SUMMIT AT POWDER MOUNTAIN
HORIZON RUN AND HEARTWOOD DRIVE
SUPPLIMENT TO MAY 2013 DRAINAGE SUMMARY

POWDER MOUNTAIN RESORT
EDEN, UTAH

JULY 2013

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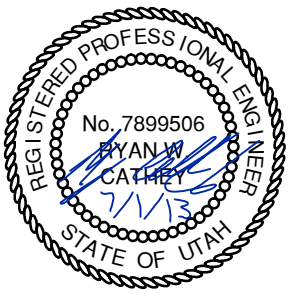
BEYOND ENGINEERING



Site Description

The proposed development at Powder Mountain Resort east of Eden Utah is an extension of the planned communities that branch off of Summit Pass. These developments include Horizon Run and Heartwood Drive. Horizon run includes 20 single family lots south, downhill of Horizon Run with three single family lots and 1 large open space parcel north of Horizon Run, between Horizon Run and Summit Pass. The Heartwood Drive subdivision includes 11 single family lots around the cul-de-sac and 1 nest cabin parcel north of Summit Pass and Heartwood Drive. The nest parcel will contain approximately 17 small cabins, approximately 400 square feet each. The majority of storm drainage for the site has historically been conveyed overland in the southwesterly directing into Lefty's Canyon. With the usage of roadside ditches, catch basins, and culverts drainage will be conveyed through the site.

Drainage Analysis

Analysis of the proposed developments has been carried out with the same method as was used for the Summit Pass and Spring Park Study dated May 2013. This analysis is intended as a supplement and update to that study. 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. Landuse consists of 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.*

In the Summit Pass and Spring Park Analysis, Haestad Method's FlowMaster was used to calculate the capacity of the roadside ditches for the development. Since the 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. The same roadside ditch will be utilized upstream, north, of both new roadways. These calculations can be found in the appendix of the Summit Pass and Spring Park Report.

Hydrology for Horizon run has not been previously calculated. See appendix for the updated hydrology for Horizon Run. A roadside ditch upstream of Horizon Run will collect all runoff from between summit Pass and Horizon Run. The roadside ditch in flows to the sag point along the alignment then falls into a catch basin that pipes stormwater under the roadway. The pipe system discharges to a natural swale that follows a lot line and ultimately discharges to a historic location of discharge previous to disturbance. See the appendix for calculations for the pipe network. There is no other stormwater management infrastructure needed for Horizon Run.

All hydrology for Heartwood Drive has been considered in the Summit Pass and Spring Park Drainage Study. The roadside ditch from the initial study is intended to be utilized for Heartwood Drive. Heartwood Drive roughly follows an existing ridge. Therefore, much of the stormwater runoff north of

the roadway flows overland away from the development. Any stormwater that falls north of the roadway then toward the roadway will be collected the roadside ditch. The ditch follows Heartwood Drive to where it discharges in the roadside ditch for Summit Pass. An additional culvert will be installed along Summit Pass at the intersection with Heartwood Drive. The culvert is designed to carry the peak flow rate through sub basin containing the development, subarea CM-5, as identified the in the May 2013 report. See the appendix for roadside ditch and culvert calculations. There is no other stormwater management infrastructure needed for Heartwood Drive.

Pipe networks and 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.

An analysis of runoff impacts due to the minor developments along Summit Pass in the initial study shows that runoff increase in volume and flow rate is negligible. Therefore, there will be no need for stormwater detention for Horizon Run and Heartwood Drive developments.

APPENDICES

1. **Horizon Run Pipe Network Calculations**
    a. **Horizon Run Overall Grading and Drainage**
    b. **Culvert Subareas Drainage Exhibit B - Revised**
    c. **Time of Concentration Calculations - Revised**
    d. **Haestad Method's PondPack Calculations - Revised**
    e. **Haestad Method's FlowMaster Roadside Ditch Capacity (From May Report)**
    f. **Haestad Method's StormCAD Node Table**
    g. **Haestad Method's StormCAD Pipes Table**
    h. **Haestad Method's FlowMaster Ditch Catch Basin Calculations**
    i. **USDA NRCS Riprap Calculations**
2. **Heartwood Drive Ditch and Culvert Calculations**
    a. **Heartwood Drive Overall Grading and Drainage**
    b. **Haestad Method's FlowMaster Roadside Ditch Capacity (From May Report)**
    c. **Haestad Method's CulvertMaster Calculations**

DATE: 7/2/13 TIME: 2:48:03 PM DRAWING NAME: SP10405.DWG
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CACHE COUNTY
SUMMIT COUNTY

SUMMIT PASS

OPEN SPACE

HORIZON RUN

8750

8725

8700

1

2

3

4

5

6R

7A

7B

8

9

10

11R

12R

13R

14R

15R

16

17

18

19

20

21

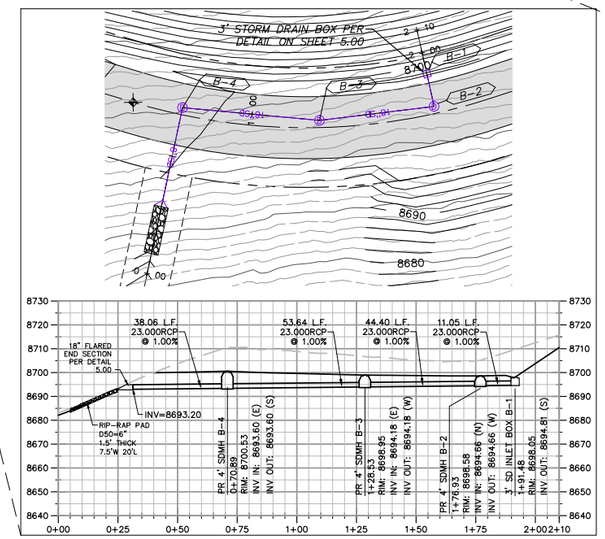
22

23R

6' WIDE 1' DEEP DRAINAGE CHANNEL ALONG LOT LINE LINE WITH REVEGATION MAT

SCALE
HORIZONTAL: 1" = 100
0 25 50 100 150

3' STORM DRAIN BOX PER DETAIL ON SHEET 5.00



CALL BEFORE YOU DIG!
IT'S THE LAW
BLUE STAKES 1 800 662 4111

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.

PHASE 1A CONSTRUCTION
HORIZON RUN
OVERALL GRADING AND DRAINAGE PLAN

PREPARED FOR: SUMMIT, LLC **DATE SUBMITTED: 7/1/2013**

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RYAN W. CATHEY
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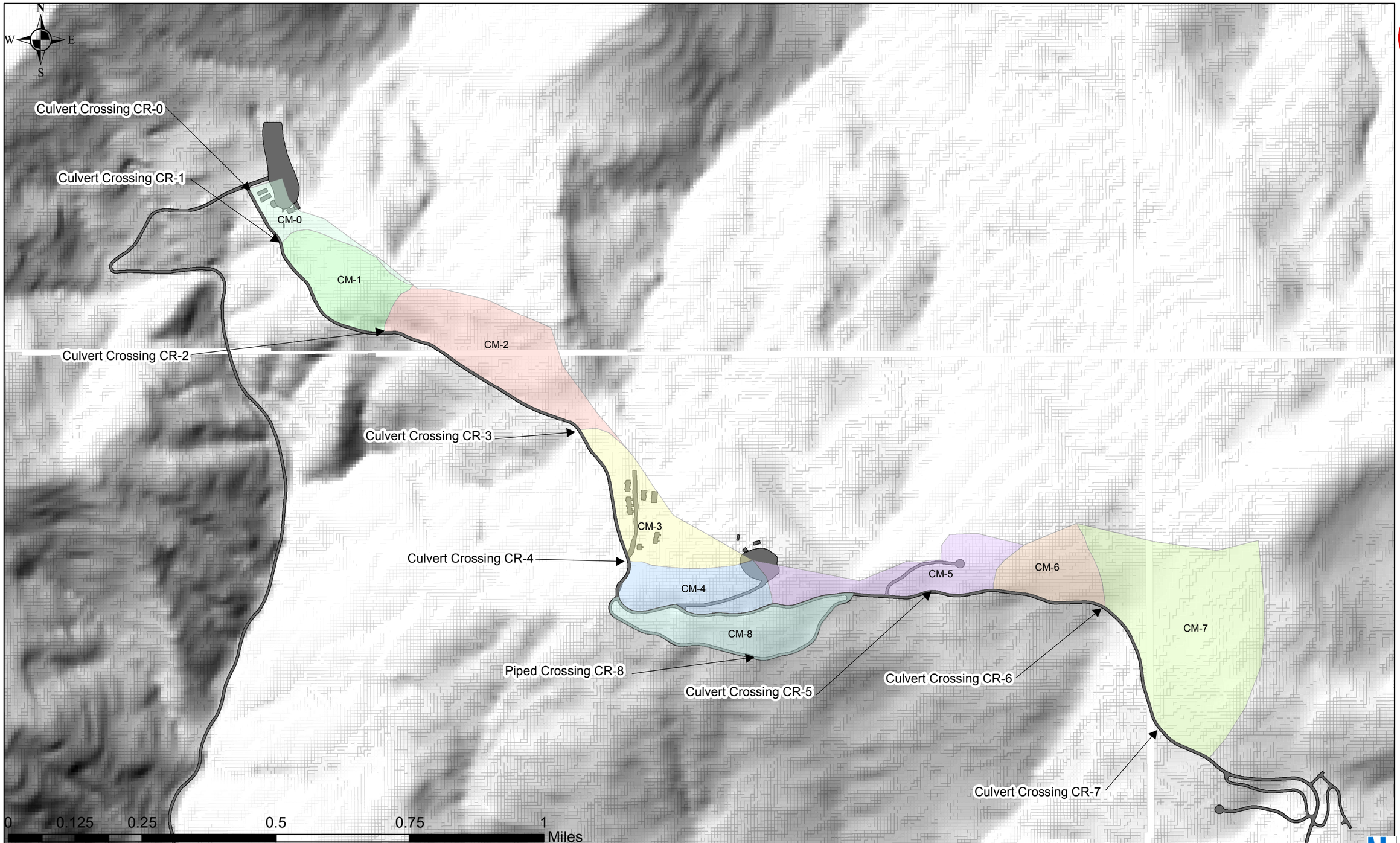
STATE OF UTAH

SHEET NUMBER
1.04

SCALE
VERTICAL: 1"= NA
HORIZONTAL: 1"= 100

JOB NUMBER
SLB079306

BOWLDEN KREPS:



B

POWDER MOUNTAIN: SUMMIT PASS & SPRING PARK ROADWAYS - HORIZON RUN SUPPLIMENT

Culvert Catchment Areas

JUNE 2013

NV5 BEYOND ENGINEERING

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

Time of Concentration Calculator

Area: **CM-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)	96.5
	10 yr 2 hr rainfall depth (in.)	1.52
	Slope (ft/ft)	0.161347
	T (hr)=	**0.03813**

Elev. 1	8787.1
Elev.2	8771.53

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

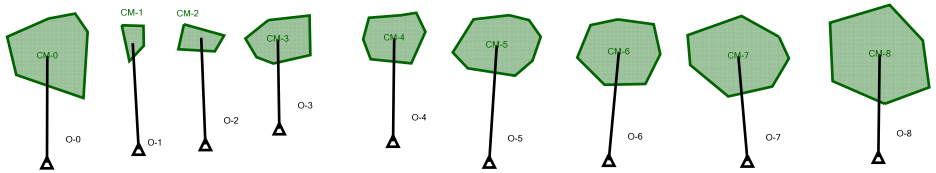
Elev. 1	n/a
Elev.2	n/a

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)	0.037184
$T_t = \frac{L}{3600\ V}$	Mannings roughness coef.	0.05
	Flow Length (ft)	1691.07
	Velocity (ft/s)	3.768815
	T (hr)=	**0.124639**

Elev. 1	8771.53
Elev.2	8708.65
Trap Channel	
Depth (ft)	0.75
Base (ft)	3
S/S (H:V)	2

Watershed Tc (hr) **0.162769**

Scenario: 10 yr 2 hr



Scenario Calculation Summary

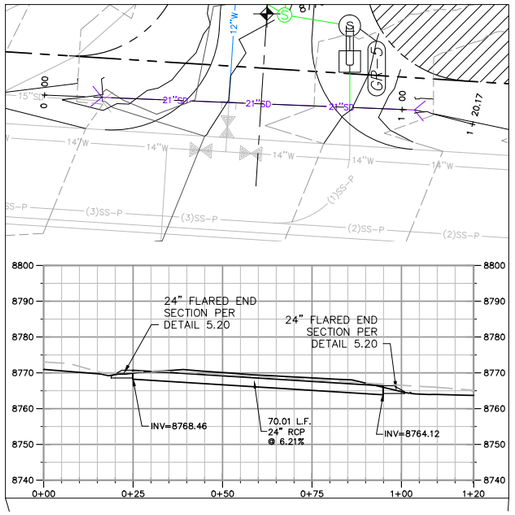
Scenario Summary	
ID	41
Label	10 yr 2 hr
Notes	
Active Topology	<I> Base Active Topology
Hydrology	<I> Base Hydrology
Rainfall Runoff	10 yr 2 hr
Physical	<I> Base Physical
Initial Condition	<I> Base Initial Condition
Boundary Condition	<I> Base Boundary Condition
Infiltration and Inflow	<I> Base Infiltration 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)
CM-8	10 yr 2 hr	10	None	0.339	0.700	7.56	(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)
O-8	10 yr 2 hr	10	None	0.339	0.700	7.56	(N/A)	(N/A)



PHASE 1B CONSTRUCTION
HEARTWOOD DRIVE
OVERALL GRADING AND DRAINAGE

DATE SUBMITTED: 7/1/2013

PREPARED FOR: SUMMIT, LLC

NO.	BY	DATE	REVISIONS

CAUTION

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STATE OF UTAH

SHEET NUMBER
1.03

SCALE
VERTICAL: 1"= NA
HORIZONTAL: 1"= 250

JOB NUMBER
SLB079306

BOWLDEN KREFS:

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

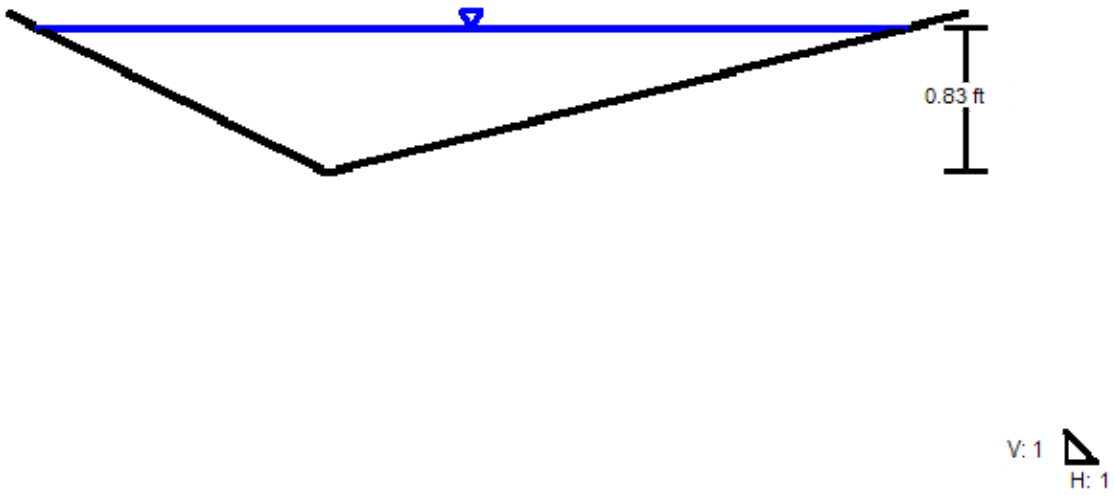
Project Description

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



StormCAD Node Summary Table

Label	Elevation (rim)	Elevation (invert)	Additional Flow (cfs)	HGL (in)	HGL (out)	Downstream Velocity (ft/s)	Structure Type
B-1	8,698.05	8,694.81	7.56	8,695.88	8,695.88	5.63	Catch Basin
B-2	8,698.58	8,694.66	0	8,695.73	8,695.73	5.63	Manhole
B-3	8,698.95	8,694.18	0	8,695.25	8,695.25	5.63	Manhole
B-4	8,700.53	8,693.60	0	8,694.67	8,694.67	5.63	Manhole
O-3	8,693.20	8,693.20	0	8,694.13	8,694.13	N/A	Outlet

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-20	8,694.81	8,694.66	0.014	18	7.29	7.56	11.1	Concrete	0.013	B-1	B-2
CO-21	8,694.66	8,694.18	0.011	18	6.67	7.56	44.4	Concrete	0.013	B-2	B-3
CO-22	8,694.18	8,693.60	0.011	18	6.67	7.56	53.6	Concrete	0.013	B-3	B-4
CO-23	8,693.60	8,693.20	0.011	18	6.6	7.56	38.1	Concrete	0.013	B-4	OF-3

Worksheet for B-1 Ditch Inlet In Sag

Project Description

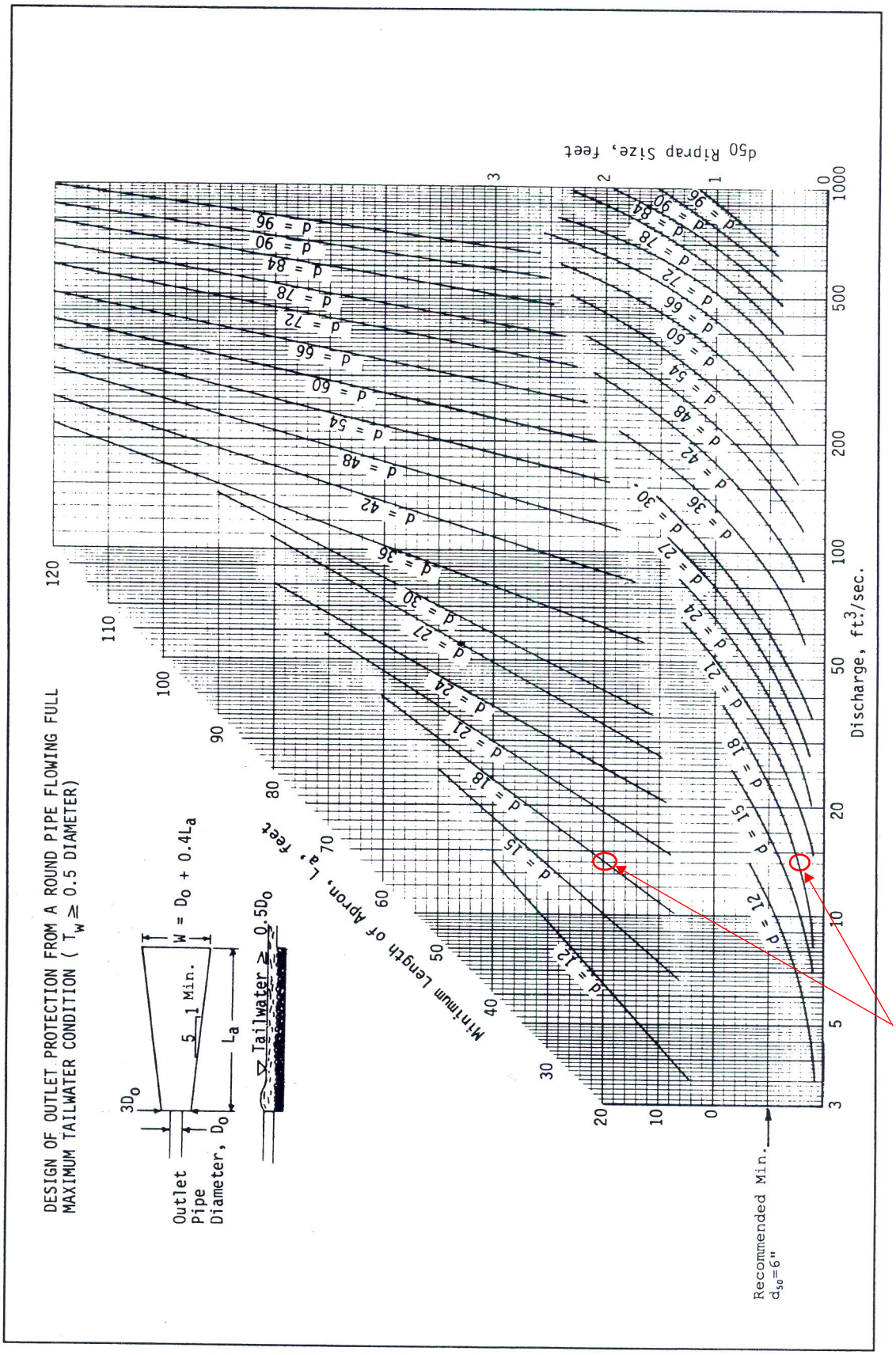
Solve For	Spread

Input Data

Discharge		7.56	ft^3/s
Left Side Slope		2.00	ft/ft (H:V)
Right Side Slope		4.00	ft/ft (H:V)
Bottom Width		0.00	ft
Grate Width		3.00	ft
Grate Length		3.00	ft
Local Depression		1.00	in
Local Depression Width		3.00	ft
Grate Type	P-30 mm (P-1-7/8")		
Clogging		50.00	%

Results

Spread	2.07	ft
Depth	0.34	ft
Wetted Perimeter	2.19	ft
Top Width	2.07	ft
Open Grate Area	2.70	ft^2
Active Grate Weir Length	9.00	ft



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

Cross Section for Roadside Ditch Capacity

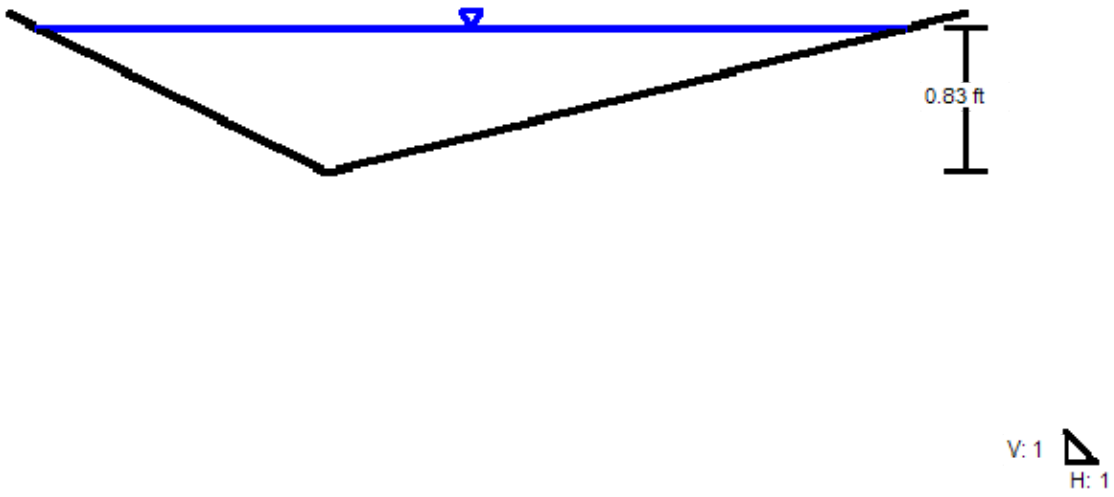
Project Description

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



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

Culvert Calculator Report
Heartwood Drive Culvert

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	8,766.46	ft	Headwater Depth/Height	0.69	
Computed Headwater Eleva	8,769.84	ft	Discharge	6.17	cfs
Inlet Control HW Elev.	8,769.65	ft	Tailwater Elevation	8,764.12	ft
Outlet Control HW Elev.	8,769.84	ft	Control Type	Entrance Control	

Grades					
Upstream Invert	8,768.46	ft	Downstream Invert	8,764.12	ft
Length	70.00	ft	Constructed Slope	0.062000	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	0.45	ft
Slope Type	Steep		Normal Depth	0.45	ft
Flow Regime	Supercritical		Critical Depth	0.88	ft
Velocity Downstream	11.77	ft/s	Critical Slope	0.004667	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	2.00	ft
Section Size	24 inch		Rise	2.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	8,769.84	ft	Upstream Velocity Head	0.33	ft
Ke	0.50		Entrance Loss	0.17	ft

Inlet Control Properties					
Inlet Control HW Elev.	8,769.65	ft	Flow Control	Unsubmerged	
Inlet Type	Square edge w/headwall		Area Full	3.1	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				