Received 12/29/04

Impact Fees shown
on last page

Final Drainage Report

For

Orchard Ridge Subdivision

Presented To:
The City of Fruita

Prepared For:
Radar Development LLC
1172 23\½ Road
Grand Junction, CO 81505

Prepared By:
ROLLAND Engineering
405 Ridges Blvd.
Grand Junction, CO 81503

June 29, 2004
Revised December 22, 2004

file: 4027drn1.doc

— Drainage fee calculated using SWMM Tables for Lot Coverage –

— Storm Drain Pipe sizing calculated using Modified City of Fru
Lot Coverage of 3200 □'/lot –

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CERTIFICATION STATEMENT

I hereby certify that this report for the preliminary drainage design of POWER/JOUFLAS SUBDIVISION was prepared by me or under my direct supervision.

36169

12/20/04

Eric S. Shryon, P.E.

Registered Professional Engineer
State of Colorado, Number 36169

I. SITE LOCATION AND DESCRIPTION

A: Property Location

The proposed Orchard Ridge Subdivision encompasses approximately 33.45 acres east of 17 Road, in Fruita, Colorado. The site is located in SE¼ of the NE¼ of Section 7, Township 1 North, Range 2 West of the Ute Meridian. The property has an address of 2269 17 Road and its Tax Parcel Number is 2697-0071-00-036. The property is bounded on the south by Comstock Estates Filing No. 8, on the east by 17 Road, on the north by the agricultural land and a single family house, and on the west by agricultural land and flood plain of the Big Salt Wash.

B: Description of Property

The property is currently vacant, but has been used agricultural in the past. Vegetative cover consists of native grasses and weeds. The site slopes evenly to the southwest at a gradient of 0.8%. The site is not within a designated 100-year flood plain. Irrigation water originates in the north east corner of the site. An existing underground irrigation pipe runs south along 17 Road. A tailwater ditch is located on the west side just off the property. Soil types of Ravola Clay Loam, with some Billings Silty Clay Loam was determined from soils maps prepared by The United States Department of Agriculture, Soil Conservation Service, 1955. These soils have slow surface runoff. Type D soil group will be used for runoff calculations.

III. EXISTING DRAINAGE CONDITIONS

A: Major Basin Description

The property lies within the Big Salt Wash major drainage basin. The Big Salt Wash empties into the Colorado River about 16¼ miles east of the Utah state line. The major drainage basin has an area of about 142 sq. miles and extends north about 11 miles into Garfield County. The Major Drainage Basin is bounded by Reed Wash to the southwest, East Salt Creek to the northwest, Roan Creek to the northeast and Little Salt Wash to the southeast. For a major basin map see Appendix A.1.

B: On-Site Flows

The site slopes to the southwest with grades of about 0.8%. Tailwater ditches collect irrigation water and stormwater along the west and south property lines. At the southwest corner of the site a tailwater ditch direct water to an inlet structure, on the adjacent property to the west, at the top of an embankment. The tailwater is piped down to the Big Salt Wash flood plain and enters the wash.

C: Off-Site Flows

Offsite stormwater runoff enters the site as sheet flow from 700 feet of the western half of 17 Road that is adjacent to the site.

III. PROPOSED DRAINAGE CONDITIONS

A: General

The proposed subdivision will have a system of streets running east west and north south. Streets will be graded such that stormwater will flow west or south. Drainage from lots will be directed to the streets along lot lines. Pairs of inlets located in the western most and in the southern most roads will collect runoff. Storm sewers in each of these streets will combine in the southwest corner of the site. A 30" RCP storm sewer will carry runoff through an existing easement, across the adjacent property to the west, to the Big Salt Wash. Due to the close proximity to the Big Salt Wash, it is being proposed that stormwater will be freely released to the Big Salt Wash without stormwater detention. The storm sewer will be sized to carry runoff from the 100-year storm event and Rip Rap installed at the outfall for erosion control.

B: Developed Basins

Basin A contains 19.77 acres in the north and west portions of the site. This basin is divided into three sub-basins for street and inlet capacity calculations. A group of inlets is located about halfway up the western most road. Stormwater is then carried south in a 24" storm sewer.

Basin B contains 11.95 acres in the south and east portions of the site. This basin is divided into two sub-basins for street and inlet capacity calculations. A pair of inlets is located in the western portion of the southern most road. Stormwater is then carried west in an 18" storm sewer. Drainage from Basins A and B combine at the intersection of the western most and southern most roads. A 30" storm sewer heads southwest in a drainage easement.

Basin C has an area of 0.85 acres and contains the rear portion of 3 lots on the south side of the southern most road. Drainage from this basin enters an inlet and combines with drainage from Basins A and B in the 30" storm sewer. The 30" storm sewer continues west for just over 1000 feet to the Big Salt Wash.

Basin D has an area of 0.64 acres and contains rear lots adjacent to and east of Comstock Drive and south of the southern most road in the subdivision. Runoff from this basin will be directed to Comstock Drive, where it will continue south to the stormwater facility area north of Comstock Estates Filing No.5.

Basin E has an area of 0.23 acres. Runoff from Basin F will sheet flow to the southeast onto the northern portion of Comstock Estates. This basin is created by an existing underground irrigation pipe that creates a divide for drainage The basin consist of the rear 16+/- feet of 6 lots in the southeast corner of the subdivision.

C: Runoff Summary

Developed Basin	Area (Ac.)	2 Year (cfs)	100 Year (cfs)
A1	6.49	0.9	5.3
A2	8.81	1.5	8.3
A3	4.47	0.7	4.1
B1	4.98	0.8	4.3
B2	6.97	1.0	5.7
C	0.85	0.2	1.1
D	0.64	0.2	0.9
E	0.23	0.1	0.3

Off-Site Basin	Area (Ac.)	2 Year (cfs)	100 Year (cfs)
OS	0.53	0.5	1.5

Historic Basin	Area (Ac.)	2 Year (cfs)	100 Year (cfs)
H	33.44	3.9	18.6

D: Street and Storm Sewer Capacity

Basins A and B were further divided into sub-basins to analyze street capacity. The inlets receiving the most runoff and those on roads at the least slopes would be the west inlet (A1) and the north inlet (A2) in Basin A and south inlet (B2) in Basin B. Sub-basin A1 has an area of 6.49 acres and produces 5.3 cfs of runoff during the 100 year storm event. The road in Sub-basin A1 is set at 0.52% and has a capacity of 9.0 cfs. Sub-basin A2 has an area of 8.81 acres and produces 8.3 cfs of runoff during the 100 year storm event. The road in Sub-basin A2 is set at 0.66% and has a capacity of 10.4 cfs. Sub-basin B2 has an area of 6.97 acres and produces 6.7 cfs of runoff, with the offsite basin, during the 100-year storm event. The road in Sub-basin B2 is set at 0.64% and has a capacity of 10.0 cfs. Runoff from the sub-basins were routed through one another to obtain 100-year storm event flow rates for each design point and can be found in Appendix A.4. A second runoff calcualation was performed with higher runoff coefficients to produce a "worst case" pipe design. Appendix B.2 details the higher coefficients and the runoff generated with those assumptions. A summary of the pipe capacities for each section can be found in Appendix B.2.

IV. DESIGN CRITERIA AND APPROACH

This Drainage Report conforms to the requirements of the Mesa County Storm Water Management Manual (SWMM) dated May 1996 and the City of Grand Junction Design Standards and Construction Specifications. The Rational Method was used to compute developed runoff for the 2 and 100-year storm events. Based on the Soil Survey, Grand Junction Area, Colorado, United States Department of Agriculture, Soil Conservation Service, issued in November 1955," the soils in this area are in Soil Group D. "Hydroflow Hydrographs 5.1" software was used in routing the runoff through subsequent basins.

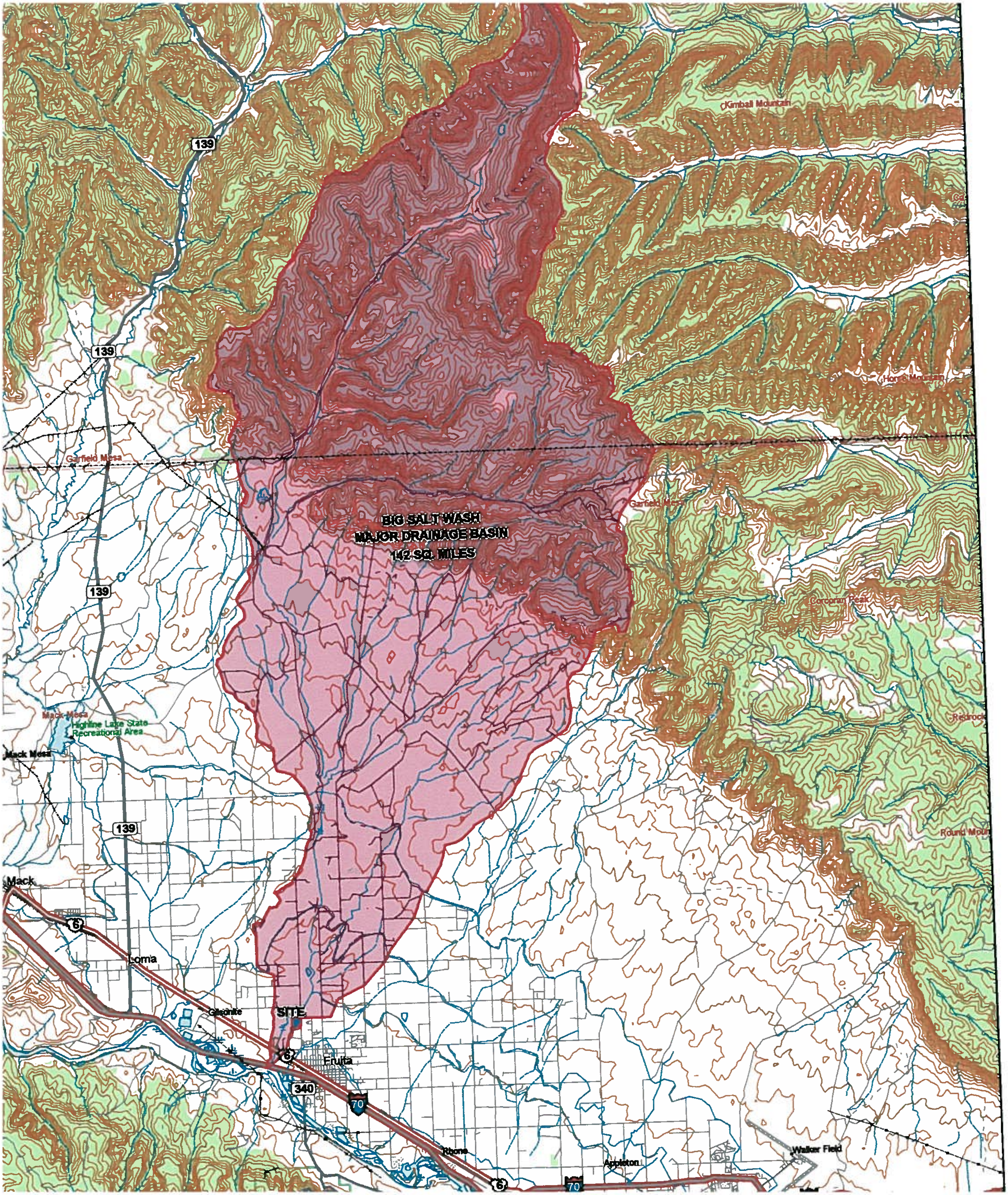
V. CONCLUSIONS

The runoff and storm sewer system for this project has been calculated in accordance with the SWMM. Stormwater is carried undetained to the Big Salt Was in a storm sewer design to carry the runoff from the 100 year storm event. A drainage fee will be paid in lieu of stormwater detention. The drainage fee foe Orchard Ridge Subdivision is ~~$12,601.15~~ and its calculation is included in Appendix C.

17,641.61

APPENDIX A

HYDROLOGIC COMPUTATION SUMMARY


Kimball Mountain
139
Horse Mountain
139
Garfield Mesa
Garfield Mesa
BIG SALT WASH
MAJOR DRAINAGE BASIN
142 SQ. MILES
139
Corcoran Peak
Mack Mesa
Highline Lake State
Recreational Area
Mack Mesa
Redrock
139
Round Moun
Mack
6
Loma
Gilsonite
SITE
6
Fruita
340
70
Rhone
Appleton
Walker Field
6
70

IDF DATA FOR USE IN THE GRAND VALLEY

Time (min)	2-Year Intensity (in/hr)	100-Year Intensity (in/hr)	Time (min)	2-Year Intensity (in/hr)	100-Year Intensity (in/hr)
5	1.11	4.41	33	0.51	2.03
6	1.07	4.23	34	0.50	1.99
7	1.03	4.07	35	0.49	1.95
8	0.99	3.92	36	0.49	1.91
9	0.95	3.78	37	0.48	1.88
10	0.92	3.64	38	0.47	1.85
11	0.89	3.52	39	0.46	1.82
12	0.86	3.41	40	0.45	1.79
13	0.83	3.30	41	0.45	1.76
14	0.81	3.20	42	0.44	1.73
15	0.79	3.11	43	0.43	1.70
16	0.76	3.02	44	0.42	1.67
17	0.74	2.93	45	0.42	1.64
18	0.72	2.85	46	0.41	1.61
19	0.70	2.77	47	0.40	1.59
20	0.68	2.70	48	0.40	1.57
21	0.67	2.63	49	0.39	1.55
22	0.65	2.57	50	0.39	1.53
23	0.64	2.51	51	0.38	1.50
24	0.62	2.45	52	0.38	1.48
25	0.61	2.39	53	0.37	1.46
26	0.59	2.34	54	0.37	1.44
27	0.58	2.29	55	0.36	1.42
28	0.57	2.24	56	0.36	1.40
29	0.56	2.19	57	0.35	1.38
30	0.54	2.15	58	0.35	1.37
31	0.53	2.11	59	0.34	1.35
32	0.52	2.07	60	0.34	1.33

Source: Mesa County 1992 (Modified) $I_2 = \frac{26.71}{Tc + 19.01}$ $I_{100} = \frac{104.94}{Tc + 18.80}$

LAND USE OR SURFACE CHARACTERISTICS	SCS HYDROLOGIC SOIL GROUP (SEE APPENDIX "C" FOR DESCRIPTIONS)											
	A			B			C			D		
	0-2%	2-6%	6%+	0-2%	2-6%	6%+	0-2%	2-6%	6%+	0-2%	2-6%	6%+
UNDEVELOPED AREAS Bare ground	[illegible]	.16 - .26 .22 - .32	.25 - .35 .30 - .40	[illegible]	.22 - .30 .28 - .36	.30 - .38 .37 - .45	[illegible]	.28 - .36 .35 - .43	.36 - .44 .40 - .48	[illegible]	.30 - .38 .40 - .48	.40 - .48 .50 - .58
Cultivated/Agricultural	[illegible]	.13 - .23 .18 - .28	.16 - .26 .22 - .32	[illegible]	.15 - .23 .21 - .29	.21 - .29 .28 - .36	[illegible]	.19 - .27 .25 - .33	.26 - .34 .34 - .42	[illegible]	.23 - .31 .29 - .37	.31 - .39 .41 - .49
Pasture	[illegible]	.20 - .30 .25 - .35	.30 - .40 .37 - .47	[illegible]	.28 - .36 .34 - .42	.37 - .45 .45 - .53	[illegible]	.34 - .42 .42 - .50	.44 - .52 .52 - .60	[illegible]	.40 - .48 .50 - .58	.50 - .58 .62 - .70
Meadow	[illegible]	.16 - .26 .22 - .32	.25 - .35 .30 - .40	[illegible]	.22 - .30 .28 - .36	.30 - .38 .37 - .45	[illegible]	.28 - .36 .35 - .43	.36 - .44 .44 - .52	[illegible]	.30 - .38 .40 - .48	.40 - .48 .50 - .58
Forest	[illegible]	.08 - .18 .11 - .21	.11 - .21 .14 - .24	[illegible]	.11 - .19 .14 - .22	.14 - .22 .18 - .26	[illegible]	.13 - .21 .16 - .24	.16 - .24 .20 - .28	[illegible]	.16 - .24 .20 - .28	.20 - .2 .25 - .3
RESIDENTIAL AREAS 1/8 acre per unit	[illegible]	.43 - .53 .52 - .62	.46 - .56 .55 - .65	[illegible]	.45 - .53 .54 - .62	.50 - .58 .59 - .67	[illegible]	.48 - .56 .57 - .65	.53 - .61 .64 - .72	[illegible]	.51 - .59 .60 - .68	.57 - .6 .69 - .7
1/4 acre per unit	[illegible]	.31 - .41 .39 - .49	.34 - .44 .42 - .52	[illegible]	.34 - .42 .42 - .50	.38 - .46 .47 - .55	[illegible]	.36 - .44 .45 - .53	.41 - .49 .52 - .60	[illegible]	.39 - .47 .47 - .55	.45 - .5 .57 - .6
1/3 acre per unit	[illegible]	.26 - .36 .35 - .45	.29 - .39 .38 - .48	[illegible]	.29 - .37 .38 - .46	.33 - .41 .42 - .50	[illegible]	.32 - .40 .41 - .49	.37 - .45 .48 - .56	[illegible]	.35 - .43 .43 - .51	.42 - .5 .53 - .6
1/2 acre per unit	[illegible]	.20 - .30 .29 - .39	.24 - .34 .32 - .42	[illegible]	.23 - .31 .32 - .40	.28 - .36 .36 - .44	[illegible]	.27 - .35 .35 - .43	.32 - .40 .42 - .50	[illegible]	.30 - .38 .38 - .46	.37 - .4 .48 - .5
1 acre per unit	[illegible]	.19 - .29 .26 - .36	.22 - .32 .29 - .39	[illegible]	.21 - .29 .28 - .36	.26 - .34 .34 - .42	[illegible]	.25 - .33 .32 - .40	.31 - .39 .40 - .48	[illegible]	.29 - .37 .35 - .43	.35 - .4 .46 - .5
MISC. SURFACES Pavement and roofs	.93 .95	.94 .96	.95 .97	.93 .95	.94 .96	.95 .97	.93 .95	.94 .96	.95 .97	.93 .95	.94 .96	.95 .97
Traffic areas (soil and gravel)	[illegible]	.60 - .70 .70 - .75	.64 - .74 .74 - .79	[illegible]	.64 - .72 .72 - .80	.67 - .75 .75 - .83	[illegible]	.67 - .75 .75 - .83	.69 - .77 .77 - .85	[illegible]	.75 - .83 .82 - .90	.77 - . .84 - .
Green landscaping (lawns, parks)	[illegible]	.16 - .26 .22 - .32	.25 - .35 .30 - .40	[illegible]	.22 - .30 .28 - .36	.30 - .38 .37 - .45	[illegible]	.28 - .36 .35 - .43	.36 - .44 .42 - .52	[illegible]	.30 - .38 .40 - .48	.40 - . .50 - .
Non-green and gravel landscaping	[illegible]	.36 - .46 .42 - .52	.45 - .55 .50 - .60	[illegible]	.42 - .50 .48 - .56	.50 - .58 .57 - .65	[illegible]	.48 - .56 .55 - .63	.56 - .64 .64 - .72	[illegible]	.50 - .58 .60 - .68	.60 - . .70 - .
Cemeteries, playgrounds	[illegible]	.26 - .36 .32 - .42	.35 - .45 .40 - .50	[illegible]	.32 - .40 .38 - .46	.40 - .48 .47 - .55	[illegible]	.38 - .44 .45 - .53	.46 - .54 .54 - .62	[illegible]	.40 - .48 .50 - .58	.50 - . .60 - .

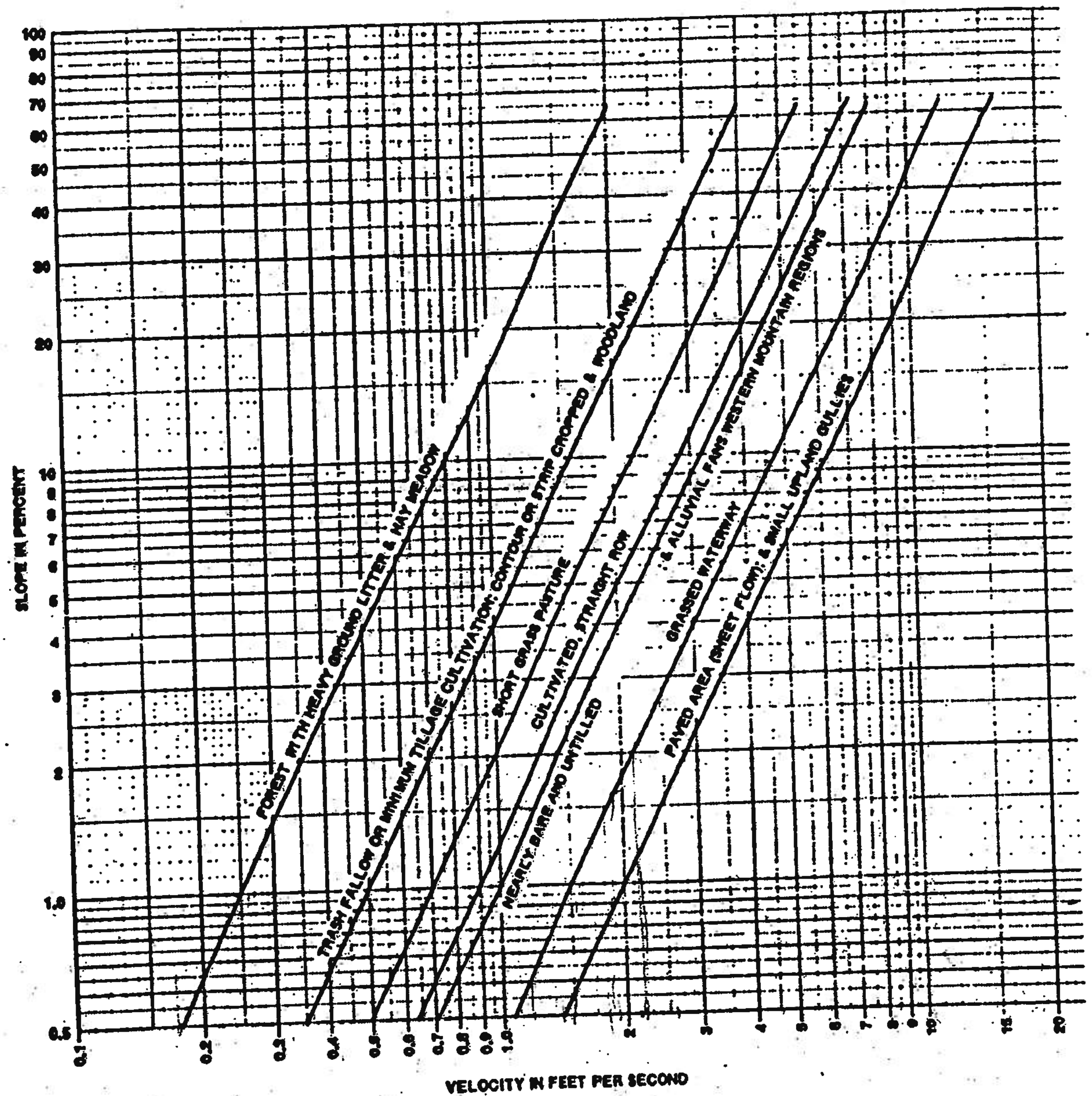
NOTES:
1. Values above and below pertain to the 2-year and 100-year storms, respectively.
2. The range of values provided allows for engineering judgement of site conditions such as basic shape, homogeneity of surface type, surface depression storage, and storm duration. In general, during shorter duration storms (Tc ≤ 10 minutes), infiltration capacity is higher, allowing use of a "C" value in the low range. Convers for longer duration storms (Tc) 30 minutes), use a ""C value in the higher range.
3. For residential development at less than 1/8 acre per unit or greater than 1 acre per unit, and also for commercial and industrial areas, use values under MISC SURFACES to estimate "C" value ranges for use.

RATIONAL METHOD RUNOFF COEFFICIENTS

(Modified from Table 4, UC-Davis, which appears to be a modification of work done by Rawls)

TABLE "B-1"

REPRODUCED FROM FIGURE



SIN NATION STORM	AREA (Acres)	Tc CALCULATION									INTENSITY	RUNOFF
		C		Ts	(Grass Swale)		Tchan	(Gutter Flow)		Tc	i	Q
			To (Minutes)	Concentrated Length (Feet)	Concentrated Velocity (F/S)	Ts (Minutes)	Channel Length (Feet)	Channel Velocity (F/S)	Tchan (Minutes)	(Minutes)	(Inch/Hr)	(CFS)
SINS YR	6.49 6.49	0.33 0.41	13.4 12.8	50 50	1.3 1.4	0.6 0.6	1860 1860	1.1 1.5	28.2 20.7	42.2 34.1	0.44 1.99	0.94 5.30
R YR	8.81 8.81	0.33 0.41	13.4 12.8	50 50	1.3 1.4	0.6 0.6	1240 1240	1.1 1.5	18.8 13.8	32.8 27.2	0.51 2.28	1.48 8.24
R YR	4.47 4.47	0.33 0.41	13.4 12.8	50 50	1.3 1.4	0.6 0.6	1330 1330	1.1 1.5	20.2 14.8	34.2 28.2	0.50 2.23	0.74 4.09
R YR	4.98 4.98	0.33 0.41	13.4 12.8	50 50	1.3 1.4	0.6 0.6	1570 1570	1.1 1.5	23.8 17.4	37.8 30.8	0.47 2.12	0.77 4.33
R YR	6.97 6.97	0.33 0.41	13.4 12.8	50 50	1.3 1.4	0.6 0.6	1880 1880	1.1 1.5	28.5 20.9	42.5 34.3	0.44 1.98	1.01 5.66
S R YR	19.77 19.77	0.33 0.41								42.2 34.1	0.44 1.99	2.87 16.13
R YR	11.95 11.95	0.33 0.41								42.5 34.3	0.44 1.98	1.74 9.70
R YR	0.85 0.85	0.30 0.34	10.0 10.0	340 340	1.1 1.1	5.2 5.2				15.2 15.2	0.92 3.62	0.23 1.05
R YR	0.64 0.64	0.33 0.41	10.0 10.0	430 430	1.1 1.1	6.5 6.5				16.5 16.5	0.88 3.47	0.19 0.91
R YR	0.23 0.23	0.30 0.34	5.0 5.0	565 340	1.1 1.1	8.6 5.2				13.6 10.2	0.82 3.62	0.06 0.28
ITE YR 00 YR	0.53 0.53	0.91 0.93	5.0 5.0				410 410	1.3 2.0	5.3 3.4	19.3 16.8	1.06 2.95	0.51 1.45
ORIC R YR	33.44 33.44	0.24 0.30	5.0 5.0	1350 1350	0.8 1.0	28.1 22.5	700 700	1.0 1.3	11.7 9.0	37.1 38.1	0.48 1.85	3.85 18.56

ulas:

Q = CiA

Tc = Overland Flow (To) + Shallow Concentrated Flow (Ts) + Channel Flow (Tchan)

To = 1.8(1.1-C)L0.5/S0.33 (5 minute minimum)

Ts = Ls/Vs

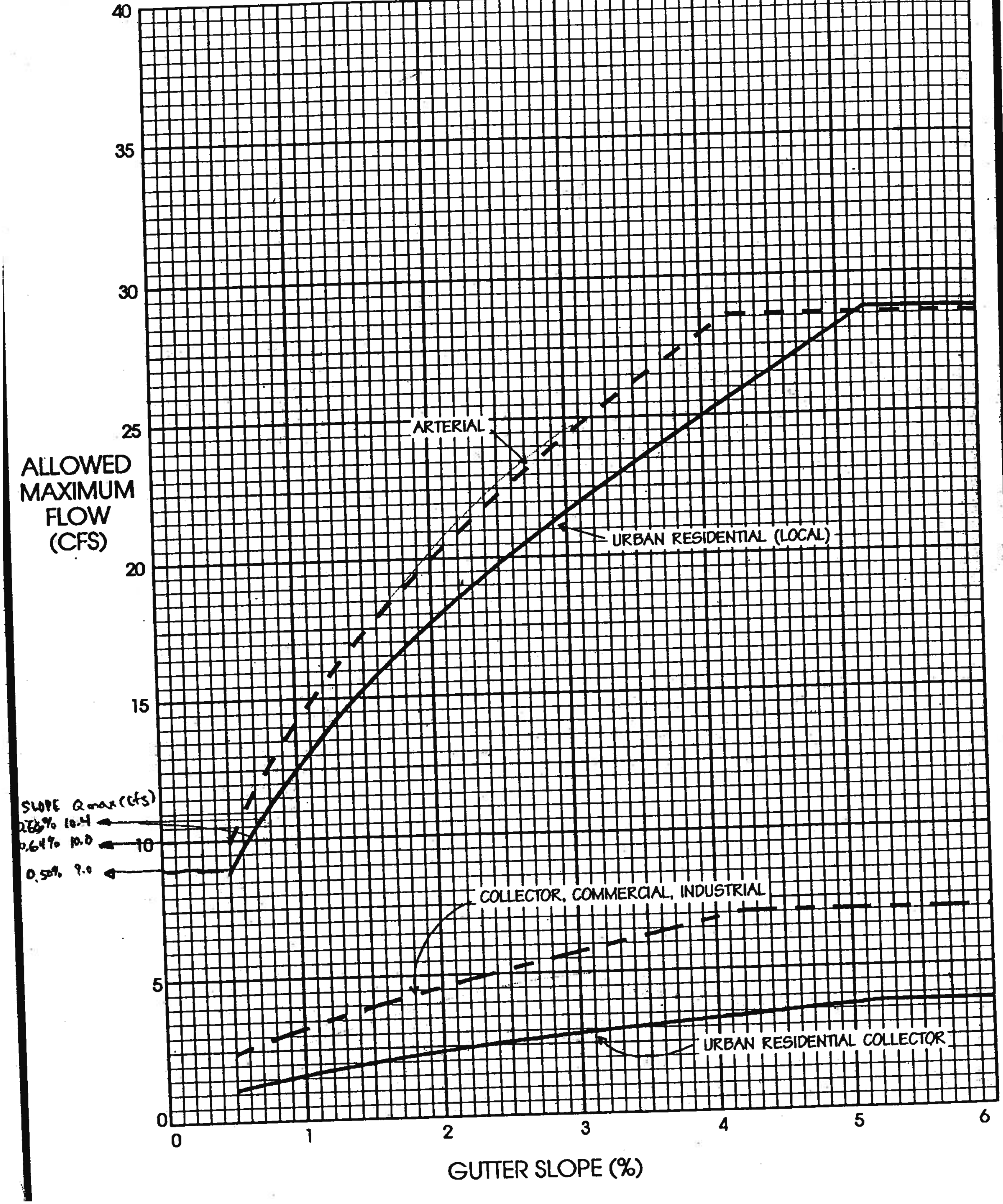
Tchan = Lchan/Vchan (Flow in Gutter for all applicable basins)

ALL REFERENCES REFER TO MESA COUNTY
STORMWATER MANAGEMENT MANUAL

(origin)	(cfs)	(min)	(min)						
Rational	5.3	1	34	0.25	100	—	—	—	BASIN A1
Rational	8.3	1	27	0.31	100	—	—	—	BASIN A2
Rational	4.1	1	28	0.16	100	—	—	—	BASIN A3
Rational	4.3	1	31	0.18	100	—	—	—	BASIN B1
Rational	5.7	1	34	0.27	100	—	—	—	BASIN B2
Rational	0.9	1	15	0.02	100	—	—	—	BASIN C
Rational	1.4	1	17	0.03	100	—	—	—	BASIN OS
Reach	1.1	1	38	0.03	100	7	—	—	OS TRAVEL
Combine	6.7	1	34	0.29	100	5 + 9	—	—	B2+OS
Combine	10.6	1	34	0.48	100	4 + 10	—	—	B1+B2+OS
Combine	12.2	1	27	0.47	100	2 + 3	—	—	A2+A3
Combine	16.4	1	27	0.71	100	1 + 12	—	—	A1+A2+A3
Reach	16.4	1	29	0.71	100	13	—	—	A TRAVEL
Reach	10.6	1	34	0.48	100	11	—	—	B TRAVEL
Combine	26.2	1	31	1.19	100	14 + 15	—	—	A+B+OS
Reach	26.2	1	31	1.19	100	16	—	—	A+B+OS TRAVEL
Combine	26.4	1	31	1.22	100	7 + 17	—	—	BASIN A+B+C+OS
Reach	26.3	1	33	1.23	100	18	—	—	A+B+C+OS TRAVE

APPENDIX B

HYDRAULIC COMPUTATION SUMMARY


ALLOWED MAXIMUM FLOW (CFS)
GUTTER SLOPE (%)
0
5
10
15
20
25
30
35
40
0
1
2
3
4
5
6
ARTERIAL
URBAN RESIDENTIAL (LOCAL)
COLLECTOR, COMMERCIAL, INDUSTRIAL
URBAN RESIDENTIAL COLLECTOR
SLOPE Qmax (cfs)
0.66% 10.4
0.64% 10.0
0.50% 9.0

Lot A 1.00 Ac ⇒ 100% Lawn

t Lot B 0.08 Ac ⇒ 1/4 Gravel Trail, 3/4 Lawn

nt of Way 6.08 Ac ⇒ 41/44 impervious, 3/44 Lawn

33.45 total

posite coefficients

ts (97) (7.126)(0.95) + (19.164)(0.34) ÷ 26.29 = 0.505

t Lot A 0.34

t Lot B 1/4(0.76) + 3/4(0.34) = 0.445

ght of Way $\frac{41}{44}(0.95) + \frac{3}{44}(0.34) = 0.908$

sins A1, A3, B1, B2

6.29 Ac @ 0.505
6.08 Ac @ 0.908
32.37 Ac @ 0.58

~~Basin A2~~

7.81 Ac @ 0.58
1.00 Ac @ 0.34
8.81 Ac @ 0.55

Basin C

0.78 @ 0.58
0.07 @ 0.445
0.85 @ 0.57

(origin)	(cfs)	(min)	(min)	(acft)	(yrs)				
Rational	Q* 7.5	1	34	0.35	100	—	——	——	BASIN A1
Rational	11.1	1	27	0.41	100	—	——	——	BASIN A2
Rational	5.8	1	28	0.22	100	—	——	——	BASIN A3
Rational	6.1	1	31	0.26	100	—	——	——	BASIN B1
Rational	8.0	1	34	0.38	100	—	——	——	BASIN B2
Rational	1.5	1	15	0.03	100	—	——	——	BASIN C
Rational	1.4	1	17	0.03	100	—	——	——	BASIN OS
Reach	1.1	1	38	0.03	100	7	——	——	OS TRAVEL
Combine	9.0	1	34	0.40	100	5 + 9	——	——	B2+OS
Combine	14.5	1	34	0.66	100	4 + 10	——	——	B1+B2+OS
Combine	16.7	1	27	0.64	100	2 + 3	——	——	A2+A3
Combine	22.7	1	28	0.99	100	1 + 12	——	——	A1+A2+A3
Reach	22.6	1	29	0.99	100	13	——	——	A TRAVEL
Reach	14.5	1	34	0.66	100	11	——	——	B TRAVEL
Combine	36.1	1	31	1.65	100	14 + 15	——	——	A+B+OS
Reach	36.1	1	31	1.65	100	16	——	——	A+B+OS TRAVEL
Combine	36.4	1	31	1.68	100	7 + 17	——	——	BASIN A+B+C+OS
Reach	36.3	1	33	1.69	100	18	——	——	A+B+C+OS TRAVE

INLET A3 - STM MH 10 Design
INLET B1 - STM MH 7 Design Point $\triangle$6

Project Description

Project File	c:\haestad\fmw\4027.fm2
Worksheet	12" RCP @ 2.57%
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Constant Data

Mannings Coefficient	0.013	
Channel Slope	0.025700	ft/ft
Diameter	12.00	in

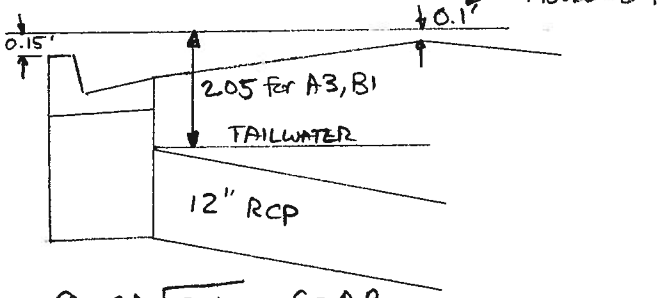
Input Data

	Minimum	Maximum	Increment
Depth	0.10	1.00	0.05 ft

Rating Table

Depth (ft)	Discharge (cfs)	Velocity (ft/s)	
0.10	0.12	2.92	
0.15	0.28	3.76	
0.20	0.50	4.47	
0.25	0.78	5.10	
0.30	1.12	5.64	
0.35	1.50	6.13	
0.40	1.92	6.56	
0.45	2.38	6.94	
0.50	2.86	7.27	
0.55	3.35	7.56	
0.60	3.84	7.80	
0.65	4.32	7.99	
0.70	4.78	8.14	
0.75	5.21	8.24	
0.80	5.58	8.29	← BASIN A3 $Q^* = 5.8$ cfs
0.85	5.89	8.27	
0.90	6.09	8.18	
0.95	6.14	7.96	← BASIN B1 $Q^* = 6.1$ cfs
1.00	5.71	7.27	

Check For Inlet (orifice) Control



$Q = CA\sqrt{2gh}$

$C = 0.8$
$A = (0.5)^2 \pi = 0.785$
$g = 32.2\ ft/s^2$
$h = 2.05\ ft$

$Q = 7.2$ cfs
(not inlet control)

INLET A1 - STM MH 7 Design Point 1
INLET A2 - STM MH 10 Design Point 2
INLET B2 - STM MH 7 Design Point 7

Project Description

Project File	c:\haestad\fmw\4027.fm2
Worksheet	15" RCP @ 2.57%
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Constant Data

Mannings Coefficient	0.013	
Channel Slope	0.025700	ft/ft
Diameter	15.00	in

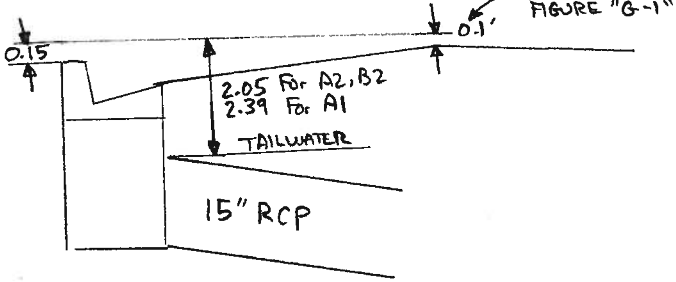
Input Data

	Minimum	Maximum	Increment
Depth	0.15	1.25	0.05 ft

Rating Table

Depth (ft)	Discharge (cfs)	Velocity (ft/s)	
0.15	0.32	3.80	
0.20	0.57	4.54	
0.25	0.91	5.19	
0.30	1.31	5.78	
0.35	1.77	6.30	
0.40	2.30	6.78	
0.45	2.87	7.22	
0.50	3.49	7.61	
0.55	4.14	7.97	
0.60	4.83	8.29	
0.65	5.53	8.58	
0.70	6.24	8.83	
0.75	6.96	9.05	← BASIN A1 $Q^* = 7.5$ cfs
0.80	7.66	9.24	
0.85	8.34	9.39	
0.90	8.99	9.50	← BASIN B2 $Q^* = 9.0$ cfs
0.95	9.59	9.58	
1.00	10.12	9.62	
1.05	10.57	9.61	
1.10	10.92	9.54	
1.15	11.11	9.41	← BASIN A2 $Q^* = 11.1$ cfs
1.20	11.09	9.16	
1.25	10.36	8.44	

Check For Inlet (orifice) control



$Q = CA\sqrt{2gh}$

$C = 0.8$
$A = (\frac{7.5}{12})^2\pi = 1.23 \text{ ft}^2$
$g = 32.2 \text{ ft/s}^2$
$h = 2.05 \text{ ft}$

$Q = 11.3$ cfs
(not inlet control)

STM MH-10 to STM MH-9 Design Point 4

Project Description

Project File	c:\haestad\fmw\4027.fm2
Worksheet	24" RCP @ 0.48%
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Constant Data

Mannings Coefficient	0.013	
Channel Slope	0.004800 ft/ft	
Diameter	24.00	in

Input Data

	Minimum	Maximum	Increment
Depth	0.10	2.00	0.10 ft

Rating Table

Depth (ft)	Discharge (cfs)	Velocity (ft/s)	
0.10	0.08	1.28	
0.20	0.33	2.00	
0.30	0.76	2.58	
0.40	1.37	3.07	
0.50	2.15	3.50	
0.60	3.07	3.87	
0.70	4.12	4.21	
0.80	5.28	4.50	
0.90	6.53	4.76	
1.00	7.84	4.99	
1.10	9.18	5.18	
1.20	10.53	5.35	
1.30	11.85	5.48	
1.40	13.12	5.59	
1.50	14.29	5.65	
1.60	15.32	5.69	
1.70	16.15	5.67	
1.80	16.70	5.61	← $Q^* = 16.7$ cfs
1.90	16.84	5.46	
2.00	15.67	4.99	

STM MH-9 to STM MH-7 Design Point 5

Project Description

Project File	c:\haestad\fmw\4027.fm2
Worksheet	24" RCP @ 0.87%
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Constant Data

Mannings Coefficient	0.013	
Channel Slope	0.008700 ft/ft	
Diameter	24.00	in

Input Data

	Minimum	Maximum	Increment
Depth	1.50	2.00	0.03 ft

Rating Table

Depth (ft)	Discharge (cfs)	Velocity (ft/s)	
1.50	19.24	7.61	
1.52	19.61	7.63	
1.55	19.96	7.64	
1.57	20.30	7.65	
1.60	20.62	7.65	
1.63	20.93	7.66	
1.65	21.22	7.65	
1.68	21.49	7.65	
1.70	21.74	7.64	
1.73	21.97	7.62	
1.75	22.17	7.61	
1.77	22.34	7.58	
1.80	22.49	7.55	
1.82	22.60	7.51	
1.85	22.67	7.47	
1.87	22.70	7.42	← Q* = 22.7 cfs
1.90	22.67	7.35	
1.93	22.58	7.28	
1.95	22.40	7.18	
1.98	22.08	7.04	
2.00	21.10	6.72	

STM MH-6 to STM MH-7 Design Point $\triangle 8$

Project Description	
Project File	c:\haestad\fmw\4027.fm2
Worksheet	18" RCP @ 3.37%
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Constant Data		
Mannings Coefficient	0.013	
Channel Slope	0.033700 ft/ft	
Diameter	18.00	in

Input Data	Minimum	Maximum	Increment
Depth	0.10	1.50	0.10 ft

Rating Table

Depth (ft)	Discharge (cfs)	Velocity (ft/s)
0.10	0.17	3.38
0.20	0.73	5.24
0.30	1.69	6.71
0.40	3.00	7.93
0.50	4.62	8.96
0.60	6.50	9.84
0.70	8.56	10.59
0.80	10.74	11.21
0.90	12.95	11.70
1.00	15.12	12.08
1.10	17.12	12.33
1.20	18.85	12.44
1.30	20.14	12.38
1.40	20.74	12.08
1.50	19.28	10.91

← $Q^* = 14.5$ cfs

STM MH-A5 to BIG SALT WASH Design Point ⚠11

Project Description

Project File	c:\haestad\fmw\4027.fm2
Worksheet	30" RCP @ 0.70%
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Constant Data

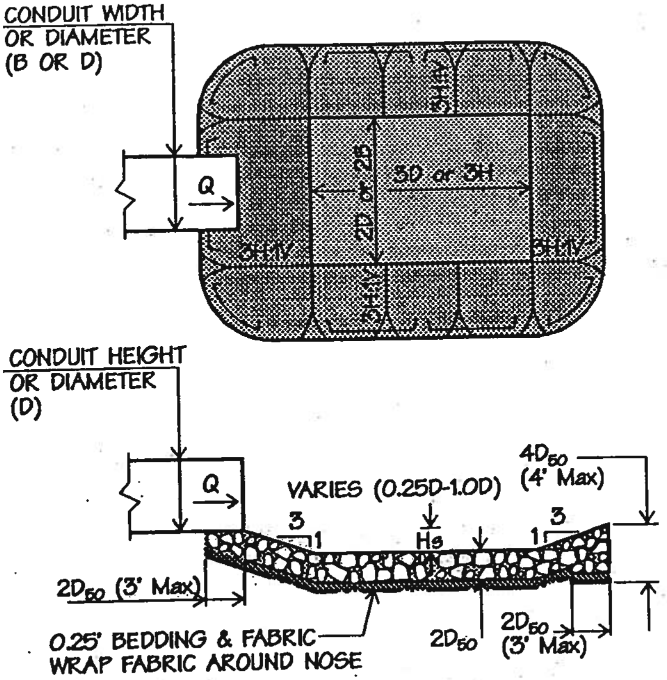
Mannings Coefficient	0.013	
Channel Slope	0.007000	ft/ft
Diameter	30.00	in

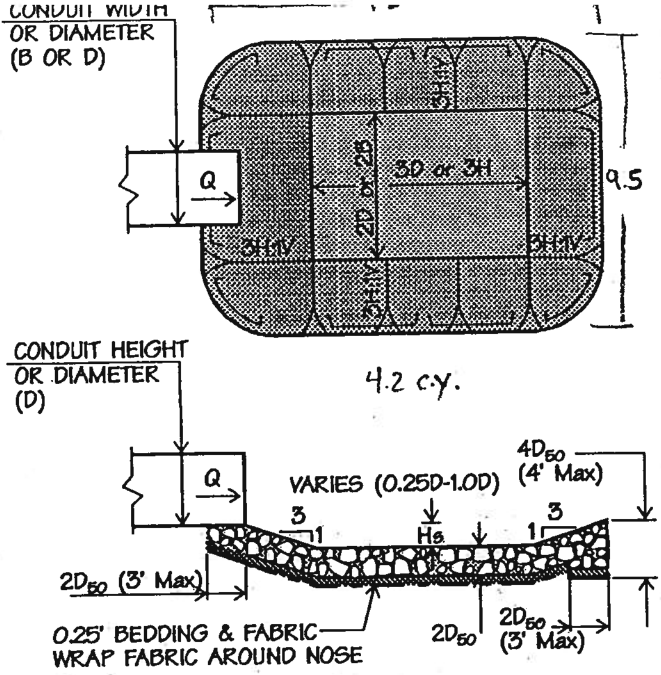
Input Data

	Minimum	Maximum	Increment
Depth	0.30	2.50	0.10 ft

Rating Table

Depth (ft)	Discharge (cfs)	Velocity (ft/s)	
0.30	1.05	3.15	
0.40	1.91	3.76	
0.50	3.01	4.30	
0.60	4.33	4.78	
0.70	5.88	5.22	
0.80	7.61	5.62	
0.90	9.51	5.98	
1.00	11.56	6.31	
1.10	13.73	6.60	
1.20	16.00	6.87	
1.30	18.33	7.11	
1.40	20.69	7.32	
1.50	23.05	7.50	
1.60	25.38	7.65	
1.70	27.64	7.78	
1.80	29.79	7.87	
1.90	31.77	7.94	
2.00	33.54	7.97	
2.10	35.04	7.96	
2.20	36.18	7.91	← Q^*_{100} = 36.3 cfs
2.30	36.83	7.80	
2.40	36.76	7.59	
2.50	34.32	6.99	





NOTE: SEE TABLE "J-10" REGARDING APPLICABILITY OF THIS PROCEDURE (SEE TABLE "L-5" FOR PARAMETER VALUES)

STEPS

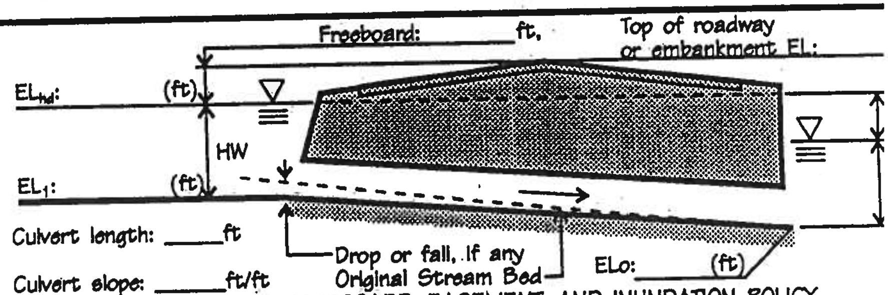
(1) - (2) Enter culvert identification number and corresponding Table "L-5" worksheet number.
(3) - (9) Enter data from Table "L-5" worksheet from the following columns: (22); (9); (5) or (6); (7); (13); (25), (26), or (27); and (33).
(10) Enter drop height Hs.
(11) Calculate D/2
(12) Calculate D_{50}:
For $Hs \leq D/2$, $D_{50} = 0.0125u^{1.33}D^2/TW$
For $Hs > D/2$, $D_{50} = 0.0082u^{1.33}D^2/TW$

Culv. I.D. No. (1)	Ref. "L-5" Sheet No. (2)	DATA FROM TABLE "L-5"							Hs (ft) (10)	D/2 (ft) (11)	D_{50} (ft) (12)	Remarks
		Trial No. (3)	Q (cfs) (4)	Dia. or Depth D (ft) (5)	Height H (ft) (6)	Width B (ft) (7)	TW (ft) (8)	Froude Param. U (9)				
			26.4	2.5	2.5	2.5	0.7	2.58	.75	1.125	~~0.09~~	
											Use 6"	

Location or Culvert I.D.:________ Design By:____________ Date:________ Q_2:_____cfs Q_{100}:___

(21)
applicable data.
al flow by # culverts and also by
ox culverts.
L-30 & 31 for applicable inlet
sign chart.
ultiply (10) by (5) or (6) to get HW
it to EL_i to get req'd HW elevation
let control.
e-determined tailwater depth, or
obtainable.
ee pp. L-30 & 31 for applicable
critical depth chart. Use D from (5) or (6).
(16) ho is greater of (13) or (15).
(17) See Table "L-4", page L-32.
(18) See pp. L-30 & 31 for applicable outlet control design chart.
(19) Add (16) and (18) to EL_o to get req'd HW elevation EL_{ho} for outlet control.
(20) Enter "I" if (12) exceeds (19); otherwise, enter "O".
(21) Enter higher value of (12) and (19). Check sketch in (1). Will the culvert meet requirements? If not, return to step (2).

(1)



Culvert length: ____ft
Culvert slope: ____ft/ft
EL_{hd} SHALL CONFORM TO FREEBOARD, EASEMENT, AND INUNDATION POLICY.

CULVERT DESCRIPTION						FLOW	HEADWATER CALCULATIONS											GOV
						PER	INLET CONTROL			OUTLET CONTROL								CC
MAT'L TYPE (3)	CULV. SHAPE (4)	DIA. D (ft) (5)	HEIGHT D (ft) (6)	WIDTH B (ft) (7)	No. OF CULV. (8)	CULV. (cfs) (9)	$\frac{HW}{D}$ (10)	HW (ft) (11)	EL_{hi} (ft) (12)	TW (ft) (13)	dc (ft) (14)	$\frac{dc+D}{2}$ (15)	h_o (ft) (16)	K_e (17)	H (ft) (18)	EL_{ho} (ft) (19)	Type (20)
		2.5				26.9				0.7							

) - (40)
umber of selected trial from above.
(20) is "I", do (23) & (24) and skip (25) -
herwise, skip (23) & (24).
ble "F-1d" on p. F-7 or see applicable
ntrol design chart for "n".
. Enter $Qn/(D^{8/3}S^{1/2})$ in Table "L-6", p.
$Qn/(1.486D^{8/3}S^{0.5})$ in Figure "L-12", p.
d read corresponding d/D. Multiply by D,
and obtain d = Yo. Skip to step (30).
(25) - (27) Calculate value for applicable column only. Use (9) and (5) or (6).
(28) Use (13) and (5) or (6)
(29) Enter (28) and (25) to (27) in Figure "L-13", pp. L-36 & 37read Yo/D. [Or, per HDS-5, skip (25) - (28), divide (14) by (5) or (6).]
(30) Enter (24)/D or (29) into Table "L-6", p. L-34, read corresponding A/D^2, multiply by $(5)^2$ or $(6)^2$ to get Ao.
(31) (9)/(30) = Vo
(32) For non-circular culverts, enter (24) or (29) x D. For circular culverts, obtain equivalent brink depth, Ye = $(Ao/2)^{0.5}$
(33) Froude number Fr = $Vo/(32.2Ye)^{0.5}$
(34) Enter permissible velocity for downstream channel per Appdendix "I" or Table "VII-1" in Section VII.
(35) If Vo/ Vp ≤ 1.3 & Fr < 0.86, only a fla
section is req'd. Otherwise, see Table
Appendix "J".
(36) Enter value from Table "L-2", p. L-28
(37) Enter corrosive I.D. No. from Table "
p. L-29.
(38) - (39) Enter pipe and bedding speci
(40) Other remarks?

DETERMINE CONDUIT OUTFLOW VELOCITY AND FROUDE NO.											OUTLET PROTECTION REQUIRED?		CORROSION PROTECTION		STRUCTURAL		RE
CONTROL TYPE							BRINK FLOW VALUES								PIPE:		
INLET		OUTLET												PIPE			
PIPE "n" (23)	Yo (ft) (24)	Froude Parameter (U) $Q/D^{2.5}$ (25)	$Q/BD^{1.5}$ (26)	$q/D^{1.5}$ (27)	$\frac{TW}{D}$ (28)	$\frac{Yo}{D}$ (29)	Ao (ft^2) (30)	Vo (fps) (31)	Ye (ft) (32)	Fr (33)	Vp (fps) (34)	$\frac{Vo}{Vp}$ (35)	CR No. (36)	CORR No. (37)	•Class •Gage •SDR (38)	Bed Class (39)	
	1.67	2.58			0.66	0.67	3.50	7.29	1.32	1.12	4	1.8					

CULVERT DESIGN WORKSHEET

TABLE "L

STM MH-A5 to BIG SALT WASH Design Point 11

Project Description

Project File	c:\haestad\fmw\4027.fm2
Worksheet	30" RCP @ 0.70%
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Constant Data

Mannings Coefficient	0.013	
Channel Slope	0.007000 ft/ft	
Diameter	30.00	in

Input Data

	Minimum	Maximum	Increment
Depth	0.30	2.50	0.10 ft

Rating Table

Depth (ft)	Discharge (cfs)	Velocity (ft/s)
0.30	1.05	3.15
0.40	1.91	3.76
0.50	3.01	4.30
0.60	4.33	4.78
0.70	5.88	5.22
0.80	7.61	5.62
0.90	9.51	5.98
1.00	11.56	6.31
1.10	13.73	6.60
1.20	16.00	6.87
1.30	18.33	7.11
1.40	20.69	7.32
1.50	23.05	7.50
1.60	25.38	7.65
1.70	27.64	7.78
1.80	29.79	7.87
1.90	31.77	7.94
2.00	33.54	7.97
2.10	35.04	7.96
2.20	36.18	7.91
2.30	36.83	7.80
2.40	36.76	7.59
2.50	34.32	6.99

Q_{100} = 26.4 cfs
depth = 1.64 ft
velocity = 7.7 ft/sec

← Q^{*}_{100} = 36.3 cfs

Project Description	
Project File	c:\haestad\fmw\4027.fm2
Worksheet	OUTLET CHANNEL
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Constant Data		
Mannings Coefficient	0.040	
Channel Slope	0.050000 ft/ft	
Left Side Slope	2.000000 H : V	
Right Side Slope	2.000000 H : V	
Bottom Width	5.00	ft

Input Data

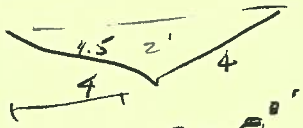
	Minimum	Maximum	Increment
Depth	0.10	2.00	0.10 ft

Rating Table

Depth (ft)	Discharge (cfs)	Velocity (ft/s)
0.10	0.90	1.74
0.20	2.89	2.68
0.30	5.76	3.43
0.40	9.42	4.06
0.50	13.86	4.62
0.60	19.05	5.12
0.70	25.01	5.58
0.80	31.74	6.01
0.90	39.24	6.41
1.00	47.53	6.79
1.10	56.62	7.15
1.20	66.53	7.49
1.30	77.27	7.82
1.40	88.87	8.14
1.50	101.33	8.44
1.60	114.67	8.74
1.70	128.92	9.03
1.80	144.09	9.31
1.90	160.20	9.58
2.00	177.26	9.85

← Tailwater

Swale Capacity



A= 4×2= 8'

P = 4.5+4.5 = 9'

R= 8/9 = 0.9

$Q = 8 \times \frac{\overset{37}{1.486}}{0.04}\ 0.9^{2/3}\ 0.003^{1/2}$

= 8×37.2 × 0.93× 0.055

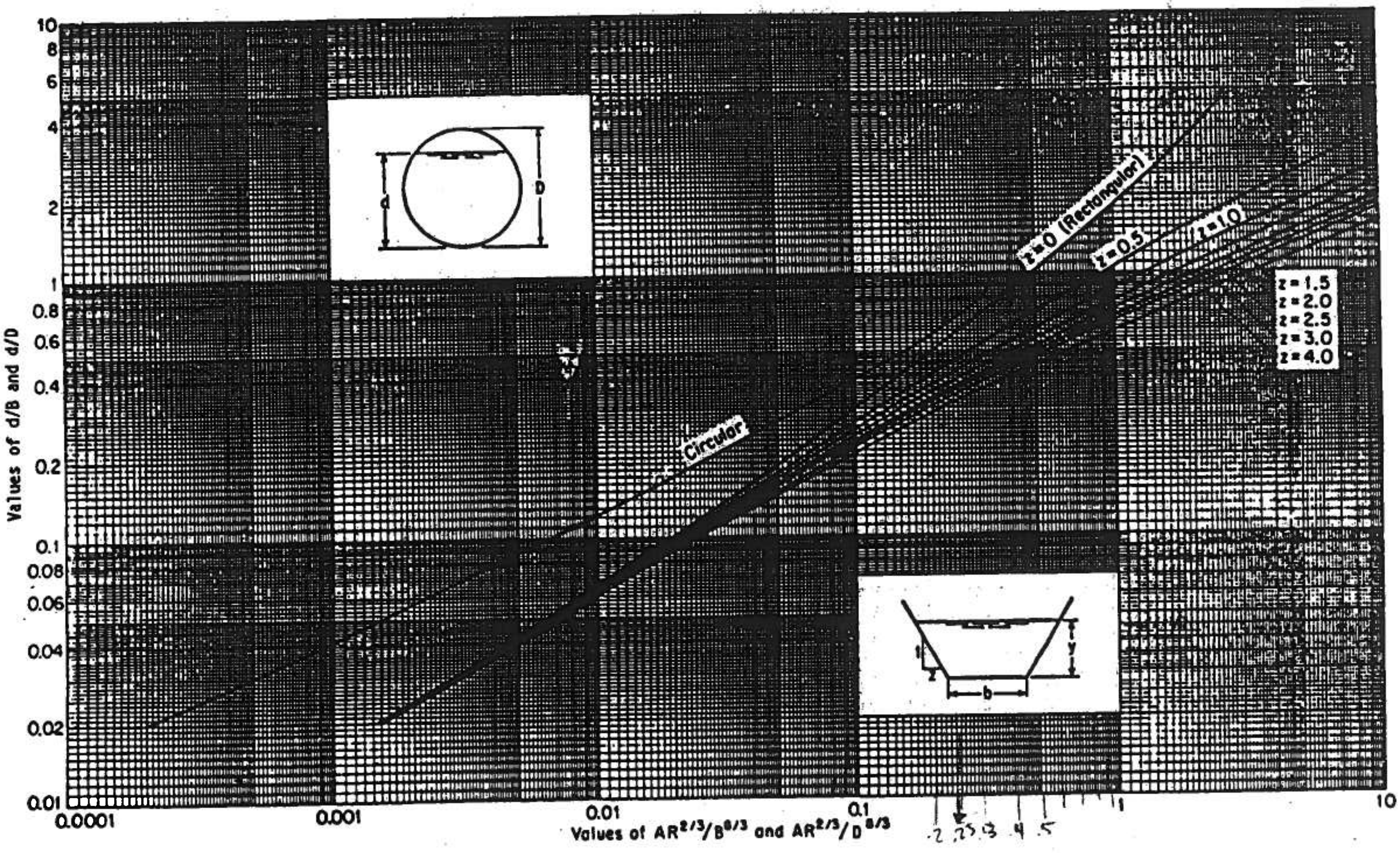
= 15.2cfs

REPRODUCED FROM FHWA HEC-14, TABLE III-2

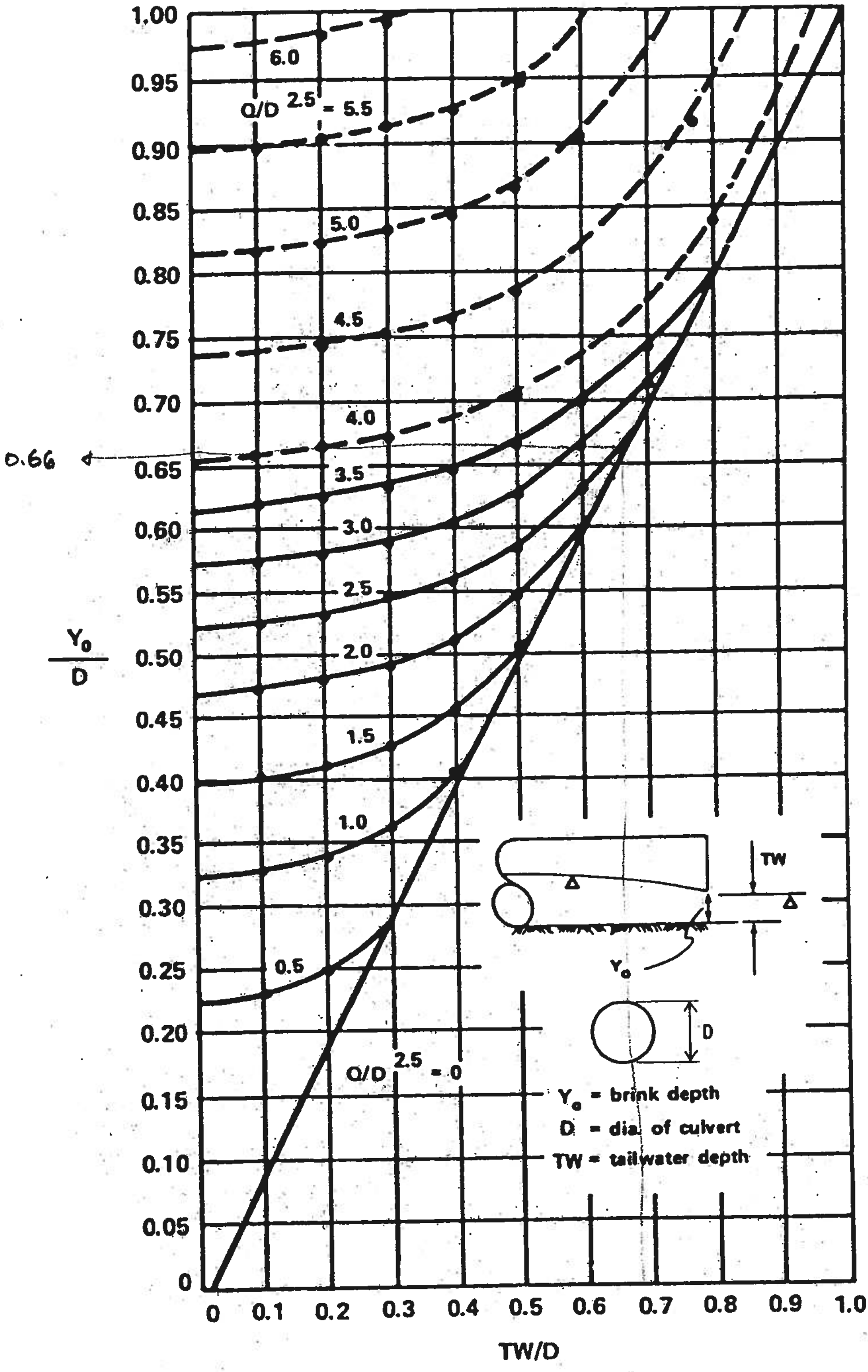
d = depth of flow (ft) = 1.65 ft.
D = diameter of pipe (ft) = 2.5 ft
A = area of flow (ft^2)
R_h = hydraulic radius (ft)

Q = discharge in cubic feet per second by Manning's formula
n = Manning's coefficient
S = slope of the channel bottom and of the water surface (ft/ft)

$\frac{d}{D}$	$\frac{A}{D^2}$	$\frac{R_h}{D}$	$\frac{Qn}{D^{8/3}S^{1/2}}$	$\frac{Qn}{d^{8/3}S^{1/2}}$	$\frac{d}{D}$	$\frac{A}{D^2}$	$\frac{R_h}{D}$	$\frac{Qn}{D^{8/3}S^{1/2}}$	$\frac{Qn}{d^{8/3}S^{1/2}}$
0.01	0.0013	0.0066	0.00007	15.04	0.51	0.4027	0.2531	0.239	1.442
0.02	0.0037	0.0132	0.00031	10.57	0.52	0.4127	0.2562	U.247	1.415
0.03	0.0069	0.0197	0.00074	8.56	0.53	0.4227	0.2592	0.255	1.388
0.04	0.0105	0.0262	0.00138	7.38	0.54	0.4327	0.2621	0.263	1.362
0.05	0.0147	0.0325	0.00222	6.55	0.55	0.4426	0.2649	0.271	1.336
0.06	0.0192	0.0389	0.00328	5.95	0.56	0.4526	0.2676	0.279	1.311
0.07	0.0242	0.0451	0.00455	5.47	0.57	0.4625	0.2703	0.287	1.286
0.08	0.0294	0.0513	0.00604	5.09	0.58	0.4724	0.2728	0.295	1.262
0.09	0.0350	0.0575	0.00775	4.76	0.59	0.4822	0.2753	0.303	1.238
0.10	0.0409	0.0636	0.00967	4.49	0.60	0.4920	0.2776	0.311	1.215
0.11	0.0470	0.0695	0.01181	4.25	0.61	0.5018	0.2799	0.319	1.192
0.12	0.0534	0.0755	0.01417	4.04	0.62	0.5115	0.2821	0.327	1.170
0.13	0.0600	0.0813	0.01674	3.86	0.63	0.5212	0.2842	0.335	1.148
0.14	0.0668	0.0871	0.01952	3.69	0.64	0.5308	0.2862	0.343	1.126
0.15	0.0739	0.0929	0.0225	3.54	0.65	0.5404	0.2882	0.350	1.105
0.16	0.0811	0.0985	0.0257	3.41	0.66	0.5499	0.2900	0.358	1.084
0.17	0.0885	0.1042	0.0291	3.28	0.67	0.5594	0.2917	0.366	1.064
0.18	0.0961	0.1097	0.0327	3.17	0.68	0.5687	0.2933	0.373	1.044
0.19	0.1039	0.1152	0.0365	3.06	0.69	0.5780	0.2948	0.380	1.024
0.20	0.1118	0.1206	0.0406	2.96	0.70	0.5872	0.2962	0.388	1.004
0.21	0.1199	0.1259	0.0448	2.87	0.71	0.5964	0.2975	0.395	0.985
0.22	0.1281	0.1312	0.0492	2.79	0.72	0.6054	0.2987	0.402	0 965
0.23	0.1365	0.1364	0 0537	2.71	0.73	0.6143	0.2998	0.409	0.947
0.24	0 1449	0.1416	0.0585	2.63	0.74	0.6231	0.3008	0.416	0.928
0.25	0.1535	0.1466	0.0634	2.56	0.75	0.6319	0.3017	0.422	0.910
0.26	0.1623	0.1516	0.0686	2.49	0.76	0.6405	0.3024	0.429	0.891
0.27	0.1711	0.1566	0.0739	2.42	0.77	0.6489	0.3031	0.435	0.873
0.28	0.1800	0.1614	0.0793	2.36	0.78	0.6573	0.3036	0.441	0.856
0.29	0.1890	0.1662	0.0849	2.30	0.79	0.6655	0.3039	0.447	0.838
0.30	0.1982	0 1709	0.0907	2.25	0.80	0.6736	0.3042	0.453	0.821
0.31	0.2074	0.1756	0.0966	2.20	0.81	0.6815	0.3043	0.458	0.804
0.32	0.2167	0.1802	0.1027	2.14	0.82	0.6893	0.3043	0.463	0.787
0.33	0.2260	0.1847	0.1089	2.09	0.83	0.6969	0.3041	0.468	0.770
0.34	0.2355	0.1891	0.1153	2 05	0.84	0.7043	0.3038	0.473	0.753
0.35	0.2450	0.1935	0.1218	2.00	0.85	0.7115	0.3033	0.477	0.736
0.36	0.2546	0.1978	0.1284	1.958	0.86	0.7186	0.3026	0.481	0.720
0.37	0.2642	0.2020	0.1351	1.915	0.87	0.7254	0.3018	0.485	0.703
0.38	0.2739	0.2062	0.1420	1.875	0.88	0.7320	0.3007	0.488	0.687
0.39	0.2836	0.2102	0.1490	1.835	0.89	0.7384	0.2995	0.491	0.670
0.40	0.2934	0.2142	0.1561	1.797	0.90	0.7445	0.2980	0.494	0.654
0.41	0.3032	0.2182	0.1633	1.760	0.91	0.7504	0.2963	0.496	0.637
0.42	0.3130	0.2220	0.1705	1.724	0.92	0.7560	0.2944	0.497	0.621
0.43	0.3229	0.2258	0.1779	1.689	0.93	0.7612	0.2921	0.498	0.604
0.44	0.3328	0.2295	0.1854	1.655	0.94	0.7662	0.2895	0.498	0.588
0.45	0.3428	0.2331	0.1929	1.622	0.95	0.7707	0.2865	0.498	0.571
0.46	0.3527	0.2366	0.201	1.590	0.96	0.7749	0.2829	0.496	0.553
0.47	0.3627	0.2401	0.208	1.559	0.97	0.7785	0.2787	0.494	0.535
0.48	0.3727	0.2435	0.216	1.530	0.98	0.7817	0.2735	0.489	0.517
0.49	0.3827	0.2468	0.224	1.500	0.99	0.7841	0.2666	0.483	0.496
0.50	0.3927	0.2500	0.232	1.471	1.00	0.7854	0.2500	0.463	0.463



$$\left(\text{Also} \quad \frac{Qn}{1.486D^{8/3}\,S^{0.5}} \quad \text{or} \quad \frac{Qn}{1.486B^{8/3}S^{0.5}}\right)$$



Applicable for TW < d_c. Enter TW/D, go vertical to $Q/D^{2.5}$, read horizontal to Y_o/D.

APPENDIX C

DRAINAGE FEE

C.1 Drainage Fee Calculation

Drainage Fee Calculation

Orchard Ridge Subdivision

	Area	Surface Type	"C" Value (runoff coefficient)
HISTORIC "h"	33.44	Cultivated Agricultural and Pasture	0.30
Total	33.44		0. 30 Composite
DEVELOPED "d"	32.37	Single family (1/3 ac. Lots) (Basins A, B, and D)	0.41
	1.07	Rear yards – Green Landscaping (Basins C, E, and F)	0.34
Total	33.44		0.408 Composite ✓

Using the values from the above table and the formula found in SWMM Sec. VIII-4, the drainage fee is calculated as follows:

$$\text{Drainage Fee} = 14{,}000 \times (C_{100d} - C_{100h})\ A^{0.7}$$
$$= 14{,}000 \times (0.408 - 0.30)\ 33.44^{.7}$$
$$= \$17{,}641.61$$

Phase II Calc

$14{,}369(.408 - .30)^{.7}(33.44)$

$= 18{,}106.59 \times 28/97 = 5226.64$

Phase III Calc:

$\$14{,}828\ (0.408 - 0.30)\ 33.44^{0.7} = \$18{,}684.48$

Pro-rated : $24/97 \times \$18{,}684.98 = \$4{,}623.09$

Addendum to

Final Drainage Report

For

Orchard Ridge Subdivision

Presented To:
The City of Fruita

Prepared For:
Radar Development LLC
1172 23\½ Road
Grand Junction, CO 81505

Prepared By:
ROLLAND Engineering
405 Ridges Blvd.
Grand Junction, CO 81503

March 30, 2006

file: 6007drn1.doc

Addendum to:
Final Drainage Report For Orchard Ridge Subdivision
Dated June 29, 2004 and Revised December 22, 2004
Prepared by: Rolland Engineering, 405 Ridges Blvd, Grand Junction, CO

At the conclusion of the first construction phase of Orchard Ridge Subdivision it was decided to decrease the grade change between the north-south roads in the subdivision.
This was accomplished by raising the western most road, Cresthaven Drive, by about 1.5 feet. As a result of raising the road the western most tier of lots were changed from Type "A" to Type "B". A PVC storm drain and inlets were added to the rear yards of those lots.

This new Basin is designated as Basin E. The former Basin E (in the original report) has been changed to Basin F. By creating this new basin, a larger portion of the stormwater is directed to the 30" RCP, prior to peak flow rates in that pipe. The actual peak flow rate in the 30" RCP actually has dropped from 26.4 cfs to 25.7 cfs.

Please find attached revised runoff summaries, pipe capacity calculations for Basin E and Drainage plans for the site and storm sewer outfall.

CERTIFICATION STATEMENT

I hereby certify that this Addendum to the report for the drainage design of Orchard Ridge Subdivision was prepared by me or under my direct supervision.

Eric S. Slivon, P.E.
3-30-06
Registered Professional Engineer
State of Colorado, Number 36169

RUNOFF SUMMARY

BASIN	AREA	RUNOFF COEFFECIENT		TIME OF CONCENTRATION		PEAK RUNOFF FLOW RATE	
	A (AC.)	C_2	C_{100}	T_C2 (MIN.)	T_C100 (MIN.)	Q_2 (CFS)	Q_{100} (CFS)
DEVELOPED							
A1	5.88	0.33	0.41	42	34	0.9	4.8
A2	8.81	0.33	0.41	33	27	1.5	8.3
A3	4.25	0.33	0.41	34	28	0.7	3.9
B1	5.20	0.33	0.41	38	31	0.8	4.5
B2	6.64	0.33	0.41	42	34	1.0	5.4
C	0.58	0.30	0.34	15	15	0.2	0.6
D	0.65	0.33	0.41	16	16	0.2	0.9
E	1.41	0.30	0.34	14	11	0.4	1.7
F	0.23	0.30	0.34	14	10	0.1	0.3
HISTORIC							
H	33.44	0.29	0.36	37	38	3.9	18.6
OFF-SITE							
O	0.53	0.91	0.93	19	17	0.5	1.5

DESIGN POINTS

DESIGN POINT	DESCRIPTION		TIME TO PEAK	PEAK RUNOFF FLOW RATE	PIPE (CURB) CAPACITY
	CONTRIBUTING BASINS	CURB OR PIPE SIZE	T_{100} (Min.)	Q_{100} (CFS)	Q_{MAX} (CFS)
1	A1	CURB	34	5.3	11.1(10.0)
2	A2	15" RCP (CURB)	27	8.3	11.1(11.5)
3	A3	12" RCP (CURB)	28	4.1	6.1(11.5)
4	A2+A3	24" RCP	27	12.2	16.8
5	A1+A2+A3	24" RCP	27	15.8	22.6
6	B1	12" RCP (CURB)	31	4.3	6.1(10.0)
7	B2+OS	15" RCP (CURB)	34	6.7	11.1(10.0)
8	B1+B2+OS	18" RCP	34	10.5	18.6
9	A+B+OS	30" RCP	31	25.5	36.3
10	C	8" PVC	15	0.6	1.6
11	A+B+C+OS	30" RCP	31	25.7	34.3
12	E	10" PVC	11	1.7	1.9
13	A+B+C+E+OS	30" RCP	31	25.7	35.5

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (acft)	Return period (yrs)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (cuft)	Hydrograph description
1	Rational	4.8	1	34	0.22	100	—	—	—	BASIN A1
2	Rational	8.3	1	27	0.31	100	—	—	—	BASIN A2
3	Rational	3.9	1	28	0.15	100	—	—	—	BASIN A3
4	Rational	4.5	1	31	0.19	100	—	—	—	BASIN B1
5	Rational	5.4	1	34	0.25	100	—	—	—	BASIN B2
6	Rational	0.6	1	15	0.01	100	—	—	—	BASIN C
7	Rational	1.4	1	17	0.03	100	—	—	—	BASIN OS
8	Rational	1.7	1	11	0.03	100	—	—	—	BASIN E
9	Reach	1.1	1	38	0.03	100	7	—	—	OS TRAVEL
10	Combine	6.4	1	34	0.28	100	5 + 9	—	—	B2+OS
11	Combine	10.5	1	34	0.47	100	4 + 10	—	—	B1+B2+OS
12	Combine	12.0	1	27	0.46	100	2 + 3	—	—	A2+A3
13	Combine	15.8	1	27	0.68	100	1 + 12	—	—	A1+A2+A3
14	Reach	15.8	1	29	0.68	100	13	—	—	A TRAVEL
15	Reach	10.5	1	34	0.47	100	11	—	—	B TRAVEL
16	Combine	25.5	1	31	1.15	100	14 + 15	—	—	A+B+OS
17	Reach	25.5	1	31	1.15	100	16	—	—	A+B+OS TRAVEL
18	Combine	25.7	1	31	1.19	100	7 + 17	—	—	BASIN A+B+C+OS
19	Combine	25.7	1	31	1.21	100	18 + 8	—	—	A+B+C+E+OS

Proj. file: 6007.GPW	IDF file: GJIDF.IDF	Run date: 03-30-2006

10" PVC @ 0.65%
Rating Table for Circular Channel

Project Description	
Project File	c:\haestad\fmw\6007.fm2
Worksheet	Basin E
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Constant Data		
Mannings Coefficient	0.012	
Channel Slope	0.006500	ft/ft
Diameter	10.00	in

Input Data	Minimum	Maximum	Increment
Depth	0.05	0.83	0.05 ft

Rating Table

Depth (ft)	Discharge (cfs)	Velocity (ft/s)
0.05	0.01	1.01
0.10	0.06	1.58
0.15	0.14	2.03
0.20	0.24	2.40
0.25	0.37	2.72
0.30	0.53	3.00
0.35	0.70	3.24
0.40	0.89	3.45
0.45	1.09	3.62
0.50	1.29	3.76
0.55	1.48	3.87
0.60	1.66	3.95
0.65	1.82	3.99
0.70	1.95	3.99
0.75	2.04	3.94
0.80	2.05	3.81
0.83	1.91	3.51

8" PVC @ 0.65%
Rating Table for Circular Channel

Project Description	
Project File	c:\haestad\fmw\6007.fm2
Worksheet	Basin E2
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Constant Data	
Mannings Coefficient	0.012
Channel Slope	0.006500 ft/ft
Diameter	8.00 in

Input Data

	Minimum	Maximum	Increment
Depth	0.02	0.67	0.05 ft

Rating Table

Depth (ft)	Discharge (cfs)	Velocity (ft/s)
0.02	0.17e-2	0.56
0.07	0.02	1.25
0.12	0.07	1.75
0.17	0.15	2.14
0.22	0.25	2.47
0.27	0.36	2.74
0.32	0.49	2.97
0.37	0.63	3.15
0.42	0.76	3.29
0.47	0.89	3.39
0.52	1.01	3.44
0.57	1.09	3.44
0.62	1.13	3.35
0.67	1.06	3.02

8" PVC @ 0.42%
Rating Table for Circular Channel

Project Description	
Project File	c:\haestad\fmw\6007.fm2
Worksheet	Basin E3
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Constant Data		
Mannings Coefficient	0.012	
Channel Slope	0.004200 ft/ft	
Diameter	8.00	in

Input Data

	Minimum	Maximum	Increment
Depth	0.02	0.67	0.05 ft

Rating Table

Depth (ft)	Discharge (cfs)	Velocity (ft/s)
0.02	0.14e-2	0.45
0.07	0.02	1.01
0.12	0.06	1.40
0.17	0.12	1.72
0.22	0.20	1.99
0.27	0.29	2.21
0.32	0.40	2.39
0.37	0.50	2.53
0.42	0.61	2.65
0.47	0.72	2.73
0.52	0.81	2.77
0.57	0.88	2.76
0.62	0.91	2.70
0.67	0.85	2.43

30" RCP @ 0.75%
Rating Table for Circular Channel

Project Description

Project File	c:\haestad\fmw\6007.fm2
Worksheet	30" RCP @ 0.75%
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Discharge

Constant Data

Mannings Coefficient	0.013	
Channel Slope	0.007500	ft/ft
Diameter	30.00	in

Input Data

	Minimum	Maximum	Increment
Depth	0.10	2.50	0.10 ft

Rating Table

Depth (ft)	Discharge (cfs)	Velocity (ft/s)
0.10	0.11	1.61
0.20	0.46	2.52
0.30	1.09	3.26
0.40	1.97	3.89
0.50	3.11	4.45
0.60	4.49	4.95
0.70	6.08	5.41
0.80	7.88	5.82
0.90	9.85	6.19
1.00	11.97	6.53
1.10	14.22	6.83
1.20	16.56	7.11
1.30	18.97	7.36
1.40	21.42	7.57
1.50	23.86	7.76
1.60	26.27	7.92
1.70	28.61	8.05
1.80	30.83	8.15
1.90	32.89	8.22
2.00	34.72	8.25
2.10	36.27	8.24
2.20	37.44	8.18
2.30	38.12	8.07

30" RCP @ 0.75%
Rating Table for Circular Channel

Rating Table

Depth (ft)	Discharge (cfs)	Velocity (ft/s)
2.40	38.06	7.86
2.50	35.52	7.24

Revision 3/30/06

0' 60' 120' 180'
1" = 60'

BENCHMARK:

MESA COUNTY SURVEY MARKER
EAST 1/4 CORNER
SECTION 7, T1S, R2W U.M.
ELEVATION: 4510.78 (NAVD 88)

LEGEND

■■■■■■■	DRAINAGE BASIN
——4511——	PROPOSED CONTOUR
⇐	PROPOSED DRAINAGE PATTERN
IV	IRRIGATION VALVE
AV	AIR VENT (IRRIGATION)
ⓘ	IRRIGATION MANHOLE
——IRR——	IRRIGATION LINE
—×—×—	FENCE
— —4510— —	EXISTING CONTOUR
16.83	SPOT ELEVATION

NOTES:

1. DRAINAGE FROM BASINS A, B AND C WILL BE DIRECTED TO A STORM SEWER AT THE SOUTHWEST CORNER OF THE SITE. THE STORM SEWER IS SIZED TO CARRY RUNOFF FROM THE 100 YEAR STORM EVENT. THE STORM WILL CARRY THE STORMWATER UNDETAINED TO THE BIG SALT WASH.
2. DRAINAGE FROM BASIN D WILL BE DIRECTED TO COMSTOCK DRIVE, WHERE IT WILL CONTINUE SOUTH TO THE STORMWATER FACILITY AREA NORTH OF COMSTOCK ESTATES FILING NO.5.
3. DRAINAGE FROM BASIN E WILL SHEET FLOW ONTO THE PROPERTY TO THE SOUTHEAST AT RATES EQUAL TO OR LESS THAN HISTORIC.
4. ALL GRADING SHOWN IN FUTURE PHASES IS PRELIMINARY AND SUBJECT TO CHANGE.
5. STORM SEWER TO BE CONSTRUCTED IN PHASE TWO. SEE SHEETS 3 AND 4 FOR UTILITIES AND GRADING TO BE CONSTRUCTED IN PHASE ONE.

RUNOFF SUMMARY

BASIN	AREA	RUNOFF COEFFECIENT		TIME OF CONCENTRATION		PEAK RUNOFF FLOW RATE	
	A (AC.)	C_2	C_{100}	T_C2 (MIN.)	T_C100 (MIN.)	Q_2 (CFS)	Q_{100} (CFS)
DEVELOPED							
A1	6.49	0.33	0.41	42	34	0.9	5.3
A2	8.81	0.33	0.41	33	27	1.5	8.3
A3	4.47	0.33	0.41	34	28	0.7	4.1
B1	4.98	0.33	0.41	38	31	0.8	4.3
B2	6.97	0.33	0.41	42	34	1.0	5.7
C	0.85	0.30	0.34	15	15	0.2	1.1
D	0.64	0.33	0.41	16	16	0.2	0.9
E	0.23	0.30	0.34	14	10	0.1	0.3
HISTORIC							
H	33.44	0.29	0.36	37	38	3.9	18.6
OFF-SITE							
O	0.53	0.91	0.93	19	17	0.5	1.5

DESIGN POINTS

DESIGN POINT	DESCRIPTION		TIME TO PEAK	PEAK RUNOFF FLOW RATE	PIPE (CURB) CAPACITY
	CONTRIBUTING BASINS	CURB OR PIPE SIZE	T_{100} (Min.)	Q_{100} (CFS)	Q_{MAX} (CFS)
1	A1	15" RCP (CURB)	34	5.3	11.1(10.0)
2	A2	15" RCP (CURB)	27	8.3	11.1(11.5)
3	A3	12" RCP (CURB)	28	4.1	6.1(11.5)
4	A2+A3	24" RCP	27	12.2	16.8
5	A1+A2+A3	24" RCP	27	16.4	22.7
6	B1	12" RCP (CURB)	31	4.3	6.1(10.0)
7	B2+OS	15" RCP (CURB)	34	6.7	11.1(10.0)
8	B1+B2+OS	18" RCP	34	10.6	20.7
9	A+B+OS	30" RCP	31	26.2	36.3
10	C	8" PVC	15	1.1	5.0
11	A+B+C+OS	30" RCP	31	26.4	36.3

ROLLAND ENGINEERING
405 Ridges Blvd
Grand Jct, CO 81503
(970) 243-8300

File Name: C:\PROJECTS\4027\4027MDRN.DWG

ORCHARD RIDGE SUBDIVISION

MASTER DRAINAGE PLAN

Designed ESS	Checked TDR	Proj# 4027	Sheet 13
Drawn ESS	Date 6/29/04	Rv: 12/22/04	Of 18

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LEGEND

■ ■ ■ ■	DRAINAGE BASIN
—4511—	PROPOSED CONTOUR
⇇	PROPOSED DRAINAGE PATTERN
IV	IRRIGATION VALVE
AV	AIR VENT (IRRIGATION)
⊙	IRRIGATION MANHOLE
—IRR—	IRRIGATION LINE
—x—x—	FENCE
—4510—	EXISTING CONTOUR
16.83	SPOT ELEVATION

NOTES:

1. ALL GRADING SHOWN IN FUTURE PHASES IS PRELIMINARY AND SUBJECT TO CHANGE.
2. STORM SEWER TO BE CONSTRUCTED IN PHASE TWO. SEE SHEETS 3 AND 4 FOR UTILITIES AND GRADING TO BE CONSTRUCTED IN PHASE ONE.
3. SEE TABLE J-12 OF THE MESA COUNTY STORMWATER MANAGEMENT MANUAL (SWMM) FOR DETAIL OF PIMA COUNTY PLUNGE BASIN.

BENCHMARK:

MESA COUNTY SURVEY MARKER
EAST 1/4 CORNER
SECTION 7, T1S, R2W U.M.
ELEVATION: 4510.78 (NAVD 88)

ROLLAND ENGINEERING
GRAND JUNCTION

ROLLAND ENGINEERING
405 Ridges Blvd
Grand Jct, CO 81503
(970) 243-8300

File Name: C:\PROJECTS\4027\4027MDRN.DWG

ORCHARD RIDGE
SUBDIVISION

OFFSITE DRAINAGE PLAN

Designed ESS	Checked TDR	Proj# 4027	Sheet 1
Drawn ESS	Date 6/29/04	Rv: 12/22/04	Of 1

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