CITY OF SCOTTSDALE

Drainage Reports

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64TH St. & Oak

Preliminary Drainage Report

3 engineering Job #: 5153

Original Date: April 10, 2020

COS #: 4-PA-2020

7-ZN-2020
4/30/2020

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64th St. & Oak

PRELIMINARY DRAINAGE REPORT

Prepared for:

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Phone: (480) 824-4175

Registered Professional Engineer (Civil)
CERTIFICATE NO.
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MATTHEW J.
MANCINI
4/10/20
Date Signed
ARIZONA, U.S.A.

Expires 12/31/2021

Matthew J. Mancini, P.E.

April 10, 2020

Submittal to:

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Appendix

1. Introduction

The purpose of this report is to present the existing and proposed drainage plan for the project site, 64th St. & Oak. It is our opinion the preliminary grading and drainage design is in accordance with the City of Scottsdale drainage requirements.

The project site, 64th St. & Oak, is located in Section 33, Township 2 North, Range 4 East of the Gila and Salt River Meridian, Maricopa County, Arizona within the City of Scottsdale. The project is located North of Oak Street, and West of 64th Street Road at 6300 E. Oak Street, Scottsdale, Arizona 85257. The site is bounded on the north by an existing commercial polo club, on the west by a residential neighborhood, on the south and east by a commercial property. See Appendix A for a site map.

Per the City of Scottsdale General Plan's Land Use Map, the project site is designated Suburban Neighborhood and is also located within the Southern Scottsdale Character Area Plan (SSCAP). The project site is zoned S-R (Service Residential) and R1-10 (Single-Family Residential). The proposed zoning is R-3. The existing land is occupied by an operational medical facility with three (3) buildings, including existing parking & site improvements. The intent of the project is to construct an 89-lot single-family attached residential subdivision project.

2. Site Description

Existing

The existing land is occupied by an operational medical facility with three (3) buildings, including existing parking & site improvements. The existing topography has an approximate slope of one percent (1.40%) and has an overall general slope from southwest to northeast. Based on field reconnaissance, and general review of asbuilt plans and aerial photos, offsite flow impacts the site from the south. Existing outfalls for the property are along the northern and eastern boundaries of the site. The site does not show any signs of containing waters of the US (404 washes).

Federal Emergency Management Agency (FEMA) Designation

According to FEMA Flood Insurance Rate Map (FIRM) # 04013C2230L, updated October 16, 2013, the site is located within the "Zone X" floodplain designation. "Zone X" is described as follows: "Area of Minimal Flood Hazard". Refer to the updated FIRM information in Appendix B.

Proposed

The proposed site, 64th St. & Oak, is proposed as an 89-lot single-family attached residential subdivision project with a private drive and gated access from Oak Street.

3. Drainage Design - Offsite

The existing land is occupied by an operational medical facility with three (3) buildings, including existing parking & site improvements. The existing topography has an approximate slope of one percent (1.40%) and has an overall general slope from southwest to northeast. Based on field reconnaissance, and general review of asbuilt plans and aerial photos, offsite flow impacts the site from the south. There are two low points near the site's southern boundary. One low point towards the site's southwest corner accepts flow in a concrete ditch, and conveys storm water through the adjacent site to the west. Asbuilt plans, and County FLO-2D models, indicate this flow remains on the adjacent site. The second low point is near the center of the site along Oak Street that conveys flow through 2-24" storm drains and into an existing rip rap channel where it directs flow to the northeast. Existing outfalls for the property are along the northern and eastern boundaries of the site. The site does not show any signs of containing waters of the US (404 washes).

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According to the Lower Indian Bend FLO-2D (Ref. 4) (Appendix F), the offsite flow adjacent to the west enters the adjacent site at 21.02 cfs. Evaluating County Mapping using Rational Method (Appendix F & G), the flow was calculated at 37.30 cfs. According to the FLO-2D mapping, this flow is contained on the adjacent site and conveyed north. In the event any overtopping does occur, the site has been designed with open space adjacent to the western property, and has a channel that would convey any flow north into basins, and to the project's outfall.

According to the Lower Indian Bend FLO-2D (Ref. 4) (Appendix F), the flow crossing Oak Street near its midpoint, enters at 28.16 cfs. Evaluating County Mapping using Rational Method (Appendix F & G), the flow was calculated at 28.41 cfs. This flow currently is conveyed through two (2) existing 24iinch storm drains that convey flow to a rip rap lined channel along the eastern edge of the project. This flow travels north and, according to the FLO-2D model, exits in various places along the eastern boundary. To mitigate this flow, the project proposes accepting the flow in the same location along Oak Street, conveying it through tow (2) 24-inch storm drains under the project's entrance, and channelizing it to the existing rip rap channel. It is proposed to maintain this existing rip rap channel in order to maintain existing historical drainage patterns. Refer to Appendix G for a CulvertMaster calculation of the proposed pipe culvert under the entrance.

4. ***Drainage Design – Onsite***

The City of Scottsdale Design Standards and Policies Manual and the Drainage Design Manual for Maricopa County, Volume 1 was followed in designing on-site drainage facilities for the site. The following standards shall be met as part of this project:

- 10-year peak discharges shall be contained below the top of curb elevations.
- 100-year peak discharges shall be contained within the private street tract.
- Sump condition catch basins and storm drain shall be designed, at a minimum, for the 10-year storm event with 100-year overflowing the sump.
- Flow-By condition catch basins storm drain shall be designed for the 100-year storm event.
- Channels shall be designed for the 100-year event.
- Retention shall be provided for the 100-year 2-hour storm event.
- There shall be 1-foot of freeboard on the basin. This freeboard shall NOT count towards the 100-year 2-hour storage requirement.
- Retention basins shall drain within 36-hour. 0.1 cfs shall be used as a drywell design rate. (post construction percolation tests shall be used to determine higher rates)
- Drainage shall enter and exit in a similar and/or historical manner as existing conditions.

Refer to the Preliminary Grading and Drainage Plan in Appendix H and the Onsite Drainage Map in Appendix F for the following discussion:

On-site drainage areas will be conveyed via surface drainage from the lots to the private accessways' curb and gutter for flow draining to the front of the lots, and directly into retention basins for flow draining to the rear of lots. Storm water exiting the lots in the front flows into the curb and gutter flows into storm drain systems and then into the surface retention basins and underground tanks. Site peak flows have been calculated using the Rational Method, as established in Ref. 1. The calculations determined the amount of flow generated on-site and directly to the catch basins. Drainage areas were determined based on the preliminary grading plans, and are shown on the Drainage Map in Appendix F. For the purposes of this report a minimum time of concentration of 5 minutes was used. (See Appendix G for street hydraulic capacities)

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StormCAD was used to design storm drain sizes. Refer to Appendix G for the StormCAD calculations. Weir Calculations were used to determined catch basin sizes. Refer to Appendix G for the Weir calculations.

Per Ref. 1 & Ref. 2 the Site is required to retain the storm water generated from the 100-year 2-hour storm event. Based on Ref. 1, and the weighted C value calculation (for retention) in Appendix G, the Site's 100-year runoff coefficient for the site is 0.79. Based on NOAA14, the site's precipitation value is 2.14 inches. For required and proposed retention volume calcs, refer to Appendix G.

All basins are designed to overflow in events exceeding 100-years storms. The following are descriptions of each basin's overflow:

- Basin A/Tank 1– Basin A & Tank 1 will fill up, and over top to the adjacent property, which is consistent with existing outfalls.
- Basin B - Basin B will fill up, and over top to the adjacent property, which is consistent with existing outfalls.
- Basin C – Basin C will fill up, and over top to the offsite channel and then to the adjacent property, which is consistent with existing outfalls.
- Basin D – Basin C will fill up, and over top to the offsite channel and then to the adjacent property, which is consistent with existing outfalls.
- Basin E/Tank 2– Basin E & Tank 2 will fill up, and back up into the street and then into Basin B, and then to adjacent property, which is consistent with existing outfalls.
- Basin F – Basin F will fill up, and overflow via channel to Basin H, which will overflow to Basin A, which will over top to the adjacent property, which is consistent with existing outfalls.
- Basin G/Tank 3– Basin G & Tank 3 will fill up, and back up into the street and then into Basin B, and then to adjacent property, which is consistent with existing outfalls.
- Basin H – Basin H will fill up, which will overflow to Basin A, which will over top to the adjacent property, which is consistent with existing outfalls.

The surface basins & tanks will drain via basin infiltration and use of drywells, as there is not a channel/wash, or existing storm drain system to bleed off into. A drywell rate of 0.1 cfs is used for the purposes of this design report; however, Geotechnical percolation tests shall be completed after construction of the basins to determine if the drywell systems can be reduced or eliminated. Refer to Appendix G for percolation calculations.

Per the City's DS&PM, the following items shall be addressed for proposed underground retention tank systems:

- **Water Quality**
  - The underground system is designed to connect to dual-chamber drywells. Dual-chamber drywells utilize a sediment chamber which removes oils and pollutants from entering the ground water during disposal.
- **System Failure (No-Storage)**
  - If the system fails, and provides no storage, storm water will back-up to the floodplain elevations associated with the bank of the wash. Finished Floors are elevated above this outfall and floodplain elevation.
- **Vector Control (mosquito breeding)**
  - The system is designed to bleed-off via drywells. The number of drywells designed shall dispose of the storm water within 36-hours, which is the maximum time period to eliminate the risk of vector control.

- **Redundancy**
  - There is not redundancy provided in the system in terms of additional pipe storage; however, an Operations & Manual has been prepared. This manual sets forth the guidelines to keep the underground system functioning correctly. This manual is reviewed and approved by the City, recorded with Maricopa County, and is enforceable by the City shall the owner not follow the guidelines. This will ensure that sediments will not cause the system to fail.
- **Initial Suspended Load Removal (First Flush)**
  - The tanks are designed with a smooth bottom, and a 0.25% slope to ensure proper drainage to the disposal portion of the system. As mentioned for Water Quality, the drywells include a sediment chamber which functions to remove oils and pollutants, typical present in first flush runoff, from the storm water.
- **75-year Design Life**
  - The tanks are designed with a minimum 75-year design life. Resistivity testing shall be completed.
- **Outfall**
  - The tanks are designed with dual chamber drywell bleed-off. Since this area is within a floodplain, pumps are not a feasible drain method. There are no storm drain outfalls for this underground system, as well. Therefore, drywells will be the means for tank outfall, and the Operations & Maintenance program will be the mechanism used to ensure proper function of the system.
- **Pipes**
  - As mentioned in Initial Suspended Load Removal, the tanks are designed with a smooth bottom. The interior shall be designed per City of Scottsdale Detail 2554.
- **Installation**
  - Excavation, bedding and backfill procedures and materials must be in accordance with MAG standards.
- **Access**
  - The underground tanks are designed with a minimum of two access points. These access points are designed in accordance with MAG standards.

Drainage easements are to be dedicated over the basin tracts. In addition, the private street (Tract A), has a drainage easement as part of its use. This will ensure that the basins and storm drain systems can be maintained in order to perform properly during storm events.

For the purpose of design, finished floors for the project have been placed a minimum of 14-inches above lot outfalls, and 18-inches above ultimate outfalls along the north boundary. The proposed project disturbs over 1.0 acre and therefore a SWPP Plan, NOI and Authorization to Discharge Letter will be required from ADEQ.

5. *Conclusions*

The following is a summary of the Scottsdale Heights Phase 2 Drainage Report.

- The site currently lies within "Zone X" floodplain designation.
- Retention is provided for 100-year 2 hour storm event.
- Retention shall dissipate within 36 hours via drywells.
- Offsite drainage is accepted and discharged in its historical locations.
- Finished floors are set a minimum of 14-inches above lot outfalls, and 18-inches above ultimate outfalls.

6. *References*

1. Maricopa County, *Drainage Design Manual, Volume I, Hydrology*, Flood Control District of Maricopa County.

2. City of Scottsdale, *Design Standards and Policies Manual,* 2018.

3. Maricopa County Drainage Design Manual, Hydraulics, Flood Control District of Maricopa County, 2013.

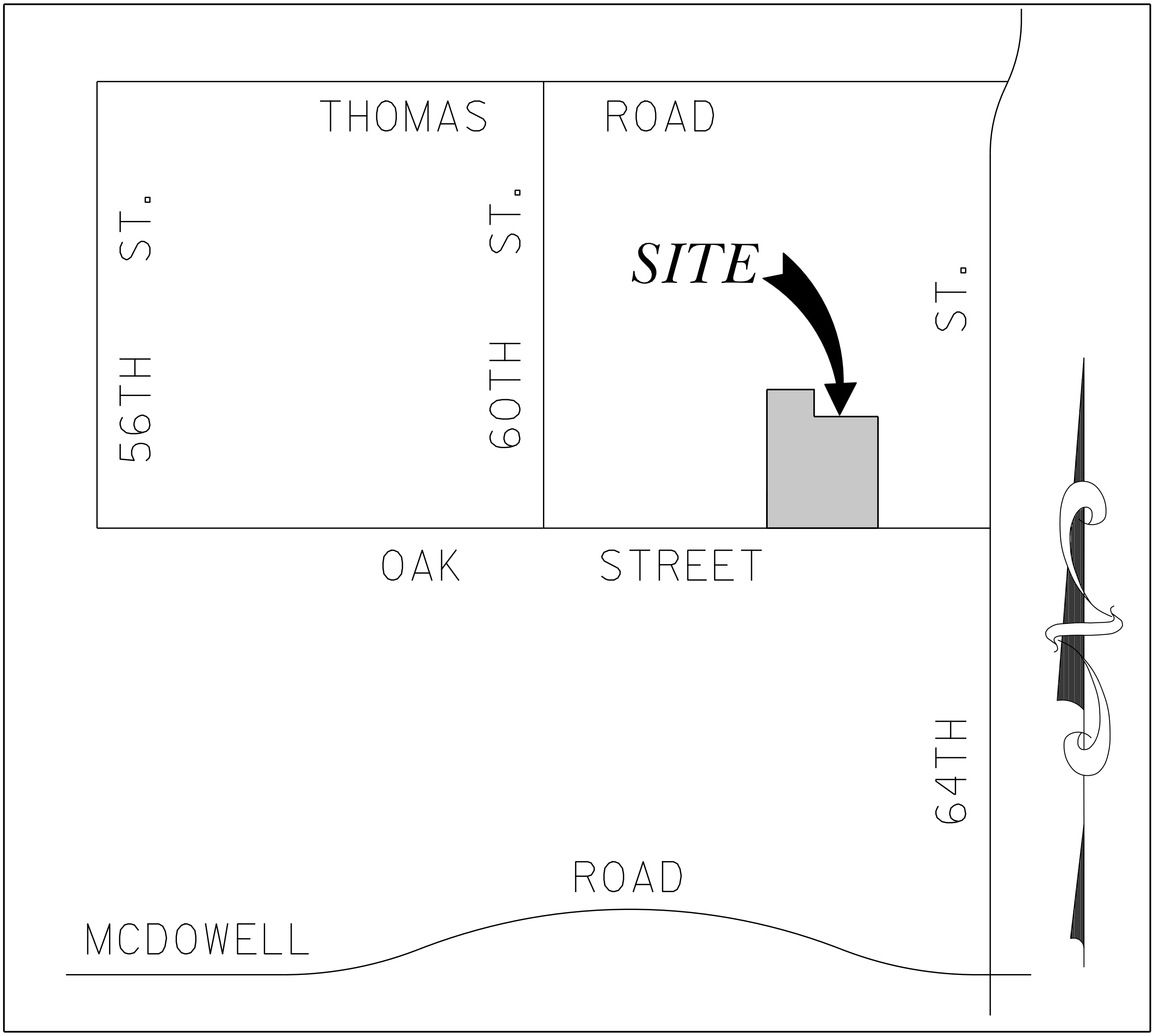
4. Lower Indian Bend Wash, FLO-2D, Flood Control District of Maricopa County

5. FlowMaster Version V8i, Bentley.

6. StormCAD Version V8i, Bentley.

APPENDIX A

Vicinity Map



VICINITY MAP

N.T.S.

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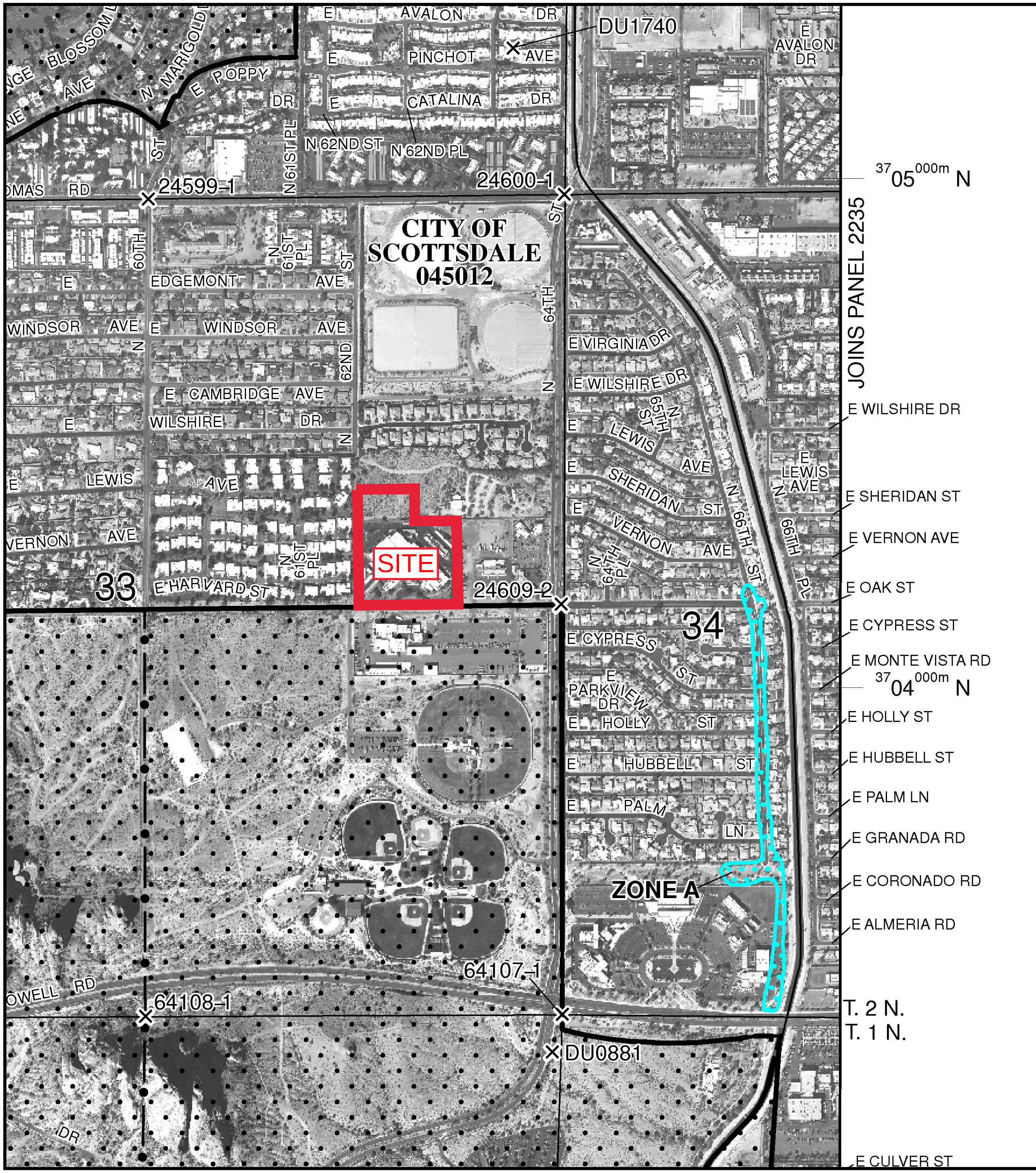
APPENDIX B

FEMA FIRM



MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

METERS

NFIP

PANEL 2230L

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP
MARICOPA COUNTY, ARIZONA
AND INCORPORATED AREAS

PANEL 2230 OF 4425

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY	040037	2230	L
PHOENIX, CITY OF	040051	2230	L
SCOTTSDALE, CITY OF	045012	2230	L
TEMPE, CITY OF	040054	2230	L

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

MAP NUMBER 04013C2230L

MAP REVISED OCTOBER 16, 2013

Federal Emergency Management Agency

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

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APPENDIX C

Warning and Disclaimer of Liability

Appendix 4-1C

WARNING & DISCLAIMER OF LIABILITY

The Drainage and Floodplain Regulations and Ordinances of the City of Scottsdale are intended to "minimize the occurrence of losses, hazards and conditions adversely affecting the public health, safety and general welfare which might result from flooding caused by the surface runoff of rainfall" (Scottsdale Revised Code §37-16).

As defined in S.R.C. §37-17, a flood plain or "*Special flood hazard* area means an area having flood and/or flood related erosion hazards as shown on a FHBM or FIRM as zone A, AO, A1-30, AE, A99, AH, or E, and those areas identified as such by the floodplain administrator, delineated in accordance with subsection 37-18(b) and adopted by the floodplain board." It is possible that a property could be inundated by greater frequency flood events or by a flood greater in magnitude than a 100-year flood. Additionally, much of the Scottsdale area is a dynamic flood area; that is, the floodplains may shift from one location to another, over time, due to natural processes.

WARNING AND DISCLAIMER OF LIABILITY PURSUANT TO S.R.C §37-22
"The degree of flood protection provided by the requirements in this article is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. Floods larger than the base flood can and will occur on rare occasions. Floodwater heights may be increased by man-made or natural causes. This article (Chapter 37, Article II) shall not create liability on the part of the city, any officer or employee thereof, or the federal government for any flood damages that result from reliance on this article or any administrative decision lawfully made thereunder."

Compliance with Drainage and Floodplain Regulations and Ordinances does not insure complete protection from flooding. The Floodplain Regulations and Ordinances meet established local and federal standards for floodplain management, but neither this review nor the Regulations and Ordinances take into account such flood related problems as natural erosion, streambed meander or man-made obstructions and diversions, all of which may have an adverse affect in the event of a flood. You are advised to consult your own engineer or other expert regarding these considerations.

I have read and understand the above. If I am an agent for an owner I have made the owner aware of and explained this disclaimer.

X-XX-XXXX		4/3/20
Plan Check No.	Owner or Agent	Date

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APPENDIX D

Topographic Map of Onsite Conditions

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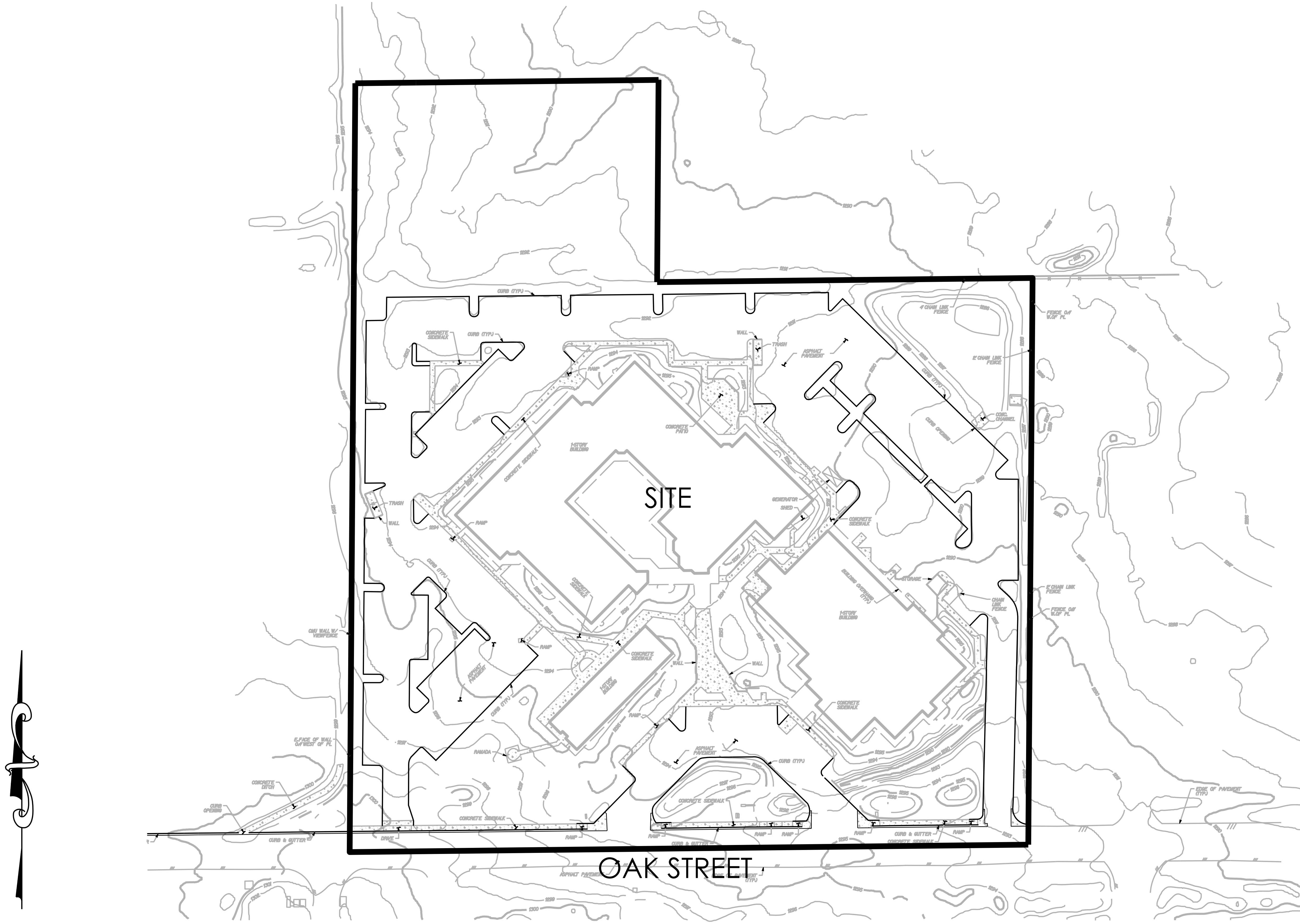

SCALE: 1"=100'

0' 50' 100' 200'

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WWW.3ENGINEERING.COM

DATE: 4/3/20

PROJECT NO. 5153

64TH ST & OAK
SCOTTSDALE, ARIZONA

TOPOGRAPHIC MAP

7-ZN-2020
4/30/2020

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APPENDIX E

Aerial Photograph of Site

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4/30/2020

SCALE: 1"=100'

0' 50' 100' 200'

64TH ST & OAK
SCOTTSDALE, ARIZONA

AERIAL MAP

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7-ZN-2020
4/30/2020

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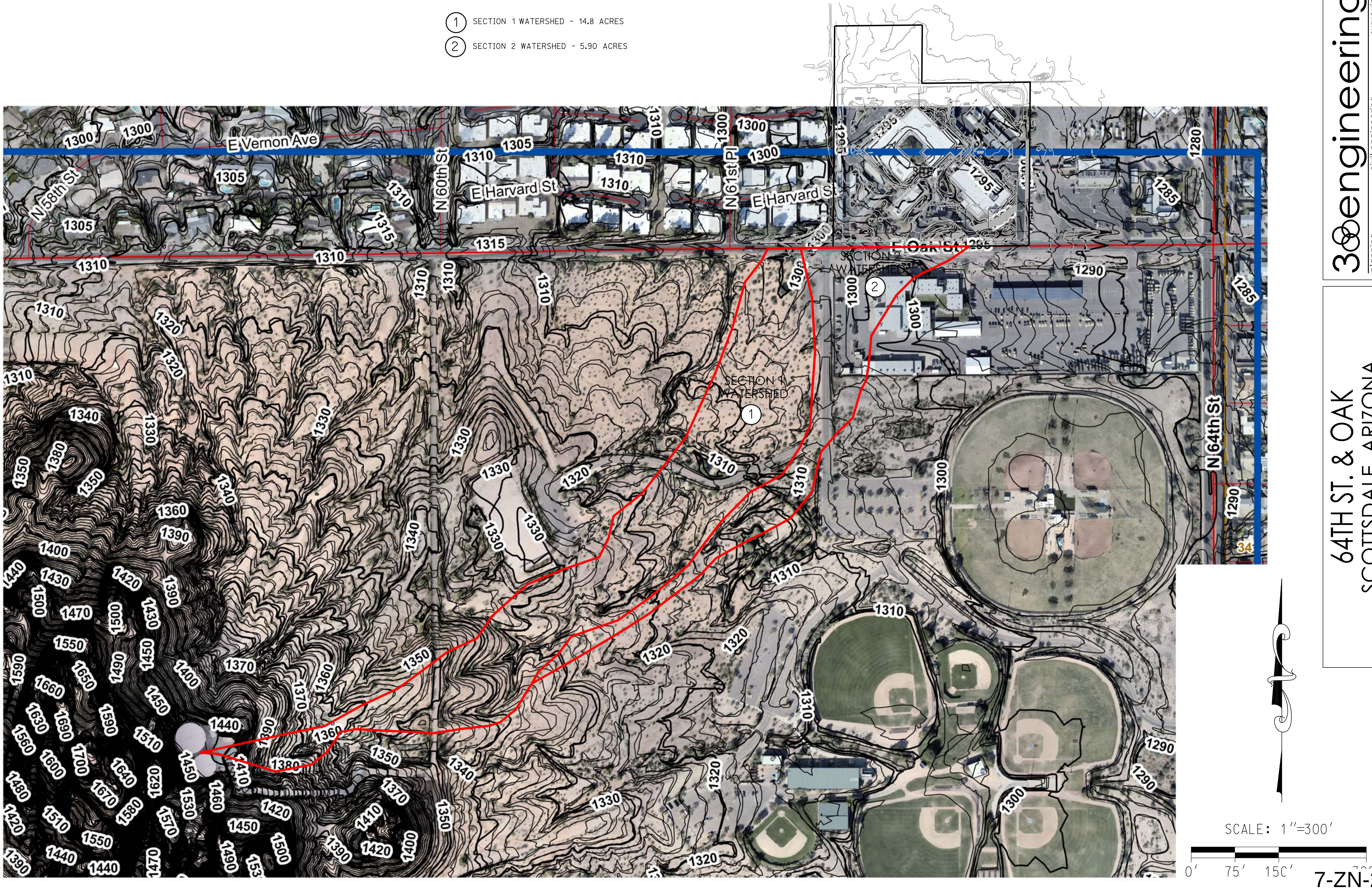
APPENDIX F

Drainage Maps
(incl. Lower Indian Bend Wash FLO2D)



64TH ST. & OAK
SCOTTSDALE, ARIZONA
OFFSITE DRAINAGE MAP

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DATE: 4/3/20

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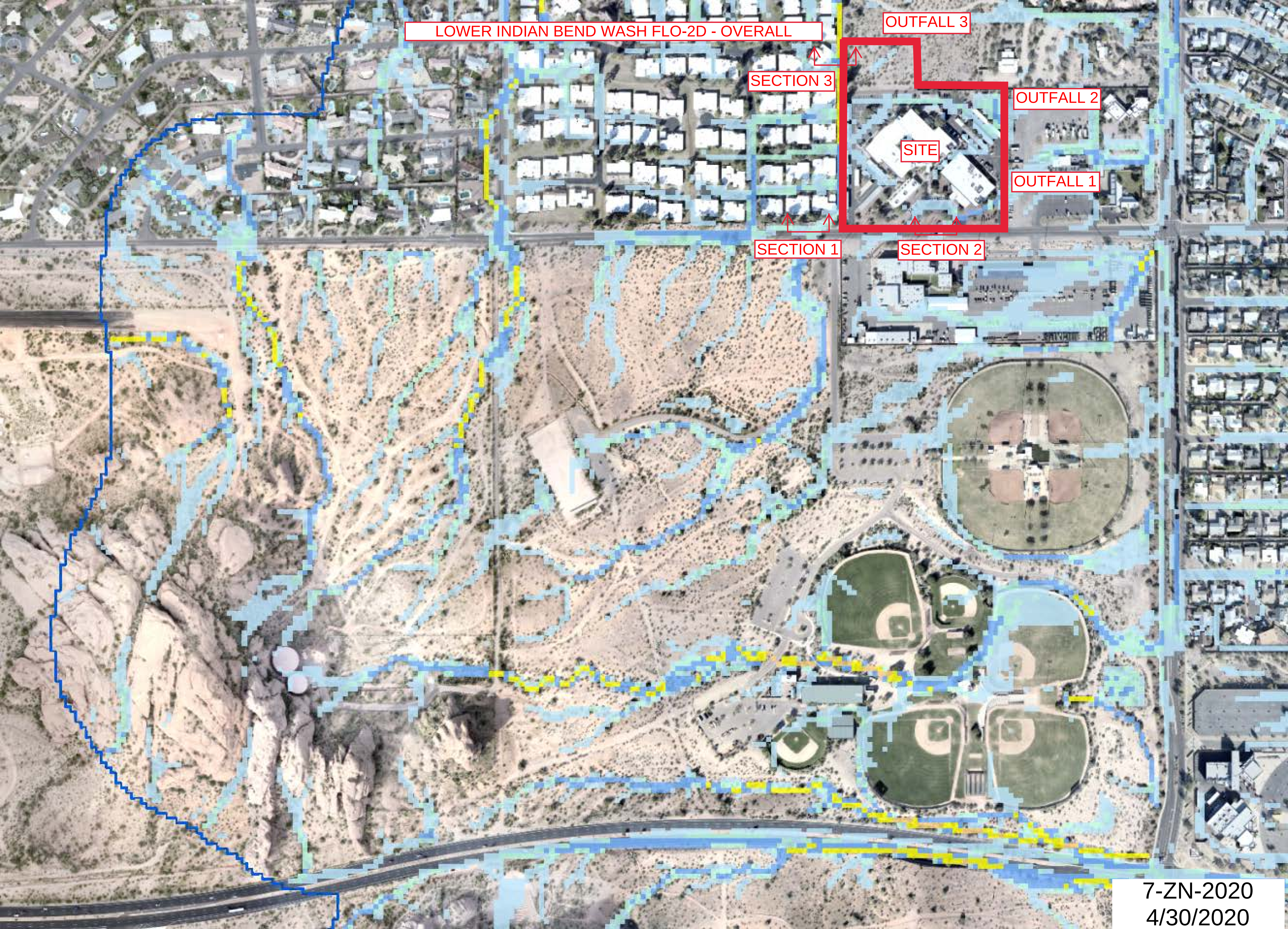

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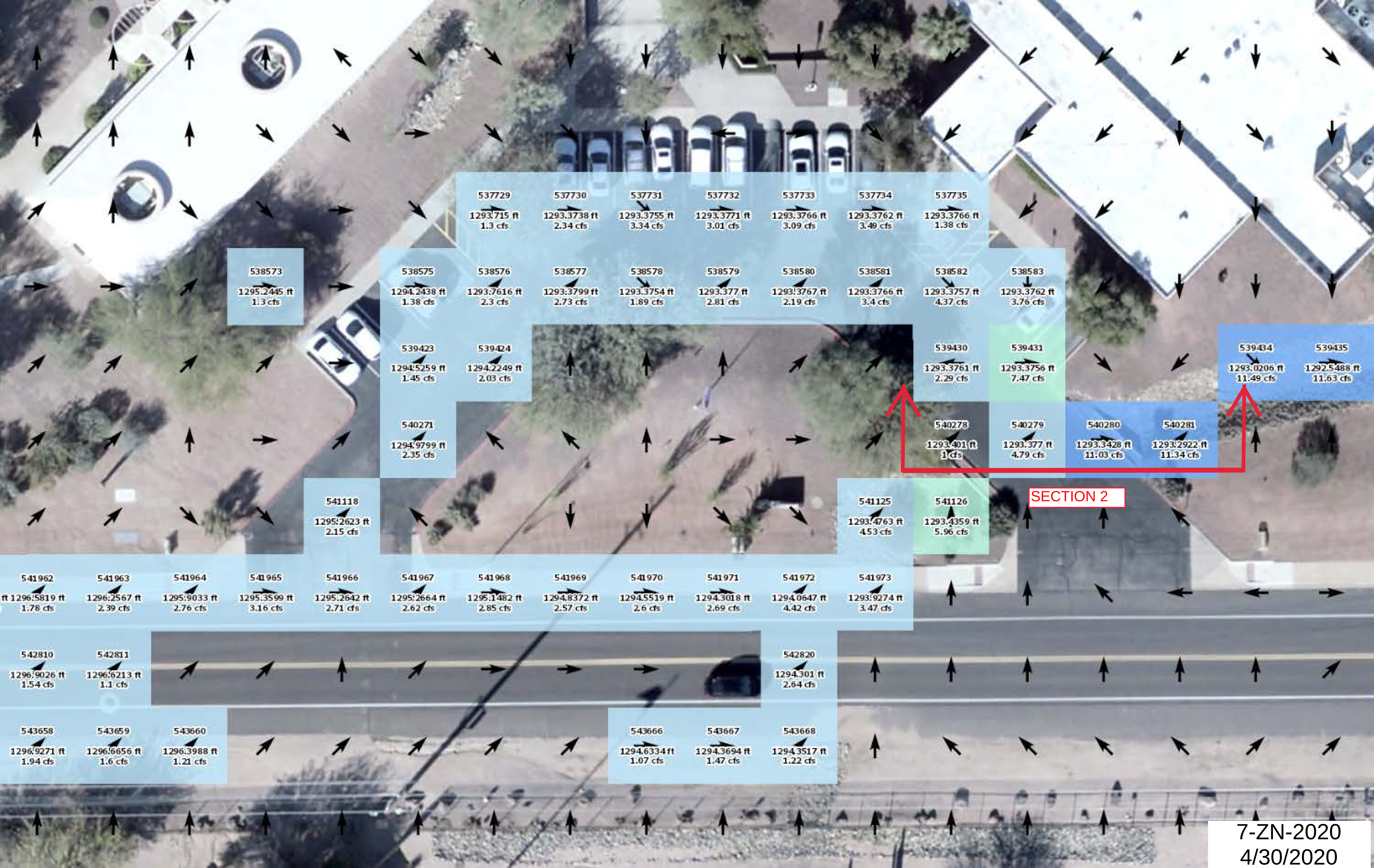

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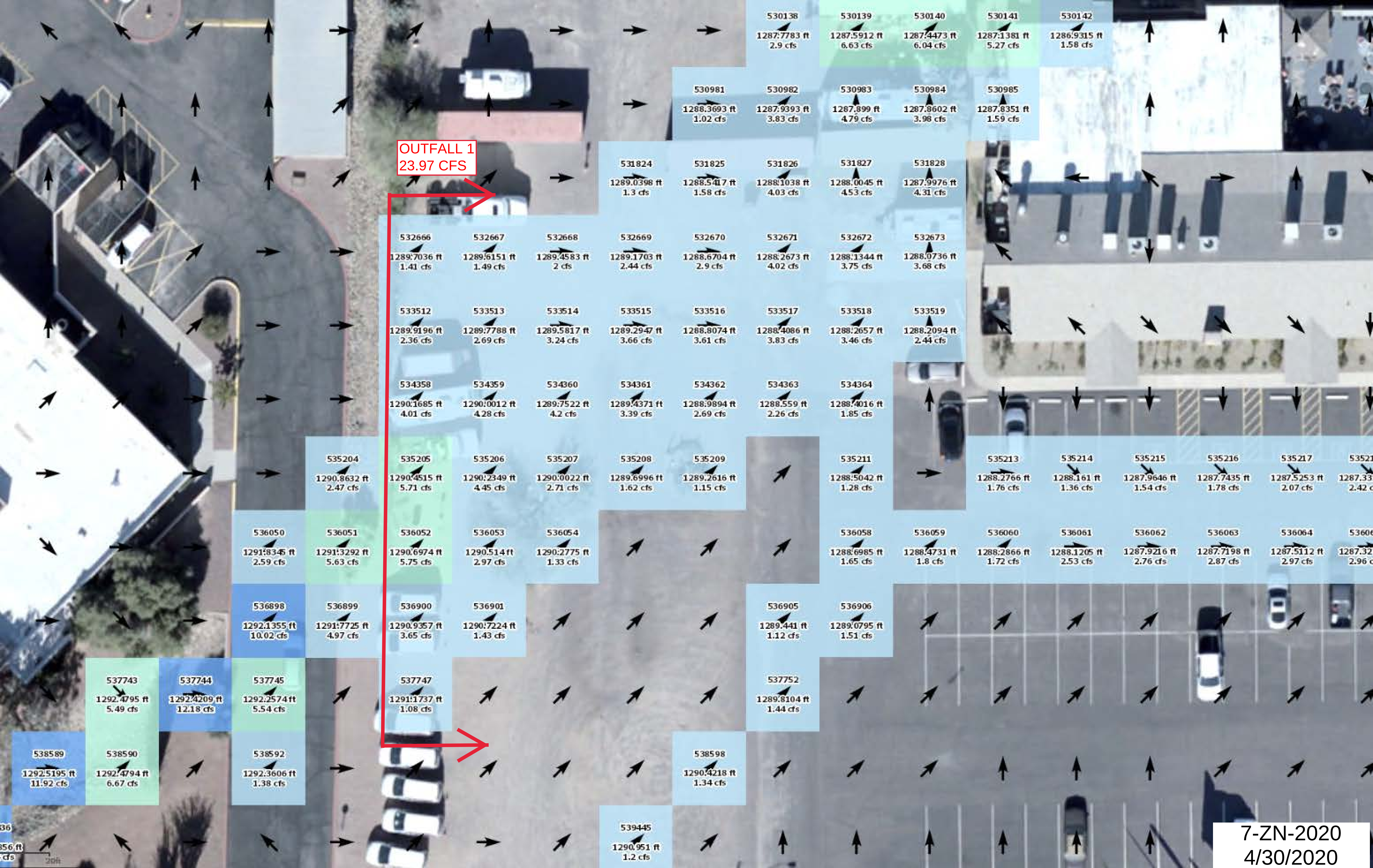

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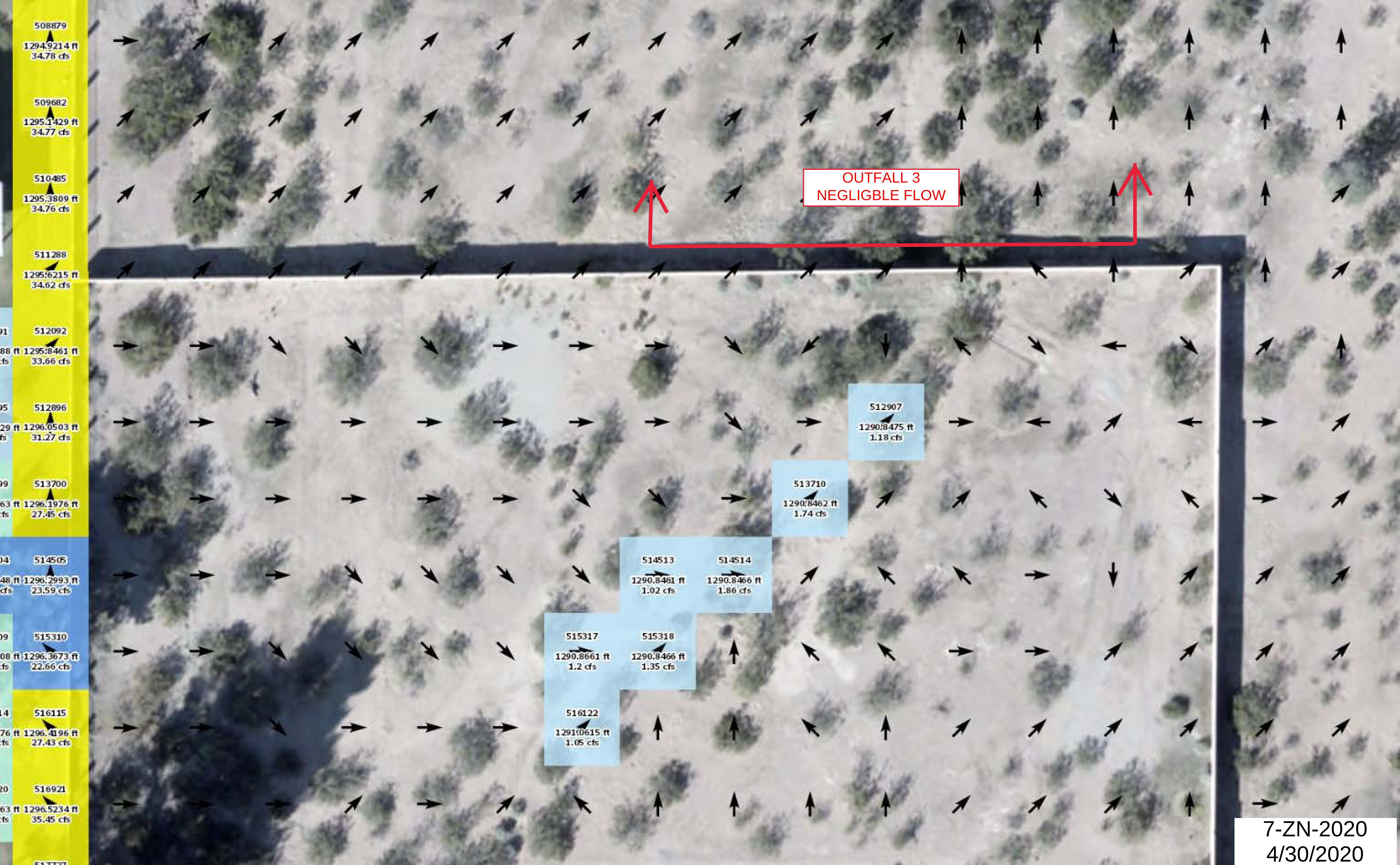

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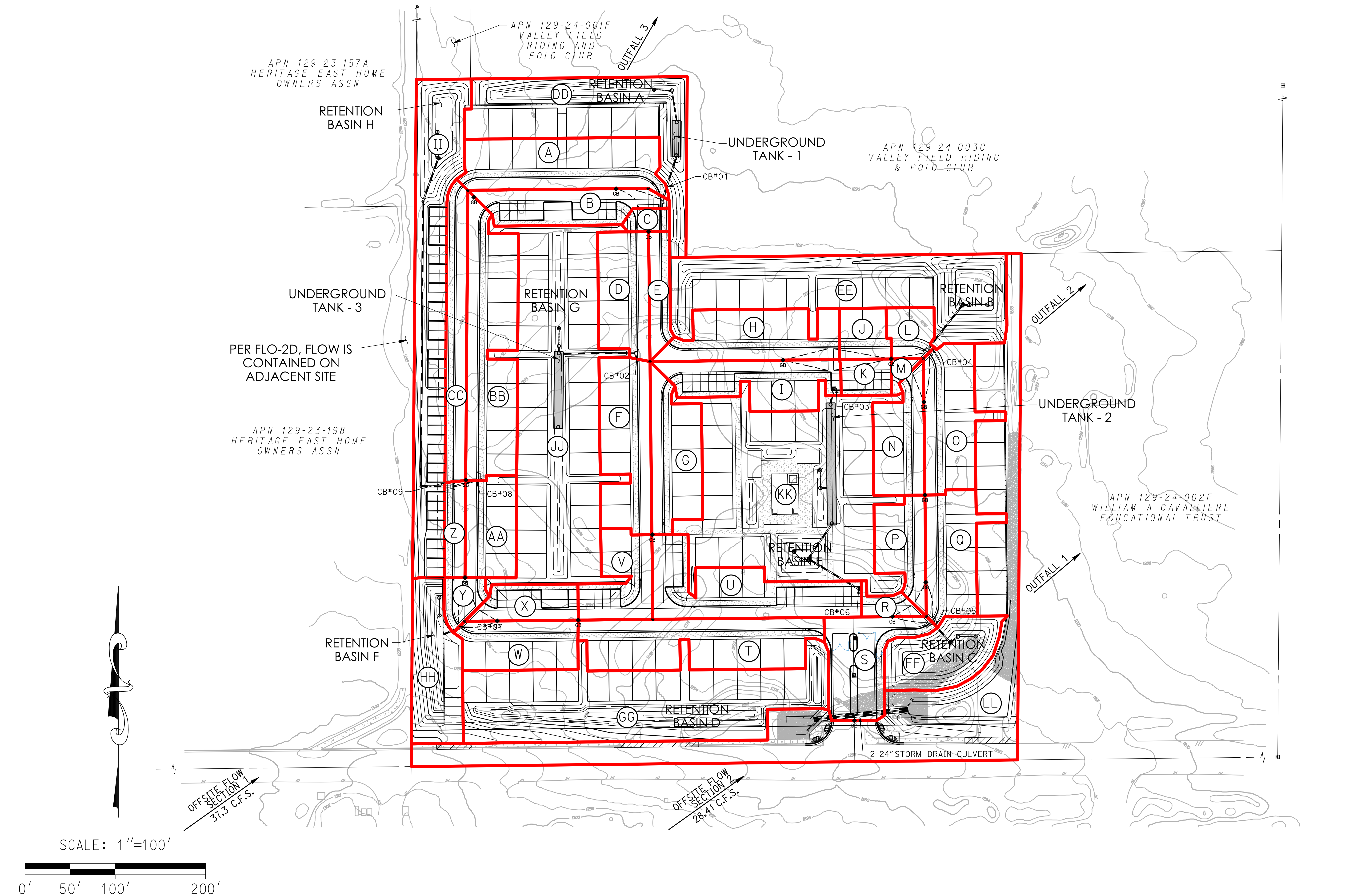

64TH ST. & OAK
SCOTTSDALE, ARIZONA

DRAINAGE MAP

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DATE: 4/3/20

PROJECT NO. 5153

7-ZN-2020
4/30/2020

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APPENDIX G

Onsite Hydrologic and Hydraulic Calculations

NOAA Atlas 14, Volume 1, Version 5
Location name: Scottsdale, Arizona, USA*
Latitude: 33.4734°, Longitude: -111.9472°
Elevation: 1300.97 ft**

* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.180 (0.152-0.218)	0.236 (0.200-0.285)	0.321 (0.270-0.386)	0.386 (0.323-0.463)	0.475 (0.391-0.566)	0.543 (0.441-0.645)	0.613 (0.488-0.725)	0.684 (0.536-0.809)	0.780 (0.594-0.924)	0.853 (0.637-1.01)
10-min	0.274 (0.231-0.332)	0.358 (0.304-0.433)	0.489 (0.410-0.587)	0.588 (0.492-0.704)	0.722 (0.595-0.861)	0.827 (0.671-0.981)	0.933 (0.743-1.10)	1.04 (0.816-1.23)	1.19 (0.905-1.41)	1.30 (0.970-1.54)
15-min	0.340 (0.286-0.411)	0.444 (0.376-0.537)	0.605 (0.509-0.728)	0.729 (0.609-0.873)	0.895 (0.737-1.07)	1.02 (0.832-1.22)	1.16 (0.921-1.37)	1.29 (1.01-1.53)	1.47 (1.12-1.74)	1.61 (1.20-1.91)
30-min	0.458 (0.386-0.554)	0.598 (0.507-0.723)	0.816 (0.686-0.980)	0.982 (0.821-1.18)	1.21 (0.993-1.44)	1.38 (1.12-1.64)	1.56 (1.24-1.84)	1.74 (1.36-2.06)	1.98 (1.51-2.35)	2.17 (1.62-2.57)
60-min	0.566 (0.477-0.685)	0.740 (0.627-0.895)	1.01 (0.848-1.21)	1.22 (1.02-1.45)	1.49 (1.23-1.78)	1.71 (1.39-2.03)	1.93 (1.54-2.28)	2.15 (1.69-2.54)	2.45 (1.87-2.90)	2.68 (2.01-3.19)
2-hr	0.656 (0.563-0.778)	0.850 (0.729-1.01)	1.14 (0.976-1.35)	1.36 (1.15-1.61)	1.66 (1.39-1.95)	1.90 (1.56-2.22)	2.14 (1.74-2.50)	2.38 (1.90-2.78)	2.71 (2.11-3.17)	2.96 (2.25-3.48)
3-hr	0.710 (0.605-0.846)	0.911 (0.781-1.09)	1.20 (1.02-1.43)	1.43 (1.21-1.69)	1.75 (1.46-2.06)	2.01 (1.65-2.36)	2.27 (1.83-2.67)	2.55 (2.03-2.99)	2.94 (2.26-3.45)	3.25 (2.44-3.83)
6-hr	0.856 (0.745-1.00)	1.09 (0.949-1.27)	1.40 (1.22-1.63)	1.64 (1.42-1.91)	1.98 (1.68-2.28)	2.24 (1.88-2.58)	2.52 (2.08-2.90)	2.80 (2.26-3.23)	3.19 (2.51-3.68)	3.49 (2.69-4.05)
12-hr	0.961 (0.844-1.11)	1.22 (1.07-1.41)	1.55 (1.35-1.78)	1.80 (1.56-2.08)	2.15 (1.84-2.47)	2.42 (2.05-2.77)	2.69 (2.25-3.09)	2.97 (2.45-3.41)	3.34 (2.68-3.86)	3.63 (2.87-4.22)
24-hr	1.16 (1.04-1.31)	1.48 (1.32-1.66)	1.91 (1.71-2.15)	2.26 (2.01-2.53)	2.74 (2.42-3.07)	3.11 (2.73-3.48)	3.51 (3.05-3.92)	3.92 (3.38-4.38)	4.48 (3.83-5.01)	4.93 (4.17-5.52)
2-day	1.25 (1.12-1.41)	1.61 (1.44-1.81)	2.11 (1.88-2.37)	2.51 (2.23-2.81)	3.07 (2.72-3.44)	3.51 (3.09-3.93)	3.98 (3.49-4.47)	4.47 (3.88-5.02)	5.16 (4.43-5.80)	5.71 (4.85-6.44)
3-day	1.33 (1.19-1.49)	1.70 (1.52-1.91)	2.23 (1.99-2.50)	2.66 (2.37-2.98)	3.27 (2.89-3.66)	3.76 (3.30-4.20)	4.27 (3.73-4.78)	4.82 (4.17-5.40)	5.58 (4.77-6.26)	6.20 (5.25-6.97)
4-day	1.40 (1.25-1.57)	1.79 (1.60-2.01)	2.36 (2.10-2.64)	2.82 (2.50-3.15)	3.47 (3.06-3.88)	4.00 (3.51-4.47)	4.56 (3.97-5.10)	5.16 (4.46-5.77)	6.00 (5.12-6.72)	6.69 (5.64-7.50)
7-day	1.55 (1.38-1.74)	1.98 (1.77-2.22)	2.61 (2.32-2.93)	3.12 (2.77-3.50)	3.84 (3.39-4.30)	4.42 (3.89-4.95)	5.05 (4.40-5.65)	5.70 (4.93-6.39)	6.63 (5.66-7.43)	7.38 (6.23-8.28)
10-day	1.68 (1.50-1.89)	2.15 (1.92-2.42)	2.84 (2.53-3.18)	3.39 (3.01-3.80)	4.17 (3.68-4.65)	4.79 (4.20-5.34)	5.44 (4.75-6.08)	6.14 (5.31-6.86)	7.11 (6.08-7.95)	7.89 (6.68-8.84)
20-day	2.06 (1.85-2.31)	2.66 (2.38-2.96)	3.51 (3.14-3.90)	4.15 (3.70-4.61)	5.01 (4.45-5.57)	5.68 (5.02-6.31)	6.35 (5.60-7.07)	7.04 (6.17-7.84)	7.96 (6.92-8.89)	8.68 (7.48-9.70)
30-day	2.41 (2.15-2.69)	3.10 (2.77-3.46)	4.09 (3.65-4.55)	4.83 (4.30-5.37)	5.84 (5.17-6.49)	6.61 (5.83-7.33)	7.40 (6.50-8.21)	8.20 (7.17-9.10)	9.29 (8.06-10.3)	10.1 (8.71-11.3)
45-day	2.79 (2.51-3.12)	3.60 (3.23-4.01)	4.74 (4.25-5.28)	5.59 (4.99-6.22)	6.70 (5.97-7.45)	7.53 (6.69-8.38)	8.38 (7.41-9.32)	9.23 (8.12-10.3)	10.3 (9.03-11.5)	11.2 (9.71-12.5)
60-day	3.10 (2.79-3.45)	4.00 (3.60-4.44)	5.26 (4.72-5.84)	6.17 (5.53-6.86)	7.37 (6.58-8.18)	8.25 (7.34-9.16)	9.14 (8.10-10.2)	10.00 (8.83-11.1)	11.1 (9.77-12.4)	12.0 (10.4-13.4)

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

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

Please refer to NOAA Atlas 14 document for more information.

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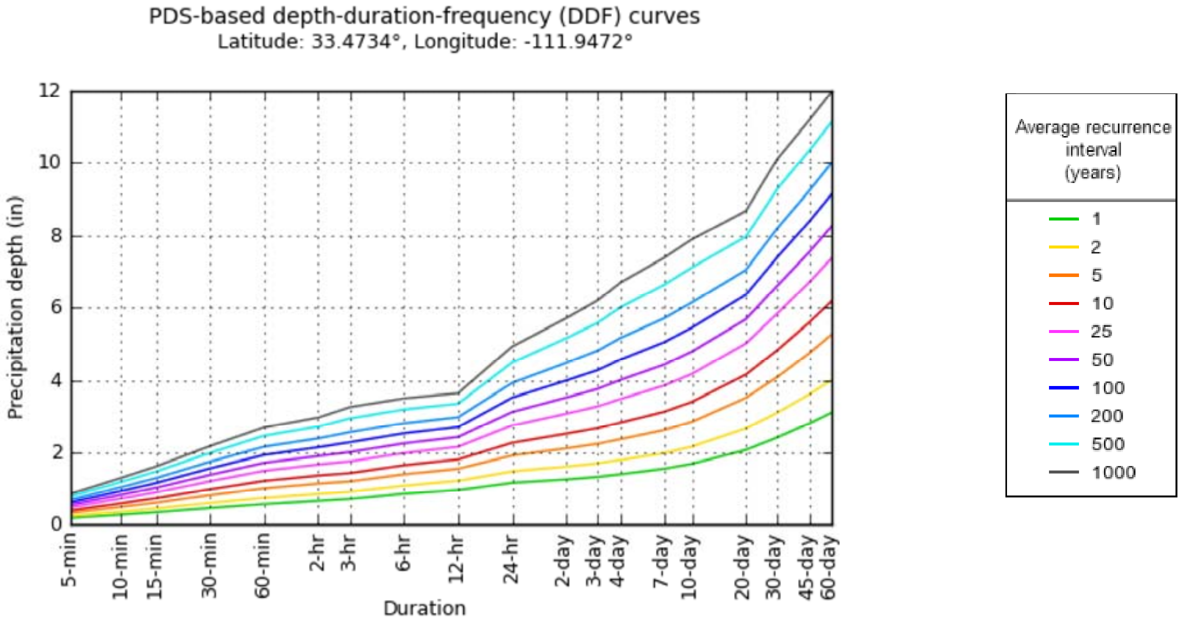
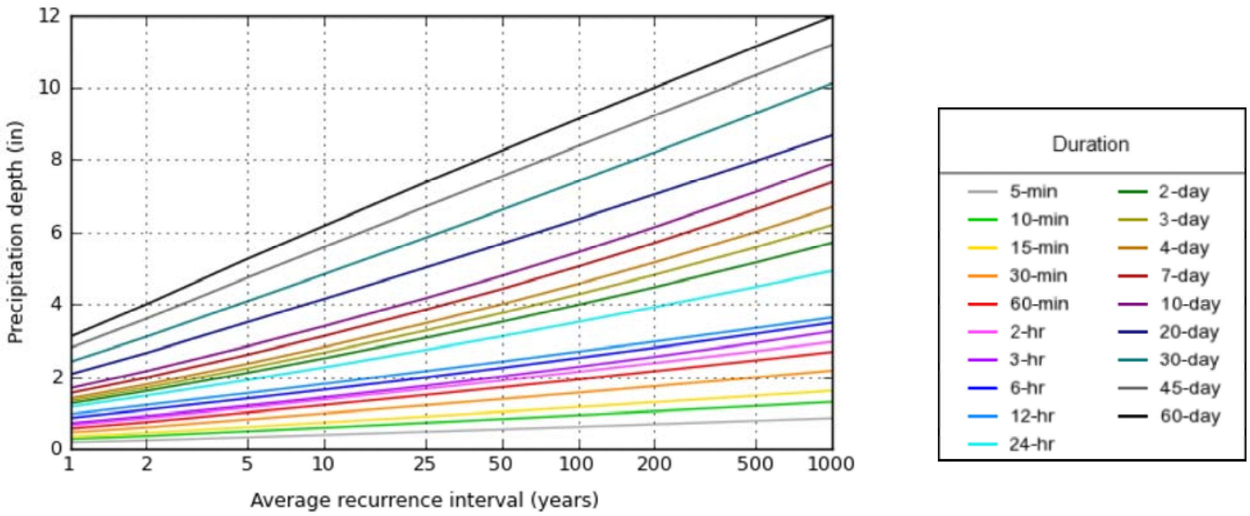
PF graphical





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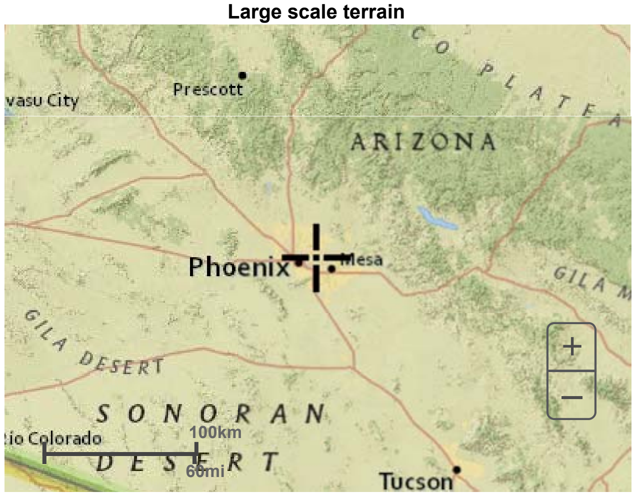
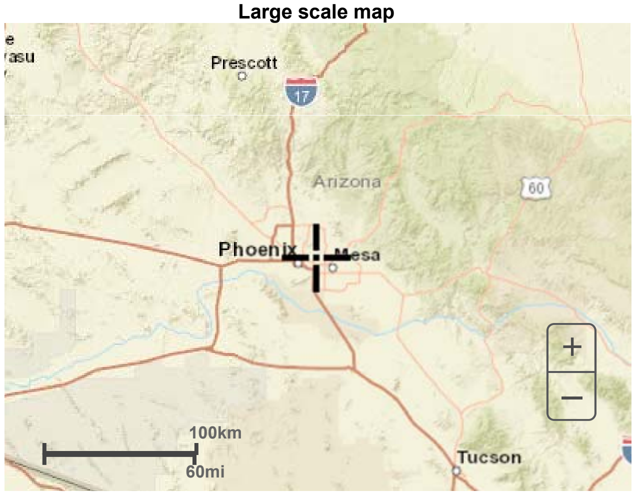
Maps & aerials

Small scale terrain

Large scale terrain



Large scale map



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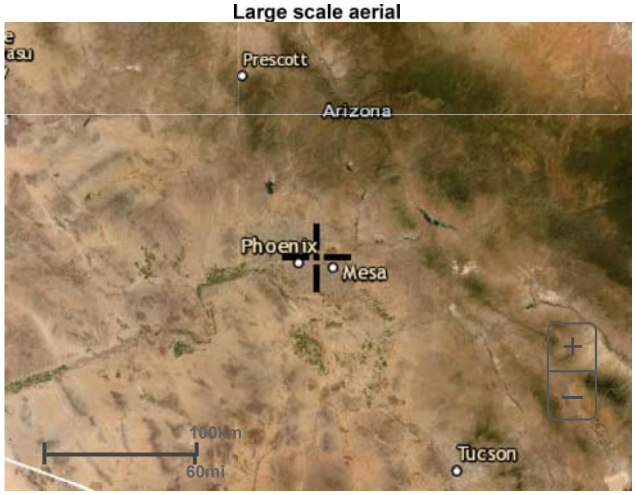
Large scale aerial



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National Oceanic and Atmospheric Administration
National Weather Service
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Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

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NOAA Atlas 14, Volume 1, Version 5
Location name: Scottsdale, Arizona, USA*
Latitude: 33.4734°, Longitude: -111.9472°
Elevation: 1300.97 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	2.16 (1.82-2.62)	2.83 (2.40-3.42)	3.85 (3.24-4.63)	4.63 (3.88-5.56)	5.70 (4.69-6.79)	6.52 (5.29-7.74)	7.36 (5.86-8.70)	8.21 (6.43-9.71)	9.36 (7.13-11.1)	10.2 (7.64-12.2)
10-min	1.64 (1.39-1.99)	2.15 (1.82-2.60)	2.93 (2.46-3.52)	3.53 (2.95-4.22)	4.33 (3.57-5.17)	4.96 (4.03-5.89)	5.60 (4.46-6.62)	6.25 (4.90-7.39)	7.12 (5.43-8.44)	7.79 (5.82-9.25)
15-min	1.36 (1.14-1.64)	1.78 (1.50-2.15)	2.42 (2.04-2.91)	2.92 (2.44-3.49)	3.58 (2.95-4.27)	4.10 (3.33-4.86)	4.62 (3.68-5.47)	5.16 (4.05-6.11)	5.88 (4.48-6.97)	6.44 (4.81-7.64)
30-min	0.916 (0.772-1.11)	1.20 (1.01-1.45)	1.63 (1.37-1.96)	1.96 (1.64-2.35)	2.41 (1.99-2.87)	2.76 (2.24-3.28)	3.11 (2.48-3.68)	3.48 (2.72-4.11)	3.96 (3.02-4.69)	4.34 (3.24-5.15)
60-min	0.566 (0.477-0.685)	0.740 (0.627-0.895)	1.01 (0.848-1.21)	1.22 (1.02-1.45)	1.49 (1.23-1.78)	1.71 (1.39-2.03)	1.93 (1.54-2.28)	2.15 (1.69-2.54)	2.45 (1.87-2.90)	2.68 (2.01-3.19)
2-hr	0.328 (0.282-0.389)	0.425 (0.364-0.505)	0.570 (0.488-0.674)	0.681 (0.576-0.802)	0.832 (0.695-0.974)	0.948 (0.782-1.11)	1.07 (0.868-1.25)	1.19 (0.948-1.39)	1.35 (1.05-1.58)	1.48 (1.13-1.74)
3-hr	0.236 (0.201-0.282)	0.303 (0.260-0.363)	0.400 (0.341-0.476)	0.476 (0.402-0.563)	0.582 (0.486-0.686)	0.668 (0.549-0.784)	0.757 (0.611-0.888)	0.849 (0.674-0.996)	0.978 (0.752-1.15)	1.08 (0.812-1.27)
6-hr	0.143 (0.124-0.168)	0.181 (0.158-0.212)	0.233 (0.203-0.272)	0.274 (0.237-0.319)	0.330 (0.281-0.381)	0.375 (0.314-0.431)	0.421 (0.347-0.484)	0.467 (0.378-0.539)	0.532 (0.420-0.615)	0.583 (0.449-0.676)
12-hr	0.080 (0.070-0.092)	0.101 (0.089-0.117)	0.128 (0.112-0.148)	0.150 (0.130-0.172)	0.179 (0.153-0.205)	0.201 (0.170-0.230)	0.223 (0.187-0.256)	0.246 (0.203-0.283)	0.277 (0.223-0.320)	0.302 (0.238-0.351)
24-hr	0.048 (0.043-0.054)	0.062 (0.055-0.069)	0.080 (0.071-0.090)	0.094 (0.084-0.106)	0.114 (0.101-0.128)	0.130 (0.114-0.145)	0.146 (0.127-0.163)	0.163 (0.141-0.182)	0.187 (0.159-0.209)	0.205 (0.174-0.230)
2-day	0.026 (0.023-0.029)	0.033 (0.030-0.038)	0.044 (0.039-0.049)	0.052 (0.047-0.059)	0.064 (0.057-0.072)	0.073 (0.064-0.082)	0.083 (0.073-0.093)	0.093 (0.081-0.105)	0.107 (0.092-0.121)	0.119 (0.101-0.134)
3-day	0.018 (0.016-0.021)	0.024 (0.021-0.026)	0.031 (0.028-0.035)	0.037 (0.033-0.041)	0.045 (0.040-0.051)	0.052 (0.046-0.058)	0.059 (0.052-0.066)	0.067 (0.058-0.075)	0.078 (0.066-0.087)	0.086 (0.073-0.097)
4-day	0.015 (0.013-0.016)	0.019 (0.017-0.021)	0.025 (0.022-0.028)	0.029 (0.026-0.033)	0.036 (0.032-0.040)	0.042 (0.037-0.047)	0.048 (0.041-0.053)	0.054 (0.046-0.060)	0.063 (0.053-0.070)	0.070 (0.059-0.078)
7-day	0.009 (0.008-0.010)	0.012 (0.011-0.013)	0.016 (0.014-0.017)	0.019 (0.016-0.021)	0.023 (0.020-0.026)	0.026 (0.023-0.029)	0.030 (0.026-0.034)	0.034 (0.029-0.038)	0.039 (0.034-0.044)	0.044 (0.037-0.049)
10-day	0.007 (0.006-0.008)	0.009 (0.008-0.010)	0.012 (0.011-0.013)	0.014 (0.013-0.016)	0.017 (0.015-0.019)	0.020 (0.018-0.022)	0.023 (0.020-0.025)	0.026 (0.022-0.029)	0.030 (0.025-0.033)	0.033 (0.028-0.037)
20-day	0.004 (0.004-0.005)	0.006 (0.005-0.006)	0.007 (0.007-0.008)	0.009 (0.008-0.010)	0.010 (0.009-0.012)	0.012 (0.010-0.013)	0.013 (0.012-0.015)	0.015 (0.013-0.016)	0.017 (0.014-0.019)	0.018 (0.016-0.020)
30-day	0.003 (0.003-0.004)	0.004 (0.004-0.005)	0.006 (0.005-0.006)	0.007 (0.006-0.007)	0.008 (0.007-0.009)	0.009 (0.008-0.010)	0.010 (0.009-0.011)	0.011 (0.010-0.013)	0.013 (0.011-0.014)	0.014 (0.012-0.016)
45-day	0.003 (0.002-0.003)	0.003 (0.003-0.004)	0.004 (0.004-0.005)	0.005 (0.005-0.006)	0.006 (0.006-0.007)	0.007 (0.006-0.008)	0.008 (0.007-0.009)	0.009 (0.008-0.010)	0.010 (0.008-0.011)	0.010 (0.009-0.012)
60-day	0.002 (0.002-0.002)	0.003 (0.002-0.003)	0.004 (0.003-0.004)	0.004 (0.004-0.005)	0.005 (0.005-0.006)	0.006 (0.005-0.006)	0.006 (0.006-0.007)	0.007 (0.006-0.008)	0.008 (0.007-0.009)	0.008 (0.007-0.009)

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

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

Please refer to NOAA Atlas 14 document for more information.

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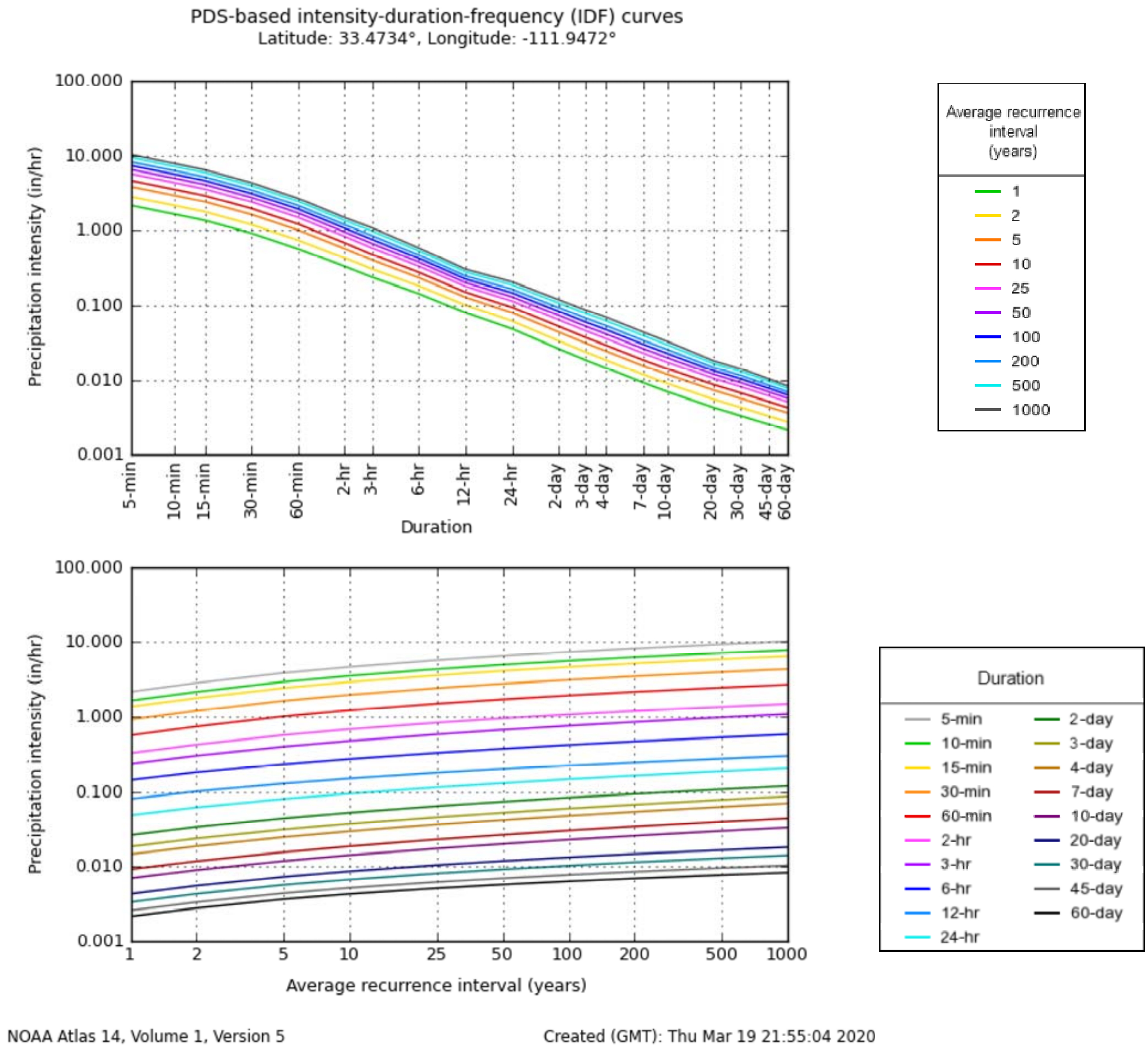
PF graphical



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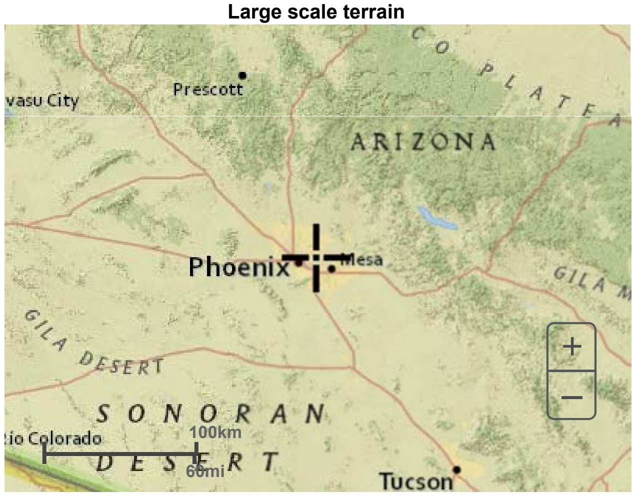
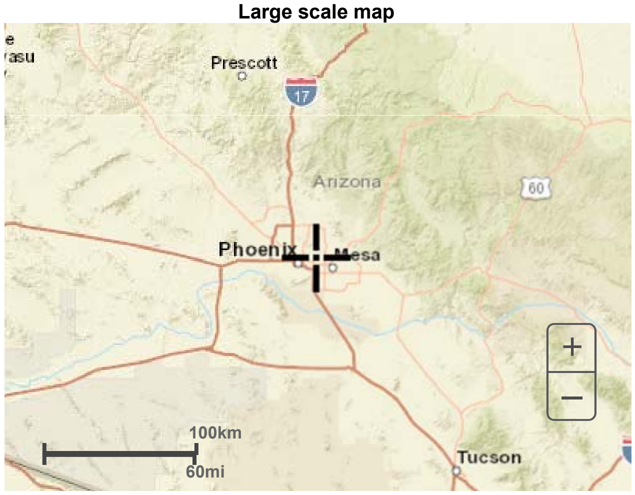
Maps & aerials

Small scale terrain

Large scale terrain



Large scale map



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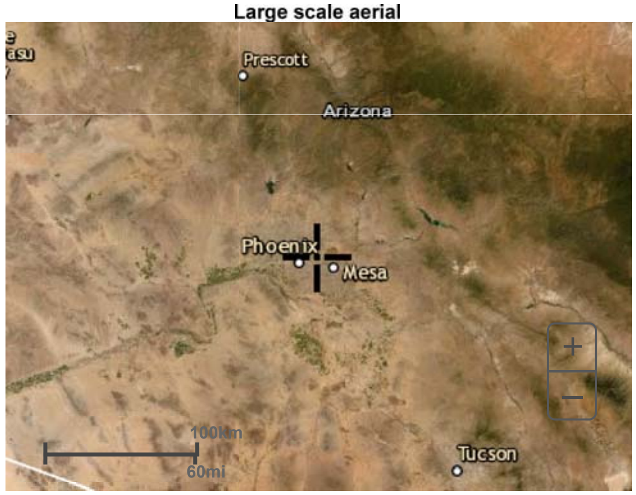
Large scale aerial



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US Department of Commerce
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Questions?: HDSC.Questions@noaa.gov

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1. The Rational Method (generally used for watersheds less than 160 acres that are regularly shaped and uniformly contoured). The methodology is provided in the FCDMC Hydrology Manual.
2. A rainfall runoff model using the USACE's HEC 1 Flood Hydrograph Package (generally used for watersheds that are larger than 160 acres, irregular in shape and contour, or if routing of flows is necessary).

B. Watershed Conditions

Watersheds are subject to change. Grading and drainage plans shall consider all watershed conditions that would result in the greatest peak discharge rate, to:

1. Size drainage facilities, and
2. Determine lowest floor elevations.

C. Split-Flow Conditions

Projects in northern parts of Scottsdale must address split-flow channel conditions where applicable. These splits in the alluvial channels usually include highly erosive soils and are generally unstable and unpredictable. In setting lowest floor elevations relative to upstream splits, assume that 100% of the flow could go either direction in any given flood event. For infrastructure design, the estimate of the actual split, based on a hydraulic analysis of the current channel cross sections, must include a minimum safety factor of 30% of the total flow. If there are extenuating factors affecting the stability of the split, the safety factor should be increased accordingly.

D. Environmentally Sensitive Lands

For special considerations regarding Environmentally Sensitive Lands, refer to the City Zoning Ordinance and DSPM Chapter 2 Section 2-2. Modification of natural watercourses with a flow of 50 cfs or greater are addressed in the City Zoning Ordinance.

E. The Rational Method

1. Precipitation. Precipitation input is rainfall intensity, "i," and can be obtained directly from NOAA 14 at http://hdsc.nws.noaa.gov/hdsc/pfds/sa/az_pfds.html
2. Time of Concentration. Time of concentration "t_c" is the total time of travel from the most hydraulically remote part of the watershed to the concentration point of interest. The calculation of "t_c" must follow FCDMC Hydrology Manual procedures.
3. Runoff Coefficients. Use Fig. 4-1.5, Runoff Coefficients for Use with Rational Method, or equivalent to obtain the runoff coefficients or "C" values. Composite "C" values for the appropriate zoning category or weighted average values calculated for the specific site are both acceptable approaches.

RUNOFF COEFFICIENTS – "C" VALUE

LAND USE	STORM FREQUENCY		
Composite Area-wide Values	2-25 Year	50 Year	100 Year
Commercial & Industrial Areas	0.80	0.83	0.86
Residential Areas – Single Family, slopes 10% or less			
R1-190	0.33	0.50	0.53

	R1-130	0.35	0.51	0.59
	R1-70	0.37	0.52	0.60
	R1-43	0.38	0.55	0.61
	R1-35	0.40	0.56	0.62
	R1-18	0.43	0.58	0.64
	R1-10	0.47	0.62	0.70
	R1-7	0.51	0.66	0.80
	R1-5	0.54	0.69	0.86
	Residential Areas – Single Family, slopes greater than 10%			
	R1-190	0.65	0.74	0.82
	R1-130	0.68	0.76	0.84
	R1-70	0.69	0.77	0.85
	R1-43	0.70	0.77	0.85
	R1-35	0.70	0.78	0.85
	R1-18	0.71	0.79	0.86
	R1-10	0.75	0.82	0.88
	R1-7	0.81	0.86	0.91
	R1-5	0.85	0.89	0.92
	Townhouse (R-2, R-4)	0.63	0.74	0.94
use for rational	Apartments & Condominiums (Condos) (R-3, R-5)	0.76	0.83	0.94
	Specified Surface Type Values			
use for weighted calc for retention	Paved streets, parking lots (concrete or asphalt), roofs, driveways, etc.	0.90	0.93	0.95
	Lawns, golf courses, & parks (grassed areas)	0.20	0.25	0.30
	Undisturbed natural desert or desert landscaping (no impervious weed barrier)	0.37	0.42	0.45
	Desert landscaping (with impervious weed barrier)	0.63	0.73	0.83
	Mountain terrain - slopes greater than 10%	0.60	0.70	0.80
	Agricultural areas (flood irrigated fields)	0.16	0.18	0.20
	Gravel floodways and shoulders	0.68	0.78	0.82

FIGURE 4-1.5 RUNOFF COEFFICIENTS FOR RATIONAL METHOD

F. HEC-1 Model

1. Minimum submittals
    a. A printout of the input data.
    b. A schematic (routing) diagram of the stream network.
    c. The runoff summary output table, including drainage basin name, area, 2, 10, and 100- year flow values.
    d. Electronic input file(s) on compact disc (CD) or digital versatile/video disc (DVD).
    e. Supporting documentation and source material for parameter selection.
    f. A narrative detailing the impact of adjustments to the modeling parameters made to address warnings and error messages.
2. Precipitation

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3 engineering
planning civil engineering surveying

64th Oak
4/2/2020

Post-Development Rational Method Calculations for Inlets (Zoning R3)

Sub-Area	Area	Area	C_{10}	C_{100}	Tc	i_{10}	i_{100}	Local Q_{10}	Local Q_{100}
	(SF)	(AC)	-	-	(min)	(in/hr)	(in/hr)	(cfs)	(cfs)
A	12427	0.29	0.76	0.94	5	4.63	7.36	1.00	1.97
B	7199	0.17	0.76	0.94	5	4.63	7.36	0.58	1.14
C	1222	0.03	0.76	0.94	5	4.63	7.36	0.10	0.19
D	7574	0.17	0.76	0.94	5	4.63	7.36	0.61	1.20
E	3069	0.07	0.76	0.94	5	4.63	7.36	0.25	0.49
F	10461	0.24	0.76	0.94	5	4.63	7.36	0.85	1.66
G	8462	0.19	0.76	0.94	5	4.63	7.36	0.68	1.34
H	9688	0.22	0.76	0.94	5	4.63	7.36	0.78	1.54
I	8644	0.20	0.76	0.94	5	4.63	7.36	0.70	1.37
J	3056	0.07	0.76	0.94	5	4.63	7.36	0.25	0.49
K	2247	0.05	0.76	0.94	5	4.63	7.36	0.18	0.36
L	2775	0.06	0.76	0.94	5	4.63	7.36	0.22	0.44
M	726	0.02	0.76	0.94	5	4.63	7.36	0.06	0.12
N	6690	0.15	0.76	0.94	5	4.63	7.36	0.54	1.06
O	9445	0.22	0.76	0.94	5	4.63	7.36	0.76	1.50
P	5395	0.12	0.76	0.94	5	4.63	7.36	0.44	0.86
Q	8245	0.19	0.76	0.94	5	4.63	7.36	0.67	1.31
R	1513	0.03	0.76	0.94	5	4.63	7.36	0.12	0.24
S	8450	0.19	0.76	0.94	5	4.63	7.36	0.68	1.34
T	14059	0.32	0.76	0.94	5	4.63	7.36	1.14	2.23
U	12536	0.29	0.76	0.94	5	4.63	7.36	1.01	1.99
V	6332	0.15	0.76	0.94	5	4.63	7.36	0.51	1.01
W	7081	0.16	0.76	0.94	5	4.63	7.36	0.57	1.12
X	4283	0.10	0.76	0.94	5	4.63	7.36	0.35	0.68
Y	2107	0.05	0.76	0.94	5	4.63	7.36	0.17	0.33
Z	2443	0.06	0.76	0.94	5	4.63	7.36	0.20	0.39
AA	6256	0.14	0.76	0.94	5	4.63	7.36	0.51	0.99
BB	15794	0.36	0.76	0.94	5	4.63	7.36	1.28	2.51
CC	7536	0.17	0.76	0.94	5	4.63	7.36	0.61	1.20
DD	19281	0.44	0.76	0.94	5	4.63	7.36	1.56	3.06
EE	26173	0.60	0.76	0.94	5	4.63	7.36	2.11	4.16
FF	7989	0.18	0.76	0.94	5	4.63	7.36	0.65	1.27
GG	31169	0.72	0.76	0.94	5	4.63	7.36	2.52	4.95
HH	9113	0.21	0.76	0.94	5	4.63	7.36	0.74	1.45
II	21695	0.50	0.76	0.94	5	4.63	7.36	1.75	3.45
JJ	38220	0.88	0.76	0.94	5	4.63	7.36	3.09	6.07
KK	40104	0.92	0.76	0.94	5	4.63	7.36	3.24	6.37
LL (1)	46551	1.07	0.76	0.94	5	4.63	7.36	3.76	7.39
Total	**436010.00**	**10.01**						**1.68**	**69.25**
SUBBASINS THAT CONTRIBUTE TO STORM DRAIN SYSTEMS									

(1) NOTE: SUBBASIN LL DOES NOT CONTRIBUTE TO BASIN. IT IS OFFSITE FLOW CONVEYANCE AREA

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3 engineering
planning civil engineering surveying

Curb Opening Catch Basin Capacity Calculations - Weir Condition

Inlet Type	Inlet Area	Q	Inlet Capacity W/25% Clogging	d	Cw	L	
		(cfs)	(cfs)	(ft)		(ft)	
CB1	A,B,C	3.31	5.09	0.50	3	6	Designed for 100yr
CB2	D,F	2.86	5.09	0.50	3	6	Designed for 100yr
CB4	L,M,N,O	3.12	5.09	0.50	3	6	Designed for 100yr
CB5	P,Q,R,S,T	5.98	7.64	0.50	3	9	Designed for 100yr
CB7	W,X,Y	2.14	2.55	0.50	3	3	Designed for 100yr
CB8	AA,BB	3.50	5.09	0.50	3	6	Designed for 100yr
CB9	Z,CC	1.58	2.55	0.50	3	3	Designed for 100yr

Q=Cw*L*d^1.5

L=(Q/(Cw*d^1.5))*1.25

Cw= 3.0 weir coefficient
Q = discharge capacity
L = curb opening length
d = flow depth
CF = clogging factor = 25% (1.25xL)

Q10 within curb
Q100 to overtop into basin

Type F Catch Basin - Grated Inlet Capacity - Weir Condition

Inlet Type	Inlet Area	Q	Inlet Capacity W/25% Clogging	d	Cw	P[1]	
		(cfs)	(cfs)	(ft)		(ft)	
CB3	E,G,H,I,J,K	5.59	10.04	0.50	3	11.83	Designed for 100yr
CB6	U,V	3.00	10.04	0.50	3	11.83	Designed for 100yr

Q=Cw*P*d^1.5

[1] **Wetted Perimeter**	**ft**
1 Type F Catch Basins	11.83
2 Type F Catch Basins	18.67
3 Type F Catch Basins	25.50
4 Type F Catch Basins	32.33

Cw= 3.0 weir coefficient
Q = discharge capacity
P = inlet perimeter
d = flow depth

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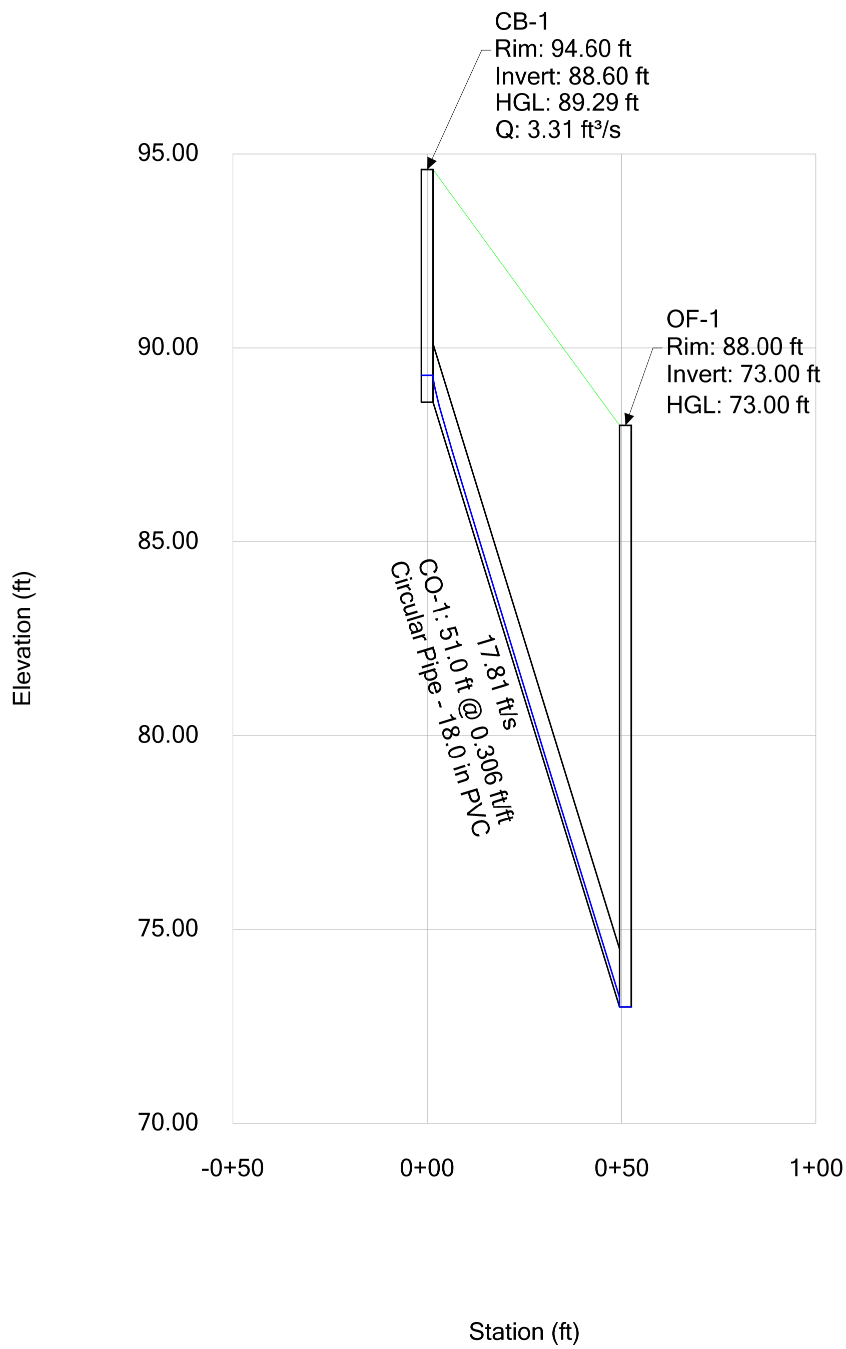
Profile Report
Engineering Profile - System 1 (5153_StormCAD.stc)



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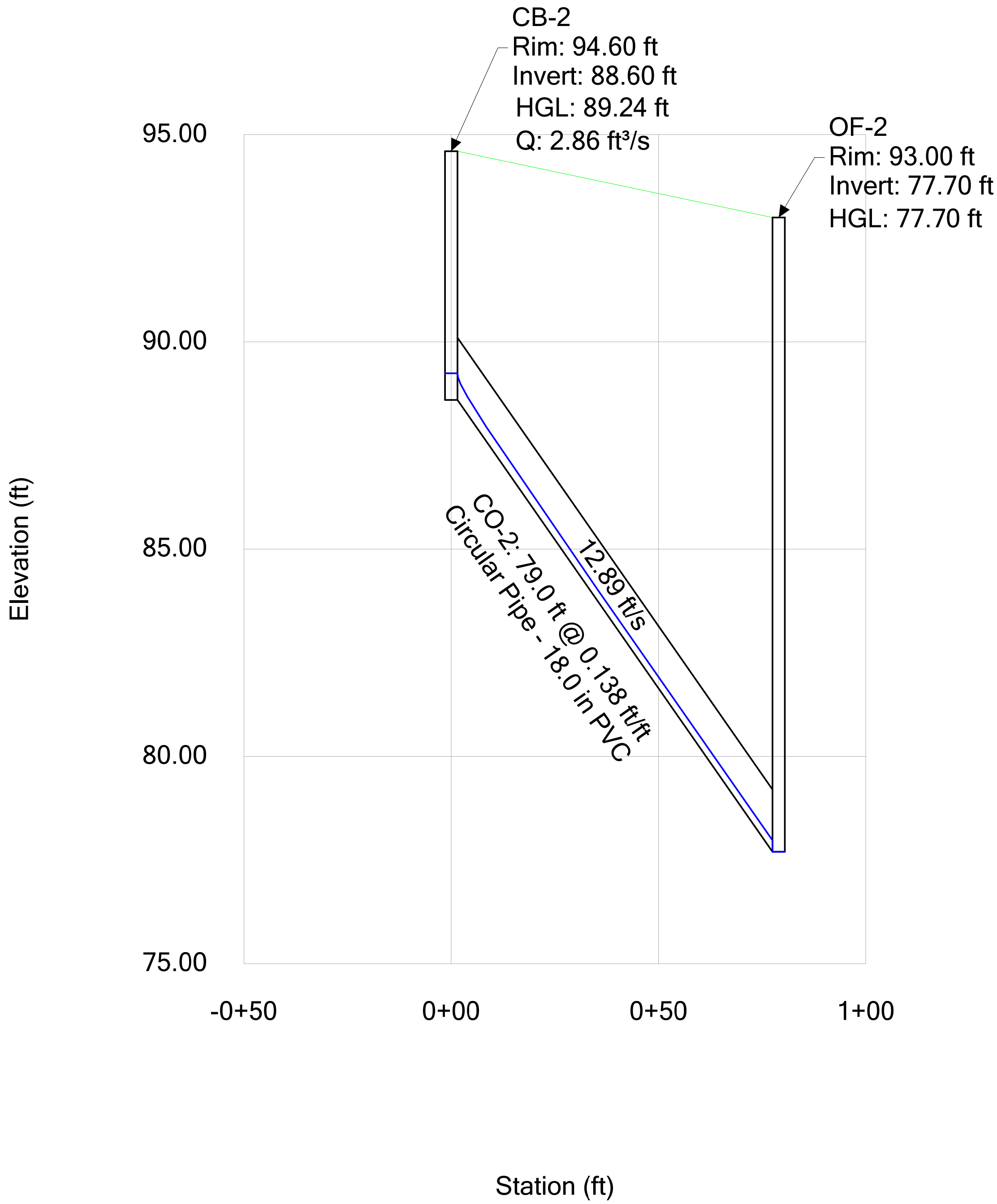
Profile Report
Engineering Profile - System 2 (5153_StormCAD.stc)



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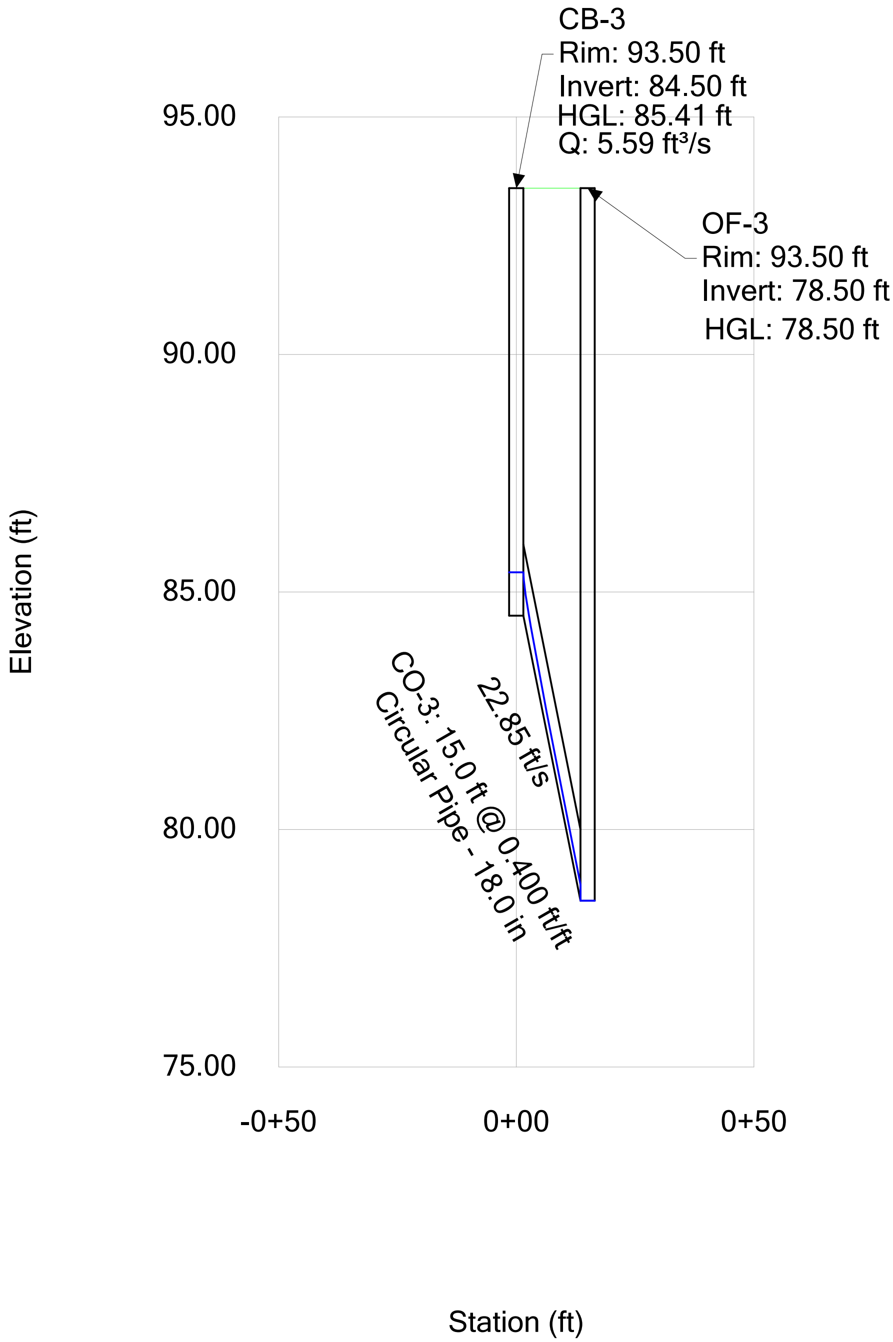
Profile Report
Engineering Profile - System 3 (5153_StormCAD.stc)



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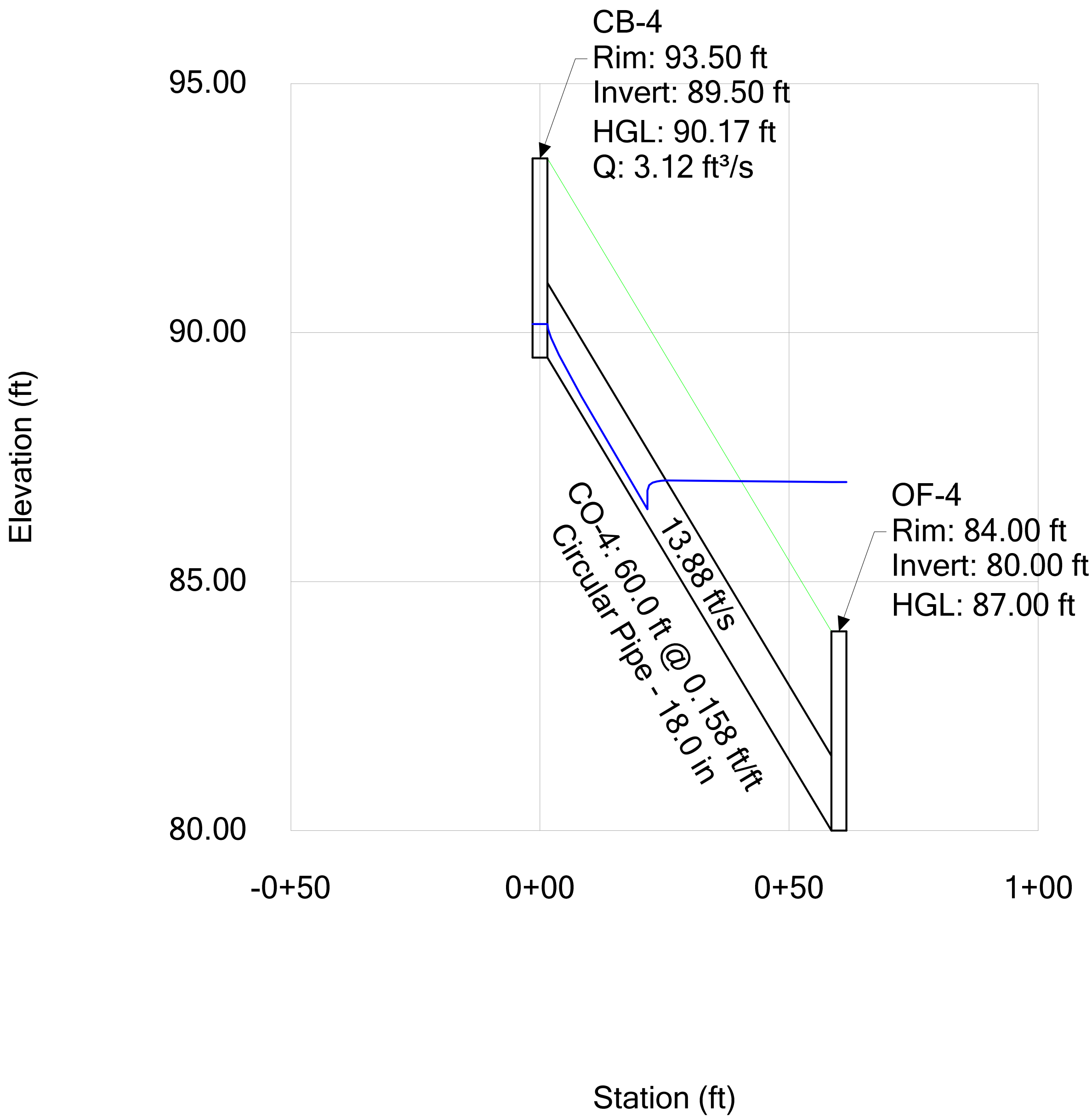
Profile Report
Engineering Profile - System 4 (5153_StormCAD.stc)



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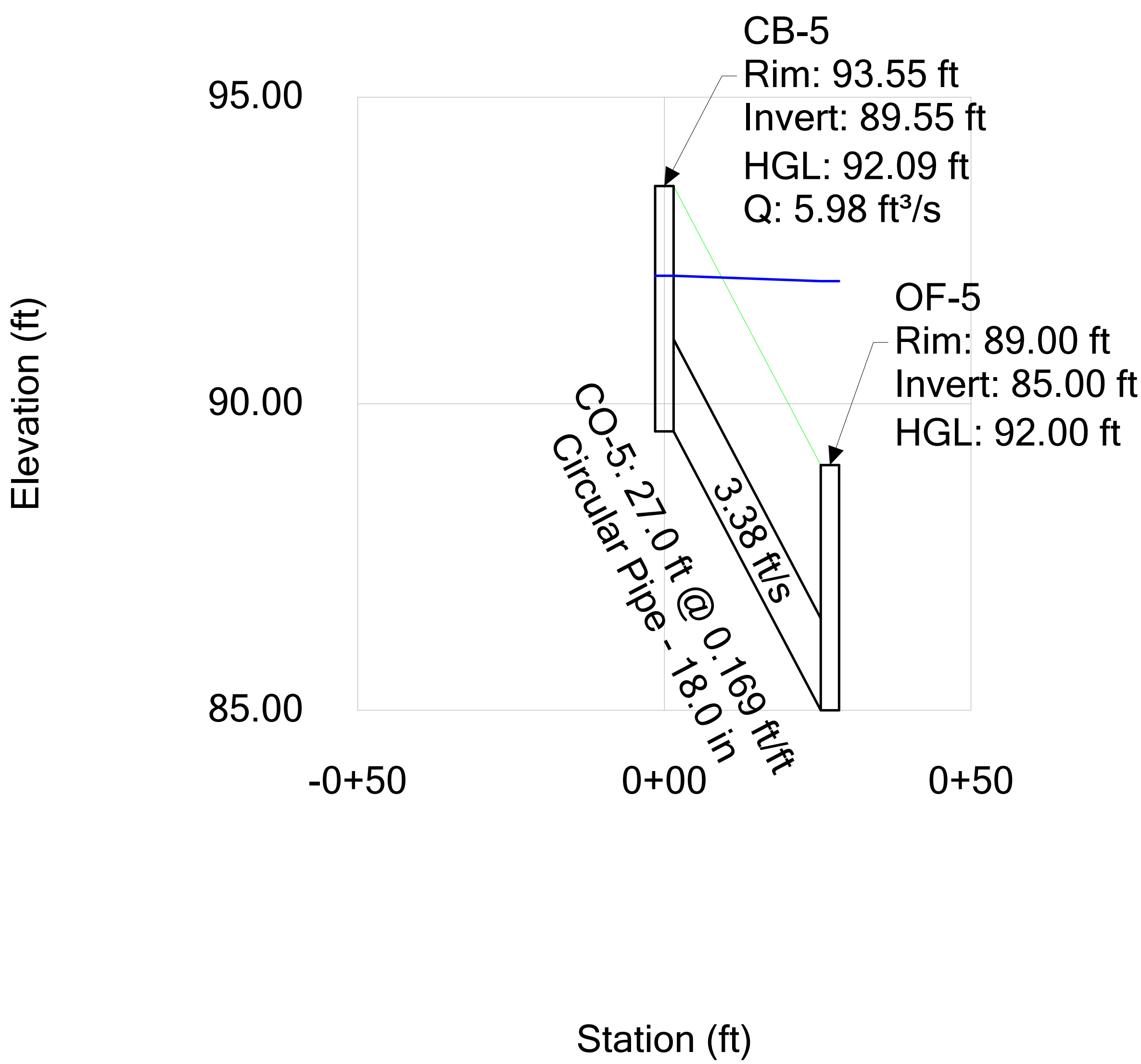
4/30/2020

Profile Report
Engineering Profile - System 5 (5153_StormCAD.stc)



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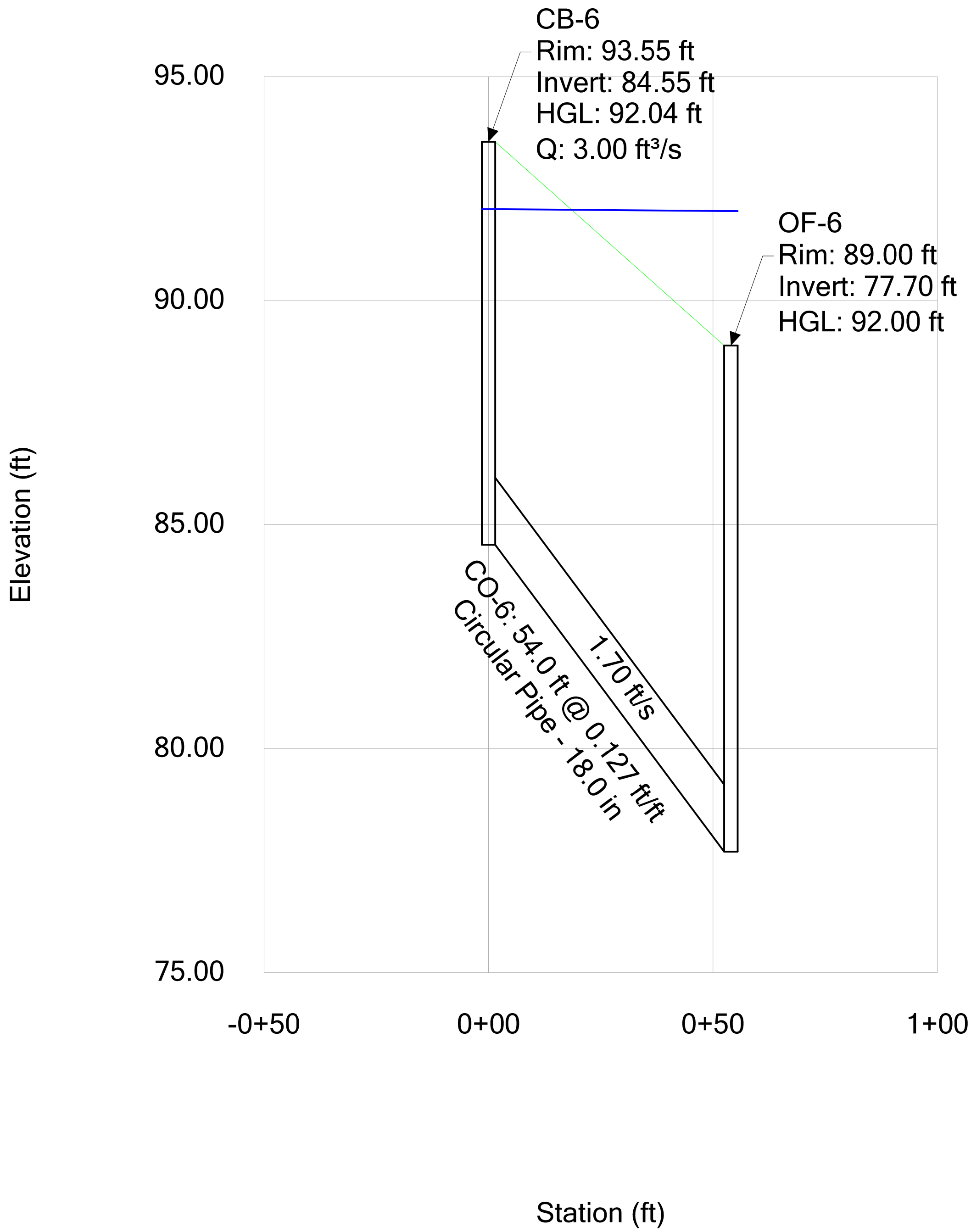
Profile Report
Engineering Profile - System 6 (5153_StormCAD.stc)



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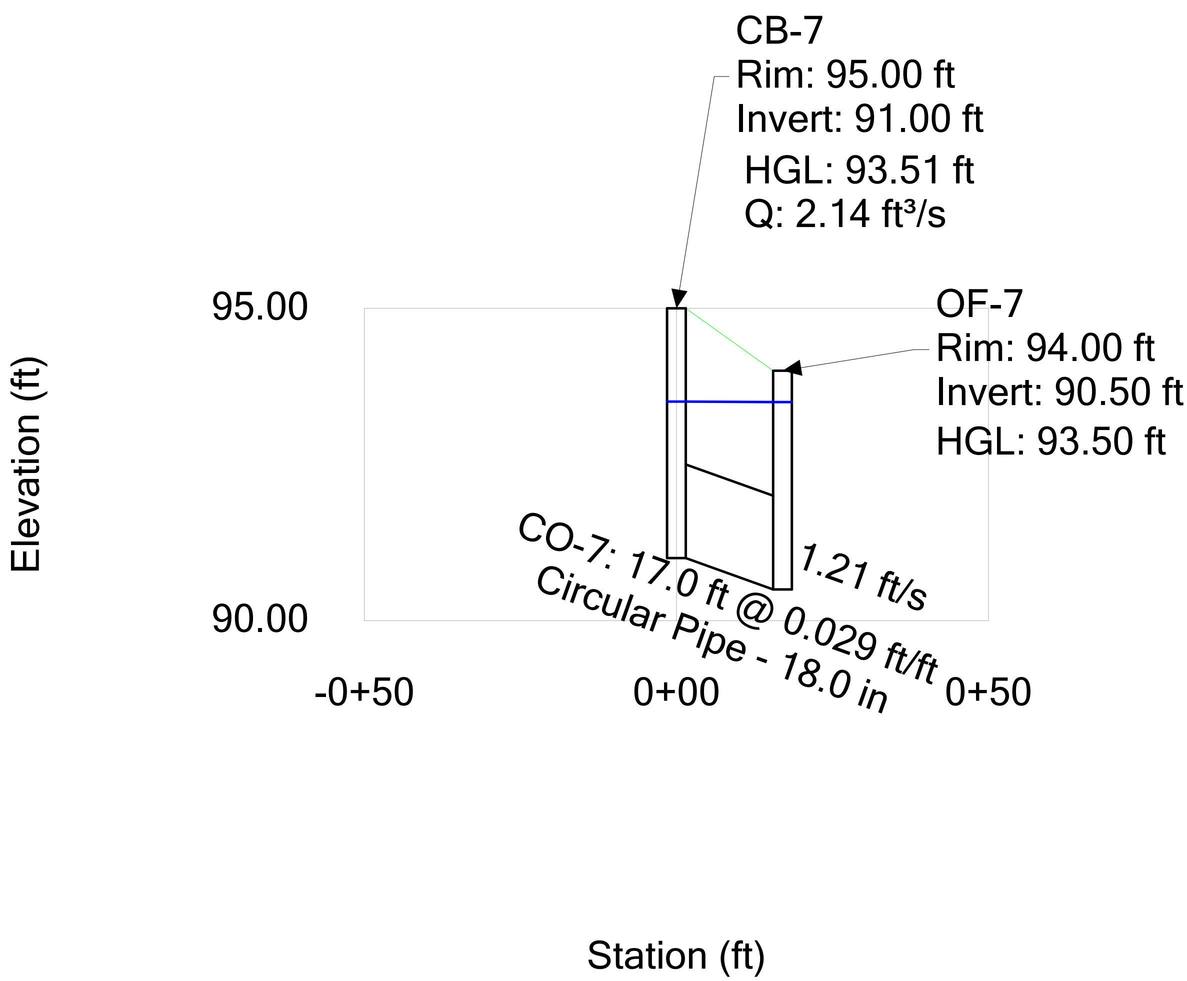
Profile Report
Engineering Profile - System 7 (5153_StormCAD.stc)



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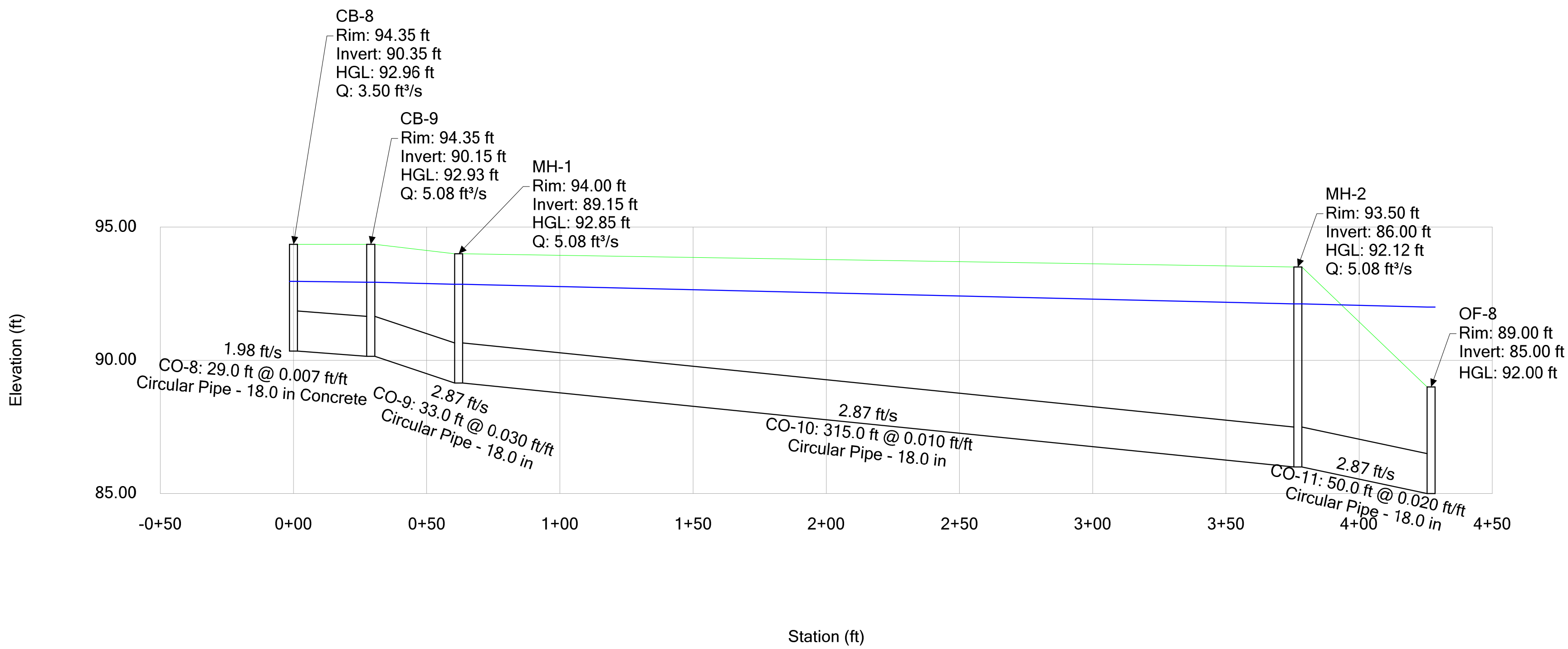
Profile Report

Engineering Profile - System 8 (5153_StormCAD.stc)



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Street Capacity Check

				(FROM RATING TABLES) (1)			
Sub-Area	Slope	Q_{10}	Q_{100}	Street Capacity - Roll Curb $^{10\ yr}$	Street Capacity - Roll Curb $^{100\ yr}$		
-	%	cfs	cfs	cfs	cfs		
A	0.40	1.00	1.97	4.55	10.79		
B	0.40	0.58	1.14	4.55	10.79		
C	0.40	0.10	0.19	4.55	10.79		
D	0.40	0.61	1.20	4.55	10.79		
E	0.40	0.25	0.49	4.55	10.79		
F	0.40	0.85	1.66	4.55	10.79		
G	0.40	0.68	1.34	4.55	10.79		
E,H	0.40	1.03	2.03	4.55	10.79		
G,I	0.40	1.38	2.72	4.55	10.79		
J	0.75	0.25	0.49	6.22	14.77		
K	0.75	0.18	0.36	6.22	14.77		
L	0.40	0.22	0.44	4.55	10.79		
M	0.40	0.06	0.12	4.55	10.79		
N	0.40	0.54	1.06	4.55	10.79		
O	0.40	0.76	1.50	4.55	10.79		
P	0.50	0.44	0.86	5.09	12.07		
Q	0.50	0.67	1.31	5.09	12.07		
R,U,V	0.40	1.65	3.24	4.55	10.79		
S,T	0.40	1.82	3.57	4.55	10.79		
T	0.40	1.14	2.23	4.55	10.79		
U,V	0.40	1.52	3.00	4.55	10.79		
V	0.40	0.51	1.01	4.55	10.79		
W	0.40	0.57	1.12	4.55	10.79		
X	0.40	0.35	0.68	4.55	10.79		
Y	0.40	0.17	0.33	4.55	10.79		
Z	0.45	0.20	0.39	4.82	11.43		
AA	0.45	0.51	0.99	4.82	11.43		
BB	0.40	1.28	2.51	4.55	10.79		
CC	0.40	0.61	1.20	4.55	10.79		

(1) Note: Flows are 1/2 of rating table to show 1/2 street capacity

Requires 6" Vertical For Portion That Exceeds Flow Rate

Cross Section for Roll Curb - 10yr

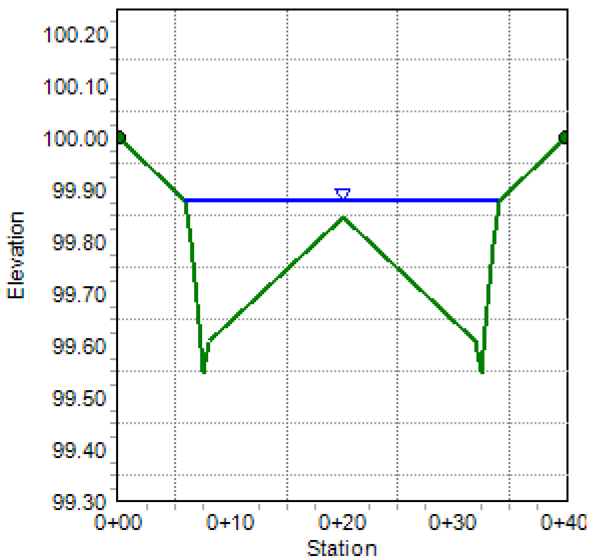
Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.40000	%
Normal Depth	0.33	ft
Discharge	9.09	ft³/s

Cross Section Image



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Worksheet for Roll Curb - 10yr

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.40000	%
Normal Depth	0.33	ft

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	100.00
0+06.00	99.88
0+06.40	99.80
0+06.80	99.72
0+07.20	99.64
0+07.58	99.55
0+08.00	99.61
0+20.00	99.85
0+32.00	99.61
0+32.42	99.55
0+32.80	99.64
0+33.20	99.72
0+33.60	99.80
0+34.00	99.88
0+40.00	100.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 100.00)	(0+40.00, 100.00)	0.013

Options

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

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Worksheet for Roll Curb - 10yr

Results

Discharge		9.09	ft³/s
Elevation Range	99.55 to 100.00 ft		
Flow Area		4.36	ft²
Wetted Perimeter		28.08	ft
Hydraulic Radius		0.16	ft
Top Width		28.00	ft
Normal Depth		0.33	ft
Critical Depth		0.32	ft
Critical Slope		0.00467	ft/ft
Velocity		2.09	ft/s
Velocity Head		0.07	ft
Specific Energy		0.40	ft
Froude Number		0.93	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.33	ft
Critical Depth	0.32	ft
Channel Slope	0.40000	%
Critical Slope	0.00467	ft/ft

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Rating Table for Roll Curb - 10yr

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.40000	%
Normal Depth	0.33	ft

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	100.00
0+06.00	99.88
0+06.40	99.80
0+06.80	99.72
0+07.20	99.64
0+07.58	99.55
0+08.00	99.61
0+20.00	99.85
0+32.00	99.61
0+32.42	99.55
0+32.80	99.64
0+33.20	99.72
0+33.60	99.80
0+34.00	99.88
0+40.00	100.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 100.00)	(0+40.00, 100.00)	0.013

Channel Slope (%)	Discharge (ft³/s)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)

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Rating Table for Roll Curb - 10yr

Input Data

Channel Slope (%)	Discharge (ft³/s)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)
0.40000	9.09	2.09	4.36	28.08	28.00
0.50000	10.17	2.33	4.36	28.08	28.00
0.60000	11.14	2.56	4.36	28.08	28.00
0.70000	12.03	2.76	4.36	28.08	28.00
0.80000	12.86	2.95	4.36	28.08	28.00
0.90000	13.64	3.13	4.36	28.08	28.00
1.00000	14.38	3.30	4.36	28.08	28.00

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Cross Section for Roll Curb - 100yr

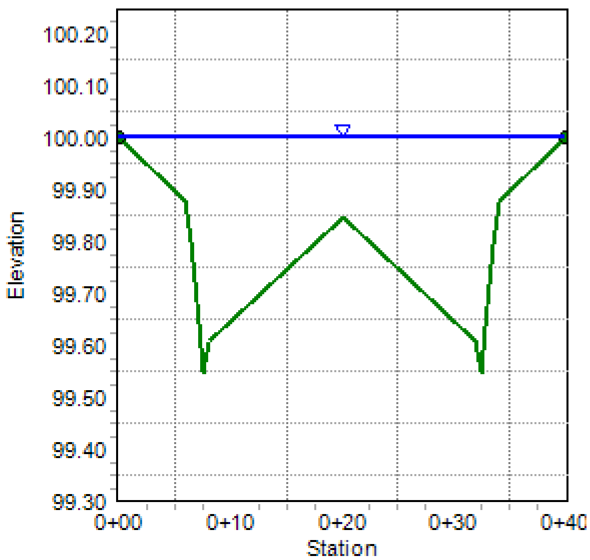
Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.40000	%
Normal Depth	0.45	ft
Discharge	21.58	ft³/s

Cross Section Image



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Worksheet for Roll Curb - 100yr

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.40000	%
Normal Depth	0.45	ft
Section Definitions		

Station (ft)	Elevation (ft)
0+00.00	100.00
0+06.00	99.88
0+06.40	99.80
0+06.80	99.72
0+07.20	99.64
0+07.58	99.55
0+08.00	99.61
0+20.00	99.85
0+32.00	99.61
0+32.42	99.55
0+32.80	99.64
0+33.20	99.72
0+33.60	99.80
0+34.00	99.88
0+40.00	100.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 100.00)	(0+40.00, 100.00)	0.013

Options

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

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Worksheet for Roll Curb - 100yr

Results

Discharge		21.58	ft^3/s
Elevation Range	99.55 to 100.00 ft		
Flow Area		8.44	ft^2
Wetted Perimeter		40.08	ft
Hydraulic Radius		0.21	ft
Top Width		40.00	ft
Normal Depth		0.45	ft
Critical Depth		0.45	ft
Critical Slope		0.00416	ft/ft
Velocity		2.56	ft/s
Velocity Head		0.10	ft
Specific Energy		0.55	ft
Froude Number		0.98	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.45	ft
Critical Depth	0.45	ft
Channel Slope	0.40000	%
Critical Slope	0.00416	ft/ft

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Rating Table for Roll Curb - 100yr

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.40000	%
Normal Depth	0.45	ft

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	100.00
0+06.00	99.88
0+06.40	99.80
0+06.80	99.72
0+07.20	99.64
0+07.58	99.55
0+08.00	99.61
0+20.00	99.85
0+32.00	99.61
0+32.42	99.55
0+32.80	99.64
0+33.20	99.72
0+33.60	99.80
0+34.00	99.88
0+40.00	100.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 100.00)	(0+40.00, 100.00)	0.013

Channel Slope (%)	Discharge (ft³/s)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)

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Rating Table for Roll Curb - 100yr

Input Data

Channel Slope (%)	Discharge (ft^3/s)	Velocity (ft/s)	Flow Area (ft^2)	Wetted Perimeter (ft)	Top Width (ft)
0.40000	21.58	2.56	8.44	40.08	40.00
0.50000	24.13	2.86	8.44	40.08	40.00
0.60000	26.43	3.13	8.44	40.08	40.00
0.70000	28.55	3.38	8.44	40.08	40.00
0.80000	30.52	3.62	8.44	40.08	40.00
0.90000	32.37	3.84	8.44	40.08	40.00
1.00000	34.12	4.04	8.44	40.08	40.00

RETENTION REQUIRED (100-yr 2-hr)

Sub-Area	Area	C-Value	P	Volume	Volume
	(SF)	weighted	inches	CF	AF
A	12427	0.79	2.14	1745	0.04
B	7199	0.79	2.14	1011	0.02
C	1222	0.79	2.14	172	0.00
D	7574	0.79	2.14	1064	0.02
E	3069	0.79	2.14	431	0.01
F	10461	0.79	2.14	1469	0.03
G	8462	0.79	2.14	1188	0.03
H	9688	0.79	2.14	1361	0.03
I	8644	0.79	2.14	1214	0.03
J	3056	0.79	2.14	429	0.01
K	2247	0.79	2.14	316	0.01
L	2775	0.79	2.14	390	0.01
M	726	0.79	2.14	102	0.00
N	6690	0.79	2.14	940	0.02
O	9445	0.79	2.14	1326	0.03
P	5395	0.79	2.14	758	0.02
Q	8245	0.79	2.14	1158	0.03
R	1513	0.79	2.14	212	0.00
S	8450	0.79	2.14	1187	0.03
T	14059	0.79	2.14	1974	0.05
U	12536	0.79	2.14	1761	0.04
V	6332	0.79	2.14	889	0.02
W	7081	0.79	2.14	994	0.02
X	4283	0.79	2.14	601	0.01
Y	2107	0.79	2.14	296	0.01
Z	2443	0.79	2.14	343	0.01
AA	6256	0.79	2.14	879	0.02
BB	15794	0.79	2.14	2218	0.05
CC	7536	0.79	2.14	1058	0.02
DD	19281	0.79	2.14	2708	0.06
EE	26173	0.79	2.14	3676	0.08
FF	7989	0.79	2.14	1122	0.03
GG	31169	0.79	2.14	4377	0.10
HH	9113	0.79	2.14	1280	0.03
II	21695	0.79	2.14	3047	0.07
JJ	38220	0.79	2.14	5368	0.12
KK	40104	0.79	2.14	5632	0.13
Total	**389459**			**54695**	**1.26**

NOTE: Sub Areas A, & V are not included in table, as these are associated offsite drainage areas

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Basin Volume - Basin A

Elevation	Area	Average Area	TOTAL	TOTAL
FT	SF	SF	CF	AF
86.5	1			0.00
87.5	1227	614	614	0.01
88.5	3231	2229	2843	0.07
0	0	0	2843	0.07
		TOTAL	**2843**	**CF**

Volume Required	
Subbasin	
A,B,C,DD	
(CF)	
5636	
2793	**CF**
SHORT	

Basin Volume - Basin B

G	Area	Average Area	TOTAL	TOTAL
FT	SF	SF	CF	AF
84	1276			0.00
85	1916	1596	1596	0.04
86	2673	2295	3891	0.09
87	3576	3125	7015	0.16
		TOTAL	**7015**	**CF**

Volume Required	
Subbasin	
L,M,N,O,EE	
(CF)	
6433	
Volume OK	CF

Basin Volume - Basin C

Elevation	Area	Average Area	TOTAL	TOTAL
FT	SF	SF	CF	AF
89	1953			0.00
90	2872	2413	2413	0.06
91	3916	3394	5807	0.13
92	5084	4500	10307	0.24
		TOTAL	**10307**	**CF**

Volume Required	
Subbasin	
P,Q,R,S,T,FF	
(CF)	
6411	
Volume OK	CF

Basin Volume - Basin D

Elevation	Area	Average Area	TOTAL	TOTAL
FT	SF	SF	CF	AF
91	363			0.00
92	1887	1125	1125	0.03
93	4476	3182	4307	0.10
93.5	6214	2673	6979	0.16
		TOTAL	**6979**	**CF**

Volume Required	
Subbasin	
GG	
(CF)	
4377	
Volume OK	CF

Basin Volume - Basin E

Elevation	Area	Average Area	TOTAL	TOTAL
FT	SF	SF	CF	AF
89	280			0.00
90	620	450	450	0.01
91	1088	854	1304	0.03
92	2359	1724	3028	0.07
		TOTAL	**3028**	**CF**

Volume Required	
Subbasin	
E,G,H,I,J,K,U,V,KK	
(CF)	
13220	
10193	**CF**
VOLUME SHORT	

Basin Volume - Basin F

Elevation	Area	Average Area	TOTAL	TOTAL
FT	SF	SF	CF	AF
90.5	663			0.00
91.5	1203	933	933	0.02
92.5	1798	1501	2434	0.06
93.5	2447	2123	4556	0.10
		TOTAL	**4556**	**CF**

Volume Required	
Subbasin	
W,X,Y,HH	
(CF)	
3172	
Volume OK	CF

Basin Volume - Basin G

Elevation	Area	Average Area	TOTAL	TOTAL
FT	SF	SF	CF	AF
92	268			0.00
93	2981	1625	1625	0.04
0	0	0	1625	0.04
0	0	0	1625	0.04
		TOTAL	**1625**	**CF**

Volume Required	
Subbasin	
D,F,JJ	
(CF)	
7900	
6276	**CF**
VOLUME SHORT	

Basin Volume - Basin H

Elevation	Area	Average Area	TOTAL	TOTAL
FT	SF	SF	CF	AF
89	1194			0.00
90	1988	1591	1591	0.04
91	2970	2479	4070	0.09
92	4170	3570	7640	0.18
		TOTAL	**7640**	**CF**

Volume Required	
Subbasin	
Z,AA,BB,CC,II	
(CF)	
7545	
Volume OK	CF

Underground Storage Tank - 1

Diameter	X-section Area	Length	TOTAL
FT	SF	LF	CF
10	78.5	40	3140
		TOTAL:	**3140 CF**

Volume Required	
Subbasin	
Excess from Basin A	
(CF)	
2793	
Volume OK	CF

Underground Storage Tank - 2

Diameter	X-section Area	Length	TOTAL
FT	SF	LF	CF
10	78.5	135	10598
		TOTAL:	**10598 CF**

Volume Required	
Subbasin	
Excess from Basin E	
(CF)	
10193	
Volume OK	CF

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Underground Storage Tank - 3

Diameter	X-section Area	Length	TOTAL
FT	SF	LF	CF
10	78.5	85	6673
		TOTAL:	**6673** **CF**

Volume Required	
Subbasin	
Excess from Basin G	
(CF)	
6276	
Volume OK	CF

Basin Percolation Rates - FOR VOLUME PROVIDED

Sub-Area	Rate of Bleedoff	Total Volume Provided	Dry-Up Time	# drywells for 36 hour dry up	
	(cfs)	(cf)	(hr)	#	
Basin A - Tank 1	0.1	5,983	16.6	0.5	**USE 1 DRYWELL**
Basin B	0.1	7,015	19.5	0.5	**USE 1 DRYWELL**
Basin C	0.1	10,307	28.6	0.8	**USE 1 DRYWELL**
Basin D	0.1	6,979	19.4	0.5	**USE 1 DRYWELL**
Basin E - Tank 2	0.1	13,625	37.8	1.1	**USE 2 DRYWELLS**
Basin F	0.1	4,556	12.7	0.4	**USE 1 DRYWELL**
Basin G- Tank 3	0.1	8,297	23.0	0.6	**USE 1 DRYWELL**
Basin H	0.1	7,640	21.2	0.6	**USE 1 DRYWELL**

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Offsite Watershed Rational Method Check					
Sub-Area	Area	C_{100}	Tc	i_{100}	Local Q_{100}
	(acre)	DSPM	(min)	(in/hr)	(cfs)
SECTION 1	14.80	0.45	10	5.60	37.30
SECTION 2	5.90	0.86	10	5.60	28.41

Culvert Calculator Report
Worksheet-1

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	94.00	ft	Headwater Depth/Height	1.70	
Computed Headwater Eleva	93.39	ft	Discharge	28.41	cfs
Inlet Control HW Elev.	92.50	ft	Tailwater Elevation	92.50	ft
Outlet Control HW Elev.	93.39	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	90.00	ft	Downstream Invert	89.50	ft
Length	105.00	ft	Constructed Slope	0.004762	ft/ft

Hydraulic Profile					
Profile	PressureProfile		Depth, Downstream	3.00	ft
Slope Type	N/A		Normal Depth	1.50	ft
Flow Regime	N/A		Critical Depth	1.36	ft
Velocity Downstream	4.52	ft/s	Critical Slope	0.006105	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	2.00	ft
Section Size	24 inch		Rise	2.00	ft
Number Sections	2				

Outlet Control Properties					
Outlet Control HW Elev.	93.39	ft	Upstream Velocity Head	0.32	ft
Ke	0.50		Entrance Loss	0.16	ft

Inlet Control Properties					
Inlet Control HW Elev.	92.50	ft	Flow Control	Unsubmerged	
Inlet Type	Square edge w/headwall		Area Full	6.3	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

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OFFSITE SECTION 1

Equations Used: $Tc = 11.4 L^{0.5} Kb^{0.52} S^{-0.31} i^{-0.38}$

Where, Tc = time of concentration

L = length of the longest flow path (miles)

Kb = watershed resistance coefficient

S = watercourse slope (ft/mile)

i = rainfall intensity (inches/hour)

From Drainage Design Manual for Maricopa County Table 3.1:

Kb=mLogA + b

Assuming Minimal Roughness:

m=-.00625; b=0.04

Watershed A

Kb=mLogA + b

A = 14.8 Ac

Kb=(-0.00625)(Log14.8)+0.04

Kb=.0327

$Tc = 11.4 L^{0.5} Kb^{0.52} S^{-0.31} i^{-0.38}$

L = 0.56 mi

Kb=.0327

S = (120ft/1 mi) = 120 ft/mi

i = 5.60(based on Tc of 10 min)

$Tc=(11.4)(0.56)^{0.5}(.0327)^{0.52}(120)^{-0.31}(5.60)^{-0.38}$

Tc=0.170 hrs = 10.18 mins

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OFFSITE SECTION 2

Equations Used: $Tc = 11.4 L^{0.5} Kb^{0.52} S^{-0.31} i^{-0.38}$

Where, Tc = time of concentration
L = length of the longest flow path (miles)
Kb = watershed resistance coefficient
S = watercourse slope (ft/mile)
i = rainfall intensity (inches/hour)

From Drainage Design Manual for Maricopa County Table 3.1:

Kb=mLogA + b

Assuming Minimal Roughness:

m=-.00625; b=0.04

Watershed A

Kb=mLogA + b
A = 5.9 Ac
Kb=(-0.00625)(Log5.9)+0.04
Kb=.0352

$Tc = 11.4 L^{0.5} Kb^{0.52} S^{-0.31} i^{-0.38}$

L = 0.37 mi
Kb=.0352
S = (107ft/1 mi) = 107 ft/mi
i = 5.60(based on Tc of 10 min)
Tc=(11.4)$(0.37)^{0.5}(.0352)^{0.52}(107)^{-0.31}(5.60)^{-0.38}$
Tc=0.15 hrs = 9 mins

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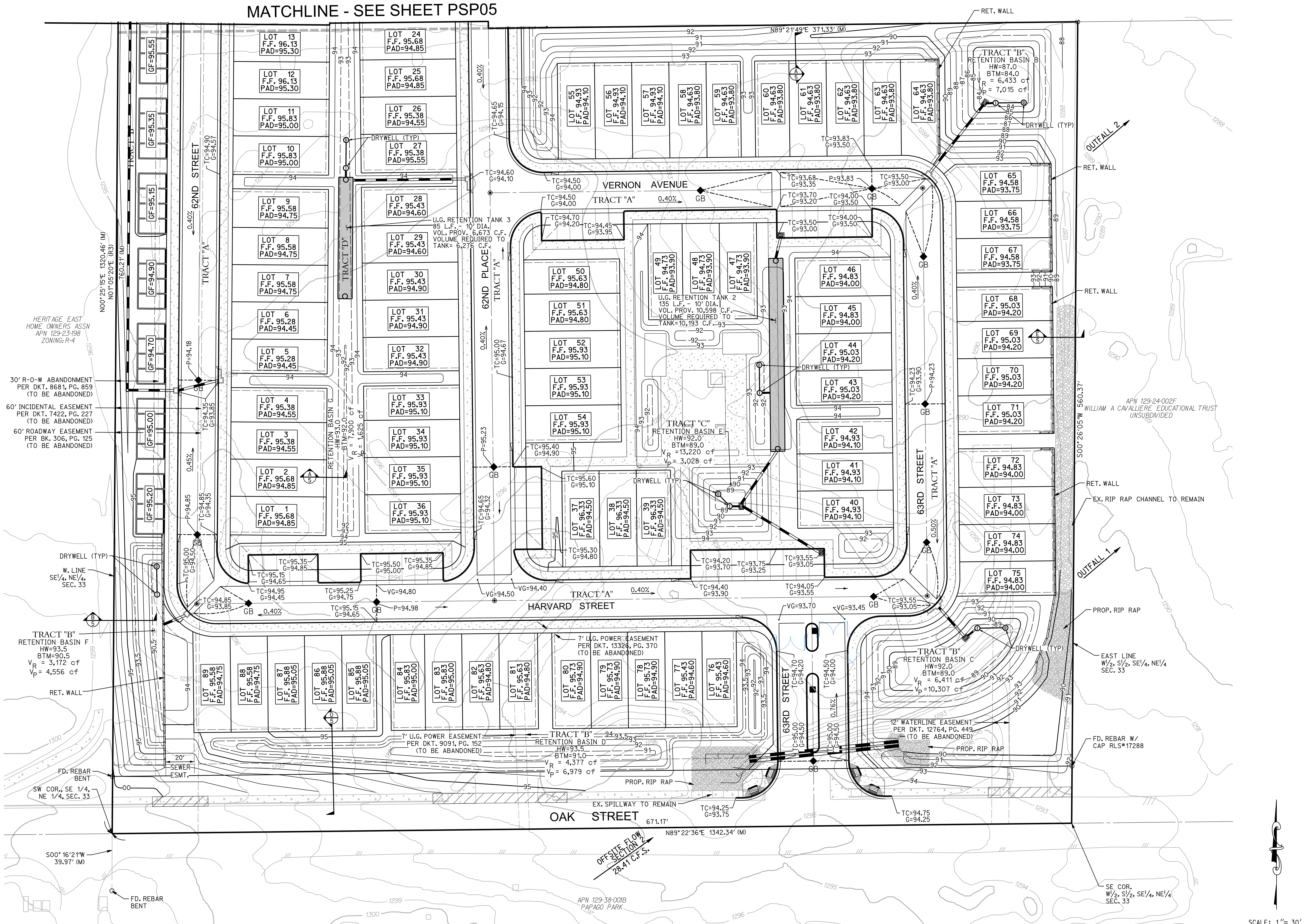
APPENDIX H

Preliminary Grading and Drainage Plans



Contact Arizona 811 at least two full working days before you begin excavation

Call 811 or click Arizona811.com

REVISIONS

64TH STREET & OAK STREET
SCOTTSDALE, ARIZONA 85252

PRELIMINARY GRADING PLAN

Registered Professional Engineer
CERTIFICATE NO. 45652
MATTHEW J. MANCINI
4/10/20
Date Signed
ARIZONA, U.S.A.

EXPIRES: 12/31/2021

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planning civil engineering surveying

ENGINEER: M. MANCINI | DESIGNER: M. MANCINI | CAD TECH: PHILLIP V.

3 ENGINEERING, LLC
6370 E. THOMAS ROAD SUITE # 200
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PHONE: (602) 334-4387
FAX: (602) 490-3230
WWW.3ENGINEERING.COM

DATE: 4/10/20

PROJECT NO. 5153

SHEET NO. PSP04
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4/30/2020

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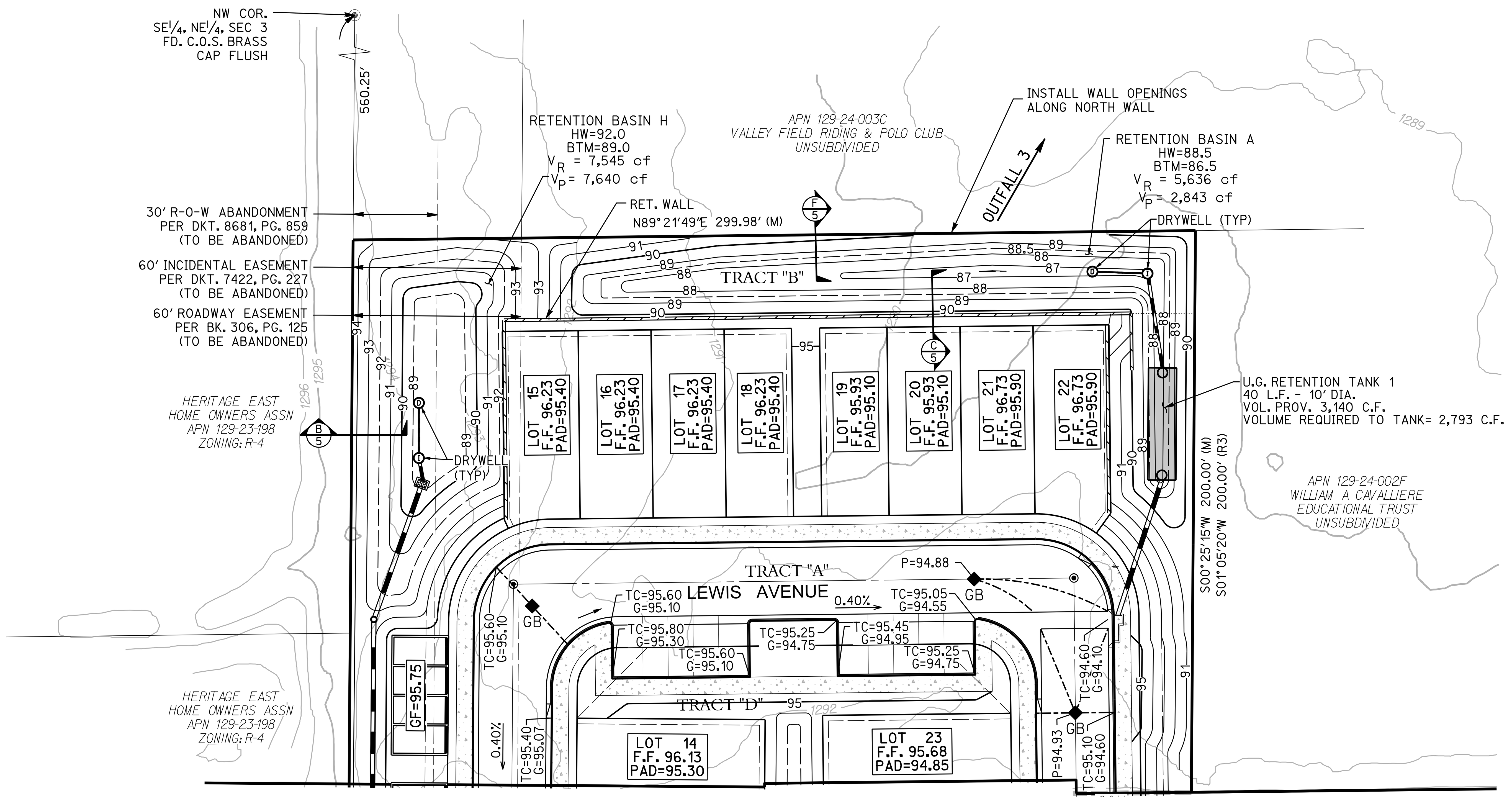


RETENTION CALCULATIONS

100 YR - 2HR STORM EVENT

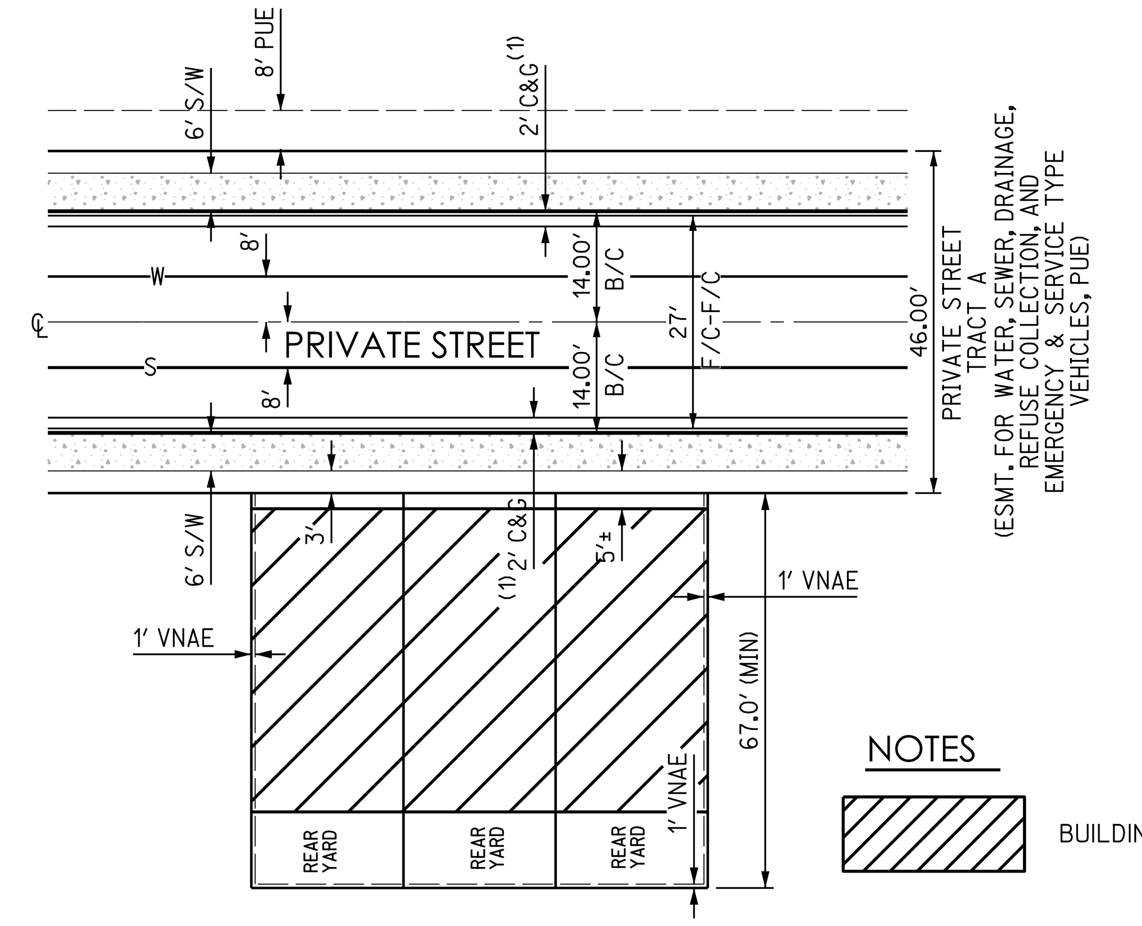
REQUIRED
C = 0.79
P = 2.14
AREA = 389,459 SF

$(0.79)\left(\frac{2.14}{12}\right)(389{,}459) = 54{,}695$ CF

TOTAL REQUIRED = 54,695 CF

PROVIDED
43,992 CF (BASIN A-H) + 20,410 CF (TANK)

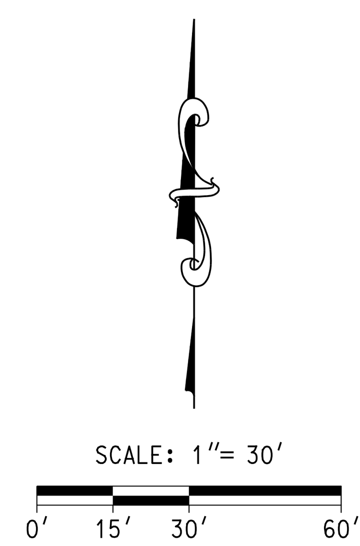
64,402 CF PROVIDED

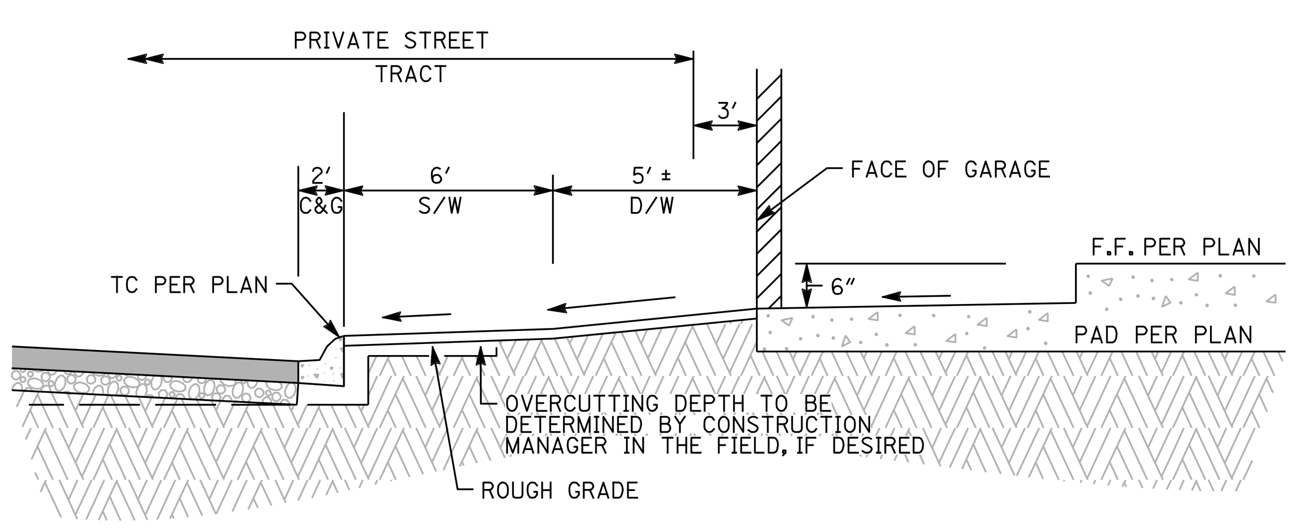


NOTES

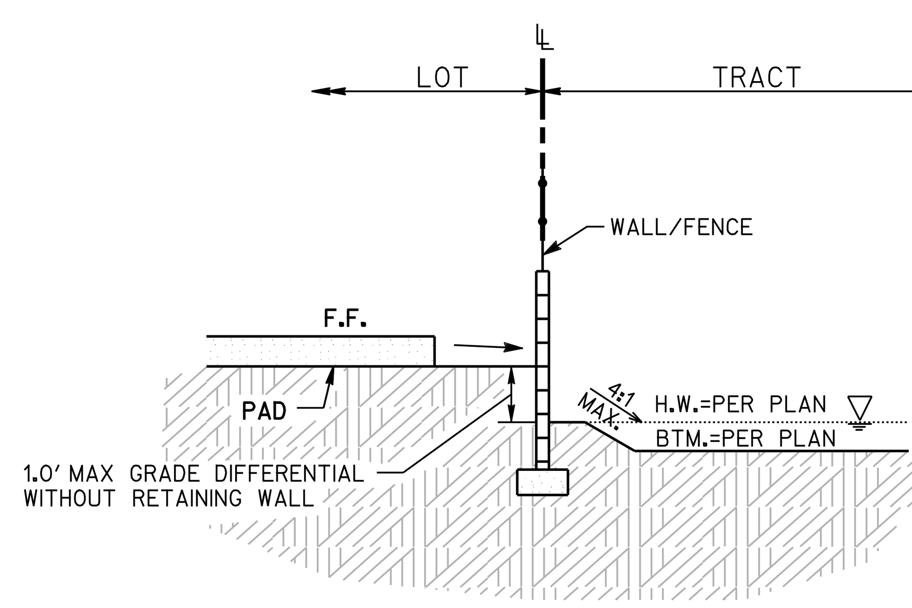
BUILDING

TYPICAL INTERIOR LOT DETAIL
N.T.S.
(1) ROLL OR VERTICAL DEPENDING ON DRAINAGE

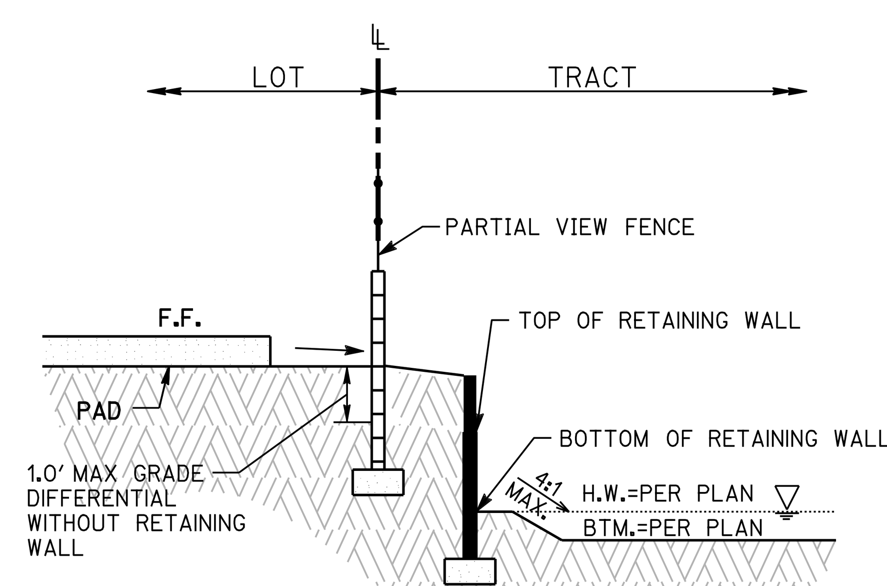




TYPICAL FRONT YARD SECTION
N.T.S.



A TYPICAL SECTION
N.T.S.



C TYPICAL SECTION
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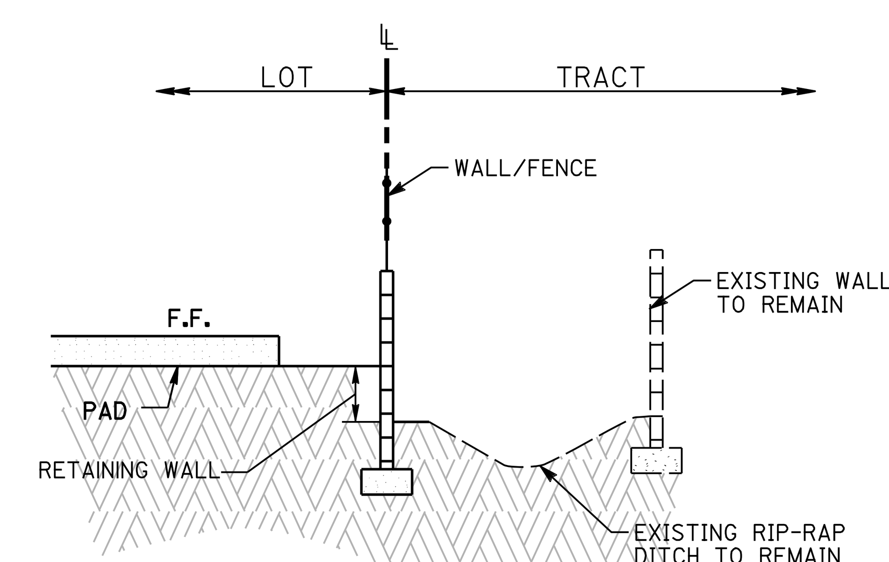
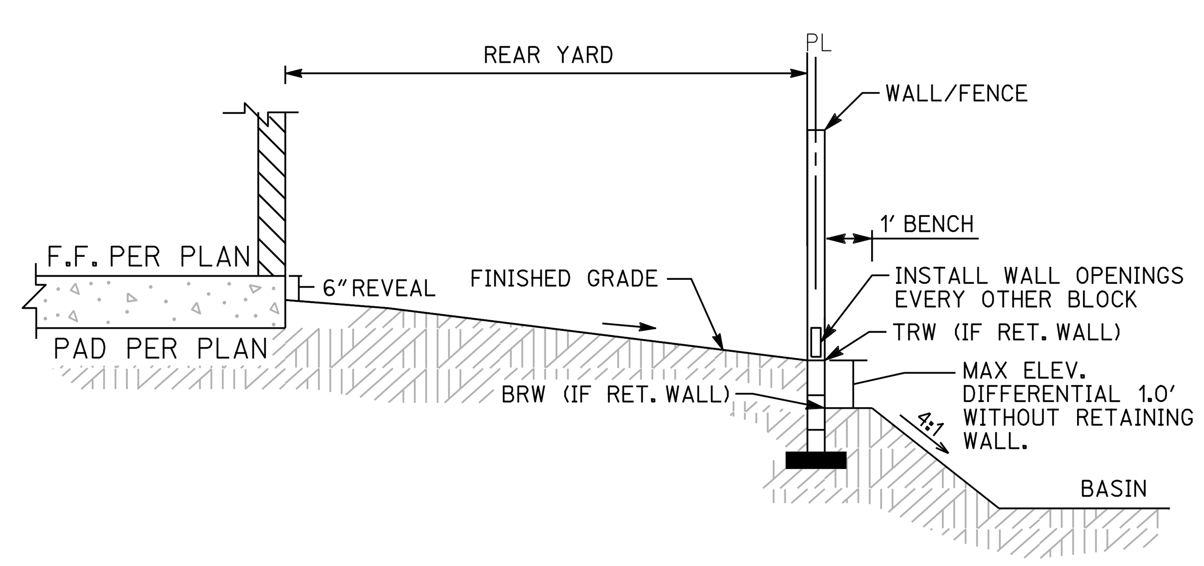
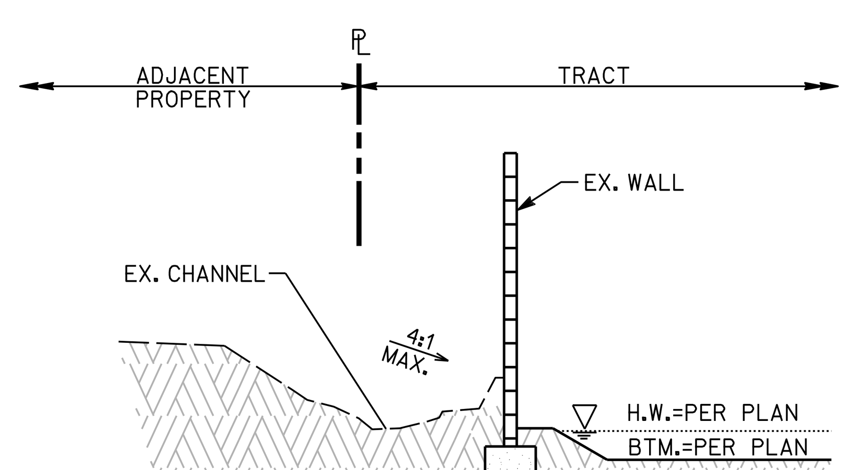


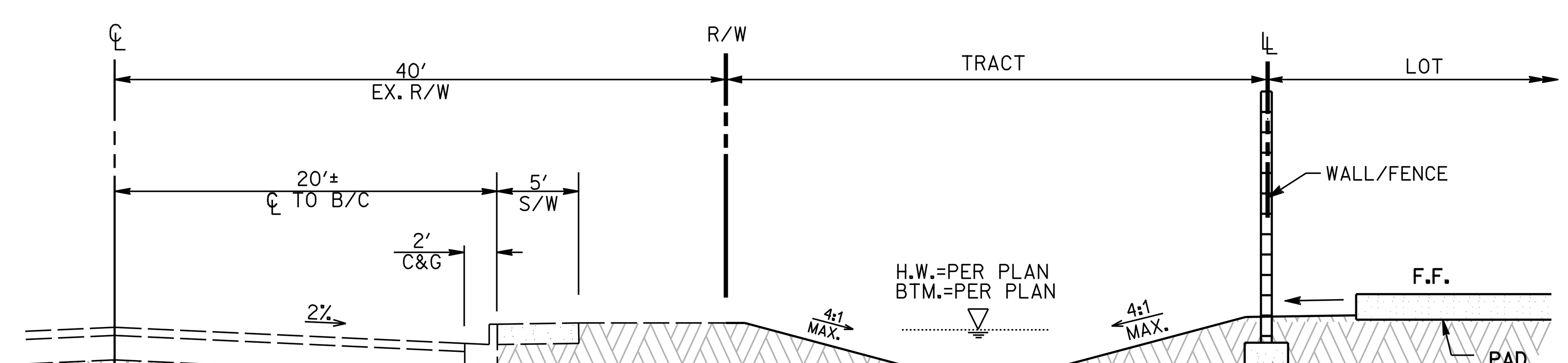
E TYPICAL SECTION
N.T.S.



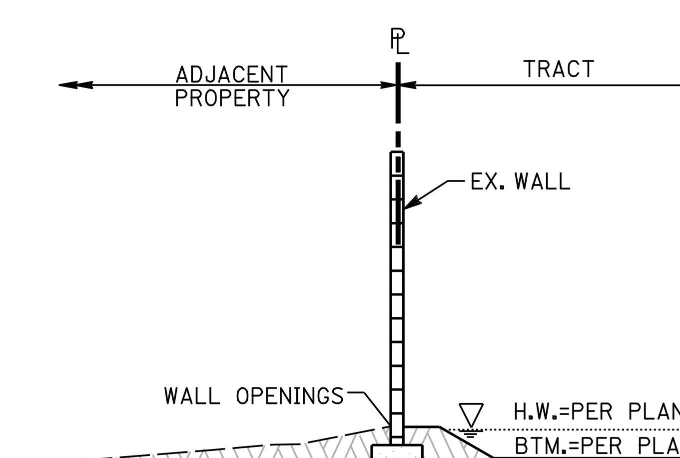
TYPICAL REAR YARD SECTION
DRAINAGE TO REAR YARD
N.T.S.



B TYPICAL SECTION
N.T.S.



D TYPICAL SECTION
N.T.S.



F TYPICAL SECTION
N.T.S.

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REVISIONS

64TH STREET & OAK STREET
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WWW.3ENGINEERING.COM

DATE: 4/10/20

PROJECT NO.
5153

SHEET NO.
PSP05
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4/30/2020

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Stormwater Review by:
Ghassan Aouad
Phone: 480-312-7055
e-mail: gaouad@scottsdaleaz.gov
Review Cycle 1 Date 05/22/2020

The comments provided are to be considered notes to be addressed at the time of plans submittal and not for Correction for this case level report

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64TH St. & Oak

Preliminary Drainage Report

3 engineering Job #: 5153
Original Date: April 10, 2020
COS #: 4-PA-2020

7-ZN-2020
4/30/2020

3 engineering

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64th St. & Oak

PRELIMINARY DRAINAGE REPORT

Prepared for:

K Hovnanian Great Western Homes, LLC
20830 N. Tatum Blvd, Suite 250
Phoenix, Arizona 85050
Contact: Chuck Chisholm
Phone: (480) 824-4175

Registered Professional Engineer (Civil)
CERTIFICATE NO.
45652
MATTHEW J.
MANCINI
4/10/20
Date Signed
ARIZONA, U.S.A.

Expires 12/31/2021

Matthew J. Mancini, P.E.

April 10, 2020

Submittal to:

City of Scottsdale
7447 E. Indian School Road, Suite 105
Scottsdale, AZ 85251

Prepared by:

3 engineering, L.L.C.
6370 E. Thomas Road, Suite 200
Scottsdale, Arizona 85251
Contact: Matthew J. Mancini, P.E.

Job Number 5153

7-ZN-2020
4/30/2020

Table of Contents

Appendix

1. Introduction

The purpose of this report is to present the existing and proposed drainage plan for the project site, 64th St. & Oak. It is our opinion the preliminary grading and drainage design is in accordance with the City of Scottsdale drainage requirements.

The project site, 64th St. & Oak, is located in Section 33, Township 2 North, Range 4 East of the Gila and Salt River Meridian, Maricopa County, Arizona within the City of Scottsdale. The project is located North of Oak Street, and West of 64th Street Road at 6300 E. Oak Street, Scottsdale, Arizona 85257. The site is bounded on the north by an existing commercial polo club, on the west by a residential neighborhood, on the south and east by a commercial property. See Appendix A for a site map.

Per the City of Scottsdale General Plan's Land Use Map, the project site is designated Suburban Neighborhood and is also located within the Southern Scottsdale Character Area Plan (SSCAP). The project site is zoned S-R (Service Residential) and R1-10 (Single-Family Residential). The proposed zoning is R-3. The existing land is occupied by an operational medical facility with three (3) buildings, including existing parking & site improvements. The intent of the project is to construct an 89-lot single-family attached residential subdivision project.

2. Site Description

Existing

The existing land is occupied by an operational medical facility with three (3) buildings, including existing parking & site improvements. The existing topography has an approximate slope of one percent (1.40%) and has an overall general slope from southwest to northeast. Based on field reconnaissance, and general review of asbuilt plans and aerial photos, offsite flow impacts the site from the south. Existing outfalls for the property are along the northern and eastern boundaries of the site. The site does not show any signs of containing waters of the US (404 washes).

Federal Emergency Management Agency (FEMA) Designation

According to FEMA Flood Insurance Rate Map (FIRM) # 04013C2230L, updated October 16, 2013, the site is located within the "Zone X" floodplain designation. "Zone X" is described as follows: "Area of Minimal Flood Hazard". Refer to the updated FIRM information in Appendix B.

Proposed

The proposed site, 64th St. & Oak, is proposed as an 89-lot single-family attached residential subdivision project with a private drive and gated access from Oak Street.

3. Drainage Design - Offsite

The existing land is occupied by an operational medical facility with three (3) buildings, including existing parking & site improvements. The existing topography has an approximate slope of one percent (1.40%) and has an overall general slope from southwest to northeast. Based on field reconnaissance, and general review of asbuilt plans and aerial photos, offsite flow impacts the site from the south. There are two low points near the site's southern boundary. One low point towards the site's southwest corner accepts flow in a concrete ditch, and conveys storm water through the adjacent site to the west. Asbuilt plans, and County FLO-2D models, indicate this flow remains on the adjacent site. The second low point is near the center of the site along Oak Street that conveys flow through 2-24" storm drains and into an existing rip rap channel where it directs flow to the northeast. Existing outfalls for the property are along the northern and eastern boundaries of the site. The site does not show any signs of containing waters of the US (404 washes).

The existing topography may no agree with the FLO-2D output regarding the outfall along the riprap channel. The existing topography reflects a drainage channel that continues north toward the NE corner. It is good that the project is planning to maintain this channel. The existing channel pattern and capacity needs to be maintained.

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Proposed retentionbasin B at the NE coer is an onsite retention basin. Similar to argument in the comment below, offsite flow can't commingle with onsite flows at an onsite retention basin. The grading around this area need to be revisted to ensure this requirement.

According to the Lower Indian Bend FLO-2D (Ref. 4) (Appendix F), the offsite flow adjacent to the west enters the adjacent site at 21.02 cfs. Evaluating County Mapping using Rational Method (Appendix F & G), the flow was calculated at 37.30 cfs. According to the FLO-2D mapping, this flow is contained on the adjacent site and conveyed north. In the event any overtopping does occur, the site has been designed with open space adjacent to the western property, and has a channel that would convey any flow north into basins, and to the project's outfall.

According to the Lower Indian Bend FLO-2D (Ref. 4) (Appendix F), the flow crossing Oak Street near its midpoint, enters at 28.16 cfs. Evaluating County Mapping using Rational Method (Appendix F & G), the flow was calculated at 28.41 cfs. This flow currently is conveyed through two (2) existing 24iinch storm drains that convey flow to a rip rap lined channel along the eastern edge of the project. This flow travels north and, according to the FLO-2D model, exits in various places along the eastern boundary. To mitigate this flow, the project proposes accepting the flow in the same location along Oak Street, conveying it through tow (2) 24-inch storm drains under the project's entrance, and channelizing it to the existing rip rap channel. It is proposed to maintain this existing rip rap channel in order to maintain existing historical drainage patterns. Refer to Appendix G for a CulvertMaster calculation of the proposed pipe culvert under the entrance.

Per the FLO-2D excerpts provided, a portion of this offsite flow enters the project site at the existing low point and a portion enters at an entrance west of the low point. The area at the western end is proposed in the project to be a retention basin (Basin D). Offsite flows are not allowed to enter onsite retention basins, otherwise the intended function of the basins will be diminished. Ensure a way to collect the western flow portion and directly convey it to the proposed pipe pipe culvert.

4. ***Drainage Design – Onsite***

The City of Scottsdale Design Standards and Policies Manual and the Drainage Design Manual for Maricopa County, Volume 1 was followed in designing on-site drainage facilities for the site. The following standards shall be met as part of this project:

The retention requirements is ok as proposed, however be aware that the City of Scottsdale retention requirements for currently developed sites is larger of:

1-post V100y,2h minus pre V100y,2h,

2-First flush volume, per DSPM calculations,

1 or 2 plus any existing stormwater storage on the site.

obviously, not to exceed the normal post V100y, 2h

- 10-year peak discharges shall be contained below the top of curb elevations.
- 100-year peak discharges shall be contained within the private street tract.
- Sump condition catch basins and storm drain shall be designed, at a minimum, for the 10-year storm event with 100-year overflowing the sump.
- Flow-By condition catch basins storm drain shall be designed for the 100-year storm event.
- Channels shall be designed for the 100-year event.
- Retention shall be provided for the 100-year 2-hour storm event.
- There shall be 1-foot of freeboard on the basin. This freeboard shall NOT count towards the 100-year 2-hour storage requirement.
- Retention basins shall drain within 36-hour. 0.1 cfs shall be used as a drywell design rate. (post construction percolation tests shall be used to determine higher rates)
- Drainage shall enter and exit in a similar and/or historical manner as existing conditions.

Refer to the Preliminary Grading and Drainage Plan in Appendix H and the Onsite Drainage Map in Appendix F for the following discussion:

Please elaborate on how the back of the lot drains into adjacent basins; is it through wall openings?, or other means

On-site drainage areas will be conveyed via surface drainage from the lots to the private accessways' curb and gutter for flow draining to the front of the lots, and directly into retention basins for flow draining to the rear of lots. Storm water exiting the lots in the front flows into the curb and gutter flows into storm drain systems and then into the surface retention basins and underground tanks. Site peak flows have been calculated using the Rational Method, as established in Ref. 1. The calculations determined the amount of flow generated on-site and directly to the catch basins. Drainage areas were determined based on the preliminary grading plans, and are shown on the Drainage Map in Appendix F. For the purposes of this report a minimum time of concentration of 5 minutes was used. (See Appendix G for street hydraulic capacities)

The first flush volume requirements need to be calculated, regardless if it is the controlling vilume for stormwater storage volume

See comments on last page regarding the City of Scottsdale retention requirements

StormCAD was used to design storm drain sizes. Refer to Appendix G for the StormCAD calculations. Weir Calculations were used to determined catch basin sizes. Refer to Appendix G for the Weir calculations.

Per Ref. 1 & Ref. 2 the Site is required to retain the storm water generated from the 100-year 2-hour storm event. Based on Ref. 1, and the weighted C value calculation (for retention) in Appendix G, the Site's 100-year runoff coefficient for the site is 0.79. Based on NOAA14, the site's precipitation value is 2.14 inches. For required and proposed retention volume calcs, refer to Appendix G.

that exceed the basins design capacity

All basins are designed to overflow in events ~~exceeding 100-years storms.~~ The following are descriptions of each basin's overflow:

- Basin A/Tank 1– Basin A & Tank 1 will fill up, and over top to the adjacent property, which is consistent with existing outfalls.
- Basin B - Basin B will fill up, and over top to the adjacent property, which is consistent with existing outfalls.
- Basin C – Basin C will fill up, and over top to the offsite channel and then to the adjacent property, which is consistent with existing outfalls.
- Basin D – Basin C will fill up, and over top to the offsite channel and then to the adjacent property, which is consistent with existing outfalls.
- Basin E/Tank 2– Basin E & Tank 2 will fill up, and back up into the street and then into Basin B, and then to adjacent property, which is consistent with existing outfalls.

No channel is reflected on the grading and drainage plans ?

- Basin F – Basin F will fill up, and overflow via channel to Basin H, which will overflow to Basin A, which will over top to the adjacent property, which is consistent with existing outfalls.
- Basin G/Tank 3– Basin G & Tank 3 will fill up, and back up into the street and then into Basin B, and then to adjacent property, which is consistent with existing outfalls.
- Basin H – Basin H will fill up, which will overflow to Basin A, which will over top to the adjacent property, which is consistent with existing outfalls.

The surface basins & tanks will drain via basin infiltration and use of drywells, as there is not a channel/wash, or existing storm drain system to bleed off into. A drywell rate of 0.1 cfs is used for the purposes of this design report; however, Geotechnical percolation tests shall be completed after construction of the basins to determine if the drywell systems can be reduced or eliminated. Refer to Appendix G for percolation calculations.

Per the City's DS&PM, the following items shall be addressed for proposed underground retention tank systems:

- **Water Quality**
  - o The underground system is designed to connect to dual-chamber drywells. Dual-chamber drywells utilize a sediment chamber which removes oils and pollutants from entering the ground water during disposal.
- **System Failure (No-Storage)**
  - o If the system fails, and provides no storage, storm water will back-up to the floodplain elevations associated with the bank of the wash. Finished Floors are elevated above this outfall and floodplain elevation.
- **Vector Control (mosquito breeding)**
  - o The system is designed to bleed-off via drywells. The number of drywells designed shall dispose of the storm water within 36-hours, which is the maximum time period to eliminate the risk of vector control.

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See earlier comment on the need to provide first flush calculations

- **Redundancy**
  - There is not redundancy provided in the system in terms of additional pipe storage; however, an Operations & Manual has been prepared. This manual sets forth the guidelines to keep the underground system functioning correctly. This manual is reviewed and approved by the City, recorded with Maricopa County, and is enforceable by the City shall the owner not follow the guidelines. This will ensure that sediments will not cause the system to fail.
- **Initial Suspended Load Removal (First Flush)**
  - The tanks are designed with a smooth bottom, and a 0.25% slope to ensure proper drainage to the disposal portion of the system. As mentioned for Water Quality, the drywells include a sediment chamber which functions to remove oils and pollutants, typical present in first flush runoff, from the storm water.
- **75-year Design Life**
  - The tanks are designed with a minimum 75-year design life. Resistivity testing shall be completed.
- **Outfall**
  - The tanks are designed with dual chamber drywell bleed-off. Since this area is within a floodplain, pumps are not a feasible drain method. There are no storm drain outfalls for this underground system, as well. Therefore, drywells will be the means for tank outfall, and the Operations & Maintenance program will be the mechanism used to ensure proper function of the system.

What does floodplain means here, what is the intention ?

- **Pipes**
  - As mentioned in Initial Suspended Load Removal, the tanks are designed with a smooth bottom. The interior shall be designed per City of Scottsdale Detail 2554.
- **Installation**
  - Excavation, bedding and backfill procedures and materials must be in accordance with MAG standards.
- **Access**
  - The underground tanks are designed with a minimum of two access points. These access points are designed in accordance with MAG standards.

Drainage easements are to be dedicated over the basin tracts. In addition, the private street (Tract A), has a drainage easement as part of its use. This will ensure that the basins and storm drain systems can be maintained in order to perform properly during storm events.

For the purpose of design, finished floors for the project have been placed a minimum of 14-inches above lot outfalls, and 18-inches above ultimate outfalls along the north boundary. The proposed project disturbs over 1.0 acre and therefore a SWPP Plan, NOI and Authorization to Discharge Letter will be required from ADEQ.

5. Conclusions

The following is a summary of the Scottsdale Heights Phase 2 Drainage Report.

- The site currently lies within "Zone X" floodplain designation.
- Retention is provided for 100-year 2 hour storm event.
- Retention shall dissipate within 36 hours via drywells.
- Offsite drainage is accepted and discharged in its historical locations.
- Finished floors are set a minimum of 14-inches above lot outfalls, and 18-inches above ultimate outfalls.

6. References

1. Maricopa County, *Drainage Design Manual, Volume I, Hydrology*, Flood Control District of Maricopa County.

2. City of Scottsdale, *Design Standards and Policies Manual,* 2018.

3. Maricopa County Drainage Design Manual, Hydraulics, Flood Control District of Maricopa County, 2013.

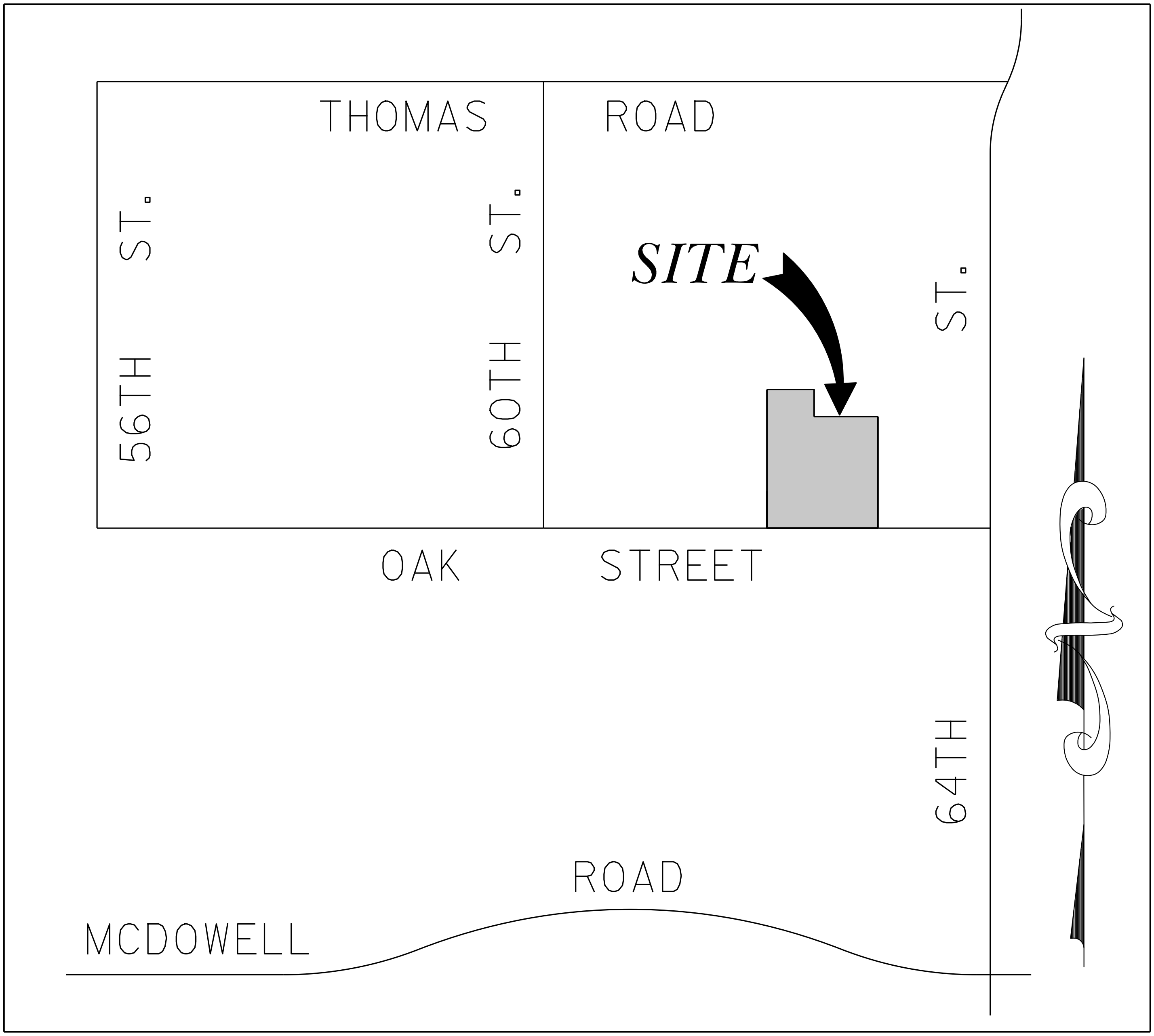
4. Lower Indian Bend Wash, FLO-2D, Flood Control District of Maricopa County

5. FlowMaster Version V8i, Bentley.

6. StormCAD Version V8i, Bentley.

APPENDIX A

Vicinity Map



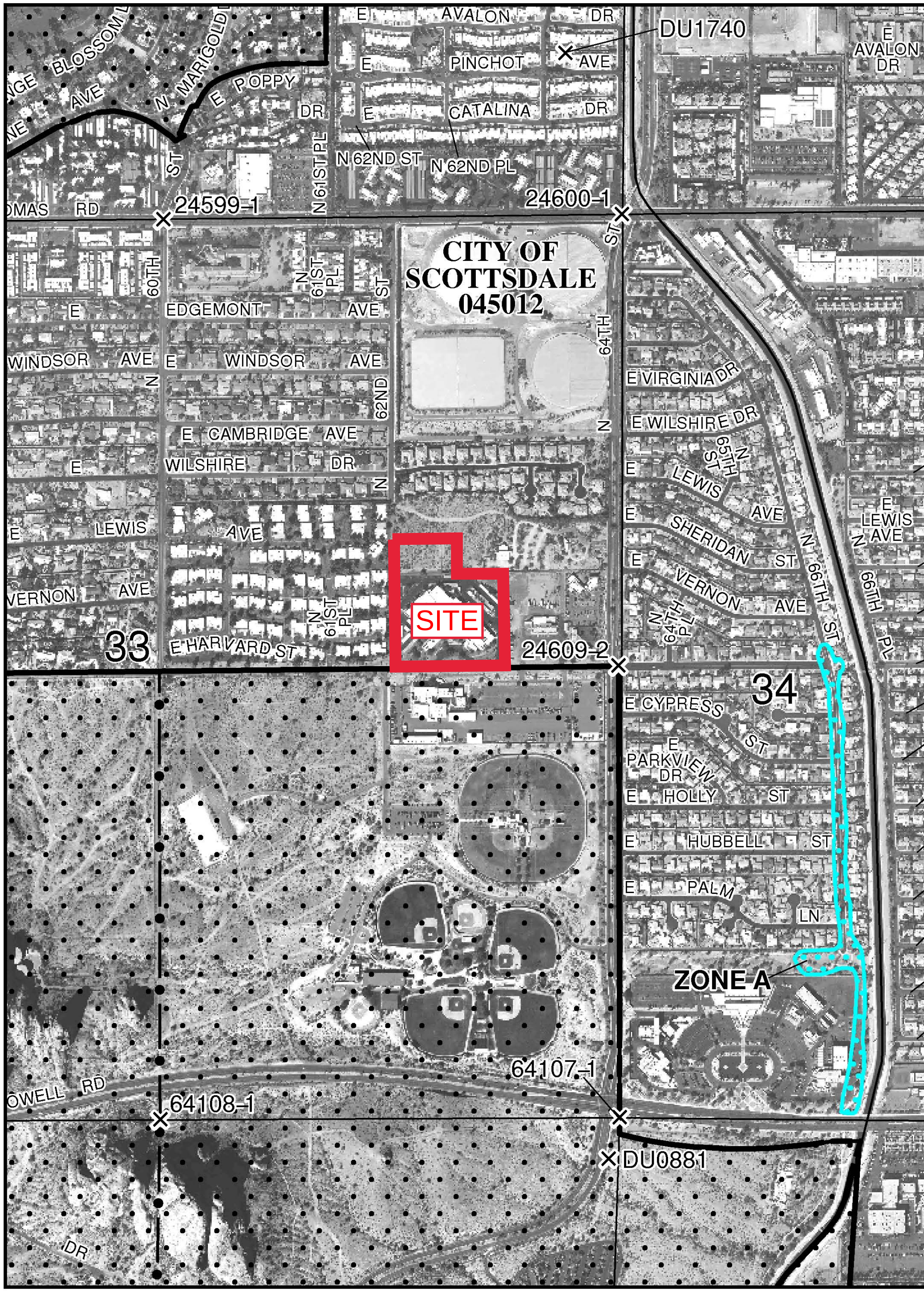
VICINITY MAP

N.T.S.

7-ZN-2020
4/30/2020

APPENDIX B

FEMA FIRM



MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

METERS

NFIP

PANEL 2230L

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA

AND INCORPORATED AREAS

PANEL 2230 OF 4425

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY	040037	2230	L
PHOENIX, CITY OF	040051	2230	L
SCOTTSDALE, CITY OF	045012	2230	L
TEMPE, CITY OF	040054	2230	L

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

MAP NUMBER 04013C2230L

MAP REVISED OCTOBER 16, 2013

Federal Emergency Management Agency

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

7-ZN-2020
4/30/2020

APPENDIX C

Warning and Disclaimer of Liability

Appendix 4-1C

WARNING & DISCLAIMER OF LIABILITY

The Drainage and Floodplain Regulations and Ordinances of the City of Scottsdale are intended to "minimize the occurrence of losses, hazards and conditions adversely affecting the public health, safety and general welfare which might result from flooding caused by the surface runoff of rainfall" (Scottsdale Revised Code §37-16).

As defined in S.R.C. §37-17, a flood plain or "*Special flood hazard* area means an area having flood and/or flood related erosion hazards as shown on a FHBM or FIRM as zone A, AO, A1-30, AE, A99, AH, or E, and those areas identified as such by the floodplain administrator, delineated in accordance with subsection 37-18(b) and adopted by the floodplain board." It is possible that a property could be inundated by greater frequency flood events or by a flood greater in magnitude than a 100-year flood. Additionally, much of the Scottsdale area is a dynamic flood area; that is, the floodplains may shift from one location to another, over time, due to natural processes.

WARNING AND DISCLAIMER OF LIABILITY PURSUANT TO S.R.C §37-22
"The degree of flood protection provided by the requirements in this article is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. Floods larger than the base flood can and will occur on rare occasions. Floodwater heights may be increased by man-made or natural causes. This article (Chapter 37, Article II) shall not create liability on the part of the city, any officer or employee thereof, or the federal government for any flood damages that result from reliance on this article or any administrative decision lawfully made thereunder."

Compliance with Drainage and Floodplain Regulations and Ordinances does not insure complete protection from flooding. The Floodplain Regulations and Ordinances meet established local and federal standards for floodplain management, but neither this review nor the Regulations and Ordinances take into account such flood related problems as natural erosion, streambed meander or man-made obstructions and diversions, all of which may have an adverse affect in the event of a flood. You are advised to consult your own engineer or other expert regarding these considerations.

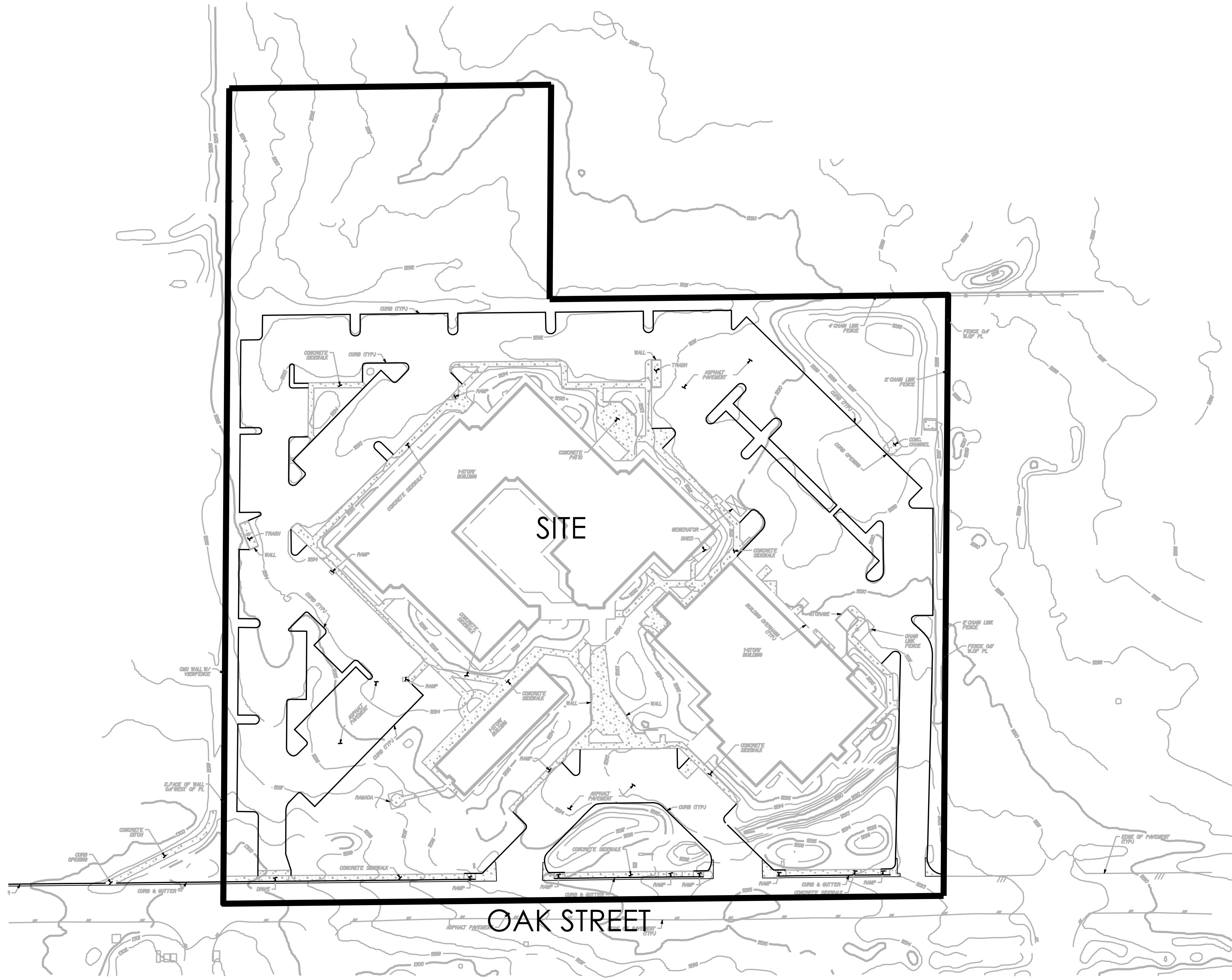
I have read and understand the above. If I am an agent for an owner I have made the owner aware of and explained this disclaimer.

Plan Check No.	Owner or Agent	Date
X-XX-XXXX		4/3/20

7-ZN-2020
4/30/2020

APPENDIX D

Topographic Map of Onsite Conditions



SCALE: 1"=100'

0' 50' 100' 200'

3engineering
planning civil engineering surveying
3 ENGINEERING, LLC
6370 E. THOMAS ROAD, SUITE # 200 - SCOTTSDALE, ARIZONA 85251
PHONE: (602) 334-4387 - FAX: (602) 490-3230
WWW.3ENGINEERING.COM

DATE: 4/3/20

PROJECT NO. 5153

64TH ST & OAK
SCOTTSDALE, ARIZONA

TOPOGRAPHIC MAP

7-ZN-2020
4/30/2020

00\5153_64th St & Oak\Reports\Drainage\Prelim\5153_TOPO MAP.dgn

APPENDIX E

Aerial Photograph of Site

7-ZN-2020
4/30/2020

SCALE: 1"=100'

0' 50' 100' 200'

64TH ST & OAK
SCOTTSDALE, ARIZONA

AERIAL MAP

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DATE:	4/3/20

7-ZN-2020
4/30/2020

00\5153_64th St & Oak\Reports\Drainage\Prelim\5153_AERIAL MAP.dgn

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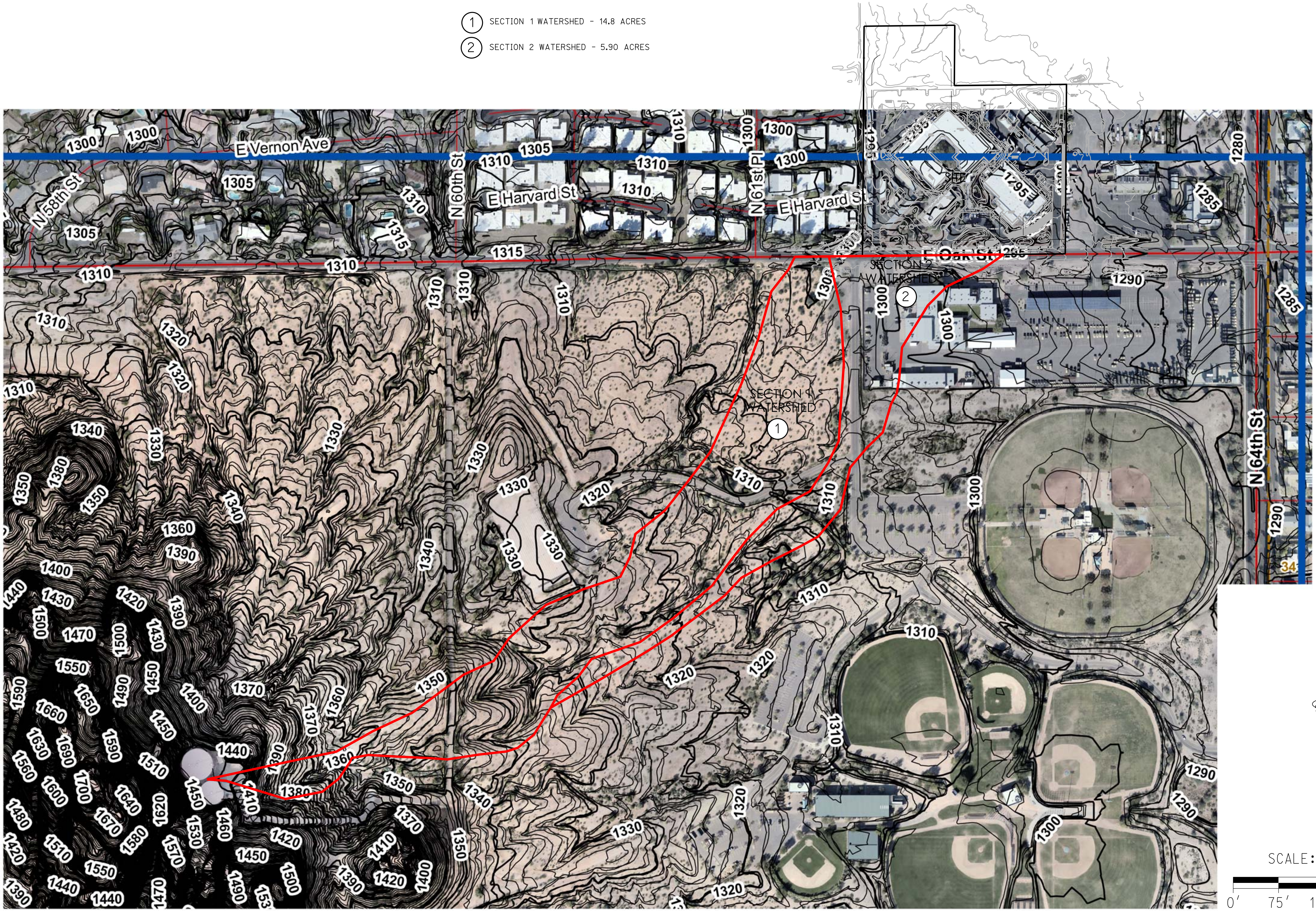
APPENDIX F

Drainage Maps (incl. Lower Indian Bend Wash FLO2D)

① SECTION 1 WATERSHED - 14.8 ACRES

② SECTION 2 WATERSHED - 5.90 ACRES



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64TH ST. & OAK
SCOTTSDALE, ARIZONA

OFFSITE DRAINAGE MAP

DATE: 4/3/20

PROJECT NO. 5153

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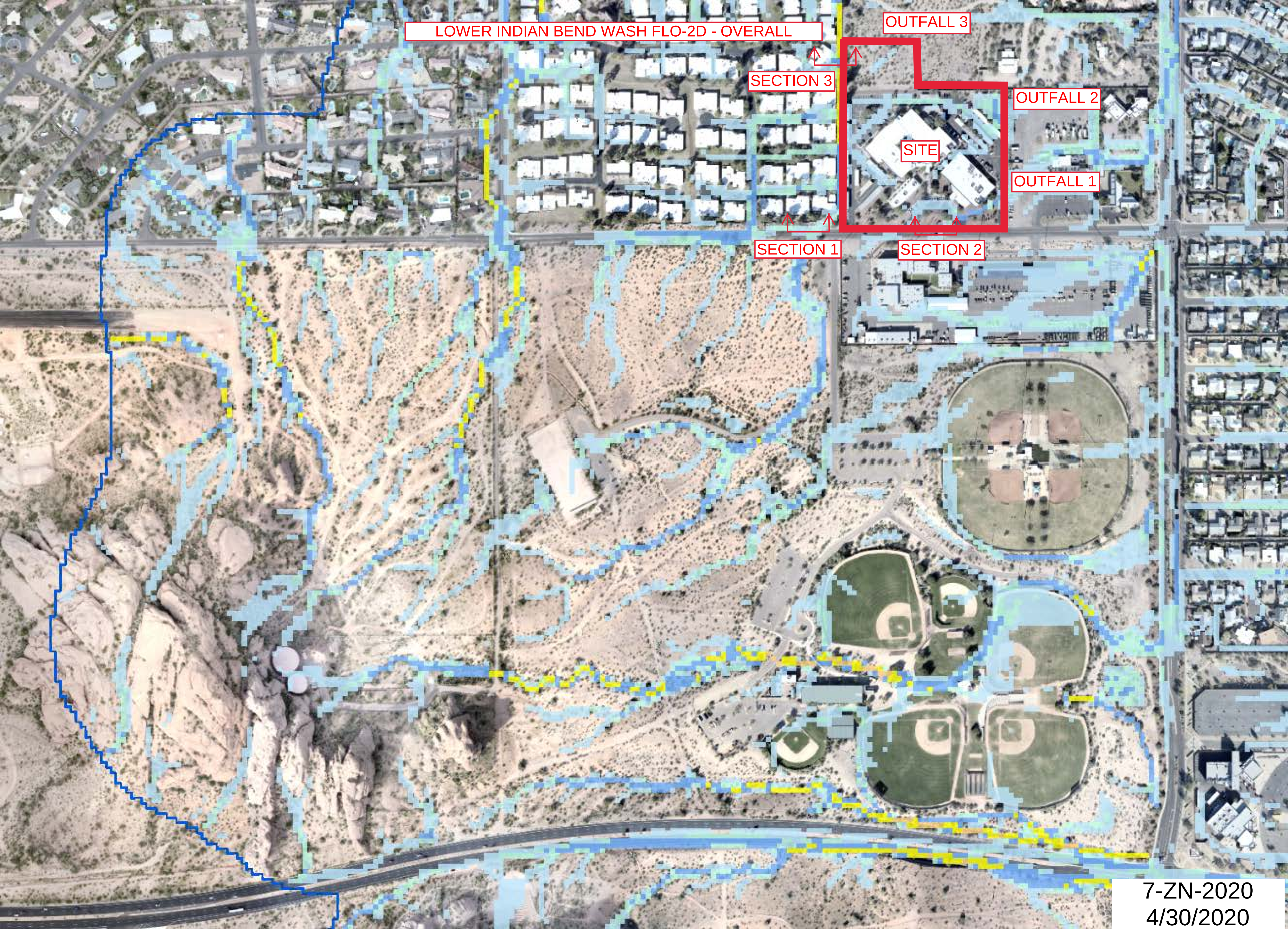
4/30/2020



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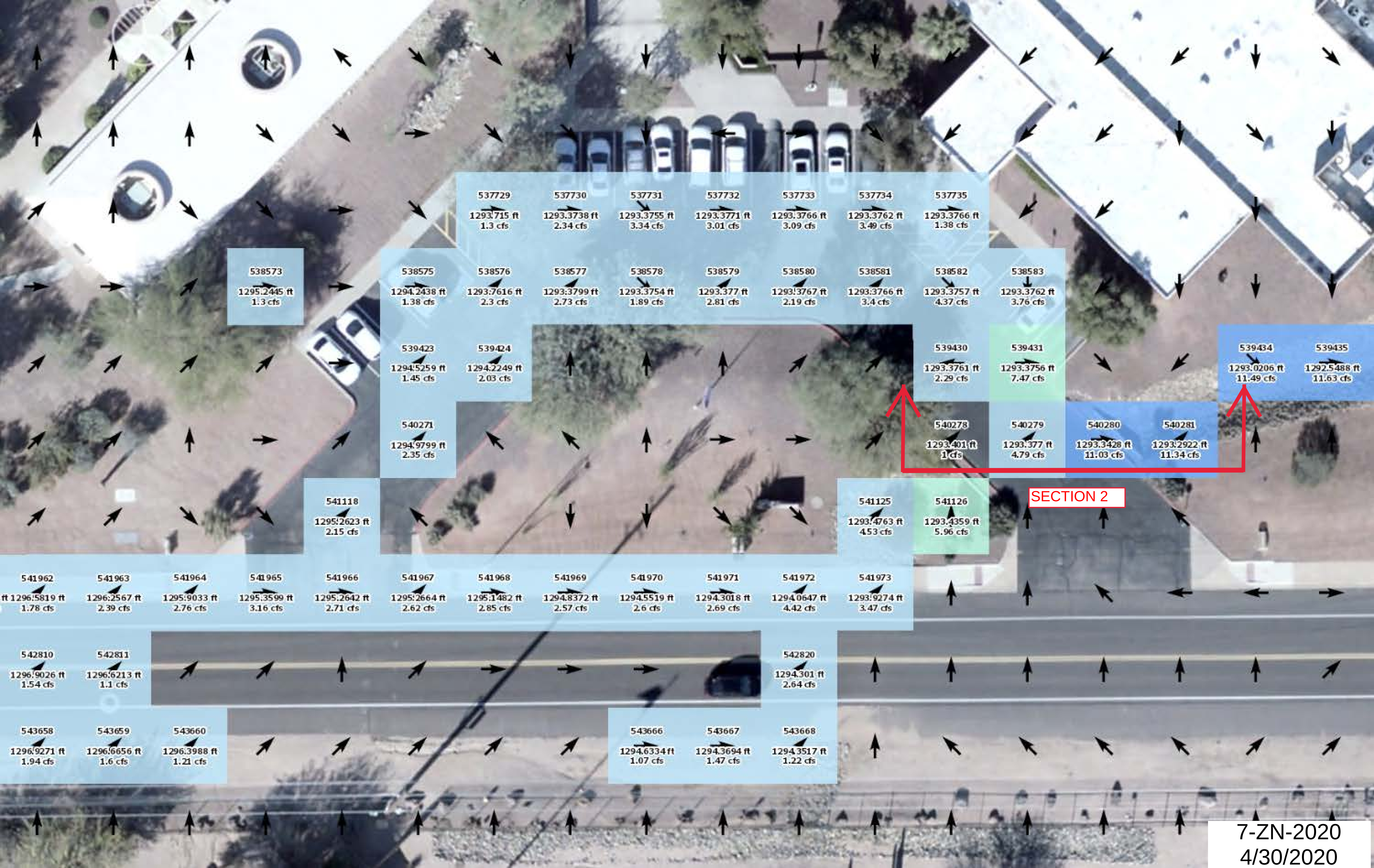
4/30/2020



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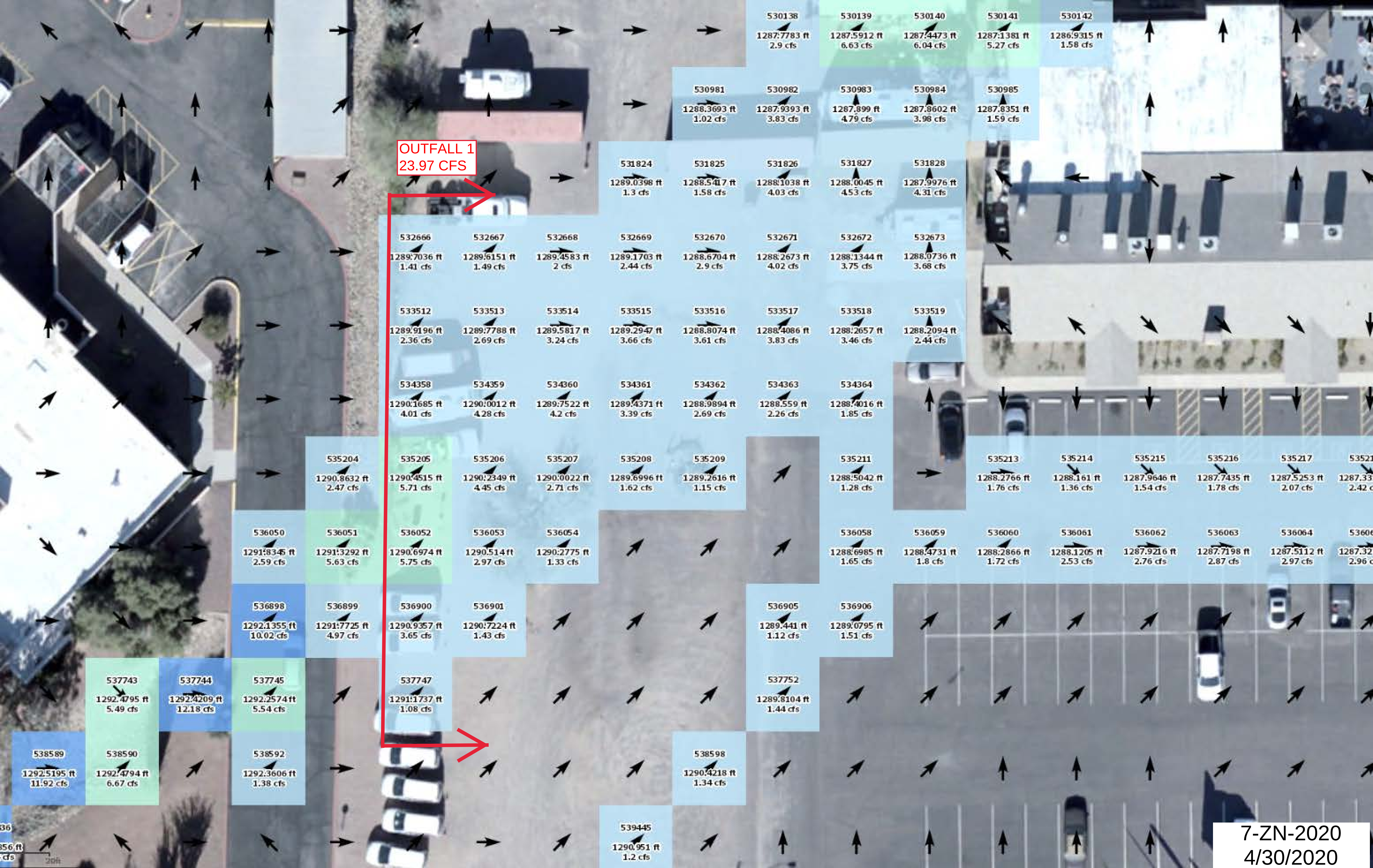
4/30/2020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OUTFALL 1
23.97 CFS
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4/30/2020

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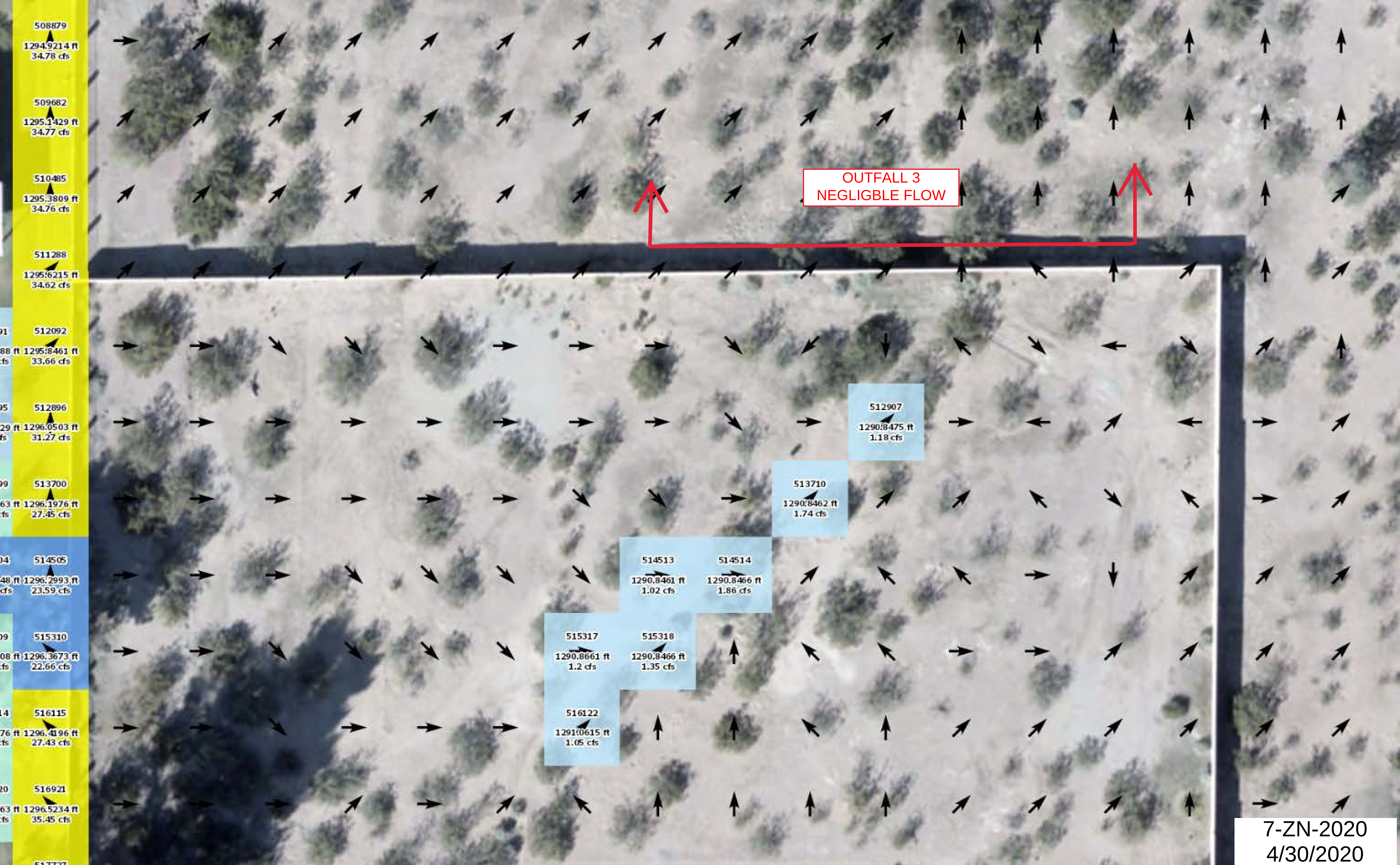
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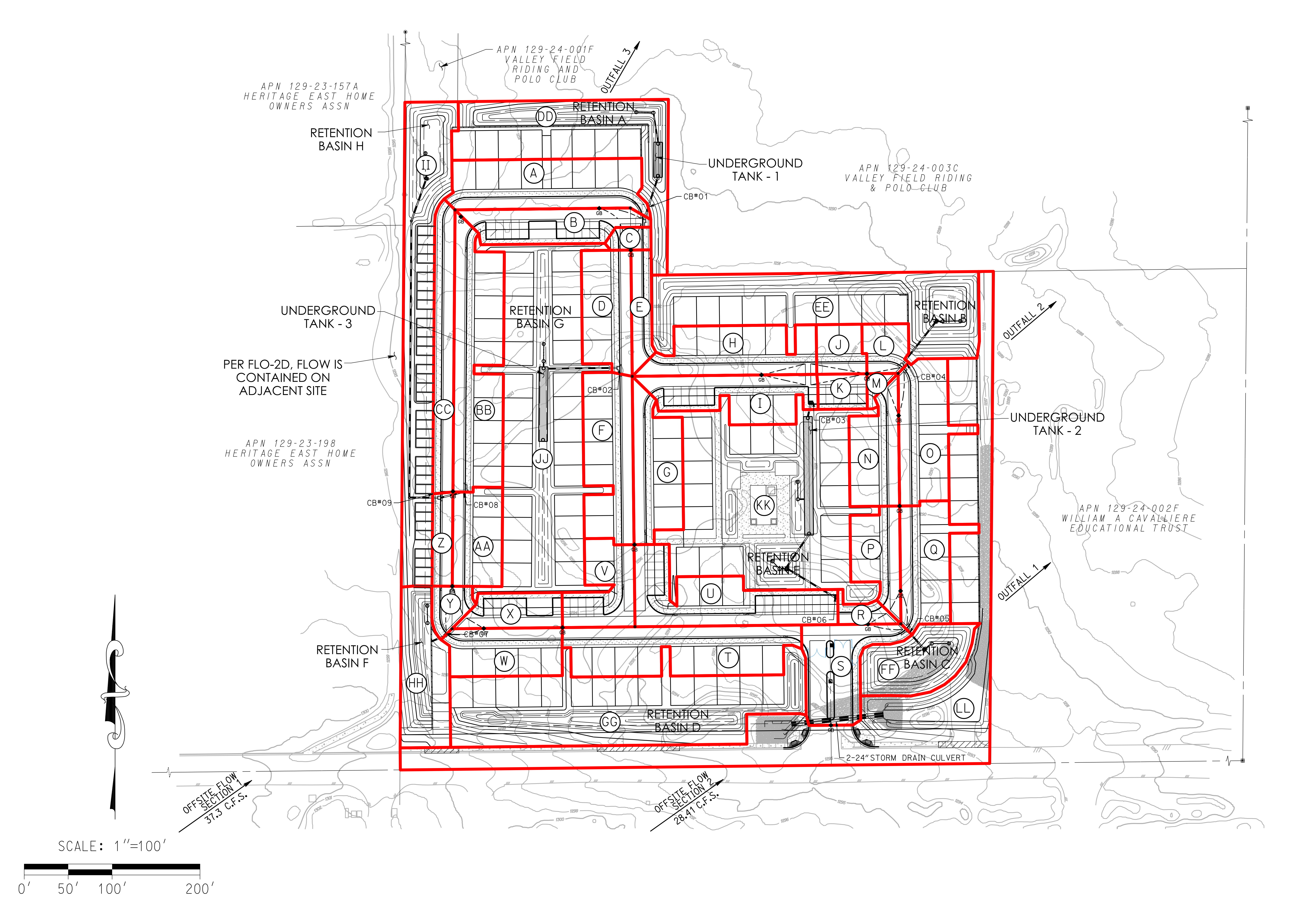
4/30/2020



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DATE: 4/3/20

PROJECT NO. 5153

64TH ST. & OAK
SCOTTSDALE, ARIZONA

DRAINAGE MAP

7-ZN-2020
4/30/2020

APPENDIX G

Onsite Hydrologic and Hydraulic Calculations

NOAA Atlas 14, Volume 1, Version 5
Location name: Scottsdale, Arizona, USA*
Latitude: 33.4734°, Longitude: -111.9472°
Elevation: 1300.97 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.180 (0.152-0.218)	0.236 (0.200-0.285)	0.321 (0.270-0.386)	0.386 (0.323-0.463)	0.475 (0.391-0.566)	0.543 (0.441-0.645)	0.613 (0.488-0.725)	0.684 (0.536-0.809)	0.780 (0.594-0.924)	0.853 (0.637-1.01)
10-min	0.274 (0.231-0.332)	0.358 (0.304-0.433)	0.489 (0.410-0.587)	0.588 (0.492-0.704)	0.722 (0.595-0.861)	0.827 (0.671-0.981)	0.933 (0.743-1.10)	1.04 (0.816-1.23)	1.19 (0.905-1.41)	1.30 (0.970-1.54)
15-min	0.340 (0.286-0.411)	0.444 (0.376-0.537)	0.605 (0.509-0.728)	0.729 (0.609-0.873)	0.895 (0.737-1.07)	1.02 (0.832-1.22)	1.16 (0.921-1.37)	1.29 (1.01-1.53)	1.47 (1.12-1.74)	1.61 (1.20-1.91)
30-min	0.458 (0.386-0.554)	0.598 (0.507-0.723)	0.816 (0.686-0.980)	0.982 (0.821-1.18)	1.21 (0.993-1.44)	1.38 (1.12-1.64)	1.56 (1.24-1.84)	1.74 (1.36-2.06)	1.98 (1.51-2.35)	2.17 (1.62-2.57)
60-min	0.566 (0.477-0.685)	0.740 (0.627-0.895)	1.01 (0.848-1.21)	1.22 (1.02-1.45)	1.49 (1.23-1.78)	1.71 (1.39-2.03)	1.93 (1.54-2.28)	2.15 (1.69-2.54)	2.45 (1.87-2.90)	2.68 (2.01-3.19)
2-hr	0.656 (0.563-0.778)	0.850 (0.729-1.01)	1.14 (0.976-1.35)	1.36 (1.15-1.61)	1.66 (1.39-1.95)	1.90 (1.56-2.22)	2.14 (1.74-2.50)	2.38 (1.90-2.78)	2.71 (2.11-3.17)	2.96 (2.25-3.48)
3-hr	0.710 (0.605-0.846)	0.911 (0.781-1.09)	1.20 (1.02-1.43)	1.43 (1.21-1.69)	1.75 (1.46-2.06)	2.01 (1.65-2.36)	2.27 (1.83-2.67)	2.55 (2.03-2.99)	2.94 (2.26-3.45)	3.25 (2.44-3.83)
6-hr	0.856 (0.745-1.00)	1.09 (0.949-1.27)	1.40 (1.22-1.63)	1.64 (1.42-1.91)	1.98 (1.68-2.28)	2.24 (1.88-2.58)	2.52 (2.08-2.90)	2.80 (2.26-3.23)	3.19 (2.51-3.68)	3.49 (2.69-4.05)
12-hr	0.961 (0.844-1.11)	1.22 (1.07-1.41)	1.55 (1.35-1.78)	1.80 (1.56-2.08)	2.15 (1.84-2.47)	2.42 (2.05-2.77)	2.69 (2.25-3.09)	2.97 (2.45-3.41)	3.34 (2.68-3.86)	3.63 (2.87-4.22)
24-hr	1.16 (1.04-1.31)	1.48 (1.32-1.66)	1.91 (1.71-2.15)	2.26 (2.01-2.53)	2.74 (2.42-3.07)	3.11 (2.73-3.48)	3.51 (3.05-3.92)	3.92 (3.38-4.38)	4.48 (3.83-5.01)	4.93 (4.17-5.52)
2-day	1.25 (1.12-1.41)	1.61 (1.44-1.81)	2.11 (1.88-2.37)	2.51 (2.23-2.81)	3.07 (2.72-3.44)	3.51 (3.09-3.93)	3.98 (3.49-4.47)	4.47 (3.88-5.02)	5.16 (4.43-5.80)	5.71 (4.85-6.44)
3-day	1.33 (1.19-1.49)	1.70 (1.52-1.91)	2.23 (1.99-2.50)	2.66 (2.37-2.98)	3.27 (2.89-3.66)	3.76 (3.30-4.20)	4.27 (3.73-4.78)	4.82 (4.17-5.40)	5.58 (4.77-6.26)	6.20 (5.25-6.97)
4-day	1.40 (1.25-1.57)	1.79 (1.60-2.01)	2.36 (2.10-2.64)	2.82 (2.50-3.15)	3.47 (3.06-3.88)	4.00 (3.51-4.47)	4.56 (3.97-5.10)	5.16 (4.46-5.77)	6.00 (5.12-6.72)	6.69 (5.64-7.50)
7-day	1.55 (1.38-1.74)	1.98 (1.77-2.22)	2.61 (2.32-2.93)	3.12 (2.77-3.50)	3.84 (3.39-4.30)	4.42 (3.89-4.95)	5.05 (4.40-5.65)	5.70 (4.93-6.39)	6.63 (5.66-7.43)	7.38 (6.23-8.28)
10-day	1.68 (1.50-1.89)	2.15 (1.92-2.42)	2.84 (2.53-3.18)	3.39 (3.01-3.80)	4.17 (3.68-4.65)	4.79 (4.20-5.34)	5.44 (4.75-6.08)	6.14 (5.31-6.86)	7.11 (6.08-7.95)	7.89 (6.68-8.84)
20-day	2.06 (1.85-2.31)	2.66 (2.38-2.96)	3.51 (3.14-3.90)	4.15 (3.70-4.61)	5.01 (4.45-5.57)	5.68 (5.02-6.31)	6.35 (5.60-7.07)	7.04 (6.17-7.84)	7.96 (6.92-8.89)	8.68 (7.48-9.70)
30-day	2.41 (2.15-2.69)	3.10 (2.77-3.46)	4.09 (3.65-4.55)	4.83 (4.30-5.37)	5.84 (5.17-6.49)	6.61 (5.83-7.33)	7.40 (6.50-8.21)	8.20 (7.17-9.10)	9.29 (8.06-10.3)	10.1 (8.71-11.3)
45-day	2.79 (2.51-3.12)	3.60 (3.23-4.01)	4.74 (4.25-5.28)	5.59 (4.99-6.22)	6.70 (5.97-7.45)	7.53 (6.69-8.38)	8.38 (7.41-9.32)	9.23 (8.12-10.3)	10.3 (9.03-11.5)	11.2 (9.71-12.5)
60-day	3.10 (2.79-3.45)	4.00 (3.60-4.44)	5.26 (4.72-5.84)	6.17 (5.53-6.86)	7.37 (6.58-8.18)	8.25 (7.34-9.16)	9.14 (8.10-10.2)	10.00 (8.83-11.1)	11.1 (9.77-12.4)	12.0 (10.4-13.4)

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

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

Please refer to NOAA Atlas 14 document for more information.

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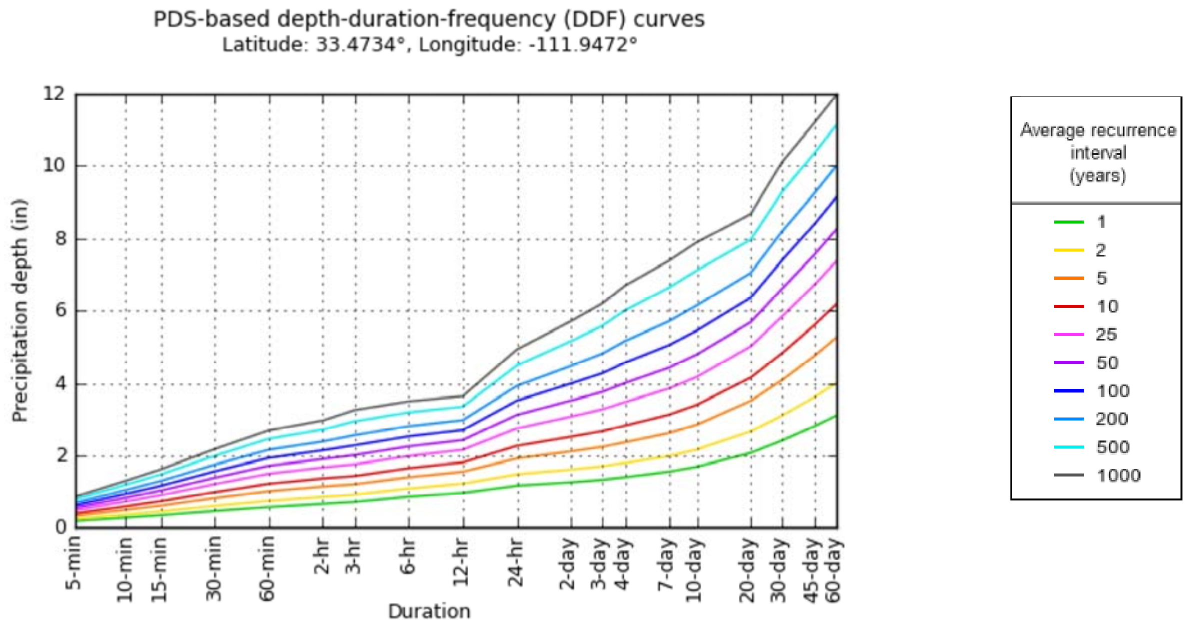
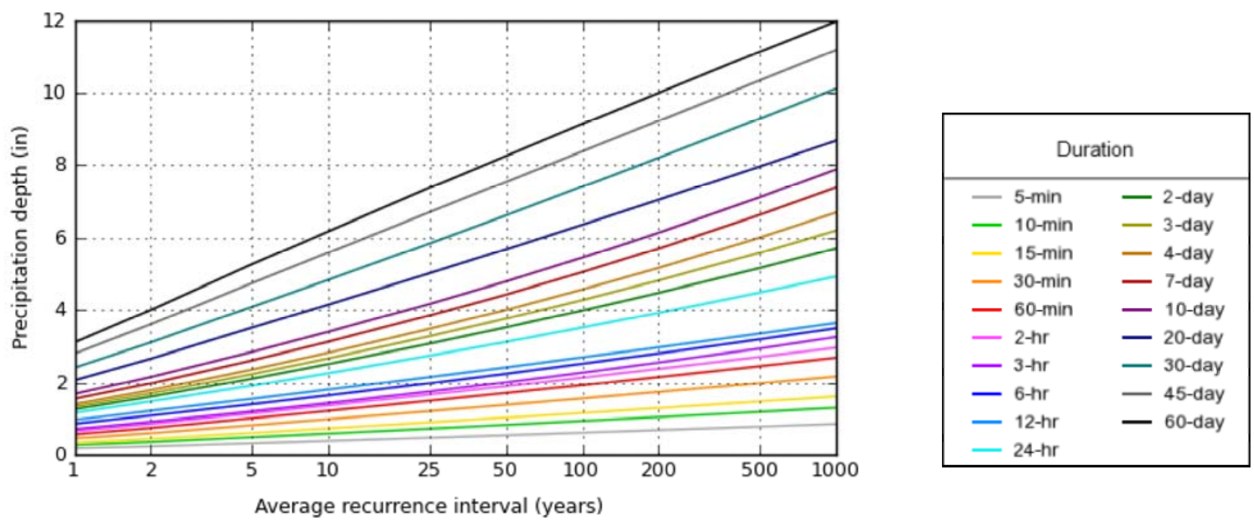
7-ZN-2020

4/30/2020

PF graphical





NOAA Atlas 14, Volume 1, Version 5

Created (GMT): Thu Mar 19 21:39:09 2020

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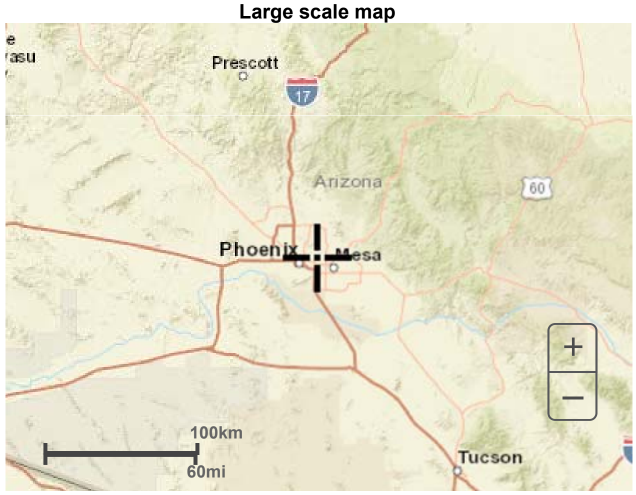
7-ZN-2020
4/30/2020

Maps & aerials

Small scale terrain

Large scale terrain

Large scale map



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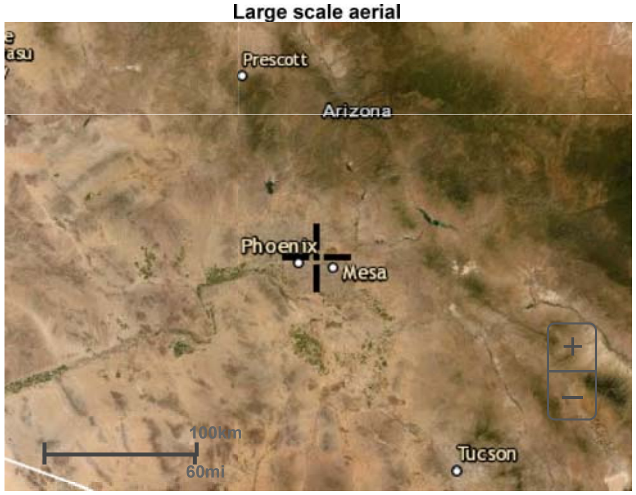
Large scale aerial



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

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NOAA Atlas 14, Volume 1, Version 5

Location name: Scottsdale, Arizona, USA*
Latitude: 33.4734°, Longitude: -111.9472°
Elevation: 1300.97 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**2.16** (1.82-2.62)	**2.83** (2.40-3.42)	**3.85** (3.24-4.63)	**4.63** (3.88-5.56)	**5.70** (4.69-6.79)	**6.52** (5.29-7.74)	**7.36** (5.86-8.70)	**8.21** (6.43-9.71)	**9.36** (7.13-11.1)	**10.2** (7.64-12.2)
10-min	**1.64** (1.39-1.99)	**2.15** (1.82-2.60)	**2.93** (2.46-3.52)	**3.53** (2.95-4.22)	**4.33** (3.57-5.17)	**4.96** (4.03-5.89)	**5.60** (4.46-6.62)	**6.25** (4.90-7.39)	**7.12** (5.43-8.44)	**7.79** (5.82-9.25)
15-min	**1.36** (1.14-1.64)	**1.78** (1.50-2.15)	**2.42** (2.04-2.91)	**2.92** (2.44-3.49)	**3.58** (2.95-4.27)	**4.10** (3.33-4.86)	**4.62** (3.68-5.47)	**5.16** (4.05-6.11)	**5.88** (4.48-6.97)	**6.44** (4.81-7.64)
30-min	**0.916** (0.772-1.11)	**1.20** (1.01-1.45)	**1.63** (1.37-1.96)	**1.96** (1.64-2.35)	**2.41** (1.99-2.87)	**2.76** (2.24-3.28)	**3.11** (2.48-3.68)	**3.48** (2.72-4.11)	**3.96** (3.02-4.69)	**4.34** (3.24-5.15)
60-min	**0.566** (0.477-0.685)	**0.740** (0.627-0.895)	**1.01** (0.848-1.21)	**1.22** (1.02-1.45)	**1.49** (1.23-1.78)	**1.71** (1.39-2.03)	**1.93** (1.54-2.28)	**2.15** (1.69-2.54)	**2.45** (1.87-2.90)	**2.68** (2.01-3.19)
2-hr	**0.328** (0.282-0.389)	**0.425** (0.364-0.505)	**0.570** (0.488-0.674)	**0.681** (0.576-0.802)	**0.832** (0.695-0.974)	**0.948** (0.782-1.11)	**1.07** (0.868-1.25)	**1.19** (0.948-1.39)	**1.35** (1.05-1.58)	**1.48** (1.13-1.74)
3-hr	**0.236** (0.201-0.282)	**0.303** (0.260-0.363)	**0.400** (0.341-0.476)	**0.476** (0.402-0.563)	**0.582** (0.486-0.686)	**0.668** (0.549-0.784)	**0.757** (0.611-0.888)	**0.849** (0.674-0.996)	**0.978** (0.752-1.15)	**1.08** (0.812-1.27)
6-hr	**0.143** (0.124-0.168)	**0.181** (0.158-0.212)	**0.233** (0.203-0.272)	**0.274** (0.237-0.319)	**0.330** (0.281-0.381)	**0.375** (0.314-0.431)	**0.421** (0.347-0.484)	**0.467** (0.378-0.539)	**0.532** (0.420-0.615)	**0.583** (0.449-0.676)
12-hr	**0.080** (0.070-0.092)	**0.101** (0.089-0.117)	**0.128** (0.112-0.148)	**0.150** (0.130-0.172)	**0.179** (0.153-0.205)	**0.201** (0.170-0.230)	**0.223** (0.187-0.256)	**0.246** (0.203-0.283)	**0.277** (0.223-0.320)	**0.302** (0.238-0.351)
24-hr	**0.048** (0.043-0.054)	**0.062** (0.055-0.069)	**0.080** (0.071-0.090)	**0.094** (0.084-0.106)	**0.114** (0.101-0.128)	**0.130** (0.114-0.145)	**0.146** (0.127-0.163)	**0.163** (0.141-0.182)	**0.187** (0.159-0.209)	**0.205** (0.174-0.230)
2-day	**0.026** (0.023-0.029)	**0.033** (0.030-0.038)	**0.044** (0.039-0.049)	**0.052** (0.047-0.059)	**0.064** (0.057-0.072)	**0.073** (0.064-0.082)	**0.083** (0.073-0.093)	**0.093** (0.081-0.105)	**0.107** (0.092-0.121)	**0.119** (0.101-0.134)
3-day	**0.018** (0.016-0.021)	**0.024** (0.021-0.026)	**0.031** (0.028-0.035)	**0.037** (0.033-0.041)	**0.045** (0.040-0.051)	**0.052** (0.046-0.058)	**0.059** (0.052-0.066)	**0.067** (0.058-0.075)	**0.078** (0.066-0.087)	**0.086** (0.073-0.097)
4-day	**0.015** (0.013-0.016)	**0.019** (0.017-0.021)	**0.025** (0.022-0.028)	**0.029** (0.026-0.033)	**0.036** (0.032-0.040)	**0.042** (0.037-0.047)	**0.048** (0.041-0.053)	**0.054** (0.046-0.060)	**0.063** (0.053-0.070)	**0.070** (0.059-0.078)
7-day	**0.009** (0.008-0.010)	**0.012** (0.011-0.013)	**0.016** (0.014-0.017)	**0.019** (0.016-0.021)	**0.023** (0.020-0.026)	**0.026** (0.023-0.029)	**0.030** (0.026-0.034)	**0.034** (0.029-0.038)	**0.039** (0.034-0.044)	**0.044** (0.037-0.049)
10-day	**0.007** (0.006-0.008)	**0.009** (0.008-0.010)	**0.012** (0.011-0.013)	**0.014** (0.013-0.016)	**0.017** (0.015-0.019)	**0.020** (0.018-0.022)	**0.023** (0.020-0.025)	**0.026** (0.022-0.029)	**0.030** (0.025-0.033)	**0.033** (0.028-0.037)
20-day	**0.004** (0.004-0.005)	**0.006** (0.005-0.006)	**0.007** (0.007-0.008)	**0.009** (0.008-0.010)	**0.010** (0.009-0.012)	**0.012** (0.010-0.013)	**0.013** (0.012-0.015)	**0.015** (0.013-0.016)	**0.017** (0.014-0.019)	**0.018** (0.016-0.020)
30-day	**0.003** (0.003-0.004)	**0.004** (0.004-0.005)	**0.006** (0.005-0.006)	**0.007** (0.006-0.007)	**0.008** (0.007-0.009)	**0.009** (0.008-0.010)	**0.010** (0.009-0.011)	**0.011** (0.010-0.013)	**0.013** (0.011-0.014)	**0.014** (0.012-0.016)
45-day	**0.003** (0.002-0.003)	**0.003** (0.003-0.004)	**0.004** (0.004-0.005)	**0.005** (0.005-0.006)	**0.006** (0.006-0.007)	**0.007** (0.006-0.008)	**0.008** (0.007-0.009)	**0.009** (0.008-0.010)	**0.010** (0.008-0.011)	**0.010** (0.009-0.012)
60-day	**0.002** (0.002-0.002)	**0.003** (0.002-0.003)	**0.004** (0.003-0.004)	**0.004** (0.004-0.005)	**0.005** (0.005-0.006)	**0.006** (0.005-0.006)	**0.006** (0.006-0.007)	**0.007** (0.006-0.008)	**0.008** (0.007-0.009)	**0.008** (0.007-0.009)

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

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

Please refer to NOAA Atlas 14 document for more information.

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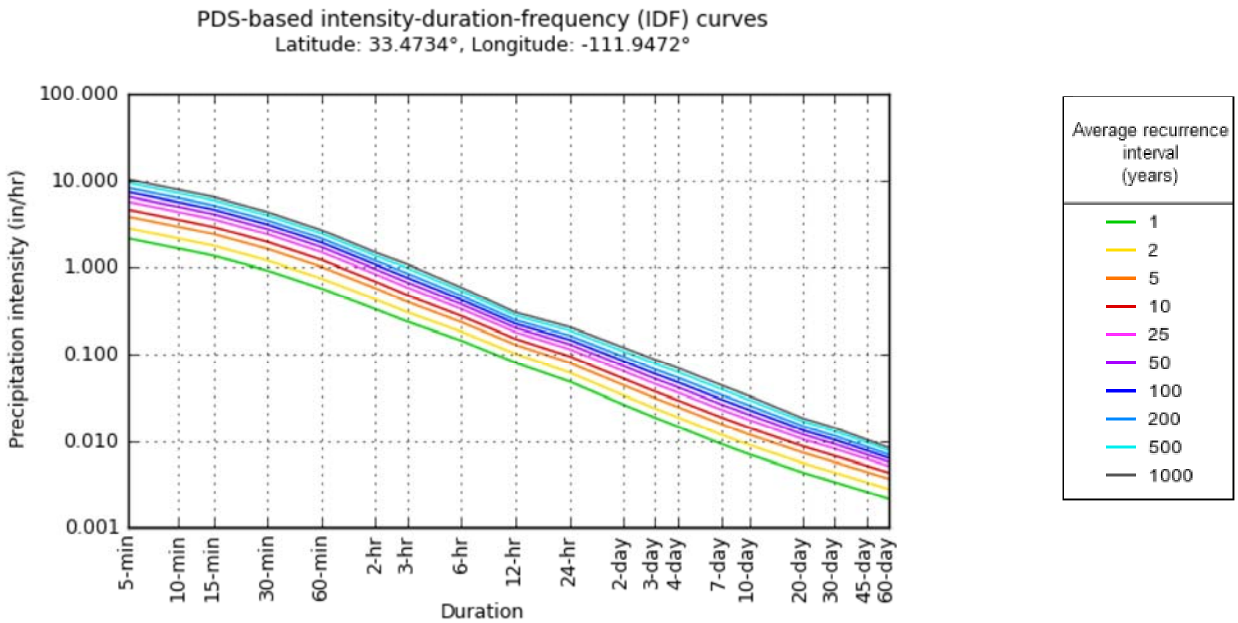
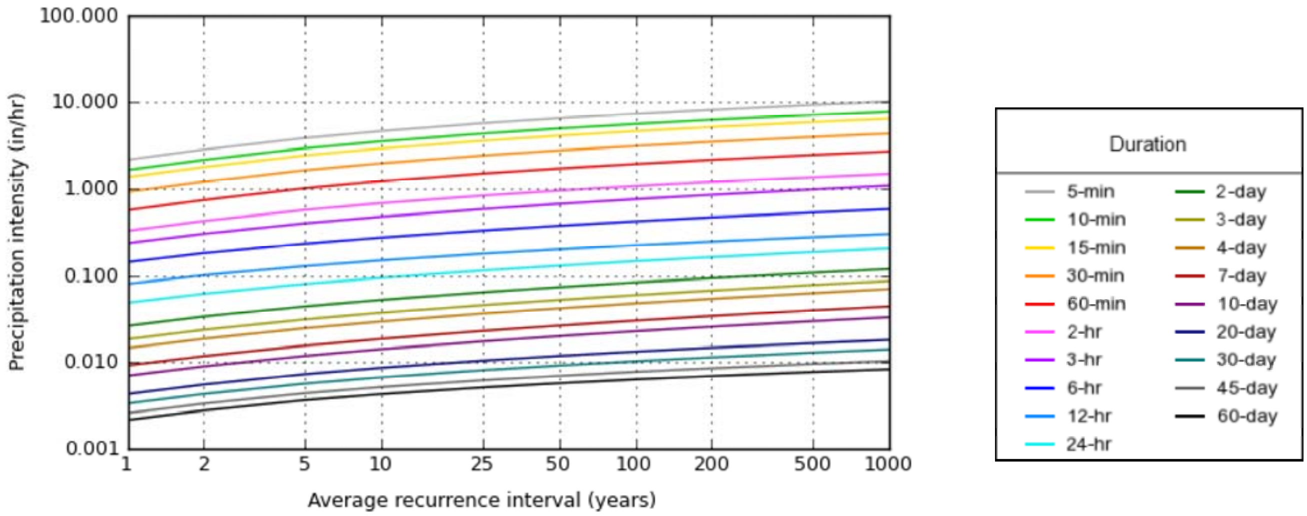
PF graphical





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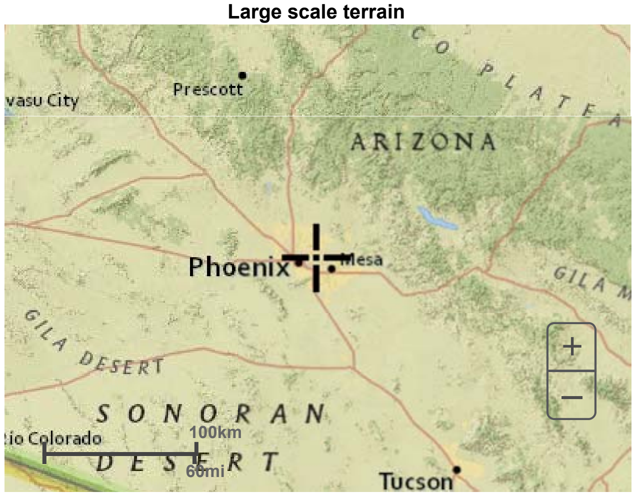
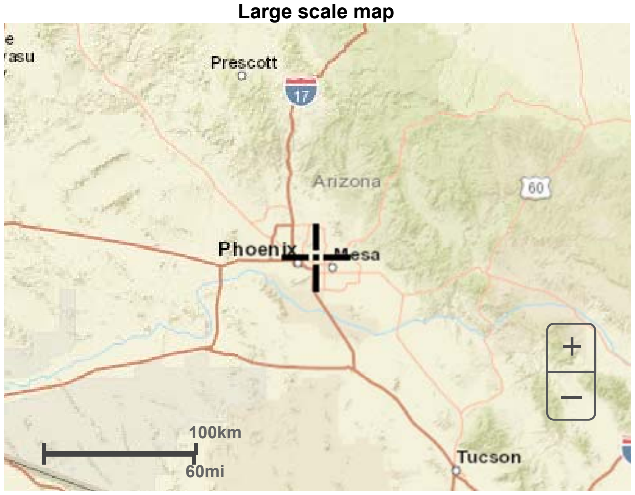
Maps & aerials

Small scale terrain

Large scale terrain



Large scale map



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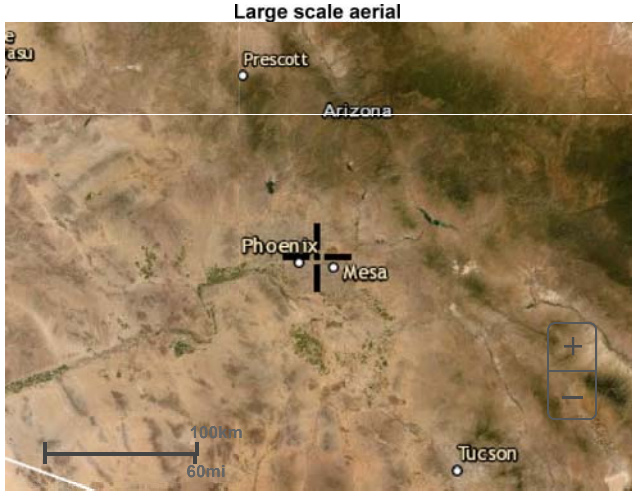
Large scale aerial



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1. The Rational Method (generally used for watersheds less than 160 acres that are regularly shaped and uniformly contoured). The methodology is provided in the FCDMC Hydrology Manual.
2. A rainfall runoff model using the USACE's HEC 1 Flood Hydrograph Package (generally used for watersheds that are larger than 160 acres, irregular in shape and contour, or if routing of flows is necessary).

B. Watershed Conditions

Watersheds are subject to change. Grading and drainage plans shall consider all watershed conditions that would result in the greatest peak discharge rate, to:

1. Size drainage facilities, and
2. Determine lowest floor elevations.

C. Split-Flow Conditions

Projects in northern parts of Scottsdale must address split-flow channel conditions where applicable. These splits in the alluvial channels usually include highly erosive soils and are generally unstable and unpredictable. In setting lowest floor elevations relative to upstream splits, assume that 100% of the flow could go either direction in any given flood event. For infrastructure design, the estimate of the actual split, based on a hydraulic analysis of the current channel cross sections, must include a minimum safety factor of 30% of the total flow. If there are extenuating factors affecting the stability of the split, the safety factor should be increased accordingly.

D. Environmentally Sensitive Lands

For special considerations regarding Environmentally Sensitive Lands, refer to the City Zoning Ordinance and DSPM Chapter 2 Section 2-2. Modification of natural watercourses with a flow of 50 cfs or greater are addressed in the City Zoning Ordinance.

E. The Rational Method

1. Precipitation. Precipitation input is rainfall intensity, "i," and can be obtained directly from NOAA 14 at http://hdsc.nws.noaa.gov/hdsc/pfds/sa/az_pfds.html
2. Time of Concentration. Time of concentration "t_c" is the total time of travel from the most hydraulically remote part of the watershed to the concentration point of interest. The calculation of "t_c" must follow FCDMC Hydrology Manual procedures.
3. Runoff Coefficients. Use Fig. 4-1.5, Runoff Coefficients for Use with Rational Method, or equivalent to obtain the runoff coefficients or "C" values. Composite "C" values for the appropriate zoning category or weighted average values calculated for the specific site are both acceptable approaches.

RUNOFF COEFFICIENTS – "C" VALUE

LAND USE	STORM FREQUENCY		
Composite Area-wide Values	2-25 Year	50 Year	100 Year
Commercial & Industrial Areas	0.80	0.83	0.86
Residential Areas – Single Family, slopes 10% or less			
R1-190	0.33	0.50	0.53

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	R1-130	0.35	0.51	0.59
	R1-70	0.37	0.52	0.60
	R1-43	0.38	0.55	0.61
	R1-35	0.40	0.56	0.62
	R1-18	0.43	0.58	0.64
	R1-10	0.47	0.62	0.70
	R1-7	0.51	0.66	0.80
	R1-5	0.54	0.69	0.86
	Residential Areas – Single Family, slopes greater than 10%			
	R1-190	0.65	0.74	0.82
	R1-130	0.68	0.76	0.84
	R1-70	0.69	0.77	0.85
	R1-43	0.70	0.77	0.85
	R1-35	0.70	0.78	0.85
	R1-18	0.71	0.79	0.86
	R1-10	0.75	0.82	0.88
	R1-7	0.81	0.86	0.91
	R1-5	0.85	0.89	0.92
	Townhouse (R-2, R-4)	0.63	0.74	0.94
use for rational	Apartments & Condominiums (Condos) (R-3, R-5)	0.76	0.83	0.94
	Specified Surface Type Values			
use for weighted calc for retention	Paved streets, parking lots (concrete or asphalt), roofs, driveways, etc.	0.90	0.93	0.95
	Lawns, golf courses, & parks (grassed areas)	0.20	0.25	0.30
	Undisturbed natural desert or desert landscaping (no impervious weed barrier)	0.37	0.42	0.45
	Desert landscaping (with impervious weed barrier)	0.63	0.73	0.83
	Mountain terrain - slopes greater than 10%	0.60	0.70	0.80
	Agricultural areas (flood irrigated fields)	0.16	0.18	0.20
	Gravel floodways and shoulders	0.68	0.78	0.82

FIGURE 4-1.5 RUNOFF COEFFICIENTS FOR RATIONAL METHOD

F. HEC-1 Model

1. Minimum submittals
   a. A printout of the input data.
   b. A schematic (routing) diagram of the stream network.
   c. The runoff summary output table, including drainage basin name, area, 2, 10, and 100- year flow values.
   d. Electronic input file(s) on compact disc (CD) or digital versatile/video disc (DVD).
   e. Supporting documentation and source material for parameter selection.
   f. A narrative detailing the impact of adjustments to the modeling parameters made to address warnings and error messages.
2. Precipitation

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Post-Development Rational Method Calculations for Inlets (Zoning R3)

Sub-Area	Area	Area	C_{10}	C_{100}	Tc	i_{10}	i_{100}	Local Q_{10}	Local Q_{100}
	(SF)	(AC)	-	-	(min)	(in/hr)	(in/hr)	(cfs)	(cfs)
A	12427	0.29	0.76	0.94	5	4.63	7.36	1.00	1.97
B	7199	0.17	0.76	0.94	5	4.63	7.36	0.58	1.14
C	1222	0.03	0.76	0.94	5	4.63	7.36	0.10	0.19
D	7574	0.17	0.76	0.94	5	4.63	7.36	0.61	1.20
E	3069	0.07	0.76	0.94	5	4.63	7.36	0.25	0.49
F	10461	0.24	0.76	0.94	5	4.63	7.36	0.85	1.66
G	8462	0.19	0.76	0.94	5	4.63	7.36	0.68	1.34
H	9688	0.22	0.76	0.94	5	4.63	7.36	0.78	1.54
I	8644	0.20	0.76	0.94	5	4.63	7.36	0.70	1.37
J	3056	0.07	0.76	0.94	5	4.63	7.36	0.25	0.49
K	2247	0.05	0.76	0.94	5	4.63	7.36	0.18	0.36
L	2775	0.06	0.76	0.94	5	4.63	7.36	0.22	0.44
M	726	0.02	0.76	0.94	5	4.63	7.36	0.06	0.12
N	6690	0.15	0.76	0.94	5	4.63	7.36	0.54	1.06
O	9445	0.22	0.76	0.94	5	4.63	7.36	0.76	1.50
P	5395	0.12	0.76	0.94	5	4.63	7.36	0.44	0.86
Q	8245	0.19	0.76	0.94	5	4.63	7.36	0.67	1.31
R	1513	0.03	0.76	0.94	5	4.63	7.36	0.12	0.24
S	8450	0.19	0.76	0.94	5	4.63	7.36	0.68	1.34
T	14059	0.32	0.76	0.94	5	4.63	7.36	1.14	2.23
U	12536	0.29	0.76	0.94	5	4.63	7.36	1.01	1.99
V	6332	0.15	0.76	0.94	5	4.63	7.36	0.51	1.01
W	7081	0.16	0.76	0.94	5	4.63	7.36	0.57	1.12
X	4283	0.10	0.76	0.94	5	4.63	7.36	0.35	0.68
Y	2107	0.05	0.76	0.94	5	4.63	7.36	0.17	0.33
Z	2443	0.06	0.76	0.94	5	4.63	7.36	0.20	0.39
AA	6256	0.14	0.76	0.94	5	4.63	7.36	0.51	0.99
BB	15794	0.36	0.76	0.94	5	4.63	7.36	1.28	2.51
CC	7536	0.17	0.76	0.94	5	4.63	7.36	0.61	1.20
DD	19281	0.44	0.76	0.94	5	4.63	7.36	1.56	3.06
EE	26173	0.60	0.76	0.94	5	4.63	7.36	2.11	4.16
FF	7989	0.18	0.76	0.94	5	4.63	7.36	0.65	1.27
GG	31169	0.72	0.76	0.94	5	4.63	7.36	2.52	4.95
HH	9113	0.21	0.76	0.94	5	4.63	7.36	0.74	1.45
II	21695	0.50	0.76	0.94	5	4.63	7.36	1.75	3.45
JJ	38220	0.88	0.76	0.94	5	4.63	7.36	3.09	6.07
KK	40104	0.92	0.76	0.94	5	4.63	7.36	3.24	6.37
LL (1)	46551	1.07	0.76	0.94	5	4.63	7.36	3.76	7.39
Total	**436010.00**	**10.01**						**1.68**	**69.25**
SUBBASINS THAT CONTRIBUTE TO STORM DRAIN SYSTEMS									

(1) NOTE: SUBBASIN LL DOES NOT CONTRIBUTE TO BASIN. IT IS OFFSITE FLOW CONVEYANCE AREA

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Curb Opening Catch Basin Capacity Calculations - Weir Condition

Inlet Type	Inlet Area	Q	Inlet Capacity W/25% Clogging	d	Cw	L	
		(cfs)	(cfs)	(ft)		(ft)	
CB1	A,B,C	3.31	5.09	0.50	3	6	Designed for 100yr
CB2	D,F	2.86	5.09	0.50	3	6	Designed for 100yr
CB4	L,M,N,O	3.12	5.09	0.50	3	6	Designed for 100yr
CB5	P,Q,R,S,T	5.98	7.64	0.50	3	9	Designed for 100yr
CB7	W,X,Y	2.14	2.55	0.50	3	3	Designed for 100yr
CB8	AA,BB	3.50	5.09	0.50	3	6	Designed for 100yr
CB9	Z,CC	1.58	2.55	0.50	3	3	Designed for 100yr

Q=Cw*L*d^1.5

L=(Q/(Cw*d^1.5))*1.25

Cw= 3.0 weir coefficient
Q = discharge capacity
L = curb opening length
d = flow depth
CF = clogging factor = 25% (1.25xL)

Q10 within curb
Q100 to overtop into basin

Type F Catch Basin - Grated Inlet Capacity - Weir Condition

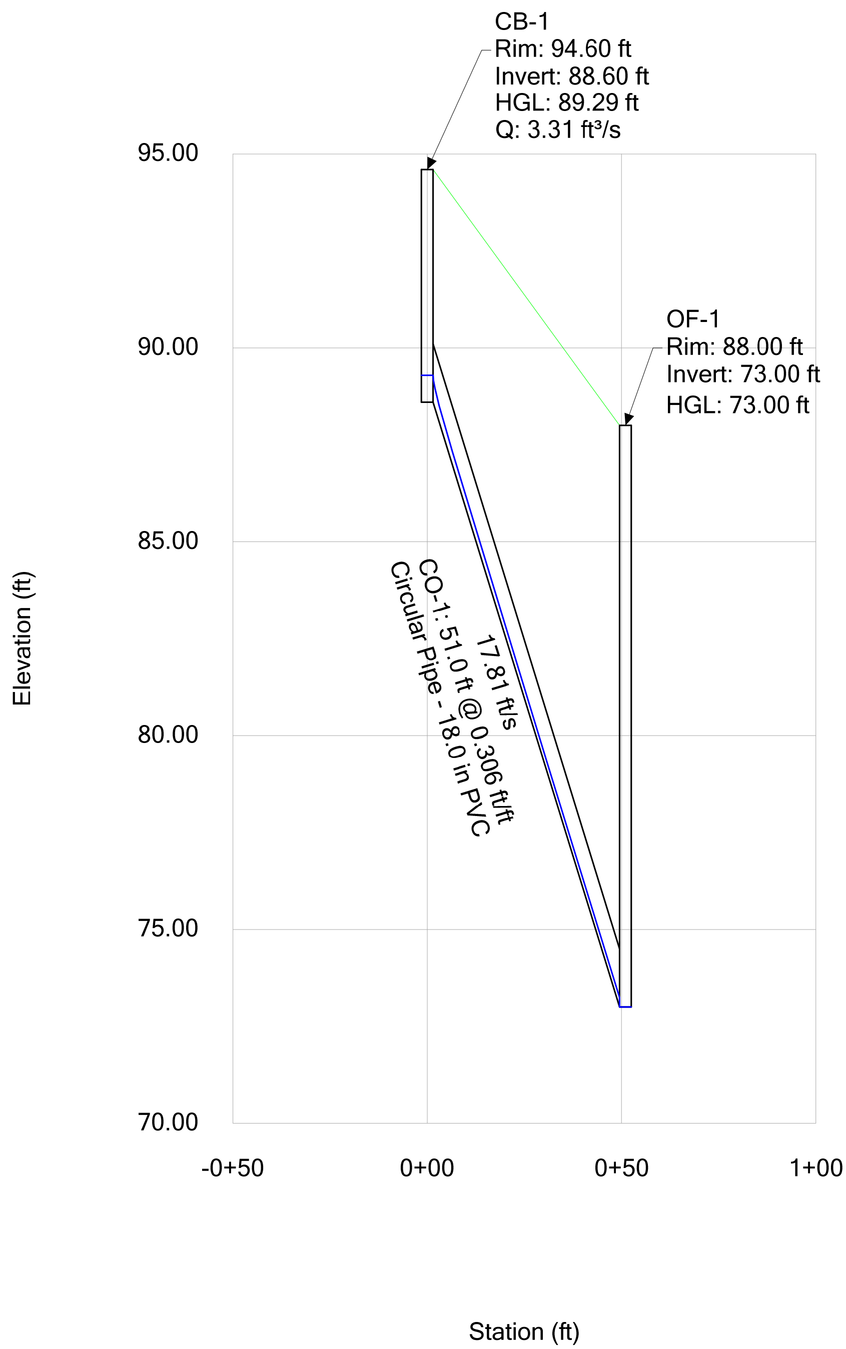
Inlet Type	Inlet Area	Q	Inlet Capacity W/25% Clogging	d	Cw	P(1)	
		(cfs)	(cfs)	(ft)		(ft)	
CB3	E,G,H,I,J,K	5.59	10.04	0.50	3	11.83	Designed for 100yr
CB6	U,V	3.00	10.04	0.50	3	11.83	Designed for 100yr

Q=Cw*P*d^1.5

(1) **Wetted Perimeter**	**ft**
1 Type F Catch Basins	11.83
2 Type F Catch Basins	18.67
3 Type F Catch Basins	25.50
4 Type F Catch Basins	32.33

Cw= 3.0 weir coefficient
Q = discharge capacity
P = inlet perimeter
d = flow depth

Profile Report
Engineering Profile - System 1 (5153_StormCAD.stc)



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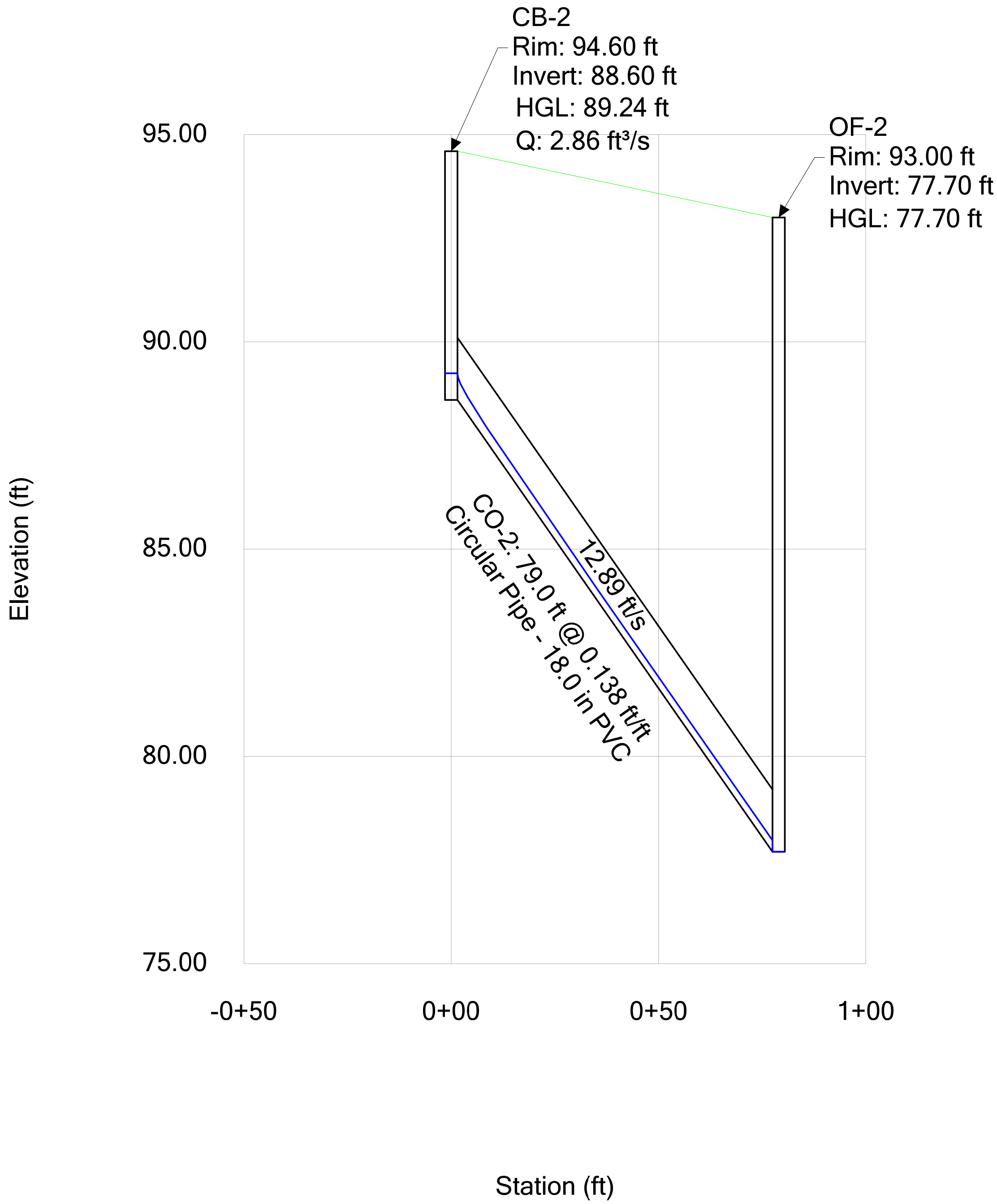
Profile Report
Engineering Profile - System 2 (5153_StormCAD.stc)



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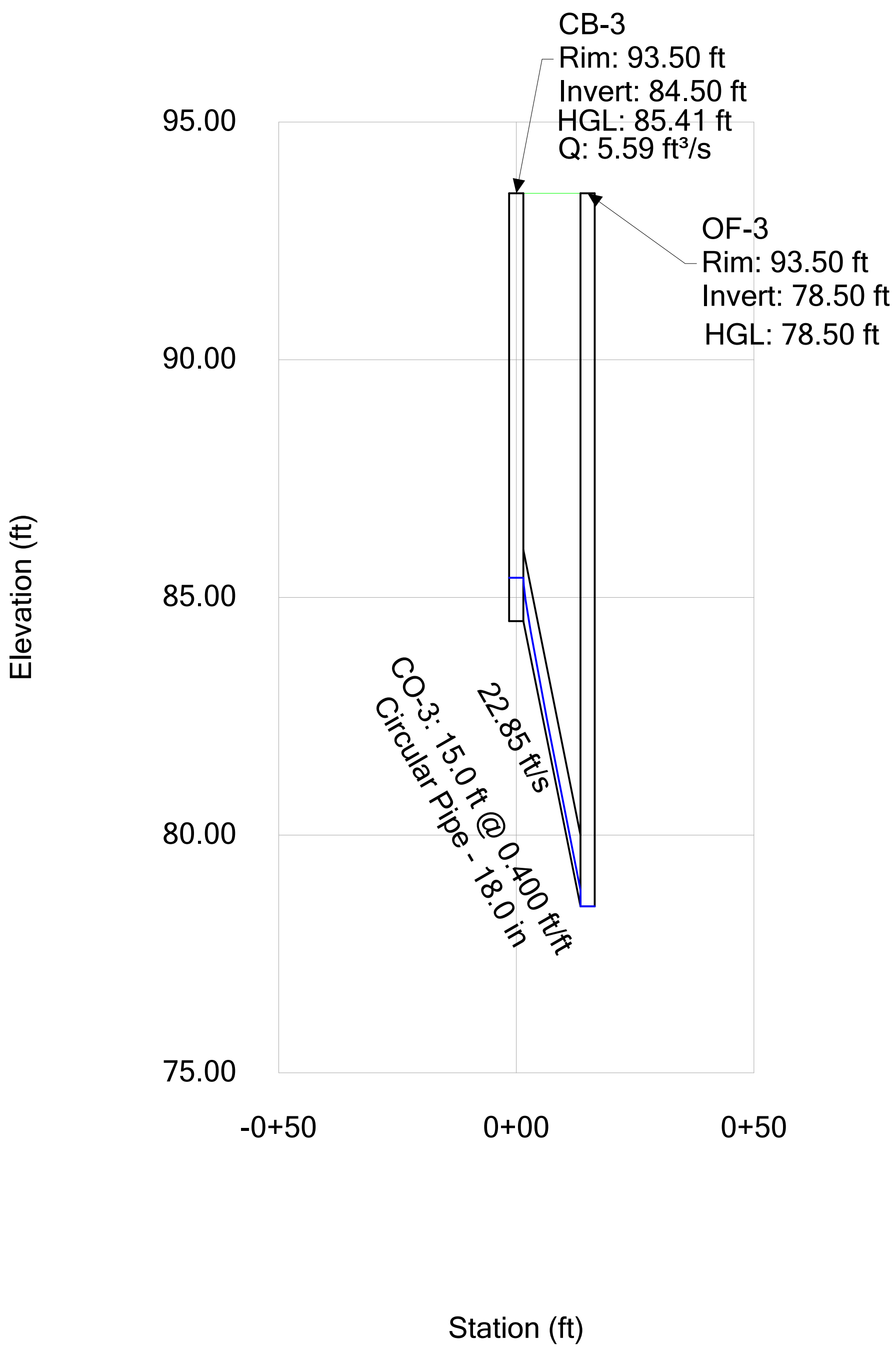
Profile Report

Engineering Profile - System 3 (5153_StormCAD.stc)



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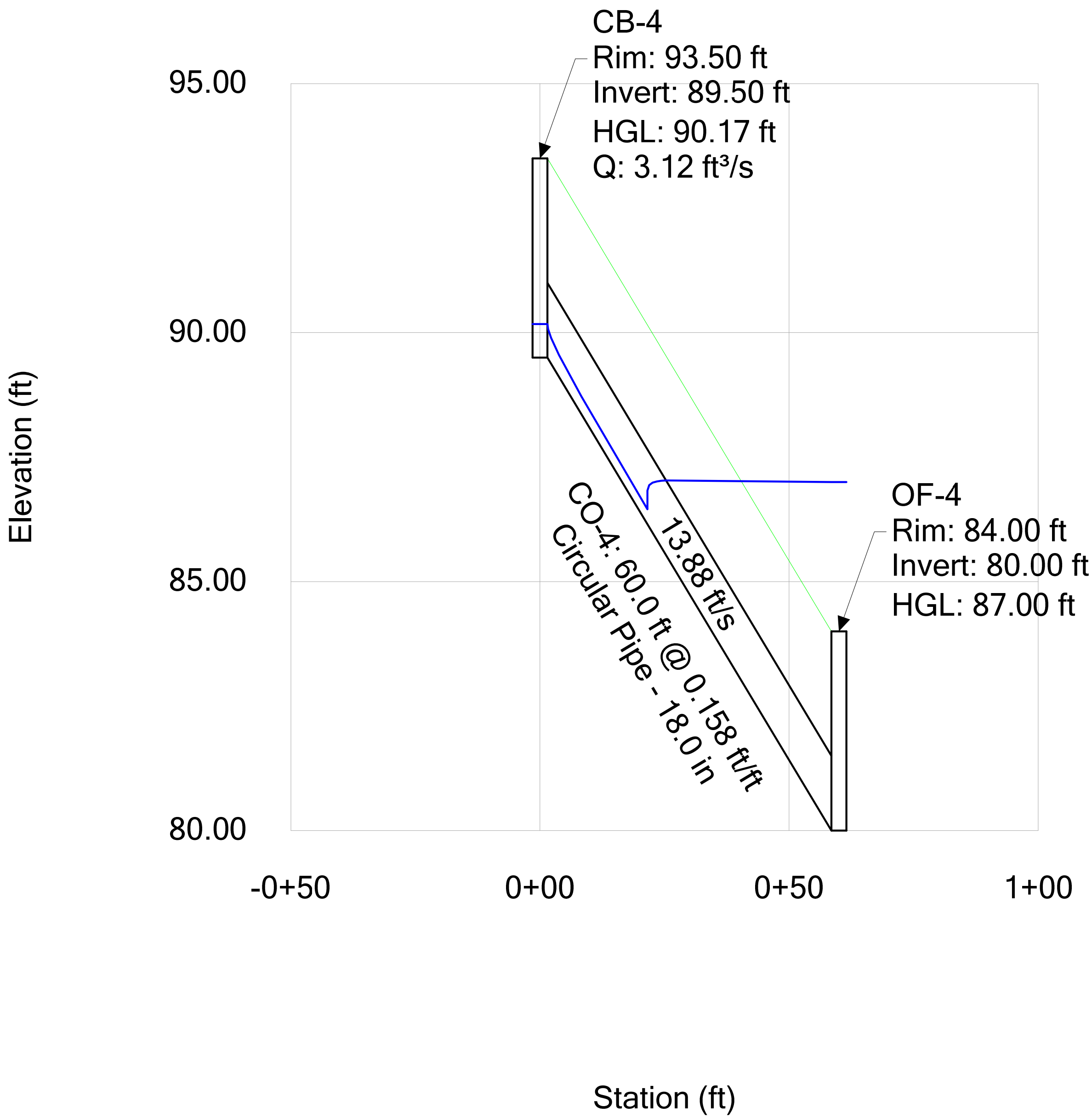
Profile Report
Engineering Profile - System 4 (5153_StormCAD.stc)



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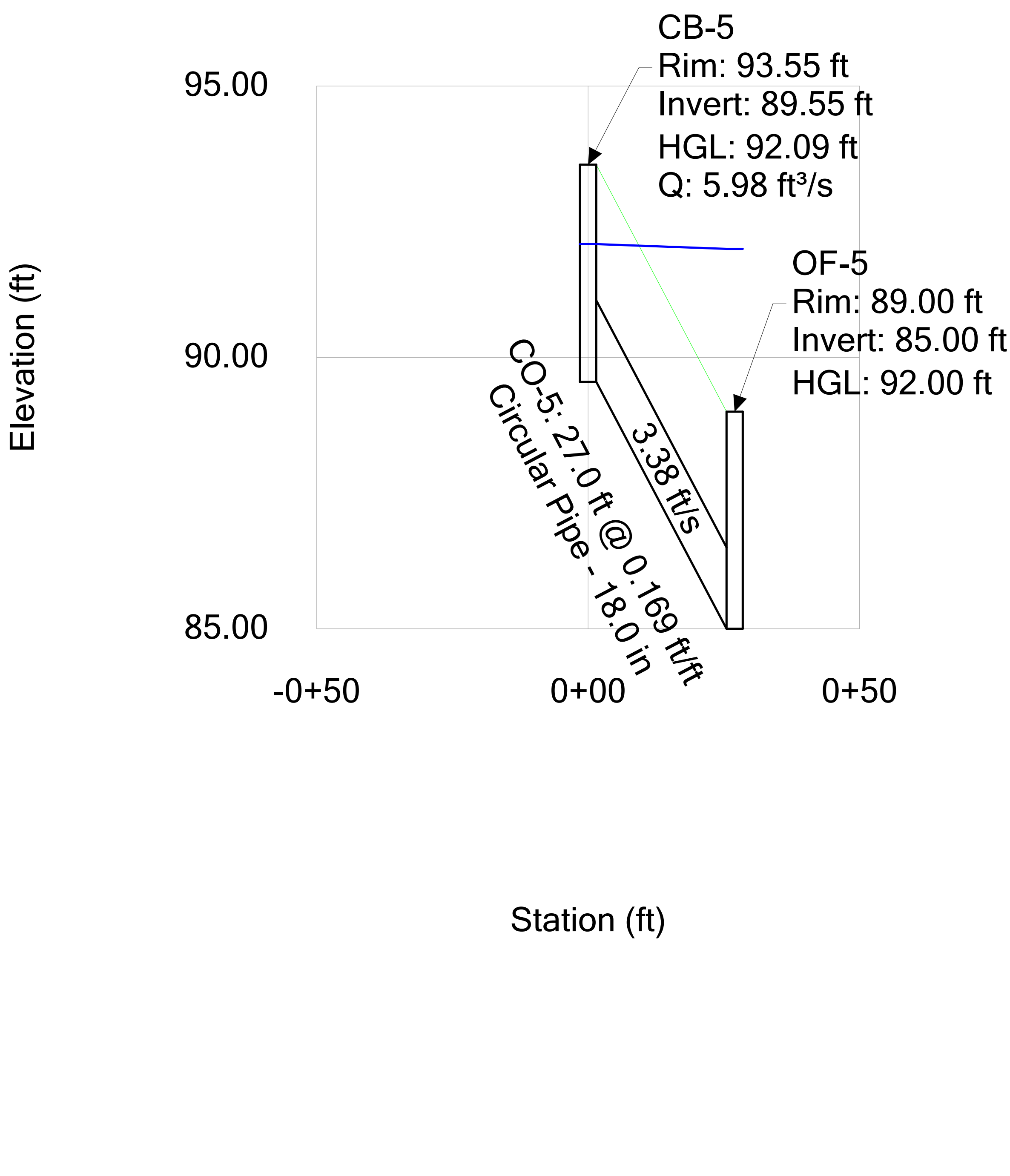
Profile Report
Engineering Profile - System 5 (5153_StormCAD.stc)



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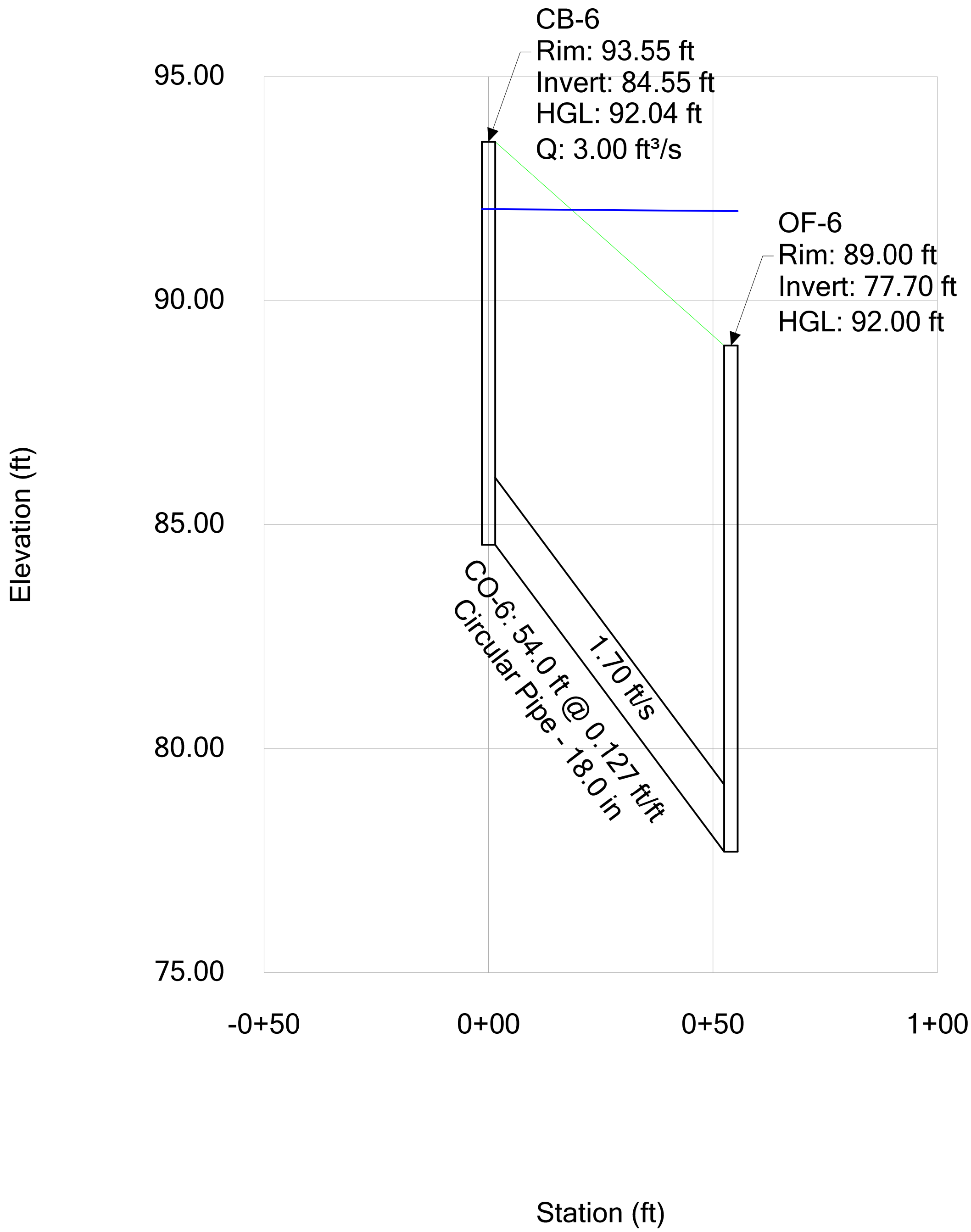
Profile Report
Engineering Profile - System 6 (5153_StormCAD.stc)



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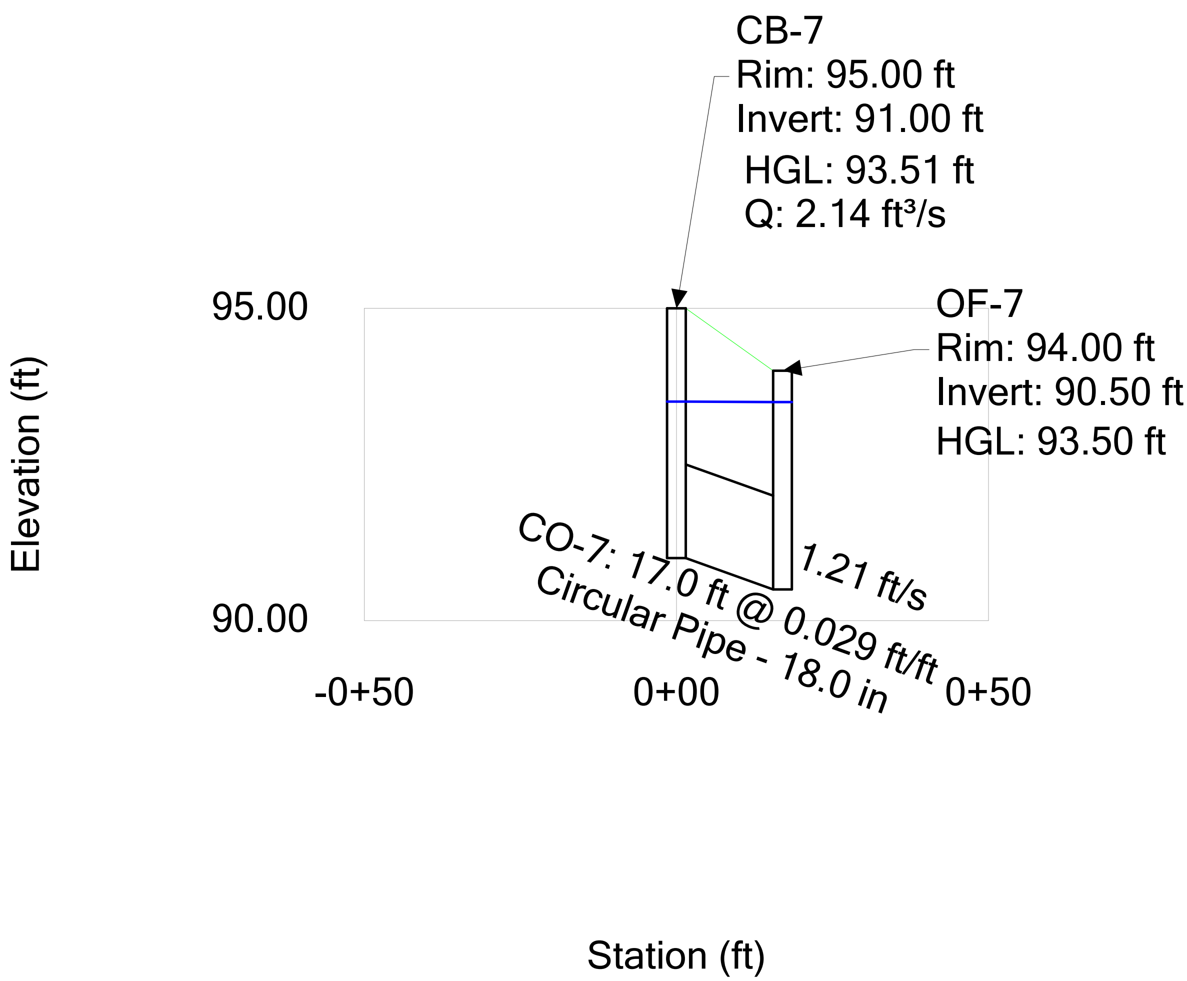
Profile Report
Engineering Profile - System 7 (5153_StormCAD.stc)



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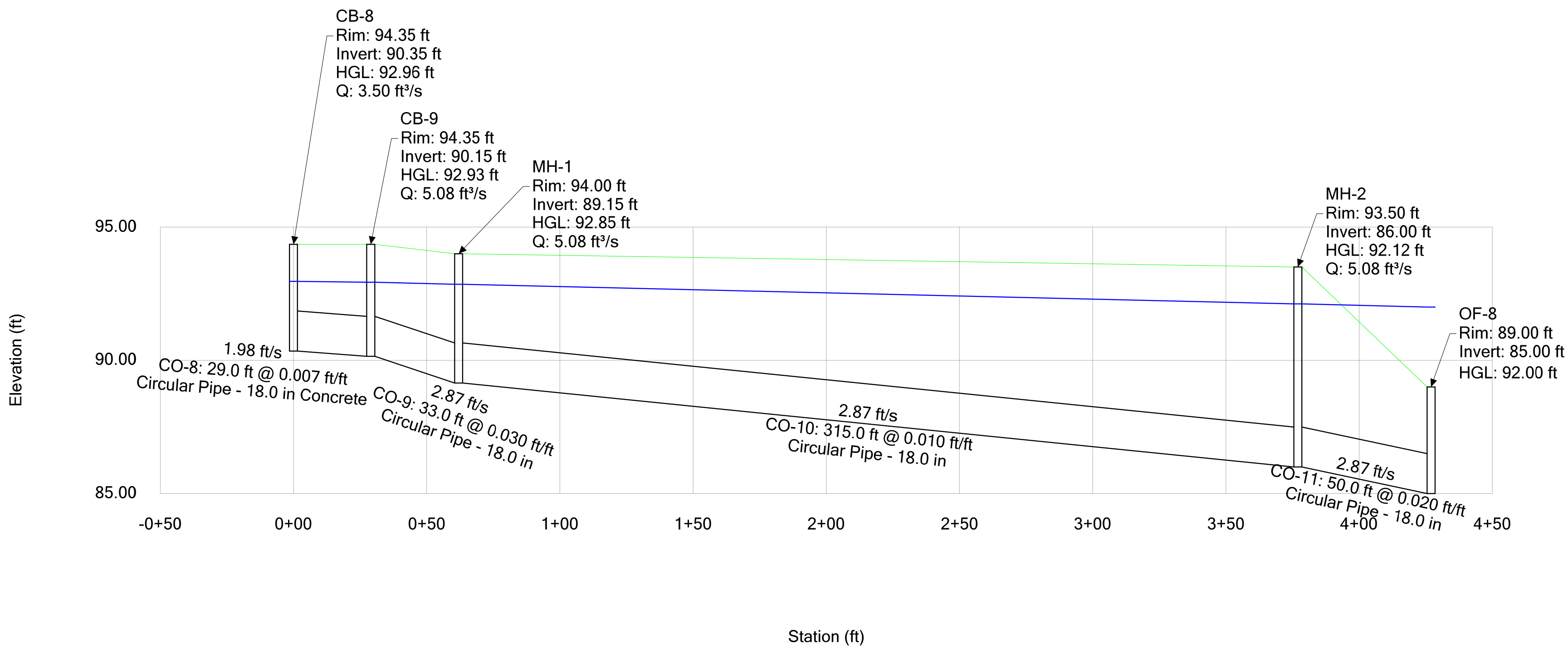
Profile Report
Engineering Profile - System 8 (5153_StormCAD.stc)



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Street Capacity Check

				(FROM RATING TABLES) (1)			
Sub-Area	Slope	Q_{10}	Q_{100}	Street Capacity - Roll Curb 10 yr	Street Capacity - Roll Curb 100 yr		
-	%	cfs	cfs	cfs	cfs		
A	0.40	1.00	1.97	4.55	10.79		
B	0.40	0.58	1.14	4.55	10.79		
C	0.40	0.10	0.19	4.55	10.79		
D	0.40	0.61	1.20	4.55	10.79		
E	0.40	0.25	0.49	4.55	10.79		
F	0.40	0.85	1.66	4.55	10.79		
G	0.40	0.68	1.34	4.55	10.79		
E,H	0.40	1.03	2.03	4.55	10.79		
G,I	0.40	1.38	2.72	4.55	10.79		
J	0.75	0.25	0.49	6.22	14.77		
K	0.75	0.18	0.36	6.22	14.77		
L	0.40	0.22	0.44	4.55	10.79		
M	0.40	0.06	0.12	4.55	10.79		
N	0.40	0.54	1.06	4.55	10.79		
O	0.40	0.76	1.50	4.55	10.79		
P	0.50	0.44	0.86	5.09	12.07		
Q	0.50	0.67	1.31	5.09	12.07		
R,U,V	0.40	1.65	3.24	4.55	10.79		
S,T	0.40	1.82	3.57	4.55	10.79		
T	0.40	1.14	2.23	4.55	10.79		
U,V	0.40	1.52	3.00	4.55	10.79		
V	0.40	0.51	1.01	4.55	10.79		
W	0.40	0.57	1.12	4.55	10.79		
X	0.40	0.35	0.68	4.55	10.79		
Y	0.40	0.17	0.33	4.55	10.79		
Z	0.45	0.20	0.39	4.82	11.43		
AA	0.45	0.51	0.99	4.82	11.43		
BB	0.40	1.28	2.51	4.55	10.79		
CC	0.40	0.61	1.20	4.55	10.79		

(1) Note: Flows are 1/2 of rating table to show 1/2 street capacity

Requires 6" Vertical For Portion That Exceeds Flow Rate

Cross Section for Roll Curb - 10yr

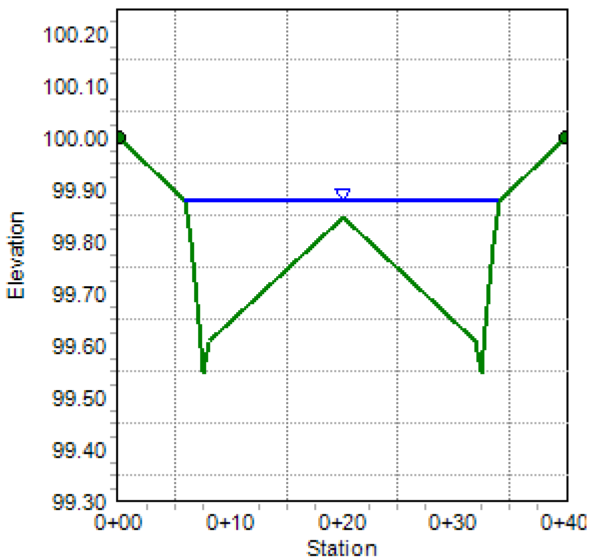
Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.40000	%
Normal Depth	0.33	ft
Discharge	9.09	ft³/s

Cross Section Image



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Worksheet for Roll Curb - 10yr

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.40000	%
Normal Depth	0.33	ft
Section Definitions		

Station (ft)	Elevation (ft)
0+00.00	100.00
0+06.00	99.88
0+06.40	99.80
0+06.80	99.72
0+07.20	99.64
0+07.58	99.55
0+08.00	99.61
0+20.00	99.85
0+32.00	99.61
0+32.42	99.55
0+32.80	99.64
0+33.20	99.72
0+33.60	99.80
0+34.00	99.88
0+40.00	100.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 100.00)	(0+40.00, 100.00)	0.013

Options

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

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Worksheet for Roll Curb - 10yr

Results

Discharge		9.09	ft³/s
Elevation Range	99.55 to 100.00 ft		
Flow Area		4.36	ft²
Wetted Perimeter		28.08	ft
Hydraulic Radius		0.16	ft
Top Width		28.00	ft
Normal Depth		0.33	ft
Critical Depth		0.32	ft
Critical Slope		0.00467	ft/ft
Velocity		2.09	ft/s
Velocity Head		0.07	ft
Specific Energy		0.40	ft
Froude Number		0.93	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.33	ft
Critical Depth	0.32	ft
Channel Slope	0.40000	%
Critical Slope	0.00467	ft/ft

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Rating Table for Roll Curb - 10yr

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.40000	%
Normal Depth	0.33	ft
Section Definitions		

Station (ft)	Elevation (ft)
0+00.00	100.00
0+06.00	99.88
0+06.40	99.80
0+06.80	99.72
0+07.20	99.64
0+07.58	99.55
0+08.00	99.61
0+20.00	99.85
0+32.00	99.61
0+32.42	99.55
0+32.80	99.64
0+33.20	99.72
0+33.60	99.80
0+34.00	99.88
0+40.00	100.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 100.00)	(0+40.00, 100.00)	0.013

Channel Slope (%)	Discharge (ft³/s)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)

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Rating Table for Roll Curb - 10yr

Input Data

Channel Slope (%)	Discharge (ft³/s)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)
0.40000	9.09	2.09	4.36	28.08	28.00
0.50000	10.17	2.33	4.36	28.08	28.00
0.60000	11.14	2.56	4.36	28.08	28.00
0.70000	12.03	2.76	4.36	28.08	28.00
0.80000	12.86	2.95	4.36	28.08	28.00
0.90000	13.64	3.13	4.36	28.08	28.00
1.00000	14.38	3.30	4.36	28.08	28.00

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Cross Section for Roll Curb - 100yr

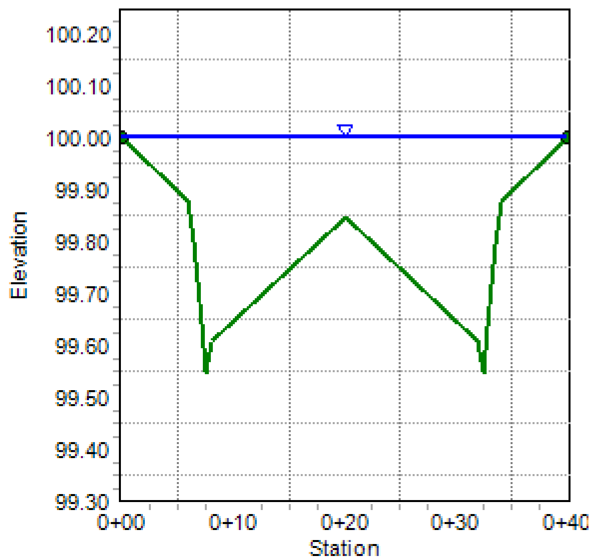
Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.40000	%
Normal Depth	0.45	ft
Discharge	21.58	ft³/s

Cross Section Image



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Worksheet for Roll Curb - 100yr

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.40000	%
Normal Depth	0.45	ft
Section Definitions		

Station (ft)	Elevation (ft)
0+00.00	100.00
0+06.00	99.88
0+06.40	99.80
0+06.80	99.72
0+07.20	99.64
0+07.58	99.55
0+08.00	99.61
0+20.00	99.85
0+32.00	99.61
0+32.42	99.55
0+32.80	99.64
0+33.20	99.72
0+33.60	99.80
0+34.00	99.88
0+40.00	100.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 100.00)	(0+40.00, 100.00)	0.013

Options

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

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Worksheet for Roll Curb - 100yr

Results

Discharge		21.58	ft^3/s
Elevation Range	99.55 to 100.00 ft		
Flow Area		8.44	ft^2
Wetted Perimeter		40.08	ft
Hydraulic Radius		0.21	ft
Top Width		40.00	ft
Normal Depth		0.45	ft
Critical Depth		0.45	ft
Critical Slope		0.00416	ft/ft
Velocity		2.56	ft/s
Velocity Head		0.10	ft
Specific Energy		0.55	ft
Froude Number		0.98	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth		0.00	ft
Length		0.00	ft
Number Of Steps		0	

GVF Output Data

Upstream Depth		0.00	ft
Profile Description			
Profile Headloss		0.00	ft
Downstream Velocity		Infinity	ft/s
Upstream Velocity		Infinity	ft/s
Normal Depth		0.45	ft
Critical Depth		0.45	ft
Channel Slope		0.40000	%
Critical Slope		0.00416	ft/ft

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Rating Table for Roll Curb - 100yr

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.40000	%
Normal Depth	0.45	ft
Section Definitions		

Station (ft)	Elevation (ft)
0+00.00	100.00
0+06.00	99.88
0+06.40	99.80
0+06.80	99.72
0+07.20	99.64
0+07.58	99.55
0+08.00	99.61
0+20.00	99.85
0+32.00	99.61
0+32.42	99.55
0+32.80	99.64
0+33.20	99.72
0+33.60	99.80
0+34.00	99.88
0+40.00	100.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 100.00)	(0+40.00, 100.00)	0.013

Channel Slope (%)	Discharge (ft³/s)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)

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Rating Table for Roll Curb - 100yr

Input Data

Channel Slope (%)	Discharge (ft^3/s)	Velocity (ft/s)	Flow Area (ft^2)	Wetted Perimeter (ft)	Top Width (ft)
0.40000	21.58	2.56	8.44	40.08	40.00
0.50000	24.13	2.86	8.44	40.08	40.00
0.60000	26.43	3.13	8.44	40.08	40.00
0.70000	28.55	3.38	8.44	40.08	40.00
0.80000	30.52	3.62	8.44	40.08	40.00
0.90000	32.37	3.84	8.44	40.08	40.00
1.00000	34.12	4.04	8.44	40.08	40.00

RETENTION REQUIRED (100-yr 2-hr)

Sub-Area	Area	C-Value	P	Volume	Volume
	(SF)	weighted	inches	CF	AF
A	12427	0.79	2.14	1745	0.04
B	7199	0.79	2.14	1011	0.02
C	1222	0.79	2.14	172	0.00
D	7574	0.79	2.14	1064	0.02
E	3069	0.79	2.14	431	0.01
F	10461	0.79	2.14	1469	0.03
G	8462	0.79	2.14	1188	0.03
H	9688	0.79	2.14	1361	0.03
I	8644	0.79	2.14	1214	0.03
J	3056	0.79	2.14	429	0.01
K	2247	0.79	2.14	316	0.01
L	2775	0.79	2.14	390	0.01
M	726	0.79	2.14	102	0.00
N	6690	0.79	2.14	940	0.02
O	9445	0.79	2.14	1326	0.03
P	5395	0.79	2.14	758	0.02
Q	8245	0.79	2.14	1158	0.03
R	1513	0.79	2.14	212	0.00
S	8450	0.79	2.14	1187	0.03
T	14059	0.79	2.14	1974	0.05
U	12536	0.79	2.14	1761	0.04
V	6332	0.79	2.14	889	0.02
W	7081	0.79	2.14	994	0.02
X	4283	0.79	2.14	601	0.01
Y	2107	0.79	2.14	296	0.01
Z	2443	0.79	2.14	343	0.01
AA	6256	0.79	2.14	879	0.02
BB	15794	0.79	2.14	2218	0.05
CC	7536	0.79	2.14	1058	0.02
DD	19281	0.79	2.14	2708	0.06
EE	26173	0.79	2.14	3676	0.08
FF	7989	0.79	2.14	1122	0.03
GG	31169	0.79	2.14	4377	0.10
HH	9113	0.79	2.14	1280	0.03
II	21695	0.79	2.14	3047	0.07
JJ	38220	0.79	2.14	5368	0.12
KK	40104	0.79	2.14	5632	0.13
Total	**389459**			**54695**	**1.26**

NOTE: Sub Areas A, & V are not included in table, as these are associated offsite drainage areas

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Basin Volume - Basin A

Elevation	Area	Average Area	TOTAL	TOTAL
FT	SF	SF	CF	AF
86.5	1			0.00
87.5	1227	614	614	0.01
88.5	3231	2229	2843	0.07
0	0	0	2843	0.07
		TOTAL	**2843**	**CF**

Volume Required	
Subbasin	
A,B,C,DD	
(CF)	
5636	
2793	**CF**
SHORT	

Basin Volume - Basin B

G	Area	Average Area	TOTAL	TOTAL
FT	SF	SF	CF	AF
84	1276			0.00
85	1916	1596	1596	0.04
86	2673	2295	3891	0.09
87	3576	3125	7015	0.16
		TOTAL	**7015**	**CF**

Volume Required	
Subbasin	
L,M,N,O,EE	
(CF)	
6433	
Volume OK	CF

Basin Volume - Basin C

Elevation	Area	Average Area	TOTAL	TOTAL
FT	SF	SF	CF	AF
89	1953			0.00
90	2872	2413	2413	0.06
91	3916	3394	5807	0.13
92	5084	4500	10307	0.24
		TOTAL	**10307**	**CF**

Volume Required	
Subbasin	
P,Q,R,S,T,FF	
(CF)	
6411	
Volume OK	CF

Basin Volume - Basin D

Elevation	Area	Average Area	TOTAL	TOTAL
FT	SF	SF	CF	AF
91	363			0.00
92	1887	1125	1125	0.03
93	4476	3182	4307	0.10
93.5	6214	2673	6979	0.16
		TOTAL	**6979**	**CF**

Volume Required	
Subbasin	
GG	
(CF)	
4377	
Volume OK	CF

Basin Volume - Basin E

Elevation	Area	Average Area	TOTAL	TOTAL
FT	SF	SF	CF	AF
89	280			0.00
90	620	450	450	0.01
91	1088	854	1304	0.03
92	2359	1724	3028	0.07
		TOTAL	**3028**	**CF**

Volume Required	
Subbasin	
E,G,H,I,J,K,U,V,KK	
(CF)	
13220	
10193	**CF**
VOLUME SHORT	

Basin Volume - Basin F

Elevation	Area	Average Area	TOTAL	TOTAL
FT	SF	SF	CF	AF
90.5	663			0.00
91.5	1203	933	933	0.02
92.5	1798	1501	2434	0.06
93.5	2447	2123	4556	0.10
		TOTAL	**4556**	**CF**

Volume Required	
Subbasin	
W,X,Y,HH	
(CF)	
3172	
Volume OK	CF

Basin Volume - Basin G

Elevation	Area	Average Area	TOTAL	TOTAL
FT	SF	SF	CF	AF
92	268			0.00
93	2981	1625	1625	0.04
0	0	0	1625	0.04
0	0	0	1625	0.04
		TOTAL	**1625**	**CF**

Volume Required	
Subbasin	
D,F,JJ	
(CF)	
7900	
6276	**CF**
VOLUME SHORT	

Basin Volume - Basin H

Elevation	Area	Average Area	TOTAL	TOTAL
FT	SF	SF	CF	AF
89	1194			0.00
90	1988	1591	1591	0.04
91	2970	2479	4070	0.09
92	4170	3570	7640	0.18
		TOTAL	**7640**	**CF**

Volume Required	
Subbasin	
Z,AA,BB,CC,II	
(CF)	
7545	
Volume OK	CF

Underground Storage Tank - 1

Diameter	X-section Area	Length	TOTAL
FT	SF	LF	CF
10	78.5	40	3140
		TOTAL:	**3140** **CF**

Volume Required	
Subbasin	
Excess from Basin A	
(CF)	
2793	
Volume OK	CF

Underground Storage Tank - 2

Diameter	X-section Area	Length	TOTAL
FT	SF	LF	CF
10	78.5	135	10598
		TOTAL:	**10598** **CF**

Volume Required	
Subbasin	
Excess from Basin E	
(CF)	
10193	
Volume OK	CF

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Underground Storage Tank - 3

Diameter	X-section Area	Length	TOTAL
FT	SF	LF	CF
10	78.5	85	6673
		TOTAL:	**6673** **CF**

Volume Required	
Subbasin	
Excess from Basin G	
(CF)	
6276	
Volume OK	CF

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3 engineering
planning civil engineering surveying

64th Oak
4/2/2020

Basin Percolation Rates - FOR VOLUME PROVIDED

Sub-Area	Rate of Bleedoff	Total Volume Provided	Dry-Up Time	# drywells for 36 hour dry up	
	(cfs)	(cf)	(hr)	#	
Basin A - Tank 1	0.1	5,983	16.6	0.5	**USE 1 DRYWELL**
Basin B	0.1	7,015	19.5	0.5	**USE 1 DRYWELL**
Basin C	0.1	10,307	28.6	0.8	**USE 1 DRYWELL**
Basin D	0.1	6,979	19.4	0.5	**USE 1 DRYWELL**
Basin E - Tank 2	0.1	13,625	37.8	1.1	**USE 2 DRYWELLS**
Basin F	0.1	4,556	12.7	0.4	**USE 1 DRYWELL**
Basin G- Tank 3	0.1	8,297	23.0	0.6	**USE 1 DRYWELL**
Basin H	0.1	7,640	21.2	0.6	**USE 1 DRYWELL**

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Offsite Watershed Rational Method Check					
Sub-Area	Area	C_{100}	Tc	i_{100}	Local Q_{100}
	(acre)	DSPM	(min)	(in/hr)	(cfs)
SECTION 1	14.80	0.45	10	5.60	37.30
SECTION 2	5.90	0.86	10	5.60	28.41

Culvert Calculator Report
Worksheet-1

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	94.00	ft	Headwater Depth/Height	1.70	
Computed Headwater Eleva	93.39	ft	Discharge	28.41	cfs
Inlet Control HW Elev.	92.50	ft	Tailwater Elevation	92.50	ft
Outlet Control HW Elev.	93.39	ft	Control Type	Outlet Control	

Grades					
Upstream Invert	90.00	ft	Downstream Invert	89.50	ft
Length	105.00	ft	Constructed Slope	0.004762	ft/ft

Hydraulic Profile					
Profile	PressureProfile		Depth, Downstream	3.00	ft
Slope Type	N/A		Normal Depth	1.50	ft
Flow Regime	N/A		Critical Depth	1.36	ft
Velocity Downstream	4.52	ft/s	Critical Slope	0.006105	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	2.00	ft
Section Size	24 inch		Rise	2.00	ft
Number Sections	2				

Outlet Control Properties					
Outlet Control HW Elev.	93.39	ft	Upstream Velocity Head	0.32	ft
Ke	0.50		Entrance Loss	0.16	ft

Inlet Control Properties					
Inlet Control HW Elev.	92.50	ft	Flow Control	Unsubmerged	
Inlet Type	Square edge w/headwall		Area Full	6.3	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

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4/30/2020

OFFSITE SECTION 1

Equations Used: $Tc = 11.4 L^{0.5} Kb^{0.52} S^{-0.31} i^{-0.38}$

Where, Tc = time of concentration
L = length of the longest flow path (miles)
Kb = watershed resistance coefficient
S = watercourse slope (ft/mile)
i = rainfall intensity (inches/hour)

From Drainage Design Manual for Maricopa County Table 3.1:

Kb=mLogA + b

Assuming Minimal Roughness:

m=-.00625; b=0.04

Watershed A

Kb=mLogA + b
A = 14.8 Ac
Kb=(-0.00625)(Log14.8)+0.04
Kb=.0327

$Tc = 11.4 L^{0.5} Kb^{0.52} S^{-0.31} i^{-0.38}$

L = 0.56 mi
Kb=.0327
S = (120ft/1 mi) = 120 ft/mi
i = 5.60(based on Tc of 10 min)
Tc=$(11.4)(0.56)^{0.5}(.0327)^{0.52}(120)^{-0.31}(5.60)^{-0.38}$
Tc=0.170 hrs = 10.18 mins

OFFSITE SECTION 2

Equations Used: $Tc = 11.4 L^{0.5} Kb^{0.52} S^{-0.31} i^{-0.38}$

Where, Tc = time of concentration
L = length of the longest flow path (miles)
Kb = watershed resistance coefficient
S = watercourse slope (ft/mile)
i = rainfall intensity (inches/hour)

From Drainage Design Manual for Maricopa County Table 3.1:

Kb=mLogA + b

Assuming Minimal Roughness:

m=-.00625; b=0.04

Watershed A

Kb=mLogA + b
A = 5.9 Ac
Kb=(-0.00625)(Log5.9)+0.04
Kb=.0352

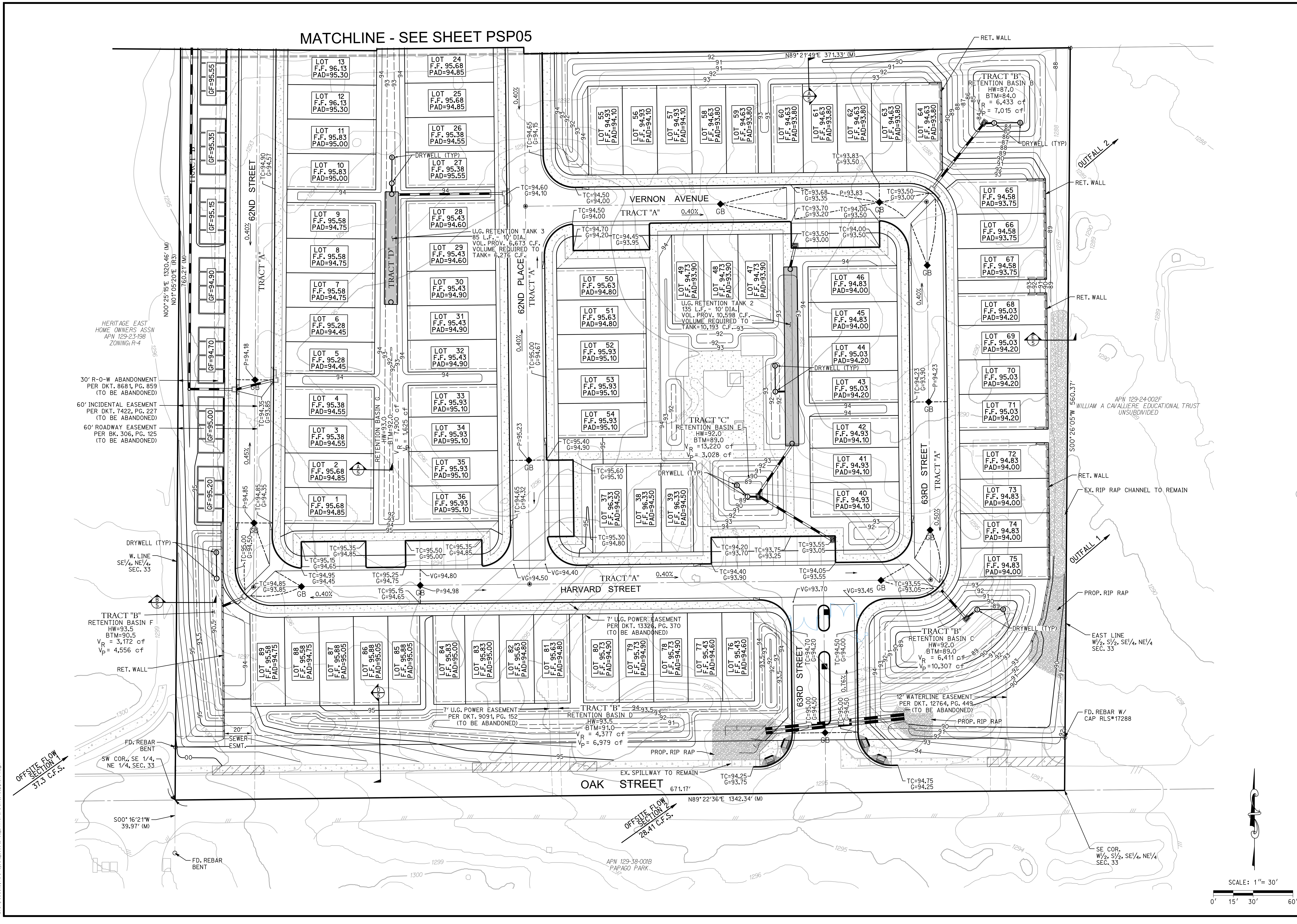
$Tc = 11.4 L^{0.5} Kb^{0.52} S^{-0.31} i^{-0.38}$

L = 0.37 mi
Kb=.0352
S = (107ft/1 mi) = 107 ft/mi
i = 5.60(based on Tc of 10 min)
Tc=(11.4)(0.37)$^{0.5}$(.0352)$^{0.52}$(107)$^{-0.31}$(5.60)$^{-0.38}$
Tc=0.15 hrs = 9 mins

APPENDIX H

Preliminary Grading and Drainage Plans

7-ZN-2020
4/30/2020



REVISIONS

64TH STREET & OAK STREET
SCOTTSDALE, ARIZONA 85252

PRELIMINARY GRADING PLAN

Registered Professional Engineer (Civil) Certificate No. 45652 MATTHEW J. MANCINI 4/10/20 Date Signed ARIZONA, U.S.A.

EXPIRES: 12/31/2021

3engineering
planning civil engineering surveying

ENGINEER: M. MANCINI | DESIGNER: M. MANCINI | CAD TECH: PHILLIE V.

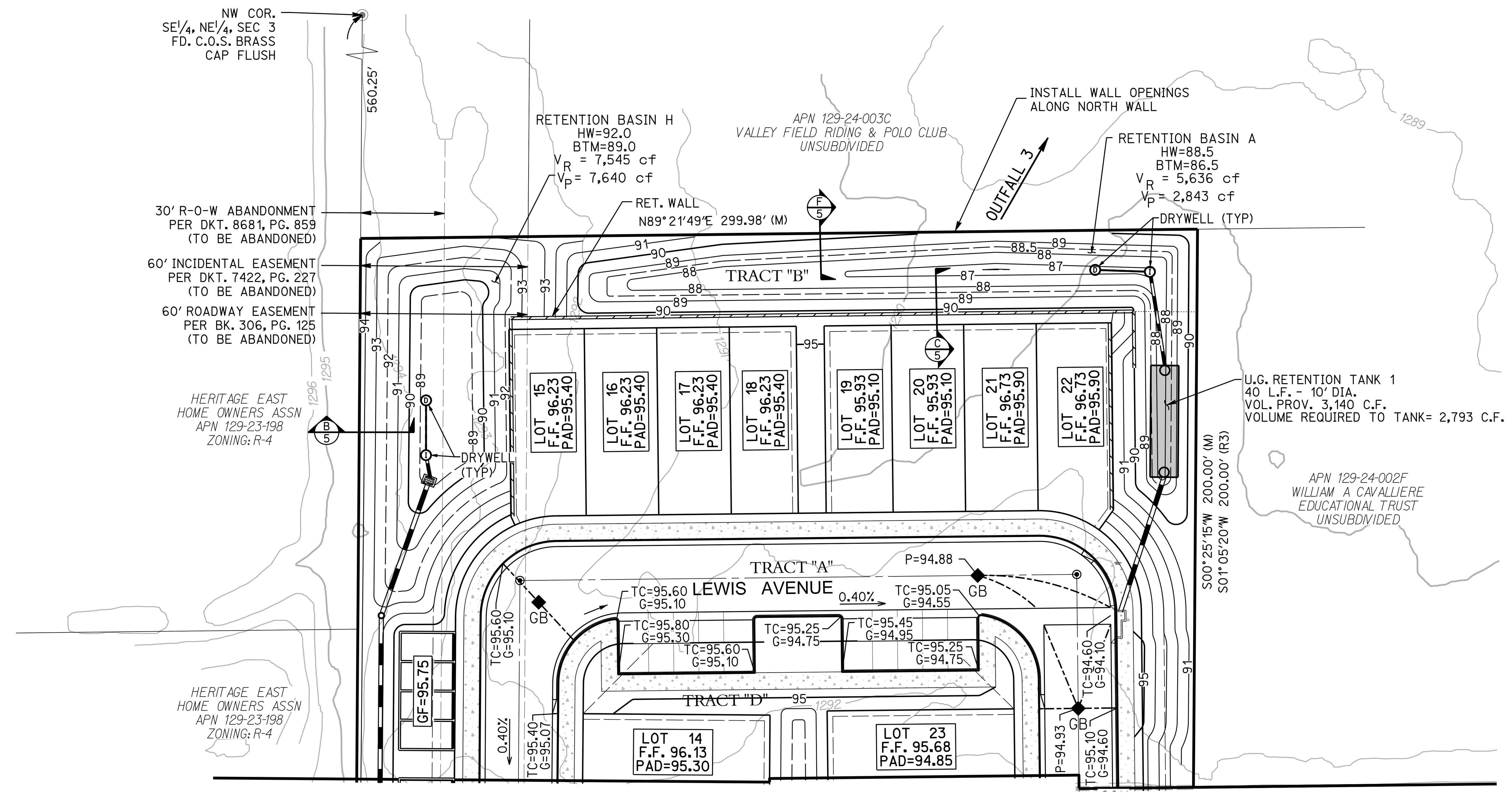
3 ENGINEERING, LLC
6370 E. THOMAS ROAD
SUITE # 200
SCOTTSDALE, ARIZONA 85251
PHONE: (602) 334-4387
FAX: (602) 490-3230
WWW.3ENGINEERING.COM

DATE: 4/10/20

PROJECT NO. 5153

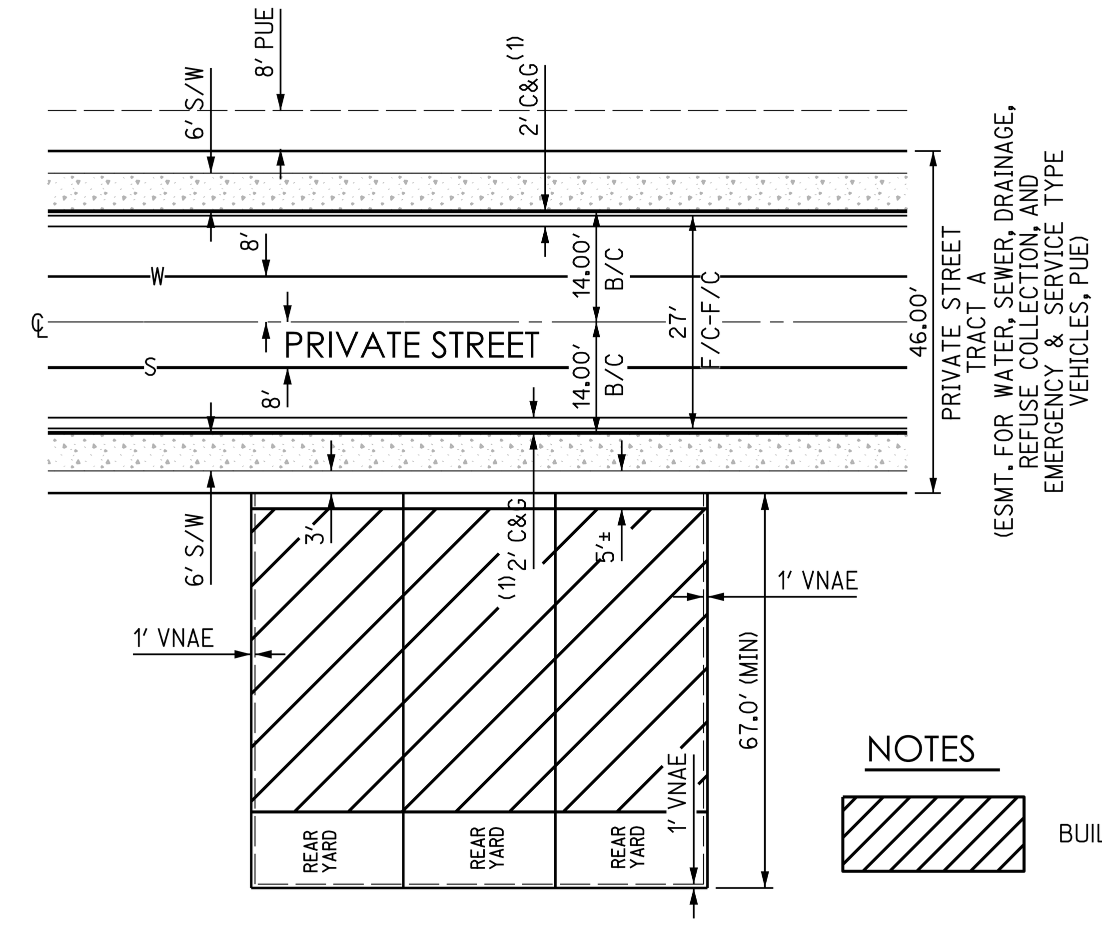
SHEET NO. PSP04
4 of 7

7-ZN-2020
4/30/2020

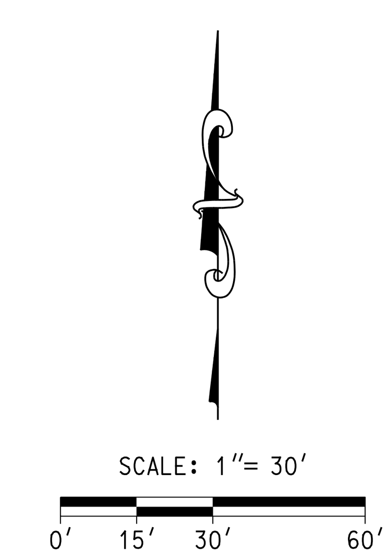


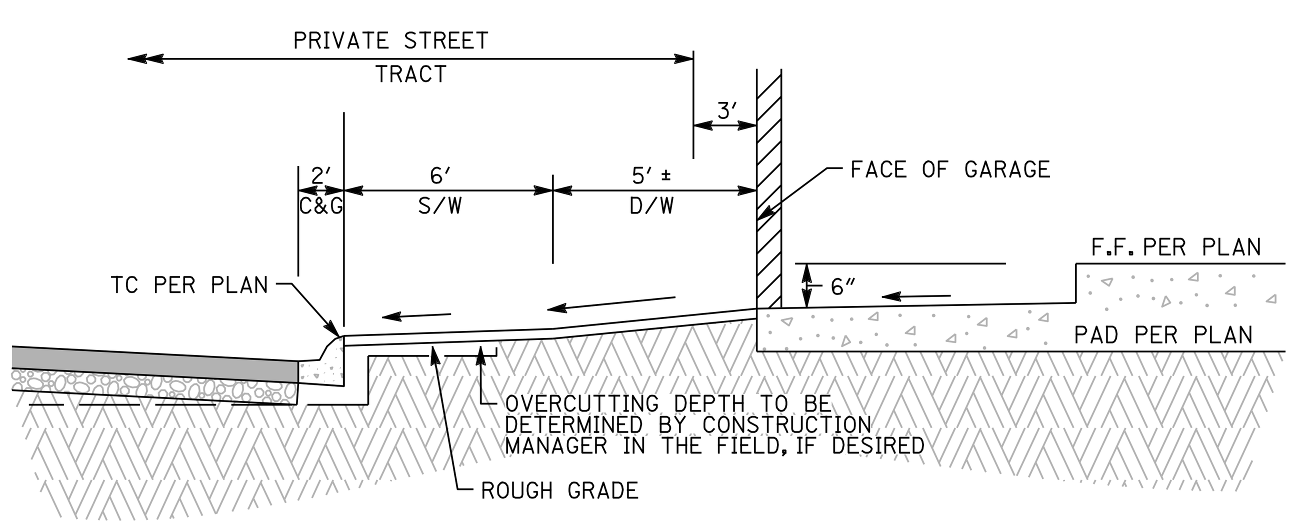
MATCHLINE - SEE SHEET PSP04

RETENTION CALCULATIONS
100 YR - 2HR STORM EVENT
REQUIRED
C = 0.79
P = 2.14
AREA = 389,459 SF
$(0.79)\left(\frac{2.14}{12}\right)(389{,}459) = 54{,}695$ CF
TOTAL REQUIRED = 54,695 CF
PROVIDED
43,992 CF (BASIN A-H) + 20,410 CF (TANK)
64,402 CF PROVIDED

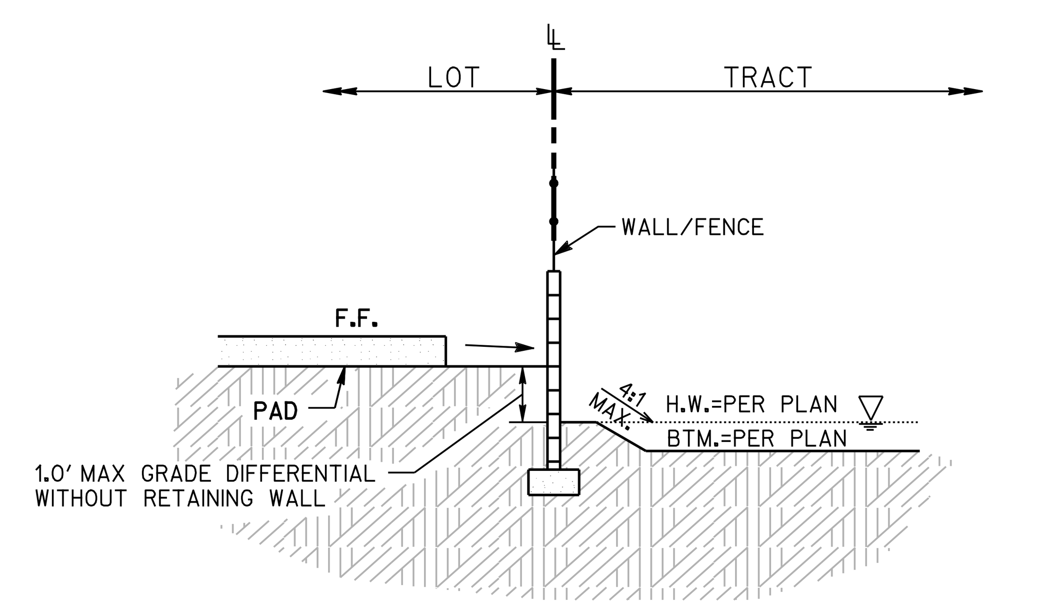


TYPICAL INTERIOR LOT DETAIL
N.T.S.
(1) ROLL OR VERTICAL DEPENDING ON DRAINAGE

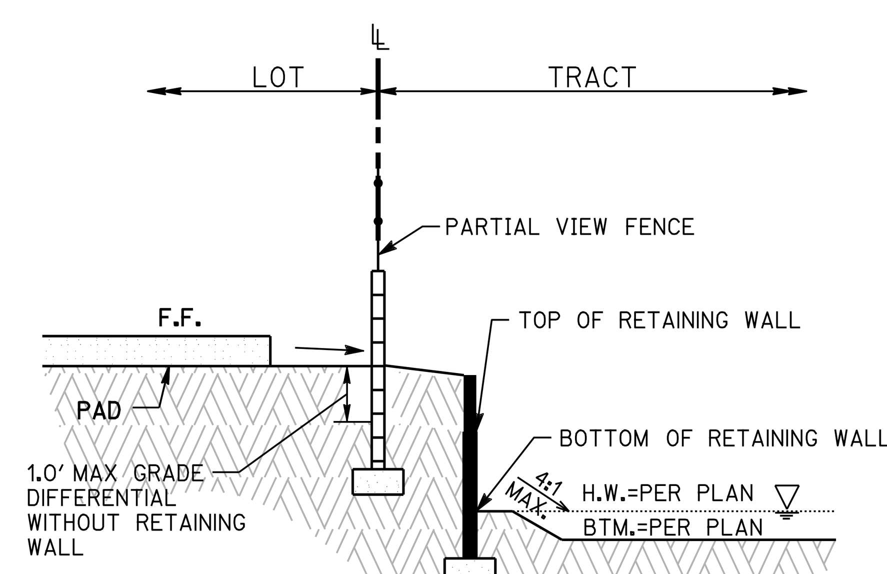




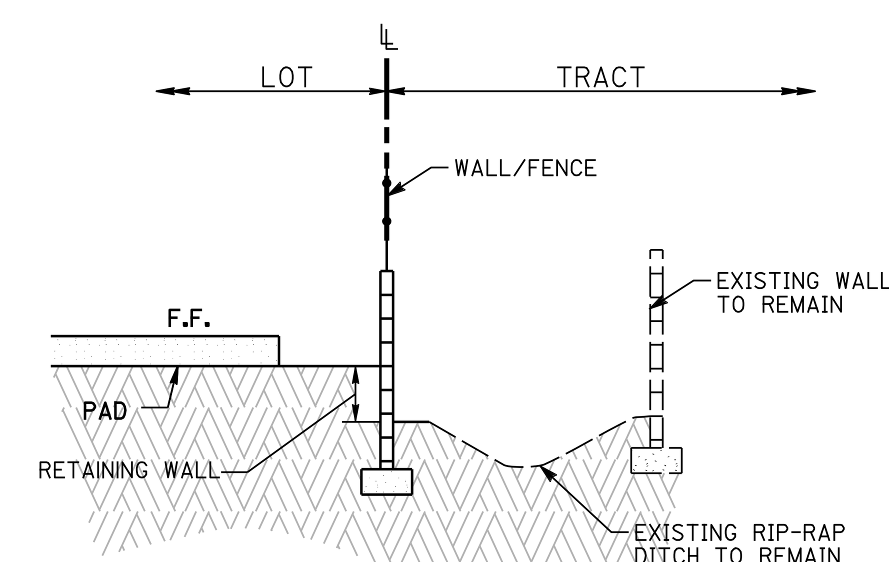
TYPICAL FRONT YARD SECTION
N.T.S.



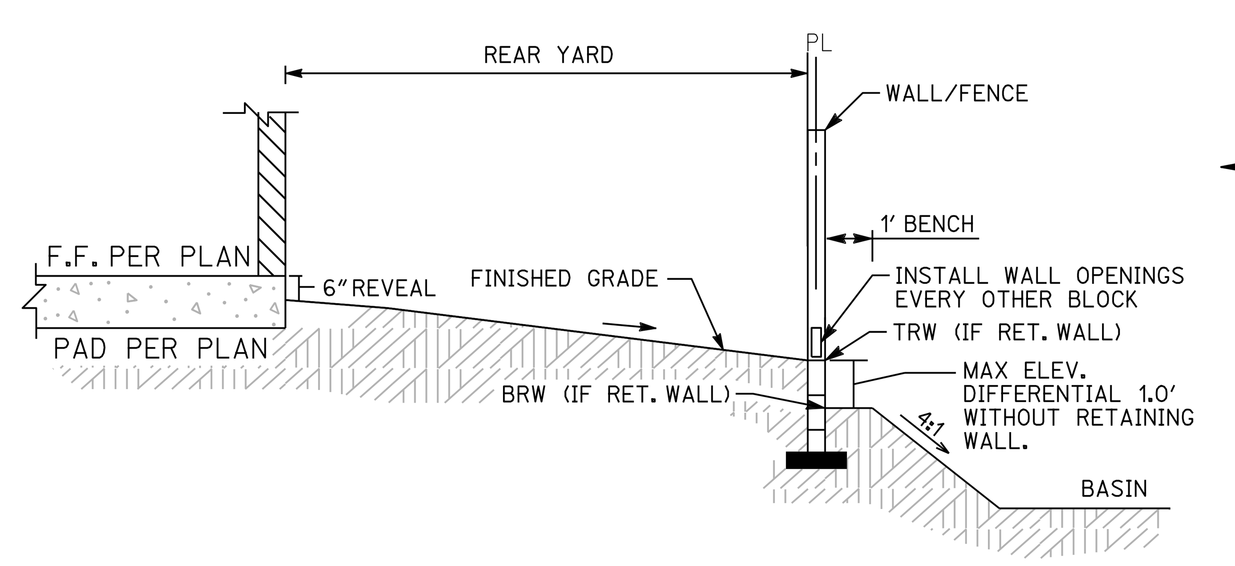
A TYPICAL SECTION
N.T.S.



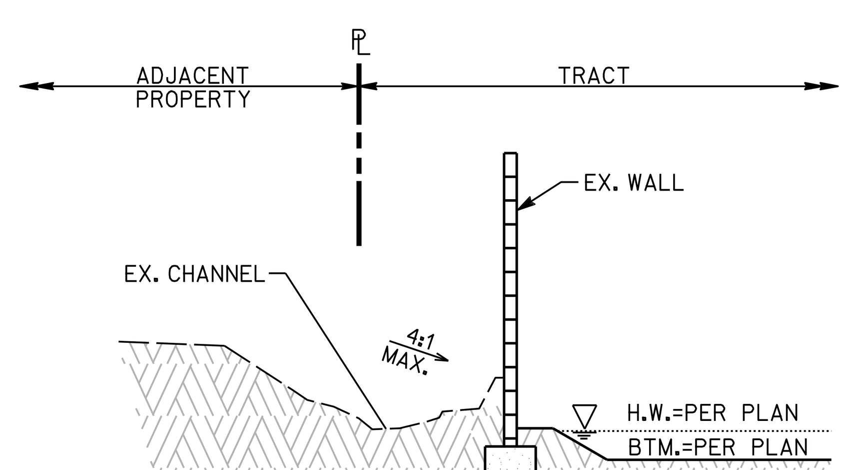
C TYPICAL SECTION
N.T.S.



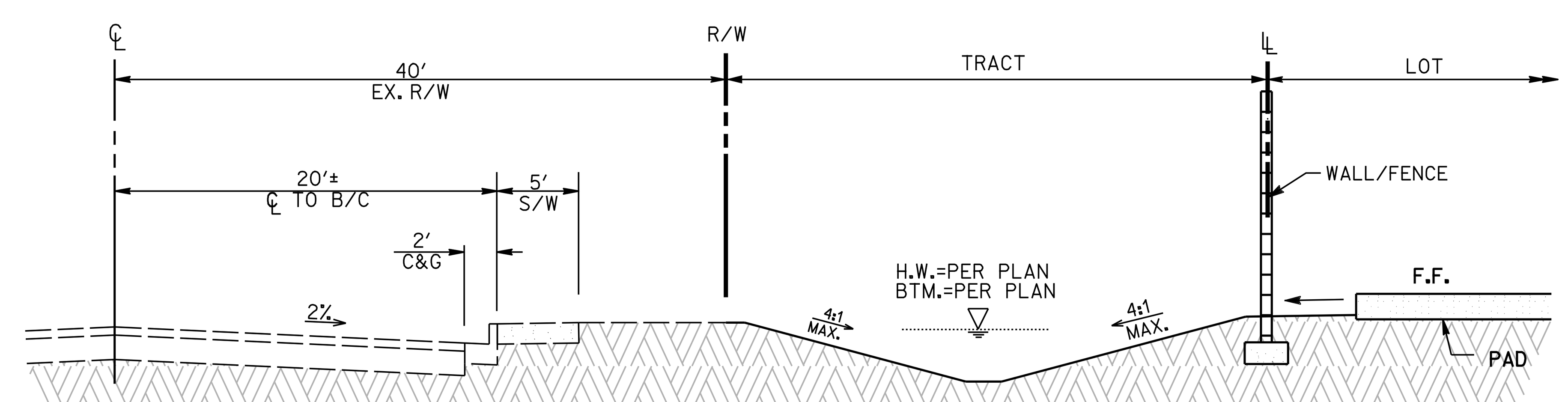
E TYPICAL SECTION
N.T.S.



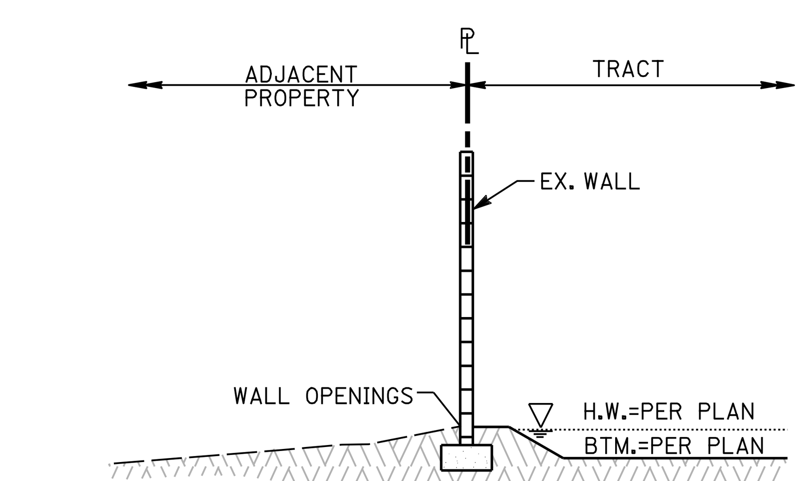
TYPICAL REAR YARD SECTION
DRAINAGE TO REAR YARD
N.T.S.



B TYPICAL SECTION
N.T.S.



D TYPICAL SECTION
N.T.S.



F TYPICAL SECTION
N.T.S.

Contact Arizona 811 at least two full working days before you begin excavation
Call 811 or click Arizona811.com

REVISIONS

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PROJECT NO. 5153
SHEET NO. PSP05

7-ZN-2020
4/30/2020

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