Preliminary Drainage Report

for

DESERT TRAILS MIDDLE SCHOOL

APN # 3096-361-07

September 6, 2019

Prepared by:

KOLIBRIEN®

Civil / Structural / Surveying
27919 Jefferson Ave., Suite 201
Temecula, CA 92590
Office: (888) 827-7140
Fax: (888) 827-9724

John H. Johnson, P.E., P.L.S.

Provided for:

Desert Trails Preparatory Academy
Contact: Debra Tarver
14530 Bellflower St.
Adelanto, CA. 92301
PHONE: (760) 530-7680

TABLE OF CONTENTS

DESCRIPTION PAGE

Contents

1 INTRODUCTION

1.1. SITE DESCRIPTION

1.1.1. LOCATION

The site is located East of Mesa View Drive, South of Pepperwood Street, North of Forest Park Lane in the City of Victorville. The site does not have an address. The APN is 3096-361-07

1.1.2. EXISTING CONDITION

The existing site is approximately 4.66 acres of undeveloped vacant land with natural vegetation. The existing drainage pattern is from the Southwest corner to the Northeast corner of the site. The groundwater table is approximately 348 feet deep. The site has type A soils with a moderately high infiltration rate of 0.5 to 1.4 in/hr to transmit water (Ksat) per the Geotechnical Report.

1.1.3. PROPOSED CONDITION

The proposed project is a charter middle school with a main building, modular buildings, sports courts, turf, landscaping, parking and an access road. Two driveways are proposed on Mesa View drive to give access to the parking lot. Due to the size of the project, it is considered a priority project. The proposed drainage discharges from the site in the northeast corner following the pattern of the existing condition.

1.2. PURPOSE OF REPORT

The purpose of this report is for the preliminary analysis of the hydrological and hydraulic conditions of the subject parcel during modeled flood events and the design recommendations to mitigate increased runoff and provide water quality treatment in accordance with the City of Victorville and San Bernardino County Flood Control, and California standards and guidelines.

1.3. FLOOD INFORMATION

The project is located in the Mojave River Watershed. FEMA area flood map 06071C6475H delineates the site as zone X which states the site is located just outside the area of 0.2% annual chance of flood; and not within any areas of 1% annual chance of flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and not within areas protected by levees from 1% annual chance flood.

2. SITE DISCUSSION

2.1. SITE

The report pulled from the San Bernardino County Stormwater GIS showed that there were no drainage facilities within two miles of the site. The drainage plan follows that of the San Bernardino County Hydrology Manual. The site is located in the Mojave River Watershed. A geotechnical study was completed for the site. The site is undisturbed and is relatively flat with a slope of 1% across the site.

3. RAINFALL DATA

3.1. Data

Rainfall data was pulled from the NOAA site and also from the San Bernardino Hydrology Manual. See the appendix for the report from NOAA.

4. ONSITE RUNOFF

4.1. ONSITE

The site is relatively flat with gentle slopes draining northerly and easterly to the northeasterly corner of the project site. The Rational Hydrology method was used to estimate peak flows, which would be used to size pipes, swales and gutters. Per the Runoff Curve Number on figure C-3 in the Hydrology Manual, a CN number of 50, which is grass for type A soils, was selected for the AMC II condition. The existing site has 0% impervious surface area. A CN number of 32, which is landscaping for type A soils, was selected for the AMC II condition. The proposed site has a 3.46 acre impervious surface area, which is 74% of the site. The existing and proposed rational hydrology maps are provided in the appendix. The following tables summarize the flows from the rational hydrology:

EXISTING CONDITION			
NODE	AREA (ACRES)	10 YEAR (CFS)	100 YEAR (CFS)
2	4.66	2.69	7.01

PROPOSED CONDITION			
NODE	AREA (ACRES)	10 YEAR (CFS)	100 YEAR (CFS)
2	1.5	2.69	4.19
3	3.16	6.78	10.73

Additionally, unit hydrographs were created following the Small Area Runoff Hydrograph Development method per Section J of the San Bernardino Hydrology Manual to estimate the volume difference between the pre-development and post-development condition. The volume and peak flow increases are mitigated by 4 bioretention basins proposed throughout the site. Here is a summary of the results for volumes:

SMALL AREA RUNOFF HYDROGRAPH SUMMARY		
STORM	VOLUME DIFFERENCE BETWEEN PRE-DEVELOPMENT AND POST DEVELOPMENT (CF)	VOLUME PROVIDED THROUGH INFILTRATION BMPS (CF)
10 YEAR	5,887	15,799
100 YEAR	5,511	15,799

Peak flow is being mitigated by the volume being captured in the basins and also by the retention time in the basins before they overflow at which point the runoff from the storm is greatly decreased. The 100 year flow is being modeled here by routing through the basins and using the Small Area Runoff Hydrographs accordingly.

Per the Hydrographs, at the time 18.87 minutes, we have the following condition:

Q_{in} = 10.73 CFS

Max. Volume = Time x 60 x Q_{in} = 12,149 CF

Available Storage Volume = 15,799 CF

Therefore,

Q_{out} = 0 CFS < Qexisting = 6.4 CFS

At the time 37.74 minutes, we have the following condition:

Q_{in} = 2.85 CFS

Max. Volume = $V_{max\ at\ 18.81}$ + (Time x 60 – 18.87 mins x 60) x Q_{in} = 15,375 CF

Available Storage Volume = 15,799 CF

Therefore,

Q_{out} = 0 CFS < Qexisting = 5 CFS

At the time 56.61 minutes, we have the following condition:

Q_{in} = 0.79 CFS

Max. Volume = $V_{max\ at\ 37.74}$ + (Time x 60 – 37.74 mins x 60) x Q_{in} = 16,270 CF

Available Storage Volume = 15,799 CF
Therefore,
Q_{out} = 0.79 CFS < Qexisting = 1.5 CFS

At the time 75.48 minutes, we have the following condition:

Q_{in} = 0.24 CFS
Max. Volume = $V_{max\ at\ 56.61}$ + (Time x 60 – 56.61 mins x 60) x Q_{in} = 16,541 CF
Available Storage Volume = 15,799 CF
Therefore,
Q_{out} = 0.24 CFS < Qexisting = 0.5 CFS

Per the analysis above, the peak flow for the proposed site after routing through the basins would be 0.79 CFS, which is at 56.61 minutes. The peak flow from the site in the existing condition from the rational method is 7.01 CFS. Therefore, the proposed condition greatly reduces the peak flow below the existing condition. The following table summarizes the analysis for the 10 year and 100 year storms.

RUNOFF HYDROGRAPH AND FLOOD ROUTING SUMMARY							
STORM EVENT	VOLUME REQUIRED (CF)	VOLUME PROVIDED (CF)	VOLUME DIFFERENCE (CF)	PEAK Q IN (CFS)	Q OUT (CFS)	PEAK Q EXISTING (CFS)	Q DIFFERENCE (CFS)
10 YEAR	5887	15799	-9912	6.78	0	2.69	-2.69
100 YEAR	5511	15799	-10288	10.73	0.79	7.01	-6.22

All onsite storm drain conveyance systems shall be sized to conservatively accommodate all 100-year rational peak flowrates.

Existing and proposed condition hydrology maps are attached in the appendix.

5. OFFSITE RUNOFF

5.1. OFFSITE

The offsite run-on to the project is a very minor area. The area is 0.09 acres and is the small slope form the residential tract to the south which drains to this site. This area was simply added to the project site area for the analysis.

6. STORMWATER TREATMENT

6.1. BMPs and Mitigation

The site development includes 4 bioretention basins sized to capture the LID BMP Volume and the Hydromodification volume. All drainage on the site is routed to these basins either through surface flow or through the pipe system. The basins will retain and infiltrate the required volumes and any flows that exceed the basin capacity will overflow through spillways to northeast corner of the site where flow from the site is discharged in the existing condition.

A preliminary WQMP has been developed and further details can be found in that report. Sheets on hydromododification have been attached in the Appendix of this report as well.

Here is a summary of the WQMP analysis:

LID BMP Design Capture Volume, DCV = 8,601 ft^3

LID Infiltration BMP Volume Captured = 15,799 ft^3

Volume Reduction Required for Hydromodification = 12,917 ft^3

Infiltration BMP Volume Captured = 15,799 ft^3

The basins throughout the site are sufficient to capture the volumes required in the WQMP. Per the WQMP, the hydromodification requirements are for the 10 years storm. The site is also increasing time of concentration by distributing flows to these basins. Additionally, the infiltration and increased time of concentration will reduce peak flows. Per the analysis in section 4, the overflow in the proposed condition is much less than the peak flow in the existing condition, so the basins mitigate the peak flow as well.

7. CONCLUSION

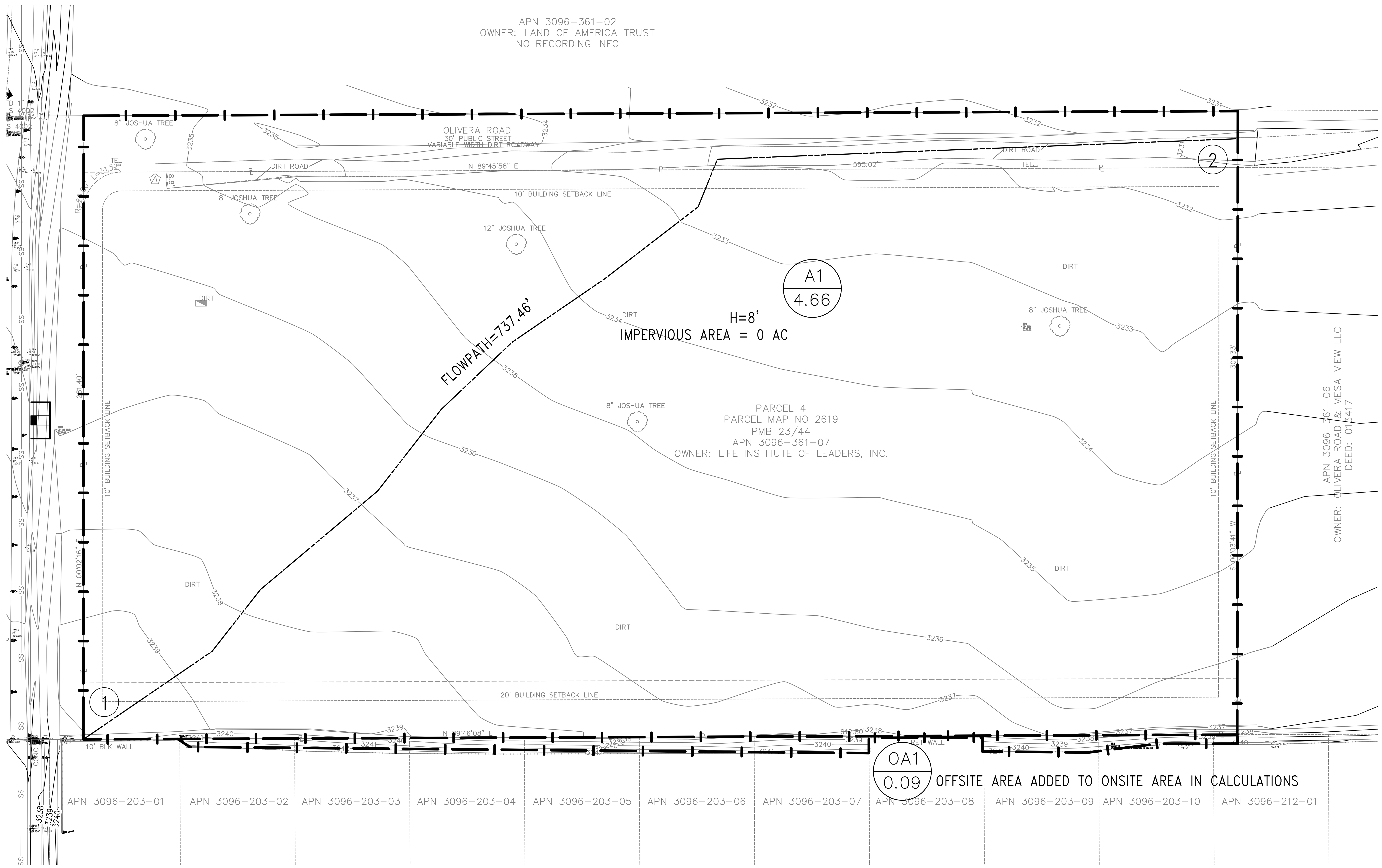
Rational Hydrology methodology was utilized to model the 10 and 100 year peak flows and flood volumes for this project. The San Bernardino County Hydrology Manual was used to develop the hydrological parameters for the 10 and 100 year storm events. Rational method runoff hydrographs were analyzed per Appendix J of the Hydrology Manual to determine flood volumes for each storm in the existing and proposed site conditions. The difference in volume and peak flows shall be mitigated via onsite infiltration as explained in Section 4 and the Stormwater Treatment summary in Section 6.

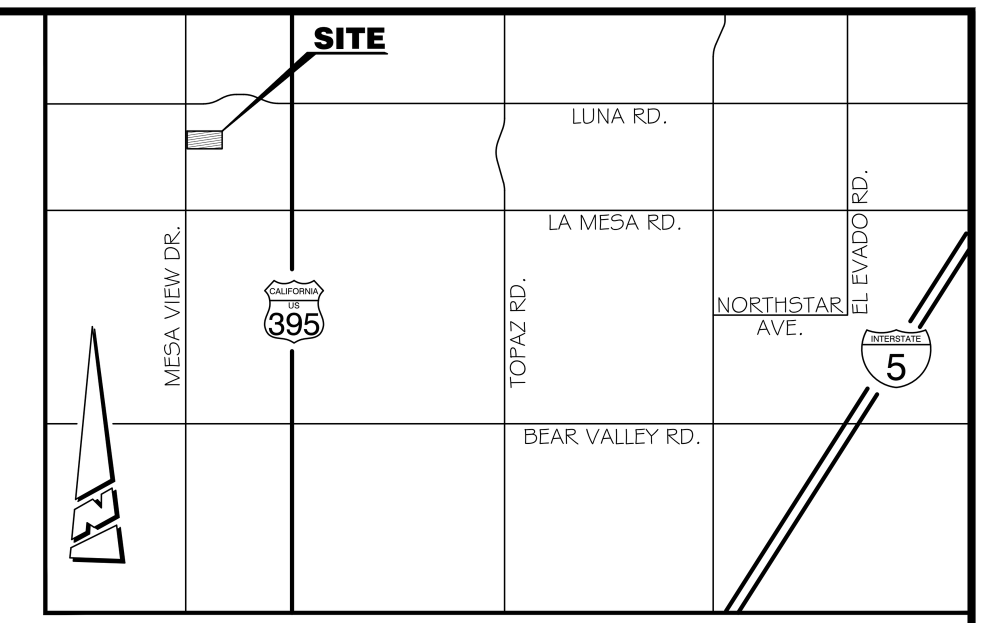
Given the analysis, the proposed site meets the requirements of the City of Victorville and San Bernardino County Flood Control, and California standards and guidelines. The construction of the proposed site will not impact the hydrology in the area.

8. APPENDIX

Figure 1

EXISTING RATIONAL HYDROLOGY MAP
for DESERT TRAILS MIDDLE SCHOOL





VICINITY MAP
NOT TO SCALE

SITE ADDRESS:
MESA VIEW DRIVE, VICTORVILLE, CA 92392
SOUTH OF PEPPERWOOD STREET, NORTH OF FOREST PARK LANE, EAST OF MESA VIEW DRIVE

ASSESSOR'S PARCEL NO.:
3096-361-07

FLOOD ZONE DESIGNATION:
THIS PROPERTY IS IN FLOODWAY AREA ZONE X, AS IS SHOWN ON FLOOD INSURANCE RATE MAPS FOR THE COUNTY OF SAN BERNARDINO, CALIFORNIA, SHOWN ON COMMUNITY PANEL NUMBER 06071C6475H.

ON-SITE DISTURBED AREA:
4.66 ACRES

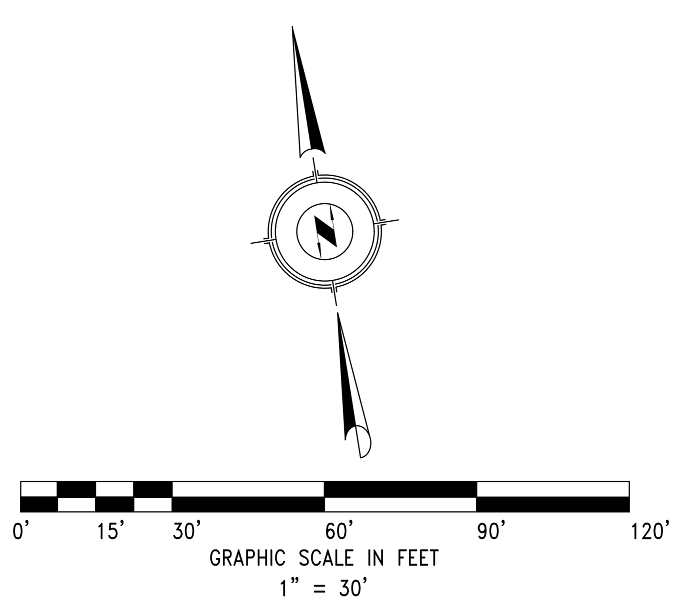
LEGEND:
- DA 1
- DMA 1
- FLOW LINE
- DRAINAGE FLOW DIRECTION
- PROP. BLDG PERIMETER
- BOUNDARY LINE
- RIGHT OF WAY
- CENTERLINE
- FLOW LINE
- FENCE LINE
- DRAINAGE MANAGEMENT AREA
- (XXX) EX. CONTOUR
- [XXX] PROP. CONTOUR
- EX. PALM TREE
- EX. TREE
- EX. FIRE HYDRANT
- EX. BUILDING
- P.C.C. CONCRETE SURFACE
- PAINT HANDICAP/CROSSWALK
- PAINT DIRECTION ARROW
- PAINT PARKING STALL
- X1 / XX.X INDICATES SUBAREA DESIGNATION, INDICATES AREA IN ACRES
- INDICATES DIRECTION OF STORMWATER RUNOFF
- (XX) NODE POINTS

HYDROLOGY SUMMARY

NODE	10 YEAR (CFS)	100 YEAR (CFS)
2	2.69	7.01

HYDROLOGY INFORMATION

ID	AREA (ACRES)	IMPERVIOUS AREA (ACRES)	PERVIOUS AREA (ACRES)	FLOWPATH LENGTH (LF)	SLOPE	TIME OF CONCENTRATION (MINUTES)
A1	4.66	0	4.66	737.46	0.0109	24.2



REGISTERED PROFESSIONAL ENGINEER
JOHN H. JOHNSON
No. 83934
Exp. 9/30/19
CIVIL
STATE OF CALIFORNIA

JOHN H. JOHNSON R.C.E. 83934 DATE
MY REGISTRATION EXPIRES ON 09/30/2019

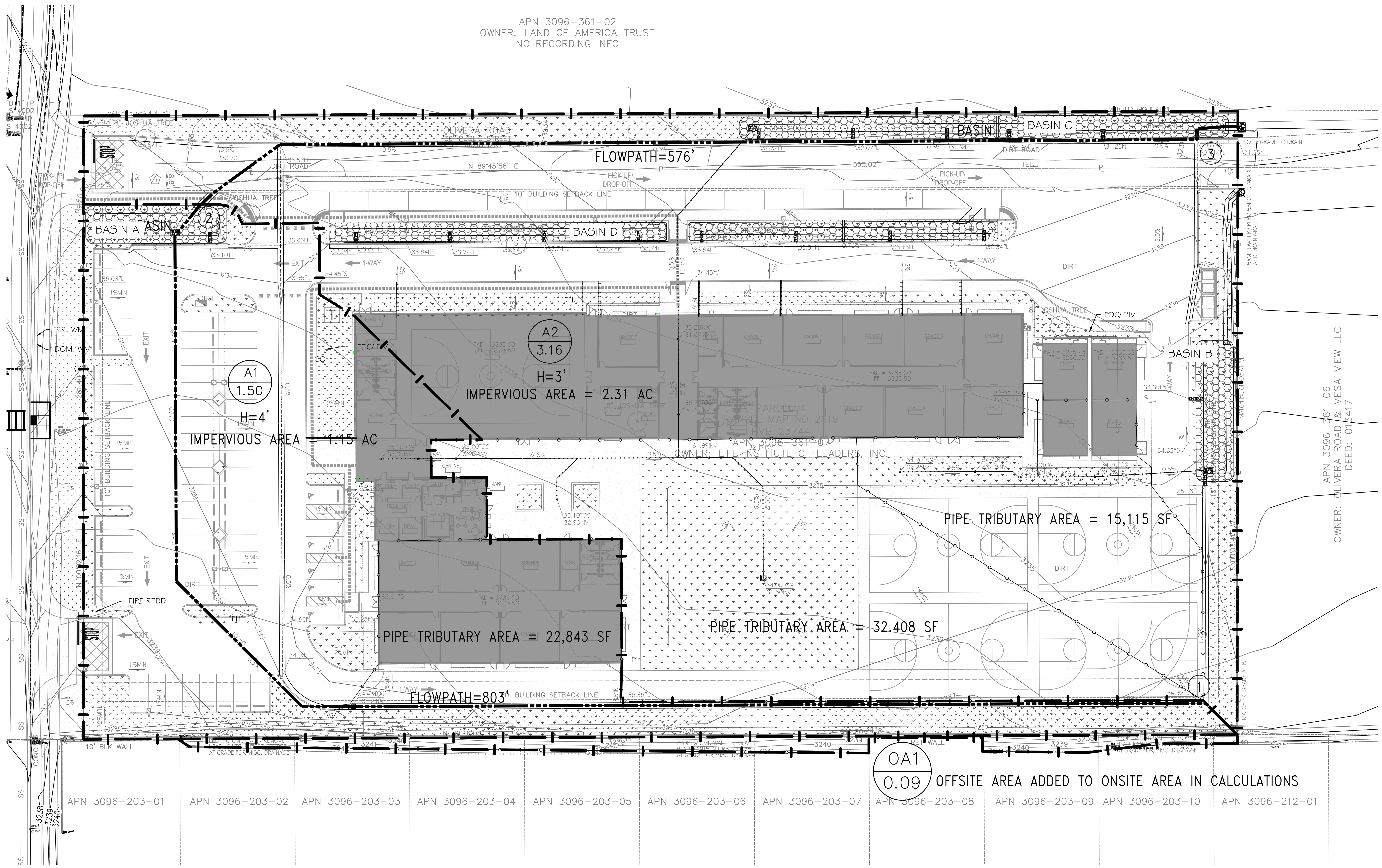
KOLIBRIEN
LAND SURVEYING - CIVIL ENGINEERING - STRUCTURAL ENGINEERING

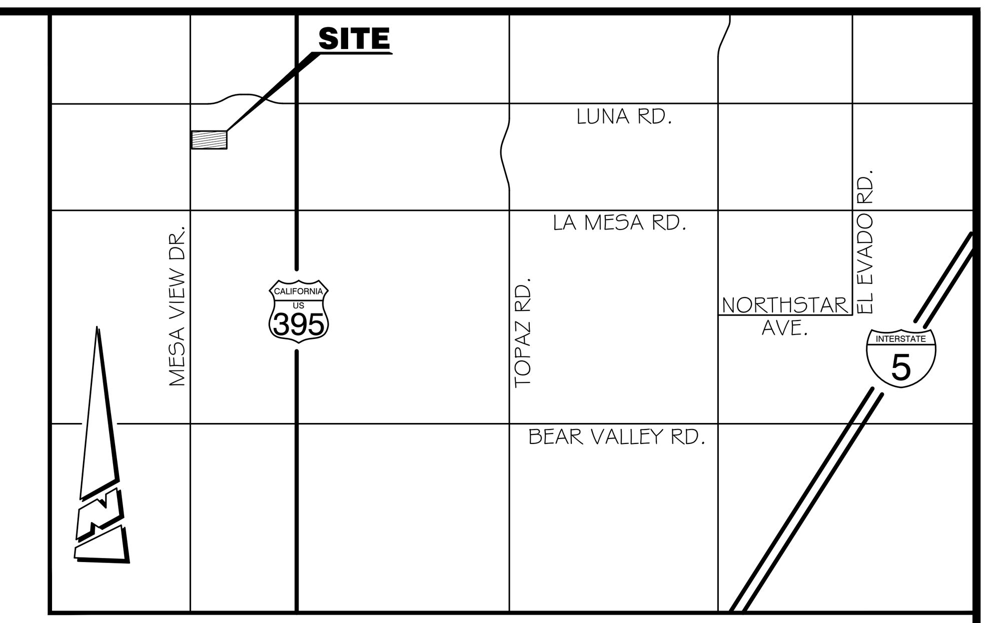
SHEET 1 OF 1

File: D03001

Figure 2

PROPOSED RATIONAL HYDROLOGY MAP
for DESERT TRAILS MIDDLE SCHOOL





VICINITY MAP
NOT TO SCALE

SITE ADDRESS:
MESA VIEW DRIVE, VICTORVILLE, CA 92392
SOUTH OF PEPPERWOOD STREET, NORTH OF FOREST PARK LANE, EAST OF MESA VIEW DRIVE

ASSESSOR'S PARCEL NO.:
3096-361-07

FLOOD ZONE DESIGNATION:
THIS PROPERTY IS IN FLOODWAY AREA ZONE X, AS IS SHOWN ON FLOOD INSURANCE RATE MAPS FOR THE COUNTY OF SAN BERNARDINO, CALIFORNIA, SHOWN ON COMMUNITY PANEL NUMBER 06071C6475H.

ON-SITE DISTURBED AREA:
4.66 ACRES

LEGEND:
- DA 1
- AREA FLOWING TO INLET AND STORM DRAIN PIPE WITHIN DA
- FLOW LINE
- DRAINAGE FLOW DIRECTION
- PROP. BLDG PERIMETER
- BOUNDARY LINE
- RIGHT OF WAY
- CENTERLINE
- FLOW LINE
- FENCE LINE
- DRAINAGE MANAGEMENT AREA
- (XXX) EX. CONTOUR
- [XXX] PROP. CONTOUR
- EX. PALM TREE
- EX. TREE
- EX. FIRE HYDRANT
- EX. BUILDING
- P.C.C. CONCRETE SURFACE
- PAINT HANDICAP/CROSSWALK
- PAINT DIRECTION ARROW
- PAINT PARKING STALL
- X1 / XX.X INDICATES SUBAREA DESIGNATION / INDICATES AREA IN ACRES
- INDICATES DIRECTION OF STORMWATER RUNNOFF
- (XX) NODE POINTS

HYDROLOGY SUMMARY

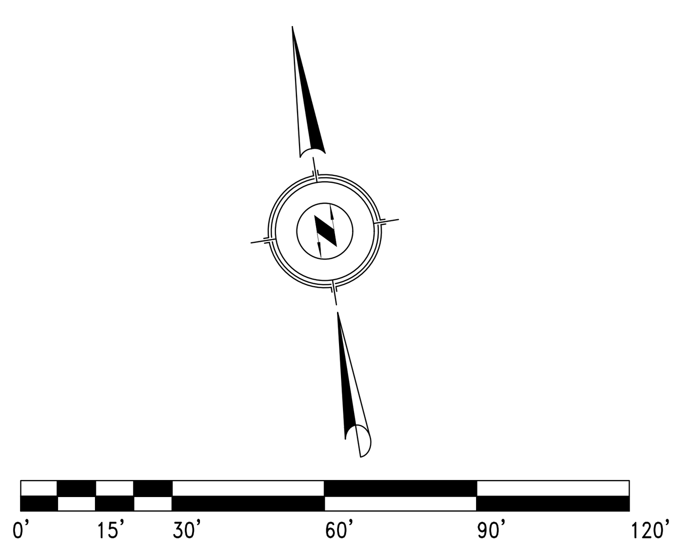
NODE	10 YEAR (CFS)	100 YEAR (CFS)
2	2.69	4.19
3	6.78	10.73

HYDROLOGY INFORMATION

ID	AREA (ACRES)	IMPERVIOUS AREA (ACRES)	PERVIOUS AREA (ACRES)	FLOWPATH LENGTH (LF)	SLOPE	TIME OF CONCENTRATION (MINUTES)
A1	1.5	1.15	0.35	803	0.005	14
A2	3.16	2.31	0.85	576	0.0053	5.56

SUMMARY FOR FLOWS TO STORM DRAIN SYSTEM

PIPE TRIBUTARY AREA PROPORTIONING					
TOTAL AREA	4.75	ACRES			
RATIONAL Q	10.71	CFS			
MAX INTENSITY	3.1	IN/HR			
MAX C	1				
INLET AND PIPE TRIBUTARY AREA WITHIN A1					
AREA (SF)	AREA (ACRES)	TOTAL AREA PROPORTION	TOTAL Q PROPORTION (CFS)	MAX POSSIBLE Q (MAX C X MAX I X AREA) (CFS)	NEEDED FOR 0.5% SLOPE
22,843.00	0.52	0.11	1.18	1.63	10"
INLET AND PIPE TRIBUTARY AREA WITHIN B1					
AREA (SF)	AREA (ACRES)	TOTAL AREA PROPORTION	TOTAL Q PROPORTION (CFS)	MAX POSSIBLE Q (MAX C X MAX I X AREA) (CFS)	PIPE SIZE NEEDED
15,115.00	0.35	0.07	0.78	1.08	8"
INLET AND PIPE TRIBUTARY AREA WITHIN C1					
AREA (SF)	AREA (ACRES)	TOTAL AREA PROPORTION	TOTAL Q PROPORTION (CFS)	MAX POSSIBLE Q (MAX C X MAX I X AREA) (CFS)	PIPE SIZE NEEDED
32,408.00	0.74	0.16	1.68	2.31	12"



GRAPHIC SCALE IN FEET
1" = 30'

REGISTERED PROFESSIONAL ENGINEER JOHN H. JOHNSON No. 83934 Exp. 9/30/19 CIVIL STATE OF CALIFORNIA

JOHN H. JOHNSON R.C.E. 83934 DATE
MY REGISTRATION EXPIRES ON 09/30/2019

KOLIBRIEN
LAND SURVEYING - CIVIL ENGINEERING - STRUCTURAL ENGINEERING

SHEET 1 OF 1

File: D03001

Appendix A

RATIONAL CALCULATIONS

EXISTING RATIONAL HYDROLOGY - 10 YEAR

Drainage Area	Soil and Development	A Acres	I in/hr	ap	Fp	Q CFS	SUM Q	Slope	L FT	V fps	TC	Sum T
								0.0109	737.00		24.20	
A1	A, grass, fair	4.75	1.45	1.00	0.82	2.6933						24.20

EXISTING RATIONAL HYDROLOGY - 100 YEAR

Drainage Area	Soil and Development	A Acres	I in/hr	ap	Fp	Q CFS	SUM Q	Slope	L FT	V fps	TC	Sum T
								0.0109	737.00		24.20	
A1	A, grass, fair	4.75	2.10	1.00	0.46	7.011						24.20

PROPOSED RATIONAL HYDROLOGY - 10 YEAR

Drainage Area	Soil and Development	A Acres	I in/hr	ap	Fp	Q CFS	SUM Q	Slope	L FT	V fps	TC	Sum T
								0.0050	803.00		14.00	
A1	Commercial, Lands	1.59	2.10	0.23	0.96	2.6864						14.00
								0.0053	567.00	1.70	5.56	
A2	Commercial, Lands	3.16	1.70	0.27	0.96	4.0976	6.78					19.56

PROPOSED RATIONAL HYDROLOGY - 100 YEAR

Drainage Area	Soil and Development	A Acres	I in/hr	ap	Fp	Q CFS	SUM Q	Slope	L FT	V fps	TC	Sum T
								0.0050	803.00		14.00	
A1	Commercial, Lands	1.59	3.10	0.23	0.74	4.1904						14.00
								0.0053	567.00	1.94	4.87	
A2	Commercial, Lands	3.16	2.50	0.27	0.74	6.5418	10.73					18.87

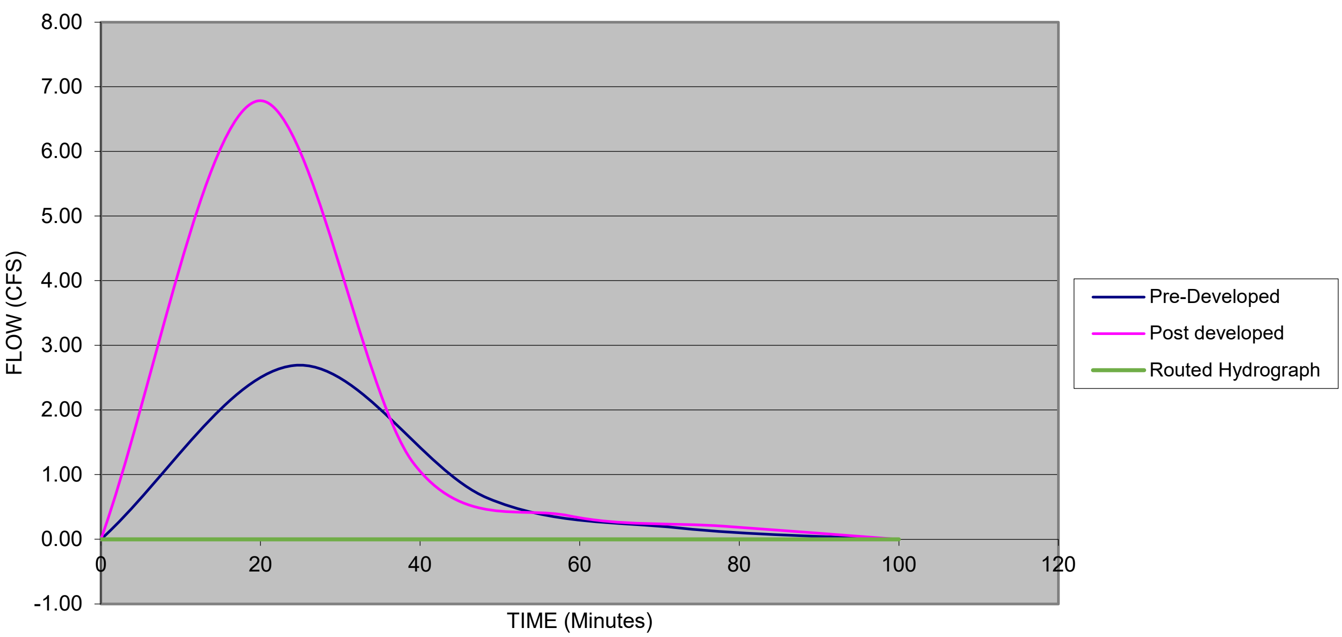
Appendix B

Small Area Runoff Hydrograph--10 year

Qpb=	Pre-developed peak flowrate =	2.69	cfs	Area =	4.75 ac
TCpb=	Pre-developed time of conc. =	24.2	min.		
Qpa=	Post-developed peak flowrate =	6.78	cfs		
TCpa=	Post-developed time of conc. =	19.56	min.		
Vs=	Volume of storage provided =	15799	ft^3	Required for Hydromodification	

Pre-Developed Hydrograph					Post-developed Hydrograph				
Unit Time	I_{TC} (in/hr)	Fm (in/hr)	Q (cfs)	Time	Unit Time	I_{TC} (in/hr)	Fm (in/hr)	Q (cfs)	Time
0			0.00	0	0			0	0
Tc	1.45	0.82	2.69	24.2	Tc	1.7	0.240	6.78	19.56
2Tc	0.86	0.82	0.64	48.4	2Tc	1.1	0.240	1.19	39.12
3Tc	0.61	0.82	0.17	72.6	3Tc	0.81	0.240	0.36	58.68
4Tc	0.46	0.82	0.01	96.8	4Tc	0.65	0.240	0.20	78.24
END	0		0.00	100	END	0		0	100

Vs required =Σ(Qpa*Tc-QpbTc)*60 = 5887 ft^3



Routed Volume = ΣQpbTc*60 -Vs =

V at 0Tc =	0	ft^3	Vout at 0Tc=	0	ft^3	Qout =	0	cfs
V at Tc =	7957	ft^3	Vout at Tc=	0	ft^3	Qout =	0	cfs
V at 2Tc =	9351	ft^3	Vout at 2Tc=	0	ft^3	Qout =	0	cfs
V at 3Tc =	9778	ft^3	Vout at 3Tc=	0	ft^3	Qout =	0	cfs
V at 4Tc =	10015	ft^3	Vout at 4Tc=	0	ft^3	Qout =	0	cfs
V at End=	10015	ft^3	Vout at End=	0	ft^3	Qout =	0	cfs

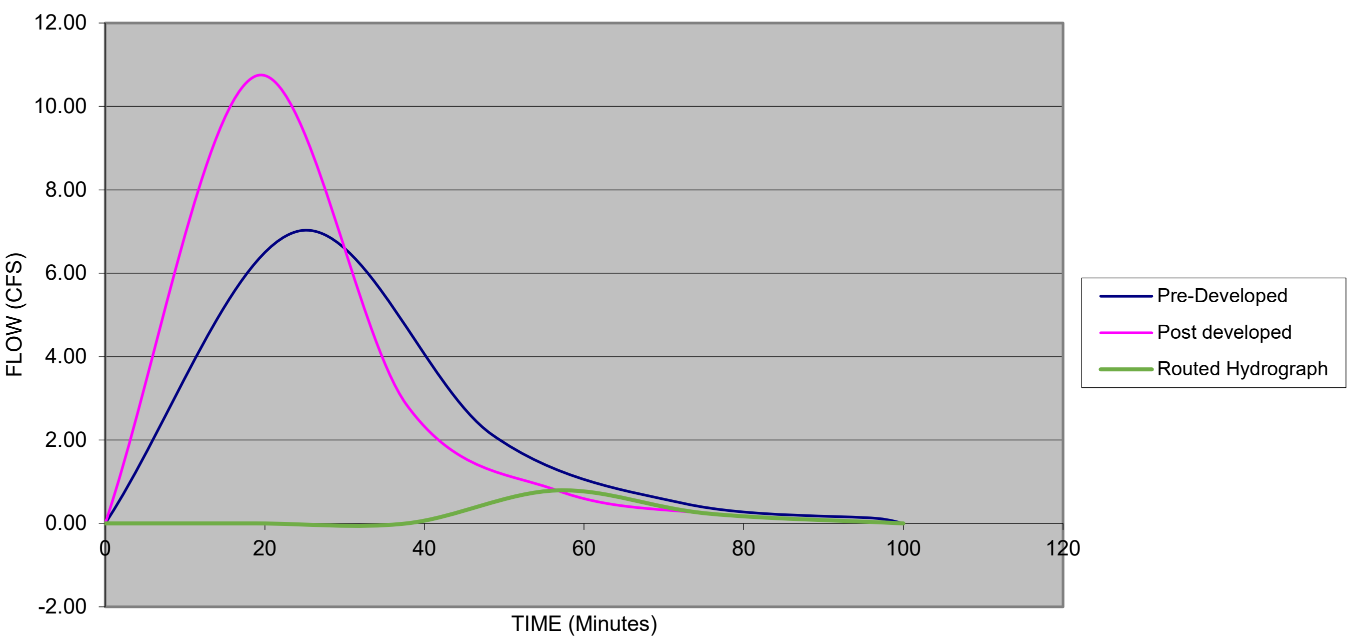
Small Area Runoff Hydrograph--100 year

Qpb= Pre-developed peak flowrate = 7.01 cfs Area = 4.75 ac
TCpb= Pre-developed time of conc. = 24.2 min.

Qpa= Post-developed peak flowrate = 10.73 cfs
TCpa= Post-developed time of conc. = 18.87 min.
Vs= Volume of storage provided = 15799 ft^3 Required for Hydromodification

Pre-Developed Hydrograph					Post-developed hydrograph				
Unit Time	I_{TC} (in/hr)	Fm (in/hr)	Q (cfs)	Time	Unit Time	I_{TC} (in/hr)	Fm (in/hr)	Q (cfs)	Time
0			0.00	0	0			0	0
Tc	2.1	0.460	7.01	24.2	Tc	2.5	0.185	10.73	18.87
2Tc	1.5	0.460	2.14	48.4	2Tc	1.85	0.185	2.85	37.74
3Tc	1.1	0.460	0.48	72.6	3Tc	1.4	0.185	0.79	56.61
4Tc	0.85	0.460	0.12	96.8	4Tc	1.1	0.185	0.24	75.48
END	0		0.00	100	END	0		0	100

Vs required =Σ(Qpa*Tc-QpbTc)*60 = 5511 ft^3



Routed Volume = ΣQpbTc*60 -Vs =

V at 0Tc =	0	ft^3	Vout at 0Tc=	0	ft^3	Qout =	0	cfs
V at Tc =	12149	ft^3	Vout at Tc=	0	ft^3	Qout =	0	cfs
V at 2Tc =	15375	ft^3	Vout at 2Tc=	0	ft^3	Qout =	0	cfs
V at 3Tc =	16272	ft^3	Vout at 3Tc=	473	ft^3	Qout =	0.79	cfs
V at 4Tc =	16540	ft^3	Vout at 4Tc=	741	ft^3	Qout =	0.24	cfs
V at End=	16540	ft^3	Vout at End=	741	ft^3	Qout =	0	cfs

BIORETENTION BASIN A HYDRAULICS (Stage vs. Storage)

Infiltration Volume Calculation		
Infiltration Rate	0.74	in/hr
Fill Time	3	hours
Basin Area	1486	sf
Infiltration Volume	274.91	cf

Use **19.64** **cf per 0.25 ft depth**

STAGE VS STORAGE Including INFILTRATION

Layer	**Stage**	**Area**	**Porosity**	**Storage**	**Infiltration**	**Total Storage**
	D (ft)	**A (ft²)**		**V (ft³)**	**Volume (ft²)**	**V (ft³)**
Gravel Layer	0.00	1486	0.4	0.00		0.00
	0.25	1486	0.4	148.60	19.64	168.24
	0.50	1486	0.4	297.20	19.64	336.48
	0.75	1486	0.4	445.80	19.64	504.72
Media Layer	1.00	1486	0.4	594.40	19.64	672.96
	1.25	1486	0.3	705.85	19.64	804.05
	1.50	1486	0.3	817.30	19.64	935.14
	1.75	1486	0.3	928.75	19.64	1066.23
	2.00	1486	0.3	1040.20	19.64	1197.32
	2.25	1486	0.3	1151.65	19.64	1328.41
	2.50	1486	0.3	1263.10	19.64	1459.50
	2.75	1486	0.3	1374.55	19.64	1590.59
Ponding Depth	3.00	1486	0.3	1486.00	19.64	1584.20
	3.25	1486	1	1857.50	19.64	2112.82
	3.50	1486	1	2229.00	19.64	2503.96

Completed by:	**RJD**
Checked by:	**JHJ**
Date:	**6/30/2019**
Sheet:	**1 of 1**

BIORETENTION BASIN B HYDRAULICS (Stage vs. Storage)

Infiltration Volume Calculation		
Infiltration Rate	0.74	in/hr
Fill Time	3	hours
Basin Area	1486	sf
Infiltration Volume	274.91	cf

Use **19.64** **cf per 0.25 ft depth**

STAGE VS STORAGE Including INFILTRATION

Layer	Stage	Area	Porosity	Storage	Infiltration	Total Storage
	D (ft)	A (ft²)		V (ft³)	Volume (ft²)	V (ft³)
Gravel Layer	0.00	1486	0.4	0.00		0.00
	0.25	1486	0.4	148.60	19.64	168.24
	0.50	1486	0.4	297.20	19.64	336.48
	0.75	1486	0.4	445.80	19.64	504.72
Media Layer	1.00	1486	0.4	594.40	19.64	672.96
	1.25	1486	0.3	705.85	19.64	804.05
	1.50	1486	0.3	817.30	19.64	935.14
	1.75	1486	0.3	928.75	19.64	1066.23
	2.00	1486	0.3	1040.20	19.64	1197.32
	2.25	1486	0.3	1151.65	19.64	1328.41
	2.50	1486	0.3	1263.10	19.64	1459.50
	2.75	1486	0.3	1374.55	19.64	1590.59
Ponding Depth	3.00	1486	0.3	1486.00	19.64	1584.20
	3.25	1486	1	1857.50	19.64	2112.82
	3.50	1486	1	2229.00	19.64	2503.96

Completed by:	**RJD**
Checked by:	**JHJ**
Date:	**6/30/2019**
Sheet:	**1 of 1**

BIORETENTION BASIN C HYDRAULICS (Stage vs. Storage)

Infiltration Volume Calculation		
Infiltration Rate	0.74	in/hr
Fill Time	3	hours
Basin Area	3106	sf
Infiltration Volume	574.61	cf

Use 41.04 cf per 0.25 ft depth

STAGE VS STORAGE Including INFILTRATION

Layer	Stage	Area	Porosity	Storage	Infiltration	Total Storage
	D (ft)	A (ft²)		V (ft³)	Volume (ft²)	V (ft³)
Gravel Layer	0.00	3106	0.4	0.00		0.00
	0.25	3106	0.4	310.60	41.04	351.64
	0.50	3106	0.4	621.20	41.04	703.28
	0.75	3106	0.4	931.80	41.04	1054.92
Media Layer	1.00	3106	0.4	1242.40	41.04	1406.56
	1.25	3106	0.3	1475.35	41.04	1680.55
	1.50	3106	0.3	1708.30	41.04	1954.54
	1.75	3106	0.3	1941.25	41.04	2228.53
	2.00	3106	0.3	2174.20	41.04	2502.52
	2.25	3106	0.3	2407.15	41.04	2776.51
	2.50	3106	0.3	2640.10	41.04	3050.50
	2.75	3106	0.3	2873.05	41.04	3324.49
Ponding Depth	3.00	3106	0.3	3106.00	41.04	3311.20
	3.25	3106	1	3882.50	41.04	4416.02
	3.50	3106	1	4659.00	41.04	5233.56

Completed by:	**RJD**
Checked by:	**JHJ**
Date:	**6/30/2019**
Sheet:	**1 of 1**

BIORETENTION BASIN D HYDRAULICS (Stage vs. Storage)

Infiltration Volume Calculation		
Infiltration Rate	0.74	in/hr
Fill Time	3	hours
Basin Area	3296	sf
Infiltration Volume	609.76	cf

Use 43.55 cf per 0.25 ft depth

STAGE VS STORAGE Including INFILTRATION

Layer	Stage	Area	Porosity	Storage	Infiltration	Total Storage
	D (ft)	A (ft^2)		V (ft^3)	Volume (ft^2)	V (ft^3)
Gravel Layer	0.00	3298	0.4	0.00		0.00
	0.25	3298	0.4	329.80	43.55	373.35
	0.50	3298	0.4	659.60	43.55	746.70
	0.75	3298	0.4	989.40	43.55	1120.05
Media Layer	1.00	3298	0.4	1319.20	43.55	1493.40
	1.25	3298	0.3	1566.55	43.55	1784.30
	1.50	3298	0.3	1813.90	43.55	2075.20
	1.75	3298	0.3	2061.25	43.55	2366.10
	2.00	3298	0.3	2308.60	43.55	2657.00
	2.25	3298	0.3	2555.95	43.55	2947.90
	2.50	3298	0.3	2803.30	43.55	3238.80
	2.75	3298	0.3	3050.65	43.55	3529.70
Ponding Depth	3.00	3298	0.3	3298.00	43.55	3515.75
	3.25	3298	1	4122.50	43.55	4688.65
	3.50	3298	1	4947.00	43.55	5556.70

Completed by:	**RJD**
Checked by:	**JHJ**
Date:	**6/30/2019**
Sheet:	**1 of 1**

ROUTING SUMMARY

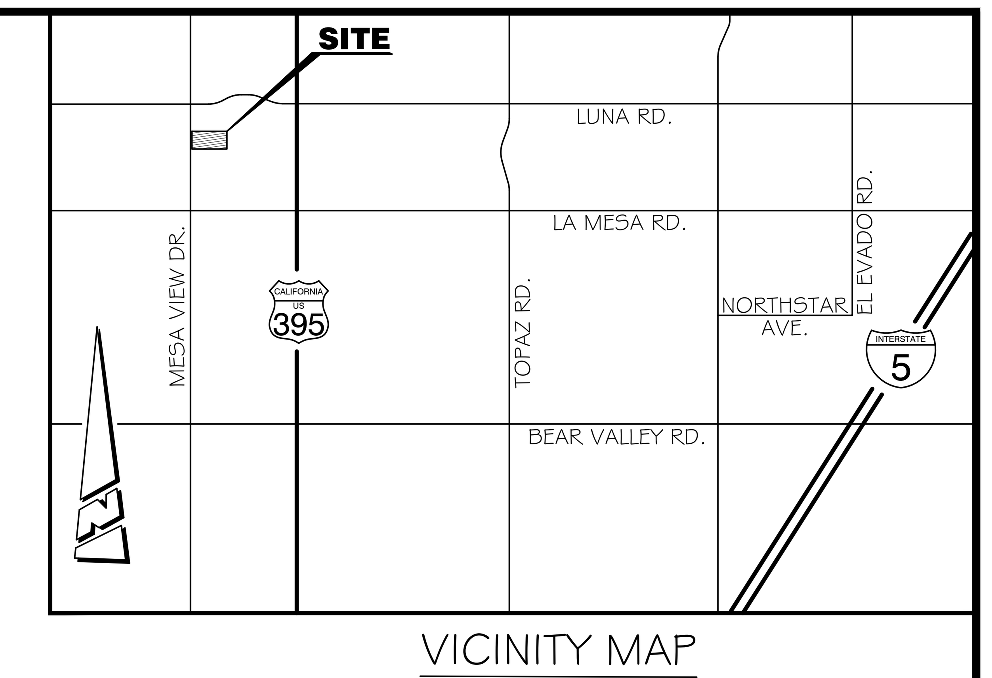
RUNOFF HYDROGRAPH AND FLOOD ROUTING SUMMARY							
	VOLUME REQUIRED (CF)	VOLUME PROVIDED (CF)	VOLUME DIFFERENCE (CF)	PEAK Q IN (CFS)	Q OUT (CFS)	PEAK Q EXISTING (CFS)	Q DIFFERENCE (CFS)
10 YEAR	5887	15799	-9912	6.78	0	2.69	-2.69
100 YEAR	5511	15799	-10288	10.73	0.79	7.01	-6.22

The table above summarizes the information from the Small Area Runoff Hydrograph sheets. It shows that the site is retaining/infiltrating the required volumes and mitigating peak flows.

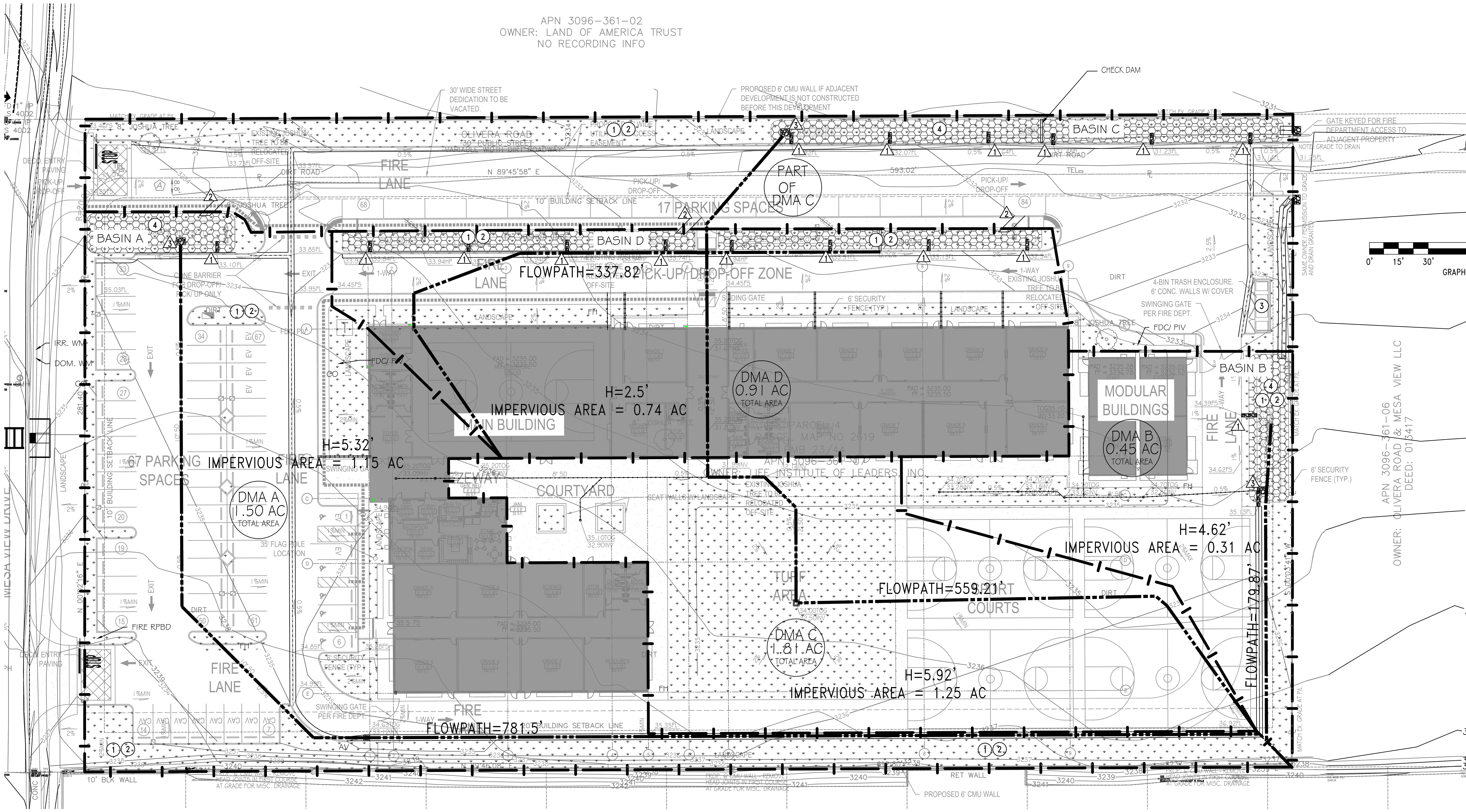
Completed by:	**RJD**
Checked by:	**JHJ**
Date:	**6/30/2019**
Sheet:	**1 of 1**

Appendix C

LID BMP SITE MAP
for DESERT TRAILS MIDDLE SCHOOL



VICINITY MAP
NOT TO SCALE



SITE ADDRESS:
MESA VIEW DRIVE, VICTORVILLE, CA 92392
SOUTH OF PEPPERWOOD STREET, NORTH OF FOREST PARK LANE, EAST OF MESA VIEW DRIVE

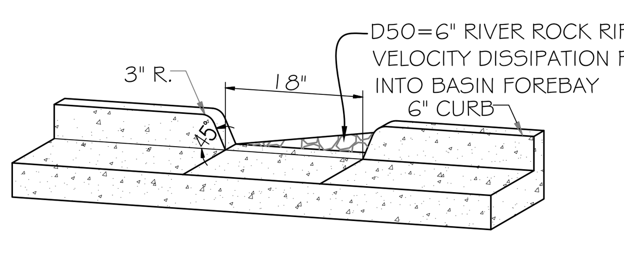
ASSESSOR'S PARCEL NO.:
3096-361-07

FLOOD ZONE DESIGNATION:
THIS PROPERTY IS IN FLOODWAY AREA ZONE X, AS IS SHOWN ON FLOOD INSURANCE RATE MAPS FOR THE COUNTY OF SAN BERNARDINO, CALIFORNIA, SHOWN ON COMMUNITY PANEL NUMBER 06071C6475H.

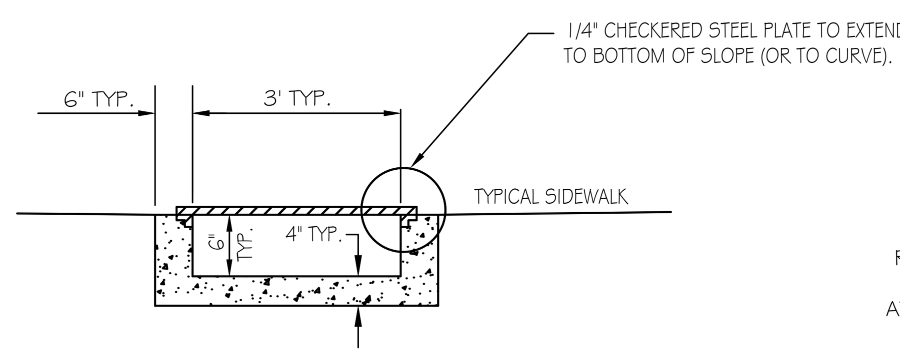
ON-SITE DISTURBED AREA:
4.66 ACRES

LEGEND:
- DX X / X.XX AC — AREA ID, AREA IN ACRES, DESCRIPTION
- DA 1
- DMA 1
- FLOW LINE
- DRAINAGE FLOW DIRECTION
- PROP. BLDG PERIMETER
- BOUNDARY LINE
- RIGHT OF WAY
- CENTERLINE
- FLOW LINE
- FENCE LINE
- DRAINAGE MANAGEMENT AREA
- (XXX) EX. CONTOUR
- [XXX] PROP. CONTOUR
- EX. PALM TREE
- EX. TREE
- EX. FIRE HYDRANT
- LANDSCAPING
- P.C.C. CONCRETE SURFACE
- PAINT HANDICAP/CROSSWALK
- PAINT DIRECTION ARROW
- PAINT PARKING STALL

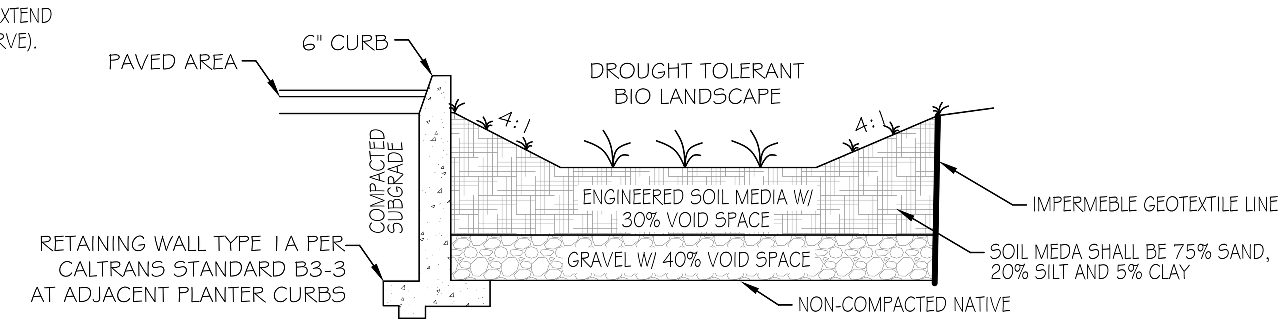
BMP NOTES
1. SD-10 DROUGHT TOLERANT LANDSCAPING AREA PER LANDSCAPE ARCHITECTURE PLANS USED TO MAXIMIZE PERVIOUS AREAS AND TREAT RUNOFF WHERE POSSIBLE.
2. SD-12 MINIMIZE NON-STORMWATER SITE RUNOFF THROUGH EFFICIENT IRRIGATION SYSTEM DESIGN AND CONTROLLERS
3. SD-32 PROVIDE SOLID ROOFS OVER TRASH ENCLOSURE.
4. TC-32 BIORETENTION BASIN



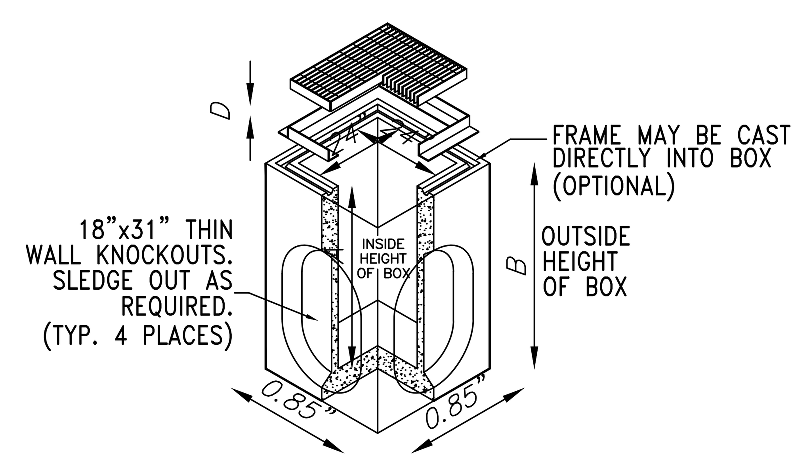
BIO-RETENTION INLET
N.T.S



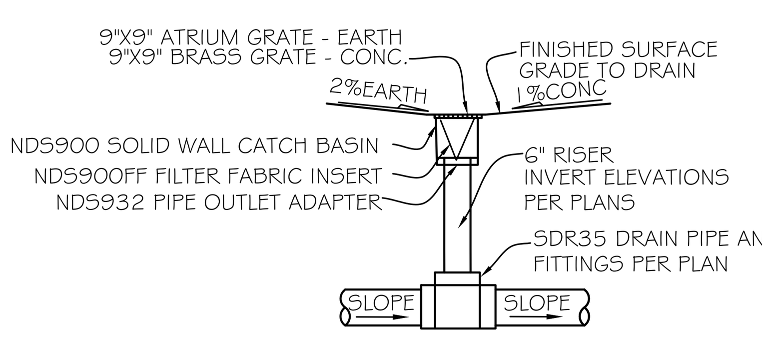
UNDERSIDEWALK DRAIN CROSS SECTION
N.T.S.
SECTION PER S.B. CO. STDS.



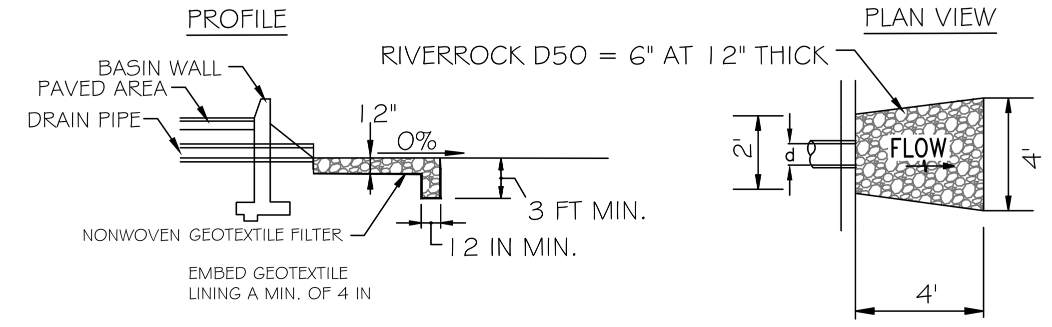
BIO-RETENTION / INFILTRATION BASINS
N.T.S



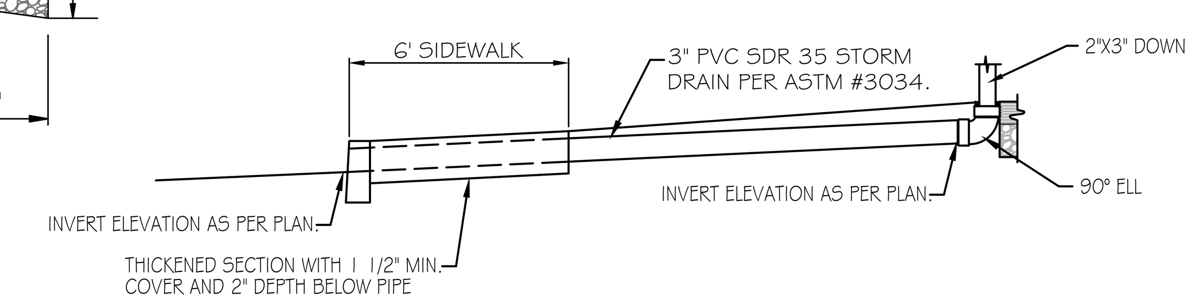
24" X 24" JENSEN PRECAST DROP INLET IN TURF AREA
NOT TO SCALE



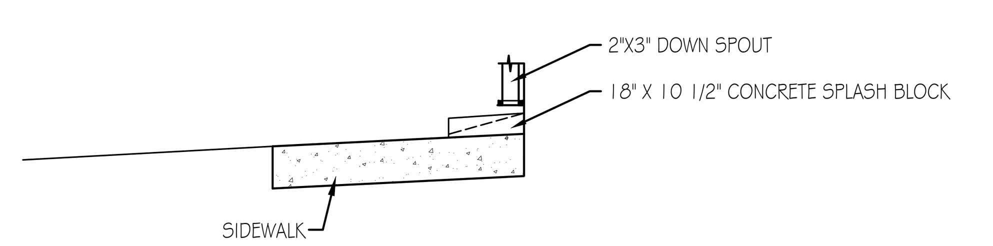
DROP INLET
N.T.S.



PIPE DISCHARGE TO BASIN
NOT TO SCALE



ROOF DOWNSPOUT TO DRAIN TO CURB
NTS



ROOF DOWNSPOUT TO SPLASH BLOCK
NTS

REGISTERED PROFESSIONAL ENGINEER
JOHN H. JOHNSON
No. 83934
Exp. 9/30/19
CIVIL
STATE OF CALIFORNIA

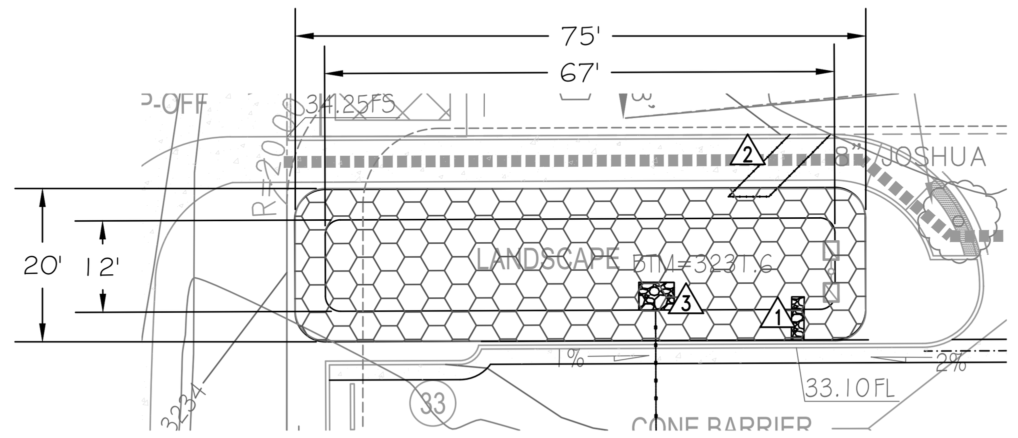
JOHN H. JOHNSON R.C.E. 83934 DATE
MY REGISTRATION EXPIRES ON 09/30/2019

KOLIBRIEN
LAND SURVEYING - CIVIL ENGINEERING - STRUCTURAL ENGINEERING

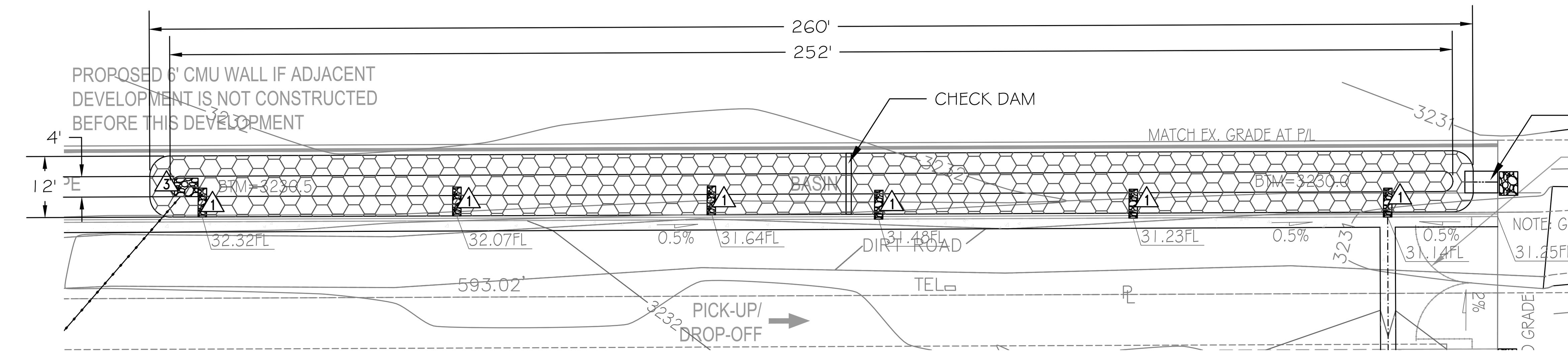
SHEET
1
OF
1

File: D03001

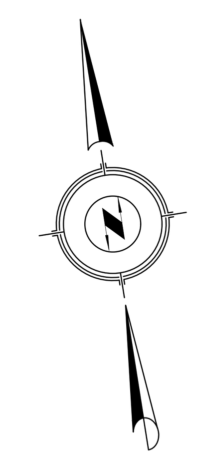
BIORETENTION BASIN DETAILS
for DESERT TRAILS MIDDLE SCHOOL

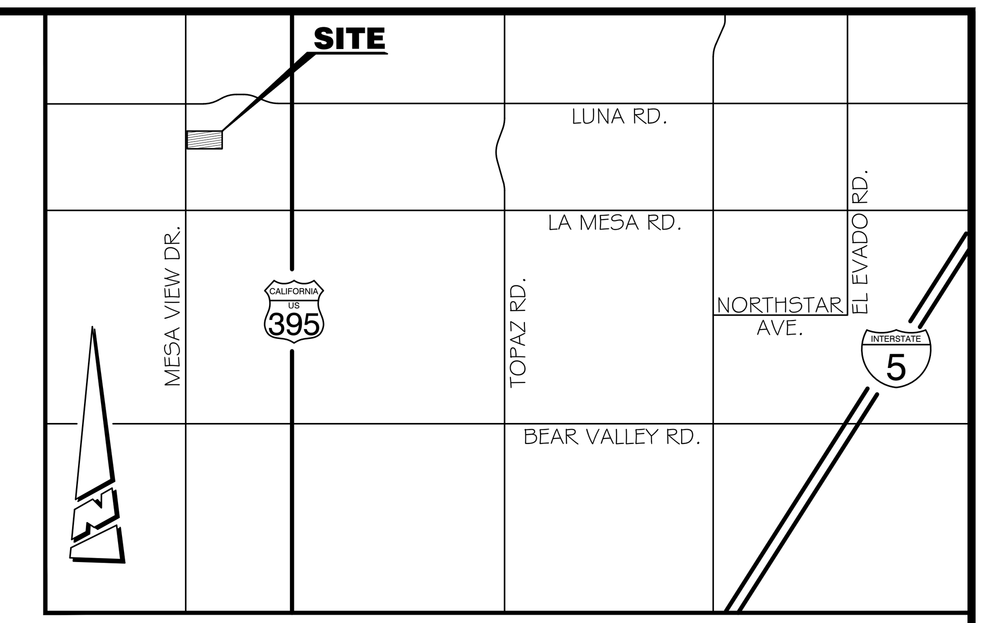


BIO-RETENTION BASIN A
SCALE 1"=20'

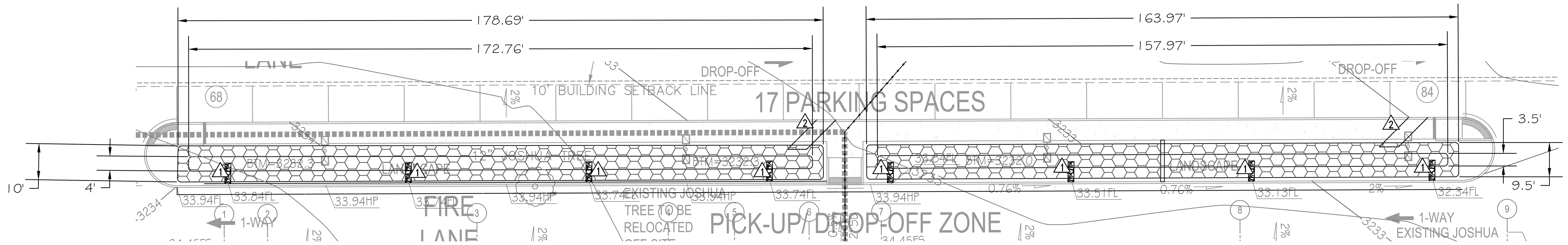


BIO-RETENTION BASIN C
SCALE 1"=20'

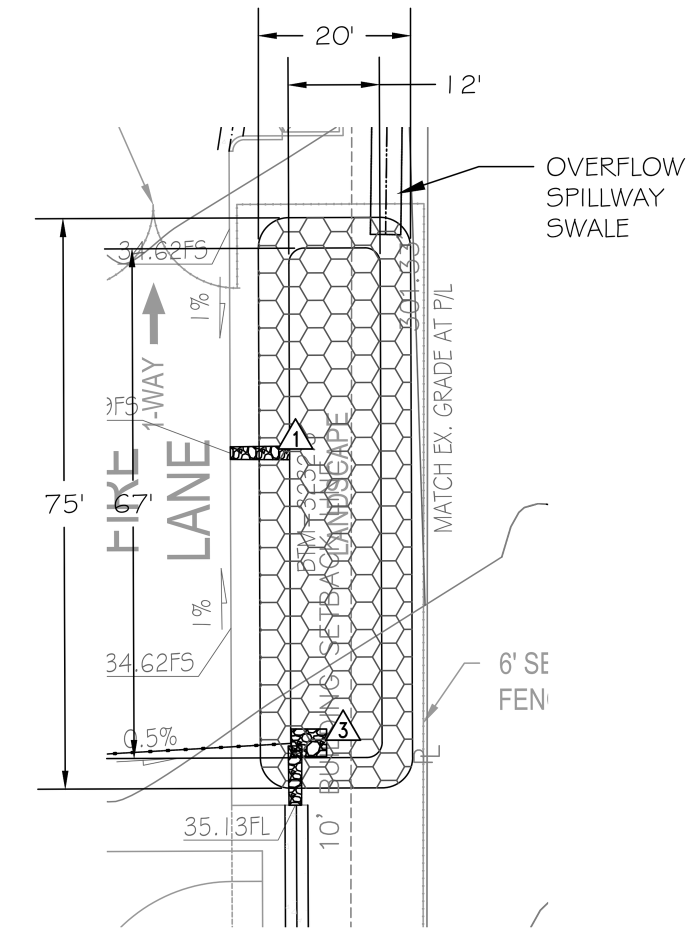




VICINITY MAP
NOT TO SCALE



BIO-RETENTION BASIN D
SCALE 1"=20'



BIO-RETENTION BASIN B
SCALE 1"=20'

SITE ADDRESS:

MESA VIEW DRIVE, VICTORVILLE, CA 92392
SOUTH OF PEPPERWOOD STREET, NORTH OF FOREST PARK LANE, EAST OF MESA VIEW DRIVE

ASSESSOR'S PARCEL NO.:

3096-361-07

FLOOD ZONE DESIGNATION:

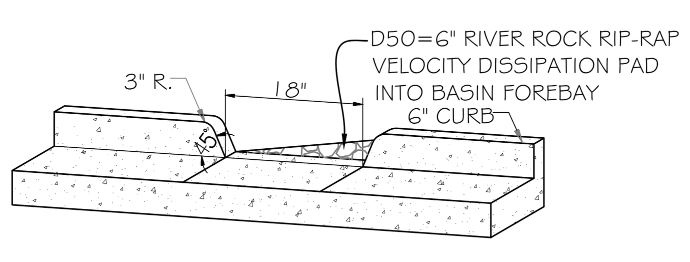
THIS PROPERTY IS IN FLOODWAY AREA ZONE X, AS IS SHOWN ON FLOOD INSURANCE RATE MAPS FOR THE COUNTY OF SAN BERNARDINO, CALIFORNIA, SHOWN ON COMMUNITY PANEL NUMBER 06071C6475H.

ON-SITE DISTURBED AREA:

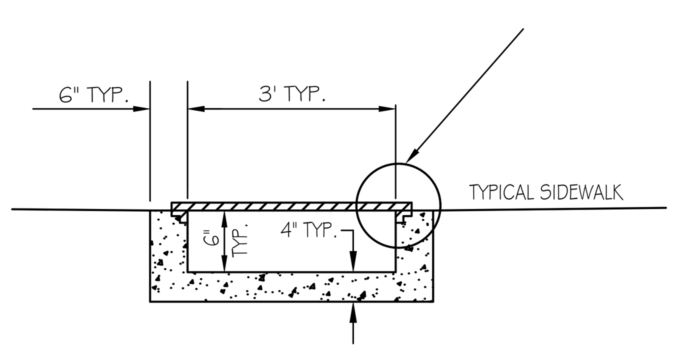
4.66 ACRES

LEGEND:

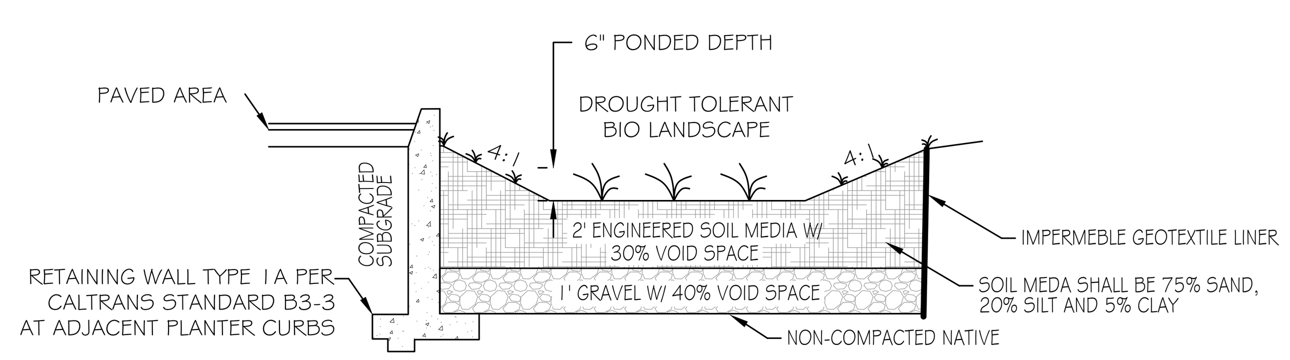
- DX X / X.XX AC — AREA ID, AREA IN ACRES, DESCRIPTION
- DA 1
- DMA 1
- FLOW LINE
- DRAINAGE FLOW DIRECTION
- PROP. BLDG PERIMETER
- BOUNDARY LINE
- RIGHT OF WAY
- CENTERLINE
- FLOW LINE
- FENCE LINE
- DRAINAGE MANAGEMENT AREA
- (XXX) EX. CONTOUR
- [XXX] PROP. CONTOUR
- EX. PALM TREE
- EX. TREE
- EX. FIRE HYDRANT
- LANDSCAPING
- P.C.C. CONCRETE SURFACE
- PAINT HANDICAP/CROSSWALK
- PAINT DIRECTION ARROW
- PAINT PARKING STALL



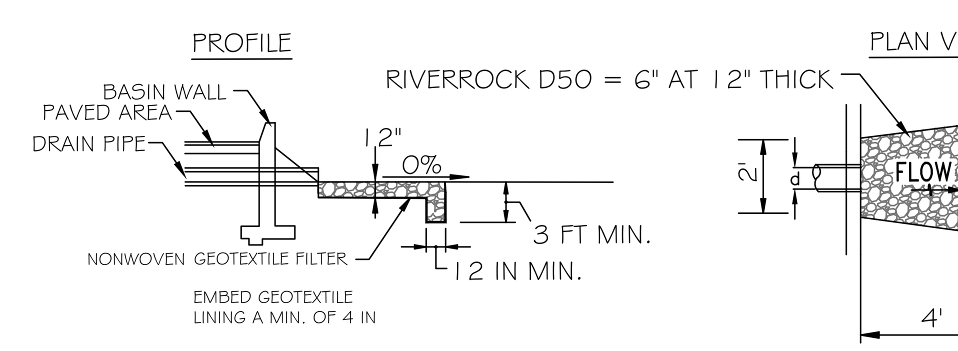
1 BIO-RETENTION INLET
N.T.S



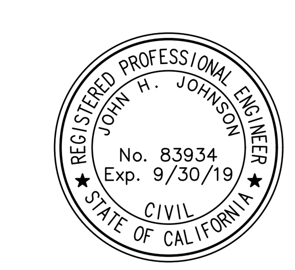
2 UNDERSIDEWALK DRAIN CROSS SECTION
N.T.S.
SECTION PER S.B. CO. STDS.



BIO-RETENTION / INFILTRATION BASINS
N.T.S



3 **PIPE DISCHARGE TO BASIN**
NOT TO SCALE



JOHN H. JOHNSON R.C.E. 83934 DATE
MY REGISTRATION EXPIRES ON 09/30/2019

KOLIBRIEN
LAND SURVEYING - CIVIL ENGINEERING - STRUCTURAL ENGINEERING

SHEET 1 OF 1

File: D03001

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA 1)		
1 Project area DA 1 (ft^2): 203050	2 Imperviousness after applying preventative site design practices (Imp%): 0.74	3 Runoff Coefficient (Rc): _0.535 *$R_c = 0.858(Imp\%)^{3} - 0.78(Imp\%)^{2} + 0.774(Imp\%) + 0.04$*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): 0.391 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html		
5 Compute P_6, Mean 6-hr Precipitation (inches): 0.484 *P_6 = Item 4 *C_1, where C_1 is a function of site climatic region specified in Form 3-1 Item 1 (Desert = 1.2371)*		
6 Drawdown Rate *Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.*		24-hrs ☐ 48-hrs ☒
7 Compute design capture volume, DCV (ft^3): 8601 *DCV = 1/12 * [Item 1* Item 3 *Item 5 * C_2], where C_2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963)* *Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2*		

Form 4.2-2 Summary of Hydromodification Assessment (DA 1)

Is the change in post- and pre- condition flows captured on-site? : Yes ☒ No ☐
If "Yes", then complete Hydromodification assessment of site hydrology for 10yr storm event using Forms 4.2-3 through 4.2-5 and insert results below *(Forms 4.2-3 through 4.2-5 may be replaced by computer software analysis based on the San Bernardino County Hydrology Manual- Addendum 1)*
If "No," then proceed to Section 4.3 BMP Selection and Sizing

Condition	Runoff Volume (ft^3)	Time of Concentration (min)	Peak Runoff (cfs)
Pre-developed	1 1178 *Form 4.2-3 Item 12*	2 24.2 *Form 4.2-4 Item 13*	3 2.64 *Form 4.2-5 Item 10*
Post-developed	4 14839 *Form 4.2-3 Item 13*	5 19.56 *Form 4.2-4 Item 14*	6 6.92 *Form 4.2-5 Item 14*
Difference	7 *13658* *Item 4 – Item 1*	8 *4.64* *Item 2 – Item 5*	9 *4.28* *Item 6 – Item 3*
Difference (as % of pre-developed)	10 *1159%* *Item 7 / Item 1*	11 *19.2%* *Item 8 / Item 2*	12 *162%* *Item 9 / Item 3*

Note: See form 4.3-9 which shows that hydromodification has been satisfied. Supporting documents are in Appendix D.

Form 4.2-3 Hydromodification Assessment for Runoff Volume (DA 1)

Weighted Curve Number Determination for: Pre-developed DA	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1a Land Cover type	Grass							
2a Hydrologic Soil Group (HSG)	A							
3a DMA Area, ft^2 *sum of areas of DMA should equal area of DA*	203050							
4a Curve Number (CN) *use Items 1 and 2 to select the appropriate CN from Appendix C-2 of the TGD for WQMP*	50							
Weighted Curve Number Determination for: Post-developed DA	DMA A	DMA B	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
1b Land Cover type	Commerci'	Lanscapin						
2b Hydrologic Soil Group (HSG)	A	A						
3b DMA Area, ft^2 *sum of areas of DMA should equal area of DA*	150506	52544						
4b Curve Number (CN) *use Items 5 and 6 to select the appropriate CN from Appendix C-2 of the TGD for WQMP*	90	32						

5 Pre-Developed area-weighted CN: 50	**7** Pre-developed soil storage capacity, S (in): 10 *S = (1000 / Item 5) - 10*	**9** Initial abstraction, I_a (in): 2 *I_a = 0.2 * Item 7*
6 Post-Developed area-weighted CN: 75	**8** Post-developed soil storage capacity, S (in): 3.33 *S = (1000 / Item 6) - 10*	**10** Initial abstraction, I_a (in): 0.67 *I_a = 0.2 * Item 8*

11 Precipitation for 10 yr, 24 hr storm (in): 2.87
Go to: http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html

12 Pre-developed Volume (ft^3): 1178
*V_{pre} =(1 / 12) * (Item sum of Item 3) * [(Item 11 – Item 9)^2 / ((Item 11 – Item 9 + Item 7)*

13 Post-developed Volume (ft^3): 14839
*V_{pre} =(1 / 12) * (Item sum of Item 3) * [(Item 11 – Item 10)^2 / ((Item 11 – Item 10 + Item 8)*

14 Volume Reduction needed to meet hydromodification requirement, (ft^3): 12916
*Vhydro = (Item 13 * 0.95) – Item 12*

Note: DMAs on this sheet are sub-areas by cover type in order to perform this analysis.

Form 4.2-4 Hydromodification Assessment for Time of Concentration (DA 1)

Compute time of concentration for pre and post developed conditions for each DA *(For projects using the Hydrology Manual complete the form below)*

Variables	Pre-developed DA1 *Use additional forms if there are more than 4 DMA*				Post-developed DA1 *Use additional forms if there are more than 4 DMA*			
	DMA A	DMA B	DMA C	DMA D	DMA A	DMA B	DMA C	DMA D
1 Length of flowpath (ft) *Use Form 3-2 Item 5 for pre-developed condition*	737				1370			
2 Change in elevation (ft)	8				7			
3 Slope (ft/ft), *S_o = Item 2 / Item 1*	0.0109				0.0051			
4 Land cover	Grass/brush				Pavement			
5 Initial DMA Time of Concentration (min) *Appendix C-1 of the TGD for WQMP*	24.2				19.56			
6 Length of conveyance from DMA outlet to project site outlet (ft) *May be zero if DMA outlet is at project site outlet*	0				0			
7 Cross-sectional area of channel (ft^2)								
8 Wetted perimeter of channel (ft)								
9 Manning's roughness of channel (n)								
10 Channel flow velocity (ft/sec) *V_{fps} = (1.49 / Item 9) * (Item 7/Item 8)^0.67 * (Item 3)^0.5*								
11 Travel time to outlet (min) *T_t = Item 6 / (Item 10 * 60)*	0				0			
12 Total time of concentration (min) *T_c = Item 5 + Item 11*	24.2				19.56			
13 Pre-developed time of concentration (min): 24.2 *Minimum of Item 12 pre-developed DMA*								
14 Post-developed time of concentration (min): 19.56 *Minimum of Item 12 post-developed DMA*								
15 Additional time of concentration needed to meet hydromodification requirement (min): 3.43 *$T_{C-Hydro}$ = (Item 13 * 0.95) – Item 14*								

Note: DMAs on this sheet are for the entire site in order to use the longest flowpath.

Form 4.2-5 Hydromodification Assessment for Peak Runoff (DA 1)

Compute peak runoff for pre- and post-developed conditions

Variables		Pre-developed DA to Project Outlet (*Use additional forms if more than 3 DMA)*			Post-developed DA to Project Outlet (*Use additional forms if more than 3 DMA)*		
		DMA A	DMA B	DMA C	DMA A	DMA B	DMA C
1 Rainfall Intensity for storm duration equal to time of concentration *I_{peak} = 10^(LOG Form 4.2-1 Item 4 - 0.7 LOG Form 4.2-4 Item 5 /60)*		1.45			1.9		
2 Drainage Area of each DMA (Acres) *For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*		4.66			4.66		
3 Ratio of pervious area to total area *For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*		1			0.26		
4 Pervious area infiltration rate (in/hr) *Use pervious area CN and antecedent moisture condition with Appendix C-3 of the TGD for WQMP*		0.82			0.96		
5 Maximum loss rate (in/hr) *F_m = Item 3 * Item 4* *Use area-weighted F_m from DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*		0.82			0.25		
6 Peak Flow from DMA (cfs) *Q_p =Item 2 * 0.9 * (Item 1 - Item 5)*		2.64			6.92		
7 Time of concentration adjustment factor for other DMA to site discharge point *Form 4.2-4 Item 12 DMA / Other DMA upstream of site discharge point (If ratio is greater than 1.0, then use maximum value of 1.0)*	DMA A	*n/a*			*n/a*		
	DMA B		*n/a*			*n/a*	
	DMA C			*n/a*			*n/a*

8 Pre-developed Q_p at T_c for DMA A: 2.64 *Q_p = Item 6_{DMAA} + [Item 6_{DMAB} * (Item 1_{DMAA} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAA/2}$] + [Item 6_{DMAC} * (Item 1_{DMAA} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAA/3}$]*	9 Pre-developed Q_p at T_c for DMA B: *Q_p = Item 6_{DMAB} + [Item 6_{DMAA} * (Item 1_{DMAB} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAB/1}$] + [Item 6_{DMAC} * (Item 1_{DMAB} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAB/3}$]*	10 Pre-developed Q_p at T_c for DMA C: *Q_p = Item 6_{DMAC} + [Item 6_{DMAA} * (Item 1_{DMAC} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAC/1}$] + [Item 6_{DMAB} * (Item 1_{DMAC} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAC/2}$]*
10 Peak runoff from pre-developed condition confluence analysis (cfs): 2.64 *Maximum of Item 8, 9, and 10 (including additional forms as needed)*		
11 Post-developed Q_p at T_c for DMA A: 6.92 *Same as Item 8 for post-developed values*	12 Post-developed Q_p at T_c for DMA B: *Same as Item 9 for post-developed values*	13 Post-developed Q_p at T_c for DMA C: *Same as Item 10 for post-developed values*
14 Peak runoff from post-developed condition confluence analysis (cfs): 6.92 *Maximum of Item 11, 12, and 13 (including additional forms as needed)*		
15 Peak runoff reduction needed to meet Hydromodification Requirement (cfs): 3.93 *$Q_{p-hydro}$ = (Item 14 * 0.95) – Item 10*		

Note: DMAs on this sheet are for the entire site in order to perform this analysis.

Form 4.3-3 Infiltration LID BMP - including underground BMPs (DA 1)

1 Remaining LID DCV not met by site design BMP (ft^3): 8601 *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item19*

BMP Type *Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs*	DA 1 DMA A BMP Type Bioretention	DA 1 DMA B BMP Type Bioretention	DA 1 DMA C BMP Type Bioretention *(Use additional forms for more BMPs)*
2 Infiltration rate of underlying soils (in/hr) *See Section 5.4.2 and Appendix C of the TGD for WQMP for minimum requirements for assessment methods*	1.1	1.1	1.1
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	1.5	1.5	1.5
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	0.74	0.74	0.74
5 Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*	48	48	48
6 Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*	.5	.5	.5
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	.5	.5	.5
8 Infiltrating surface area, SA_{BMP} (ft^2) *the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP*	1486	1486	3106
9 Amended soil depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details*	2	2	2
10 Amended soil porosity	.3	.3	.3
11 Gravel depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details*	1	1	1
12 Gravel porosity	.4	.4	.4
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	3	3	3
14 Above Ground Retention Volume (ft^3) *$V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*	2504	2504	5234
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*			

16 Total Retention Volume from LID Infiltration BMPs: 15799 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*

17 Fraction of DCV achieved with infiltration BMP: 184% *Retention% = Item 16 / Form 4.2-1 Item 7*

18 Is full LID DCV retained onsite with combination of hydrologic source control and LID retention/infiltration BMPs? Yes ☒ No ☐

If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.

Form 4.3-3 Infiltration LID BMP - including underground BMPs (DA 1)

1 Remaining LID DCV not met by site design BMP (ft^3): 8601 *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item19*

BMP Type *Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs*	DA 1 DMA D BMP Type BIORETENTION	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
2 Infiltration rate of underlying soils (in/hr) *See Section 5.4.2 and Appendix C of the TGD for WQMP for minimum requirements for assessment methods*	1.1		
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	1.5		
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	0.74		
5 Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*	48		
6 Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*	0.5		
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	0.5		
8 Infiltrating surface area, SA_{BMP} (ft^2) *the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP*	3298		
9 Amended soil depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details*	2		
10 Amended soil porosity	0.3		
11 Gravel depth, d_{media} (ft) *Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details*	1		
12 Gravel porosity	0.4		
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	3		
14 Above Ground Retention Volume (ft^3) *$V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*	5557		
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*			

16 Total Retention Volume from LID Infiltration BMPs: 15799 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*

17 Fraction of DCV achieved with infiltration BMP: 184% *Retention% = Item 16 / Form 4.2-1 Item 7*

18 Is full LID DCV retained onsite with combination of hydrologic source control and LID retention/infiltration BMPs? Yes ☒ No ☐

If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.

4.3.5 Conformance Summary

Complete Form 4.3-8 to demonstrate how on-site LID DCV is met with proposed site design, infiltration, and/or biotreatment BMP. The bottom line of the form is used to describe the basis for infeasibility determination for on-site LID BMP to achieve full LID DCV, and provides methods for computing remaining volume to be addressed in an alternative compliance plan. If the project has more than one outlet, then complete additional versions of this form for each outlet.

Form 4.3-8 Conformance Summary and Alternative Compliance Volume Estimate (DA 1)
1 Total LID DCV for the Project DA-1 (ft^3): 8601 *Copy Item 7 in Form 4.2-1*
2 On-site retention with site design BMP (ft^3): *Copy Item18 in Form 4.3-2*
3 On-site retention with LID infiltration BMP (ft^3): 15799 *Copy Item 16 in Form 4.3-3*
4 On-site biotreatment with volume based biotreatment BMP (ft^3): *Copy Item 3 in Form 4.3-4*
5 Flow capacity provided by flow based biotreatment BMP (cfs): *Copy Item 6 in Form 4.3-4*
6 LID BMP performance criteria are achieved if answer to any of the following is "Yes": • Full retention of LID DCV with site design or infiltration BMP: Yes ☒ No ☐ *If yes, sum of Items 2, 3, and 4 is greater than Item 1* • Combination of on-site retention BMPs for a portion of the LID DCV and volume-based biotreatment BMP that address all pollutants of concern for the remaining LID DCV: Yes ☐ No ☐ *If yes, a) sum of Items 2, 3, 4, and 5 is greater than Item 1, and Items 2, 3 and 4 are maximized; or b) Item 6 is greater than Form 4.3--5 Item 6 and Items 2, 3 and 4 are maximized* ▪ On-site retention and infiltration is determined to be infeasible; therefore biotreatment BMP provides biotreatment for all pollutants of concern for full LID DCV: Yes ☐ No ☐ *If yes, Form 4.3-1 Items 7 and 8 were both checked yes*
7 If the LID DCV is not achieved by any of these means, then the project may be allowed to develop an alternative compliance plan. Check box that describes the scenario which caused the need for alternative compliance: • Combination of Site Design, retention and infiltration, , and biotreatment BMPs provide less than full LID DCV capture: ☐ *Checked yes if Form 4.3-4 Item 7is checked yes, Form 4.3-4 Item 6 is zero, and sum of Items 2, 3, 4, and 5 is less than Item 1. If so, apply water quality credits and calculate volume for alternative compliance, V_{alt} = (Item 1 – Item 2 – Item 3 – Item 4 – Item 5) * (100 - Form 2.4-1 Item 2)%* • Facilities, or a combination of facilities, of a different design than in Section E.12.e.(ii)(f) may be permitted if all of the following Phase II Small MS4 General Permit 2013-0001-DWQ 55 February 5, 2013 measures of equivalent effectiveness are demonstrated: 1) Equal or greater amount of runoff infiltrated or evapotranspired; ☐ 2) Equal or lower pollutant concentrations in runoff that is discharged after biotreatment; ☐ 3) Equal or greater protection against shock loadings and spills; ☐ 4) Equal or greater accessibility and ease of inspection and maintenance. ☐

4.3.6 Hydromodification Control BMP

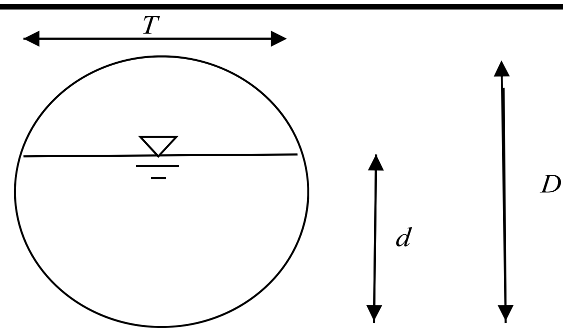
Use Form 4.3-9 to compute the remaining runoff volume retention, after Site Design BMPs are implemented, needed to address hydromodification, and the increase in time of concentration and decrease in peak runoff necessary to meet targets for protection of waterbodies with a potential hydromodification. Describe the proposed hydromodification treatment control BMP. Section 5.6 of the TGD for WQMP provides additional details on selection and evaluation of hydromodification control BMP.

Form 4.3-9 Hydromodification Control BMPs (DA 1)	
1 Volume reduction needed for hydromodification performance criteria (ft^3): 12917 *(Form 4.2-2 Item 4 * 0.95) – Form 4.2-2 Item 1*	**2** On-site retention with site design and infiltration, BMP (ft^3): 15799 *Sum of Form 4.3-8 Items 2, 3, and 4. Evaluate option to increase implementation of on-site retention in Forms 4.3-2, 4.3-3, and 4.3-4 in excess of LID DCV toward achieving hydromodification volume reduction*
3 Remaining volume for hydromodification volume capture (ft^3): -2882 *Item 1 – Item 2*	**4** Volume capture provided by incorporating additional on-site BMPs (ft^3):
5 Is Form 4.2-2 Item 11 less than or equal to 5%: Yes ☐ No ☒ *If yes, hydromodification performance criteria is achieved. If no, select one or more mitigation options below:* • Demonstrate increase in time of concentration achieved by proposed LID site design, LID BMP, and additional on-site BMP ☒ • Increase time of concentration by preserving pre-developed flow path and/or increase travel time by reducing slope and increasing cross-sectional area and roughness for proposed on-site conveyance facilities ☐	
6 Form 4.2-2 Item 12 less than or equal to 5%: Yes ☐ No ☒ *If yes, hydromodification performance criteria is achieved. If no, select one or more mitigation options below:* • Demonstrate reduction in peak runoff achieved by proposed LID site design, LID BMPs, and additional on-site retention BMPs ☒	

Please see the hydromodification documents provided in Appendix D. The Small Area Runoff Hydrograph Analysis shows that the peak flows are being reduced below the existing condition. Additionally, the basins provide a retention time before volume builds and flow is able to discharge, which significantly increases the proposed time of concentration. With this analysis, the hydromodification requirements are being satisfied.

Appendix D

HYDRAULIC PIPE COMPUTATIONS FOR 8" HDPE



DIAMETER =	8 in.	HDPE

$$Q = \frac{K_U}{n} A \left(\frac{A}{P_W} \right)^{2/3} (S_L)^{1/2}$$

K_U	1.486	
S_L	0.005	ft/ft
n	0.011	

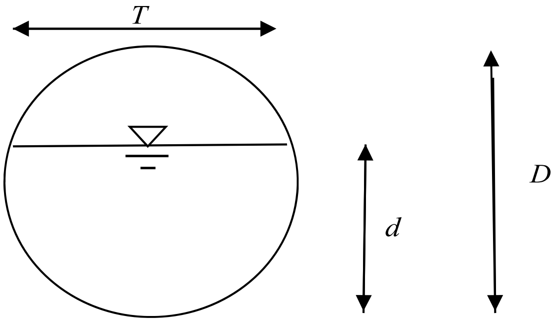
HYDRAULIC ELEMENTS FOR CIRCULAR CHANNEL

d	d/D	θ	A	T	P_W	V	Froud	Q
ft	ft/ft	°	ft²	ft	ft	ft²/s	No.	ft³/s
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.03	0.05	51.68	0.01	0.29	0.30	0.74	0.87	0.00
0.07	0.10	73.74	0.02	0.40	0.43	1.16	0.96	0.02
0.10	0.15	91.15	0.03	0.48	0.53	1.50	1.00	0.05
0.13	0.20	106.26	0.05	0.53	0.62	1.78	1.03	0.09
0.17	0.25	120.00	0.07	0.58	0.70	2.03	1.04	0.14
0.20	0.30	132.84	0.09	0.61	0.77	2.25	1.04	0.20
0.23	0.35	145.08	0.11	0.64	0.84	2.44	1.04	0.27
0.27	0.40	156.93	0.13	0.65	0.91	2.61	1.03	0.34
0.30	0.45	168.52	0.15	0.66	0.98	2.76	1.02	0.42
0.33	0.50	180.00	0.17	0.67	1.05	2.89	1.00	0.50
0.37	0.55	191.48	0.20	0.66	1.11	3.01	0.97	0.59
0.40	0.60	203.07	0.22	0.65	1.18	3.10	0.94	0.68
0.43	0.65	214.92	0.24	0.64	1.25	3.18	0.91	0.76
0.47	0.70	227.16	0.26	0.61	1.32	3.24	0.87	0.85
0.50	0.75	240.00	0.28	0.58	1.40	3.28	0.83	0.92
0.53	0.80	253.74	0.30	0.53	1.48	3.30	0.78	0.99
0.57	0.85	268.85	0.32	0.48	1.56	3.29	0.71	1.04
0.60	0.90	286.26	0.33	0.40	1.67	3.25	0.63	1.08
0.63	0.95	308.32	0.34	0.29	1.79	3.17	0.51	1.09
0.67	1.00	360.00	0.35	0.00	2.09	2.89	∞	1.01

Critical Depth	0.49	ft
Maximum Discharge	1.09	ft³/s

Completed by:	**JHJ**
Checked by:	**JHJ**
Date:	**6/23/2019**
Sheet:	**1 of 1**

HYDRAULIC PIPE COMPUTATIONS FOR 10" HDPE



DIAMETER =	**10 in.**	HDPE

$$Q=\frac{K_U}{n}A\left(\frac{A}{P_W}\right)^{2/3}\left(S_L\right)^{1/2}$$

K_U	**1.486**	
S_L	**0.005**	**ft/ft**
n	**0.011**	

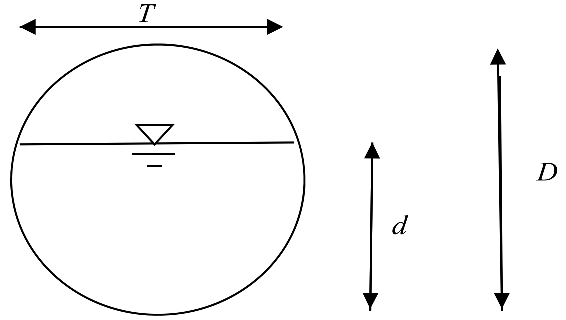
HYDRAULIC ELEMENTS FOR CIRCULAR CHANNEL

d	**d/D**	**θ**	**A**	**T**	**P_W**	**V**	**Froud**	**Q**
ft	ft/ft	°	ft²	ft	ft	ft²/s	**No.**	ft³/s
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.04	0.05	51.68	0.01	0.36	0.38	0.86	0.91	0.01
0.08	0.10	73.74	0.03	0.50	0.54	1.35	1.00	0.04
0.13	0.15	91.15	0.05	0.60	0.66	1.73	1.04	0.09
0.17	0.20	106.26	0.08	0.67	0.77	2.06	1.07	0.16
0.21	0.25	120.00	0.11	0.72	0.87	2.35	1.08	0.25
0.25	0.30	132.84	0.14	0.76	0.97	2.61	1.08	0.36
0.29	0.35	145.08	0.17	0.79	1.06	2.83	1.08	0.48
0.33	0.40	156.93	0.20	0.82	1.14	3.03	1.07	0.62
0.38	0.45	168.52	0.24	0.83	1.23	3.20	1.05	0.76
0.42	0.50	180.00	0.27	0.83	1.31	3.36	1.03	0.92
0.46	0.55	191.48	0.31	0.83	1.39	3.49	1.01	1.07
0.50	0.60	203.07	0.34	0.82	1.48	3.60	0.98	1.23
0.54	0.65	214.92	0.38	0.79	1.56	3.69	0.95	1.38
0.58	0.70	227.16	0.41	0.76	1.65	3.76	0.91	1.53
0.63	0.75	240.00	0.44	0.72	1.75	3.81	0.86	1.67
0.67	0.80	253.74	0.47	0.67	1.85	3.83	0.80	1.79
0.71	0.85	268.85	0.49	0.60	1.96	3.82	0.74	1.89
0.75	0.90	286.26	0.52	0.50	2.08	3.77	0.65	1.95
0.79	0.95	308.32	0.54	0.36	2.24	3.68	0.53	1.97
0.83	1.00	360.00	0.55	0.00	2.62	3.36	∞	1.83

Critical Depth	0.62	ft
Maximum Discharge	1.97	ft³/s

Completed by:	**JHJ**
Checked by:	**JHJ**
Date:	**6/23/2019**
Sheet:	**1 of 1**

HYDRAULIC PIPE COMPUTATIONS FOR 12" HDPE



DIAMETER =	**12 in.**	HDPE

$$Q = \frac{K_U}{n} A \left(\frac{A}{P_W} \right)^{2/3} (S_L)^{1/2}$$

K_U	**1.486**	
S_L	**0.005**	**ft/ft**
n	**0.011**	

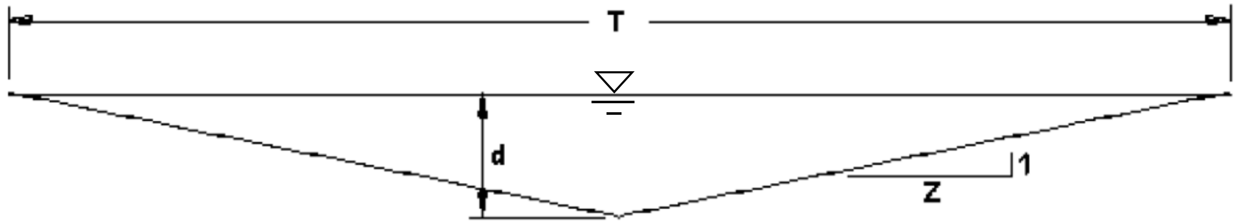
HYDRAULIC ELEMENTS FOR CIRCULAR CHANNEL

d	d/D	θ	A	T	P_W	V	Froud	Q
ft	ft/ft	°	ft²	ft	ft	ft²/s	No.	ft³/s
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.05	0.05	51.68	0.01	0.44	0.45	0.97	0.94	0.01
0.10	0.10	73.74	0.04	0.60	0.64	1.52	1.03	0.06
0.15	0.15	91.15	0.07	0.71	0.80	1.96	1.07	0.14
0.20	0.20	106.26	0.11	0.80	0.93	2.33	1.10	0.26
0.25	0.25	120.00	0.15	0.87	1.05	2.66	1.11	0.41
0.30	0.30	132.84	0.20	0.92	1.16	2.94	1.12	0.58
0.35	0.35	145.08	0.24	0.95	1.27	3.20	1.11	0.78
0.40	0.40	156.93	0.29	0.98	1.37	3.42	1.10	1.00
0.45	0.45	168.52	0.34	0.99	1.47	3.62	1.09	1.24
0.50	0.50	180.00	0.39	1.00	1.57	3.79	1.07	1.49
0.55	0.55	191.48	0.44	0.99	1.67	3.94	1.04	1.74
0.60	0.60	203.07	0.49	0.98	1.77	4.07	1.01	2.00
0.65	0.65	214.92	0.54	0.95	1.88	4.17	0.98	2.25
0.70	0.70	227.16	0.59	0.92	1.98	4.24	0.93	2.49
0.75	0.75	240.00	0.63	0.87	2.09	4.30	0.89	2.71
0.80	0.80	253.74	0.67	0.80	2.21	4.32	0.83	2.91
0.85	0.85	268.85	0.71	0.71	2.35	4.31	0.76	3.07
0.90	0.90	286.26	0.74	0.60	2.50	4.26	0.67	3.17
0.95	0.95	308.32	0.77	0.44	2.69	4.15	0.55	3.20
1.00	1.00	360.00	0.79	0.00	3.14	3.79	∞	2.98

Critical Depth	0.75	ft
Maximum Discharge	3.20	ft³/s

Completed by:	**JHJ**
Checked by:	**JHJ**
Date:	**6/23/2019**
Sheet:	**1 of 1**

HYDRAULIC CALCULATIONS FOR RIBBON GUTTER



Z =	9 H:V

$$Q = \frac{K_U}{n} A \left(\frac{A}{P_W} \right)^{2/3} \left(S_L \right)^{1/2}$$

K_U	1.486	
S_L	0.005	ft/ft
n	0.013	

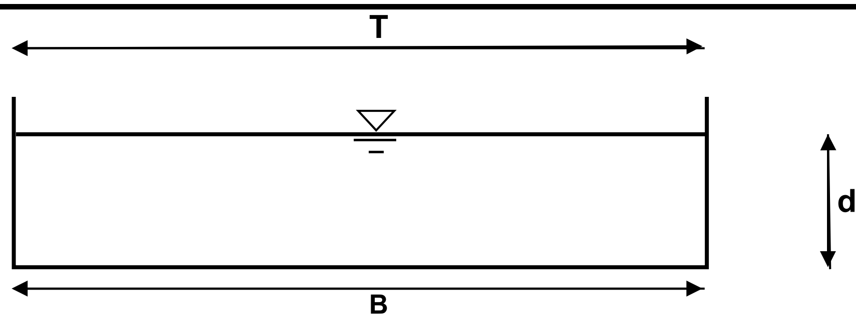
HYDRAULIC ELEMEMENTS OF TRAPEZOIDAL SECTION

d	A	T	P_W	V	Froud	Q
ft	ft²	ft	ft	ft²/s	No.	ft³/s
0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.10	0.09	1.80	1.81	1.09	0.86	0.10
0.20	0.36	3.60	3.62	1.73	0.97	0.62
0.30	0.81	5.40	5.43	2.27	1.03	1.84
0.40	1.44	7.20	7.24	2.75	1.08	3.96
0.50	2.25	9.00	9.06	3.19	1.13	7.19
0.60	3.24	10.80	10.87	3.61	1.16	11.69
0.70	4.41	12.60	12.68	4.00	1.19	17.63
0.80	5.76	14.40	14.49	4.37	1.22	25.17
0.90	7.29	16.20	16.30	4.73	1.24	34.46
1.00	9.00	18.00	18.11	5.07	1.26	45.64
1.10	10.89	19.80	19.92	5.40	1.28	58.85
1.20	12.96	21.60	21.73	5.73	1.30	74.21
1.30	15.21	23.40	23.54	6.04	1.32	91.87
1.40	17.64	25.20	25.36	6.35	1.34	111.95
1.50	20.25	27.00	27.17	6.64	1.35	134.56

Critical Depth	1.69	ft

Completed by:	JHJ
Checked by:	RD
Date:	6/30/2019
Sheet:	1 of 1

HYDRAULIC CALCULATIONS FOR PARKWAY DRAIN, BASIN OVERFLOW



B =	3 ft

$$Q = \frac{K_U}{n} A \left(\frac{A}{P_W} \right)^{2/3} (S_L)^{1/2}$$

K_U	1.486	
S_L	0.02	ft/ft
n	0.015	

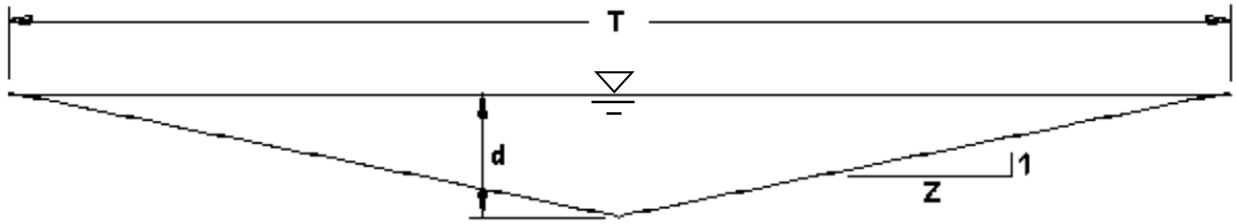
HYDRAULIC ELEMEMENTS OF RECTANGULAR SECTION

d	A	T	P_W	V	Froud	Q	
ft	ft²	ft	ft	ft²/s	No.	ft³/s	
0.00	0.00	3.00	3.00	0.00	0.00	0.00	
0.25	0.75	3.00	3.50	5.02	1.77	3.76	
0.50	1.50	3.00	4.00	7.29	1.82	10.93	MAX IS GREATER
0.75	2.25	3.00	4.50	8.83	1.80	19.86	THAN Q100
1.00	3.00	3.00	5.00	9.97	1.76	29.90	
1.25	3.75	3.00	5.50	10.85	1.71	40.70	
1.50	4.50	3.00	6.00	11.57	1.66	52.04	
1.75	5.25	3.00	6.50	12.15	1.62	63.79	
2.00	6.00	3.00	7.00	12.64	1.58	75.85	
2.25	6.75	3.00	7.50	13.06	1.53	88.15	
2.50	7.50	3.00	8.00	13.42	1.50	100.65	
2.75	8.25	3.00	8.50	13.73	1.46	113.31	
3.00	9.00	3.00	9.00	14.01	1.43	126.09	
3.25	9.75	3.00	9.50	14.25	1.39	138.98	
3.50	10.50	3.00	10.00	14.47	1.36	151.97	
3.75	11.25	3.00	10.50	14.67	1.33	165.03	
4.00	12.00	3.00	11.00	14.85	1.31	178.16	
4.25	12.75	3.00	11.50	15.01	1.28	191.35	
4.50	13.50	3.00	12.00	15.15	1.26	204.59	
4.75	14.25	3.00	12.50	15.29	1.24	217.87	
5.00	15.00	3.00	13.00	15.41	1.21	231.19	

Critical Depth	5.692	ft

Completed by:	JHJ
Checked by:	FDG
Date:	6/30/2019
Sheet:	1 of 1

HYDRAULIC CALCULATIONS FOR VEGETATED SWALE, BASIN OVERFLOW



Z =	4 H:V

$$Q = \frac{K_U}{n} A \left(\frac{A}{P_W} \right)^{2/3} (S_L)^{1/2}$$

K_U	1.486	
S_L	0.04	ft/ft
n	0.035	

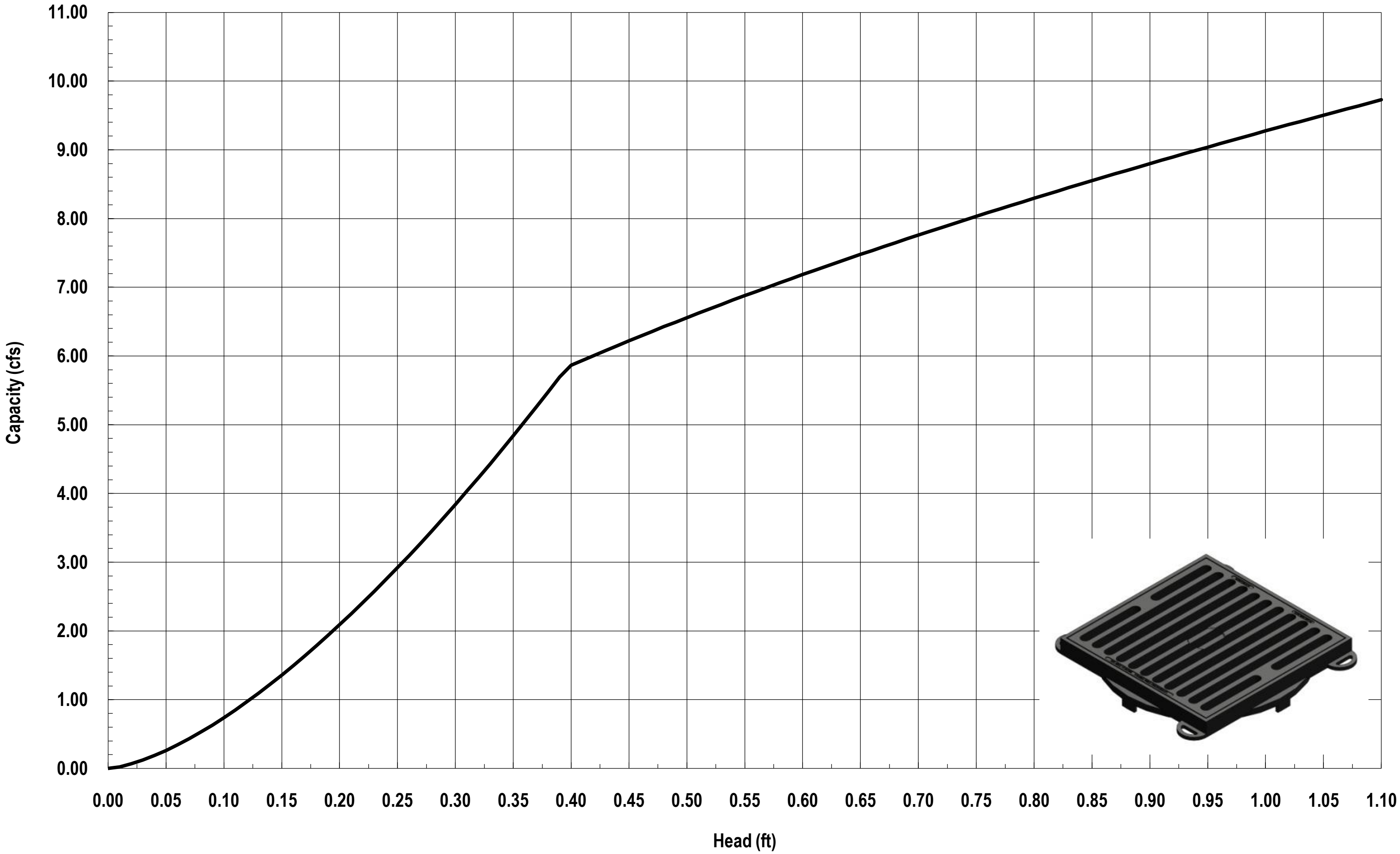
HYDRAULIC ELEMEMENTS OF TRAPEZOIDAL SECTION

d ft	A ft^2	T ft	P_W ft	V ft^2/s	Froud No.	Q ft^3/s
0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.10	0.04	0.80	0.82	1.13	0.89	0.05
0.20	0.16	1.60	1.65	1.79	1.00	0.29
0.30	0.36	2.40	2.47	2.35	1.07	0.85
0.40	0.64	3.20	3.30	2.85	1.12	1.82
0.50	1.00	4.00	4.12	3.30	1.16	3.30
0.60	1.44	4.80	4.95	3.73	1.20	5.37
0.70	1.96	5.60	5.77	4.13	1.23	8.10
0.80	2.56	6.40	6.60	4.52	1.26	11.57
0.90	3.24	7.20	7.42	4.89	1.28	15.83
1.00	4.00	8.00	8.25	5.24	1.31	20.97
1.10	4.84	8.80	9.07	5.59	1.33	27.04
1.20	5.76	9.60	9.90	5.92	1.35	34.10
1.30	6.76	10.40	10.72	6.24	1.36	42.21
1.40	7.84	11.20	11.54	6.56	1.38	51.43
1.50	9.00	12.00	12.37	6.87	1.40	61.82

Critical Depth	1.72	ft

Completed by:	JHJ
Checked by:	RD
Date:	6/30/2019
Sheet:	1 of 1

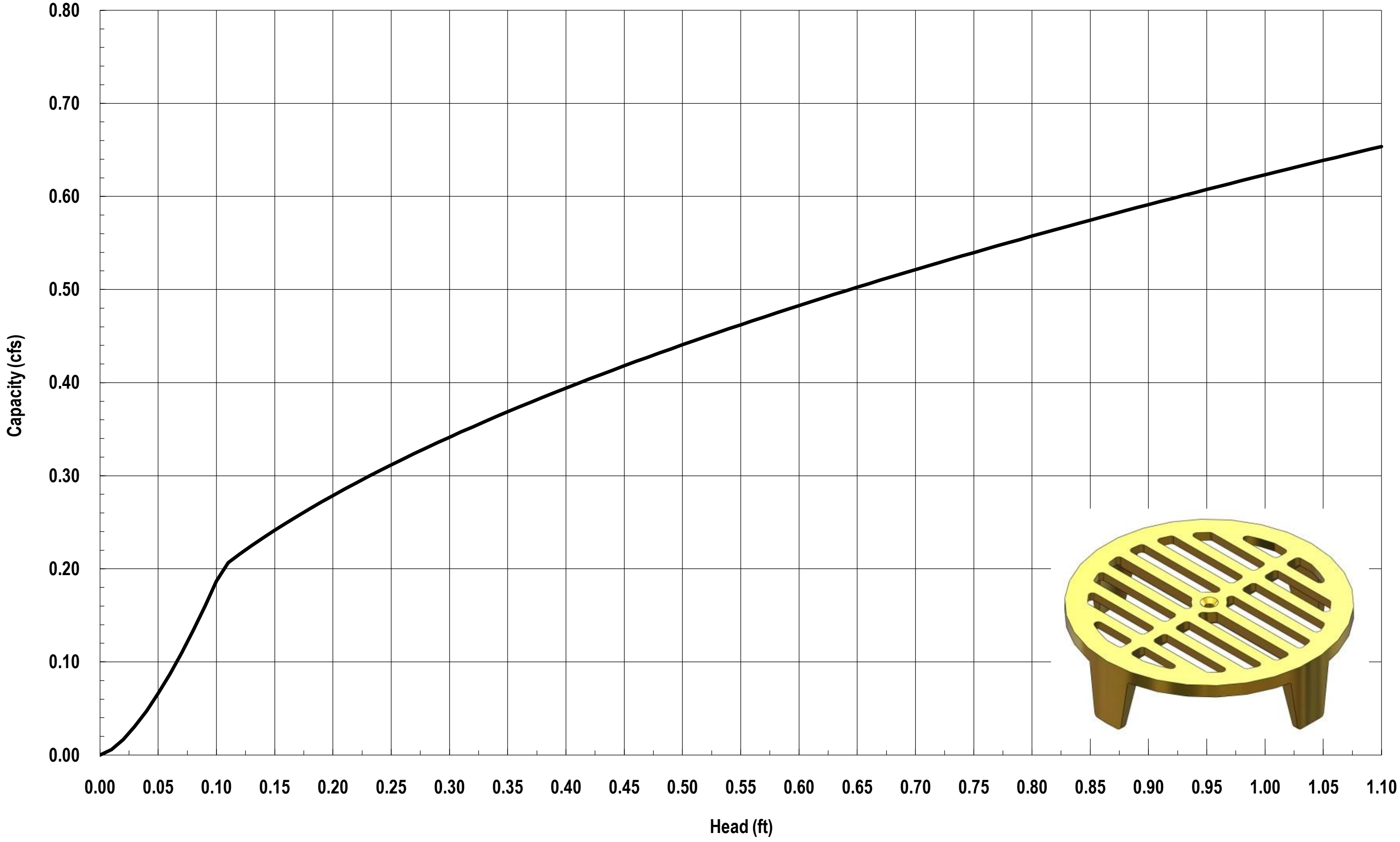
Nyloplast 2' x 2' Road & Highway Grate Inlet Capacity Chart



Nyloplast

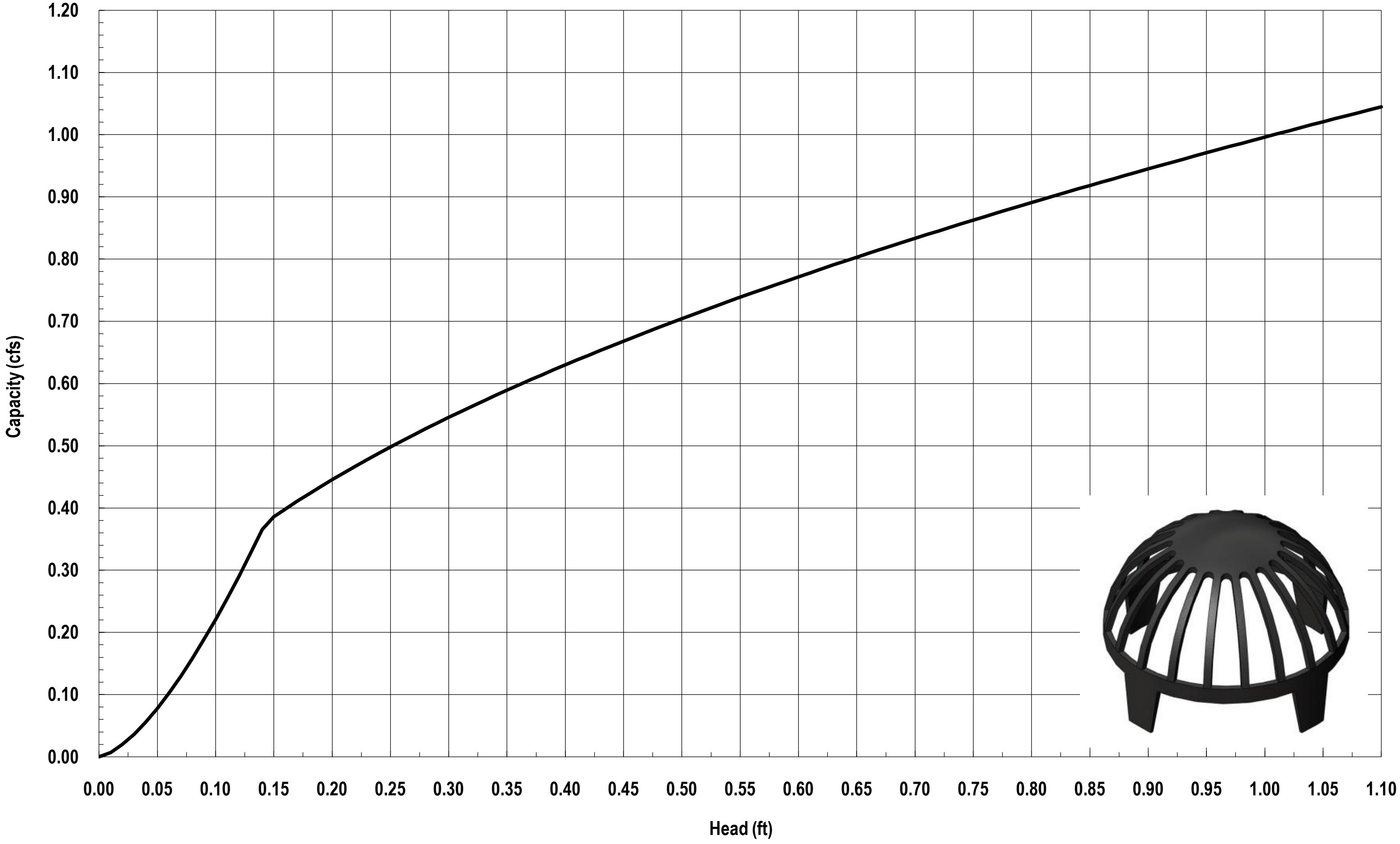
3130 Verona Avenue • Buford, GA 30518
(866) 888-8479 / (770) 932-2443 • Fax: (770) 932-2490

Nyloplast 8" Bronze Grate Inlet Capacity Chart



Nyloplast®
3130 Verona Avenue • Buford, GA 30518
(866) 888-8479 / (770) 932-2443 • Fax: (770) 932-2490

Nyloplast 8" Dome Grate Inlet Capacity Chart



Nyloplast®
3130 Verona Avenue • Buford, GA 30518
(866) 888-8479 / (770) 932-2443 • Fax: (770) 932-2490

Appendix E

NOAA Atlas 14, Volume 6, Version 2
Location name: Victorville, California, USA*
Latitude: 34.4898°, Longitude: -117.4071°
Elevation: 3239.42 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	**0.078** (0.064-0.095)	**0.112** (0.093-0.137)	**0.158** (0.130-0.193)	**0.195** (0.159-0.241)	**0.245** (0.194-0.314)	**0.284** (0.220-0.371)	**0.324** (0.245-0.434)	**0.365** (0.268-0.503)	**0.421** (0.297-0.604)	**0.465** (0.316-0.690)
10-min	**0.112** (0.092-0.137)	**0.161** (0.133-0.197)	**0.226** (0.186-0.277)	**0.279** (0.228-0.345)	**0.352** (0.278-0.450)	**0.408** (0.315-0.532)	**0.465** (0.351-0.622)	**0.524** (0.384-0.721)	**0.604** (0.425-0.866)	**0.666** (0.453-0.989)
15-min	**0.135** (0.112-0.165)	**0.195** (0.161-0.238)	**0.273** (0.225-0.335)	**0.338** (0.276-0.418)	**0.425** (0.336-0.544)	**0.493** (0.381-0.644)	**0.562** (0.424-0.752)	**0.633** (0.465-0.872)	**0.730** (0.514-1.05)	**0.805** (0.548-1.20)
30-min	**0.203** (0.167-0.248)	**0.292** (0.241-0.357)	**0.410** (0.337-0.503)	**0.506** (0.413-0.626)	**0.637** (0.504-0.815)	**0.739** (0.572-0.965)	**0.843** (0.636-1.13)	**0.949** (0.697-1.31)	**1.10** (0.771-1.57)	**1.21** (0.821-1.79)
60-min	**0.271** (0.224-0.332)	**0.391** (0.323-0.479)	**0.549** (0.452-0.674)	**0.678** (0.554-0.839)	**0.854** (0.675-1.09)	**0.990** (0.766-1.29)	**1.13** (0.852-1.51)	**1.27** (0.934-1.75)	**1.47** (1.03-2.10)	**1.62** (1.10-2.40)
2-hr	**0.381** (0.315-0.465)	**0.518** (0.428-0.634)	**0.704** (0.580-0.864)	**0.861** (0.703-1.07)	**1.08** (0.855-1.39)	**1.26** (0.974-1.65)	**1.44** (1.09-1.93)	**1.64** (1.20-2.26)	**1.91** (1.35-2.74)	**2.13** (1.45-3.17)
3-hr	**0.478** (0.395-0.584)	**0.638** (0.527-0.781)	**0.860** (0.708-1.05)	**1.05** (0.857-1.30)	**1.32** (1.04-1.69)	**1.54** (1.19-2.01)	**1.77** (1.34-2.37)	**2.02** (1.49-2.78)	**2.38** (1.67-3.41)	**2.67** (1.81-3.96)
6-hr	**0.653** (0.540-0.798)	**0.865** (0.714-1.06)	**1.16** (0.957-1.43)	**1.42** (1.16-1.76)	**1.80** (1.42-2.30)	**2.11** (1.63-2.76)	**2.45** (1.85-3.27)	**2.81** (2.07-3.87)	**3.34** (2.36-4.80)	**3.78** (2.58-5.62)
12-hr	**0.814** (0.673-0.995)	**1.12** (0.925-1.37)	**1.55** (1.28-1.90)	**1.93** (1.57-2.38)	**2.47** (1.95-3.16)	**2.93** (2.26-3.82)	**3.41** (2.58-4.57)	**3.95** (2.90-5.43)	**4.72** (3.32-6.77)	**5.36** (3.65-7.96)
24-hr	**1.11** (0.985-1.28)	**1.60** (1.41-1.84)	**2.28** (2.01-2.63)	**2.87** (2.51-3.34)	**3.72** (3.16-4.48)	**4.43** (3.68-5.45)	**5.19** (4.20-6.54)	**6.02** (4.74-7.80)	**7.23** (5.46-9.75)	**8.23** (6.01-11.5)
2-day	**1.20** (1.06-1.38)	**1.71** (1.51-1.97)	**2.43** (2.15-2.81)	**3.07** (2.69-3.57)	**3.99** (3.39-4.81)	**4.76** (3.95-5.86)	**5.60** (4.53-7.05)	**6.51** (5.13-8.44)	**7.85** (5.93-10.6)	**8.97** (6.55-12.5)
3-day	**1.27** (1.13-1.47)	**1.81** (1.60-2.08)	**2.57** (2.27-2.97)	**3.24** (2.83-3.77)	**4.21** (3.57-5.07)	**5.02** (4.17-6.18)	**5.91** (4.78-7.44)	**6.88** (5.42-8.91)	**8.30** (6.28-11.2)	**9.50** (6.94-13.3)
4-day	**1.37** (1.22-1.58)	**1.94** (1.72-2.23)	**2.75** (2.43-3.17)	**3.45** (3.02-4.02)	**4.49** (3.80-5.41)	**5.35** (4.44-6.58)	**6.29** (5.09-7.92)	**7.32** (5.76-9.48)	**8.83** (6.67-11.9)	**10.1** (7.38-14.1)
7-day	**1.48** (1.32-1.71)	**2.08** (1.84-2.40)	**2.93** (2.59-3.38)	**3.67** (3.21-4.27)	**4.74** (4.02-5.71)	**5.63** (4.67-6.92)	**6.59** (5.34-8.30)	**7.63** (6.01-9.89)	**9.16** (6.92-12.4)	**10.4** (7.61-14.6)
10-day	**1.59** (1.41-1.83)	**2.21** (1.96-2.55)	**3.10** (2.74-3.58)	**3.87** (3.39-4.51)	**5.00** (4.23-6.02)	**5.92** (4.91-7.28)	**6.91** (5.60-8.70)	**7.99** (6.29-10.3)	**9.55** (7.22-12.9)	**10.8** (7.92-15.1)
20-day	**1.91** (1.70-2.20)	**2.65** (2.35-3.06)	**3.70** (3.27-4.28)	**4.62** (4.04-5.38)	**5.95** (5.04-7.16)	**7.04** (5.84-8.65)	**8.20** (6.64-10.3)	**9.47** (7.46-12.3)	**11.3** (8.52-15.2)	**12.8** (9.32-17.8)
30-day	**2.23** (1.98-2.57)	**3.07** (2.72-3.54)	**4.27** (3.77-4.94)	**5.32** (4.66-6.20)	**6.85** (5.80-8.24)	**8.10** (6.72-9.95)	**9.43** (7.64-11.9)	**10.9** (8.56-14.1)	**12.9** (9.77-17.5)	**14.6** (10.7-20.4)
45-day	**2.62** (2.32-3.01)	**3.56** (3.16-4.11)	**4.92** (4.34-5.68)	**6.10** (5.34-7.11)	**7.84** (6.64-9.43)	**9.26** (7.69-11.4)	**10.8** (8.74-13.6)	**12.4** (9.79-16.1)	**14.8** (11.2-19.9)	**16.7** (12.2-23.3)
60-day	**2.94** (2.61-3.39)	**3.95** (3.50-4.56)	**5.41** (4.78-6.25)	**6.69** (5.86-7.79)	**8.57** (7.26-10.3)	**10.1** (8.40-12.4)	**11.8** (9.54-14.8)	**13.6** (10.7-17.6)	**16.1** (12.2-21.7)	**18.2** (13.3-25.4)

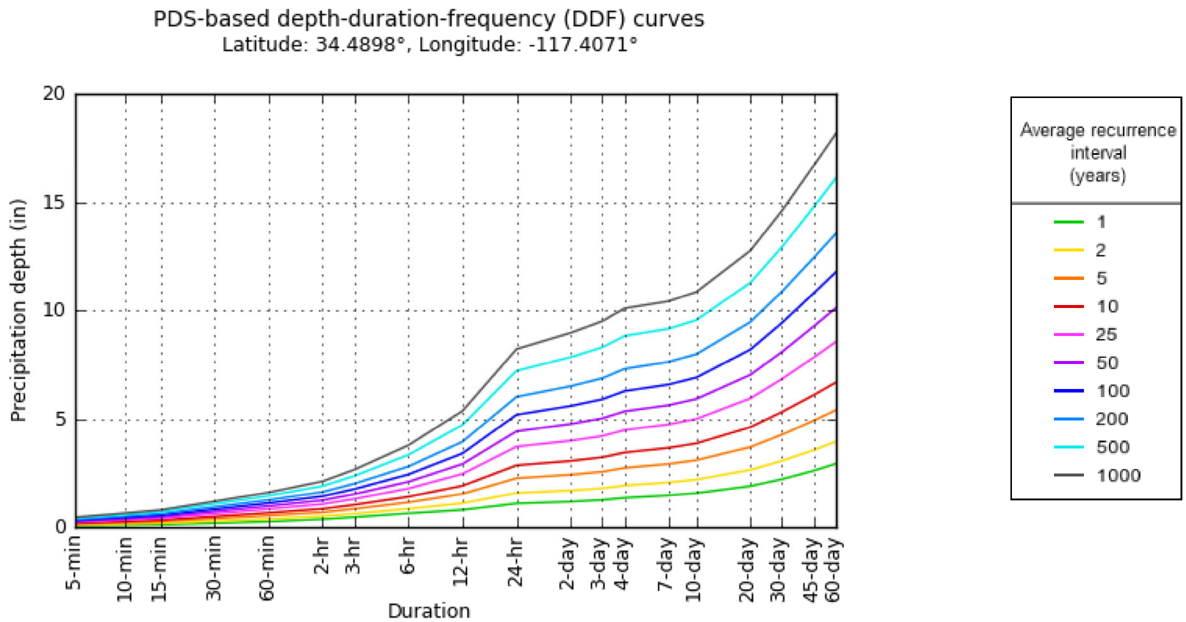
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

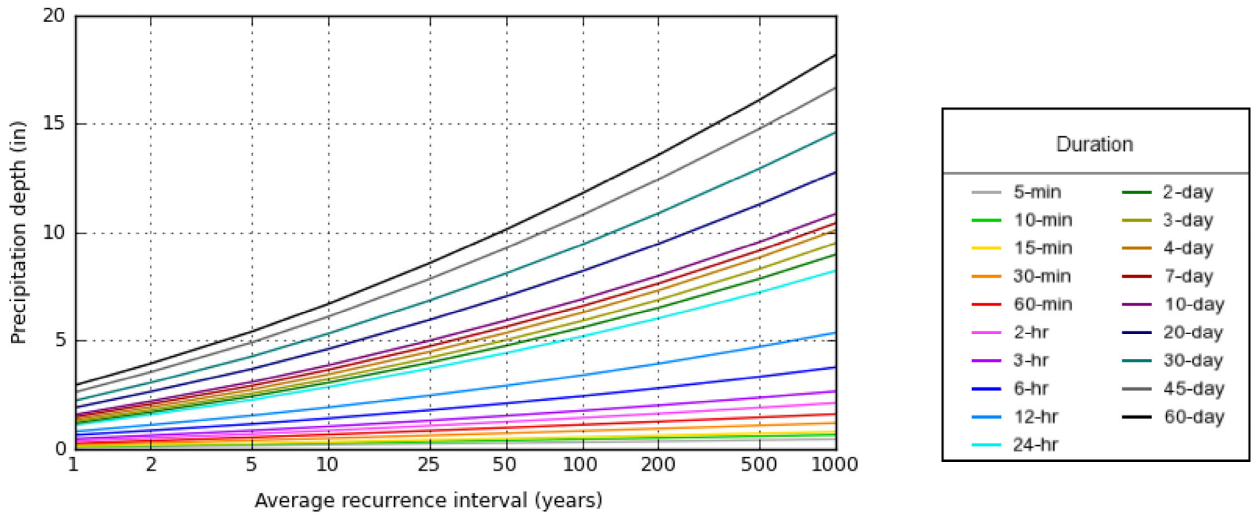
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper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

Please refer to NOAA Atlas 14 document for more information.

Back to Top

PF graphical





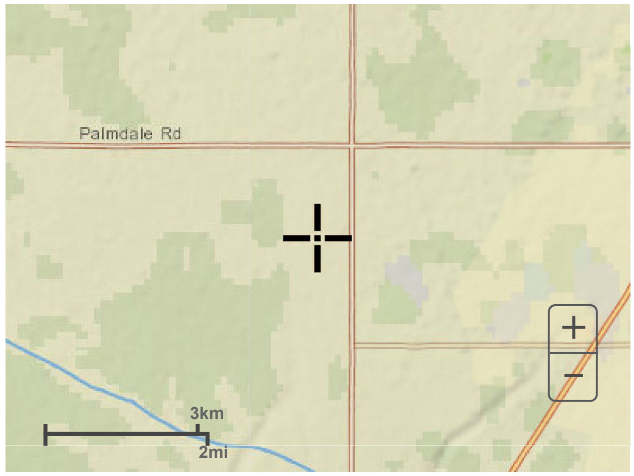
NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Sat Jun 8 22:55:32 2019

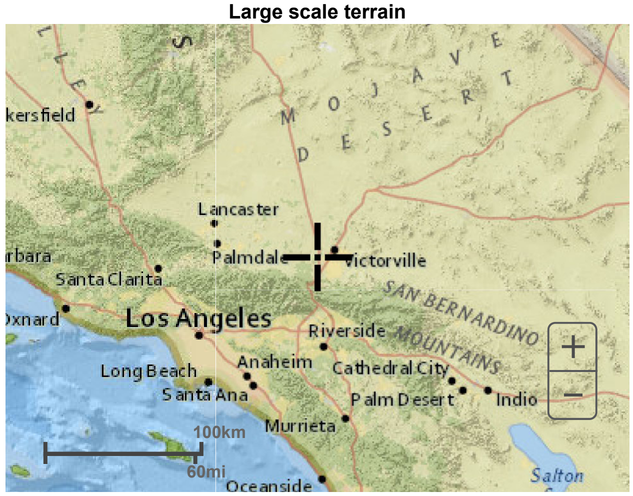
Back to Top

Maps & aerials

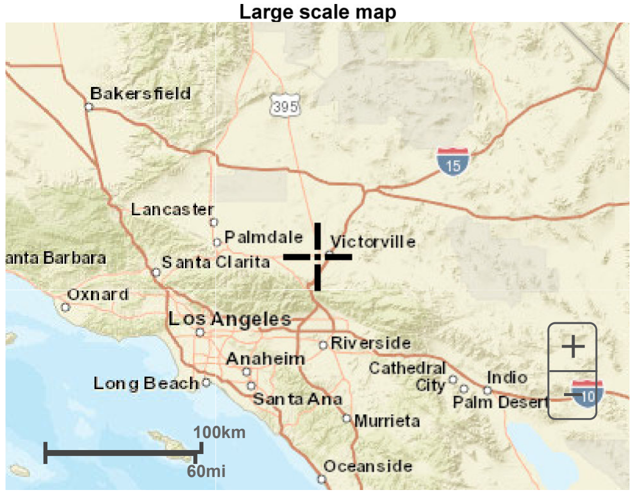
Small scale terrain



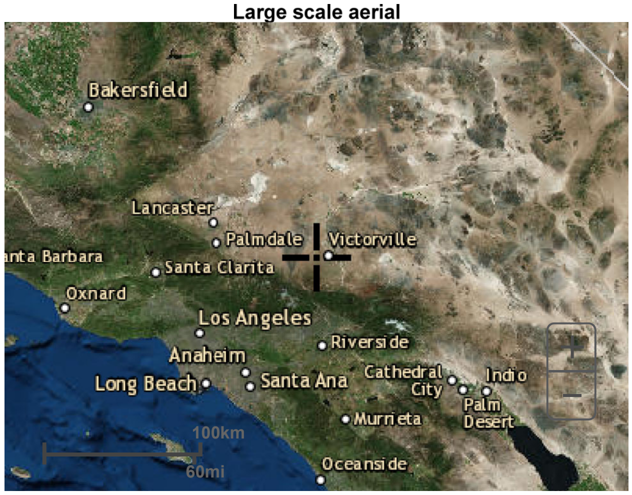
Large scale terrain



Large scale map

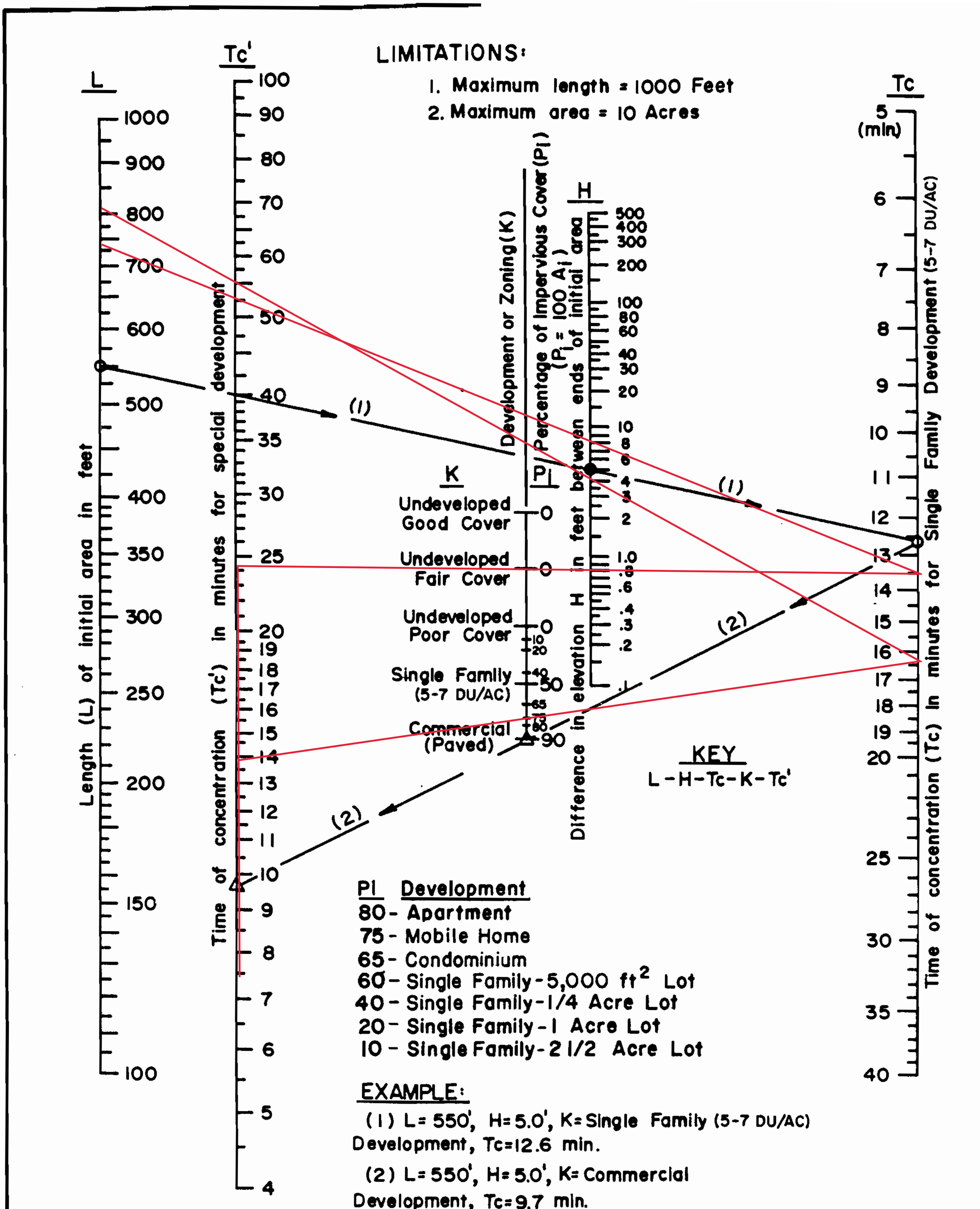


Large scale aerial



Back to Top

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



SAN BERNARDINO COUNTY

HYDROLOGY MANUAL

TIME OF CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA

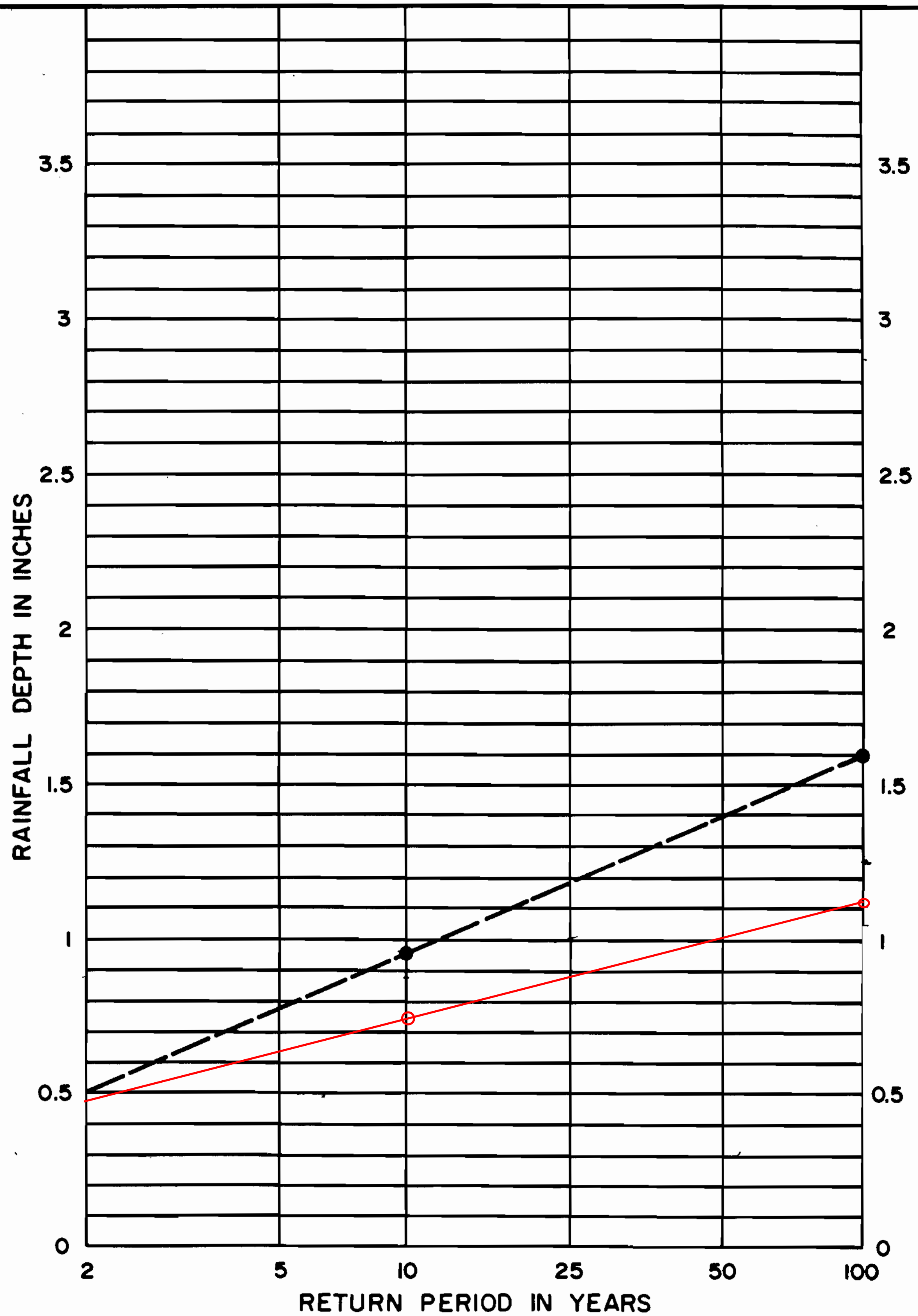
Figure D-1

Curve (1) Numbers of Hydrologic Soil-Cover Complexes For Pervious Areas-AMC II					
Cover Type (3)	Quality of Cover (2)	Soil Group A	B	C	D
NATURAL COVERS -					
Barren (Rockland, eroded and graded land)		78	86	91	93
Chaparral, Broadleaf (Manzonita, ceanothus and scrub oak)	Poor	53	70	80	85
	Fair	40	63	75	81
	Good	31	57	71	78
Chaparral, Narrowleaf (Chamise and redshank)	Poor	71	82	88	91
	Fair	55	72	81	86
Grass, Annual or Perennial	Poor	67	78	86	89
	Fair	50	69	79	84
	Good	38	61	74	80
Meadows or Cienegas (Areas with seasonally high water table, principal vegetation is sod forming grass)	Poor	63	77	85	88
	Fair	51	70	80	84
	Good	30	58	71	78
Open Brush (Soft wood shrubs - buckwheat, sage, etc.)	Poor	62	76	84	88
	Fair	46	66	77	83
	Good	41	63	75	81
Woodland (Coniferous or broadleaf trees predominate. Canopy density is at least 50 percent.)	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	25	55	70	77
Woodland, Grass (Coniferous or broadleaf trees with canopy density from 20 to 50 percent)	Poor	57	73	82	86
	Fair	44	65	77	82
	Good	33	58	72	79
URBAN COVERS -					
Residential or Commercial Landscaping (Lawn, shrubs, etc.)	Good	32	56	69	75
Turf (Irrigated and mowed grass)	Poor	58	74	83	87
	Fair	44	65	77	82
	Good	33	58	72	79
AGRICULTURAL COVERS -					
Fallow (Land plowed but not tilled or seeded)		77	86	91	94

SAN BERNARDINO COUNTY

HYDROLOGY MANUAL

CURVE NUMBERS FOR PERVIOUS AREAS



NOTE:

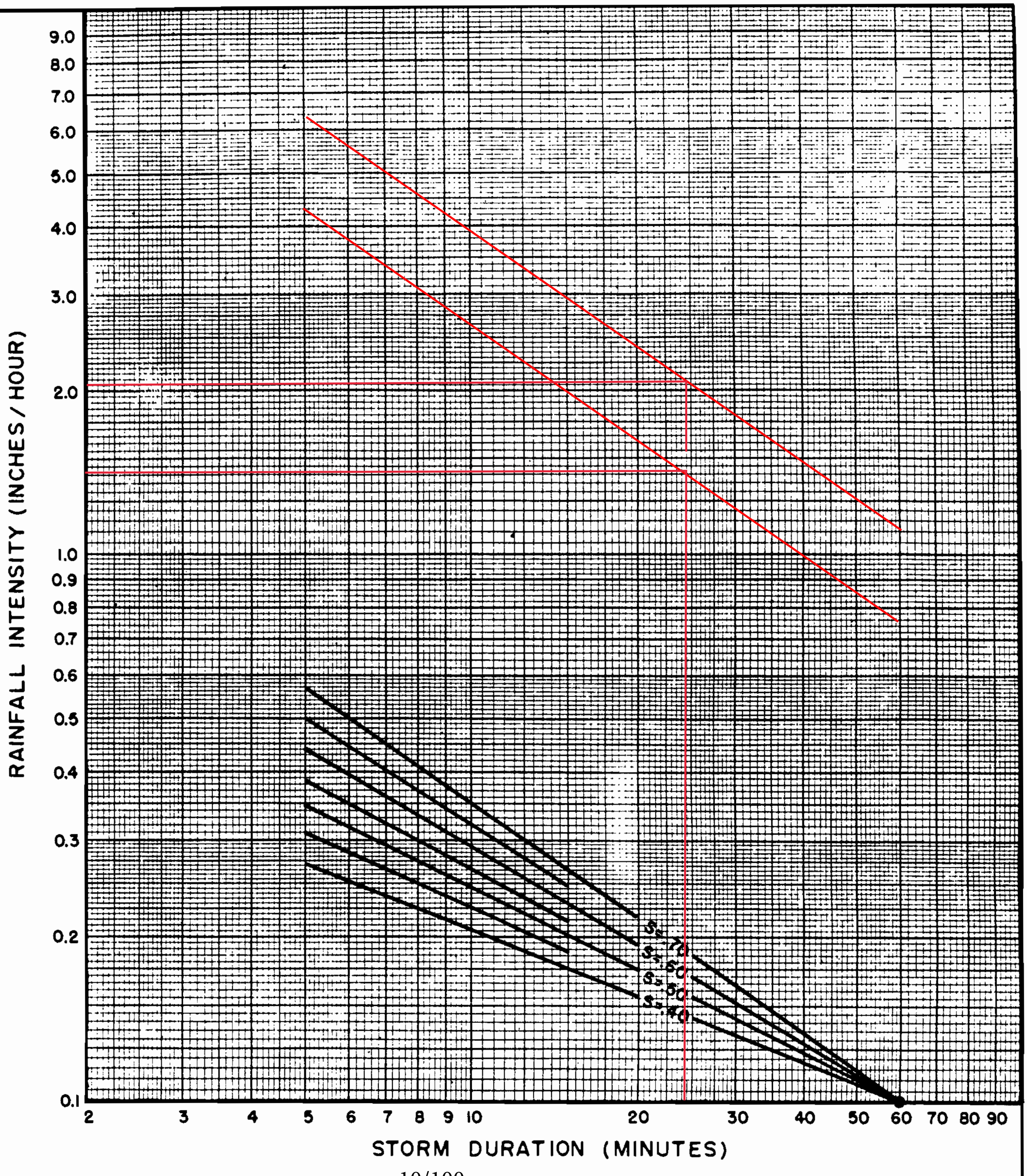
1. FOR INTERMEDIATE RETURN PERIODS PLOT 10-YEAR AND 100-YEAR ONE HOUR VALUES FROM MAPS, THEN CONNECT POINTS AND READ VALUE FOR DESIRED RETURN PERIOD. FOR EXAMPLE GIVEN 10-YEAR ONE HOUR = 0.95" AND 100-YEAR CNE HOUR = 1.60", 25-YEAR ONE HOUR = 1.18".

REFERENCE: NOAA ATLAS 2, VOLUME XI - CAL., 1973

SAN BERNARDINO COUNTY

HYDROLOGY MANUAL

RAINFALL DEPTH VERSUS RETURN PERIOD FOR PARTIAL DURATION SERIES



DESIGN STORM FREQUENCY = 10/100 YEARS

ONE HOUR POINT RAINFALL = .75/1.1 INCHES

LOG-LOG SLOPE = .7

PROJECT LOCATION = Mesa View, Victorville

SAN BERNARDINO COUNTY

HYDROLOGY MANUAL

INTENSITY - DURATION CURVES CALCULATION SHEET

FIGURE D-3

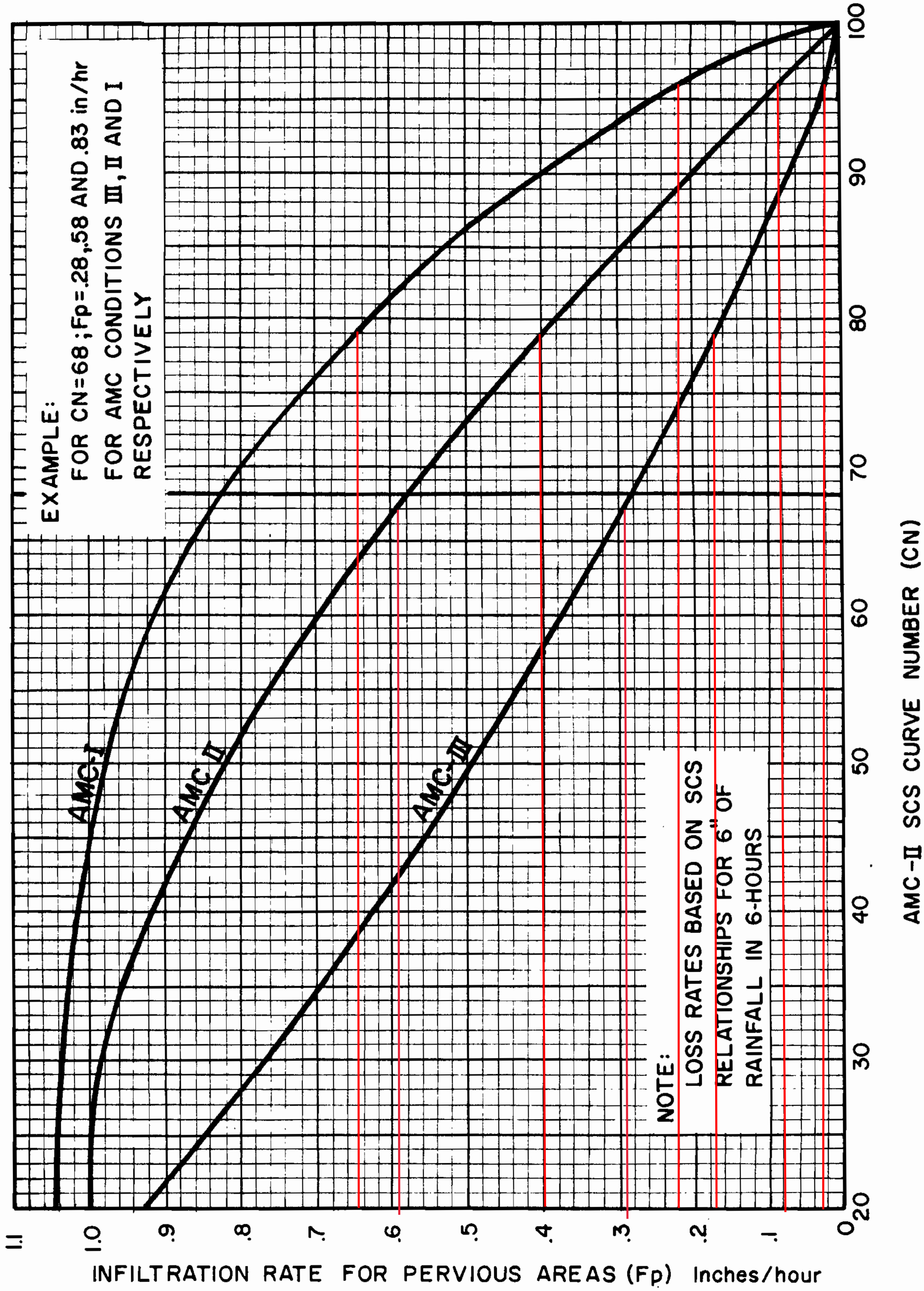
TABLE C.1. CURVE NUMBER RELATIONSHIPS

CN for AMC Condition II	Corresponding CN for AMC Condition I	III
100	100	100
95	87	99
90	78	98
85	70	97
80	63	94
75	57	91
70	51	87
65	45	83
60	40	79
55	35	75
50	31	70
45	27	65
40	23	60
35	19	55
30	15	50
25	12	45
20	9	39
15	7	33
10	4	26
5	2	17
0	0	0

C.6. ESTIMATION OF LOSS RATES

In estimating loss rates for design hydrology, a watershed curve number (CN) is determined for each soil-cover complex within the watershed using Figure C-3. The working range of CN values is between 0 and 98, where a low CN indicates low runoff potential (high infiltration), and a high CN indicates high runoff potential (low infiltration). Selection of a CN takes into account the major factors affecting loss rates on pervious surfaces including the hydrologic soil group, cover type and quality, and antecedent moisture condition (AMC).

Also included in the CN selection are the effects of "initial abstraction" (Ia) which represents the combined effects of other effective rainfall losses including depression storage, vegetation interception, evaporation, and transpiration, among other factors.



SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

INFILTRATION RATE FOR PERVIOUS AREAS VERSUS SCS CURVE NUMBERS

Figure C-6