



**STORMWATER MANAGEMENT
REPORT**

Lone Tree Project

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1.0 PROJECT INTRODUCTION

1.1 PROJECT BACKGROUND

The proposed Lone Tree Project is located at the northwest quadrant of the intersection of Highway 22 and Sioux Ave. in Johnson County, Iowa, west of Lone Tree. The project includes construction of approximately 21,465 photovoltaic (PV) solar modules with associated equipment and infrastructure. The 50-acre site is entirely planted row crops with the exception of two drainageways that cross portions of the site along the western border. The areas surrounding the project are also planted row crops. The site primarily sheet flows east to west into the two drainageways and then west Otter Creek, a tributary of the Iowa River. This report will detail the existing and proposed development conditions and summarize the proposed water quality treatment volumes to be provided.

1.2 EXISTING CONDITIONS

The entire parcel area is 50 acres located within the Iowa River Watershed. The site generally drains from east to west by sheet flow to the identified drainageways; off-site areas to the north sheet flow across the site, and a portion of the rights-of-way or Highway 22 and Sioux Avenue are conveyed by roadside swales to the southernmost drainageway. The two drainageways converge off-site before continuing west into Otter Creek approximately 1 mile upstream of the Iowa River. Per the Iowa Department of Natural Resources 2018 Impaired Waters Map, Otter Creek is not identified as a Total Max Daily Load (TMDL) Impaired Waterbody, the Iowa River is identified as a Total Max Daily Load (TMDL) Impaired Waterbody.

According to the USDA Natural Resource Conservation Service Soils Survey, existing soil types are:

Map Symbol	Soil Type	Hydrologic Soil Group	Percentage of Site
M162B	Downs silt loam	C	9%
M162C	Downs silt loam	C	1%
291	Atterberry silt loam	C/D	24%
160	Walford silt loam	C/D	12%
122	Sperry silt loam	D	37%
121B	Tama silt loam	C	15%
175B	Dickinson fine sandy loam	A	2%

The majority of the site consists of soils with a hydrologic soil group of D or C/D (73%), with small areas of group C (25%) soils and one single area of group A soils (2%); given the abundance of D or C/D soils throughout the site, a hydrologic soil group of D was utilized to calculate curve numbers for both pre and post developed conditions.

The area is currently cultivated agriculture with a cover type identified “Row crops, straight row, poor condition”. Existing overall site drainage is shown on the enclosed Pre-developed Drainage Exhibit (Appendix B).



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1.3 PROPOSED CONDITIONS

The proposed development will include approximately 21,465 PV solar modules, and 84 power inverters, underground infrastructure, and 12' wide service roads. The site does not currently have stormwater controls. The existing drainage pattern will be preserved after development. The proposed development will improve the existing cultivated land into a vegetated meadow condition and therefore will reduce post-developed runoff rates to less than pre-developed rates as well as reduce pollutant loads to downstream waterways. Per industry standards, solar array areas were considered pervious surface due to panels being elevated off the ground allowing for runoff beneath them.

2.0 HYDROLOGIC ANALYSIS

2.1 RUNOFF COEFFICIENTS

A pre-developed curve number (CN) of 91 was used to represent the existing agricultural site and is classified as "Row crops, straight row, poor condition" with Hydrologic Soil Group (HSG) D. For post-developed conditions, a composite CN of 81 was utilized based on a combination of service roads and good condition grass cover with HSG D.

Pre-Developed			
Cover Type	CN (HSG D)	Area (ac.)	Weighted CN
Row crops, Straight row (SR), Poor	91	50	91
Post-Developed			
Cover Type	CN (HSG D)	Area (ac.)	Weighted CN
Impervious	98	2.72	5
Open space, Good conditdion	80	47.28	76
Composite CN			81

2.2 TIME OF CONCENTRATION

Travel time for existing conditions was calculated using the NRCS TR-55 method with a combination of sheet, shallow concentrated flow, and channelized flow as observed in the aerial topography. A maximum length of 100 feet of sheet flow was used before transitioning to shallow concentrated flow. The total time of concentration was calculated at 18.1 minutes. The total travel path is shown on the Pre-Developed Drainage exhibit found in Appendix B.

The proposed development will have minimal grading and will maintain the existing drainage patterns and improved ground cover. The time of concentration for post-developed conditions was calculated at 27.6. The travel paths are detailed on the pre- and post-developed drainage exhibits.



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2.3 PRE-DEVELOPED VS. POST-DEVELOPED RUNOFF RATES

Peak runoff rates were calculated Using the input criteria listed in the sections above for both pre-developed and post-developed conditions for the 5-, 25-, and 100-yr storm events. The reduction in peak runoff rate from pre to post developed conditions is shown below:

	5-Year	25-Year	100-Year
Pre-Developed Peak Runoff Rate (cfs)	116.48	180.24	246.32
Post-Developed Peak Runoff Rate (cfs)	87.94	155.36	228.04
Runoff Rate Reduction (cfs)	28.54	24.88	18.28

3.0 HYDRAULIC ANALYSIS

3.1 MODELING PARAMETERS

Hydrologic modeling was performed using the Hydraflow Hydrographs Extension version 2021 software.. This model uses the Soil Conservation Service (SCS) TR-20 methodology to determine peak flows and runoff volumes.

A Type II 24-hour storm type was selected to model the rainfall distribution across each rainfall event as per the Iowa Stormwater Management Manual. Precipitation data was taken from NRCS rainfall distribution data.

3.2 DETENTION REQUIREMENTS

Post-developed peak runoff rates for all storm events have decreased from existing peak rates; peak rate control detention is unwarranted.

3.3 WATER QUALITY SUMMARY

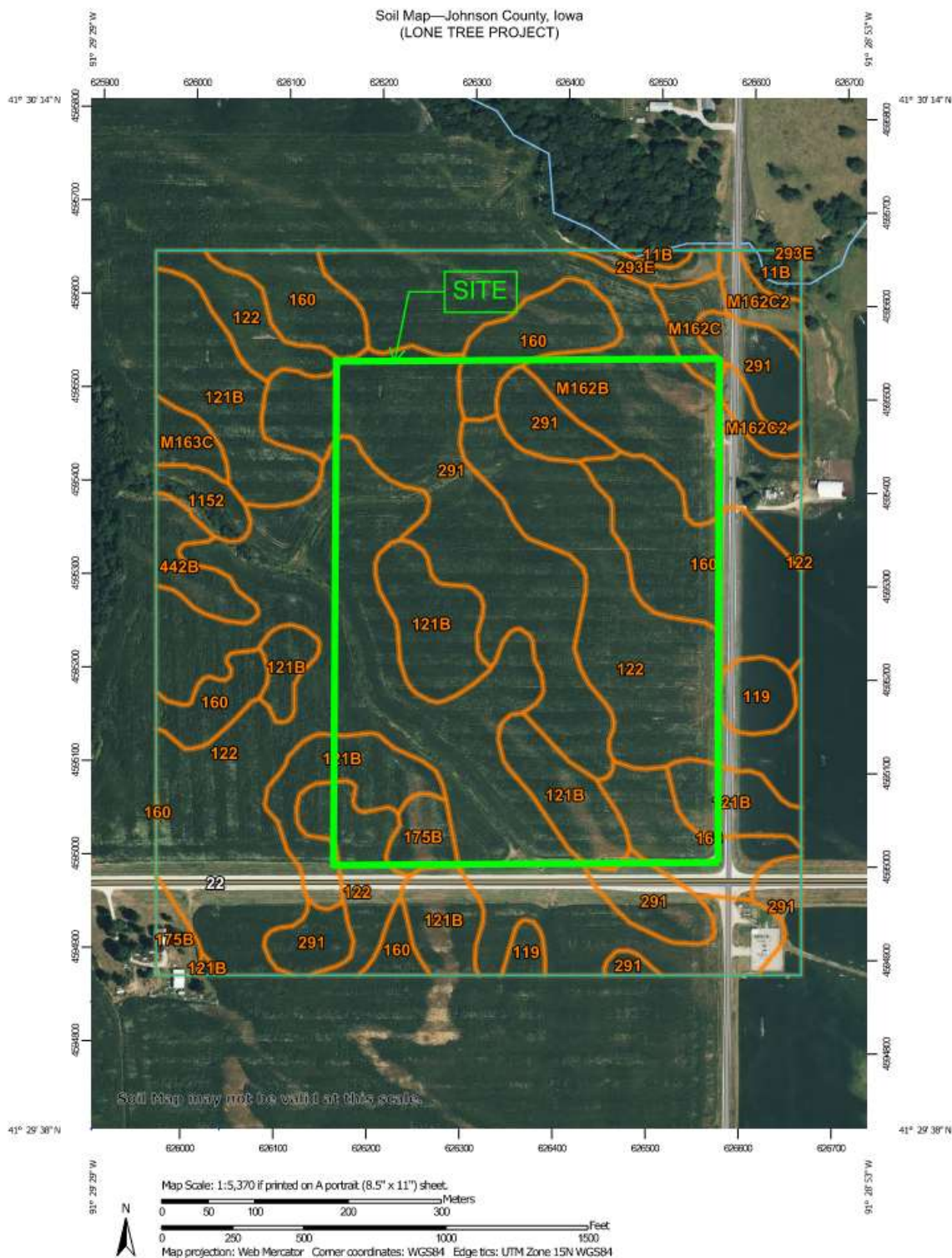
The conversion of cultivated agricultural use to a more densely vegetated meadow-like condition will cause a significant reduction in overall pollution to downstream areas, including a decrease in TSS, nitrogen, and phosphorus loading rates. The D and C/D soil groups encountered on site do not allow for infiltration of retained runoff; group C soils allow for very little to negligible infiltration. Due to the soil types encountered on this site, infiltration of runoff is impractical or ineffective. With the reduction in pollutant load, and the site soil conditions, a waiver for water quality retention requirements is requested.

4.0 CONCLUSIONS

The proposed development is designed to maintain existing drainage patterns while improving the site by establishing permanent, good quality, vegetated cover. The improvements will significantly reduce post-developed peak runoff rates and pollutant loads from the existing conditions. In summary, these improvements help contribute to an environmentally sound development.



APPENDIX A SOILS MAP



APPENDIX B PRE-DEVELOPED DRAINAGE



APPENDIX C POST-DEVELOPED DRAINAGE



APPENDIX D HYDROGRAPH REPORTS



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	116.48	10	730	479,278	----	----	----	Pre-Developed Site
2	SCS Runoff	87.94	2	730	353,233	----	----	----	Post-Developed Site

Hydrograph Report

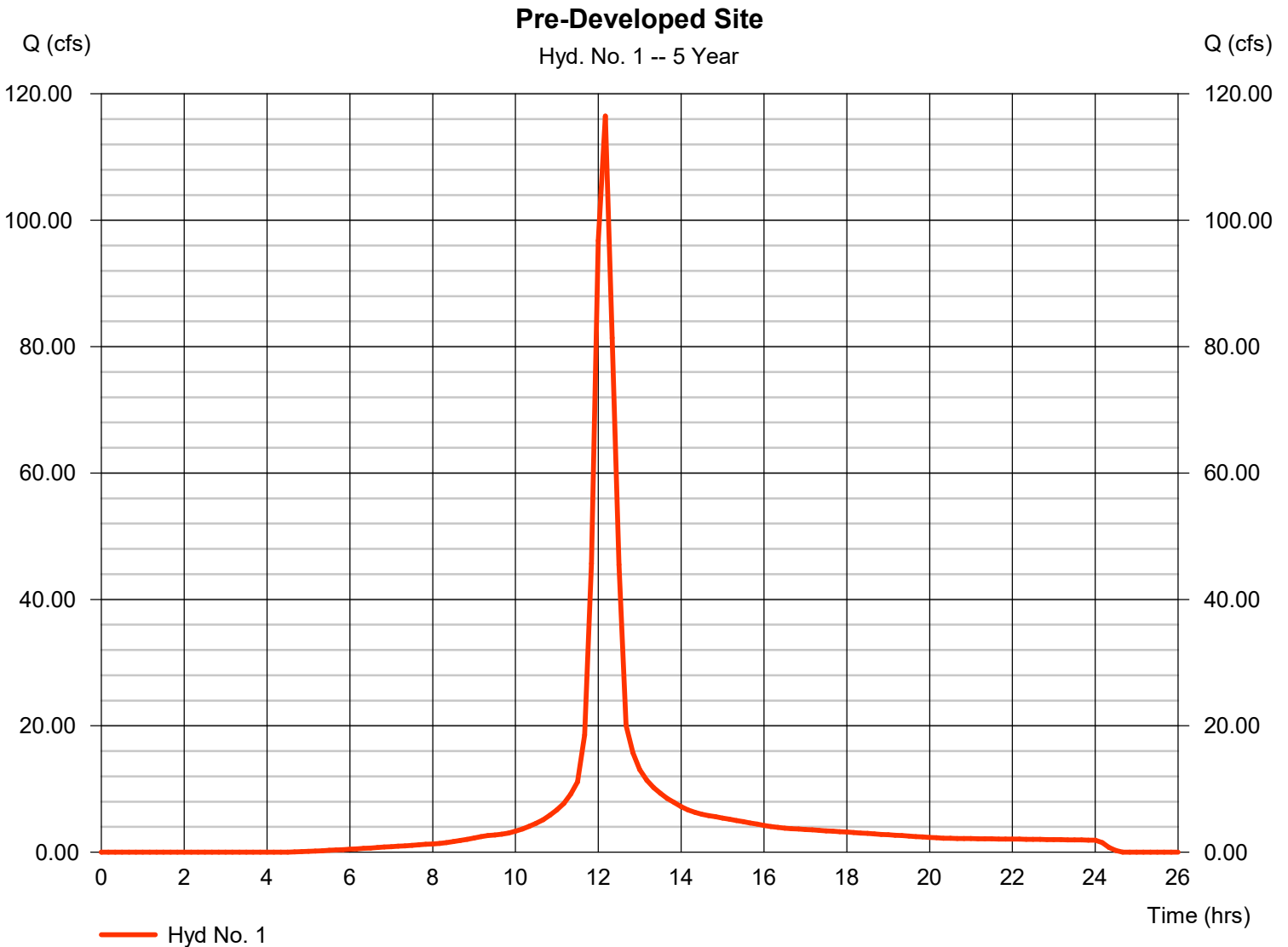
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Wednesday, 11 / 30 / 2022

Hyd. No. 1

Pre-Developed Site

Hydrograph type	= SCS Runoff	Peak discharge	= 116.48 cfs
Storm frequency	= 5 yrs	Time to peak	= 12.17 hrs
Time interval	= 10 min	Hyd. volume	= 479,278 cuft
Drainage area	= 50.000 ac	Curve number	= 91
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 18.10 min
Total precip.	= 3.79 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



TR55 Tc Worksheet

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Hyd. No. 1

Pre-Developed Site

<u>Description</u>	<u>A</u>		<u>B</u>		<u>C</u>		<u>Totals</u>
Sheet Flow							
Manning's n-value	= 0.060		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.61		0.00		0.00		
Land slope (%)	= 2.61		0.00		0.00		
Travel Time (min)	= 4.69	+	0.00	+	0.00	=	4.69
Shallow Concentrated Flow							
Flow length (ft)	= 1435.00		0.00		0.00		
Watercourse slope (%)	= 1.53		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=2.00		0.00		0.00		
Travel Time (min)	= 11.98	+	0.00	+	0.00	=	11.98
Channel Flow							
X sectional flow area (sqft)	= 12.00		0.00		0.00		
Wetted perimeter (ft)	= 11.00		0.00		0.00		
Channel slope (%)	= 0.74		0.00		0.00		
Manning's n-value	= 0.025		0.015		0.015		
Velocity (ft/s)	=5.43		0.00		0.00		
Flow length (ft)	{{0}}462.0		0.0		0.0		
Travel Time (min)	= 1.42	+	0.00	+	0.00	=	1.42
Total Travel Time, Tc							18.10 min

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	180.24	10	730	758,710	----	----	----	Pre-Developed Site
2	SCS Runoff	155.36	2	730	621,112	----	----	----	Post-Developed Site

Hydrograph Report

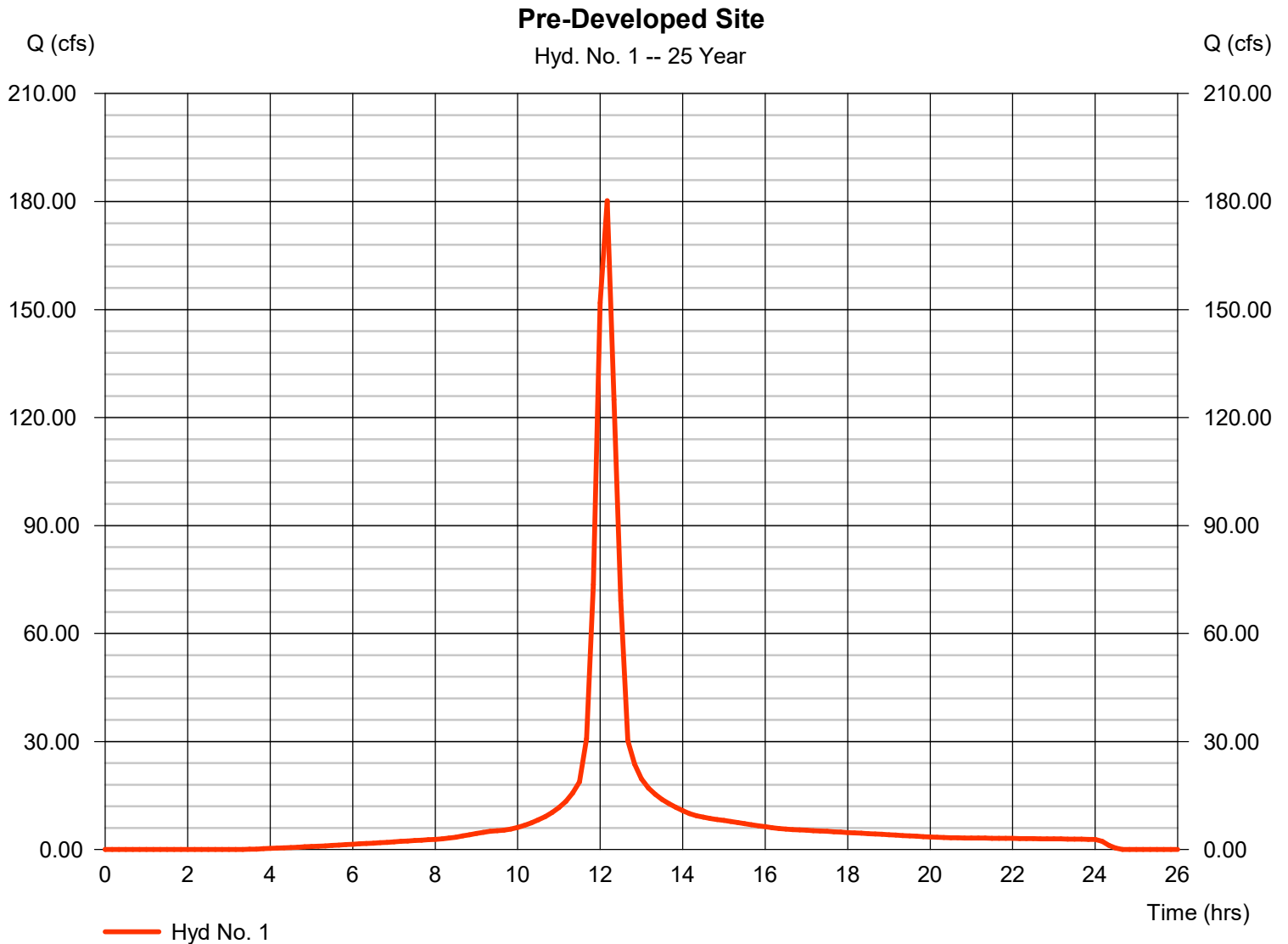
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Wednesday, 11 / 30 / 2022

Hyd. No. 1

Pre-Developed Site

Hydrograph type	= SCS Runoff	Peak discharge	= 180.24 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.17 hrs
Time interval	= 10 min	Hyd. volume	= 758,710 cuft
Drainage area	= 50.000 ac	Curve number	= 91
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 18.10 min
Total precip.	= 5.49 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	246.32	10	730	1,055,732	----	----	----	Pre-Developed Site
2	SCS Runoff	228.04	2	730	917,800	----	----	----	Post-Developed Site

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Wednesday, 11 / 30 / 2022

Hyd. No. 1

Pre-Developed Site

Hydrograph type	= SCS Runoff	Peak discharge	= 246.32 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.17 hrs
Time interval	= 10 min	Hyd. volume	= 1,055,732 cuft
Drainage area	= 50.000 ac	Curve number	= 91
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 18.10 min
Total precip.	= 7.27 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

