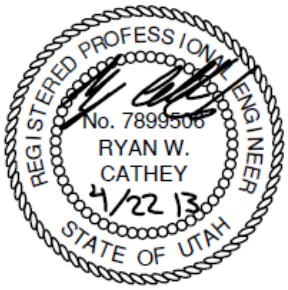
SUMMIT AT POWDER MOUNTAIN
SUMMIT PASS AND SPRING PARK
DRAINAGE SUMMARY

POWDER MOUNTAIN RESORT
EDEN, UTAH



April 2013

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Site Description

The proposed Summit at Powder Mountain Summit Pass and Spring Park Development is a mixed use residential community consisting as single family, townhouse, hotel and commercial property landuse located east of Eden, Utah. Storm drainage for the site has historically been conveyed overland in the southwesterly directing into Lefty's Canyon. With the usage of curb and gutter, roadside ditches, storm drain piping and catch basins, drainage will be conveyed through the site.

Drainage Analysis

Hydrology for the proposed development was calculated using the SCS Method. This methodology was input into Haestad Method's PondPack to calculate storm discharge rates as well as detention basin sizing. Onsite sub-basin delineation was determined by High Definition Survey (HDS), topographic information provided by the *Utah Automated Geographic Reference Center (AGRC)* at: http://gis.utah.gov/ and proposed grading. Landuse consists of sidewalks, pavement, grass, meadows, forestry and gravel roads. Time of Concentration was calculated using the Technical Release 55 Method. Rainfall depths were determined using the National Oceanic and Atmospheric Administration (NOAA) website. Weber County requires drainage infrastructure to convey 10-year 2 hour storm events and discharge stormwater at a release rate such that post development discharge is less than pre development discharge. Soil maps for SCS Methodology have been provided by the *United States Department of Agriculture (USDA) Natural Resources Conservation Service (NCRC) Web Soil Survey.*

Phase 1 will be served by Summit Pass roadway. An analysis was conducted for the tributary areas involved in the disturbance of the Powder Mountain Phase 1 Development. Based on the findings of Sub-1 and Sub-2 storm drainage discharge, increase is minimal from pre to post flows as the increase of impervious area for the 26' wide road and residential house pads is negligible in comparison to the remainder affected Sub-basins 1 & 2 as can be seen in the following results and appendix.

	Curve Number	Time of Concentration (hr)	Area A (ac)	10-yr 2 hr Q (cfs)	Storm Volume (CF)
Pre-1	59	0.52	247.74	0.91	2,134
Pre-2	69	0.74	715.89	40.86	196,194
			963.63	**41.77**	**198,329**
Post-1	60	0.57	247.74	1.50	4,574
Post-2	69	0.74	715.89	40.96	196,194
			963.63	**42.46**	**200,768**

LF Road	CFS/LF (Increase)
14,077	0.00005

Diff in Storm Vol. CF	**2,439**

Haestad Methods FlowMaster was used for catch basin calculations. Consideration for both sag and on grade scenarios has been taken into account. Inlets were assumed to have up to 50% clogging. Using a spreadsheet, downstream inlets will receive bypassing flows from on grade inlets. Calculated inlet flows were than input into Haestad Method's StormCAD to size storm drain pipes and verify that downstream inlets and manholes will not propagate above the ground elevation. The storm drain pipes will collect onsite stormwater and convey to two detention ponds. These ponds and orifices have been sized using Haestad Methods PondPack. Pond 1 and Pond 2 (as shown in the appendix and following table) will be 10,000 CF with an 10" orifice and 6,000 CF with 2" orifice respectively.

Haestad Method's FlowMaster was used to calculate the capacity of the roadside ditches and street capacity for the development. As the streets and roadside ditches are uniform throughout the development, the largest contributing flow to the least amount of slope road and ditch were compared for modeling the whole development. These calculations can be found in the appendix. The roadside ditches flow to historic locations of discharge previous to disturbance as well as sag sections of Summit Pass road into proposed culverts. These culverts were sized using Haestad Method's PondPack and CulvertMaster. Riprap apron calculations for these culverts were conducted using *Plate 3.18-4 of the USDA-SCS RIPRAP STD & SPEC 3.19* as shown in the appendix.

Subarea (correlates with culv #)	Curve Number	Size	Slope	Time of Concentration (hr)	Area (ac)	10-yr 2 hr Q (cfs)	Riprap (LxWxD) (ft)	Riprap Apron D50 (ft)
CR-1	55	18"	1.00%	0.167	16.40	0.03	20'x7.5'x1.5'	0.5'
CR-2	55.12	18"	1.00%	0.188	29.96	0.03	20'x7.5'x1.5'	0.5'
CR-3	65.92	18"	1.00%	0.244	18.22	0.77	20'x7.5'x1.5'	0.5'
CR-4	66.90	18"	1.00%	0.295	14.40	0.75	20'x7.5'x1.5'	0.5'
CR-5	77.84	18"	1.00%	0.335	18.36	6.17	20'x7.5'x1.5'	0.5'
CR-6	70	18"	1.00%	0.256	12.84	1.42	20'x7.5'x1.5'	0.5'
CR-7	70	18"	1.00%	0.304	58.28	6.07	20'x7.5'x1.5'	0.5'

Based on the dense impact of the southerly portion of Phase 1, it has been deemed necessary to provide detention for this portion of the development per Weber County drainage requirements stated previously. Detention has been provided in two locations that could easily be maintained as shown in the attached exhibit in the appendix and sized as follows:

		Curve Number	Time of Concentration (hr)	Area A (ac)	10-yr 2 hr Q (cfs)
Pond 1	PRE - CM-A-3	70	0.135	4.93	0.71
	PRE - CM-A-4	70	0.156	5.95	0.81
	PRE - CM-A-5	70	0.301	9.48	1.00
	PRE - CM-A-8	70	0.137	0.32	0.05
	PRE - CM-E-4	68.51	0.124	8.61	0.90
	PRE - CM-P-1	68.55	0.130	5.43	0.56
			Pond 1 Totals	**34.72**	**3.58**
Pond 2	PRE - CM-A-10	62.32	0.135	10.70	.017
	PRE - CM-A-12	58.55	0.041	0.82	0.00
	PRE - CM-P-2	63.36	0.213	5.61	0.50
			Pond 2 Totals	**17.13**	**0.17**

		Curve Number	Time of Concentration (hr)	Area A (ac)	10-yr 2 hr Q (cfs)
Pond 1	CM-A-3	70.78	0.135	4.93	0.83
	CM-A-4	71.57	0.156	5.95	1.09
	CM-A-5	71.42	0.301	9.48	1.30
	CM-A-8	97.24	0.137	0.32	0.10
	CM-E-4	83.96	0.124	8.61	8.86
	CM-P-1	71.49	0.130	5.43	1.04
			Pond 1 Totals	**34.72**	**9.37**
Pond 2	CM-A-10	68.99	0.135	10.70	1.23
	CM-A-12	64.77	0.041	0.82	0.03
	CM-P-2	63.39	0.213	5.61	0.11
			Pond 2 Totals	**17.13**	**1.25**

	Pond 1	Pond 2
Detention Pond Size (CF)	**10,000.00**	**6,000.00**
Orifice (in.)	**10"**	**2”**
Peak Flow Out (cfs)	**3.35**	**0.17**

In conclusion, the proposed development will discharge post development flows at or below the pre development flow rates as indicated in the above table for a 10 year 2 hour storm event per the required Weber County requirements. This will require approximately 16,000 cubic feet of detention. The proposed onsite storm drainage system and detention will reduce the potential for downstream flooding and improve the current drainage conditions.

APPENDICES

1. **Sub-basins 1- 2 Calculations**
    a. **Drainage Exhibit A**
    b. **Time of Concentration Calculations**
    c. **Haestad Method's PondPack Calculations**
2. **Summit Pass Culvert Calculations**
    a. **Culvert Subareas Drainage Exhibit B**
    b. **Time of Concentration Calculations**
    c. **Haestad Method's PondPack Calculations**
    d. **Haestad Method's FlowMaster Roadside Ditch Capacity**
    e. **Haestad Method's CulvertMaster Calculations**
    f. **USDA NRCS Riprap Calculations**
3. **Summit Pass and Spring Park Storm Drain System**
    a. **Village Area Pond Tributary Area Exhibit C**
    b. **Time of Concentration Calculations**
    c. **Haestad Method's PondPack Calculations**
    d. **Haestad Method's FlowMaster Pond Oriface Calculations**
    e. **Haestad Method's FlowMaster Channel To Pond Capacity**
4. **Village Storm Drain and Tributary Area Exhibits D and D1**
    a. **Haestad Method's FlowMaster Gutter Flow Capacity**
    b. **Haestad Method's StormCAD Inlet Table**
    c. **Haestad Method's StormCAD Pipes Table**
    d. **Haestad Method's FlowMaster Catch Basin Calculations**
5. **NOAA Precipitation Table**
6. **Soils Map/ Report**
7. **Figure 3-1 Average velocities for estimating travel time for shallow concentrated flow**

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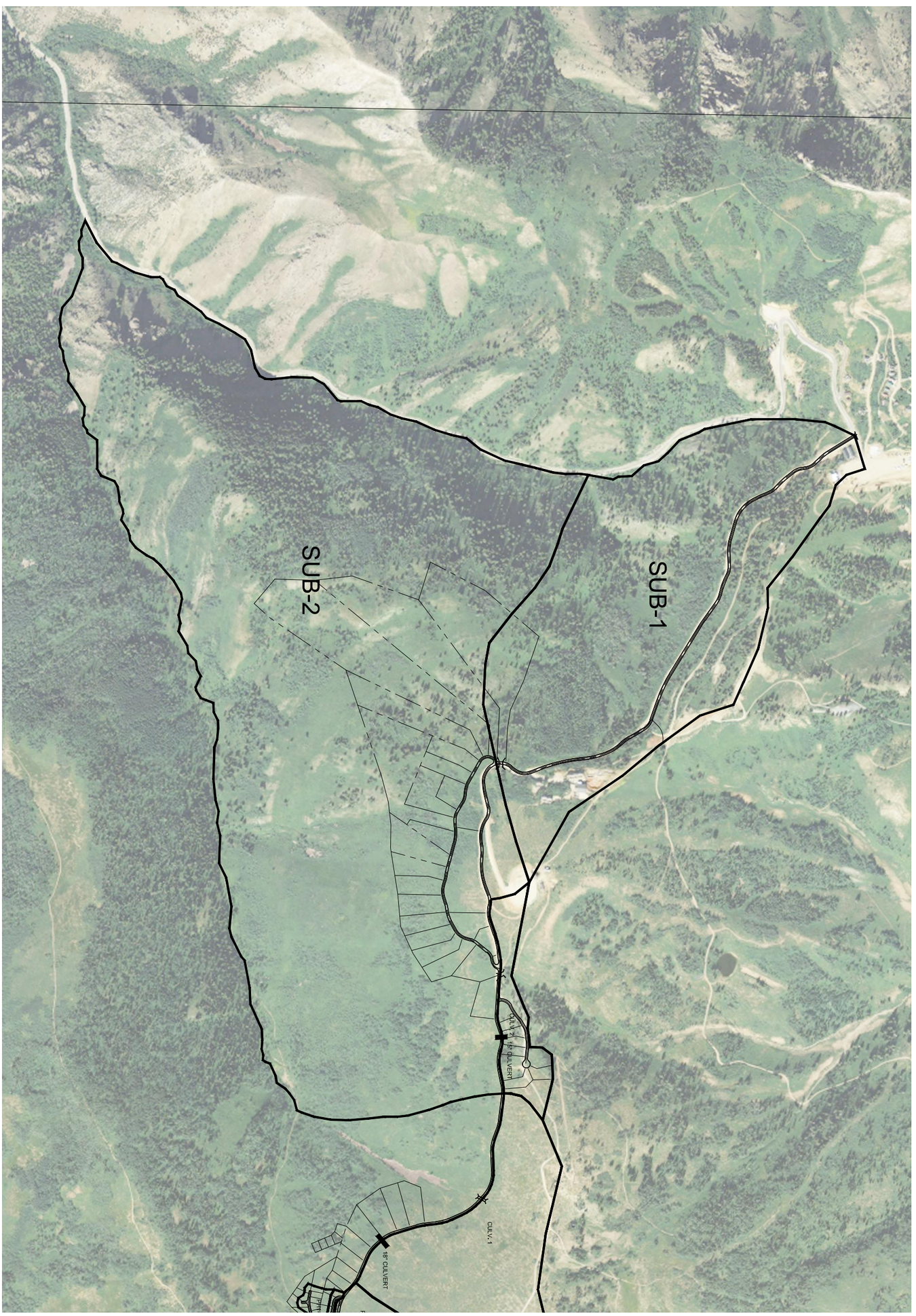

SCALE 1" = 500'
HORIZONTAL

PRELIMINARY

NOT FOR CONSTRUCTION

JOB NUMBER	SLB0793306
SCALE	HORIZONTAL 1" = 250'
SHEETS	--
SHEET NUMBER	A

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SUMMIT AT POWDER MTN PH1

OVERALL DRAINAGE PLAN

PREPARED FOR: SUMMIT, LLC DATE SUBMITTED: 12/21/2012

NO.	BY	DATE	REVISIONS

CAUTION: The engineer preparing these plans will not be responsible for, or liable for, unauthorized changes to or uses of these plans. All changes to the plans must be in writing and must be approved by the preparer of these plans.

Time of Concentration Calculator

Area: **Pre-1 (Sub-1)**

Sheet Flow		
$T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	Mannings roughness coef.	0.045
	Flow Length (<300 lf)	300
	10 yr 2 hr rainfall depth (in.)	1.52
	Slope (ft/ft)	0.062967
	T (hr)=	**0.137657**

Elev. 1	8904	
Elev.2	8885.11	

Shallow Concentrated Flow		
$T_t = \frac{L}{3600\ V}$	Flow Length (ft)	2716
	Slope (ft/ft)	0.252301
	Average Velocity (ft/s)	8
	T (hr)=	**0.094306**

Elev. 1	8885.11	
Elev.2	8199.86	

Channel Flow		
$V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	Cross-Sectional Area (sf)	0.5
	Wetted Perimeter (ft)	12
	Hydraulic Radius, r=a/Pw (ft)	0.041667
	Slope (ft/ft)	0.02
$T_t = \frac{L}{3600\ V}$	Mannings roughness coef.	0.012
	Flow Length (ft)	2179
	Velocity (ft/s)	2.11047
	T (hr)=	**0.286798**

Elev. 1	8199.86	
Elev.2	7645	
Trap Channel		
Depth (ft)	0.5	
Base (ft)	5	
S/S (H:V)	2	

Watershed Tc (hr) **0.51876**

Time of Concentration Calculator

Area: **Pre-2 (Sub-2)**

Sheet Flow		
$T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	Mannings roughness coef.	0.045
	Flow Length (<300 lf)	300
	10 yr 2 hr rainfall depth (in.)	1.52
	Slope (ft/ft)	0.08
	T (hr)=	**0.125086**

Elev. 1	8849	
Elev.2	8825	

Shallow Concentrated Flow		
$T_t = \frac{L}{3600\ V}$	Flow Length (ft)	3151.77
	Slope (ft/ft)	0.260964
	Average Velocity (ft/s)	8
	T (hr)=	**0.109436**

Elev. 1	8825	
Elev.2	8002.5	

Channel Flow		
$V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	Cross-Sectional Area (sf)	3
	Wetted Perimeter (ft)	7.236068
	Hydraulic Radius, r=a/Pw (ft)	0.41459
	Slope (ft/ft)	0.113285
$T_t = \frac{L}{3600\ V}$	Mannings roughness coef.	0.05
	Flow Length (ft)	10244.1
	Velocity (ft/s)	5.576748
	T (hr)=	**0.510259**

Elev. 1	8002.5	
Elev.2	6842	
Trap Channel		
Depth (ft)	0.5	
Base (ft)	5	
S/S (H:V)	2	

Watershed Tc (hr) **0.744781**

Time of Concentration Calculator

Area: **Post-1 (Sub-1)**

Sheet Flow		
$T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	Mannings roughness coef.	0.045
	Flow Length (<300 lf)	300
	10 yr 2 hr rainfall depth (in.)	1.52
	Slope (ft/ft)	0.062967
	T (hr)=	**0.137657**

Elev. 1	8904	
Elev.2	8885.11	

Shallow Concentrated Flow		
$T_t = \frac{L}{3600\ V}$	Flow Length (ft)	1000
	Slope (ft/ft)	0.09661
	Average Velocity (ft/s)	5
	T (hr)=	**0.055556**

Elev. 1	8885.11	
Elev.2	8788.5	

Channel Flow		
$V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	Cross-Sectional Area (sf)	3.375
	Wetted Perimeter (ft)	6.354102
	Hydraulic Radius, r=a/Pw (ft)	0.531153
	Slope (ft/ft)	0.122565
$T_t = \frac{L}{3600\ V}$	Mannings roughness coef.	0.05
	Flow Length (ft)	9329.76
	Velocity (ft/s)	6.842459
	T (hr)=	**0.378753**

Elev. 1	8788.5	
Elev.2	7645	
Trap Channel		
Depth (ft)	0.75	
Base (ft)	3	
S/S (H:V)	2	

Watershed Tc (hr) **0.571966**

Time of Concentration Calculator

Area: **Post-2 (Sub-2)**

Sheet Flow		
$T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	Mannings roughness coef.	0.045
	Flow Length (<300 lf)	300
	10 yr 2 hr rainfall depth (in.)	1.52
	Slope (ft/ft)	0.057667
	T (hr)=	**0.142585**

Elev. 1	8904	
Elev.2	8886.7	

Shallow Concentrated Flow		
$T_t = \frac{L}{3600\ V}$	Flow Length (ft)	4611.64
	Slope (ft/ft)	0.200948
	Average Velocity (ft/s)	7
	T (hr)=	**0.183002**

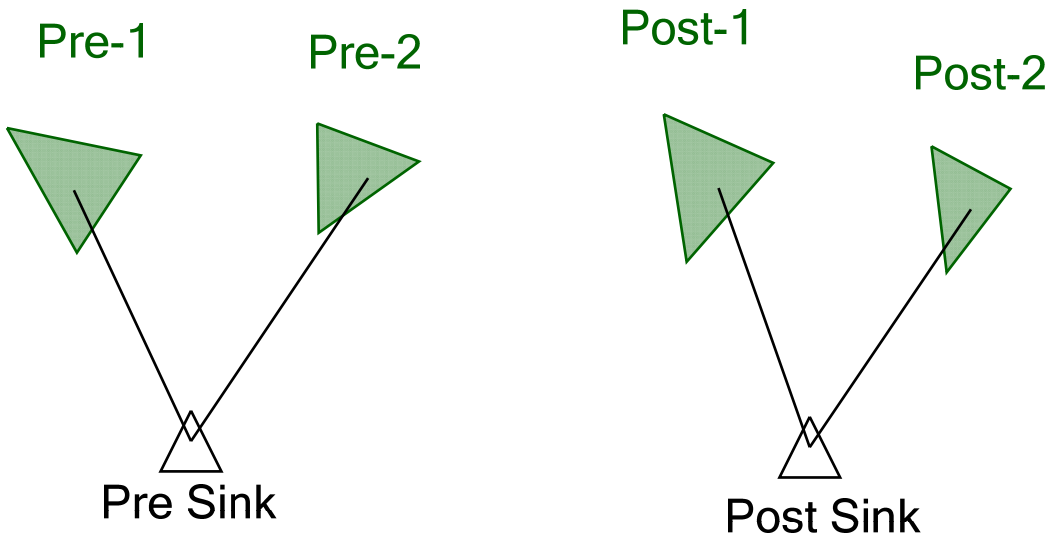
Elev. 1	8886.7	
Elev.2	7960	

Channel Flow		
$V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	Cross-Sectional Area (sf)	3.375
	Wetted Perimeter (ft)	6.354102
	Hydraulic Radius, r=a/Pw (ft)	0.531153
	Slope (ft/ft)	0.113571
$T_t = \frac{L}{3600\ V}$	Mannings roughness coef.	0.05
	Flow Length (ft)	9844.02
	Velocity (ft/s)	6.586641
	T (hr)=	**0.415151**

Elev. 1	7960	
Elev.2	6842	
Trap Channel		
Depth (ft)	0.75	
Base (ft)	3	
S/S (H:V)	2	

Watershed Tc (hr) **0.740737**

Scenario: 10 yr 2 hr



Scenario Calculation Summary

Scenario Summary	
ID	41
Label	10 yr 2 hr
Notes	
Active Topology	<I> Base Active Topology
Hydrology	<I> Base Hydrology
Rainfall Runoff	10 yr 2 hr
Physical	<I> Base Physical
Initial Condition	<I> Base Initial Condition
Boundary Condition	<I> Base Boundary Condition
Infiltration and Inflow	<I> Base Infiltration and Inflow
Output	<I> Base Output
User Data Extensions	<I> Base User Data Extensions
PondPack Engine Calculation Options	<I> Base Calculation Options

Output Summary			
Output Increment	0.050 hours	Duration	24.000 hours

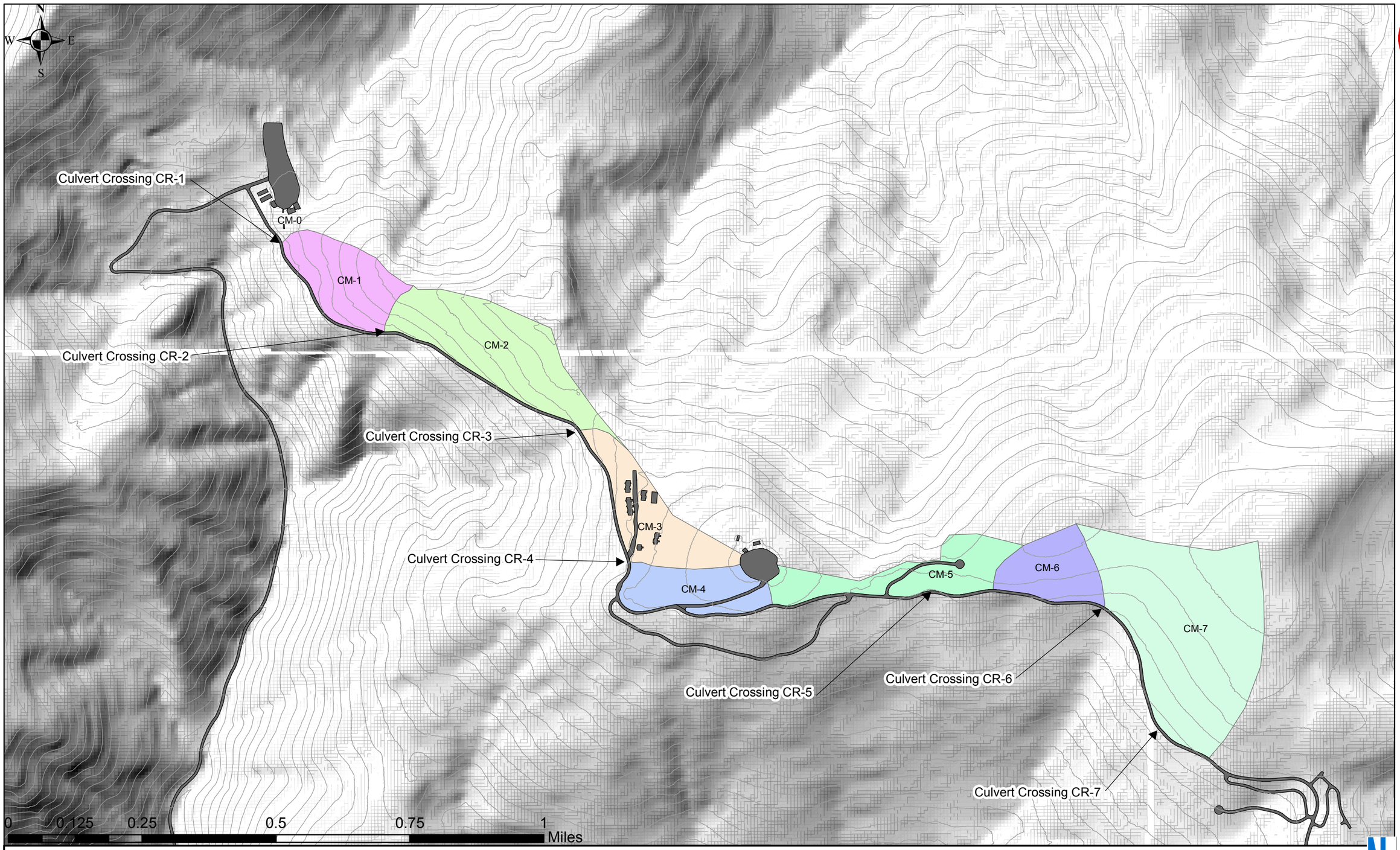
Rainfall Summary			
Return Event Tag	10	Rainfall Type	Time-Depth Curve
Total Depth	1.520 in	Storm Event	10 yr 2 hr

Executive Summary (Nodes)

Label	Scenario	Return Event (years)	Truncation	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
Post Sink	10 yr 2 hr	10	None	4.609	1.250	40.96	(N/A)	(N/A)
Post-1	10 yr 2 hr	10	None	0.105	2.150	1.50	(N/A)	(N/A)
Post-2	10 yr 2 hr	10	None	4.504	1.250	40.86	(N/A)	(N/A)
Pre Sink	10 yr 2 hr	10	None	4.554	1.250	40.86	(N/A)	(N/A)
Pre-1	10 yr 2 hr	10	None	0.049	2.150	0.91	(N/A)	(N/A)
Pre-2	10 yr 2 hr	10	None	4.504	1.250	40.86	(N/A)	(N/A)

Executive Summary (Links)

Label	Type	Location	Hydrograph Volume (ac-ft)	Peak Time (hours)	Peak Flow (ft^3/s)	End Point	Node Flow Direction



B

POWDER MOUNTAIN: SUMMIT PASS & SPRING PARK ROADWAYS

Culvert Catchment Areas

APRIL 2013

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Time of Concentration Calculator

Area: **CM-1**

Sheet Flow		
$T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	Mannings roughness coef.	0.045
	Flow Length (<300 lf)	300
	10 yr 2 hr rainfall depth (in.)	1.52
	Slope (ft/ft)	0.083333
	T (hr)=	**0.12306**

Elev. 1 8543
Elev.2 8518

Shallow Concentrated Flow		
$T_t = \frac{L}{3600\ V}$	Flow Length (ft)	1180
	Slope (ft/ft)	0.238983
	Average Velocity (ft/s)	7.5
	T (hr)=	**0.043704**

Elev. 1 8518
Elev.2 8236

Channel Flow		
$V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	Cross-Sectional Area (sf)	N/A
	Wetted Perimeter (ft)	N/A
	Hydraulic Radius, r=a/Pw (ft)	N/A
	Slope (ft/ft)	N/A
$T_t = \frac{L}{3600\ V}$	Mannings roughness coef.	N/A
	Flow Length (ft)	N/A
	Velocity (ft/s)	N/A
	T (hr)=	**N/A**

Elev. 1 N/A
Elev.2 N/A

Trap Channel
Depth (ft) N/A
Base (ft) N/A
S/S (H:V) N/A

Watershed Tc (hr) **0.166763**

Time of Concentration Calculator

Area: **CM-2**

Sheet Flow		
$T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	Mannings roughness coef.	0.045
	Flow Length (<300 lf)	300
	10 yr 2 hr rainfall depth (in.)	1.52
	Slope (ft/ft)	0.083333
	T (hr)=	**0.12306**

Elev. 1 8714
Elev.2 8689

Shallow Concentrated Flow		
$T_t = \frac{L}{3600\ V}$	Flow Length (ft)	1645
	Slope (ft/ft)	0.192097
	Average Velocity (ft/s)	7
	T (hr)=	**0.065278**

Elev. 1 8689
Elev.2 8373

Channel Flow		
$V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	Cross-Sectional Area (sf)	N/A
	Wetted Perimeter (ft)	N/A
	Hydraulic Radius, r=a/Pw (ft)	N/A
	Slope (ft/ft)	N/A
$T_t = \frac{L}{3600\ V}$	Mannings roughness coef.	N/A
	Flow Length (ft)	N/A
	Velocity (ft/s)	N/A
	T (hr)=	**N/A**

Elev. 1 N/A
Elev.2 N/A

Trap Channel
Depth (ft) N/A
Base (ft) N/A
S/S (H:V) N/A

Watershed Tc (hr) **0.188337**

Time of Concentration Calculator

Area: **CM-3**

Sheet Flow		
$T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	Mannings roughness coef.	0.045
	Flow Length (<300 lf)	300
	10 yr 2 hr rainfall depth (in.)	1.52
	Slope (ft/ft)	0.046667
	T (hr)=	**0.155182**

Elev. 1 8904
Elev.2 8890

Shallow Concentrated Flow		
$T_t = \frac{L}{3600\ V}$	Flow Length (ft)	1925
	Slope (ft/ft)	0.145974
	Average Velocity (ft/s)	6
	T (hr)=	**0.08912**

Elev. 1 8890
Elev.2 8609

Channel Flow		
$V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	Cross-Sectional Area (sf)	N/A
	Wetted Perimeter (ft)	N/A
	Hydraulic Radius, r=a/Pw (ft)	N/A
	Slope (ft/ft)	N/A
$T_t = \frac{L}{3600\ V}$	Mannings roughness coef.	N/A
	Flow Length (ft)	N/A
	Velocity (ft/s)	N/A
	T (hr)=	**N/A**

Elev. 1 N/A
Elev.2 N/A

Trap Channel
Depth (ft) N/A
Base (ft) N/A
S/S (H:V) N/A

Watershed Tc (hr) **0.244302**

Time of Concentration Calculator

Area: **CM-4**

Sheet Flow		
$T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	Mannings roughness coef.	0.045
	Flow Length (<300 lf)	300
	10 yr 2 hr rainfall depth (in.)	1.52
	Slope (ft/ft)	0.04
	T (hr)=	**0.165051**

Elev. 1 8904
Elev.2 8892

Shallow Concentrated Flow		
$T_t = \frac{L}{3600\ V}$	Flow Length (ft)	180
	Slope (ft/ft)	0.194444
	Average Velocity (ft/s)	7
	T (hr)=	**0.007143**

Elev. 1 8892
Elev.2 8857

Channel Flow		
$V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	Cross-Sectional Area (sf)	3.375
	Wetted Perimeter (ft)	6.354102
	Hydraulic Radius, r=a/Pw (ft)	0.531153
	Slope (ft/ft)	0.052764
$T_t = \frac{L}{3600\ V}$	Mannings roughness coef.	0.05
	Flow Length (ft)	1990
	Velocity (ft/s)	4.489494
	T (hr)=	**0.123127**

Elev. 1 8857
Elev.2 8752

Trap Channel
Depth (ft) 0.75
Base (ft) 3
S/S (H:V) 2

Watershed Tc (hr) **0.295321**

Time of Concentration Calculator

Area: **CM-5**

Sheet Flow		
$T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	Mannings roughness coef.	0.045
	Flow Length (<300 lf)	300
	10 yr 2 hr rainfall depth (in.)	1.52
	Slope (ft/ft)	0.013333
	T (hr)=	**0.256134**

Shallow Concentrated Flow		
$T_t = \frac{L}{3600\ V}$	Flow Length (ft)	942
	Slope (ft/ft)	0.129512
	Average Velocity (ft/s)	6
	T (hr)=	**0.043611**

Channel Flow		
$V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	Cross-Sectional Area (sf)	3.375
	Wetted Perimeter (ft)	6.354102
	Hydraulic Radius, r=a/Pw (ft)	0.531153
$T_t = \frac{L}{3600\ V}$	Slope (ft/ft)	0.055932
	Mannings roughness coef.	0.05
	Flow Length (ft)	590
	Velocity (ft/s)	4.622323
	T (hr)=	**0.035456**

Watershed Tc (hr) **0.335201**

Elev. 1	8904
Elev.2	8900
Elev. 1	8900
Elev.2	8778
Elev. 1	8778
Elev.2	8745
Trap Channel	
Depth (ft)	0.75
Base (ft)	3
S/S (H:V)	2

Time of Concentration Calculator

Area: **CM-6**

Sheet Flow		
$T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	Mannings roughness coef.	0.045
	Flow Length (<300 lf)	300
	10 yr 2 hr rainfall depth (in.)	1.52
	Slope (ft/ft)	0.043333
	T (hr)=	**0.159851**

Shallow Concentrated Flow		
$T_t = \frac{L}{3600\ V}$	Flow Length (ft)	658
	Slope (ft/ft)	0.113982
	Average Velocity (ft/s)	5.5
	T (hr)=	**0.033232**

Channel Flow		
$V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	Cross-Sectional Area (sf)	3.375
	Wetted Perimeter (ft)	6.354102
	Hydraulic Radius, r=a/Pw (ft)	0.531153
$T_t = \frac{L}{3600\ V}$	Slope (ft/ft)	0.065062
	Mannings roughness coef.	0.05
	Flow Length (ft)	1122
	Velocity (ft/s)	4.985335
	T (hr)=	**0.062517**

Watershed Tc (hr) **0.2556**

Elev. 1	8872
Elev.2	8859
Elev. 1	8859
Elev.2	8784
Elev. 1	8784
Elev.2	8711
Trap Channel	
Depth (ft)	0.75
Base (ft)	3
S/S (H:V)	2

Time of Concentration Calculator

Area: **CM-7**

Sheet Flow		
$T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	Mannings roughness coef.	0.045
	Flow Length (<300 lf)	300
	10 yr 2 hr rainfall depth (in.)	1.52
	Slope (ft/ft)	0.04
	T (hr)=	**0.165051**

Elev. 1	8894
Elev.2	8882

Shallow Concentrated Flow		
$T_t = \frac{L}{3600\ V}$	Flow Length (ft)	1986
	Slope (ft/ft)	0.1143
	Average Velocity (ft/s)	5.5
	T (hr)=	**0.100303**

Elev. 1	8882
Elev.2	8655

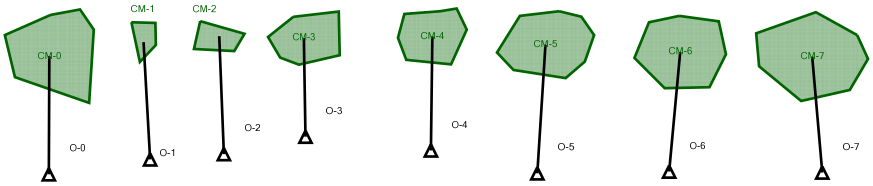
Channel Flow		
$V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	Cross-Sectional Area (sf)	3.375
	Wetted Perimeter (ft)	6.354102
	Hydraulic Radius, r=a/Pw (ft)	0.531153
	Slope (ft/ft)	0.0477
$T_t = \frac{L}{3600\ V}$	Mannings roughness coef.	0.05
	Flow Length (ft)	587
	Velocity (ft/s)	4.268638
	T (hr)=	**0.038198**

Elev. 1	8655
Elev.2	8627

Trap Channel	
Depth (ft)	0.75
Base (ft)	3
S/S (H:V)	2

Watershed Tc (hr) **0.303553**

Scenario: 10 yr 2 hr



Scenario Calculation Summary

Scenario Summary	
ID	41
Label	10 yr 2 hr
Notes	
Active Topology	<I> Base Active Topology
Hydrology	<I> Base Hydrology
Rainfall Runoff	10 yr 2 hr
Physical	<I> Base Physical
Initial Condition	<I> Base Initial Condition
Boundary Condition	<I> Base Boundary Condition
Infiltration and Inflow	<I> Base Infiltration and Inflow
Output	<I> Base Output
User Data Extensions	<I> Base User Data Extensions
PondPack Engine Calculation Options	<I> Base Calculation Options

Output Summary			
Output Increment	0.050 hours	Duration	2.000 hours

Rainfall Summary			
Return Event Tag	10	Rainfall Type	Time-Depth Curve
Total Depth	1.520 in	Storm Event	10 yr 2 hr

Executive Summary (Nodes)

Label	Scenario	Return Event (years)	Truncation	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
CM-0	10 yr 2 hr	10	None	0.006	2.000	0.09	(N/A)	(N/A)
CM-1	10 yr 2 hr	10	None	0.000	0.000	0.00	(N/A)	(N/A)
CM-2	10 yr 2 hr	10	None	0.000	0.000	0.00	(N/A)	(N/A)
CM-3	10 yr 2 hr	10	None	0.055	0.950	0.77	(N/A)	(N/A)
CM-4	10 yr 2 hr	10	None	0.053	0.950	0.75	(N/A)	(N/A)
CM-5	10 yr 2 hr	10	None	0.334	0.800	6.17	(N/A)	(N/A)
CM-6	10 yr 2 hr	10	None	0.086	0.850	1.42	(N/A)	(N/A)
CM-7	10 yr 2 hr	10	None	0.383	0.850	6.07	(N/A)	(N/A)
O-0	10 yr 2 hr	10	None	0.006	2.000	0.09	(N/A)	(N/A)
O-1	10 yr 2 hr	10	None	0.000	0.000	0.00	(N/A)	(N/A)
O-2	10 yr 2 hr	10	None	0.000	0.000	0.00	(N/A)	(N/A)
O-3	10 yr 2 hr	10	None	0.055	0.950	0.77	(N/A)	(N/A)
O-4	10 yr 2 hr	10	None	0.053	0.950	0.75	(N/A)	(N/A)
O-5	10 yr 2 hr	10	None	0.334	0.800	6.17	(N/A)	(N/A)
O-6	10 yr 2 hr	10	None	0.086	0.850	1.42	(N/A)	(N/A)
O-7	10 yr 2 hr	10	None	0.383	0.850	6.07	(N/A)	(N/A)

Executive Summary (Links)

Scenario Calculation Summary

Executive Summary (Links)

Label	Type	Location	Hydrograph Volume (ac-ft)	Peak Time (hours)	Peak Flow (ft^3/s)	End Point	Node Flow Direction

Worksheet for Roadside Ditch Capacity

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.01580	ft/ft
Normal Depth	1.00	ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)

Results

Discharge	11.32	ft^3/s
Flow Area	3.00	ft^2
Wetted Perimeter	6.36	ft
Hydraulic Radius	0.47	ft
Top Width	6.00	ft
Critical Depth	0.98	ft
Critical Slope	0.01800	ft/ft
Velocity	3.77	ft/s
Velocity Head	0.22	ft
Specific Energy	1.22	ft
Froude Number	0.94	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.00	ft
Critical Depth	0.98	ft
Channel Slope	0.01580	ft/ft
Critical Slope	0.01800	ft/ft

Cross Section for Roadside Ditch Capacity

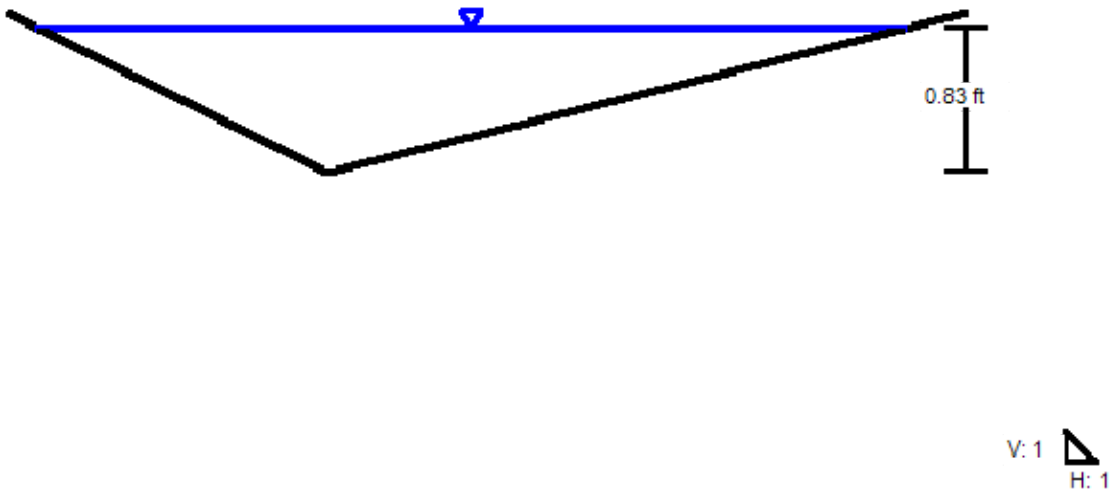
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.01580	ft/ft
Normal Depth	0.83	ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Discharge	6.90	ft³/s

Cross Section Image



Culvert Calculator Report
Culvert CR-1

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	8,233.50	ft	Headwater Depth/Height	0.21	
Computed Headwater Elevation	8,231.08	ft	Discharge	0.33	cfs
Inlet Control HW Elev.	8,231.04	ft	Tailwater Elevation	8,230.38	ft
Outlet Control HW Elev.	8,231.08	ft	Control Type	Entrance Control	

Grades					
Upstream Invert	8,230.76	ft	Downstream Invert	8,230.38	ft
Length	38.00	ft	Constructed Slope	0.010000	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	0.18	ft
Slope Type	Steep		Normal Depth	0.18	ft
Flow Regime	Supercritical		Critical Depth	0.21	ft
Velocity Downstream	2.70	ft/s	Critical Slope	0.005354	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	1.50	ft
Section Size	18 inch		Rise	1.50	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	8,231.08	ft	Upstream Velocity Head	0.07	ft
Ke	0.50		Entrance Loss	0.04	ft

Inlet Control Properties					
Inlet Control HW Elev.	8,231.04	ft	Flow Control	Unsubmerged	
Inlet Type	Square edge w/headwall		Area Full	1.8	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

Culvert Calculator Report
Culvert CR-2

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	8,371.61	ft	Headwater Depth/Height	0.26	
Computed Headwater Elevation	8,369.25	ft	Discharge	0.47	cfs
Inlet Control HW Elev.	8,369.19	ft	Tailwater Elevation	8,368.55	ft
Outlet Control HW Elev.	8,369.25	ft	Control Type	Entrance Control	

Grades					
Upstream Invert	8,368.86	ft	Downstream Invert	8,368.55	ft
Length	31.00	ft	Constructed Slope	0.010000	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	0.22	ft
Slope Type	Steep		Normal Depth	0.22	ft
Flow Regime	Supercritical		Critical Depth	0.25	ft
Velocity Downstream	3.00	ft/s	Critical Slope	0.005161	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	1.50	ft
Section Size	18 inch		Rise	1.50	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	8,369.25	ft	Upstream Velocity Head	0.09	ft
Ke	0.50		Entrance Loss	0.04	ft

Inlet Control Properties					
Inlet Control HW Elev.	8,369.19	ft	Flow Control	Unsubmerged	
Inlet Type	Square edge w/headwall		Area Full	1.8	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

Culvert Calculator Report
Culvert CR-3

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	8,606.33	ft	Headwater Depth/Height	0.33	
Computed Headwater Elevation	8,604.08	ft	Discharge	0.77	cfs
Inlet Control HW Elev.	8,604.02	ft	Tailwater Elevation	8,603.24	ft
Outlet Control HW Elev.	8,604.08	ft	Control Type	Entrance Control	

Grades					
Upstream Invert	8,603.58	ft	Downstream Invert	8,603.24	ft
Length	34.00	ft	Constructed Slope	0.010000	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	0.27	ft
Slope Type	Steep		Normal Depth	0.27	ft
Flow Regime	Supercritical		Critical Depth	0.33	ft
Velocity Downstream	3.47	ft/s	Critical Slope	0.004989	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	1.50	ft
Section Size	18 inch		Rise	1.50	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	8,604.08	ft	Upstream Velocity Head	0.11	ft
Ke	0.50		Entrance Loss	0.06	ft

Inlet Control Properties					
Inlet Control HW Elev.	8,604.02	ft	Flow Control	Unsubmerged	
Inlet Type	Square edge w/headwall		Area Full	1.8	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

Culvert Calculator Report
Culvert CR-4

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	8,751.38	ft	Headwater Depth/Height	0.33	
Computed Headwater Elevation	8,749.12	ft	Discharge	0.75	cfs
Inlet Control HW Elev.	8,749.06	ft	Tailwater Elevation	8,748.26	ft
Outlet Control HW Elev.	8,749.12	ft	Control Type	Entrance Control	

Grades					
Upstream Invert	8,748.63	ft	Downstream Invert	8,748.26	ft
Length	37.00	ft	Constructed Slope	0.010000	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	0.27	ft
Slope Type	Steep		Normal Depth	0.27	ft
Flow Regime	Supercritical		Critical Depth	0.32	ft
Velocity Downstream	3.44	ft/s	Critical Slope	0.005001	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	1.50	ft
Section Size	18 inch		Rise	1.50	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	8,749.12	ft	Upstream Velocity Head	0.11	ft
Ke	0.50		Entrance Loss	0.06	ft

Inlet Control Properties					
Inlet Control HW Elev.	8,749.06	ft	Flow Control	Unsubmerged	
Inlet Type	Square edge w/headwall		Area Full	1.8	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

Culvert Calculator Report
Culvert CR-5

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	8,745.52	ft	Headwater Depth/Height	1.05	
Computed Headwater Elevation	8,744.35	ft	Discharge	6.17	cfs
Inlet Control HW Elev.	8,744.26	ft	Tailwater Elevation	8,742.41	ft
Outlet Control HW Elev.	8,744.35	ft	Control Type	Entrance Control	

Grades					
Upstream Invert	8,742.77	ft	Downstream Invert	8,742.41	ft
Length	36.00	ft	Constructed Slope	0.010000	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	0.83	ft
Slope Type	Steep		Normal Depth	0.83	ft
Flow Regime	Supercritical		Critical Depth	0.96	ft
Velocity Downstream	6.12	ft/s	Critical Slope	0.006310	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	1.50	ft
Section Size	18 inch		Rise	1.50	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	8,744.35	ft	Upstream Velocity Head	0.41	ft
Ke	0.50		Entrance Loss	0.21	ft

Inlet Control Properties					
Inlet Control HW Elev.	8,744.26	ft	Flow Control	Unsubmerged	
Inlet Type	Square edge w/headwall		Area Full	1.8	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

Culvert Calculator Report
Culvert CR-6

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	8,709.63	ft	Headwater Depth/Height	0.46	
Computed Headwater Elevation	8,707.57	ft	Discharge	1.42	cfs
Inlet Control HW Elev.	8,707.49	ft	Tailwater Elevation	8,706.52	ft
Outlet Control HW Elev.	8,707.57	ft	Control Type	Entrance Control	

Grades					
Upstream Invert	8,706.88	ft	Downstream Invert	8,706.52	ft
Length	36.00	ft	Constructed Slope	0.010000	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	0.37	ft
Slope Type	Steep		Normal Depth	0.37	ft
Flow Regime	Supercritical		Critical Depth	0.45	ft
Velocity Downstream	4.15	ft/s	Critical Slope	0.004905	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	1.50	ft
Section Size	18 inch		Rise	1.50	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	8,707.57	ft	Upstream Velocity Head	0.16	ft
Ke	0.50		Entrance Loss	0.08	ft

Inlet Control Properties					
Inlet Control HW Elev.	8,707.49	ft	Flow Control	Unsubmerged	
Inlet Type	Square edge w/headwall		Area Full	1.8	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

Culvert Calculator Report
Culvert CR-7

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	8,622.08	ft	Headwater Depth/Height	1.04	
Computed Headwater Elevation	8,620.90	ft	Discharge	6.07	cfs
Inlet Control HW Elev.	8,620.80	ft	Tailwater Elevation	8,618.98	ft
Outlet Control HW Elev.	8,620.90	ft	Control Type	Entrance Control	

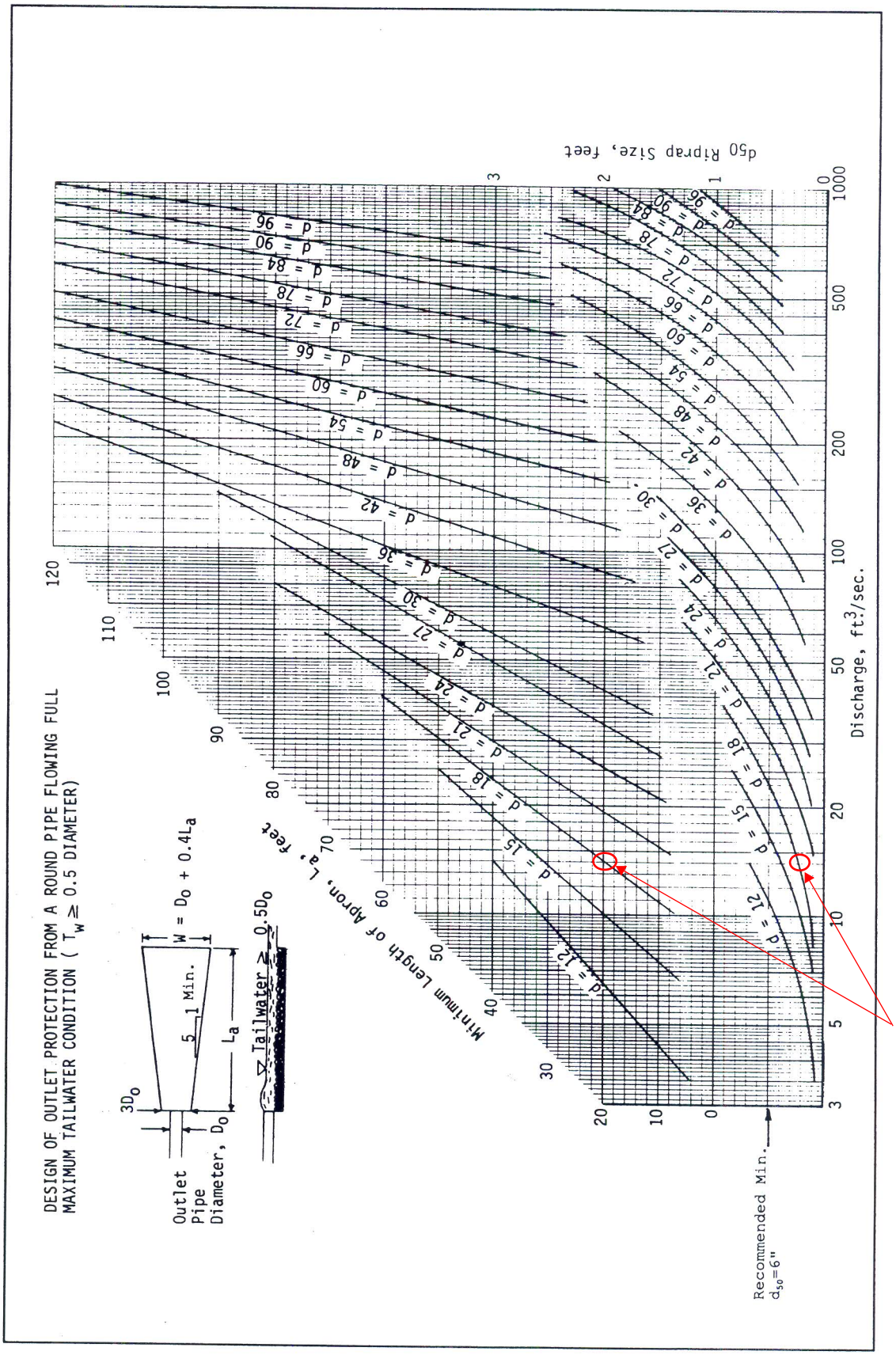
Grades					
Upstream Invert	8,619.33	ft	Downstream Invert	8,618.98	ft
Length	35.00	ft	Constructed Slope	0.010000	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	0.83	ft
Slope Type	Steep		Normal Depth	0.82	ft
Flow Regime	Supercritical		Critical Depth	0.95	ft
Velocity Downstream	6.09	ft/s	Critical Slope	0.006260	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	1.50	ft
Section Size	18 inch		Rise	1.50	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	8,620.90	ft	Upstream Velocity Head	0.41	ft
Ke	0.50		Entrance Loss	0.20	ft

Inlet Control Properties					
Inlet Control HW Elev.	8,620.80	ft	Flow Control	Unsubmerged	
Inlet Type	Square edge w/headwall		Area Full	1.8	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				



Based on the above figure. The riprap aprons for the culverts under Summit Pass will have, as a minimum, D50=6", an apron that is 7.5' (wide) x 20' (long). The apron will be 18" thick.

Source: USDA-SCS

Plate 3.18-4

C

N
W E
S

Tributary Area for Pond 1

Tributary Area for Pond 2

0 0.075 0.15 0.3 0.45 0.6
Miles

POWDER MOUNTAIN: SUMMIT PASS & SPRING PARK ROADWAYS

Pond Tributary Areas

APRIL 2013

BEYOND ENGINEERING

FILENAME: N:\SLB0153\GIS\MXD\StormDrainMOBI\D3MOBIntCBAreas.mxd

Time of Concentration Calculator

Area: **CM-A-10**

Sheet Flow		
$T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	Mannings roughness coef.	0.045
	Flow Length (<300 lf)	300
	10 yr 2 hr rainfall depth (in.)	1.52
	Slope (ft/ft)	0.096667
	T (hr)=	**0.115967**

Shallow Concentrated Flow		
$T_t = \frac{L}{3600\ V}$	Flow Length (ft)	515
	Slope (ft/ft)	0.209709
	Average Velocity (ft/s)	7.5
	T (hr)=	**0.019074**

Channel Flow		
$V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	Cross-Sectional Area (sf)	3.375
	Wetted Perimeter (ft)	6.354102
	Hydraulic Radius, r=a/Pw (ft)	0.531153
$T_t = \frac{L}{3600\ V}$	Slope (ft/ft)	0.013065
	Mannings roughness coef.	0.05
	Flow Length (ft)	1990
	Velocity (ft/s)	2.234032
	T (hr)=	**0.247435**

Watershed Tc (hr) **0.135041**

Elev. 1	8772
Elev.2	8743
Elev. 1	8743
Elev.2	8635
Elev. 1	8635
Elev.2	8609
Trap Channel	
Depth (ft)	0.75
Base (ft)	3
S/S (H:V)	2

Time of Concentration Calculator

Area: **CM-A-12**

Sheet Flow		
$T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	Mannings roughness coef.	0.045
	Flow Length (<300 lf)	78
	10 yr 2 hr rainfall depth (in.)	1.52
	Slope (ft/ft)	0.089744
	T (hr)=	**0.040665**

Shallow Concentrated Flow		
$T_t = \frac{L}{3600\ V}$	Flow Length (ft)	0
	Slope (ft/ft)	#VALUE!
	Average Velocity (ft/s)	7
	T (hr)=	**0**

Channel Flow		
$V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	Cross-Sectional Area (sf)	3.375
	Wetted Perimeter (ft)	6.354102
	Hydraulic Radius, r=a/Pw (ft)	0.531153
$T_t = \frac{L}{3600\ V}$	Slope (ft/ft)	0.22
	Mannings roughness coef.	0.05
	Flow Length (ft)	50
	Velocity (ft/s)	9.167284
	T (hr)=	**0.001515**

Watershed Tc (hr) **0.040665**

Elev. 1	8627
Elev.2	8620
Elev. 1	N/A
Elev.2	N/A
Elev. 1	8620
Elev.2	8609
Trap Channel	
Depth (ft)	0.75
Base (ft)	3
S/S (H:V)	2

Time of Concentration Calculator

Area: **CM-A-3**

Sheet Flow		
$T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	Mannings roughness coef.	0.045
	Flow Length (<300 lf)	300
	10 yr 2 hr rainfall depth (in.)	1.52
	Slope (ft/ft)	0.1
	T (hr)=	**0.114405**

Elev. 1 8815
Elev.2 8785

Shallow Concentrated Flow		
$T_t = \frac{L}{3600\ V}$	Flow Length (ft)	592
	Slope (ft/ft)	0.228041
	Average Velocity (ft/s)	8
	T (hr)=	**0.020556**

Elev. 1 8785
Elev.2 8650

Channel Flow		
$V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ $T_t = \frac{L}{3600\ V}$	Cross-Sectional Area (sf)	3.375
	Wetted Perimeter (ft)	6.354102
	Hydraulic Radius, r=a/Pw (ft)	0.531153
	Slope (ft/ft)	0.033113
	Mannings roughness coef.	0.05
	Flow Length (ft)	453
	Velocity (ft/s)	3.556525
	T (hr)=	**0.035381**

Elev. 1 8650
Elev.2 8635

Trap Channel
Depth (ft) 0.75
Base (ft) 3
S/S (H:V) 2

Watershed Tc (hr) **0.13496**

Time of Concentration Calculator

Area: **CM-A-4**

Sheet Flow		
$T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	Mannings roughness coef.	0.045
	Flow Length (<300 lf)	300
	10 yr 2 hr rainfall depth (in.)	1.52
	Slope (ft/ft)	0.093333
	T (hr)=	**0.117606**

Elev. 1 8827
Elev.2 8799

Shallow Concentrated Flow		
$T_t = \frac{L}{3600\ V}$	Flow Length (ft)	816
	Slope (ft/ft)	0.198529
	Average Velocity (ft/s)	7
	T (hr)=	**0.032381**

Elev. 1 8799
Elev.2 8637

Channel Flow		
$V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ $T_t = \frac{L}{3600\ V}$	Cross-Sectional Area (sf)	3.375
	Wetted Perimeter (ft)	6.354102
	Hydraulic Radius, r=a/Pw (ft)	0.531153
	Slope (ft/ft)	0.027778
	Mannings roughness coef.	0.05
	Flow Length (ft)	72
	Velocity (ft/s)	3.257452
	T (hr)=	**0.00614**

Elev. 1 8637
Elev.2 8635

Trap Channel
Depth (ft) 0.75
Base (ft) 3
S/S (H:V) 2

Watershed Tc (hr) **0.156126**

Time of Concentration Calculator

Area: **CM-A-5**

Sheet Flow		
$T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	Mannings roughness coef.	0.045
	Flow Length (<300 lf)	300
	10 yr 2 hr rainfall depth (in.)	1.52
	Slope (ft/ft)	0.04
	T (hr)=	**0.165051**

Shallow Concentrated Flow		
$T_t = \frac{L}{3600\ V}$	Flow Length (ft)	2133
	Slope (ft/ft)	0.113455
	Average Velocity (ft/s)	5.5
	T (hr)=	**0.107727**

Channel Flow		
$V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	Cross-Sectional Area (sf)	3.375
	Wetted Perimeter (ft)	6.354102
	Hydraulic Radius, r=a/Pw (ft)	0.531153
$T_t = \frac{L}{3600\ V}$	Slope (ft/ft)	0.013216
	Mannings roughness coef.	0.05
	Flow Length (ft)	227
	Velocity (ft/s)	2.246865
	T (hr)=	**0.028064**

Watershed Tc (hr) **0.300842**

Elev. 1	8894
Elev.2	8882
Elev. 1	8882
Elev.2	8640
Elev. 1	8640
Elev.2	8637
Trap Channel	
Depth (ft)	0.75
Base (ft)	3
S/S (H:V)	2

Time of Concentration Calculator

Area: **CM-A-8**

Sheet Flow		
$T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	Mannings roughness coef.	0.045
	Flow Length (<300 lf)	170
	10 yr 2 hr rainfall depth (in.)	1.52
	Slope (ft/ft)	0.117647
	T (hr)=	**0.068057**

Shallow Concentrated Flow		
$T_t = \frac{L}{3600\ V}$	Flow Length (ft)	0
	Slope (ft/ft)	#VALUE!
	Average Velocity (ft/s)	5.5
	T (hr)=	**0**

Channel Flow		
$V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	Cross-Sectional Area (sf)	3.375
	Wetted Perimeter (ft)	6.354102
	Hydraulic Radius, r=a/Pw (ft)	0.531153
$T_t = \frac{L}{3600\ V}$	Slope (ft/ft)	0.010246
	Mannings roughness coef.	0.05
	Flow Length (ft)	488
	Velocity (ft/s)	1.978356
	T (hr)=	**0.068519**

Watershed Tc (hr) **0.136576**

Elev. 1	8655
Elev.2	8635
Elev. 1	N/A
Elev.2	N/A
Elev. 1	8635
Elev.2	8630
Trap Channel	
Depth (ft)	0.75
Base (ft)	3
S/S (H:V)	2

Time of Concentration Calculator

Area: **CM-E-4**

Sheet Flow		
$T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	Mannings roughness coef.	0.045
	Flow Length (<300 lf)	300
	10 yr 2 hr rainfall depth (in.)	1.52
	Slope (ft/ft)	0.17
	T (hr)=	**0.092526**

Elev. 1 8635
Elev.2 8584

Shallow Concentrated Flow		
$T_t = \frac{L}{3600\ V}$	Flow Length (ft)	75
	Slope (ft/ft)	0.146667
	Average Velocity (ft/s)	6
	T (hr)=	**0.003472**

Elev. 1 8584
Elev.2 8573

Channel Flow		
$V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	Cross-Sectional Area (sf)	3.375
	Wetted Perimeter (ft)	6.354102
	Hydraulic Radius, r=a/Pw (ft)	0.531153
$T_t = \frac{L}{3600\ V}$	Slope (ft/ft)	0.064706
	Mannings roughness coef.	0.05
	Flow Length (ft)	510
	Velocity (ft/s)	4.971658
	T (hr)=	**0.028495**

Elev. 1 8573
Elev.2 8540

Trap Channel
Depth (ft) 0.75
Base (ft) 3
S/S (H:V) 2

Watershed Tc (hr) **0.124493**

Time of Concentration Calculator

Area: **CM-P-1**

Sheet Flow		
$T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	Mannings roughness coef.	0.045
	Flow Length (<300 lf)	300
	10 yr 2 hr rainfall depth (in.)	1.52
	Slope (ft/ft)	0.156667
	T (hr)=	**0.095599**

Elev. 1 8623
Elev.2 8576

Shallow Concentrated Flow		
$T_t = \frac{L}{3600\ V}$	Flow Length (ft)	644
	Slope (ft/ft)	0.13354
	Average Velocity (ft/s)	5.25
	T (hr)=	**0.034074**

Elev. 1 8576
Elev.2 8490

Channel Flow		
$V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	Cross-Sectional Area (sf)	N/A
	Wetted Perimeter (ft)	N/A
	Hydraulic Radius, r=a/Pw (ft)	N/A
$T_t = \frac{L}{3600\ V}$	Slope (ft/ft)	N/A
	Mannings roughness coef.	N/A
	Flow Length (ft)	N/A
	Velocity (ft/s)	N/A
	T (hr)=	**N/A**

Elev. 1 N/A
Elev.2 N/A

Trap Channel
Depth (ft) N/A
Base (ft) N/A
S/S (H:V) N/A

Watershed Tc (hr) **0.129673**

Time of Concentration Calculator

Area: **CM-P-2**

Sheet Flow		
$T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	Mannings roughness coef.	0.045
	Flow Length (<300 lf)	300
	10 yr 2 hr rainfall depth (in.)	1.52
	Slope (ft/ft)	0.036667
	T (hr)=	**0.170897**

Elev. 1	8637
Elev.2	8626

Shallow Concentrated Flow		
$T_t = \frac{L}{3600\ V}$	Flow Length (ft)	757
	Slope (ft/ft)	0.097754
	Average Velocity (ft/s)	5
	T (hr)=	**0.042056**

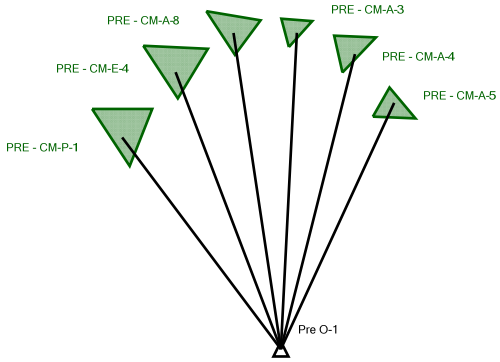
Elev. 1	8626
Elev.2	8552

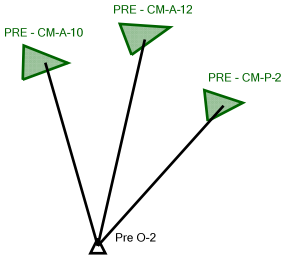
Channel Flow		
$V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	Cross-Sectional Area (sf)	N/A
	Wetted Perimeter (ft)	N/A
	Hydraulic Radius, r=a/Pw (ft)	N/A
	Slope (ft/ft)	N/A
$T_t = \frac{L}{3600\ V}$	Mannings roughness coef.	N/A
	Flow Length (ft)	N/A
	Velocity (ft/s)	N/A
	T (hr)=	**N/A**

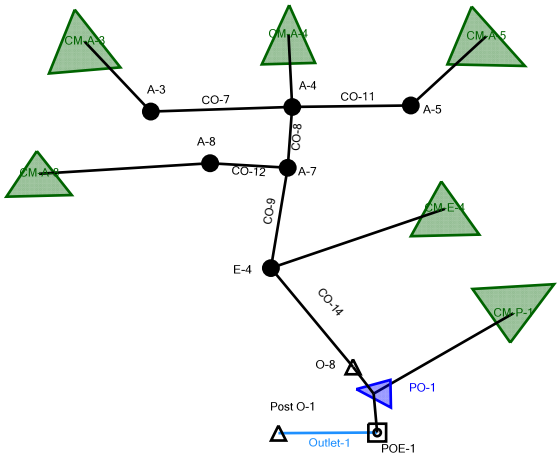
Elev. 1	N/A
Elev.2	N/A
Trap Channel	
Depth (ft)	N/A
Base (ft)	N/A
S/S (H:V)	N/A

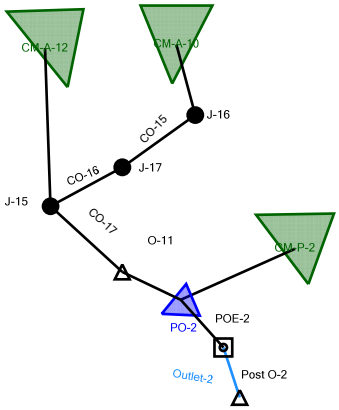
Watershed Tc (hr) **0.212953**

Scenario: 10 yr 2 hr









Scenario Calculation Summary

Scenario Summary	
ID	41
Label	10 yr 2 hr
Notes	
Active Topology	<I> Base Active Topology
Hydrology	<I> Base Hydrology
Rainfall Runoff	10 yr 2 hr
Physical	<I> Base Physical
Initial Condition	<I> Base Initial Condition
Boundary Condition	<I> Base Boundary Condition
Infiltration and Inflow	<I> Base Infiltration and Inflow
Output	<I> Base Output
User Data Extensions	<I> Base User Data Extensions
PondPack Engine Calculation Options	<I> Base Calculation Options

Output Summary			
Output Increment	0.010 hours	Duration	2.000 hours

Rainfall Summary			
Return Event Tag	10	Rainfall Type	Time-Depth Curve
Total Depth	1.520 in	Storm Event	10 yr 2 hr

Executive Summary (Nodes)

Label	Scenario	Return Event (years)	Truncation	Hydrograph Volume (ft³)	Time to Peak (hours)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ft³)
A-3	10 yr 2 hr	10	None	1,702.000	0.720	0.83	(N/A)	(N/A)
A-4	10 yr 2 hr	10	None	7,362.000	0.750	2.89	(N/A)	(N/A)
A-5	10 yr 2 hr	10	None	3,392.000	0.840	1.30	(N/A)	(N/A)
A-7	10 yr 2 hr	10	None	7,345.000	0.760	2.89	(N/A)	(N/A)
A-8	10 yr 2 hr	10	None	0.000	0.000	0.00	(N/A)	(N/A)
CM-A-10	10 yr 2 hr	10	None	2,767.000	0.720	1.23	(N/A)	(N/A)
CM-A-12	10 yr 2 hr	10	None	90.000	0.860	0.03	(N/A)	(N/A)
CM-A-3	10 yr 2 hr	10	None	1,702.000	0.720	0.83	(N/A)	(N/A)
CM-A-4	10 yr 2 hr	10	None	2,291.000	0.730	1.09	(N/A)	(N/A)
CM-A-5	10 yr 2 hr	10	None	3,392.000	0.840	1.30	(N/A)	(N/A)
CM-A-8	10 yr 2 hr	10	None	0.000	0.000	0.00	(N/A)	(N/A)
CM-E-4	10 yr 2 hr	10	None	12,954.000	0.560	8.86	(N/A)	(N/A)
CM-P-1	10 yr 2 hr	10	None	2,086.000	0.710	1.04	(N/A)	(N/A)
CM-P-2	10 yr 2 hr	10	None	377.000	1.050	0.11	(N/A)	(N/A)
E-4	10 yr 2 hr	10	None	20,089.000	0.560	8.92	(N/A)	(N/A)
J-15	10 yr 2 hr	10	None	2,842.000	0.730	1.24	(N/A)	(N/A)
J-16	10 yr 2 hr	10	None	2,767.000	0.720	1.23	(N/A)	(N/A)
J-17	10 yr 2 hr	10	None	2,760.000	0.730	1.23	(N/A)	(N/A)
PO-1 (IN)	10 yr 2 hr	10	None	22,142.000	0.710	9.37	(N/A)	(N/A)
PO-1 (OUT)	10 yr 2 hr	10	None	15,023.000	1.100	3.35	8,480.60	9,999.000

Scenario Calculation Summary

Executive Summary (Nodes)

Label	Scenario	Return Event (years)	Truncation	Hydrograph Volume (ft^3)	Time to Peak (hours)	Peak Flow (ft^3/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ft^3)
PO-2 (IN)	10 yr 2 hr	10	None	3,211.000	0.740	1.25	(N/A)	(N/A)
PO-2 (OUT)	10 yr 2 hr	10	None	749.000	2.000	0.17	8,536.79	2,452.000
PRE - CM-A-10	10 yr 2 hr	10	None	524.000	2.000	0.17	(N/A)	(N/A)
PRE - CM-A-12	10 yr 2 hr	10	None	4.000	2.000	0.00	(N/A)	(N/A)
PRE - CM-A-3	10 yr 2 hr	10	None	1,507.000	0.720	0.71	(N/A)	(N/A)
PRE - CM-A-4	10 yr 2 hr	10	None	1,804.000	0.730	0.81	(N/A)	(N/A)
PRE - CM-A-5	10 yr 2 hr	10	None	2,717.000	0.880	1.00	(N/A)	(N/A)
PRE - CM-A-8	10 yr 2 hr	10	None	98.000	0.720	0.05	(N/A)	(N/A)
PRE - CM-E-4	10 yr 2 hr	10	None	2,056.000	0.720	0.90	(N/A)	(N/A)
PRE - CM-P-1	10 yr 2 hr	10	None	1,303.000	0.720	0.56	(N/A)	(N/A)
PRE - CM-P-2	10 yr 2 hr	10	None	0.000	0.000	0.00	(N/A)	(N/A)
Post O-1	10 yr 2 hr	10	None	15,023.000	1.100	3.35	(N/A)	(N/A)
Post O-2	10 yr 2 hr	10	None	749.000	2.000	0.17	(N/A)	(N/A)
Pre O-1	10 yr 2 hr	10	None	9,485.000	0.730	3.68	(N/A)	(N/A)
Pre O-2	10 yr 2 hr	10	None	528.000	2.000	0.17	(N/A)	(N/A)

Executive Summary (Links)

Label	Type	Location	Hydrograph Volume (ft^3)	Peak Time (hours)	Peak Flow (ft^3/s)	End Point	Node Flow Direction
CO-11	Channel	Upstream	3,392.000	0.840	1.30	A-5	
CO-11	Channel	Link	3,379.000	0.850	1.30		
CO-11	Channel	Downstream	7,362.000	0.750	2.89	A-4	
CO-12	Channel	Upstream	0.000	0.000	0.00	A-8	
CO-12	Channel	Link	0.000	0.000	0.00		
CO-12	Channel	Downstream	7,345.000	0.760	2.89	A-7	
CO-14	Channel	Upstream	20,089.000	0.560	8.92	E-4	
CO-14	Channel	Link	20,089.000	0.570	8.90		
CO-14	Channel	Downstream	22,142.000	0.710	9.37	PO-1	
CO-15	Channel	Upstream	2,767.000	0.720	1.23	J-16	
CO-15	Channel	Link	2,767.000	0.730	1.23		
CO-15	Channel	Downstream	2,760.000	0.730	1.23	J-17	
CO-16	Channel	Upstream	2,760.000	0.730	1.23	J-17	
CO-16	Channel	Link	2,760.000	0.730	1.22		
CO-16	Channel	Downstream	2,842.000	0.730	1.24	J-15	

Scenario Calculation Summary

Executive Summary (Links)

Label	Type	Location	Hydrograph Volume (ft^3)	Peak Time (hours)	Peak Flow (ft^3/s)	End Point	Node Flow Direction
CO-17	Channel	Upstream	2,842.000	0.730	1.24	J-15	
CO-17	Channel	Link	2,842.000	0.740	1.24		
CO-17	Channel	Downstream	3,211.000	0.740	1.25	PO-2	
CO-7	Channel	Upstream	1,702.000	0.720	0.83	A-3	
CO-7	Channel	Link	1,693.000	0.720	0.82		
CO-7	Channel	Downstream	7,362.000	0.750	2.89	A-4	
CO-8	Channel	Upstream	7,362.000	0.750	2.89	A-4	
CO-8	Channel	Link	7,362.000	0.760	2.89		
CO-8	Channel	Downstream	7,345.000	0.760	2.89	A-7	
CO-9	Channel	Upstream	7,345.000	0.760	2.89	A-7	
CO-9	Channel	Link	7,135.000	0.800	2.78		
CO-9	Channel	Downstream	20,089.000	0.560	8.92	E-4	
Outlet-1	Pond Outlet	Upstream	22,142.000	0.710	9.37	PO-1	Pond Inflow
Outlet-1	Pond Outlet	Outflow	15,023.000	1.100	3.35	PO-1	Pond Outflow
Outlet-1	Pond Outlet	Link	15,023.000	1.100	3.35		
Outlet-1	Pond Outlet	Downstream	15,023.000	1.100	3.35	Post O-1	
Outlet-2	Pond Outlet	Upstream	3,211.000	0.740	1.25	PO-2	Pond Inflow
Outlet-2	Pond Outlet	Outflow	749.000	2.000	0.17	PO-2	Pond Outflow
Outlet-2	Pond Outlet	Link	749.000	2.000	0.17		
Outlet-2	Pond Outlet	Downstream	749.000	2.000	0.17	Post O-2	

Messages

Message Id	15
Scenario	10 yr 2 hr
Element Type	Composite Outlet Structure
Element Id	34
Label	Composite Outlet Structure - Pond 1
Time	(N/A)
Message	Kr (reverse flow entrance loss coefficient) was not specified. Kr was set to same value as Ke= 0.200 .
Source	Warning
Message Id	41
Scenario	10 yr 2 hr
Element Type	Conduit
Element Id	114
Label	CO-11
Time	(N/A)
Message	For weighted average inflow = 0.81 ft^3/s, travel time is shorter than the output increment in calculation options = 0.007 hours. Consider reducing output increment.
Source	Warning

Scenario Calculation Summary

Messages

Message Id	41
Scenario	10 yr 2 hr
Element Type	Conduit
Element Id	109
Label	CO-7
Time	(N/A)
Message	For weighted average inflow = 0.43 ft³/s, travel time is shorter than the output increment in calculation options = 0.009 hours. Consider reducing output increment.
Source	Warning
Message Id	41
Scenario	10 yr 2 hr
Element Type	Conduit
Element Id	128
Label	CO-15
Time	(N/A)
Message	For weighted average inflow = 0.66 ft³/s, travel time is shorter than the output increment in calculation options = 0.001 hours. Consider reducing output increment.
Source	Warning
Message Id	41
Scenario	10 yr 2 hr
Element Type	Conduit
Element Id	110
Label	CO-8
Time	(N/A)
Message	For weighted average inflow = 1.75 ft³/s, travel time is shorter than the output increment in calculation options = 0.002 hours. Consider reducing output increment.
Source	Warning
Message Id	41
Scenario	10 yr 2 hr
Element Type	Conduit
Element Id	115
Label	CO-12
Time	(N/A)
Message	For weighted average inflow = 0.00 ft³/s, travel time is shorter than the output increment in calculation options = 0.000 hours. Consider reducing output increment.
Source	Warning
Message Id	41
Scenario	10 yr 2 hr
Element Type	Conduit
Element Id	129
Label	CO-16
Time	(N/A)
Message	For weighted average inflow = 0.66 ft³/s, travel time is shorter than the output increment in calculation options = 0.001 hours. Consider reducing output increment.
Source	Warning

Scenario Calculation Summary

Messages

Message Id	41
Scenario	10 yr 2 hr
Element Type	Conduit
Element Id	130
Label	CO-17
Time	(N/A)
Message	For weighted average inflow = 0.68 ft³/s, travel time is shorter than the output increment in calculation options = 0.001 hours. Consider reducing output increment.
Source	Warning
Message Id	40
Scenario	10 yr 2 hr
Element Type	Pond
Element Id	81
Label	PO-2
Time	(N/A)
Message	Mass balance for routing volumes vary by more than 0.5 %. (0.5 % of Inflow Volume))
Source	Warning
Message Id	48
Scenario	10 yr 2 hr
Element Type	Pond
Element Id	81
Label	PO-2
Time	(N/A)
Message	Outflow hydrograph never crested (last ordinate = max outflow).
Source	Warning
Message Id	41
Scenario	10 yr 2 hr
Element Type	Conduit
Element Id	119
Label	CO-14
Time	(N/A)
Message	For weighted average inflow = 5.20 ft³/s, travel time is shorter than the output increment in calculation options = 0.002 hours. Consider reducing output increment.
Source	Warning

Worksheet for Orifice - Pond 1

Project Description

Solve For	Discharge

Input Data

Headwater Elevation	8480.60	ft
Centroid Elevation	8478.64	ft
Tailwater Elevation	8477.40	ft
Discharge Coefficient	0.60	
Diameter	10.00	in

Results

Discharge	3.68	ft^3/s
Headwater Height Above Centroid	1.96	ft
Tailwater Height Above Centroid	-1.24	ft
Flow Area	0.55	ft^2
Velocity	6.74	ft/s

Worksheet for Orifice - Pond 2

Project Description

Solve For	Discharge

Input Data

Headwater Elevation	8536.79	ft
Centroid Elevation	8534.10	ft
Tailwater Elevation	8532.90	ft
Discharge Coefficient	0.60	
Diameter	2.00	in

Results

Discharge	0.17	ft^3/s
Headwater Height Above Centroid	2.69	ft
Tailwater Height Above Centroid	-1.20	ft
Flow Area	0.02	ft^2
Velocity	7.89	ft/s

Worksheet for Overflow Weir - Pond 1

Project Description

Solve For	Headwater Elevation

Input Data

Discharge	9.37	ft^3/s
Crest Elevation	8481.00	ft
Weir Coefficient	3.33	US
Crest Length	15.00	ft

Results

Headwater Elevation	8481.33	ft
Headwater Height Above Crest	0.33	ft
Flow Area	4.92	ft^2
Velocity	1.91	ft/s
Wetted Perimeter	15.66	ft
Top Width	15.00	ft

Worksheet for Overflow Weir - Pond 2

Project Description

Solve For	Headwater Elevation

Input Data

Discharge	1.25	ft^3/s
Crest Elevation	8540.00	ft
Weir Coefficient	3.33	US
Crest Length	5.00	ft

Results

Headwater Elevation	8540.18	ft
Headwater Height Above Crest	0.18	ft
Flow Area	0.89	ft^2
Velocity	1.40	ft/s
Wetted Perimeter	5.36	ft
Top Width	5.00	ft

Worksheet for Channel to Pond 1

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.02000	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Discharge	9.37	ft^3/s

Results

Normal Depth	0.89	ft
Flow Area	2.38	ft^2
Wetted Perimeter	5.63	ft
Hydraulic Radius	0.42	ft
Top Width	5.34	ft
Critical Depth	0.90	ft
Critical Slope	0.01833	ft/ft
Velocity	3.94	ft/s
Velocity Head	0.24	ft
Specific Energy	1.13	ft
Froude Number	1.04	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.89	ft
Critical Depth	0.90	ft
Channel Slope	0.02000	ft/ft
Critical Slope	0.01833	ft/ft

Worksheet for Channel to Pond 2

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.02000	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Discharge	1.25	ft^3/s

Results

Normal Depth	0.42	ft
Flow Area	0.52	ft^2
Wetted Perimeter	2.64	ft
Hydraulic Radius	0.20	ft
Top Width	2.51	ft
Critical Depth	0.40	ft
Critical Slope	0.02397	ft/ft
Velocity	2.38	ft/s
Velocity Head	0.09	ft
Specific Energy	0.51	ft
Froude Number	0.92	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.42	ft
Critical Depth	0.40	ft
Channel Slope	0.02000	ft/ft
Critical Slope	0.02397	ft/ft

D

N
W E
S

CM-A-5
CM-A-4
CM-A-3
CM-A-8
CM-E-4
CM-A-10
CM-P-1
Pond 1
CM-A-12
CM-P-2
Pond 2

0 0.05 0.1 0.2 0.3 0.4
Miles

POWDER MOUNTAIN: SUMMIT PASS & SPRING PARK ROADWAYS

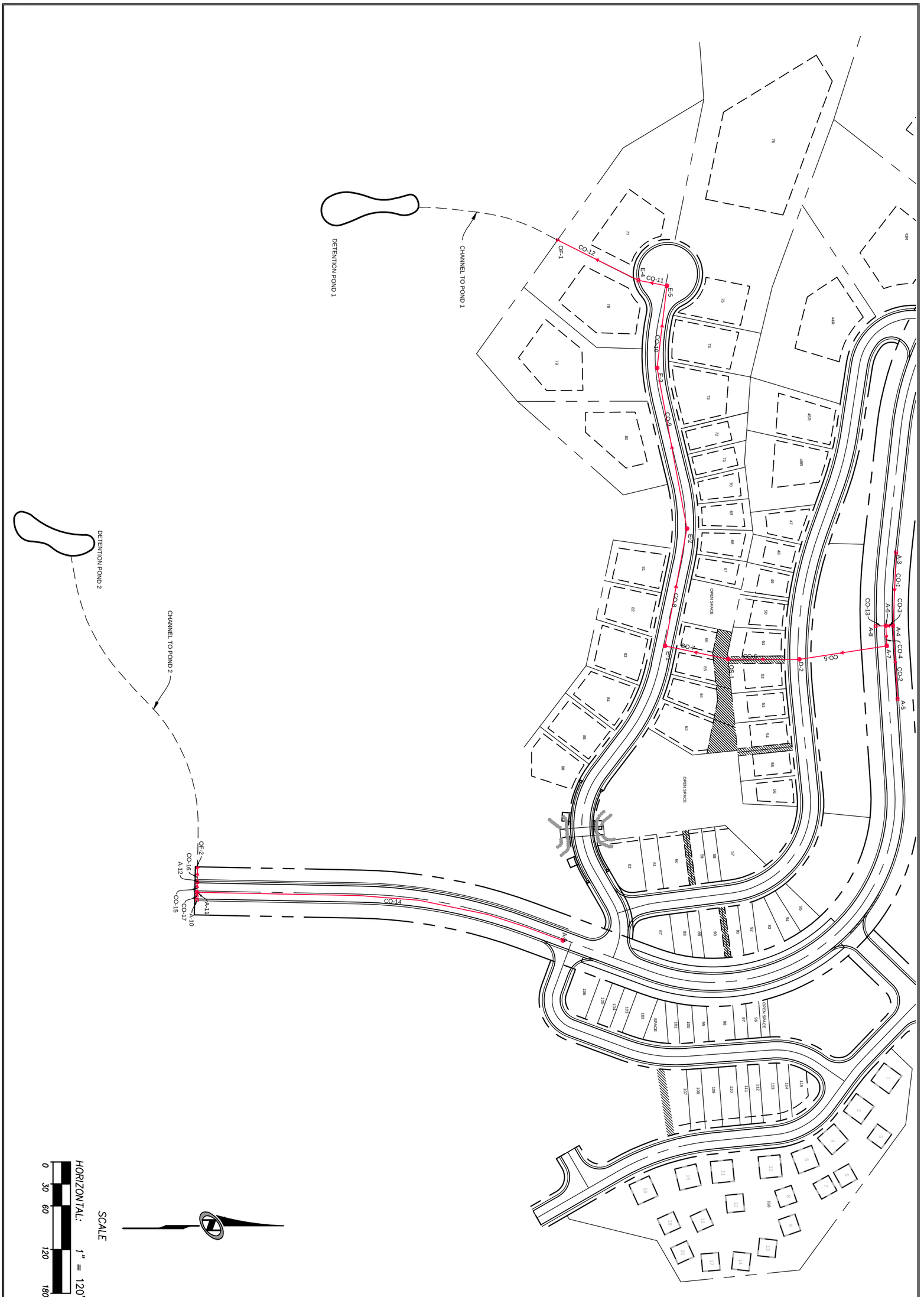
Village Storm Drain Tributary Areas

APRIL 2013

NV5
BEYOND ENGINEERING

FILENAME: N:\SLB0153\GIS\MXD\StormDrain\MOB\D3MOBIntCBAreas.mxd

TOONE
XREFS:



JOB NUMBER SLB07930	SHEET NUMBER D1	DATE: 4/22/13 TIME: 5:09:41 PM	NV5 BEYOND ENGINEERING	SUMMIT AT POWDER MOUNTAIN PH1
OF - SHEETS		NETWORK: SLS0	5217 SOUTH STATE STREET, SUITE 300	SUMMIT PASS AND SPRING LAKE
		PATH: N:\SLB0793\PROJECTS\PHASE 1\HAESTAD\STORM CAD	801.743.1300 TEL 801.743.0300 FAX	STORM DRAIN PLAN
		DWG NAME: PH1 PUB STORM DRAIN-JST.DWG	MURRAY, UT 84107	
		LAYOUT: Layout1	WWW.NV5.COM	PREPARED FOR: SUMMIT, LLC DATE SUBMITTED: 4/22/2013
		DESIGNER: JST MGR: RWC		

Worksheet for Curb and Gutter Improved Road Capacity

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01000	ft/ft
Discharge	2.32	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	0.33
0+00.67	0.00
0+02.17	0.13
0+12.57	0.33

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.00, 0.33)	(0+12.57, 0.33)	0.012

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.27	ft
Elevation Range	0.00 to 0.33 ft	
Flow Area	0.89	ft²
Wetted Perimeter	9.35	ft
Hydraulic Radius	0.10	ft
Top Width	9.28	ft
Normal Depth	0.27	ft
Critical Depth	0.30	ft
Critical Slope	0.00440	ft/ft

Worksheet for Curb and Gutter Improved Road Capacity

Results

Velocity		2.59	ft/s
Velocity Head		0.10	ft
Specific Energy		0.38	ft
Froude Number		1.47	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.27	ft
Critical Depth	0.30	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.00440	ft/ft

Cross Section for Curb and Gutter Improved Road Capacity

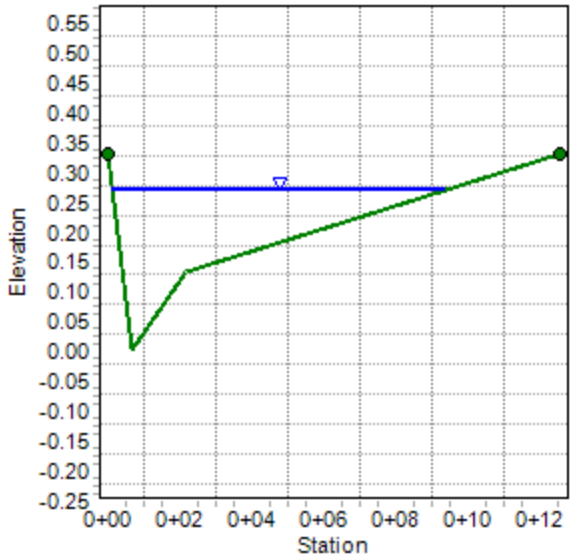
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01000	ft/ft
Normal Depth	0.27	ft
Discharge	2.32	ft³/s

Cross Section Image



StormCAD Inlet Summary Table

Label	Elevation (rim)	Elevation (invert)	Additional Flow (cfs)	HGL (in)	HGL (out)	Downstream Velocity (ft/s)
A-3	8,632.52	8,629.18	0.83	8,629.54	8,629.54	2.87
A-4	8,631.58	8,628.18	1.09	8,628.59	8,628.59	3.1
A-5	8,632.56	8,629.39	1.3	8,629.84	8,629.84	3.26
A-8	8,631.58	8,628.26	0	8,628.47	8,628.47	0
A-10	8,606.91	8,603.40	1.23	8,603.84	8,603.84	3.21
A-12	8,606.91	8,603.16	0.03	8,603.23	8,603.23	1.19
E-4	8,546.04	8,536.04	8.86	8,537.19	8,537.19	6.08

StormCAD Pipes Summary Table

Label	Invert (Upstream) (ft)	Invert (Downstream) (ft)	Slope (ft/ft)	Diameter (in)	Velocity (ft/s)	Flow (ft^3/s)	Length (ft)	Material	Manning's n	Start Node	Stop Node
CO-1	8,629.18	8,628.18	0.01	15	3.61	0.83	100.6	Concrete	0.013	A-3	A-4
CO-2	8,629.39	8,628.18	0.012	15	4.39	1.3	100.5	Concrete	0.013	A-5	A-4
CO-3	8,628.18	8,628.06	0.012	15	4.18	1.09	10	Concrete	0.013	A-4	A-6
CO-4	8,628.06	8,627.78	0.01	15	3.91	1.09	27.6	Concrete	0.013	A-6	A-7
CO-5	8,627.78	8,594.88	0.272	15	12.58	1.09	121.4	Concrete	0.013	A-7	D-2
CO-6	8,594.88	8,580.62	0.146	18	9.84	1.09	97.6	Concrete	0.013	D-2	OS-1
CO-7	8,580.62	8,568.56	0.137	18	9.64	1.09	88.4	Concrete	0.013	OS-1	E-1
CO-8	8,568.56	8,552.63	0.097	18	8.56	1.09	163.7	Concrete	0.013	E-1	E-2
CO-9	8,552.63	8,541.22	0.051	18	6.82	1.09	224.2	Concrete	0.013	E-2	E-3
CO-10	8,541.22	8,536.33	0.043	18	6.44	1.09	113.3	Concrete	0.013	E-3	E-5
CO-11	8,536.33	8,536.04	0.007	18	3.43	1.09	40	Concrete	0.013	E-5	E-4
CO-12	8,536.04	8,511.41	0.199	18	20.36	8.86	123.8	Concrete	0.013	E-4	OF-1
CO-13	8,628.26	8,628.06	0.014	15	0	0	14	Concrete	0.013	A-8	A-6
CO-14	8,616.31	8,603.30	0.026	15	0	0	509.9	Concrete	0.013	A-9	A-11
CO-15	8,603.30	8,603.16	0.01	15	4.05	1.23	14	Concrete	0.013	A-11	A-12
CO-16	8,603.16	8,602.26	0.045	15	2.24	0.03	20	Concrete	0.013	A-12	OF-2
CO-17	8,603.40	8,603.30	0.01	15	4.05	1.23	10	Concrete	0.013	A-10	A-11

Worksheet for CB-A-3 (on grade)

Project Description

Solve For	Efficiency

Input Data

Discharge		0.83	ft^3/s
Slope		0.01850	ft/ft
Gutter Width		1.75	ft
Gutter Cross Slope		0.06	ft/ft
Road Cross Slope		0.02	ft/ft
Roughness Coefficient		0.012	
Grate Width		1.67	ft
Grate Length		4.00	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%

Options

Grate Flow Option	Exclude None

Results

Efficiency	86.78	%
Intercepted Flow	0.72	ft^3/s
Bypass Flow	0.11	ft^3/s
Spread	4.34	ft
Depth	0.16	ft
Flow Area	0.25	ft^2
Gutter Depression	0.07	ft
Total Depression	0.07	ft
Velocity	3.32	ft/s
Splash Over Velocity	8.13	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.18	
Grate Flow Ratio	0.84	
Active Grate Length	2.00	ft

Worksheet for CB-A-4 (Sag)

Project Description

Solve For	Spread

Input Data

Discharge		1.09	ft^3/s
Gutter Width		1.75	ft
Gutter Cross Slope		0.06	ft/ft
Road Cross Slope		0.02	ft/ft
Grate Width		1.67	ft
Grate Length		8.00	ft
Local Depression		3.00	in
Local Depression Width		1.38	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%

Results

Spread	5.15	ft
Depth	0.17	ft
Gutter Depression	0.07	ft
Total Depression	0.32	ft
Open Grate Area	6.00	ft^2
Active Grate Weir Length	9.67	ft

Worksheet for CB-A-5 (on grade)

Project Description

Solve For	Efficiency

Input Data

Discharge		1.30	ft³/s
Slope		0.01850	ft/ft
Gutter Width		1.75	ft
Gutter Cross Slope		0.06	ft/ft
Road Cross Slope		0.02	ft/ft
Roughness Coefficient		0.012	
Grate Width		1.67	ft
Grate Length		4.00	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%

Options

Grate Flow Option	Exclude None

Results

Efficiency	77.91	%
Intercepted Flow	1.01	ft³/s
Bypass Flow	0.29	ft³/s
Spread	5.51	ft
Depth	0.18	ft
Flow Area	0.36	ft²
Gutter Depression	0.07	ft
Total Depression	0.07	ft
Velocity	3.57	ft/s
Splash Over Velocity	8.13	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.17	
Grate Flow Ratio	0.73	
Active Grate Length	2.00	ft

Worksheet for CB-A-8 (Sag)

Project Description

Solve For	Spread

Input Data

Discharge		0.01	ft^3/s
Gutter Width		1.75	ft
Gutter Cross Slope		0.06	ft/ft
Road Cross Slope		0.02	ft/ft
Grate Width		1.67	ft
Grate Length		4.00	ft
Local Depression		3.00	in
Local Depression Width		1.38	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%

Results

Spread	1.03	ft
Depth	0.00	ft
Gutter Depression	0.07	ft
Total Depression	0.32	ft
Open Grate Area	3.00	ft^2
Active Grate Weir Length	5.67	ft

Worksheet for CB-A-10 (on grade)

Project Description

Solve For	Efficiency

Input Data

Discharge		1.23	ft^3/s
Slope		0.01850	ft/ft
Gutter Width		1.75	ft
Gutter Cross Slope		0.06	ft/ft
Road Cross Slope		0.02	ft/ft
Roughness Coefficient		0.012	
Grate Width		1.67	ft
Grate Length		4.00	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%

Options

Grate Flow Option	Exclude None

Results

Efficiency	79.04	%
Intercepted Flow	0.97	ft^3/s
Bypass Flow	0.26	ft^3/s
Spread	5.36	ft
Depth	0.18	ft
Flow Area	0.35	ft^2
Gutter Depression	0.07	ft
Total Depression	0.07	ft
Velocity	3.53	ft/s
Splash Over Velocity	8.13	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.17	
Grate Flow Ratio	0.75	
Active Grate Length	2.00	ft

Worksheet for CB-A-12 (on grade)

Project Description

Solve For	Efficiency

Input Data

Discharge		0.03	ft³/s
Slope		0.01850	ft/ft
Gutter Width		1.75	ft
Gutter Cross Slope		0.06	ft/ft
Road Cross Slope		0.02	ft/ft
Roughness Coefficient		0.012	
Grate Width		1.67	ft
Grate Length		4.00	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%

Options

Grate Flow Option	Exclude None

Results

Efficiency	100.00	%
Intercepted Flow	0.03	ft³/s
Bypass Flow	0.00	ft³/s
Spread	0.78	ft
Depth	0.05	ft
Flow Area	0.02	ft²
Gutter Depression	0.07	ft
Total Depression	0.07	ft
Velocity	1.63	ft/s
Splash Over Velocity	8.13	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.45	
Grate Flow Ratio	1.00	
Active Grate Length	2.00	ft

Worksheet for CB-E-4 (Sag)

Project Description

Solve For	Spread

Input Data

Discharge		4.92	ft³/s
Gutter Width		1.75	ft
Gutter Cross Slope		0.06	ft/ft
Road Cross Slope		0.02	ft/ft
Grate Width		1.67	ft
Grate Length		8.00	ft
Local Depression		3.00	in
Local Depression Width		1.38	ft
Grate Type	P-50 mm (P-1-7/8")		
Clogging		50.00	%

Results

Spread	15.14	ft
Depth	0.37	ft
Gutter Depression	0.07	ft
Total Depression	0.32	ft
Open Grate Area	6.00	ft²
Active Grate Weir Length	9.67	ft

NOAA Atlas 14, Volume 1, Version 5
Location name: Eden, Utah, US*
Coordinates: 41.3687, -111.7714
Elevation: 8549 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

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	**0.184** (0.162-0.210)	**0.233** (0.207-0.268)	**0.315** (0.276-0.359)	**0.386** (0.336-0.441)	**0.497** (0.425-0.573)	**0.598** (0.498-0.695)	**0.717** (0.579-0.843)	**0.856** (0.667-1.03)	**1.08** (0.799-1.35)	**1.30** (0.912-1.67)
10-min	**0.280** (0.246-0.320)	**0.355** (0.316-0.407)	**0.479** (0.421-0.546)	**0.588** (0.512-0.672)	**0.757** (0.646-0.872)	**0.911** (0.758-1.06)	**1.09** (0.881-1.28)	**1.30** (1.02-1.57)	**1.65** (1.22-2.05)	**1.98** (1.39-2.54)
15-min	**0.347** (0.306-0.397)	**0.440** (0.391-0.505)	**0.594** (0.522-0.677)	**0.729** (0.635-0.833)	**0.939** (0.802-1.08)	**1.13** (0.939-1.31)	**1.35** (1.09-1.59)	**1.61** (1.26-1.94)	**2.05** (1.51-2.54)	**2.46** (1.72-3.14)
30-min	**0.467** (0.412-0.534)	**0.593** (0.527-0.681)	**0.800** (0.703-0.912)	**0.982** (0.855-1.12)	**1.26** (1.08-1.46)	**1.52** (1.26-1.77)	**1.82** (1.47-2.14)	**2.17** (1.70-2.61)	**2.76** (2.03-3.42)	**3.31** (2.32-4.23)
60-min	**0.578** (0.510-0.662)	**0.734** (0.652-0.842)	**0.990** (0.870-1.13)	**1.22** (1.06-1.39)	**1.56** (1.34-1.80)	**1.88** (1.56-2.19)	**2.25** (1.82-2.65)	**2.69** (2.10-3.24)	**3.41** (2.51-4.24)	**4.10** (2.87-5.24)
2-hr	**0.780** (0.697-0.879)	**0.979** (0.873-1.10)	**1.26** (1.11-1.42)	**1.52** (1.33-1.72)	**1.94** (1.66-2.21)	**2.31** (1.94-2.66)	**2.76** (2.25-3.21)	**3.28** (2.59-3.90)	**4.12** (3.07-5.05)	**4.91** (3.49-6.17)
3-hr	**0.896** (0.811-0.999)	**1.11** (1.01-1.24)	**1.38** (1.24-1.54)	**1.64** (1.46-1.83)	**2.04** (1.79-2.30)	**2.41** (2.07-2.74)	**2.86** (2.39-3.29)	**3.37** (2.74-3.95)	**4.20** (3.25-5.07)	**4.96** (3.69-6.24)
6-hr	**1.27** (1.16-1.39)	**1.55** (1.43-1.71)	**1.87** (1.71-2.05)	**2.15** (1.95-2.38)	**2.58** (2.31-2.86)	**2.94** (2.60-3.28)	**3.34** (2.91-3.77)	**3.79** (3.23-4.34)	**4.66** (3.85-5.44)	**5.44** (4.37-6.49)
12-hr	**1.71** (1.56-1.87)	**2.09** (1.91-2.30)	**2.52** (2.29-2.78)	**2.90** (2.62-3.21)	**3.47** (3.10-3.87)	**3.94** (3.47-4.43)	**4.45** (3.85-5.06)	**4.99** (4.24-5.74)	**5.82** (4.80-6.84)	**6.47** (5.22-7.76)
24-hr	**2.37** (2.12-2.65)	**2.92** (2.61-3.26)	**3.51** (3.13-3.93)	**4.01** (3.58-4.49)	**4.71** (4.19-5.27)	**5.25** (4.65-5.88)	**5.83** (5.13-6.51)	**6.41** (5.62-7.16)	**7.21** (6.27-8.07)	**7.84** (6.76-8.80)
2-day	**2.92** (2.61-3.30)	**3.60** (3.22-4.07)	**4.36** (3.88-4.92)	**4.99** (4.43-5.63)	**5.87** (5.18-6.62)	**6.56** (5.76-7.40)	**7.27** (6.37-8.21)	**8.01** (6.97-9.05)	**9.02** (7.79-10.2)	**9.81** (8.40-11.1)
3-day	**3.42** (3.04-3.85)	**4.21** (3.76-4.75)	**5.12** (4.56-5.78)	**5.88** (5.22-6.63)	**6.94** (6.13-7.82)	**7.78** (6.83-8.77)	**8.65** (7.57-9.76)	**9.55** (8.31-10.8)	**10.8** (9.30-12.2)	**11.8** (10.1-13.4)
4-day	**3.90** (3.48-4.40)	**4.83** (4.30-5.44)	**5.89** (5.24-6.64)	**6.78** (6.01-7.64)	**8.01** (7.08-9.03)	**9.00** (7.91-10.1)	**10.0** (8.76-11.3)	**11.1** (9.64-12.5)	**12.6** (10.8-14.2)	**13.7** (11.7-15.6)
7-day	**4.96** (4.39-5.68)	**6.13** (5.43-7.03)	**7.48** (6.59-8.58)	**8.60** (7.56-9.87)	**10.2** (8.89-11.6)	**11.4** (9.93-13.1)	**12.7** (11.0-14.5)	**14.0** (12.1-16.1)	**15.8** (13.5-18.2)	**17.3** (14.6-20.0)
10-day	**5.75** (5.09-6.58)	**7.11** (6.29-8.12)	**8.59** (7.59-9.83)	**9.80** (8.64-11.2)	**11.4** (10.0-13.1)	**12.7** (11.1-14.5)	**13.9** (12.1-16.0)	**15.2** (13.2-17.4)	**16.9** (14.5-19.4)	**18.2** (15.6-21.0)
20-day	**7.66** (6.82-8.61)	**9.45** (8.41-10.6)	**11.3** (10.0-12.7)	**12.7** (11.3-14.3)	**14.6** (12.9-16.4)	**16.0** (14.1-18.0)	**17.3** (15.3-19.5)	**18.7** (16.4-21.1)	**20.4** (17.8-23.1)	**21.7** (18.8-24.6)
30-day	**9.39** (8.43-10.5)	**11.6** (10.4-13.0)	**13.7** (12.3-15.4)	**15.4** (13.8-17.4)	**17.7** (15.7-19.9)	**19.3** (17.1-21.7)	**20.9** (18.5-23.6)	**22.5** (19.8-25.4)	**24.5** (21.5-27.8)	**26.0** (22.6-29.5)
45-day	**11.9** (10.8-13.2)	**14.7** (13.2-16.3)	**17.4** (15.7-19.3)	**19.6** (17.6-21.7)	**22.4** (20.0-24.8)	**24.5** (21.8-27.2)	**26.6** (23.6-29.5)	**28.6** (25.3-31.9)	**31.3** (27.5-35.0)	**33.4** (29.1-37.5)
60-day	**13.9** (12.6-15.4)	**17.1** (15.5-18.9)	**20.3** (18.3-22.4)	**22.7** (20.5-25.1)	**25.7** (23.1-28.5)	**28.0** (25.1-31.1)	**30.2** (27.0-33.6)	**32.3** (28.8-36.0)	**35.1** (31.1-39.2)	**37.1** (32.7-41.6)

[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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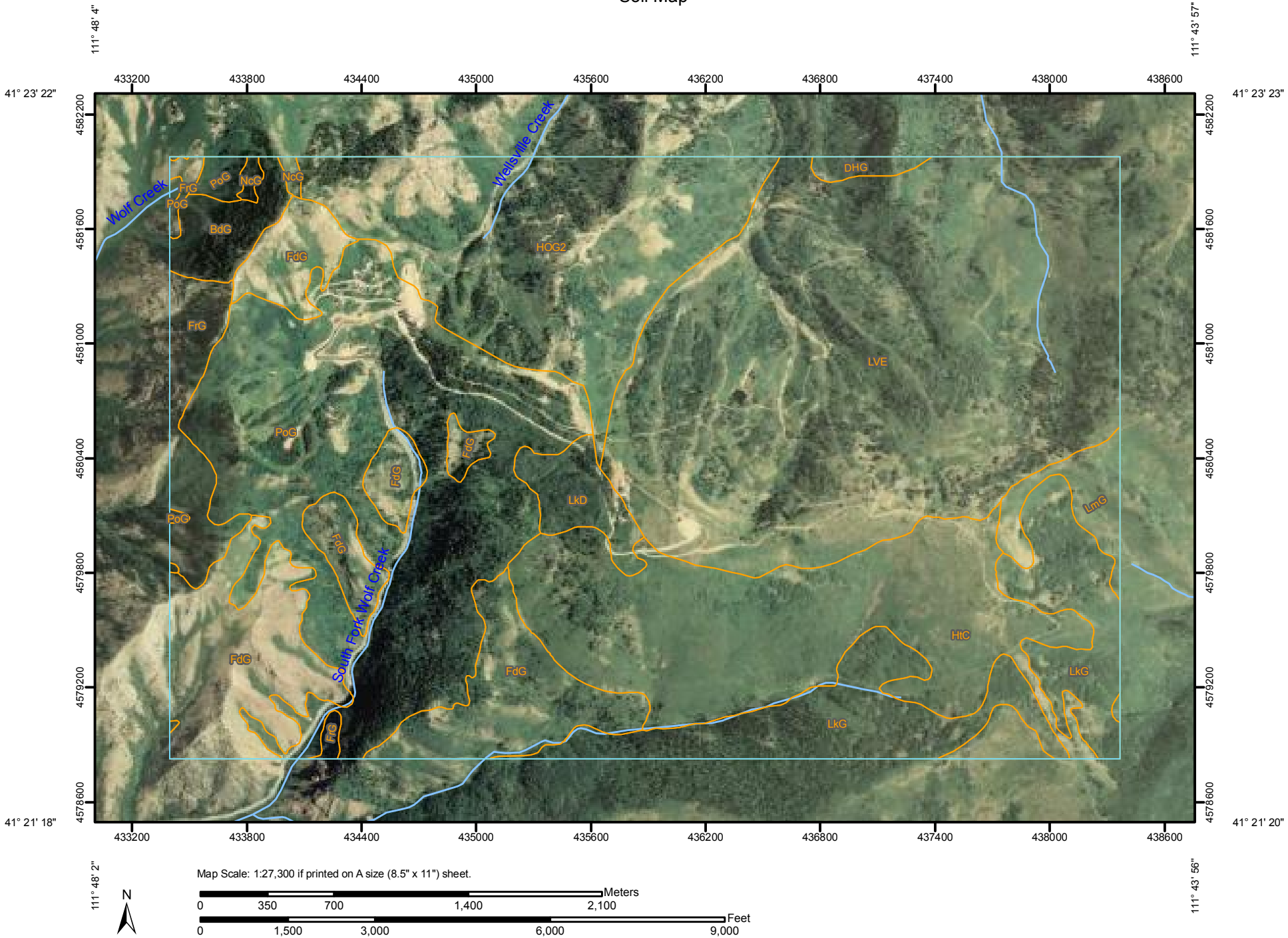
Custom Soil Resource Report
Soil Map



Map Scale: 1:27,300 if printed on A size (8.5" x 11") sheet.

N

Meters
0 350 700 1,400 2,100

Feet
0 1,500 3,000 6,000 9,000

Water Features– Cache Valley Area, Parts of Cache and Box Elder Counties, Utah										
Map unit symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				Ft	*Ft*	*Ft*				
DHG—DATEMAN-BRADSHAW ASSOCIATION										
Dateman	C	—	Jan-Dec	—	—	—	—	None	—	—
Bradshaw	B	—	Jan-Dec	—	—	—	—	None	—	—
HOG2—HOSKIN-SCOUT ASSOCIATION, ERODED										
Hoskin	C	—	Jan-Dec	—	—	—	—	None	—	—
Scout	B	—	Jan-Dec	—	—	—	—	None	—	—
LVE—LUCKY STAR-HOSKIN ASSOCIATION										
Lucky star	B	—	Jan-Dec	—	—	—	—	None	—	—
Hoskin	C	—	Jan-Dec	—	—	—	—	None	—	—

Water Features– Morgan Area, Utah - Morgan County and Part of Weber County										
Map unit symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				Ft	*Ft*	*Ft*				
BdG—Broad Canyon stony loam, 30 to 70 percent										
Broad canyon	B	—	Jan-Dec	—	—	—	—	None	—	—
FdG—Foxol-Durfee complex, 30 to 70 percent slopes										
Foxol	D	—	Jan-Dec	—	—	—	—	None	—	—
Durfee	C	—	Jan-Dec	—	—	—	—	None	—	—

Water Features– Morgan Area, Utah - Morgan County and Part of Weber County										
Map unit symbol and soil name	Hydrologic group	Surface runoff	Month	Water table		Ponding			Flooding	
				Upper limit	Lower limit	Surface depth	Duration	Frequency	Duration	Frequency
				Ft	*Ft*	*Ft*				
FrG—Foxol-Rock outcrop complex, 40 to 70 percent slopes										
Foxol	D	—	Jan-Dec	—	—	—	—	None	—	—
Rock outcrop	—	—	Jan-Dec	—	—	—	—	None	—	—
HtC—Herd-Yence complex, 3 to 15 percent slopes										
Herd	C	—	Jan-Dec	—	—	—	—	None	—	—
Yence	C	—	Jan-Dec	—	—	—	—	None	—	—
LkD—Lucky Star silt loam, 15 to 30 percent slopes										
Lucky star	B	—	Jan-Dec	—	—	—	—	None	—	—
LkG—Lucky Star silt loam, 30 to 60 percent slopes										
Lucky star	B	—	Jan-Dec	—	—	—	—	None	—	—
LmG—Lucky Star-Charcol complex, 30 to 60 percent slopes										
Charcol	B	—	Jan-Dec	—	—	—	—	None	—	—
Lucky star	B	—	Jan-Dec	—	—	—	—	None	—	—
NcG—Nagitsy-Rock outcrop complex, 50 to 70 percent slopes										
Nagitsy	C	—	Jan-Dec	—	—	—	—	None	—	—
Rock outcrop	—	—	Jan-Dec	—	—	—	—	None	—	—
PoG—Poleline stony loam, 40 to 70 percent slopes										
Poleline	B	—	Jan-Dec	—	—	—	—	None	—	—

Figure 3-1 Average velocities for estimating travel time for shallow concentrated flow