

**FINAL ENGINEERING  
DRAINAGE STUDY**

**FOR**

**South Escondido  
Escondido, CA 92027**

**APN: 240-110-54, 55, 56**

**OWNER:**

South Escondido, LP  
1555 Camino Del Mar, Suite 307  
Del Mar, CA 92014  
Tel: xxxxxx

**ENGINEER:**

MASSON & ASSOCIATES, INC.  
200 E. Washington Ave. Suite 200  
Escondido, CA 92025  
(760) 741-3570

BY:

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Robert D'Amaro, RCE# C081699



PN: 18157  
Date: May 28, 2019

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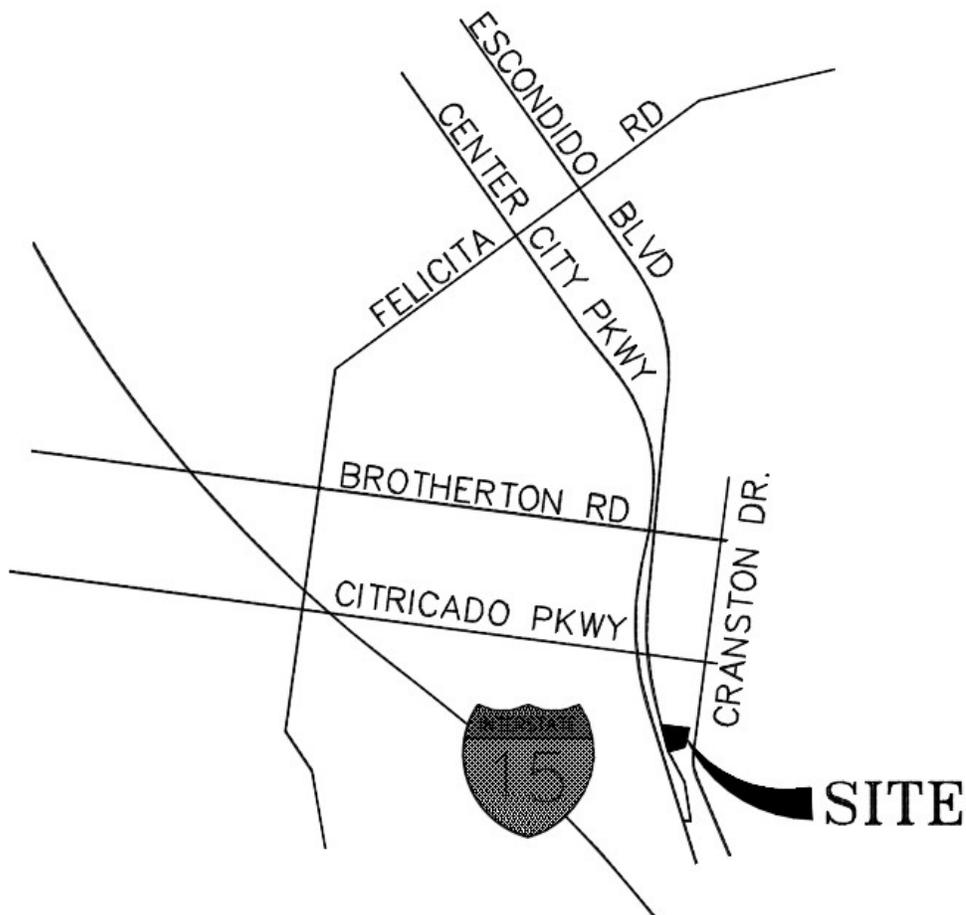
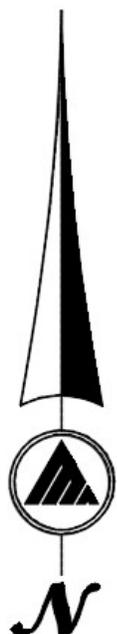
**EXHIBITS:**

Exhibit A – Pre-Development Hydrology Map

Exhibit B – Post-Development Hydrology Map

**VICINITY MAP  
South Escondido**

CITY OF ESCONDIDO, CALIFORNIA



**VICINITY MAP**

NTS

**CURRENT  
CONDITION**



## **Current Conditions:**

The Project is an existing building with approximately 1.75 acres operated as restaurant located on South Escondido Blvd within the City of Escondido, California. The site slopes gently from northwest to southeasterly direction on an average slope of 2 percent. The site runoff currently drains onto South Escondido via surface flow and an existing ditch located on the south portion of the site from east to west. The existing ditch discharges the runoff onto south Escondido Blvd and then into an existing storm drain system located on South Escondido Blvd and ultimately onto Lake Hodge reservoir. The project site is located on GC zoning area (General Commercial). There are no offsite onto project site.

See Appendix A for calculations and exhibits.

According to the NRCS Websoil Survey, the site is situated in hydrologic soil group C.

## **METHODOLOGY:**

The method used herein to determine discharge quantities is the Rational Method as described in the City of Escondido Drainage Design Standards. A 50 year storm frequently was used due to the location of the site in a local valley and the potential for adverse effect on neighboring properties.

Per the City standards, the following parameters will be used:

Intensity (I) =	3.3 in/hr (Figure 1, 50-yr event)
Time of Concentration (Tc) =	10 minutes minimum (Figure 2)
Runoff coefficients (C):	
Commercial (Existing) =	0.85 (Figure 1)
Multiple Units (Proposed) =	0.7

Pre and post development hydrology maps are located in the back of this report as Exhibit 'A' and Exhibit 'B' respectively. The included maps outline the sub-basins, flow paths and concentration points for runoff discharging from the site area. All applicable tables and charts referenced from the manual are included herein.

## **PROPOSED CONDITIONS:**

The proposed development project will consist of 42 3-story Townhomes, driveway, parking lot, treatment basin.

The project will have one onsite drainage basin. The Proposed drainage basin will drain southeasterly via a proposed roof drain, curb gutter into a proposed treatment basin and then discharge into south Escondido Blvd prior to discharging into an existing storm drain system located on South Escondido Blvd downstream of the project site. All the proposed runoff will ultimately discharge onto Lake Hodge Reservoir.

See Appendix B for calculations and exhibit.

**CONCLUSIONS:**

A comparison of the on-site runoff from the existing condition to the proposed conditions shows decrease in runoff because of the existing and proposed development types and the C factor.

One treatment basin facility will be designed to treat and retain the onsite runoff for Hydromodification purpose. The retention of water will have the beneficial side effect of helping to reduce the peak rate of flow exiting the site.

**Summary Table-Onsite**

Basin	Area (Ac) Pre	Q <sub>50</sub> (CFS) Pre	Area (Ac) Post	Q <sub>50</sub> (CFS) Post
1	1.75	4.9	1.75	4.0

Difference  $Q(\text{post}) - Q(\text{pre}) = - 0.9 \text{ cfs}$  (Decreased)

The site runoff has been decreased by 0.9 cfs which as mentioned above will be reduced further more by the use of biofiltration basin to below the existing condition runoff.

**APPENDIX A  
EXISTING CONDITIONS CALCULATIONS**

<b>Existing Condition Hydrology</b>									
BASIN ID	AREA	AREA	C	CA	Change in Elevation	Longest Runoff Length	T <sub>c</sub>	I <sub>50</sub>	Q <sub>50</sub>
	(ft <sup>2</sup> )	(ac.)					(min.)	(in/hr)	(cfs)
1	76102	1.75	0.85	1.49	7.00	380.0	<b>10.0</b>	<b>3.30</b>	<b>4.9</b>

Notes:

Minimum Tc used in 10 minutes

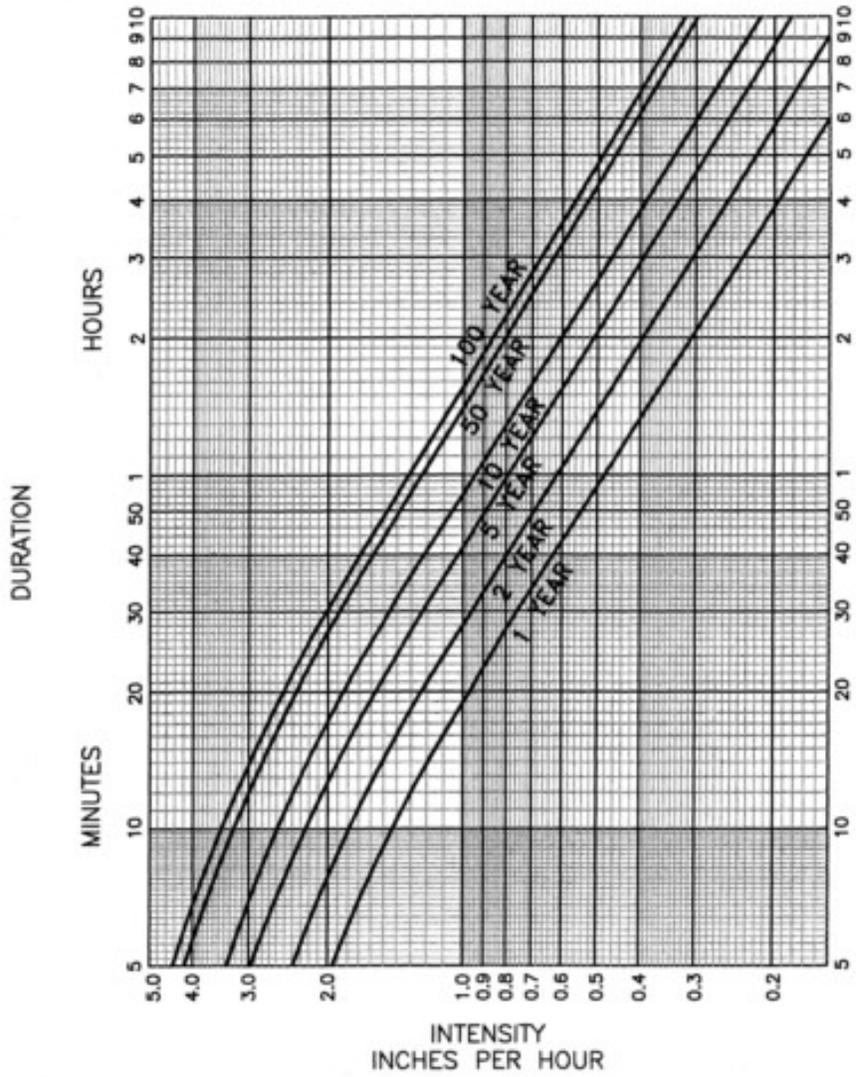
**APPENDIX B  
POST DEVELOPMENT CALCULATIONS**

<b>PROPOSED CONDITIONS HYDROLOGY</b>									
BASIN ID	AREA	AREA	C	CA	Change in Elevation	Longest Runoff Length	T <sub>c</sub>	I <sub>50</sub>	Q <sub>50</sub>
	(ft <sup>2</sup> )	(ac.)					(min.)	(in/hr)	(cfs)
1	76102	1.75	0.70	1.22	7.00	382.0	<b>10.0</b>	<b>3.30</b>	<b>4.0</b>

Notes:

Minimum T<sub>c</sub> used in 10 minutes

**APPENDIX C**  
**TABLES AND FIGURES FROM CITY OF ESCONDIDO DRAINAGE**  
**STANDARDS**



**ESCONDIDO RUNOFF COEFFICIENTS**

PARKS, GOLF COURSES, CEMETERIES.....	0.25
UNDEVELOPED LAND, OPEN SPACE.....	0.35
RURAL - OVER 1/2 ACRE LOTS.....	0.45
SINGLE FAMILY.....	0.55
MOBILE HOME.....	0.65
MULTIPLE UNITS.....	0.70
COMMERCIAL.....	0.85
INDUSTRIAL.....	0.95

APPROVED:	DATE: 5/6/09
<i>Edward J. Dan</i>	
DIRECTOR OF ENGINEERING SERVICES	
REVISED	APPROVED

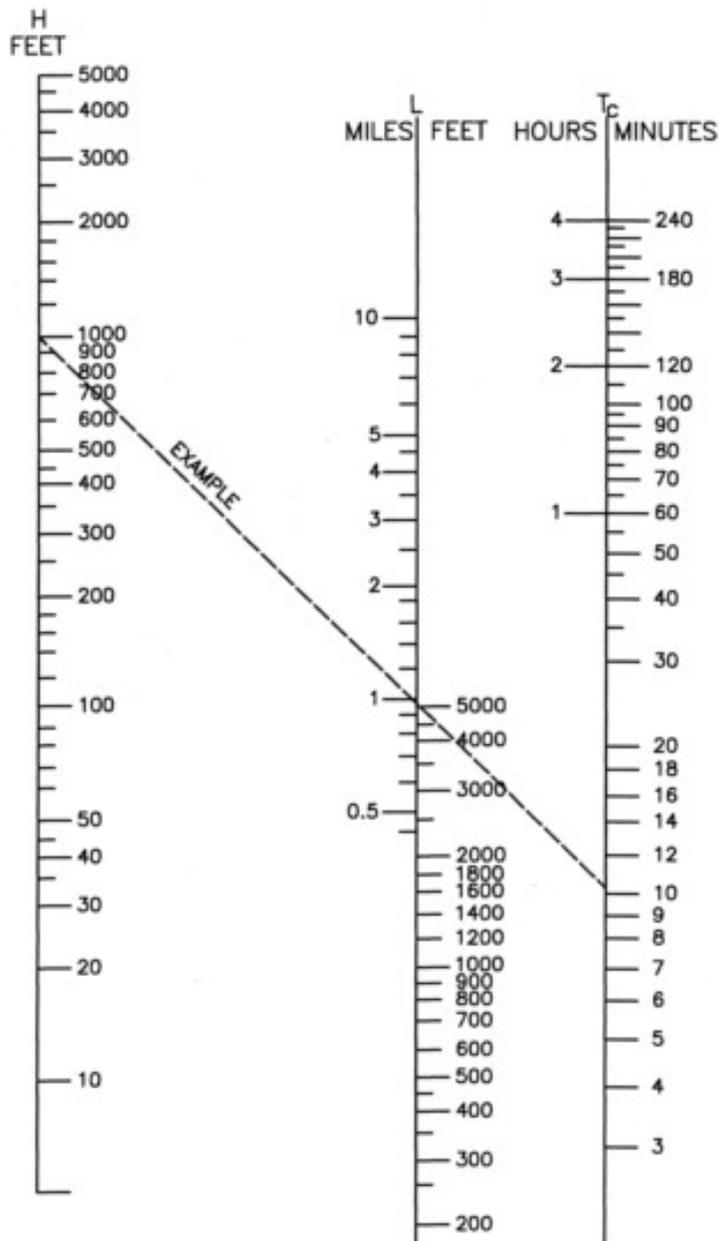
**CITY OF ESCONDIDO**  
DEPARTMENT OF ENGINEERING SERVICES

SCALE:  
NOT TO SCALE

**RUNOFF INTENSITY  
DURATION CURVE**

FIGURE NO.

**1**



$$T_c = \left( \frac{11.9 L^3}{H} \right)^{.385}$$

**NOTE:**

THIS CHART SHALL BE USED FOR ALL BASINS WITHIN THE CITY OF ESCONDIDO LESS 0.5 SQUARE MILE. THE MINIMUM T<sub>c</sub> TO BE USED IS 10 MINUTES

T<sub>c</sub> = TIME OF CONCENTRATION (HOURS)  
 L = LENGTH OF DRAINAGE COURSE (MILES)  
 H = DIFFERENCE IN ELEVATION FROM FURTHER MOST POINT OF DESIGN (FEET)

APPROVED:	DATE: 5/5/09
<i>[Signature]</i>	
DIRECTOR OF ENGINEERING SERVICES	
REVISED	APPROVED

**CITY OF ESCONDIDO**  
 DEPARTMENT OF ENGINEERING SERVICES

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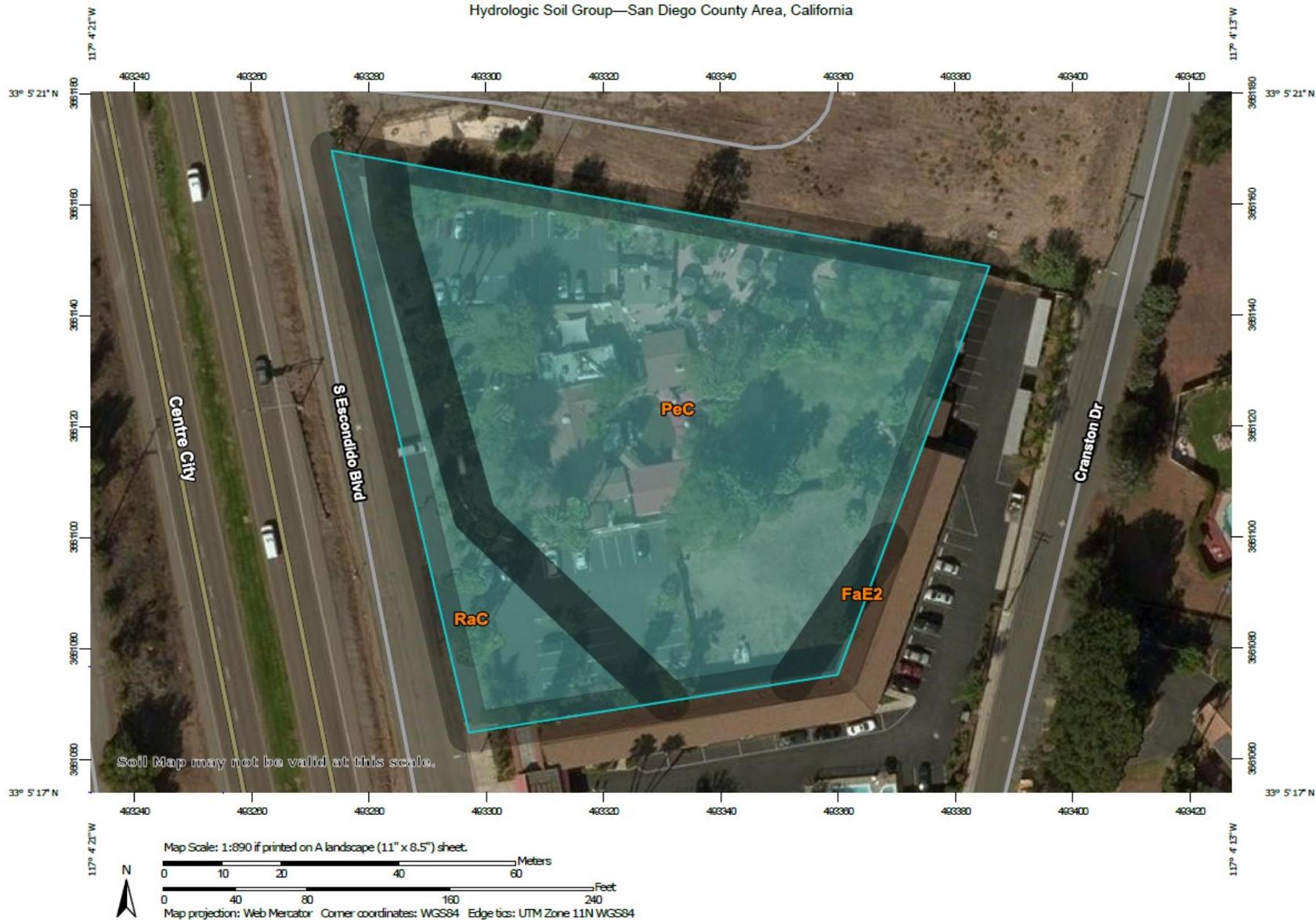
**RUNOFF  
 TIME CHART**

FIGURE NO.

**2**

**APPENDIX D**  
**NRCS HYDROLOGIC SOILS GROUP DATA**

Hydrologic Soil Group—San Diego County Area, California



### MAP LEGEND

- Area of Interest (AOI)**  
 Area of Interest (AOI)
- Soils**
- Soil Rating Polygons**
-  A
  -  A/D
  -  B
  -  B/D
  -  C
  -  C/D
  -  D
  -  Not rated or not available
- Soil Rating Lines**
-  A
  -  A/D
  -  B
  -  B/D
  -  C
  -  C/D
  -  D
  -  Not rated or not available
- Soil Rating Points**
-  A
  -  A/D
  -  B
  -  B/D
- Soils**
-  C
  -  C/D
  -  D
  -  Not rated or not available
- Water Features**
-  Streams and Canals
- Transportation**
-  Rails
  -  Interstate Highways
  -  US Routes
  -  Major Roads
  -  Local Roads
- Background**
-  Aerial Photography

### MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service  
 Web Soil Survey URL:  
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Diego County Area, California  
 Survey Area Data: Version 12, Sep 13, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Nov 3, 2014—Nov 22, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

## Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
FaE2	Fallbrook sandy loam, 15 to 30 percent slopes, eroded	C	0.0	1.1%
PeC	Placentia sandy loam, 2 to 9 percent slopes, warm MAAT, MLRA 19	C	1.6	80.9%
RaC	Ramona sandy loam, 5 to 9 percent slopes	C	0.3	18.0%
<b>Totals for Area of Interest</b>			<b>1.9</b>	<b>100.0%</b>

## Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff:* None Specified

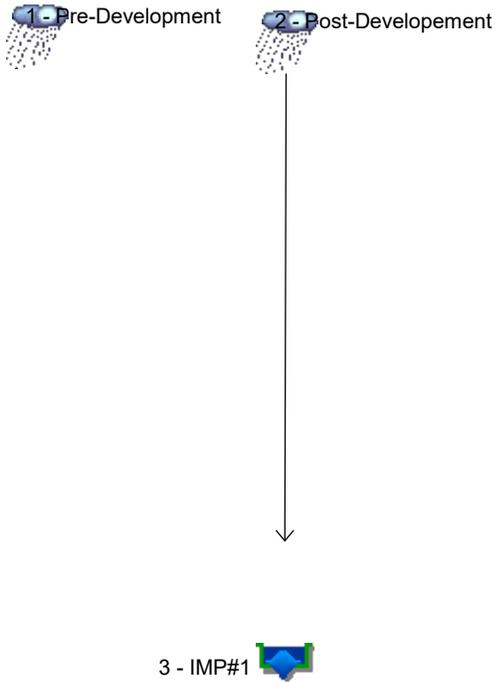
*Tie-break Rule:* Higher

**APPENDIX E**  
**100-YR FLOOD CONTROL CALCULATION**

<b>Watershed Model Schematic.....</b>	<b>1</b>
<b>Hydrograph Return Period Recap.....</b>	<b>2</b>
<b>100 - Year</b>	
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# Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020



## Legend

<u>Hyd.</u>	<u>Origin</u>	<u>Description</u>
1	Manual	Pre-Development
2	Manual	Post-Development
3	Reservoir	IMP#1

# Hydrograph Return Period Recap

Hydroflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)								Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	Manual	----	----	----	----	----	----	----	----	2.200	Pre-Development
2	Manual	----	----	----	----	----	----	----	----	3.090	Post-Development
3	Reservoir	2	----	----	----	----	----	----	----	0.057	IMP#1

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description	
1	Manual	2.200	5	245	3,450	----	----	----	Pre-Development	
2	Manual	3.090	5	245	4,347	----	----	----	Post-Developement	
3	Reservoir	0.057	5	360	4,314	2	563.22	3,723	IMP#1	
18157- Attenuation-Deeper Tank.gpw					Return Period: 100 Year			Wednesday, 05 / 29 / 2019		

# Hydrograph Report

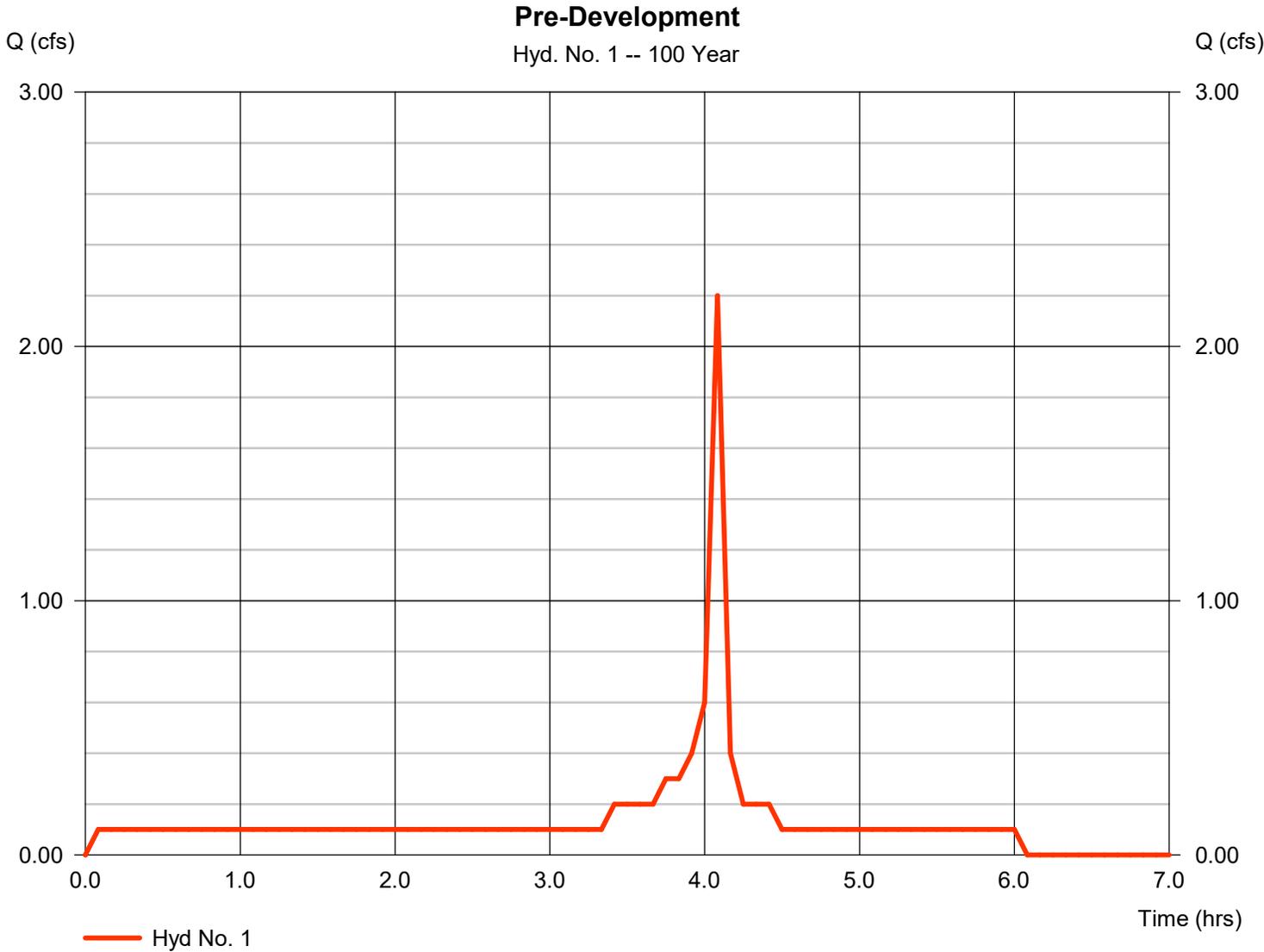
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Wednesday, 05 / 29 / 2019

## Hyd. No. 1

Pre-Development

Hydrograph type	= Manual	Peak discharge	= 2.200 cfs
Storm frequency	= 100 yrs	Time to peak	= 4.08 hrs
Time interval	= 5 min	Hyd. volume	= 3,450 cuft



# Hydrograph Report

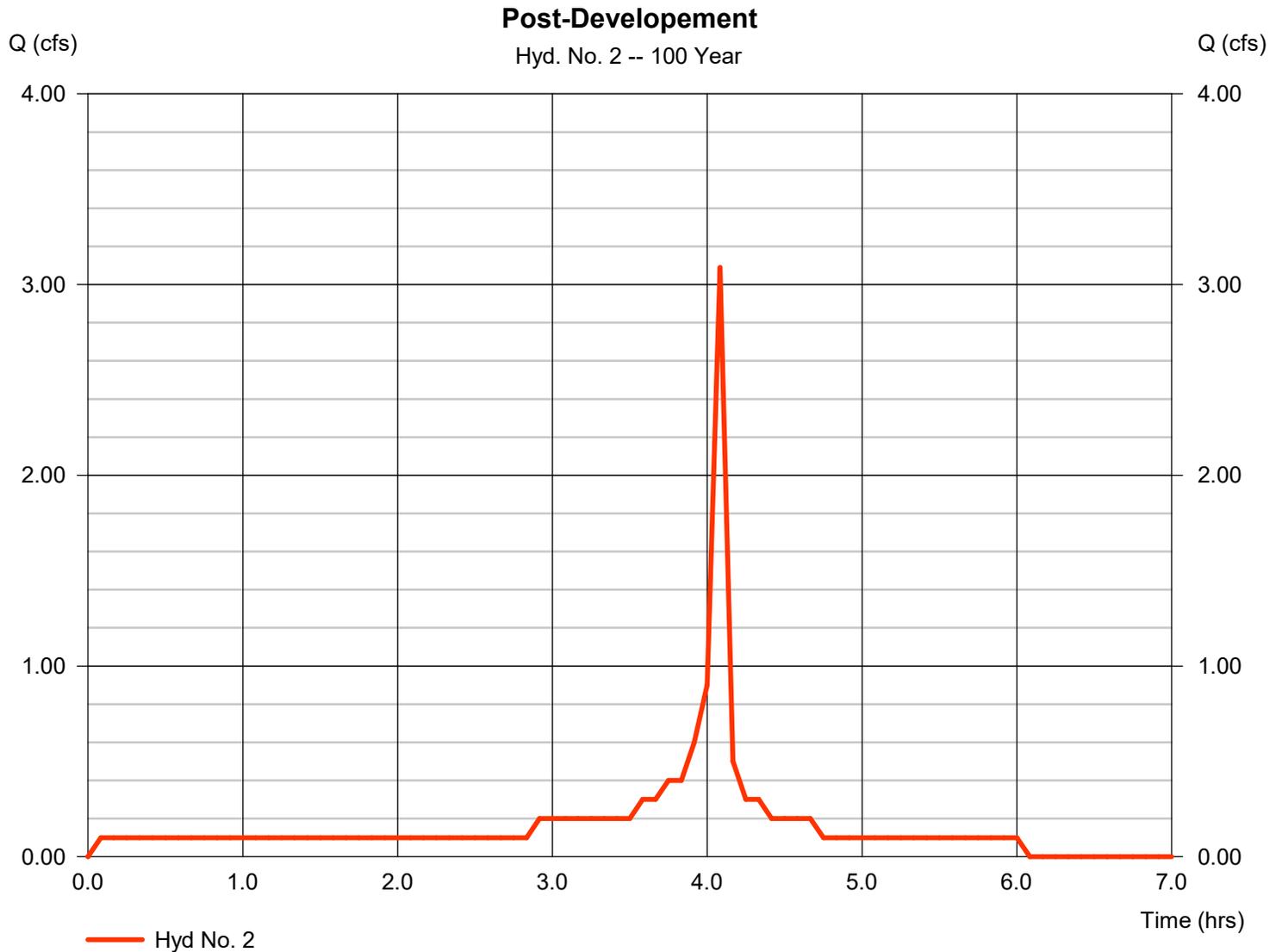
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Wednesday, 05 / 29 / 2019

## Hyd. No. 2

Post-Development

Hydrograph type	= Manual	Peak discharge	= 3.090 cfs
Storm frequency	= 100 yrs	Time to peak	= 4.08 hrs
Time interval	= 5 min	Hyd. volume	= 4,347 cuft



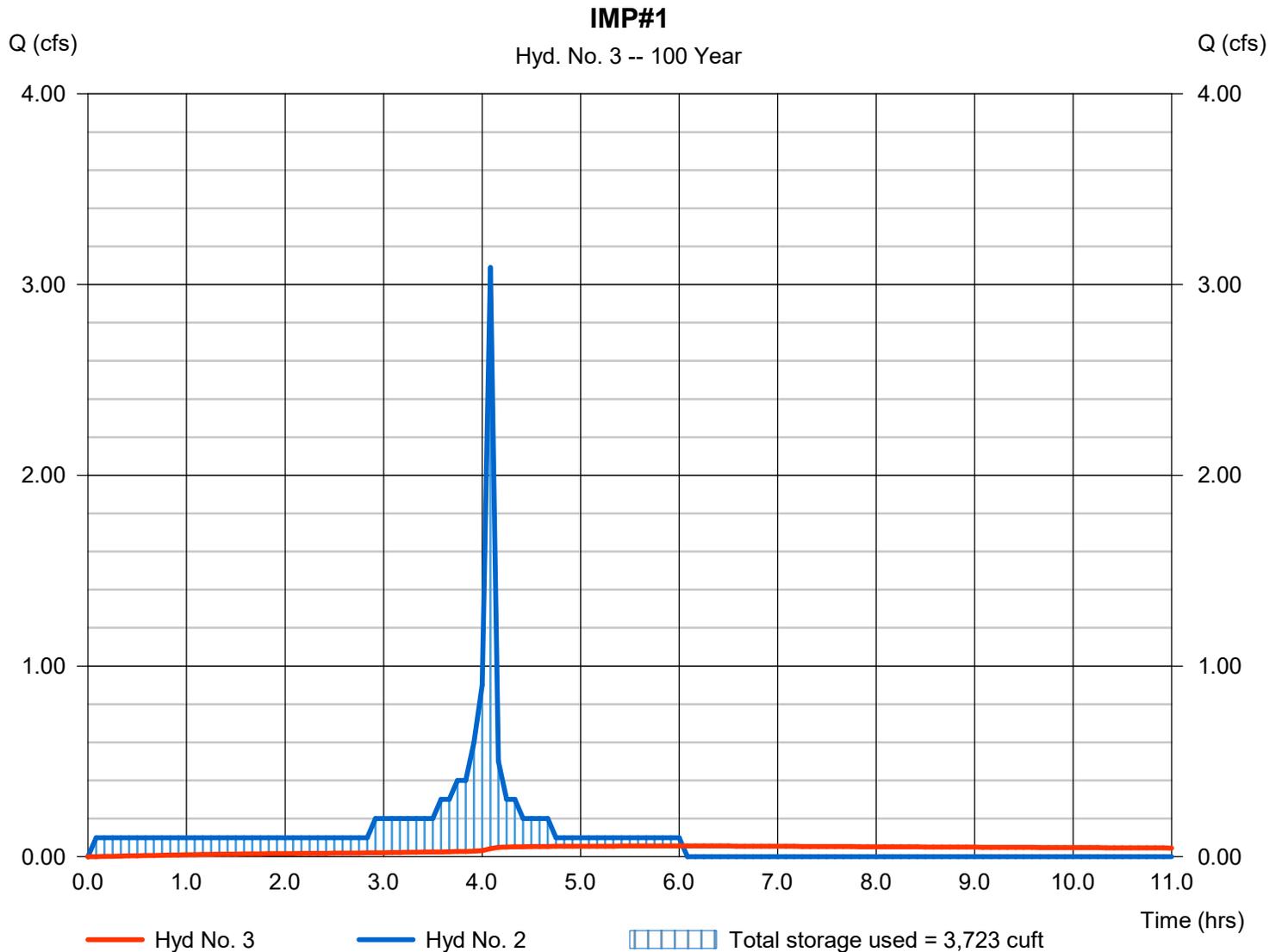
# Hydrograph Report

## Hyd. No. 3

IMP#1

Hydrograph type	= Reservoir	Peak discharge	= 0.057 cfs
Storm frequency	= 100 yrs	Time to peak	= 6.00 hrs
Time interval	= 5 min	Hyd. volume	= 4,314 cuft
Inflow hyd. No.	= 2 - Post-Development	Max. Elevation	= 563.22 ft
Reservoir name	= IMP#1	Max. Storage	= 3,723 cuft

Storage Indication method used.



## Pond No. 1 - IMP#1

### Pond Data

Contours -User-defined contour areas. Average end area method used for volume calculation. Beginning Elevation = 560.85 ft

### Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	560.85	2,603	0	0
0.75	561.60	2,603	1,952	1,952
0.75	561.60	1,096	2	1,954
2.75	563.60	1,096	2,191	4,145
2.75	563.60	2,740	2	4,147
3.75	564.60	3,360	3,047	7,194
4.75	565.60	3,990	3,675	10,869
5.08	565.93	4,190	1,350	12,219
5.25	566.10	4,930	775	12,994

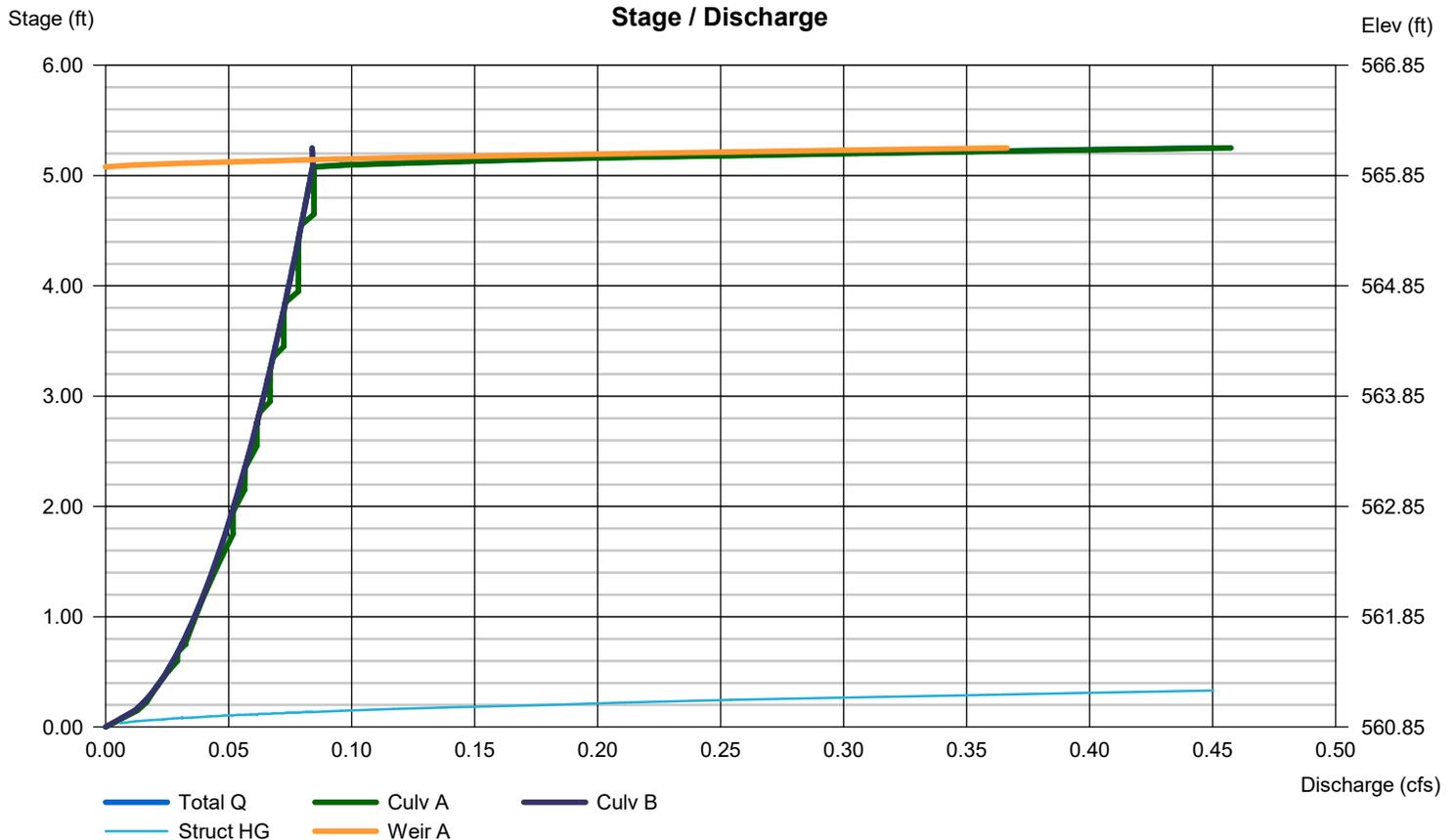
### Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	1.20	0.00	0.00
Span (in)	= 12.00	1.20	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 560.85	560.85	0.00	0.00
Length (ft)	= 100.00	0.00	0.00	0.00
Slope (%)	= 0.50	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	No

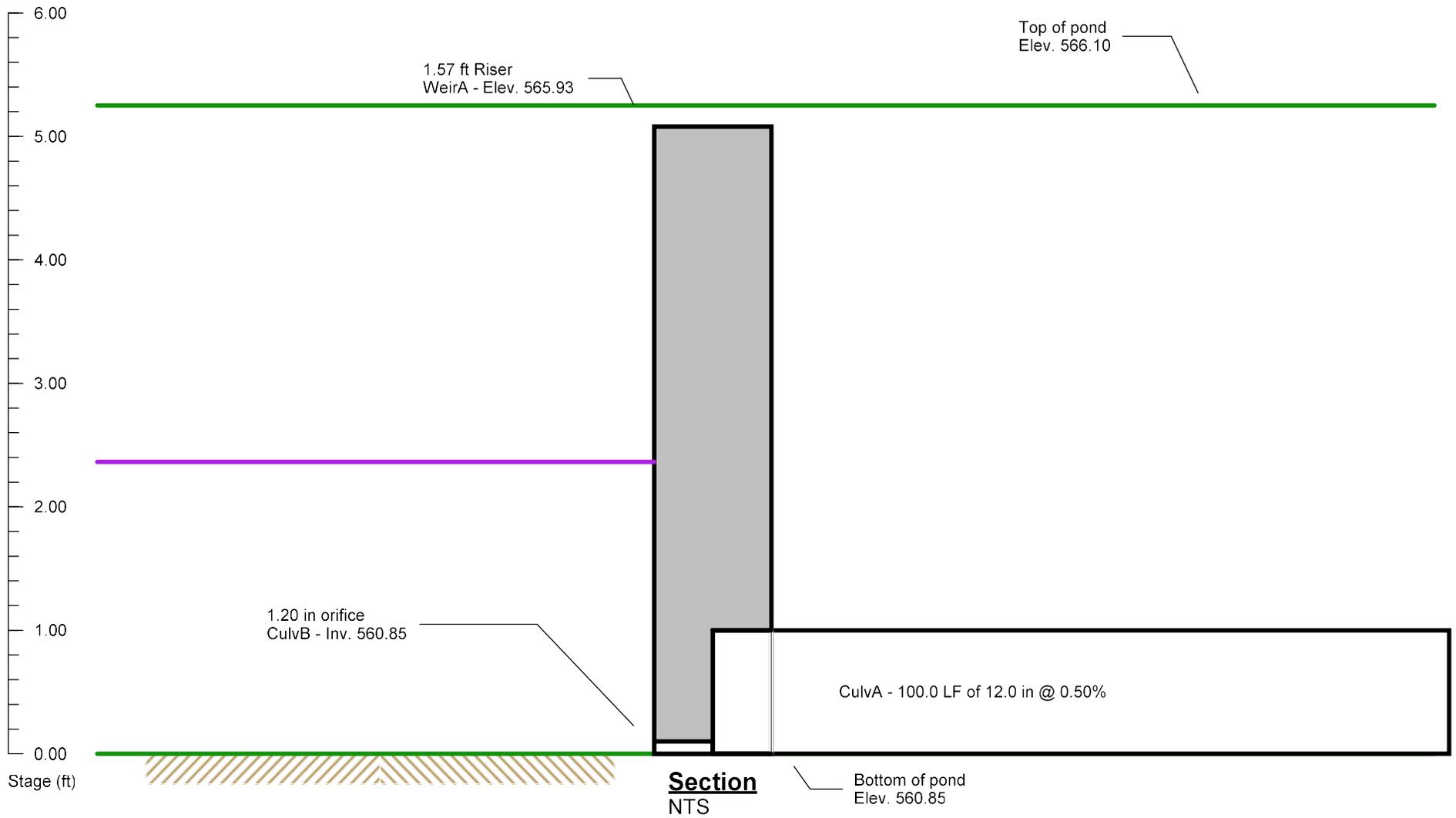
### Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 1.57	0.00	0.00	0.00
Crest El. (ft)	= 565.93	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	No	No
Exfil.(in/hr)	= 0.000 (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).



# Pond No. 1 - IMP#1



100-yr

Inflow hydrograph = 2. Manual - Post-Development

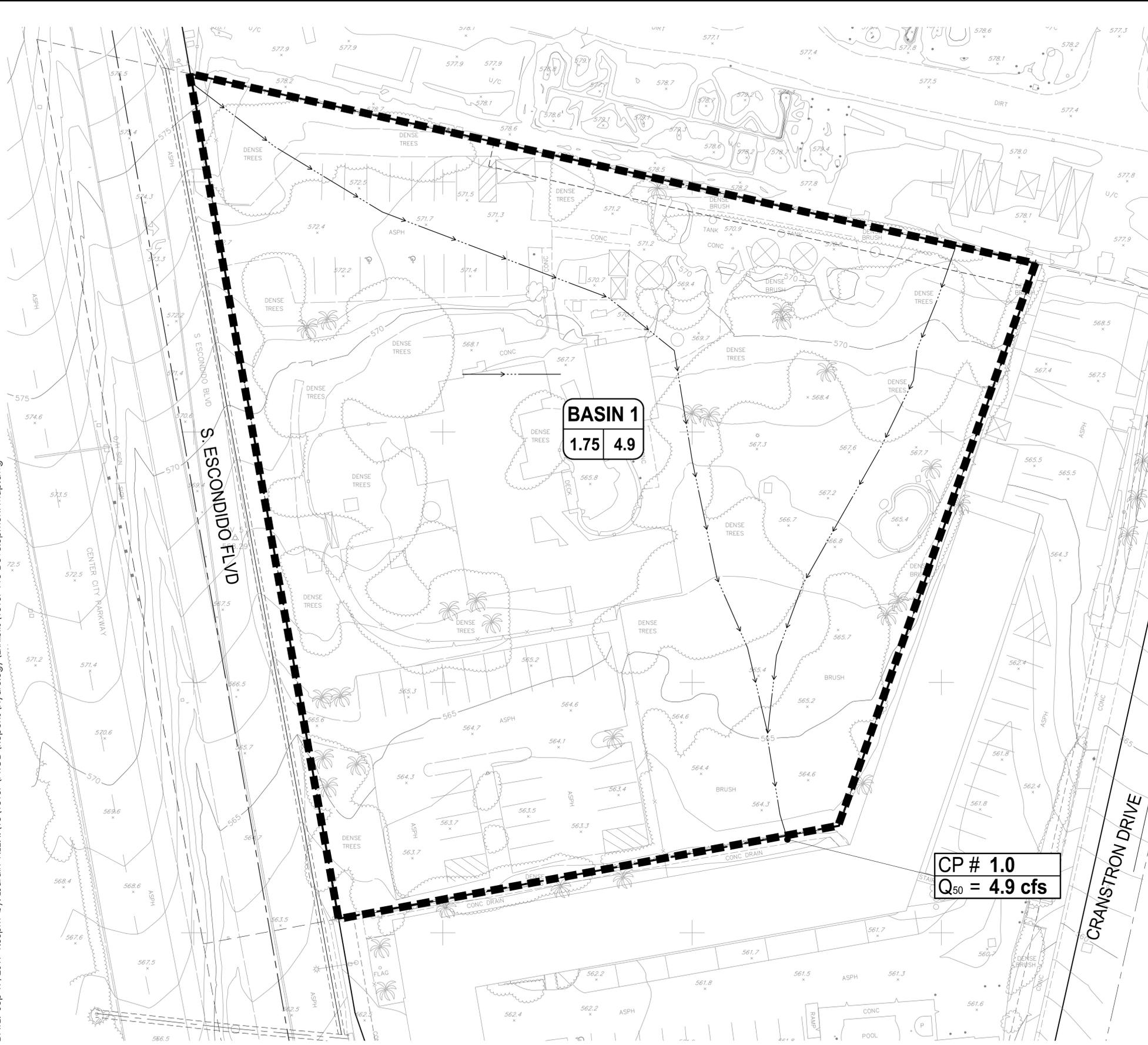
Stage	Elevation	Contour Area	Incremental Storage	Total Storage
(ft)	(ft)	(sqft)	(cuft)	(cuft)
0.00	560.60	<b>RTank</b> 2,603 <b>95% Void</b>	0.000	0.000
1.00	561.60	<b>RTank</b> 2,603 <b>95% Void</b>	2,603	2,603
1.00	561.60	1,096 <b>40% Void</b>	1.85	2,605
3.00	563.60	1,096 <b>40% Void</b>	2,191	4,796
3.00	563.60	2,740 <b>100% Void</b>	1.92	4,798
4.00	564.60	3,360 <b>100% Void</b>	3,047	7,845
5.00	565.60	3,990 <b>100% Void</b>	3,675	11,520
5.33	565.93	4,190 <b>100% Void</b>	1,350	12,869
5.50	566.10	4,930 <b>100% Void</b>	775	13,645

**Underground**

**Aboveground**

# EXHIBIT A

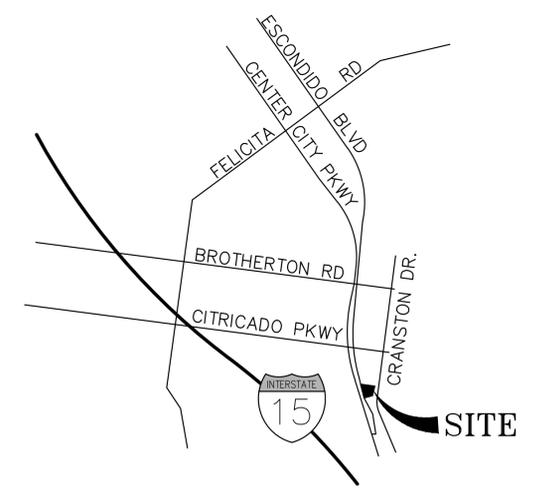
DATE: Sep 17, 2019-1:53pm by: Ljardin FILE: I:\18\18157\PROD\Reports\Hydrology\Exhibits\18157-Pre-Development Map.dwg



**LEGEND**

SYMBOL	DESCRIPTION
<b>BASIN 2</b> A ac Q cfs	BASIN DESIGNATION BASIN AREA (ACRES) AND RUNOFF (CFS)
<b>CP # 1.0</b> <b>Q<sub>50</sub> = 2.6 cfs</b>	CONCENTRATION POINT NUMBER 50-YEAR DISCHARGE
▬▬▬▬▬▬▬▬	BASIN BOUNDARY
-----	PROPERTY LINE
→.....→	FLOW PATH

**CITY OF ESCONDIDO, CALIFORNIA**



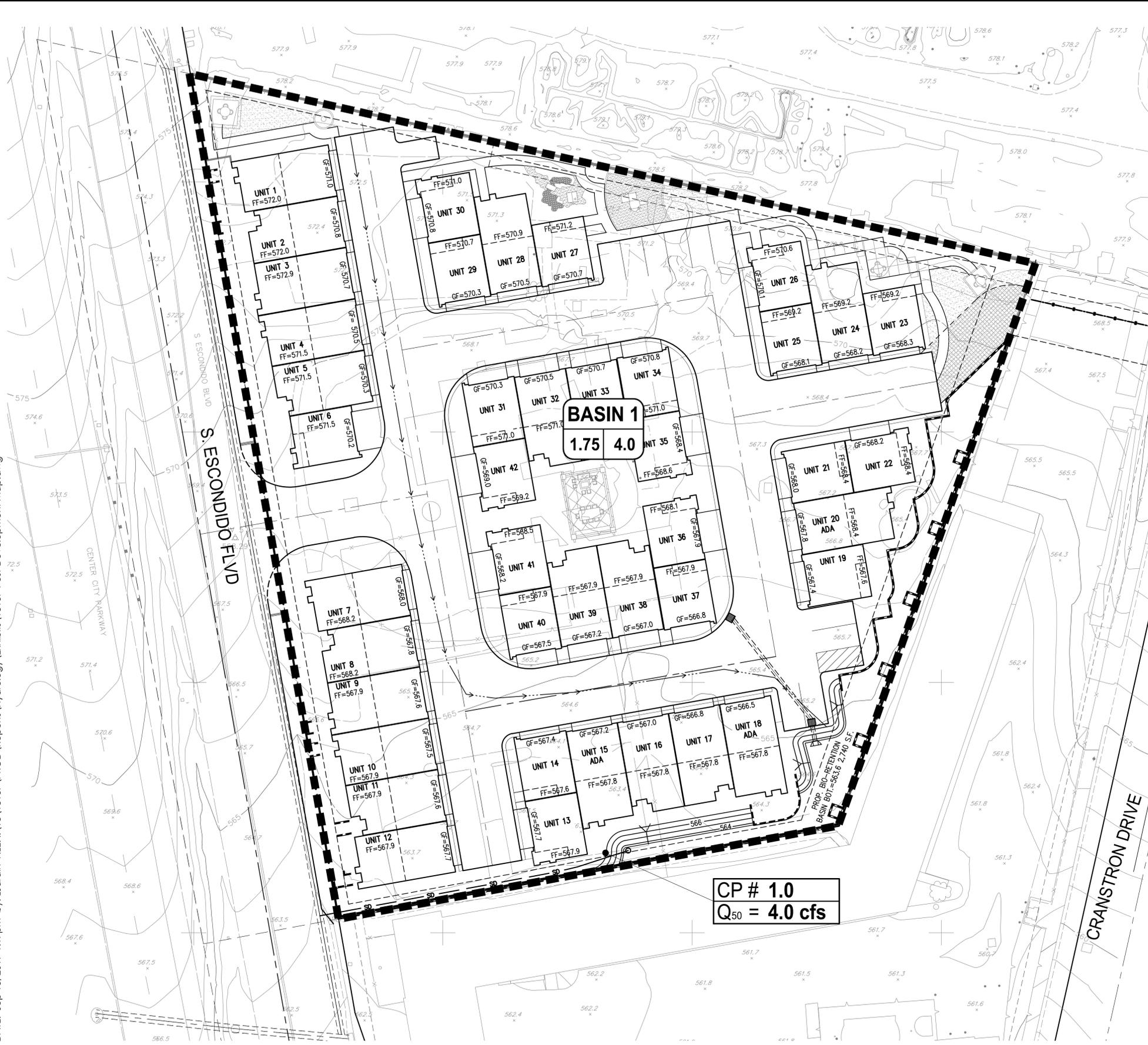
**VICINITY MAP**  
NTS

**EXHIBIT 'A'**  
**PRE DEVELOPMENT MAP FOR**  
**SOUTH ESCONDIDO**  
**CITY OF ESCONDIDO, CA**


**Planning ▲ Engineering ▲ Surveying**  
**Solved.**  
 200 E. Washington Ave., Suite 200  
 Escondido, CA 92025  
 O. 760.741.3570  
 F. 760.741.1786  
 www.masson-assoc.com

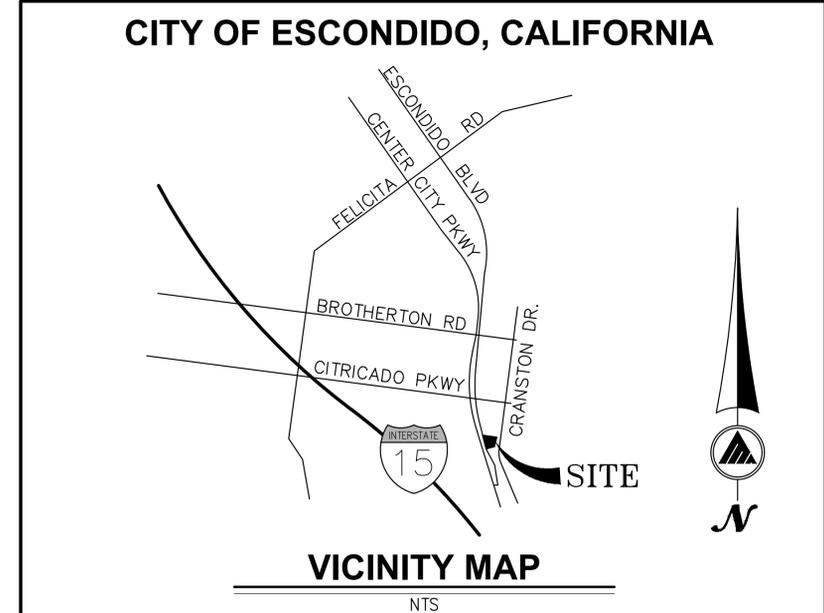
# EXHIBIT B

DATE: Sep 13, 2019-1:17pm by: Ljardin FILE: I:\18\18157\PROD\Reports\Hydrology\Exhibits\18157-Post-Development Map.dwg



**LEGEND**

SYMBOL	DESCRIPTION
<b>BASIN 2</b> A ac Q cfs	BASIN DESIGNATION BASIN AREA (ACRES) AND RUNOFF (CFS)
<b>CP # 1.0</b> Q <sub>50</sub> = 2.6 cfs	CONCENTRATION POINT NUMBER 50-YEAR DISCHARGE
▬▬▬▬▬▬▬▬	BASIN BOUNDARY
---	PROPERTY LINE
→	FLOW PATH



**EXHIBIT 'B'**  
**POST DEVELOPMENT MAP FOR**  
**SOUTH ESCONDIDO**  
**CITY OF ESCONDIDO, CA**



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