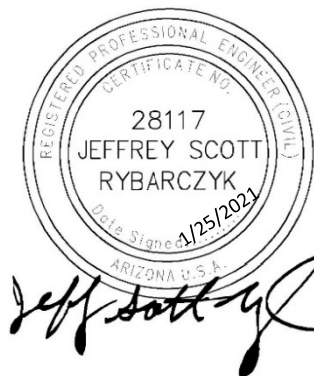


**PRELIMINARY DRAINAGE REPORT**  
**FOR**  
**CHRISTIAN BROTHERS AUTOMOTIVE**  
**NORTHWEST CORNER OF**  
**THOMAS ROAD AND PIMA ROAD**  
**SCOTTSDALE, ARIZONA**

Prepared for:  
**CHRISTIAN BROTHERS AUTOMOTIVE**  
17725 Katy Freeway, Suite 200  
Houston, Texas 77094

Prepared By:  
**Bowman**  
CONSULTING  
1295 W Washington Street  
Suite 108  
Tempe, Arizona 85281  
480-629-8830



JANUARY 25, 2021  
Bowman Project No. 050840-01-001

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- D. First Flush and Dewatering Calculations
- E. Pima Self Storage LOMR
- F. Pima Self Storage Drainage Report



## **1. INTRODUCTION**

### **1.1. PROJECT NAME**

The proposed development is called Christian Brothers Automotive (The Project).

### **1.2. PROJECT LOCATION**

The Project is assessor parcel number (APN) 130-39-100B, located within the southeast quarter of Section 25, Township 2 North, Range 4 East, Gila and Salt River Meridian, Maricopa County, Arizona. More specifically, the project is located at the northwest corner of the intersection of Thomas Road and Pima Road. The subject property is Lot 1D of Minor Land Division Plat 8700 East Thomas Road as recorded in Book 1442 Page 24 MCR. Lot 1D is 1.05 acres. A vicinity map is in **Appendix A, figure 1**.

### **1.3. TYPE OF DRAINAGE REPORTS**

This is a Preliminary Drainage Report, created to support the Conditional Use Permit application.

### **1.4. PROJECT DESCRIPTION**

The proposed Project includes the development of an automotive repair facility on 1.05 acres of vacant land. Development includes a 4800 square-foot, 8-bay automotive garage and lobby building, associated parking, utilities and landscaping.

### **1.5. EXISTING DRAINAGE STUDIES**

Information from several previous studies was used to compile this report. There is the Final Drainage Report and LOMR for Pima Self Storage (located adjacent to the north) and the Drainage Narrative for Black Rock Coffee (located adjacent to the west).

### **1.6. PURPOSE AND OBJECTIVES FOR SUBMITTING A DRAINAGE REPORT**

This report will address criteria for establishing a finished floor elevation; for routing overland flow of storm drainage towards drainage facilities, and for the first flush volume of stormwater.

The site is located within the City of Scottsdale drainage service area. All proposed drainage infrastructure shall be constructed per the city's development regulations and approved material list.

## **2. ONSITE DRAINAGE CONDITIONS (EXISTING)**

### **2.1. EXISTING DRAINAGE**

The site is 1.05 acres and was previously analyzed as part of the Pima Self Storage project located adjacent to the north of this site. The site is within flood zone AE and the minimum finish floor elevation was established as part of the Self -Storage drainage report. A LOMR was approved on December 7, 2018 which includes the flow rate and base flood elevation for this site. The LOMR and portions of the Self – Storage report are included in **Appendix E and F**.

### **2.2. TOPOGRAPHIC MAP**

A topographic survey of the site was performed that shows the site is highest on the north end, has a low point in the middle for a temporary retention basin, and then outfalls at the south end.

### **2.3. ADJACENT DEVELOPMENTS**

The proposed use is light automotive repair. The site is bounded by the following land uses: (south) Thomas Road; (east) Pima Road; (north) existing self-storage facility; and (west) existing coffee shop.

## **3. OFFSITE WATERSHED CONDITIONS**

The site is located within zone AE and is impacted by flows in the Granite Reef wash. The base flood elevations at the building has been determined to be 1227.9 with a flow rate of 594 cfs.

## **4. FLOODPLAIN DESIGNATION**

Federal Emergency Management Agency’s Flood Insurance Rate Map (FIRM) 04013C2235M, effective September 18, 2020, classifies the project site as Zone X (shaded): “Areas of 0.2% annual flood hazard; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile”; and Zone AE: “Special Flood Hazard Areas with Base Flood Elevation.” See **Appendix A, figure 2** for a copy of the FIRM.

## **5. PROPOSED DRAINAGE PLAN**

### **5.1. BASIS OF DESIGN**

The Project is designed using the guidelines set in the City of Scottsdale Design Standards and Policies Manual (2018) and the Maricopa County Drainage Design Manual (MCDDM), Hydrology. Per comments received from the City of Scottsdale at the pre – app meeting, no stormwater storage is required unless proposed improvements go into historical landscape areas. Although standard

stormwater storage is not required, if the disturbed area is greater than 1.0 acre, then “first flush” volume for water quality must be provided onsite.

#### Regulations

- DSPM Section 4-1.201, C2: first flush volume shall be calculated by  $V = CPA$
- DSPM Section 4-1.201, B: draining of stormwater storage facilities
- DSPM Section 4-1.102, Special Flood hazard Areas

#### Criteria

- MCDDM Table 3.2: for 100-year storm, commercial 2, C is 0.95.

#### Calculations

The contributing area of the drainage basin can be viewed on the Drainage Map in **Appendix A, figure 3**. The Project will utilize a drywell for the release of first flush stormwater. The drywell will be sized and installed to ensure drainage of first flush stormwater within 36 hours. Drywell calculations are provided within the first flush calculations as part of **Appendix D**.

The runoff produced onsite will be captured and conveyed using catch basins, scuppers, and storm drain. These drainage structures will be sized for the 10-year event. The onsite drainage area was broken out into subbasins and peak flows were determined for each subbasin using the Rational Method,  $Q=CiA$ .

Where:

$Q$  = flow (cfs)

$C$  = runoff Coefficient

$i$  = 100-year rainfall intensity (in/hr) for a storm lasting for length “ $T_c$ ”

$T_c$  = time of concentration (5 minute minimum)

$A$  = contributing area (acres)

The subbasins mostly consist of asphalt, concrete and rooftop; therefore 0.95 was used for the runoff coefficient in the rational method calculations. The rational method calculations, inlet capacity calculations, and first flush calculations are provided in **Appendix B, Appendix C, and Appendix D** respectively.

## **5.2. PRE- AND POST-PROJECT TOPOLOGY**

The existing site has a low point in the middle for a temporary retention basin. The proposed site will be a self-contained watershed. All stormwater will be conveyed to the proposed first flush system. The system will be drained via a drywell.

## **5.3. PRE- AND POST-PROJECT STORMWATER RUNOFF OF OFFSITE FLOWS**

Existing offsite flows will continue to be conveyed thru the site. Per the pre – app comments from the City of Scottsdale, a pre versus post HEC RAS model will be prepared to demonstrate a “zero rise” in the 100 year water surface elevation due to the proposed building in the AE flood zone.

## **5.4. BASIS FOR SELECTION OF FINISHED FLOOR ELEVATION**

The site is within flood zone AE and the minimum finish floor elevation was established as part of the Self -Storage drainage report. The minimum finish floor is 1229.00 which is at least 12 inches above the base flood elevation.

## **6. SPECIAL CONDITIONS**

There are no special conditions for this site.

## **7. DATA ANALYSIS METHODS**

First flush, peak flows, and inlet capacity calculations were calculated using Microsoft Excel, and the storm drain capacity was calculated using Bentley StormCAD. All the calculations and analysis are based on the methods outlined in the MCDDM. The Maricopa County Drainage Design Management System (DDMS) uses a minimum time of concentration at 10 minutes. Storm rainfall depths and intensities are taken from the NOAA Atlas 14. The rainfall depths and intensities used for this project are attached at **Appendix A, figure 4**.

## **8. CONCLUSIONS**

Christian Brothers Automotive Center is a self-contained watershed that provides for first flush storage and has the finish floor set at least 12 inches above the base flood elevation.

## **9. REFERENCES**

- 1) City of Scottsdale Design Standards and Policies Manual, 2018 Edition
- 2) Drainage Design Manual for Maricopa County (Hydrology and Hydraulics), 2018 Edition

## **APPENDIX A**

### **FIGURES**

1. Vicinity Map
2. FIRM Map
3. Drainage Map
4. NOAA Atlas 14 Rainfall Data



**Bowman**  
CONSULTING

1295 West Washington Ste 108  
Tempe, Arizona 85281

Phone: (480) 629-8830  
www.bowmanconsulting.com

CHRISTIAN BROTHERS AUTO

SCOTTSDALE, AZ

VICINITY MAP

JOB #	50840-01-001
DATE	12/21/2020
SCALE	N.T.S.
DRAWN	JMB

SHT 1 OF 1

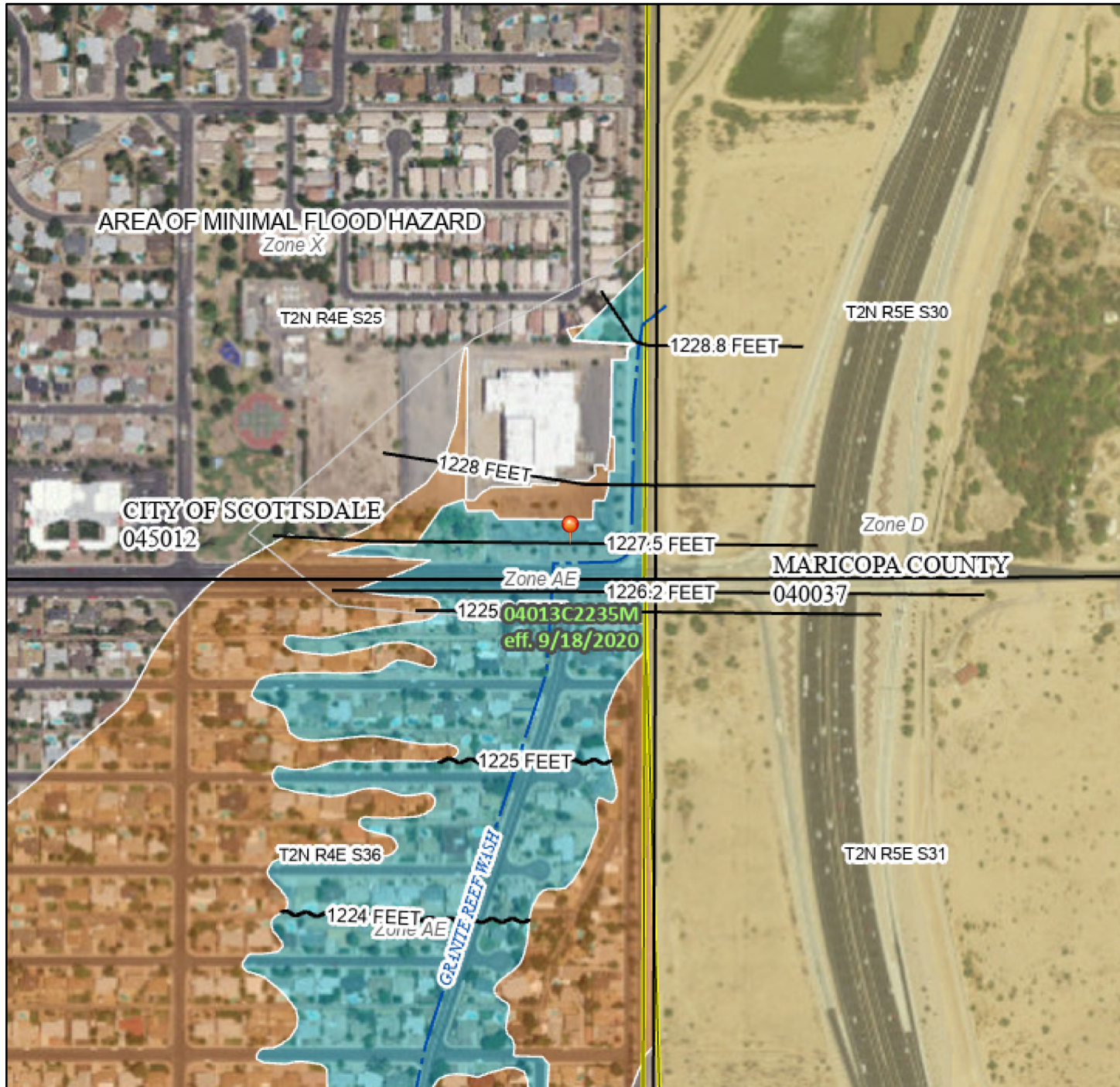
1-UP-2021

2/1/2021

# National Flood Hazard Layer FIRMette



111°53'52"W 33°29'5"N



## Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D

OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard Zone D
		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall

OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
		17.5
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
OTHER FEATURES		Jurisdiction Boundary
		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature

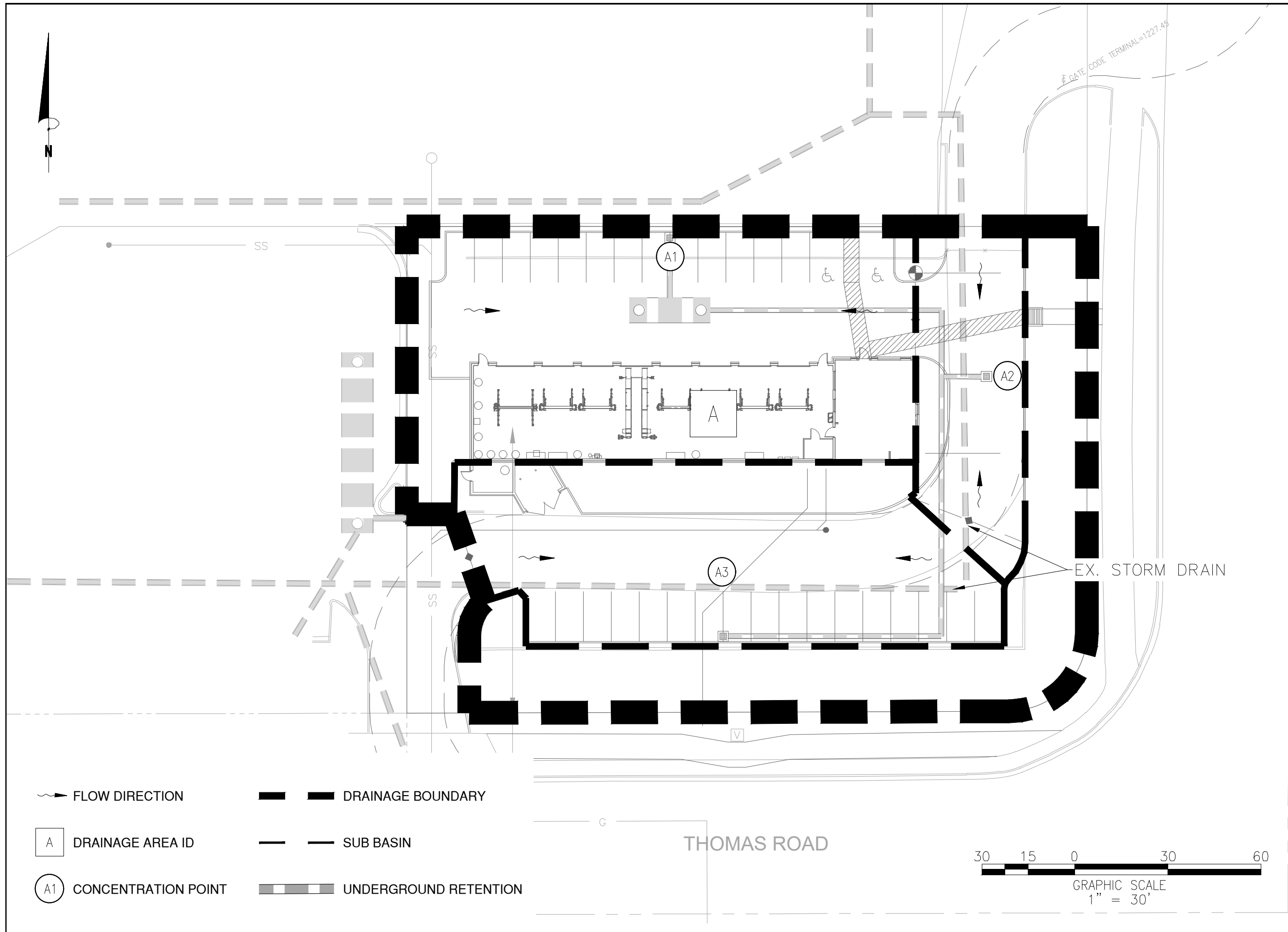
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped
		The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.



This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards.

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on **1/11/2021 at 10:42 AM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.



**CHRISTIAN BROTHERS AUTOMOTIVE**  
 SCOTTSDALE, AZ  
**DRAINAGE EXHIBIT**

1295 West Washington Ste 108  
 Tempe, Arizona 85281  
 Phone: (480) 629-8830  
 www.bowmanconsulting.com



JOB #	050840
DATE	1/11/21
SCALE	1"=30'
DRAWN	PS
SHT	1 OF 1

CAD FILE NAME: P:\050840 - Christian Brothers Automotive Scottsdale\050840-01-001 (ENG)\Engineering\Exhibits\Drainage\050840-EX-DDM.dwg 01/28/2021



**NOAA Atlas 14, Volume 1, Version 5**  
**Location name: Scottsdale, Arizona, USA\***  
**Latitude: 33.4808°, Longitude: -111.8925°**  
**Elevation: 1224.74 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**

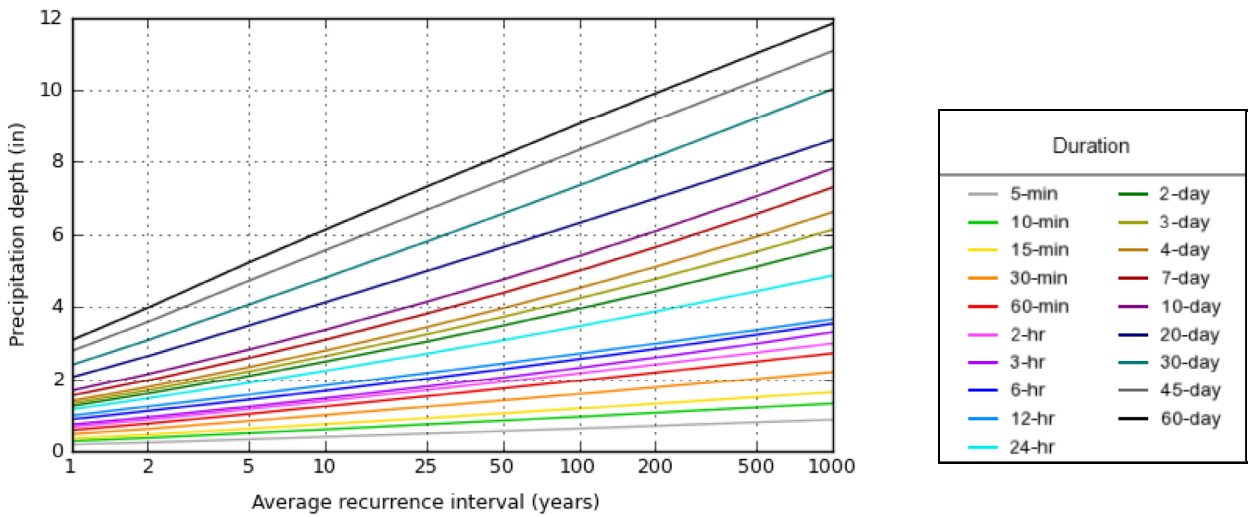
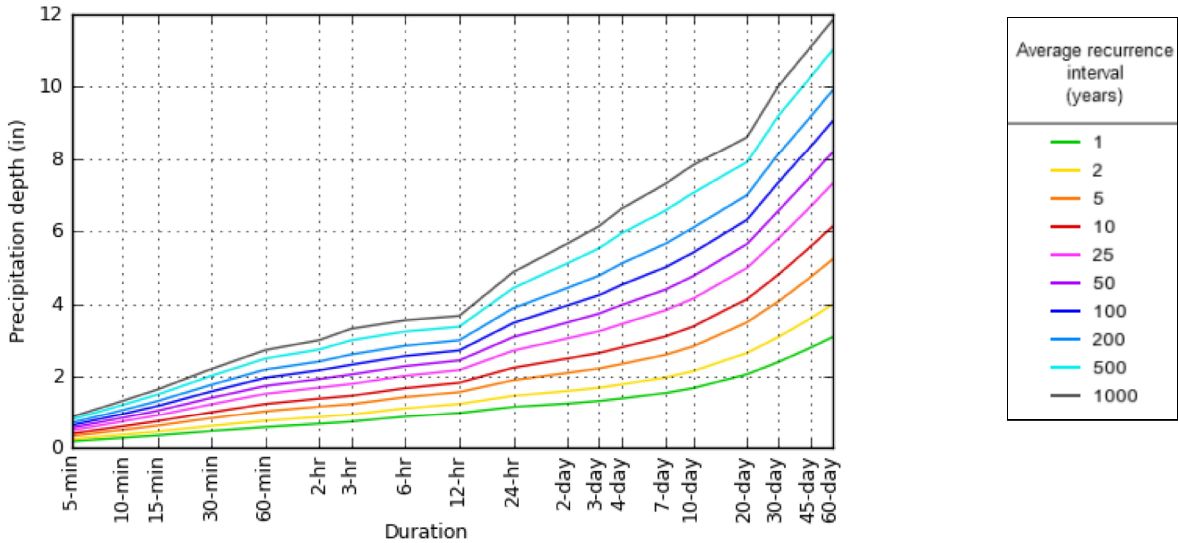
<b>PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)<sup>1</sup></b>										
<b>Duration</b>	<b>Average recurrence interval (years)</b>									
	<b>1</b>	<b>2</b>	<b>5</b>	<b>10</b>	<b>25</b>	<b>50</b>	<b>100</b>	<b>200</b>	<b>500</b>	<b>1000</b>
<b>5-min</b>	<b>0.184</b> (0.154-0.224)	<b>0.240</b> (0.202-0.293)	<b>0.327</b> (0.273-0.396)	<b>0.393</b> (0.326-0.474)	<b>0.482</b> (0.394-0.580)	<b>0.552</b> (0.445-0.660)	<b>0.623</b> (0.493-0.743)	<b>0.695</b> (0.541-0.828)	<b>0.792</b> (0.600-0.944)	<b>0.866</b> (0.643-1.03)
<b>10-min</b>	<b>0.280</b> (0.234-0.341)	<b>0.366</b> (0.308-0.446)	<b>0.497</b> (0.415-0.603)	<b>0.598</b> (0.496-0.722)	<b>0.735</b> (0.599-0.882)	<b>0.840</b> (0.677-1.00)	<b>0.948</b> (0.750-1.13)	<b>1.06</b> (0.823-1.26)	<b>1.21</b> (0.913-1.44)	<b>1.32</b> (0.979-1.57)
<b>15-min</b>	<b>0.347</b> (0.290-0.422)	<b>0.453</b> (0.382-0.553)	<b>0.616</b> (0.515-0.748)	<b>0.741</b> (0.615-0.895)	<b>0.910</b> (0.743-1.09)	<b>1.04</b> (0.839-1.25)	<b>1.18</b> (0.929-1.40)	<b>1.31</b> (1.02-1.56)	<b>1.49</b> (1.13-1.78)	<b>1.63</b> (1.21-1.95)
<b>30-min</b>	<b>0.467</b> (0.391-0.569)	<b>0.611</b> (0.514-0.744)	<b>0.829</b> (0.693-1.01)	<b>0.998</b> (0.828-1.21)	<b>1.23</b> (1.00-1.47)	<b>1.40</b> (1.13-1.68)	<b>1.58</b> (1.25-1.89)	<b>1.77</b> (1.37-2.10)	<b>2.01</b> (1.52-2.40)	<b>2.20</b> (1.63-2.63)
<b>60-min</b>	<b>0.578</b> (0.484-0.704)	<b>0.756</b> (0.636-0.921)	<b>1.03</b> (0.858-1.25)	<b>1.24</b> (1.02-1.49)	<b>1.52</b> (1.24-1.82)	<b>1.74</b> (1.40-2.08)	<b>1.96</b> (1.55-2.34)	<b>2.19</b> (1.70-2.60)	<b>2.49</b> (1.89-2.97)	<b>2.72</b> (2.02-3.25)
<b>2-hr</b>	<b>0.670</b> (0.570-0.799)	<b>0.866</b> (0.738-1.04)	<b>1.16</b> (0.984-1.38)	<b>1.38</b> (1.16-1.65)	<b>1.69</b> (1.40-2.00)	<b>1.92</b> (1.58-2.27)	<b>2.17</b> (1.75-2.56)	<b>2.41</b> (1.91-2.84)	<b>2.74</b> (2.12-3.23)	<b>3.00</b> (2.27-3.56)
<b>3-hr</b>	<b>0.729</b> (0.619-0.879)	<b>0.935</b> (0.796-1.13)	<b>1.23</b> (1.04-1.48)	<b>1.46</b> (1.23-1.75)	<b>1.79</b> (1.48-2.13)	<b>2.05</b> (1.67-2.43)	<b>2.32</b> (1.85-2.75)	<b>2.60</b> (2.05-3.08)	<b>2.99</b> (2.28-3.55)	<b>3.31</b> (2.46-3.93)
<b>6-hr</b>	<b>0.876</b> (0.759-1.03)	<b>1.11</b> (0.965-1.31)	<b>1.42</b> (1.23-1.67)	<b>1.67</b> (1.43-1.96)	<b>2.01</b> (1.70-2.34)	<b>2.28</b> (1.90-2.64)	<b>2.56</b> (2.10-2.96)	<b>2.84</b> (2.28-3.30)	<b>3.23</b> (2.53-3.76)	<b>3.54</b> (2.71-4.13)
<b>12-hr</b>	<b>0.977</b> (0.855-1.13)	<b>1.23</b> (1.08-1.43)	<b>1.56</b> (1.36-1.81)	<b>1.82</b> (1.58-2.10)	<b>2.17</b> (1.86-2.50)	<b>2.44</b> (2.07-2.80)	<b>2.71</b> (2.27-3.12)	<b>2.99</b> (2.46-3.44)	<b>3.37</b> (2.70-3.89)	<b>3.66</b> (2.89-4.26)
<b>24-hr</b>	<b>1.15</b> (1.03-1.29)	<b>1.46</b> (1.32-1.64)	<b>1.89</b> (1.70-2.12)	<b>2.24</b> (2.00-2.50)	<b>2.71</b> (2.41-3.02)	<b>3.08</b> (2.72-3.43)	<b>3.47</b> (3.04-3.87)	<b>3.87</b> (3.37-4.32)	<b>4.43</b> (3.81-4.94)	<b>4.87</b> (4.15-5.45)
<b>2-day</b>	<b>1.25</b> (1.12-1.40)	<b>1.59</b> (1.43-1.79)	<b>2.09</b> (1.87-2.34)	<b>2.49</b> (2.22-2.78)	<b>3.04</b> (2.70-3.40)	<b>3.48</b> (3.07-3.89)	<b>3.95</b> (3.46-4.42)	<b>4.43</b> (3.86-4.96)	<b>5.11</b> (4.40-5.74)	<b>5.66</b> (4.82-6.36)
<b>3-day</b>	<b>1.32</b> (1.18-1.48)	<b>1.69</b> (1.51-1.89)	<b>2.22</b> (1.98-2.48)	<b>2.64</b> (2.36-2.95)	<b>3.24</b> (2.88-3.62)	<b>3.72</b> (3.28-4.15)	<b>4.23</b> (3.71-4.73)	<b>4.77</b> (4.14-5.33)	<b>5.53</b> (4.74-6.18)	<b>6.14</b> (5.21-6.89)
<b>4-day</b>	<b>1.39</b> (1.25-1.56)	<b>1.78</b> (1.59-1.99)	<b>2.34</b> (2.09-2.62)	<b>2.79</b> (2.49-3.12)	<b>3.44</b> (3.05-3.84)	<b>3.96</b> (3.49-4.42)	<b>4.52</b> (3.95-5.04)	<b>5.11</b> (4.43-5.70)	<b>5.94</b> (5.08-6.63)	<b>6.62</b> (5.60-7.41)
<b>7-day</b>	<b>1.54</b> (1.38-1.72)	<b>1.96</b> (1.76-2.20)	<b>2.59</b> (2.32-2.90)	<b>3.10</b> (2.76-3.46)	<b>3.81</b> (3.38-4.26)	<b>4.39</b> (3.87-4.89)	<b>5.00</b> (4.37-5.58)	<b>5.65</b> (4.90-6.31)	<b>6.56</b> (5.62-7.34)	<b>7.30</b> (6.18-8.18)
<b>10-day</b>	<b>1.67</b> (1.50-1.87)	<b>2.14</b> (1.92-2.40)	<b>2.82</b> (2.53-3.15)	<b>3.37</b> (3.01-3.76)	<b>4.14</b> (3.67-4.60)	<b>4.75</b> (4.19-5.28)	<b>5.40</b> (4.74-6.01)	<b>6.09</b> (5.29-6.78)	<b>7.05</b> (6.05-7.85)	<b>7.82</b> (6.64-8.72)
<b>20-day</b>	<b>2.06</b> (1.85-2.29)	<b>2.64</b> (2.37-2.94)	<b>3.49</b> (3.13-3.88)	<b>4.13</b> (3.69-4.59)	<b>4.98</b> (4.44-5.54)	<b>5.64</b> (5.01-6.27)	<b>6.31</b> (5.58-7.02)	<b>6.99</b> (6.14-7.79)	<b>7.91</b> (6.88-8.82)	<b>8.61</b> (7.43-9.62)
<b>30-day</b>	<b>2.40</b> (2.15-2.67)	<b>3.09</b> (2.77-3.43)	<b>4.06</b> (3.65-4.51)	<b>4.80</b> (4.30-5.33)	<b>5.80</b> (5.17-6.43)	<b>6.57</b> (5.83-7.27)	<b>7.35</b> (6.49-8.13)	<b>8.14</b> (7.15-9.02)	<b>9.21</b> (8.03-10.2)	<b>10.0</b> (8.68-11.2)
<b>45-day</b>	<b>2.78</b> (2.51-3.10)	<b>3.59</b> (3.23-3.99)	<b>4.72</b> (4.25-5.24)	<b>5.56</b> (4.99-6.17)	<b>6.67</b> (5.96-7.39)	<b>7.50</b> (6.68-8.31)	<b>8.33</b> (7.39-9.24)	<b>9.16</b> (8.09-10.2)	<b>10.3</b> (8.99-11.4)	<b>11.1</b> (9.66-12.4)
<b>60-day</b>	<b>3.08</b> (2.79-3.42)	<b>3.98</b> (3.59-4.40)	<b>5.23</b> (4.71-5.78)	<b>6.13</b> (5.51-6.78)	<b>7.31</b> (6.56-8.08)	<b>8.18</b> (7.31-9.05)	<b>9.06</b> (8.06-10.0)	<b>9.91</b> (8.78-11.0)	<b>11.0</b> (9.71-12.2)	<b>11.8</b> (10.4-13.2)

<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.

[Back to Top](#)

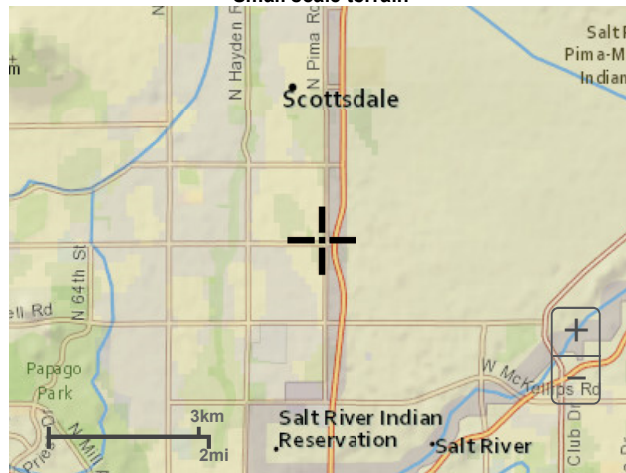
## PF graphical

PDS-based depth-duration-frequency (DDF) curves  
Latitude: 33.4808°, Longitude: -111.8925°



## Maps & aerals

Small scale terrain



Large scale terrain



Large scale map



### Large scale aerial



[Back to Top](#)

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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](mailto:HDSC.Questions@noaa.gov)

[Disclaimer](#)

## **APPENDIX B**

### **RATIONAL METHOD CALCULATIONS**



## **APPENDIX C**

### **INLET CAPACITY CALCULATIONS**



## **APPENDIX D**

### **FIRST FLUSH AND DEWATERING CALCULATIONS**

# RETENTION WORKSHEET FOR 100-YR, 2-HR EVENT

Project: 050840-01-001

Description: Christian Brothers Automotive

Prepared by: PS

DATE: 1/28/2021

## Basin A Summary

Extra Provided		Required Drywells
7 cf	0.00 Ac-ft	1.0

### Volume Required:

$$V_r = 0.5/12 \times A \times C$$

D = 100yr, 2hr Rainfall, 0.50 in.

A = Area in Square Feet

C = Coefficient of Runoff

Sub Area Type	Area (Sq. Ft.)	Runoff Coefficient	Retention Required (cf)	Retention Required (ac-ft)
Commercial Area	32,825	0.95	1,299 cf	0.03 Ac-ft
<b>Totals</b>	<b>32,825</b>		<b>1,299 cf</b>	<b>0.03 Ac-ft</b>

Total Retention Required      **1,299 cf**      **0.03 Ac-ft**

### Volume Provided:

$V = L * \pi * r^2$	L (ft)	D (ft)	V (cf)	V (ac-ft)
	26	8	1,306	0.03
<b>TOTALS</b>	<b>26</b>		<b>1,306</b>	<b>0.03</b>

**TOTAL VOLUME PROVIDED      1,306**

### Dissipation Calculations for Surface Percolation

Retention Required (cf)	Derated Surface Percolation Rate (cf/hr/sf)	Basin Bottom Area (sf)	Surface Percolation in 36hrs (cf)	Volume to be Drained Through Drywells (cf)
1,299	0.00	0	0	1,299

### Dissipation Calculations for Drywells

Volume to be drain Through Drywells (cf)	Drywell Percolation Rate (cf/36hr)	Number of Drywells Required
1,299	12,960	1.0

Time to Drain:                      3.6 hrs

## **APPENDIX E**

### **PIMA SELF STORAGE LOMR**



# Federal Emergency Management Agency

Washington, D.C. 20472

July 23, 2018

CERTIFIED MAIL  
RETURN RECEIPT REQUESTED

The Honorable W.J. "Jim" Lane  
Mayor, City of Scottsdale  
City Hall  
3939 North Drinkwater Boulevard  
Scottsdale, AZ 85251

IN REPLY REFER TO:

Case No.: 18-09-0983P  
Follows Conditional  
Case No.: 17-09-0053R  
Community Name: City of Scottsdale, AZ  
Community No.: 045012  
Effective Date of  
This Revision: **December 7, 2018**

Dear Mayor Lane:

The Flood Insurance Study Report and Flood Insurance Rate Map for your community have been revised by this Letter of Map Revision (LOMR). Please use the enclosed annotated map panel(s) revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals issued in your community.

Additional documents are enclosed which provide information regarding this LOMR. Please see the List of Enclosures below to determine which documents are included. Other attachments specific to this request may be included as referenced in the Determination Document. If you have any questions regarding floodplain management regulations for your community or the National Flood Insurance Program (NFIP) in general, please contact the Consultation Coordination Officer for your community. If you have any technical questions regarding this LOMR, please contact the Director, Mitigation Division of the Department of Homeland Security's Federal Emergency Management Agency (FEMA) in Oakland, California, at (510) 627-7175, or the FEMA Map Information eXchange (FMIX) toll free at 1-877-336-2627 (1-877-FEMA MAP). Additional information about the NFIP is available on our website at <http://www.fema.gov/business/nfip>.

Sincerely,

Patrick "Rick" F. Sacbibit, P.E., Branch Chief  
Engineering Services Branch  
Federal Insurance and Mitigation Administration

List of Enclosures:

Letter of Map Revision Determination Document  
Annotated Flood Insurance Rate Map  
Annotated Flood Insurance Study Report

cc: Ms. Ashley Couch, P.E., CFM  
Floodplain Administrator, City of Scottsdale

Mr. Tim Murphy, P.E.  
Mitigation Planning and Technical Programs Manager  
Flood Control District of Maricopa County

Mr. Chris Hall  
Acting Director  
Flood Control District of Maricopa County

Mr. Michael S. Wolf, P.E.  
Director of Engineering Design  
Hubbard Engineering

Mr. Jared Langenhuizen  
Director of Construction  
Wentworth Property Company, LLC

Ms. Kelli Sertich  
FMS Division Manager  
Flood Control District of Maricopa County

Mr. Kusi Akuoko  
GIS Analyst  
Flood Control District of Maricopa County

Follows Conditional Case No.: 17-09-0053R



**Federal Emergency Management Agency**  
Washington, D.C. 20472

**LETTER OF MAP REVISION  
DETERMINATION DOCUMENT**

COMMUNITY AND REVISION INFORMATION		PROJECT DESCRIPTION	BASIS OF REQUEST
COMMUNITY	City of Scottsdale Maricopa County Arizona	CHANNEL RELOCATION EXCAVATION FILL	HYDRAULIC ANALYSIS HYDROLOGIC ANALYSIS UPDATED TOPOGRAPHIC DATA
	COMMUNITY NO.: 045012		
IDENTIFIER	Pima Storage	APPROXIMATE LATITUDE & LONGITUDE: 33.481, -111.892 SOURCE: USGS QUADRANGLE      DATUM: NAD 83	
ANNOTATED MAPPING ENCLOSURES		ANNOTATED STUDY ENCLOSURES	
TYPE: FIRM*      NO.: 04013C2235L      DATE: October 16, 2013		DATE OF EFFECTIVE FLOOD INSURANCE STUDY: November 04, 2015 PROFILE(S): 592P SUMMARY OF DISCHARGES TABLE: 3	

Enclosures reflect changes to flooding sources affected by this revision.  
\* FIRM - Flood Insurance Rate Map

**FLOODING SOURCE(S) & REVISED REACH(ES)**

Granite Reef Wash - from approximately 100 feet downstream East Thomas Road to just downstream of North Pima Road

**SUMMARY OF REVISIONS**

Flooding Source	Effective Flooding	Revised Flooding	Increases	Decreases
Granite Reef Wash	Zone AE	Zone AE	YES	YES
	BFEs*	BFEs	YES	YES

\* BFEs - Base Flood Elevations

**DETERMINATION**

This document provides the determination from the Department of Homeland Security's Federal Emergency Management Agency (FEMA) regarding a request for a Letter of Map Revision (LOMR) for the area described above. Using the information submitted, we have determined that a revision to the flood hazards depicted in the Flood Insurance Study (FIS) report and/or National Flood Insurance Program (NFIP) map is warranted. This document revises the effective NFIP map, as indicated in the attached documentation. Please use the enclosed annotated map panels revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals in your community.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Information eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 3601 Eisenhower Avenue, Suite 500, Alexandria, VA 22304-6426. Additional Information about the NFIP is available on our website at <http://www.fema.gov/nfip>.

Patrick "Rick" F. Sacbibit, P.E., Branch Chief  
Engineering Services Branch  
Federal Insurance and Mitigation Administration



Federal Emergency Management Agency  
Washington, D.C. 20472

**LETTER OF MAP REVISION  
DETERMINATION DOCUMENT (CONTINUED)**

**COMMUNITY INFORMATION**

**APPLICABLE NFIP REGULATIONS/COMMUNITY OBLIGATION**

We have made this determination pursuant to Section 206 of the Flood Disaster Protection Act of 1973 (P.L. 93-234) and in accordance with the National Flood Insurance Act of 1968, as amended (Title XIII of the Housing and Urban Development Act of 1968, P.L. 90-448), 42 U.S.C. 4001-4128, and 44 CFR Part 65. Pursuant to Section 1361 of the National Flood Insurance Act of 1968, as amended, communities participating in the NFIP are required to adopt and enforce floodplain management regulations that meet or exceed NFIP criteria. These criteria, including adoption of the FIS report and FIRM, and the modifications made by this LOMR, are the minimum requirements for continued NFIP participation and do not supersede more stringent State/Commonwealth or local requirements to which the regulations apply.

NFIP regulations Subparagraph 60.3(b)(7) requires communities to ensure that the flood-carrying capacity within the altered or relocated portion of any watercourse is maintained. This provision is incorporated into your community's existing floodplain management ordinances; therefore, responsibility for maintenance of the altered or relocated watercourse, including any related appurtenances such as bridges, culverts, and other drainage structures, rests with your community. We may request that your community submit a description and schedule of maintenance activities necessary to ensure this requirement.

**COMMUNITY REMINDERS**

We based this determination on the 1-percent-annual-chance discharges computed in the submitted hydrologic model. Future development of projects upstream could cause increased discharges, which could cause increased flood hazards. A comprehensive restudy of your community's flood hazards would consider the cumulative effects of development on discharges and could, therefore, indicate that greater flood hazards exist in this area.

Your community must regulate all proposed floodplain development and ensure that permits required by Federal and/or State/Commonwealth law have been obtained. State/Commonwealth or community officials, based on knowledge of local conditions and in the interest of safety, may set higher standards for construction or may limit development in floodplain areas. If your State/Commonwealth or community has adopted more restrictive or comprehensive floodplain management criteria, those criteria take precedence over the minimum NFIP requirements.

We will not print and distribute this LOMR to primary users, such as local insurance agents or mortgage lenders; instead, the community will serve as a repository for the new data. We encourage you to disseminate the information in this LOMR by preparing a news release for publication in your community's newspaper that describes the revision and explains how your community will provide the data and help interpret the NFIP maps. In that way, interested persons, such as property owners, insurance agents, and mortgage lenders, can benefit from the information.

This revision has met our criteria for removing an area from the 1-percent-annual-chance floodplain to reflect the placement of fill. However, we encourage you to require that the lowest adjacent grade and lowest floor (including basement) of any structure placed within the subject area be elevated to or above the Base (1-percent-annual-chance) Flood Elevation.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Information eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 3601 Eisenhower Avenue, Suite 500, Alexandria, VA 22304-6426. Additional Information about the NFIP is available on our website at <http://www.fema.gov/nfip>.

Patrick "Rick" F. Sacbibit, P.E., Branch Chief  
Engineering Services Branch  
Federal Insurance and Mitigation Administration



## Federal Emergency Management Agency

Washington, D.C. 20472

### LETTER OF MAP REVISION DETERMINATION DOCUMENT (CONTINUED)

We have designated a Consultation Coordination Officer (CCO) to assist your community. The CCO will be the primary liaison between your community and FEMA. For information regarding your CCO, please contact:

Ms. Juliette Hayes  
Director, Mitigation Division  
Federal Emergency Management Agency, Region IX  
1111 Broadway, Suite 1200  
Oakland, CA 94607-4052  
(510) 627-7211

#### STATUS OF THE COMMUNITY NFIP MAPS

We will not physically revise and republish the FIRM and FIS report for your community to reflect the modifications made by this LOMR at this time. When changes to the previously cited FIRM panel(s) and FIS report warrant physical revision and republication in the future, we will incorporate the modifications made by this LOMR at that time.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Information eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 3601 Eisenhower Avenue, Suite 500, Alexandria, VA 22304-6426. Additional Information about the NFIP is available on our website at <http://www.fema.gov/nfip>.

Patrick "Rick" F. Sacbibit, P.E., Branch Chief  
Engineering Services Branch  
Federal Insurance and Mitigation Administration



Federal Emergency Management Agency  
Washington, D.C. 20472

**LETTER OF MAP REVISION  
DETERMINATION DOCUMENT (CONTINUED)**

**PUBLIC NOTIFICATION OF REVISION**

A notice of changes will be published in the *Federal Register*. This information also will be published in your local newspaper on or about the dates listed below, and through FEMA's Flood Hazard Mapping website at [https://www.floodmaps.fema.gov/fhm/bfe\\_status/bfe\\_main.asp](https://www.floodmaps.fema.gov/fhm/bfe_status/bfe_main.asp)

LOCAL NEWSPAPER Name: *Arizona Business Gazette*  
Dates: August 2, 2018 and August 9, 2018

Within 90 days of the second publication in the local newspaper, any interested party may request that we reconsider this determination. Any request for reconsideration must be based on scientific or technical data. Therefore, this letter will be effective only after the 90-day appeal period has elapsed and we have resolved any appeals that we receive during this appeal period. Until this LOMR is effective, the revised flood hazard determination presented in this LOMR may be changed.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Information eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 3601 Eisenhower Avenue, Suite 500, Alexandria, VA 22304-6426. Additional Information about the NFIP is available on our website at <http://www.fema.gov/nfip>.

Patrick "Rick" F. Sacbibit, P.E., Branch Chief  
Engineering Services Branch  
Federal Insurance and Mitigation Administration

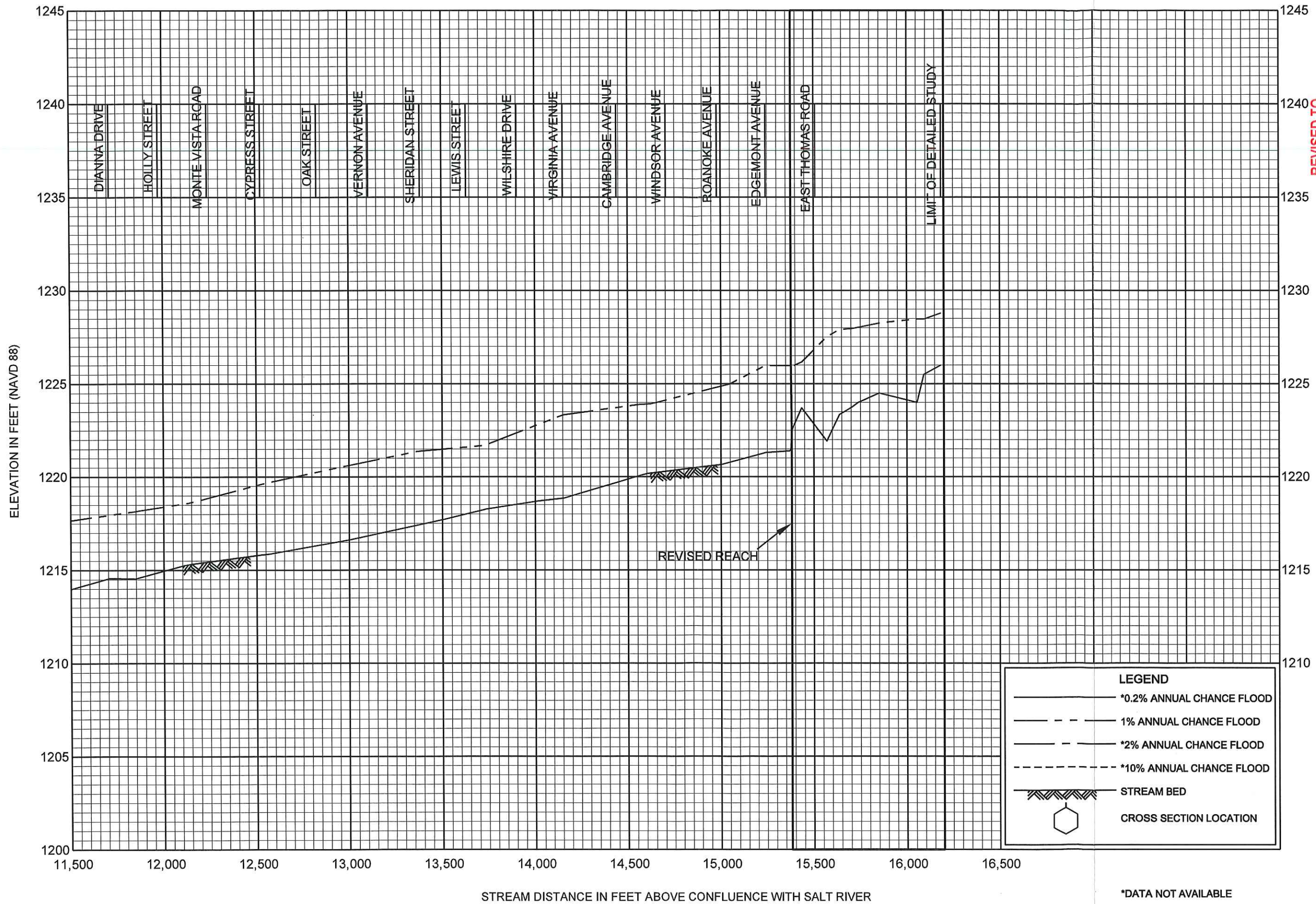
Table 3. Summary of Discharges

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (Sq. Miles)	PEAK DISCHARGES (cfs)			
		10-PERCENT ANNUAL CHANCE	2-PERCENT ANNUAL CHANCE	1-PERCENT ANNUAL CHANCE	0.2-PERCENT ANNUAL CHANCE
<b>Granite Reef Wash</b>					
Van Buren Street	7.5	720	1,158	1,417	3,150
McDowell Road	7.2	580	950	1,240	2,660
Pima Road	6.2	74	278	594	1,431
<b>Grapevine Wash</b>					
Upstream of confluence with Rowe Wash	3.8	2,865	4,266	5,004	6,316
<b>Grass Wash</b>					
At U.S. Highways 60/70	70.6	3,340	8,660	11,100	-- <sup>1</sup>
At NW corner of Section 25, T7N, R9W	39.9	2,430	5,950	7,500	-- <sup>1</sup>
At SE corner of Section 25, T7N, R9W	23.9	1,720	3,900	4,870	-- <sup>1</sup>
<b>Greystone Wash</b>					
At Sycamore Drive	0.38	-- <sup>1</sup>	-- <sup>1</sup>	396	-- <sup>1</sup>
<b>Hacker Wash</b>					
Just upstream of Gila Bend Canal	-- <sup>1</sup>	-- <sup>1</sup>	-- <sup>1</sup>	8,960	-- <sup>1</sup>
Just upstream of confluence with Evans Wash	2.33	-- <sup>1</sup>	-- <sup>1</sup>	1,348	-- <sup>1</sup>
<b>Hacker Wash Diversion</b>					
Just upstream of Pima Road (It derives its peak 1%-annual-chance discharge from flow diverted from Hacker Wash above Interstate 8)	-- <sup>1</sup>	-- <sup>1</sup>	-- <sup>1</sup>	5,571	-- <sup>1</sup>
<b>Happy Valley Wash</b>					
At the Agua Fria River confluence	3.71	-- <sup>1</sup>	-- <sup>1</sup>	2,340	-- <sup>1</sup>

--<sup>1</sup> Data Not Computed

--<sup>2</sup> Data Not Available

REVISED TO REFLECT LOMR EFFECTIVE: December 7, 2018



REVISED TO  
 REFLECT LOMR  
 FLOOD PROFILES EFFECTIVE: December 7, 2018

GRANITE REEF WASH

FEDERAL EMERGENCY MANAGEMENT AGENCY  
 MARICOPA COUNTY, AZ  
 AND INCORPORATED AREAS

592P

\*DATA NOT AVAILABLE



## **APPENDIX F**

### **PIMA SELF STORAGE DRAINAGE REPORT**

# PIMA SELF STORAGE – PHASE I

LOCATED AT THE NORTHWEST CORNER OF THE INTERSECTION OF PIMA ROAD  
AND THOMAS ROAD

## FINAL DRAINAGE REPORT

FEBRUARY 13, 2017

Project No.: 15138

PREPARED FOR:

WENTWORTH PROPERTY COMPANY, LLC  
2701 EAST CAMELBACK RD., SUITE 185  
PHOENIX, AZ 85016  
(602) 628-1885

PREPARED BY:

HUBBARD ENGINEERING  
1201 S. ALMA SCHOOL RD., SUITE 12000  
MESA, ARIZONA 85210  
(480) 892-3313  
MICHAEL S. WOLF, PE



**H U B B A R D**  
**E N G I N E E R I N G**



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### FIGURES

Figure 1	Site Vicinity Map
Figure 2	Aerial Topographic Maps
Figure 3	Flood Insurance Rate Map

### APPENDICES

Appendix A	Reference Data
Appendix B	Rational Method Peak Flow Calculations
Appendix C	Onsite Hydraulic Calculations
Appendix D	Retention and Dissipation Calculations
Appendix E	Storm Drain Calculations

### EXHIBITS

Exhibit 1	Proposed Site Drainage Map
Exhibit 2	Proposed Grading and Drainage
Exhibit 3	Hec-Ras Cross Sections



# 1. INTRODUCTION AND SCOPE OF WORK

This report presents the results of a *Final Drainage Study* conducted by Hubbard Engineering at the request of Wentworth Property Company, LLC (“client”), for Pima Storage (“site”). The purpose of this report is to provide a hydrologic and hydraulic evaluation for the site. This report addresses off-site and on-site conditions as well as storm water runoff detention.

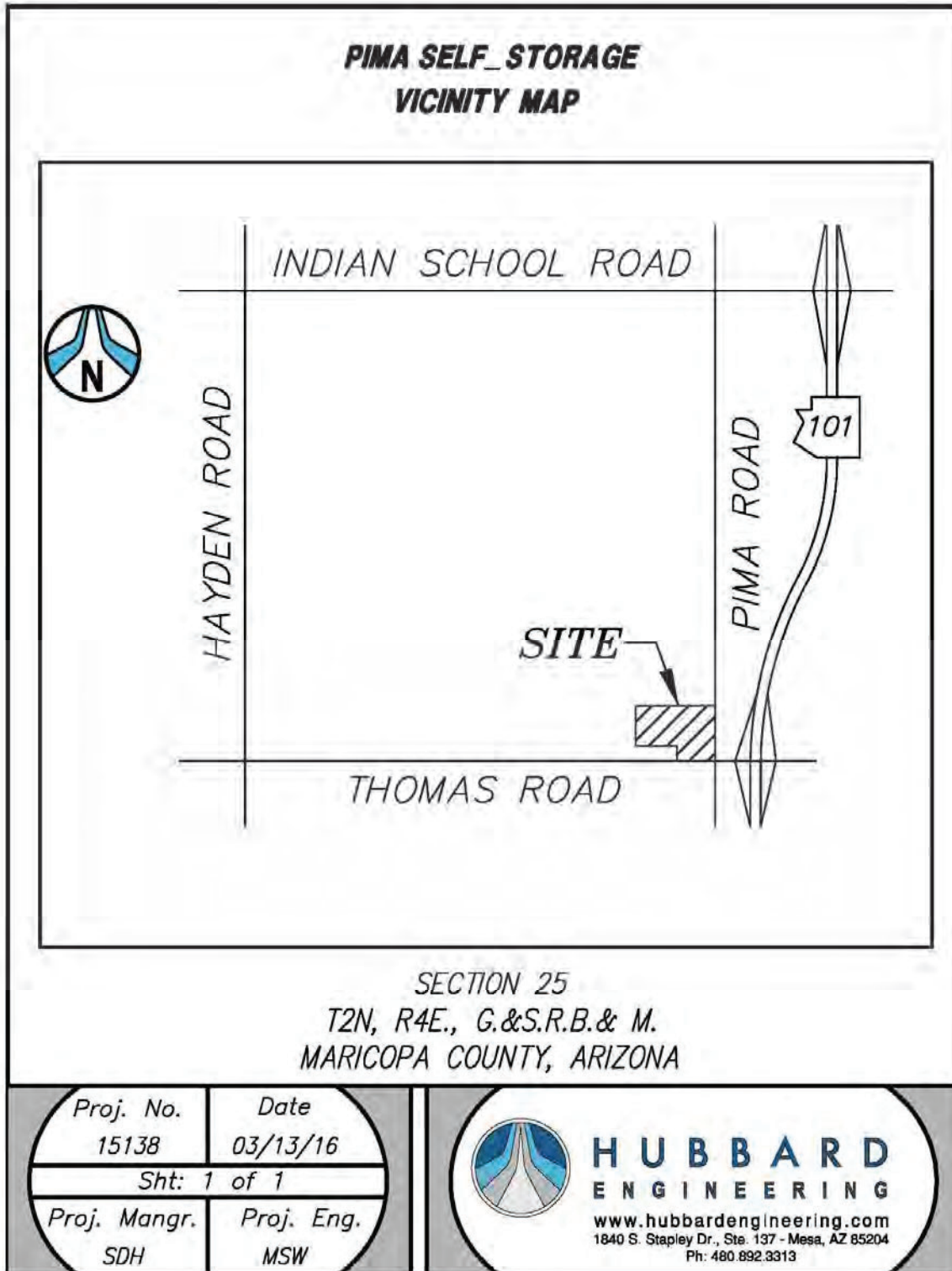
## 1.1 Site Description

The site is located in Section 25 of Township 2N, Range 4E of the Gila and Salt River Base and Meridian, Maricopa County, Arizona. The location of the site is shown on the site *Vicinity Map*, **FIGURE 1**, on the next page. The project is bounded by City Park to the west, Thomas Road to the south, Pima Rd to the east and residential subdivisions to the north.

## 1.2 Project Type

The site is rectangular in shape and encompasses approximately 10.78 gross acres. The site is currently developed with 1 existing building and parking lot. The proposed development for the site is a 2-phased project. Phase 1 will encompass renovation of the existing Microsemi building for storage, constructing a site wall, re-grading the driveways along Pima Road and also, re-grading a portion of landscaped area just outside of the right of way to west side of Pima Road. The landscaped area lies between the two existing driveways on Pima Rd. A basin/swale will be graded in the landscaped area. The basin/swale will consist of 6:1 side slopes adjacent to the right of way, 6:1 side slopes along the north and south sides of the driveways and a proposed block wall as shown in **Exhibit 2**. The basin/swale will provide additional capacity that is needed to keep the water surface elevation within the required tolerances. See **Exhibit 2** for the Grading and Drainage Plan. Phase 1 will encompass the addition of storage units and site improvements within Lot 1 which is the development outside the new flood plain limits. Lot 2 is the southern portion of the site that has 2 future planned retail pads. This area will be rough graded to accommodate the new flood plain. Lot 2 also includes a portion along Pima Rd that will contain the new flood plain allowing for Lot 1 to be out of the flood plain.

Figure 1 – Vicinity Map



### 1.3 Regulatory Issues

The criteria used in the drainage design and analysis of the site was established using the guidelines as described in the following:

- *Design Standards & Policies Manual Chapter 4 Grading and Drainage, City of Scottsdale, Dated January, 2010.* (Reference 1).
- *Drainage Design Manual for Maricopa County, Arizona, Volume I, Hydrology* (Reference 2).
- *Drainage Design Manual for Maricopa County, Arizona, Volume II, Hydraulics* (Reference 3)

## 2. DESCRIPTION OF EXIST. DRAINAGE COND. & CHARACTERISTICS

### 2.1 Onsite Drainage

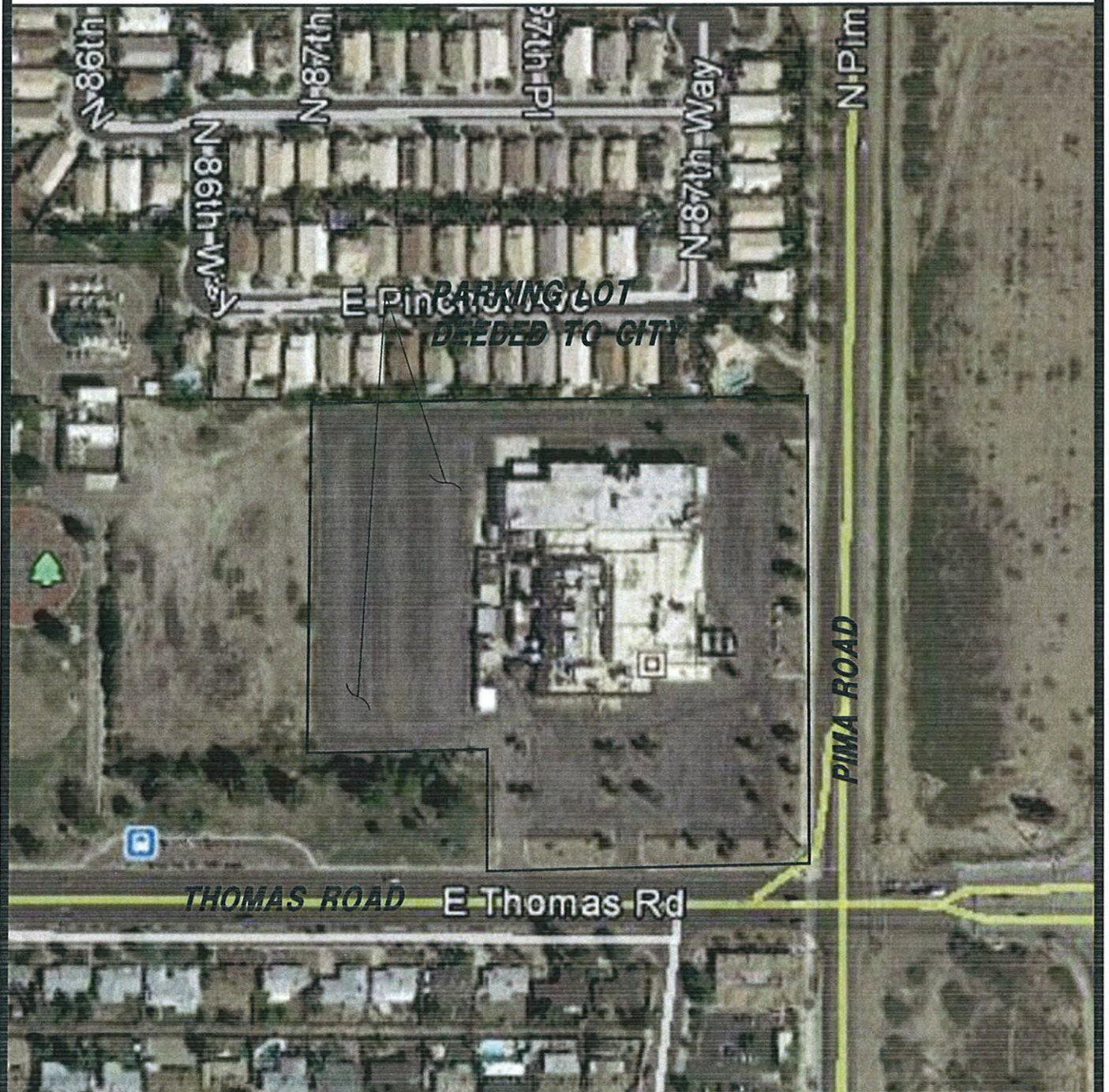
The site currently lies within the Flood Plain Zone AE with established water surface elevations. The flood zone begins at the northeast portion of the site from Pima Rd. and then fans out across the site. The flood waters pass through the site and discharges into Thomas Rd through two existing driveways.

The site has historically discharged the storm water into Thomas Rd. with no retention at a flow rate of 74.15 cfs. The site drains from the northwest to south following the same flow pattern as the flood plain.


See *Aerial Topographic Map (FIGURE 2)*.

Figure 2

# PIMA SELF STORAGE AERIAL MAP



Proj. No. <b>15138</b>	Date <b>03/30/16</b>
Sht: 1 of 1	
Proj. Mangr. <b>SDH</b>	Proj. Eng. <b>SDH</b>



**HUBBARD  
ENGINEERING**  
www.hubbardengineering.com  
1840 S. Stapley Dr., Ste. 137 - Mesa, AZ 85204  
Ph: 480.892.3313

## 2.2 Existing Off-Site Conditions Characteristics

As discussed in the previous section, the site does lie within the Flood Plain Zone AE. The off-site flows come from the northeast of the site from Thomas Rd. and fan out through the site to eventually discharge into Thomas Rd.

The site lies within the Granite Reef Wash. The Granite Reef Wash has been analyzed previously as recorded in the Granite Reef Wash Floodplain Delineation Study prepared by Entellus for the Flood Control District of Maricopa County dated May 1997 (Reference 4). The Granite Reef Wash Floodplain Delineation Study started at River Mile 0.320 and ended at River Mile 2.218. See **Appendix A**. River Mile 2.218 is at Thomas Rd just south of the project site. Therefore, our project site is outside the limit of study for the Granite Reef Wash Floodplain Delineation Study. However, the Granite Reef Wash Floodplain Delineation Study shows an approximate flow of 644 cfs coming onto the site from the northeast corner from Pima Rd. Hubbard Engineering (HE) has submitted a CLOMR to FEMA to remove the floodplain off of the property that will have the existing and proposed storage buildings on the property. The results of the CLOMR can be found in the CLOMR approved by the City of Scottsdale for this report.

## 2.3 Flood Zone Information

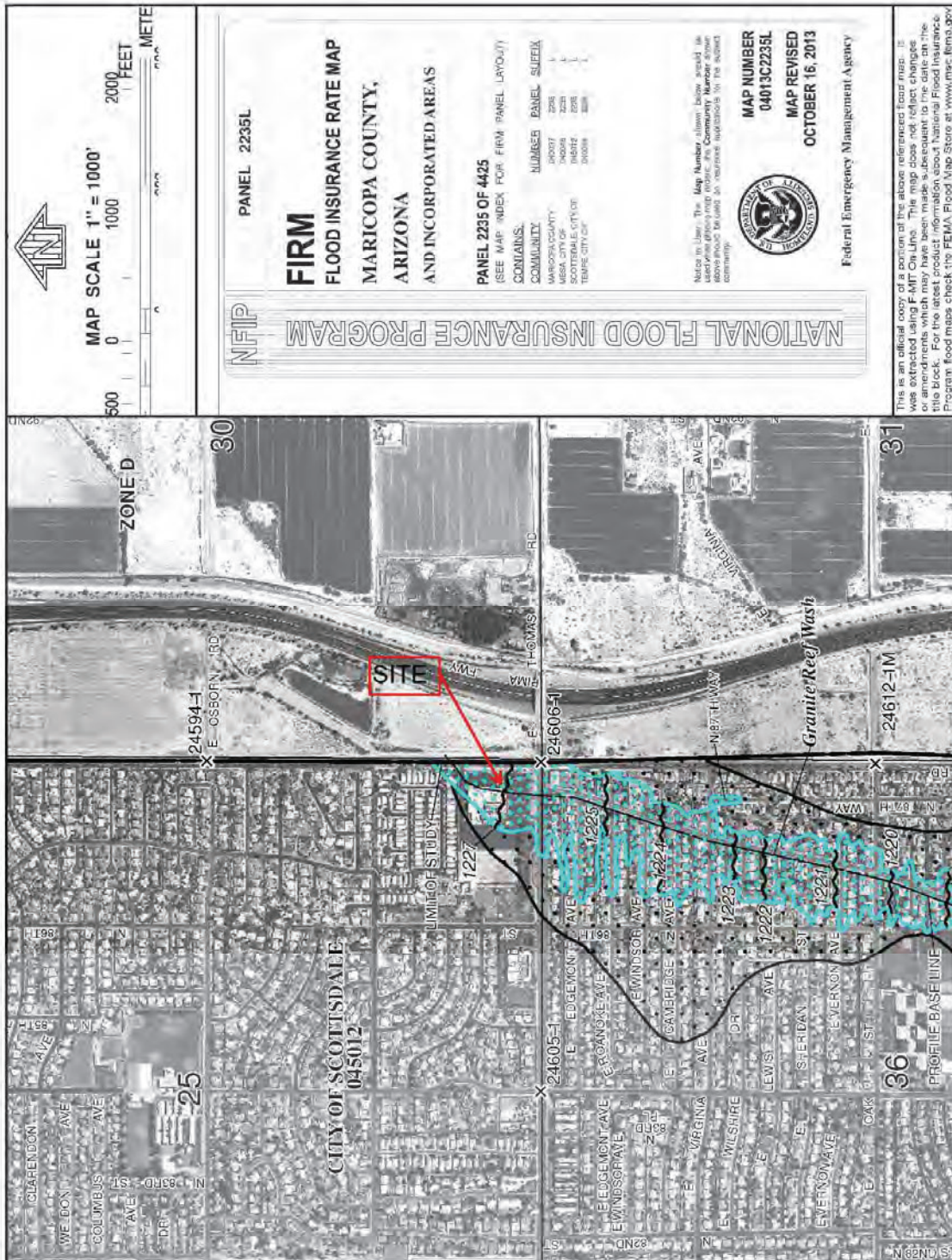
Based on Flood Insurance Rate Map No. 04013C2235L, dated October 16, 2013, the property is located in Zone AE, which is described as:

“Base Flood Elevations Determined.”

The existing building has an existing exterior elevation of 1228.10 with the base flood elevation of a 1227.00. Refer to FEMA Firmette in **FIGURE 3**.

## 2.4 Adjacent Properties

The adjacent property to the north is single family and separated with a 12' site wall. An existing City park is to the west with Pima Rd. to the east and Thomas Rd. to the south.



**Figure 3 – FIRM**

### 3. PROPOSED DRAINAGE PLAN

#### 3.1 On-Site Hydrology

The final site configuration and grading design indicates that the Rational Method of hydrology as described in the *Drainage Design Manual for Maricopa County, Volume I* (Reference 2) will be applicable in developing design storm discharges for the site. Since the site has been historically discharging into Thomas Rd., being a part of the flood plain, the City allows the same drainage pattern so long the pre vs. post hydrology is not exceeded. The proposed site will be captured by grate inlets and be allowed to discharge via storm drain into the existing storm drain that is in Thomas Rd. See **Exhibit 1** for proposed drainage areas and **Appendix C** for inlet calculations. Based on the improvements Phase 1, of the site will discharge to the existing storm drain that is in Thomas Rd. Along the west side of property line for improvements being done in Phase 1 a swale will need to be graded on the City of Scottsdale's property to direct runoff from the City of Scottsdale's property away from the northern site, Phase 1. The remainder of the site, Phase 2, will discharge into Thomas Rd via sheet flow at a rate of 8.31 cfs. The new discharge flow rate is significantly lower than the pre discharge rate mentioned early. A typical C-value of 0.95 is used for the on-site impervious areas and a C-value of 0.45 is used for desert landscape areas in accordance with the City of Scottsdale's *Design Standards and Policies Manual* (Reference 1).

The proposed site is graded so that the off-site flow from Pima Rd will not inundate the northern site, Phase 1. See **Exhibit 2** for the grading and drainage plans for the proposed site. The northern driveway along Pima Rd has a proposed grade of 1229.00 at the property line and a high water elevation of 1228.85 was determined from the post-development HEC-RAS model ran by Hubbard Engineering. See **Table 1** below for results of the approved post-development vs pre-development water surface elevations and **Section 3.2** for additional information on the HEC-RAS models and methodology used for the models. A proposed wall will be constructed as shown in **Exhibit 2** between the northern driveway and the southern driveway along Pima Rd. The proposed top of wall at the north driveway will have an elevation of 1229. The wall will continue on at an elevation of 1229 until the wall reaches the north side of the southern driveway. The adjacent high water elevation along the entire wall has been determined to be lower than 1229. See **Exhibit 3** for River Mile cross sections mentioned in **Table 1**. The southern driveway along Pima Rd will allow inundation of the high water elevation but not on the property of Phase 1. The grades adjacent to the property of Phase 1 located near the southern driveway have been raised so that the high water elevation will not inundate the northern site, Phase 1. The grades near the driveway have a proposed elevation of 1228.25 at the property line. The adjacent high water elevation was also determined to be lower. Just south of the southern driveway the high water elevation will inundate the southern site, Phase 2 as shown on **Exhibit 2**. The proposed wall along the north side of the Phase 2 site will keep the water from inundating the northern site along with having the entrances along the south side by having elevations as shown on **Exhibit 2**. The high water elevation along the south side of the site was determined to be 1227.96 from the post-development HEC-RAS model run by Hubbard Engineering. The emergency outfall for the DA-A is located at the southwest corner of the site at an elevation of 1227.15. See approved

CLOMR for additional information also, see **Exhibit 1**. As shown in **Exhibit 2** the floodplain is kept off of the proposed northern site, Phase 1.

Table 1: Post-Development vs. Pre-Development Results

Post Project Model Comparison to Pre Project Model

Cross Section ID	FIS WSE	Duplicate Model WSE	Corrected Effective WSE	Pre Project WSE	Post Project WSE	Difference
Original Model	[NAVD 88]	[NAVD 88]	[NAVD 88]	[NAVD 88]	[NAVD 88]	
	[1]	[2]	[3]	[4]	[5]	[5] - [4]
2.355	28.58	28.59	28.86	28.89	28.85	-0.04
<b>2.342</b>			28.71	28.78	28.55	-0.23
<b>2.335</b>			28.66	28.68	28.53	-0.15
2.295	27.30	27.31	28.02	28.14	28.23	0.09
<b>2.275</b>			27.83	27.95	28.02	0.07
<b>2.269</b>			27.51	27.87	27.96	0.09
<b>2.256</b>			27.41	27.85	27.90	0.05
<b>2.243</b>			27.12	27.54	27.52	-0.02
2.218	26.14	26.25	26.26	26.17	26.17	0.00
2.208	25.88	25.92	25.92	25.82	25.82	0.00

WSE=Water Surface Elevation

Vertical Datum NAVD 88

- 2.355 Existing Cross Sections
- 2.342** Proposed Cross Sections

### 3.2 CLOMR Methodology and Study Results

The study of the re-grading and proposed construction of a wall to re-delineate the floodplain was done using HEC-RAS, Version 4.1.0 from the Army Corps of Engineers. The original HEC-2 data was obtained from the FCD of Maricopa County records [Effective Model] and converted to HEC-RAS [Duplicate Effective Model]. The existing water surface elevations from the original HEC-2 data were then compared to the HEC-RAS [Duplicate Effective Model] water surface elevations and were within 0.5-feet of the reported water surface elevations. These results can be seen in the **Table 1** located in the Request For CLOMR report done by Hubbard Engineering and is approved by the City of Scottsdale. The [Duplicate Effective Model] was then used to create the [Corrected Effective Model]. When creating the [Corrected Effective Model] it was determined that the original topography used in the FDS done by Entellus was the Maricopa County topography. The topography was flown with contours at 1 foot intervals. As part of this project, Hubbard Engineering went out and surveyed the site and surrounding area with ground survey that had a vertical tolerance of 3/4-inch. The new topography was incorporated into the

[Corrected Effective Model] along with additional cross sections and extensions of the existing cross section between river stations **2.218** to **2.355** to ensure adequate coverage of flows on the geometry.

Up to this point all the models were run using the flows determined in the current FDS study which can be found in **Appendix A** and is also located in the Request For CLOMR report approved by the City of Scottsdale and done by Hubbard Engineering. The flows that were determined in the current FDS study did not account for the existing storm drain system in Pima Road. It was determined that the existing storm drain system originated a significant distance upstream from the project site. The distance was significant enough to incorporate the flows that the existing storm drain system in Pima Road was taking on before the offsite flow approached the project site. With the assistance and coordination of the City of Scottsdale's engineering consultant, a flow rate of 50.5 cfs was determined for the Granite Reef Watershed Project as described in more detail in **Section 5.3** which is located in the approved Request For CLOMR report done by Hubbard Engineering. The storm drain capacity of 50.5 cfs was determined to be a conservative flow rate to be removed by the existing storm drain system. See **Appendix B** of the approved Request For CLOMR report done by Hubbard Engineering for local storm drain flows. This flow was then subtracted from the original flow of 644 cfs at river station **2.355** and 1,240 cfs at river station **2.218** and was then used in modeling the HEC-RAS [Pre-Project Existing Conditions Model] and the [Post-Project Proposed Conditions Model]. The study results from the [Pre-Project Existing Conditions Model] and the [Post-Project Proposed Conditions Model] were compared and analyzed. The [Post-Project Proposed Conditions Model] showed a rise in the base flood elevations of less than 1-foot. See **Tables 1 through 4** located in the approved Request For CLOMR report done by Hubbard Engineering for the water surface elevation results from the corresponding HEC-RAS models. See **Appendices C through G** which are located in the approved Request For CLOMR report done by Hubbard Engineering for all data associated with the HEC-RAS models, or **Appendix A** which is also located in the approved Request For CLOMR report done by Hubbard Engineering for the original reference data. Refer to the approved Request For CLOMR report done by Hubbard Engineering for additional information on the HEC-RAS models.

### **3.3 Proposed Drainage System**

The proposed site is split into 2-major drainage areas. See **Exhibit 1**. Drainage area DA-A, Phase 1 conveys the storm water via surface flow to grate inlets which will be connected with storm pipe. The proposed storm drain system used the Rational Method to determine peak flows for each drainage area. Refer to **Appendix B and C** for calculations. The site will drain from the north to the south through a storm drain system, which will tie into an existing catch basin located at the southeast driveway along Thomas Rd. The storm drain pipe will capture the 100-yr, 2-hr storm event per the City of Scottsdale's *Design Standards and Policies Manual* (Reference 1) requirements. See **Appendix E** storm drain calculations. A small portion of DA-A will be stored in RB-1. RB-1 will also act as a swale and add additional capacity that is needed to keep the water surface elevation within the required tolerances mentioned in the approved Request For CLOMR report done by Hubbard Engineering. The storm water will convey via sheet flow to the proposed retention basin.

The second major drainage area is DA-B, Phase 2. See **Exhibit 1**. The storm water is conveyed via surface flow to Thomas Rd. as it has been historically discharging. The southern site labeled as “Phase 2” will discharge through the south driveways along at a flow rate of 8.31 cfs as previously mentioned.

### 3.4 Storm Water Storage

As previously mentioned a small portion of DA-A will be stored in RB-1. The storm water will convey via sheet flow to the proposed retention basin RB-1. The proposed basin will have 6:1 side slopes as shown in the **Exhibit 2** and have a depth of 0.85 feet. The required volume that the retention basin must hold per City of Scottsdale’s *Design Standards and Policies Manual* (Reference 1) is 821 cubic feet. The proposed retention basin will provide 3,231 cubic feet of water. The basin will not require any drywells see drain time calculations in **Appendix D**. In the case that the retention basin reaches an elevation higher than 1225.85 the water will drain into a catch basin and drain through the storm drain system shown in **Exhibit 1**. The retention required and retention provided calculations can be found in **Appendix D**.

For storm events that exceed the 100-year, 2-hour event, or for back-to-back events that inundate the retention facilities, the storm water will cascade toward the low outfall of the site, Phase 1. The ultimate outfall is located at the southwest corner of the site at an elevation of 1227.15 ft. See **Exhibit 1**. The ultimate outfall for Phase 2 is the south driveways at an elevation of 1225.90.

### 3.5 Finish Floor Elevations

The site is split into Lot 1 and Lot 2. The approved CLOMR for the project takes the flood plain out of Lot 1 so there are no requirements for the proposed finish floors that pertain to the new flood plain. The 2 proposed retail pads in Lot 2 will be in the new flood plain. The CLOMR modeling has incorporated the proposed building footprints within the flood plain determination. Based on the model, the adjacent water surface elevation will be 1,227.96. The proposed finish floor elevations of the 2 retail pads will need to be a minimum of 1,229.00 in order to meet the 1’ above water surface elevation requirement.

## **4. SPECIAL CONDITIONS**

### **4.1 Section 404 & 401**

The site is not delineated as a 404 & 401 jurisdiction.

### **4.2 AZPDES**

More than one acre of land will be disturbed and will require an AZPDES permit.

### **4.3 ESL**

The site does not qualify as an Environmentally Sensitive Land on the City of Scottsdale Environmentally Sensitive Land Inventories.

## **5. DATA ANALYSIS METHODS**

### **5.1 Peak Flows and Stormwater Storage**

Storage for the 100-year, 2-hour and peak flow for the 100-year storm was determined by rational method per COS Requirements. See the associated Appendices for the references and parameters that were used to calculate the storm water flows and required retention.

## 6. SUMMARY AND CONCLUSION

- The project is bound by Thomas Rd to the south, Pima Rd. to the east, City park to the west and a single family residence to the north.
- The proposed development for this site consists of self-storage.
- The site has moved out of the Flood Plain Zone AE.
- The City is in process of designing a new public storm drain in Pima Rd. to mitigate the existing flood plain. This mitigation will have the potential to taking the site, Phase 2 out of the flood plain.
- The majority of the site will convey the 100-yr storm event into storm drain pipe and discharge into the existing storm system south of the site. The remainder of the storm water will discharge via surface flow into Thomas Rd.
- Subject site is currently located in Flood Plain Zone AE per FEMA No. 04013C2235L.

## 7. REFERENCES

1. *Design Standards & Policies Manual Chapter 4 Grading and Drainage, City of Scottsdale, Dated January, 2010.*
2. *Drainage Design Manual For Maricopa County, Arizona, Volume I, Hydrology, Flood Control District Of Maricopa County, February 2011.*
3. *Drainage Design Manual For Maricopa County, Arizona, Volume II, Hydraulics, Flood Control District Of Maricopa County, January 1996.*  
*Flood Insurance Rate Map (F.I.R.M.) Maricopa County, Arizona and Incorporated areas, Panel 2235 of 4425*
4. *Granite Reef Wash FloodPlain Delineation Study (FCD 95-29), Entellus, May 1997.*

## 8. LIMITATIONS

This report is focused on providing practical design information, evaluation, and calculations for statistical flood events up to and including the 100-year frequency flood. The procedures used herein are derived from, and performed with, currently accepted engineering methodologies and practices. Additionally, the criteria for this evaluation is designed to conform to currently applicable ordinances, regulations and policies effected by the appropriate jurisdictional regulatory authorities for the site.

The analysis presented herein focuses on developing design estimates of storm water runoff resulting from a statistical evaluation of storm events of particular duration and frequency up to and including a 100-year frequency event. A storm event exceeding the 100-year frequency event may cause or create the risk of greater flood impact than is addressed and presented herein. However, the scope of this assessment does not include evaluation of storm water runoff resulting from storm events exceeding the 100-year frequency event. Hubbard Engineering assumes no responsibility for actual flood damage, increased risks of flood damage, or increased construction or development cost resulting from or related to any such events. Nor shall Hubbard Engineering be responsible for any changes in, or additions to, regulatory requirements which may result from, or be related to, any such events or changes in hydrologic or hydraulic conditions within the watershed.

In performing the services contained herein, Hubbard Engineering has received or will receive information prepared or compiled by others. Hubbard Engineering, as engineering professionals, are not required to verify the information, but may rely on the information unless actual knowledge concerning the validity of the information is known or is obvious to the professional. Therefore, Hubbard Engineering is entitled to rely upon the accuracy and completeness of this information without independent evaluation or verification.

**Appendix A**  
Reference Data  
*Pima Storage*

**FLOOD CONTROL DISTRICT  
OF MARICOPA COUNTY**  
**FLOOD DELINEATION STUDY OF  
GRANITE REEF WASH**  
 F.C.D. CONTRACT NO. FCD 96-29

**LEGEND**

100-YR FLOODPLAIN BOUNDARY	—
100-YR FLOODWAY BOUNDARY	- - -
HYDRAULIC BASE LINE & RIVER MILE	2.0
CROSS SECTION	FP= 1207.8    0.627 FW= 1207.8    0.1417
ELEVATION REFERENCE MARK	▲ 2
BASE FLOOD ELEVATIONS	1500
ZONE DESIGNATIONS	ZONE AE
CORPORATE LIMITS	Corporate Limits
SECTION LINE	Section Boundary

**ELEVATION REFERENCE MARKS**

NOTE: ALL ELEVATIONS ARE BASED ON NORTH AMERICA VERTICAL DATUM OF 1988

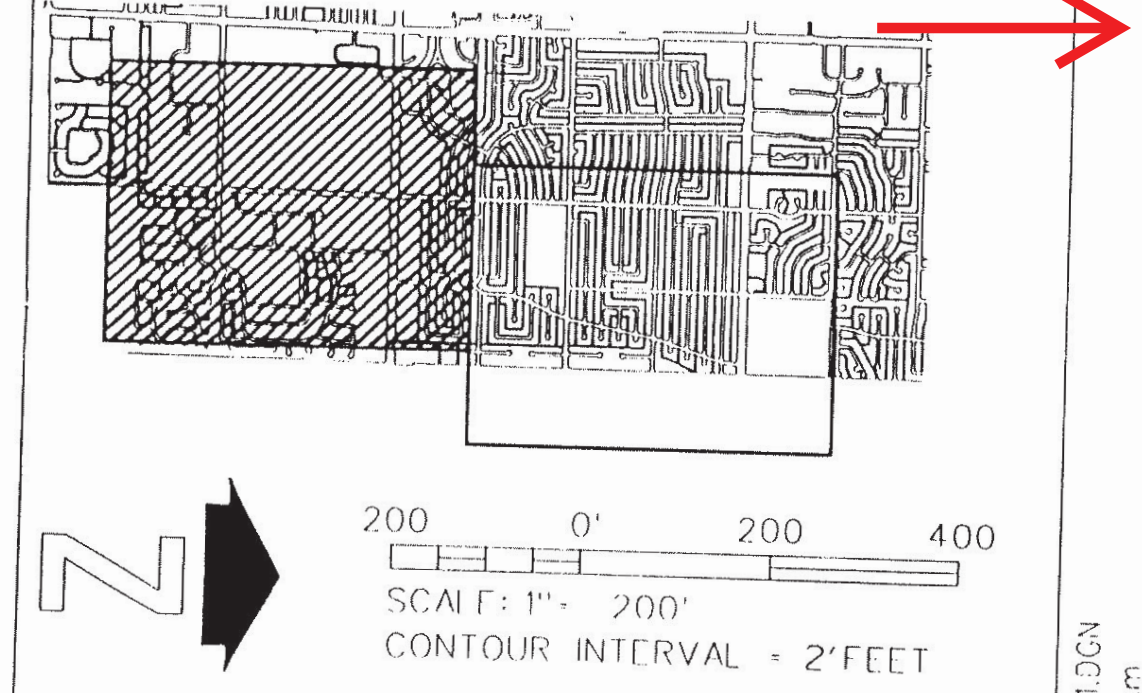
I.D. NUM.	ELEV. (FT)	DESCRIPTION/LOCATION
1	1188.06	ARIZONA DEPARTMENT OF TRANSPORTATION BRASS CAP, AT INTERSECTION OF McKELLIPS ROAD & GRANITE REEF ALIGNMENT
2	1202.70	C.O.S. BRASS CAP IN HAND HOLE INTERSECTION OF ROOSEVELT STREET & GRANITE REEF ROAD.
3	1218.10	MARICOPA COUNTY BRASS CAP, IN HAND HOLE, INTERSECTION OF McDOWELL ROAD & GRANITE REEF ROAD.



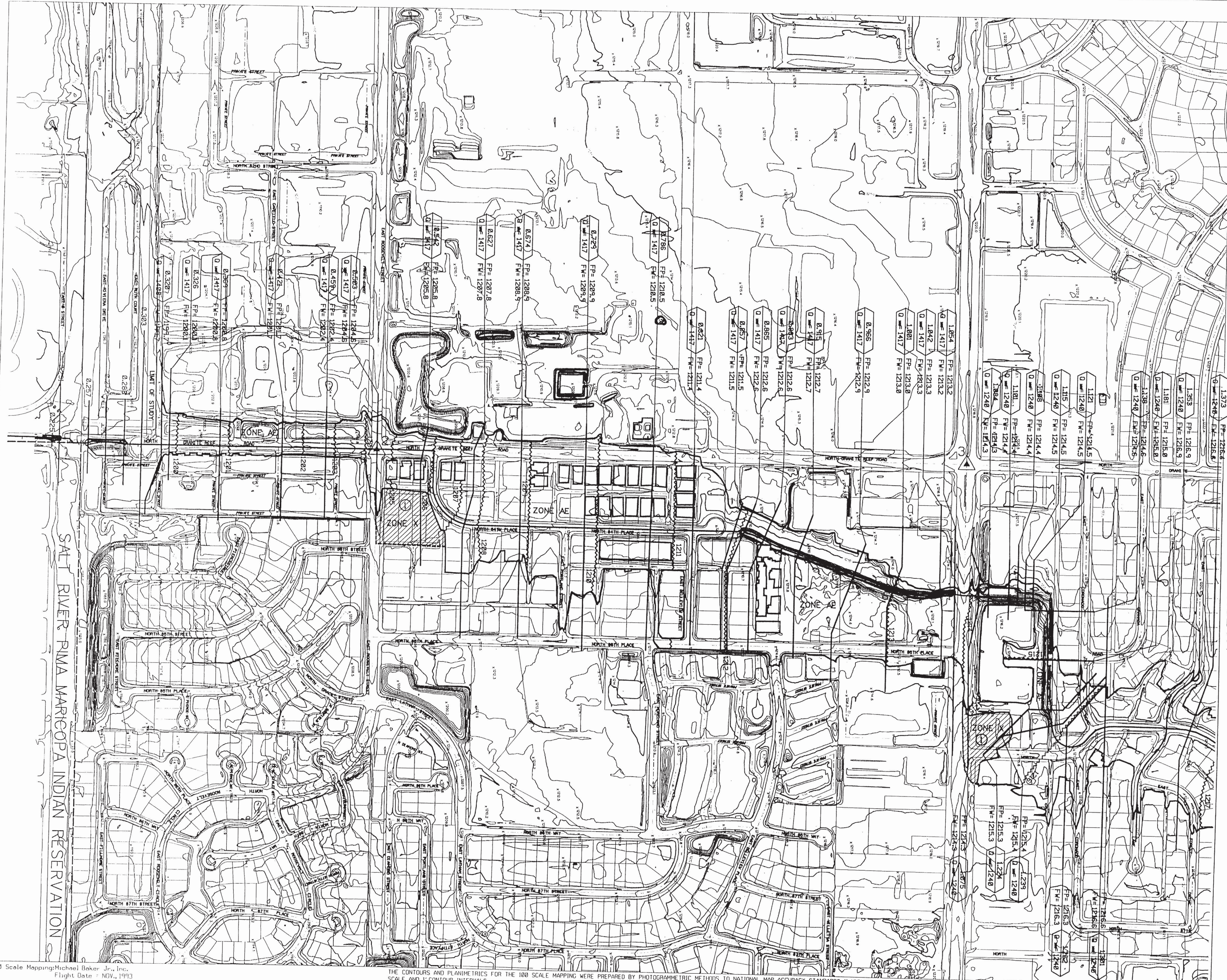
**NOTES**

- ① ZONE X - AREAS OF 100-YEAR FLOOD WITH AVERAGE DEPTHS OF LESS THAN 1 FOOT OR WITH DRAINAGE AREAS LESS THAN 1 SQUARE MILE; AND AREAS PROTECTED BY LEVELS FROM 100 YEAR FLOOD. SEE SPECIAL PROBLEM SECTION

INDEX MAP  
**CONT**



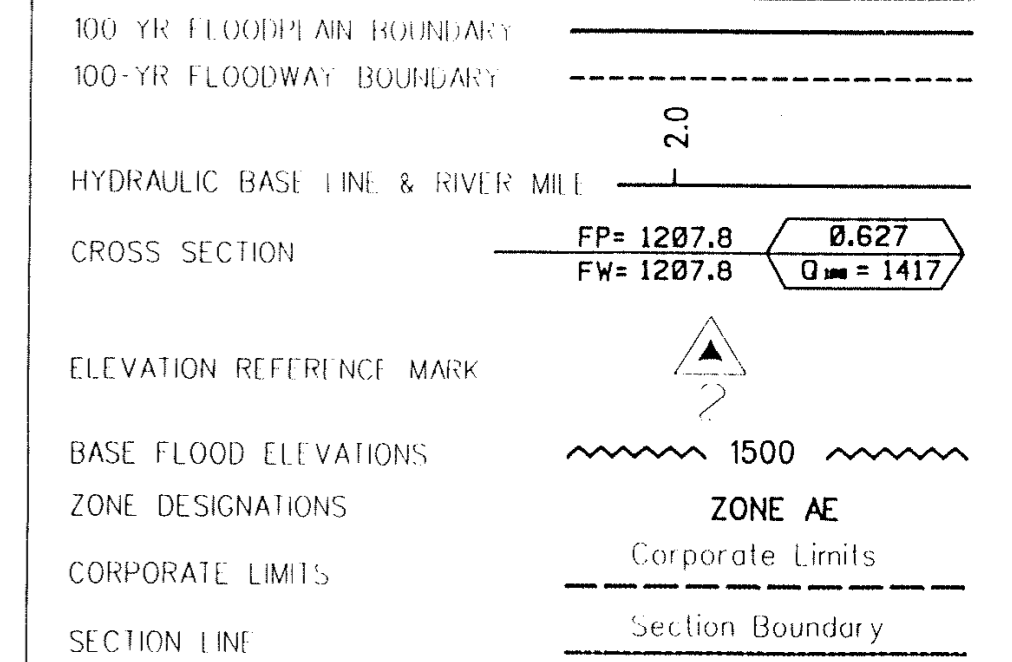
<b>Entellus</b>		2855 N. 44th St., Suite 300 Phoenix, AZ 85018 Phone (602) 844-2666 Fax (602) 844-8047	30.45
DESIGN	BY HAA	DATE 05/97	FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
DESIGN CHK.	SFK	05/97	RECOMMENDED BY: _____ DATE: _____
PLANS	ECES	05/97	APPROVED BY: _____ DATE: _____
PLANS CHK.	HAA	05/97	CHEF ENGINEER AND GENERAL MANAGER
SUBMITTED BY:			SHEET 1 OF 2



100 Scale Mapping: Michael Baker Jr., Inc.  
Flight Date - NOV., 1993

THE CONTOURS AND PLANIMETRICS FOR THE 100 SCALE MAPPING WERE PREPARED BY PHOTOGRAMMETRIC METHODS TO NATIONAL MAP ACCURACY STANDARDS 1"=100' HORIZONTAL SCALE AND 1" CONTOUR INTERVALS.

**FLOOD CONTROL DISTRICT  
OF MARICOPA COUNTY**  
FLOOD DELINEATION STUDY OF  
GRANITE REEF WASH  
F.C.D. CONTRACT NO. FCD 96-29  
11 (1) (1) (1) (1)



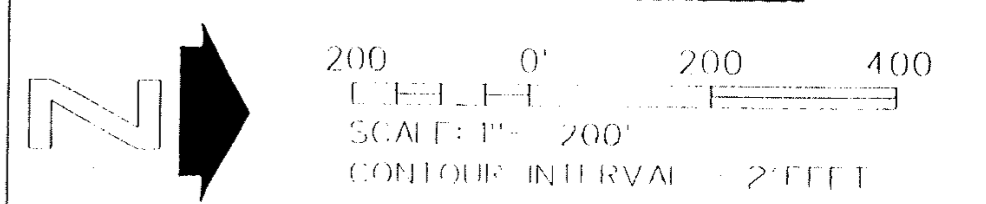
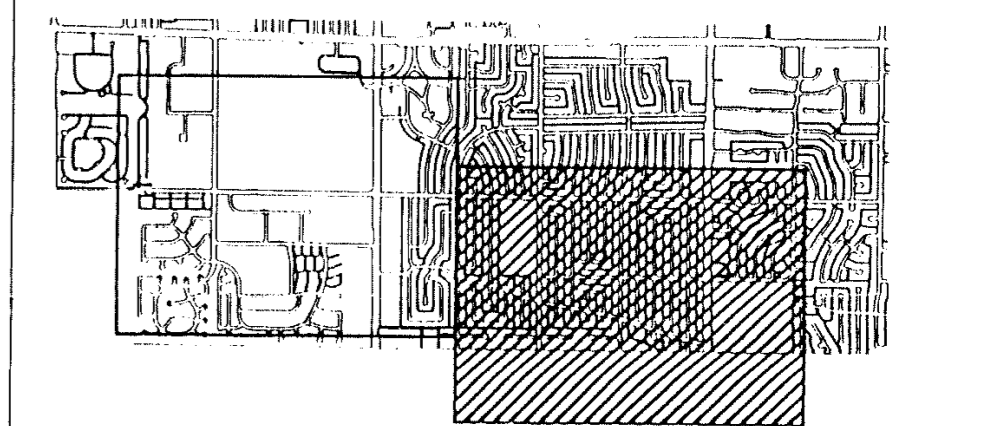
**ELEVATION REFERENCE MARKS**  
NOTE: ALL ELEVATIONS ARE BASED ON NORTH AMERICA VERTICAL DATUM OF 1985

I.D. NUM.	ELEV. (FT)	DESCRIPTION/LOCATION
4	1227.01	MARICOPA COUNTY BRASS CAP IN HAND HOLE INTERSECTION OF OAK STREET & GRANITE REEF ROAD.
5	1226.12	C.O.P. BRASS CAP IN HAND HOLE INTERSECTION OF THOMAS ROAD & PRIMA ROAD.
6	1232.73	C.O.S. BRASS CAP IN HAND HOLE INTERSECTION OF THOMAS ROAD & GRANITE REEF ROAD.

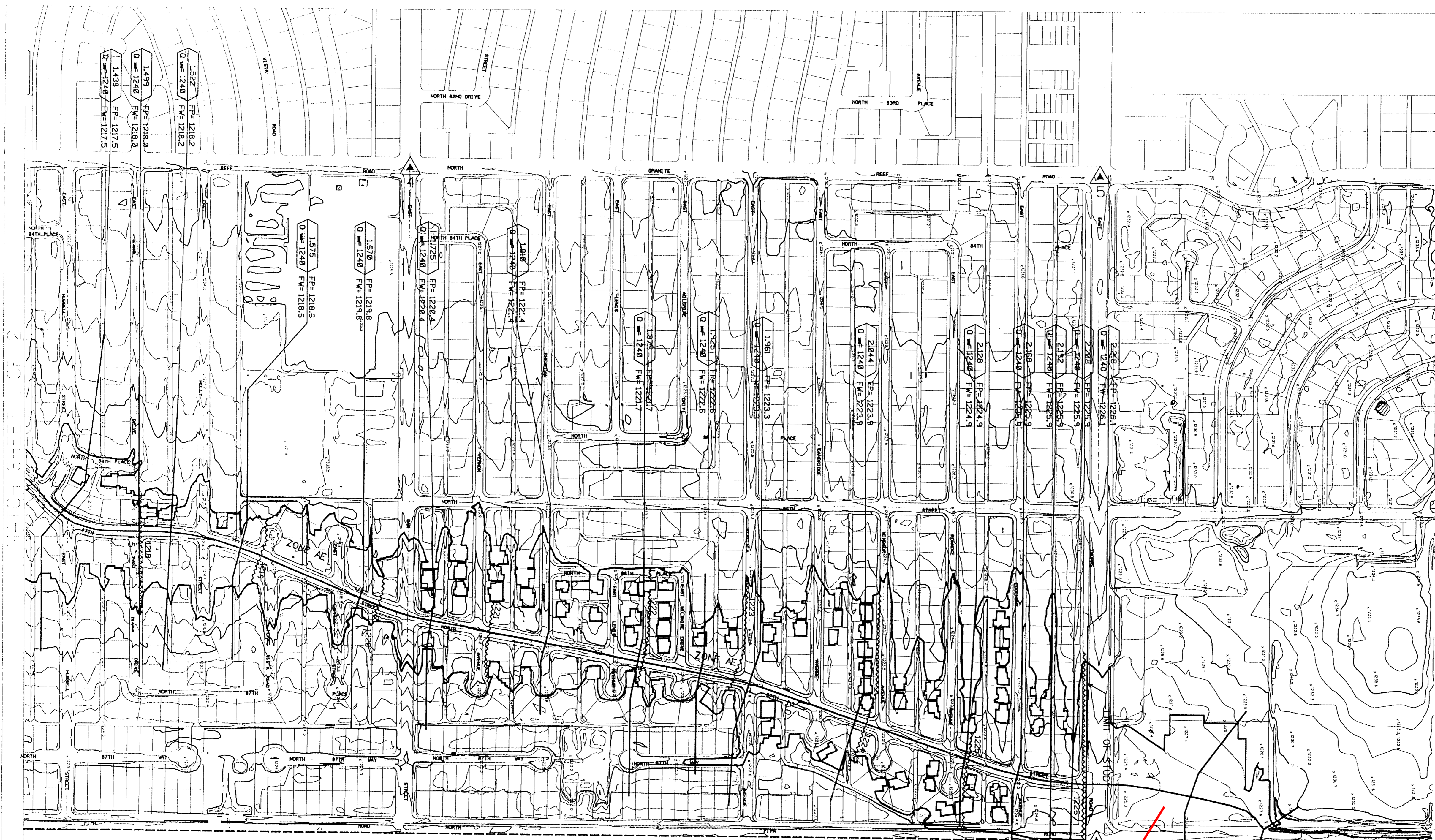


**NOTES**

**INDEX MAP**



		2255 N. 44th St., Suite 330 Phoenix, AZ 85006 Phone (602) 244-2599 Fax (602) 244-8977	
DESIGN	BY: HAA	DATE: 05/97	FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
DESIGN CHK.	SEK	05/97	
PLANS	LCLS	05/97	
PLANS CHK.	HAA	05/97	
SUBMITTED BY:	DATE:	APPROVED BY:	DATE:
		CHECKED BY: AND CENTRAL MANAGER:	



**SITE**

FP= 1228.6  
FW= 1228.6  
Q= 644

FP= 1227.3  
FW= 1227.3  
Q= 644

FP= 1227.3  
FW= 1227.3  
Q= 644

100 Scale Mapping: Michael Baker, Jr., Inc.  
Flight Date: Fall, 1993

THE CONTOURS AND ELEVATION MARKS FOR THE 100 SCALE MAPPING WERE PREPARED BY PHOTOGRAMMETRIC METHODS TO NATIONAL MAP ACCURACY STANDARDS 1" HORIZONTAL SCALE AND 1" VERTICAL SCALE.

Drawn: 05/97  
 Date: 05/97  
 Rev: 05/97  
 1-UP-2021  
 2/1/2021

**Appendix B**  
Rational Peak Flow Calculations  
*Pima Storage*

**HYDROLOGIC DESIGN DATA SHEET  
RATIONAL METHOD  
Hubbard Engineering  
Project No. 15138**

**Concentration Point ID: DA-1**

**Project Name:** Pima Storage  
**Project No.:** 15138

**Prepared by:** BAH  
**Revised by:**

**Date:** 10/12/16  
**Date:**

**Location Data**

City of

State: Arizona                      County: Maricopa                      Jurisdiction: Scottsdale

**Design Data**

Design Frequency:	100	[yrs]	Flow Path Length (L)=	158.00	[ft]
Check Frequency:	50	[yrs]	Elevation <sub>Max</sub> :	29.00	[ft]
Check Frequency:	10	[yrs]	Elevation <sub>Min</sub> :	27.35	[ft]
Drainage Area (A)=	0.53	[acres]	Elevation <sub>Difference</sub> :	1.65	[ft]
			Flow Path Slope <sub>Average</sub> (S)=	0.01044	[ft/ft]

**Watershed Characteristics**

Hydrologic Soil Group: --  
Vegetation Cover: <25 [%]  
Classification Type: A (Reference, Table 3.1, Page 3-3)

**Rational Method Computations**

Time of Concentration, (T<sub>c</sub>)<sup>(2)</sup>:  
T<sub>c</sub> = 11.4\*L0.5\*K<sub>b</sub>0.52\*S-0.31\*i-0.38+Time to Retention

L	[mi]	K <sub>b</sub> =m Log A + b
S	[ft/mi]	m= -0.00625
i	[in/hr]	b= 0.04
		A = Area [acres]

Frequency				T <sub>c</sub>	i
[yr]	m	b	K <sub>b</sub>	[min]	[in/hr]
10	-0.00625	0.04	0.041745	4.0	4.72
50	-0.00625	0.04	0.041745	3.0	6.6
100	-0.00625	0.04	0.041745	3.0	7.48

Peak Discharge (Q):  
Q = C<sub>1</sub>\*i<sup>3</sup>\*A                      [cfs]

A	[acres]
i <sup>3</sup>	[in/hr]
C <sup>1</sup>	Runoff Coefficient
	C <sub>10</sub> <sup>(3)</sup> = 0.90
	C <sub>50</sub> <sup>(3)</sup> = 0.93
	C <sub>100</sub> <sup>(3)</sup> = 0.95

**Q<sub>10</sub> = 2.23 [cfs]**  
**Q<sub>50</sub> = 3.23 [cfs]**  
**Q<sub>100</sub> = 3.74 [cfs]**

**Reference:**

1. Scottsdale Drainage Design Policy
2. Flood Control District of Maricopa County Drainage Design Manual, Hydrology
3. NOAA Atlas 14, Volume, Version 5, Maricopa Station ID 02-5270

**HYDROLOGIC DESIGN DATA SHEET**  
**RATIONAL METHOD**  
**Hubbard Engineering**  
**Project No. 15138**

**Concentration Point ID: DA-2**

**Project Name:** Pima Storage  
**Project No.:** 15138

**Prepared by:** BAH  
**Revised by:**

**Date:** 10/12/16  
**Date:**

**Location Data**

City of

State: Arizona                      County: Maricopa                      Jurisdiction: Scottsdale

**Design Data**

Design Frequency:	100	[yrs]	Flow Path Length (L)=	227.00	[ft]
Check Frequency:	50	[yrs]	Elevation <sub>Max</sub> :	31.00	[ft]
Check Frequency:	10	[yrs]	Elevation <sub>Min</sub> :	27.60	[ft]
Drainage Area (A)=	0.67	[acres]	Elevation <sub>Difference</sub> :	3.40	[ft]
			Flow Path Slope <sub>Average</sub> (S)=	0.01498	[ft/ft]

**Watershed Characteristics**

Hydrologic Soil Group: --  
Vegetation Cover: <25 [%]  
Classification Type: A (Reference, Table 3.1, Page 3-3)

**Rational Method Computations**

Time of Concentration, (T<sub>c</sub>)<sup>(2)</sup>:  
T<sub>c</sub> = 11.4\*L0.5\*K<sub>b</sub>0.52\*S-0.31\*i-0.38+Time to Retention

L	[mi]	K <sub>b</sub> =m Log A + b
S	[ft/mi]	m= -0.00625
i	[in/hr]	b= 0.04
		A = Area [acres]

Frequency				T <sub>c</sub>	i
[yr]	m	b	K <sub>b</sub>	[min]	[in/hr]
10	-0.00625	0.04	0.04108	4.0	4.72
50	-0.00625	0.04	0.04108	3.0	6.6
100	-0.00625	0.04	0.04108	3.0	7.48

Peak Discharge (Q):  
Q = C<sub>1</sub>\*i<sup>3</sup>\*A                      [cfs]

A                      [acres]  
i<sup>3</sup>                      [in/hr]  
C<sup>1</sup>                      Runoff Coefficient  
C<sub>10</sub><sup>(3)</sup> = 0.90  
C<sub>50</sub><sup>(3)</sup> = 0.93  
C<sub>100</sub><sup>(3)</sup> = 0.95

**Q<sub>10</sub> = 2.85 [cfs]**  
**Q<sub>50</sub> = 4.12 [cfs]**  
**Q<sub>100</sub> = 4.77 [cfs]**

**Reference:**

1. Scottsdale Drainage Design Policy
2. Flood Control District of Maricopa County Drainage Design Manual, Hydrology
3. NOAA Atlas 14, Volume, Version 5, Maricopa Station ID 02-5270

**HYDROLOGIC DESIGN DATA SHEET**  
**RATIONAL METHOD**  
**Hubbard Engineering**  
**Project No. 15138**

**Concentration Point ID: DA-3**

**Project Name:** Pima Storage  
**Project No.:** 15138

**Prepared by:** BAH  
**Revised by:**

**Date:** 10/12/16  
**Date:**

**Location Data**

City of

State: Arizona                      County: Maricopa                      Jurisdiction: Scottsdale

**Design Data**

Design Frequency:	100	[yrs]	Flow Path Length (L)=	55.00	[ft]
Check Frequency:	50	[yrs]	Elevation <sub>Max</sub> :	28.27	[ft]
Check Frequency:	10	[yrs]	Elevation <sub>Min</sub> :	27.70	[ft]
Drainage Area (A)=	0.08	[acres]	Elevation <sub>Difference</sub> :	0.57	[ft]
			Flow Path Slope <sub>Average</sub> (S)=	0.01036	[ft/ft]

**Watershed Characteristics**

Hydrologic Soil Group: --  
Vegetation Cover: <25 [%]  
Classification Type: A (Reference, Table 3.1, Page 3-3)

**Rational Method Computations**

Time of Concentration, (Tc)<sup>(2)</sup>:  
Tc = 11.4\*L0.5\*Kb0.52\*S-0.31\*i-0.38+Time to Retention

L	[mi]	Kb=m Log A + b
S	[ft/mi]	m= -0.00625
i	[in/hr]	b= 0.04
		A = Area [acres]

Frequency				T <sub>c</sub>	i
[yr]	m	b	K <sub>b</sub>	[min]	[in/hr]
10	-0.00625	0.04	0.046743	2.0	4.72
50	-0.00625	0.04	0.046743	2.0	6.6
100	-0.00625	0.04	0.046743	2.0	7.48

Peak Discharge (Q):  
Q = C<sub>1</sub>\*i<sup>3</sup>\*A                      [cfs]

A	[acres]
i <sup>3</sup>	[in/hr]
C <sup>1</sup>	Runoff Coefficient
	C <sub>10</sub> <sup>(3)</sup> = 0.90
	C <sub>50</sub> <sup>(3)</sup> = 0.93
	C <sub>100</sub> <sup>(3)</sup> = 0.95

**Q<sub>10</sub> = 0.35 [cfs]**  
**Q<sub>50</sub> = 0.51 [cfs]**  
**Q<sub>100</sub> = 0.59 [cfs]**

**Reference:**

1. Scottsdale Drainage Design Policy
2. Flood Control District of Maricopa County Drainage Design Manual, Hydrology
3. NOAA Atlas 14, Volume 5, Maricopa Station ID 02-5270

**HYDROLOGIC DESIGN DATA SHEET  
RATIONAL METHOD  
Hubbard Engineering  
Project No. 15138**

**Concentration Point ID: DA-4**

**Project Name:** Pima Storage  
**Project No.:** 15138

**Prepared by:** BAH  
**Revised by:**

**Date:** 10/12/16  
**Date:**

**Location Data**

State: Arizona                      County: Maricopa                      City of  
Jurisdiction: Scottsdale

**Design Data**

Design Frequency:	100	[yrs]	Flow Path Length (L)=	36.50	[ft]
Check Frequency:	50	[yrs]	Elevation <sub>Max</sub> :	28.27	[ft]
Check Frequency:	10	[yrs]	Elevation <sub>Min</sub> :	27.70	[ft]
Drainage Area (A)=	0.07	[acres]	Elevation <sub>Difference</sub> :	0.57	[ft]
			Flow Path Slope <sub>Average</sub> (S)=	0.01562	[ft/ft]

**Watershed Characteristics**

Hydrologic Soil Group: --  
Vegetation Cover: <25 [%]  
Classification Type: A (Reference, Table 3.1, Page 3-3)

**Rational Method Computations**

Time of Concentration, (T<sub>c</sub>)<sup>(2)</sup>:  
T<sub>c</sub> = 11.4\*L0.5\*K<sub>b</sub>0.52\*S-0.31\*i-0.38+Time to Retention

L [mi]                      K<sub>b</sub>=m Log A + b  
S [ft/mi]                      m= -0.00625  
i [in/hr]                      b= 0.04  
A = Area [acres]

Frequency				T <sub>c</sub>	i
[yr]	m	b	K <sub>b</sub>	[min]	[in/hr]
10	-0.00625	0.04	0.047201	2.0	4.72
50	-0.00625	0.04	0.047201	1.0	6.6
100	-0.00625	0.04	0.047201	1.0	7.48

Peak Discharge (Q):  
Q = C<sub>i</sub>\*i\*A                      [cfs]

A [acres]  
i<sup>3</sup> [in/hr]  
C<sup>1</sup>      Runoff Coefficient  
C<sub>10</sub><sup>(3)</sup> = 0.90  
C<sub>50</sub><sup>(3)</sup> = 0.93  
C<sub>100</sub><sup>(3)</sup> = 0.95

**Q<sub>10</sub> = 0.30 [cfs]**  
**Q<sub>50</sub> = 0.43 [cfs]**  
**Q<sub>100</sub> = 0.50 [cfs]**

**Reference:**

1. Scottsdale Drainage Design Policy
2. Flood Control District of Maricopa County Drainage Design Manual, Hydrology
3. NOAA Atlas 14, Volume, Version 5, Maricopa Station ID 02-5270

**HYDROLOGIC DESIGN DATA SHEET  
RATIONAL METHOD  
Hubbard Engineering  
Project No. 15138**

**Concentration Point ID: DA-5**

**Project Name:** Pima Storage  
**Project No.:** 15138

**Prepared by:** BAH  
**Revised by:**

**Date:** 10/12/16  
**Date:**

**Location Data**

State: Arizona                      County: Maricopa                      City of  
Jurisdiction: Scottsdale

**Design Data**

Design Frequency:	100	[yrs]	Flow Path Length (L)=	41.50	[ft]
Check Frequency:	50	[yrs]	Elevation <sub>Max</sub> :	28.27	[ft]
Check Frequency:	10	[yrs]	Elevation <sub>Min</sub> :	27.70	[ft]
Drainage Area (A)=	0.07	[acres]	Elevation <sub>Difference</sub> :	0.57	[ft]
			Flow Path Slope <sub>Average</sub> (S)=	0.01373	[ft/ft]

**Watershed Characteristics**

Hydrologic Soil Group: --  
Vegetation Cover: <25 [%]  
Classification Type: A (Reference, Table 3.1, Page 3-3)

**Rational Method Computations**

Time of Concentration, (Tc)<sup>(2)</sup>:  
Tc = 11.4\*L0.5\*Kb0.52\*S-0.31\*i-0.38+Time to Retention

L	[mi]	Kb=m Log A + b
S	[ft/mi]	m= -0.00625
i	[in/hr]	b= 0.04
		A = Area [acres]

Frequency				T <sub>c</sub>	i
[yr]	m	b	K <sub>b</sub>	[min]	[in/hr]
10	-0.00625	0.04	0.047261	2.0	4.72
50	-0.00625	0.04	0.047261	2.0	6.6
100	-0.00625	0.04	0.047261	2.0	7.48

Peak Discharge (Q):  
Q = C<sub>i</sub>\*i\*A                      [cfs]

A	[acres]
i <sup>3</sup>	[in/hr]
C <sup>1</sup>	Runoff Coefficient
	C <sub>10</sub> <sup>(3)</sup> = 0.90
	C <sub>50</sub> <sup>(3)</sup> = 0.93
	C <sub>100</sub> <sup>(3)</sup> = 0.95

**Q<sub>10</sub> = 0.29 [cfs]**  
**Q<sub>50</sub> = 0.42 [cfs]**  
**Q<sub>100</sub> = 0.49 [cfs]**

**Reference:**

1. Scottsdale Drainage Design Policy
2. Flood Control District of Maricopa County Drainage Design Manual, Hydrology
3. NOAA Atlas 14, Volume, Version 5, Maricopa Station ID 02-5270

**HYDROLOGIC DESIGN DATA SHEET**  
**RATIONAL METHOD**  
**Hubbard Engineering**  
**Project No. 15138**

**Concentration Point ID: DA-6**

**Project Name:** Pima Storage  
**Project No.:** 15138

**Prepared by:** BAH  
**Revised by:**

**Date:** 10/12/16  
**Date:**

**Location Data**

City of

State: Arizona                      County: Maricopa                      Jurisdiction: Scottsdale

**Design Data**

Design Frequency:	100	[yrs]	Flow Path Length (L)=	213.00	[ft]
Check Frequency:	50	[yrs]	Elevation <sub>Max</sub> :	30.20	[ft]
Check Frequency:	10	[yrs]	Elevation <sub>Min</sub> :	27.00	[ft]
Drainage Area (A)=	0.23	[acres]	Elevation <sub>Difference</sub> :	3.20	[ft]
			Flow Path Slope <sub>Average</sub> (S)=	0.01502	[ft/ft]

**Watershed Characteristics**

Hydrologic Soil Group: --  
Vegetation Cover: <25 [%]  
Classification Type: A (Reference, Table 3.1, Page 3-3)

**Rational Method Computations**

Time of Concentration, (Tc)<sup>(2)</sup>:  
Tc = 11.4\*L0.5\*Kb0.52\*S-0.31\*i-0.38+Time to Retention

L	[mi]	Kb=m Log A + b
S	[ft/mi]	m= -0.00625
i	[in/hr]	b= 0.04
		A = Area [acres]

Frequency				T <sub>c</sub>	i
[yr]	m	b	K <sub>b</sub>	[min]	[in/hr]
10	-0.00625	0.04	0.043974	4.0	4.72
50	-0.00625	0.04	0.043974	3.0	6.6
100	-0.00625	0.04	0.043974	3.0	7.48

Peak Discharge (Q):  
Q = C<sup>1</sup>\*i\*A                      [cfs]

A                      [acres]  
i<sup>3</sup>                      [in/hr]  
C<sup>1</sup>                      Runoff Coefficient  
C<sub>10</sub><sup>(3)</sup> = 0.90  
C<sub>50</sub><sup>(3)</sup> = 0.93  
C<sub>100</sub><sup>(3)</sup> = 0.95

**Q<sub>10</sub> = 0.98 [cfs]**  
**Q<sub>50</sub> = 1.42 [cfs]**  
**Q<sub>100</sub> = 1.64 [cfs]**

**Reference:**

1. Scottsdale Drainage Design Policy
2. Flood Control District of Maricopa County Drainage Design Manual, Hydrology
3. NOAA Atlas 14, Volume, Version 5, Maricopa Station ID 02-5270

**HYDROLOGIC DESIGN DATA SHEET**  
**RATIONAL METHOD**  
**Hubbard Engineering**  
**Project No. 15138**

**Concentration Point ID: DA-7A**

**Project Name:** Pima Storage  
**Project No.:** 15138

**Prepared by:** BAH  
**Revised by:**

**Date:** 10/12/16  
**Date:**

**Location Data**

City of

State: Arizona                      County: Maricopa                      Jurisdiction: Scottsdale

**Design Data**

Design Frequency:	100	[yrs]	Flow Path Length (L)=	82.60	[ft]
Check Frequency:	50	[yrs]	Elevation <sub>Max</sub> :	28.12	[ft]
Check Frequency:	10	[yrs]	Elevation <sub>Min</sub> :	27.60	[ft]
Drainage Area (A)=	0.24	[acres]	Elevation <sub>Difference</sub> :	0.52	[ft]
			Flow Path Slope <sub>Average</sub> (S)=	0.00630	[ft/ft]

**Watershed Characteristics**

Hydrologic Soil Group: --  
Vegetation Cover: <25 [%]  
Classification Type: A (Reference, Table 3.1, Page 3-3)

**Rational Method Computations**

Time of Concentration, (T<sub>c</sub>)<sup>(2)</sup>:  
T<sub>c</sub> = 11.4\*L0.5\*K<sub>b</sub>0.52\*S-0.31\*i-0.38+Time to Retention

L	[mi]	K <sub>b</sub> =m Log A + b
S	[ft/mi]	m= -0.00625
i	[in/hr]	b= 0.04
		A = Area [acres]

Frequency				T <sub>c</sub>	i
[yr]	m	b	K <sub>b</sub>	[min]	[in/hr]
10	-0.00625	0.04	0.043871	3.0	4.72
50	-0.00625	0.04	0.043871	3.0	6.6
100	-0.00625	0.04	0.043871	3.0	7.48

Peak Discharge (Q):  
Q = C<sub>1</sub>\*i\*A                      [cfs]

A                      [acres]  
i<sup>3</sup>                      [in/hr]  
C<sup>1</sup>                      Runoff Coefficient  
C<sub>10</sub><sup>(3)</sup> = 0.90  
C<sub>50</sub><sup>(3)</sup> = 0.93  
C<sub>100</sub><sup>(3)</sup> = 0.95

**Q<sub>10</sub> = 1.02 [cfs]**  
**Q<sub>50</sub> = 1.47 [cfs]**  
**Q<sub>100</sub> = 1.71 [cfs]**

**Reference:**

1. Scottsdale Drainage Design Policy
2. Flood Control District of Maricopa County Drainage Design Manual, Hydrology
3. NOAA Atlas 14, Volume, Version 5, Maricopa Station ID 02-5270

**HYDROLOGIC DESIGN DATA SHEET**  
**RATIONAL METHOD**  
**Hubbard Engineering**  
**Project No. 15138**

**Concentration Point ID: DA-7B**

**Project Name:** Pima Storage  
**Project No.:** 15138

**Prepared by:** BAH  
**Revised by:**

**Date:** 10/12/16  
**Date:**

**Location Data**

City of

State: Arizona                      County: Maricopa                      Jurisdiction: Scottsdale

**Design Data**

Design Frequency:	100	[yrs]	Flow Path Length (L)=	72.00	[ft]
Check Frequency:	50	[yrs]	Elevation <sub>Max</sub> :	28.93	[ft]
Check Frequency:	10	[yrs]	Elevation <sub>Min</sub> :	27.50	[ft]
Drainage Area (A)=	0.19	[acres]	Elevation <sub>Difference</sub> :	1.43	[ft]
			Flow Path Slope <sub>Average</sub> (S)=	0.01986	[ft/ft]

**Watershed Characteristics**

Hydrologic Soil Group: --  
Vegetation Cover: <25 [%]  
Classification Type: A (Reference, Table 3.1, Page 3-3)

**Rational Method Computations**

Time of Concentration, (T<sub>c</sub>)<sup>(2)</sup>:  
T<sub>c</sub> = 11.4\*L0.5\*K<sub>b</sub>0.52\*S-0.31\*i-0.38+Time to Retention

L	[mi]	K <sub>b</sub> =m Log A + b
S	[ft/mi]	m= -0.00625
i	[in/hr]	b= 0.04
		A = Area [acres]

Frequency				T <sub>c</sub>	i
[yr]	m	b	K <sub>b</sub>	[min]	[in/hr]
10	-0.00625	0.04	0.044525	2.0	4.72
50	-0.00625	0.04	0.044525	2.0	6.6
100	-0.00625	0.04	0.044525	2.0	7.48

Peak Discharge (Q):  
Q = C<sub>1</sub>\*i<sub>3</sub>\*A                      [cfs]

A                      [acres]  
i<sup>3</sup>                      [in/hr]  
C<sup>1</sup>                      Runoff Coefficient  
C<sub>10</sub><sup>(3)</sup> = 0.90  
C<sub>50</sub><sup>(3)</sup> = 0.93  
C<sub>100</sub><sup>(3)</sup> = 0.95

**Q<sub>10</sub> = 0.80 [cfs]**  
**Q<sub>50</sub> = 1.16 [cfs]**  
**Q<sub>100</sub> = 1.34 [cfs]**

**Reference:**

1. Scottsdale Drainage Design Policy
2. Flood Control District of Maricopa County Drainage Design Manual, Hydrology
3. NOAA Atlas 14, Volume, Version 5, Maricopa Station ID 02-5270

**HYDROLOGIC DESIGN DATA SHEET**  
**RATIONAL METHOD**  
**Hubbard Engineering**  
**Project No. 15138**

**Concentration Point ID: DA-8**

**Project Name:** Pima Storage  
**Project No.:** 15138

**Prepared by:** BAH  
**Revised by:**

**Date:** 10/12/16  
**Date:**

**Location Data**

City of

State: Arizona                      County: Maricopa                      Jurisdiction: Scottsdale

**Design Data**

Design Frequency:	100	[yrs]	Flow Path Length (L)=	45.00	[ft]
Check Frequency:	50	[yrs]	Elevation <sub>Max</sub> :	28.90	[ft]
Check Frequency:	10	[yrs]	Elevation <sub>Min</sub> :	27.90	[ft]
Drainage Area (A)=	0.10	[acres]	Elevation <sub>Difference</sub> :	1.00	[ft]
			Flow Path Slope <sub>Average</sub> (S)=	0.02222	[ft/ft]

**Watershed Characteristics**

Hydrologic Soil Group: --  
Vegetation Cover: <25 [%]  
Classification Type: A (Reference, Table 3.1, Page 3-3)

**Rational Method Computations**

Time of Concentration, (T<sub>c</sub>)<sup>(2)</sup>:  
T<sub>c</sub> = 11.4\*L0.5\*K<sub>b</sub>0.52\*S-0.31\*i-0.38+Time to Retention

L	[mi]	K <sub>b</sub> =m Log A + b
S	[ft/mi]	m= -0.00625
i	[in/hr]	b= 0.04
		A = Area [acres]

Frequency				T <sub>c</sub>	i
[yr]	m	b	K <sub>b</sub>	[min]	[in/hr]
10	-0.00625	0.04	0.046317	2.0	4.72
50	-0.00625	0.04	0.046317	1.0	6.6
100	-0.00625	0.04	0.046317	1.0	7.48

Peak Discharge (Q):  
Q = C<sub>1</sub>\*i<sub>3</sub>\*A                      [cfs]

A                      [acres]  
i<sup>3</sup>                      [in/hr]  
C<sup>1</sup>                      Runoff Coefficient  
C<sub>10</sub><sup>(3)</sup> = 0.90  
C<sub>50</sub><sup>(3)</sup> = 0.93  
C<sub>100</sub><sup>(3)</sup> = 0.95

**Q<sub>10</sub> = 0.41 [cfs]**  
**Q<sub>50</sub> = 0.60 [cfs]**  
**Q<sub>100</sub> = 0.69 [cfs]**

**Reference:**

1. Scottsdale Drainage Design Policy
2. Flood Control District of Maricopa County Drainage Design Manual, Hydrology
3. NOAA Atlas 14, Volume, Version 5, Maricopa Station ID 02-5270

**HYDROLOGIC DESIGN DATA SHEET  
RATIONAL METHOD  
Hubbard Engineering  
Project No. 15138**

**Concentration Point ID: DA-9**

**Project Name:** Pima Storage  
**Project No.:** 15138

**Prepared by:** BAH  
**Revised by:**

**Date:** 10/12/16  
**Date:**

**Location Data**

City of

State: Arizona                      County: Maricopa                      Jurisdiction: Scottsdale

**Design Data**

Design Frequency:	100	[yrs]	Flow Path Length (L)=	167.00	[ft]
Check Frequency:	50	[yrs]	Elevation <sub>Max</sub> :	28.20	[ft]
Check Frequency:	10	[yrs]	Elevation <sub>Min</sub> :	27.90	[ft]
Drainage Area (A)=	0.17	[acres]	Elevation <sub>Difference</sub> :	0.30	[ft]
			Flow Path Slope <sub>Average</sub> (S)=	0.00180	[ft/ft]

**Watershed Characteristics**

Hydrologic Soil Group: --  
Vegetation Cover: <25 [%]  
Classification Type: A (Reference, Table 3.1, Page 3-3)

**Rational Method Computations**

Time of Concentration, (Tc)<sup>(2)</sup>:  
Tc = 11.4\*L0.5\*Kb0.52\*S-0.31\*i-0.38+Time to Retention

L	[mi]	Kb=m Log A + b
S	[ft/mi]	m= -0.00625
i	[in/hr]	b= 0.04
		A = Area [acres]

Frequency				T <sub>c</sub>	i
[yr]	m	b	K <sub>b</sub>	[min]	[in/hr]
10	-0.00625	0.04	0.04485	7.0	4.2
50	-0.00625	0.04	0.04485	6.0	6.3
100	-0.00625	0.04	0.04485	6.0	7.04

Peak Discharge (Q):  
Q = C<sub>i</sub>\*i\*A                      [cfs]

A                      [acres]  
i<sup>3</sup>                      [in/hr]  
C<sup>1</sup>                      Runoff Coefficient  
C<sub>10</sub><sup>(3)</sup> =    0.90  
C<sub>50</sub><sup>(3)</sup> =    0.93  
C<sub>100</sub><sup>(3)</sup> =    0.95

**Q<sub>10</sub> = 0.63 [cfs]**  
**Q<sub>50</sub> = 0.97 [cfs]**  
**Q<sub>100</sub> = 1.12 [cfs]**

**Reference:**

1. Scottsdale Drainage Design Policy
2. Flood Control District of Maricopa County Drainage Design Manual, Hydrology
3. NOAA Atlas 14, Volume, Version 5, Maricopa Station ID 02-5270

**HYDROLOGIC DESIGN DATA SHEET**  
**RATIONAL METHOD**  
**Hubbard Engineering**  
**Project No. 15138**

**Concentration Point ID: DA-10**

**Project Name:** Pima Storage  
**Project No.:** 15138

**Prepared by:** BAH  
**Revised by:**

**Date:** 10/12/16  
**Date:**

**Location Data**

City of

State: Arizona                      County: Maricopa                      Jurisdiction: Scottsdale

**Design Data**

Design Frequency:	100	[yrs]	Flow Path Length (L)=	153.00	[ft]
Check Frequency:	50	[yrs]	Elevation <sub>Max</sub> :	28.20	[ft]
Check Frequency:	10	[yrs]	Elevation <sub>Min</sub> :	27.90	[ft]
Drainage Area (A)=	0.10	[acres]	Elevation <sub>Difference</sub> :	0.30	[ft]
			Flow Path Slope <sub>Average</sub> (S)=	0.00196	[ft/ft]

**Watershed Characteristics**

Hydrologic Soil Group: --  
Vegetation Cover: <25 [%]  
Classification Type: A (Reference, Table 3.1, Page 3-3)

**Rational Method Computations**

Time of Concentration, (T<sub>c</sub>)<sup>(2)</sup>:  
T<sub>c</sub> = 11.4\*L0.5\*K<sub>b</sub>0.52\*S-0.31\*i-0.38+Time to Retention

L	[mi]	K <sub>b</sub> =m Log A + b
S	[ft/mi]	m= -0.00625
i	[in/hr]	b= 0.04
		A = Area [acres]

Frequency				T <sub>c</sub>	i
[yr]	m	b	K <sub>b</sub>	[min]	[in/hr]
10	-0.00625	0.04	0.046233	6.0	4.44
50	-0.00625	0.04	0.046233	6.0	6.3
100	-0.00625	0.04	0.046233	5.0	7.48

Peak Discharge (Q):  
Q = C<sub>1</sub>\*i<sup>3</sup>\*A                      [cfs]

A                      [acres]  
i<sup>3</sup>                      [in/hr]  
C<sup>1</sup>                      Runoff Coefficient  
C<sub>10</sub><sup>(3)</sup> = 0.90  
C<sub>50</sub><sup>(3)</sup> = 0.93  
C<sub>100</sub><sup>(3)</sup> = 0.95

**Q<sub>10</sub> = 0.40 [cfs]**  
**Q<sub>50</sub> = 0.58 [cfs]**  
**Q<sub>100</sub> = 0.72 [cfs]**

**Reference:**

1. Scottsdale Drainage Design Policy
2. Flood Control District of Maricopa County Drainage Design Manual, Hydrology
3. NOAA Atlas 14, Volume, Version 5, Maricopa Station ID 02-5270

**HYDROLOGIC DESIGN DATA SHEET**  
**RATIONAL METHOD**  
**Hubbard Engineering**  
**Project No. 15138**

**Concentration Point ID: DA-11**

**Project Name:** Pima Storage  
**Project No.:** 15138

**Prepared by:** BAH  
**Revised by:**

**Date:** 10/12/16  
**Date:**

**Location Data**

City of

State: Arizona                      County: Maricopa                      Jurisdiction: Scottsdale

**Design Data**

Design Frequency:	100	[yrs]	Flow Path Length (L)=	153.00	[ft]
Check Frequency:	50	[yrs]	Elevation <sub>Max</sub> :	28.30	[ft]
Check Frequency:	10	[yrs]	Elevation <sub>Min</sub> :	27.90	[ft]
Drainage Area (A)=	0.13	[acres]	Elevation <sub>Difference</sub> :	0.40	[ft]
			Flow Path Slope <sub>Average</sub> (S)=	0.00261	[ft/ft]

**Watershed Characteristics**

Hydrologic Soil Group: --  
Vegetation Cover: <25 [%]  
Classification Type: A (Reference, Table 3.1, Page 3-3)

**Rational Method Computations**

Time of Concentration, (T<sub>c</sub>)<sup>(2)</sup>:  
 $T_c = 11.4 * L^{0.5} * K_b^{0.52} * S^{-0.31} * i^{-0.38} + \text{Time to Retention}$

L	[mi]	K <sub>b</sub> =m Log A + b
S	[ft/mi]	m= -0.00625
i	[in/hr]	b= 0.04
		A = Area [acres]

Frequency				T <sub>c</sub>	i
[yr]	m	b	K <sub>b</sub>	[min]	[in/hr]
10	-0.00625	0.04	0.045489	6.0	4.44
50	-0.00625	0.04	0.045489	5.0	6.6
100	-0.00625	0.04	0.045489	5.0	7.48

Peak Discharge (Q):  
 $Q = C^1 * i^3 * A$                       [cfs]

A                      [acres]  
i<sup>3</sup>                      [in/hr]  
C<sup>1</sup>                      Runoff Coefficient  
C<sub>10</sub><sup>(3)</sup> = 0.90  
C<sub>50</sub><sup>(3)</sup> = 0.93  
C<sub>100</sub><sup>(3)</sup> = 0.95

**Q<sub>10</sub> = 0.53 [cfs]**  
**Q<sub>50</sub> = 0.81 [cfs]**  
**Q<sub>100</sub> = 0.94 [cfs]**

**Reference:**

1. Scottsdale Drainage Design Policy
2. Flood Control District of Maricopa County Drainage Design Manual, Hydrology
3. NOAA Atlas 14, Volume, Version 5, Maricopa Station ID 02-5270

**HYDROLOGIC DESIGN DATA SHEET  
RATIONAL METHOD  
Hubbard Engineering  
Project No. 15138**

**Concentration Point ID: DA-12**

**Project Name:** Pima Storage  
**Project No.:** 15138

**Prepared by:** BAH  
**Revised by:**

**Date:** 10/12/16  
**Date:**

**Location Data**

City of

State: Arizona                      County: Maricopa                      Jurisdiction: Scottsdale

**Design Data**

Design Frequency:	100	[yrs]	Flow Path Length (L)=	156.00	[ft]
Check Frequency:	50	[yrs]	Elevation <sub>Max</sub> :	28.30	[ft]
Check Frequency:	10	[yrs]	Elevation <sub>Min</sub> :	27.90	[ft]
Drainage Area (A)=	0.13	[acres]	Elevation <sub>Difference</sub> :	0.40	[ft]
			Flow Path Slope <sub>Average</sub> (S)=	0.00256	[ft/ft]

**Watershed Characteristics**

Hydrologic Soil Group: --  
Vegetation Cover: <25 [%]  
Classification Type: A (Reference, Table 3.1, Page 3-3)

**Rational Method Computations**

Time of Concentration, (T<sub>c</sub>)<sup>(2)</sup>:  
T<sub>c</sub> = 11.4\*L0.5\*K<sub>b</sub>0.52\*S-0.31\*i-0.38+Time to Retention

L	[mi]	K <sub>b</sub> =m Log A + b
S	[ft/mi]	m= -0.00625
i	[in/hr]	b= 0.04
		A = Area [acres]

Frequency				T <sub>c</sub>	i
[yr]	m	b	K <sub>b</sub>	[min]	[in/hr]
10	-0.00625	0.04	0.045444	6.0	4.44
50	-0.00625	0.04	0.045444	5.0	6.6
100	-0.00625	0.04	0.045444	5.0	7.48

Peak Discharge (Q):  
Q = C<sub>1</sub>\*i<sub>3</sub>\*A                      [cfs]

A                      [acres]  
i<sup>3</sup>                      [in/hr]  
C<sup>1</sup>                      Runoff Coefficient  
C<sub>10</sub><sup>(3)</sup> =            0.90  
C<sub>50</sub><sup>(3)</sup> =            0.93  
C<sub>100</sub><sup>(3)</sup> =           0.95

**Q<sub>10</sub> = 0.54 [cfs]**  
**Q<sub>50</sub> = 0.83 [cfs]**  
**Q<sub>100</sub> = 0.96 [cfs]**

**Reference:**

1. Scottsdale Drainage Design Policy
2. Flood Control District of Maricopa County Drainage Design Manual, Hydrology
3. NOAA Atlas 14, Volume, Version 5, Maricopa Station ID 02-5270

**HYDROLOGIC DESIGN DATA SHEET**  
**RATIONAL METHOD**  
**Hubbard Engineering**  
**Project No. 15138**

**Concentration Point ID: DA-13**

**Project Name:** Pima Storage  
**Project No.:** 15138

**Prepared by:** BAH  
**Revised by:**

**Date:** 10/12/16  
**Date:**

**Location Data**

City of

State: Arizona                      County: Maricopa                      Jurisdiction: Scottsdale

**Design Data**

Design Frequency:	100	[yrs]	Flow Path Length (L)=	153.00	[ft]
Check Frequency:	50	[yrs]	Elevation <sub>Max</sub> :	28.30	[ft]
Check Frequency:	10	[yrs]	Elevation <sub>Min</sub> :	27.90	[ft]
Drainage Area (A)=	0.13	[acres]	Elevation <sub>Difference</sub> :	0.40	[ft]
			Flow Path Slope <sub>Average</sub> (S)=	0.00261	[ft/ft]

**Watershed Characteristics**

Hydrologic Soil Group: --  
Vegetation Cover: <25 [%]  
Classification Type: A (Reference, Table 3.1, Page 3-3)

**Rational Method Computations**

Time of Concentration, (T<sub>c</sub>)<sup>(2)</sup>:  
T<sub>c</sub> = 11.4\*L0.5\*K<sub>b</sub>0.52\*S-0.31\*i-0.38+Time to Retention

L	[mi]	K <sub>b</sub> =m Log A + b
S	[ft/mi]	m= -0.00625
i	[in/hr]	b= 0.04
		A = Area [acres]

Frequency				T <sub>c</sub>	i
[yr]	m	b	K <sub>b</sub>	[min]	[in/hr]
10	-0.00625	0.04	0.045447	6.0	4.44
50	-0.00625	0.04	0.045447	5.0	6.6
100	-0.00625	0.04	0.045447	5.0	7.48

Peak Discharge (Q):  
Q = C<sub>1</sub>\*i\*A                      [cfs]

A                      [acres]  
i<sup>3</sup>                      [in/hr]  
C<sup>1</sup>                      Runoff Coefficient  
C<sub>10</sub><sup>(3)</sup> = 0.90  
C<sub>50</sub><sup>(3)</sup> = 0.93  
C<sub>100</sub><sup>(3)</sup> = 0.95

**Q<sub>10</sub> = 0.54 [cfs]**  
**Q<sub>50</sub> = 0.83 [cfs]**  
**Q<sub>100</sub> = 0.96 [cfs]**

**Reference:**

1. Scottsdale Drainage Design Policy
2. Flood Control District of Maricopa County Drainage Design Manual, Hydrology
3. NOAA Atlas 14, Volume 5, Maricopa Station ID 02-5270

**HYDROLOGIC DESIGN DATA SHEET  
RATIONAL METHOD  
Hubbard Engineering  
Project No. 15138**

**Concentration Point ID: DA-14**

**Project Name:** Pima Storage  
**Project No.:** 15138

**Prepared by:** BAH  
**Revised by:**

**Date:** 10/12/16  
**Date:**

**Location Data**

City of

State: Arizona                      County: Maricopa                      Jurisdiction: Scottsdale

**Design Data**

Design Frequency:	100	[yrs]	Flow Path Length (L)=	155.00	[ft]
Check Frequency:	50	[yrs]	Elevation <sub>Max</sub> :	28.30	[ft]
Check Frequency:	10	[yrs]	Elevation <sub>Min</sub> :	27.75	[ft]
Drainage Area (A)=	0.14	[acres]	Elevation <sub>Difference</sub> :	0.55	[ft]
			Flow Path Slope <sub>Average</sub> (S)=	0.00355	[ft/ft]

**Watershed Characteristics**

Hydrologic Soil Group: --  
Vegetation Cover: <25 [%]  
Classification Type: A (Reference, Table 3.1, Page 3-3)

**Rational Method Computations**

Time of Concentration, (T<sub>c</sub>)<sup>(2)</sup>:  
T<sub>c</sub> = 11.4\*L0.5\*K<sub>b</sub>0.52\*S-0.31\*i-0.38+Time to Retention

L	[mi]	K <sub>b</sub> =m Log A + b
S	[ft/mi]	m= -0.00625
i	[in/hr]	b= 0.04
		A = Area [acres]

Frequency				T <sub>c</sub>	i
[yr]	m	b	K <sub>b</sub>	[min]	[in/hr]
10	-0.00625	0.04	0.045415	5.0	4.72
50	-0.00625	0.04	0.045415	5.0	6.6
100	-0.00625	0.04	0.045415	4.0	7.48

Peak Discharge (Q):  
Q = C<sub>1</sub>\*i<sub>3</sub>\*A                      [cfs]

A                      [acres]  
i<sup>3</sup>                      [in/hr]  
C<sup>1</sup>                      Runoff Coefficient  
C<sub>10</sub><sup>(3)</sup> =    0.90  
C<sub>50</sub><sup>(3)</sup> =    0.93  
C<sub>100</sub><sup>(3)</sup> =    0.95

**Q<sub>10</sub> = 0.58 [cfs]**  
**Q<sub>50</sub> = 0.83 [cfs]**  
**Q<sub>100</sub> = 0.97 [cfs]**

**Reference:**

1. Scottsdale Drainage Design Policy
2. Flood Control District of Maricopa County Drainage Design Manual, Hydrology
3. NOAA Atlas 14, Volume, Version 5, Maricopa Station ID 02-5270

**HYDROLOGIC DESIGN DATA SHEET**  
**RATIONAL METHOD**  
**Hubbard Engineering**  
**Project No. 15138**

**Concentration Point ID: DA-15**

**Project Name:** Pima Storage  
**Project No.:** 15138

**Prepared by:** BAH  
**Revised by:**

**Date:** 10/12/16  
**Date:**

**Location Data**

City of

State: Arizona                      County: Maricopa                      Jurisdiction: Scottsdale

**Design Data**

Design Frequency:	100	[yrs]	Flow Path Length (L)=	166.00	[ft]
Check Frequency:	50	[yrs]	Elevation <sub>Max</sub> :	28.30	[ft]
Check Frequency:	10	[yrs]	Elevation <sub>Min</sub> :	27.75	[ft]
Drainage Area (A)=	0.10	[acres]	Elevation <sub>Difference</sub> :	0.55	[ft]
			Flow Path Slope <sub>Average</sub> (S)=	0.00331	[ft/ft]

**Watershed Characteristics**

Hydrologic Soil Group: --  
Vegetation Cover: <25 [%]  
Classification Type: A (Reference, Table 3.1, Page 3-3)

**Rational Method Computations**

Time of Concentration, (Tc)<sup>(2)</sup>:  
 $T_c = 11.4 * L^{0.5} * K_b^{0.52} * S^{-0.31} * i^{-0.38} + \text{Time to Retention}$

L	[mi]	Kb=m Log A + b
S	[ft/mi]	m= -0.00625
i	[in/hr]	b= 0.04
		A = Area [acres]

Frequency				T <sub>c</sub>	i
[yr]	m	b	K <sub>b</sub>	[min]	[in/hr]
10	-0.00625	0.04	0.046121	6.0	4.44
50	-0.00625	0.04	0.046121	5.0	6.6
100	-0.00625	0.04	0.046121	5.0	7.48

Peak Discharge (Q):  
 $Q = C^1 * i^3 * A$                       [cfs]

A	[acres]
i <sup>3</sup>	[in/hr]
C <sup>1</sup>	Runoff Coefficient
	C <sub>10</sub> <sup>(3)</sup> = 0.90
	C <sub>50</sub> <sup>(3)</sup> = 0.93
	C <sub>100</sub> <sup>(3)</sup> = 0.95

**Q<sub>10</sub>** = 0.42 [cfs]  
**Q<sub>50</sub>** = 0.64 [cfs]  
**Q<sub>100</sub>** = 0.75 [cfs]

**Reference:**

1. Scottsdale Drainage Design Policy
2. Flood Control District of Maricopa County Drainage Design Manual, Hydrology
3. NOAA Atlas 14, Volume, Version 5, Maricopa Station ID 02-5270

**HYDROLOGIC DESIGN DATA SHEET**  
**RATIONAL METHOD**  
**Hubbard Engineering**  
**Project No. 15138**

**Concentration Point ID: DA-16**

**Project Name:** Pima Storage  
**Project No.:** 15138

**Prepared by:** BAH  
**Revised by:**

**Date:** 10/12/16  
**Date:**

**Location Data**

City of

State: Arizona                      County: Maricopa                      Jurisdiction: Scottsdale

**Design Data**

Design Frequency:	100	[yrs]	Flow Path Length (L)=	135.00	[ft]
Check Frequency:	50	[yrs]	Elevation <sub>Max</sub> :	28.00	[ft]
Check Frequency:	10	[yrs]	Elevation <sub>Min</sub> :	26.90	[ft]
Drainage Area (A)=	0.45	[acres]	Elevation <sub>Difference</sub> :	1.10	[ft]
			Flow Path Slope <sub>Average</sub> (S)=	0.00815	[ft/ft]

**Watershed Characteristics**

Hydrologic Soil Group: --  
Vegetation Cover: <25 [%]  
Classification Type: A (Reference, Table 3.1, Page 3-3)

**Rational Method Computations**

Time of Concentration, (T<sub>c</sub>)<sup>(2)</sup>:  
T<sub>c</sub> = 11.4\*L0.5\*K<sub>b</sub>0.52\*S-0.31\*i-0.38+Time to Retention

L	[mi]	K <sub>b</sub> =m Log A + b
S	[ft/mi]	m= -0.00625
i	[in/hr]	b= 0.04
		A = Area [acres]

Frequency				T <sub>c</sub>	i
[yr]	m	b	K <sub>b</sub>	[min]	[in/hr]
10	-0.00625	0.04	0.042195	4.0	4.72
50	-0.00625	0.04	0.042195	3.0	6.6
100	-0.00625	0.04	0.042195	3.0	7.48

Peak Discharge (Q):  
Q = C<sub>1</sub>\*i\*A                      [cfs]

A                      [acres]  
i<sup>3</sup>                      [in/hr]  
C<sup>1</sup>                      Runoff Coefficient  
C<sub>10</sub><sup>(3)</sup> = 0.90  
C<sub>50</sub><sup>(3)</sup> = 0.93  
C<sub>100</sub><sup>(3)</sup> = 0.95

**Q<sub>10</sub> = 1.89 [cfs]**  
**Q<sub>50</sub> = 2.73 [cfs]**  
**Q<sub>100</sub> = 3.17 [cfs]**

**Reference:**

1. Scottsdale Drainage Design Policy
2. Flood Control District of Maricopa County Drainage Design Manual, Hydrology
3. NOAA Atlas 14, Volume, Version 5, Maricopa Station ID 02-5270

**HYDROLOGIC DESIGN DATA SHEET  
RATIONAL METHOD  
Hubbard Engineering  
Project No. 15138**

**Concentration Point ID: DA-17**

**Project Name:** Pima Storage  
**Project No.:** 15138

**Prepared by:** BAH  
**Revised by:**

**Date:** 10/12/16  
**Date:**

**Location Data**

State: Arizona                      County: Maricopa                      City of  
Jurisdiction: Scottsdale

**Design Data**

Design Frequency:	100	[yrs]	Flow Path Length (L)=	190.00	[ft]
Check Frequency:	50	[yrs]	Elevation <sub>Max</sub> :	27.75	[ft]
Check Frequency:	10	[yrs]	Elevation <sub>Min</sub> :	26.95	[ft]
Drainage Area (A)=	0.16	[acres]	Elevation <sub>Difference</sub> :	0.80	[ft]
			Flow Path Slope <sub>Average</sub> (S)=	0.00421	[ft/ft]

**Watershed Characteristics**

Hydrologic Soil Group: --  
Vegetation Cover: <25 [%]  
Classification Type: A (Reference, Table 3.1, Page 3-3)

**Rational Method Computations**

Time of Concentration, (Tc)<sup>(2)</sup>:  
Tc = 11.4\*L0.5\*Kb0.52\*S-0.31\*i-0.38+Time to Retention

L	[mi]	Kb=m Log A + b
S	[ft/mi]	m= -0.00625
i	[in/hr]	b= 0.04
		A = Area [acres]

Frequency [yr]	m	b	K <sub>b</sub>	T <sub>c</sub> [min]	i [in/hr]
10	-0.00625	0.04	0.045055	6.0	4.44
50	-0.00625	0.04	0.045055	5.0	6.6
100	-0.00625	0.04	0.045055	5.0	7.48

Peak Discharge (Q):  
Q = C<sub>i</sub>\*i\*A                      [cfs]

A                      [acres]  
i<sup>3</sup>                      [in/hr]  
C<sup>1</sup>                      Runoff Coefficient  
C<sub>10</sub><sup>(3)</sup> = 0.90  
C<sub>50</sub><sup>(3)</sup> = 0.93  
C<sub>100</sub><sup>(3)</sup> = 0.95

**Q<sub>10</sub> = 0.62 [cfs]**  
**Q<sub>50</sub> = 0.95 [cfs]**  
**Q<sub>100</sub> = 1.10 [cfs]**

**Reference:**

1. Scottsdale Drainage Design Policy
2. Flood Control District of Maricopa County Drainage Design Manual, Hydrology
3. NOAA Atlas 14, Volume 5, Maricopa Station ID 02-5270

**HYDROLOGIC DESIGN DATA SHEET**  
**RATIONAL METHOD**  
**Hubbard Engineering**  
**Project No. 15138**

**Concentration Point ID: DA-18**

**Project Name:** Pima Storage  
**Project No.:** 15138

**Prepared by:** BAH  
**Revised by:**

**Date:** 10/12/16  
**Date:**

**Location Data**

City of

State: Arizona                      County: Maricopa                      Jurisdiction: Scottsdale

**Design Data**

Design Frequency:	100	[yrs]	Flow Path Length (L)=	183.00	[ft]
Check Frequency:	50	[yrs]	Elevation <sub>Max</sub> :	27.50	[ft]
Check Frequency:	10	[yrs]	Elevation <sub>Min</sub> :	26.85	[ft]
Drainage Area (A)=	0.22	[acres]	Elevation <sub>Difference</sub> :	0.65	[ft]
			Flow Path Slope <sub>Average</sub> (S)=	0.00355	[ft/ft]

**Watershed Characteristics**

Hydrologic Soil Group: --  
Vegetation Cover: <25 [%]  
Classification Type: A (Reference, Table 3.1, Page 3-3)

**Rational Method Computations**

Time of Concentration, (T<sub>c</sub>)<sup>(2)</sup>:  
T<sub>c</sub> = 11.4\*L0.5\*K<sub>b</sub>0.52\*S-0.31\*i-0.38+Time to Retention

L	[mi]	K <sub>b</sub> =m Log A + b
S	[ft/mi]	m= -0.00625
i	[in/hr]	b= 0.04
		A = Area [acres]

Frequency				T <sub>c</sub>	i
[yr]	m	b	K <sub>b</sub>	[min]	[in/hr]
10	-0.00625	0.04	0.044054	6.0	4.44
50	-0.00625	0.04	0.044054	5.0	6.6
100	-0.00625	0.04	0.044054	5.0	7.48

Peak Discharge (Q):  
Q = C<sub>1</sub>\*i\*A                      [cfs]

A                      [acres]  
i<sup>3</sup>                      [in/hr]  
C<sup>1</sup>                      Runoff Coefficient  
C<sub>10</sub><sup>(3)</sup> = 0.90  
C<sub>50</sub><sup>(3)</sup> = 0.93  
C<sub>100</sub><sup>(3)</sup> = 0.95

**Q<sub>10</sub> = 0.90 [cfs]**  
**Q<sub>50</sub> = 1.38 [cfs]**  
**Q<sub>100</sub> = 1.60 [cfs]**

**Reference:**

1. Scottsdale Drainage Design Policy
2. Flood Control District of Maricopa County Drainage Design Manual, Hydrology
3. NOAA Atlas 14, Volume, Version 5, Maricopa Station ID 02-5270

**HYDROLOGIC DESIGN DATA SHEET**  
**RATIONAL METHOD**  
**Hubbard Engineering**  
**Project No. 15138**

**Concentration Point ID: DA-19**

**Project Name:** Pima Storage  
**Project No.:** 15138

**Prepared by:** BAH  
**Revised by:**

**Date:** 10/12/16  
**Date:**

**Location Data**

City of

State: Arizona                      County: Maricopa                      Jurisdiction: Scottsdale

**Design Data**

Design Frequency:	100	[yrs]	Flow Path Length (L)=	122.00	[ft]
Check Frequency:	50	[yrs]	Elevation <sub>Max</sub> :	28.10	[ft]
Check Frequency:	10	[yrs]	Elevation <sub>Min</sub> :	26.20	[ft]
Drainage Area (A)=	0.21	[acres]	Elevation <sub>Difference</sub> :	1.90	[ft]
			Flow Path Slope <sub>Average</sub> (S)=	0.01557	[ft/ft]

**Watershed Characteristics**

Hydrologic Soil Group: --  
Vegetation Cover: <25 [%]  
Classification Type: A (Reference, Table 3.1, Page 3-3)

**Rational Method Computations**

Time of Concentration, (T<sub>c</sub>)<sup>(2)</sup>:  
T<sub>c</sub> = 11.4\*L0.5\*K<sub>b</sub>0.52\*S-0.31\*i-0.38+Time to Retention

L	[mi]	K <sub>b</sub> =m Log A + b
S	[ft/mi]	m= -0.00625
i	[in/hr]	b= 0.04
		A = Area [acres]

Frequency				T <sub>c</sub>	i
[yr]	m	b	K <sub>b</sub>	[min]	[in/hr]
10	-0.00625	0.04	0.044221	3.0	4.72
50	-0.00625	0.04	0.044221	3.0	6.6
100	-0.00625	0.04	0.044221	2.0	7.48

Peak Discharge (Q):  
Q = C<sub>1</sub>\*i<sup>3</sup>\*A                      [cfs]

A                      [acres]  
i<sup>3</sup>                      [in/hr]  
C<sup>1</sup>                      Runoff Coefficient  
C<sub>10</sub><sup>(3)</sup> = 0.90  
C<sub>50</sub><sup>(3)</sup> = 0.93  
C<sub>100</sub><sup>(3)</sup> = 0.95

**Q<sub>10</sub> = 0.90 [cfs]**  
**Q<sub>50</sub> = 1.30 [cfs]**  
**Q<sub>100</sub> = 1.50 [cfs]**

**Reference:**

1. Scottsdale Drainage Design Policy
2. Flood Control District of Maricopa County Drainage Design Manual, Hydrology
3. NOAA Atlas 14, Volume, Version 5, Maricopa Station ID 02-5270

**HYDROLOGIC DESIGN DATA SHEET**  
**RATIONAL METHOD**  
**Hubbard Engineering**  
**Project No. 15138**

**Concentration Point ID: DA-20**

**Project Name:** Pima Storage  
**Project No.:** 15138

**Prepared by:** BAH  
**Revised by:**

**Date:** 10/12/16  
**Date:**

**Location Data**

City of

State: Arizona                      County: Maricopa                      Jurisdiction: Scottsdale

**Design Data**

Design Frequency:	100	[yrs]	Flow Path Length (L)=	75.00	[ft]
Check Frequency:	50	[yrs]	Elevation <sub>Max</sub> :	27.75	[ft]
Check Frequency:	10	[yrs]	Elevation <sub>Min</sub> :	27.00	[ft]
Drainage Area (A)=	0.08	[acres]	Elevation <sub>Difference</sub> :	0.75	[ft]
			Flow Path Slope <sub>Average</sub> (S)=	0.01000	[ft/ft]

**Watershed Characteristics**

Hydrologic Soil Group: --  
Vegetation Cover: <25 [%]  
Classification Type: A (Reference, Table 3.1, Page 3-3)

**Rational Method Computations**

Time of Concentration, (T<sub>c</sub>)<sup>(2)</sup>:  
T<sub>c</sub> = 11.4\*L0.5\*K<sub>b</sub>0.52\*S-0.31\*i-0.38+Time to Retention

L	[mi]	K <sub>b</sub> =m Log A + b
S	[ft/mi]	m= -0.00625
i	[in/hr]	b= 0.04
		A = Area [acres]

Frequency				T <sub>c</sub>	i
[yr]	m	b	K <sub>b</sub>	[min]	[in/hr]
10	-0.00625	0.04	0.046782	3.0	4.72
50	-0.00625	0.04	0.046782	2.0	6.6
100	-0.00625	0.04	0.046782	2.0	7.48

Peak Discharge (Q):  
Q = C<sub>1</sub>\*i<sup>3</sup>\*A                      [cfs]

A                      [acres]  
i<sup>3</sup>                      [in/hr]  
C<sup>1</sup>                      Runoff Coefficient  
C<sub>10</sub><sup>(3)</sup> = 0.90  
C<sub>50</sub><sup>(3)</sup> = 0.93  
C<sub>100</sub><sup>(3)</sup> = 0.95

**Q<sub>10</sub> = 0.35 [cfs]**  
**Q<sub>50</sub> = 0.50 [cfs]**  
**Q<sub>100</sub> = 0.58 [cfs]**

**Reference:**

1. Scottsdale Drainage Design Policy
2. Flood Control District of Maricopa County Drainage Design Manual, Hydrology
3. NOAA Atlas 14, Volume, Version 5, Maricopa Station ID 02-5270

**Appendix C**  
*Onsite Hydraulic Calculations*  
Pima Storage

**INLETS SUMMARY SHEET**  
**Summary of Inlets**  
**Hubbard Engineering**  
**15138**

**Project Name:** Pima Storage  
**Project No.:** 15138

**Prepared By:** BAH  
**Revised By:** BAH

**Date:** 10/12/16  
**Date:** 02/08/17

Complete calculations for each concentration point are presented in the attached hydrologic calculation sheets.

$$Q=C_w*P*d^{1.5}$$

**Q**=discharge capacity  
**C<sub>w</sub>** = 3.0 weir coefficient  
**P**=inlet perimeter  
**d**=flow depth

Reference 2

**L**=length

Inlet ID	Q <sub>100</sub>	INLET				INLET CAPACITY W / Clogging	CLOGGING FACTOR
		DESCRIPTION	d (ft)	C <sub>w</sub>	P or L (ft)		
I-1	3.74	30" NYLOPLAST-STD	0.65	3	7.85	6.17	50%
I-2	4.77	2-30" NYLOPLAST-STD	0.5	3	15.7	8.33	50%
I-3	0.59	24" NYLOPLAST-STD	0.25	3	6.28	1.18	50%
I-4	0.50	24" NYLOPLAST-STD	0.25	3	6.28	1.18	50%
I-5	0.49	30" NYLOPLAST-STD	0.15	3	7.85	0.68	50%
I-6	1.64	30" NYLOPLAST-STD	0.15	3	7.85	0.68	50%
I-7A	1.71	30" NYLOPLAST-STD	0.3	3	7.85	1.93	50%
I-7B	1.34	30" NYLOPLAST-STD	0.6	3	7.85	5.47	150%
I-8	0.69	24" NYLOPLAST-STD	0.2	3	6.28	0.84	50%
I-9	1.12	30" NYLOPLAST-STD	0.2	3	7.85	1.05	50%
I-10	0.72	30" NYLOPLAST-STD	0.2	3	7.85	1.05	50%
I-11	0.94	30" NYLOPLAST-STD	0.2	3	7.85	1.05	50%
I-12	0.96	30" NYLOPLAST-STD	0.2	3	7.85	1.05	50%
I-13	0.96	30" NYLOPLAST-STD	0.2	3	7.85	1.05	50%
I-14	0.97	30" NYLOPLAST-STD	0.2	3	7.85	1.05	50%
I-15	0.74	30" NYLOPLAST-STD	0.2	3	7.85	1.05	50%
I-16	3.17	2-Type 'F' Catch Basin	0.25	3	17.5	3.28	50%
I-17	1.04	2-30" NYLOPLAST-STD	0.15	3	15.7	1.37	50%
I-18	1.60	2-30" NYLOPLAST-STD	0.15	3	15.7	1.37	50%
I-19	1.50	30" NYLOPLAST-STD	0.25	3	7.85	1.47	50%
I-20	0.58	2-30" NYLOPLAST-STD	0.15	3	15.7	1.37	50%

**Appendix D**  
Retention Dissipation Calculations  
*Pima Storage*

**HYDRAULIC CALCULATION SHEET**  
**Retention Calculations**  
**Hubbard Engineering**  
**Project No. 15138**

**Project Name:** Pima Storage  
**Project No.:** 15138

**Prepared by:** BAH  
**Revised By:**

**Date:** 10/12/16  
**Date:**

**Purpose:** Evaluate the required and provided retention volumes in order to assess conformance to project criteria.

**Methodology:** Calculate the volume of stormwater required to be retained using City of Scottsdale criteria. Calculate the estimated volume of stormwater retained using retention basin geometry.

**Criteria:** Retain the calculated stormwater run-off for the 100-YEAR 2-HOUR duration storm event.

- References:** 1. Scottsdale Drainage Design Policy  
 2. Drainage Design Manual for Maricopa County, Arizona, Volume II: Hydraulics, September 2003.

**Calculations:** Volume Required =  $C_{Composite} * D / 12 * A$  [ft<sup>3</sup>] (Reference 1)

D = 2.2 [in] (Reference 1)

C = 0.45 (Desert landscape) (Reference 1)

$$\text{Composite } C = (C1 * A1 + C2 * A2 + \dots) / (A1 + A2 + \dots)$$

$$\text{Volume Required} = \text{Composite } C * P / 12 * A$$

**Results:**

Identifiers	CALCULATE RETENTION VOLUME REQUIRED		Volume Required		
	Contributory Area ID	Area [acres]	C	[acre-ft]	[ft <sup>3</sup> ]
	DA-21	0.23	0.45	0.02	820.88
<b>Total Area:</b>		<b>0.23</b>	<b>TOTAL VOLUME REQUIRED:</b>	<b>0.02</b>	<b>820.88</b>

# HYDRAULIC CALCULATION SHEET

**Retention Provided  
Hubbard Engineering  
Project No. 15138**

**Project Name:** Pima Storage  
**Project No.:** 15138

**Prepared By:** BAH  
**Revised By:**

**Date:** 10/12/16  
**Date:**

RETENTION BASINS					
Drainage Area	HW Area ft <sup>2</sup>	Bottom ft <sup>2</sup>	H ft	Volume Provided ft <sup>3</sup>	Drainage Areas contributing to Basins
RB-1	4,550.00	3,100.00	0.85	3,231.60	
				0.00	
<b>Total -&gt;</b>				<b>3,231.60</b>	

4,550.00 <= Total Area @ H.W.'s

$$\text{Volume Provided} = H/3 * (A_{H.W.} + A_{BOTTOM} + (A_{H.W.} * A_{BOTTOM})^{0.5})$$

**HYDRAULIC CALCULATION SHEET**  
**Retention Basin Drain Time Calculations**  
**Hubbard Engineering**  
**Project No. 15138**

**Project Name:** Pima Storage  
**Project No.:** 15138

**Prepared by:** BAH  
**Revised by:**

**Date:** 10/12/16  
**Date:**

**Purpose:** Calculate the number of drywells required to facilitate drainage of the required volume within 36 hours.

**Methodology:** Calculate the number of drywells necessary to drain the retention basin within 36 hours, assuming a drywell infiltration rate of 0.1 cfs.

**Criteria:**

1. Drywell drainage capacity must discharge the retention volume provided within 36 hours.
2. Percolation rates obtained from testing performed on the site will be reduced 50% for use in calculations.

**References:**

1. Scottsdale Drainage Design Policy
2. Flood Control District of Maricopa County Drainage Design Manual, Hydrology

**Calculations:**

$$\text{Number of Drywells Required} = V_{\text{DW}} / (\text{Drywell Infiltration Rate} * 3600 * 36 \text{ hours})$$

$$\text{Drywell Infiltration Rate} = 0.1 \quad \text{[cfs]} \quad (\text{Reference 2})$$

**Results:**

Identifiers	Infiltration Drainage Capacity Calculations				V <sub>DW</sub> [ft <sup>3</sup> ]	Number of Drywells Required		
	Retention Basin ID	Volume <sup>(Ref. 1)</sup> Provided [ft <sup>3</sup> ]	Bottom <sup>(Ref. 1)</sup> Area [ft <sup>2</sup> ]	Percolation Rate <sup>(Ref. 2)</sup>			Infiltration Drain Capacity [ft <sup>3</sup> ]	
				Test Location *				[ft <sup>3</sup> /hr/ft <sup>2</sup> ] <sup>2</sup>
1	3,232.0	3,100.0	--	0.10	5580.000	0		
			--	0.00	0.000	0		
			--	0.00	0.000	0		
			--	0.00	0.000	0		
<b>Total Number of Drywells =</b>						<b>0</b>		

**Conclusion:** These calculations indicate that the number of drywells required will adequately drain the calculated volume required from the retention basins within the project criteria. However, no percolation test data was available for use in analyzing the performance of the basins. Therefore, only the drywell infiltration rate was used for the determining the number of drywells. These numbers will be revised when the field data becomes available.

Total Vol. = 3,232.0 [ft<sup>3</sup>]  
D.W. Rate = 0.1 cfs  
1347 seconds  
0.4 Hours (with no surface infiltration)

**Appendix E**  
Storm Drain Calculations  
*Pima Storage*

**HYDROLOGIC CALCULATION SHEET**  
**INFLOW HYDROGRAPH RESULTS**  
**HUBBARD ENGINEERING**  
**Project No.: 15138**

Project Name: Pima Storage  
 Project No.: 15138

Prepared by: BAH  
 Prepared by:

**Purpose:** Determine the inflow hydrograph for the detention basin from the contributing drainage area for a 2-hour duration storm event.

**Methodology:** Inflow hydrograph developed using the 2-hour hypothetical storm distribution developed by the Flood Control District of Maricopa County (Reference 1).

**Criteria:** 100-year frequency, 2-hour duration

- References:** 1. Drainage Design Manual for Maricopa County, Arizona, Volume I: Hydrology, August 2013.  
 2. Design Standards & Policies Manual City of Scottsdale, January 2010

**Calculations:**  $Q = C \cdot i \cdot A$

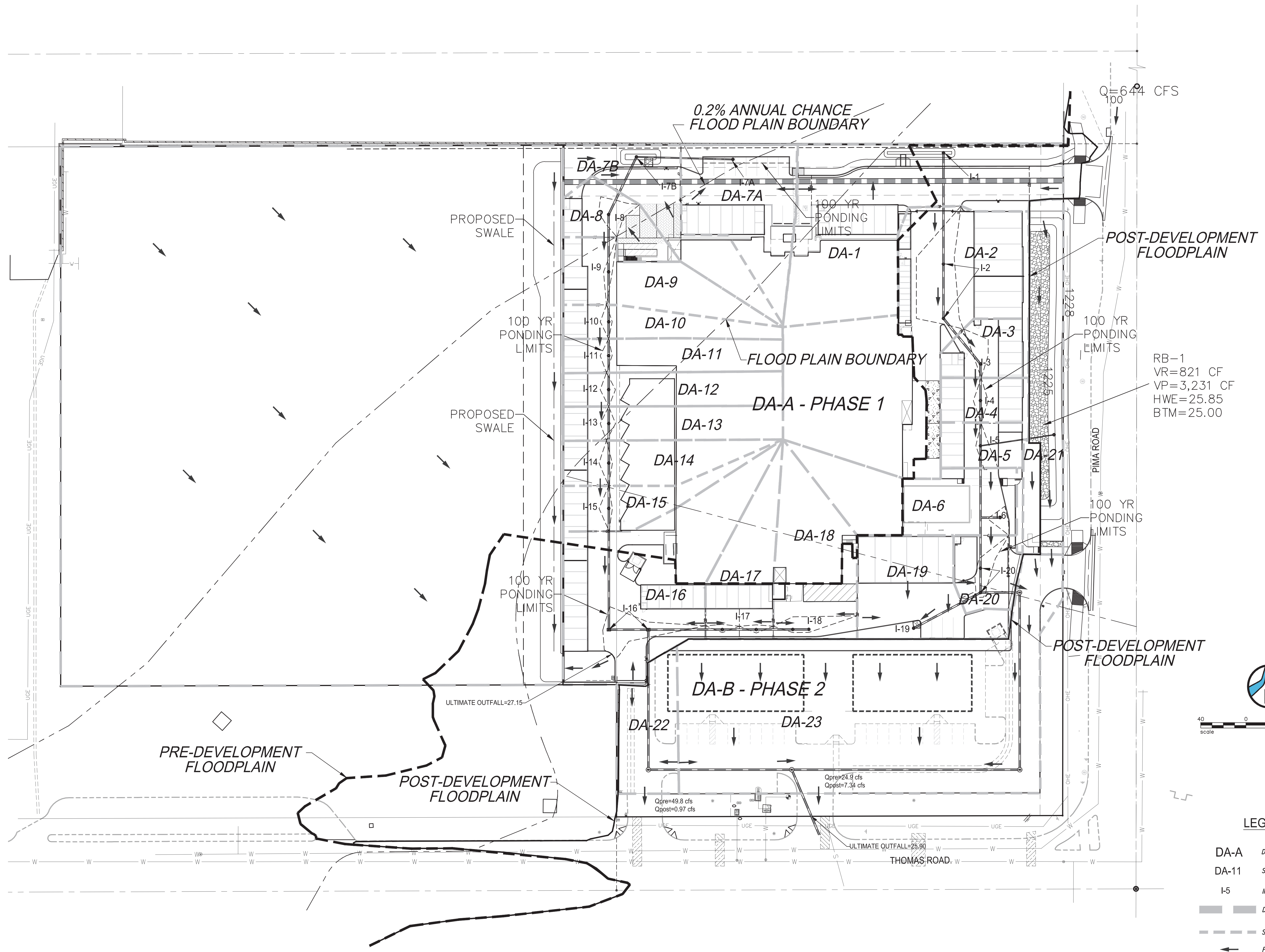
Where:

C = Post-Development Composite Runoff Coefficient  
 i = Rainfall intensity in inches per hour  
 A = Area of contributing sub-basin in acres

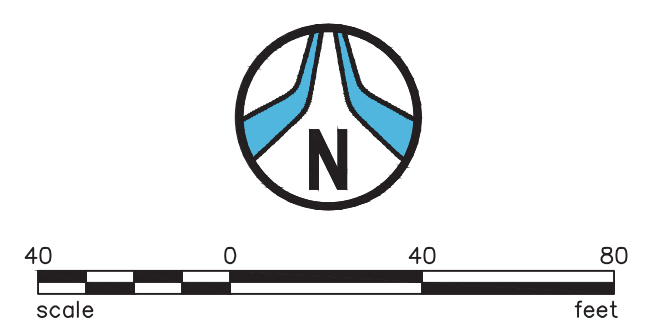
<b>PARCEL</b>					
Return Period	A [acres]	C	I [in/hr]	Q [cfs]	Pipe Volume (cf)
100-Year Post	4.16	0.95	7.48	29.84	3,208.00

<b>INFLOW HYDROGRAPH</b>					
Time (min)	Depth (%)	Q/Qp (%)	Q (Post) (cfs)	Volume (Post) (cf)	Volume (Post) - Pipe Volume (cf)
0	0.000	0.000	0.000	0.000	
2	0.002	0.025	0.746	89.520	-3,118.48
4	0.007	0.087	2.596	311.530	-2,896.47
6	0.020	0.160	4.774	572.928	-2,635.07
8	0.036	0.243	7.251	870.134	-2,337.87
10	0.063	0.346	10.325	1238.957	-1,969.04
12	0.096	0.451	13.458	1614.941	-1,593.06
14	0.136	0.576	17.188	2062.541	-1,145.46
16	0.180	0.738	22.022	2642.630	-565.37
18	0.253	0.887	26.468	3176.170	-31.83
20	0.325	1.000	29.840	3580.800	372.80
22	0.400	0.924	27.572	3308.659	100.66
24	0.464	0.839	25.036	3004.291	-203.71
26	0.523	0.756	22.559	2707.085	-500.92
28	0.578	0.678	20.232	2427.782	-780.22
30	0.627	0.604	18.023	2162.803	-1,045.20
32	0.671	0.545	16.263	1951.536	-1,256.46
34	0.707	0.482	14.383	1725.946	-1,482.05
36	0.742	0.424	12.652	1518.259	-1,689.74
38	0.773	0.372	11.100	1332.058	-1,875.94
40	0.799	0.323	9.638	1156.598	-2,051.40
42	0.841	0.241	7.191	862.973	-2,345.03
44	0.875	0.179	5.341	640.963	-2,567.04
46	0.900	0.136	4.058	486.989	-2,721.01
48	0.917	0.102	3.044	365.242	-2,842.76
50	0.932	0.078	2.328	279.302	-2,928.70
52	0.953	0.049	1.462	175.459	-3,032.54
54	0.965	0.030	0.895	107.424	-3,100.58
56	0.973	0.020	0.597	71.616	-3,136.38
58	0.979	0.012	0.358	42.970	-3,165.03
60	0.983	0.008	0.239	28.646	-3,179.35
62	1.000	0.000	0.000	0.000	-3,208.00
<b>TOTAL (CF)=</b>			<b>40,517</b>	<b>238</b>	

**Exhibits**  
*Pima Storage*



RB-1  
 VR=821 CF  
 VP=3,231 CF  
 HWE=25.85  
 BTM=25.00

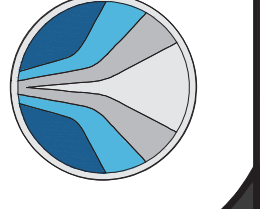


**LEGEND**

- DA-A DRAINAGE AREA ID
- DA-11 SUB-DRAINAGE AREA ID
- I-5 INLET ID
- DRAINAGE AREA DESIGNATION
- SUB-DRAINAGE AREA DESIGNATION
- FLOW ARROW
- STORM DRAIN

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**DRAINAGE EXHIBIT - 1**  
 PIMA SELF STORAGE

Date	02/08/17	Project Eng.	M.S.W., P.E.
Project No.	15138	Project Mgr.	SDH



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CONSTRUCTION NOTES

GRADING NOTES:

- 1) CONSTRUCT ASPHALT PAVEMENT 3" AC OVER 6" ABC OVER 12" PREPARED SUBGRADE FOR TRUCK PARKING, MAIN DRIVES, & FIRE LANES. ALTERNATIVE PAVEMENT FOR AREAS 6" PCPP OVER 12" PREPARED SUBGRADE PER GEOTECHNICAL REPORT DONE BY "SPEEDIE AND ASSOCIATES" DATED FEBRUARY 18, 2017 PROJECT NO. 160982SA. SEE DETAILS ON SHEET C1.2 FOR PAVEMENT CROSS-SECTIONS.
- 3) INSTALL 6" THICK PORTLAND CEMENT CONCRETE OVER 12" PREPARED SUBGRADE PER GEOTECHNICAL REPORT DONE BY "SPEEDIE AND ASSOCIATES" DATED FEBRUARY 18, 2017 PROJECT NO. 160982SA.
- 4) INSTALL SINGLE CURB PER M.A.G. STD. DTL. 222 TYPE 'A'.
- 6) CONSTRUCT 3' CURB OPENING. SEE DETAIL 3 ON SHEET C1.2.
- 11) CONSTRUCT TRASH ENCLOSURE PER COS STD. DTL. 2146-1.
- 13) PROPOSED SITE WALL PER ARCHITECTS DETAIL ON SHEET 5/A8.0 AND STRUCTURAL SHEET 14/S11.01.
- 22) PROPOSED SITE FENCE PER ARCHITECTS DETAIL ON SHEET 20/A8.0.

NOTE:  
FROM A CONSTRUCTION STAND POINT THE APPROVAL OF THE CLOMR BY F.E.M.A. WILL BE BASED ON THE FOLLOWING: THE GRADING OF THE SWALE AND THE CONSTRUCTION OF THE RETAINING WALL ALONG THE WEST SIDE OF PIMA RD, THE GRADING OF LOT 2 TO PROPOSED FINISHED GRADES, GRADING THE EAST AND SOUTH PORTIONS OF LOT 1 ALONG THE PROPOSED FLOODPLAIN DELINEATION LINE SHOWN ON THE PLANS TO FINISHED GRADES.

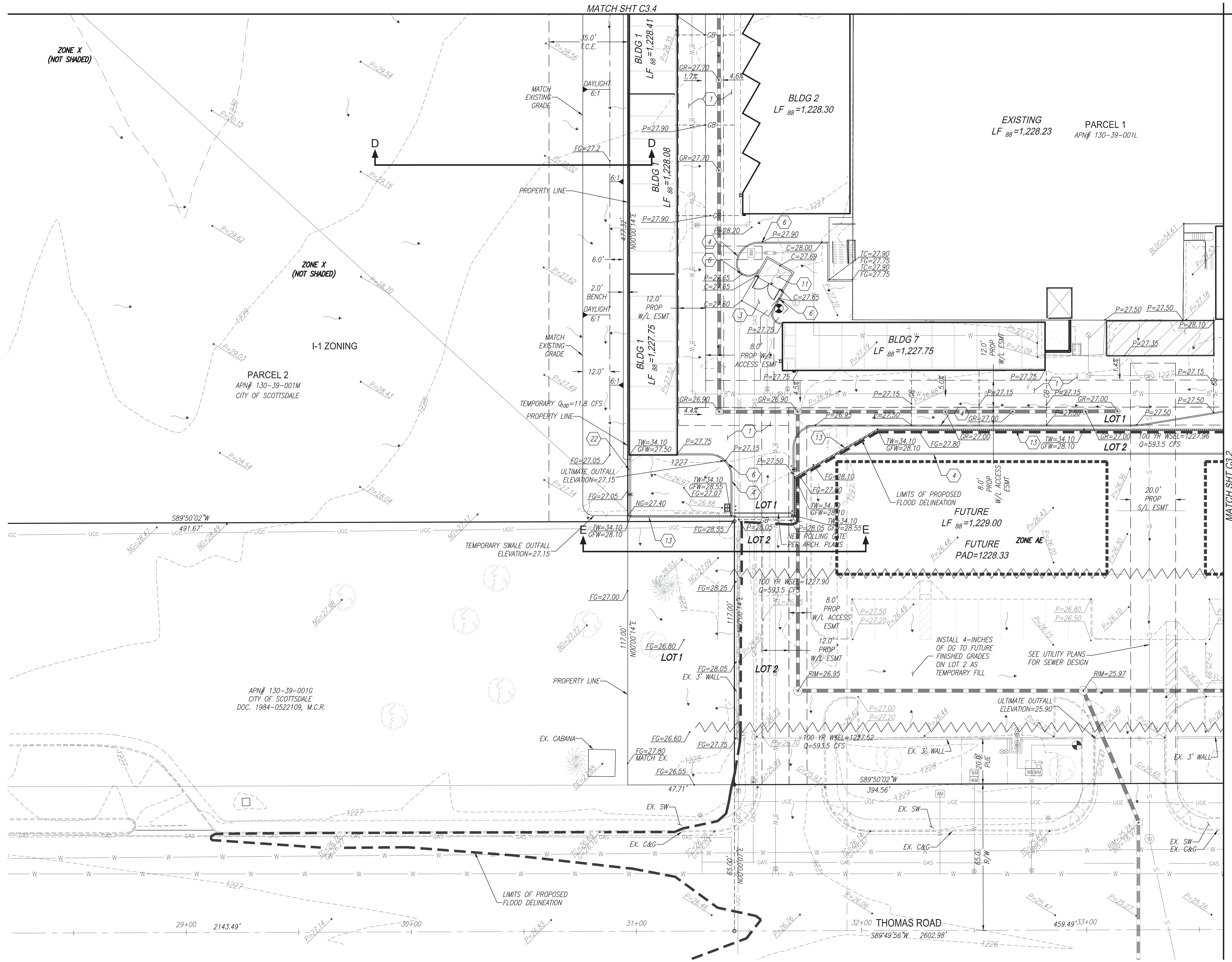
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GRADING PLAN SHEET  
PIMA SELF STORAGE

A PORTION OF THE SOUTHEAST QUARTER OF SECTION 25  
TOWNSHIP 2 NORTH, RANGE 4 EAST OF THE GILA AND SALT RIVER  
MERIDIAN, MARICOPA COUNTY, ARIZONA

Project No. 15138	Date 05/15/2017	Sheet No. SHT: 05 OF 17
Project Manager B. HAMMERSLAND	Project Engineer M. WOLF, P.E.	C3.1

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CASE #57-DR-2015 (PLAN CHECK #6995-16-1)





CONSTRUCTION NOTES

GRADING NOTES:

- 1 CONSTRUCT ASPHALT PAVEMENT, 3" AC OVER 6" ABC OVER 12" PREPARED SUBGRADE FOR TRUCK PARKING, MAIN DRIVES, & FIRE LANES. ALTERNATIVE PAVEMENT FOR AREAS 6" PCPP OVER 12" PREPARED SUBGRADE PER GEOTECHNICAL REPORT DONE BY "SPEEDIE AND ASSOCIATES" DATED FEBRUARY 18, 2017 PROJECT NO. 1609825A. SEE DETAILS ON SHEET C1.2 FOR PAVEMENT CROSS-SECTIONS.
- 2 CONSTRUCT ASPHALT PAVEMENT, 2" AC OVER 4" ABC OVER 12" PREPARED SUBGRADE FOR PARKING SPACES. ALTERNATIVE PAVEMENT OPTION 6" PCPP OVER 12" PREPARED SUBGRADE PER GEOTECHNICAL REPORT DONE BY "SPEEDIE AND ASSOCIATES" DATED FEBRUARY 18, 2017 PROJECT NO. 1609825A. SEE DETAILS ON SHEET C1.2 FOR PAVEMENT CROSS-SECTIONS.
- 4 INSTALL SINGLE CURB PER M.A.G. STD. DTL. 222 TYPE 'A'.
- 5 INSTALL CURB AND GUTTER PER M.A.G. STD. DTL. 220-1 TYPE 'A'.
- 7 CONSTRUCT SIDEWALK SCUPPER PER M.A.G. STD. DTL. 206 WIDTH=6".
- 9 PROPOSED CROSSWALK. REFER TO ARCHITECT'S PLAN FOR DETAILS.
- 10 CONSTRUCT SIDEWALK RAMP PER DETAIL 4 ON SHEET C1.2.
- 120 INSTALL 3"-6" GROUTED RIP RAP, DEPTH = 1'. GRAY COLOR. NATIVE STONE.
- 13 PROPOSED SITE WALL PER ARCHITECT'S DETAIL ON SHEET 5/AB.0 AND STRUCTURAL SHEET 14/S11.01.
- 16 GRADE SWALE PER PLAN.
- 17 GRADE DETENTION BASIN PER PLAN.
- 18 CONSTRUCT CONCRETE RAMP PER DETAIL ON SHEET C3.4.

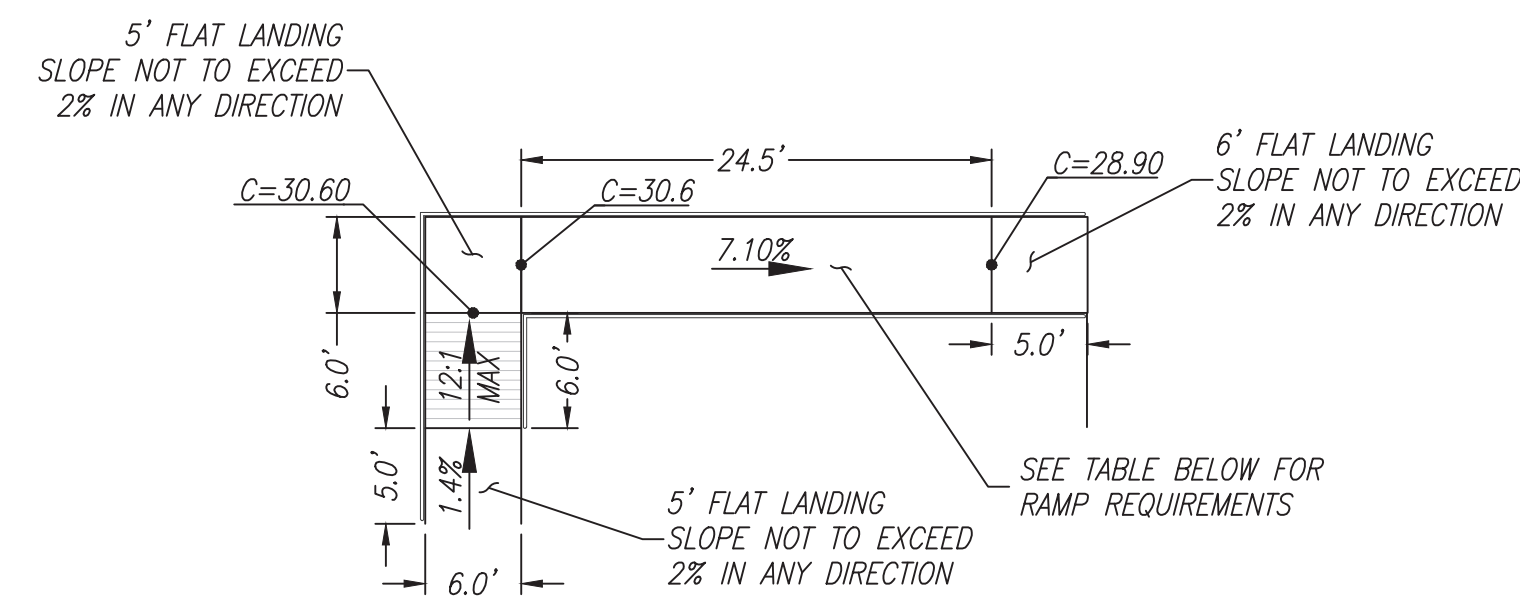


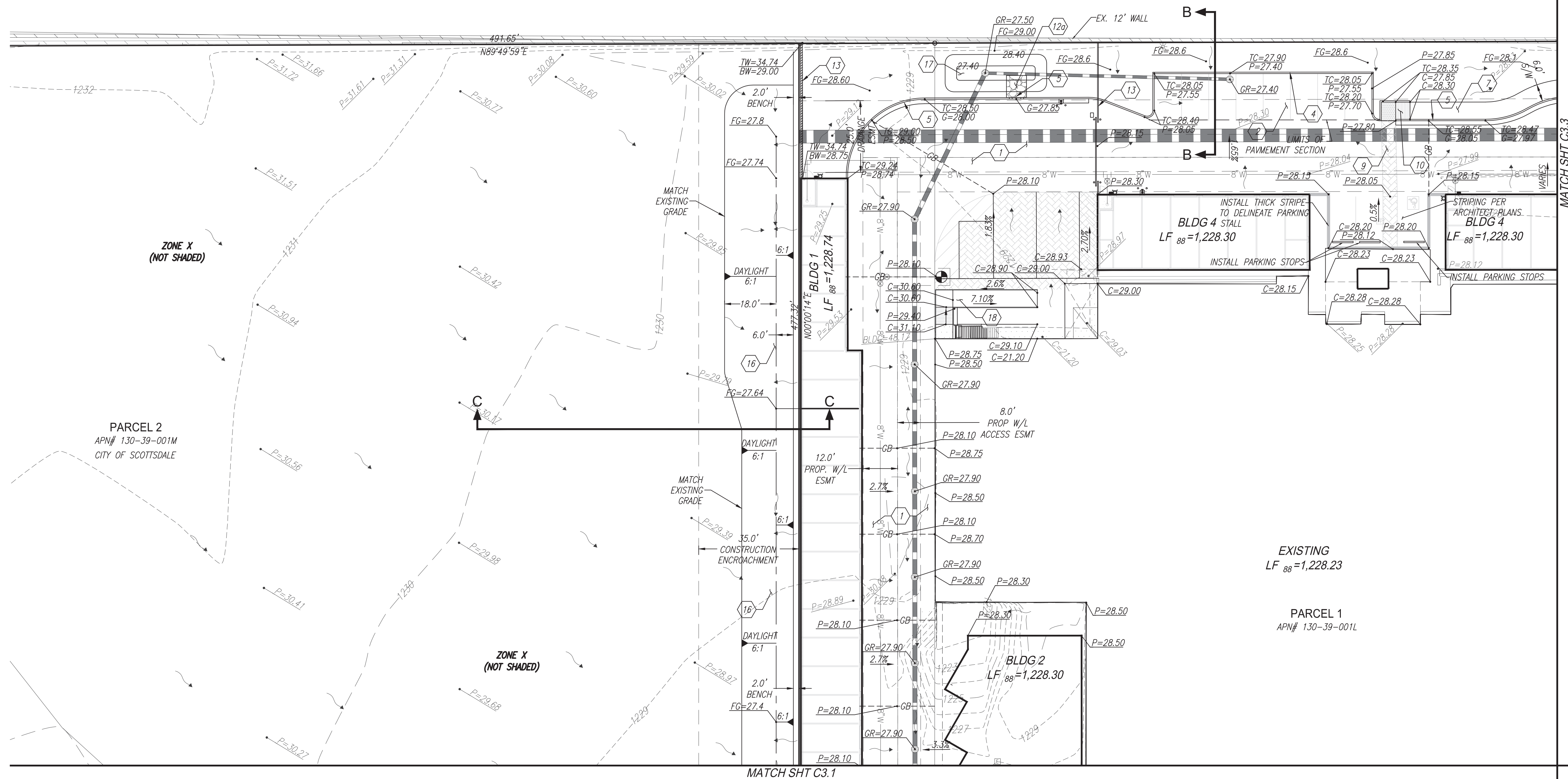
TABLE: SIDEWALK RAMP DESIGN CRITERIA

SLOPE	MAX RISE	MAX HORIZONTAL PROJECTION
1:12 TO < 1:16	30 INCHES	30 FEET
1:16 TO < 1:20	30 INCHES	40 FEET

ADA RAMP GRADING CRITERIA DETAIL

SCALE: 1"=10'

SCOTTSDALE SUMMIT  
BK. 452, PG. 10, M.C.R.



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38925  
MICHAEL S. WOLF  
Professional Engineer  
Arizona State License No. 15114

GRADING PLAN SHEET  
PIMA SELF STORAGE

A PORTION OF THE SOUTHEAST QUARTER OF SECTION 25  
TOWNSHIP 2 NORTH, RANGE 4 EAST OF THE GILA AND SALT RIVER  
MERIDIAN, MARICOPA COUNTY, ARIZONA

Project No. 15138	Date 05/15/2017	Sheet No. SHT: 08 OF 17
Project Manager B. HAMMERSLAND	Project Engineer M. WOLF, P.E.	C3.4

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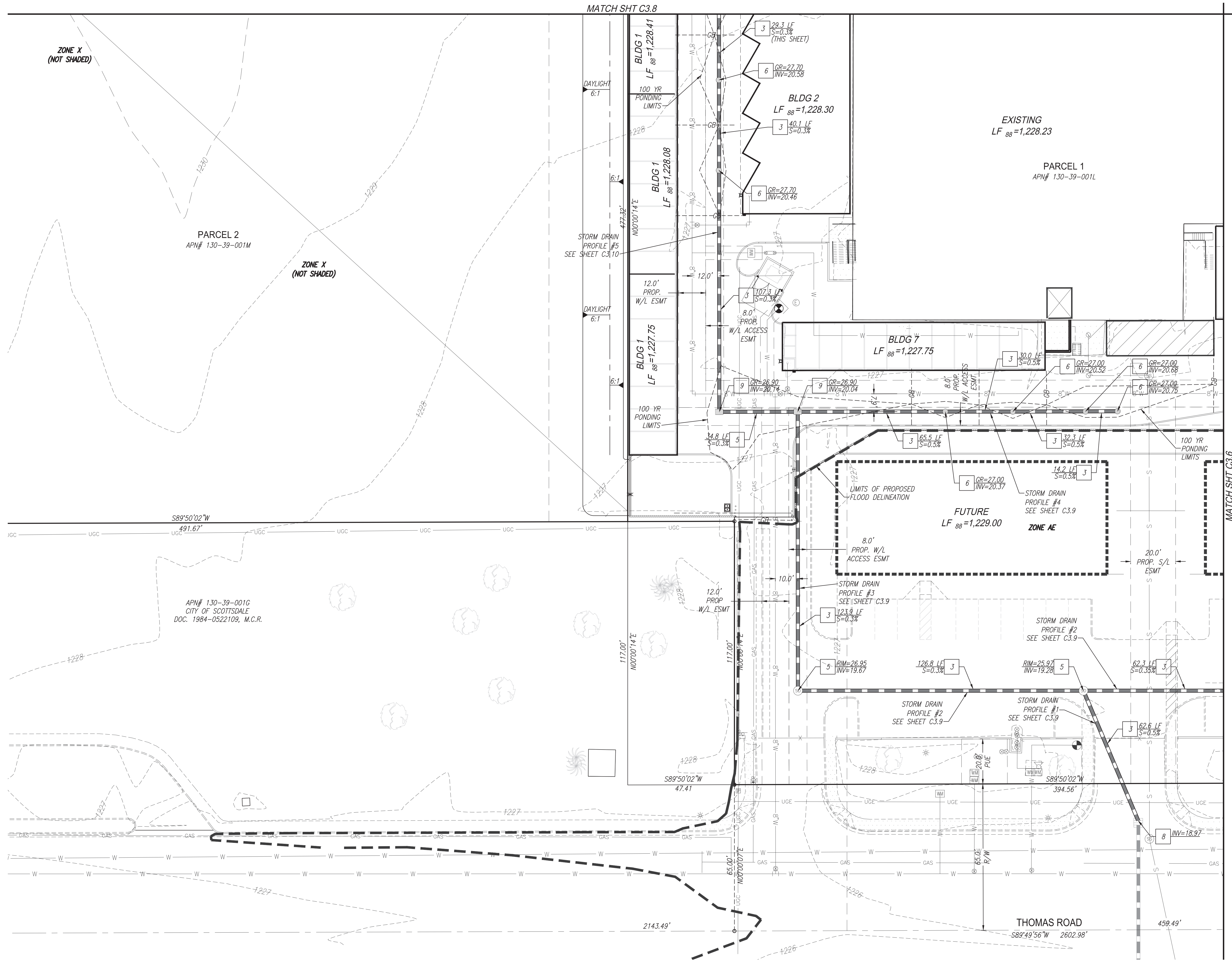
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CASE #57-DR-2015 (PLAN CHECK #6995-16-1)

CONSTRUCTION NOTES

STORM DRAIN NOTES:

- 3 INSTALL 18" HDPE STORM DRAIN PIPE. LENGTH AND SLOPE PER PLAN.
- 5 INSTALL 12" NYLOPLAST POLYPROPYLENE STORM DRAIN RISER WITH STANDARD 30" STANDARD ASSEMBLY.
- 6 INSTALL 12" NYLOPLAST POLYPROPYLENE STORM DRAIN RISER WITH STANDARD 30" GRATE ASSEMBLY.
- 8 CONNECT TO EXISTING. SIZE AND INVERT PER PLANS.
- 9 INSTALL TYPE 'F' CATCH BASIN PER M.A.G. STD. DTL. 535.



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38925  
MICHAEL S. WOLF  
Professional Engineer  
Arizona State License # 15717

Scale: 0 20 40 feet

**STORM DRAIN PLAN  
PIMA SELF STORAGE**

A PORTION OF THE SOUTHEAST QUARTER OF SECTION 25  
TOWNSHIP 2 NORTH, RANGE 4 EAST OF THE GILA AND SALT RIVER  
MERIDIAN, MARICOPA COUNTY, ARIZONA

Project No. 15138	Date 05/15/2017	Sheet No. SHT: 09 OF 17
Project Manager B. HAMMERSLAND	Project Engineer M. WOLF, P.E.	C3.5

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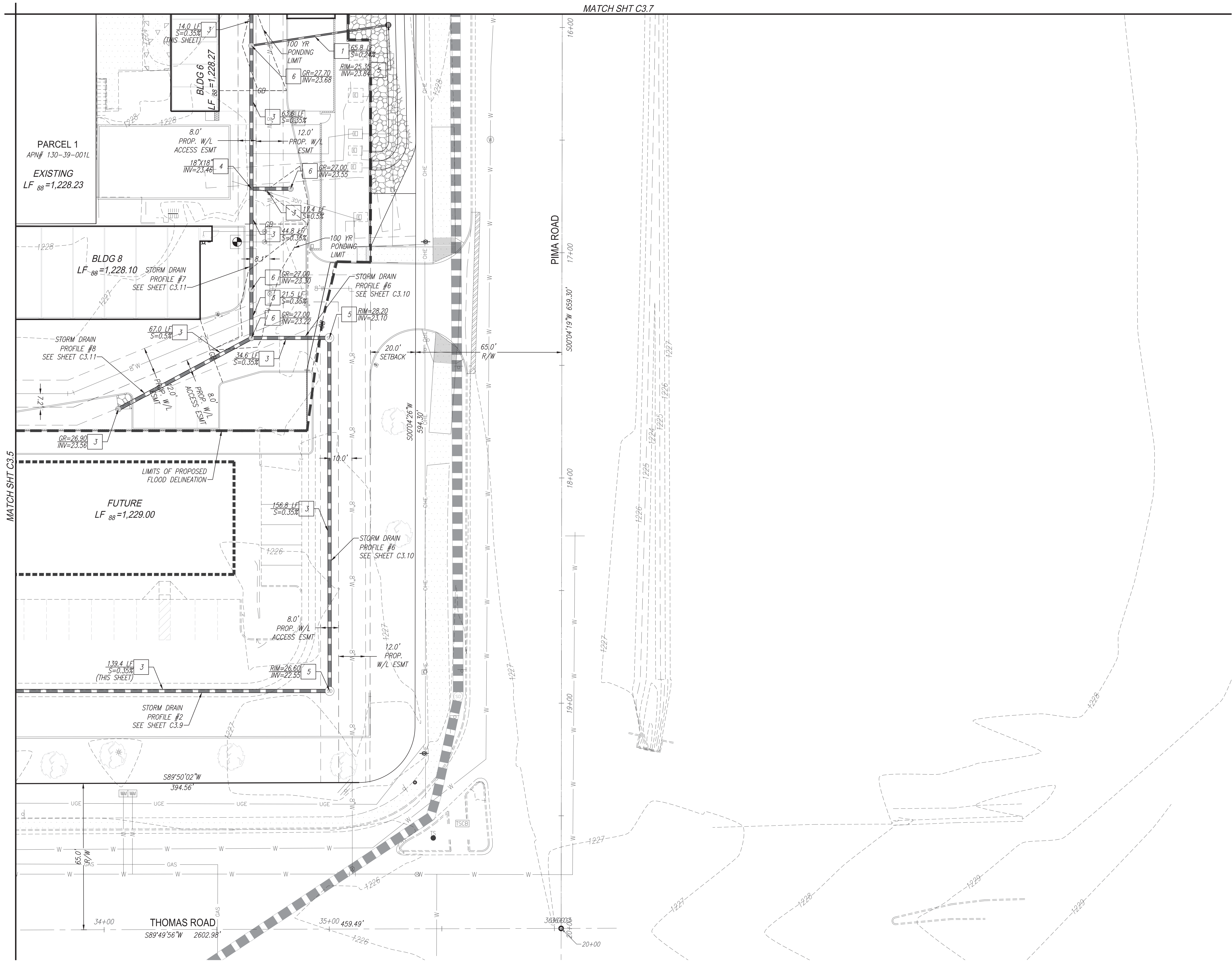
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CASE #57-DR-2015 (PLAN CHECK #6995-16-1)

CONSTRUCTION NOTES

STORM DRAIN NOTES:

- 1 INSTALL 8" HDPE STORM DRAIN PIPE. LENGTH AND SLOPE PER PLAN.
- 3 INSTALL 18" HDPE STORM DRAIN PIPE. LENGTH AND SLOPE PER PLAN.
- 4 INSTALL HDPE STORM DRAIN TEE. SIZE PER PLAN.
- 5 INSTALL 12" NYLOPLAST POLYPROPYLENE STORM DRAIN RISER WITH STANDARD 30" STANDARD ASSEMBLY.
- 6 INSTALL 12" NYLOPLAST POLYPROPYLENE STORM DRAIN RISER WITH STANDARD 30" GRATE ASSEMBLY.



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38925  
MICHAEL S. WOLF  
Professional Engineer  
Arizona State Board of Professional Engineers and Land Surveyors

Scale: 0 20 40 feet

**STORM DRAIN PLAN**  
**PIMA SELF STORAGE**  
A PORTION OF THE SOUTHEAST QUARTER OF SECTION 25  
TOWNSHIP 2 NORTH, RANGE 4 EAST OF THE GILA AND SALT RIVER  
MERIDIAN, MARICOPA COUNTY, ARIZONA

Project No. 15138	Date 05/15/2017	Sheet No. SHT: 10 OF 17
Project Manager B. HAMMERSLAND	Project Engineer M. WOLF, P.E.	C3.6

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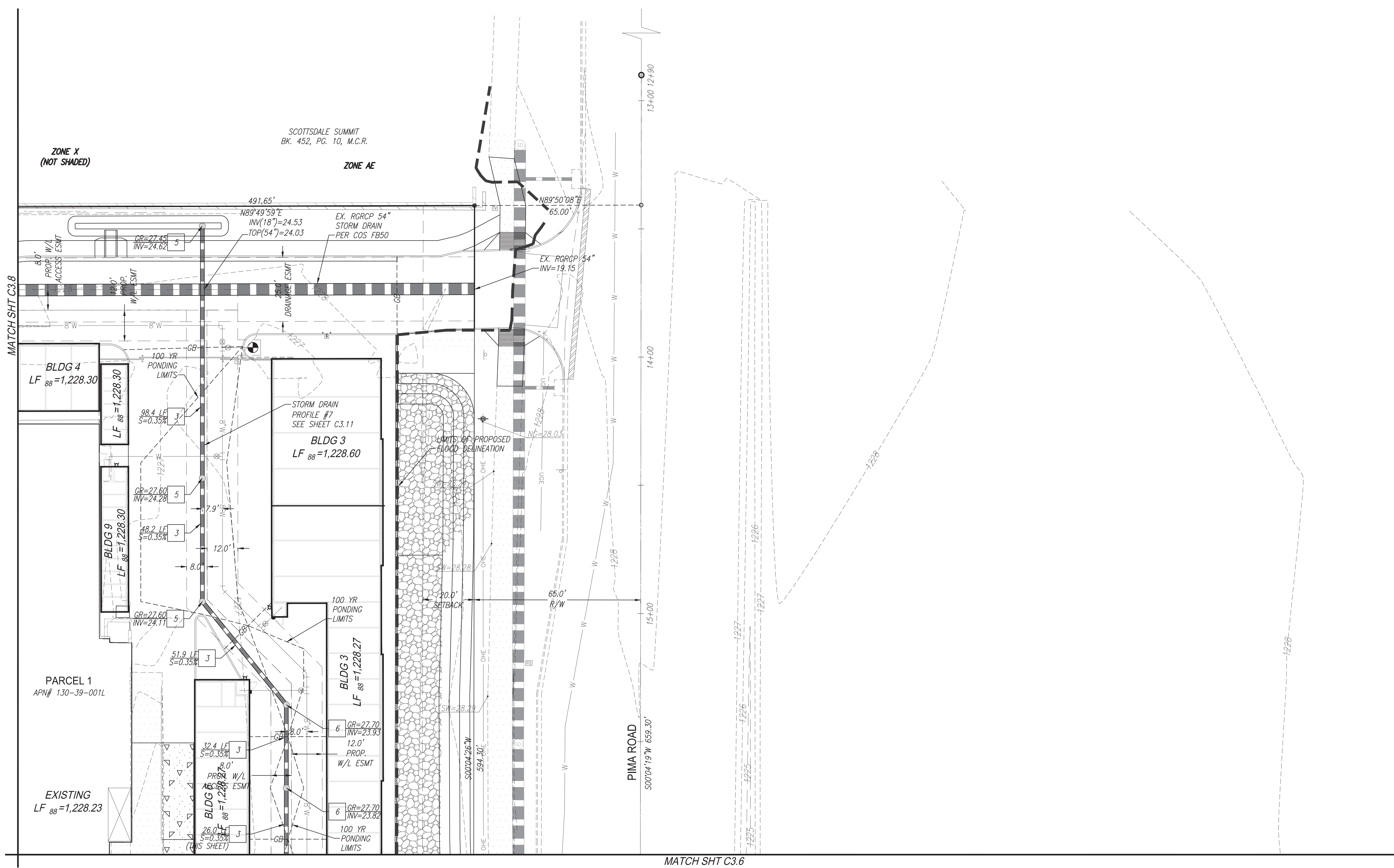
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CASE #57-DR-2015 (PLAN CHECK #6995-16-1)

CONSTRUCTION NOTES

STORM DRAIN NOTES:

- 3 INSTALL 18" HDPE STORM DRAIN PIPE. LENGTH AND SLOPE PER PLAN.
- 5 INSTALL 12" NYLOPLAST POLYPROPYLENE STORM DRAIN RISER WITH STANDARD 30" STANDARD ASSEMBLY.
- 6 INSTALL 12" NYLOPLAST POLYPROPYLENE STORM DRAIN RISER WITH STANDARD 30" GRATE ASSEMBLY.



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Professional Engineer  
State of Arizona

**STORM DRAIN PLAN**  
**PIMA SELF STORAGE**  
A PORTION OF THE SOUTHEAST QUARTER OF SECTION 25  
TOWNSHIP 2 NORTH, RANGE 4 EAST OF THE GILA AND SALT RIVER  
MERIDIAN, MARICOPA COUNTY, ARIZONA

Project No. 15138	Date 05/15/2017	Sheet No. SHT: 11 OF 17
Project Manager B. HAMMERSLAND	Project Engineer M. WOLF, P.E.	C3.7

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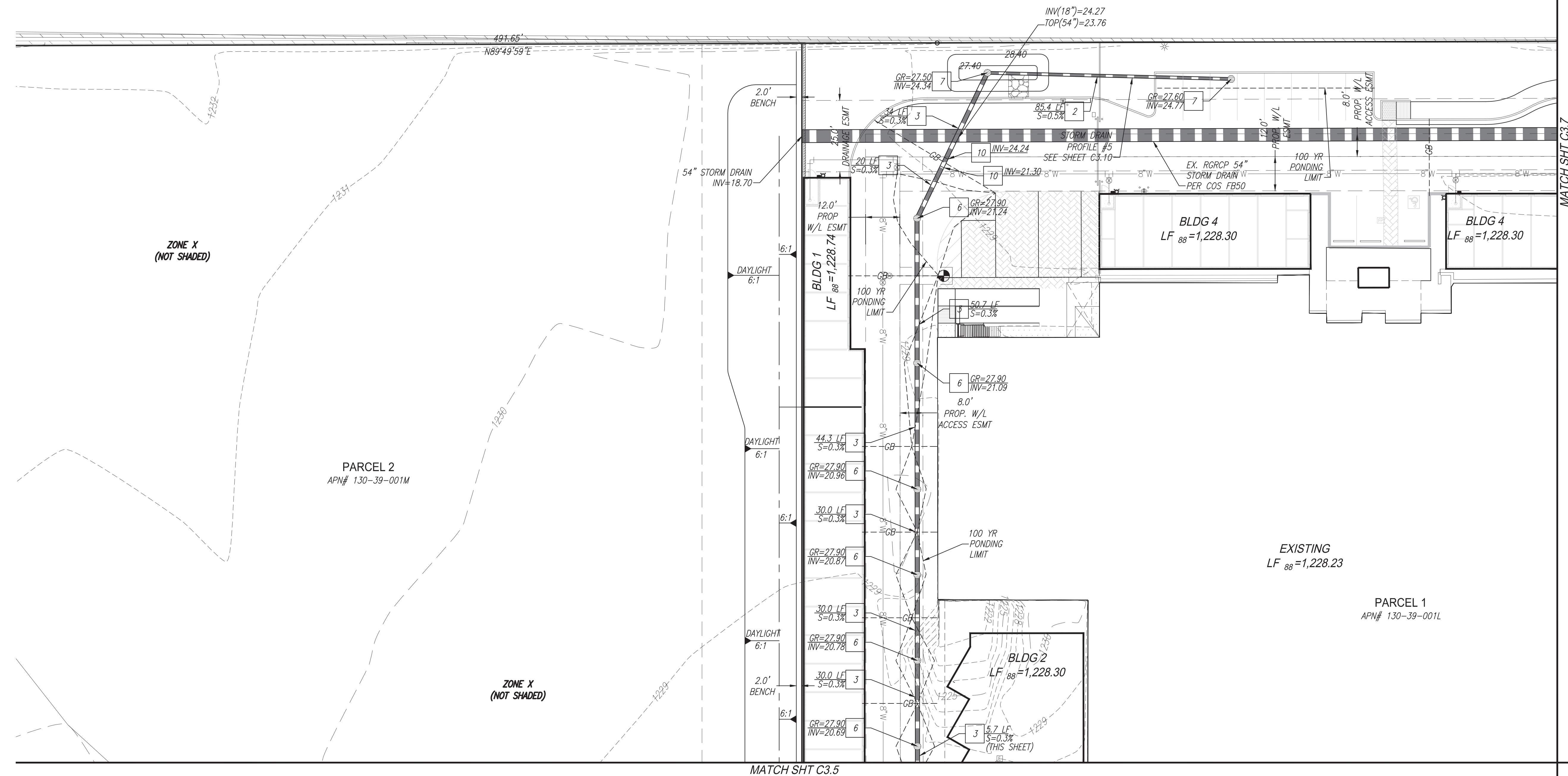
CASE #57-DR-2015 (PLAN CHECK #6995-16-1)

CONSTRUCTION NOTES

STORM DRAIN NOTES:

- 2 INSTALL 12" HDPE STORM DRAIN PIPE. LENGTH AND SLOPE PER PLAN.
- 3 INSTALL 18" HDPE STORM DRAIN PIPE. LENGTH AND SLOPE PER PLAN.
- 6 INSTALL 12" NYLOPLAST POLYPROPYLENE STORM DRAIN RISER WITH STANDARD 30" GRATE ASSEMBLY.
- 7 INSTALL 12" NYLOPLAST POLYPROPYLENE STORM DRAIN RISER WITH STANDARD 24" GRATE ASSEMBLY.
- 10 INSTALL HDPE 45° VERTICAL BEND.

SCOTTSDALE SUMMIT  
BK. 452, PG. 10, M.C.R.



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602.263.1100

38925  
MICHAEL S. WOLF  
Professional Engineer  
Arizona State License No. 38925  
P.E.

20 0 20 40  
feet  
scale

STORM DRAIN PLAN  
PIMA SELF STORAGE

A PORTION OF THE SOUTHEAST QUARTER OF SECTION 25  
TOWNSHIP 2 NORTH, RANGE 4 EAST OF THE GILA AND SALT RIVER  
MERIDIAN, MARICOPA COUNTY, ARIZONA

Project No. 15138	Date 05/15/2017	Sheet No. SHT: 12 OF 17
Project Manager B. HAMMERSLAND	Project Engineer M. WOLF, P.E.	C3.8

**HUBBARD ENGINEERING**  
www.hubbardengineering.com  
1201 S. Alma School Rd., Ste. 12000 - Mesa, AZ 85210  
PH: 480.892.3313

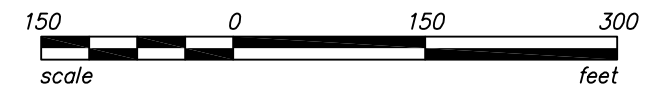
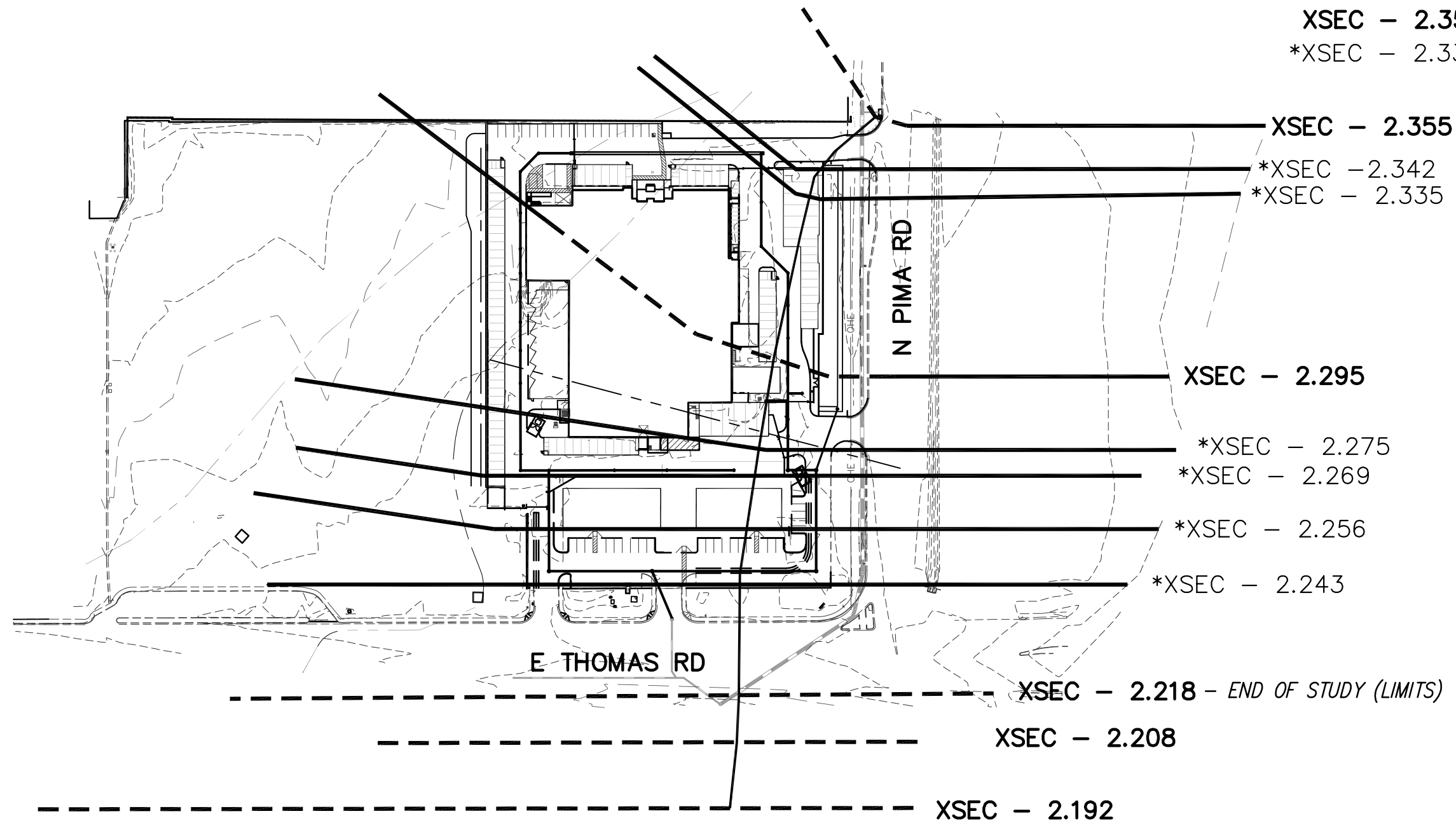
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CASE #57-DR-2015 (PLAN CHECK #6995-16-1)

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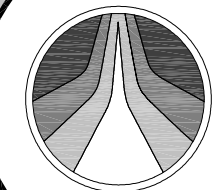
### LEGEND

- EXISTING CROSS SECTIONS
- ADDITIONAL/EXTENDED CROSS SECTIONS
- XSEC - 2.355 EXISTING CROSS SECTIONS
- \*XSEC - 2.335 ADDITIONAL CROSS SECTIONS



Proj. No. 15138	Date 3/30/16
Sht: 1 of 1	

**HEC-RAS CROSS SECTIONS**  
**EXHIBIT 3**  
**PIMA STORAGE**



HUBBARD

ENGINEERING

www.hubbardengineering.com

1201 S. Alma School Rd.  
Suite 12000  
Mesa, AZ 85210  
Ph: 480.892.3313



**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**

<b>PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)<sup>1</sup></b>										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.184 (0.154-0.224)	0.240 (0.202-0.293)	0.327 (0.273-0.396)	0.393 (0.326-0.474)	0.482 (0.394-0.580)	0.552 (0.445-0.660)	0.623 (0.493-0.743)	0.695 (0.541-0.828)	0.792 (0.600-0.944)	0.866 (0.643-1.03)
10-min	0.280 (0.234-0.341)	0.366 (0.308-0.446)	0.497 (0.415-0.603)	0.598 (0.496-0.722)	0.735 (0.599-0.882)	0.840 (0.677-1.00)	0.948 (0.750-1.13)	1.06 (0.823-1.26)	1.21 (0.913-1.44)	1.32 (0.979-1.57)
15-min	0.347 (0.290-0.422)	0.453 (0.382-0.553)	0.616 (0.515-0.748)	0.741 (0.615-0.895)	0.910 (0.743-1.09)	1.04 (0.839-1.25)	1.18 (0.929-1.40)	1.31 (1.02-1.56)	1.49 (1.13-1.78)	1.63 (1.21-1.95)
30-min	0.467 (0.391-0.569)	0.611 (0.514-0.744)	0.829 (0.693-1.01)	0.998 (0.828-1.21)	1.23 (1.00-1.47)	1.40 (1.13-1.68)	1.58 (1.25-1.89)	1.77 (1.37-2.10)	2.01 (1.52-2.40)	2.20 (1.63-2.63)
60-min	0.578 (0.484-0.704)	0.756 (0.636-0.921)	1.03 (0.858-1.25)	1.24 (1.02-1.49)	1.52 (1.24-1.82)	1.74 (1.40-2.08)	1.96 (1.55-2.34)	2.19 (1.70-2.60)	2.49 (1.89-2.97)	2.72 (2.02-3.25)
2-hr	0.670 (0.570-0.799)	0.866 (0.738-1.04)	1.16 (0.984-1.38)	1.38 (1.16-1.65)	1.69 (1.40-2.00)	1.92 (1.58-2.27)	2.17 (1.75-2.56)	2.41 (1.91-2.84)	2.74 (2.12-3.23)	3.00 (2.27-3.56)
3-hr	0.729 (0.619-0.879)	0.935 (0.796-1.13)	1.23 (1.04-1.48)	1.46 (1.23-1.75)	1.79 (1.48-2.13)	2.05 (1.67-2.43)	2.32 (1.85-2.75)	2.60 (2.05-3.08)	2.99 (2.28-3.55)	3.31 (2.46-3.93)
6-hr	0.876 (0.759-1.03)	1.11 (0.965-1.31)	1.42 (1.23-1.67)	1.67 (1.43-1.96)	2.01 (1.70-2.34)	2.28 (1.90-2.64)	2.56 (2.10-2.96)	2.84 (2.28-3.30)	3.23 (2.53-3.76)	3.54 (2.71-4.13)
12-hr	0.977 (0.855-1.13)	1.23 (1.08-1.43)	1.56 (1.36-1.81)	1.82 (1.58-2.10)	2.17 (1.86-2.50)	2.44 (2.07-2.80)	2.71 (2.27-3.12)	2.99 (2.46-3.44)	3.37 (2.70-3.89)	3.66 (2.89-4.26)
24-hr	1.15 (1.03-1.29)	1.46 (1.32-1.64)	1.89 (1.70-2.12)	2.24 (2.00-2.50)	2.71 (2.41-3.02)	3.08 (2.72-3.43)	3.47 (3.04-3.87)	3.87 (3.37-4.32)	4.43 (3.81-4.94)	4.87 (4.15-5.45)
2-day	1.25 (1.12-1.40)	1.59 (1.43-1.79)	2.09 (1.87-2.34)	2.49 (2.22-2.78)	3.04 (2.70-3.40)	3.48 (3.07-3.89)	3.95 (3.46-4.42)	4.43 (3.86-4.96)	5.11 (4.40-5.74)	5.66 (4.82-6.36)
3-day	1.32 (1.18-1.48)	1.69 (1.51-1.89)	2.22 (1.98-2.48)	2.64 (2.36-2.95)	3.24 (2.88-3.62)	3.72 (3.28-4.15)	4.23 (3.71-4.73)	4.77 (4.14-5.33)	5.53 (4.74-6.18)	6.14 (5.21-6.89)
4-day	1.39 (1.25-1.56)	1.78 (1.59-1.99)	2.34 (2.09-2.62)	2.79 (2.49-3.12)	3.44 (3.05-3.84)	3.96 (3.49-4.42)	4.52 (3.95-5.04)	5.11 (4.43-5.70)	5.94 (5.08-6.63)	6.62 (5.60-7.41)
7-day	1.54 (1.38-1.72)	1.96 (1.76-2.20)	2.59 (2.32-2.90)	3.10 (2.76-3.46)	3.81 (3.38-4.26)	4.39 (3.87-4.89)	5.00 (4.37-5.58)	5.65 (4.90-6.31)	6.56 (5.62-7.34)	7.30 (6.18-8.18)
10-day	1.67 (1.50-1.87)	2.14 (1.92-2.40)	2.82 (2.53-3.15)	3.37 (3.01-3.76)	4.14 (3.67-4.60)	4.75 (4.19-5.28)	5.40 (4.74-6.01)	6.09 (5.29-6.78)	7.05 (6.05-7.85)	7.82 (6.64-8.72)
20-day	2.06 (1.85-2.29)	2.64 (2.37-2.94)	3.49 (3.13-3.88)	4.13 (3.69-4.59)	4.98 (4.44-5.54)	5.64 (5.01-6.27)	6.31 (5.58-7.02)	6.99 (6.14-7.79)	7.91 (6.88-8.82)	8.61 (7.43-9.62)
30-day	2.40 (2.15-2.67)	3.09 (2.77-3.43)	4.06 (3.65-4.51)	4.80 (4.30-5.33)	5.80 (5.17-6.43)	6.57 (5.83-7.27)	7.35 (6.49-8.13)	8.14 (7.15-9.02)	9.21 (8.03-10.2)	10.0 (8.68-11.2)
45-day	2.78 (2.51-3.10)	3.59 (3.23-3.99)	4.72 (4.25-5.24)	5.56 (4.99-6.17)	6.67 (5.96-7.39)	7.50 (6.68-8.31)	8.33 (7.39-9.24)	9.16 (8.09-10.2)	10.3 (8.99-11.4)	11.1 (9.66-12.4)
60-day	3.08 (2.79-3.42)	3.98 (3.59-4.40)	5.23 (4.71-5.78)	6.13 (5.51-6.78)	7.31 (6.56-8.08)	8.18 (7.31-9.05)	9.06 (8.06-10.0)	9.91 (8.78-11.0)	11.0 (9.71-12.2)	11.8 (10.4-13.2)

<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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**PF graphical**