Vegetated Treatment Area Design
IL-635

Design of a Vegetated Treatment Area (VTA) may be done using the latest version of the VTA design spreadsheet posted on the Illinois NRCS engineering website, or by the following procedure.

1. Determine number of animal units on the animal feeding operation, using definitions provided by EPA. The VTA standard applies only to small animal feeding operations, typically less than 300 animal units.

2. Determine the infiltration rate of soils on site.
   Soil Interpretation Records and the Table of Physical and Chemical Properties of the Soils in the County Soil Survey contain permeability ranges for soils. If no other data are available (perc tests, etc) use an average of the values in the Soil Survey. If the strip is to be excavated, use infiltration rates consistent with values shown for the horizon to be exposed. Base the infiltration determination on the most restrictive soil layer within the root zone, regardless of its thickness.

   Infiltration Rate_____ in/hr
   Allowable range: 1.0 to 6.0 inches/hour

3. Measure feedlot area. Include all roofs that will contribute to filter strip and other areas that will drain across the feedlot.
   Total Contributing Area _____ ft^2

4. Determine 1yr, 2 hr rainfall and runoff (see fig. IL 11-3).

   1 yr, 2 hr Rainfall _____ in

   1 yr, 2 hr Runoff = Rainfall x 0.9 = _____ in

5. Calculate design runoff volume from the 1 yr, 2 hr event.

$$Design\ Runoff\ Volume = \frac{Runoff\ (in)}{12\ in/ft}\ x\ Total\ Contributing\ Area\ (ft^2)$$

   Design Runoff Volume = _____ ft^3

6. Calculate minimum VTA area required to infiltrate the runoff from a 1 yr, 2 hr rainfall in 2 hours.

$$Minimum\ VTA\ Infiltration\ Area = \frac{Runoff\ (in)\ x\ Total\ Contributing\ Area\ (ft^2)}{2\,hr\ x\ Infiltration\ Rate\ (in/hr) - 1yr, 2\,hr\ Rain\ (in)}$$

   Minimum VTA Infiltration Area = _____ ft^2

7. Calculate minimum capacity of the VTA required to handle the volume of runoff from a 1 yr, 2 hr rainfall in 2 hours.

$$Minimum\,VTA\ Capacity = \frac{Design\,Runoff\,Volume\,(ft^3)}{2\,hr\ x\ 3600\,\sec/\,hr}$$

Minimum VTA Capacity = _____ cfs

8. Determine the design slope of the VTA (see fig. 11-4 for alternative layouts). If the design of the VTA requires a compound design slope, the design spreadsheet method is recommended.

VTA Design Slope = _____ %
Allowable range: 0.3 to 6.0 %

9. Determine the minimum VTA flow length required for a 2 hour contact time.

Slope *(%)*	Velocity *(ft / sec)*	Flow Length *(ft)*
0.3	0.033	238
0.5	0.042	302
0.75	0.051	367
1.0	0.059	425
1.5	0.073	526
2.0	0.084	605
3.0	0.103	742
4.0	0.119	857
5.0	0.133	958
6.0	0.146	1,050

Velocity = _____ ft/sec

Minimum VTA Flow Length = _____ ft

10. Calculate minimum VTA width required to provide the required infiltration area. Select a VTA design length longer than the minimum determined, if needed to achieve the required area with a width in the allowable range.

$$Minimum\ VTA\ Width = \frac{VTA\,Area\,(ft^2)}{VTA\,Design\,Length\,(ft)}$$

VTA Design Length = _____ ft

Minimum VTA Width = _____ ft
Allowable range: 20 to 100 ft.

11. Calculate actual VTA design capacity with a ½ inch flow depth. Select a VTA design width larger than the minimum determined, if needed to meet or exceed the minimum capacity determined above.

$$VTA\,Design\,Capacity = VTA\,Design\,Width\,(ft)\ x \left[\frac{\frac{1}{2}\,in\,flow\,depth}{12\ in/ft}\right] x\ Velocity\,(ft/\sec)$$

VTA Design Width = _____ ft

VTA Design Capacity = _____ cfs

12. Calculate the Nitrogen loading from the settling basin discharge to be delivered to the VTA.

Livestock Type	Nitrogen Loading Rate *(lb/year per 1000 ft² feedlot)*
Cattle	10
Swine	25

$$Nitrogen\,Loading\,(lb/yr) = \frac{Loading\,Rate\,(lb/yr\ per\ 1000\,ft^2)\ x\ Lot\,Area\,(ft^2)}{1000}$$

Nitrogen loading = _____lb/yr

13. Determine the required Nitrogen uptake of the vegetation in the VTA: one third of the annual Nitrogen loading. Volatilization and denitrification will account for additional nitrogen loss.

Required N Uptake = Nitrogen Applied (lb/yr) ÷ 3 = _____ lb/yr

14. Select VTA vegetation and determine the capability of the selected vegetation to remove Nitrogen.

Species	Seeding Rate PLS/acre	Nitrogen Removed Per Ton Harvested (Lbs./ton)
Tall Fescue	24	30
Smooth Bromegrass	24	22.4
Orchard Grass Tall Fescue	6 20	25
Tall Fescue Smooth Bromegrass	12 12	25

Nitrogen Removed Per Ton of Grass Harvested = _____lb/ton

15. Determine the yield of the vegetation in the VTA. For grass yield specific to the design location, refer to the grass-legume hay productivity tables for Illinois Soils in Bulletin 810, "Average Crop, Pasture, and Forestry Productivity Ratings for Illinois Soils", University of Illinois at Urbana-Champaign, August 2000. *Default choice is 4.0 tons/ac/yr.*

Grass Yield = _____ tons/ac/yr

16. Estimate the Nitrogen uptake of the vegetation in the designed VTA. Increase the area of the VTA if necessary to ensure that the VTA will uptake at least the required pounds per year of Nitrogen.

$$Nitrogen\ Uptake\,(lb/yr) = \frac{N\ Harvested\,(lb/ton)\ x\ Yield\,(tons/ac/yr)\ x\ VTA\ Design\ Area\,(ft^2)}{43560\,(ft^2/ac)}$$

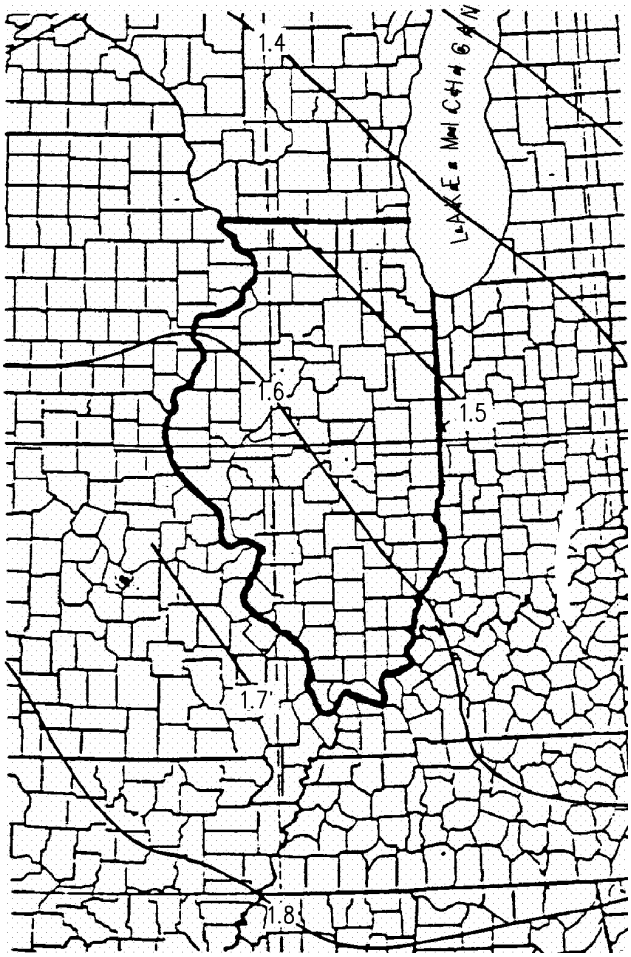
VTA Design Area = Design Length (ft) x Design Width (ft) = _____ ft^2

N Uptake by VTA = _____ lb/yr

Final VTA Design Parameters:

Width (ft)	
Length (ft)	
Area (ft^2)	
Slope (%)	
Capacity (cfs)	

Figure IL 11-3. 1 Year, 2 Hour Rainfall for Illinois (inches)



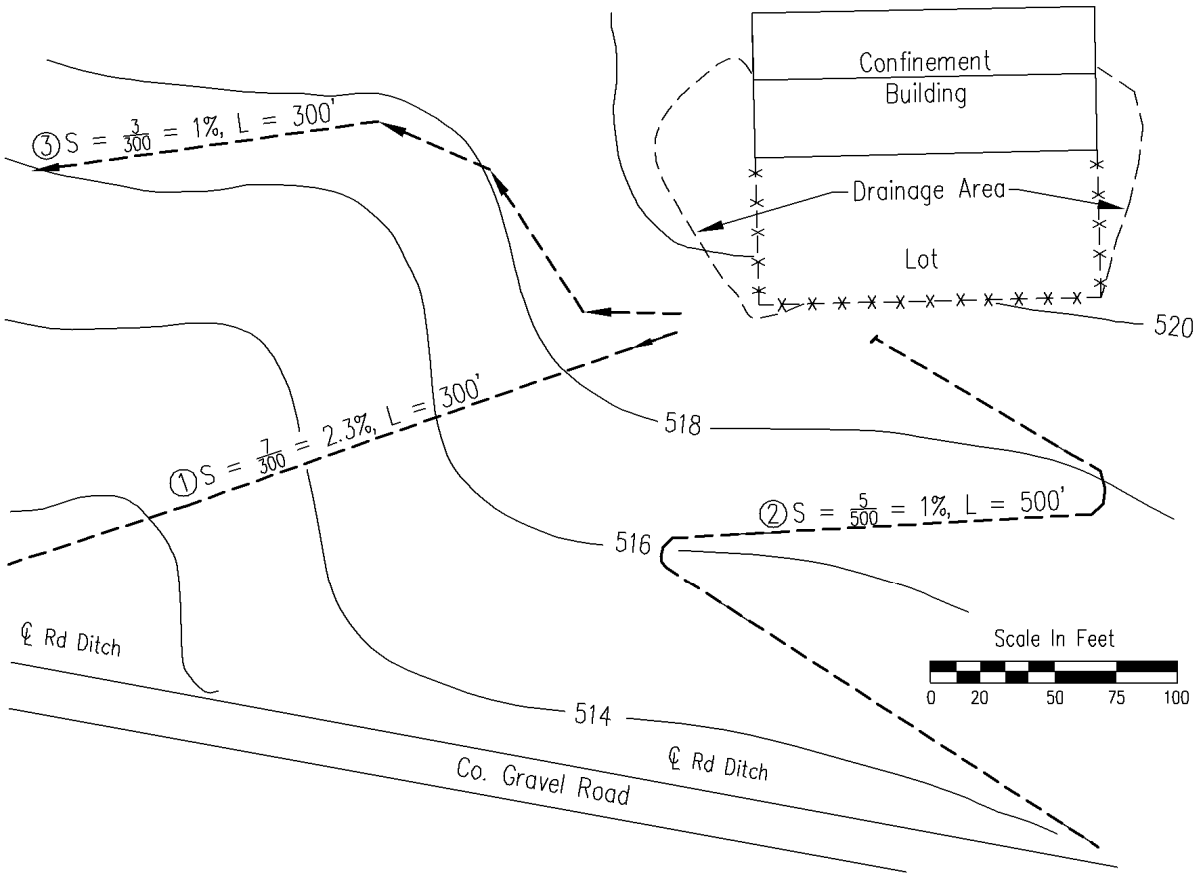


Figure IL 11-4. Typical VTA Layout Alternatives

1 – Downhill
2 – Serpentine
3 – Cross Slope