	12.25	0.83	0.180	(0.292)	0.090	0.090
148	12.33	0.87	0.187	(0.290)	0.094	0.094
149	12.42	0.87	0.187	(0.289)	0.094	0.094
150	12.50	0.87	0.187	(0.287)	0.094	0.094
151	12.58	0.93	0.202	(0.286)	0.101	0.101
152	12.67	0.93	0.202	(0.284)	0.101	0.101
153	12.75	0.93	0.202	(0.283)	0.101	0.101
154	12.83	0.97	0.209	(0.282)	0.104	0.104
155	12.92	0.97	0.209	(0.280)	0.104	0.104
156	13.00	0.97	0.209	(0.279)	0.104	0.104

157	13.08	1.13	0.245	(0.277)	0.122	0.122
158	13.17	1.13	0.245	(0.276)	0.122	0.122
159	13.25	1.13	0.245	(0.275)	0.122	0.122
160	13.33	1.13	0.245	(0.273)	0.122	0.122
161	13.42	1.13	0.245	(0.272)	0.122	0.122
162	13.50	1.13	0.245	(0.270)	0.122	0.122
163	13.58	0.77	0.166	(0.269)	0.083	0.083
164	13.67	0.77	0.166	(0.268)	0.083	0.083
165	13.75	0.77	0.166	(0.266)	0.083	0.083
166	13.83	0.77	0.166	(0.265)	0.083	0.083
167	13.92	0.77	0.166	(0.264)	0.083	0.083
168	14.00	0.77	0.166	(0.262)	0.083	0.083
169	14.08	0.90	0.194	(0.261)	0.097	0.097
170	14.17	0.90	0.194	(0.260)	0.097	0.097
171	14.25	0.90	0.194	(0.258)	0.097	0.097
172	14.33	0.87	0.187	(0.257)	0.094	0.094
173	14.42	0.87	0.187	(0.256)	0.094	0.094
174	14.50	0.87	0.187	(0.254)	0.094	0.094
175	14.58	0.87	0.187	(0.253)	0.094	0.094
176	14.67	0.87	0.187	(0.252)	0.094	0.094
177	14.75	0.87	0.187	(0.250)	0.094	0.094
178	14.83	0.83	0.180	(0.249)	0.090	0.090
179	14.92	0.83	0.180	(0.248)	0.090	0.090
180	15.00	0.83	0.180	(0.247)	0.090	0.090
181	15.08	0.80	0.173	(0.245)	0.086	0.086
182	15.17	0.80	0.173	(0.244)	0.086	0.086
183	15.25	0.80	0.173	(0.243)	0.086	0.086
184	15.33	0.77	0.166	(0.242)	0.083	0.083
185	15.42	0.77	0.166	(0.240)	0.083	0.083
186	15.50	0.77	0.166	(0.239)	0.083	0.083
187	15.58	0.63	0.137	(0.238)	0.068	0.068
188	15.67	0.63	0.137	(0.237)	0.068	0.068
189	15.75	0.63	0.137	(0.235)	0.068	0.068
190	15.83	0.63	0.137	(0.234)	0.068	0.068
191	15.92	0.63	0.137	(0.233)	0.068	0.068
192	16.00	0.63	0.137	(0.232)	0.068	0.068
193	16.08	0.13	0.029	(0.231)	0.014	0.014
194	16.17	0.13	0.029	(0.229)	0.014	0.014
195	16.25	0.13	0.029	(0.228)	0.014	0.014
196	16.33	0.13	0.029	(0.227)	0.014	0.014
197	16.42	0.13	0.029	(0.226)	0.014	0.014
198	16.50	0.13	0.029	(0.225)	0.014	0.014
199	16.58	0.10	0.022	(0.224)	0.011	0.011
200	16.67	0.10	0.022	(0.223)	0.011	0.011
201	16.75	0.10	0.022	(0.221)	0.011	0.011
202	16.83	0.10	0.022	(0.220)	0.011	0.011
203	16.92	0.10	0.022	(0.219)	0.011	0.011
204	17.00	0.10	0.022	(0.218)	0.011	0.011
205	17.08	0.17	0.036	(0.217)	0.018	0.018
206	17.17	0.17	0.036	(0.216)	0.018	0.018
207	17.25	0.17	0.036	(0.215)	0.018	0.018
208	17.33	0.17	0.036	(0.214)	0.018	0.018
209	17.42	0.17	0.036	(0.213)	0.018	0.018
210	17.50	0.17	0.036	(0.212)	0.018	0.018
211	17.58	0.17	0.036	(0.211)	0.018	0.018
212	17.67	0.17	0.036	(0.209)	0.018	0.018
213	17.75	0.17	0.036	(0.208)	0.018	0.018
214	17.83	0.13	0.029	(0.207)	0.014	0.014
215	17.92	0.13	0.029	(0.206)	0.014	0.014
216	18.00	0.13	0.029	(0.205)	0.014	0.014
217	18.08	0.13	0.029	(0.204)	0.014	0.014
218	18.17	0.13	0.029	(0.203)	0.014	0.014
219	18.25	0.13	0.029	(0.202)	0.014	0.014
220	18.33	0.13	0.029	(0.201)	0.014	0.014
221	18.42	0.13	0.029	(0.200)	0.014	0.014
222	18.50	0.13	0.029	(0.199)	0.014	0.014
223	18.58	0.10	0.022	(0.198)	0.011	0.011
224	18.67	0.10	0.022	(0.197)	0.011	0.011
225	18.75	0.10	0.022	(0.197)	0.011	0.011
226	18.83	0.07	0.014	(0.196)	0.007	0.007
227	18.92	0.07	0.014	(0.195)	0.007	0.007
228	19.00	0.07	0.014	(0.194)	0.007	0.007
229	19.08	0.10	0.022	(0.193)	0.011	0.011
230	19.17	0.10	0.022	(0.192)	0.011	0.011
231	19.25	0.10	0.022	(0.191)	0.011	0.011
232	19.33	0.13	0.029	(0.190)	0.014	0.014
233	19.42	0.13	0.029	(0.189)	0.014	0.014
234	19.50	0.13	0.029	(0.188)	0.014	0.014
235	19.58	0.10	0.022	(0.187)	0.011	0.011
236	19.67	0.10	0.022	(0.187)	0.011	0.011
237	19.75	0.10	0.022	(0.186)	0.011	0.011
238	19.83	0.07	0.014	(0.185)	0.007	0.007
239	19.92	0.07	0.014	(0.184)	0.007	0.007
240	20.00	0.07	0.014	(0.183)	0.007	0.007
241	20.08	0.10	0.022	(0.182)	0.011	0.011
242	20.17	0.10	0.022	(0.182)	0.011	0.011

243	20.25	0.10	0.022	(0.181)	0.011	0.011
244	20.33	0.10	0.022	(0.180)	0.011	0.011
245	20.42	0.10	0.022	(0.179)	0.011	0.011
246	20.50	0.10	0.022	(0.179)	0.011	0.011
247	20.58	0.10	0.022	(0.178)	0.011	0.011
248	20.67	0.10	0.022	(0.177)	0.011	0.011
249	20.75	0.10	0.022	(0.176)	0.011	0.011
250	20.83	0.07	0.014	(0.176)	0.007	0.007
251	20.92	0.07	0.014	(0.175)	0.007	0.007
252	21.00	0.07	0.014	(0.174)	0.007	0.007
253	21.08	0.10	0.022	(0.174)	0.011	0.011
254	21.17	0.10	0.022	(0.173)	0.011	0.011
255	21.25	0.10	0.022	(0.172)	0.011	0.011
256	21.33	0.07	0.014	(0.172)	0.007	0.007
257	21.42	0.07	0.014	(0.171)	0.007	0.007
258	21.50	0.07	0.014	(0.170)	0.007	0.007
259	21.58	0.10	0.022	(0.170)	0.011	0.011
260	21.67	0.10	0.022	(0.169)	0.011	0.011
261	21.75	0.10	0.022	(0.168)	0.011	0.011
262	21.83	0.07	0.014	(0.168)	0.007	0.007
263	21.92	0.07	0.014	(0.167)	0.007	0.007
264	22.00	0.07	0.014	(0.167)	0.007	0.007
265	22.08	0.10	0.022	(0.166)	0.011	0.011
266	22.17	0.10	0.022	(0.166)	0.011	0.011
267	22.25	0.10	0.022	(0.165)	0.011	0.011
268	22.33	0.07	0.014	(0.165)	0.007	0.007
269	22.42	0.07	0.014	(0.164)	0.007	0.007
270	22.50	0.07	0.014	(0.164)	0.007	0.007
271	22.58	0.07	0.014	(0.163)	0.007	0.007
272	22.67	0.07	0.014	(0.163)	0.007	0.007
273	22.75	0.07	0.014	(0.162)	0.007	0.007
274	22.83	0.07	0.014	(0.162)	0.007	0.007
275	22.92	0.07	0.014	(0.161)	0.007	0.007
276	23.00	0.07	0.014	(0.161)	0.007	0.007
277	23.08	0.07	0.014	(0.161)	0.007	0.007
278	23.17	0.07	0.014	(0.160)	0.007	0.007
279	23.25	0.07	0.014	(0.160)	0.007	0.007
280	23.33	0.07	0.014	(0.160)	0.007	0.007
281	23.42	0.07	0.014	(0.159)	0.007	0.007
282	23.50	0.07	0.014	(0.159)	0.007	0.007
283	23.58	0.07	0.014	(0.159)	0.007	0.007
284	23.67	0.07	0.014	(0.158)	0.007	0.007
285	23.75	0.07	0.014	(0.158)	0.007	0.007
286	23.83	0.07	0.014	(0.158)	0.007	0.007
287	23.92	0.07	0.014	(0.158)	0.007	0.007
288	24.00	0.07	0.014	(0.158)	0.007	0.007

(Loss Rate Not Used)
Sum = 100.0 Sum = 10.8

Flood volume = Effective rainfall 0.90(In)
times area 28.4(Ac.)/[(In)/(Ft.)] = 2.1(Ac.Ft)
Total soil loss = 0.90(In)
Total soil loss = 2.132(Ac.Ft)
Total rainfall = 1.80(In)
Flood volume = 92875.7 Cubic Feet
Total soil loss = 92875.7 Cubic Feet

Peak flow rate of this hydrograph = 3.509(CFS)

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24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	2.5	5.0	7.5	10.0
0+ 5	0.0004	0.07	Q				
0+10	0.0016	0.16	Q				
0+15	0.0029	0.19	Q				
0+20	0.0044	0.23	Q				
0+25	0.0064	0.28	VQ				
0+30	0.0085	0.30	VQ				
0+35	0.0106	0.31	VQ				
0+40	0.0127	0.31	VQ				
0+45	0.0148	0.31	VQ				
0+50	0.0172	0.34	VQ				
0+55	0.0199	0.39	VQ				
1+ 0	0.0226	0.40	VQ				
1+ 5	0.0252	0.38	VQ				
1+10	0.0275	0.33	VQ				
1+15	0.0297	0.32	VQ				
1+20	0.0319	0.31	VQ				
1+25	0.0340	0.31	VQ				
1+30	0.0361	0.31	VQ				
1+35	0.0383	0.31	VQ				

1+40	0.0404	0.31	VQ				
1+45	0.0425	0.31	VQ				
1+50	0.0449	0.34	VQ				
1+55	0.0476	0.39	VQ				
2+ 0	0.0504	0.40	VQ				
2+ 5	0.0532	0.41	VQ				
2+10	0.0560	0.41	Q				
2+15	0.0589	0.41	Q				
2+20	0.0617	0.41	Q				
2+25	0.0645	0.41	Q				
2+30	0.0674	0.41	Q				
2+35	0.0704	0.45	Q				
2+40	0.0739	0.49	Q				
2+45	0.0773	0.51	VQ				
2+50	0.0809	0.51	VQ				
2+55	0.0844	0.51	VQ				
3+ 0	0.0880	0.52	VQ				
3+ 5	0.0915	0.52	VQ				
3+10	0.0951	0.52	VQ				
3+15	0.0986	0.52	VQ				
3+20	0.1022	0.52	VQ				
3+25	0.1057	0.52	VQ				
3+30	0.1093	0.52	Q				
3+35	0.1128	0.52	Q				
3+40	0.1164	0.52	Q				
3+45	0.1199	0.52	Q				
3+50	0.1237	0.55	Q				
3+55	0.1278	0.60	Q				
4+ 0	0.1320	0.61	Q				
4+ 5	0.1363	0.61	Q				
4+10	0.1405	0.62	Q				
4+15	0.1448	0.62	Q				
4+20	0.1493	0.65	Q				
4+25	0.1541	0.70	Q				
4+30	0.1590	0.71	Q				
4+35	0.1639	0.72	QV				
4+40	0.1689	0.72	QV				
4+45	0.1739	0.72	QV				
4+50	0.1791	0.75	Q				
4+55	0.1846	0.80	Q				
5+ 0	0.1902	0.82	Q				
5+ 5	0.1954	0.76	Q				
5+10	0.2000	0.66	QV				
5+15	0.2044	0.64	QV				
5+20	0.2089	0.66	QV				
5+25	0.2138	0.70	Q V				
5+30	0.2187	0.71	Q V				
5+35	0.2239	0.75	QV				
5+40	0.2294	0.80	QV				
5+45	0.2350	0.82	QV				
5+50	0.2407	0.82	QV				
5+55	0.2463	0.82	QV				
6+ 0	0.2520	0.83	QV				
6+ 5	0.2579	0.86	QV				
6+10	0.2642	0.91	QV				
6+15	0.2705	0.92	Q V				
6+20	0.2769	0.92	Q V				
6+25	0.2833	0.93	Q V				
6+30	0.2897	0.93	Q V				
6+35	0.2963	0.96	Q V				
6+40	0.3032	1.01	QV				
6+45	0.3103	1.02	QV				
6+50	0.3174	1.03	QV				
6+55	0.3245	1.03	Q V				
7+ 0	0.3316	1.03	Q V				
7+ 5	0.3387	1.03	Q V				
7+10	0.3458	1.03	Q V				
7+15	0.3529	1.03	Q V				
7+20	0.3602	1.06	Q V				
7+25	0.3679	1.11	Q V				
7+30	0.3756	1.13	Q V				
7+35	0.3836	1.16	Q V				
7+40	0.3920	1.22	Q V				
7+45	0.4005	1.23	Q V				
7+50	0.4092	1.27	Q V				
7+55	0.4183	1.32	Q V				
8+ 0	0.4274	1.33	Q V				
8+ 5	0.4371	1.40	Q V				
8+10	0.4475	1.50	Q V				
8+15	0.4580	1.53	Q V				
8+20	0.4686	1.54	Q V				
8+25	0.4792	1.54	Q V				
8+30	0.4899	1.55	Q V				
8+35	0.5008	1.58	Q V				
8+40	0.5120	1.63	Q V				
8+45	0.5233	1.64	Q V				

8+50	0.5349	1.68	Q	V		
8+55	0.5468	1.73	Q	V		
9+ 0	0.5588	1.74	Q	V		
9+ 5	0.5713	1.81	Q	V		
9+10	0.5845	1.92	Q	V		
9+15	0.5979	1.94	Q	V		
9+20	0.6115	1.98	Q	V		
9+25	0.6256	2.04	Q	V		
9+30	0.6397	2.05	Q	V		
9+35	0.6541	2.09	Q	V		
9+40	0.6689	2.14	Q	V		
9+45	0.6837	2.16	Q	V		
9+50	0.6989	2.20	Q	V		
9+55	0.7143	2.25	Q	V		
10+ 0	0.7299	2.26	Q	V		
10+ 5	0.7439	2.04	Q	V		
10+10	0.7556	1.70	Q	V		
10+15	0.7668	1.62	Q	V		
10+20	0.7776	1.58	Q	V		
10+25	0.7884	1.56	Q	V		
10+30	0.7990	1.55	Q	V		
10+35	0.8108	1.71	Q	V		
10+40	0.8243	1.96	Q	V		
10+45	0.8382	2.02	Q	V		
10+50	0.8522	2.04	Q	V		
10+55	0.8664	2.06	Q	V		
11+ 0	0.8806	2.06	Q	V		
11+ 5	0.8946	2.03	Q	V		
11+10	0.9082	1.98	Q	V		
11+15	0.9218	1.97	Q	V		
11+20	0.9353	1.97	Q	V		
11+25	0.9489	1.96	Q	V		
11+30	0.9624	1.96	Q	V		
11+35	0.9754	1.90	Q	V		
11+40	0.9878	1.80	Q	V		
11+45	1.0000	1.77	Q	V		
11+50	1.0124	1.80	Q	V		
11+55	1.0251	1.84	Q	V		
12+ 0	1.0378	1.85	Q	V		
12+ 5	1.0521	2.08	Q	V		
12+10	1.0688	2.43	Q	V		
12+15	1.0861	2.51	Q	V		
12+20	1.1039	2.58	Q	V		
12+25	1.1221	2.65	Q	V		
12+30	1.1406	2.67	Q	V		
12+35	1.1595	2.74	Q	V		
12+40	1.1790	2.84	Q	V		
12+45	1.1988	2.87	Q	V		
12+50	1.2189	2.91	Q	V		
12+55	1.2393	2.97	Q	V		
13+ 0	1.2599	2.98	Q	V		
13+ 5	1.2816	3.15	Q	V		
13+10	1.3050	3.40	Q	V		
13+15	1.3288	3.46	Q	V		
13+20	1.3528	3.49	Q	V		
13+25	1.3769	3.50	Q	V		
13+30	1.4011	3.51	Q	V		
13+35	1.4228	3.15	Q	V		
13+40	1.4408	2.61	Q	V		
13+45	1.4578	2.48	Q	V		
13+50	1.4745	2.42	Q	V		
13+55	1.4910	2.39	Q	V		
14+ 0	1.5073	2.37	Q	V		
14+ 5	1.5246	2.50	Q	V		
14+10	1.5432	2.70	Q	V		
14+15	1.5621	2.75	Q	V		
14+20	1.5809	2.74	Q	V		
14+25	1.5995	2.70	Q	V		
14+30	1.6181	2.69	Q	V		
14+35	1.6366	2.69	Q	V		
14+40	1.6551	2.68	Q	V		
14+45	1.6736	2.68	Q	V		
14+50	1.6918	2.65	Q	V		
14+55	1.7097	2.60	Q	V		
15+ 0	1.7276	2.59	Q	V		
15+ 5	1.7451	2.55	Q	V		
15+10	1.7623	2.50	Q	V		
15+15	1.7795	2.49	Q	V		
15+20	1.7963	2.45	Q	V		
15+25	1.8128	2.40	Q	V		
15+30	1.8293	2.38	Q	V		
15+35	1.8447	2.25	Q	V		
15+40	1.8588	2.05	Q	V		
15+45	1.8726	2.00	Q	V		
15+50	1.8862	1.98	Q	V		
15+55	1.8998	1.97	Q	V		

16+ 0	1.9133	1.96				V
16+ 5	1.9234	1.47				V
16+10	1.9285	0.74				V
16+15	1.9324	0.56				V
16+20	1.9357	0.48				V
16+25	1.9387	0.44				V
16+30	1.9415	0.41				V
16+35	1.9441	0.38				V
16+40	1.9464	0.33				V
16+45	1.9486	0.32				V
16+50	1.9508	0.31				V
16+55	1.9529	0.31				V
17+ 0	1.9551	0.31				V
17+ 5	1.9576	0.37				V
17+10	1.9609	0.47				V
17+15	1.9643	0.50				V
17+20	1.9678	0.51				V
17+25	1.9713	0.51				V
17+30	1.9749	0.52				V
17+35	1.9784	0.52				V
17+40	1.9820	0.52				V
17+45	1.9856	0.52				V
17+50	1.9889	0.48				V
17+55	1.9919	0.43				V
18+ 0	1.9948	0.42				V
18+ 5	1.9977	0.42				V
18+10	2.0005	0.41				V
18+15	2.0034	0.41				V
18+20	2.0062	0.41				V
18+25	2.0090	0.41				V
18+30	2.0119	0.41				V
18+35	2.0145	0.38				V
18+40	2.0168	0.33				V
18+45	2.0190	0.32				V
18+50	2.0209	0.28				V
18+55	2.0225	0.23				V
19+ 0	2.0240	0.22				V
19+ 5	2.0257	0.24				V
19+10	2.0277	0.29				V
19+15	2.0297	0.30				V
19+20	2.0321	0.34				V
19+25	2.0347	0.39				V
19+30	2.0375	0.40				V
19+35	2.0401	0.38				V
19+40	2.0424	0.33				V
19+45	2.0446	0.32				V
19+50	2.0465	0.28				V
19+55	2.0481	0.23				V
20+ 0	2.0496	0.22				V
20+ 5	2.0513	0.24				V
20+10	2.0532	0.29				V
20+15	2.0553	0.30				V
20+20	2.0574	0.31				V
20+25	2.0595	0.31				V
20+30	2.0617	0.31				V
20+35	2.0638	0.31				V
20+40	2.0659	0.31				V
20+45	2.0681	0.31				V
20+50	2.0700	0.28				V
20+55	2.0715	0.23				V
21+ 0	2.0730	0.22				V
21+ 5	2.0747	0.24				V
21+10	2.0767	0.29				V
21+15	2.0788	0.30				V
21+20	2.0806	0.27				V
21+25	2.0822	0.23				V
21+30	2.0837	0.22				V
21+35	2.0854	0.24				V
21+40	2.0874	0.29				V
21+45	2.0894	0.30				V
21+50	2.0913	0.27				V
21+55	2.0929	0.23				V
22+ 0	2.0944	0.22				V
22+ 5	2.0960	0.24				V
22+10	2.0980	0.29				V
22+15	2.1001	0.30				V
22+20	2.1020	0.27				V
22+25	2.1035	0.23				V
22+30	2.1050	0.22				V
22+35	2.1065	0.21				V
22+40	2.1079	0.21				V
22+45	2.1093	0.21				V
22+50	2.1107	0.21				V
22+55	2.1122	0.21				V
23+ 0	2.1136	0.21				V
23+ 5	2.1150	0.21				V

23+10	2.1164	0.21	Q				V
23+15	2.1178	0.21	Q				V
23+20	2.1193	0.21	Q				V
23+25	2.1207	0.21	Q				V
23+30	2.1221	0.21	Q				V
23+35	2.1235	0.21	Q				V
23+40	2.1250	0.21	Q				V
23+45	2.1264	0.21	Q				V
23+50	2.1278	0.21	Q				V
23+55	2.1292	0.21	Q				V
24+ 0	2.1306	0.21	Q				V
24+ 5	2.1316	0.14	Q				V
24+10	2.1319	0.04	Q				V
24+15	2.1320	0.02	Q				V
24+20	2.1321	0.01	Q				V
24+25	2.1321	0.00	Q				V

UNIT HYDROGRAPH SUMMARY							
Storm Event	Existing Condition		Developed		Routed Basin		
	Flow (cfs)	Volume (ac.ft.)	Flow (cfs)	Volume (ac.ft.)	Routed Basin Out Flow (cfs)	Storage Volume (ac.ft.)	Depth (ft)
2 Year - 24 Hour	0.942	0.4342	3.509	2.1321	1.002	1.477	4.38

Basin Size and Flow Calculations

BASIN

Horiz. : Vert.

4 : 1 = Basin Side Slope

Basin Elevation	BASIN PARAMETERS					OUTLET								
	Depth	Area S.F.	Volume C.F.	Volume AC-FT	Effective Volume AC-FT	Q1 Orifice Plate (cfs)	Q2 Orifice Plate (cfs)	Q3 Orifice Plate (cfs)	Q4 Orifice Plate (cfs)	Q5 Orifice Plate (cfs)	Q6 Orifice Plate (cfs)	Q7 Orifice Plate (cfs)	Q Weir 1 (cfs)	Q Total (cfs)
1349.00	0.00	11,304.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1350.00	1.00	12,705.00	12,004.50	0.276	0.276	0.133	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.133
1351.00	2.00	14,154.00	25,458.00	0.584	0.584	0.193	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.193
1352.00	3.00	15,701.00	40,507.50	0.930	0.930	0.238	0.000	0.462	0.000	0.000	0.000	0.000	0.000	0.700
1352.50	3.50	16,531.50	48,712.13	1.118	1.118	0.258	0.000	0.566	0.000	0.000	0.000	0.000	0.000	0.824
1353.00	4.00	17,362.00	57,332.00	1.316	1.316	0.276	0.000	0.654	0.000	0.000	0.000	0.000	0.000	0.930
1353.50	4.50	18,270.50	66,542.63	1.528	1.528	0.293	0.000	0.731	0.000	0.000	0.000	0.000	0.000	1.024
1353.75	4.75	18,724.75	71,318.28	1.637	1.637	0.301	0.000	0.766	0.000	0.000	0.000	0.000	0.000	1.068
1354.00	5.00	19,179.00	76,207.50	1.749	1.749	0.309	0.000	0.801	0.000	0.000	0.000	0.000	17.173	18.283
1355.00	6.00	21,093.00	97,191.00	2.231	2.231	0.340	0.000	0.924	0.000	0.000	0.000	0.000	252.391	253.655

SUPPORTING DESIGN PARAMETERS

Orifice Coefficient	0.66	Dia of Orifice	2.20	4.00										
Gravimetric Constant	32.2 ft/s^2	Eff Dia of Orifice	0.1833	0.0000	0.3333	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
Number of Rows		Area of Orifice	0.0264	0.0000	0.0873	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		
Minimum Orifice Plate Height		Number of Orifices	1	1	1	1	1	1	1	1	1	1		
Minimum Orifice Plate Width		Elev	1349.1	1351	1352	1352								
		Weir												
		Sharp Crest Weir Coefficient											4	
		Length of Weir											48.00	
		Elev. at Crest of Weir											1353.8	

Q100 Elevation Weir Calc		
Basin Weir Calc		
Crest Wier Elev.	1353.80	
Q100	55.63	cfs
Weir Length	48	
Weir Coeff.	4	
H Weir	0.43786	
Q100 Elevation	1354.24	

Q100 Elevation Weir Calc		
Emergency Spillway Weir Calc		
Crest Wier Elev.	1354.25	
Q100	55.63	cfs
Weir Length	85	
Weir Coeff.	4	
H Weir	0.29915	
Q100 Elevation	1354.55	

Program License Serial Number 5006

***** HYDROGRAPH INFORMATION *****

From study/file name: pro2242.rte
 *****HYDROGRAPH DATA*****
 Number of intervals = 292
 Time interval = 5.0 (Min.)
 Maximum/Peak flow rate = 3.509 (CFS)
 Total volume = 2.132 (Ac.Ft)
 Status of hydrographs being held in storage
 Stream 1 Stream 2 Stream 3 Stream 4 Stream 5
 Peak (CFS) 0.000 0.000 0.000 0.000 0.000
 Vol (Ac.Ft) 0.000 0.000 0.000 0.000 0.000

++++++
 Process from Point/Station 1.000 to Point/Station 2.000
 *** RETARDING BASIN ROUTING ***

User entry of depth-outflow-storage data

 Total number of inflow hydrograph intervals = 292
 Hydrograph time unit = 5.000 (Min.)
 Initial depth in storage basin = 0.00(Ft.)

Initial basin depth = 0.00 (Ft.)
 Initial basin storage = 0.00 (Ac.Ft)
 Initial basin outflow = 0.00 (CFS)

Depth vs. Storage and Depth vs. Discharge data:

Basin Depth (Ft.)	Storage (Ac.Ft)	Outflow (CFS)	(S-O*dt/2) (Ac.Ft)	(S+O*dt/2) (Ac.Ft)
0.000	0.000	0.000	0.000	0.000
1.000	0.276	0.133	0.276	0.276
2.000	0.584	0.193	0.583	0.585
3.000	0.930	0.700	0.928	0.932
3.500	1.118	0.824	1.115	1.121
4.000	1.316	0.930	1.313	1.319
4.500	1.528	1.024	1.524	1.532
4.750	1.637	1.068	1.633	1.641
5.000	1.749	18.283	1.686	1.812
6.000	2.231	253.655	1.358	3.104

Hydrograph Detention Basin Routing

Graph values: 'I'= unit inflow; 'O'=outflow at time shown

Time (Hours)	Inflow (CFS)	Outflow (CFS)	Storage (Ac.Ft)	.0	0.9	1.75	2.63	3.51	Depth (Ft.)
0.083	0.08	0.00	0.000	O					0.00
0.167	0.18	0.00	0.001	OI					0.00
0.250	0.20	0.00	0.002	OI					0.01
0.333	0.25	0.00	0.004	O I					0.01
0.417	0.29	0.00	0.006	O I					0.02
0.500	0.30	0.00	0.008	O I					0.03
0.583	0.31	0.00	0.010	O I					0.04
0.667	0.31	0.01	0.012	O I					0.04
0.750	0.31	0.01	0.014	O I					0.05
0.833	0.35	0.01	0.016	O I					0.06
0.917	0.40	0.01	0.019	O I					0.07
1.000	0.41	0.01	0.022	O I					0.08
1.083	0.37	0.01	0.024	O I					0.09
1.167	0.32	0.01	0.026	O I					0.10
1.250	0.32	0.01	0.029	O I					0.10
1.333	0.31	0.01	0.031	O I					0.11
1.417	0.31	0.02	0.033	O I					0.12

1.500	0.31	0.02	0.035	0	I					0.13
1.583	0.31	0.02	0.037	0	I					0.13
1.667	0.31	0.02	0.039	0	I					0.14
1.750	0.31	0.02	0.041	0	I					0.15
1.833	0.35	0.02	0.043	0	I					0.16
1.917	0.40	0.02	0.045	0	I					0.16
2.000	0.41	0.02	0.048	0	I					0.17
2.083	0.41	0.02	0.051	0	I					0.18
2.167	0.41	0.03	0.053	0	I					0.19
2.250	0.41	0.03	0.056	0	I					0.20
2.333	0.41	0.03	0.059	0	I					0.21
2.417	0.41	0.03	0.061	0	I					0.22
2.500	0.41	0.03	0.064	0	I					0.23
2.583	0.45	0.03	0.067	0	I					0.24
2.667	0.50	0.03	0.070	0	I					0.25
2.750	0.51	0.04	0.073	0	I					0.26
2.833	0.51	0.04	0.076	0	I					0.28
2.917	0.52	0.04	0.079	0	I					0.29
3.000	0.52	0.04	0.083	0	I					0.30
3.083	0.52	0.04	0.086	0	I					0.31
3.167	0.52	0.04	0.089	0	I					0.32
3.250	0.52	0.04	0.093	0	I					0.34
3.333	0.52	0.05	0.096	0	I					0.35
3.417	0.52	0.05	0.099	0	I					0.36
3.500	0.52	0.05	0.102	0	I					0.37
3.583	0.52	0.05	0.105	0	I					0.38
3.667	0.52	0.05	0.109	0	I					0.39
3.750	0.52	0.05	0.112	0	I					0.41
3.833	0.56	0.06	0.115	0	I					0.42
3.917	0.60	0.06	0.119	0	I					0.43
4.000	0.61	0.06	0.123	0	I					0.44
4.083	0.62	0.06	0.126	0	I					0.46
4.167	0.62	0.06	0.130	0	I					0.47
4.250	0.62	0.06	0.134	0	I					0.49
4.333	0.66	0.07	0.138	0	I					0.50
4.417	0.71	0.07	0.142	0	I					0.52
4.500	0.72	0.07	0.147	0	I					0.53
4.583	0.72	0.07	0.151	0	I					0.55
4.667	0.72	0.07	0.156	0	I					0.56
4.750	0.72	0.08	0.160	0	I					0.58
4.833	0.76	0.08	0.165	0	I					0.60
4.917	0.81	0.08	0.169	0	I					0.61
5.000	0.82	0.08	0.175	0	I					0.63
5.083	0.74	0.09	0.179	0	I					0.65
5.167	0.65	0.09	0.183	0	I					0.66
5.250	0.63	0.09	0.187	0	I					0.68
5.333	0.66	0.09	0.191	0	I					0.69
5.417	0.71	0.09	0.195	0	I					0.71
5.500	0.72	0.10	0.199	0	I					0.72
5.583	0.76	0.10	0.204	0	I					0.74
5.667	0.81	0.10	0.209	0	I					0.76
5.750	0.82	0.10	0.213	0	I					0.77
5.833	0.82	0.11	0.218	0	I					0.79
5.917	0.83	0.11	0.223	0	I					0.81
6.000	0.83	0.11	0.228	0	I					0.83
6.083	0.87	0.11	0.233	0	I					0.85
6.167	0.91	0.12	0.239	0	I					0.86
6.250	0.92	0.12	0.244	0	I					0.88
6.333	0.93	0.12	0.250	0	I					0.91
6.417	0.93	0.12	0.255	0	I					0.93
6.500	0.93	0.13	0.261	0	I					0.95
6.583	0.97	0.13	0.267	0	I					0.97
6.667	1.02	0.13	0.273	0	I					0.99
6.750	1.03	0.13	0.279	0	I					1.01
6.833	1.03	0.13	0.285	0	I					1.03
6.917	1.03	0.14	0.291	0	I					1.05
7.000	1.03	0.14	0.297	0	I					1.07
7.083	1.03	0.14	0.303	0	I					1.09
7.167	1.03	0.14	0.309	0	I					1.11
7.250	1.03	0.14	0.316	0	I					1.13
7.333	1.07	0.14	0.322	0	I					1.15
7.417	1.12	0.14	0.328	0	I					1.17
7.500	1.13	0.14	0.335	0	I					1.19
7.583	1.18	0.15	0.342	0	I					1.21
7.667	1.22	0.15	0.349	0	I					1.24
7.750	1.23	0.15	0.357	0	I					1.26
7.833	1.28	0.15	0.364	0	I					1.29
7.917	1.33	0.15	0.372	0	I					1.31
8.000	1.34	0.15	0.380	0	I					1.34
8.083	1.42	0.15	0.389	0	I					1.37
8.167	1.52	0.16	0.398	0	I					1.40
8.250	1.54	0.16	0.407	0	I					1.43
8.333	1.54	0.16	0.417	0	I					1.46
8.417	1.55	0.16	0.426	0	I					1.49
8.500	1.55	0.16	0.436	0	I					1.52
8.583	1.59	0.17	0.446	0	I					1.55

8.667	1.64	0.17	0.456	O		I				1.58
8.750	1.65	0.17	0.466	O		I				1.62
8.833	1.69	0.17	0.476	O		I				1.65
8.917	1.74	0.17	0.487	O		I				1.68
9.000	1.75	0.18	0.497	O		I				1.72
9.083	1.84	0.18	0.509	O		I				1.76
9.167	1.93	0.18	0.520	O		I				1.79
9.250	1.95	0.18	0.532	O		I				1.83
9.333	2.00	0.19	0.545	O		I				1.87
9.417	2.05	0.19	0.557	O		I				1.91
9.500	2.06	0.19	0.570	O		I				1.96
9.583	2.10	0.19	0.583	O		I				2.00
9.667	2.15	0.21	0.597	O		I				2.04
9.750	2.16	0.23	0.610	O		I				2.07
9.833	2.21	0.25	0.623	O		I				2.11
9.917	2.25	0.27	0.637	O		I				2.15
10.000	2.26	0.29	0.650	O		I				2.19
10.083	1.97	0.31	0.663	O		I				2.23
10.167	1.66	0.32	0.673	O		I				2.26
10.250	1.59	0.34	0.682	O		I				2.28
10.333	1.56	0.35	0.691	O		I				2.31
10.417	1.55	0.36	0.699	O		I				2.33
10.500	1.55	0.37	0.707	O		I				2.36
10.583	1.76	0.39	0.716	O		I				2.38
10.667	1.99	0.40	0.726	O		I				2.41
10.750	2.04	0.42	0.737	O		I				2.44
10.833	2.06	0.43	0.748	O		I				2.47
10.917	2.06	0.45	0.759	O		I				2.51
11.000	2.06	0.47	0.770	O		I				2.54
11.083	2.02	0.48	0.781	O		I				2.57
11.167	1.98	0.50	0.792	O		I				2.60
11.250	1.97	0.51	0.802	O		I				2.63
11.333	1.96	0.53	0.812	O		I				2.66
11.417	1.96	0.54	0.822	O		I				2.69
11.500	1.96	0.56	0.831	O		I				2.71
11.583	1.88	0.57	0.841	O		I				2.74
11.667	1.79	0.58	0.849	O		I				2.77
11.750	1.77	0.59	0.857	O		I				2.79
11.833	1.80	0.61	0.866	O		I				2.81
11.917	1.84	0.62	0.874	O		I				2.84
12.000	1.85	0.63	0.882	O		I				2.86
12.083	2.15	0.64	0.892	O		I				2.89
12.167	2.47	0.66	0.903	O		I				2.92
12.250	2.54	0.68	0.916	O		I				2.96
12.333	2.61	0.70	0.929	O		I				3.00
12.417	2.67	0.71	0.942	O		I				3.03
12.500	2.68	0.72	0.956	O		I				3.07
12.583	2.77	0.73	0.969	O		I				3.10
12.667	2.86	0.74	0.984	O		I				3.14
12.750	2.88	0.75	0.998	O		I				3.18
12.833	2.93	0.75	1.013	O		I				3.22
12.917	2.98	0.76	1.028	O		I				3.26
13.000	2.99	0.77	1.044	O		I				3.30
13.083	3.20	0.79	1.059	O		I				3.34
13.167	3.43	0.80	1.077	O		I				3.39
13.250	3.48	0.81	1.095	O		I				3.44
13.333	3.50	0.82	1.114	O		I				3.49
13.417	3.51	0.83	1.132	O		I				3.54
13.500	3.51	0.84	1.150	O		I				3.58
13.583	3.05	0.85	1.167	O		I				3.62
13.667	2.54	0.86	1.181	O		I				3.66
13.750	2.44	0.86	1.192	O		I				3.69
13.833	2.39	0.87	1.202	O		I				3.71
13.917	2.37	0.87	1.213	O		I				3.74
14.000	2.37	0.88	1.223	O		I				3.77
14.083	2.54	0.89	1.234	O		I				3.79
14.167	2.72	0.89	1.246	O		I				3.82
14.250	2.76	0.90	1.259	O		I				3.86
14.333	2.74	0.91	1.271	O		I				3.89
14.417	2.70	0.91	1.284	O		I				3.92
14.500	2.69	0.92	1.296	O		I				3.95
14.583	2.68	0.93	1.308	O		I				3.98
14.667	2.68	0.93	1.320	O		I				4.01
14.750	2.68	0.94	1.332	O		I				4.04
14.833	2.64	0.94	1.344	O		I				4.07
14.917	2.60	0.95	1.356	O		I				4.09
15.000	2.59	0.95	1.367	O		I				4.12
15.083	2.54	0.96	1.378	O		I				4.15
15.167	2.49	0.96	1.389	O		I				4.17
15.250	2.48	0.97	1.399	O		I				4.20
15.333	2.44	0.97	1.410	O		I				4.22
15.417	2.39	0.98	1.420	O		I				4.24
15.500	2.38	0.98	1.429	O		I				4.27
15.583	2.21	0.98	1.438	O		I				4.29
15.667	2.02	0.99	1.446	O		I				4.31
15.750	1.98	0.99	1.453	O		I				4.32

15.833	1.97	0.99	1.460			O	I		4.34
15.917	1.96	1.00	1.466			O	I		4.35
16.000	1.96	1.00	1.473			O	I		4.37
16.083	1.33	1.00	1.477			O	I		4.38
16.167	0.64	1.00	1.477		I	O			4.38
16.250	0.50	1.00	1.474		I	O			4.37
16.333	0.44	1.00	1.471		I	O			4.36
16.417	0.41	1.00	1.467		I	O			4.36
16.500	0.41	1.00	1.463		I	O			4.35
16.583	0.37	0.99	1.459		I	O			4.34
16.667	0.32	0.99	1.454		I	O			4.33
16.750	0.32	0.99	1.450		I	O			4.32
16.833	0.31	0.99	1.445		I	O			4.30
16.917	0.31	0.99	1.440		I	O			4.29
17.000	0.31	0.98	1.436		I	O			4.28
17.083	0.39	0.98	1.431		I	O			4.27
17.167	0.49	0.98	1.428		I	O			4.26
17.250	0.50	0.98	1.424		I	O			4.26
17.333	0.51	0.98	1.421		I	O			4.25
17.417	0.52	0.98	1.418		I	O			4.24
17.500	0.52	0.97	1.415		I	O			4.23
17.583	0.52	0.97	1.412		I	O			4.23
17.667	0.52	0.97	1.408		I	O			4.22
17.750	0.52	0.97	1.405		I	O			4.21
17.833	0.47	0.97	1.402		I	O			4.20
17.917	0.43	0.97	1.398		I	O			4.19
18.000	0.42	0.96	1.395		I	O			4.19
18.083	0.41	0.96	1.391		I	O			4.18
18.167	0.41	0.96	1.387		I	O			4.17
18.250	0.41	0.96	1.383		I	O			4.16
18.333	0.41	0.96	1.380		I	O			4.15
18.417	0.41	0.96	1.376		I	O			4.14
18.500	0.41	0.95	1.372		I	O			4.13
18.583	0.37	0.95	1.368		I	O			4.12
18.667	0.32	0.95	1.364		I	O			4.11
18.750	0.32	0.95	1.360		I	O			4.10
18.833	0.27	0.95	1.355		I	O			4.09
18.917	0.22	0.95	1.350		I	O			4.08
19.000	0.21	0.94	1.345		I	O			4.07
19.083	0.25	0.94	1.341		I	O			4.06
19.167	0.29	0.94	1.336		I	O			4.05
19.250	0.30	0.94	1.332		I	O			4.04
19.333	0.35	0.94	1.327		I	O			4.03
19.417	0.40	0.93	1.323		I	O			4.02
19.500	0.41	0.93	1.320		I	O			4.01
19.583	0.37	0.93	1.316		I	O			4.00
19.667	0.32	0.93	1.312		I	O			3.99
19.750	0.32	0.93	1.308		I	O			3.98
19.833	0.27	0.92	1.304		I	O			3.97
19.917	0.22	0.92	1.299		I	O			3.96
20.000	0.21	0.92	1.294		I	O			3.94
20.083	0.25	0.92	1.289		I	O			3.93
20.167	0.29	0.91	1.285		I	O			3.92
20.250	0.30	0.91	1.281		I	O			3.91
20.333	0.31	0.91	1.277		I	O			3.90
20.417	0.31	0.91	1.272		I	O			3.89
20.500	0.31	0.90	1.268		I	O			3.88
20.583	0.31	0.90	1.264		I	O			3.87
20.667	0.31	0.90	1.260		I	O			3.86
20.750	0.31	0.90	1.256		I	O			3.85
20.833	0.27	0.90	1.252		I	O			3.84
20.917	0.22	0.89	1.247		I	O			3.83
21.000	0.21	0.89	1.243		I	O			3.81
21.083	0.25	0.89	1.238		I	O			3.80
21.167	0.29	0.89	1.234		I	O			3.79
21.250	0.30	0.88	1.230		I	O			3.78
21.333	0.27	0.88	1.226		I	O			3.77
21.417	0.22	0.88	1.221		I	O			3.76
21.500	0.21	0.88	1.217		I	O			3.75
21.583	0.25	0.87	1.212		I	O			3.74
21.667	0.29	0.87	1.208		I	O			3.73
21.750	0.30	0.87	1.204		I	O			3.72
21.833	0.27	0.87	1.200		I	O			3.71
21.917	0.22	0.87	1.196		I	O			3.70
22.000	0.21	0.86	1.192		I	O			3.69
22.083	0.25	0.86	1.187		I	O			3.67
22.167	0.29	0.86	1.183		I	O			3.66
22.250	0.30	0.86	1.179		I	O			3.65
22.333	0.27	0.85	1.175		I	O			3.64
22.417	0.22	0.85	1.171		I	O			3.63
22.500	0.21	0.85	1.167		I	O			3.62
22.583	0.21	0.85	1.162		I	O			3.61
22.667	0.21	0.85	1.158		I	O			3.60
22.750	0.21	0.84	1.154		I	O			3.59
22.833	0.21	0.84	1.149		I	O			3.58
22.917	0.21	0.84	1.145		I	O			3.57

23.000	0.21	0.84	1.141	I	O					3.56
23.083	0.21	0.83	1.136	I	O					3.55
23.167	0.21	0.83	1.132	I	O					3.54
23.250	0.21	0.83	1.128	I	O					3.52
23.333	0.21	0.83	1.123	I	O					3.51
23.417	0.21	0.82	1.119	I	O					3.50
23.500	0.21	0.82	1.115	I	O					3.49
23.583	0.21	0.82	1.111	I	O					3.48
23.667	0.21	0.82	1.106	I	O					3.47
23.750	0.21	0.81	1.102	I	O					3.46
23.833	0.21	0.81	1.098	I	O					3.45
23.917	0.21	0.81	1.094	I	O					3.44
24.000	0.21	0.81	1.090	I	O					3.42
24.083	0.12	0.80	1.085	I	O					3.41
24.167	0.03	0.80	1.080	I	O					3.40
24.250	0.01	0.80	1.075	I	O					3.39
24.333	0.00	0.79	1.070	I	O					3.37
24.417	0.00	0.79	1.064	I	O					3.36
24.500	0.00	0.78	1.059	I	O					3.34
24.583	0.00	0.78	1.053	I	O					3.33
24.667	0.00	0.78	1.048	I	O					3.31
24.750	0.00	0.77	1.043	I	O					3.30
24.833	0.00	0.77	1.037	I	O					3.29
24.917	0.00	0.77	1.032	I	O					3.27
25.000	0.00	0.76	1.027	I	O					3.26
25.083	0.00	0.76	1.021	I	O					3.24
25.167	0.00	0.76	1.016	I	O					3.23
25.250	0.00	0.75	1.011	I	O					3.22
25.333	0.00	0.75	1.006	I	O					3.20
25.417	0.00	0.75	1.001	I	O					3.19
25.500	0.00	0.74	0.996	I	O					3.17
25.583	0.00	0.74	0.990	I	O					3.16
25.667	0.00	0.74	0.985	I	O					3.15
25.750	0.00	0.73	0.980	I	O					3.13
25.833	0.00	0.73	0.975	I	O					3.12
25.917	0.00	0.73	0.970	I	O					3.11
26.000	0.00	0.72	0.965	I	O					3.09
26.083	0.00	0.72	0.960	I	O					3.08
26.167	0.00	0.72	0.955	I	O					3.07
26.250	0.00	0.71	0.950	I	O					3.05
26.333	0.00	0.71	0.946	I	O					3.04
26.417	0.00	0.71	0.941	I	O					3.03
26.500	0.00	0.70	0.936	I	O					3.02
26.583	0.00	0.70	0.931	I	O					3.00
26.667	0.00	0.69	0.926	I	O					2.99
26.750	0.00	0.69	0.921	I	O					2.98
26.833	0.00	0.68	0.917	I	O					2.96
26.917	0.00	0.67	0.912	I	O					2.95
27.000	0.00	0.67	0.907	I	O					2.93
27.083	0.00	0.66	0.903	I	O					2.92
27.167	0.00	0.65	0.898	I	O					2.91
27.250	0.00	0.65	0.894	I	O					2.90
27.333	0.00	0.64	0.889	I	O					2.88
27.417	0.00	0.63	0.885	I	O					2.87
27.500	0.00	0.63	0.881	I	O					2.86
27.583	0.00	0.62	0.876	I	O					2.85
27.667	0.00	0.62	0.872	I	O					2.83
27.750	0.00	0.61	0.868	I	O					2.82
27.833	0.00	0.60	0.864	I	O					2.81
27.917	0.00	0.60	0.860	I	O					2.80
28.000	0.00	0.59	0.856	I	O					2.78
28.083	0.00	0.58	0.851	I	O					2.77
28.167	0.00	0.58	0.847	I	O					2.76
28.250	0.00	0.57	0.843	I	O					2.75
28.333	0.00	0.57	0.840	I	O					2.74
28.417	0.00	0.56	0.836	I	O					2.73
28.500	0.00	0.56	0.832	I	O					2.72
28.583	0.00	0.55	0.828	I	O					2.71
28.667	0.00	0.55	0.824	I	O					2.69
28.750	0.00	0.54	0.820	I	O					2.68
28.833	0.00	0.53	0.817	I	O					2.67
28.917	0.00	0.53	0.813	I	O					2.66
29.000	0.00	0.52	0.810	I	O					2.65
29.083	0.00	0.52	0.806	I	O					2.64
29.167	0.00	0.51	0.802	I	O					2.63
29.250	0.00	0.51	0.799	I	O					2.62
29.333	0.00	0.50	0.795	I	O					2.61
29.417	0.00	0.50	0.792	I	O					2.60
29.500	0.00	0.49	0.789	I	O					2.59
29.583	0.00	0.49	0.785	I	O					2.58
29.667	0.00	0.48	0.782	I	O					2.57
29.750	0.00	0.48	0.779	I	O					2.56
29.833	0.00	0.47	0.775	I	O					2.55
29.917	0.00	0.47	0.772	I	O					2.54
30.000	0.00	0.46	0.769	I	O					2.53
30.083	0.00	0.46	0.766	I	O					2.52

30.167	0.00	0.45	0.762	I	O	2.52
30.250	0.00	0.45	0.759	I	O	2.51
30.333	0.00	0.45	0.756	I	O	2.50
30.417	0.00	0.44	0.753	I	O	2.49
30.500	0.00	0.44	0.750	I	O	2.48
30.583	0.00	0.43	0.747	I	O	2.47
30.667	0.00	0.43	0.744	I	O	2.46
30.750	0.00	0.42	0.741	I	O	2.45
30.833	0.00	0.42	0.738	I	O	2.45
30.917	0.00	0.42	0.736	I	O	2.44
31.000	0.00	0.41	0.733	I	O	2.43
31.083	0.00	0.41	0.730	I	O	2.42
31.167	0.00	0.40	0.727	I	O	2.41
31.250	0.00	0.40	0.724	I	O	2.41
31.333	0.00	0.39	0.722	I	O	2.40
31.417	0.00	0.39	0.719	I	O	2.39
31.500	0.00	0.39	0.716	I	O	2.38
31.583	0.00	0.38	0.714	I	O	2.37
31.667	0.00	0.38	0.711	I	O	2.37
31.750	0.00	0.38	0.708	I	O	2.36
31.833	0.00	0.37	0.706	I	O	2.35
31.917	0.00	0.37	0.703	I	O	2.34
32.000	0.00	0.36	0.701	I	O	2.34
32.083	0.00	0.36	0.698	I	O	2.33
32.167	0.00	0.36	0.696	I	O	2.32
32.250	0.00	0.35	0.693	I	O	2.32
32.333	0.00	0.35	0.691	I	O	2.31
32.417	0.00	0.35	0.688	I	O	2.30
32.500	0.00	0.34	0.686	I	O	2.30
32.583	0.00	0.34	0.684	I	O	2.29
32.667	0.00	0.34	0.681	I	O	2.28
32.750	0.00	0.33	0.679	I	O	2.27
32.833	0.00	0.33	0.677	I	O	2.27
32.917	0.00	0.33	0.675	I	O	2.26
33.000	0.00	0.32	0.672	I	O	2.26
33.083	0.00	0.32	0.670	I	O	2.25
33.167	0.00	0.32	0.668	I	O	2.24
33.250	0.00	0.31	0.666	I	O	2.24
33.333	0.00	0.31	0.664	I	O	2.23
33.417	0.00	0.31	0.662	I	O	2.22
33.500	0.00	0.30	0.659	I	O	2.22
33.583	0.00	0.30	0.657	I	O	2.21
33.667	0.00	0.30	0.655	I	O	2.21
33.750	0.00	0.29	0.653	I	O	2.20
33.833	0.00	0.29	0.651	I	O	2.19
33.917	0.00	0.29	0.649	I	O	2.19
34.000	0.00	0.29	0.647	I	O	2.18
34.083	0.00	0.28	0.645	I	O	2.18
34.167	0.00	0.28	0.643	I	O	2.17
34.250	0.00	0.28	0.641	I	O	2.17
34.333	0.00	0.27	0.640	I	O	2.16
34.417	0.00	0.27	0.638	I	O	2.16
34.500	0.00	0.27	0.636	I	O	2.15
34.583	0.00	0.27	0.634	I	O	2.14
34.667	0.00	0.26	0.632	I	O	2.14
34.750	0.00	0.26	0.630	I	O	2.13
34.833	0.00	0.26	0.629	I	O	2.13
34.917	0.00	0.26	0.627	I	O	2.12
35.000	0.00	0.25	0.625	I	O	2.12
35.083	0.00	0.25	0.623	I	O	2.11
35.167	0.00	0.25	0.622	I	O	2.11
35.250	0.00	0.25	0.620	I	O	2.10
35.333	0.00	0.24	0.618	I	O	2.10
35.417	0.00	0.24	0.617	I	O	2.09
35.500	0.00	0.24	0.615	I	O	2.09
35.583	0.00	0.24	0.613	I	O	2.08
35.667	0.00	0.23	0.612	I	O	2.08
35.750	0.00	0.23	0.610	I	O	2.08
35.833	0.00	0.23	0.608	I	O	2.07
35.917	0.00	0.23	0.607	I	O	2.07
36.000	0.00	0.22	0.605	I	O	2.06
36.083	0.00	0.22	0.604	I	O	2.06
36.167	0.00	0.22	0.602	I	O	2.05
36.250	0.00	0.22	0.601	I	O	2.05
36.333	0.00	0.22	0.599	IO		2.04
36.417	0.00	0.21	0.598	IO		2.04
36.500	0.00	0.21	0.596	IO		2.04
36.583	0.00	0.21	0.595	IO		2.03
36.667	0.00	0.21	0.593	IO		2.03
36.750	0.00	0.20	0.592	IO		2.02
36.833	0.00	0.20	0.591	IO		2.02
36.917	0.00	0.20	0.589	IO		2.02
37.000	0.00	0.20	0.588	IO		2.01
37.083	0.00	0.20	0.587	IO		2.01
37.167	0.00	0.19	0.585	IO		2.00
37.250	0.00	0.19	0.584	IO		2.00

37.333	0.00	0.19	0.582	IO					2.00
37.417	0.00	0.19	0.581	IO					1.99
37.500	0.00	0.19	0.580	IO					1.99
37.583	0.00	0.19	0.579	IO					1.98
37.667	0.00	0.19	0.577	IO					1.98
37.750	0.00	0.19	0.576	IO					1.97
37.833	0.00	0.19	0.575	IO					1.97
37.917	0.00	0.19	0.573	IO					1.97
38.000	0.00	0.19	0.572	IO					1.96
38.083	0.00	0.19	0.571	IO					1.96
38.167	0.00	0.19	0.569	IO					1.95
38.250	0.00	0.19	0.568	IO					1.95
38.333	0.00	0.19	0.567	IO					1.94
38.417	0.00	0.19	0.565	IO					1.94
38.500	0.00	0.19	0.564	IO					1.94
38.583	0.00	0.19	0.563	IO					1.93
38.667	0.00	0.19	0.561	IO					1.93
38.750	0.00	0.19	0.560	IO					1.92
38.833	0.00	0.19	0.559	IO					1.92
38.917	0.00	0.19	0.558	IO					1.91
39.000	0.00	0.19	0.556	IO					1.91
39.083	0.00	0.19	0.555	IO					1.91
39.167	0.00	0.19	0.554	IO					1.90
39.250	0.00	0.19	0.552	IO					1.90
39.333	0.00	0.19	0.551	IO					1.89
39.417	0.00	0.19	0.550	IO					1.89
39.500	0.00	0.19	0.549	IO					1.89
39.583	0.00	0.19	0.547	IO					1.88
39.667	0.00	0.19	0.546	IO					1.88
39.750	0.00	0.19	0.545	IO					1.87
39.833	0.00	0.19	0.543	IO					1.87
39.917	0.00	0.18	0.542	IO					1.86
40.000	0.00	0.18	0.541	IO					1.86
40.083	0.00	0.18	0.540	IO					1.86
40.167	0.00	0.18	0.538	IO					1.85
40.250	0.00	0.18	0.537	IO					1.85
40.333	0.00	0.18	0.536	IO					1.84
40.417	0.00	0.18	0.535	IO					1.84
40.500	0.00	0.18	0.533	IO					1.84
40.583	0.00	0.18	0.532	IO					1.83
40.667	0.00	0.18	0.531	IO					1.83
40.750	0.00	0.18	0.530	IO					1.82
40.833	0.00	0.18	0.528	IO					1.82
40.917	0.00	0.18	0.527	IO					1.82
41.000	0.00	0.18	0.526	IO					1.81
41.083	0.00	0.18	0.525	IO					1.81
41.167	0.00	0.18	0.523	IO					1.80
41.250	0.00	0.18	0.522	IO					1.80
41.333	0.00	0.18	0.521	IO					1.79
41.417	0.00	0.18	0.520	IO					1.79
41.500	0.00	0.18	0.518	IO					1.79
41.583	0.00	0.18	0.517	IO					1.78
41.667	0.00	0.18	0.516	IO					1.78
41.750	0.00	0.18	0.515	IO					1.77
41.833	0.00	0.18	0.513	IO					1.77
41.917	0.00	0.18	0.512	IO					1.77
42.000	0.00	0.18	0.511	IO					1.76
42.083	0.00	0.18	0.510	IO					1.76
42.167	0.00	0.18	0.508	IO					1.75
42.250	0.00	0.18	0.507	IO					1.75
42.333	0.00	0.18	0.506	IO					1.75
42.417	0.00	0.18	0.505	IO					1.74
42.500	0.00	0.18	0.504	IO					1.74
42.583	0.00	0.18	0.502	IO					1.73
42.667	0.00	0.18	0.501	IO					1.73
42.750	0.00	0.18	0.500	IO					1.73
42.833	0.00	0.18	0.499	IO					1.72
42.917	0.00	0.18	0.497	IO					1.72
43.000	0.00	0.18	0.496	IO					1.72
43.083	0.00	0.18	0.495	IO					1.71
43.167	0.00	0.18	0.494	IO					1.71
43.250	0.00	0.18	0.493	IO					1.70
43.333	0.00	0.17	0.491	IO					1.70
43.417	0.00	0.17	0.490	IO					1.70
43.500	0.00	0.17	0.489	IO					1.69
43.583	0.00	0.17	0.488	IO					1.69
43.667	0.00	0.17	0.487	IO					1.68
43.750	0.00	0.17	0.485	IO					1.68
43.833	0.00	0.17	0.484	IO					1.68
43.917	0.00	0.17	0.483	IO					1.67
44.000	0.00	0.17	0.482	IO					1.67
44.083	0.00	0.17	0.481	IO					1.66
44.167	0.00	0.17	0.479	IO					1.66
44.250	0.00	0.17	0.478	IO					1.66
44.333	0.00	0.17	0.477	IO					1.65
44.417	0.00	0.17	0.476	IO					1.65

44.500	0.00	0.17	0.475	IO					1.65
44.583	0.00	0.17	0.474	IO					1.64
44.667	0.00	0.17	0.472	IO					1.64
44.750	0.00	0.17	0.471	IO					1.63
44.833	0.00	0.17	0.470	IO					1.63
44.917	0.00	0.17	0.469	IO					1.63
45.000	0.00	0.17	0.468	IO					1.62
45.083	0.00	0.17	0.466	IO					1.62
45.167	0.00	0.17	0.465	IO					1.61
45.250	0.00	0.17	0.464	IO					1.61
45.333	0.00	0.17	0.463	IO					1.61
45.417	0.00	0.17	0.462	IO					1.60
45.500	0.00	0.17	0.461	IO					1.60
45.583	0.00	0.17	0.459	IO					1.60
45.667	0.00	0.17	0.458	IO					1.59
45.750	0.00	0.17	0.457	IO					1.59
45.833	0.00	0.17	0.456	IO					1.58
45.917	0.00	0.17	0.455	IO					1.58
46.000	0.00	0.17	0.454	IO					1.58
46.083	0.00	0.17	0.453	IO					1.57
46.167	0.00	0.17	0.451	IO					1.57
46.250	0.00	0.17	0.450	IO					1.57
46.333	0.00	0.17	0.449	IO					1.56
46.417	0.00	0.17	0.448	IO					1.56
46.500	0.00	0.17	0.447	IO					1.55
46.583	0.00	0.17	0.446	IO					1.55
46.667	0.00	0.17	0.444	IO					1.55
46.750	0.00	0.17	0.443	IO					1.54
46.833	0.00	0.17	0.442	IO					1.54
46.917	0.00	0.17	0.441	IO					1.54
47.000	0.00	0.16	0.440	IO					1.53
47.083	0.00	0.16	0.439	IO					1.53
47.167	0.00	0.16	0.438	IO					1.52
47.250	0.00	0.16	0.437	IO					1.52
47.333	0.00	0.16	0.435	IO					1.52
47.417	0.00	0.16	0.434	IO					1.51
47.500	0.00	0.16	0.433	IO					1.51
47.583	0.00	0.16	0.432	IO					1.51
47.667	0.00	0.16	0.431	IO					1.50
47.750	0.00	0.16	0.430	IO					1.50
47.833	0.00	0.16	0.429	IO					1.50
47.917	0.00	0.16	0.428	IO					1.49
48.000	0.00	0.16	0.426	IO					1.49
48.083	0.00	0.16	0.425	IO					1.48
48.167	0.00	0.16	0.424	IO					1.48
48.250	0.00	0.16	0.423	IO					1.48
48.333	0.00	0.16	0.422	IO					1.47
48.417	0.00	0.16	0.421	IO					1.47
48.500	0.00	0.16	0.420	IO					1.47
48.583	0.00	0.16	0.419	IO					1.46
48.667	0.00	0.16	0.418	IO					1.46
48.750	0.00	0.16	0.416	IO					1.46
48.833	0.00	0.16	0.415	IO					1.45
48.917	0.00	0.16	0.414	IO					1.45
49.000	0.00	0.16	0.413	IO					1.45
49.083	0.00	0.16	0.412	IO					1.44
49.167	0.00	0.16	0.411	IO					1.44
49.250	0.00	0.16	0.410	IO					1.43
49.333	0.00	0.16	0.409	IO					1.43
49.417	0.00	0.16	0.408	IO					1.43
49.500	0.00	0.16	0.407	IO					1.42
49.583	0.00	0.16	0.405	IO					1.42
49.667	0.00	0.16	0.404	IO					1.42
49.750	0.00	0.16	0.403	IO					1.41
49.833	0.00	0.16	0.402	IO					1.41
49.917	0.00	0.16	0.401	IO					1.41
50.000	0.00	0.16	0.400	IO					1.40
50.083	0.00	0.16	0.399	IO					1.40
50.167	0.00	0.16	0.398	IO					1.40
50.250	0.00	0.16	0.397	IO					1.39
50.333	0.00	0.16	0.396	IO					1.39
50.417	0.00	0.16	0.395	IO					1.39
50.500	0.00	0.16	0.394	IO					1.38
50.583	0.00	0.16	0.392	IO					1.38
50.667	0.00	0.16	0.391	IO					1.37
50.750	0.00	0.16	0.390	IO					1.37
50.833	0.00	0.16	0.389	IO					1.37
50.917	0.00	0.15	0.388	IO					1.36
51.000	0.00	0.15	0.387	IO					1.36
51.083	0.00	0.15	0.386	IO					1.36
51.167	0.00	0.15	0.385	IO					1.35
51.250	0.00	0.15	0.384	IO					1.35
51.333	0.00	0.15	0.383	IO					1.35
51.417	0.00	0.15	0.382	IO					1.34
51.500	0.00	0.15	0.381	IO					1.34
51.583	0.00	0.15	0.380	IO					1.34

51.667	0.00	0.15	0.379	IO					1.33
51.750	0.00	0.15	0.378	IO					1.33
51.833	0.00	0.15	0.377	IO					1.33
51.917	0.00	0.15	0.375	IO					1.32
52.000	0.00	0.15	0.374	IO					1.32
52.083	0.00	0.15	0.373	IO					1.32
52.167	0.00	0.15	0.372	IO					1.31
52.250	0.00	0.15	0.371	IO					1.31
52.333	0.00	0.15	0.370	IO					1.31
52.417	0.00	0.15	0.369	IO					1.30
52.500	0.00	0.15	0.368	IO					1.30
52.583	0.00	0.15	0.367	IO					1.30
52.667	0.00	0.15	0.366	IO					1.29
52.750	0.00	0.15	0.365	IO					1.29
52.833	0.00	0.15	0.364	IO					1.29
52.917	0.00	0.15	0.363	IO					1.28
53.000	0.00	0.15	0.362	IO					1.28
53.083	0.00	0.15	0.361	IO					1.28
53.167	0.00	0.15	0.360	IO					1.27
53.250	0.00	0.15	0.359	IO					1.27
53.333	0.00	0.15	0.358	IO					1.27
53.417	0.00	0.15	0.357	IO					1.26
53.500	0.00	0.15	0.356	IO					1.26
53.583	0.00	0.15	0.355	IO					1.26
53.667	0.00	0.15	0.354	IO					1.25
53.750	0.00	0.15	0.353	IO					1.25
53.833	0.00	0.15	0.352	IO					1.25
53.917	0.00	0.15	0.351	IO					1.24
54.000	0.00	0.15	0.350	IO					1.24
54.083	0.00	0.15	0.349	IO					1.24
54.167	0.00	0.15	0.348	IO					1.23
54.250	0.00	0.15	0.347	IO					1.23
54.333	0.00	0.15	0.346	IO					1.23
54.417	0.00	0.15	0.345	IO					1.22
54.500	0.00	0.15	0.344	IO					1.22
54.583	0.00	0.15	0.343	IO					1.22
54.667	0.00	0.15	0.342	IO					1.21
54.750	0.00	0.15	0.341	IO					1.21
54.833	0.00	0.15	0.340	IO					1.21
54.917	0.00	0.15	0.339	IO					1.20
55.000	0.00	0.15	0.338	IO					1.20
55.083	0.00	0.14	0.337	IO					1.20
55.167	0.00	0.14	0.336	IO					1.19
55.250	0.00	0.14	0.335	IO					1.19
55.333	0.00	0.14	0.334	IO					1.19
55.417	0.00	0.14	0.333	IO					1.18
55.500	0.00	0.14	0.332	IO					1.18
55.583	0.00	0.14	0.331	IO					1.18
55.667	0.00	0.14	0.330	IO					1.17
55.750	0.00	0.14	0.329	IO					1.17
55.833	0.00	0.14	0.328	IO					1.17
55.917	0.00	0.14	0.327	IO					1.16
56.000	0.00	0.14	0.326	IO					1.16
56.083	0.00	0.14	0.325	IO					1.16
56.167	0.00	0.14	0.324	IO					1.16
56.250	0.00	0.14	0.323	IO					1.15
56.333	0.00	0.14	0.322	IO					1.15
56.417	0.00	0.14	0.321	IO					1.15
56.500	0.00	0.14	0.320	IO					1.14
56.583	0.00	0.14	0.319	IO					1.14
56.667	0.00	0.14	0.318	IO					1.14
56.750	0.00	0.14	0.317	IO					1.13
56.833	0.00	0.14	0.316	IO					1.13
56.917	0.00	0.14	0.315	IO					1.13
57.000	0.00	0.14	0.314	IO					1.12
57.083	0.00	0.14	0.313	IO					1.12
57.167	0.00	0.14	0.312	IO					1.12
57.250	0.00	0.14	0.311	IO					1.11
57.333	0.00	0.14	0.310	IO					1.11
57.417	0.00	0.14	0.309	IO					1.11
57.500	0.00	0.14	0.308	IO					1.10
57.583	0.00	0.14	0.307	IO					1.10
57.667	0.00	0.14	0.306	IO					1.10
57.750	0.00	0.14	0.305	IO					1.10
57.833	0.00	0.14	0.304	IO					1.09
57.917	0.00	0.14	0.303	IO					1.09
58.000	0.00	0.14	0.303	IO					1.09
58.083	0.00	0.14	0.302	IO					1.08
58.167	0.00	0.14	0.301	IO					1.08
58.250	0.00	0.14	0.300	IO					1.08
58.333	0.00	0.14	0.299	IO					1.07
58.417	0.00	0.14	0.298	IO					1.07
58.500	0.00	0.14	0.297	IO					1.07
58.583	0.00	0.14	0.296	IO					1.06
58.667	0.00	0.14	0.295	IO					1.06
58.750	0.00	0.14	0.294	IO					1.06

58.833	0.00	0.14	0.293	IO					1.06
58.917	0.00	0.14	0.292	IO					1.05
59.000	0.00	0.14	0.291	IO					1.05
59.083	0.00	0.14	0.290	IO					1.05
59.167	0.00	0.14	0.289	IO					1.04
59.250	0.00	0.14	0.288	IO					1.04
59.333	0.00	0.14	0.287	IO					1.04
59.417	0.00	0.14	0.287	IO					1.03
59.500	0.00	0.13	0.286	IO					1.03
59.583	0.00	0.13	0.285	IO					1.03
59.667	0.00	0.13	0.284	IO					1.03
59.750	0.00	0.13	0.283	IO					1.02
59.833	0.00	0.13	0.282	IO					1.02
59.917	0.00	0.13	0.281	IO					1.02
60.000	0.00	0.13	0.280	IO					1.01
60.083	0.00	0.13	0.279	IO					1.01
60.167	0.00	0.13	0.278	IO					1.01
60.250	0.00	0.13	0.277	IO					1.00
60.333	0.00	0.13	0.276	IO					1.00
60.417	0.00	0.13	0.275	IO					1.00
60.500	0.00	0.13	0.275	IO					0.99
60.583	0.00	0.13	0.274	IO					0.99
60.667	0.00	0.13	0.273	IO					0.99
60.750	0.00	0.13	0.272	IO					0.98
60.833	0.00	0.13	0.271	IO					0.98
60.917	0.00	0.13	0.270	IO					0.98
61.000	0.00	0.13	0.269	IO					0.98
61.083	0.00	0.13	0.268	IO					0.97
61.167	0.00	0.13	0.267	IO					0.97
61.250	0.00	0.13	0.266	IO					0.97
61.333	0.00	0.13	0.266	IO					0.96
61.417	0.00	0.13	0.265	IO					0.96
61.500	0.00	0.13	0.264	IO					0.96
61.583	0.00	0.13	0.263	IO					0.95
61.667	0.00	0.13	0.262	IO					0.95
61.750	0.00	0.13	0.261	IO					0.95
61.833	0.00	0.13	0.260	IO					0.94
61.917	0.00	0.13	0.259	IO					0.94
62.000	0.00	0.12	0.259	IO					0.94
62.083	0.00	0.12	0.258	IO					0.93
62.167	0.00	0.12	0.257	IO					0.93
62.250	0.00	0.12	0.256	IO					0.93
62.333	0.00	0.12	0.255	IO					0.92
62.417	0.00	0.12	0.254	IO					0.92
62.500	0.00	0.12	0.254	IO					0.92
62.583	0.00	0.12	0.253	IO					0.92
62.667	0.00	0.12	0.252	IO					0.91
62.750	0.00	0.12	0.251	IO					0.91
62.833	0.00	0.12	0.250	IO					0.91
62.917	0.00	0.12	0.249	IO					0.90
63.000	0.00	0.12	0.249	IO					0.90
63.083	0.00	0.12	0.248	IO					0.90
63.167	0.00	0.12	0.247	IO					0.89
63.250	0.00	0.12	0.246	IO					0.89
63.333	0.00	0.12	0.245	IO					0.89
63.417	0.00	0.12	0.244	IO					0.89
63.500	0.00	0.12	0.244	IO					0.88
63.583	0.00	0.12	0.243	IO					0.88
63.667	0.00	0.12	0.242	IO					0.88
63.750	0.00	0.12	0.241	IO					0.87
63.833	0.00	0.12	0.240	IO					0.87
63.917	0.00	0.12	0.240	IO					0.87
64.000	0.00	0.12	0.239	IO					0.87
64.083	0.00	0.11	0.238	IO					0.86
64.167	0.00	0.11	0.237	IO					0.86
64.250	0.00	0.11	0.236	IO					0.86
64.333	0.00	0.11	0.236	IO					0.85
64.417	0.00	0.11	0.235	IO					0.85
64.500	0.00	0.11	0.234	IO					0.85
64.583	0.00	0.11	0.233	IO					0.85
64.667	0.00	0.11	0.233	IO					0.84
64.750	0.00	0.11	0.232	IO					0.84
64.833	0.00	0.11	0.231	IO					0.84
64.917	0.00	0.11	0.230	IO					0.83
65.000	0.00	0.11	0.229	IO					0.83
65.083	0.00	0.11	0.229	IO					0.83
65.167	0.00	0.11	0.228	IO					0.83
65.250	0.00	0.11	0.227	O					0.82
65.333	0.00	0.11	0.226	O					0.82
65.417	0.00	0.11	0.226	O					0.82
65.500	0.00	0.11	0.225	O					0.82
65.583	0.00	0.11	0.224	O					0.81
65.667	0.00	0.11	0.223	O					0.81
65.750	0.00	0.11	0.223	O					0.81
65.833	0.00	0.11	0.222	O					0.80
65.917	0.00	0.11	0.221	O					0.80

66.000	0.00	0.11	0.221	0					0.80
66.083	0.00	0.11	0.220	0					0.80
66.167	0.00	0.11	0.219	0					0.79
66.250	0.00	0.11	0.218	0					0.79
66.333	0.00	0.10	0.218	0					0.79
66.417	0.00	0.10	0.217	0					0.79
66.500	0.00	0.10	0.216	0					0.78
66.583	0.00	0.10	0.215	0					0.78
66.667	0.00	0.10	0.215	0					0.78
66.750	0.00	0.10	0.214	0					0.78
66.833	0.00	0.10	0.213	0					0.77
66.917	0.00	0.10	0.213	0					0.77
67.000	0.00	0.10	0.212	0					0.77
67.083	0.00	0.10	0.211	0					0.77
67.167	0.00	0.10	0.211	0					0.76
67.250	0.00	0.10	0.210	0					0.76
67.333	0.00	0.10	0.209	0					0.76
67.417	0.00	0.10	0.208	0					0.76
67.500	0.00	0.10	0.208	0					0.75
67.583	0.00	0.10	0.207	0					0.75

Remaining water in basin = 0.21 (Ac.Ft)

```

*****HYDROGRAPH DATA*****
      Number of intervals = 811
      Time interval = 5.0 (Min.)
      Maximum/Peak flow rate = 1.002 (CFS)
      Total volume = 1.925 (Ac.Ft)
      Status of hydrographs being held in storage
      Stream 1 Stream 2 Stream 3 Stream 4 Stream 5
      Peak (CFS) 0.000 0.000 0.000 0.000 0.000
      Vol (Ac.Ft) 0.000 0.000 0.000 0.000 0.000
*****

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Program License Serial Number 5006

```
***** HYDROGRAPH INFORMATION *****
***** From study/file name: 72hr.rte *****
***** Hydrograph Information *****
***** From manual input hydrograph *****
*****HYDROGRAPH DATA*****
      Number of intervals = 432
      Time interval = 10.0 (Min.)
      Maximum/Peak flow rate = 127.013 (CFS)
      Total volume = 1.749 (Ac.Ft)
      Status of hydrographs being held in storage
      Stream 1 Stream 2 Stream 3 Stream 4 Stream 5
      Peak (CFS) 0.000 0.000 0.000 0.000 0.000
      Vol (Ac.Ft) 0.000 0.000 0.000 0.000 0.000
*****
+++++
Process from Point/Station 1.000 to Point/Station 1.000
**** RETARDING BASIN ROUTING ****
```

User entry of depth-outflow-storage data

Total number of inflow hydrograph intervals = 432
 Hydrograph time unit = 10.000 (Min.)
 Initial depth in storage basin = 0.00(Ft.)

Initial basin depth = 0.00 (Ft.)
 Initial basin storage = 0.00 (Ac.Ft)
 Initial basin outflow = 0.00 (CFS)

Depth vs. Storage and Depth vs. Discharge data:

Basin Depth (Ft.)	Storage (Ac.Ft)	Outflow (CFS)	(S-O*dt/2) (Ac.Ft)	(S+O*dt/2) (Ac.Ft)
0.000	0.000	0.000	0.000	0.000
1.000	0.276	0.133	0.275	0.277
2.000	0.584	0.193	0.583	0.585
3.000	0.930	0.700	0.925	0.935
3.500	1.118	0.824	1.112	1.124
4.000	1.316	0.930	1.310	1.322
4.500	1.528	1.024	1.521	1.535
4.750	1.637	1.068	1.630	1.644
5.000	1.749	18.283	1.623	1.875
6.000	2.231	253.655	0.484	3.978

Hydrograph Detention Basin Routing

Graph values: 'I'= unit inflow; 'O'=outflow at time shown

Time (Hours)	Inflow (CFS)	Outflow (CFS)	Storage (Ac.Ft)	Depth (Ft.)
0.167	127.01	0.61	0.871	2.83
0.333	0.00	8.29	1.684	4.85
0.500	0.00	1.06	1.620	4.71
0.667	0.00	1.06	1.605	4.68
0.833	0.00	1.05	1.591	4.64
1.000	0.00	1.04	1.576	4.61
1.167	0.00	1.04	1.562	4.58
1.333	0.00	1.03	1.548	4.54
1.500	0.00	1.03	1.533	4.51
1.667	0.00	1.02	1.519	4.48
1.833	0.00	1.01	1.505	4.45
2.000	0.00	1.01	1.491	4.41
2.167	0.00	1.00	1.477	4.38
2.333	0.00	1.00	1.464	4.35
2.500	0.00	0.99	1.450	4.32
2.667	0.00	0.98	1.436	4.28
2.833	0.00	0.98	1.423	4.25
3.000	0.00	0.97	1.410	4.22
3.167	0.00	0.97	1.396	4.19
3.333	0.00	0.96	1.383	4.16
3.500	0.00	0.95	1.370	4.13
3.667	0.00	0.95	1.357	4.10
3.833	0.00	0.94	1.344	4.07
4.000	0.00	0.94	1.331	4.03
4.167	0.00	0.93	1.318	4.00
4.333	0.00	0.92	1.305	3.97
4.500	0.00	0.92	1.292	3.94

4.667	0.00	0.91	1.280	0					3.91
4.833	0.00	0.90	1.267	0					3.88
5.000	0.00	0.90	1.255	0					3.85
5.167	0.00	0.89	1.243	0					3.81
5.333	0.00	0.88	1.230	0					3.78
5.500	0.00	0.88	1.218	0					3.75
5.667	0.00	0.87	1.206	0					3.72
5.833	0.00	0.86	1.194	0					3.69
6.000	0.00	0.86	1.182	0					3.66
6.167	0.00	0.85	1.171	0					3.63
6.333	0.00	0.85	1.159	0					3.60
6.500	0.00	0.84	1.147	0					3.57
6.667	0.00	0.83	1.136	0					3.54
6.833	0.00	0.83	1.124	0					3.52
7.000	0.00	0.82	1.113	0					3.49
7.167	0.00	0.81	1.102	0					3.46
7.333	0.00	0.81	1.091	0					3.43
7.500	0.00	0.80	1.080	0					3.40
7.667	0.00	0.79	1.069	0					3.37
7.833	0.00	0.78	1.058	0					3.34
8.000	0.00	0.78	1.047	0					3.31
8.167	0.00	0.77	1.036	0					3.28
8.333	0.00	0.76	1.026	0					3.25
8.500	0.00	0.76	1.015	0					3.23
8.667	0.00	0.75	1.005	0					3.20
8.833	0.00	0.74	0.995	0					3.17
9.000	0.00	0.74	0.984	0					3.14
9.167	0.00	0.73	0.974	0					3.12
9.333	0.00	0.72	0.964	0					3.09
9.500	0.00	0.72	0.954	0					3.07
9.667	0.00	0.71	0.945	0					3.04
9.833	0.00	0.70	0.935	0					3.01
10.000	0.00	0.69	0.925	0					2.99
10.167	0.00	0.68	0.916	0					2.96
10.333	0.00	0.67	0.907	0					2.93
10.500	0.00	0.65	0.897	0					2.91
10.667	0.00	0.64	0.889	0					2.88
10.833	0.00	0.63	0.880	0					2.86
11.000	0.00	0.61	0.871	0					2.83
11.167	0.00	0.60	0.863	0					2.81
11.333	0.00	0.59	0.855	0					2.78
11.500	0.00	0.58	0.847	0					2.76
11.667	0.00	0.57	0.839	0					2.74
11.833	0.00	0.56	0.831	0					2.71
12.000	0.00	0.54	0.824	0					2.69
12.167	0.00	0.53	0.816	0					2.67
12.333	0.00	0.52	0.809	0					2.65
12.500	0.00	0.51	0.802	0					2.63
12.667	0.00	0.50	0.795	0					2.61
12.833	0.00	0.49	0.788	0					2.59
13.000	0.00	0.48	0.781	0					2.57
13.167	0.00	0.47	0.775	0					2.55
13.333	0.00	0.46	0.768	0					2.53
13.500	0.00	0.45	0.762	0					2.51
13.667	0.00	0.44	0.756	0					2.50
13.833	0.00	0.44	0.750	0					2.48
14.000	0.00	0.43	0.744	0					2.46
14.167	0.00	0.42	0.738	0					2.44
14.333	0.00	0.41	0.732	0					2.43
14.500	0.00	0.40	0.727	0					2.41
14.667	0.00	0.39	0.721	0					2.40
14.833	0.00	0.39	0.716	0					2.38
15.000	0.00	0.38	0.710	0					2.37
15.167	0.00	0.37	0.705	0					2.35
15.333	0.00	0.36	0.700	0					2.34
15.500	0.00	0.36	0.695	0					2.32
15.667	0.00	0.35	0.690	0					2.31
15.833	0.00	0.34	0.686	0					2.29
16.000	0.00	0.34	0.681	0					2.28
16.167	0.00	0.33	0.676	0					2.27
16.333	0.00	0.32	0.672	0					2.25
16.500	0.00	0.32	0.668	0					2.24
16.667	0.00	0.31	0.663	0					2.23
16.833	0.00	0.30	0.659	0					2.22
17.000	0.00	0.30	0.655	0					2.20
17.167	0.00	0.29	0.651	0					2.19
17.333	0.00	0.29	0.647	0					2.18
17.500	0.00	0.28	0.643	0					2.17
17.667	0.00	0.27	0.639	0					2.16
17.833	0.00	0.27	0.635	0					2.15
18.000	0.00	0.26	0.632	0					2.14
18.167	0.00	0.26	0.628	0					2.13
18.333	0.00	0.25	0.625	0					2.12
18.500	0.00	0.25	0.621	0					2.11
18.667	0.00	0.24	0.618	0					2.10
18.833	0.00	0.24	0.615	0					2.09

19.000	0.00	0.23	0.611	0					2.08
19.167	0.00	0.23	0.608	0					2.07
19.333	0.00	0.22	0.605	0					2.06
19.500	0.00	0.22	0.602	0					2.05
19.667	0.00	0.21	0.599	0					2.04
19.833	0.00	0.21	0.596	0					2.03
20.000	0.00	0.21	0.593	0					2.03
20.167	0.00	0.20	0.590	0					2.02
20.333	0.00	0.20	0.588	0					2.01
20.500	0.00	0.19	0.585	0					2.00
20.667	0.00	0.19	0.582	0					1.99
20.833	0.00	0.19	0.580	0					1.99
21.000	0.00	0.19	0.577	0					1.98
21.167	0.00	0.19	0.574	0					1.97
21.333	0.00	0.19	0.572	0					1.96
21.500	0.00	0.19	0.569	0					1.95
21.667	0.00	0.19	0.566	0					1.94
21.833	0.00	0.19	0.564	0					1.93
22.000	0.00	0.19	0.561	0					1.93
22.167	0.00	0.19	0.559	0					1.92
22.333	0.00	0.19	0.556	0					1.91
22.500	0.00	0.19	0.553	0					1.90
22.667	0.00	0.19	0.551	0					1.89
22.833	0.00	0.19	0.548	0					1.88
23.000	0.00	0.19	0.546	0					1.88
23.167	0.00	0.19	0.543	0					1.87
23.333	0.00	0.18	0.541	0					1.86
23.500	0.00	0.18	0.538	0					1.85
23.667	0.00	0.18	0.536	0					1.84
23.833	0.00	0.18	0.533	0					1.83
24.000	0.00	0.18	0.531	0					1.83
24.167	0.00	0.18	0.528	0					1.82
24.333	0.00	0.18	0.526	0					1.81
24.500	0.00	0.18	0.523	0					1.80
24.667	0.00	0.18	0.521	0					1.79
24.833	0.00	0.18	0.518	0					1.79
25.000	0.00	0.18	0.516	0					1.78
25.167	0.00	0.18	0.513	0					1.77
25.333	0.00	0.18	0.511	0					1.76
25.500	0.00	0.18	0.508	0					1.75
25.667	0.00	0.18	0.506	0					1.75
25.833	0.00	0.18	0.503	0					1.74
26.000	0.00	0.18	0.501	0					1.73
26.167	0.00	0.18	0.498	0					1.72
26.333	0.00	0.18	0.496	0					1.71
26.500	0.00	0.18	0.494	0					1.71
26.667	0.00	0.17	0.491	0					1.70
26.833	0.00	0.17	0.489	0					1.69
27.000	0.00	0.17	0.486	0					1.68
27.167	0.00	0.17	0.484	0					1.68
27.333	0.00	0.17	0.482	0					1.67
27.500	0.00	0.17	0.479	0					1.66
27.667	0.00	0.17	0.477	0					1.65
27.833	0.00	0.17	0.474	0					1.64
28.000	0.00	0.17	0.472	0					1.64
28.167	0.00	0.17	0.470	0					1.63
28.333	0.00	0.17	0.467	0					1.62
28.500	0.00	0.17	0.465	0					1.61
28.667	0.00	0.17	0.463	0					1.61
28.833	0.00	0.17	0.460	0					1.60
29.000	0.00	0.17	0.458	0					1.59
29.167	0.00	0.17	0.456	0					1.58
29.333	0.00	0.17	0.453	0					1.58
29.500	0.00	0.17	0.451	0					1.57
29.667	0.00	0.17	0.449	0					1.56
29.833	0.00	0.17	0.447	0					1.55
30.000	0.00	0.17	0.444	0					1.55
30.167	0.00	0.17	0.442	0					1.54
30.333	0.00	0.16	0.440	0					1.53
30.500	0.00	0.16	0.437	0					1.52
30.667	0.00	0.16	0.435	0					1.52
30.833	0.00	0.16	0.433	0					1.51
31.000	0.00	0.16	0.431	0					1.50
31.167	0.00	0.16	0.428	0					1.49
31.333	0.00	0.16	0.426	0					1.49
31.500	0.00	0.16	0.424	0					1.48
31.667	0.00	0.16	0.422	0					1.47
31.833	0.00	0.16	0.420	0					1.47
32.000	0.00	0.16	0.417	0					1.46
32.167	0.00	0.16	0.415	0					1.45
32.333	0.00	0.16	0.413	0					1.44
32.500	0.00	0.16	0.411	0					1.44
32.667	0.00	0.16	0.409	0					1.43
32.833	0.00	0.16	0.406	0					1.42
33.000	0.00	0.16	0.404	0					1.42
33.167	0.00	0.16	0.402	0					1.41

33.333	0.00	0.16	0.400	0					1.40
33.500	0.00	0.16	0.398	0					1.39
33.667	0.00	0.16	0.395	0					1.39
33.833	0.00	0.16	0.393	0					1.38
34.000	0.00	0.16	0.391	0					1.37
34.167	0.00	0.16	0.389	0					1.37
34.333	0.00	0.15	0.387	0					1.36
34.500	0.00	0.15	0.385	0					1.35
34.667	0.00	0.15	0.383	0					1.35
34.833	0.00	0.15	0.381	0					1.34
35.000	0.00	0.15	0.378	0					1.33
35.167	0.00	0.15	0.376	0					1.33
35.333	0.00	0.15	0.374	0					1.32
35.500	0.00	0.15	0.372	0					1.31
35.667	0.00	0.15	0.370	0					1.31
35.833	0.00	0.15	0.368	0					1.30
36.000	0.00	0.15	0.366	0					1.29
36.167	0.00	0.15	0.364	0					1.29
36.333	0.00	0.15	0.362	0					1.28
36.500	0.00	0.15	0.360	0					1.27
36.667	0.00	0.15	0.358	0					1.27
36.833	0.00	0.15	0.356	0					1.26
37.000	0.00	0.15	0.354	0					1.25
37.167	0.00	0.15	0.352	0					1.25
37.333	0.00	0.15	0.349	0					1.24
37.500	0.00	0.15	0.347	0					1.23
37.667	0.00	0.15	0.345	0					1.23
37.833	0.00	0.15	0.343	0					1.22
38.000	0.00	0.15	0.341	0					1.21
38.167	0.00	0.15	0.339	0					1.21
38.333	0.00	0.14	0.337	0					1.20
38.500	0.00	0.14	0.335	0					1.19
38.667	0.00	0.14	0.333	0					1.19
38.833	0.00	0.14	0.331	0					1.18
39.000	0.00	0.14	0.329	0					1.17
39.167	0.00	0.14	0.328	0					1.17
39.333	0.00	0.14	0.326	0					1.16
39.500	0.00	0.14	0.324	0					1.15
39.667	0.00	0.14	0.322	0					1.15
39.833	0.00	0.14	0.320	0					1.14
40.000	0.00	0.14	0.318	0					1.14
40.167	0.00	0.14	0.316	0					1.13
40.333	0.00	0.14	0.314	0					1.12
40.500	0.00	0.14	0.312	0					1.12
40.667	0.00	0.14	0.310	0					1.11
40.833	0.00	0.14	0.308	0					1.10
41.000	0.00	0.14	0.306	0					1.10
41.167	0.00	0.14	0.304	0					1.09
41.333	0.00	0.14	0.302	0					1.09
41.500	0.00	0.14	0.300	0					1.08
41.667	0.00	0.14	0.299	0					1.07
41.833	0.00	0.14	0.297	0					1.07
42.000	0.00	0.14	0.295	0					1.06
42.167	0.00	0.14	0.293	0					1.05
42.333	0.00	0.14	0.291	0					1.05
42.500	0.00	0.14	0.289	0					1.04
42.667	0.00	0.14	0.287	0					1.04
42.833	0.00	0.13	0.285	0					1.03
43.000	0.00	0.13	0.284	0					1.02
43.167	0.00	0.13	0.282	0					1.02
43.333	0.00	0.13	0.280	0					1.01
43.500	0.00	0.13	0.278	0					1.01
43.667	0.00	0.13	0.276	0					1.00
43.833	0.00	0.13	0.274	0					0.99
44.000	0.00	0.13	0.273	0					0.99
44.167	0.00	0.13	0.271	0					0.98
44.333	0.00	0.13	0.269	0					0.97
44.500	0.00	0.13	0.267	0					0.97
44.667	0.00	0.13	0.265	0					0.96
44.833	0.00	0.13	0.264	0					0.96
45.000	0.00	0.13	0.262	0					0.95
45.167	0.00	0.13	0.260	0					0.94
45.333	0.00	0.12	0.258	0					0.94
45.500	0.00	0.12	0.257	0					0.93
45.667	0.00	0.12	0.255	0					0.92
45.833	0.00	0.12	0.253	0					0.92
46.000	0.00	0.12	0.252	0					0.91
46.167	0.00	0.12	0.250	0					0.91
46.333	0.00	0.12	0.248	0					0.90
46.500	0.00	0.12	0.247	0					0.89
46.667	0.00	0.12	0.245	0					0.89
46.833	0.00	0.12	0.243	0					0.88
47.000	0.00	0.12	0.242	0					0.88
47.167	0.00	0.12	0.240	0					0.87
47.333	0.00	0.12	0.239	0					0.86
47.500	0.00	0.11	0.237	0					0.86

47.667	0.00	0.11	0.236	0					0.85
47.833	0.00	0.11	0.234	0					0.85
48.000	0.00	0.11	0.232	0					0.84
48.167	0.00	0.11	0.231	0					0.84
48.333	0.00	0.11	0.229	0					0.83
48.500	0.00	0.11	0.228	0					0.83
48.667	0.00	0.11	0.226	0					0.82
48.833	0.00	0.11	0.225	0					0.81
49.000	0.00	0.11	0.223	0					0.81
49.167	0.00	0.11	0.222	0					0.80
49.333	0.00	0.11	0.220	0					0.80
49.500	0.00	0.11	0.219	0					0.79
49.667	0.00	0.10	0.217	0					0.79
49.833	0.00	0.10	0.216	0					0.78
50.000	0.00	0.10	0.215	0					0.78
50.167	0.00	0.10	0.213	0					0.77
50.333	0.00	0.10	0.212	0					0.77
50.500	0.00	0.10	0.210	0					0.76
50.667	0.00	0.10	0.209	0					0.76
50.833	0.00	0.10	0.208	0					0.75
51.000	0.00	0.10	0.206	0					0.75
51.167	0.00	0.10	0.205	0					0.74
51.333	0.00	0.10	0.204	0					0.74
51.500	0.00	0.10	0.202	0					0.73
51.667	0.00	0.10	0.201	0					0.73
51.833	0.00	0.10	0.200	0					0.72
52.000	0.00	0.10	0.198	0					0.72
52.167	0.00	0.09	0.197	0					0.71
52.333	0.00	0.09	0.196	0					0.71
52.500	0.00	0.09	0.194	0					0.70
52.667	0.00	0.09	0.193	0					0.70
52.833	0.00	0.09	0.192	0					0.69
53.000	0.00	0.09	0.190	0					0.69
53.167	0.00	0.09	0.189	0					0.69
53.333	0.00	0.09	0.188	0					0.68
53.500	0.00	0.09	0.187	0					0.68
53.667	0.00	0.09	0.185	0					0.67
53.833	0.00	0.09	0.184	0					0.67
54.000	0.00	0.09	0.183	0					0.66
54.167	0.00	0.09	0.182	0					0.66
54.333	0.00	0.09	0.181	0					0.65
54.500	0.00	0.09	0.179	0					0.65
54.667	0.00	0.09	0.178	0					0.65
54.833	0.00	0.09	0.177	0					0.64
55.000	0.00	0.08	0.176	0					0.64
55.167	0.00	0.08	0.175	0					0.63
55.333	0.00	0.08	0.174	0					0.63
55.500	0.00	0.08	0.172	0					0.62
55.667	0.00	0.08	0.171	0					0.62
55.833	0.00	0.08	0.170	0					0.62
56.000	0.00	0.08	0.169	0					0.61
56.167	0.00	0.08	0.168	0					0.61
56.333	0.00	0.08	0.167	0					0.60
56.500	0.00	0.08	0.166	0					0.60
56.667	0.00	0.08	0.165	0					0.60
56.833	0.00	0.08	0.163	0					0.59
57.000	0.00	0.08	0.162	0					0.59
57.167	0.00	0.08	0.161	0					0.58
57.333	0.00	0.08	0.160	0					0.58
57.500	0.00	0.08	0.159	0					0.58
57.667	0.00	0.08	0.158	0					0.57
57.833	0.00	0.08	0.157	0					0.57
58.000	0.00	0.08	0.156	0					0.57
58.167	0.00	0.07	0.155	0					0.56
58.333	0.00	0.07	0.154	0					0.56
58.500	0.00	0.07	0.153	0					0.55
58.667	0.00	0.07	0.152	0					0.55
58.833	0.00	0.07	0.151	0					0.55
59.000	0.00	0.07	0.150	0					0.54
59.167	0.00	0.07	0.149	0					0.54
59.333	0.00	0.07	0.148	0					0.54
59.500	0.00	0.07	0.147	0					0.53
59.667	0.00	0.07	0.146	0					0.53
59.833	0.00	0.07	0.145	0					0.53
60.000	0.00	0.07	0.144	0					0.52
60.167	0.00	0.07	0.143	0					0.52
60.333	0.00	0.07	0.142	0					0.52
60.500	0.00	0.07	0.141	0					0.51
60.667	0.00	0.07	0.140	0					0.51
60.833	0.00	0.07	0.139	0					0.51
61.000	0.00	0.07	0.138	0					0.50
61.167	0.00	0.07	0.138	0					0.50
61.333	0.00	0.07	0.137	0					0.50
61.500	0.00	0.07	0.136	0					0.49
61.667	0.00	0.06	0.135	0					0.49
61.833	0.00	0.06	0.134	0					0.49

62.000	0.00	0.06	0.133	0				0.48
62.167	0.00	0.06	0.132	0				0.48
62.333	0.00	0.06	0.131	0				0.48
62.500	0.00	0.06	0.130	0				0.47
62.667	0.00	0.06	0.130	0				0.47
62.833	0.00	0.06	0.129	0				0.47
63.000	0.00	0.06	0.128	0				0.46
63.167	0.00	0.06	0.127	0				0.46
63.333	0.00	0.06	0.126	0				0.46
63.500	0.00	0.06	0.125	0				0.45
63.667	0.00	0.06	0.125	0				0.45
63.833	0.00	0.06	0.124	0				0.45
64.000	0.00	0.06	0.123	0				0.45
64.167	0.00	0.06	0.122	0				0.44
64.333	0.00	0.06	0.121	0				0.44
64.500	0.00	0.06	0.120	0				0.44
64.667	0.00	0.06	0.120	0				0.43
64.833	0.00	0.06	0.119	0				0.43
65.000	0.00	0.06	0.118	0				0.43
65.167	0.00	0.06	0.117	0				0.43
65.333	0.00	0.06	0.117	0				0.42
65.500	0.00	0.06	0.116	0				0.42
65.667	0.00	0.06	0.115	0				0.42
65.833	0.00	0.06	0.114	0				0.41
66.000	0.00	0.05	0.113	0				0.41
66.167	0.00	0.05	0.113	0				0.41
66.333	0.00	0.05	0.112	0				0.41
66.500	0.00	0.05	0.111	0				0.40
66.667	0.00	0.05	0.111	0				0.40
66.833	0.00	0.05	0.110	0				0.40
67.000	0.00	0.05	0.109	0				0.40
67.167	0.00	0.05	0.108	0				0.39
67.333	0.00	0.05	0.108	0				0.39
67.500	0.00	0.05	0.107	0				0.39
67.667	0.00	0.05	0.106	0				0.38
67.833	0.00	0.05	0.105	0				0.38
68.000	0.00	0.05	0.105	0				0.38
68.167	0.00	0.05	0.104	0				0.38
68.333	0.00	0.05	0.103	0				0.37
68.500	0.00	0.05	0.103	0				0.37
68.667	0.00	0.05	0.102	0				0.37
68.833	0.00	0.05	0.101	0				0.37
69.000	0.00	0.05	0.101	0				0.36
69.167	0.00	0.05	0.100	0				0.36
69.333	0.00	0.05	0.099	0				0.36
69.500	0.00	0.05	0.099	0				0.36
69.667	0.00	0.05	0.098	0				0.36
69.833	0.00	0.05	0.097	0				0.35
70.000	0.00	0.05	0.097	0				0.35
70.167	0.00	0.05	0.096	0				0.35
70.333	0.00	0.05	0.095	0				0.35
70.500	0.00	0.05	0.095	0				0.34
70.667	0.00	0.05	0.094	0				0.34
70.833	0.00	0.05	0.094	0				0.34
71.000	0.00	0.04	0.093	0				0.34
71.167	0.00	0.04	0.092	0				0.33
71.333	0.00	0.04	0.092	0				0.33
71.500	0.00	0.04	0.091	0				0.33
71.667	0.00	0.04	0.091	0				0.33
71.833	0.00	0.04	0.090	0				0.33
72.000	0.00	0.04	0.089	0				0.32
72.167	0.00	0.04	0.089	0				0.32

Remaining water in basin = 0.09 (Ac.Ft)

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*****HYDROGRAPH DATA*****
      Number of intervals = 433
      Time interval = 10.0 (Min.)
      Maximum/Peak flow rate = 8.287 (CFS)
      Total volume = 1.661 (Ac.Ft)
      Status of hydrographs being held in storage
      Stream 1 Stream 2 Stream 3 Stream 4 Stream 5
      Peak (CFS) 0.000 0.000 0.000 0.000 0.000
      Vol (Ac.Ft) 0.000 0.000 0.000 0.000 0.000
*****

```

Appendix 8: Source Control

Pollutant Sources/Source Control Checklist

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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

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

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

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☐ I. Outdoor storage of equipment or materials. (See rows J and K for source control measures for vehicle cleaning, repair, and maintenance.)	☐ Show any outdoor storage areas, including how materials will be covered. Show how areas will be graded and bermed to prevent run-on or run-off from area. ☐ Storage of non-hazardous liquids shall be covered by a roof and/or drain to the sanitary sewer system, and be contained by berms, dikes, liners, or vaults. ☐ Storage of hazardous materials and wastes must be in compliance with the local hazardous materials ordinance and a Hazardous Materials Management Plan for the site.	<p>Include a detailed description of materials to be stored, storage areas, and structural features to prevent pollutants from entering storm drains.</p> <p>Where appropriate, reference documentation of compliance with the requirements of Hazardous Materials Programs for:</p> <ul style="list-style-type: none"> ▪ 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 <p>www.cchealth.org/groups/hazmat/</p>	☐ 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

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

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☐ K. Vehicle/Equipment Repair and Maintenance	☐ Accommodate all vehicle equipment repair and maintenance indoors. Or designate an outdoor work area and design the area to prevent run-on and runoff of stormwater. ☐ Show secondary containment for exterior work areas where motor oil, brake fluid, gasoline, diesel fuel, radiator fluid, acid-containing batteries or other hazardous materials or hazardous wastes are used or stored. Drains shall not be installed within the secondary containment areas. ☐ Add a note on the plans that states either (1) there are no floor drains, or (2) floor drains are connected to wastewater pretreatment systems prior to discharge to the sanitary sewer and an industrial waste discharge permit will be obtained.	☐ State that no vehicle repair or maintenance will be done outdoors, or else describe the required features of the outdoor work area. ☐ State that there are no floor drains or if there are floor drains, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements. ☐ State that there are no tanks, containers or sinks to be used for parts cleaning or rinsing or, if there are, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements.	<p>In the Stormwater Control Plan, note that all of the following restrictions apply to use the site:</p> ☐ 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. <p>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/</p> <p>Refer to Outdoor Cleaning Activities and Professional Mobile Service Providers for many of the Potential Sources of Runoff Pollutants categories below. Brochure can be found at http://rcflood.org/stormwater/</p>

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☐ 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

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

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☐ 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
<p>O. Miscellaneous Drain or Wash Water or Other Sources</p> ☐ Boiler drain lines ☐ Condensate drain lines ☐ Rooftop equipment ☐ Drainage sumps ☐ Roofing, gutters, and trim. ☐ Other sources		☐ Boiler drain lines shall be directly or indirectly connected to the sanitary sewer system and may not discharge to the storm drain system. ☐ Condensate drain lines may discharge to landscaped areas if the flow is small enough that runoff will not occur. Condensate drain lines may not discharge to the storm drain system. ☐ Rooftop equipment with potential to produce pollutants shall be roofed and/or have secondary containment. ☐ Any drainage sumps on-site shall feature a sediment sump to reduce the quantity of sediment in pumped water. ☐ Avoid roofing, gutters, and trim made of copper or other unprotected metals that may leach into runoff. Include controls for other sources as specified by local reviewer.	

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

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

Appendix 9: O&M

Operation and Maintenance Plan and Maintenance and Recording Mechanisms

Operations & Maintenance Responsibility for Treatment Control BMP's

BMP Required Maintenance	Frequency	Maintenance Requirements	Responsibility
Roof Drains/ Gutters	Before wet season, or significant rain event, or when needed	<ul style="list-style-type: none"> Roof Gutters shall be visually inspected for defects and possible leakage. Damage or defects found shall be corrected as soon as possible. Owners should avoid use of gutters, roofing, and trim made of copper so as to prevent the metal from leaching into runoff. 	Property Owner
Landscaping	Weekly	<ul style="list-style-type: none"> Maintain Landscaping using minimum or no pesticides 	HOA
Sidewalks	As needed	<ul style="list-style-type: none"> Sweep sidewalks 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. 	HOA
Extended Detention Basin	As needed	<ul style="list-style-type: none"> Maintain vegetation as needed without fertilizers Care should be taken to avoid contact with the low-flow or other trenches, and the media filter in the bottom stage Any product used should be applied in accordance with their labeling, especially in relation to application to water, and in areas subjected to flooding No ponded water should be present for more than 72 hours to avoid nuisance or vector problems. No algae formation should be visible. Correct problems as needed. 	HOA
	Annually, if possible schedule these inspections before the beginning of rain season.	<ul style="list-style-type: none"> Remove debris and litter from the entire basin. Inspect hydraulic and structural facilities. Examine the outlet of clogging, the embankment and spillway integrity, as well as damage to any structural element. Check for erosion, slumping and overgrowth. Repair as needed. Inspect sand media at the filter drain to verify it is allowing acceptable infiltration. Scarify top 3 inches by raking the filter drain's sand surface annually. Check the media filter underdrains (via the cleanout) for damage or clogging. Repair as needed. Remove accumulated sediment and debris from the forebay, and ensure that the notch weir is clear and will allow proper drainage. Check gravel filled low flow and collector trenches for sediment buildup and repair as needed. Remove the top 3 inches of sand from the filter drain and backfill with 3 inches of new sand to return the sand layer to its original depth. 	
	Every 5 years (or when observed drain times are less than 72 hours.)		

		<ul style="list-style-type: none">• When scarification or removal of the top 3 inches of sand is no longer effective, remove and replace sand filter layer.	
	Whenever substantial sediment accumulation has occurred.	<ul style="list-style-type: none">• Remove accumulated sediment from the bottom of the basin. Removal should extend to the original basin depth.	

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

Funding

Funding for Ongoing Maintenance will be provided by the Property Owner and HOA.

Acceptance of Responsibility

Property Owner accepts responsibility of said BMP's for maintenance and operation, as listed herein, from the time BMPs are constructed and accepted until the responsibility is legally transferred.

Basin Site Maintenance Summary Form

[illegible]

Recorded at the request of: COUNTY
OF RIVERSIDE TRANSPORTATION
DEPARTMENT

THIS INSTRUMENT IS FOR THE BENEFIT
OF THE COUNTY OF RIVERSIDE AND
ENTITLED TO BE RECORDED WITHOUT
FEE.(GOV. CODE 6103)

RETURN TO:
RIVERSIDE COUNTY TRANSPORTATION
DEPARTMENT.
4080 Lemon Street, 8th Floor
Riverside, CA 92501

**COVENANT AND AGREEMENT REGARDING WATER QUALITY
MANAGEMENT PLAN BMP, CONSENT TO INSPECT, MAINTENANCE AND
INDEMNIFICATION**

APN: _____ **PROJECT No.** _____ **IP No.** _____

OWNER(S): _____

PROPERTY ADDRESS: _____

LEGAL DESCRIPTION: _____

: _____
: _____

THIS AGREEMENT is made and entered into in Riverside County, California,
this ____ day of _____ Year_____, by and between _____

(hereinafter referred to as "Covenantor" or "Owner") and the COUNTY OF RIVERSIDE via
its Department of Transportation, a political subdivision of the State of California
(hereinafter referred to as "County"). The Covenantor and County may collectively be known
as "Parties" or individually as "Part."

RECITALS

WHEREAS, the Covenantor owns real property ("Property") in the County of Riverside,
State of California, more specifically described in Exhibit "A" and depicted in Exhibit "B",
each of these exhibits is attached, and incorporated herein by this reference;

WHEREAS, the County is the owner of interests in that certain real property within the
unincorporated area of the County of Riverside, State of California, containing storm drains,
pipelines, and related appurtenances constituting the County's municipal separate storm
sewer system (the County's "MS4");

WHEREAS, Covenantor intends to develop, improve, and/or use the Property in such a way that approval by the County for such development, improvement, and/or use is required pursuant to applicable laws;

WHEREAS, As a condition for said approval by the County, County required Covenantor, and Covenantor desires to, restrict the use of the Property according to the conditions, covenants, equitable servitudes, and restrictions contained herein for the express benefit of the County's MS4, which include requirements that the Property incorporate post construction on-site stormwater quality control measures;

WHEREAS, the Covenantor/Owner has chosen to install one or more _____

hereinafter referred to as "Device", as the on-site control measure to minimize pollutants in urban runoff;

WHEREAS, said Device has been installed in accordance with plans and specifications accepted by the County;

WHEREAS, said Device, with installation on private property is a private facility with all maintenance or replacement, therefore, the sole responsibility of the Covenantor/Owner in accordance with the terms of this Agreement;

WHEREAS, the Covenantor/Owner is aware that periodic and continuous maintenance, including, but not necessarily limited to, filter material replacement and sediment removal, is required to assure peak performance of Device and that, furthermore, such maintenance activity will require compliance with all Local, State, or Federal laws and regulations, including those pertaining; to confined space and waste disposal methods, in effect at the time such maintenance occurs;

NOW THEREFORE, incorporating the foregoing Recitals and in consideration of the covenants and conditions contained herein, and for other good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, and expressly for the benefit of, and to bind, their successors in interest, the Parties hereto agree as follows:

1. Covenantor/Owner hereby provides the County or County's designee complete access to the Device and its immediate vicinity and such access onto the property to permit access to the device at any time, upon twenty-four (24) hour advance notice in writing, of any duration for the purpose of inspection, sampling and testing of the Device. County shall make every effort at all times to minimize or avoid interference with Owner's use of the Property.
2. Covenantor/Owner shall use its best efforts diligently to maintain the Device in a manner assuring peak performance at all times. All reasonable precautions shall be exercised by Owner and Owner's representative or contractor in the removal and extraction of material(s) from the Device and the ultimate disposal of the material(s) in a manner consistent with all relevant laws and regulations in effect at the time. As may be requested

from time to time by the County / Regional Water Quality Control Board (RWQCB), the Owner shall provide the RWQCB with documentation identifying the material(s) removed, the quantity, and disposal destination.

3. In the event Covenantor/Owner, or its successors or assigns, fails to accomplish the necessary maintenance contemplated by this Agreement, within five (5) days of being given written notice by the County, the County is hereby authorized to cause any maintenance necessary to be done and charge the entire cost and expense to the Owner or Owner's successors or assigns, including administrative costs and interest thereon at the maximum rate authorized by the Civil Code from the date of notice of expense until paid in full.

4. The County may require the Covenantor/Owner to post security in a form and for a time period satisfactory to the County to guarantee the performance of the obligations stated herein. Should the Owner fail to perform the obligations under this Agreement, the County may, in the case of a cash deposit, certificate of deposit or letter of credit, act for the Owner using the proceeds from it, or in the case of a surety bond, require the sureties to perform the obligations of the Agreement.

5. The County may, but shall not be obligated to, enforce this Agreement by a proceeding at law or in equity against any person or persons violating or attempting to violate any condition, covenant, equitable servitude, or restriction provided for herein, either to restrain such violation or to recover damages.

6. This Agreement constitutes the entire agreement and understanding between the Parties with respect to the subject matter of this Agreement and supersedes all prior or contemporaneous agreements and understandings with respect to the subject matter hereof, whether oral or written.

7. If any part of this Agreement is declared by a final decision of a court of competent jurisdiction to be invalid for any reason, such shall not affect the validity of the rest of the Agreement. The other parts of this Agreement shall remain in effect as if this Agreement had been executed without the invalid parts(s). The Parties declare that they intend and desire that the remaining parts of this Agreement continue to be effective without any part(s) that have been declared invalid.

8. This Agreement may be executed in counterparts, each of which so executed shall, irrespective of the date of its execution and delivery, be deemed an original, and all such counterparts together shall constitute one and the same instrument.

9. This Agreement shall be recorded in the Office of the Recorder of Riverside County, California and shall constitute notice to all successors and assigns of the title to said Property of the obligation herein set forth.

10. In the event of legal action occasioned by any default or action of the Covenantor/Owner, or its successors or assigns, then the Covenantor/Owner and its

successors or assigns agree(s) to pay all costs incurred by the County in enforcing the terms of this Agreement, including reasonable attorney's fees and costs, and that the same shall become a part of the lien against said Property.

11. Covenantor/Owner agrees to indemnify, defend, and hold harmless the County, its elected officers, employees, agents, and contractors from and against any and all liability, expense, including costs and reasonable legal fees, and claims of damage of any nature whatsoever including, but not limited to, death, bodily injury, personal injury, or property damage arising from or connected with the County inspection of the Property except where such liability, expense, or claim for damage results from the sole negligence or willful misconduct of the County.

12. It is the intent of the Parties hereto that burdens and benefits herein undertaken shall constitute covenants that run with said Property and constitute a lien thereon against.

13. The obligations herein undertaken shall be binding upon the heirs, successors, executors, administrators and assigns of the Parties hereto and any other present or future interest holders or estate holders in the property. The term "Owner" shall include not only the present Owner, but also its heirs, successors in interest and in title to the property, executors, administrators, and assigns. Owner shall notify any successor to title of all or part of the Property about the existence of this Agreement. Owner shall provide such notice prior to such successor obtaining an interest in all or part of the Property. Owner shall provide a copy of such notice to the County at the same time such notice is provided to the successor. Notwithstanding the foregoing, and subject to Section 12, subsequent to any sale of the Property, the prior owner of the property shall be released of any liability thereafter accruing for the breach of the agreement.

14. Time is of the essence in the performance of this Agreement.

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15. Any notice to a Party required or called for in this Agreement shall be served in person, or by deposit in the U.S. Mail, first class postage prepaid, to the address set forth below. Notice(s) shall be deemed effective upon receipt, or seventy-two (72) hours after deposit in the U.S. Mail, whichever is earlier. A Party may change a notice address only by providing written notice thereof to the other Party.

COVENANTOR/OWNER:

COUNTY:

Riverside County Department of Transportation
Attn: Transportation Director
4080 Lemon Street, 8th Floor
Riverside, CA

**COUNTY OF RIVERSIDE
TRANSPORTATION DEPARTMENT**

COVENANTOR/OWNER

Director of Transportation

Date

(Attest)

Date

(Print Name)

(Print Title)

Signature

Company/Corporation/Partnership

(Print Name)

(Print Title)

Attach Notary

CO-PERMITTEE O&M COST DATA WORKSHEET (1 LID BMP per Worksheet)

Unit costs assume only urbanized areas drain to BMP. Undeveloped or large tributary areas will significantly increase costs

DOES THE COPERMITTEE REQUIRE O&M COST DATA ? ☒ YES ☐ NO

Development Project Number(s): <input style="width: 90%;" type="text"/> BMP Type (per WQMP): <input style="width: 90%;" type="text"/> Latitude (decimal format): <input style="width: 90%;" type="text"/> Maintenance Entity: <input style="width: 90%;" type="text"/> Maintenance Activities: <input style="width: 90%;" type="text"/>	DMA size (Acres): <input style="width: 90%;" type="text"/> BMP O&M \$/Acre: <input style="width: 90%;" type="text"/> Estimated Total Annual \$: <input style="width: 90%; text-align: center; value: \$0.00;" type="text"/> BMP Number (Sequential): <input style="width: 90%;" type="text"/> Longitude (decimal format): <input style="width: 90%;" type="text"/> Maintenance Frequency: <input style="width: 90%; text-align: center; value: 4 times per year;" type="text"/>
---	--

ANNUAL MAINTENANCE	UNIT	QUANTITY	CRITERIA	UNIT COSTS ¹	TOTAL ²	FREQUENCY see WQMP (#/YR) ³	ANNUAL COST
Maintain Vegetation & Remove Debris	SF		Rip Rap	\$0.48	\$0.00	4	\$0.00
			Typical	\$0.12	\$0.00	4	\$0.00
Sediment Removal / Forebay	CY			\$20.00	\$0.00	4	\$0.00
Grading and Scarifying	SF		< 40,000 SF	\$0.40	\$0.00	0.5	\$0.00
			> 40,000 SF	\$0.30	\$0.00	0.5	\$0.00
Revegetation	SF			\$5.00	\$0.00	0.33	\$0.00
Hazardous Disposal Costs	CY			\$8.00	\$0.00	0.33	\$0.00
Stabilize misc. erosion and rilling ⁴	SF			\$1.00	\$0.00	1	\$0.00
Maintain Impermeable layer	SF			\$1.00	\$0.00	0.33	\$0.00
Maintaining Access Rd	SF			\$0.15	\$0.00	1	\$0.00
Fencing (water depth>2')	LF		Chain Link	\$0.25	\$0.00	1	\$0.00
			Wrought Iron	\$1.50	\$0.00	1	\$0.00
Catch Basin Inserts (unit is length of CB)	LF			\$85.00	\$0.00	1	\$0.00
Proprietary BMPs ⁵ (can include catch basin insert regular maintenance)	EA		Misc		\$0.00	3	\$0.00
			Misc		\$0.00	3	\$0.00
			Misc		\$0.00	3	\$0.00
Dry Well	EA		Vac & Disposal	\$2,500.00	\$0.00	0.33	\$0.00
			Replace	\$1,800.00	\$0.00	1	\$0.00
Misc. Removals	LS		(Specify)		\$0.00		\$0.00
			(Specify)		\$0.00		\$0.00
Other misc. items	EA		(Specify)		\$0.00		\$0.00
Replace Biofiltration Media over time	CY		Only Media	\$65.00	\$0.00	0.1	\$0.00
Co-Permittee Inspection & NPDES reporting to Regional Board	LS			\$250.00	\$0.00	4	\$0.00
TOTAL ANNUAL MAINTENANCE COSTS*							\$0.00

Notes:

1. Use Co-Permittee costs or provide cost backup for new unit costs. For Public Maintenance, prevailing wage rates shall apply, unless classified as renovation.
2. Total includes \$1,000 mobilization for Grading, Revegetation, Hazardous Disposal, and Fixing Erosion
3. May not need to be done every year. For example, for every 3 years use 0.33 for the Frequency.
4. Includes basin bottom for BioRetention/BioFiltration
5. Attach Backup from manufacturer, including confirmation whether there are any sole source components.

*Does not include escalation, which may be added by the County.

Preparer's Name (Print)

Preparer's Name (Signature)

Owner's Name (Print)

Owner's Name (Signature)

This document is only used for cost estimating purposes and does not obligate specific activities or actions from the owner. The responsible party for O&M is solely responsible for ensuring inspection and maintenance as required by the WQMP, in perpetuity or the life of the WQMP.

Appendix 10: Educational Materials

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

Affidavit for NPDES Education

After the Storm (RCFC&WCD Handout)

Outdoor Cleaning Activities (RCFC & WCD Handout)

Guidelines for Maintaining Pools (RCFC & WCD Handout)

10 Ways to Save Water Outdoors (RCFC& WCD Handout)

CASQA GUIDELINES

SD-10 - Site Design & Landscape Planning

SD-11 – Roof Runoff Controls

SD-12 – Efficient Irrigation

SD-13 – Storm Drain Signage

TC-22 Extended Detention Basin

TC-32 - Bioretention

WARREN D. WILLIAMS
General Manager-Chief Engineer



1995 MARKET STREET
RIVERSIDE, CA 92501
951.955.1200
951.788.9965 FAX

RIVERSIDE COUNTY FLOOD CONTROL
AND WATER CONSERVATION DISTRICT

Affidavit to provide Riverside County National Pollutant Discharge Elimination System (NPDES) Public Education Materials to Prospective Property Owners within Commercial/Residential Developments

The property owner or developer of the proposed project must, on company letterhead, complete and return a notarized original copy of this affidavit directly, by mail or with your plan check submittal to the address shown below. The affidavit states that the distribution of educational materials to the tenants is assured prior to the issuance of occupancy permits. **Do not place the original affidavit into the Water Quality Management Report (WQMP).** Upon receipt, the Riverside County Flood Control and Water Conservation District (Plan Check Section) will date stamp, file and remove the appropriate "Flood RI BMP_Education" Condition of Approval for the development project identified prior to occupancy or final building inspection.

Placing a copy of the affidavit in the WQMP without submitting the original will not guarantee clearance of the condition.

Development Review/Plan Check Section
Riverside County Flood Control
and Water Conservation District
1995 Market Street
Riverside, CA 92501

Tract # _____ Tract Name: _____
 Developer: _____
 Engineer: _____

Residential Units (gross number): _____

Commercial Units (gross number): _____

Watershed Location (Place a check box by the appropriate watershed and circle appropriate community):

___ **Santa Ana:** Alberhill, Arnold Heights, Belltown, Beaumont, Calimesa, Canyon Lake, Cherry Valley, Eastvale, El Cariso, El Cerrito, Glen Avon, Glen Ivy Hot Springs, Glen Valley, Green Acres, Good Hope, Highgrove, Home Gardens, Homeland, Idyllwild, Juniper Flats, Jurupa Valley, Lake Elsinore, Lakeland Village, Lakeview, Mead Valley, Menifee, Mira Loma, Moreno Valley, Mountain Center, Nuevo, Norco, Pedley, Perris, Pine Cove, Quail Valley, Romoland, Rubidoux, San Jacinto, Sedco Hills, Sun City, Sunnyslope, Winchester, Wood Crest,
 Other: _____.

___ **Whitewater:** Banning, Bermuda Dunes, Cabazon, Cathedral City, Coachella, Desert Haven, Desert Hot Springs, Indian Wells, Indio, Indio Hills, La Quinta, North Palm Springs, Palm Desert, Palm Springs, Rancho Mirage, San Geronio, Sky Valley, Thousand Palms, Thermal, Whitewater, Other
 _____.

___ **Santa Margarita:** Aguanga, Anza, Murrieta, Temecula, French Valley, Wildomar,
 Other _____.

I certify that my staff has obtained the appropriate number of required National Pollutant Discharge Elimination System (NPDES) homeowner and/or business owner education materials for the above referenced development from the:

___ Public Information Specialist, Riverside County Flood Control District, by contacting 1.800.506.2555 or by e-mailing a request to FLOOD.fcnpdes@rcflood.org.

These materials will be distributed to each homeowner/business owner or successor in interest within the development prior to move in, occupancy or transfer of property, as appropriate.

Signature: _____

Title: _____ Date: _____



A Citizen's Guide to Understanding Stormwater



EPA 833-B-03-002

January 2003

Internet Address (URL) • HTTP://www.epa.gov
Recycled/Recyclable • Printed With Vegetable
Oil Based Inks on 100% Postconsumer
Process Chlorine Free Recycled Paper

or visit
www.epa.gov/nps/stormwater
www.epa.gov/nps

For more information contact:



After the Storm

What is stormwater runoff?



Stormwater runoff occurs when precipitation from rain or snowmelt flows over the ground. Impervious surfaces like driveways, sidewalks, and streets prevent stormwater from naturally soaking into the ground.

Why is stormwater runoff a problem?



Stormwater can pick up debris, chemicals, dirt, and other pollutants and flow into a storm sewer system or directly to a lake, stream, river, wetland, or coastal water. Anything that enters a storm sewer system is discharged untreated into the waterbodies we use for swimming, fishing, and providing drinking water.

The effects of pollution

Polluted stormwater runoff can have many adverse effects on plants, fish, animals, and people.

- ◆ Sediment can cloud the water and make it difficult or impossible for aquatic plants to grow. Sediment also can destroy aquatic habitats.
- ◆ Excess nutrients can cause algae blooms. When algae die, they sink to the bottom and decompose in a process that removes oxygen from the water. Fish and other aquatic organisms can't exist in water with low dissolved oxygen levels.
- ◆ Bacteria and other pathogens can wash into swimming areas and create health hazards, often making beach closures necessary.
- ◆ Debris—plastic bags, six-pack rings, bottles, and cigarette butts—washed into waterbodies can choke, suffocate, or disable aquatic life like ducks, fish, turtles, and birds.
- ◆ Household hazardous wastes like insecticides, pesticides, paint, solvents, used motor oil, and other auto fluids can poison aquatic life. Land animals and people can become sick or die from eating diseased fish and shellfish or ingesting polluted water.
- ◆ Polluted stormwater often affects drinking water sources. This, in turn, can affect human health and increase drinking water treatment costs.



Stormwater Pollution Solutions

Residential

Recycle or properly dispose of household products that contain chemicals, such as insecticides, pesticides, paint, solvents, and used motor oil and other auto fluids. Don't pour them onto the ground or into storm drains.

Lawn care

Excess fertilizers and pesticides applied to lawns and gardens wash off and pollute streams. In addition, yard clippings and leaves can wash into storm drains and contribute nutrients and organic matter to streams.

- ◆ Don't overwater your lawn. Consider using a soaker hose instead of a sprinkler.
- ◆ Use pesticides and fertilizers sparingly. When use is necessary, use these chemicals in the recommended amounts. Use organic mulch or safer pest control methods whenever possible.
- ◆ Compost or mulch yard waste. Don't leave it in the street or sweep it into storm drains or streams.
- ◆ Cover piles of dirt or mulch being used in landscaping projects.



Septic systems

Leaking and poorly maintained septic systems release nutrients and pathogens (bacteria and viruses) that can be picked up by stormwater and discharged into nearby waterbodies. Pathogens can cause public health problems and environmental concerns.

- ◆ Inspect your system every 3 years and pump your tank as necessary (every 3 to 5 years).
- ◆ Don't dispose of household hazardous waste in sinks or toilets.



Auto care

Washing your car and degreasing auto parts at home can send detergents and other contaminants through the storm sewer system. Dumping automotive fluids into storm drains has the same result as dumping the materials directly into a waterbody.

- ◆ Use a commercial car wash that treats or recycles its wastewater, or wash your car on your yard so the water infiltrates into the ground.
- ◆ Repair leaks and dispose of used auto fluids and batteries at designated drop-off or recycling locations.



Pet waste

Pet waste can be a major source of bacteria and excess nutrients in local waters.

- ◆ When walking your pet, remember to pick up the waste and dispose of it properly. Flushing pet waste is the best disposal method. Leaving pet waste on the ground increases public health risks by allowing harmful bacteria and nutrients to wash into the storm drain and eventually into local waterbodies.



Residential landscaping

Permeable Pavement—Traditional concrete and asphalt don't allow water to soak into the ground. Instead these surfaces rely on storm drains to divert unwanted water. Permeable pavement systems allow rain and snowmelt to soak through, decreasing stormwater runoff.

Rain Barrels—You can collect rainwater from rooftops in mosquito-proof containers. The water can be used later on lawn or garden areas.

Rain Gardens and Grassy Swales—Specially designed areas planted with native plants can provide natural places for



rainwater to collect and soak into the ground. Rain from rooftop areas or paved areas can be diverted into these areas rather than into storm drains.



Vegetated Filter Strips—Filter strips are areas of native grass or plants created along roadways or streams. They trap the pollutants stormwater picks up as it flows across driveways and streets.

Commercial

Dirt, oil, and debris that collect in parking lots and paved areas can be washed into the storm sewer system and eventually enter local waterbodies.

- ◆ Sweep up litter and debris from sidewalks, driveways and parking lots, especially around storm drains.
- ◆ Cover grease storage and dumpsters and keep them clean to avoid leaks.
- ◆ Report any chemical spill to the local hazardous waste cleanup team. They'll know the best way to keep spills from harming the environment.

Erosion controls that aren't maintained can cause excessive amounts of sediment and debris to be carried into the stormwater system. Construction vehicles can leak fuel, oil, and other harmful fluids that can be picked up by stormwater and deposited into local waterbodies.

- ◆ Divert stormwater away from disturbed or exposed areas of the construction site.
- ◆ Install silt fences, vehicle mud removal areas, vegetative cover, and other sediment and erosion controls and properly maintain them, especially after rainstorms.
- ◆ Prevent soil erosion by minimizing disturbed areas during construction projects, and seed and mulch bare areas as soon as possible.

Construction



Agriculture

Lack of vegetation on streambanks can lead to erosion. Overgrazed pastures can also contribute excessive amounts of sediment to local waterbodies. Excess fertilizers and pesticides can poison aquatic animals and lead to destructive algae blooms. Livestock in streams can contaminate waterways with bacteria, making them unsafe for human contact.

- ◆ Keep livestock away from streambanks and provide them a water source away from waterbodies.
- ◆ Store and apply manure away from waterbodies and in accordance with a nutrient management plan.
- ◆ Vegetate riparian areas along waterways.
- ◆ Rotate animal grazing to prevent soil erosion in fields.
- ◆ Apply fertilizers and pesticides according to label instructions to save money and minimize pollution.



Forestry

Improperly managed logging operations can result in erosion and sedimentation.

- ◆ Conduct preharvest planning to prevent erosion and lower costs.
- ◆ Use logging methods and equipment that minimize soil disturbance.
- ◆ Plan and design skid trails, yard areas, and truck access roads to minimize stream crossings and avoid disturbing the forest floor.
- ◆ Construct stream crossings so that they minimize erosion and physical changes to streams.
- ◆ Expedite revegetation of cleared areas.



Automotive Facilities



Uncovered fueling stations allow spills to be washed into storm drains. Cars waiting to be repaired can leak fuel, oil, and other harmful fluids that can be picked up by stormwater.

- ◆ Clean up spills immediately and properly dispose of cleanup materials.
- ◆ Provide cover over fueling stations and design or retrofit facilities for spill containment.
- ◆ Properly maintain fleet vehicles to prevent oil, gas, and other discharges from being washed into local waterbodies.
- ◆ Install and maintain oil/water separators.

Helpful telephone numbers and links:

Riverside County Stormwater Protection Partners

Flood Control District	(951) 955-1200
County of Riverside	(951) 955-1000
City of Banning	(951) 922-3105
City of Beaumont	(951) 769-8520
City of Calimesa	(909) 795-9801
City of Canyon Lake	(951) 244-2955
Cathedral City	(760) 770-0327
City of Coachella	(760) 398-4978
City of Corona	(951) 736-2447
City of Desert Hot Springs	(760) 329-6411
City of Eastvale	(951) 361-0900
City of Hemet	(951) 765-2300
City of Indian Wells	(760) 346-2489
City of Indio	(760) 391-4000
City of Lake Elsinore	(951) 674-3124
City of La Quinta	(760) 777-7000
City of Menifee	(951) 672-6777
City of Moreno Valley	(951) 413-3000
City of Murrieta	(951) 304-2489
City of Norco	(951) 270-5607
City of Palm Desert	(760) 346-0611
City of Palm Springs	(760) 323-8299
City of Perris	(951) 943-6100
City of Rancho Mirage	(760) 324-4511
City of Riverside	(951) 361-0900
City of San Jacinto	(951) 654-7337
City of Temecula	(951) 694-6444
City of Wildomar	(951) 677-7751

REPORT ILLEGAL STORM DRAIN DISPOSAL

1-800-506-2555 or e-mail us at
fcnpdes@rcflood.org

- Riverside County Flood Control and Water Conservation District
www.rcflood.org

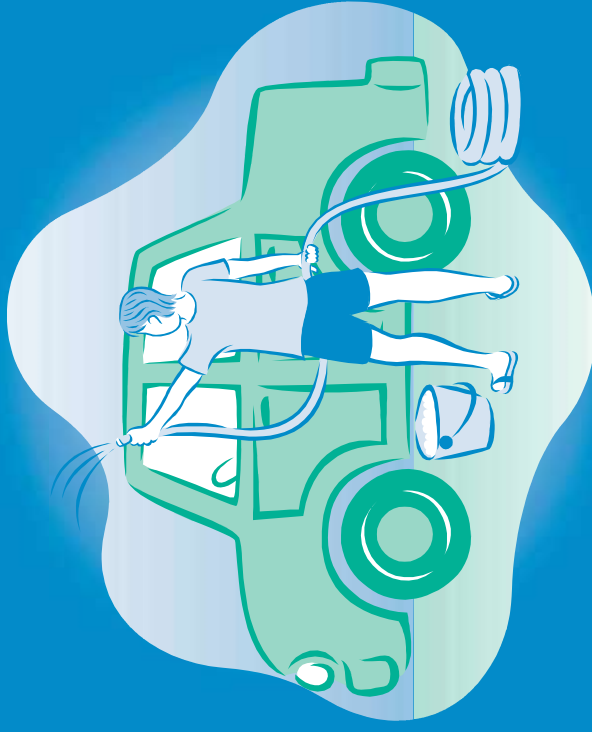
Online resources include:

- California Storm Water Quality Association
www.casqa.org
- State Water Resources Control Board
www.waterboards.ca.gov
- Power Washers of North America
www.thepwna.org

Stormwater Pollution

What you should know for...

Outdoor Cleaning Activities and Professional Mobile Service Providers



Storm drain pollution prevention information for:

- Car Washing / Mobile Detailers
- Window and Carpet Cleaners
- Power Washers
- Waterproofers / Street Sweepers
- Equipment cleaners or degreasers and all mobile service providers

Do you know where street flows actually go?

Storm drains are NOT connected to sanitary sewer systems and treatment plants!



The primary purpose of storm drains is to carry *rain* water away from developed areas to prevent flooding. Pollutants discharged to storm drains are transported directly into rivers, lakes and streams. Soaps, degreasers, automotive fluids, litter and a host of materials are washed off buildings, sidewalks, plazas and parking areas. Vehicles and equipment must be properly managed to prevent the pollution of local waterways.

Unintentional spills by mobile service operators can flow into storm drains and pollute our waterways. **Avoid mishaps.** *Always* have a **Spill Response Kit** on hand to clean up unintentional spills. Only emergency **Mechanical** repairs should be done in City streets, using drip pans for spills. **Plumbing** should be done on private property. Always store chemicals in a leak-proof container and keep covered when not in use. **Window/Power Washing** waste water shouldn't be released into the streets, but should be disposed of in a sanitary sewer, landscaped area or in the soil. Soiled **Carpet Cleaning** wash water should be filtered before being discharged into the sanitary sewer. Dispose of all filter debris properly. **Car Washing/Detailing** operators should wash cars on private property and use a regulated hose nozzle for water flow control and runoff prevention. Capture and dispose of waste water and chemicals properly. Remember, storm drains are for receiving rain water runoff only.



REPORT ILLEGAL STORM DRAIN DISPOSAL

1-800-506-2555

Help Protect Our Waterways!

Use these guidelines for Outdoor Cleaning Activities and Wash Water Disposal

Did you know that disposing of pollutants into the street, gutter, storm drain or body of water is **PROHIBITED** by law and can result in stiff penalties?

Best Management Practices

Waste wash water from Mechanics, Plumbers, Window/Power Washers, Carpet Cleaners, Car Washing and Mobile Detailing activities may contain significant quantities of motor oil, grease, chemicals, dirt, detergents, brake pad dust, litter and other materials.

Best Management Practices, or BMPs as they are known, are guides to prevent pollutants from entering the storm drains. *Each of us* can do our part to keep stormwater clean by using the suggested BMPs below:

Simple solutions for both light and heavy duty jobs:

Do....consider dry cleaning methods first such as a mop, broom, rag or wire brush. Always keep a spill response kit on site.

Do....prepare the work area before power cleaning by using sand bags, rubber mats, vacuum booms, containment pads or temporary berms to keep wash water away from the gutters and storm drains.

Do....use vacuums or other machines to remove and collect loose debris or litter before applying water.

Do....obtain the property owner's permission to dispose of *small amounts* of power washing waste water on to landscaped, gravel or unpaved surfaces.

Do....check your local sanitary sewer agency's policies on wash water disposal regulations before disposing of wash water into the sewer. (See list on reverse side)

Do....be aware that if discharging to landscape areas, soapy wash water may damage landscaping. Residual wash water may remain on paved surfaces to evaporate. Sweep up solid residuals and dispose of properly. Vacuum booms are another option for capturing and collecting wash water.

Do....check to see if local ordinances prevent certain activities.

Do not let....wash or waste water from sidewalk, plaza or building cleaning go into a street or storm drain.



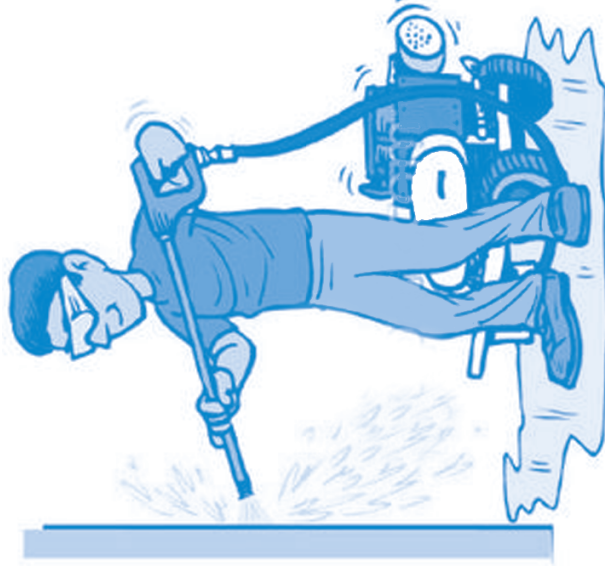
Report illegal storm drain disposal

Call Toll Free

1-800-506-2555

Using Cleaning Agents

Try using biodegradable/phosphate-free products. They are easier on the environment, but don't confuse them with being toxic free. Soapy water entering the storm drain system can impact the delicate aquatic environment.



When cleaning surfaces with a **high-pressure washer** or **steam cleaner**, additional precautions should be taken to prevent the discharge of pollutants into the storm drain system. These two methods of surface cleaning can loosen additional material that can contaminate local waterways.

Think Water Conservation

Minimize water use by using high pressure, low volume nozzles. Be sure to check all hoses for leaks. Water is a precious resource, don't let it flow freely and be sure to shut it off in between uses.

Screening Wash Water

Conduct thorough dry cleanup before washing exterior surfaces, such as buildings and decks **with loose paint**, sidewalks or plaza areas. Keep debris from entering the storm drain after cleaning by first passing the wash water through a "20 mesh" or finer screen to catch the solid materials, then dispose of the mesh in a refuse container. Do not let the remaining wash water enter a street, gutter or storm drain.

Drain Inlet Protection & Collection of Wash Water

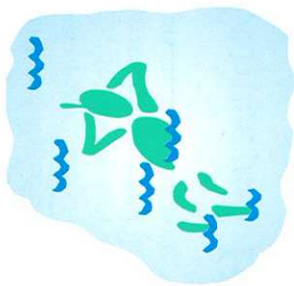
- Prior to any washing, block all storm drains with an impervious barrier such as sandbags or berms, or seal the storm drain with plugs or other appropriate materials.
- Create a containment area with berms and traps or take advantage of a low spot to keep wash water contained.
- Wash vehicles and equipment on grassy or gravel areas so that the wash water can seep into the ground.
- Pump or vacuum up all wash water in the contained area.

Concrete/Coring/Saw Cutting and Drilling Projects

Protect any down-gradient inlets by using dry activity techniques whenever possible. If water is used, minimize the amount of water used during the coring/drilling or saw cutting process. Place a barrier of sandbags and/or absorbent berms to protect the storm drain inlet or watercourse. Use a shovel or wet vacuum to remove the residue from the pavement. Do not wash residue or particulate matter into a storm drain inlet or watercourse.

Saltwater Pools

- Salt water pools, although different from regular pools, are in fact, sanitized using chlorine. A salt-chlorine generator separates the chlorine and sodium molecules in salt and reintroduces them into the pool water. The same harmful effects of chlorine still apply.
- A salt water pool is still maintained with chemicals such as Muriatic acid, soda ash and sodium carbonate to help keep a proper pH, total Alkalinity, Calcium Hardness and Stabilizer levels.



- It may be illegal to discharge salt water to land. The salt may kill plants and the build-up of salt in soil puts animals, plants, and groundwater at risk. Consult your city representatives to determine local requirements regarding salt water drainage.

NEVER put unused chemicals into the trash, onto the ground or down a storm drain.

IMPORTANT: The discharge of pollutants into the street, gutter, storm drain system or waterways - without a permit or waiver - is strictly prohibited by local ordinances, state and federal law. Violations may result in monetary fines and enforcement actions.

Helpful telephone numbers and links

RIVERSIDE COUNTY WATER AGENCIES:

City of Banning.....	(951) 922-3130
City of Beaumont/Cherry Valley.....	(951) 845-9581
City of Blythe.....	(760) 922-6161
City of Coachella.....	(760) 398-3502
City of Corona.....	(951) 736-2263
City of Hemet.....	(951) 765-3710
City of Norco.....	(951) 270 5607
City of Riverside Public Works.....	(951) 351-6140
City of San Jacinto.....	(951) 654-4041
Coachella Valley Water District.....	(760) 398-2651
Desert Water Agency (Palm Springs).....	(760) 323-4971
Eastern Municipal Water District.....	(951) 928-3777
Elsinore Valley Municipal Water District.....	(951) 674 3146
Elsinore Water District.....	(951) 674-2168
Farm Mutual Water Company.....	(951) 244-4198
Idyllwild Water District.....	(951) 659-2143
Indio Water Authority.....	(760) 391-4129
Jurupa Community Services District.....	(951) 685-7434
Lee Lake Water.....	(951) 658-3241
Mission Springs Water.....	(760) 329-6448
Rancho California Water District.....	(951) 296-6900
Ripley, CSA #62.....	(760) 922-4951
Riverside Co. Service Area #51.....	(760) 227-3203
Rubidoux Community Services District.....	(951) 684-7580
Valley Sanitary District.....	(760) 347-2356
Western Municipal Water District.....	(951) 789-5000
Yucaipa Valley Water District.....	(909) 797-5117

CALL 1-800-506-2555 to:

- Report clogged storm drains or illegal storm drain disposal from residential, industrial, construction and commercial sites into public streets, storm drains and/or water bodies.
- Find out about our various storm drain pollution prevention materials.
- Locate the dates and times of Household Hazardous Waste (HHW) Collection Events.
- Request adult, neighborhood, or classroom presentations.
- Locate other County environmental services.
- Receive grasscycling information and composting workshop information.

Or visit our

Riverside County Flood Control and Water Conservation District
website at: www.rcflood.org

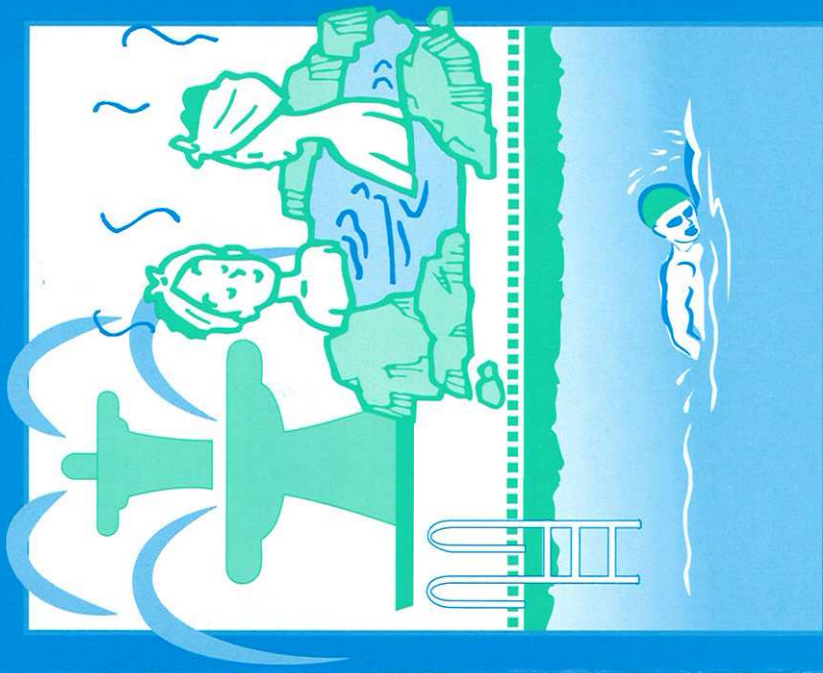
Other links to additional storm drain pollution information:

- County of Riverside Environmental Health: www.rivcoeh.org
- State Water Resources Control Board: www.waterboards.ca.gov
- California Stormwater Quality Association: www.casqa.org
- United States Environmental Protection Agency (EPA): www.epa.gov/compliance/assistance (compliance assistance information)



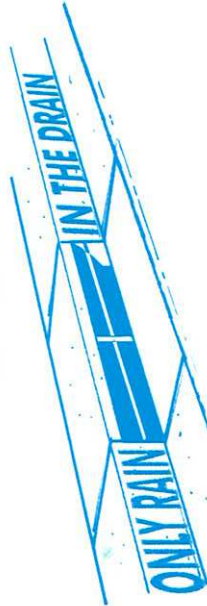
Riverside County's, "Only Rain Down the Storm Drain" Pollution Prevention Program gratefully acknowledges the Bay Area Stormwater Management Agencies Association and the Cleaning Equipment Trade Association for information provided in this brochure.

Guidelines for Maintaining your...



Swimming Pool, Jacuzzi and Garden Fountain

Where does the water go?



Pool, Jacuzzi and Fountain wastewater and rain water runoff (also called stormwater) that reach streets can enter the storm drain and be conveyed directly into local streams, rivers and lakes.



A storm drain's purpose is to prevent flooding by carrying rain water away from developed areas. Storm drains are not connected to sanitary sewers systems and treatment plants!

Wastewater, from residential swimming pools, Jacuzzis, fishponds and fountains, often contains chemicals used for sanitizing or cleansing purposes. Toxic chemicals (such as chlorine or copper-based algaecides) may pollute the environment when discharged into a storm drain system.

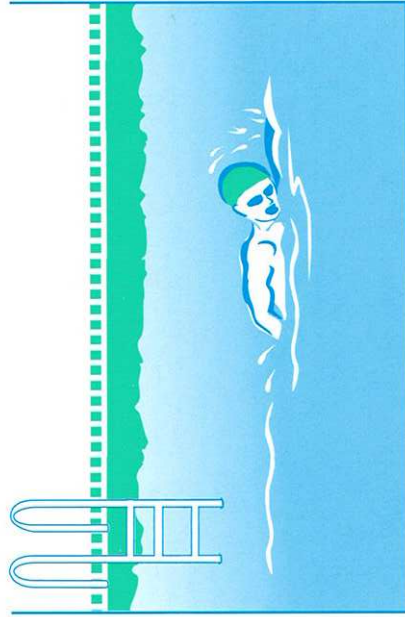
The Cities and County of Riverside have adopted ordinances that prohibit the discharge of wastewater to the street and storm drain system.



Discharge Regulations

Regulatory requirements for discharging wastewater from your pool may differ from city to city. Chlorinated water should not be discharged into the street, storm drain or surface waters. Check with your water agency to see if disposal to the sanitary sewer line is allowed for pool discharges (see reverse for Riverside County sewer agencies).

If allowed, a hose can be run from the pool Jacuzzi, or fountain to the private sewer cleanout, washing machine drain or a sink or bathtub.



If you cannot discharge to the sewer, you may drain your fountain, pool, or jacuzzi to your landscaping by following these guidelines:

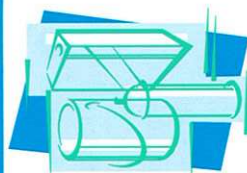
First, reduce or eliminate solids (e.g. debris, leaves or dirt) in the pool water and allow the chemicals in the pool water to dissipate before draining the pool (this could take up to 7 days, verify using a home pool test kit).

Second, slowly drain to a landscaped area away from buildings or structures. Control the flow to prevent soil erosion; it may take more than one day to empty. Do not allow sediment to enter the street, gutter or storm drain.

Maintenance & Chemicals

Cleaning Filters

Filter rinse water and backwash must be discharged to the sanitary sewer, on-site septic tank and drain field system (if properly designed and adequately sized), or a seepage pit. Alternatively, rinse water or backwash may be diverted to landscaped or dirt areas. Filter media and other non-hazardous solids should be picked up and disposed of in the trash.

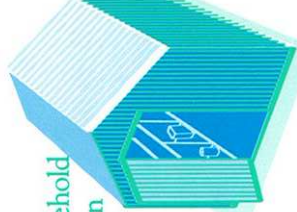


Algaecides

Avoid using copper-based algaecides unless absolutely necessary. Control algae with chlorine, organic polymers or other alternatives to copper-based pool chemicals. Copper is a heavy metal that can be toxic to aquatic life when you drain your pool.

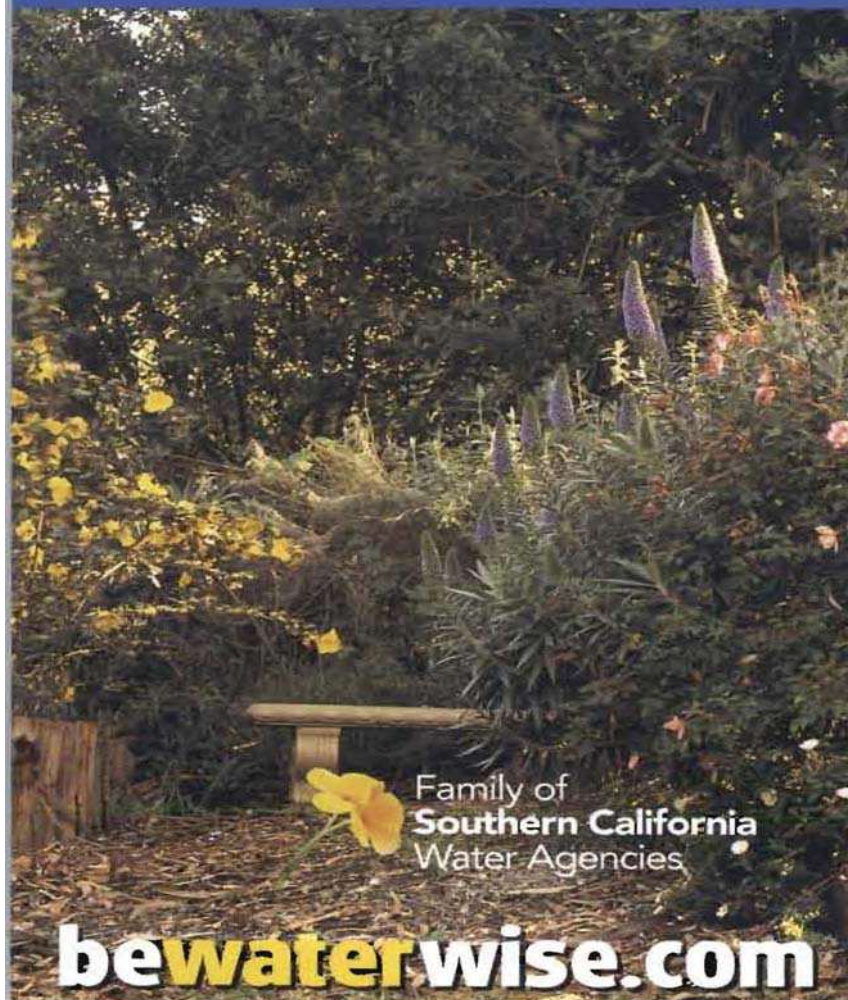
Chemical Storage and Handling

- Use only the amount indicated on product labels
- Store chlorine and other chemicals in a covered area to prevent runoff. Keep out of reach of children and pets.
- Chlorine kits, available at retail swimming pool equipment and supply stores, should be used to monitor the chlorine and pH levels before draining your pool.
- Chlorine and other pool chemicals should never be allowed to flow into the gutter or storm drain system.



Take unwanted chemicals to a Household Hazardous Waste (HHW) Collection Event. There's no cost for taking HHW items to collection events – it's FREE! Call 1-800-506-2555 for a schedule of HHW events in your community.

10 Ways to **Save** Water Outdoors



Family of
Southern California
Water Agencies

bewaterwise.com

TIP #1 The average homeowner uses twice the amount of water needed to keep plants healthy. Use the watering calculator and index at bewaterwise.com to know exactly how much water your plants need.

TIP #2 Check your sprinkler system for leaks, overspray and broken sprinkler heads. Update with drip or other more water-efficient sprinklers where appropriate.

TIP #3 This fall, plant a portion of your garden with beautiful native and California Friendly plants. Browse the plant database at bewaterwise.com to find just the right look for your outdoor spaces.

TIP #4 Reduce the amount of water-thirsty grass. Keep only what you need and replace the rest with less-thirsty plants or permeable paving.

TIP #5 For the grass you keep, set your lawnmower blade higher.

TIP #6 Adjust your sprinkler timer downward in September. Plants need less water when days are shorter.

TIP #7 Use a broom instead of the hose for cleaning sidewalks and patios.

TIP #8 Mulch! A layer of bark, gravel, compost, sawdust or low-growing groundcover evens out soil temperature and allows better water retention.

TIP #9 Check the list of invasive plants that hurt our environment at caleppc.org and remove any from your garden.

TIP #10 Share these tips with your gardener, neighbors and friends. Water conservation should be a part of every Southern Californian's lifestyle, but that doesn't mean we can't have lush and beautiful outdoor spaces.

bewaterwise.com

3.1 INFILTRATION BASIN

Type of BMP	LID - Infiltration
Treatment Mechanisms	Infiltration, Evapotranspiration (when vegetated), Evaporation, and Sedimentation
Maximum Treatment Area	50 acres
Other Names	Bioinfiltration Basin

Description

An Infiltration Basin is a flat earthen basin designed to capture the design capture volume, V_{BMP} . The stormwater infiltrates through the bottom of the basin into the underlying soil over a 72 hour drawdown period. Flows exceeding V_{BMP} must discharge to a downstream conveyance system. Trash and sediment accumulate within the forebay as stormwater passes into the basin. Infiltration basins are highly effective in removing all targeted pollutants from stormwater runoff.



Figure 1 – Infiltration Basin

See Appendix A, and Appendix C, Section 1 of *Basin Guidelines*, for additional requirements.

Siting Considerations

The use of infiltration basins may be restricted by concerns over ground water contamination, soil permeability, and clogging at the site. See the applicable WQMP for any specific feasibility considerations for using infiltration BMPs. Where this BMP is being used, the soil beneath the basin must be thoroughly evaluated in a geotechnical report since the underlying soils are critical to the basin's long term performance. To protect the basin from erosion, the sides and bottom of the basin must be vegetated, preferably with native or low water use plant species.

In addition, these basins may not be appropriate for the following site conditions:

- Industrial sites or locations where spills of toxic materials may occur
- Sites with very low soil infiltration rates
- Sites with high groundwater tables or excessively high soil infiltration rates, where pollutants can affect ground water quality
- Sites with unstabilized soil or construction activity upstream
- On steeply sloping terrain
- Infiltration basins located in a fill condition should refer to Appendix A of this Handbook for details on special requirements/restrictions

INFILTRATION BASIN BMP FACT SHEET

Setbacks

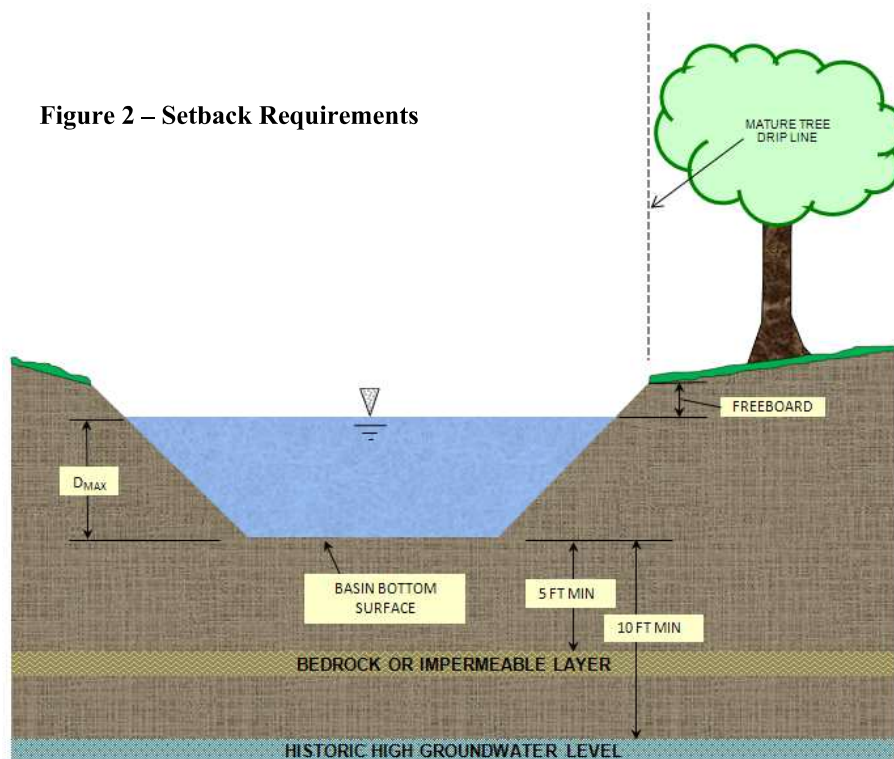
Always consult your geotechnical engineer for site specific recommendations regarding setbacks for infiltration trenches. Recommended setbacks are needed to protect buildings, existing trees, walls, onsite or nearby wells, streams, and tanks. Setbacks should be considered early in the design process since they can affect where infiltration facilities may be placed and how deep they are allowed to be. For instance, depth setbacks can dictate fairly shallow facilities that will have a larger footprint and, in some cases, may make an infiltration basin infeasible. In that instance, another BMP must be selected.

Infiltration basins typically must be set back:

- 10 feet from the historic high groundwater (measured vertically from the bottom of the basin, as shown in Figure 2)
- 5 feet from bedrock or impermeable surface layer (measured vertically from the bottom of the basin, as shown in Figure 2)
- From all existing mature tree drip lines as indicated in Figure 2 (to protect their root structure)
- 100 feet horizontally from wells, tanks or springs

Setbacks to walls and foundations must be included as part of the Geotechnical Report. All other setbacks shall be in accordance with applicable standards of the District's *Basin Guidelines* (Appendix C).

Figure 2 – Setback Requirements



INFILTRATION BASIN BMP FACT SHEET

Forebay

A concrete forebay shall be provided to reduce sediment clogging and to reduce erosion. The forebay shall have a design volume of at least 0.5% V_{BMP} and a minimum 1 foot high concrete splashwall / berm. Full height notch-type weir(s), offset from the line of flow from the basin inlet to prevent short circuiting, shall be used to outlet the forebay. It is recommended that two weirs be used and that they be located on opposite sides of the forebay (see Figure 2).

Overflow

Flows exceeding V_{BMP} must discharge to an acceptable downstream conveyance system. Where an adequate outlet is present, an overflow structure may be used. Where an embankment is present, an emergency spillway may be used instead. Overflows must be placed just above the design water surface for V_{BMP} and be near the outlet of the system. The overflow structure shall be similar to the District's Standard Drawing CB 110. Additional details may be found in the District's *Basin Guidelines* (Appendix C).

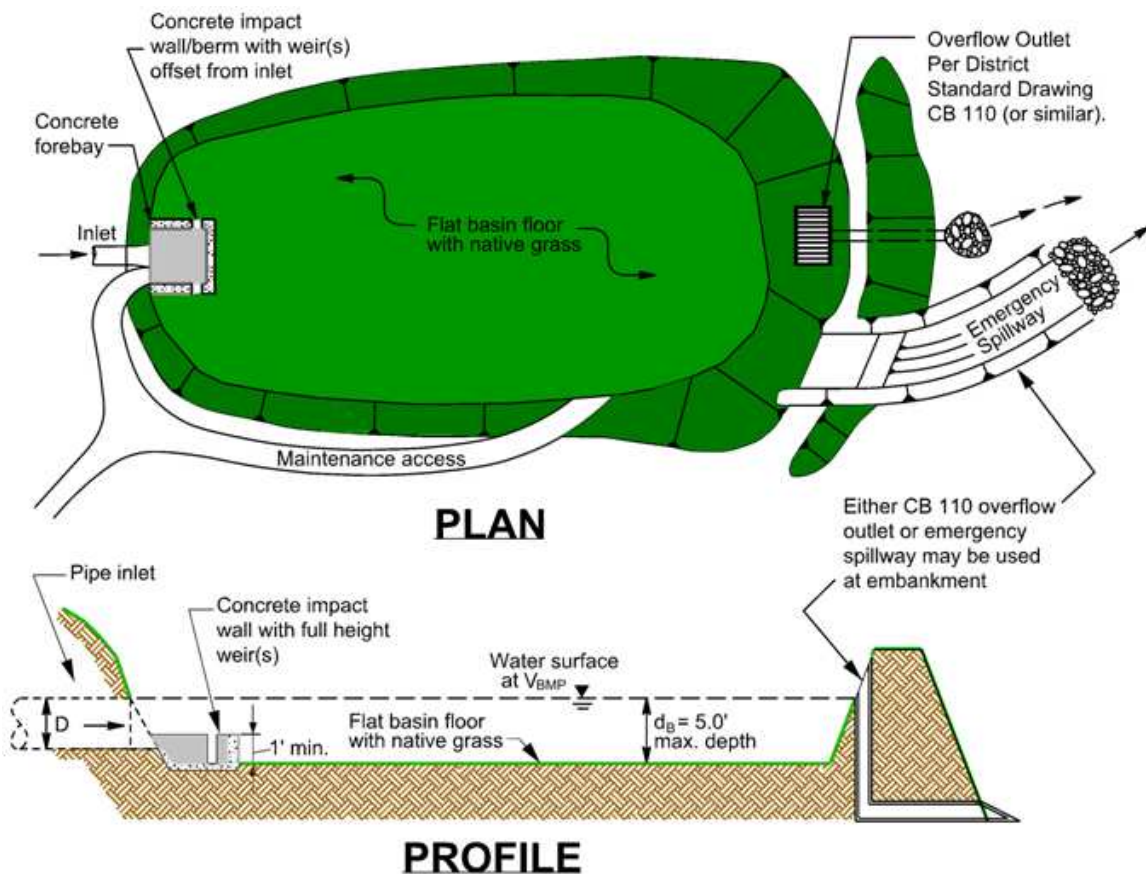


Figure 3 – Infiltration Basin

INFILTRATION BASIN BMP FACT SHEET

Landscaping Requirements

Basin vegetation provides erosion protection, improves sediment removal and assists in allowing infiltration to occur. The basin surface and side slopes shall be planted with native grasses. Proper landscape management is also required to ensure that the vegetation does not contribute to water pollution through pesticides, herbicides, or fertilizers. Landscaping shall be in accordance with County of Riverside Ordinance 859 and the District's *Basin Guidelines* (Appendix C), or other guidelines issued by the Engineering Authority.

Maintenance

Normal maintenance of an infiltration basin includes the maintenance of landscaping, debris and trash removal from the surface of the basin, and tending to problems associated with standing water (vectors, odors, etc.). Significant ponding, especially more than 72 hours after an event, may indicate that the basin surface is no longer providing sufficient infiltration and requires aeration. See the District's *Basin Guidelines* (Appendix C) for additional requirements (i.e., fencing, maintenance access, etc.).

Table 1 - Inspection and Maintenance

Schedule	Inspection and Maintenance Activity
Ongoing including just before annual storm seasons and following rainfall events.	<ul style="list-style-type: none"> Maintain vegetation as needed. Use of fertilizers, pesticides and herbicides should be strenuously avoided to ensure they don't contribute to water pollution. If appropriate native plant selections and other IPM methods are used, such products shouldn't be needed. If such projects are used, <ul style="list-style-type: none"> Products shall be applied in accordance with their labeling, especially in relation to application to water, and in areas subjected to flooding. Fertilizers should not be applied within 15 days before, after, or during the rain season. Remove debris and litter from the entire basin to minimize clogging and improve aesthetics. Check for obvious problems and repair as needed. Address odor, insects, and overgrowth issues associated with stagnant or standing water in the basin bottom. There should be no long-term ponding water. Check for erosion and sediment laden areas in the basin. Repair as needed. Clean forebay if needed. Revegetate side slopes where needed.
Annually. If possible, schedule these inspections within 72 hours after a significant rainfall.	<ul style="list-style-type: none"> Inspection of hydraulic and structural facilities. Examine the inlet for blockage, the embankment and spillway integrity, as well as damage to any structural element. Check for erosion, slumping and overgrowth. Repair as needed. Check basin depth for sediment build up and reduced total capacity. Scrape bottom as needed and remove sediment. Restore to original cross-section and infiltration rate. Replant basin vegetation. Verify the basin bottom is allowing acceptable infiltration. Use a disc or other method to aerate basin bottom only if there is actual significant loss of infiltrative capacity, rather than on a routine basis¹. No water should be present 72 hours after an event. No long term standing water should be present at all. No algae formation should be visible. Correct problem as needed.
1. CA Stormwater BMP Handbook for New Development and Significant Redevelopment	

INFILTRATION BASIN BMP FACT SHEET

Table 2 - Design and Sizing Criteria for Infiltration Basins

Design Parameter	Infiltration Basin
Design Volume	V_{BMP}
Forebay Volume	0.5% V_{BMP}
Drawdown time (maximum)	72 hours
Maximum tributary area	50 acres ²
Minimum infiltration rate	Must be sufficient to drain the basin within the required Drawdown time over the life of the BMP. The WQMP may include specific requirements for minimum tested infiltration rates.
Maximum Depth	5 feet
Spillway erosion control	Energy dissipators to reduce velocities ¹
Basin Slope	0%
Freeboard (minimum)	1 foot ¹
Historic High Groundwater Setback (max)	10 feet
Bedrock/impermeable layer setback (max)	5 feet
Tree setbacks	Mature tree drip line must not overhang the basin
Set back from wells, tanks or springs	100 feet
Set back from foundations	As recommended in Geotechnical Report
^{1.} Ventura County's Technical Guidance Manual for Stormwater Quality Control Measures ^{2.} CA Stormwater BMP Handbook for New Development and Significant Redevelopment	

Note: The information contained in this BMP Factsheet is intended to be a summary of design considerations and requirements. Additional information which applies to all detention basins may be found in the District's Basin Guidelines (Appendix C). In addition, information herein may be superseded by other guidelines issued by the co-permittee.

INFILTRATION BASIN SIZING PROCEDURE

1. Find the Design Volume, V_{BMP} .
 - a) Enter the Tributary Area, A_T .
 - b) Enter the Design Volume, V_{BMP} , determined from Section 2.1 of this Handbook.
2. Determine the Maximum Depth.
 - a) Enter the infiltration rate. The infiltration rate shall be established as described in Appendix A: "Infiltration Testing".
 - b) Enter the design Factor of Safety from Table 1 in Appendix A: "Infiltration Testing".
 - c) The spreadsheet will determine D_1 , the maximum allowable depth of the basin based on the infiltration rate along with the maximum drawdown time (72 hours) and the Factor of Safety.

$$D_1 = [(t) \times (I)] / 12s$$

Where I = site infiltration rate (in/hr)
 s = safety factor
 t = drawdown time (maximum 72 hours)

INFILTRATION BASIN BMP FACT SHEET

- d) Enter the depth of freeboard.
- e) Enter the depth to the historic high groundwater level measured from the top of the basin.
- f) Enter the depth to the top of bedrock or other impermeable layer measured from the finished grade.
- g) The spreadsheet will determine D_2 , the total basin depth (including freeboard, if used) of the basin, based on restrictions to the depth by groundwater and an impermeable layer.

$$D_2 = \text{Depth to groundwater} - (10 + \text{freeboard}) \text{ (ft);}$$

or

$$D_2 = \text{Depth to impermeable layer} - (5 + \text{freeboard}) \text{ (ft)}$$

Whichever is least.

- h) The spreadsheet will determine the maximum allowable effective depth of basin, D_{MAX} , based on the smallest value between D_1 and D_2 . D_{MAX} is the maximum depth of water only and does not include freeboard. D_{MAX} shall not exceed 5 feet.

3. Basin Geometry

- a) Enter the basin side slopes, z (no steeper than 4:1).
- b) Enter the proposed basin depth, d_B excluding freeboard.
- c) The spreadsheet will determine the minimum required surface area of the basin:

$$A_s = V_{BMP} / d_B$$

Where A_s = minimum area required (ft^2)

V_{BMP} = volume of the infiltration basin (ft^3)

d_B = proposed depth not to exceed maximum allowable depth, D_{MAX} (ft)

- d) Enter the proposed bottom surface area. This area shall not be less than the minimum required surface area.

4. Forebay

A concrete forebay with a design volume of at least 0.5% V_{BMP} and a minimum 1 foot high concrete splashwall shall be provided. Full-height rectangular weir(s) shall be used to outlet the forebay. The weir(s) must be offset from the line of flow from the basin inlet. It is recommended that two weirs be used and that they be located on opposite sides of the forebay (see Figure 2).

- a) The spreadsheet will determine the minimum required forebay volume based on 0.5% V_{BMP} .
- b) Enter the proposed depth of the forebay berm/splashwall (1foot minimum).
- c) The spreadsheet will determine the minimum required forebay surface area.
- d) Enter the width of rectangular weir to be used (minimum 1.5 inches). Weir width should be established based on a 5 minute drawdown time.

Site Design & Landscape Planning SD-10



Design Objectives

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

Description

Each project site possesses unique topographic, hydrologic, and vegetative features, some of which are more suitable for development than others. Integrating and incorporating appropriate landscape planning methodologies into the project design is the most effective action that can be done to minimize surface and groundwater contamination from stormwater.

Approach

Landscape planning should couple consideration of land suitability for urban uses with consideration of community goals and projected growth. Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Suitable Applications

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

Design Considerations

Design requirements for site design and landscapes planning should conform to applicable standards and specifications of agencies with jurisdiction and be consistent with applicable General Plan and Local Area Plan policies.



SD-10 Site Design & Landscape Planning

Designing New Installations

Begin the development of a plan for the landscape unit with attention to the following general principles:

- Formulate the plan on the basis of clearly articulated community goals. Carefully identify conflicts and choices between retaining and protecting desired resources and community growth.
- Map and assess land suitability for urban uses. Include the following landscape features in the assessment: wooded land, open unwooded land, steep slopes, erosion-prone soils, foundation suitability, soil suitability for waste disposal, aquifers, aquifer recharge areas, wetlands, floodplains, surface waters, agricultural lands, and various categories of urban land use. When appropriate, the assessment can highlight outstanding local or regional resources that the community determines should be protected (e.g., a scenic area, recreational area, threatened species habitat, farmland, fish run). Mapping and assessment should recognize not only these resources but also additional areas needed for their sustenance.

Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Conserve Natural Areas during Landscape Planning

If applicable, the following items are required and must be implemented in the site layout during the subdivision design and approval process, consistent with applicable General Plan and Local Area Plan policies:

- Cluster development on least-sensitive portions of a site while leaving the remaining land in a natural undisturbed condition.
- Limit clearing and grading of native vegetation at a site to the minimum amount needed to build lots, allow access, and provide fire protection.
- Maximize trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought tolerant plants.
- Promote natural vegetation by using parking lot islands and other landscaped areas.
- Preserve riparian areas and wetlands.

Maximize Natural Water Storage and Infiltration Opportunities Within the Landscape Unit

- Promote the conservation of forest cover. Building on land that is already deforested affects basin hydrology to a lesser extent than converting forested land. Loss of forest cover reduces interception storage, detention in the organic forest floor layer, and water losses by evapotranspiration, resulting in large peak runoff increases and either their negative effects or the expense of countering them with structural solutions.
- Maintain natural storage reservoirs and drainage corridors, including depressions, areas of permeable soils, swales, and intermittent streams. Develop and implement policies and

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regulations to discourage the clearing, filling, and channelization of these features. Utilize them in drainage networks in preference to pipes, culverts, and engineered ditches.

- Evaluating infiltration opportunities by referring to the stormwater management manual for the jurisdiction and pay particular attention to the selection criteria for avoiding groundwater contamination, poor soils, and hydrogeological conditions that cause these facilities to fail. If necessary, locate developments with large amounts of impervious surfaces or a potential to produce relatively contaminated runoff away from groundwater recharge areas.

Protection of Slopes and Channels during Landscape Design

- Convey runoff safely from the tops of slopes.
- Avoid disturbing steep or unstable slopes.
- Avoid disturbing natural channels.
- Stabilize disturbed slopes as quickly as possible.
- Vegetate slopes with native or drought tolerant vegetation.
- Control and treat flows in landscaping and/or other controls prior to reaching existing natural drainage systems.
- Stabilize temporary and permanent channel crossings as quickly as possible, and ensure that increases in run-off velocity and frequency caused by the project do not erode the channel.
- Install energy dissipaters, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined channels in accordance with applicable specifications to minimize erosion. Energy dissipaters shall be installed in such a way as to minimize impacts to receiving waters.
- Line on-site conveyance channels where appropriate, to reduce erosion caused by increased flow velocity due to increases in tributary impervious area. The first choice for linings should be grass or some other vegetative surface, since these materials not only reduce runoff velocities, but also provide water quality benefits from filtration and infiltration. If velocities in the channel are high enough to erode grass or other vegetative linings, riprap, concrete, soil cement, or geo-grid stabilization are other alternatives.
- Consider other design principles that are comparable and equally effective.

Redeveloping Existing Installations

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

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Redevelopment may present significant opportunity to add features which had not previously been implemented. Examples include incorporation of depressions, areas of permeable soils, and swales in newly redeveloped areas. While some site constraints may exist due to the status of already existing infrastructure, opportunities should not be missed to maximize infiltration, slow runoff, reduce impervious areas, disconnect directly connected impervious areas.

Other Resources

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

Stormwater Management Manual for Western Washington, Washington State Department of Ecology, August 2001.

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

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

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



Rain Garden

Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

Designing New Installations

Cisterns or Rain Barrels

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



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

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

A cistern system with a permanently open outlet can also provide for metering stormwater runoff. If the cistern outlet is significantly smaller than the size of the downspout inlet (say 1/4 to 1/2 inch diameter), runoff will build up inside the cistern during storms, and will empty out slowly after peak intensities subside. This is a feasible way to mitigate the peak flow increases caused by rooftop impervious land coverage, especially for the frequent, small storms.

Dry wells and Infiltration Trenches

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

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

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

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

Pop-up Drainage Emitter

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

Foundation Planting

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

Redeveloping Existing Installations

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

Supplemental Information

Examples

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

Other Resources

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

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

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



Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

Designing New Installations

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

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



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

Redeveloping Existing Installations

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

Other Resources

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

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

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

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



Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

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

Designing New Installations

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

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



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

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

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

Redeveloping Existing Installations

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

Additional Information

Maintenance Considerations

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

Placement

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

Supplemental Information

Examples

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

Other Resources

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

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

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

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



Design Considerations

- Tributary Area
- Area Required
- Hydraulic Head

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

Description

Extended detention basins (dry ponds, dry extended detention ponds, detention ponds, extended detention ponds) are basins whose outlets have been designed to detain the stormwater runoff from a water quality design storm for some minimum time (typically 48 hours) to allow particles, trash and associated pollutants to settle. Unlike wet ponds, these facilities do not have a large permanent pool. They can also be used to provide flood control by including additional flood detention storage.



California Experience

Caltrans constructed and monitored five extended detention basins in southern California with design drain times of 72 hours. Four of the basins were earthen, less costly and had substantially better load reduction because of infiltration than the concrete basin. The Caltrans study reaffirmed the flexibility and performance of this conventional technology. Extended detention basins, while not as effective as systems that provide filtration such as bioretention areas or sand filters, have been shown to be effective at reducing many of the pollutants regulated by the State and Regional Water Boards. Additionally, the Water Boards have determined that extended detention basins can qualify as a "Full Capture System (FCS)"¹ for trash. Accordingly, in addition to providing general specifications, this fact sheet includes trash-specific information to assist with upgrading either an existing BMP or the design of a planned BMP to meet the FCS definition. See the "**Full Trash Capture Compliance**" section and "**Trash FCS**" subsections in this fact sheet for more information.

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

Advantages

- Extended detention basins can have a simple, low-cost design, and meet hydromodification management requirements and the full capture system definition for trash control.
- Widespread application can provide significant control of channel erosion and flood management.

Limitations

- The recommended minimum orifice diameter of 0.5" may be too large in drainages less than 5 acres.
- Dry extended detention basins are relatively ineffective at removing soluble pollutants.
- Can detract from property value due to the aesthetics of dry and bare areas.

Performance

The primary purpose of most detention basins is flood control, but they can also garner pollutant removal performance (Table 1). Variations in design can vary this performance, for example vegetated detention basins provide improved pollutant removal when compared to concrete basins. An optional micropool at the basin's outlet can be incorporated to increase performance of soluble pollutants.

Table 1. Typical pollutant removal and removal processes for constituents

Pollutant	Typical Removal	Median Effluent Concentration ¹	Removal Processes	References
Sediment	Med/High 50-99%	<u>23.3 mg/L</u>	Settling in pretreatment, filtration	Geosyntec Consultants and Wright Water Engineering 2012; Barrett 2008; Harper 1999; Revitt 2004; Scholes 2007
Metals	Medium TCd: 88% TCu: 46-96% TCr: 95% TPb: 92% TZn: 35-95%	TAs: 1.71 µg/L <u>TCd: 0.24 µg/L</u> <u>TCr: 2.55 µg/L</u> <u>TCu: 4.99 µg/L</u> <u>TPb: 3.86 µg/L</u> <u>TNi: 2.73 µg/L</u> <u>TZn: 21.3 µg/L</u>	Removal with sediment, sorption	Geosyntec Consultants and Wright Water Engineering 2012; Barrett 2008; Scholes 2007
Total phosphorus	Low	<u>0.197 mg/L</u>	Settling with sediment, sorption, biological uptake	Barrett 2008; Harper 1999; Geosyntec Consultants and Wright Water Engineering 2012; Walker 1987
Total nitrogen	Low	TN: 1.60 mg/L, TKN: 1.49 mg/L, <u>NO_{2,3}-N: 0.27 mg/L</u>	Settling with sediment, sorption, filtration, biological uptake	Barrett 2008; Harper 1999; Geosyntec Consultants and Wright Water Engineering 2012

Pollutant	Typical Removal	Median Effluent Concentration ¹	Removal Processes	References
Bacteria	Medium	E. coli – <u>429</u> (MPN/100 mL) Fecal Coliform - <u>727</u> (MPN/100 mL)	Sorption, microbial degradation, settling, photolysis	Geosyntec Consultants and Wright Water Engineering 2012; Barrett 2008, Harper 1999; Scholes 2007
Trash	High	N/A	Filtration (Media treatment depth of 1.5 feet) and/or outlet screen	Barrett et al. 2013

¹ Underlined effluent concentrations were (statistically) significantly lower than influent concentrations, as determined by statistical hypothesis testing on the available sampled data.

Trash FCS

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

Suitability and Design

Dry extended detention basins are among the most widely applicable BMPs and are especially useful in retrofit situations where their low hydraulic head requirements allow them to be sited within the constraints of the existing storm drain system. Fundamental extended detention basin design components and suitability are as follows:

- Drawdown time of 48 hours is required for vector control, but design should also incorporate long flow paths, promote the establishment of low velocities, for improved water quality.
- A facility's drawdown time is regulated by an orifice or weir; with minor design adjustments in outlet design, extended detention basins are applicable in all soils and geology.
- 10-ft setback from foundations, 100-ft from septic fields and water supply wells, and 50-ft from steep slopes.

Extended detention basin design is highly dependent on the constraints of the considered site and costs vary accordingly with design. An optional micropool at the basin's outlet can be incorporated to increase performance of soluble pollutants. Table 2 details a number of core construction components and corresponding design considerations.

Table 2. Cost of design components and associated considerations

Component	Cost	Design Consideration
Excavation	\$5.00–\$15.00/ft ²	Capture volume determined by local requirements or sized to treat runoff produced by the 85 th percentile storm. Length to width ratio of 1.5:1 if feasible. Basin depth of 2 to 5 feet is optimal. Include energy dissipation

Component	Cost	Design Consideration
		in the inlet design to reduce resuspension of sediment. Incorporate maintenance access to the basin design
Vegetation		
Sod (buffalo)	\$0.67/ft ²	Turf grasses (not bunch grasses) should be maintained on the surface to prevent erosion and improve treatment.
Seeding	\$0.15–\$0.22/ft ²	Water and spot fertilize during first year.
Subsurface Option (Figure 3)		
Excavation, Installation, and Backfill	\$9.20/ft ²	Constructing a subsurface facility includes excavating to depth, installing concrete unit, overdig, and backfill.
Concrete Unit	\$59.93/ft ²	Concrete unit assumed here: 11' 4". Requires pretreatment BMP to capture trash and debris.
Outlet Structure		No more than 50% of the water quality volume drains within the first 24 hours.

Outlet Design

Design of the outflow structure is crucial in successful operation of the basin. Outlet design can include an outlet riser with orifices sized to discharge the water quality volume, and riser overflow height set to the design storm elevation. A trash rack (i.e. stainless steel screen) should be implemented to prevent clogging at the entrance to the outflow pipes. Screens should have a mesh smaller than 5 mm to meet the full capture requirement for trash. An image with these design components is presented in Figure 1.

Alternative outlet design includes a separate riser or broad crested weir for overflow of runoff for the 25 and greater year storms. Figure 2 shows an example of an outlet that provides a variable flow as outlet flow increase with depth.

Outlet design should also ensure that no more than 50% of the water quality volume drains within the first 24 hours. Discharge through a control orifice is calculated from:

$$Q = CA(2gH - H_0)^{0.5}$$

Where:

Q = discharge (ft³/s)

C = orifice coefficient



Figure 1. Example of outlet structure.



Figure 2. Variable flow outlet structure.

A = area of the orifice (ft^2)

g = gravitational constant (32.2)

H = water surface elevation (ft)

H_o = orifice elevation (ft)

Recommended values for C are 0.66 for thin materials and 0.80 when the material is thicker than the orifice diameter. This equation can be implemented in spreadsheet form with the basin stage/volume relationship to calculate drain time. To do this, use the initial height of the water above the orifice for the water quality volume. Calculate the discharge and assume that it remains constant for approximately 10 minutes. Based on that discharge, estimate the total discharge during that interval and the new elevation based on the stage volume relationship. Continue to iterate until H is approximately equal to H_o . When using multiple orifices the discharge from each is summed.

Subsurface Option

Subsurface extended detention basins are ideal when a surface detention basin is infeasible because of land constraints (Figure 3). Open space parks (e.g., baseball fields, etc.) are an example of where a subsurface extended detention basin is ideal because the park's purpose as a recreational area is not compromised. Additionally, recreational areas typically lack large structures, therefore the issue of overhead weight over the subsurface unit is not a concern.



Figure 3. Subsurface design of an extended detention basin, during construction.

Full Trash Capture Compliance

This section provides trash-specific information to assist with upgrading either an existing BMP or the design of a planned BMP to meet the FCS definition. In addition to developing and adopting the Trash Amendments, the State Water Board provides implementation information on its Trash Implementation web page:

https://www.waterboards.ca.gov/water_issues/programs/stormwater/trash_implementation.html.

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

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

The extended detention basin must be configured to allow trash to enter the system and for trash to remain in the system until it can be collected and removed. To meet the requirement, inlets must be designed to pass the peak flow produced by the 1 year 1 hour design storm and solids that would be retained by a 5 mm screen or mesh must remain in the system. Preventing trash migration may require modifications to the inlets, and outlets.

Inlets

There are a multitude of inlet configurations that will allow trash to enter and be captured in an extended detention basin. In general, an open inlet is recommended to allow for flow and trash to enter the extended detention basin unrestricted (Figure 4). A forebay or other pretreatment configuration is recommended to consolidate trash collection in the basin.



Figure 4. Example inlet structure.

Trash Containment

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

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

Figure 5 shows an example of an outlet with a screen to contain trash. A larger grate on the top of the structure allows larger flows to safely flow out of the system.



Figure 5. Outlet structure with a 5mm screen.

Maintenance

Routine maintenance activity consists primarily of sediment, trash, and debris removal, but also mowing the turf to meet aesthetic and flow routing design of the basin. Vector control can also a significant investment of maintenance hours when poor drainage exists or stilling basins are installed as energy dissipaters.

Table 3. Typical maintenance activities and associated costs and frequency

Frequency	Cost	Activity
Routine Maintenance (required monthly to every 2 years)		<u>Remove excess sediment, trash, and debris across the surface, inlet, and outlet.</u> Check for and stabilize erosion. Mowing overgrown vegetation that interferes with access, or safety.
Routine (small)	\$0.44/ft ²	
Routine (medium)	\$0.34/ft ²	
Routine (large)	\$0.24/ft ²	
End of Life Replacement (service life of 20 years)		Excavate to the depth of soil media. Test soil for excessive soil contamination of common stormwater pollutants (e.g. metals, nutrients). Continue to remove underlying soil if pollutants exceed standard for contaminated soil. Replace with clean soil.
Replacement (small)	\$8.19ft ²	
Replacement (medium)	\$6.43/ft ²	
Replacement (large)	\$5.99/ft ²	
Note: Small System = 500 ft ² ; Medium System = 2000 ft ² ; Large System = 4000 ft ²		
<u>Underlined</u> statement indicates that the activity may be required more frequently than shown in the table to meet the SWRCB's maintenance criteria for Multi-Benefit Treatment Systems to be qualified as Full Capture Systems.		

Trash FCS

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

For Multi-Benefit Treatment Systems to be qualified as Full Capture Systems, the State Water Board requires regular maintenance to maintain adequate trash capture capacity and to ensure that trapped trash does not migrate offsite. Additionally, the State Water Board requires the BMP owner to establish a maintenance schedule based on site-specific factors, including the design trash capacity of the Extended Detention Basin Multi-Benefit Trash Treatment System, storm frequency, and estimated or measured trash loading from the drainage area. To meet those criteria, it is likely that the frequency of trash and debris removal will have to be increased above the recommended monthly interval during the wet season to prevent trash from being blown from the extended detention basin or being washed out of the system in the subsequent rain events. Trash can also clog the inlet and the surface of the limiting the flow into the basin and reducing the surface infiltration capacity. Depending on the frequency and size of storms, and upstream pollutant characteristics, trash and debris removal can be as frequent as before and after every wet weather event. The optimum maintenance interval is best determined by observing the BMP in operation for a wet season.

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

Schematics

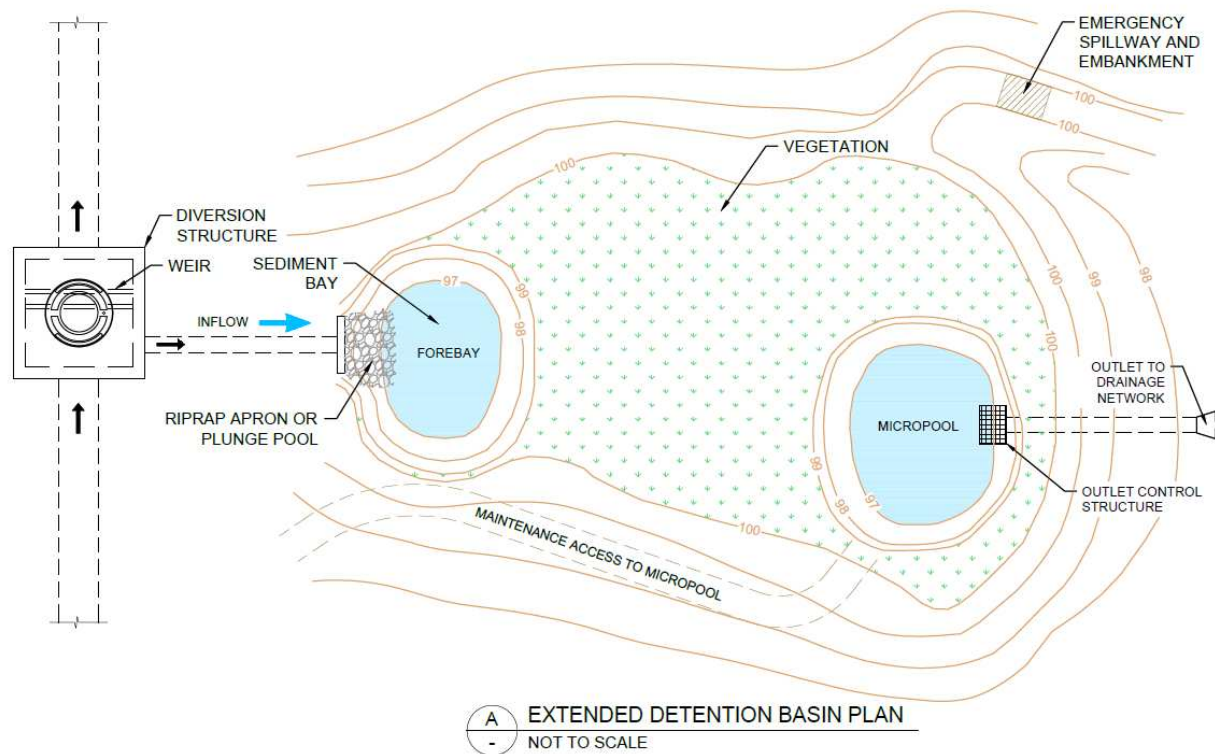


Figure 6. Schematic of an extended detention basin.

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3.6 Extended Detention Basin

Type of BMP	LID - Biotreatment
Treatment Mechanisms	Sedimentation, Infiltration, Biofiltration, Evapotranspiration, and Evaporation
Minimum Tributary Drainage Area	5 acres
Other Names	Enhanced Water Quality Basin

Overview

The Extended Detention Basin (EDB) is designed to detain the design volume of stormwater, V_{BMP} , and maximize opportunities for volume losses through infiltration, evaporation, evapotranspiration and surface wetting. Additional pollutant removal is provided through sedimentation, in which pollutants can attach to sediment accumulated in the basin through the process of settling. Stormwater enters the EDB through a *forebay* where any trash, debris, and sediment accumulate for easy removal. Flows from the forebay enter the basin which is vegetated with native grasses that enhance infiltration and evapotranspiration, and which is interspersed with gravel-filled trenches that help further enhance infiltration. Water that does not get infiltrated or evapotranspired is conveyed to the *bottom stage* of the basin. At the bottom stage of the basin, low or incidental dry weather flows will be treated through a sand filter and collected in a subdrain structure. Any additional flows will be detained in the basin for an extended period by incorporating an outlet structure that is more restrictive than a traditional detention basin outlet. The restrictive outlet structure extends the drawdown time of the basin which further allows particles and associated pollutants to settle out before exiting the basin, while maximizing opportunities for additional incidental volume losses.

EXTENDED DETENTION BASIN BMP FACT SHEET

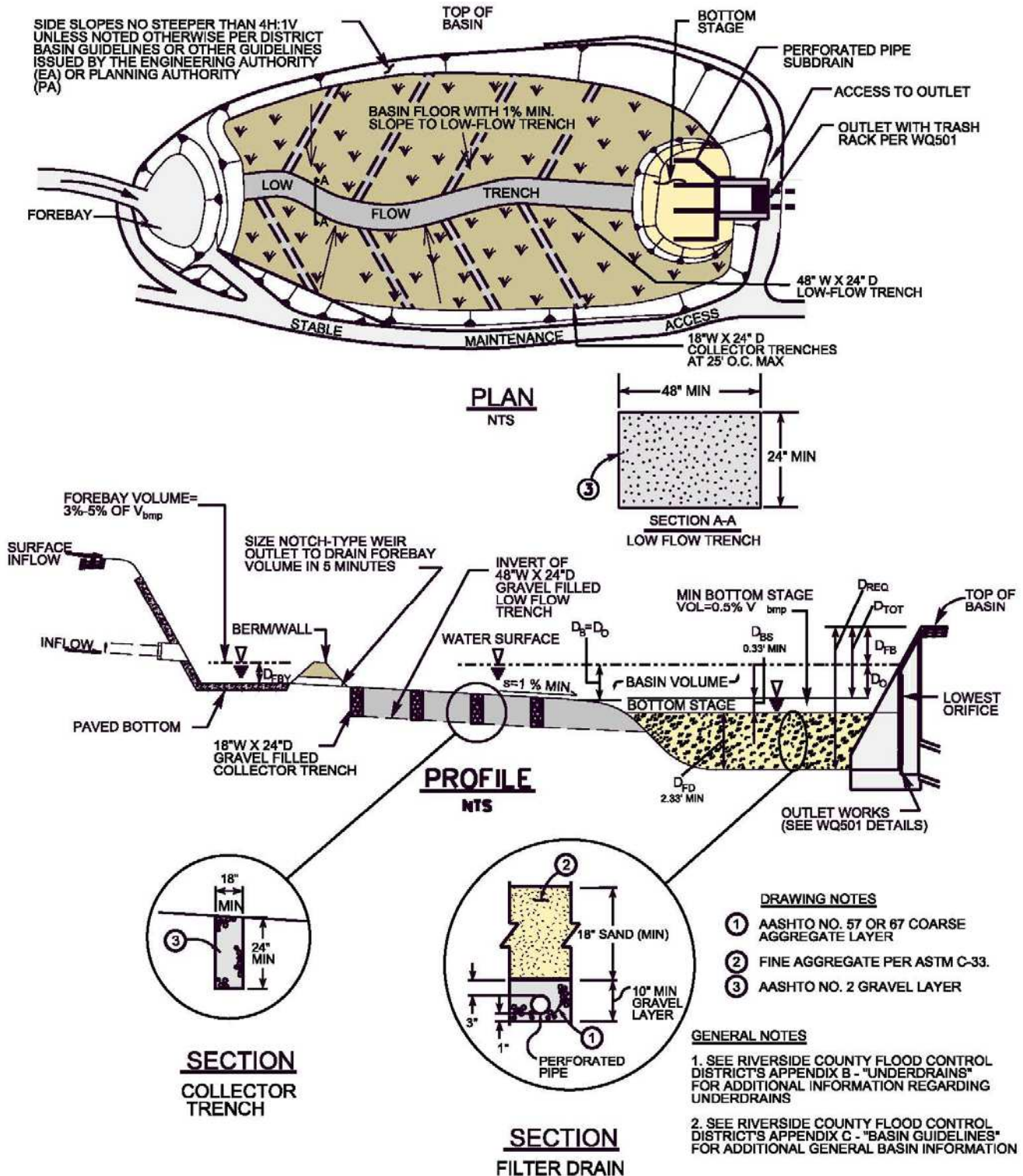


Figure 1 – Extended Detention Basin

EXTENDED DETENTION BASIN BMP FACT SHEET

Siting Considerations

Soils: EDBs can be used with almost all soils and geology. However, pollutant removal effectiveness is greatly improved when the underlying soil permits at least some infiltration.

Tributary Area: EDBs should only be used where the tributary drainage area is at least 5 acres, since meeting the draw-down requirements (discussed below) for smaller areas would result in very small outlet orifice diameters which would be prone to clogging.

Proximity to Receiving Waters: All site runoff must be treated to the MEP with appropriate BMPs *before* being discharged into Receiving Waters; as such the EDB cannot be constructed in-line within Receiving Waters.

Setbacks: Due to the infiltration characteristics incorporated into the EDB design, the lowest pervious point (beneath the filter drain) of the extended detention facility should be a minimum of 10' above the seasonal high groundwater table. All other setbacks shall be in accordance with applicable standards of the "Basin Guidelines" (Appendix C) or other guidelines issued by the Engineering Authority (EA).

Basin Guidelines: See Section 1 of the "Basin Guidelines" (Appendix C) for additional requirements (i.e., fencing, maintenance access, etc.) that may be required by the Engineering Authority (EA).

Landscaping Requirements

Basin vegetation provides erosion protection, enhances evapotranspiration and infiltration, and improves pollutant removal. The upper stage basin surface, berms and side slopes shall be planted with native grasses. Proper landscape management is also required to ensure that the vegetation does not contribute to water pollution through the use of pesticides, herbicides, or fertilizers. Landscaping shall be in accordance with applicable standards of the "Basin Guidelines" (Appendix C) or other guidelines issued by the EA.

EXTENDED DETENTION BASIN BMP FACT SHEET

Maintenance Guidelines

Schedule	Inspection and Maintenance Activity
During every scheduled maintenance check (per below), and <i>as needed</i> at other times	<ul style="list-style-type: none"> Maintain vegetation as needed. Use of fertilizers, pesticides and herbicides should be strongly avoided to ensure they don't contribute to water pollution. If appropriate native plant selections and other IPM methods are used, such products shouldn't be needed. If such projects are used: <ul style="list-style-type: none"> Care should be taken to avoid contact with the low-flow or other trenches, and the media filter in the bottom stage. Products shall be applied in accordance with their labeling, especially in relation to application to water, and in areas subjected to flooding. Fertilizers should not be applied within 15 days before, after, or during the rainy season. No ponded water should be present for more than 72 hours to avoid nuisance or vector problems. No algae formation should be visible. Correct problems as needed.
Annually. If possible, schedule these inspections before the beginning of the rain season to allow for any repairs to occur before rains occur.	<ul style="list-style-type: none"> Remove debris and litter from the entire basin Inspect hydraulic and structural facilities. Examine the outlet for clogging, the embankment and spillway integrity, as well as damage to any structural element. Check for erosion, slumping and overgrowth. Repair as needed. Inspect sand media at the filter drain to verify it is allowing acceptable infiltration. Scarify top 3 inches by raking the filter drain's sand surface annually. Check the media filter underdrains (via the cleanout) for damage or clogging. Repair as needed. Remove accumulated sediment and debris from the forebay, and ensure that the notch weir is clear and will allow proper drainage. Check gravel filled low flow and collector trenches for sediment buildup and repair as needed.
Every 5 years or sooner (depending on whether observed drain times to empty the basin are less than 72 hours).	<ul style="list-style-type: none"> Remove the top 3 inches of sand from the filter drain and backfill with 3 inches of new sand to return the sand layer to its original depth. When scarification or removal of the top 3 inches of sand is no longer effective, remove and replace sand filter layer.
Whenever substantial sediment accumulation has occurred.	<ul style="list-style-type: none"> Remove accumulated sediment from the bottom of the basin. Removal should extend to original basin depth.

EXTENDED DETENTION BASIN BMP FACT SHEET

Design Summary

Design Parameter	Extended Detention Basin
Drawdown time (total)	72 hours ^{2,3}
Minimum drawdown time for 50% V_{BMP}	24 hours ²
Minimum tributary area	5 acres ²
Outlet erosion control	Energy dissipaters to reduce velocities ¹
Forebay volume	3 to 5 % of V_{BMP} ³
Basin Invert Longitudinal Slope (min.)	1%
Basin Invert Transverse (cross) Slope (min)	1%
Low-flow trench width (min.)	48 inches
Low-flow trench depth (min.)	24 inches
Slope of low-flow trench along bottom excavated Surface (max.)	1%
Slope of gravel collector trenches along bottom excavated surface (max.)	1 %
Length to width ratio (min.)	1.5:1
Basin depth (min.)	1 foot ³
Bottom stage volume	0.5 % of V_{BMP} ³
Bottom stage depth (min)	0.33 feet ³
Filter drain depth (min)	2.33 feet ³
<ol style="list-style-type: none"> 1. Ventura County's Technical Guidance Manual for Stormwater Quality Control Measures 2. CA Stormwater BMP Handbook for New Development and Significant Redevelopment 3. Denver, Colorado's UDFCD Drainage Criteria Manual, Volume 3 	

Note: The information contained in this BMP Factsheet is intended to be a summary of design considerations and requirements. Additional information which applies to all detention basins may be found in the "Basin Guidelines" (Appendix C). In addition, information herein may be superseded by other guidelines issued by the Engineering Authority.

Design Procedure

These steps correspond to and provide a description of the information required in the EDB Design Worksheet.

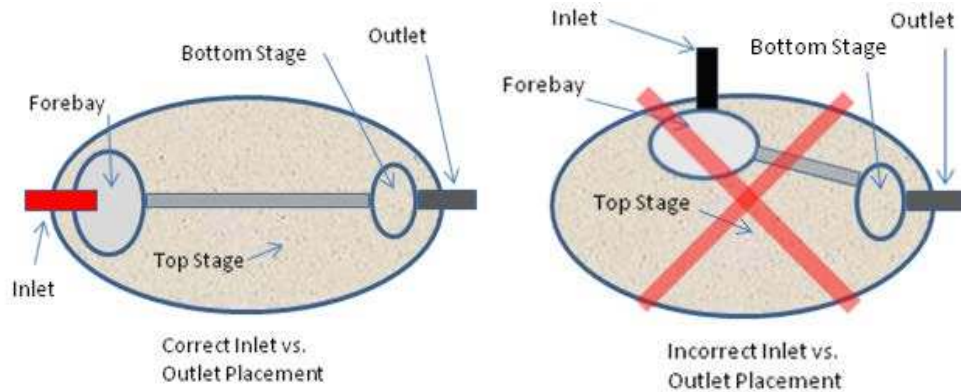
1. Find the Design Volume, V_{BMP} .

- a) Enter the tributary area, A_T to the BMP. The minimum tributary area is 5 acres.
- b) Enter the Design Volume, V_{BMP} , determined from Section 2.1 of this Handbook.

EXTENDED DETENTION BASIN BMP FACT SHEET

2. Basin Footprint

- a) Enter the length and width of the EDB. The length shall be measured between the inlet to the basin and the outlet structure; and the width shall be measured at the widest point of the basin invert. The length to width ratio should be 1.5:1 or longer to prevent short-circuiting and increase the overall effectiveness of the BMP.



- b) Enter the internal basin side slopes. See the “Basin Guidelines” (Appendix C) for side slope requirements. If variable internal side-slopes are used, enter the steepest slope that will be used.
- c) Using Figure 1 as a guide, enter the proposed basin depth, D_B , and the freeboard depth, D_{FB} . Based on the information provided, the spreadsheet will calculate the minimum total depth required, D_{REQ} , for this BMP. D_{REQ} is the depth from the bottom of the underdrain layer in the bottom stage (see step 5c), to the top of the freeboard. This calculated minimum required depth can be used to determine if enough elevation difference is available within the design topography to allow for use of this BMP.
- d) Additionally, the basin depth D_B is equal to D_O , which is the depth from the design pond water surface elevation to the lowest orifice in the outlet structure. D_O is confirmed by the spreadsheet and is used in the Basin Outlet Design described in step 6 below. It should be noted that this lowest orifice is a critical elevation in the design of this BMP. The Volume of the Basin V_{Basin} described in step 3d) is the volume of water above this lowest orifice. This lowest-orifice also represents the dry weather ponded water surface discussed in step 5c below. Below this elevation there must be a minimum of a 4-inch drop down to the surface of the Sand Filter in the bottom stage.

EXTENDED DETENTION BASIN BMP FACT SHEET

3. Basin Design

- The Total Basin Depth, D_{TOT} , is calculated automatically, and is the sum of the basin depth D_B plus the freeboard depth D_{FB} .
- Enter the longitudinal slope of the basin invert. This slope must be at least 1% and is measured along the low flow trench between the forebay and the bottom stage. Note that the surface of the sand layer in the bottom stage must be level (see Figure 1).
- Enter the transverse slope of the basin invert. This transverse (cross sectional) slope must be at least 1% sloped toward the low flow trench.
- Enter the Volume of the Basin, V_{Basin} . This volume must be the actual volume of water held within the basin as substantiated by modeling or appropriate volumetric calculations, and must be equal to or greater than V_{BMP} . This volume must be held above the lowest orifice in the Basin Outlet Design described in step 6 below.

4. Forebay Design

All flows must enter the basin through the forebay. The forebay provides a location for the settlement and collection of larger particles, and any other trash or debris. A relatively smooth and level concrete bottom surface should be provided to facilitate mechanical removal of any accumulated sediment, trash and debris.



Figure 2: Forebay filled with storm water

- Enter the Forebay Volume V_{FB} . This volume must be from 3 to 5 percent of V_{BMP} .
- A rock or concrete berm must be constructed to detain water before it drains into the basin. The top of the berm shall be set no higher than the invert of the inlet conveyance. Enter the Forebay Depth, D_{FBY} .
- The spreadsheet will calculate the minimum surface area of the forebay, A_{FB} , based on the provided Forebay Volume and Depth. Ensure that the plans provide for a forebay area at least this large.
- Although the forebay will be well submerged in the design event, a full height rectangular notch-type weir shall be constructed through the berm to prevent permanent ponding in the forebay, and allow water to slowly and fully drain to the main body of the basin. This notch should be offset from the inflow streamline to prevent low-flows from short circuiting. Enter the width, W , of this rectangular notch weir. The width shall not be less than 1.5 inches to prevent clogging. Additionally,

EXTENDED DETENTION BASIN BMP FACT SHEET

immediately outside the notch construct a minimum 1-foot by 1-foot gravel pad to prevent vegetative growth within the basin invert from blocking the notch.

5. Dry Weather and Low-Flow Management

The basin shall have both a low-flow gravel trench and a network of gravel collector trenches across the invert of the basin, as well as a bottom stage sand filter to treat low flows and dry weather flows (see Figure 1).

- a) Low Flow Trench: The low-flow gravel trench conveys flow from the forebay to the bottom stage, while allowing for maximum incidental infiltration and volume loss. The trench shall be a minimum of 48 inches wide by 24 inches deep. This trench shall be unlined and backfilled with AASHTO No. 2 gravel (or similar) to the finished surface of the basin invert, and shall not use underdrains. The bottom excavated surface of the low-flow trench shall be 1 percent or flatter to promote infiltration.



Figure 3: Gravel filled low-flow trench

- b) Collector Trenches: Gravel collector trenches beneath the top stage shall be arranged as illustrated in Figure 1 of Appendix C with minimal slope (1% maximum) along their bottom excavated surface to promote infiltration, and must extend from the low-flow trench to the toe of the basin side slopes. They shall be a minimum of 18-inches wide by 24-inches deep, unlined and backfilled with AASHTO No. 2 gravel (or similar) to the finished basin invert surface. The gravel collector trenches shall not use underdrains and shall be constructed with a maximum spacing of 25 feet, center to center. See Figure 1 of Appendix C.
- c) Bottom Stage: A depressed sand filter drain area, referred to as the bottom stage, must be constructed adjacent to the outlet structure to treat any dry weather flows. To ensure that dry weather flows are treated through the sand filter and not discharged through the orifice plate, the top surface of the sand filter must be depressed at least 4 inches below the lowest orifice in the outlet structure. This depressed area will create a micro pool of water that is then filtered down through the sand filter and out through underdrains. Based on the minimum dimensions described below, the minimum depth of excavation below the lowest orifice in the outlet structure is 2.33 feet.
- i. Enter the Depth of the bottom stage, D_{BS} . As mentioned above, this depth must be at least 4 inches, and extend down below the lowest orifice in the outlet structure.
 - ii. Enter the area of the bottom stage, A_{BS} .

EXTENDED DETENTION BASIN BMP FACT SHEET

- iii. Based on the D_{BS} and A_{BS} entered, the spreadsheet will calculate V_{BS} . This volume is the volume of ponded water that will be held below the lowest orifice in the outlet structure, and above the surface of the sand filter. This volume must be at least 0.5% of V_{BMP} .
- iv. Enter the thickness of the ASTM C-33 sand layer that will be provided, D_s . A minimum thickness of 18 inches is required.
- v. Below the sand layer, a minimum 10-inch thick layer of gravel shall be installed with underdrains to drain the water that has been treated through the sand filter. The underdrains shall connect into the outlet structure. See Appendix B for standard underdrain construction. Enter the diameter of the underdrain pipe (minimum 6" dia.), and the spacing of the underdrains. The maximum spacing of the underdrains is 20 feet on center, however where the area of the bottom stage is particularly small (less than 500 square feet), the underdrain pipes shall be placed at no more than a 10-foot separation on center.

6. Basin Outlet Design

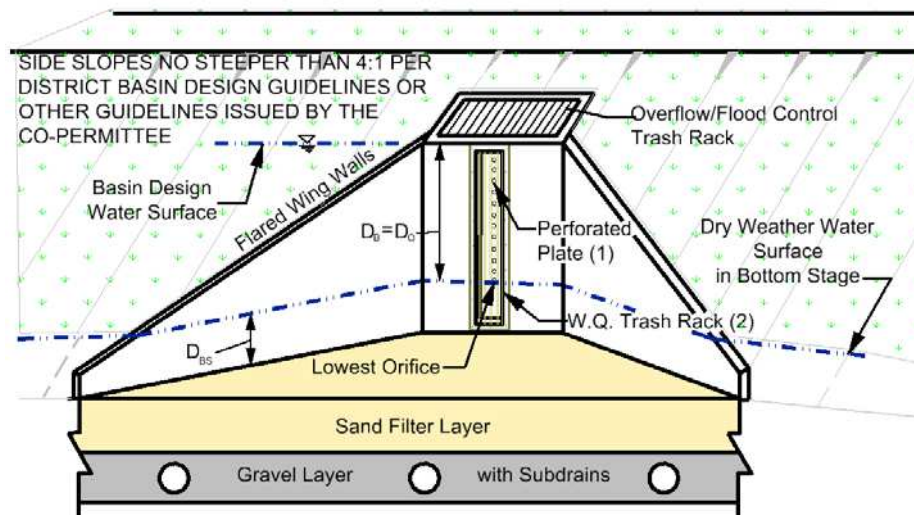


Figure 4: Basin Outlet Structure with Bottom Stage Shown

Outlet structures for publicly maintained basins shall conform to District Standard Drawings WQ501 unless approved in advance by the local Engineering Authority (EA). This standardization is to provide for efficient maintenance. The basin outlet should be sized to release the design volume, V_{BMP} , within a 72-hour period but 50 percent of V_{BMP} within 24 hours. This is an iterative design process where an appropriate control orifice can be selected using the following steps:

- a. Develop a Stage vs. Discharge Curve for the Outlet Structure

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Estimate the orifice size and outlet plate configuration (number per row, etc.). Based on D_o provided in the Basin Footprint section, the spreadsheet will automatically generate the stage vs. discharge relationship for this outlet:

$$Q = C * A * [2 * g * (H - H_o)]^{0.5}$$

Where:

Q = discharge (ft^3/s)

g = gravitational constant (32.2 ft/s^2)

C = orifice coefficient

H = water surface elevation (ft)

A = area of the orifice (ft^2)

H_o = orifice elevation (ft)

The lowest orifice shall be located with its centerline at the top of the bottom stage; at least 4 inches above the surface of the sand filter drain. To help avoid clogging, the minimum orifice diameter is limited to 3/8 inch. Since the 1/4 inch thickness of the orifice plate will be less than the orifice diameter, a value for C of 0.66 may be used. If another value for C is used, justification may be required.

b. Develop a Discharge/Volume vs. Stage Table for the Basin

Based on the shape and size of the basin, develop a relationship between the stage and the volume of water in the basin. Since the orifice spacing is 4 inches on center for the standard orifice plate, the stage intervals must also be 4 inches. Enter the basin volume at each interval starting at the centerline of the lowest orifice.

c. Route the Design Volume through the Basin

The spreadsheet assumes that the Design Volume, V_{BMP} , enters the basin instantaneously and as such, no inflow/outflow hydrograph is necessary. The drawdown time for each stage becomes:

$$\Delta t = V_i / Q$$

Where:

Δt = drawdown time for each stage

V_i = the volume at each stage

Q = the flow rate corresponding to the headwater elevation at each stage.

The spreadsheet automatically determines the drawdown time from the sum of the Δt values for each stage. If the orifice size and plate configuration estimate meets the

EXTENDED DETENTION BASIN BMP FACT SHEET

hydraulic retention time requirements (50% of the volume empties in not less than 24 hours, 100% of the volume empties in no more than 72 hours), the outlet is correctly sized. If these requirements are not met, select a new orifice size or configuration and repeat the process starting at Step 6a.

7. Outlet Protection

To prevent the orifices from clogging, trash racks are required where perforated vertical outlet control plates are used. This allows for easier access to outlet orifices for inspection and cleaning. Trash racks shall be sized to prevent clogging of the primary water quality outlet without restricting the hydraulic capacity of the outlet control orifices. The orifice plate shall be protected with a trash rack conforming to Standard Drawing WQ501 (at end of this section) with at least six square feet of open surface area or 25 times the total orifice area, whichever is greater. The rack shall be adequately secured to prevent it from being removed or opened when maintenance is not occurring.

Overflow Structure Similar to Standard Drawing Number WQ 501

(Photo courtesy of Colorado Association of Stormwater Floodplain Managers)

Trash rack with screen



EXTENDED DETENTION BASIN BMP FACT SHEET

8. Overflow Outlet

Overflow outlets for publicly maintained basins shall conform to Standard Drawing WQ501 (at end of this section) unless approved in advance by the Engineering Authority (EA).

9. Embankment

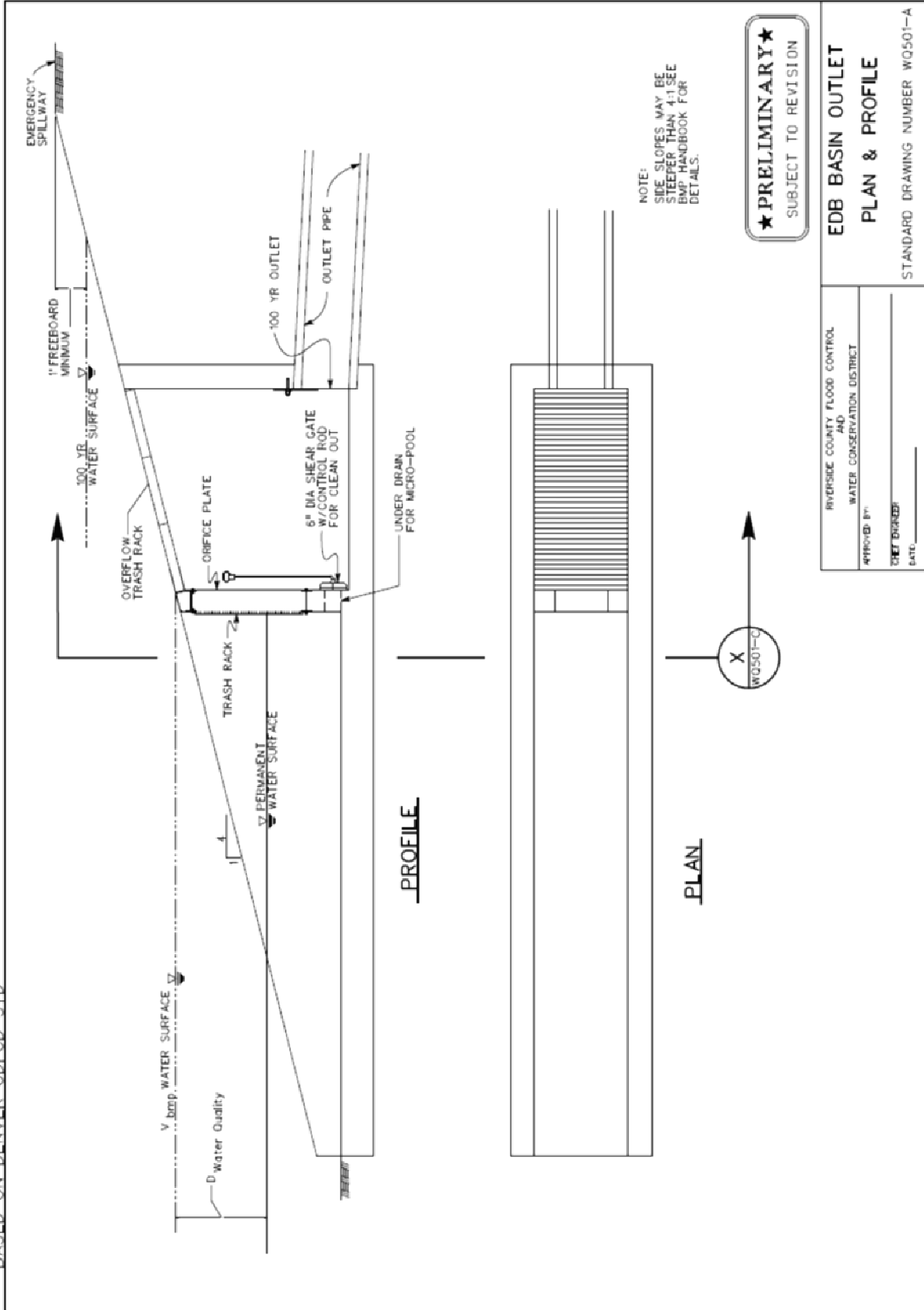
Embankments shall be designed in accordance with applicable standards of Riverside County Flood Control District's "Basin Guidelines" (Appendix C) or other guidelines issued by the Engineering Authority (EA). Where applicable, embankment designs must additionally conform to the requirements of the State of California Division of Safety of Dams.

10. Spillway and Overflow Structures

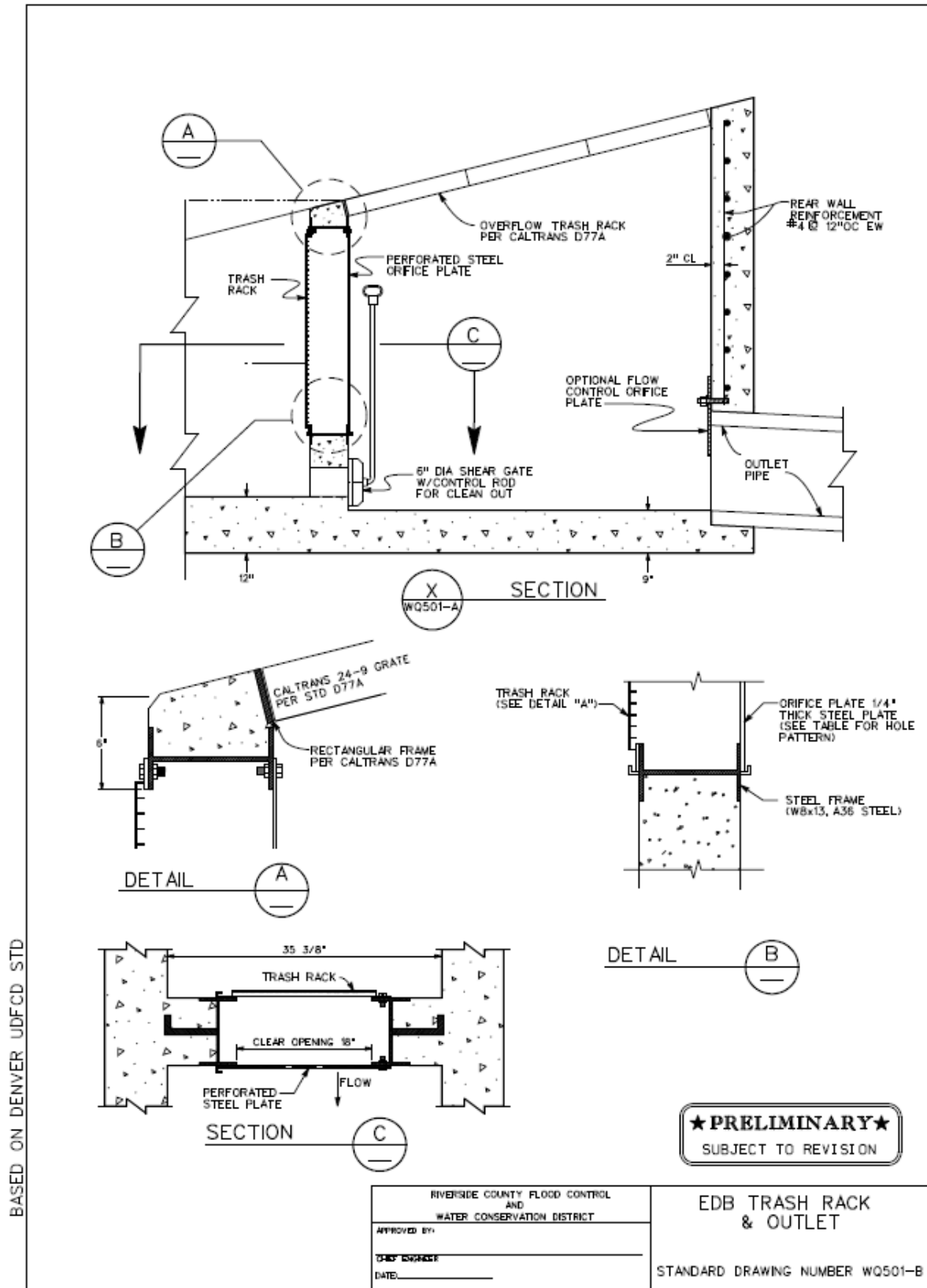
Spillway and overflow structures should be designed in accordance with applicable standards of the "Basin Guidelines" (Appendix C) or other guidelines issued by the Engineering Authority (EA).

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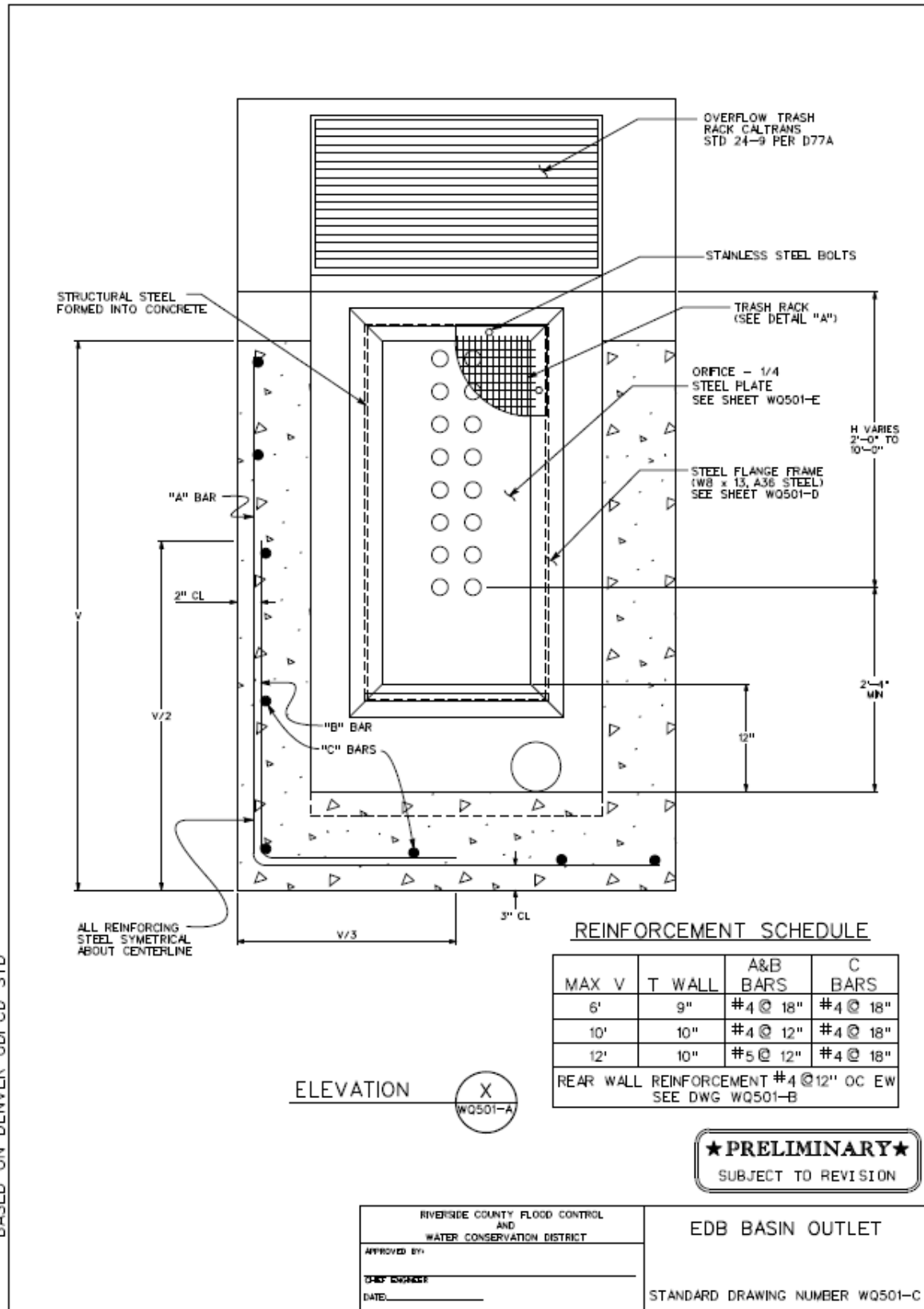
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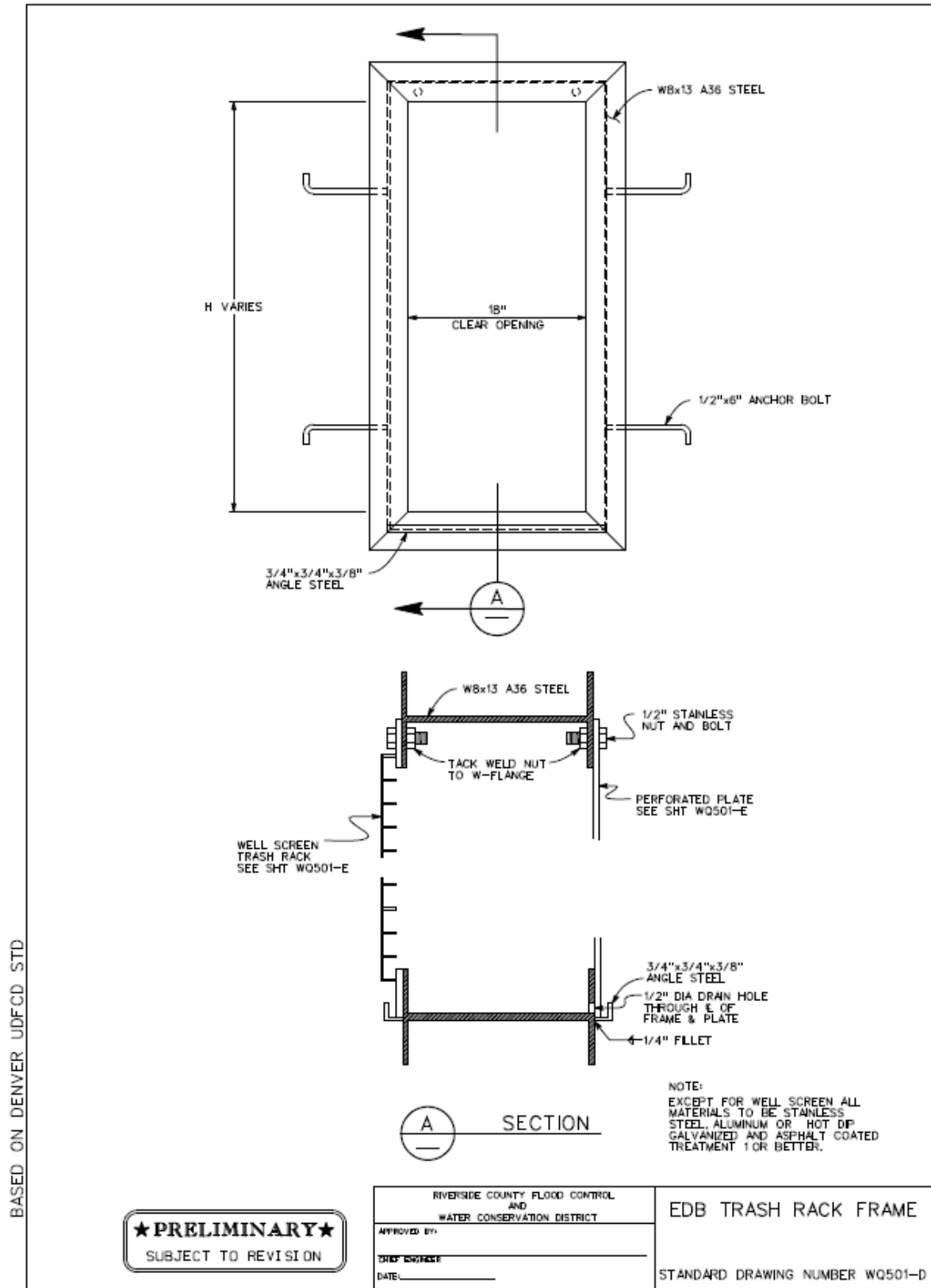
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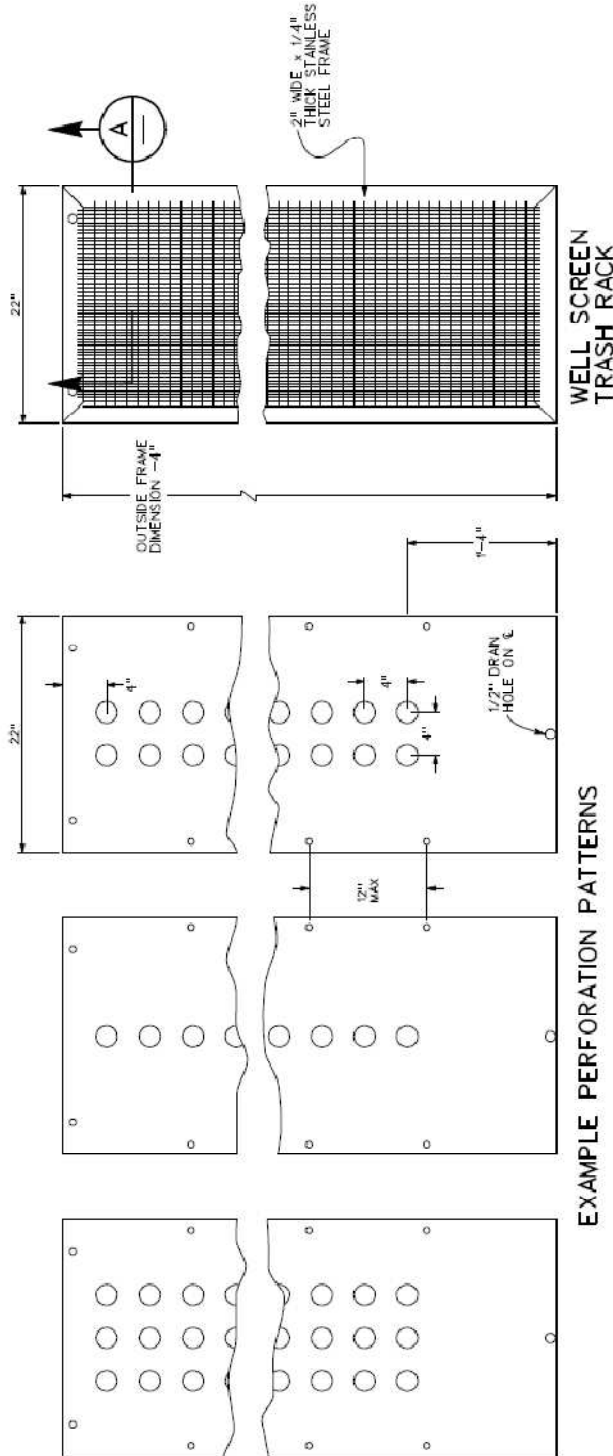


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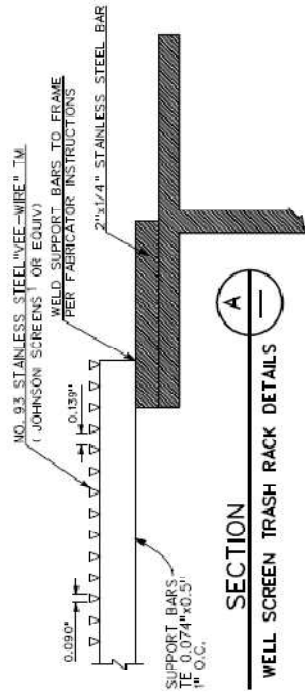


EXTENDED DETENTION BASIN BMP FACT SHEET

BASED ON DENVER UDFCD STD



- NOTE:
1. THE GOAL IN DESIGNING THE OUTLET IS TO MINIMIZE THE NUMBER OF COLUMNS OF PERFORATIONS THAT WILL DRAW THE VORTEX IN THE DESIRED TIME DO NOT HOWEVER INCREASE THE DIAMETER OF CIRCULAR PERFORATIONS BEYOND 2 INCHES. USE THE ALLOWED PERFORATION SHAPES AND CONFIGURATIONS SHOWN ABOVE, ALONG WITH FIGURE EDB-2 "ORIFICE PLATE PERFORATION SIZING" TO DETERMINE THE PATTERN THAT PROVIDES AN AREA PER ROW CLOSEST TO THAT REQUIRED WITHOUT EXCEEDING IT.
 2. PERFORATED PLATE TO BE 1/4" STAINLESS STEEL TREATMENT OR BOTH.



★ PRELIMINARY ★
SUBJECT TO REVISION

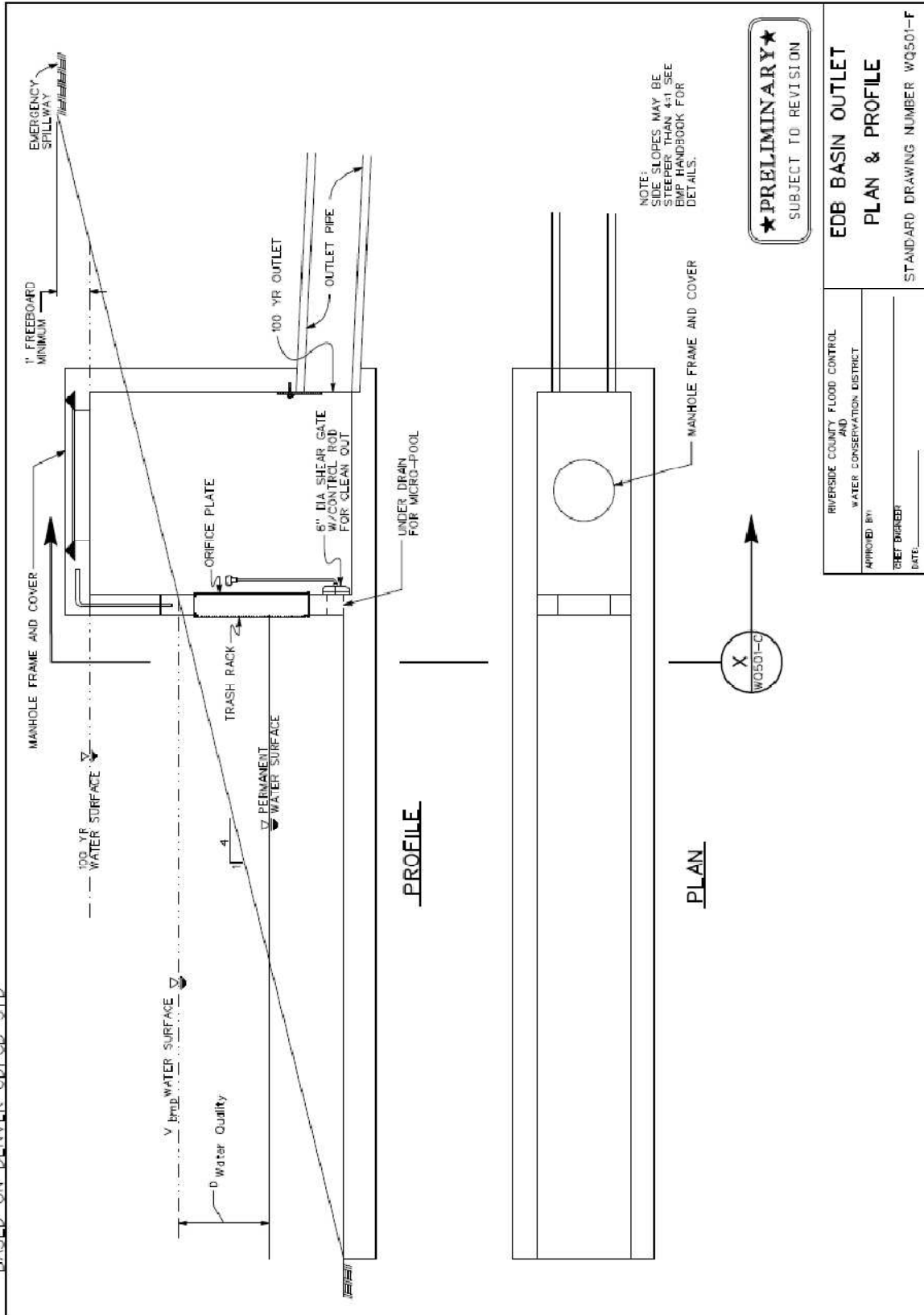
RIVERSIDE COUNTY FLOOD CONTROL DISTRICT	
WATER CONSERVATION DISTRICT	
PROJECT BY:	
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DATE:	

EDB BASIN OUTLET
PERFORATED PLATE &
WELL SCREEN TRASH RACK
STANDARD DRAWING NUMBER WQ501-E

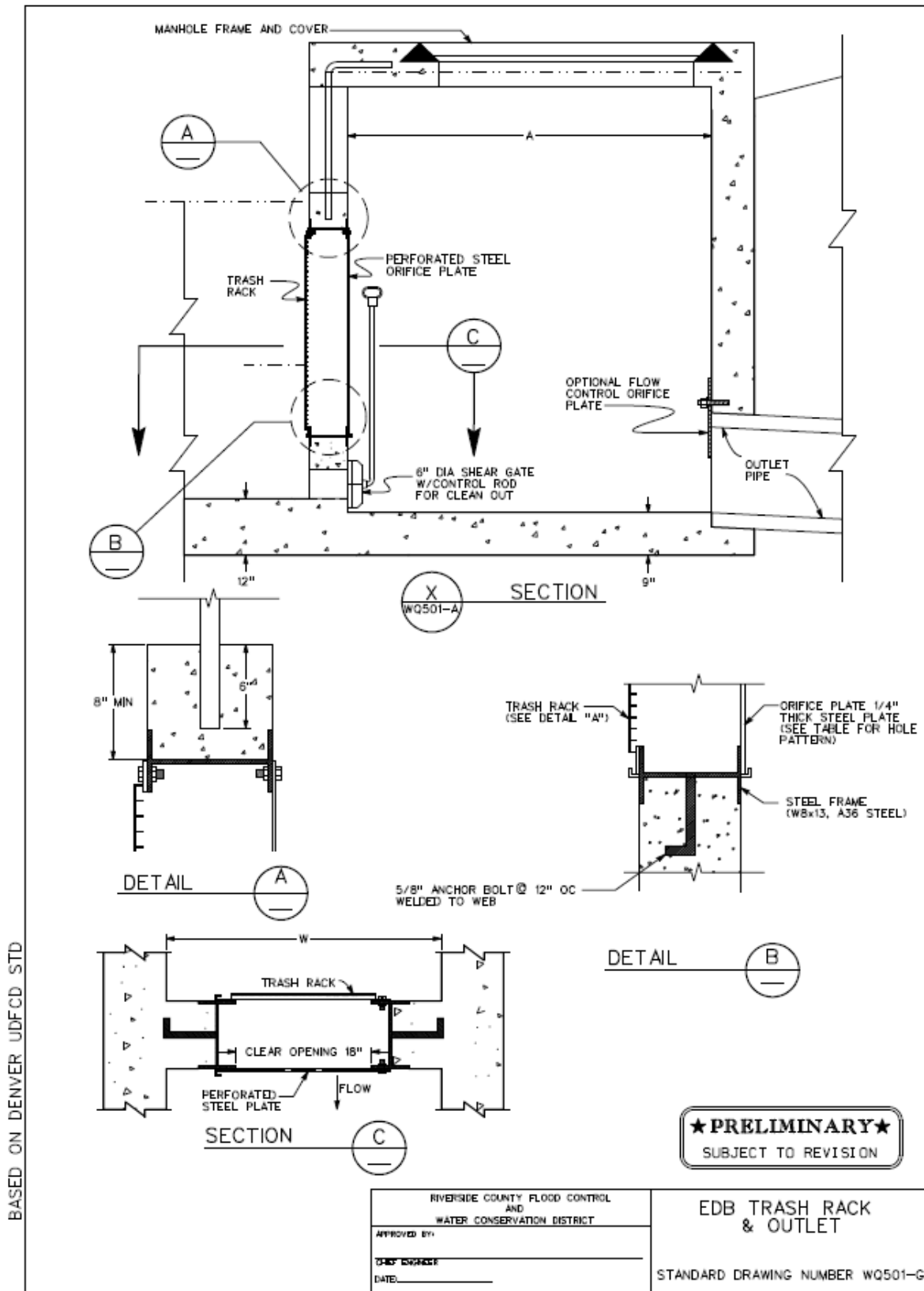
¹ JOHNSON SCREENS, ST. PAUL, MN USA 1-800-833-9473

EXTENDED DETENTION BASIN BMP FACT SHEET

BASED ON DENVER UDFCD STD



EXTENDED DETENTION BASIN BMP FACT SHEET



EXTENDED DETENTION BASIN BMP FACT SHEET

