

FINAL DRAINAGE REPORT

Prepared for:
Alkemista Café & Bar
2144 W. State Route 89A
Sedona, Arizona 86336



January 25, 2023

Prepared by:





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TABLE OF CONTENT

General Location and Description 1
 Project Location..... 1
 Project Developer 1
 Description of Property 1
 Previous Studies 1
 Drainage Basins and Sub-Basins 2
 Major Basin..... 2
 Minor Basin 2
 Drainage Design Criteria 2
 Hydrologic Analysis and Results 2
 Hydraulic Analysis..... 4
 Drainage Facility Design 4
 General Concept..... 4
 Specific Details 5
 Recommendation and Conclusion 6

APPENDIX

Appendix A – Hydrologic Model Data and Results
 Appendix B – Grading and Drainage Plan





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I. GENERAL LOCATION AND DESCRIPTION

A. Project Location

The proposed development of Alkemista Café & Bar is a commercial development that will be located within the incorporated City of Sedona, Yavapai County, Arizona. More specifically described as Assessor Parcel Number (APN) 408-24-070A and 408-24-070C in a portion of the Southeast ¼ of the Southeast ¼ of Section 11, Township 17 North, Range 5 East of the Gila and Salt River Base and Meridian. The property is located northeast of the intersection of State Route 89A and Goodrow Lane. The proposed access point to the development will be located off Goodrow Lane.

- B. Property Owner/Developer Sergio Goma Properties
2144 State Route 89A
Sedona, Arizona 86336

C. Description of Property

The proposed development of Alkemista Café & Bar will consist of four (4) new buildings to replace the existing three (3) building within the property. The development encompasses approximately 0.89 acres and is currently developed. The property is currently zoned as Commercial (CO). Surrounding zones are Single-Family Residential (RS-10) to the North, Lodging (L) to the west, and Commercial (CO) to the east. The proposed usage will be Commercial.

The general soil condition is classified as “Upland Sandyloam” which is Natural Resource Conservation Services (NRCS) Hydrologic Soil Group ‘B’ soil with an estimated 40% vegetative cover consisting of desert brush and grasses. NRCS Type ‘B’ soil is typically characterized as highly fine, sandy loam which has a high rate of infiltration therefore a low runoff potential. The existing topography of the property is moderately sloped with an average of 2 to 5 percent grade in a northeast to southwest direction within the upper portion of the property, and a southeast to northwest direction within the lower portion of the property. There are no irrigation facilities within the property.

The property is not situated within any designated FEMA Special Flood Hazard Areas as indicated in the current FEMA Flood Insurance Rate Map (FIRM) No. 04025C1435G, effective September 3, 2010. The property does fall within the City of Sedona designated 100-year floodplain as identified as Andante Creek – Yucca Tributary within the 2022 City of Sedona Stormwater Master Plan.

D. Previous Studies

The property is included in the following drainage studies, but it should be noted that the hydrologic methodology used in this drainage report is specifically for this property and does not override previous studies. The following studies were used as reference for this drainage study:

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Email: info@sefengco.com ~ www.SeftonEngineeringCompany.com

In affiliation with:

Heritage Land Surveying & Mapping, Inc. with office in Sedona, Camp Verde & Colorado



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- i. City of Sedona Stormwater Master Plan Update prepared by JE Fuller, dated June 2022.

II. DRAINAGE BASINS AND SUB-BASINS

A. Major Basin

The proposed development falls within a portion of the West 1 Drainage Basin as delineated within the City of Sedona Stormwater Master Plan Update Study. Runoff flows through the basin is through developed and undeveloped areas consisting of shallow overland flows to well-defined drainage paths.

The drainage basin was divided into an off-site sub-basin and an on-site sub-basin. The on-site sub-basin encompasses the Alkemista Café & Bar development which is approximately 0.87 acres. Currently, runoff through the on-site area is within a well-defined channel running in an east to west direction to the existing 48-in. diameter beneath Goodrow Lane. The off-site sub-basin encapsulates the off-site runoff flows that will enter the property along the eastern and northern property boundary.

B. Minor Basin

For a hydrologic analysis of this development the on-site sub-basin was evaluated for the pre-development and post-development conditions.

III. DRAINAGE DESIGN CRITERIA

A. Hydrologic Analysis and Results

i. Methodology

The methodology used for this hydrologic analysis was based on the Rational Method as described within the Arizona Department of Transportation Drainage Design Manual. The hydrologic modeling software HydraFlow Hydrographs was used to calculate the runoff for the pre-development and post-development conditions. The hydrologic methods used within the previous drainage studies are not the same methods used for this drainage study. The hydrologic calculations used within this report will be used for addressing the post-development design conditions in comparison to the pre-development hydrologic conditions. This report does not override any previously accepted studies by the local jurisdiction.

Rainfall intensities were derived from the rainfall depth-duration frequency statistics from NOAA 14 Precipitation-Frequency Atlas and Table 3-2: Mean Precipitation Frequency Estimates within the City of Sedona Design Review, Engineering and Administrative Manual.

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The Time of Concentration was estimated using equation 2.2 within the ADOT Drainage Design Manual

The Runoff Coefficient was derived using Figure 2-1 for the developed areas. The on-site sub-basin which is partially developed was determined to have a runoff coefficient of 0.58 for the pre-development condition and 0.90 for the post-development condition.

ii. Hydrologic Results

The on-site sub-basin, containing the Alkemista development, was evaluated to determine the difference between the pre-development and post-development hydrologic conditions.

Table 3.1 Summary Discharges

DISCHARGES (cfs)						
Sub-Basin	2-yr Peak	5-yr Peak	10-yr Peak	25-yr Peak	50-yr Peak	100-yr Peak
Pre	1.28	1.72	2.09	2.62	3.06	3.54
Post	1.99	2.68	3.24	4.06	4.75	5.49

As a result of the development and the increase in impervious area, there was an increase in the peak discharges between the pre-development and post-development conditions.

The following table shows the discharges with the proposed mitigation as described later in this report.

Table 3.2 Summary Discharges with mitigations

DISCHARGES (cfs)						
Sub-Basin	2-yr Peak	5-yr Peak	10-yr Peak	25-yr Peak	50-yr Peak	100-yr Peak
Pre	1.28	1.72	2.09	2.62	3.06	3.54
Post w/ Mitigation	1.21	1.50	1.75	2.14	2.50	2.84

Using the City of Sedona Stormwater Master Plan Update, the 100-year peak discharge from the off-site sub-basin entering the on-site basin is 252 cfs. A portion of the off-site flows will be contained within the existing stormwater system in the adjacent commercial development to the east and enter the property thru a 4'x4' box culvert. The existing hydraulic conditions of the stormwater system to the east is unknown.

B. Hydraulic Analysis

- i. A hydraulic analysis of the proposed 48-inch diameter culvert was not performed since the amount of off-site flows contained within the existing stormwater system in the adjacent commercial development to the east cannot be confirmed. The installation of the new 48-inch culvert within the proposed development would require connecting the existing 4'x4' box culvert on the east property boundary to the existing 48-inch culvert on the west property boundary. It should be noted that the existing 48-inch culvert along the west property boundary beneath Goodrow Lane is undersized and is not able to contain the 100-year storm event.
- ii. The proposed building locations within the development were compared to the 100-year floodplain as shown within the City of Sedona Stormwater Master Plan Update to determine the depths of flow across the development. The 100-year Base Flood Elevations (BFE) across the development were determined to effect three proposed buildings within the development. The affected buildings were Building 2, Building 3, and Building 4. Building 1 is not within the flood hazard area. The 100-year Base Flood Elevation upstream of Building 2 is 4405.20 feet. The 100-year Base Flood Elevation of Building 3 is 4407.20 feet. The 100-year Base Flood Elevation of Building 4 is 4401.80 feet.

IV. DRAINAGE FACILITY DESIGN

A. General Concept

- i. The proposed development of Alkemista Café & Bar resulted in an increase in the pre-development peak discharge leaving the site. The increase in the peak discharge can be attributed to the increase in impermeable area because of the development. To reduce the peak runoff leaving the site an underground detention basin was implemented on-site. Runoff from the on-site basin will be directed to the underground detention basin for storage and attenuation.
- ii. A portion of the proposed development lies within a 100-year floodplain and therefore any structures that fall within the boundaries of the flood hazard area will be elevated at least 1-foot above the determined Base Flood Elevation.
- iii. To convey the off-site runoff from the existing 4'x4' box culvert a 48-inch diameter culvert will be installed to extend from the box culvert to the existing 48-inch culvert along the western property boundary beneath Goodrow Lane.
- iv. For post construction stormwater management to minimize water quality impacts from the development the proposed underground detention basin will

be used for storage and filtration of all on-site runoff flows from paved areas. The crushed stone and underlaying storage area will be sized to treat the initial First Flush volume from the development. First Flush is defined as the first half inch of runoff from the developed area. The crushed stone will provide removal of sediments, and other non-point source pollutants from the development along with removal of petrochemicals and hydrocarbons within the parking lot area. This system is compliant with the Arizona Pollutant Discharge Elimination System (AZPDES) permit and the City of Sedona regulations.

- v. During the construction phase of the development storm water quality will be managed as specified within the Storm Water Pollution Prevention Plan (SWPPP) included within the approved construction plans.

B. Specific Details

- i. For post construction storm water quality management and post-development attenuation, runoff flows from the on-site sub-basin will be contained and filtered within proposed underground detention basin. The basin will have a total storage capacity of 1,644 cubic feet for runoff storage within the 5-foot deep underground crushed stone storage area excluding the area for the 48-inch diameter culvert. The crush stone storage area will be lined with a filter fabric to separate the crushed stone and the natural soil to maintain a separation between the two types of media. A 6-inch and 4-inch perforated PVC pipe will be embedded within the crushed stone to provided filtered drainage out of the basin. The required First Flush volume to be contained is 1,582 cubic feet. The basin has a crushed stone storage area of 1,644 cubic feet for containment and filtration. Running thru the 5-foot deep by 9.6-foot wide crushed stone storage area will be a 48-inch diameter culvert which is only to convey the off-site runoff from the existing 4'x4' box culvert thru the development. The 12-inch laterals used to direct flows from catch basins within the basin will feed directly into the crush stone storage area and not tie into the 48-inch diameter culvert.
- ii. To convey the off-site runoff entering the development from the existing 4'x4' box culvert, a 48-inch diameter HDPE culvert will be installed connecting the box culvert with the existing 48-inch diameter culvert beneath Goodrow Lane. The culvert has a length of 161 linear feet and a maximum slope of 13.3 percent.
- iii. Building 2 located along the eastern property boundary has a determined Base Flood Elevation of 4405.20 feet. Since the lowest floor of the proposed building will be storage space and not livable space, the lowest finished floor elevation of the building will be at 4404.50 feet and the exterior walls will be constructed of flood proof material up to the Regulatory Flood Elevation of 4406.20 feet.

- iv. Building 3 located along the eastern property boundary has a determined Base Flood Elevation of 4407.20 feet. The lowest finished floor elevation of the building will be at a minimum elevation of 4408.20 feet since it is located within a flood hazard area.
- v. Building 4 located on the western property boundary adjacent to Goodrow Lane has a determined Base Flood Elevation of 4401.80 feet. The lowest finished floor elevation of the building will be at a minimum elevation of 4402.80 feet since it is located within a flood hazard area.

V. RECOMMENDATION AND CONCLUSION

It is the engineer's recommendation that the site be developed as proposed. The plan will satisfy the conditions for design while maintaining a cost-effective, low maintenance drainage facility. The facility will mitigate any anticipated increase in runoff up to the 100-year storm event because of the proposed development. The facility follows the standards and regulations of the City of Sedona.

- The post-development 100-year peak discharge with mitigation from the development is **2.84 cubic feet per second** which is lower than the pre-development 100-year peak discharge of **3.54 cubic feet per second**. The peak discharge occurs along the western property boundary at the inlet of the existing 48-inch culvert beneath Goodrow Lane.
- The increase in runoff flows because of the development was attenuated through thru an underground detention basin. Post-development Runoff flows from the development were directed to the basin for attenuation and treatment.
- Post construction stormwater quality management was achieved using underground crush stone storage areas sized to contain the First Flush volume.
- A 48-inch diameter culvert will be installed to capture and convey off-site flows from the existing 4'x4' box culvert thru the development. The culvert will extend from the east property boundary to the existing 48-inch culvert beneath Goodrow Lane along the west property boundary.
- The proposed storm drains and detention basin will be services and maintained by the developer. The devices and basin should be inspected on a quarterly basis or after significant rainfall events.
- No additional county, state, or federal permits regarding drainage is anticipated or required at this time.

Appendix A

Hydrologic Model Data and Results

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Watershed Model Schematic.....	1
Hydrograph Return Period Recap.....	2
10 - Year	
Summary Report.....	3
Hydrograph Reports.....	4
Hydrograph No. 1, Rational, Pre-Development.....	4
Hydrograph No. 2, Rational, Post-Development.....	5
Hydrograph No. 3, Reservoir, Underground Storage.....	6
Pond Report - DB-1.....	7
100 - Year	
Summary Report.....	8
Hydrograph Reports.....	9
Hydrograph No. 1, Rational, Pre-Development.....	9
Hydrograph No. 2, Rational, Post-Development.....	10
Hydrograph No. 3, Reservoir, Underground Storage.....	11
IDF Report.....	12

Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020



Legend

<u>Hyd.</u>	<u>Origin</u>	<u>Description</u>
1	Rational	Pre-Development
2	Rational	Post-Development
3	Reservoir	Underground Storage

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)								Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	Rational	-----	-----	1.283	-----	1.724	2.090	2.619	3.061	3.537	Pre-Development
2	Rational	-----	-----	1.991	-----	2.676	3.243	4.064	4.749	5.489	Post-Development
3	Reservoir	2	-----	1.206	-----	1.504	1.751	2.136	2.497	2.843	Underground Storage

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description	
1	Rational	2.090	1	10	1,254	-----	-----	-----	Pre-Development	
2	Rational	3.243	1	10	1,946	-----	-----	-----	Post-Development	
3	Reservoir	1.751	1	15	1,945	2	4395.02	841	Underground Storage	
Alkemista.gpw					Return Period: 10 Year			Tuesday, 12 / 21 / 2021		

Hydrograph Report

Hyd. No. 1

Pre-Development

Hydrograph type	= Rational	Peak discharge	= 2.090 cfs
Storm frequency	= 10 yrs	Time to peak	= 10 min
Time interval	= 1 min	Hyd. volume	= 1,254 cuft
Drainage area	= 0.870 ac	Runoff coeff.	= 0.58
Intensity	= 4.142 in/hr	Tc by User	= 10.00 min
IDF Curve	= Sedona.IDF	Asc/Rec limb fact	= 1/1



Hydrograph Report

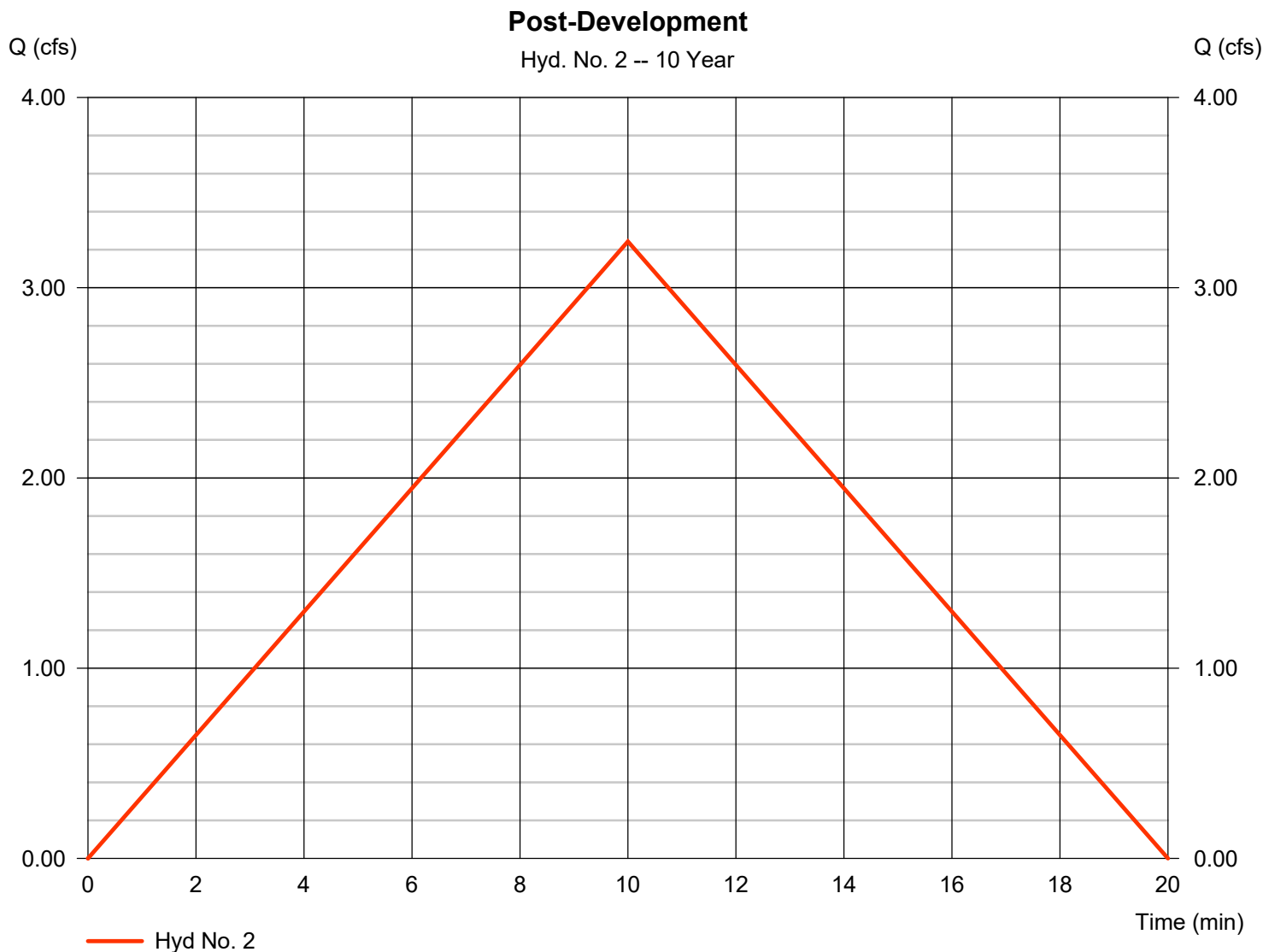
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

Tuesday, 12 / 21 / 2021

Hyd. No. 2

Post-Development

Hydrograph type	= Rational	Peak discharge	= 3.243 cfs
Storm frequency	= 10 yrs	Time to peak	= 10 min
Time interval	= 1 min	Hyd. volume	= 1,946 cuft
Drainage area	= 0.870 ac	Runoff coeff.	= 0.9
Intensity	= 4.142 in/hr	Tc by User	= 10.00 min
IDF Curve	= Sedona.IDF	Asc/Rec limb fact	= 1/1



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

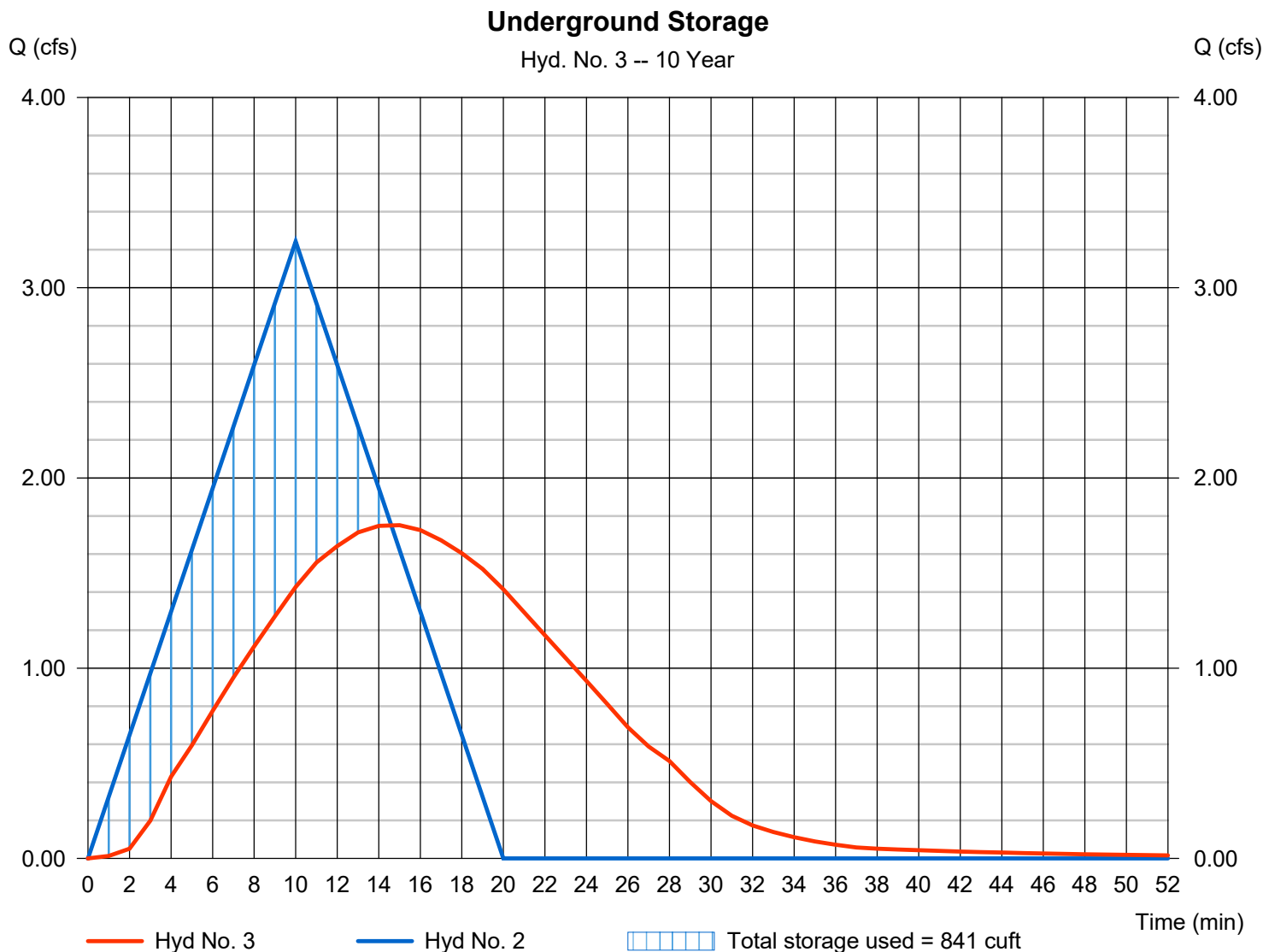
Tuesday, 12 / 21 / 2021

Hyd. No. 3

Underground Storage

Hydrograph type	= Reservoir	Peak discharge	= 1.751 cfs
Storm frequency	= 10 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 1,945 cuft
Inflow hyd. No.	= 2 - Post-Development	Max. Elevation	= 4395.02 ft
Reservoir name	= DB-1	Max. Storage	= 841 cuft

Storage Indication method used.



Pond No. 1 - DB-1

Pond Data

Contours -User-defined contour areas. Average end area method used for volume calculation. Beginning Elevation = 4392.78 ft. Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	4392.78	965	0	0
1.00	4393.78	965	386	386
2.00	4394.78	965	386	772
3.00	4395.78	485	290	1,062
4.00	4396.78	485	194	1,256
5.00	4397.78	485	194	1,450
6.00	4398.78	485	194	1,644

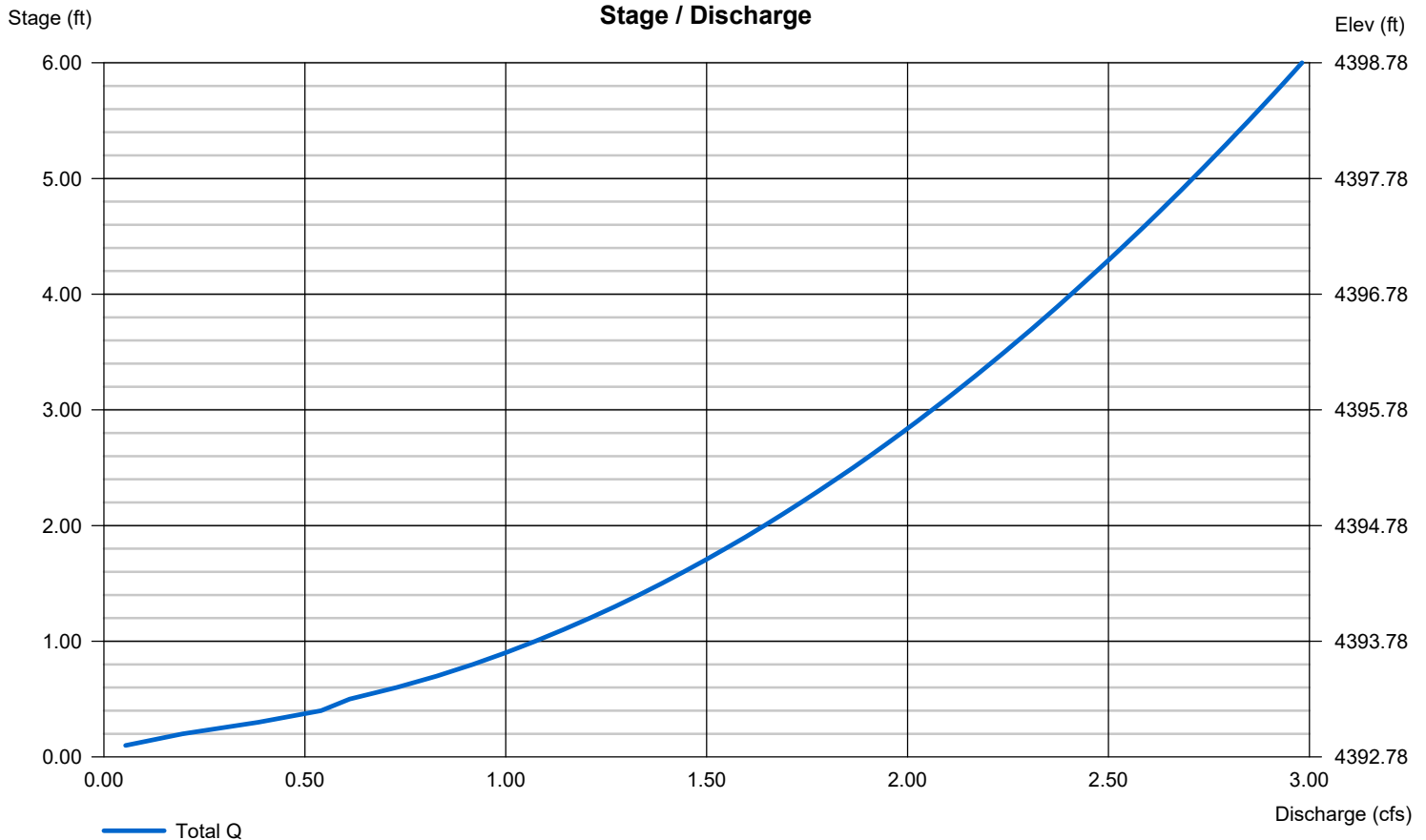
Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 4.00	6.00	0.00	0.00
Span (in)	= 4.00	6.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 4392.78	4392.78	0.00	0.00
Length (ft)	= 20.00	20.00	0.00	0.00
Slope (%)	= 1.00	1.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.00	0.00	0.00	0.00
Crest El. (ft)	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= ---	---	---	---
Multi-Stage	= No	No	No	No
Exfil.(in/hr)	= 0.000 (by Wet area)			
TW Elev. (ft)	= 0.00			

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description	
1	Rational	3.537	1	10	2,122	-----	-----	-----	Pre-Development	
2	Rational	5.489	1	10	3,293	-----	-----	-----	Post-Development	
3	Reservoir	2.843	1	15	3,293	2	4398.26	1,543	Underground Storage	
Alkemista.gpw					Return Period: 100 Year			Tuesday, 12 / 21 / 2021		

Hydrograph Report

Hyd. No. 1

Pre-Development

Hydrograph type	= Rational	Peak discharge	= 3.537 cfs
Storm frequency	= 100 yrs	Time to peak	= 10 min
Time interval	= 1 min	Hyd. volume	= 2,122 cuft
Drainage area	= 0.870 ac	Runoff coeff.	= 0.58
Intensity	= 7.010 in/hr	Tc by User	= 10.00 min
IDF Curve	= Sedona.IDF	Asc/Rec limb fact	= 1/1



Hydrograph Report

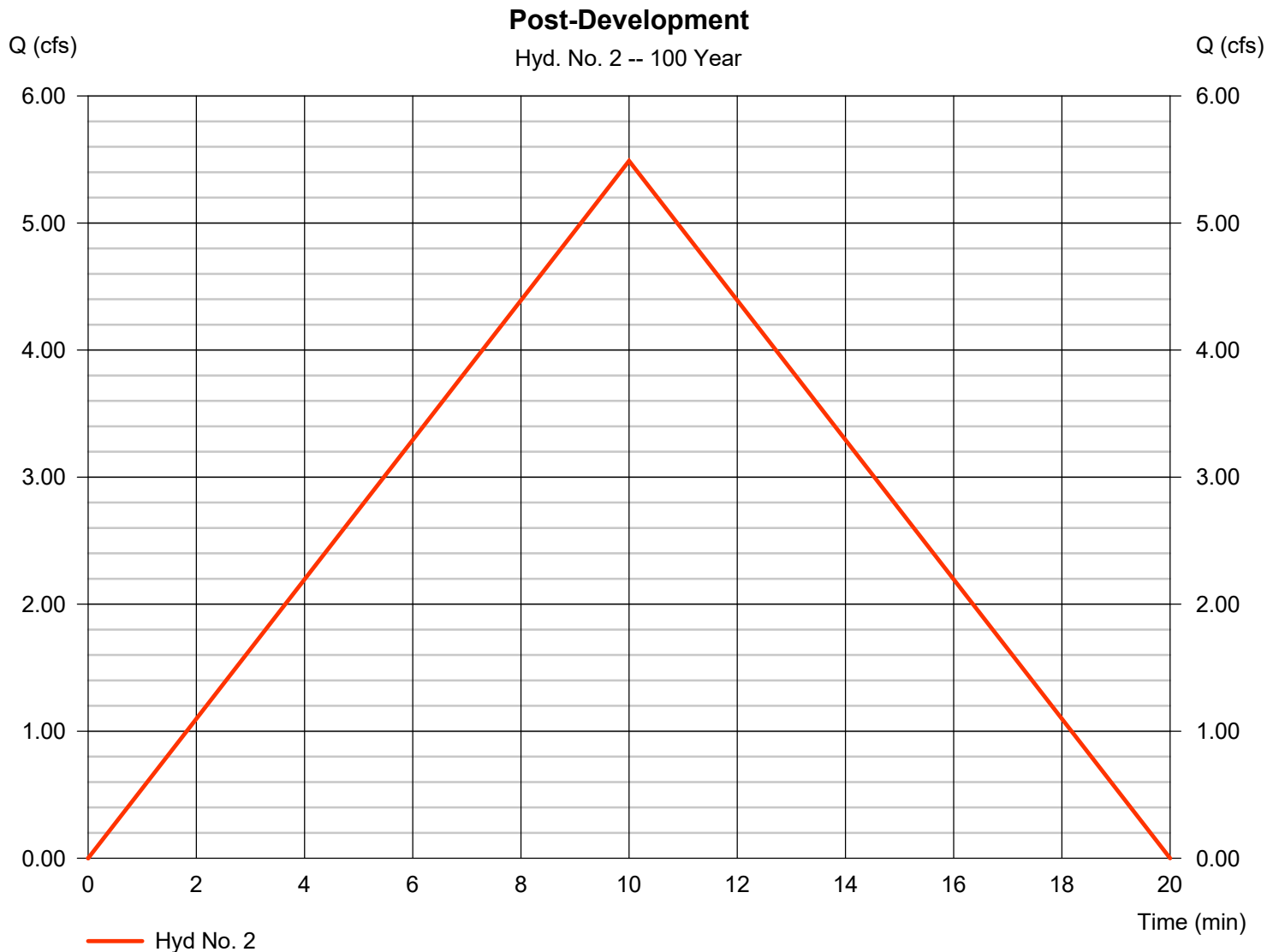
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

Tuesday, 12 / 21 / 2021

Hyd. No. 2

Post-Development

Hydrograph type	= Rational	Peak discharge	= 5.489 cfs
Storm frequency	= 100 yrs	Time to peak	= 10 min
Time interval	= 1 min	Hyd. volume	= 3,293 cuft
Drainage area	= 0.870 ac	Runoff coeff.	= 0.9
Intensity	= 7.010 in/hr	Tc by User	= 10.00 min
IDF Curve	= Sedona.IDF	Asc/Rec limb fact	= 1/1



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

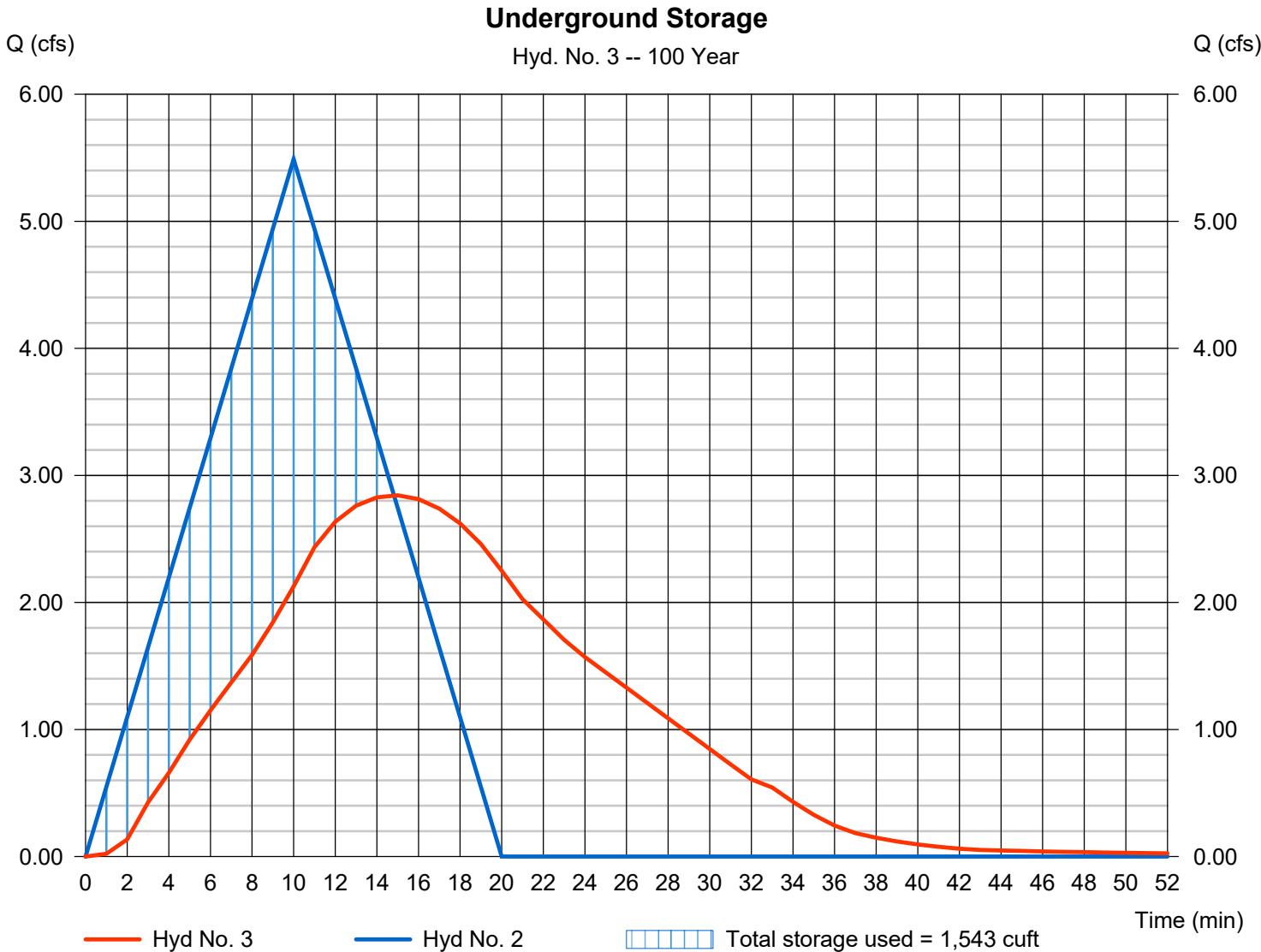
Tuesday, 12 / 21 / 2021

Hyd. No. 3

Underground Storage

Hydrograph type	= Reservoir	Peak discharge	= 2.843 cfs
Storm frequency	= 100 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 3,293 cuft
Inflow hyd. No.	= 2 - Post-Development	Max. Elevation	= 4398.26 ft
Reservoir name	= DB-1	Max. Storage	= 1,543 cuft

Storage Indication method used.



Hydraflow Rainfall Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

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Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	-----
2	30.5834	9.1000	0.8432	-----
3	0.0000	0.0000	0.0000	-----
5	39.8064	8.9000	0.8353	-----
10	47.9118	8.9000	0.8330	-----
25	61.3299	9.0000	0.8387	-----
50	70.5549	8.9000	0.8349	-----
100	83.5403	9.1000	0.8401	-----

File name: Sedona.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	3.28	2.54	2.09	1.78	1.56	1.39	1.26	1.15	1.06	0.98	0.92	0.86
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	4.42	3.42	2.81	2.40	2.10	1.87	1.69	1.54	1.42	1.32	1.24	1.16
10	5.35	4.14	3.41	2.91	2.55	2.27	2.05	1.88	1.73	1.61	1.50	1.41
25	6.71	5.19	4.27	3.64	3.19	2.84	2.57	2.35	2.16	2.01	1.87	1.76
50	7.84	6.07	4.99	4.25	3.72	3.32	3.00	2.74	2.53	2.35	2.19	2.06
100	9.05	7.01	5.77	4.92	4.31	3.84	3.47	3.17	2.92	2.71	2.54	2.38

Tc = time in minutes. Values may exceed 60.

Precip. file name: Sample.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	0.00	2.20	0.00	3.30	4.25	5.77	6.80	7.95
SCS 6-Hr	0.00	1.80	0.00	0.00	2.60	0.00	0.00	4.00
Huff-1st	0.00	1.55	0.00	2.75	4.00	5.38	6.50	8.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	1.75	0.00	2.80	3.90	5.25	6.00	7.10

Appendix B

Grading and Drainage Plan

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In affiliation with:

Heritage Land Surveying & Mapping, Inc. with office in Sedona, Camp Verde & Colorado