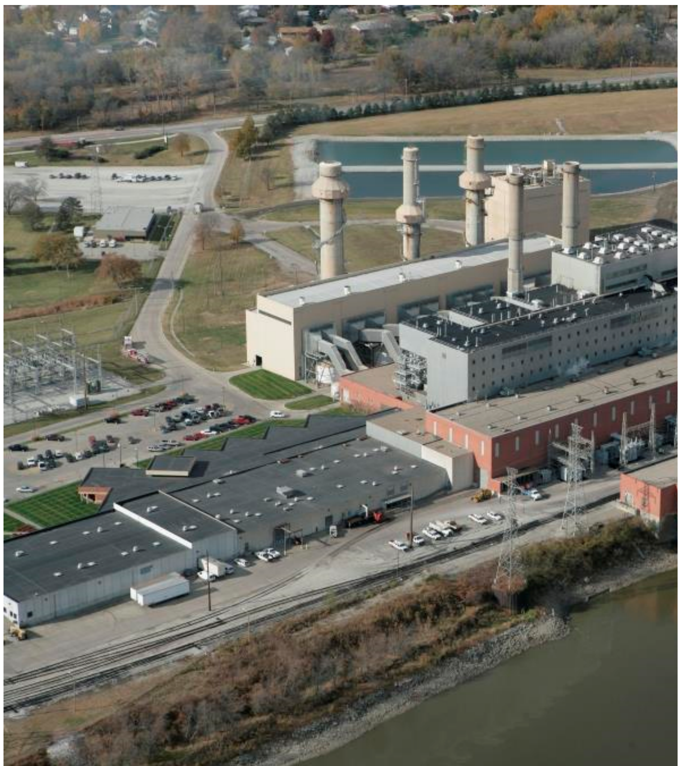

North Omaha Ash Landfill

Run-on and Run-off Control System Plan

Omaha Public Power District

North Omaha Station

Omaha, Nebraska

October 17, 2016

OPPD North Omaha Ash Landfill
Run-On and Run-Off Control System Plan

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OPPD North Omaha Ash Landfill
Run-On and Run-Off Control System Plan

Professional Engineer Certification

"I hereby certify that this Run-on and Run-off Control System Plan for the CCR landfill known as the North Omaha Ash Landfill at the North Omaha Generating Station, owned and operated by the Omaha Public Power District, meets the requirements of the Coal Combustion Residual Rule 40 CFR 257.81. I am a duly licensed Professional Engineer under the laws of the State of Nebraska."

Print Name: Garrett M. Williams

Signature:

Date: October 17, 2016

License #: E-15124

My license renewal date is December 31, 2016.

I. Introduction

A. Purpose

On April 17, 2015 the U.S. Environmental Protection Agency (EPA) published the final rule for the regulation and management of coal combustion residuals (CCR) under the Resource Conservation and Recovery Act (RCRA). Section 40 CFR 257.81 requires that an owner or operator of a CCR landfill must prepare an initial run-on and run-off control system plan. The plan must document how the control systems have been designed and constructed to meet the applicable requirements of the CCR rule, supported by appropriate engineering calculations. In accordance with the CCR rule 40 CFR 257.81, the intent of stormwater management is to design, construct, operate, and maintain:

- A run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm; and
- A run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm. Run-off from the active portion of the CCR unit must be handled in accordance with the surface water requirements under 40 CFR 257.3-3.

B. Facility Background

OPPD has a five-unit, fossil fuel-fired generating plant at the North Omaha Station (Station) in Omaha, Nebraska, along the west shore of the Missouri River. Recently Units 1-3 were retired from coal operations; Units 4 and 5 were retrofitted for air pollution control equipment and are still operating. The need for CCR disposal capacity is anticipated to continue to at least year 2023. This Station has an existing CCR landfill (the North Omaha Ash Landfill) that is permitted under the current NDEQ Title 132 regulations for fossil fuel combustion ash disposal area (Permit No. NE0054739, Facility ID 59763). Under the CCR rule, the North Omaha Ash Landfill is an existing CCR landfill since it has and will receive CCR both before and after October 19, 2015 – the effective date of the CCR rule. The North Omaha Ash Landfill is an unlined CCR landfill of approximately 18 acres.

The NDEQ Title 132 permit for the North Omaha Ash Landfill includes an operations plan which describes the routine maintenance activities for the site drainage system. The permit also includes descriptions, calculations and figures of run-on and run-off control system features. This plan checks, expands and confirms compliance with the CCR rule for run-on and run-off controls from the active areas of the North Omaha Ash Landfill.

II. Run-On Control System

The run-on control system for the North Omaha Ash Landfill consists of perimeter ditches, access roads and grading sloped away from the ash disposal area to prevent and minimize stormwater run-on to the active portion of the CCR landfill. As shown on the Figure 1 in Appendix A, potential run-on does not reach the CCR and is diverted around the North Omaha

Ash Landfill. There is a contributing area of approximately 1.7 acres west of the adjacent public road, John J Pershing Drive, with off-site run-on draining into the west perimeter ditch at the western toe of slope for the North Omaha Ash Landfill. Currently this drainage is flowing south and becomes combined with the run-off from the active CCR landfill area. Improvements will be completed in year 2017 which will re-direct this run-on with non-contact water towards the north stormwater inlet. Calculation of the run-on volume is contained in Appendix A and the west perimeter ditch sizing is contained in Appendix B. Grading and improved perimeter ditches will continue to intercept, divert and prevent potential storm water run-on to the CCR landfill.

III. Run-Off Control System

The current run-off control system for the North Omaha Ash Landfill consists of directing the majority of the run-off from the active CCR landfill to the existing onsite coal pile run-off pond and the remainder to the North Pond, located at the north end of the landfill. Due to additional drainage areas contributing run-off to these two ponds, the capacity in these existing ponds is insufficient to contain or control the 25-year, 24-hour storm inflow from all of the contributing areas. A recent topographic survey completed August 29, 2016 is included in Appendix A.

The contributing volume of runoff was modeled for a 25-year, 24-hour storm event. The Rainfall depths were obtained from NOAA Atlas 14. The results of the hydrologic modeling, with the planned drainage areas schematic, are found in Appendix A.

The results of the hydrologic modeling, included in Appendix A, indicate approximately 59,000 cubic feet (CF) of non-contact stormwater will flow to the north. This consists of 19,780 CF of off-site run-on, 8,875 CF along the east side slope and 13,925 CF along the west slope flowing toward the north. The modeling also indicates approximately 172,150 CF of run-off flow in the active portion of the CCR landfill that would be directed to the West Process Pond.

The following drainage controls improvements to more effectively manage the run-off from the North Omaha Ash Landfill will be completed in year 2017:

- The north, west and east sideslopes of the North Omaha Ash Landfill will be partially closed and covered with a final cover system with run-off directed north. Only non-contact water (water that has not been in direct contact with CCR) will be directed to the north stormwater inlet for management as clean stormwater. Run-off volumes during the 25-year, 24-hour storm are provided in Appendix B.
    - Run-off controls for the final cover system are described in the NDEQ Title 132 permit application and are not part of the CCR Rule requirement for this plan.
    - Upon installation of the partial final cover system on the sideslopes, the North Pond will no longer be required for management of CCR run-off. The pond may be retained for temporary sediment control, while vegetation on final cover system is established, or filled in and the area graded for the storm water to enter the storm sewer located immediately east.

- Perimeter ditches will be improved and constructed along the west and east sides of the North Omaha Ash Landfill. Ditch sizing calculations and figures are contained in Appendix B.
  - o An east perimeter ditch will be constructed at the toe of the CCR landfill to collect and convey run-off from the covered Phase 2 sideslopes (through partial closure) to the north. If needed to accommodate ditch construction, CCR will be excavated along the east toe of slope, moved and placed within the active portion of the CCR landfill. The east perimeter ditch will have minimum bottom width of 2-feet, be graded at minimum slope of 0.5% and have a depth of 1.5-feet.
  - o The west perimeter ditch will be improved to collect and convey as much of the run-off from the covered Phase 1 sideslopes (through partial closure) to the north. The high point of the ditch will be located immediately south of the outlet bringing the off-site run-on from the area west of John J Pershing Drive onto the site. This off-site run-on will be collected in the west perimeter ditch and conveyed to the north along with the sideslope run-off. The west perimeter ditch will have minimum bottom width of 2-feet, be graded at minimum slope of 0.5% and have a depth of 1.5-feet. The ditch will tie-in to the existing, natural ditch which has an approximate slope of 7.5%. The perimeter ditch is sized to handle the combined flow (see calculations in Appendix B).
- Run-off from the active portion of the North Omaha Ash Landfill will be directed towards a new central channel constructed and extended south from the landfill to an existing process water pond (West Process Pond) on the Station property. Run-off volumes from the active portion during the 25-year, 24-hour storm are provided in Appendix C.
  - o The active CCR fill within the North Omaha Ash Landfill has been and will further be graded to facilitate surface water run-off from the active portion of the CCR landfill towards the interior channels.
  - o A new channel will be constructed from the south-central end of the CCR landfill (starting near existing ash building) to collect and convey run-off from the active portion of the CCR landfill south directly into the West Process Pond. The channel will have bottom width of 10-feet, be graded at minimum slope of 0.5% and have a depth of 2-feet. Channel sizing calculations are included in Appendix C.
  - o Three 24-inch reinforced concrete or similar culverts capable of providing sufficient capacity and strength will be installed under the service road to convey flow from the proposed interior channel south into the West Process Pond while preventing flow over the roadway.
  - o The West Process Pond has approximately 931,700 CF of available storage from bottom elevation 987 to elevation 999; when maintaining 2 feet of freeboard the available capacity is 732,000 CF. The active portion of the CCR landfill produces approximately 172,150 CF of run-off during the 25-year, 24-hour storm event. An additional 51,600 CF of non-contact water also drains to or directly falls in the pond. At this contribution of approximately 223,745 CF run-off to the West Process Pond, process water levels within the pond should be maintained at elevation 995.5 or lower, depending upon the quantity of other process waters in-flows.

- Run-off from the southeast portion of the North Omaha Ash Landfill cannot be feasibly directed to the new interior central channel. This run-off from the sideslopes will continue to flow into the existing Coal Pile Run-off Pond. In order to prevent CCR contact water from entering the Coal Pile Run-off Pond, the sideslopes of the southeast portion of the landfill will be covered with a temporary soil or alternative cover, or graded and closed with a final cover system. This will become non-contact water run-off. Since run-off from the active portion of the CCR landfill will be redirected to the new central channel, the management of the Coal Pile Run-off Pond does not fall under this plan.

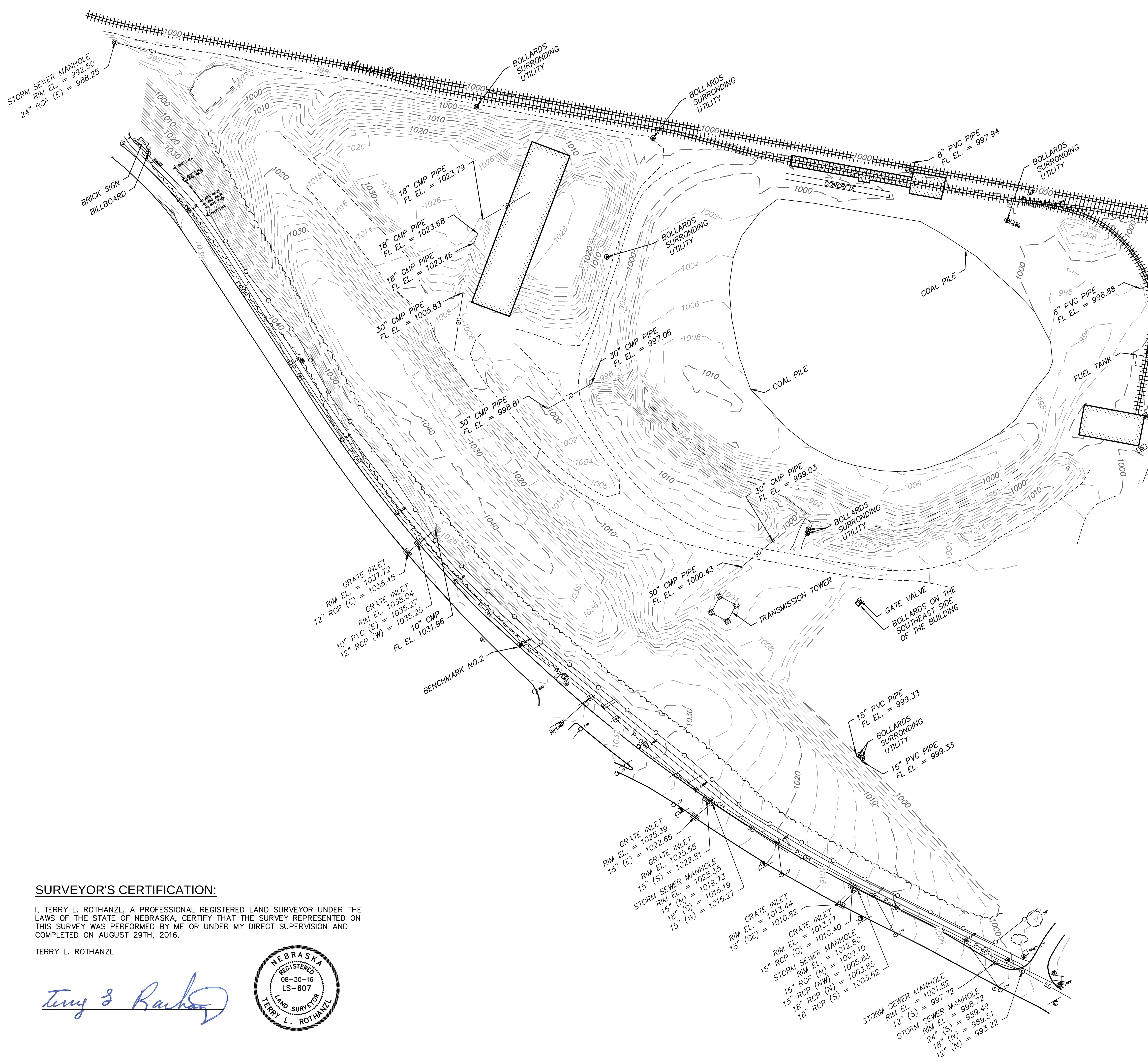
The majority of non-contact water run-off from the covered areas of the North Omaha Ash Landfill will be collected, controlled and conveyed north via perimeter ditches for management in accordance with the existing surface water requirements in the Station's stormwater pollution prevention plan (SWPPP). The non-contact water run-off from the southeastern portion of the North Omaha Ash Landfill will be collected in the Coal Pile Run-off Pond for management in accordance with the Station's industrial National Pollution Discharge Elimination System (NPDES) permit.

CCR contact water run-off generated from the 25-year, 24-hour storm (and lesser storms) will be collected, controlled and conveyed south to the existing West Process Pond direct via the new channel. This run-off will be managed in accordance with existing requirements of the Station's industrial NPDES permit.

Calculations, figures and management of stormwater run-off from the North Omaha Ash Landfill are contained in Appendices A, B, and C of this plan.

Appendix A
Stormwater Drainage Areas and Hydraflow Report

TOPOGRAPHIC SURVEY
OPPD NORTH OMAHA STATION



LEGEND

- EDGE OF GRAVEL LINE
- RAILROAD RAIL LINE
- EDGE OF WATER LINE
- STORM SEWER LINE
- OVERHEAD POWER LINE
- CHAIN LINK FENCE
- SPLIT RAIL FENCE
- BENCHMARK
- STORM CURB INLETS
- BOLLARD
- DECIDUOUS TREE
- ELECTRIC MANHOLE
- ELECTRIC VAULT
- FIRE HYDRANT
- GAS RISER
- GUY POLE
- GRATE INLET
- FLARED END SECTION
- GUY WIRE
- GAS VALVE
- LIGHT POLE
- MONITORING WELL
- POST INDICATOR VALVE
- POWER POLE W/ LIGHT
- POWER POLE
- STORM SEWER MANHOLE
- SIGN
- TRANSMISSION TOWER
- VENT PIPE
- WOOD POST
- WATER MANHOLE
- WATER VALVE
- WATER METER PIT
- WATER MARKER
- FROG
- SWITCH
- BUILDING
- TREEMASS

BENCHMARK NOTE

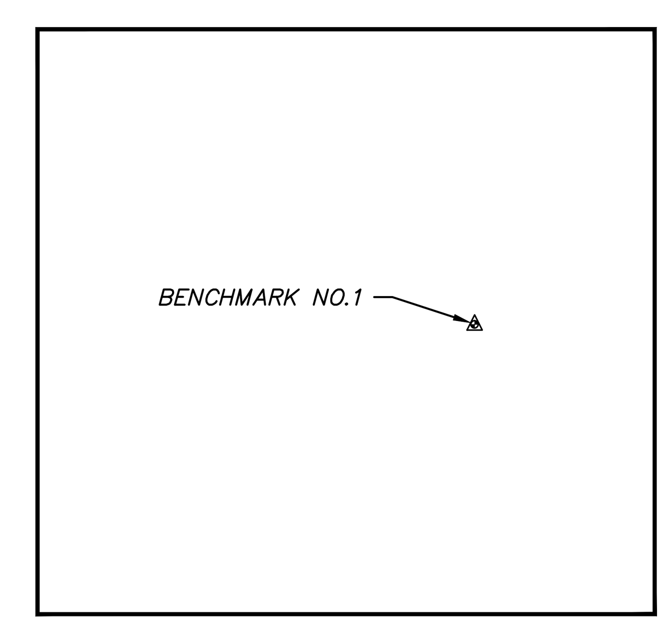
BENCHMARK NO. 1 – NE ANCHOR BOLT OF LIGHT POLE ON WEST SIDE OF JOHN J. PERSHING DRIVE, 2ND POLE NORTH OF REED STREET. EL=999.01

BENCHMARK NO. 2 – 60D NAIL IN WEST FACE OF LIGHT POLE ON EAST SIDE OF JOHN J. PERSHING DRIVE. EL=1038.78

GENERAL NOTES

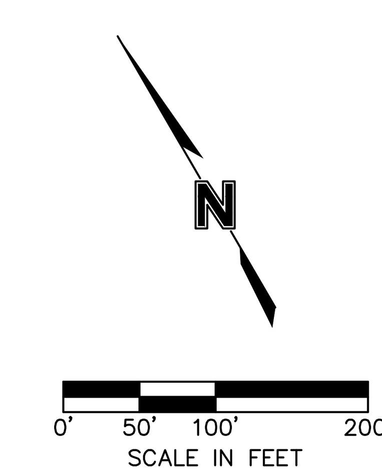
HORIZONTAL DATUM IS NEBRASKA STATE PLANE (MODIFIED)

VERTICAL DATUM IS NAVD 88



BENCHMARK DETAIL

BENCHMARK LOCATED APPROXIMATELY 1900± FEET SOUTHEAST OF SUBJECT PROPERTY.



SURVEYOR'S CERTIFICATION:

I, TERRY L. ROTHANZL, A PROFESSIONAL REGISTERED LAND SURVEYOR UNDER THE LAWS OF THE STATE OF NEBRASKA, CERTIFY THAT THE SURVEY REPRESENTED ON THIS SURVEY WAS PERFORMED BY ME OR UNDER MY DIRECT SUPERVISION AND COMPLETED ON AUGUST 29TH, 2016.

TERRY L. ROTHANZL

Terry L. Rothanzl

NEBRASKA REGISTERED 08-30-16 LS-607 LAND SURVEYOR TERRY L. ROTHANZL

DWG: F:\2016\2001-2500\016-2362\40-Design\Survey\SRVY\Xref\016-2362_SRVY TOP0.dwg USER: dhastings
DATE: Aug 30, 2016 7:52am XREFS: TERRY_ROTHANZL_LS_NE

OLSSON ASSOCIATES
2111 South 67th Street, Suite 200
Omaha, NE 68106
TEL 402.341.1116
FAX 402.341.5895
www.olssonassociates.com

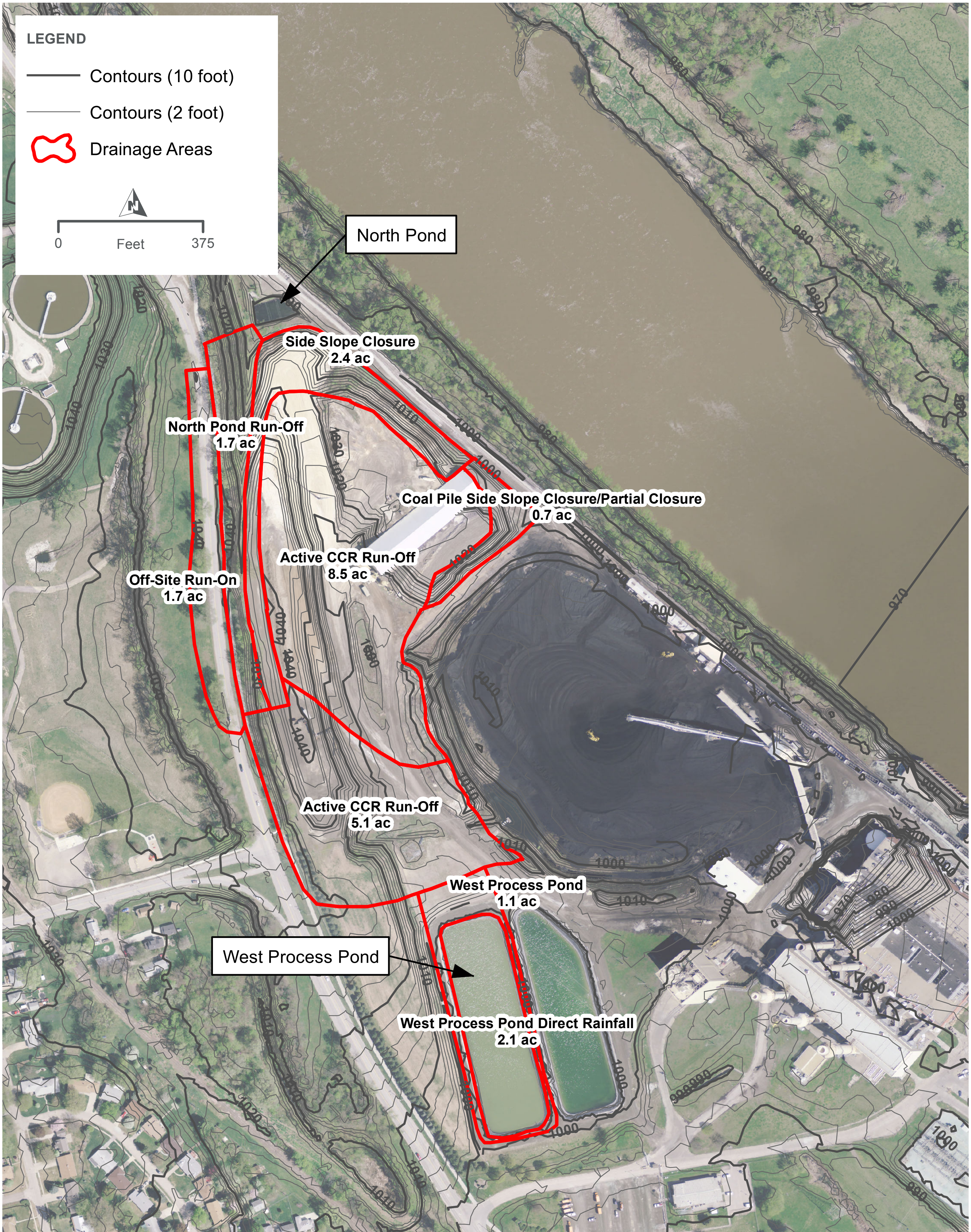
REVISIONS

REV. NO.	DATE	REVISIONS DESCRIPTION

TOPOGRAPHIC SURVEY
OPPD NORTH OMAHA STATION
OMAHA, NEBRASKA
2016

drawn by:	DSH
checked by:	EDF
approved by:	TLR
QA/QC by:	TLR
project no.:	016-2362
drawing no.:	
date:	08.30.16

SHEET
1 of 1



FDR

OPPD NORTH OMAHA STATION

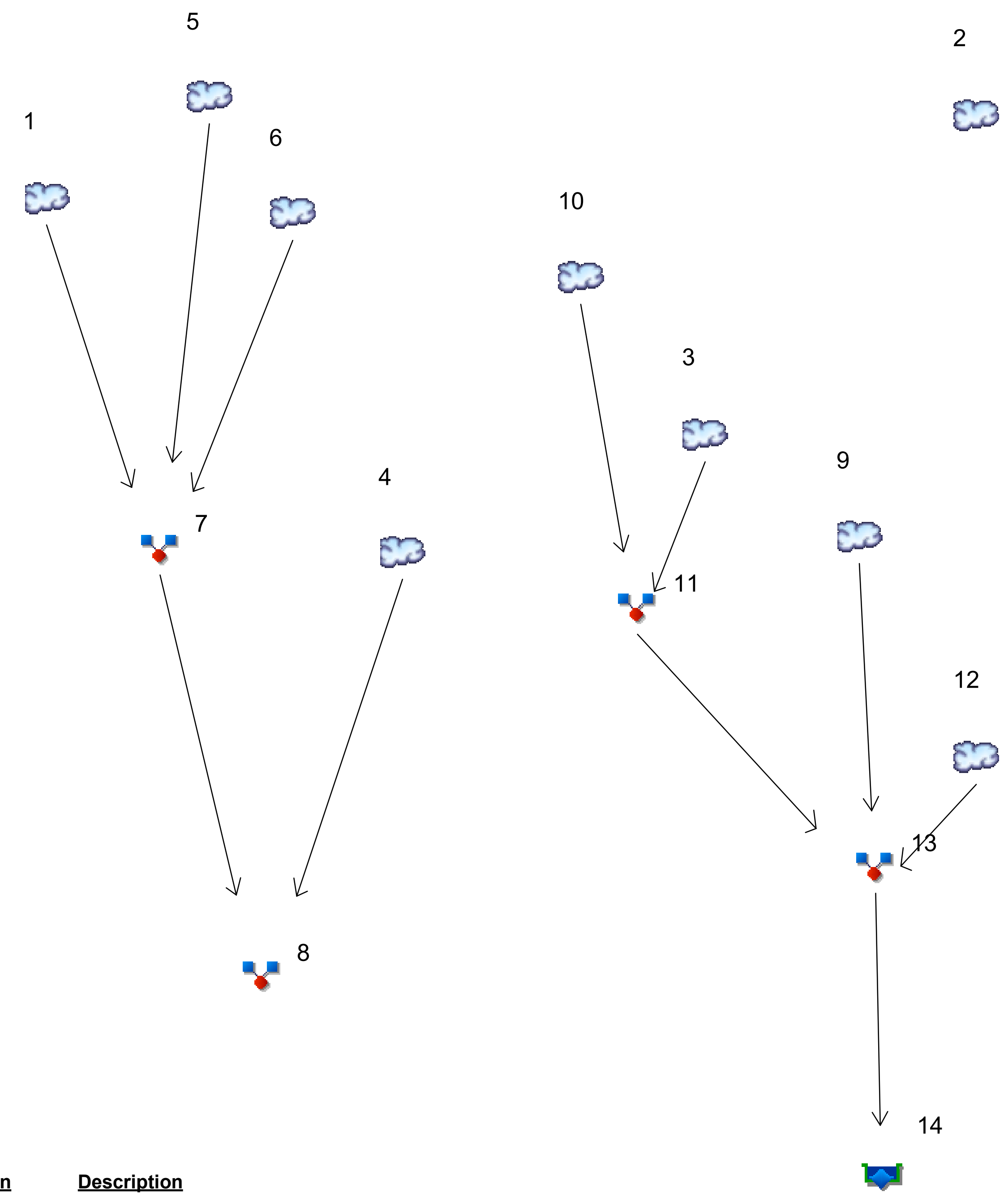
DRAINAGE AREAS

FIGURE 1

PATH: Z:\PROJECTS\OPPD\10040659_OPPD_CCR_RO_ROFF_CTRL_PLANS\MAP_DOCS\DRAFT\BASEMAP.MXD - USER: STEWILLI - DATE: 10/13/2016

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3



Legend

Hyd.	Origin	Description
1	SCS Runoff	Off-Site Run-On
2	SCS Runoff	SE Corner
3	SCS Runoff	Active CCR Runoff
4	SCS Runoff	Side Slope (East)
5	SCS Runoff	North Pond
6	SCS Runoff	Side-Slope (West)
7	Combine	North Pond (West Ditch)
8	Combine	North Pond (Total)
9	SCS Runoff	West Process Pond
10	SCS Runoff	Active CCR Runoff - to Culvert
11	Combine	Active CCR Total Runoff
12	SCS Runoff	West Proces Pond Direct Rainfall
13	Combine	West Pro Pond Runoff
14	Reservoir	West Process Pond

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

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	9.599	2	716	19,782	------	------	------	Off-Site Run-On
2	SCS Runoff	5.041	2	716	12,554	------	------	------	SE Corner
3	SCS Runoff	30.85	2	716	64,559	------	------	------	Active CCR Runoff
4	SCS Runoff	7.864	2	716	16,456	------	------	------	Side Slope (East)
5	SCS Runoff	4.402	2	718	8,875	------	------	------	North Pond
6	SCS Runoff	6.654	2	716	13,925	------	------	------	Side-Slope (West)
7	Combine	20.46	2	716	42,582	1, 5, 6	------	------	North Pond (West Ditch)
8	Combine	28.33	2	716	59,038	4, 7	------	------	North Pond (Total)
9	SCS Runoff	6.654	2	716	13,925	------	------	------	West Process Pond
10	SCS Runoff	51.42	2	716	107,599	------	------	------	Active CCR Runoff - to Culvert
11	Combine	82.27	2	716	172,159	3, 10	------	------	Active CCR Total Runoff
12	SCS Runoff	15.12	2	716	37,662	------	------	------	West Proces Pond Direct Rainfall
13	Combine	104.04	2	716	223,745	9, 11, 12	------	------	West Pro Pond Runoff
14	Reservoir	0.000	2	n/a	0	13	998.78	909,045	West Process Pond

N_Omaha.gpw	Return Period: 25 Year	Monday, 10 / 17 / 2016

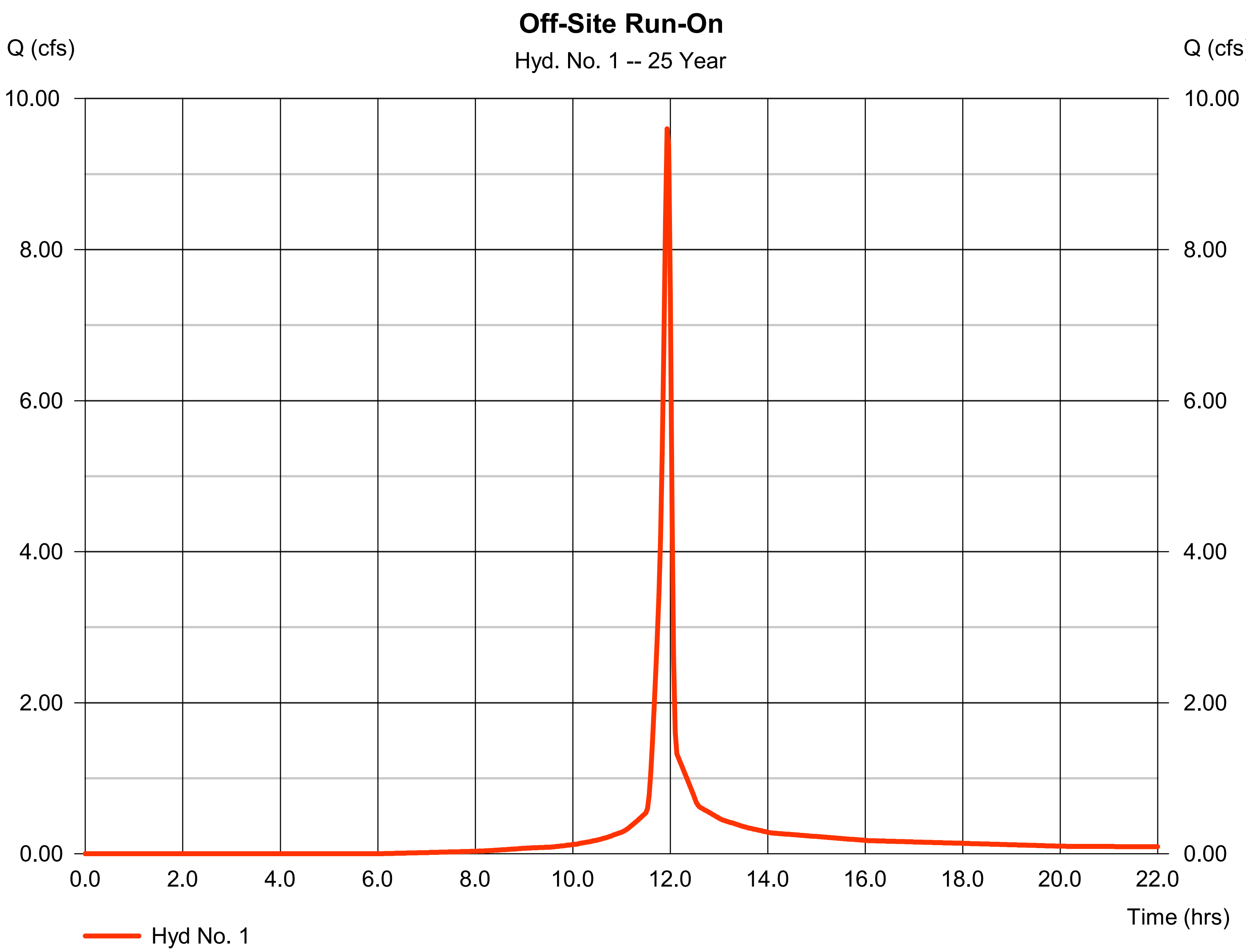
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Monday, 10 / 17 / 2016

Hyd. No. 1

Off-Site Run-On

Hydrograph type	= SCS Runoff	Peak discharge	= 9.599 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 19,782 cuft
Drainage area	= 1.700 ac	Curve number	= 83
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.27 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



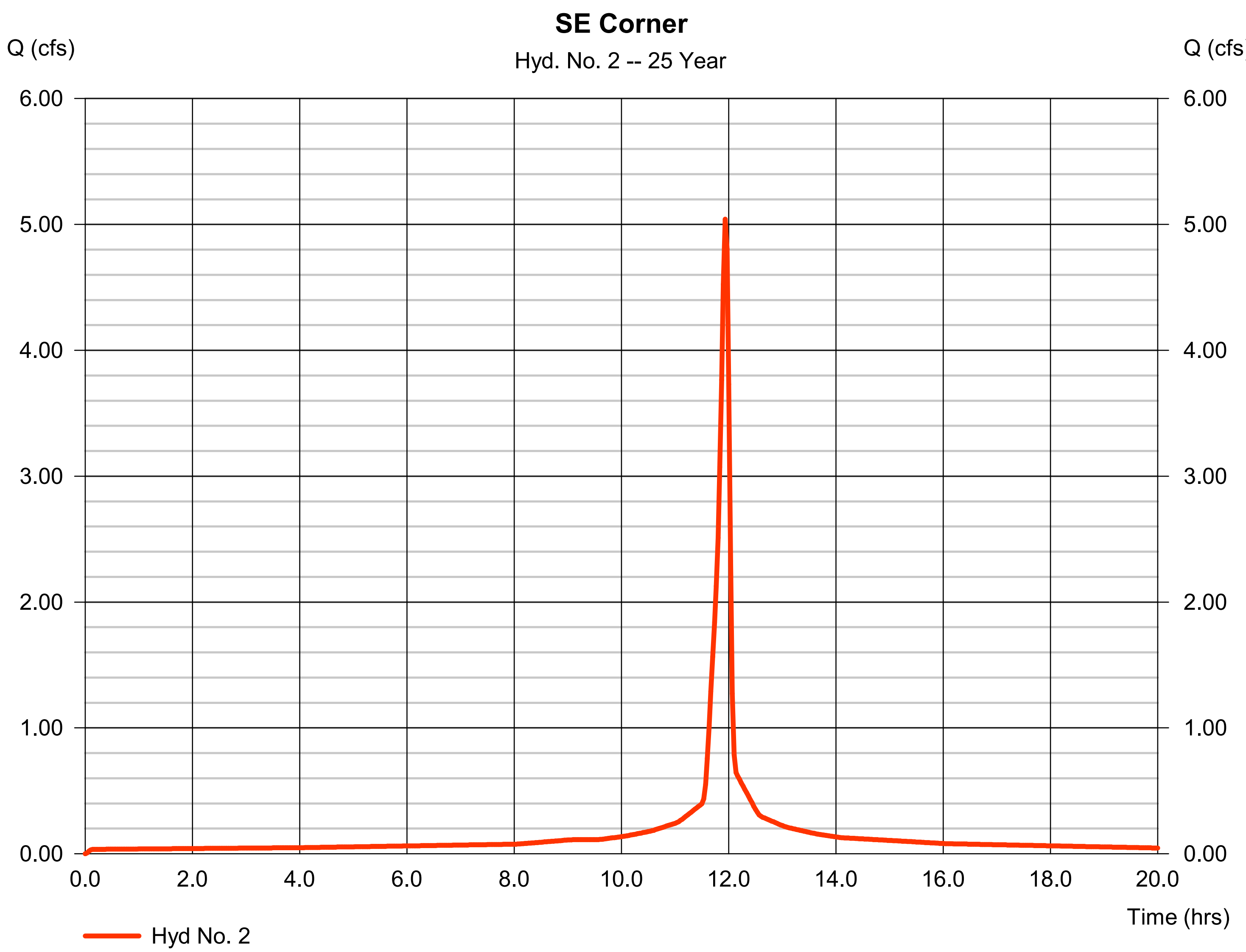
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Monday, 10 / 17 / 2016

Hyd. No. 2

SE Corner

Hydrograph type	= SCS Runoff	Peak discharge	= 5.041 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 12,554 cuft
Drainage area	= 0.700 ac	Curve number	= 100
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.27 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



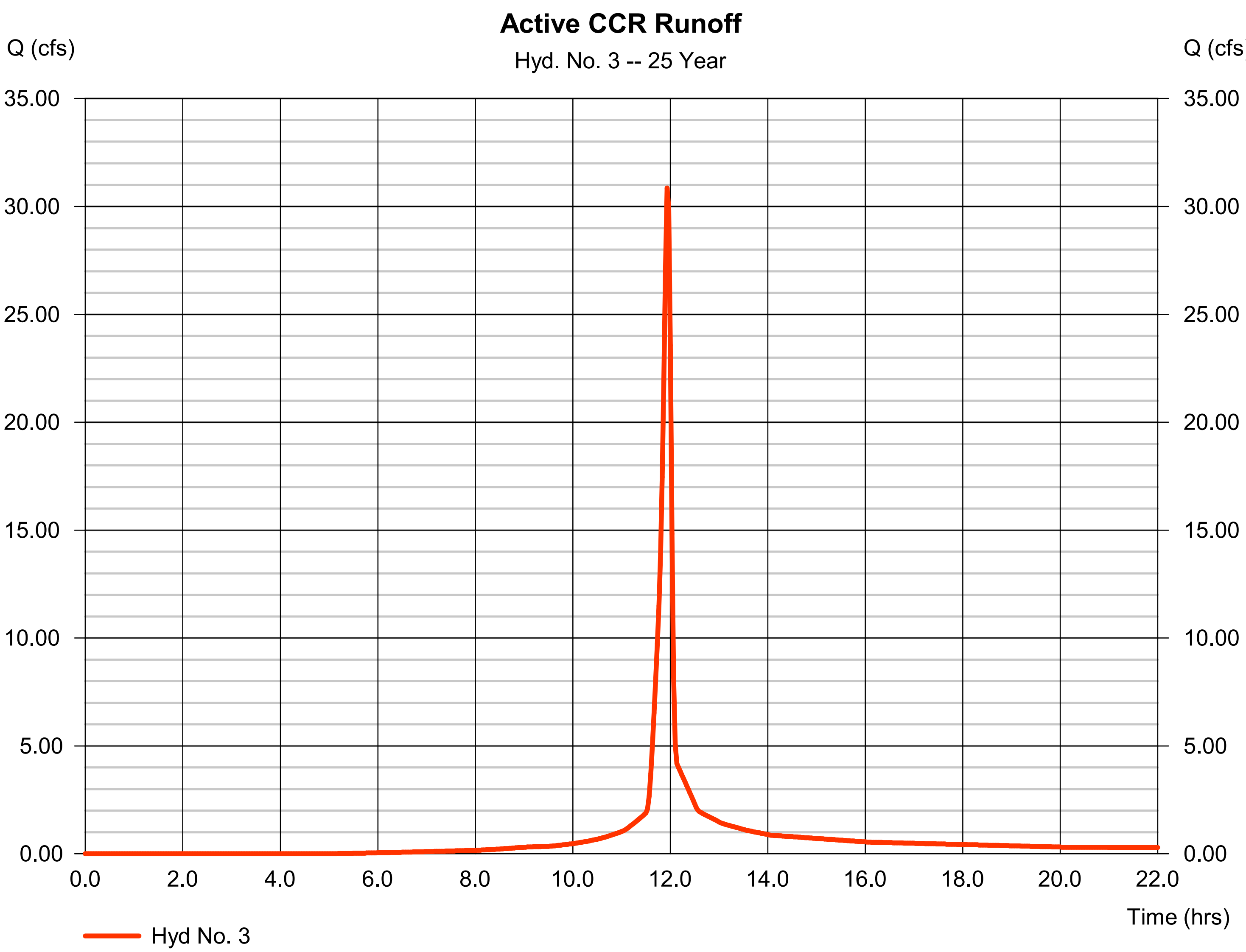
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 | Monday, 10 / 17 / 2016

Hyd. No. 3

Active CCR Runoff

Hydrograph type	= SCS Runoff	Peak discharge	= 30.85 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 64,559 cuft
Drainage area	= 5.100 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.27 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



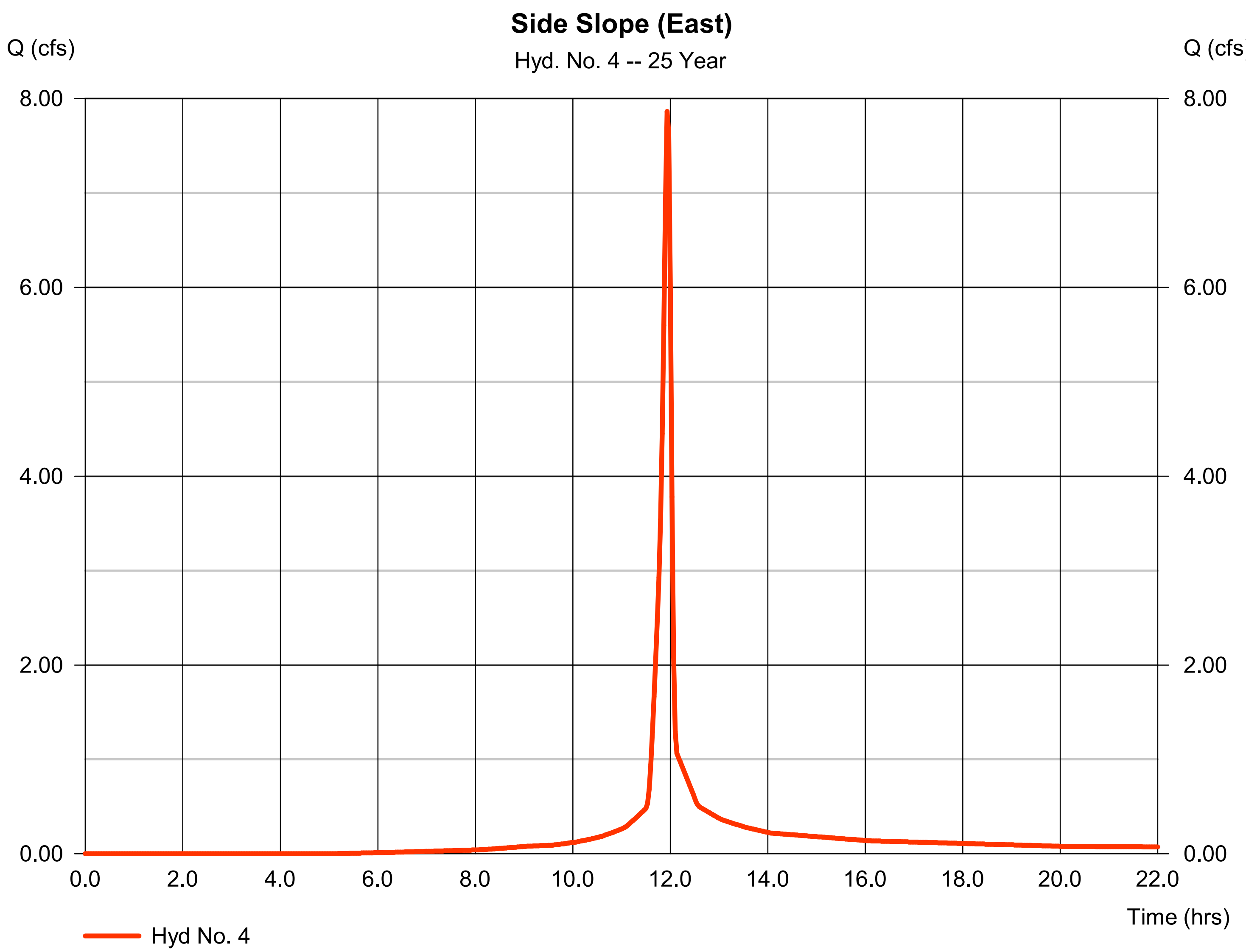
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Monday, 10 / 17 / 2016

Hyd. No. 4

Side Slope (East)

Hydrograph type	= SCS Runoff	Peak discharge	= 7.864 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 16,456 cuft
Drainage area	= 1.300 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.27 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



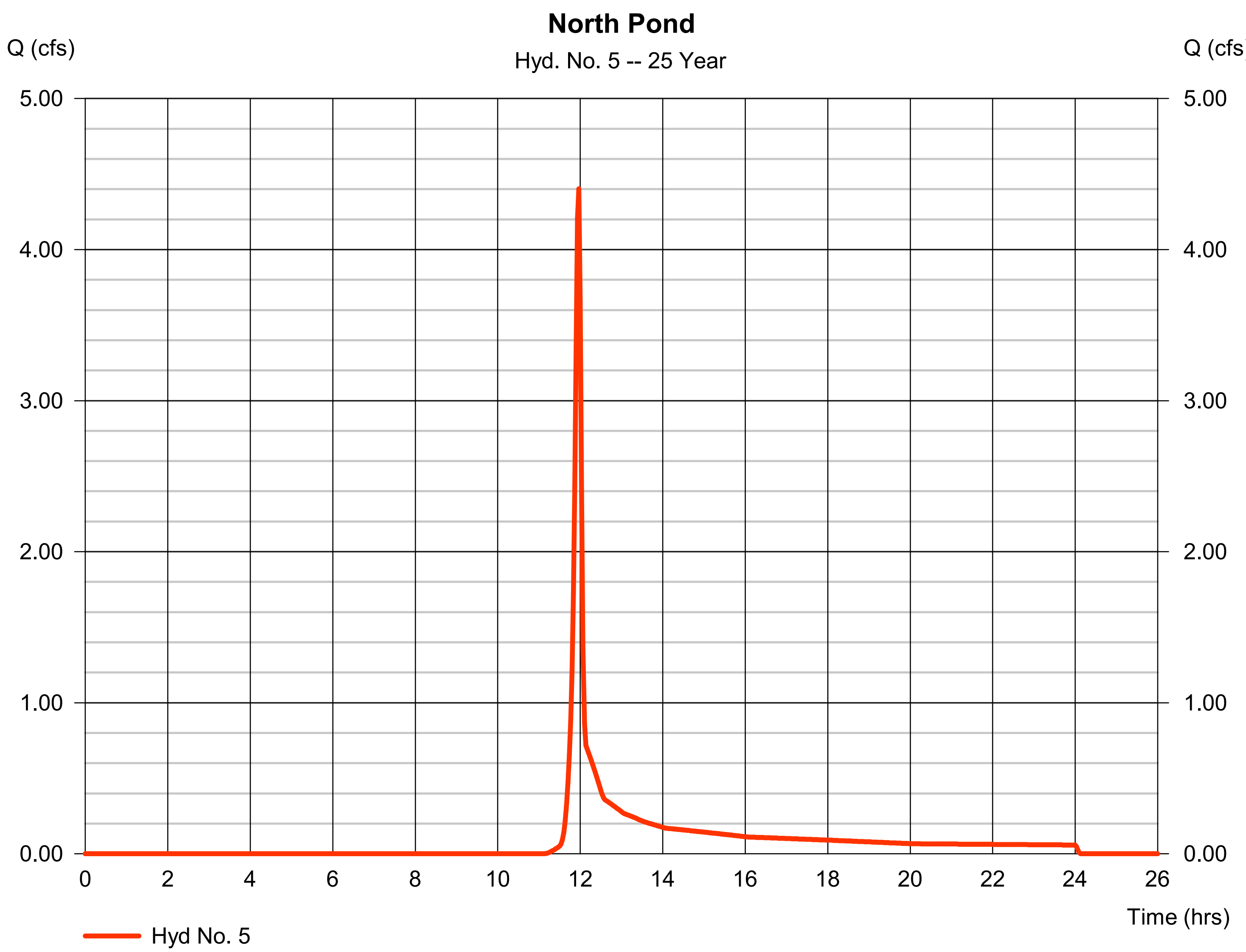
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 — Monday, 10 / 17 / 2016

Hyd. No. 5

North Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 4.402 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 8,875 cuft
Drainage area	= 1.700 ac	Curve number	= 61
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.27 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

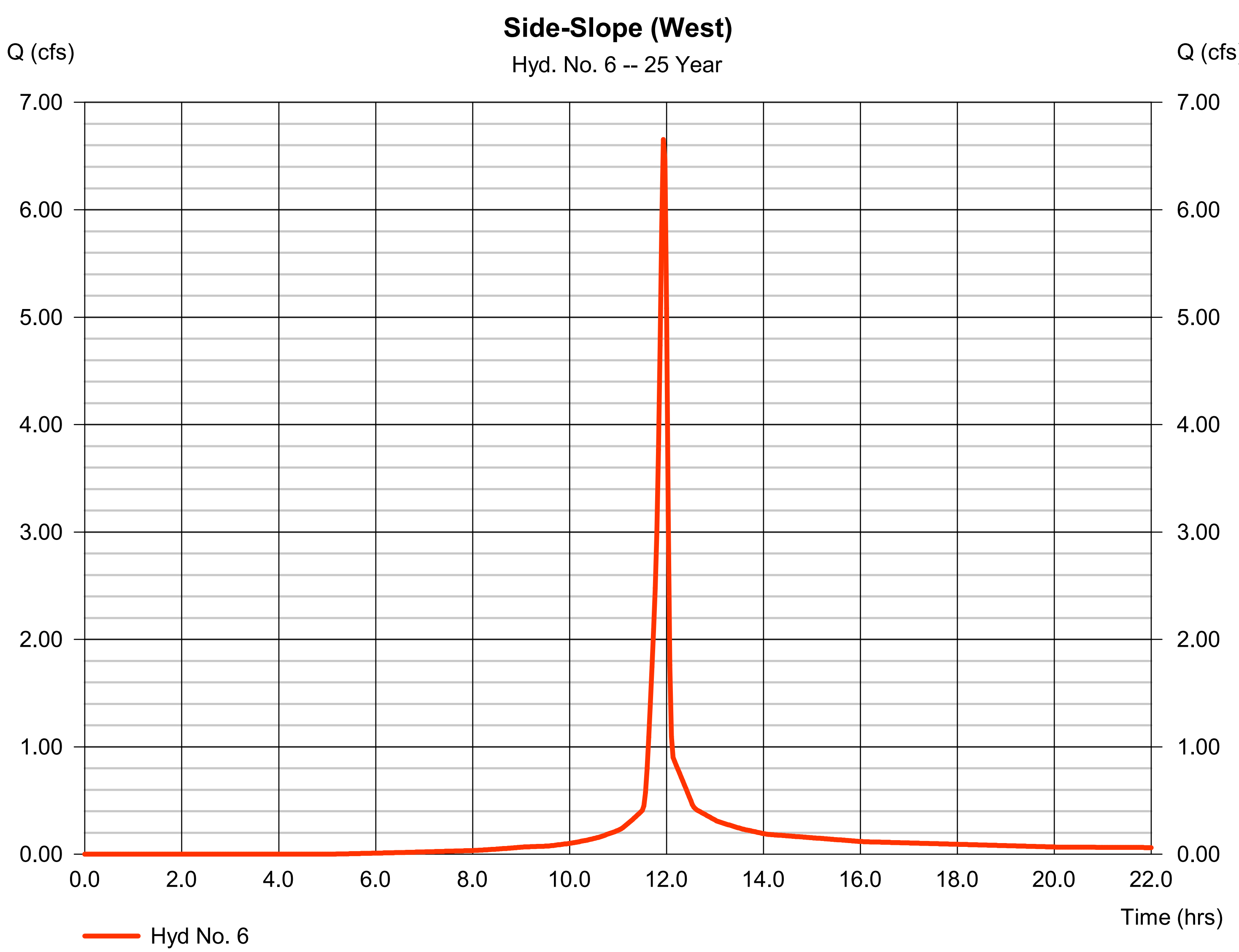


Hydrograph Report

Hyd. No. 6

Side-Slope (West)

Hydrograph type	= SCS Runoff	Peak discharge	= 6.654 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 13,925 cuft
Drainage area	= 1.100 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.27 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



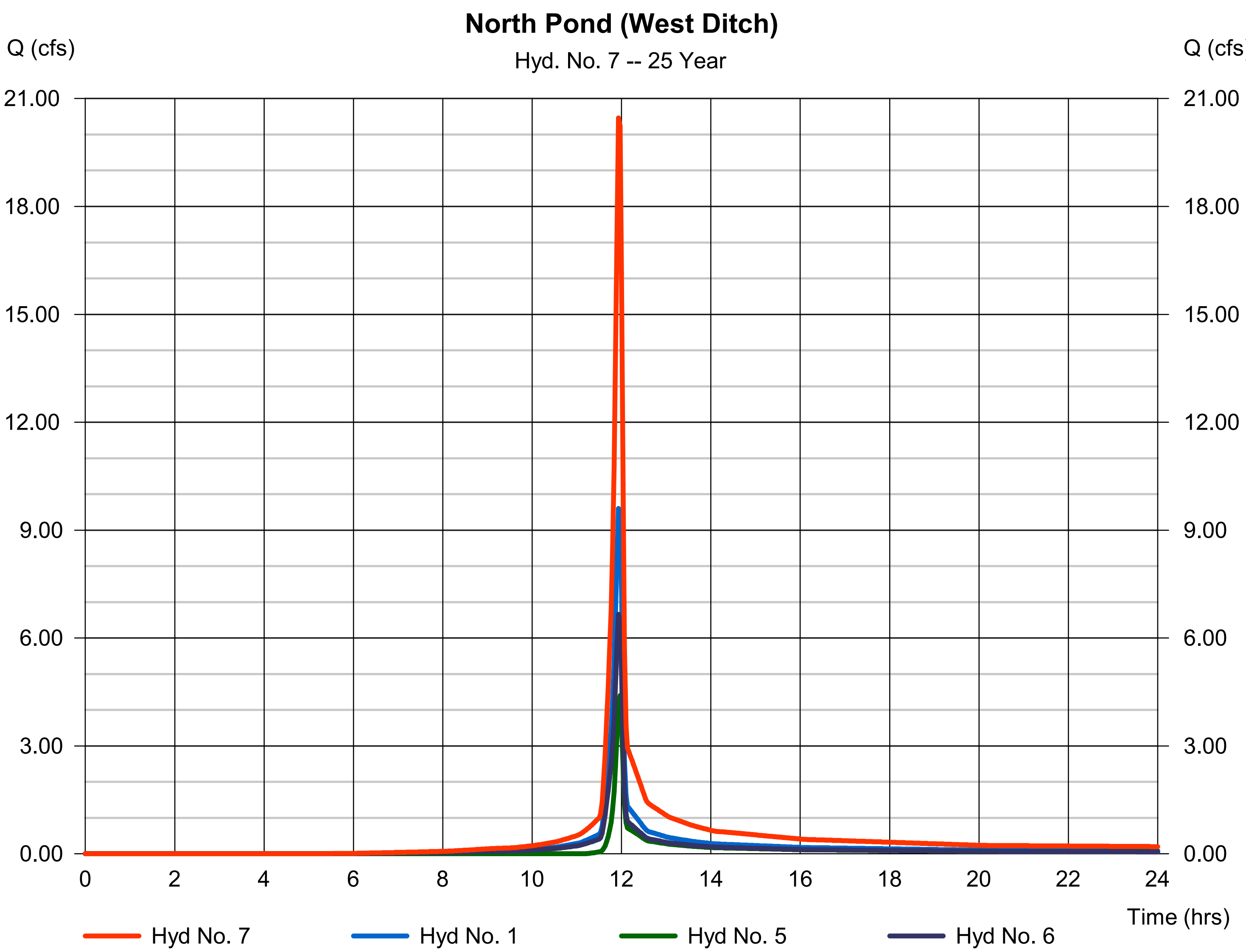
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Monday, 10 / 17 / 2016

Hyd. No. 7

North Pond (West Ditch)

Hydrograph type	= Combine	Peak discharge	= 20.46 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 42,582 cuft
Inflow hyds.	= 1, 5, 6	Contrib. drain. area	= 4.500 ac



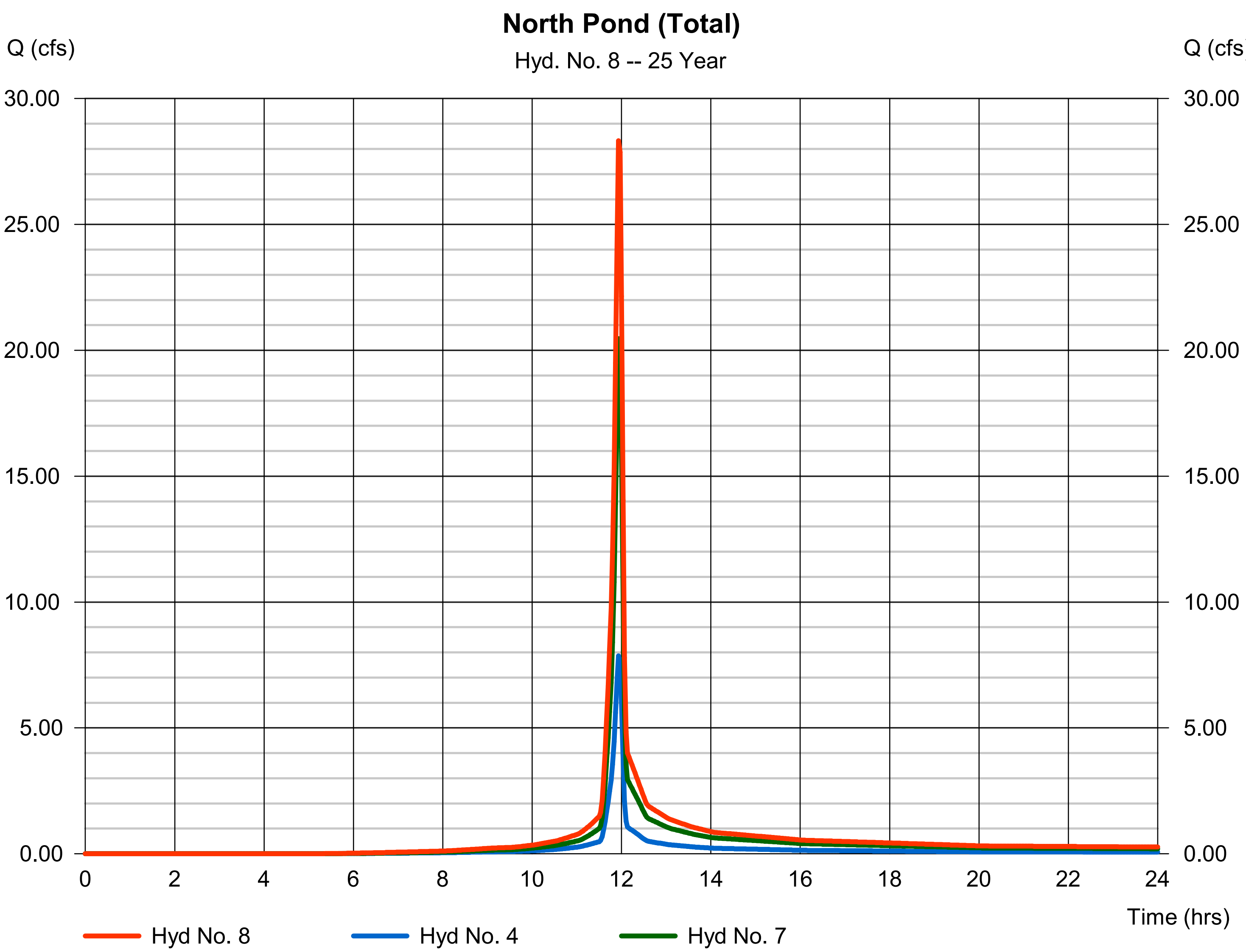
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Monday, 10 / 17 / 2016

Hyd. No. 8

North Pond (Total)

Hydrograph type	= Combine	Peak discharge	= 28.33 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 59,038 cuft
Inflow hyds.	= 4, 7	Contrib. drain. area	= 1.300 ac



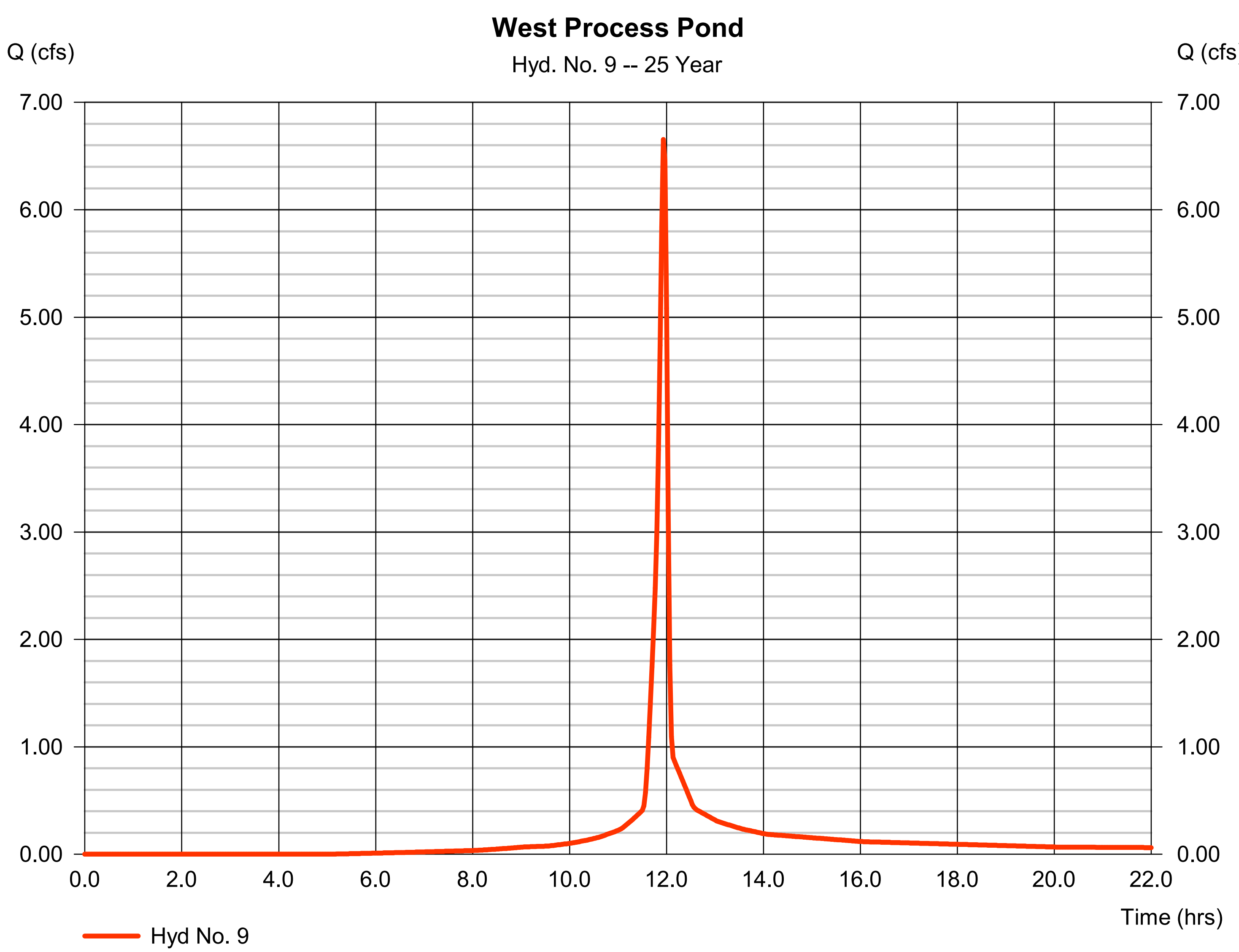
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Monday, 10 / 17 / 2016

Hyd. No. 9

West Process Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 6.654 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 13,925 cuft
Drainage area	= 1.100 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.27 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

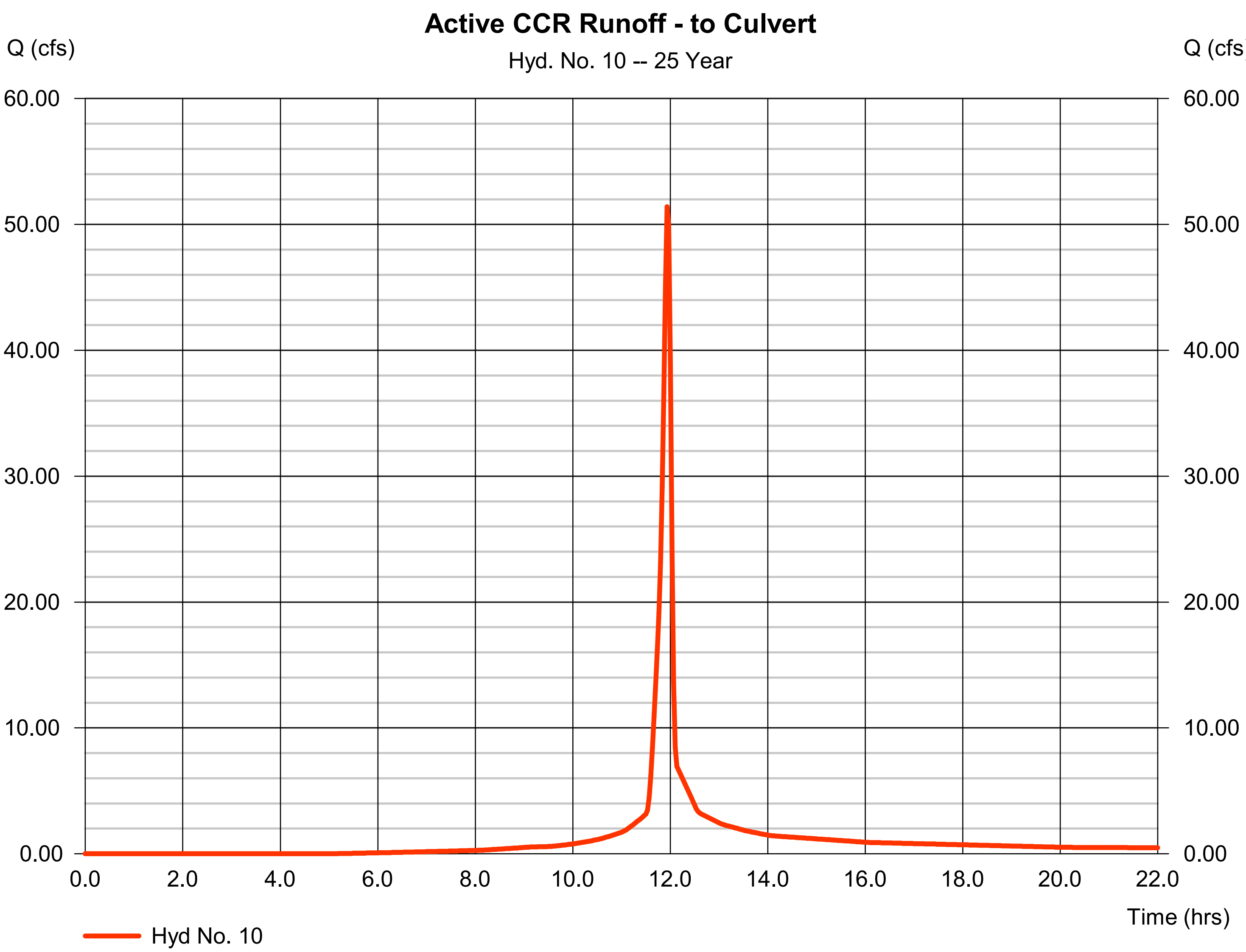


Hydrograph Report

Hyd. No. 10

Active CCR Runoff - to Culvert

Hydrograph type	= SCS Runoff	Peak discharge	= 51.42 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 107,599 cuft
Drainage area	= 8.500 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.27 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



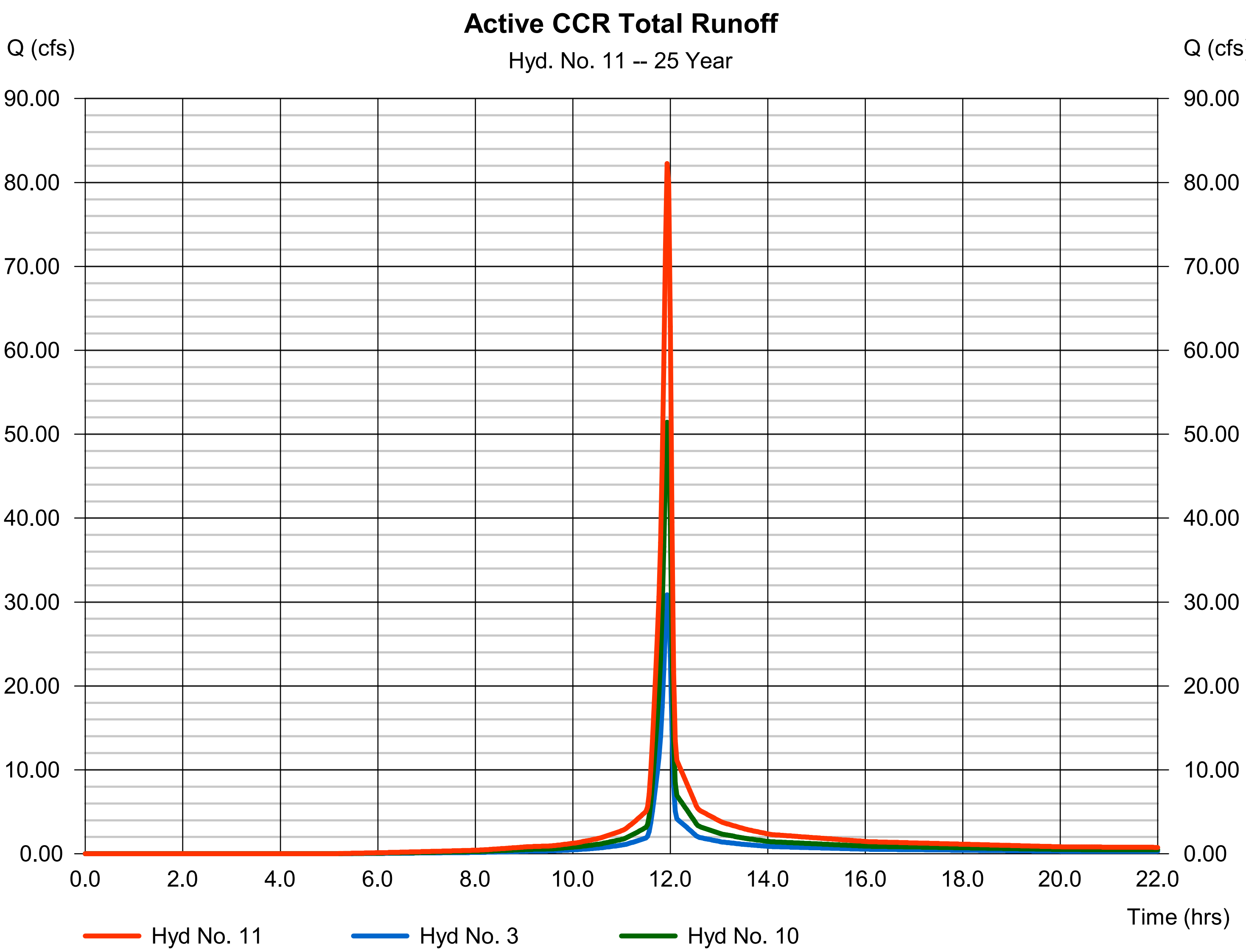
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Monday, 10 / 17 / 2016

Hyd. No. 11

Active CCR Total Runoff

Hydrograph type	= Combine	Peak discharge	= 82.27 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 172,159 cuft
Inflow hyds.	= 3, 10	Contrib. drain. area	= 13.600 ac



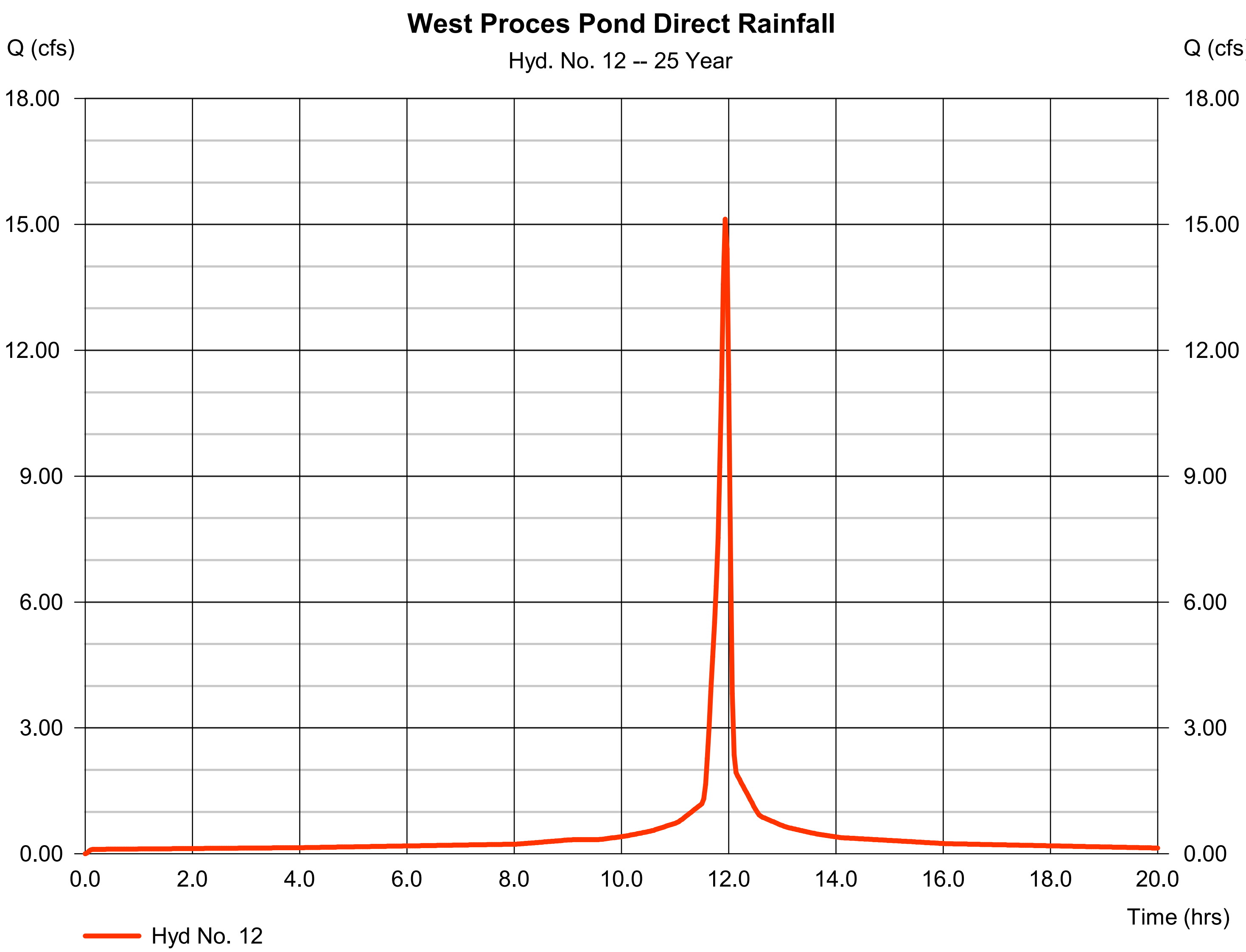
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Monday, 10 / 17 / 2016

Hyd. No. 12

West Proces Pond Direct Rainfall

Hydrograph type	= SCS Runoff	Peak discharge	= 15.12 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 37,662 cuft
Drainage area	= 2.100 ac	Curve number	= 100
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.27 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



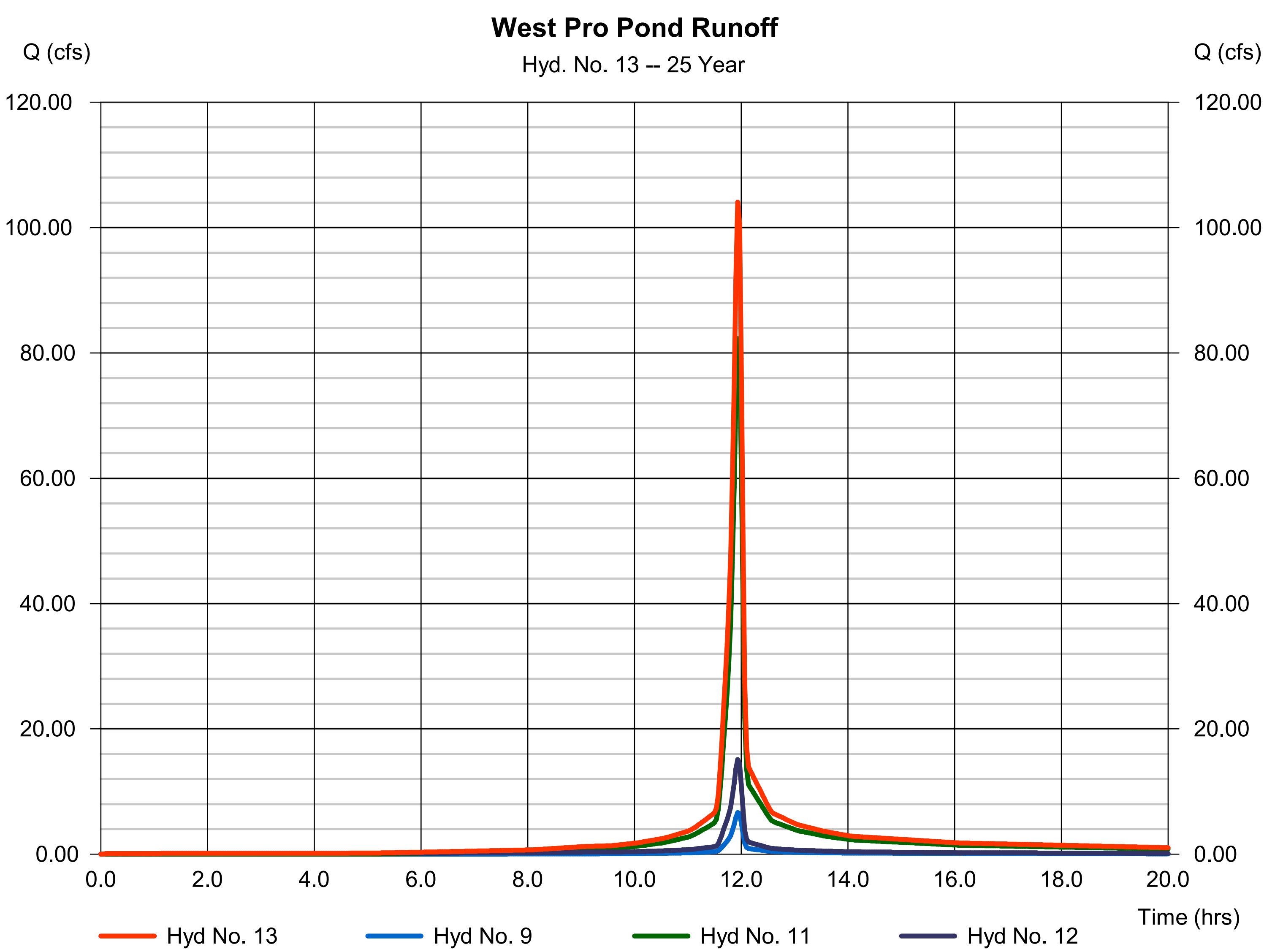
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Monday, 10 / 17 / 2016

Hyd. No. 13

West Pro Pond Runoff

Hydrograph type	= Combine	Peak discharge	= 104.04 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 223,745 cuft
Inflow hyds.	= 9, 11, 12	Contrib. drain. area	= 3.200 ac



Hydrograph Report

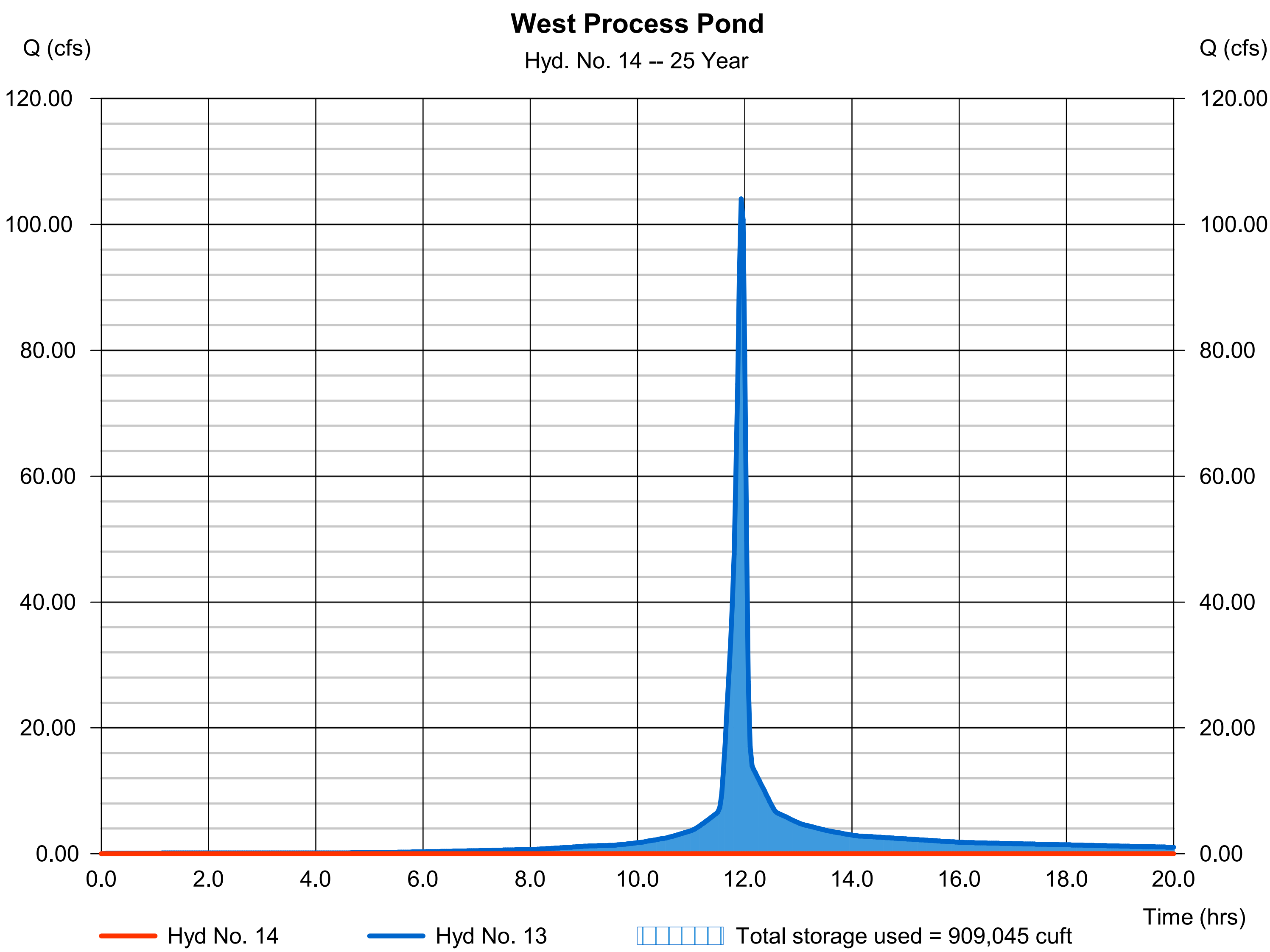
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Monday, 10 / 17 / 2016

Hyd. No. 14

West Process Pond

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 25 yrs	Time to peak	= n/a
Time interval	= 2 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 13 - West Pro Pond Runoff	Max. Elevation	= 998.78 ft
Reservoir name	= West Process Pond	Max. Storage	= 909,045 cuft

Storage Indication method used. Wet pond routing start elevation = 996.50 ft.



Pond Report

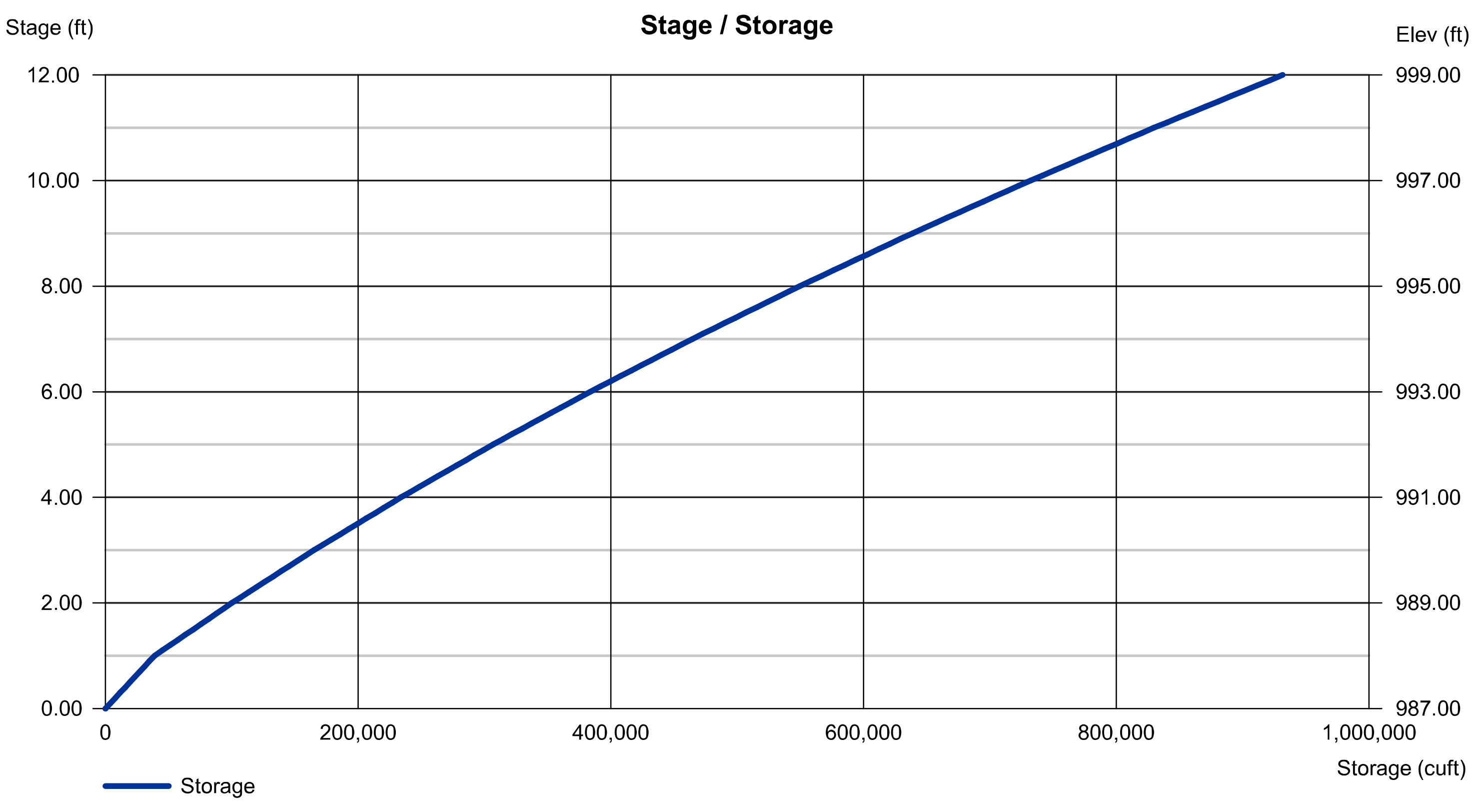
Pond No. 6 - West Process Pond

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	987.00	n/a	0	0
1.00	988.00	n/a	38,800	38,800
2.00	989.00	n/a	61,200	100,000
3.00	990.00	n/a	65,000	165,000
4.00	991.00	n/a	68,900	233,900
5.00	992.00	n/a	72,800	306,700
6.00	993.00	n/a	76,800	383,500
7.00	994.00	n/a	80,900	464,400
8.00	995.00	n/a	85,000	549,400
9.00	996.00	n/a	89,200	638,600
10.00	997.00	n/a	93,400	732,000
11.00	998.00	n/a	97,700	829,700
12.00	999.00	n/a	102,000	931,700



NOAA Atlas 14, Volume 8, Version 2
Location name: Omaha, Nebraska, US*
Latitude: 41.3302°, Longitude: -95.9496°
Elevation: 994 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

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	0.354 (0.300–0.424)	0.421 (0.356–0.503)	0.532 (0.449–0.638)	0.627 (0.526–0.755)	0.763 (0.617–0.944)	0.870 (0.687–1.09)	0.981 (0.746–1.25)	1.10 (0.798–1.43)	1.25 (0.875–1.66)	1.38 (0.933–1.85)
10-min	0.519 (0.440–0.621)	0.616 (0.521–0.737)	0.779 (0.657–0.934)	0.918 (0.770–1.11)	1.12 (0.904–1.38)	1.27 (1.01–1.59)	1.44 (1.09–1.83)	1.61 (1.17–2.09)	1.83 (1.28–2.44)	2.01 (1.37–2.70)
15-min	0.633 (0.536–0.757)	0.751 (0.636–0.899)	0.950 (0.801–1.14)	1.12 (0.939–1.35)	1.36 (1.10–1.69)	1.55 (1.23–1.94)	1.75 (1.33–2.23)	1.96 (1.42–2.55)	2.24 (1.56–2.97)	2.46 (1.67–3.30)
30-min	0.935 (0.792–1.12)	1.12 (0.944–1.33)	1.42 (1.19–1.70)	1.67 (1.40–2.01)	2.03 (1.65–2.52)	2.32 (1.83–2.90)	2.61 (1.99–3.32)	2.91 (2.12–3.79)	3.32 (2.32–4.42)	3.64 (2.47–4.89)
60-min	1.22 (1.04–1.46)	1.47 (1.25–1.76)	1.90 (1.60–2.28)	2.28 (1.91–2.74)	2.81 (2.28–3.50)	3.25 (2.57–4.08)	3.70 (2.82–4.73)	4.18 (3.05–5.45)	4.84 (3.39–6.45)	5.37 (3.64–7.20)
2-hr	1.51 (1.29–1.80)	1.83 (1.56–2.18)	2.39 (2.03–2.85)	2.88 (2.43–3.44)	3.60 (2.94–4.45)	4.18 (3.33–5.22)	4.80 (3.68–6.10)	5.45 (4.00–7.07)	6.36 (4.48–8.43)	7.09 (4.84–9.46)
3-hr	1.68 (1.43–1.98)	2.03 (1.74–2.41)	2.66 (2.27–3.16)	3.23 (2.73–3.85)	4.08 (3.36–5.05)	4.78 (3.83–5.96)	5.53 (4.26–7.02)	6.33 (4.67–8.20)	7.47 (5.28–9.87)	8.38 (5.74–11.1)
6-hr	1.97 (1.69–2.31)	2.35 (2.02–2.76)	3.05 (2.61–3.59)	3.70 (3.15–4.37)	4.70 (3.90–5.81)	5.54 (4.48–6.89)	6.46 (5.03–8.18)	7.47 (5.55–9.64)	8.90 (6.35–11.7)	10.1 (6.95–13.3)
12-hr	2.28 (1.97–2.66)	2.64 (2.28–3.09)	3.32 (2.86–3.89)	3.96 (3.39–4.65)	4.97 (4.17–6.12)	5.84 (4.76–7.23)	6.80 (5.33–8.56)	7.86 (5.89–10.1)	9.38 (6.74–12.3)	10.6 (7.39–14.0)
24-hr	2.61 (2.27–3.02)	2.95 (2.57–3.42)	3.61 (3.13–4.20)	4.25 (3.66–4.96)	5.27 (4.46–6.45)	6.17 (5.06–7.59)	7.16 (5.65–8.96)	8.26 (6.24–10.6)	9.87 (7.15–12.9)	11.2 (7.83–14.6)
2-day	2.94 (2.58–3.39)	3.34 (2.93–3.85)	4.09 (3.56–4.72)	4.79 (4.15–5.54)	5.87 (4.98–7.11)	6.81 (5.61–8.29)	7.83 (6.21–9.71)	8.95 (6.79–11.3)	10.6 (7.69–13.6)	11.9 (8.37–15.4)
3-day	3.20 (2.82–3.67)	3.65 (3.21–4.19)	4.47 (3.91–5.14)	5.22 (4.54–6.02)	6.37 (5.40–7.65)	7.34 (6.05–8.87)	8.38 (6.66–10.3)	9.52 (7.24–12.0)	11.1 (8.13–14.3)	12.5 (8.81–16.1)
4-day	3.44 (3.04–3.94)	3.93 (3.46–4.49)	4.79 (4.20–5.49)	5.57 (4.86–6.41)	6.75 (5.73–8.06)	7.73 (6.39–9.31)	8.79 (7.00–10.8)	9.93 (7.57–12.4)	11.5 (8.44–14.8)	12.8 (9.10–16.5)
7-day	4.10 (3.64–4.67)	4.63 (4.10–5.27)	5.56 (4.90–6.34)	6.38 (5.59–7.30)	7.59 (6.46–8.97)	8.58 (7.12–10.2)	9.63 (7.70–11.7)	10.7 (8.22–13.3)	12.3 (9.04–15.6)	13.6 (9.66–17.3)
10-day	4.69 (4.17–5.31)	5.27 (4.68–5.98)	6.27 (5.55–7.12)	7.14 (6.28–8.13)	8.39 (7.16–9.86)	9.41 (7.82–11.2)	10.5 (8.40–12.7)	11.6 (8.90–14.3)	13.1 (9.68–16.6)	14.4 (10.3–18.3)
20-day	6.33 (5.67–7.13)	7.12 (6.36–8.02)	8.42 (7.50–9.50)	9.51 (8.42–10.8)	11.0 (9.43–12.8)	12.2 (10.2–14.3)	13.4 (10.8–16.1)	14.7 (11.3–17.9)	16.3 (12.1–20.4)	17.6 (12.7–22.2)
30-day	7.71 (6.92–8.63)	8.68 (7.78–9.73)	10.2 (9.15–11.5)	11.5 (10.2–13.0)	13.3 (11.4–15.3)	14.6 (12.2–17.0)	15.9 (12.9–18.9)	17.3 (13.3–20.9)	19.0 (14.1–23.6)	20.3 (14.7–25.6)
45-day	9.46 (8.53–10.6)	10.7 (9.59–11.9)	12.5 (11.2–14.0)	14.1 (12.5–15.8)	16.1 (13.8–18.4)	17.5 (14.7–20.3)	19.0 (15.4–22.4)	20.4 (15.8–24.6)	22.1 (16.5–27.3)	23.4 (17.0–29.4)
60-day	11.0 (9.92–12.2)	12.3 (11.1–13.7)	14.5 (13.0–16.2)	16.2 (14.5–18.1)	18.4 (15.8–20.9)	19.9 (16.7–23.0)	21.4 (17.4–25.2)	22.9 (17.7–27.4)	24.6 (18.3–30.2)	25.8 (18.8–32.3)

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

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

Please refer to NOAA Atlas 14 document for more information.

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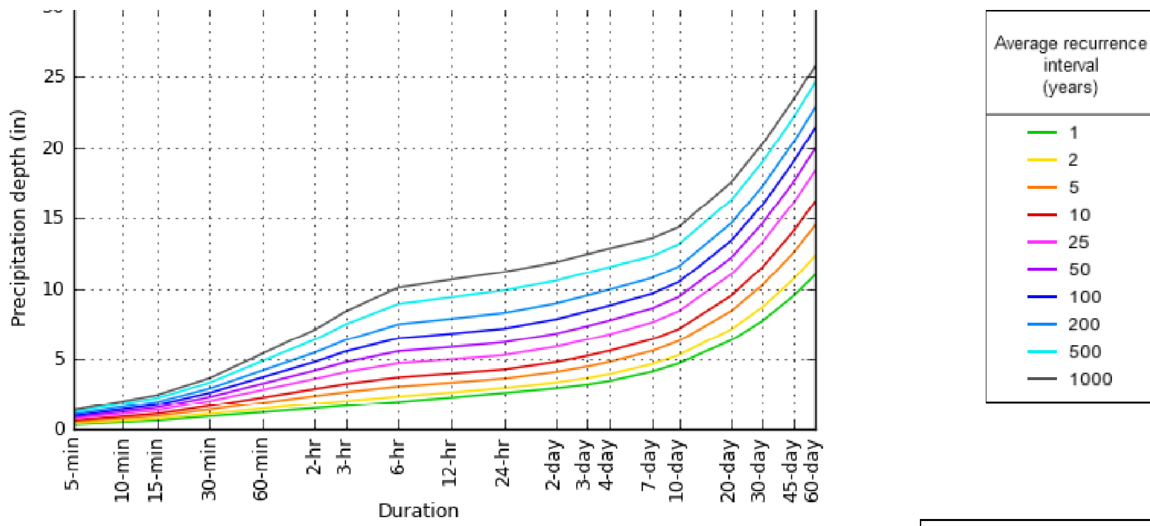
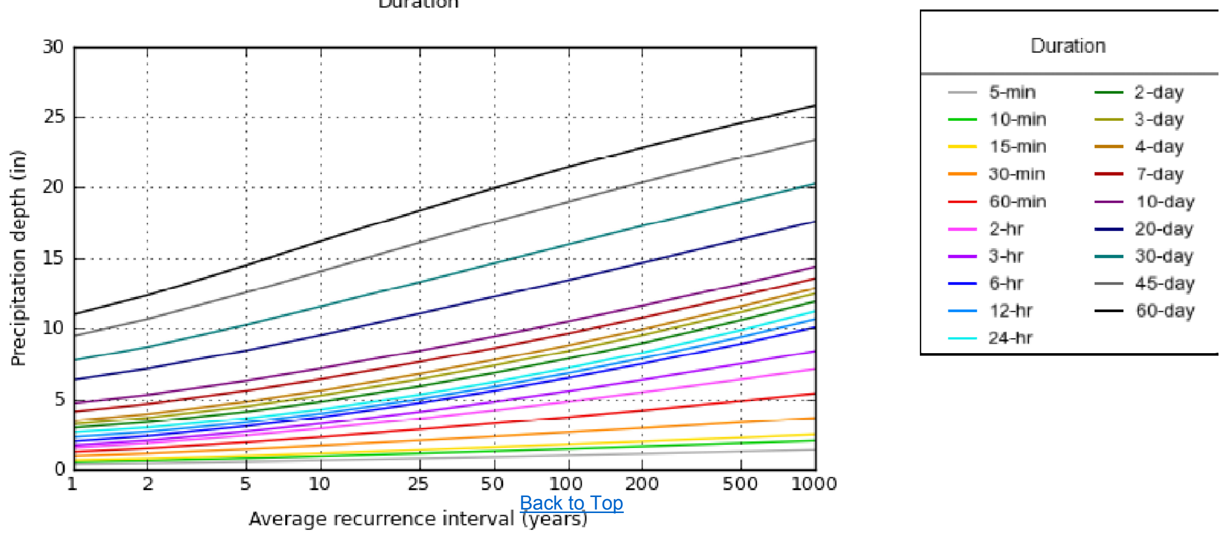
PF graphical





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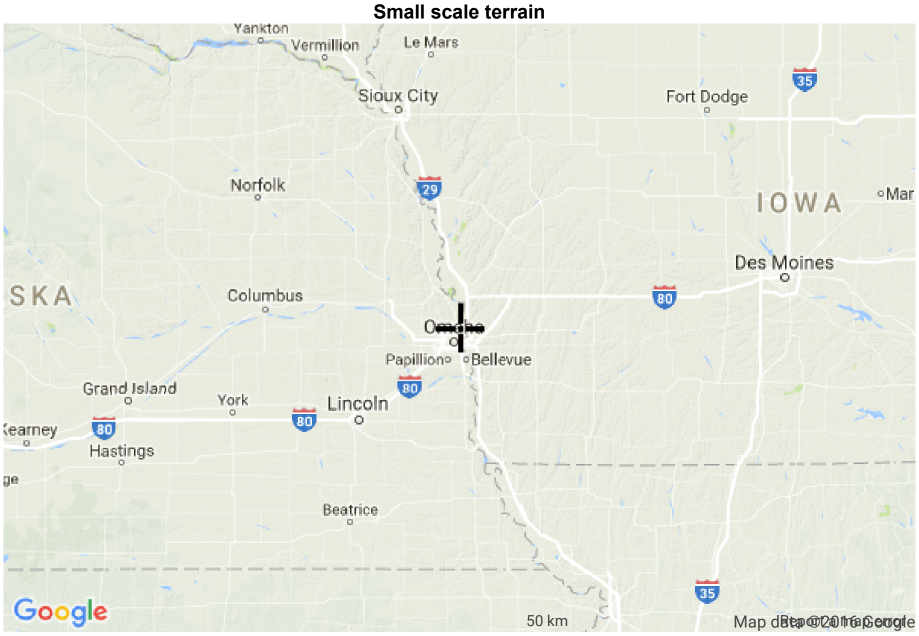
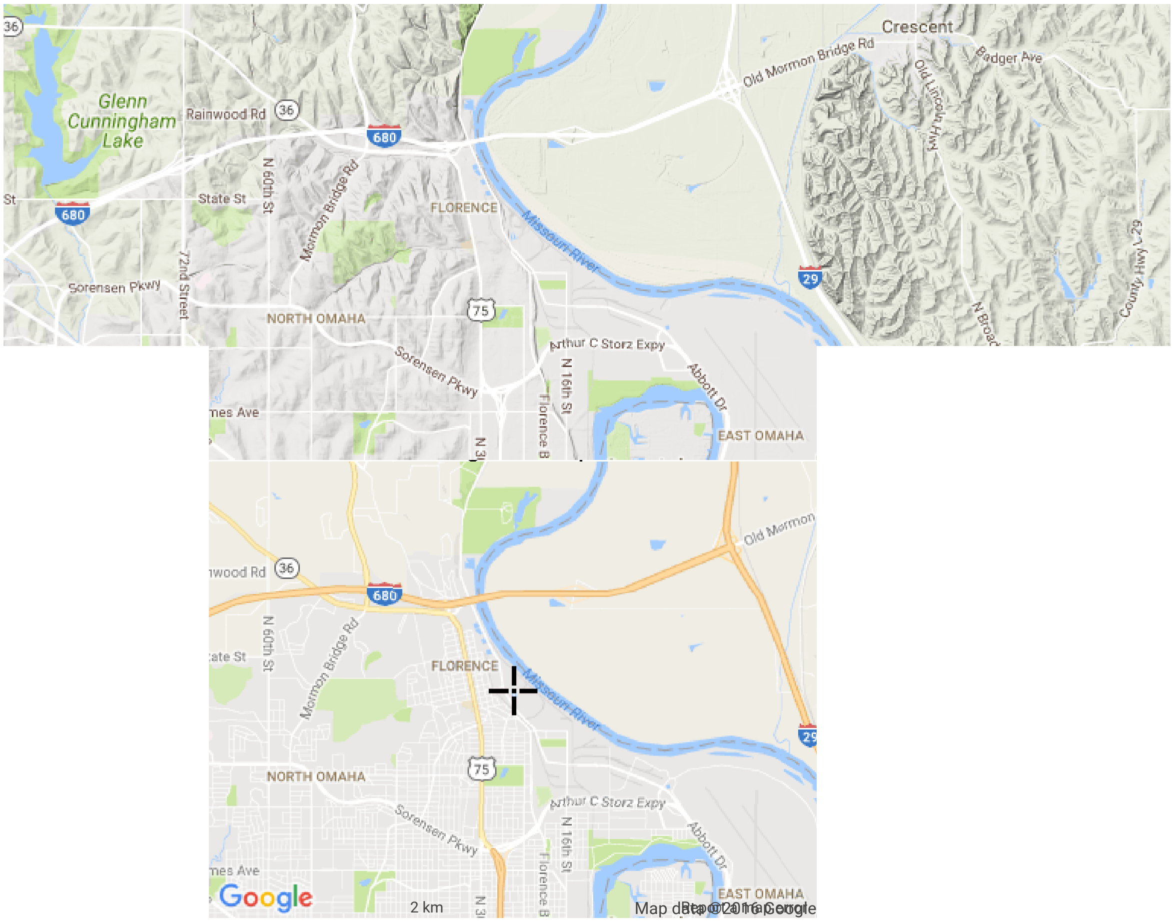
NOAA Atlas 14, Volume 8, Version 2 Created (GMT): Thu Aug 25 14:16:29 2016

Maps & aerials

Small scale terrain



Large scale terrain



Large scale aerial

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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

Disclaimer

Appendix B
Stormwater Run-Off Calculations and Perimeter Ditches to North

Channel Report

West Ditch to North Pond 0.5%

Trapezoidal

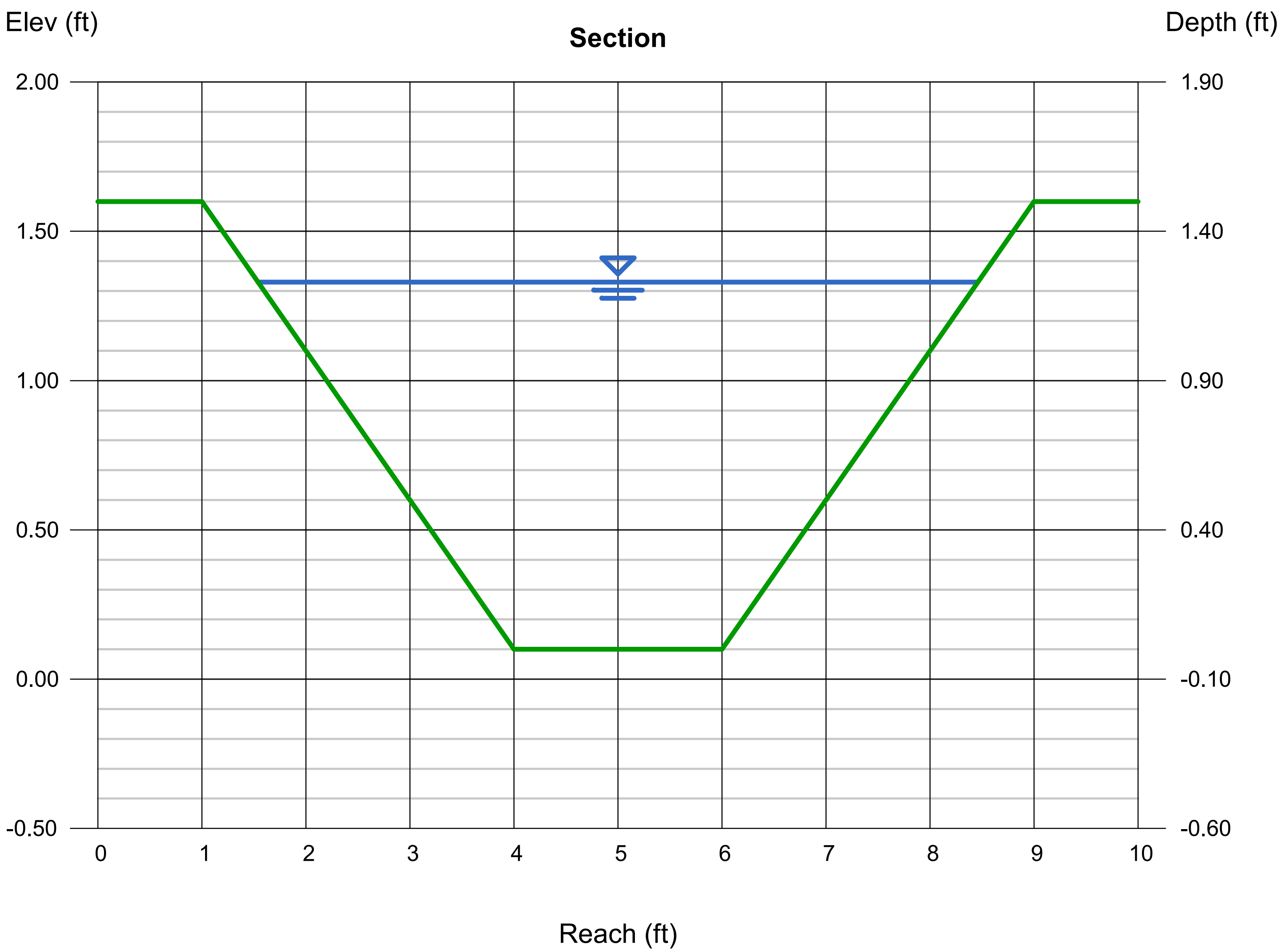
Bottom Width (ft)	= 2.00
Side Slopes (z:1)	= 2.00, 2.00
Total Depth (ft)	= 1.50
Invert Elev (ft)	= 0.10
Slope (%)	= 0.50
N-Value	= 0.022

Calculations

Compute by:	Known Q
Known Q (cfs)	= 21.00

Highlighted

Depth (ft)	= 1.23
Q (cfs)	= 21.00
Area (sqft)	= 5.49
Velocity (ft/s)	= 3.83
Wetted Perim (ft)	= 7.50
Crit Depth, Yc (ft)	= 1.07
Top Width (ft)	= 6.92
EGL (ft)	= 1.46



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Oct 13 2016

West Ditch to North Pond 7.5%

Trapezoidal

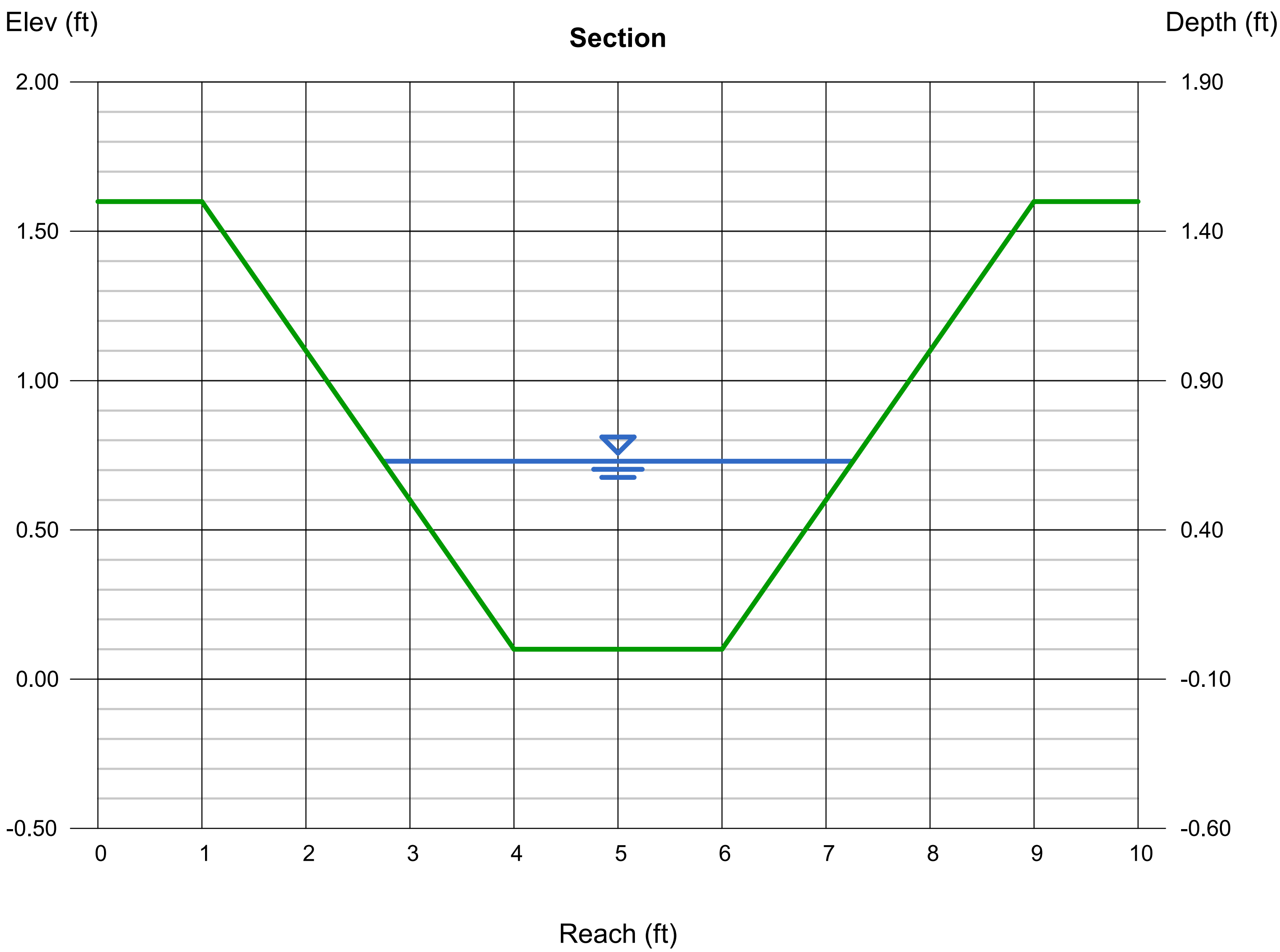
Bottom Width (ft)	= 2.00
Side Slopes (z:1)	= 2.00, 2.00
Total Depth (ft)	= 1.50
Invert Elev (ft)	= 0.10
Slope (%)	= 7.50
N-Value	= 0.022

Calculations

Compute by:	Known Q
Known Q (cfs)	= 21.00

Highlighted

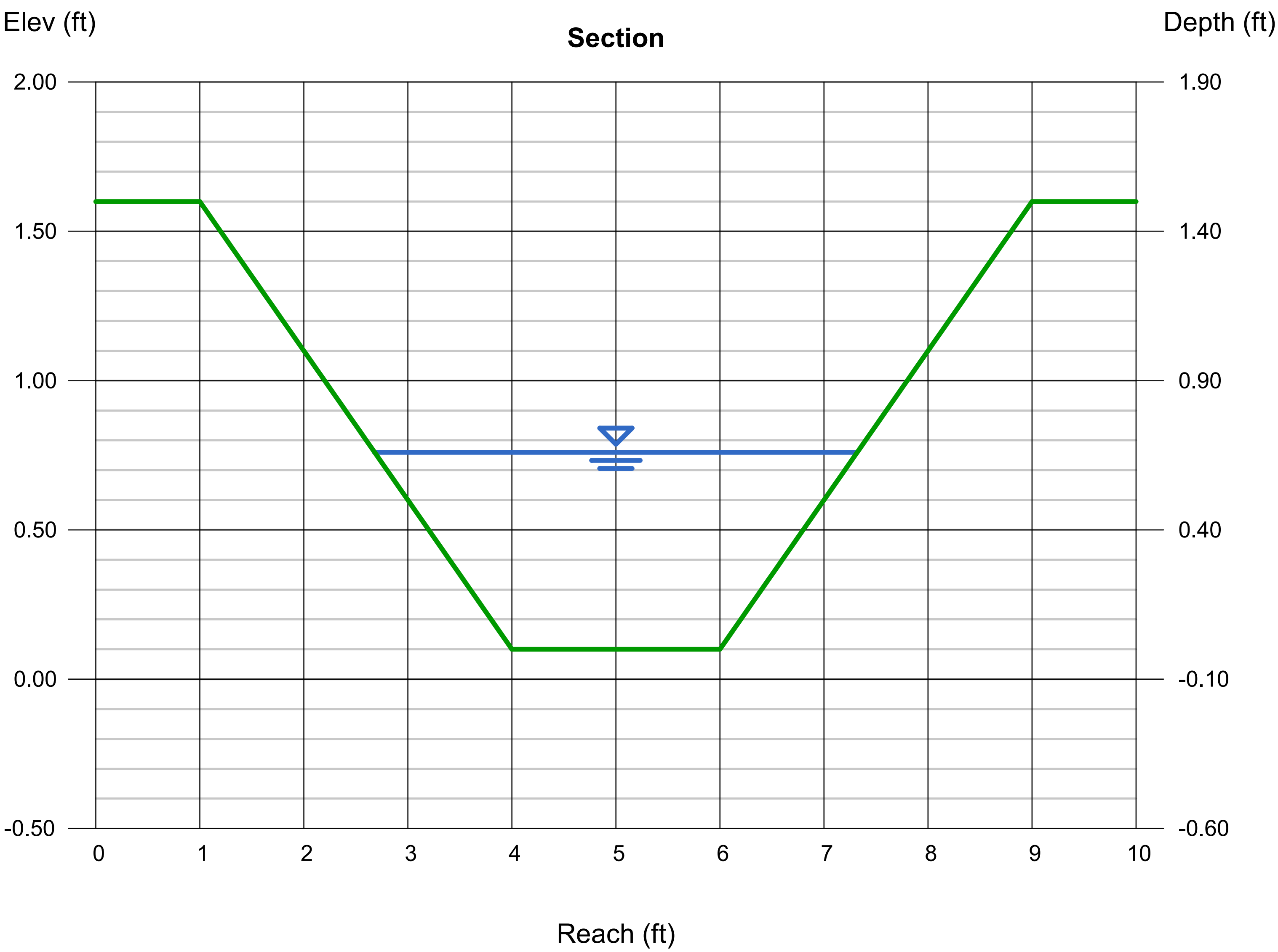
Depth (ft)	= 0.63
Q (cfs)	= 21.00
Area (sqft)	= 2.05
Velocity (ft/s)	= 10.22
Wetted Perim (ft)	= 4.82
Crit Depth, Yc (ft)	= 1.07
Top Width (ft)	= 4.52
EGL (ft)	= 2.26



Channel Report

East Ditch to North Pond

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 2.00	Depth (ft)	= 0.66
Side Slopes (z:1)	= 2.00, 2.00	Q (cfs)	= 8.000
Total Depth (ft)	= 1.50	Area (sqft)	= 2.19
Invert Elev (ft)	= 0.10	Velocity (ft/s)	= 3.65
Slope (%)	= 0.90	Wetted Perim (ft)	= 4.95
N-Value	= 0.022	Crit Depth, Yc (ft)	= 0.64
		Top Width (ft)	= 4.64
Calculations		EGL (ft)	= 0.87
Compute by:	Known Q		
Known Q (cfs)	= 8.00		

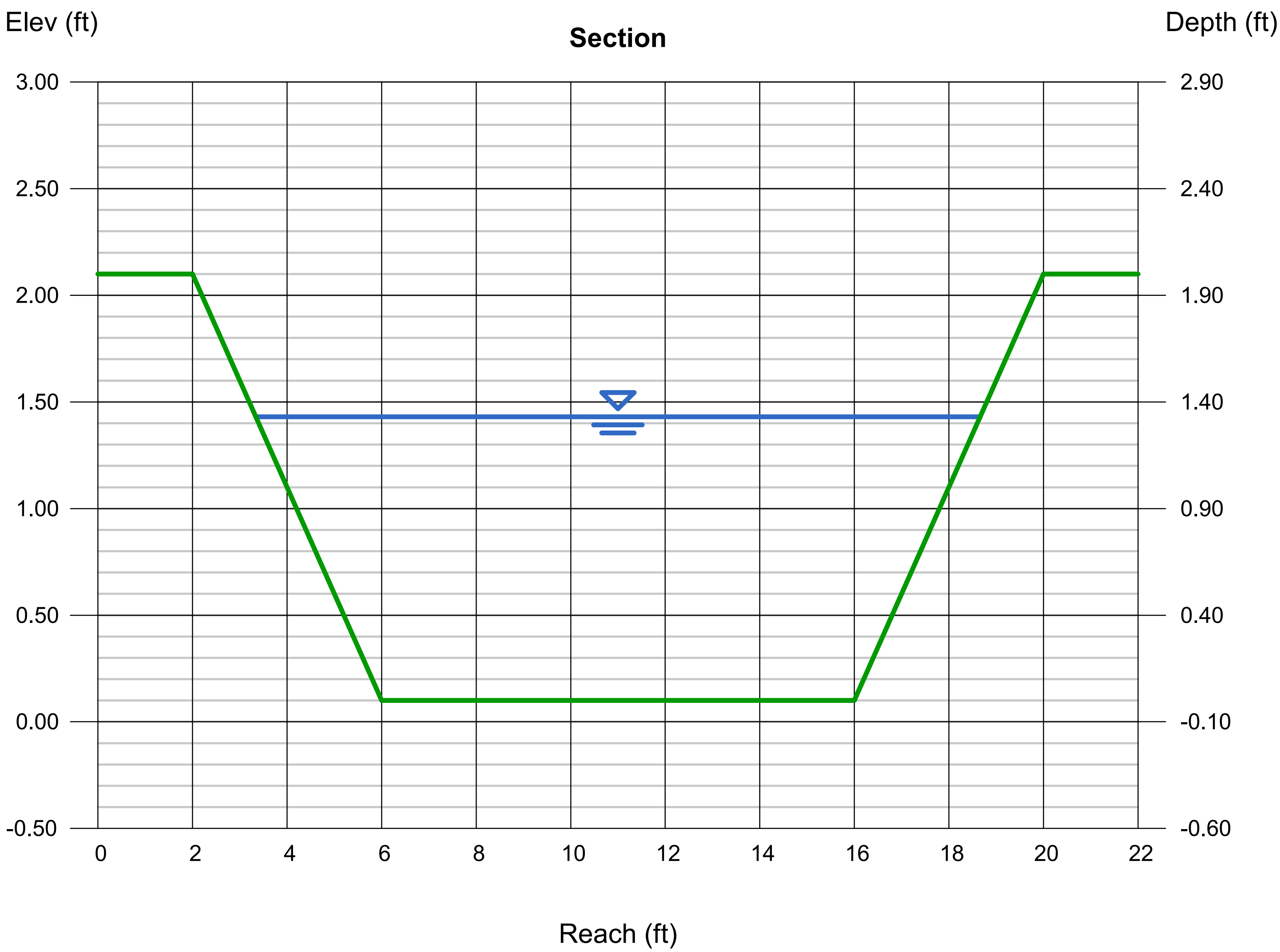


Appendix C
Stormwater Run-off Calculations and Channel to West Process Pond

Channel Report

Interior Ditch

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 10.00	Depth (ft)	= 1.33
Side Slopes (z:1)	= 2.00, 2.00	Q (cfs)	= 83.00
Total Depth (ft)	= 2.00	Area (sqft)	= 16.84
Invert Elev (ft)	= 0.10	Velocity (ft/s)	= 4.93
Slope (%)	= 0.50	Wetted Perim (ft)	= 15.95
N-Value	= 0.022	Crit Depth, Yc (ft)	= 1.19
		Top Width (ft)	= 15.32
Calculations		EGL (ft)	= 1.71
Compute by:	Known Q		
Known Q (cfs)	= 83.00		



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Oct 10 2016

Interior Culverts - 3 24-in CMP

Invert Elev Dn (ft)	=	1004.00
Pipe Length (ft)	=	100.00
Slope (%)	=	0.50
Invert Elev Up (ft)	=	1004.50
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	3
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

Top Elevation (ft)	=	1008.00
Top Width (ft)	=	20.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	60.00
Tailwater Elev (ft)	=	Normal

Highlighted

Qtotal (cfs)	=	50.00
Qpipe (cfs)	=	50.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	5.77
Veloc Up (ft/s)	=	6.73
HGL Dn (ft)	=	1005.73
HGL Up (ft)	=	1005.97
Hw Elev (ft)	=	1006.80
Hw/D (ft)	=	1.15
Flow Regime	=	Inlet Control