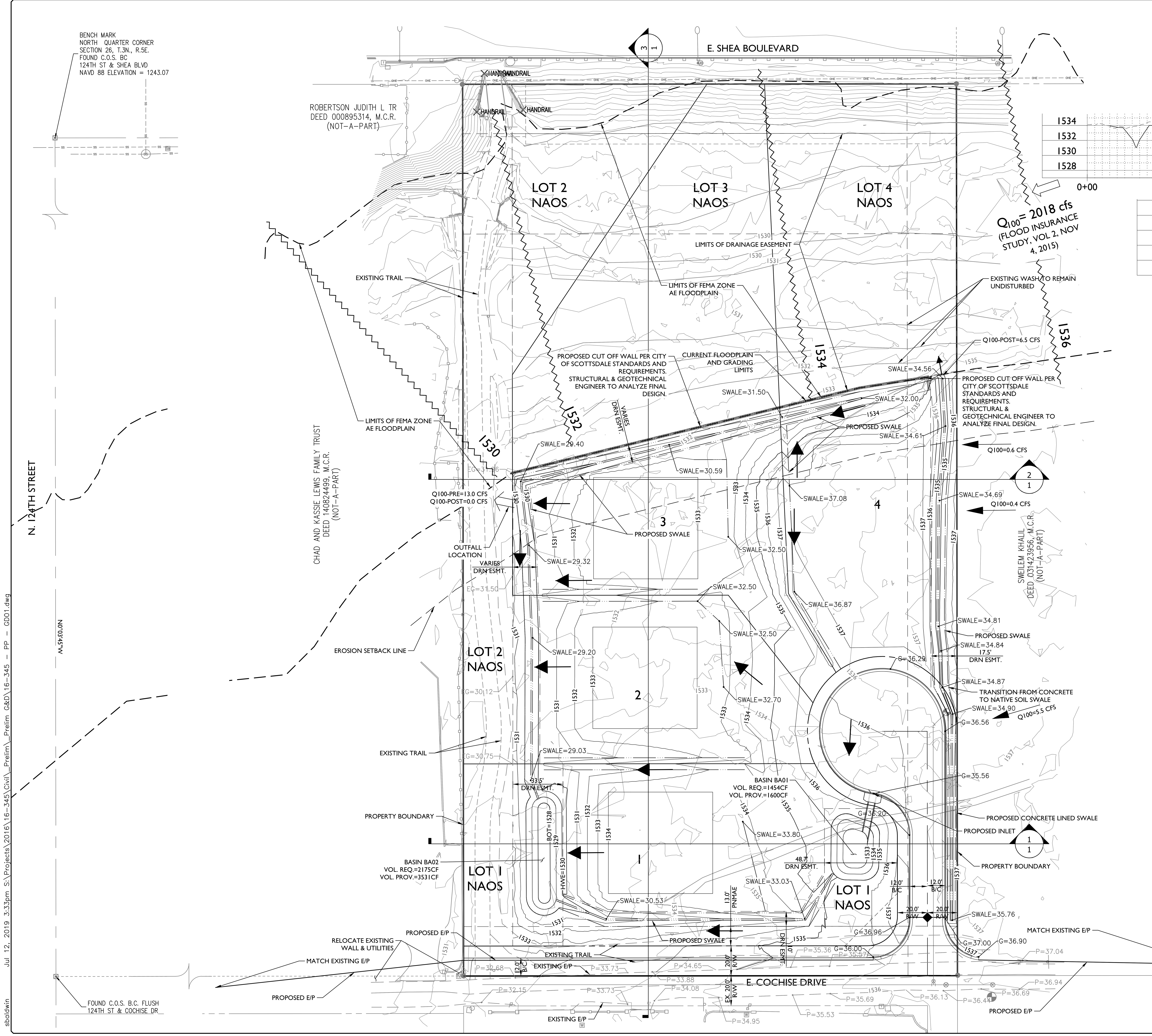
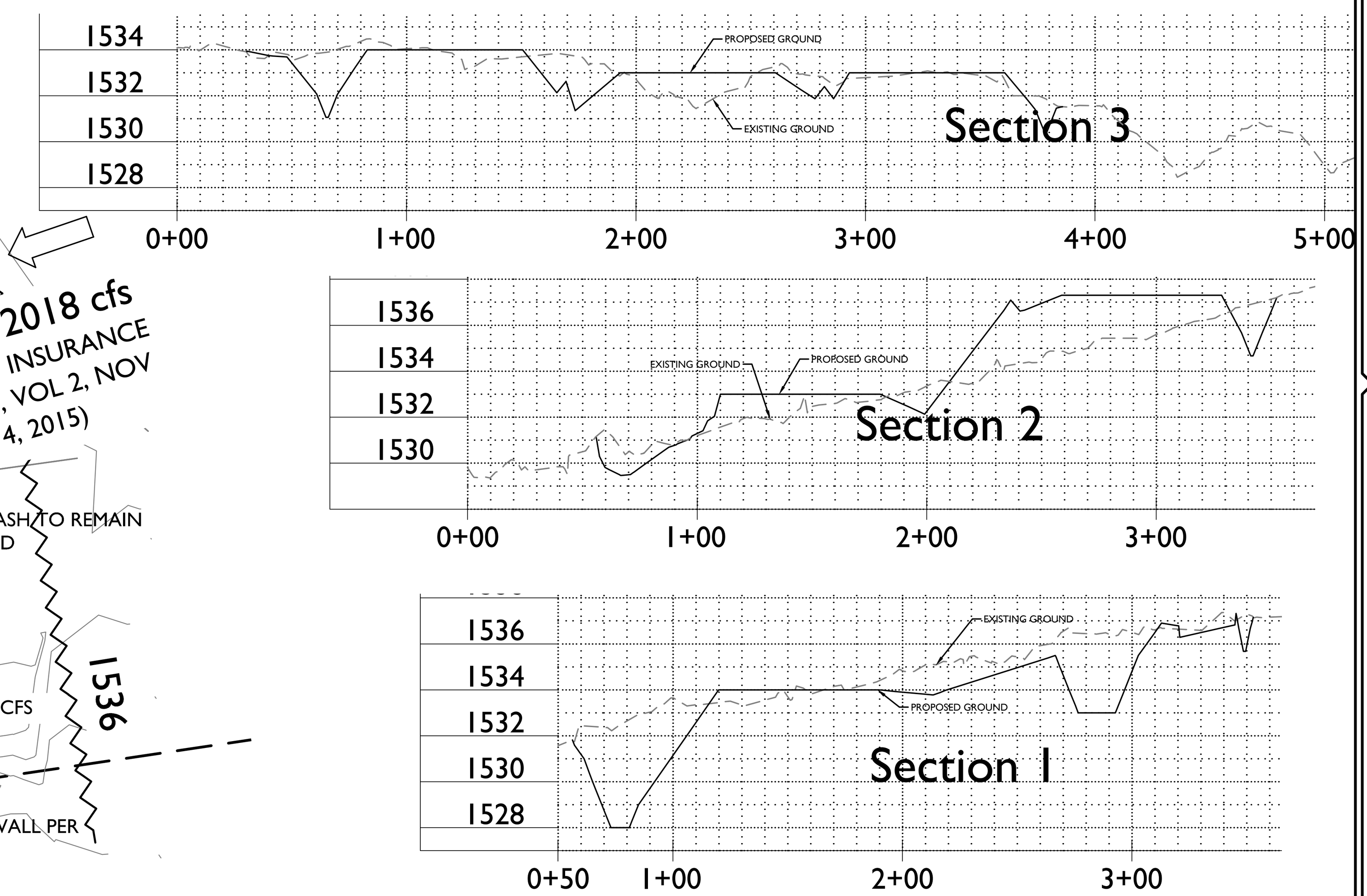
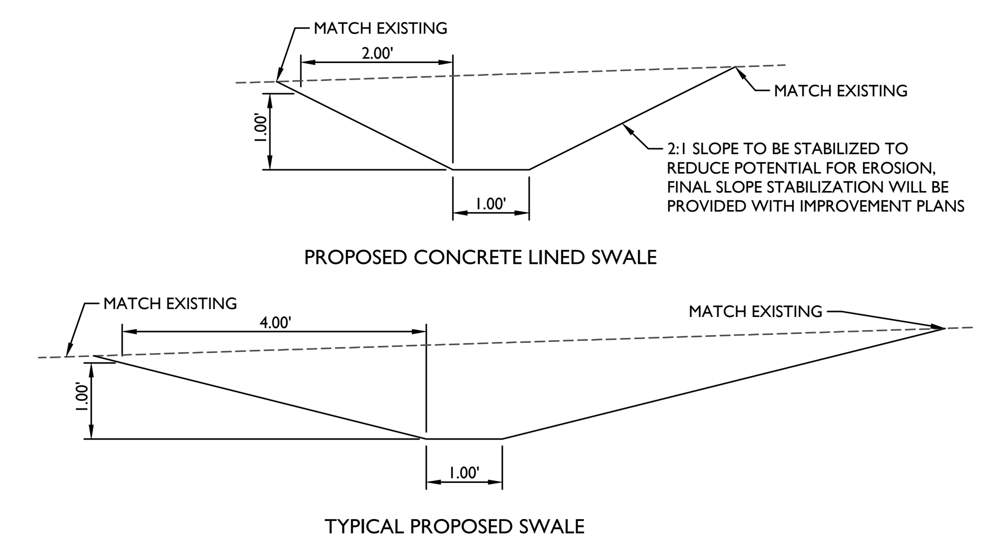
CITY OF SCOTTSDALE

Drainage Reports




## BASIS OF BEARING

THE MEASURED WEST LINE OF THE NORTHEAST QUARTER OF SECTION 26, TOWNSHIP 3 NORTH RANGE 5 EAST OF THE GILA AND SALT RIVER BASE AND MERIDIAN, MARICOPA COUNTY, ARIZONA, SAID BEARING BEING: NORTH 00 DEGREES 03 MINUTES 45 SECONDS WEST.

## BENCHMARK:

NORTH QUARTER CORNER SECTION 26, T.3N., R.5E. FOUND C.O.S. BC
124TH ST AND SHEA BLVD
NAVD 88 ELEVATION = 1243.07


EPS GROUP
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Mesa, AZ 85210
T:480.503.2250 | F:480.503.2258
www.epsgroupinc.com


Project:
Hanella Estates Subdivision
Scottsdale, AZ

# Preliminary Grading and Drainage

Revisions:

Call at least two full working days before you begin excavation. ARIZONA 811. Dial 8-1-1 or 1-800-STAKE-IT (782-5348). In Maricopa County: (602)263-1100

Designer: JSD
Drawn by: JSD

Registered Professional Engineer (Civil), Certificate No. 54652, Brian Nicholls, Arizona

Job No. 16-345
GD01
Sheet No. 1 of 1

Jul 12, 2019 3:33pm S:\Projects\2016\16-345\Civil_Prelim_Prelim G&D\16-345 - PP - GD01.dwg
sbaldwin

3-PP-2018
8/28/2019

EPS GROUP

# Preliminary Drainage Report

For

# Hanella Estates

## The City of Scottsdale, Arizona

Submitted by: Ross & Joy Stuart
12481 E. Shea Blvd
Scottsdale Az, 85259

Plan # ____________

Case # 3-PP-2018

Q-S # ____________

X Accepted

____ Corrections

MR 7/14/21
Reviewed By Date

Registered Professional Engineer (Civil)
CERTIFICATE NO.
54652
BRIAN
NICHOLLS
Date Signed 07/12/19
ARIZONA, U.S.A.

Project No. 16-345 Case No. 3-PP-2018
Date: January 2018
Revised: August 2018
Revised: December 2018
Revised: March 2019
Revised: July 2019

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# Table of Contents



# Appendix List

Appendix:

- Vicinity Map
- Offsite Aerial Photograph
- FEMA Flood Map
- Grading Plan
- Pre & Post Development Exhibits
- ALTA
- Drainage Calculations

## 1.0 Introduction

Hanella Estates, "the Project," is a proposed single-family development located on the northwest corner of Cochise Dr & 125th St. The project consists of 4 single-family residential units covering 4.58 acres in Scottsdale Arizona. The Project is currently zoned for R1-43.

The Project is in Section 26, Township 3 North, Range 5 East of the Gila and Salt River base and meridian, City of Scottsdale, Maricopa County, Arizona. The site is currently undeveloped desert land. Refer to the Vicinity Map in Appendix A for the project location.

## 2.0 Off-site Watershed

Hanella Estates subdivision is located in a partially developed area of Scottsdale, Arizona. Offsite flows are conveyed through a wash in the northern portion of the site. The $Q_{100}$ for Wash B is 2,018 cfs. This value was found in FLOOD INSURANCE STUDY(FIS), Vol. 2 of 31: Maricopa County, Arizona. This study was done by the Federal Emergency Management Agency (Flood Insurance Study Number 04013CV002C) and was revised on November 4, 2015. The flows from Cochise Drive, sheet flow, west, towards 124th St. From there it enters a wash.

| | PEAK DSICARGES (cfs) | | | | |
|---|---|---|---|---|---|
| Flooding Source and Location | Drainage Area (Sq. Miles) | 10-Percent Annual Chance | 2-percent Annual Chance | 1-Percent Annual Chance | 0.2-Percent Annual Chance |
| WASH B | | | | | |
| Above Shea Blvd | 1.63 | - | - | 2,018 | - |

Table 1. Summary of Discharges, on pg 123 of Flood Insurance Study Vol. 2 of 31

The area east of the property flows toward the site and has a flow of 6.5 cfs for the 100 year event.

## 3.0 Flood Hazard Zones on the Property, FIRM Maps

This project is located in FIRM Zone X & Zone AE as identified on panel number 04013C1785L and dated October 16th, 2013. See appendix for FEMA FIRM Map.

## 4.0 Proposed Drainage Plan

The project will be designed to protect in place the existing wash on the north side of the property (designated as wash B on the FIS). This wash will continue to flow to the west as historically. The Project will be designed for the lots to drain into the street and/or into a drainage swale. The intent is to be able to leave as much of the lot natural as possible. Once in the street, stormwater will flow through a scupper into the retention basin. Most of the storm water will drain to the rear of the lots into a drainage swale. From there it will flow into a second retention basin. The basins are designed to hold the difference between the pre-and post-development flows. As Basin BA01 fills and overtops, excess storm water will flow via a swale to basin BA02. As Basin BA02 fills and overtops, storm water will flow northwest at the northwest corner of the site which is the historic site outfall.

The Project will be protected from erosion from Wash B through the construction of a cutoff wall. The existing Wash B will not be disturbed and any sediment transport will remain as it historically has been. The cutoff wall will be built along the FEMA defined floodplain boundary. It will be built per City of Scottsdale and Maricopa County Flood Control District (MCFCD) standards and requirements. For added protection, the finished floor will be placed 14 inches above the FEMA floodplain elevation. Preliminary scour depth calculations are provided in the appendix and a Structural engineer and Geotechnical engineer will be needed for final design. The general scour depth was calculated using the Lacey Equation as shown in the Appendix. Our analysis shows a scour depth of 0.92' so the cut off wall shall extend at least 1' below the bottom of the channel.

The subdivision/road plan shall provide improvements as shown on the grading plans. These improvements are to include all grading for lots, swales, and roads, installation of pavement, curb & gutter, scupper, and applicable utilities to the lots. The subdivision/road plan should adhere to the preliminary grading plan.

## 4.1 Calculation Methodology – Peak Flow and Time of Concentration

The Rational Method will be used to calculate peak flows at critical locations in the development. Peak flows will be calculated as follows:

$$Q = C * i * A$$

Where Q is the Peak Discharge, C is the weighted "c" value of the area, i is the rainfall intensity (as defined by the local time of concentration and the site specific IDF curve) in inches per hour, and A is the area in acres.

As required by Maricopa County the time of concentration calculations for the storm drainage will be performed using the Papadakis and Kazan equation as follows:

$$T_c = 11.4 L^{0.5} K_b^{0.52} S^{-0.31} i^{-0.38}$$

Where Tc is the time of concentration (in hours), L is the length of the longest flow path (in miles), Kb is the watershed resistance coefficient, S is the watercourse slope (in feet per mile), and i is the rainfall intensity (in inches per hour).

Intensity will be estimated by linearly interpolating the site specific I-D-F curve that is derived from the NOAA ATLAS 14 data (that is described in section 5.1 of this report) at a specific time of concentration.

As can be seen the time of concentration is a function of the intensity and the intensity is a function of the time of concentration. Therefore, the equations will be iterated until both equations can be satisfied. When both equations are satisfied for each sub basin area the resulting values will be applied to that sub basin area and the peak flow at the concentration point will be calculated.

The time of concentration will be calculated from the high point of the sub basin area to the low point of the sub basin area. For the onsite flow of the project, runoff will start in a residential lot and drain to the street and then the street will drain to a low point where drainage will be conveyed to a retention basin. In this circumstance the drainage length "L" will be measured from the high point in the lot to the low point in the street along the flow line. The slope of the watercourse "S" will be calculated by dividing the difference in the pad elevation of the lot and the low point elevation by the drainage length "L". For the offsite flow of the project, runoff will start at the high point of the drainage area and drain to the low point where drainage will be conveyed to a retention basin. In this circumstance the drainage length "L" will be measured from the high point to the low point in the swale along the flow line. The slope of the watercourse "S" will be calculated by dividing the difference in the high point elevation of the lot and the low point elevation by the drainage length "L".

Peak flows were calculated for the onsite and the offsite areas for pre-developed and post developed conditions using the rational method within DDMSW. These peak flows were used to size the swales. See the Appendix for Hydrology & Hydraulic calculations.

## 4.2 Pre-developed Condition

Per Chapter 4, Figure 4-1.5 of the 2018 City of Scottsdale Design Standards & Policies Manual, the onsite and offsite drainage basins have a C-value of 0.45 for "undisturbed natural desert or desert landscaping (no impervious weed barrier)" for the pre-developed condition, 100 year storm. The pre-developed condition has 6 drainage basins that are affecting the site. Three are designated offsite and three onsite. The rational method was used for analysis and the combined total of the flow passing through the site and entering Wash B is 14.4 cfs.

### 4.3 Post-developed Condition

The post-developed offsite drainage basin will retain the same pre-developed C-value since this area is not being changed. The post-developed onsite drainage basin will have a 100 year storm C-value of 0.61 for the lot area, since this property is zoned R1-43. The street area will have a C-value of 0.95 and the retention basin areas/NAOS will have a C-value of 0.45 since it will be "undisturbed natural desert or desert landscaping (no impervious weed barrier)". Please see the appendix for weighted C-value calculations for the drainage basins. The post-developed condition has 3 offsite drainage basins which are the same as the pre-developed condition. These three offsite drainage basins will be conveyed by a swale on the east side of the project and outlet to Wash B with a combined flow of 6.5 cfs. The onsite drainage basins were routed rationally utilizing the DDMSW program with an outflow of 0 cfs leaving the site. The retention basins are sized to retain the difference in volume between the pre-development and post development conditions.

The typical proposed swale is designed with a 1' bottom and 4:1 side slopes that will have a capacity of 7.7 cfs. A short portion of the swale on the east side of the property is designed with a 1' bottom and 2:1 side slopes that is concrete lined. This portion of the channel is located between the property line and the proposed back of curb. The swales and retention basins will be located within drainage easements.

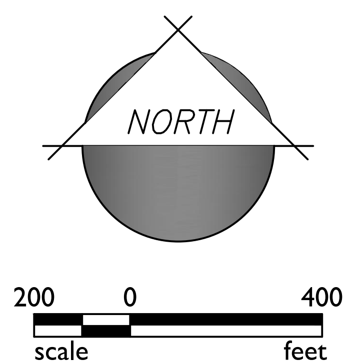
The detention basins are designed to not have more than 2 feet of ponded water for the 100 year storm event. They are also designed to have 4:1 side slopes (horizontal:vertical). These basins shall be dewatered within 36 hours of the end of a storm event by means of surface percolation. Surface percolation test results shall be provided with the final drainage report. If surface percolation is not sufficient to dewater within the 36 hour window, then drywells shall be utilized.

The drainage concepts for this project are to maintain the historic drainage patterns of the parcel as much as possible. However, the cut off wall and the swales on the lots will be installed with the development of the subdivision and the street improvements. The proposed development of the parcel will not adversely affect offsite flows or downstream properties.

## 5.0 Conclusions

The Project will not have a negative impact on historic flows. The finished floor elevations for Hanella Estates has been set a minimum of 18 inches above site outfall per City of Scottsdale design criteria and 14 inches above FEMA flood plain elevation. The construction of a cutoff wall will add additional protection by preventing flood waters from entering the development by means of lateral erosion. Storm water runoff will be detained in retention basins. Once filled they will flow northwest at the northwest corner of the site as the site historically has. The post-developed flow is less than the pre-developed flow leaving the site.

# Appendix


Jan 24, 2019 3:10pm S:\Projects\2016\16-345\Civil_Prelim\Design\Drainage\16-345 – PP – Vicinity Map.dwg

16-345

Hanella Estates
Scottsdale, AZ

Vicinity Map

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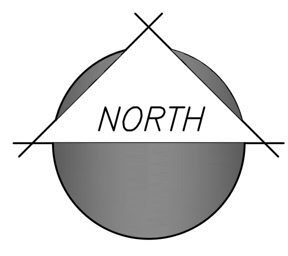



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16-345

Hanella Estates
Scottsdale, AZ

Offsite Aerial Photograph

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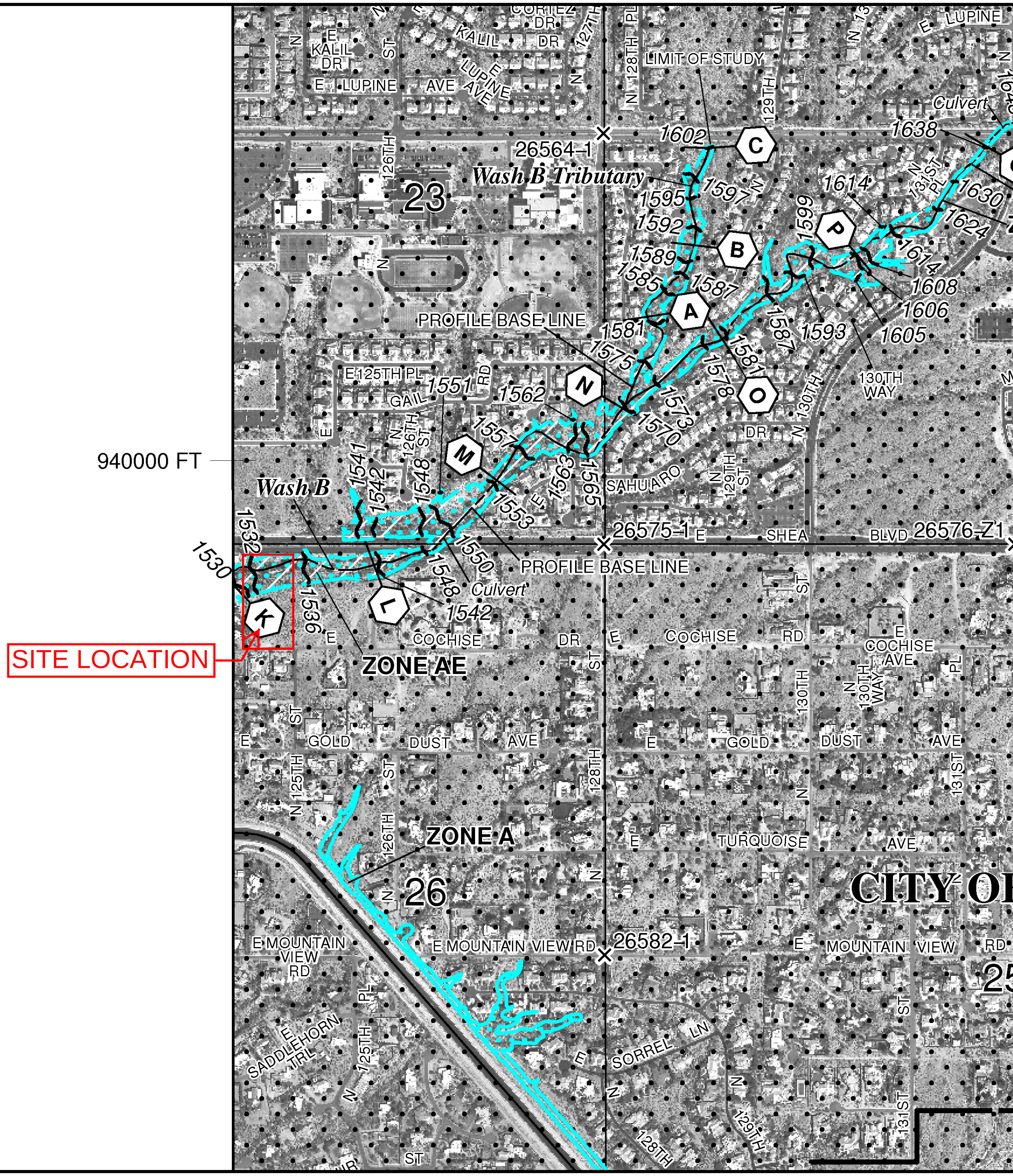



MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

METERS

PANEL 1785L

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

# FIRM

## FLOOD INSURANCE RATE MAP

## MARICOPA COUNTY, ARIZONA

## AND INCORPORATED AREAS

**PANEL 1785 OF 4425**

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|---|---|---|---|
| MARICOPA COUNTY | 040037 | 1785 | L |
| FOUNTAIN HILLS, TOWN OF | 040135 | 1785 | L |
| SCOTTSDALE, CITY OF | 045012 | 1785 | L |

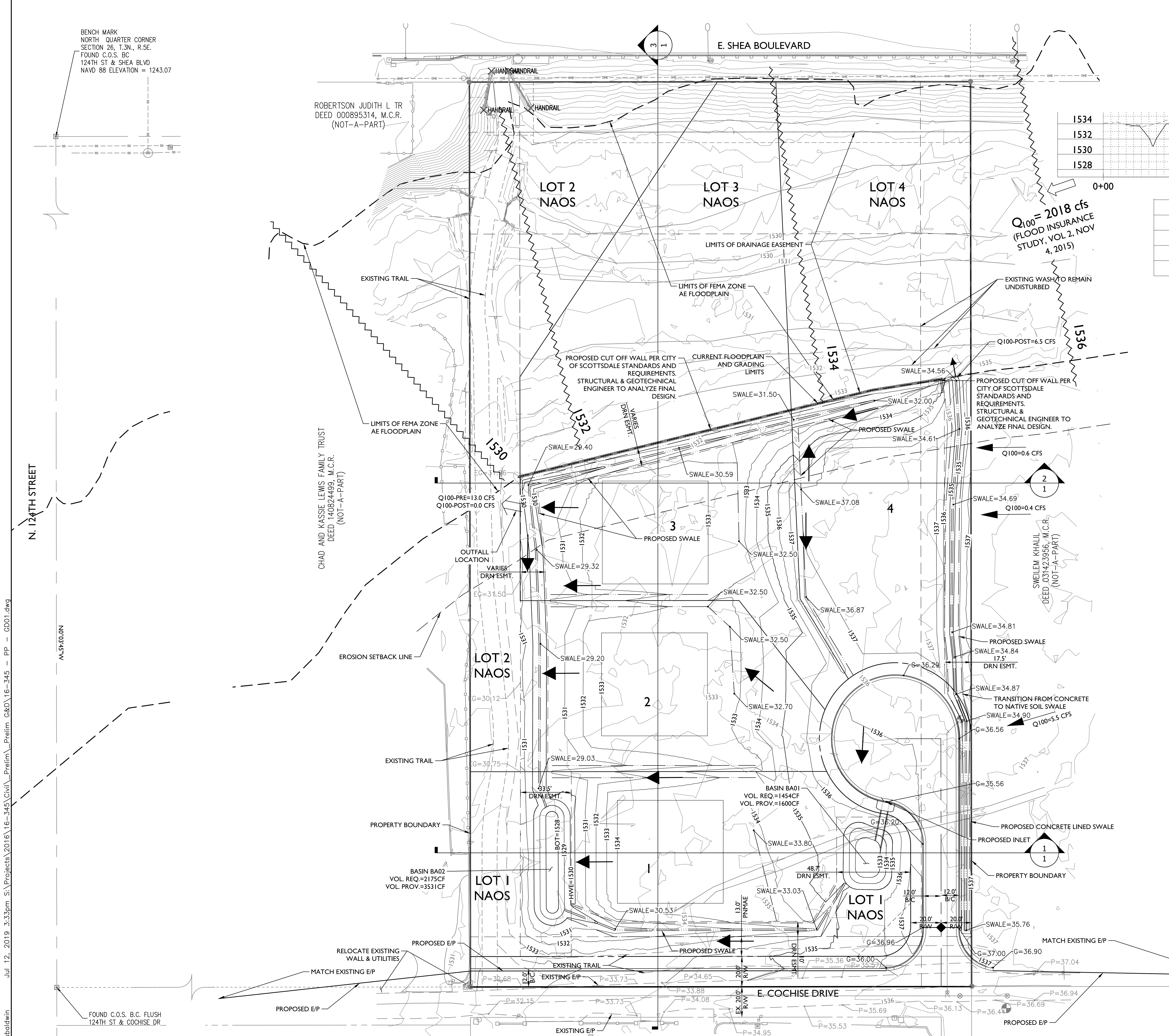
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

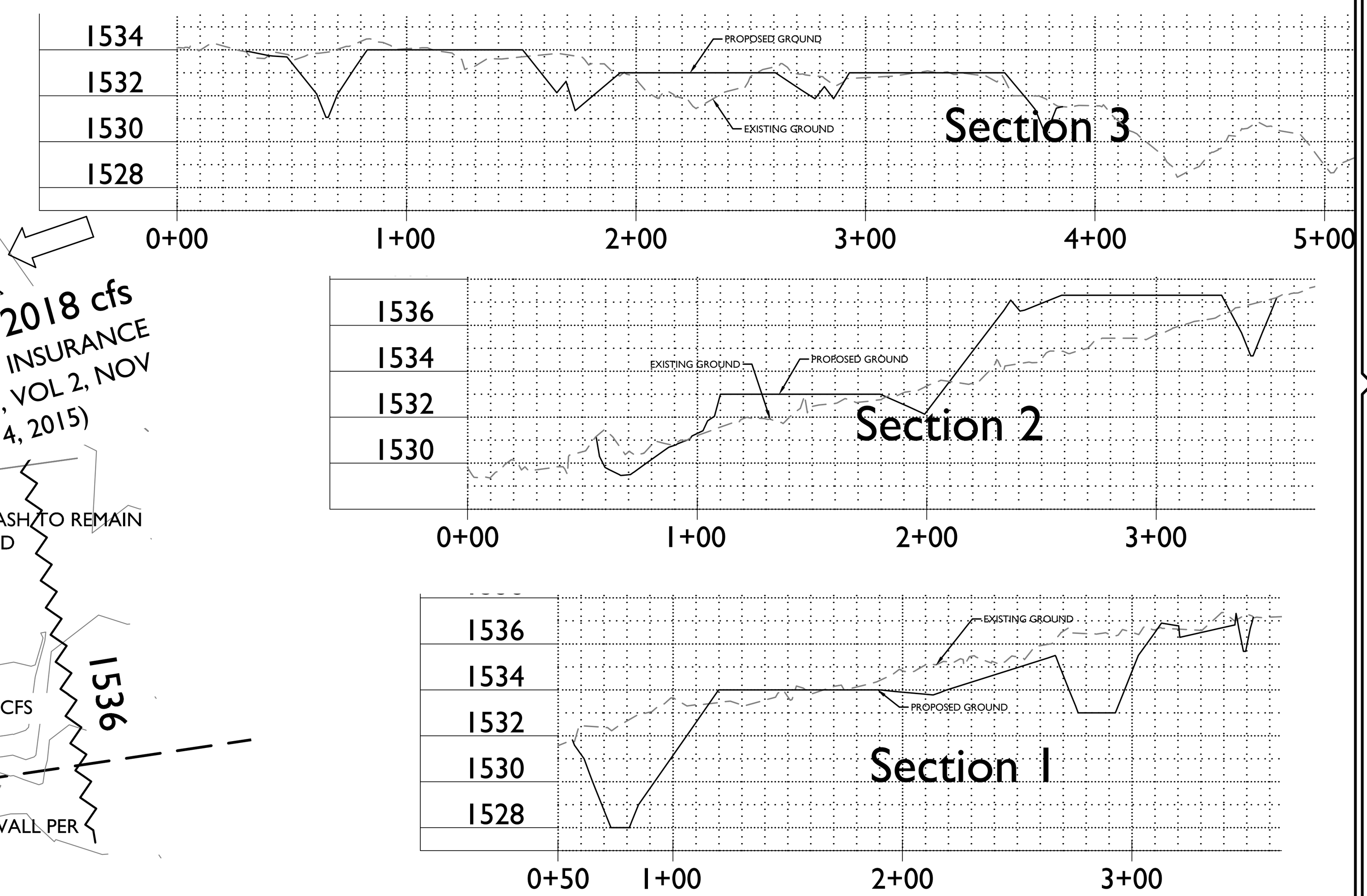
**MAP NUMBER 04013C1785L**

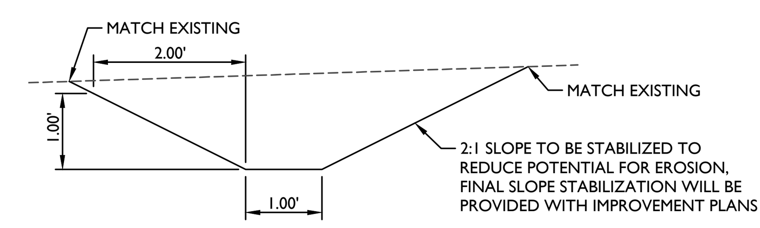
**MAP REVISED OCTOBER 16, 2013**

Federal Emergency Management Agency

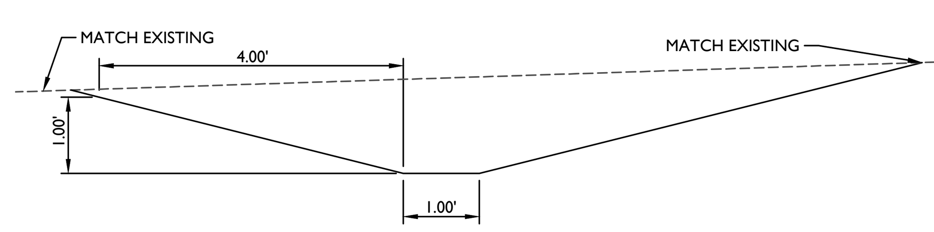
This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov




PROPOSED CONCRETE LINED SWALE




TYPICAL PROPOSED SWALE

## BASIS OF BEARING

THE MEASURED WEST LINE OF THE NORTHEAST QUARTER OF SECTION 26, TOWNSHIP 3 NORTH RANGE 5 EAST OF THE GILA AND SALT RIVER BASE AND MERIDIAN, MARICOPA COUNTY, ARIZONA, SAID BEARING BEING: NORTH 00 DEGREES 03 MINUTES 45 SECONDS WEST.

## BENCHMARK:

NORTH QUARTER CORNER SECTION 26, T.3N., R.5E. FOUND C.O.S. BC
124TH ST & SHEA BLVD
NAVD 88 ELEVATION = 1243.07

30 0 30 60
scale feet

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Project:

# Hanella Estates Subdivision

Scottsdale, AZ

# Preliminary Grading and Drainage

Revisions:

ARIZONA 811 — Call at least two full working days before you begin excavation. Dial 8-1-1 or 1-800-STAKE-IT (782-5348). In Maricopa County: (602)263-1100

Designer: JSD
Drawn by: JSD

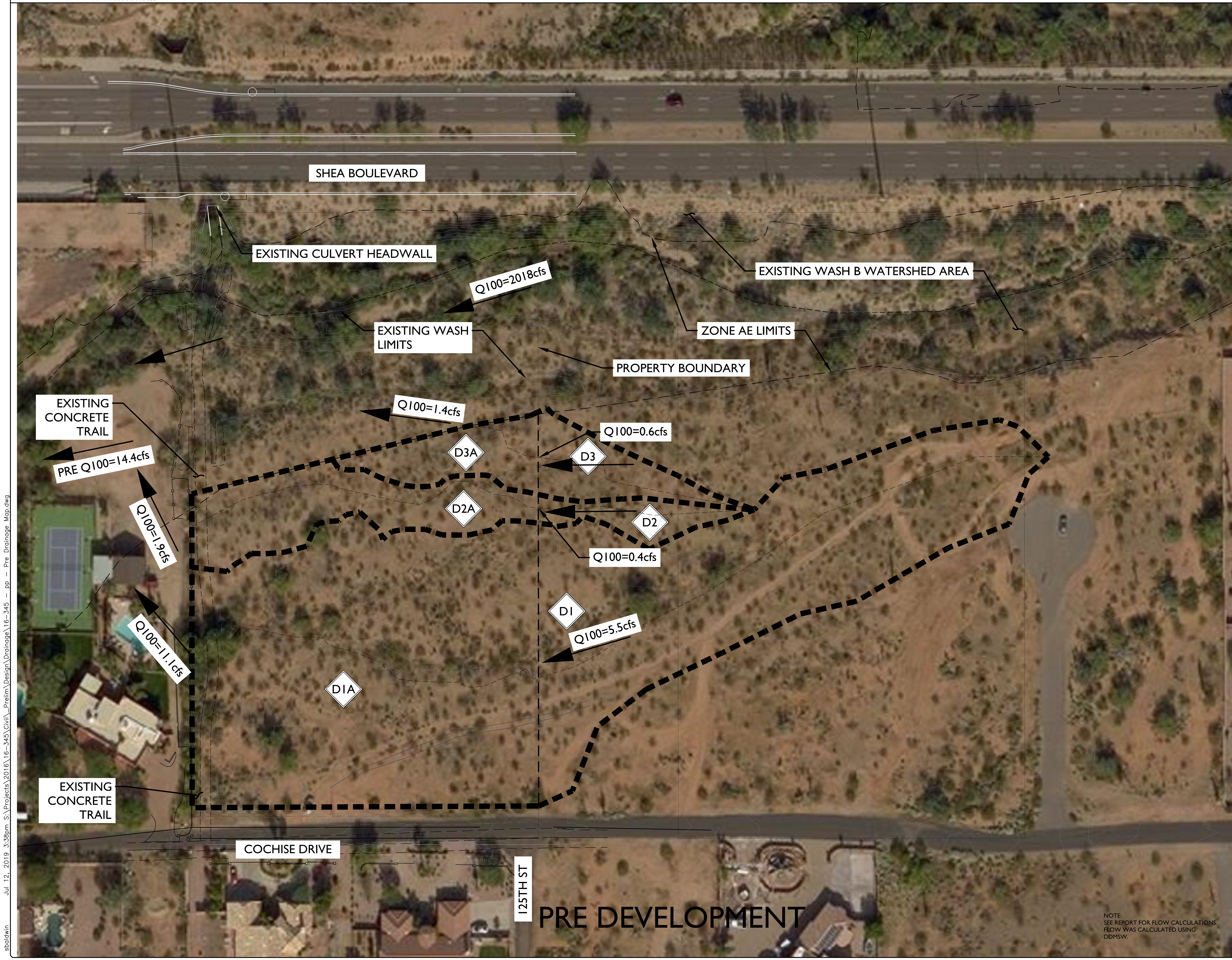
Registered Professional Engineer (Civil) — Certificate No. 54652 — Brian Nicholls — Arizona — Date Signed 07-12-19

Job No.
16-345

GD01

Sheet No.
1
of 1

Construction Notes




40 0 40 80
scale feet

16-345

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sbaldwin

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Project:
Hanella Estates
125th & Cochise
Scottsdale, Arizona

Pre Drainage Map

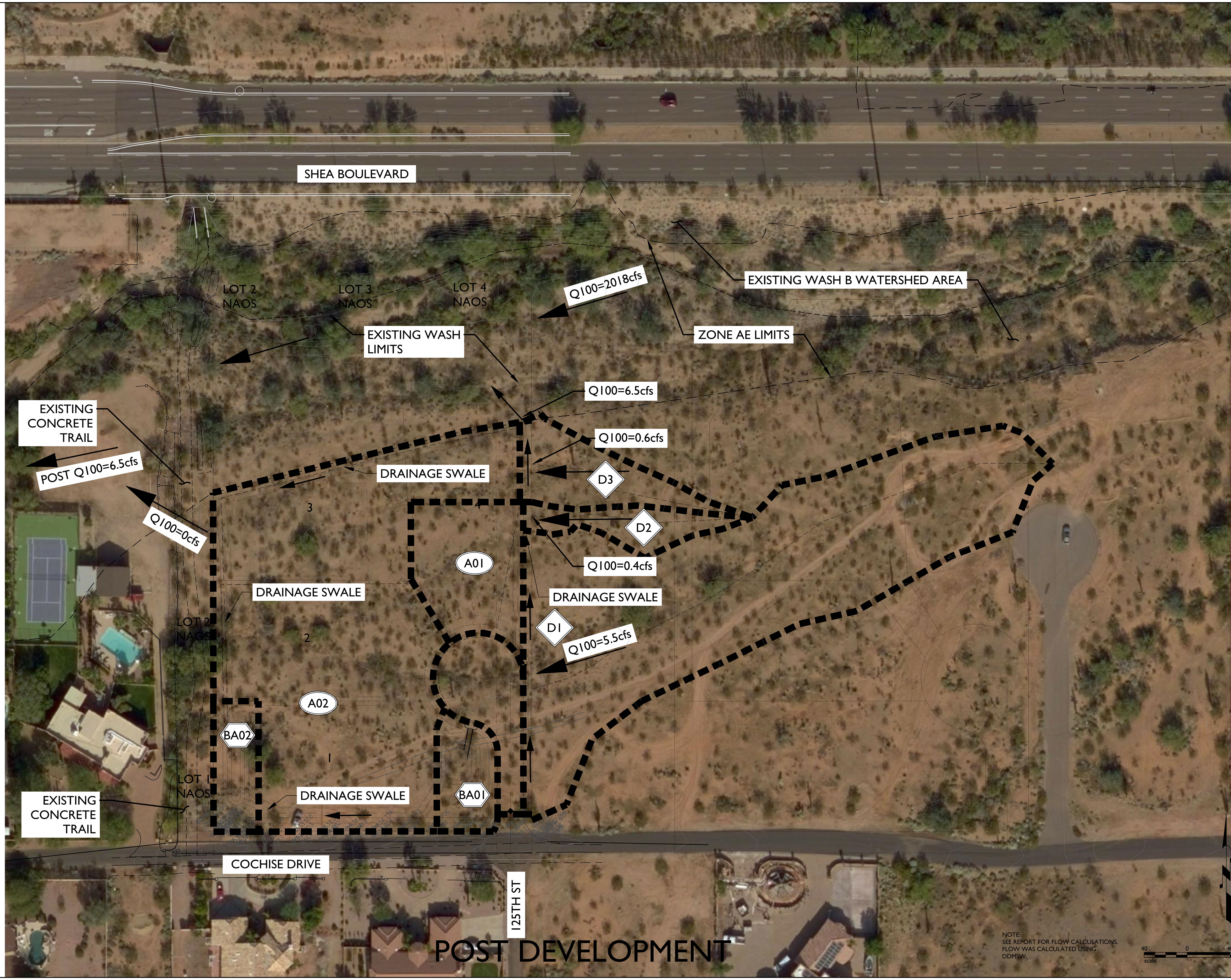
Revisions:

Designer: SRB
Drawn by: SRB

Job No.
16-345

Sheet No.
1
of 1

Construction Notes




16-345

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www.epsgroupinc.com

Project:
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125th & Cochise
Scottsdale, Arizona

# Post Development Drainage Map

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ARIZONA 811
Arizona Blue Stake, Inc.
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In Maricopa County: (602)263-1100

Designer: SRB
Drawn by: SRB

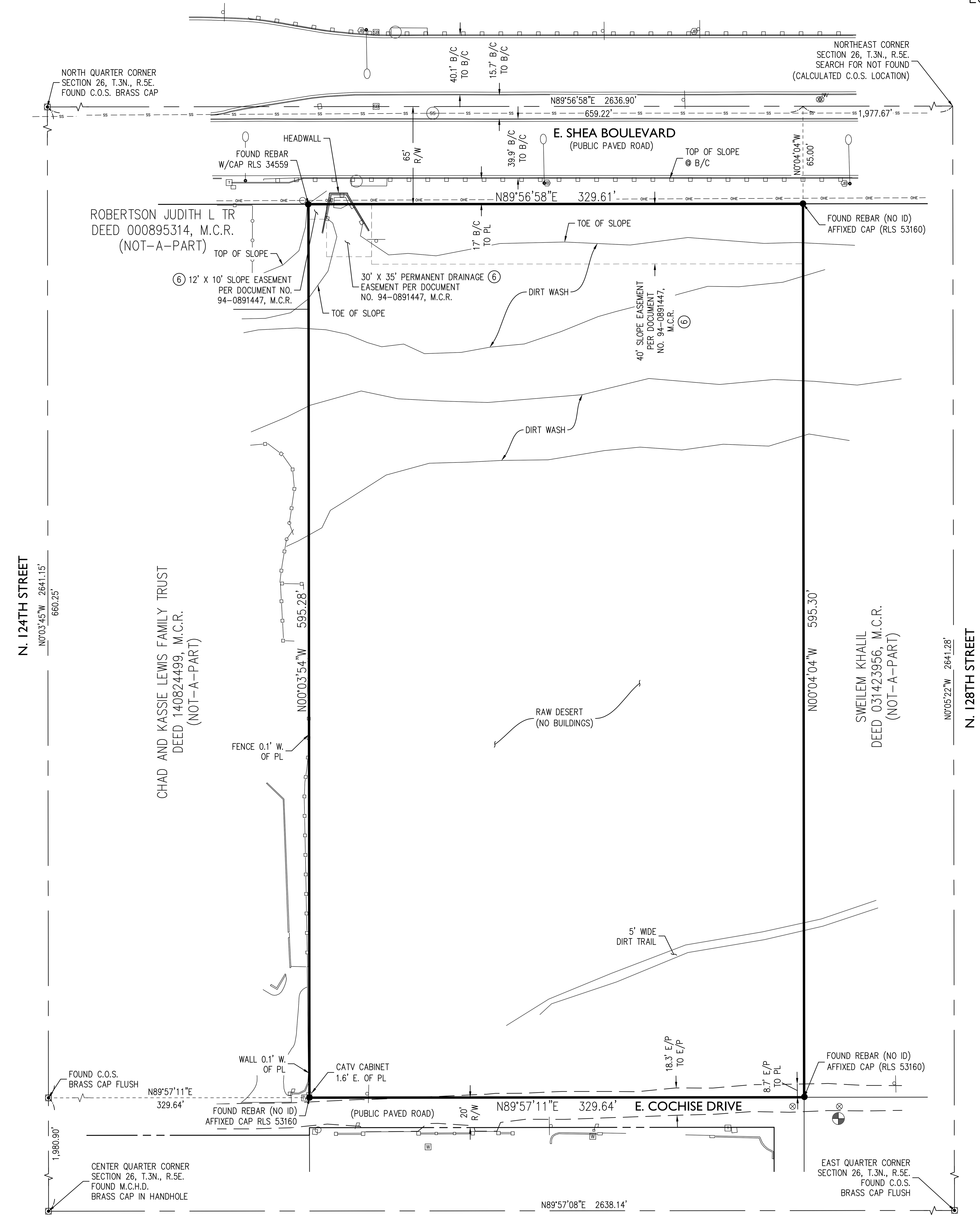
Job No.
16-345

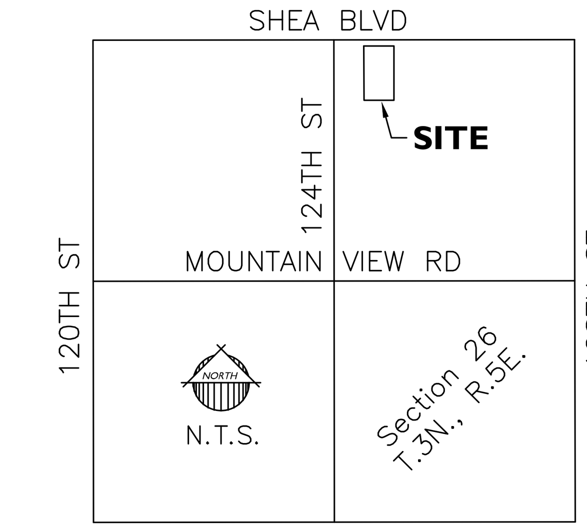
Sheet No.
1
of 1

# ALTA/NSPS LAND TITLE SURVEY

## 12481 E SHEA BLVD

LOT 7, SECTION 26, TOWNSHIP 3 NORTH, RANGE 5 EAST
OF THE GILA AND SALT RIVER BASE AND MERIDIAN,
MARICOPA COUNTY, ARIZONA;




**VICINITY MAP**

N.T.S.

## LEGEND

- FOUND CAP AS NOTED
- FOUND REBAR AS NOTED
- FIRE HYDRANT
- WATER METER
- WATER VALVE
- SEWER MANHOLE
- TV PEDESTAL
- STREET LIGHT
- LIGHT POLE
- LIGHT POLE
- ELECTRIC METER
- LIGHT POLE
- LIGHT POLE
- SIGN
- FENCE
- SEWER LINE
- UNDER GROUND ELECTRIC LINE

| | |
|---|---|
| PL | PROPERTY LINE |
| R/W | RIGHT OF WAY |
| B/W | BACK OF WALK |
| E/P | EDGE OF PAVEMENT |
| RLS | REGISTERED LAND SURVEYOR |
| B.S.E. | BUILDING SETBACK EASEMENT |
| C.O.S. | CITY OF SCOTTSDALE |
| M.C.H.D. | MARICOPA COUNTY HIGHWAY DEPARTMENT |
| M.C.R. | MARICOPA COUNTY RECORDER |

## OWNER

ROSS BLANCHARD STUART

## SCHEDULE B DOCUMENTS:

**THE FOLLOWING ITEMS LISTED AS EXCEPTIONS PERTAIN TO THE SURVEYED PROPERTY HOWEVER, ARE NOT SURVEY RELATED MATTERS: ITEMS 1, 2 AND 4.**

3. RESERVATIONS, RIGHTS, EASEMENTS OR OTHER MATTERS AS MAY BE SET FORTH IN THE PATENT TO SAID LAND RECORDED IN THE OFFICE OF THE COUNTY RECORDER, OR IN ACTS AUTHORIZING THE ISSUANCE THEREOF.
**(ITEM HAS NOT BEEN SUPPLIED BY TITLE)**

5. RIGHT OF WAY NOT EXCEEDING 33 FEET IN WIDTH FOR ROADWAY AND PUBLIC UTILITIES PURPOSES TO BE LOCATED ACROSS SAID LAND OR AS NEAR AS PRACTICABLE TO THE EXTERIOR BOUNDARIES OF SAID LAND AS SET FORTH IN PATENT.
**(ITEM HAS NOT BEEN SUPPLIED BY TITLE)**

6. AN EASEMENT FOR SLOPE AND PERMANENT DRAINAGE AND RIGHTS INCIDENTAL THERETO, RECORDED IN DOCUMENT NO. 94-0891447.
**(ITEM IS SHOWN HEREON)**

7. TERMS AND PROVISIONS AS SET FORTH IN THE WAIVER OF RIGHT TO MAKE A CLAIM UNDER PROPOSITION 207 RECORDED IN DOCUMENT NO. 2007-1089190.
**(ITEM IS BLANKET IN NATURE AND IS NOT SHOWN)**

## LEGAL DESCRIPTION

G.L.O. LOT 7 OF SECTION 26, TOWNSHIP 3 NORTH, RANGE 5 EAST OF THE GILA AND SALT RIVER BASE AND MERIDIAN, MARICOPA COUNTY, ARIZONA;

**EXCEPT** THE NORTH 65.00 FEET THEREOF; AND

**EXCEPT** ALL OIL, GAS AND OTHER MINERAL DEPOSITS AS RESERVED UNTO THE UNITED STATES OF AMERICA IN PATENT TO SAID LAND; AND

**EXCEPT** ALL URANIUM, THORIUM OR ANY OTHER MATERIAL WHICH IS OR MAY BE DETERMINED TO BE PECULIARLY ESSENTIAL TO THE PRODUCTION OF FISSIONABLE MATERIALS AS RESERVED UNTO THE UNITED STATES OF AMERICA IN PATENT TO SAID LAND.

## BASIS OF BEARING

THE MEASURED WEST LINE OF THE NORTHEAST QUARTER OF SECTION 26, TOWNSHIP 3 NORTH RANGE 5 EAST OF THE GILA AND SALT RIVER BASE AND MERIDIAN, MARICOPA COUNTY, ARIZONA, SAID BEARING BEING: **NORTH 00 DEGREES 03 MINUTES 45 SECONDS WEST.**

## SURVEYOR'S NOTES

1. WITH REGARDS TO ALTA/NSPS LAND TITLE SURVEY STANDARDS, TABLE A, ITEM 4: THE GROSS/NET AREA OF THE SUBJECT PROPERTY CONTAINS 196,223 SQUARE FEET OR 4.5047 ACRES, MORE OR LESS.
2. WITH REGARDS TO ALTA/NSPS LAND TITLE SURVEY STANDARDS, TABLE A, ITEM 8: SUBSTANTIAL FEATURES OBSERVED IN THE PROCESS OF CONDUCTING THE SURVEY. ARE SHOWN HEREON.
3. THERE IS DIRECT ACCESS TO THE SUBJECT PROPERTY VIA E. COCHISE DRIVE, BEING PUBLIC RIGHT OF WAY.
4. THE SURVEYED PROPERTY IS RAW DESERT AND CONTAINS NO BUILDINGS.
5. A PORTION THE PAVED ROAD ALONG THE SOUTH BOUNDARY LIES WITHIN THE SURVEYED PROPERTY. THE ROAD IS DEPICTED AND DIMENSIONED AS SUCH.
6. A CATV RISER APPEARS TO LIE INSIDE THE SURVEYED PROPERTY AT THE SOUTHWEST CORNER. THE LOCATION IS DEPICTED AND DIMENSIONED AS SUCH.
7. THE SURVEYED PROPERTY AS SHOWN HEREON IS THE SAME PROPERTY DESCRIBED IN SCHEDULE A OF AMERICAN TITLE SERVICE AGENCY, LLC., FILE NO. 00083525-051, EFFECTIVE DATE: OCTOBER 26, 2016 AT 8:00 A.M.

## CERTIFICATION

TO: ROSS BLANCHARD STUART, A MARRIED MAN, AS HIS SOLE AND SEPARATE PROPERTY AND AMERICAN TITLE SERVICE AGENCY, LLC.

THIS IS TO CERTIFY THAT THIS MAP OR PLAT AND THE SURVEY ON WHICH IT IS BASED WERE MADE IN ACCORDANCE WITH THE 2016 MINIMUM STANDARD DETAIL REQUIREMENTS FOR ALTA/NSPS LAND TITLE SURVEYS, JOINTLY ESTABLISHED AND ADOPTED BY ALTA AND NSPS, AND INCLUDES ITEMS 1, 4, AND 8 OF TABLE A THEREOF. THE FIELD WORK WAS COMPLETED ON 10/25/2016.

RAYMOND MUNOZ, RLS (NO. 53160)
EPS GROUP, INC.
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MESA, AZ 85210


EPS GROUP
2045 S. Vineyard Ave, Suite 101
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T:480.503.2250 | F:480.503.2258
www.epsgroupinc.com


Project: 12481 E SHEA BLVD
SCOTTSDALE, ARIZONA
MARICOPA COUNTY, ARIZONA

ALTA/NSPS LAND TITLE SURVEY

Revisions:



Designer: RM
Drawn by: AG

REGISTERED LAND SURVEYOR CERTIFICATE NO. 53160 RAYMOND S. MUNOZ III Date Signed 9/11/17 ARIZONA, U.S.A. Expires 3/31/18

Job No. 16-345

BS

Sheet No. 1 of 1

16-133

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rmunoz

# Retention Calculations

| | | |
|---|---|---|
| **Project:** | Hanella Estates | |
| **Storm Event:** | 100-yr 2-hr | |
| **Prepared by:** | Scott Baldwin | **Date:** 3/27/2019 |

**V = C * A * P / 12** [1]
Where:
V = Runoff Volume
C = Runoff Coefficient
A = Drainage Area
P = 2.35 in

## Surface Retention Basin Volume Calculations

| Basin ID | Elevation | Area ($ft^2$) | Incremental Volume ($ft^3$) | Volume Provided, $V_p$ ($ft^3$) |
|---|---|---|---|---|
| BA01 | 1533 | 380 | | |
| | 1534 | 775 | 578 | |
| | 1535 | 1,269 | 1,022 | 1,600 |
| BA02 | | | | |
| | 1528 | 521 | | |
| | 1529 | 1,144 | 833 | |
| | 1530 | 4,252 | 2,698 | 3,531 |

## Volume Required and Summary

| Basin ID | Sub-Basin ID | Sub Basin Area Description | Contributing Area ($ft^2$) | C = | Volume Required, $V_R$ ($ft^3$) | Volume Provided, $V_p$ ($ft^3$) | Estimated Water Depth (ft) |
|---|---|---|---|---|---|---|---|
| Pre | D01 | Desert Land | 44,796 | 0.45 | 3,948 | | |
| | | | | | | | |
| | | Total | 44,796 | 0.45 | 3,948 | | |
| Post | R1 | ROAD | 6,803 | 0.95 | 1,266 | | |
| | A1 | Lot 4 | 29,627 | 0.61 | 3,539 | | |
| | BA01 | BASIN | 6,774 | 0.45 | 597 | 1,600 | |
| | | | | | 0 | | |
| | | Total | 43,205 | 0.64 | 5,402 | 1,600 | 1.82 |
| | | | | | **PRE V POST DIFFERENCE** | **1,454 $ft^3$** | |
| Pre | D02 | Desert Land | 78,255 | 0.45 | 6,896 | | |
| | | | | | | | |
| | | Total | 78,255 | 0.45 | 6,896 | | |
| Post | A2 | Lots 2, 3, & 4 | 72,165 | 0.61 | 8,621 | | |
| | BA02 | BASIN | 5,110 | 0.45 | 450 | 3,531 | |
| | | | | | | | |
| | | | | | | | |
| | | Total | 77,275 | 0.60 | 9,071 | 3,531 | 1.23 |
| | | | | | **PRE V POST DIFFERENCE** | **2,175 $ft^3$** | |

Notes:
(1) Equation 2-4 taken from Pinal County Drainage Manual

**NOAA Atlas 14, Volume 1, Version 5**
**Location name: Scottsdale, Arizona, USA***
**Latitude: 33.5818°, Longitude: -111.8123°**
**Elevation: 1534.18 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 | 0.200 (0.166-0.248) | 0.262 (0.218-0.325) | 0.354 (0.292-0.437) | 0.424 (0.347-0.522) | 0.519 (0.418-0.634) | 0.591 (0.470-0.719) | 0.664 (0.519-0.806) | 0.738 (0.568-0.894) | 0.837 (0.628-1.01) | 0.912 (0.671-1.11) |
| 10-min | 0.305 (0.253-0.378) | 0.399 (0.332-0.494) | 0.539 (0.444-0.666) | 0.646 (0.529-0.794) | 0.789 (0.636-0.965) | 0.899 (0.716-1.09) | 1.01 (0.790-1.23) | 1.12 (0.865-1.36) | 1.27 (0.956-1.54) | 1.39 (1.02-1.69) |
| 15-min | 0.378 (0.313-0.468) | 0.494 (0.411-0.613) | 0.668 (0.550-0.825) | 0.801 (0.656-0.984) | 0.978 (0.788-1.20) | 1.11 (0.887-1.36) | 1.25 (0.980-1.52) | 1.39 (1.07-1.69) | 1.58 (1.19-1.91) | 1.72 (1.27-2.09) |
| 30-min | 0.509 (0.422-0.631) | 0.666 (0.554-0.825) | 0.900 (0.741-1.11) | 1.08 (0.883-1.33) | 1.32 (1.06-1.61) | 1.50 (1.20-1.83) | 1.69 (1.32-2.05) | 1.88 (1.44-2.27) | 2.13 (1.60-2.58) | 2.32 (1.70-2.82) |
| 60-min | 0.630 (0.522-0.781) | 0.824 (0.686-1.02) | 1.11 (0.917-1.38) | 1.34 (1.09-1.64) | 1.63 (1.31-2.00) | 1.86 (1.48-2.26) | 2.09 (1.63-2.53) | 2.32 (1.79-2.81) | 2.63 (1.98-3.19) | 2.87 (2.11-3.49) |
| 2-hr | 0.737 (0.618-0.890) | 0.955 (0.803-1.16) | 1.27 (1.06-1.53) | 1.51 (1.25-1.82) | 1.84 (1.51-2.20) | 2.09 (1.69-2.50) | 2.35 (1.86-2.80) | 2.60 (2.03-3.10) | 2.94 (2.25-3.51) | 3.21 (2.40-3.85) |
| 3-hr | 0.800 (0.671-0.982) | 1.03 (0.863-1.26) | 1.34 (1.12-1.65) | 1.59 (1.32-1.95) | 1.94 (1.58-2.35) | 2.22 (1.78-2.68) | 2.50 (1.98-3.02) | 2.80 (2.18-3.38) | 3.21 (2.42-3.87) | 3.54 (2.61-4.28) |
| 6-hr | 0.962 (0.826-1.14) | 1.22 (1.05-1.45) | 1.55 (1.33-1.84) | 1.82 (1.54-2.15) | 2.18 (1.82-2.56) | 2.47 (2.03-2.89) | 2.76 (2.24-3.23) | 3.06 (2.44-3.59) | 3.47 (2.69-4.06) | 3.79 (2.87-4.45) |
| 12-hr | 1.10 (0.955-1.29) | 1.39 (1.20-1.62) | 1.75 (1.51-2.04) | 2.04 (1.75-2.37) | 2.42 (2.06-2.81) | 2.72 (2.28-3.15) | 3.03 (2.50-3.50) | 3.33 (2.72-3.86) | 3.74 (2.98-4.35) | 4.06 (3.17-4.75) |
| 24-hr | 1.32 (1.18-1.51) | 1.68 (1.50-1.91) | 2.17 (1.93-2.48) | 2.56 (2.27-2.92) | 3.11 (2.73-3.53) | 3.54 (3.08-4.01) | 3.99 (3.45-4.52) | 4.46 (3.82-5.05) | 5.10 (4.31-5.79) | 5.61 (4.69-6.39) |
| 2-day | 1.47 (1.30-1.67) | 1.88 (1.66-2.14) | 2.47 (2.18-2.81) | 2.94 (2.59-3.34) | 3.60 (3.15-4.09) | 4.13 (3.59-4.68) | 4.69 (4.04-5.33) | 5.28 (4.51-6.00) | 6.10 (5.14-6.96) | 6.77 (5.63-7.74) |
| 3-day | 1.59 (1.41-1.80) | 2.03 (1.80-2.31) | 2.69 (2.37-3.05) | 3.21 (2.83-3.64) | 3.96 (3.47-4.48) | 4.56 (3.97-5.16) | 5.21 (4.49-5.89) | 5.89 (5.03-6.68) | 6.85 (5.77-7.79) | 7.64 (6.36-8.70) |
| 4-day | 1.70 (1.51-1.93) | 2.19 (1.94-2.48) | 2.90 (2.57-3.28) | 3.49 (3.07-3.94) | 4.32 (3.78-4.87) | 5.00 (4.35-5.64) | 5.73 (4.95-6.46) | 6.50 (5.56-7.35) | 7.60 (6.41-8.61) | 8.51 (7.09-9.67) |
| 7-day | 1.92 (1.69-2.19) | 2.46 (2.17-2.80) | 3.28 (2.88-3.73) | 3.94 (3.45-4.48) | 4.89 (4.26-5.55) | 5.67 (4.90-6.42) | 6.50 (5.57-7.37) | 7.39 (6.28-8.40) | 8.66 (7.25-9.85) | 9.70 (8.03-11.1) |
| 10-day | 2.10 (1.86-2.39) | 2.70 (2.39-3.06) | 3.59 (3.17-4.06) | 4.31 (3.79-4.87) | 5.33 (4.66-6.01) | 6.15 (5.34-6.93) | 7.03 (6.06-7.94) | 7.97 (6.81-9.01) | 9.29 (7.83-10.5) | 10.4 (8.64-11.8) |
| 20-day | 2.61 (2.32-2.96) | 3.37 (2.99-3.81) | 4.47 (3.95-5.04) | 5.31 (4.67-5.98) | 6.44 (5.66-7.26) | 7.33 (6.40-8.26) | 8.24 (7.15-9.31) | 9.17 (7.91-10.4) | 10.4 (8.92-11.9) | 11.4 (9.69-13.0) |
| 30-day | 3.08 (2.73-3.47) | 3.97 (3.53-4.48) | 5.26 (4.65-5.91) | 6.24 (5.52-7.01) | 7.58 (6.66-8.51) | 8.62 (7.54-9.67) | 9.69 (8.43-10.9) | 10.8 (9.32-12.1) | 12.3 (10.5-13.8) | 13.5 (11.4-15.2) |
| 45-day | 3.65 (3.24-4.12) | 4.71 (4.18-5.31) | 6.24 (5.53-7.03) | 7.39 (6.53-8.33) | 8.92 (7.85-10.1) | 10.1 (8.84-11.4) | 11.3 (9.84-12.8) | 12.5 (10.8-14.2) | 14.2 (12.1-16.1) | 15.5 (13.1-17.7) |
| 60-day | 4.10 (3.64-4.62) | 5.31 (4.72-5.98) | 7.02 (6.23-7.90) | 8.28 (7.32-9.32) | 9.92 (8.74-11.2) | 11.2 (9.79-12.6) | 12.4 (10.8-14.0) | 13.7 (11.9-15.5) | 15.4 (13.2-17.5) | 16.7 (14.2-19.0) |

[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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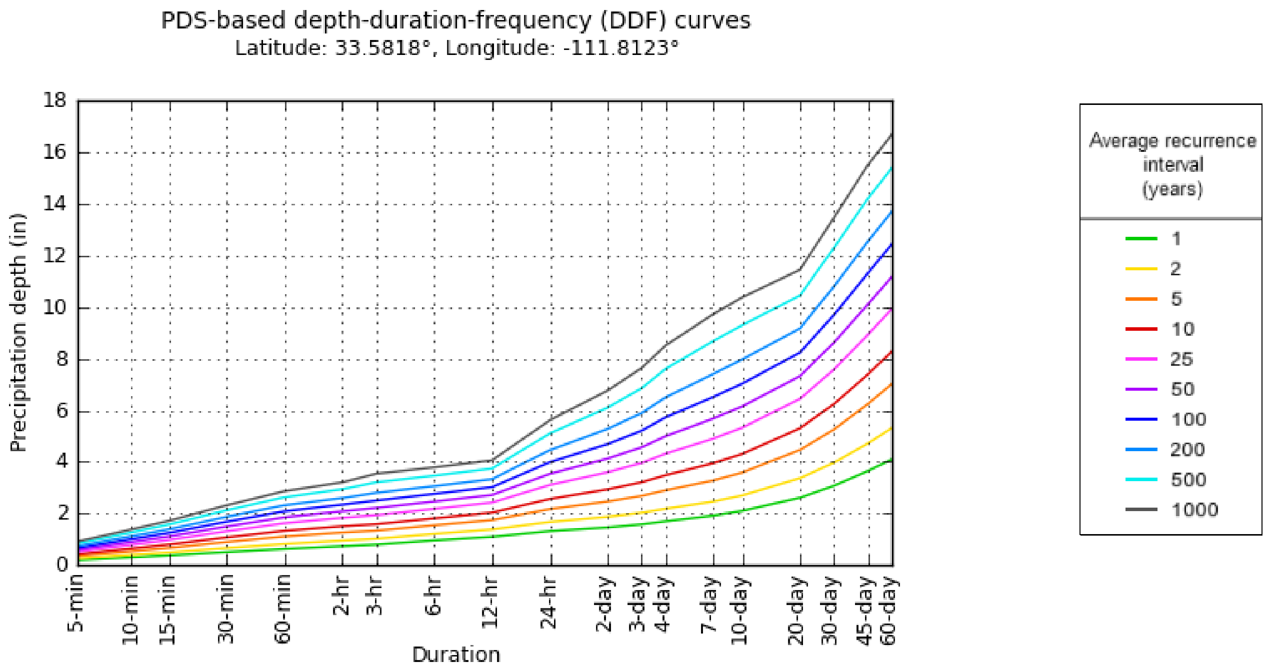
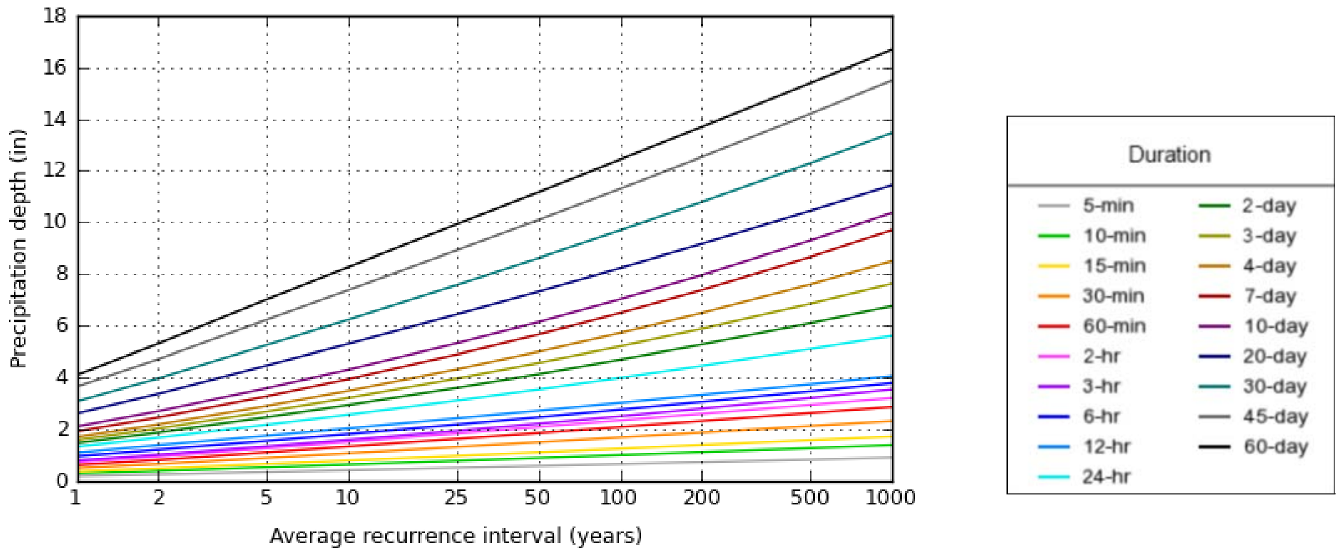
# PF graphical




NOAA Atlas 14, Volume 1, Version 5

Created (GMT): Tue Sep 5 22:45:35 2017

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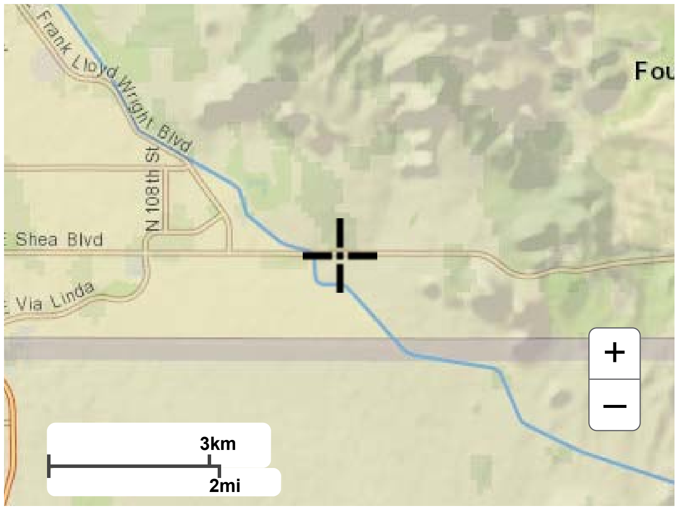
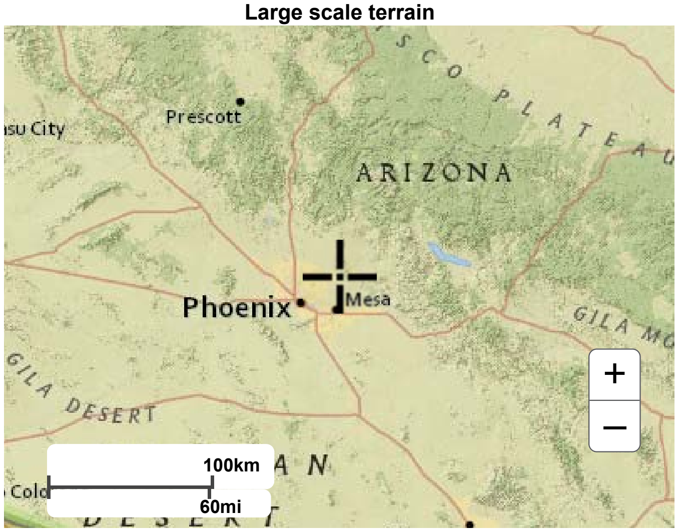
## Maps & aerials

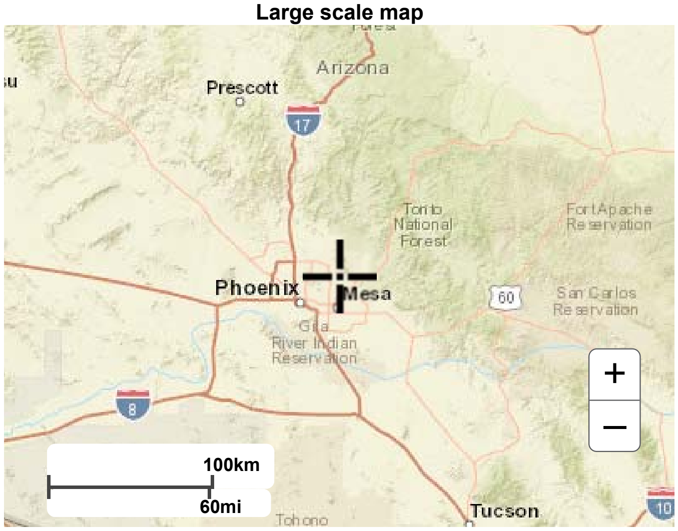
**Small scale terrain**



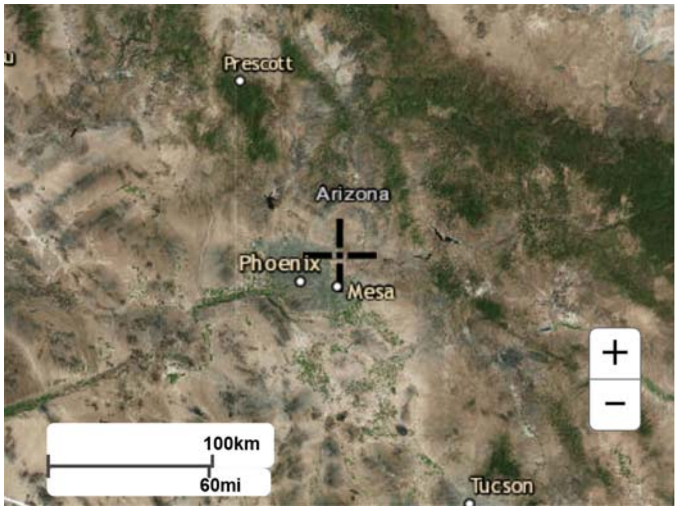

Large scale terrain




Large scale map




Large scale aerial

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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

# Project Rainfall Data and IDF Curve

**Project:** Hanella

**Prepared By:** Scott Baldwin **Date:** 1/26/2019

## Site Specific Rainfall Data

| Duration | Duration | Storm Event Return Period | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 yr | 2 yr | 5 yr | 10 yr | 25 yr | 50 yr | 100 yr | 200 yr | 500 yr | 1,000 yr |
| 5 min | 5 min | 0.20 | 0.26 | 0.35 | 0.42 | 0.52 | 0.59 | 0.66 | 0.74 | 0.84 | 0.91 |
| 10 min | 10 min | 0.31 | 0.40 | 0.54 | 0.65 | 0.79 | 0.90 | 1.01 | 1.12 | 1.27 | 1.39 |
| 15 min | 15 min | 0.38 | 0.49 | 0.67 | 0.80 | 0.98 | 1.11 | 1.25 | 1.39 | 1.58 | 1.72 |
| 30 min | 30 min | 0.51 | 0.67 | 0.90 | 1.08 | 1.32 | 1.50 | 1.69 | 1.88 | 2.13 | 2.32 |
| 60 min | 60 min | 0.63 | 0.82 | 1.11 | 1.34 | 1.63 | 1.86 | 2.09 | 2.32 | 2.63 | 2.87 |
| 2 hr | 120 min | 0.74 | 0.96 | 1.27 | 1.51 | 1.84 | 2.09 | 2.35 | 2.60 | 2.94 | 3.21 |
| 3 hr | 180 min | 0.80 | 1.03 | 1.34 | 1.59 | 1.94 | 2.22 | 2.50 | 2.80 | 3.21 | 3.54 |
| 6 hr | 360 min | 0.96 | 1.22 | 1.55 | 1.82 | 2.18 | 2.47 | 2.76 | 3.06 | 3.47 | 3.79 |
| 12 hr | 720 min | 1.10 | 1.39 | 1.75 | 2.04 | 2.42 | 2.72 | 3.03 | 3.33 | 3.74 | 4.06 |
| 24 hr | 1,440 min | 1.32 | 1.68 | 2.17 | 2.56 | 3.11 | 3.54 | 3.99 | 4.46 | 5.10 | 5.61 |

## Site Specific IDF Curve

| Time | Time | Storm Event Return Period | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 yr | 2 yr | 5 yr | 10 yr | 25 yr | 50 yr | 100 yr | 200 yr | 500 yr | 1,000 yr |
| 5 min | 5 min | 2.40 | 3.14 | 4.25 | 5.09 | 6.23 | 7.09 | 7.97 | 8.86 | 10.04 | 10.94 |
| 10 min | 10 min | 1.83 | 2.39 | 3.23 | 3.88 | 4.73 | 5.39 | 6.06 | 6.72 | 7.62 | 8.34 |
| 15 min | 15 min | 1.51 | 1.98 | 2.67 | 3.20 | 3.91 | 4.44 | 5.00 | 5.56 | 6.32 | 6.88 |
| 30 min | 30 min | 1.02 | 1.33 | 1.80 | 2.16 | 2.64 | 3.00 | 3.38 | 3.76 | 4.26 | 4.64 |
| 60 min | 60 min | 0.63 | 0.82 | 1.11 | 1.34 | 1.63 | 1.86 | 2.09 | 2.32 | 2.63 | 2.87 |
| 2 hr | 120 min | 0.37 | 0.48 | 0.64 | 0.76 | 0.92 | 1.05 | 1.18 | 1.30 | 1.47 | 1.61 |
| 3 hr | 180 min | 0.27 | 0.34 | 0.45 | 0.53 | 0.65 | 0.74 | 0.83 | 0.93 | 1.07 | 1.18 |
| 6 hr | 360 min | 0.16 | 0.20 | 0.26 | 0.30 | 0.36 | 0.41 | 0.46 | 0.51 | 0.58 | 0.63 |
| 12 hr | 720 min | 0.09 | 0.12 | 0.15 | 0.17 | 0.20 | 0.23 | 0.25 | 0.28 | 0.31 | 0.34 |
| 24 hr | 1,440 min | 0.06 | 0.07 | 0.09 | 0.11 | 0.13 | 0.15 | 0.17 | 0.19 | 0.21 | 0.23 |

# Input Parameters for Papadakis and Kazan Equation

**Project:** Hanella

**Prepared By:** Scott Baldwin **Date:** 1/26/2019

Table 2-2: Watershed Resistance Coefficients

| Type | Description | Typical Applications | m | b |
|---|---|---|---|---|
| A | Minimal roughness: Relatively smooth and/or well-graded and uniform land surfaces. Surfaces runoff is sheet flow. | Commercial/industrial areas<br>Residential area<br>Parks and golf courses | -0.00625 | 0.04 |
| B | Moderately low roughness: Land surfaces have irregularly spaced roughness elements that protrude<br>from the surface but the overall character of the surface is relatively uniform. Surface runoff is predominately sheet | Agricultural fields<br>Pastures<br>Desert rangelands<br>Undeveloped urban lands | -0.01375 | 0.08 |
| C | Moderately high roughness: Land surfaces that have significant large to medium-sized roughness elements and/or poorly graded land surfaces that cause the flow to be diverted around the roughness elements. Surface runoff is sheet flow for short distances draining into | Hillslopes<br>Brushy alluvial fans<br>Hilly rangeland<br>Disturbed land, mining, etc.<br>Forests with underbrush | -0.02500 | 0.15 |
| D | Maximum roughness: Rough land surfaces with torturous flow paths. Surface runoff is concentrated in numerous short flow paths that are often oblique to the main flow direction. | Mountains<br>Some wetlands | -0.03000 | 0.20 |

# Street Capacity Calculations using Manning's Equation

| | | | |
|---|---|---|---|
| **Project:** | Hanella | | |
| **Prepared By:** | Scott Baldwin | **Date:** | 1/26/2019 |

Reference: Pinal County Drainage Manual Section 3.3.1

Hydraulic Capacity Equation:

$$Q = A\left(\frac{1.49}{n}\right)R^{0.67}S^{0.5}$$

Hydraulic Capacity Equation:

$$Q = KS^{0.5}$$

Where:

$$K = A\left(\frac{1.49}{n}\right)R^{0.67}$$

Hydraulic Radius:

$$R = \frac{A}{P}$$

Where:

Q = Flow Capacity (cfs)
A = Flow Area ($ft^2$)
n = Manning's n
R = Hydraulic Radius
S = Longitudinal Street Slope
P = Wetted Perimeter
K = Hydraulic Capacity Coefficient

**Local Road - 4" Roll - 10-yr**

| | |
|---|---|
| A = | 2.08 |
| P = | 12.07 |
| R = | 0.17 |
| n = | 0.015 |
| **K =** | **63.609** |

**Local Road - 4" Roll - 100-yr**

| | |
|---|---|
| A = | 5.07 |
| P = | 20.07 |
| R = | 0.25 |
| n = | 0.015 |
| **K =** | **200.333** |

Notes:
All values on this sheet refer to the half street hydraulics only.

# Peak Flow Calculations using the Rational Method and the Papadakis and Kazan Equation with Street Capacity using Manning's Equation

**Project:** Hanella

**Prepared By:** Scott Baldwin **Date:** 5/2/2019

| "C" Value Adjustment | |
|---|---|
| 100-yr | 1.00 |
| 50-yr | 0.96 |
| 25-yr | 0.88 |
| 10-yr | 0.80 |

| Street Code | Description | 10 yr "K" | 100 yr "K" |
|---|---|---|---|
| 1 | Local Road - 4" Roll | 63.61 | 200.33 |
| | | #REF! | #REF! |
| | | #REF! | #REF! |
| | | #REF! | #REF! |
| | | #REF! | #REF! |
| | | #REF! | #REF! |

| Sub Basin Area Description | | | | | | | | | | | | | Time of Concentation | | | | Time of Concentation | | | | Street Capacity Calculations | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | Storm Event: | | 10 yr | | Storm Event: | | 100 yr | | | | | 10 yr Street Capacity | | 100 yr Street Capacity | |
| Concentration Point ID | Local Contributing Areas | Area (ac) | Length (ft) | High Point Elevation | Low Point Elevation | Watercourse slope | Initial Lot Tc (min) | Kb | Type | Roughness Description | m | b | Cw | Time of Concentration (min) | Intensity (in/hr) | **Peak Flow (cfs)** | Cw | Time of Concentration (min) | Intensity (in/hr) | **Peak Flow (cfs)** | Street Code | Half/Full Street | Critical Slope | Capacity | Check | Capacity | Check |
| A1 | Road | See DDMSW analysis for results | | | | | | | | | | | | | | **1.5** | | | | **2.4** | 1 | h | 0.0030 | 3.5 | OK | 11.0 | OK |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |

# Inlet Capacity (Combination Inlets in Sump, Curb Opening & Grate)

**Project:** Hanella Estates
**Storm Event:** 100 yr
**Prepared By:** Scott Baldwin **Date:** 5/2/2019

**Design Capacity for Grate:**

Design Capacity as a Weir:

$$Q = C_W P(1 - F_{CL})d^{1.5}$$

Design Capacity as an Orifice:

$$Q = C_O A_g (1 - F_{CL})(2gd)^{0.5}$$

Where:

- Cw = 3.0
- Co = 0.67
- P = Perimeter Length of Grate
- Ag = Open Area of Grate
- Fcl = 0.0% (Percent Clogged)
- d = 0.67 ft
- g = 32.2 (ft/sec2)

**Design Capacity for Curb Opening:**

Design Capacity as a Weir:

$$Q = C_W ((L + 1.8W) * (1 - F_{CL}))d^{1.5}$$

Design Capacity as an Orifice:

$$Q = C_O hL(1 - F_{CL})(2gd)^{0.5}$$

Where:

- Cw = 2.3
- Co = 0.67
- h = d*1.4 (minimum)
- L= Total Curb Opening Length
- Fcl = 20.0% (Percent Clogged)
- W = Width of grate or depressed gutter
- g = 32.2 (ft/sec2)
- d = 0.67 ft

**Compute Grates as:** **None**

**Compute Curb Openings as:** **Weir**

| Catch Basin ID | Concentration Point | Estimated Peak Flow (cfs) | Catch Basin Type | Capacity of Grate (CFS) | Capacity of Curb Opening (CFS) | Total Inlet Capacity (CFS) |
|---|---|---|---|---|---|---|
| Scupper | | 2.4 | MAG 206-1 (4') | 0.0 | 6.8 | 6.8 |
| | | | | | | |
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Notes:

# Riprap Apron Calculations - Hydraulic Jump at Toe of Scupper Spillway

**Project:** Hanella Estates
**Storm Event:** 100 yr
**Prepared By:** Scott Baldwin  **Date:** 5/2/2019

| Scupper ID | Scupper Width (ft) | Q (cfs) | Manning's "n" | s (h:v) | s (ft/ft) | $y_n$ (ft) | $Fr_1$ | $L/y_1$ | **L (ft)** |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 4 | 2.4 | 0.015 | 4.0:1 | 0.2500 | 0.071 | 5.6 | 45 | **3.2** |
| | | | | | | | | | |
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| | | | | | | | | | |

**Symbols:**

- Q — Scupper Capacity
- s — Spillway Slope
- $y_n$ — Normal Depth of Flow in Scupper Spillway
- $Fr_1$ — Upstream Froude Number (in scupper spillway)
- $L/y_1$ — L/y1 is Determined by Figure 6.5 from the HEC 14
- L — Length of Hydraulic Jump and Min. Length of Riprap Apron

**Reference:**

Hydraulic Jump Methodology Taken from HEC 14 - Section 6.2.1
http://www.fhwa.dot.gov/engineering/hydraulics/pubs/06086/hec14ch06.cfm

# Trapezoidal Channel - Manning's Equation

**Project:** Hanella

**Prepared By:** Scott Baldwin **Date:** 3/27/2019

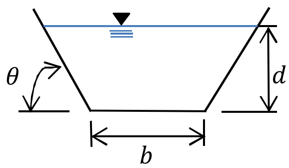
## Manning's Equation:

$$Q = \left(\frac{1.49}{n}\right) AR^{2/3}\sqrt{S}$$

$$A = \left(b + \frac{d}{tan\theta}\right)d$$

$$R = \frac{A}{P}$$

$$P = b + 2\left(\frac{d}{sin\theta}\right)$$




## Definition of Variables:

Q = Total Peak Flow
n = Manning's n
A = Area
R = Hydraulic Radius
P = Wetted Perimeter
S = Slope
b = Bottom width of Channel
d = Depth of Channel Flow
Θ = Angle of Channel Side Slope
V = Velocity

| b (ft) | d (ft) | Θ (deg) | A ($ft^2$) | P (ft) | R (ft) | n | S | Q (cfs) | V (ft/s) |
|---|---|---|---|---|---|---|---|---|---|
| 1.0 | 1.000 | 14.04 | 5.00 | 9.25 | 0.54 | 0.025 | 0.78% | **17.5** | **3.49** |
| 1.0 | 1.000 | 14.04 | 5.00 | 9.25 | 0.54 | 0.025 | 0.15% | **7.7** | **1.53** |
| 1.0 | 1.000 | 26.57 | 3.00 | 5.47 | 0.55 | 0.025 | 0.78% | **10.6** | **3.53** |
| 1.0 | 1.000 | 26.57 | 3.00 | 5.47 | 0.55 | 0.025 | 0.25% | **6.0** | **2.00** |

# General Scour Depth Calculation

## Lacey Equation

The Lacey equation is more applicable to a natural river system (Blench, 1969) where there are no upstream structures that capture sediment:

$$Z_{general} = Z\left(0.47\left[\frac{Q}{f}\right]^{1/3}\right) \quad (11.56)$$

where:

$Z_{general}$ = general scour depth, ft;

$Q$ = design discharge, cfs;

$f$ = Lacey's silt factor = $1.76(D_m)^{1/2}$ ;

$D_m$ = mean grain size, which may be approximated by $D_{50}$, (diameter where 50% is finer by dry weight) mm; and

$Z$ = multiplying factor (0.25 for a straight reach, 0.5 for a moderate bend, 0.75 for a severe bend, 1.0 for right angle bends, and 1.25 for a vertical rock bank or wall).

The bend scour should be computed for the areas both at the bend and downstream of the bend because the secondary currents will still cause scour downstream of the bend. The distance from the bend at which the secondary currents will have decayed to a negligible magnitude can be found in Section 11.8.2.3.

$Z_{general} = Z\left[0.47\left[\frac{Q}{f}\right]^{1/3}\right] =$ 0.836744 ft FS= 1.1 = **$Z_t$= 0.92 ft**

| | | | |
|---|---|---|---|
| f= | 5.588 | Lacey's silt factor, based on $D_{50}$ | |
| $D_m$= | 0.25 | in = | 6.35 mm |
| Q= | 2018 | cfs | |
| Z= | 0.25 | - (0.25, 0.50, 0.75, 1.0) | |

**Erosion Setback Calculations**

| | | |
|---|---|---|
| | Q100^0.50 | 44.92215 |
| CHANNEL BEND ANGLE FACTOR | F0 | 0 |
| CHANNEL VELOCITY FACTOR | FVCH | 0.1 |
| BANKFULL WIDTH/DEPTH RATIO | FW/D | 0.02 |
| BANK MATERIALS FACTOR | FBM | 0.1 |
| BANK CEMENTATION FACTOR | Fc3 | 0.2 |
| BANK VEGETATION FACTOR | FBVD | 0.15 |
| BANK VEGETATION TYPE FACTOR | FBVT | 0.1 |
| BANK CONDITIONS FACTOR | FCB | 0 |
| FLOW CONDITIONS FACTOR | FQ | 0.05 |
| WATERSHED DEVELOPMENT FACTOR | FW | 0.1 |
| MANMADE CHANNEL DISTURBANCE FACTOR | FMD | 0 |
| VERTICAL CHANNEL STABILITY FACTOR | FVERT | 0.15 |
| | | |
| | Setback | 43.57449 |

# DDMSW Data

| Type / ID | Conveyance Length (ft) | Conveyance Velocity (ft/sec) | Conveyance Tpipe (min) | Combine | | Return Period (Years) 2 | 5 | 10 | 25 | 50 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| cF irs tP ipe | | | | | | | | | | | |
| **Major Basin ID: 01** | | | | | | | | | | | |
| Sub Basin | - | - | - | - | Q (cfs) | 2.0 | 2.8 | 3.5 | 4.3 | 4.9 | 5.5 |
| **D1** | | | | | CA (ac) | 0.68 | 0.68 | 0.68 | 0.68 | 0.68 | 0.68 |
| | | | | | Tc (min) | 6.4 | 5.6 | 5.2 | 5.0 | 5.0 | 5.0 |
| | | | | | i (in/hr) | 2.95 | 4.16 | 5.09 | 6.29 | 7.16 | 8.05 |
| | | | | | Volume (ac-ft) | 0.0235 | 0.0288 | 0.0335 | 0.0395 | 0.0451 | 0.0506 |
| Sub Basin | - | - | - | - | Q (cfs) | 3.7 | 5.4 | 6.6 | 8.4 | 9.7 | 11.1 |
| **D1A** | | | | | CA (ac) | 1.42 | 1.42 | 1.42 | 1.42 | 1.42 | 1.42 |
| | | | | | Tc (min) | 8.5 | 7.4 | 6.8 | 6.2 | 5.9 | 5.6 |
| | | | | | i (in/hr) | 2.63 | 3.77 | 4.67 | 5.89 | 6.82 | 7.79 |
| | | | | | Volume (ac-ft) | 0.0578 | 0.0735 | 0.0825 | 0.0958 | 0.1052 | 0.1143 |
| Sub Basin | - | - | - | - | Q (cfs) | 0.2 | 0.2 | 0.3 | 0.3 | 0.4 | 0.4 |
| **D2** | | | | | CA (ac) | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| | | | | | Tc (min) | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| | | | | | i (in/hr) | 3.18 | 4.30 | 5.15 | 6.29 | 7.16 | 8.05 |
| | | | | | Volume (ac-ft) | 0.0018 | 0.0018 | 0.0028 | 0.0028 | 0.0037 | 0.0037 |
| Sub Basin | - | - | - | - | Q (cfs) | 0.7 | 1.0 | 1.2 | 1.5 | 1.7 | 1.9 |
| **D2A** | | | | | CA (ac) | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 |
| | | | | | Tc (min) | 6.4 | 5.6 | 5.2 | 5.0 | 5.0 | 5.0 |
| | | | | | i (in/hr) | 2.95 | 4.16 | 5.09 | 6.29 | 7.16 | 8.05 |
| | | | | | Volume (ac-ft) | 0.0082 | 0.0103 | 0.0115 | 0.0138 | 0.0156 | 0.0175 |
| Sub Basin | - | - | - | - | Q (cfs) | 0.3 | 0.3 | 0.4 | 0.5 | 0.6 | 0.6 |
| **D3** | | | | | CA (ac) | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 |
| | | | | | Tc (min) | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| | | | | | i (in/hr) | 3.18 | 4.30 | 5.15 | 6.29 | 7.16 | 8.05 |
| | | | | | Volume (ac-ft) | 0.0028 | 0.0028 | 0.0037 | 0.0046 | 0.0055 | 0.0055 |
| Sub Basin | - | - | - | - | Q (cfs) | 0.5 | 0.7 | 0.9 | 1.1 | 1.2 | 1.4 |
| **D3A** | | | | | CA (ac) | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 |
| | | | | | Tc (min) | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| | | | | | i (in/hr) | 3.18 | 4.30 | 5.15 | 6.29 | 7.16 | 8.05 |
| | | | | | Volume (ac-ft) | 0.0046 | 0.0064 | 0.0083 | 0.0101 | 0.0110 | 0.0129 |
| Sub Basin | - | - | - | - | Q (cfs) | 0.9 | 1.3 | 1.5 | 1.9 | 2.1 | 2.4 |
| **A01** | | | | | CA (ac) | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| | | | | | Tc (min) | 6.2 | 5.5 | 5.1 | 5.0 | 5.0 | 5.0 |
| | | | | | i (in/hr) | 2.98 | 4.18 | 5.12 | 6.29 | 7.16 | 8.05 |
| | | | | | Volume (ac-ft) | 0.0103 | 0.0131 | 0.0141 | 0.0175 | 0.0193 | 0.0221 |
| Storage | - | - | - | - | Q (cfs) | - | - | - | - | - | - |
| **BA01** | | | | | CA (ac) | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| | | | | | Tc (min) | - | - | - | - | - | - |
| | | | | | i (in/hr) | - | - | - | - | - | - |
| | | | | | Volume (ac-ft) | 0.0103 | 0.0131 | 0.0141 | 0.0175 | 0.0193 | 0.0221 |
| Convey | 212 | 6.6 | 0.5 | - | Q (cfs) | - | - | - | - | - | - |
| **B01B02** | | | | | CA (ac) | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| | | | | | Tc (min) | - | - | - | - | - | - |
| | | | | | i (in/hr) | - | - | - | - | - | - |
| | | | | | Volume (ac-ft) | - | - | - | - | - | - |
| Sub Basin | - | - | - | - | Q (cfs) | 3.0 | 4.3 | 5.3 | 6.4 | 7.3 | 8.2 |
| **A02** | | | | | CA (ac) | 1.02 | 1.02 | 1.02 | 1.02 | 1.02 | 1.02 |
| | | | | | Tc (min) | 6.2 | 5.4 | 5.0 | 5.0 | 5.0 | 5.0 |
| | | | | | i (in/hr) | 2.98 | 4.20 | 5.15 | 6.29 | 7.16 | 8.05 |
| | | | | | Volume (ac-ft) | 0.0342 | 0.0427 | 0.0487 | 0.0588 | 0.0671 | 0.0754 |

* First Pipe

| Type<br>ID | Conveyance Length (ft) | Conveyance Velocity (ft/sec) | Conveyance Tpipe (min) | Combine | | Return Period (Years) 2 | 5 | 10 | 25 | 50 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Major Basin ID: 01** | | | | | | | | | | | |
| Combine | - | - | - | 2 | Q (cfs) | 2.9 | 4.0 | 5.3 | 6.4 | 7.3 | 8.2 |
| **A02** | | | | | CA (ac) | 1.32 | 1.32 | 1.32 | 1.32 | 1.32 | 1.32 |
| | | | | | Tc (min) | - | - | - | - | - | - |
| | | | | | i (in/hr) | - | - | - | - | - | - |
| | | | | | Volume (ac-ft) | 0.0342 | 0.0427 | 0.0487 | 0.0588 | 0.0671 | 0.0754 |
| Storage | - | - | - | - | Q (cfs) | - | - | - | - | - | - |
| **BA02** | | | | | CA (ac) | 1.32 | 1.32 | 1.32 | 1.32 | 1.32 | 1.32 |
| | | | | | Tc (min) | - | - | - | - | - | - |
| | | | | | i (in/hr) | - | - | - | - | - | - |
| | | | | | Volume (ac-ft) | 0.0342 | 0.0427 | 0.0487 | 0.0588 | 0.0671 | 0.0754 |

* First Pipe

| | Type | Model ID | Sort | Comments |
|---|---|---|---|---|
| **Major Basin: 01** | Sub Basin | D1 | 2 | |
| | Sub Basin | D1A | 4 | |
| | Sub Basin | D2 | 6 | |
| | Sub Basin | D2A | 8 | |
| | Sub Basin | D3 | 10 | |
| | Sub Basin | D3A | 12 | |
| | Sub Basin | A01 | 14 | |
| | Storage | BA01 | 16 | |
| | Convey | B01B02 | 20 | |
| | Sub Basin | A02 | 22 | |
| | Combine | A02 | 24 | |
| | Storage | BA02 | 26 | |

EPS Group Inc.
Drainage Design Management System
RATIONAL METHOD STORAGE FACILITIES
**Project Reference: 16-345-RATIONAL**



**Storage Basin ID:** BA01

| | |
|---|---|
| Elevation Top of Dam: | |
| Length of Dam: | |
| Discharge Coefficient: | 3.00 |
| Weir Coefficient: | 1.50 |

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Volume (ac-ft)** | 0 | 0.010 | 0.040 | 0.051 | 0.055 | - | - | - | - | - |
| **Discharge (cfs)** | 0.00 | 0.00 | 0.00 | 1.00 | 2.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Elevation (ft)** | 1,533.00 | 1,534.00 | 1,535.00 | 1,535.40 | 1,535.50 | - | - | - | - | - |

| | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Volume (ac-ft)** | - | - | - | - | - | - | - | - | - | - |
| **Discharge (cfs)** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Elevation (ft)** | - | - | - | - | - | - | - | - | - | - |

| | 2 Year | 5 Year | 10 Year | 25 Year | 50 Year | 100 Year |
|---|---|---|---|---|---|---|
| **Peak Volume (ac-ft)** | 0.010 | 0.013 | 0.014 | 0.017 | 0.019 | 0.022 |
| **Peak Stage (ft)** | 1,534.93 | 1,534.93 | 1,534.94 | 1,534.94 | 1,534.95 | 1,534.96 |
| **Peak Discharge (cfs)** | | | | | | |

**Storage Basin ID:** BA02

| | |
|---|---|
| Elevation Top of Dam: | |
| Length of Dam: | |
| Discharge Coefficient: | 3.00 |
| Weir Coefficient: | 1.50 |

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Volume (ac-ft)** | 0 | 0.020 | 0.110 | 0.110 | 0.110 | 0.110 | 0.110 | 0.110 | 0.110 | 0.110 |
| **Discharge (cfs)** | 0.00 | 0.00 | 0.00 | 0.00 | 1.00 | 4.00 | 9.00 | 15.00 | 22.00 | 30.00 |
| **Elevation (ft)** | 1,528.00 | 1,529.00 | 1,530.00 | 1,530.29 | 1,530.40 | 1,530.50 | 1,530.60 | 1,530.70 | 1,530.80 | 1,530.90 |

| | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Volume (ac-ft)** | - | - | - | - | - | - | - | - | - | - |
| **Discharge (cfs)** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Elevation (ft)** | - | - | - | - | - | - | - | - | - | - |

| | 2 Year | 5 Year | 10 Year | 25 Year | 50 Year | 100 Year |
|---|---|---|---|---|---|---|
| **Peak Volume (ac-ft)** | 0.034 | 0.043 | 0.049 | 0.059 | 0.067 | 0.075 |
| **Peak Stage (ft)** | 1,529.93 | 1,529.94 | 1,529.94 | 1,529.95 | 1,529.96 | 1,529.97 |
| **Peak Discharge (cfs)** | | | | | | |

| ID | | Elevations | | Existing Section | | | | Area (acres) | | Return Period (Years) | | | | | | Design/ Custom | Capacity (cfs) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Ground | Invert | Length (ft) | Slope | Man N | Size | | | 2 | 5 | 10 | 25 | 50 | 100 | | |
| **B01B02** | **US** | | 1535.00 | 212 | 0.0283 | 0.025 | 1.00'W x 1.00'H x 4.00Z I | 0.470 | **Hydrology (cfs)** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 33.2 |
| | **DS** | | 1529.00 | | | | | | **Depth in Street (ft)** | - | - | - | - | - | - | - | |

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

# Custom Soil Resource Report for Aguila-Carefree Area, Arizona, Parts of Maricopa and Pinal Counties

## Hanella Estates


January 26, 2019

# Preface

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

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

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

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

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

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

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# Contents

# How Soil Surveys Are Made

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

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

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

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

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

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

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

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

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

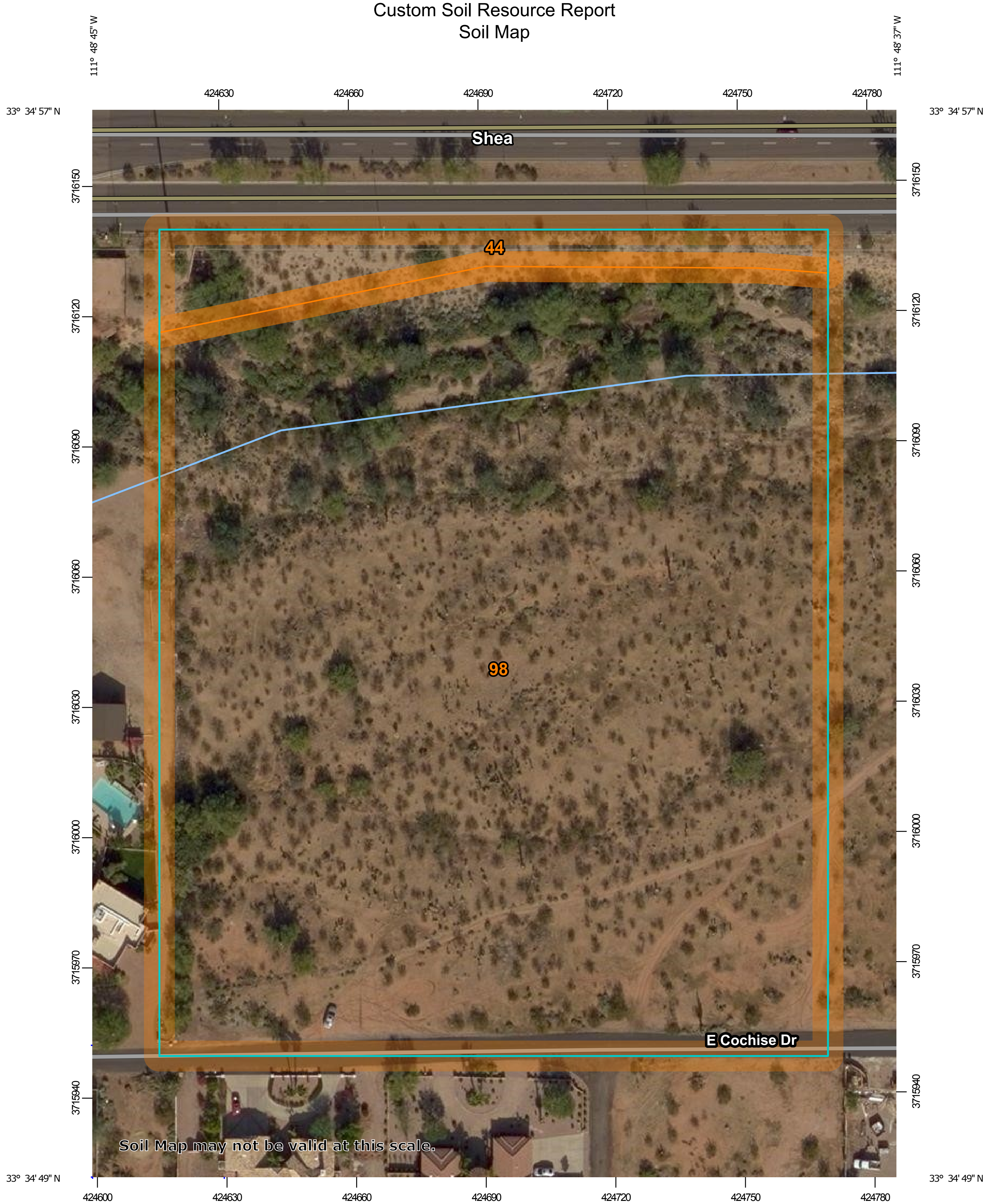
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree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

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

# Soil Map

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

# Custom Soil Resource Report
## Soil Map




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

N

Meters: 0, 15, 30, 60, 90

Feet: 0, 50, 100, 200, 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N 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: Aguila-Carefree Area, Arizona, Parts of Maricopa and Pinal Counties
Survey Area Data: Version 12, Sep 15, 2018

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

Date(s) aerial images were photographed: Oct 31, 2014—Dec 7, 2014

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

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

# Map Unit Legend

| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
|---|---|---|---|
| 44 | Ebon very gravelly loam, 1 to 8 percent slopes | 0.5 | 6.5% |
| 98 | Pinamt-Tremant complex, 1 to 10 percent slopes | 6.8 | 93.5% |
| **Totals for Area of Interest** | | **7.3** | **100.0%** |

# Map Unit Descriptions

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

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

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

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

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

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

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

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

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

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

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

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

# Aguila-Carefree Area, Arizona, Parts of Maricopa and Pinal Counties

## 44—Ebon very gravelly loam, 1 to 8 percent slopes

### Map Unit Setting

*National map unit symbol:* 1s75
*Elevation:* 1,200 to 2,200 feet
*Mean annual precipitation:* 7 to 10 inches
*Mean annual air temperature:* 70 to 73 degrees F
*Frost-free period:* 250 to 300 days
*Farmland classification:* Not prime farmland

### Map Unit Composition

*Ebon and similar soils:* 100 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Ebon

#### Setting

*Landform:* Fan terraces
*Landform position (two-dimensional):* Summit
*Landform position (three-dimensional):* Tread
*Down-slope shape:* Convex
*Across-slope shape:* Convex
*Parent material:* Mixed alluvium

#### Typical profile

*A - 0 to 1 inches:* very gravelly loam
*Btk - 1 to 43 inches:* very gravelly sandy clay
*2Bk - 43 to 60 inches:* gravelly loamy sand

#### Properties and qualities

*Slope:* 1 to 8 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Well drained
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum in profile:* 30 percent
*Salinity, maximum in profile:* Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
*Available water storage in profile:* Low (about 4.7 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 7s
*Hydrologic Soil Group:* C
*Ecological site:* Clay Loam Upland 7-10" p.z. (R040XB205AZ)
*Hydric soil rating:* No

## 98—Pinamt-Tremant complex, 1 to 10 percent slopes

**Map Unit Setting**

*National map unit symbol:* 1sbq
*Elevation:* 1,200 to 2,200 feet
*Mean annual precipitation:* 7 to 10 inches
*Mean annual air temperature:* 70 to 73 degrees F
*Frost-free period:* 250 to 300 days
*Farmland classification:* Not prime farmland

**Map Unit Composition**

*Pinamt and similar soils:* 45 percent
*Tremant and similar soils:* 35 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Pinamt**

**Setting**

*Landform:* Fan terraces
*Landform position (two-dimensional):* Summit
*Landform position (three-dimensional):* Tread
*Down-slope shape:* Convex
*Across-slope shape:* Convex
*Parent material:* Mixed alluvium

**Typical profile**

*A - 0 to 1 inches:* extremely gravelly sandy loam
*Btk - 1 to 28 inches:* very gravelly sandy clay loam
*Bk - 28 to 60 inches:* extremely gravelly sandy loam

**Properties and qualities**

*Slope:* 1 to 10 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Well drained
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.57 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum in profile:* 30 percent
*Gypsum, maximum in profile:* 4 percent
*Salinity, maximum in profile:* Slightly saline to strongly saline (4.0 to 16.0 mmhos/cm)
*Sodium adsorption ratio, maximum in profile:* 30.0
*Available water storage in profile:* Low (about 4.2 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 7s
*Hydrologic Soil Group:* C
*Ecological site:* Limy Upland, Deep 7-10" p.z. (R040XB208AZ)

*Hydric soil rating:* No

### Description of Tremant

#### Setting

*Landform:* Fan terraces
*Landform position (two-dimensional):* Summit
*Landform position (three-dimensional):* Tread
*Down-slope shape:* Convex
*Across-slope shape:* Convex
*Parent material:* Mixed alluvium

#### Typical profile

*A - 0 to 5 inches:* gravelly loam
*Btk - 5 to 29 inches:* sandy clay loam
*2Bk - 29 to 60 inches:* gravelly sand

#### Properties and qualities

*Slope:* 1 to 10 percent
*Depth to restrictive feature:* More than 80 inches
*Natural drainage class:* Well drained
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.57 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Calcium carbonate, maximum in profile:* 35 percent
*Salinity, maximum in profile:* Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
*Available water storage in profile:* Moderate (about 6.3 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 7s
*Hydrologic Soil Group:* C
*Ecological site:* Loamy Upland 7-10" p.z. (R040XB213AZ)
*Hydric soil rating:* No

# References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

# GRADING & DRAINAGE LANGUAGE

**WARNING AND DISCLAIMER OF LIABILITY**

The City's Stormwater and Floodplain Management Ordinance is intended to minimize the occurrence of losses, hazards and conditions adversely affecting the public health, safety and general welfare which might result from flooding.

The Stormwater and Floodplain Management Ordinance identifies floodplains, floodways, flood fringes and special flood hazard areas. However, a property outside these areas could be inundated by floods. Also, much of the city is a dynamic flood area; floodways, floodplains, flood fringes and special flood hazard areas may shift from one location to another, over time, due to natural processes.

WARNING AND DISCLAIMER OF LIABILITY

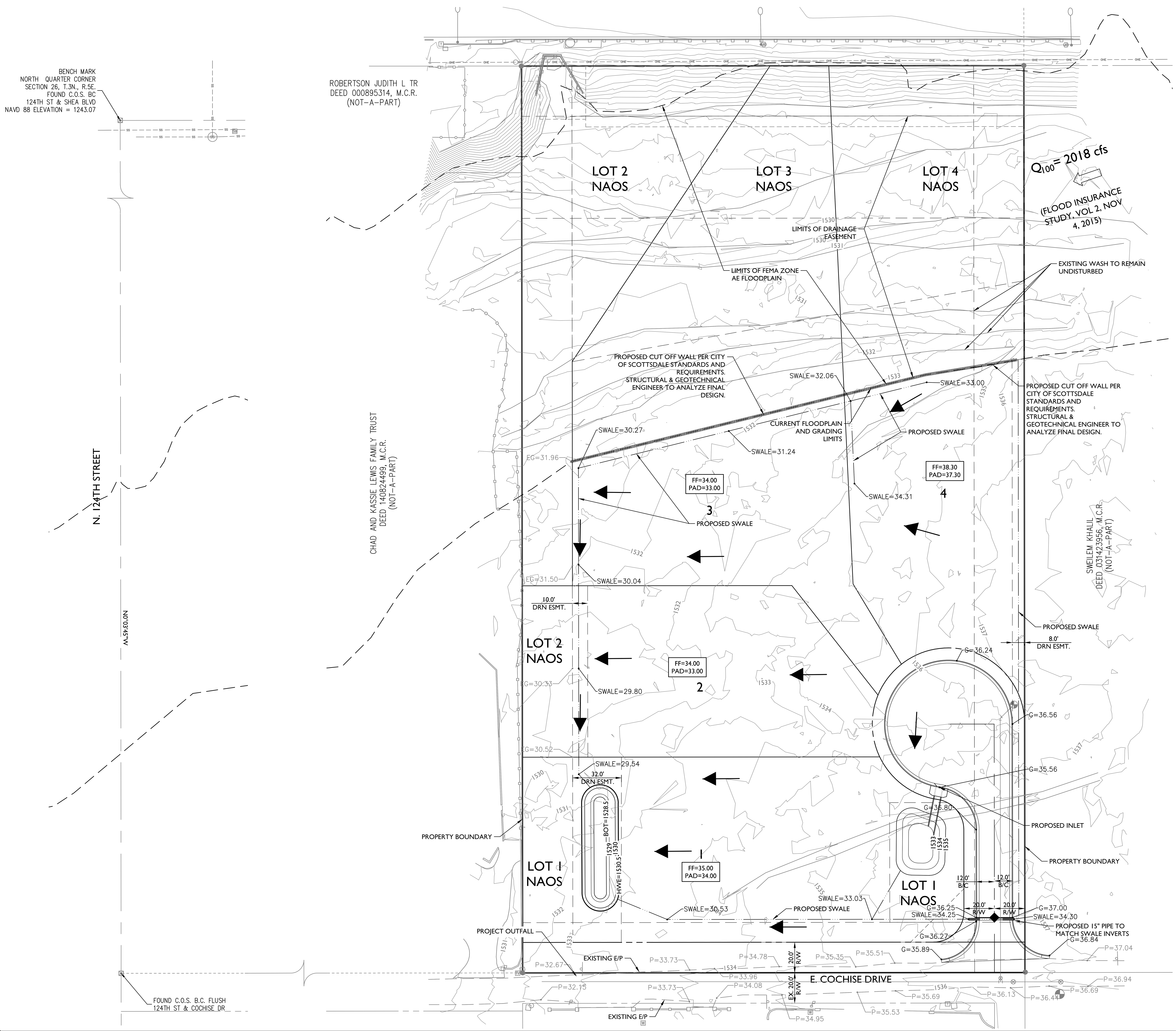
The flood protection provided by the Stormwater and Floodplain Management Ordinance is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. Floods larger than the base flood can and will occur on rare occasions. Floodwater heights may be increased by constructed or natural causes. The Stormwater and Floodplain Management Ordinance does not create liability on the part of the city, any officer or employee thereof, or the federal, state or county government for any flood damages that result from reliance on the Ordinance or any administrative decision lawfully made thereunder.

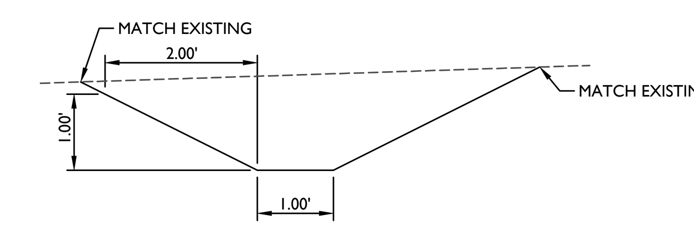
Compliance with the Stormwater and Floodplain Management Ordinance does not ensure complete protection from flooding. Flood-related problems such as natural erosion, streambed meander, or constructed obstructions and diversions may occur and have an adverse effect in the event of a flood. You are advised to consult your own engineer or other expert regarding these considerations.

I have read and understand the above.

| Plan Check # | Owner | Date |
|---|---|---|
| | [signature] | 3/30/19 |

16-345




TYPICAL PROPOSED SWALE

## BASIS OF BEARING

THE MEASURED WEST LINE OF THE NORTHEAST QUARTER OF SECTION 26, TOWNSHIP 3 NORTH RANGE 5 EAST OF THE GILA AND SALT RIVER BASE AND MERIDIAN, MARICOPA COUNTY, ARIZONA, SAID BEARING BEING: NORTH 00 DEGREES 03 MINUTES 45 SECONDS WEST.

## BENCHMARK:

NORTH QUARTER CORNER SECTION 26, T.3N., R.5E. FOUND C.O.S. BC
124TH ST AND SHEA BLVD
NAVD 88 ELEVATION = 1243.07

2045 S. Vineyard Ave, Suite 101
Mesa, AZ 85210
T:480.503.2250 | F:480.503.2258
www.epsgroupinc.com

EPS GROUP

Project:

Hanella Estates Subdivision

Scottsdale, AZ

**Preliminary Grading and Drainage**

Revisions:

Call at least two full working days before you begin excavation. ARIZONA 811 Arizona Blue Stake, Inc. Dial 8-1-1 or 1-800-STAKE-IT (782-5348) In Maricopa County: (602)263-1100

Designer: JSD
Drawn by: JSD

Registered Professional Engineer (Civil) CERTIFICATE NO. 54652 BRIAN NICHOLLS ARIZONA, U.S.A.

Job No.
16-345

GD01

Sheet No.
1
of 1

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