

## CONSERVATION PRACTICE STANDARD

### VEGETATED TREATMENT AREA

(Ac.)

#### CODE 635

#### DEFINITION

An area of permanent vegetation used for agricultural wastewater treatment.

#### PURPOSE

To improve water quality by reducing loading of nutrients, organics, pathogens, and other contaminants associated with livestock, poultry, and other agricultural operations.

#### CONDITIONS WHERE PRACTICE APPLIES

Where a Vegetated Treatment Area (VTA) can be constructed, operated and maintained to treat contaminated runoff from such areas as feedlots, compost areas, barnyards, and other livestock holding areas; or to treat process wastewater from agricultural operations.

#### CRITERIA

##### General Criteria

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

Treatment areas shall not be located within 50 feet of the 25-year, 24-hour floodway of any stream, 50 feet up gradient from an open sinkhole, 50 feet up gradient from a spring, or 100 feet from a water well.

Clean water runoff from the 25-year, 24-hour storm shall be diverted away from the treatment area to the fullest extent possible. Clean water runoff that is not diverted shall be included in the design of the treatment area and components.

Inflow to vegetated treatment areas shall be pretreated by settling or other appropriate methods.

Discharge to and through treatment areas shall be as sheet flow or uniform sprinkler application.

If sheet flow is used, design flow depth must be limited to no more than 0.5" to maintain a sheet flow condition. 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 area. Land grading and structural components necessary to maintain sheet flow throughout the length (dimension parallel to the flow) of the treatment area shall be provided as necessary.

If sprinkler application is used, the sprinkler system shall be designed to provide uniform coverage over the entire treatment area. The application rate shall not exceed the lesser of the soil infiltration rate or the nutrient uptake rate.

Dosing and distribution systems shall be designed to meet the criteria in the Manure Transfer Standard (PA634) or Irrigation System, Sprinkler Standard (PA442).

Permanent herbaceous 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. Vegetation shall be able to withstand anticipated wetting and/or saturated soil conditions.

The Critical Area Planting Standard and Specification (PA342) shall be used to determine vegetative requirements adapted to the site and the water, sediment, nutrients, and pollutants to be applied to the treatment area.

No plants listed on the noxious weed list of the state will be established in the treatment area.

The nitrogen and phosphorus loading shall not exceed the vegetation's agronomic nutrient requirement. Harvesting of vegetation shall be used to prevent build up of nutrients in the treatment area. If harvested by grazing, the manure deposited in the treatment area shall be included in the nutrient balance.

The treatment area shall be fenced according to the Fencing Standard and Specification (PA382) to control grazing if livestock will have access to the treatment area.

Designs shall be based on NRCS Design Guide PA-5, the Slow Rate Process in the latest edition of the *Environmental Protection Agency Technology Transfer Process Design Manual for Land Treatment of Municipal Wastewater*, or other technically acceptable reference approved by the State Conservation Engineer.

Base the total treatment area for the VTA on the soil's capacity to infiltrate and retain runoff within the root zone and the vegetation's agronomic nutrient requirements. Use the soil's water holding capacity in the root zone, infiltration rate, permeability, and hydraulic conductivity to determine its ability to absorb and retain runoff. Base the runoff determination on the most restrictive soil layer within the root zone regardless of its thickness. These criteria can be met by using Pa NRCS Design Guide 5.

Design the VTA based on the need to treat the runoff volume from the 25-year, 24-hour storm event from the agricultural animal management facility. Infiltrate a portion or the entire volume of the design storm, based on management objectives. The portion of the design volume not infiltrated shall be stored for utilization or treatment unless discharge is permitted by applicable regulations. These criteria can be met by using Pa NRCS Design Guide 5.

Treatment areas with more than one type of wastewater shall meet the criteria for each type.

The water table shall be either naturally deep enough or artificially lowered so that the infiltrated runoff does not mingle with the

ground water at the bottom of the root zone. Subsurface drainage shall not be provided within the VTA. Subsurface drainage may be used to lower the seasonal high water table to an acceptable level provided the subsurface drain lines are at least 10 feet away from the VTA.

#### **Additional Criteria for Treating Wastewater from Runoff Sources**

These criteria apply to treatment areas for runoff from feedlots, barnyards, manure stacking facilities, and composting facilities.

A settling facility shall be provided between the waste source and treatment area. The settling facility shall have sufficient storage capacity and outlet control to reduce the 25-year peak flow to the peak flow from the 2-year storm. Additional storage capacity, based on frequency of cleaning, shall be provided for manure and other solids settled within the basin. If the facility is to be cleaned after every significant runoff event, additional storage equivalent to at least 0.5" from the drainage area shall be provided. If infrequent cleaning of the facility is planned, additional storage equivalent to at least 0.5 in. from the drainage area shall be provided for each month between planned cleanings.

The settling facility shall be designed to completely empty within 24 hours, and not produce a sustained trickle flow to the treatment area. The outlet from the settling facility shall be gravity flow or be pumped.

If the wastewater is expected to contain floating solids, the settling facility shall be equipped with screens or baffles.

In addition, the criteria in the Sediment Basin Standard (PA350) shall be met if the contributing drainage area exceeds one acre or the settling facility includes an embankment greater than three feet high.

The design hydraulic loading shall be based on the more restrictive of two limiting conditions:

- a. The capacity of the soil profile to assimilate the volume of runoff from the 25-year, 24-hour storm within the root zone, or
- b. The nitrogen concentration in the water percolating below the root zone. The

percolate total nitrogen concentration leaving the root zone shall not exceed 10 mg/L.

The treatment area shall be pressure dosed (except as noted below) with the effluent from the settling facility using a pump, siphon, or flout, at a rate in excess of the soil infiltration rate to force the water to flow down the slope as sheet flow.

Pressure dosing is required in all cases unless the following conditions are met:

- the wastewater source is a paved barnyard or feedlot,
- the slope length of the barnyard or feedlot plus any other contributing drainage area is no more than 50 feet,
- roof water is routed away from the feedlot,
- the storage area or pad provides sufficient detention time to reduce the peak flow entering the treatment area to a 2-year storm event or less,
- the lower edge of the barnyard or feedlot is constructed on the contour,
- the barnyard or feedlot and any upslope drainage area are no wider than the lower edge of the barnyard or feedlot,
- the settling facility must be cleaned at least weekly
- the treatment area will be as wide as the lower edge of the barnyard or feedlot,
- the average treatment area slope will be at least 1%, but no more than 25%,
- the treatment area is not within the groundwater recharge area of a public water supply,
- the treatment area is not within the watershed of a high quality or exceptional value stream,
- the soil in the treatment area is at least 40 inches to bedrock,
- the soil in the treatment area is in NRCS soil intake family 0.3 to 0.5 (NRCS soil intake families 0.3 to 1.0 can be used if underlain by a fragipan that will prevent deep percolation). Soil intake families are defined in Design Guide #5, Table 2.

Storage shall be provided when the amount of available wastewater exceeds the design hydraulic loading rate or for treatment area non-operating periods.

#### **Additional Criteria for Treating Wastewater from Process Sources**

These criteria apply to treatment areas for wastewater from milking centers, on-farm food processing, silos, and Waste Treatment Lagoons (PA359).

If floatable or settleable solids are expected in the waste water, provide a settling facility with a minimum of two-day detention volume. The outlet from this settling facility shall be gravity flow. If the wastewater is expected to contain floatable solids, the inlet shall be equipped with a baffle, and the outlet shall be submerged at least 1/4 of the useable tank depth or be equipped with a gas deflector.

A pump, siphon, or flout for distribution of wastewater shall be located in a dosing tank separate from the settling facility.

The treatment area shall be dosed with the volume of flow from the wastewater source or from the settling facility where required. The peak flow used to size the treatment area shall be based on the capacity of the pump, siphon, or flout.

A sheet flow system shall apply wastewater to the treatment area on no more than one of any three consecutive days. Sprinkler systems may apply wastewater daily if all other criteria are met.

The minimum treatment area size shall be determined by the greater of:

- a. Hydraulic loading - provide an area adequate for a maximum application depth of 2" per week including direct precipitation on the treatment area, based on the highest long term average monthly precipitation for the locality. The weekly application depth shall not exceed the available water capacity of the treatment area soils within the root zone, or
- b. Nutrient loading rate – the annual nitrogen and phosphorus loads and any other nutrient applications shall not exceed the crop removal rate of the treatment area vegetation.

**Additional Criteria for Treating Constructed Wetland Effluent**

These criteria apply to treatment areas which receive the effluent from Constructed Wetlands (PA656).

The minimum treatment area size shall be determined by the greater of:

- a. Hydraulic loading rate - provide an area adequate for a maximum application rate of 2" per week including direct precipitation on the treatment area, based on the highest long term average monthly precipitation for the locality. The weekly application rate shall be compatible with the treatment area soils to prevent percolation below the root zone and surface runoff from the treatment area under normal soil conditions, or
- b. The length and width required to infiltrate the 25-year 24-hour outflow hydrograph from the wetland with sheet flow in the treatment area.
- c. Nutrient loading rate – the annual nitrogen and phosphorus loads and any other nutrient applications shall not exceed the crop removal rate of the treatment area vegetation.

Settling, dosing, and three-day rest periods are not required.

The treatment area shall be no wider than the wetland cell providing the effluent, unless pressure dosing is used.

**CONSIDERATIONS**

- More than one treatment area should be considered to allow for resting, harvesting vegetation, maintenance, and to minimize the potential for overloading.
- Consider additional pretreatment to reduce organic and nutrient loading, odor generation, and maintenance requirements.
- Consider suspension of application to treatment areas when weather conditions are not favorable for aerobic activity or when soil temperatures are lower than 39<sup>0</sup> F in the soil treatment zone. When soil temperatures are between 39<sup>0</sup> F and 50<sup>0</sup> F the reduction of application rate and

increased application period, while maintaining the hydraulic loading rate constant, should also be considered.

- Consider chemical make up and pH of process wastewater if large quantities of cleaning agents, disinfectants, or other chemicals are being used.
- Consider using existing, well-developed vegetation for the treatment area if the slope is acceptably uniform in cross section to provide sheet flow within the design flow length.
- Consider the use of cross-slope stone berms or shallow furrows on the contour at 50-foot intervals to maintain sheet flow, especially where an existing vegetated site is being used without regrading.
- Consider potential adverse health affects of grazing to harvest vegetation and the need to prevent overgrazing and soil compaction.
- Consider storing the effluent from the VTA for land application, recycling through the wastewater management system, or otherwise using in the agricultural operation.
- Consider managing 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.
- Consider storing seasonal contaminated water upstream of the VTA during excessively wet or cold climatic conditions.
- Consider using 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.

**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, materials needed, construction sequence, and vegetation establishment.

Specifications will include:

- Length, width, and slope of the treatment areas to accomplish the planned purpose (length refers to flow length down the slope of the treatment area)
- Fencing requirements and setback limitations, if applicable
- 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

#### **OPERATION AND MAINTENANCE**

An Operation and Maintenance Plan shall be developed and reviewed with the landowner. It shall be consistent with the purposes of the practice, its intended life, safety requirements, and its design. The plan shall include the following:

- Harvest treatment area 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
- If vegetation is harvested by grazing livestock, care must be taken to limit this to dry soil conditions, and prevent

overgrazing, soil compaction, and trampling of vegetation

- Control undesired weed species, especially state-listed noxious weeds
- Inspect and repair treatment areas after storm events to fill in gullies, remove flow disrupting sediment accumulation, re-seed disturbed areas, and take other measures to prevent concentrated flow
- Apply supplemental nutrients as needed to maintain the desired species composition and stand density of herbaceous vegetation
- Maintain or restore the treatment area as necessary by periodically grading if deposition jeopardizes its function, and then reestablishing to herbaceous vegetation
- Conduct maintenance activities only when the treatment area is dry and moisture content in the surface soil layer will not allow compaction

#### **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/>