NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

VEGETATED TREATMENT AREA

CODE 635

(Ac.)

DEFINITION

An area of permanent vegetation used for agricultural wastewater treatment.

PURPOSE

Improve water quality by using vegetation to reduce the loading of nutrients, organics, pathogens, and other contaminants associated with livestock, poultry, and other agricultural operations.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where:

- A vegetated treatment area (VTA) can be constructed, operated and maintained to treat contaminated runoff from such areas as feedlots, feed storage, compost areas, solid manure storage areas, barnyards, and other livestock holding areas; or to treat process wastewater from agricultural operations.
- A VTA is a component of a planned agricultural waste management system.

CRITERIA

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

Base designs on the Slow Rate Process described in the latest edition of the Environmental Protection Agency “Technology Transfer Process Design Manual for Land Treatment of Municipal Wastewater” or other technically acceptable references. Refer to additional criteria within this standard as well as the references section for further design guidance.

Size the total treatment area for the VTA on both the contributing site water runoff and vegetation nutrient balances.

- Water balance is the soil’s capacity to infiltrate and retain runoff within the root zone. Base the runoff determination on the most restrictive soil layer within the root zone regardless of its thickness. 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.
- Nutrient balance utilizes the nutrients from the waste runoff to meet the nutrient removal requirements in the harvested vegetation. Base the nutrient balance on the most limiting nutrient (i.e. nitrogen or phosphorus).

Divert uncontaminated water from the treatment area to the fullest extent possible unless additional moisture is needed to manage vegetation growth in the treatment area.

Establish permanent vegetation in the treatment area. Use a single species or a mixture of grasses, legumes, and other forbs adapted to the soil and climate. Select species to meet the 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. Complete site preparation and seeding at a time and in a manner that best ensures survival and growth of the selected species.

Select vegetation that will withstand anticipated wetting or submerged conditions. Harvest 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.

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. Unless discharge is permitted by applicable regulations, store the noninfiltrated portion of the design volume for utilization or treatment.

Exclude all livestock, including grazing, from the VTA.

Apply discharge into and through vegetated treatment area as sheet flow. To encourage sheet flow across the treatment area, provide a means to disperse concentrated flow, such as a ditch, curb, gated pipe, level spreader, or a sprinkler system. Provisions should be made to prevent sustained trickle flow from entering the treatment area. Complete land grading and install structural components necessary to maintain sheet flow throughout the treatment area.

Limit the natural or constructed slope of the VTA from 0.3 to 6 percent, although slopes from 2 to 6 percent are recommended. The minimum entrance slope to the VTA is 1 percent. The flow length of the area shall be sufficient to provide a minimum of 15 minutes of flow-through time, calculated using an appropriate Manning's n-value at a design flow depth of 0.5 inch or less. The minimum flow length is 100 feet. This flow length criterion does not apply to VTAs receiving wastewater through a sprinkler system. The design application depth shall not exceed 25% of the available water capacity of the soil within the root zone and above the seasonal water table and/or bedrock.

Use NRCS Conservation Practice Standard (CPS) Code 632, Waste Separation Facility, to pretreat influent with waste separation (i.e., settling basin) to reduce organic loading and nutrients to levels that are tolerated by the VTA and to prevent excessive accumulation of solids in the treatment area. If the wastewater is expected to contain floating solids, the settling facility shall be equipped with screens or baffles. Further storage may be required when the amount of available wastewater exceeds the design hydraulic loading rate or for non-operating treatment periods. Pumps, siphons, tanks, and other devices required for transporting and dosing of wastewater shall meet the applicable NRCS standards.

Utilize inlet control structures to control the rate and timing of inflow during normal operations and to control inflow as necessary for operation and maintenance.

Locate VTAs outside of floodplains. However, if site restrictions require location within a floodplain, provide protection from inundation or damage from a 25-year flood event, or larger, if required by regulation. The entire treatment area shall be at least 100 feet from a drinking well, and the area shall not discharge in the direction of a well. The minimum separation distance of the lower end of the area from surface water, wetland, surface drain, road ditch, or other conveyance that discharges to surface water or wetland should be a minimum of 100 feet.

Install VTAs where the water table is either naturally deep or artificially lowered so that the infiltrated runoff does not mingle with the groundwater at the bottom of the root zone. There shall be a minimum of 2 feet of soil depth between the finished surface of the treatment area and the seasonal high water table, and a minimum of 3 feet of soil depth to bedrock. Subsurface drainage within the VTA is not allowed.

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 boundary.

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

Ensure that appropriate erosion control measures and sheet flow control measures (i.e., gravel spreaders) are adequately addressed over the entire length of the VTA.

High concentrated silage effluent must not be applied or allowed to discharge onto the treatment area. The concentrated effluent must be stored separately and applied to the land according to nutrient management plan, or diluted at least 1:1 with clean water prior to applying to a treatment area. If leachate is diluted and applied to a treatment area, then provisions must be included in the design to adjust the level of dilution in case the vegetation on the area is damaged by the 1:1 dilution. Water shall flow to the treatment area only during storm runoff events or after dilution.

Additional Criteria for Pressure Dosing Systems

Distribute the effluent over the VTA through sprinkler irrigation or other pressure dosing system. Match the application rate of sprinkler nozzles to the most restrictive soil infiltration rate or other factors to prevent effluent from discharging from the VTA.

CONSIDERATIONS

Additional nutrient and infiltration design guidance in Vegetated Treatment Systems for Open Lot Runoff, (Koelsch, et. al., 2006).

Provide more than one vegetated treatment area to allow for resting, harvesting vegetation, and maintenance, and to minimize the potential for overloading.

Provide additional storage in the basin collection area to minimize or eliminate discharge into the VTA during rainfall events. Delay application until rainfall has ended to improve infiltration and nutrient uptake.

To maximize nutrient uptake, use warm and cool season species in separate areas to ensure that plants are actively growing during different times of the year.

Supplement water as necessary to maintain plants in a condition suitable for the treatment purpose.

Direct contaminated effluent to a waste storage facility during excessively wet or cold climatic conditions.

Consider suspension of application to treatment area when weather conditions are not favorable for aerobic activity or when soil temperatures are lower than 39° F. When soil temperatures are between 39° F and 50° F, consider reducing application rate and increasing application period while maintaining a constant hydraulic loading rate.

Manage the VTA to maintain vegetative treatment 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.

Install a berm around the lower end of the VTA to contain excess runoff that may occur.

Effluent from the VTA may be stored for land application, recycled through the wastewater management system, or otherwise used in the agricultural operation.

Install fences or other measures to exclude or minimize access of the VTA to humans or animals.

Install a pumping system at the bottom of the VTA to either recirculate the effluent to the top of the VTA or transfer to a waste storage facility.

Consider relocation of barnyards to provide more separation from water resources and allow more room for treatment of runoff.

Cover silos to prevent rainfall from entering and leaching through the silage or haylage.

Divert all surface water from bunk silos, and subsurface water should be intercepted and diverted before it becomes contaminated.

Consider using silage bags instead of bunk silos to reduce the potential for producing leachate.

If possible, add silage leachate to liquid or slurry waste storage facilities. However, do not mix silage with manure in enclosed tanks because silage accelerates the release of hydrogen sulphide gas from manure. Mix only with manure in uncovered, outdoor storage facilities.

PLANS AND SPECIFICATIONS

Prepare plans and specifications that describe the requirements for applying the practice to achieve its intended use.

As a minimum include:

- Critical construction perimeters, necessary construction sequence, vegetation establishment requirements, level spreader mechanism requirements, associated practices and agronomic nutrient removal
- Plan view showing the location of the VTA
- Details of the length, width, and slope of the treatment area to accomplish the planned purpose (length refers to flow length down the slope of the treatment area)
- Herbaceous species, 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
- Site preparation sufficient to establish and grow selected species

OPERATION AND MAINTENANCE

Develop an operation and maintenance plan consistent with the purposes of the practice, its intended life, safety requirements, and the criteria for its design.

Include the following items as appropriate:

- Control undesired weed species, especially state-listed noxious weeds, and other pests that could inhibit proper functioning of the VTA
- Inspect and repair treatment areas after storm events to address gullies, reseed disturbed areas, and prevent concentrated flow
- Apply supplemental nutrients and soil amendments 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 or removing excess material when deposition jeopardizes its function. Reestablish herbaceous vegetation
- Routinely dethatch or aerate a treatment area used for treating runoff from livestock holding areas in order to promote infiltration
- Conduct maintenance activities only when the surface layer of the VTA is dry enough to prohibit compaction

Monitor treatment areas in arid or semiarid regions that potentially could be affected by high salinity or sodium content for excessive salt and sodium buildup. Take corrective action if excessive salt or sodium is found.

Monitor all treatment areas to maintain optimal crop growth and environmental protection. Ensure that neither phosphorus is accumulating in the soil profile, nor nitrogen is leaching below the root zone.

REFERENCES

USDA/NRCS, National Engineering Handbook, Part 651, Agricultural Waste Management Field Handbook.

Koelsch, R., B. Kintzer, and D. Meyer. (ed.) 2006. Vegetated Treatment Systems for Open Lot Runoff - A Collaborative Report. USDA, NRCS.

USDA/NRCS, Massachusetts, Vegetated Treatment Area Code 635, November 2010, and associated references.

EPA, Process Design Manual - Land Treatment of Municipal Wastewater, EPA, 1981.

USDA/ARS, Chapter VI, Vegetative Treatment Area Design, 2004, 5th Draft.

USDA/NRCS, Ohio, Chapter 10 – Agricultural Waste Management System Component Design, Vegetated Treatment Area Design Guide, March 2008.