

PART III

HYDRAULIC TABLES FOR OPEN CHANNEL, GRASSED
WATERWAY, AND SURFACE DRAINAGE DITCHGENERAL

This part contains tables for the most commonly designed for open channels (Drainage Main or Lateral - 608 or Open Channel - 582) grassed waterways (412), and surface drainage ditches (Drainage Field Ditch - 607).

In all cases, values are not given where the velocity exceeds 5 ft./sec.

A detailed use and examples for 1. Open Channel 2. Grassed Waterway
3. Surface Drain follows:

Open Channel

The values for this practice are the table IN-14-4. The headings and values are self-explanatory.

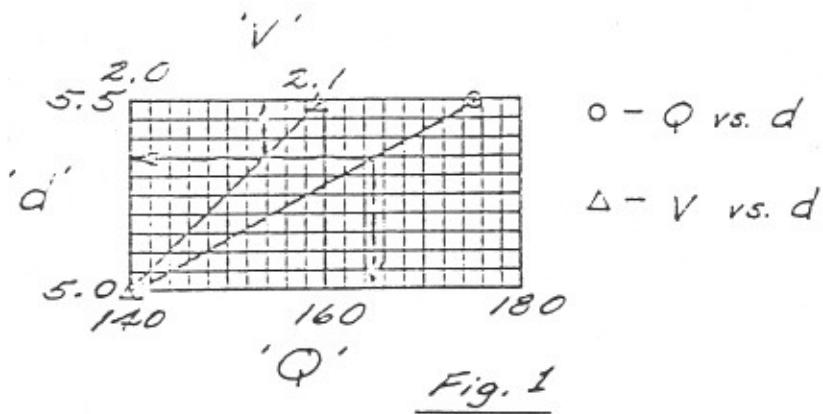
By the use of a simple two or three point plot, values can be interpolated between the figures given in the tables.

Example: Design and field information give the following requirements - channel slope - $s = 0.0008 \text{ ft/ft.}$; side slopes = 2:1; toughness coefficient - $n = 0.04$; bottom width - $b = 4 \text{ ft.}$; and the required discharge - $Q = 165 \text{ cfs.}$

Find: The required depth - d and the velocity - V .

Referring to page 14-150, it is noted that the depth of flow must be somewhere between 5.0 and 5.5 ft. By a plot of depth versus discharge with values of $d = 5.0 \text{ ft.}$ & $Q = 141 \text{ cfs}$ and $d = 5.5 \text{ ft.}$ & $Q = 176 \text{ cfs}$ (See Fig. 1), an estimated depth of 5.35 ft. is required for the discharge of 165 cfs.

By plotting the velocity values on the same graph with values of $d = 5.0 \text{ ft.}$ & $V = 2 \text{ ft./sec.}$ and $d = 5.5 \text{ ft.}$ & $V = 2.1 \text{ ft./sec.}$, an estimated velocity of 2.07 ft./sec. is given for the depth of 5.35 ft.



A similar technique may be used to attain values for channel slope - S when the field value is something other than that shown in the tables.

A roughness coefficient of $n = 0.04$ is a generalized estimate that is not necessarily true for all the depth ranges shown in the open channel tables. Other factors are important for the final determination of "n" such as the lining (whether in earth, gravel, rock, etc.); roughness of the wetted perimeter (rough slopes, etc.); changing cross-sections; obstructions (log jams, etc.); degree of vegetative retardance; and channel meander. Since the values for velocity and discharge are inversely proportional to the roughness coefficient it is easy to correct them for other than 0.04 "roughness" values.

Example: Standard Practice 582 - Open Channel states that channels must be stable under the following conditions:

1. As-built condition - Bankfull flow, design discharge, or 10 year frequency flow, whichever is smallest but not less than 50% of design discharge.
2. Aged condition - Bankfull flow or design discharge, whichever is larger, except that it is not necessary to check stability for discharges greater than the 100-year frequency.

Given and required: Channel slope - $S = 0.001$; bottom width - $b = .4$ ft.; $n = 0.04$; side slope = 2:1; and $Q = 71$ cfs. From the data on page 14-150, it is noted that the design depth - $d = 3.5$ ft. However, to meet the need for an adequate tile outlet, the constructed depth will be 5.5 ft.

Find: The velocities for the as-built and aged conditions.

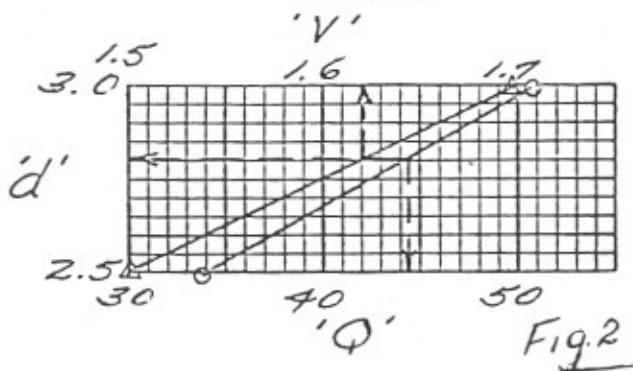
The following procedure to find the as-built velocity will give results within acceptable tolerance.

For the as-built condition, the design discharge would be the smallest value. An $n = 0.025$ (bare soil) will be used along with the design discharge of 71 cfs. Since our charts are for $n = 0.04$, the equivalent discharge from our tables would be - $\frac{0.025}{0.04} \times 71 = 44.4$ cfs (discharge at the as-built depth, would $n = 0.025$).

With a two-point plot of depth versus discharge values of $d = 2.5$ & $Q = 34$ and $d = 3.0$ & $Q = 51$, the as-built design depth of 2.80 ft. is required for the discharge of 44.4 cfs (See Fig. 2).

By plotting the table velocities on the same graph, the velocity (for $n = 0.04$) for a depth of 2.80 ft. would be approx. 1.62 ft./sec.

The as-built velocity would then be - $\frac{0.04}{0.025} \times 1.62 = 2.59$ ft./sec.



For the aged condition, it is apparent that the bankfull flow will be larger than the design discharge of 71 cfs. We shall also assume that the aged "roughness" will be 0.045.

From the table, it is noted that the velocity is 2.4 ft/sec. for the constructed depth of 5.5 ft. The aged velocity for bankfull flow would be $\frac{0.04 \times 2.4}{0.045} = 2.13$ ft./sec.

Grassed Waterway

The tables for this practice are contained on pages 14-152 and 14-153. The values are given for "C" retardance (moderate vegetal retardance) which is considered the best average condition for grassed waterway design in the state.

As may be noted, the channel slopes are flatter than normal for grassed waterway design. However, it is possible that a grassed watercourse may be required for flat grades such as in an urban setting. These tables are also needed for decision-making for a choice between a grassed waterway and a bare-earth surface drain.

The roughness coefficient for a grassed waterway is extremely variable with depth changes. The relationship of Manning's n and VR (the product of velocity and hydraulic radius) may be noted on Fig. 13 of SCS-TP-61 - Handbook of Channel Design for Soil and Water Conservation. Therefore, when values are given or needed between the given depth increments, a three point plot should be used.

Example: Channel slope - $S = 0.0035$; side slopes = 6:1; bottom width - $b = 4$ ft; and discharge - $Q = 100$ cfs

Find: Design depth - d and design velocity - v.

Plot the values of $d = 2.0$ ft. & $Q = 52$ cfs; $d = 2.5$ & $Q = 110$; and $d = 3.0$ & $Q = 198$ (See Fig. 3).

By using a french curve to connect the three points, the design depth is approx. 2.42 ft.

A plot of the velocities on the same graph gives a design velocity of approx. 2.2 ft./sec.

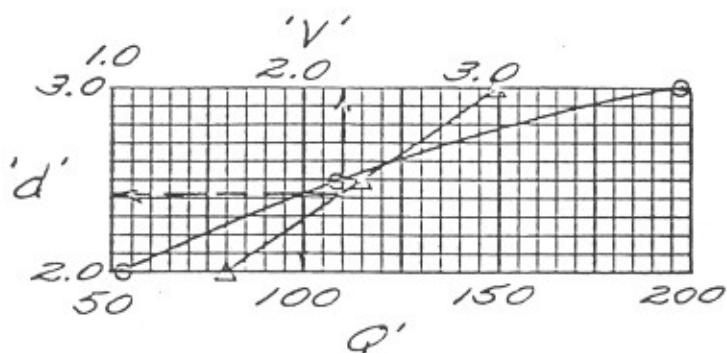


Fig. 3

A common problem exists when the grassed waterway is on too flat a grade and the design velocity is less than 1.5 ft./sec. The following section on surface drains is available for the selection of a waterway that may be maintained on bare earth.

Surface Drain

The tables for this practice are contained on pages 14-154 and 14-155. The roughness coefficient - $n = 0.025$ is an average figure for bare soil lining. However, n could be as low as 0.02 for a straight and uniform ditch in clay soil and it could be as high as 0.033 for cobble lining. The design can be adjusted in the same manner for varying "roughness" values as was previously noted in the examples for Open Channel.

The following example is, perhaps, where a landowner has requested cost-sharing for a grassed waterway. SCS investigation indicates a flat-grade situation and a determination must be made for the proper practice.

Example: Channel slope - $S = 0.0015$; side slopes = 6:1; bottom width - $b = 6$ ft.; discharge - $Q = 66$ cfs; and the channel will be in a sandy clay loam soil.

Find: The proper practice and the design parameters.

Going into page 14-152 for grassed waterway, it is noted that the design gives a depth - $d = 2.5$ ft. and a velocity - $V = 1.3$ ft./sec.

Going into page 14-154, it is noted that the depth would be somewhere between 1.5 and 2.0 ft. Using a two-point plot (See Fig. 4), the design depth would be 1.69 ft. and the design velocity would be 2.35 ft./sec.

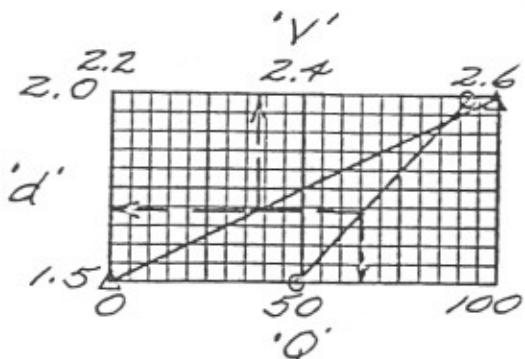


Fig. 4

At this point, Table 14-2 on page 14-26 of the Engineering Field Manual should be checked to determine whether the permissible velocity for the soil type has been exceeded. The value for sandy clay loam is 3.5 ft./sec. so this is satisfactory. However, field experience with the specific soil should be taken into account as to whether or not it will erode under the design conditions.

For this example, it is assumed that the surface drain would be acceptable (with the above design) and the grassed waterway would develop into a silting-up problem and, therefore, would not be satisfactory.

1:1 SIDE SLOPE										n = 0.04																	
S =		.0002		.0004		.0006		.0008		.0010		.0015		.0020		.0025		.0030		.0035		.0040		.0045		.0050	
b	d	A	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	
0	0.5	.2	.2	-	.2	-	.3	-	.4	-	.5	-	.5	-	.6	-	.6	-	.7	-	.7	-	.8	-	.8	-	
1.0	1.0	.3	-	.4	-	.5	-	.5	-	.6	1	.7	1	.8	1	.9	1	1.0	1	1.1	1	1.2	1	1.3	1		
1.5	2.2	.3	1	.5	1	.6	1	.7	2	.8	2	.9	2	1.1	2	1.2	3	1.3	3	1.4	3	1.5	3	1.6	4		
2.0	4.0	.4	2	.6	2	.7	3	.8	3	.9	4	1.1	5	1.3	5	1.5	6	1.6	6	1.7	7	2.0	8	2.1	8		
2.5	4.2	.5	3	.7	4	.8	5	1.0	6	1.1	7	1.3	8	1.5	10	1.7	11	1.9	12	2.0	13	2.2	14	2.3	14		
3.0	9.0	.5	5	.8	5	.9	9	1.1	10	1.2	11	1.5	13	1.7	16	1.9	17	2.1	19	2.3	21	2.4	22	2.6	23		
3.5	12.2	.6	7	.9	10	1.0	13	1.2	15	1.4	17	1.7	20	1.9	23	2.1	24	2.3	29	2.5	31	2.7	31	2.9	31		
4.0	16.0	.7	11	.9	15	1.1	18	1.3	21	1.5	24	1.8	29	2.1	33	2.3	37	2.6	41	2.8	46	3.0	47	3.1	50		
4.5	20.2	.7	14	1.0	21	1.2	25	1.4	29	1.6	32	2.0	40	2.3	46	2.5	51	2.8	56	3.0	61	3.2	65	3.4	69		
5.0	25.0	.8	19	1.1	27	1.3	33	1.5	38	1.7	43	2.1	53	2.4	61	2.7	68	3.0	74	3.2	80	3.4	85	3.6	91		
5.5	30.2	.8	25	1.2	35	1.4	43	1.6	50	1.8	55	2.2	68	2.6	78	2.9	88	3.2	96	3.4	104	3.7	111	3.9	117		
6.0	36.0	.9	31	1.2	44	1.5	54	1.7	62	1.9	70	2.4	86	2.7	99	3.1	110	3.4	121	3.6	131	3.9	143	4.1	148		
2	0.5	1.2	.3	-	.4	-	.5	1	.5	1	.6	1	.7	1	.9	1	1.0	1	1.1	1	1.2	2	1.3	2	1.3	2	
1.0	3.0	.6	1	.5	2	.7	2	.8	2	.9	3	1.0	3	1.2	4	1.4	4	1.5	4	1.6	5	1.7	5	1.8	5		
1.5	5.2	.5	2	.7	3	.8	4	.9	5	1.0	5	1.3	7	1.5	8	1.7	9	1.8	10	2.0	10	2.1	11	2.2	12		
2.0	8.0	.5	4	.8	6	.9	7	1.1	9	1.2	10	1.5	12	1.7	14	1.9	15	2.1	17	2.3	18	2.4	19	2.6	21		
2.5	11.2	.6	7	.9	10	1.1	12	1.2	14	1.4	15	1.7	19	1.9	22	2.1	24	2.3	26	2.5	29	2.7	31	2.9	32		
3.0	15.0	.7	10	.9	14	1.2	17	1.3	20	1.5	22	1.8	27	2.1	32	2.4	35	2.6	39	2.8	42	3.0	45	3.2	47		
3.5	19.2	.7	14	1.0	20	1.3	24	1.6	28	1.6	31	2.0	38	2.3	44	2.6	49	2.8	54	3.0	58	3.2	62	3.4	66		
4.0	24.0	.8	19	1.1	26	1.3	32	1.6	37	1.7	42	2.1	51	2.5	59	2.8	66	3.0	72	3.3	78	3.5	84	3.7	89		
4.5	29.2	.8	24	1.2	34	1.4	42	1.7	49	1.9	54	2.3	66	2.6	77	2.9	86	3.2	94	3.5	102	3.7	109	3.9	115		
5.0	35.0	.9	31	1.2	44	1.5	53	1.8	62	2.0	69	2.4	84	2.8	97	3.1	109	3.4	119	3.7	129	3.9	138	4.2	146		
5.5	41.2	.9	38	1.3	54	1.6	66	1.9	77	2.1	86	2.5	105	2.9	121	3.3	135	3.6	148	3.9	160	4.2	171	4.4	182		
6.0	48.0	1.0	47	1.4	66	1.7	81	2.0	94	2.2	105	2.7	128	3.1	148	3.4	166	3.8	181	4.1	196	4.4	209	4.6	222		
4	0.5	2.2	.3	1	.4	1	.5	1	.6	1	.7	1	.8	2	.9	2	1.0	2	1.1	3	1.2	3	1.3	3	1.4	3	
1.0	5.0	.4	2	.6	3	.7	4	.9	4	1.0	5	1.2	6	1.3	7	1.5	8	1.7	8	1.8	9	1.9	10	2.0	10		
1.5	8.2	.5	4	.7	6	.9	8	1.1	9	1.2	10	1.4	12	1.7	14	1.9	15	2.0	17	2.2	18	2.4	19	2.5	21		
2.0	12.0	.6	7	.9	10	1.1	13	1.2	15	1.4	16	1.7	20	1.9	23	2.1	26	2.4	28	2.5	30	2.7	33	2.9	35		
2.5	16.2	.7	11	1.0	16	1.2	21	1.4	22	1.5	25	1.9	30	2.1	35	2.4	39	2.6	43	2.8	46	3.0	49	3.2	55		
3.0	21.0	.7	16	1.1	22	1.3	27	1.5	31	1.7	35	2.0	43	2.3	49	2.6	55	2.9	60	3.1	65	3.3	70	3.5	74		
3.5	26.2	.8	21	1.1	30	1.3	36	1.6	42	1.8	48	2.2	58	2.5	67	2.8	74	3.1	82	3.4	88	3.6	94	3.8	100		
4.0	32.0	.9	27	1.2	39	1.5	48	1.7	55	1.9	61	2.4	75	2.7	87	3.0	97	3.3	106	3.6	115	3.8	123	4.1	130		
4.5	38.2	.9	35	1.3	49	1.6	60	1.8	70	2.0	78	2.5	96	2.9	110	3.2	123	3.5	135	3.8	146	4.1	156	4.3	165		
5.0	45.0	1.0	43	1.4	61	1.7	75	1.9	87	2.2	97	2.6	119	3.0	137	3.4	153	3.7	168	4.0	181	4.3	196	4.6	205		
5.5	52.2	1.0	53	1.4	75	1.9	92	2.0	106	2.3	118	2.8	145	3.2	167	3.6	187	3.9	205	4.2	221	4.5	236	4.8	251		
6.0	60.0	1.1	64	1.5	90	1.8	110	2.1	127	2.4	142	2.9	174	3.3	201	3.7	225	4.1	246	4.4	266	4.7	284				
6	0.5	3.2	.3	1	.4	1	.5	2	.6	2	.7	2	.8	3	1.0	3	1.1	3	1.2	4	1.3	4	1.4	4	1.5	5	
1.0	7.0	.5	3	.6	4	.8	5	.9	6	1.0	7	1.2	9	1.4	10	1.6	11	1.7	12	1.9	13	2.0	14	2.1	15		
1.5	11.2	.6	6	.8	9	1.0	11	1.1	13	1.3	14	1.5	17	1.8	20	2.0	22	2.2	24	2.3	26	2.5	28	2.7	31		
2.0	16.0	.6	10	.9	15	1.1	18	1.3	21	1.5	23	1.8	28	2.1	33	2.3	37	2.5	40	2.7	43	2.9	46	3.1	52		
2.5	21.2	.7	15	1.0	22	1.3	27	1.5	31	1.6	35	2.0	42	2.3	47	2.6	55	2.8	60	3.0	65	3.2	69	3.4	77		
3.0	27.0	.8	21	1.1	30	1.4	37	1.6	43	1.8	48	2.2	59	2.5	66	2.8	76	3.1	83	3.3	90	3.6	96	3.8	102		
3.5	33.2	.9	29	1.2	40	1.5	49	1.7	57	1.9	66	2.4	78	2.7	90	3.0	101	3.3	111	3.6	120	3.8	128	4.1	136		
4.0	40.0	.9	37	1.3	53	1.6	64	1.8	73	2.1	82	2.5	101	2.9	116	3.2	130	3.6	142	3.8	154	4.1	164	4.4	174		
4.5	47.2	1.0	46	1.4	65	1.7	80	1.9	92	2.2	103	2.6	127	3.0	146	3.4	164	3.7	179	4.0	194	4.3	207	4.6	219		
5.0	56.2	1.0	57	1.4	81	1.8	100	2.0	115	2.3	129	2.8	157	3.2	182	3.6	203	4.0	223	4.3	241	4.6	257	4.8	273		
5.5	65.0	1.1	70	1.5	99	1.9	121	2.2	140	2.4	157	2.9	192	3.4	221	3.8	248	4.2	271	4.5	293	4.8	313				
6.0	74.0	1.1	84	1.6	119	2.0	145	2.3	168	2.5	188	3.1	230	3.6	265	4.0	296	4.4	325	4.7	351						
10	0.5	5.2	.3	2	.4	2	.5																				

1.5:1 SIDE SLOPE				n = 0.04																							
S =		.0002	.0004	.0006		.0008		.0010		.0015		.0020		.0025		.0030		.0035		.0040		.0045		.0050			
b	d	A	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	
r	0.5	.3	.2	.+	.3	-	.3	-	.4	-	.4	-	.5	-	.6	-	.7	-	.7	-	.8	-	.8	-	.9	-	.9
r	1.0	1.5	.3	.4	1	.5	.1	.6	1	.7	1	.8	1	.9	1	1.0	2	1.1	2	1.2	2	1.3	2	1.4	2	1.5	
r	1.5	3.3	.4	1	.5	2	.7	2	.8	3	.9	3	1.1	4	1.2	4	1.4	5	1.5	5	1.6	5	1.7	6	1.8	6	1.9
r	2.0	6.0	.5	3	.7	4	.8	5	.9	6	1.0	6	1.3	8	1.5	9	1.6	10	1.8	11	1.9	12	2.1	12	2.2	13	2.3
r	2.5	9.3	.5	5	.8	7	.9	9	1.1	10	1.2	11	1.5	14	1.7	16	1.9	18	2.1	20	2.3	21	2.4	23	2.6	24	2.7
r	3.0	13.5	.6	8	.9	12	1.1	14	1.2	16	1.4	18	1.7	23	1.9	26	2.2	29	2.4	32	2.5	34	2.7	37	2.9	39	3.0
r	3.5	18.3	.7	12	1.0	18	1.2	21	1.3	25	1.5	28	1.8	34	2.1	39	2.4	44	2.6	48	2.8	52	3.0	55	3.2	59	3.4
r	4.0	24.0	.	18	1.0	25	1.3	31	1.5	35	1.6	40	2.0	48	2.3	56	2.6	63	2.9	69	3.1	74	3.3	79	3.5	84	3.7
r	4.5	30.3	.8	24	1.1	34	1.4	42	1.6	48	1.8	54	2.2	66	2.5	77	2.8	86	3.1	94	3.3	101	3.6	108	3.8	115	4.0
r	5.0	37.5	.9	32	1.2	45	1.5	56	1.7	64	1.9	72	2.3	88	2.7	102	3.0	114	3.3	124	3.6	134	3.8	144	4.1	152	4.3
r	5.5	45.3	.9	41	1.3	59	1.6	72	1.8	83	2.0	93	2.5	113	2.9	131	3.2	146	3.5	160	3.8	173	4.1	185	4.3	196	4.6
r	6.0	54.0	1.0	52	1.4	74	1.7	90	1.9	104	2.2	117	2.6	143	3.1	165	3.4	185	3.7	202	4.0	218	4.3	233	4.6	248	4.8
2	0.5	1.3	.3	+	.4	1	.5	1	.6	1	.7	1	.8	1	.9	1	1.0	1	1.1	2	1.2	2	1.3	2	1.3	2	
2	1.0	3.5	.4	2	.5	2	.7	2	.8	3	.9	3	1.1	4	1.2	4	1.4	5	1.5	5	1.6	6	1.7	6	1.8	7	
2	1.5	6.3	.5	3	.7	4	.8	5	1.0	6	1.1	7	1.3	8	1.5	10	1.7	11	1.8	12	2.0	13	2.1	14	2.3		
2	2.0	10.0	.6	6	.8	8	1.0	10	1.1	11	1.2	12	1.5	15	1.8	18	2.0	20	2.1	21	2.3	23	2.5	26	2.8		
2	2.5	14.3	.6	9	.9	13	1.1	16	1.3	18	1.4	20	1.7	25	2.0	29	2.2	32	2.4	35	2.6	38	2.8	40	3.0		
2	3.0	19.5	.7	14	1.0	19	1.2	23	1.4	27	1.6	30	1.9	37	2.2	43	2.5	48	2.7	52	2.9	57	3.1	61	3.3		
2	3.5	25.3	.8	19	1.1	27	1.3	33	1.5	39	1.7	43	2.1	53	2.4	61	2.7	68	2.9	75	3.2	81	3.4	86	3.6		
2	4.0	32.0	.8	26	1.2	37	1.4	45	1.6	52	1.8	59	2.2	72	2.6	83	2.9	93	3.2	102	3.4	110	3.7	117	3.9		
2	4.5	39.3	.9	35	1.2	49	1.5	60	1.8	69	2.0	77	2.4	95	2.8	109	3.1	122	3.4	134	3.7	145	3.9	155	4.2		
2	5.0	47.5	.9	44	1.3	63	1.6	77	1.9	89	2.1	99	2.6	122	3.0	140	3.3	157	3.6	172	3.9	186	4.2	198	4.4		
2	5.5	56.3	1.0	56	1.4	79	1.7	97	2.0	111	2.2	125	2.7	153	3.1	176	3.5	197	3.8	216	4.1	233	4.4	249	4.7		
2	6.0	64.0	1.0	69	1.5	97	1.8	119	2.1	138	2.3	154	2.9	186	3.3	217	3.7	243	4.0	266	4.4	288	4.7	308	4.9		
"	0.5	2.3	.3	1	.4	1	.5	1	.6	1	.7	1	.8	1	.9	1	1.0	2	1.1	3	1.2	3	1.3	3	1.4	3	
"	1.0	5.5	.4	2	.5	3	.7	4	.8	5	.9	5	1.4	13	1.7	16	1.9	20	2.1	22	2.3	25	2.5	26	2.6	25	
"	1.5	9.3	.5	5	.7	7	.9	10	1.0	12	1.1	13	1.7	23	1.9	27	2.0	30	2.2	34	2.4	38	2.6	40	2.8	43	
"	2.0	14.0	.6	9	.9	12	1.1	15	1.2	17	1.4	19	1.9	36	2.1	42	2.2	30	2.4	33	2.5	36	2.7	38	2.9	40	
"	2.5	19.3	.7	13	1.0	19	1.2	23	1.4	27	1.5	30	2.0	53	2.4	61	2.7	47	2.9	51	3.1	56	3.3	63	3.4	66	
"	3.0	25.5	.8	19	1.1	27	1.3	33	1.5	38	1.7	43	2.2	73	2.6	84	2.7	68	2.9	75	3.2	80	3.4	86	3.6	91	
"	3.5	32.3	.8	27	1.2	38	1.4	46	1.6	53	1.8	59	2.2	73	2.6	84	2.7	68	2.9	75	3.2	80	3.4	86	3.6	96	
"	4.0	40.0	.9	35	1.2	50	1.5	61	1.8	70	2.0	79	2.4	97	2.8	111	3.1	125	3.4	136	3.7	147	3.9	158	4.2	167	
"	4.5	48.3	.9	45	1.3	64	1.6	79	1.9	91	2.1	102	2.6	124	3.0	144	3.3	161	3.6	176	3.9	190	4.2	203	4.5	216	
"	5.0	56.5	1.0	57	1.4	81	1.7	99	2.0	115	2.2	128	2.7	159	3.2	181	3.5	202	3.9	222	4.2	240	4.5	256	4.7	272	
"	5.5	67.3	1.1	71	1.5	100	1.8	123	2.1	142	2.3	158	2.9	194	3.3	224	3.7	250	4.1	274	4.4	296	4.7	317	5.0	336	
"	6.0	78.0	1.1	86	1.6	122	1.9	149	2.1	172	2.3	192	2.5	237	3.0	237	3.5	304	4.3	333	4.6	360	4.9	385			
e	0.5	3.3	.3	1	.4	1	.5	2	.6	2	.7	2	.8	3	1.0	3	1.1	4	1.2	4	1.3	4	1.4	5	1.5	5	
e	1.0	7.5	.4	3	.5	5	.8	6	.9	7	1.0	12	1.3	19	1.4	21	1.6	22	1.7	23	1.9	24	2.0	25	2.1	27	
e	1.5	12.3	.6	7	.8	10	1.0	12	1.1	14	1.2	15	1.5	19	1.8	22	2.0	24	2.1	27	2.3	29	2.5	31	2.6	34	
e	2.0	18.0	.6	12	.9	16	1.1	20	1.3	23	1.4	26	1.8	32	2.0	37	2.3	41	2.5	45	2.7	52	2.9	55	3.2	58	
e	2.5	24.3	.7	18	1.0	25	1.3	31	1.5	35	1.6	40	2.0	48	2.3	56	2.6	63	2.8	69	3.0	74	3.2	79	3.4	88	
e	3.0	31.5	.8	25	1.1	36	1.4	44	1.6	50	1.8	56	2.2	69	2.5	80	2.8	89	3.1	97	3.3	105	3.6	112	3.8	119	
e	3.5	39.3	.9	34	1.2	48	1.5	59	1.7	68	1.9	76	2.4	93	2.7	108	3.1	120	3.4	132	3.6	143	3.9	152	4.1	162	
e	4.0	48.0	.9	45	1.3	63	1.6	77	1.9	89	2.1	100	2.5	122	2.9	141	3.3	158	3.6	173	3.9	186	4.2	199	4.4	211	
e	4.5	57.3	1.0	52	1.3	59	1.6	72	1.8	84	2.0	94	2.5	115	2.9	132	3.2	148	3.5	162	3.8	175	4.0	187	4.3	198	
e	5.0	66.0	1.0	64	1.4	77	1.7	94	1.9	108	2.2	121	2.6	148	3.1	171	3.4	191	3.7	210	4.0	227	4.3	242	4.6	257	
e	5.5	76.3	1.0	68	1.5	97	1.8	118	2.1	137	2.3	153	2.8	187	3.3	216	3.6	241	4.0	264	4.3	286	4.6	305	4.9	324	
e	6.0	102.0	1.2	122	1.7	173	2.1	212	2.4	244	2.7	273	3.3	335	3.8	386	4.2	432	4.6	473							
10	0.5	5.3	.3	2	.4	2	.5	3	.6	3	.7	4	.9	5	1.0	5	1.1	6	1.2	6	1.3	7	1.4	7	1.5	8	
10	1.0	11.5	.5	5	.7	8	.8	9	.9	11	1.1	12	1.3	15	1.5	17	1.7	19	1.8	21	2.0	23	2.1	24	2.2	26	
10	1.5	18.3	.6	11	.8	15	1.0	19	1.2	22	1.3	26	1.6	30	1.9	36	2.1	38	2.3	42	2.5	45	2.6	49	2.8	51	
10	2.0	26.0	.7	18	1.0	25	1.2	31	1.4	36	1.5	40	1.9	49	2.2	57	2.4	64									

2:1 SIDE SLOPES												n = 0.04															
S =		.0002		.0004		.0006		.0008		.0010		.0015		.0020		.0025		.0030		.0035		.0040		.0045		.0050	
b	d	A	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	
0	0.5	.5	.2	-	.3	-	.3	-	.4	-	.4	-	.5	-	.6	-	.7	-	.7	-	.8	-	.9	-	.9	-	1.0
1.0	2.0	.3	1	.6	1	.5	1	.6	1	.7	1	.8	2	1.0	2	1.1	2	1.2	2	1.3	3	1.4	3	1.5	3	1.5	
1.5	4.5	.4	2	.6	3	.7	3	.8	4	.9	4	1.1	5	1.3	6	1.4	6	1.6	7	1.7	8	1.8	8	1.9	9	2.0	
2.0	8.0	.5	4	.7	6	.8	7	1.0	8	1.1	9	1.3	11	1.5	12	1.7	14	1.9	15	2.0	16	2.2	17	2.3	19	2.4	
2.5	12.5	.6	7	.8	10	1.0	12	1.1	14	1.3	16	1.5	19	1.8	22	2.0	25	2.2	27	2.4	30	2.5	32	2.7	34	2.8	
3.0	18.0	.6	12	.9	16	1.1	20	1.3	23	1.4	26	1.8	32	2.0	36	2.3	41	2.5	45	2.7	48	2.9	51	3.0	55	3.2	
3.5	24.5	.7	17	1.0	25	1.2	30	1.4	35	1.6	39	1.9	48	2.2	55	2.5	61	2.7	67	3.0	73	3.2	78	3.4	82	3.5	
4.0	32.0	.8	25	1.1	35	1.3	43	1.5	50	1.7	55	2.1	68	2.4	78	2.7	88	3.0	98	3.2	104	3.5	111	3.7	118	3.9	
4.5	40.5	.8	34	1.2	48	1.5	59	1.7	68	1.9	76	2.3	93	2.6	107	3.0	120	3.2	131	3.5	142	3.7	152	4.0	161	4.2	
5.0	50.0	.9	45	1.3	64	1.6	78	1.8	90	2.0	100	2.5	123	2.8	142	3.2	159	3.5	174	3.8	188	4.0	201	4.3	213	4.5	
5.5	60.5	1.0	58	1.4	82	1.7	100	1.9	116	2.1	130	2.6	159	3.0	183	3.4	205	3.7	224	4.0	242	4.3	259	4.5	275	4.8	
6.0	72.0	1.0	73	1.4	103	1.8	127	2.0	146	2.3	163	2.8	200	3.2	231	3.6	258	3.9	283	4.2	308	4.5	327	4.8	347	-	
2	0.5	1.5	.3	-	.6	1	.5	1	.6	1	.7	-	.8	1	.9	1	1.0	2	1.1	2	1.2	2	1.2	2	1.3	2	
1.0	4.0	.4	2	.5	2	.7	3	.8	3	.9	3	1.0	4	1.2	5	1.3	6	1.5	6	1.7	7	1.8	7	1.9	8		
1.5	7.5	.5	4	.7	5	.8	6	1.0	7	1.1	8	1.3	10	1.5	11	1.7	13	1.8	14	2.0	15	2.1	16	2.3	17	2.4	
2.0	12.0	.6	7	.8	9	1.0	12	1.1	13	1.2	15	1.5	18	2.0	21	2.2	24	2.4	26	2.5	30	2.6	32	2.8	34		
2.5	17.5	.6	11	.9	16	1.1	19	1.3	22	1.4	25	1.7	30	2.0	35	2.2	39	2.5	43	2.7	46	2.8	50	3.0	53	3.2	
3.0	24.0	.7	17	1.0	24	1.2	29	1.4	36	1.6	38	1.9	46	2.2	54	2.5	60	2.7	68	3.0	71	3.2	76	3.3	80	3.5	
3.5	31.5	.8	24	1.1	34	1.3	42	1.5	49	1.7	54	2.1	67	2.4	77	2.7	86	3.0	94	3.2	102	3.5	109	3.7	115	3.9	
4.0	40.0	.8	33	1.2	47	1.4	58	1.7	67	1.9	75	2.3	92	2.6	106	3.0	118	3.2	130	3.5	140	3.7	150	4.0	159	4.2	
4.5	49.5	.9	44	1.3	63	1.6	77	1.8	89	2.0	99	2.5	122	2.8	141	3.2	157	3.5	173	3.8	186	4.0	199	4.3	211	4.5	
5.0	60.0	1.0	57	1.4	81	1.7	100	1.9	115	2.1	129	2.6	157	3.0	182	3.4	203	3.7	223	4.0	241	4.3	257	4.5	273	4.8	
5.5	71.5	1.0	73	1.4	103	1.8	126	2.0	145	2.3	162	2.8	199	3.2	230	3.6	257	3.9	281	4.2	304	4.5	325	4.8	345		
6.0	84.0	1.1	90	1.5	127	1.9	156	2.1	180	2.4	201	2.9	247	3.4	285	3.8	318	4.2	349	4.5	377	4.8	403	-			
4	0.5	2.5	.3	1	.4	1	.5	1	.6	1	.7	2	.8	2	.9	2	1.0	3	1.1	3	1.2	3	1.3	3	1.4	4	
1.0	6.0	.4	3	.6	4	.7	4	.8	5	.9	6	1.1	7	1.3	8	1.5	9	1.6	10	1.7	10	1.9	11	2.0	12	2.1	
1.5	10.5	.5	5	.7	8	.9	9	1.0	11	1.2	12	1.4	15	1.6	17	1.8	19	2.0	21	2.2	23	2.4	25	2.6	27		
2.0	16.0	.6	10	.9	14	1.0	17	1.2	19	1.4	22	1.7	27	1.9	31	2.1	36	2.3	37	2.5	41	2.7	43	2.9	46	3.0	
2.5	22.5	.7	15	1.0	22	1.2	27	1.4	31	1.5	34	1.9	42	2.2	49	2.4	54	2.6	60	2.8	64	3.1	69	3.2	73	3.4	
3.0	30.0	.8	23	1.1	32	1.3	39	1.5	45	1.7	51	2.1	62	2.4	72	2.7	80	2.9	88	3.2	95	3.4	101	3.6	107	3.8	
3.5	38.5	.8	32	1.2	45	1.4	55	1.6	63	1.8	71	2.3	87	2.6	100	2.9	112	3.2	123	3.4	132	3.7	142	3.9	150	4.1	
4.0	48.0	.9	43	1.3	60	1.5	74	1.8	85	2.0	95	2.4	117	2.8	135	3.1	150	3.4	165	3.7	178	4.0	190	4.2	202	4.4	
4.5	58.5	.9	55	1.3	78	1.6	96	1.9	111	2.1	124	2.6	152	3.0	175	3.4	196	3.7	215	4.0	232	4.2	248	4.5	263	4.7	
5.0	70.0	1.0	71	1.4	100	1.7	122	2.0	141	2.3	158	2.8	193	3.2	223	3.6	249	3.9	273	4.2	295	4.5	315	4.8	335		
5.5	82.5	1.1	88	1.5	124	1.8	152	2.1	176	2.4	196	2.9	241	3.4	278	3.8	311	4.1	340	4.5	367	4.8	393	-			
6.0	96.0	1.1	108	1.6	152	1.9	186	2.2	215	2.5	240	3.1	295	3.5	340	4.0	380	4.3	417	4.7	450	-	-	-	-	-	
8	0.5	4.5	.3	1	.4	2	.5	2	.6	3	.7	3	.8	4	1.0	4	1.1	5	1.2	5	1.3	6	1.4	6	1.5	8	
1.0	10.0	.5	5	.6	6	.8	8	.9	9	1.0	10	1.2	12	1.4	14	1.6	16	1.8	18	1.9	19	2.0	20	2.2	22	2.3	
1.5	16.5	.6	9	.8	13	1.0	16	1.1	19	1.3	21	1.6	26	1.8	30	2.0	33	2.2	36	2.4	39	2.5	42	2.7	44		
2.0	24.0	.7	16	.9	22	1.1	28	1.3	32	1.5	36	1.8	44	2.1	50	2.3	56	2.5	62	2.8	67	3.0	71	3.1	75	3.4	
2.5	32.5	.7	24	1.1	34	1.3	43	1.5	49	1.7	54	2.0	66	2.4	77	2.6	86	2.9	94	3.1	102	3.3	109	3.5	115	3.8	
3.0	42.0	.8	35	1.2	49	1.4	60	1.6	69	1.8	77	2.3	95	2.6	109	2.9	122	3.2	134	3.4	145	3.7	155	3.9	164	4.2	
3.5	52.5	.9	47	1.3	66	1.5	81	1.8	94	2.0	105	2.4	129	2.8	148	3.2	166	3.5	182	3.7	196	4.0	210	4.2	223	4.6	
4.0	64.0	1.0	61	1.4	87	1.7	106	1.9	123	2.1	137	2.6	168	3.0	194	3.4	217	3.7	238	4.0	257	4.3	275	4.6	292	4.9	
4.5	76.5	1.0	78	1.4	111	1.8	136	2.0	157	2.3	175	2.8	214	3.2	248	3.6	277	4.0	303	4.3	328	4.6	350	4.9	371		
5.0	90.0	1.1	98	1.5	138	1.9	169	2.2	195	2.4	218	3.0	267	3.4	309	3.8	345	4.2	378	4.5	408	4.8	436	-			
5.5	104.5	1.1	119	1.6	169	2.0	207	2.3	239	2.6	267	3.1	327	3.6	377	4.0	422	4.4	462	4.8	499	-	-	-	-	-	
6.0	120.0	1.2	144	1.7	203	2.1	249	2.4	288	2.7	322	3.3	394	3.8	455	4.2	508	4.6	557	-	-	-	-	-			
10	0.5	5.5	.3	2	.4	2	.5	3	.6	3	.7	4	.8	5	1.0	5	1.1	6	1.2	7							

3:1 SIDE SLOPE												n = 0.04															
S =		.0002		.0004		.0006		.0008		.0010		.0015		.0020		.0025		.0030		.0035		.0040		.0045		.0050	
b	d	A	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	
0	0.5	.7	.2	.5	.3	.3	.4	.5	.6	.7	.8	.9	.8	.9	.7	.8	.9	.8	.9	.8	.9	.8	.9	1.0	1.0	1	
1.0	3.0	.3	1	.5	1	.6	2	.8	2	.9	3	1.0	3	1.1	3	1.2	4	1.3	4	1.4	4	1.5	4	1.6	5		
1.5	6.7	.4	3	.6	4	.7	5	.8	6	.9	8	1.3	9	1.5	10	1.6	11	1.8	12	1.9	13	2.0	13	2.1	14		
2.0	12.0	.5	6	.7	9	.9	11	1.0	12	1.1	14	1.4	17	1.6	19	1.8	22	2.0	24	2.1	25	2.3	27	2.4	29	2.5	
2.5	18.7	.6	11	.8	16	1.0	19	1.2	21	1.3	23	1.6	30	1.9	35	2.1	39	2.3	43	2.5	46	2.6	49	2.8	52	2.9	
3.0	27.0	.7	18	.9	25	1.2	31	1.3	36	1.5	40	1.8	49	2.1	57	2.4	63	2.6	70	2.8	75	3.0	80	3.2	85	3.3	
3.5	36.7	.7	27	1.0	38	1.3	47	1.5	54	1.6	61	2.0	74	2.3	86	2.6	96	2.9	105	3.1	113	3.3	121	3.5	128	3.7	
4.0	48.0	.8	39	1.1	55	1.4	67	1.6	77	1.8	86	2.2	106	2.5	122	2.8	137	3.1	150	3.4	162	3.6	173	3.8	183	4.0	
4.5	60.7	.9	53	1.2	75	1.5	92	1.7	106	1.9	118	2.4	145	2.8	167	3.1	187	3.4	205	3.6	221	3.9	237	4.1	251	4.4	
5.0	75.0	.9	70	1.3	99	1.6	121	1.9	140	2.1	157	2.6	192	3.0	222	3.3	248	3.6	271	3.9	293	4.2	313	4.5	332	4.7	
5.5	90.7	1.0	90	1.4	128	1.7	157	2.0	181	2.2	202	2.7	247	3.1	286	3.5	319	3.9	350	4.2	378	4.5	404	4.7	429	5.0	
6.0	108.0	1.1	114	1.5	161	1.8	197	2.1	228	2.4	255	2.9	312	3.3	360	3.7	403	4.1	441	4.4	477	4.7	510				
2	0.5	1.7	.3	.4	1	.4	1	.5	1	.6	1	.7	1	.8	1	.9	2	1.0	2	1.1	2	1.2	2	1.3	2		
1.0	5.0	.4	2	.5	3	.6	3	.7	4	.8	4	1.0	5	1.2	6	1.3	7	1.4	8	1.5	9	1.6	9	1.7	9		
1.5	9.7	.5	5	.7	6	.8	8	.9	9	1.1	10	1.3	13	1.5	15	1.7	16	1.8	18	2.0	19	2.1	21	2.2	22		
2.0	16.0	.6	9	1.2	13	1.0	15	1.1	18	1.2	20	1.5	24	1.8	28	2.0	32	2.3	35	2.5	40	2.6	42	2.8	45		
2.5	23.7	.6	15	.9	21	1.1	26	1.3	30	1.4	34	1.7	41	2.0	48	2.3	53	2.5	59	2.7	63	2.8	68	3.0	72	3.2	
3.0	33.0	.7	23	1.0	33	1.2	41	1.4	47	1.6	52	1.9	64	2.2	74	2.5	83	2.8	91	3.0	98	3.2	105	3.4	111	3.6	
3.5	43.7	.8	36	1.1	48	1.4	59	1.6	68	1.7	76	2.1	94	2.5	108	2.8	121	3.0	132	3.3	143	3.5	153	3.7	162	3.9	
4.0	56.0	.8	48	1.2	67	1.5	82	1.7	95	1.9	106	2.3	130	2.7	150	3.0	168	3.3	184	3.5	199	3.8	212	4.0	225	4.2	
4.5	69.7	.9	64	1.3	90	1.6	110	1.8	127	2.0	142	2.5	174	2.9	201	3.2	225	3.5	247	3.8	266	4.1	285	4.3	302	4.6	
5.0	85.0	1.0	83	1.4	117	1.7	144	1.9	166	2.1	185	2.7	227	3.1	262	3.4	293	3.8	321	4.1	347	4.4	371	4.6	393	4.9	
5.5	101.7	1.0	105	1.5	149	1.8	182	2.1	211	2.3	236	2.8	288	3.3	333	3.7	372	4.0	408	4.3	441	4.6	471	4.9	500		
6.0	120.0	1.1	131	1.5	186	1.9	227	2.2	263	2.4	293	3.0	359	3.5	413	3.9	466	4.2	508	4.6	549	4.9	587				
4	0.5	2.7	.3	1	.4	1	.5	1	.6	2	.7	.8	2	.9	2	1.0	3	1.1	3	1.2	3	1.3	4	1.4	5		
1.0	7.0	.4	3	.6	4	.7	5	.8	6	.9	6	1.1	8	1.3	9	1.4	10	1.6	11	1.7	12	1.8	13	1.9	13		
1.5	12.7	.5	6	.7	9	.9	11	1.0	13	1.1	14	1.4	18	1.6	20	1.8	23	2.0	25	2.1	27	2.3	29	2.4	31	2.5	
2.0	20.0	.6	12	.8	17	1.0	21	1.2	24	1.3	27	1.6	33	1.9	38	2.1	42	2.3	46	2.5	50	2.7	53	2.8	56	3.0	
2.5	28.7	.7	19	1.0	27	1.2	34	1.3	39	1.5	43	1.8	53	2.1	61	2.4	68	2.6	75	2.8	81	3.0	87	3.2	92	3.4	
3.0	39.0	.7	29	1.1	41	1.3	51	1.5	58	1.7	65	2.0	80	2.4	92	2.6	103	2.9	113	3.1	122	3.3	130	3.5	138	3.7	
3.5	50.7	.8	41	1.2	59	1.4	72	1.6	83	1.8	93	2.2	114	2.6	131	2.9	147	3.2	161	3.4	174	3.7	186	3.9	197	4.1	207
4.0	64.0	.9	57	1.3	80	1.5	98	1.8	113	2.0	127	2.4	155	2.8	179	3.1	200	3.4	219	3.7	237	4.0	253	4.2	269	4.4	283
4.5	78.7	.9	75	1.3	106	1.6	129	1.9	149	2.1	167	2.6	205	3.0	236	3.4	264	3.7	285	4.0	312	4.2	334	4.5	354	4.7	374
5.0	95.0	1.0	96	1.4	136	1.7	166	2.0	192	2.3	215	2.8	263	3.2	304	3.6	339	3.9	372	4.2	402	4.5	429	4.8	455		
5.5	112.7	1.1	121	1.5	171	1.9	209	2.1	241	2.4	270	2.9	330	3.4	382	3.8	427	4.1	467	4.5	505	4.8	540				
6.0	132.0	1.1	149	1.6	211	2.0	258	2.3	298	2.5	333	3.1	348	3.6	471	4.0	527	4.4	577	4.7	623						
6	0.5	3.7	.3	1	.4	2	.5	2	.6	2	.7	.8	3	.9	3	1.0	4	1.1	4	1.2	5	1.3	5	1.4	5		
1.0	9.0	.4	4	.6	5	.7	.9	8	1.0	9	1.2	11	1.3	12	1.5	14	1.7	15	1.8	16	1.9	17	2.0	18	2.1	19	
1.5	15.7	.5	8	.8	12	.9	14	1.1	17	1.2	19	1.5	23	1.7	26	1.9	30	2.1	32	2.2	35	2.4	37	2.5	40	2.7	
2.0	24.0	.6	15	.9	21	1.1	26	1.3	30	1.4	33	1.7	41	2.0	47	2.2	53	2.4	58	2.6	62	2.8	67	3.0	71	3.1	
2.5	33.7	.7	24	1.0	34	1.2	41	1.4	47	1.6	53	1.9	62	2.2	75	2.5	84	2.7	92	2.9	99	3.1	106	3.3	113	3.5	
3.0	45.0	.8	35	1.1	50	1.3	61	1.6	70	1.7	78	2.1	96	2.5	111	2.8	130	3.1	136	3.3	146	3.5	157	3.7	166	3.9	
3.5	57.7	.8	49	1.2	69	1.5	85	1.7	98	1.9	110	2.3	134	2.7	155	3.0	173	3.3	190	3.5	205	3.8	219	4.0	232	4.2	245
4.0	72.0	.9	66	1.3	93	1.6	114	1.8	132	2.0	147	2.5	181	2.9	208	3.2	233	3.5	255	3.8	276	4.1	295	4.3	313	4.6	330
4.5	87.7	1.0	106	1.4	122	1.7	149	2.0	172	2.2	192	2.7	235	3.1	272	3.5	304	3.8	333	4.1	360	4.4	384	4.6	408	4.9	430
5.0	105.0	1.0	109	1.5	155	1.8	189	2.1	219	2.3	245	2.9	299	3.3	346	3.7	387	4.0	424	4.4	457	4.7	489	4.9	519		
5.5	123.7	1.1	136	1.6	213	2.0	263	2.3	305	2.5	340	3.1	417	3.6	481	4.0	538	4.4	589	4.7	636						
6.0	156.0	1.2	185	1.7	262	2.1	321	2.4	370	2.7	414	3.3	507	3.8	585	4.2	655	4.6	717	5.0	775						
10	0.5	5.3	.3	2	.4	2	.5	3	.6	3	.7	.8	4	.9	4	1.1	5	1.2	6	1.3	7	1.4	8	1.4	8		
1.0	13.0	.5	6	.6	8	.8	10	.9	12	1.0	13	1.2	16	1.4	19	1.6	21	1.7	23	1.9	25	2.0	26	2.1	28	2.3	29
1.5	21.7	.6	12	.8	17	1.0	21	1.1	25	1.3	27	1.5	34	1.8	39	2.0	43	2.2	48	2.4	51	2.5	55	2.7	58	2.8	61
2.0	32.0	.7	21	.9	30	1.1	37	1.3	42	1.5	47	1.8	58														

				4:1				SIDE SLOPE				"C" Retardance							
S +	.0010		.0015	.0020		.0025		.0030		.0035		.0040		.0045		.0050			
b	d	A	V	Q	V	Q	V	Q	V	Q	V	V	Q	V	Q	V	Q		
0	0.5	1.0	.1	-	.1	-	.1	-	.1	-	.1	0	.1	-	.1	-	.		
	1.0	4.0	.1	-	.1	-	.2	1	.2	1	.2	1	.2	1	.2	1	.		
	1.5	9.0	.1	1	.2	1	.2	2	.2	2	.2	2	.3	2	.6	5	.7		
	2.0	16.0	.2	3	.2	3	.6	9	.8	13	1.0	16	1.1	18	1.4	22	1.5		
	2.5	25.0	.5	13	.8	21	1.1	28	1.4	36	1.6	41	1.9	47	2.1	52	2.3		
	3.0	36.0	.8	30	1.3	46	1.6	58	1.9	69	2.3	81	2.5	91	2.8	100	3.0		
2	0.5	2.0	.1	-	.1	-	.1	-	.1	-	.1	-	.1	-	.2	-	.2		
	1.0	6.0	.1	1	.1	1	.2	1	.2	1	.2	1	.2	1	.2	1	.		
	1.5	12.0	.1	2	.2	2	.2	3	.6	7	.8	9	.9	11	1.0	12	1.1		
	2.0	20.0	.2	3	.6	11	.8	17	1.1	21	1.3	25	1.5	30	1.7	34	1.9		
	2.5	30.0	.7	20	1.1	32	1.4	41	1.7	51	1.9	58	2.2	65	2.4	72	2.6		
	3.0	42.0	1.0	42	1.4	61	1.8	77	2.2	92	2.5	106	2.8	120	3.1	129	3.4		
4	0.5	3.0	.1	-	.1	-	.1	-	.1	-	.2	-	.2	-	.2	1	.2		
	1.0	8.0	.1	1	.1	1	.2	1	.2	1	.2	2	.2	2	.3	2	.3		
	1.5	15.0	.1	2	.2	3	.3	4	.6	9	.8	13	1.0	15	1.1	17	1.3		
	2.0	24.0	.4	10	.8	18	1.0	24	1.3	30	1.5	36	1.7	42	2.0	48	2.2		
	2.5	35.0	.8	28	1.2	42	1.5	54	1.9	66	2.2	76	2.4	85	2.7	95	2.9		
	3.0	48.0	1.1	55	1.6	77	2.0	97	2.4	115	2.7	132	3.0	146	3.4	162	3.7		
6	0.5	4.0	.1	-	.1	-	.1	-	.1	1	.1	1	.1	1	.1	1	.1		
	1.0	10.0	.1	1	.2	2	.2	2	.2	2	.2	2	.2	2	.3	3	.6		
	1.5	18.0	.2	3	.3	5	.6	11	.8	14	1.0	18	1.2	22	1.4	24	1.5		
	2.0	28.0	.6	16	.9	25	1.2	34	1.5	42	1.7	48	2.0	55	2.2	61	2.4		
	2.5	40.0	0.9	38	1.4	54	1.7	68	2.0	81	2.3	94	2.6	105	2.9	117	3.2		
	3.0	54.0	1.3	68	1.8	97	2.2	118	2.6	139	2.8	158	3.2	175	3.6	195	3.8		
8	0.5	5.0	.1	-	.1	1	.1	1	.1	1	.2	1	.2	1	.2	1	.2		
	1.0	12.0	.1	2	.2	2	.2	2	.2	2	.2	3	.3	3	.6	.8	.9		
	1.5	21.0	.2	3	.5	10	.7	15	.9	20	1.1	24	1.4	28	1.5	32	1.7		
	2.0	32.0	.6	20	1.0	32	1.4	43	1.6	51	1.9	61	2.1	68	2.4	77	2.6		
	2.5	45.0	1.0	45	1.5	68	1.8	82	2.2	99	2.5	114	2.8	128	3.1	139	3.4		
	3.0	60.0	1.4	81	1.9	114	2.3	139	2.7	164	3.1	185	3.5	208	3.8	228	4.1		
10	0.5	6.0	.1	1	.1	1	.1	1	.1	1	.2	1	.2	1	.2	1	.2		
	1.0	14.0	.1	2	.2	2	.2	3	.2	3	.2	3	.6	9	.8	11	.9		
	1.5	24.0	.2	4	.6	14	.8	20	1.1	26	1.3	30	1.5	36	1.7	41	1.8		
	2.0	36.0	.8	27	1.1	41	1.4	51	1.7	62	2.0	72	2.3	81	2.5	91	2.7		
	2.5	50.0	1.1	56	1.6	80	2.0	100	2.3	116	2.7	135	3.0	150	3.2	162	3.5		
	3.0	66.0	1.4	95	2.0	132	2.4	161	2.8	188	3.2	214	3.6	238	4.0	261	4.3		

				4:1				SIDE SLOPE				"C" Retardance							
S +	.0010		.0015	.0020		.0025		.0030		.0035		.0040		.0045		.0050			
b	d	A	V	Q	V	Q	V	Q	V	Q	V	V	Q	V	Q	V	Q		
0	0.5	1.5	.1	-	.1	-	.1	-	.1	-	.1	-	.2	-	.1	-	.		
	1.0	6.0	.1	1	.1	1	.2	1	.2	1	.2	1	.2	1	.2	1	.		
	1.5	13.5	.1	2	.2	2	.2	2	.3	2	.3	.5	7	.6	9	.8	10		
	2.0	24.0	.2	4	.2	6	.6	15	.8	20	1.0	24	1.2	29	1.4	33	1.5		
	2.5	37.5	.5	19	.8	32	1.2	43	1.4	53	1.7	63	1.9	72	2.1	80	2.3		
	3.0	54.0	.9	49	1.3	69	1.7	91	2.0	138	2.3	123	2.6	139	2.8	154	3.1		
2	0.5	2.5	.1	-	.1	-	.1	-	.1	-	.1	-	.1	-	.2	-	.		
	1.0	8.0	.1	1	.1	1	.2	1	.2	1	.2	2	.2	2	.2	2	.		
	1.5	16.5	.1	2	.2	3	.2	3	.4	5	.8	.6	10	.8	13	.9	16		
	2.0	28.0	.2	5	.6	16	.8	22	1.0	28	1.3	35	1.4	40	1.6	45	1.8		
	2.5	42.5	.6	27	1.0	43	1.4	57	1.6	58	1.9	81	2.1	91	2.4	102	2.6		
	3.0	60.0	1.0	60	1.4	85	1.8	108	2.2	130	2.5	148	2.8	167	3.0	182	3.3		
4	0.5	3.5	.1	-	.1	-	.1	-	.1	-	.1	1	.2	1	.2	1	.		
	1.0	10.0	.1	1	.1	1	.2	2	.2	2	.2	2	.2	2	.2	2	.		
	1.5	19.5	.1	3	.2	3	.2	4	.5	10	.7	14	.8	16	1.0	20	1.2		
	2.0	32.0	.2	6	.7	22	.9	30	1.2	38	1.4	46	1.5	52	1.8	58	2.0		
	2.5	47.5	.8	36	1.1	51	1.5	71	1.8	86	2.1	98	2.3	110	2.6	122	2.8		
	3.0	66.0	1.1	74	1.5	102	2.0	132	2.3	153	2.6	174	3.0	198	3.2	214	3.5		
6	0.5	4.5	.1	-	.1	-	.1	1	.1	1	.2	1	.2	1	.2	1	.		
	1.0	12.0	.1	1	.1	1	.2	2	.2	2	.2	2	.2	3	.3	3	.		
	1.5	22.5	.1	3	.2	4	.4	9	.7	15	.8	19	1.0	23	1.2	27	1.4		
	2.0	36.0	.4	15	.8	29	1.1	38	1.4	49	1.6	58	1.8	65	2.0	72	2.3		
	2.5	52.5	.8	44	1.3	66	1.6	84	1.9	100	2.3	118	2.5	130	2.7	144	3.0		
	3.0	72.0	1.2	86	1.7	122	2.1	150	2.4	175	2.8	200	3.1	225	3.4	246	3.7		
8	0.5	5.5	.1	-	.1	1	.1	1	.1	1	.2	1	.2	1	.2	1	.		
	1.0	14.0	.1	2	.2	2	.2	3	.2	3	.2	3	.3	3	.4	.5	.		
	1.5	25.5	.2	4	.5	14	.8	20	1.0	26	1.2	29	1.4	34	1.5	38	1.7		
	2.0	40.0	.5	21	.9	35	1.2	48	1.4	57	1.7	68	1.9	77	2.2	87	2.4		
	2.5	57.5	1.0	55	1.4	78	1.7	97	2.0	117	2.3	135	2.6	152	2.9	166	3.2		
	3.0	78.0	1.3	99	1.7	135	2.2	169	2.6	200	2.9	228	3.2	253	3.6	281	3.8		
10	0.5	6.5	.1	1	.1	1	.1	1	.1	1	.2	1	.2	1	.2	1	.		
	1.0	16.0	.1	2	.2	2	.2	3	.2	3	.2	4	.3	4	.5	.7	11		
	1.5	28.5	.2	4	.4	11	.7	19	.9	26	1.1	30	1.3	36	1.4	41	1.6		
	2.0	44.0	.6	26	.9	42	1.3	56	1.5	68	1.8	79	2.1	90	2.3	100	2.5		
	2.5	62.5	1.0	63	1.4	89	1.8	113	2.1	133	2.4	152	2.7	171	3.0	190	3.3		
	3.0	84.0	1.4	114	1.8	153	2.3	192	2.7	227	3.0	255	3.4	284	3.7	311	4.0		

Table IN-14-5 Grassed Waterway "C" Retardance s:s = 4:1 and 6:1)

(EFM Notice IN38, August 1981)

(Sheet 1 of 2)

			8:1		S I D E		S L O P E		'C' Retardance											
S =			.0010		.0015		.0020		.0025		.0030		.0035		.0040		.0045		.0050	
b	d	A	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q
0	0.5	2.0	.1	-	.1	-	.1	-	.1	-	.1	-	.1	-	.1	-	.1	-	.1	-
	1.0	8.0	.1	1	.1	1	.1	1	.2	1	.2	1	.2	1	.2	2	.2	2	.2	2
	1.5	18.0	.1	2	.2	2	.2	3	.2	4	.2	4	.2	4	.5	9	.6	11	.8	14
	2.0	32.0	.2	5	.3	6	.6	20	.8	27	1.1	34	1.2	39	1.4	46	1.6	51	1.7	55
	2.5	50.0	.6	28	.8	32	1.2	60	1.4	72	1.7	84	1.9	96	2.2	108	2.4	120	2.6	128
	3.0	72.0	.9	65	1.3	69	1.7	122	2.0	144	2.3	166	2.6	187	2.9	208	3.1	225	3.4	243
2	0.5	3.0	.1	-	.1	-	.1	-	.1	-	.1	-	.1	-	.1	-	.1	-	.2	-
	1.0	10.0	.1	1	.1	1	.1	1	.2	2	.2	2	.2	2	.2	2	.2	2	.2	2
	1.5	21.0	.1	3	.2	3	.2	4	.2	4	.2	5	.6	13	.8	16	.9	19	1.0	21
	2.0	36.0	.2	6	.5	18	.8	27	1.0	36	1.2	43	1.4	51	1.6	58	1.8	65	1.9	69
	2.5	55.0	.6	35	1.0	55	1.3	71	1.6	88	1.9	104	2.1	117	2.3	129	2.6	141	2.8	153
	3.0	78.0	1.0	78	1.4	111	1.8	141	2.1	167	2.5	193	2.7	214	3.0	237	3.3	257	3.6	278
4	0.5	4.0	.1	-	.1	-	.1	-	.1	-	.1	1	.1	1	.2	1	.2	1	.2	1
	1.0	12.0	.1	1	.1	2	.2	2	.2	2	.2	2	.2	2	.2	3	.2	3	.2	3
	1.5	24.0	.1	3	.2	4	.2	5	.2	5	.6	15	.8	19	.9	23	1.1	26	1.2	29
	2.0	40.0	.3	10	.6	25	.9	36	1.1	45	1.4	54	1.5	62	1.7	69	1.9	77	2.1	85
	2.5	60.0	.7	43	1.1	64	1.4	85	1.7	103	2.0	120	2.3	135	2.5	152	2.7	164	3.0	178
	3.0	84.0	1.1	90	1.5	126	1.9	159	2.3	189	2.6	218	2.9	242	3.2	269	3.5	291	3.7	311
6	0.5	5.0	.1	-	.1	-	.1	1	.1	1	.1	1	.1	1	.2	1	.2	1	.2	1
	1.0	14.0	.1	2	.1	2	.2	2	.2	3	.2	3	.2	3	.2	3	.2	3	.3	4
	1.5	27.0	.1	4	.2	5	.2	6	.6	15	.8	20	.9	26	1.1	29	1.3	34	1.4	37
	2.0	44.0	.4	17	.7	31	1.0	44	1.3	56	1.5	66	1.7	74	1.9	84	2.1	94	2.3	100
	2.5	65.0	.8	52	1.2	78	1.5	98	1.8	119	2.1	139	2.4	156	2.6	171	2.9	188	3.1	203
	3.0	90.0	1.1	101	1.6	144	2.0	180	2.4	216	2.7	243	3.0	270	3.3	300	3.6	324	3.8	346
8	0.5	6.0	.1	-	.1	1	.1	1	.1	1	.1	1	.2	1	.2	1	.2	1	.2	1
	1.0	16.0	.1	2	.1	2	.2	3	.2	3	.2	3	.2	4	.2	4	.3	4	.3	4
	1.5	30.0	.1	4	.2	5	.5	14	.7	20	.8	25	1.1	32	1.2	36	1.4	41	1.5	45
	2.0	48.0	.5	23	.8	38	1.1	51	1.4	65	1.6	77	1.8	86	2.0	97	2.3	108	2.4	117
	2.5	70.0	.8	59	1.3	89	1.6	112	1.9	135	2.3	158	2.5	177	2.8	194	3.0	210	3.2	227
	3.0	96.0	1.2	115	1.7	162	2.1	205	2.5	237	2.8	273	3.1	300	3.4	328	3.8	360	4.0	385
10	0.5	7.0	.1	1	.1	1	.1	1	.1	1	.1	1	.2	1	.2	1	.2	1	.2	1
	1.0	18.0	.1	2	.1	3	.2	3	.2	3	.2	4	.2	4	.3	5	.5	9		
	1.5	33.0	.2	5	.2	6	.6	19	.8	25	.9	31	1.1	37	1.4	45	1.5	50	1.6	54
	2.0	52.0	.5	26	.8	44	1.1	59	1.4	74	1.7	88	1.9	99	2.1	111	2.3	122	2.6	133
	2.5	75.0	.9	68	1.4	101	1.7	127	2.0	150	2.3	173	2.6	195	2.9	216	3.1	234	3.4	253
	3.0	102.0	1.3	129	1.7	177	2.2	221	2.6	262	2.9	298	3.2	331	3.6	363	3.8	393	4.1	419

Table IN-14-5 Grassed Waterway - "C" Retardance (s:s = 8:1)

4:1 SIDE SLOPE												n = .025																
b	d	A	V	Q	V	Q	V	Q	V	Q	V	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q					
0	0.5	1.0	.3	-	.5	-	.6	1	.7	1	.9	1	1.0	1	1.2	1	1.3	1	1.4	1	1.5	1	1.6	2				
	1.0	.6	.5	2	.7	3	.9	4	1.0	4	1.2	5	1.4	6	1.6	7	1.8	7	2.0	8	2.2	9	2.3	10				
	1.5	9.0	.7	6	1.0	9	1.2	11	1.4	12	1.5	14	1.9	17	2.2	19	2.4	22	2.6	24	2.8	26	3.0	27				
	2.0	16.0	.8	13	1.2	19	1.4	23	1.6	26	1.8	29	2.3	36	2.6	42	2.9	47	3.2	51	3.4	55	3.7	59				
	2.5	25.0	1.0	24	1.4	34	1.7	41	1.9	48	2.1	53	2.6	65	3.0	76	3.4	84	3.7	93	4.0	100	4.3	107				
	3.0	36.0	1.1	39	1.5	55	1.9	67	2.2	78	2.4	87	3.0	106	3.4	123	3.8	137	4.2	151	4.5	163	4.8	174				
2	0.5	2.0	.4	1	.6	1	.7	1	.8	2	.9	2	1.1	2	1.3	3	1.4	3	1.5	3	1.7	3	1.8	4	1.9	4		
	1.0	6.0	.6	4	.8	5	1.0	6	1.2	7	1.3	8	1.6	10	1.9	11	2.1	12	2.3	14	2.5	15	2.6	16	2.8	17		
	1.5	12.0	.7	9	1.1	13	1.3	15	1.5	18	1.7	20	2.0	24	2.4	28	2.6	32	2.9	35	3.1	37	3.3	40	3.5	42		
	2.0	20.0	.9	18	1.3	25	1.5	31	1.8	35	2.0	40	2.4	49	2.8	56	3.1	63	3.4	69	3.7	74	4.0	79	4.2	84		
	2.5	30.0	1.0	30	1.4	43	1.8	53	2.0	61	2.3	68	2.8	83	3.2	96	3.6	108	3.9	118	4.2	127	4.5	136	4.8	144		
	3.0	42.0	1.1	48	1.6	67	2.0	83	2.3	95	2.5	107	3.1	131	3.6	151	4.0	169	4.4	185	4.8	200	-	-	-	-		
4	0.5	3.0	.4	1	.6	2	.7	2	.9	3	1.0	3	1.2	4	1.4	4	1.5	5	1.7	5	1.8	5	1.9	6	2.1	6		
	1.0	8.0	.6	5	.9	7	1.1	9	1.3	10	1.4	11	1.7	14	2.0	16	2.2	18	2.5	20	2.6	21	2.8	23	3.0	24		
	1.5	15.0	.8	12	1.1	17	1.4	21	1.6	24	1.8	27	2.2	33	2.5	38	2.8	42	3.1	46	3.3	50	3.5	53	3.8	56		
	2.0	24.0	.9	22	1.3	32	1.6	39	1.9	45	2.1	50	2.6	61	3.0	71	3.3	79	3.6	87	3.9	94	4.2	100	4.4	106		
	2.5	35.0	1.1	37	1.5	53	1.8	64	2.1	74	2.4	83	2.9	102	3.4	118	3.8	132	4.1	144	4.4	156	4.8	166	-	-		
	3.0	48.0	1.2	57	1.7	80	2.0	98	2.4	114	2.6	127	3.2	156	3.7	180	4.2	201	4.6	220	5.0	238	-	-	-	-		
6	0.5	4.0	.5	2	.6	3	.8	3	.9	4	1.0	4	1.2	5	1.4	6	1.6	6	1.8	7	1.9	8	2.0	8	2.1	9		
	1.0	10.0	.7	7	.9	9	1.1	11	1.3	13	1.5	15	1.8	18	2.1	21	2.3	23	2.6	26	2.8	28	3.0	30	3.1	31		
	1.5	18.0	.8	15	1.2	21	1.4	26	1.7	30	1.9	33	2.3	41	2.6	47	2.9	53	3.2	58	3.5	62	3.7	67	3.9	71		
	2.0	28.0	1.0	27	1.4	39	1.7	47	1.9	54	2.2	63	2.7	75	3.1	86	3.4	96	3.8	105	4.1	114	4.4	122	4.6	129		
	2.5	40.0	1.1	44	1.6	62	1.9	76	2.2	88	2.5	99	3.0	121	3.5	140	3.9	156	4.3	171	4.6	185	4.9	197	-	-		
	3.0	54.0	1.2	66	1.7	93	2.1	114	2.4	132	2.7	148	3.4	181	3.9	209	4.3	234	4.7	256	-	-	-	-	-	-		
8	0.5	5.0	.5	2	.7	3	.8	4	.9	5	1.0	6	1.3	8	1.5	7	1.6	8	1.8	9	1.9	10	2.1	11	2.3	12		
	1.0	12.0	.7	8	1.0	12	1.2	14	1.4	16	1.5	18	1.9	21	2.2	26	2.4	29	2.7	32	2.9	34	3.1	37	3.3	39		
	1.5	21.0	.9	18	1.2	25	1.5	31	1.7	36	1.9	40	2.3	49	2.7	57	3.0	64	3.3	70	3.6	75	3.8	81	4.1	85		
	2.0	32.0	1.0	22	1.4	45	1.7	56	2.0	64	2.2	72	2.8	88	3.2	102	3.6	114	3.9	125	4.2	134	4.5	144	4.8	152		
	2.5	45.0	1.1	51	1.6	72	2.0	89	2.3	102	2.5	114	3.1	140	3.6	162	4.0	181	4.4	198	4.8	214	-	-	-	-		
	3.0	60.0	1.3	76	1.8	107	2.2	131	2.5	151	2.8	169	3.4	207	4.0	239	4.5	267	4.9	293	-	-	-	-	-	-		
10	0.5	6.0	.5	3	.7	4	.8	5	1.0	6	1.1	8	1.3	9	1.7	10	1.8	11	2.0	12	2.1	13	2.3	14	2.4	15		
	1.0	14.0	.7	10	1.0	14	1.2	17	1.4	20	1.6	22	1.9	27	2.2	31	2.5	35	2.7	38	2.9	41	3.2	44	3.3	47		
	1.5	24.0	.9	21	1.2	30	1.5	37	1.8	42	2.0	47	2.4	58	2.8	67	3.1	75	3.4	82	3.7	88	3.9	95	4.2	100		
	2.0	36.0	1.0	37	1.5	53	1.8	64	2.1	74	2.3	83	2.8	102	3.3	117	3.6	131	4.0	144	4.3	155	4.6	166	4.9	176		
	2.5	50.0	1.2	58	1.6	82	2.0	101	2.3	117	2.6	130	3.2	160	3.7	184	4.1	206	4.5	226	4.9	244	-	-	-	-	-	-
	3.0	66.0	1.3	85	1.8	120	2.2	147	2.6	170	2.9	190	3.5	233	4.1	269	4.6	301	5.0	330	-	-	-	-	-	-		

6:1 SIDE SLOPE												n = .025														
b	d	A	V	Q	V	Q	V	Q	V	Q	V	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q			
0	0.5	1.5	.3	-	.5	1	.6	1	.7	1	.9	1	1.0	2	1.2	2	1.3	2	1.4	2	1.5	2	1.6	2		
	1.0	6.0	.5	3	.7	4	.9	5	1.0	6	1.2	7	1.4	9	1.7	10	1.9	11	2.0	12	2.2	13	2.3	16		
	1.5	13.5	.7	9	1.0	13	1.2	16	1.4	19	1.5	21	1.9	23	2.5	22	2.9	33	3.2	36	3.9	39	3.1	44		
	2.0	24.0	.8	20	1.2	28	1.4	35	1.7	40	1.9	45	2.3	55	2.6	63	2.9	71	3.2	77	3.5	84	3.7	95		
	2.5	37.5	1.0	36	1.4	51	1.7	63	1.9	72	2.2	81	2.6	99	3.1	115	3.4	128	3.7	140	4.0	152	4.3	161		
	3.0	54.0	1.1	59	1.5	83	1.9	102	2.2	118	2.4	132	3.0	161	3.5	186	3.9	208	4.2	228	4.6	247	4.9	264	-	-
2	0.5	2.5	.4	1	.5	1	.7	2	.8	2	.9	2	1.1	3	1.2	3	1.4	3	1.5	4	1.6	4	1.7	4		
	1.0	8.0	.6	5	.8	5	1.0	9	1.3	10	1.6	13	1.8	15	2.0	16	2.2	18	2.4	19	2.6	21	2.7	22	2.9	23
	1.5	16.5	.7	12	1.0	13	1.3	21	1.5	24	1.6	27	2.0	33	2.3	38	2.6	43	2.8	47	3.1	51	3.3	57	3.7	61
	2.0	28.0	.9	25	1.2	25	1.5	42	1.8	49	2.0	55	2.4	67	2.8	78	3.1	87	3.4	95	3.7	103	3.9	110	4.2	116
	2.5	42.5	1.0	49	1.4	70	1.8	86	2.1	99	2.3	111	2.9	136	3.3	157	3.7	175	4.0	192	4.4	207	4.7	221	4.9	235
	3.0	72.0	1.1	86	1.7	122	2.1	149	2.4	172	2.7	192	3.3	254	3.8	272	4.2	304	4.6	333	5.0					

S:1 SIDE SLOPE												n = .025																		
s	d	A	V	Q	V	Q	V	Q	V	Q	V	V	Q	V	Q	V	Q	V	Q	V	Q	V	Q							
0	0.5	2.0	.3	1	.5	1	.6	1	.7	1	.9	2	1.0	2	1.2	1	1.3	3	1.4	3	1.5	3	1.6	3						
	1.0	8.0	.5	4	.7	6	.9	7	1.1	8	1.2	9	1.4	12	1.7	13	1.9	15	2.0	16	2.2	18	2.4	19						
	1.5	18.0	.7	12	1.0	18	1.2	22	1.4	25	1.5	28	1.9	34	2.2	39	2.4	44	2.7	48	2.9	52	3.1	56						
	2.0	32.0	.8	27	1.2	38	1.4	46	1.7	54	1.9	60	2.3	73	2.6	85	3.0	95	3.2	104	3.5	112	3.7	120						
	2.5	56.0	1.0	49	1.4	69	1.7	84	1.9	97	2.2	108	2.7	133	3.1	153	3.4	172	3.8	188	4.1	203	4.3	217						
	3.0	72.0	1.1	79	1.5	112	1.9	137	2.2	158	2.5	176	3.0	216	3.5	250	3.9	279	4.2	306	4.6	330	4.9	353						
2	0.5	3.0	.4	1	.5	2	.6	2	.8	2	.8	3	1.0	3	1.2	4	1.3	4	1.5	4	1.6	5	1.7	5	1.8	6				
	1.0	10.0	.6	6	.8	8	1.0	10	1.1	11	1.3	13	1.5	15	1.8	18	2.0	20	2.2	22	2.4	24	2.5	25	2.7	27				
	1.5	21.0	.7	15	1.0	22	1.3	26	1.5	30	1.6	34	2.0	42	2.3	48	2.6	54	2.8	59	3.0	64	3.2	68	3.4	72				
	2.0	36.0	.9	31	1.2	44	1.5	54	1.7	63	1.9	70	2.4	86	2.7	99	3.1	111	3.4	121	3.6	131	3.9	140	4.1	148				
	2.5	55.0	1.0	55	1.4	78	1.7	95	2.0	110	2.2	123	2.7	153	3.2	174	3.5	195	3.9	213	4.2	230	4.5	246	4.7	261				
	3.0	78.0	1.1	88	1.6	124	1.9	152	2.3	176	2.5	196	3.1	240	3.6	278	4.0	310	4.4	340	4.7	367								
4	0.5	4.0	.4	2	.6	2	.7	3	.8	3	.9	4	1.1	4	1.3	5	1.4	6	1.6	6	1.7	7	1.8	7	1.9	8	2.0	8		
	1.0	12.0	.6	7	.8	10	1.0	12	1.2	14	1.3	16	1.6	20	1.9	23	2.1	25	2.3	28	2.5	30	2.7	32	2.8	34	3.0	36		
	1.5	24.0	.8	18	1.1	26	1.3	31	1.5	36	1.7	41	2.1	50	2.4	57	2.7	64	2.9	70	3.2	76	3.4	82	3.6	86	3.8	91		
	2.0	40.0	.9	36	1.3	51	1.6	62	1.8	72	2.0	80	2.5	98	2.8	114	3.2	127	3.5	139	3.8	150	4.0	161	4.3	170	4.5	180		
	2.5	60.0	1.0	62	1.5	87	1.8	107	2.1	123	2.3	138	2.8	169	3.3	195	3.6	218	4.0	239	4.3	258	4.6	276	4.9	293				
	3.0	84.0	1.2	97	1.6	137	2.0	168	2.3	194	2.6	216	3.2	265	3.6	306	4.1	342	4.5	375	4.8	405								
6	0.5	5.0	.4	2	.6	3	.7	4	.8	4	.9	5	1.2	6	1.3	7	1.5	7	1.6	8	1.8	9	1.9	9	2.0	10	2.1	11		
	1.0	14.0	.6	9	.9	12	1.1	15	1.2	17	1.4	19	1.7	24	2.0	27	2.2	31	2.4	34	2.6	36	2.8	39	2.9	41	3.1	43		
	1.5	27.0	.8	21	1.1	30	1.4	36	1.6	42	1.7	47	2.1	58	2.5	67	2.8	74	3.0	82	3.3	88	3.5	94	3.7	100	3.9	105		
	2.0	44.0	.9	41	1.3	57	1.6	70	1.8	81	2.1	91	2.5	111	2.9	128	3.3	144	3.6	157	3.9	170	4.1	182	4.4	193	4.6	203		
	2.5	65.0	1.1	68	1.5	97	1.8	119	2.1	137	2.4	153	2.9	188	3.3	217	3.7	242	4.1	265	4.4	287	4.7	306	5.0	325				
	3.0	90.0	1.2	106	1.7	150	2.0	183	2.4	212	2.6	237	3.2	290	3.7	335	4.2	374	4.6	410	4.9	443								
8	0.5	6.0	.4	3	.6	4	.8	5	.9	5	1.0	6	1.2	7	1.4	8	1.5	9	1.7	10	1.8	11	1.9	12	2.1	12	2.2	13		
	1.0	16.0	.6	10	.9	14	1.1	18	1.3	20	1.4	23	1.8	28	2.0	32	2.3	36	2.5	40	2.7	43	2.9	46	3.0	49	3.2	51		
	1.5	30.0	.8	24	1.1	36	1.4	42	1.6	48	1.8	54	2.2	66	2.5	76	2.8	85	3.1	93	3.4	101	3.6	108	3.8	114	4.0	120		
	2.0	48.0	.9	45	1.3	64	1.6	79	1.9	91	2.1	101	2.6	124	3.0	143	3.3	160	3.7	176	4.0	190	4.2	203	4.5	215	4.7	227		
	2.5	70.0	1.1	75	1.5	107	1.9	131	2.2	151	2.4	168	2.9	206	3.4	238	3.8	266	4.2	292	4.5	315	4.8	337						
	3.0	96.0	1.2	115	1.7	163	2.1	199	2.4	230	2.7	257	3.3	315	3.8	364	4.2	407	4.6	446										
10	0.5	7.0	.4	3	.6	4	.8	5	.9	6	1.0	7	1.2	9	1.4	10	1.6	11	1.7	12	1.9	13	2.0	14	2.1	15	2.2	16		
	1.0	18.0	.7	12	.9	17	1.1	20	1.3	24	1.5	26	1.8	32	2.1	37	2.3	42	2.5	46	2.7	49	2.9	53	3.1	56	3.3	59		
	1.5	33.0	.8	27	1.2	38	1.4	47	1.6	54	1.8	61	2.2	74	2.6	86	2.9	96	3.2	105	3.4	113	3.7	121	3.9	129	4.1	135		
	2.0	52.0	1.0	50	1.4	71	1.7	87	1.9	100	2.2	112	2.6	137	3.1	159	3.4	177	3.7	194	4.0	210	4.3	225	4.6	238	4.8	251		
	2.5	75.0	1.1	82	1.6	116	1.9	142	2.2	165	2.5	184	3.0	225	3.5	260	3.9	291	4.2	319	4.6	344	4.9	368						
	3.0	102.0	1.2	124	1.7	176	2.1	215	2.4	249	2.7	278	3.3	341	3.9	393	4.3	440	4.7	482										

Table IN-14-6 Surface Drain (n = 0.025 - s:s = 8:1)

(Sheet 2 of 2)