Grassed Waterway Design Charts
for
Drainage Areas from 0 to 30 Acres

A large number of waterways are constructed throughout Iowa which have drainage areas ranging from 0 to 30 acres. The charts with this amendment provide a standard design for these size waterways. The charts are only applicable if a parabolic waterway cross section is selected.

These charts should not be used if any of the following conditions exist:

1. The drainage area and/or slope exceeds the limits of the chart.
2. The chart shows "na" for the specific condition.
3. There are complex geologic, hydrologic, or topographic features at the site.

For these cases, site specific designs should be completed. A more detailed design procedure may be used in any situation when a site specific design is desired.

Following are some assumptions that went into the development of the charts:

1. The hydrology used for design was based on:
    a. A typical watershed shape was used where the watershed length was equal to 1.5 times the width.
    b. A typical watershed slope was selected for each drainage area and waterway slope.
    c. Runoff curve numbers were based on contoured row crops with a RCN = 75 for hydrologic soil group "B" and a RCN = 82 for hydrologic soil group "C".
    d. The state was divided into two regions based on rainfall. Counties with 10yr.-24hr. rainfalls of 4.2 to 4.5 inches were placed in the North Region and counties with rainfalls of 4.6 to 4.9 inches were placed in the South Region.
2. The vegetative factor used was 0.87. This is valid for brome grass and brome grass mixtures.
3. Designs for grassed waterways with drainage areas from 0 to 10 acres were based on B-C retardance values for capacity and stability design respectively. Designs for waterways with drainage areas from 11 to 30 acres were based on B-D retardance values for capacity and stability design respectively.
4. The minimum waterway depth used is 1.0 ft.
5. Minimum top widths varied depending on the side slope (z) ratio. For a "z" value of 6, the minimum top width is 30 ft. For a "z" value of 8, the minimum top width is 32 ft.

Waterway designs using the charts may be completed by utilizing the following procedure:

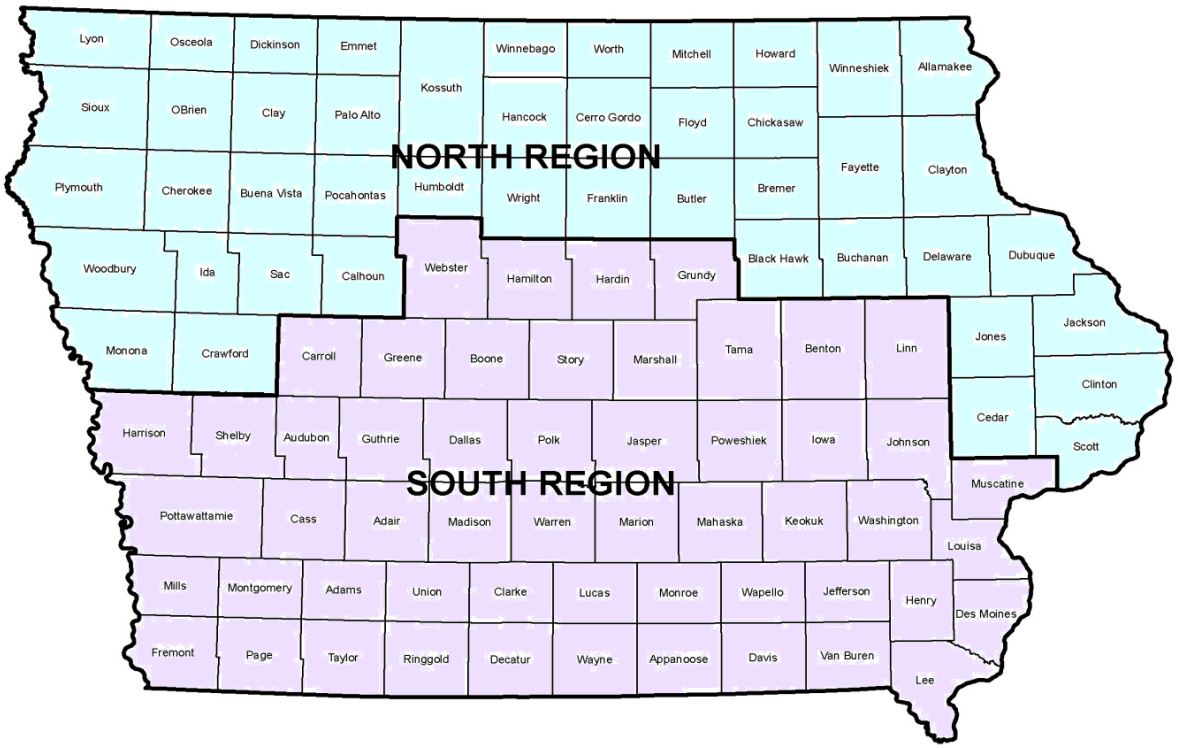
1. Determine if the county where the waterway is located is in the North or South Region of the state from Exhibit IA7-2.
2. Determine if the maximum side slope "z" at the outer edges of the waterway will be 6:1 or 8:1.
3. Determine the drainage area of the waterway.
4. Determine the slope of the waterway.
5. Determine if the average runoff curve number of the drainage area is approximately 75 or 82.
6. Using the type of soil in the planned waterway, determine the soil erodibility category from Exhibit IA7-1.
7. Using the information from steps 1 through 6, enter the appropriate design chart in Exhibit IA7-3 and select the waterway dimensions.

Waterway dimensions taken from the design charts may be used with standard drawings, job sheets, etc. to meet minimum documentation requirements as shown in the Field Office Technical Guide Statement of Work for Grassed Waterways.

Note: The Design Tables for Parabolic Channels presented in Appendix D of this chapter are based on a side slope ratio of 1:1 at the outer edges of the waterway. These tables may be used for design; however, the designer should be aware that the cross section will generally not be crossable with any type of farm equipment.

Grassed Waterway Design

Rainfall Regions Map



GRASSED WATERWAY DESIGN CHARTS									
South Region RCN = 75 z=6									
DA	WW Slope	Allowable Stress							
Acres	Per Cent	Easily Eroded		Erodible		Erosion Resistant		Very Erosion	
		Top Width	Depth	Top Width	Depth	Top Width	Depth	Top Width	Depth
Design Based on B - C Retardance									
0-6	0-1	34	1.4	34	1.4	34	1.4	34	1.4
	2	30	1.2	30	1.2	30	1.2	30	1.2
*	3	30	1.1	30	1.1	30	1.1	30	1.1
*	4	30	1.0	30	1.0	30	1.0	30	1.0
*	6	30	1.0	30	1.0	30	1.0	30	1.0
*	8	30	1.0	30	1.0	30	1.0	30	1.0
*	10	30	1.0	30	1.0	30	1.0	30	1.0
*	12	30	1.0	30	1.0	30	1.0	30	1.0
7-10	0-1	34	1.4	34	1.4	34	1.4	34	1.4
	2	30	1.2	30	1.2	30	1.2	30	1.2
	3	30	1.1	30	1.1	30	1.1	30	1.1
	4	30	1.0	30	1.0	30	1.0	30	1.0
	6	30	1.0	30	1.0	30	1.0	30	1.0
	8	30	1.0	30	1.0	30	1.0	30	1.0
	10	34	1.0	30	1.0	30	1.0	30	1.0
	12	36	1.0	30	1.0	30	1.0	30	1.0
Design Based on B - D Retardance									
11-20	0-1	38	1.5	38	1.5	38	1.5	38	1.5
	2	32	1.3	32	1.3	32	1.3	32	1.3
	3	42	1.2	30	1.2	30	1.2	30	1.2
	4	50	1.0	34	1.1	30	1.2	30	1.2
	6	70	1.0	48	1.0	30	1.0	30	1.1
	8	na	na	58	1.0	36	1.0	30	1.0
	10	na	na	68	1.0	42	1.0	40	1.0
21-30	0-1	40	1.6	40	1.6	40	1.6	40	1.6
	2	36	1.4	34	1.4	34	1.4	34	1.4
	3	48	1.2	32	1.3	32	1.3	32	1.3
	4	70	1.0	46	1.1	30	1.2	30	1.2
	6	na	na	62	1.0	38	1.0	30	1.1
	8	na	na	80	1.0	50	1.0	36	1.0

* The dimensions for waterways in this line may be changed to T=20 ft. and d=0.75 ft. if the criteria for Special Treatment Areas in the 412 Standard is met.

GRASSED WATERWAY DESIGN CHARTS									
South Region RCN = 82 z=6									
DA	WW Slope	Allowable Stress							
Acres	Per Cent	Easily Eroded		Erodible		Erosion Resistant		Very Erosion	
		Top Width	Depth	Top Width	Depth	Top Width	Depth	Top Width	Depth
Design Based on B - C Retardance									
0-6	0-1	34	1.4	34	1.4	34	1.4	34	1.4
	2	30	1.2	30	1.2	30	1.2	30	1.2
*	3	30	1.1	30	1.1	30	1.1	30	1.1
*	4	30	1.0	30	1.0	30	1.0	30	1.0
*	6	30	1.0	30	1.0	30	1.0	30	1.0
*	8	30	1.0	30	1.0	30	1.0	30	1.0
*	10	30	1.0	30	1.0	30	1.0	30	1.0
*	12	30	1.0	30	1.0	30	1.0	30	1.0
7-10	0-1	36	1.5	36	1.5	36	1.5	36	1.5
	2	32	1.3	32	1.3	32	1.3	32	1.3
	3	30	1.2	30	1.2	30	1.2	30	1.2
	4	30	1.1	30	1.1	30	1.1	30	1.1
	6	32	1.0	30	1.0	30	1.0	30	1.0
	8	40	1.0	30	1.0	30	1.0	30	1.0
	10	44	1.0	32	1.0	30	1.0	30	1.0
	12	50	1.0	36	1.0	36	1.0	30	1.0
Design Based on B - D Retardance									
11-20	0-1	40	1.6	40	1.6	40	1.6	40	1.6
	2	38	1.4	34	1.4	34	1.4	34	1.4
	3	54	1.2	36	1.3	32	1.3	32	1.3
	4	70	1.0	46	1.1	30	1.2	30	1.2
	6	na	na	62	1.0	38	1.0	30	1.1
	8	na	na	80	1.0	50	1.0	36	1.0
	10	na	na	na	na	58	1.0	56	1.0
21-30	0-1	42	1.7	42	1.7	42	1.7	42	1.7
	2	52	1.4	38	1.5	38	1.5	38	1.5
	3	72	1.2	48	1.3	34	1.4	34	1.4
	4	na	na	66	1.1	38	1.3	32	1.3
	6	na	na	na	na	54	1.0	38	1.1
	8	na	na	na	na	70	1.0	52	1.0

* The dimensions for waterways in this line may be changed to T=20 ft. and d=0.75 ft. if the criteria for Special Treatment Areas in the 412 Standard is met.

GRASSED WATERWAY DESIGN CHARTS									
North Region RCN = 75 z=6									
DA	WW Slope	Allowable Stress							
Acres	Per Cent	Easily Eroded		Erodible		Erosion Resistant		Very Erosion	
		Top Width	Depth	Top Width	Depth	Top Width	Depth	Top Width	Depth
Design Based on B - C Retardance									
0-6	0-1	34	1.4	34	1.4	34	1.4	34	1.4
	2	30	1.1	30	1.1	30	1.1	30	1.1
*	3	30	1.0	30	1.0	30	1.0	30	1.0
*	4	30	1.0	30	1.0	30	1.0	30	1.0
*	6	30	1.0	30	1.0	30	1.0	30	1.0
*	8	30	1.0	30	1.0	30	1.0	30	1.0
*	10	30	1.0	30	1.0	30	1.0	30	1.0
*	12	30	1.0	30	1.0	30	1.0	30	1.0
7-10	0-1	34	1.4	34	1.4	34	1.4	34	1.4
	2	30	1.2	30	1.2	30	1.2	30	1.2
	3	30	1.1	30	1.1	30	1.1	30	1.1
	4	30	1.0	30	1.0	30	1.0	30	1.0
	6	30	1.0	30	1.0	30	1.0	30	1.0
	8	30	1.0	30	1.0	30	1.0	30	1.0
	10	30	1.0	30	1.0	30	1.0	30	1.0
	12	32	1.0	30	1.0	30	1.0	30	1.0
Design Based on B - D Retardance									
11-20	0-1	36	1.5	36	1.5	36	1.5	36	1.5
	2	32	1.3	32	1.3	32	1.3	32	1.3
	3	36	1.2	30	1.2	30	1.2	30	1.2
	4	44	1.0	30	1.1	30	1.1	30	1.1
	6	62	1.0	42	1.0	30	1.0	30	1.0
	8	74	1.0	50	1.0	30	1.0	30	1.0
	10	na	na	58	1.0	36	1.0	36	1.0
21-30	0-1	40	1.6	40	1.6	40	1.6	40	1.6
	2	36	1.4	34	1.4	34	1.4	34	1.4
	3	48	1.2	32	1.3	32	1.3	32	1.3
	4	62	1.0	42	1.1	30	1.2	30	1.2
	6	na	na	56	1.0	34	1.0	30	1.1
	8	na	na	70	1.0	42	1.0	32	1.0

* The dimensions for waterways in this line may be changed to T=20 ft. and d=0.75 ft. if the criteria for Special Treatment Areas in the 412 Standard is met.

GRASSED WATERWAY DESIGN CHARTS									
North Region RCN = 82 z=6									
DA	WW Slope	Allowable Stress							
Acres	Per Cent	Easily Eroded		Erodible		Erosion Resistant		Very Erosion	
		Top Width	Depth	Top Width	Depth	Top Width	Depth	Top Width	Depth
Design Based on B - C Retardance									
0-6	0-1	34	1.4	34	1.4	34	1.4	34	1.4
	2	30	1.2	30	1.2	30	1.2	30	1.2
*	3	30	1.1	30	1.1	30	1.1	30	1.1
*	4	30	1.0	30	1.0	30	1.0	30	1.0
*	6	30	1.0	30	1.0	30	1.0	30	1.0
*	8	30	1.0	30	1.0	30	1.0	30	1.0
*	10	30	1.0	30	1.0	30	1.0	30	1.0
*	12	30	1.0	30	1.0	30	1.0	30	1.0
7-10	0-1	36	1.5	36	1.5	36	1.5	36	1.5
	2	30	1.3	30	1.3	30	1.3	30	1.3
	3	30	1.1	30	1.1	30	1.1	30	1.1
	4	30	1.1	30	1.1	30	1.1	30	1.1
	6	30	1.0	30	1.0	30	1.0	30	1.0
	8	36	1.0	30	1.0	30	1.0	30	1.0
	10	40	1.0	30	1.0	30	1.0	30	1.0
	12	44	1.0	32	1.0	32	1.0	30	1.0
Design Based on B - D Retardance									
11-20	0-1	38	1.6	38	1.6	38	1.6	38	1.6
	2	34	1.4	34	1.4	34	1.4	34	1.4
	3	48	1.2	32	1.3	32	1.3	32	1.3
	4	62	1.0	42	1.1	30	1.2	30	1.2
	6	na	na	58	1.0	36	1.0	30	1.1
	8	na	na	72	1.0	44	1.0	32	1.0
	10	na	na	na	na	50	1.0	50	1.0
21-30	0-1	42	1.8	42	1.8	42	1.8	42	1.8
	2	46	1.4	36	1.5	36	1.5	36	1.5
	3	66	1.2	44	1.3	34	1.4	34	1.4
	4	na	na	58	1.1	34	1.3	32	1.3
	6	na	na	78	1.0	48	1.0	34	1.2
	8	na	na	na	na	62	1.0	46	1.0

* The dimensions for waterways in this line may be changed to T=20 ft. and d=0.75 ft. if the criteria for Special Treatment Areas in the 412 Standard is met.

GRASSED WATERWAY DESIGN CHARTS									
South Region RCN = 75 z=8									
DA	WW Slope	Allowable Stress							
Acres	Per Cent	Easily Eroded		Erodible		Erosion Resistant		Very Erosion	
		Top Width	Depth	Top Width	Depth	Top Width	Depth	Top Width	Depth
Design Based on B - C Retardance									
0-6	0-1	44	1.4	44	1.4	44	1.4	44	1.4
	2	36	1.1	36	1.1	36	1.1	36	1.1
*	3	34	1.0	34	1.0	34	1.0	34	1.0
*	4	32	1.0	32	1.0	32	1.0	32	1.0
*	6	32	1.0	32	1.0	32	1.0	32	1.0
*	8	32	1.0	32	1.0	32	1.0	32	1.0
*	10	32	1.0	32	1.0	32	1.0	32	1.0
*	12	32	1.0	32	1.0	32	1.0	32	1.0
7-10	0-1	46	1.4	46	1.4	46	1.4	46	1.4
	2	38	1.2	38	1.2	38	1.2	38	1.2
	3	34	1.1	34	1.1	34	1.1	34	1.1
	4	32	1.0	32	1.0	32	1.0	32	1.0
	6	32	1.0	32	1.0	32	1.0	32	1.0
	8	32	1.0	32	1.0	32	1.0	32	1.0
	10	34	1.0	32	1.0	32	1.0	32	1.0
	12	36	1.0	32	1.0	32	1.0	32	1.0
Design Based on B - D Retardance									
11-20	0-1	48	1.5	48	1.5	48	1.5	48	1.5
	2	42	1.3	40	1.3	40	1.3	40	1.3
	3	42	1.2	38	1.2	38	1.2	38	1.2
	4	50	1.0	36	1.1	36	1.1	36	1.1
	6	70	1.0	48	1.0	32	1.0	32	1.0
	8	na	na	58	1.0	36	1.0	32	1.0
	10	na	na	68	1.0	42	1.0	40	1.0
21-30	0-1	50	1.5	50	1.5	50	1.5	50	1.5
	2	44	1.3	44	1.3	44	1.3	44	1.3
	3	48	1.2	40	1.2	40	1.2	40	1.2
	4	70	1.0	46	1.1	38	1.2	38	1.2
	6	na	na	62	1.0	38	1.0	34	1.1
	8	na	na	80	1.0	50	1.0	36	1.0

* The dimensions for waterways in this line may be changed to T=20 ft. and d=0.75 ft. if the criteria for Special Treatment Areas in the 412 Standard is met.

GRASSED WATERWAY DESIGN CHARTS									
South Region RCN = 82 z=8									
DA	WW Slope	Allowable Stress							
Acres	Per Cent	Easily Eroded		Erodible		Erosion Resistant		Very Erosion	
		Top Width	Depth	Top Width	Depth	Top Width	Depth	Top Width	Depth
Design Based on B - C Retardance									
0-6	0-1	44	1.4	44	1.4	44	1.4	44	1.4
	2	38	1.2	38	1.2	38	1.2	38	1.2
*	3	34	1.1	34	1.1	34	1.1	34	1.1
*	4	32	1.0	32	1.0	32	1.0	32	1.0
*	6	32	1.0	32	1.0	32	1.0	32	1.0
*	8	32	1.0	32	1.0	32	1.0	32	1.0
*	10	32	1.0	32	1.0	32	1.0	32	1.0
*	12	32	1.0	32	1.0	32	1.0	32	1.0
7-10	0-1	46	1.4	46	1.4	46	1.4	46	1.4
	2	40	1.2	40	1.2	40	1.2	40	1.2
	3	36	1.1	36	1.1	36	1.1	36	1.1
	4	34	1.0	34	1.0	34	1.0	34	1.0
	6	32	1.0	32	1.0	32	1.0	32	1.0
	8	40	1.0	32	1.0	32	1.0	32	1.0
	10	44	1.0	32	1.0	32	1.0	32	1.0
	12	50	1.0	36	1.0	36	1.0	32	1.0
Design Based on B - D Retardance									
11-20	0-1	50	1.6	50	1.6	50	1.6	50	1.6
	2	44	1.4	44	1.4	44	1.4	44	1.4
	3	54	1.2	40	1.2	40	1.2	40	1.2
	4	70	1.0	46	1.1	38	1.2	38	1.2
	6	na	na	62	1.0	38	1.0	34	1.1
	8	na	na	80	1.0	50	1.0	36	1.0
	10	na	na	na	na	58	1.0	56	1.0
21-30	0-1	52	1.6	52	1.6	52	1.6	52	1.6
	2	52	1.4	46	1.4	46	1.4	46	1.4
	3	72	1.2	48	1.3	42	1.3	42	1.3
	4	na	na	66	1.1	40	1.3	40	1.3
	6	na	na	na	na	54	1.0	38	1.1
	8	na	na	na	na	70	1.0	52	1.0

* The dimensions for waterways in this line may be changed to T=20 ft. and d=0.75 ft. if the criteria for Special Treatment Areas in the 412 Standard is met.

GRASSED WATERWAY DESIGN CHARTS									
North Region RCN = 75 z=8									
DA	WW Slope	Allowable Stress							
Acres	Per Cent	Easily Eroded		Erodible		Erosion Resistant		Very Erosion	
		Top Width	Depth	Top Width	Depth	Top Width	Depth	Top Width	Depth
Design Based on B - C Retardance									
0-6	0-1	42	1.3	42	1.3	42	1.3	42	1.3
	2	36	1.1	36	1.1	36	1.1	36	1.1
*	3	32	1.0	32	1.0	32	1.0	32	1.0
*	4	32	1.0	32	1.0	32	1.0	32	1.0
*	6	32	1.0	32	1.0	32	1.0	32	1.0
*	8	32	1.0	32	1.0	32	1.0	32	1.0
*	10	32	1.0	32	1.0	32	1.0	32	1.0
*	12	32	1.0	32	1.0	32	1.0	32	1.0
7-10	0-1	44	1.4	44	1.4	44	1.4	44	1.4
	2	38	1.2	38	1.2	38	1.2	38	1.2
	3	34	1.1	34	1.1	34	1.1	34	1.1
	4	32	1.0	32	1.0	32	1.0	32	1.0
	6	32	1.0	32	1.0	32	1.0	32	1.0
	8	32	1.0	32	1.0	32	1.0	32	1.0
	10	32	1.0	32	1.0	32	1.0	32	1.0
	12	32	1.0	32	1.0	32	1.0	32	1.0
Design Based on B - D Retardance									
11-20	0-1	48	1.5	48	1.5	48	1.5	48	1.5
	2	42	1.3	40	1.3	40	1.3	40	1.3
	3	38	1.2	38	1.2	38	1.2	38	1.2
	4	44	1.0	34	1.1	34	1.1	34	1.1
	6	62	1.0	42	1.0	32	1.0	32	1.0
	8	74	1.0	50	1.0	32	1.0	32	1.0
	10	na	na	58	1.0	36	1.0	36	1.0
21-30	0-1	50	1.6	50	1.6	50	1.6	50	1.6
	2	44	1.3	42	1.3	42	1.3	42	1.3
	3	48	1.2	40	1.2	40	1.2	40	1.2
	4	62	1.0	42	1.1	38	1.1	38	1.1
	6	na	na	56	1.0	34	1.0	34	1.0
	8	na	na	70	1.0	42	1.0	32	1.0

* The dimensions for waterways in this line may be changed to T=20 ft. and d=0.75 ft. if the criteria for Special Treatment Areas in the 412 Standard is met.

GRASSED WATERWAY DESIGN CHARTS									
North Region RCN = 82 z=8									
DA	WW Slope	Allowable Stress							
Acres	Per Cent	Easily Eroded		Erodible		Erosion Resistant		Very Erosion	
		Top Width	Depth	Top Width	Depth	Top Width	Depth	Top Width	Depth
Design Based on B - C Retardance									
0-6	0-1	44	1.4	44	1.4	44	1.4	44	1.4
	2	38	1.2	38	1.2	38	1.2	38	1.2
*	3	34	1.0	34	1.0	34	1.0	34	1.0
*	4	32	1.0	32	1.0	32	1.0	32	1.0
*	6	32	1.0	32	1.0	32	1.0	32	1.0
*	8	32	1.0	32	1.0	32	1.0	32	1.0
*	10	32	1.0	32	1.0	32	1.0	32	1.0
*	12	32	1.0	32	1.0	32	1.0	32	1.0
7-10	0-1	46	1.4	46	1.4	46	1.4	46	1.4
	2	40	1.2	40	1.2	40	1.2	40	1.2
	3	36	1.1	36	1.1	36	1.1	36	1.1
	4	34	1.0	34	1.0	34	1.0	34	1.0
	6	32	1.0	32	1.0	32	1.0	32	1.0
	8	36	1.0	32	1.0	32	1.0	32	1.0
	10	40	1.0	32	1.0	32	1.0	32	1.0
	12	44	1.0	32	1.0	32	1.0	32	1.0
Design Based on B - D Retardance									
11-20	0-1	48	1.5	48	1.5	48	1.5	48	1.5
	2	42	1.3	42	1.3	42	1.3	42	1.3
	3	48	1.2	40	1.2	40	1.2	40	1.2
	4	62	1.0	42	1.1	38	1.1	36	1.1
	6	na	na	58	1.0	36	1.0	34	1.1
	8	na	na	72	1.0	44	1.0	32	1.0
	10	na	na	na	na	50	1.0	50	1.0
21-30	0-1	54	1.7	54	1.7	54	1.7	54	1.7
	2	46	1.4	46	1.4	46	1.4	46	1.4
	3	66	1.2	44	1.3	42	1.3	42	1.3
	4	na	na	58	1.1	40	1.2	40	1.2
	6	na	na	78	1.0	48	1.0	36	1.1
	8	na	na	na	na	62	1.0	46	1.0

* The dimensions for waterways in this line may be changed to T=20 ft. and d=0.75 ft. if the criteria for Special Treatment Areas in the 412 Standard is met.

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