SUMMIT AT POWDER MOUNTAIN PH1
DRAINAGE SUMMARY

POWDER MOUNTAIN RESORT
EDEN, UTAH

DECEMBER 2012

NV5
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BEYOND ENGINEERING

Site Description

The proposed Summit at Powder Mountain Phase 1 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 Powder Ridge Road. 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.**	**2,439**

Haestad Methods FlowMaster was used for catch basin calculations. Consideration for both sag and on grade scenarios has been taken into account. Sag inlets were assumed to have up to 50% clogging as cleaning velocities typically are slow in these scenarios. 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 8,000 CF with an 18" orifice and 6,000 CF with 4.5" 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 Powder Ridge 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 A (ac)	10-yr 2 hr Q (cfs)	Riprap (LxWxD) (ft)	Riprap Apron D50 (ft)
Culv. 1	74	15"	2.00%	0.37	71.12	13.38	15'x8'x1'	0.5'
Culv. 2	77	18"	2.00%	0.26	18.36	6.16	15'x8'x1'	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	**Ph1-Post1**	76	0.175	21.39	7.33
	Ph1-Post2	83	0.083	2.95	3.03
Pond 2	**Ph1-Post3**	78	0.163	2.96	1.28
	Ph1-Post4	82	0.174	4.09	2.82
	Ph1-Post5	69	0.162	4.71	0.50
Pond 1	**Ph1-Post6**	81	0.083	4.57	4.02
				40.66	**18.98**

Ph1-Pre1	74	0.175	21.39	5.50
Ph1-Pre2	71	0.083	2.95	0.59
Ph1-Pre3	70	0.163	2.96	0.39
Ph1-Pre4	68	0.174	4.09	0.33
Ph1-Pre5	61	0.162	4.71	0.05
Ph1-Pre6	73	0.083	4.57	1.23
			40.66	**8.09**

	Pond 1	**Pond 2**
Detention Pond Size (CF)	**8,000.00**	**6,000.00**
Orifice (in.)	**18"**	**4.50”**

In conclusion, the proposed development would be able to discharge post development flows than than pre development levels as indicated in the above table in a 10 year 2 hour storm event per the required Weber County requirements. This would require approximately 14,000 cubic feet of detention. The proposed onsite storm drainage system and detention will reduce the potential for downstream flooding and improve the current drainage situation.

APPENDICES

1. **Sub-basins 1- 2 Calculations**
    a. **Drainage Exhibit A**
    b. **Time of Concentration Calculations**
    c. **Haestad Method's PondPack Calculations**
2. **Powder Ridge Drive Culvert Calculations**
    a. **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. **Powder Ridge Drive Culvert Calculations**
    a. **Drainage Exhibit C**
    b. **Time of Concentration Calculations**
    c. **Haestad Method's PondPack Calculations**
    d. **Storm Drain Plan Exhibit D**
    e. **Haestad Method's FlowMaster Powder Ridge Road Capacity**
    f. **Catch Basin Summary Table**
    g. **Haestad Method's FlowMaster Catch Basin Calculations**
    h. **Haestad Method's StormCAD Inlet Table**
    i. **Haestad Method's StormCAD Pipes Table**
4. **NOAA Precipitation Table**
5. **Soils Map/ Report**
6. **Figure 3-1 Average velocities for estimating travel time for shallow concentrated flow**

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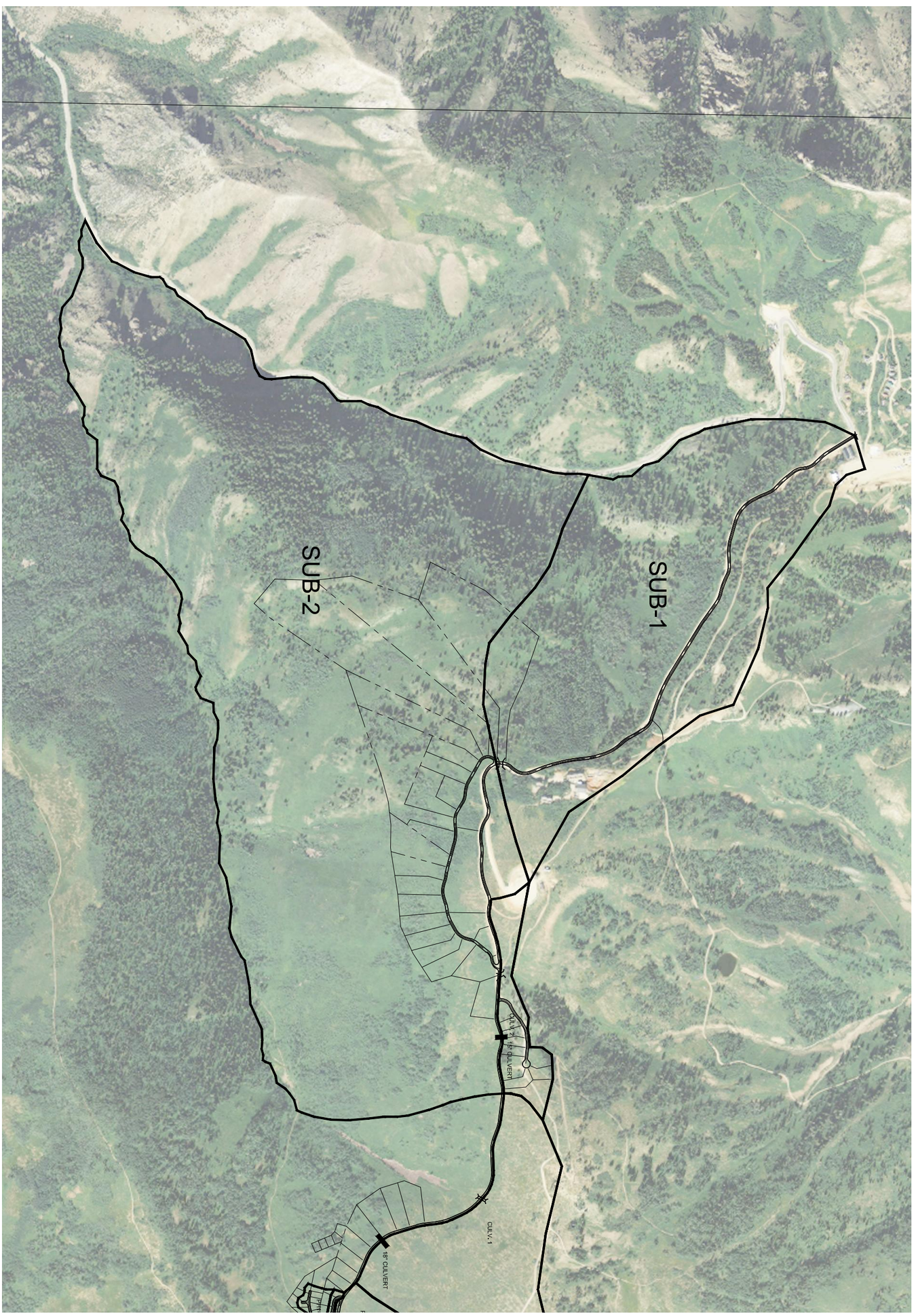

SCALE 1" = 500'
HORIZONTAL

PRELIMINARY

NOT FOR CONSTRUCTION

JOB NUMBER	SLB0793306
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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 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

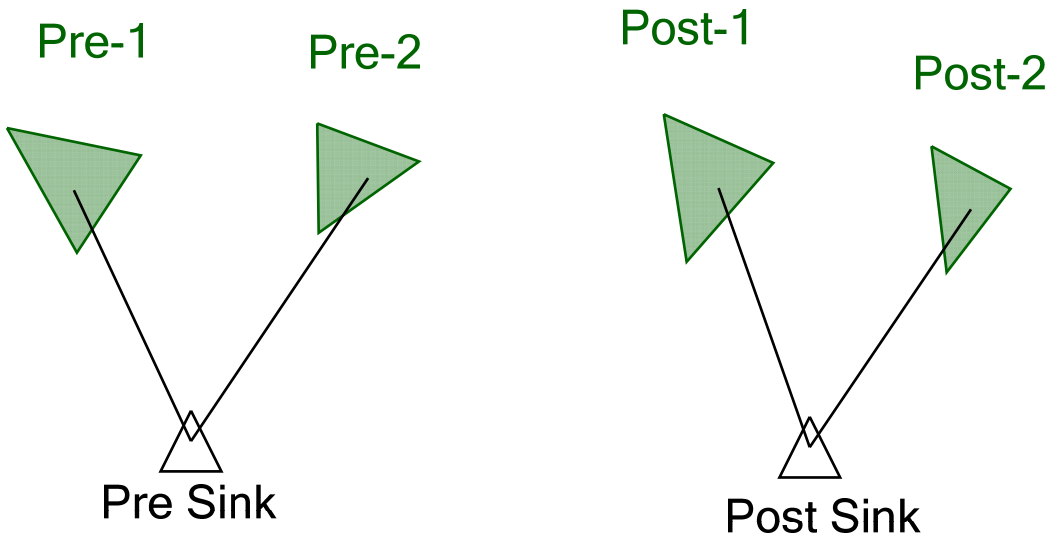
Executive Summary (Nodes)

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

Scenario: 10 yr 2 hr



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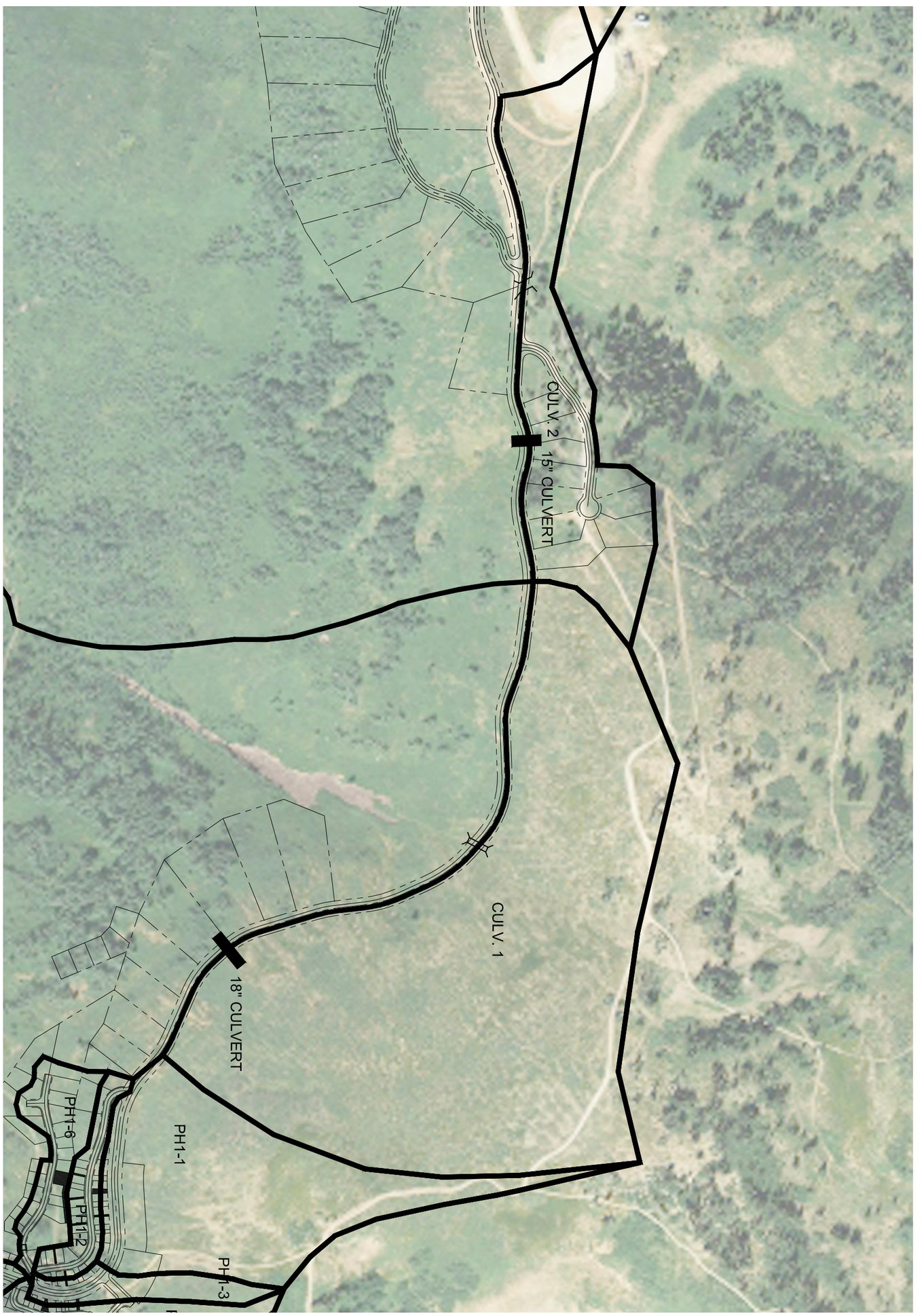

SCALE
HORIZONTAL: 1" = 200'

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SUMMIT AT POWDER MTN PH1
POWDER RIDGE DRIVE CULVERTS DRAINAGE PLAN

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

NO.	BY	DATE	REVISIONS:

JOB NUMBER SLB0793306
SCALE HORIZONTAL: 1" = 250'
SHEETS OF 1
SHEET NUMBER B

Time of Concentration Calculator

Area: **Culv. 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)	0.02
	T (hr)=	**0.217787**

Elev. 1 8874
Elev.2 8868

Shallow Concentrated Flow		
$T_t = \frac{L}{3600\ V}$	Flow Length (ft)	598.56
	Slope (ft/ft)	0.217188
	Average Velocity (ft/s)	7
	T (hr)=	**0.023752**

Elev. 1 8868
Elev.2 8738

Channel Flow		
$V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	Cross-Sectional Area (sf)	3
	Wetted Perimeter (ft)	6.324555
	Hydraulic Radius, r=a/Pw (ft)	0.474342
$T_t = \frac{L}{3600\ V}$	Slope (ft/ft)	0.056991
	Mannings roughness coef.	0.05
	Flow Length (ft)	2017.86
	Velocity (ft/s)	4.326936
	T (hr)=	**0.129541**

Elev. 1 8738
Elev.2 8623

Trap Channel
Depth (ft) 1
Base (ft) 0
S/S (H:V) 3

Watershed Tc (hr) **0.37108**

Time of Concentration Calculator

Area: **Culv. 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)	0.04
	T (hr)=	**0.165051**

Elev. 1 8904
Elev.2 8892

Shallow Concentrated Flow		
$T_t = \frac{L}{3600\ V}$	Flow Length (ft)	176
	Slope (ft/ft)	0.181818
	Average Velocity (ft/s)	7
	T (hr)=	**0.006984**

Elev. 1 8892
Elev.2 8860

Channel Flow		
$V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	Cross-Sectional Area (sf)	3
	Wetted Perimeter (ft)	6.324555
	Hydraulic Radius, r=a/Pw (ft)	0.474342
$T_t = \frac{L}{3600\ V}$	Slope (ft/ft)	0.072172
	Mannings roughness coef.	0.05
	Flow Length (ft)	1538
	Velocity (ft/s)	4.869232
	T (hr)=	**0.087739**

Elev. 1 8860
Elev.2 8749

Trap Channel
Depth (ft) 1
Base (ft) 0
S/S (H:V) 3

Watershed Tc (hr) **0.259775**

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

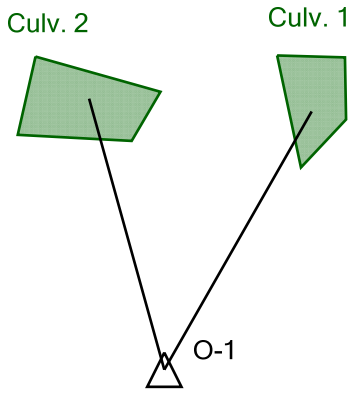
Executive Summary (Nodes)

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)
Culv. 1	10 yr 2 hr	10	None	0.914	0.850	13.38	(N/A)	(N/A)
Culv. 2	10 yr 2 hr	10	None	0.333	0.750	6.16	(N/A)	(N/A)
O-1	10 yr 2 hr	10	None	1.247	0.850	18.73	(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

Scenario: 10 yr 2 hr



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	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)

Results

Discharge	15.37	ft^3/s
Flow Area	4.00	ft^2
Wetted Perimeter	8.25	ft
Hydraulic Radius	0.49	ft
Top Width	8.00	ft
Critical Depth	0.98	ft
Critical Slope	0.01730	ft/ft
Velocity	3.84	ft/s
Velocity Head	0.23	ft
Specific Energy	1.23	ft
Froude Number	0.96	
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	0.01730	ft/ft

Cross Section for Roadside Ditch Capacity

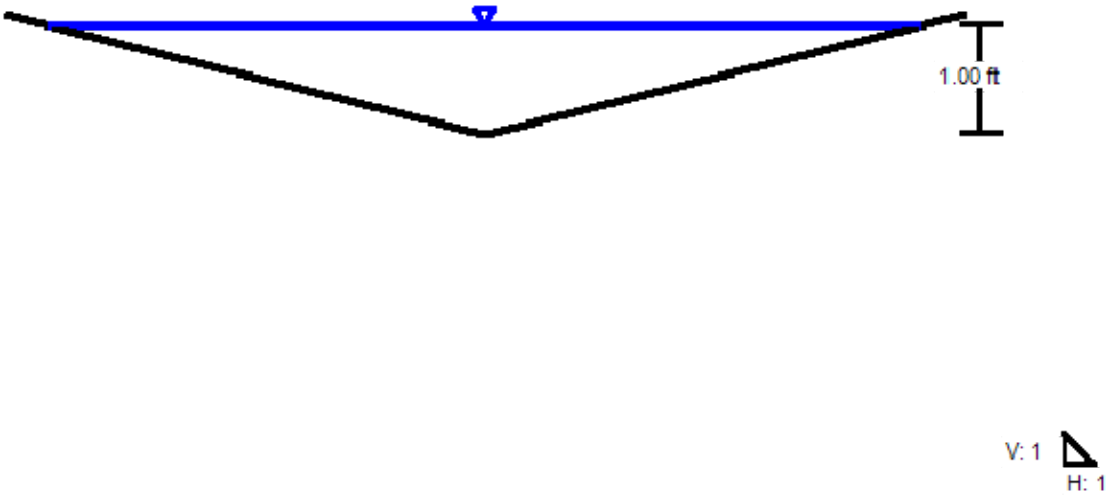
Project Description

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	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Discharge	15.37	ft³/s

Cross Section Image



Culvert Calculator Report
15" Culvert (Subarea: Culv. 2)

Solve For: Discharge

Culvert Summary					
Allowable HW Elevation	5.50	ft	Headwater Depth/Height	2.80	
Computed Headwater Elevation	5.50	ft	Discharge	10.06	cfs
Inlet Control HW Elev.	5.50	ft	Tailwater Elevation	2.50	ft
Outlet Control HW Elev.	5.28	ft	Control Type	Inlet Control	

Grades					
Upstream Invert	2.00	ft	Downstream Invert	1.00	ft
Length	50.00	ft	Constructed Slope	0.020000	ft/ft

Hydraulic Profile					
Profile	PressureProfile		Depth, Downstream	1.50	ft
Slope Type	N/A		Normal Depth	N/A	ft
Flow Regime	N/A		Critical Depth	1.19	ft
Velocity Downstream	8.20	ft/s	Critical Slope	0.020998	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	1.25	ft
Section Size	15 inch		Rise	1.25	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	5.28	ft	Upstream Velocity Head	1.04	ft
Ke	0.50		Entrance Loss	0.52	ft

Inlet Control Properties					
Inlet Control HW Elev.	5.50	ft	Flow Control	N/A	
Inlet Type	Square edge w/headwall		Area Full	1.2	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
18" Culvert (Subarea: Culv. 1)

Solve For: Discharge

Culvert Summary					
Allowable HW Elevation	6.00	ft	Headwater Depth/Height	2.33	
Computed Headwater Elevation	5.50	ft	Discharge	14.01	cfs
Inlet Control HW Elev.	5.50	ft	Tailwater Elevation	2.50	ft
Outlet Control HW Elev.	5.30	ft	Control Type	Inlet Control	

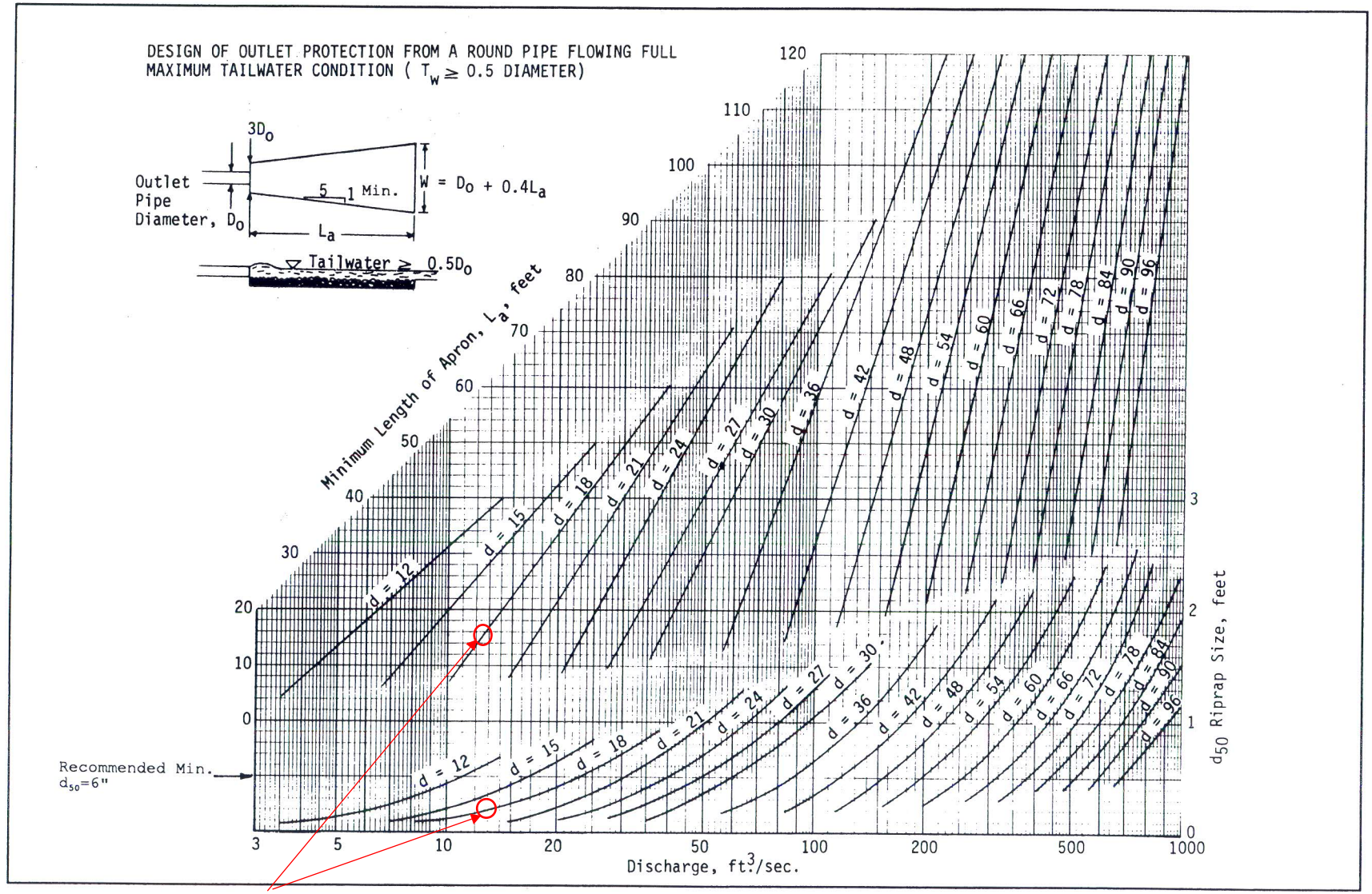
Grades					
Upstream Invert	2.00	ft	Downstream Invert	1.50	ft
Length	50.00	ft	Constructed Slope	0.010000	ft/ft

Hydraulic Profile					
Profile	CompositeM2PressureProfile		Depth, Downstream	1.38	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	1.38	ft
Velocity Downstream	8.23	ft/s	Critical Slope	0.015441	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.	5.30	ft	Upstream Velocity Head	0.98	ft
Ke	0.50		Entrance Loss	0.49	ft

Inlet Control Properties					
Inlet Control HW Elev.	5.50	ft	Flow Control	N/A	
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				



Source: USDA-SCS

Plate 3.18-4

Based on the above figure. The riprap aprons for the culverts under Powder Ridge Road will have D50=6", an apron that is 8' (wide) x 15' (long). The apron will be 12" thick.

DATE: 12/21/12 TIME: 10:45:28 AM DRAWING NAME: 2012-12-11 JS DRAINAGE.DWG
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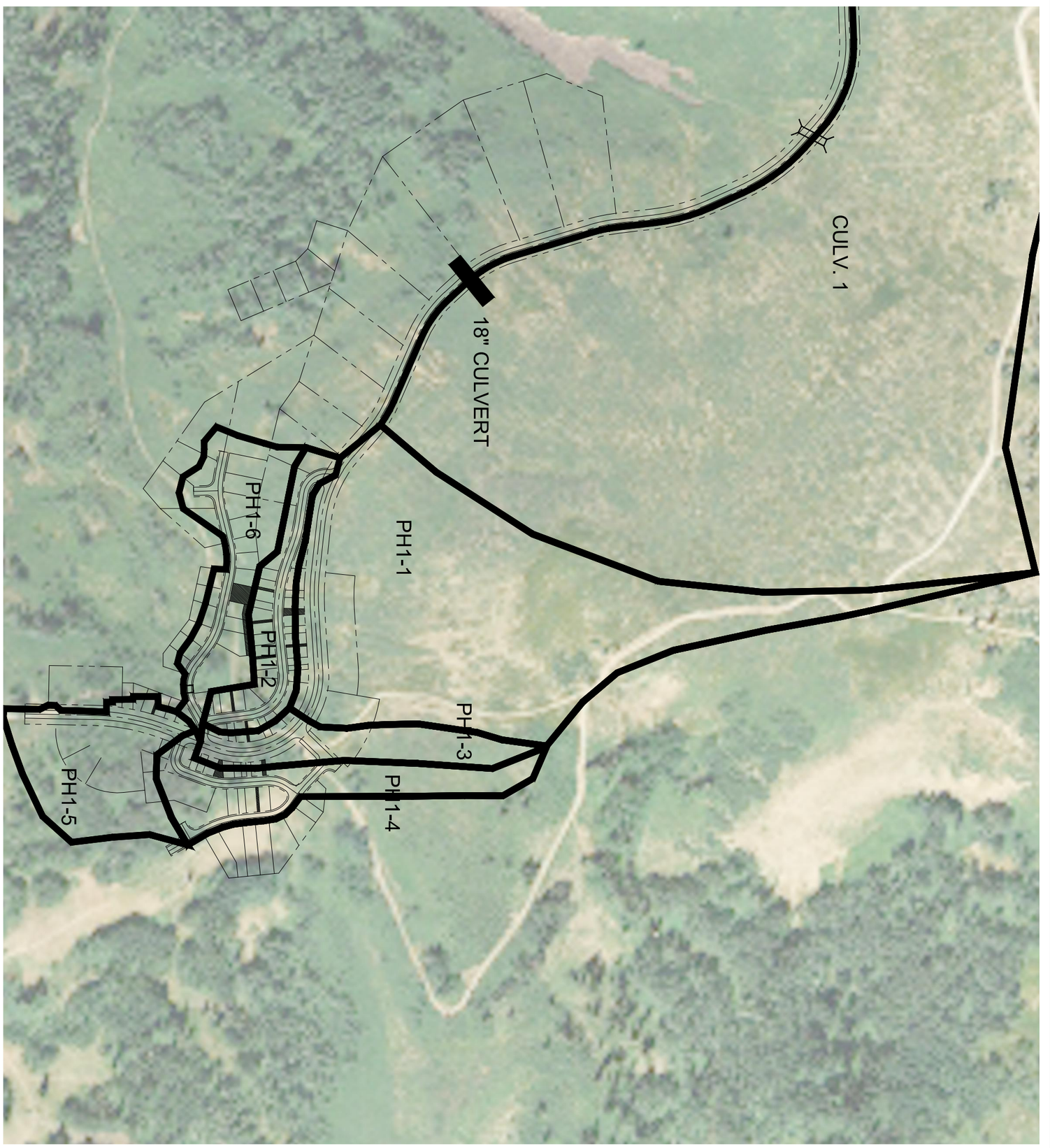

HORIZONTAL: 1" = 150'

SCALE

PRELIMINARY

NOT FOR CONSTRUCTION

NV5
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SUMMIT AT POWDER MTN PH1

PHASE 1 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.

JOB NUMBER SLB0793306

SCALE: HORIZONTAL: 1" = 250'
VERTICAL: 1" = N/A

SHEETS OF

SHEET NUMBER C - [illegible]

Time of Concentration Calculator

Area: **Ph1-1**

Sheet Flow		
$T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$	Mannings roughness coef.	0.012
	Flow Length (<300 lf)	300
	10 yr 2 hr rainfall depth (in.)	1.52
	Slope (ft/ft)	0.084667
	T (hr)=	**0.042475**

Elev. 1	8821.6
Elev.2	8796.2

Shallow Concentrated Flow		
$T_t = \frac{L}{3600\ V}$	Flow Length (ft)	1931.64
	Slope (ft/ft)	0.075946
	Average Velocity (ft/s)	5
	T (hr)=	**0.107313**

Elev. 1	8796.2
Elev.2	8649.5

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)	0.19425
$T_t = \frac{L}{3600\ V}$	Mannings roughness coef.	0.012
	Flow Length (ft)	600
	Velocity (ft/s)	6.577255
	T (hr)=	**0.02534**

Elev. 1	8649.5
Elev.2	8532.95
Trap Channel	
Depth (ft)	0.25
Base (ft)	1
S/S (H:V)	50

Watershed Tc (hr)	**0.175128**

Time of Concentration Calculator

Area: **Ph1-2**

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)	20
	10 yr 2 hr rainfall depth (in.)	1.52
	Slope (ft/ft)	0.05
	T (hr)=	**0.017297**

Elev. 1	8643.15
Elev.2	8642.15

Shallow Concentrated Flow		
$T_t = \frac{L}{3600\ V}$	Flow Length (ft)	20
	Slope (ft/ft)	0.05
	Average Velocity (ft/s)	3.5
	T (hr)=	**0.001587**

Elev. 1	8642.15
Elev.2	8641.15

Channel Flow		
$V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	Cross-Sectional Area (sf)	3.375
	Wetted Perimeter (ft)	26.005
	Hydraulic Radius, r=a/Pw (ft)	0.129783
	Slope (ft/ft)	0.059099
$T_t = \frac{L}{3600\ V}$	Mannings roughness coef.	0.012
	Flow Length (ft)	566
	Velocity (ft/s)	7.737598
	T (hr)=	**0.020319**

Elev. 1	8641.15
Elev.2	8607.7
Trap Channel	
Depth (ft)	0.25
Base (ft)	1
S/S (H:V)	50

Watershed Tc (hr)	**0.039204**

Time of Concentration Calculator

Area: **Ph1-3**

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)	0.073333
	T (hr)=	**0.129516**

Elev. 1 8772
Elev.2 8750

Shallow Concentrated Flow		
$T_t = \frac{L}{3600\ V}$	Flow Length (ft)	405
	Slope (ft/ft)	0.258025
	Average Velocity (ft/s)	8
	T (hr)=	**0.014063**

Elev. 1 8750
Elev.2 8645.5

Channel Flow		
$V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	Cross-Sectional Area (sf)	3.375
	Wetted Perimeter (ft)	26.005
	Hydraulic Radius, r=a/Pw (ft)	0.129783
	Slope (ft/ft)	0.047379
$T_t = \frac{L}{3600\ V}$	Mannings roughness coef.	0.012
	Flow Length (ft)	496
	Velocity (ft/s)	6.928024
	T (hr)=	**0.019887**

Elev. 1 8645.5
Elev.2 8622

Trap Channel
Depth (ft) 0.25
Base (ft) 1
S/S (H:V) 50

Watershed Tc (hr)	**0.163465**

Time of Concentration Calculator

Area: **Ph1-4**

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)	0.071667
	T (hr)=	**0.130712**

Elev. 1 8772
Elev.2 8750.5

Shallow Concentrated Flow		
$T_t = \frac{L}{3600\ V}$	Flow Length (ft)	494
	Slope (ft/ft)	0.214575
	Average Velocity (ft/s)	7
	T (hr)=	**0.019603**

Elev. 1 8750.5
Elev.2 8644.5

Channel Flow		
$V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	Cross-Sectional Area (sf)	3.375
	Wetted Perimeter (ft)	26.005
	Hydraulic Radius, r=a/Pw (ft)	0.129783
	Slope (ft/ft)	0.040179
$T_t = \frac{L}{3600\ V}$	Mannings roughness coef.	0.012
	Flow Length (ft)	560
	Velocity (ft/s)	6.379895
	T (hr)=	**0.024382**

Elev. 1 8644.5
Elev.2 8622

Trap Channel
Depth (ft) 0.25
Base (ft) 1
S/S (H:V) 50

Watershed Tc (hr)	**0.174698**

Time of Concentration Calculator

Area: **Ph1-5**

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)	0.061667
	T (hr)=	**0.138811**

Elev. 1	8644
Elev.2	8625.5

Shallow Concentrated Flow		
$T_t = \frac{L}{3600\ V}$	Flow Length (ft)	63
	Slope (ft/ft)	0.087302
	Average Velocity (ft/s)	5
	T (hr)=	**0.0035**

Elev. 1	8625.5
Elev.2	8620

Channel Flow		
$V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	Cross-Sectional Area (sf)	3.375
	Wetted Perimeter (ft)	26.005
	Hydraulic Radius, r=a/Pw (ft)	0.129783
	Slope (ft/ft)	0.031313
$T_t = \frac{L}{3600\ V}$	Mannings roughness coef.	0.012
	Flow Length (ft)	396
	Velocity (ft/s)	5.632219
	T (hr)=	**0.01953**

Elev. 1	8620
Elev.2	8607.6
Trap Channel	
Depth (ft)	0.25
Base (ft)	1
S/S (H:V)	50

Watershed Tc (hr)	**0.161841**

Time of Concentration Calculator

Area: **Ph1-6**

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)	64
	10 yr 2 hr rainfall depth (in.)	1.52
	Slope (ft/ft)	0.101563
	T (hr)=	**0.033037**

Elev. 1	8606.5
Elev.2	8600

Shallow Concentrated Flow		
$T_t = \frac{L}{3600\ V}$	Flow Length (ft)	37.6
	Slope (ft/ft)	0.026596
	Average Velocity (ft/s)	3
	T (hr)=	**0.003481**

Elev. 1	8600
Elev.2	8599

Channel Flow		
$V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$	Cross-Sectional Area (sf)	3.375
	Wetted Perimeter (ft)	26.005
	Hydraulic Radius, r=a/Pw (ft)	0.129783
	Slope (ft/ft)	0.068441
$T_t = \frac{L}{3600\ V}$	Mannings roughness coef.	0.012
	Flow Length (ft)	789
	Velocity (ft/s)	8.326734
	T (hr)=	**0.026321**

Elev. 1	8599
Elev.2	8545
Trap Channel	
Depth (ft)	0.25
Base (ft)	1
S/S (H:V)	50

Watershed Tc (hr)	**0.062839**

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	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)
PO-1 (IN)	10 yr 2 hr	10	None	0.567	0.690	11.90	(N/A)	(N/A)
PO-1 (OUT)	10 yr 2 hr	10	None	0.567	0.880	6.48	3.00	0.183
PO-2 (IN)	10 yr 2 hr	10	None	0.211	0.700	4.37	(N/A)	(N/A)
PO-2 (OUT)	10 yr 2 hr	10	None	0.211	2.070	0.65	2.97	0.134
Ph1-Post1	10 yr 2 hr	10	None	0.348	0.720	7.33	(N/A)	(N/A)
Ph1-Post2	10 yr 2 hr	10	None	0.096	0.540	3.03	(N/A)	(N/A)
Ph1-Post3	10 yr 2 hr	10	None	0.060	0.700	1.28	(N/A)	(N/A)
Ph1-Post4	10 yr 2 hr	10	None	0.122	0.620	2.82	(N/A)	(N/A)
Ph1-Post5	10 yr 2 hr	10	None	0.030	0.740	0.50	(N/A)	(N/A)
Ph1-Post6	10 yr 2 hr	10	None	0.124	0.540	4.02	(N/A)	(N/A)
Ph1-Pre1	10 yr 2 hr	10	None	0.275	0.720	5.50	(N/A)	(N/A)
Ph1-Pre2	10 yr 2 hr	10	None	0.025	0.690	0.59	(N/A)	(N/A)
Ph1-Pre3	10 yr 2 hr	10	None	0.022	0.740	0.39	(N/A)	(N/A)
Ph1-Pre4	10 yr 2 hr	10	None	0.022	0.770	0.33	(N/A)	(N/A)
Ph1-Pre5	10 yr 2 hr	10	None	0.003	2.010	0.05	(N/A)	(N/A)
Ph1-Pre6	10 yr 2 hr	10	None	0.052	0.690	1.23	(N/A)	(N/A)
Post O-1	10 yr 2 hr	10	None	0.567	0.880	6.48	(N/A)	(N/A)
Post O-2	10 yr 2 hr	10	None	0.211	2.070	0.65	(N/A)	(N/A)
Pre O-1	10 yr 2 hr	10	None	0.352	0.700	7.15	(N/A)	(N/A)
Pre O-2	10 yr 2 hr	10	None	0.047	0.750	0.71	(N/A)	(N/A)

Scenario Calculation Summary

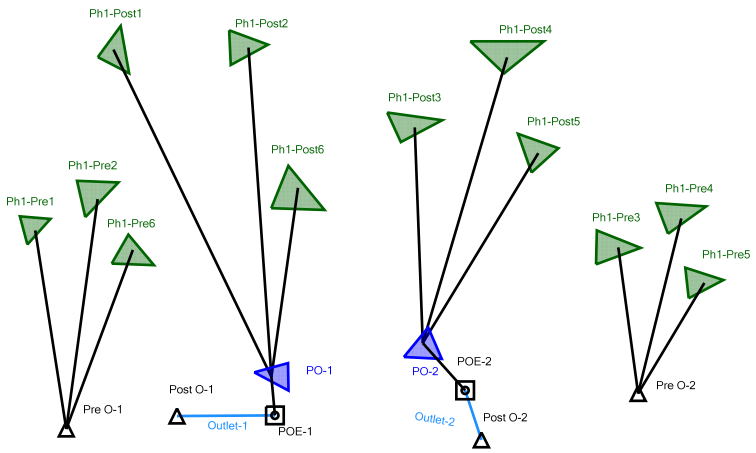
Executive Summary (Links)

Label	Type	Location	Hydrograph Volume (ac-ft)	Peak Time (hours)	Peak Flow (ft^3/s)	End Point	Node Flow Direction
Outlet-1	Pond Outlet	Upstream	0.567	0.690	11.90	PO-1	Pond Inflow
Outlet-1	Pond Outlet	Outflow	0.567	0.880	6.48	PO-1	Pond Outflow
Outlet-1	Pond Outlet	Link	0.567	0.880	6.48		
Outlet-1	Pond Outlet	Downstream	0.567	0.880	6.48	Post O-1	
Outlet-2	Pond Outlet	Upstream	0.211	0.700	4.37	PO-2	Pond Inflow
Outlet-2	Pond Outlet	Outflow	0.211	2.070	0.65	PO-2	Pond Outflow
Outlet-2	Pond Outlet	Link	0.211	2.070	0.65		
Outlet-2	Pond Outlet	Downstream	0.211	2.070	0.65	Post O-2	

Messages

Message Id	29
Scenario	10 yr 2 hr
Element Type	Catchment
Element Id	47
Label	Ph1-Post2
Time	(N/A)
Message	Tm > .25Tp. Computation increment, Tm, is greater than 1/4 Time to Peak on Unit Hydrograph. Using a larger Tc can solve this problem.
Source	Warning

Scenario: 10 yr 2 hr



SPANGLER

XREFS: PRPN_PH1, PRUD_BB, PRTOCN, GRID, EXTO-E3_2-10, EXTO-D3_2-10, EXUT, 2012-12-11 JS Drainage, PRUT_PH1, 24X36S-PH1, PRPFSDLP-ALL

DATE: 12/21/12 TIME: 10:46:56 AM DRAWING NAME: PH1 STORM DRAIN.DWG

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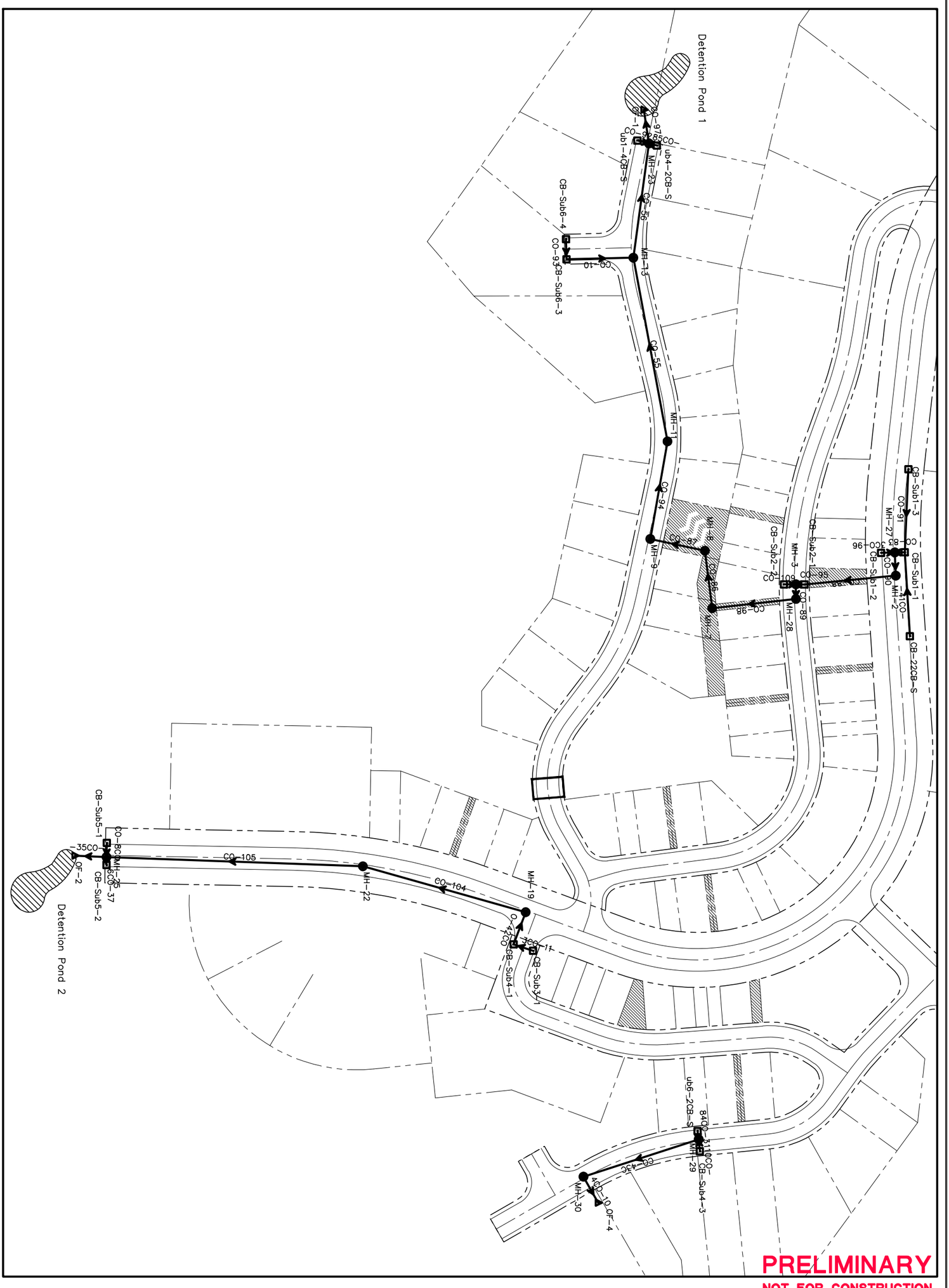

PRELIMINARY

NOT FOR CONSTRUCTION

JOB NUMBER 8L50792306	SCALE HORIZONTAL 1" = 250' VERTICAL 1" = 50'	SHEET NUMBER D OF -- SHEETS	

NV5 BEYOND ENGINEERING

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SUMMIT AT POWDER MTN PH1

STORM DRAIN PLAN

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

NO.	BY	DATE	REVISIONS:

NOTICE: 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.

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

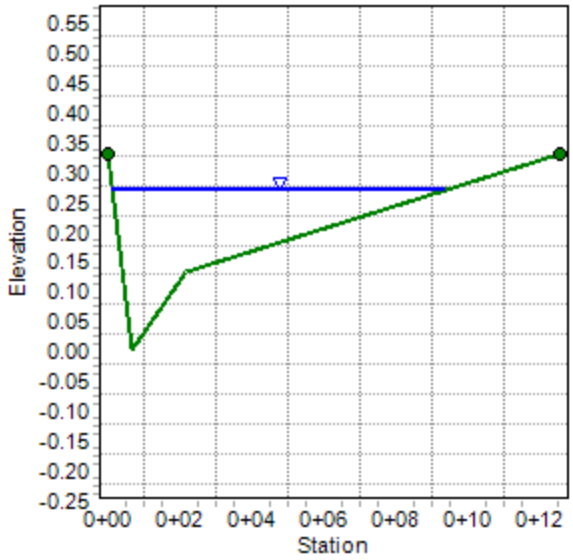
Project Description

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



Catch Basin Summary Table

Inlet	Type	Grate Slope (at grade)	Sub Basin	Accepted Q (cfs)	Bypass Q (cfs)	Bypass Inlet	# of Grates
CB-Sub1-1	sag	na	Ph1-1	3.31	0.00	CB-Sub1-2	2
CB-Sub1-2	sag	na	Ph1-1	0.37	0.00	na	1
CB-Sub1-3	on grade	1.15%	Ph1-1	1.84	0.48	na	1
CB-Sub1-4	on grade	1.85%	Ph1-1	1.81	0.51	na	1
CB-Sub2-1	on grade	2.00%	Ph1-2	0.61	2.42	CB-Sub2-2	1
CB-Sub2-2	sag	na	Ph1-2	2.42	0.00	na	1
CB-Sub3-1	sag	na	Ph1-3	1.28	0.00	na	1
CB-Sub4-1	on grade	3.89%	Ph1-4	1.86	0.51	CB-Sub5-1	1
CB-Sub4-2	sag	na	Ph1-4	0.23	0.00	na	1
CB-Sub4-3	sag	na	Ph1-4	0.23	0.00	na	1
CB-Sub5-1	sag	na	Ph1-5	0.91	0.00	na	1
CB-Sub5-2	on grade	2.00%	Ph1-5	0.10	0.00	CB-Sub5-1	1
CB-Sub6-1	on grade	2.00%	Ph1-6	0.24	0.00	CB-Sub6-2	1
CB-Sub6-2	sag	na	Ph1-6	0.96	0.00	na	1
CB-Sub6-3	on grade	2.000%	Ph1-6	0.56	0.00	CB-Sub6-4	1
CB-Sub6-4	sag	na	Ph1-6	2.25	0.00	na	1

Worksheet for CB-Sub1-1 (sag)

Project Description

Solve For	Spread

Input Data

Discharge		3.31	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	11.54	ft
Depth	0.30	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-Sub1-2 (sag)

Project Description

Solve For	Spread

Input Data

Discharge		0.37	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	1.67	ft
Depth	0.10	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-Sub1-3 (on grade)

Project Description

Solve For	Efficiency

Input Data

Discharge		2.32	ft³/s
Slope		0.01150	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		0.00	%

Options

Grate Flow Option	Exclude None

Results

Efficiency	79.26	%
Intercepted Flow	1.84	ft³/s
Bypass Flow	0.48	ft³/s
Spread	8.04	ft
Depth	0.23	ft
Flow Area	0.71	ft²
Gutter Depression	0.07	ft
Total Depression	0.07	ft
Velocity	3.28	ft/s
Splash Over Velocity	11.51	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.53	
Grate Flow Ratio	0.56	
Active Grate Length	4.00	ft

Worksheet for CB-Sub1-4 (on grade)

Project Description

Solve For	Efficiency

Input Data

Discharge		2.32	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		0.00	%

Options

Grate Flow Option	Exclude None

Results

Efficiency	78.20	%
Intercepted Flow	1.81	ft³/s
Bypass Flow	0.51	ft³/s
Spread	7.24	ft
Depth	0.21	ft
Flow Area	0.58	ft²
Gutter Depression	0.07	ft
Total Depression	0.07	ft
Velocity	3.97	ft/s
Splash Over Velocity	11.51	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.45	
Grate Flow Ratio	0.60	
Active Grate Length	4.00	ft

Worksheet for CB-Sub2-1 (sag)

Project Description

Solve For	Spread

Input Data

Discharge		0.61	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	3.61	ft
Depth	0.14	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-Sub2-2 (sag)

Project Description

Solve For	Spread

Input Data

Discharge		2.42	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	12.27	ft
Depth	0.32	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-Sub3-1 (sag)

Project Description

Solve For	Spread

Input Data

Discharge		1.28	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	7.40	ft
Depth	0.22	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-Sub4-1 (on grade)

Project Description

Solve For	Efficiency

Input Data

Discharge		2.37	ft³/s
Slope		0.03890	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		0.00	%

Options

Grate Flow Option	Exclude None

Results

Efficiency	78.37	%
Intercepted Flow	1.86	ft³/s
Bypass Flow	0.51	ft³/s
Spread	6.16	ft
Depth	0.19	ft
Flow Area	0.44	ft²
Gutter Depression	0.07	ft
Total Depression	0.07	ft
Velocity	5.38	ft/s
Splash Over Velocity	11.51	ft/s
Frontal Flow Factor	1.00	
Side Flow Factor	0.32	
Grate Flow Ratio	0.68	
Active Grate Length	4.00	ft

Worksheet for CB-Sub4-2 (sag)

Project Description

Solve For	Spread

Input Data

Discharge		0.23	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	1.06	ft
Depth	0.01	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-Sub4-3 (sag)

Project Description

Solve For	Spread

Input Data

Discharge		0.23	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	1.06	ft
Depth	0.01	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-Sub5-1 (sag)

Project Description

Solve For	Spread

Input Data

Discharge		0.91	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	5.47	ft
Depth	0.18	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-Sub5-2 (sag)

Project Description

Solve For	Spread

Input Data

Discharge		0.10	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-Sub6-1 (sag)

Project Description

Solve For	Spread

Input Data

Discharge		0.24	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	1.09	ft
Depth	0.01	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-Sub6-2 (sag)

Project Description

Solve For	Spread

Input Data

Discharge		0.96	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	5.75	ft
Depth	0.18	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-Sub6-3 (sag)

Project Description

Solve For	Spread

Input Data

Discharge		0.56	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	3.25	ft
Depth	0.14	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-Sub6-4 (sag)

Project Description

Solve For	Spread

Input Data

Discharge		2.25	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	11.61	ft
Depth	0.30	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

StormCAD Inlet Summary Table

Label	Elevation (rim)	Elevation (invert)	Additional Flow (cfs)	HGL (in)	HGL (out)	Downstream Velocity (ft/s)	Flow (total out)
CB-Sub1-1	8,631.62	8,628.53	3.31	8,629.59	8,629.59	6.28	6.96
CB-Sub1-2	8,631.61	8,628.36	0.37	8,629.31	8,629.31	0.35	0.37
CB-Sub1-3	8,632.53	8,629.28	1.84	8,629.82	8,629.82	3.63	1.84
CB-Sub1-4	8,632.74	8,629.49	1.81	8,630.02	8,630.02	3.62	1.81
CB-Sub2-1	8,608.02	8,604.77	0.61	8,605.88	8,605.88	6.88	7.94
CB-Sub2-2	8,607.80	8,604.35	2.42	8,605.44	8,605.44	2.13	2.42
CB-Sub3-1	8,620.32	8,617.07	1.28	8,617.56	8,617.56	2.84	1.28
CB-Sub4-1	8,620.76	8,616.88	1.86	8,617.59	8,617.59	4.33	3.14
CB-Sub4-2	8,626.62	8,623.37	0.23	8,623.56	8,623.56	2.02	0.23
CB-Sub4-3	8,627.06	8,623.81	0.23	8,624.00	8,624.00	2.04	0.23
CB-Sub5-1	8,608.00	8,604.20	0.91	8,604.82	8,604.82	1.5	0.91
CB-Sub5-2	8,608.00	8,604.20	0.1	8,604.83	8,604.83	0	0.1
CB-Sub6-1	8,548.62	8,545.54	0.24	8,545.73	8,545.73	2.05	0.24
CB-Sub6-2	8,545.69	8,542.44	0.96	8,542.83	8,542.83	2.99	0.96
CB-Sub6-3	8,544.19	8,540.31	0.56	8,542.33	8,542.33	2.3	2.81
CB-Sub6-4	8,543.75	8,540.50	2.25	8,542.36	8,542.36	1.84	2.25

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-112	8,623.81	8,623.29	0.037	15	3.93	0.23	14.2	PVC	0.013	CB-Sub4-3	MH-29
CO-109	8,623.37	8,623.29	0.008	15	2.29	0.23	10.2	PVC	0.013	CB-Sub4-2	MH-29
CO-110	8,623.29	8,621.80	0.01	15	3.08	0.46	145.3	PVC	0.013	MH-29	MH-30
CO-111	8,621.80	8,618.00	0.106	15	6.96	0.46	35.8	PVC	0.013	MH-30	OF-4
CO-107	8,604.20	8,604.00	0.012	15	3.94	0.91	16.9	PVC	0.013	CB-Sub5-1	MH-25
CO-108	8,604.20	8,604.00	0.02	15	2.46	0.1	9.7	PVC	0.013	CB-Sub5-2	MH-25
CO-102	8,617.07	8,616.88	0.008	15	3.71	1.28	24.7	PVC	0.013	CB-Sub3-1	CB-Sub4-1
CO-103	8,616.88	8,616.58	0.007	15	4.65	3.14	41.3	PVC	0.013	CB-Sub4-1	MH-19
CO-104	8,616.58	8,615.06	0.007	15	4.69	3.14	203	PVC	0.013	MH-19	MH-22
CO-105	8,615.06	8,604.00	0.036	15	8.35	3.14	308	PVC	0.013	MH-22	MH-25
CO-106	8,604.00	8,602.50	0.039	15	9.33	4.15	38.1	PVC	0.013	MH-25	OF-2
CO-97	8,542.44	8,538.30	0.296	15	12.44	0.96	14.3	PVC	0.013	CB-Sub6-2	MH-23
CO-96	8,545.54	8,538.30	0.724	15	11.15	0.24	9.8	PVC	0.013	CB-Sub6-1	MH-23
CO-98	8,540.50	8,540.31	0.008	15	1.83	2.25	24.2	PVC	0.013	CB-Sub6-4	CB-Sub6-3
CO-99	8,540.31	8,539.71	0.008	15	2.29	2.81	80.2	PVC	0.013	CB-Sub6-3	MH-13
CO-100	8,604.35	8,604.24	0.008	15	4.47	2.42	14.3	PVC	0.013	CB-Sub2-2	MH-28
CO-101	8,628.36	8,628.23	0.008	15	2.66	0.37	16.4	PVC	0.013	CB-Sub1-2	MH-27
CO-113	8,629.49	8,628.53	0.01	15	4.43	1.81	100.9	PVC	0.013	CB-Sub1-4	CB-Sub1-1
CO-83	8,629.28	8,628.53	0.008	15	4.09	1.84	99.8	PVC	0.013	CB-Sub1-3	CB-Sub1-1
CO-84	8,628.53	8,628.23	0.025	15	8.95	6.96	12.1	PVC	0.013	CB-Sub1-1	MH-27
CO-85	8,628.23	8,627.50	0.026	15	9.2	7.33	27.8	PVC	0.013	MH-27	MH-2
CO-86	8,627.50	8,604.77	0.207	15	19.88	7.33	110.2	PVC	0.013	MH-2	CB-Sub2-1
CO-87	8,604.77	8,604.24	0.053	15	12.32	7.94	10.3	PVC	0.013	CB-Sub2-1	MH-28
CO-88	8,604.24	8,599.67	0.269	15	24.07	10.36	17.4	PVC	0.013	MH-28	MH-3
CO-89	8,599.67	8,583.06	0.164	15	20.09	10.36	101.1	PVC	0.013	MH-3	MH-7
CO-90	8,583.06	8,571.60	0.164	15	20.05	10.36	69.6	PVC	0.013	MH-7	MH-8
CO-91	8,571.60	8,565.83	0.086	15	15.79	10.36	67	PVC	0.013	MH-8	MH-9
CO-92	8,565.83	8,556.79	0.076	15	15.06	10.36	118.9	PVC	0.013	MH-9	MH-11
CO-93	8,556.79	8,539.71	0.076	15	15.08	10.36	224.2	PVC	0.013	MH-11	MH-13
CO-94	8,539.71	8,538.30	0.01	18	7.45	13.17	138.4	PVC	0.013	MH-13	MH-23
CO-95	8,538.30	8,537.80	0.012	18	8.13	14.37	40.9	PVC	0.013	MH-23	OF-1

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)

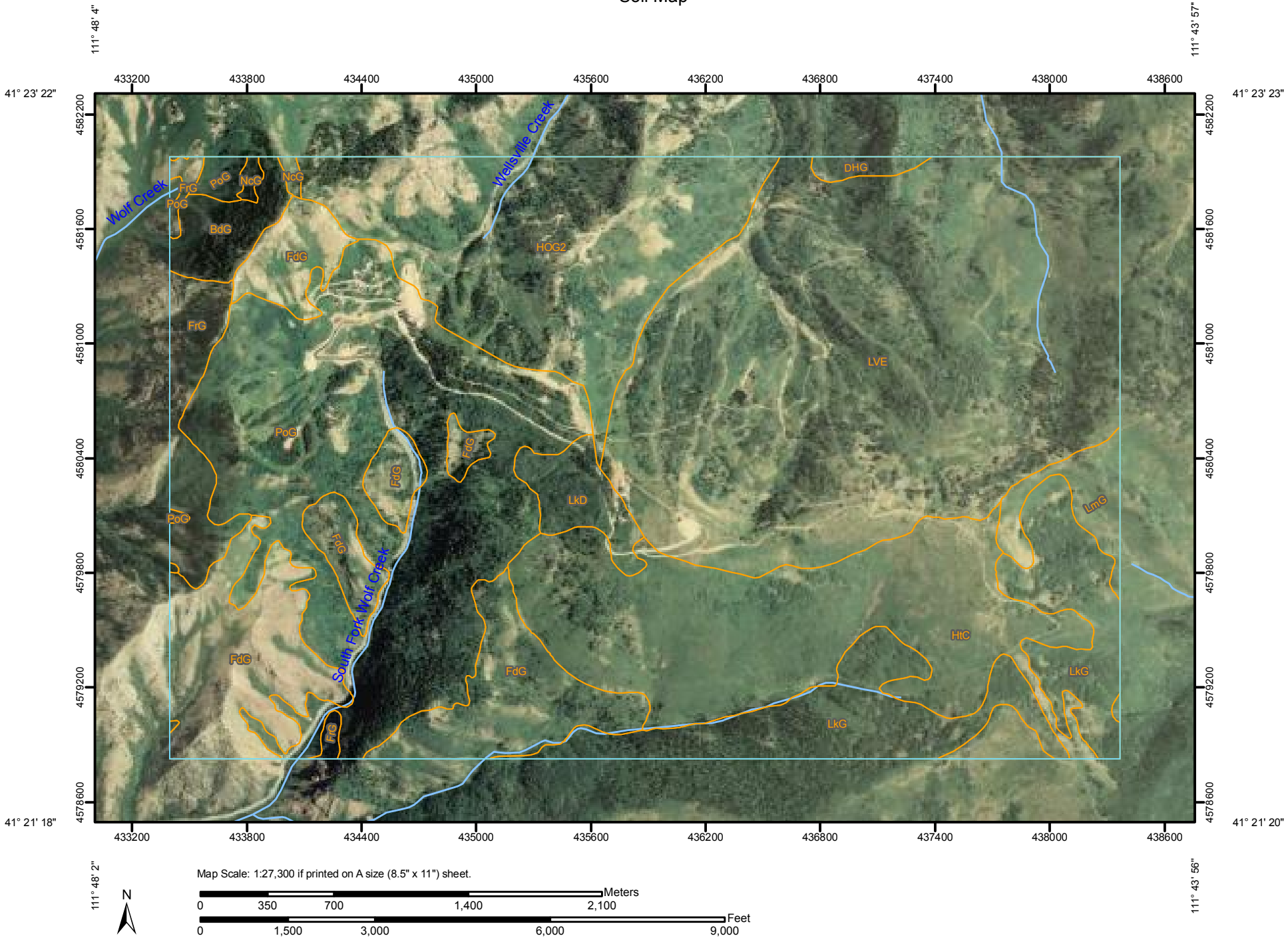
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

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.

Back to Top

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