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LASSEN COUNTY DEPARTMENT OF  
PLANNING AND BUILDING SERVICES

## DRAINAGE REPORT

GEOFORTIS MINERALS, LLC  
US 395 HAUL ROAD

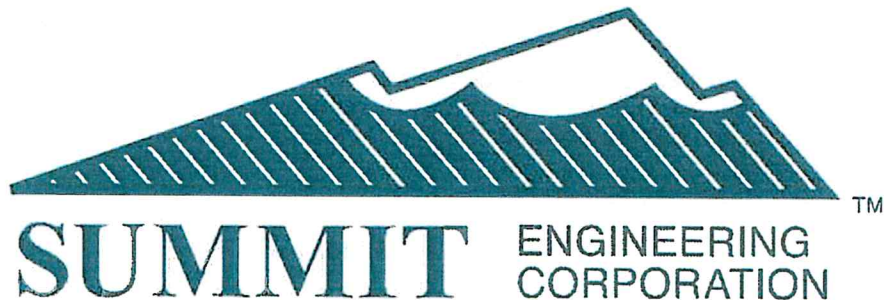
US 395 CALTRANS ENCROACHMENT PERMIT

File No. 30758

Prepared for:

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1024 Country Club Drive  
Moraga, CA 94556

Prepared by:



February 25, 2019



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## Drainage Study

Geofortis Minerals, LLC is a supplier of natural pozzolans to the western United States. The company currently owns a pozzolan mine located approximately 6 miles north of Hallelujah Junction on US 395 north, just west of the highway, more specifically located within the SW and SE quarters of Section 11 and the NW and NE quarters of Section 14 within Township 23 North, Range 17 East. Currently, there is access from the mine site to US 395 from the west.



Geofortis Minerals is proposing to mine a new area to the east of US 395 very near the intersection of the existing haul road and US 395. Proposed improvements will encompass the extension of the existing access (west of US 395) to the east side of US 395 (East Haul Road). Improvements include extending the existing road to the east of US 395 incorporating storm drain improvements. Storm drain improvements will need to perpetuate existing flows from the upper basin upstream and east of the project site. Refer to the Project Grading Plan, Attachment A.

### **Existing Conditions**

The existing road from the mine site's former and historic processing area is currently unpaved and varies in width from 15 to 25 feet to a point approximately 180 feet west of US 395 N. From this point, the road is paved to the highway at its east extent. At and near this intersection (Caltrans Route 395 Postmile LAS 9.935), surrounding terrain is prolific with grasses, sagebrush and conifers. Upstream basin terrain ranges in slopes from 2-3% to as high as 72%.

The natural lay of the land is toward the north. Long Valley Creek runs along the west side of US 395 and drains in a northerly direction in various tributaries. Approximately 200 feet north of the proposed east haul road and US 395 intersection is an 18-inch diameter/inlet structure that diverts existing flows toward the east. The drainage flows to a ditch/tributary that runs along the east side of the highway eventually draining back to Long Valley Creek under the highway approximately a half-mile to the north.

The existing hydrology-basin mapping is provided in Attachment B. Drainage mapping indicates the area of land that contributes to the project area is approximately 5,520 acres of land, flowing in drainage ways as depicted in Attachment B. Eight (8) separate sub-basins with associated acres are also depicted in this attachment.

### **Soils Survey**

Natural Resources Conservation Service ("NRCS") soils mapping identifies the contributing area as consisting mainly of sandy, coarse-sand and cobbly-sandy loam with areas of rock-outcroppings.

USGS Soils Mapping is provided in Attachment C. As drainage areas generally consist of loam, the hydrologic soils grouping used in the hydrology modeling is soils class A.

### **Analysis and Discussion**

The Caltrans District 2 Hydraulics Drainage Review Requirements (dated February 25, 2006) indicates cross drains and storm drain networks within California State Right of Way are designed for the 10-year flows. The computer program utilized to model upstream basin flows for this road extension project was AutoDesk Storm and Sanitary Analysis (SSA).

National Oceanic and Atmospheric Administration ("NOAA") and the National Weather Service ("NWS") provide location information and precipitation frequency estimates as shown below:



Curves

PF estimates with confidence intervals

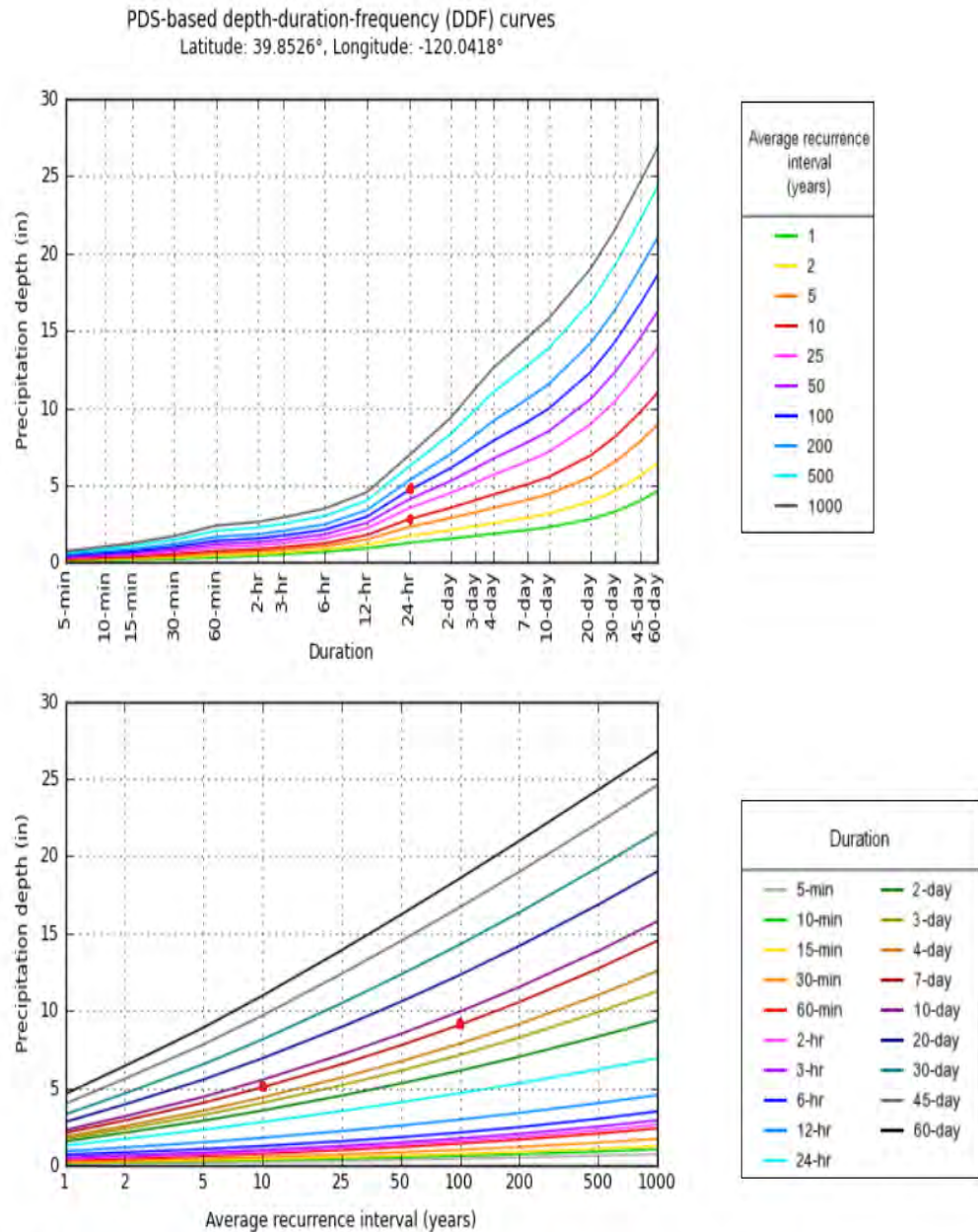


Figure 2 - Precipitation Frequency Graph

# POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION

NOAA Atlas 14, Volume 6, Version 2

PF tabular

PF graphical

Supplementary information

Print page

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches) <sup>1</sup>										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.096 (0.081-0.116)	<b>0.130</b> (0.109-0.156)	<b>0.180</b> (0.151-0.217)	<b>0.225</b> (0.187-0.274)	0.295 (0.236-0.372)	0.355 (0.278-0.458)	<b>0.423</b> (0.323-0.560)	0.500 (0.370-0.682)	0.618 (0.439-0.881)	<b>0.720</b> (0.492-1.07)
10-min	<b>0.138</b> (0.116-0.166)	0.186 (0.157-0.224)	0.258 (0.216-0.311)	<b>0.323</b> (0.258-0.393)	0.423 (0.338-0.533)	0.509 (0.398-0.656)	<b>0.606</b> (0.463-0.803)	0.717 (0.531-0.978)	0.886 (0.628-1.26)	1.03 (0.706-1.53)
15-min	<b>0.167</b> (0.141-0.201)	0.225 (0.189-0.271)	0.312 (0.261-0.376)	<b>0.390</b> (0.324-0.475)	0.511 (0.409-0.645)	0.615 (0.482-0.794)	<b>0.733</b> (0.559-0.971)	0.867 (0.642-1.18)	1.07 (0.759-1.53)	1.25 (0.853-1.85)
30-min	0.228 (0.192-0.274)	<b>0.307</b> (0.258-0.370)	<b>0.425</b> (0.356-0.513)	<b>0.532</b> (0.442-0.649)	0.697 (0.558-0.879)	0.840 (0.657-1.08)	<b>1.00</b> (0.763-1.32)	1.18 (0.876-1.61)	<b>1.46</b> (1.03-2.08)	<b>1.70</b> (1.16-2.52)
60-min	0.320 (0.269-0.364)	<b>0.431</b> (0.362-0.518)	<b>0.596</b> (0.499-0.719)	<b>0.746</b> (0.619-0.908)	0.977 (0.782-1.23)	1.18 (0.921-1.52)	<b>1.40</b> (1.07-1.86)	1.66 (1.23-2.26)	<b>2.05</b> (1.45-2.92)	<b>2.39</b> (1.63-3.53)
2-hr	0.426 (0.358-0.512)	0.540 (0.453-0.649)	0.710 (0.594-0.856)	<b>0.865</b> (0.716-1.05)	1.11 (0.886-1.40)	1.32 (1.03-1.70)	<b>1.56</b> (1.19-2.06)	1.83 (1.36-2.50)	<b>2.26</b> (1.60-3.21)	2.63 (1.80-3.88)
3-hr	0.514 (0.432-0.618)	0.637 (0.535-0.766)	0.820 (0.687-0.990)	<b>0.968</b> (0.820-1.20)	1.25 (1.00-1.58)	1.48 (1.16-1.91)	<b>1.74</b> (1.33-2.30)	2.04 (1.51-2.78)	<b>2.50</b> (1.77-3.56)	<b>2.91</b> (1.99-4.30)
6-hr	<b>0.687</b> (0.577-0.825)	<b>0.833</b> (0.699-1.00)	<b>1.05</b> (0.878-1.26)	<b>1.25</b> (1.03-1.52)	1.55 (1.24-1.96)	1.82 (1.42-2.34)	<b>2.12</b> (1.62-2.80)	2.47 (1.83-3.36)	3.01 (2.13-4.28)	3.49 (2.38-5.15)
12-hr	<b>0.913</b> (0.767-1.10)	<b>1.15</b> (0.964-1.38)	<b>1.48</b> (1.24-1.79)	<b>1.78</b> (1.47-2.16)	2.21 (1.77-2.78)	2.57 (2.01-3.31)	<b>2.98</b> (2.26-3.91)	3.39 (2.51-4.62)	4.01 (2.84-5.72)	4.54 (3.10-6.71)
24-hr	1.27 (1.08-1.53)	1.70 (1.45-2.05)	2.30 (1.95-2.77)	2.80 (2.35-3.39)	3.60 (2.87-4.36)	4.07 (3.28-5.15)	4.67 (3.69-6.02)	<b>5.30</b> (4.10-6.99)	<b>6.20</b> (4.64-8.45)	<b>6.92</b> (5.04-9.69)
2-day	1.84 (1.31-1.86)	2.10 (1.78-2.53)	2.88 (2.44-3.47)	3.54 (2.98-4.30)	4.50 (3.69-5.60)	5.28 (4.26-6.68)	6.12 (4.84-7.89)	<b>7.02</b> (5.44-9.26)	<b>8.32</b> (6.23-11.3)	<b>9.38</b> (6.83-13.1)
3-day	1.72 (1.46-2.07)	2.35 (1.99-2.82)	<b>3.25</b> (2.75-3.91)	4.03 (3.39-4.89)	5.17 (4.24-6.43)	6.11 (4.93-7.73)	7.14 (5.65-9.20)	8.26 (6.39-10.9)	9.90 (7.41-13.5)	11.3 (8.21-15.8)
4-day	1.85 (1.57-2.22)	2.54 (2.15-3.05)	3.53 (2.99-4.25)	4.39 (3.70-5.33)	5.66 (4.64-7.05)	6.72 (5.42-8.50)	7.87 (6.23-10.1)	9.14 (7.07-12.0)	11.0 (8.24-15.0)	<b>12.6</b> (9.15-17.6)
7-day	2.10 (1.78-2.52)	2.89 (2.45-3.48)	4.04 (3.42-4.87)	5.04 (4.24-6.12)	6.52 (5.35-8.12)	7.75 (6.25-9.81)	9.09 (7.19-11.7)	10.6 (8.17-13.9)	12.7 (9.52-17.3)	14.5 (10.6-20.3)
10-day	<b>2.28</b> (1.94-2.74)	3.16 (2.68-3.80)	4.42 (3.75-5.33)	5.53 (4.65-6.70)	7.15 (5.86-8.90)	8.49 (6.85-10.7)	9.94 (7.87-12.8)	11.5 (8.92-15.2)	13.9 (10.4-18.9)	15.8 (11.5-22.1)
20-day	2.80 (2.38-3.36)	3.93 (3.34-4.73)	5.54 (4.69-6.67)	6.92 (5.83-8.40)	8.93 (7.33-11.1)	10.6 (8.53-13.4)	<b>12.3</b> (9.74-15.9)	<b>14.2</b> (11.0-18.7)	<b>16.8</b> (12.6-23.0)	<b>19.0</b> (13.8-26.6)
30-day	3.30 (2.80-3.96)	4.64 (3.94-5.58)	6.52 (5.53-7.86)	8.14 (6.85-9.87)	10.5 (8.58-13.0)	12.3 (9.95-15.6)	<b>14.3</b> (11.3-18.4)	<b>16.4</b> (12.7-21.6)	<b>19.3</b> (14.4-26.2)	<b>21.6</b> (15.7-30.2)
45-day	3.98 (3.38-4.79)	5.59 (4.74-6.72)	7.81 (6.61-9.41)	9.69 (8.15-11.8)	12.4 (10.1-15.4)	14.5 (11.7-18.3)	16.7 (13.2-21.5)	19.0 (14.7-25.0)	22.1 (16.6-30.2)	24.6 (17.9-34.4)
60-day	4.61 (3.92-5.54)	6.42 (5.44-7.71)	8.89 (7.53-10.7)	11.0 (9.23-13.3)	13.9 (11.4-17.3)	16.2 (13.1-20.5)	18.6 (14.7-23.9)	21.0 (16.2-27.7)	24.3 (18.2-33.1)	26.8 (19.5-37.5)

<sup>1</sup> 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.

Estimates from the table in CSV format

Figure 3 - Precipitation Frequency Estimates

### **Existing Flows**

SSA was run for both the 10-year and 100-year storms. Refer to Attachment D for the SSA analysis output report for the 10-year storm. Attachment E is the SSA analysis output report for the 100-year storm.

SSA analysis output for the 10-year existing storm indicates a  $Q_{ex}(10)$  capacity of 297.84 cfs at the point of interest, just south of the proposed road extension. Per Attachment F, Hydraflow Express calculations show that given this capacity, the average velocity of the existing 10-year flow through the existing channel is 6.50 ft/s.

The 100-year storm event was also modelled with the following results:  $Q_{ex}(100) = 602.03$  cfs with a maximum velocity of 8.46 ft/s through the existing channel. Attachment F provides the Hydraflow Express calculations for the existing unlined channels for both the 10-year and 100-year flows. These existing flows will be perpetuated with the proposed design.

### **Proposed Design**

The new haul road extension will consist of a 321-lineal foot, 24-foot wide road (2-12-foot lanes with 6-foot shoulders). Within Caltrans right-of-way, the road section will consist of 6 inches of hot-mix asphalt over 1.10 feet of Class 2 aggregate from the US 395 tie-in up to the east extents of the returns. The road section from this point on into Bureau of Land Management (BLM) and private property will consist of 4 inches of hot-mix asphalt over 8 inches of Class 2 aggregate base. Road-section design is shown on the civil plans on both the profile and detail sheets (see sheets P-1 and D-1) provided with this report.

The proposed road and culvert will be designed to concentrate and perpetuate the 10-year storm under and through the road extension. It is proposed that the storm design will include two headwall structures with an entrance (south of the proposed road) and exit (north of the proposed road) with three (3) 48-inch by ~60-foot long corrugated metal pipe (CMP (8-gauge)) culverts.

Attached as Attachment G is a Hydraflow Express culvert report depicting the inlet and outlet conditions and the hydraulic grade lines associated with the new storm design during the 10-year storm. This attachment shows that the proposed storm design will concentrate and perpetuate just over the 10-year storm (at 300 cfs) with a 5.14-foot headwater depth ( $4728.42 \text{ (Hw)} - 4723.28 \text{ (Inlet Invert)} = 5.14$  feet) with inlet control, which is not anticipated to overtop the new road. The 10-year storm will flow through the new storm structure at no more than 9.80 ft/s.

The maximum capacity of the new storm structure is 474.20 cfs during the 100-year event. Any runoff beyond the maximum capacity of the storm structure ( $602.03 - 474.20 \text{ cfs} = 127.83 \text{ cfs}$ ) is anticipated to overflow atop the low point in the road and head north into the newly aligned channel.

Attachment H is the 100-year Hydraflow Express culvert report showing 474.20 cfs flowing through the new culvert system with the remaining flows (125.80 cfs) overtopping the road. The 100-year storm will flow through the new storm structure at no more than 13.12 ft/s under these conditions.

Runoff flowing upstream and downstream of the proposed storm structure will be perpetuated by trapezoidal channels lined in riprap and graded to a minimum bottom width of 4 feet with 3:1 slopes to a minimum depth of 3 feet. Channeling before and after the new culvert/headwall system will encompass riprap-lined 20-foot bottom widths with 1:5 to 1 side slopes.

Attachment I provides the downstream channel reports for the proposed and improved condition. The affected portions of the channels impacted by this proposed design will be lined with Class V riprap resulting in lower outlet velocities than in the pre-existing condition. The velocities of the downstream channel flows are 5.80 ft/s for the 10-year storm and 6.92 ft/s for the 100-year storm.

Refer to the next section for riprap sizing and depths.



## Riprap

Sizing of riprap for the channels was determined by the USACE Modified Maynard et al. Method:

$$D_{30} = (SF)(C_S)(C_V)(C_T)(Y) \left[ \sqrt{\frac{\gamma_W}{\gamma_S - \gamma_W}} \times \left( \frac{v}{\sqrt{K_1(g)(d)}} \right) \right]^{2.5}$$

Where:

SF (safety factor) = 1.2

C<sub>s</sub> (stability coefficient) = 0.30 for angular rock

C<sub>v</sub> (vertical velocity distribution coefficient) =  $1.283 - \log\left(\frac{R}{W}\right) = 1.21$

- Where:

- R (centerline radius of bend) = 30 feet
- W (water surface width) = 25.6 feet

C<sub>T</sub> (thickness coefficient, from USACOE 1991, EM 1110-2-1601) = 1.0

K<sub>1</sub> (side slope correction factor) =  $\sqrt{1 - \frac{\sin \Theta}{\sin \Phi}} = 0.713$

- Where:

- Θ (angle of side slope [3:1]) = 18.4°
- Φ (angle of repose) = 40°

Y (depth of water) = 3.54 feet

d (hydraulic depth) ≅ 3 feet

γ<sub>w</sub> (specific weight of water) = 62.4 pcf

γ<sub>s</sub> (specific weight of stone) = 135 pcf

v (local velocity) = 1.5v<sub>avg</sub> = 8.70 fps

- Where: v<sub>avg</sub> = 5.80 fps

g (gravitational acceleration) = 32.2 fps

$$D_{30} = (1.2)(0.30)(1.21)(1.0)(3.54)(0.93)$$

∴ D<sub>30</sub> = 1.44 feet (17.3 inches) → **Class V riprap** = 17.0 to 20.5 inches (D<sub>50</sub>)

D<sub>100</sub> = 36 inches

T (blanket thickness) = 1.5D<sub>50</sub> or D<sub>100</sub> = 26 inches or **36 inches** whichever is larger.

Summit recommends the installation of Class V riprap with a blanket thickness of 36 inches along the channels which will be improved along with the installation of the new culvert system.

## **Conclusions**

The construction of the Geofortis Minerals haul road extension to the eastern side of US 395 will be completed in accordance with Caltrans and AASHTO requirements. The proposed storm facilities will encompass 2 headwalls (entrance and exit) incorporating three 60-foot long 48-inch CMP barrels which will concentrate and perpetuate the 10-year storm. The capacity of this structure will allow as much as 474.20 cfs of storm waters without overtopping the road extension.

The 100-year storm is anticipated to produce as much as 602.03 cfs where the proposed storm structure will allow as much as 410 cfs without overtopping the road. During the 100-year event, it is anticipated that approximately 125.80 cfs (with 474.20 cfs through the culvert storm structure) will overtop the road and flow northerly along trapezoidal channels graded to 4 feet in bottom width with 3:1 slopes at a minimum depth of 3 feet. The channels will be lined with a minimum 36-inch thick blanket of Class V riprap.

**Attachment A**

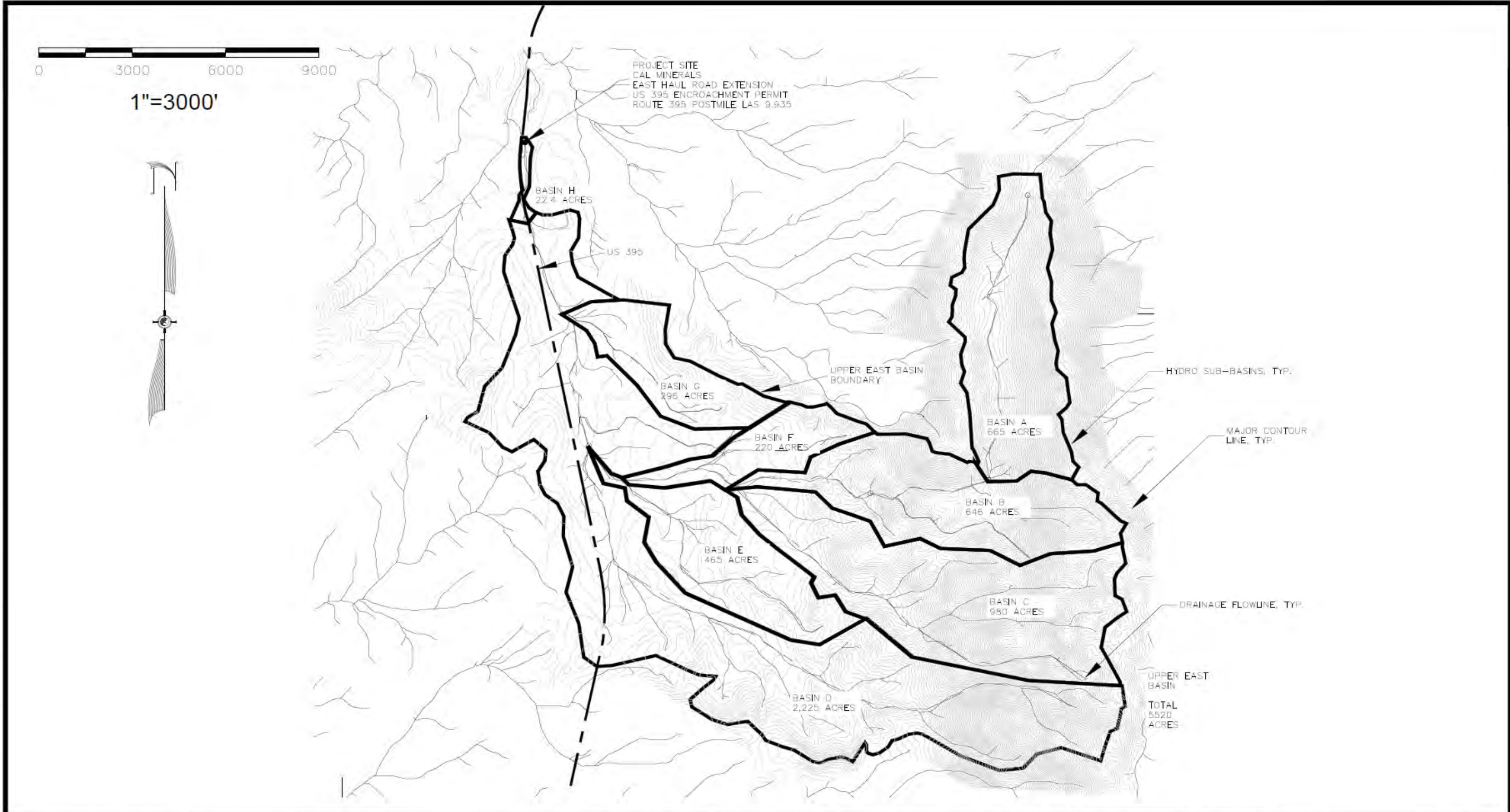
**PROJECT SITE MAPPING**





**Attachment B**

**EXISTING HYDROLOGY BASIN MAPPING**



SCALE: 1"=3000'

JOB #: 1-30758

Copyright SUMMIT ENG 2018

DESIGNED BY: JMK

CHECKED BY: CGT

DRAWN BY: jkareck

N:\DWGS\J30758\_US\_395\_CALTRANS\_Encroachment\Civil\Hydro\CalMinRoadHydroBasin.DWG - 2:35 PM \* 07-DEC-2018

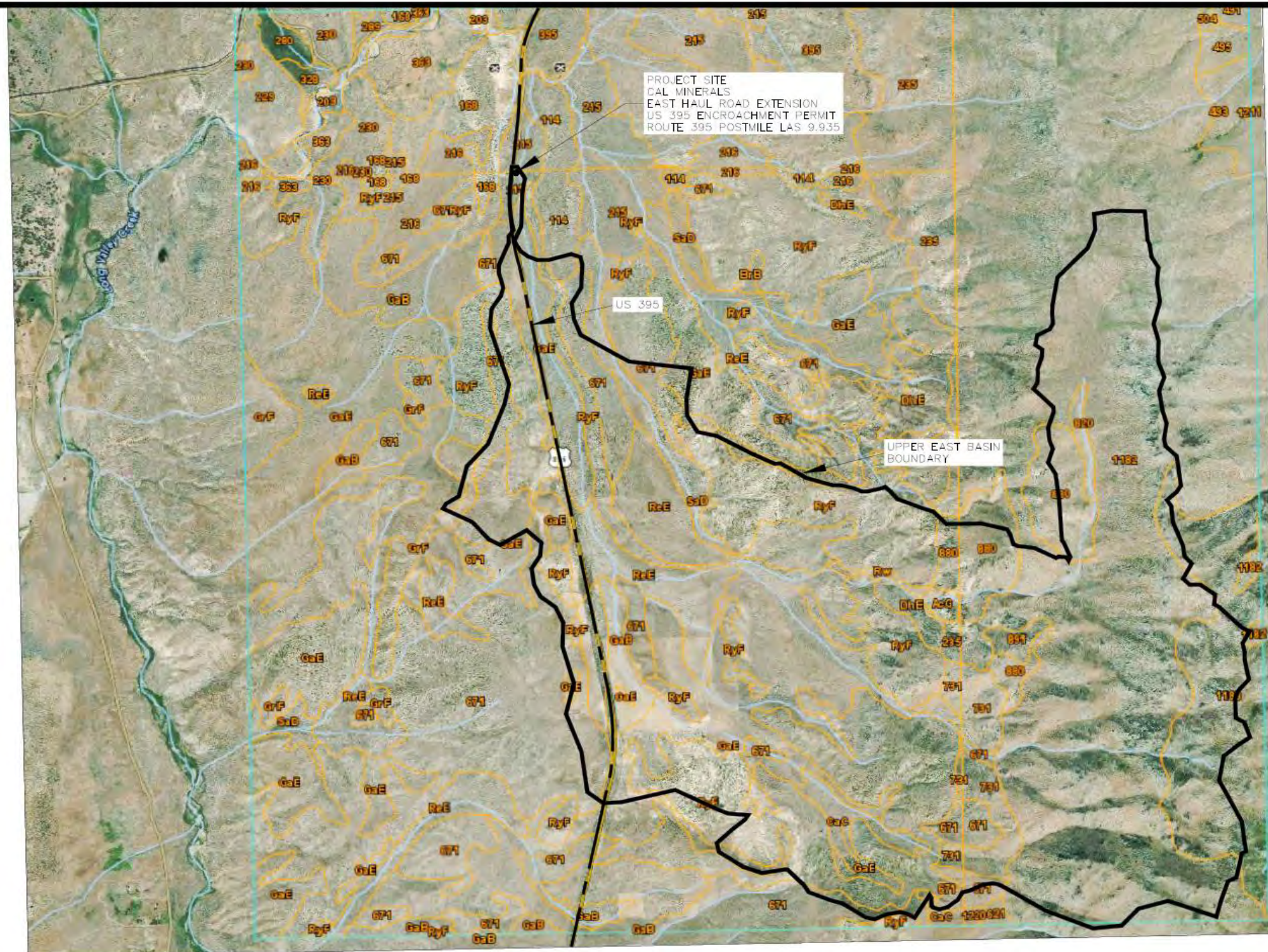
CAL MINERALS EAST HAUL ROAD EXTENSION  
US 395 CALTRANS ENCROACHMENT PERMIT  
HYDROLOGY BASIN MAP

SHEET  
1  
OF  
1

**Attachment C**

**USGS SOILS MAPPING**





1"=3000'



SCALE: 1"=3000'

JOB #: 1-30758

Copyright SUMMIT ENG 2018

DESIGNED BY: JMK

CHECKED BY: CGT

DRAWN BY: jkareck

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CAL MINERALS EAST HAUL ROAD EXTENSION  
US 395 CALTRANS ENCROACHMENT PERMIT  
USGS SOILS MAPPING

SHEET  
1  
OF  
1



**Attachment D**

**SSA Analysis Results**

**10-YR Existing Storm Report**

## Project Description

File Name ..... CAL-MINERALS\_EX-10-YR.SPF

## Project Options

Flow Units ..... CFS  
Elevation Type ..... Elevation  
Hydrology Method ..... Rational  
Time of Concentration (TOC) Method ..... Kirpich  
Link Routing Method ..... Kinematic Wave  
Enable Overflow Ponding at Nodes ..... YES  
Skip Steady State Analysis Time Periods ..... NO

## Analysis Options

Start Analysis On ..... Oct 26, 2018 00:00:00  
End Analysis On ..... Oct 27, 2018 00:00:00  
Start Reporting On ..... Oct 26, 2018 00:00:00  
Antecedent Dry Days ..... 0 days  
Runoff (Dry Weather) Time Step ..... 0 01:00:00 days hh:mm:ss  
Runoff (Wet Weather) Time Step ..... 0 00:05:00 days hh:mm:ss  
Reporting Time Step ..... 0 00:05:00 days hh:mm:ss  
Routing Time Step ..... 30 seconds

## Number of Elements

	Qty
Rain Gages .....	0
Subbasins.....	5
Nodes.....	9
<i>Junctions</i> .....	9
<i>Outfalls</i> .....	0
<i>Flow Diversions</i> .....	0
<i>Inlets</i> .....	0
<i>Storage Nodes</i> .....	0
Links.....	8
<i>Channels</i> .....	8
<i>Pipes</i> .....	0
<i>Pumps</i> .....	0
<i>Orifices</i> .....	0
<i>Weirs</i> .....	0
<i>Outlets</i> .....	0
Pollutants .....	0
Land Uses .....	0

## Rainfall Details

Return Period..... 10 year(s)

## Subbasin Summary

SN	Subbasin ID	Area	Weighted Runoff Coefficient	Average Slope	Flow Length	Total Rainfall	Total Runoff	Total Runoff Volume	Peak Runoff	Time of Concentration
		(ac)		(%)	(ft)	(in)	(in)	(ac-in)	(cfs)	(days hh:mm:ss)
1	Sub-01	665.00	0.3700	50.0000	10270.00	0.08	0.03	18.62	88.16	0 00:12:30
2	Sub-02	1646.00	0.3700	35.0000	13800.00	0.13	0.05	77.36	257.73	0 00:18:00
3	Sub-05	465.00	0.3700	30.0000	6455.00	0.06	0.02	10.23	57.20	0 00:10:38
4	Sub-06	2225.00	0.3700	25.0000	20628.00	0.24	0.09	198.03	424.10	0 00:27:55
5	Sub-07	22.40	0.3700	15.0000	2594.00	0.05	0.02	0.45	2.68	0 00:10:00

## Node Summary

SN	Element ID	Element Type	Invert Elevation	Ground/Rim (Max) Elevation	Initial Water Elevation	Surcharge Elevation	Ponded Area	Peak Inflow	Max HGL Elevation Attained	Max Surcharge Depth Attained	Min Freeboard Attained	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
			(ft)	(ft)	(ft)	(ft)	(ft²)	(cfs)	(ft)	(ft)	(ft)	(days hh:mm)	(ac-in)	(min)
1	Jun-05	Junction	5935.00	100.00	0.00	0.00	0.00	14.24	5936.45	0.00	798.55	0 00:00	0.00	0.00
2	Jun-06	Junction	5490.00	100.00	0.00	0.00	0.00	0.00	5490.00	0.00	800.00	0 00:00	0.00	0.00
3	Jun-07	Junction	5006.00	100.00	0.00	0.00	0.00	257.73	5007.29	0.00	398.71	0 00:00	0.00	0.00
4	Jun-08	Junction	4938.00	100.00	0.00	0.00	0.00	222.97	4939.06	0.00	398.94	0 00:00	0.00	0.00
5	Jun-09	Junction	4888.00	100.00	0.00	0.00	0.00	620.56	4890.27	0.00	297.73	0 00:00	0.00	0.00
6	Jun-10	Junction	4840.00	100.00	0.00	0.00	0.00	548.10	4852.47	0.00	287.53	0 00:00	0.00	0.00
7	Jun-11	Junction	4840.00	50.00	0.00	0.00	0.00	312.39	4848.95	0.00	41.05	0 00:00	0.00	0.00
8	Out-03	Junction	4730.00	50.00	0.00	0.00	0.00	297.84	4734.00	0.00	0.00	0 00:00	0.00	0.00
9	UpperEastBasin	Junction	6694.00	100.00	0.00	0.00	0.00	88.16	6694.10	0.00	199.90	0 00:00	0.00	0.00



## Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope	Diameter or Height	Manning's Roughness	Peak Flow	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Reported Surcharged Condition
					(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)		(ft/sec)	(ft)		(min)
1	Link-03	Channel	UpperEastBasin	Jun-05	10270.00	6694.00	5935.00	7.3900	2400.000	0.0400	14.24	40096768.26	0.00	0.72	0.05	0.00	0.00
2	Link-04	Channel	Jun-05	Jun-06	4132.00	5935.00	5490.00	10.7700	9600.000	0.0400	0.00	813440873.53	0.00	0.00	0.73	0.00	0.00
3	Link-05	Channel	Jun-06	Jun-07	4753.00	5490.00	5006.00	10.1800	2700.000	0.0400	0.00	43773442.64	0.00	0.00	0.00	0.00	0.00
4	Link-06	Channel	Jun-07	Jun-08	3804.00	5006.00	4938.00	1.7900	4800.000	0.0400	222.97	82279903.09	0.00	9.74	1.06	0.00	0.00
5	Link-07	Channel	Jun-08	Jun-09	1770.00	4938.00	4888.00	2.8200	3600.000	0.0400	273.90	48722679.32	0.00	12.65	0.89	0.00	0.00
6	Link-08	Channel	Jun-09	Jun-10	4753.00	4888.00	4840.00	1.0100	3600.000	0.0400	548.10	29131946.60	0.00	9.48	2.05	0.01	0.00
7	Link-09	Channel	Jun-10	Jun-11	3500.00	4840.00	4840.00	0.0000	600.000	0.0400	312.39	6215.06	0.05	0.17	6.39	0.13	0.00
8	Link-10	Channel	Jun-11	Out-03	2594.00	4840.00	4730.00	4.2400	48.000	0.0400	297.84	19546.55	0.02	3.64	0.33	0.08	0.00

## Subbasin Hydrology

### Subbasin : Sub-01

#### Input Data

Area (ac) ..... 665.00  
Weighted Runoff Coefficient ..... 0.3700  
Average Slope (%) ..... 50.0000  
Flow Length (ft) ..... 10270.00

#### Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
Pasture, 25 years or greater	665.00	A (6%+)	0.37
Composite Area & Weighted Runoff Coeff.	665.00		0.37

#### Time of Concentration

TOC Method : Kirpich

Sheet Flow Equation :

$$T_c = (0.0078 * ((L_f^{0.77}) * (S_f^{-0.385})))$$

Where :

$T_c$  = Time of Concentration (min)  
 $L_f$  = Flow Length (ft)  
 $S_f$  = Slope (ft/ft)

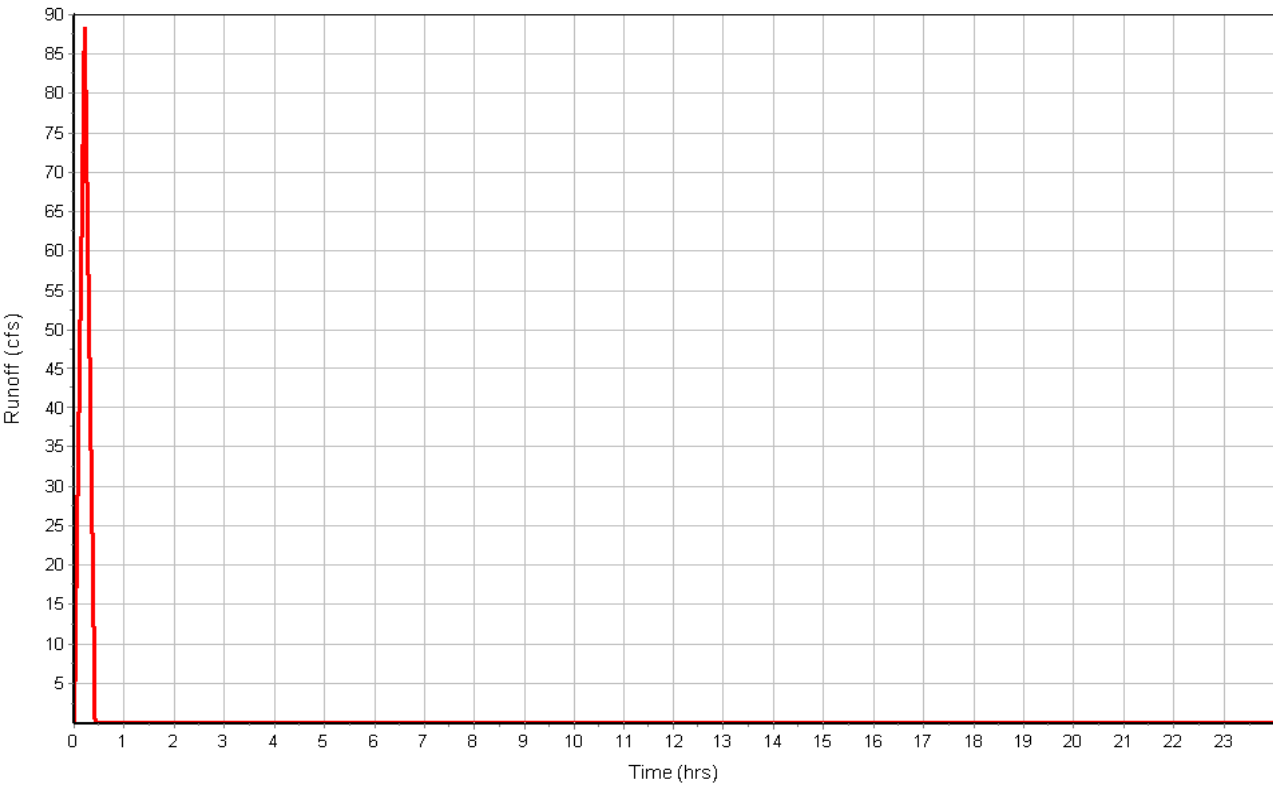
Flow Length (ft) ..... 10270.00  
Slope (%) ..... 50  
Computed TOC (min) ..... 12.50

#### Subbasin Runoff Results

Total Rainfall (in) ..... 0.08  
Total Runoff (in) ..... 0.03  
Peak Runoff (cfs) ..... 88.16  
Rainfall Intensity ..... 0.358  
Weighted Runoff Coefficient ..... 0.3700  
Time of Concentration (days hh:mm:ss) ..... 0 00:12:30

Subbasin : Sub-01

Runoff Hydrograph



## Subbasin : Sub-02

### Input Data

Area (ac) ..... 1646.00  
Weighted Runoff Coefficient ..... 0.3700  
Average Slope (%) ..... 35.0000  
Flow Length (ft) ..... 13800.00

### Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
Pasture, 25 years or greater	1646.00	A (6%+)	0.37
Composite Area & Weighted Runoff Coeff.	1646.00		0.37

### Time of Concentration

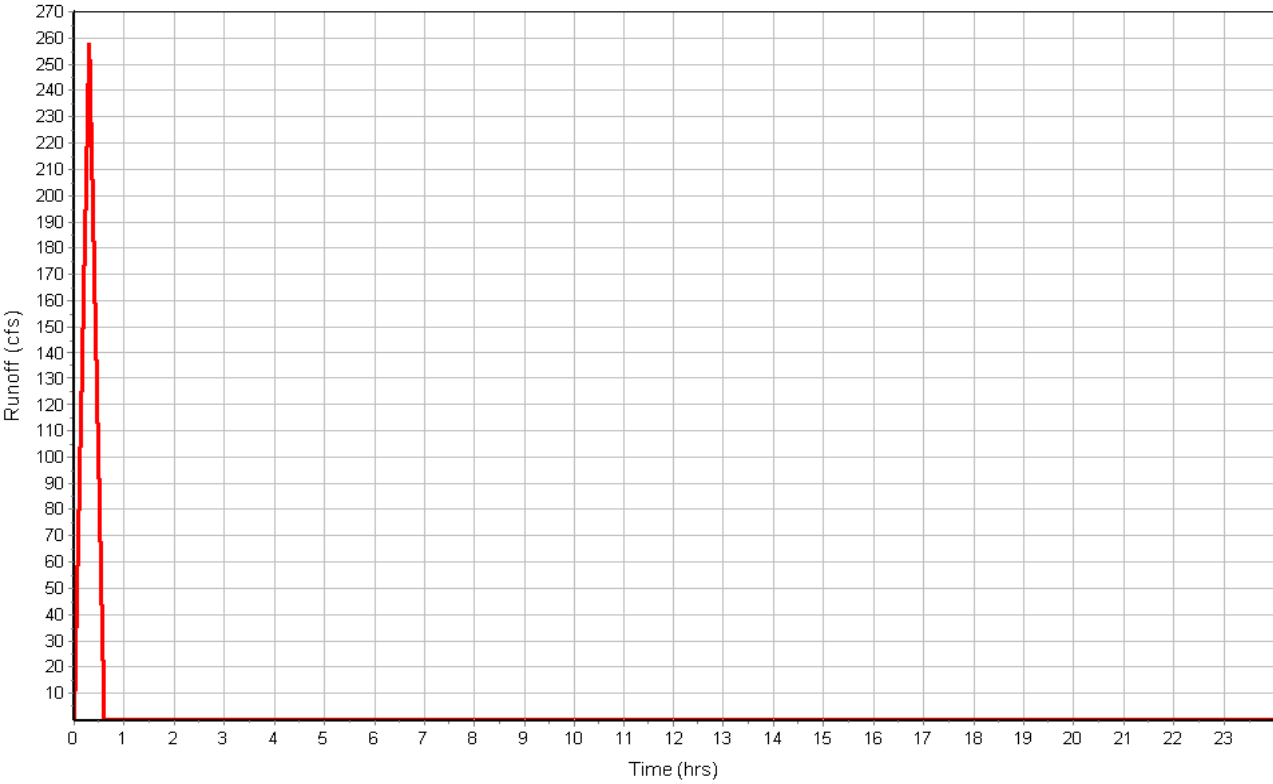
Flow Length (ft) ..... 13800.00  
Slope (%) ..... 35  
Computed TOC (min) ..... 18.00

### Subbasin Runoff Results

Total Rainfall (in) ..... 0.13  
Total Runoff (in) ..... 0.05  
Peak Runoff (cfs) ..... 257.73  
Rainfall Intensity ..... 0.423  
Weighted Runoff Coefficient ..... 0.3700  
Time of Concentration (days hh:mm:ss) ..... 0 00:18:00



Runoff Hydrograph



## Subbasin : Sub-05

### Input Data

Area (ac) ..... 465.00  
Weighted Runoff Coefficient ..... 0.3700  
Average Slope (%) ..... 30.0000  
Flow Length (ft) ..... 6455.00

### Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
Pasture, 25 years or greater	465.00	A (6%+)	0.37
Composite Area & Weighted Runoff Coeff.	465.00		0.37

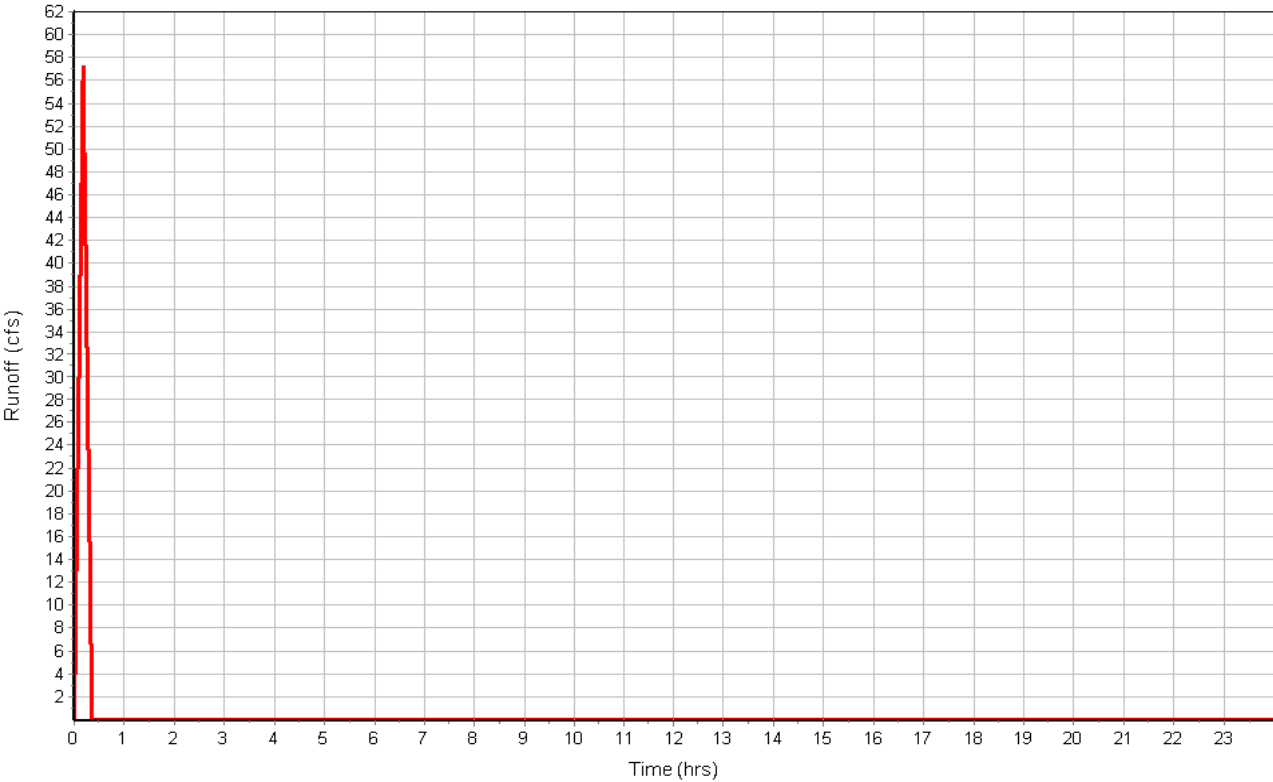
### Time of Concentration

Flow Length (ft) ..... 6455.00  
Slope (%) ..... 30  
Computed TOC (min) ..... 10.64

### Subbasin Runoff Results

Total Rainfall (in) ..... 0.06  
Total Runoff (in) ..... 0.02  
Peak Runoff (cfs) ..... 57.20  
Rainfall Intensity ..... 0.332  
Weighted Runoff Coefficient ..... 0.3700  
Time of Concentration (days hh:mm:ss) ..... 0 00:10:38

Runoff Hydrograph



## Subbasin : Sub-06

### Input Data

Area (ac) ..... 2225.00  
Weighted Runoff Coefficient ..... 0.3700  
Average Slope (%) ..... 25.0000  
Flow Length (ft) ..... 20628.00

### Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
Pasture, 25 years or greater	2225.00	A (6%+)	0.37
Composite Area & Weighted Runoff Coeff.	2225.00		0.37

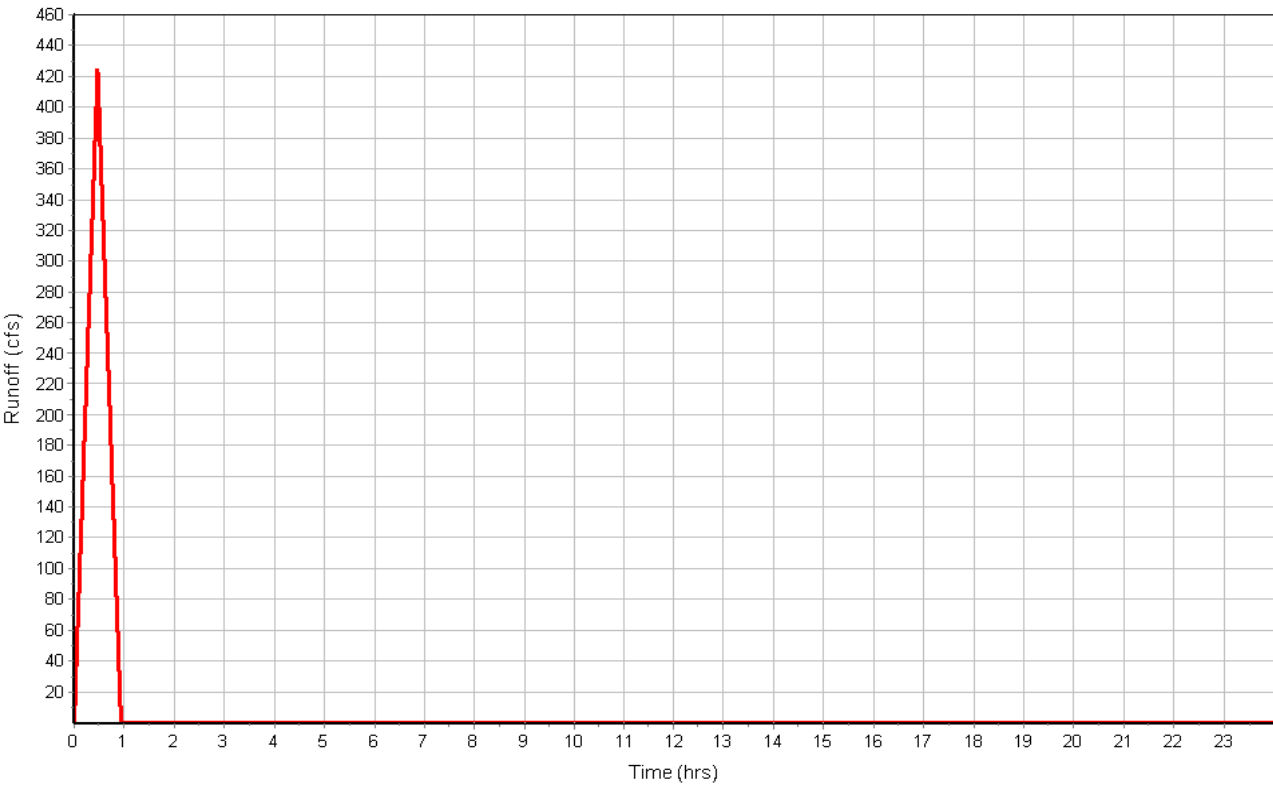
### Time of Concentration

Flow Length (ft) ..... 20628.00  
Slope (%) ..... 25  
Computed TOC (min) ..... 27.92

### Subbasin Runoff Results

Total Rainfall (in) ..... 0.24  
Total Runoff (in) ..... 0.09  
Peak Runoff (cfs) ..... 424.10  
Rainfall Intensity ..... 0.515  
Weighted Runoff Coefficient ..... 0.3700  
Time of Concentration (days hh:mm:ss) ..... 0 00:27:55

Runoff Hydrograph



**Subbasin : Sub-07**

**Input Data**

Area (ac) ..... 22.40  
Weighted Runoff Coefficient ..... 0.3700  
Average Slope (%) ..... 15.0000  
Flow Length (ft) ..... 2594.00

**Runoff Coefficient**

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
Pasture, 25 years or greater	22.40	A (6%+)	0.37
Composite Area & Weighted Runoff Coeff.	22.40		0.37

**Time of Concentration**

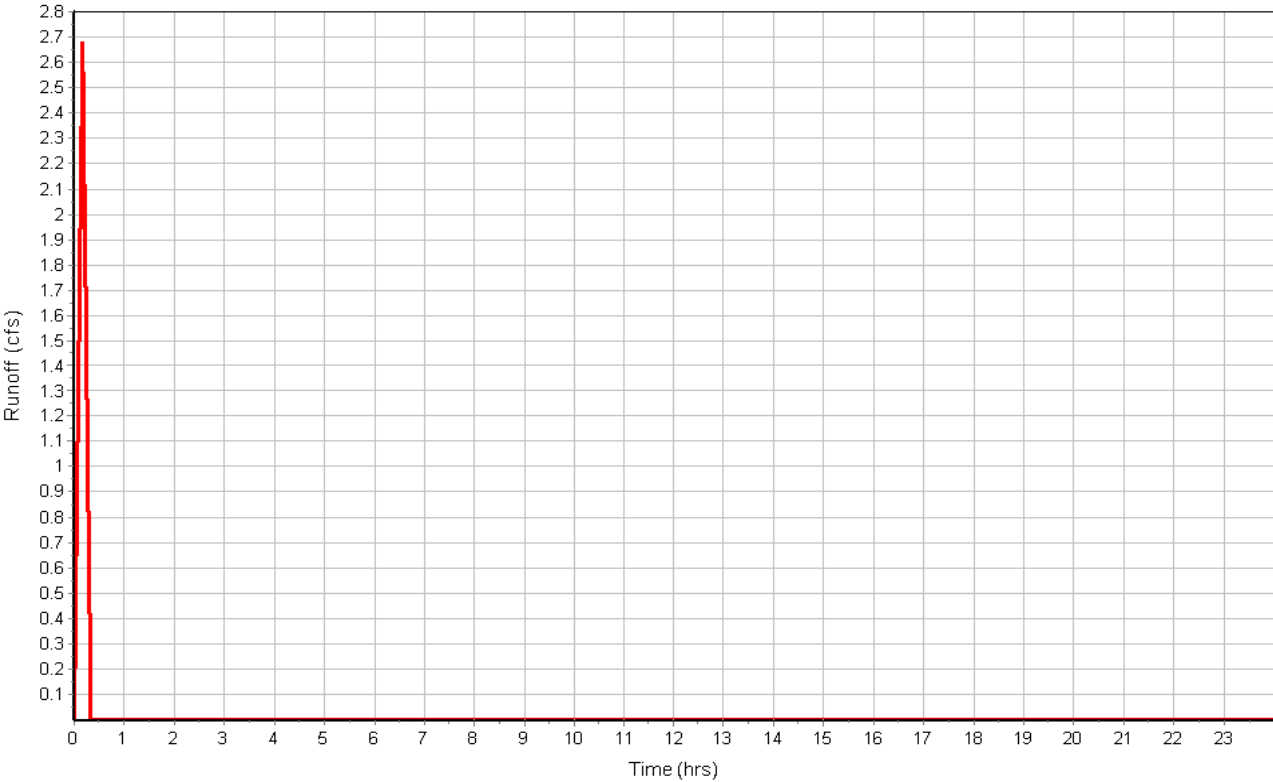
Flow Length (ft) ..... 2594.00  
Slope (%) ..... 15  
Computed TOC (min) ..... 6.89

**Subbasin Runoff Results**

Total Rainfall (in) ..... 0.05  
Total Runoff (in) ..... 0.02  
Peak Runoff (cfs) ..... 2.68  
Rainfall Intensity ..... 0.323  
Weighted Runoff Coefficient ..... 0.3700  
Time of Concentration (days hh:mm:ss) ..... 0 00:06:53



Runoff Hydrograph



## Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft²)	Minimum Pipe Cover (in)
1	Jun-05	5935.00	100.00	-5835.00	0.00	-5935.00	0.00	-100.00	0.00	0.00
2	Jun-06	5490.00	100.00	-5390.00	0.00	-5490.00	0.00	-100.00	0.00	0.00
3	Jun-07	5006.00	100.00	-4906.00	0.00	-5006.00	0.00	-100.00	0.00	0.00
4	Jun-08	4938.00	100.00	-4838.00	0.00	-4938.00	0.00	-100.00	0.00	0.00
5	Jun-09	4888.00	100.00	-4788.00	0.00	-4888.00	0.00	-100.00	0.00	0.00
6	Jun-10	4840.00	100.00	-4740.00	0.00	-4840.00	0.00	-100.00	0.00	0.00
7	Jun-11	4840.00	50.00	-4790.00	0.00	-4840.00	0.00	-50.00	0.00	0.00
8	Out-03	4730.00	50.00	-4680.00	0.00	-4730.00	0.00	-50.00	0.00	0.00
9	UpperEastBasin	6694.00	100.00	-6594.00	0.00	-6694.00	0.00	-100.00	0.00	0.00

## Junction Results

SN Element ID	Peak Inflow	Peak Lateral Inflow	Max HGL Elevation Attained	Max HGL Depth Attained	Max Surcharge Depth Attained	Min Freeboard Attained	Average HGL Elevation Attained	Average HGL Depth Attained	Time of Max HGL Occurrence	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(days hh:mm)	(days hh:mm)	(ac-in)	(min)
1 Jun-05	14.24	0.00	5936.45	1.45	0.00	798.55	5935.01	0.01	0 00:19	0 00:00	0.00	0.00
2 Jun-06	0.00	0.00	5490.00	0.00	0.00	800.00	5490.00	0.00	0 00:00	0 00:00	0.00	0.00
3 Jun-07	257.73	257.73	5007.29	1.29	0.00	398.71	5006.02	0.02	0 00:18	0 00:00	0.00	0.00
4 Jun-08	222.97	57.20	4939.06	1.06	0.00	398.94	4938.02	0.02	0 00:31	0 00:00	0.00	0.00
5 Jun-09	620.56	424.10	4890.27	2.27	0.00	297.73	4888.05	0.05	0 00:28	0 00:00	0.00	0.00
6 Jun-10	548.10	0.00	4852.47	12.47	0.00	287.53	4840.34	0.34	0 00:36	0 00:00	0.00	0.00
7 Jun-11	312.39	2.68	4848.95	8.95	0.00	41.05	4843.63	3.63	0 01:20	0 00:00	0.00	0.00
8 Out-03	297.84	0.00	4734.00	4.00	0.00	0.00	4733.96	3.96	0 00:10	0 00:00	0.00	0.00
9 UpperEastBasin	88.16	88.16	6694.10	0.10	0.00	199.90	6694.00	0.00	0 00:12	0 00:00	0.00	0.00

## Channel Input

SN Element ID	Length	Inlet Invert Elevation	Inlet Invert Offset	Outlet Invert Elevation	Outlet Invert Offset	Total Drop	Average Slope	Shape	Height	Width	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow	Flap Gate
	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(%)		(ft)	(ft)					(cfs)	
1 Link-03	10270.00	6694.00	0.00	5935.00	0.00	759.00	7.3900	Trapezoidal	200.000	1200.000	0.0400	0.5000	0.5000	0.0000	0.00	No
2 Link-04	4132.00	5935.00	0.00	5490.00	0.00	445.00	10.7700	Trapezoidal	800.000	3240.000	0.0400	0.5000	0.5000	0.0000	0.00	No
3 Link-05	4753.00	5490.00	0.00	5006.00	0.00	484.00	10.1800	Trapezoidal	225.000	1390.000	0.0400	0.5000	0.5000	0.0000	0.00	No
4 Link-06	3804.00	5006.00	0.00	4938.00	0.00	68.00	1.7900	Trapezoidal	400.000	2440.000	0.0400	0.5000	0.5000	0.0000	0.00	No
5 Link-07	1770.00	4938.00	0.00	4888.00	0.00	50.00	2.8200	Trapezoidal	300.000	1840.000	0.0400	0.5000	0.5000	0.0000	0.00	No
6 Link-08	4753.00	4888.00	0.00	4840.00	0.00	48.00	1.0100	Trapezoidal	300.000	1840.000	0.0400	0.5000	0.5000	0.0000	0.00	No
7 Link-09	3500.00	4840.00	0.00	4840.00	0.00	0.00	0.0000	Trapezoidal	50.000	700.000	0.0400	0.5000	0.5000	0.0000	0.00	No
8 Link-10	2594.00	4840.00	0.00	4730.00	0.00	110.00	4.2400	Trapezoidal	4.000	274.000	0.0400	0.5000	0.5000	0.0000	0.00	No

## Channel Results

SN Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
	(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1 Link-03	14.24	0 00:19	40096768.26	0.00	0.72	237.73	0.05	0.00	0.00		
2 Link-04	0.00	0 00:00	813440873.53	0.00	0.00		0.73	0.00	0.00		
3 Link-05	0.00	0 00:00	43773442.64	0.00	0.00		0.00	0.00	0.00		
4 Link-06	222.97	0 00:31	82279903.09	0.00	9.74	6.51	1.06	0.00	0.00		
5 Link-07	273.90	0 00:41	48722679.32	0.00	12.65	2.33	0.89	0.00	0.00		
6 Link-08	548.10	0 00:36	29131946.60	0.00	9.48	8.36	2.05	0.01	0.00		
7 Link-09	312.39	0 01:20	6215.06	0.05	0.17	343.14	6.39	0.13	0.00		
8 Link-10	297.84	0 01:36	19546.55	0.02	3.64	11.88	0.33	0.08	0.00		

**Attachment E**

**SSA Analysis Results**

**100-YR Existing Storm Report**

Project Description

File Name ..... CAL-MINERALS\_EX-100-YR.SPF

Project Options

Flow Units ..... CFS  
Elevation Type ..... Elevation  
Hydrology Method ..... Rational  
Time of Concentration (TOC) Method ..... Kirpich  
Link Routing Method ..... Kinematic Wave  
Enable Overflow Ponding at Nodes ..... YES  
Skip Steady State Analysis Time Periods ..... NO

Analysis Options

Start Analysis On ..... Oct 26, 2018 00:00:00  
End Analysis On ..... Oct 27, 2018 00:00:00  
Start Reporting On ..... Oct 26, 2018 00:00:00  
Antecedent Dry Days ..... 0 days  
Runoff (Dry Weather) Time Step ..... 0 01:00:00 days hh:mm:ss  
Runoff (Wet Weather) Time Step ..... 0 00:05:00 days hh:mm:ss  
Reporting Time Step ..... 0 00:05:00 days hh:mm:ss  
Routing Time Step ..... 30 seconds

Number of Elements

	Qty
Rain Gages .....	0
Subbasins.....	5
Nodes.....	9
<i>Junctions</i> .....	9
<i>Outfalls</i> .....	0
<i>Flow Diversions</i> .....	0
<i>Inlets</i> .....	0
<i>Storage Nodes</i> .....	0
Links.....	8
<i>Channels</i> .....	8
<i>Pipes</i> .....	0
<i>Pumps</i> .....	0
<i>Orifices</i> .....	0
<i>Weirs</i> .....	0
<i>Outlets</i> .....	0
Pollutants .....	0
Land Uses .....	0

Rainfall Details

Return Period..... 100 year(s)

## Subbasin Summary

SN	Subbasin ID	Area	Weighted Runoff Coefficient	Average Slope	Flow Length	Total Rainfall	Total Runoff	Total Runoff Volume	Peak Runoff	Time of Concentration
		(ac)		(%)	(ft)	(in)	(in)	(ac-in)	(cfs)	(days hh:mm:ss)
1	Sub-01	665.00	0.3700	50.0000	10270.00	0.14	0.05	34.58	165.57	0 00:12:30
2	Sub-02	1646.00	0.3700	35.0000	13800.00	0.24	0.09	144.85	484.42	0 00:18:00
3	Sub-05	465.00	0.3700	30.0000	6455.00	0.11	0.04	19.07	107.34	0 00:10:38
4	Sub-06	2225.00	0.3700	25.0000	20628.00	0.45	0.17	371.58	797.16	0 00:27:55
5	Sub-07	22.40	0.3700	15.0000	2594.00	0.10	0.04	0.83	5.02	0 00:10:00



## Node Summary

SN	Element ID	Element Type	Invert Elevation	Ground/Rim (Max) Elevation	Initial Water Elevation	Surcharge Elevation	Ponded Area	Peak Inflow	Max HGL Elevation Attained	Max Surcharge Depth Attained	Min Freeboard Attained	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
			(ft)	(ft)	(ft)	(ft)	(ft²)	(cfs)	(ft)	(ft)	(ft)	(days hh:mm)	(ac-in)	(min)
1	Jun-05	Junction	5935.00	100.00	0.00	0.00	0.00	107.74	5936.52	0.00	798.48	0 00:00	0.00	0.00
2	Jun-06	Junction	5490.00	100.00	0.00	0.00	0.00	0.00	5490.00	0.00	800.00	0 00:00	0.00	0.00
3	Jun-07	Junction	5006.00	100.00	0.00	0.00	0.00	484.42	5007.73	0.00	398.27	0 00:00	0.00	0.00
4	Jun-08	Junction	4938.00	100.00	0.00	0.00	0.00	407.46	4939.51	0.00	398.49	0 00:00	0.00	0.00
5	Jun-09	Junction	4888.00	100.00	0.00	0.00	0.00	1188.80	4891.29	0.00	296.71	0 00:00	0.00	0.00
6	Jun-10	Junction	4840.00	100.00	0.00	0.00	0.00	1103.02	4858.77	0.00	281.23	0 00:00	0.00	0.00
7	Jun-11	Junction	4840.00	50.00	0.00	0.00	0.00	624.44	4853.46	0.00	36.54	0 00:00	0.00	0.00
8	Out-03	Junction	4730.00	50.00	0.00	0.00	0.00	602.03	4733.00	0.00	0.00	0 00:00	0.00	0.00
9	UpperEastBasin	Junction	6694.00	100.00	0.00	0.00	0.00	165.57	6694.15	0.00	199.85	0 00:00	0.00	0.00

## Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope	Diameter or Height	Manning's Roughness	Peak Flow	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Reported	Surcharged Condition
					(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)		(ft/sec)	(ft)		(min)	
1	Link-03	Channel	UpperEastBasin	Jun-05	10270.00	6694.00	5935.00	7.3900	2400.000	0.0400	107.74	40096768.26	0.00	4.74	0.08	0.00	0.00	
2	Link-04	Channel	Jun-05	Jun-06	4132.00	5935.00	5490.00	10.7700	9600.000	0.0400	0.00	813440873.53	0.00	0.00	0.76	0.00	0.00	
3	Link-05	Channel	Jun-06	Jun-07	4753.00	5490.00	5006.00	10.1800	2700.000	0.0400	0.00	43773442.64	0.00	0.00	0.00	0.00	0.00	
4	Link-06	Channel	Jun-07	Jun-08	3804.00	5006.00	4938.00	1.7900	4800.000	0.0400	407.46	82279903.09	0.00	11.54	1.52	0.00	0.00	
5	Link-07	Channel	Jun-08	Jun-09	1770.00	4938.00	4888.00	2.8200	3600.000	0.0400	401.30	48722679.32	0.00	12.84	1.32	0.00	0.00	
6	Link-08	Channel	Jun-09	Jun-10	4753.00	4888.00	4840.00	1.0100	3600.000	0.0400	1103.02	29131946.60	0.00	11.21	3.06	0.01	0.00	
7	Link-09	Channel	Jun-10	Jun-11	3500.00	4840.00	4840.00	0.0000	600.000	0.0400	624.44	6215.06	0.10	0.22	9.53	0.19	0.00	
8	Link-10	Channel	Jun-11	Out-03	2594.00	4840.00	4730.00	4.2400	36.000	0.0400	602.03	12056.80	0.05	4.81	0.50	0.17	0.00	

## Subbasin Hydrology

### Subbasin : Sub-01

#### Input Data

Area (ac) ..... 665.00  
Weighted Runoff Coefficient ..... 0.3700  
Average Slope (%) ..... 50.0000  
Flow Length (ft) ..... 10270.00

#### Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
Pasture, 25 years or greater	665.00	A (6%+)	0.37
Composite Area & Weighted Runoff Coeff.	665.00		0.37

#### Time of Concentration

TOC Method : Kirpich

Sheet Flow Equation :

$$T_c = (0.0078 * ((L_f^{0.77}) * (S_f^{-0.385})))$$

Where :

$T_c$  = Time of Concentration (min)  
 $L_f$  = Flow Length (ft)  
 $S_f$  = Slope (ft/ft)

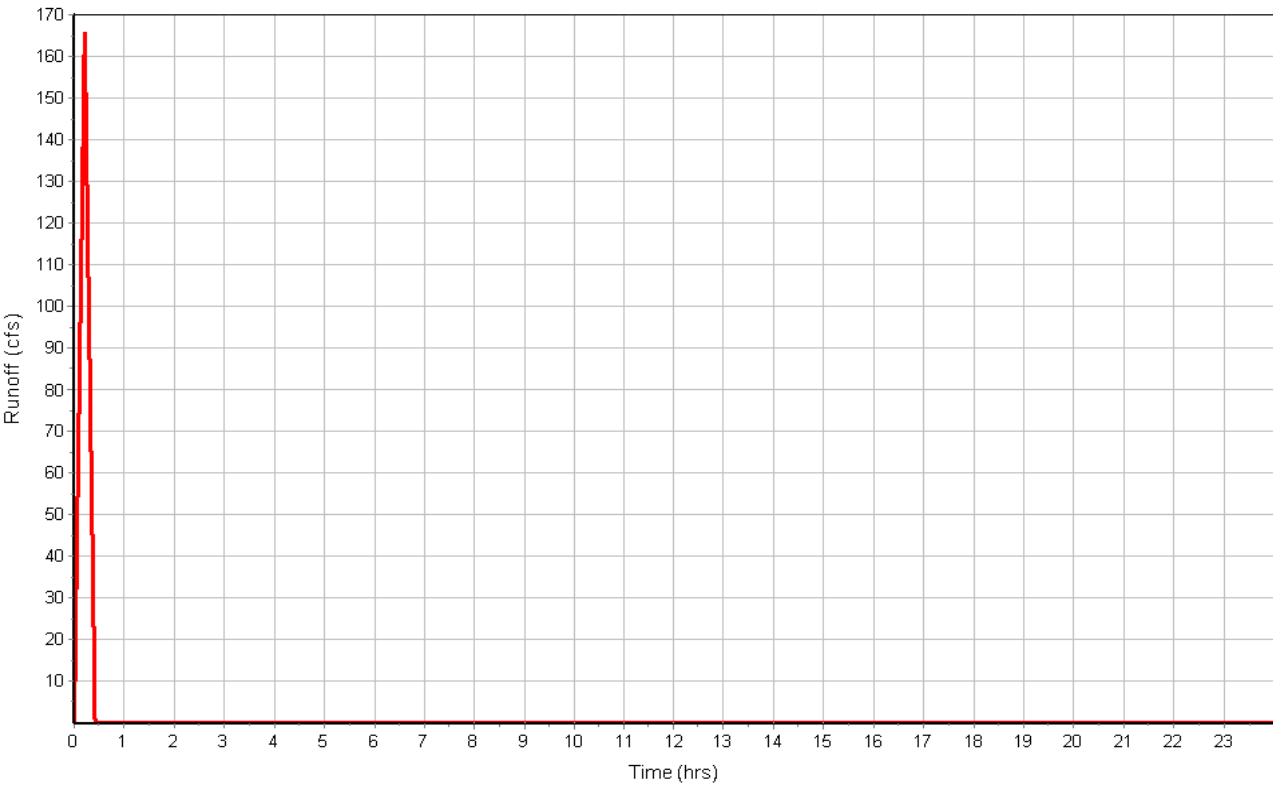
Flow Length (ft) ..... 10270.00  
Slope (%) ..... 50  
Computed TOC (min) ..... 12.50

#### Subbasin Runoff Results

Total Rainfall (in) ..... 0.14  
Total Runoff (in) ..... 0.05  
Peak Runoff (cfs) ..... 165.57  
Rainfall Intensity ..... 0.673  
Weighted Runoff Coefficient ..... 0.3700  
Time of Concentration (days hh:mm:ss) ..... 0 00:12:30

Subbasin : Sub-01

Runoff Hydrograph



## Subbasin : Sub-02

### Input Data

Area (ac) ..... 1646.00  
Weighted Runoff Coefficient ..... 0.3700  
Average Slope (%) ..... 35.0000  
Flow Length (ft) ..... 13800.00

### Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
Pasture, 25 years or greater	1646.00	A (6%+)	0.37
Composite Area & Weighted Runoff Coeff.	1646.00		0.37

### Time of Concentration

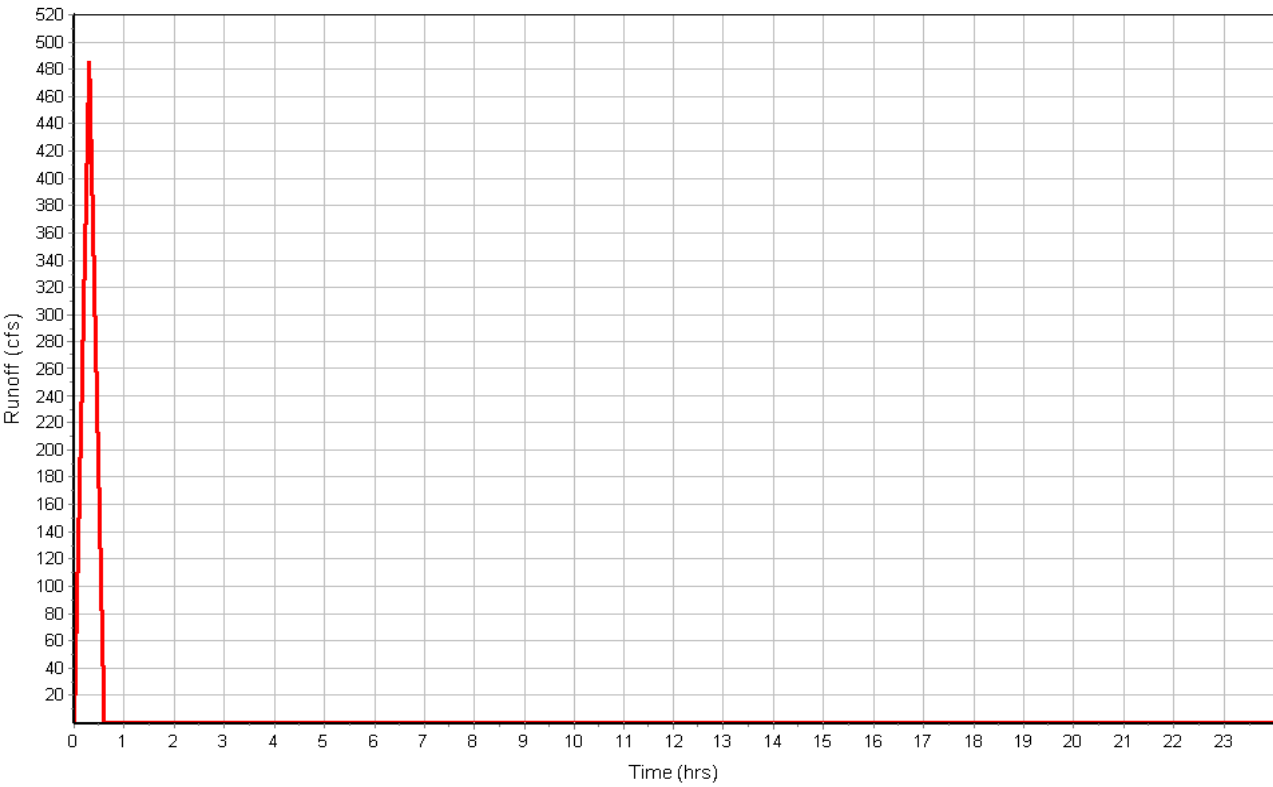
Flow Length (ft) ..... 13800.00  
Slope (%) ..... 35  
Computed TOC (min) ..... 18.00

### Subbasin Runoff Results

Total Rainfall (in) ..... 0.24  
Total Runoff (in) ..... 0.09  
Peak Runoff (cfs) ..... 484.42  
Rainfall Intensity ..... 0.795  
Weighted Runoff Coefficient ..... 0.3700  
Time of Concentration (days hh:mm:ss) ..... 0 00:18:00

Subbasin : Sub-02

Runoff Hydrograph



## Subbasin : Sub-05

### Input Data

Area (ac) ..... 465.00  
Weighted Runoff Coefficient ..... 0.3700  
Average Slope (%) ..... 30.0000  
Flow Length (ft) ..... 6455.00

### Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
Pasture, 25 years or greater	465.00	A (6%+)	0.37
Composite Area & Weighted Runoff Coeff.	465.00		0.37

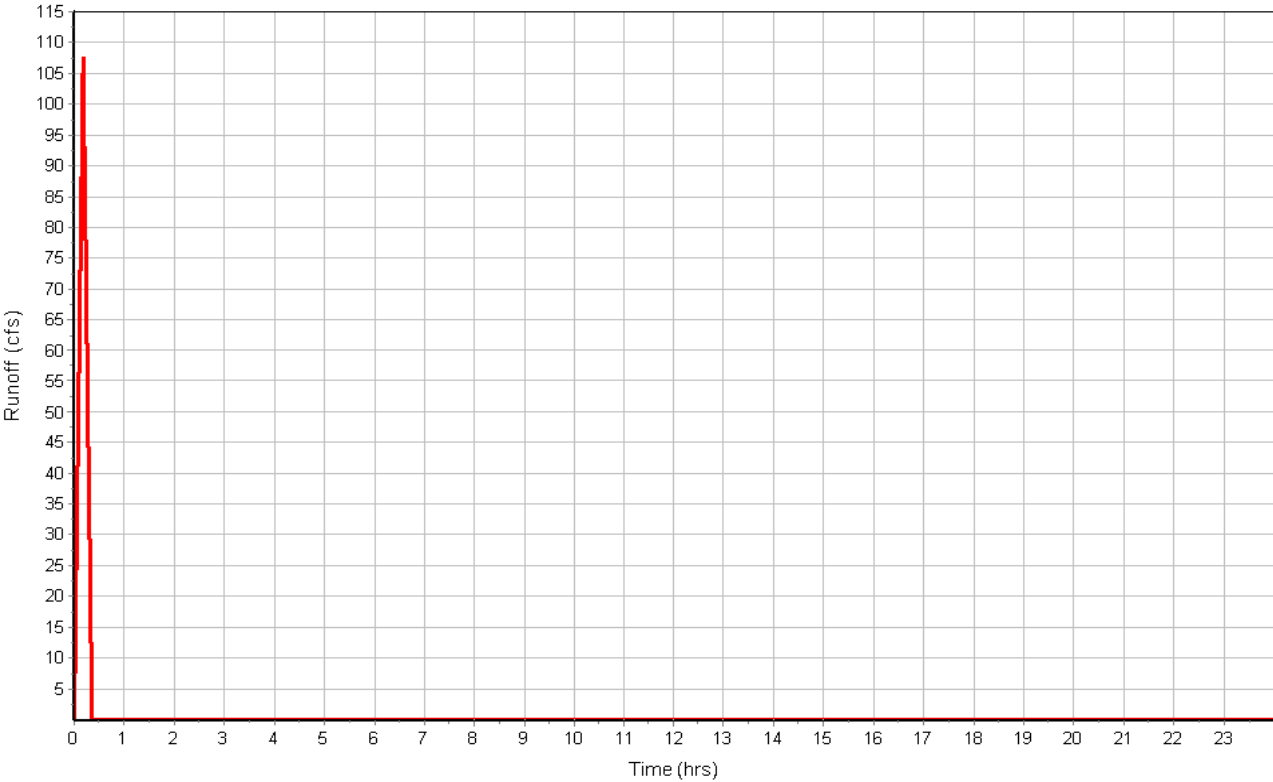
### Time of Concentration

Flow Length (ft) ..... 6455.00  
Slope (%) ..... 30  
Computed TOC (min) ..... 10.64

### Subbasin Runoff Results

Total Rainfall (in) ..... 0.11  
Total Runoff (in) ..... 0.04  
Peak Runoff (cfs) ..... 107.34  
Rainfall Intensity ..... 0.624  
Weighted Runoff Coefficient ..... 0.3700  
Time of Concentration (days hh:mm:ss) ..... 0 00:10:38

Runoff Hydrograph





## Subbasin : Sub-06

### Input Data

Area (ac) ..... 2225.00  
Weighted Runoff Coefficient ..... 0.3700  
Average Slope (%) ..... 25.0000  
Flow Length (ft) ..... 20628.00

### Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
Pasture, 25 years or greater	2225.00	A (6%+)	0.37
Composite Area & Weighted Runoff Coeff.	2225.00		0.37

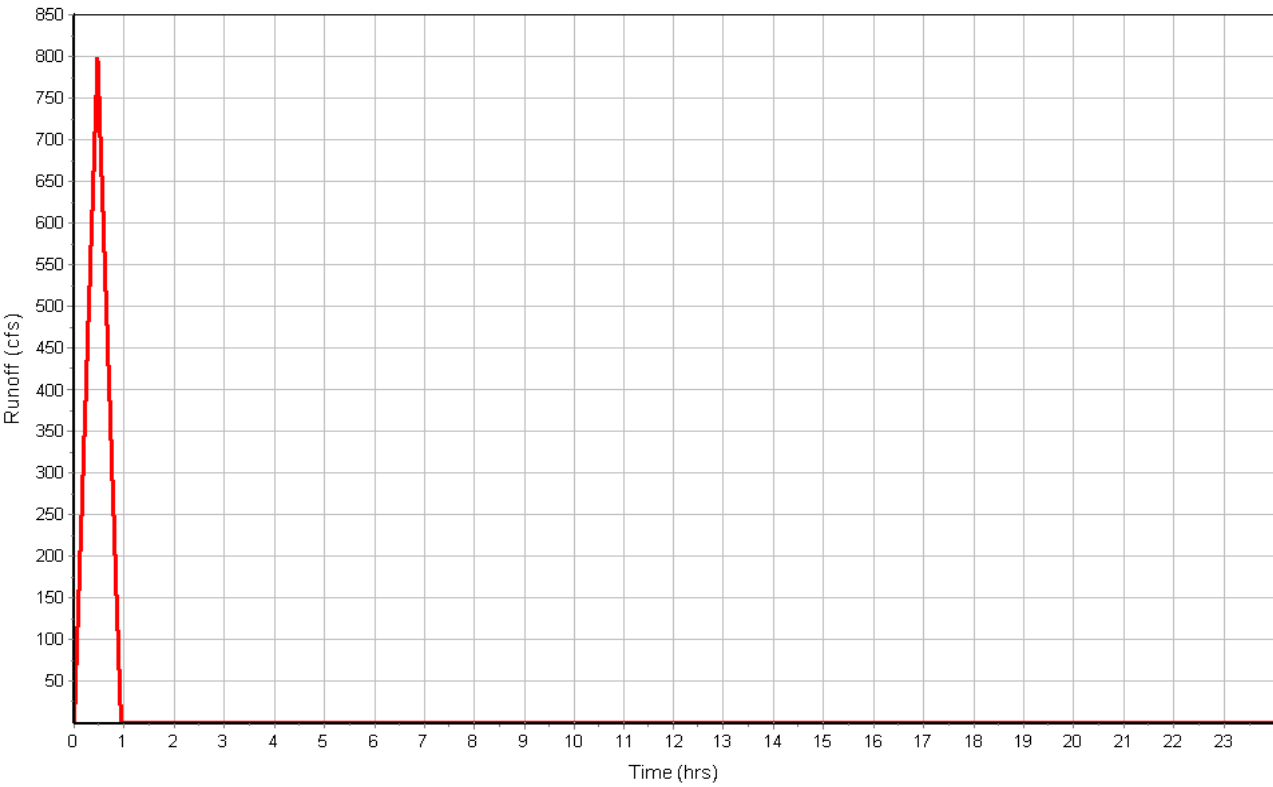
### Time of Concentration

Flow Length (ft) ..... 20628.00  
Slope (%) ..... 25  
Computed TOC (min) ..... 27.92

### Subbasin Runoff Results

Total Rainfall (in) ..... 0.45  
Total Runoff (in) ..... 0.17  
Peak Runoff (cfs) ..... 797.16  
Rainfall Intensity ..... 0.968  
Weighted Runoff Coefficient ..... 0.3700  
Time of Concentration (days hh:mm:ss) ..... 0 00:27:55

Runoff Hydrograph



## Subbasin : Sub-07

### Input Data

Area (ac) ..... 22.40  
Weighted Runoff Coefficient ..... 0.3700  
Average Slope (%) ..... 15.0000  
Flow Length (ft) ..... 2594.00

### Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
Pasture, 25 years or greater	22.40	A (6%+)	0.37
Composite Area & Weighted Runoff Coeff.	22.40		0.37

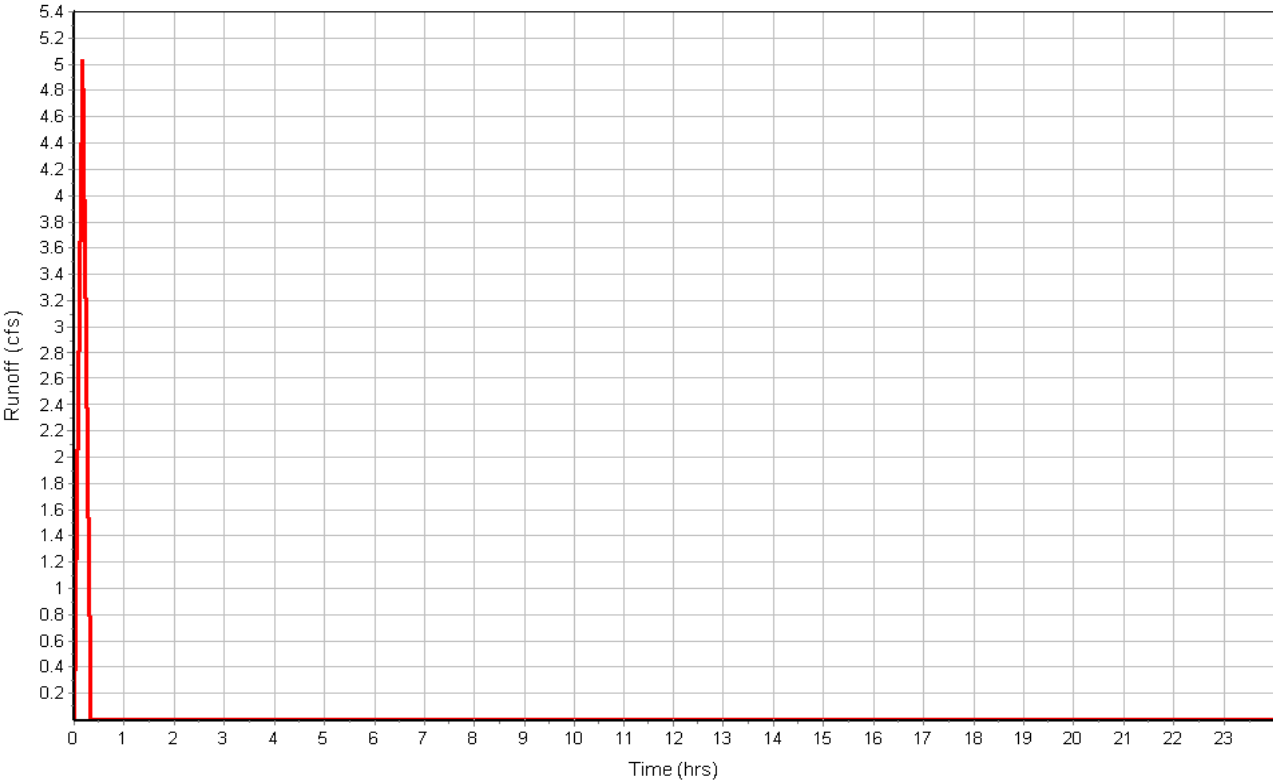
### Time of Concentration

Flow Length (ft) ..... 2594.00  
Slope (%) ..... 15  
Computed TOC (min) ..... 6.89

### Subbasin Runoff Results

Total Rainfall (in) ..... 0.10  
Total Runoff (in) ..... 0.04  
Peak Runoff (cfs) ..... 5.02  
Rainfall Intensity ..... 0.606  
Weighted Runoff Coefficient ..... 0.3700  
Time of Concentration (days hh:mm:ss) ..... 0 00:06:53

Runoff Hydrograph



## Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft²)	Minimum Pipe Cover (in)
1	Jun-05	5935.00	100.00	-5835.00	0.00	-5935.00	0.00	-100.00	0.00	0.00
2	Jun-06	5490.00	100.00	-5390.00	0.00	-5490.00	0.00	-100.00	0.00	0.00
3	Jun-07	5006.00	100.00	-4906.00	0.00	-5006.00	0.00	-100.00	0.00	0.00
4	Jun-08	4938.00	100.00	-4838.00	0.00	-4938.00	0.00	-100.00	0.00	0.00
5	Jun-09	4888.00	100.00	-4788.00	0.00	-4888.00	0.00	-100.00	0.00	0.00
6	Jun-10	4840.00	100.00	-4740.00	0.00	-4840.00	0.00	-100.00	0.00	0.00
7	Jun-11	4840.00	50.00	-4790.00	0.00	-4840.00	0.00	-50.00	0.00	0.00
8	Out-03	4730.00	50.00	-4680.00	0.00	-4730.00	0.00	-50.00	0.00	0.00
9	UpperEastBasin	6694.00	100.00	-6594.00	0.00	-6694.00	0.00	-100.00	0.00	0.00

## Junction Results

SN Element ID	Peak Inflow	Peak Lateral Inflow	Max HGL Elevation Attained	Max HGL Depth Attained	Max Surcharge Depth Attained	Min Freeboard Attained	Average HGL Elevation Attained	Average HGL Depth Attained	Time of Max HGL Occurrence	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
	(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(days hh:mm)	(days hh:mm)	(ac-in)	(min)
1 Jun-05	107.74	0.00	5936.52	1.52	0.00	798.48	5935.05	0.05	0 00:25	0 00:00	0.00	0.00
2 Jun-06	0.00	0.00	5490.00	0.00	0.00	800.00	5490.00	0.00	0 00:00	0 00:00	0.00	0.00
3 Jun-07	484.42	484.42	5007.73	1.73	0.00	398.27	5006.03	0.03	0 00:18	0 00:00	0.00	0.00
4 Jun-08	407.46	107.34	4939.51	1.51	0.00	398.49	4938.03	0.03	0 00:23	0 00:00	0.00	0.00
5 Jun-09	1188.80	797.16	4891.29	3.29	0.00	296.71	4888.08	0.08	0 00:28	0 00:00	0.00	0.00
6 Jun-10	1103.02	0.00	4858.77	18.77	0.00	281.23	4840.50	0.50	0 00:33	0 00:00	0.00	0.00
7 Jun-11	624.44	5.02	4853.46	13.46	0.00	36.54	4844.82	4.82	0 01:23	0 00:00	0.00	0.00
8 Out-03	602.03	0.00	4733.00	3.00	0.00	0.00	4732.96	2.96	0 00:10	0 00:00	0.00	0.00
9 UpperEastBasin	165.57	165.57	6694.15	0.15	0.00	199.85	6694.00	0.00	0 00:12	0 00:00	0.00	0.00



## Channel Input

SN Element ID	Length	Inlet Invert Elevation	Inlet Invert Offset	Outlet Invert Elevation	Outlet Invert Offset	Total Drop	Average Slope	Shape	Height	Width	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow	Flap Gate
	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(%)		(ft)	(ft)					(cfs)	
1 Link-03	10270.00	6694.00	0.00	5935.00	0.00	759.00	7.3900	Trapezoidal	200.000	1200.000	0.0400	0.5000	0.5000	0.0000	0.00	No
2 Link-04	4132.00	5935.00	0.00	5490.00	0.00	445.00	10.7700	Trapezoidal	800.000	3240.000	0.0400	0.5000	0.5000	0.0000	0.00	No
3 Link-05	4753.00	5490.00	0.00	5006.00	0.00	484.00	10.1800	Trapezoidal	225.000	1390.000	0.0400	0.5000	0.5000	0.0000	0.00	No
4 Link-06	3804.00	5006.00	0.00	4938.00	0.00	68.00	1.7900	Trapezoidal	400.000	2440.000	0.0400	0.5000	0.5000	0.0000	0.00	No
5 Link-07	1770.00	4938.00	0.00	4888.00	0.00	50.00	2.8200	Trapezoidal	300.000	1840.000	0.0400	0.5000	0.5000	0.0000	0.00	No
6 Link-08	4753.00	4888.00	0.00	4840.00	0.00	48.00	1.0100	Trapezoidal	300.000	1840.000	0.0400	0.5000	0.5000	0.0000	0.00	No
7 Link-09	3500.00	4840.00	0.00	4840.00	0.00	0.00	0.0000	Trapezoidal	50.000	700.000	0.0400	0.5000	0.5000	0.0000	0.00	No
8 Link-10	2594.00	4840.00	0.00	4730.00	0.00	110.00	4.2400	Trapezoidal	3.000	268.000	0.0400	0.5000	0.5000	0.0000	0.00	No

## Channel Results

SN Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
	(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1 Link-03	107.74	0 00:25	40096768.26	0.00	4.74	36.11	0.08	0.00	0.00		
2 Link-04	0.00	0 00:00	813440873.53	0.00	0.00		0.76	0.00	0.00		
3 Link-05	0.00	0 00:00	43773442.64	0.00	0.00		0.00	0.00	0.00		
4 Link-06	407.46	0 00:23	82279903.09	0.00	11.54	5.49	1.52	0.00	0.00		
5 Link-07	401.30	0 00:26	48722679.32	0.00	12.84	2.30	1.32	0.00	0.00		
6 Link-08	1103.02	0 00:33	29131946.60	0.00	11.21	7.07	3.06	0.01	0.00		
7 Link-09	624.44	0 01:23	6215.06	0.10	0.22	265.15	9.53	0.19	0.00		
8 Link-10	602.03	0 01:33	12056.80	0.05	4.81	8.99	0.50	0.17	0.00		

**Attachment F**

**Hydraflow Express**

**Existing Channel Conditions**

**For the 10-year and 100-year Events**

# Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Sunday, Feb 24 2019

## Existing Upstream Channel - 10Yr

### Trapezoidal

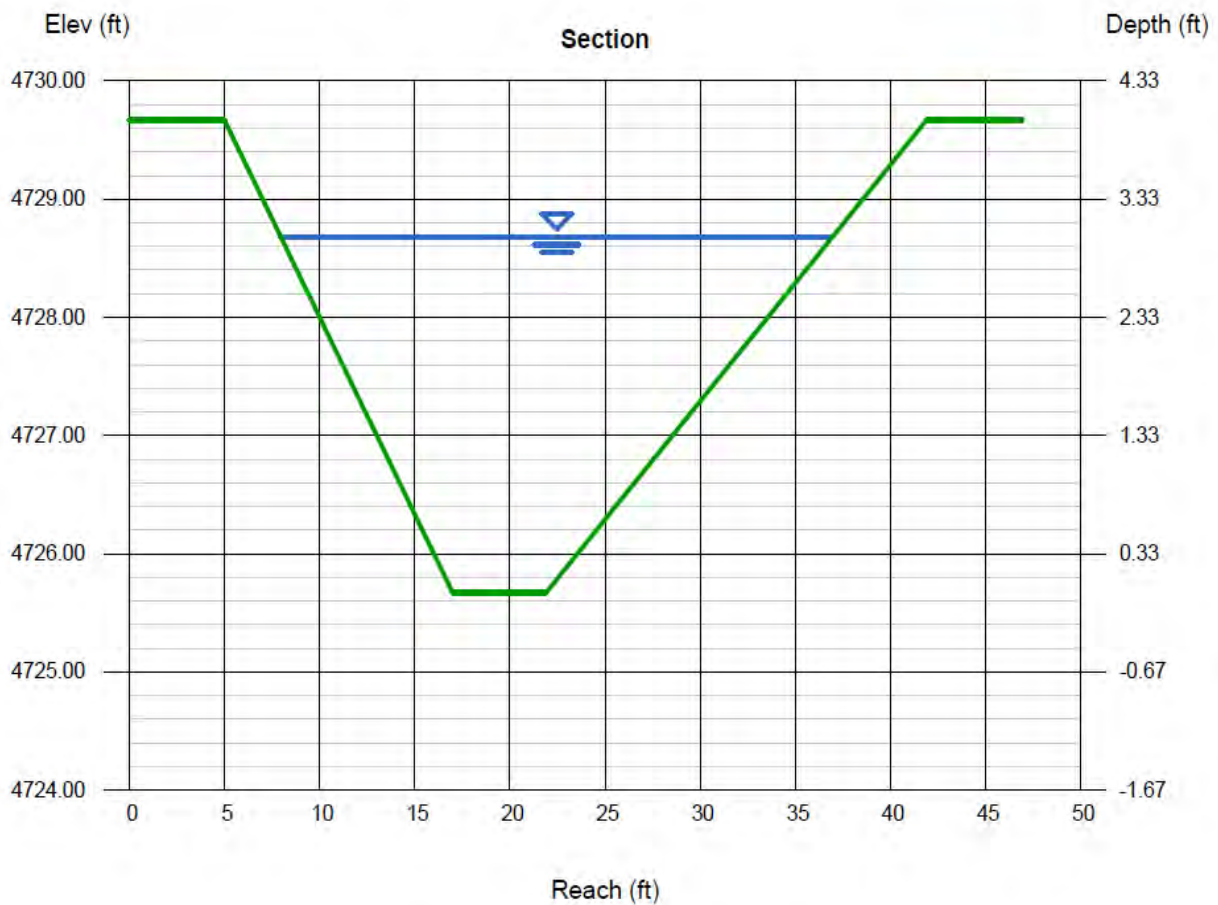
Bottom Width (ft) = 4.90  
Side Slopes (z:1) = 3.00, 5.00  
Total Depth (ft) = 4.00  
Invert Elev (ft) = 4725.67  
Slope (%) = 1.00  
N-Value = 0.036

### Calculations

Compute by: Known Q  
Known Q (cfs) = 300.00

### Highlighted

Depth (ft) = 3.01  
Q (cfs) = 300.00  
Area (sqft) = 50.99  
Velocity (ft/s) = 5.88  
Wetted Perim (ft) = 29.77  
Crit Depth, Yc (ft) = 2.69  
Top Width (ft) = 28.98  
EGL (ft) = 3.55



# Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Sunday, Feb 24 2019

## Existing Downstream Channel - 10 Yr Storm

### Trapezoidal

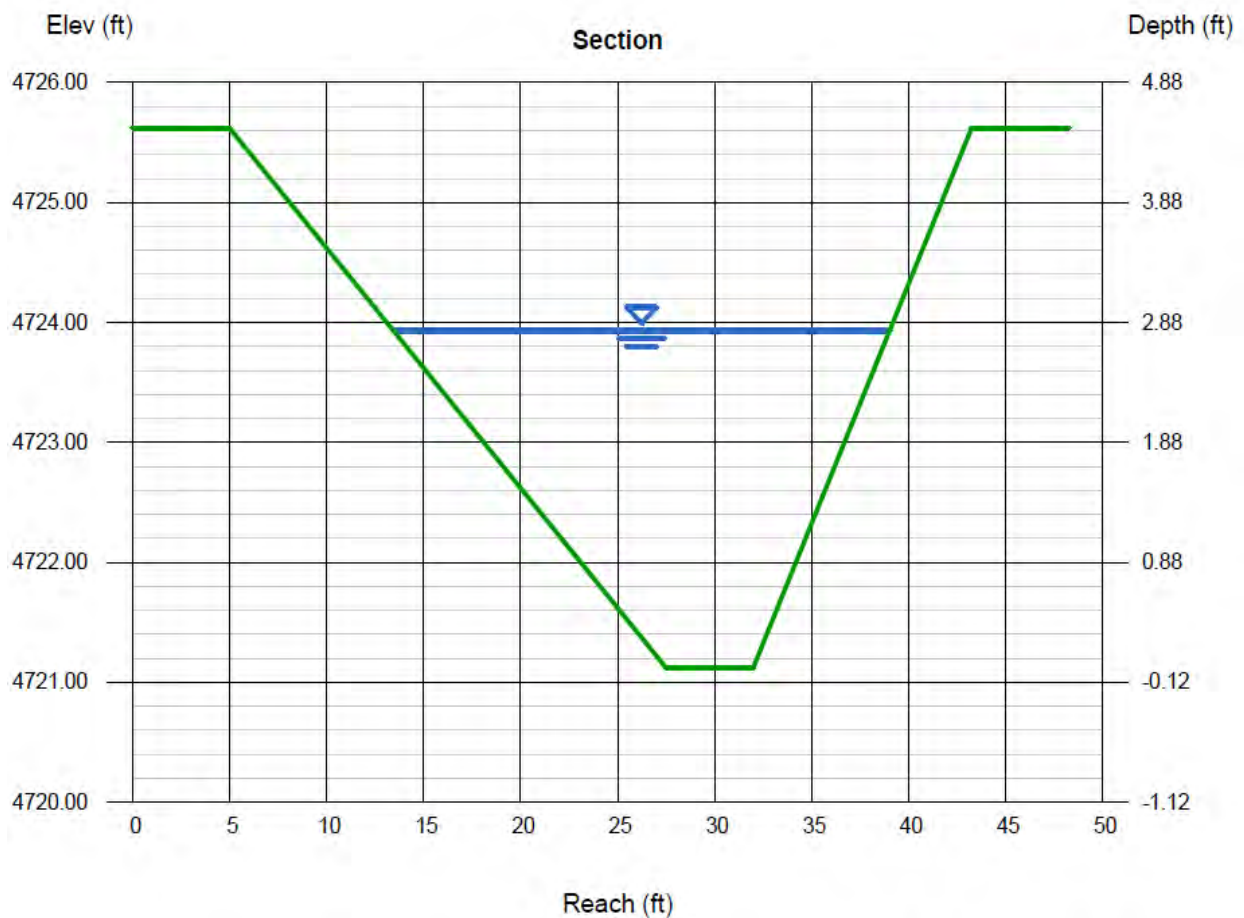
Bottom Width (ft) = 4.50  
Side Slopes (z:1) = 5.00, 2.50  
Total Depth (ft) = 4.50  
Invert Elev (ft) = 4721.12  
Slope (%) = 1.50  
N-Value = 0.035

### Calculations

Compute by: Known Q  
Known Q (cfs) = 300.00

### Highlighted

Depth (ft) = 2.81  
Q (cfs) = 300.00  
Area (sqft) = 42.26  
Velocity (ft/s) = 7.10  
Wetted Perim (ft) = 26.39  
Crit Depth, Yc (ft) = 2.78  
Top Width (ft) = 25.57  
EGL (ft) = 3.59



# Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Sunday, Feb 24 2019

## Existing Upstream Channel - 100Yr

### Trapezoidal

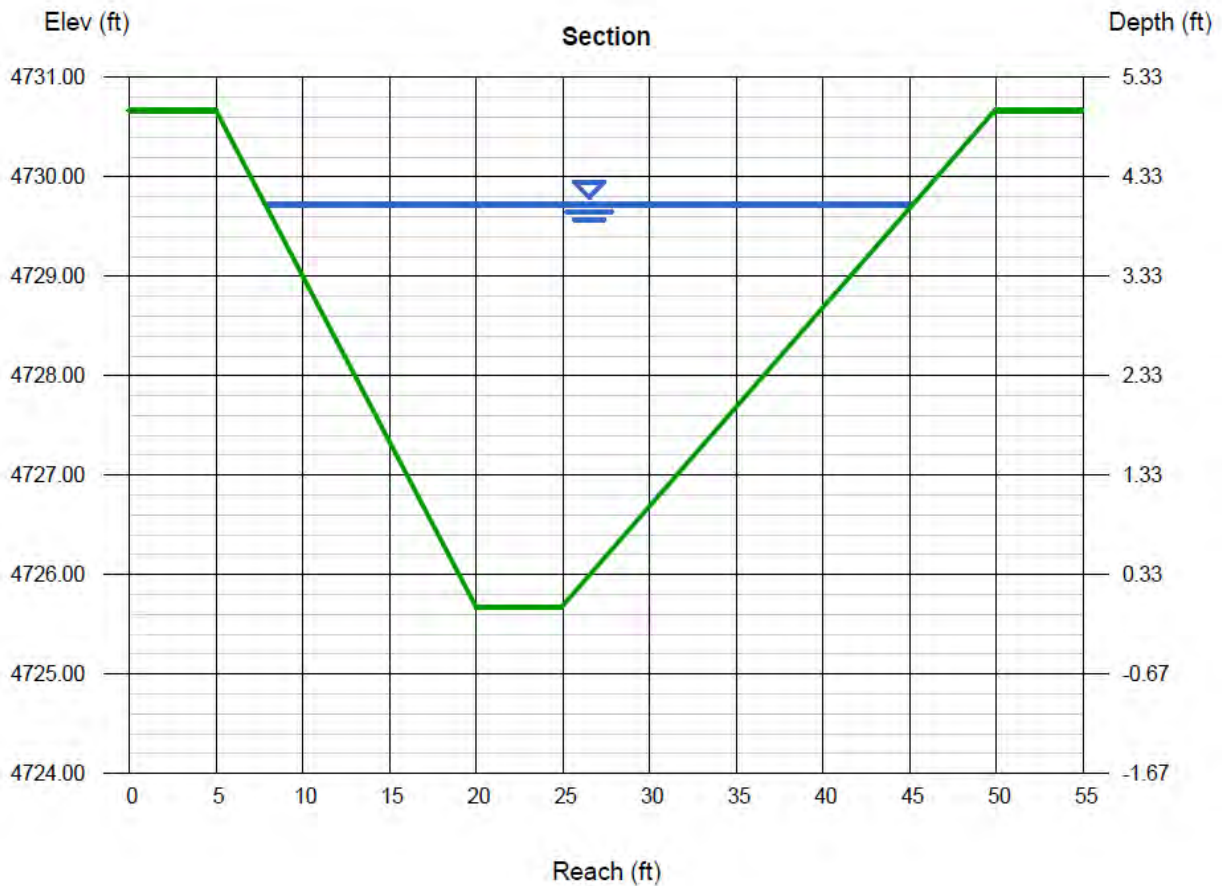
Bottom Width (ft) = 4.90  
Side Slopes (z:1) = 3.00, 5.00  
Total Depth (ft) = 5.00  
Invert Elev (ft) = 4725.67  
Slope (%) = 1.00  
N-Value = 0.036

### Calculations

Compute by: Known Q  
Known Q (cfs) = 600.00

### Highlighted

Depth (ft) = 4.05  
Q (cfs) = 600.00  
Area (sqft) = 85.45  
Velocity (ft/s) = 7.02  
Wetted Perim (ft) = 38.36  
Crit Depth, Yc (ft) = 3.70  
Top Width (ft) = 37.30  
EGL (ft) = 4.82



# Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Sunday, Feb 24 2019

## Existing Downstream Channel - 100 Yr Storm

### Trapezoidal

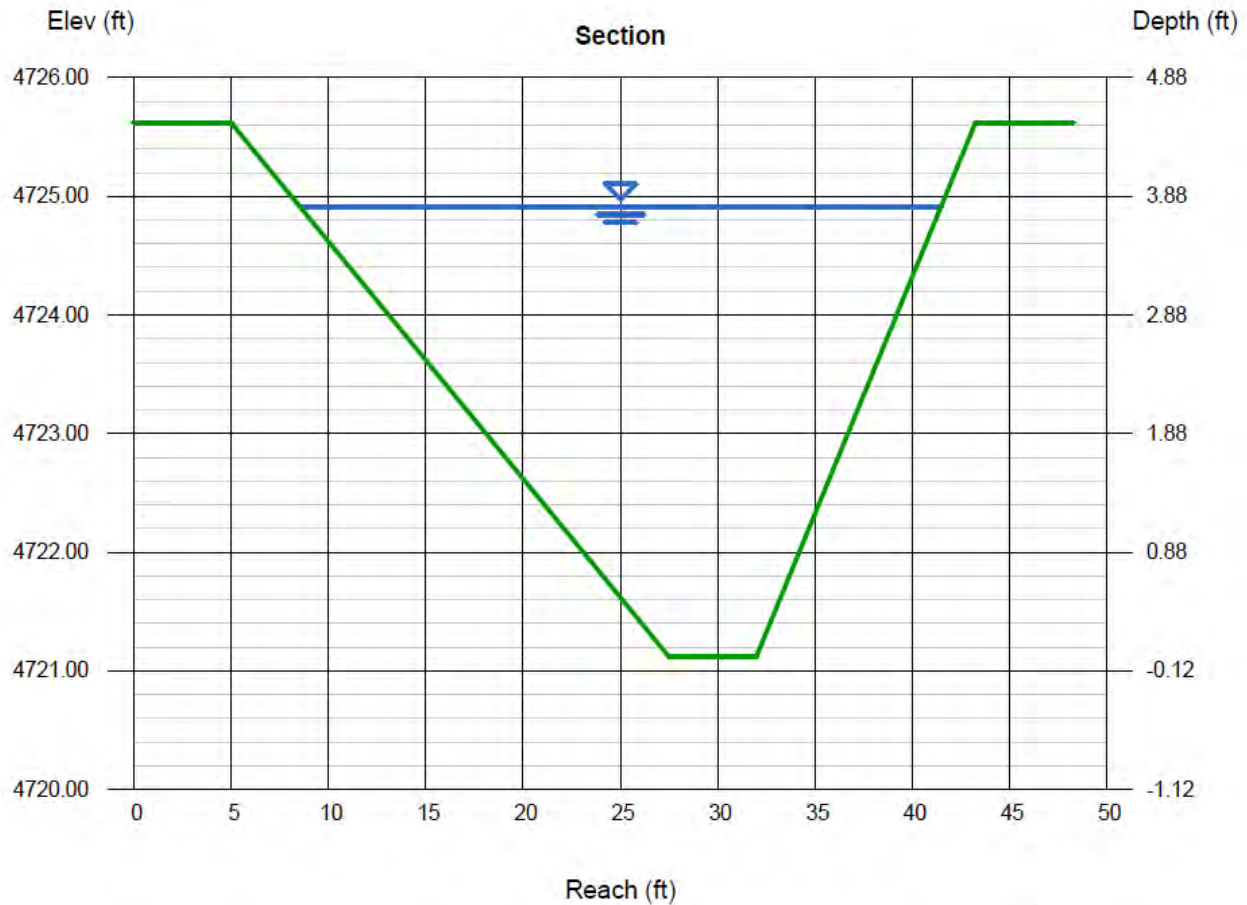
Bottom Width (ft) = 4.50  
Side Slopes (z:1) = 5.00, 2.50  
Total Depth (ft) = 4.50  
Invert Elev (ft) = 4721.12  
Slope (%) = 1.50  
N-Value = 0.035

### Calculations

Compute by: Known Q  
Known Q (cfs) = 600.00

### Highlighted

Depth (ft) = 3.79  
Q (cfs) = 600.00  
Area (sqft) = 70.92  
Velocity (ft/s) = 8.46  
Wetted Perim (ft) = 34.03  
Crit Depth, Yc (ft) = 3.82  
Top Width (ft) = 32.92  
EGL (ft) = 4.90



**Attachment G**

**Hydraflow Express Culvert Report**

**Proposed Design – 10 Year Storm**



# Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Sunday, Feb 24 2019

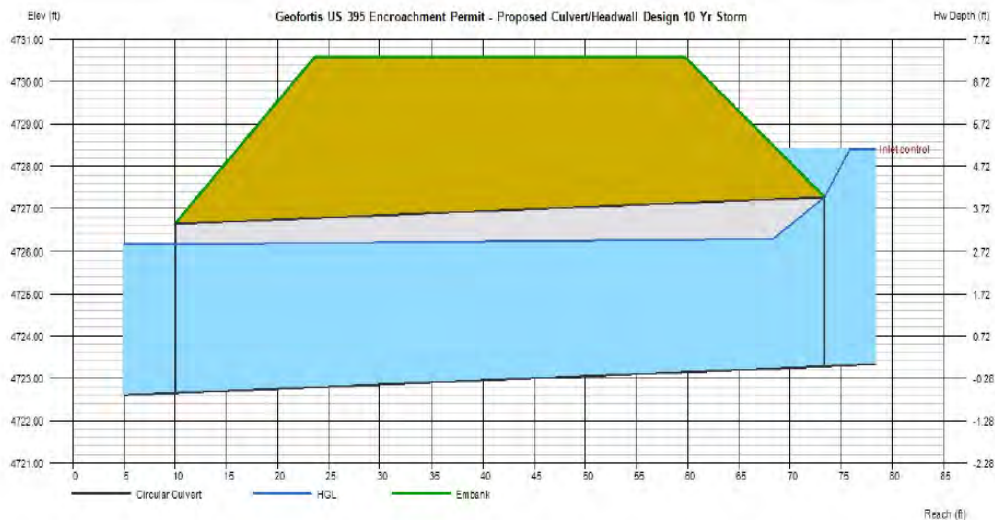
## Geofortis US 395 Encroachment Permit - Proposed Culvert/Headwall Design 10 Yr Storm

Invert Elev Dn (ft) = 4722.65  
 Pipe Length (ft) = 63.38  
 Slope (%) = 0.99  
 Invert Elev Up (ft) = 4723.28  
 Rise (in) = 48.0  
 Shape = Circular  
 Span (in) = 48.0  
 No. Barrels = 3  
 n-Value = 0.012  
 Culvert Type = Circular Corrugate Metal Pipe  
 Culvert Entrance = Headwall  
 Coeff. K,M,c,Y,k = 0.0078, 2, 0.0379, 0.69, 0.5

**Embankment**  
 Top Elevation (ft) = 4730.60  
 Top Width (ft) = 36.00  
 Crest Width (ft) = 24.00

**Calculations**  
 Qmin (cfs) = 300.00  
 Qmax (cfs) = 300.00  
 Tailwater Elev (ft) = (dc+D)/2

**Highlighted**  
 Qtotal (cfs) = 300.00  
 Qpipe (cfs) = 300.00  
 Qovertop (cfs) = 0.00  
 Veloc Dn (ft/s) = 8.55  
 Veloc Up (ft/s) = 9.80  
 HGL Dn (ft) = 4726.16  
 HGL Up (ft) = 4726.31  
 Hw Elev (ft) = 4728.42  
 Hw/D (ft) = 1.29  
 Flow Regime = Inlet Control



**Attachment H**

**Hydraflow Express Culvert Report**

**Proposed Design – 100 Year Storm**

# Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Sunday, Feb 24 2019

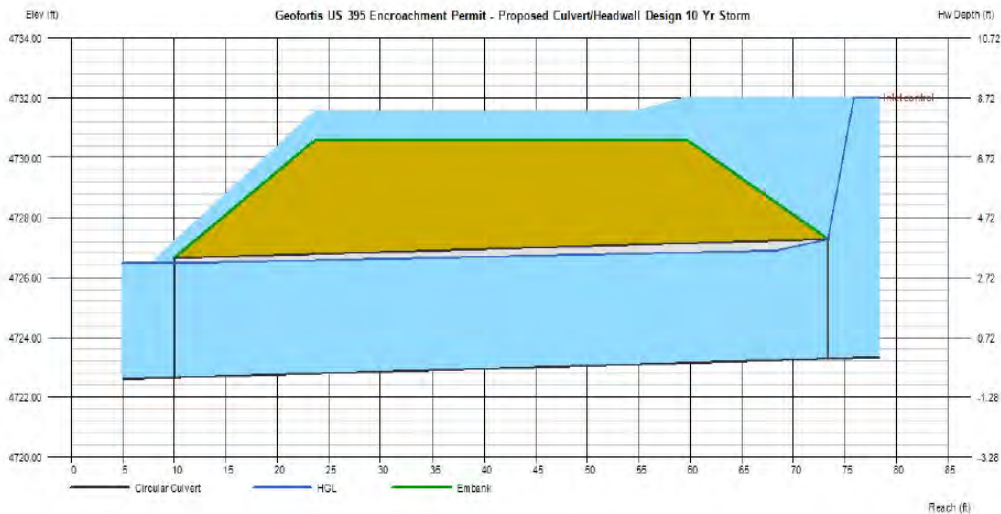
## Geofortis US 395 Encroachment Permit - Proposed Culvert/Headwall Design 100 Yr Stc

Invert Elev Dn (ft) = 4722.65  
 Pipe Length (ft) = 63.38  
 Slope (%) = 0.99  
 Invert Elev Up (ft) = 4723.28  
 Rise (in) = 48.0  
 Shape = Circular  
 Span (in) = 48.0  
 No. Barrels = 3  
 n-Value = 0.012  
 Culvert Type = Circular Corrugate Metal Pipe  
 Culvert Entrance = Headwall  
 Coeff. K,M,c,Y,k = 0.0078, 2, 0.0379, 0.69, 0.5

**Embankment**  
 Top Elevation (ft) = 4730.60  
 Top Width (ft) = 36.00  
 Crest Width (ft) = 24.00

**Calculations**  
 Qmin (cfs) = 600.00  
 Qmax (cfs) = 600.00  
 Tailwater Elev (ft) = (dc+D)/2

**Highlighted**  
 Qtotal (cfs) = 600.00  
 Qpipe (cfs) = 474.20  
 Qovertop (cfs) = 125.80  
 Veloc Dn (ft/s) = 12.77  
 Veloc Up (ft/s) = 13.12  
 HGL Dn (ft) = 4726.48  
 HGL Up (ft) = 4726.94  
 Hw Elev (ft) = 4732.02  
 Hw/D (ft) = 2.18  
 Flow Regime = Inlet Control



**Attachment I**

**Hydraflow Express Channel Report**

**Proposed Channel Conditions**

**For the 10-year and 100-year Events**

# Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Sunday, Feb 24 2019

## Proposed Downstream Channel - 10Yr Storm

### Trapezoidal

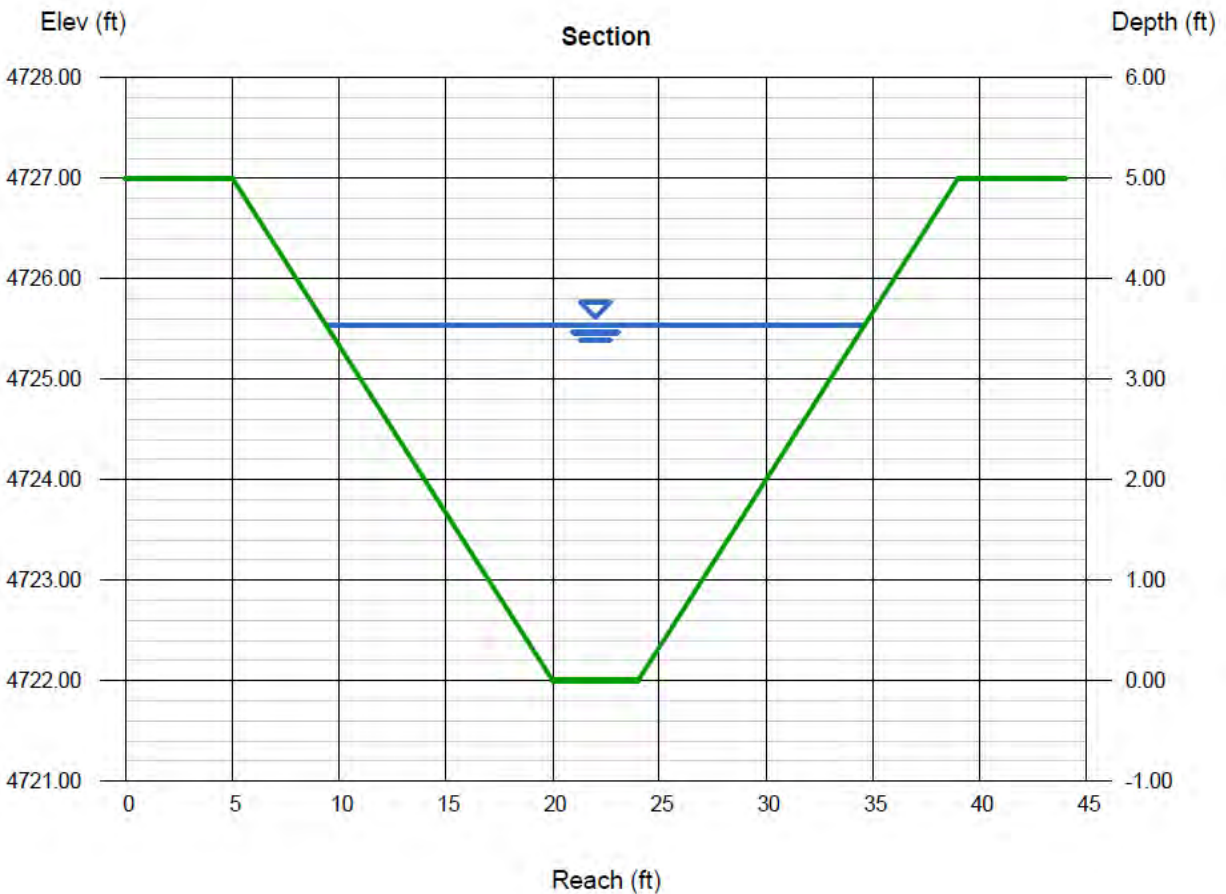
Bottom Width (ft) = 4.00  
Side Slopes (z:1) = 3.00, 3.00  
Total Depth (ft) = 5.00  
Invert Elev (ft) = 4722.00  
Slope (%) = 1.00  
N-Value = 0.040

### Calculations

Compute by: Known Q  
Known Q (cfs) = 300.00

### Highlighted

Depth (ft) = 3.54  
Q (cfs) = 300.00  
Area (sqft) = 51.75  
Velocity (ft/s) = 5.80  
Wetted Perim (ft) = 26.39  
Crit Depth, Yc (ft) = 3.03  
Top Width (ft) = 25.24  
EGL (ft) = 4.06





# Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Sunday, Feb 24 2019

## Proposed Downstream Channel - 100Yr Storm

### Trapezoidal

Bottom Width (ft) = 4.00  
Side Slopes (z:1) = 3.00, 3.00  
Total Depth (ft) = 5.00  
Invert Elev (ft) = 4722.00  
Slope (%) = 1.00  
N-Value = 0.040

### Calculations

Compute by: Known Q  
Known Q (cfs) = 600.00

### Highlighted

Depth (ft) = 4.75  
Q (cfs) = 600.00  
Area (sqft) = 86.69  
Velocity (ft/s) = 6.92  
Wetted Perim (ft) = 34.04  
Crit Depth, Yc (ft) = 4.17  
Top Width (ft) = 32.50  
EGL (ft) = 5.49

