Preliminary Hydrology Report

for

TENTATIVE TRACT 20721

APN: 1201-371-14-0000, 1201-371-16-0000

East Highland – Alta Vista

DECEMEBR 17, 2024

PREPARED FOR:

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This Preliminary Drainage Report has been prepared by Kimley-Horn and Associates, Inc. under the direct supervision of the following Registered Civil engineer. The undersigned attests to the technical data contained in this study, and to the qualifications of technical specialists providing engineering computations upon which the recommendations and conclusions are based.

Certification by Engineer

For Review
12/18/2024 11:38:05 AM

___________________________________ ___________

Rob R. Otte, PE Date

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Hydrology Manual. San Bernardino County, August 1986.

2010 San Bernardino County Hydrology Manual Addendum.

INTRODUCTION

Kimley-Horn and Associates has been retained to prepare a Preliminary Hydrology Report for the proposed East Highland – Alta Vista development in the City of Highland, San Bernardino County. The purpose of this report is to demonstrate preliminary analysis of the hydrologic and hydraulic conditions associated with the development of the project site. To do so, the following is the scope of this report:

- Discuss the pre-development discharge patterns and points
- Discuss the post-development discharge patterns and points
- Determine the pre-development onsite flow rates for the 2-year and 100-year events
- Determine the post-development un-mitigated flow rates for the 2-year and 100-year events
- Determine required post-development onsite mitigation for the 100-year event

Even though this report discusses stormwater, this report is not a Stormwater Pollution Prevention Plan (SWPPP), a Groundwater Study, a Geotechnical Report, nor a Water Quality Management Plan (WQMP). Each of these separate reports discusses separate aspects of stormwater. Portions of the Geotechnical Report are utilized and referenced for the purpose of this report. Similarly, the requirements of the WQMP are considered for the stormwater mitigation and sizing of outlet structures for this project.

PROJECT DESCRIPTION

The existing vacant parcels will be developed into 113 single-family residential lots. The proposed development will include single-family housing with associated residential landscaping, concrete hardscape and asphalt paving community streets. The associated improvements include, but are not limited to onsite and offsite grading, domestic water service, sanitary sewer service, storm drain infrastructure, street improvements, concrete and asphalt pavement, landscaping and irrigation. The proposed development is approximately 12-acres. The proposed single-family residential lots will be homeowner maintained. The private streets, open space, common area landscape, park amenities, and storm drain infrastructure onsite will be maintained by the future homeowner's association. Public streets and public storm drain systems will be maintained by the City of Highland. The APN's for the project site are 1201-371-14-0000 and 1201-371-16-0000. **Appendix A** contains an aerial photograph that depicts the project location.

LOCATION

The proposed site consists of 12 +/- acres located on the northwest and northeast side of the intersection of Greenspot Road and Alta Vista in the City of Highland, San Bernardino County. It is approximately 2.8 miles east of the 210 Freeway along Greenspot road. The site is bounded by the Greenspot Road to the south, Alta Vista to the east and west, Santa Ana Canyon Road to the north, and by private property to the east and west. For reference, see **Appendix A** and **Figure 1** for the Location Map.

FIGURE 1: LOCATION MAP

METHODOLOGY

The hydrologic and hydraulic analyses were completed following the methods outlined in the San Bernardino County Hydrology Manual. The rational method was used to estimate time of concentrations and peak flow rates generated from the existing and proposed 100-year, 1-hour storm event. The synthetic unit hydrograph method was used to determine the onsite proposed hydrographs for the 24-hour duration of the 100-year storm event. The CIVILDESIGN (Civil D) Engineering Software – 2018 Version 9.0 'San Bernardino County Rational Hydrology Program' option within the software was used to complete the rational method and synthetic unit hydrograph analyses. The results of the analyses are included in **Appendix E and F**. HydroCAD Stormwater Modeling System - Since 1986 was used to complete the basin routing using Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method. The results of the analyses are included in **Appendix G**. Complete onsite and offsite drainage system analyses will be provided in the Final Hydrology Report.

The rainfall data used for the analyses is important for the flow and runoff results. Per the 2010 San Bernardino County Hydrology Manual Addendum, San Bernardino County should consider all available rainfall data for hydrology studies. After review of available data, the NOAA Atlas 14 rainfall data was used for this study as included in **Appendix C**.

The type of soil and soil conditions are major factors affecting infiltration/detention and resultant storm water runoff. The Natural Resources Conservation Service (NRCS) has classified soil into one general hydrologic soil group for comparing infiltration and runoff rates. The group is based on properties that influence runoff, such as water infiltration rate, texture, natural discharge, and moisture condition. The runoff potential is based on the amount of runoff at the end of a long duration storm that occurs after wetting and swelling of the soil not protected by vegetation. Using the United States Department of Agriculture Natural Resources Conservation Service Web Soil Survey online tool, it was determined the predominant hydrologic soil group classification is, Soil group A is defined as soils having high infiltration rates (low runoff potential). These soils have a high rate of water transmission. Based on the Percolation Test Results Report prepared by Petra Geosciences, Inc. on March 27, 2024, a total of 4 tests were conducted, two per infiltration basin. It was concluded that the conservative infiltration rate is approximately 20.13 in/hr for Basin 1 and 29.48 in/hr for Basin 2. As demonstrated in the test results, the infiltration rate improves with depth. See **Appendix H** for the soil information.

In addition, antecedent moisture condition (AMC) I for the 2-year and AMC III peak flows based on the 2010 San Bernardino County Hydrology Manual Addendum. An annual grass land use was used for the existing condition of the site. The residential land use was used for the proposed drainage areas. The combination of the soil and coverage type was used as the basis for selecting the appropriate curve numbers used to calculate the soil loss rates. See **Appendix C Figure C-4** for curve numbers based on hydrologic soil conditions for pervious areas.

DRAINAGE CHARACTERISTICS

FEMA MAPPING

The site is located in Zone A and Zone X per the Federal Emergency Management Administration (FEMA) Flood Insurance Rate Map (FIRM) panel 06071C8707J, dated September 2, 2016. Zone A, special flood hazard areas subject to inundation by the 1% annual chance flood, is defined by FEMA as the 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The section of the site being located in Zone A will be rezoned through a Letter Of Map Revision (LOMR) to Zone X. Zone X is defined by FEMA as areas determined to be outside the 0.2% annual chance flood. For reference, see **Appendix B** FIRM Map.

GROUNDWATER

Groundwater was not encountered during the Geotechnical Engineering Investigation prepared by RMA GeoScience. The maximum depth explored was approximately 8 feet. The closest well data available indicates a median groundwater depth of 145 feet over the past decade, with a minimum depth to groundwater of 131 feet in 2011. Additional information can be found in the Geotechnical Investigation (RMA Project No.:15-I27-0) by RMA GeoScience dated August 13, 2015.

PRE-DEVELOPMENT CONDITION

The existing project site is currently vacant, generally flat, and vegetation consists primarily of grasses, flowering plants, large bushes, and small trees on the north half of the site, and grasses, shrubs, and small trees on the south end of the site. There are two (2) drainage areas (DA) on the Existing Hydrology Exhibit. Onsite area DA-1 flows drain west of the site where the stormwater flows currently experience some localized ponding onsite before continuing down stream through the natural drainage course. Onsite area

DA-2 sheet flows west towards Alta Vista and ultimately onto the street continuing westerly on Greenspot Road along curb and gutter until it is conveyed to an existing public storm inlet located on Weaver.

Under existing conditions, the site not only conveys onsite flows, but it also accepts offsite flows. The existing site currently accepts offsite flows from the north from a low point in Santa Ana Canyon Road. Offsite flows sheet flow onsite and confluence with onsite flows. The combined onsite and offsite flows will ultimately discharge west, as described above.

The existing site also accepts flows from an existing 36" RCP storm drain (Line B) at the north boundary of the project site, per the reference storm drain plan (DRA 21-013, Tract 20142) DWG No. 15-108. The existing 36" RCP storm drain conveys to an existing outlet headwall into a rock swale, which ultimately discharges into the site. The existing 36" RCP storm drain discharging into the project site does not have any direct connections from the project site. The reference storm drain plan indicates that the existing 36" RCP storm drain (Line B) cumulative discharge for 100-year is 77.39 cfs with max velocity 10.95 fps.

Table 1 shows a summary of the pre-development flows for the onsite drainage areas. See **Appendix G** for the Existing Drainage Map and **Appendix H** for the rational method calculations.

Table 1: Pre-Development Flows

Drainage Area/s ID	Drainage Area (AC)	Q_2 rational method (cfs)	Q_{100} rational method (cfs)
DA-1 (onsite)	**10.00**	**0.18**	**20.23**
DA-2 (onsite)	**1.98**	**0.73**	**5.69**
Total	**11.98**	**0.91**	**25.92**

POST-DEVELOPMENT CONDITION

The post-development condition for the project site consists of two (2) DA's which are comprised of eleven (12) sub-areas. The DA's were divided based on the proposed site grading, of which intends to maintain the existing natural flow pattern to the maximum extent possible. Separate storm drain systems are proposed for each DA to capture and convey stormwater to the proposed storm drain facilities.

DA-1 includes approximately 9.47 acres along the northerly and westerly part of the site. Runoff from drainage sub-areas DA-1.1, DA-1.2, DA-1.3, DA-1.4, DA-1.5, DA-1.6, DA-1.7, DA-1.8 and DA-1.9 are intercepted by a proposed private storm drain system onsite, which then convey flows into a proposed onsite infiltration basin (Basin 1) on the southwest corner and adjacent to Greenspot road. The proposed outflow of Basin 1 is controlled by an outlet weir structure proposed to outlet into a proposed offsite public storm drain pipe that is proposed to connect to an existing box culvert approximately 1,000 L.F. westerly in Greenspot road. Overflows exit the basin via an emergency overflow onto Greenspot Rd.

DA-3 includes approximately 1.85 acres along the southeast part of the site across Alta Vista. Runoff from drainage sub-areas DA-3.1, DA-3.2 and DA-3.3 are intercepted by a proposed private storm drain system onsite, which then convey flows into a proposed onsite infiltration basin (Basin 2) on the southwest corner and adjacent to Alta Vista. The proposed outflow of Basin 2 is controlled by an outlet weir structure proposed to outlet into a proposed offsite public storm drain pipe in Greenspot road, as mentioned above. Overflows exit the basin via an emergency overflow onto Alta Vista.

Similar to existing condition, the onsite not only conveys onsite flows, but it also accepts offsite flows from the existing 36" storm drain (Line B) and Santa Ana Canyon Road. Under the post-development condition, offsite flows from the existing 36" storm drain (Line B) will be intercepted and conveyed into a proposed public by-pass storm drain system onsite, separate from the private onsite storm drain, through the site proposed to outlet into a proposed offsite public storm drain pipe in Greenspot road, as mentioned above. A catch basin with filter inserts will be installed at the low point along the south side of Santa Ana Canyon Road to collect the reminder of the offsite flows that drain to this street and then convey these flows to the proposed public by-pass storm drain system as storm drain (Line B) mentioned above. Offsite flows in Santa Ana Canyon Road will be considered in the Final Hydrology Report.

Table 2 shows a summary of the post-development flows prior to detention. See **Appendix G** for the Proposed Drainage Map and **Appendix H** for the rational method calculations.

Table 2: Post-Development Flows (Un-mitigated)

Drainage Area/s ID	Drainage Area (AC)	Q_2 rational method (cfs)	Q_{100} rational method (cfs)
DA-1.1, DA-1.2, DA-1.3, DA-1.4, DA-1.5, DA-1.6, DA-1.7, DA-1.8 and DA-1.9 (onsite)	**9.47**	**8.25**	**26.94**
DA-3.1, DA-3.2, and DA-3.3 (onsite)	**1.85**	**1.83**	**6.54**
Total	**11.32**	**10.08**	**33.48**

STORMWATER MITIGATION

For proposed onsite flows, stormwater mitigation is needed to ensure the proposed flows do not negatively impact the existing downstream drainage facilities. Since the design flows appear to be based on an undeveloped condition of Parcels 1 and 2, the proposed flows will need to be mitigated. Based on the area distribution, it is estimated that the project site can discharge approximately 18.21 cfs from Basin 1 and the east onsite property can discharge 5.12 cfs max from Basin 2. Based on the results presented on Table 2 for the onsite project area, the proposed development exceeds the allowable discharge. To mitigate the increase in flows, two infiltration basins are proposed.

The volume of storage provided in the infiltration basins along with the size of the outflow is intended to restrict peak flows in the proposed condition. Based on the basin routing for the 100-year storm event, the highest routed (mitigated) onsite outflows from the infiltration basins are just under the allowable flows from the project site. The results of the analyses are included in **Appendix G**, *HydroCAD Stormwater Modeling System*.

Table 3 shows a summary of the proposed 100-year final mitigated flows compared to the existing flows.

Table 3: Proposed 100-year Final (Mitigated) Flows vs. Allowable Flows

Drainage Area/s	Drainage Area (AC)	Final Q_{100} (cfs)	Max Allowable Q_{100} (cfs)
DA-1 (onsite)	9.47	15.26	18.21
DA-3 (offsite)	1.85	2.50	5.12
Total	11.32	17.76	23.33

HYDRAULIC ANALYSIS

The project proposes onsite storm drain pipes and inlets that discharge into two (2) infiltration basins. There will also be a proposed public offsite storm drain pipe from the infiltration basins that will confluence with the existing box culvert approximately 1,000 L.F. westerly in Greenspot road. The calculated peak flows from the analyses discussed above along with the offsite flows will be used to size the onsite drainage devices. All drainage devices will be sized in the Final Hydrology Report. See **Appendix I** for the Sizing Calculations.

CONCLUSION

In conclusion, the following was covered in this report:

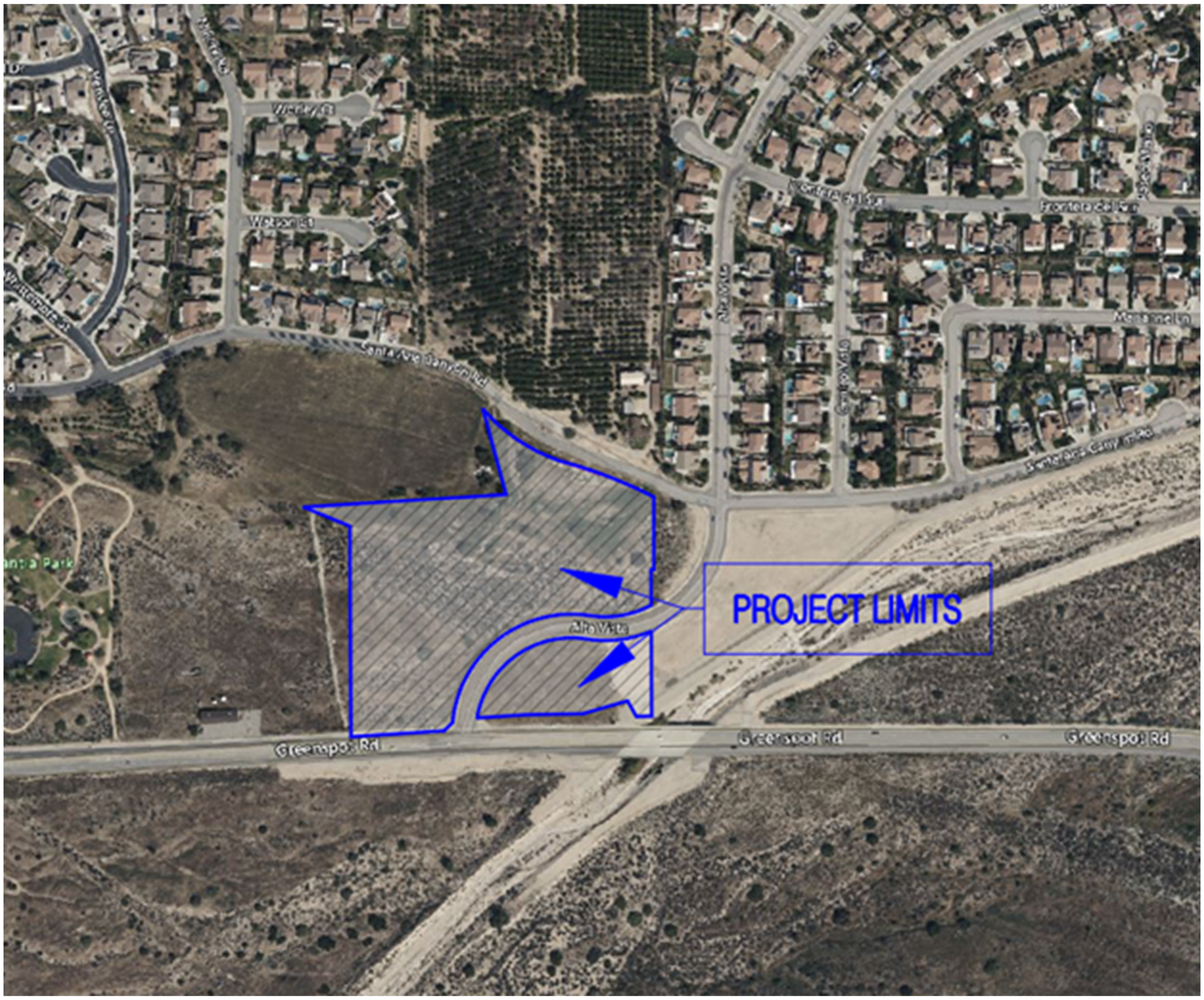
- The pre-development discharge patterns and points were discussed
- The post-development discharge patterns and points were discussed
- The pre-development flow rates for the 2-year and 100-years event were determined
- The post-development un-mitigated flow rates for the 2-year and 100-year event were determined
- The post-development stormwater mitigation for the 100-year event was analyzed

As discussed in the contents of this report, the development of the existing vacant site into the proposed development is not expected to cause a significant impact to downstream systems for storms up to the 100-year condition. The mitigated development discharges less stormwater flows than allowable discharge flows.

Appendix A - Location Map

Vicinity Map

East Highland – Alta Vista



Appendix B - FIRM MAP

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations (BFEs) shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 11 North. The **horizontal datum** was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242** or visit its website at http://www.ngs.noaa.gov/.

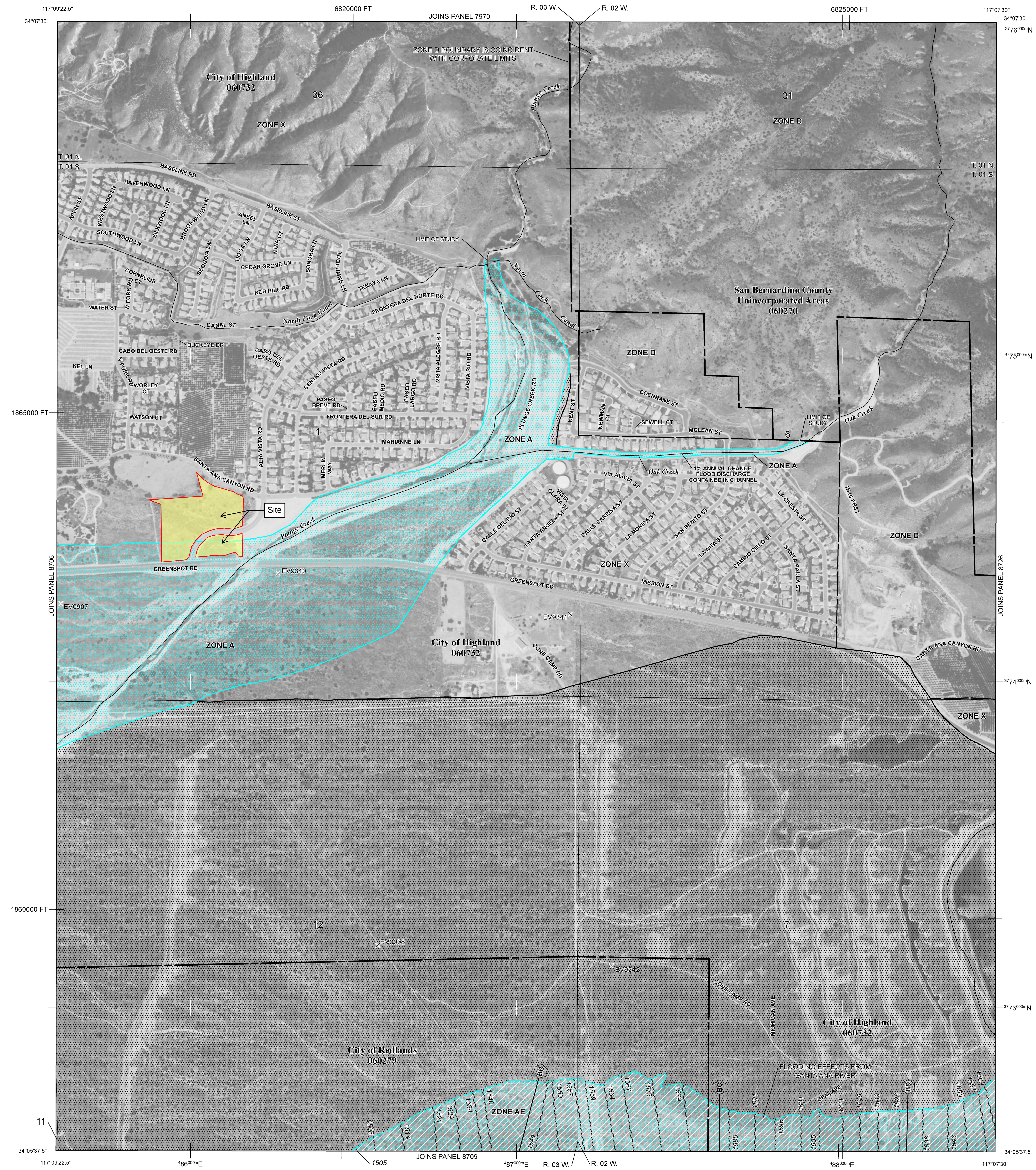
Base map information shown on this FIRM was provided in digital format by the San Bernardino County ISD.GIS Department, United States Geological Survey, the Bureau of Land Management, the United States Department of Agriculture, and the National Geodetic Survey. The imagery was flown by U.S. Department of Agricuture Farm Sevice Agency in 2012 and was produced with a 1-meter ground sampling distance.

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products, or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Map Service Center website or by calling the FEMA Map Information eXchange.



LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Areas to be protected from 1% annual chance flood event by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	1% annual chance floodplain boundary
	0.2% annual chance floodplain boundary
	Floodway boundary
	Zone D boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

A — A	Cross section line
23 - - - 23	Transect line
97°07'30", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
4275000mE	1000-meter Universal Transverse Mercator grid values, zone 11
6000000 FT	5000-foot grid ticks: California State Plane coordinate system, Zone V (FIPSZONE = 405), Lambert projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
● M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories List on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
August 28, 2008

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
September 2, 2016 – to change Base Flood Elevations, to add Base Flood Elevations, to change Special Flood Hazard Areas, to add Special Flood Hazard Areas, to change zone designations, to incorporate previously issued Letters of Map Revision, and to reflect updated topographic information.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 250 500 750 1,000 FEET
150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 8707J

FIRM
FLOOD INSURANCE RATE MAP
SAN BERNARDINO COUNTY, CALIFORNIA AND INCORPORATED AREAS

PANEL 8707 OF 9400

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
HIGHLAND, CITY OF	060732	8707	J
REDLANDS, CITY OF	060279	8707	J
SAN BERNARDINO COUNTY	060270	8707	J

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER 06071C8707J

MAP REVISED SEPTEMBER 2, 2016

Federal Emergency Management Agency

Appendix C - Reference Material

Residential Landscaping (Lawn, Shrubs, etc.) - The pervious portions of commercial establishments, single and multiple family dwellings, trailer parks and schools where the predominant land cover is lawn, shrubbery and trees.

Row Crops - Lettuce, tomatoes, beets, tulips or any field crop planted in rows far enough apart that most of the soil surface is exposed to rainfall impact throughout the growing season. At plowing, planting and harvest times it is equivalent to fallow.

Small Grain - Wheat, oats, barley, flax, etc. planted in rows close enough that the soil surface is not exposed except during planting and shortly thereafter.

Legumes - Alfalfa, sweetclover, timothy, etc. and combinations are either planted in close rows or broadcast.

Fallow - Fallow land is land plowed but not yet seeded or tilled.

Woodland - grass - Areas with an open cover of broadleaf or coniferous trees usually live oak and pines, with the intervening ground space occupied by annual grasses or weeds. The trees may occur singly or in small clumps. Canopy density, the amount of ground surface shaded at high noon, is from 20 to 50 percent.

Woodland - Areas on which coniferous or broadleaf trees predominate. The canopy density is at least 50 percent. Open areas may have a cover of annual or perennial grasses or of brush. Herbaceous plant cover under the trees is usually sparse because of leaf or needle litter accumulation.

Chaparral - Land on which the principal vegetation consists of evergreen shrubs with broad, hard, stiff leaves such as manzonita, ceanothus and scrub oak. The brush cover is usually dense or moderately dense. Diffusely branched evergreen shrubs with fine needle-like leaves, such as chamise and redchank, with dense high growth are also included in this soil cover.

Annual Grass - Land on which the principal vegetation consists of annual grasses and weeds such as annual bromes, wild barley, soft chess, ryegrass and filaree.

Irrigated Pasture - Irrigated land planted to perennial grasses and legumes for production of forage and which is cultivated only to establish or renew the stand of plants. Dry land pasture is considered as annual grass.

Meadow - Land areas with seasonally high water table, locally called cienegas. Principal vegetation consists of sod-forming grasses interspersed with other plants.

Orchard (Deciduous) - Land planted to such deciduous trees as apples, apricots, pears, walnuts, and almonds.

Orchard (Evergreen) - Land planted to evergreen trees which include citrus and avocados and coniferous plantings.

Turf - Golf courses, parks and similar lands where the predominant cover is irrigated mowed close-grown turf grass. Parks in which trees are dense may be classified as woodland.

SCS COVER TYPE DESCRIPTIONS

Figure C-2

POOR: Heavily grazed or regularly burned areas. Less than 50 percent of the ground surface is protected by plant cover or brush and tree canopy.

FAIR: Moderate cover with 50 percent to 75 percent of the ground surface protected by vegetation.

GOOD: Heavy or dense cover with more than 75 percent of the ground surface protected by vegetation.

In most cases, watershed existing conditions cover type and quality can be readily determined by a field review of a watershed. In ultimate planned open spaces, the soil cover condition shall be considered as "good." Figure C-3 provides the CN values for various types and quality of ground cover. Impervious areas shall be assigned a CN of 98. It is noted that for ultimately developed conditions, the CN for urban landscaping (turf) is provided in Figure C-3.

C.4. WATERSHED DEVELOPMENT CONDITIONS

Ultimate development of the watershed should normally be assumed since watershed urbanization is reasonably likely within the expected life of most hydraulic facilities. Long range master plans for the County and incorporated cities should be reviewed to insure that reasonable land use assumptions are made for the ultimate development of the watershed. A field review shall also be made to confirm existing use and drainage patterns. Particular attention shall be paid to existing and proposed landscape practices, as it is common in some areas to use ornamental gravels underlain by impervious plastic materials in place of lawns and shrubs. Appropriate actual impervious percentages can then be selected from Figure C-4. It should be noted that the recommended values from these figures are for average conditions and, therefore, some adjustment for particular applications may be required.

Curve (1) Numbers of Hydrologic Soil-Cover Complexes For Pervious Areas-AMC II					
Cover Type (3)	Quality of Cover (2)	Soil Group			
		A	B	C	D
NATURAL COVERS -					
Barren (Rockland, eroded and graded land)		78	86	91	93
Chaparral, Broadleaf (Manzonita, ceanothus and scrub oak)	Poor	53	70	80	85
	Fair	40	63	75	81
	Good	31	57	71	78
Chaparral, Narrowleaf (Chamise and redshank)	Poor	71	82	88	91
	Fair	55	72	81	86
Grass, Annual or Perennial	Poor	67	78	86	89
	Fair	50	69	79	84
	Good	38	61	74	80
Meadows or Cienegas (Areas with seasonally high water table, principal vegetation is sod forming grass)	Poor	63	77	85	88
	Fair	51	70	80	84
	Good	30	58	71	78
Open Brush (Soft wood shrubs - buckwheat, sage, etc.)	Poor	62	76	84	88
	Fair	46	66	77	83
	Good	41	63	75	81
Woodland (Coniferous or broadleaf trees predominate. Canopy density is at least 50 percent.)	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	25	55	70	77
Woodland, Grass (Coniferous or broadleaf trees with canopy density from 20 to 50 percent)	Poor	57	73	82	86
	Fair	44	65	77	82
	Good	33	58	72	79
URBAN COVERS -					
Residential or Commercial Landscaping (Lawn, shrubs, etc.)	Good	32	56	69	75
Turf (Irrigated and mowed grass)	Poor	58	74	83	87
	Fair	44	65	77	82
	Good	33	58	72	79
AGRICULTURAL COVERS -					
Fallow (Land plowed but not tilled or seeded)		77	86	91	94

SAN BERNARDINO COUNTY

HYDROLOGY MANUAL

CURVE NUMBERS FOR PERVIOUS AREAS

Curve (1) Numbers of Hydrologic Soil-Cover Complexes For Pervious Areas-AMC II

Cover Type (3)	Quality of Cover (2)	Soil Group A	B	C	D
AGRICULTURAL COVERS (Continued)					
Legumes, Close Seeded	Poor	66	77	85	89
(Alfalfa, sweetclover, timothy, etc.)	Good	58	72	81	85
Orchards, Evergreen	Poor	57	73	82	86
(Citrus, avocados, etc.)	Fair	44	65	77	82
	Good	33	58	72	79
Pasture, Dryland	Poor	68	79	86	89
(Annual grasses)	Fair	49	69	79	84
	Good	39	61	74	80
Pasture, Irrigated	Poor	58	74	83	87
(Legumes and perennial grass)	Fair	44	65	77	82
	Good	33	58	72	79
Row Crops	Poor	72	81	88	91
(Field crops - tomatoes, sugar beets, etc.)	Good	67	78	85	89
Small grain	Poor	65	76	84	88
(Wheat, oats, barley, etc.)	Good	63	75	83	87

Notes:

1. All curve numbers are for Antecedent Moisture Condition (AMC) II.

2. Quality of cover definitions:

   Poor-Heavily grazed, regularly burned areas, or areas of high burn potential. Less than 50 percent of the ground surface is protected by plant cover or brush and tree canopy.

   Fair-Moderate cover with 50 percent to 75 percent of the ground surface protected.

   Good-Heavy or dense cover with more than 75 percent of the ground surface protected.

3. See Figure C-2 for definition of cover types.

ACTUAL IMPERVIOUS COVER

Land Use (1)	Range-Percent	Recommended Value For Average Conditions-Percent (2)
Natural or Agriculture	0 - 0	0
Public Park	10 - 25	15
School	30 - 50	40
Single Family Residential: (3)		
2.5 acre lots	5 - 15	10
1 acre lots	10 - 25	20
2 dwellings/acre	20 - 40	30
3-4 dwellings/acre	30 - 50	40
5-7 dwellings/acre	35 - 55	50
8-10 dwellings/acre	50 - 70	60
More than 10 dwellings/acre	65 - 90	80
Multiple Family Residential:		
Condominiums	45 - 70	65
Apartments	65 - 90	80
Mobile Home Park	60 - 85	75
Commercial, Downtown Business or Industrial	80 - 100	90

Notes:

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

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

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

SAN BERNARDINO COUNTY

HYDROLOGY MANUAL

ACTUAL IMPERVIOUS COVER FOR DEVELOPED AREAS

Figure C-4

NOAA Atlas 14, Volume 6, Version 2
Location name: Highland, California, USA*
Latitude: 34.1113°, Longitude: -117.1511°
Elevation: 1457 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)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.111 (0.092-0.135)	0.144 (0.119-0.175)	0.190 (0.157-0.232)	0.230 (0.189-0.282)	0.287 (0.228-0.365)	0.334 (0.260-0.435)	0.385 (0.292-0.513)	0.440 (0.324-0.604)	0.521 (0.368-0.745)	0.588 (0.401-0.872)
10-min	0.159 (0.132-0.193)	0.206 (0.171-0.251)	0.272 (0.225-0.332)	0.329 (0.270-0.405)	0.411 (0.327-0.524)	0.479 (0.372-0.623)	0.552 (0.418-0.736)	0.631 (0.465-0.866)	0.747 (0.527-1.07)	0.843 (0.574-1.25)
15-min	0.192 (0.160-0.233)	0.249 (0.207-0.303)	0.329 (0.273-0.402)	0.398 (0.327-0.489)	0.497 (0.395-0.633)	0.579 (0.450-0.753)	0.667 (0.506-0.889)	0.763 (0.562-1.05)	0.903 (0.637-1.29)	1.02 (0.695-1.51)
30-min	0.284 (0.236-0.344)	0.368 (0.306-0.448)	0.486 (0.402-0.592)	0.587 (0.482-0.722)	0.734 (0.583-0.934)	0.855 (0.664-1.11)	0.984 (0.746-1.31)	1.13 (0.829-1.54)	1.33 (0.940-1.91)	1.50 (1.02-2.23)
60-min	0.400 (0.332-0.486)	0.519 (0.431-0.631)	0.684 (0.567-0.835)	0.827 (0.680-1.02)	1.04 (0.821-1.32)	1.20 (0.936-1.57)	1.39 (1.05-1.85)	1.59 (1.17-2.18)	1.88 (1.32-2.69)	2.12 (1.44-3.14)
2-hr	0.571 (0.475-0.694)	0.732 (0.608-0.890)	0.950 (0.787-1.16)	1.13 (0.931-1.40)	1.39 (1.11-1.77)	1.60 (1.24-2.08)	1.82 (1.38-2.43)	2.05 (1.51-2.82)	2.38 (1.68-3.41)	2.64 (1.80-3.92)
3-hr	0.702 (0.584-0.853)	0.894 (0.742-1.09)	1.15 (0.954-1.41)	1.37 (1.12-1.68)	1.67 (1.32-2.12)	1.91 (1.48-2.48)	2.16 (1.63-2.87)	2.42 (1.78-3.32)	2.78 (1.96-3.98)	3.07 (2.09-4.55)
6-hr	0.981 (0.816-1.19)	1.24 (1.03-1.51)	1.59 (1.32-1.94)	1.88 (1.55-2.32)	2.28 (1.81-2.90)	2.59 (2.01-3.36)	2.90 (2.20-3.87)	3.23 (2.38-4.44)	3.69 (2.60-5.28)	4.04 (2.76-6.00)
12-hr	1.32 (1.10-1.61)	1.69 (1.40-2.06)	2.17 (1.80-2.65)	2.56 (2.10-3.15)	3.09 (2.45-3.94)	3.50 (2.72-4.55)	3.92 (2.97-5.22)	4.35 (3.20-5.97)	4.93 (3.48-7.06)	5.39 (3.67-7.99)
24-hr	1.79 (1.59-2.06)	2.31 (2.04-2.67)	2.99 (2.64-3.46)	3.55 (3.10-4.14)	4.30 (3.64-5.18)	4.88 (4.05-6.00)	5.46 (4.43-6.88)	6.07 (4.78-7.86)	6.88 (5.21-9.28)	7.52 (5.50-10.5)
2-day	2.18 (1.93-2.51)	2.86 (2.53-3.30)	3.77 (3.32-4.36)	4.51 (3.95-5.26)	5.53 (4.69-6.66)	6.33 (5.25-7.78)	7.14 (5.79-9.00)	7.99 (6.30-10.3)	9.16 (6.93-12.3)	10.1 (7.37-14.0)
3-day	2.35 (2.08-2.70)	3.12 (2.76-3.60)	4.15 (3.66-4.80)	5.01 (4.38-5.84)	6.20 (5.25-7.47)	7.14 (5.92-8.78)	8.11 (6.57-10.2)	9.13 (7.20-11.8)	10.6 (7.98-14.2)	11.7 (8.54-16.3)
4-day	2.53 (2.24-2.91)	3.38 (2.99-3.90)	4.53 (4.00-5.24)	5.49 (4.80-6.40)	6.83 (5.78-8.22)	7.88 (6.54-9.69)	8.98 (7.28-11.3)	10.1 (7.99-13.1)	11.7 (8.89-15.8)	13.0 (9.54-18.2)
7-day	2.92 (2.58-3.36)	3.93 (3.48-4.54)	5.29 (4.67-6.12)	6.42 (5.62-7.49)	8.00 (6.78-9.64)	9.24 (7.67-11.4)	10.5 (8.54-13.3)	11.9 (9.37-15.4)	13.8 (10.4-18.6)	15.3 (11.2-21.3)
10-day	3.18 (2.81-3.66)	4.30 (3.80-4.96)	5.80 (5.12-6.71)	7.05 (6.17-8.22)	8.79 (7.44-10.6)	10.2 (8.43-12.5)	11.6 (9.38-14.6)	13.1 (10.3-16.9)	15.1 (11.5-20.4)	16.8 (12.3-23.4)
20-day	3.93 (3.48-4.53)	5.36 (4.74-6.19)	7.28 (6.43-8.43)	8.88 (7.78-10.4)	11.1 (9.41-13.4)	12.9 (10.7-15.8)	14.7 (11.9-18.5)	16.6 (13.1-21.5)	19.2 (14.5-25.9)	21.3 (15.6-29.7)
30-day	4.66 (4.12-5.37)	6.36 (5.63-7.34)	8.65 (7.63-10.0)	10.6 (9.23-12.3)	13.2 (11.2-15.9)	15.3 (12.7-18.8)	17.5 (14.1-22.0)	19.7 (15.6-25.6)	22.9 (17.3-30.9)	25.4 (18.6-35.5)
45-day	5.60 (4.96-6.45)	7.61 (6.73-8.78)	10.3 (9.09-11.9)	12.6 (11.0-14.6)	15.7 (13.3-18.9)	18.2 (15.1-22.4)	20.8 (16.8-26.1)	23.5 (18.5-30.4)	27.3 (20.6-36.7)	30.3 (22.1-42.2)
60-day	6.58 (5.82-7.58)	8.86 (7.84-10.2)	11.9 (10.5-13.8)	14.5 (12.7-16.9)	18.1 (15.3-21.8)	20.9 (17.3-25.7)	23.8 (19.3-30.0)	26.9 (21.2-34.9)	31.3 (23.7-42.2)	34.7 (25.4-48.4)

[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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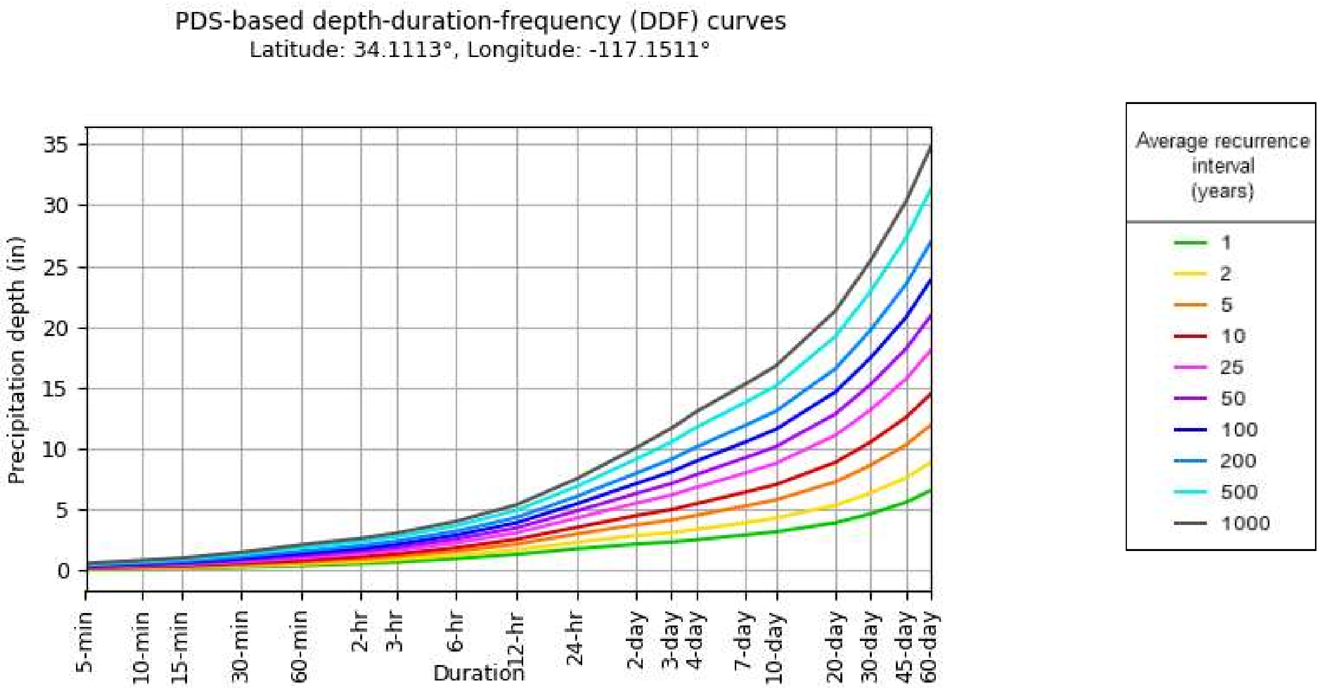
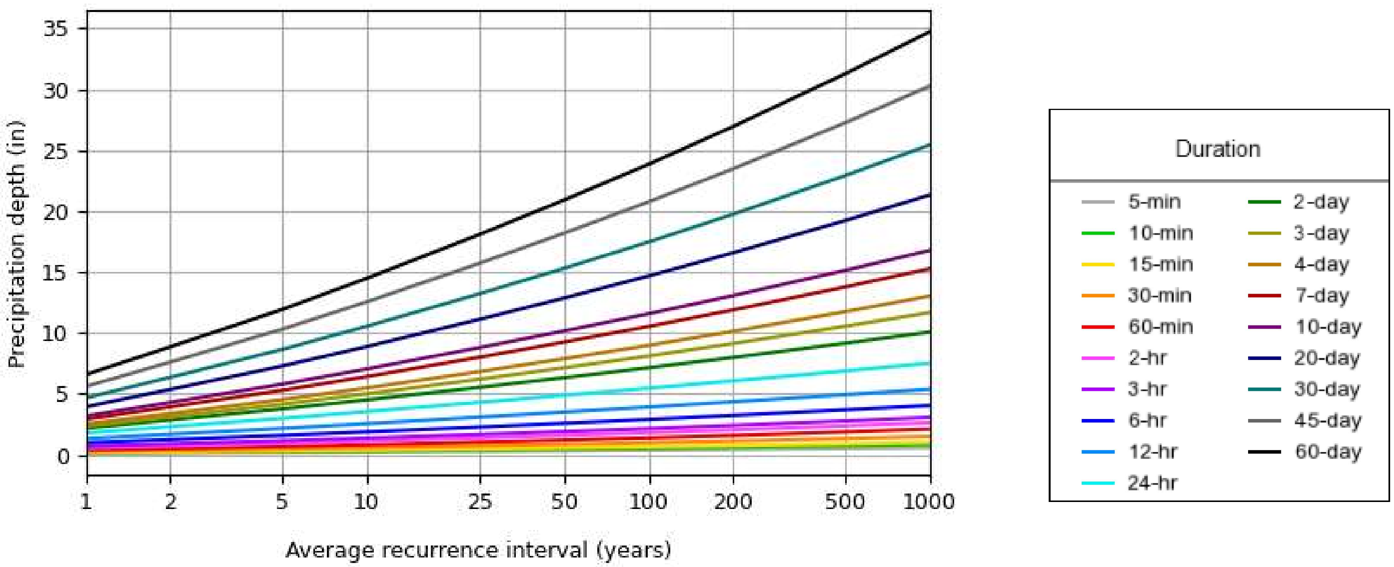
PF graphical





NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Tue Mar 5 16:05:42 2024

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Maps & aerials

Small scale terrain

Large scale terrain

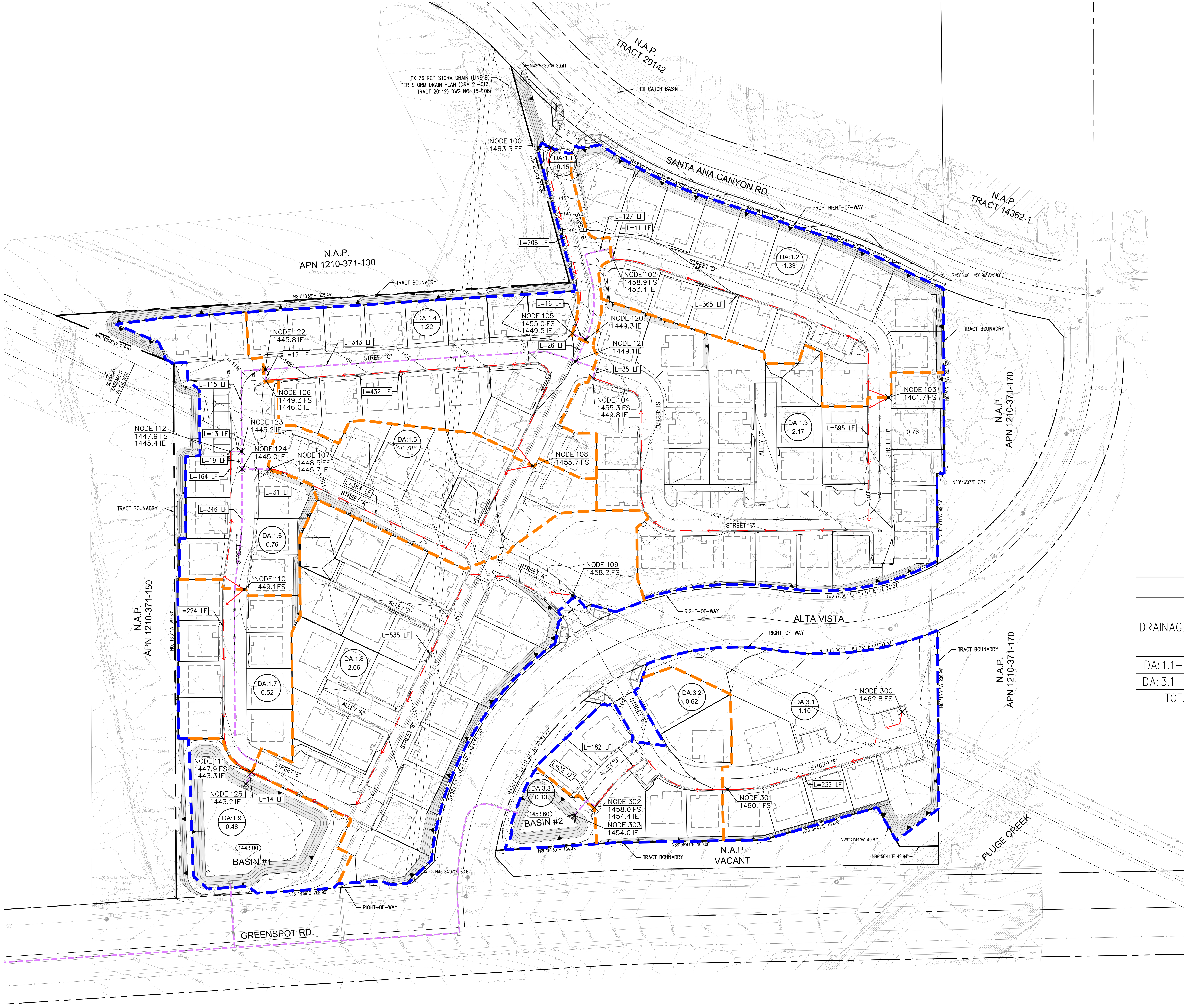
Large scale map

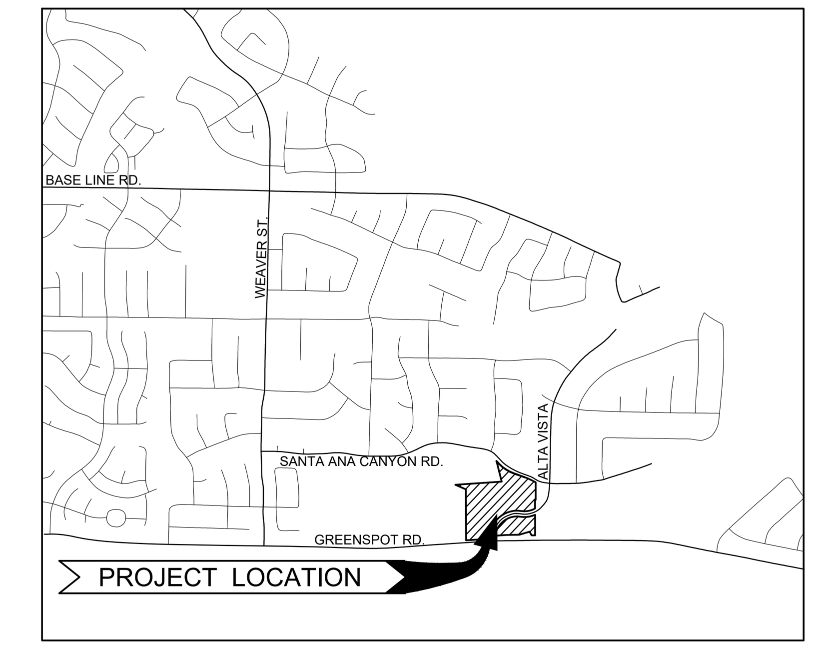
Large scale aerial

[Back to Top]

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Appendix D - Existing and Proposed Drainage Maps





VICINITY MAP

NOT TO SCALE

LEGEND

1400	PROPOSED CONTOUR
-1400-	EXISTING CONTOUR
	DMA BOUNDARY
	DMA SUB BOUNDARY
	PROPOSED STORM DRAIN
	FLOW PATH
NODE 100 1450.0 FS	NODE ID AND ELEVATION
X / XX	DA NAME
	DA AREA (IN ACRES)
	RIGHT OF WAY

DRAINAGE AREA SUMMARY

DRAINAGE AREA	AREA (AC)	UNMITIGATED 2-YR FLOWS (CFS)	UNMITIGATED 100-YR FLOW (CFS)	MITIGATED 100-YR FLOW (CFS)
DA:1.1-DA:1.9	9.470	8.255	26.941	15.260
DA:3.1-DA:3.3	1.850	1.829	6.540	2.280
TOTAL	11.320	10.084	33.481	17.540

NORTH

GRAPHIC SCALE IN FEET
0 25 50 100
SCALE: 1"=50'
(WHEN PRINTED AT 24"X36")

CITY OF HIGHLAND

PROPOSED PRELIMINARY-DRAINAGE EXHIBIT

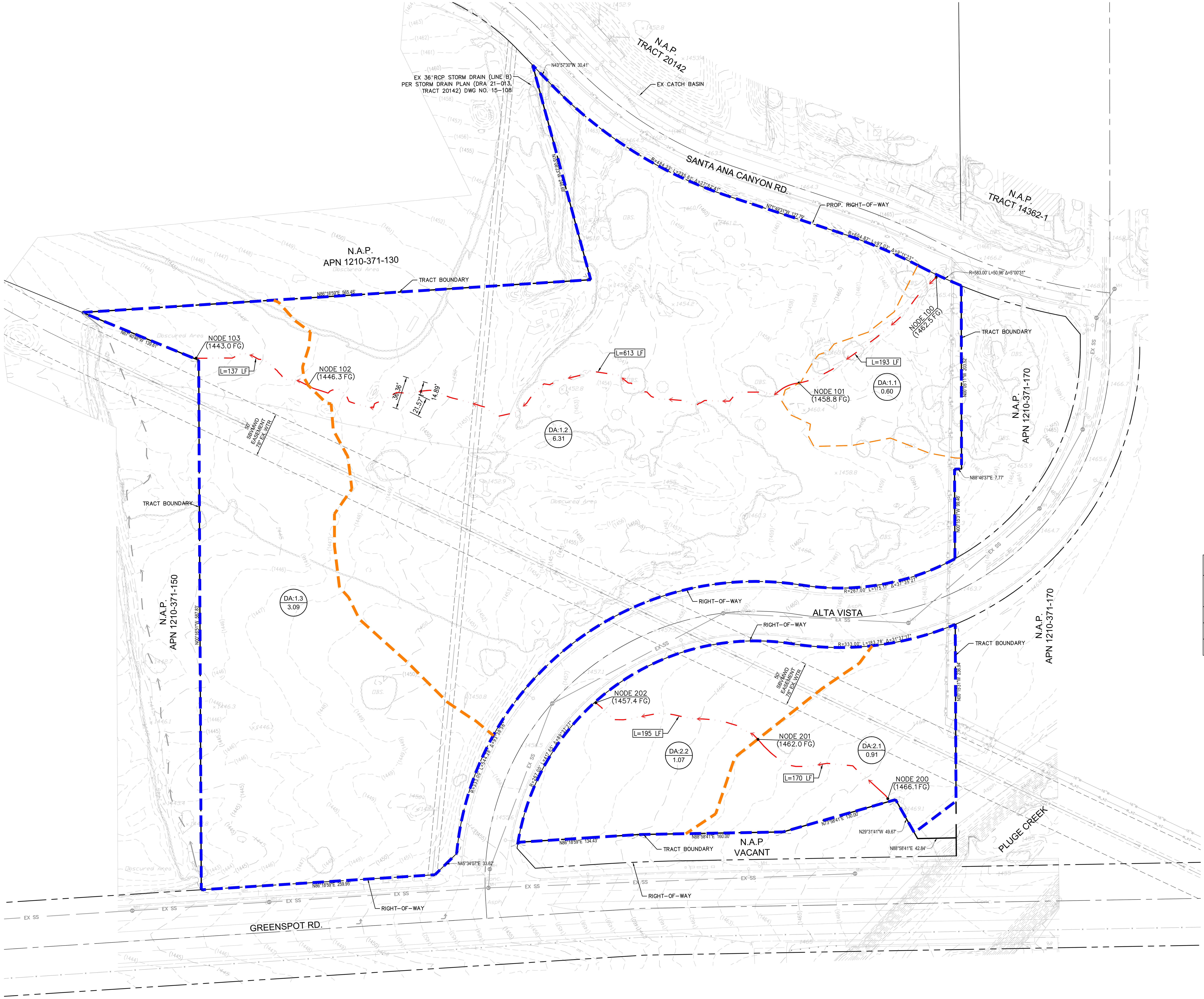
EAST HIGHLAND RANCH - ALTA VISTA
TENTATIVE TRACT MAP NO. 20721

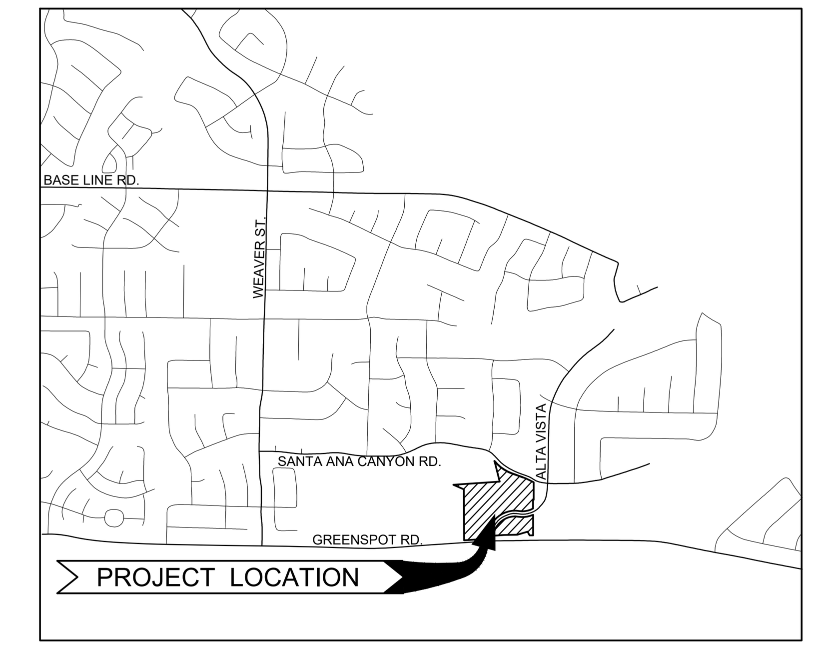
SCALE:	1"=50'
DATE:	12/2024
DESIGNED:	JDA
CHECKED:	RRO
PLN CK REF:	
F.B.	

Kimley»Horn
3801 UNIVERSITY AVENUE, SUITE 300, RIVERSIDE, CA 92501
PHONE: (951) 543-9868 WWW.KIMLEY-HORN.COM

PROJ. # 195266009
SHEET 1 OF 1 SHEETS
DWG. NO.

K:\RIV_LDEV\195256009 - EAST HIGHLAND-ALTA VISTA\REPORTS\PRELIM_H&H (DRAINAGE)\EXHIBITS\HIGHLAND_PRELIM POST DRAINAGE CONDITIONS.DWG 12/17/2024 9:40:06 AM





VICINITY MAP
NOT TO SCALE

LEGEND

1400	PROPOSED CONTOUR
-1400-	EXISTING CONTOUR
	DMA BOUNDARY
	DMA SUB BOUNDARY
	PROPOSED STORM DRAIN
	FLOW PATH
NODE 100 1450.0 FS	NODE ID AND ELEVATION
X XX	DA NAME DA AREA (IN ACRES)
	RIGHT OF WAY

DRAINAGE AREA SUMMARY			
DRAINAGE AREA	AREA (AC)	2-YR FLOW (CFS)	100-YR FLOW (CFS)
DA:1.1-DA:1.4	10.000	0.178	20.234
DA:2.1-DA:2.2	1.980	0.726	5.689
TOTAL	11.980	0.904	25.923

NORTH

GRAPHIC SCALE IN FEET
0 25 50 100
SCALE: 1"=50'
(WHEN PRINTED AT 24"X36")

CITY OF HIGHLAND

EXISTING DRAINAGE EXHIBIT
EAST HIGHLAND RANCH - ALTA VISTA
TENTATIVE TRACT MAP NO. 20721

SCALE:	1"=50'
DATE:	12/2024
DESIGNED:	JDA
CHECKED:	RRO
PLN CK REF:	
F.B.	

Kimley»Horn
3801 UNIVERSITY AVENUE, SUITE 300, RIVERSIDE, CA 92501
PHONE: (951) 543-9868 WWW.KIMLEY-HORN.COM

PROJ. # 195266009
SHEET 1
OF 1 SHEETS
DWG. NO.

K:\RIV_LDEV\195266009 - EAST HIGHLAND-ALTA VISTA\REPORTS\PRELIM_H&H (DRAINAGE)\EXHIBITS\HIGHLAND_PRELIM EXISTING DRAINAGE CONDITIONS.DWG 12/17/2024 9:17:23 AM

Appendix E - Rational Method Analysis

```
                San Bernardino County Rational Hydrology Program

                    (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2018 Version 9.0
        Rational Hydrology Study        Date: 12/13/24
------------------------------------------------------------------------
EXISTING CONDITIONS EAST HIGHLAND RANCH
EXISTING 100-YR DESIGN STORM
RATIONAL METHOD
KIMLEY-HORN
------------------------------------------------------------------------


Program License Serial Number 6443

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------
Rational hydrology study storm event year is   100.0
Computed rainfall intensity:
Storm year =   100.00   1 hour rainfall =     1.390 (In.)
Slope used for rainfall intensity curve b =  0.6000
Soil antecedent moisture condition (AMC) = 3



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      100.000 to Point/Station      101.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 50.00
Adjusted SCS curve number for AMC 3 = 70.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.532(In/Hr)
Initial subarea data:
Initial area flow distance =   193.000(Ft.)
Top (of initial area) elevation =  1462.500(Ft.)
Bottom (of initial area) elevation =  1458.800(Ft.)
Difference in elevation =     3.700(Ft.)
Slope =    0.01917  s(%)=       1.92
TC = k(0.706)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   12.779 min.
Rainfall intensity =      3.516(In/Hr) for a   100.0 year storm
```

```
Effective runoff coefficient used for area (Q=KCIA) is C = 0.764
Subarea runoff =      1.611(CFS)
Total initial stream area =        0.600(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.532(In/Hr)
```

↑

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      101.000 to Point/Station      102.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.368(Ft.), Average velocity =   1.960(Ft/s)
        ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              1.00
        2             20.00              0.00
        3             61.00              1.00
Manning's 'N' friction factor =   0.035
-----------------------------------------------------------------
Sub-Channel flow  =      8.093(CFS)
  '     '        flow top width =     22.443(Ft.)
  '     '    velocity=    1.960(Ft/s)
  '     '        area =      4.129(Sq.Ft)
  '     '        Froude number =     0.805

Upstream point elevation =  1458.800(Ft.)
Downstream point elevation =  1446.300(Ft.)
Flow length =   613.000(Ft.)
Travel time  =    5.21 min.
Time of concentration =   17.99 min.
Depth of flow =   0.368(Ft.)
Average velocity =   1.960(Ft/s)
Total irregular channel flow =     8.093(CFS)
Irregular channel normal depth above invert elev. =   0.368(Ft.)
Average velocity of channel(s) =   1.960(Ft/s)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 50.00
Adjusted SCS curve number for AMC 3 = 70.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.532(In/Hr)
Rainfall intensity =      2.863(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
```

```
rational method)(Q=KCIA) is C = 0.733
Subarea runoff =     12.885(CFS) for    6.310(Ac.)
Total runoff =     14.496(CFS)
Effective area this stream =        6.91(Ac.)
Total Study Area (Main Stream No. 1) =        6.91(Ac.)
Area averaged Fm value =    0.532(In/Hr)
Depth of flow =   0.458(Ft.), Average velocity =   2.268(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      102.000 to Point/Station      103.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.478(Ft.), Average velocity =   2.538(Ft/s)
        ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00               1.00
        2             30.00               0.00
        3             60.00               1.00
Manning's 'N' friction factor =   0.035
-----------------------------------------------------------------
Sub-Channel flow  =     17.412(CFS)
  '     '        flow top width =     28.694(Ft.)
  '     '    velocity=    2.538(Ft/s)
  '     '        area =      6.861(Sq.Ft)
  '     '        Froude number =     0.915

Upstream point elevation =  1446.300(Ft.)
Downstream point elevation =  1443.000(Ft.)
Flow length =   137.000(Ft.)
Travel time  =    0.90 min.
Time of concentration =   18.89 min.
Depth of flow =   0.478(Ft.)
Average velocity =   2.538(Ft/s)
Total irregular channel flow =    17.412(CFS)
Irregular channel normal depth above invert elev. =   0.478(Ft.)
Average velocity of channel(s) =   2.538(Ft/s)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 50.00
Adjusted SCS curve number for AMC 3 = 70.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.532(In/Hr)
```

```
Rainfall intensity =      2.781(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.728
Subarea runoff =      5.738(CFS) for    3.090(Ac.)
Total runoff =     20.234(CFS)
Effective area this stream =       10.00(Ac.)
Total Study Area (Main Stream No. 1) =       10.00(Ac.)
Area averaged Fm value =    0.532(In/Hr)
Depth of flow =   0.506(Ft.), Average velocity =   2.635(Ft/s)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      200.000 to Point/Station      201.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 50.00
Adjusted SCS curve number for AMC 3 = 70.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.532(In/Hr)
Initial subarea data:
Initial area flow distance =   170.000(Ft.)
Top (of initial area) elevation =  1466.100(Ft.)
Bottom (of initial area) elevation =  1462.000(Ft.)
Difference in elevation =     4.100(Ft.)
Slope =    0.02412  s(%)=       2.41
TC = k(0.706)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   11.602 min.
Rainfall intensity =      3.726(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.771
Subarea runoff =      2.615(CFS)
Total initial stream area =        0.910(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.532(In/Hr)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      201.000 to Point/Station      202.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.013(Ft.), Average velocity =   4.890(Ft/s)
        ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
```

```
Point number      'X' coordinate     'Y' coordinate
        1              0.00              1.00
        2             37.00              0.00
        3            101.00              0.00
        4            129.00              1.00
Manning's 'N' friction factor =   0.035
-----------------------------------------------------------------
Sub-Channel flow  =      4.153(CFS)
  '     '        flow top width =     64.857(Ft.)
  '     '    velocity=    4.891(Ft/s)
  '     '        area =      0.849(Sq.Ft)
  '     '        Froude number =     7.532

Upstream point elevation =  1462.000(Ft.)
Downstream point elevation =  1457.400(Ft.)
Flow length =     1.070(Ft.)
Travel time  =    0.00 min.
Time of concentration =   11.61 min.
Depth of flow =   0.013(Ft.)
Average velocity =   4.890(Ft/s)
Total irregular channel flow =     4.153(CFS)
Irregular channel normal depth above invert elev. =   0.013(Ft.)
Average velocity of channel(s) =   4.890(Ft/s)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 50.00
Adjusted SCS curve number for AMC 3 = 70.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.532(In/Hr)
Rainfall intensity =      3.725(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.771
Subarea runoff =      3.074(CFS) for    1.070(Ac.)
Total runoff =      5.689(CFS)
Effective area this stream =        1.98(Ac.)
Total Study Area (Main Stream No. 1) =       11.98(Ac.)
Area averaged Fm value =    0.532(In/Hr)
Depth of flow =   0.016(Ft.), Average velocity =   5.540(Ft/s)
End of computations, Total Study Area =           11.98 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number =  50.0
```

```
                San Bernardino County Rational Hydrology Program

                    (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2018 Version 9.0
        Rational Hydrology Study       Date: 12/17/24
------------------------------------------------------------------------
PROPOSED CONDITIONS EAST HIGHLAND RANCH
PROPOSED 100 YEAR DESIGN STORM
RATIONAL METHOD
KIMLEY-HORN
------------------------------------------------------------------------


Program License Serial Number 6443

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------
Rational hydrology study storm event year is   100.0
Computed rainfall intensity:
Storm year =   100.00   1 hour rainfall =     1.390 (In.)
Slope used for rainfall intensity curve b =  0.6000
Soil antecedent moisture condition (AMC) = 3



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      100.000 to Point/Station      105.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(8 - 10 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.4000     Max loss rate(Fm)=     0.314(In/Hr)
Initial subarea data:
Initial area flow distance =   208.000(Ft.)
Top (of initial area) elevation =  1463.300(Ft.)
Bottom (of initial area) elevation =  1455.000(Ft.)
Difference in elevation =     8.300(Ft.)
Slope =    0.03990  s(%)=       3.99
TC = k(0.374)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.024 min.
Rainfall intensity =      5.520(In/Hr) for a   100.0 year storm
```

```
Effective runoff coefficient used for area (Q=KCIA) is C = 0.849
Subarea runoff =      0.703(CFS)
Total initial stream area =       0.150(Ac.)
Pervious area fraction = 0.400
Initial area Fm value =    0.314(In/Hr)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      105.000 to Point/Station      120.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1449.600(Ft.)
Downstream point/station elevation =  1449.300(Ft.)
Pipe length  =    16.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.703(CFS)
Nearest computed pipe diameter  =      6.00(In.)
Calculated individual pipe flow  =     0.703(CFS)
Normal flow depth in pipe =    4.51(In.)
Flow top width inside pipe =    5.18(In.)
Critical Depth =    5.07(In.)
Pipe flow velocity =      4.44(Ft/s)
Travel time through pipe =    0.06 min.
Time of concentration (TC) =     6.08 min.
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      120.000 to Point/Station      120.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      0.150(Ac.)
Runoff from this stream =      0.703(CFS)
Time of concentration =    6.08 min.
Rainfall intensity =     5.488(In/Hr)
Area averaged loss rate (Fm) =    0.3141(In/Hr)
Area averaged Pervious ratio (Ap) = 0.4000
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station      102.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(8 - 10 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
```

```
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.4000     Max loss rate(Fm)=     0.314(In/Hr)
Initial subarea data:
Initial area flow distance =   365.000(Ft.)
Top (of initial area) elevation =  1461.700(Ft.)
Bottom (of initial area) elevation =  1458.900(Ft.)
Difference in elevation =     2.800(Ft.)
Slope =    0.00767  s(%)=       0.77
TC = k(0.374)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   10.491 min.
Rainfall intensity =      3.957(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.829
Subarea runoff =      4.361(CFS)
Total initial stream area =        1.330(Ac.)
Pervious area fraction = 0.400
Initial area Fm value =    0.314(In/Hr)
```

↑

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      102.000 to Point/Station      120.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1453.400(Ft.)
Downstream point/station elevation =  1449.300(Ft.)
Pipe length  =   127.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     4.361(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     4.361(CFS)
Normal flow depth in pipe =    7.27(In.)
Flow top width inside pipe =   11.73(In.)
Critical Depth =   10.52(In.)
Pipe flow velocity =      8.77(Ft/s)
Travel time through pipe =    0.24 min.
Time of concentration (TC) =    10.73 min.
```

↑

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      120.000 to Point/Station      120.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.330(Ac.)
Runoff from this stream =      4.361(CFS)
Time of concentration =   10.73 min.
Rainfall intensity =     3.904(In/Hr)
Area averaged loss rate (Fm) =    0.3141(In/Hr)
Area averaged Pervious ratio (Ap) = 0.4000
```

```
Summary of stream data:

Stream Flow rate    Area    TC      Fm       Rainfall Intensity
 No.    (CFS)   (Ac.)       (min) (In/Hr)     (In/Hr)


1      0.70     0.150      6.08    0.314      5.488
2      4.36     1.330     10.73    0.314      3.904
Qmax(1) =
           1.000 *    1.000 *     0.703) +
           1.441 *    0.567 *     4.361) + =       4.266
Qmax(2) =
           0.694 *    1.000 *     0.703) +
           1.000 *    1.000 *     4.361) + =       4.849

Total of 2 streams to confluence:
Flow rates before confluence point:
       0.703       4.361
Maximum flow rates at confluence using above data:
        4.266       4.849
Area of streams before confluence:
        0.150       1.330
Effective area values after confluence:
        0.904       1.480
Results of confluence:
Total flow rate =      4.849(CFS)
Time of concentration =    10.732 min.
Effective stream area after confluence =      1.480(Ac.)
Study area average Pervious fraction(Ap) =  0.400
Study area average soil loss rate(Fm) =    0.314(In/Hr)
Study area total (this main stream) =       1.48(Ac.)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      120.000 to Point/Station      121.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1449.300(Ft.)
Downstream point/station elevation =  1449.100(Ft.)
Pipe length  =    26.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     4.849(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     4.849(CFS)
Normal flow depth in pipe =   10.69(In.)
Flow top width inside pipe =   13.58(In.)
Critical Depth =   10.71(In.)
Pipe flow velocity =      5.19(Ft/s)
Travel time through pipe =    0.08 min.
Time of concentration (TC) =    10.82 min.
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      121.000 to Point/Station      121.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      1.480(Ac.)
Runoff from this stream =      4.849(CFS)
Time of concentration =   10.82 min.
Rainfall intensity =     3.886(In/Hr)
Area averaged loss rate (Fm) =    0.3141(In/Hr)
Area averaged Pervious ratio (Ap) = 0.4000
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station      104.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(8 - 10 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.4000     Max loss rate(Fm)=     0.314(In/Hr)
Initial subarea data:
Initial area flow distance =   595.000(Ft.)
Top (of initial area) elevation =  1461.700(Ft.)
Bottom (of initial area) elevation =  1455.300(Ft.)
Difference in elevation =     6.400(Ft.)
Slope =    0.01076  s(%)=       1.08
TC = k(0.374)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   11.922 min.
Rainfall intensity =      3.665(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.823
Subarea runoff =      6.545(CFS)
Total initial stream area =        2.170(Ac.)
Pervious area fraction = 0.400
Initial area Fm value =    0.314(In/Hr)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      104.000 to Point/Station      121.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
```

```
Upstream point/station elevation =  1449.800(Ft.)
Downstream point/station elevation =  1449.100(Ft.)
Pipe length  =    35.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     6.545(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     6.545(CFS)
Normal flow depth in pipe =    9.40(In.)
Flow top width inside pipe =   14.51(In.)
Critical Depth =   12.36(In.)
Pipe flow velocity =      8.10(Ft/s)
Travel time through pipe =    0.07 min.
Time of concentration (TC) =    11.99 min.
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      121.000 to Point/Station      121.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      2.170(Ac.)
Runoff from this stream =      6.545(CFS)
Time of concentration =   11.99 min.
Rainfall intensity =     3.652(In/Hr)
Area averaged loss rate (Fm) =    0.3141(In/Hr)
Area averaged Pervious ratio (Ap) = 0.4000
Summary of stream data:

Stream Flow rate    Area    TC      Fm       Rainfall Intensity
 No.    (CFS)   (Ac.)       (min) (In/Hr)     (In/Hr)


1      4.85     1.480     10.82    0.314      3.886
2      6.54     2.170     11.99    0.314      3.652
Qmax(1) =
           1.000 *    1.000 *     4.849) +
           1.070 *    0.902 *     6.545) + =      11.164
Qmax(2) =
           0.935 *    1.000 *     4.849) +
           1.000 *    1.000 *     6.545) + =      11.076

Total of 2 streams to confluence:
Flow rates before confluence point:
       4.849       6.545
Maximum flow rates at confluence using above data:
       11.164       11.076
Area of streams before confluence:
        1.480        2.170
Effective area values after confluence:
        3.437        3.650
```

```
Results of confluence:
Total flow rate =     11.164(CFS)
Time of concentration =    10.816 min.
Effective stream area after confluence =      3.437(Ac.)
Study area average Pervious fraction(Ap) =  0.400
Study area average soil loss rate(Fm) =    0.314(In/Hr)
Study area total (this main stream) =       3.65(Ac.)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      121.000 to Point/Station      122.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1449.100(Ft.)
Downstream point/station elevation =  1445.800(Ft.)
Pipe length  =   343.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    11.164(CFS)
Nearest computed pipe diameter  =     21.00(In.)
Calculated individual pipe flow  =    11.164(CFS)
Normal flow depth in pipe =   13.17(In.)
Flow top width inside pipe =   20.31(In.)
Critical Depth =   14.95(In.)
Pipe flow velocity =      7.03(Ft/s)
Travel time through pipe =    0.81 min.
Time of concentration (TC) =    11.63 min.
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      122.000 to Point/Station      122.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      3.437(Ac.)
Runoff from this stream =     11.164(CFS)
Time of concentration =   11.63 min.
Rainfall intensity =     3.720(In/Hr)
Area averaged loss rate (Fm) =    0.3141(In/Hr)
Area averaged Pervious ratio (Ap) = 0.4000
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      108.000 to Point/Station      106.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(8 - 10 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
```

```
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.4000     Max loss rate(Fm)=     0.314(In/Hr)
Initial subarea data:
Initial area flow distance =   432.000(Ft.)
Top (of initial area) elevation =  1455.700(Ft.)
Bottom (of initial area) elevation =  1449.300(Ft.)
Difference in elevation =     6.400(Ft.)
Slope =    0.01481  s(%)=       1.48
TC = k(0.374)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.838 min.
Rainfall intensity =      4.113(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.831
Subarea runoff =      4.171(CFS)
Total initial stream area =        1.220(Ac.)
Pervious area fraction = 0.400
Initial area Fm value =    0.314(In/Hr)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      106.000 to Point/Station      122.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1446.000(Ft.)
Downstream point/station elevation =  1445.800(Ft.)
Pipe length  =    12.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     4.171(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     4.171(CFS)
Normal flow depth in pipe =    8.95(In.)
Flow top width inside pipe =   10.45(In.)
Critical Depth =   10.34(In.)
Pipe flow velocity =      6.63(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =     9.87 min.
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      122.000 to Point/Station      122.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.220(Ac.)
Runoff from this stream =      4.171(CFS)
Time of concentration =    9.87 min.
Rainfall intensity =     4.105(In/Hr)
```

```
Area averaged loss rate (Fm) =    0.3141(In/Hr)
Area averaged Pervious ratio (Ap) = 0.4000
Summary of stream data:

Stream Flow rate    Area    TC     Fm       Rainfall Intensity
 No.    (CFS)   (Ac.)       (min) (In/Hr)     (In/Hr)


1     11.16     3.437     11.63    0.314      3.720
2      4.17     1.220      9.87    0.314      4.105
Qmax(1) =
           1.000 *    1.000 *    11.164) +
           0.898 *    1.000 *     4.171) + =      14.911
Qmax(2) =
           1.113 *    0.849 *    11.164) +
           1.000 *    1.000 *     4.171) + =      14.716

Total of 2 streams to confluence:
Flow rates before confluence point:
      11.164       4.171
Maximum flow rates at confluence using above data:
       14.911       14.716
Area of streams before confluence:
        3.437        1.220
Effective area values after confluence:
        4.657        4.137
Results of confluence:
Total flow rate =     14.911(CFS)
Time of concentration =    11.629 min.
Effective stream area after confluence =      4.657(Ac.)
Study area average Pervious fraction(Ap) =  0.400
Study area average soil loss rate(Fm) =    0.314(In/Hr)
Study area total (this main stream) =      4.66(Ac.)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      122.000 to Point/Station      123.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1445.800(Ft.)
Downstream point/station elevation =  1445.200(Ft.)
Pipe length  =   115.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    14.911(CFS)
Nearest computed pipe diameter  =     24.00(In.)
Calculated individual pipe flow  =    14.911(CFS)
Normal flow depth in pipe =   18.00(In.)
Flow top width inside pipe =   20.78(In.)
Critical Depth =   16.71(In.)
Pipe flow velocity =      5.90(Ft/s)
```

```
Travel time through pipe =    0.33 min.
Time of concentration (TC) =    11.95 min.
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      123.000 to Point/Station      123.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      4.657(Ac.)
Runoff from this stream =     14.911(CFS)
Time of concentration =   11.95 min.
Rainfall intensity =     3.659(In/Hr)
Area averaged loss rate (Fm) =    0.3141(In/Hr)
Area averaged Pervious ratio (Ap) = 0.4000
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      110.000 to Point/Station      112.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(8 - 10 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.4000     Max loss rate(Fm)=     0.314(In/Hr)
Initial subarea data:
Initial area flow distance =   164.000(Ft.)
Top (of initial area) elevation =  1449.100(Ft.)
Bottom (of initial area) elevation =  1447.900(Ft.)
Difference in elevation =     1.200(Ft.)
Slope =    0.00732  s(%)=       0.73
TC = k(0.374)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.690 min.
Rainfall intensity =      4.768(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.841
Subarea runoff =      3.047(CFS)
Total initial stream area =        0.760(Ac.)
Pervious area fraction = 0.400
Initial area Fm value =    0.314(In/Hr)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      112.000 to Point/Station      123.000
```

```
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1445.400(Ft.)
Downstream point/station elevation =  1445.200(Ft.)
Pipe length  =    13.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.047(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     3.047(CFS)
Normal flow depth in pipe =    7.32(In.)
Flow top width inside pipe =   11.70(In.)
Critical Depth =    8.97(In.)
Pipe flow velocity =      6.07(Ft/s)
Travel time through pipe =    0.04 min.
Time of concentration (TC) =     7.73 min.



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      123.000 to Point/Station      123.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.760(Ac.)
Runoff from this stream =      3.047(CFS)
Time of concentration =    7.73 min.
Rainfall intensity =     4.755(In/Hr)
Area averaged loss rate (Fm) =    0.3141(In/Hr)
Area averaged Pervious ratio (Ap) = 0.4000
Summary of stream data:

Stream Flow rate    Area    TC      Fm       Rainfall Intensity
 No.    (CFS)   (Ac.)       (min) (In/Hr)     (In/Hr)


1     14.91     4.657     11.95    0.314      3.659
2      3.05     0.760      7.73    0.314      4.755
Qmax(1) =
           1.000 *    1.000 *    14.911) +
           0.753 *    1.000 *     3.047) + =      17.206
Qmax(2) =
           1.328 *    0.646 *    14.911) +
           1.000 *    1.000 *     3.047) + =      15.840

Total of 2 streams to confluence:
Flow rates before confluence point:
      14.911       3.047
Maximum flow rates at confluence using above data:
       17.206       15.840
Area of streams before confluence:
        4.657        0.760
```

```
Effective area values after confluence:
        5.417       3.770
Results of confluence:
Total flow rate =     17.206(CFS)
Time of concentration =    11.954 min.
Effective stream area after confluence =      5.417(Ac.)
Study area average Pervious fraction(Ap) =  0.400
Study area average soil loss rate(Fm) =    0.314(In/Hr)
Study area total (this main stream) =      5.42(Ac.)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      123.000 to Point/Station      124.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1445.200(Ft.)
Downstream point/station elevation =  1445.000(Ft.)
Pipe length  =    19.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    17.206(CFS)
Nearest computed pipe diameter  =     24.00(In.)
Calculated individual pipe flow  =    17.206(CFS)
Normal flow depth in pipe =   15.38(In.)
Flow top width inside pipe =   23.03(In.)
Critical Depth =   17.94(In.)
Pipe flow velocity =      8.09(Ft/s)
Travel time through pipe =    0.04 min.
Time of concentration (TC) =    11.99 min.
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      124.000 to Point/Station      124.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      5.417(Ac.)
Runoff from this stream =     17.206(CFS)
Time of concentration =   11.99 min.
Rainfall intensity =     3.652(In/Hr)
Area averaged loss rate (Fm) =    0.3141(In/Hr)
Area averaged Pervious ratio (Ap) = 0.4000
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      108.000 to Point/Station      107.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(8 - 10 dwl/acre)
```

```
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.4000     Max loss rate(Fm)=     0.314(In/Hr)
Initial subarea data:
Initial area flow distance =   364.000(Ft.)
Top (of initial area) elevation =  1455.700(Ft.)
Bottom (of initial area) elevation =  1448.500(Ft.)
Difference in elevation =     7.200(Ft.)
Slope =    0.01978  s(%)=       1.98
TC = k(0.374)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    8.671 min.
Rainfall intensity =      4.437(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.836
Subarea runoff =      2.894(CFS)
Total initial stream area =        0.780(Ac.)
Pervious area fraction = 0.400
Initial area Fm value =    0.314(In/Hr)
```

↑

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      107.000 to Point/Station      124.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1445.700(Ft.)
Downstream point/station elevation =  1445.000(Ft.)
Pipe length  =    31.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.894(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     2.894(CFS)
Normal flow depth in pipe =    6.29(In.)
Flow top width inside pipe =   11.99(In.)
Critical Depth =    8.75(In.)
Pipe flow velocity =      6.95(Ft/s)
Travel time through pipe =    0.07 min.
Time of concentration (TC) =     8.75 min.
```

↑

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      124.000 to Point/Station      124.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.780(Ac.)
Runoff from this stream =      2.894(CFS)
```

```
Time of concentration =    8.75 min.
Rainfall intensity =     4.414(In/Hr)
Area averaged loss rate (Fm) =    0.3141(In/Hr)
Area averaged Pervious ratio (Ap) = 0.4000
Summary of stream data:

Stream Flow rate    Area    TC     Fm       Rainfall Intensity
 No.    (CFS)   (Ac.)       (min) (In/Hr)     (In/Hr)


1     17.21     5.417     11.99    0.314      3.652
2      2.89     0.780      8.75    0.314      4.414
Qmax(1) =
           1.000 *    1.000 *    17.206) +
           0.814 *    1.000 *     2.894) + =      19.563
Qmax(2) =
           1.228 *    0.729 *    17.206) +
           1.000 *    1.000 *     2.894) + =      18.305

Total of 2 streams to confluence:
Flow rates before confluence point:
      17.206       2.894
Maximum flow rates at confluence using above data:
       19.563       18.305
Area of streams before confluence:
        5.417        0.780
Effective area values after confluence:
        6.197        4.730
Results of confluence:
Total flow rate =     19.563(CFS)
Time of concentration =    11.993 min.
Effective stream area after confluence =      6.197(Ac.)
Study area average Pervious fraction(Ap) =  0.400
Study area average soil loss rate(Fm) =    0.314(In/Hr)
Study area total (this main stream) =       6.20(Ac.)



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      124.000 to Point/Station      111.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1445.000(Ft.)
Downstream point/station elevation =  1443.300(Ft.)
Pipe length  =   346.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    19.563(CFS)
Nearest computed pipe diameter  =     27.00(In.)
Calculated individual pipe flow  =    19.563(CFS)
Normal flow depth in pipe =   20.06(In.)
Flow top width inside pipe =   23.60(In.)
```

```
Critical Depth =   18.58(In.)
Pipe flow velocity =      6.18(Ft/s)
Travel time through pipe =    0.93 min.
Time of concentration (TC) =    12.93 min.
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      111.000 to Point/Station      111.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      6.197(Ac.)
Runoff from this stream =     19.563(CFS)
Time of concentration =   12.93 min.
Rainfall intensity =     3.492(In/Hr)
Area averaged loss rate (Fm) =    0.3141(In/Hr)
Area averaged Pervious ratio (Ap) = 0.4000
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      110.000 to Point/Station      111.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(8 - 10 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.4000     Max loss rate(Fm)=     0.314(In/Hr)
Initial subarea data:
Initial area flow distance =   224.000(Ft.)
Top (of initial area) elevation =  1449.100(Ft.)
Bottom (of initial area) elevation =  1447.900(Ft.)
Difference in elevation =     1.200(Ft.)
Slope =    0.00536  s(%)=       0.54
TC = k(0.374)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.272 min.
Rainfall intensity =      4.262(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.834
Subarea runoff =      1.848(CFS)
Total initial stream area =        0.520(Ac.)
Pervious area fraction = 0.400
Initial area Fm value =    0.314(In/Hr)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      111.000 to Point/Station      111.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.520(Ac.)
Runoff from this stream =      1.848(CFS)
Time of concentration =    9.27 min.
Rainfall intensity =     4.262(In/Hr)
Area averaged loss rate (Fm) =    0.3141(In/Hr)
Area averaged Pervious ratio (Ap) = 0.4000
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      109.000 to Point/Station      111.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(8 - 10 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.4000     Max loss rate(Fm)=     0.314(In/Hr)
Initial subarea data:
Initial area flow distance =   535.000(Ft.)
Top (of initial area) elevation =  1458.200(Ft.)
Bottom (of initial area) elevation =  1447.900(Ft.)
Difference in elevation =    10.300(Ft.)
Slope =    0.01925  s(%)=       1.93
TC = k(0.374)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   10.170 min.
Rainfall intensity =      4.032(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.830
Subarea runoff =      6.893(CFS)
Total initial stream area =        2.060(Ac.)
Pervious area fraction = 0.400
Initial area Fm value =    0.314(In/Hr)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      111.000 to Point/Station      111.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 3
Stream flow area =      2.060(Ac.)
Runoff from this stream =      6.893(CFS)
```

```
Time of concentration =   10.17 min.
Rainfall intensity =     4.032(In/Hr)
Area averaged loss rate (Fm) =    0.3141(In/Hr)
Area averaged Pervious ratio (Ap) = 0.4000
Summary of stream data:

Stream Flow rate    Area    TC     Fm       Rainfall Intensity
 No.    (CFS)   (Ac.)       (min) (In/Hr)     (In/Hr)


1     19.56     6.197     12.93    0.314      3.492
2      1.85     0.520      9.27    0.314      4.262
3      6.89     2.060     10.17    0.314      4.032
Qmax(1) =
           1.000 *    1.000 *    19.563) +
           0.805 *    1.000 *     1.848) +
           0.855 *    1.000 *     6.893) + =      26.941
Qmax(2) =
           1.242 *    0.717 *    19.563) +
           1.000 *    1.000 *     1.848) +
           1.062 *    0.912 *     6.893) + =      25.955
Qmax(3) =
           1.170 *    0.787 *    19.563) +
           0.942 *    1.000 *     1.848) +
           1.000 *    1.000 *     6.893) + =      26.641

Total of 3 streams to confluence:
Flow rates before confluence point:
      19.563       1.848       6.893
Maximum flow rates at confluence using above data:
       26.941       25.955       26.641
Area of streams before confluence:
        6.197        0.520        2.060
Effective area values after confluence:
        8.777        6.843        7.455
Results of confluence:
Total flow rate =     26.941(CFS)
Time of concentration =    12.926 min.
Effective stream area after confluence =      8.777(Ac.)
Study area average Pervious fraction(Ap) =  0.400
Study area average soil loss rate(Fm) =    0.314(In/Hr)
Study area total (this main stream) =       8.78(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      111.000 to Point/Station      125.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1443.300(Ft.)
```

```
Downstream point/station elevation =  1443.200(Ft.)
Pipe length  =    14.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    26.941(CFS)
Nearest computed pipe diameter  =     30.00(In.)
Calculated individual pipe flow  =    26.941(CFS)
Normal flow depth in pipe =   19.88(In.)
Flow top width inside pipe =   28.37(In.)
Critical Depth =   21.23(In.)
Pipe flow velocity =      7.80(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =    12.96 min.
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      125.000 to Point/Station      125.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
RESIDENTIAL(8 - 10 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.4000     Max loss rate(Fm)=     0.314(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =     26.432(CFS)
therefore the upstream flow rate of Q =     26.941(CFS) is being used
Time of concentration =    12.96 min.
Rainfall intensity =      3.487(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.819
Subarea runoff =      0.000(CFS) for    0.480(Ac.)
Total runoff =      26.941(CFS)
Effective area this stream =        9.26(Ac.)
Total Study Area (Main Stream No. 1) =         9.47(Ac.)
Area averaged Fm value =    0.314(In/Hr)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      300.000 to Point/Station      301.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(8 - 10 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
```

```
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.4000     Max loss rate(Fm)=     0.314(In/Hr)
Initial subarea data:
Initial area flow distance =   232.000(Ft.)
Top (of initial area) elevation =  1462.800(Ft.)
Bottom (of initial area) elevation =  1460.100(Ft.)
Difference in elevation =     2.700(Ft.)
Slope =    0.01164  s(%)=       1.16
TC = k(0.374)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    8.052 min.
Rainfall intensity =      4.638(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.839
Subarea runoff =      4.281(CFS)
Total initial stream area =        1.100(Ac.)
Pervious area fraction = 0.400
Initial area Fm value =    0.314(In/Hr)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      301.000 to Point/Station      302.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1460.100(Ft.)
Downstream point elevation =  1458.000(Ft.)
Channel length thru subarea  =   182.000(Ft.)
Channel base width      =   14.750(Ft.)
Slope or 'Z' of left channel bank =   3.270
Slope or 'Z' of right channel bank =  21.470
Estimated mean flow rate at midpoint of channel =      5.238(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    0.330(Ft.)
Flow(q) thru subarea =      5.238(CFS)
Depth of flow =   0.127(Ft.), Average velocity =   2.527(Ft/s)
Channel flow top width =   17.892(Ft.)
Flow Velocity =    2.53(Ft/s)
Travel time  =    1.20 min.
Time of concentration =    9.25 min.
Critical depth =      0.150(Ft.)
 Adding area flow to channel
RESIDENTIAL(8 - 10 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.4000     Max loss rate(Fm)=     0.314(In/Hr)
Rainfall intensity =      4.267(In/Hr) for a   100.0 year storm
```

```
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.834
Subarea runoff =      1.839(CFS) for    0.620(Ac.)
Total runoff =      6.120(CFS)
Effective area this stream =        1.72(Ac.)
Total Study Area (Main Stream No. 1) =       11.19(Ac.)
Area averaged Fm value =    0.314(In/Hr)
Depth of flow =   0.139(Ft.), Average velocity =   2.671(Ft/s)
Critical depth =      0.166(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      302.000 to Point/Station      303.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1454.400(Ft.)
Downstream point/station elevation =  1454.000(Ft.)
Pipe length  =    32.00(Ft.)   Manning's N = 0.015
No. of pipes = 1  Required pipe flow  =     6.120(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     6.120(CFS)
Normal flow depth in pipe =   12.00(In.)
Flow top width inside pipe =   12.00(In.)
Critical Depth =   11.99(In.)
Pipe flow velocity =      5.81(Ft/s)
Travel time through pipe =    0.09 min.
Time of concentration (TC) =     9.34 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      303.000 to Point/Station      303.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
RESIDENTIAL(8 - 10 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Adjusted SCS curve number for AMC 3 = 52.00
Pervious ratio(Ap) = 0.4000     Max loss rate(Fm)=     0.314(In/Hr)
Time of concentration =     9.34 min.
Rainfall intensity =      4.242(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.833
Subarea runoff =      0.421(CFS) for    0.130(Ac.)
Total runoff =      6.540(CFS)
Effective area this stream =        1.85(Ac.)
```

Total Study Area (Main Stream No. 1) =   11.32(Ac.)
Area averaged Fm value =   0.314(In/Hr)
End of computations, Total Study Area =   11.32 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.400
Area averaged SCS curve number = 32.0

```
                San Bernardino County Rational Hydrology Program

                    (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2018 Version 9.0
        Rational Hydrology Study       Date: 12/13/24
------------------------------------------------------------------------
EXISTING CONDITIONS EAST HIGHLAND RANCH
EXISTING 2 YR DESIGN STORM
RATIONAL METHOD
KIMLEY-HORN
------------------------------------------------------------------------


Program License Serial Number 6443

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------
Rational hydrology study storm event year is     2.0
Computed rainfall intensity:
Storm year =     2.00   1 hour rainfall =     0.519 (In.)
Slope used for rainfall intensity curve b =  0.6000
Soil antecedent moisture condition (AMC) = 1



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      100.000 to Point/Station      101.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 50.00
Adjusted SCS curve number for AMC 1 = 31.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.983(In/Hr)
Initial subarea data:
Initial area flow distance =   193.000(Ft.)
Top (of initial area) elevation =  1462.500(Ft.)
Bottom (of initial area) elevation =  1458.800(Ft.)
Difference in elevation =     3.700(Ft.)
Slope =    0.01917  s(%)=       1.92
TC = k(0.706)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   12.779 min.
Rainfall intensity =      1.313(In/Hr) for a     2.0 year storm
```

```
Effective runoff coefficient used for area (Q=KCIA) is C = 0.226
Subarea runoff =      0.178(CFS)
Total initial stream area =        0.600(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.983(In/Hr)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      101.000 to Point/Station      102.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.093(Ft.), Average velocity =   0.784(Ft/s)
        ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00             1.00
        2             20.00             0.00
        3             61.00             1.00
Manning's 'N' friction factor =   0.035
-----------------------------------------------------------------
Sub-Channel flow  =      0.207(CFS)
  '     '        flow top width =      5.677(Ft.)
  '     '    velocity=    0.784(Ft/s)
  '     '        area =      0.264(Sq.Ft)
  '     '        Froude number =     0.641

Upstream point elevation =  1458.800(Ft.)
Downstream point elevation =  1446.300(Ft.)
Flow length =   613.000(Ft.)
Travel time  =   13.03 min.
Time of concentration =   25.81 min.
Depth of flow =   0.093(Ft.)
Average velocity =   0.784(Ft/s)
Total irregular channel flow =     0.207(CFS)
Irregular channel normal depth above invert elev. =   0.093(Ft.)
Average velocity of channel(s) =   0.784(Ft/s)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 50.00
Adjusted SCS curve number for AMC 1 = 31.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.983(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =      0.000(CFS)
```

```
therefore the upstream flow rate of Q =      0.178(CFS) is being used
Rainfall intensity =      0.861(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.000
Subarea runoff =      0.000(CFS) for    6.310(Ac.)
Total runoff =      0.178(CFS)
Effective area this stream =        6.91(Ac.)
Total Study Area (Main Stream No. 1) =        6.91(Ac.)
Area averaged Fm value =    0.983(In/Hr)
Depth of flow =   0.088(Ft.), Average velocity =   0.755(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      102.000 to Point/Station      103.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
______________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.092(Ft.), Average velocity =   0.849(Ft/s)
        ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              1.00
        2             30.00              0.00
        3             60.00              1.00
Manning's 'N' friction factor =   0.035
-----------------------------------------------------------------
Sub-Channel flow  =      0.218(CFS)
  '     '         flow top width =      5.548(Ft.)
  '     '     velocity=    0.849(Ft/s)
  '     '         area =      0.257(Sq.Ft)
  '     '         Froude number =     0.695

Upstream point elevation =  1446.300(Ft.)
Downstream point elevation =  1443.000(Ft.)
Flow length =   137.000(Ft.)
Travel time  =    2.69 min.
Time of concentration =   28.50 min.
Depth of flow =   0.092(Ft.)
Average velocity =   0.849(Ft/s)
Total irregular channel flow =     0.218(CFS)
Irregular channel normal depth above invert elev. =   0.092(Ft.)
Average velocity of channel(s) =   0.849(Ft/s)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
```

```
SCS curve number for soil(AMC 2)  = 50.00
Adjusted SCS curve number for AMC 1 = 31.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.983(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =      0.000(CFS)
therefore the upstream flow rate of Q =      0.178(CFS) is being used
Rainfall intensity =      0.811(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.000
Subarea runoff =      0.000(CFS) for    3.090(Ac.)
Total runoff =      0.178(CFS)
Effective area this stream =       10.00(Ac.)
Total Study Area (Main Stream No. 1) =       10.00(Ac.)
Area averaged Fm value =    0.983(In/Hr)
Depth of flow =   0.086(Ft.), Average velocity =   0.807(Ft/s)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      200.000 to Point/Station      201.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 50.00
Adjusted SCS curve number for AMC 1 = 31.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.983(In/Hr)
Initial subarea data:
Initial area flow distance =   170.000(Ft.)
Top (of initial area) elevation =  1466.100(Ft.)
Bottom (of initial area) elevation =  1462.000(Ft.)
Difference in elevation =     4.100(Ft.)
Slope =    0.02412  s(%)=       2.41
TC = k(0.706)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   11.602 min.
Rainfall intensity =      1.391(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.264
Subarea runoff =      0.334(CFS)
Total initial stream area =        0.910(Ac.)
Pervious area fraction = 1.000
Initial area Fm value =    0.983(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      201.000 to Point/Station      202.000
**** IRREGULAR CHANNEL FLOW TRAVEL TIME ****
```

```
____________________________________________________________________________
Estimated mean flow rate at midpoint of channel =      0.000(CFS)
Depth of flow =   0.004(Ft.), Average velocity =   2.154(Ft/s)
        ******* Irregular Channel Data ***********
-----------------------------------------------------------------
Information entered for subchannel number 1 :
Point number      'X' coordinate     'Y' coordinate
        1              0.00              1.00
        2             37.00              0.00
        3            101.00              0.00
        4            129.00              1.00
Manning's 'N' friction factor =   0.035
-----------------------------------------------------------------
Sub-Channel flow  =      0.531(CFS)
  '     '        flow top width =     64.250(Ft.)
  '     '    velocity=    2.156(Ft/s)
  '     '        area =      0.246(Sq.Ft)
  '     '        Froude number =     6.137

Upstream point elevation =  1462.000(Ft.)
Downstream point elevation =  1457.400(Ft.)
Flow length =     1.070(Ft.)
Travel time  =    0.01 min.
Time of concentration =   11.61 min.
Depth of flow =   0.004(Ft.)
Average velocity =   2.154(Ft/s)
Total irregular channel flow =     0.530(CFS)
Irregular channel normal depth above invert elev. =   0.004(Ft.)
Average velocity of channel(s) =   2.154(Ft/s)
 Adding area flow to channel
UNDEVELOPED (average cover) subarea
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 50.00
Adjusted SCS curve number for AMC 1 = 31.00
Pervious ratio(Ap) = 1.0000     Max loss rate(Fm)=     0.983(In/Hr)
Rainfall intensity =      1.390(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.264
Subarea runoff =      0.392(CFS) for    1.070(Ac.)
Total runoff =      0.726(CFS)
Effective area this stream =         1.98(Ac.)
Total Study Area (Main Stream No. 1) =       11.98(Ac.)
Area averaged Fm value =    0.983(In/Hr)
Depth of flow =   0.005(Ft.), Average velocity =   2.442(Ft/s)
End of computations, Total Study Area =           11.98 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
```

Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 1.000
Area averaged SCS curve number = 50.0

```
                 San Bernardino County Rational Hydrology Program

                    (Hydrology Manual Date - August 1986)

 CIVILCADD/CIVILDESIGN  Engineering Software, (c) 1989-2018 Version 9.0
        Rational Hydrology Study       Date: 12/17/24
------------------------------------------------------------------------
PROPOSED CONDITIONS EAST HIGHLAND RANCH
PROPOSED 2 YEAR DESIGN STORM
RATIONAL METHOD
KIMLEY-HORN
------------------------------------------------------------------------


Program License Serial Number 6443

------------------------------------------------------------------------
 *********   Hydrology Study Control Information **********

------------------------------------------------------------------------
Rational hydrology study storm event year is     2.0
Computed rainfall intensity:
Storm year =     2.00   1 hour rainfall =     0.510 (In.)
Slope used for rainfall intensity curve b =  0.6000
Soil antecedent moisture condition (AMC) = 2



++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      100.000 to Point/Station      105.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(8 - 10 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.4000     Max loss rate(Fm)=     0.391(In/Hr)
Initial subarea data:
Initial area flow distance =   208.000(Ft.)
Top (of initial area) elevation =  1463.300(Ft.)
Bottom (of initial area) elevation =  1455.000(Ft.)
Difference in elevation =     8.300(Ft.)
Slope =    0.03990  s(%)=       3.99
TC = k(0.374)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.024 min.
Rainfall intensity =      2.025(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.726
```

```
Subarea runoff =      0.221(CFS)
Total initial stream area =        0.150(Ac.)
Pervious area fraction = 0.400
Initial area Fm value =    0.391(In/Hr)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      105.000 to Point/Station      120.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1449.600(Ft.)
Downstream point/station elevation =  1449.300(Ft.)
Pipe length  =    16.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.221(CFS)
Nearest computed pipe diameter  =      6.00(In.)
Calculated individual pipe flow  =     0.221(CFS)
Normal flow depth in pipe =    2.20(In.)
Flow top width inside pipe =    5.78(In.)
Critical Depth =    2.83(In.)
Pipe flow velocity =      3.38(Ft/s)
Travel time through pipe =    0.08 min.
Time of concentration (TC) =     6.10 min.
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      120.000 to Point/Station      120.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      0.150(Ac.)
Runoff from this stream =      0.221(CFS)
Time of concentration =    6.10 min.
Rainfall intensity =     2.010(In/Hr)
Area averaged loss rate (Fm) =    0.3911(In/Hr)
Area averaged Pervious ratio (Ap) = 0.4000
```

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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station      102.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(8 - 10 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
```

```
Pervious ratio(Ap) = 0.4000     Max loss rate(Fm)=     0.391(In/Hr)
Initial subarea data:
Initial area flow distance =   365.000(Ft.)
Top (of initial area) elevation =  1461.700(Ft.)
Bottom (of initial area) elevation =  1458.900(Ft.)
Difference in elevation =     2.800(Ft.)
Slope =    0.00767  s(%)=       0.77
TC = k(0.374)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   10.491 min.
Rainfall intensity =      1.452(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.658
Subarea runoff =      1.270(CFS)
Total initial stream area =        1.330(Ac.)
Pervious area fraction = 0.400
Initial area Fm value =    0.391(In/Hr)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      102.000 to Point/Station      120.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1453.400(Ft.)
Downstream point/station elevation =  1449.300(Ft.)
Pipe length  =   127.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.270(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     1.270(CFS)
Normal flow depth in pipe =    4.11(In.)
Flow top width inside pipe =    8.97(In.)
Critical Depth =    6.22(In.)
Pipe flow velocity =      6.46(Ft/s)
Travel time through pipe =    0.33 min.
Time of concentration (TC) =    10.82 min.
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      120.000 to Point/Station      120.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.330(Ac.)
Runoff from this stream =      1.270(CFS)
Time of concentration =   10.82 min.
Rainfall intensity =     1.425(In/Hr)
Area averaged loss rate (Fm) =    0.3911(In/Hr)
Area averaged Pervious ratio (Ap) = 0.4000
Summary of stream data:
```

```
Stream Flow rate    Area    TC      Fm       Rainfall Intensity
 No.    (CFS)   (Ac.)       (min) (In/Hr)     (In/Hr)


1      0.22     0.150      6.10    0.391      2.010
2      1.27     1.330     10.82    0.391      1.425
Qmax(1) =
           1.000 *    1.000 *     0.221) +
           1.565 *    0.564 *     1.270) + =       1.342
Qmax(2) =
           0.639 *    1.000 *     0.221) +
           1.000 *    1.000 *     1.270) + =       1.411

Total of 2 streams to confluence:
Flow rates before confluence point:
       0.221       1.270
Maximum flow rates at confluence using above data:
        1.342       1.411
Area of streams before confluence:
        0.150       1.330
Effective area values after confluence:
        0.900       1.480
Results of confluence:
Total flow rate =      1.411(CFS)
Time of concentration =    10.818 min.
Effective stream area after confluence =      1.480(Ac.)
Study area average Pervious fraction(Ap) =  0.400
Study area average soil loss rate(Fm) =    0.391(In/Hr)
Study area total (this main stream) =       1.48(Ac.)
```

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```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      120.000 to Point/Station      121.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1449.300(Ft.)
Downstream point/station elevation =  1449.100(Ft.)
Pipe length  =    26.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.411(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     1.411(CFS)
Normal flow depth in pipe =    7.16(In.)
Flow top width inside pipe =    7.26(In.)
Critical Depth =    6.57(In.)
Pipe flow velocity =      3.74(Ft/s)
Travel time through pipe =    0.12 min.
Time of concentration (TC) =    10.93 min.
```

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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      121.000 to Point/Station      121.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      1.480(Ac.)
Runoff from this stream =      1.411(CFS)
Time of concentration =   10.93 min.
Rainfall intensity =     1.416(In/Hr)
Area averaged loss rate (Fm) =    0.3911(In/Hr)
Area averaged Pervious ratio (Ap) = 0.4000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station      104.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(8 - 10 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.4000     Max loss rate(Fm)=     0.391(In/Hr)
Initial subarea data:
Initial area flow distance =   595.000(Ft.)
Top (of initial area) elevation =  1461.700(Ft.)
Bottom (of initial area) elevation =  1455.300(Ft.)
Difference in elevation =     6.400(Ft.)
Slope =    0.01076  s(%)=       1.08
TC = k(0.374)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   11.922 min.
Rainfall intensity =      1.345(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.638
Subarea runoff =      1.863(CFS)
Total initial stream area =        2.170(Ac.)
Pervious area fraction = 0.400
Initial area Fm value =    0.391(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      104.000 to Point/Station      121.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1449.800(Ft.)
Downstream point/station elevation =  1449.100(Ft.)
Pipe length  =    35.00(Ft.)   Manning's N = 0.013
```

```
No. of pipes = 1  Required pipe flow  =     1.863(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     1.863(CFS)
Normal flow depth in pipe =    6.07(In.)
Flow top width inside pipe =    8.43(In.)
Critical Depth =    7.48(In.)
Pipe flow velocity =      5.88(Ft/s)
Travel time through pipe =    0.10 min.
Time of concentration (TC) =    12.02 min.
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      121.000 to Point/Station      121.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      2.170(Ac.)
Runoff from this stream =      1.863(CFS)
Time of concentration =   12.02 min.
Rainfall intensity =     1.338(In/Hr)
Area averaged loss rate (Fm) =    0.3911(In/Hr)
Area averaged Pervious ratio (Ap) = 0.4000
Summary of stream data:

Stream Flow rate    Area    TC      Fm       Rainfall Intensity
 No.    (CFS)   (Ac.)       (min) (In/Hr)     (In/Hr)


1      1.41     1.480     10.93    0.391      1.416
2      1.86     2.170     12.02    0.391      1.338
Qmax(1) =
           1.000 *    1.000 *     1.411) +
           1.083 *    0.910 *     1.863) + =       3.245
Qmax(2) =
           0.924 *    1.000 *     1.411) +
           1.000 *    1.000 *     1.863) + =       3.166

Total of 2 streams to confluence:
Flow rates before confluence point:
       1.411       1.863
Maximum flow rates at confluence using above data:
        3.245        3.166
Area of streams before confluence:
        1.480        2.170
Effective area values after confluence:
        3.454        3.650
Results of confluence:
Total flow rate =      3.245(CFS)
Time of concentration =    10.934 min.
```

```
Effective stream area after confluence =      3.454(Ac.)
Study area average Pervious fraction(Ap) =  0.400
Study area average soil loss rate(Fm) =    0.391(In/Hr)
Study area total (this main stream) =       3.65(Ac.)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      121.000 to Point/Station      122.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1449.100(Ft.)
Downstream point/station elevation =  1445.800(Ft.)
Pipe length  =   343.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.245(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     3.245(CFS)
Normal flow depth in pipe =    9.14(In.)
Flow top width inside pipe =   10.22(In.)
Critical Depth =    9.25(In.)
Pipe flow velocity =      5.05(Ft/s)
Travel time through pipe =    1.13 min.
Time of concentration (TC) =    12.07 min.
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      122.000 to Point/Station      122.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      3.454(Ac.)
Runoff from this stream =      3.245(CFS)
Time of concentration =   12.07 min.
Rainfall intensity =     1.335(In/Hr)
Area averaged loss rate (Fm) =    0.3911(In/Hr)
Area averaged Pervious ratio (Ap) = 0.4000
```

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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      108.000 to Point/Station      106.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(8 - 10 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
```

```
Pervious ratio(Ap) = 0.4000     Max loss rate(Fm)=     0.391(In/Hr)
Initial subarea data:
Initial area flow distance =   432.000(Ft.)
Top (of initial area) elevation =  1455.700(Ft.)
Bottom (of initial area) elevation =  1449.300(Ft.)
Difference in elevation =     6.400(Ft.)
Slope =    0.01481  s(%)=       1.48
TC = k(0.374)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.838 min.
Rainfall intensity =      1.509(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.667
Subarea runoff =      1.227(CFS)
Total initial stream area =        1.220(Ac.)
Pervious area fraction = 0.400
Initial area Fm value =    0.391(In/Hr)
```

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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      106.000 to Point/Station      122.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1446.000(Ft.)
Downstream point/station elevation =  1445.800(Ft.)
Pipe length  =    12.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.227(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     1.227(CFS)
Normal flow depth in pipe =    4.89(In.)
Flow top width inside pipe =    8.97(In.)
Critical Depth =    6.12(In.)
Pipe flow velocity =      5.00(Ft/s)
Travel time through pipe =    0.04 min.
Time of concentration (TC) =     9.88 min.
```

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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      122.000 to Point/Station      122.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.220(Ac.)
Runoff from this stream =      1.227(CFS)
Time of concentration =    9.88 min.
Rainfall intensity =     1.505(In/Hr)
Area averaged loss rate (Fm) =    0.3911(In/Hr)
Area averaged Pervious ratio (Ap) = 0.4000
Summary of stream data:
```

```
Stream Flow rate    Area    TC     Fm       Rainfall Intensity
 No.    (CFS)   (Ac.)       (min) (In/Hr)     (In/Hr)


1      3.25     3.454     12.07    0.391      1.335
2      1.23     1.220      9.88    0.391      1.505
Qmax(1) =
           1.000 *    1.000 *     3.245) +
           0.847 *    1.000 *     1.227) + =       4.285
Qmax(2) =
           1.180 *    0.819 *     3.245) +
           1.000 *    1.000 *     1.227) + =       4.363

Total of 2 streams to confluence:
Flow rates before confluence point:
       3.245       1.227
Maximum flow rates at confluence using above data:
        4.285        4.363
Area of streams before confluence:
        3.454        1.220
Effective area values after confluence:
        4.674        4.048
Results of confluence:
Total flow rate =      4.363(CFS)
Time of concentration =     9.878 min.
Effective stream area after confluence =      4.048(Ac.)
Study area average Pervious fraction(Ap) =  0.400
Study area average soil loss rate(Fm) =    0.391(In/Hr)
Study area total (this main stream) =       4.67(Ac.)
```

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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      122.000 to Point/Station      123.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1445.800(Ft.)
Downstream point/station elevation =  1445.200(Ft.)
Pipe length  =   115.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     4.363(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     4.363(CFS)
Normal flow depth in pipe =   11.51(In.)
Flow top width inside pipe =   12.68(In.)
Critical Depth =   10.16(In.)
Pipe flow velocity =      4.32(Ft/s)
Travel time through pipe =    0.44 min.
Time of concentration (TC) =    10.32 min.
```

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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      123.000 to Point/Station      123.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      4.048(Ac.)
Runoff from this stream =      4.363(CFS)
Time of concentration =   10.32 min.
Rainfall intensity =     1.466(In/Hr)
Area averaged loss rate (Fm) =    0.3911(In/Hr)
Area averaged Pervious ratio (Ap) = 0.4000
```

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++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      110.000 to Point/Station      112.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(8 - 10 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.4000     Max loss rate(Fm)=     0.391(In/Hr)
Initial subarea data:
Initial area flow distance =   164.000(Ft.)
Top (of initial area) elevation =  1449.100(Ft.)
Bottom (of initial area) elevation =  1447.900(Ft.)
Difference in elevation =     1.200(Ft.)
Slope =    0.00732  s(%)=       0.73
TC = k(0.374)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.690 min.
Rainfall intensity =      1.749(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.699
Subarea runoff =      0.929(CFS)
Total initial stream area =        0.760(Ac.)
Pervious area fraction = 0.400
Initial area Fm value =    0.391(In/Hr)
```

🡅

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      112.000 to Point/Station      123.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1445.400(Ft.)
Downstream point/station elevation =  1445.200(Ft.)
Pipe length  =    13.00(Ft.)   Manning's N = 0.013
```

```
No. of pipes = 1  Required pipe flow  =     0.929(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     0.929(CFS)
Normal flow depth in pipe =    4.25(In.)
Flow top width inside pipe =    8.99(In.)
Critical Depth =    5.29(In.)
Pipe flow velocity =      4.53(Ft/s)
Travel time through pipe =    0.05 min.
Time of concentration (TC) =     7.74 min.
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      123.000 to Point/Station      123.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.760(Ac.)
Runoff from this stream =      0.929(CFS)
Time of concentration =    7.74 min.
Rainfall intensity =     1.743(In/Hr)
Area averaged loss rate (Fm) =    0.3911(In/Hr)
Area averaged Pervious ratio (Ap) = 0.4000
Summary of stream data:

Stream Flow rate    Area    TC      Fm       Rainfall Intensity
 No.    (CFS)   (Ac.)       (min) (In/Hr)     (In/Hr)


1      4.36     4.048     10.32    0.391      1.466
2      0.93     0.760      7.74    0.391      1.743
Qmax(1) =
           1.000 *    1.000 *     4.363) +
           0.795 *    1.000 *     0.929) + =       5.102
Qmax(2) =
           1.257 *    0.750 *     4.363) +
           1.000 *    1.000 *     0.929) + =       5.042

Total of 2 streams to confluence:
Flow rates before confluence point:
       4.363       0.929
Maximum flow rates at confluence using above data:
        5.102        5.042
Area of streams before confluence:
        4.048        0.760
Effective area values after confluence:
        4.808        3.794
Results of confluence:
Total flow rate =      5.102(CFS)
Time of concentration =    10.322 min.
```

```
Effective stream area after confluence =      4.808(Ac.)
Study area average Pervious fraction(Ap) =  0.400
Study area average soil loss rate(Fm) =    0.391(In/Hr)
Study area total (this main stream) =      4.81(Ac.)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      123.000 to Point/Station      124.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1445.200(Ft.)
Downstream point/station elevation =  1445.000(Ft.)
Pipe length  =    19.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     5.102(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     5.102(CFS)
Normal flow depth in pipe =    9.87(In.)
Flow top width inside pipe =   14.23(In.)
Critical Depth =   10.99(In.)
Pipe flow velocity =      5.96(Ft/s)
Travel time through pipe =    0.05 min.
Time of concentration (TC) =    10.38 min.
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      124.000 to Point/Station      124.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      4.808(Ac.)
Runoff from this stream =      5.102(CFS)
Time of concentration =   10.38 min.
Rainfall intensity =     1.462(In/Hr)
Area averaged loss rate (Fm) =    0.3911(In/Hr)
Area averaged Pervious ratio (Ap) = 0.4000
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      108.000 to Point/Station      107.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(8 - 10 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
```

```
Pervious ratio(Ap) = 0.4000     Max loss rate(Fm)=     0.391(In/Hr)
Initial subarea data:
Initial area flow distance =   364.000(Ft.)
Top (of initial area) elevation =  1455.700(Ft.)
Bottom (of initial area) elevation =  1448.500(Ft.)
Difference in elevation =     7.200(Ft.)
Slope =    0.01978  s(%)=       1.98
TC = k(0.374)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    8.671 min.
Rainfall intensity =      1.628(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.684
Subarea runoff =      0.868(CFS)
Total initial stream area =        0.780(Ac.)
Pervious area fraction = 0.400
Initial area Fm value =    0.391(In/Hr)
```

↑

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      107.000 to Point/Station      124.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1445.700(Ft.)
Downstream point/station elevation =  1445.000(Ft.)
Pipe length  =    31.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.868(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     0.868(CFS)
Normal flow depth in pipe =    3.67(In.)
Flow top width inside pipe =    8.85(In.)
Critical Depth =    5.11(In.)
Pipe flow velocity =      5.13(Ft/s)
Travel time through pipe =    0.10 min.
Time of concentration (TC) =     8.77 min.
```

↑

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      124.000 to Point/Station      124.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.780(Ac.)
Runoff from this stream =      0.868(CFS)
Time of concentration =    8.77 min.
Rainfall intensity =     1.617(In/Hr)
Area averaged loss rate (Fm) =    0.3911(In/Hr)
Area averaged Pervious ratio (Ap) = 0.4000
Summary of stream data:
```

```
Stream Flow rate    Area    TC      Fm       Rainfall Intensity
 No.    (CFS)   (Ac.)       (min) (In/Hr)     (In/Hr)


1      5.10     4.808     10.38    0.391      1.462
2      0.87     0.780      8.77    0.391      1.617
Qmax(1) =
           1.000 *    1.000 *     5.102) +
           0.874 *    1.000 *     0.868) + =       5.861
Qmax(2) =
           1.145 *    0.845 *     5.102) +
           1.000 *    1.000 *     0.868) + =       5.806

Total of 2 streams to confluence:
Flow rates before confluence point:
       5.102       0.868
Maximum flow rates at confluence using above data:
        5.861        5.806
Area of streams before confluence:
        4.808        0.780
Effective area values after confluence:
        5.588        4.845
Results of confluence:
Total flow rate =      5.861(CFS)
Time of concentration =    10.375 min.
Effective stream area after confluence =      5.588(Ac.)
Study area average Pervious fraction(Ap) =  0.400
Study area average soil loss rate(Fm) =    0.391(In/Hr)
Study area total (this main stream) =       5.59(Ac.)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      124.000 to Point/Station      111.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1445.000(Ft.)
Downstream point/station elevation =  1443.300(Ft.)
Pipe length  =   346.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     5.861(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     5.861(CFS)
Normal flow depth in pipe =   12.14(In.)
Flow top width inside pipe =   16.87(In.)
Critical Depth =   11.21(In.)
Pipe flow velocity =      4.63(Ft/s)
Travel time through pipe =    1.25 min.
Time of concentration (TC) =    11.62 min.
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      111.000 to Point/Station      111.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      5.588(Ac.)
Runoff from this stream =      5.861(CFS)
Time of concentration =   11.62 min.
Rainfall intensity =     1.366(In/Hr)
Area averaged loss rate (Fm) =    0.3911(In/Hr)
Area averaged Pervious ratio (Ap) = 0.4000
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      110.000 to Point/Station      111.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(8 - 10 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.4000     Max loss rate(Fm)=     0.391(In/Hr)
Initial subarea data:
Initial area flow distance =   224.000(Ft.)
Top (of initial area) elevation =  1449.100(Ft.)
Bottom (of initial area) elevation =  1447.900(Ft.)
Difference in elevation =     1.200(Ft.)
Slope =    0.00536  s(%)=       0.54
TC = k(0.374)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.272 min.
Rainfall intensity =      1.564(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.675
Subarea runoff =      0.549(CFS)
Total initial stream area =        0.520(Ac.)
Pervious area fraction = 0.400
Initial area Fm value =    0.391(In/Hr)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      111.000 to Point/Station      111.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.520(Ac.)
Runoff from this stream =      0.549(CFS)
```

```
Time of concentration =    9.27 min.
Rainfall intensity =     1.564(In/Hr)
Area averaged loss rate (Fm) =    0.3911(In/Hr)
Area averaged Pervious ratio (Ap) = 0.4000
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      109.000 to Point/Station      111.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(8 - 10 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.4000     Max loss rate(Fm)=     0.391(In/Hr)
Initial subarea data:
Initial area flow distance =   535.000(Ft.)
Top (of initial area) elevation =  1458.200(Ft.)
Bottom (of initial area) elevation =  1447.900(Ft.)
Difference in elevation =    10.300(Ft.)
Slope =    0.01925  s(%)=       1.93
TC = k(0.374)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =   10.170 min.
Rainfall intensity =      1.479(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.662
Subarea runoff =      2.018(CFS)
Total initial stream area =        2.060(Ac.)
Pervious area fraction = 0.400
Initial area Fm value =    0.391(In/Hr)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      111.000 to Point/Station      111.000
**** CONFLUENCE OF MINOR STREAMS ****
______________________________________________________________________
Along Main Stream number: 1 in normal stream number 3
Stream flow area =      2.060(Ac.)
Runoff from this stream =      2.018(CFS)
Time of concentration =   10.17 min.
Rainfall intensity =     1.479(In/Hr)
Area averaged loss rate (Fm) =    0.3911(In/Hr)
Area averaged Pervious ratio (Ap) = 0.4000
Summary of stream data:

Stream Flow rate    Area    TC      Fm       Rainfall Intensity
 No.    (CFS)   (Ac.)       (min) (In/Hr)     (In/Hr)
```

```
1      5.86     5.588     11.62    0.391      1.366
2      0.55     0.520      9.27    0.391      1.564
3      2.02     2.060     10.17    0.391      1.479
Qmax(1) =
           1.000 *    1.000 *     5.861) +
           0.831 *    1.000 *     0.549) +
           0.895 *    1.000 *     2.018) + =       8.123
Qmax(2) =
           1.203 *    0.798 *     5.861) +
           1.000 *    1.000 *     0.549) +
           1.078 *    0.912 *     2.018) + =       8.158
Qmax(3) =
           1.117 *    0.875 *     5.861) +
           0.928 *    1.000 *     0.549) +
           1.000 *    1.000 *     2.018) + =       8.255

Total of 3 streams to confluence:
Flow rates before confluence point:
       5.861       0.549       2.018
Maximum flow rates at confluence using above data:
        8.123        8.158        8.255
Area of streams before confluence:
        5.588        0.520        2.060
Effective area values after confluence:
        8.168        6.856        7.470
Results of confluence:
Total flow rate =      8.255(CFS)
Time of concentration =    10.170 min.
Effective stream area after confluence =      7.470(Ac.)
Study area average Pervious fraction(Ap) =  0.400
Study area average soil loss rate(Fm) =    0.391(In/Hr)
Study area total (this main stream) =       8.17(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      111.000 to Point/Station      125.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1443.300(Ft.)
Downstream point/station elevation =  1443.200(Ft.)
Pipe length  =    14.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     8.255(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     8.255(CFS)
Normal flow depth in pipe =   13.73(In.)
Flow top width inside pipe =   15.31(In.)
Critical Depth =   13.35(In.)
```

```
Pipe flow velocity =      5.71(Ft/s)
Travel time through pipe =    0.04 min.
Time of concentration (TC) =    10.21 min.


+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      125.000 to Point/Station      125.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
RESIDENTIAL(8 - 10 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.4000     Max loss rate(Fm)=     0.391(In/Hr)
The area added to the existing stream causes a
a lower flow rate of Q =      7.760(CFS)
therefore the upstream flow rate of Q =      8.255(CFS) is being used
Time of concentration =    10.21 min.
Rainfall intensity =      1.476(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.661
Subarea runoff =      0.000(CFS) for    0.480(Ac.)
Total runoff =      8.255(CFS)
Effective area this stream =        7.95(Ac.)
Total Study Area (Main Stream No. 1) =         9.47(Ac.)
Area averaged Fm value =    0.391(In/Hr)


+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      300.000 to Point/Station      301.000
**** INITIAL AREA EVALUATION ****
______________________________________________________________________
RESIDENTIAL(8 - 10 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.4000     Max loss rate(Fm)=     0.391(In/Hr)
Initial subarea data:
Initial area flow distance =   232.000(Ft.)
Top (of initial area) elevation =  1462.800(Ft.)
Bottom (of initial area) elevation =  1460.100(Ft.)
Difference in elevation =     2.700(Ft.)
Slope =    0.01164  s(%)=       1.16
TC = k(0.374)*[(length^3)/(elevation change)]^0.2
```

```
Initial area time of concentration =    8.052 min.
Rainfall intensity =      1.702(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.693
Subarea runoff =      1.298(CFS)
Total initial stream area =        1.100(Ac.)
Pervious area fraction = 0.400
Initial area Fm value =    0.391(In/Hr)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      301.000 to Point/Station      302.000
**** IMPROVED CHANNEL TRAVEL TIME ****
______________________________________________________________________
Upstream point elevation =  1460.100(Ft.)
Downstream point elevation =  1458.000(Ft.)
Channel length thru subarea  =   182.000(Ft.)
Channel base width      =   14.750(Ft.)
Slope or 'Z' of left channel bank =   3.270
Slope or 'Z' of right channel bank =  21.470
Estimated mean flow rate at midpoint of channel =      1.548(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    0.330(Ft.)
Flow(q) thru subarea =      1.548(CFS)
Depth of flow =   0.062(Ft.), Average velocity =   1.612(Ft/s)
Channel flow top width =   16.281(Ft.)
Flow Velocity =    1.61(Ft/s)
Travel time  =    1.88 min.
Time of concentration =    9.93 min.
Critical depth =      0.068(Ft.)
 Adding area flow to channel
RESIDENTIAL(8 - 10 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.4000     Max loss rate(Fm)=     0.391(In/Hr)
Rainfall intensity =      1.500(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.665
Subarea runoff =      0.419(CFS) for    0.620(Ac.)
Total runoff =      1.717(CFS)
Effective area this stream =        1.72(Ac.)
Total Study Area (Main Stream No. 1) =       11.19(Ac.)
Area averaged Fm value =    0.391(In/Hr)
Depth of flow =   0.066(Ft.), Average velocity =   1.676(Ft/s)
Critical depth =      0.073(Ft.)
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      302.000 to Point/Station      303.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
______________________________________________________________________
Upstream point/station elevation =  1454.400(Ft.)
Downstream point/station elevation =  1454.000(Ft.)
Pipe length  =    32.00(Ft.)   Manning's N = 0.015
No. of pipes = 1  Required pipe flow  =     1.717(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     1.717(CFS)
Normal flow depth in pipe =    5.98(In.)
Flow top width inside pipe =   12.00(In.)
Critical Depth =    6.68(In.)
Pipe flow velocity =      4.39(Ft/s)
Travel time through pipe =    0.12 min.
Time of concentration (TC) =    10.06 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      303.000 to Point/Station      303.000
**** SUBAREA FLOW ADDITION ****
______________________________________________________________________
RESIDENTIAL(8 - 10 dwl/acre)
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.4000     Max loss rate(Fm)=     0.391(In/Hr)
Time of concentration =    10.06 min.
Rainfall intensity =      1.489(In/Hr) for a     2.0 year storm
Effective runoff coefficient used for area,(total area with modified
rational method)(Q=KCIA) is C = 0.664
Subarea runoff =      0.112(CFS) for    0.130(Ac.)
Total runoff =      1.829(CFS)
Effective area this stream =        1.85(Ac.)
Total Study Area (Main Stream No. 1) =       11.32(Ac.)
Area averaged Fm value =    0.391(In/Hr)
End of computations, Total Study Area =          11.32 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.400
Area averaged SCS curve number =  32.0
```

Appendix F - Unit Hydrograph Analysis

```
        U n i t   H y d r o g r a p h   A n a l y s i s

        Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2018, Version 9.0

                Study date  12/13/24

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
------------------------------------------------------------------------

San Bernardino County Synthetic Unit Hydrology Method
                Manual date - August 1986


Program License Serial Number 6443

---------------------------------------------------------------------
UNIT HYDROGRAPH EAST HIGHLAND
PROPOSED CONDITION - BASIN 1
100-YR 24-HR STORM
KIMLEY-HORN
--------------------------------------------------------------------

        Storm Event Year = 100

        Antecedent Moisture Condition = 3

 English (in-lb) Input Units Used

 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



Area averaged rainfall intensity isohyetal data:
        Sub-Area        Duration        Isohyetal
        (Ac.)            (hours)          (In)
Rainfall data for year 10
             9.47            1           0.83
--------------------------------------------------------------------
Rainfall data for year 2
             9.47            6           1.24
--------------------------------------------------------------------
Rainfall data for year 2
             9.47           24           2.31
--------------------------------------------------------------------
Rainfall data for year 100
```

```
             9.47            1            1.39
--------------------------------------------------------------------
Rainfall data for year 100
             9.47            6            2.90
--------------------------------------------------------------------
Rainfall data for year 100
             9.47           24            5.46
--------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

******** Area-averaged max loss rate, Fm ********


SCS curve  SCS curve     Area      Area      Fp(Fig C6)    Ap       Fm
No.(AMCII) NO.(AMC 3)    (Ac.)     Fraction     (In/Hr)  (dec.)   (In/Hr)
 32.0      52.0          9.47       1.000     0.785    0.400    0.314

Area-averaged adjusted loss rate Fm (In/Hr) =  0.314

********* Area-Averaged low loss rate fraction, Yb **********

Area       Area          SCS CN    SCS CN      S      Pervious
 (Ac.)      Fract         (AMC2)    (AMC3)            Yield Fr
     3.79   0.400         32.0      52.0       9.23     0.186
     5.68   0.600         98.0      98.0       0.20     0.957

Area-averaged catchment yield fraction, Y =  0.648
Area-averaged low loss fraction, Yb =  0.352
Direct entry of lag time by user
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Watershed area =       9.47(Ac.)
Catchment Lag time =   0.173 hours
Unit interval =  15.000 minutes
Unit interval percentage of lag time = 144.6759
Hydrograph baseflow =     0.00(CFS)
Average maximum watershed loss rate(Fm) =  0.314(In/Hr)
Average low loss rate fraction (Yb) = 0.352 (decimal)
VALLEY DEVELOPED S-Graph Selected
Computed peak 5-minute rainfall =  0.514(In)
Computed peak 30-minute rainfall =  1.053(In)
Specified peak 1-hour rainfall =  1.390(In)
Computed peak 3-hour rainfall =  2.182(In)
Specified peak 6-hour rainfall =  2.900(In)
Specified peak 24-hour rainfall =  5.460(In)


Rainfall depth area reduction factors:
Using a total area of      9.47(Ac.) (Ref: fig. E-4)

5-minute factor = 1.000     Adjusted rainfall =  0.514(In)
```

```
30-minute factor = 1.000    Adjusted rainfall =  1.053(In)
1-hour factor = 1.000       Adjusted rainfall =  1.389(In)
3-hour factor = 1.000       Adjusted rainfall =  2.182(In)
6-hour factor = 1.000       Adjusted rainfall =  2.900(In)
24-hour factor = 1.000      Adjusted rainfall =  5.460(In)
---------------------------------------------------------------------

                        U n i t   H y d r o g r a p h
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Interval           'S' Graph          Unit Hydrograph
Number             Mean values             ((CFS))
---------------------------------------------------------------------
                (K =         38.18 (CFS))

  1                 32.670                 12.472
  2                 94.430                 23.578
  3                100.000                  2.126
---------------------------------------------------------------------
--------------------------------------------------------------------
--------------------------------------------------------------------
Total soil rain loss =      1.71(In)
Total effective rainfall =      3.75(In)
Peak flow rate in flood hydrograph =     15.90(CFS)
--------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                    24 - H O U R    S T O R M
               R u n o f f     H y d r o g r a p h
--------------------------------------------------------------------
            Hydrograph in  15   Minute intervals ((CFS))

--------------------------------------------------------------------
Time(h+m) Volume Ac.Ft    Q(CFS)  0        5.0       10.0       15.0      20.0
-----------------------------------------------------------------------
  0+15       0.0044      0.21  Q         |         |         |         |
  0+30       0.0170      0.61  VQ        |         |         |         |
  0+45       0.0304      0.65  VQ        |         |         |         |
  1+ 0       0.0440      0.66  VQ        |         |         |         |
  1+15       0.0577      0.66  VQ        |         |         |         |
  1+30       0.0716      0.67  VQ        |         |         |         |
  1+45       0.0855      0.68  |Q        |         |         |         |
  2+ 0       0.0996      0.68  |Q        |         |         |         |
  2+15       0.1139      0.69  |Q        |         |         |         |
  2+30       0.1282      0.70  |Q        |         |         |         |
  2+45       0.1427      0.70  |Q        |         |         |         |
  3+ 0       0.1574      0.71  |QV       |         |         |         |
  3+15       0.1722      0.72  |QV       |         |         |         |
  3+30       0.1872      0.72  |QV       |         |         |         |
  3+45       0.2023      0.73  |QV       |         |         |         |
  4+ 0       0.2176      0.74  |QV       |         |         |         |
  4+15       0.2331      0.75  |Q V      |         |         |         |
```

```
  4+30       0.2487      0.76  |Q V      |         |         |         |
  4+45       0.2645      0.77  |Q V      |         |         |         |
  5+ 0       0.2805      0.78  |Q V      |         |         |         |
  5+15       0.2967      0.78  |Q  V     |         |         |         |
  5+30       0.3132      0.79  |Q  V     |         |         |         |
  5+45       0.3298      0.80  |Q  V     |         |         |         |
  6+ 0       0.3466      0.82  |Q  V     |         |         |         |
  6+15       0.3637      0.83  |Q  V     |         |         |         |
  6+30       0.3810      0.84  |Q   V    |         |         |         |
  6+45       0.3985      0.85  |Q   V    |         |         |         |
  7+ 0       0.4163      0.86  |Q   V    |         |         |         |
  7+15       0.4344      0.87  |Q   V    |         |         |         |
  7+30       0.4527      0.89  |Q    V   |         |         |         |
  7+45       0.4713      0.90  |Q    V   |         |         |         |
  8+ 0       0.4903      0.92  |Q    V   |         |         |         |
  8+15       0.5095      0.93  |Q    V   |         |         |         |
  8+30       0.5291      0.95  |Q     V  |         |         |         |
  8+45       0.5490      0.96  |Q     V  |         |         |         |
  9+ 0       0.5693      0.98  |Q     V  |         |         |         |
  9+15       0.5900      1.00  | Q    V  |         |         |         |
  9+30       0.6111      1.02  | Q     V |         |         |         |
  9+45       0.6326      1.04  | Q     V |         |         |         |
 10+ 0       0.6545      1.06  | Q     V |         |         |         |
 10+15       0.6770      1.09  | Q      V|         |         |         |
 10+30       0.7000      1.11  | Q      V|         |         |         |
 10+45       0.7235      1.14  | Q      V|         |         |         |
 11+ 0       0.7476      1.17  | Q       V         |         |         |
 11+15       0.7724      1.20  | Q       V         |         |         |
 11+30       0.7979      1.23  | Q       V         |         |         |
 11+45       0.8241      1.27  | Q        V        |         |         |
 12+ 0       0.8511      1.31  | Q       |V        |         |         |
 12+15       0.8781      1.31  | Q       |V        |         |         |
 12+30       0.9042      1.27  | Q       | V       |         |         |
 12+45       0.9313      1.31  | Q       | V       |         |         |
 13+ 0       0.9596      1.37  | Q       | V       |         |         |
 13+15       0.9892      1.43  | Q       |  V      |         |         |
 13+30       1.0203      1.51  |  Q      |  V      |         |         |
 13+45       1.0532      1.59  |  Q      |   V     |         |         |
 14+ 0       1.0881      1.69  |  Q      |   V     |         |         |
 14+15       1.1254      1.81  |  Q      |    V    |         |         |
 14+30       1.1658      1.95  |  Q      |    V    |         |         |
 14+45       1.2098      2.13  |   Q     |     V   |         |         |
 15+ 0       1.2586      2.36  |   Q     |      V  |         |         |
 15+15       1.3139      2.68  |    Q    |      V  |         |         |
 15+30       1.3785      3.13  |     Q   |       V |         |         |
 15+45       1.4589      3.89  |      Q  |        V|         |         |
 16+ 0       1.5982      6.74  |         |  Q      |V        |         |
 16+15       1.8990     14.56  |         |         |    V   Q|         |
 16+30       2.2275     15.90  |         |         |         VQ        |
 16+45       2.3153      4.25  |       Q |         |          V        |
```

```
   17+ 0       2.3653      2.42  |   Q     |         |         |V        |
   17+15       2.4061      1.98  |  Q      |         |         | V       |
   17+30       2.4413      1.70  |  Q      |         |         |  V      |
   17+45       2.4726      1.51  |  Q      |         |         |  V      |
   18+ 0       2.5009      1.37  | Q       |         |         |  V      |
   18+15       2.5280      1.31  | Q       |         |         |   V     |
   18+30       2.5549      1.30  | Q       |         |         |   V     |
   18+45       2.5804      1.23  | Q       |         |         |   V     |
   19+ 0       2.6045      1.17  | Q       |         |         |    V    |
   19+15       2.6276      1.11  | Q       |         |         |    V    |
   19+30       2.6496      1.06  | Q       |         |         |    V    |
   19+45       2.6707      1.02  | Q       |         |         |     V   |
   20+ 0       2.6910      0.98  |Q        |         |         |     V   |
   20+15       2.7106      0.95  |Q        |         |         |     V   |
   20+30       2.7295      0.92  |Q        |         |         |     V   |
   20+45       2.7478      0.89  |Q        |         |         |      V  |
   21+ 0       2.7657      0.86  |Q        |         |         |      V  |
   21+15       2.7830      0.84  |Q        |         |         |      V  |
   21+30       2.7998      0.82  |Q        |         |         |      V  |
   21+45       2.8162      0.79  |Q        |         |         |       V |
   22+ 0       2.8323      0.78  |Q        |         |         |       V |
   22+15       2.8479      0.76  |Q        |         |         |       V |
   22+30       2.8632      0.74  |Q        |         |         |       V |
   22+45       2.8782      0.72  |Q        |         |         |       V |
   23+ 0       2.8928      0.71  |Q        |         |         |        V|
   23+15       2.9072      0.70  |Q        |         |         |        V|
   23+30       2.9213      0.68  |Q        |         |         |        V|
   23+45       2.9352      0.67  |Q        |         |         |        V|
   24+ 0       2.9487      0.66  |Q        |         |         |        V|
-----------------------------------------------------------------------
```

```
        U n i t   H y d r o g r a p h   A n a l y s i s

        Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2018, Version 9.0

                Study date  12/17/24

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
------------------------------------------------------------------------

San Bernardino County Synthetic Unit Hydrology Method
                Manual date - August 1986


Program License Serial Number 6443

---------------------------------------------------------------------
UNIT HYDROGRAPH EAST HIGHLAND
PROPOSED CONDITION - BASIN 2
100-YR 24-HR STORM
KIMLEY-HORN
--------------------------------------------------------------------

        Storm Event Year = 100

        Antecedent Moisture Condition = 3

 English (in-lb) Input Units Used

 English Rainfall Data (Inches) Input Values Used

 English Units used in output format




Area averaged rainfall intensity isohyetal data:
        Sub-Area       Duration       Isohyetal
        (Ac.)           (hours)         (In)
Rainfall data for year 10
             1.85           1           0.83
--------------------------------------------------------------------
Rainfall data for year 2
             1.85           6           1.24
--------------------------------------------------------------------
Rainfall data for year 2
             1.85          24           2.31
--------------------------------------------------------------------
Rainfall data for year 100
```

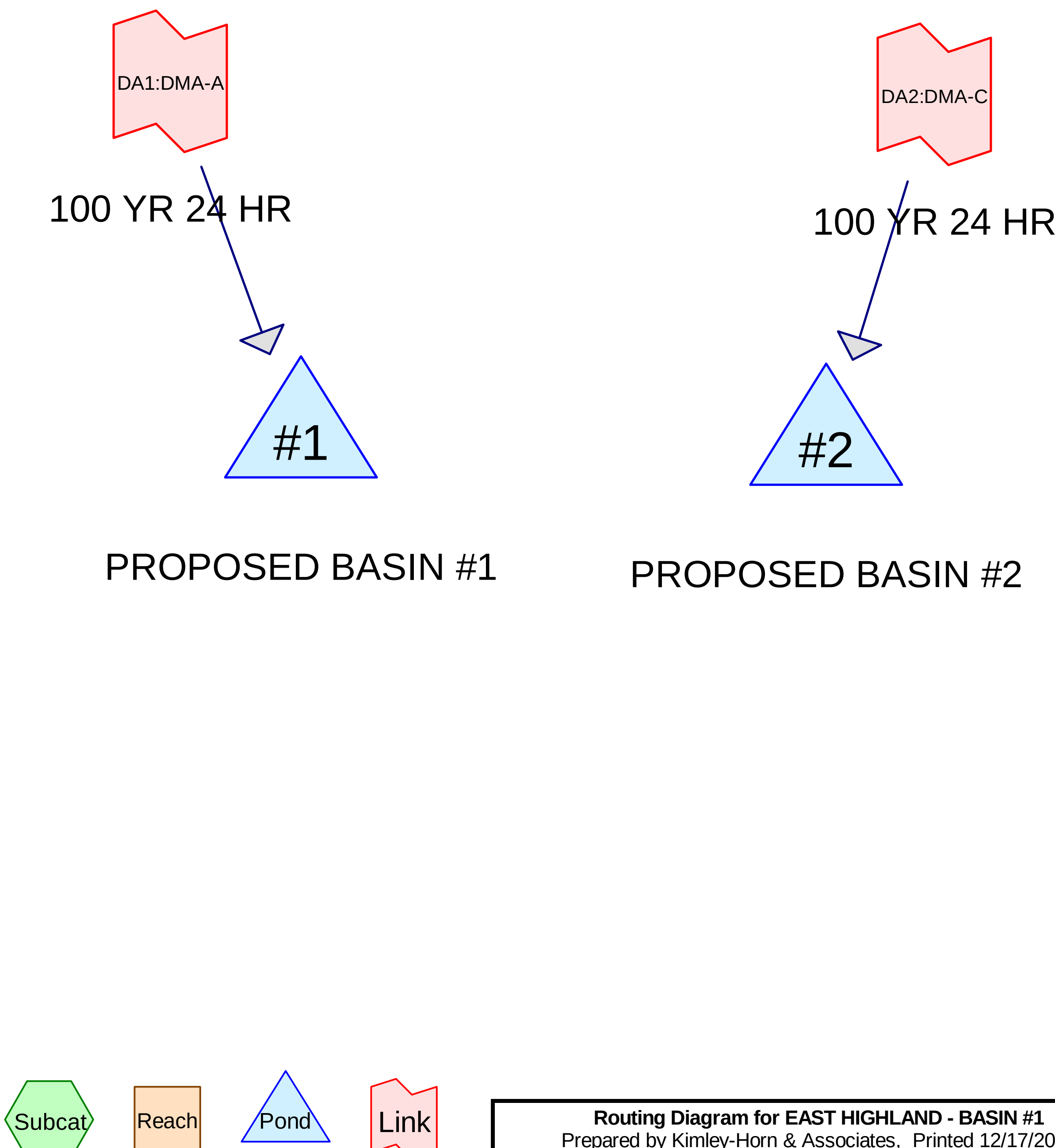
```
             1.85            1           1.39
--------------------------------------------------------------------
Rainfall data for year 100
             1.85            6           2.90
--------------------------------------------------------------------
Rainfall data for year 100
             1.85           24           5.46
--------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

******** Area-averaged max loss rate, Fm ********


SCS curve  SCS curve     Area     Area     Fp(Fig C6)    Ap       Fm
No.(AMCII) NO.(AMC 3)    (Ac.)    Fraction     (In/Hr)  (dec.)   (In/Hr)
 32.0      52.0          1.85      1.000     0.785    0.580    0.455

Area-averaged adjusted loss rate Fm (In/Hr) =  0.455

********* Area-Averaged low loss rate fraction, Yb **********

Area        Area          SCS CN    SCS CN      S      Pervious
 (Ac.)       Fract         (AMC2)    (AMC3)            Yield Fr
     1.07   0.580          32.0      52.0       9.23     0.186
     0.78   0.420          98.0      98.0       0.20     0.957

Area-averaged catchment yield fraction, Y =  0.510
Area-averaged low loss fraction, Yb =  0.490
Direct entry of lag time by user
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Watershed area =       1.85(Ac.)
Catchment Lag time =   0.125 hours
Unit interval =  15.000 minutes
Unit interval percentage of lag time = 200.8032
Hydrograph baseflow =     0.00(CFS)
Average maximum watershed loss rate(Fm) =  0.455(In/Hr)
Average low loss rate fraction (Yb) = 0.490 (decimal)
VALLEY DEVELOPED S-Graph Selected
Computed peak 5-minute rainfall =  0.514(In)
Computed peak 30-minute rainfall =  1.053(In)
Specified peak 1-hour rainfall =  1.390(In)
Computed peak 3-hour rainfall =  2.182(In)
Specified peak 6-hour rainfall =  2.900(In)
Specified peak 24-hour rainfall =  5.460(In)


Rainfall depth area reduction factors:
Using a total area of       1.85(Ac.) (Ref: fig. E-4)

5-minute factor = 1.000     Adjusted rainfall =  0.514(In)
```

```
30-minute factor = 1.000    Adjusted rainfall =  1.053(In)
1-hour factor = 1.000       Adjusted rainfall =  1.390(In)
3-hour factor = 1.000       Adjusted rainfall =  2.182(In)
6-hour factor = 1.000       Adjusted rainfall =  2.900(In)
24-hour factor = 1.000      Adjusted rainfall =  5.460(In)
---------------------------------------------------------------------

                        U n i t   H y d r o g r a p h
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Interval           'S' Graph          Unit Hydrograph
Number             Mean values             ((CFS))
---------------------------------------------------------------------
                (K =         7.46 (CFS))

  1                 48.463                  3.614
  2                100.000                  1.807
---------------------------------------------------------------------
--------------------------------------------------------------------
--------------------------------------------------------------------
Total soil rain loss =      2.39(In)
Total effective rainfall =      3.07(In)
Peak flow rate in flood hydrograph =      2.50(CFS)
---------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                    24 - H O U R    S T O R M
               R u n o f f      H y d r o g r a p h
--------------------------------------------------------------------
            Hydrograph in  15   Minute intervals ((CFS))

--------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
-----------------------------------------------------------------------
  0+15       0.0010      0.05   Q         |         |         |         |
  0+30       0.0025      0.07   Q         |         |         |         |
  0+45       0.0040      0.07   Q         |         |         |         |
  1+ 0       0.0055      0.07   Q         |         |         |         |
  1+15       0.0071      0.07   Q         |         |         |         |
  1+30       0.0086      0.08   QV        |         |         |         |
  1+45       0.0102      0.08   QV        |         |         |         |
  2+ 0       0.0117      0.08   QV        |         |         |         |
  2+15       0.0133      0.08   QV        |         |         |         |
  2+30       0.0150      0.08   QV        |         |         |         |
  2+45       0.0166      0.08   QV        |         |         |         |
  3+ 0       0.0182      0.08   Q V       |         |         |         |
  3+15       0.0199      0.08   Q V       |         |         |         |
  3+30       0.0216      0.08   Q V       |         |         |         |
  3+45       0.0233      0.08   Q V       |         |         |         |
  4+ 0       0.0250      0.08   Q V       |         |         |         |
  4+15       0.0267      0.08   Q  V      |         |         |         |
  4+30       0.0285      0.08   Q  V      |         |         |         |
```

```
 4+45       0.0302      0.09  Q  V      |         |         |         |
 5+ 0       0.0320      0.09  Q  V      |         |         |         |
 5+15       0.0339      0.09  Q  V      |         |         |         |
 5+30       0.0357      0.09  Q   V     |         |         |         |
 5+45       0.0376      0.09  Q   V     |         |         |         |
 6+ 0       0.0394      0.09  Q   V     |         |         |         |
 6+15       0.0414      0.09  Q   V     |         |         |         |
 6+30       0.0433      0.09  Q    V    |         |         |         |
 6+45       0.0453      0.10  Q    V    |         |         |         |
 7+ 0       0.0473      0.10  Q    V    |         |         |         |
 7+15       0.0493      0.10  Q    V    |         |         |         |
 7+30       0.0514      0.10  Q    V    |         |         |         |
 7+45       0.0535      0.10  Q     V   |         |         |         |
 8+ 0       0.0556      0.10  Q     V   |         |         |         |
 8+15       0.0577      0.10  Q     V   |         |         |         |
 8+30       0.0599      0.11  Q     V   |         |         |         |
 8+45       0.0622      0.11  Q      V  |         |         |         |
 9+ 0       0.0645      0.11  Q      V  |         |         |         |
 9+15       0.0668      0.11  Q      V  |         |         |         |
 9+30       0.0692      0.11  Q       V |         |         |         |
 9+45       0.0716      0.12  Q       V |         |         |         |
10+ 0       0.0741      0.12  Q       V |         |         |         |
10+15       0.0766      0.12  Q       V |         |         |         |
10+30       0.0792      0.13  Q        V|         |         |         |
10+45       0.0818      0.13  Q        V|         |         |         |
11+ 0       0.0846      0.13  Q        V|         |         |         |
11+15       0.0873      0.14  Q         V         |         |         |
11+30       0.0902      0.14  Q         V         |         |         |
11+45       0.0932      0.14  Q         V         |         |         |
12+ 0       0.0962      0.15  Q          V        |         |         |
12+15       0.0992      0.14  Q         |V        |         |         |
12+30       0.1021      0.14  Q         |V        |         |         |
12+45       0.1052      0.15  Q         | V       |         |         |
13+ 0       0.1084      0.16  Q         | V       |         |         |
13+15       0.1118      0.16  Q         |  V      |         |         |
13+30       0.1153      0.17  Q         |  V      |         |         |
13+45       0.1191      0.18  Q         |  V      |         |         |
14+ 0       0.1231      0.19  Q         |   V     |         |         |
14+15       0.1274      0.21  Q         |   V     |         |         |
14+30       0.1320      0.22  Q         |    V    |         |         |
14+45       0.1371      0.25  Q         |    V    |         |         |
15+ 0       0.1428      0.28  |Q        |     V   |         |         |
15+15       0.1493      0.32  |Q        |      V  |         |         |
15+30       0.1570      0.37  |Q        |       V |         |         |
15+45       0.1671      0.49  |Q        |        V|         |         |
16+ 0       0.1897      1.09  |   Q     |         | V       |         |
16+15       0.2413      2.50  |         Q         |       V |         |
16+30       0.2678      1.28  |    Q    |         |          V        |
16+45       0.2743      0.32  |Q        |         |         |V        |
17+ 0       0.2794      0.25  Q         |         |         | V       |
```

```
    17+15       0.2837      0.21  Q         |         |         |  V      |
    17+30       0.2874      0.18  Q         |         |         |  V      |
    17+45       0.2907      0.16  Q         |         |         |  V      |
    18+ 0       0.2938      0.15  Q         |         |         |   V     |
    18+15       0.2968      0.15  Q         |         |         |   V     |
    18+30       0.2998      0.14  Q         |         |         |   V     |
    18+45       0.3026      0.13  Q         |         |         |    V    |
    19+ 0       0.3052      0.13  Q         |         |         |    V    |
    19+15       0.3077      0.12  Q         |         |         |    V    |
    19+30       0.3102      0.12  Q         |         |         |     V   |
    19+45       0.3125      0.11  Q         |         |         |     V   |
    20+ 0       0.3147      0.11  Q         |         |         |     V   |
    20+15       0.3169      0.10  Q         |         |         |     V   |
    20+30       0.3190      0.10  Q         |         |         |      V  |
    20+45       0.3210      0.10  Q         |         |         |      V  |
    21+ 0       0.3229      0.10  Q         |         |         |      V  |
    21+15       0.3249      0.09  Q         |         |         |      V  |
    21+30       0.3267      0.09  Q         |         |         |       V |
    21+45       0.3285      0.09  Q         |         |         |       V |
    22+ 0       0.3303      0.09  Q         |         |         |       V |
    22+15       0.3320      0.08  Q         |         |         |       V |
    22+30       0.3337      0.08  Q         |         |         |       V |
    22+45       0.3354      0.08  Q         |         |         |        V|
    23+ 0       0.3370      0.08  Q         |         |         |        V|
    23+15       0.3386      0.08  Q         |         |         |        V|
    23+30       0.3402      0.08  Q         |         |         |        V|
    23+45       0.3417      0.07  Q         |         |         |        V|
    24+ 0       0.3432      0.07  Q         |         |         |        V|
 -----------------------------------------------------------------------
```

Appendix G - Basin Routing Analysis



Routing Diagram for EAST HIGHLAND - BASIN #1
Prepared by Kimley-Horn & Associates, Printed 12/17/2024

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Pond #1: PROPOSED BASIN #1 Peak Elev=1,445.56' Storage=28,641 cf Inflow=16.10 cfs 2.944 af
Primary=15.26 cfs 2.429 af Secondary=0.00 cfs 0.000 af Outflow=15.26 cfs 2.429 af

Pond #2: PROPOSED BASIN #2 Peak Elev=1,455.48' Storage=3,819 cf Inflow=2.50 cfs 0.343 af
Primary=2.28 cfs 0.270 af Secondary=0.00 cfs 0.000 af Outflow=2.28 cfs 0.270 af

Link 09 - East Highland-Alta Vista\Reports\Prelim_H&H (Drainage)\CIVILD\EASTHIGHLAND10024-15min.csv Inflow=16.10 cfs 2.944 af
Primary=16.10 cfs 2.944 af

Link 5009 - East Highland-Alta Vista\Reports\Prelim_H&H (Drainage)\CIVILD\EASTHIGHLAND10024-15min.csv Inflow=2.50 cfs 0.343 af
Primary=2.50 cfs 0.343 af

Summary for Pond #1: PROPOSED BASIN #1

Inflow = 16.10 cfs @ 16.48 hrs, Volume= 2.944 af
Outflow = 15.26 cfs @ 16.51 hrs, Volume= 2.429 af, Atten= 5%, Lag= 1.6 min
Primary = 15.26 cfs @ 16.51 hrs, Volume= 2.429 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 1,445.56' @ 16.51 hrs Surf.Area= 12,949 sf Storage= 28,641 cf

Plug-Flow detention time= 204.6 min calculated for 2.424 af (82% of inflow)
Center-of-Mass det. time= 124.5 min (960.6 - 836.1)

Volume	Invert	Avail.Storage	Storage Description
#1	1,443.00'	56,451 cf	**BASIN #1 (Prismatic)** Listed below (Recalc)

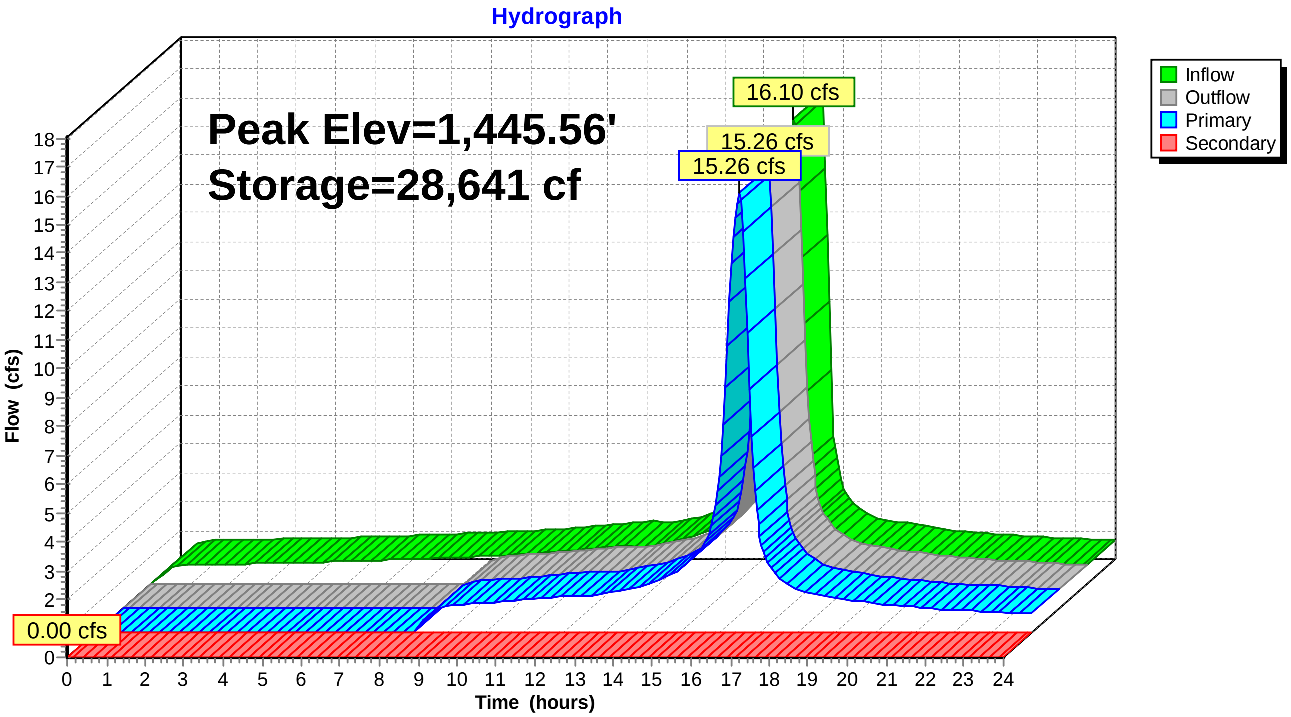
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,443.00	9,444	0	0
1,444.00	10,764	10,104	10,104
1,445.00	12,140	11,452	21,556
1,446.00	13,572	12,856	34,412
1,447.00	15,062	14,317	48,729
1,447.50	15,827	7,722	56,451

Device	Routing	Invert	Outlet Devices
#1	Primary	1,445.00'	**42.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Secondary	1,447.00'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=15.23 cfs @ 16.51 hrs HW=1,445.56' (Free Discharge)
↑—**1=Orifice/Grate** (Weir Controls 15.23 cfs @ 2.46 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,443.00' (Free Discharge)
↑—**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond #1: PROPOSED BASIN #1



Summary for Pond #2: PROPOSED BASIN #2

Inflow = 2.50 cfs @ 16.25 hrs, Volume= 0.343 af
Outflow = 2.28 cfs @ 16.31 hrs, Volume= 0.270 af, Atten= 9%, Lag= 3.2 min
Primary = 2.28 cfs @ 16.31 hrs, Volume= 0.270 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 1,455.48' @ 16.31 hrs Surf.Area= 2,577 sf Storage= 3,819 cf

Plug-Flow detention time= 232.4 min calculated for 0.269 af (79% of inflow)
Center-of-Mass det. time= 142.0 min (979.2 - 837.2)

Volume	Invert	Avail.Storage	Storage Description
#1	1,453.60'	10,763 cf	**BASIN #2 (Prismatic)** Listed below (Recalc)

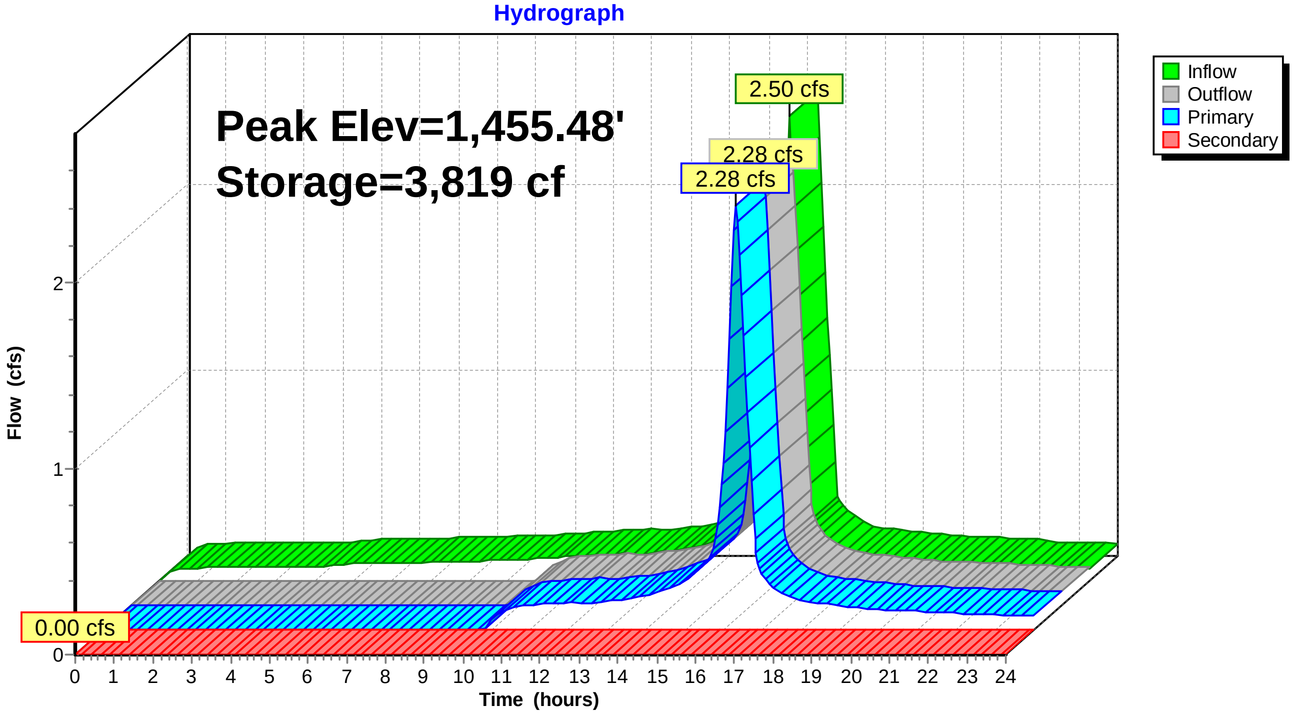
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,453.60	1,513	0	0
1,454.60	2,052	1,783	1,783
1,455.60	2,648	2,350	4,133
1,456.60	3,301	2,975	7,107
1,457.60	4,010	3,656	10,763

Device	Routing	Invert	Outlet Devices
#1	Primary	1,455.20'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Secondary	1,456.10'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=2.27 cfs @ 16.31 hrs HW=1,455.48' (Free Discharge)
└─**1=Orifice/Grate** (Weir Controls 2.27 cfs @ 1.73 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,453.60' (Free Discharge)
└─**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond #2: PROPOSED BASIN #2



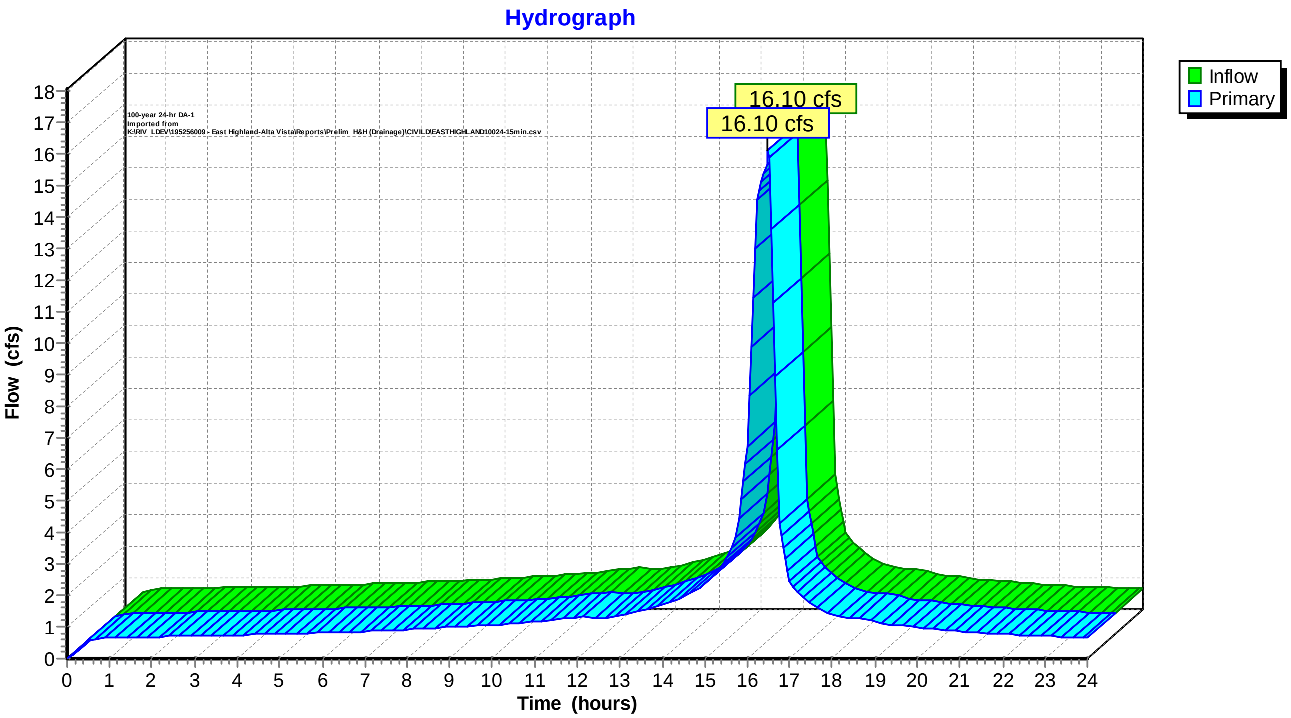
Summary for Link DA1:DMA-A: 100 YR 24 HR

Inflow = 16.10 cfs @ 16.48 hrs, Volume= 2.944 af
Primary = 16.10 cfs @ 16.48 hrs, Volume= 2.944 af, Atten= 0%, Lag= 0.0 min
Routed to Pond #1 : PROPOSED BASIN #1

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

100-year 24-hr DA-1 Imported from K:\RIV_LDEV\195256009 - East Highland-Alta Vista\Reports\Prelim_H&H (Drainage)

Link DA1:DMA-A: 100 YR 24 HR



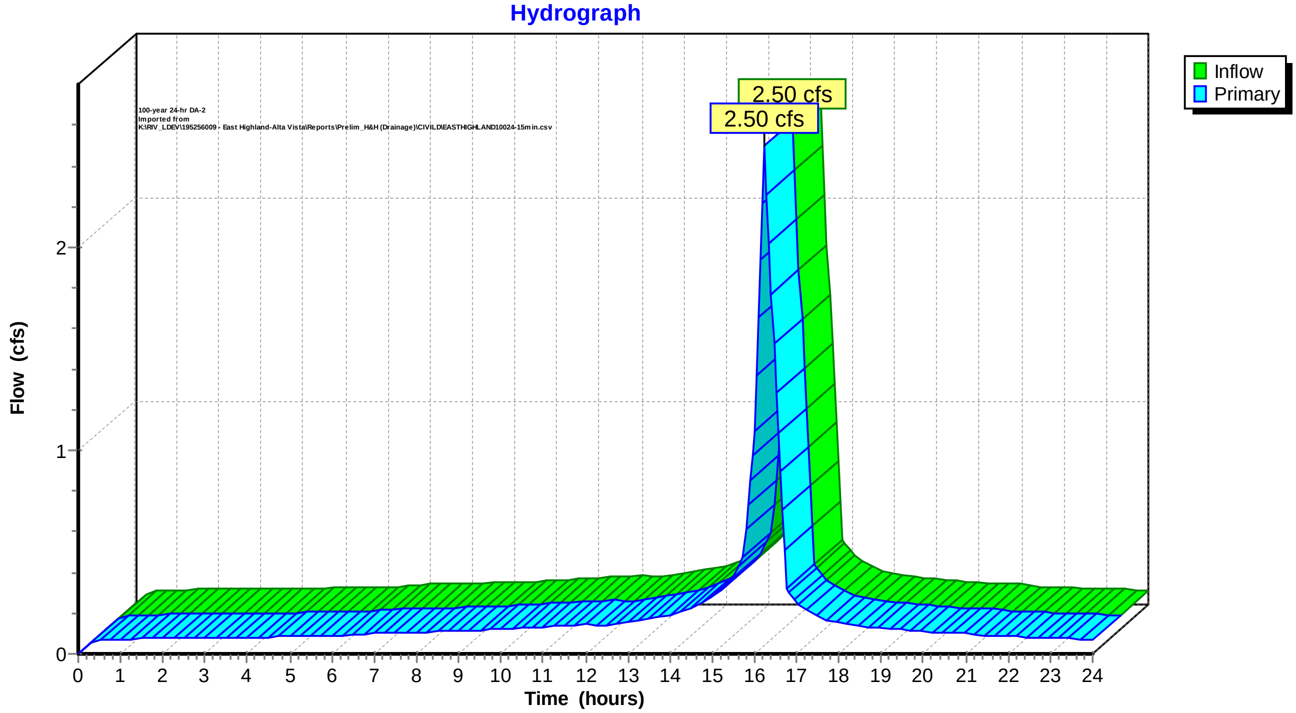
Summary for Link DA2:DMA-C: 100 YR 24 HR

Inflow = 2.50 cfs @ 16.25 hrs, Volume= 0.343 af
Primary = 2.50 cfs @ 16.25 hrs, Volume= 0.343 af, Atten= 0%, Lag= 0.0 min
Routed to Pond #2 : PROPOSED BASIN #2

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

100-year 24-hr DA-2 Imported from K:\RIV_LDEV\195256009 - East Highland-Alta Vista\Reports\Prelim_H&H (Drainage)

Link DA2:DMA-C: 100 YR 24 HR



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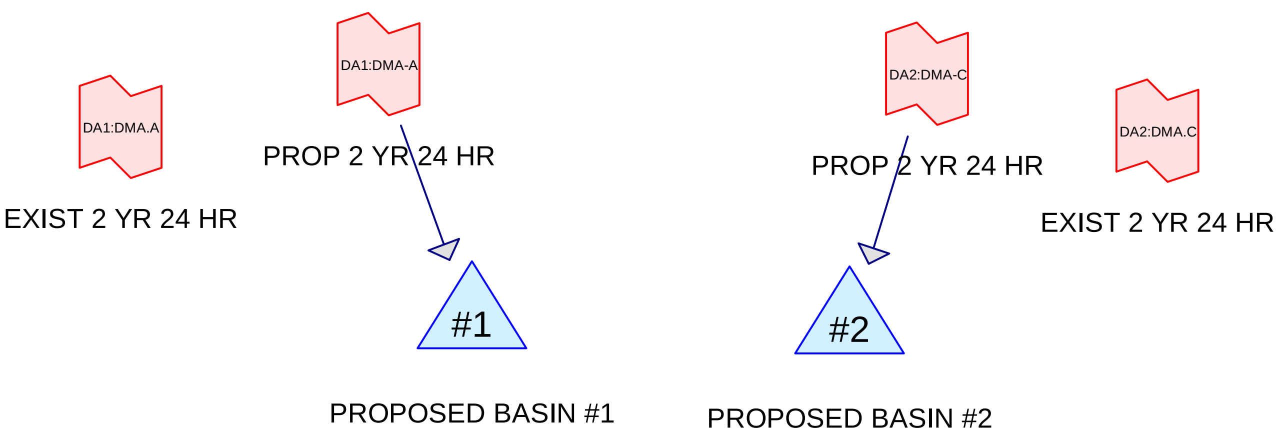
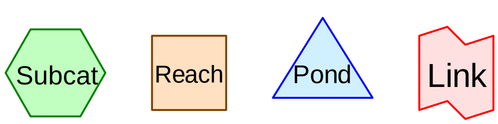




Routing Diagram for EAST HIGHLAND - 2 YR BASIN #1&2
Prepared by Kimley-Horn & Associates, Printed 12/17/2024
HydroCAD® 10.20-5c s/n 02344 © 2023 HydroCAD Software Solutions LLC

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Pond #1: PROPOSED BASIN #1 Peak Elev=1,445.28' Storage=25,005 cf Inflow=7.34 cfs 1.015 af
Primary=5.32 cfs 0.511 af Secondary=0.00 cfs 0.000 af Outflow=5.32 cfs 0.511 af

Pond #2: PROPOSED BASIN #2 Peak Elev=1,455.36' Storage=3,515 cf Inflow=1.18 cfs 0.142 af
Primary=0.99 cfs 0.070 af Secondary=0.00 cfs 0.000 af Outflow=0.99 cfs 0.070 af

Link 56009 - East Highland-Alta Vista\Reports\Prelim_H&H (Drainage)\CIVILD\EASTHIGHLAND 2_24-5min.csv Inflow=7.34 cfs 1.015 af
Primary=7.34 cfs 1.015 af

Link 56009 - East Highland-Alta Vista\Reports\Prelim_H&H (Drainage)\CIVILD\EASTHIGHLAND 2_24-5min.csv Inflow=1.85 cfs 0.065 af
Primary=1.85 cfs 0.065 af

Link 56009 - East Highland-Alta Vista\Reports\Prelim_H&H (Drainage)\CIVILD\EASTHIGHLAND 2_24-5min.csv Inflow=1.18 cfs 0.142 af
Primary=1.18 cfs 0.142 af

Link 56009 - East Highland-Alta Vista\Reports\Prelim_H&H (Drainage)\CIVILD\EASTHIGHLAND 2_24-5min.csv Inflow=0.76 cfs 0.013 af
Primary=0.76 cfs 0.013 af

Summary for Pond #1: PROPOSED BASIN #1

Inflow	=	7.34 cfs @	16.23 hrs,	Volume=	1.015 af
Outflow	=	5.32 cfs @	16.29 hrs,	Volume=	0.511 af, Atten= 27%, Lag= 4.1 min
Primary	=	5.32 cfs @	16.29 hrs,	Volume=	0.511 af
Secondary	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 1,445.28' @ 16.29 hrs Surf.Area= 12,540 sf Storage= 25,005 cf

Plug-Flow detention time= 485.5 min calculated for 0.511 af (50% of inflow)
Center-of-Mass det. time= 248.4 min (1,071.1 - 822.7)

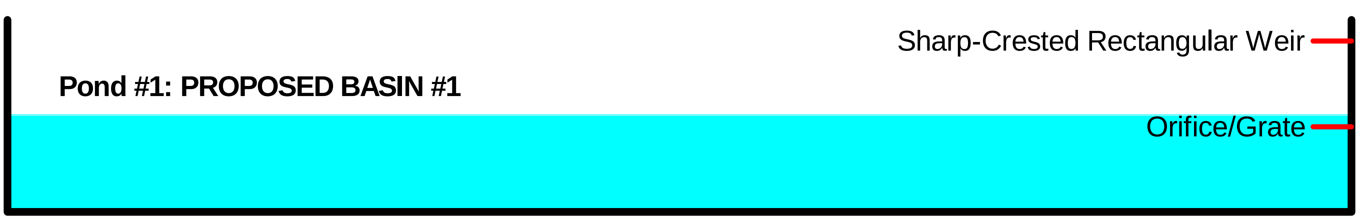
Volume	Invert	Avail.Storage	Storage Description
#1	1,443.00'	56,451 cf	**BASIN #1 (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,443.00	9,444	0	0
1,444.00	10,764	10,104	10,104
1,445.00	12,140	11,452	21,556
1,446.00	13,572	12,856	34,412
1,447.00	15,062	14,317	48,729
1,447.50	15,827	7,722	56,451

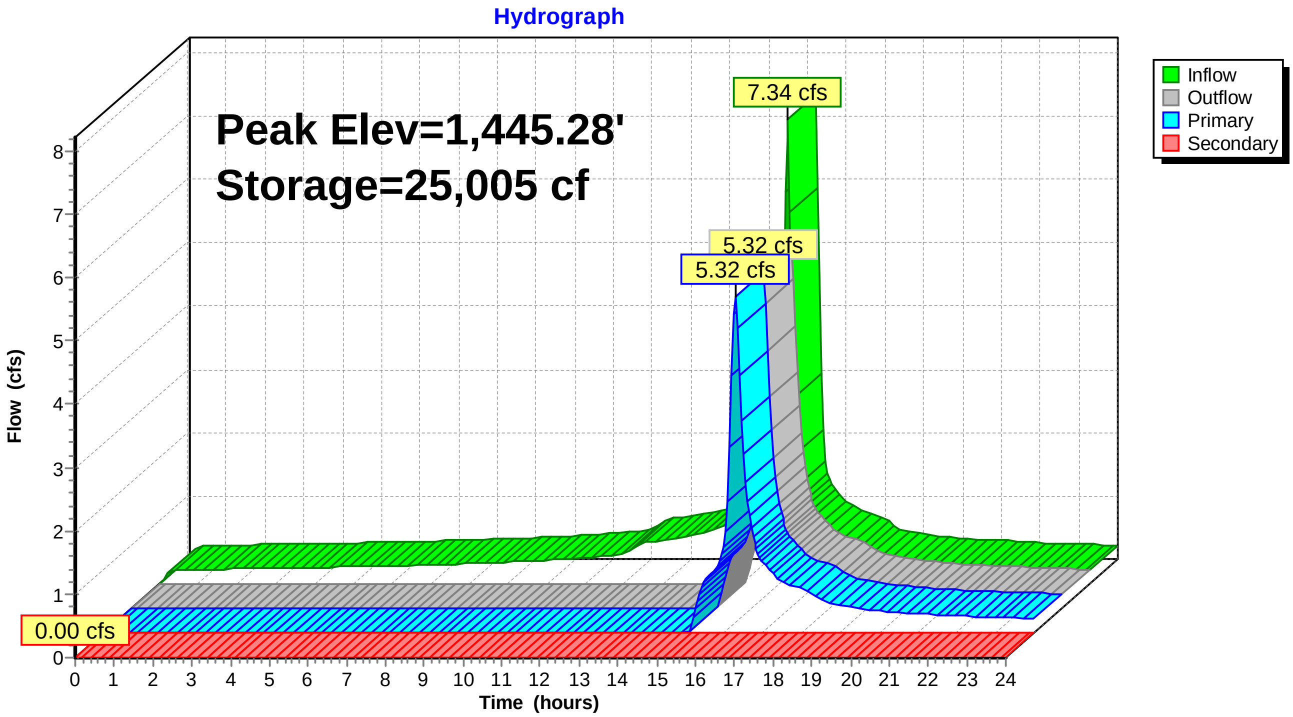
Device	Routing	Invert	Outlet Devices
#1	Primary	1,445.00'	**42.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Secondary	1,447.00'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=5.27 cfs @ 16.29 hrs HW=1,445.28' (Free Discharge)
↑—**1=Orifice/Grate** (Weir Controls 5.27 cfs @ 1.72 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,443.00' (Free Discharge)
↑—**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)



Pond #1: PROPOSED BASIN #1



Summary for Pond #2: PROPOSED BASIN #2

Inflow =	1.18 cfs @	16.22 hrs,	Volume=	0.142 af	
Outflow =	0.99 cfs @	16.27 hrs,	Volume=	0.070 af,	Atten= 16%, Lag= 3.0 min
Primary =	0.99 cfs @	16.27 hrs,	Volume=	0.070 af	
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 1,455.36' @ 16.27 hrs Surf.Area= 2,505 sf Storage= 3,515 cf

Plug-Flow detention time= 480.8 min calculated for 0.070 af (49% of inflow)
Center-of-Mass det. time= 242.6 min (1,070.6 - 828.0)

Volume	Invert	Avail.Storage	Storage Description
#1	1,453.60'	10,763 cf	**BASIN #2 (Prismatic)** Listed below (Recalc)

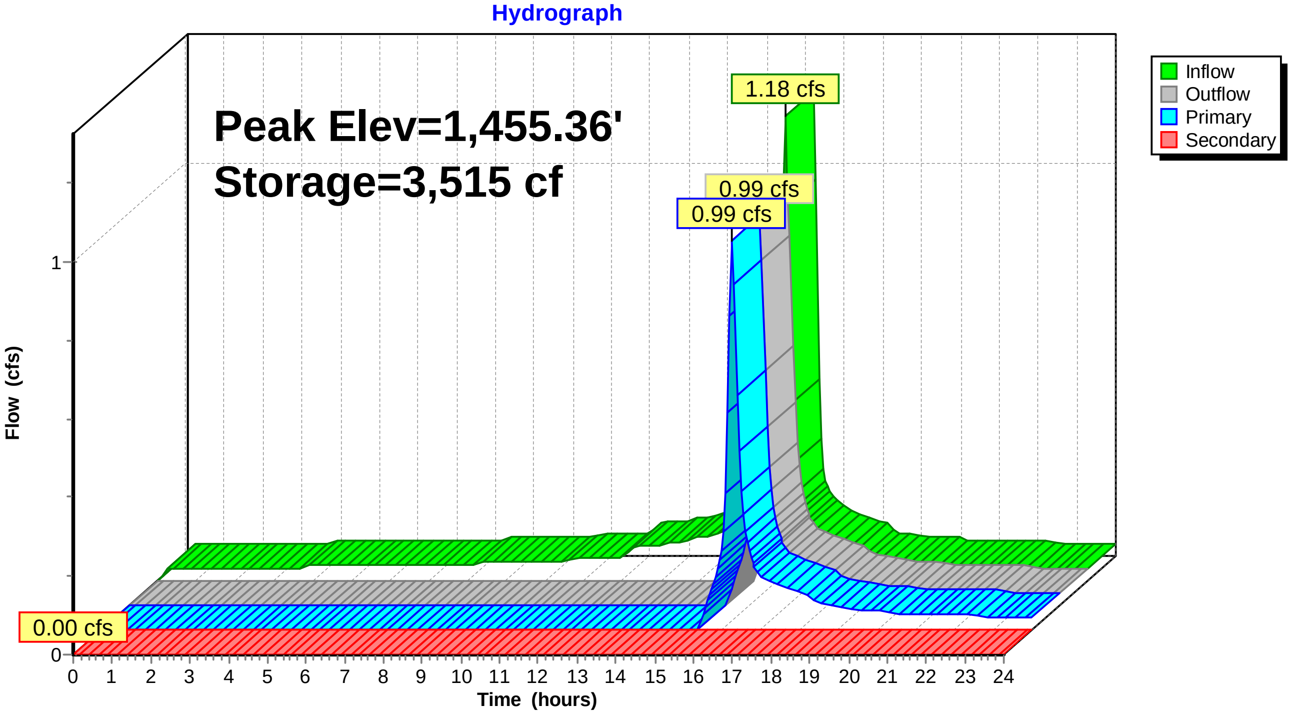
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,453.60	1,513	0	0
1,454.60	2,052	1,783	1,783
1,455.60	2,648	2,350	4,133
1,456.60	3,301	2,975	7,107
1,457.60	4,010	3,656	10,763

Device	Routing	Invert	Outlet Devices
#1	Primary	1,455.20'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Secondary	1,456.10'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=0.97 cfs @ 16.27 hrs HW=1,455.36' (Free Discharge)
↑—**1=Orifice/Grate** (Weir Controls 0.97 cfs @ 1.30 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,453.60' (Free Discharge)
↑—**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond #2: PROPOSED BASIN #2

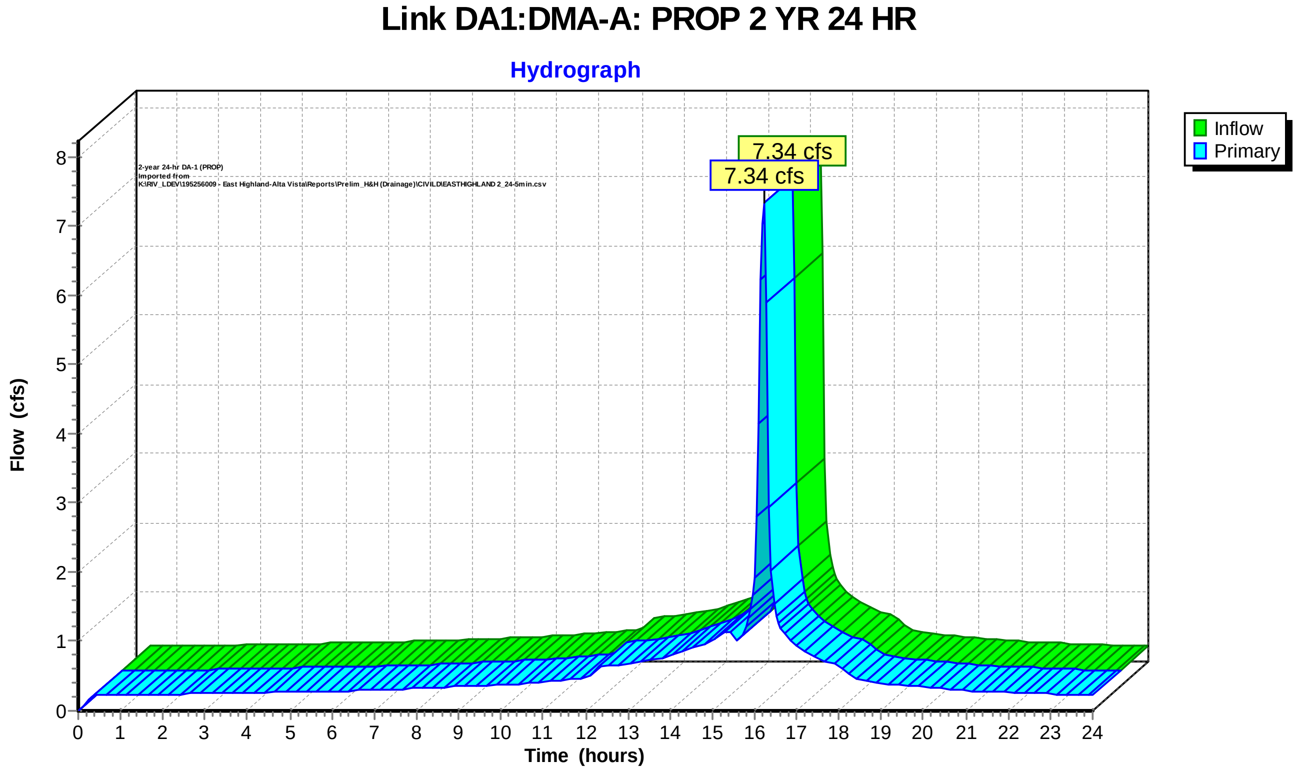


Summary for Link DA1:DMA-A: PROP 2 YR 24 HR

Inflow = 7.34 cfs @ 16.23 hrs, Volume= 1.015 af
Primary = 7.34 cfs @ 16.23 hrs, Volume= 1.015 af, Atten= 0%, Lag= 0.0 min
Routed to Pond #1 : PROPOSED BASIN #1

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

2-year 24-hr DA-1 (PROP) Imported from K:\RIV_LDEV\195256009 - East Highland-Alta Vista\Reports\Prelim_H&H (Dra

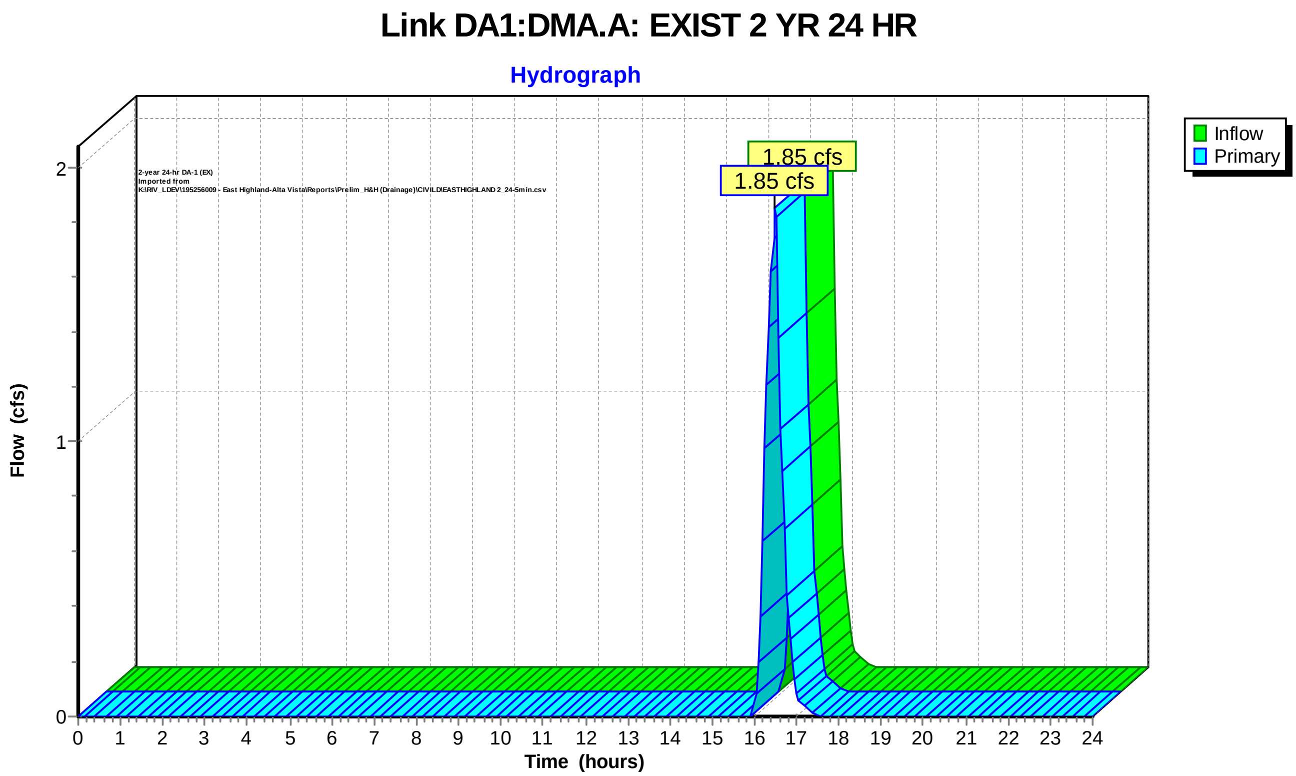


Summary for Link DA1:DMA.A: EXIST 2 YR 24 HR

Inflow = 1.85 cfs @ 16.48 hrs, Volume= 0.065 af
Primary = 1.85 cfs @ 16.48 hrs, Volume= 0.065 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

2-year 24-hr DA-1 (EX) Imported from K:\RIV_LDEV\195256009 - East Highland-Alta Vista\Reports\Prelim_H&H (Draina



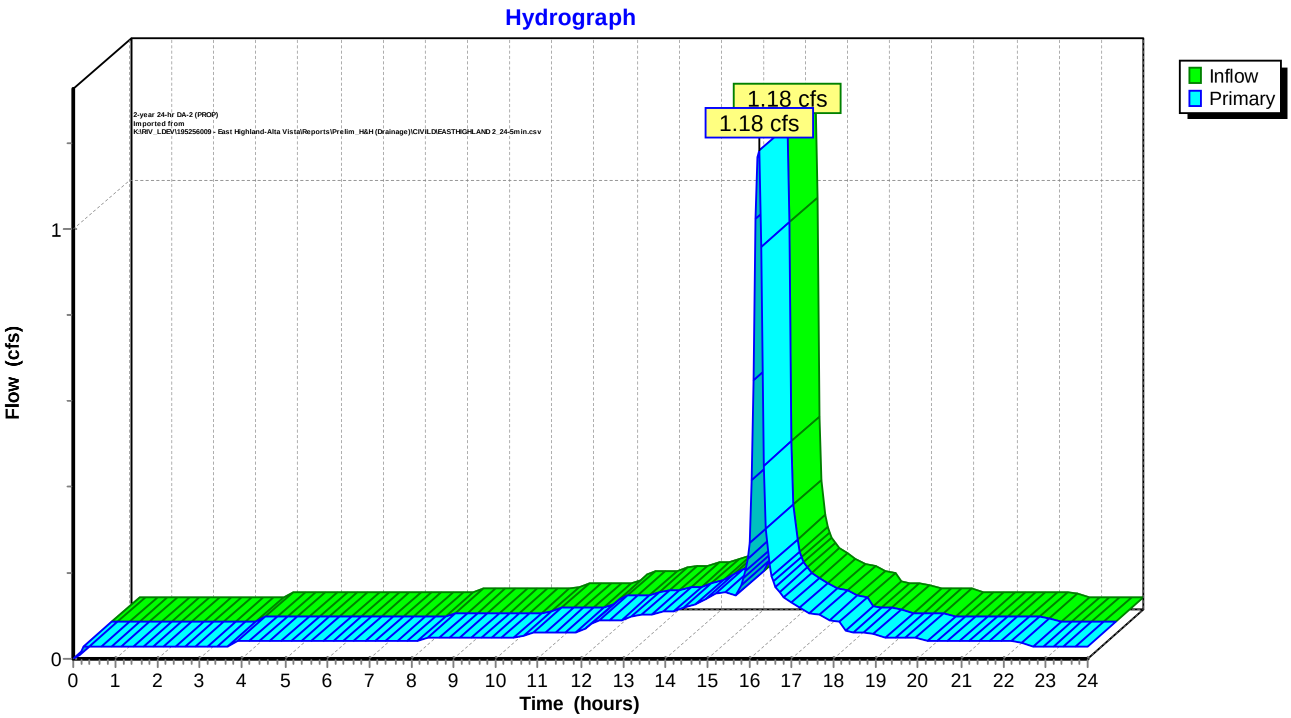
Summary for Link DA2:DMA-C: PROP 2 YR 24 HR

Inflow = 1.18 cfs @ 16.22 hrs, Volume= 0.142 af
Primary = 1.18 cfs @ 16.22 hrs, Volume= 0.142 af, Atten= 0%, Lag= 0.0 min
Routed to Pond #2 : PROPOSED BASIN #2

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

2-year 24-hr DA-2 (PROP) Imported from K:\RIV_LDEV\195256009 - East Highland-Alta Vista\Reports\Prelim_H&H (Dra

Link DA2:DMA-C: PROP 2 YR 24 HR

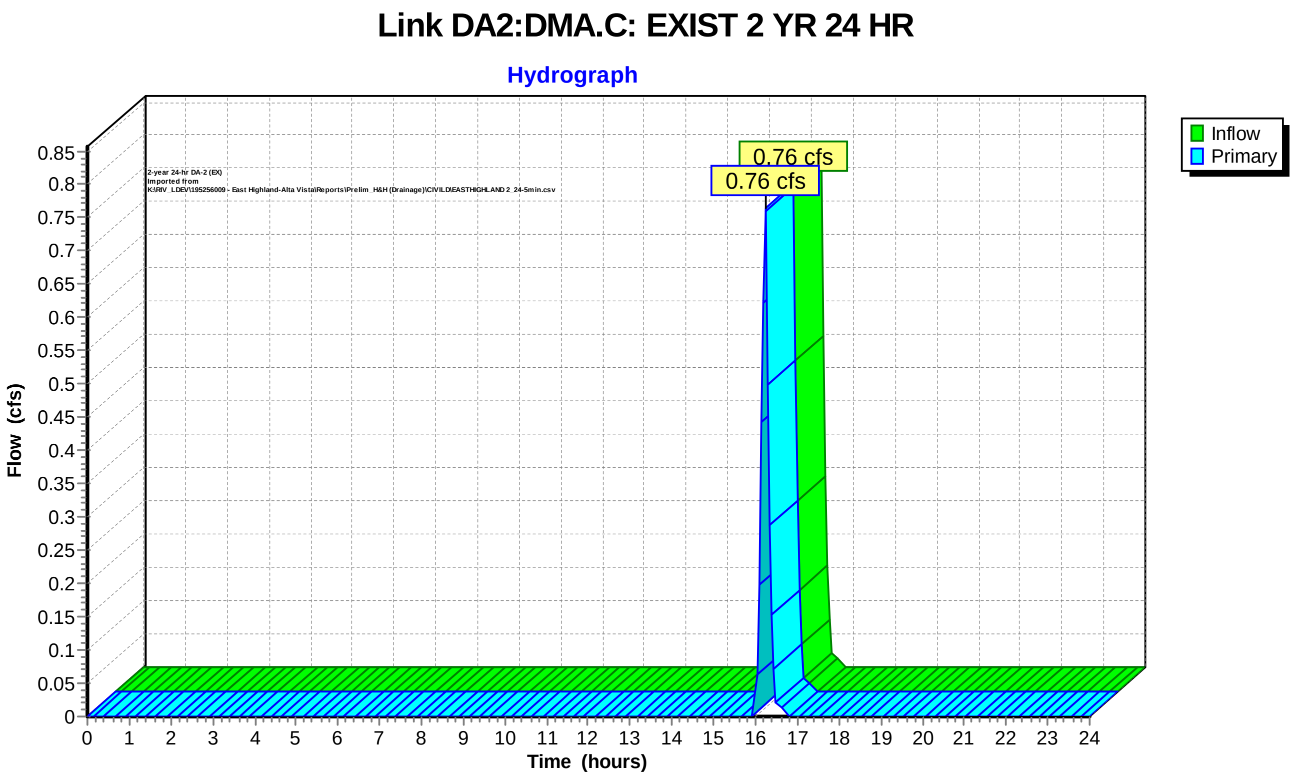


Summary for Link DA2:DMA.C: EXIST 2 YR 24 HR

Inflow	=	0.76 cfs @	16.24 hrs, Volume=	0.013 af
Primary	=	0.76 cfs @	16.24 hrs, Volume=	0.013 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

2-year 24-hr DA-2 (EX) Imported from K:\RIV_LDEV\195256009 - East Highland-Alta Vista\Reports\Prelim_H&H (Draina



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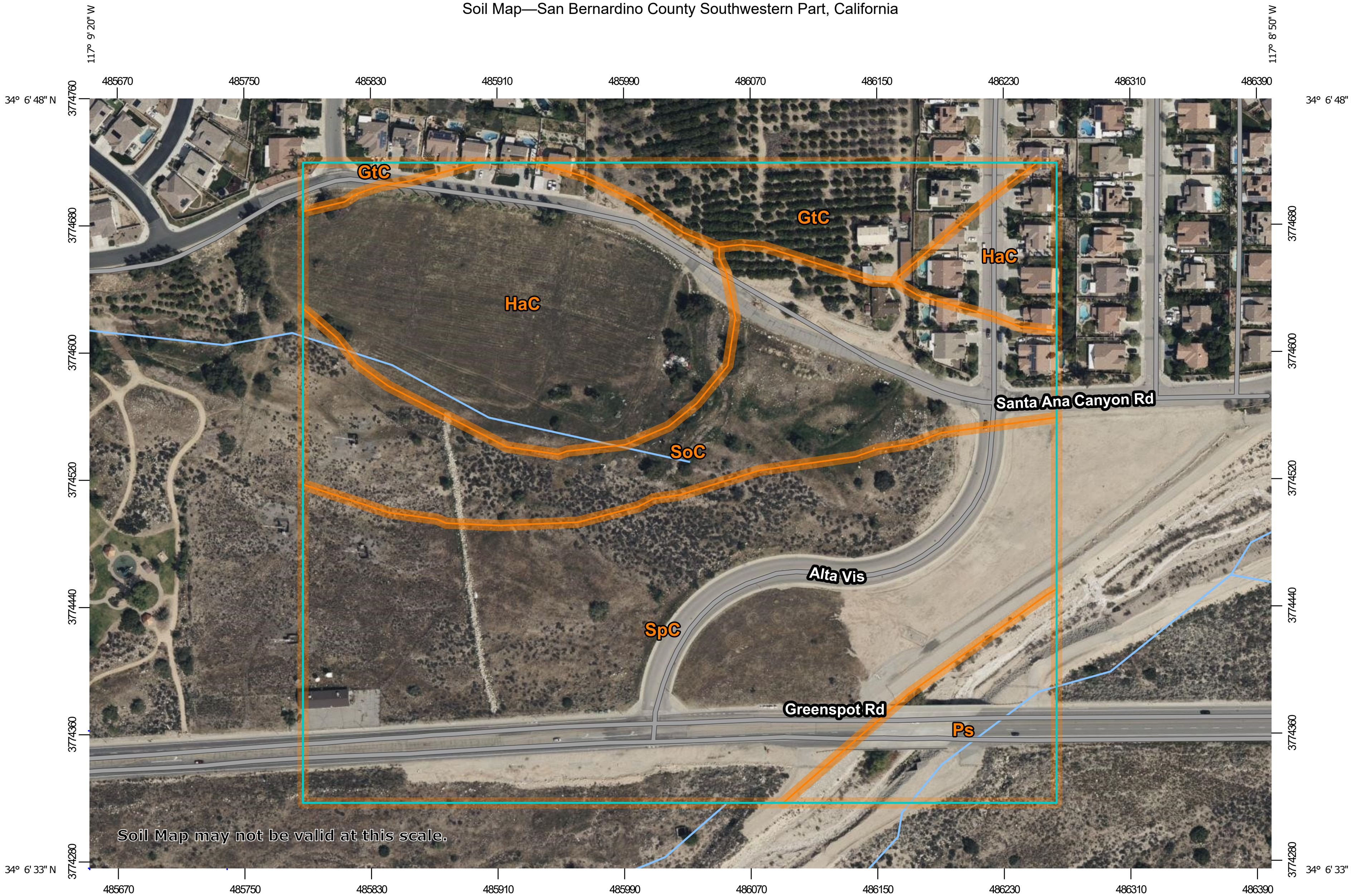
Appendix H – Soils Information

Soil Map—San Bernardino County Southwestern Part, California



Map Scale: 1:3,420 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 50, 100, 200, 300

Feet: 0, 150, 300, 600, 900

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 15, Aug 30, 2023

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

Date(s) aerial images were photographed: Mar 17, 2022—Jun 12, 2022

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
GtC	Greenfield sandy loam, 2 to 9 percent slopes	3.6	7.6%
HaC	Hanford coarse sandy loam, 2 to 9 percent slopes	10.8	22.8%
Ps	Psamments, Fluvents and Frequently flooded soils	3.0	6.4%
SoC	Soboba gravelly loamy sand, 0 to 9 percent slopes	9.3	19.5%
SpC	Soboba stony loamy sand, 2 to 9 percent slopes	20.8	43.7%
Totals for Area of Interest		**47.6**	**100.0%**

San Bernardino County Southwestern Part, California

HaC—Hanford coarse sandy loam, 2 to 9 percent slopes

Map Unit Setting

National map unit symbol: 2y8tl
Elevation: 890 to 2,860 feet
Mean annual precipitation: 11 to 22 inches
Mean annual air temperature: 64 to 65 degrees F
Frost-free period: 320 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: 2 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: 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: Rare
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): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: A
Ecological site: R019XG911CA - Loamy Fan
Hydric soil rating: No

Minor Components

Greenfield, sandy loam

Percent of map unit: 10 percent
Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Tujunga, loamy sand

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

Data Source Information

Soil Survey Area: San Bernardino County Southwestern Part, California
Survey Area Data: Version 15, Aug 30, 2023

San Bernardino County Southwestern Part, California

SoC—Soboba gravelly loamy sand, 0 to 9 percent slopes

Map Unit Setting

National map unit symbol: hckt
Elevation: 30 to 4,200 feet
Mean annual precipitation: 10 to 20 inches
Mean annual air temperature: 61 to 63 degrees F
Frost-free period: 175 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Soboba

Setting

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

Typical profile

H1 - 0 to 12 inches: gravelly loamy sand
H2 - 12 to 36 inches: very gravelly loamy sand
H3 - 36 to 60 inches: very stony sand

Properties and qualities

Slope: 0 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: 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: Rare
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.2 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: R019XG912CA - Sandy Fan
Hydric soil rating: No

Minor Components

Unnamed

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

Delhi, fine sand

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

Tujunga, gravelly loam

Percent of map unit: 3 percent
Hydric soil rating: No

Unnamed

Percent of map unit: 2 percent
Landform: Drainageways
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: San Bernardino County Southwestern Part, California
Survey Area Data: Version 15, Aug 30, 2023

San Bernardino County Southwestern Part, California

SpC—Soboba stony loamy sand, 2 to 9 percent slopes

Map Unit Setting

National map unit symbol: hckv
Elevation: 960 to 3,690 feet
Mean annual precipitation: 12 to 39 inches
Mean annual air temperature: 60 to 65 degrees F
Frost-free period: 260 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Soboba

Setting

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

Typical profile

Ap - 0 to 10 inches: stony loamy sand
C1 - 10 to 24 inches: very stony loamy sand
C2 - 24 to 60 inches: very stony sand

Properties and qualities

Slope: 2 to 9 percent
Surface area covered with cobbles, stones or boulders: 0.1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 19.99 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: R019XG912CA - Sandy Fan

Hydric soil rating: No

Minor Components

Hanford

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

Ramona

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

Tujunga, gravelly loamy sand

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

Data Source Information

Soil Survey Area: San Bernardino County Southwestern Part, California
Survey Area Data: Version 15, Aug 30, 2023

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SOLID AS A ROCK

ENGINEERS + GEOLOGISTS + ENVIRONMENTAL SCIENTISTS

PRELIMINARY GEOTECHNICAL EVALUATION REPORT
EAST HIGHLAND RANCH, APPROXIMATELY 12.5-ACRE OF VACANT LAND NORTH OF GREENSPOT ROAD AND BISECTED BY ALTA VISTA
CITY OF HIGHLAND, SAN BERNARDINO COUNTY, CALIFORNIA

DIVERSIFIED PACIFIC COMMUNITIES

AUGUST 12, 2024
J.N. 24-156

August 12, 2024
J.N. 24-156

DIVERSIFIED PACIFIC COMMUNITIES
10621 Civic Center Drive
Rancho Cucamonga, California 91730

Attention: Mr. Jake Sowder

Subject: Preliminary Geotechnical Evaluation Report, *East Highland Ranch*, Approximately 12.5-Acre of Vacant Land North of Greenspot Road and Bisected by Alta Vista, City of Highland, San Bernardino County, California

Dear Mr. Sowder:

In accordance with your request and authorization, **Petra Geosciences, Inc. (Petra)** is submitting this preliminary geotechnical evaluation report for the proposed multi-family residential development in the city of Highland, California.

The purpose of our evaluation was to obtain available geotechnical and geologic information on the nature of current site conditions, to evaluate the potential geologic constraints that may affect development of the property, and to provide recommendations pertaining to site remedial grading and construction of anticipated site improvements. This report presents the results of our preliminary field exploration, limited laboratory testing, engineering judgement, opinions, conclusions, and recommendations pertaining to geotechnical design aspects for the presumed site development.

Should you have questions regarding the contents of this report, or should you require additional information, please contact the undersigned.

Respectfully submitted,

PETRA GEOSCIENCES, INC.

Paul D. Theriault, CEG
Associate Geologist

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CITY OF HIGHLAND, SAN BERNARDINO COUNTY, CALIFORNIA

INTRODUCTION

Petra Geosciences, Inc. (Petra) is presenting herein the results of our preliminary geotechnical evaluation for the proposed development of a multi-family residential tract on 12.5-acres located north of Greenspot Road and bisected by Alta Vista, in the city of Highland, California. The purpose of this study was to obtain preliminary information on the general geologic and geotechnical conditions within the project area in order to provide conclusions and recommendations for the feasibility of the proposed project and preliminary geotechnical recommendations for site grading and improvements. Our geotechnical evaluation included a review of geological maps and data for the site and surrounding area, excavation of exploratory test pits, percolation testing, laboratory testing, and geologic and engineering analysis.

SCOPE OF WORK

The scope of our evaluation consisted of the following.

- Review of available published and unpublished data and geotechnical reports concerning geologic and soil conditions within the site and nearby area that could impact on the proposed development.
- Review readily available aerial photographs of the site and surrounding area.
- Excavation, logging, and select sampling of 12 exploratory test pits.
- Perform four percolation tests to aid in evaluating infiltration rates.
- Perform laboratory tests including maximum density at optimum moisture, grain size analyses, expansion index, corrosivity, and remolded shear.
- Preparation of this geotechnical report presenting the results of our analysis and providing recommendations for the proposed site development in general conformance with the requirements of the 2022 California Building Code (2022 CBC) and applicable state and local jurisdictional requirements.

LOCATION AND SITE DESCRIPTION

The irregularly shaped site is situated immediately north of Greenspot Road and bisected by Alta Vista in the city of Highland. The approximately 12.5-acre parcel is currently vacant and bounded by Santa Ana Canyon Road on the north, vacant parcels on the east and west, and Greenspot Road on the south. A Metropolitan Water District (MWD) easement traverses the site from northwest to southeast. Existing improvements within Greenspot Road and Alta Vista were observed to include sewer, water, storm drain, and electrical (street lights). Overhead power lines are present along Santa Ana Canyon Road. A structure associated with the MWD easement was observed at the eastern boundary just north of the easement. Oak Creek, an ephemeral tributary of the Santa Ana River flows southwest just to the east of the site.

A chain-link fence and some debris were observed on the western portion of the property. Sparse shrubs and bushes were observed west of Alta Vista while sparse grasses were observed on the east. The property descends at a low gradient generally towards the west-northwest, with elevations ranging from approximately 1,467 feet above mean sea level (MSL) in the southeast corner to 1,445 feet above MSL in the northwest corner. The surficial soils across the site are generally loose and dry with some cobbles and boulders exposed on the ground surface.

PROPOSED DEVELOPMENT AND GRADING

Conceptual Design, prepared by KTGY Architecture + Planning (2024) indicates the planned development will consist of two- and three-story residential units with attached garages, appurtenant interior alleyways, and drive aisles. Anticipated ancillary site improvements include underground utilities, perimeter walls, storm water basins, a recreation site, and landscaping. Entry to the development will be from Alta Vista. The proposed grading is expected to entail shallow cuts and fills on the order of 2 to 5 feet from existing grades. Appreciable cut or fill slopes are not anticipated.

EVALUATION METHODOLOGY

Literature and Aerial Photo Review

We have reviewed the geotechnical investigation report by RMA GeoScience (RMA, 2015) for the subject site, available online aerial imagery, historic aerial photographs, published geologic maps, and geotechnical literature related to the property and surrounding area (References).

Pertinent findings from our review of RMA's 2015 report are provided below. Clarification to recommendations provided by RMA are presented in parentheses and italics as needed.

RMA Geotechnical Investigation (2015)

- Based on a review of aerial photographs, the site appears to have been vacant dating back to 1938.
- Based on field exploration and analysis, mapping lab testing and geotechnical evaluations, the subject site is geotechnically feasible for the proposed development. The scope of fieldwork included geologic mapping, subsurface exploration with 7 test pits via a backhoe to a maximum depth of 8 feet.

- The site consists of a veneer of topsoil underlain by alluvial fan deposits. Topsoil was approximately 0.5 to 2 feet in depth and consisted of sand with some gravel, cobble, and boulders up to 14 inches in diameter. Alluvial fan deposits generally consisted of sand and gravelly sand with cobbles and some boulders up to 6 feet in diameter. *(Petra: Our field exploration encountered approximately 15-25% more cobbles and boulders.)*

- A review of California Department of Water resource Water Data Library indicates that historic high groundwater is approximately 131 feet below ground surface, as measured in 2011.

- Faults, active or potentially active, are not known to project through the site and the site does not lie within an AP hazard zone. The possibility of damage due to ground rupture is considered low. However, the closest active fault is the San Bernardino strand of the San Andreas fault, located approximately 0.5 miles northeast of the site.

- The potential of damage due to liquefaction is considered nil due to the depth to groundwater.

- Laboratory testing of upper soils indicate a very low expansion potential.

- The existing onsite soils appear to be suitable material for use as fill, provided they are relatively free of rocks larger than 12 inches in maximum dimension, debris and/or organic material. Oversize material greater than 12 inches should be reduced in size or nested a minimum of 10 feet below final grades. (*Petra: Oversize rock should be placed in accordance with our Earthwork Recommendations provided herein.)*

- Following the recommend overexcavation of compressible soils to competent alluvial soils, exposed bottom surface should be scarified to approximately 6 inches, watered to achieve a moisture content of optimum or higher and then compacted in-place to relative compaction of 90 percent or more prior to fill placement.

Field Exploration and Laboratory Testing

Field Exploration

Petra performed a subsurface exploration on March 26, 2024, and included the excavation of 12 exploratory test pits (TP-1 through TP-12) to a maximum depth of 10 feet below the existing ground surface (bgs). Based on the results of our exploratory trenches, the site consists of alluvial fan deposits to the depths explored. A minor amount of artificial fill, likely associated with the construction of Santa Ana Canyon Road and Alta Vista. The alluvial fan deposits consist of sands, gravelly sands, with varying amounts of cobbles and of boulders. As observed during our exploration, the cobble and boulder content (3+ inches in diameter) is estimated to vary between 20 and 60 percent. Test pit logs (Petra, this report; RMA, 2015) are presented in Appendix A. In-situ moisture and density results presented on the boring logs were taken with a nuclear moisture density gauge.

Percolation Testing

Petra performed four percolation tests to evaluate the infiltration rates of the site soils at two proposed basin locations as shown on Figure 2. Methodology and test results are provided in Appendix C

Laboratory Testing

Limited laboratory testing was conducted on various representative undisturbed and bulk soil samples collected from the test pits for engineering properties. Based on the laboratory testing conducted, site soils have a negligible corrosion potential to concrete materials, low exposure to chlorides, and are not considered corrosive with respect to buried metallic elements. Site soils are very sandy and have a very low expansion potential. A summary of the lab results (Petra, this report; RMA, 2015) is included in Appendix B. In-situ dry density and moisture content performed during our site exploration are presented in Appendix A.

FINDINGS

Regional Geologic Setting

The subject property is situated within the northmost portion of the Peninsular Ranges Geomorphic Province (PRGP), near the boundary with the Transverse Ranges Geomorphic Province on the proximal portion of a large alluvial fan that extends southwest from the flanks of the adjacent San Bernardino Mountains to the northeast. The PRGP is composed of series of ranges, separated by northwest trending valleys, subparallel to faults and extends south to Baja California, east to the Colorado Desert, and west into the Pacific Ocean.

Locally, the subject site is located on alluvial fan and active wash deposits emanating from tributaries of the Santa Ana River in the eastern Upper Santa Ana River Valley, causing erosion of the San Bernardino Mountains, located less than one mile to the northeast. The alluvial-fan deposits in the vicinity of the site are on the order of hundreds of feet thick, and composed of silty sands, sands, gravel, cobble, and boulders.

Local Geology and Subsurface Soil Conditions

Earth units encountered within our field evaluation consisted of artificial fill, and alluvial fan deposits. The onsite soil units are discussed in detail below.

- Artificial Fill – Artificial fill was observed overlying alluvial fan deposits in test pits TP-1 and TP-2 to depths of 1.5 to 2.5 feet. These soils were generally composed of silty fine to coarse sand with gravels, cobbles, and boulders, which was light brown to brown, dry, and loose.

- Alluvial Fan Deposits – Alluvial fan deposits were observed beneath the artificial fill and at all test pit locations. The alluvial fan deposits generally consisted of sand to gravelly sand with lesser amounts of sandy gravels with abundant subrounded cobbles and boulders, generally on the order of 20 to 40 percent and occasionally up to 60 percent. These fan deposits were locally weathered and generally loose to medium dense. This unit was non-cohesive and slight caving was observed within all the test pits.

Groundwater

Neither groundwater nor seepage was encountered in the test pits during our subsurface exploration. Based on our review of published geotechnical literature, the depth to groundwater is in excess of 100 feet bgs. Groundwater is not anticipated to affect the proposed development.

Faulting

The geologic structure of the southern California area is dominated mainly by northwest-trending faults associated with the San Andreas system. Active faults in the system include Newport-Inglewood, Whittier, Elsinore, San Jacinto, and San Andreas faults. The San Andreas, Elsinore, and San Jacinto faults have ruptured the ground surface in historic times.

Based on our review of published and unpublished geotechnical maps and literature pertaining to site and regional geology, the closest active fault to the site is the San Bernadino section of the San Andreas fault, approximately 0.62 miles to the northeast. Based on our review of the referenced geologic literature no active faults appear to project through or toward the site, nor does the site lie within an Alquist-Priolo Earthquake Fault Hazard Zone. Additionally, based on historic aerial photos, no lineaments appear to cross or trend towards the property. The potential for active fault rupture at the site is considered to be very low.

Secondary Seismic Effects

Secondary effects of seismic activity normally considered as possible hazards to a site include several types of ground failure. Various general types of ground failures, which might occur due to severe ground shaking at the site include ground subsidence, ground lurching, and lateral spreading. The probability of occurrence of each type of ground failure depends on the severity of the earthquake, distance from faults, topography, subsoil and groundwater conditions, among other factors. The potential for ground lurching and lateral spreading are considered very low.

The potential for seismically induced flooding due to tsunami, seiche (i.e., a wave-like oscillation of the surface of water in an enclosed basin), is considered negligible due to the sites distance from the ocean and closed bodies of water, respectively. Extrapolation of the County of San Bernardino Flood Control District, Seven Oaks Dam, Dam Inundation Based on Dam Breach Map 2 of 7 (References), failure of the Seven Oaks Dam, located approximately 3 miles to the east, would result in inundation in roughly 15 minutes from the breach, with water encompassing the entire site, ranging from approximately 5 feet in the north to 20 feet in the south. These numbers are based on the dam failing while at capacity. To date, the dam has only ever been filled to one-third of its capacity. The dam was built to withstand a magnitude 8.0 earthquake (Orange County Department of Public Works, 2012). Based on the dam's design and limited actual storage (Riverside County Flood Control and Water Conservation District, 2012), the probability of the site becoming inundated is considered very low.

Liquefaction and Seismically-Induced Settlement

Liquefaction is the transformation of a cohesionless soil from a solid to a liquid state caused by an increase in pore pressure and a reduction of effective stress. Liquefaction can occur when loose saturated cohesionless (sandy) soils are subjected to strong ground motion during an earthquake. Typically, liquefaction occurs in areas where groundwater lies within the upper 50 feet of the ground surface. The site is within a San Bernardino County Liquefaction Zone, generally susceptible to medium liquefaction. However, due to the gravelly to cobbly nature of the underlying alluvial-fan materials, as well as the depth to groundwater (expected to be deeper than 100 feet bgs), the potential for liquefaction is considered to be very low. Thus, neither liquefaction nor dynamic settlement should be considered as major geotechnical concerns for site development.

Compressible Near-Surface Soils

A geotechnical factor affecting the project is the presence of low-density and dry, near-surface alluvial fan deposits. Such materials in their present state are not considered suitable for support of fill or structural loads. Accordingly, these materials will require removal to competent alluvial fan deposits as observed by the geotechnical consultant. The unsuitable material may be reused as engineered fill, provided it is placed in accordance with the recommendations provided herein.

CONCLUSIONS AND RECOMMENDATIONS

General

From a geotechnical engineering and engineering geologic point of view, the subject property is considered suitable for the proposed grading and development provided the following conclusions and recommendations are incorporated into the design criteria and project specifications and implemented during construction.

Earthwork Recommendations

General Earthwork Recommendations

Earthwork should be performed in accordance with the Grading Code of the city of Highland and with the applicable provisions of the 2022 California Building Code (2022 CBC), and the site-specific recommendations presented herein.

Geotechnical Observations and Testing

Prior to the start of earthwork, a meeting should be held at the site with the owner, contractor, and geotechnical consultant to discuss the work schedule and geotechnical aspects of the grading. Earthwork, which in this instance will generally entail removal and re-compaction of the near surface soils, should be accomplished under full-time observation and testing of the geotechnical consultant. A representative of the project geotechnical consultant should be present onsite during all earthwork operations to document placement and compaction of fills, as well as to document compliance with the other recommendations presented herein.

Clearing and Grubbing

Clearing operations will include the removal of all existing vegetation, shrubs, stumps any existing dumped trash or construction debris, oversize boulders, undocumented fill, and deleterious materials. All weeds, grasses, bushes, shrubs, tree stumps etc. existing within areas to be graded should be stripped and removed from the site. Any deleterious materials encountered within the site may need to be removed by hand (i.e. by root pickers) during the grading operations.

The project geotechnical consultant should provide periodic observation services during clearing and grubbing operations to document compliance with the above recommendations. In addition, should unusual or adverse soil conditions or buried structures be encountered during grading that are not described herein, these conditions should be brought to the immediate attention of the project geotechnical consultant for corrective recommendations.

Excavation Characteristics

The existing site soils can be readily excavated with conventional earthmoving equipment, however, oversize rocks, those exceeding 12 inches in maximum dimension, are very likely to be encountered during grading.

Ground Preparation

Unsuitable Soil Removals

All existing surficial soils (artificial fill and the upper portions of the alluvial fan deposits) are considered unsuitable in their current state for support of proposed fills, structures, flatwork, pavement, and other improvements. These materials should be removed to underlying competent alluvial fan deposits, as approved by the project geotechnical consultant. Remedial removals are estimated to be approximately 3 to 4 feet below existing grades to expose competent alluvial fan deposits, however, soil removals may also need to be locally deeper depending upon the exposed conditions encountered during grading. The actual depths and horizontal limits of removals and over-excavations should be evaluated during grading by the project geotechnical consultant.

Prior to placing engineered fill, all exposed removal bottom surfaces in the building pad areas should be moisture conditioned (watered or dried) as necessary, to achieve moisture conditions at to slightly above optimum and compacted in-place to a relative compaction of at least 90 percent per ASTM D1557. Horizontal limits of removals should extend across the entire level portion of the lot.

Overexcavation of Cut and Cut-Fill Transition Lots

After removal of unsuitable materials, lots located entirely in cut or cut/fill transitions should be eliminated from building pad areas to reduce the detrimental effects of differential settlement. Cut and cut/fill transition lots should be overexcavated to a minimum of 3 feet below proposed finished pad grade elevations and replaced as properly compacted fill. Prior to placing engineered fill, all exposed overexcavation bottom surfaces in the building pad areas should be moisture conditioned as above, as necessary, to achieve moisture conditions at to slightly above optimum and compacted in-place to a relative compaction of at least 90 percent per ASTM D1557. Horizontal limits of over-excavation should extend across the entire level portion of the lot.

Suitability of Site Soils as Fill

Site soils are suitable for use in engineered fills provided they are clean from any organics, debris, and oversize rocks (greater than 12 inches in diameter). Oversize rocks are likely to be encountered during remedial grading and may be incorporated within specified depths of the engineered fills as discussed in the following section.

Oversize Rock

Removals and over-excavation during grading are expected to produce oversize rock, defined as rock or irreducible rock fragments greater than 12 inches in maximum diameter. Rock less than 12 inches in diameter may be placed as general fill so long as they are placed in a manner to avoid nesting. Oversize rock up greater than 12 inches in diameter may be placed deeper than 5 feet below finished pad grades in a manner to avoid nesting and then completely covered/mixed with granular soil materials. As with the placement of all oversized rock in engineered fills, the granular materials should be watered in a manner to assure the infilling of all voids.

Due to the anticipated relatively shallow fills onsite, i.e., generally expected to be less than 5 feet in depth, exporting of oversize rock greater than 12 inches should be anticipated. The grading contactor should provide either a screening operation to remove oversize rocks from the fill soils or utilize mechanical removal of oversize rocks from the fill areas by heavy equipment equipped with rock rakes or similar equipment.

Fill Placement

Fill materials for building pad areas should be placed in approximately 6- to 8-inch-thick loose lifts, watered or air-dried as necessary to achieve a moisture content at or slightly above optimum moisture, then compacted in-place to a minimum relative compaction of 90 percent. The laboratory maximum dry density and optimum moisture content for each change in soil type should be determined in accordance with ASTM D 1557.

Import Soils for Grading

If imported soils are needed to achieve final design grades, the soils should be free of deleterious materials, oversize rock, and any hazardous materials. Additionally, soils should be non-expansive (i.e., have “very low” expansion potential), non-corrosive, and be approved by the project geotechnical consultant *prior* to being brought onsite.

Soil Shrinkage

Volumetric changes in earth quantities will occur when excavated onsite soils are replaced as engineered fill. Based on similar soil conditions in the nearby area, we estimated the soil shrinkage factor to be on the order of 10 to 15 percent for soil removed and replaced as compacted fill and a subsidence factor of 0.1 foot during recompaction of removal bottoms and overexcavation surfaces. *Also note that volume associated with the removal of oversize rocks greater than 12 inches from the site during planned removals,* *over-excavations, or deep utility trenching should also be accounted for in determining final earthwork quantities*.

The estimate of shrinkage is intended as an aid for project engineers in determining earthwork quantities, however, this estimate should not be considered as absolute values and should be used with some caution. Contingencies should be made for balancing earthwork quantities based on actual shrinkage that occurs during the grading operations.

Temporary Excavations

Temporary excavations up to a depth of 4 feet below existing grades may be required to accommodate the recommended overexcavation. Based on the physical properties of the onsite soils, temporary excavations exceeding 4 feet in height should be cut back to an inclination of 1:1 (h:v) or flatter for the duration of the overexcavation of unsuitable soil material and replacement as compacted fill, as well as placement of underground utilities. It is the responsibility of the contractor and their competent person to ensure that all excavations are constructed in accordance with applicable OSHA guidelines. Other factors to be considered with respect to the stability of the temporary slopes include construction traffic and storage of materials near the tops of slopes, construction scheduling, presence of nearby walls, structures on adjacent properties, and weather conditions at the time of construction.

Geotechnical Observations

Observation of clearing operations, overexcavation of unsuitable surficial materials, fill placement, slope construction, and general grading procedures should be performed by the project geotechnical consultant. Fills should not be placed without prior observation and approval of the removal bottom surfaces by the geotechnical consultant. The project geotechnical consultant or his representative should be present onsite during grading operations to observe and document proper placement and compaction of fill, as well as to observe and document compliance with the other recommendations presented herein.

PRELIMINARY FOUNDATION DESIGN GUIDELINES

Seismic Design Parameters

Earthquake loads on earthen structures and buildings are a function of ground acceleration which may be determined from the site-specific ground motion analysis. Alternatively, a design response spectrum can be developed for certain sites based on the code guidelines. We used two computer applications to provide the design team with the parameters necessary to construct the design acceleration response spectrum for this project. The first was developed by Structural Engineering Association of California (SEA) and California's Office of Statewide Health Planning and Development (OSHPD). The SEA/OSHPD Seismic Design Maps Tool website, https://seismicmaps.org, is used to calculate ground motion parameters. The second, the United Stated Geological Survey (USGS) Unified Hazard Tool website, https://earthquake.usgs.gov/hazards/interactive/, is used to estimate the earthquake magnitude and the distance to surface projection of the fault.

To run the applications discussed above, the following parameters are required: site latitude and longitude; seismic risk category; and site class. The site class designation depends on the direct measurement and the ASCE 7-16 recommended procedure for calculating average small-strain shear wave velocity, Vs30, within the upper 30 meters (approximately 100 feet) of site soils.

A seismic risk category of II was assigned to the proposed building in accordance with 2022 CBC, Table 1604.5. Shear wave velocity measurement were not performed as part of this exploration. However, the subsurface materials at the site exhibit the characteristics of a stiff soil, in accordance with ASCE 7-16, Table 20.3-1 for a Site Class D-Default designation. As such, the following table, Table 1, provides parameters required to construct the seismic response coefficient, C_s, curve based on ASCE 7-16, Article 12.8 guidelines.

TABLE 1

Seismic Design Parameters

Ground Motion Parameters	Specific Reference	Parameter Value	Unit
Site Latitude (North)	-	34.110981	°
Site Longitude (West)	-	-117.150963	°
Site Class Definition	Section 1613.2.2 (1), Chapter 20 (2)	D-Default (4)	-
Assumed Seismic Risk Category	Table 1604.5 (1)	II	-
M_w - Earthquake Magnitude	USGS Unified Hazard Tool (3)	7.9 (3)	-
R – Distance to Surface Projection of Fault	USGS Unified Hazard Tool (3)	1.9(3)	km
S_s - Mapped Spectral Response Acceleration Short Period (0.2 second)	Figure 1613.2.1(1) (1)	2.53 (4)	g
S_1 - Mapped Spectral Response Acceleration Long Period (1.0 second)	Figure 1613.2.1(2) (1)	1.016 (4)	g
F_a – Short Period (0.2 second) Site Coefficient	Table 1613.2.3(1) (1)	1.2 (4)	-
F_v – Long Period (1.0 second) Site Coefficient	Table 1613.2.3(2) (1)	Null (4)	-
S_{MS} – MCE_R Spectral Response Acceleration Parameter Adjusted for Site Class Effect (0.2 second)	Equation 16-36 (1)	3.036 (4)	g
S_{M1} - MCE_R Spectral Response Acceleration Parameter Adjusted for Site Class Effect (1.0 second)	Equation 16-37 (1)	Null (4)	g
S_{DS} - Design Spectral Response Acceleration at 0.2-s	Equation 16-38 (1)	2.024 (4)	g
S_{D1} - Design Spectral Response Acceleration at 1-s	Equation 16-39 (1)	Null (4)	g
$T_o = 0.2\ S_{D1}/\ S_{DS}$	Section 11.4.6 (2)	Null	s
$T_s = S_{D1}/\ S_{DS}$	Section 11.4.6 (2)	Null	s
T_L - Long Period Transition Period	Figure 22-14 (2)	8 (4)	s
PGA - Peak Ground Acceleration at MCE_G (*)	Figure 22-9 (2)	1.045	g
F_{PGA} - Site Coefficient Adjusted for Site Class Effect (2)	Table 11.8-1 (2)	1.2 (4)	-
PGA_M –Peak Ground Acceleration (2) Adjusted for Site Class Effect	Equation 11.8-1 (2)	1.254 (4)	g
Design PGA ≈ (⅔ PGA_M) - Slope Stability (†)	Similar to Eqs. 16-38 & 16-39 (2)	0.836	g
Design PGA ≈ (0.4 S_{DS}**)** – Short Retaining Walls (‡)	Equation 11.4-5 (2)	0.81	g
C_{RS} - Short Period Risk Coefficient	Figure 22-18A (2)	0.906 (4)	-
C_{R1} - Long Period Risk Coefficient	Figure 22-19A (2)	0.886 (4)	-
SDC - Seismic Design Category (§)	Section 1613.2.5 (1)	Null (4)	-

References:
(1) California Building Code (CBC), 2022, California Code of Regulations, Title 24, Part 2, Volume I and II.
(2) American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI), 2016, Minimum Design Loads and Associated Criteria for Buildings and Other Structures, Standards 7-16.
(3) USGS Unified Hazard Tool - https://earthquake.usgs.gov/hazards/interactive/
(4) SEI/OSHPD Seismic Design Map Application – https://seismicmaps.org
Related References:
Federal Emergency Management Agency (FEMA), 2015, NEHERP (National Earthquake Hazards Reduction Program) Recommended Seismic Provision for New Building and Other Structures (FEMA P-1050).

Notes:
* PGA Calculated at the MCE return period of 2475 years (2 percent chance of exceedance in 50 years).
† PGA Calculated at the Design Level of ⅔ of MCE; approximately equivalent to a return period of 475 years (10 percent chance of exceedance in 50 years).
‡ PGA Calculated for short, stubby retaining walls with an infinitesimal (zero) fundamental period.
§ The designation provided herein may be superseded by the structural engineer in accordance with Section 1613.2.5.1, if applicable.

Discussion

General

Owing to the characteristics of the subsurface soils, as defined by Site Class D-Default designation, and proximity of the site to the sources of major ground shaking, the site is expected to experience strong ground shaking during its anticipated life span. Under these circumstances, where the code-specified design response spectrum may not adequately characterize site response, the 2022 CBC typically requires a site-specific seismic response analysis to be performed. This requirement is signified/identified by the "null" values that are output using SEAOC/OSHPD software in determination of short period, but mostly, in determination of long period seismic parameters, see Table 1.

For conditions where a "null" value is reported for the site, a variety of analytical design approaches are permitted by 2022 CBC and ASCE 7-16 (see Table 12.6-1)in lieu of a site-specific seismic hazard analysis. For any specific site, these alternative design approaches, which include Equivalent Lateral Force (ELF) procedure, Modal Response Spectrum Analysis (MRSA) procedure, Linear Response History Analysis (LRHA) procedure and Simplified Design procedure, among other methods, are expected to provide results that may or may not be more economical than those that are obtained if a site-specific seismic hazards analysis is performed. These design approaches and their limitations should be evaluated by the project structural engineer.

Seismic Design Category

Please note that the Seismic Design Category, SDC, is also designated as "null" in Table 1. For Risk Category I, II or III structures, where the mapped spectral response acceleration parameter at 1 – second period, S_1, is greater than or equal to 0.75, the 2022 CBC, Section 1613.2.5 requires that these structures be assigned to Seismic Design Category E.

Allowable Bearing Capacity, Estimated Settlement and Lateral Resistance

Allowable Soil Bearing Capacities

Pad Footings

An allowable soil bearing capacity of 1,500 pounds per square foot may be utilized for design of isolated 24-inch-square footings founded at a minimum depth of 12 inches below the lowest adjacent final grade for pad footings that are not a part of the slab system and are used for support of such features as roof overhang, second-story decks, patio covers, etc. This value may be increased by 20 percent for each additional foot of depth and by 10 percent for each additional foot of width, to a maximum value of 2,500 pounds per square foot. The recommended allowable bearing value includes both dead and live loads and may be increased by one-third for short duration wind and seismic forces.

Continuous Footings

An allowable soil bearing capacity of 1,500 pounds per square foot may be utilized for design of continuous footings founded at a minimum depth of 12 inches below the lowest adjacent final grade. This value may be increased by 20 percent for each additional foot of depth and by 10 percent for each additional foot of width, to a maximum value of 2,500 pounds per square foot. The recommended allowable bearing value includes both dead and live loads and may be increased by one-third for short duration wind and seismic forces.

Estimated Footing Settlement

Based on the allowable bearing values provided above, total static settlement of the footings under the anticipated loads is expected to be less than ¾ inch. Differential settlement is expected to be less than ½ inch over a horizontal span of 30 feet. Most of the settlement is likely to take place as footing loads are applied or shortly thereafter.

Lateral Resistance

A passive earth pressure of 250 pounds per square foot per foot of depth, to a maximum value of 2,500 pounds per square foot, may be used to determine lateral bearing resistance for footings. In addition, a coefficient of friction of 0.40 times the dead load forces may be used between concrete and the supporting soils to determine lateral sliding resistance. The above values may be increased by one-third when designing for transient wind or seismic forces. It should be noted that the above values are based on the condition where footings are cast in direct contact with compacted fill or competent native soils. In cases where the footing sides are formed, all backfill placed against the footings upon removal of forms should be compacted to at least 90 percent of the applicable maximum dry density.

Guidelines for Footings and Slabs on-Grade Design and Construction

Near-surface soils within the site will exhibit expansion indices (EI's) that are in the Very Low category (EI $\leq$ 20) following site grading. As indicated in Section 1803.5.3 of 2022 California Building Code (2022 CBC), these soils are considered non-expansive and, as such, the design of slabs on-grade is exempt from the procedures outlined in Sections 1808.6.2 of the 2022 CBC and may be performed using any method deemed rational and appropriate by the project structural engineer. However, the following minimum recommendations are presented herein for conditions where the project design team may require geotechnical engineering guidelines for design and construction of footings and slabs on-grade the project site.

The design and construction guidelines that follow are based on the above soil conditions and may be considered for reducing the effects of variability in fabric, composition and, therefore, the detrimental behavior of the site soils such as excessive short- and long-term total and differential heave or settlement. These guidelines have been developed based on the previous experience of this firm on projects with similar soil conditions. Although construction performed in accordance with these guidelines has been found to reduce post-construction movement and distress, they do not eliminate all potential effects of variability in soils characteristics and future heave or settlement.

It should also be noted that the suggestions for dimension and reinforcement provided herein are performance-based and intended only as preliminary guidelines to achieve adequate performance under the anticipated soil conditions. However, they should not be construed as replacement for structural engineering analyses, experience, and judgment. The project structural engineer, architect or civil engineer should make appropriate adjustments to slab and footing dimensions, and reinforcement type, size and spacing to account for internal (e.g., thermal, shrinkage and expansion) and external (e.g., applied loads) concrete forces as deemed necessary. Consideration should also be given to minimum design criteria as dictated by local building code requirements.

Conventional Slab-on-Grade System

Given the expansion index is expected to be less than 20, we recommend that footings and floor slabs be designed and constructed in accordance with the following minimum criteria.

Footings

1. Exterior continuous footings supporting one- and two-story structures should be founded at a minimum depth of 12 inches below the lowest adjacent final grade, respectively. Interior continuous footings may be founded at a minimum depth of 10 inches below the top of the adjacent finish floor slabs.

2. In accordance with Table 1809.7 of 2022 CBC for light-frame construction, all continuous footings should have minimum widths of 12 inches for one- and two-story construction. We recommend all continuous footings should be reinforced with a minimum of two No. 4 bars, one top and one bottom.

3. A minimum 12-inch-wide grade beam founded at the same depth as adjacent footings should be provided across garage entrances or similar openings (such as large doors or bay windows). The grade beam should be reinforced with a similar manner as provided above.

4. Interior isolated pad footings, if required, should be a minimum of 24 inches square and founded at a minimum depth of 12 inches below the bottoms of the adjacent floor slabs for one- and two-story

buildings. Pad footings should be reinforced with No. 4 bars spaced a maximum of 18 inches on centers, both ways, placed near the bottoms of the footings.

5. Exterior isolated pad footings intended for support of roof overhangs such as second-story decks, patio covers, and similar construction should be a minimum of 24 inches square and founded at a minimum depth of 18 inches below the lowest adjacent final grade. The pad footings should be reinforced with No. 4 bars spaced a maximum of 18 inches on centers, both ways, placed near the bottoms of the footings. Exterior isolated pad footings may need to be connected to adjacent pad and/or continuous footings via tie beams at the discretion of the project structural engineer.

6. The minimum footing dimensions and reinforcement recommended herein may be modified (increased or decreased subject to the constraints of Chapter 18 of the 2022 CBC) by the structural engineer responsible for foundation design based on his/her calculations, engineering experience and judgment.

<u>Building Floor Slabs</u>

1. Concrete floor slabs should be a minimum of 4 inches thick and reinforced with No. 3 bars spaced a maximum of 24 inches on centers, both ways. Alternatively, the structural engineer may recommend the use of prefabricated welded wire mesh for slab reinforcement. For this condition, the welded wire mesh should be of sheet type (not rolled) and should consist of 6x6/W2.9xW2.9 WWF (per the Wire Reinforcement Institute, WRI, designation) or stronger. All slab reinforcement should be properly supported to ensure the desired placement near mid-depth. Care should be exercised to prevent warping of the welded wire mesh between the chairs in order to ensure its placement at the desired mid-slab position.

   Slab dimension, reinforcement type, size and spacing need to account for internal concrete forces (e.g., thermal, shrinkage, and expansion) as well as external forces (e.g., applied loads), as deemed necessary.

2. Living area concrete floor slabs and areas to receive moisture sensitive floor covering should be underlain with a moisture vapor retarder consisting of a minimum 10-mil-thick polyethylene or polyolefin membrane that meets the minimum requirements of ASTM E96 and ASTM E1745 for vapor retarders (such as Husky Yellow Guard®, Stego® Wrap, or equivalent). All laps within the membrane should be sealed, and at least 2 inches of clean sand should be placed over the membrane to promote uniform curing of the concrete. To reduce the potential for punctures, the membrane should be placed on a pad surface that has been graded smooth without any sharp protrusions. If a smooth surface cannot be achieved by grading, consideration should be given to lowering the pad finished grade an additional inch and then placing a 1-inch-thick leveling course of sand across the pad surface prior to the placement of the membrane.

   At the present time, some slab designers, geotechnical professionals, and concrete experts view the sand layer below the slab (blotting sand) as a place for entrapment of excess moisture that could adversely impact moisture-sensitive floor coverings. As a preventive measure, the potential for moisture intrusion into the concrete slab could be reduced if the concrete is placed directly on the vapor retarder. However, if this sand layer is omitted, appropriate curing methods must be implemented to ensure that the concrete slab cures uniformly. A qualified materials engineer with experience in slab design and construction should provide recommendations for alternative methods of curing and supervise the construction process to ensure uniform slab curing. Additional steps would also need to be taken to prevent puncturing of the vapor retarder during concrete placement.

3. Garage floor slabs should be a minimum 4 inches thick and reinforced in a similar manner as living area floor slabs. Garage slabs should also be poured separately from adjacent wall footings with a positive separation maintained using ¾-inch-minimum felt expansion joint material. To control the propagation of shrinkage cracks, garage floor slabs should be quartered with weakened plane joints. Consideration should be given to placement of a moisture vapor retarder below the garage slab, like that provided in Item 2 above, should the garage slab be overlain with moisture sensitive floor covering.

4. Pre-saturation of the subgrade below floor slabs will not be required; however, prior to placing concrete, the subgrade below all dwelling and garage floor slab areas should be thoroughly moistened to achieve a moisture content that is at least equal to or slightly greater than optimum moisture content. This moisture content should penetrate to a minimum depth of 12 inches below the bottoms of the slabs.

5. The minimum dimensions and reinforcement recommended herein for building floor slabs may be modified (increased or decreased subject to the constraints of Chapter 18 of the 2022 CBC) by the structural engineer responsible for foundation design based on his/her calculations, engineering experience and judgment.

Foundation Excavation Observations

Foundation excavations should be observed by a representative of this firm to document that they have been excavated into competent engineered fill soils prior to the placement of forms, reinforcement, or concrete. Following grading, the presence of rock, up to 12 inches diameter, in the compacted fill may result in larger footings than designed and may require the use of forms when pouring concrete. The excavations should be trimmed neat, level, and square. All loose, sloughed or moisture-softened soils and any construction debris should be removed prior to placing of concrete. Excavated soils derived from footing or utility trenches should not be placed in building slab-on-grade areas or exterior concrete flatwork areas unless the soils are compacted to at least 90 percent of maximum dry density.

Foundation Concrete Over-Pour

As noted in the previous section, the on-site soils contain a large percentage of cobbles which will result in widened and potentially deepened footing excavations due to the excavation of rocks in the fill. Even with forming, concrete quantities in excess of calculated footing volumes should be expected.

General Corrosivity Screening

As a screening level study, limited chemical and electrical tests were performed on select samples considered representative of the onsite soils to identify potential corrosive characteristics of these soils. The common indicators associated with soil corrosivity include water-soluble sulfate and chloride levels, pH (a measure of acidity), and minimum electrical resistivity. Test results are presented in Table 2 below and summarized on Plate B-1 in Appendix B.

It should be noted that Petra does not practice corrosion engineering; therefore, the test results, opinion and engineering judgment provided herein should be considered general guidelines. Additional analyses would be warranted, especially, for cases where buried metallic building materials (such as copper and cast or ductile iron pipes) in contact with site soils are planned for the project.

In many cases, the project geotechnical engineer may not be informed of these choices. Therefore, for conditions where such elements are considered, we recommend that other, relevant project design professionals (e.g., the architect, landscape architect, civil, or structural engineer) also consider recommending a qualified corrosion engineer to conduct additional sampling and testing of near-surface soils during the final stages of site grading to provide a complete assessment of soil corrosivity. Recommendations to mitigate the detrimental effects of corrosive soils on buried metallic and other building materials that may be exposed to corrosive soils should be provided by the corrosion engineer as deemed appropriate.

In general, a soil's water-soluble sulfate levels and pH relate to the potential for concrete degradation; water-soluble chlorides in soils impact ferrous metals embedded or encased in concrete, e.g., reinforcing steel; and electrical resistivity is a measure of a soil's corrosion potential to a variety of buried metals used in the building industry, such as copper tubing and cast or ductile iron pipes. Table 2, below, presents test results with an interpretation of current code indicators and guidelines that are commonly used in this industry. The table includes the classifications of the soils as they relate to the various tests, as well as a general recommendation for possible mitigation measures in view of the potential adverse impact on various components of the proposed structures in direct contact with site soils. The guidelines provided herein should be evaluated and confirmed, or modified, in their entirety by the project structural engineer, corrosion engineer, or the contractor responsible for concrete placement for structural concrete used in exterior and interior footings, interior slabs on-ground, garage slabs, wall foundations and concrete exposed to weather such as driveways, patios, porches, walkways, ramps, steps, curbs, etc.

TABLE 2

Soil Corrosivity Screening Results

Test	Test Results	Classification	General Recommendations
Soluble Sulfates (Cal 417)	0.0030 percent	S0[1]	Type II cement; min. fc' = 2,500 psi; no water/cement ratio restrictions
pH (Cal 643)	6.4	Neutral	No special requirements
Soluble Chloride (Cal 422)	315 ppm	C1[2] C2[3]	Residence: No special recommendations Pools/Decking: water/cement ratio 0.40, fc' = 5,000 psi
Resistivity (Cal 643)	3,200 ohm-cm	Mildly Corrosive[4]	No special requirements, however, may need to consult a corrosion engineer for sensitive applications.

Notes:
1. ACI 318-14, Section 19.3
2. ACI 318-14, Section 19.3
3. Exposure classification C2 applies specifically to swimming pools and appurtenant concrete elements
4. Pierre R. Roberge, "Handbook of Corrosion Engineering"

Post-Grading Considerations

Precise Grading and Drainage

Surface and subsurface drainage systems consisting of sloping concrete flatwork, drainage swales and possibly subsurface area drains will be constructed on the subject lots to collect and direct all surface water to the adjacent streets. In addition, the ground surface around the proposed buildings should be sloped to provide a positive drainage gradient away from the structures. The purpose of the drainage systems is to prevent ponding of surface water within the level areas of the site and against building foundations and associated site improvements. The drainage systems should be properly maintained throughout the life of the proposed development.

Section 1804.3 of the 2022 CBC requires that "The ground immediately adjacent to the foundation shall be sloped away from the building at a slope of not less than one unit vertical in 20 units horizontal (5-percent slope) for a minimum distance of 10 feet (3048 mm) measured perpendicular to the face of the wall". Further, "Swales used for this purpose shall be sloped a minimum of 2 percent where located within 10 feet (3048 mm) of the building foundation".

These provisions fall under the purview of the Design Civil Engineer. However, exceptions to allow modifications to these criteria are provided within the same section of the Code as "Where climatic or soil conditions warrant, the slope of the ground away from the building foundations is permitted to be reduced to not less than one unit in 48 units horizontal (2-percent slope)". This exemption provision appears to fall under the purview of the Geotechnical Engineer-of-Record.

It is our understanding that the state-of-the-practice for projects in various cities and unincorporated areas of San Bernardino County, as well as throughout Southern California, has been to construct earthen slopes at 2 percent minimum gradient away from the foundations and at 1 percent minimum for earthen swale gradients. Structures constructed and properly maintained under those criteria have performed satisfactorily. Therefore, considering the semi-arid climate, site soil conditions and an appropriate irrigation regime, Petra considers that the implementation of 2 percent slopes away from the structures and 1 percent swales to be acceptable for the subject lots.

It should be emphasized that the homeowners are cautioned that the slopes away from the structures and swales be properly maintained, not be obstructed, and that future improvements do not alter established gradients unless replaced with suitable alternative drainage systems. Further, where the flow line of the swale exists within five feet of the structure, adjacent footings shall be deepened appropriately to maintain minimum embedment requirements, measured from the flow line of the swale.

Utility Trench Backfill

Utility trench backfill should be compacted to a minimum relative compaction of 90 percent. Trench backfill materials should be screened of any rock greater than 6 inches in diameter. The backfill should be placed in 8- to 12-inch lifts, moisture-conditioned as necessary to achieve slightly above optimum moisture conditions and compacted in place to achieve a minimum relative compaction of 90 percent. A representative of this firm should observe and test the backfill to document the adequate compaction has been achieved.

For shallow trenches where pipe or utilities might be damaged by mechanical compaction equipment, imported sand having a Sand Equivalent (SE) value of 30 or greater may be used for backfill. Sand backfill materials should be watered to achieve above optimum moisture conditions, and then tamped with hand-operated pneumatic tampers to ensure proper consolidation of the backfill. No specific relative compaction will be required; however, observation, probing and, if deemed necessary, testing should be performed by a representative of this firm to verify that the backfill is adequately compacted and will not be subject to excessive settlement.

Where a utility trench is proposed in a direction that is parallel to a building footing, the bottom of the trench should not extend below a 1:1 (h:v) plane projected downward from the bottom edge of the adjacent footing. Where this condition occurs, the adjacent footing should be deepened or the trench backfilled and compacted prior to construction of the footing.

Masonry Block Screen Walls

Construction on Level Ground

Where masonry walls are proposed on level ground and 5 feet or more from the tops of descending slopes, the footings may be founded a minimum of 18 inches below the lowest adjacent final grade. Footing trenches should be observed by the project geotechnical representative to document that the footing trenches have been excavated into competent bearing soils and to the recommended embedment. These observations should be performed prior to placing forms or reinforcing steel. The footings should be reinforced with two No. 4 bars, one top and one bottom. The footings should be placed monolithically with continuous rebars to serve as effective "grade beams" along the full lengths of the walls.

Construction Joints

To reduce the potential for cracking related to the effects of differential settlement, positive separations (construction joints) should be provided in the walls at horizontal intervals of approximately 20 to 25 feet and at each corner. The separations should be provided in the blocks only and not extend through the footings.

Retaining Walls

Footing Embedment

The base of retaining wall footings constructed on level ground may be founded a minimum of 12 inches below the lowest adjacent final grade. Footing trenches should be observed by the project geotechnical representative to document that the footing trenches have been excavated into competent bearing soils and to the recommended embedment. These observations should be performed prior to placing forms or reinforcing steel. The footings should be reinforced with two No. 4 bars, one top and one bottom. The footings should be placed monolithically with continuous rebars to serve as effective "grade beams" along the full lengths of the walls.

Allowable Soil Bearing Capacity

An allowable soil bearing capacity of 1,500 pounds per square foot, including dead and live loads, may be utilized for design of 12-inch-wide continuous footings founded in compacted fill at a minimum depth of 12 inches below the lowest adjacent final grade. This value may be increased by 20 percent for each additional foot of depth and by 10 percent for each additional foot of width to a maximum value of 2,500 pounds per square foot. Recommended allowable bearing values include both dead and live loads and may be increased by one-third for short duration wind and seismic forces.

Lateral Resistance

A passive earth pressure of 250 pounds per square foot per foot of depth, to a maximum value of 2,500 pounds per square foot, may be used to determine lateral bearing resistance for footings. In addition, a coefficient of friction of 0.40 times the dead load forces may be used between concrete and the supporting soils to determine lateral sliding resistance. When calculating passive resistance, the resistance of the upper 6 inches of the soil cover in front of the wall should be ignored in areas where the front of the wall will not be covered with concrete flatwork. The above values may be increased by one-third when designing for transient wind or seismic forces. It should be noted that the above values are based on the condition where footings are cast in direct contact with compacted fill or competent native soils. In cases where the footing sides are formed, all backfill placed against the footings upon removal of forms should be compacted to at least 90 percent of the applicable maximum dry density.

Active Earth Pressures

Existing site soils exhibit expansion potentials that are very low in expansion potential; therefore, the proposed retaining walls are expected to be backfilled with on-site soils. Retaining wall plans should specify the type of backfill to be used by the project structural engineer.

On-Site Soils Used for Backfill

On-site soils used for retaining wall backfill should use an active lateral earth pressure equivalent to a fluid having a density of 35 pounds per cubic foot (pcf) for design of cantilevered walls retaining a drained level backfill. Where the wall backfill slopes upward at 2:1 (h:v), the above value should be increased to 51 pcf.

All wall backfill soils should be screened of rock particles greater than 6-inches in diameter. The values provided herein are for retaining walls that have been supplied with a proper subdrain system (see Figure RW-1). Retaining walls should be designed to resist surcharge loads imposed by other nearby walls or structures in addition to the above active earth pressures.

Geotechnical Observation and Testing

All earthwork associated with retaining wall construction, including backcut excavations, observation of the footing trenches, installation of the backdrain systems, and placement of backfill should be provided by a representative of the project geotechnical consultant.

Backdrains

To reduce the likelihood of the entrapment of water in the backfill soils, weepholes or open vertical masonry joints may be considered for retaining walls not exceeding a height of 3 feet. Weepholes, if used, should be 3-inches minimum diameter and provided at maximum intervals of 6 feet along the wall. Open vertical masonry joints, if used, should be provided at 32-inch intervals. A continuous gravel fill, 3 inches by 12 inches, should be placed behind the weepholes or open masonry joints. The gravel should be wrapped in filter fabric to prevent infiltration of fines and subsequent clogging of the gravel. Filter fabric should consist of Mirafi 140N or equivalent.

A perforated pipe-and-gravel subdrain should be constructed behind retaining walls exceeding a height of 3 feet (see Figure RW-1). Perforated pipe should consist of 4-inch-minimum diameter PVC Schedule 40, or ABS SDR-35, with the perforations laid down. The pipe should be encased in a 1-foot-wide column of ¾-inch to 1½-inch open-graded gravel. If on-site soils are used as backfill, the open-graded gravel should extend above the wall footings to a minimum height equal to one-third the wall height or to a minimum height of 1.5 feet above the footing, whichever is greater. The open-graded gravel should be completely wrapped in filter fabric consisting of Mirafi 140N or equivalent. Solid outlet pipes should be connected to the subdrains and routed to a suitable area for discharge of accumulated water.

Waterproofing

The backfilled sides of retaining walls should be coated with an approved waterproofing compound or covered with a similar material to inhibit migration of moisture through the walls.

Wall Backfill

Recommended active pressures for design of retaining walls are based on the physical and mechanical properties of the onsite soil materials. The backfill behind the proposed retaining walls should be screened of rock fragments greater than 6-inches in diameter, placed in approximately 6- to 8-inch-thick maximum lifts, watered as necessary to achieve slightly above optimum moisture conditions, and then mechanically compacted in place to a minimum relative compaction of 90 percent. Flooding or jetting of the backfill materials should be avoided. A representative of the project geotechnical consultant should observe the backfill procedures and test the wall backfill to verify adequate compaction.

Preliminary Pavement Section

Onsite soils are granular and testing within adjacent developments have resulted in R-values over 50. Based on an assumed traffic index of 5.5 and utilizing a preliminary design R-Value of 50, the recommended preliminary pavement sections for the in-tract streets is 3 inches of asphalt concrete over 3.5 inches of aggregate base on properly compacted subgrade soils. R-value testing and final pavement design recommendations should be conducted based on the as-graded conditions at the conclusion grading operations and wet utility trench backfill placement.

The upper 12 inches of subgrade soil immediately below the aggregate base should be compacted to a minimum relative compaction of 95 percent based on ASTM D1557 approximately two percent above optimum moisture content. Final subgrade compaction should be performed prior to placing base materials and after utility-trench backfills have been compacted and tested. Asphaltic concrete materials and construction should conform to Section 203 of the Greenbook or by City of Highland specifications.

Exterior Concrete Flatwork

General

Near-surface compacted fill soils within the site are expected to exhibit an expansion index of 0 to 20, i.e., non-expansive. We recommend that all exterior concrete flatwork such as sidewalks, patio slabs, large decorative slabs, concrete subslabs that will be covered with decorative pavers, vehicular driveways, and access roads within and adjacent to the site, be designed by the project architect or structural engineer with consideration given to mitigating the potential cracking and uplift that can develop in soils exhibiting expansion index values that fall in the very low category. The guidelines that follow should be considered as minimums and are subject to review and revision by the project architect, structural engineer, or landscape consultant as deemed appropriate.

Thickness and Joint Spacing

To reduce the potential of cracking, concrete walkways, patio-type slabs, large decorative slabs and concrete subslabs to be covered with decorative pavers should be at least 4 inches thick and provided with construction joints or expansion joints every 6 feet or less. Private driveways that will be designed for the use of passenger cars for access to private garages should also be at least 4 inches thick and provided with construction joints or expansion joints every 10 feet or less. Concrete pavement that will be designed based on an unlimited number of applications of an 18-kip single-axle load in public access areas, segments of road that will be paved with concrete (such as bus stops and cross-walks) or access roads and driveways, which serve multiple residential units or garages, which will be subject to heavy truck loadings should have a minimum thickness of 5 inches and be provided with control joints spaced at maximum 10-foot intervals. A modulus of subgrade reaction of 125 pounds per cubic foot may be used for design of the public and access roads.

Reinforcement

All concrete flatwork having their largest plan-view panel dimension exceeding 10 feet should be reinforced with a minimum of No. 3 bars spaced 24 inches on centers, both ways. Alternatively, the slab reinforcement may consist of welded wire mesh of the sheet type (not rolled) with 6x6/W1.4xW1.4 designation in accordance with the Wire Reinforcement Institute (WRI). The reinforcement should be properly positioned near the middle of the slabs.

> *The reinforcement recommendations provided herein are intended as guidelines to achieve adequate performance for anticipated soil conditions. The project architect, civil, or structural engineer should make appropriate adjustments in reinforcement type, size and spacing to account for concrete internal (e.g., shrinkage and thermal) and external (e.g., applied loads) forces as deemed necessary.*

Edge Beams

Where the outer edges of concrete flatwork are to be bordered by landscaping, it is recommended that consideration be given to the use of edge beams (thickened edges) to prevent excessive infiltration and accumulation of water under the slabs. Edge beams, if used, should be 6 to 8 inches wide, extend 8 inches below the tops of the finish slab surfaces. Although edge beams are not required, their inclusion in flatwork construction adjacent to landscaped areas is intended to reduce the potential for vertical and horizontal movement and subsequent cracking of the flatwork related to uplift forces that can develop in expansive soils.

Subgrade Preparation

Compaction

To reduce the potential for distress to concrete flatwork, the subgrade soils below concrete flatwork areas should be moisture conditioned to at least optimum moisture content and compacted to a minimum relative compaction of 90 percent to a minimum depth of 12 inches (or deeper, as either prescribed elsewhere in this report or determined in the field). Where concrete public roads, concrete segments of roads, or concrete access driveways are proposed, the upper 12 inches of subgrade soil should be compacted to at least 95 percent relative compaction.

Pre-Moistening

To further reduce the potential for concrete flatwork cracking, subgrade soils should be thoroughly moistened prior to placing concrete. The moisture content of the soils should be at least 1.2 times the optimum moisture content and penetrate to a minimum depth of 12 inches into the subgrade. Flooding or ponding of the subgrade is not recommended as this would require construction of numerous earth berms to contain the water. Moisture conditioning should be achieved with a light spray applied to the subgrade over a period of time until recommended moisture content is achieved prior to pouring concrete. Pre-watering of the soils is intended to promote uniform curing of the concrete, reduce the development of shrinkage cracks, and reduce the potential for differential expansion pressure on freshly poured flatwork. A representative of the project geotechnical consultant should observe and verify the density and moisture content of the soils, and the depth of moisture penetration prior to pouring concrete.

Drainage

Drainage from patios and other flatwork areas should be directed to local area drains or graded earth swales designed to carry runoff water to approved drainage structures. The concrete flatwork should be sloped at a minimum gradient of one percent, or as prescribed by project civil engineer or local codes, away from building foundations, retaining walls, masonry garden walls and slope areas.

Tree Wells

Tree wells are not recommended in concrete flatwork areas since they introduce excessive water into the subgrade soils and allow root invasion, both of which can cause heaving and cracking of the flatwork.

GRADING AND FINAL PLAN REVIEWS

This report has been prepared for the exclusive use of Diversified Pacific Communities to assist the project engineers and architect in the design of the proposed development. It is recommended that Petra be engaged to review the rough grading and any other final-design drawings and specifications prior to construction to ensure that the recommendations contained in this report have been properly interpreted and are incorporated into the project specifications. If Petra is not given the opportunity to review these documents, we take no responsibility for misinterpretation of our recommendations.

We recommend that Petra be retained to provide soil-engineering services during construction of the excavation and foundation phases of the work to ensure compliance with the design, specifications, and recommendations, and to allow design changes in the event that subsurface conditions differ from those anticipated prior to start of construction.

If the project plans change significantly (e.g., major slopes or type of structures), we should review our original design recommendations and their applicability to the revised construction. If conditions are encountered during construction that are different than those indicated in this report, this office should be notified immediately. Design and construction revisions may be needed.

REPORT LIMITATIONS

This report is based on the proposed residential development, our preliminary subsurface exploration, geotechnical laboratory testing, and analysis. The materials encountered on the project site and utilized in our laboratory evaluation are believed representative of the total area; however, soil materials, moisture contents, and oversize rock conditions can vary in characteristics between excavations, both laterally and vertically.

The conclusions and opinions contained in this report are based on the results of the described geotechnical evaluations and represent our professional judgment. This report has been prepared consistent with that level of care being provided by other professionals providing similar services at the same locale and in the same time period. The contents of this report are professional opinions and as such, are not to be considered a guaranty or warranty. This report has not been prepared for use by parties or projects other than those named or described herein. This report may not contain sufficient information for other parties or other purposes. In addition, this report should be reviewed and updated after a period of 1 year or if the site ownership or project concept changes from that described herein.

This opportunity to be of service is sincerely appreciated. If you have any additional questions or concerns, please feel free contact this office.

Respectfully submitted,
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FIGURES

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COSTA MESA TEMECULA LOS ANGELES PALM DESERT CORONA ESCONDIDO

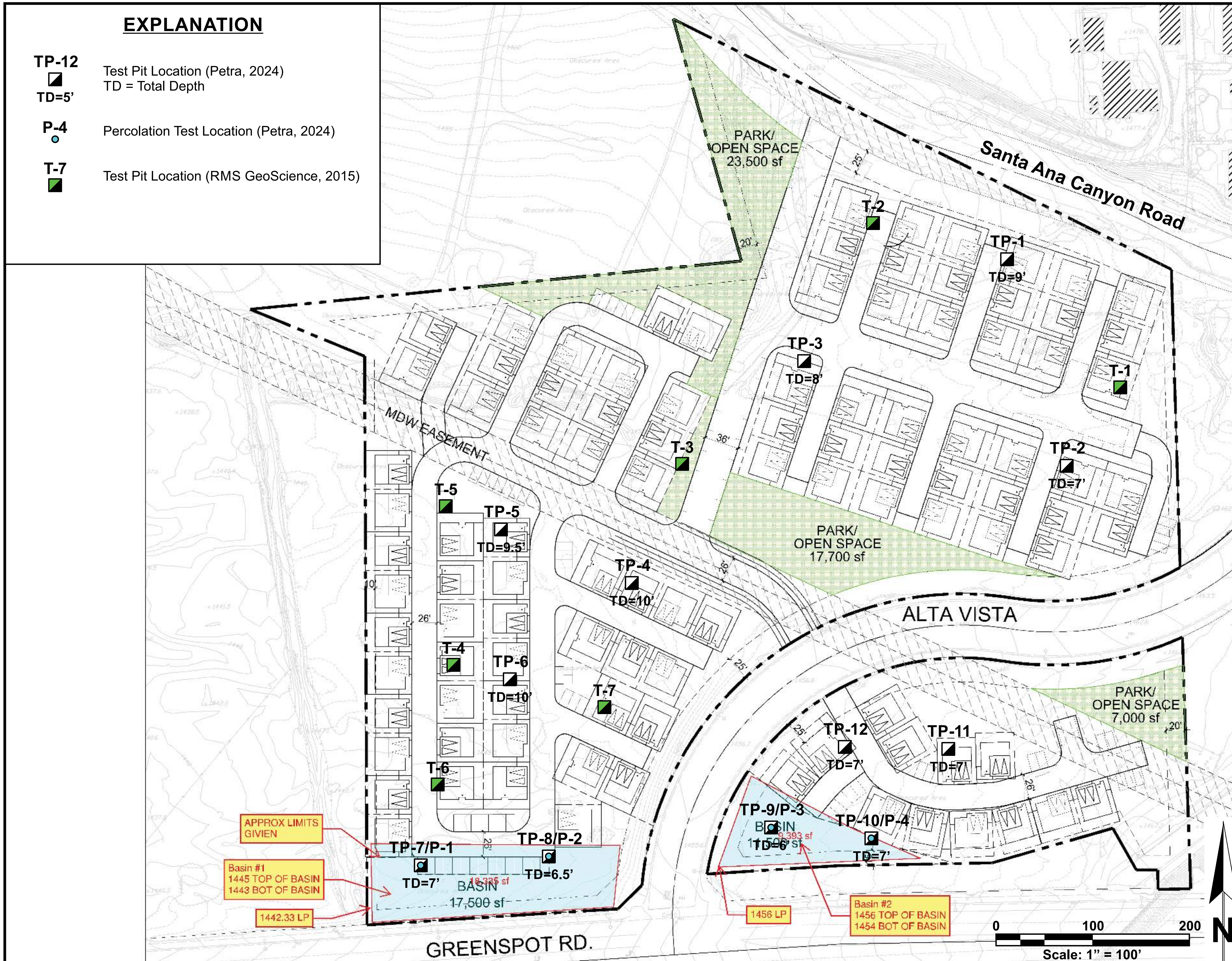
SITE LOCATION MAP

EAST HIGHLAND RANCH
HIGHLAND, CALIFORNIA

DATE: August, 2024

J.N.: 24-156

Figure 1



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EXPLORATION LOCATION MAP

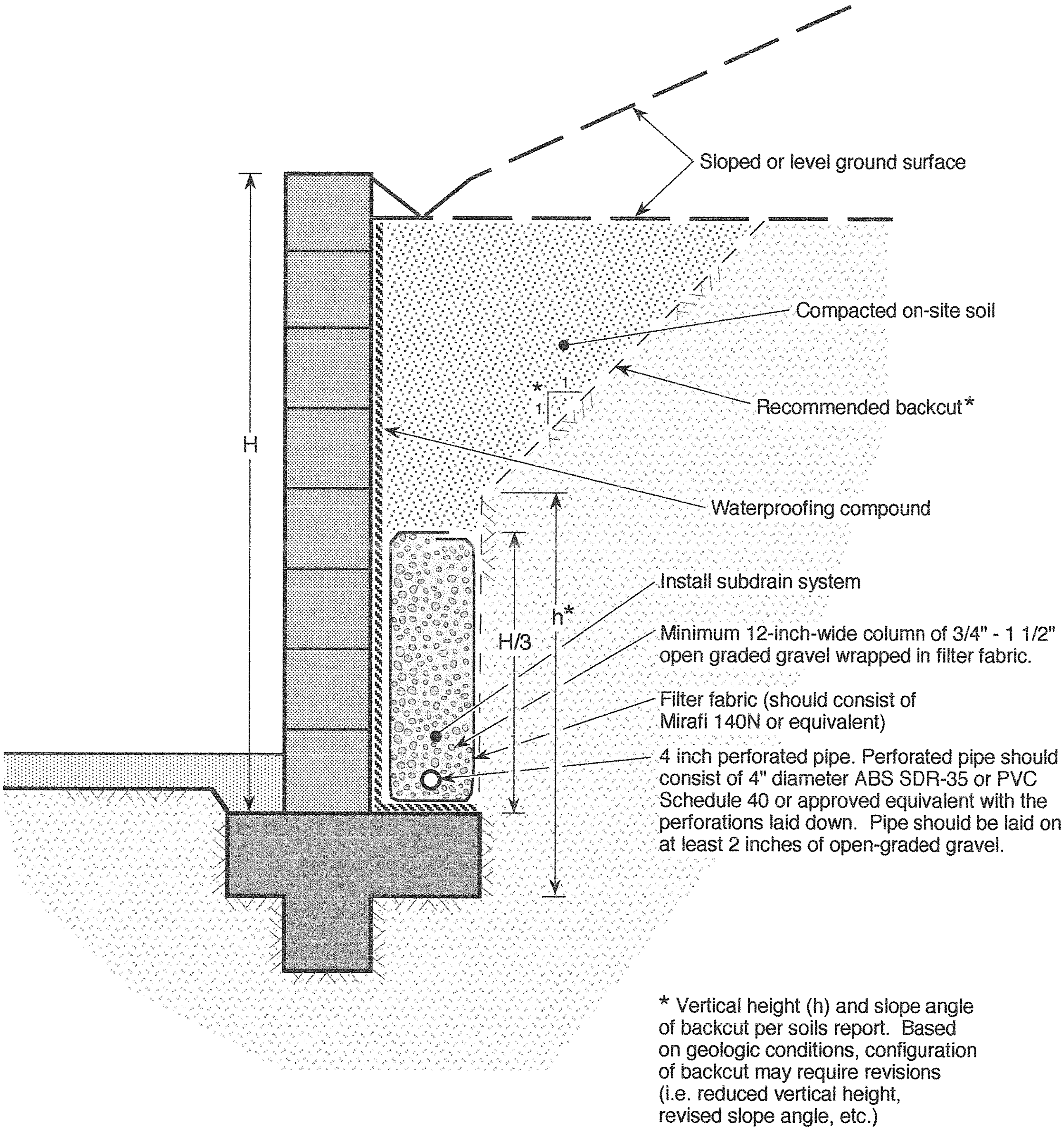
East Highland Ranch,
Highland, California

DATE: August, 2024

J.N.: 24-156

Figure 2

NATIVE SOIL BACKFILL



* Vertical height (h) and slope angle of backcut per soils report. Based on geologic conditions, configuration of backcut may require revisions (i.e. reduced vertical height, revised slope angle, etc.)

PETRA	RETAINING WALL BACKFILL AND SUBDRAIN DETAILS	FIGURE RW-1

APPENDIX A

FIELD EXPLORATION LOGS
(PETRA, 2024; RMA, 2015)

Key to Soil and Bedrock Symbols and Terms

PETRA

Unified Soil Classification System

Major Divisions				Symbol	Description
Coarse-grained Soils > 1/2 of materials is larger than #200 sieve	The No. 200 U.S. Standard Sieve is about the smallest particle visible to the naked eye	**GRAVELS** more than half of coarse fraction is larger than #4 sieve	Clean Gravels (less than 5% fines)	**GW**	Well-graded gravels, gravel-sand mixtures, little or no fines
				GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
			Gravels with fines	**GM**	Silty Gravels, poorly-graded gravel-sand-silt mixtures
				GC	Clayey Gravels, poorly-graded gravel-sand-clay mixtures
		SANDS more than half of coarse fraction is smaller than #4 sieve	Clean Sands (less than 5% fines)	**SW**	Well-graded sands, gravelly sands, little or no fines
				SP	Poorly-graded sands, gravelly sands, little or no fines
			Sands with fines	**SM**	Silty Sands, poorly-graded sand-gravel-silt mixtures
				SC	Clayey Sands, poorly-graded sand-gravel-clay mixtures
Fine-grained Soils > 1/2 of materials is smaller than #200 sieve		**SILTS & CLAYS** Liquid Limit Less Than 50		**ML**	Inorganic silts & very fine sands, silty or clayey fine sands, clayey silts with slight plasticity
				CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
				OL	Organic silts & clays of low plasticity
		SILTS & CLAYS Liquid Limit Greater Than 50		**MH**	Inorganic silts, micaceous or diatomaceous fine sand or silt
				CH	Inorganic clays of high plasticity, fat clays
				OH	Organic silts and clays of medium-to-high plasticity
Highly Organic Soils				**PT**	Peat, humus swamp soils with high organic content

Grain Size

Description		Sieve Size	Grain Size	Approximate Size
Boulders		>12"	>12"	Larger than basketball-sized
Cobbles		3 - 12"	3 - 12"	Fist-sized to basketball-sized
Gravel	coarse	3/4 - 3"	3/4 - 3"	Thumb-sized to fist-sized
	fine	#4 - 3/4"	0.19 - 0.75"	Pea-sized to thumb-sized
Sand	coarse	#10 - #4	0.079 - 0.19"	Rock salt-sized to pea-sized
	medium	#40 - #10	0.017 - 0.079"	Sugar-sized to rock salt-sized
	fine	#200 - #40	0.0029 - 0.017"	Flour-sized to sugar-sized to
Fines		Passing #200	<0.0029"	Flour-sized and smaller

Modifiers

Trace	< 1 %
Few	1 - 5%
Some	5 - 12 %
Numerous	12 - 20 %

Laboratory Test Abbreviations

MAX	Maximum Dry Density	MA	Mechanical (Particle Size) Analysis
EXP	Expansion Potential	AT	Atterberg Limits
SO4	Soluble Sulfate Content	#200	#200 Screen Wash
RES	Resistivity	DSU	Direct Shear (Undisturbed Sample)
pH	Acidity	DSR	Direct Shear (Remolded Sample)
CON	Consolidation	HYD	Hydrometer Analysis
SW	Swell	SE	Sand Equivalent
CL	Chloride Content	OC	Organic Content
RV	R-Value	COMP	Mortar Cylinder Compression

Bedrock Hardness

Soft	Can be crushed and granulated by hand; "soil like" and structureless
Moderately Hard	Can be grooved with fingernails; gouged easily with butter knife; crumbles under light hammer blows
Hard	Cannot break by hand; can be grooved with a sharp knife; breaks with a moderate hammer blow
Very Hard	Sharp knife leaves scratch; chips with repeated hammer blows

Sampler and Symbol Descriptions

Approximate Depth of Groundwater Encountered

Approximate Depth of Standing Groundwater

Modified California Split Spoon Sample

No Recovery in Mod. Calif. Split Spoon Sample

Standard Penetration Test

Shelby Tube Sample

Bulk Sample

No Recovery in SPT Sampler

No Recovery in Shelby Tube

Notes:

Blows Per Foot: Number of blows required to advance sampler 1 foot (unless a lesser distance is specified). Samplers in general were driven into the soil or bedrock at the bottom of the hole with a standard (140 lb.) hammer dropping a standard 30 inches unless noted otherwise in Log Notes. Drive samples collected in bucket auger borings may be obtained by dropping non-standard weight from variable heights. When a SPT sampler is used the blow count conforms to ASTM D-1586

TEST PIT LOG

Project:	East Highland Ranch		Boring No.:	TP-1
Location:	Highland		Elevation:	1464±
Job No.:	24-156	Client: Diversified Pacific Communities	Date:	3/26/24
Drill Method:	Backhoe	Driving Weight: N/A	Logged By:	SS

Depth (Feet)	Lithology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ARTIFICIAL FILL (af)** Silty SAND (SM): Light brown to brown, slightly moist, loose, fine- to coarse-grained, some gravel, 15% cobbles and boulders.							
		ALLUVIUM (Qal) SAND with Silt (SP-SM): Light brown, slightly moist, loose medium dense, fine- to coarse-grained, some gravel, 50% cobbles and boulders.					6.3	93.1	
						■			
							8.1	86.6	
5									
							4.8	104.1	
		25% cobbles and boulders.							
10		Total Depth = 9' No groundwater encountered Slight caving from 6-9' Test Pits backfilled with spoils Moisture and dry density reading taken on site with Nuke Gauge.							
15									
20									
25									
30									
35									

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TEST PIT LOG

Project:	**East Highland Ranch**	Boring No.:	**TP-2**
Location:	**Highland**	Elevation:	**1461±**
Job No.: **24-156**	Client: **Diversified Pacific Communities**	Date:	**3/26/24**
Drill Method: **Backhoe**	Driving Weight: **N/A**	Logged By:	**SS**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ARTIFICIAL FILL (af)** Silty SAND (SM): Light brown, dry to slightly moist, loose, fine- to coarse-grained, some gravel, 25% cobbles and boulders.				■	2.2	93.1	
		ALLUVIUM (Qal) SAND (SP): Light brown to gray, slightly moist, loose to medium dense, fine- to coarse-grained, some gravel, 35% cobbles and boulders.				■	4.0	94.2	
5							3.6	100.0	
		Total Depth = 7' No groundwater encountered Slight caving from 5-7' Test Pits backfilled with spoils Moisture and dry density reading taken on site with Nuke Gauge.							
10									
15									
20									
25									
30									
35									

Petra Geosciences, Inc.

TEST PIT LOG

Project: **East Highland Ranch**		Boring No.:	**TP-3**
Location: **Highland**		Elevation:	**1453±**
Job No.: **24-156**	Client: **Diversified Pacific Communities**	Date:	**3/26/24**
Drill Method: **Backhoe**	Driving Weight: **N/A**	Logged By:	**SS**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ALLUVIUM (Qal)** Silty SAND (SM): Light brown, slightly moist, loose, fine- to medium-grained, some gravel, 35% cobbles and boulders.					5.3	90.8	
		SAND (SP): Light brown to gray, slightly moist, loose, fine- to coarse-grained, some gravel, 35% cobbles and boulders.							
		SAND with Silt (SP-SM): Light brown to brown, slightly moist, loose, fine- to coarse-grained, some gravel, 55% cobbles and boulders.				■	8.6	97.8	
5							4.4	98.3	
		Total Depth = 8' No groundwater encountered Slight caving from 6-8' Test Pits backfilled with spoils Moisture and dry density reading taken on site with Nuke Gauge.							
10									
15									
20									
25									
30									
35									

PLATE A-3

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TEST PIT LOG

Project: **East Highland Ranch**		Boring No.:	**TP-4**
Location: **Highland**		Elevation:	**1454±**
Job No.: **24-156**	Client: **Diversified Pacific Communities**	Date:	**3/26/24**
Drill Method: **Backhoe**	Driving Weight: **N/A**	Logged By:	**SS**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ALLUVIUM (Qal)** Silty SAND (SM): Light brown to brown, dry to slightly moist, loose, fine- to coarse-grained, some gravel, 25% cobbles.							
		SAND with Silt (SP-SM): Light brown, slightly moist, loose to medium dense, fine- to coarse-grained, some gravel, 35% cobbles and boulders.				■	5.7	88.5	
5		55% cobbles and boulders.				■	5.8	83.7	MAX, DSR, MA
							3.6	101.3	
		45% cobbles and boulders.							
10		Total Depth = 10' No groundwater encountered Slight caving from 6-10' Test Pits backfilled with spoils Moisture and dry density reading taken on site with Nuke Gauge.							
15									
20									
25									
30									
35									

PLATE A-4

TEST PIT LOG

Project:	East Highland Ranch			Boring No.:	TP-5
Location:	Highland			Elevation:	1447±
Job No.:	24-156	Client:	Diversified Pacific Communities	Date:	3/26/24
Drill Method:	Backhoe	Driving Weight:	N/A	Logged By:	SS

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ALLUVIUM (Qal)** Silty SAND (SM): Light brown, dry, loose, fine- to coarse-grained, some gravel, 35% cobbles.					3.7	114.8	
		SAND (SP): Light brown to brown, slightly moist, loose, some gravel, 50% cobbles and boulders.				■	3.0	114.3	
5							3.6	104.3	
10		Total Depth = 9.5' No groundwater encountered Slight caving from 5-9.5' Test Pits backfilled with spoils Moisture and dry density reading taken on site with Nuke Gauge.							
15									
20									
25									
30									
35									

Petra Geosciences, Inc.

TEST PIT LOG

Project: **East Highland Ranch**		Boring No.:	**TP-6**
Location: **Highland**		Elevation:	**1449±**
Job No.: **24-156**	Client: **Diversified Pacific Communities**	Date:	**3/26/24**
Drill Method: **Backhoe**	Driving Weight: **N/A**	Logged By:	**SS**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ALLUVIUM (Qal)** Silty SAND (SM): Light brown to brown, dry to slightly moist, loose, fine- to coarse-grained, some gravel, 25% cobbles.				■			
		SAND with Silt (SP-SM): Light brown, slightly moist, loose, fine- to coarse-grained, some gravel, 35% cobbles and boulders.					4.7	102.6	
		SAND (SP): Light brown, slightly moist, loose, fine- to coarse-grained, some gravel, 45% cobbles and boulders.					5.5	94.6	
5							5.0	105.0	
10		Total Depth = 10' No groundwater encountered Slight caving from 6-10' Test Pits backfilled with spoils Moisture and dry density reading taken on site with Nuke Gauge.							
15									
20									
25									
30									
35									

Petra Geosciences, Inc.

TEST PIT LOG

Project:	**East Highland Ranch**	Boring No.:	**TP-7**
Location:	**Highland**	Elevation:	**1445±**
Job No.: **24-156**	Client: **Diversified Pacific Communities**	Date:	**3/26/24**
Drill Method: **Backhoe**	Driving Weight: **N/A**	Logged By:	**SS**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ALLUVIUM (Qal)** Silty SAND (SM): Light brown, dry, loose, fine- to coarse-grained, some gravel, 25% cobbles.					3.0	105.0	
		SAND with Silt (SP-SM): Light brown to gray, slightly moist, loose, fine- to coarse-grained, some gravel, 45% cobbles and boulders.					3.0	101.3	
						■			
5							4.0	110.8	
		Total Depth = 7' No groundwater encountered Slight caving from 5-7' Test Pit converted to percolation well P-1 Test Pits backfilled with spoils Moisture and dry density reading taken on site with Nuke Gauge.							

PLATE A-7

Petra Geosciences, Inc.

TEST PIT LOG

Project: **East Highland Ranch**		Boring No.:	**TP-8**
Location: **Highland**		Elevation:	**1448±**
Job No.: **24-156**	Client: **Diversified Pacific Communities**	Date:	**3/26/24**
Drill Method: **Backhoe**	Driving Weight: **N/A**	Logged By:	**SS**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ALLUVIUM (Qal)** Silty SAND (SM): Light brown, dry, loose, fine- to medium-grained, some gravel, few cobbles.							
		SAND (SP): Light brown to gray, slightly moist, loose, fine- to coarse-grained, some gravel, 25% cobbles.				■	3.4	110.3	
		35% cobbles and boulders.					4.2	108.8	
5									
							4.3	101.9	
		Total Depth = 6.5' No groundwater encountered Slight caving from 5-6.5' Test Pit converted to percolation well P-2 Test Pits backfilled with spoils Moisture and dry density reading taken on site with Nuke Gauge.							
10									
15									
20									
25									
30									
35									

Petra Geosciences, Inc.

TEST PIT LOG

Project:	East Highland Ranch	Boring No.:	TP-9
Location:	Highland	Elevation:	1458±
Job No.: 24-156	Client: Diversified Pacific Communities	Date:	3/26/24
Drill Method: Backhoe	Driving Weight: N/A	Logged By:	SS

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ALLUVIUM (Qal)** Silty SAND (SM): Light brown, dry, loose, fine- to coarse-grained, some gravel, 15% cobbles. brown to dark yellow, slightly moist. brown to dark brown, 25% cobbles.					8.6	96.6	
							15.6	88.1	
5						■	33.9	71.9	pH, RES, S04, CL
		Total Depth = 6' No groundwater encountered Slight caving from 5-6' Test Pit converted to percolation well P-3 Test Pits backfilled with spoils Moisture and dry density reading taken on site with Nuke Gauge.							
10									
15									
20									
25									
30									
35									

TEST PIT LOG

Project:	East Highland Ranch			Boring No.:	TP-10
Location:	Highland			Elevation:	1461±
Job No.:	24-156	Client:	Diversified Pacific Communities	Date:	3/26/24
Drill Method:	Backhoe	Driving Weight:	N/A	Logged By:	SS

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ALLUVIUM (Qal)** Silty SAND (SM): Light brown, dry, loose, fine- to coarse-grained, numerous gravel. Brown to dark brown, slightly moist, 25% cobbles and boulders.				■	6.7	104.9	
5							6.2	102.0	
		SAND (SP): Light brown to brown, slightly moist, loose, fine- to coarse-grained.					13.0	92.2	
		Total Depth = 7' No groundwater encountered Slight caving from 5-7' Test Pit converted to percolation well P-4 Test Pits backfilled with spoils Moisture and dry density reading taken on site with Nuke Gauge.							
10									
15									
20									
25									
30									
35									

Petra Geosciences, Inc.

TEST PIT LOG

Project: **East Highland Ranch**		Boring No.:	**TP-11**
Location: **Highland**		Elevation:	**1462±**
Job No.: **24-156**	Client: **Diversified Pacific Communities**	Date:	**3/26/24**
Drill Method: **Backhoe**	Driving Weight: **N/A**	Logged By:	**SS**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0	SM	**ALLUVIUM (Qal)** Silty SAND (SM): Light brown, dry, loose, fine- to coarse-grained, some gravel, 25% cobbles. Brown to dark brown, slightly moist.					9.0	93.8	
							11.1	89.5	
5	SP	SAND (SP): Light brown, slightly moist, loose, fine- to coarse-grained, some gravel, 25% cobbles, trace boulders.				■	5.4	95.4	
7		Total Depth = 7' No groundwater encountered Slight caving from 5-7' Test Pits backfilled with spoils Moisture and dry density reading taken on site with Nuke Gauge.							

PLATE A-11

Petra Geosciences, Inc.

TEST PIT LOG

Project:	East Highland Ranch			Boring No.:	TP-12
Location:	Highland			Elevation:	1457±
Job No.:	24-156	Client:	Diversified Pacific Communities	Date:	3/26/24
Drill Method:	Backhoe	Driving Weight:	N/A	Logged By:	SS

Depth (Feet)	Lithology	Material Description	WATER	Blows per 6 in.	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
0		**ALLUVIUM (Qal)** Silty SAND (SM): Light brown to brown, dry, loose, fine- to coarse-grained, some gravel, 15% cobbles. Dark brown to brown, slightly moist.							
2							9.2	93.5	
3–4						■			
4							8.2	79.1	
5		SAND (SP): Light brown, slightly moist, loose, fine- to coarse-grained, some gravel, 25% cobbles and boulders.							
6							6.0	103.8	
7		Total Depth = 7' No groundwater encountered Slight caving from 5-7' Test Pits backfilled with spoils Moisture and dry density reading taken on site with Nuke Gauge.							
10									
15									
20									
25									
30									
35									

PLATE A-12

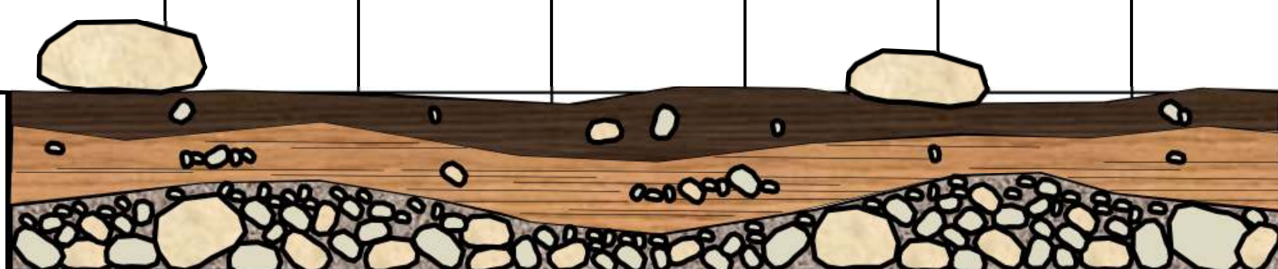
Petra Geosciences, Inc.

Log of Exploratory Trench

Project Name: East Highland Land
Trench Number: 1 Date: October 7, 2015
Project Number: 15-I27-0
Location: Highland, CA
Equipment: Backhoe - Williams Construction
Notes:
Logged By: ams Elevation: 1466 ft

USCS Classification	Density (PCF)	Material Description
-	-	Surface: vegetated with grass and sparse flowers, bushes, and small trees, sporadic boulders ≤ 6' diameter
SM		0-1.5': Dark brown, silty fine to coarse grained sand, slightly moist, roots and rootlets prevalent to approximately 2.5', mottled clay layers 0.5-6 cm thick, subangular to rounded coarse gravel and small cobbles, porous, wavy gradational contact
SW		1.5'-3.5': Light yellow brown, fine to coarse grained laminated to massively bedded sand, dry, sporadic subangular to rounded gravel with lenses of gravel and small cobbles, laminated silt-rich beds gray in color approximately 4-6 cm apart and less than 0.5 cm thick, wavy contact
GW		3.5-5': Light yellow brown, gravel, clasts, and boulders sourced primarily from diorite, granite, and other igneous rocks, dry, normally graded, clast supported with a medium to coarse sand martix

1 inch = 5 feet



52% Sand
40% Gravel
5% Cobbles
3% Boulders

Log of Exploratory Trench

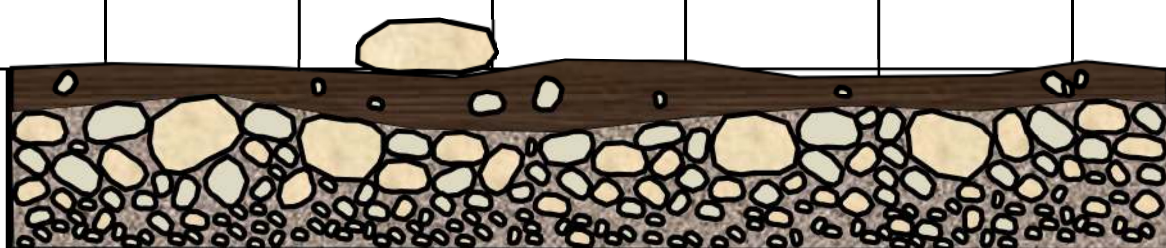
RMA GeoScience

Project Name: East Highland Land
Project Number: 15-I27-0
Equipment: Backhoe - Williams Construction
Logged By: ams Elevation: 1466 ft

Trench Number: 2 Date: October 7, 2015
Location: Highland, CA
Notes:

USCS Classification	Density (PCF)	Material Description
-	-	Surface: vegetated with grass and sparse flowers, bushes, and small trees, sporadic boulders ≤ 6' diameter
SM		0-1.5': Dark brown, silty fine to coarse grained sand, slightly moist, roots and rootlets prevalent, mottled clay layers 0.5-6 cm thick, subangular to rounded coarse gravel and small cobbles, porous, wavy gradational contact
GW		1.5-5': Light yellow brown, gravel, clasts, and boulders sourced primarily from diorite, granite, and other igneous rocks, dry, reverse graded, clast supported with a medium to coarse sand martix

1 inch = 5 feet



45% Sand
40% Gravel
10% Cobbles
5% Boulders

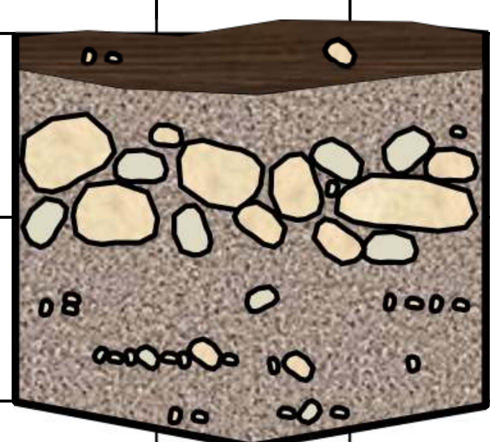
Log of Exploratory Trench

Project Name: East Highland Land
Trench Number: 3 Date: October 7, 2015
Project Number: 15-I27-0
Location: Highland, CA
Equipment: Backhoe - Williams Construction
Notes:
Logged By: ams Elevation: 1466 ft

USCS Classification	Density (PCF)	Material Description
-	-	Surface: vegetated with grass, shrubs, and small trees, sporadic boulders ≤ 4' diameter
SM		0-1': Dark brown, silty fine to coarse grained sand, slightly moist, roots and rootlets to approximately 2 feet prevalent, subangular to rounded coarse gravel and small cobbles, porous, wavy gradational contact
SW		1'-2': White to tan medium to coarse grained clean sand, slightly moist, sproadic roots
GW		2-6': Tan brown sub angular to rounded gravel, cobbles, and boulders with medium to coarse grained sand matrix, dry
SW		6'-8': Yellow tan medium to coarse grained clean sand, dry, sporadic cobbles and gravel in lenses

1 inch = 5 feet

49% Sand
35% Gravel
10% Cobbles
6% Boulders



Subject to caving

Log of Exploratory Trench

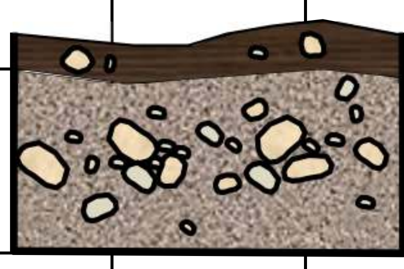
RMA GeoScience

Project Name: East Highland Land
Project Number: 15-I27-0
Equipment: Backhoe - Williams Construction
Logged By: ams Elevation: 1466 ft

Trench Number: 4 Date: October 7, 2015
Location: Highland, CA
Notes:

USCS Classification	Density (PCF)	Material Description
-	-	Surface: vegetated with grasses, sporadic boulders ≤ 4' diameter
SM		0-1.5': Dark brown, silty fine to coarse grained sand, slightly moist, roots and rootlets prevalent, subangular to rounded coarse gravel and small cobbles, porous, wavy gradational contact
GW		1.5-6': Light yellow brown fine to coarse sand, gravel, clasts, and boulders sourced primarily from diorite, granite, and other igneous rocks, dry, matrix supported, with lenses of thicker clast supported regions

1 inch = 5 feet



86% Sand
10% Gravel
3% Cobbles
1% Boulders

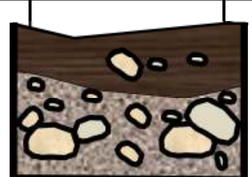
Subject to caving

Log of Exploratory Trench

Project Name: East Highland Land
Trench Number: 5
Date: October 7, 2015
Project Number: 15-I27-0
Location: Highland, CA
Equipment: Backhoe - Williams Construction
Notes:
Logged By: ams
Elevation: 1466 ft

USCS Classification	Density (PCF)	Material Description
-	-	Surface: vegetated with shrubs and small trees, sporadic boulders ≤ 4' diameter
SM		0-1.5': Dark brown, silty fine to coarse grained sand, slightly moist, roots and rootlets prevalent, subangular to rounded coarse gravel and small cobbles, porous, wavy gradational contact
SW		1.5-5': Light yellow brown fine to coarse sand, gravel, clasts, and a few small boulders ,matrix supported, with lenses of thicker clast supported regions

1 inch = 5 feet



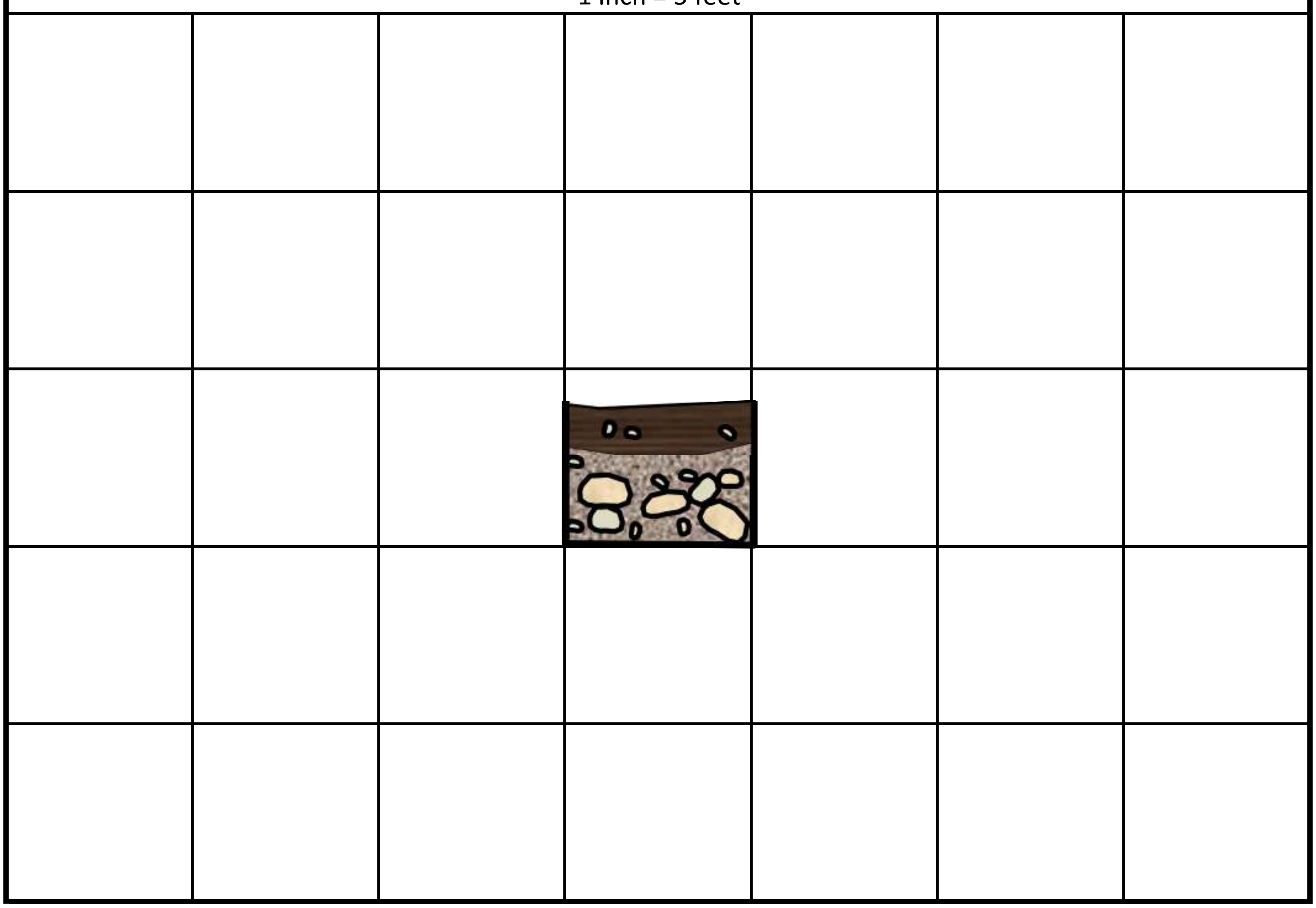
Log of Exploratory Trench

RMA GeoScience

Project Name: East Highland Land
Trench Number: 6
Date: October 7, 2015
Project Number: 15-I27-0
Location: Highland, CA
Equipment: Backhoe - Williams Construction
Notes:
Logged By: ams
Elevation: 1466 ft

USCS Classification	Density (PCF)	Material Description
-	-	Surface: vegetated with shrubs and small trees, sporadic boulders ≤ 4' diameter
SM		0-2': Dark brown, silty fine to coarse grained sand, slightly moist, roots and rootlets prevalent, subangular to rounded coarse gravel and small cobbles, porous, wavy gradational contact
SW		2-4': Tan to light brown fine to coarse sand, gravel, clasts, and a few small boulders, matrix supported

1 inch = 5 feet



Log of Exploratory Trench

RMA GeoScience

Project Name: East Highland Land
Project Number: 15-I27-0
Equipment: Backhoe - Williams Construction
Logged By: ams Elevation: 1466 ft

Trench Number: 7 Date: October 7, 2015
Location: Highland, CA
Notes:

USCS Classification	Density (PCF)	Material Description
-	-	Surface: vegetated with shrubs and small trees, sporadic boulders ≤ 4' diameter
SM		0-1': Dark brown, silty fine to coarse grained sand, slightly moist, roots and rootlets prevalent, subangular to rounded coarse gravel and small cobbles, porous, wavy gradational contact
SW		1-4': Light yellow brown fine to coarse sand, gravel, clasts, and a few small boulders matrix supported

1 inch = 5 feet

Subject to caving

APPENDIX B

LABORATORY TEST PROCEDURES

LABORATORY DATA SUMMARY (PETRA, 2024; RMA, 2015)

LABORATORY TEST PROCEDURES

Soil Classification

Soils encountered within the exploration borings were initially classified in the field in general accordance with the visual-manual procedures of the Unified Soil Classification System (ASTM D 2488). The samples were re-examined in the laboratory and the classifications reviewed and then revised where appropriate.

Laboratory Maximum Dry Density and Optimum Moisture Content

The maximum dry unit weight and optimum moisture content of various on-site soil types were determined for selected bulk samples in accordance with current version of Method A of ASTM D 1557. The results of these tests are presented on Plate B-1.

Expansion Index

Expansion index tests were performed on selected samples of soil in accordance with ASTM D 4829. The expansion potential classification was determined from 2016 CBC Section 1802.3.2 on the basis of the expansion index value. The test results and expansion potential are presented on Plate B-1.

Soil Corrosivity

Chemical analyses were performed on a selected sample of soil to determine concentrations of soluble sulfate and chloride, as well as pH and resistivity. These tests were performed in accordance with California Test Method Nos. 417 (sulfate), 422 (chloride) and 643 (pH and resistivity). Test results are included on Plate B-1.

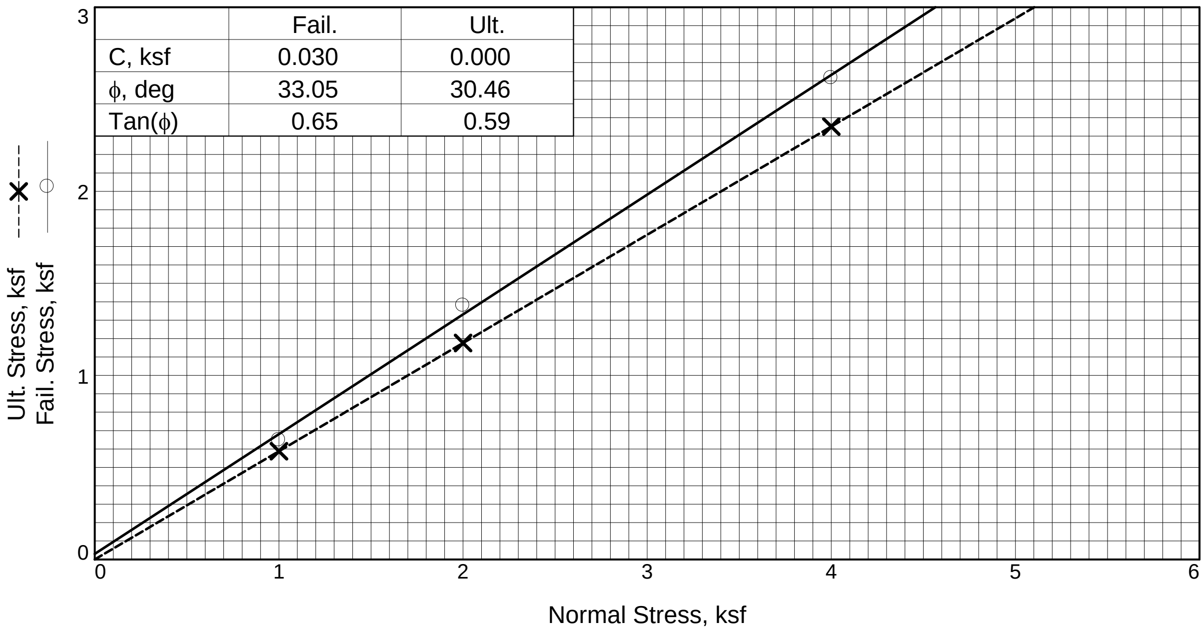
Direct Shear-Remolded

The Coulomb shear strength parameters, angle of internal friction and cohesion, were determined for undisturbed and disturbed (bulk) samples remolded to approximately 90 percent of maximum dry density. These tests were performed in general accordance with ASTM D 3080. Three specimens were prepared for each test. The test specimens were artificially saturated, and then sheared under varied normal loads at a maximum constant rate of strain of 0.05 inches per minute. Results are graphically depicted on Plate B-2.

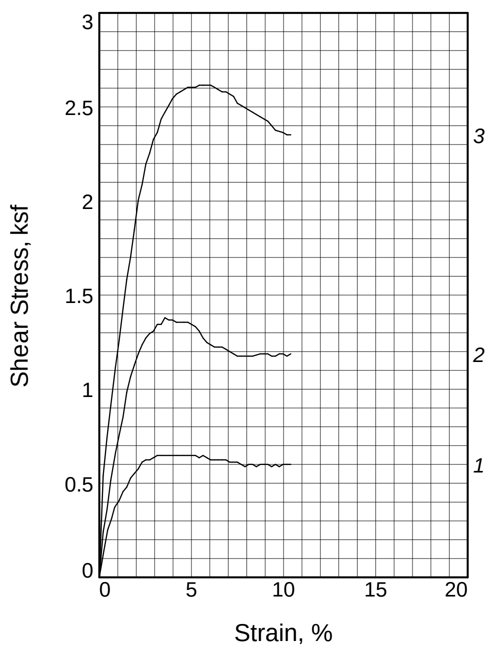
LABORATORY DATA SUMMARY														
Test Pit Number	Sample Depth (ft)	Soil Description	Compaction[1]		Expansion[2]		Atterberg Limits[3]			Soluble Sulfate Content[4] (%)	Chloride Content[5] (ppm)	pH[6]	Minimum Resistivity[6] (Ohm-cm)
			Max. Dry Density (pcf)	Optimum Moisture (%)	Index	Potential	LL	PL	PI				
3	3-5	Sand with Gravel/Cobbles	120.5	9.5	-	-	-	-	-	-	-	-	-
6	1	Sand with Gravel/Cobbles	-	-	0	Non Expansive	-	-	-	-	-	-	-
9	4	Sand with Gravel/Cobble some Silt	-	-	-	-	-	-	-	0.0030	315	6.4	3,200

Test Procedures:

[1] Per ASTM Test Method ASTM D 1557
[2] Per ASTM Test Method ASTM D 4829
[3] Per ASTM Test Method ASTM D 4318
[4] Per California Test Method CTM 417
[5] Per California Test Method CTM 422
[6] Per California Test Method CTM 643



	Fail.	Ult.
C, ksf	0.030	0.000
ϕ, deg	33.05	30.46
Tan(ϕ)	0.65	0.59



Sample No.		1	2	3
Initial	Water Content, %	10.5	10.5	10.5
	Dry Density, pcf	103.6	103.9	104.3
	Saturation, %	46.6	47.0	47.5
	Void Ratio	0.5969	0.5921	0.5859
	Diameter, in.	2.416	2.416	2.416
	Height, in.	1.017	1.014	1.010
At Test	Water Content, %	20.8	20.6	19.6
	Dry Density, pcf	104.8	106.4	108.0
	Saturation, %	95.4	98.6	97.8
	Void Ratio	0.5790	0.5545	0.5315
	Diameter, in.	2.416	2.416	2.416
	Height, in.	1.006	0.990	0.975
Normal Stress, ksf		1.000	2.000	4.000
Fail. Stress, ksf		0.648	1.380	2.616
Strain, %		4.0	3.6	6.0
Ult. Stress, ksf		0.588	1.176	2.352
Strain, %		9.8	7.5	10.4
Strain rate, in./min.		0.040	0.040	0.040

Sample Type: Remolded
Description: Brown Fine to Coarse Sand with Gravel

Specific Gravity= 2.65
Remarks:

Figure ______

Client: Diversified Pacific

Project: East Highland Ranch

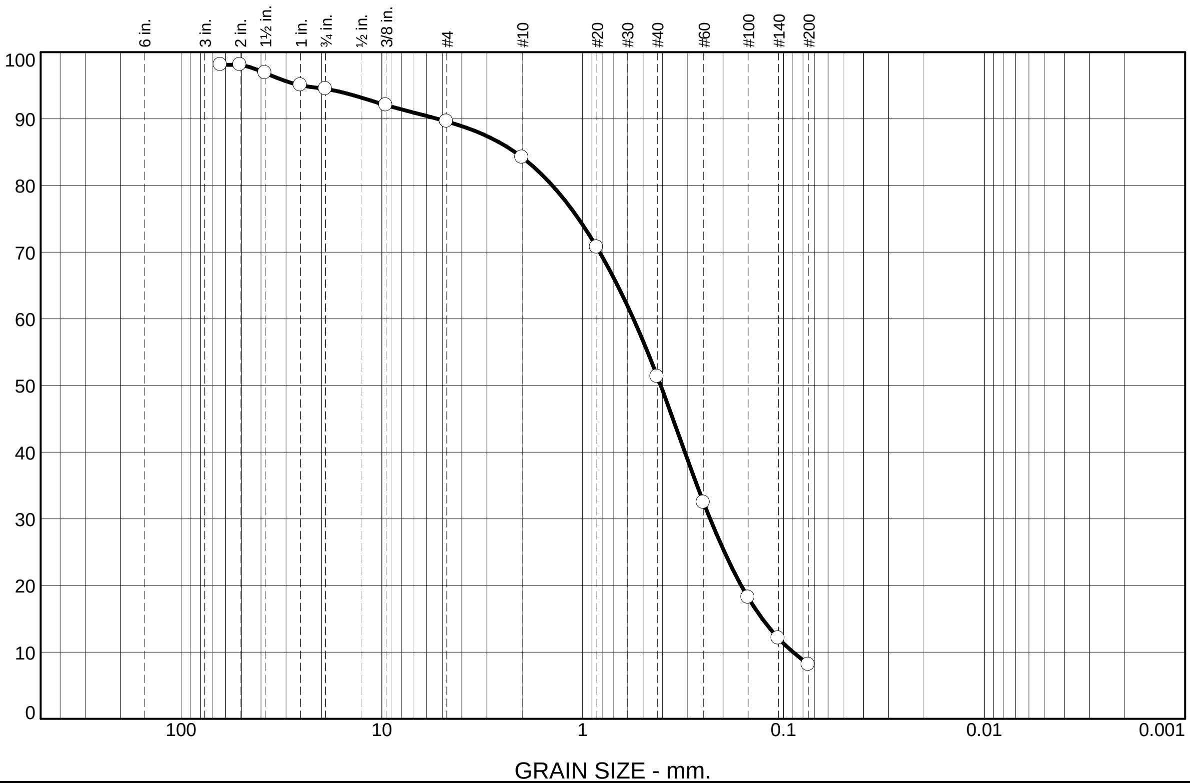
Source of Sample: 24L052 **Depth:** 3-5
Sample Number: TP-4
Proj. No.: 24-156 **Date Sampled:** 7/17/2024

PETRA GEOSCIENCES INC.

Laboratory:
1251 West Pomona Road, Unit #103, Corona, Ca 92882 Phone #. 714.549.8921

Tested By: DI

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
		4.9	5.4	32.9	43.2	8.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
2.5	98.1		
2	98.1		
1.5	96.9		
1	95.0		
.75	94.5		
.375	92.1		
#4	89.6		
#10	84.2		
#20	70.7		
#40	51.3		
#60	32.4		
#100	18.2		
#140	12.1		
#200	8.1		

* (no specification provided)

Soil Description

Brown Fine to Coarse Sand with Gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 5.3040 D_{85}= 2.1732 D_{60}= 0.5589
D_{50}= 0.4089 D_{30}= 0.2321 D_{15}= 0.1276
D_{10}= 0.0896 C_u= 6.24 C_c= 1.08

Classification

USCS= AASHTO=

Remarks

Source of Sample: 24L052 **Depth:** 3-5
Sample Number: TP-4
Date: 7/17/2024

PETRA GEOSCIENCES INC.

Client: Diversified Pacific
Project: East Highland Ranch
Project No: 24-156 **Figure**

Laboratory:
1251 West Pomona Road, Unit #103, Corona, Ca 92882 Phone #. 714.549.8921

Tested By: DI

APPENDIX B

B-1.00 LABORATORY TESTS

B-1.01 Maximum Density

Maximum density - optimum moisture relationships for the major soil types encountered during the field exploration were performed in the laboratory using the standard procedures of ASTM D1557.

B-1.02 Test Results

Test results for all laboratory tests performed on the subject project are presented in this appendix. For a sample-by-sample description, see the Trench Logs presented in Appendix A.

MAXIMUM DENSITY - OPTIMUM MOISTURE
(Test Method: ASTM D1557)

Sample Number	Optimum Moisture (Percent)	Maximum Density (lbs/ft^3)
T-2 at 0-2 ft	9.8	123.7
T-3 at 1-3 ft	___	___

APPENDIX C

PERCOLATION TEST PROCEDURES / RESULTS

Preliminary Percolation Tests Results

Percolation testing was performed to evaluate infiltration rates of the site soils, consisting of alluvial deposits, to aid in the design of proposed stormwater basins.

Test Method

Methodology included drilling four borings to depths between 7 and 8 feet below the existing ground surface, to the bottom elevation of the proposed basins. We subsequently performed falling head percolation tests in each of the four borings. The depths and locations of the percolation tests were provided by Kimley Horn. The locations of the percolation boreholes are shown in Figure 2.

Percolation tests to evaluate site infiltration rates were performed in conformance with Design Handbook for Low Impact Development, Best Management Practices, by Riverside County Flood Control and Water Conservation District, dated September 2011 (Handbook). Log and field-classify soil materials encountered in each boring in accordance with the visual-manual procedures outlined in the Unified Soil Classification System and the American Society for Testing and Materials (ASTM) Procedure D 2488-90. All field activities were performed by or under the direct observation of a State of California Certified Engineering Geologist.

Test Description and Results

The falling head percolation testing method was used in accordance with the above-referenced Handbook. The borings for the percolation tests were advanced using an 8-inch diameter hollow-stem auger to depths of approximately 7 to 8 feet below the existing ground surface. Percolation testing was performed in the bottom one foot of the boreholes, within the alluvial deposits. The locations of the percolation test borings are shown on Figure 2. Logs of percolation test borings are provided in Appendix A. A grain size analysis was performed on a representative soil sample. Laboratory results are presented in Appendix B.

Following a presoaking period, field testing was conducted in a perforated pipe lowered into the borehole, with ¾-inch gravel surrounding the pipe. Tests were conducted at 10-minute intervals for a period of approximately one hour. The falling-head percolation test data were utilized in determining the test infiltration rate, I_t, expressed in units of inches/hour, utilizing the Porchet Method (RCFCWCD, 2011). The infiltration rate, I_t, was calculated by determining the volumetric water flow rate through the wetted borehole surface area. The un-factored test results are summarized in the following table, Table 1. It should be noted that infiltration rates were higher than measurable in accordance the Handbook, as such, the time to record a drop of 12 inches was used in the time interval column on the percolation test sheets.

TABLE 1

Un-Factored Infiltration Test Results

Test No.	Borehole Total Depth (feet)	Approx. Test Zone (feet below existing grade)	Geologic Unit / Soil Description	Infiltration Test Rate, I_t (in/hr)
P-1	8	7-8	Qal Poorly Graded Silty SAND with Gravel (SP-SM)	29.38
P-2	7.5	6.5-7.5	Qal Poorly Graded SAND (SP)	29.48
P-3	7	6-7	Qal Silty SAND (SM)	29.48
P-4	8	7-8	Qal Poorly Graded SAND (SP)	29.48

The test data indicates the alluvial deposits at the depths evaluated are considered permeable. It is our professional opinion that the infiltration rates measured 7 to 8 feet below ground surface, as well as the material descriptions, are indicative of sufficient permeability to be suitable for the intended infiltration purposes.

Discussion

Suitability Assessment

In view of the test data, certain jurisdictions consider such factors as infiltration assessment method, soil texture, site soils variability, and depth to groundwater/impervious layer to assign a Suitability Assessment Safety Factor that should be applied to the infiltration rates.

To perform such an evaluation, we have adopted a procedure provided by Santa Ana Regional Water Quality Control Board (SARWQCB) in their Technical Guidance Document (TGD) for the Preparation of Conceptual/Preliminary and/or Project Water Quality Management Plans (WQMPs), with Appendices, For Santa Ana Regional Board consideration, dated December 20, 2013 (SARWQCB, 2013). Based on Appendix D of this document, using Table VII.3: Suitability Assessment Related Considerations for Infiltration Facility Safety Factors, and Worksheet H: Factor of Safety and Design Infiltration Rate and Worksheet, of the Orange County BMP Design Manual, the following is presented.

TABLE 2

Site Suitability Reduction Factor (Category A) for Infiltration Rate

Considerations		**Concern**		**Reduction Factor**
Description	**Weight**	**Level**	**Safety Factor**	**Weight x Safety Factor**
Soil Assessment Method	0.25	Low	1.0	0.25
Predominant Soil Texture	0.25	Low	1.0	0.25
Site Soil Variability	0.50	Medium	1.0	0.50
Depth to Groundwater/Impervious Layer	0.25	Low	1.0	0.25
Reduction Factor (sum of individual Reduction Factors)				**1.25**

Based on the information provided in Table 2, a Reduction Factor of 1.25 should be applied to the values of Infiltration Rate, I_t, provided in Table 1, above, for Site Suitability considerations.

Construction Procedure

The infiltration rates provided herein are considered representative of the native soils in the vicinity of the percolation test locations. Care should be taken to minimize disturbance of the exposed bottom surface of the basins as fill placement or any compaction effort applied to the area will have a detrimental effect on the anticipated infiltration rate of the proposed infiltration areas.

Environmental Impact

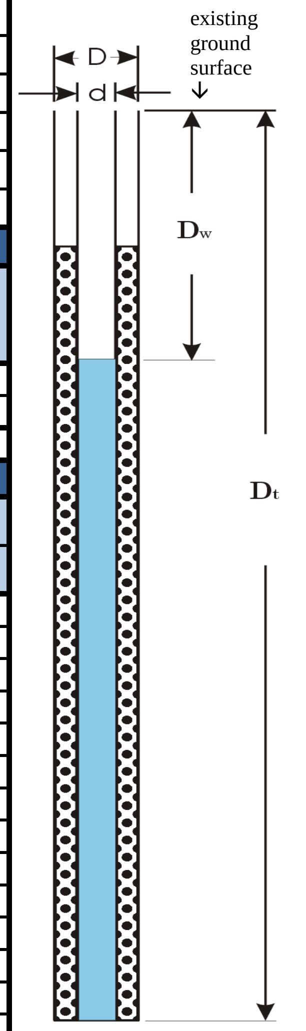
It should be noted that clean, potable water was used for the test. Surface runoff usually carries with it debris and fine particles that are typically expected to reduce the calculated infiltration rate.

Factor of Safety

The values of infiltration rate provided in Table 1 are raw test values. As discussed above, these values should be corrected for site suitability considerations by applying a Reduction factor as provided in Table 2. Further, the project civil engineer needs to consider a Design Safety Factor, which incorporates such items as tributary area size, level of pretreatment/expected sediment load, redundancy/contingency plan, and compaction during construction, in combination with the Suitability Assessment Safety/Reduction Factor for the design of the system.

Boring/Test Number: P-1

Total Depth of Boring, D_T (ft):	8	**Test Date:**	3/27/2024
Diameter of Hole, D (in):	6	**Tested By:**	SS
Diameter of Casing, d (in):	2	**USCS Soil Type:**	SP-SM
Depth of Slotted Casing (ft):	3 to 8	**Depth to Groundwater (ft):**	
Porosity of Annulus Material, *n* :	0.44	**Ground Elevation (msl ft):**	1445
Depth from Existing Ground Surface to Bottom of Prop. Infiltration System (ft):			



SANDY SOIL CRITERIA TEST

Trial No.	Time Interval Δt (min.)	Depth to Water, D_w		Change in Water Level ΔD (in.)	Change in Height of Water Greater Than or Equal to 6"? (Yes/No)*
		Initial, D_o (ft.)	Final, D_f (ft.)		
1	25	6.90	8.04	13.68	yes
2	25	6.90	8.04	13.68	yes

Standard Time Interval Between Readings (min.), [* if yes = 10, if no = 30]: 10

PERCOLATION TEST

Trial No.	Time Interval Δt (min.)	Depth to Water, D_w		Change in Water Level ΔH (in.)	Percolation Rate	
		Initial, D_o (ft.)	Final, D_f (ft.)		(min/in.)	(gal/day/ft^2)
1	2.07	6.90	7.90	12.00	0.17	450.60
2	2.53	6.90	7.90	12.00	0.21	368.67
3	2.67	6.90	7.90	12.00	0.22	349.34
4	2.83	6.90	7.90	12.00	0.24	329.59
5	2.83	6.90	7.90	12.00	0.24	329.59
6	2.83	6.90	7.90	12.00	0.24	329.59

TEST RESULTS**

Infiltration Rate [Porchet Method]# (inches/hour)	Percolation Rate	
	(min/in.)	(gal/day/ft^2)
29.38	**0.24**	**329.59**

**Raw Results. Does Not Include a Factor of Safety

FACTOR OF SAFETY

Testing Option	Testing Requirements	Factor of Safety per Reference
Option 2	**4 tests minimum with at least two borings per basin**	**3**

Where Infiltration Rate, $I_t = \Delta H (60r) / \Delta t (r + 2H_{avg})$

$r = D / 2$

$H_o = D_T - D_o$

$H_f = D_T - D_f$

$\Delta H = \Delta D = H_o - H_f$

$H_{avg} = (H_o + H_f) / 2$

Reference:
RCFCWCD, Design Handbook for LID, dated September, 2011

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PERCOLATION TEST SUMMARY

Highland Ranch
Highland, CA

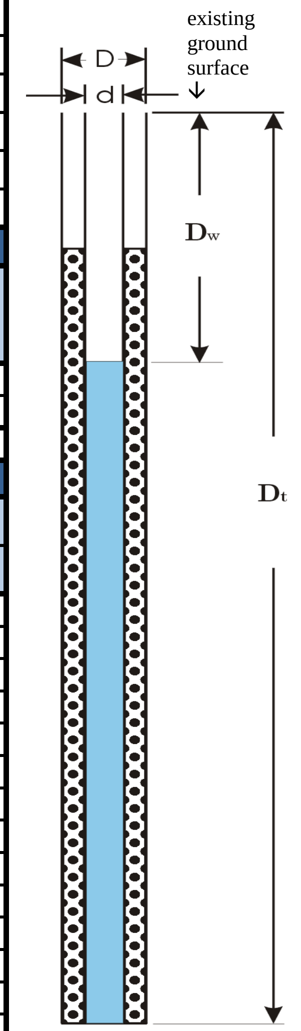
PETRA GEOSCIENCES INC.

DATE: August, 2024
J.N.: 24-156

Appendix C

Boring/Test Number: P-2

Total Depth of Boring, D_T (ft):	7.5	**Test Date:**	3/27/2024
Diameter of Hole, D (in):	6	**Tested By:**	SS
Diameter of Casing, d (in):	2	**USCS Soil Type:**	SP
Depth of Slotted Casing (ft):	2.5 to 7.5	**Depth to Groundwater (ft):**	
Porosity of Annulus Material, *n* :	0.44	**Ground Elevation (msl ft):**	1448
Depth from Existing Ground Surface to Bottom of Prop. Infiltration System (ft):			



SANDY SOIL CRITERIA TEST

Trial No.	Time Interval Δt (min.)	Depth to Water, D_w		Change in Water Level ΔD (in.)	Change in Height of Water Greater Than or Equal to 6"? (Yes/No)*
		Initial, D_o (ft.)	Final, D_f (ft.)		
1	25	6.40	7.45	12.6	yes
2	25	6.40	7.48	12.96	yes

Standard Time Interval Between Readings (min.), [* if yes = 10, if no = 30]: 10

PERCOLATION TEST

Trial No.	Time Interval Δt (min.)	Depth to Water, D_w		Change in Water Level ΔH (in.)	Percolation Rate	
		Initial, D_o (ft.)	Final, D_f (ft.)		(min/in.)	(gal/day/ft^2)
1	3.33	6.40	7.40	12.00	0.28	280.10
2	3.75	6.40	7.40	12.00	0.31	248.73
3	3.93	6.40	7.40	12.00	0.33	237.34
4	3.98	6.40	7.40	12.00	0.33	234.36
5	4.20	6.40	7.40	12.00	0.35	222.08
6	4.13	6.40	7.40	12.00	0.34	225.85
7	4.25	6.40	7.40	12.00	0.35	219.47
8	4.23	6.40	7.40	12.00	0.35	220.51
9	4.25	6.40	7.40	12.00	0.35	219.47
10	4.25	6.40	7.40	12.00	0.35	219.47

TEST RESULTS**

Infiltration Rate [Porchet Method][#] (inches/hour)	Percolation Rate	
	(min/in.)	(gal/day/ft^2)
20.13	**0.34**	**225.85**

**Raw Results. Does Not Include a Factor of Safety

FACTOR OF SAFETY

Testing Option	Testing Requirements	Factor of Safety per Reference
Option 2	**4 tests minimum with at least two borings per basin**	**3**

[#] Where Infiltration Rate, $I_t = \Delta H\ (60r) / \Delta t\ (r + 2H_{avg})$

$r = D / 2$

$H_o = D_T - D_o$

$H_f = D_T - D_f$

$\Delta H = \Delta D = H_o - H_f$

$H_{avg} = (H_o + H_f) / 2$

Reference:
RCFCWCD, Design Handbook for LID, dated September, 2011

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PERCOLATION TEST SUMMARY

Highland Ranch
Highland, CA

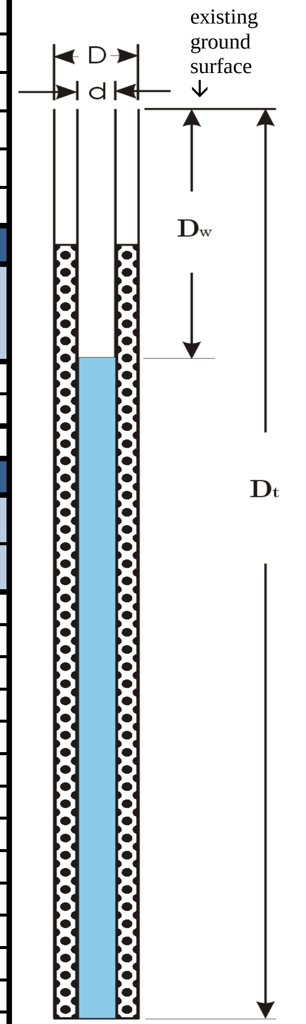
PETRA GEOSCIENCES

DATE: August, 2024
J.N.: 24-156

Appendix C

Boring/Test Number: P-3

Total Depth of Boring, D_T (ft):	7	**Test Date:**	3/27/2024
Diameter of Hole, D (in):	6	**Tested By:**	SS
Diameter of Casing, d (in):	2	**USCS Soil Type:**	SM
Depth of Slotted Casing (ft):	2 to 7	**Depth to Groundwater (ft):**	
Porosity of Annulus Material, *n* :	0.44	**Ground Elevation (msl ft):**	1458
Depth from Existing Ground Surface to Bottom of Prop. Infiltration System (ft):			



SANDY SOIL CRITERIA TEST

Trial No.	Time Interval Δt (min.)	Depth to Water, D_w		Change in Water Level ΔD (in.)	Change in Height of Water Greater Than or Equal to 6"? (Yes/No)*
		Initial, D_o (ft.)	Final, D_f (ft.)		
1	25	5.90	7.18	15.36	yes
2	25	5.90	7.19	15.48	yes

Standard Time Interval Between Readings (min.), [* if yes = 10, if no = 30]: 10

PERCOLATION TEST

Trial No.	Time Interval Δt (min.)	Depth to Water, D_w		Change in Water Level ΔH (in.)	Percolation Rate	
		Initial, D_o (ft.)	Final, D_f (ft.)		(min/in.)	(gal/day/ft^2)
1	2.52	5.90	6.90	12.00	0.21	370.14
2	2.73	5.90	6.90	12.00	0.23	341.66
3	2.82	5.90	6.90	12.00	0.24	330.76
4	2.80	5.90	6.90	12.00	0.23	333.12
5	2.80	5.90	6.90	12.00	0.23	333.12
6	2.82	5.90	6.90	12.00	0.24	330.76

TEST RESULTS**

Infiltration Rate [Porchet Method][#] (inches/hour)	Percolation Rate	
	(min/in.)	(gal/day/ft^2)
29.48	**0.24**	**330.76**

**Raw Results. Does Not Include a Factor of Safety

FACTOR OF SAFETY

Testing Option	Testing Requirements	Factor of Safety per Reference
Option 2	**4 tests minimum with at least two borings per basin**	**3**

[#] Where Infiltration Rate, It = $\Delta H (60r) / \Delta t (r + 2H_{avg})$

$r = D / 2$

$H_o = D_T - D_o$

$H_f = D_T - D_f$

$\Delta H = \Delta D = H_o - H_f$

$H_{avg} = (H_o + H_f) / 2$

Reference:
RCFCWCD, Design Handbook for LID, dated September, 2011

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COSTA MESA TEMECULA LOS ANGELES PALM DESERT CORONA ESCONDIDO

PERCOLATION TEST SUMMARY

Highland Ranch
Highland, CA

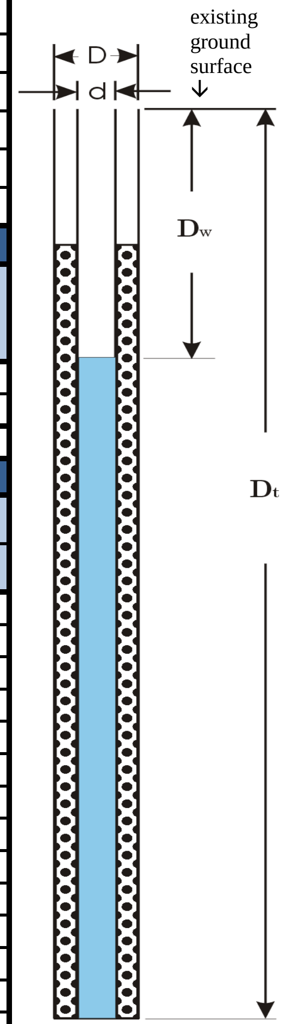
PETRA GEOSCIENCES

DATE: August, 2024
J.N.: 24-156

Appendix C

Boring/Test Number: P-4

Total Depth of Boring, D_T (ft):	8	**Test Date:**	3/27/2024
Diameter of Hole, D (in):	6	**Tested By:**	SS
Diameter of Casing, d (in):	2	**USCS Soil Type:**	SP
Depth of Slotted Casing (ft):	3 to 8	**Depth to Groundwater (ft):**	
Porosity of Annulus Material, *n* :	0.44	**Ground Elevation (msl ft):**	1461
Depth from Existing Ground Surface to Bottom of Prop. Infiltration System (ft):			



SANDY SOIL CRITERIA TEST

Trial No.	Time Interval Δt (min.)	Depth to Water, D_w		Change in Water Level ΔD (in.)	Change in Height of Water Greater Than or Equal to 6"? (Yes/No)*
		Initial, D_o (ft.)	Final, D_f (ft.)		
1	25	6.90	7.98	12.96	yes
2	25	6.90	7.98	12.96	yes

Standard Time Interval Between Readings (min.), [* if yes = 10, if no = 30]: 10

PERCOLATION TEST

Trial No.	Time Interval Δt (min.)	Depth to Water, D_w		Change in Water Level ΔH (in.)	Percolation Rate	
		Initial, D_o (ft.)	Final, D_f (ft.)		(min/in.)	(gal/day/ft^2)
1	2.52	6.90	7.90	12.00	0.21	370.14
2	2.73	6.90	7.90	12.00	0.23	341.66
3	2.82	6.90	7.90	12.00	0.24	330.76
4	2.80	6.90	7.90	12.00	0.23	333.12
5	2.80	6.90	7.90	12.00	0.23	333.12
6	2.82	6.90	7.90	12.00	0.24	330.76

TEST RESULTS**

Infiltration Rate [Porchet Method]# (inches/hour)	Percolation Rate	
	(min/in.)	(gal/day/ft^2)
29.48	**0.24**	**330.76**

**Raw Results. Does Not Include a Factor of Safety

FACTOR OF SAFETY

Testing Option	Testing Requirements	Factor of Safety per Reference
Option 2	**4 tests minimum with at least two borings per basin**	**3**

Where Infiltration Rate, $I_t = \Delta H\,(60r) / \Delta t\,(r + 2H_{avg})$

$r = D / 2$

$H_o = D_T - D_o$

$H_f = D_T - D_f$

$\Delta H = \Delta D = H_o - H_f$

$H_{avg} = (H_o + H_f) / 2$

Reference:
RCFCWCD, Design Handbook for LID, dated September, 2011

PETRA GEOSCIENCES, INC.
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PHONE: (714) 549-8921
COSTA MESA TEMECULA LOS ANGELES PALM DESERT CORONA ESCONDIDO

PERCOLATION TEST SUMMARY

Highland Ranch
Highland, CA

PETRA GEOSCIENCES INC.

DATE: August, 2024	**Appendix C**
J.N.: 24-156	

APPENDIX D

STANDARD GRADING SPECIFICATIONS

STANDARD GRADING SPECIFICATIONS

These specifications present the usual and minimum requirements for projects on which Petra Geosciences, Inc. (Petra) is the geotechnical consultant. No deviation from these specifications will be allowed, except where specifically superseded in the preliminary geology and soils report, or in other written communication signed by the Soils Engineer and Engineering Geologist of record (Geotechnical Consultant).

I. GENERAL

A. The Geotechnical Consultant is the Owner's or Builder's representative on the project. For the purpose of these specifications, participation by the Geotechnical Consultant includes that observation performed by any person or persons employed by, and responsible to, the licensed Soils Engineer and Engineering Geologist signing the soils report.

B. The contractor should prepare and submit to the Owner and Geotechnical Consultant a work plan that indicates the sequence of earthwork grading, the number of "spreads" and the estimated quantities of daily earthwork to be performed prior to the commencement of grading. This work plan should be reviewed by the Geotechnical Consultant to schedule personnel to perform the appropriate level of observation, mapping, and compaction testing as necessary.

C. All clearing, site preparation, or earthwork performed on the project shall be conducted by the Contractor in accordance with the recommendations presented in the geotechnical report and under the observation of the Geotechnical Consultant.

D. It is the Contractor's responsibility to prepare the ground surface to receive the fills to the satisfaction of the Geotechnical Consultant and to place, spread, mix, water, and compact the fill in accordance with the specifications of the Geotechnical Consultant. The Contractor shall also remove all material considered unsatisfactory by the Geotechnical Consultant.

E. It is the Contractor's responsibility to have suitable and sufficient compaction equipment on the job site to handle the amount of fill being placed. If necessary, excavation equipment will be shut down to permit completion of compaction to project specifications. Sufficient watering apparatus will also be provided by the Contractor, with due consideration for the fill material, rate of placement, and time of year.

F. After completion of grading a report will be submitted by the Geotechnical Consultant.

II. SITE PREPARATION

A. Clearing and Grubbing

1. All vegetation such as trees, brush, grass, roots, and deleterious material shall be disposed of offsite. This removal shall be concluded prior to placing fill.

2. Any underground structures such as cesspools, cisterns, mining shafts, tunnels, septic tanks, wells, pipe lines, etc., are to be removed or treated in a manner prescribed by the Geotechnical Consultant.

III. FILL AREA PREPARATION

A. Remedial Removals/Overexcavations

1. Remedial removals, as well as overexcavation for remedial purposes, shall be evaluated by the Geotechnical Consultant. Remedial removal depths presented in the geotechnical report and shown on the geotechnical plans are estimates only. The actual extent of removal should be determined by the Geotechnical Consultant based on the conditions exposed during grading. All soft, loose, dry, saturated, spongy, organic-rich, highly fractured or otherwise unsuitable ground shall be overexcavated to competent ground as determined by the Geotechnical Consultant.

2. Soil, alluvium, or bedrock materials determined by the Soils Engineer as being unsuitable for placement in compacted fills shall be removed from the site. Any material incorporated as a part of a compacted fill must be approved by the Geotechnical Consultant.

3. Should potentially hazardous materials be encountered, the Contractor should stop work in the affected area. An environmental consultant specializing in hazardous materials should be notified immediately for evaluation and handling of these materials prior to continuing work in the affected area.

B. Evaluation/Acceptance of Fill Areas

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

C. Processing

After the ground surface to receive fill has been declared satisfactory for support of fill by the Geotechnical Consultant, it shall be scarified to a minimum depth of 6 inches and until the ground surface is uniform and free from ruts, hollows, hummocks, or other uneven features which may prevent uniform compaction.

The scarified ground surface shall then be brought to optimum moisture, mixed as required, and compacted to a minimum relative compaction of 90 percent.

D. Subdrains

Subdrainage devices shall be constructed in compliance with the ordinances of the controlling governmental agency, and/or with the recommendations of the Geotechnical Consultant. (Typical Canyon Subdrain details are given on Plate SG-1).

E. Cut/Fill & Deep Fill/Shallow Fill Transitions

In order to provide uniform bearing conditions in cut/fill and deep fill/shallow fill transition lots, the cut and shallow fill portions of the lot should be overexcavated to the depths and the horizontal limits discussed in the approved geotechnical report and replaced with compacted fill. (Typical details are given on Plate SG-7.)

STANDARD GRADING SPECIFICATIONS

IV. COMPACTED FILL MATERIAL

A. General

Materials excavated on the property may be utilized in the fill, provided each material has been determined to be suitable by the Geotechnical Consultant. Material to be used for fill shall be essentially free of organic material and other deleterious substances. Roots, tree branches, and other matter missed during clearing shall be removed from the fill as recommended by the Geotechnical Consultant. Material that is spongy, subject to decay, or otherwise considered unsuitable shall not be used in the compacted fill.

Soils of poor quality, such as those with unacceptable gradation, high expansion potential, or low strength shall be placed in areas acceptable to the Geotechnical Consultant or mixed with other soils to achieve satisfactory fill material.

B. Oversize Materials

Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 12 inches in diameter, shall be taken offsite or placed in accordance with the recommendations of the Geotechnical Consultant in areas designated as suitable for rock disposal (Typical details for Rock Disposal are given on Plate SG-4).

Rock fragments less than 12 inches in diameter may be utilized in the fill provided, they are not nested or placed in concentrated pockets; they are surrounded by compacted fine grained soil material and the distribution of rocks is approved by the Geotechnical Consultant.

C. Laboratory Testing

Representative samples of materials to be utilized as compacted fill shall be analyzed by the laboratory of the Geotechnical Consultant to determine their physical properties. If any material other than that previously tested is encountered during grading, the appropriate analysis of this material shall be conducted by the Geotechnical Consultant as soon as possible.

D. Import

If importing of fill material is required for grading, proposed import material should meet the requirements of the previous section. The import source shall be given to the Geotechnical Consultant at least 2 working days prior to importing so that appropriate tests can be performed and its suitability determined.

V. FILL PLACEMENT AND COMPACTION

A. Fill Layers

Material used in the compacting process shall be evenly spread, watered, processed, and compacted in thin lifts not to exceed 6 inches in thickness to obtain a uniformly dense layer. The fill shall be placed and compacted on a horizontal plane, unless otherwise approved by the Geotechnical Consultant.

B. Moisture Conditioning

Fill soils shall be watered, dried back, blended, and/or mixed, as necessary to attain a relatively uniform moisture content at or slightly above optimum moisture content.

C. Compaction

Each layer shall be compacted to 90 percent of the maximum density in compliance with the testing method specified by the controlling governmental agency. (In general, ASTM D 1557-02, will be used.)

If compaction to a lesser percentage is authorized by the controlling governmental agency because of a specific land use or expansive soils condition, the area to received fill compacted to less than 90 percent shall either be delineated on the grading plan or appropriate reference made to the area in the soils report.

D. Failing Areas

If the moisture content or relative density varies from that required by the Geotechnical Consultant, the Contractor shall rework the fill until it is approved by the Geotechnical Consultant.

E. Benching

All fills shall be keyed and benched through all topsoil, colluvium, alluvium or creep material, into sound bedrock or firm material where the slope receiving fill exceeds a ratio of 5 horizontal to 1 vertical, in accordance with the recommendations of the Geotechnical Consultant.

VI. SLOPES

A. Fill Slopes

The contractor will be required to obtain a minimum relative compaction of 90 percent out to the finish slope face of fill slopes, buttresses, and stabilization fills. 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, or by any other procedure that produces the required compaction.

B. Side Hill Fills

The key for side hill fills shall be a minimum of 15 feet within bedrock or firm materials, unless otherwise specified in the soils report. (See detail on Plate SG-5.)

C. Fill-Over-Cut Slopes

Fill-over-cut slopes shall be properly keyed through topsoil, colluvium or creep material into rock or firm materials, and the transition shall be stripped of all soils prior to placing fill. (see detail on Plate SG-6).

D. Landscaping

All fill slopes should be planted or protected from erosion by other methods specified in the soils report.

E. Cut Slopes

1. The Geotechnical Consultant should observe all cut slopes at vertical intervals not exceeding 10 feet.

2. If any conditions not anticipated in the preliminary report such as perched water, seepage, lenticular or confined strata of a potentially adverse nature, unfavorably inclined bedding, joints or fault planes are encountered during grading, these conditions shall be evaluated by the Geotechnical Consultant, and recommendations shall be made to treat these problems (Typical details for stabilization of a portion of a cut slope are given in Plates SG-2 and SG-3.).

3. Cut slopes that face in the same direction as the prevailing drainage shall be protected from slope wash by a non-erodible interceptor swale placed at the top of the slope.

4. Unless otherwise specified in the soils and geological report, no cut slopes shall be excavated higher or steeper than that allowed by the ordinances of controlling governmental agencies.

5. Drainage terraces shall be constructed in compliance with the ordinances of controlling governmental agencies, or with the recommendations of the Geotechnical Consultant.

VII. GRADING OBSERVATION

A. General

All cleanouts, processed ground to receive fill, key excavations, subdrains, and rock disposals must be observed and approved by the Geotechnical Consultant prior to placing any fill. It shall be the Contractor's responsibility to notify the Geotechnical Consultant when such areas are ready.

B. Compaction Testing

Observation of the fill placement shall be provided by the Geotechnical Consultant during the progress of grading. Location and frequency of tests shall be at the Consultants discretion based on field conditions encountered. Compaction test locations will not necessarily be selected on a random basis. Test locations may be selected to verify adequacy of compaction levels in areas that are judged to be susceptible to inadequate compaction.

C. Frequency of Compaction Testing

In general, density tests should be made at intervals not exceeding 2 feet of fill height or every 1000 cubic yards of fill placed. This criteria will vary depending on soil conditions and the size of the job. In any event, an adequate number of field density tests shall be made to verify that the required compaction is being achieved.

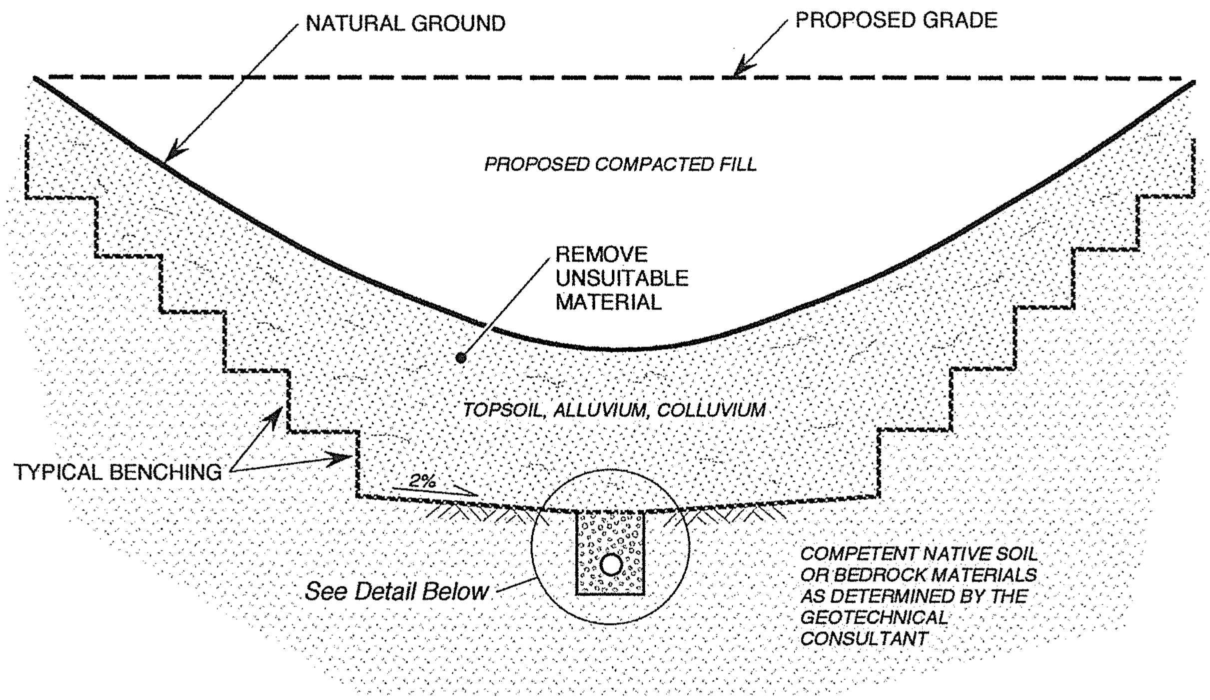
VIII. CONSTRUCTION CONSIDERATIONS

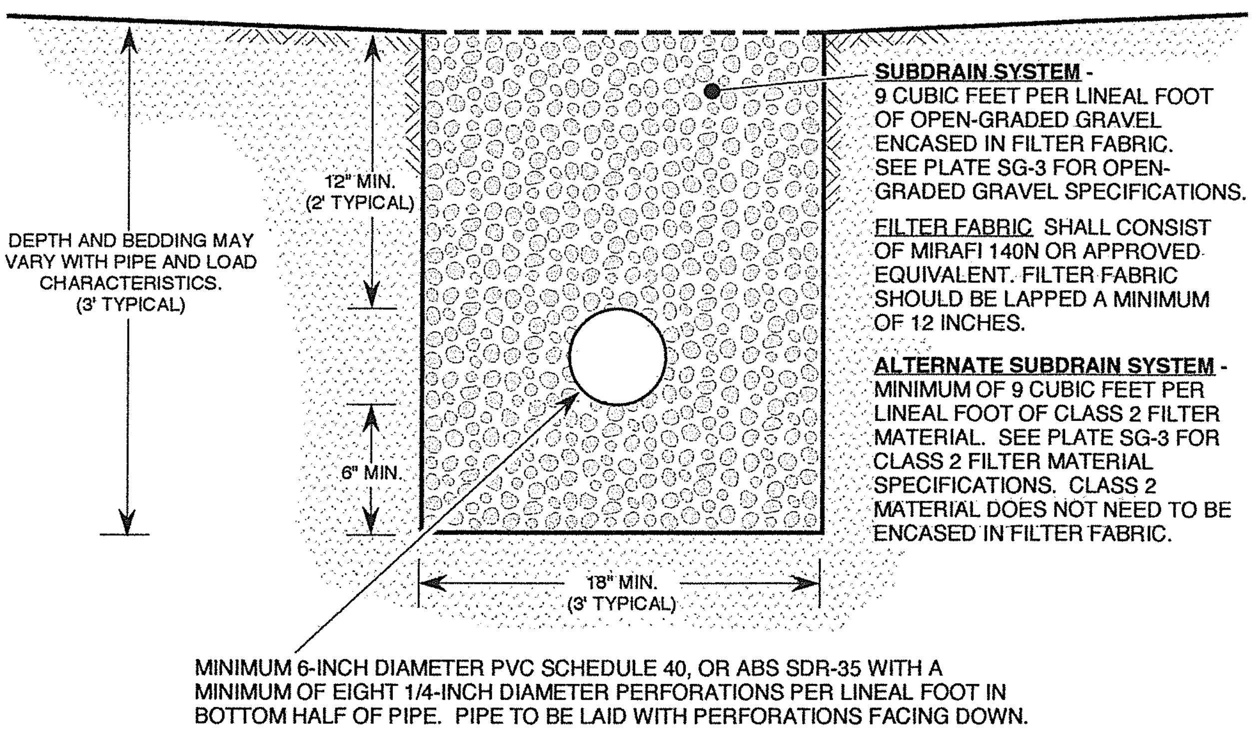
A. Erosion control measures, when necessary, shall be provided by the Contractor during grading and prior to the completion and construction of permanent drainage controls.

B. Upon completion of grading and termination of observations by the Geotechnical Consultant, no further filling or excavating, including that necessary for footings, foundations, large tree wells, retaining walls, or other features shall be performed without the approval of the Geotechnical Consultant.

C. Care shall be taken by the Contractor during final grading to preserve any berms, drainage terraces, interceptor swales, or other devices of permanent nature on or adjacent to the property.

S:\!BOILERS-WORK\REPORT INSERTS\STANDARD GRADING SPECS

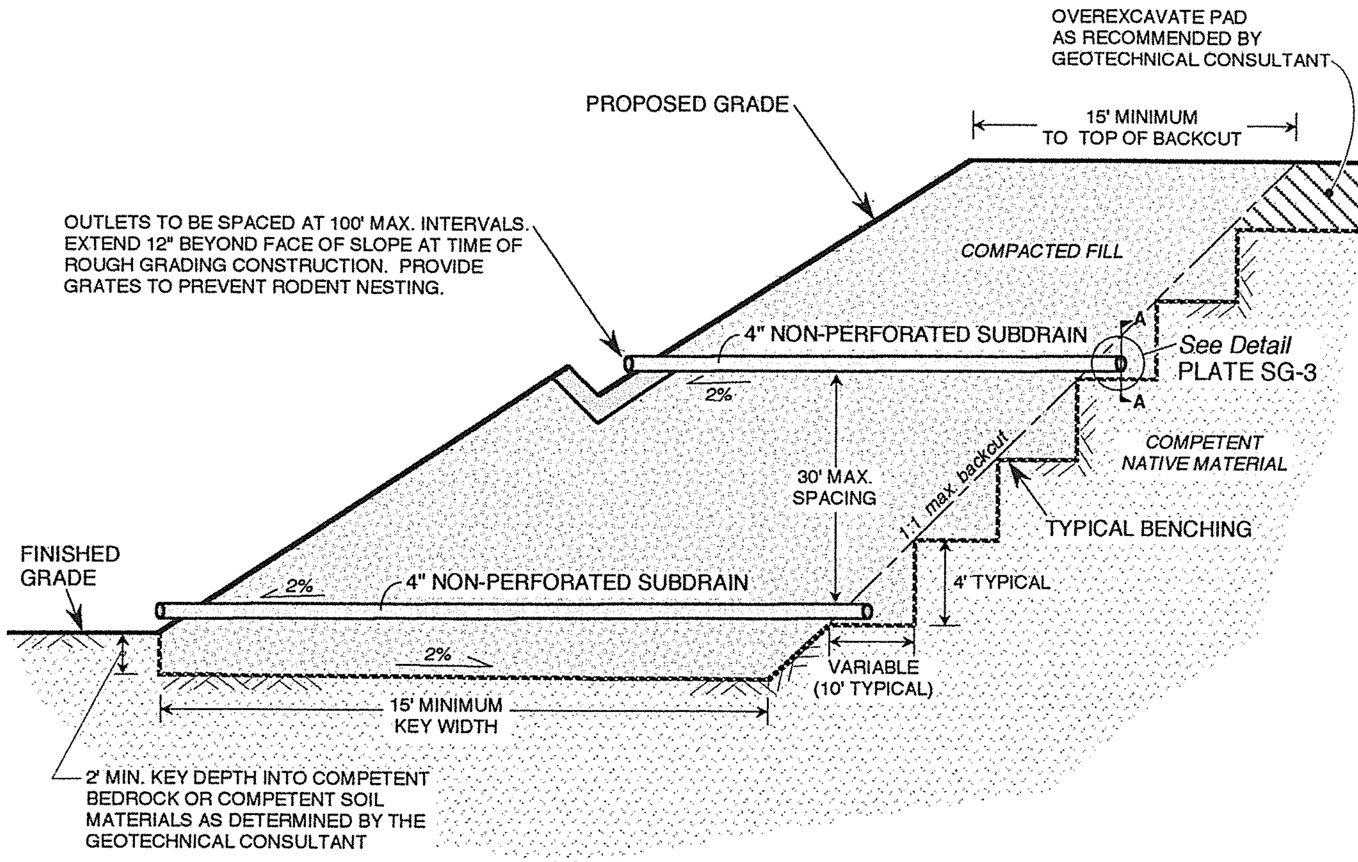




NOTES:

1. FOR CONTINUOUS RUNS IN EXCESS OF 500 FEET USE 8-INCH DIAMETER PIPE.
2. FINAL 20 FEET OF PIPE AT OUTLET SHALL BE NON-PERFORATED AND BACKFILLED WITH FINE-GRAINED MATERIAL.

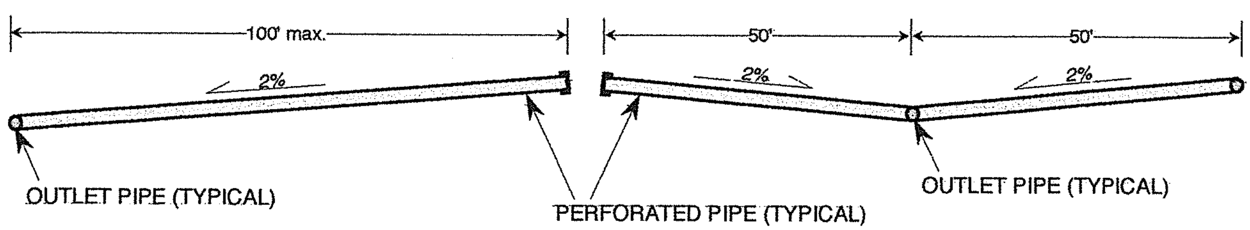
PETRA	CANYON SUBDRAIN DETAIL	PLATE SG-1



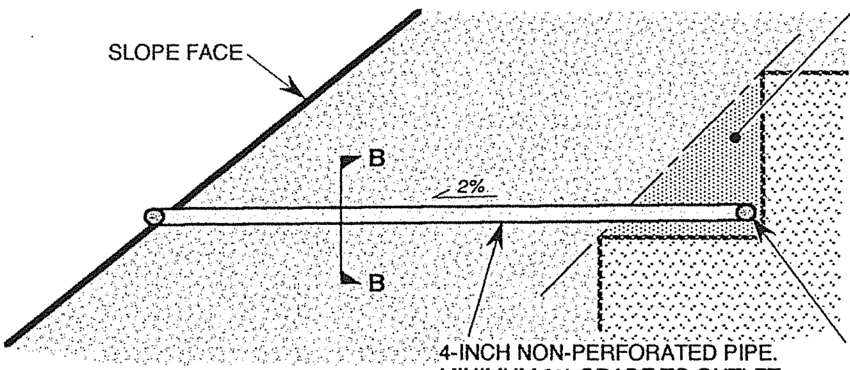
NOTES:

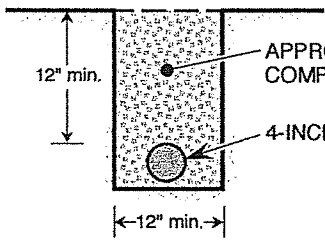
1. 30' MAXIMUM VERTICAL SPACING BETWEEN SUBDRAIN SYSTEMS.
2. 100' MAXIMUM HORIZONTAL DISTANCE BETWEEN NON-PERFORATED OUTLET PIPES. *(See Below)*
3. MINIMUM GRADIENT OF 2% FOR ALL PERFORATED AND NON-PERFORATED PIPE.

SECTION A-A (PERFORATED PIPE PROFILE)



PETRA	BUTTRESS OR STABILIZATION FILL DETAIL	PLATE SG-2





SECTION B-B (OUTLET PIPE)

PIPE SPECIFICATIONS:

1. 4-INCH MINIMUM DIAMETER, PVC SCHEDULE 40 OR ABS SDR-35.
2. FOR PERFORATED PIPE, MINIMUM 8 PERFORATIONS PER FOOT ON BOTTOM HALF OF PIPE.

FILTER MATERIAL/FABRIC SPECIFICATIONS:

OPEN-GRADED GRAVEL ENCASED IN FILTER FABRIC.
(MIRAFI 140N OR EQUIVALENT)

OPEN-GRADED GRAVEL

SIEVE SIZE	PERCENT PASSING
1 1/2-INCH	88 - 100
1-INCH	5 - 40
3/4-INCH	0 - 17
3/8-INCH	0 - 7
No. 200	0 - 3

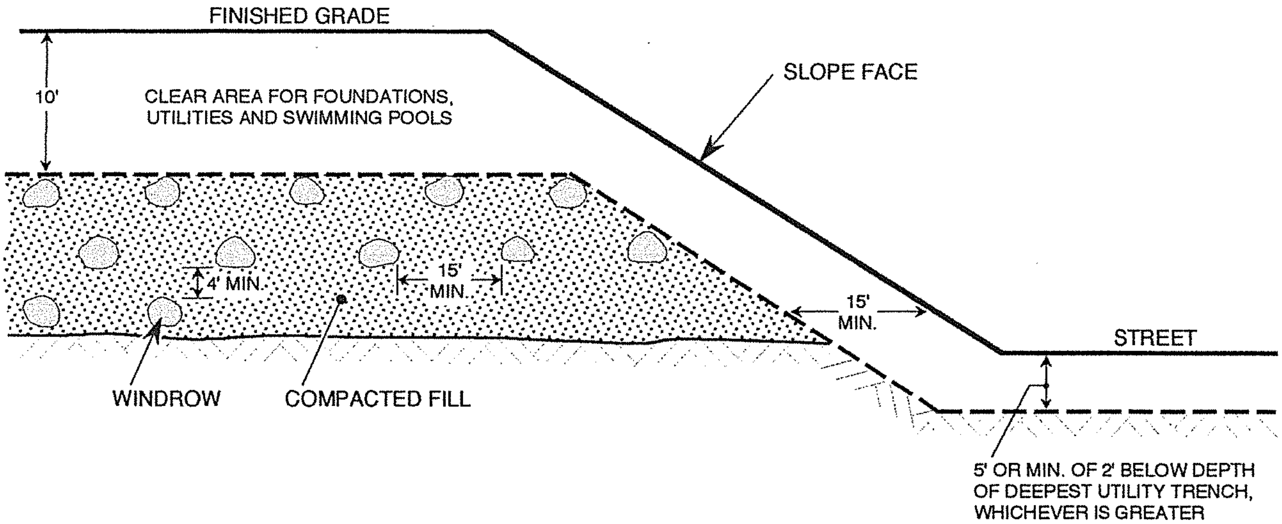
ALTERNATE:

CLASS 2 PERMEABLE FILTER MATERIAL PER CALTRANS STANDARD SPECIFICATION 68-1.025.

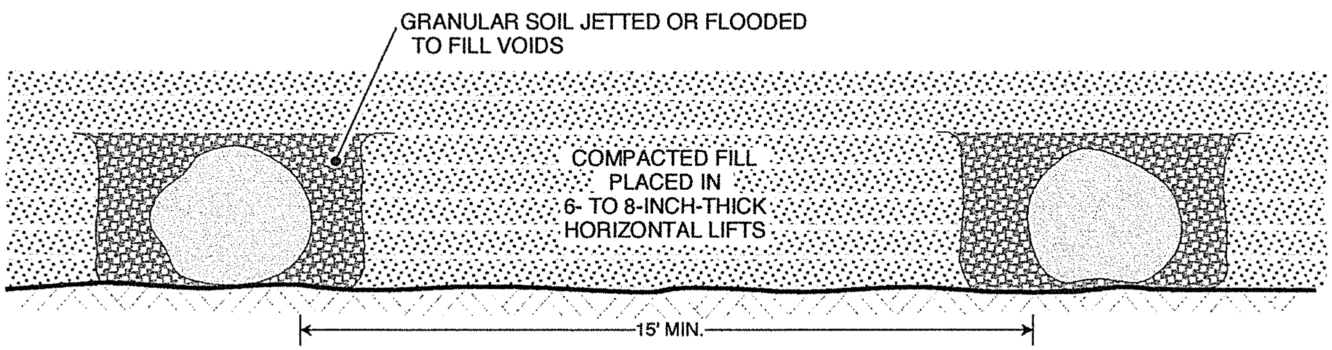
CLASS 2 FILTER MATERIAL

SIEVE SIZE	PERCENT PASSING
1-INCH	100
3/4-INCH	90 - 100
3/8-INCH	40 - 100
No. 4	25 - 40
No. 8	18 - 33
No. -30	5 - 15
No. -50	0 - 7
No. 200	0 - 3

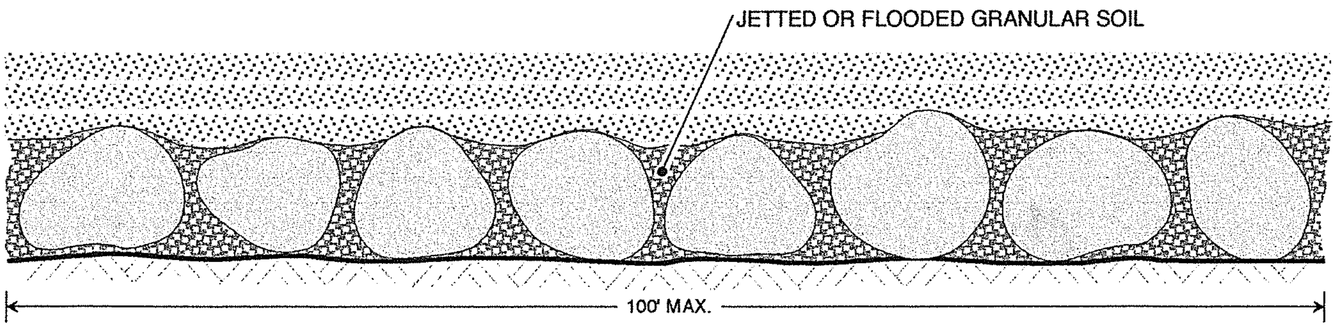
PETRA	BUTTRESS OR STABILIZATION FILL SUBDRAIN	PLATE SG-3



TYPICAL WINDROW DETAIL (END VIEW)

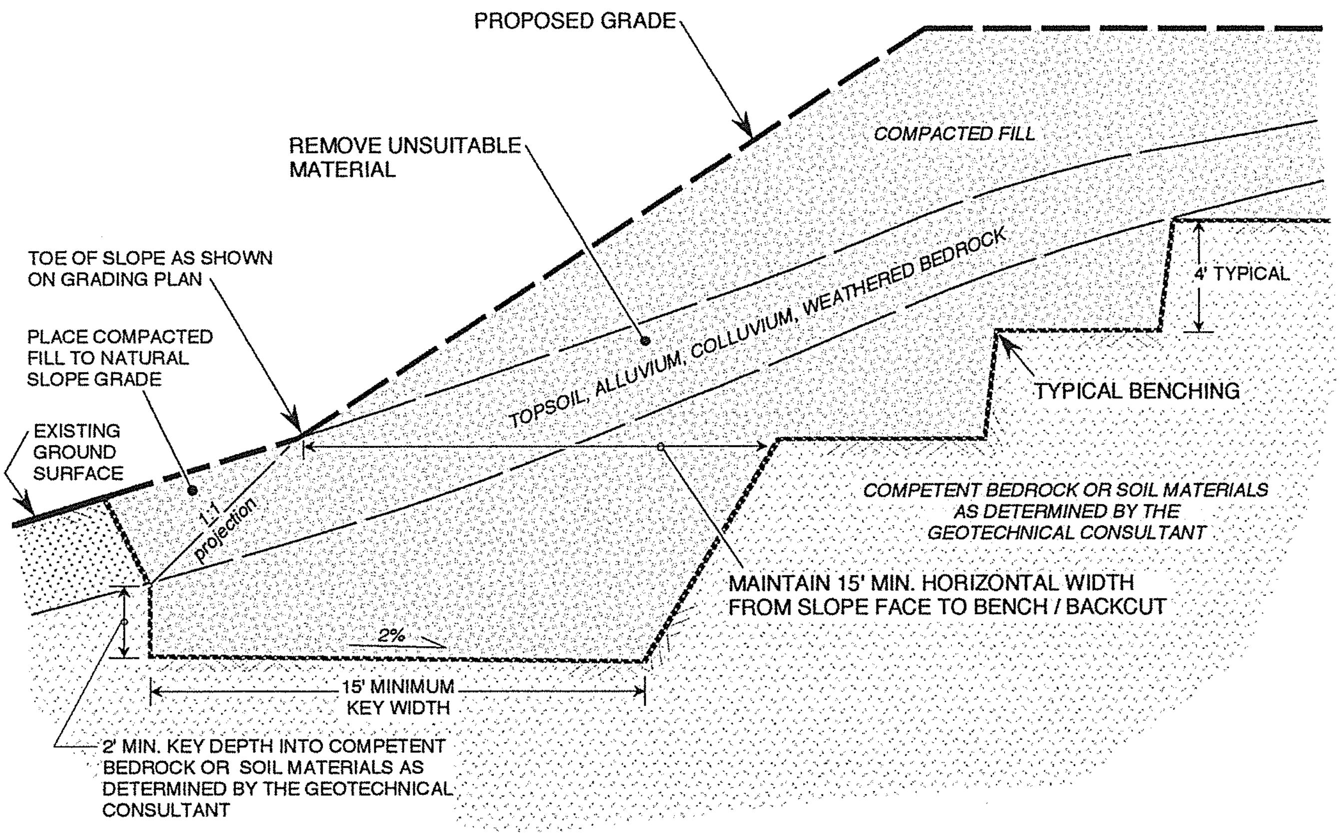


TYPICAL WINDROW DETAIL (PROFILE VIEW)



NOTE: OVERSIZE ROCK IS DEFINED AS CLASTS HAVING A MAXIMUM DIMENSION OF 12" OR LARGER

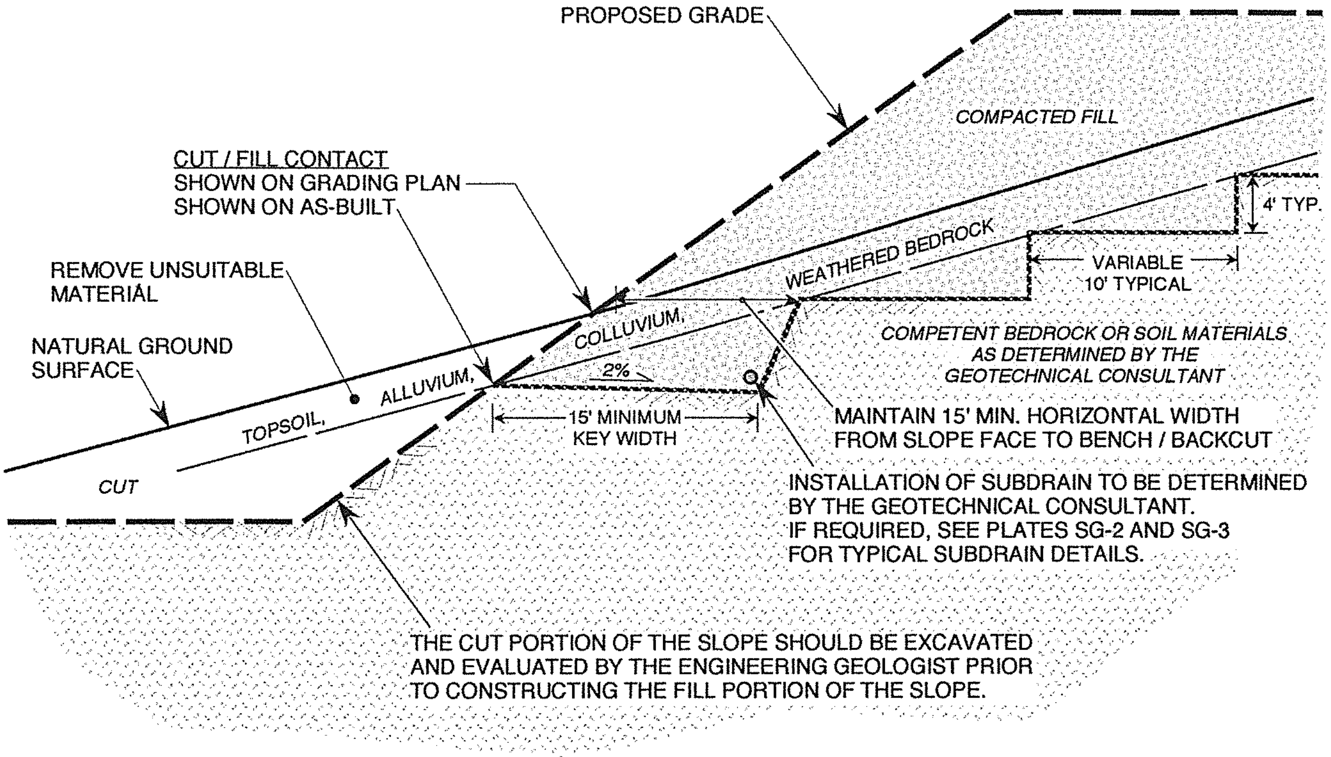
PETRA	TYPICAL ROCK DISPOSAL DETAIL	PLATE SG-4



NOTES:

1. WHERE NATURAL SLOPE GRADIENT IS 5:1 OR LESS, BENCHING IS NOT NECESSARY; HOWEVER, FILL IS NOT TO BE PLACED ON COMPRESSIBLE OR UNSUITABLE MATERIAL.
2. SOILS ENGINEER TO DETERMINE IF SUBDRAIN IS REQUIRED.

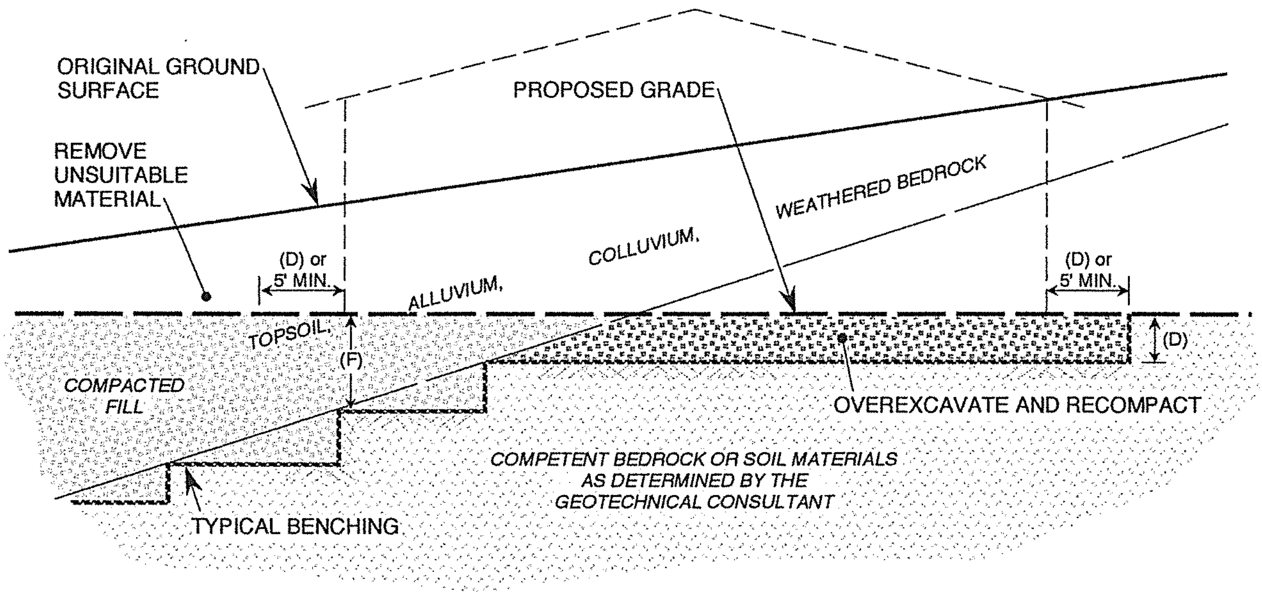
PETRA	FILL SLOPE ABOVE NATURAL SLOPE	PLATE SG-5



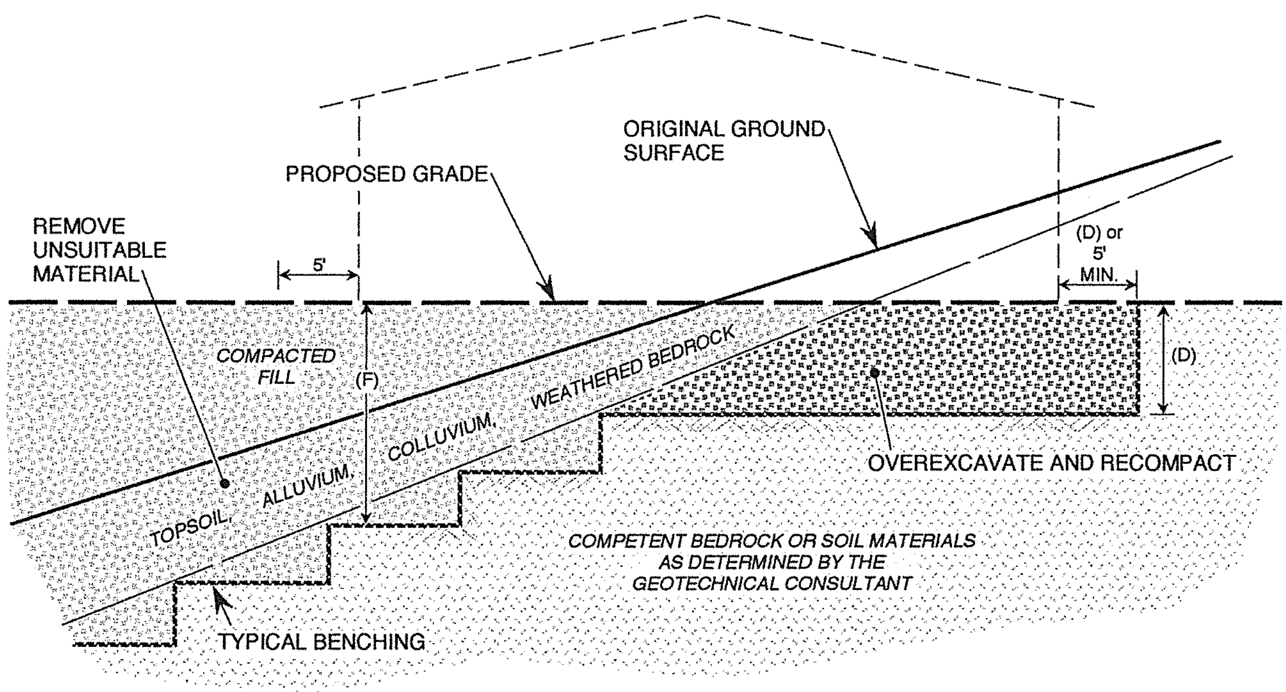
PETRA	FILL SLOPE ABOVE CUT SLOPE	PLATE SG-6

CUT LOT

UNSUITABLE MATERIAL EXPOSED IN PORTION OF CUT PAD



CUT-FILL TRANSITION LOT

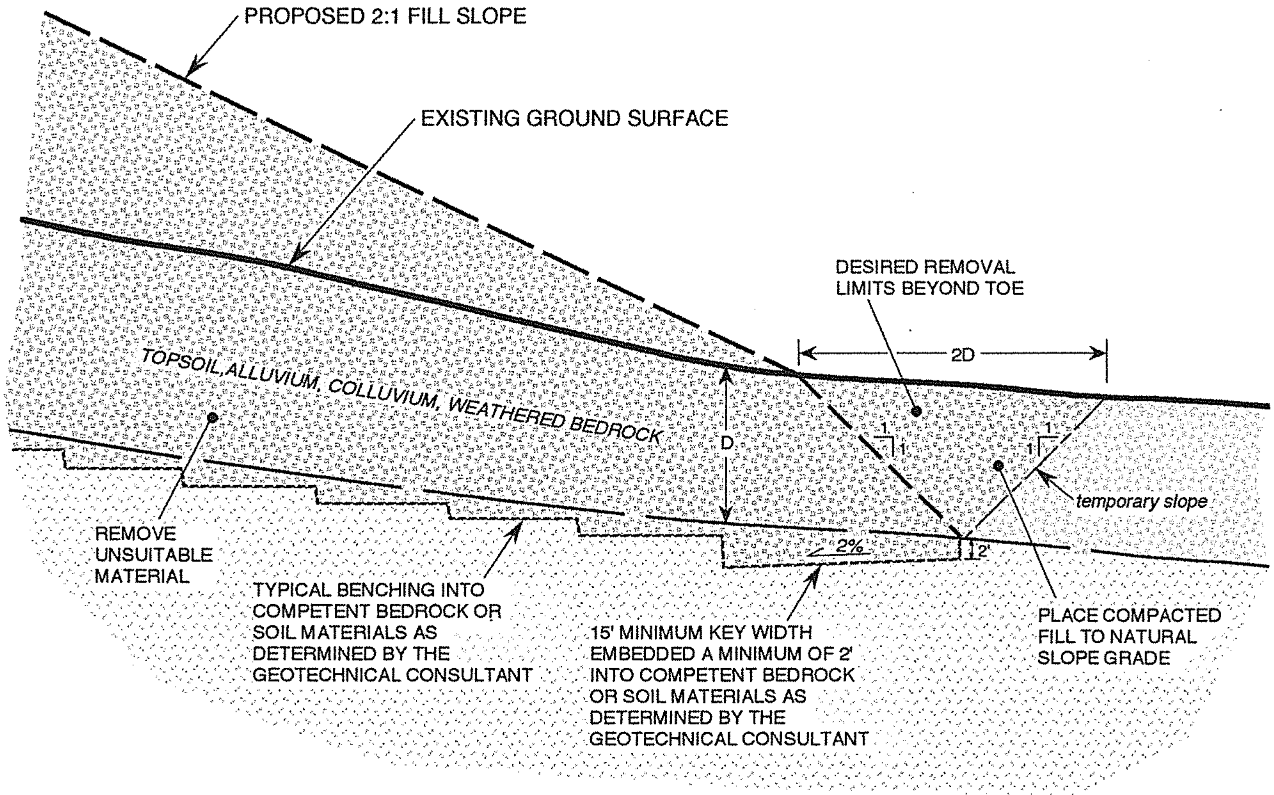


MAXIMUM FILL THICKNESS (F)	DEPTH OF OVEREXCAVATION (D)
FOOTING DEPTH TO 3 FEET	EQUAL DEPTH
3 TO 6 FEET	3 FEET
GREATER THAN 6 FEET	1/2 THE THICKNESS OF DEEPEST FILL PLACED WITHIN THE "FILL" PORTION (F) TO 15 FEET MAXIMUM

PETRA

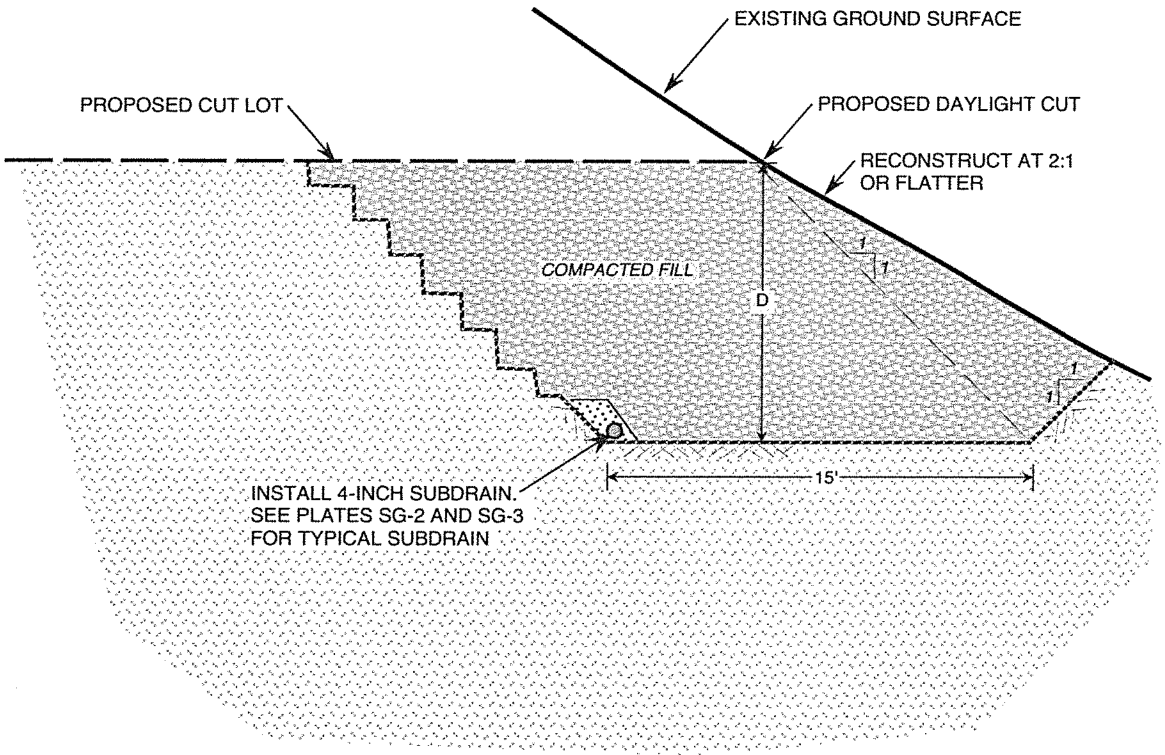
CUT LOTS AND CUT-FILL TRANSITION LOTS

PLATE SG-7



D = RECOMMENDED DEPTH OF REMOVAL
PER GEOTECHNICAL REPORT

PETRA	**TYPICAL REMOVALS BEYOND TOE OF PROPOSED FILL SLOPE**	**PLATE SG-8**



NOTE:

1. "D" SHALL BE 10 FEET MINIMUM OR AS DETERMINED BY SOILS ENGINEER.

PETRA	SHEAR KEY ON DAYLIGHT CUT LOTS	PLATE SG-9

Appendix I – Sizing Calculations

Channel Report

GREENSPOT RD MAINLINE Q100 = 94.40 CFS

Circular

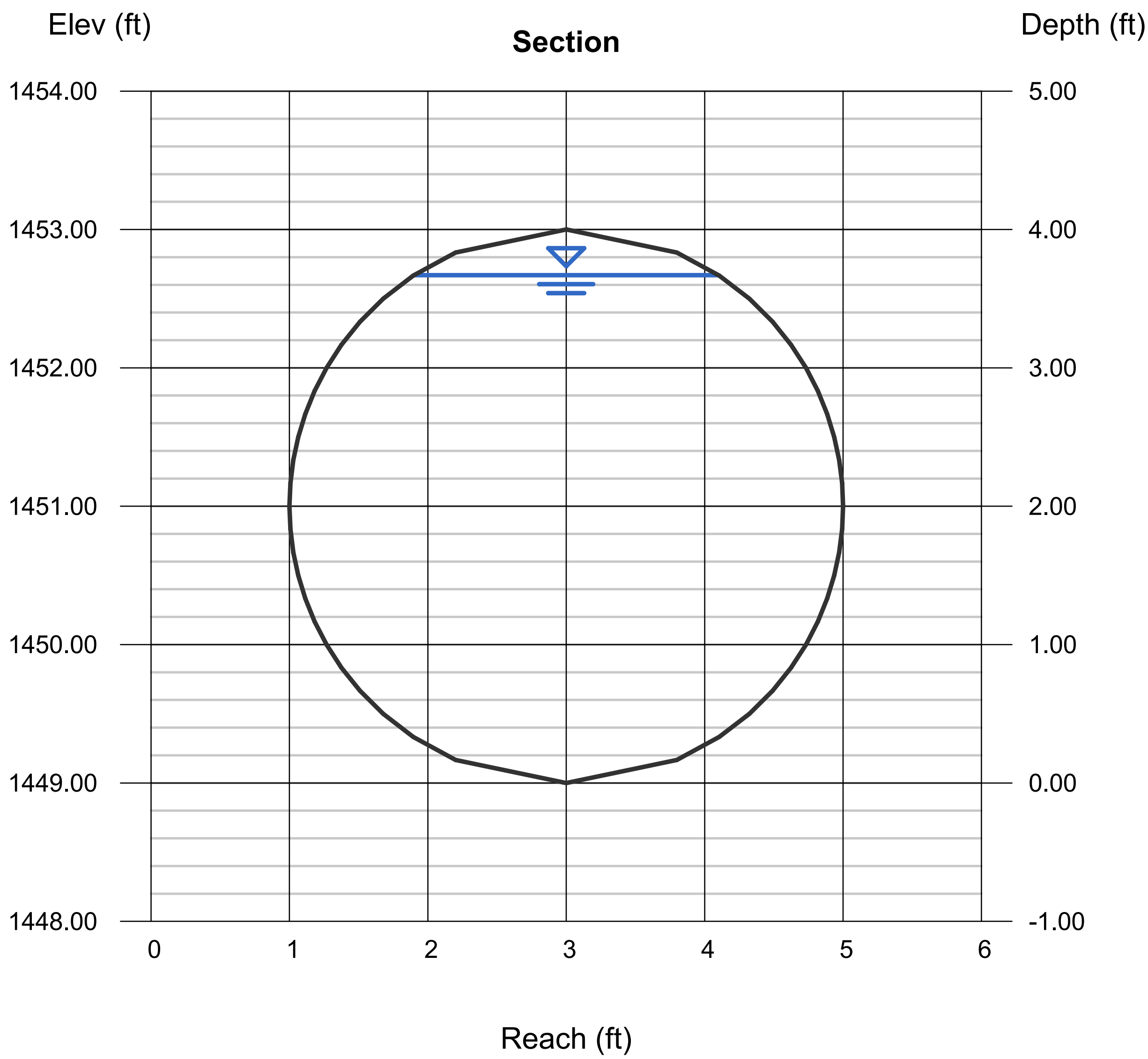
Diameter (ft)	=	4.00
Invert Elev (ft)	=	1449.00
Slope (%)	=	0.50
N-Value	=	0.015

Calculations

Compute by:		Known Q
Known Q (cfs)	=	94.40

Highlighted

Depth (ft)	=	3.67
Q (cfs)	=	94.40
Area (sqft)	=	12.08
Velocity (ft/s)	=	7.82
Wetted Perim (ft)	=	10.24
Crit Depth, Yc (ft)	=	2.94
Top Width (ft)	=	2.20
EGL (ft)	=	4.62



Channel Report

OUTLET PIPE FROM BASIN #1 Q100 = 14.70 CFS

Circular

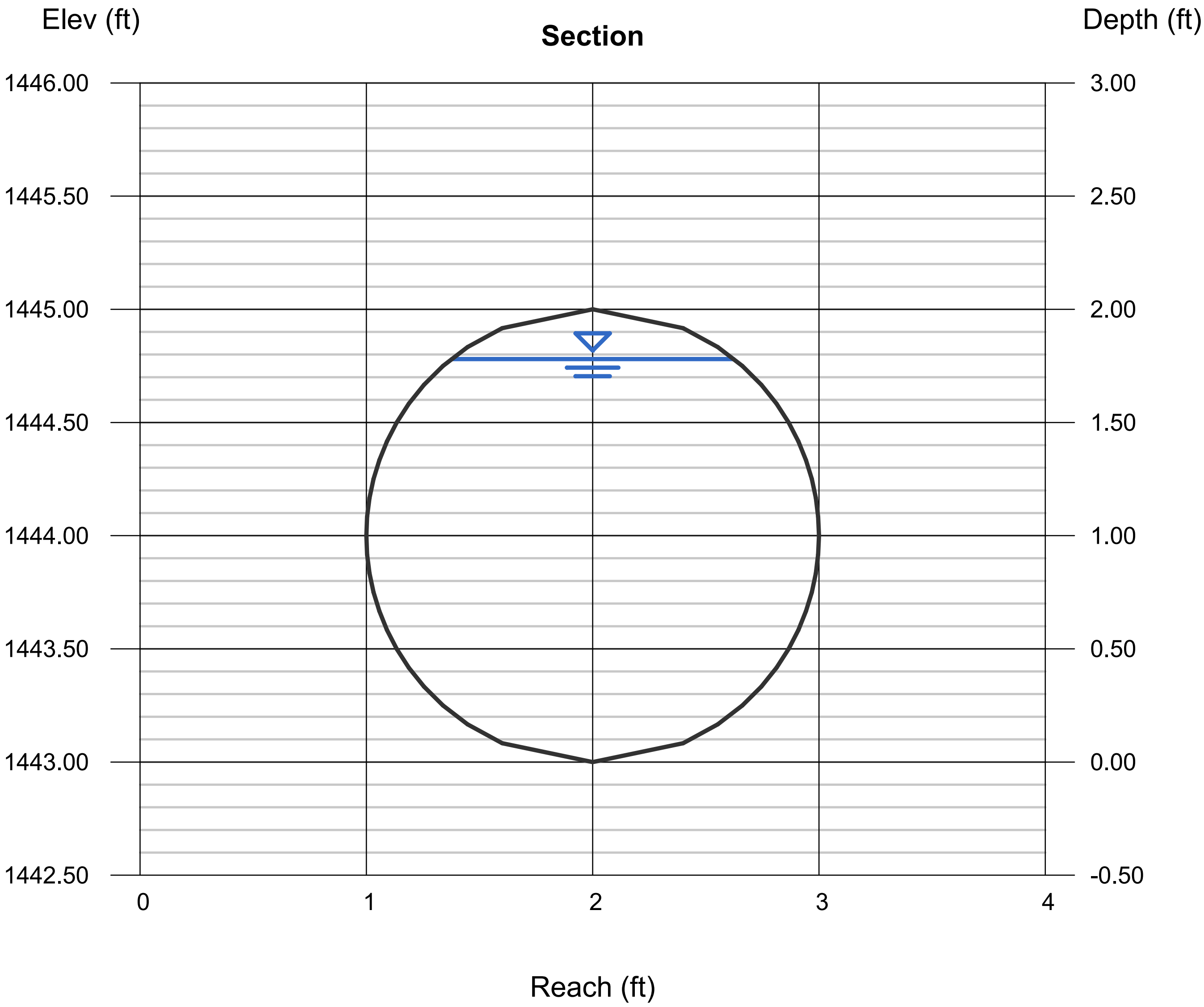
Diameter (ft)	= 2.00
Invert Elev (ft)	= 1443.00
Slope (%)	= 0.50
N-Value	= 0.015

Calculations

Compute by:	Known Q
Known Q (cfs)	= 14.70

Highlighted

Depth (ft)	= 1.78
Q (cfs)	= 14.70
Area (sqft)	= 2.96
Velocity (ft/s)	= 4.97
Wetted Perim (ft)	= 4.94
Crit Depth, Yc (ft)	= 1.38
Top Width (ft)	= 1.24
EGL (ft)	= 2.16



Channel Report

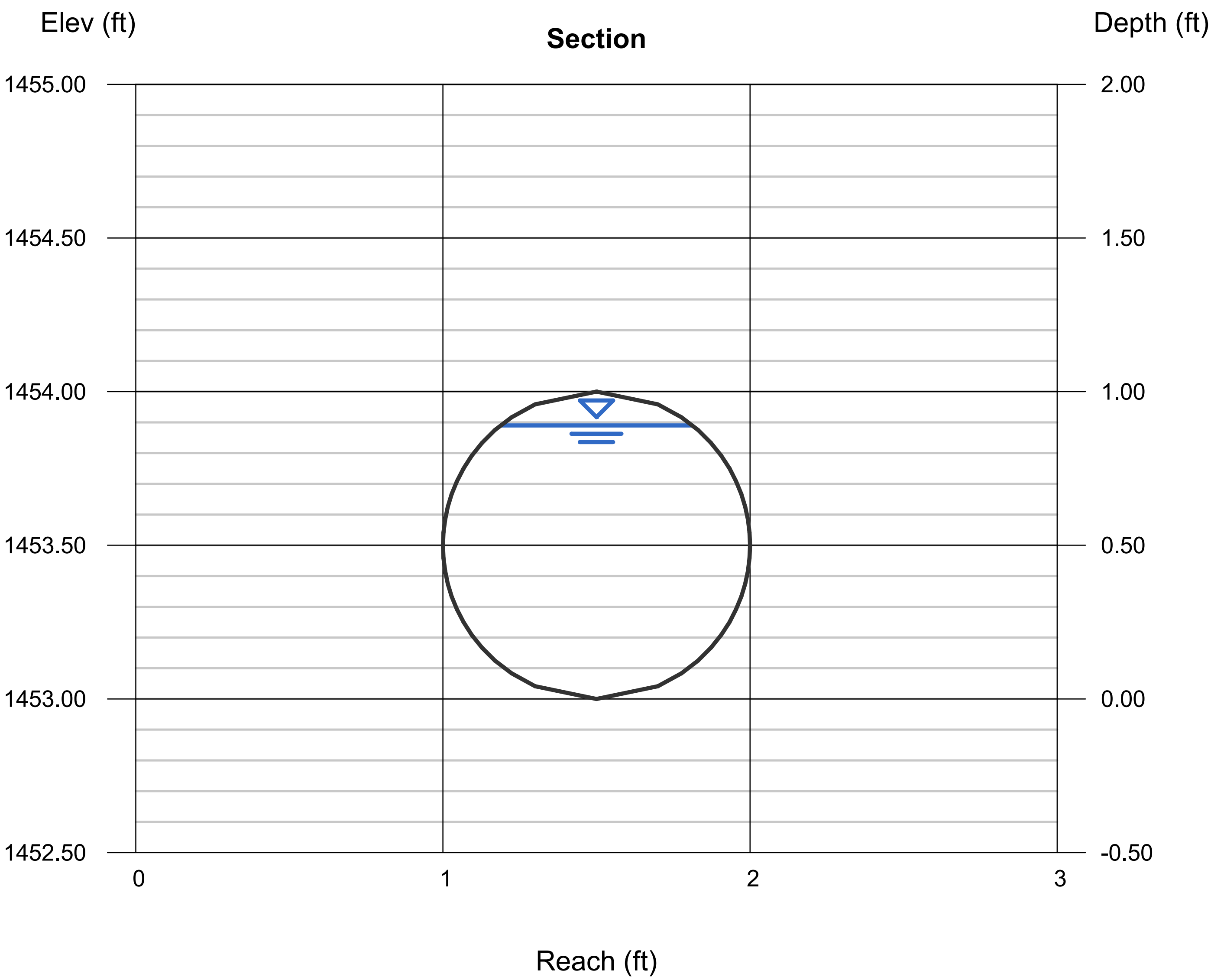
OUTLET PIPE FROM BASIN #2 Q100 = 2.31 CFS

Circular
Diameter (ft) = 1.00

Invert Elev (ft) = 1453.00
Slope (%) = 0.50
N-Value = 0.015

Calculations
Compute by: Known Q
Known Q (cfs) = 2.31

Highlighted
Depth (ft) = 0.89
Q (cfs) = 2.310
Area (sqft) = 0.74
Velocity (ft/s) = 3.12
Wetted Perim (ft) = 2.47
Crit Depth, Yc (ft) = 0.65
Top Width (ft) = 0.62
EGL (ft) = 1.04

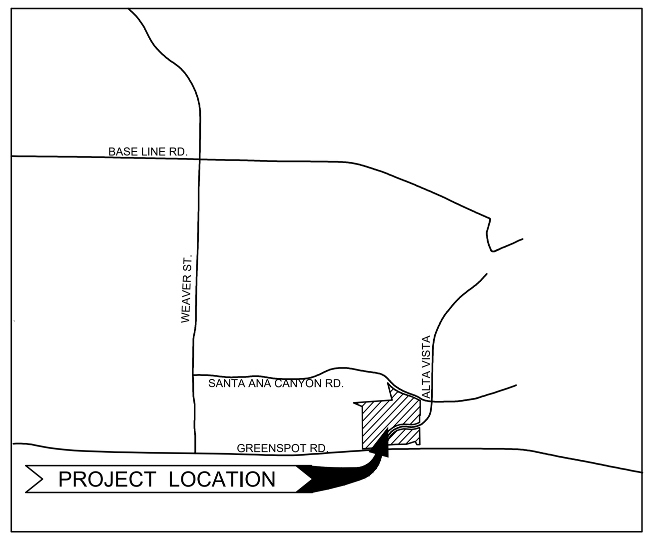


Appendix J – Reference Plans

IN THE CITY OF HIGHLAND, STATE OF CALIFORNIA

TENTATIVE TRACT MAP NO. 20721

ALL THAT PORTION OF THE NORTH HALF OF THE SOUTHWEST QUARTER OF SECTION 1, TOWNSHIP 1 SOUTH, RANGE 3 WEST, SAN BERNARDINO BASE AND MERIDIAN, IN THE CITY OF HIGHLAND, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA.



VICINITY MAP

NOT TO SCALE

LEGEND

- TRACT BOUNDARY
- RIGHT OF WAY
- EX PARCEL LINE
- STREET CENTERLINE
- EX CONTOUR (1400)
- PROP MAJOR CONTOUR (1400)
- PROP MINOR CONTOUR (1400)
- LOT LINE
- EASEMENT LINE
- BUILDING SETBACK LINE
- BUILDING FOOTPRINT
- EX FENCE
- PROP RET. WALL
- PROP SEWER
- PROP STORM DRAIN
- PROP WATER
- PROP FIRE HYDRANT
- FLOWLINE
- SLOPE DIRECTION
- EX CURB
- PROP CURB

SETBACKS

FRONT YARD ---------------------------3FT
SIDE SETBACK---------------------------5FT
REAR SETBACK--------------------------10FT

EARTHWORK QUANTITIES

RAW NUMBERS:

CUT = 7,000 CY
FILL = 30,500 CY
NET = 23,500 CY OF FILL

AREA SUMMARY

TOTAL GROSS AREA: 11.98± ACRES
NUMBERED LOTS: 113 – AREA: 7.01± ACRES
STREET AREA: 2.28± ACRES
OPEN SPACE AREA: 2.70± ACRES

SHEET INDEX

1 – TITLE SHEET & PRELIMINARY GRADING PLAN
2 – SECTIONS
3 – PLOT PLAN

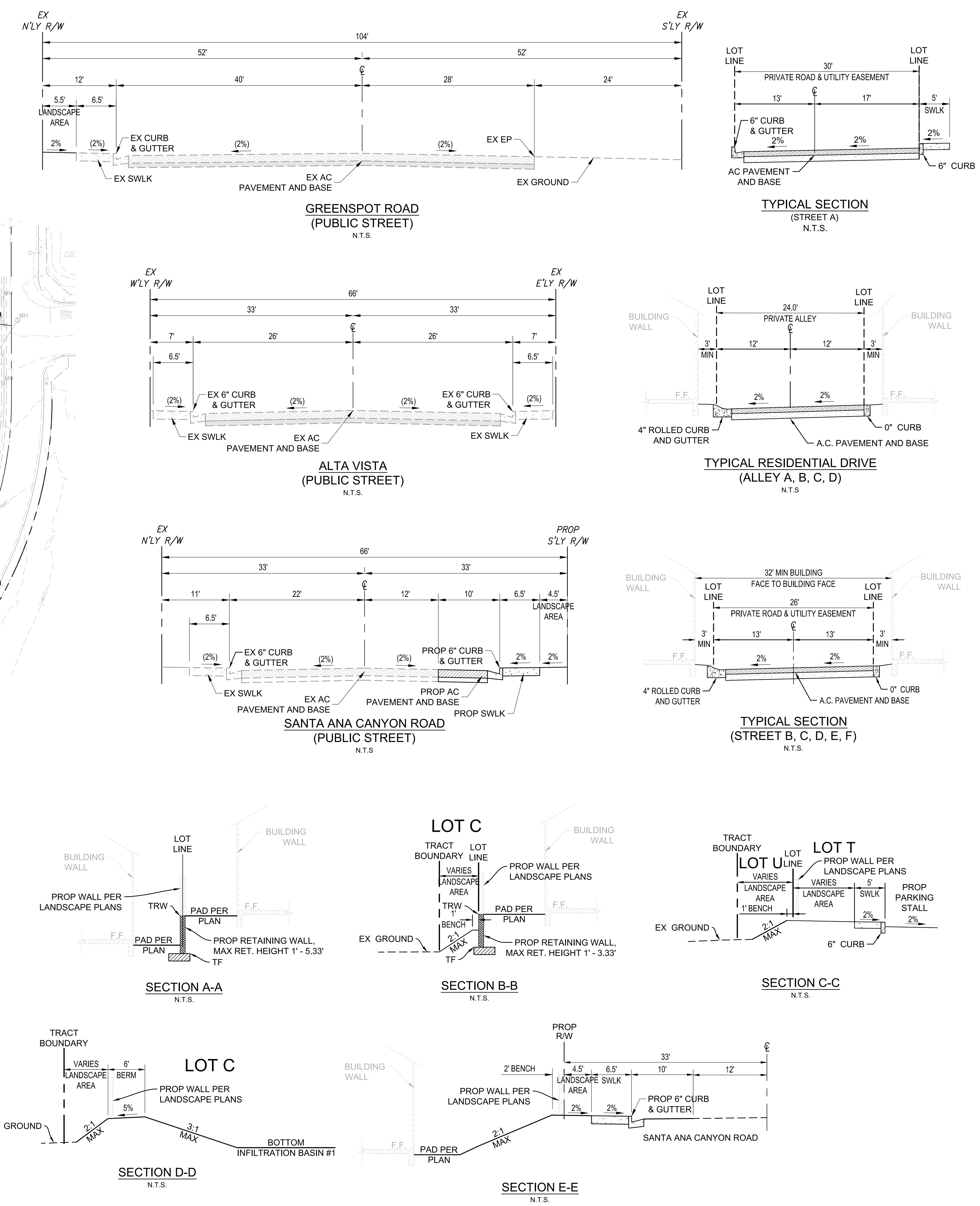
NORTH

GRAPHIC SCALE IN FEET
0 25 50 100

SCALE: 1" = 50' WHEN PRINTED AT FULL SIZE (30" X 42")

ABBREVIATIONS

BLDG – BUILDING
BSL – BUILDING SETBACK LINE
BTM – BOTTOM
BW – BACK OF SIDEWALK
C&G – CURB & GUTTER
℄ – CENTERLINE
CONC – CONCRETE
EP – EDGE OF PAVEMENT
EX – EXISTING
FG – FINISHED GROUND
FL – FLOWLINE
FS – FINISHED SURFACE
FH – FIRE HYDRANT
N.T.S – NOT TO SCALE
PE – PAD ELEVATION
PROP – PROPOSED
PIP – PROTECT IN PLACE
PVMT – PAVEMENT
RET. – RETAINING
R/W – RIGHT OF WAY
SD – STORM DRAIN
SWLK – SIDEWALK
TYP – TYPICAL
TC – TOP OF CURB



GENERAL NOTES

1. ASSESSOR'S PARCEL NUMBERS: 1210–371–16 & 1210–371–14
2. EXISTING ZONING: R1–10,000 SINGLE FAMILY RES. 10,000, INCLUDING PROPERTIES TO THE EAST, WEST, AND NORTH. THE PROPERTY TO THE SOUTH IS A/EQ – AGRICULTURAL/EQUESTRIAN RES.
3. PROPOSED ZONING: PD–PLANNED DEVELOPMENT
4. THERE ARE 113 RESIDENTIAL LOTS PROPOSED WITHIN THIS TRACT BOUNDARY WHICH CONTAINS 12 GROSS ACRES FOR AN OVERALL RESIDENTIAL LOT DENSITY OF 9.42 LOTS PER GROSS ACRE.
5. THERE ARE 22 LETTERED LOTS THAT WILL BE PRIVATELY OWNED.
6. THERE IS APPROXIMATELY 4,180 LINEAL FEET OF NEW STREET PROPOSED WITHIN THIS DEVELOPMENT.
7. THIS TENTATIVE MAP SHOWS ENTIRE CONTIGUOUS OWNERSHIP.
8. THE LETTERED LOTS "A" & "B" ARE PRIVATE STREETS.
9. NO REGULATED TREES EXIST ON SITE.
10. ONE PHASE AND ONE FINAL MAP IS PLANNED.
11. CONTOUR INTERVAL = 2 FEET
12. ALL SLOPES SHALL BE 2:1 OR FLATTER.
13. LOT DIMENSIONS SHOWN HEREON ARE APPROXIMATE.
14. BOUNDARY SURVEY PROVIDED BY DAWSON SURVEYS.
15. THE LOCATION OF EXISTING UTILITIES SHOWN ON THIS MAP ARE APPROXIMATE AND WERE OBTAINED FROM APPROVED PLANS & UTILITY COMPANY MAPS.
16. SANTA ANA CANYON ROAD FOR PUBLIC ROAD DEDICATION.
17. HOMEOWNER'S ASSOCIATION TO MAINTAIN WQMP SYSTEMS & ALL LETTERED LOTS.

LEGAL DESCRIPTION

APN: 1210–371–16 & 1210–371–14
THE LAND REFERRED TO HEREIN BELOW IS SITUATED IN THE COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA AND IS DESCRIBED AS FOLLOWS:
PARCEL 1:
ALL THAT PORTION OF THE NORTH HALF OF THE SOUTHWEST QUARTER OF SECTION 1, TOWNSHIP 1 SOUTH, RANGE 3 WEST, SAN BERNARDINO BASE AND MERIDIAN, IN THE CITY OF HIGHLAND, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT OF SAID LAND FILED IN THE DISTRICT LAND OFFICE FEBRUARY 24, 1869, DESCRIBED AS FOLLOWS:
COMMENCING AT A POINT FOUND IN THE FOLLOWING MANNER:
BEGINNING AT THE CENTER OF SAID SECTION 1; THENCE RUNNING SOUTH 88 DEGREES 17' WEST 676 FEET; THENCE SOUTH 1 DEGREES WEST 635 FEET TO A STAKE, WHICH IS THE POINT IN THE BOUNDARY LINE OF THE LAND HEREBY, DESCRIBED AT WHICH THE DESCRIBED THEREON IS TO BEGIN, TO WIT:
BEGINNING AT SAID STAKE AND RUNNING THENCE NORTH 60° 12' WEST 557 FEET; THENCE SOUTH 13° 55' EAST 363.5 FEET; THENCE SOUTH 58° 33' EAST 298 FEET; THENCE EAST 143 FEET; THENCE NORTH 230 FEET TO THE POINT OF BEGINNING.

PARCEL 2:
ALL THAT PORTION OF THE NORTH ½ OF THE SOUTHWEST ¼ OF SECTION 1, TOWNSHIP 1 SOUTH, RANGE 3 WEST, SAN BERNARDINO BASE AND MERIDIAN, IN THE CITY OF HIGHLAND, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA, ACCORDING TO THE OFFICIAL PLAT THEREOF DESCRIBED AS FOLLOWS:
BEGINNING AT A POINT ON THE COUNTY ROAD, 515 FEET EAST AND 243 FEET SOUTH OF THE QUARTER SECTION CORNER OF THE WEST LINE OF SECTION 1, TOWNSHIP 1 SOUTH, RANGE 3 WEST, SAN BERNARDINO BASE AND MERIDIAN; THENCE RUNNING NORTH 71° 00' EAST, 303 FEET; THENCE SOUTH 78° 57' EAST, 539 FEET; THENCE SOUTH 60° 12' EAST, 787 FEET; THENCE SOUTH 655 FEET; THENCE WEST 1498 FEET; THENCE NORTH 1077 FEET TO THE POINT OF BEGINNING.
EXCEPTING THEREFROM THE PROPERTY DESCRIBED IN A DEED FROM ADOLPH F. H. CORNELIUS AND WIFE, TO ROBERTA T. GREEPE, RECORDED IN BOOK 464, PAGE 126, OF DEEDS AS FOLLOWS:
A PORTION OF THE NORTH ½ OF THE SOUTHWEST ¼ OF SECTION 1, TOWNSHIP 1 SOUTH, RANGE 3 WEST, SAN BERNARDINO BASE AND MERIDIAN, DESCRIBED AS FOLLOWS:
COMMENCING AT A POINT FOUND IN THE FOLLOWING MANNER:
BEGINNING AT THE CENTER OF SAID SECTION 1; THENCE SOUTH 88° 17' WEST, 676 FEET; THENCE SOUTH 1 WEST, 635 FEET TO A STAKE WHICH IS THE POINT IN THE BOUNDARY LINE OF LAND CONVEYED, AT WHICH DESCRIPTION IS TO BEGIN TO–WIT:
BEGINNING AT SAID STAKE; THENCE NORTH 60° 12' WEST, 557 FEET; THENCE SOUTH 13° 55' EAST, 363.5 FEET; THENCE SOUTH 58° 33' EAST 298 FEET; THENCE EAST 143 FEET; THENCE NORTH 230 FEET TO BEGINNING;ALSO EXCEPTING THAT PORTION CONVEYED TO ALBERT O'HOUNSIN RECORDED MARCH 26, 1953, IN BOOK 3134, PAGE 560 OF OFFICIAL RECORDS; ALSO EXCEPTING THAT PORTION CONVEYED TO SOUTHWEST BROADCASTING COMPANY, INC. BY DEED RECORDED FEBRUARY 23, 1962, IN BOOK 5651, PAGE 48 OF OFFICIAL RECORDS; ALSO EXCEPTING THAT PORTION CONVEYED TO JOE ARREDONDO ET AL. BY DEED RECORDED AUGUST 4, 1967, IN BOOK 6867, PAGE 697 OF OFFICIAL RECORDS.
ALSO EXCEPTING THEREFROM THAT PORTION CONVEYED TO THE CITY OF HIGHLAND, A MUNICIPAL CORPORATION BY DEED RECORDED JULY 22, 1994 AS INSTRUMENT NO. 94–315824 OF OFFICIAL RECORDS.

UTILITY PROVIDERS

WATER/SEWER:
EAST VALLEY WATER DISTRICT
31111 GREENSPOT ROAD
HIGHLAND, CA 92346
PH: (909) 889–9501

POWER:
SOUTERN CALIFORNIA EDISON
287 TENNESSEE STREET
REDLANDS, CA 92373
PH: (909) 307–6749

GAS:
SOUTHERN CALIFORNIA GAS COMPANY
1981 WEST LUGONIA AVENUE
REDLANDS, CA92374–9796
PH: (909)335–7772

TELEPHONE:
VERIZON
19800 ORANGE TREE LN. STE 100
REDLAND, CA 92374–7880
PH: (909) 748–6649

EXISTING EASEMENTS

THE FOLLOWING MATTERS AFFECT PARCEL 1:

1. EASEMENT(S) FOR THE PURPOSE(S) SHOWN BELOW AND RIGHTS INCIDENTAL THERETO AS SET FORTH IN A DOCUMENT:

   PURPOSE: EXISTING DITCH, WATER PIPELINES
   RECORDING DATE: SEPTEMBER 12, 1961
   RECORDING NO.: BOOK 5532, PAGE 454, OF OFFICIAL RECORDS

2. EASEMENT(S) FOR THE PURPOSE(S) SHOWN BELOW AND RIGHTS INCIDENTAL THERETO, AS GRANTED IN A DOCUMENT:

   GRANTED TO: CITY OF HIGHLAND, A MUNICIPAL CORPORATION
   PURPOSE: ROADS, DRAINAGE AND PUBLIC UTILITY
   RECORDING DATE: APRIL 18, 2022
   RECORDING NO.: 2022–143198, OF OFFICIAL RECORDS
   AFFECTS: SAID LAND MORE PARTICULARLY DESCRIBED THEREIN

THE FOLLOWING MATTERS AFFECT PARCEL 2:

3. EASEMENT(S) FOR THE PURPOSE(S) SHOWN BELOW AND RIGHTS INCIDENTAL THERETO, AS GRANTED IN A DOCUMENT:

   GRANTED TO: SOUTHERN CALIFORNIA EDISON COMPANY, A CORPORATION
   PURPOSE: PUBLIC UTILITIES
   RECORDING DATE: DECEMBER 22, 1960
   RECORDING NO.: BOOK 5311, PAGE 211, OF OFFICIAL RECORDS
   AFFECTS: SAID LAND MORE PARTICULARLY DESCRIBED THEREIN

4. EASEMENT(S) FOR THE PURPOSE(S) SHOWN BELOW AND RIGHTS INCIDENTAL THERETO, AS GRANTED IN A DOCUMENT:

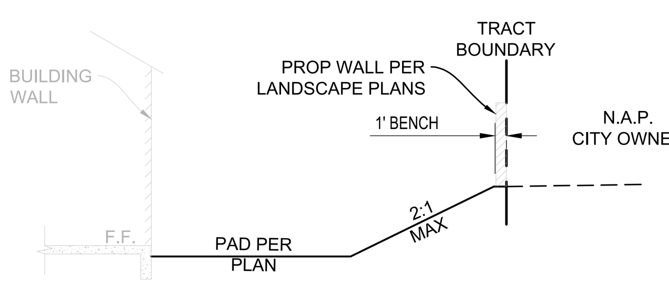
   GRANTED TO: SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT
   PURPOSE: PUBLIC UTILITIES
   RECORDING DATE: SEPTEMBER 28, 1973
   RECORDING NO.: BOOK 8277, PAGE 252, OF OFFICIAL RECORDS
   AFFECTS: SAID LAND MORE PARTICULARLY DESCRIBED THEREIN

PRELIMINARY
NOT FOR CONSTRUCTION

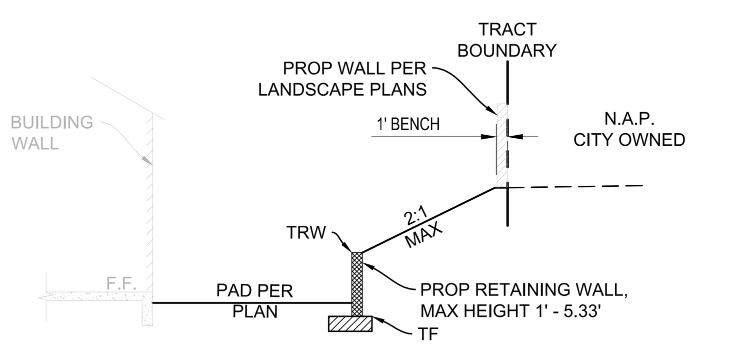
REGISTERED PROFESSIONAL ENGINEER
ROBERT R. OTTE
No. 44120
CIVIL
STATE OF CALIFORNIA

TITLE SHEET & PRELIMINARY GRADING PLAN	
ASSESSOR'S PARCEL NO.: 1210-371-16 & 1210-371-14	
TRACT NO.: 20721	
APPLICANT INFORMATION:	EAST HIGHLAND LAND, LLC. C/O JAKE SOWDER DIVERSIFIED PACIFIC 10621 CIVIC CENTER DRIVE RANCHO CUCAMONGA, CA 91730 D: (909) 373-2637 M: (714) 329-5438
ENGINEER INFORMATION:	ROBERT R. OTTE, PE 3801 UNIVERSITY AVENUE, SUITE 300, RIVERSIDE, CA 92501 D: (951) 534-5630 M: (909) 953-6070
MAP PREPARED BY:	Kimley»Horn 3801 UNIVERSITY AVENUE, SUITE 300, RIVERSIDE, CA 92501 PHONE: (951) 543-9868 WWW.KIMLEY-HORN.COM
MAP PREPARED ON: DECEMBER 17, 2024	SHEET 1 OF 3

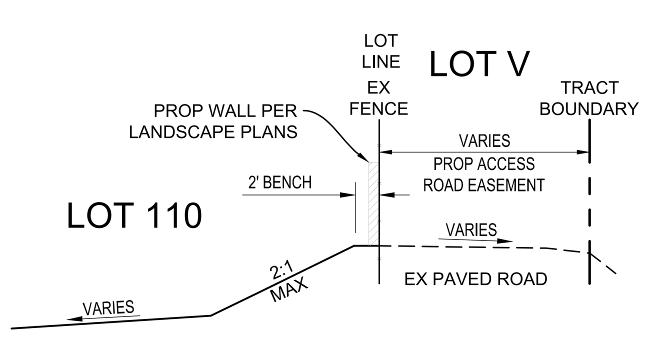
SCALE: 1" = 50' WHEN PRINTED AT FULL SIZE (30" X 42")



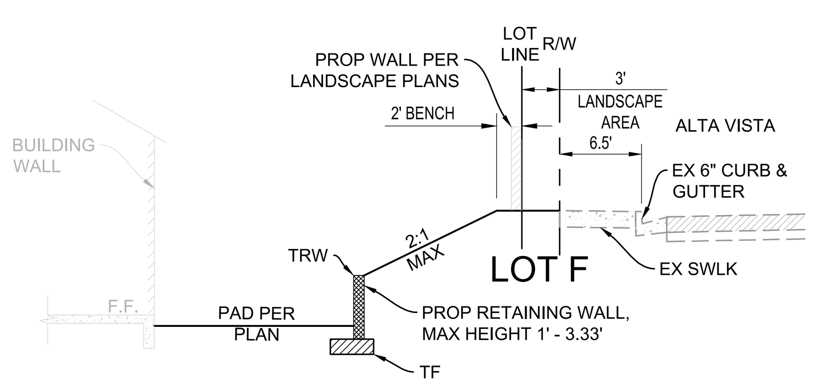
SECTION G-G
N.T.S.



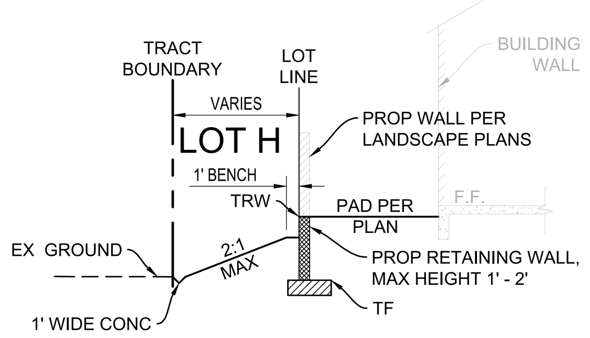
SECTION H-H
N.T.S.



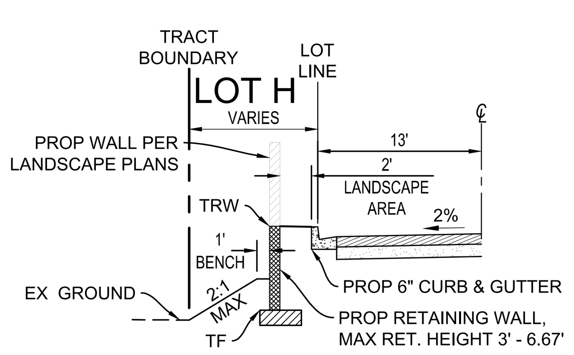
SECTION I-I
N.T.S.



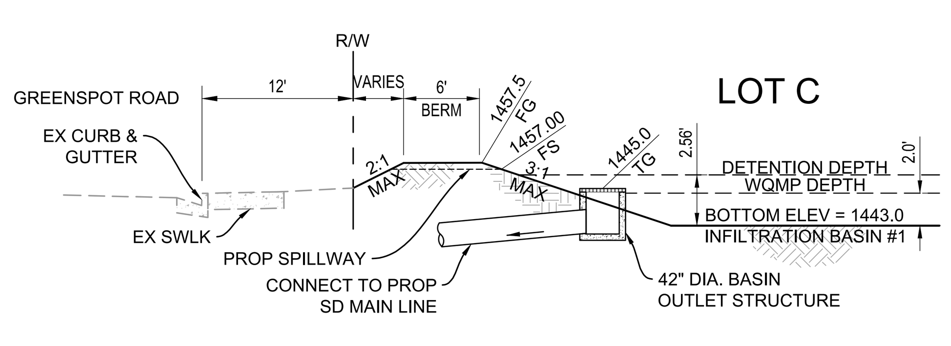
SECTION J-J
N.T.S.



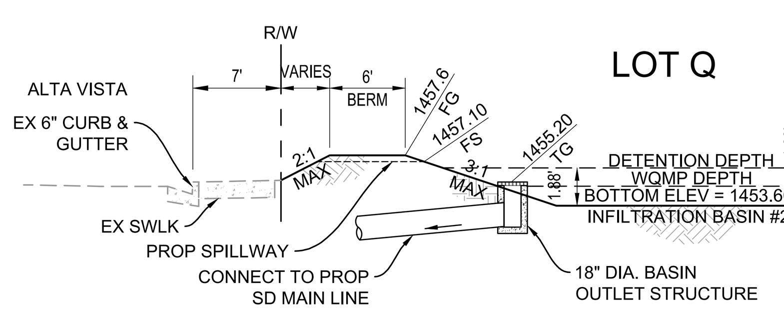
SECTION K-K
N.T.S.



SECTION L-L
N.T.S.



BASIN #1 DETAIL
N.T.S.



BASIN #2 DETAIL
N.T.S.

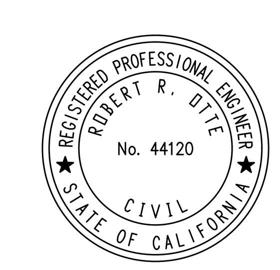
LOT SUMMARY				
LOT NUMBER	LOT AREA (SF)	PAD AREA (SF)	PLAN TYPE	ELEVATION
1	4,531	3,544	P3	FARMHOUSE
2	3,172	2,749	P1	COTTAGE
3	2,939	2,439	P2	SPANISH
4	2,621	2,159	P3	COTTAGE
5	2,500	2,190	P2	FARMHOUSE
6	2,339	1,947	P1	SPANISH
7	3,019	2,388	P2	COTTAGE
8	4,140	3,464	P1	FARMHOUSE
9	2,200	2,200	P3	COTTAGE
10	2,901	2,882	P2	SPANISH
11	2,202	2,202	P3	SPANISH
12	2,000	1,987	P1	COTTAGE
13	3,468	3,424	P1	FARMHOUSE
14	3,095	3,060	P3	SPANISH
15	2,250	2,235	P2	COTTAGE
16	2,302	2,302	P3	FARMHOUSE
17	2,200	2,200	P3	SPANISH
18	2,250	2,200	P2	FARMHOUSE
19	2,250	2,250	P3	COTTAGE
20	3,422	3,396	P2	SPANISH
21	3,077	2,441	P1	COTTAGE
22	2,163	1,981	P1	SPANISH
23	2,565	2,556	P2	FARMHOUSE
24	2,289	2,003	P1	COTTAGE
25	2,000	1,987	P1	SPANISH
26	2,250	2,235	P2	FARMHOUSE
27	2,360	2,341	P1	SPANISH
28	2,205	2,175	P3	FARMHOUSE
29	1,960	1,933	P1	COTTAGE
30	2,205	2,175	P2	FARMHOUSE
31	2,214	2,183	P3	SPANISH
32	2,325	2,290	P2	COTTAGE
33	2,196	2,166	P3	FARMHOUSE
34	2,205	2,175	P2	SPANISH
35	3,444	3,541	P2	FARMHOUSE
36	2,040	2,013	P1	COTTAGE
37	2,295	2,265	P2	SPANISH
38	2,040	2,013	P1	COTTAGE
39	2,295	2,265	P2	FARMHOUSE
40	2,295	2,265	P3	SPANISH

LOT NUMBER	LOT AREA (SF)	PAD AREA (SF)	PLAN TYPE	ELEVATION
41	2,295	2,295	P2	COTTAGE
42	2,295	2,295	P3	SPANISH
43	2,295	2,295	P2	FARMHOUSE
44	2,711	2,711	P3	COTTAGE
45	3,237	3,148	P2	COTTAGE
46	2,796	2,796	P3	FARMHOUSE
47	2,432	2,432	P2	SPANISH
48	2,760	2,760	P3	COTTAGE
49	2,490	2,490	P2	FARMHOUSE
50	2,663	2,334	P1	FARMHOUSE
51	3,428	3,090	P3	SPANISH
52	3,341	3,004	P2	COTTAGE
53	2,568	2,275	P3	FARMHOUSE
54	2,588	2,588	P1	SPANISH
55	2,250	2,250	P2	COTTAGE
56	2,670	2,670	P1	SPANISH
57	3,423	3,102	P2	SPANISH
58	1,920	1,920	P1	COTTAGE
59	2,643	2,430	P1	FARMHOUSE
60	3,257	3,032	P3	COTTAGE
61	2,181	2,181	P3	FARMHOUSE
62	3,297	3,185	P3	COTTAGE
63	2,726	2,570	P2	SPANISH
64	2,329	2,164	P1	FARMHOUSE
65	2,759	2,521	P2	COTTAGE
66	2,617	2,402	P1	SPANISH
67	3,067	2,694	P3	FARMHOUSE
68	2,659	2,289	P1	COTTAGE
69	2,250	2,220	P2	SPANISH
70	2,207	2,132	P1	FARMHOUSE
71	2,606	2,457	P2	COTTAGE
72	2,322	2,094	P1	SPANISH
73	2,666	2,298	P2	FARMHOUSE
74	4,134	3,207	P1	COTTAGE
75	3,044	2,596	P2	FARMHOUSE
76	2,691	2,302	P1	SPANISH
77	3,155	2,690	P3	COTTAGE
78	2,970	2,565	P2	FARMHOUSE
79	2,640	2,287	P1	SPANISH
80	3,008	2,624	P2	FARMHOUSE

LOT NUMBER	LOT AREA (SF)	PAD AREA (SF)	PLAN TYPE	ELEVATION
81	2,874	2,555	P1	COTTAGE
82	4,604	3,764	P3	FARMHOUSE
83	2,735	2,513	P3	SPANISH
84	2,250	2,235	P2	COTTAGE
85	2,250	2,235	P3	FARMHOUSE
86	2,250	2,250	P2	SPANISH
87	2,203	2,203	P1	FARMHOUSE
88	2,536	2,516	P3	FARMHOUSE
89	2,250	2,235	P2	SPANISH
90	2,000	2,000	P1	COTTAGE
91	2,000	2,000	P1	FARMHOUSE
92	2,250	2,235	P2	COTTAGE
93	3,015	2,995	P3	SPANISH
94	4,009	3,983	P3	FARMHOUSE
95	2,250	2,235	P2	SPANISH
96	2,000	1,987	P1	COTTAGE
97	2,000	1,987	P1	SPANISH
98	2,250	2,235	P2	FARMHOUSE
99	2,141	2,128	P1	SPANISH
100	3,927	3,452	P2	COTTAGE
101	2,810	2,513	P3	FARMHOUSE
102	2,819	2,819	P3	FARMHOUSE
103	2,344	2,344	P2	SPANISH
104	3,485	3,264	P3	COTTAGE
105	2,932	2,707	P2	FARMHOUSE
106	2,217	2,017	P1	SPANISH
107	2,848	2,557	P2	FARMHOUSE
108	2,478	2,253	P3	COTTAGE
109	2,475	2,250	P2	SPANISH
110	5,186	3,109	P1	COTTAGE
111	4,046	4,046	P3	FARMHOUSE
112	4,105	4,105	P2	COTTAGE
113	4,163	4,163	P3	SPANISH
TOTAL AREA (SF)	305,316			
TOTAL AREA (AC)	7.01			
AVERAGE LOT(SF)	2,702			

LETTERED LOT SUMMARY	
LOT LETTER	LOT AREA (SF)
LOT A	105,173
LOT B	16,462
LOT C	25,005
LOT D	1,636
LOT E	490
LOT F	948
LOT G	2,476
LOT H	10,214
LOT I	505
LOT J	459
LOT K	641
LOT L	13,072
LOT M	1,234
LOT N	1,234
LOT O	942
LOT P	8,291
LOT Q	254
LOT R	22,071
LOT S	2,290
LOT T	2,664
LOT U	3,616
LOT V	1,089
TOTAL STREETS AREA (SF)	2.70
TOTAL OPEN SPACE AREA (SF)	2.28

PRELIMINARY
NOT FOR CONSTRUCTION



SECTIONS

ASSESSOR'S PARCEL NO.: 1210-371-16 & 1210-371-14

TRACT NO.: 20721

APPLICANT INFORMATION:
EAST HIGHLAND LAND, LLC.
C/O JAKE SOWDER
DIVERSIFIED PACIFIC
10621 CIVIC CENTER DRIVE
RANCHO CUCAMONGA, CA 91730
D: (909) 373-2637 M: (714) 329-5438

ENGINEER INFORMATION:
ROBERT R. OTTE, PE
3801 UNIVERSITY AVENUE, SUITE 300,
RIVERSIDE, CA 92501
D: (951) 534-5630 M: (909) 953-6070

MAP PREPARED BY:

Kimley»Horn

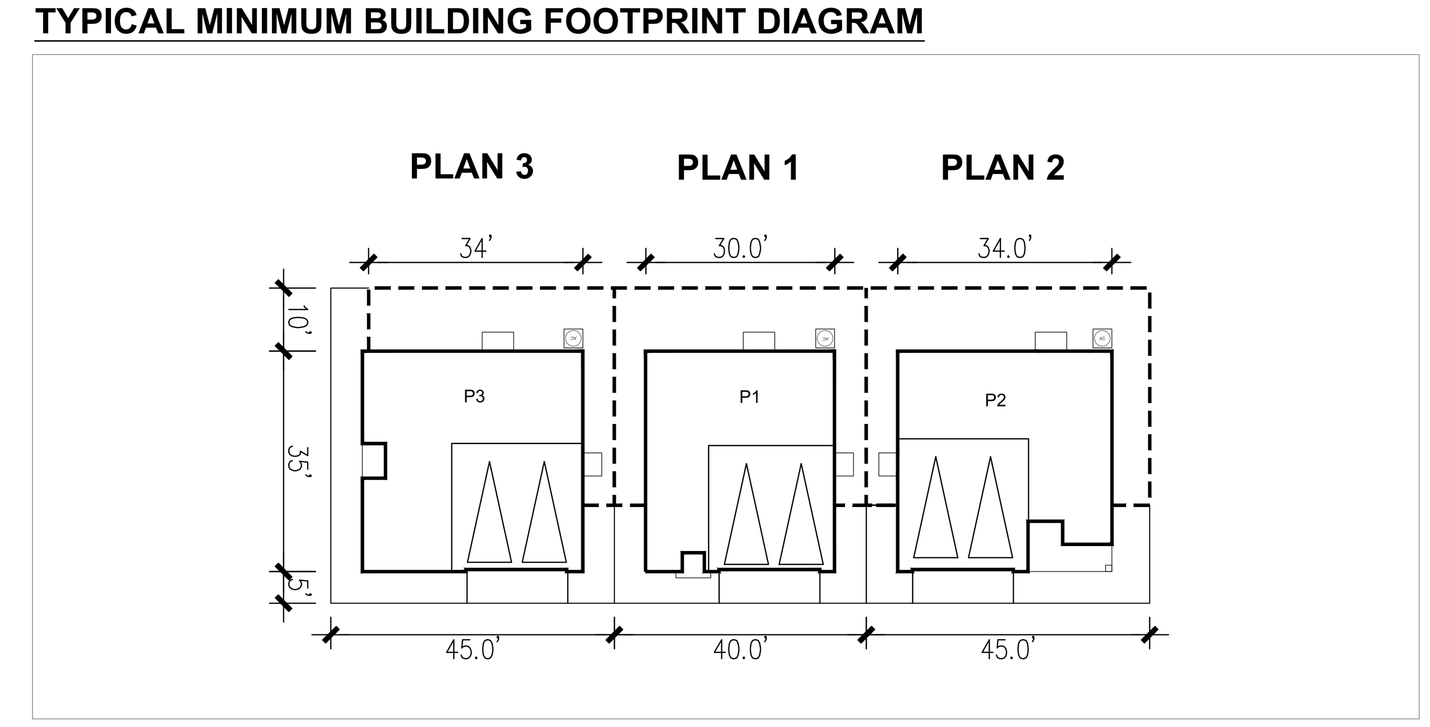
3801 UNIVERSITY AVENUE, SUITE 300, RIVERSIDE, CA 92501
PHONE: (951) 543-9868 WWW.KIMLEY-HORN.COM

MAP PREPARED ON: DECEMBER 17, 2024

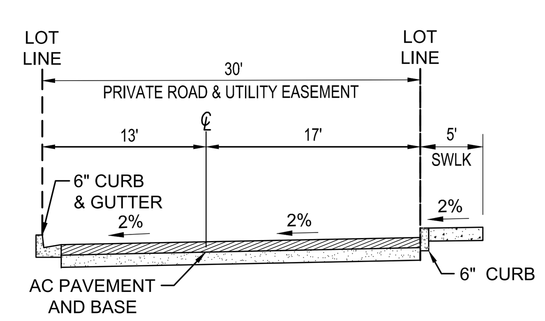
PROJECT SUMMARY

Unit Mix			
P1	35	31%	
P2	43	38%	
P3	35	31%	
Total	113	100%	
Parking			
Required			
2+BD	113x2/du	226 spaces	
Guest	113x0.5/du	57 spaces	
Total		283 spaces	
Provided			
Garage	113x2/du	226 spaces	
Guest		59 spaces	
Parallel Street		8 spaces	
Total		293 spaces	

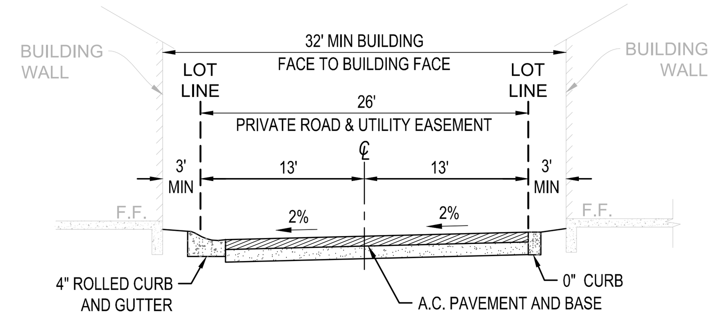
TYPICAL MINIMUM BUILDING FOOTPRINT DIAGRAM



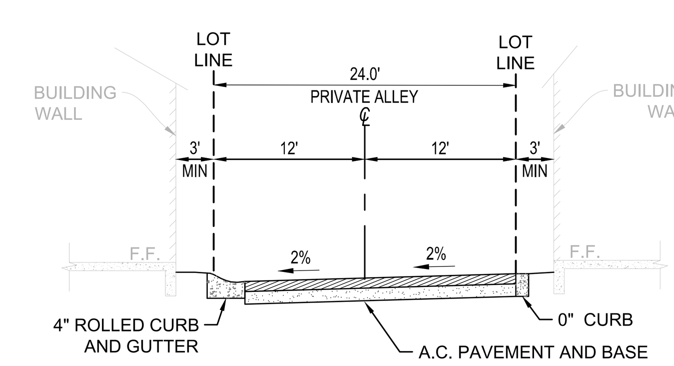
NTS



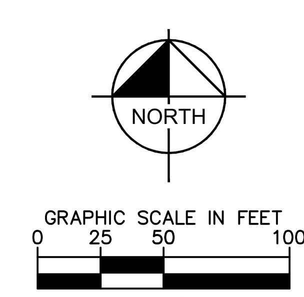
TYPICAL SECTION
(STREET A)
N.T.S.



TYPICAL SECTION
(STREET B, C, D, E, F)
N.T.S.



TYPICAL RESIDENTIAL DRIVE
(ALLEY A, B, C, D)
N.T.S.



SCALE: 1"=50'
(WHEN PRINTED AT 24"X36")

PRELIMINARY
NOT FOR CONSTRUCTION

PLOT PLAN	
ASSESSOR'S PARCEL NO.: 1210-371-16 & 1210-371-14	
TRACT NO.: 20721	
APPLICANT INFORMATION:	EAST HIGHLAND LAND, LLC. C/O JAKE SOWDER DIVERSIFIED PACIFIC 10621 CIVIC CENTER DRIVE RANCHO CUCAMONGA, CA 91730 D: (909) 373-2637 M: (714) 329-5438
ENGINEER INFORMATION:	ROBERT R. OTTE, PE 3801 UNIVERSITY AVENUE, SUITE 300, RIVERSIDE, CA 92501 D: (951) 534-5630 M: (909) 953-6070
MAP PREPARED BY:	Kimley»Horn 3801 UNIVERSITY AVENUE, SUITE 300, RIVERSIDE, CA 92501 PHONE: (951) 543-9868 WWW.KIMLEY-HORN.COM
MAP PREPARED ON: DECEMBER 17, 2024	SHEET 3 OF 3