

APPENDIX F: Preliminary Drainage Report

Available on the City of Twentynine Palms Website:

[www.ci.twentynine-palms.ca.us](http://www.ci.twentynine-palms.ca.us)

# **PRELIMINARY DRAINAGE STUDY**

**FOR**

**Proposed Ofland Twentynine Palms  
APN 0614-121-15  
City of Twentynine Palms, California  
County of San Bernardino**

**Job No. 227523-0000210.00  
February 22, 2024**

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DATE

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Station ID: 04-9099
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## **I. INTRODUCTION**

### **A. Purpose of Study**

This study shall provide the offsite hydrologic analyzes in accordance with the San Bernardino County drainage requirements. The proposed project consists of a 152.7 acre parcel on which a destination resort consisting of 130 hard cabins, 2 swimming pools, 2 clubhouses, employee housing, outdoor theater screen, as well as other possible amenities, are proposed.

Hydrologic and hydraulic calculations were performed using methodologies defined in the *San Bernardino County Flood Control District Hydrology Manual* (August 1986) and County of San Bernardino Hydrology Manual Addendum for Arid Regions (April 2010), as required by the City of Twentynine Palms.

### **B. Scope**

This study involves the hydrologic analyses of approximately 472 acres of upstream offsite watershed that will impact the existing project site.

Runoff values for the 100-year, 24 hour storm frequency have been determined for the offsite drainage tributary using the Rational Method. The runoff values will be used to determine how best to situate and protect the proposed structures from that storm and allow the drainage to continue through the site and exit the property in its natural historic pattern. Structures will need to be located on pads elevated above the ground surface and anticipated storm flows.

## **II. SITE AREA**

### **A. Area Characteristics**

This site is currently bounded by Twentynine Palms Highway on the north, Sullivan Road on the south, Shoshone Valley Road on the east and, and Lear Avenue on the west. The property is undeveloped, desert terrain with scattered native plants sloping from the south towards the north with approximate slopes of 5%. The offsite drainage area to the south is similarly undeveloped, desert terrain with scattered native plans. This area slopes towards the project site from south to north with approximate slopes of 5%.

### **B. Soils Group**

Per San Bernardino County Hydrology Manual, Addendum for Arid Regions (April 2010), soil grouping information was found from the NRCS Web Soil Survey (copy of analysis enclosed in Appendix I). It was determined that approximately 53% of the offsite watershed is within a Soil Type "A". The small rocky hills at the southern end of the offsite watershed are within Soil Type "D" and make up 12% of the area. The

final 35%, covering the offsite area directly south of the project site, did not have data available in the Web Soil Survey so a Soil Type “B” was assumed based on Plate C-3 of the San Bernardino County Flood Hydrology Manual.

**C. Land Use**

The existing Land Use Zoning classification for this site is RS-E (Single Family Residential Estate, 2.5 acre minimum) but is proposed to change to CT (Tourist Commercial) with this project.

**D. Flood Insurance Rate Maps (FIRM)**

The site is located in Zone X of the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM), San Bernardino County, California and incorporated areas panel 8175 of 9400 with map number 06071C8175H dated September 2, 2016. A Zone X is defined as areas determined to be outside of the 0.2% annual chance of flood or a 1% annual chance of flood with average depths of less than 1’ or with drainage areas less than one square mile. The FIRM for this project is located in Appendix I.

**E. Rainfall Intensity**

The rainfall data used in the study are per NOAA Atlas 14, Volume 6, Version 2 as recommended by the San Bernardino County Hydrology Manual, Addendum for Arid Regions (April 2010). Data from the Twentynine Palms Station ID: 04-9099 is included in Appendix I.

**F. Antecedent Moisture Condition (AMC)**

Per San Bernardino County Hydrology Manual, Addendum for Arid Regions (April 2010), this project lies within the area mapped as AMC1 on Figure ADD-1 as included in Appendix I.

**III. HYDROLOGIC METHODOLOGY**

**Description of Hydrologic Modeling Software**

The CivilDesign Hydrology-Hydraulics software, Rational Hydrology program package was used to perform the hydrologic calculations.

The CivilDesign Program is a computer-aided design program where the user develops a node-link model of the watershed. The intensity-duration-frequency relationships are applied to each of the drainage areas in the model to get the peak flow rates at each point of interest. The model follows the San Bernardino Hydrology Design methodology.

**A. Rational Method**

The materials included with this study are presented to satisfy the requirements set forth in the San Bernardino County Flood Control District (SBCFCD) Hydrology Manual. Existing offsite watershed was evaluated and runoff values were generated by the Rational Method. The Rational Method was also used to calculate the peak Q's for the 100-year storm and the times of concentration for both the pre-development conditions and post development conditions for the project on-site.

**C. Storm Frequency**

Per *San Bernardino County* criteria, the 100-year, 1-, 6-, 24- hour storm frequency was used to calculate peak flows using the Rational Method Analysis. The hydrologic frequency obtained from the Point Precipitation Frequency Estimates NOAA Atlas 14 are 2.03"(1 hour storm), 2.72" (6 hour storm) and 3.66" (24 hour storm), respectively.

**IV. HYDROLOGIC RESULTS**

**A. Offsite Basin**

The 100-year, 24-hour peak discharge values at the most downstream point for the offsite basin has been determined to be 487 cfs (cubic feet per second). Runoff from the offsite basin of approximately 472 acres (see offsite hydrology map in Appendix III) impacts the project site along the southerly boundary of the property. These values are provided in a detailed analysis provided in Appendix II of this report.

The offsite runoff value for the project is provided in **Table 1** below.

**TABLE 1  
EXISTING OFFSITE PEAK FLOW RATES**

Unit Hydrograph Basin (Offsite)	Area (acres)	100-year (cfs) 24 hour Peak Flow
OFFSITE-EX	472	487

## **V. SUMMARY**

### **A. Recommendations**

The following recommendations have been provided to facilitate safety, both public and private, for the proposed development.

1. Proposed finished floor elevations for the development shall be determined by the Final Drainage Study. Finished floors elevations for the proposed buildings should be located at a minimum of 1' above the highest ground elevation beneath the building footprint.
2. A Final Drainage Study shall address any modification or changes for the offsite and onsite drainage conditions. This Preliminary Drainage Study only addresses the existing offsite watershed basins.
3. Proposed retention basin design will be determined during final design based upon the final drainage study. Proposed retention basins should be sized to retain, at a minimum, the incremental increase in storm water runoff volume.
4. Runoff should follow existing drainage patterns when leaving the site.

### **B. Conclusions**

Development of this project can be accomplished in a manner that will maintain historical downstream flow patterns. The development should not adversely impact surrounding or downstream properties and the effects of post-development incremental increase flows shall be mitigated and designed in the Final Drainage Study for the onsite development.

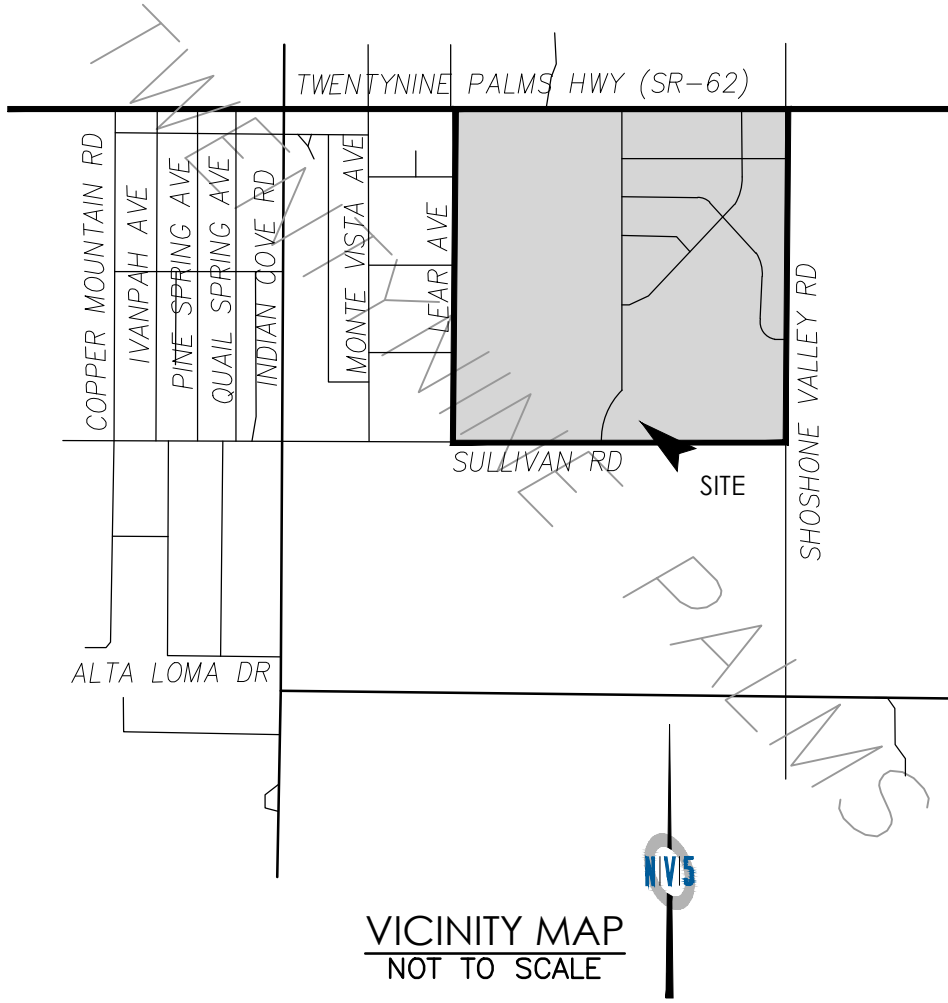
### **C. References**

1. *CivilDesign Engineering Software, Rational Method Hydrology System Model*, © 1989-2001, Version 6.4.
2. County of San Bernardino, *Hydrology Manual*, ©August 1986.
3. SB County Hydrology Manual, Addendum for Arid Regions (April, 2010)
4. USGS Indian Cove Quadrangle, 1995

## **APPENDIX I**

### **Figures**

- Vicinity Map
- Flood Insurance Rate Map (FIRM)
- Hydrologic Soils Map
- Point Precipitation frequency estimates – NOAA Atlas 14, Volume 6, Version 2 Twentynine Palms Station ID: 04-9099



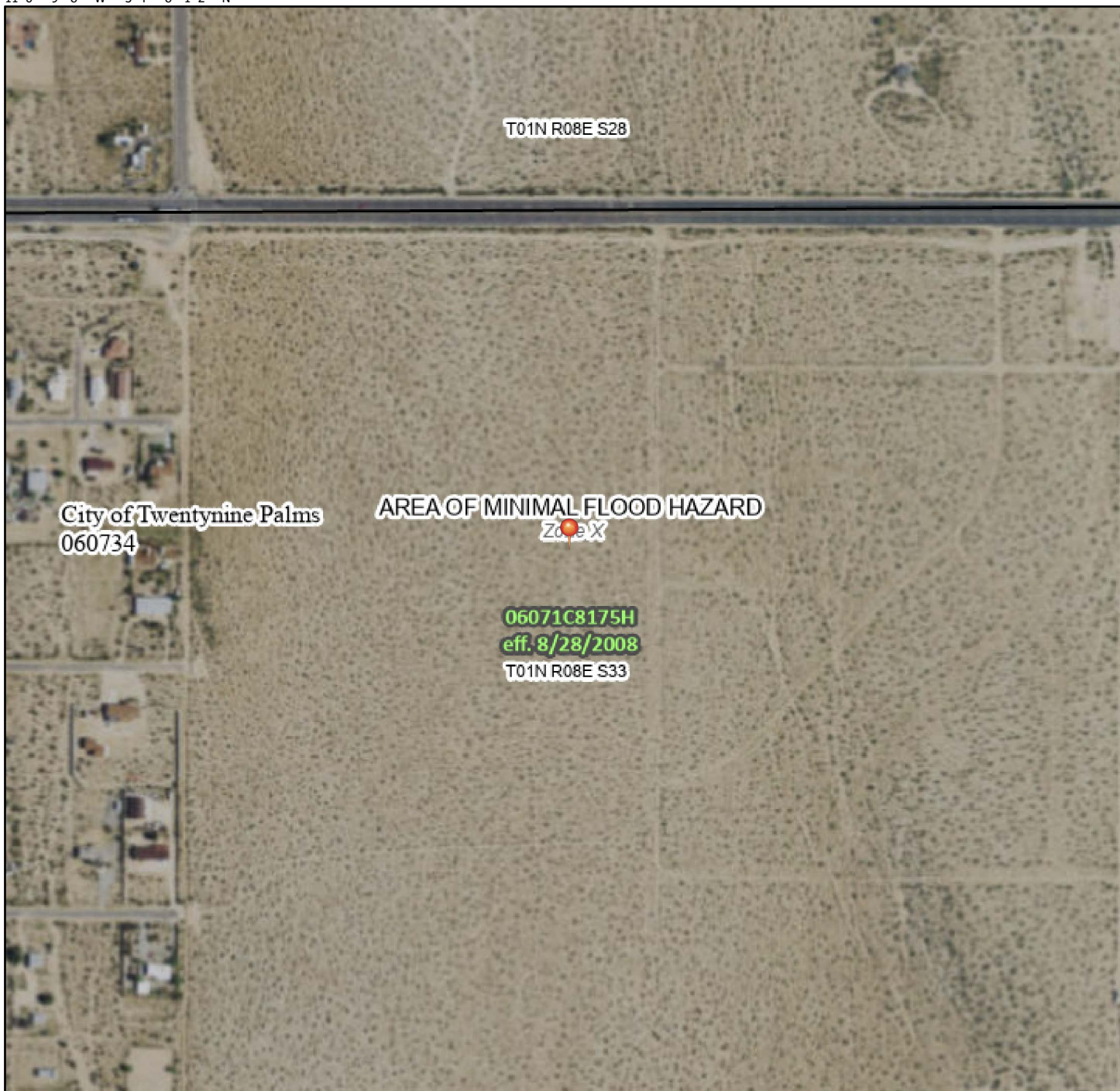
### VICINITY MAP

SHEET NUMBER

OF 1 SHEETS

JOB NUMBER  
227523-0000210

116°9'8"W 34°8'12"N



Legend

SPECIAL HAZARD	Without Base Flood Zone	With BFE Zone	Residual Flood
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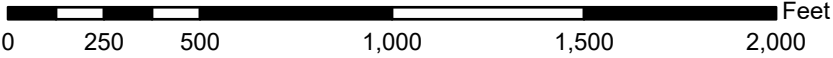
OTHER AREAS	0.2% Annual Chance of 1% Annual Flood Depth	Future Conditions 1% Chance Flood Hazard	Area with Flood Risk
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OTHER AREAS	No Section of Minimal Flood	Effective MRs	Other Areas of Unneeded Flood
GENERAL STRUCTURE RISKS	Channel, to be removed	Low, Dir Flood	

OTHER FEATURES	2.0' Cross Sections with 1% Water Elevation	1.7' Water Elevation	Coastal Slight	Base Flood Elevation (BFE)	Limit of JS	Jurisdiction Boundary	Coastal Slight Baseline	Profile Baseline	Hydrographic
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MAPPING	Digital Available	No Digital Available	Unmapped
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The pin indicates the map projection point at the user's location.



1:6,000

116°31'W 34°7'42"N

This map complies with the FEMA standards for digital maps as described below. The base map complies with FEMA's accuracy standards.

The flood hazard information displayed here is not intended to be used for any purpose other than the one for which it was prepared. It is not intended to be used for any purpose other than the one for which it was prepared.

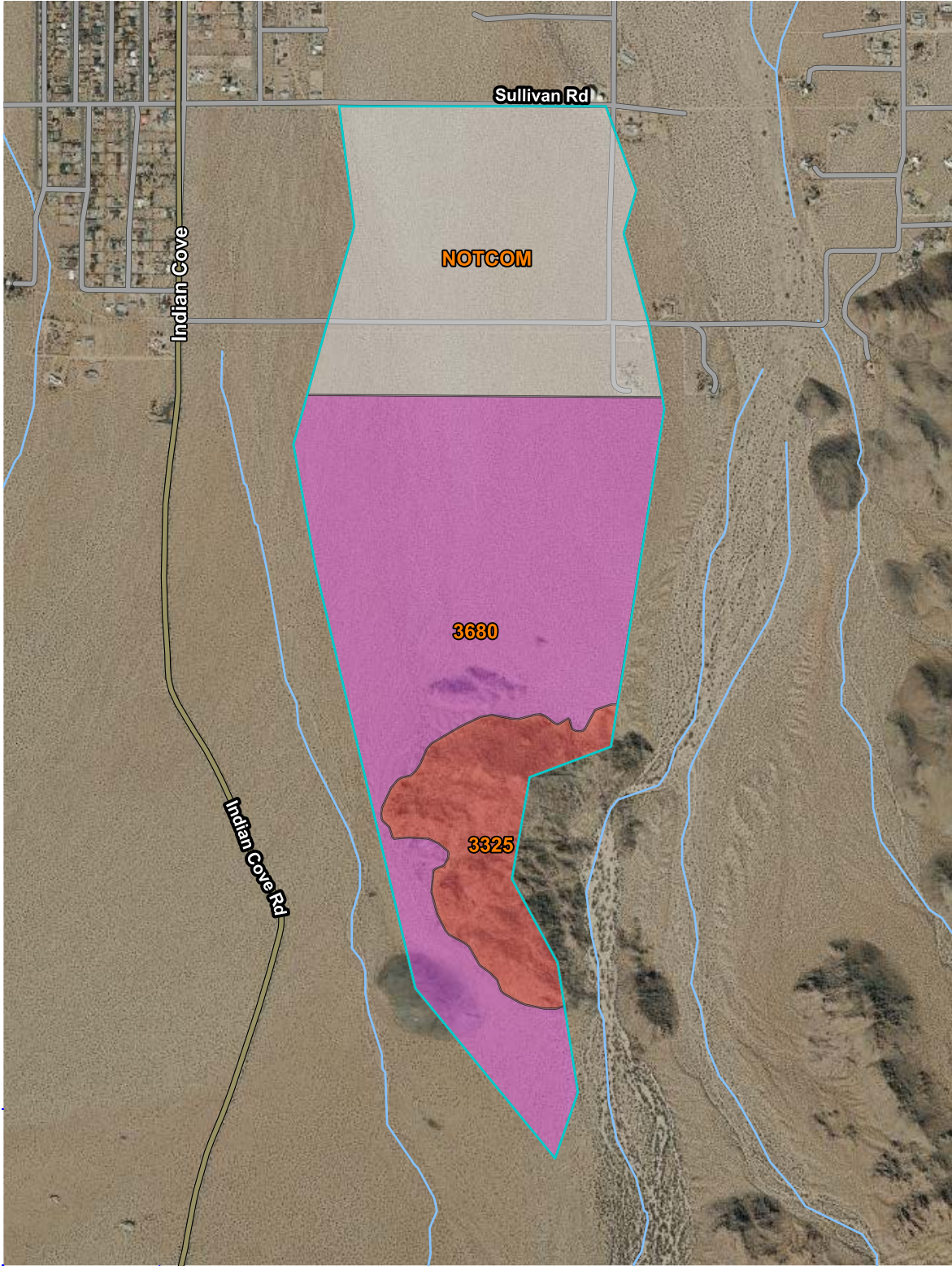
This map and its contents are not to be used for any purpose other than the one for which it was prepared. It is not intended to be used for any purpose other than the one for which it was prepared.

116° 9' 37" W

116° 7' 53" W

34° 7' 49" N

34° 7' 49" N



34° 5' 55" N

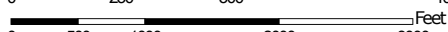
34° 5' 55" N

116° 9' 37" W

116° 7' 53" W



Map Scale: 1:17,200 if printed on A portrait (8.5" x 11") sheet.




Map projection: Web Mercator Corner coordinates: WGS84



## MAP LEGEND

### Area of Interest (AOI)









 Area of Interest (AOI)

### Soils

#### Soil Rating Polygons





 A  
 A/D  
 B  
 B/D  
 C  
 C/D  
 D  
 Not rated or not available

#### Soil Rating Lines


 A  
 A/D  
 B  
 B/D  
 C  
 C/D  
 D  
 Not rated or not available

#### Soil Rating Points






 A  
 A/D  
 B  
 B/D

 C  
 C/D  
 D  
 Not rated or not available

### Water Features

 Streams and Canals

### Transportation

 Rails  
 Interstate Highways  
 US Routes  
 Major Roads  
 Local Roads

### Background

 Aerial Photography

## MAP INFORMATION

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

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: Joshua Tree National Park, California  
 Survey Area Data: Version 13, Aug 30, 2023

Soil Survey Area: Mojave Desert Area, West Central Part, California  
 Survey Area Data: Version 16, Aug 30, 2023

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

Date(s) aerial images were photographed: Feb 27, 2021—May 27, 2021

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

## Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
3325	Ironped-Rock outcrop-Hexie complex, 30 to 60 percent slopes	D	59.6	12.4%
3680	Morongo loamy sand, 2 to 8 percent slopes, dry	A	253.9	52.8%
<b>Subtotals for Soil Survey Area</b>			<b>313.5</b>	<b>65.2%</b>
<b>Totals for Area of Interest</b>			<b>481.1</b>	<b>100.0%</b>

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
NOTCOM	No Digital Data Available	B -Assumed from SBCo Hydrology Manual Map	167.5	34.8%
<b>Subtotals for Soil Survey Area</b>			<b>167.5</b>	<b>34.8%</b>
<b>Totals for Area of Interest</b>			<b>481.1</b>	<b>100.0%</b>

## Description

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

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

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

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

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

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

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

## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff:* None Specified

*Tie-break Rule:* Higher

NOAA Atlas 14, Volume 6, Version 2

TWENTYNINE PALMS

Station ID: 04-9099



Location name: Twentynine Palms, California, USA\*

Latitude: 34.1281°, Longitude: -116.0369°

Elevation:

Elevation (station metadata): 1975 ft\*\*

\* source ESRI Maps

\*\* source USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitana, 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) <sup>1</sup>										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.157 (0.130-0.192)	0.221 (0.182-0.270)	0.308 (0.254-0.377)	0.383 (0.313-0.473)	0.490 (0.388-0.625)	0.577 (0.447-0.752)	0.669 (0.506-0.893)	0.769 (0.566-1.06)	0.911 (0.644-1.30)	1.03 (0.702-1.52)
10-min	0.226 (0.187-0.275)	0.316 (0.261-0.386)	0.441 (0.364-0.541)	0.549 (0.448-0.678)	0.702 (0.556-0.896)	0.827 (0.641-1.08)	0.959 (0.726-1.28)	1.10 (0.811-1.51)	1.31 (0.923-1.87)	1.47 (1.01-2.18)
15-min	0.273 (0.226-0.333)	0.382 (0.316-0.467)	0.534 (0.440-0.654)	0.663 (0.542-0.819)	0.849 (0.672-1.08)	1.00 (0.775-1.30)	1.16 (0.878-1.55)	1.33 (0.981-1.83)	1.58 (1.12-2.26)	1.78 (1.22-2.64)
30-min	0.393 (0.325-0.479)	0.550 (0.455-0.673)	0.768 (0.633-0.941)	0.955 (0.780-1.18)	1.22 (0.967-1.56)	1.44 (1.12-1.88)	1.67 (1.26-2.23)	1.92 (1.41-2.63)	2.27 (1.61-3.25)	2.56 (1.75-3.79)
60-min	0.476 (0.394-0.582)	0.668 (0.552-0.816)	0.932 (0.768-1.14)	1.16 (0.947-1.43)	1.48 (1.17-1.89)	1.75 (1.35-2.28)	2.03 (1.53-2.70)	2.33 (1.71-3.19)	2.76 (1.95-3.94)	3.11 (2.12-4.60)
2-hr	0.551 (0.456-0.672)	0.762 (0.622-0.919)	1.03 (0.853-1.27)	1.28 (1.05-1.58)	1.63 (1.29-2.09)	1.93 (1.49-2.51)	2.24 (1.69-2.99)	2.58 (1.90-3.54)	3.07 (2.17-4.39)	3.48 (2.38-5.15)
3-hr	0.589 (0.488-0.719)	0.803 (0.663-0.981)	1.10 (0.908-1.35)	1.36 (1.11-1.68)	1.74 (1.38-2.22)	2.05 (1.59-2.67)	2.38 (1.80-3.18)	2.75 (2.02-3.77)	3.27 (2.31-4.68)	3.71 (2.53-5.49)
6-hr	0.668 (0.553-0.815)	0.918 (0.759-1.12)	1.27 (1.04-1.55)	1.57 (1.28-1.93)	2.00 (1.58-2.55)	2.35 (1.82-3.06)	2.72 (2.06-3.64)	3.13 (2.30-4.30)	3.71 (2.62-5.31)	4.19 (2.86-6.20)
12-hr	0.733 (0.607-0.895)	1.04 (0.881-1.27)	1.46 (1.20-1.79)	1.81 (1.46-2.23)	2.30 (1.82-2.93)	2.68 (2.08-3.50)	3.09 (2.34-4.12)	3.51 (2.59-4.82)	4.11 (2.90-5.87)	4.58 (3.13-6.78)
24-hr	0.828 (0.733-0.953)	1.22 (1.08-1.41)	1.74 (1.53-2.01)	2.16 (1.89-2.52)	2.74 (2.33-3.30)	3.20 (2.66-3.93)	3.66 (2.87-4.60)	4.14 (3.27-5.35)	4.80 (3.64-6.46)	5.31 (3.89-7.39)
2-day	0.963 (0.853-1.11)	1.44 (1.28-1.66)	2.09 (1.84-2.41)	2.62 (2.30-3.06)	3.37 (2.86-4.06)	3.96 (3.29-4.87)	4.57 (3.71-5.75)	5.22 (4.12-6.74)	6.11 (4.63-8.22)	6.82 (5.00-9.49)
3-day	1.01 (0.891-1.16)	1.52 (1.34-1.75)	2.21 (1.95-2.56)	2.80 (2.45-3.26)	3.63 (3.08-4.37)	4.29 (3.57-5.27)	4.99 (4.05-6.28)	5.74 (4.53-7.42)	6.79 (5.15-9.13)	7.64 (5.60-10.6)
4-day	1.05 (0.932-1.21)	1.59 (1.41-1.83)	2.33 (2.05-2.69)	2.96 (2.59-3.44)	3.85 (3.26-4.63)	4.57 (3.80-5.62)	5.34 (4.33-6.71)	6.16 (4.86-7.96)	7.32 (5.55-9.85)	8.27 (6.06-11.5)
7-day	1.11 (0.984-1.28)	1.68 (1.48-1.93)	2.46 (2.17-2.84)	3.12 (2.74-3.64)	4.08 (3.46-4.92)	4.86 (4.04-5.97)	5.69 (4.62-7.16)	6.58 (5.20-8.50)	7.86 (5.96-10.6)	8.90 (6.52-12.4)
10-day	1.12 (0.996-1.30)	1.70 (1.50-1.96)	2.49 (2.20-2.88)	3.17 (2.78-3.70)	4.15 (3.52-5.00)	4.95 (4.11-6.08)	5.80 (4.70-7.29)	6.71 (5.30-8.67)	8.02 (6.08-10.8)	9.10 (6.67-12.7)
20-day	1.22 (1.08-1.41)	1.87 (1.66-2.16)	2.77 (2.45-3.21)	3.55 (3.11-4.14)	4.87 (3.96-5.62)	5.68 (4.64-6.86)	6.55 (5.32-8.24)	7.61 (6.00-9.83)	9.11 (6.91-12.3)	10.4 (7.59-14.4)
30-day	1.33 (1.18-1.53)	2.06 (1.82-2.37)	3.08 (2.71-3.56)	3.95 (3.46-4.60)	5.21 (4.42-5.27)	6.23 (5.18-7.66)	7.33 (5.94-9.21)	8.51 (6.72-11.0)	10.2 (7.73-13.7)	11.6 (8.49-16.1)
45-day	1.47 (1.31-1.70)	2.32 (2.05-2.67)	3.48 (3.07-4.03)	4.48 (3.93-5.23)	5.93 (5.02-7.13)	7.10 (5.90-8.72)	8.35 (6.77-10.5)	9.69 (7.65-12.5)	11.6 (8.80-15.6)	13.2 (9.66-18.3)
60-day	1.64 (1.46-1.89)	2.60 (2.30-3.00)	3.93 (3.47-4.54)	5.07 (4.44-5.91)	6.70 (5.68-8.07)	8.03 (6.67-9.86)	9.44 (7.65-11.9)	10.9 (8.64-14.2)	13.1 (9.94-17.6)	14.9 (10.9-20.7)

<sup>1</sup> 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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## **APPENDIX II**

- **Civild Rational Method – Existing Offsite**

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2014 Version 9.0  
Rational Hydrology Study Date: 02/14/24

-----  
Program License Serial Number 6360

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\*\*\*\*\* Hydrology Study Control Information \*\*\*\*\*

-----  
Rational hydrology study storm event year is 100.0  
Computed rainfall intensity:  
Storm year = 100.00 1 hour rainfall = 2.030 (In.)  
Slope used for rainfall intensity curve b = 0.7000  
Soil antecedent moisture condition (AMC) = 1

+++++  
Process from Point/Station 1.000 to Point/Station 2.000  
\*\*\*\* 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 = 1000.000(Ft.)  
Top (of initial area) elevation = 2950.000(Ft.)  
Bottom (of initial area) elevation = 2925.000(Ft.)  
Difference in elevation = 25.000(Ft.)  
Slope = 0.02500 s(%)= 2.50  
TC =  $k(0.706)*[(length^3)/(elevation\ change)]^{0.2}$   
Initial area time of concentration = 23.400 min.  
Rainfall intensity = 3.924(In/Hr) for a 100.0 year storm  
Effective runoff coefficient used for area (Q=KCIA) is C = 0.675  
Subarea runoff = 26.469(CFS)  
Total initial stream area = 10.000(Ac.)  
Pervious area fraction = 1.000  
Initial area Fm value = 0.983(In/Hr)

+++++  
Process from Point/Station 2.000 to Point/Station 3.000  
\*\*\*\* IRREGULAR CHANNEL FLOW TRAVEL TIME \*\*\*\*

-----  
Estimated mean flow rate at midpoint of channel = 0.000(CFS)  
Depth of flow = 0.632(Ft.), Average velocity = 3.986(Ft/s)  
\*\*\*\*\* Irregular Channel Data \*\*\*\*\*

-----  
Information entered for subchannel number 1 :  
Point number 'X' coordinate 'Y' coordinate  
1 0.00 4.00  
2 12.00 0.00  
3 112.00 0.00  
4 124.00 4.00

Manning's 'N' friction factor = 0.050  
-----

Sub-Channel flow = 256.537(CFS)  
' ' flow top width = 103.789(Ft.)  
' ' velocity = 3.986(Ft/s)  
' ' area = 64.353(Sq.Ft)  
' ' Froude number = 0.892

Upstream point elevation = 2925.000(Ft.)  
Downstream point elevation = 2635.000(Ft.)  
Flow length = 8500.000(Ft.)  
Travel time = 35.54 min.  
Time of concentration = 58.94 min.  
Depth of flow = 0.632(Ft.)  
Average velocity = 3.986(Ft/s)  
Total irregular channel flow = 256.536(CFS)  
Irregular channel normal depth above invert elev. = 0.632(Ft.)  
Average velocity of channel(s) = 3.986(Ft/s)  
Adding area flow to channel  
UNDEVELOPED (average cover) subarea  
Decimal fraction soil group A = 0.500  
Decimal fraction soil group B = 0.360  
Decimal fraction soil group C = 0.000  
Decimal fraction soil group D = 0.140  
SCS curve number for soil(AMC 2) = 61.60  
Adjusted SCS curve number for AMC 1 = 41.60  
Pervious ratio(Ap) = 1.0000 Max loss rate(Fm)= 0.901(In/Hr)  
Rainfall intensity = 2.056(In/Hr) for a 100.0 year storm  
Effective runoff coefficient used for area,(total area with modified  
rational method)(Q=KCIA) is C = 0.505  
Subarea runoff = 460.050(CFS) for 459.100(Ac.)  
Total runoff = 486.519(CFS)  
Effective area this stream = 469.10(Ac.)  
Total Study Area (Main Stream No. 1) = 469.10(Ac.)  
Area averaged Fm value = 0.903(In/Hr)

Depth of flow = 0.926(Ft.), Average velocity = 5.113(Ft/s)  
End of computations, Total Study Area = 469.10 (Ac.)

The following figures may

be used for a unit hydrograph study of the same area.

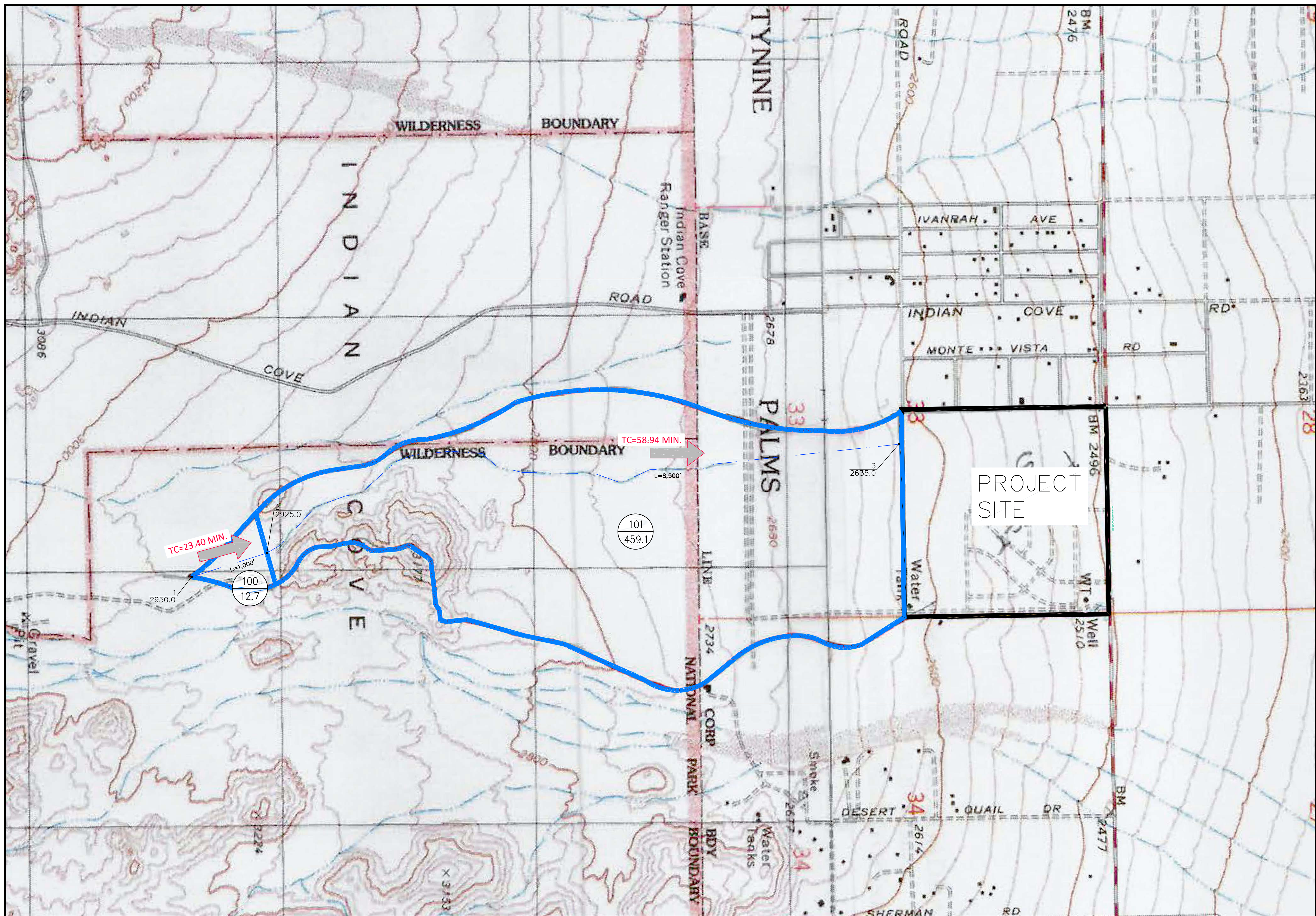
Note: These figures do not consider reduced effective area effects caused by confluences in the rational equation.

Area averaged pervious area fraction( $A_p$ ) = 1.000

Area averaged SCS curve number = 61.4

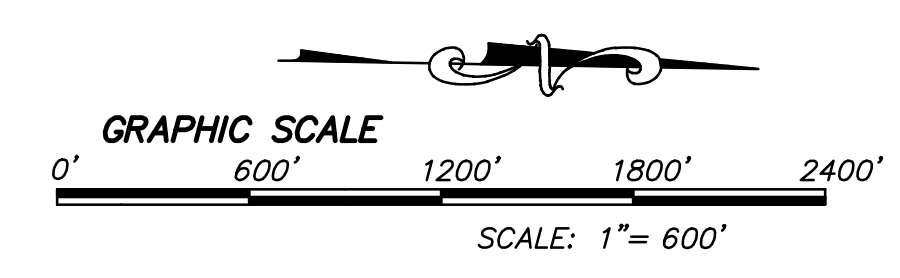
## **APPENDIX III**

- Offsite Hydrology Map



**LEGEND**

- BASIN I.D.
- AREA (ac)
- NODE I.D.
- ELEVATION (FT)
- BASIN BOUNDARY
- FLOW PATH
- TC=IN MIN. TIME OF CONCENTRATION



SCALE 1" = 600'
JOB NUMBER 227523-0000210
CREATED: 2/2024

**NV5**  
 42-829 COOK STREET, SUITE 104  
 PALM DESERT, CA 92211  
 P: 760.341.3101 WWW.NV5.COM

JOSHUA TREE, CA
OFLAND TWENTYNINE PALMS
OFFSITE HYDROLOGY MAP
APN'S: 0614-121-15

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