STORM WATER INLET COMPUTATIONS

PROJECT:______________________

DESIGN BY:______________________ DATE:______________

INLET			STATION	DRAINAGE AREA (AC)	C	CA	Σ CA	I (IN/HR)	Q INCR (CFS)	Q CARRY OVER (CFS)	Q_T GUTTER FLOW (CFS)	S GUTTER SLOPE (FT/FT)	Sx CROSS SLOPE (FT/FT)	T (SPREAD) (FT)	W (FT)	W/T	Sw (FT/FT)	Sw/Sx	Eo	a=12W(Sw-Sx) +LOC. DEP.	SW= a/12W	Se(FT/FT)= Sx+Sw'Eo	Lt(FT)	P EFFEC. LENGTH FT	L/LT	d(FT)	E	h(FT)	Qi INTERCEPTED CFS	d/h	Qb CARRYOVER CFS	T SPREAD @ SAG (FT)	REMARKS
NUMBER	TYPE	LENGTH (FT)																															

NOTE: REFER TO THE VIRGINIA DEPARTMENT OF TRANSPORTATION DRAINAGE MANUAL.

Drawing
DD-16

STORM SEWER DESIGN COMPUTATIONS

PROJECT: ____________________

DESIGN BY: ____________________ DATE: __________

FROM	TO	TYPE OF STRUCT.	DRAIN. AREA	RUN OFF COEF.	C X A		TIME OF CONCENTRATION				TOTAL FLOW (C.F.S.)		PIPE RUN MANNING'S "N" VALUE ___			CAPACITY OF PIPE		ELEVATIONS					ROADWAY STATION	REMARKS
			(ACRES)	"C"	INCR.	ACCUM.	TC TO PIPE	TIME IN PIPE	ACCUM. TIME	I (IN/HRS)	INCR.	ACCUM.	LNGTH (FT)	DIA.(IN.)	SLOPE %	C.F.S.	VELOCITY F.P.S.	UPPER (OUT) INVERT	FALL (PIPE-RUN)	LOWER (IN) INVERT	DROP IN STRUC.	TOP OF STRUC.		

HYDRAULIC GRADE LINE

PROJECT:__________
DESIGN BY:__________ DATE:__________

INLET STATION	OUTLET WATER SURFACE ELEV.	D_o	Q_o	L_o	S_{f_o} %	H_f	JUNCTION LOSS												FINAL H	INLET WATER SURFACE ELEV.	RIM ELEV.	REMARKS
							V_o	H_o	Q_i	V_i	$Q_i V_i$	$\frac{V_i^2}{2g}$	H_i	ANGLE	H_Δ	H_t	1.3 H_t	0.5 H_t				

BEND ANGLE (DEGREES)	"K" FACTOR
90	0.70
80	0.66
70	0.61
60	0.56
50	0.55
40	0.43
30	0.35
25	0.30
20	0.25
15	0.19
10	0.13
5	0.06

NOTES:

$H_i = 0.35 \frac{V_i^2}{2g}$

$H_o = 0.25 \frac{V_o^2}{2g}$

$H_\Delta = K \frac{V_i^2}{2g}$

$H_t = H_o + H_i + H_\Delta$

FINAL $H = H_f + H_t$

Drawing DD-18

ARTICLE 5-231.1

VALUES OF RUNOFF COEFFICIENT (C) FOR RATIONAL FORMULA

LAND USE	C	LAND USE	C
Business:		Lawns:	
Downtown areas	0.70 – 0.95	Sandy soil, flat, 2%	0.05 – 0.10
Neighborhood areas	0.50 – 0.70	Sandy soil, average,2-7%	0.10 – 0.15
		Sandy soil, steep, 7%	0.15 – 0.20
Residential:		Heavy soil, flat, 2%	0.13 – 0.17
Single-family areas	0.30 – 0.50	Heavy soil, average,2-7%	0.18 – 0.22
Multi-units, detached	0.40 – 0.60	Heavy soil, steep, 7%	0.25 – 0.35
Multi-units, attached	0.60 - 0.75		
Suburban	0.25 - 0.40	Agriculture land:	
Apartment	0.50 – 0.70	Bare packed soil	
		Smooth	0.30 – 0.60
Industrial:		Rough	0.20 – 0.50
Light areas	0.50 – 0.80	Pasture	
Heavy areas	0.60 – 0.90	Heavy soil	0.15 – 0.45
		Sandy soil	0.05 – 0.25
Parks	0.10 – 0.25	Woodlands	0.05 – 0.25
Unimproved areas	0.10 – 0.30		
Streets:			
Asphalt	0.70 – 0.95		
Concrete	0.80 – 0.95		
Brick	0.70 – 0.85		
Drives and walks	0.75 – 0.85		
Roofs	0.75 – 0.95		

Note: The designer must use judgement to select the appropriate C value within the range. Generally, larger areas with permeable soils, flat slopes and dense vegetation should have lowest (c) values. Smaller areas with dense soils, moderate to steep slopes, and sparse vegetation should be assigned highest (c) values.

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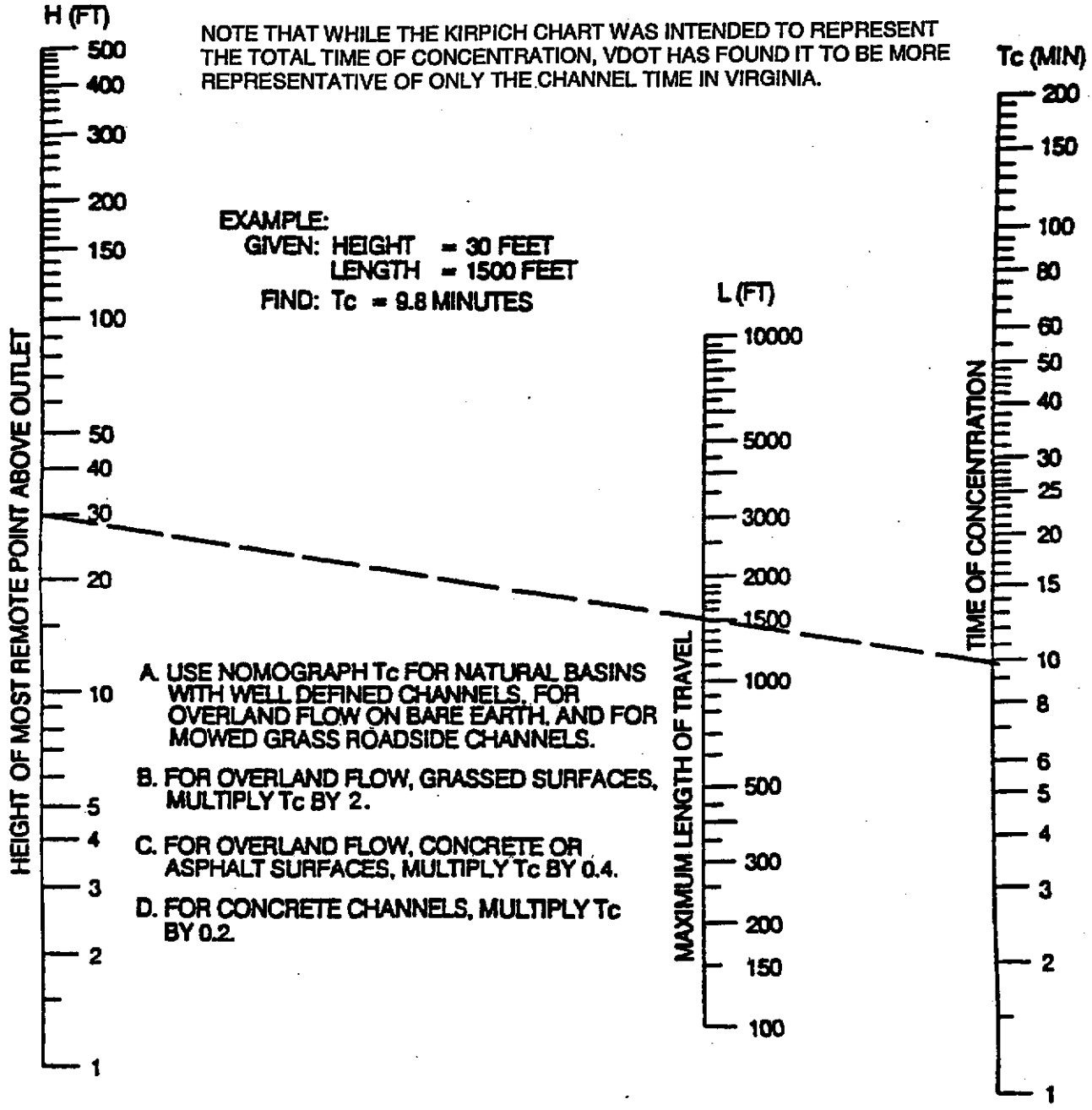
NO.	DATE		

RUNOFF COEFFICIENT "C" VALUES

DRAWING
DD-1

PAGE
111

ARTICLE 5-231.1A



BASED ON STUDY BY P.Z. KIRPICH

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NO.	DATE	
1	11/2008	

TIME OF CONCENTRATION VALUES FOR SMALL DRAINAGE SHEDS (Tc Values)

DRAWING
DD-2

PAGE
112

ARTICLE 5-231.1B

LEESBURG PEAK RAINFALL INTENSITY

RETURN INTERVAL (YEARS)	DURATION	RAINFALL DEPTH (INCHES)
1	24 Hours	2.6
2	24 Hours	3.1
5	24 Hours	4.0
10	24 Hours	4.7
25	24 Hours	5.9
50	24 Hours	6.9
100	24 Hours	8.0

ARTICLE 5-231.1B

LEESBURG PEAK RAINFALL INTENSITY (INCHES PER HOUR)

RATIONAL METHOD

DURATION (MINUTES)	RETURN INTERVAL (YEARS)				
	2	10	25	50	100
5	5.75	7.27	8.27	9.06	9.84
6	5.44	6.91	7.86	8.50	9.41
7	5.22	6.64	7.53	8.39	9.00
8	4.99	6.38	7.26	8.18	8.60
9	4.78	6.14	6.99	7.72	8.41
10	4.60	5.92	6.77	7.43	8.10
11	4.43	5.74	6.55	7.24	7.90
12	4.30	5.57	6.38	7.05	7.68
13	4.17	5.40	6.17	6.84	7.45
14	4.05	5.27	6.00	6.66	7.24
15	3.90	5.10	5.86	6.46	7.05
16	3.80	4.99	5.71	6.31	6.88
17	3.71	4.89	5.58	6.16	6.72
18	3.60	4.75	5.45	6.01	6.57
19	3.52	4.65	5.33	5.88	6.42
20	3.44	4.55	5.22	5.74	6.29
21	3.35	4.44	5.11	5.62	6.15
22	3.27	4.34	5.00	5.52	6.03
23	3.20	4.26	4.90	5.41	5.93
24	3.12	4.16	4.80	5.31	5.81
25	3.06	4.08	4.72	5.20	5.69
26	3.00	4.00	4.62	5.11	5.59
27	2.92	3.92	4.54	5.02	5.50
28	2.87	3.84	4.46	4.93	5.40
29	2.81	3.79	4.39	4.85	5.32
30	2.75	3.71	4.30	4.76	5.22
35	2.51	3.42	3.99	4.43	4.85
40	2.31	3.17	3.71	4.14	4.54
45	2.13	2.96	3.49	3.89	4.27
50	1.99	2.80	3.30	3.67	4.05
55	1.86	2.64	3.13	3.49	3.86
60	1.73	2.50	2.95	3.30	3.65
65	1.65	2.37	2.83	3.16	3.50
70	1.56	2.26	2.70	3.01	3.35
75	1.47	2.14	2.56	2.87	3.19
80	1.40	2.04	2.45	2.75	3.05
85	1.32	1.95	2.34	2.63	2.91
90	1.26	1.87	2.24	2.51	2.79
95	1.20	1.79	2.14	2.41	2.67
100	1.15	1.72	2.06	2.31	2.56
110	1.08	1.59	1.90	2.14	2.37
120	1.01	1.48	1.76	1.97	2.18

REVISIONS			
NO.	DATE		

PEAK RAINFALL INTENSITIES

DRAWING
DD-4

ARTICLE 5-242.5

Per Diameter in D Inches	Joint Opening in Inches											
	1/8	1/4	3/8	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4	1-3/8	1-1/2
RADIUS OF CURVATURE FOR STRAIGHT DEFLECTED PIPE LENGTH OF 4 FEET												
18	736	368	245	184	147	123	105	92	82	74	67	61
21	848	424	283	212	170	141	121	106	94	85	77	71
24	960	480	320	240	192	160	137	120	107	96	87	80
27	1072	536	357	268	214	179	153	134	119	107	97	89
30	1184	592	395	296	237	197	169	148	132	118	107	99
33	1296	648	432	324	259	216	185	162	144	130	118	108
36	1408	704	469	352	282	235	201	176	156	141	128	117
42	1632	816	544	408	326	272	233	204	181	163	148	136
48	1856	928	619	464	371	309	265	232	206	186	169	155
54	2080	1040	693	520	416	347	297	260	231	208	189	173
60	2304	1152	768	576	461	384	329	288	256	230	209	191
66	2528	1264	843	632	506	421	361	316	281	253	230	211
72	2752	1376	917	688	550	459	393	344	306	275	250	229
RADIUS OF CURVATURE FOR STRAIGHT DEFLECTED PIPE LENGTH OF 6 FEET												
18	1104	552	368	276	221	184	158	138	123	110	100	92
21	1272	636	424	318	254	212	182	159	141	127	116	106
24	1440	720	480	360	288	240	206	180	160	144	131	120
27	1608	804	536	402	322	268	230	201	179	161	146	134
30	1776	888	592	444	355	296	254	222	197	178	161	148
33	1944	972	648	486	389	324	278	243	216	194	177	162
36	2112	1056	704	528	422	352	302	264	235	211	192	176
42	2448	1224	816	612	490	408	350	306	272	245	223	204
48	2784	1392	928	696	557	464	398	348	309	278	253	232
54	3120	1560	1040	780	624	520	446	390	347	312	284	260
60	3456	1728	1152	864	691	576	494	432	384	346	314	288
66	3792	1896	1264	946	758	632	542	474	421	379	345	316
72	4128	2064	1376	1032	826	688	590	516	459	413	375	344
RADIUS OF CURVATURE FOR STRAIGHT DEFLECTED PIPE LENGTH OF 8 FEET												
18	1472	736	491	368	294	245	210	184	164	147	134	123
21	1696	848	565	424	339	283	242	212	188	170	154	141
24	1920	960	640	480	384	320	274	240	213	192	175	160
27	2144	1072	715	436	429	357	306	268	238	214	195	189
30	2368	1184	789	592	474	395	338	296	263	237	215	197
33	2592	1296	864	648	518	432	370	324	288	259	236	216
36	2816	1408	939	704	563	469	402	352	313	282	256	235
42	3264	1632	1088	816	653	544	466	408	363	326	297	272
48	3712	1856	1237	928	742	619	530	464	412	371	337	310
54	4160	2080	1387	1040	832	693	594	520	462	416	378	347
60	4608	2304	1536	1152	922	768	658	576	512	461	419	384
66	5056	2528	1685	1264	1011	843	722	632	562	506	460	421
72	5504	2752	1835	1376	1101	917	786	688	612	550	500	459

REVISIONS			
NO.	DATE		

RADIUS OF CURVATURE

DRAWING
DD-5

ARTICLE 5-

REVISIONS			
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DRAWING
DD-6

ARTICLE 5-

REVISIONS			
NO.	DATE		

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DRAWING
DD-7

PAGE
117

ARTICLE 5-

REVISIONS			
NO.	DATE		

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ARTICLE 5-

REVISIONS			
NO.	DATE		

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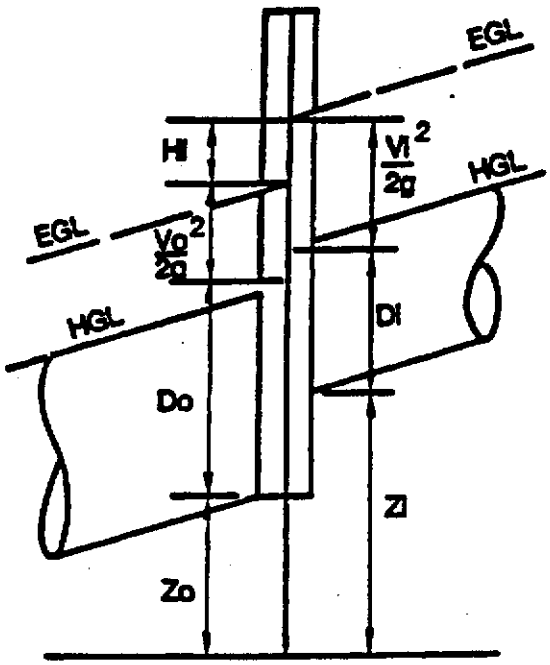
DRAWING
DD-9

ARTICLE 5-249.1

EGL = ENERGY GRADE LINE
HGL = HYDRAULIC GRADE LINE
h = ENERGY LOSS THROUGH A BEND
hI = ENERGY LOSS THOUGH EXPANSION
ho = ENERGY LOSS THROUGH CONTRACTION
HI = TOTAL ENERGY LOSS THROUGH A JUNCTION



NON – PRESSURE FLOW

BEND ANGLE (DEGREES)	"K" FACTOR
90	0.70
80	0.66
70	0.61
60	0.56
50	0.55
40	0.43
30	0.35
25	0.30
20	0.25
15	0.19
10	0.13
5	0.06

$$DROP = ZI - Zo = (Do - DI) + \left(\frac{Vo^2}{2g} - \frac{Vi^2}{2g}\right) + HI$$

$$HI = hi + ho + h$$

$$h = K \times \frac{Vi^2}{2g}$$

$$ho = .25\,\frac{Vo^2}{2g}$$

$$hi = .35\,\frac{Vi^2}{2g}$$

ZI, Zo = INCOMING AND OUTGOING PIPE INVERT

DI, Do = INCOMING AND OUTGOING DEPTH OF FLOW

PI, Po = INCOMING AND OUTGOING PRESSURE HEADS

$\frac{Vi^2}{2g}, \frac{Vo^2}{2g}$ = INCOMING AND OUTGOING VELOCITY HEADS

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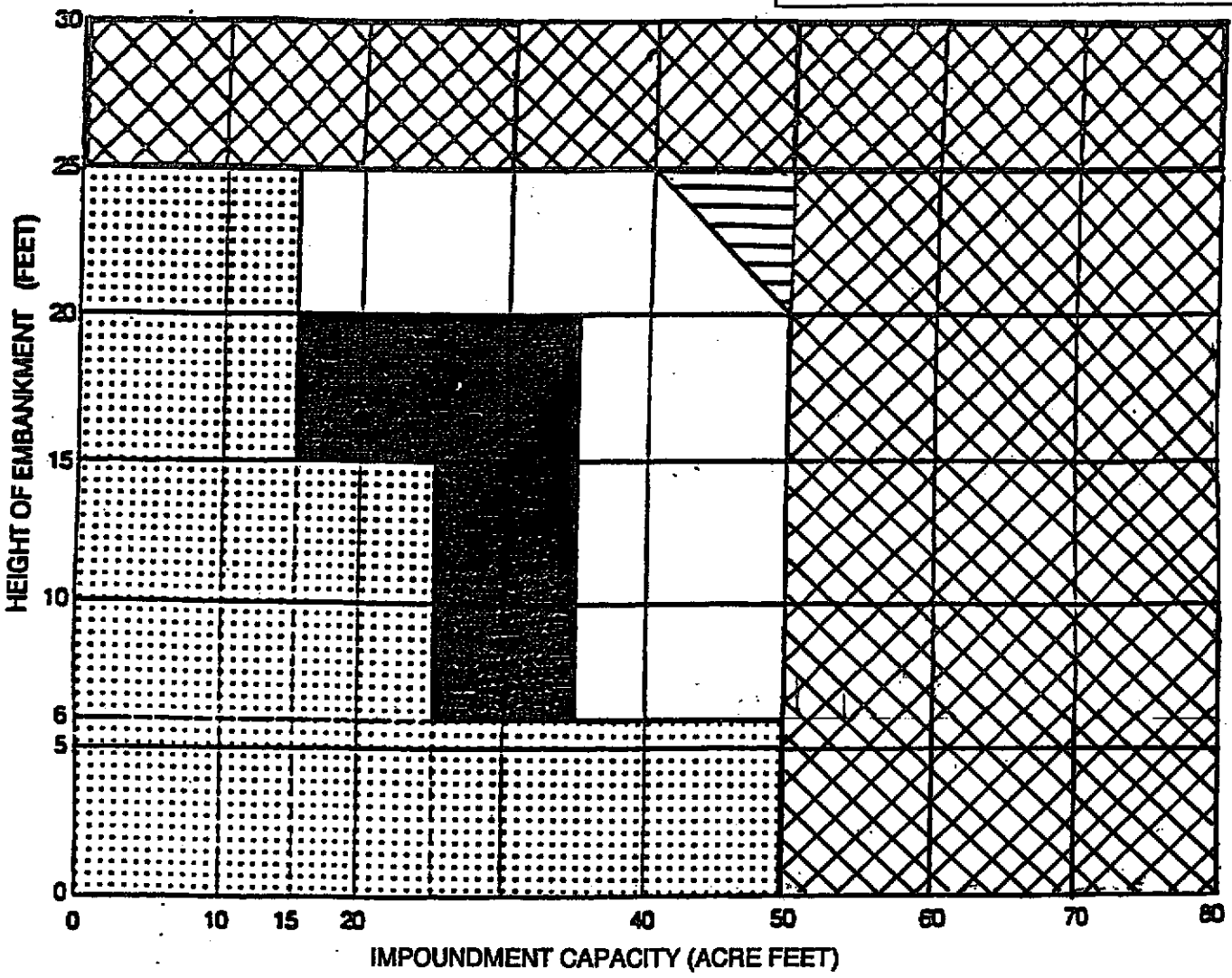
NO.	DATE		
1	11/2008		

HYDRAULIC GRADE LINE IN CLOSED CONDUIT JUNCTION

DRAWING
DD-10

ARTICLE 5-322.1



DAMS REGULATED BY THE DEPARTMENT OF CONSERVATION AND HISTORIC RESOURCES :

DAMS REGULATED BY THE TOWN OF LEESBURG:

PROBABLE MAXIMUM FLOOD DESIGN

MINIMUM = 1 X (100 YEAR) — 100 YEAR
0.3 PMF = 1.5 X (100 YEAR)
0.4 PMF = 2.0 X (100 YEAR)
0.5 PMF = 2.5 X (100 YEAR)
1.0 PMF = 5.0 X (100 YEAR)

NOTE: UTILIZE FOR SPILLWAY FREEBOARD ANALYSIS AND FOR SPILLWAY DESIGN.

REVISIONS			
NO.	DATE		
1	11/2008		

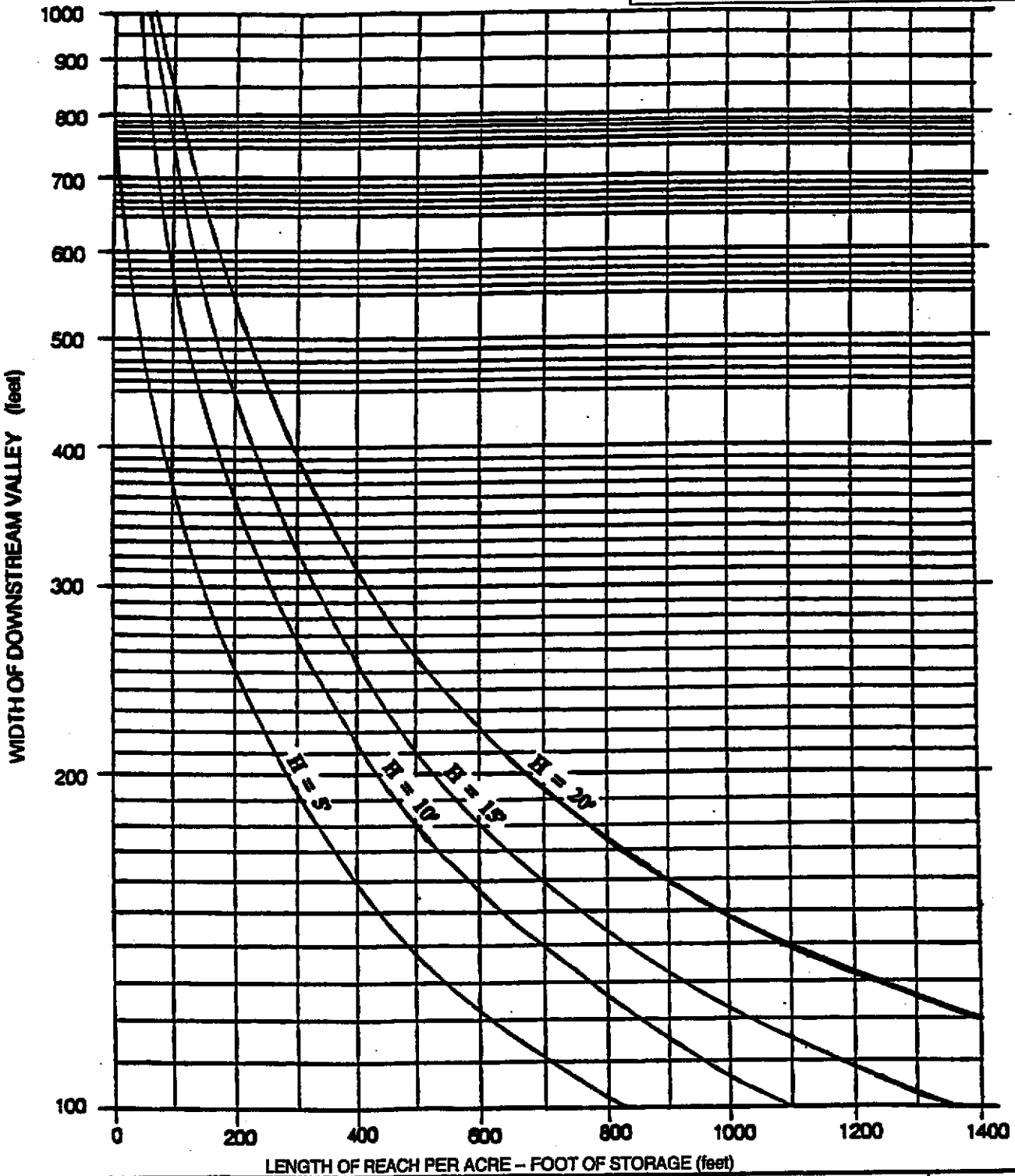
DESIGN STORM FOR DAMS

DRAWING
DD-11

PAGE
121

H EQUAL TO DAM HEIGHT

ARTICLE 5-324.4C



REVISIONS			
NO.	DATE		

DANGER REACH LENGTH

DRAWING
DD-12

PAGE
122

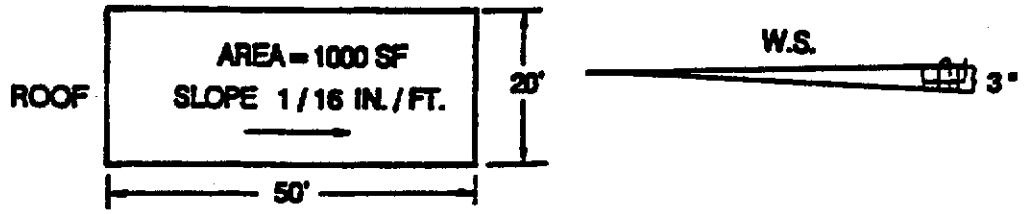
H_p AND SLOPE RANGE AT RETARDANCE VALUES FOR VARIOUS DISCHARGES, VELOCITIES, AND CREST LENGTHS

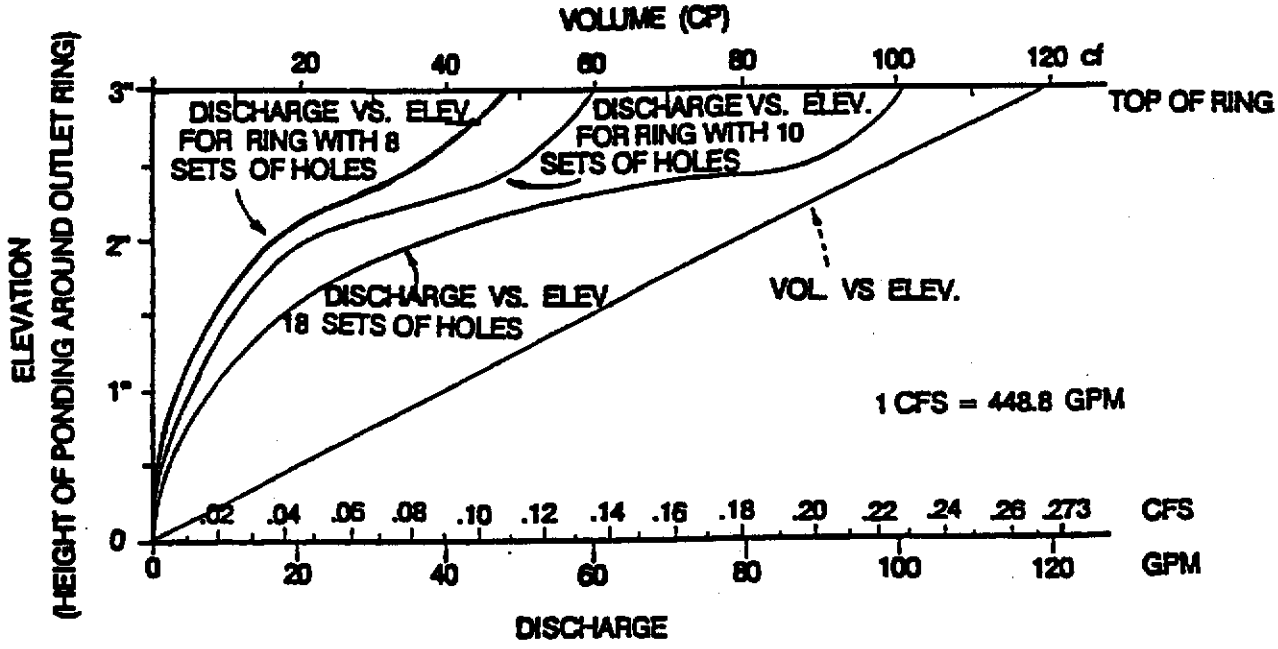
	MAXIMUM VELOCITY V	DISCHARGE q	H_p L(ft) 25	50	100	200	SLOPE MIN.	MAX.
	ft/s	$ft^3/s/ft$	ft	ft	ft	ft	pct	
Retardance A	3	3	2.3	2.5	2.5	2.5	1	11
	4	4	2.3	2.5	2.8	3.1	1	12
	4	5	2.5	2.6	2.9	3.2	1	7
	5	6	2.6	2.7	3.0	3.3	1	9
	6	7	2.7	2.8	3.1	3.5	1	12
	7	10	3.0	3.2	3.4	3.8	1	9
	8	12.5	3.3	3.5	3.7	4.1	1	10
Retardance B	2	1	1.2	1.4	1.5	1.8	1	12
	2	1.25	1.3	1.4	1.6	1.9	1	7
	3	1.5	1.3	1.5	1.7	1.9	1	12
	3	2	1.4	1.5	1.7	1.9	1	8
	4	3	1.6	1.7	1.9	2.2	1	9
	5	4	1.8	1.9	2.1	2.4	1	8
	6	5	1.9	2.1	2.3	2.5	1	10
	7	6	2.1	2.1	2.4	2.7	1	11
	8	7	2.2	2.4	2.6	2.9	1	12
Retardance D	2	0.5	0.6	0.7	0.8	0.9	1	6
	3	1	0.8	0.9	1.0	1.1	1	6
	3	1.25	0.8	0.9	1.0	1.2	1	4
	4	1.25	0.8	0.9	1.0	1.2	1	10
	4	2	1.0	1.1	1.3	1.4	1	4
	5	1.5	0.9	1.0	1.2	1.3	1	12
	5	2	1.0	1.2	1.3	1.4	1	9
	5	3	1.2	1.3	1.5	1.7	1	4
	6	2.5	1.1	1.2	1.4	1.5	1	11
	6	3	1.2	1.3	1.5	1.7	1	7
	7	3	1.2	1.3	1.5	1.7	1	12
	7	4	1.4	1.5	1.7	1.9	1	7
	8	4	1.4	1.5	1.7	1.9	1	12
	8	5	1.6	1.7	1.9	2.0	1	8
	10	6	1.8	1.9	2.0	2.2	1	12
Retardance E	2	0.5	0.5	0.5	0.6	0.7	1	2
	3	0.5	0.5	0.5	0.6	0.7	1	9
	3	1	0.7	0.7	0.8	0.9	1	3
	4	1	0.7	0.7	0.8	0.9	1	6
	4	1.25	0.7	0.8	0.9	1.0	1	5
	5	1	0.7	0.7	0.8	0.9	1	12
	5	2	0.9	1.0	1.1	1.2	1	4
	6	1.5	0.8	0.9	1.0	1.1	1	12
	6	2	0.9	1.0	1.1	1.2	1	7
	6	3	1.2	1.2	1.4	1.5	1	4
	7	2	0.9	1.0	1.1	1.2	1	12
	7	3	1.2	1.2	1.3	1.5	1	7

ARTICLE 5-331.2

CAPACITY THROUGH HOLES				
WATER DEPTH AT INLET (INCHES)	DISCHARGE (GPM)			
	1 SET HOLES	8 SETS	10 SETS	18 SETS
1.5	1	8	10	18
2.0	2	16	20	36
2.5	5	40	50	90
3.0	6	48	60	108

ROOFTOP DETENTION PERFORMANCE CURVE





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ROOFTOP STORM WATER DETENTION

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DD-14

ARTICLE 5-

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DD-15