PRELIMINARY DRAINAGE REPORT
For
Tentative Tract No. 20520

PROJECT LOCATION

Tentative Tract Number 20520
City of Redlands, CA

PREPARED FOR:

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9/13/2022

Jeffery T Okamoto, P.E. — Date

PREPARED: September 13, 2022

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1.0 Introduction

This preliminary engineering drainage report has been prepared for TTLC Redlands Texas St, LLC in support of the residential development (Tentative Tract Map 20520, City of Redlands, in the County of San Bernardino, California). The project site is bounded by Red Park and a shooting range to the east, Texas Street to the west, the Santa Ana River to the north, and residential subdivisions to the south. The tract is located south of the Santa Ana River as part of the Santa Ana River Watershed where all on-site and off-site runoff eventually drain. A vicinity map is included under Appendix A.

The site is currently used as a citrus orchard under the agricultural land use type. The site is under a HCOC exempt condition as seen in the WAP Report in Appendix B-4. The project proposes to develop 11.56 acres of land into a mix of medium-density single-family residences, lots, public streets and recreational space.

Onsite runoff from this project area, including areas associated with the public street improvements of Texas Street, will be captured by an on-site storm drain inlet and conveyed to an onsite detention basin which will allow infiltration of the LID design capture volume (see Appendix A for proposed drainage area map).

Maintenance of the proposed public streets and utilities will be transferred to the City of Redlands and/or the utility purveyor upon completion of the project.

2.0 Purpose & Design Criteria

The purpose of this report is the analysis of the existing hydrologic conditions associated with the project site and to determine design flow rates and storm drain sizes required for the proposed improvements. The evaluation of hydraulic conditions is deferred to final engineering. The hydrology maps and calculations reflect the tributary areas and associated Q_{10} and Q_{100} flows. Analysis will include calculations for onsite and offsite areas.

The criteria, methods, and assumptions are consistent with Section 2 Storm Drain Standards of the City of Redlands Public Works Standards and the County of San Bernardino County Flood Control District (SBCFCD) Hydrology Manual. Specifically:

- The facilities shall be designed to minimize the inundation of private properties from storm runoff from a 100-year frequency storm;
- Public streets shall be protected from flooding from runoff of a 10-year frequency storm, in accordance with city standards or approved equivalent;
- The drainage facilities shall be designed in accordance with the City master plan of drainage and applicable elements of the city general plan or any adopted specific plan;
- For flood control purposes flows are to be fully mitigated for the 100-year storm frequency, in accordance with City standards or approved equivalent.

3.0 Methodology

3.1 Hydrologic Analysis

Onsite and offsite hydrologic analysis was prepared using the methodology outlined in the SBCFCD Hydrology Manual. Rational Method and Unit Hydrograph method calculations were completed for the 10- and 100-year return event using AES software.

- The 1-hour precipitation rate for the 10-and 100-year frequency events were taken from the latest NOAA Atlas 14 precipitation statistics consistent with the County's Hydrology Manual (see Appendix B).
- A calculated intensity duration curve slope of 0.474.
- Rainfall intensities were derived by AES based on the rainfall intensity curve and the expected time of concentration.
- 10-year analysis assumes AMC of II;
- 100-year assumes AMC of III;
- Based on the soils report provided by Geo Tek Inc. (J.N. 2820-CR) and included under Appendix B, the underlying soils are composed of alluvial soils consisting of medium dense fine to medium grained silty sands and sandy silt at an explored depth ranging from 16.5 to 51.5 feet below the ground surface. The USCS data base classifies the hydrologic soil group as type "A".

Calculations and tabulation can be found in Appendix C.

3.2 Hydraulic Analysis

Onsite and offsite hydraulic analyses will be performed during final engineering. Calculations will be based on the 10- and 100-year rational method hydrologic flow rates. The following hydraulic calculations will be included in the final drainage report:

- Street Flow Depth and Capacity - Street Flow calculations will be completed using Bentley FlowMaster V8i. Streets will be modeled as irregular open channels based on the typical street section (existing or proposed). The software calculates flow capacity, velocity, and depth using Manning Equation of open channel flow.
- Catch Basin Capacity (Sizing) - Catch basin calculations will be completed using AES software. The software calculates a minimum width dimension of a catch basin with relation to flow condition, ponding depth and flow rate capture.
- Pipe Flow – Hydraulic analysis for the 100-year HGL will be completed using the Water Surface Pressure Gradient for Windows (WSPGW) software. The 100- year flow rates from AES will be used in the analysis of the proposed storm drain pipes.

Calculations and tabulation are found in Appendix D of the final drainage report.

4.0 Existing Conditions

See Appendix A for Existing Condition Hydrology Map that highlights drainage areas and drainage patterns.

4.1 Onsite Drainage

Most of the site is currently being used for agricultural purposes as a citrus orchard. Some plots are fallowed or left vacant without any orchard trees. A dirt access road borders the site to the west. A soil type combination of fallow, orchards (in poor condition), and barren (for the dirt roads) were used in the existing condition hydrology analysis.

The site was divided into subdrainage areas in accordance with the 10 acre/1000 feet flow path length limit for the upstream initial subarea as identified in the SBCFCD Hydrology Manual. Roughly 90% of site runoff flows in a northeasterly direction into an existing swale that runs along the dirt road and outlets at the Santa Ana River. The remaining 10% flows south into an existing channel within the jurisdiction of the California Department of Fish and Wildlife that also discharges into the river.

4.2 Offsite Drainage

Texas Street is an existing public road with pavement ending at the project entrance to the south before becoming a dirt access road that borders the project site in the west. Texas Street is crowned but curb and gutter improvements are not present for the entire length of the roadway. Current curb and gutter improvements extend from approximately 300 feet south of Pioneer Ave to the intersection with Domestic Avenue. Where curb and gutter improvements do not exist, street runoff from the southbound lane sheet flows to the adjacent agricultural fields.

In the existing condition, runoff from the half-section of Texas St that runs northerly to Domestic Avenue and is comingled with runoff from the agricultural fields. This offsite flow from the northbound lane of Texas Street continues to flow north into a drainage ditch that runs alongside the dirt access road until it empties into the Santa Ana River.

The basin in the adjacent Red Park has an overflow channel that discharges in the vicinity of existing CDFW swale found in the eastern section of the project site. No run-on from Red Park will discharge onto the proposed project limits.

5.0 Proposed Conditions

See Appendix A for Proposed Condition Hydrology Map that highlights drainage areas and drainage patterns.

5.1 Onsite Drainage Improvements

Existing drainage patterns are to be moderately modified in the proposed condition. All runoff will still be directed to either of the two existing outlets to the Santa Ana River. A majority of the project site, composed of Drainage Areas 1-6 (10.72 acres), will maintain existing drainage conditions by discharging to the Santa Ana River north of Texas St. All lots will be graded to allow runoff to drain towards Streets A, B, or C that will convey flows west to cross gutters on Texas Street. All runoff will then be conveyed through curb and gutter present on half of Texas Street to a single in-sag inlet found at the end of the cul de sac. Runoff captured by the catch basin will then be piped to the infiltration basin. Inlets, curb and gutter, and storm drain pipes are sized per City standards. The remaining runoff from the eastern 0.84 acres north of Red Park will retain the existing drainage path into the CDFW swale. This drainage area will remain undeveloped as to maintain the existing condition.

The footprint of the basin was determined based on design infiltration rates as well as the 48 hour drawdown mitigation criteria. The basin is designed to fully retain the DCV at a ponding depth of 1.5 feet. 100-year flood routing analysis was performed to ensure that overflow from this basin does not exceed flows in the existing condition. The basin will have an 18" overflow orifice structure at 1.5 feet as well as an emergency spillway in case of orifice failure. The basin will also have 2 feet of freeboard. At full capacity, the basin will have a storage volume of approximately 53,500 cubic feet. The required DCV of 19,009 cu. ft was based on a conservative impervious fraction of 0.517 assuming 60% imperviousness for medium-density residential developments. The development is composed of a mix of medium-density single-family residences, public roads, and recreational spaces.

5.2 Offsite Drainage Improvements

Street flow from the eastern half of Texas St will be captured at the entrance of the project site and conveyed in a separate pipe to the basin outlet to prevent comingling of onsite and offsite flows. A ditch connecting the overflow spillway from Red Park to the CDFW channel will be constructed to facilitate flows and prevent offsite run on from impacting the project site. A berm will be placed on the western side of the ditch. Basin overflow as well as offsite flows from Texas St will be discharged onto a riprap pad before flowing into the Santa Ana River. Riprap pad sizing calculations will be provided during Final Engineering.

6.0 Results

The hydrologic analysis performed demonstrate that the comparison between existing and proposed conditions of the 100-year peak discharges is decreased in the proposed condition with the implementation of infiltration/detention basin. Summary of the hydrology analysis is found in the table below.

Table 1- ***Results from AES***

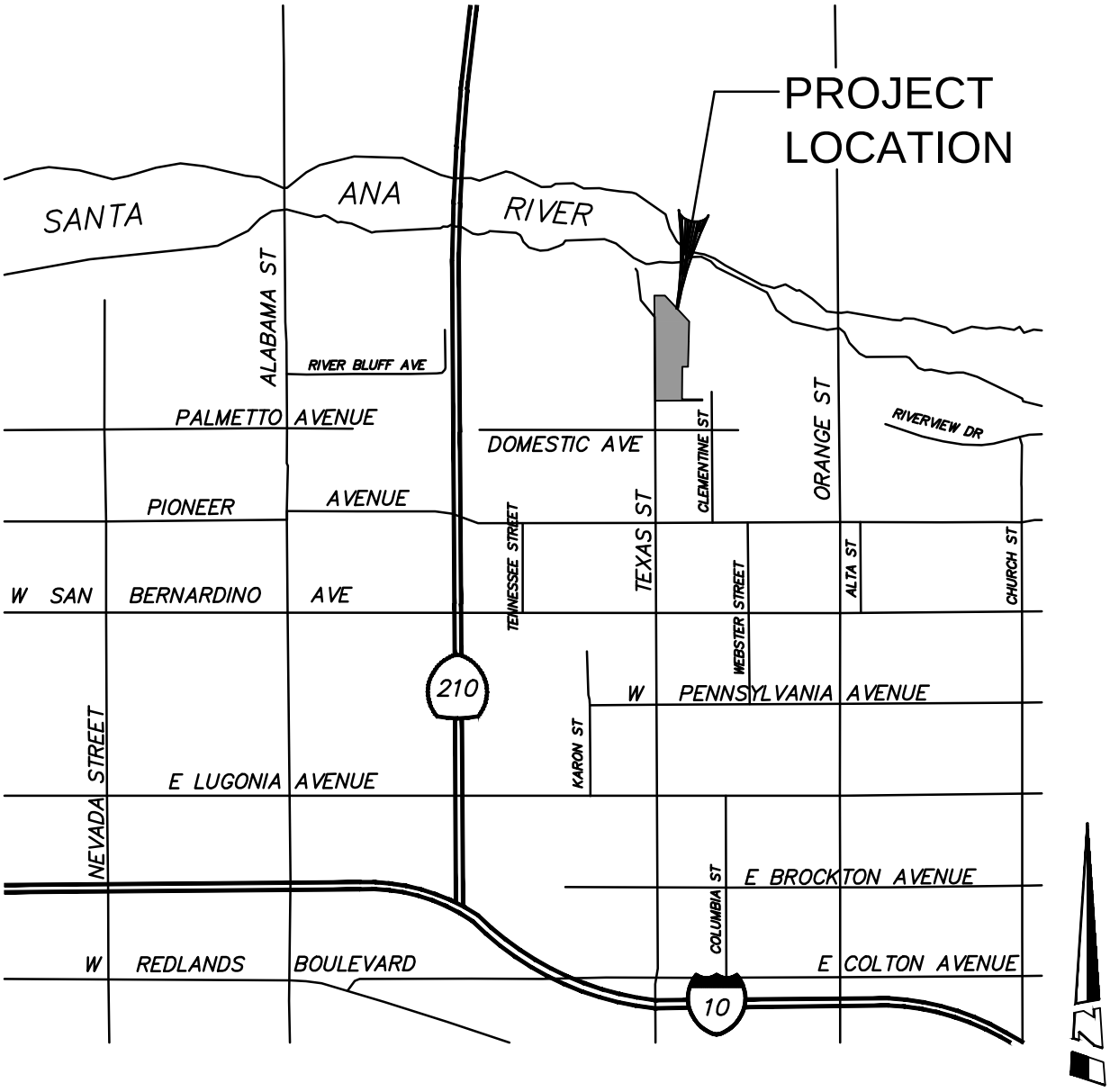
Condition	Q100 (cfs)	Method used
Existing	17.69	Rational
Proposed without basins (unmitigated)	22.19	Rational
Proposed with basins (mitigated)	9.05	Unit Hydrograph

Appendix C-3 shows the stage outflow relationship entered into AES for the unit hydrograph method for the detention basin. Storage values were obtained from proposed grading and outflow was calculated using the orifice equation for the orifice and weir equation. AES was used to obtain Q_{10} and Q_{100} values and Flow Master was used to determine the catch basin sizes. Curb inlets were sized to adequately capture flows in the 10-year storm condition, while storm drains were sized to adequately convey runoff for 100-year storm conditions. Flow Master was also utilized to verify the 100-year flow half-street conveyance capacity. HGL analysis from WSPG will be provided in the final H&H Report.

Appendix A

Maps

A-1: Vicinity Map
A-2: Existing Hydrology Map
A-3: Proposed Hydrology Map



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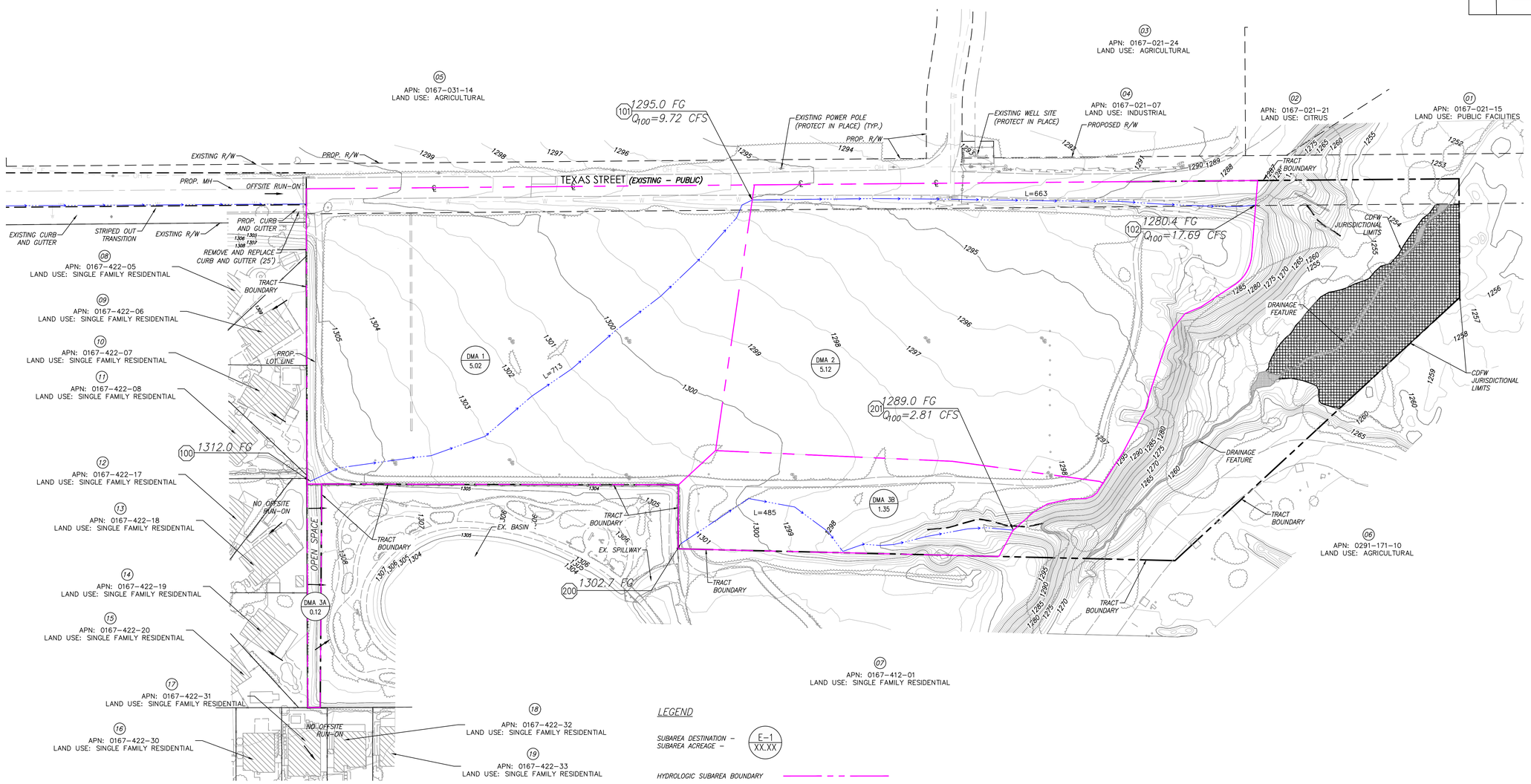
VICINITY MAP

EXISTING CONDITION HYDROLOGY EXHIBIT

CITY OF REDLANDS,
IN THE COUNTY OF SAN BERNARDINO,
STATE OF CALIFORNIA

VICINITY MAP
NOT TO SCALE



LEGEND

SUBAREA DESTINATION –
SUBAREA ACREAGE – E-1 XX.XX

HYDROLOGIC SUBAREA BOUNDARY

PROPOSED TRACT BOUNDARY

DRAINAGE DELINEATIONS/FLOW-PATHS

60 0 30 60 120
SCALE 1"= 60'

SEAL-DESIGN ENGINEER
REGISTERED PROFESSIONAL ENGINEER
JEFFREY T. OKAMOTO
No. 46049
Expiration 12-31-22
CIVIL
STATE OF CALIFORNIA

OWNER:
TTLC Redlands Texas St, LLC
2942 CENTURY PLACE, SUITE 121
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DESIGNED BY	HZ
DRAWN BY	RK/NL
CHECKED BY	JTO
DATE	9/13/22

CITY OF REDLANDS
EXISTING CONDITION HYDROLOGY EXHIBIT

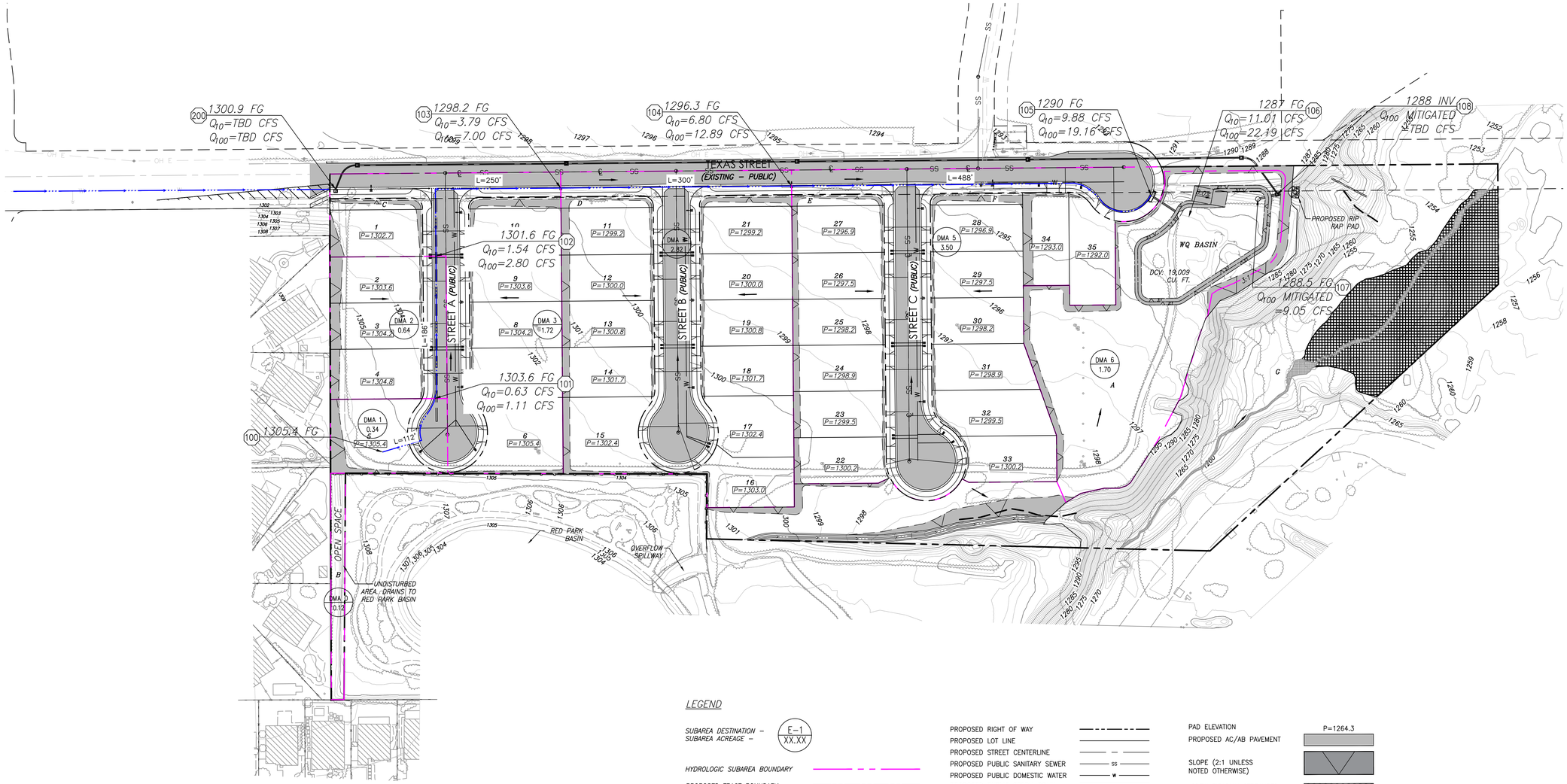
SHEET	1
OF	1
SHEETS	
JOB NO.	R314586.01

Q:\R314586.01 - 35 Lots east of Texas Street in Redlands\10 CADD & BIM\10.13 Civil\Exhibits\HHWQ\45680_EX201 - Existing Hydrology Exhibit.dwg, Layout: EX HYDRO, Sep 13 2022 5:38pm

PROPOSED CONDITION HYDROLOGY EXHIBIT

CITY OF REDLANDS,
IN THE COUNTY OF SAN BERNARDINO,
STATE OF CALIFORNIA

VICINITY MAP
NOT TO SCALE



LEGEND

SUBAREA DESTINATION – E–1
SUBAREA ACREAGE – XX.XX

HYDROLOGIC SUBAREA BOUNDARY
PROPOSED TRACT BOUNDARY
DRAINAGE DELINEATIONS/FLOW–PATHS

PROPOSED RIGHT OF WAY
PROPOSED LOT LINE
PROPOSED STREET CENTERLINE
PROPOSED PUBLIC SANITARY SEWER
PROPOSED PUBLIC DOMESTIC WATER
PROPOSED PUBLIC STORM DRAIN
EXISTING SANITARY SEWER
EXISTING DOMESTIC WATER
EXISTING STORM DRAIN
LOT NUMBER/LETTER — LOT A

PAD ELEVATION P=1264.3
PROPOSED AC/AB PAVEMENT
SLOPE (2:1 UNLESS NOTED OTHERWISE)
CDFW RIPARIAN STREAMBED
DRAINAGE AREA
PROPOSED RIP RAP

60 0 30 60 120
SCALE 1"= 60'

SEAL–DESIGN ENGINEER
REGISTERED PROFESSIONAL ENGINEER
JEFFREY T. OKAMOTO
No. 46049
Expiration 12–31–22
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CITY OF REDLANDS
PROPOSED CONDITION HYDROLOGY EXHIBIT

SHEET 1 OF 1 SHEETS
JOB NO. R314586.01

O:\R314586.01 – 35 Lots east of Texas Street in Redlands\10 CADD & BIM\10.13 Civil\Exhibits\XHWQ\456801_EX202 – Proposed Hydrology Exhibit.dwg, Layout: PR HYDRO, Sep 13 2022 5:47pm

Appendix B

Hydrology Parameters

B-1: NOAA Atlas 14 Precipitation Statistics
B-2: Geotechnical Investigations Report
B-3: Soil Report by Geotechnical Engineer
B-4: San Bernardino WAP Report

NOAA Atlas 14, Volume 6, Version 2
Location name: Redlands, California, USA*
Latitude: 34.0868°, Longitude: -117.1904°
Elevation: 1303.97 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**1.19** (0.984-1.44)	**1.54** (1.28-1.87)	**2.02** (1.67-2.46)	**2.41** (1.98-2.96)	**2.95** (2.35-3.76)	**3.40** (2.64-4.40)	**3.84** (2.92-5.12)	**4.32** (3.18-5.93)	**4.99** (3.52-7.14)	**5.52** (3.76-8.18)
10-min	**0.852** (0.708-1.03)	**1.10** (0.918-1.34)	**1.45** (1.19-1.76)	**1.73** (1.42-2.12)	**2.12** (1.68-2.69)	**2.43** (1.89-3.16)	**2.75** (2.09-3.67)	**3.10** (2.28-4.25)	**3.58** (2.52-5.11)	**3.95** (2.69-5.86)
15-min	**0.688** (0.572-0.836)	**0.892** (0.740-1.08)	**1.16** (0.964-1.42)	**1.39** (1.14-1.71)	**1.71** (1.36-2.17)	**1.96** (1.52-2.55)	**2.22** (1.68-2.96)	**2.50** (1.84-3.42)	**2.88** (2.03-4.12)	**3.19** (2.17-4.73)
30-min	**0.512** (0.426-0.620)	**0.662** (0.550-0.806)	**0.866** (0.718-1.06)	**1.03** (0.850-1.27)	**1.27** (1.01-1.62)	**1.46** (1.13-1.89)	**1.65** (1.25-2.20)	**1.86** (1.37-2.55)	**2.14** (1.51-3.07)	**2.37** (1.62-3.52)
60-min	**0.370** (0.308-0.449)	**0.480** (0.399-0.583)	**0.627** (0.519-0.764)	**0.749** (0.616-0.921)	**0.920** (0.730-1.17)	**1.06** (0.820-1.37)	**1.20** (0.906-1.59)	**1.34** (0.990-1.84)	**1.55** (1.10-2.22)	**1.72** (1.17-2.55)
2-hr	**0.264** (0.220-0.320)	**0.339** (0.282-0.412)	**0.438** (0.364-0.534)	**0.522** (0.428-0.641)	**0.636** (0.504-0.808)	**0.725** (0.564-0.942)	**0.817** (0.620-1.09)	**0.914** (0.672-1.25)	**1.05** (0.738-1.50)	**1.15** (0.784-1.71)
3-hr	**0.216** (0.180-0.262)	**0.276** (0.230-0.336)	**0.357** (0.296-0.435)	**0.423** (0.347-0.520)	**0.514** (0.408-0.654)	**0.585** (0.455-0.760)	**0.658** (0.499-0.876)	**0.734** (0.540-1.01)	**0.838** (0.591-1.20)	**0.920** (0.627-1.36)
6-hr	**0.152** (0.126-0.184)	**0.194** (0.161-0.235)	**0.249** (0.207-0.304)	**0.295** (0.242-0.362)	**0.357** (0.283-0.454)	**0.405** (0.315-0.526)	**0.454** (0.344-0.605)	**0.505** (0.372-0.693)	**0.575** (0.406-0.822)	**0.629** (0.429-0.932)
12-hr	**0.101** (0.084-0.122)	**0.129** (0.107-0.157)	**0.166** (0.138-0.203)	**0.197** (0.162-0.242)	**0.238** (0.189-0.303)	**0.270** (0.210-0.351)	**0.302** (0.229-0.402)	**0.335** (0.247-0.459)	**0.380** (0.268-0.543)	**0.415** (0.282-0.615)
24-hr	**0.068** (0.060-0.078)	**0.088** (0.078-0.101)	**0.114** (0.100-0.132)	**0.135** (0.118-0.157)	**0.163** (0.138-0.197)	**0.185** (0.154-0.228)	**0.207** (0.168-0.261)	**0.230** (0.181-0.297)	**0.260** (0.197-0.351)	**0.284** (0.208-0.396)
2-day	**0.042** (0.037-0.048)	**0.055** (0.049-0.063)	**0.072** (0.064-0.083)	**0.086** (0.075-0.100)	**0.105** (0.089-0.127)	**0.120** (0.100-0.148)	**0.135** (0.109-0.170)	**0.151** (0.119-0.195)	**0.172** (0.130-0.232)	**0.188** (0.138-0.262)
3-day	**0.030** (0.027-0.035)	**0.040** (0.036-0.046)	**0.053** (0.047-0.062)	**0.064** (0.056-0.075)	**0.079** (0.067-0.096)	**0.091** (0.076-0.112)	**0.103** (0.084-0.130)	**0.116** (0.092-0.150)	**0.134** (0.101-0.180)	**0.147** (0.108-0.206)
4-day	**0.024** (0.022-0.028)	**0.033** (0.029-0.038)	**0.044** (0.039-0.051)	**0.053** (0.047-0.062)	**0.066** (0.056-0.080)	**0.076** (0.063-0.094)	**0.087** (0.070-0.109)	**0.098** (0.077-0.126)	**0.113** (0.085-0.152)	**0.125** (0.092-0.174)
7-day	**0.016** (0.014-0.019)	**0.022** (0.019-0.025)	**0.029** (0.026-0.034)	**0.036** (0.031-0.042)	**0.045** (0.038-0.054)	**0.052** (0.043-0.063)	**0.059** (0.048-0.074)	**0.066** (0.052-0.086)	**0.077** (0.058-0.104)	**0.085** (0.062-0.119)
10-day	**0.012** (0.011-0.014)	**0.017** (0.015-0.019)	**0.023** (0.020-0.026)	**0.027** (0.024-0.032)	**0.034** (0.029-0.041)	**0.040** (0.033-0.049)	**0.045** (0.037-0.057)	**0.051** (0.040-0.066)	**0.060** (0.045-0.080)	**0.066** (0.048-0.092)
20-day	**0.008** (0.007-0.009)	**0.010** (0.009-0.012)	**0.014** (0.012-0.016)	**0.017** (0.015-0.020)	**0.022** (0.018-0.026)	**0.025** (0.021-0.031)	**0.029** (0.023-0.036)	**0.033** (0.026-0.042)	**0.038** (0.029-0.052)	**0.043** (0.031-0.059)
30-day	**0.006** (0.005-0.007)	**0.008** (0.007-0.009)	**0.011** (0.010-0.013)	**0.014** (0.012-0.016)	**0.017** (0.015-0.021)	**0.020** (0.017-0.025)	**0.023** (0.019-0.029)	**0.026** (0.021-0.034)	**0.030** (0.023-0.041)	**0.034** (0.025-0.047)
45-day	**0.005** (0.004-0.005)	**0.006** (0.006-0.007)	**0.009** (0.008-0.010)	**0.011** (0.009-0.013)	**0.014** (0.012-0.016)	**0.016** (0.013-0.020)	**0.018** (0.015-0.023)	**0.021** (0.016-0.027)	**0.024** (0.018-0.033)	**0.027** (0.020-0.038)
60-day	**0.004** (0.004-0.005)	**0.006** (0.005-0.007)	**0.008** (0.007-0.009)	**0.009** (0.008-0.011)	**0.012** (0.010-0.014)	**0.014** (0.011-0.017)	**0.016** (0.013-0.020)	**0.018** (0.014-0.023)	**0.021** (0.016-0.028)	**0.023** (0.017-0.033)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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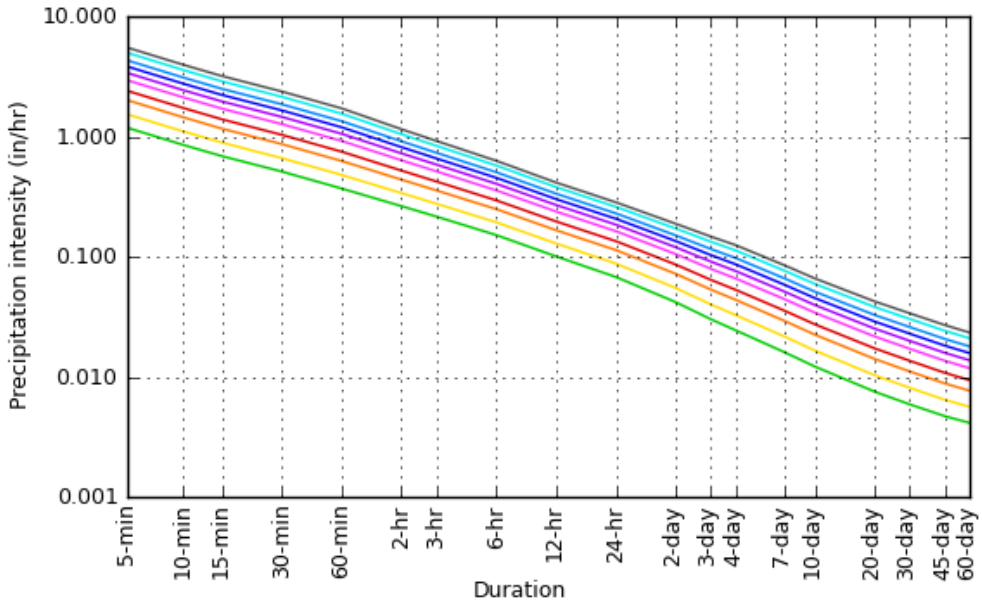
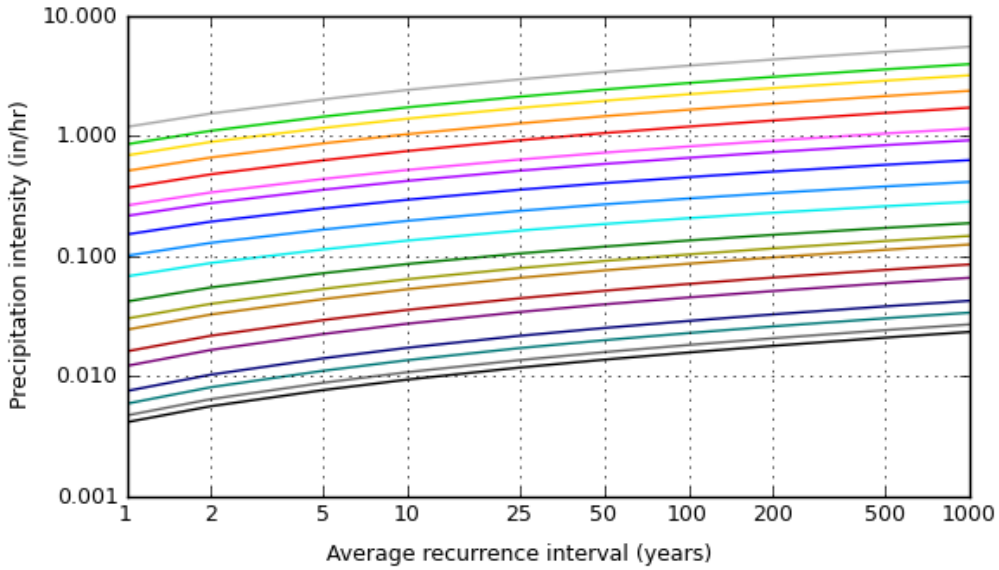
PF graphical

PDS-based intensity-duration-frequency (IDF) curves
Latitude: 34.0868°, Longitude: -117.1904°





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Large scale aerial

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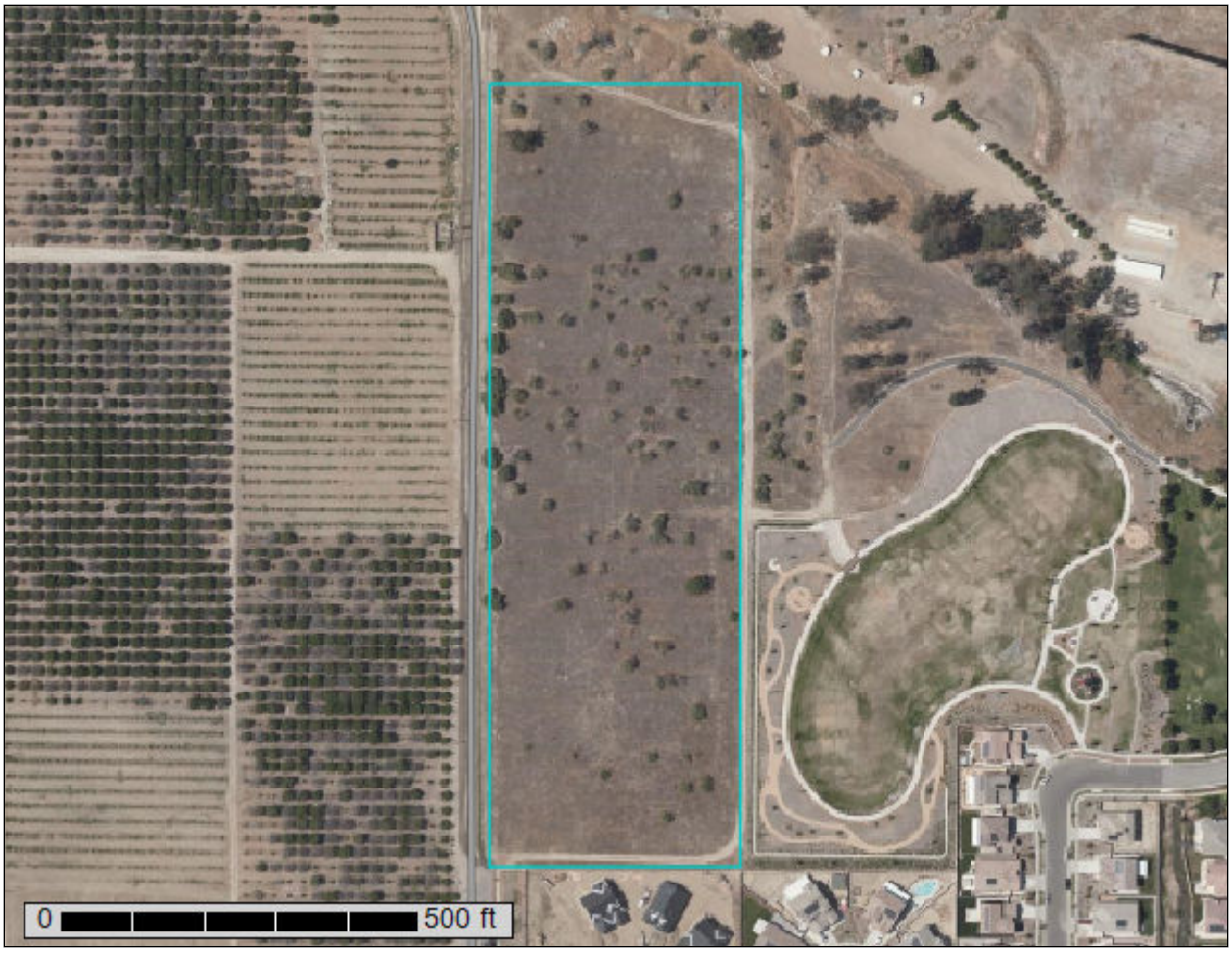
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for San Bernardino County Southwestern Part, California



December 22, 2021

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:1,950 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 25 50 100 150

Feet
0 50 100 200 300

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

MAP LEGEND

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

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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

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

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

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

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

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

Soil Survey Area: San Bernardino County Southwestern Part, California
Survey Area Data: Version 13, Sep 13, 2021

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

Date(s) aerial images were photographed: Apr 1, 2018—Jun 30, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
HbA	Hanford sandy loam, 0 to 2 percent slopes	8.8	99.9%
Ps	Psamments, Fluvents and Frequently flooded soils	0.0	0.1%
Totals for Area of Interest		**8.8**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however,

onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

San Bernardino County Southwestern Part, California

HbA—Hanford sandy loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2y8tv
Elevation: 790 to 1,610 feet
Mean annual precipitation: 10 to 19 inches
Mean annual air temperature: 65 to 65 degrees F
Frost-free period: 345 to 365 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Hanford and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hanford

Setting

Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

A - 0 to 12 inches: sandy loam
C - 12 to 60 inches: fine sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: RareNone
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: A
Ecological site: R019XG911CA - Loamy Fan
Hydric soil rating: No

Minor Components

Hanford, steeper slopes

Percent of map unit: 5 percent
Landform: Alluvial fans
Landform position (three-dimensional): Tread

Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Greenfield, sandy loam

Percent of map unit: 5 percent
Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Unnamed

Percent of map unit: 5 percent
Hydric soil rating: No

Ps—Psamments, Fluvents and Frequently flooded soils

Map Unit Setting

National map unit symbol: hckh
Elevation: 10 to 1,500 feet
Mean annual precipitation: 10 to 25 inches
Mean annual air temperature: 59 to 64 degrees F
Frost-free period: 250 to 350 days
Farmland classification: Not prime farmland

Map Unit Composition

Psamments and similar soils: 55 percent
Fluvents and similar soils: 45 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Psamments

Setting

Landform: Drainageways
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium

Typical profile

A - 0 to 12 inches: sand
C1 - 12 to 48 inches: fine sand
C2 - 48 to 60 inches: stratified gravelly sand to gravelly loamy sand

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Very low

Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: FrequentNone
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A
Ecological site: R019XG905CA - Riparian
Hydric soil rating: No

Description of Fluvents

Setting

Landform: Drainageways
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 10 inches: gravelly sand
C1 - 10 to 30 inches: stratified gravelly sand to gravelly loam
C2 - 30 to 60 inches: stratified gravelly sand to gravelly loam

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: FrequentNone
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 6.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A
Ecological site: R019XG905CA - Riparian
Hydric soil rating: Yes

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GEOTECHNICAL AND INFILTRATION EVALUATION
PROPOSED 35-LOT RESIDENTIAL DEVELOPMENT
APN 167-041-01
NORTHEAST OF THE TERMINUS OF TEXAS STREET
REDLANDS, SAN BERNARDINO COUNTY, CALIFORNIA

PREPARED FOR

THE TRUE LIFE COMPANIES
2942 CENTURY PLACE, SUITE 121
COSTA MESA, CALIFORNIA 92626

PREPARED BY

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

PROJECT NO. 2820-CR **JULY 30, 2021**

GEOTEK

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July 30, 2021
Project No. 2820-CR

The True Life Companies
2942 Century Place, Suite 121
Costa Mesa, California 92626

Attention: Mr. Michael Torres

Subject: Geotechnical and Infiltration Evaluation
Proposed 35-Lot Residential Development
APN 167-041-01
Northeast of the Terminus of Texas Street
Redlands, San Bernardino County, California

Dear Mr. Torres:

GeoTek, Inc. (GeoTek) is pleased to provide the results of this geotechnical and infiltration evaluation for the proposed project located in Redlands, San Bernardino County, California. This report presents the results of GeoTek's evaluation, discussion of findings, and provides geotechnical recommendations for foundation design and construction.

Based upon review and evaluation, site development appears feasible from a geotechnical viewpoint provided that the recommendations included in this report are incorporated into the design and construction phases of the project.

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

Respectfully submitted,
GeoTek, Inc.

Bruce A. Hick
GE 2244, Exp. 12/31/22
Geotechnical Engineer

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

Kyle R. McHargue
PG 9790, Exp. 02/28/22
Project Geologist

Distribution: (1) Addressee via email (one PDF file)

G:\Projects\2801 to 2850\2820CR The True Life Companies APN 167-041-01 Redlands\Geotechnical Report\2820CR Geotechnical and Infiltration Evaluation 35-Lot Residential .doc

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1. PURPOSE AND SCOPE OF SERVICES

The purpose of this study was to evaluate the geotechnical engineering and geologic conditions at the project site, as outlined in GeoTek's proposal P-0605521-CR, dated June 21, 2021. Services provided for this study included the following:

- Research and review of available geologic data and general information pertinent to the site,
- Site exploration consisting of the excavation, logging, and sampling of six (6) exploratory test borings extending to depths ranging from 16.5 to 51.5 feet below grade,
- Excavation of two (2) additional borings to a depth of about five (5) feet below grade and performing an infiltration test in each boring,
- Laboratory testing of soil samples collected during the field investigation,
- Review and evaluation of site seismicity, and
- Preparation of this geotechnical report which presents GeoTek's findings, conclusions, and recommendations for this site.

2. SITE DESCRIPTION AND PROPOSED DEVELOPMENT

2.1 SITE DESCRIPTION

The approximate 13.54-acre roughly rectangular-shaped project site is located northeast of the Terminus of Texas Street, approximately 500 feet north of Domestic Avenue, in the City of Redlands, San Bernardino County, California (See Figure 1). Access to the site is available from Texas Street, a moderately maintained dirt road located adjacent to the western boundary of the site. Poorly maintained dirt roads provide access to the site along the southern, eastern and northern boundaries of the site. The site is bordered to the north by the Santa Ana River, to the west by Texas Street, followed by agricultural fields (orchards), to the south by existing single-family residences and to the east by a park and vacant land.

Topographically, the majority of the site slopes gently downward to the north at an approximate two (2) percent gradient. Elevation of the southern portion of the the site is approximately 1,300 feet with approximately 15 feet of elevation differential across the site. The northern-most portion of the parcel extends down into the Santa Ana River area which has an approximate elevation of 1,253 above mean sea level. It is our understanding that no development will extend beyond the northerly descending slope or into the Santa Ana River area.

The site was vacant land at the time of the field exploration. The site appears to have been previously utilized as an agricultural orchard. The site was vegetated with moderate covering of weeds, grasses and brush and remnants of the previous orchard.

2.2 PROJECT DESCRIPTION

Based upon review of the Site Plan prepared by Blue Engineering and Consulting, Inc. (undated), revised 8/7/20, GeoTek understands the subject property is to be developed with about 35 single-family residential lots and associated infrastructure improvements. Stormwater disposal is to be by means of a stormwater detention basin. No development is planned in the northern portion of the site adjacent to the Santa Ana River.

The proposed residential structures are anticipated to be of wood-frame construction, one- to two-stories in height, and incorporate conventional shallow foundations and concrete slab-on-grade floors. It is our understanding that sewage disposal will be by a public sewer. For the purposes of this report, it is assumed maximum column and wall loads will be about 50 kips and 2.5 kips per foot, respectively. Specific site development plans were not provided as of the date of this report. Once actual loads are known that information should be provided to GeoTek to determine if modifications to the recommendations presented in this report are warranted.

If site development differs from the assumptions made herein, the recommendations included in this report should be subject to further review and evaluation. Site development plans should be reviewed by GeoTek when they become available.

3. FIELD EXPLORATION AND LABORATORY TESTING

3.1 FIELD EXPLORATION

The field exploration for this report was conducted on July 9, 2021 and consisted of excavating six (6) geotechnical exploratory borings with a hollow-stem drill rig to depths ranging from about 16.5 to 51.5 feet below grade. The approximate locations of the GeoTek excavations are shown on the Exploration Location Map (Figure 2). An engineer from GeoTek logged the excavations and collected soil samples for use in subsequent laboratory testing. The logs of the exploratory borings are included in Appendix A.

Relatively undisturbed soil samples were recovered at various intervals in the geotechnical borings with a California sampler. The California sampler is a 3-inch outside diameter, 2.5-inch inside diameter, split barrel sampler lined with brass rings. The sampler was 18 inches long. The sampler conformed to the requirements of ASTM D 3550. A 140-pound automatic trip hammer was utilized, dropping 30 inches for each blow. The relatively undisturbed samples, together with bulk samples of representative soil types, were returned to the laboratory for testing and evaluation. The California sampler test data are presented on the boring logs in Appendix A.

Percolation Testing

In addition to the geotechnical exploratory borings, two percolation test borings (I-1 and I-2) were excavated in the area of the proposed storm water management basin to depths of about 5 feet. Infiltration/percolation testing was conducted in these borings in general accordance with the requirements of the County of San Bernardino.

The percolation tests consisted of drilling an eight-inch diameter test hole to the desired depth and installing approximately two inches of gravel in the bottom of the hole. A three-inch diameter perforated PVC pipe, wrapped in a filter sock, was placed in the excavations and the annular space was filled with gravel to prevent caving within the boring. Water was then placed in the borings to presoak the holes and percolation testing was performed the following the pre-soak period. Following presoaking, it was determined that "sandy soil" criteria was met within both percolation borings. The percolation tests were then performed which consisted of adding water to each test hole and measuring the water drop over a 10-minute period. The water drop was recorded for ten test intervals. Water was added to the test holes after each test interval. The field percolation rates were then converted to an infiltration rate using the Porchet Method.

The results of the conversions indicate infiltration rate range from about 1.56 to 2.59 inch per hour. Copies of the percolation data sheets and the Porchet infiltration rate conversion calculations are presented in Appendix C. No factors of safety were applied to the rates provided. Over the lifetime of the infiltration areas, the infiltration rates may be affected by sediment build up and biological activities, as well as local variations in near surface soil conditions. A suitable factor of safety should be applied to the field rate in designing the infiltration system.

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

3.2 LABORATORY TESTING

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

4. GEOLOGIC AND SOILS CONDITIONS

4.1 REGIONAL SETTING

The subject property is situated in the Peninsular Ranges geomorphic province. The Peninsular Ranges province is one of the largest geomorphic units in western North America. It extends approximately 975 miles south of the Transverse Ranges geomorphic province to the tip of Baja California. This province varies in width from about 30 to 100 miles. It is bounded on the west by the Pacific Ocean, on the south by the Gulf of California and on the east by the Colorado Desert Province.

The Peninsular Ranges are essentially a series of northwest-southeast oriented fault blocks. Several major fault zones are found in this province. The Elsinore Fault zone and the San

Jacinto Fault zone trend northwest-southeast and are found near the middle of the province. The San Andreas Fault zone borders the northeasterly margin of the province.

More specific to the subject property, the site is located in an area geologically mapped to be underlain by alluvium (Dibblee, T.W., and Minch, J.A., 2004a, 2004b). No active faults are shown in the immediate site vicinity on the maps reviewed for the area.

4.2 GENERAL SOIL CONDITIONS

A brief description of the earth materials encountered is presented in the following section. Based on the site reconnaissance, the exploratory excavations and review of published geologic maps, the area investigated is locally underlain by fill that is over younger alluvium.

4.2.1 Fill

Fill was encountered in most of the exploratory borings to depths ranging from approximately 1.5 to 2.5 feet below existing grade. This fill is likely a result of the historical use as an agricultural orchard and the subsequent ground disturbance/tilling that has occurred after the orchard trees were removed. The fill encountered in the exploratory borings generally consisted of silty fine sand and locally sandy silt (SM and ML soil types based upon the Unified Soil Classification System). Greater depths of fill may be present within unexplored areas of the site.

4.2.2 Younger Alluvium

Younger alluvial soils were encountered in the borings beneath the fill soils and extended to the maximum depths explored (51.5 feet). As encountered in the borings, the alluvium consisted of interbedded layers of silty sands and relatively clean sands with variable amounts of gravel (SM and SP soil types based upon the Unified Soil Classification System).

Based on the laboratory test results, the near surface soils have a "very low" expansion potential (ASTM D 4829). Based on the laboratory test results, the near surface soils have a soluble sulfate content of less than 0.1 percent (ASTM D 4327). The test results are provided in Appendix B.

4.3 SURFACE WATER AND GROUNDWATER

4.3.1 Surface Water

If encountered during earthwork operations, surface water on this site is the result of precipitation or possibly some minor surface run-off from the surrounding areas. Overall site

area drainage varies due to the site topography and existing improvements. Provisions for surface drainage will need to be accounted for by the project civil engineer.

4.3.2 Groundwater

Groundwater was not encountered within any of the exploratory borings drilled at the site to the maximum depth drilled of 51.5 below the existing ground surface. The Santa Ana River is located adjacent to the northern boundary of the site. An approximate 25 foot high scarp is present along the boundary between the north end of the property and the Santa Ana River. Based on a review of groundwater depths noted on the State Department of Water Resources Water Data Library website, it is estimated the historic high groundwater depth is in excess of 80 feet below existing grade at the site. Based on the results of the field exploration, review of site area geomorphology and geology, groundwater is not anticipated to adversely affect the proposed improvements.

4.4 FAULTING AND SEISMICITY

4.4.1 Faulting

The geologic structure of the entire California area is dominated mainly by northwest-trending faults associated with the San Andreas system. The site is in a seismically active region. However, the site is not situated within a State of California designated *"Alquist-Priolo"* Earthquake Fault Zone. The nearest known active fault is the San Andreas fault located about 3.75 miles to the northeast.

4.4.2 Seismic Design Parameters

The site is located at approximately 34.0886 degrees West Latitude and -117.1904 degrees North Longitude. Site spectral accelerations (S_a and S_1) for 0.2 and 1.0 second periods for a Class "D" site, was determined from the SEAOC/OSHPD web interface that utilizes the USGS web services and retrieves the seismic design data and presents that information in a report format. Using the ASCE 7-16 option on the SEAOC/OSHPD website results in the values for S_{M1} and S_{D1} reported as "null-See Section 11.4.8" (of ASCE 7-16). As noted in ASCE 7-16, Section 11.4.8, a site-specific ground motion procedure is recommended for Site Class D when the value S_1 exceeds 0.2. The value S_1 for the subject site exceeds 0.2.

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

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

SITE SEISMIC PARAMETERS	
Mapped 0.2 sec Period Spectral Acceleration, S_S	2.111g
Mapped 1.0 sec Period Spectral Acceleration, S_1	0.82g
Site Coefficient for Site Class "D", F_a	1.2
Site Coefficient for Site Class "D", F_v	1.7
Maximum Considered Earthquake Spectral Response Acceleration for 0.2 Second, S_{MS}	2.533g
Maximum Considered Earthquake Spectral Response Acceleration for 1.0 Second, S_{M1}	1.394g
5% Damped Design Spectral Response Acceleration Parameter at 0.2 Second, S_{DS}	1.689g
5% Damped Design Spectral Response Acceleration Parameter at 1 second, S_{D1}	0.929g
Peak Ground Acceleration (PGA_M)	1.044g
Seismic Design Category	E

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

4.5 LIQUEFACTION

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

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

A historic high groundwater depth of 30 feet was used in our analysis. The soil profile identified within B-1 was also used. A mean magnitude weighted (Mw) seismic event of 7.3 was incorporated into the analysis. A PGA_M value of 1.044g was obtained from the USGS website

and incorporated the ASCE 7-16 provisions. Based on the recommendations provided in this report, engineered fill will be incorporated within the upper five feet of pad grade; this change has been incorporated into the liquefaction analysis. GeoTek evaluated the liquefaction potential of the on-site soils using the computer program LiquefyPro Version 5.

The results of the analyses indicated that the soils within Boring B-1 are not susceptible to soil liquefaction during the design-level earthquake. Therefore, deep ground improvement is not warranted for this site. The results of the liquefaction analysis are presented within Appendix D.

4.6 OTHER SEISMIC HAZARDS

The potential for seismic densification (dry seismic settlement) resulting from seismic activity was assessed. For this analysis, the soil profile identified within Boring B-1, a ground acceleration (PGA_M) of 1.044g and a mean earthquake magnitude of 7.3. The ground acceleration and earthquake magnitude values were obtained from the USGS websites. The computer software program LiquefyPro Version 5 was utilized to estimate the dry seismic settlement potential.

The result of this analysis indicates a total seismic settlement of about 0.80 inch. It is estimated a seismic differential settlement of ½ the total estimated settlement over a 40-foot span will occur. Based on the magnitudes of estimated seismic settlements, special mitigation or design is not considered necessary. However, the estimated seismic settlements should be considered in structural design. A copy of the computer output file for this analysis is presented in Appendix D.

Due to the general flat terrain, the potential for seismic induced landslides or lateral spreading is considered nil. The potential for secondary seismic hazards such as a seiche and tsunami is considered negligible due to site elevation and distance from an open body of water.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 GENERAL

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

5.2 EARTHWORK CONSIDERATIONS

5.2.1 General

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

5.2.2 Site Clearing

Initial site preparation should commence with removal of debris, deleterious materials and vegetation within the limits of the planned improvements. These materials should be properly disposed of off-site. Voids resulting from removing any materials should be replaced with engineered fill materials with expansion characteristics similar to the onsite materials.

5.2.3 Site Preparation

Due to the non-uniform nature and thickness of the near-surface undocumented fill and loose condition of the upper younger alluvium, it is recommended that the soils be removed beneath the planned building footprint of the proposed structure to a depth of at least 4 feet below existing natural (below existing fill) grade, or two (2) feet beneath the base of the proposed foundations, whichever is greater. Removal bottoms should be relatively uniform in soil type which is not visibly porous and having an in-place density of at least 85 percent of the soil's maximum dry density as determined by ASTM D 1557 test procedures. A representative of this firm should observe and approve the bottom of all remedial excavations. The lateral extent of this recommended over-excavation should extend at least 5 feet beyond the building or foundation limits.

Following site clearing operations, over-excavation and lowering of site grades, where necessary, it is recommended that the exposed subgrade soils beneath all surface improvements be proof rolled with a heavy rubber-tired piece of construction equipment approved by and in the presence of the geotechnical engineering representative. The proof rolling equipment should possess a minimum weight of 15 tons and proof rolling should include at least 4 passes, two in each perpendicular direction. All soil that ruts or excessively deflects during proof rolling should be removed as recommended by the GeoTek representative. Following proof rolling and removal of any unsuitable bearing soil, the exposed subgrade should be scarified to a depth of about 12 inches, be moisture conditioned to slightly above the soil's optimum moisture content and then be compacted to at least 90 percent of the soil's maximum dry density as determined by ASTM D-1557 test procedures.

5.2.4 Engineered Fill

The on-site soils are generally considered suitable for reuse as engineered fill provided they are free from vegetation, debris, oversized materials (6 inch diameter or greater) and other deleterious material. All areas should be brought to final subgrade elevations with fill materials that are placed and compacted in general accordance with minimum project standards. Engineered fill should be placed in 6-to-8-inch loose lifts, moisture conditioned to slightly above the optimum moisture content and compacted to a minimum relative compaction of 90 percent as determined by ASTM D-1557 test procedures.

If wet soils are encountered during remedial grading, methods for drying soils such as stockpiling or mixing with dry soils may be required to bring the soils to the required moisture content for placement as engineered fill. Placement of engineered fill should be observed and tested on a full-time basis by a GeoTek representative during grading activities.

5.2.5 Transition Lot Condition

Building pads graded with a cut/fill transition should be undercut to reduce the potential for differential settlement. The cut portion of the cut/fill transition should be undercut to a depth of at least 3 feet or one (1) foot below the deepest proposed footing, whichever is deeper, and be backfilled with a properly compacted engineered fill. The bottom of the undercut should be sloped at a minimum of 1 percent toward the adjacent street/parking lot area.

5.2.6 Oversized Rock Disposal

Although unlikely, oversized cobbles, boulders and rock fragments may be encountered during rough grading and utility trench operations. If encountered, on-site disposal of oversized materials is possible, provided the oversized materials are placed as recommended on Plate 4 within Appendix E. Alternatively, over-sized materials can be exported from the site.

5.2.7 Excavation Characteristics

Excavations in the on-site younger alluvium should be readily accomplished with heavy-duty earthmoving or excavating equipment in good operating condition. All excavations should be formed in accordance with current Cal-OSHA requirements.

5.2.8 Trench Excavations and Backfill

Temporary trench excavations within the on-site materials should be stable at a 1:1 inclination for short durations during construction and where cuts do not exceed 15 feet in height. Deeper temporary excavations should be reviewed by GeoTek prior to their planned excavation to determine if supplemental recommendations or analysis are warranted. It is anticipated that temporary cuts to a maximum height of 4 feet can be excavated vertically.

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

Utility trench backfill should be compacted to at least 90 percent relative compaction (as determined by ASTM D-1557 test procedures). Under-slab trenches should also be compacted to project specifications. Where applicable, based on jurisdictional requirements, the top 12 inches of backfill below subgrade for road pavements should be compacted to at least 95 percent relative compaction. On-site materials may not be suitable for use as bedding material but should be suitable as backfill provided particles larger than 6 inches are removed.

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

5.2.9 Shrinkage and Bulking

For planning purposes, a shrinkage loss of about 10 to 20 percent is anticipated for excavations within the younger alluvium at the site. Several factors will impact earthwork balancing on the site, including shrinkage, trench spoil from utilities and footing excavations, as well as the accuracy of topography. Shrinkage and bulking are primarily dependent upon the degree of compactive effort achieved during construction, depth of fill and underlying site conditions.

A subsidence loss of up to about 0.2 foot is estimated for the site.

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

5.2.10 Grading Plan Review

Upon completion of the site grading plans, it is recommended that those plans be provided to GeoTek for review. Based on that review, some modifications to the recommendations provided in this report may be necessary.

5.3 DESIGN RECOMMENDATIONS

5.3.1 Foundation Design Criteria

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

Based on the expansion index testing performed for this report and visual examination of the site soils, site soils possess a "very low" (0-20) expansion potential (ASTM D4829). Therefore, it is GeoTek's opinion that conventional foundations supported by engineered fill may be used for this site.

A summary of GeoTek's preliminary foundation design recommendations is presented in the table below:

Design Parameter	"Very Low" Expansion Potential (0≤EI≤20)
Foundation Depth or Minimum Perimeter Beam Depth (inches below lowest adjacent grade)	12 - One- and -two Stories
Minimum Foundation Width (Inches)*	12
Minimum Slab Thickness (actual)	4 inches
Minimum Slab Reinforcing	6" x 6" – W2.9/W2.9 welded wire fabric placed in middle of slab or No. 3 bars at 18-inch centers.
Minimum Footing Reinforcement	Two No. 4 Reinforcing Bars, one top and one bottom
Presaturation of Subgrade Soil (Percent of Optimum)	Minimum 100% to a depth of 12 inches prior to placement of concrete

*Code minimums per Table 1809.7 of the 2019 CBC.

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

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

5.3.1.1 An allowable bearing capacity of 2,000 pounds per square foot (psf) may be used for design of continuous and perimeter footings 12 inches deep and 12 inches wide, and pad footings 24 inches square and 12 inches deep. This allowable soil bearing capacity may be increased by 300 psf for each additional foot of footing depth and 300 psf for each additional foot of footing width to a maximum value of 4,000 psf. An increase of one-third may be applied when considering short-term live loads (e.g., seismic and wind loads).

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

5.3.1.3 The passive earth pressure may be computed as an equivalent fluid having a density of 350 psf per foot of depth, to a maximum earth pressure of 2,500 psf for footings founded on engineered fill or competent native soil. A coefficient of friction between soil and concrete of 0.35 may be used with dead load forces. When combining passive pressure and frictional resistance, the passive pressure component should be reduced by one-third. The upper one foot of soil should be ignored in the passive pressure calculations unless the surface is covered with pavements.

5.3.1.4 A grade beam, a minimum of 12 inches wide and 12 inches deep, should be utilized across large entrances. The base of the grade beam should be at the same elevation as the bottom of the adjoining footings.

5.3.1.5 A moisture and vapor retarding system should be placed below slabs-on-grade where moisture migration through the slab is undesirable. Guidelines for these are provided in the 2019 California Green Building Standards Code (CALGreen) Section 4.505.2, the 2019 CBC Section 1907.1 and ACI 360R-10. The vapor retarder design and construction should also meet the requirements of ASTM E 1643. A portion of the vapor retarder design should be the implementation of a moisture vapor retardant membrane.

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

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

thickness, composition, strength, and permeability) to achieve the desired performance level.

Moisture retarders can reduce, but not eliminate, moisture vapor rise from the underlying soils up through the slab. Moisture retarder systems should be designed and constructed in accordance with applicable American Concrete Institute, Portland Cement Association, Post-Tensioning Concrete Institute, ASTM and California Building Code requirements and guidelines.

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

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

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

5.3.2 Miscellaneous Foundation Recommendations

5.3.2.1 To reduce moisture penetration beneath the slab on grade areas, utility trench excavations should be backfilled with engineered fill, lean concrete or concrete slurry where they intercept the perimeter footing or thickened slab edge.

5.3.2.2 Soils from the footing excavations should not be placed in the slab-on-grade areas unless properly compacted and tested. The excavations should be free of loose/sloughed materials and be neatly trimmed at the time of concrete placement.

5.3.3 Foundation Setbacks

Minimum setbacks for all foundations should comply with the 2019 CBC or City of Redlands requirements, whichever is more stringent. Improvements not conforming to these setbacks are subject to the increased likelihood of excessive lateral movements and/or differential settlements. If large enough, these movements can compromise the integrity of the improvements. The top outside edge of all footings should be set back a minimum of H/3 (where H is the slope height) from the face of any descending slope. The setback should be at least five feet and need not exceed 40 feet.

5.3.4 Soil Corrosivity

The soil resistivity at this site was tested in the laboratory on a sample collected during the field investigation. The results of the testing indicate that the on-site soils are considered "essentially non-corrosive" (27,470 ohm-cm) (Roberge, 2000) to buried ferrous metal in accordance with current standards used by corrosion engineers. Recommendations for protection of buried ferrous metal should be provided by a corrosion engineer. Additional corrosion testing should be performed at the time of site grading to assess the corrosion of potential of the as-graded soils.

5.3.5 Soil Sulfate Content

The sulfate content was determined in the laboratory on a sample collected during the field investigation. The results indicate that the water-soluble sulfate result is less than 0.1 percent by weight, which is considered "negligible" as per Table 4.2.1 of ACI 318. Based on the test results and Table 4.3.1 of ACI 318, no special recommendations for concrete are required for this project due to soil sulfate exposure.

5.4 RETAINING AND GARDEN WALL DESIGN AND CONSTRUCTION

5.4.1.1 General Design Criteria

Recommendations presented in this report apply to typical masonry or concrete vertical retaining walls to a maximum height of up to six (6) feet. Additional review and recommendations should be requested for higher walls. These are typical design criteria and are not intended to supersede the design by the structural engineer.

Retaining wall foundations should be embedded a minimum of 18 inches into engineered fill. Retaining wall foundations should be designed in accordance with Section 5.3 of this report. Structural needs may govern and should be evaluated by the project structural engineer.

All earth retention structure plans, as applicable, should be reviewed by this office prior to finalization.

Earthwork considerations, site clearing and remedial earthwork for all earth retention structures should meet the requirements of this report, unless specifically provided otherwise, or more stringent requirements or recommendations are made by the designer. The backfill material placement for all earth retention structures should meet the requirement of Section 5.2.4 in this report.

In general, cantilever earth retention structures, which are designed to yield at least 0.001H, where H is equal to the height of the earth retention structure, may be designed using the "active" condition. Rigid earth retention structures (including but not limited to rigid walls, and walls braced at top, such as typical basement walls) should be designed using the "at-rest" condition.

In addition to the design lateral forces due to retained earth, surcharges due to improvements, such as an adjacent building or traffic loading, should be considered in the design of the earth retention structures. Loads applied within a 1:1 (horizontal:vertical) projection from the surcharge on the stem of the earth retention structure should be considered in the design.

Final selection of the appropriate design parameters should be made by the designer of the earth retention structures.

5.4.1.2 Cantilevered Walls

The recommendations presented below are for cantilevered retaining walls up to six (6) feet high. Active earth pressure may be used for retaining wall design, provided the top of the wall is not restrained from minor deflections. An equivalent fluid pressure approach may be used to compute the horizontal pressure against the wall. Appropriate fluid unit weights are given below for specific slope gradients of the retained material. These do not include other superimposed loading conditions such as traffic, structures, seismic events, or adverse geologic conditions.

ACTIVE EARTH PRESSURES	
Surface Slope of Retained Materials (horizontal:vertical)	Equivalent Fluid Pressure (pcf) Select Backfill* and Native Soils
Level	35
2:1	60

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

For walls with a retained height greater than 6 feet, an incremental seismic pressure should be included into the wall design. Where needed, it is recommended that an equivalent fluid pressure of 25 pcf be included into the wall design to account for seismic loading conditions. This pressure may be applied as an inverted triangular distribution.

5.4.1.3 Retaining Wall Backfill and Drainage

The wall backfill should also include a minimum one (1) foot wide section of ¾- to 1-inch clean crushed rock (or an approved equivalent). The rock should be placed immediately adjacent to the back of the wall and extend up from a back drain to within approximately 24 inches of the finish grade. The upper 24 inches should consist of compacted on-site materials. The rock should be separated from the earth with filter fabric. The presence of other materials might necessitate revision to the parameters provided and modification of the wall designs. The backfill materials should be placed in lifts no greater than eight (8) inches in thickness and compacted to a minimum of 90% relative compaction as determined by ASTM D 1557 test procedures. Proper surface drainage needs to be provided and maintained.

As an alternative to the drain, rock and fabric, a pre-manufactured wall drainage product (example: Mira Drain 6000 or approved equivalent) may be used behind the retaining wall. The wall drainage product should extend from the base of the wall to within two (2) feet of the ground surface. The subdrain should be placed in direct contact with the wall drainage product.

Retaining walls should be provided with an adequate pipe and gravel back drain system to help prevent buildup of hydrostatic pressures. Backdrains should consist of a four (4)-inch diameter perforated collector pipe (Schedule 40, SDR 35, or approved equivalent) embedded in a minimum of one (1) cubic foot per linear foot of ¾ to 1-inch clean crushed rock or an approved equivalent, wrapped in filter fabric (Mirafi 140N or an approved equivalent). The

drain system should be connected to a suitable outlet. Waterproofing of site walls should be performed where moisture migration through the walls is undesirable.

5.4.1.4 Restrained Retaining Walls

Retaining walls that will be restrained at the top that support level backfill or that have reentrant or male corners, should be designed for an equivalent at-rest fluid pressure of 55 pcf, plus any applicable surcharge loading. For areas of male or reentrant corners, the restrained wall design should extend a minimum distance of twice the height of the wall laterally from the corner, or a distance otherwise determined by the project structural engineer.

5.4.1.5 Other Design Considerations

- Wall design should consider the additional surcharge loads from superjacent slopes and/or footings, where appropriate.
- No backfill should be placed against concrete until minimum design strengths are evident by compression tests of cylinders.
- The retaining wall footing excavations, backcuts, and backfill materials should be approved by the project geotechnical engineer or their authorized representative.
- Positive separations should be provided in garden walls at horizontal distances not exceeding 20 feet.

5.5 PRELIMINARY PAVEMENT DESIGN RECOMMENDATIONS

Although planned final grades beneath the street improvements within the site are not yet known, the following preliminary pavement design recommendations are based on assumed Traffic Indexes of 5.0 and 6.0. Preliminary pavement thickness design is based on the CalTrans Highway Design Manual (2018). An R-value of 40 has been assumed for the preliminary design of the project pavement sections. Once the traffic loading information becomes more defined, revision to the pavement design recommendations may be warranted. It is recommended that the final pavement design be based on R-value testing of the as-graded subgrade soils within the pavement areas.

Based on the assumptions noted above the following preliminary pavement recommendations are provided for the site:

PRELIMINARY MINIMUM PAVEMENT SECTION		
Traffic Index	Thickness of Asphalt Concrete (inches)	Thickness of Aggregate Base (inches)
5.0	3.0	4
6.0	4.0	4

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

All base material and the upper 12 inches of subgrade should be compacted to at least 95 percent of the material's maximum dry density as determined by ASTM D 1557 test procedures. All materials and methods of construction should conform to the requirements of the City of Redlands.

5.6 CONCRETE CONSTRUCTION

5.6.1 General

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

5.6.2 Concrete Mix Design

As discussed in Section 5.3.5, no special recommendations for concrete are required for this project due to soil sulfate exposure. Additional testing should be performed during grading so that specific recommendations can be formulated based on the as-graded conditions.

5.6.3 Concrete Flatwork

Exterior concrete flatwork is often one of the most visible aspects of site development. They are typically given the least level of quality control, being considered "non-structural" components. Cracking of these features is common due to various factors. While cracking usually does not affect the structural performance of the concrete, it is unsightly. It is

recommended that the same standards of care be applied to these features as to the structure itself.

Flatwork should consist of a minimum four-inch (actual) thick concrete and the use of temperature and shrinkage control reinforcement is suggested. The project structural engineer should provide final design recommendations.

5.6.4 Concrete Performance

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

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

5.7 PLAN REVIEW AND CONSTRUCTION OBSERVATIONS

It is recommended that site grading, specifications, and foundation plans be reviewed by this office prior to construction to check for conformance with the recommendations of this report. It is also recommended that GeoTek representatives be present during site grading and foundation construction to observe and document for proper implementation of the geotechnical recommendations. The owner/developer should have GeoTek perform at least the following duties:

- Observe site clearing and grubbing operations for proper removal of all unsuitable materials.
- Observe and test bottom of removals prior to fill placement.
- Evaluate the suitability of on-site and import materials for fill placement and collect soil samples for laboratory testing where necessary.

- Observe the fill for uniformity during placement, including utility trench excavation backfill. Also, test the fill for density, relative compaction and moisture content.
- Observe and probe foundation excavations to confirm suitability of bearing materials with respect to density.

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

6. INTENT

It is the intent of this report to aid in the design and construction of the proposed development. Implementation of the advice presented in this report is intended to reduce risk associated with construction projects. The professional opinions and geotechnical advice contained in this report are not intended to imply total performance of the project or guarantee that unusual or variable conditions will not be discovered during or after construction.

The scope of GeoTek's evaluation is limited to the area explored that is shown on the Exploration Location Map (Figure 2). This evaluation does not and should in no way be construed to encompass any areas beyond the specific area of the proposed construction as indicated to GeoTek by the client. Further, no evaluation of any existing site improvements is included. The scope is based on GeoTek's understanding of the project and the client's needs, GeoTek's proposal (Proposal No. P-0605521-CR) dated June 21, 2021 and geotechnical engineering standards normally used on similar projects in this region.

7. LIMITATIONS

GeoTek's findings are based on site conditions observed and the stated sources. Thus, GeoTek's comments are professional opinions that are limited to the extent of the available data.

GeoTek has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering at this time and location and science

professions currently practicing under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report.

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

8. SELECTED REFERENCES

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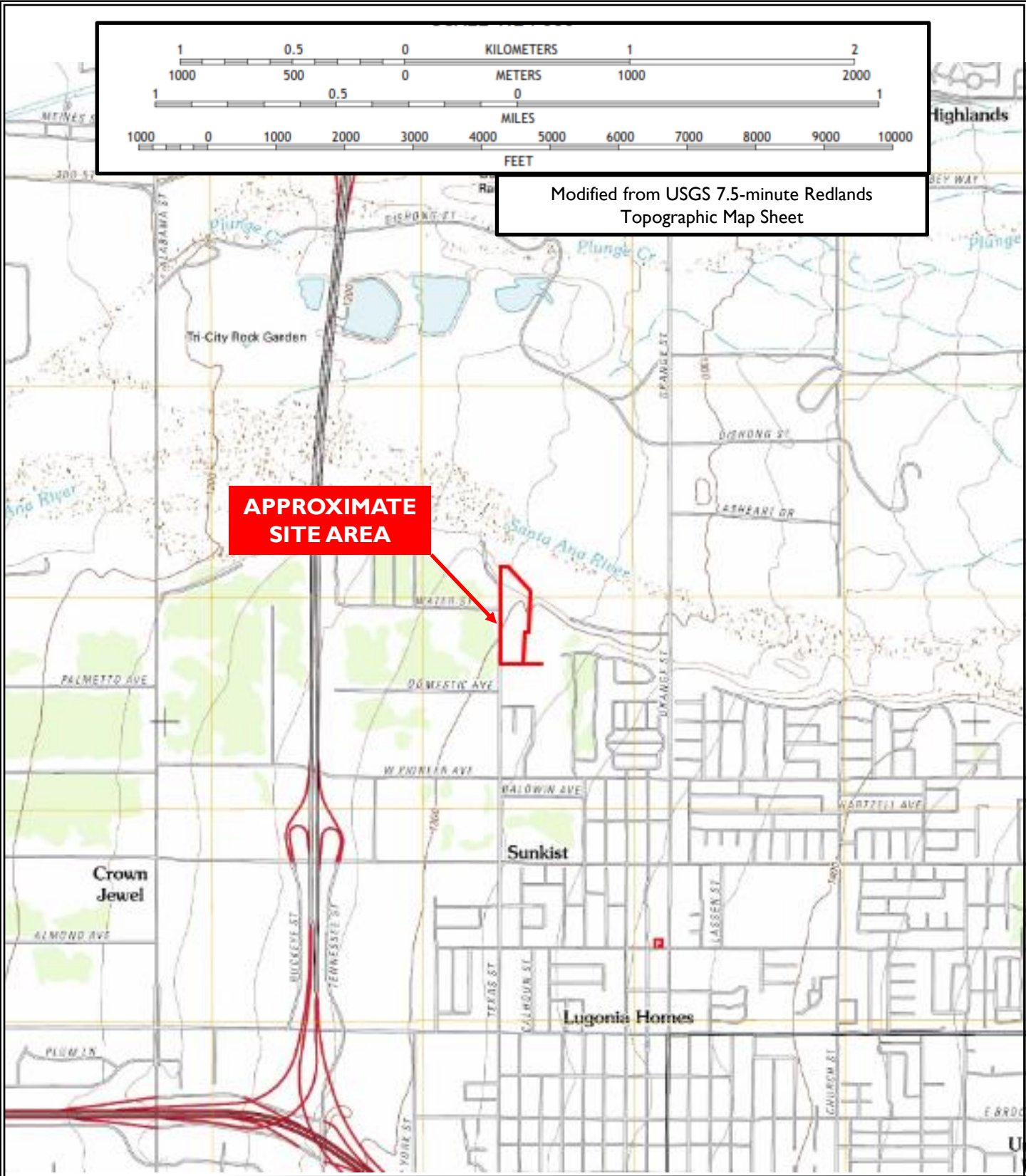


The True Life Companies
APN 167-041-01
Redlands, San Bernardino County, California

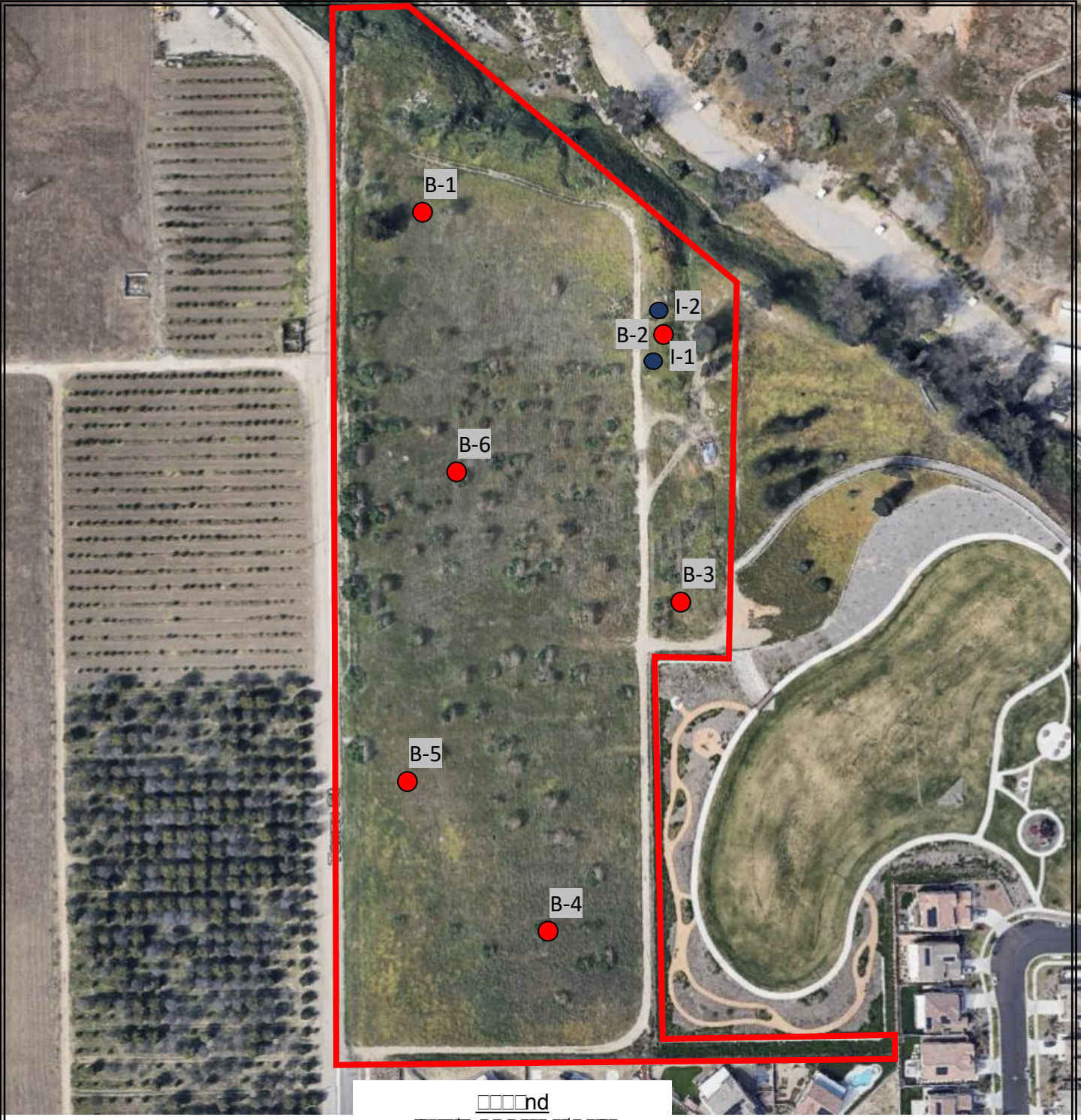
GeoTek Project No. 2820-CR

NORTH

Figure 1

Site Location Map

GEOTEK



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250 ft
SCALE

The True Life Companies
APN 167-041-01
Redlands, San Bernardino County, California

GeoTek Project No. 2820-CR

N

Figure 2

Exploration Location Map

GEOTEK

APPENDIX A

LOG OF EXPLORATORY BORINGS

Proposed 35-Lot Residential Development
Northeast of the Terminus of Texas Street
Redlands, San Bernardino County, California
Project No. 2820-CR

GEOTEK

A - FIELD TESTING AND SAMPLING PROCEDURES

The Modified Split-Barrel Sampler (Ring)

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

Bulk Samples (Large)

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

Bulk Samples (Small)

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

B - BORING LOG LEGEND

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

SOILS

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

GEOLOGIC

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

(Additional denotations and symbols are provided on the boring logs)

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	The True Life Companies	**DRILLER:**	2R Drilling, Inc.	**LOGGED BY:**	D. Alvarez
PROJECT NAME:	APN 167-041-01	**DRILL METHOD:**	Hollow Stem	**OPERATOR:**	Miguel
PROJECT NO.:	2820-CR	**HAMMER:**	140#/30"	**RIG TYPE:**	CME 75
LOCATION:	Redlands, CA			**DATE:**	7/8/2021

Boring No.: B-1

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
0					**Disturbed Soil/Undocumented fill**			
		4 6 7		SM	F-m SAND with some silt and few gravel, light brown, dry, loose	1.0	91.1	Maximum Density = 116.5 pcf Optimum Moisture = 8.0% Corrosion Testing
					Alluvium			SH
		5 7 9			-Becomes slightly moist, brown, medium dense @ 3.0 feet	1.3	110.2	
5		8 12 12		SP	M SAND, tan, slightly moist, medium dense			
		8 12		SM	Silty f SAND, light brown, slightly moist, medium dense	1.2	99.5	Collapse Test
		14		SP	M SAND, tan, slightly moist, medium dense			
10		9 12 18		SM	F-m SAND with few silt, light brown, slightly moist, medium dense Silty f-m SAND, light brown, slightly moist	1.2	101.0	
15		9 14 19			F SAND with silt, light gray-brown, slightly moist, medium dense	1.2	99.5	
20		16 20 24			Silty f SAND, light brown, sligthly moist, dense	1.4	108.4	
25		11 15 21		SP	F-m SAND with some granitics, light brown, slightly moist, medium dense	0.8		
30		12 17 22			M-c SAND, gray, slightly moist, dense			

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

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

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	The True Life Companies	**DRILLER:**	2R Drilling, Inc.	**LOGGED BY:**	D. Alvarez
PROJECT NAME:	APN 167-041-01	**DRILL METHOD:**	Hollow Stem	**OPERATOR:**	Miguel
PROJECT NO.:	2820-CR	**HAMMER:**	140#/30"	**RIG TYPE:**	CME 75
LOCATION:	Redlands, CA			**DATE:**	7/8/2021

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	Boring No.: B-1 (Continued) / MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
35	Ring	17 19 21		SM	Silty f SAND, light gray-brown, slightly moist, medium dense		2.1	
40	Ring	20 23 28		SP	F-m SAND, light brown, slightly moist, medium dense			
45	Ring	22 23 25			M-c SAND with some gravel, gray, slightly moist, medium dense		2.8	
50	Ring	13 50/6			M SAND, gray, slightly moist, very dense - Becomes c SAND @ 51.0 feet			
					BORING TERMINATED AT 51 FEET			
					Boring backfilled with excavated soils. No groundwater encountered.			
55								
60								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

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

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	The True Life Companies	**DRILLER:**	2R Drilling, Inc.	**LOGGED BY:**	D. Alvarez
PROJECT NAME:	APN 167-041-01	**DRILL METHOD:**	Hollow Stem	**OPERATOR:**	Miguel
PROJECT NO.:	2820-CR	**HAMMER:**	140#/30"	**RIG TYPE:**	CME 75
LOCATION:	Redlands, CA			**DATE:**	7/8/2021

Boring No.: B-2

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
0					**Disturbed Soil/Undocumented fill**			
				SM-ML	Silty f SAND to sandy SILT, light brown, slightly moist			
		4 5 7		SM	**Alluvium** F-m SAND, gray-brown, slightly moist, loose	1.2	105.1	
5		6 10 13		SP	M-c SAND with some gravel, gray, slightly moist, medium dense	1.6		
		6 8 11		SM	F-m SAND with some silt, light brown, moist, medium dense	1.9	107.9	
10		6 9 13			Silty f SAND, gray, slightly moist, medium dense	1.6	106.6	Collapse Test
15		8 12 14		SP	F-m SAND, gray, slightly moist, medium dense			
20		10 17 20						
					BORING TERMINATED AT 21.5 FEET Boring backfilled with excavated soils. No groundwater encountered.			
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

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

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	The True Life Companies	**DRILLER:**	2R Drilling, Inc.	**LOGGED BY:**	D. Alvarez
PROJECT NAME:	APN 167-041-01	**DRILL METHOD:**	Hollow Stem	**OPERATOR:**	Miguel
PROJECT NO.:	2820-CR	**HAMMER:**	140#/30"	**RIG TYPE:**	CME 75
LOCATION:	Redlands, CA			**DATE:**	7/8/2021

Boring No.: B-3

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
0					**Disturbed Soil/Undocumented fill**			
	Ring	5 9 10		SM	F-m SAND with few silt, light brown, slightly moist, medium dense	1.3	97.9	
	Ring	8 9 10		SM-ML	**Alluvium** Silty f SAND to sandy SILT, light brown, slightly moist, medium dense to stiff			
5	Ring	6 8 10		SM	F-m SAND with some silt, light brown, slightly moist, medium dense	1.8	100.2	
10	Ring	6 8 12		SP	F SAND, light gray-brown, slightly moist, medium dense	1.4	97.3	Collapse Test
15	Ring	12 21 26			M-c SAND, gray, slightly moist, dense	1.9	114.0	
					BORING TERMINATED AT 16.5 FEET Boring backfilled with excavated soils. No groundwater encountered.			
20								
25								
30								

LEGEND

Sample type: Ring, SPT, Small Bulk, Large Bulk, No Recovery, Water Table

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

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	The True Life Companies	**DRILLER:**	2R Drilling, Inc.	**LOGGED BY:**	D. Alvarez
PROJECT NAME:	APN 167-041-01	**DRILL METHOD:**	Hollow Stem	**OPERATOR:**	Miguel
PROJECT NO.:	2820-CR	**HAMMER:**	140#/30"	**RIG TYPE:**	CME 75
LOCATION:	Redlands, CA			**DATE:**	7/8/2021

Boring No.: B-4

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
0					**Disturbed Soil/Undocumented fill**			
		3		SM	Silty f-m SAND with few gravel, light brown, slightly moist, loose			
		5 7			**Alluvium**	0.9		Expansion Index = 0 Corrosion Testing
		7 8 10		SM	F-m SAND with few silt, light brown, slightly moist, medium dense	1.0	102.1	
5		5 8 13		SP	M-c SAND with some gravel, light brown, slightly moist, medium dense	0.7		
		10 12 14			-Becomes tan-white, medium dense @ 7.5 feet -Some cobble @ 9.0 feet			
10		7 12 20		SM	F-m SAND, gray, slightly moist, medium dense	2.2	104.9	
15		11 20 24		SP	M-c SAND, tan, slightly moist, medium dense	2.1	104.3	
20		15 20 25			M SAND, gray, slightly moist to moist, medium dense	2.6	108.1	
					BORING TERMINATED AT 21.5 FEET Boring backfilled with excavated soils. No groundwater encountered.			
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

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

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	The True Life Companies	**DRILLER:**	2R Drilling, Inc.	**LOGGED BY:**	D. Alvarez
PROJECT NAME:	APN 167-041-01	**DRILL METHOD:**	Hollow Stem	**OPERATOR:**	Miguel
PROJECT NO.:	2820-CR	**HAMMER:**	140#/30"	**RIG TYPE:**	CME 75
LOCATION:	Redlands, CA			**DATE:**	7/8/2021

Boring No.: B-5

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
0				SM	**Disturbed Soil/Undocumented fill** Silty f SAND, brown, slightly moist to moist, loose			
		3 5 7		SM	**Alluvium** Silty f SAND, brown, slightly moist to moist, loose	2.3	108.0	
5		3 4 7			F-m SAND with silt, gray, slightly moist, loose	4.0	109.0	
		3 4		SP	M-c SAND, tan, slightly moist, loose	8.7	106.4	
		6		SM	Silty f-m SAND, brown, moist, loose			
10		5 6 8		SP	M SAND, brown, moist, loose			
15		10 17 20			M-c SAND with some gravel, tan, slightly moist, medium dense	1.8	105.6	
					BORING TERMINATED AT 16.5 FEET Boring backfilled with excavated soils. No groundwater encountered.			
20								
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

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

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	The True Life Companies	**DRILLER:**	2R Drilling, Inc.	**LOGGED BY:**	D. Alvarez
PROJECT NAME:	APN 167-041-01	**DRILL METHOD:**	Hollow Stem	**OPERATOR:**	Miguel
PROJECT NO.:	2820-CR	**HAMMER:**	140#/30"	**RIG TYPE:**	CME 75
LOCATION:	Redlands, CA			**DATE:**	7/8/2021

Boring No.: B-6

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
0					**Disturbed Soil/Undocumented fill**			
		3 4 6		SM	Silty f-m SAND, light brown, slightly moist, loose	1.1	95.4	
		6			Becomes loose to medium dense @ 3.0 feet			
		7 8		SM	**Alluvium** Silty f-m SAND, light brown, slightly moist, loose to medium dense	1.1	100.8	
5		6 8 10			F-m SAND with some gravel, tan-light brown, slightly moist, medium dense			
		6 7 7		SP	M-c SAND with some gravel, tan, slightly moist, loose	0.7		
10		5 8 10		SM	Silty f SAND, light brown, slightly moist, medium dense	1.4	103.9	
15		9 12 15		SP	M-c SAND, tan, slightly moist, medium dense	0.6		
20		9 14 18		SM	Silty f SAND, light brown, slightly moist, medium dense	1.5	110.2	
					BORING TERMINATED AT 21.5 FEET			
25					Boring backfilled with excavated soils. No groundwater encountered.			
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

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

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	The True Life Companies	**DRILLER:**	2R Drilling, Inc.	**LOGGED BY:**	D. Alvarez
PROJECT NAME:	APN 167-041-01	**DRILL METHOD:**	Hollow Stem	**OPERATOR:**	Miguel
PROJECT NO.:	2820-CR	**HAMMER:**	140#/30"	**RIG TYPE:**	CME 75
LOCATION:	Redlands, CA			**DATE:**	7/8/2021

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	Boring No.: I-1 MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
0				SM-ML	**Disturbed Soil/Undocumented fill** Silty f SAND to sandy SILT, light brown, slightly moist			
				SM	**Alluvium** F-m SAND with few silt, light brown, slightly moist, medium dense			
5					**BORING TERMINATED AT 5.0 FEET** Boring subsequently prepared for infiltration testing (pvc, pipe, filter sock, gravel) No groundwater encountered			
10								
15								
20								
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

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

GeoTek, Inc.

LOG OF EXPLORATORY BORING

CLIENT:	The True Life Companies	**DRILLER:**	2R Drilling, Inc.	**LOGGED BY:**	D. Alvarez
PROJECT NAME:	APN 167-041-01	**DRILL METHOD:**	Hollow Stem	**OPERATOR:**	Miguel
PROJECT NO.:	2820-CR	**HAMMER:**	140#/30"	**RIG TYPE:**	CME 75
LOCATION:	Redlands, CA			**DATE:**	7/8/2021

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	**Boring No.: I-2** / MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing: Others
0				SM-ML	**Disturbed Soil/Undocumented fill** Silty f SAND to sandy SILT, light brown, slightly moist			
				SM	**Alluvium** F-m SAND with few silt, light brown, slightly moist, medium dense			
5					**BORING TERMINATED AT 5.0 FEET** Boring subsequently prepared for infiltration testing (pvc, pipe, filter sock, gravel) No groundwater encountered			
10								
15								
20								
25								
30								

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---No Recovery ---Water Table

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

APPENDIX B

RESULTS OF LABORATORY TESTING

Proposed 35-Lot Residential Development
Northeast of the Terminus of Texas Street
Redlands, San Bernardino County, California
Project No. 2820-CR

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SUMMARY OF LABORATORY TESTING

Classification

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

Collapse Test

Collapse tests were performed on selected samples of the site soils in general accordance with ASTM D 5333 test procedures. The results of this test are presented graphically in Appendix B.

Direct Shear

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

Expansion Index

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

Boring No.	Depth (ft.)	Description	Expansion Index	Classification
B-4	0-5	Silty Sand	0	Very Low

In-Situ Moisture and Density

The natural water content of sampled soils was determined in general accordance with ASTM D 2216 test procedures on samples of the materials recovered from the subsurface exploration. In addition, in-place dry density of the sampled soils was determined in general accordance with ASTM D 2937 test procedures on relatively undisturbed samples to measure the unit weight of the subsurface soils. Results of these tests are shown on the boring logs at the appropriate sample depths in Appendix A.

Moisture-Density Relationship

Laboratory testing was performed on two samples collected during the subsurface exploration. The laboratory maximum dry density and optimum moisture content for the soil type was determined in general accordance with test method ASTM Test Procedure D 1557. The results are presented herein.

Sulfate Content, Resistivity and Chloride Content

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

Boring #	Depth (ft.)	pH ASTM D4972	Chloride ASTM D4327 (mg/kg)	Sulfate ASTM D4327 (% by weight)	Resistivity ASTM G187 (ohm-cm)
B-1	0-5	7.7	4.9	0.0013	30,820
B-4	0-5	7.9	3.9	0.0009	24,470

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EXPANSION INDEX TEST

(ASTM D4829)

Client:	The Tr□□ □i□□ □ □□ □□ni□□	***Tested/ Checked By:***	□D La □N□ □□r□n□
Project Number:	□□20 □□R	***Date Tested:***	□□□□□□□□□
Project Location:	A□N' □□□-04 □□□□	***Sample Source:***	□□ □ □□□
		Sample Description:	

Rin□ □□_______ Rin□ Di□□ □ 4. □1" Rin□ □ □□"

DENSITY DETERMINATION

A	□ □i□□□□□□□□ □□□□d □□□ □□□ □ rin□ □□□ □	□□□. □
B	□ □i□□□□□rin□ (gm □	□□□. □
C	N□□□ □i□□□□□□□□ □□□ □□□)	**408.8**
D	□ □□D□n□i□□□□ □□3 □□ □0 □30 □□□	**123.3**
E	Dr□ D□n□i□□, □□ □□3 □D / □F)	**113.3**

SATURATION DETERMINATION

F	M□i□□□r□ □ □n□□n□□□	□□□
G	□□□□i□i□□ □r□□i□□, □ssume d	**2.70**
H	□ni□□ □□□□□ □□□r □ □□°C, (pcf)	**62.4**
I	□ □□□□r□i□n	**48.8**

READINGS			
DATE	TIME	READIN□	
7/ □□/ □□21		□□2 □□□	Ini□i□□
7/ □□/ □□21		□□2 □□□	□□ □ in □Dr□
7/ □□/ □□21		□□2 □□□	Fin□□

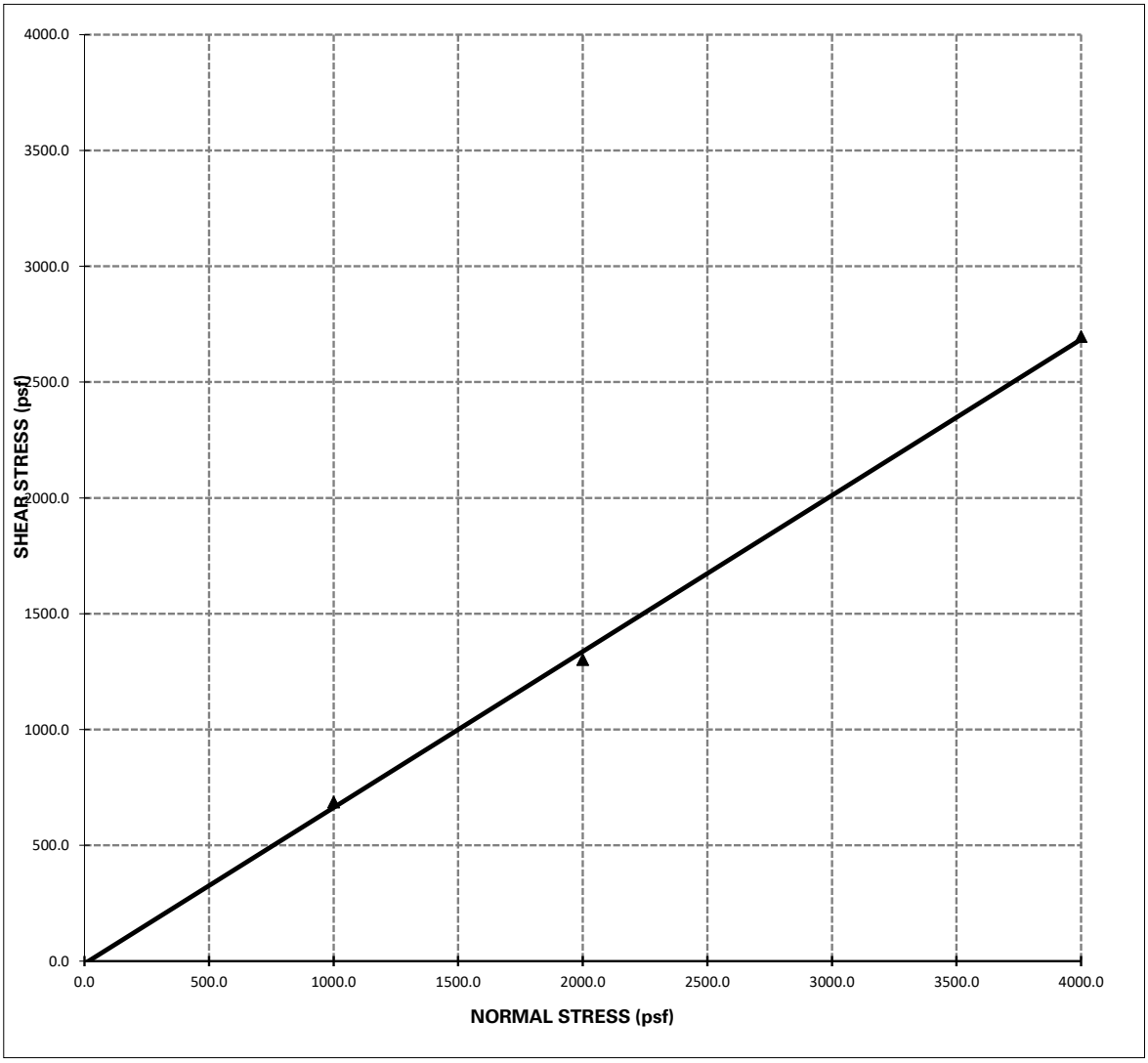
FINAL MOISTURE	
Fin□□□ □i□□□□□□we □ □□□ □□□ □ □□r□	□ M□i□□□r□
8 □□□□	**16.5**

EXPANSION INDEX = 0

DIRECT SHEAR TEST

Project Name:	The True Life Companies	***Sample Location:***	B1 @ 0-5'
Project Number:	2820-CR	***Date Tested:***	7/29/2021

PEAK VALUE



Shear Strength: Φ = 34 ° , C = 11 psf

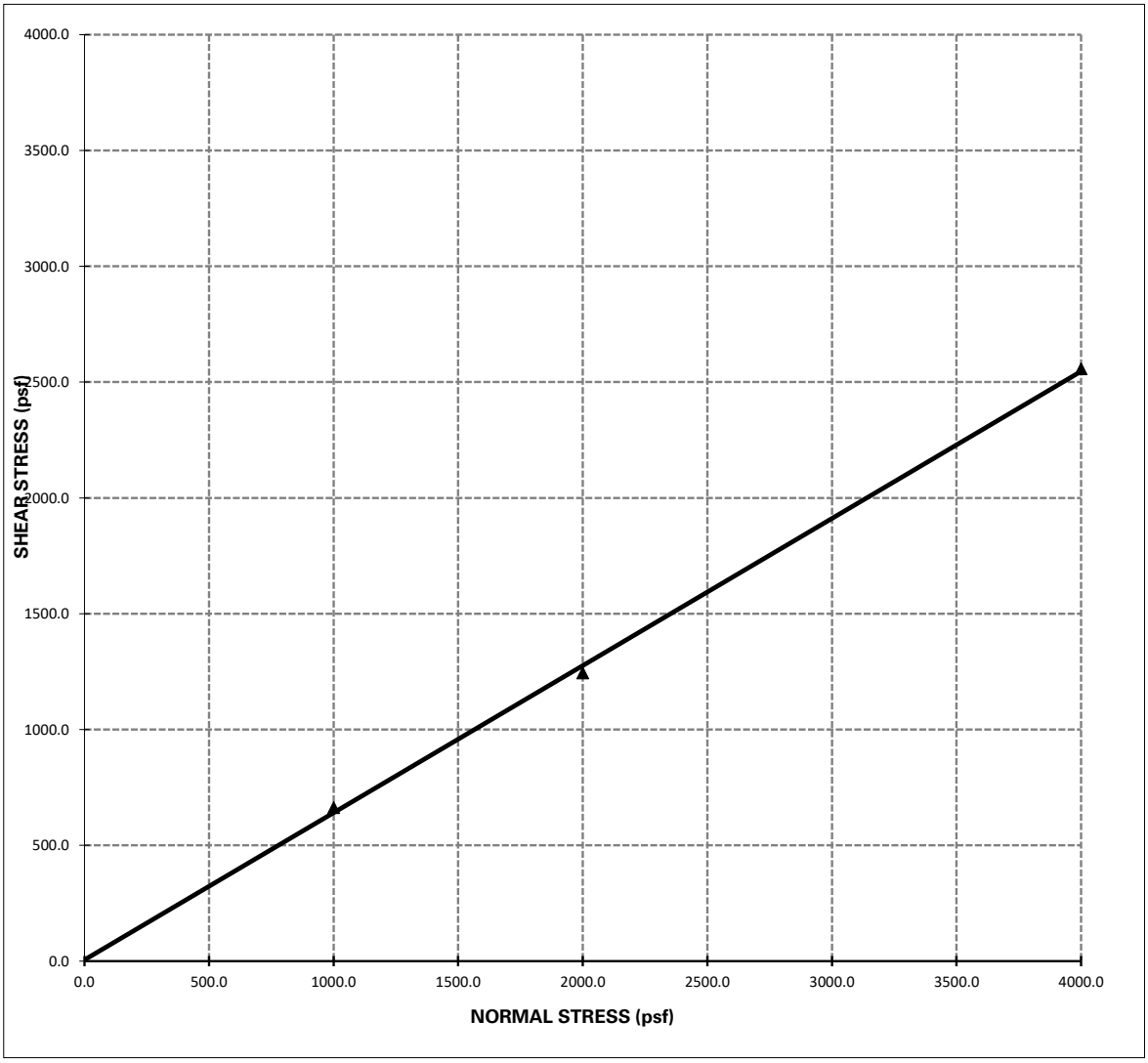
Notes: 1 - The soil specimen used in the shear box was a ring sample remolded to approximately 90% relative compaction from a bulk sample collected during the field investigation.

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

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

DIRECT SHEAR TEST

Project Name:	The True Life Partners	***Sample Location:***	B1 @ 0-5'
Project Number:	2820-CR	***Date Tested:***	7/29/2021

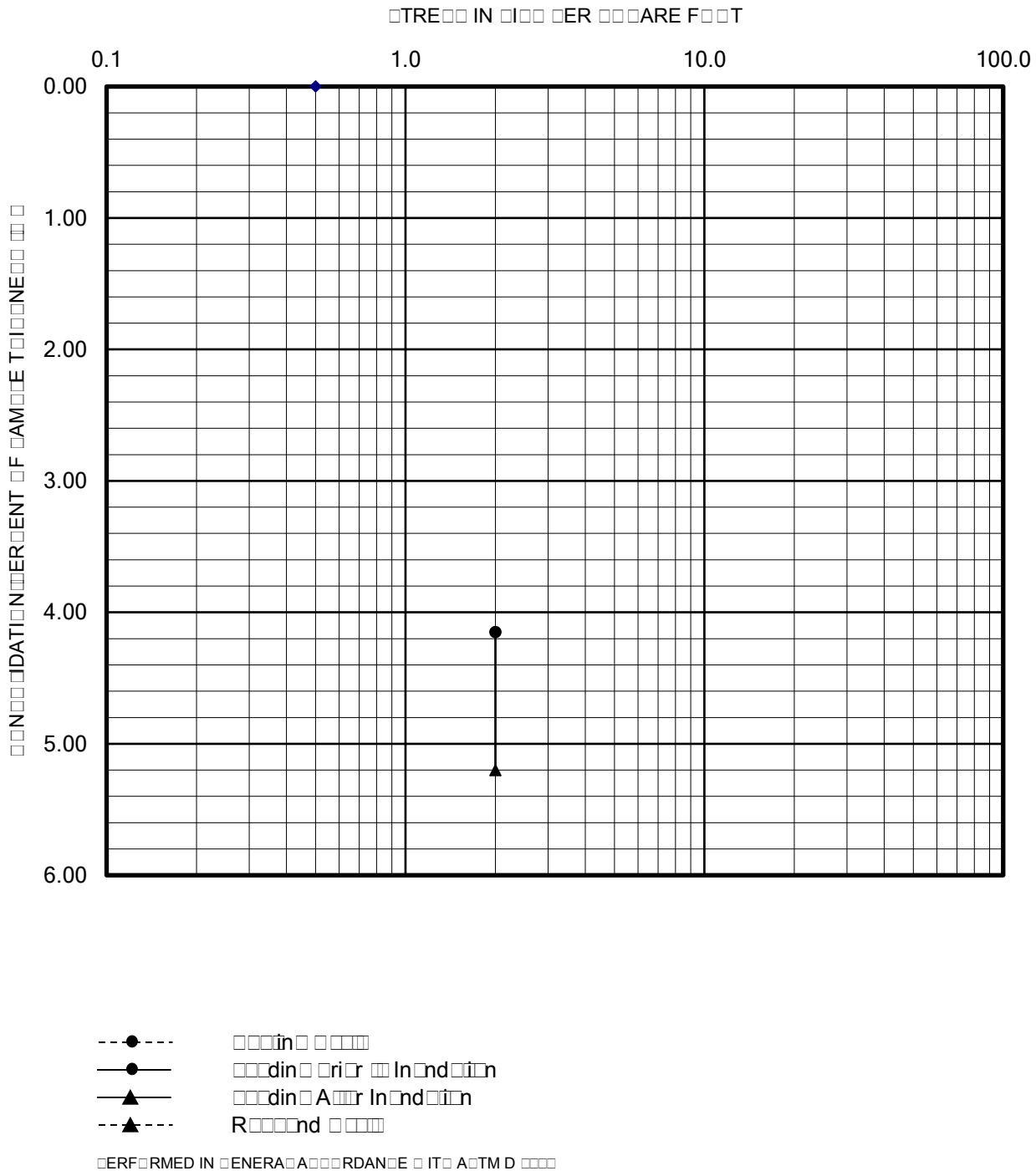


Shear Strength: Φ = 32 ° C = 6 psf

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

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

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



□ERF□RMED IN □ENERA□ A□□□RDAN□E □ IT□ A□TM D □□□□

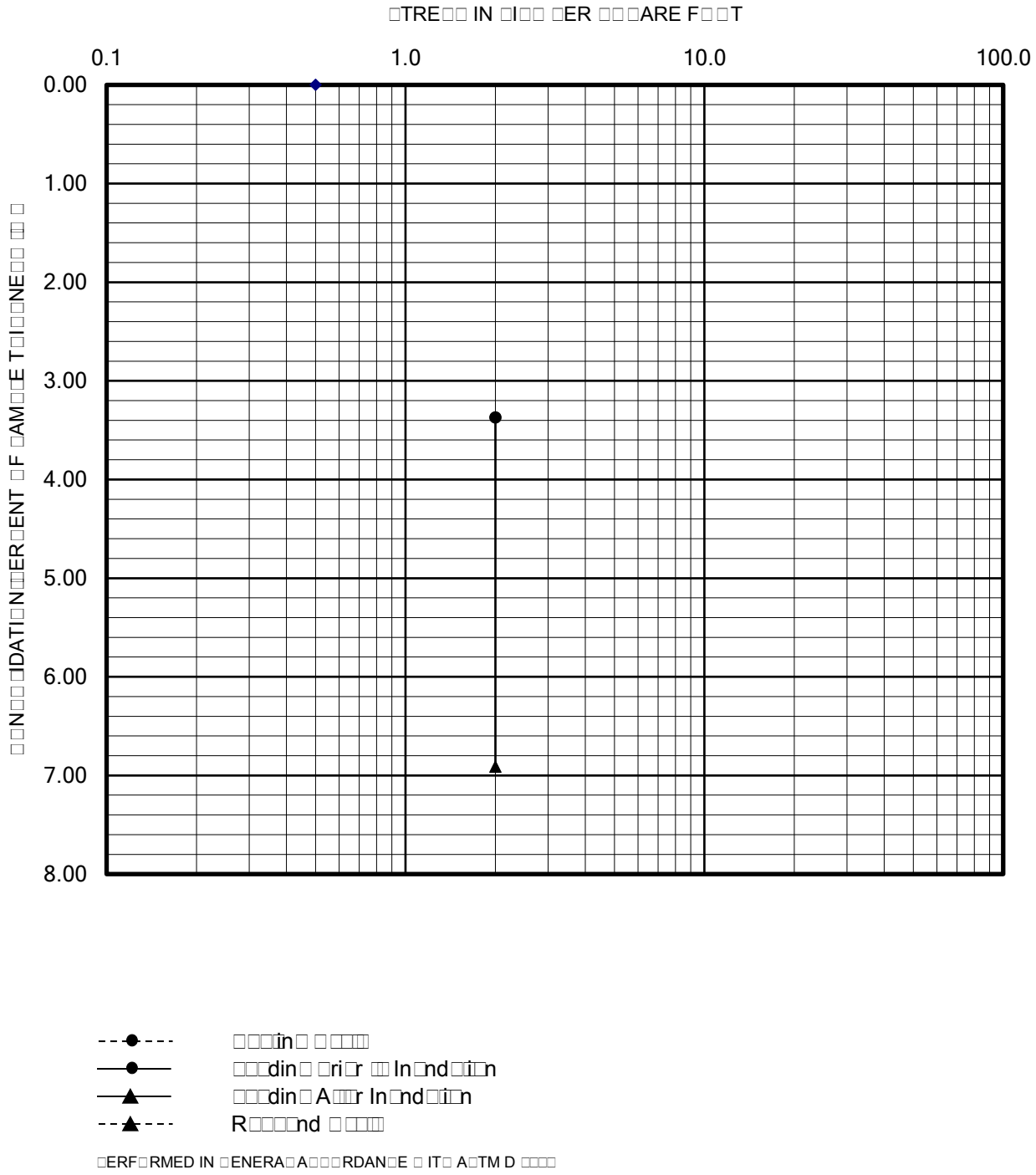
GEOTEK

COLLAPSE REPORT

Sample: B-1 @ 7.5 feet

Plate B-1

□□E□□ED □□□R□	□□□□□□r□n□
□R□ □E□T N□ □□□□□□□□□R	D□□□□□□□□□□□□



□ERF□RMED IN □ENERA□ A□□□RDAN□E □ IT□ A□TM D □□□□

GEOTEK	**COLLAPSE REPORT** **Sample: B-2 @ 10 feet**
□□E□□ED □□□R□	□□□□□□r□n□
□R□ □E□T N□ □□□□□□□□□R	D□□□□□□□□□□□□

Plate B-1

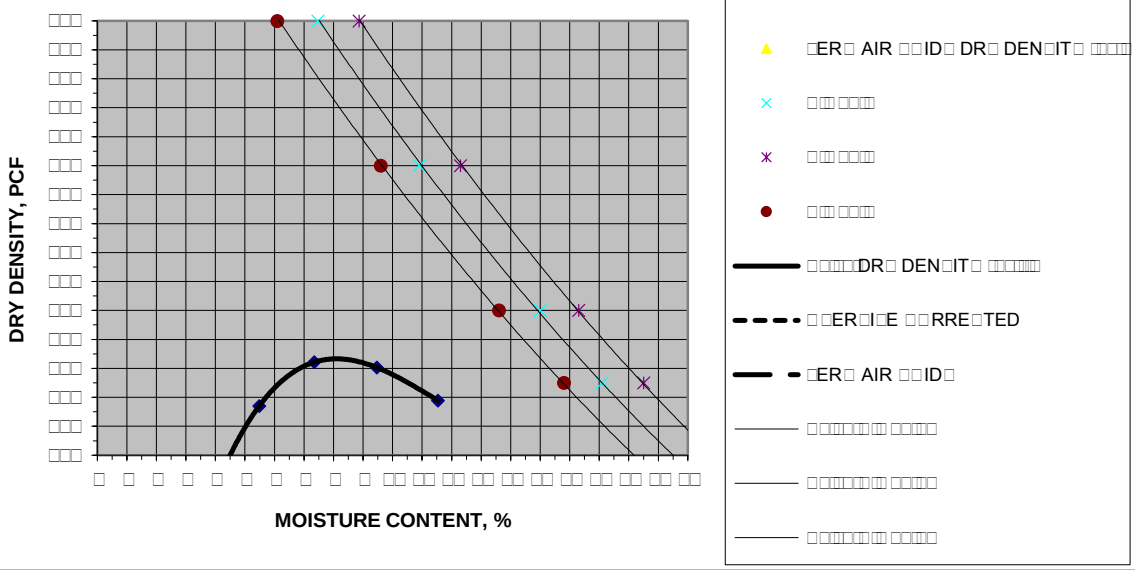
GEOTEK

MOISTURE/DENSITY RELATIONSHIP

Client: T□□ Tr□□ □i□□ □ □□ □□ni□□ **Job No.:** □□□□□□R
Project: A□N □□□□□□□□□□□ **Lab No.:** □□r□n□
Location: R□d□□nd□
Material Type: □□□r□□n Fin□ □□nd
Material Supplier: □
Material Source: □
Sample Location: □□ □ □□□□□
□
Sampled By: DA **Date Sampled:** □□□□□□□□□□
Received By: R□ **Date Received:** □□□□□□□□□□
Tested By: R□ **Date Tested:** □□□□□□□□□□
Reviewed By: R□ **Date Reviewed:** □□□□□□□□□□

Test Procedure: A□TM D□□□□ **Method:** A
Oversized Material (%): □□□ **Correction Required:** ☐ yes ☒ no

MOISTURE/DENSITY RELATIONSHIP CURVE



MOISTURE DENSITY RELATIONSHIP VALUES

Maximum Dry Density, pcf □□□□□ **@ Optimum Moisture, %** □□□
Corrected Maximum Dry Density, pcf **@ Optimum Moisture, %**

MATERIAL DESCRIPTION

Grain Size Distribution:

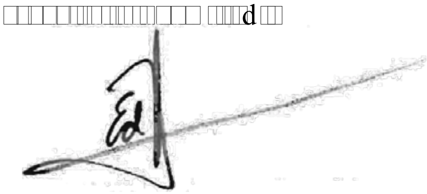
□ □r□□□□r□□□in□d □n N□□□□
□ □□nd □□□□in□N□□□□R□□□in□d □n N□□□□□□
□ □i□□nd □□□□ □□□□in□N□□□□□□

Atterberg Limits:

□i□□id □i□i□□□
□□□□i□ □i□i□□□
□□□□i□i□□Ind□□□□

Classification:

□ni□□d □□i□□ □□□□i□i□□□n□
AA□□T□ □□i□□ □□□□i□i□□□n□




REGISTERED PROFESSIONAL ENGINEER
EDUARDO HERNANDEZ
No. M37102
MECHANICAL
STATE OF CALIFORNIA

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Project X Corrosion Engineering

Corrosion Control - Soil, Water, and Metallurgy Labs

Lab Request Sheet Chain of Custody

Phone: (213) 928-7213 · Fax (951) 226-1720 · www.projectxcorrosion.com

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

Project X Job Number: S210726C Geotek 2820-CR APN 167-041-01 1 Full

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

Company Name:	Geotek Inc	Contact Name:	Kyle
Mailing Address:	1548 N Maple St. Corona CA, 92880	Phone No:	951-206-5443
Accounting Contact:		Contact Email:	kmcharque@geotekusa.com
Client Project No:	2820-CR	Invoice Email:	
P.O. #:		Project Name:	APN 167-041-01

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

Results By: ☐ Phone ☐ Fax ☑ Email

Date & Received by: 07/26

Special Instructions:

ANALYSIS REQUESTED (Please circle)

SAMPLE ID - BORE #	DESCRIPTION	DEPTH (ft)	DATE COLLECTED
1 (239) B1		0-5	
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

Default Method	Soil Resistivity	pH	Sulfate	Chloride	Redox Potential	Sulfide	Ammonia	Nitrate	Flouride	Phosphate	Lithium	Sodium	Potassium	Magnesium	Calcium	BiCarbonate	Full Corrosion Series	Soil Corrosivity Evaluation Report	Water Corrosivity Mini Report	Moisture Content	Total Alkalinity	Thermal Resistivity	Metallurgical Analysis	Langelier Index	Puckorius Index	XRF Elemental Analysis	Water Hardness
	Caltrans CTM643	Caltrans CTM643	Caltrans CTM417	Caltrans CTM422																							
	AASHTO T2888	AASHTO T 289	AASHTO T 290	AASHTO T 291	SM 2580B		SM 4500-NH3	SM 4500-NO3																			
	ASTM G187	ASTM G 51	ASTM D4327	ASTM D4327	ASTM G200	SM 4500-S2	ASTM D6919	ASTM D3327	ASTM D4327	ASTM D4327	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	SM 2320B			ASTM D2216	SM 2320B						
									Full Corrosion Series																		
	Geo Quad								Reports																		
1									✓																		
2																											
3																											
4																											
5																											
6																											
7																											
8																											
9																											
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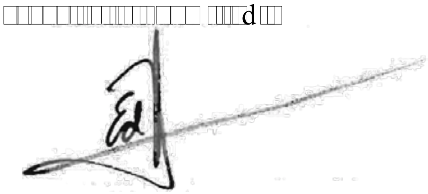
*Req: Min. 3 Samples, site map, and groundwater info




REGISTERED PROFESSIONAL ENGINEER
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MECHANICAL
STATE OF CALIFORNIA

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

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

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

Project X Job Number: S210721C Geotek 2820-CR APN-167-041-01 Full

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

Company Name:	Geotek USA	**Contact Name:**	Kyle McHargue
Mailing Address:	1548 N. Maple st Corona Ca. 92880	**Phone No:**	951. 206-5443
Accounting Contact:		**Contact Email:**	K.mchargue@geotekusa.com
Client Project No:	2820-CR The True Life Companies	**Invoice Email:**	
P.O. #:		**Project Name:**	APN-167-041-01 Redlands

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

Results By: ☐ Phone ☐ Fax ☒ Email

Date & Received by : 07/21/21

Special Instructions:

ANALYSIS REQUESTED (Please circle)

SAMPLE ID - BORE #	DESCRIPTION	DEPTH (ft)	DATE COLLECTED
1	2820-CR · B-4	0-5	
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

(210)

Default Method	Geo Quad: Soil Resistivity	pH	Sulfate	Chloride
	Caltrans CTM643	Caltrans CTM643	Caltrans CTM417	Caltrans CTM422
	AASHTO T288	AASHTO T 289	AASHTO T 290	AASHTO T 291
	ASTM G187	ASTM G51	ASTM D4327	ASTM D4327

Default Method	Full Corrosion Series: Redox Potential	Sulfide	Ammonia	Nitrate	Flouride	Phosphate	Lithium	Sodium	Potassium	Magnesium	Calcium	BiCarbonate
			SM 4500-NH3	SM 4500-NO3								
	SM 2580B											
	ASTM G200	SM 4500-S2	ASTM D5919	ASTM D4327	ASTM D4327	ASTM D4327	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	SM 2320B

Full Corrosion Series	Reports: Soil Corrosivity Evaluation Report	Water Corrosivity Mini Report	Moisture Content	Total Alkalinity	Thermal Resistivity	Metallurgical Analysis	Langelier Index	Puckorius Index	XRF Elemental Analysis	Water Hardness
X			ASTM D2216	SM 2320B						

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

7/20

APPENDIX C

PERCOLATION DATA SHEETS & PORCHET CALCULATIONS

Proposed 35-Lot Residential Development
Northeast of the Terminus of Texas Street
Redlands, San Bernardino County, California
Project No. 2820-CR

GEOTEK

Percolation Test Data Sheet

□r□□□□□□□□ A□N □□□□□□□□□□□□ R□d□□nd□ □□□ N□□□ □□□□□□□R

T□□□□□ □□□ N□□□ I□□

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Percolation Test Data

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Design Percolation Rate: **min/inch**

Percolation Test Data Sheet

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Percolation Test Data

Ti□ □	Ti□ □ In□□r□□□ □□ in□	T□□□□E□□□□□d Ti□ □ □□ in□	Ini□i□□□ □□□r □in□□□□□	Fin□□□ □□□r □in□□□□□	Δ in □ □□□r □in□□□□□	□□r□□□□□i□n R□□□ □□ in□in□□□
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Design Percolation Rate: **min/inch**

Client:	**The True Life Companies**
Project:	**APN 167-041-01**
Project No:	**2820-CR**
Date:	**7/9/2021**

Boring No. **I-1**

Infiltration Rate (Porchet Method)

Time Interval, Δt =	10
Final Depth to Water, D_F =	50
Test Hole Radius, r =	4
Initial Depth to Water, D_O =	40
Total Test Hole Depth, D_T =	120

Equation - $I_t = \dfrac{\Delta H\,(60r)}{\Delta t\,(r+2H_{avg})}$

$H_O = D_T - D_O$ =	80
$H_F = D_T - D_F$ =	70
$\Delta H = \Delta D = H_O - H_F$ =	10
$H_{avg} = (H_O+H_F)/2$ =	75

I_t = 1.56 **Inches per Hour**

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Client:	**The True Life Companies**
Project:	**APN 167-041-01**
Project No:	**2820-CR**
Date:	**7/9/2021**

Boring No. **I-2**

Infiltration Rate (Porchet Method)

Time Interval, Δt =	10
Final Depth to Water, D_F =	56
Test Hole Radius, r =	4
Initial Depth to Water, D_O =	40
Total Test Hole Depth, D_T =	120

Equation - $I_t = \dfrac{\Delta H\,(60r)}{\Delta t\,(r+2H_{avg})}$

$H_O = D_T - D_O$ =	80
$H_F = D_T - D_F$ =	64
$\Delta H = \Delta D = H_O - H_F$ =	16
$H_{avg} = (H_O+H_F)/2$ =	72

I_t = 2.59 **Inches per Hour**

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APPENDIX D

LIQUEFACTION ANALYSIS

Proposed 35-Lot Residential Development
Northeast of the Terminus of Texas Street
Redlands, San Bernardino County, California
Project No. 2820-CR

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LIQUEFACTION ANALYSIS SUMMARY

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Input File Name: UNTITLED
Title: 35-Lot Residential Development - Redlands
Subtitle: Liquefction Analysis

Surface Elev.=1290
Hole No.=B-1
Depth of Hole= 50.00 ft
Water Table during Earthquake= 30.00 ft
Water Table during In-Situ Testing= 50.00 ft
Max. Acceleration= 0.7 g
Earthquake Magnitude= 7.30

Input Data:
Surface Elev.=1290
Hole No.=B-1
Depth of Hole=50.00 ft
Water Table during Earthquake= 30.00 ft
Water Table during In-Situ Testing= 50.00 ft
Max. Acceleration=0.7 g
Earthquake Magnitude=7.30
No-Liquefiable Soils: CL, OL are Non-Liq. Soil

1. SPT or BPT Calculation.
2. Settlement Analysis Method: Ishihara / Yoshimine
3. Fines Correction for Liquefaction: Idriss/Seed
4. Fine Correction for Settlement: During Liquefaction*
5. Settlement Calculation in: All zones*
6. Hammer Energy Ratio, Ce = 1.25
7. Borehole Diameter, Cb= 1
8. Sampling Method, Cs= 1
9. User request factor of safety (apply to CSR) , User= 1
   Plot one CSR curve (fs1=User)
10. Use Curve Smoothing: Yes*
* Recommended Options

In-Situ Test Data:

Depth	SPT	gamma	Fines

ft		pcf	%
1.00	50.00	93.00	20.00
3.00	50.00	112.00	10.00
5.00	15.00	112.00	10.00
7.50	16.00	102.00	20.00
10.00	19.00	103.00	20.00
15.00	21.00	102.00	20.00
20.00	28.00	110.00	20.00
25.00	36.00	102.00	10.00
30.00	39.00	102.00	10.00
35.00	40.00	102.00	20.00
40.00	51.00	102.00	10.00
45.00	48.00	102.00	10.00
50.00	63.00	102.00	10.00

Output Results:

Settlement of Saturated Sands=0.00 in.
Settlement of Unsaturated Sands=0.27 in.
Total Settlement of Saturated and Unsaturated Sands=0.27 in.
Differential Settlement=0.136 to 0.179 in.

Depth ft	CRRm	CSRfs	F.S.	S_sat. in.	S_dry in.	S_all in.
1.00	0.54	0.45	5.00	0.00	0.27	0.27
2.00	0.54	0.45	5.00	0.00	0.27	0.27
3.00	0.54	0.45	5.00	0.00	0.27	0.27
4.00	0.54	0.45	5.00	0.00	0.27	0.27
5.00	0.31	0.45	5.00	0.00	0.26	0.26
6.00	0.36	0.45	5.00	0.00	0.26	0.26
7.00	0.49	0.45	5.00	0.00	0.25	0.25
8.00	0.54	0.45	5.00	0.00	0.24	0.24
9.00	0.54	0.45	5.00	0.00	0.23	0.23
10.00	0.54	0.44	5.00	0.00	0.22	0.22
11.00	0.54	0.44	5.00	0.00	0.21	0.21
12.00	0.54	0.44	5.00	0.00	0.20	0.20
13.00	0.54	0.44	5.00	0.00	0.19	0.19
14.00	0.54	0.44	5.00	0.00	0.17	0.17
15.00	0.54	0.44	5.00	0.00	0.16	0.16
16.00	0.54	0.44	5.00	0.00	0.15	0.15
17.00	0.54	0.44	5.00	0.00	0.14	0.14
18.00	0.54	0.44	5.00	0.00	0.13	0.13
19.00	0.54	0.43	5.00	0.00	0.11	0.11
20.00	0.54	0.43	5.00	0.00	0.10	0.10
21.00	0.54	0.43	5.00	0.00	0.09	0.09
22.00	0.54	0.43	5.00	0.00	0.08	0.08
23.00	0.54	0.43	5.00	0.00	0.06	0.06
24.00	0.54	0.43	5.00	0.00	0.05	0.05

25.00	0.54	0.43	5.00	0.00	0.04	0.04
26.00	0.54	0.43	5.00	0.00	0.04	0.04
27.00	0.54	0.43	5.00	0.00	0.03	0.03
28.00	0.54	0.43	5.00	0.00	0.02	0.02
29.00	0.54	0.42	5.00	0.00	0.01	0.01
30.00	0.54	0.42	5.00	0.00	0.00	0.00
31.00	0.54	0.43	1.25	0.00	0.00	0.00
32.00	0.54	0.43	1.24	0.00	0.00	0.00
33.00	0.53	0.44	1.23	0.00	0.00	0.00
34.00	0.53	0.44	1.21	0.00	0.00	0.00
35.00	0.53	0.44	1.20	0.00	0.00	0.00
36.00	0.53	0.45	1.18	0.00	0.00	0.00
37.00	0.52	0.45	1.17	0.00	0.00	0.00
38.00	0.52	0.45	1.16	0.00	0.00	0.00
39.00	0.52	0.45	1.15	0.00	0.00	0.00
40.00	0.52	0.45	1.14	0.00	0.00	0.00
41.00	0.51	0.46	1.13	0.00	0.00	0.00
42.00	0.51	0.46	1.12	0.00	0.00	0.00
43.00	0.51	0.46	1.11	0.00	0.00	0.00
44.00	0.51	0.46	1.10	0.00	0.00	0.00
45.00	0.50	0.46	1.10	0.00	0.00	0.00
46.00	0.50	0.46	1.09	0.00	0.00	0.00
47.00	0.50	0.46	1.09	0.00	0.00	0.00
48.00	0.50	0.46	1.08	0.00	0.00	0.00
49.00	0.50	0.46	1.08	0.00	0.00	0.00
50.00	0.49	0.46	1.07	0.00	0.00	0.00

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* F.S.<1, Liquefaction Potential Zone
(F.S. is limited to 5, CRR is limited to 2, CSR is limited to 2)

Units: Unit: qc, fs, Stress or Pressure = atm (1.0581tsf); Unit Weight = pcf; Depth = ft; Settlement = in.

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1 atm (atmosphere) = 1 tsf (ton/ft2)
CRRm Cyclic resistance ratio from soils
CSRsf Cyclic stress ratio induced by a given earthquake (with user request factor of safety)
F.S. Factor of Safety against liquefaction, F.S.=CRRm/CSRsf
S_sat Settlement from saturated sands
S_dry Settlement from Unsaturated Sands
S_all Total Settlement from Saturated and Unsaturated Sands
NoLiq No-Liquefy Soils

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LIQUEFACTION ANALYSIS CALCULATION DETAILS

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Input File Name: UNTITLED
Title: 35-Lot Residential Development - Redlands
Subtitle: Seismic Settlement Analysis

Input Data:
Surface Elev.=1290
Hole No.=B-1
Depth of Hole=50.00 ft
Water Table during Earthquake= 0.00 ft
Water Table during In-Situ Testing= 50.00 ft
Max. Acceleration=0.7 g
Earthquake Magnitude=7.30
No-Liquefiable Soils: CL, OL are Non-Liq. Soil
1. SPT or BPT Calculation.
2. Settlement Analysis Method: Ishihara / Yoshimine
3. Fines Correction for Liquefaction: Idriss/Seed
4. Fine Correction for Settlement: During Liquefaction*
5. Settlement Calculation in: All zones*
6. Hammer Energy Ratio, Ce = 1.25
7. Borehole Diameter, Cb= 1
8. Sampling Method, Cs= 1
9. User request factor of safety (apply to CSR) , User= 1
Plot one CSR curve (fs1=User)
10. Average two input data between two Depths: Yes*
* Recommended Options

In-Situ Test Data:

Depth ft	SPT	Gamma pcf	Fines %
1.00	50.00	93.00	20.00
3.00	50.00	112.00	10.00
5.00	15.00	112.00	10.00
7.50	16.00	102.00	20.00
10.00	19.00	103.00	20.00
15.00	21.00	102.00	20.00
20.00	28.00	110.00	20.00

25.00	36.00	102.00	10.00
30.00	39.00	102.00	10.00
35.00	40.00	102.00	20.00
40.00	51.00	102.00	10.00
45.00	48.00	102.00	10.00
50.00	63.00	102.00	10.00

Output Results:
Calculation segment, dz=0.050 ft
User defined Print Interval, dp=1.00 ft

Peak Ground Acceleration (PGA), a_max = 0.70g

CSR Calculation:

Depth	gamma	sigma	gamma'	sigma'	rd	mZ	a(z)	CSR	x fs1 =CSRfs
ft	pcf	atm	pcf	atm		g	g		
1.00	93.00	0.044	30.60	0.014	1.00	0.000	0.700	1.38	1.00 1.38
2.00	102.50	0.090	40.10	0.031	1.00	0.000	0.700	1.31	1.00 1.31
3.00	112.00	0.141	49.60	0.052	0.99	0.000	0.700	1.22	1.00 1.22
4.00	112.00	0.194	49.60	0.076	0.99	0.000	0.700	1.15	1.00 1.15
5.00	112.00	0.246	49.60	0.099	0.99	0.000	0.700	1.12	1.00 1.12
6.00	108.00	0.298	45.60	0.122	0.99	0.000	0.700	1.10	1.00 1.10
7.00	104.00	0.349	41.60	0.142	0.98	0.000	0.700	1.10	1.00 1.10
8.00	102.20	0.397	39.80	0.161	0.98	0.000	0.700	1.10	1.00 1.10
9.00	102.60	0.445	40.20	0.180	0.98	0.000	0.700	1.10	1.00 1.10
10.00	103.00	0.494	40.60	0.199	0.98	0.000	0.700	1.10	1.00 1.10
11.00	102.80	0.543	40.40	0.218	0.97	0.000	0.700	1.10	1.00 1.10
12.00	102.60	0.591	40.20	0.237	0.97	0.000	0.700	1.10	1.00 1.10
13.00	102.40	0.640	40.00	0.256	0.97	0.000	0.700	1.10	1.00 1.10
14.00	102.20	0.688	39.80	0.275	0.97	0.000	0.700	1.10	1.00 1.10

15.00	102.00	0.736	39.60	0.294	0.97	0.000	0.700	1.10	1.00
1.10									
16.00	103.60	0.785	41.20	0.313	0.96	0.000	0.700	1.10	1.00
1.10									
17.00	105.20	0.834	42.80	0.333	0.96	0.000	0.700	1.10	1.00
1.10									
18.00	106.80	0.884	44.40	0.353	0.96	0.000	0.700	1.09	1.00
1.09									
19.00	108.40	0.935	46.00	0.375	0.96	0.000	0.700	1.08	1.00
1.08									
20.00	110.00	0.987	47.60	0.397	0.95	0.000	0.700	1.08	1.00
1.08									
21.00	108.40	1.038	46.00	0.419	0.95	0.000	0.700	1.07	1.00
1.07									
22.00	106.80	1.089	44.40	0.440	0.95	0.000	0.700	1.07	1.00
1.07									
23.00	105.20	1.139	42.80	0.461	0.95	0.000	0.700	1.06	1.00
1.06									
24.00	103.60	1.189	41.20	0.481	0.94	0.000	0.700	1.06	1.00
1.06									
25.00	102.00	1.237	39.60	0.500	0.94	0.000	0.700	1.06	1.00
1.06									
26.00	102.00	1.285	39.60	0.519	0.94	0.000	0.700	1.06	1.00
1.06									
27.00	102.00	1.334	39.60	0.537	0.94	0.000	0.700	1.06	1.00
1.06									
28.00	102.00	1.382	39.60	0.556	0.93	0.000	0.700	1.06	1.00
1.06									
29.00	102.00	1.430	39.60	0.575	0.93	0.000	0.700	1.06	1.00
1.06									
30.00	102.00	1.478	39.60	0.594	0.93	0.000	0.700	1.05	1.00
1.05									
31.00	102.00	1.526	39.60	0.612	0.92	0.000	0.700	1.05	1.00
1.05									
32.00	102.00	1.575	39.60	0.631	0.91	0.000	0.700	1.04	1.00
1.04									
33.00	102.00	1.623	39.60	0.650	0.91	0.000	0.700	1.03	1.00
1.03									
34.00	102.00	1.671	39.60	0.668	0.90	0.000	0.700	1.02	1.00
1.02									
35.00	102.00	1.719	39.60	0.687	0.89	0.000	0.700	1.01	1.00
1.01									
36.00	102.00	1.767	39.60	0.706	0.88	0.000	0.700	1.00	1.00
1.00									
37.00	102.00	1.816	39.60	0.725	0.87	0.000	0.700	1.00	1.00
1.00									
38.00	102.00	1.864	39.60	0.743	0.86	0.000	0.700	0.99	1.00
0.99									
39.00	102.00	1.912	39.60	0.762	0.86	0.000	0.700	0.98	1.00
0.98									

40.00	102.00	1.960	39.60	0.781	0.85	0.000	0.700	0.97	1.00
0.97									
41.00	102.00	2.008	39.60	0.799	0.84	0.000	0.700	0.96	1.00
0.96									
42.00	102.00	2.057	39.60	0.818	0.83	0.000	0.700	0.95	1.00
0.95									
43.00	102.00	2.105	39.60	0.837	0.82	0.000	0.700	0.94	1.00
0.94									
44.00	102.00	2.153	39.60	0.855	0.82	0.000	0.700	0.93	1.00
0.93									
45.00	102.00	2.201	39.60	0.874	0.81	0.000	0.700	0.93	1.00
0.93									
46.00	102.00	2.249	39.60	0.893	0.80	0.000	0.700	0.92	1.00
0.92									
47.00	102.00	2.298	39.60	0.912	0.79	0.000	0.700	0.91	1.00
0.91									
48.00	102.00	2.346	39.60	0.930	0.78	0.000	0.700	0.90	1.00
0.90									
49.00	102.00	2.394	39.60	0.949	0.78	0.000	0.700	0.89	1.00
0.89									
50.00	102.00	2.442	39.60	0.968	0.77	0.000	0.700	0.88	1.00
0.88									

CSR is based on water table at 0.00 during earthquake

CRR Calculation from SPT or BPT data:

Depth	SPT	Cebs	Cr	sigma'	Cn	(N1)60	Fines	d(N1)60	(N1)60f	CRR7.5
ft				atm			%			
1.00	50.00	1.25	0.75	0.044	1.70	79.69	20.00	9.95	89.63	0.50
2.00	50.00	1.25	0.75	0.090	1.70	79.69	15.00	6.33	86.02	0.50
3.00	50.00	1.25	0.75	0.141	1.70	79.69	10.00	2.59	82.28	0.50
4.00	32.50	1.25	0.75	0.194	1.70	51.80	10.00	1.99	53.79	0.50
5.00	15.00	1.25	0.75	0.246	1.70	23.91	10.00	1.39	25.29	0.29
6.00	15.40	1.25	0.75	0.298	1.70	24.54	14.00	3.24	27.79	0.34
7.00	15.80	1.25	0.75	0.349	1.69	25.09	18.00	4.90	29.99	0.46
8.00	16.60	1.25	0.75	0.397	1.59	24.70	20.00	5.58	30.27	0.50

	9.00	17.80	1.25	0.85	0.445	1.50	28.34	20.00	5.87
34.20	0.50								
	10.00	19.00	1.25	0.85	0.494	1.42	28.72	20.00	5.90
34.62	0.50								
	11.00	19.40	1.25	0.85	0.543	1.36	27.98	20.00	5.84
33.82	0.50								
	12.00	19.80	1.25	0.85	0.591	1.30	27.36	20.00	5.79
33.15	0.50								
	13.00	20.20	1.25	0.85	0.640	1.25	26.84	20.00	5.75
32.58	0.50								
	14.00	20.60	1.25	0.85	0.688	1.21	26.39	20.00	5.71
32.10	0.50								
	15.00	21.00	1.25	0.95	0.736	1.17	29.06	20.00	5.92
34.99	0.50								
	16.00	22.40	1.25	0.95	0.785	1.13	30.03	20.00	6.00
36.03	0.50								
	17.00	23.80	1.25	0.95	0.834	1.09	30.95	20.00	6.07
37.02	0.50								
	18.00	25.20	1.25	0.95	0.884	1.06	31.82	20.00	6.14
37.97	0.50								
	19.00	26.60	1.25	0.95	0.935	1.03	32.67	20.00	6.21
38.88	0.50								
	20.00	28.00	1.25	0.95	0.987	1.01	33.48	20.00	6.27
39.75	0.50								
	21.00	29.60	1.25	0.95	1.038	0.98	34.50	18.00	5.52
40.02	0.50								
	22.00	31.20	1.25	0.95	1.089	0.96	35.50	16.00	4.68
40.19	0.50								
	23.00	32.80	1.25	0.95	1.139	0.94	36.49	14.00	3.75
40.24	0.50								
	24.00	34.40	1.25	0.95	1.189	0.92	37.47	12.00	2.74
40.21	0.50								
	25.00	36.00	1.25	0.95	1.237	0.90	38.43	10.00	1.70
40.14	0.50								
	26.00	36.60	1.25	0.95	1.285	0.88	38.34	10.00	1.70
40.03	0.50								
	27.00	37.20	1.25	0.95	1.334	0.87	38.25	10.00	1.70
39.95	0.50								
	28.00	37.80	1.25	1.00	1.382	0.85	40.20	10.00	1.74
41.94	0.50								
	29.00	38.40	1.25	1.00	1.430	0.84	40.14	10.00	1.74
41.88	0.50								
	30.00	39.00	1.25	1.00	1.478	0.82	40.10	10.00	1.74
41.83	0.50								
	31.00	39.20	1.25	1.00	1.526	0.81	39.66	12.00	2.81
42.47	0.50								
	32.00	39.40	1.25	1.00	1.575	0.80	39.25	14.00	3.87
43.12	0.50								
	33.00	39.60	1.25	1.00	1.623	0.79	38.86	16.00	4.87
43.72	0.50								

	34.00	39.80	1.25	1.00	1.671	0.77	38.49	18.00	5.79
44.27	0.50								
	35.00	40.00	1.25	1.00	1.719	0.76	38.13	20.00	6.64
44.78	0.50								
	36.00	42.20	1.25	1.00	1.767	0.75	39.68	18.00	5.87
45.55	0.50								
	37.00	44.40	1.25	1.00	1.816	0.74	41.19	16.00	4.99
46.18	0.50								
	38.00	46.60	1.25	1.00	1.864	0.73	42.67	14.00	4.01
46.68	0.50								
	39.00	48.80	1.25	1.00	1.912	0.72	44.12	12.00	2.95
47.06	0.50								
	40.00	51.00	1.25	1.00	1.960	0.71	45.53	10.00	1.85
47.39	0.50								
	41.00	50.40	1.25	1.00	2.008	0.71	44.46	10.00	1.83
46.29	0.50								
	42.00	49.80	1.25	1.00	2.057	0.70	43.41	10.00	1.81
45.22	0.50								
	43.00	49.20	1.25	1.00	2.105	0.69	42.39	10.00	1.79
44.18	0.50								
	44.00	48.60	1.25	1.00	2.153	0.68	41.40	10.00	1.76
43.17	0.50								
	45.00	48.00	1.25	1.00	2.201	0.67	40.44	10.00	1.74
42.19	0.50								
	46.00	51.00	1.25	1.00	2.249	0.67	42.51	10.00	1.79
44.29	0.50								
	47.00	54.00	1.25	1.00	2.298	0.66	44.53	10.00	1.83
46.36	0.50								
	48.00	57.00	1.25	1.00	2.346	0.65	46.52	10.00	1.88
48.40	0.50								
	49.00	60.00	1.25	1.00	2.394	0.65	48.47	10.00	1.92
50.39	0.50								
	50.00	63.00	1.25	1.00	2.442	0.64	50.39	10.00	1.96
52.35	0.50								

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CRR is based on water table at 50.00 during In-Situ Testing

Factor of Safety, - Earthquake Magnitude= 7.30:

Depth	sigC'	CRR7.5	x Ksig	=CRRv	x MSF	=CRRm	CSRfs	F.S.=CRRm/CSRfs
ft	atm							
1.00	0.03	0.50	1.00	0.50	1.07	0.54	1.38	0.39 *
2.00	0.06	0.50	1.00	0.50	1.07	0.54	1.31	0.41 *
3.00	0.09	0.50	1.00	0.50	1.07	0.54	1.22	0.44 *
4.00	0.13	0.50	1.00	0.50	1.07	0.54	1.15	0.46 *
5.00	0.16	0.29	1.00	0.29	1.07	0.31	1.12	0.28 *
6.00	0.19	0.34	1.00	0.34	1.07	0.36	1.10	0.33 *

7.00	0.23	0.46	1.00	0.46	1.07	0.49	1.10	0.44 *
8.00	0.26	0.50	1.00	0.50	1.07	0.54	1.10	0.49 *
9.00	0.29	0.50	1.00	0.50	1.07	0.54	1.10	0.49 *
10.00	0.32	0.50	1.00	0.50	1.07	0.54	1.10	0.49 *
11.00	0.35	0.50	1.00	0.50	1.07	0.54	1.10	0.49 *
12.00	0.38	0.50	1.00	0.50	1.07	0.54	1.10	0.49 *
13.00	0.42	0.50	1.00	0.50	1.07	0.54	1.10	0.49 *
14.00	0.45	0.50	1.00	0.50	1.07	0.54	1.10	0.49 *
15.00	0.48	0.50	1.00	0.50	1.07	0.54	1.10	0.49 *
16.00	0.51	0.50	1.00	0.50	1.07	0.54	1.10	0.49 *
17.00	0.54	0.50	1.00	0.50	1.07	0.54	1.10	0.49 *
18.00	0.57	0.50	1.00	0.50	1.07	0.54	1.09	0.49 *
19.00	0.61	0.50	1.00	0.50	1.07	0.54	1.08	0.49 *
20.00	0.64	0.50	1.00	0.50	1.07	0.54	1.08	0.50 *
21.00	0.67	0.50	1.00	0.50	1.07	0.54	1.07	0.50 *
22.00	0.71	0.50	1.00	0.50	1.07	0.54	1.07	0.50 *
23.00	0.74	0.50	1.00	0.50	1.07	0.54	1.06	0.50 *
24.00	0.77	0.50	1.00	0.50	1.07	0.54	1.06	0.50 *
25.00	0.80	0.50	1.00	0.50	1.07	0.54	1.06	0.51 *
26.00	0.84	0.50	1.00	0.50	1.07	0.54	1.06	0.51 *
27.00	0.87	0.50	1.00	0.50	1.07	0.54	1.06	0.51 *
28.00	0.90	0.50	1.00	0.50	1.07	0.54	1.06	0.51 *
29.00	0.93	0.50	1.00	0.50	1.07	0.54	1.06	0.51 *
30.00	0.96	0.50	1.00	0.50	1.07	0.54	1.05	0.51 *
31.00	0.99	0.50	1.00	0.50	1.07	0.54	1.05	0.51 *
32.00	1.02	0.50	1.00	0.50	1.07	0.54	1.04	0.52 *
33.00	1.05	0.50	1.00	0.50	1.07	0.53	1.03	0.52 *
34.00	1.09	0.50	0.99	0.50	1.07	0.53	1.02	0.52 *
35.00	1.12	0.50	0.99	0.49	1.07	0.53	1.01	0.52 *
36.00	1.15	0.50	0.98	0.49	1.07	0.53	1.00	0.52 *
37.00	1.18	0.50	0.98	0.49	1.07	0.52	1.00	0.53 *
38.00	1.21	0.50	0.97	0.49	1.07	0.52	0.99	0.53 *
39.00	1.24	0.50	0.97	0.48	1.07	0.52	0.98	0.53 *
40.00	1.27	0.50	0.96	0.48	1.07	0.52	0.97	0.53 *
41.00	1.31	0.50	0.96	0.48	1.07	0.51	0.96	0.54 *
42.00	1.34	0.50	0.96	0.48	1.07	0.51	0.95	0.54 *
43.00	1.37	0.50	0.95	0.48	1.07	0.51	0.94	0.54 *
44.00	1.40	0.50	0.95	0.47	1.07	0.51	0.93	0.54 *
45.00	1.43	0.50	0.94	0.47	1.07	0.50	0.93	0.55 *
46.00	1.46	0.50	0.94	0.47	1.07	0.50	0.92	0.55 *
47.00	1.49	0.50	0.93	0.47	1.07	0.50	0.91	0.55 *
48.00	1.52	0.50	0.93	0.46	1.07	0.50	0.90	0.55 *
49.00	1.56	0.50	0.93	0.46	1.07	0.50	0.89	0.56 *
50.00	1.59	0.50	0.92	0.46	1.07	0.49	0.88	0.56 *

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* F.S.<1: Liquefaction Potential Zone. (If above water table: F.S.=5)
^ No-liquefiable Soils or above Water Table.
(F.S. is limited to 5, CRR is limited to 2, CSR is limited to 2)

CPT convert to SPT for Settlement Analysis:
Fines Correction for Settlement Analysis:

Depth ft	Ic	qc/N60	qc1 atm	(N1)60	Fines %	d(N1)60	(N1)60s
1.00	-	-	-	89.63	20.00	0.00	89.63
2.00	-	-	-	86.02	15.00	0.00	86.02
3.00	-	-	-	82.28	10.00	0.00	82.28
4.00	-	-	-	53.79	10.00	0.00	53.79
5.00	-	-	-	25.29	10.00	0.00	25.29
6.00	-	-	-	27.79	14.00	0.00	27.79
7.00	-	-	-	29.99	18.00	0.00	29.99
8.00	-	-	-	30.27	20.00	0.00	30.27
9.00	-	-	-	34.20	20.00	0.00	34.20
10.00	-	-	-	34.62	20.00	0.00	34.62
11.00	-	-	-	33.82	20.00	0.00	33.82
12.00	-	-	-	33.15	20.00	0.00	33.15
13.00	-	-	-	32.58	20.00	0.00	32.58
14.00	-	-	-	32.10	20.00	0.00	32.10
15.00	-	-	-	34.99	20.00	0.00	34.99
16.00	-	-	-	36.03	20.00	0.00	36.03
17.00	-	-	-	37.02	20.00	0.00	37.02
18.00	-	-	-	37.97	20.00	0.00	37.97
19.00	-	-	-	38.88	20.00	0.00	38.88
20.00	-	-	-	39.75	20.00	0.00	39.75
21.00	-	-	-	40.02	18.00	0.00	40.02
22.00	-	-	-	40.19	16.00	0.00	40.19
23.00	-	-	-	40.24	14.00	0.00	40.24
24.00	-	-	-	40.21	12.00	0.00	40.21
25.00	-	-	-	40.14	10.00	0.00	40.14
26.00	-	-	-	40.03	10.00	0.00	40.03
27.00	-	-	-	39.95	10.00	0.00	39.95
28.00	-	-	-	41.94	10.00	0.00	41.94
29.00	-	-	-	41.88	10.00	0.00	41.88
30.00	-	-	-	41.83	10.00	0.00	41.83
31.00	-	-	-	42.47	12.00	0.00	42.47
32.00	-	-	-	43.12	14.00	0.00	43.12
33.00	-	-	-	43.72	16.00	0.00	43.72
34.00	-	-	-	44.27	18.00	0.00	44.27
35.00	-	-	-	44.78	20.00	0.00	44.78
36.00	-	-	-	45.55	18.00	0.00	45.55
37.00	-	-	-	46.18	16.00	0.00	46.18
38.00	-	-	-	46.68	14.00	0.00	46.68
39.00	-	-	-	47.06	12.00	0.00	47.06
40.00	-	-	-	47.39	10.00	0.00	47.39
41.00	-	-	-	46.29	10.00	0.00	46.29
42.00	-	-	-	45.22	10.00	0.00	45.22
43.00	-	-	-	44.18	10.00	0.00	44.18
44.00	-	-	-	43.17	10.00	0.00	43.17
45.00	-	-	-	42.19	10.00	0.00	42.19

46.00	-	-	-	44.29	10.00	0.00	44.29
47.00	-	-	-	46.36	10.00	0.00	46.36
48.00	-	-	-	48.40	10.00	0.00	48.40
49.00	-	-	-	50.39	10.00	0.00	50.39
50.00	-	-	-	52.35	10.00	0.00	52.35

(N1)60s has been fines corrected in liquefaction analysis, therefore d(N1)60=0.

Fines=NoLiq means the soils are not liquefiable.

Settlement of Saturated Sands:

Settlement Analysis Method: Ishihara / Yoshimine

Depth S ft	CSRsf	/ MSF*	=CSRm	F.S.	Fines %	(N1)60s	Dr %	ec %	dsz in.	dsp in.
49.95	0.88	1.00	0.88	0.56	10.00	52.25	100.00	0.000	0.0E0	0.000
49.00	0.89	1.00	0.89	0.56	10.00	50.39	100.00	0.000	0.0E0	0.000
48.00	0.90	1.00	0.90	0.55	10.00	48.40	100.00	0.000	0.0E0	0.000
47.00	0.91	1.00	0.91	0.55	10.00	46.36	100.00	0.000	0.0E0	0.000
46.00	0.92	1.00	0.92	0.55	10.00	44.29	100.00	0.000	0.0E0	0.000
45.00	0.93	1.00	0.93	0.55	10.00	42.19	100.00	0.000	0.0E0	0.000
44.00	0.93	1.00	0.93	0.54	10.00	43.17	100.00	0.000	0.0E0	0.000
43.00	0.94	1.00	0.94	0.54	10.00	44.18	100.00	0.000	0.0E0	0.000
42.00	0.95	1.00	0.95	0.54	10.00	45.22	100.00	0.000	0.0E0	0.000
41.00	0.96	1.00	0.96	0.54	10.00	46.29	100.00	0.000	0.0E0	0.000
40.00	0.97	1.00	0.97	0.53	10.00	47.39	100.00	0.000	0.0E0	0.000
39.00	0.98	1.00	0.98	0.53	12.00	47.06	100.00	0.000	0.0E0	0.000
38.00	0.99	1.00	0.99	0.53	14.00	46.68	100.00	0.000	0.0E0	0.000
37.00	1.00	1.00	1.00	0.53	16.00	46.18	100.00	0.000	0.0E0	0.000
36.00	1.00	1.00	1.00	0.52	18.00	45.55	100.00	0.000	0.0E0	0.000

	35.00	1.01	1.00	1.01	0.52	20.00	44.78	100.00	0.000
0.0E0	0.000	0.000							
	34.00	1.02	1.00	1.02	0.52	18.00	44.27	100.00	0.000
0.0E0	0.000	0.000							
	33.00	1.03	1.00	1.03	0.52	16.00	43.72	100.00	0.000
0.0E0	0.000	0.000							
	32.00	1.04	1.00	1.04	0.52	14.00	43.12	100.00	0.000
0.0E0	0.000	0.000							
	31.00	1.05	1.00	1.05	0.51	12.00	42.47	100.00	0.000
0.0E0	0.000	0.000							
	30.00	1.05	1.00	1.05	0.51	10.00	41.83	100.00	0.000
0.0E0	0.000	0.000							
	29.00	1.06	1.00	1.06	0.51	10.00	41.88	100.00	0.000
0.0E0	0.000	0.000							
	28.00	1.06	1.00	1.06	0.51	10.00	41.94	100.00	0.000
0.0E0	0.000	0.000							
	27.00	1.06	1.00	1.06	0.51	10.00	39.95	100.00	0.000
0.0E0	0.000	0.000							
	26.00	1.06	1.00	1.06	0.51	10.00	40.03	100.00	0.000
0.0E0	0.000	0.000							
	25.00	1.06	1.00	1.06	0.51	10.00	40.14	100.00	0.000
0.0E0	0.000	0.000							
	24.00	1.06	1.00	1.06	0.50	12.00	40.21	100.00	0.000
0.0E0	0.000	0.000							
	23.00	1.06	1.00	1.06	0.50	14.00	40.24	100.00	0.000
0.0E0	0.000	0.000							
	22.00	1.07	1.00	1.07	0.50	16.00	40.19	100.00	0.000
0.0E0	0.000	0.000							
	21.00	1.07	1.00	1.07	0.50	18.00	40.02	100.00	0.000
0.0E0	0.000	0.000							
	20.00	1.08	1.00	1.08	0.50	20.00	39.75	100.00	0.000
0.0E0	0.000	0.000							
	19.00	1.08	1.00	1.08	0.49	20.00	38.88	100.00	0.000
0.0E0	0.000	0.000							
	18.00	1.09	1.00	1.09	0.49	20.00	37.97	100.00	0.000
0.0E0	0.000	0.000							
	17.00	1.10	1.00	1.10	0.49	20.00	37.02	100.00	0.000
0.0E0	0.000	0.000							
	16.00	1.10	1.00	1.10	0.49	20.00	36.03	100.00	0.000
0.0E0	0.000	0.000							
	15.00	1.10	1.00	1.10	0.49	20.00	34.99	100.00	0.000
0.0E0	0.000	0.000							
	14.00	1.10	1.00	1.10	0.49	20.00	32.10	95.01	0.649
3.9E-3	0.067	0.067							
	13.00	1.10	1.00	1.10	0.49	20.00	32.58	96.21	0.493
3.0E-3	0.068	0.136							
	12.00	1.10	1.00	1.10	0.49	20.00	33.15	97.65	0.305
1.8E-3	0.048	0.183							
	11.00	1.10	1.00	1.10	0.49	20.00	33.82	99.41	0.077
4.6E-4	0.023	0.206							

	10.00	1.10	1.00	1.10	0.49	20.00	34.62	100.00	0.000
0.0E0	0.001	0.207							
	9.00	1.10	1.00	1.10	0.49	20.00	34.20	100.00	0.000
0.0E0	0.000	0.207							
	8.00	1.10	1.00	1.10	0.49	20.00	30.27	90.68	1.212
7.3E-3	0.037	0.244							
	7.00	1.10	1.00	1.10	0.44	18.00	29.99	90.03	1.308
7.8E-3	0.151	0.395							
	6.00	1.10	1.00	1.10	0.33	14.00	27.79	85.27	1.523
9.1E-3	0.171	0.566							
	5.00	1.12	1.00	1.12	0.28	10.00	25.29	80.28	1.734
1.0E-2	0.196	0.762							
	4.00	1.15	1.00	1.15	0.46	10.00	53.79	100.00	0.000
0.0E0	0.037	0.799							
	3.00	1.22	1.00	1.22	0.44	10.00	82.28	100.00	0.000
0.0E0	0.000	0.799							
	2.00	1.31	1.00	1.31	0.41	15.00	86.02	100.00	0.000
0.0E0	0.000	0.799							
	1.00	1.38	1.00	1.38	0.39	20.00	89.63	100.00	0.000
0.0E0	0.000	0.799							

Settlement of Saturated Sands=0.799 in.
qc1 and (N1)60 is after fines correction in liquefaction analysis
dsz is per each segment, dz=0.05 ft
dsp is per each print interval, dp=1.00 ft
S is cumulated settlement at this depth

Settlement of Unsaturated Sands:

Depth	sigma'	sigC'	(N1)60s	CSRsf	Gmax	g*Ge/Gm	g_eff	ec7.5	Cec	ec
dsz	dsp	S								
ft	atm	atm			atm			%		%
in.	in.	in.								

Settlement of Unsaturated Sands

Settlement of Unsaturated Sands=0.000 in.
dsz is per each segment, dz=0.05 ft
dsp is per each print interval, dp=1.00 ft
S is cumulated settlement at this depth

Total Settlement of Saturated and Unsaturated Sands=0.799 in.
Differential Settlement=0.399 to 0.527 in.

Units: Unit: qc, fs, Stress or Pressure = atm (1.0581tsf); Unit Weight =

pcf; Depth = ft; Settlement = in.

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1 atm (atmosphere) = 1.0581 tsf(1 tsf = 1 ton/ft2 = 2 kip/ft2)
1 atm (atmosphere) = 101.325 kPa(1 kPa = 1 kN/m2 = 0.001 Mpa)

SPT	Field data from Standard Penetration Test (SPT)
BPT	Field data from Becker Penetration Test (BPT)
qc	Field data from Cone Penetration Test (CPT) [atm (tsf)]
fs	Friction from CPT testing [atm (tsf)]
Rf	Ratio of fs/qc (%)
gamma	Total unit weight of soil
gamma'	Effective unit weight of soil
Fines	Fines content [%]
D50	Mean grain size
Dr	Relative Density
sigma	Total vertical stress [atm]
sigma'	Effective vertical stress [atm]
sigC'	Effective confining pressure [atm]
rd	Acceleration reduction coefficient by Seed
a_max.	Peak Ground Acceleration (PGA) in ground surface
mZ	Linear acceleration reduction coefficient X depth
a_min.	Minimum acceleration under linear reduction, mZ
CRRv	CRR after overburden stress correction, CRRv=CRR7.5 * Ksig
CRR7.5	Cyclic resistance ratio (M=7.5)
Ksig	Overburden stress correction factor for CRR7.5
CRRm	After magnitude scaling correction CRRm=CRRv * MSF
MSF	Magnitude scaling factor from M=7.5 to user input M
CSR	Cyclic stress ratio induced by earthquake
CSRfs	CSRfs=CSR*fs1 (Default fs1=1)
fs1	First CSR curve in graphic defined in #9 of Advanced page
fs2	2nd CSR curve in graphic defined in #9 of Advanced page
F.S.	Calculated factor of safety against liquefaction

F.S.=CRRm/CSRsf

Cebs	Energy Ratio, Borehole Dia., and Sampling Method Corrections
Cr	Rod Length Corrections
Cn	Overburden Pressure Correction
(N1)60	SPT after corrections, (N1)60=SPT * Cr * Cn * Cebs
d(N1)60	Fines correction of SPT
(N1)60f	(N1)60 after fines corrections, (N1)60f=(N1)60 + d(N1)60
Cq	Overburden stress correction factor
qc1	CPT after Overburden stress correction
dqc1	Fines correction of CPT
qc1f	CPT after Fines and Overburden correction, qc1f=qc1 + dqc1
qc1n	CPT after normalization in Robertson's method
Kc	Fine correction factor in Robertson's Method
qc1f	CPT after Fines correction in Robertson's Method
Ic	Soil type index in Suzuki's and Robertson's Methods
(N1)60s	(N1)60 after settlement fines corrections
CSRm	After magnitude scaling correction for Settlement

calculation CSRm=CSRsf / MSF*

CSRfs Cyclic stress ratio induced by earthquake with user inputed fs

MSF* Scaling factor from CSR, MSF*=1, based on Item 2 of Page C.

ec	Volumetric strain for saturated sands
dz	Calculation segment, dz=0.050 ft
dsz	Settlement in each segment, dz
dp	User defined print interval
dsp	Settlement in each print interval, dp
Gmax	Shear Modulus at low strain
g_eff	gamma_eff, Effective shear Strain
g*Ge/Gm	gamma_eff * G_eff/G_max, Strain-modulus ratio
ec7.5	Volumetric Strain for magnitude=7.5
Cec	Magnitude correction factor for any magnitude
ec	Volumetric strain for unsaturated sands, ec=Cec * ec7.5
NoLiq	No-Liquefy Soils

References:

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1. NCEER Workshop on Evaluation of Liquefaction Resistance of Soils. Youd, T.L., and Idriss, I.M., eds., Technical Report NCEER 97-0022.

SP117. Southern California Earthquake Center. Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction in California. University of Southern California. March 1999.

2. RECENT ADVANCES IN SOIL LIQUEFACTION ENGINEERING AND SEISMIC SITE RESPONSE EVALUATION, Paper No. SPL-2, PROCEEDINGS: Fourth International Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics, San Diego, CA, March 2001.

3. RECENT ADVANCES IN SOIL LIQUEFACTION ENGINEERING: A UNIFIED AND CONSISTENT FRAMEWORK, Earthquake Engineering Research Center, Report No. EERC 2003-06 by R.B Seed and etc. April 2003.

Note: Print Interval you selected does not show complete results. To get complete results, you should select 'Segment' in Print Interval (Item 12, Page C).

APPENDIX E

GENERAL EARTHWORK GRADING GUIDELINES

Proposed 35-Lot Residential Development
Northeast of the Terminus of Texas Street
Redlands, San Bernardino County, California
Project No. 2820-CR

GEOTEK

GENERAL GRADING GUIDELINES

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

General

Grading should be performed to at least the minimum requirements of governing agencies, Chapters 18 and 33 of the Uniform Building Code, CBC (2019) and the guidelines presented below.

Preconstruction Meeting

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

Grading Observation and Testing

1. Observation of the fill placement should be provided by our representative during grading. Verbal communication during the course of each day will be used to inform the contractor of test results. The contractor should receive a copy of the "Daily Field Report" indicating results of field density tests that day. If our representative does not provide the contractor with these reports, our office should be notified.
2. Testing and observation procedures are, by their nature, specific to the work or area observed and location of the tests taken, variability may occur in other locations. The contractor is responsible for the uniformity of the grading operations; our observations and test results are intended to evaluate the contractor's overall level of efforts during grading. The contractor's personnel are the only individuals participating in all aspect of site work. Compaction testing and observation should not be considered as relieving the contractor's responsibility to properly compact the fill.
3. Cleanouts, processed ground to receive fill, key excavations, and subdrains should be observed by our representative prior to placing any fill. It will be the contractor's responsibility to notify our representative or office when such areas are ready for observation.

4. Density tests may be made on the surface material to receive fill, as considered warranted by this firm.
5. In general, density tests would be made at maximum intervals of two feet of fill height or every 1,000 cubic yards of fill placed. Criteria will vary depending on soil conditions and size of the fill. More frequent testing may be performed. In any case, an adequate number of field density tests should be made to evaluate the required compaction and moisture content is generally being obtained.
6. Laboratory testing to support field test procedures will be performed, as considered warranted, based on conditions encountered (e.g. change of material sources, types, etc.) Every effort will be made to process samples in the laboratory as quickly as possible and in progress construction projects are our first priority. However, laboratory workloads may cause in delays and some soils may require a **minimum of 48 to 72 hours to complete test procedures**. Whenever possible, our representative(s) should be informed in advance of operational changes that might result in different source areas for materials.
7. Procedures for testing of fill slopes are as follows:
    a) Density tests should be taken periodically during grading on the flat surface of the fill, three to five feet horizontally from the face of the slope.
    b) If a method other than over building and cutting back to the compacted core is to be employed, slope compaction testing during construction should include testing the outer six inches to three feet in the slope face to determine if the required compaction is being achieved.
8. Finish grade testing of slopes and pad surfaces should be performed after construction is complete.

Site Clearing

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

Treatment of Existing Ground

1. Following site clearing, all surficial deposits of alluvium should be removed unless otherwise specifically indicated in the text of this report.
2. In some cases, removal may be recommended to a specified depth (e.g. flat sites where partial alluvial removals may be sufficient). The contractor should not exceed these depths unless directed otherwise by our representative.
3. Groundwater existing in alluvial areas may make excavation difficult. Deeper removals than indicated in the text of the report may be necessary due to saturation during winter months.
4. Subsequent to removals, the natural ground should be processed to a depth of six inches, moistened to near optimum moisture conditions and compacted to fill standards.

Fill Placement

1. Unless otherwise indicated, all site soil may be reused for compacted fill; however, some special processing or handling may be required (see text of report).
2. Material used in the compacting process should be evenly spread, moisture conditioned, processed, and compacted in thin lifts six (6) to eight (8) inches in compacted thickness to obtain a uniformly dense layer. The fill should be placed and compacted on a nearly horizontal plane, unless otherwise found acceptable by our representative.
3. If the moisture content or relative density varies from that recommended by this firm, the contractor should rework the fill until it is in accordance with the following:
    a) Moisture content of the fill should be at or above optimum moisture. Moisture should be evenly distributed without wet and dry pockets. Pre-watering of cut or removal areas should be considered in addition to watering during fill placement, particularly in clay or dry surficial soils. The ability of the contractor to obtain the proper moisture content will control production rates.
    b) Each six-inch layer should be compacted to at least 90 percent of the maximum dry density in compliance with the testing method specified by the controlling governmental agency. In most cases, the testing method is ASTM Test Designation D 1557.
4. Rock fragments less than eight inches in diameter may be utilized in the fill, provided:
    a) They are not placed in concentrated pockets;
    b) There is a sufficient percentage of fine-grained material to surround the rocks;
    c) The distribution of the rocks is observed by, and acceptable to, our representative.
5. Rocks exceeding eight (8) inches in diameter should be taken off site, broken into smaller fragments, or placed in accordance with recommendations of this firm in areas designated suitable for rock disposal. On projects where significant large quantities of oversized materials

are anticipated, alternate guidelines for placement may be included. If significant oversize materials are encountered during construction, these guidelines should be requested.

6. In clay soil, dry or large chunks or blocks are common. If in excess of eight (8) inches minimum dimension, then they are considered as oversized. Sheepsfoot compactors or other suitable methods should be used to break up blocks. When dry, they should be moisture conditioned to provide a uniform condition with the surrounding fill.

Slope Construction

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

UTILITY TRENCH CONSTRUCTION AND BACKFILL

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

Compaction methods vary for trench compaction and experience indicates many methods can be successful. However, procedures that "worked" on previous projects may or may not prove effective on a given site. The contractor(s) should outline the procedures proposed, so that we may discuss

them **prior** to construction. We will offer comments based on our knowledge of site conditions and experience.

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

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

JOB SAFETY

General

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

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

1. Safety Meetings: Our field personnel are directed to attend the contractor's regularly scheduled safety meetings.
2. Safety Vests: Safety vests are provided for and are to be worn by our personnel while on the job site.
3. Safety Flags: Safety flags are provided to our field technicians; one is to be affixed to the vehicle when on site, the other is to be placed atop the spoil pile on all test pits.

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

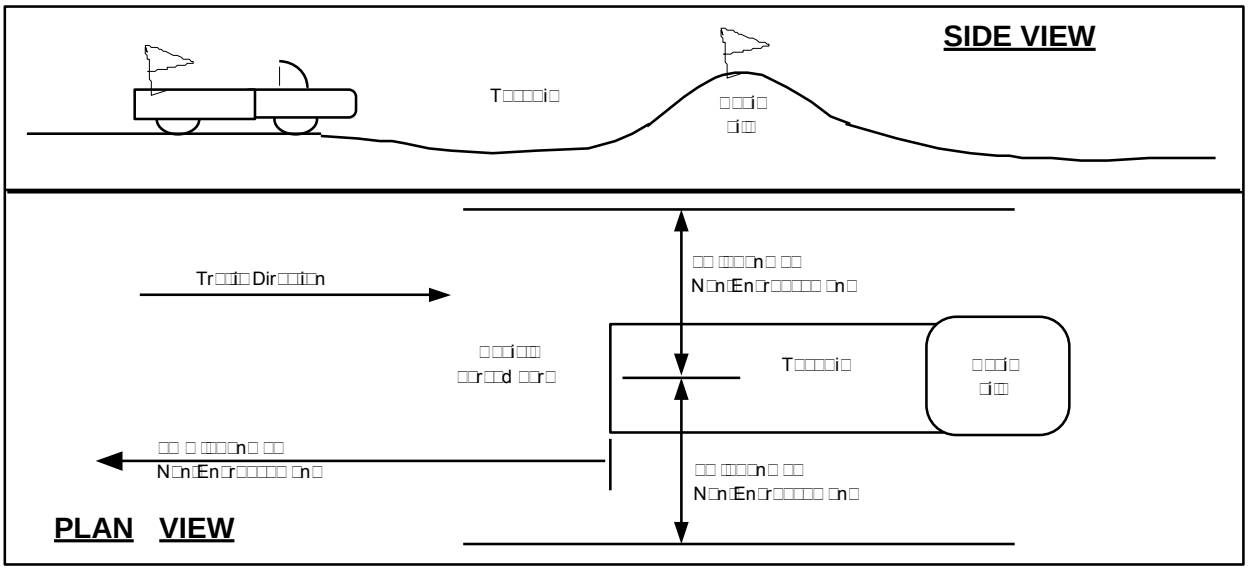
Test Pits Location, Orientation and Clearance

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

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

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

TEST PIT SAFETY PLAN



Slope Tests

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

The technician is directed to withdraw from the active portion of the fill as soon as possible following testing. The technician's vehicle should be parked at the perimeter of the fill in a highly visible location.

Trench Safety

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

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

Our personnel are directed not to enter any excavation which;

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

4. displays any other evidence of any unsafe conditions regardless of depth.

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

Procedures

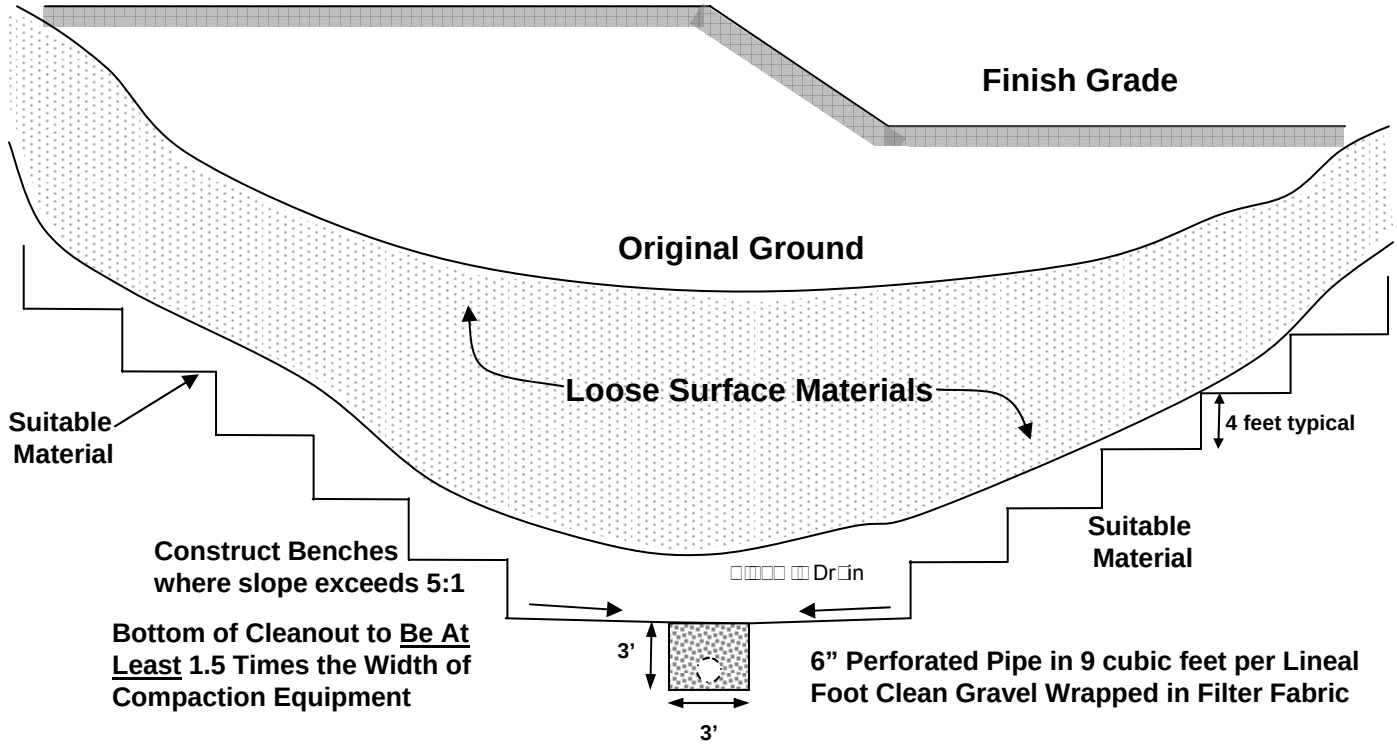
In the event that the technician's safety is jeopardized or compromised as a result of the contractor's failure to comply with any of the above, the technician is directed to inform both the developer's and contractor's representatives. If the condition is not rectified, the technician is required, by company policy, to immediately withdraw and notify their supervisor. The contractor's representative will then be contacted in an effort to effect a solution. No further testing will be performed until the situation is rectified. Any fill placed in the interim can be considered unacceptable and subject to reprocessing, recompaction or removal.

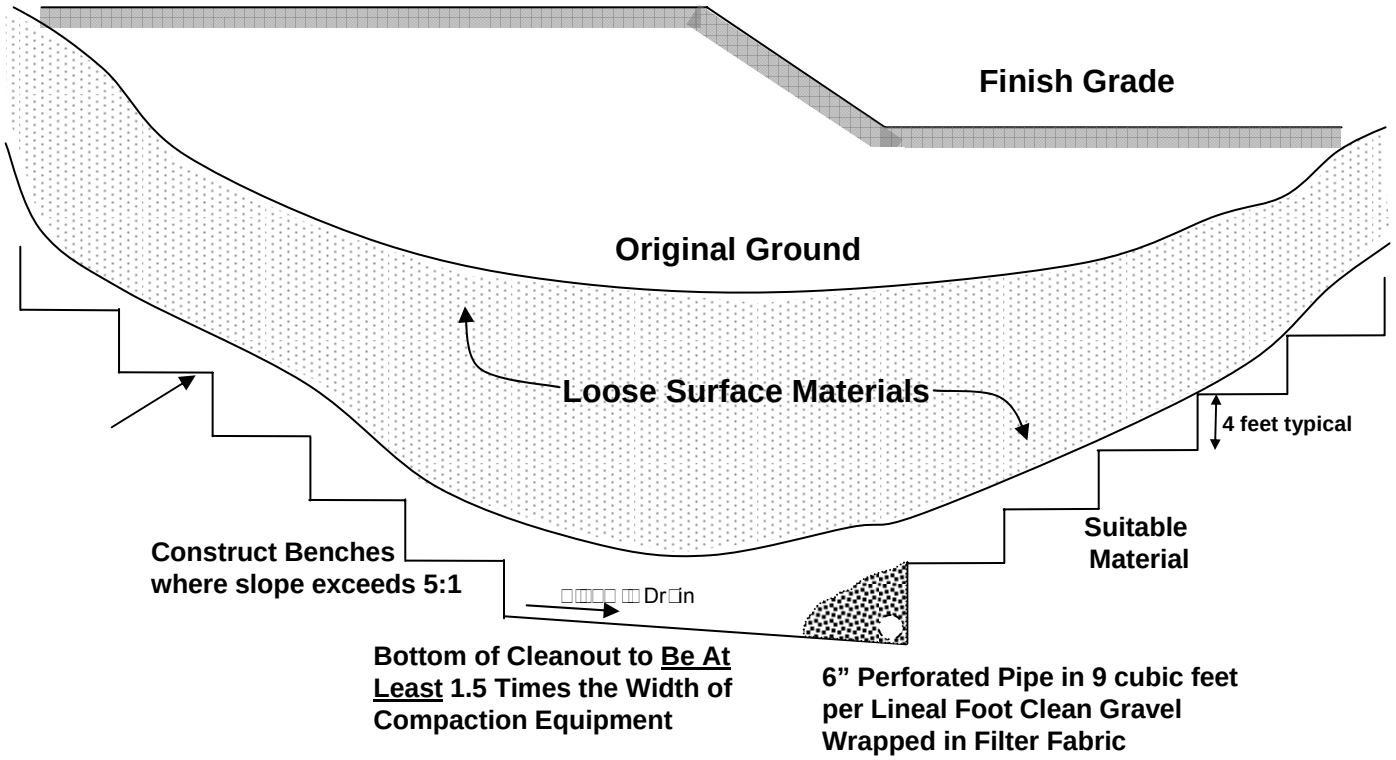
In the event that the soil technician does not comply with the above or other established safety guidelines, we request that the contractor bring this to technicians attention and notify our project manager or office. Effective communication and coordination between the contractors' representative and the field technician(s) is strongly encouraged in order to implement the above safety program and safety in general.

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

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

ALTERNATES





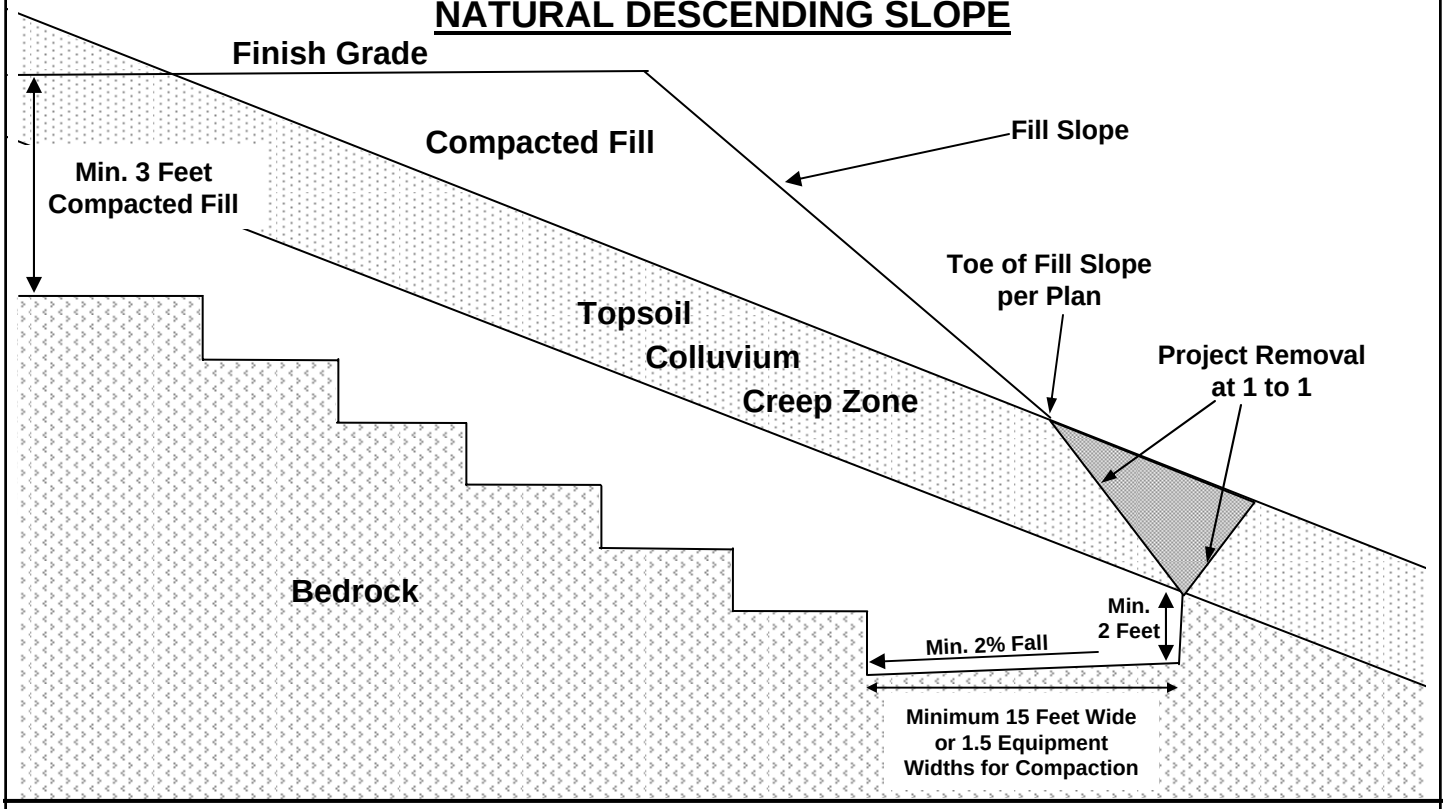
GEOTEK
1548 North Maple Street
Corona, California 92880

TYPICAL CANYON CLEANOUT

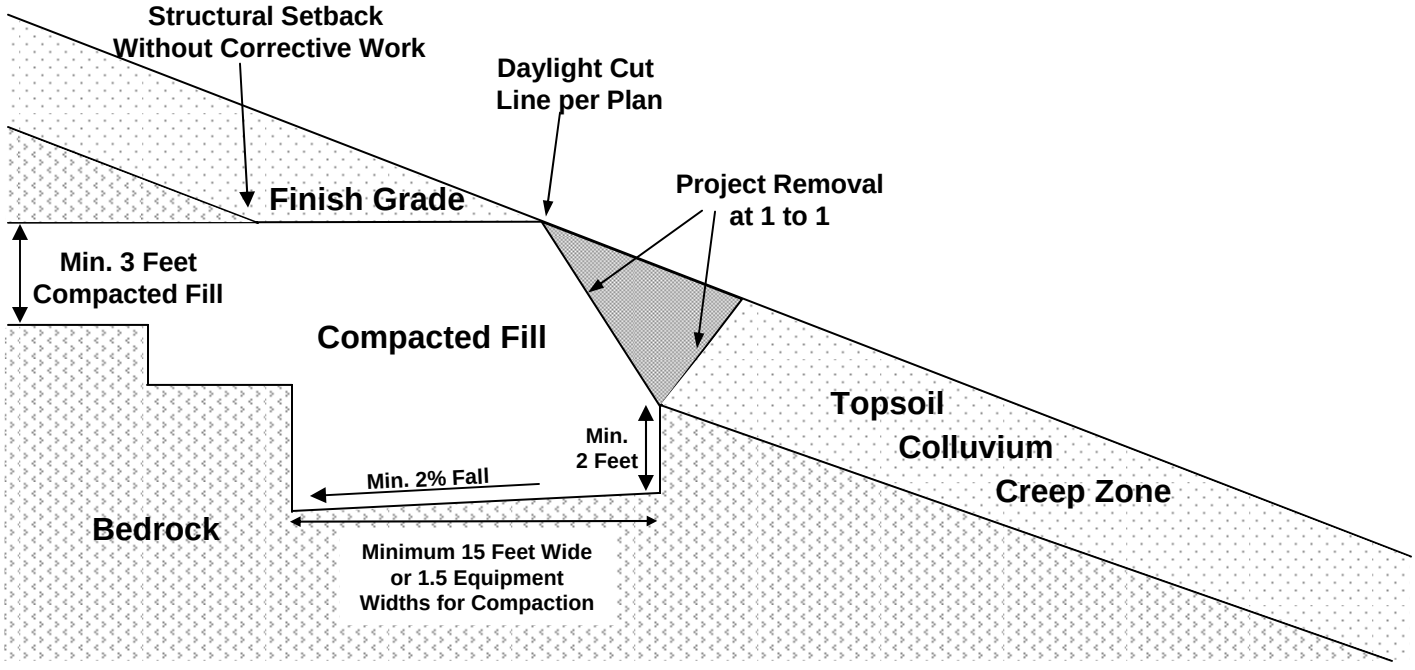
STANDARD GRADING GUIDELINES

PLATE G-1

TYPICAL FILL SLOPE OVER NATURAL DESCENDING SLOPE



DAYLIGHT CUT AREA OVER NATURAL DESCENDING SLOPE



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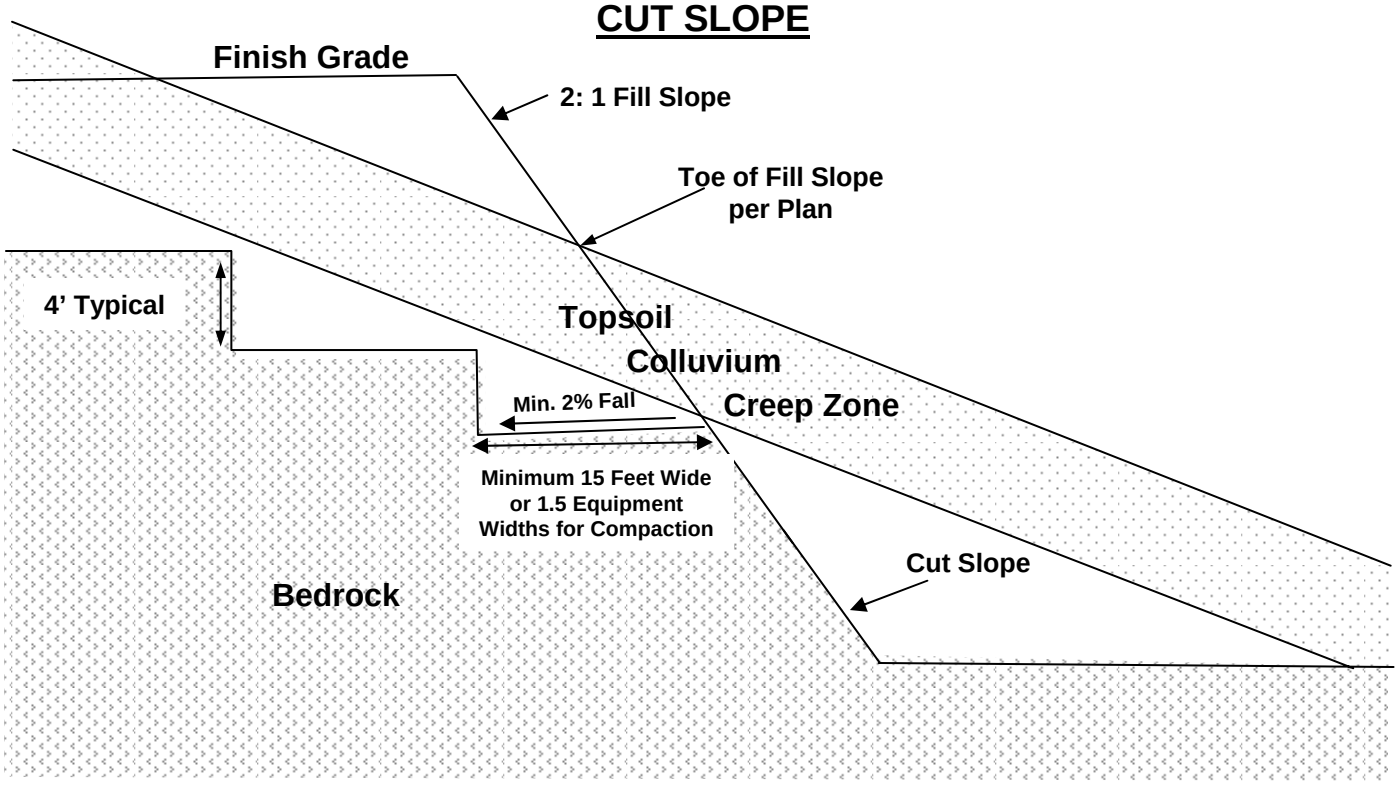
TREATMENT ABOVE NATURAL SLOPES

STANDARD GRADING GUIDELINES

PLATE G-2

TYPICAL FILL SLOPE OVER CUT SLOPE



TYPICAL FILL SLOPE

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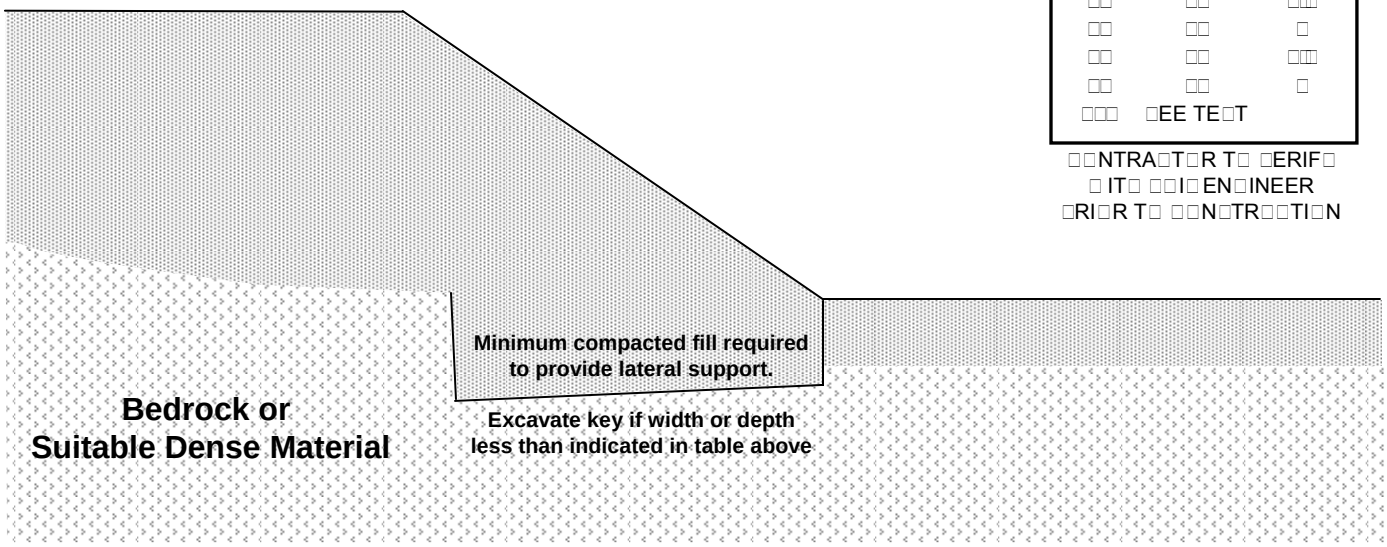

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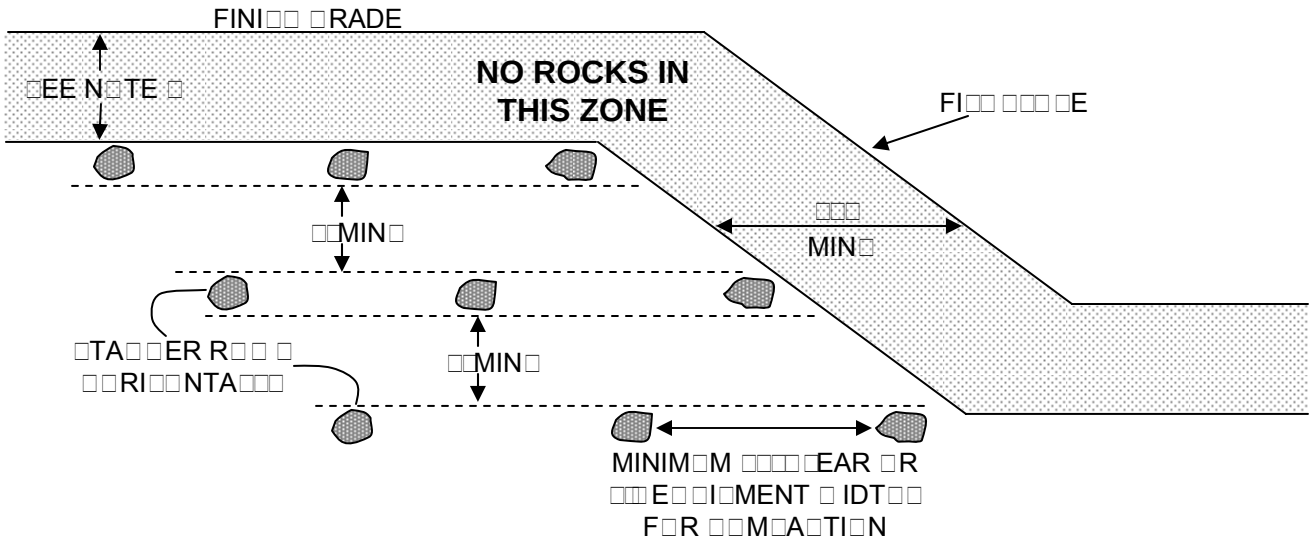
Corona, California 92880

COMMON FILL SLOPE KEYS

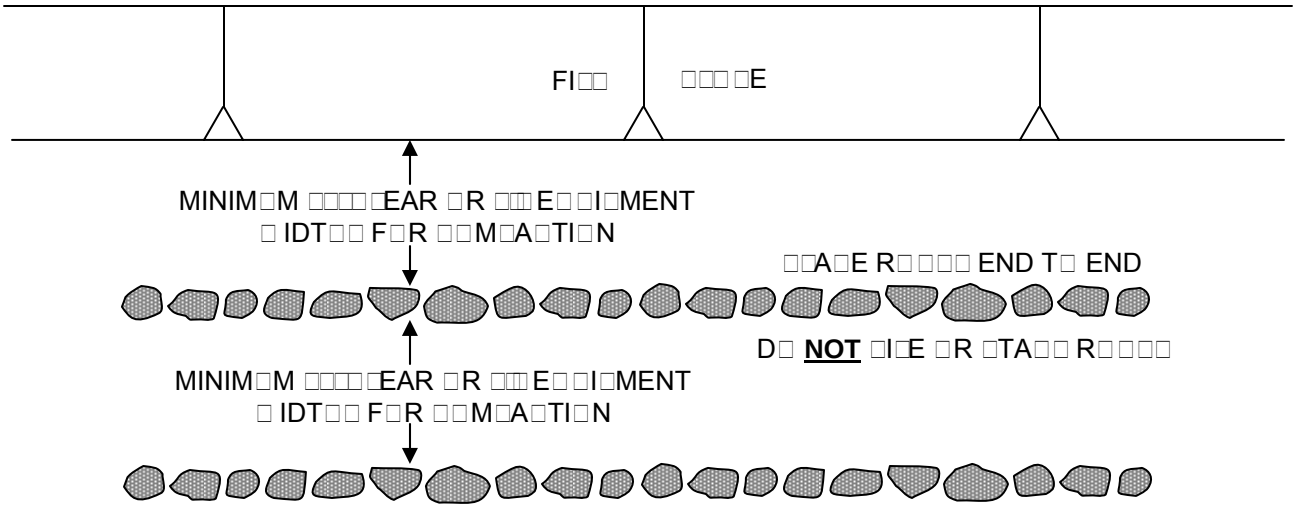
STANDARD GRADING GUIDELINES

PLATE G-3

CROSS SECTIONAL VIEW



PLAN VIEW



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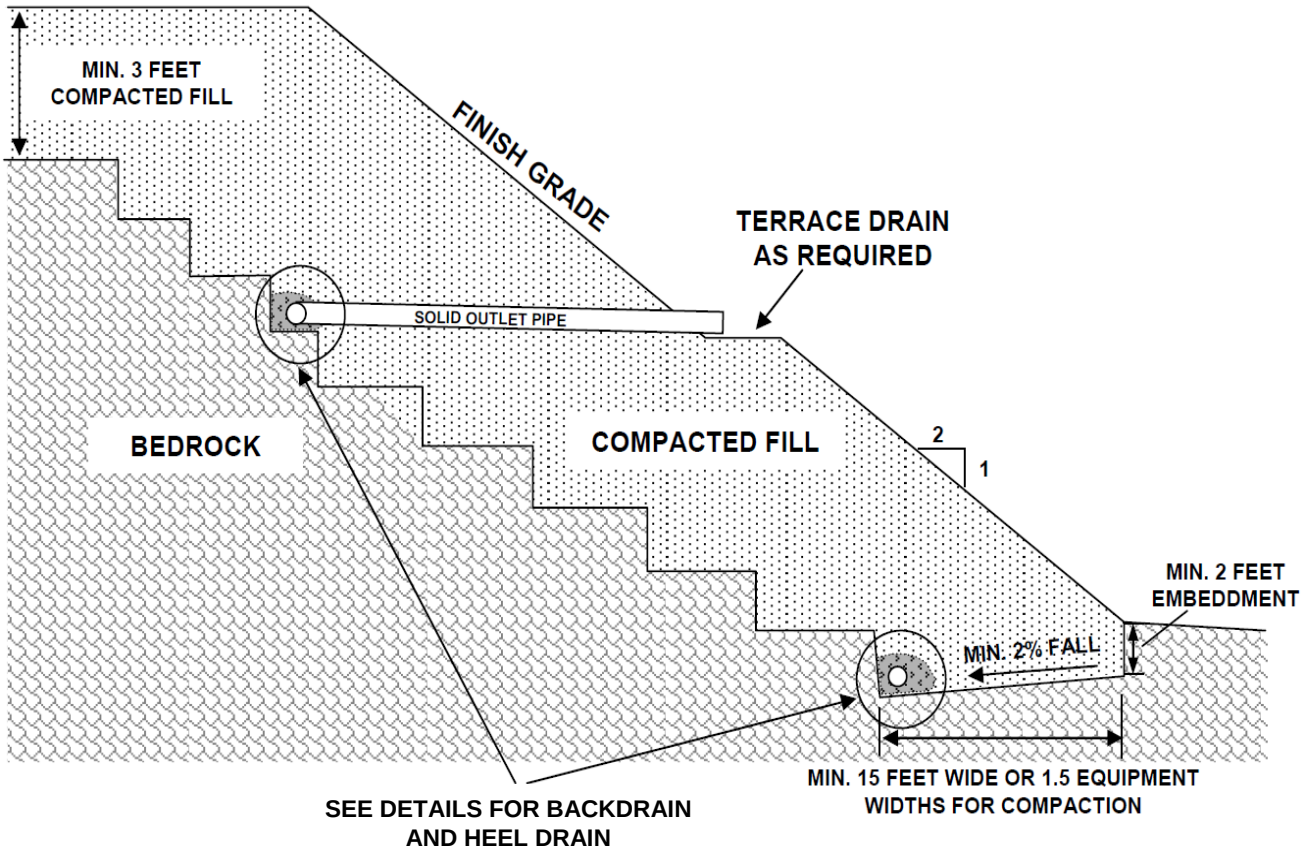
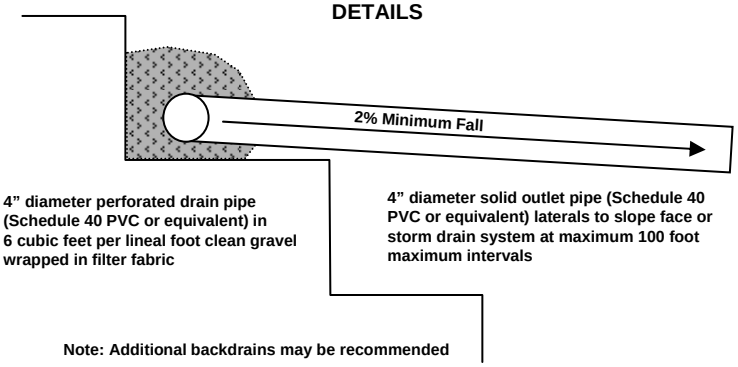
GEOTEK	1548 North Maple Street Corona, California 92880	ROCK BURIAL DETAILS	STANDARD GRADING GUIDELINES PLATE G-4



BACKDRAIN DETAILS



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

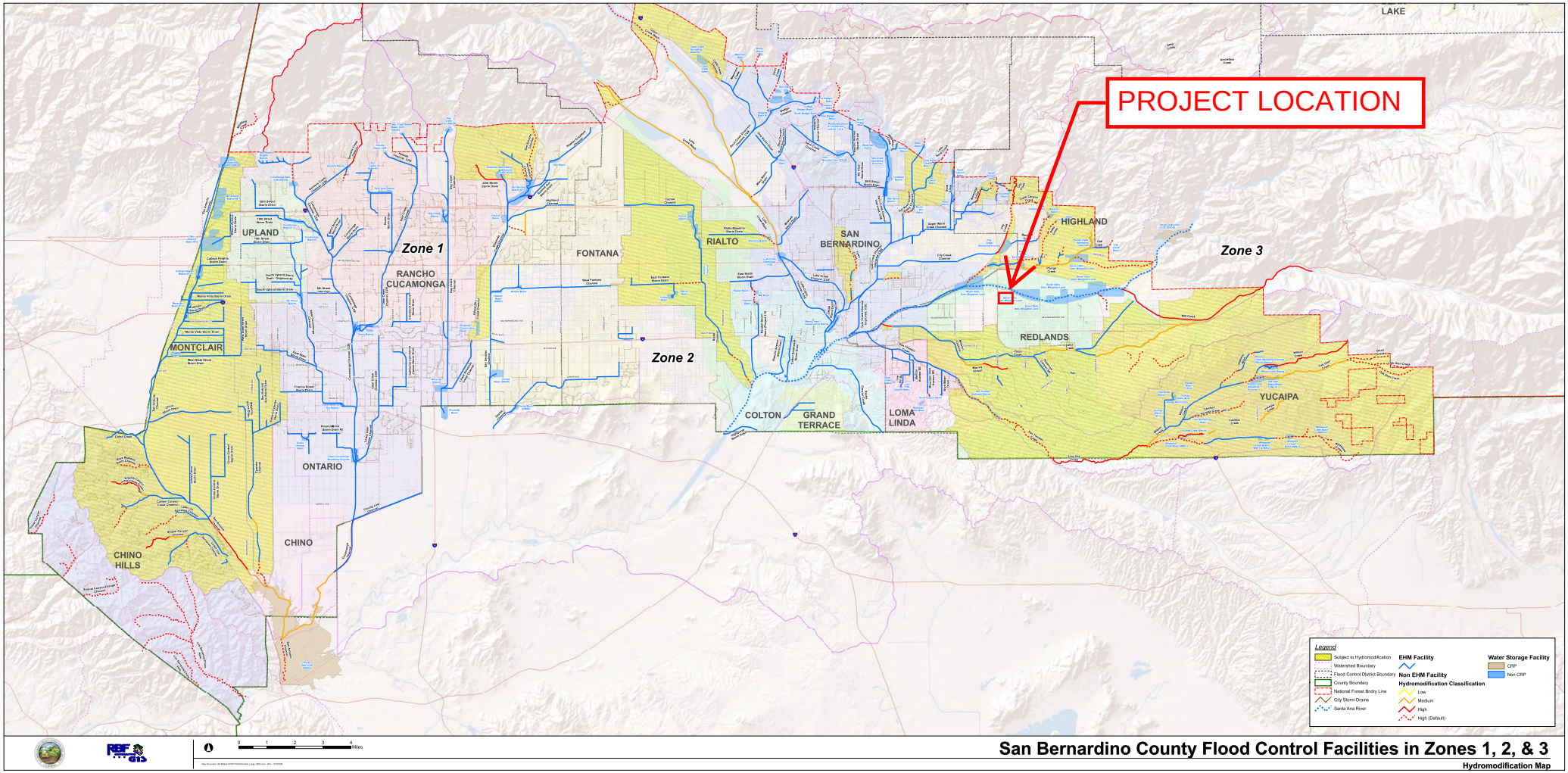
4" diameter solid outlet pipe (Schedule 40 PVC or equivalent) laterals to slope face or storm drain system at maximum 100 foot maximum intervals

Note: Additional backdrains may be recommended

HEEL DRAIN DETAILS

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

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



San Bernardino County Flood Control Facilities in Zones 1, 2, & 3

Hydromodification Map

Appendix C

Hydrology Analyses

C-1: Existing AES Hydrologic Analysis (100-yr)
C-2: Proposed AES Hydrologic Analysis (10-, 100-yr)
C-3: Hydrographs and Flood Routing Analysis (100-yr)
C-4: Stage-Outflow Relationship
C-5: San Bernardino County Unit Hydrograph Procedures

C-1: Existing AES Hydrologic Analysis (100-yr)

```
************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
         (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
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            Ver. 21.0  Release Date: 06/01/2014  License ID 1202

                        Analysis prepared by:

                         Huitt-Zollars, Inc.
                    2603 Main Street, Irvine CA. 92614
                             Suite 400
                           949-988-5815

 ************************* DESCRIPTION OF STUDY *************************
* TEXAS STREET - REDLANDS CA                                            *
* 100 YEAR STORM EVENT EXISTING CONDITIONS                              *
* RYAN KIM HC 12/29/21                                                  *
 ************************************************************************

  FILE NAME: TEX100E.DAT
  TIME/DATE OF STUDY: 10:19 12/29/2021
========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.4740
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2000

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    101.00 IS CODE =  21
------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   713.00
  ELEVATION DATA: UPSTREAM(FEET) =   1312.00  DOWNSTREAM(FEET) =   1295.00
```

```
  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   15.343
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.290
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  AGRICULTURAL POOR COVER
  "FALLOW"                    A        4.70      0.19     1.000    92   15.34
  NATURAL POOR COVER
  "BARREN"                    A        0.44      0.18     1.000    93   15.34
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.19
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      9.72
  TOTAL AREA(ACRES) =      5.14   PEAK FLOW RATE(CFS) =      9.72

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1295.00  DOWNSTREAM(FEET) =   1280.40
  CHANNEL LENGTH THRU SUBAREA(FEET) =   663.00   CHANNEL SLOPE =  0.0220
  CHANNEL FLOW THRU SUBAREA(CFS) =       9.72
  FLOW VELOCITY(FEET/SEC) =   3.68 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   3.00   Tc(MIN.) =   18.34
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =    1376.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    102.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   18.34
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.104
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  AGRICULTURAL POOR COVER
  "FALLOW"                    A        4.61      0.19     1.000    92
  NATURAL POOR COVER
  "BARREN"                    A        0.51      0.18     1.000    93
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.19
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA AREA(ACRES) =    5.12      SUBAREA RUNOFF(CFS) =    8.83
  EFFECTIVE AREA(ACRES) =     10.26   AREA-AVERAGED Fm(INCH/HR) =  0.19
  AREA-AVERAGED Fp(INCH/HR) =  0.19  AREA-AVERAGED Ap =  1.00
  TOTAL AREA(ACRES) =       10.3       PEAK FLOW RATE(CFS) =      17.69

****************************************************************************
  FLOW PROCESS FROM NODE    200.00 TO NODE    201.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   485.00
  ELEVATION DATA: UPSTREAM(FEET) =   1302.70  DOWNSTREAM(FEET) =   1289.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   12.713
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.504
```

```
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  AGRICULTURAL POOR COVER
  "FALLOW"                    A        1.35      0.19     1.000    92   12.71
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.19
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  1.000
  SUBAREA RUNOFF(CFS) =      2.81
  TOTAL AREA(ACRES) =      1.35   PEAK FLOW RATE(CFS) =      2.81
================================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        1.4  TC(MIN.) =     12.71
  EFFECTIVE AREA(ACRES) =      1.35  AREA-AVERAGED Fm(INCH/HR)=  0.19
  AREA-AVERAGED Fp(INCH/HR) =  0.19  AREA-AVERAGED Ap = 1.000
  PEAK FLOW RATE(CFS)   =       2.81
================================================================================
================================================================================
  END OF RATIONAL METHOD ANALYSIS
```

C-2: Proposed AES Hydrologic Analysis (10-, 100-yr)

```
******************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
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            Ver. 21.0  Release Date: 06/01/2014  License ID 1202

                          Analysis prepared by:

                           Huitt-Zollars, Inc.
                      2603 Main Street, Irvine CA. 92614
                                Suite 400
                               949-988-5815

 ************************* DESCRIPTION OF STUDY *************************
* 35 LOTS EAST OF TEXAS ST                                              *
* 10 YEAR STORM EVENT PROPOSED CONDITIONS                               *
* RYAN KIM HC 12/23/21                                                  *
 ************************************************************************

  FILE NAME: TEX10P.DAT
  TIME/DATE OF STUDY: 13:25 12/23/2021
==============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.4740
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 0.7490

  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     18.0    0.020/0.020/ ---    0.67    2.00 0.0313 0.167 0.0150
  2   33.0     21.0    0.020/0.020/ ---    0.67    2.00 0.0313 0.167 0.0130

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.67 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

******************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    101.00 IS CODE =  21
------------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   112.00
  ELEVATION DATA: UPSTREAM(FEET) =   1305.40  DOWNSTREAM(FEET) =   1303.60
```

```
  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.432
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "5-7 DWELLINGS/ACRE"       A        0.24      0.98     0.500    32    5.87
  COMMERCIAL                 A        0.10      0.98     0.100    32    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.97
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.382
  SUBAREA RUNOFF(CFS) =      0.63
  TOTAL AREA(ACRES) =      0.34   PEAK FLOW RATE(CFS) =      0.63

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1303.60  DOWNSTREAM ELEVATION(FEET) = 1301.60
  STREET LENGTH(FEET) =   186.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  18.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.13
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.28
    HALFSTREET FLOOD WIDTH(FEET) =    6.07
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.03
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.57
  STREET FLOW TRAVEL TIME(MIN.) =   1.53   Tc(MIN.) =    6.53
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.143
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "5-7 DWELLINGS/ACRE"       A        0.50      0.98     0.500    32
  COMMERCIAL                 A        0.14      0.98     0.100    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.412
  SUBAREA AREA(ACRES) =    0.64      SUBAREA RUNOFF(CFS) =    1.00
  EFFECTIVE AREA(ACRES) =      0.98    AREA-AVERAGED Fm(INCH/HR) =  0.39
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.40
  TOTAL AREA(ACRES) =        1.0        PEAK FLOW RATE(CFS) =       1.54

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.30   HALFSTREET FLOOD WIDTH(FEET) =   7.33
  FLOW VELOCITY(FEET/SEC.) =  2.12   DEPTH*VELOCITY(FT*FT/SEC.) =   0.65
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     298.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  62
----------------------------------------------------------------------------
```

```
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) = 1301.60  DOWNSTREAM ELEVATION(FEET) = 1298.20
  STREET LENGTH(FEET) =   250.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  18.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.76
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.34
    HALFSTREET FLOOD WIDTH(FEET) =    9.30
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.62
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.90
  STREET FLOW TRAVEL TIME(MIN.) =   1.59   Tc(MIN.) =    8.12
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  1.933
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "5-7 DWELLINGS/ACRE"       A        1.16      0.98     0.500    32
  COMMERCIAL                 A        0.56      0.98     0.100    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.370
  SUBAREA AREA(ACRES) =    1.72      SUBAREA RUNOFF(CFS) =    2.43
  EFFECTIVE AREA(ACRES) =      2.70    AREA-AVERAGED Fm(INCH/HR) =  0.37
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.38
  TOTAL AREA(ACRES) =        2.7        PEAK FLOW RATE(CFS) =       3.79

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.37   HALFSTREET FLOOD WIDTH(FEET) =  10.78
  FLOW VELOCITY(FEET/SEC.) =  2.81   DEPTH*VELOCITY(FT*FT/SEC.) =   1.05
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    103.00 =     548.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    104.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  2 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) = 1298.20  DOWNSTREAM ELEVATION(FEET) = 1296.30
  STREET LENGTH(FEET) =   300.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 33.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  21.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0130

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.53
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.44
    HALFSTREET FLOOD WIDTH(FEET) =   14.02
```

```
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.56
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.12
  STREET FLOW TRAVEL TIME(MIN.) =   1.95   Tc(MIN.) =   10.07
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  1.745
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "5-7 DWELLINGS/ACRE"       A        2.05      0.98     0.500    32
  COMMERCIAL                 A        0.77      0.98     0.100    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.391
  SUBAREA AREA(ACRES) =    2.82      SUBAREA RUNOFF(CFS) =    3.46
  EFFECTIVE AREA(ACRES) =      5.52    AREA-AVERAGED Fm(INCH/HR) =  0.38
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.39
  TOTAL AREA(ACRES) =        5.5        PEAK FLOW RATE(CFS) =       6.80

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.46   HALFSTREET FLOOD WIDTH(FEET) =  15.29
  FLOW VELOCITY(FEET/SEC.) =  2.69   DEPTH*VELOCITY(FT*FT/SEC.) =   1.25
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    104.00 =     848.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    105.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  2 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1296.30  DOWNSTREAM ELEVATION(FEET) = 1290.00
  STREET LENGTH(FEET) =   488.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 33.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  21.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0130

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       8.72
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.45
    HALFSTREET FLOOD WIDTH(FEET) =   14.62
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.75
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.69
  STREET FLOW TRAVEL TIME(MIN.) =   2.17   Tc(MIN.) =   12.24
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  1.591
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "5-7 DWELLINGS/ACRE"       A        2.45      0.98     0.500    32
  COMMERCIAL                 A        1.05      0.98     0.100    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.380
  SUBAREA AREA(ACRES) =    3.50      SUBAREA RUNOFF(CFS) =    3.85
  EFFECTIVE AREA(ACRES) =      9.02    AREA-AVERAGED Fm(INCH/HR) =  0.37
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.38
  TOTAL AREA(ACRES) =        9.0        PEAK FLOW RATE(CFS) =       9.88

  END OF SUBAREA STREET FLOW HYDRAULICS:
```

```
  DEPTH(FEET) = 0.47   HALFSTREET FLOOD WIDTH(FEET) =  15.41
  FLOW VELOCITY(FEET/SEC.) =  3.85   DEPTH*VELOCITY(FT*FT/SEC.) =   1.80
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    105.00 =    1336.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    106.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1290.00  DOWNSTREAM(FEET) =  1287.00
  FLOW LENGTH(FEET) =    46.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  15.0 INCH PIPE IS   8.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  13.77
  ESTIMATED PIPE DIAMETER(INCH) =  15.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       9.88
  PIPE TRAVEL TIME(MIN.) =   0.06    Tc(MIN.) =   12.30
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    106.00 =    1382.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    106.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   12.30
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  1.588
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK               A        1.70      0.98     0.850    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA AREA(ACRES) =    1.70      SUBAREA RUNOFF(CFS) =    1.16
  EFFECTIVE AREA(ACRES) =     10.72   AREA-AVERAGED Fm(INCH/HR) =  0.45
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.46
  TOTAL AREA(ACRES) =       10.7       PEAK FLOW RATE(CFS) =      11.01
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       10.7  TC(MIN.) =     12.30
  EFFECTIVE AREA(ACRES) =     10.72  AREA-AVERAGED Fm(INCH/HR)=  0.45
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap = 0.458
  PEAK FLOW RATE(CFS)   =      11.01
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
******************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
         (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
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            Ver. 21.0  Release Date: 06/01/2014  License ID 1202

                          Analysis prepared by:

                           Huitt-Zollars, Inc.
                      2603 Main Street, Irvine CA. 92614
                                Suite 400
                               949-988-5815

 ************************* DESCRIPTION OF STUDY *************************
* 35 LOTS EAST OF TEXAS ST                                              *
* 100 YEAR STORM EVENT PROPOSED CONDITIONS                              *
* RYAN KIM HC 12/23/21                                                  *
 ************************************************************************

  FILE NAME: TEX100P.DAT
  TIME/DATE OF STUDY: 13:20 12/23/2021
==============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.4740
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2000

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     18.0    0.020/0.020/ ---    0.67    2.00 0.0313 0.167 0.0150
  2   33.0     21.0    0.020/0.020/ ---    0.67    2.00 0.0313 0.167 0.0130

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.67 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

******************************************************************************
  FLOW PROCESS FROM NODE    100.00 TO NODE    101.00 IS CODE =  21
------------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   112.00
  ELEVATION DATA: UPSTREAM(FEET) =   1305.40  DOWNSTREAM(FEET) =   1303.60
```

```
  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.897
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "5-7 DWELLINGS/ACRE"       A        0.24      0.74     0.500    52    5.87
  COMMERCIAL                 A        0.10      0.74     0.100    52    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.382
  SUBAREA RUNOFF(CFS) =      1.11
  TOTAL AREA(ACRES) =      0.34   PEAK FLOW RATE(CFS) =      1.11

****************************************************************************
  FLOW PROCESS FROM NODE    101.00 TO NODE    102.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1303.60  DOWNSTREAM ELEVATION(FEET) = 1301.60
  STREET LENGTH(FEET) =   186.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  18.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.02
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.33
    HALFSTREET FLOOD WIDTH(FEET) =    8.43
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.24
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.73
  STREET FLOW TRAVEL TIME(MIN.) =   1.38   Tc(MIN.) =    6.38
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.471
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "5-7 DWELLINGS/ACRE"       A        0.50      0.74     0.500    52
  COMMERCIAL                 A        0.14      0.74     0.100    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.412
  SUBAREA AREA(ACRES) =    0.64      SUBAREA RUNOFF(CFS) =    1.82
  EFFECTIVE AREA(ACRES) =      0.98    AREA-AVERAGED Fm(INCH/HR) =  0.30
  AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap =  0.40
  TOTAL AREA(ACRES) =        1.0        PEAK FLOW RATE(CFS) =       2.80

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.36   HALFSTREET FLOOD WIDTH(FEET) =   9.85
  FLOW VELOCITY(FEET/SEC.) =  2.41   DEPTH*VELOCITY(FT*FT/SEC.) =   0.86
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    102.00 =     298.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    102.00 TO NODE    103.00 IS CODE =  62
----------------------------------------------------------------------------
```

```
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) = 1301.60  DOWNSTREAM ELEVATION(FEET) = 1298.20
  STREET LENGTH(FEET) =   250.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  18.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.04
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.40
    HALFSTREET FLOOD WIDTH(FEET) =   12.20
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.00
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.21
  STREET FLOW TRAVEL TIME(MIN.) =   1.39   Tc(MIN.) =    7.77
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.162
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "5-7 DWELLINGS/ACRE"       A        1.16      0.74     0.500    52
  COMMERCIAL                 A        0.56      0.74     0.100    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.370
  SUBAREA AREA(ACRES) =    1.72      SUBAREA RUNOFF(CFS) =    4.47
  EFFECTIVE AREA(ACRES) =      2.70    AREA-AVERAGED Fm(INCH/HR) =  0.28
  AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap =  0.38
  TOTAL AREA(ACRES) =        2.7        PEAK FLOW RATE(CFS) =       7.00

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.44   HALFSTREET FLOOD WIDTH(FEET) =  14.00
  FLOW VELOCITY(FEET/SEC.) =  3.25   DEPTH*VELOCITY(FT*FT/SEC.) =   1.43
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    103.00 =     548.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    103.00 TO NODE    104.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  2 USED)<<<<<
================================================================================
  UPSTREAM ELEVATION(FEET) = 1298.20  DOWNSTREAM ELEVATION(FEET) = 1296.30
  STREET LENGTH(FEET) =   300.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 33.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  21.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0130

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      10.29
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.52
    HALFSTREET FLOOD WIDTH(FEET) =   18.14
```

```
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.96
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.54
  STREET FLOW TRAVEL TIME(MIN.) =   1.69   Tc(MIN.) =    9.46
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.880
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "5-7 DWELLINGS/ACRE"       A        2.05      0.74     0.500    52
  COMMERCIAL                 A        0.77      0.74     0.100    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.391
  SUBAREA AREA(ACRES) =    2.82      SUBAREA RUNOFF(CFS) =    6.57
  EFFECTIVE AREA(ACRES) =      5.52    AREA-AVERAGED Fm(INCH/HR) =  0.29
  AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap =  0.39
  TOTAL AREA(ACRES) =        5.5        PEAK FLOW RATE(CFS) =      12.89

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.55   HALFSTREET FLOOD WIDTH(FEET) =  19.83
  FLOW VELOCITY(FEET/SEC.) =  3.13   DEPTH*VELOCITY(FT*FT/SEC.) =   1.73
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    104.00 =     848.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    104.00 TO NODE    105.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  2 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1296.30  DOWNSTREAM ELEVATION(FEET) = 1290.00
  STREET LENGTH(FEET) =   488.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 33.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  21.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0130

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      16.61
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.54
    HALFSTREET FLOOD WIDTH(FEET) =   19.04
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    4.35
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    2.35
  STREET FLOW TRAVEL TIME(MIN.) =   1.87   Tc(MIN.) =   11.33
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.644
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "5-7 DWELLINGS/ACRE"       A        2.45      0.74     0.500    52
  COMMERCIAL                 A        1.05      0.74     0.100    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.380
  SUBAREA AREA(ACRES) =    3.50      SUBAREA RUNOFF(CFS) =    7.44
  EFFECTIVE AREA(ACRES) =      9.02    AREA-AVERAGED Fm(INCH/HR) =  0.28
  AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap =  0.38
  TOTAL AREA(ACRES) =        9.0        PEAK FLOW RATE(CFS) =      19.16

  END OF SUBAREA STREET FLOW HYDRAULICS:
```

```
  DEPTH(FEET) = 0.56   HALFSTREET FLOOD WIDTH(FEET) =  20.13
  FLOW VELOCITY(FEET/SEC.) =  4.51   DEPTH*VELOCITY(FT*FT/SEC.) =   2.53
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    105.00 =    1336.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    105.00 TO NODE    106.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1290.00  DOWNSTREAM(FEET) =  1287.00
  FLOW LENGTH(FEET) =    46.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  11.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  16.16
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      19.16
  PIPE TRAVEL TIME(MIN.) =   0.05    Tc(MIN.) =   11.38
  LONGEST FLOWPATH FROM NODE    100.00 TO NODE    106.00 =    1382.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE    106.00 TO NODE    106.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   11.38
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.639
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK               A        1.70      0.74     0.850    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.74
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA AREA(ACRES) =    1.70      SUBAREA RUNOFF(CFS) =    3.07
  EFFECTIVE AREA(ACRES) =     10.72   AREA-AVERAGED Fm(INCH/HR) =  0.34
  AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap =  0.46
  TOTAL AREA(ACRES) =       10.7       PEAK FLOW RATE(CFS) =      22.19
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       10.7  TC(MIN.) =     11.38
  EFFECTIVE AREA(ACRES) =     10.72  AREA-AVERAGED Fm(INCH/HR)=  0.34
  AREA-AVERAGED Fp(INCH/HR) =  0.74  AREA-AVERAGED Ap = 0.458
  PEAK FLOW RATE(CFS)   =      22.19
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

C-3: Hydrographs and Flood Routing Analysis (100-yr)

```
**************************************************************************
          NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                    AND LOW LOSS FRACTION ESTIMATIONS
==========================================================================
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                           Analysis prepared by:

                            Huitt-Zollars, Inc.
                        2603 Main Street, Irvine CA. 92614
                                  Suite 400
                                949-988-5815

**************************************************************************
--------------------------------------------------------------------------

 Problem Descriptions:
  Texas Redlands
  100 Year Storm Event Flood Routing
  Ryan Kim HC 12/29/21
==========================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC III:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     4.97 (inches)

    SOIL-COVER     AREA      PERCENT OF    SCS CURVE    LOSS RATE
       TYPE      (Acres)   PERVIOUS AREA     NUMBER    Fp(in./hr.)    YIELD
         1          2.62        0.00       98.(AMC II)     0.000       0.952
         2          1.70       90.00       58.(AMC II)     0.399       0.566
         3          6.40       40.00       58.(AMC II)     0.399       0.781

    TOTAL AREA (Acres) =     10.72
                              _
    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.152
```

```
    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.212
==========================================================================

 Problem Descriptions:
  Texas Redlands
  100 Year Storm Event Flood Routing
  Ryan Kim HC 12/29/21
--------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
    TOTAL CATCHMENT AREA(ACRES) =   10.72
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.152
    LOW LOSS FRACTION = 0.212
    TIME OF CONCENTRATION(MIN.) = 11.38
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    USER SPECIFIED RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) = 100
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.32
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.83
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  1.20
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  1.98
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  2.72
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  4.97

--------------------------------------------------------------------------

    TOTAL CATCHMENT   RUNOFF  VOLUME(ACRE-FEET) =     3.21
    TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) =     1.23

**************************************************************************
  TIME     VOLUME       Q    0.        7.5      15.0      22.5      30.0
 (HOURS)    (AF)      (CFS)
--------------------------------------------------------------------------
  0.07      0.0000      0.00  Q         .         .         .         .
  0.26      0.0054      0.69  Q         .         .         .         .
```

0.45	0.0162	0.69	Q	.	.	.	.
0.64	0.0271	0.70	Q	.	.	.	.
0.83	0.0380	0.70	Q	.	.	.	.
1.02	0.0491	0.71	Q	.	.	.	.
1.21	0.0602	0.71	Q	.	.	.	.
1.40	0.0714	0.72	Q	.	.	.	.
1.59	0.0826	0.72	Q	.	.	.	.
1.77	0.0940	0.73	Q	.	.	.	.
1.96	0.1054	0.73	Q	.	.	.	.
2.15	0.1170	0.74	Q	.	.	.	.
2.34	0.1286	0.74	Q	.	.	.	.
2.53	0.1403	0.75	.Q	.	.	.	.
2.72	0.1521	0.75	.Q	.	.	.	.
2.91	0.1640	0.76	.Q	.	.	.	.
3.10	0.1760	0.77	.Q	.	.	.	.
3.29	0.1880	0.78	.Q	.	.	.	.
3.48	0.2002	0.78	.Q	.	.	.	.
3.67	0.2125	0.79	.Q	.	.	.	.
3.86	0.2249	0.79	.Q	.	.	.	.
4.05	0.2374	0.80	.Q	.	.	.	.
4.24	0.2500	0.81	.Q	.	.	.	.
4.43	0.2628	0.82	.Q	.	.	.	.
4.62	0.2756	0.82	.Q	.	.	.	.
4.81	0.2886	0.83	.Q	.	.	.	.
5.00	0.3017	0.84	.Q	.	.	.	.
5.19	0.3149	0.85	.Q	.	.	.	.
5.38	0.3283	0.85	.Q	.	.	.	.
5.57	0.3417	0.87	.Q	.	.	.	.
5.76	0.3554	0.87	.Q	.	.	.	.
5.95	0.3691	0.88	.Q	.	.	.	.
6.14	0.3830	0.89	.Q	.	.	.	.
6.33	0.3971	0.90	.Q	.	.	.	.
6.52	0.4113	0.91	.Q	.	.	.	.
6.71	0.4257	0.92	.Q	.	.	.	.
6.90	0.4402	0.93	.Q	.	.	.	.
7.09	0.4549	0.95	.Q	.	.	.	.
7.28	0.4698	0.95	.Q	.	.	.	.

7.46	0.4848	0.97	.Q	.	.	.	.
7.65	0.5001	0.98	.Q	.	.	.	.
7.84	0.5155	0.99	.Q	.	.	.	.
8.03	0.5311	1.00	.Q	.	.	.	.
8.22	0.5470	1.02	.Q	.	.	.	.
8.41	0.5630	1.03	.Q	.	.	.	.
8.60	0.5793	1.05	.Q	.	.	.	.
8.79	0.5958	1.06	.Q	.	.	.	.
8.98	0.6126	1.08	.Q	.	.	.	.
9.17	0.6296	1.09	.Q	.	.	.	.
9.36	0.6469	1.11	.Q	.	.	.	.
9.55	0.6644	1.13	.Q	.	.	.	.
9.74	0.6823	1.15	.Q	.	.	.	.
9.93	0.7004	1.16	.Q	.	.	.	.
10.12	0.7189	1.19	.Q	.	.	.	.
10.31	0.7377	1.21	.Q	.	.	.	.
10.50	0.7568	1.24	.Q	.	.	.	.
10.69	0.7763	1.25	.Q	.	.	.	.
10.88	0.7962	1.29	.Q	.	.	.	.
11.07	0.8165	1.30	.Q	.	.	.	.
11.26	0.8372	1.34	.Q	.	.	.	.
11.45	0.8584	1.36	.Q	.	.	.	.
11.64	0.8800	1.40	.Q	.	.	.	.
11.83	0.9022	1.43	.Q	.	.	.	.
12.02	0.9250	1.48	.Q	.	.	.	.
12.21	0.9487	1.55	. Q	.	.	.	.
12.40	0.9737	1.64	. Q	.	.	.	.
12.59	0.9997	1.67	. Q	.	.	.	.
12.78	1.0264	1.74	. Q	.	.	.	.
12.97	1.0539	1.77	. Q	.	.	.	.
13.15	1.0824	1.85	. Q	.	.	.	.
13.34	1.1118	1.90	. Q	.	.	.	.
13.53	1.1423	2.00	. Q	.	.	.	.
13.72	1.1741	2.05	. Q	.	.	.	.
13.91	1.2072	2.18	. Q	.	.	.	.
14.10	1.2419	2.25	. Q	.	.	.	.
14.29	1.2783	2.40	. Q	.	.	.	.

14.48	1.3166	2.49	. Q . . . .
14.67	1.3575	2.72	. Q . . . .
14.86	1.4013	2.86	. Q . . . .
15.05	1.4488	3.21	. Q . . . .
15.24	1.5009	3.44	. Q . . . .
15.43	1.5613	4.28	. Q . . . .
15.62	1.6363	5.30	. Q . . . .
15.81	1.7349	7.28	. Q. . . .
16.00	1.8678	9.68	. . Q . . .
16.19	2.1293	23.69	. . . .Q .
16.38	2.3627	6.09	. Q . . . .
16.57	2.4395	3.71	. Q . . . .
16.76	2.4923	3.02	. Q . . . .
16.95	2.5363	2.60	. Q . . . .
17.14	2.5748	2.31	. Q . . . .
17.33	2.6095	2.11	. Q . . . .
17.52	2.6413	1.95	. Q . . . .
17.71	2.6708	1.81	. Q . . . .
17.90	2.6984	1.70	. Q . . . .
18.09	2.7244	1.61	. Q . . . .
18.28	2.7483	1.45	.Q . . . .
18.47	2.7706	1.38	.Q . . . .
18.66	2.7917	1.32	.Q . . . .
18.84	2.8120	1.27	.Q . . . .
19.03	2.8316	1.22	.Q . . . .
19.22	2.8503	1.18	.Q . . . .
19.41	2.8685	1.14	.Q . . . .
19.60	2.8860	1.10	.Q . . . .
19.79	2.9031	1.07	.Q . . . .
19.98	2.9196	1.04	.Q . . . .
20.17	2.9356	1.01	.Q . . . .
20.36	2.9513	0.98	.Q . . . .
20.55	2.9665	0.96	.Q . . . .
20.74	2.9814	0.94	.Q . . . .
20.93	2.9959	0.92	.Q . . . .
21.12	3.0102	0.90	.Q . . . .
21.31	3.0241	0.88	.Q . . . .

21.50	3.0377	0.86	.Q	.	.	.	.
21.69	3.0510	0.84	.Q	.	.	.	.
21.88	3.0641	0.83	.Q	.	.	.	.
22.07	3.0770	0.81	.Q	.	.	.	.
22.26	3.0896	0.80	.Q	.	.	.	.
22.45	3.1020	0.78	.Q	.	.	.	.
22.64	3.1142	0.77	.Q	.	.	.	.
22.83	3.1262	0.76	.Q	.	.	.	.
23.02	3.1380	0.75	Q	.	.	.	.
23.21	3.1496	0.74	Q	.	.	.	.
23.40	3.1610	0.72	Q	.	.	.	.
23.59	3.1723	0.71	Q	.	.	.	.
23.78	3.1834	0.70	Q	.	.	.	.
23.97	3.1944	0.69	Q	.	.	.	.
24.16	3.2052	0.69	Q	.	.	.	.
24.35	3.2105	0.00	Q	.	.	.	.

TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
(Note: 100% of Peak Flow Rate estimate assumed to have
an instantaneous time duration)

Percentile of Estimated Peak Flow Rate	Duration (minutes)
0%	1445.3
10%	170.7
20%	56.9
30%	34.1
40%	22.8
50%	11.4
60%	11.4
70%	11.4
80%	11.4
90%	11.4

Problem Descriptions:

Texas Redlands
100 Year Storm Event Flood Routing
Ryan Kim HC 12/29/21

RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
TOTAL CATCHMENT AREA(ACRES) = 10.72
SOIL-LOSS RATE, Fm,(INCH/HR) = 0.152
LOW LOSS FRACTION = 0.212
TIME OF CONCENTRATION(MIN.) = 11.38
SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
USER SPECIFIED RAINFALL VALUES ARE USED
RETURN FREQUENCY(YEARS) = 100
5-MINUTE POINT RAINFALL VALUE(INCHES) = 0.32
30-MINUTE POINT RAINFALL VALUE(INCHES) = 0.83
1-HOUR POINT RAINFALL VALUE(INCHES) = 1.20
3-HOUR POINT RAINFALL VALUE(INCHES) = 1.98
6-HOUR POINT RAINFALL VALUE(INCHES) = 2.72
24-HOUR POINT RAINFALL VALUE(INCHES) = 4.97

TOTAL CATCHMENT RUNOFF VOLUME(ACRE-FEET) = 3.21
TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) = 1.23

****

TIME (HOURS)	VOLUME (AF)	Q (CFS)	0.	7.5	15.0	22.5	30.0
0.07	0.0000	0.00	Q	.	.	.	.
0.26	0.0054	0.69	Q	.	.	.	.
0.45	0.0162	0.69	Q	.	.	.	.
0.64	0.0271	0.70	Q	.	.	.	.
0.83	0.0380	0.70	Q	.	.	.	.
1.02	0.0491	0.71	Q	.	.	.	.
1.21	0.0602	0.71	Q	.	.	.	.

1.40	0.0714	0.72	Q	.	.	.	.
1.59	0.0826	0.72	Q	.	.	.	.
1.77	0.0940	0.73	Q	.	.	.	.
1.96	0.1054	0.73	Q	.	.	.	.
2.15	0.1170	0.74	Q	.	.	.	.
2.34	0.1286	0.74	Q	.	.	.	.
2.53	0.1403	0.75	.Q	.	.	.	.
2.72	0.1521	0.75	.Q	.	.	.	.
2.91	0.1640	0.76	.Q	.	.	.	.
3.10	0.1760	0.77	.Q	.	.	.	.
3.29	0.1880	0.78	.Q	.	.	.	.
3.48	0.2002	0.78	.Q	.	.	.	.
3.67	0.2125	0.79	.Q	.	.	.	.
3.86	0.2249	0.79	.Q	.	.	.	.
4.05	0.2374	0.80	.Q	.	.	.	.
4.24	0.2500	0.81	.Q	.	.	.	.
4.43	0.2628	0.82	.Q	.	.	.	.
4.62	0.2756	0.82	.Q	.	.	.	.
4.81	0.2886	0.83	.Q	.	.	.	.
5.00	0.3017	0.84	.Q	.	.	.	.
5.19	0.3149	0.85	.Q	.	.	.	.
5.38	0.3283	0.85	.Q	.	.	.	.
5.57	0.3417	0.87	.Q	.	.	.	.
5.76	0.3554	0.87	.Q	.	.	.	.
5.95	0.3691	0.88	.Q	.	.	.	.
6.14	0.3830	0.89	.Q	.	.	.	.
6.33	0.3971	0.90	.Q	.	.	.	.
6.52	0.4113	0.91	.Q	.	.	.	.
6.71	0.4257	0.92	.Q	.	.	.	.
6.90	0.4402	0.93	.Q	.	.	.	.
7.09	0.4549	0.95	.Q	.	.	.	.
7.28	0.4698	0.95	.Q	.	.	.	.
7.46	0.4848	0.97	.Q	.	.	.	.
7.65	0.5001	0.98	.Q	.	.	.	.
7.84	0.5155	0.99	.Q	.	.	.	.
8.03	0.5311	1.00	.Q	.	.	.	.
8.22	0.5470	1.02	.Q	.	.	.	.

8.41	0.5630	1.03	.Q	.	.	.	.
8.60	0.5793	1.05	.Q	.	.	.	.
8.79	0.5958	1.06	.Q	.	.	.	.
8.98	0.6126	1.08	.Q	.	.	.	.
9.17	0.6296	1.09	.Q	.	.	.	.
9.36	0.6469	1.11	.Q	.	.	.	.
9.55	0.6644	1.13	.Q	.	.	.	.
9.74	0.6823	1.15	.Q	.	.	.	.
9.93	0.7004	1.16	.Q	.	.	.	.
10.12	0.7189	1.19	.Q	.	.	.	.
10.31	0.7377	1.21	.Q	.	.	.	.
10.50	0.7568	1.24	.Q	.	.	.	.
10.69	0.7763	1.25	.Q	.	.	.	.
10.88	0.7962	1.29	.Q	.	.	.	.
11.07	0.8165	1.30	.Q	.	.	.	.
11.26	0.8372	1.34	.Q	.	.	.	.
11.45	0.8584	1.36	.Q	.	.	.	.
11.64	0.8800	1.40	.Q	.	.	.	.
11.83	0.9022	1.43	.Q	.	.	.	.
12.02	0.9250	1.48	.Q	.	.	.	.
12.21	0.9487	1.55	. Q	.	.	.	.
12.40	0.9737	1.64	. Q	.	.	.	.
12.59	0.9997	1.67	. Q	.	.	.	.
12.78	1.0264	1.74	. Q	.	.	.	.
12.97	1.0539	1.77	. Q	.	.	.	.
13.15	1.0824	1.85	. Q	.	.	.	.
13.34	1.1118	1.90	. Q	.	.	.	.
13.53	1.1423	2.00	. Q	.	.	.	.
13.72	1.1741	2.05	. Q	.	.	.	.
13.91	1.2072	2.18	. Q	.	.	.	.
14.10	1.2419	2.25	. Q	.	.	.	.
14.29	1.2783	2.40	. Q	.	.	.	.
14.48	1.3166	2.49	. Q	.	.	.	.
14.67	1.3575	2.72	. Q	.	.	.	.
14.86	1.4013	2.86	. Q	.	.	.	.
15.05	1.4488	3.21	. Q	.	.	.	.
15.24	1.5009	3.44	. Q	.	.	.	.

15.43	1.5613	4.28	. Q . . . .
15.62	1.6363	5.30	. Q . . . .
15.81	1.7349	7.28	. Q. . . .
16.00	1.8678	9.68	. . Q . . .
16.19	2.1293	23.69	. . . .Q .
16.38	2.3627	6.09	. Q . . . .
16.57	2.4395	3.71	. Q . . . .
16.76	2.4923	3.02	. Q . . . .
16.95	2.5363	2.60	. Q . . . .
17.14	2.5748	2.31	. Q . . . .
17.33	2.6095	2.11	. Q . . . .
17.52	2.6413	1.95	. Q . . . .
17.71	2.6708	1.81	. Q . . . .
17.90	2.6984	1.70	. Q . . . .
18.09	2.7244	1.61	. Q . . . .
18.28	2.7483	1.45	.Q . . . .
18.47	2.7706	1.38	.Q . . . .
18.66	2.7917	1.32	.Q . . . .
18.84	2.8120	1.27	.Q . . . .
19.03	2.8316	1.22	.Q . . . .
19.22	2.8503	1.18	.Q . . . .
19.41	2.8685	1.14	.Q . . . .
19.60	2.8860	1.10	.Q . . . .
19.79	2.9031	1.07	.Q . . . .
19.98	2.9196	1.04	.Q . . . .
20.17	2.9356	1.01	.Q . . . .
20.36	2.9513	0.98	.Q . . . .
20.55	2.9665	0.96	.Q . . . .
20.74	2.9814	0.94	.Q . . . .
20.93	2.9959	0.92	.Q . . . .
21.12	3.0102	0.90	.Q . . . .
21.31	3.0241	0.88	.Q . . . .
21.50	3.0377	0.86	.Q . . . .
21.69	3.0510	0.84	.Q . . . .
21.88	3.0641	0.83	.Q . . . .
22.07	3.0770	0.81	.Q . . . .
22.26	3.0896	0.80	.Q . . . .

22.45	3.1020	0.78	.Q	.	.	.	.
22.64	3.1142	0.77	.Q	.	.	.	.
22.83	3.1262	0.76	.Q	.	.	.	.
23.02	3.1380	0.75	Q	.	.	.	.
23.21	3.1496	0.74	Q	.	.	.	.
23.40	3.1610	0.72	Q	.	.	.	.
23.59	3.1723	0.71	Q	.	.	.	.
23.78	3.1834	0.70	Q	.	.	.	.
23.97	3.1944	0.69	Q	.	.	.	.
24.16	3.2052	0.69	Q	.	.	.	.
24.35	3.2105	0.00	Q	.	.	.	.

TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
(Note: 100% of Peak Flow Rate estimate assumed to have
an instantaneous time duration)

Percentile of Estimated Peak Flow Rate	Duration (minutes)
0%	1445.3
10%	170.7
20%	56.9
30%	34.1
40%	22.8
50%	11.4
60%	11.4
70%	11.4
80%	11.4
90%	11.4

Problem Descriptions:
Texas Redlands
100 Year Storm Event Flood Routing
Ryan Kim HC 12/29/21

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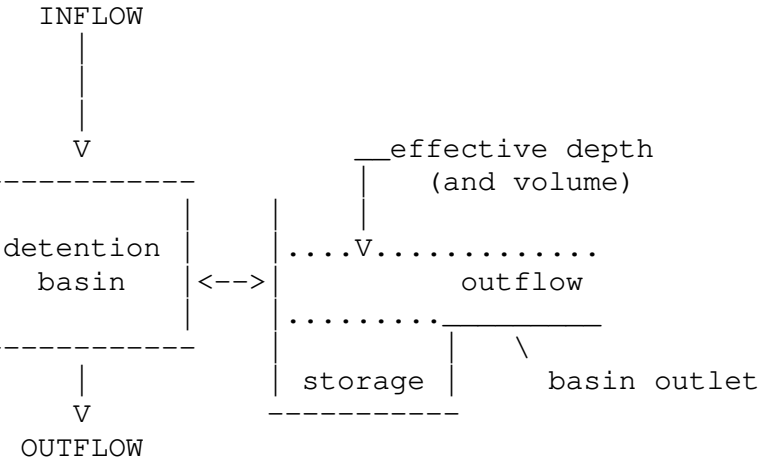
==========================================================================
     FLOW-THROUGH DETENTION BASIN MODEL

     SPECIFIED BASIN CONDITIONS ARE AS FOLLOWS:
     CONSTANT HYDROGRAPH TIME UNIT(MINUTES) =   11.380
     DEAD STORAGE(AF) =       0.00
     SPECIFIED DEAD STORAGE(AF) FILLED =       0.00
     ASSUMED INITIAL DEPTH(FEET) IN STORAGE BASIN =    0.00
```

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     DEPTH-VS.-STORAGE AND DEPTH-VS.-DISCHARGE INFORMATION:
     TOTAL NUMBER OF BASIN DEPTH INFORMATION ENTRIES =   4
     *BASIN-DEPTH  STORAGE    OUTFLOW  **BASIN-DEPTH  STORAGE    OUTFLOW  *
     *   (FEET)  (ACRE-FEET)   (CFS)   **   (FEET)  (ACRE-FEET)   (CFS)   *
     *      0.000      0.000      0.000**      1.500      0.436      0.110*
     *      2.500      0.750      6.220**      3.500      1.100     10.770*
--------------------------------------------------------------------------
     BASIN STORAGE, OUTFLOW AND DEPTH ROUTING VALUES:
      INTERVAL   DEPTH   {S-O*DT/2}   {S+O*DT/2}
       NUMBER   (FEET)   (ACRE-FEET)  (ACRE-FEET)
```

1	0.00	0.00000	0.00000
2	1.50	0.43514	0.43686
3	2.50	0.70125	0.79875
4	3.50	1.01559	1.18441

WHERE S=STORAGE(AF);O=OUTFLOW(AF/MIN.);DT=UNIT INTERVAL(MIN.)

DETENTION BASIN ROUTING RESULTS:

NOTE: COMPUTED BASIN DEPTH, OUTFLOW, AND STORAGE QUANTITIES OCCUR AT THE GIVEN TIME. BASIN INFLOW VALUES REPRESENT THE AVERAGE INFLOW DURING THE RECENT HYDROGRAPH UNIT INTERVAL.

TIME (HRS)	DEAD-STORAGE FILLED(AF)	INFLOW (CFS)	EFFECTIVE DEPTH(FT)	OUTFLOW (CFS)	EFFECTIVE VOLUME(AF)
0.068	0.000	0.00	0.00	0.00	0.000
0.258	0.000	0.69	0.04	0.00	0.011
0.447	0.000	0.69	0.07	0.00	0.022
0.637	0.000	0.70	0.11	0.01	0.032
0.827	0.000	0.70	0.15	0.01	0.043
1.016	0.000	0.71	0.19	0.01	0.054
1.206	0.000	0.71	0.22	0.02	0.065
1.396	0.000	0.72	0.26	0.02	0.076
1.585	0.000	0.72	0.30	0.02	0.087
1.775	0.000	0.73	0.34	0.02	0.098
1.965	0.000	0.73	0.38	0.03	0.109
2.154	0.000	0.74	0.41	0.03	0.120
2.344	0.000	0.74	0.45	0.03	0.131
2.534	0.000	0.75	0.49	0.03	0.143
2.723	0.000	0.75	0.53	0.04	0.154
2.913	0.000	0.76	0.57	0.04	0.165
3.103	0.000	0.77	0.61	0.04	0.176
3.292	0.000	0.78	0.65	0.05	0.188
3.482	0.000	0.78	0.69	0.05	0.199
3.672	0.000	0.79	0.73	0.05	0.211
3.861	0.000	0.79	0.77	0.05	0.222
4.051	0.000	0.80	0.81	0.06	0.234
4.241	0.000	0.81	0.85	0.06	0.246

4.430	0.000	0.82	0.89	0.06	0.258
4.620	0.000	0.82	0.93	0.07	0.269
4.810	0.000	0.83	0.97	0.07	0.281
4.999	0.000	0.84	1.01	0.07	0.293
5.189	0.000	0.85	1.05	0.08	0.306
5.379	0.000	0.85	1.09	0.08	0.318
5.568	0.000	0.87	1.14	0.08	0.330
5.758	0.000	0.87	1.18	0.08	0.342
5.948	0.000	0.88	1.22	0.09	0.355
6.137	0.000	0.89	1.26	0.09	0.367
6.327	0.000	0.90	1.31	0.09	0.380
6.517	0.000	0.91	1.35	0.10	0.393
6.706	0.000	0.92	1.40	0.10	0.406
6.896	0.000	0.93	1.44	0.10	0.419
7.086	0.000	0.95	1.49	0.11	0.432
7.275	0.000	0.95	1.52	0.19	0.444
7.465	0.000	0.97	1.56	0.36	0.453
7.655	0.000	0.98	1.58	0.52	0.461
7.844	0.000	0.99	1.60	0.64	0.466
8.034	0.000	1.00	1.61	0.74	0.470
8.224	0.000	1.02	1.62	0.81	0.474
8.413	0.000	1.03	1.63	0.87	0.476
8.603	0.000	1.05	1.63	0.91	0.478
8.793	0.000	1.06	1.64	0.95	0.480
8.982	0.000	1.08	1.65	0.98	0.482
9.172	0.000	1.09	1.65	1.01	0.483
9.362	0.000	1.11	1.65	1.03	0.484
9.551	0.000	1.13	1.66	1.06	0.485
9.741	0.000	1.15	1.66	1.08	0.486
9.931	0.000	1.16	1.66	1.10	0.487
10.120	0.000	1.19	1.67	1.12	0.488
10.310	0.000	1.21	1.67	1.14	0.489
10.500	0.000	1.24	1.67	1.16	0.491
10.689	0.000	1.25	1.68	1.18	0.492
10.879	0.000	1.29	1.68	1.21	0.493
11.069	0.000	1.30	1.69	1.23	0.494
11.258	0.000	1.34	1.69	1.25	0.495

11.448	0.000	1.36	1.69	1.28	0.497
11.638	0.000	1.40	1.70	1.31	0.498
11.827	0.000	1.43	1.70	1.34	0.500
12.017	0.000	1.48	1.71	1.37	0.501
12.207	0.000	1.55	1.72	1.41	0.504
12.396	0.000	1.64	1.72	1.46	0.507
12.586	0.000	1.67	1.73	1.51	0.509
12.776	0.000	1.74	1.74	1.56	0.512
12.965	0.000	1.77	1.75	1.61	0.514
13.155	0.000	1.85	1.76	1.67	0.517
13.345	0.000	1.90	1.77	1.72	0.520
13.534	0.000	2.00	1.78	1.78	0.524
13.724	0.000	2.05	1.79	1.85	0.527
13.914	0.000	2.18	1.80	1.92	0.531
14.103	0.000	2.25	1.81	2.00	0.535
14.293	0.000	2.40	1.83	2.08	0.540
14.483	0.000	2.49	1.85	2.18	0.545
14.672	0.000	2.72	1.87	2.29	0.551
14.862	0.000	2.86	1.89	2.42	0.558
15.052	0.000	3.21	1.92	2.59	0.568
15.241	0.000	3.44	1.95	2.78	0.578
15.431	0.000	4.28	2.01	3.06	0.597
15.621	0.000	5.30	2.10	3.52	0.625
15.810	0.000	7.28	2.25	4.25	0.673
16.000	0.000	9.68	2.47	5.37	0.740
16.190	0.000	23.69	3.19	7.69	0.991
16.379	0.000	6.09	3.06	9.05	0.944
16.569	0.000	3.71	2.85	8.28	0.873
16.759	0.000	3.02	2.66	7.37	0.805
16.948	0.000	2.60	2.48	6.51	0.743
17.138	0.000	2.31	2.32	5.59	0.692
17.328	0.000	2.11	2.19	4.70	0.651
17.517	0.000	1.95	2.08	3.99	0.619
17.707	0.000	1.81	2.00	3.43	0.594
17.897	0.000	1.70	1.94	2.99	0.574
18.086	0.000	1.61	1.89	2.64	0.558
18.276	0.000	1.45	1.84	2.34	0.544

18.466	0.000	1.38	1.81	2.10	0.533
18.655	0.000	1.32	1.78	1.90	0.524
18.845	0.000	1.27	1.76	1.74	0.516
19.035	0.000	1.22	1.74	1.61	0.510
19.224	0.000	1.18	1.72	1.50	0.505
19.414	0.000	1.14	1.71	1.41	0.501
19.604	0.000	1.10	1.69	1.33	0.497
19.793	0.000	1.07	1.68	1.27	0.494
19.983	0.000	1.04	1.68	1.21	0.491
20.173	0.000	1.01	1.67	1.16	0.489
20.362	0.000	0.98	1.66	1.12	0.487
20.552	0.000	0.96	1.66	1.08	0.485
20.742	0.000	0.94	1.65	1.05	0.483
20.931	0.000	0.92	1.65	1.01	0.482
21.121	0.000	0.90	1.64	0.99	0.480
21.311	0.000	0.88	1.64	0.96	0.479
21.500	0.000	0.86	1.63	0.94	0.478
21.690	0.000	0.84	1.63	0.91	0.477
21.880	0.000	0.83	1.63	0.89	0.476
22.069	0.000	0.81	1.62	0.87	0.475
22.259	0.000	0.80	1.62	0.86	0.474
22.449	0.000	0.78	1.62	0.84	0.473
22.638	0.000	0.77	1.62	0.82	0.472
22.828	0.000	0.76	1.61	0.81	0.471
23.018	0.000	0.75	1.61	0.79	0.471
23.207	0.000	0.74	1.61	0.78	0.470
23.397	0.000	0.72	1.61	0.77	0.469
23.587	0.000	0.71	1.60	0.75	0.469
23.776	0.000	0.70	1.60	0.74	0.468
23.966	0.000	0.69	1.60	0.73	0.468
24.156	0.000	0.69	1.60	0.72	0.467
24.345	0.000	0.00	1.57	0.62	0.457
24.535	0.000	0.00	1.55	0.46	0.450
24.725	0.000	0.00	1.53	0.34	0.445
24.914	0.000	0.00	1.52	0.25	0.441
25.104	0.000	0.00	1.51	0.18	0.438
25.294	0.000	0.00	1.50	0.13	0.436

25.483	0.000	0.00	1.49	0.11	0.434
25.673	0.000	0.00	1.49	0.11	0.433
25.863	0.000	0.00	1.48	0.11	0.431
26.052	0.000	0.00	1.48	0.11	0.429
26.242	0.000	0.00	1.47	0.11	0.428
26.432	0.000	0.00	1.47	0.11	0.426
26.621	0.000	0.00	1.46	0.11	0.424
26.811	0.000	0.00	1.45	0.11	0.423
27.001	0.000	0.00	1.45	0.11	0.421
27.190	0.000	0.00	1.44	0.11	0.419
27.380	0.000	0.00	1.44	0.11	0.418
27.570	0.000	0.00	1.43	0.11	0.416
27.759	0.000	0.00	1.43	0.10	0.414
27.949	0.000	0.00	1.42	0.10	0.413
28.139	0.000	0.00	1.41	0.10	0.411
28.328	0.000	0.00	1.41	0.10	0.409
28.518	0.000	0.00	1.40	0.10	0.408
28.708	0.000	0.00	1.40	0.10	0.406
28.897	0.000	0.00	1.39	0.10	0.405
29.087	0.000	0.00	1.39	0.10	0.403
29.277	0.000	0.00	1.38	0.10	0.401
29.466	0.000	0.00	1.38	0.10	0.400
29.656	0.000	0.00	1.37	0.10	0.398
29.846	0.000	0.00	1.36	0.10	0.397
30.035	0.000	0.00	1.36	0.10	0.395
30.225	0.000	0.00	1.35	0.10	0.394
30.415	0.000	0.00	1.35	0.10	0.392
30.604	0.000	0.00	1.34	0.10	0.390
30.794	0.000	0.00	1.34	0.10	0.389
30.984	0.000	0.00	1.33	0.10	0.387
31.173	0.000	0.00	1.33	0.10	0.386
31.363	0.000	0.00	1.32	0.10	0.384
31.553	0.000	0.00	1.32	0.10	0.383
31.742	0.000	0.00	1.31	0.10	0.381
31.932	0.000	0.00	1.31	0.10	0.380
32.122	0.000	0.00	1.30	0.10	0.378
32.311	0.000	0.00	1.30	0.10	0.377

32.501	0.000	0.00	1.29	0.09	0.375
32.691	0.000	0.00	1.29	0.09	0.374
32.880	0.000	0.00	1.28	0.09	0.372
33.070	0.000	0.00	1.28	0.09	0.371
33.260	0.000	0.00	1.27	0.09	0.369
33.449	0.000	0.00	1.27	0.09	0.368
33.639	0.000	0.00	1.26	0.09	0.366
33.829	0.000	0.00	1.26	0.09	0.365
34.018	0.000	0.00	1.25	0.09	0.364
34.208	0.000	0.00	1.25	0.09	0.362
34.398	0.000	0.00	1.24	0.09	0.361
34.587	0.000	0.00	1.24	0.09	0.359
34.777	0.000	0.00	1.23	0.09	0.358
34.967	0.000	0.00	1.23	0.09	0.356
35.156	0.000	0.00	1.22	0.09	0.355
35.346	0.000	0.00	1.22	0.09	0.354
35.536	0.000	0.00	1.21	0.09	0.352
35.725	0.000	0.00	1.21	0.09	0.351
35.915	0.000	0.00	1.20	0.09	0.349
36.105	0.000	0.00	1.20	0.09	0.348
36.294	0.000	0.00	1.19	0.09	0.347
36.484	0.000	0.00	1.19	0.09	0.345
36.674	0.000	0.00	1.18	0.09	0.344
36.863	0.000	0.00	1.18	0.09	0.343
37.053	0.000	0.00	1.17	0.09	0.341
37.243	0.000	0.00	1.17	0.09	0.340
37.432	0.000	0.00	1.16	0.09	0.339
37.622	0.000	0.00	1.16	0.09	0.337
37.812	0.000	0.00	1.16	0.08	0.336
38.001	0.000	0.00	1.15	0.08	0.335
38.191	0.000	0.00	1.15	0.08	0.333
38.381	0.000	0.00	1.14	0.08	0.332
38.570	0.000	0.00	1.14	0.08	0.331
38.760	0.000	0.00	1.13	0.08	0.329
38.950	0.000	0.00	1.13	0.08	0.328
39.139	0.000	0.00	1.12	0.08	0.327
39.329	0.000	0.00	1.12	0.08	0.325

39.519	0.000	0.00	1.12	0.08	0.324
39.708	0.000	0.00	1.11	0.08	0.323
39.898	0.000	0.00	1.11	0.08	0.322
40.088	0.000	0.00	1.10	0.08	0.320
40.277	0.000	0.00	1.10	0.08	0.319
40.467	0.000	0.00	1.09	0.08	0.318
40.657	0.000	0.00	1.09	0.08	0.317
40.846	0.000	0.00	1.08	0.08	0.315
41.036	0.000	0.00	1.08	0.08	0.314
41.226	0.000	0.00	1.08	0.08	0.313
41.415	0.000	0.00	1.07	0.08	0.312
41.605	0.000	0.00	1.07	0.08	0.310
41.795	0.000	0.00	1.06	0.08	0.309
41.984	0.000	0.00	1.06	0.08	0.308
42.174	0.000	0.00	1.06	0.08	0.307
42.364	0.000	0.00	1.05	0.08	0.306
42.553	0.000	0.00	1.05	0.08	0.304
42.743	0.000	0.00	1.04	0.08	0.303
42.933	0.000	0.00	1.04	0.08	0.302
43.122	0.000	0.00	1.03	0.08	0.301
43.312	0.000	0.00	1.03	0.08	0.300
43.502	0.000	0.00	1.03	0.08	0.298
43.691	0.000	0.00	1.02	0.08	0.297
43.881	0.000	0.00	1.02	0.07	0.296
44.071	0.000	0.00	1.01	0.07	0.295
44.260	0.000	0.00	1.01	0.07	0.294
44.450	0.000	0.00	1.01	0.07	0.293
44.640	0.000	0.00	1.00	0.07	0.291
44.829	0.000	0.00	1.00	0.07	0.290
45.019	0.000	0.00	0.99	0.07	0.289
45.209	0.000	0.00	0.99	0.07	0.288
45.398	0.000	0.00	0.99	0.07	0.287
45.588	0.000	0.00	0.98	0.07	0.286
45.778	0.000	0.00	0.98	0.07	0.285
45.967	0.000	0.00	0.98	0.07	0.283
46.157	0.000	0.00	0.97	0.07	0.282
46.347	0.000	0.00	0.97	0.07	0.281

46.536	0.000	0.00	0.96	0.07	0.280
46.726	0.000	0.00	0.96	0.07	0.279
46.916	0.000	0.00	0.96	0.07	0.278
47.105	0.000	0.00	0.95	0.07	0.277
47.295	0.000	0.00	0.95	0.07	0.276
47.485	0.000	0.00	0.94	0.07	0.275
47.674	0.000	0.00	0.94	0.07	0.273
47.864	0.000	0.00	0.94	0.07	0.272
48.054	0.000	0.00	0.93	0.07	0.271
48.243	0.000	0.00	0.93	0.07	0.270
48.433	0.000	0.00	0.93	0.07	0.269
48.623	0.000	0.00	0.92	0.07	0.268
48.812	0.000	0.00	0.92	0.07	0.267
49.002	0.000	0.00	0.92	0.07	0.266
49.192	0.000	0.00	0.91	0.07	0.265
49.381	0.000	0.00	0.91	0.07	0.264
49.571	0.000	0.00	0.90	0.07	0.263
49.761	0.000	0.00	0.90	0.07	0.262
49.950	0.000	0.00	0.90	0.07	0.261
50.140	0.000	0.00	0.89	0.07	0.260
50.330	0.000	0.00	0.89	0.07	0.259
50.519	0.000	0.00	0.89	0.07	0.258
50.709	0.000	0.00	0.88	0.06	0.257
50.899	0.000	0.00	0.88	0.06	0.256
51.088	0.000	0.00	0.88	0.06	0.255
51.278	0.000	0.00	0.87	0.06	0.254
51.468	0.000	0.00	0.87	0.06	0.253
51.657	0.000	0.00	0.87	0.06	0.252
51.847	0.000	0.00	0.86	0.06	0.251
52.037	0.000	0.00	0.86	0.06	0.250
52.226	0.000	0.00	0.86	0.06	0.249
52.416	0.000	0.00	0.85	0.06	0.248
52.606	0.000	0.00	0.85	0.06	0.247
52.795	0.000	0.00	0.85	0.06	0.246
52.985	0.000	0.00	0.84	0.06	0.245
53.175	0.000	0.00	0.84	0.06	0.244
53.364	0.000	0.00	0.84	0.06	0.243

53.554	0.000	0.00	0.83	0.06	0.242
53.744	0.000	0.00	0.83	0.06	0.241
53.933	0.000	0.00	0.83	0.06	0.240
54.123	0.000	0.00	0.82	0.06	0.239
54.313	0.000	0.00	0.82	0.06	0.238
54.502	0.000	0.00	0.82	0.06	0.237
54.692	0.000	0.00	0.81	0.06	0.236
54.882	0.000	0.00	0.81	0.06	0.235
55.071	0.000	0.00	0.81	0.06	0.234
55.261	0.000	0.00	0.80	0.06	0.233
55.451	0.000	0.00	0.80	0.06	0.233
55.640	0.000	0.00	0.80	0.06	0.232
55.830	0.000	0.00	0.79	0.06	0.231
56.020	0.000	0.00	0.79	0.06	0.230
56.209	0.000	0.00	0.79	0.06	0.229
56.399	0.000	0.00	0.78	0.06	0.228
56.589	0.000	0.00	0.78	0.06	0.227
56.778	0.000	0.00	0.78	0.06	0.226
56.968	0.000	0.00	0.78	0.06	0.225
57.158	0.000	0.00	0.77	0.06	0.224
57.347	0.000	0.00	0.77	0.06	0.224
57.537	0.000	0.00	0.77	0.06	0.223
57.727	0.000	0.00	0.76	0.06	0.222
57.916	0.000	0.00	0.76	0.06	0.221
58.106	0.000	0.00	0.76	0.06	0.220
58.296	0.000	0.00	0.75	0.06	0.219
58.485	0.000	0.00	0.75	0.06	0.218
58.675	0.000	0.00	0.75	0.05	0.217
58.865	0.000	0.00	0.75	0.05	0.217
59.054	0.000	0.00	0.74	0.05	0.216
59.244	0.000	0.00	0.74	0.05	0.215
59.434	0.000	0.00	0.74	0.05	0.214
59.623	0.000	0.00	0.73	0.05	0.213
59.813	0.000	0.00	0.73	0.05	0.212
60.003	0.000	0.00	0.73	0.05	0.212
60.192	0.000	0.00	0.72	0.05	0.211
60.382	0.000	0.00	0.72	0.05	0.210

60.572	0.000	0.00	0.72	0.05	0.209
60.761	0.000	0.00	0.72	0.05	0.208
60.951	0.000	0.00	0.71	0.05	0.207
61.141	0.000	0.00	0.71	0.05	0.207
61.330	0.000	0.00	0.71	0.05	0.206
61.520	0.000	0.00	0.70	0.05	0.205
61.710	0.000	0.00	0.70	0.05	0.204
61.899	0.000	0.00	0.70	0.05	0.203
62.089	0.000	0.00	0.70	0.05	0.202
62.279	0.000	0.00	0.69	0.05	0.202
62.468	0.000	0.00	0.69	0.05	0.201
62.658	0.000	0.00	0.69	0.05	0.200
62.848	0.000	0.00	0.69	0.05	0.199
63.037	0.000	0.00	0.68	0.05	0.199
63.227	0.000	0.00	0.68	0.05	0.198
63.417	0.000	0.00	0.68	0.05	0.197
63.606	0.000	0.00	0.67	0.05	0.196
63.796	0.000	0.00	0.67	0.05	0.195
63.986	0.000	0.00	0.67	0.05	0.195
64.175	0.000	0.00	0.67	0.05	0.194
64.365	0.000	0.00	0.66	0.05	0.193
64.555	0.000	0.00	0.66	0.05	0.192
64.744	0.000	0.00	0.66	0.05	0.192
64.934	0.000	0.00	0.66	0.05	0.191
65.124	0.000	0.00	0.65	0.05	0.190
65.313	0.000	0.00	0.65	0.05	0.189
65.503	0.000	0.00	0.65	0.05	0.189
65.693	0.000	0.00	0.65	0.05	0.188
65.882	0.000	0.00	0.64	0.05	0.187
66.072	0.000	0.00	0.64	0.05	0.186
66.262	0.000	0.00	0.64	0.05	0.186
66.451	0.000	0.00	0.64	0.05	0.185
66.641	0.000	0.00	0.63	0.05	0.184
66.831	0.000	0.00	0.63	0.05	0.183
67.020	0.000	0.00	0.63	0.05	0.183
67.210	0.000	0.00	0.63	0.05	0.182
67.400	0.000	0.00	0.62	0.05	0.181

67.589	0.000	0.00	0.62	0.05	0.181
67.779	0.000	0.00	0.62	0.05	0.180
67.969	0.000	0.00	0.62	0.05	0.179
68.158	0.000	0.00	0.61	0.05	0.178
68.348	0.000	0.00	0.61	0.04	0.178
68.538	0.000	0.00	0.61	0.04	0.177
68.727	0.000	0.00	0.61	0.04	0.176
68.917	0.000	0.00	0.60	0.04	0.176
69.107	0.000	0.00	0.60	0.04	0.175
69.296	0.000	0.00	0.60	0.04	0.174
69.486	0.000	0.00	0.60	0.04	0.174
69.676	0.000	0.00	0.59	0.04	0.173
69.865	0.000	0.00	0.59	0.04	0.172
70.055	0.000	0.00	0.59	0.04	0.172
70.245	0.000	0.00	0.59	0.04	0.171
70.434	0.000	0.00	0.59	0.04	0.170
70.624	0.000	0.00	0.58	0.04	0.169
70.814	0.000	0.00	0.58	0.04	0.169
71.003	0.000	0.00	0.58	0.04	0.168
71.193	0.000	0.00	0.58	0.04	0.167
71.383	0.000	0.00	0.57	0.04	0.167
71.572	0.000	0.00	0.57	0.04	0.166
71.762	0.000	0.00	0.57	0.04	0.166
71.952	0.000	0.00	0.57	0.04	0.165
72.141	0.000	0.00	0.56	0.04	0.164
72.331	0.000	0.00	0.56	0.04	0.164
72.521	0.000	0.00	0.56	0.04	0.163
72.710	0.000	0.00	0.56	0.04	0.162
72.900	0.000	0.00	0.56	0.04	0.162
73.090	0.000	0.00	0.55	0.04	0.161
73.279	0.000	0.00	0.55	0.04	0.160
73.469	0.000	0.00	0.55	0.04	0.160
73.659	0.000	0.00	0.55	0.04	0.159
73.848	0.000	0.00	0.55	0.04	0.158
74.038	0.000	0.00	0.54	0.04	0.158
74.228	0.000	0.00	0.54	0.04	0.157
74.417	0.000	0.00	0.54	0.04	0.157

74.607	0.000	0.00	0.54	0.04	0.156
74.797	0.000	0.00	0.53	0.04	0.155
74.986	0.000	0.00	0.53	0.04	0.155
75.176	0.000	0.00	0.53	0.04	0.154
75.366	0.000	0.00	0.53	0.04	0.154
75.555	0.000	0.00	0.53	0.04	0.153
75.745	0.000	0.00	0.52	0.04	0.152
75.935	0.000	0.00	0.52	0.04	0.152
76.124	0.000	0.00	0.52	0.04	0.151
76.314	0.000	0.00	0.52	0.04	0.151
76.504	0.000	0.00	0.52	0.04	0.150
76.693	0.000	0.00	0.51	0.04	0.149
76.883	0.000	0.00	0.51	0.04	0.149
77.073	0.000	0.00	0.51	0.04	0.148
77.262	0.000	0.00	0.51	0.04	0.148
77.452	0.000	0.00	0.51	0.04	0.147
77.642	0.000	0.00	0.50	0.04	0.146
77.831	0.000	0.00	0.50	0.04	0.146
78.021	0.000	0.00	0.50	0.04	0.145
78.211	0.000	0.00	0.50	0.04	0.145
78.400	0.000	0.00	0.50	0.04	0.144
78.590	0.000	0.00	0.49	0.04	0.144
78.780	0.000	0.00	0.49	0.04	0.143
78.969	0.000	0.00	0.49	0.04	0.142
79.159	0.000	0.00	0.49	0.04	0.142
79.349	0.000	0.00	0.49	0.04	0.141
79.538	0.000	0.00	0.48	0.04	0.141
79.728	0.000	0.00	0.48	0.04	0.140
79.918	0.000	0.00	0.48	0.04	0.140
80.107	0.000	0.00	0.48	0.04	0.139
80.297	0.000	0.00	0.48	0.04	0.139
80.487	0.000	0.00	0.47	0.03	0.138
80.676	0.000	0.00	0.47	0.03	0.137
80.866	0.000	0.00	0.47	0.03	0.137
81.056	0.000	0.00	0.47	0.03	0.136
81.245	0.000	0.00	0.47	0.03	0.136
81.435	0.000	0.00	0.47	0.03	0.135

81.625	0.000	0.00	0.46	0.03	0.135
81.814	0.000	0.00	0.46	0.03	0.134
82.004	0.000	0.00	0.46	0.03	0.134
82.194	0.000	0.00	0.46	0.03	0.133
82.383	0.000	0.00	0.46	0.03	0.133
82.573	0.000	0.00	0.45	0.03	0.132
82.763	0.000	0.00	0.45	0.03	0.132
82.952	0.000	0.00	0.45	0.03	0.131
83.142	0.000	0.00	0.45	0.03	0.131
83.332	0.000	0.00	0.45	0.03	0.130
83.521	0.000	0.00	0.45	0.03	0.130
83.711	0.000	0.00	0.44	0.03	0.129
83.901	0.000	0.00	0.44	0.03	0.129
84.090	0.000	0.00	0.44	0.03	0.128
84.280	0.000	0.00	0.44	0.03	0.127
84.470	0.000	0.00	0.44	0.03	0.127
84.659	0.000	0.00	0.44	0.03	0.126
84.849	0.000	0.00	0.43	0.03	0.126
85.039	0.000	0.00	0.43	0.03	0.125
85.228	0.000	0.00	0.43	0.03	0.125
85.418	0.000	0.00	0.43	0.03	0.124
85.608	0.000	0.00	0.43	0.03	0.124
85.797	0.000	0.00	0.42	0.03	0.124
85.987	0.000	0.00	0.42	0.03	0.123
86.177	0.000	0.00	0.42	0.03	0.123
86.366	0.000	0.00	0.42	0.03	0.122
86.556	0.000	0.00	0.42	0.03	0.122
86.746	0.000	0.00	0.42	0.03	0.121
86.935	0.000	0.00	0.41	0.03	0.121
87.125	0.000	0.00	0.41	0.03	0.120
87.315	0.000	0.00	0.41	0.03	0.120
87.504	0.000	0.00	0.41	0.03	0.119
87.694	0.000	0.00	0.41	0.03	0.119
87.884	0.000	0.00	0.41	0.03	0.118
88.073	0.000	0.00	0.41	0.03	0.118
88.263	0.000	0.00	0.40	0.03	0.117
88.453	0.000	0.00	0.40	0.03	0.117

88.642	0.000	0.00	0.40	0.03	0.116
88.832	0.000	0.00	0.40	0.03	0.116
89.022	0.000	0.00	0.40	0.03	0.115
89.211	0.000	0.00	0.40	0.03	0.115
89.401	0.000	0.00	0.39	0.03	0.115
89.591	0.000	0.00	0.39	0.03	0.114
89.780	0.000	0.00	0.39	0.03	0.114
89.970	0.000	0.00	0.39	0.03	0.113
90.160	0.000	0.00	0.39	0.03	0.113
90.349	0.000	0.00	0.39	0.03	0.112
90.539	0.000	0.00	0.38	0.03	0.112
90.729	0.000	0.00	0.38	0.03	0.111
90.918	0.000	0.00	0.38	0.03	0.111
91.108	0.000	0.00	0.38	0.03	0.111
91.298	0.000	0.00	0.38	0.03	0.110
91.487	0.000	0.00	0.38	0.03	0.110
91.677	0.000	0.00	0.38	0.03	0.109
91.867	0.000	0.00	0.37	0.03	0.109
92.056	0.000	0.00	0.37	0.03	0.108
92.246	0.000	0.00	0.37	0.03	0.108
92.436	0.000	0.00	0.37	0.03	0.108
92.625	0.000	0.00	0.37	0.03	0.107
92.815	0.000	0.00	0.37	0.03	0.107
93.005	0.000	0.00	0.37	0.03	0.106
93.194	0.000	0.00	0.36	0.03	0.106
93.384	0.000	0.00	0.36	0.03	0.105
93.574	0.000	0.00	0.36	0.03	0.105
93.763	0.000	0.00	0.36	0.03	0.105
93.953	0.000	0.00	0.36	0.03	0.104
94.143	0.000	0.00	0.36	0.03	0.104
94.332	0.000	0.00	0.36	0.03	0.103
94.522	0.000	0.00	0.35	0.03	0.103
94.712	0.000	0.00	0.35	0.03	0.103
94.901	0.000	0.00	0.35	0.03	0.102
95.091	0.000	0.00	0.35	0.03	0.102
95.281	0.000	0.00	0.35	0.03	0.101
95.470	0.000	0.00	0.35	0.03	0.101

95.660	0.000	0.00	0.35	0.03	0.101
95.850	0.000	0.00	0.34	0.03	0.100
96.039	0.000	0.00	0.34	0.03	0.100
96.229	0.000	0.00	0.34	0.03	0.099
96.419	0.000	0.00	0.34	0.03	0.099
96.608	0.000	0.00	0.34	0.02	0.099
96.798	0.000	0.00	0.34	0.02	0.098
96.988	0.000	0.00	0.34	0.02	0.098
97.177	0.000	0.00	0.34	0.02	0.097
97.367	0.000	0.00	0.33	0.02	0.097
97.557	0.000	0.00	0.33	0.02	0.097
97.746	0.000	0.00	0.33	0.02	0.096
97.936	0.000	0.00	0.33	0.02	0.096
98.126	0.000	0.00	0.33	0.02	0.096
98.315	0.000	0.00	0.33	0.02	0.095
98.505	0.000	0.00	0.33	0.02	0.095
98.695	0.000	0.00	0.32	0.02	0.094
98.884	0.000	0.00	0.32	0.02	0.094
99.074	0.000	0.00	0.32	0.02	0.094
99.264	0.000	0.00	0.32	0.02	0.093
99.453	0.000	0.00	0.32	0.02	0.093
99.643	0.000	0.00	0.32	0.02	0.093
99.833	0.000	0.00	0.32	0.02	0.092
100.022	0.000	0.00	0.32	0.02	0.092
100.212	0.000	0.00	0.31	0.02	0.091
100.402	0.000	0.00	0.31	0.02	0.091
100.591	0.000	0.00	0.31	0.02	0.091
100.781	0.000	0.00	0.31	0.02	0.090
100.971	0.000	0.00	0.31	0.02	0.090
101.160	0.000	0.00	0.31	0.02	0.090
101.350	0.000	0.00	0.31	0.02	0.089
101.540	0.000	0.00	0.31	0.02	0.089
101.729	0.000	0.00	0.30	0.02	0.089
101.919	0.000	0.00	0.30	0.02	0.088
102.109	0.000	0.00	0.30	0.02	0.088
102.298	0.000	0.00	0.30	0.02	0.088
102.488	0.000	0.00	0.30	0.02	0.087

102.678	0.000	0.00	0.30	0.02	0.087
102.867	0.000	0.00	0.30	0.02	0.087
103.057	0.000	0.00	0.30	0.02	0.086
103.247	0.000	0.00	0.30	0.02	0.086
103.436	0.000	0.00	0.29	0.02	0.086
103.626	0.000	0.00	0.29	0.02	0.085
103.816	0.000	0.00	0.29	0.02	0.085
104.005	0.000	0.00	0.29	0.02	0.084
104.195	0.000	0.00	0.29	0.02	0.084
104.385	0.000	0.00	0.29	0.02	0.084
104.574	0.000	0.00	0.29	0.02	0.084
104.764	0.000	0.00	0.29	0.02	0.083
104.954	0.000	0.00	0.29	0.02	0.083
105.143	0.000	0.00	0.28	0.02	0.083
105.333	0.000	0.00	0.28	0.02	0.082
105.523	0.000	0.00	0.28	0.02	0.082
105.712	0.000	0.00	0.28	0.02	0.082
105.902	0.000	0.00	0.28	0.02	0.081
106.092	0.000	0.00	0.28	0.02	0.081
106.281	0.000	0.00	0.28	0.02	0.081
106.471	0.000	0.00	0.28	0.02	0.080
106.661	0.000	0.00	0.28	0.02	0.080
106.850	0.000	0.00	0.27	0.02	0.080
107.040	0.000	0.00	0.27	0.02	0.079
107.230	0.000	0.00	0.27	0.02	0.079
107.419	0.000	0.00	0.27	0.02	0.079
107.609	0.000	0.00	0.27	0.02	0.078
107.799	0.000	0.00	0.27	0.02	0.078
107.988	0.000	0.00	0.27	0.02	0.078
108.178	0.000	0.00	0.27	0.02	0.077
108.368	0.000	0.00	0.27	0.02	0.077
108.557	0.000	0.00	0.26	0.02	0.077
108.747	0.000	0.00	0.26	0.02	0.077
108.937	0.000	0.00	0.26	0.02	0.076
109.126	0.000	0.00	0.26	0.02	0.076
109.316	0.000	0.00	0.26	0.02	0.076
109.506	0.000	0.00	0.26	0.02	0.075

109.695	0.000	0.00	0.26	0.02	0.075
109.885	0.000	0.00	0.26	0.02	0.075
110.075	0.000	0.00	0.26	0.02	0.074
110.264	0.000	0.00	0.26	0.02	0.074
110.454	0.000	0.00	0.25	0.02	0.074
110.644	0.000	0.00	0.25	0.02	0.074
110.833	0.000	0.00	0.25	0.02	0.073
111.023	0.000	0.00	0.25	0.02	0.073
111.213	0.000	0.00	0.25	0.02	0.073
111.402	0.000	0.00	0.25	0.02	0.072
111.592	0.000	0.00	0.25	0.02	0.072
111.782	0.000	0.00	0.25	0.02	0.072
111.971	0.000	0.00	0.25	0.02	0.072
112.161	0.000	0.00	0.25	0.02	0.071
112.351	0.000	0.00	0.24	0.02	0.071
112.540	0.000	0.00	0.24	0.02	0.071
112.730	0.000	0.00	0.24	0.02	0.070
112.920	0.000	0.00	0.24	0.02	0.070
113.109	0.000	0.00	0.24	0.02	0.070
113.299	0.000	0.00	0.24	0.02	0.070
113.489	0.000	0.00	0.24	0.02	0.069
113.678	0.000	0.00	0.24	0.02	0.069
113.868	0.000	0.00	0.24	0.02	0.069
114.058	0.000	0.00	0.24	0.02	0.069
114.247	0.000	0.00	0.23	0.02	0.068
114.437	0.000	0.00	0.23	0.02	0.068
114.627	0.000	0.00	0.23	0.02	0.068
114.816	0.000	0.00	0.23	0.02	0.067
115.006	0.000	0.00	0.23	0.02	0.067
115.196	0.000	0.00	0.23	0.02	0.067
115.385	0.000	0.00	0.23	0.02	0.067
115.575	0.000	0.00	0.23	0.02	0.066
115.765	0.000	0.00	0.23	0.02	0.066
115.954	0.000	0.00	0.23	0.02	0.066
116.144	0.000	0.00	0.23	0.02	0.066
116.334	0.000	0.00	0.22	0.02	0.065
116.523	0.000	0.00	0.22	0.02	0.065

116.713	0.000	0.00	0.22	0.02	0.065
116.903	0.000	0.00	0.22	0.02	0.065
117.092	0.000	0.00	0.22	0.02	0.064
117.282	0.000	0.00	0.22	0.02	0.064
117.472	0.000	0.00	0.22	0.02	0.064
117.661	0.000	0.00	0.22	0.02	0.064
117.851	0.000	0.00	0.22	0.02	0.063
118.041	0.000	0.00	0.22	0.02	0.063
118.230	0.000	0.00	0.22	0.02	0.063
118.420	0.000	0.00	0.22	0.02	0.063
118.610	0.000	0.00	0.21	0.02	0.062
118.799	0.000	0.00	0.21	0.02	0.062
118.989	0.000	0.00	0.21	0.02	0.062
119.179	0.000	0.00	0.21	0.02	0.062
119.368	0.000	0.00	0.21	0.02	0.061
119.558	0.000	0.00	0.21	0.02	0.061
119.748	0.000	0.00	0.21	0.02	0.061
119.937	0.000	0.00	0.21	0.02	0.061
120.127	0.000	0.00	0.21	0.02	0.060
120.317	0.000	0.00	0.21	0.02	0.060
120.506	0.000	0.00	0.21	0.02	0.060
120.696	0.000	0.00	0.21	0.02	0.060
120.886	0.000	0.00	0.20	0.02	0.059
121.075	0.000	0.00	0.20	0.01	0.059
121.265	0.000	0.00	0.20	0.01	0.059
121.455	0.000	0.00	0.20	0.01	0.059
121.644	0.000	0.00	0.20	0.01	0.058
121.834	0.000	0.00	0.20	0.01	0.058
122.024	0.000	0.00	0.20	0.01	0.058
122.213	0.000	0.00	0.20	0.01	0.058
122.403	0.000	0.00	0.20	0.01	0.058
122.593	0.000	0.00	0.20	0.01	0.057
122.782	0.000	0.00	0.20	0.01	0.057
122.972	0.000	0.00	0.20	0.01	0.057
123.162	0.000	0.00	0.19	0.01	0.057
123.351	0.000	0.00	0.19	0.01	0.056
123.541	0.000	0.00	0.19	0.01	0.056

123.731	0.000	0.00	0.19	0.01	0.056
123.920	0.000	0.00	0.19	0.01	0.056
124.110	0.000	0.00	0.19	0.01	0.056
124.300	0.000	0.00	0.19	0.01	0.055
124.489	0.000	0.00	0.19	0.01	0.055
124.679	0.000	0.00	0.19	0.01	0.055
124.869	0.000	0.00	0.19	0.01	0.055
125.058	0.000	0.00	0.19	0.01	0.054
125.248	0.000	0.00	0.19	0.01	0.054
125.438	0.000	0.00	0.19	0.01	0.054
125.627	0.000	0.00	0.19	0.01	0.054
125.817	0.000	0.00	0.18	0.01	0.054
126.007	0.000	0.00	0.18	0.01	0.053
126.196	0.000	0.00	0.18	0.01	0.053
126.386	0.000	0.00	0.18	0.01	0.053
126.576	0.000	0.00	0.18	0.01	0.053
126.765	0.000	0.00	0.18	0.01	0.053
126.955	0.000	0.00	0.18	0.01	0.052
127.145	0.000	0.00	0.18	0.01	0.052
127.334	0.000	0.00	0.18	0.01	0.052
127.524	0.000	0.00	0.18	0.01	0.052
127.714	0.000	0.00	0.18	0.01	0.052
127.903	0.000	0.00	0.18	0.01	0.051
128.093	0.000	0.00	0.18	0.01	0.051
128.283	0.000	0.00	0.18	0.01	0.051
128.472	0.000	0.00	0.17	0.01	0.051
128.662	0.000	0.00	0.17	0.01	0.051
128.852	0.000	0.00	0.17	0.01	0.050
129.041	0.000	0.00	0.17	0.01	0.050
129.231	0.000	0.00	0.17	0.01	0.050
129.421	0.000	0.00	0.17	0.01	0.050
129.610	0.000	0.00	0.17	0.01	0.050
129.800	0.000	0.00	0.17	0.01	0.049
129.990	0.000	0.00	0.17	0.01	0.049
130.179	0.000	0.00	0.17	0.01	0.049
130.369	0.000	0.00	0.17	0.01	0.049
130.559	0.000	0.00	0.17	0.01	0.049

130.748	0.000	0.00	0.17	0.01	0.048
130.938	0.000	0.00	0.17	0.01	0.048
131.128	0.000	0.00	0.17	0.01	0.048
131.317	0.000	0.00	0.16	0.01	0.048
131.507	0.000	0.00	0.16	0.01	0.048
131.697	0.000	0.00	0.16	0.01	0.047
131.886	0.000	0.00	0.16	0.01	0.047
132.076	0.000	0.00	0.16	0.01	0.047
132.266	0.000	0.00	0.16	0.01	0.047
132.455	0.000	0.00	0.16	0.01	0.047
132.645	0.000	0.00	0.16	0.01	0.047
132.835	0.000	0.00	0.16	0.01	0.046
133.024	0.000	0.00	0.16	0.01	0.046
133.214	0.000	0.00	0.16	0.01	0.046
133.404	0.000	0.00	0.16	0.01	0.046
133.593	0.000	0.00	0.16	0.01	0.046
133.783	0.000	0.00	0.16	0.01	0.045
133.973	0.000	0.00	0.16	0.01	0.045
134.162	0.000	0.00	0.16	0.01	0.045
134.352	0.000	0.00	0.15	0.01	0.045
134.542	0.000	0.00	0.15	0.01	0.045
134.731	0.000	0.00	0.15	0.01	0.045
134.921	0.000	0.00	0.15	0.01	0.044
135.111	0.000	0.00	0.15	0.01	0.044
135.300	0.000	0.00	0.15	0.01	0.044
135.490	0.000	0.00	0.15	0.01	0.044
135.680	0.000	0.00	0.15	0.01	0.044
135.869	0.000	0.00	0.15	0.01	0.043
136.059	0.000	0.00	0.15	0.01	0.043
136.249	0.000	0.00	0.15	0.01	0.043
136.438	0.000	0.00	0.15	0.01	0.043
136.628	0.000	0.00	0.15	0.01	0.043
136.818	0.000	0.00	0.15	0.01	0.043
137.007	0.000	0.00	0.15	0.01	0.042
137.197	0.000	0.00	0.15	0.01	0.042
137.387	0.000	0.00	0.14	0.01	0.042
137.576	0.000	0.00	0.14	0.01	0.042

137.766	0.000	0.00	0.14	0.01	0.042
137.956	0.000	0.00	0.14	0.01	0.042
138.145	0.000	0.00	0.14	0.01	0.041
138.335	0.000	0.00	0.14	0.01	0.041
138.525	0.000	0.00	0.14	0.01	0.041
138.714	0.000	0.00	0.14	0.01	0.041
138.904	0.000	0.00	0.14	0.01	0.041
139.094	0.000	0.00	0.14	0.01	0.041
139.283	0.000	0.00	0.14	0.01	0.040
139.473	0.000	0.00	0.14	0.01	0.040
139.663	0.000	0.00	0.14	0.01	0.040
139.852	0.000	0.00	0.14	0.01	0.040
140.042	0.000	0.00	0.14	0.01	0.040
140.232	0.000	0.00	0.14	0.01	0.040
140.421	0.000	0.00	0.14	0.01	0.040
140.611	0.000	0.00	0.14	0.01	0.039
140.801	0.000	0.00	0.13	0.01	0.039
140.990	0.000	0.00	0.13	0.01	0.039
141.180	0.000	0.00	0.13	0.01	0.039
141.370	0.000	0.00	0.13	0.01	0.039
141.559	0.000	0.00	0.13	0.01	0.039
141.749	0.000	0.00	0.13	0.01	0.038
141.939	0.000	0.00	0.13	0.01	0.038
142.128	0.000	0.00	0.13	0.01	0.038
142.318	0.000	0.00	0.13	0.01	0.038
142.508	0.000	0.00	0.13	0.01	0.038
142.697	0.000	0.00	0.13	0.01	0.038
142.887	0.000	0.00	0.13	0.01	0.038
143.077	0.000	0.00	0.13	0.01	0.037
143.266	0.000	0.00	0.13	0.01	0.037
143.456	0.000	0.00	0.13	0.01	0.037
143.646	0.000	0.00	0.13	0.01	0.037
143.835	0.000	0.00	0.13	0.01	0.037
144.025	0.000	0.00	0.13	0.01	0.037
144.215	0.000	0.00	0.13	0.01	0.037
144.404	0.000	0.00	0.13	0.01	0.036
144.594	0.000	0.00	0.12	0.01	0.036

144.784	0.000	0.00	0.12	0.01	0.036
144.973	0.000	0.00	0.12	0.01	0.036
145.163	0.000	0.00	0.12	0.01	0.036
145.353	0.000	0.00	0.12	0.01	0.036
145.542	0.000	0.00	0.12	0.01	0.036
145.732	0.000	0.00	0.12	0.01	0.035
145.922	0.000	0.00	0.12	0.01	0.035
146.111	0.000	0.00	0.12	0.01	0.035
146.301	0.000	0.00	0.12	0.01	0.035
146.491	0.000	0.00	0.12	0.01	0.035
146.680	0.000	0.00	0.12	0.01	0.035
146.870	0.000	0.00	0.12	0.01	0.035
147.060	0.000	0.00	0.12	0.01	0.034
147.249	0.000	0.00	0.12	0.01	0.034
147.439	0.000	0.00	0.12	0.01	0.034
147.629	0.000	0.00	0.12	0.01	0.034
147.818	0.000	0.00	0.12	0.01	0.034
148.008	0.000	0.00	0.12	0.01	0.034
148.198	0.000	0.00	0.12	0.01	0.034
148.387	0.000	0.00	0.12	0.01	0.033
148.577	0.000	0.00	0.11	0.01	0.033
148.767	0.000	0.00	0.11	0.01	0.033
148.956	0.000	0.00	0.11	0.01	0.033
149.146	0.000	0.00	0.11	0.01	0.033
149.336	0.000	0.00	0.11	0.01	0.033
149.525	0.000	0.00	0.11	0.01	0.033
149.715	0.000	0.00	0.11	0.01	0.033
149.905	0.000	0.00	0.11	0.01	0.032
150.094	0.000	0.00	0.11	0.01	0.032
150.284	0.000	0.00	0.11	0.01	0.032
150.474	0.000	0.00	0.11	0.01	0.032
150.663	0.000	0.00	0.11	0.01	0.032
150.853	0.000	0.00	0.11	0.01	0.032
151.043	0.000	0.00	0.11	0.01	0.032
151.232	0.000	0.00	0.11	0.01	0.032
151.422	0.000	0.00	0.11	0.01	0.031
151.612	0.000	0.00	0.11	0.01	0.031

151.801	0.000	0.00	0.11	0.01	0.031
151.991	0.000	0.00	0.11	0.01	0.031
152.181	0.000	0.00	0.11	0.01	0.031
152.370	0.000	0.00	0.11	0.01	0.031
152.560	0.000	0.00	0.11	0.01	0.031
152.750	0.000	0.00	0.11	0.01	0.031
152.939	0.000	0.00	0.10	0.01	0.030
153.129	0.000	0.00	0.10	0.01	0.030
153.319	0.000	0.00	0.10	0.01	0.030
153.508	0.000	0.00	0.10	0.01	0.030
153.698	0.000	0.00	0.10	0.01	0.030
153.888	0.000	0.00	0.10	0.01	0.030
154.077	0.000	0.00	0.10	0.01	0.030
154.267	0.000	0.00	0.10	0.01	0.030
154.457	0.000	0.00	0.10	0.01	0.030
154.646	0.000	0.00	0.10	0.01	0.029
154.836	0.000	0.00	0.10	0.01	0.029
155.026	0.000	0.00	0.10	0.01	0.029
155.215	0.000	0.00	0.10	0.01	0.029
155.405	0.000	0.00	0.10	0.01	0.029
155.595	0.000	0.00	0.10	0.01	0.029
155.784	0.000	0.00	0.10	0.01	0.029
155.974	0.000	0.00	0.10	0.01	0.029
156.164	0.000	0.00	0.10	0.01	0.028
156.353	0.000	0.00	0.10	0.01	0.028
156.543	0.000	0.00	0.10	0.01	0.028
156.733	0.000	0.00	0.10	0.01	0.028
156.922	0.000	0.00	0.10	0.01	0.028
157.112	0.000	0.00	0.10	0.01	0.028
157.302	0.000	0.00	0.10	0.01	0.028
157.491	0.000	0.00	0.10	0.01	0.028
157.681	0.000	0.00	0.09	0.01	0.028
157.871	0.000	0.00	0.09	0.01	0.027
158.060	0.000	0.00	0.09	0.01	0.027
158.250	0.000	0.00	0.09	0.01	0.027
158.440	0.000	0.00	0.09	0.01	0.027
158.629	0.000	0.00	0.09	0.01	0.027

158.819	0.000	0.00	0.09	0.01	0.027
159.009	0.000	0.00	0.09	0.01	0.027
159.198	0.000	0.00	0.09	0.01	0.027
159.388	0.000	0.00	0.09	0.01	0.027
159.578	0.000	0.00	0.09	0.01	0.027
159.767	0.000	0.00	0.09	0.01	0.026
159.957	0.000	0.00	0.09	0.01	0.026
160.147	0.000	0.00	0.09	0.01	0.026
160.336	0.000	0.00	0.09	0.01	0.026
160.526	0.000	0.00	0.09	0.01	0.026
160.716	0.000	0.00	0.09	0.01	0.026
160.905	0.000	0.00	0.09	0.01	0.026
161.095	0.000	0.00	0.09	0.01	0.026
161.285	0.000	0.00	0.09	0.01	0.026
161.474	0.000	0.00	0.09	0.01	0.025
161.664	0.000	0.00	0.09	0.01	0.025
161.854	0.000	0.00	0.09	0.01	0.025
162.043	0.000	0.00	0.09	0.01	0.025
162.233	0.000	0.00	0.09	0.01	0.025
162.423	0.000	0.00	0.09	0.01	0.025
162.612	0.000	0.00	0.09	0.01	0.025
162.802	0.000	0.00	0.09	0.01	0.025
162.992	0.000	0.00	0.08	0.01	0.025
163.181	0.000	0.00	0.08	0.01	0.025
163.371	0.000	0.00	0.08	0.01	0.025
163.561	0.000	0.00	0.08	0.01	0.024
163.750	0.000	0.00	0.08	0.01	0.024
163.940	0.000	0.00	0.08	0.01	0.024
164.130	0.000	0.00	0.08	0.01	0.024
164.319	0.000	0.00	0.08	0.01	0.024
164.509	0.000	0.00	0.08	0.01	0.024
164.699	0.000	0.00	0.08	0.01	0.024
164.888	0.000	0.00	0.08	0.01	0.024
165.078	0.000	0.00	0.08	0.01	0.024
165.268	0.000	0.00	0.08	0.01	0.024
165.457	0.000	0.00	0.08	0.01	0.023
165.647	0.000	0.00	0.08	0.01	0.023

165.837	0.000	0.00	0.08	0.01	0.023
166.026	0.000	0.00	0.08	0.01	0.023
166.216	0.000	0.00	0.08	0.01	0.023
166.406	0.000	0.00	0.08	0.01	0.023
166.595	0.000	0.00	0.08	0.01	0.023
166.785	0.000	0.00	0.08	0.01	0.023
166.975	0.000	0.00	0.08	0.01	0.023
167.164	0.000	0.00	0.08	0.01	0.023
167.354	0.000	0.00	0.08	0.01	0.023
167.544	0.000	0.00	0.08	0.01	0.022
167.733	0.000	0.00	0.08	0.01	0.022
167.923	0.000	0.00	0.08	0.01	0.022
168.113	0.000	0.00	0.08	0.01	0.022
168.302	0.000	0.00	0.08	0.01	0.022
168.492	0.000	0.00	0.08	0.01	0.022
168.682	0.000	0.00	0.08	0.01	0.022
168.871	0.000	0.00	0.08	0.01	0.022
169.061	0.000	0.00	0.07	0.01	0.022
169.251	0.000	0.00	0.07	0.01	0.022
169.440	0.000	0.00	0.07	0.01	0.022
169.630	0.000	0.00	0.07	0.01	0.022
169.820	0.000	0.00	0.07	0.01	0.021
170.009	0.000	0.00	0.07	0.01	0.021
170.199	0.000	0.00	0.07	0.01	0.021
170.389	0.000	0.00	0.07	0.01	0.021
170.578	0.000	0.00	0.07	0.01	0.021
170.768	0.000	0.00	0.07	0.01	0.021
170.958	0.000	0.00	0.07	0.01	0.021
171.147	0.000	0.00	0.07	0.01	0.021
171.337	0.000	0.00	0.07	0.01	0.021
171.527	0.000	0.00	0.07	0.01	0.021
171.716	0.000	0.00	0.07	0.01	0.021
171.906	0.000	0.00	0.07	0.01	0.021
172.096	0.000	0.00	0.07	0.01	0.020
172.285	0.000	0.00	0.07	0.01	0.020
172.475	0.000	0.00	0.07	0.01	0.020
172.665	0.000	0.00	0.07	0.01	0.020

172.854	0.000	0.00	0.07	0.01	0.020
173.044	0.000	0.00	0.07	0.01	0.020
173.234	0.000	0.00	0.07	0.01	0.020
173.423	0.000	0.00	0.07	0.01	0.020
173.613	0.000	0.00	0.07	0.01	0.020
173.803	0.000	0.00	0.07	0.00	0.020
173.992	0.000	0.00	0.07	0.00	0.020
174.182	0.000	0.00	0.07	0.00	0.020
174.372	0.000	0.00	0.07	0.00	0.019
174.561	0.000	0.00	0.07	0.00	0.019
174.751	0.000	0.00	0.07	0.00	0.019
174.941	0.000	0.00	0.07	0.00	0.019
175.130	0.000	0.00	0.07	0.00	0.019
175.320	0.000	0.00	0.07	0.00	0.019
175.510	0.000	0.00	0.07	0.00	0.019
175.699	0.000	0.00	0.07	0.00	0.019
175.889	0.000	0.00	0.06	0.00	0.019
176.079	0.000	0.00	0.06	0.00	0.019
176.268	0.000	0.00	0.06	0.00	0.019
176.458	0.000	0.00	0.06	0.00	0.019
176.648	0.000	0.00	0.06	0.00	0.019
176.837	0.000	0.00	0.06	0.00	0.019
177.027	0.000	0.00	0.06	0.00	0.018
177.217	0.000	0.00	0.06	0.00	0.018
177.406	0.000	0.00	0.06	0.00	0.018
177.596	0.000	0.00	0.06	0.00	0.018
177.786	0.000	0.00	0.06	0.00	0.018
177.975	0.000	0.00	0.06	0.00	0.018
178.165	0.000	0.00	0.06	0.00	0.018
178.355	0.000	0.00	0.06	0.00	0.018
178.544	0.000	0.00	0.06	0.00	0.018
178.734	0.000	0.00	0.06	0.00	0.018
178.924	0.000	0.00	0.06	0.00	0.018
179.113	0.000	0.00	0.06	0.00	0.018
179.303	0.000	0.00	0.06	0.00	0.018
179.493	0.000	0.00	0.06	0.00	0.018
179.682	0.000	0.00	0.06	0.00	0.017

179.872	0.000	0.00	0.06	0.00	0.017
180.062	0.000	0.00	0.06	0.00	0.017
180.251	0.000	0.00	0.06	0.00	0.017
180.441	0.000	0.00	0.06	0.00	0.017
180.631	0.000	0.00	0.06	0.00	0.017
180.820	0.000	0.00	0.06	0.00	0.017
181.010	0.000	0.00	0.06	0.00	0.017
181.200	0.000	0.00	0.06	0.00	0.017
181.389	0.000	0.00	0.06	0.00	0.017
181.579	0.000	0.00	0.06	0.00	0.017
181.769	0.000	0.00	0.06	0.00	0.017
181.958	0.000	0.00	0.06	0.00	0.017
182.148	0.000	0.00	0.06	0.00	0.017
182.338	0.000	0.00	0.06	0.00	0.017
182.527	0.000	0.00	0.06	0.00	0.016
182.717	0.000	0.00	0.06	0.00	0.016
182.907	0.000	0.00	0.06	0.00	0.016
183.096	0.000	0.00	0.06	0.00	0.016
183.286	0.000	0.00	0.06	0.00	0.016
183.476	0.000	0.00	0.06	0.00	0.016
183.665	0.000	0.00	0.06	0.00	0.016
183.855	0.000	0.00	0.06	0.00	0.016
184.045	0.000	0.00	0.05	0.00	0.016
184.234	0.000	0.00	0.05	0.00	0.016
184.424	0.000	0.00	0.05	0.00	0.016
184.614	0.000	0.00	0.05	0.00	0.016
184.803	0.000	0.00	0.05	0.00	0.016
184.993	0.000	0.00	0.05	0.00	0.016
185.183	0.000	0.00	0.05	0.00	0.016
185.372	0.000	0.00	0.05	0.00	0.015
185.562	0.000	0.00	0.05	0.00	0.015
185.752	0.000	0.00	0.05	0.00	0.015
185.941	0.000	0.00	0.05	0.00	0.015
186.131	0.000	0.00	0.05	0.00	0.015
186.321	0.000	0.00	0.05	0.00	0.015
186.510	0.000	0.00	0.05	0.00	0.015
186.700	0.000	0.00	0.05	0.00	0.015

186.890	0.000	0.00	0.05	0.00	0.015
187.079	0.000	0.00	0.05	0.00	0.015
187.269	0.000	0.00	0.05	0.00	0.015
187.459	0.000	0.00	0.05	0.00	0.015
187.648	0.000	0.00	0.05	0.00	0.015
187.838	0.000	0.00	0.05	0.00	0.015
188.028	0.000	0.00	0.05	0.00	0.015
188.217	0.000	0.00	0.05	0.00	0.015
188.407	0.000	0.00	0.05	0.00	0.015
188.597	0.000	0.00	0.05	0.00	0.014
188.786	0.000	0.00	0.05	0.00	0.014
188.976	0.000	0.00	0.05	0.00	0.014
189.166	0.000	0.00	0.05	0.00	0.014
189.355	0.000	0.00	0.05	0.00	0.014
189.545	0.000	0.00	0.05	0.00	0.014
189.735	0.000	0.00	0.05	0.00	0.014
189.924	0.000	0.00	0.05	0.00	0.014
190.114	0.000	0.00	0.05	0.00	0.014
190.304	0.000	0.00	0.05	0.00	0.014
190.493	0.000	0.00	0.05	0.00	0.014
190.683	0.000	0.00	0.05	0.00	0.014
190.873	0.000	0.00	0.05	0.00	0.014
191.062	0.000	0.00	0.05	0.00	0.014
191.252	0.000	0.00	0.05	0.00	0.014
191.442	0.000	0.00	0.05	0.00	0.014
191.631	0.000	0.00	0.05	0.00	0.014
191.821	0.000	0.00	0.05	0.00	0.014
192.011	0.000	0.00	0.05	0.00	0.013
192.200	0.000	0.00	0.05	0.00	0.013
192.390	0.000	0.00	0.05	0.00	0.013
192.580	0.000	0.00	0.05	0.00	0.013
192.769	0.000	0.00	0.05	0.00	0.013
192.959	0.000	0.00	0.05	0.00	0.013
193.149	0.000	0.00	0.05	0.00	0.013
193.338	0.000	0.00	0.05	0.00	0.013
193.528	0.000	0.00	0.04	0.00	0.013
193.718	0.000	0.00	0.04	0.00	0.013

193.907	0.000	0.00	0.04	0.00	0.013
194.097	0.000	0.00	0.04	0.00	0.013
194.287	0.000	0.00	0.04	0.00	0.013
194.476	0.000	0.00	0.04	0.00	0.013
194.666	0.000	0.00	0.04	0.00	0.013
194.856	0.000	0.00	0.04	0.00	0.013
195.045	0.000	0.00	0.04	0.00	0.013
195.235	0.000	0.00	0.04	0.00	0.013
195.425	0.000	0.00	0.04	0.00	0.013
195.614	0.000	0.00	0.04	0.00	0.013
195.804	0.000	0.00	0.04	0.00	0.012
195.994	0.000	0.00	0.04	0.00	0.012
196.183	0.000	0.00	0.04	0.00	0.012
196.373	0.000	0.00	0.04	0.00	0.012
196.563	0.000	0.00	0.04	0.00	0.012
196.752	0.000	0.00	0.04	0.00	0.012
196.942	0.000	0.00	0.04	0.00	0.012
197.132	0.000	0.00	0.04	0.00	0.012
197.321	0.000	0.00	0.04	0.00	0.012
197.511	0.000	0.00	0.04	0.00	0.012
197.701	0.000	0.00	0.04	0.00	0.012
197.890	0.000	0.00	0.04	0.00	0.012
198.080	0.000	0.00	0.04	0.00	0.012
198.270	0.000	0.00	0.04	0.00	0.012
198.459	0.000	0.00	0.04	0.00	0.012
198.649	0.000	0.00	0.04	0.00	0.012
198.839	0.000	0.00	0.04	0.00	0.012
199.028	0.000	0.00	0.04	0.00	0.012
199.218	0.000	0.00	0.04	0.00	0.012
199.408	0.000	0.00	0.04	0.00	0.012
199.597	0.000	0.00	0.04	0.00	0.012
199.787	0.000	0.00	0.04	0.00	0.011
199.977	0.000	0.00	0.04	0.00	0.011
200.166	0.000	0.00	0.04	0.00	0.011
200.356	0.000	0.00	0.04	0.00	0.011
200.546	0.000	0.00	0.04	0.00	0.011
200.735	0.000	0.00	0.04	0.00	0.011

200.925	0.000	0.00	0.04	0.00	0.011
201.115	0.000	0.00	0.04	0.00	0.011
201.304	0.000	0.00	0.04	0.00	0.011
201.494	0.000	0.00	0.04	0.00	0.011
201.684	0.000	0.00	0.04	0.00	0.011
201.873	0.000	0.00	0.04	0.00	0.011
202.063	0.000	0.00	0.04	0.00	0.011
202.253	0.000	0.00	0.04	0.00	0.011
202.442	0.000	0.00	0.04	0.00	0.011
202.632	0.000	0.00	0.04	0.00	0.011
202.822	0.000	0.00	0.04	0.00	0.011
203.011	0.000	0.00	0.04	0.00	0.011
203.201	0.000	0.00	0.04	0.00	0.011
203.391	0.000	0.00	0.04	0.00	0.011
203.580	0.000	0.00	0.04	0.00	0.011
203.770	0.000	0.00	0.04	0.00	0.011
203.960	0.000	0.00	0.04	0.00	0.011
204.149	0.000	0.00	0.04	0.00	0.010
204.339	0.000	0.00	0.04	0.00	0.010
204.529	0.000	0.00	0.04	0.00	0.010
204.718	0.000	0.00	0.04	0.00	0.010
204.908	0.000	0.00	0.04	0.00	0.010
205.098	0.000	0.00	0.04	0.00	0.010
205.287	0.000	0.00	0.04	0.00	0.010
205.477	0.000	0.00	0.04	0.00	0.010
205.667	0.000	0.00	0.03	0.00	0.010
205.856	0.000	0.00	0.03	0.00	0.010
206.046	0.000	0.00	0.03	0.00	0.010
206.236	0.000	0.00	0.03	0.00	0.010
206.425	0.000	0.00	0.03	0.00	0.010
206.615	0.000	0.00	0.03	0.00	0.010
206.805	0.000	0.00	0.03	0.00	0.010
206.994	0.000	0.00	0.03	0.00	0.010
207.184	0.000	0.00	0.03	0.00	0.010
207.374	0.000	0.00	0.03	0.00	0.010
207.563	0.000	0.00	0.03	0.00	0.010
207.753	0.000	0.00	0.03	0.00	0.010

207.943	0.000	0.00	0.03	0.00	0.010
208.132	0.000	0.00	0.03	0.00	0.010
208.322	0.000	0.00	0.03	0.00	0.010
208.512	0.000	0.00	0.03	0.00	0.010
208.701	0.000	0.00	0.03	0.00	0.010
208.891	0.000	0.00	0.03	0.00	0.009
209.081	0.000	0.00	0.03	0.00	0.009
209.270	0.000	0.00	0.03	0.00	0.009
209.460	0.000	0.00	0.03	0.00	0.009
209.650	0.000	0.00	0.03	0.00	0.009
209.839	0.000	0.00	0.03	0.00	0.009
210.029	0.000	0.00	0.03	0.00	0.009
210.219	0.000	0.00	0.03	0.00	0.009
210.408	0.000	0.00	0.03	0.00	0.009
210.598	0.000	0.00	0.03	0.00	0.009
210.788	0.000	0.00	0.03	0.00	0.009
210.977	0.000	0.00	0.03	0.00	0.009
211.167	0.000	0.00	0.03	0.00	0.009
211.357	0.000	0.00	0.03	0.00	0.009
211.546	0.000	0.00	0.03	0.00	0.009
211.736	0.000	0.00	0.03	0.00	0.009
211.926	0.000	0.00	0.03	0.00	0.009
212.115	0.000	0.00	0.03	0.00	0.009
212.305	0.000	0.00	0.03	0.00	0.009
212.495	0.000	0.00	0.03	0.00	0.009
212.684	0.000	0.00	0.03	0.00	0.009
212.874	0.000	0.00	0.03	0.00	0.009
213.064	0.000	0.00	0.03	0.00	0.009
213.253	0.000	0.00	0.03	0.00	0.009
213.443	0.000	0.00	0.03	0.00	0.009
213.633	0.000	0.00	0.03	0.00	0.009
213.822	0.000	0.00	0.03	0.00	0.009
214.012	0.000	0.00	0.03	0.00	0.009

C-4: Stage-Outflow Relationship

True Life Basin
Project:
Basin Description:

Contour Elevation	Contour Area (sq. ft)	Depth (ft)	Incremental Volume Avg. End (cu. ft)	Cumulative Volume Avg. End (cu. ft)	Incremental Volume Conic (cu. ft)	Cumulative Volume Conic (cu. ft)
1,288.60	13,977.80	N/A	N/A	0.00	N/A	0.00
1,288.80	14,331.65	0.20	2830.94	2830.94	2830.87	2830.87
1,289.00	14,687.39	0.20	2901.90	5732.85	2901.83	5732.70
1,289.20	15,045.05	0.20	2973.24	8706.09	2973.17	8705.87
1,289.40	15,404.61	0.20	3044.97	11751.06	3044.89	11750.77
1,289.60	15,766.07	0.20	3117.07	14868.13	3117.00	14867.77
1,289.80	16,129.43	0.20	3189.55	18057.68	3189.48	18057.25
1,290.00	16,608.22	0.20	3273.77	21331.44	3273.65	21330.90
1,290.20	16,876.21	0.20	3348.44	24679.88	3348.41	24679.30
1,290.40	17,145.07	0.20	3402.13	28082.01	3402.09	28081.40
1,290.60	17,414.82	0.20	3455.99	31538.00	3455.95	31537.35
1,290.80	17,685.44	0.20	3510.03	35048.03	3509.99	35047.34
1,291.00	17,956.94	0.20	3564.24	38612.26	3564.20	38611.54
1,291.20	18,229.31	0.20	3618.62	42230.89	3618.59	42230.13
1,291.40	18,502.57	0.20	3673.19	45904.08	3673.15	45903.29
1,291.60	18,776.70	0.20	3727.93	49632.00	3727.89	49631.18
1,291.80	19,051.71	0.20	3782.84	53414.84	3782.81	53413.99

C-5: San Bernardino County Unit Hydrograph Procedures

Appendix D

Hydraulic Analyses

D-1: WSPG Analysis
D-2: AES Catch Basin Analysis
D-3: Emergency Overflow Calculations

Worksheet for Curb Inlet In Sag - 1

Project Description

Solve For	Spread

Input Data

Discharge		9.88	ft^3/s
Gutter Width		4.00	ft
Gutter Cross Slope		0.08	ft/ft
Road Cross Slope		0.02	ft/ft
Curb Opening Length		14.00	ft
Opening Height		0.67	ft
Curb Throat Type	Horizontal		
Local Depression		4.00	in
Local Depression Width		2.00	ft
Throat Incline Angle		90.00	degrees

Results

Spread	17.25	ft
Depth	0.60	ft
Gutter Depression	0.25	ft
Total Depression	0.59	ft

Worksheet for Irregular Section - 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01290	ft/ft
Discharge	19.16	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	0.00
0+19	-0.38
0+21	-0.55
0+21	0.12

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 0.00)	(0+21, 0.12)	0.013

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.54	ft
Elevation Range	-0.55 to 0.12 ft	
Flow Area	4.26	ft²
Wetted Perimeter	20.86	ft
Hydraulic Radius	0.20	ft
Top Width	20.32	ft
Normal Depth	0.54	ft
Critical Depth	0.63	ft
Critical Slope	0.00387	ft/ft

Worksheet for Irregular Section - 1

Results

Velocity		4.50	ft/s
Velocity Head		0.31	ft
Specific Energy		0.85	ft
Froude Number		1.73	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.54	ft
Critical Depth	0.63	ft
Channel Slope	0.01290	ft/ft
Critical Slope	0.00387	ft/ft

Appendix E

Referenced Materials

Pictures of Existing Condition