

July 14, 2017
Revised August 8, 2017

City of Mission
Planning & Zoning Department
6090 Woodson
Mission, KS 66202



RE: Mission Trails FDP – Final Stormwater Summary

Dear City:

This letter summarizes final stormwater calculations to support the proposed Mission Trails mixed use project at 6201 Johnson Drive. The project includes retail, multi-story residential, and a parking garage.

An existing one story building and surface parking lot is located on the 2.82 acre site. Most of the site discharges to the southeast to storm infrastructure along Beverly Avenue. The remainder drains to curb inlets on the south side of Johnson Drive. Approximately 0.52 acres of offsite drainage area from the Salvation Army site to the west drains onto the site. Much of the site is covered with impervious building, parking, and walking surfaces, resulting in 2.30 acres or 81.6% of the total site area. The underlying soils are Sharpsburg-Urban land complex, 4 to 8 percent slopes, with a hydrologic soil group rating of C. The hydrologic soil group rating has been downgraded to D soils, to account for significant previous development on the site. See attached Exhibit A for a delineation of existing pervious area and drainage boundaries. The site lies within flood zone X (areas outside the limits of the 0.2% annual chance floodplain); see attached Exhibit B for a FEMA flood insurance rate map.

The proposed condition removes the existing building and parking lot. The proposed multi-story building with courtyard and parking garage will cover 1.98 acres of the site, with open space, sidewalks, and surface parking accounting for the balance of 0.84 acres. The proposed impervious area is 2.33 acres or 82.6% of the total site area. This is a modest increase in impervious area over existing conditions of 1,152 square feet. As the incremental increase in impervious area is less than 5,000 square feet for this redevelopment project, APWA 5600 allows an exemption from stormwater detention requirements. This exemption also extends to the inclusion of MARC Best Management Practices (BMP's) for Stormwater Quality on the project. Therefore no stormwater detention or BMP's are proposed for this project. See attached Exhibit C for a delineation of proposed pervious area and drainage boundaries.

The table below summarizes the peak site discharge rate for existing and proposed conditions, for a SCS Type II 24-hour rainfall. There is not a significant enough change in impervious area to change the CN between existing and proposed conditions. The proposed impervious area calculations do account for 3,820 square feet of pervious area within the courtyard area.

Condition	Area (ac)	CN	Tc (min)	Peak Discharge		
				50% storm (cfs)	10% storm (cfs)	1% storm (cfs)
Existing	2.82	95 (94.68)	5	13.15	19.87	30.03
Proposed	2.82	95 (94.87)	5	13.15	19.87	30.03

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All of the flow from the proposed building, parking garage, and offsite tributary runoff from the Salvation Army site will be captured in enclosed storm sewer systems and piped to the existing storm sewer infrastructure on Beverly Avenue. A swale is provided along the south side of the property to convey runoff from the 0.85 acre drainage area west and south of the building, should the enclosed storm sewer become clogged. The area north of the building will surface drain to Johnson Drive, as it does in the existing condition. See attached Hydraflow Hydrographs Report for summary of peak discharge rate calculations, and attached Bentley Flowmaster Report for a summary of the south swale capacity for the 1% storm event and full flow swale capacity. The cross section for the swale calculation is conservatively located near the southwest corner of the building where the running swale slope is the lowest. The swale capacity increases further downstream to the east where the running slope increases and the sideslopes become flatter.

An emergency overflow pipe is proposed from the internal courtyard area to the swale on the south side of the property. This backup measure provides redundancy in the event the internal courtyard storm conveyance system or downstream receiving system becomes clogged, to provide an additional protection measure for residences and businesses on the first floor of the building.

The site discharges to an existing 5'x5' box culvert at Beverly Avenue. The size is derived from AIMS data and the outfall pipe measurement at Rock Creek, as the box itself is not accessible from the Beverly Avenue curb inlets. The Johnson Drive Improvement project added a 7'x6' box culvert along Johnson Drive, and redirected approximately 75 acres of watershed north of Johnson Drive that used to discharge to the Mission Trails site outfall. Therefore the 5'x5' box culvert currently only receives approximately 3.9 acres of tributary area (project site + bar) at the site outfall location, with a peak 1% storm flow rate of 41.5 cfs. The box culvert has a full flow manning's capacity of 487.33 cfs across Beverly, therefore the downstream storm system in the vicinity of this site has sufficient capacity. See attached Bentley Flowmaster Report for a summary of the box culvert capacity calculation.

Please contact Matt Kist, P.E., or Dan McGhee, P.E., should you have any questions regarding this letter.

SHAFFER, KLINE & WARREN, INC.

Enclosure(s)



EXHIBIT A

DRAINAGE BOUNDARY

JOHNSON DR

0.34 ac
DISCHARGES TO
JOHNSON DR

SITE AREA = 122,670 SF = 2.82 ac +/-
EXIST PERVIOUS = 22,640 SF = 0.52 ac
EXIST IMPERVIOUS = 2.30 ac
 $2.30 \text{ ac} / 2.82 \text{ ac} = 81.6\% \text{ IMPERVIOUS}$

CURVE NUMBER:

$((0.52 \text{ ac} \times 80) + (2.30 \text{ ac} \times 98)) / 2.82 =$
 $94.68 = 95$

EXISTING BUILDING

PERVIOUS
AREA (TYP)

SITE
BOUNDARY

LAMAR AVE

OFFSITE
DRAINAGE AREA
(0.52 ac +/-)

EXISTING PARKING

BEVERLY AVE

BALANCE OF SITE (AND OFFSITE) DISCHARGES
TO BEVERLY AVE STORM SYSTEM

5'x5' RCB

SHAFER, KLINE & WARREN

11250 Corporate Avenue
Lenexa, KS 66219-1392
913.888.7800 FAX: 913.888.7868

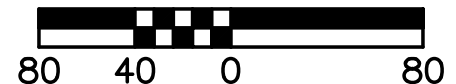
SURVEYING | ENGINEERING | CONSTRUCTION



PERVIOUS AREA

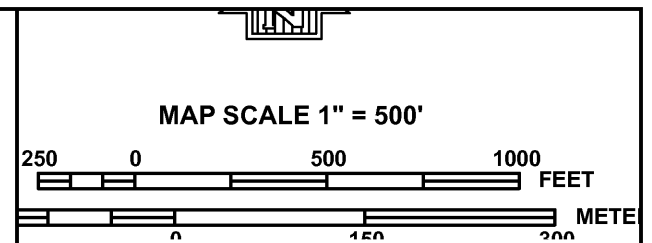
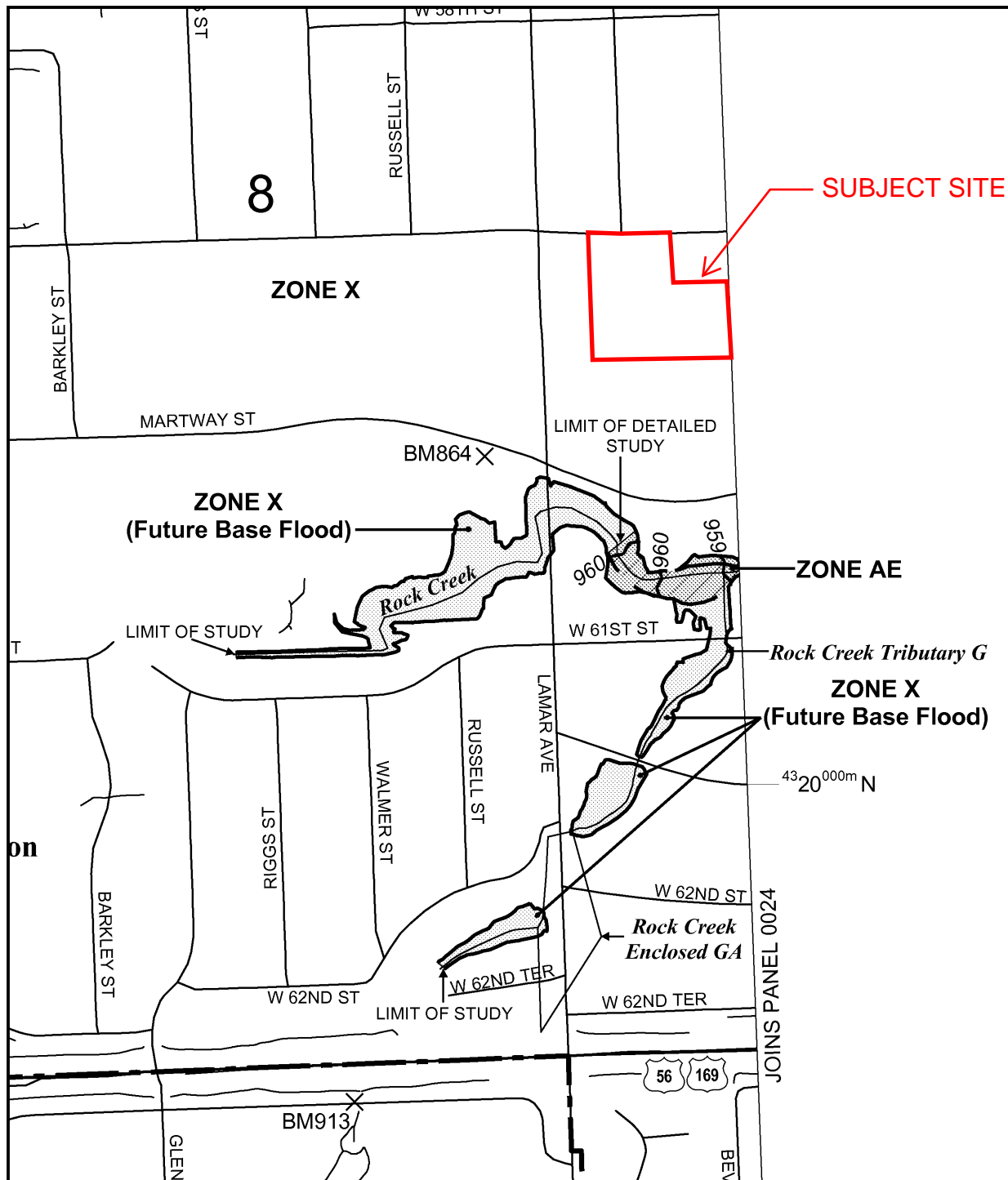



SCALE: 1"=80'



PROJECT NO.170249-010 DATE:05/12/17 BY:MDM

EXISTING CONDITIONS

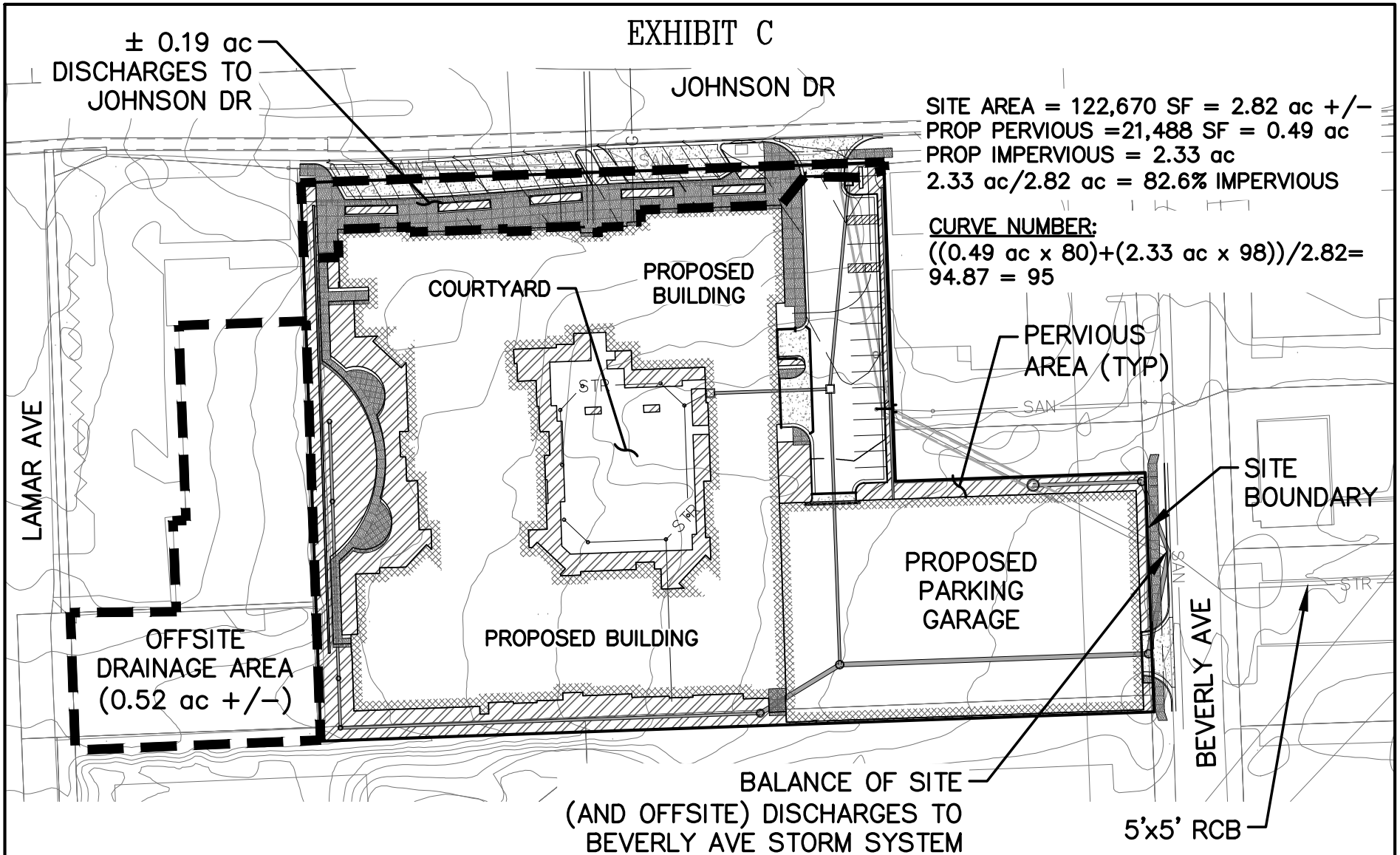


<div style="border: 2px solid black; padding: 5px; font-weight: bold; font-size: 2em; margin: 0 auto;">NFIP</div>	<div style="border: 1px solid black; padding: 5px; font-weight: bold; font-size: 1.2em;">PANEL 0023G</div>																
<div style="border: 1px solid black; padding: 5px; font-weight: bold; font-size: 1.5em; transform: rotate(-90deg); transform-origin: center;">NATIONAL FLOOD INSURANCE PROGRAM</div>	<div style="font-size: 3em; font-weight: bold; margin-bottom: 10px;">FIRM</div> <div style="font-size: 1.5em; font-weight: bold; margin-bottom: 20px;">FLOOD INSURANCE RATE MAP</div> <div style="font-size: 1.5em; font-weight: bold; margin-bottom: 20px;">JOHNSON COUNTY, KANSAS</div> <div style="font-size: 1.5em; font-weight: bold; margin-bottom: 20px;">AND INCORPORATED AREAS</div> <div style="font-size: 1.5em; font-weight: bold; margin-bottom: 20px;">PANEL 23 OF 161</div> <div style="font-size: 1.2em; font-weight: bold; margin-bottom: 20px;">(SEE MAP INDEX FOR FIRM PANEL LAYOUT)</div> <div style="font-size: 1.1em; font-weight: bold; margin-bottom: 10px;"><u>CONTAINS:</u></div> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left; font-weight: normal; font-size: 0.9em;"><u>COMMUNITY</u></th> <th style="text-align: left; font-weight: normal; font-size: 0.9em;"><u>NUMBER</u></th> <th style="text-align: left; font-weight: normal; font-size: 0.9em;"><u>PANEL</u></th> <th style="text-align: left; font-weight: normal; font-size: 0.9em;"><u>SUFFIX</u></th> </tr> </thead> <tbody> <tr> <td>MERRIAM, CITY OF</td> <td>200169</td> <td>0023</td> <td>G</td> </tr> <tr> <td>MISSION, CITY OF</td> <td>200170</td> <td>0023</td> <td>G</td> </tr> <tr> <td>OVERLAND PARK, CITY OF</td> <td>200174</td> <td>0023</td> <td>G</td> </tr> </tbody> </table> <div style="margin-top: 20px; font-size: 1.1em;"> <p>Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.</p> </div> <div style="text-align: center; margin-top: 20px;">  <div style="font-weight: bold; font-size: 1.2em; margin: 10px 0;">MAP NUMBER</div> <div style="font-weight: bold; font-size: 1.5em; margin: 5px 0;">20091C0023G</div> <div style="font-weight: bold; font-size: 1.2em; margin: 10px 0;">MAP REVISED</div> <div style="font-weight: bold; font-size: 1.5em; margin: 5px 0;">AUGUST 3, 2009</div> <div style="font-weight: bold; font-size: 1.1em; margin-top: 20px;">Federal Emergency Management Agency</div> </div>	<u>COMMUNITY</u>	<u>NUMBER</u>	<u>PANEL</u>	<u>SUFFIX</u>	MERRIAM, CITY OF	200169	0023	G	MISSION, CITY OF	200170	0023	G	OVERLAND PARK, CITY OF	200174	0023	G
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MISSION, CITY OF	200170	0023	G														
OVERLAND PARK, CITY OF	200174	0023	G														

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

EXHIBIT B

EXHIBIT C



SHAFFER, KLINE & WARREN

11250 Corporate Avenue
 Lenexa, KS 66219-1392
 913.888.7800 FAX: 913.888.7868

SURVEYING | ENGINEERING | CONSTRUCTION

PROJECT NO. 170249-010 | DATE: 07/14/17 | BY: MDM

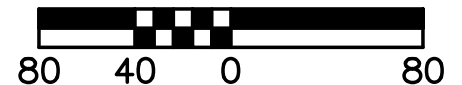


PERVIOUS AREA

PROPOSED CONDITIONS



SCALE: 1"=80'



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

Monday, 04 / 10 / 2017

Hyd. No. 1

Mission Trails Site

Hydrograph type	= SCS Runoff	Peak discharge	= 13.15 cfs
Storm frequency	= 2 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 29,148 cuft
Drainage area	= 2.820 ac	Curve number	= 95
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.60 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

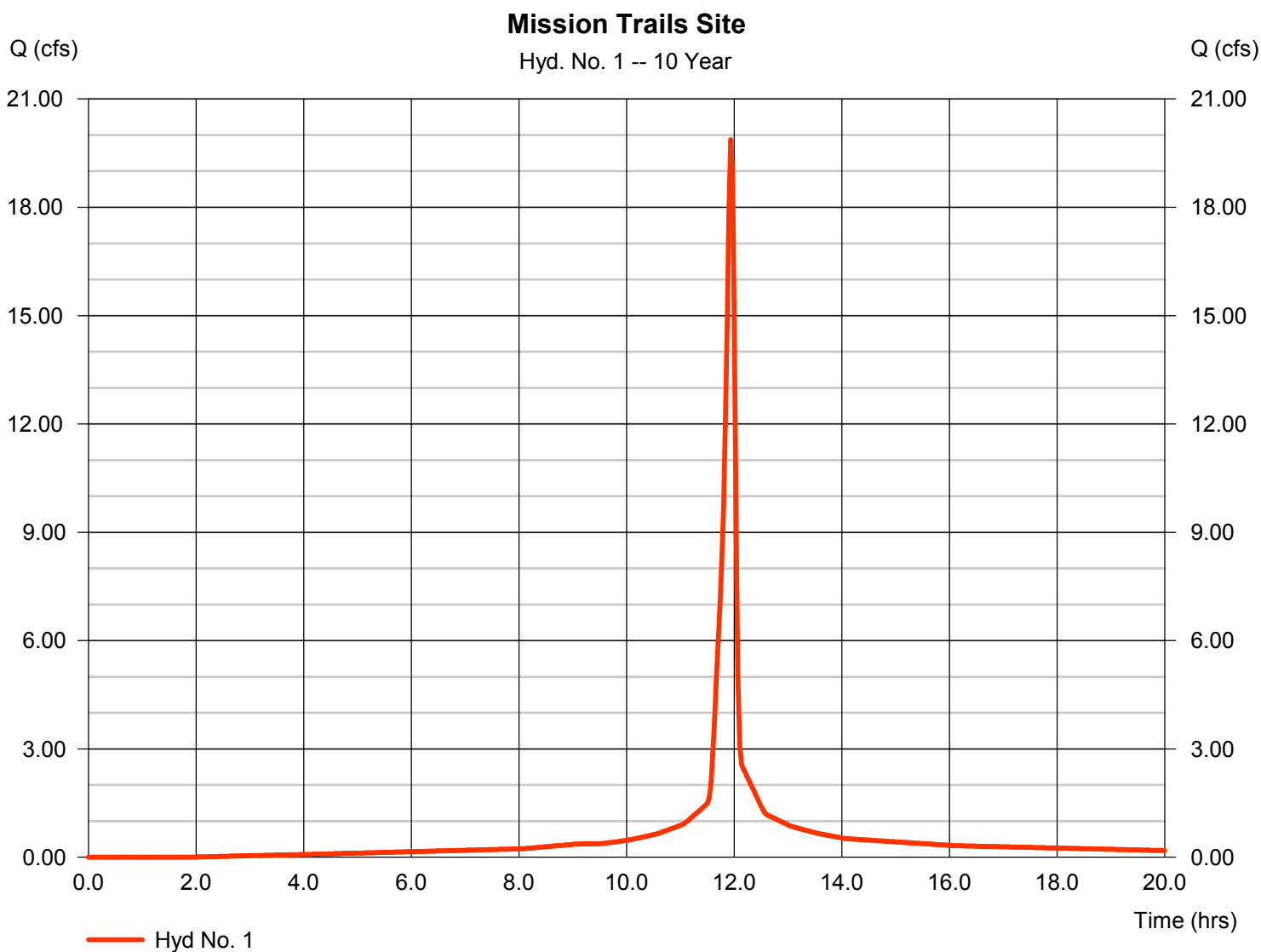
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

Monday, 04 / 10 / 2017

Hyd. No. 1

Mission Trails Site

Hydrograph type	= SCS Runoff	Peak discharge	= 19.87 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 45,267 cuft
Drainage area	= 2.820 ac	Curve number	= 95
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

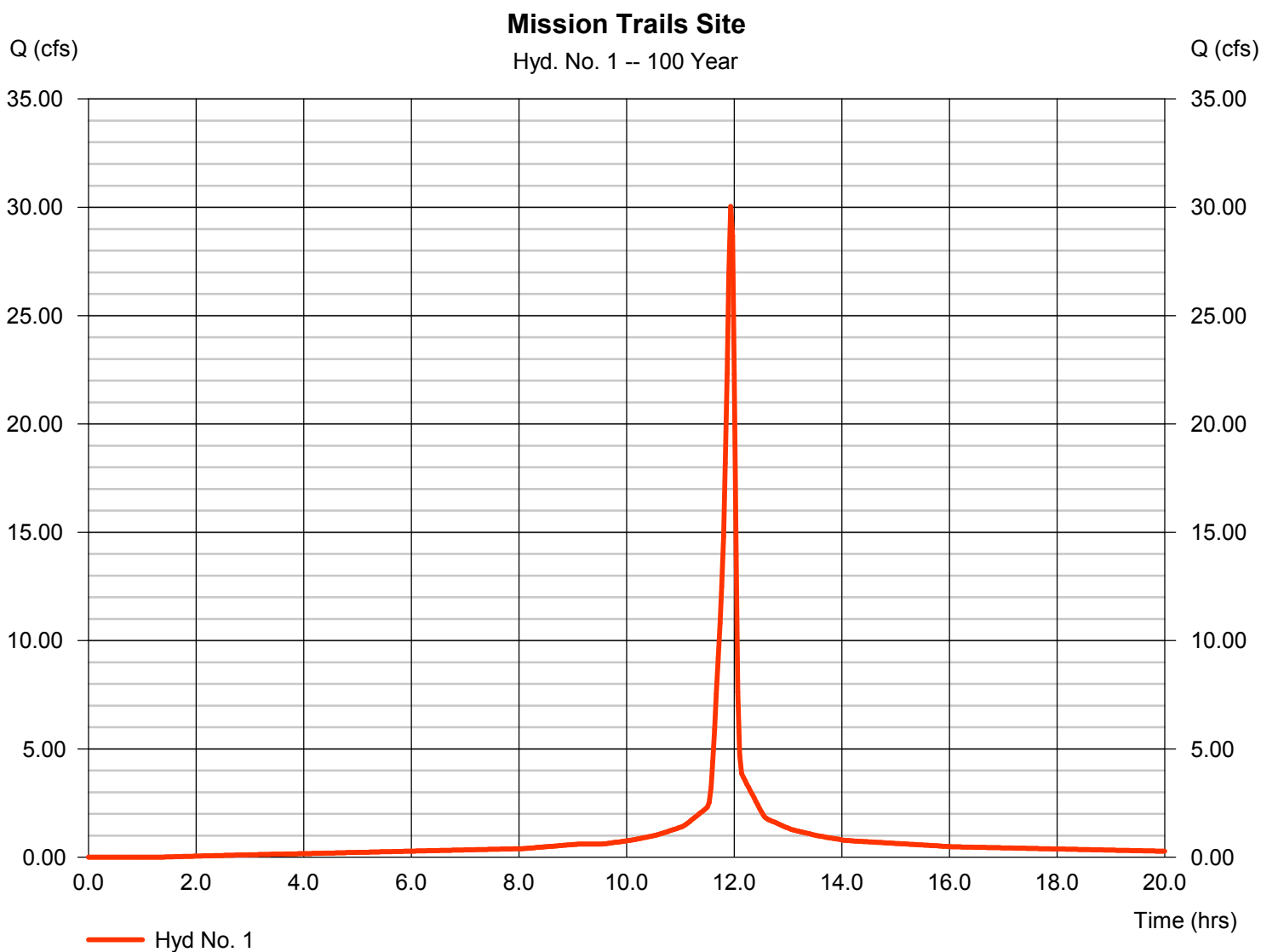
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

Monday, 04 / 10 / 2017

Hyd. No. 1

Mission Trails Site

Hydrograph type	= SCS Runoff	Peak discharge	= 30.03 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 70,073 cuft
Drainage area	= 2.820 ac	Curve number	= 95
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 7.90 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

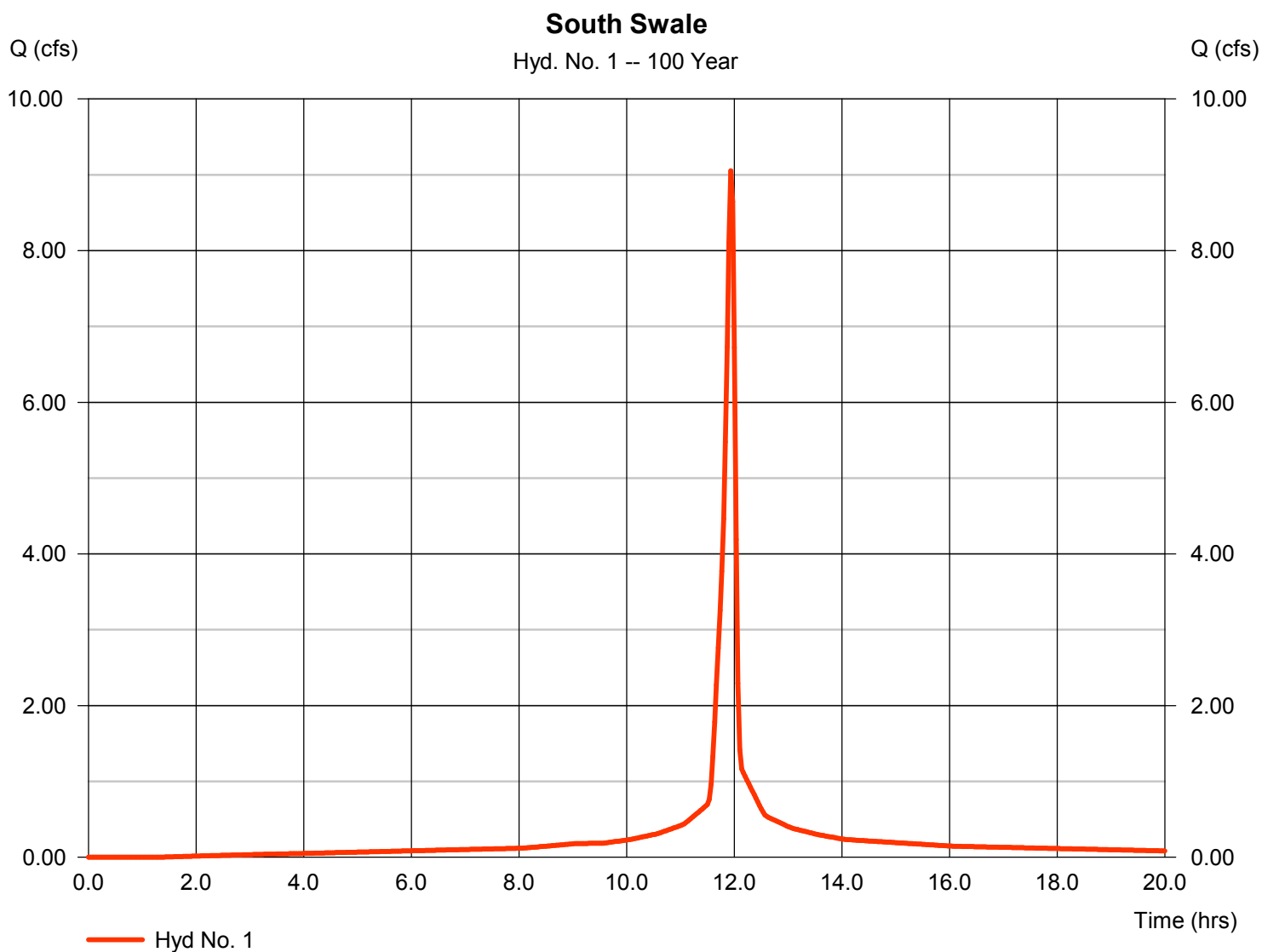
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5

Tuesday, 08 / 8 / 2017

Hyd. No. 1

South Swale

Hydrograph type	= SCS Runoff	Peak discharge	= 9.053 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 21,121 cuft
Drainage area	= 0.850 ac	Curve number	= 95
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 7.90 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



South Swale Depth - 1% Storm

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	2.25000	%
Left Side Slope	4.00	H:V
Right Side Slope	3.00	H:V
Bottom Width	4.00	ft
Discharge	9.05	ft ³ /s

Results

Normal Depth	0.45	ft
Flow Area	2.49	ft ²
Wetted Perimeter	7.26	ft
Hydraulic Radius	0.34	ft
Top Width	7.13	ft
Critical Depth	0.47	ft
Critical Slope	0.01883	ft/ft
Velocity	3.64	ft/s
Velocity Head	0.21	ft
Specific Energy	0.65	ft
Froude Number	1.09	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.45	ft
Critical Depth	0.47	ft
Channel Slope	2.25000	%

Shafer, Kline & Warren, Inc.

South Swale Depth - 1% Storm

GVF Output Data

Critical Slope 0.01883 ft/ft

South Swale - Full Flow Capacity

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.030	
Channel Slope	2.25000	%
Normal Depth	1.00	ft
Left Side Slope	4.00	H:V
Right Side Slope	3.00	H:V
Bottom Width	4.00	ft

Results

Discharge	42.43	ft ³ /s
Flow Area	7.50	ft ²
Wetted Perimeter	11.29	ft
Hydraulic Radius	0.66	ft
Top Width	11.00	ft
Critical Depth	1.10	ft
Critical Slope	0.01502	ft/ft
Velocity	5.66	ft/s
Velocity Head	0.50	ft
Specific Energy	1.50	ft
Froude Number	1.21	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	1.10	ft
Channel Slope	2.25000	%

Shafer, Kline & Warren, Inc.

South Swale - Full Flow Capacity

GVF Output Data

Critical Slope 0.01502 ft/ft

Existing 5'x5' RCB Capacity

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.02160	ft/ft
Normal Depth	5.00	ft
Height	5.00	ft
Bottom Width	5.00	ft

Results

Discharge	487.29	ft ³ /s
Flow Area	25.00	ft ²
Wetted Perimeter	20.00	ft
Hydraulic Radius	1.25	ft
Top Width	5.00	ft
Critical Depth	6.66	ft
Percent Full	100.0	%
Critical Slope	0.00739	ft/ft
Velocity	19.49	ft/s
Velocity Head	5.90	ft
Specific Energy	10.90	ft
Froude Number	1.54	
Discharge Full	487.29	ft ³ /s
Slope Full	0.02160	ft/ft
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s

Existing 5'x5' RCB Capacity

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	5.00	ft
Critical Depth	6.66	ft
Channel Slope	0.02160	ft/ft
Critical Slope	0.00739	ft/ft