Section 1 Introduction to Vegetative Treatment Systems

Section 1 Introduction to Vegetative Treatment Systems

Contents

Tables

Section 1 Introduction to Vegetative Treatment Systems

Topics

- Application of information to animal feeding operations (AFO) and concentrated animal feeding operations (CAFO)
- Why consider a vegetative treatment system (VTS)
- Summary of guidance document contents
- Supporting U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Practice Standards

Purpose

Runoff from open lot livestock production systems poises a risk to the environment. Contaminants in this runoff can produce fish kills due to ammonia and organic solids, eutrophication (algae blooms) due to nutrients, drinking water quality risks due to pathogens and nitrogen, and risk to recreational uses of water due to pathogens and other contaminants. Controlling and managing manure-contaminated runoff is a responsibility of every livestock producer.

Traditionally, runoff containment or holding ponds have been used to collect and store runoff until it is practical to land apply. This conventional approach is currently the only acceptable approach for large CAFOs based upon current federal regulations. A holding pond designed to meet current regulations performs well in the drier areas of the High Plains, but is difficult to manage to avoid unplanned releases in higher precipitation climates. To avoid discharges, collected runoff must often be land applied under less than desirable soil conditions. Thus, alternatives to this traditional approach are being examined.

This document introduces the use of VTSs for managing open lot runoff. A VTS approach utilizes forage or grass-based production areas to filter contaminants and infiltrate runoff in the soil. Significant research over the past 30 years has demonstrated the performance of these systems, typically on smaller livestock operations. This document focuses on application of a VTS to achieve the water quality goals of the United States relative to managing runoff on CAFOs. It summarizes the research and makes recommendations relative to siting, design, and management for achieving those water quality goals with VTS. In many circumstances, a VTS may also benefit the producer in terms of reduced capital cost, less management complexity, and reduced odor nuisances.

This document targets the performance standards required of a large CAFO and the design and management considerations of a vegetative system for meeting those standards specific to open lot runoff. This information should be useful to all AFOs. However, other siting, design, and management options may be acceptable locally for operations not required to maintain a regulatory permit.

Application to AFOs and CAFOs

Those livestock operations defined as a large CAFO must recognize that VTSs can only be utilized under the Voluntary Alternative Performance Standards of the CAFO permit program. This standard places the burden of proof on the individual large CAFO to demonstrate that this technology will perform equal or better than the conventional technology (runoff holding pond) allowed under these rules. The focus of this document is to help the large CAFO recognize the key siting, design, and management issues that must be considered to attain this level of performance. The recommendations made in this document target issues critical to the large CAFO.

Most other AFOs are not required to meet this same standard. Discussion on identifying systems options, siting systems, design of plant based systems, and management of systems will be helpful to all AFOs regardless of the need for an environmental permit. However, other approaches not discussed in this document may be equally appropriate. AFOs should consult with a local NRCS office, State environmental agency, or private sector technical service provider to identify if other options are available that meet the AFOs' environmental and economic goals.

Caution for large CAFOs

Existing large CAFOs have been required to control open lot runoff and maintain a National Pollution Discharge System (NPDES) permit since the mid-1970s. Open lot beef cattle and dairy operations with more than 1,000 and 700 head capacity, respectively, without an NPDES permit (or letter of exemption) are currently out of compliance. Additional implementation delays for a runoff control system produce significant legal liability and environmental risk until the date of achieving compliance. If implementation of a VTS will add to this delay, a more conventional system should be strongly considered.

Current and past research and field performance studies on VTS have been done exclusively on smaller open lot systems. At the time of this document, no performance evaluations of VTS on large CAFOs have been conducted. The design, siting, and management recommendations in this document are the combined best professional judgment of a team of researchers from land grant university and USDA Agricultural Research Service (ARS), field engineers from NRCS and private sector, and regulatory representatives. Those recommendations target VTS application to large CAFOs based upon the currently available knowledge.

However, if the recommendations contained in this document are carefully followed, producers and design consultants must recognize that permitting of a VTS on large CAFOs will include a burden of proof not required of a baseline technology. In addition, there are risks associated with alternative technologies if that burden of proof is not met during the design phase or in field performance is less than predicted during the operation of the VTS.

Why consider a vegetative treatment system

VTS can offer several environmental and economic benefits over a conventional holding pond and irrigation system. Some of the more common benefits include:

- Reduced capital and operating costs for some systems involving vegetative treatment options (sec. 3).
- Reduced odor and other air emissions from most systems involving vegetative treatment options as opposed to a holding pond and sprinkler irrigation system. Visually, a VTS is also more aesthetically acceptable than a holding pond.
- Little or no long-term storage of runoff in earthen ponds, resulting in less ground water risk for most systems involving vegetative treatment options.
- Lower risk of system catastrophic failures due to poor design, management, or unplanned weather events.
- Reliance on cropping systems based upon forages or grasses, as opposed to row crops (corn and soybeans). These crops provide a longer season for nutrient removal and water evapotranspiration, reducing the risk of land application of runoff early in spring and late in fall. If managed properly, these crops provide thick, dormant vegetation that also reduces environmental risk of land application of runoff during the winter. Because of the use of perennial vegetation, surface water risks should be a minor issue for well-managed systems.

From the above list, why would any producer not select a VTS for managing runoff? The design and management of a VTS include some challenges that must be recognized when this option is selected. Some of the more critical considerations include:

- Many VTS will only be accepted under the Voluntary Alternative Performance Standards set by the CAFO regulations. The burden of proof is currently placed on the producer to document that a VTS will perform equally or better than baseline technology (pond and irrigation system). Additional costs will be incurred in obtaining an NPDES permit at the time this publication was prepared.
- Improper design or management of a VTS has a risk of surface water discharge. Planner or producer mistakes could place a producer at a greater risk of violation of environmental regulations. Until VTS becomes an accepted technology by the regulatory community, a producer must accept that the permitting authority for the NPDES program could require livestock operations to replace poor performing VTS with conventional systems to maintain the NPDES permit.
- A well-managed VTS will not distribute nutrients as uniformly as a pivot irrigation system. The potential for nitrate contamination of ground water due to excess nutrients in the headlands of a vegetative treatment area (VTA) must constantly be monitored. Monitoring of VTA soil nutrient status and maintenance of uniform distribution of runoff will require a greater investment of time and financial resources than a conventional system.

Summary of guidance document contents

This publication has nine sections addressing the following issues:

- Section 2—*Understanding Environmental Regulations and Procedures for Evaluating Alternative Technologies* summarizes the regulatory standard set by the U.S. Environmental Protection Agency (EPA) for open lot runoff and the process by which alternative technologies, such as vegetative treatment systems, may be considered acceptable for an NPDES permit.
- Section 3—*Systems Options Based upon Vegetative Treatment Areas* summarizes the primary plant-based treatment technologies options for managing runoff and describes several combinations of treatment technologies (including vegetative systems) that produce a low risk of discharge and potential for application on CAFOs.
- Section 4—*Siting Criteria for Vegetative Treatment Systems* provides procedures for reviewing a potential site for risk factors associated for the location of a VTS.
- Section 5—*Liquid-Solid Separation* describes design considerations for solids removal and the role it plays in a VTS.
- Section 6—*Vegetative Treatment Area Design* describes in detail critical design considerations including sizing, distributed runoff flow, plant materials selection, and options for reducing discharge.
- Section 7—*Vegetative Infiltration Basin Design* presents in detail critical design considerations including sizing, tile drain design, and plant materials selection.
- Section 8—*Management Guidelines for Vegetative Treatment Systems* presents critical management issues including soil sampling, sheet flow maintenance, and control of runoff release. Suggested standard operating procedures and records for documenting good management for a VTS are also described.
- Section 9—*Literature Review* summarizes the current research and field experience with VTAs and vegetative infiltration basins (VIB), as well as conventional runoff control technologies.

The primary audience for this document is the technical service provider assisting with the permitting, planning, and design of a VTS. Table 1 lists common questions and the sections in which the answers are found.

Other audiences including the permit writer, livestock producer, or policy maker may find specific components of this document useful. Table 1–2 lists questions common to other audiences and may help identify parts of the document that are of greatest benefit to these audiences.

Table 1–1 Technical service providers

I am a technical service provider with the following questions:	Section
How well do vegetative systems perform?	9
What are the regulations relevant to application of a VTS to a *large*, *medium*, or *small* CAFO or to an AFO?	2
How will the performance of a VTS be compared to that of a baseline technology currently under the CAFO regulations?	2
What system options involving vegetative technologies provide the best opportunity for success?	3
What factors should be considered in reviewing a potential VTS site?	4
What design principles should be used for the:	
Settling basin or other solids removal options?	5
VTA?	6
VIB?	7
What standard operating procedures and records should be recommended for a VTS?	8
Will a VTS meet NRCS Conservation Practice Standards?	1

Table 1–2 Other audiences

I am a large CAFO and have the following questions	Section
How well do vegetative systems perform?	9
What are the regulations relevant to application of a VTS?	2
Is the site I have selected for controls appropriate for a VTS?	4
What proof must I provide EPA that a VTS works on my farm?	2
What is a VTS other than spreading runoff over a grassed area?	3, 5, 6, 7
What is the difference between a VTA and a VIB?	6, 7
What must be done to manage a VTS?	8
What records must I keep on my VTS?	8

I am with a regulatory agency and have the following questions:	Section
What research has been done with VTS?	9
How well do baseline technologies perform?	9
What tools are available for comparing a VTS and a baseline technology?	2
What design considerations minimize the potential for discharge?	3, 5, 6
What factors should be considered in reviewing a potential VTS site?	4
What design principles should be used for the:	
Settling basin or other solids removal options?	5
VTA?	6
VIB?	7
Will a VTS meet NRCS conservation practice standards?	1
What records and management procedures might be addressed by an NPDES to demonstrate a well-managed VTS?	8

Table 1–2 Other audiences—Continued

I am an AFO and have the following questions:	Section
Are there simple systems that will minimize my financial risk?	3 (options 1, 2)
What is the difference between a VTA and VIB?	3
Is the site I have selected for controls appropriate for a VTS?	4
Is a VTS more than spreading runoff over a grassed area?	3, 6, 7
How should a VTS be managed to maintain its performance?	8

Supporting NRCS practice standards

NRCS conservation practice standards provide guidance for applying conservation technology on the land and set the minimum level for acceptable application of the technology. Individual conservation practices can be collected and arranged as components of a VTS. Some conservation practice standards that are central to the design of a VTS include:

Topic	NRCS Conservation Practice Standard
Solids settling facilities	Sediment Basin (350)
Storage of feedlot runoff	Waste Storage Facility (313)
VIB	Subsurface Drain (606)
VTA	Class III Dike in Dike (356)
	Wastewater Treatment Strip (635)
Large VTA	Waste Utilization (633) Nutrient Management (590)

Some components may be considered ancillary to the major components, but, if their use is critical or extensive, they should be identified as individual components on their own. These may include:

Topic	NRCS Conservation Practice Standard
Diversion of uncontaminated runoff	Roof Runoff Structure (558) Diversion (362)
Collection and conveyance of contaminated runoff	Diversion (362) Manure Transfer (634)
Pipe drops, weirs, or other structured used to control flow	Structure for Water Control (587)
Distribution of the runoff over a VTA or VIB	Precision Land Forming (462) Irrigation Land Leveling (464)
Establishing permanent vegetation	Pasture and Hay Planting (512)
Seedbed preparation, fertilizing, seeding, and mulching for areas disturbed during the construction	Critical Area Planting (342) and Mulching (484)
Fencing out livestock or unauthorized people	Exclusion (472) and Fence (382)

Each state determines which conservation practice standards are applicable in their state. States add the specific technical detail to national standards as needed to effectively use the standards at the field office level, and issue them as state conservation practice standards. State conservation practice standards may be found in section IV of the eFOTG (Electronic Field Office Technical Guide at *http://www.nrcs.usda.gov/technical/efotg/*.

Using these practices in a VTS may be a new application of this technology. If the practice standard does not allow the desired use of the practice or if the technical criteria in the standard will not allow the practice to function as intended in this application, it may be necessary to request a variance for some of these practices. As experience in using these practices in VTS is gained, these standards can be modified at either the state or national level or, if necessary, new standards can be developed.