DRAINAGE REPORT

Navajo Lofts

Sedona, Arizona

Prepared for:

MKC HOLDINGS, LLC
15010 N 78TH Way, Suite 109
Scottsdale, AZ 85260

Prepared by:

LANDCOR
CONSULTING

6859 E. Rembrandt Ave, #124
Mesa, AZ 85212
480-223-8573

Registered Professional Engineer (Civil)
CERTIFICATE NO.
53735
JOEL D.
MILLER
Date Signed 7/14/2021
ARIZONA, U.S.A.

April 2021
Revised July 2021
Job # 1763

DRAINAGE REPORT

FOR

NAVAJO LOFTS

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1.0   INTRODUCTION

This project consists of thirty new duplex buildings, each having two units, as well as associated site improvements including an office, pool, and ramada. The site is located just north of State Route 89A and east of Dry Creek Road in Sedona, AZ, in Section 11, Township 17 North, Range 5 East of the Gila and Salt River Base and Meridian. The site is bounded by Aria Street to the north, Symphony Way to the east, vacant land to the south, and Navajo Drive to the west. The terrain is typical high desert, and slopes generally from northeast to southwest.

This report presents the results of an analysis used to support the Preliminary Grading & Drainage Plan for the subject property prepared by Landcor Consulting. The drainage design presented with this report complies with the City of Sedona *Design Review, Engineering, and Administrative Manual* and the *Drainage Design Manual for Yavapai County* and is compatible with existing drainage conditions in the area.

2.0   FLOODPLAIN DESIGNATION

The site is located within FEMA Flood Zone "X" as shown on the FEMA Flood Insurance Rate Map 04025C1435G dated September 3, 2010 (see Figure 1).

Flood Zone "X" is defined as:

> "Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood."

The site is located within a City of Sedona 100-yr Local Floodplain (see Figure 2). The zone is classified as "AO" with a depth of 0.5 feet, which is defined as:

> "Flood depths of 0.5 feet to 3 feet (usually sheet flow on sloped terrain); average depth determined.

3.0   OFFSITE DRAINAGE

Offsite flows approach the site on both the northern and eastern property lines flowing toward the south and southwest. There are existing culverts that cross Aria Street on both the northeast and northwest corners of the site. These culverts convey flow under Aria Street into swales that run north-south on the east and west property lines. The western swale continues south until reaching State Route 89A, the eastern swale terminates approximately 170-ft south of Aria Street at which point the stormwater sheet flows across the property to the southwest. There is also a culvert which crosses Symphony Way just north of Cantabile Street and outlets flow onto the site. From there, the flow sheets across the property toward the southwest.

A Floodplain Analysis of the local floodplain (Harmony Floodplain) was completed by Heritage Land Survey and Engineering in May of 2014. This study shows that roughly 103-cfs enters the property along the eastern boundary as sheet flow which passes through the site, leaving near the southwest property corner (see Appendix D). Per City of Sedona requirements, the peak flow rates for the 2-year, 10-year, 25-year, and 100-year storms are provided in Appendix E

Lastly, there is some amount of flow which enters the site on the north side of the property, sheet flowing across Aria Street. This flow enters as a result of the existing swale on the north side of Aria Street overtopping during larger storm events.

4.0   ON-SITE DRAINAGE

The existing culverts entering the site will be maintained in their current location without any modification. The existing swale along the west side of the property will also be maintained.

On the east side of the property, a new channel will be constructed to intercept the offsite flows entering along the eastern boundary. This channel will be sized for 103-cfs which is the 100-yr peak flow rate calculated in the Harmony Floodplain Study (see Appendix D). This channel will convey flow along the eastern and southern property boundary before releasing it in its historic location near the southwest property corner. This offsite flow will not be co-mingled with the onsite flows, thereby maintaining historic peak discharge rates.

Flows crossing Aria Street will be intercepted in a swale along the south side of Aria Street and conveyed west into the existing swale along Navajo Street.

There will be no adverse impacts to adjacent properties as a result of these improvements. All flows will enter and exit the site in their historic locations.

5.0   STORMWATER DETENTION

Stormwater Retention will be provided for the pre- vs. post-development storm events. Retention will be stored in above ground basins located on the south side of the site. Stormwater will be collected and conveyed to the basins with catch basins and underground storm drain pipe. Storm Drain Hydraulic calculations will be performed during final design. The pre- and post-development flow rates for various storm events were calculated to ensure that post-development flows did not exceed pre-development. These computations were accomplished using *Autodesk Hydraflow Hydrographs* (2021). Below is a summary of pre- and post-development flow rates, calculations can be found in Appendix E.

Recurrence Interval	Pre-Development Q (cfs)	Post-Development Q (cfs)
2-year	2.9	2.9
10-year	6.5	4.2
25-year	8.9	4.9
100-year	13.1	7.0

Also included in Appendix C are drain time calculations which show that the basin will drain within 12-hours.

6.0 FINISHED FLOOR

The finished floor elevations for the proposed condominium buildings will be set a minimum of 12 inches above the 100-year base flood elevation of the adjacent washes. Therefore, the finished floor elevation is established in accordance with City of Sedona requirements and is free from inundation by the 100-year peak runoff event.

7.0 CONCLUSIONS

- The project is located within FEMA flood Zone "X" and City of Sedona Local Floodplain Zone "AO" with a depth of 0.5 feet.

- All off-site flows will enter and exit the site as per historical conditions with no adverse effects to adjacent properties.

- Finished floor elevations for new construction are established in accordance with the minimum requirements of the City of Sedona and are free from inundation during a 100-year event.

- Stormwater Retention is being provided for the pre- vs. post-development flows.

- This report has been prepared in accordance with the current versions of the City of Sedona *Design Review, Engineering, and Administrative Manual* and the *Drainage Design Manual for Yavapai County* and is compatible with existing drainage conditions in the area

APPENDIX A

FIGURES

National Flood Hazard Layer FIRMette

FIGURE 1

111°48'55"W 34°52'3"N

CITY OF SEDONA
040130

04025C1430G
eff. 9/3/2010

AREA OF MINIMAL FLOOD HAZARD
Zone X

04025C1435G
eff. 9/3/2010

111°48'17"W 34°51'34"N

Feet   1:6,000
0   250   500   1,000   1,500   2,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

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

SPECIAL FLOOD HAZARD AREAS

Without Base Flood Elevation (BFE) *Zone A, V, A99*

With BFE or Depth *Zone AE, AO, AH, VE, AR*

Regulatory Floodway

0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*

Future Conditions 1% Annual Chance Flood Hazard *Zone X*

Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*

Area with Flood Risk due to Levee *Zone D*

OTHER AREAS OF FLOOD HAZARD

NO SCREEN Area of Minimal Flood Hazard *Zone X*

Effective LOMRs

Area of Undetermined Flood Hazard *Zone D*

OTHER AREAS

GENERAL STRUCTURES

Channel, Culvert, or Storm Sewer

Levee, Dike, or Floodwall

OTHER FEATURES

20.2 Cross Sections with 1% Annual Chance
17.5 Water Surface Elevation

Coastal Transect

Base Flood Elevation Line (BFE)

Limit of Study

Jurisdiction Boundary

Coastal Transect Baseline

Profile Baseline

Hydrographic Feature

MAP PANELS

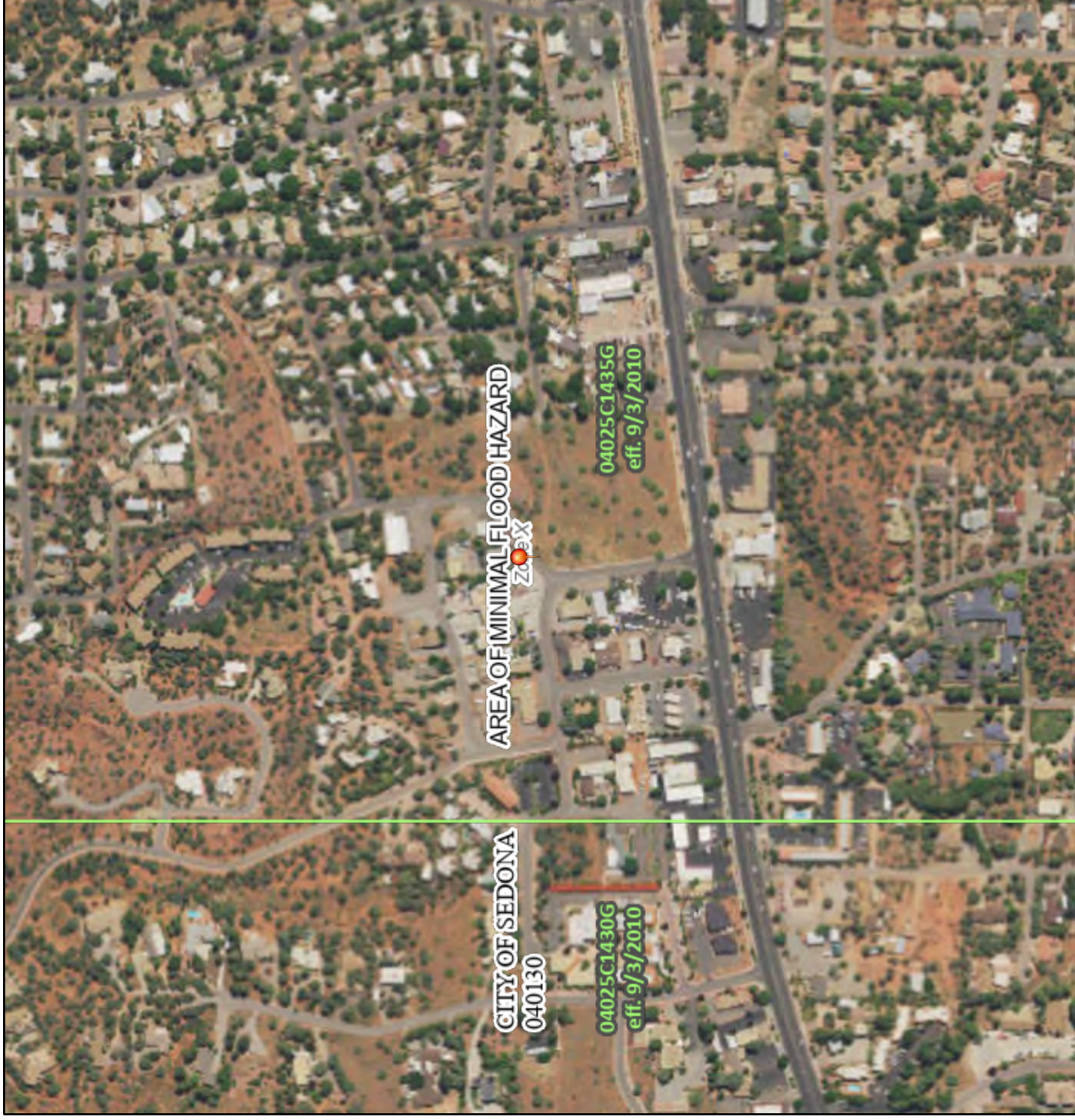Digital Data Available

No Digital Data Available

Unmapped

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.
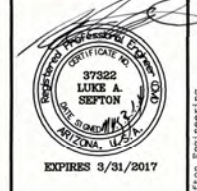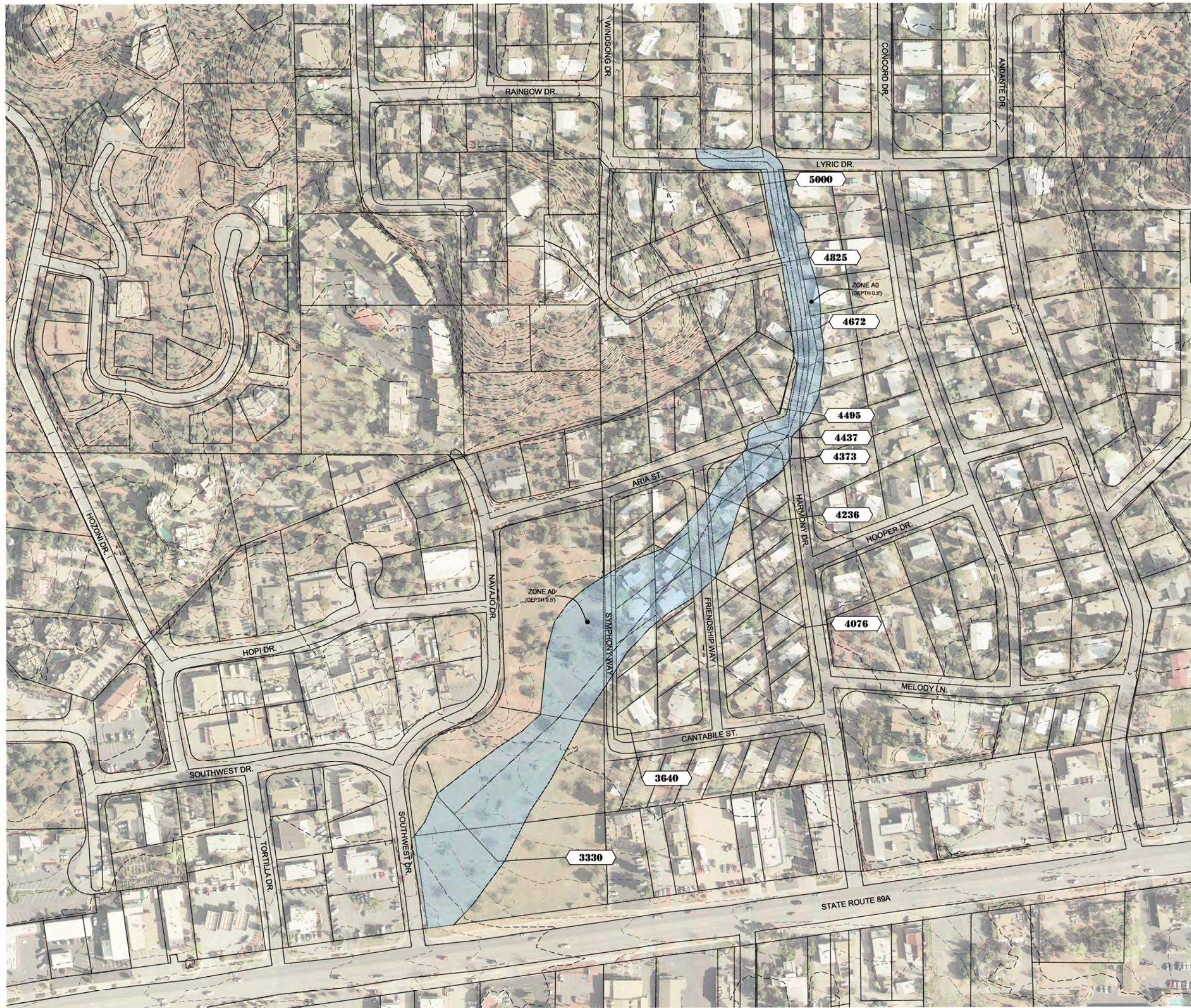
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 4/29/2021 at 2:12 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

CITY OF SEDONA

100-YEAR FLOODPLAIN

CITY OF SEDONA HARMONY

LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, and AO. The Base Flood Elevation is the water-surface elevation of the 1 % annual chance flood.

ZONE A — No Base Flood Elevation determined

ZONE AE — Base Flood Elevations determined

ZONE AH — Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined

ZONE AO — Flood depths of 0.5 to 3 feet (usually sheet flow on sloped terrain); average depths determined

—————— FLOODPLAIN BOUNDARY

⟨ XXXX ⟩ CROSS SECTION ID

SHEET TITLE:

PROJECT TITLE:

DRAWN BY: T.C.H.

SCALE: 1'=100'

DATE: 5/1/14

PROJECT NO: 14-0304

SHEET NO.

C-1

FIGURE 2

SCALE IN FEET
0 50' 100' 200'

PRELIMINARY GRADING & DRAINAGE PLAN
FOR
NAVAJO LOFTS

OWNER
MKC HOLDINGS LLC
15010 N 78TH WAY SUITE 109
SCOTTSDALE AZ 85260
PHONE: (602) 390-9401
CONTACT: KEITH HOLBEN
EMAIL: kh@mkcompany.com

ENGINEER
LANDCOR CONSULTING
6859 E. REMBRANDT AVE. #124
MESA, AZ 85212
PHONE: (480) 734-9157
CONTACT: JOEL D. MILLER, P.E.
EMAIL: joel@landcorconsulting.com

PROJECT DATA
ADDRESS: 10 NAVAJO DR
CITY OF SEDONA
TAX ASSESSORS PARCEL NUMBER: 408-24-536B
ZONING: CO
PARCEL AREA: 196,020 SQFT. (4.5 ACRES)

LEGAL DESCRIPTION
PER 2019-0036008 YAVAPAI COUNTY RECORDER.

SHEET INDEX
COVER SHEET	C1.1
PRELIMINARY GRADING & DRAINAGE PLAN	C1.2 - 1.3

RETENTION CALCULATIONS

RETENTION VOLUME REQUIRED:

	A (S.F.)	
Area (gross)	196,020	4.50 AC

A = Drainage Area in square feet
Cpre = 0.50   Undeveloped Desert Rangeland
Cpost = 0.94   Multiple Family Residential
ΔC = Cpost - Cpre   Runoff Coefficient
P = Precipitation Depth (100-yr, 2-hr)   2.64 inches
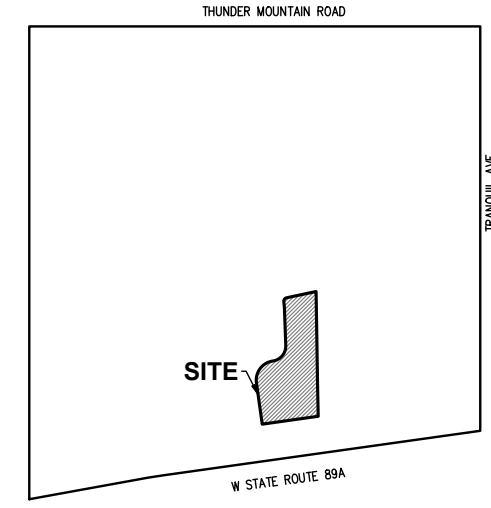Vr = Retention Volume Required, cubic feet

Vr = C x P/12 x A

	Area (S.F.)	ΔC	Pre vs. Post Volume (C.F.)	First Flush Volume (C.F.)
DA1	196,020	0.44	18,975	8,168
Total Required	196,020		18,975	8,168

RETENTION VOLUME PROVIDED:

Basin No.	Top Area (S.F.)	Bot. Area (S.F.)	Depth (FT)	Volume Provided (C.F.)
1	6,760	3,617	3.0	15,566
2	1,908	757	3.0	3,998
			TOTAL =	19,563

VICINITY MAP
SEC 11, T17N, R5E
NTS

THUNDER MOUNTAIN ROAD
TRANQUIL AVE
SITE
W STATE ROUTE 89A

NAVAJO LOFTS
PRELIMINARY GRADING & DRAINAGE PLAN
10 NAVAJO DRIVE
SEDONA, ARIZONA
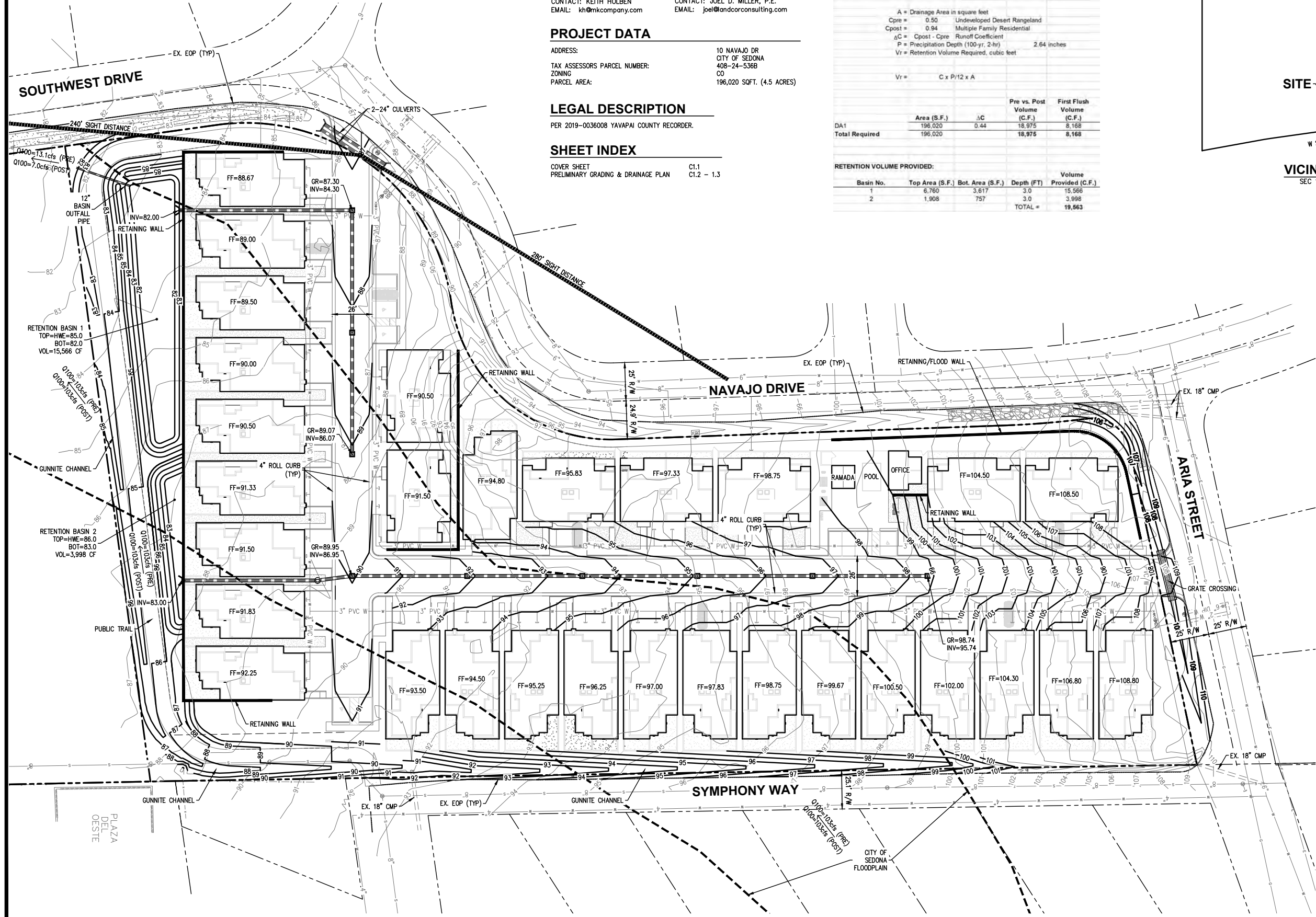
FIGURE 3

PRELIMINARY
NOT FOR
CONSTRUCTION

53735
JOEL D. MILLER
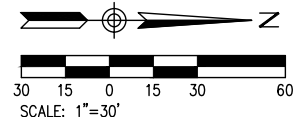
DATE:
REVISIONS:

PRELIMINARY GRADING & DRAINAGE PLAN

DATE: 7/14/21
PROJ. #: 1763

C1.1
1 OF 3

SCALE: 1"=30'
30 15 0 15 30 60

Plan view labels (drawing):

SOUTHWEST DRIVE
NAVAJO DRIVE
ARIA STREET
SYMPHONY WAY
PLAZA DEL OESTE

EX. EOP (TYP)
240' SIGHT DISTANCE
280' SIGHT DISTANCE
2-24" CULVERTS
Q100=13.1cfs (PRE)
Q100=7.0cfs (POST)
12" BASIN OUTFALL PIPE
INV=82.00
RETAINING WALL
GR=87.30 INV=84.30
FF=88.67
FF=89.00
FF=89.50
FF=90.00
FF=90.50
FF=90.50
FF=91.33
FF=91.50
FF=91.50
FF=91.83
FF=92.25
GR=89.07 INV=86.07
GR=89.95 INV=86.95
INV=83.00
RETENTION BASIN 1 TOP=HWE=85.0 BOT=82.0 VOL=15,566 CF
RETENTION BASIN 2 TOP=HWE=86.0 BOT=83.0 VOL=3,998 CF
4" ROLL CURB (TYP)
GUNNITE CHANNEL
PUBLIC TRAIL
RETAINING WALL
FF=91.50
FF=94.80
FF=95.83
FF=97.33
FF=98.75
FF=104.50
FF=108.50
RAMADA POOL OFFICE
RETAINING/FLOOD WALL
EX. EOP (TYP)
EX. 18" CMP
25' R/W 24.9' R/W
RETAINING WALL
GR=98.74 INV=95.74
FF=93.50
FF=94.50
FF=95.25
FF=96.25
FF=97.00
FF=97.83
FF=98.75
FF=99.67
FF=100.50
FF=102.00
FF=104.30
FF=106.80
FF=108.80
GRATE CROSSING
25' R/W 25' R/W
EX. 18" CMP
CITY OF SEDONA FLOODPLAIN
Q100=10.5cfs (PRE)
Q100=10.5cfs (POST)
GUNNITE CHANNEL
EX. EOP (TYP)
EX. 18" CMP

APPENDIX B

HYDRAULIC CALCULATIONS

Channel Report

TRAPEZOIDAL CHANNEL ON EAST PROPERTY LINE

Trapezoidal

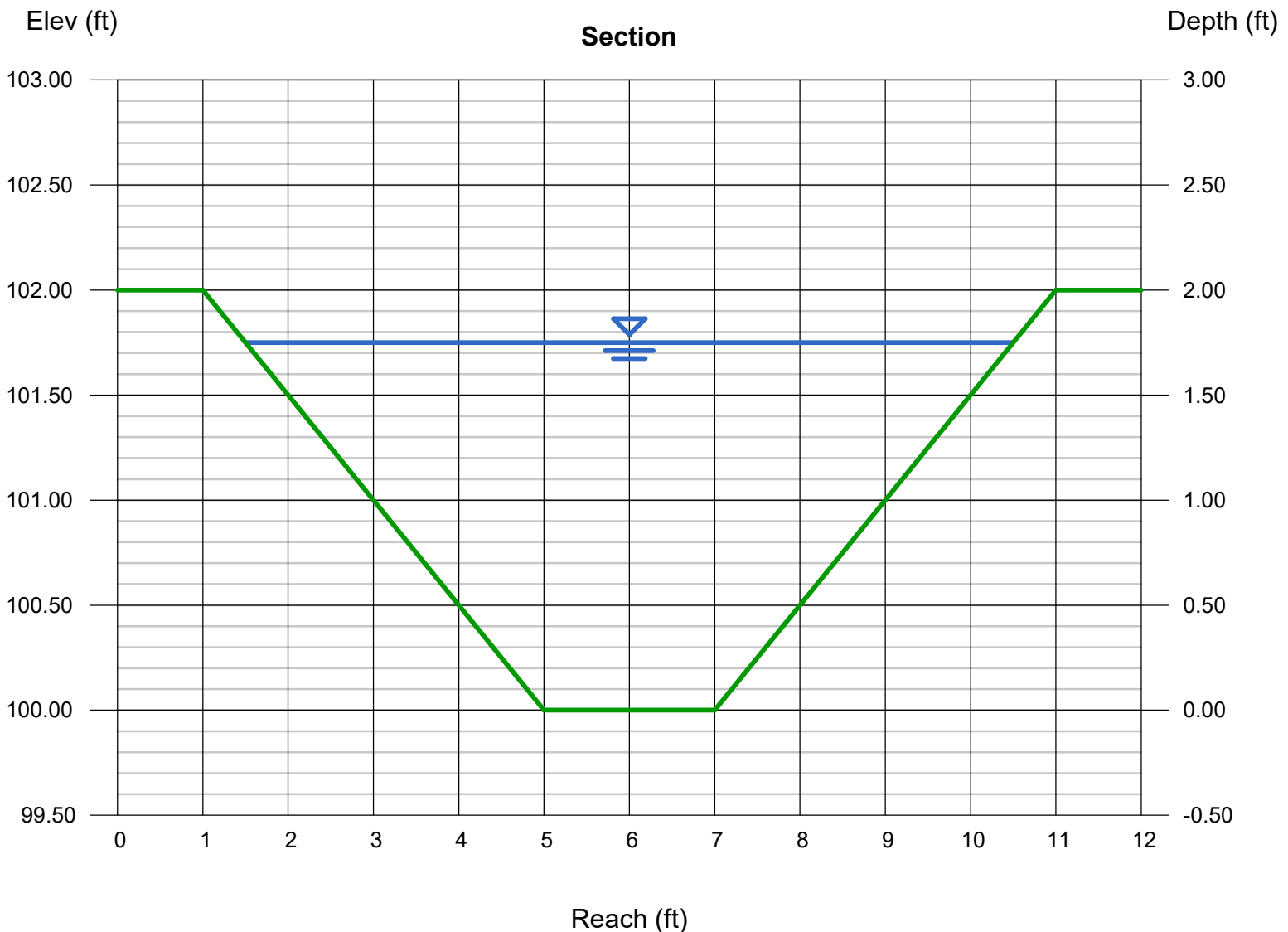|		
Bottom Width (ft)	=	2.00
Side Slopes (z:1)	=	2.00, 2.00
Total Depth (ft)	=	2.00
Invert Elev (ft)	=	100.00
Slope (%)	=	1.77
N-Value	=	0.018

Calculations

Compute by:	Known Q	
Known Q (cfs)	=	103.00

Highlighted

Depth (ft)	=	1.75
Q (cfs)	=	103.00
Area (sqft)	=	9.62
Velocity (ft/s)	=	10.70
Wetted Perim (ft)	=	9.83
Crit Depth, Yc (ft)	=	2.00
Top Width (ft)	=	9.00
EGL (ft)	=	3.53

APPENDIX C

STORMWATER RETENTION CALCULATIONS

RETENTION CALCULATIONS

Sedona Lofts

RETENTION VOLUME REQUIRED:

	A (S.F.)	
Area (gross)	196,020	4.50 AC

A = Drainage Area in square feet
C_{pre} = 0.50 Undeveloped Desert Rangeland
C_{post} = 0.94 Multiple Family Residential
ΔC = $C_{post} - C_{pre}$ Runoff Coefficient
P = Precipitation Depth (100-yr, 2-hr) 2.64 inches
Vr = Retention Volume Required, cubic feet

$$Vr = C \times P/12 \times A$$

	Area (S.F.)	**ΔC**	**Pre vs. Post Volume (C.F.)**	**First Flush Volume (C.F.)**
DA1	196,020	0.44	18,975	8,168
Total Required	196,020		**18,975**	**8,168**

RETENTION VOLUME PROVIDED:

Basin No.	**Top Area (S.F.)**	**Bot. Area (S.F.)**	**Depth (FT)**	**Volume Provided (C.F.)**
1	6,760	3,617	3.0	15,566
2	1,908	757	3.0	3,998
			TOTAL =	**19,563**

Project: **Navajo Lofts**
Job No.: **1763**
Date: **7/13/2021**

ORIFICE CALCULATIONS (for proposed bleed-off pipe)

Orifice Flow Equation:

$$Q = 0.5A(2gH)^{.5}$$

where,

Q = Flow in cfs
A = Area if Orifice in ft^2
H = Head in feet
g = 32.2 (feet per sec^2)

Therefore,

ORIFICE CALCULATOR

H =	1.00	ft (average)
Orifice Size =	12.0	inches
A =	0.785	ft^2
g =	32.2	ft/s^2
Q =	3.15	cfs

DRAIN TIME CALCULATIONS

Retention Basin:

Q =	3.15	cfs (from orifice calculation)
Vp =	19,563	ft^3

Time to Drain =   Vp/Q/3600 =   1.7 hrs

APPENDIX D

HARMONY FLOODPLAIN ANALYSIS

May 6, 2014

David Peck
City of Sedona Public Works
104 Roadrunner Drive
Sedona, Arizona 86336

Subject: COS Harmony Floodplain Analysis
                    Final Report

Mr. Peck,

The purpose of this letter is to provide a report of the floodplain analysis performed on Profile 4400B as identified within the City of Sedona Floodplain Management Study dated May 1994. Within the original 1994 Floodplain Management Study, Profile 4440 had a break-out flow occur at Lyric Drive which resulted in two different flow profiles from Lyric Drive to State Route 89A, Profile 4400 and Profile 4400B. The City of Sedona has completed a drainage improvement project, extending from State Route 89A to Thunder Mountain Road, which was designed to contain storm flows up to the 25-year frequency event. This report assumes the new drainage system does contain storm flows up to the 25-year event. Based on the changes in hydrologic conditions, a floodplain analysis was performed from Lyric Drive to State Route 89A to show changes to the 100-year floodplain of Profile 4400B. As a result of the drainage improvements completed by the City of Sedona, the hydrology and hydraulics of the area have been modified; therefore, the 100-year floodplain of Profile 4400B, as identified within the 1994 City of Sedona Floodplain Management Study, is not effective.

Hydrology

A hydrologic review was conducted to determine the break-out discharge near Lyric Drive since the completion of the drainage improvements, during the 100-year storm event.   We have reviewed the Harmony-Windsong Drainage Improvements Design Report for Phase III prepared by Dibble Engineering and the Final Drainage Report for Harmony-Windsong Phase IV prepared by Shephard Wesnitzer. Based on the results presented within these two drainage studies we have determined that a break-out flow of **40 cfs** will occur near Lyric Drive.

According to the drainage studies for Harmony-Windsong Phase III and Phase IV, the system was designed to capture and convey peak discharges for storm events up to the 25-year event. The Harmony-Windsong Phase I through Phase IV projects extend from Thunder Mountain Road to the south side of State Route 89A. At Concentration Point A33AC located at Thunder Mountain Road, the 25-year peak discharge and the 100-year peak discharge are 537.9 cfs and 590.5 cfs respectively. Since the system has a 25-year

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* Daniel L. Mc Donald, S.P.C. (928-301-7206) * Jesse Sharp S.P.C. (928-301-6238)
* Luke Sefton, P.E. (928-646-3494) * Timothy Huskett, E.I.T (928-707-2078)

- 1 -

capacity, there will be an overflow of 52.6 cfs during the 100-year storm event at this location. A hydraulic analysis of the improved channel, extending from CP-A33AC to Manhole 4A & 4B as shown in the construction plans for Phase IV, shows the overflow will be contained within the channel, at an approximate depth of 1 foot. At Manhole 4A & 4B, approximately 20 cfs of the 52.6 cfs overflow will drain back into the dual pipes, and allow 32.6 cfs to bypass the grated manholes, and continue down the improved channel to Manhole 3A & 3B. At Manhole 3A & 3B, the 32.6 cfs will combine with runoff flow from Sub-Basin A29B-1. Sub-Basin A29B-1 has a 25-year and 100-year peak discharge of 33.1 cfs and 42.1 cfs respectively. Flows through each of the manholes were determined with a 50% clogging factor. Since the improved drainage system was designed to accept discharges up to the 25-year event, the amount of runoff from A29B-1 bypassing Manhole 3A & 3B is 9 cfs. Of the 32.6 cfs coming from upstream, another 20 cfs will drain back into the dual pipes, and allow 12.6 cfs to bypass the grated manhole. The combination of the 9 cfs and the 12.6 cfs will then overtop Moonglow Drive, and add to the overflow from Sub-Basin A29B-2. Sub-Basin A29B-2 has a 25-year and 100-year peak discharge of 43.3 cfs and 55.1 cfs respectively. The improved drainage system will accept the 25-year event; therefore approximately 11.8 cfs will combine with the 21.6 cfs overtopping Moonglow Drive upstream, and drain to Manhole 2A & 2B. The combined flow of 33.4 cfs will be contained within the improved channel between Moonglow Drive and Manhole 2A & 2B. At Manhole 2A & 2B, the 33.4 cfs will bypass the grated manholes and continue within the improved channel to Manhole 1A & 1B, since the system at this point will be under pressure during the 100-year storm event. At Manhole 1A & 1B, the 33.4 cfs will again bypass the opening during the 100-year storm event. The improved drainage system accepting runoff from Sub-Basin A29B-3, and conveying the flow to the dual pipes, has the capacity to contain the peak discharges from the basin up to the 100-year storm event; therefore there will be no overflow from Sub-Basin A29B-3. The overflow of 33.4 cfs, from Manhole 1A & 1B, will combine with the overflow from Sub-Basin A29B-4. Sub-Basin A29B-4 has a 25-year and 100-year peak discharge of 23.5 cfs and 29.8 cfs respectively. Since the improved drainage system was designed to accept discharges up to the 25-year storm event, the amount of runoff bypassing the 24-in pipe beneath Lyric Drive is 6.3 cfs. A combined flow of **40 cfs** will then overtop Lyric Drive.

Of the **40 cfs** crossing Lyric Drive, **10 cfs** will continue directly across the street to a small drainage channel along the westside of the improved drainage system. Therefore approximately **30 cfs** will flow east down Lyric Drive towards the intersection of Harmony Drive and Lyric Drive.

Local drainage through Basin A37B as identified within the City of Sedona Stormwater Master Plan was determined, and added to the break-out flow near Lyric Drive. The Basin A37B was sub-divided into 6 sub-basins. The Rational Method was used to calculate the 25-year and 100-year peak discharges. Calculations were based on a Time of Concentration of 10 minutes, since this is the minimum time that could be used for the Rational Method. The 25-year rainfall intensity and 100-year rainfall intensity were 6.06 inches per hour and 8.22 inches per hour, respectively. The rainfall intensities was based on the precipitation data within Table 8.3 of the City of Sedona Land Development Code Article 8.

* Dugan L. Mc Donald, R.L.S., P.L.S., (928-301-5964) * Clinton Gillespie R.L.S. (928-301-3072) * Shane Nauert, R.L.S. (928-451-2493)
* Daniel L. Mc Donald, S.P.C. (928-301-7206) * Jesse Sharp S.P.C. (928-301-6238)
* Luke Sefton, P.E. (928-646-3494) * Timothy Huskett, E.I.T (928-707-2078)

Table 8.3

Upper Limit Precipitation Frequency Estimates

Freq (yr)	5-min	10-min	15-min	30-min	60-min	120-min	3-hr	6-hr	12-hr	24-hr	2-day	4-day	7-day	10-day	20-day
1	0.26	0.39	0.48	0.65	0.80	0.93	0.99	1.16	1.49	1.88	2.23	2.57	3.00	3.43	4.43
2	0.33	0.50	0.62	0.83	1.03	1.18	1.26	1.44	1.84	2.36	2.79	3.21	3.75	4.27	5.50
5	0.44	0.67	0.83	1.12	1.39	1.55	1.60	1.79	2.24	2.94	3.47	4.02	4.64	5.26	6.68
10	0.54	0.82	1.01	1.36	1.69	1.87	1.91	2.10	2.57	3.41	4.01	4.68	5.39	6.05	7.56
25	0.67	1.02	1.26	1.70	2.10	2.31	2.34	2.54	3.03	4.05	4.77	5.60	6.43	7.10	8.70
50	0.78	1.19	1.47	1.98	2.46	2.69	2.71	2.89	3.38	4.55	5.36	6.34	7.27	7.94	9.56
100	0.90	1.37	1.70	2.29	2.84	3.12	3.14	3.29	3.76	5.08	5.99	7.14	8.16	8.80	10.40
200	1.03	1.57	1.95	2.63	3.25	3.57	3.59	3.72	4.14	5.63	6.66	7.97	9.06	9.66	11.21
500	1.23	1.88	2.33	3.12	3.88	4.24	4.27	4.37	4.70	6.40	7.56	9.18	10.37	10.84	12.26
1,000	1.40	2.13	2.65	3.56	4.41	4.79	4.85	4.90	5.15	7.02	8.28	10.15	11.39	11.74	13.05

Using the Rational Method, the accumulated flow from the sub-basins of Basin A37B, was determined to equal 179.60 cfs for the 100-year storm event. According to the City of Sedona Dry Creek HEC-1 Model Output, which was calculated using HEC-1 methodology, the Basin A37B had a 100-year peak discharge of 156 cfs. The difference in the peak discharges can be attributed to the different hydrology methods used but an attempt was made to match the output from the City of Sedona Master Plan.

Hydraulics

A steady state hydraulic analysis of the break-out flow through the area was performed using HEC-RAS version 4.1.0 to determine the hydraulic conditions, including the depth of flow, through the project area. Ten cross-sections were delineated along a 1900 feet reach from Lyric Drive to State Route 89A, using the City of Sedona 2-ft topography. The Manning's Roughness Coefficients ranged from 0.065 to 0.100, since the project area was identified as dense residential. Smooth surfaces, such as road surfaces were assigned a roughness coefficient of 0.015. The flow path through the project area has an average slope of 1% along the reach; therefore the steady state boundary condition used for the model was based on a Normal Depth of 0.01 foot per foot.

The 100-year peak discharges, along the flow path, were adjusted based on the 100-year hydrologic calculations for local drainage within Basin A37B. It should be noted that each cross section is not located

* Dugan L. Mc Donald, R.L.S., P.L.S., (928-301-5964) * Clinton Gillespie R.L.S. (928-301-3072) * Shane Nauert, R.L.S. (928-451-2493)
* Daniel L. Mc Donald, S.P.C. (928-301-7206) * Jesse Sharp S.P.C. (928-301-6238)
* Luke Sefton, P.E. (928-646-3494) * Timothy Huskett, E.I.T (928-707-2078)

SERVING: AZ. CO. NM. OK.   (PHONE: 928-567-9170)

at a well-defined concentration point but the associated discharge does account for the hydraulic conditions at or near the cross section location.

Conclusion

The hydraulic results from the HEC-RAS model were used to determine the effective flood hazard area and the depth of flow. A Special Flood Hazard Map identifying the 100-year floodplain area with depth of flow has been provided. The hydraulic conditions within this report represent the current conditions at the time this report was developed.

If you have any questions, please contact me at (928) 202-3999.

Sincerely,

Luke A. Sefton, P.E.
President

Expires 3/31/17

Attachment: Hydrologic Map Network
                 Hydraulic Structure Calcs
                 HEC-RAS Summary Table
                 HEC-RAS Cross Sections
                 100-year Floodplain Map
                 Drainage Map

LAS:tch

14-0304

* Dugan L. Mc Donald, R.L.S., P.L.S., (928-301-5964) * Clinton Gillespie R.L.S. (928-301-3072) * Shane Nauert, R.L.S. (928-451-2493)
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- 4 -

$Q_{100} = 590.5 @ 21:59$

↓

Thunder Mountain Rd. ▲ CP-A33AC

$Q_{PIPE} = 537.9\ cfs$
↓ $Q_{OVER} = 52.6\ cfs$

• MH 4A & 4B

$Q_{PIPE} = 557.9\ cfs$
↓ $Q_{OVER} = 32.6\ cfs$

• MH 3A & 3B

$Q_{PIPE} = 577.9\ cfs$
↓ $Q_{OVER} = 12.6\ cfs$

Moonglow Dr. ▲ A29C-1 — — — — — — — A29B-1
$Q_{100} = 42.1 @ 21.59$

$Q_{PIPE} = 611\ cfs$
↓ $Q_{OVER} = 21.6\ cfs$

A29B-2 — — — — — — — • TEE 4A
$Q_{100} = 55.1 @ 22:00$

$Q_{PIPE} = 654.3\ cfs$
$Q_{OVER} = 33.4\ cfs$
↓

• MH 2A & 2B

$Q_{PIPE} = 654.3\ cfs$
$Q_{OVER} = 33.4\ cfs$
↓

A29B-3 — — — — — — • MH 1A & 1B
$Q_{100} = 50.3 @ 21.59$

$Q_{PIPE} = 654.3\ cfs$
↓ $Q_{OVER} = 33.4\ cfs$

A29B-4
$Q_{100} = 29.8 @ 21.57$

▲ A29C — — — — — — — —
$Q_P = 677.8\ cfs$ | Lyric Drive
$Q_O = 40\ cfs$
↓

HEC-RAS Plan: Revised   River: Profile 4400B   Reach: Harmony   Profile: 100-YR

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Harmony	5000	100-YR	30.00	4431.57	4432.60	4432.60	4432.73	0.026751	2.95	10.17	46.08	1.11
Harmony	4825	100-YR	30.00	4425.61	4427.58	4427.41	4427.63	0.015241	1.79	16.72	50.33	0.55
Harmony	4672	100-YR	30.00	4421.82	4422.88	4422.88	4423.04	0.083887	3.19	9.40	30.40	1.01
Harmony	4495	100-YR	30.00	4414.60	4415.32	4415.32	4415.43	0.018533	2.74	10.93	50.44	1.04
Harmony	4437	100-YR	30.00	4412.80	4413.30	4413.30	4413.38	0.014530	2.32	12.95	77.22	1.00
Harmony	4373	100-YR	55.00	4410.82	4412.08	4411.84	4412.12	0.013953	1.68	32.83	67.40	0.42
Harmony	4236	100-YR	55.00	4406.53	4407.08	4407.08	4407.24	0.216976	3.23	17.05	53.36	1.01
Harmony	4076	100-YR	80.30	4402.65	4403.55		4403.58	0.010173	1.40	57.34	140.61	0.39
Harmony	3640	100-YR	102.85	4391.07	4391.72	4391.72	4391.89	0.086790	3.32	30.94	89.21	0.99
Harmony	3330	100-YR	102.85	4383.67	4384.37	4384.13	4384.40	0.010019	1.23	83.54	211.67	0.35
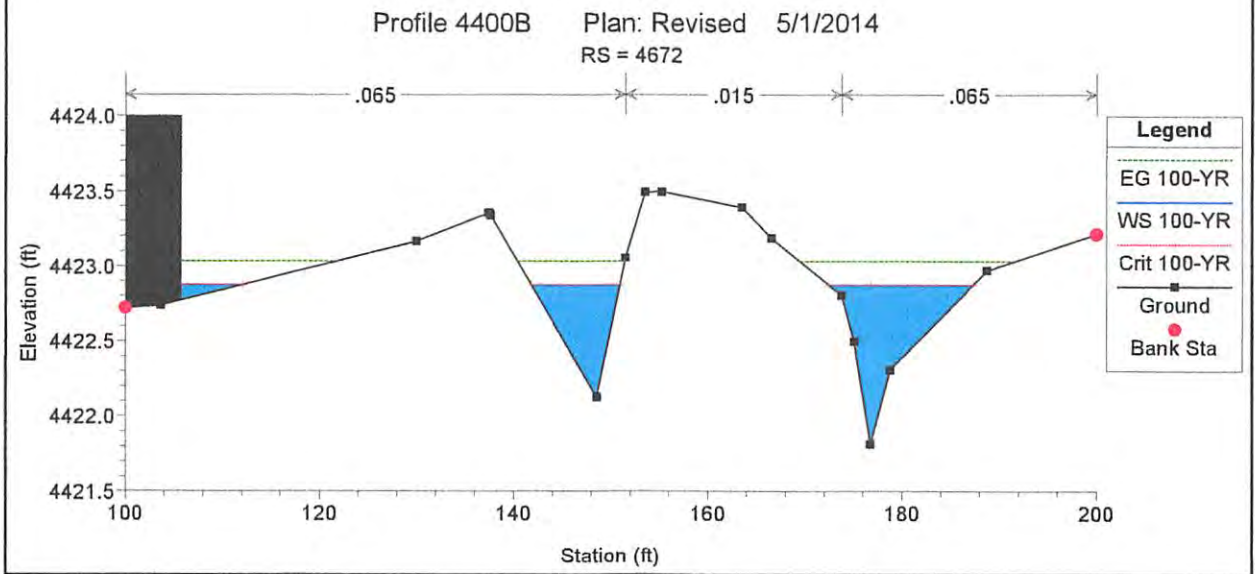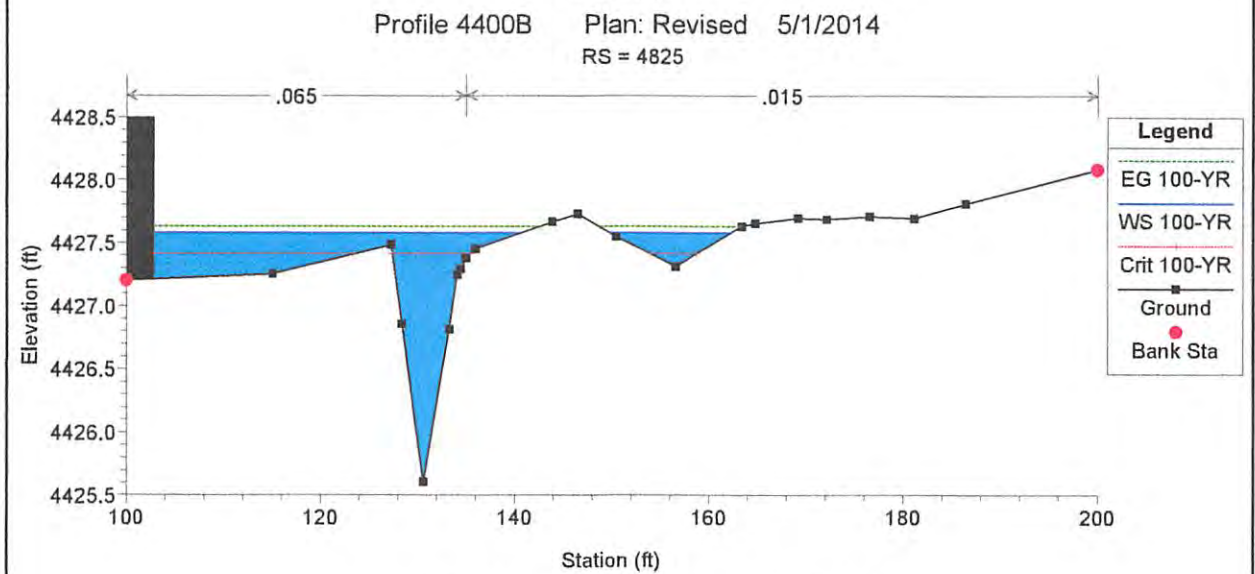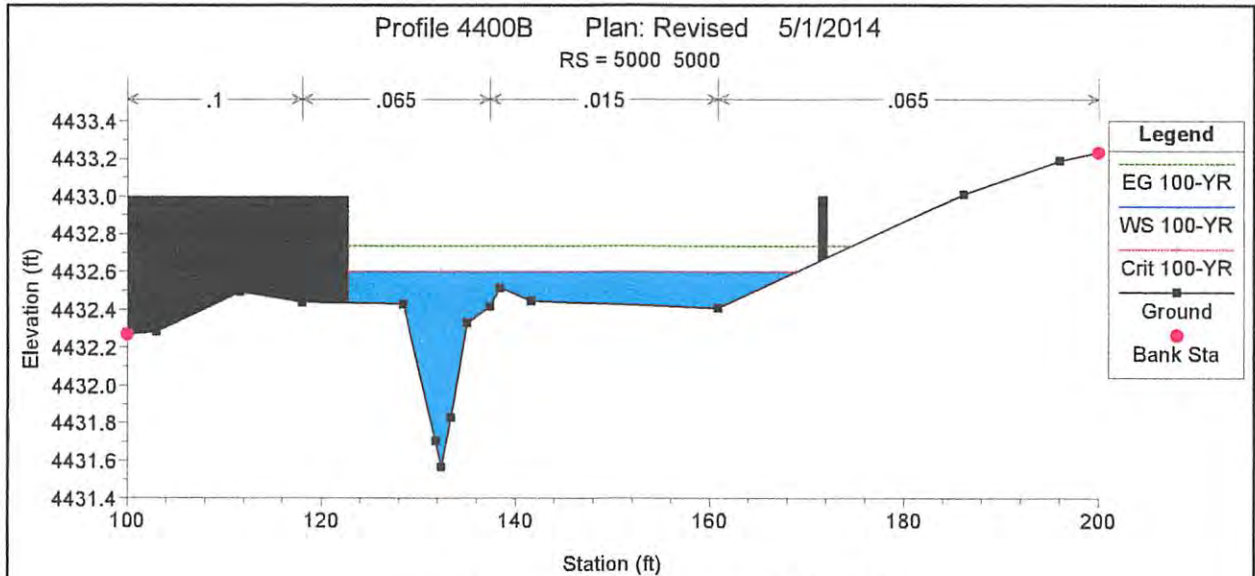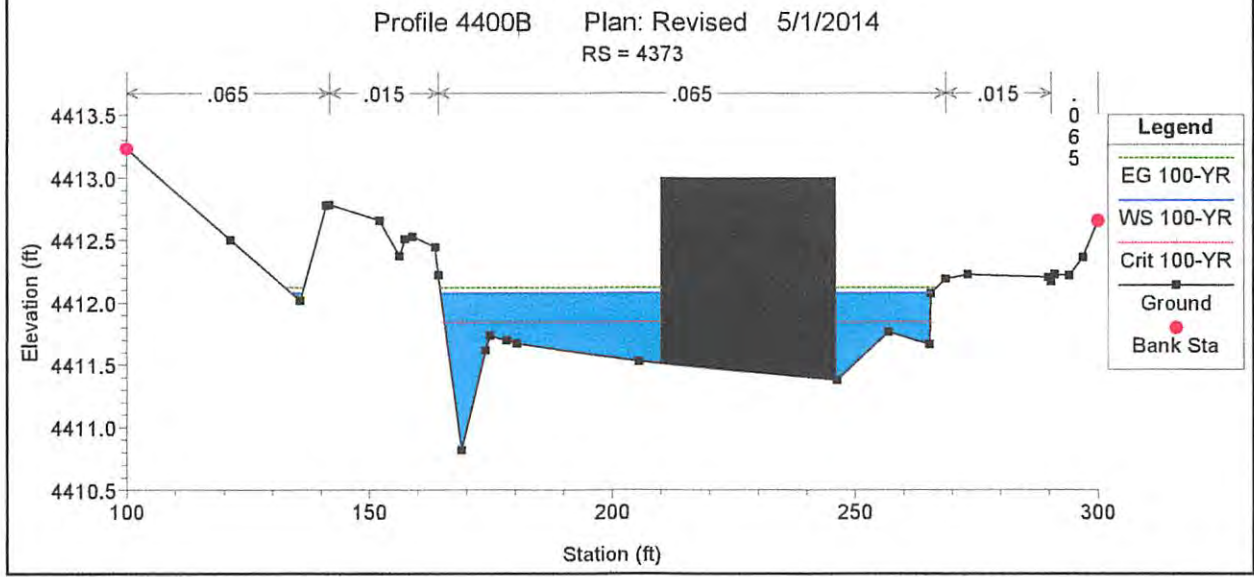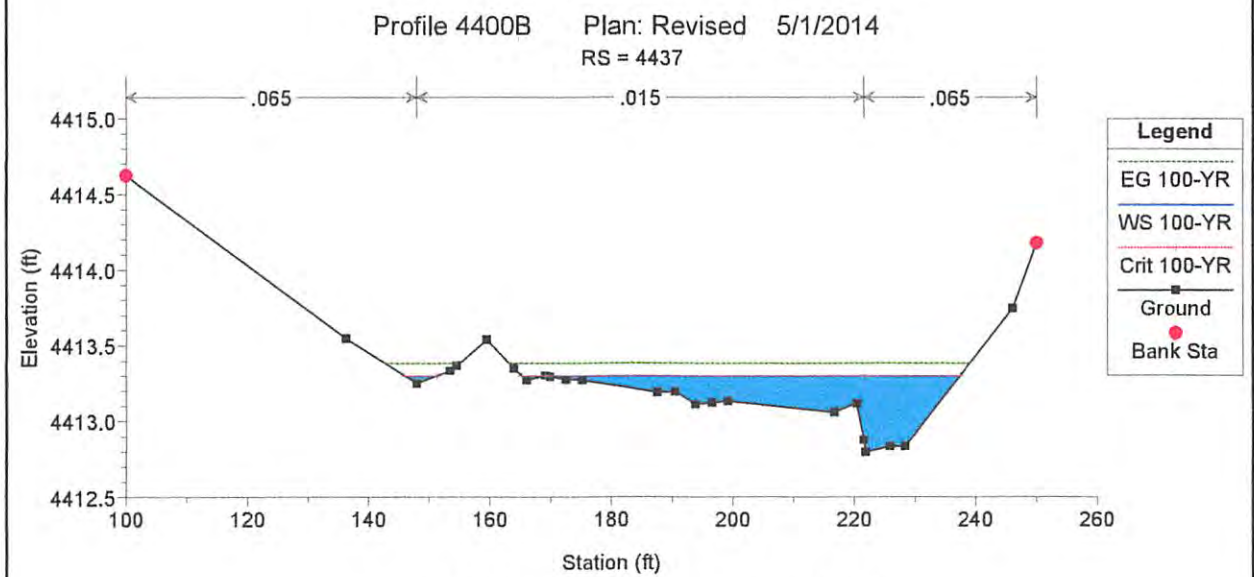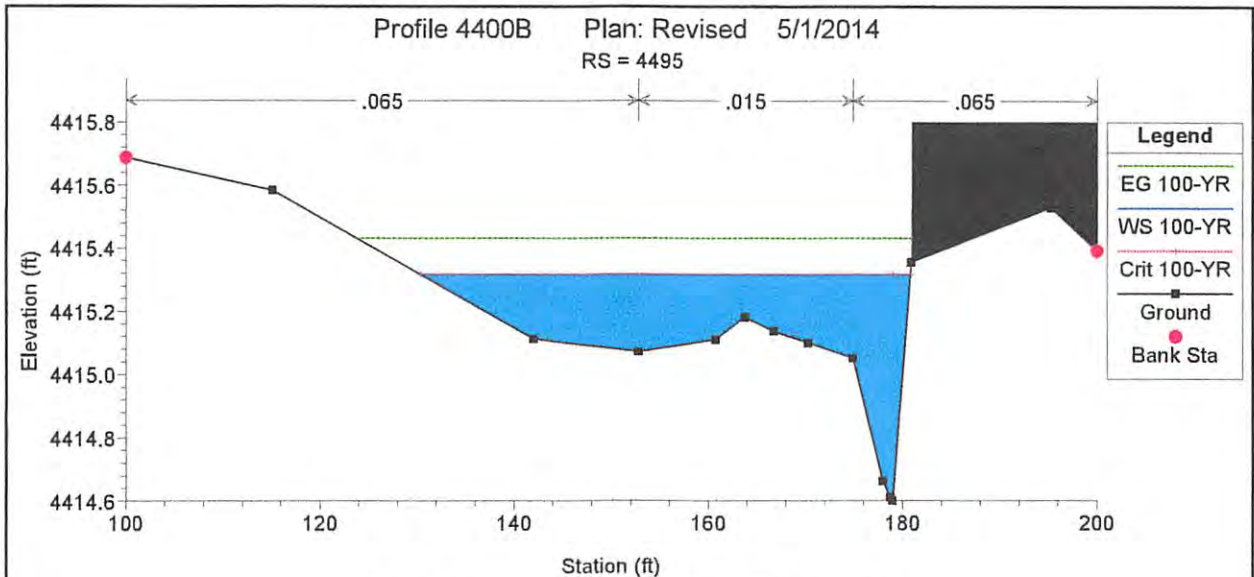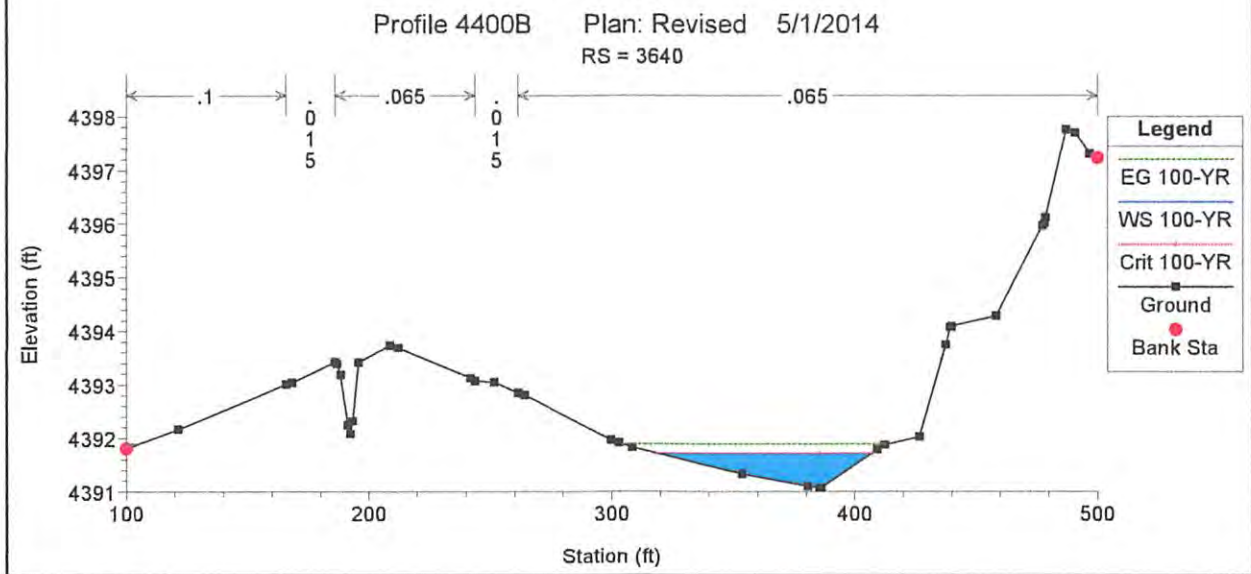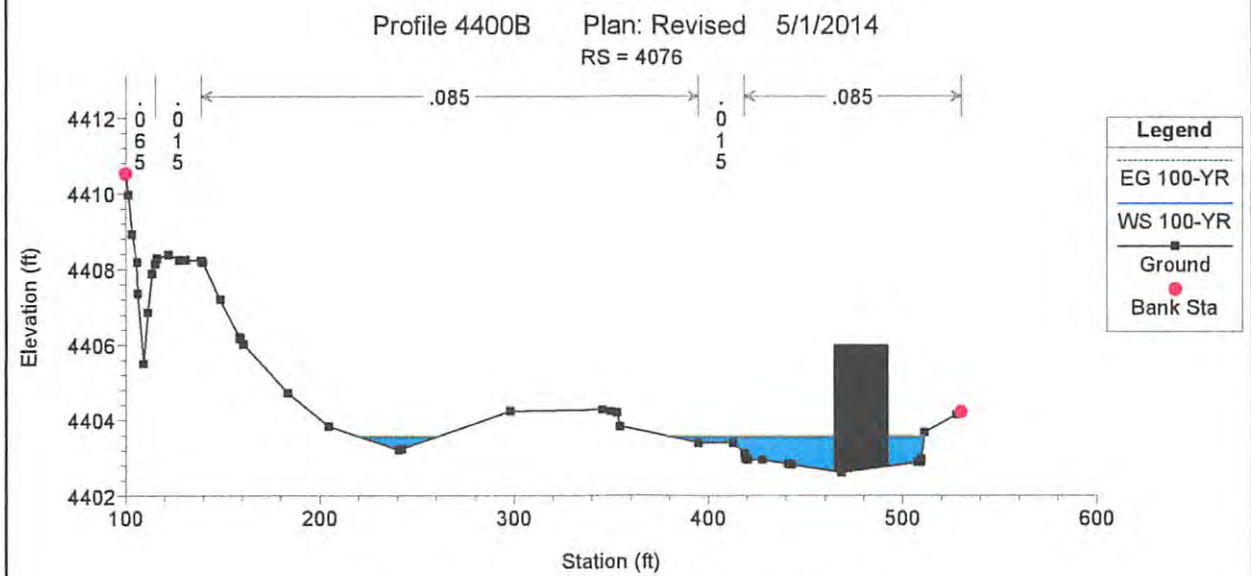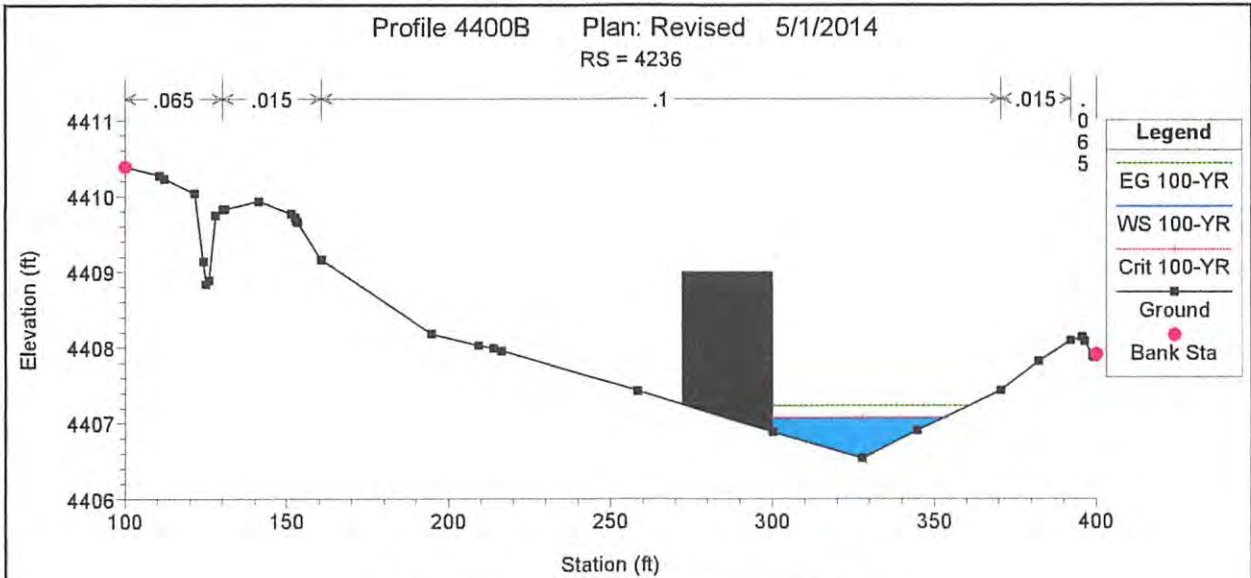
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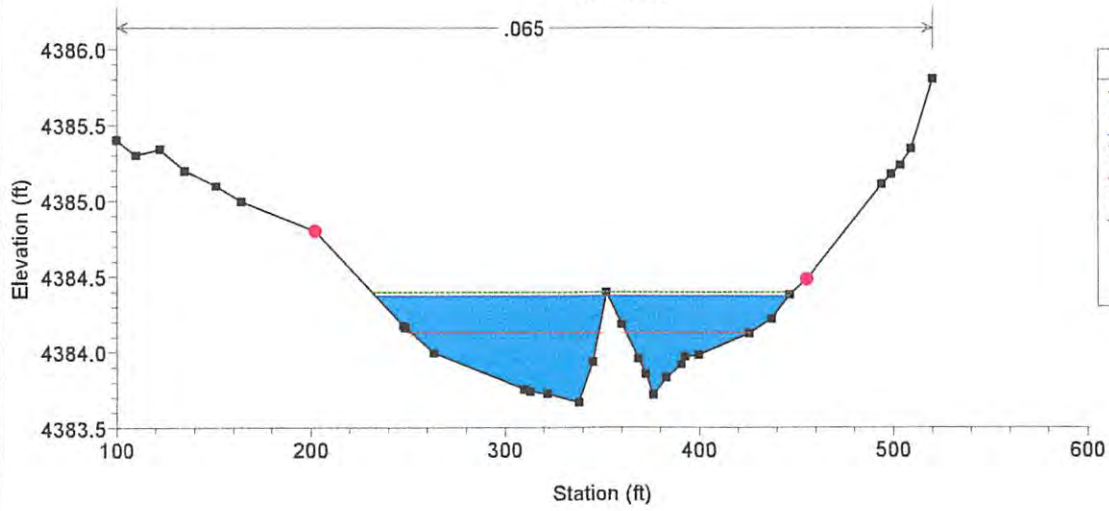
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Profile 4400B   Plan: Revised   5/1/2014
RS = 4495

Profile 4400B   Plan: Revised   5/1/2014
RS = 4437

Profile 4400B   Plan: Revised   5/1/2014
RS = 4373

Profile 4400B   Plan: Revised   5/1/2014
RS = 4236

Profile 4400B   Plan: Revised   5/1/2014
RS = 4076

Profile 4400B   Plan: Revised   5/1/2014
RS = 3640

Profile 4400B   Plan: Revised   5/1/2014
RS = 3330

Culvert Report

Inlet A29B3

Invert Elev Dn (ft)	=	4432.98
Pipe Length (ft)	=	169.20
Slope (%)	=	5.03
Invert Elev Up (ft)	=	4441.49
Rise (in)	=	30.0
Shape	=	Cir
Span (in)	=	30.0
No. Barrels	=	1
n-Value	=	0.023
Inlet Edge	=	Sq Edge
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

Top Elevation (ft)	=	4446.00
Top Width (ft)	=	155.00
Crest Width (ft)	=	10.00

Calculations

Qmin (cfs)	=	42.00
Qmax (cfs)	=	50.00
Tailwater Elev (ft)	=	4439.02

Highlighted

Qtotal (cfs)	=	50.00
Qpipe (cfs)	=	44.24
Qovertop (cfs)	=	5.76
Veloc Dn (ft/s)	=	9.01
Veloc Up (ft/s)	=	9.01
HGL Dn (ft)	=	4439.02
HGL Up (ft)	=	4445.19
Hw Elev (ft)	=	4446.34
Hw/D (ft)	=	1.94
Flow Regime	=	Inlet Control
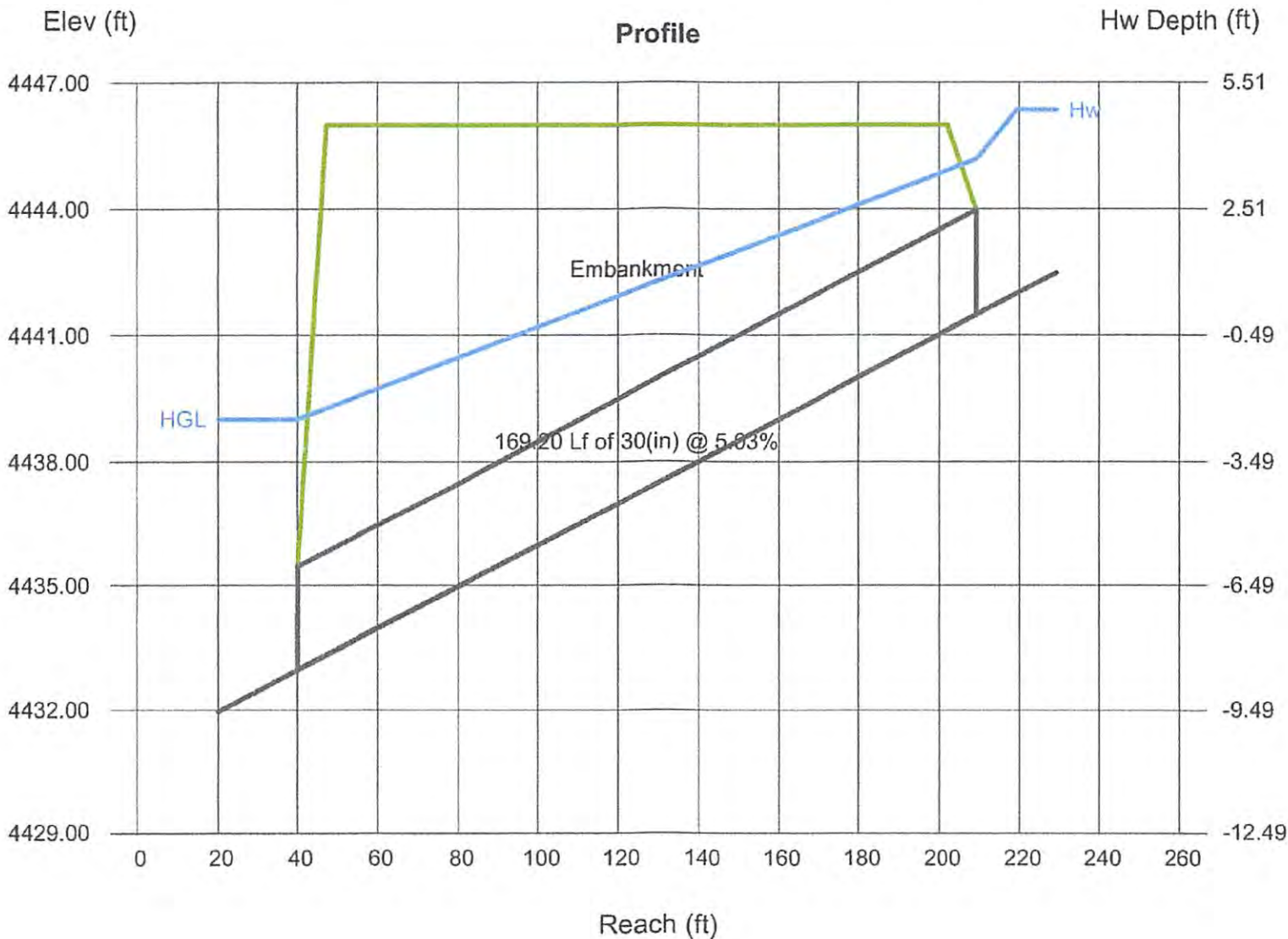
169.20 Lf of 30(in) @ 5.03%

Channel Report

Drainage Channel Above Pipe

User-defined

Invert Elev (ft)	=	97.25
Slope (%)	=	5.50
N-Value	=	0.023

Calculations

Compute by:		Known Q
Known Q (cfs)	=	53.00

Highlighted

Depth (ft)	=	0.97
Q (cfs)	=	53.00
Area (sqft)	=	6.48
Velocity (ft/s)	=	8.19
Wetted Perim (ft)	=	15.53
Crit Depth, Yc (ft)	=	1.28
Top Width (ft)	=	15.32
EGL (ft)	=	2.01

(Sta, El, n)-(Sta, El, n)...

(13.00, 99.00)-(16.00, 98.00, 0.023)-(21.00, 97.75, 0.023)-(23.00, 97.25, 0.023)-(25.00, 97.75, 0.023)-(30.00, 98.00, 0.023)-(33.00, 99.00, 0.023)
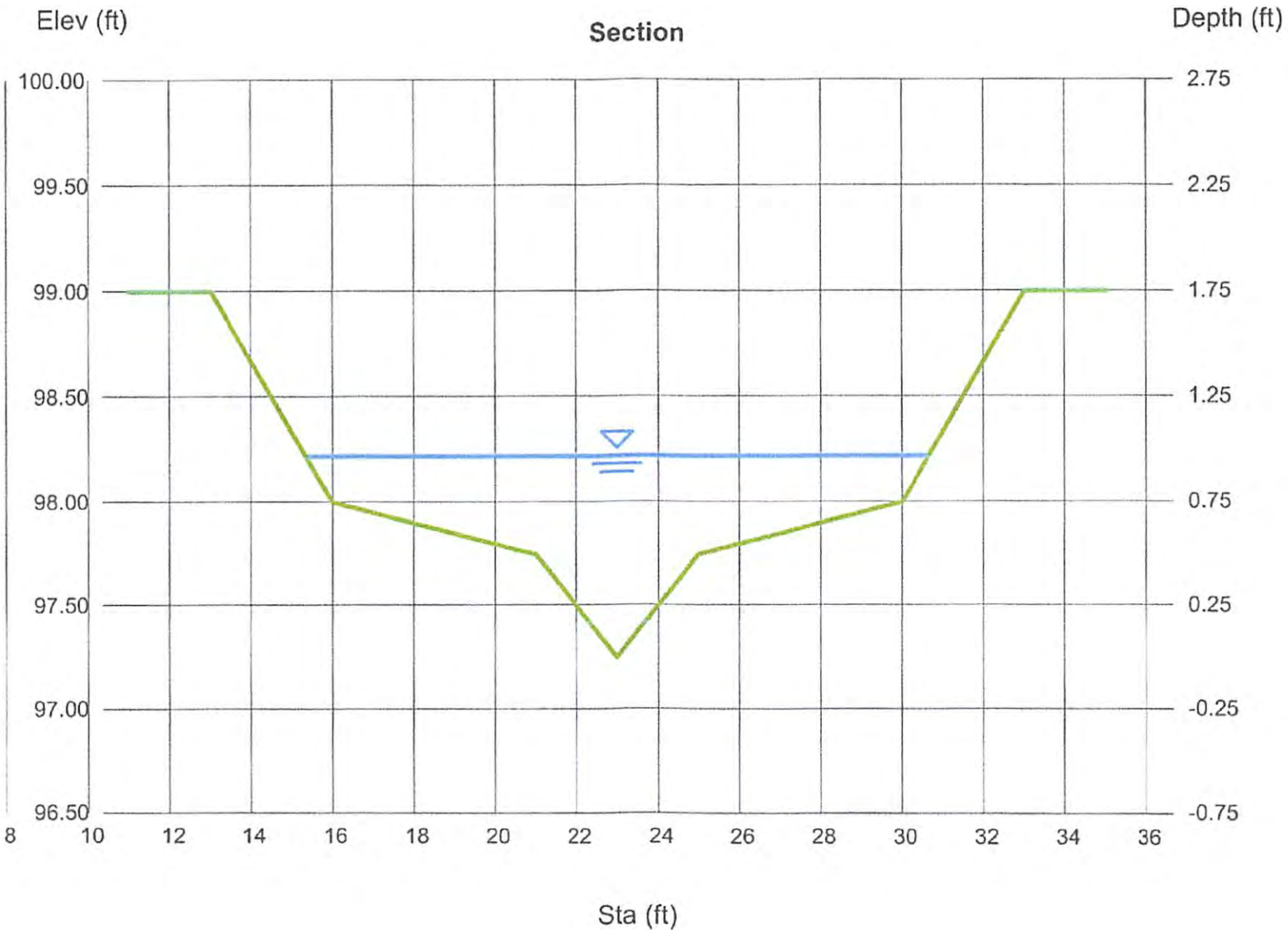
Inlet Report

<Name>

Drop Grate Inlet

Location	=	Sag
Curb Length (ft)	=	-0-
Throat Height (in)	=	-0-
Grate Area (sqft)	=	2.60
Grate Width (ft)	=	2.60
Grate Length (ft)	=	2.50
Grate Length (ft)	=	2.50

Gutter

Slope, Sw (ft/ft)	=	0.500
Slope, Sx (ft/ft)	=	0.500
Local Depr (in)	=	-0-
Gutter Width (ft)	=	2.50
Gutter Slope (%)	=	-0-
Gutter n-value	=	-0-

Calculations

Compute by:		Known Q
Q (cfs)	=	20.00

Highlighted

Q Total (cfs)	=	20.00
Q Capt (cfs)	=	20.00
Q Bypass (cfs)	=	-0-
Depth at Inlet (in)	=	24.59
Efficiency (%)	=	100
Gutter Spread (ft)	=	10.70
Gutter Vel (ft/s)	=	-0-
Bypass Spread (ft)	=	-0-
Bypass Depth (in)	=	-0-

All dimensions in feet

2.05

4.10   2.50   4.10

CITY OF SEDONA

LEGEND

| | SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD |

The 1% annual flood (100-year), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, and AO. The Base Flood Elevation is the water-surface elevation of the 1 % annual chance flood.

ZONE A — No Base Flood Elevation determined

ZONE AE — Base Flood Elevations determined

ZONE AH — Flood depths of 1 to 3 feet (usually areas of ponding; Base Flood Elevations determined

ZONE AO — Flood depths of 0.5 to 3 feet (usually sheet flow on sloped terrain); average depths determined

FLOODPLAIN BOUNDARY

XXXX — CROSS SECTION ID

HERITAGE LAND SURVEY & ENGINEERING
P.O. BOX 3270
CAMP VERDE, ARIZONA 86322
PH: (928) 301-5964
dbmcdonald78@gmail.com

37322
LUKE A. SEFTON
EXPIRES 3/31/2017

100-YEAR FLOOPLAIN

SHEET TITLE:

PROJECT TITLE:

CITY OF SEDONA HARMONY

DRAWN BY: T.C.H.

SCALE: 1'=100'

DATE: 5/1/14

PROJECT NO: 14-0304

SHEET NO.

C-1

Map labels:

RAINBOW DR.
WINDSONG DR.
CONCORD DR.
ANDANTE DR.
LYRIC DR.
HOZONI DR.
NAVAJO DR.
HOPI DR.
ARIA ST.
HARMONY DR.
HOOPER DR.
SYMPHONY WAY
FRIENDSHIP WAY
MELODY LN.
CANTABILE ST.
SOUTHWEST DR.
TORTILLA DR.
STATE ROUTE 89A

ZONE AO (DEPTH 0.5')
ZONE AO (DEPTH 0.5')

Cross section IDs:
5000
4825
4672
4495
4437
4373
4236
4076
3640
3330

SCALE IN FEET
0   50'   100'   200'

N S

DRAINAGE MAP

PEAK DISCHARGES

SUB-BASIN	2-yr PEAK (cfs)	5-yr PEAK (cfs)	10-yr PEAK (cfs)	25-yr PEAK (cfs)	50-yr PEAK (cfs)	100-yr PEAK (cfs)
A37B-1	-	-	-	20.60	-	27.95
A37B-2	-	-	-	15.15	-	20.55
A37B-3	-	-	-	37.10	-	50.30
A37B-4	-	-	-	17.70	-	24.00
A37B-5	-	-	-	22.20	-	30.10
A37B-6	-	-	-	19.70	-	26.70
DESIGN PT						
1	-	-	-	132.45	-	179.60
2	-	-	-	74.45	-	100.95
3	-	-	-	37.10	-	50.30
4	-	-	-	17.70	-	24.00

A = BASIN DESIGNATION
B = AREA IN ACRES
C = COMPOSITE RUNOFF COEFFICIENTS

D = DESIGN POINT DESIGNATION
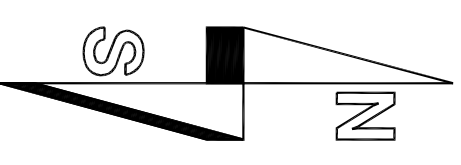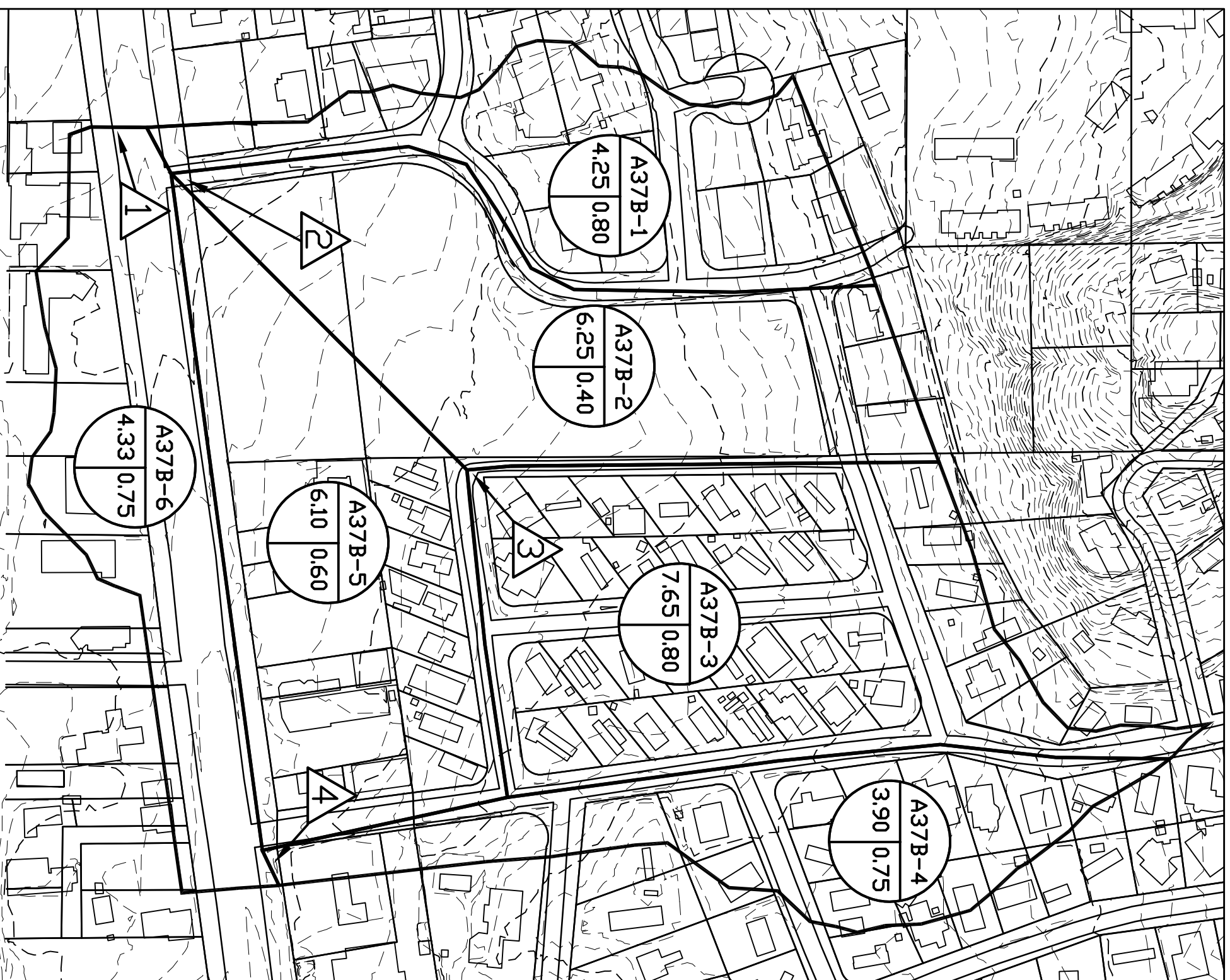
NTS

APPENDIX E

2-, 10-, 25-year STORM CALCULATIONS

NOAA Atlas 14, Volume 1, Version 5
Location name: Sedona, Arizona, USA*
Latitude: 34.8635°, Longitude: -111.81°
Elevation: 4397.28 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]

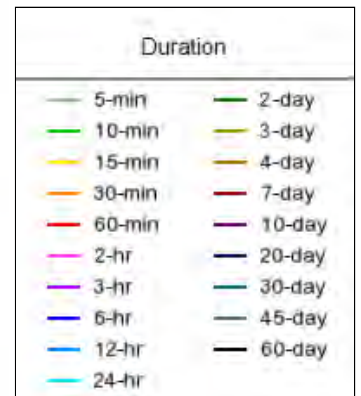| Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.211 (0.177-0.251)	0.272 (0.228-0.322)	0.366 (0.307-0.435)	0.446 (0.373-0.529)	0.559 (0.464-0.660)	0.654 (0.538-0.771)	0.756 (0.616-0.893)	0.866 (0.696-1.02)	1.03 (0.810-1.22)	1.16 (0.903-1.39)
10-min	0.321 (0.270-0.381)	0.414 (0.347-0.491)	0.558 (0.468-0.662)	0.679 (0.568-0.804)	0.851 (0.707-1.00)	0.995 (0.819-1.17)	1.15 (0.938-1.36)	1.32 (1.06-1.56)	1.56 (1.23-1.86)	1.77 (1.38-2.12)
15-min	0.398 (0.334-0.473)	0.513 (0.430-0.609)	0.691 (0.579-0.821)	0.841 (0.705-0.997)	1.06 (0.876-1.25)	1.23 (1.02-1.46)	1.43 (1.16-1.68)	1.64 (1.31-1.93)	1.94 (1.53-2.31)	2.19 (1.71-2.62)
30-min	0.537 (0.450-0.637)	0.691 (0.579-0.820)	0.931 (0.780-1.11)	1.13 (0.949-1.34)	1.42 (1.18-1.68)	1.66 (1.37-1.96)	1.92 (1.57-2.27)	2.20 (1.77-2.60)	2.61 (2.06-3.11)	2.95 (2.30-3.53)
60-min	0.664 (0.557-0.788)	0.855 (0.717-1.01)	1.15 (0.966-1.37)	1.40 (1.17-1.66)	1.76 (1.46-2.07)	2.06 (1.69-2.42)	2.38 (1.94-2.81)	2.73 (2.19-3.22)	3.23 (2.55-3.84)	3.65 (2.84-4.37)
2-hr	0.784 (0.681-0.908)	0.991 (0.857-1.15)	1.31 (1.13-1.52)	1.58 (1.35-1.83)	1.97 (1.67-2.27)	2.29 (1.92-2.64)	2.64 (2.20-3.06)	3.03 (2.48-3.51)	3.59 (2.89-4.18)	4.06 (3.21-4.73)
3-hr	0.843 (0.742-0.973)	1.07 (0.942-1.23)	1.37 (1.20-1.58)	1.63 (1.43-1.87)	2.01 (1.74-2.30)	2.32 (2.00-2.66)	2.67 (2.27-3.08)	3.06 (2.56-3.53)	3.62 (2.97-4.20)	4.09 (3.29-4.78)
6-hr	1.02 (0.915-1.14)	1.27 (1.14-1.42)	1.58 (1.41-1.76)	1.85 (1.65-2.07)	2.24 (1.99-2.50)	2.56 (2.25-2.86)	2.91 (2.53-3.25)	3.28 (2.81-3.68)	3.82 (3.22-4.32)	4.26 (3.53-4.85)
12-hr	1.31 (1.18-1.46)	1.62 (1.46-1.81)	1.98 (1.78-2.20)	2.28 (2.05-2.52)	2.69 (2.41-2.98)	3.01 (2.67-3.32)	3.34 (2.93-3.70)	3.68 (3.20-4.08)	4.15 (3.57-4.64)	4.54 (3.86-5.10)
24-hr	1.65 (1.49-1.81)	2.05 (1.86-2.27)	2.56 (2.32-2.83)	2.96 (2.68-3.28)	3.52 (3.17-3.89)	3.96 (3.56-4.37)	4.41 (3.94-4.88)	4.88 (4.34-5.40)	5.52 (4.85-6.13)	6.02 (5.25-6.70)
2-day	1.92 (1.75-2.12)	2.39 (2.17-2.64)	2.97 (2.71-3.28)	3.44 (3.13-3.80)	4.09 (3.71-4.51)	4.61 (4.15-5.06)	5.13 (4.60-5.64)	5.68 (5.06-6.26)	6.42 (5.67-7.10)	7.00 (6.13-7.76)
3-day	2.06 (1.88-2.27)	2.57 (2.34-2.83)	3.21 (2.93-3.53)	3.72 (3.39-4.10)	4.44 (4.03-4.88)	5.01 (4.52-5.50)	5.61 (5.03-6.16)	6.22 (5.55-6.85)	7.07 (6.24-7.81)	7.73 (6.77-8.57)
4-day	2.21 (2.02-2.42)	2.75 (2.51-3.03)	3.44 (3.15-3.79)	4.00 (3.65-4.40)	4.79 (4.35-5.26)	5.42 (4.89-5.94)	6.08 (5.46-6.68)	6.76 (6.03-7.44)	7.72 (6.81-8.52)	8.47 (7.41-9.39)
7-day	2.59 (2.37-2.83)	3.22 (2.95-3.53)	3.99 (3.65-4.37)	4.63 (4.23-5.06)	5.51 (5.02-6.02)	6.21 (5.63-6.79)	6.94 (6.26-7.59)	7.69 (6.89-8.42)	8.72 (7.75-9.59)	9.53 (8.39-10.5)
10-day	2.94 (2.69-3.22)	3.66 (3.35-4.01)	4.52 (4.13-4.95)	5.19 (4.74-5.68)	6.10 (5.55-6.67)	6.80 (6.17-7.44)	7.51 (6.78-8.23)	8.23 (7.38-9.02)	9.19 (8.19-10.1)	9.92 (8.79-10.9)
20-day	3.81 (3.50-4.16)	4.72 (4.34-5.17)	5.74 (5.28-6.27)	6.51 (5.97-7.10)	7.49 (6.85-8.16)	8.21 (7.49-8.95)	8.91 (8.10-9.72)	9.58 (8.69-10.5)	10.4 (9.40-11.4)	11.0 (9.91-12.1)
30-day	4.57 (4.19-5.00)	5.68 (5.20-6.21)	6.87 (6.28-7.51)	7.77 (7.10-8.48)	8.91 (8.12-9.72)	9.74 (8.86-10.6)	10.5 (9.55-11.5)	11.3 (10.2-12.4)	12.3 (11.1-13.5)	12.9 (11.6-14.2)
45-day	5.41 (4.93-5.98)	6.72 (6.13-7.43)	8.16 (7.44-8.99)	9.25 (8.41-10.2)	10.7 (9.68-11.7)	11.7 (10.6-12.8)	12.7 (11.4-13.9)	13.6 (12.3-15.0)	14.9 (13.3-16.4)	15.7 (14.1-17.4)
60-day	6.30 (5.74-6.92)	7.82 (7.13-8.59)	9.43 (8.59-10.4)	10.6 (9.65-11.6)	12.1 (11.0-13.3)	13.2 (11.9-14.5)	14.2 (12.8-15.6)	15.2 (13.7-16.7)	16.4 (14.7-18.0)	17.2 (15.4-18.9)

[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

PDS-based depth-duration-frequency (DDF) curves
Latitude: 34.8635°, Longitude: -111.8100°

Average recurrence interval (years)

- 1
- 2
- 5
- 10
- 25
- 50
- 100
- 200
- 500
- 1000

Duration

5-min	2-day
10-min	3-day
15-min	4-day
30-min	7-day
60-min	10-day
2-hr	20-day
3-hr	30-day
6-hr	45-day
12-hr	60-day
24-hr	

NOAA Atlas 14, Volume 1, Version 5

Created (GMT): Mon Jul 12 21:45:17 2021
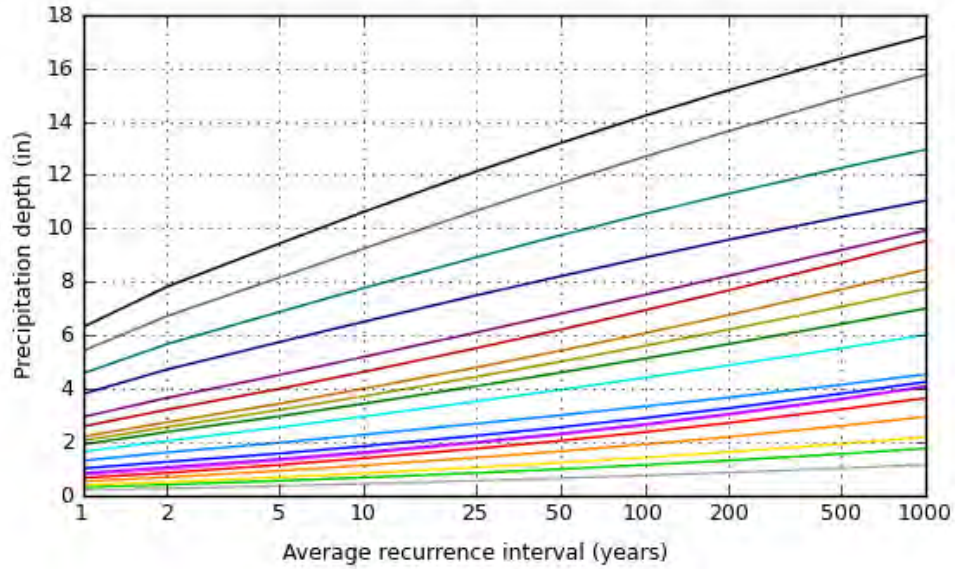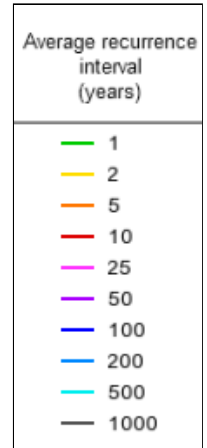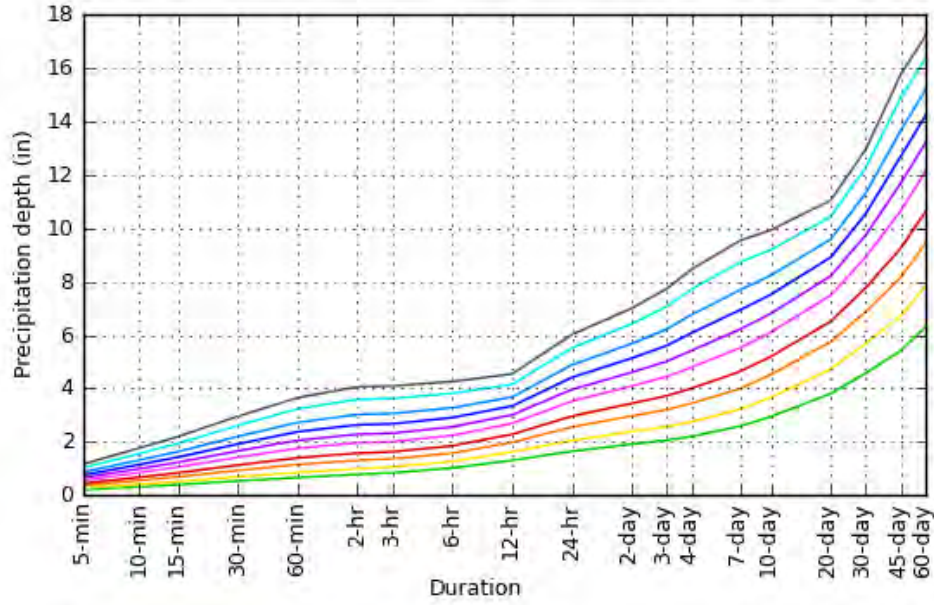
Maps & aerials

Small scale terrain
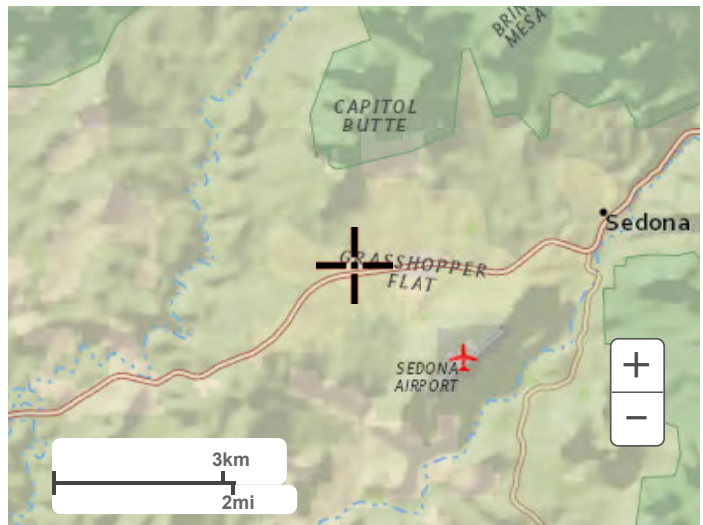
Large scale terrain

Large scale map

Large scale aerial
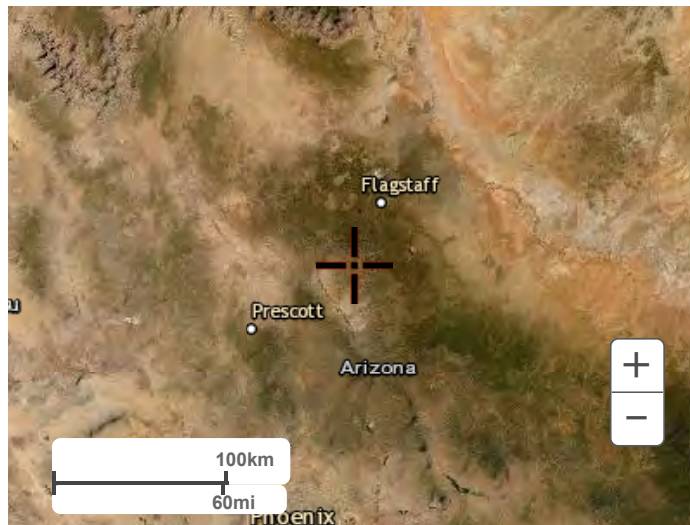
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Hydraflow Table of Contents

Watershed Model Schematic
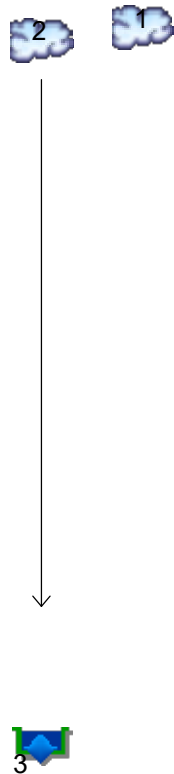
Legend

Hyd.	Origin	Description
1	SCS Runoff	Pre-Development
2	SCS Runoff	Post-Development Hydrograph
3	Reservoir	Retention Basin

Hydrograph Return Period Recap

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	SCS Runoff	------	-------	2.904	-------	-------	6.456	8.925	-------	13.07	Pre-Development
2	SCS Runoff	------	-------	7.384	-------	-------	12.52	15.72	-------	20.81	Post-Development Hydrograph
3	Reservoir	2	-------	2.911	-------	-------	4.235	4.858	-------	7.016	Retention Basin

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

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	SCS Runoff	2.904	2	724	8,791	------	------	------	Pre-Development
2	SCS Runoff	7.384	2	720	19,149	------	------	------	Post-Development Hydrograph
3	Reservoir	2.911	2	730	11,148	2	83.09	5,158	Retention Basin

1763-Hydrology.gpw	Return Period: 2 Year	Wednesday, 07 / 14 / 2021

Hydrograph Report

Hyd. No. 1

Pre-Development

Hydrograph type	= SCS Runoff		Peak discharge	= 2.904 cfs
Storm frequency	= 2 yrs		Time to peak	= 724 min
Time interval	= 2 min		Hyd. volume	= 8,791 cuft
Drainage area	= 4.500 ac		Curve number	= 79
Basin Slope	= 3.4 %		Hydraulic length	= 840 ft
Tc method	= LAG		Time of conc. (Tc)	= 15.40 min
Total precip.	= 2.05 in		Distribution	= Type II
Storm duration	= 24 hrs		Shape factor	= 484

Pre-Development

Hyd. No. 1 -- 2 Year
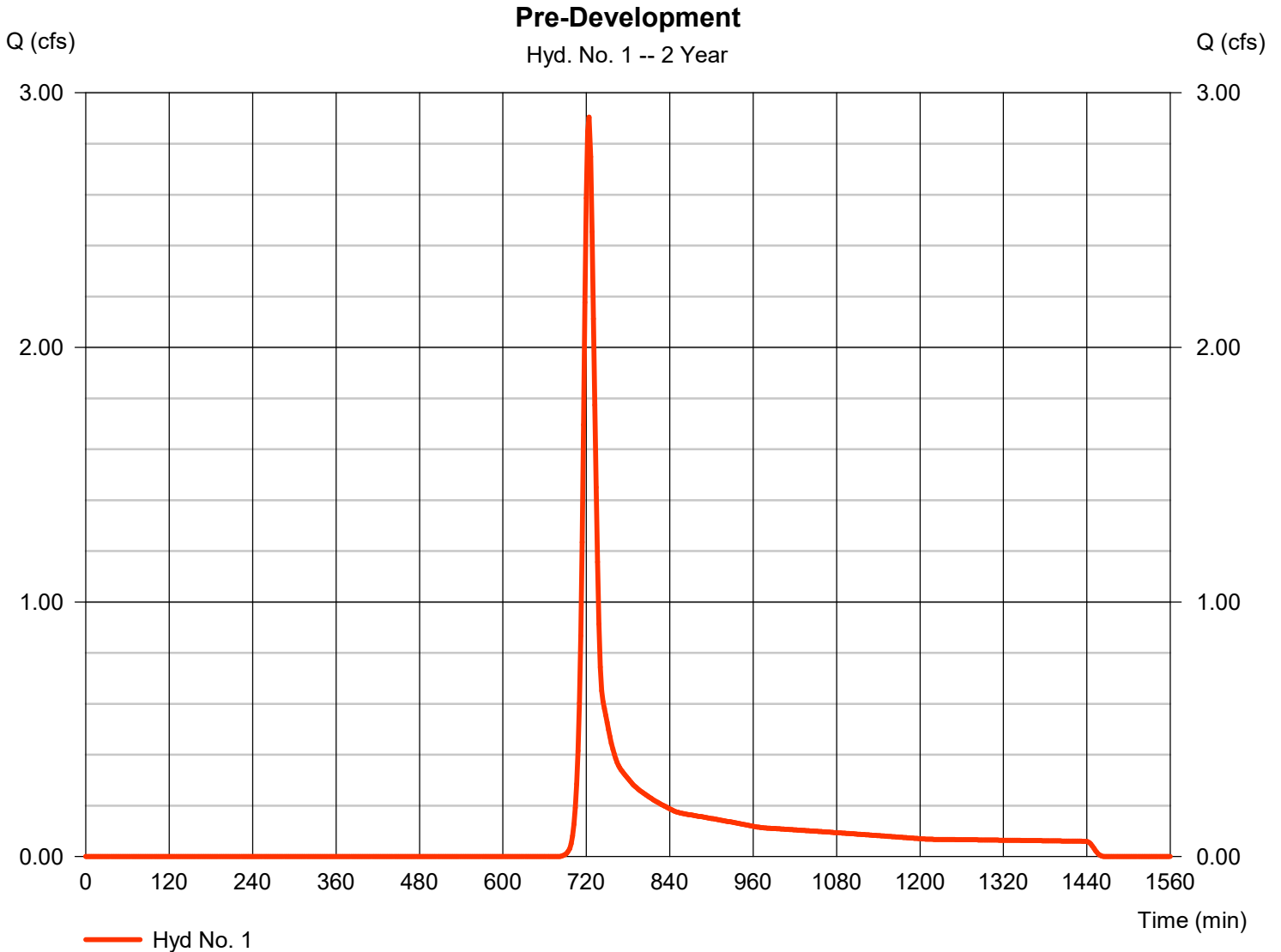
Hydrograph Report

Hyd. No. 2

Post-Development Hydrograph

Hydrograph type	= SCS Runoff	Peak discharge	= 7.384 cfs
Storm frequency	= 2 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 19,149 cuft
Drainage area	= 4.500 ac	Curve number	= 90
Basin Slope	= 3.4 %	Hydraulic length	= 840 ft
Tc method	= LAG	Time of conc. (Tc)	= 10.50 min
Total precip.	= 2.05 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

Post-Development Hydrograph

Hyd. No. 2 -- 2 Year

Q (cfs)

— Hyd No. 2

Time (min)
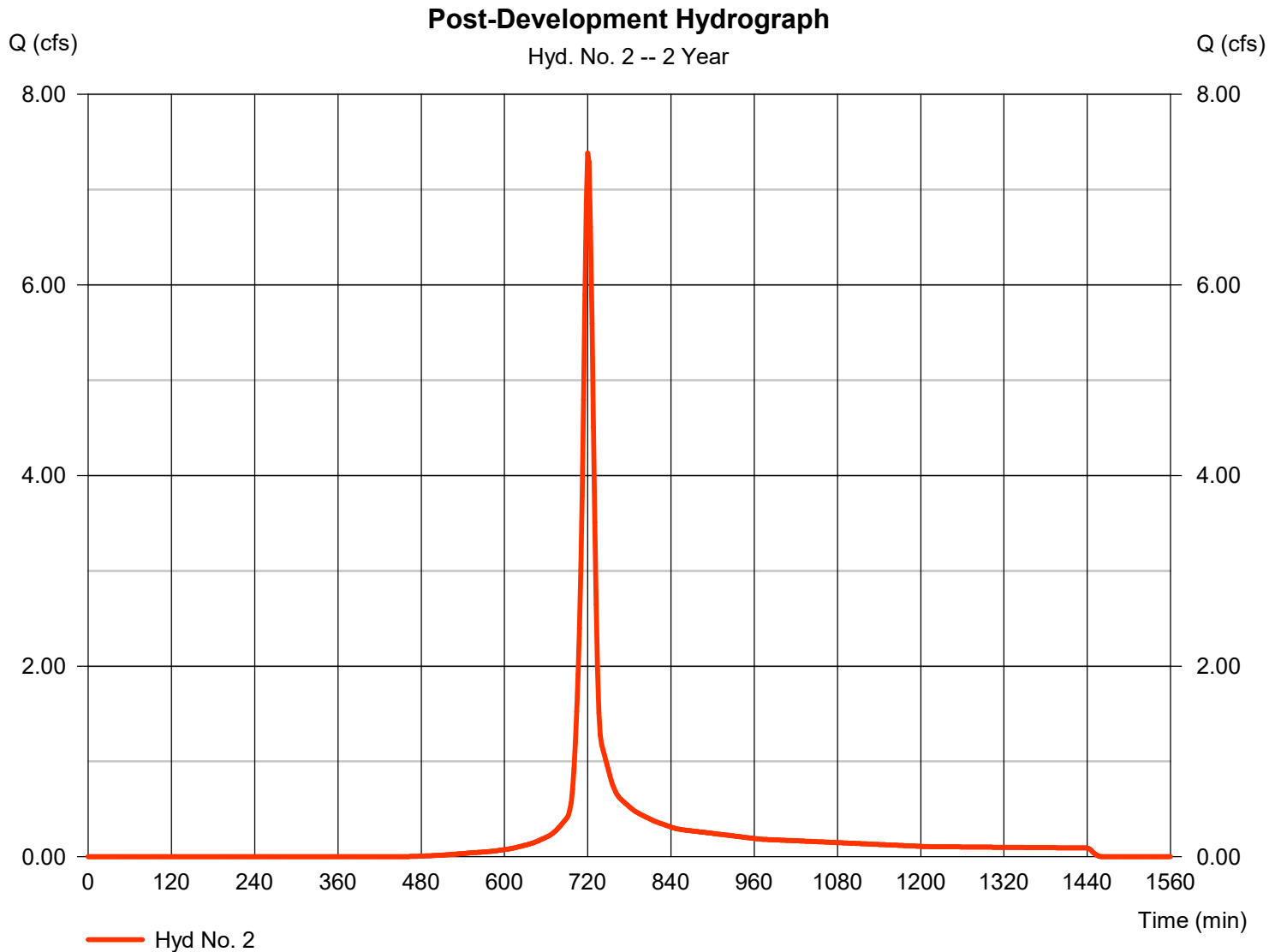
Hydrograph Report

Wednesday, 07 / 14 / 2021

Hyd. No. 3

Retention Basin

Hydrograph type	= Reservoir	Peak discharge	= 2.911 cfs
Storm frequency	= 2 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 11,148 cuft
Inflow hyd. No.	= 2 - Post-Development Hydrograph	Max. Elevation	= 83.09 ft
Reservoir name	= Retention Basin	Max. Storage	= 5,158 cuft

Storage Indication method used. Exfiltration extracted from Outflow.

Retention Basin

Hyd. No. 3 -- 2 Year

Hyd No. 3   Hyd No. 2   Total storage used = 5,158 cuft

Pond Report
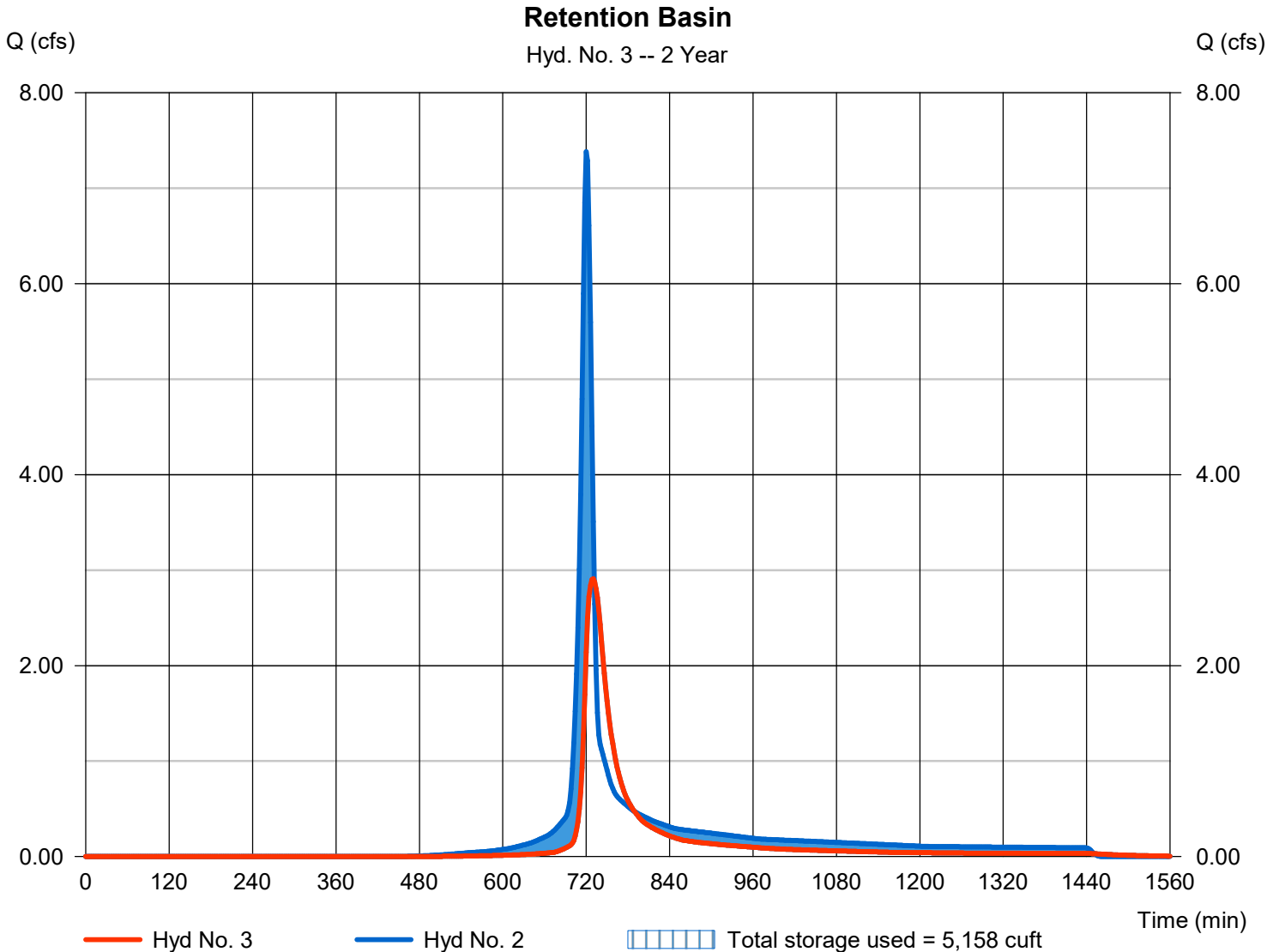
Pond No. 1 - Retention Basin

Pond Data

Contours -User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 82.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	82.00	3,614	0	0
1.00	83.00	5,528	4,571	4,571
2.00	84.00	7,114	6,321	10,892
3.00	85.00	10,228	8,671	19,563

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	Inactive	Inactive	Inactive
Span (in)	= 12.00	12.00	0.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 82.00	82.50	83.00	0.00
Length (ft)	= 38.00	0.00	38.00	0.00
Slope (%)	= 3.40	0.00	3.90	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 6.00	0.00	0.00	0.00
Crest El. (ft)	= 84.50	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= No	No	No	No
Exfil.(in/hr)	= 7.000 (by Contour)			
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).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	82.00	0.00	0.00	---	---	0.00	---	---	---	0.000	---	0.000
1.00	4,571	83.00	2.67 ic	0.00	---	---	0.00	---	---	---	0.896	---	3.569
2.00	10,892	84.00	4.63 ic	0.00	---	---	0.00	---	---	---	1.153	---	5.784
3.00	19,563	85.00	5.98 ic	0.00	---	---	7.06	---	---	---	1.657	---	14.70

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

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	SCS Runoff	6.456	2	722	18,464	------	------	------	Pre-Development
2	SCS Runoff	12.52	2	720	32,805	------	------	------	Post-Development Hydrograph
3	Reservoir	4.235	2	730	20,876	2	83.76	9,345	Retention Basin

1763-Hydrology.gpw	Return Period: 10 Year	Wednesday, 07 / 14 / 2021

Hydrograph Report

Hyd. No. 1

Pre-Development

Hydrograph type	= SCS Runoff		Peak discharge	= 6.456 cfs
Storm frequency	= 10 yrs		Time to peak	= 722 min
Time interval	= 2 min		Hyd. volume	= 18,464 cuft
Drainage area	= 4.500 ac		Curve number	= 79
Basin Slope	= 3.4 %		Hydraulic length	= 840 ft
Tc method	= LAG		Time of conc. (Tc)	= 15.40 min
Total precip.	= 2.96 in		Distribution	= Type II
Storm duration	= 24 hrs		Shape factor	= 484

Pre-Development

Hyd. No. 1 -- 10 Year
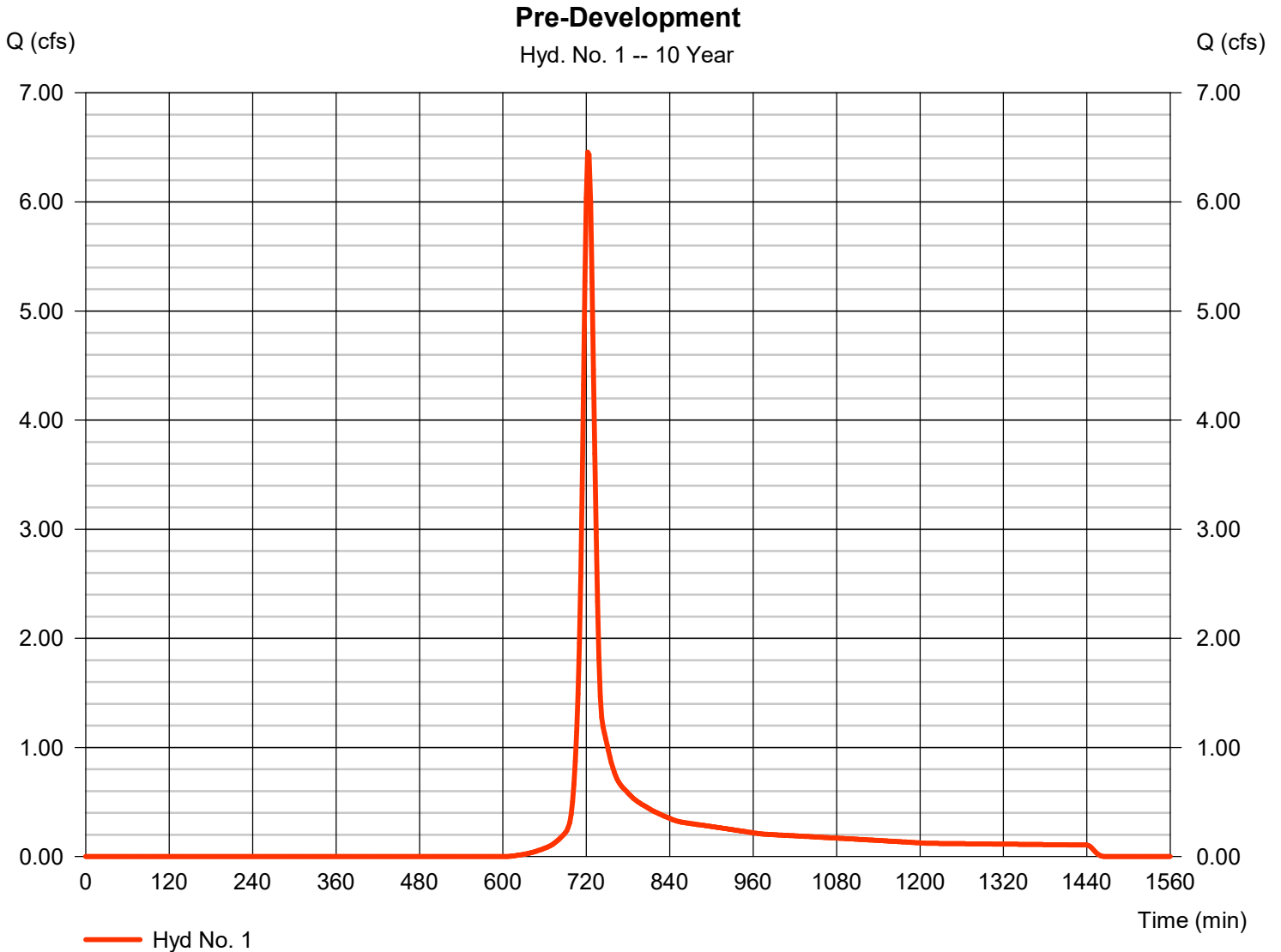
Hydrograph Report

Hyd. No. 2

Post-Development Hydrograph

Hydrograph type	= SCS Runoff	Peak discharge	= 12.52 cfs
Storm frequency	= 10 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 32,805 cuft
Drainage area	= 4.500 ac	Curve number	= 90
Basin Slope	= 3.4 %	Hydraulic length	= 840 ft
Tc method	= LAG	Time of conc. (Tc)	= 10.50 min
Total precip.	= 2.96 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

Post-Development Hydrograph

Hyd. No. 2 -- 10 Year

Q (cfs)

Time (min)
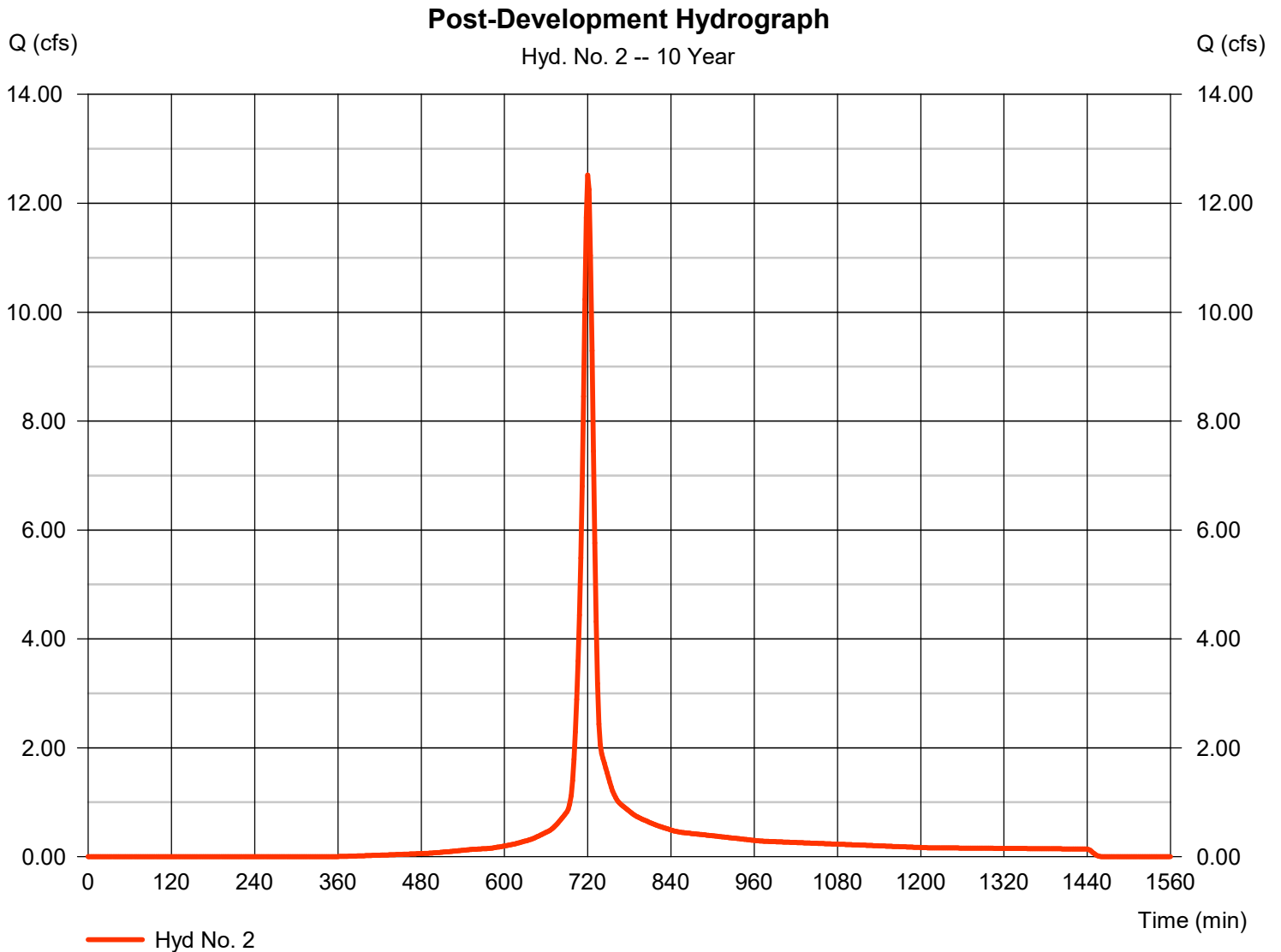
Hyd No. 2

Hydrograph Report

Hyd. No. 3

Retention Basin

Hydrograph type	= Reservoir	Peak discharge	= 4.235 cfs
Storm frequency	= 10 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 20,876 cuft
Inflow hyd. No.	= 2 - Post-Development Hydrograph	Max. Elevation	= 83.76 ft
Reservoir name	= Retention Basin	Max. Storage	= 9,345 cuft

Storage Indication method used. Exfiltration extracted from Outflow.
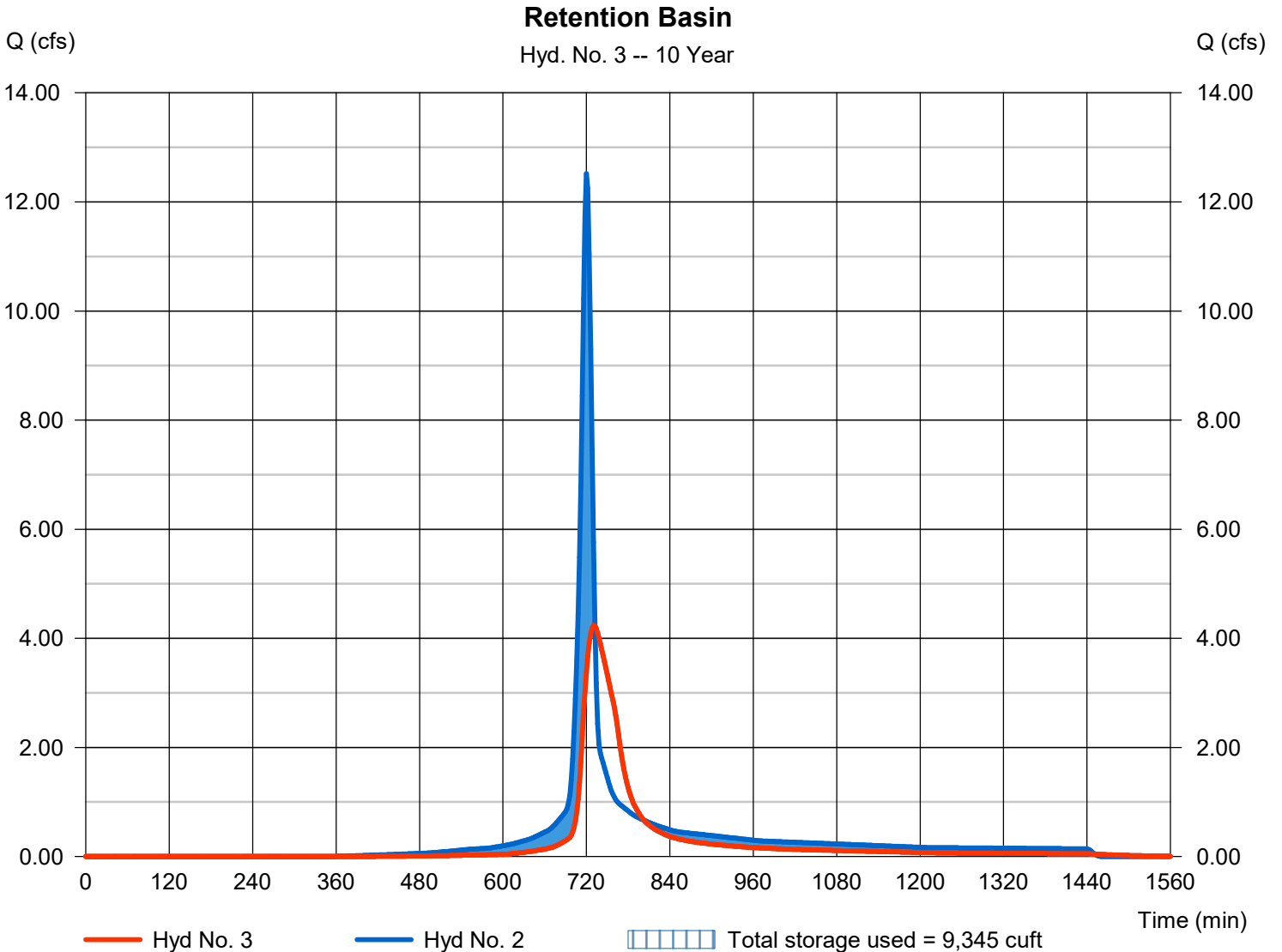
Retention Basin

Hyd. No. 3 -- 10 Year

Hydrograph Summary Report

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	SCS Runoff	8.925	2	722	25,189	------	------	------	Pre-Development
2	SCS Runoff	15.72	2	720	41,552	------	------	------	Post-Development Hydrograph
3	Reservoir	4.858	2	732	27,322	2	84.15	12,201	Retention Basin

1763-Hydrology.gpw	Return Period: 25 Year	Wednesday, 07 / 14 / 2021

Hydrograph Report

Hyd. No. 1

Pre-Development

Hydrograph type	= SCS Runoff	Peak discharge	= 8.925 cfs
Storm frequency	= 25 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 25,189 cuft
Drainage area	= 4.500 ac	Curve number	= 79
Basin Slope	= 3.4 %	Hydraulic length	= 840 ft
Tc method	= LAG	Time of conc. (Tc)	= 15.40 min
Total precip.	= 3.52 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

Pre-Development

Hyd. No. 1 -- 25 Year
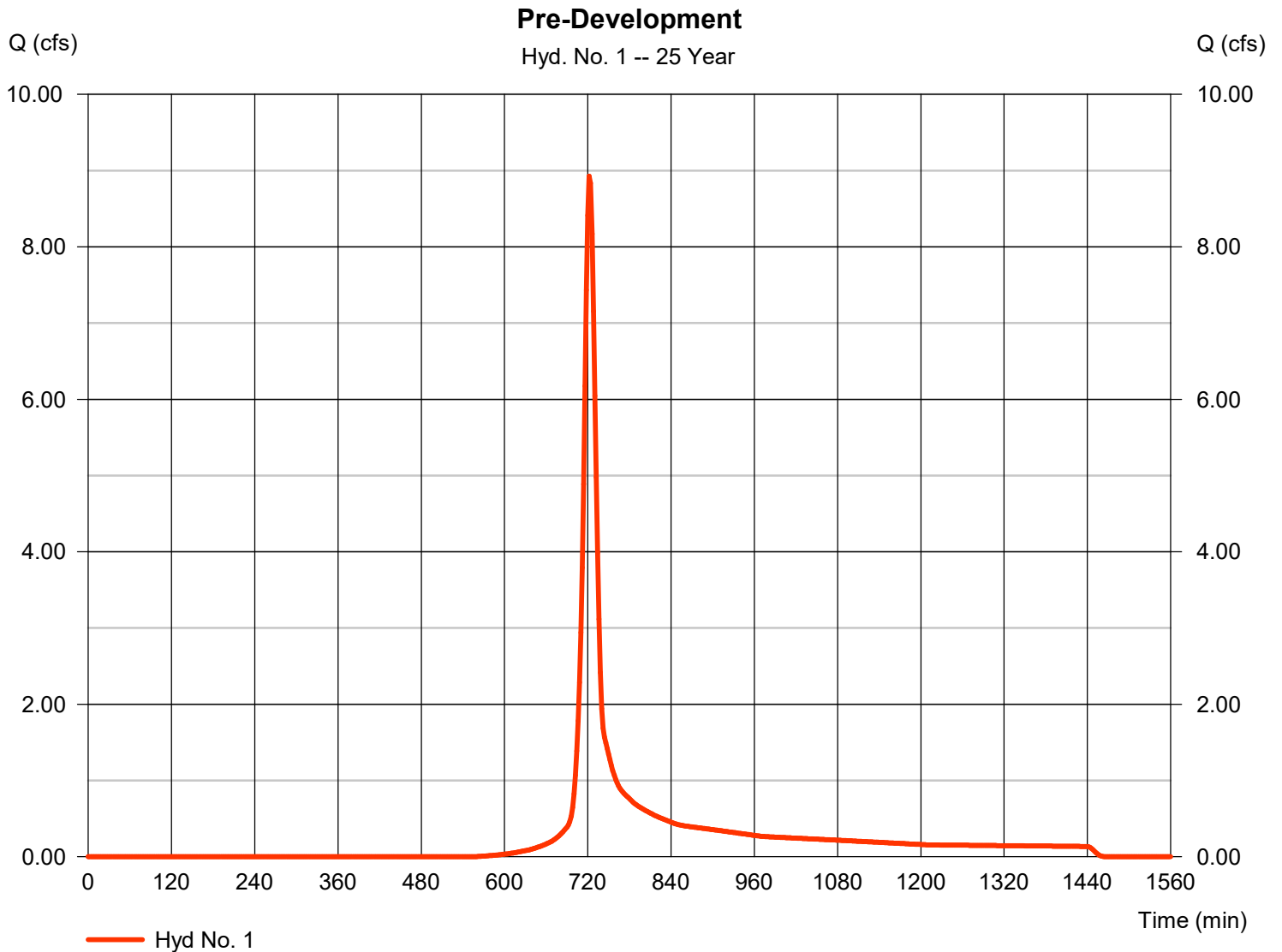
Hydrograph Report

Hyd. No. 2

Post-Development Hydrograph

Hydrograph type	= SCS Runoff	Peak discharge	= 15.72 cfs
Storm frequency	= 25 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 41,552 cuft
Drainage area	= 4.500 ac	Curve number	= 90
Basin Slope	= 3.4 %	Hydraulic length	= 840 ft
Tc method	= LAG	Time of conc. (Tc)	= 10.50 min
Total precip.	= 3.52 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

Post-Development Hydrograph

Hyd. No. 2 -- 25 Year
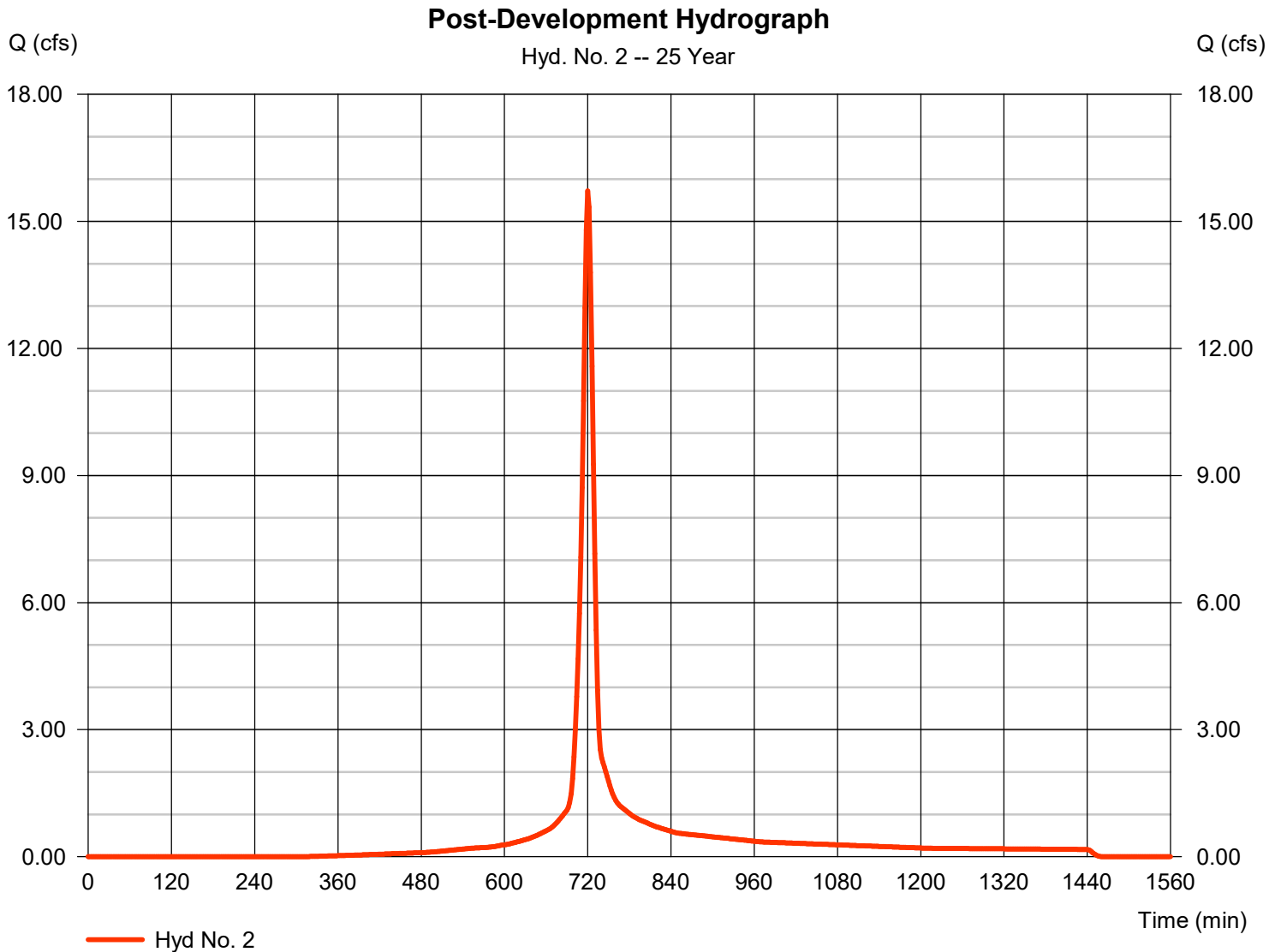
— Hyd No. 2

Hydrograph Report

Hyd. No. 3

Retention Basin

Hydrograph type	= Reservoir		Peak discharge	= 4.858 cfs
Storm frequency	= 25 yrs		Time to peak	= 732 min
Time interval	= 2 min		Hyd. volume	= 27,322 cuft
Inflow hyd. No.	= 2 - Post-Development Hydrograph		Max. Elevation	= 84.15 ft
Reservoir name	= Retention Basin		Max. Storage	= 12,201 cuft

Storage Indication method used. Exfiltration extracted from Outflow.
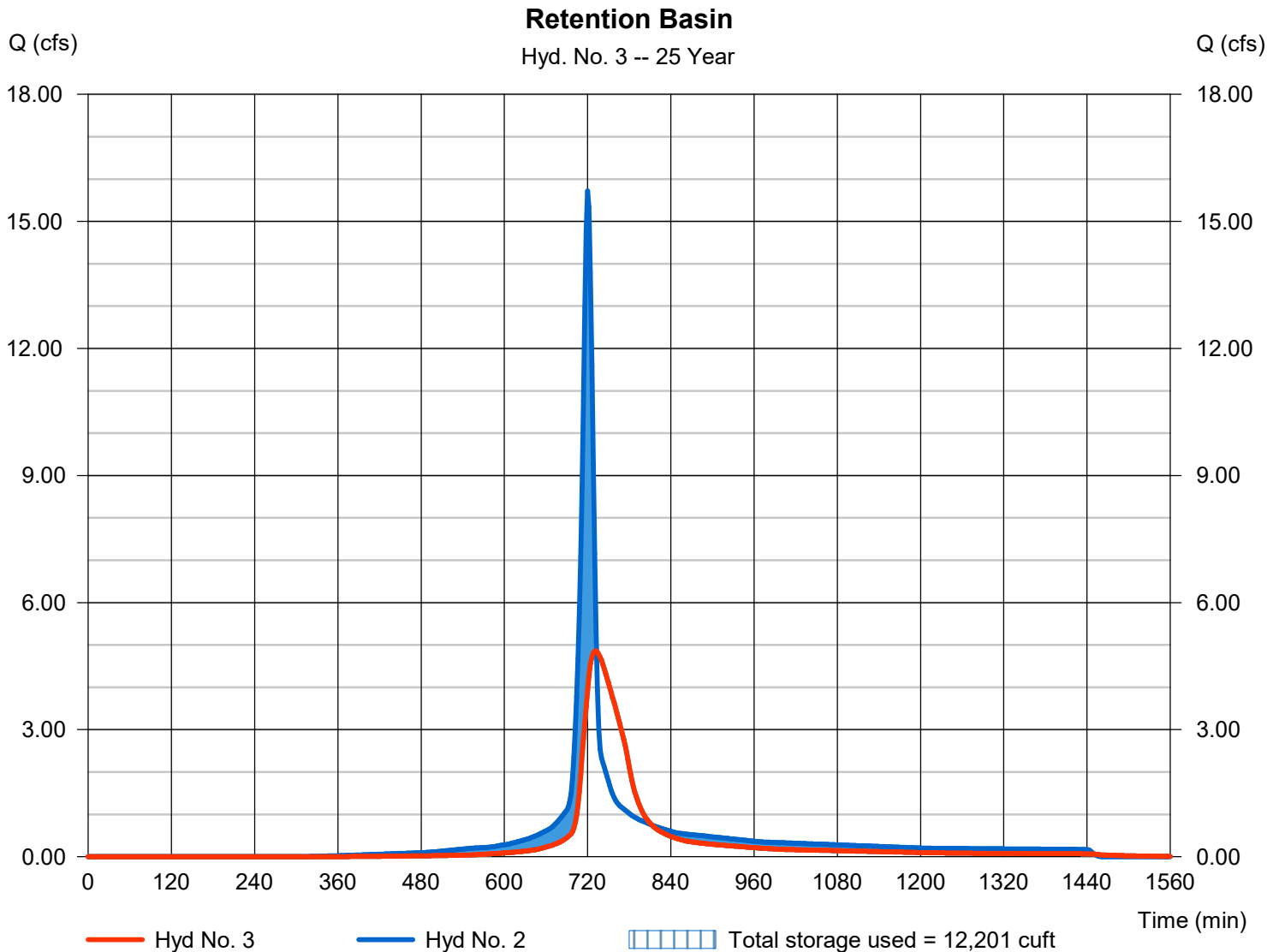
Retention Basin

Hyd. No. 3 -- 25 Year

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

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	SCS Runoff	13.07	2	722	36,649	------	------	------	Pre-Development
2	SCS Runoff	20.81	2	720	55,753	------	------	------	Post-Development Hydrograph
3	Reservoir	7.016	2	730	37,925	2	84.67	16,706	Retention Basin

Hydrograph Report

Hyd. No. 1

Pre-Development

Hydrograph type	= SCS Runoff	Peak discharge	= 13.07 cfs
Storm frequency	= 100 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 36,649 cuft
Drainage area	= 4.500 ac	Curve number	= 79
Basin Slope	= 3.4 %	Hydraulic length	= 840 ft
Tc method	= LAG	Time of conc. (Tc)	= 15.40 min
Total precip.	= 4.41 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

Pre-Development

Hyd. No. 1 -- 100 Year

Hydrograph Report

Hyd. No. 2

Post-Development Hydrograph

Hydrograph type	= SCS Runoff		Peak discharge	= 20.81 cfs
Storm frequency	= 100 yrs		Time to peak	= 720 min
Time interval	= 2 min		Hyd. volume	= 55,753 cuft
Drainage area	= 4.500 ac		Curve number	= 90
Basin Slope	= 3.4 %		Hydraulic length	= 840 ft
Tc method	= LAG		Time of conc. (Tc)	= 10.50 min
Total precip.	= 4.41 in		Distribution	= Type II
Storm duration	= 24 hrs		Shape factor	= 484

Post-Development Hydrograph

Hyd. No. 2 -- 100 Year

Q (cfs)

Time (min)
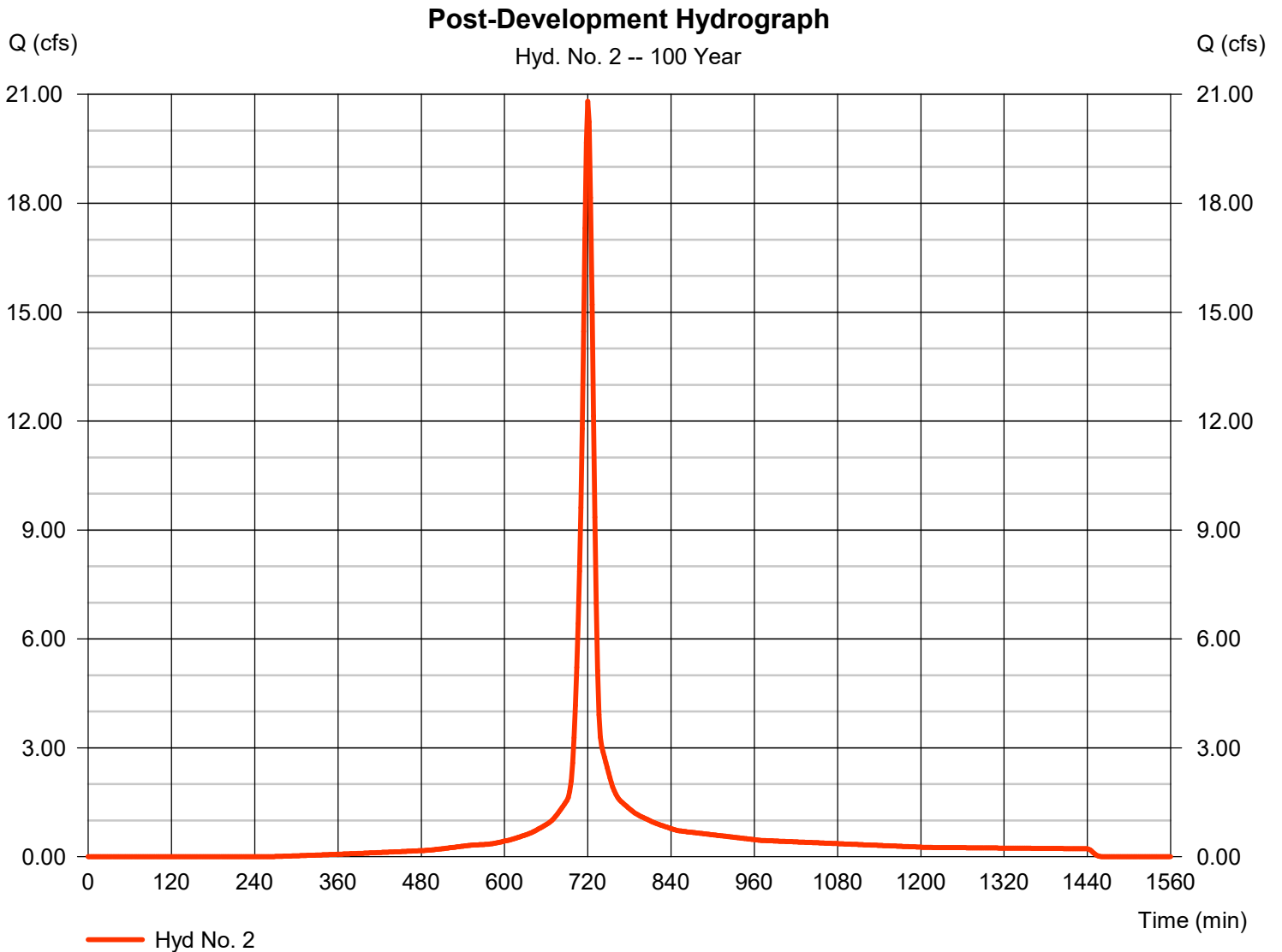
Hyd No. 2

Hydrograph Report

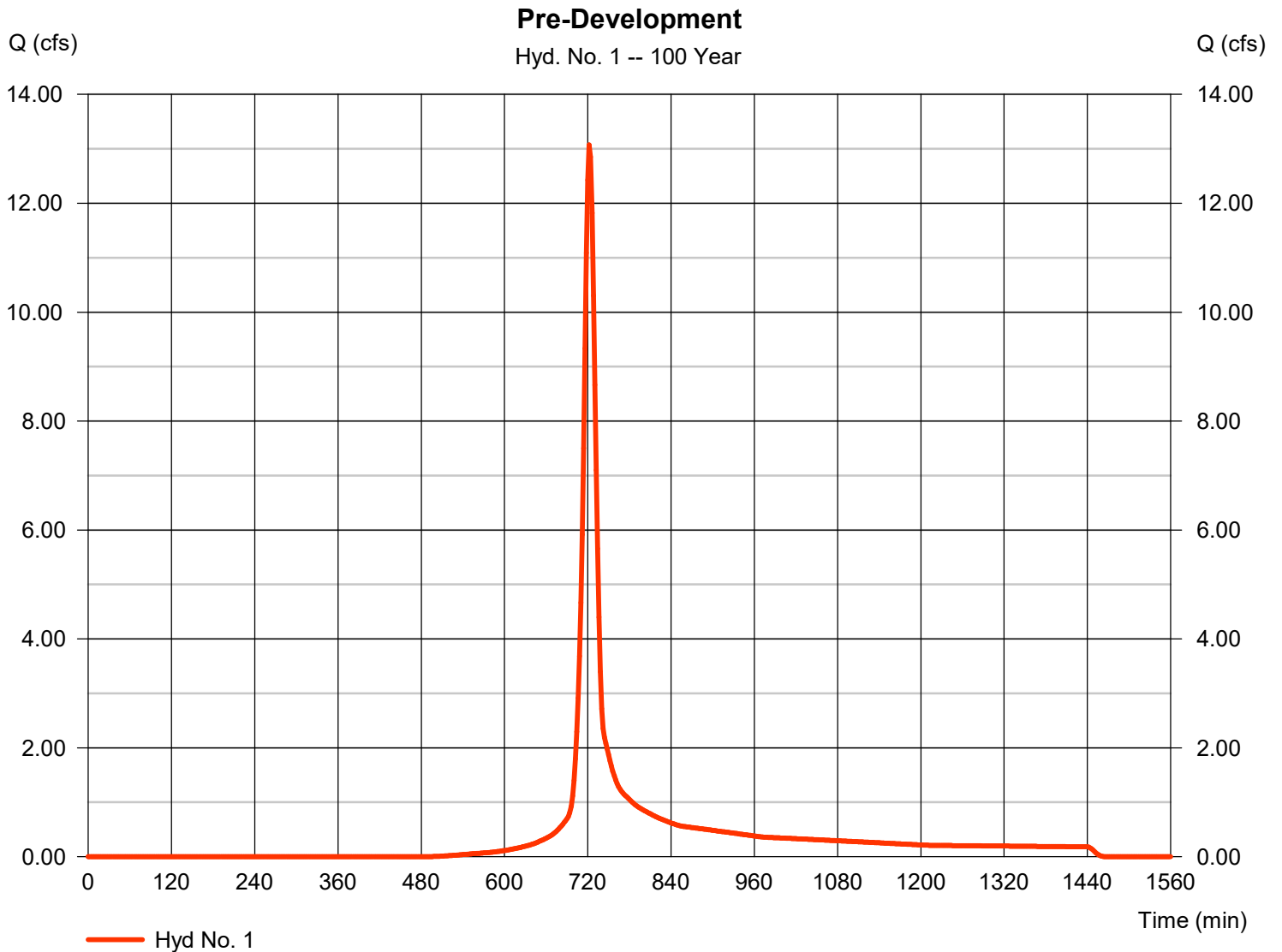Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Wednesday, 07 / 14 / 2021

Hyd. No. 3

Retention Basin

Hydrograph type	= Reservoir	Peak discharge	= 7.016 cfs
Storm frequency	= 100 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 37,925 cuft
Inflow hyd. No.	= 2 - Post-Development Hydrograph	Max. Elevation	= 84.67 ft
Reservoir name	= Retention Basin	Max. Storage	= 16,706 cuft

Storage Indication method used. Exfiltration extracted from Outflow.

Retention Basin

Hyd. No. 3 -- 100 Year
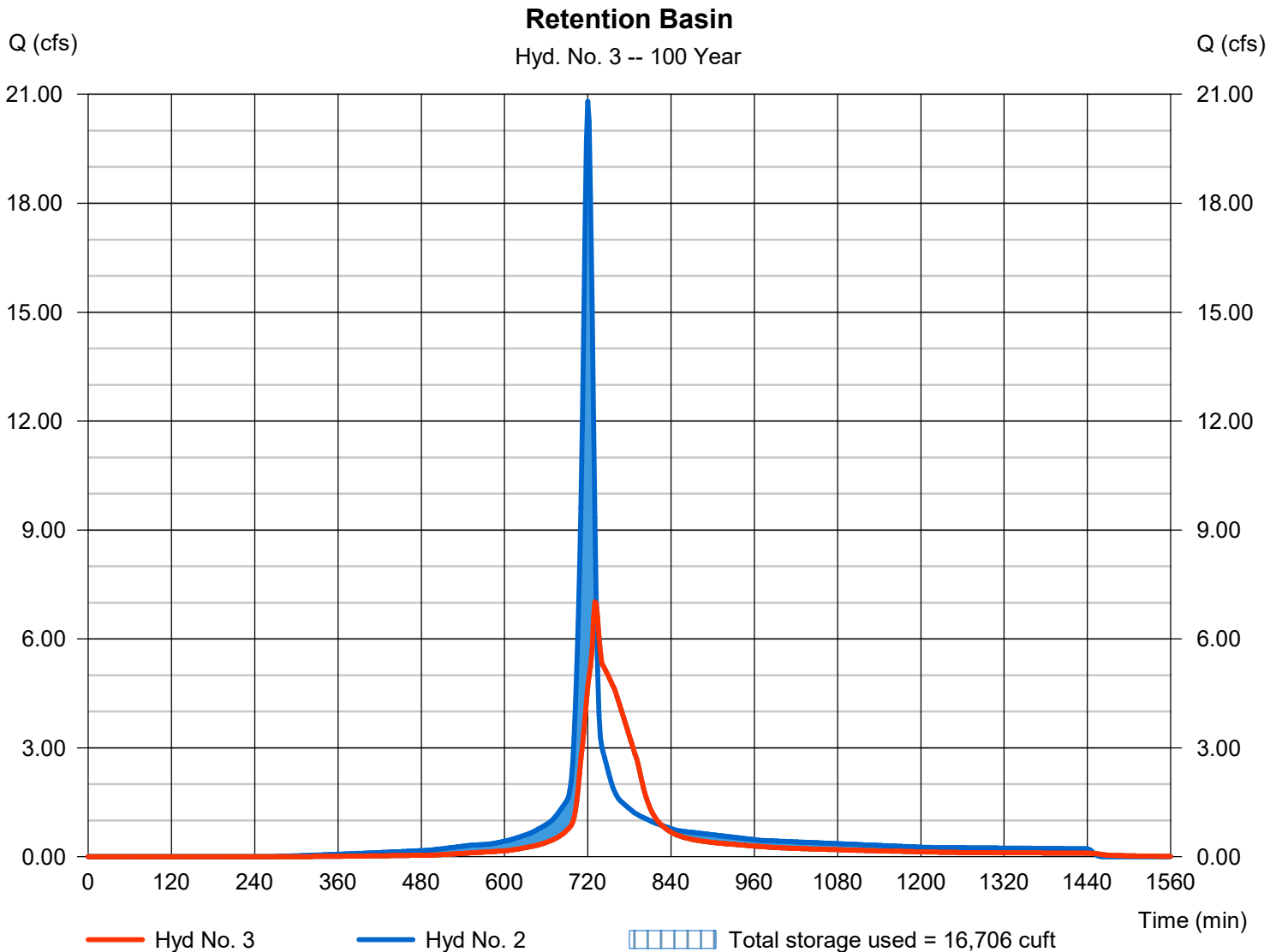
Hydraflow Rainfall Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022   Wednesday, 07 / 14 / 2021

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	--------
2	26.4069	10.7000	0.8283	--------
3	0.0000	0.0000	0.0000	--------
5	40.0690	10.7000	0.8283	--------
10	50.4836	10.7000	0.8283	--------
25	62.2420	10.7000	0.8283	--------
50	72.3207	10.7000	0.8283	--------
100	81.2794	10.7000	0.8283	--------

File name: Navajo Rainfall Data.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	2.70	2.15	1.79	1.55	1.37	1.23	1.11	1.02	0.95	0.88	0.82	0.78
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	4.09	3.26	2.72	2.35	2.07	1.86	1.69	1.55	1.43	1.34	1.25	1.18
10	5.16	4.10	3.43	2.96	2.61	2.34	2.13	1.95	1.81	1.68	1.58	1.48
25	6.36	5.06	4.23	3.65	3.22	2.89	2.62	2.41	2.23	2.07	1.94	1.83
50	7.39	5.88	4.91	4.24	3.74	3.36	3.05	2.80	2.59	2.41	2.26	2.12
100	8.31	6.61	5.52	4.77	4.21	3.77	3.43	3.15	2.91	2.71	2.54	2.39

Tc = time in minutes. Values may exceed 60.

s_Morgan Taylor Homes\1763 - Sedona Lofts\Documents\Drainage Report\Hydrology\Precipitation - Navajo Lofts.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	2.05	0.00	3.30	2.96	3.52	6.80	4.41
SCS 6-Hr	0.00	1.27	0.00	0.00	1.85	2.24	0.00	2.91
Huff-1st	0.00	0.00	0.00	2.75	0.00	0.00	6.50	0.00
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	0.00	0.00	2.80	0.00	0.00	6.00	0.00

SEWER REPORT

Navajo Lofts

10 Navajo Drive
Sedona, AZ 86336

Prepared for:

MKC HOLDINGS, LLC
15010 N 78th Way, Suite 109
Scottsdale, AZ 85260

Prepared by:

LANDCOR CONSULTING

6859 E. Rembrandt Ave. #124
Mesa, Arizona 85212
(480) 223-8573

Registered Professional Engineer (Civil)
CERTIFICATE NO.
53735
JOEL D.
MILLER
Date Signed 7/14/2021
ARIZONA, U.S.A.

July 2021
Job # 1763

SEWER REPORT
FOR
NAVAJO LOFTS

TABLE OF CONTENTS

I.   PROJECT DESCRIPTION

This project consists of thirty new duplex buildings, each having two units, as well as associated site improvements including an office, pool, and ramada. The site is located just north of State Route 89A and east of Dry Creek Road in Sedona, AZ, in Section 11, Township 17 North, Range 5 East of the Gila and Salt River Base and Meridian. The site is bounded by Aria Street to the north, Symphony Way to the east, vacant land to the south, and Navajo Drive to the west. The terrain is typical high desert, and slopes generally from northeast to southwest.

Sewer improvements proposed as part of this project include two new sewer taps connecting to the existing sewer main in Navajo Drive and associated onsite piping. See the *Preliminary Sewer Plan* (Appendix A) for the location of existing and proposed sewer facilities.

II.   EXISTING CONDITIONS

The public sanitary sewer line serving the site is an 8-in line which runs in Navajo Drive, flowing to the south. There is also an 8" sewer line running in Symphony Way to the east of the site, and a 6" line in a portion of Aria Street on the north side of the site.

III.   BASIS OF DESIGN

Wastewater discharge from this site will be collected in two new 8-inch services which will be constructed to the existing public sewer main in Navajo Drive.

Based on the Arizona Administrative Code *Town of Queen Creek Sewer Modeling and Master Plan,* Table 1.4.5.1, the projected sewer flow for this project is 9,120 GPD.

The 8-inch sewer service is adequately sized to accommodate flow from this Project combined (see Appendix B).

IV.   CONCLUSIONS

- Sewer infrastructure will be designed in accordance with City of Sedona design guidelines.

- The proposed 8-inch sewer service is adequately sized to meet the calculated wastewater demand.

- All construction will be in compliance with applicable environmental laws and regulations.

1

APPENDIX A

FIGURES

DRY CREEK RD

ANDANTE DR

HARMONY DR

PROJECT SITE

SR89A

N

LANDCOR
CONSULTING

6859 E. Rembrandt Ave, 124
Phoenix, AZ 85212
Ph: (480) 223-8573
landcorconsulting.com

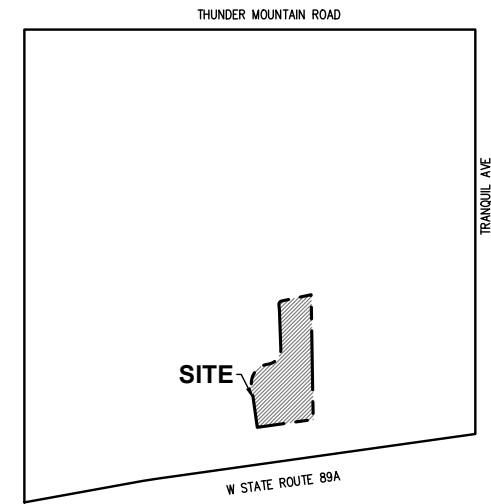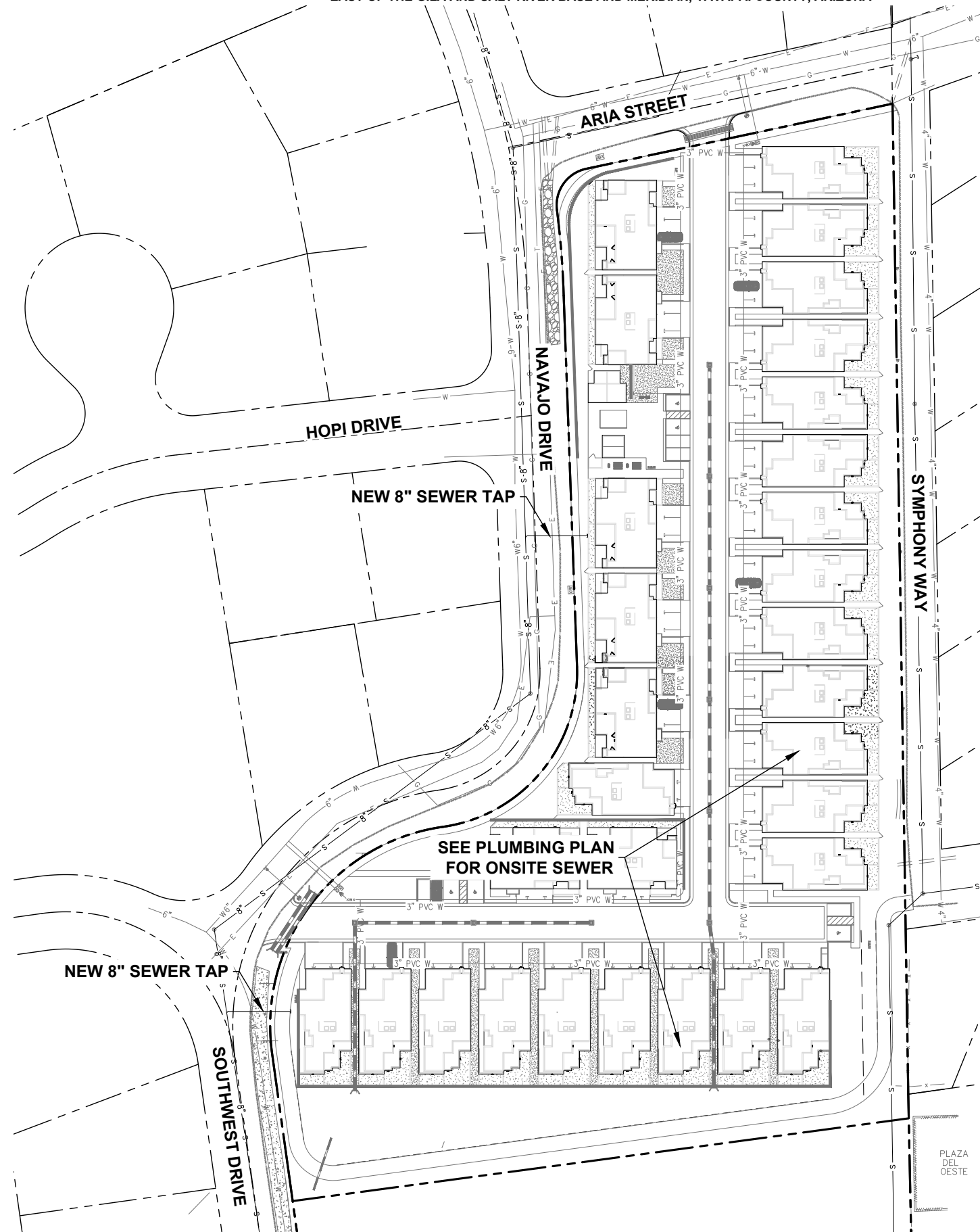| DATE: 7/14/21	FIGURE 1	JOB NO.
SCALE: 1"=750'	SITE LOCATION MAP	1763

PRELIMINARY SEWER PLAN
FOR
10 NAVAJO DR

APN:408-24-536B
SOUTHWEST QUARTER OF THE SOUTHWEST QUARTER OF SECTION 11, TOWNSHIP 17 NORTH, RANGE 5
EAST OF THE GILA AND SALT RIVER BASE AND MERIDIAN, YAVAPAI COUNTY, ARIZONA

ARIA STREET

NAVAJO DRIVE

HOPI DRIVE

NEW 8" SEWER TAP

SYMPHONY WAY

**SEE PLUMBING PLAN
FOR ONSITE SEWER**

NEW 8" SEWER TAP

SOUTHWEST DRIVE

PLAZA
DEL
OESTE

THUNDER MOUNTAIN ROAD

TRANQUIL AVE

SITE

W STATE ROUTE 89A

VICINITY MAP
SEC 11, T17N, R5E
NTS

OWNER

MKC HOLDINGS LLC
15010 N 78TH WAY SUITE 109
SCOTTSDALE AZ 85260
PHONE: (602) 390-9401
CONTACT: KEITH HOLBEN
EMAIL: kh@mkcompany.com

ENGINEER

LANDCOR CONSULTING
6859 E. REMBRANDT AVE. #124
MESA, AZ 85212
PHONE: (480) 734-9157
CONTACT: JOEL D. MILLER, P.E.
EMAIL: joel@landcorconsulting.com

PROJECT DATA

ADDRESS:	10 NAVAJO DR
	CITY OF SEDONA
TAX ASSESSORS PARCEL NUMBER:	408-24-536B
ZONING	CO
PARCEL AREA:	196,020 SQFT. (4.5 ACRES)
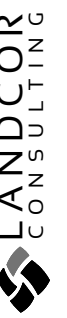
NAVAJO LOFTS
PRELIMINARY SEWER PLAN
10 NAVAJO DRIVE
SEDONA, ARIZONA

DATE:

REVISIONS:

PRELIMINARY
SEWER
PLAN

DATE: 7/14/21

PROJ. # : 1763

C2.1

1 OF 1

FIGURE 2

N

**PRELIMINARY
NOT FOR
CONSTRUCTION**

53735
JOEL D.
MILLER

| 40 | 20 | 0 | 20 | 40 | | 80 |
SCALE: 1"=40'

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

ARIZONA811

Call 811 or click Arizona811.com

APPENDIX B

SEWER CALCULATIONS

LANDCOR
CONSULTING

6859 E. Rembrandt Ave. #124
Mesa, Arizona 85212
(480) 223-8573

Navajo Lofts
Wastewater Calculations

Development Data:

Development:	Navajo Lofts
Location:	10 Navajo Dr Sedona, AZ
Land Use:	Condominium
Population:	See below

Wastewater Impact:

Wastewater Source	Use	Sewage Design Flow per Applicable Unit (GPD)*	Applicable Unit	Quantity**	Sewage Design Flow (GPD)
Condominiums	Residential	80	Person	114.0	9,120

Design Flow =	**9,120**	GPD
Peak Day = 4.5 x Design Flow =	**41,040**	GPD
=	**28.5**	GPM
=	**0.06**	CFS

* Sewage Design Flow per AAC Title 18, Chapter 9, Table 1. Unit Design flows
**Based on 60 units @ 1.9 persons/dwelling unit.

Channel Report

Navajo Lofts Sewer Capacity

Circular

Diameter (ft)	=	0.67
Invert Elev (ft)	=	93.00
Slope (%)	=	0.50
N-Value	=	0.013

Calculations

Compute by:		Known Q
Known Q (cfs)	=	0.06

Highlighted

Depth (ft)	=	0.12
Q (cfs)	=	0.060
Area (sqft)	=	0.04
Velocity (ft/s)	=	1.40
Wetted Perim (ft)	=	0.59
Crit Depth, Yc (ft)	=	0.12
Top Width (ft)	=	0.51
EGL (ft)	=	0.15
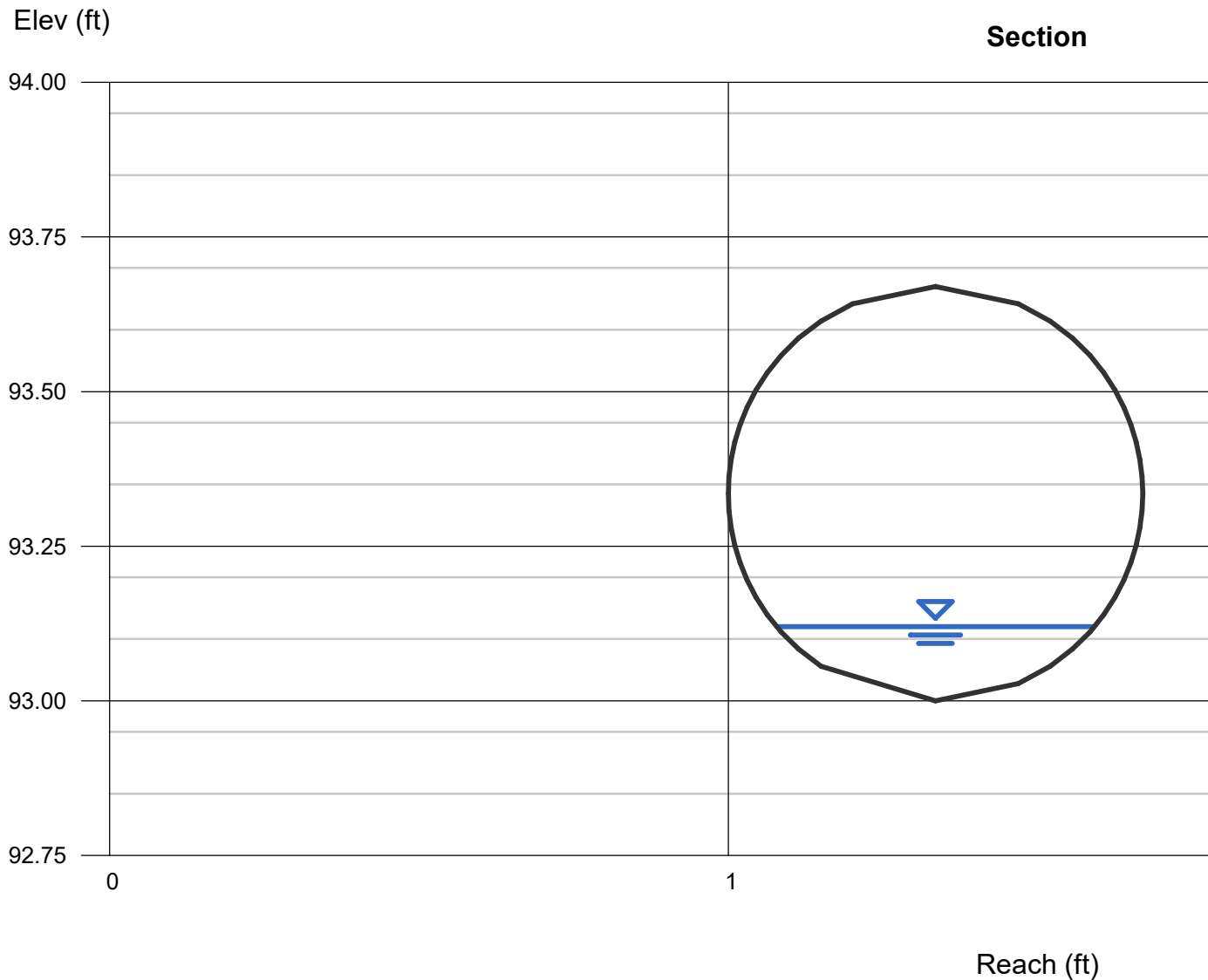
      b.   Any changes are reflected in as-built plans submitted with the Engineer's Certificate of Completion.

    2.   The name of the service provider or certified operator that is responsible for implementing the performance assurance plan.

G.   Reporting requirement. The permittee shall provide the Department with the following information on the anniversary date of the Discharge Authorization:

    1.   A form signed by the certified operator or service provider that:

        a.   Provides any data or documentation required by the performance assurance plan,

        b.   Certifies compliance with the requirements of the performance assurance plan, and

        c.   Describes any additions to the facility during the year that increased flows and certifies that the flow did not exceed 24,000 gallons per day during any day; and

    2.   Any applicable fee required by 18 A.A.C. 14.

H.   Facility expansion. If an expansion of an on-site wastewater treatment facility operating under this Section involves the installation of a separate on-site wastewater treatment facility on the property with a design flow of less than 3000 gallons per day, the applicant shall submit the applicable Notice of Intent to Discharge and fee required under 18 A.A.C. 14 for the separate on-site wastewater treatment facility.

    1.   The applicant shall indicate in the Notice of Intent to Discharge the Department's file number and the issuance date of the Discharge Authorization previously issued by the Director under this Section for the property.

    2.   Upon satisfactory review, the Director shall reissue the Discharge Authorization for this Section, with the new issuance date and updated information reflecting the expansion.

    3.   If the expansion causes the accumulative design flow from on-site wastewater treatment facilities on the property to equal or exceed 24,000 gallons per day, the Director shall not reissue the Discharge Authorization, but shall require the applicant to submit an application for an individual permit addressing all proposed and operating facilities on the property.

Historical Note

New Section adopted by final rulemaking at 7 A.A.R. 235, effective January 1, 2001 (Supp. 00-4). Amended by final rulemaking at 11 A.A.R. 4544, effective November 12, 2005 (05-3).

Table 1.   **Unit Design Flows**

Wastewater Source	Applicable Unit	Sewage Design Flow per Applicable Unit, Gallons Per Day
Airport	Passenger (average daily number)	4
	Employee	15
Auto Wash	Facility	Per manufacturer, if consistent with this Chapter
Bar/Lounge	Seat	30
Barber Shop	Chair	35
Beauty Parlor	Chair	100
Bowling Alley (snack bar only)	Lane	75

Camp
  Day camp, no cooking facilities
  Campground, overnight, flush toilets
  Campground, overnight, flush toilets and shower
  Campground, luxury
  Camp, youth, summer, or seasonal
	
	Camping unit
	Camping unit
	Camping unit
	Person
	Person
		
		30
		75
		150
		100-150
		50

Church
  Without kitchen
  With kitchen
	
	Person (maximum attendance)
	Person (maximum attendance)
		
		5
		7

Country Club	Resident Member	100
	Nonresident Member	10
Dance Hall	Patron	5
Dental Office	Chair	500
Dog Kennel	Animal, maximum occupancy	15
Dwelling For determining design flow for sewage treatment facilities under R18-9-B202(A)(9)(a) and sewage collection systems under R18-9-E301(D) and R18-9-B301(K), excluding peaking factor.	Person	80

Dwelling For on-site wastewater treatment facilities per R18-9-E302 through R18-9-E323: Apartment Building		
1 bedroom	Apartment	200
2 bedroom	Apartment	300
3 bedroom	Apartment	400
4 bedroom	Apartment	500
Seasonal or Summer Dwelling (with recorded seasonal occupancy restriction)	Resident	100
Single Family Dwellings	see R18-9-A314(D)(1)	see R18-9-A314(D)(1)
Other than Single Family Dwelling, the greater flow value based on: Bedroom count		
1-2 bedrooms	Bedroom	300
Each bedroom over 2	Bedroom	150
Fixture count	Fixture unit	25
Fire Station	Employee	45
Hospital		
All flows	Bed	250
Kitchen waste only	Bed	25
Laundry waste only	Bed	40
Hotel/motel		
Without kitchen	Bed (2 person)	50
With kitchen	Bed (2 person)	60
Industrial facility		
Without showers	Employee	25
With showers	Employee	35
Cafeteria, add	Employee	5
Institutions		
Resident	Person	75
Nursing home	Person	125
Rest home	Person	125
Laundry		
Self service	Wash cycle	50
Commercial	Washing machine	Per manufacturer, if consistent with this Chapter
Office Building	Employee	20
Park (temporary use)		
Picnic, with showers, flush toilets	Parking space	40
Picnic, with flush toilets only	Parking space	20
Recreational vehicle, no water or sewer connections	Vehicle space	75
Recreational vehicle, with water and sewer connections	Vehicle space	100
Mobile home/Trailer	Space	250
Restaurant/Cafeteria	Employee	20
With toilet, add	Customer	7
Kitchen waste, add	Meal	6
Garbage disposal, add	Meal	1
Cocktail lounge, add	Customer	2
Kitchen waste disposal service, add	Meal	2
Restroom, public	Toilet	200

School		
Staff and office	Person	20
Elementary, add	Student	15
Middle and High, add	Student	20
with gym & showers, add	Student	5
with cafeteria, add	Student	3
Boarding, total flow	Person	100
Service Station with toilets	First bay	1000
	Each additional bay	500
Shopping Center, no food or laundry	Square foot of retail space	0.1
Store	Employee	20
Public restroom, add	Square foot of retail space	0.1
Swimming Pool, Public	Person	10
Theater		
Indoor	Seat	5
Drive-in	Car space	10

Note: Unit flow rates published in standard texts, literature sources, or relevant area or regional studies are considered by the Department, if appropriate to the project.

Historical Note
New Section adopted by final rulemaking at 7 A.A.R. 235, effective January 1, 2001 (Supp. 00-4). Amended by final rulemaking at 11 A.A.R. 4544, effective November 12, 2005 (05-3).

ARTICLE 4. NITROGEN MANAGEMENT GENERAL PERMITS

R18-9-401.   **Definitions**
In addition to the definitions established in A.R.S. §§ 49-101 and 49-201 and A.A.C. R18-9-101, the following terms apply to this Article:
1. "Application of nitrogen fertilizer" means any use of a substance containing nitrogen for the commercial production of a crop or plant. The commercial production of a crop or plant includes commercial sod farms and nurseries.
2. "Contact stormwater" means stormwater that comes in contact with animals or animal wastes within a concentrated animal feeding operation.
3. "Crop or plant needs" means the amount of water and nitrogen required to meet the physiological demands of a crop or plant to achieve a defined yield.
4. "Crop or plant uptake" means the amount of water and nitrogen that can be physiologically absorbed by the roots and vegetative parts of a crop or plant following the application of water.
5. "Impoundment" means any structure, other than a tank or a sump, designed and maintained to contain liquids. A structure that stores or impounds only non-contact stormwater is not an impoundment under this Article.
6. "Liner" or "lining system" means any natural, amendment, or synthetic material used to reduce seepage of impounded liquids into a vadose zone or aquifer.
7. "NRCS guidelines" means the United States Department of Agriculture, Natural Resources Conservation Service, National Engineering Handbook, Part 651 Agricultural Waste Management Field Handbook, Chapter 10, 651.1080, Appendix 10D – Geotechnical, Design, and Construction Guideline (November 1997). This material is incorporated by reference and does not include any later amendments or editions of the incorporated material. Copies of the incorporated material are available for inspection at the Arizona Department of Environmental Quality, 1110 W. Washington, Phoenix, AZ 85007 or may be obtained from the United States Department of Agriculture, Natural Resources Conservation Service at ftp://

ftp.wcc.nrcs.usda.gov/downloads/wastemgmt/AWMFH/awmfh-chap10-app10d.pdf.

Historical Note
Adopted effective January 4, 1991 (Supp. 91-1). Section R18-9-401 renumbered from R18-9-201 and amended by final rulemaking at 7 A.A.R. 235, effective December 8, 2000 (Supp. 00-4). Amended by final rulemaking at 11 A.A.R. 4544, effective November 12, 2005 (05-3).

R18-9-402.   **Nitrogen Management General Permits: Nitrogen Fertilizers**
An owner or operator may apply a nitrogen fertilizer under this general permit without submitting a notice to the Director, if the owner or operator complies with the following best management practices:
1. Limit application of the fertilizer so that it meets projected crop or plant needs;
2. Time application of the fertilizer to coincide to maximum crop or plant uptake;
3. Apply the fertilizer by a method designed to deliver nitrogen to the area of maximum crop or plant uptake;
4. Manage and time application of irrigation water to minimize nitrogen loss by leaching and runoff; and
5. Use tillage practices that maximize water and nitrogen uptake by a crop or plant.

Historical Note
Adopted effective January 4, 1991 (Supp. 91-1). Section R18-9-402 renumbered from R18-9-202 and amended by final rulemaking at 7 A.A.R. 235, effective December 8, 2000 (Supp. 00-4). Amended by final rulemaking at 11 A.A.R. 4544, effective November 12, 2005 (05-3).

R18-9-403.   **Nitrogen Management General Permits: Concentrated Animal Feeding Operations**
A. An owner or operator may discharge from a concentrated animal feeding operation without submitting a notice to the Director, if the owner or operator complies with the following best management practices:
1. Harvest, stockpile, and dispose of animal manure from a concentrated animal feeding operation to minimize discharge of any nitrogen pollutant by leaching and runoff;