DRAINAGE REPORT

FOR

COMSTOCK WEST SUBDIVISION

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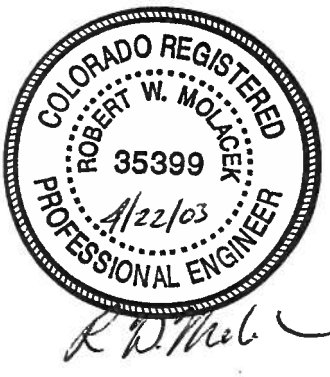
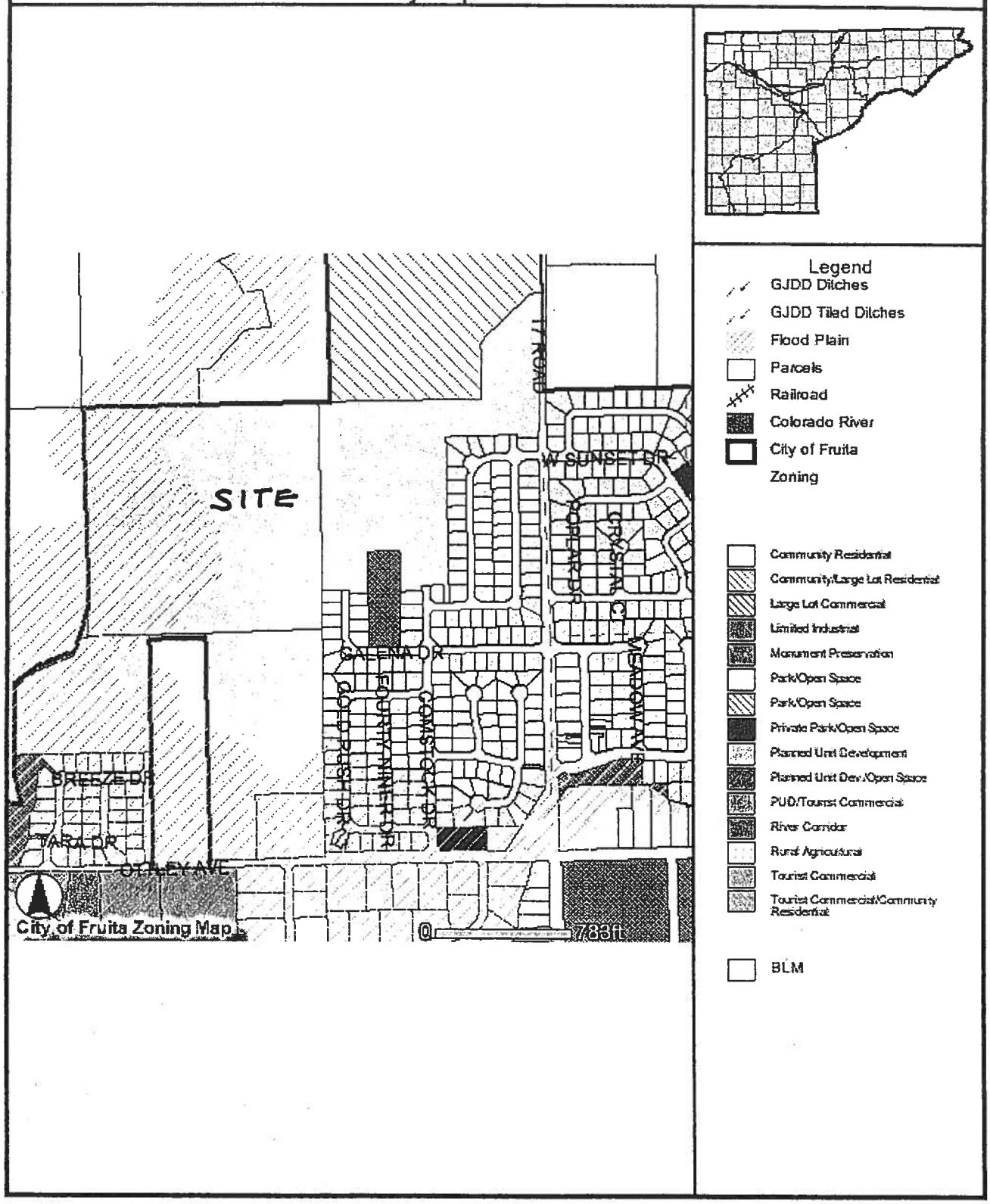


October, 2002
Revised March 2003

Vicinity Map-Comstock West



NARRATIVE

INTRODUCTION

The purpose of this drainage report is to ensure the safe diversion of stormwater through Comstock West Subdivision. This report will calculate historic and developed basin flows, street carrying capacities, inlet capacities, and storm sewer sizing to the Big Salt Wash located on the property to the west. This design will comply with all requirements of the City of Fruita.

LOCATION & DESCRIPTION

Comstock West Subdivision is located in a portion of the NW quarter of the SE quarter of Section 7, Township 1 North, Range 2 West of the Ute Principal Meridian in Mesa County Colorado. More specifically it is situated approximately ¼ mile north of K Road (Ottley Avenue) and approximately ¼ mile west of 17 Road (Coulson Avenue). The development will adjoin the Comstock Estates Subdivision to the east. The entire property contains approximately 40 acres, however, only the 20.6 acres above the floodplain of the Big Salt Wash will be developed. The development will contain 81 single-family residential units.

HISTORIC HYDROLOGIC CONDITIONS

The site has previously been in agricultural production and currently lies in a fallow state. There is one single-family resident with a garage and a few sheds on site in the southwest corner of the proposed developed area. Ground cover consists primarily of natural grasses and weeds. The soil is primarily a Billings silty clay loam, hydrologic soil group 'C'. The ground slopes slightly to the south at approximately 0.5%. The western 40' of Comstock Estates, which consists primarily of back yards, drains west onto the proposed subdivision. There is no other substantial off-site drainage flowing onto the site. There is a swale along the south boundary of the property that diverts surface water west to Big Salt Wash.

HYDROLOGIC PROCEDURE

The Rational Method has been used to calculate both historic and developed basin flows for the 2 and 100-year events. Runoff coefficients, flow velocities, and rainfall intensities have been obtained from the Stormwater Management Manual for Mesa County. Standard HEC-12 procedures, also obtained from the Stormwater Management Manual, have been used to calculate street inundation and inlet capacities. No detention calculations have been performed. Stormwater from the site will be directly discharged to Big Salt Wash due to the close proximity of the development to the wash.

DEVELOPED HYDROLOGIC CONDITIONS

The upper 20.6 acres of this 40-acre parcel will be developed into 81 single-family residential home sites. The remaining 19.4 acres is located in the floodplain of Big Salt Wash. One large lot consisting of 6.3 acres will be created in the upper portion of the floodplain and the remaining 13.1 acres will remain as open space. Access to the site will be attained through the existing Comstock Estates Subdivision to the east and the proposed, currently unnamed, subdivision to the south.

Surface runoff from the development will travel south, as in pre-existing conditions, through street gutters and concrete crosspans. Fifty percent of the runoff will be divided evenly between single combination Inlets #1 and #2 (See Figure 1 for Inlet locations). The two-year flow to each of these inlets is 0.78 cfs. The remaining 50% of the runoff will be collected at single combination Inlet #3. This inlet will have a two-year flow of 1.54 cfs, 0.04 cfs more than the recommended 1.50 cfs for a single combination inlet, however, per a conversation with the City of Fruita Engineer the somewhat increased flow will be acceptable. All collected runoff will be diverted west through an 18" ADS culvert releasing to an open swale at the base of the bluff and traveling to the Big Salt Wash.

On-site detention is not a preferred alternative for this site because of its close proximity to the wash. This site is a good candidate for early and direct discharge to the watercourse in order to release stormwater early from sites lower in the basin prior to the peak discharge from upstream in the major basin.

An 18" RCP will connect all three inlets and will drain into an 18" ADS pipe to the bottom of the bluff. The storm sewer will be constructed at a constant grade of 1.90% for 400 feet. The storm sewer is designed to handle up to the 100-year flow event. The outlet velocity of the sewer has been calculated to be 8.8 fps and therefore a 5' long by 3' wide riprap apron using 6 to 9" dia. rocks has been designed for energy dissipation and erosion control. A swale 1' deep with 3:1 side slopes and a 1' bottom width will carry the flow into the Big Salt Wash.

CONCLUSIONS

Implementation of this drainage plan will safely divert the 100-year storm flows away from the proposed development and will not adversely affect adjacent property. This plan is in compliance with all applicable regulations of the City of Fruita.

CALCULATIONS
&
DETAILS

COMSTOCK WEST
FLOW SUMMARY

Historic Basin Flow

Q(2)=0.98 cfs
Q(100)=5.12 cfs

Developed Basin Flow

Q(2)=03.10 cfs
Q(100)=15.32 cfs

Street Carrying Capacity (2 year event)

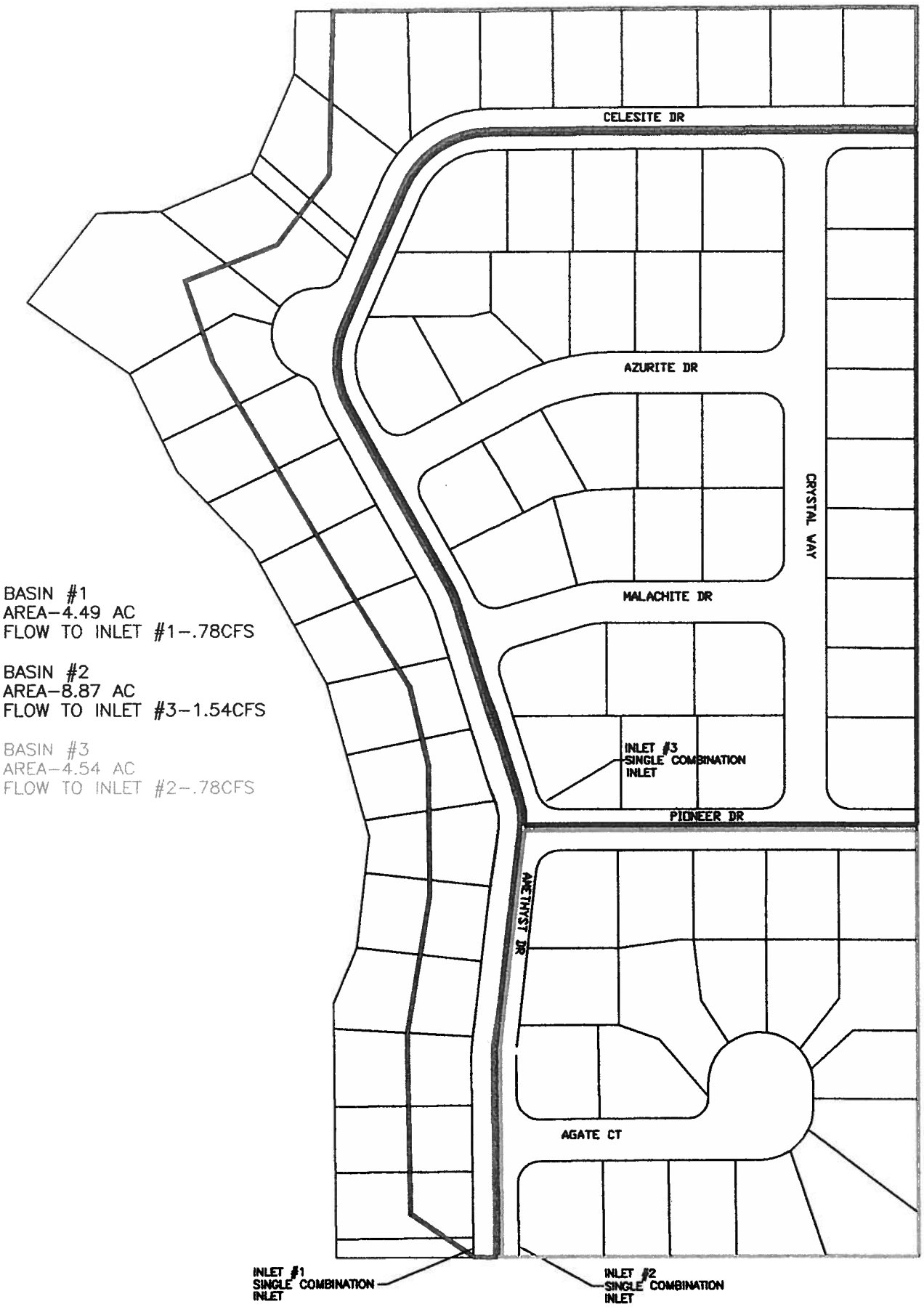
Maximum flow on Amethyst to Inlet #1 = 0.78 cfs
Maximum flow on Amethyst to Inlet #2 = 0.78 cfs
Maximum flow on Amethyst to Inlet #3 = 0.98 cfs
Maximum flow on Pioneer to Inlet #3 = 0.56 cfs

Maximum Half Street Flow = 1.00 cfs (See Figure G-5)

Inlet Capacity- On-Grade Condition (See Figure 1)

2-year flow to Inlet #1 = 0.78 cfs
2-year flow to Inlet #2 = 0.78 cfs
2-year flow to Inlet #3 = 1.54 cfs

Maximum Single Combination Inlet Capacity = 1.50 cfs (See Figure G-7b)



COMSTOCK WEST
DRAINAGE BASINS AND ON-GRADE INLETS
FIGURE 1

FLOW CALCULATION WORKSHEET

JOB NAME: Comstock West

DATE: 10/25/02

BASIN DESIGNATION: Historic basin #1
FLOWING TO: Big Salt Wash

1. Basin Area — 18.70 acres

2. Longest Runoff Distance — 1450 feet

3. Overland Runoff Distance — 500 feet
   Avg. Slope — 0.50%

4. Concentrated Flow Distance — 950 feet
   Avg. Slope — 0.50%
   velocity — 0.6 fps

5. Runoff Coefficients
   c(2)= 0.18
   c(100)= 0.24

6. Time of Concentration · t(c) = t(i) + t(t)

$$= \frac{1.8(1.1 - c(2))\langle L(i)\rangle^{1/2}}{(s)^{1/3}} + \frac{L(t)}{60(V)}$$

$$= 46.65 + 26.39$$

$$= \textbf{73.04 min.}$$

7. L/180 + 10 for developed only

8. Q = CIA

Q(2)=	0.18	x 0.29	x	18.70	=	**0.98 cfs**
Q(100)=	0.24	x 1.14	x	18.70	=	**5.12 cfs**

FLOW CALCULATION WORKSHEET

JOB NAME: Comstock West

DATE: 10/25/02

BASIN DESIGNATION: Developed basin #1
FLOWING TO: Big Salt Wash

1. Basin Area — 18.70 acres

2. Longest Runoff Distance — 1950 feet

3. Overland Runoff Distance — 100 feet
   Avg. Slope — 0.50%

4. Concentrated Flow Distance — 1850 feet
   Avg. Slope — 0.40%
   velocity — 1.4 fps

5. Runoff Coefficients — c(2)= 0.36; c(100)= 0.45

6. Time of Concentration · t(c) = t(i) + t(t)

$$= \frac{1.8(1.1 - c(2))\langle L(i)\rangle^{1/2}}{(s)^{1/3}} + \frac{L(t)}{60(V)}$$

$$= 16.78 + 22.02$$

$$= \textbf{38.81 min.}$$

7. L/180 + 10 — for developed only

8. Q = CIA

Q(2)= 0.36 x 0.46 x 18.70 = **3.10 cfs**
Q(100)= 0.45 x 1.82 x 18.70 = **15.32 cfs**

18" RCP between inlets on Amethyst Dr.

Comstock West Subdivision

Culverts -- English Units

Civil Tools for Windows
(10-27-2002, 08:20:16)

```
           Diameter = 18 in
             Length = 30 ft
     Friction Coeff = .011
     Ent+Exit Coeff = 1
Inlet Control Coeff = .61
       Inv Elev Out = 4497.15 ft
        Inv Elev In = 4497.3 ft
     Tailwater Elev = 4498.5 ft
     Elev Increment = .5 ft
```

Headwater ft		Flowrate cfs	
4498.80	OC	4.66	
4499.30	IC	7.74	
4499.80	IC	9.86	
4500.30	IC	11.61	←
4500.80	IC	13.12	
4501.30	IC	14.48	
4501.80	IC	15.71	
4502.30	IC	16.86	
4502.80	IC	17.94	
4503.30	IC	18.95	
4503.80	IC	19.92	
4504.30	IC	20.83	
4504.80	IC	21.71	
4505.30	IC	22.56	
4505.80	IC	23.37	
4506.30	IC	24.16	

18" ADS storm sewer to swale

Comstock West Subdivision

Culverts -- English Units

Civil Tools for Windows
(10-27-2002, 09:18:14)

```
           Diameter = 18 in
             Length = 400 ft
     Friction Coeff = .01
     Ent+Exit Coeff = 1
Inlet Control Coeff = .61
       Inv Elev Out = 4487.5 ft
        Inv Elev In = 4495 ft
     Tailwater Elev = 4488 ft
     Elev Increment = .5 ft
```

Headwater ft		Flowrate cfs
4496.50	IC	7.49
4497.00	IC	9.67
4497.50	IC	11.44
4498.00	IC	12.98
4498.50	IC	14.35
4499.00	IC	15.60 ←
4499.50	IC	16.75
4500.00	IC	17.83
4500.50	IC	18.85
4501.00	IC	19.82
4501.50	IC	20.74
4502.00	IC	21.63
4502.50	IC	22.47
4503.00	OC	23.02
4503.50	OC	23.43
4504.00	OC	23.83

Swale from culvert to Big Salt Wash

Comstock West Subdivision

Man Made Channels -- English Units

Civil Tools for Windows
(10-27-2002, 09:25:26)

```
          Flow Depth = 1.057 ft
            Flowrate = 15.300 cfs
Channel Bottom Width = 1.000 ft
  Channel Side Slope = 3.000 ft/ft
       Channel Slope = 0.01400 ft/ft
   Channel Roughness = 0.035
         Wetted Area = 4.41 sf
    Wetted Perimeter = 7.69 ft
            Velocity = 3.47 fps
          Froude No. = 0.79
                Flow = Sub-Critical
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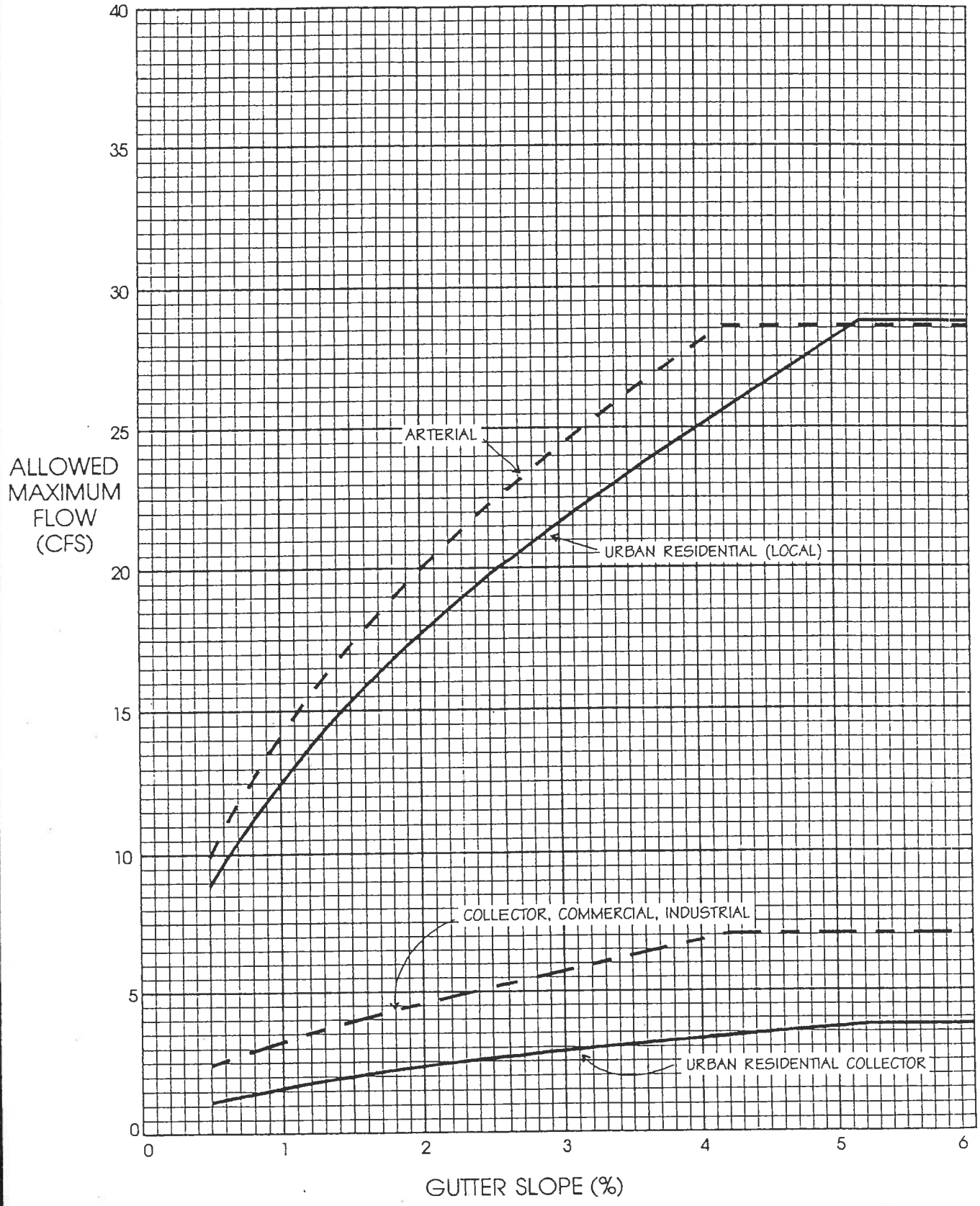
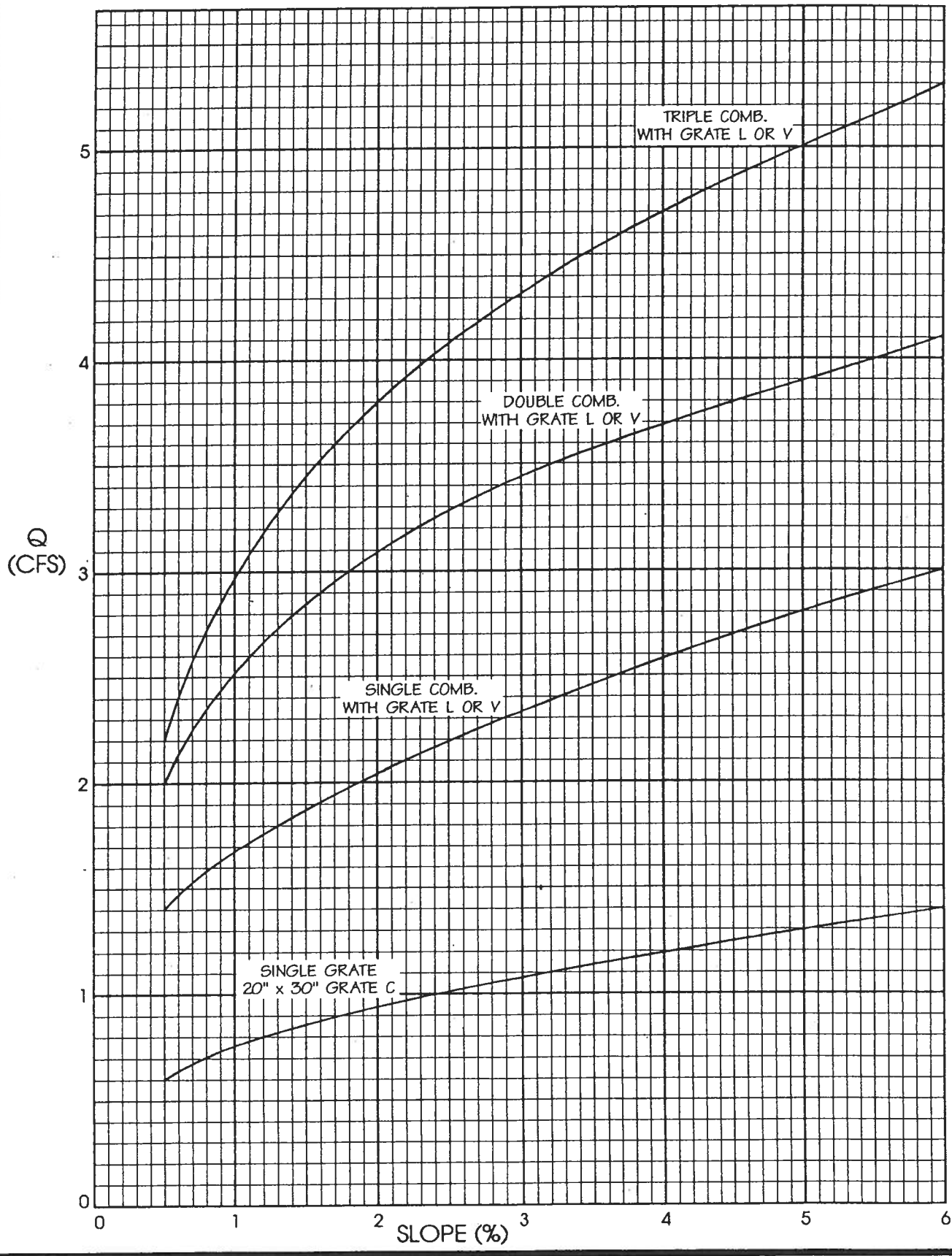


MAXIMUM HALF STREET FLOWS (Sx=2%, n=0.016)
(Based upon Figures G-3 and G-4)

FIGURE "G-5"

INLET CAPACITIES PROVIDED ARE BASED UPON FIGURE "G-4", MAXIMUM ALLOWED FLOW CONDITIONS, SMF ENGINEERING CORP.'S HEC-12 SOFTWARE, CLOGGING FACTORS PRESENTED IN SECTION VI, AND CITY\COUNTY STANDARD INLETS.



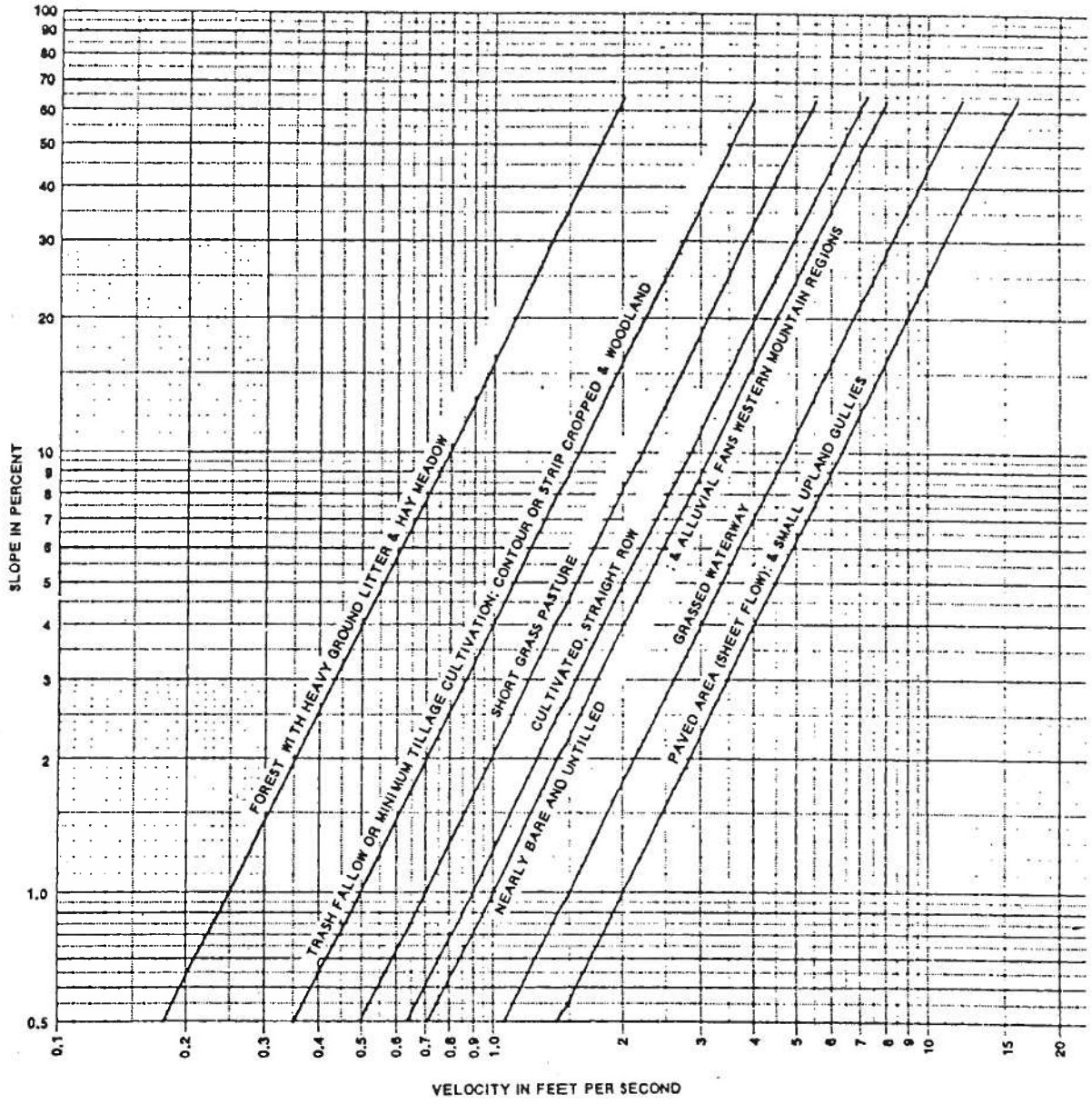
MAXIMUM INLET CAPACITIES: ON-GRADE
RESIDENTIAL COLLECTOR, COMMERCIAL, INDUSTRIAL

FIGURE "G-7b"

TABLE "A-1a" 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) $I_2 = \frac{26.71}{Tc + 19.01}$ $I_{100} = \frac{104.94}{Tc + 18.80}$

REPRODUCED FROM FIGURE 15.2, SCS 1972



DETERMINATION OF "Ts"	FIGURE "E-3"

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	.10 - .20 .14 - .24	.16 - .26 .22 - .32	.25 - .35 .30 - .40	.14 - .22 .20 - .28	.22 - .30 .28 - .36	.30 - .38 .37 - .45	.20 - .28 .26 - .34	.28 - .36 .35 - .43	.36 - .44 .40 - .48	.24 - .32 .30 - .38	.30 - .38 .40 - .48	.40 - .48 .50 - .58
Cultivated/Agricultural	.08 - .18 .14 - .24	.13 - .23 .18 - .28	.16 - .26 .22 - .32	.11 - .19 .16 - .24	.15 - .23 .21 - .29	.21 - .29 .28 - .36	.14 - .22 .20 - .28	.19 - .27 .25 - .33	.26 - .34 .34 - .42	.18 - .26 .24 - .32	.23 - .31 .29 - .37	.31 - .39 .41 - .49
Pasture	.12 - .22 .15 - .25	.20 - .30 .25 - .35	.30 - .40 .37 - .47	.18 - .26 .23 - .31	.28 - .36 .34 - .42	.37 - .45 .45 - .53	.24 - .32 .30 - .38	.34 - .42 .42 - .50	.44 - .52 .52 - .60	.30 - .38 .37 - .45	.40 - .48 .50 - .58	.50 - .58 .62 - .70
Meadow	.10 - .20 .14 - .24	.16 - .26 .22 - .32	.25 - .35 .30 - .40	.14 - .22 .20 - .28	.22 - .30 .28 - .36	.30 - .38 .37 - .45	.20 - .28 .26 - .34	.28 - .36 .35 - .43	.36 - .44 .44 - .52	.24 - .32 .30 - .38	.30 - .38 .40 - .48	.40 - .48 .50 - .58
Forest	.05 - .15 .08 - .18	.08 - .18 .11 - .21	.11 - .21 .14 - .24	.08 - .16 .10 - .18	.11 - .19 .14 - .22	.14 - .22 .18 - .26	.10 - .18 .12 - .20	.13 - .21 .16 - .24	.16 - .24 .20 - .28	.12 - .20 .15 - .23	.16 - .24 .20 - .28	.20 - .28 .25 - .33
RESIDENTIAL AREAS 1/8 acre per unit	.40 - .50 .48 - .58	.43 - .53 .52 - .62	.46 - .56 .55 - .65	.42 - .50 .50 - .58	.45 - .53 .54 - .62	.50 - .58 .59 - .67	.45 - .53 .53 - .61	.48 - .56 .57 - .65	.53 - .61 .64 - .72	.48 - .56 .56 - .64	.51 - .59 .60 - .68	.57 - .65 .69 - .77
1/4 acre per unit	.27 - .37 .35 - .45	.31 - .41 .39 - .49	.34 - .44 .42 - .52	.29 - .37 .38 - .46	.34 - .42 .42 - .50	.38 - .46 .47 - .55	.32 - .40 .41 - .49	.36 - .44 .45 - .53	.41 - .49 .52 - .60	.35 - .43 .43 - .51	.39 - .47 .47 - .55	.45 - .53 .57 - .65
1/3 acre per unit	.22 - .32 .31 - .41	.26 - .36 .35 - .45	.29 - .39 .38 - .48	.25 - .33 .33 - .41	.29 - .37 .38 - .46	.33 - .41 .42 - .50	.28 - .36 .36 - .44	.32 - .40 .41 - .49	.37 - .45 .48 - .56	.31 - .39 .39 - .47	.35 - .43 .43 - .51	.42 - .50 .53 - .61
1/2 acre per unit	.16 - .26 .25 - .35	.20 - .30 .29 - .39	.24 - .34 .32 - .42	.19 - .27 .28 - .36	.23 - .31 .32 - .40	.28 - .36 .36 - .44	.22 - .30 .31 - .39	.27 - .35 .35 - .43	.32 - .40 .42 - .50	.26 - .34 .34 - .42	.30 - .38 .38 - .46	.37 - .45 .48 - .56
1 acre per unit	.14 - .24 .22 - .32	.19 - .29 .26 - .36	.22 - .32 .29 - .39	.17 - .25 .24 - .32	.21 - .29 .28 - .36	.26 - .34 .34 - .42	.20 - .28 .28 - .36	.25 - .33 .32 - .40	.31 - .39 .40 - .48	.24 - .32 .31 - .39	.29 - .37 .35 - .43	.35 - .43 .46 - .54
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)	.55 - .65 .65 - .70	.60 - .70 .70 - .75	.64 - .74 .74 - .79	.60 - .68 .68 - .76	.64 - .72 .72 - .80	.67 - .75 .75 - .83	.64 - .72 .72 - .80	.67 - .75 .75 - .83	.69 - .77 .77 - .85	.72 - .80 .79 - .87	.75 - .83 .82 - .90	.77 - .85 .84 - .92
Green landscaping (lawns, parks)	.10 - .20 .14 - .24	.16 - .26 .22 - .32	.25 - .35 .30 - .40	.14 - .22 .20 - .28	.22 - .30 .28 - .36	.30 - .38 .37 - .45	.20 - .28 .26 - .34	.28 - .36 .35 - .43	.36 - .44 .42 - .52	.24 - .32 .30 - .38	.30 - .38 .40 - .48	.40 - .48 .50 - .58
Non-green and gravel landscaping	.30 - .40 .34 - .44	.36 - .46 .42 - .52	.45 - .55 .50 - .60	.45 - .55 .50 - .60	.42 - .50 .48 - .56	.50 - .58 .57 - .65	.40 - .48 .46 - .54	.48 - .56 .55 - .63	.56 - .64 .64 - .72	.44 - .52 .50 - .58	.50 - .58 .60 - .68	.60 - .68 .70 - .78
Cemeteries, playgrounds	.20 - .30 .24 - .34	.26 - .36 .32 - .42	.35 - .45 .40 - .50	.35 - .45 .40 - .50	.32 - .40 .38 - .46	.40 - .48 .47 - .55	.30 - .38 .36 - .44	.38 - .44 .45 - .53	.46 - .54 .54 - .62	.34 - .42 .40 - .48	.40 - .48 .50 - .58	.50 - .58 .60 - .68

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. Conversely, 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"