

## Chapter 7 - Grassed Waterways

### Retardance Values

Grassed waterways are only as good as the assumptions and data used in design. One of the most important factors is the correct selection of the retardance factors. Generally, retardance “D” is used in Michigan to select a channel width to give a safe velocity during the establishment period. The next step is to find the depth required for the design capacity when the vegetation has matured. Mature vegetation usually has an A, B, or C retardance. The degree of vegetal retardance depends on the height and density of the vegetation. Exhibit 7-2, Table MI 7-2.1, and Table MI 7-2.2 can be used for this determination. Determination of good or fair stand for design should be made using local experience with the seeding mixture, soils, and climate.

Table MI 7-2.1 General Guide to Selection of Vegetal Retardance Values for Grassed Waterways

Stand*	Average Height of Vegetation (inches)	Retardance	Stand*	Average Height of Vegetation (inches)	Retardance
Good	Greater than 24	A	Fair	Greater than 24	B
Good	11 to 24	B	Fair	11 to 24	C
Good	6 to 10	C	Fair	6 to 10	D
Good	2 to 6	D	Fair	2 to 6	D
Good	Less than 2	E	Fair	Less than 2	E

\* Good stand has a minimum of 160 stems per square foot

\* Fair stand has less than 160 and more than 100 stems per square foot

Table MI 7-2.2 Vegetal Retardance – Michigan Critical Area Planting Seeding Mixtures

Seeding Mixture	Mature Height <sup>1/</sup> (inches)	Mowed Height <sup>2/</sup> (inches)	Retardance			
			Good Stand <sup>3/</sup>		Fair Stand <sup>4/</sup>	
			Mature	Mowed	Mature	Mowed
Creeping Red Fescue	12	2	C	E	D	E
Creeping Red Fescue	12	4	C	D	D	D
Creeping Red Fescue Tall Fescue Kentucky Bluegrass Perennial Ryegrass	30	6	B	D	C	D
Tall Fescue Smooth Bromegrass	36	6	A	D	B	D
Tall Fescue Redtop Perennial Ryegrass	30	6	B	D	C	D
Smooth Bromegrass	36	6	A	D	B	D
Smooth Bromegrass Redtop Perennial Ryegrass	36	6	A	D	B	D

<sup>1/</sup> Average height is assumed to be 70% of mature height

<sup>2/</sup> Average height is assumed to be 90% of mowed height

<sup>3/</sup> Good stand has a minimum of 160 stems per square foot

<sup>4/</sup> Fair stand has less than 160 and more than 100 stems per square foot

## Chapter 7 - Grassed Waterways

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## GRASSED WATERWAY DESIGN CHARTS

This is a simplified grassed waterway design procedure. It was developed to improve the efficiency of delivering service to our customers for situations with low risk to property or life. The design charts may be used when the assumptions reflect the actual conditions. For other conditions, a site specific design should be completed using approved design methods such as Engineering Field Handbook (EFH), Chapter 7, Grassed Waterways and the Ohio Engineering Computer Program.

The charts are intended to be used for the following situations:

1. Drainage areas within the limits shown on the charts.
2. Situations in which there are no complex hydrologic or topographic features. Complex hydrologic features are defined as significantly different runoff curve numbers (RCN) or ponding within the watershed.
3. The actual conditions would be similar to those shown below. If your conditions are similar to another zone, you are encouraged to use the other zone's design.

Following is a brief discussion concerning the major **assumptions** which were made to develop the design charts:

1. The state was divided into three zones (see page MI 7-49.2 for Zone Locations). The boundaries for the zones were selected based upon rainfall and topography.
2. Typical watershed slopes, RCNs, and average rainfall amounts were based upon experience of field engineers and estimates taken from topographic maps, soils maps, and EFH Chapter 2 precipitation tables. The following average rainfall, RCN's and watershed slopes were used for determining peak flows:

Zone	Average 10yr.-24 hr. Rainfall (in.)	Average RCN	Average Watershed Slope (%)
1	3.25	76	4
2	3.25	70	4
3	3.75	77	3

3. The Ohio Engineering Grassed Waterway Design Program was used to determine the capacity of the waterway.
4. For waterway slopes less than 1%, 50% out of bank flow was used. When designing a waterway for <1% slope, caution should be used to make sure that the waterway will function as such.
5. When selecting a waterway dimension, three factors were considered. First, the waterway was designed for stability using "D" retardance. Second, the waterway was designed for capacity using "C" retardance. Third, dimensions were chosen to make sure the waterway was crossable with farm equipment.

## **ZONE LOCATIONS**

Zone 1 includes all of the Upper Peninsula of Michigan

Zone 2 includes Muskegon, Newaygo, Mecosta, Isabella, Gladwin, and Arenac counties and all counties to the north in the Lower Peninsula of Michigan.

Zone 3 includes Ottawa, Kent, Montcalm, Gratiot, Midland, and Bay counties and all counties to the south in the Lower Peninsula of Michigan.

**PARABOLIC GRASSED WATERWAY DESIGN CHART**

**Zone 1**

Drainage Area (acres)	Waterway Slope	Waterway Dimensions (feet)	
		Top Width	Depth
0 to 25	< 1 to 2%	15	1.2
	2 to 6%	20	0.8
	*6 to 16%	25	0.8
26 to 40	< 1 to 2%	20	1.3
	2 to 4%	20	1.0
	4 to 6 %	30	0.8
	*7 to 10%	30	0.8
41 to 60	< 1 to 3%	20	1.3
	3 to 4%	30	0.9
	*5 to 8%	30	0.8
	*9 to 16%	40	0.8

**\* Not recommended for easily eroded soils because velocity exceeds EFH recommendation - calculate using another approved method.** (See EFH page 7-19 for more on erosion resistance.)

Note: 50% out of bank flow included in calculations for waterways with slopes < 1%.

Steps for using the design chart:

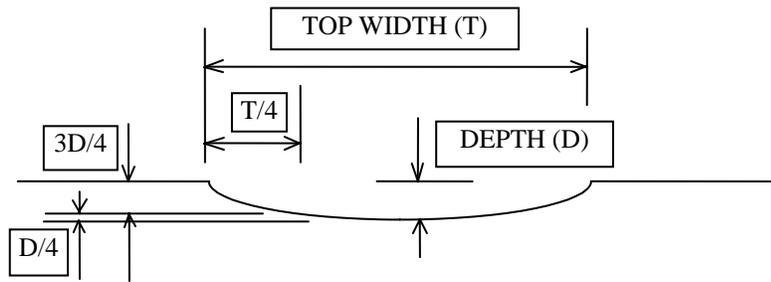
1. Determine the drainage area in acres.
2. Determine the slope of the waterway in percent.
3. Select the appropriate waterway dimensions from the chart.

**Design Documentation**

Tract and Field Number \_\_\_\_\_ Landowner Name: \_\_\_\_\_  
 Drainage Area, Acres \_\_\_\_\_ Designer / Date: \_\_\_\_\_  
 Waterway Number \_\_\_\_\_ Engineering Job Class: \_\_\_\_\_

Waterway Segment	1	2	3	4
Elevation or Grade Rod (ft.)	_____	_____	_____	_____
Elevation or Grade Rod (ft.)	_____	_____	_____	_____
Distance (ft.)	_____	_____	_____	_____
Waterway Slope (%)	_____	_____	_____	_____
Dimensions: Top Width (ft.)	_____	_____	_____	_____
Depth (ft.)	_____	_____	_____	_____

**TYPICAL CROSS SECTION**



**CONSTRUCTION SPECIFICATIONS**

All trees brush, stumps and other objectionable material shall be removed from the site. The waterway shall be constructed to the dimensions selected from the design chart and in accordance with the above cross section. The fill material shall be free of frozen material, brush, roots, and other material which will not produce the desired compaction. Available topsoil shall be salvaged and stockpiled for later spreading. All fills shall be placed in layers of 9 inches or less with each layer compacted by the wheels and/or tracks of the construction equipment. The moisture content of the fill material shall be such that when kneaded in the hand, the soil forms a ball which does not readily separate. Excess excavated material not needed for construction shall be spread in a manner which will not interfere with the functioning of the waterway.

All grading and shaping operations will be completed and the area to be seeded shall be reasonably smooth, free of rills and gullies, and shall have the designed cross section before seedbed preparation. Prior to seedbed preparation, divert any concentrated flow of off site water from the area. After the seedbed is prepared, the waterway shall be fertilized, seeded, and mulched at the following rates:

Seed:	<u>Kind of Seed</u>	<u>Pounds Per Acre</u>
	_____	_____
	_____	_____
	_____	_____

Fertilizer: Apply 12-12-12 fertilizer at the rate of 12 pounds per 1000 square feet.

Mulch: Apply straw mulch at the rate of 2 to 3 bales per 1000 square feet.

**CONSTRUCTION DOCUMENTATION**

Waterway Segment	1	2	3	4
Length (ft.)	_____	_____	_____	_____
Waterway Slope (%)	_____	_____	_____	_____
Top Width (ft.)	_____	_____	_____	_____
Depth (ft.)	_____	_____	_____	_____
Depth at T/4 (ft.)	_____	_____	_____	_____

I am providing documentation that the grassed waterway(s) has been installed and seeded in accordance with the design chart and construction specifications.

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Circle One:    Landowner                      Tenant                      Contractor                      Other

**TRAPEZOIDAL GRASSED WATERWAY DESIGN CHART**

**Zone 1**

Drainage Area (acres)	Waterway Slope	Bottom Width (feet)	Depth (feet)	Side Slope (ft/ft)
0 to 25	< 1%	8	1.1	8:1
	1 to 3%	8	1.0	8:1
	3 to 7 %	8	0.8	8:1
	*7 to 16%	12	0.8	8:1
26 to 40	< 1 to 2%	8	1.2	8:1
	2 to 4%	8	1.0	8:1
	*5 to 8%	12	0.8	8:1
	*9 to 12%	20	0.8	8:1
41 to 60	< 1 to 2%	10	1.2	8:1
	2 to 3%	8	1.0	8:1
	*3 to 6%	10	1.0	8:1
	*7 to 9%	20	0.8	8:1

**\* Not recommended for easily eroded soils because velocity exceeds EFH recommendation - calculate using another approved method.** (See EFH page 7-19 for more on erosion resistance.)

Note: 50% out of bank flow included in calculations for waterways with slopes < 1%.

Steps for using the design chart:

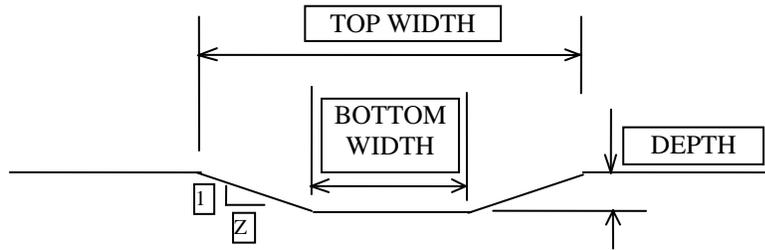
1. Determine the drainage area in acres.
2. Determine the slope of the waterway in percent.
3. Select the appropriate waterway dimensions from the chart.

**Design Documentation**

Tract and Field Number \_\_\_\_\_ Landowner Name: \_\_\_\_\_  
 Drainage Area (acres) \_\_\_\_\_ Designer / Date: \_\_\_\_\_  
 Waterway Number \_\_\_\_\_ Engineering Job Class: \_\_\_\_\_

Waterway Segment	1	2	3	4
Elevation or Grade Rod (ft.)	_____	_____	_____	_____
Elevation or Grade Rod (ft.)	_____	_____	_____	_____
Distance (ft.)	_____	_____	_____	_____
Waterway Slope (%)	_____	_____	_____	_____
Dimensions: Bottom Width (ft.)	_____	_____	_____	_____
Depth (ft.)	_____	_____	_____	_____
Side Slope (ft/ft)	_____	_____	_____	_____

**TYPICAL CROSS SECTION**



**CONSTRUCTION SPECIFICATIONS**

All trees brush, stumps and other objectionable material shall be removed from the site. The waterway shall be constructed to the dimensions selected from the design chart and in accordance with the above cross section. The fill material shall be free of frozen material, brush, roots, and other material which will not produce the desired compaction. Available topsoil shall be salvaged and stockpiled for later spreading. All fills shall be placed in layers of 9 inches or less with each layer compacted by the wheels and/or tracks of the construction equipment. The moisture content of the fill material shall be such that when kneaded in the hand, the soil forms a ball which does not readily separate. Excess excavated material not needed for construction shall be spread in a manner which will not interfere with the functioning of the waterway.

All grading and shaping operations will be completed and the area to be seeded shall be reasonably smooth, free of rills and gullies, and shall have the designed cross section before seedbed preparation. Prior to seedbed preparation, divert any concentrated flow of off site water from the area. After the seedbed is prepared, the waterway shall be fertilized, seeded, and mulched at the following rates:

Seed:	<u>Kind of Seed</u>	<u>Pounds Per Acre</u>
	_____	_____
	_____	_____
	_____	_____

Fertilizer: Apply 12-12-12 fertilizer at the rate of 12 pounds per 1000 square feet.

Mulch: Apply straw mulch at the rate of 2 to 3 bales per 1000 square feet.

**CONSTRUCTION DOCUMENTATION**

Waterway Segment	1	2	3	4
Length (ft.)	_____	_____	_____	_____
Slope (%)	_____	_____	_____	_____
Bottom Width (ft.)	_____	_____	_____	_____
Depth at Center (ft.)	_____	_____	_____	_____

I am providing documentation that the grassed waterway(s) have been installed and seeded in accordance with the design chart and construction specifications.

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Circle One:    Landowner                      Tenant                      Contractor                      Other

**PARABOLIC GRASSED WATERWAY DESIGN CHART**

**Zone 2**

Drainage Area (acres)	Waterway Slope	Waterway Dimensions (feet)	
		Top Width	Depth
0 to 40	< 1 to 2%	15	1.2
	2 to 6%	20	0.8
	*6 to 16%	25	0.8
41 to 80	< 1 to 2%	20	1.3
	2 to 4%	20	1.0
	4 to 6 %	30	0.8
	*7 to 10%	30	0.8

**\* Not recommended for easily eroded soils because velocity exceeds EFH recommendation - calculate using another approved method.** (See EFH page 7-19 for more on erosion resistance.)

Note: 50% out of bank flow included in calculations for waterways with slopes < 1%.

Steps for using the design chart:

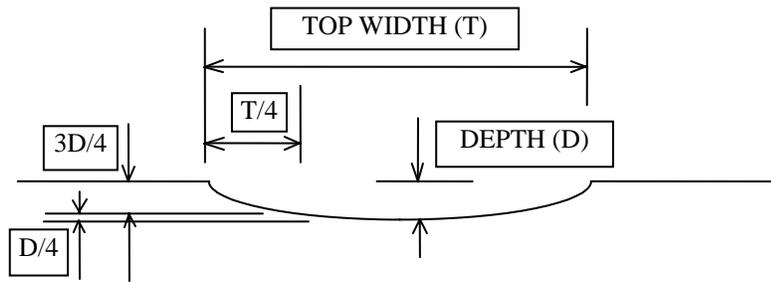
1. Determine the drainage area in acres.
2. Determine the slope of the waterway in percent.
3. Select the appropriate waterway dimensions from the chart.

**Design Documentation**

Tract and Field Number \_\_\_\_\_ Landowner Name: \_\_\_\_\_  
 Drainage Area (acres) \_\_\_\_\_ Designer / Date: \_\_\_\_\_  
 Waterway Number \_\_\_\_\_ Engineering Job Class: \_\_\_\_\_

Waterway Segment	1	2	3	4
Elevation or Grade Rod (ft.)	_____	_____	_____	_____
Elevation or Grade Rod (ft.)	_____	_____	_____	_____
Distance (ft.)	_____	_____	_____	_____
Waterway Slope (%)	_____	_____	_____	_____
Dimensions: Top Width (ft.)	_____	_____	_____	_____
Depth (ft.)	_____	_____	_____	_____

**TYPICAL CROSS SECTION**



**CONSTRUCTION SPECIFICATIONS**

All trees brush, stumps and other objectionable material shall be removed from the site. The waterway shall be constructed to the dimensions selected from the design chart and in accordance with the above cross section. The fill material shall be free of frozen material, brush, roots, and other material which will not produce the desired compaction. Available topsoil shall be salvaged and stockpiled for later spreading. All fills shall be placed in layers of 9 inches or less with each layer compacted by the wheels and/or tracks of the construction equipment. The moisture content of the fill material shall be such that when kneaded in the hand, the soil forms a ball which does not readily separate. Excess excavated material not needed for construction shall be spread in a manner which will not interfere with the functioning of the waterway.

All grading and shaping operations will be completed and the area to be seeded shall be reasonably smooth, free of rills and gullies, and shall have the designed cross section before seedbed preparation. Prior to seedbed preparation, divert any concentrated flow of off site water from the area. After the seedbed is prepared, the waterway shall be fertilized, seeded, and mulched at the following rates:

Seed:	<u>Kind of Seed</u>	<u>Pounds Per Acre</u>
	_____	_____
	_____	_____
	_____	_____

Fertilizer: Apply 12-12-12 fertilizer at the rate of 12 pounds per 1000 square feet.

Mulch: Apply straw mulch at the rate of 2 to 3 bales per 1000 square feet.

**CONSTRUCTION DOCUMENTATION**

Waterway Segment	1	2	3	4
Length (ft.)	_____	_____	_____	_____
Waterway Slope (%)	_____	_____	_____	_____
Top Width (ft.)	_____	_____	_____	_____
Depth (ft.)	_____	_____	_____	_____
Depth at T/4 (ft.)	_____	_____	_____	_____

I am providing documentation that the grassed waterway(s) has been installed and seeded in accordance with the design chart and construction specifications.

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Circle One: Landowner      Tenant      Contractor      Other

**TRAPEZOIDAL GRASSED WATERWAY DESIGN CHART**

**Zone 2**

Drainage Area (acres)	Waterway Slope	Bottom Width (feet)	Depth (feet)	Side Slope (ft/ft)
0 to 40	< 1%	8	1.1	8:1
	1 to 3%	8	1.0	8:1
	3 to 7%	8	0.8	8:1
	*7 to 16%	12	0.8	8:1
41 to 80	< 1 to 2%	8	1.2	8:1
	2 to 4%	8	1.0	8:1
	*5 to 8 %	12	0.8	8:1
	*9 to 12%	20	0.8	8:1

**\* Not recommended for easily eroded soils because velocity exceeds EFH recommendation - calculate using another approved method. (See EFH page 7-19 for more on erosion resistance.)**

Note: 50% out of bank flow included in calculations for waterways with slopes < 1%.

Steps for using the design chart:

1. Determine the drainage area in acres.
2. Determine the slope of the waterway in percent.
3. Select the appropriate waterway dimensions from the chart.

**Design Documentation**

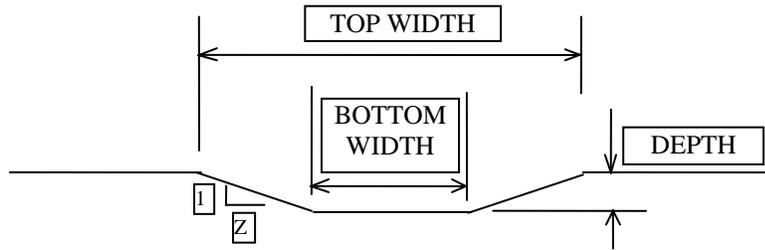
Tract and Field Number \_\_\_\_\_ Landowner Name: \_\_\_\_\_

Drainage Area (acres) \_\_\_\_\_ Designer / Date: \_\_\_\_\_

Waterway Number \_\_\_\_\_ Engineering Job Class: \_\_\_\_\_

Waterway Segment	1	2	3	4
Elevation or Grade Rod (ft.)	_____	_____	_____	_____
Elevation or Grade Rod (ft.)	_____	_____	_____	_____
Distance (ft.)	_____	_____	_____	_____
Waterway Slope (%)	_____	_____	_____	_____
Dimensions: Bottom Width (ft.)	_____	_____	_____	_____
Depth (ft.)	_____	_____	_____	_____
Side Slope (ft/ft)	_____	_____	_____	_____

**TYPICAL CROSS SECTION**



**CONSTRUCTION SPECIFICATIONS**

All trees brush, stumps and other objectionable material shall be removed from the site. The waterway shall be constructed to the dimensions selected from the design chart and in accordance with the above cross section. The fill material shall be free of frozen material, brush, roots, and other material which will not produce the desired compaction. Available topsoil shall be salvaged and stockpiled for later spreading. All fills shall be placed in layers of 9 inches or less with each layer compacted by the wheels and/or tracks of the construction equipment. The moisture content of the fill material shall be such that when kneaded in the hand, the soil forms a ball which does not readily separate. Excess excavated material not needed for construction shall be spread in a manner which will not interfere with the functioning of the waterway.

All grading and shaping operations will be completed and the area to be seeded shall be reasonably smooth, free of rills and gullies, and shall have the designed cross section before seedbed preparation. Prior to seedbed preparation, divert any concentrated flow of off site water from the area. After the seedbed is prepared, the waterway shall be fertilized, seeded, and mulched at the following rates:

Seed:	<u>Kind of Seed</u>	<u>Pounds Per Acre</u>
	_____	_____
	_____	_____
	_____	_____

Fertilizer: Apply 12-12-12 fertilizer at the rate of 12 pounds per 1000 square feet.

Mulch: Apply straw mulch at the rate of 2 to 3 bales per 1000 square feet.

**CONSTRUCTION DOCUMENTATION**

Waterway Segment	1	2	3	4
Length (ft.)	_____	_____	_____	_____
Slope (%)	_____	_____	_____	_____
Bottom Width (ft.)	_____	_____	_____	_____
Depth at Center (ft.)	_____	_____	_____	_____

I am providing documentation that the grassed waterway(s) have been installed and seeded in accordance with the design chart and construction specifications.

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Circle One:    Landowner                      Tenant                      Contractor                      Other

**PARABOLIC GRASSED WATERWAY DESIGN CHART**

**Zone 3**

Drainage Area (acres)	Waterway Slope	Waterway Dimensions (feet)	
		Top Width	Depth
0 to 20	< 1 to 2%	15	1.2
	2 to 6%	20	0.8
	*6 to 16%	25	0.8
21 to 40	< 1 to 3%	20	1.3
	3 to 4%	30	0.9
	*5 to 8%	30	0.8
	*9 to 16%	40	0.8

**\* Not recommended for easily eroded soils because velocity exceeds EFH recommendation - calculate using another approved method.** (See EFH page 7-19 for more on erosion resistance.)

Note: 50% out of bank flow included in calculations for waterways with slopes < 1%.

Steps for using the design chart:

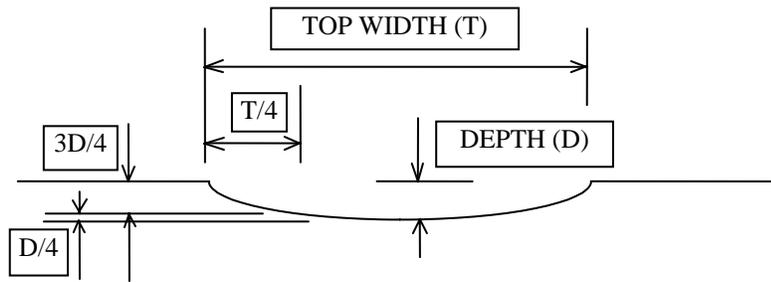
1. Determine the drainage area in acres.
2. Determine the slope of the waterway in percent.
3. Select the appropriate waterway dimensions from the chart.

**Design Documentation**

Tract and Field Number \_\_\_\_\_ Landowner Name: \_\_\_\_\_  
 Drainage Area (acres) \_\_\_\_\_ Designer / Date: \_\_\_\_\_  
 Waterway Number \_\_\_\_\_ Engineering Job Class: \_\_\_\_\_

Waterway Segment	1	2	3	4
Elevation or Grade Rod (ft.)	_____	_____	_____	_____
Elevation or Grade Rod (ft.)	_____	_____	_____	_____
Distance (ft.)	_____	_____	_____	_____
Waterway Slope (%)	_____	_____	_____	_____
Dimensions: Top Width (ft.)	_____	_____	_____	_____
Depth (ft.)	_____	_____	_____	_____

**TYPICAL CROSS SECTION**



**CONSTRUCTION SPECIFICATIONS**

All trees brush, stumps and other objectionable material shall be removed from the site. The waterway shall be constructed to the dimensions selected from the design chart and in accordance with the above cross section. The fill material shall be free of frozen material, brush, roots, and other material which will not produce the desired compaction. Available topsoil shall be salvaged and stockpiled for later spreading. All fills shall be placed in layers of 9 inches or less with each layer compacted by the wheels and/or tracks of the construction equipment. The moisture content of the fill material shall be such that when kneaded in the hand, the soil forms a ball which does not readily separate. Excess excavated material not needed for construction shall be spread in a manner which will not interfere with the functioning of the waterway.

All grading and shaping operations will be completed and the area to be seeded shall be reasonably smooth, free of rills and gullies, and shall have the designed cross section before seedbed preparation. Prior to seedbed preparation, divert any concentrated flow of off site water from the area. After the seedbed is prepared, the waterway shall be fertilized, seeded, and mulched at the following rates:

Seed:	<u>Kind of Seed</u>	<u>Pounds Per Acre</u>
	_____	_____
	_____	_____
	_____	_____

Fertilizer: Apply 12-12-12 fertilizer at the rate of 12 pounds per 1000 square feet.

Mulch: Apply straw mulch at the rate of 2 to 3 bales per 1000 square feet.

**CONSTRUCTION DOCUMENTATION**

Waterway Segment	1	2	3	4
Length (ft.)	_____	_____	_____	_____
Waterway Slope (%)	_____	_____	_____	_____
Top Width (ft.)	_____	_____	_____	_____
Depth (ft.)	_____	_____	_____	_____
Depth at T/4 (ft.)	_____	_____	_____	_____

I am providing documentation that the grassed waterway(s) has been installed and seeded in accordance with the design chart and construction specifications.

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Circle One: Landowner      Tenant      Contractor      Other

**TRAPEZOIDAL GRASSED WATERWAY DESIGN CHART**

**Zone 3**

Drainage Area (acres)	Waterway Slope	Bottom Width (feet)	Depth (feet)	Side Slope (ft/ft)
0 to 20	< 1%	8	1.1	8:1
	1 to 3%	8	1.0	8:1
	3 to 7 %	8	0.8	8:1
	*7 to 16%	12	0.8	8:1
21 to 40	< 1 to 2%	10	1.2	8:1
	2 to 3 %	8	1.0	8:1
	*3 to 6 %	10	1.0	8:1
	*7 to 9%	20	0.8	8:1

**\* Not recommended for easily eroded soils because velocity exceeds EFH recommendation - calculate using another approved method.** (See EFH page 7-19 for more on erosion resistance.)

Note: 50% out of bank flow included in calculations for waterways with slopes < 1%.

Steps for using the design chart:

1. Determine the drainage area in acres.
2. Determine the slope of the waterway in percent.
3. Select the appropriate waterway dimensions from the chart.

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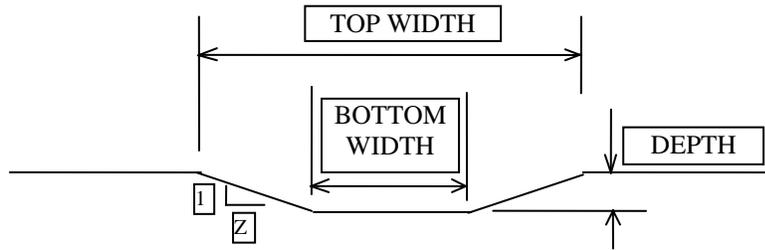
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**Design Documentation**

Tract and Field Number \_\_\_\_\_ Landowner Name: \_\_\_\_\_  
 Drainage Area (acres) \_\_\_\_\_ Designer / Date: \_\_\_\_\_  
 Waterway Number \_\_\_\_\_ Engineering Job Class: \_\_\_\_\_

Waterway Segment	1	2	3	4
Elevation or Grade Rod (ft.)	_____	_____	_____	_____
Elevation or Grade Rod (ft.)	_____	_____	_____	_____
Distance (ft.)	_____	_____	_____	_____
Waterway Slope (%)	_____	_____	_____	_____
Dimensions: Bottom Width (ft.)	_____	_____	_____	_____
Depth (ft.)	_____	_____	_____	_____
Side Slope (ft/ft)	_____	_____	_____	_____

**TYPICAL CROSS SECTION**



**CONSTRUCTION SPECIFICATIONS**

All trees brush, stumps and other objectionable material shall be removed from the site. The waterway shall be constructed to the dimensions selected from the design chart and in accordance with the above cross section. The fill material shall be free of frozen material, brush, roots, and other material which will not produce the desired compaction. Available topsoil shall be salvaged and stockpiled for later spreading. All fills shall be placed in layers of 9 inches or less with each layer compacted by the wheels and/or tracks of the construction equipment. The moisture content of the fill material shall be such that when kneaded in the hand, the soil forms a ball which does not readily separate. Excess excavated material not needed for construction shall be spread in a manner which will not interfere with the functioning of the waterway.

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Seed:	<u>Kind of Seed</u>	<u>Pounds Per Acre</u>
	_____	_____
	_____	_____
	_____	_____

Fertilizer: Apply 12-12-12 fertilizer at the rate of 12 pounds per 1000 square feet.

Mulch: Apply straw mulch at the rate of 2 to 3 bales per 1000 square feet.

**CONSTRUCTION DOCUMENTATION**

Waterway Segment	1	2	3	4
Length (ft.)	_____	_____	_____	_____
Slope (%)	_____	_____	_____	_____
Bottom Width (ft.)	_____	_____	_____	_____
Depth at Center (ft.)	_____	_____	_____	_____

I am providing documentation that the grassed waterway(s) have been installed and seeded in accordance with the design chart and construction specifications.

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Circle One:    Landowner                      Tenant                      Contractor                      Other