HILGARTWILSON
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PRELIMINARY DRAINAGE REPORT

FOR

ASHLER HILLS PARK

ASHLER HILLS DRIVE & 74TH Way
SCOTTSDALE, ARIZONA

CASE NUMBER: 960-PA-2020

Plan # ____
Case # 51-DR-2021
Q-S # ____
[X] Accepted
[ ] Corrections
N.Baronas 6/20/2022
Reviewed By Date

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REGISTERED PROFESSIONAL ENGINEER (CIVIL)
CERTIFICATE NO.
59301
BRIAN
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Date Signed 3/31/22
ARIZONA U.S.A.

March, 2022
HILGARTWILSON Project No.: 2299.01

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FOR
ASHLER HILLS PARK

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1.0 INTRODUCTION

1.1 PROJECT NAME, LOCATION, AND TOPOGRAPHY

Ashler Hills Park (the Project) is located on Ashler Hills Drive and 74th Way in Scottsdale, Arizona. The Project site is bound by single-family residences to the north, existing commercial space to the west, Ashler Hills Drive to the south, and 74th Way to the east. The area surrounding the site generally drains to the west at an approximate slope of 3%. The Project lies within Section 14, Township 5 North, Range 4 East of the Gila and Salt River Baseline and Meridian. The Vicinity Map (Figure 1, Appendix A) presents an overview of the site location and surrounding areas.

1.2 PURPOSE

The purpose of this report is to describe the methodology used and provide 100-year design hydrologic analysis for the drainage-related infrastructure for the Project and to provide drainage design criteria and guidelines to be used as the property is developed. This drainage report has been prepared in accordance with the City of Scottsdale 2018 Design Standards & Policies Manual (DSPM) and the Flood Control District of Maricopa County's (FCDMC) current versions of the Drainage Policies and Standards (DPSM) (FCDMC 2018a), Drainage Design Manuals (DDM) for Maricopa County, - Hydrology (FCDMC 2018b) and - Hydraulics (FCDMC 2018c).

1.3 FEMA FLOODPLAIN DESIGNATION

Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) coverage for the Project is provided on FIRM panels 04013C0891M & 04013C0893M (FEMA, July 20, 2021). According to this FIRM the Project resides entirely within a flood hazard Zone X. FEMA defines this flood hazard zone as follows:

> Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

The FEMA FIRM panel and the Project boundary are shown on the FEMA Map (Figure 2, Appendix A).

2.0 EXECUTIVE SUMMARY

The Project site is comprised of undeveloped desert on approximately 15 acres, surrounded by commercial space, single-family residences, and undeveloped desert. The proposed development consists of a park and associated trails. Offsite drainage from east of the project is collected and routed to an existing storm drain system along the western border of the Project, which discharges to the historical outfall location. Onsite drainage is conveyed to retention basins and underground tanks via surface flow. Retained runoff drains from the basins and tanks in less than 36 hours, accomplished through a combination of natural infiltration and drywells where necessary. Hydrologic and hydraulic calculations have been performed in accordance with the City of Scottsdale standards. These calculations show that there is no increase in flows discharging from the site as a result of the Project's development.

3.0 MANAGEMENT OF OFFSITE FLOWS

3.1 PREDEVELOPMENT

Offsite flows approach the Project from the undeveloped desert generated east of the site. These flows approach the site and pass beneath 74th Way through a series of existing culverts. Once within the Project, these offsite flows are conveyed west through natural washes. Offsite flows passing through the Project, ultimately outfall into an existing stormdrain system within the commercial space along the eastern boundary of the site. Existing drainage patterns can be found on the Undeveloped Hydrology Exhibit (Figure 3, Appendix A).

3.2 POST DEVELOPMENT

Runoff generated by the tributary drainage areas to the east of the Project will continue to be conveyed through the existing culverts and natural washes and then routed through sediment basins and stormdrains onsite. As the offsite runoff is generated from undeveloped land, runoff may be sediment laden. **Routing the runoff through onsite sediment basins promotes sediment deposition and helps ensure that runoff discharging from the property will be better quality as compared to existing conditions.**

A larger 404 wash passes through the Project, splitting the site which will be unaltered during development of the Project. A pedestrian bridge is proposed to cross the wash such that it remains undisturbed. The 404 Wash was analyzed to verify that the high-water elevation of the wash is at least 12 inches below the bridge.

Runoff from the drainage area OFF-1 will be conveyed through two proposed culverts, CU-1E and CU-1W, after passing underneath 74th Way. An underground stormdrain will then convey the offsite flow from the sediment basin to their historical outfall at the western boundary of the site. Runoff from drainage area OFF-2 will also be conveyed beneath the roadway where it will combine with the primarily undisturbed ON-1 drainage area and conveyed to its respective sediment basin. While ON-1 is included in the peak flow to size the stormdrain, compensatory retention has also been included in the onsite retention basin RB-2. The proposed stormdrains onsite discharge to basins lined with riprap along the western boundary of the site. These basins overflow into the existing stormdrain system offsite. Riprap sizing will be provided during final design to ensure no adverse erosional impacts. The proposed hydrologic drainage patterns can be found on the Developed Hydrology Exhibit (Figure 4, Appendix A).

4.0 MANAGEMENT OF ONSITE FLOWS

4.1 PREDEVELOPMENT

Under existing conditions, stormwater runoff is routed west via surface flow through the natural washes toward the existing stormdrain system in the commercial space offsite. The Project is separated from the commercial space by a wall equipped with wall openings which allow runoff from the site to discharge into inlets as part of the existing stormdrain system. Riprap has been placed before each inlet to reduce flow velocities and to protect against erosion. No stormwater storage facilities exist onsite.

4.2 POST DEVELOPMENT

The proposed grading improvements allow runoff generated within the Project to be discharged to retention basins located throughout the site. Offsite flows impacting the site are routed through the site to retention facilities and ultimately discharge to its historic location. Retention is not provided for the wash areas that pass through the site. An overview of the proposed drainage improvements and patterns is shown on the Preliminary Drainage Plan (Figure 5, Appendix A).

The onsite retention facilities have all been sized to accommodate the 100-year, 2-hour runoff volume produced by the tributary drainage areas, in accordance with the DPSM. A combination of surface retention and underground storage has been selected as the means of storing the volume generated. These retention basins and storage tanks will be dewatered through a combination of natural infiltration and drywells.

5.0 HYDROLOGIC CALCULATIONS

Peak flow estimation utilizing the Rational Method is typically recommended by the FCDMC for smaller drainage areas of less than 160 acres (0.25 square miles). As such, the Rational Method was conservatively used to calculate peak flows for the two smaller washes impacting the Project. These flows have been used for analyzing the proposed culverts and stormdrains onsite.

It was noted that the Project lies within the Whisper Rock portion of the regional Pinnacle Peak Area Drainage Master Study (ADMS; 2013 FCDMC) which quantified flows utilizing FLO-2D. This particular FLO-2D study area encompassed approximately 15.1 square miles, comprised of 20 feet by 20 feet grid elements with results made available on the FCDMC's FLO-2D Viewer website. FLO-2D results for the larger 404 wash traversing the site were only referenced in order to determine an adequate elevation to set the bridge providing sufficient freeboard while leaving the wash undisturbed.

Comparing the resultant flows between the two models, it was observed that the Rational Method provided the more conservative (higher) flows compared to the ADMS FLO-2D study. As such, the Rational Method results were utilized for sizing of the onsite drainage conveyance facilities which were more critical to the development. **This does not indicate that there is an increase in flows discharging from the property as a result of development.** The difference in flows is due to the different analyses and computations. Furthermore, by virtue of the onsite 100-year retention provided, there is an overall reduction of flows discharging from the site. To demonstrate this, an existing versus developed conditions comparison was performed detailing an overall decease in flows discharging from the site as shown on Figures 3 and Figure 4 and supporting calculation provided in Appendix B.

The following section describes the methodology used for the analysis in this report. Hydrologic equations and calculations used to determine the 100-year peak flows can be found in Appendix B.

5.1 METHODOLOGY

The Rational Method calculation was used to estimate the rainfall runoff for the onsite and offsite drainage areas, referencing parameters from the DSPM and the DDM. Peak discharges were determined at concentration points using the Rational Method in accordance with Section 3.6.2 of the DDM, Volume 1. Where drainage areas are combined, peak flows were conservatively added to each other. Parameters used in the Rational Method analysis are described in the following sections.

5.2 RAINFALL DATA

Precipitation depths were determined using National Oceanic and Atmospheric Administration Atlas 14 (NOAA 14). The full NOAA report for the Project has been included in Appendix B.

5.3 RUNOFF COEFFICIENTS

Rational Method runoff coefficients "C" were referenced from Table 4-1.5 of the DSPM and can be seen in the Table 1 below.

Table 1: Land Use Runoff Coefficients "C"	
Land Use	**100-Year "C" Coefficient**
Desert Landscaping	0.45
Stabilized DG Parking and Trails	0.82
Paved Streets, Roads, and Parking Lots	0.95

5.4 DRAINAGE AREAS

For Rational Method calculations, the Project was divided into drainage areas as shown on Figure 5. The onsite drainage areas were divided based on a combination of the grading design and existing topography.

5.5 ANALYSIS RESULTS

The results of Rational Method analysis for the existing and developed conditions can be seen in Table 2. The flows discharging from the site are shown decrease as a result of development of the Project.

Table 2: 100-Year Hydrologic Results		
Outfall	**Existing Conditions**	**Developed Conditions**
North Outfall	14	10
South Outfall	16	12

6.0 HYDRAULIC ANALYSIS

Hydraflow was utilized to model the proposed culverts which convey offsite flows to their historic outfall. Hydraflow results are provided in Appendix C. Additional discussion of hydraulic design of specific onsite structures is provided in the following section.

7.0 DRAINAGE DESIGN

Rainfall runoff generated onsite is routed to retention basins and underground storage tanks throughout the Project as shown on Figure 5. All retention basins and underground storage tanks are located within dedicated drainage easements. Further discussion of the Projects stormwater management is provided below.

7.1 STORM DRAIN ANALYSIS

Storm drain capacity calculations were performed utilizing StormCAD, a computer software program by Bentley, Inc. The stormdrain pipes have been sized to accept and convey the 100-year peak design discharges. For the 100-year storm event, the tailwater condition was set to represent the outfall basin at full capacity.

The StormCAD model for the Project has identified that the hydraulic grade line (HGL) elevations, which include head losses for each junction, are at or near the inlet rim elevations for the 100-year storm event. The StormCAD labels have been included in Figure 5, and storm drain profiles can be found in Appendix D.

7.2 RETENTION REQUIREMENTS

Retention basins have been designed to retain the onsite runoff generated from the 100-Year, 2-Hour runoff volume generated by the developed areas of the site. The retention basin volumes have been calculated according to the following equation (DSPM 4-1.201.C.1):

$$V_R = C * (P/ 12) * A$$

where: V_R = Required Retention Volume (ft^3)
C = Area-Weighted Runoff Coefficient
P = 100-year, 2-hour Precipitation Depth (in) = 2.65 inches
A = Drainage Area (ft^2)

A graphical representation of the retention basin layout can be seen on Figure 5. Runoff coefficients for onsite drainage areas were taken from Table 4-1.5 of the DSPM detailed in Table 1 in Section 5.3 of this report.

The applicable runoff coefficients from this table are weighted based on the land uses and gross areas. The retention basins have been graded such that the basin bottom is no more than 3-feet below the retention basin outfall elevation.

7.3 DISSIPATION OF STORED RUNOFF

The stormwater storage basins and tanks are designed such that retained water is de-watered within 36-hours of the storm event in accordance with the City's DSPM. Outlet facilities consist of natural infiltration and drywells. In accordance with the DDM, the design disposal rate utilized for drywells is 0.1 cfs. Dewatering calculations determining the number of drywells anticipated to be required for the retention basins are included in Appendix E. Post-construction tests shall be performed in order to determine the actual drywell disposal rate as well as the true natural infiltration rate of each basin. The number of drywells required will be updated according to this report with additional drywells installed if necessary.

7.4 ULTIMATE OUTFALL

The Project is split into sections due to the unaltered 404 wash that traverses through the site. As such, there are outfalls for each section the Project, which drain west to the historic outfall location. This ultimate outfall elevation for the southern portion of the Project is approximately 2262 feet while the ultimate outfall elevation for the northern portion is approximately 2259 feet. After discharging, the runoff will drain into the existing stormdrain system in the commercial area west of the Project, conserving pre-development drainage patterns.

8.0 ADEQ WATER QUALITY REQUIREMENTS

Per ADEQ Water Quality Requirements, for redevelopment with disturbance areas greater than one acre, a Notice of Intention (NOI) is required. Given the area of the proposed improvements (approximately 15 acres) a NOI shall be submitted to ADEQ and an approved NOI Certification with an AZCON number will be provided to City of Scottsdale during the improvement plans submittal.

9.0 SUMMARY & CONCLUSIONS

It has been determined in this report's analysis that the drainage infrastructure has been designed to adequately manage the design flows. The proposed development is in compliance with City of Scottsdale's design criteria and other required drainage laws. No adverse drainage impacts are expected to either downstream existing properties or drainage ways from the site. The study has determined that:

- Offsite flows are collected in existing washes and conveyed to an existing stormdrain system west of the Project to their respective historical outfalls.
- The offsite flows are routed through sediment basins, ensuring the stormwater discharging from the site is better quality as compared to existing conditions.
- Onsite flows are conveyed to the retention basins via surface flow.
- Onsite retention basins provide, at a minimum, a storage volume equivalent to the 100-year, 2-hour runoff volume.
- By virtue of the retention provided, there is an overall reduction in flows discharging from the site.

- Riprap aprons will be placed downstream of all points of concentrated discharge including stormdrains to protect against erosion and scour.
- All retention basins shall be drained within 36 hours. The dewatering of the basins is accomplished by a combination of natural infiltration and drywells.

10.0 REFERENCES

City of Scottsdale. (January, 2018). *Design Standards & Policies Manual.* City of Scottsdale, Arizona.

Federal Emergency Management Agency, FEMA (July 20, 2021). *Flood Insurance Rate Map 04013C0891M & 04013C0893M.*

Flood Control District of Maricopa County (December, 2018). *Maricopa County Drainage Manual Volume I, Hydrology*

Flood Control District of Maricopa County (December, 2018). *Maricopa County Drainage Manual Volume II, Hydrology*

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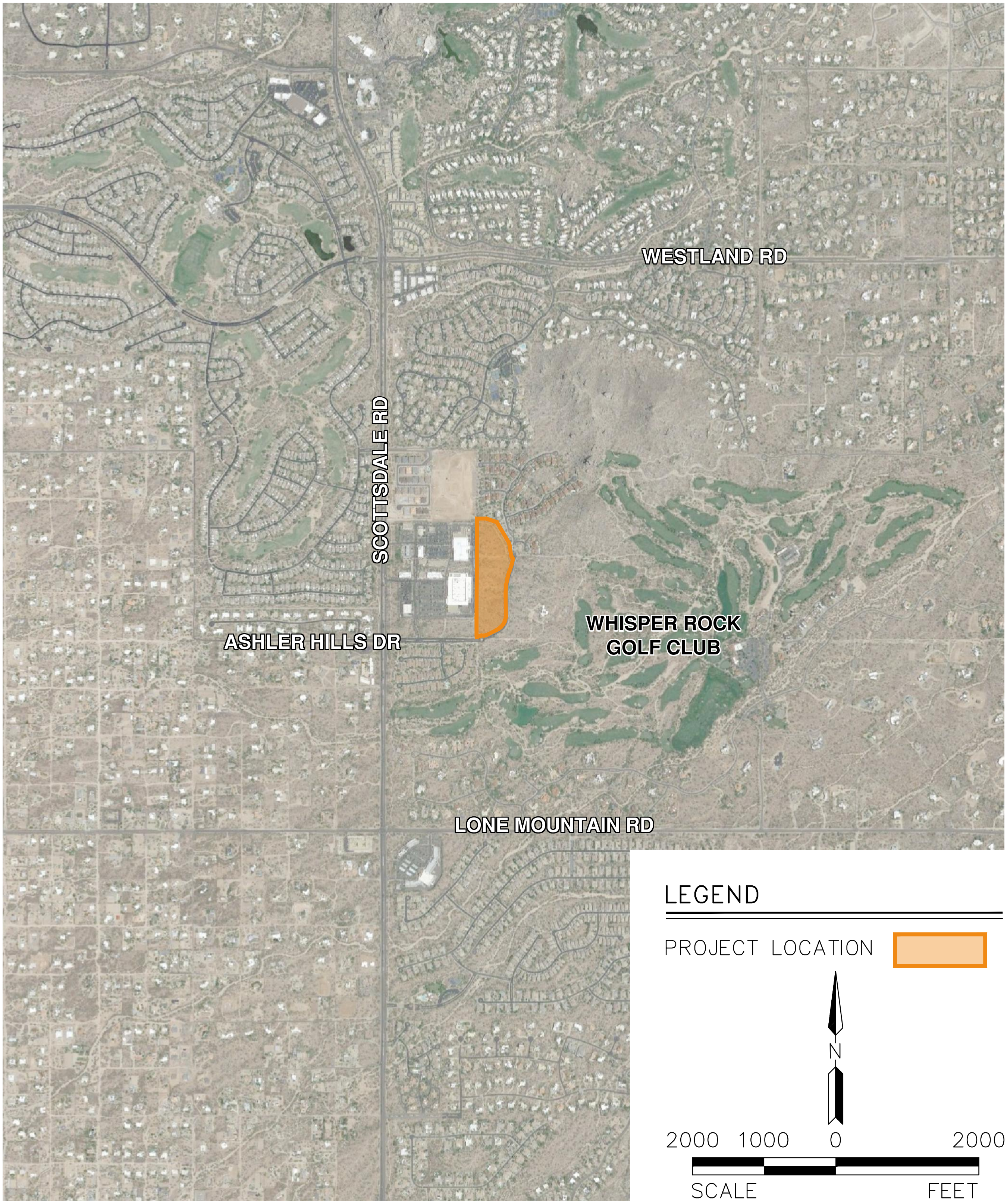
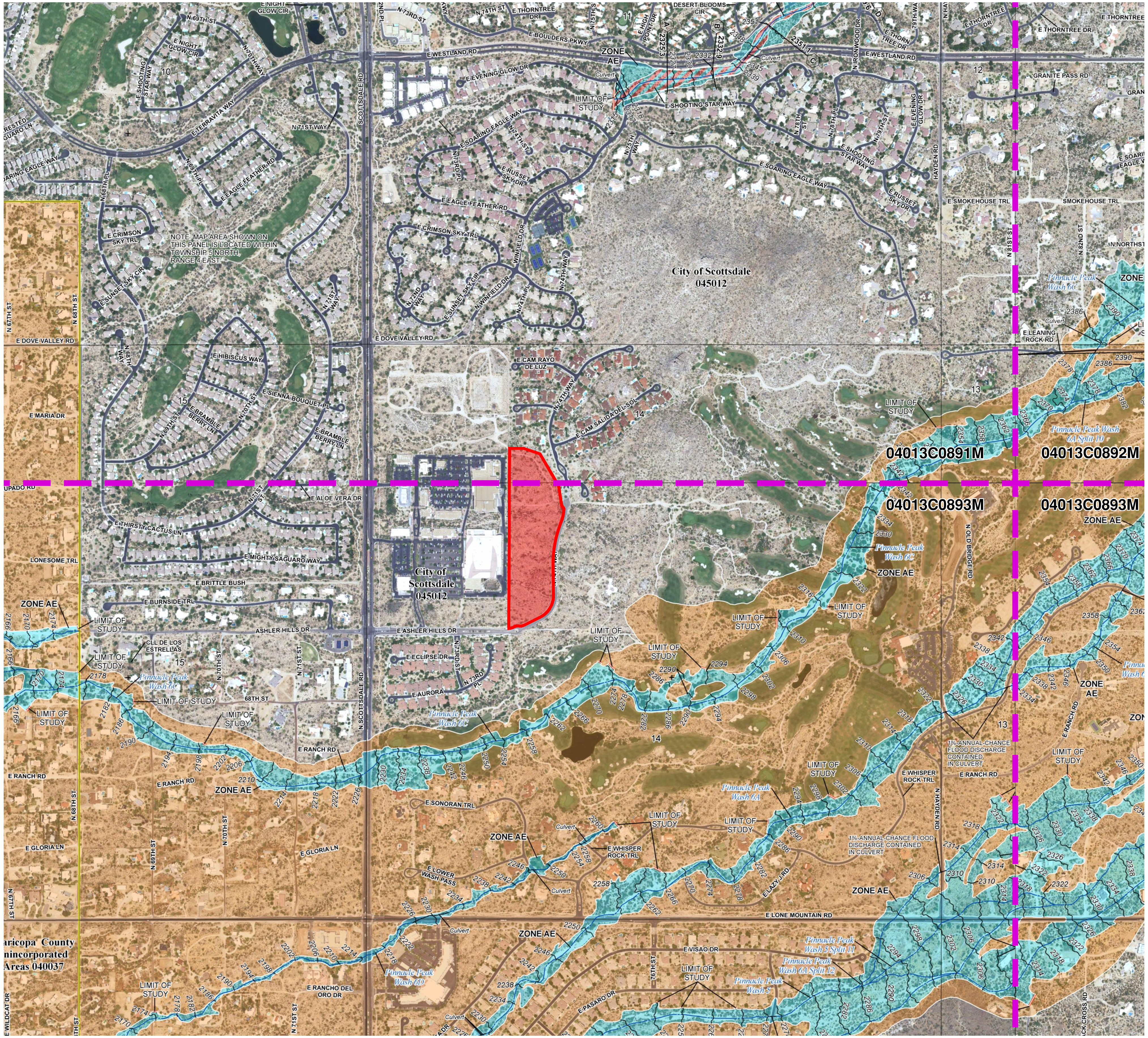
APPENDIX A

FIGURES



PROJ.NO.:	2299	ASHLER HILLS PARK	HILGARTWILSON
DATE:	OCT 2021	CITY OF SCOTTSDALE, ARIZONA	2141 E. HIGHLAND AVE., STE. 250
SCALE:	1" = 2,000'		PHOENIX, AZ 85016
DRAWN BY:	DM	FIG 1: VICINITY MAP	P: 602.490.0535 / F: 602.368.2436
CHECKED BY:	BB		

U:\2200\2299\2299.01 Floor Associates\REPORTS\DRAINAGE\Exhibits\2299 Fig 1 – Vicinity Map.dwg 10/14/2021 8:09 AM



LEGEND

PROJECT LOCATION	(red box)
FEMA MAP LIMITS	(magenta dashed line)

N

1000 500 0 1000

SCALE FEET

HILGARTWILSON
2141 E. HIGHLAND AVE., STE. 250
PHOENIX, AZ 85016
P: 602.490.0535 / F: 602.368.2436

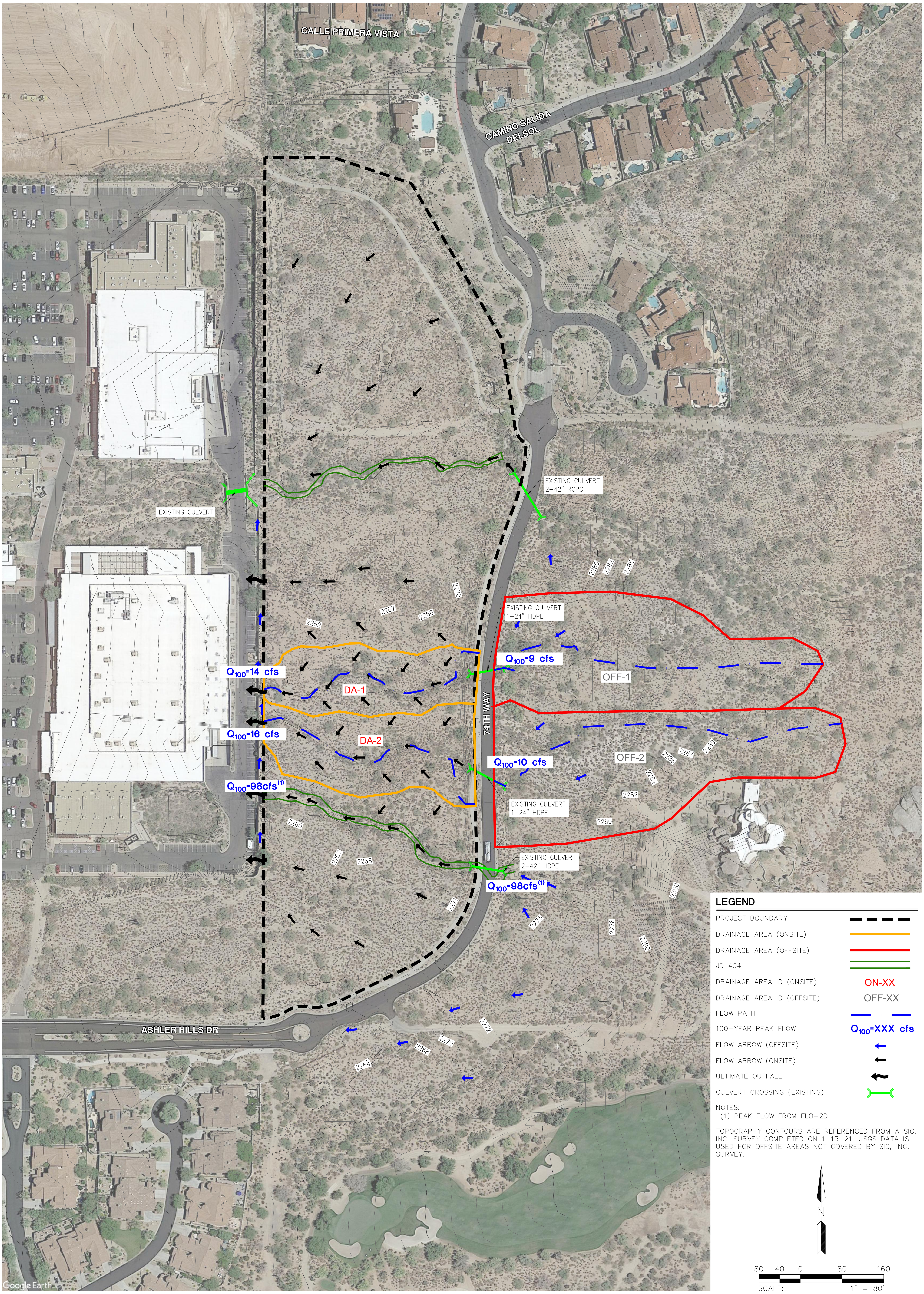
ASHLER HILLS PARK

CITY OF SCOTTSDALE, ARIZONA

FIG 2: FEMA FLOOD MAP

PROJ. NO.:	2299
DATE:	OCT 2021
SCALE:	1" = 1,000'
DRAWN BY:	DM
CHECKED BY:	BB

U:\2200\2299\2299.01 Floor Associates\REPORTS\DRAINAGE\Exhibits\2299 Fig 2 – FEMA Flood Map.dwg 10/14/2021 8:11 AM



LEGEND

PROJECT BOUNDARY	
DRAINAGE AREA (ONSITE)	
DRAINAGE AREA (OFFSITE)	
JD 404	
DRAINAGE AREA ID (ONSITE)	ON-XX
DRAINAGE AREA ID (OFFSITE)	OFF-XX
FLOW PATH	
100-YEAR PEAK FLOW	Q_{100}=XXX cfs
FLOW ARROW (OFFSITE)	
FLOW ARROW (ONSITE)	
ULTIMATE OUTFALL	
CULVERT CROSSING (EXISTING)	

NOTES:
(1) PEAK FLOW FROM FLO-2D

TOPOGRAPHY CONTOURS ARE REFERENCED FROM A SIG, INC. SURVEY COMPLETED ON 1-13-21. USGS DATA IS USED FOR OFFSITE AREAS NOT COVERED BY SIG, INC. SURVEY.

N

80 40 0 80 160

SCALE: 1" = 80'

HILGARTWILSON

PROJ NO.: 2299
DATE: MAR 2022
SCALE: 1" = 80'
DRAWN: DM
DESIGNED: JF
APPROVED: BB

DWG. NO. 3

ASHLER HILLS PARK

CITY OF SCOTTSDALE, ARIZONA

FIG 3: UNDEVELOPED HYDROLOGY EXHIBIT

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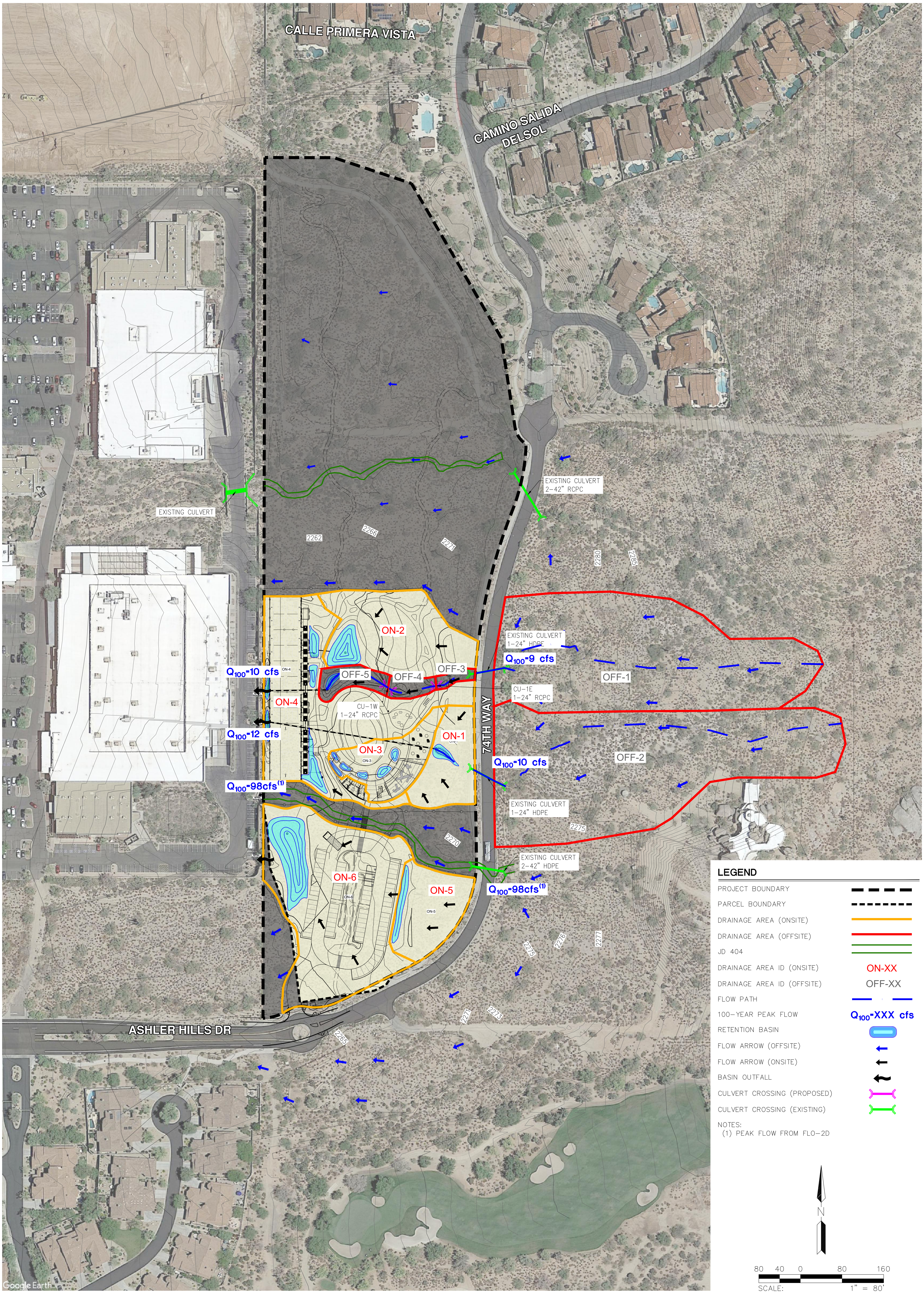
REV.:



HILGARTWILSON	
DWG. NO. 4	PROJ NO.: 2299
	DATE: MAR 2022
	SCALE: 1" = 80'
	DRAWN: DM
	DESIGNED: JF
	APPROVED: BB

ASHLER HILLS PARK

CITY OF SCOTTSDALE, ARIZONA

FIG 4: DEVELOPED HYDROLOGY EXHIBIT

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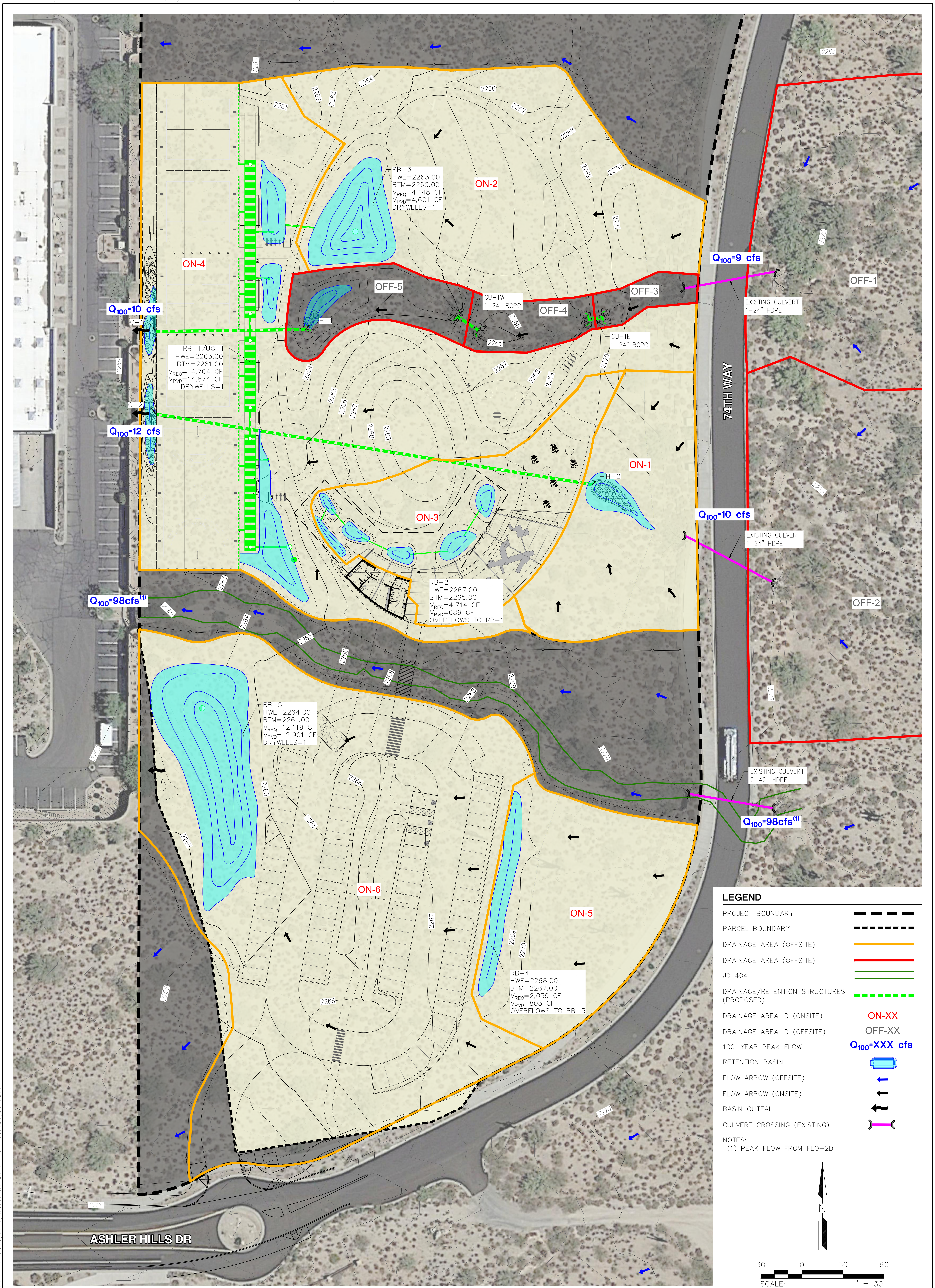
REV.:



HILGARTWILSON	ASHLER HILLS PARK	HILGARTWILSON	REV.:
PROJ NO.: 2299	CITY OF SCOTTSDALE, ARIZONA	ENGINEER | PLAN | SURVEY | MANAGE	
DATE: MAR 2022	FIG 5: PRELIMINARY DRAINAGE PLAN	2141 E. HIGHLAND AVE., STE. 250 PHOENIX, AZ 85016 | P: 602.490.0535 / F: 602.368.2436 www.hilgartwilson.com	
SCALE: 1" = 30'			
DRAWN: DM			
DESIGNED: JF			
APPROVED: BB			
DWG. NO. 5			

APPENDIX B

HYDROLOGIC CALCULATIONS

DRAINAGE SUBAREA SUMMARY TABLE

Project: 2299 Ashler Hills

Prepared by: JF

Date: Mar, 2022

Drainage Subarea ID(s)	Land Use Category (1)			Total Area	Total Area	Length of Longest Flowpath	Length of Longest Flowpath	Top Elevation	Bottom Elevation	Change in Elevation	Slope	Slope
	Desert Landscaping	Stabilized DG Parking and Trails	Paved Streets, Roads, and Parking Lots									
	[ft^2]	[ft^2]	[ft^2]	[ft^2]	[ac]	[ft]	[mi]	[ft]	[ft]	[ft]	[ft/ft]	[ft/mi]
UNDEVELOPED												
OFF-1	115,324	0	0	115,324	2.6	683	0.129	2,285.6	2,277.3	8.3	0.0121	63.9
OFF-2	129,627	0	0	129,627	3.0	730	0.138	2,285.6	2,276.0	9.6	0.0132	69.5
DA-1	47,719	0	0	47,719	1.1	502	0.095	2,277.8	2,256.5	21.3	0.042	224.3
DA-2	60,411	0	0	60,411	1.4	507	0.096	2,275.2	2,259.7	15.6	0.031	162.2
DEVELOPED												
OFF-3	1,828	0	0	1,828	0.1	117	0.022	2,272.3	2,269.8	2.5	0.022	114.4
OFF-4	3,238	0	0	3,238	0.1	97	0.018	2,269.8	2,266.4	3.5	0.035	187.0
OFF-5	6,096	0	0	6,096	0.1	143	0.027	2,266.4	2,261.0	5.3	0.037	197.8
ON-1	17,780	0	0	17,780	0.4	131	0.025	2,271.0	2,268.0	3.0	0.023	120.8
ON-2	34,697	3,868	0	38,564	0.9	FOR RETENTION ONLY						
ON-3	6,709	3,091	8,811	18,611	0.4	FOR RETENTION ONLY						
ON-4	33,157	9,137	26,991	69,285	1.6	FOR RETENTION ONLY						
ON-5	20,523	0	0	20,523	0.5	FOR RETENTION ONLY						
ON-6	48,116	12,810	18,023	78,948	1.8	FOR RETENTION ONLY						
TOTAL	**525,226**	**28,905**	**53,825**	**607,956**	**14.0**							

(1) From *2018 City of Scottsdale Design Standards & Policies Manual; Table 4-1.5 - Runoff Coefficients For Rational Method.*

WEIGHTED RUNOFF COEFFICIENT CALCULATIONS

Project: 2299 Ashler Hills

Prepared by: JF

Date: Mar, 2022

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Landuse(1)(2)	2 & 10 Year C Coefficient	100 Year C Coefficient
Desert Landscaping	0.37	0.45
Stabilized DG Parking and Trails	0.68	0.82
Paved Streets, Roads, and Parking Lots	0.90	0.95

(1) From *2018 City of Scottsdale Design Standards and Policies Manual; Figure 4-1.5*

Drainage Subarea ID(s)	Subarea Surface Types & Areas					Weighted Coefficient	
	Desert Landscaping	Stabilized DG Parking and Trails	Paved Streets, Roads, and Parking Lots	Total	Total	C_w - 2 & 10 Year	C_w - 100 Year
	[ft^2]	[ft^2]	[ft^2]	[ft^2]	[ac]		
UNDEVELOPED							
OFF-1	115,324	0	0	115,324	2.6	0.37	0.45
OFF-2	129,627	0	0	129,627	3.0	0.37	0.45
DA-1	47,719	0	0	47,719	1.1	0.37	0.45
DA-2	60,411	0	0	60,411	1.4	0.37	0.45
DEVELOPED							
OFF-3	1,828	0	0	1,828	0.1	0.37	0.45
OFF-4	3,238	0	0	3,238	0.1	0.37	0.45
OFF-5	6,096	0	0	6,096	0.1	0.37	0.45
ON-1	17,780	0	0	17,780	0.4	0.37	0.45
ON-2	34,697	3,868	0	38,564	0.9	0.40	0.49
ON-3	6,709	3,091	8,811	18,611	0.4	0.67	0.75
ON-4	33,157	9,137	26,991	69,285	1.6	0.62	0.69
ON-5	20,523	0	0	20,523	0.5	0.37	0.45
ON-6	48,116	12,810	18,023	78,948	1.8	0.54	0.62

TIME OF CONCENTRATION CALCULATIONS

Project: 2299 Ashler Hills

Prepared by: JF

Date: Mar, 2022

HILGARTWILSON
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									2-Year Storm Analysis			10-Year Storm Analysis			100-Year Storm Analysis		
Drainage Subarea ID(s)	Length of Longest Flowpath	Area	Slope	Adjusted Slope	$m_{weighted}$	$b_{weighted}$	K_b	$11.4 \times L^{0.5} \times K_b^{0.52} \times S^{-0.31}$	Assumed T_c	i_{10}	T_c	Assumed T_c	i_{10}	T_c	Assumed T_c	i_{100}	T_c
	[mi]	[ac]	[ft/mi]	[ft/mi]					[min]	[in/hr]	[min]	[min]	[in/hr]	[min]	[min]	[in/hr]	[min]
UNDEVELOPED																	
OFF-1	0.13	2.6	64	64	-0.01375	0.08000	0.074	0.292	12.4	2.48	12.4	10.0	4.38	10.0	8.1	7.69	8.1
OFF-2	0.14	3.0	70	70	-0.01375	0.08000	0.073	0.293	12.4	2.48	12.4	10.0	4.38	10.0	8.1	7.69	8.1
DA-1	0.10	1.1	224	224	-0.01375	0.08000	0.079	0.176	6.7	3.29	6.7	5.5	5.62	5.5	5.0	8.98	4.6
DA-2	0.10	1.4	162	162	-0.01375	0.08000	0.078	0.194	7.5	3.14	7.5	6.1	5.48	6.1	5.0	8.98	5.0
DEVELOPED																	
OFF-3	0.02	0.1	114	114	-0.01375	0.08000	0.094	0.114	5.0	3.56	4.2	5.0	5.76	3.5	5.0	8.98	3.0
OFF-4	0.02	0.1	187	187	-0.01375	0.08000	0.096	0.090	5.0	3.56	3.3	5.0	5.76	2.8	5.0	8.98	2.4
OFF-5	0.03	0.1	198	198	-0.01375	0.08000	0.092	0.105	5.0	3.56	3.9	5.0	5.76	3.2	5.0	8.98	2.7
ON-1	0.02	0.4	121	121	-0.00625	0.04000	0.042	0.079	5.0	3.56	2.9	5.0	5.76	2.4	5.0	8.98	2.0

From Equation 3.2 of the Flood Control District of Maricopa County (FCDMC)

Drainage Design Manual for Maricopa County, Arizona, Hydrology, December, 2018

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

Where

T_c = The time of concentration in hours

L = The length of the longest flow path in miles

K_b = The watershed resitance coefficient (Kb = m * log(A) + b)

S = The watercourse slope in ft/ mi

i = The rainfall intensity in in/ hr

m & b = Equation parameter from Table 3.1 of FCDMC

A = Drainage area in acres

PEAK FLOW RATE CALCULATIONS

Project: 2299 Ashler Hills

Prepared by: JF

Date: Mar, 2022

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Drainage Subarea ID(s)	Average Slope [ft/ft]	Total Area [ac]	2-Year Storm Event Weighted C	2-Year Rainfall Intensity [in/hr]	2-Year Flow Rate (1) [cfs]	10-Year Storm Event Weighted C	10-Year Rainfall Intensity [in/hr]	10-Year Flow Rate (1) [cfs]	100-Year Storm Event Weighted C	100-Year Rainfall Intensity [in/hr]	100-Year Flow Rate (1) [cfs]
UNDEVELOPED											
OFF-1	0.0121	2.6	0.37	2.48	2.4	0.37	4.38	4.3	0.45	7.69	9.2
OFF-2	0.0132	3.0	0.37	2.48	2.7	0.37	4.38	4.8	0.45	7.69	10.3
DA-1	0.0425	1.1	0.37	3.29	1.3	0.37	5.62	2.3	0.45	8.98	4.4
DA-2	0.0307	1.4	0.37	3.14	1.6	0.37	5.48	2.8	0.45	8.98	5.6
DEVELOPED											
OFF-3	0.0217	0.1	0.37	3.56	0.1	0.37	5.76	0.2	0.45	8.98	0.4
OFF-4	0.0354	0.1	0.37	3.56	0.1	0.37	5.76	0.2	0.45	8.98	0.3
OFF-5	0.0375	0.1	0.37	3.56	0.2	0.37	5.76	0.3	0.45	8.98	0.6
ON-1	0.0229	0.4	0.37	3.56	0.5	0.37	5.76	0.9	0.45	8.98	1.6

NOTES:

(1) The flow rate values shown were calculated using the following process:

From Equation 3.1 of the Flood Control District of Maricopa County (FCDMC) *Drainage Design Manual for Maricopa County, Arizona, Hydrology* , December, 2018

Q = CiA

Where

Q = The the peak discharge (cfs) from a given area.

C = A coefficient relating the runoff to rainfall.

i= The average rainfall intensity (inches/ hour), lasting for a T_c

T_c = The time of concentration (hours)

A= The drainage area (acres)

DDF/IDF TABLES

DDF/IDF TABLES

Project: 2299 Ashler Hills
Prepared by: JF
Date: Oct, 2021

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Rainfall Depth (inches)										
Frequency (years)	Duration									
	5-min	10-min	15-min	30-min	1-hr	2-hr	3-hr	6-hr	12-hr	24-hr
2	0.30	0.45	0.56	0.75	0.93	1.08	1.15	1.34	1.58	1.81
5	0.40	0.61	0.76	1.02	1.26	1.43	1.49	1.70	1.99	2.37
10	0.48	0.73	0.91	1.22	1.51	1.70	1.77	1.99	2.31	2.82
25	0.59	0.89	1.10	1.49	1.84	2.07	2.16	2.39	2.74	3.46
50	0.67	1.01	1.26	1.69	2.09	2.35	2.47	2.71	3.08	3.98
100	0.75	1.14	1.41	1.90	2.35	2.65	2.79	3.04	3.42	4.54

Rainfall Intensity (inches/hour)			
Duration	Frequency (years)		
	2	10	100
5-min	3.56	5.76	8.98
10-min	2.71	4.38	6.84
15-min	2.24	3.62	5.64
30-min	1.51	2.44	3.80
1-hr	0.93	1.51	2.35
2-hr	0.54	0.85	1.33
3-hr	0.38	0.59	0.93
6-hr	0.26	0.39	0.57
12-hr	0.13	0.19	0.29
24-hr	0.08	0.12	0.19

1) intensity = Rainfall Depth / Duration

IDF CURVE TABLE

IDF CURVE TABLE

Project: 2299 Ashler Hills
Prepared by: JF
Date: Oct, 2021

	10-year storm	100-year storm
Assumed Tc	I	I
[min]	[in/hr]	[in/hr]
5.000	5.76	8.98
5.125	5.73	8.92
5.250	5.69	8.87
5.375	5.66	8.82
5.500	5.62	8.76
5.625	5.59	8.71
5.750	5.55	8.66
5.875	5.52	8.60
6.000	5.48	8.55
6.125	5.45	8.50
6.250	5.42	8.44
6.375	5.38	8.39
6.500	5.35	8.34
6.625	5.31	8.28
6.750	5.28	8.23
6.875	5.24	8.18
7.000	5.21	8.12
7.125	5.17	8.07
7.250	5.14	8.01
7.375	5.10	7.96
7.500	5.07	7.91
7.625	5.04	7.85
7.750	5.00	7.80
7.875	4.97	7.75
8.000	4.93	7.69
8.125	4.90	7.64
8.250	4.86	7.59
8.375	4.83	7.53
8.500	4.79	7.48
8.625	4.76	7.43
8.750	4.72	7.37
8.875	4.69	7.32
9.000	4.66	7.27
9.125	4.62	7.21
9.250	4.59	7.16
9.375	4.55	7.11
9.500	4.52	7.05
9.625	4.48	7.00
9.750	4.45	6.95
9.875	4.41	6.89
10.000	4.38	6.84
10.125	4.36	6.81
10.250	4.34	6.78
10.375	4.32	6.75
10.500	4.30	6.72
10.625	4.29	6.69
10.750	4.27	6.66
10.875	4.25	6.63
11.000	4.23	6.60
11.125	4.21	6.57
11.250	4.19	6.54
11.375	4.17	6.51
11.500	4.15	6.48
11.625	4.13	6.45
11.750	4.11	6.42
11.875	4.10	6.39
12.000	4.08	6.36
12.125	4.06	6.33
12.250	4.04	6.30
12.375	4.02	6.27
12.500	4.00	6.24
12.625	3.98	6.21
12.750	3.96	6.18
12.875	3.94	6.15
13.000	3.92	6.12
13.125	3.91	6.09
13.250	3.89	6.06
13.375	3.87	6.03
13.500	3.85	6.00
13.625	3.83	5.97
13.750	3.81	5.94
13.875	3.79	5.91
14.000	3.77	5.88
14.125	3.75	5.85

IDF CURVE TABLE

Project: 2299 Ashler Hills
Prepared by: JF
Date: Oct, 2021

HILGARTWILSON
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	10-year storm	100-year storm
Assumed Tc	I	I
[min]	[in/hr]	[in/hr]
14.250	3.73	5.82
14.375	3.72	5.79
14.500	3.70	5.76
14.625	3.68	5.73
14.750	3.66	5.70
14.875	3.64	5.67
15.000	3.62	5.64
15.125	3.60	5.60
15.250	3.57	5.57
15.375	3.55	5.53
15.500	3.53	5.49
15.625	3.50	5.46
15.750	3.48	5.42
15.875	3.45	5.38
16.000	3.43	5.35
16.125	3.41	5.31
16.250	3.38	5.27
16.375	3.36	5.24
16.500	3.34	5.20
16.625	3.31	5.16
16.750	3.29	5.12
16.875	3.27	5.09
17.000	3.24	5.05
17.125	3.22	5.01
17.250	3.20	4.98
17.375	3.17	4.94
17.500	3.15	4.90
17.625	3.12	4.87
17.750	3.10	4.83
17.875	3.08	4.79
18.000	3.05	4.76
18.125	3.03	4.72
18.250	3.01	4.68
18.375	2.98	4.65
18.500	2.96	4.61
18.625	2.94	4.57
18.750	2.91	4.54
18.875	2.89	4.50
19.000	2.86	4.46
19.125	2.84	4.43
19.250	2.82	4.39
19.375	2.79	4.35
19.500	2.77	4.32
19.625	2.75	4.28
19.750	2.72	4.24
19.875	2.70	4.20
20.000	2.68	4.17
21.000	2.65	4.13
22.000	2.63	4.09
23.000	2.61	4.06
24.000	2.58	4.02
25.000	2.56	3.98
26.000	2.53	3.95
27.000	2.51	3.91
28.000	2.49	3.87
29.000	2.46	3.84
30.000	2.44	3.80
35.000	2.29	3.56
40.000	2.13	3.32
45.000	1.98	3.08
50.000	1.82	2.83
55.000	1.67	2.59
60.000	1.51	2.35
90.000	1.18	1.84
120.000	0.85	1.33
150.000	0.72	1.13
180.000	0.59	0.93
270.000	0.49	0.75
360.000	0.39	0.57
540.000	0.29	0.43
720.000	0.19	0.29
1080.000	0.16	0.24
1440.000	0.12	0.19

NOAA14 RAINFALL DATA REPORT

NOAA Atlas 14, Volume 1, Version 5
Location name: Scottsdale, Arizona, USA*
Latitude: 33.7793°, Longitude: -111.921°
Elevation: 2265.1 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	**0.228** (0.190-0.279)	**0.297** (0.248-0.363)	**0.400** (0.331-0.488)	**0.480** (0.394-0.583)	**0.585** (0.475-0.708)	**0.666** (0.534-0.801)	**0.748** (0.591-0.898)	**0.832** (0.648-0.998)	**0.944** (0.718-1.13)	**1.03** (0.770-1.25)
10-min	**0.347** (0.289-0.424)	**0.451** (0.378-0.553)	**0.609** (0.504-0.743)	**0.730** (0.600-0.887)	**0.890** (0.723-1.08)	**1.01** (0.813-1.22)	**1.14** (0.900-1.37)	**1.27** (0.987-1.52)	**1.44** (1.09-1.73)	**1.57** (1.17-1.90)
15-min	**0.430** (0.358-0.526)	**0.559** (0.468-0.685)	**0.755** (0.625-0.921)	**0.905** (0.744-1.10)	**1.10** (0.896-1.34)	**1.26** (1.01-1.51)	**1.41** (1.12-1.69)	**1.57** (1.22-1.88)	**1.78** (1.36-2.14)	**1.95** (1.45-2.35)
30-min	**0.579** (0.482-0.708)	**0.754** (0.630-0.923)	**1.02** (0.842-1.24)	**1.22** (1.00-1.48)	**1.49** (1.21-1.80)	**1.69** (1.36-2.04)	**1.90** (1.50-2.28)	**2.11** (1.65-2.54)	**2.40** (1.83-2.88)	**2.62** (1.96-3.16)
60-min	**0.717** (0.596-0.876)	**0.933** (0.780-1.14)	**1.26** (1.04-1.54)	**1.51** (1.24-1.83)	**1.84** (1.49-2.23)	**2.09** (1.68-2.52)	**2.35** (1.86-2.82)	**2.62** (2.04-3.14)	**2.97** (2.26-3.57)	**3.25** (2.42-3.92)
2-hr	**0.834** (0.705-1.00)	**1.08** (0.909-1.29)	**1.43** (1.20-1.71)	**1.70** (1.42-2.03)	**2.07** (1.71-2.47)	**2.35** (1.92-2.80)	**2.65** (2.13-3.14)	**2.94** (2.33-3.49)	**3.34** (2.59-3.96)	**3.66** (2.78-4.36)
3-hr	**0.897** (0.758-1.09)	**1.15** (0.973-1.39)	**1.49** (1.26-1.81)	**1.77** (1.48-2.13)	**2.16** (1.78-2.58)	**2.47** (2.01-2.94)	**2.79** (2.23-3.32)	**3.12** (2.46-3.71)	**3.59** (2.75-4.26)	**3.96** (2.97-4.72)
6-hr	**1.06** (0.923-1.25)	**1.34** (1.17-1.58)	**1.70** (1.47-1.99)	**1.99** (1.71-2.32)	**2.39** (2.02-2.78)	**2.71** (2.26-3.13)	**3.04** (2.50-3.51)	**3.37** (2.72-3.90)	**3.82** (3.01-4.43)	**4.18** (3.22-4.84)
12-hr	**1.26** (1.10-1.46)	**1.58** (1.38-1.84)	**1.99** (1.73-2.30)	**2.31** (1.99-2.67)	**2.74** (2.34-3.16)	**3.08** (2.60-3.54)	**3.42** (2.85-3.94)	**3.77** (3.10-4.34)	**4.23** (3.40-4.89)	**4.59** (3.63-5.34)
24-hr	**1.43** (1.26-1.63)	**1.81** (1.60-2.08)	**2.37** (2.09-2.70)	**2.82** (2.47-3.21)	**3.46** (3.00-3.95)	**3.98** (3.40-4.56)	**4.54** (3.81-5.25)	**5.13** (4.23-5.98)	**5.97** (4.79-7.07)	**6.66** (5.23-7.99)
2-day	**1.63** (1.42-1.87)	**2.07** (1.81-2.38)	**2.72** (2.37-3.11)	**3.25** (2.82-3.71)	**3.99** (3.42-4.57)	**4.59** (3.89-5.28)	**5.23** (4.37-6.07)	**5.90** (4.86-6.93)	**6.85** (5.49-8.16)	**7.62** (5.99-9.21)
3-day	**1.71** (1.50-1.96)	**2.19** (1.92-2.50)	**2.89** (2.53-3.29)	**3.47** (3.02-3.94)	**4.30** (3.70-4.89)	**4.97** (4.23-5.70)	**5.70** (4.78-6.61)	**6.48** (5.35-7.60)	**7.60** (6.11-9.05)	**8.52** (6.70-10.3)
4-day	**1.80** (1.58-2.06)	**2.30** (2.03-2.63)	**3.06** (2.69-3.47)	**3.69** (3.23-4.17)	**4.60** (3.98-5.22)	**5.35** (4.58-6.13)	**6.18** (5.20-7.15)	**7.07** (5.84-8.28)	**8.36** (6.73-9.95)	**9.43** (7.42-11.4)
7-day	**2.07** (1.81-2.38)	**2.64** (2.31-3.02)	**3.51** (3.07-4.01)	**4.24** (3.69-4.83)	**5.30** (4.56-6.06)	**6.19** (5.26-7.12)	**7.16** (5.98-8.32)	**8.22** (6.75-9.71)	**9.76** (7.80-11.7)	**11.1** (8.63-13.5)
10-day	**2.27** (1.99-2.59)	**2.90** (2.55-3.31)	**3.85** (3.37-4.38)	**4.63** (4.04-5.26)	**5.78** (4.98-6.59)	**6.73** (5.73-7.72)	**7.76** (6.51-8.99)	**8.88** (7.33-10.4)	**10.5** (8.44-12.6)	**11.9** (9.31-14.5)
20-day	**2.88** (2.54-3.29)	**3.70** (3.26-4.22)	**4.89** (4.29-5.56)	**5.83** (5.08-6.62)	**7.14** (6.18-8.15)	**8.19** (7.01-9.39)	**9.30** (7.87-10.8)	**10.5** (8.73-12.2)	**12.1** (9.87-14.4)	**13.4** (10.7-16.2)
30-day	**3.43** (3.01-3.91)	**4.40** (3.87-5.01)	**5.81** (5.10-6.60)	**6.91** (6.04-7.82)	**8.42** (7.30-9.57)	**9.60** (8.25-11.0)	**10.8** (9.22-12.5)	**12.1** (10.2-14.0)	**13.9** (11.4-16.4)	**15.3** (12.4-18.3)
45-day	**4.07** (3.59-4.62)	**5.23** (4.63-5.94)	**6.90** (6.09-7.80)	**8.19** (7.19-9.26)	**9.95** (8.67-11.3)	**11.3** (9.78-12.9)	**12.7** (10.9-14.6)	**14.2** (12.0-16.5)	**16.2** (13.4-19.2)	**17.8** (14.5-21.3)
60-day	**4.52** (4.01-5.12)	**5.82** (5.16-6.57)	**7.64** (6.76-8.61)	**9.02** (7.95-10.1)	**10.9** (9.51-12.3)	**12.3** (10.7-14.0)	**13.8** (11.8-15.7)	**15.3** (13.0-17.6)	**17.3** (14.4-20.4)	**18.8** (15.5-22.5)

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

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

Please refer to NOAA Atlas 14 document for more information.

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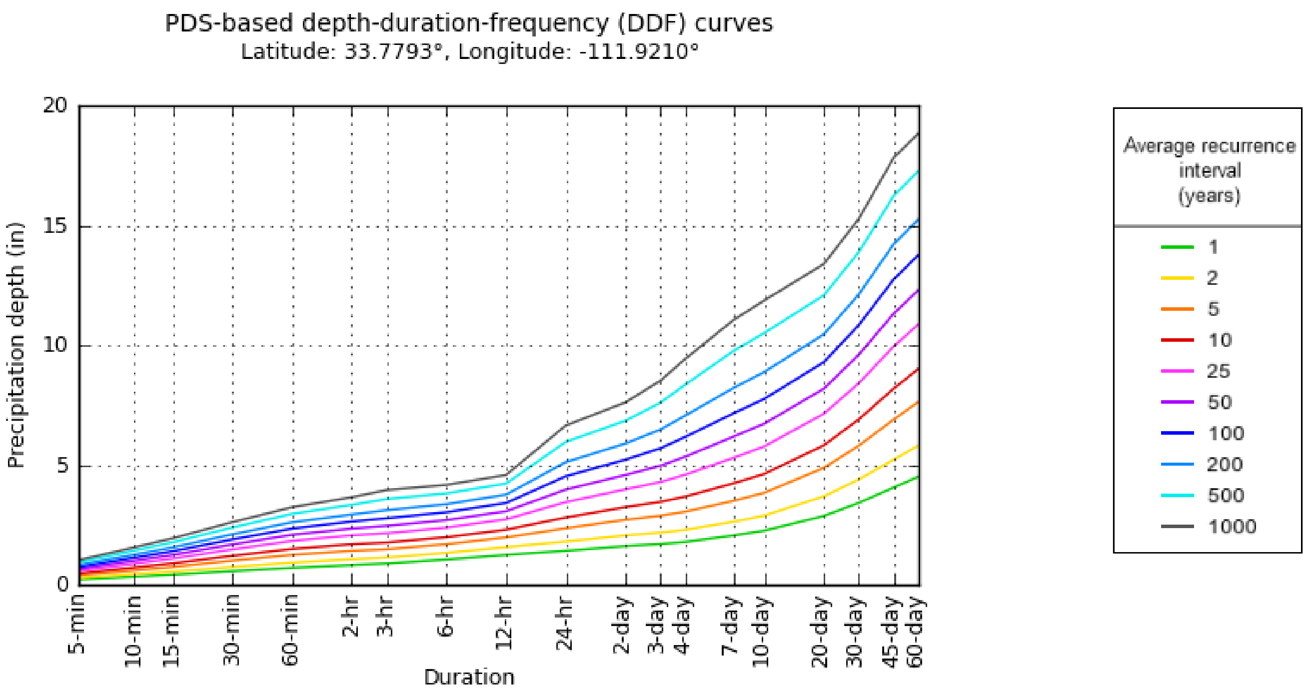
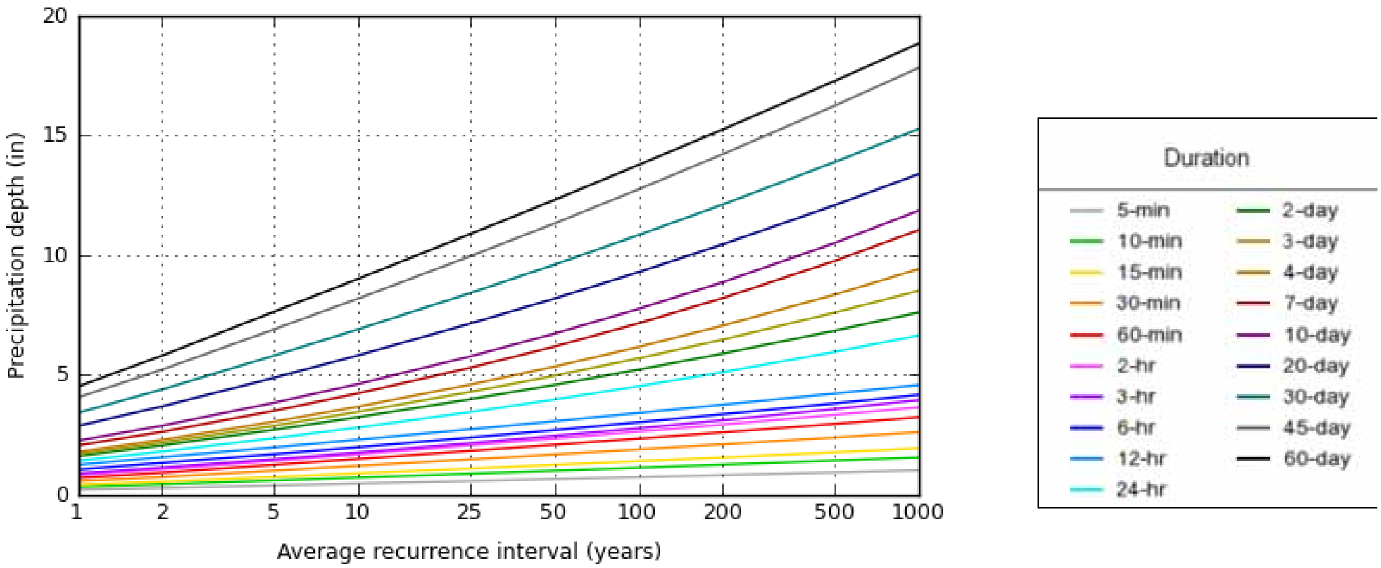
PF graphical





NOAA Atlas 14, Volume 1, Version 5

Created (GMT): Mon Jun 7 18:55:02 2021

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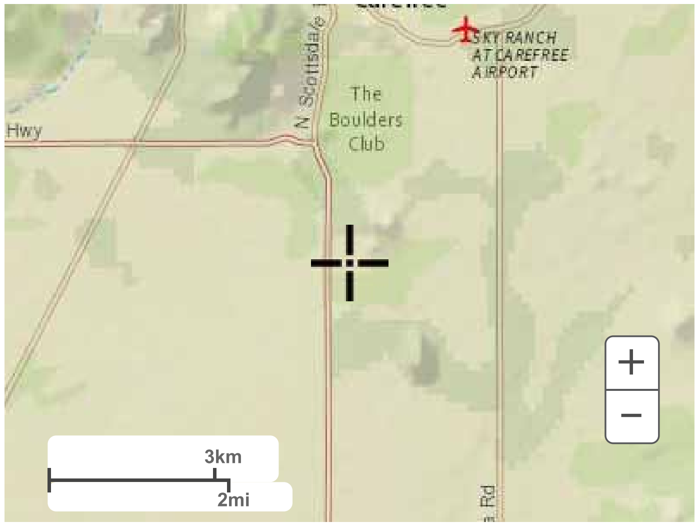
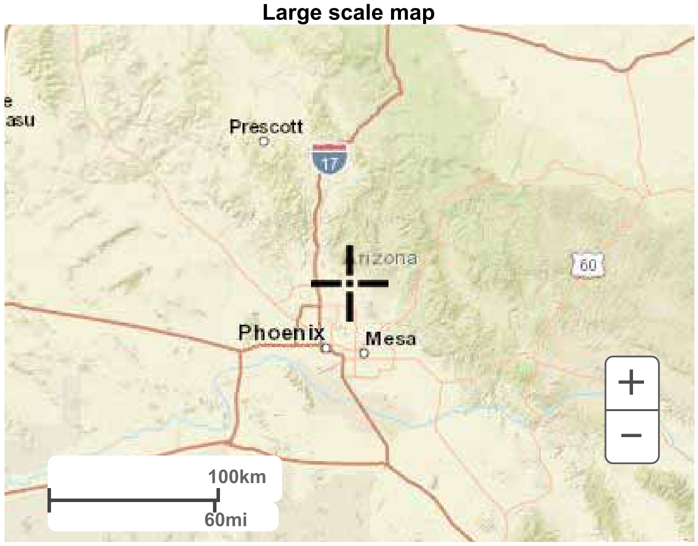
Maps & aerials

Small scale terrain



Large scale terrain

Large scale map



Large scale aerial

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APPENDIX C

HYDRAULIC CALCULATIONS

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Oct 29 2021

CU-1E

Invert Elev Dn (ft)	=	2267.21
Pipe Length (ft)	=	10.00
Slope (%)	=	4.40
Invert Elev Up (ft)	=	2267.65
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

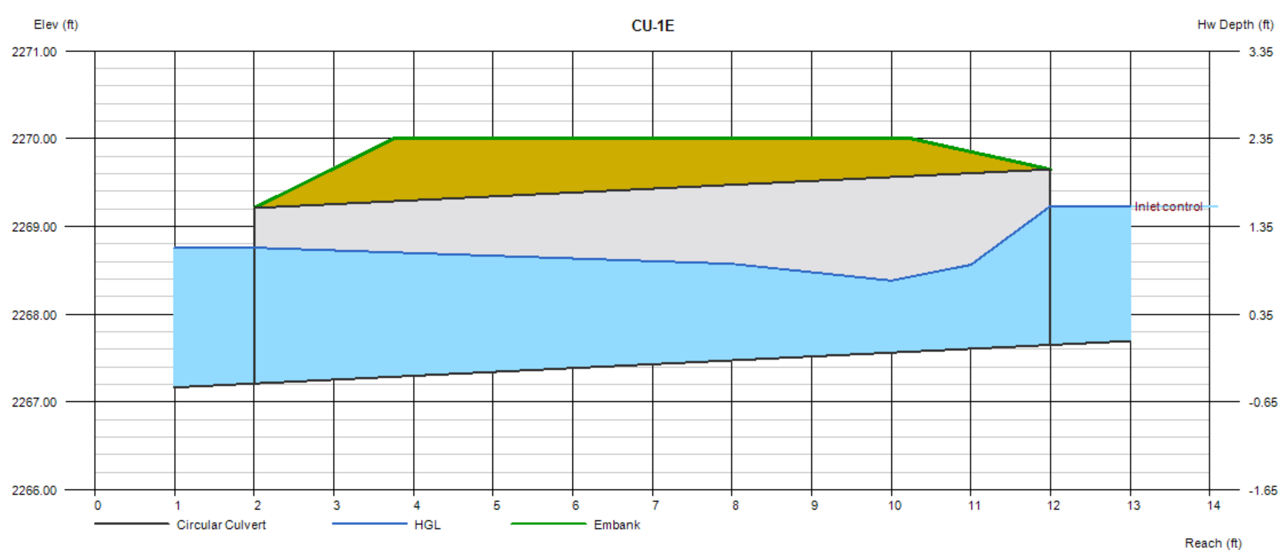
Top Elevation (ft)	=	2270.00
Top Width (ft)	=	6.50
Crest Width (ft)	=	5.00

Calculations

Qmin (cfs)	=	9.40
Qmax (cfs)	=	9.40
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	9.40
Qpipe (cfs)	=	9.40
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	3.60
Veloc Up (ft/s)	=	5.34
HGL Dn (ft)	=	2268.76
HGL Up (ft)	=	2268.74
Hw Elev (ft)	=	2269.23
Hw/D (ft)	=	0.79
Flow Regime	=	Inlet Control



Culvert Report

CU-1W

Invert Elev Dn (ft)	= 2267.21
Pipe Length (ft)	= 10.00
Slope (%)	= 4.40
Invert Elev Up (ft)	= 2267.65
Rise (in)	= 24.0
Shape	= Circular
Span (in)	= 24.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

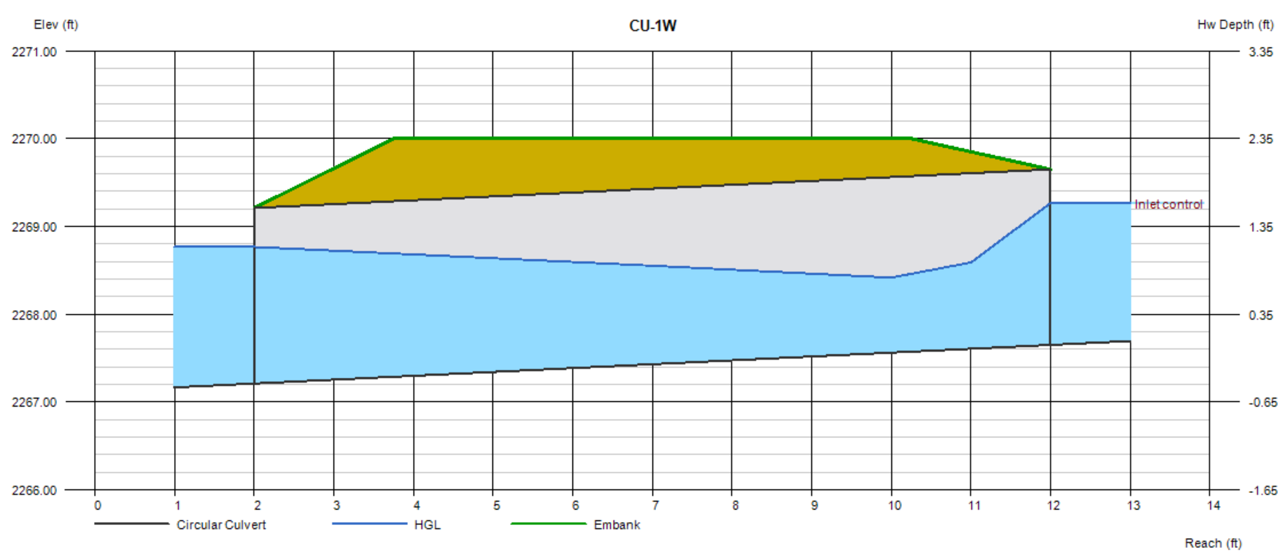
Top Elevation (ft)	= 2270.00
Top Width (ft)	= 6.50
Crest Width (ft)	= 5.00

Calculations

Qmin (cfs)	= 9.70
Qmax (cfs)	= 9.70
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 9.70
Qpipe (cfs)	= 9.70
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 3.70
Veloc Up (ft/s)	= 5.40
HGL Dn (ft)	= 2268.77
HGL Up (ft)	= 2268.76
Hw Elev (ft)	= 2269.27
Hw/D (ft)	= 0.81
Flow Regime	= Inlet Control



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Nov 3 2021

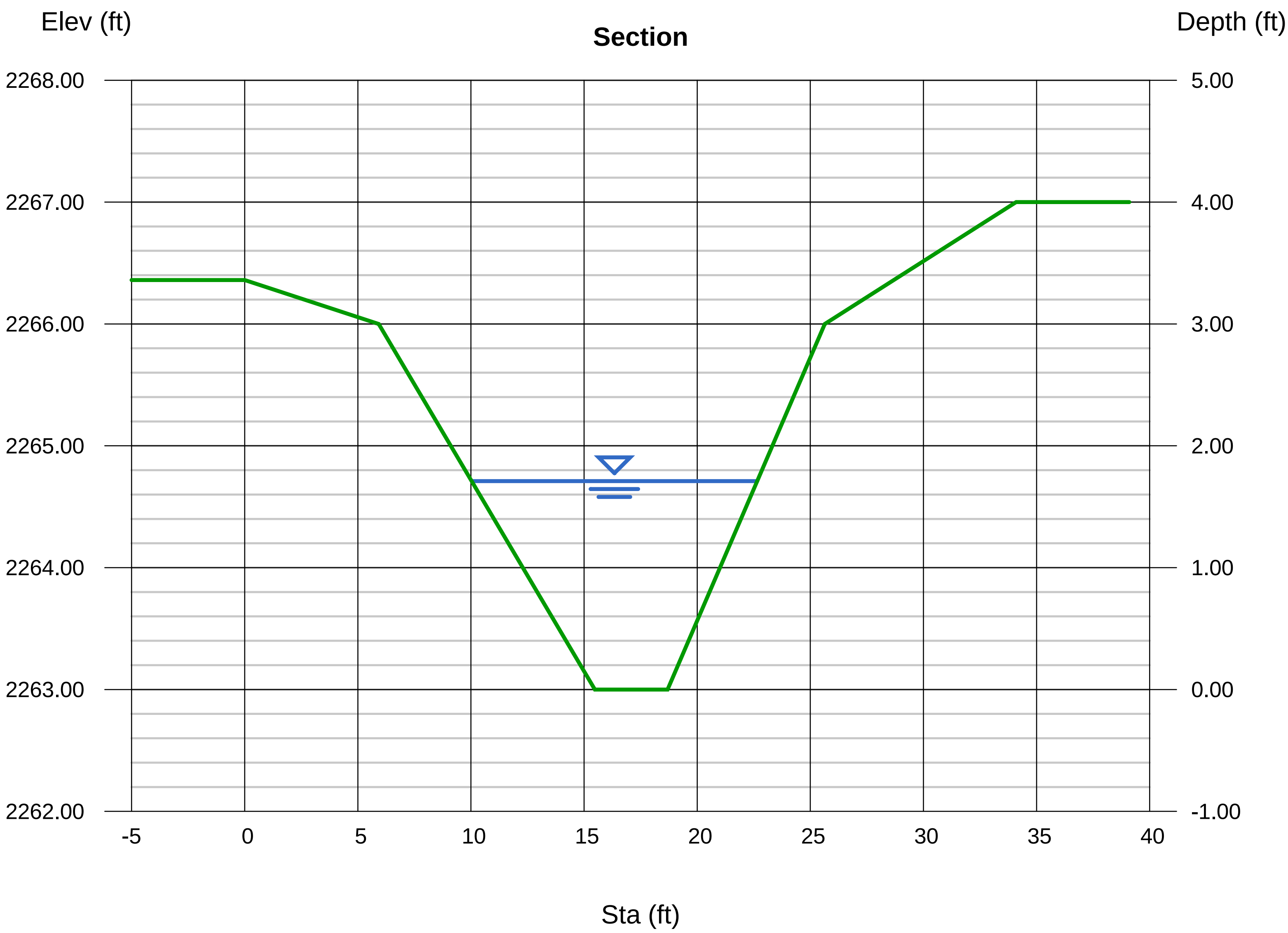
404 Wash

User-defined
Invert Elev (ft) = 2263.00
Slope (%) = 2.40
N-Value = 0.032

Calculations
Compute by: Known Q
Known Q (cfs) = 98.00

Highlighted
Depth (ft) = 1.71
Q (cfs) = 98.00
Area (sqft) = 13.53
Velocity (ft/s) = 7.24
Wetted Perim (ft) = 13.24
Crit Depth, Yc (ft) = 1.90
Top Width (ft) = 12.62
EGL (ft) = 2.53

(Sta, El, n)-(Sta, El, n)...
(0.00, 2266.36)-(5.92, 2266.00, 0.032)-(15.48, 2263.00, 0.032)-(18.69, 2263.00, 0.032)-(25.64, 2266.00, 0.032)-(34.10, 2267.00, 0.032)



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APPENDIX D

STORMCAD OUTPUT

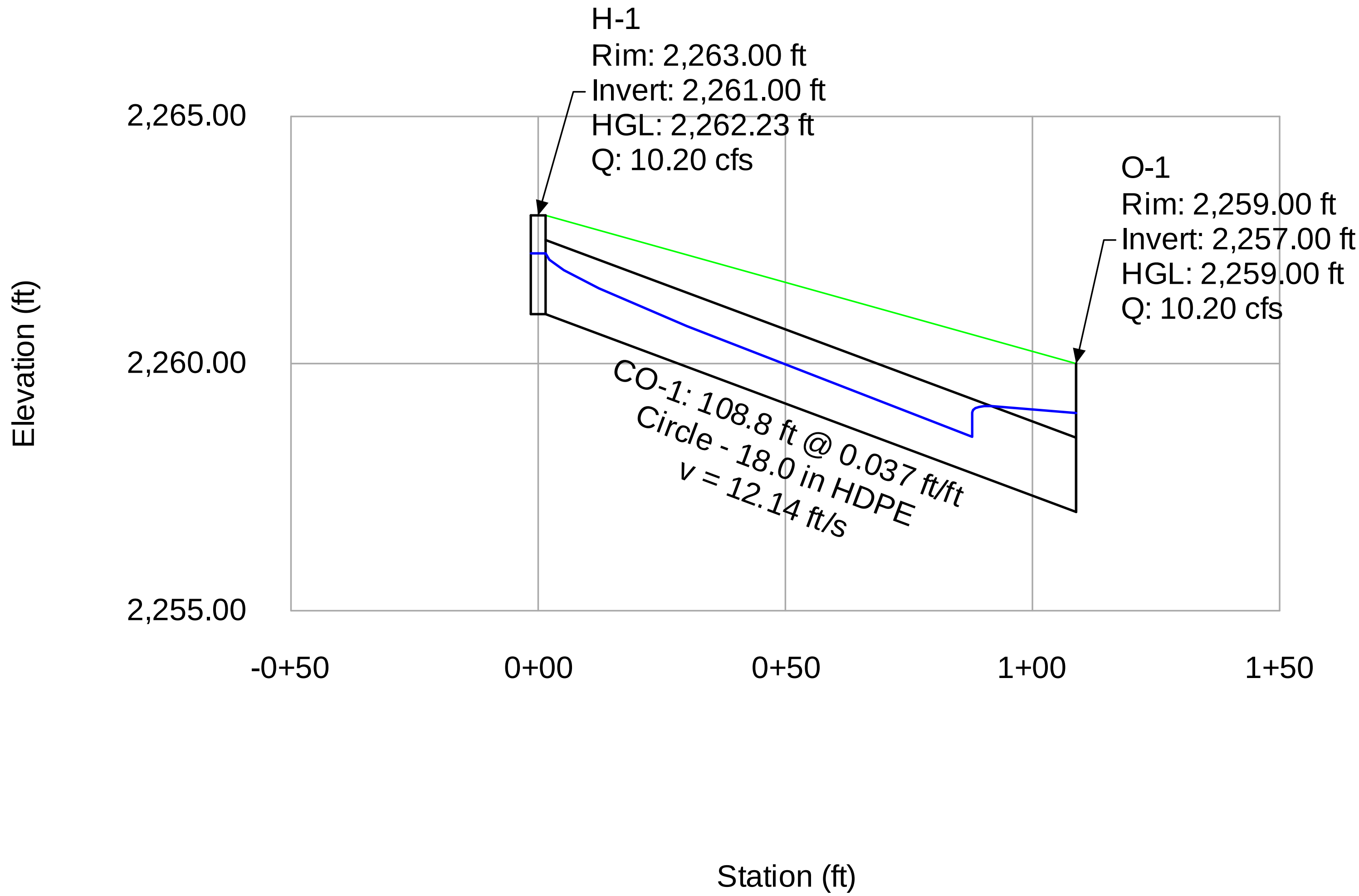
STORMCAD RESULTS

100-YEAR

Profile Report

Engineering Profile - H-1 to O-1 (2299 StormCAD.stsw)

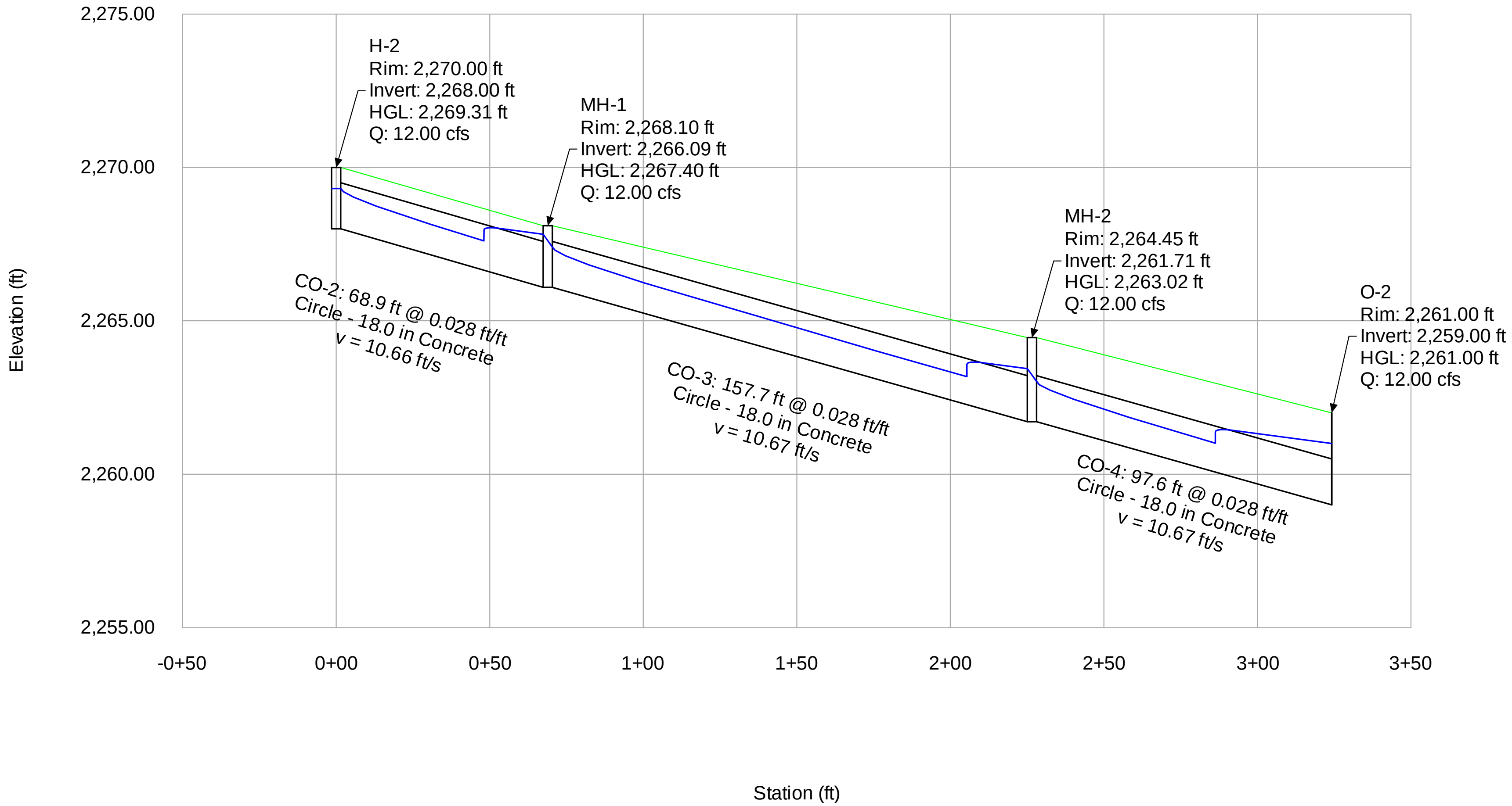
Active Scenario: 100-Yr



Profile Report

Engineering Profile - H-2 to O-2 (2299 StormCAD.stsw)

Active Scenario: 100-Yr



Conduit FlexTable: Combined Pipe/Node Report

Active Scenario: 100-Yr

Label	Diameter (in)	Length (Unified) (ft)	Slope (Calculated) (ft/ft)	Start Node	Stop Node	Invert (Start) (ft)	Invert (Stop) (ft)	Manning's n	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Flow (cfs)	Velocity (ft/s)	Cover (Start) (ft)	Cover (Stop) (ft)
CO-1	18.0	108.8	0.037	H-1	O-1	2,261.00	2,257.00	0.012	2,262.23	2,259.00	10.20	12.14	0.50	1.50
CO-2	18.0	68.9	0.028	H-2	MH-1	2,268.00	2,266.09	0.013	2,269.31	2,267.82	12.00	10.66	0.50	0.51
CO-3	18.0	157.7	0.028	MH-1	MH-2	2,266.09	2,261.71	0.013	2,267.40	2,263.44	12.00	10.67	0.51	1.24
CO-4	18.0	97.6	0.028	MH-2	O-2	2,261.71	2,259.00	0.013	2,263.02	2,261.00	12.00	10.67	1.24	1.50

FlexTable: Outfall Table

Active Scenario: 100-Yr

Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Boundary Condition Type	Elevation (User Defined Tailwater) (ft)	Hydraulic Grade (ft)	Flow (Total Out) (cfs)
O-1	2,260.00	2,257.00	User Defined Tailwater	2,259.00	2,259.00	10.20
O-2	2,262.00	2,259.00	User Defined Tailwater	2,261.00	2,261.00	12.00

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APPENDIX E

RETENTION AND DEWATERING CALCULATIONS

RETENTION CALCULATIONS TABLE

Project: 2299 Ashler Hills
Prepared By: JF
Date: Mar, 2022

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100-YEAR, 2-HOUR CALCULATIONS

Retention Volume Required (100-Year, 2-Hour) = C * (P/12) * A

P = 2.65 in - Precipitation depth associated with the 100-year, 2-hour storm event

A = Plan-view area of an individual drainage area

C = Weighted average runoff coefficient

Drainage Area	Retention Basin ID	Area [ft²]	Weighted Runoff Coefficient (100-YR)	Runoff Volume Required for 100-Year, 2-Hour [ft³]	Overflow From Upstream [ft³]	Total Retention Required [ft³]	Surface Retention Provided [ft³]	Underground Vault Diameter [ft]	Underground Vault Length [ft]	Undergroun Retention Provided [ft³]	TOTAL Retention Volume Provided [ft³]	Overflow Volume [ft³]	Overflows to Basin
ON-4	RB-1/UG-1	69,285	0.69	10,612	4,153	14,764	2,056	8	255	12,818	14,874	0	--
ON-1	RB-2	17,780	0.45	1,767	0	4,842	689	0	0	0	689	4,153	RB-1/UG-1
ON-3		18,611	0.75	3,075									
ON-2	RB-3	38,564	0.49	4,148	0	4,148	4,601	0	0	0	4,601	0	--
ON-5	RB-4	20,523	0.45	2,039	0	2,039	803	0	0	0	803	1,236	RB-5
ON-6	RB-5	78,948	0.62	10,882	1,236	12,119	12,901	0	0	0	12,901	0	--

Volume Required: 32,524 CF

Total Volume Provided: 33,868 CF

NOTES:

(1) NOAA Atlas 14, Volume 1, Version 5, Point Precipitation Frequency Estimates (100-year, 2-hour).

CALCULATIONS FOR 36-HOUR DEWATERING OF RETENTION BASINS

Project: 2299 Ashler Hills
Prepared by: JF
Date: Mar, 2022

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DEWATERING TYPE	EQUATION	VARIABLES	Units
Drywells	Time to Drain $T = V_P / 3600R_T$	V_P = Volume Provided R_T = TOTAL Drain Rate	Hours

Retention Basin ID	Retention Volume	Drywell Disposal Rate [1]	Number of Drywells[2]	Drywell Drain Rate	TOTAL Drain Rate	Time to Drain [3] $T=V_P/3600\ R_T$
	[ft^3]	[cfs]	[ea.]	[cfs]	[cfs]	[hr]
UG-1	12,818	0.1	1	0.1	0.1	35.6
RB-3	4,148		1	0.1	0.1	11.5
RB-5	12,119		1	0.1	0.1	33.7
		TOTAL:	3			

NOTE:
1. Percolation rate of 0.1 is based on Flood Control District of Maricopa County (FCDMC) Drainage Design Manual for Maricopa County, Arizona, Hydrology, December, 2018
2. The required number of drywells can be reduced based on as-built test data of the basin bottom surface area and as-built drywell percolation test results.
3. Design of all stormwater storage facilities is such that the stored runoff is completely discharged from the facility within 36 hours after the runoff event has ended.
4. All drywells must be registered with the Arizona Department of Environmental Quality (ADEQ).