

**NATURAL RESOURCES CONSERVATION SERVICE  
CONSERVATION PRACTICE STANDARD**

**VEGETATED TREATMENT AREA**

(Ac.)

**CODE 635**

**DEFINITION**

A treatment component of an agricultural waste management system consisting of a strip or area of herbaceous vegetation.

**PURPOSE**

The purpose of this practice is to improve water quality by reducing loading of nutrients, organics, pathogens, and other contaminants associated with animal manure and other wastes, and wastewater by treating agricultural wastewater and runoff from livestock holding areas

**CONDITIONS WHERE PRACTICE APPLIES**

The control of wastewater and feedlot runoff is bracketed into five levels of control with Level 1 being full runoff control. The primary Minnesota NRCS conservation practice standards addressing the control of wastewater and feedlot runoff and their respective levels of control are:

- Waste Storage Facility (313),  
Level 1
- Waste Facility Cover (367),  
Level 1, Feedlot Roof Structure
- Vegetated Treatment Area (635),  
Levels 2 - 5

Wastewater and feedlot runoff from Concentrated Animal Feeding Operations (CAFO's) must be controlled using LEVEL 1 methods, unless all necessary permits have been obtained from the Minnesota Pollution Control Agency (MPCA).

This practice applies:

- To provide levels 2 thru 5 control of contaminated runoff from such areas as feedlots, barnyards, and other livestock holding areas
- Where the treatment system is a component of a planned agricultural waste management system

- Where the treatment system can be constructed, operated and maintained without polluting air or water resources

Conditions where each level of treatment covered in this standard applies are as follows:

LEVEL 2—Vegetated Infiltration Area

Runoff is pretreated in a settling basin. Liquids are discharged onto a confined vegetated area to be infiltrated into the soil root zone and utilized by vegetation. This is considered to be zero surface water discharge.

Acceptable uses:

1. Runoff from all feedlots designated as Animal Feeding Operations (AFO's) by MPCA where site conditions are appropriate and adequate land is available.
2. Where manure solids from the feedlot can be effectively trapped prior to discharge to the treatment area.

LEVEL 3—Controlled Discharge Vegetated Treatment Strip (sunny day release).

Runoff is stored in an impoundment for solids separation and during periods of dormant vegetation or filter strip saturation. Liquids are discharged onto a graded vegetated treatment strip with active growth in such a way as to eliminate or minimize discharge from the strip.

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Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact the MN Natural Resources Conservation Service in your area, or download it from the electronic Field Office Technical Guide for Minnesota.

Acceptable uses:

1. Runoff from AFO's where a relatively high level of treatment is required to protect surface waters.
2. Where soil conditions are appropriate and adequate land area is available.
3. Where manure solids from the feedlot can be effectively trapped prior to discharge to the treatment area.

#### LEVEL 4—Vegetated Treatment Strip

Runoff is pretreated in a settling basin. Liquids are discharged onto a graded vegetated treatment strip.

Acceptable uses:

1. For runoff from AFO feedlots with less than 300 animal units on the feedlot.
2. Runoff from AFO's where receiving waters can accept occasional discharges of pollutants estimated to be within MPCA effluent limits.
3. Where manure solids from the feedlot can be effectively trapped prior to discharge to the treatment area.
4. Where soil conditions are appropriate and adequate land area is available.

#### LEVEL 5—Vegetated Buffer Strip

Solids and liquids are separated. Liquids are then discharged to a vegetated buffer strip.

Acceptable uses:

1. For runoff from AFO's with less than 1 acre of open lot area (including contributing clean water areas) and total operation size of less than 300 animal units and less than 100 animal units utilizing the lot in question.
2. Where the receiving water can accept occasional discharges estimated to be within MPCA effluent limits.
3. Where a minimum of 200 feet of separation exists between the end of the buffer and a receiving water.
4. Where manure solids from the feedlot can be effectively trapped prior to discharge to the buffer area.
5. Where soil conditions are appropriate and adequate land area is available.

## **CRITERIA**

### **General Criteria Applicable To All Purposes**

The installation and operation of the vegetated treatment area shall comply with all federal, state, and local laws, rules, and regulations.

Discharge to and through treatment areas shall be as sheet flow. Some means, such as a ditch, curb, or gated pipe, shall be provided to disperse concentrated flow and ensure sheet flow across the width (dimension perpendicular to flow length) of the treatment strip. Land grading and structural components necessary to maintain sheet flow throughout the length (dimension parallel to the flow) of the treatment strip shall be provided as necessary.

Permanent vegetation consisting of a single species or a mixture of grasses, legumes and/or other forbs adapted to the soil and climate shall be established in the treatment area. Selected species shall be suited to current site conditions and intended use. Selected species will have the capacity to achieve adequate density, vigor and yield within an appropriate time frame to treat contaminated runoff. Site preparation and seeding shall be done at a time and in a manner that best ensures survival and growth of the selected species.

Vegetation shall be able to withstand anticipated wetting and/or submerged conditions. Harvest VTA as appropriate to encourage dense growth, maintain an upright growth habit, and remove nutrients and other contaminants that are contained in the plant tissue.

Exclude livestock access to the vegetated treatment area.

Clean water shall be diverted from the treatment strip to the fullest extent possible unless needed to promote vegetation growth in the treatment strip.

Treatment strips should be located outside of floodplains. However, if site restrictions require location within a floodplain, they shall be protected from inundation or damage from a 25-year flood event, or larger if required by law.

Infiltration areas shall not be planned where soil features such as cracking will result in preferential flow paths that transport untreated runoff from the surface to below the root zone, unless the soil moisture can be maintained to prevent drying and cracking.

## LEVEL 2—Vegetated Infiltration Area

Siting Parameters. This process shall be limited to well-drained loamy soil with published permeabilities between 0.2 inches per hour and 6 inches per hour to a depth of 5 feet and with a growing season typical water table greater than 5 feet deep. Subsurface drains that discharge to a receiving water may not be used to lower the water table.

Settling Basin. Contaminated runoff shall be pretreated by solid/liquid separation off the feedlot. Criteria shall match that for Level 4. In ground water sensitive areas, runoff during dormant vegetation periods must be stored until active vegetation growth resumes.

Distribution System. Effluent shall be discharged onto the infiltration area in such a way as to promote spreading the effluent over the entire area.

Infiltration Area. The minimum size of the infiltration area shall be 100% of the contributing feedlot size. The treatment area shall be sized to infiltrate the 25-year, 24-hour runoff from the feedlot and contributing area. Runoff shall be infiltrated into the root zone of the vegetation to be grown. The depth of water application shall be equal to the maximum available soil water capacity of the soil in the root zone minus 1 inch.

$$\text{Area (ac)} = \frac{\text{Runoff Volume (ac-in)}}{(\text{Water Holding Capacity} - 1'')$$

The treatment strip shall be a uniformly graded strip or wide bottomed trapezoidal channel.

*The infiltration area shall be level and on native undisturbed soils to the extent possible. Care must be taken during construction to prevent soil compaction from construction machinery. Fill soil shall be lightly compacted and consist of topsoil of the same texture as the in-place soil. The maximum topsoil fill shall be limited to 2 feet. The treatment area shall be contained such that there is no surface discharge.*

## LEVEL 3—Controlled Discharge Vegetated Treatment Strip

Impoundment. Feedlot runoff shall be stored in an impoundment during vegetation dormant periods or filter strip saturation periods. For sites where impoundment overflow can be routed onto the treatment strip the impoundment shall be sized to hold runoff from November 1 through May 30, or the 25-year, 24-hour runoff, whichever is greater. For sites where the impoundment overflow is not routed onto the treatment strip the impoundment shall be sized to hold the sum of the runoff from November 1 through May 30 plus the 25-year, 24-hour runoff. The impoundment shall be located off the feedlot and meet Minnesota Conservation Practice Standard (313), Waste Storage Facility, except for the storage volume criteria. Means shall be provided to allow the operator to control outflow from the impoundment in a practical manner to facilitate the timely operation of the treatment strip.

Treatment Strip Siting Parameters. The treatment strip shall be situated or constructed in a 2-foot minimum depth of soil with at least 20% passing the Number 200 sieve and a minimum separation to the seasonal high water table of 2 feet.

Treatment Strip. The treatment strip dimensions shall be sufficient to provide a 30 minute flow through time for the maximum discharge from the impoundment at a depth of 1.0 inch using Manning's Equation with Manning's  $n = 0.24$ .

Minimum filter strip slope shall be 1.0% and the minimum filter strip area shall be 60% of the contributing drainage area size.

The treatment strip shall be graded level across its width to promote sheet flow.

Discharge onto a filter strip shall be evenly distributed at the head of the strip by using a level spreader, weir, gated pipe or other device. Additional devices should be considered to promote sheet flow as needed down the length of the strip.

Derivations of Manning's Eq. for computing dimensions of vegetated strips:

$$\text{Min Width (ft)} = \frac{Q * n}{0.02363 * S^{1/2}}$$

$$\text{Min Length (ft)} = \frac{510 * S^{1/2}}{n}$$

Where: Q = discharge, cfs  
 S = slope, ft/ft  
 n = 0.24 for vegetated treatment strips  
 Depth of flow = 1.0"  
 Flow Through Time for Length Computation = 30 minutes

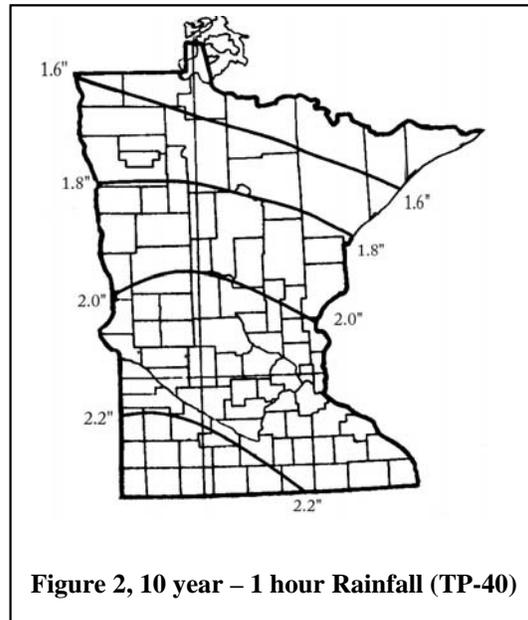


Figure 2, 10 year – 1 hour Rainfall (TP-40)

#### LEVEL 4—Vegetated Treatment Strip

**Settling Basin.** Contaminated runoff shall be pretreated by solid/liquid separation. The settling basin shall be sized to route onto the treatment strip the runoff from the feedlot and contributing area during the design 25 year, 24-hour rainfall event. The minimum volume shall equal the runoff volume from its drainage area during a 10 year, 1-hour rainfall event. The surface area of the settling basin shall be equal to at least 5 percent of the drainage area. It is suggested to limit the settling basin design storage depth to not more than 3 feet.

If the settling basin will not be emptied after each runoff event additional volume is required. Additional volume shall be equivalent to at least 0.5 inch over the feedlot area for an earthen lot and 1.0 inch over the area of a paved lot.

**Treatment Strip Siting Parameters.** The treatment strip shall be situated or constructed in a 2-foot minimum depth of soil with at least 20% passing the Number 200 sieve and a minimum separation to the seasonal high water table of 2 feet.

**Treatment Strip.** This criteria is the same as for Level 3.

#### LEVEL 5—Vegetated Buffer Strip

**Solids Settling.** Solids shall be settled from the runoff prior to discharge to the buffer strip.

**Buffer Strip.** The buffer strip shall be sized using the Feedlot Evaluation (FLEVAL) model. The flow length shall be sufficient to achieve a zero ranking when modeling the filter strip as a buffer area in the FLEVAL model using the following conditions:

1. “Permanent Meadow” shall be used to describe the cover crop of the vegetated buffer area. Tilled cropland may not be considered part of the buffer under this standard.
2. Number of animal units shall be the maximum that will use the feedlot.

The width of the filter strip shall be such as to pass the discharge on to the strip from a 25 year, 24-hour rainfall at a depth of 1 inch using Manning's n = 0.24.

The flow length of the buffer strip shall be placed perpendicular to the slope contours to promote sheet flow. Means such as gravel spreaders or gated pipes should be used to promote sheet flow across the width of the buffer strip.

## CONSIDERATIONS

- More than one overland flow treatment strip should be considered to allow for resting, harvesting vegetation, maintenance, and to minimize the potential for overloading.
- Use warm and cool season species in separate areas to ensure that plants are actively growing to maximize nutrient uptake during different times of the year.
- Utilize inlet control structures to prevent undesirable debris from entering the VTA, to control the rate and timing of inflow during normal operations and to control inflow as necessary for operation and maintenance.
- Supplement water as necessary to maintain plants in a condition suitable for the treatment purpose.
- Store seasonal contaminated water upstream of the VTA during excessively wet or cold climatic conditions.
- Consider pretreating overland flow influent with solid/liquid separation to reduce organic loading, odor generation, and maintenance requirements
- Consider suspension of application to treatment strips when weather conditions are not favorable for aerobic activity or when soil temperatures are lower than 39<sup>0</sup> F. When soil temperatures are between 39<sup>0</sup> F and 50<sup>0</sup> F reduction of application rate and increased application period while maintaining the hydraulic loading rate constant should also be considered.
- Manage the VTA to maintain effectiveness throughout the growing season. Time the harvest of the VTA plants so vegetation can regrow to a sufficient height to effectively filter effluent late in the growing season.
- Effluent from the VTA may be stored for land application, recycled through the wastewater management system, or otherwise used in the agricultural operation.
- Air Quality. The need for odor control must be considered in selecting system components and location.
- Wetlands. In some cases waste management systems can adversely affect wetlands. Minnesota NRCS policy regarding work

affecting wetlands is found in the General Manual, Title 190, Part 410-Compliance with NEPA. Other federal, state or local permits or restrictions may apply to activities impacting wetlands. The Army Corps of Engineers administers Clean Water Act permits, the Local Government Unit administers State Wetland Conservation Act permits and the Minnesota Department of Natural Resources administers protected water permits.

- Safety. Safety features and devices shall be included in waste management systems, as appropriate, to protect animals and humans from drowning, dangerous gases, and other hazards. Fencing shall be provided, as necessary, to discourage human entry and to prevent livestock from using facilities for other purposes. Warning signs are required for storage ponds, storage structures, confined spaces and other facilities that may present a hazard to humans.

## PLANS AND SPECIFICATIONS

Plans and specifications shall be prepared in accordance with the criteria of this standard and shall describe the requirements for applying the practice to achieve its intended use. Plans should include information about the location, construction sequence, and vegetation establishment.

Plans and Specifications will include:

- A location map or plan view showing the location of the VTA
- Length, width, and slope of the treatment strips to accomplish the planned purpose (length refers to flow length down the slope of the treatment strip)
- Herbaceous species and seed selection, and seeding rates to accomplish the planned purpose
- Planting dates, care, and handling of the seed to ensure that planted materials have an acceptable rate of survival
- Statement that only viable, certified weed free, high quality, and regionally adapted seed will be used
- Site preparation sufficient to establish and grow selected species
- Requirements of the MPCA

## OPERATION AND MAINTENANCE

An operation and maintenance plan shall be developed that is consistent with the purposes of the practice, its intended life, safety requirements, and the criteria for its design. The plan shall include the following as appropriate:

- Requirement to harvest the treatment strip vegetation as appropriate to encourage dense growth, maintain an upright growth habit, and remove nutrients and other contaminants that are contained in the plant tissue. Include harvesting suggestions developed with the operator.
- Control undesired weed species, especially state-listed noxious weeds.
- Inspect and repair treatment strips after storm events to fill in gullies, remove flow disrupting sediment accumulation, re-seed disturbed areas, and take other measures to prevent concentrated flow.
- Maintain or restore the treatment strip as necessary by periodically grading when deposition jeopardizes its function, and then reestablishing to herbaceous vegetation.
- The requirement for safety warnings, particularly where there is danger of drowning or exposure to poisonous or explosive gases.
- Specify the maximum operation levels for impoundments.
- Sediment removal recommendations for impoundments and settling basins.
- Discharge schedules for controlled discharge vegetated treatment strip impoundments and from milk house wastewater settling tanks.
- Details for maintaining a level cross width of treatment strips.
- Maintenance requirements for other components.
- Routinely de-thatch and/or aerate treatment strips used for treating runoff from livestock holding areas in order to promote infiltration
- Conduct maintenance activities only when the treatment strip is dry and moisture content in the surface soil layer will not allow compaction
- Prevent grazing in treatment strips

## REFERENCES

USDA/NRCS, National Engineering Handbook, Part 651, Agricultural Waste Management Field Handbook.1992, Last revised, June 1999.

Koelsch, R., B. Kintzer, and D. Meyer. (ed.) 2006. Vegetated Treatment Systems for Open Lot Runoff - A Collaborative Report. USDA, NRCS. <http://www.heartlandwq.iastate.edu/ManureManagement/AlternativeTech/Avtsguidance/>