Livestock and Poultry Environmental Stewardship <LPES> Curriculum

# LPES Small Farms Fact Sheets*

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# Need a Vegetative Treatment System for Your Barnyard or Lot?

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## Summary

*Runoff from livestock barnyards and feedlots can kill fish and cause algae blooms in streams and lakes. Controlling and managing this runoff is the responsibility of every livestock producer. A Vegetative Treatment System (VTS) is an economical and environmentally friendly approach for managing the runoff from barnyards and lots. This fact sheet introduces the use of a VTS and how to evaluate if one is suitable for your farm. It is a companion fact sheet to "Got Barnyard Runoff?"*

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## What is a VTS?

A Vegetative Treatment System (VTS) refers to a combination of treatment steps for managing runoff. The VTS first separates the solids from the liquids in runoff. A settling basin is most commonly used to remove solids. The runoff then flows into a Vegetative Treatment Area (VTA), where soil further filters the runoff and prevents it from leaving the farm. Once the runoff is in the soil, natural processes allow plants to use the nutrients.

A VTA is an area of perennial vegetation, such as a grass or a forage. The VTA is used to treat runoff from a feedlot or barnyard. It treats runoff by settling, infiltration, and nutrient use.

A VTA is commonly confused with vegetative buffer (or filter) strips. A buffer strip is a narrow strip of vegetation (usually 30-60 feet wide), between cropland and a stream or other surface water. Runoff passes through buffers with some "filtering" of pollutants, but no attempt is made to control solids or flow. A VTS, however, collects runoff from a barnyard or feedlot, separates the solids from the liquids, and uniformly distributes the runoff to the vegetated area. Little or no runoff should leave a VTA.

## Why Consider a VTS?

Some of the more common advantages of a VTA include:

- Lower initial and operating costs.
- Less odor.
- Visually pleasing.
- No long-term storage of runoff.

Why would anyone decide against using a VTS to manage runoff? Challenges with a VTS include:

- A VTA may not be a "closed" system. Wet soils from previous rains could allow a discharge.
- When soil is frozen, runoff can create risks. Fortunately, large storms do not usually occur in winter.
- VTAs can be damaged by a lack of maintenance and attention. Gullies, erosion, and poor vegetation stands dramatically reduce their effectiveness.

After weighing the pros and cons, a well-designed and managed VTS is still an excellent option for managing the runoff from smaller farm barnyards and feedlots.

## Types of Vegetative Treatments

The six types of VTAs are sloped VTAs, infiltration basins, terraces, constructed wetlands, sprinkler VTAs, and tree treatment areas. Which one is best for your farm will depend on your site's characteristics.

### Sloped VTA

A sloped VTA refers to a treatment area that is slightly sloped. The slope allows liquid to uniformly spread across the width of the treatment area and flow the length of the VTA. Sloped VTAs should be between 1% to 5% downslope and level from side to side. Borders or berms, furrows, and cross ditches have been used to maintain uniform flow.

### Infiltration Basin

A Vegetative Infiltration Basin (VIB) is a level grass or cropped area designed to allow the liquids to "soak in." A berm, one to three feet high, is placed around the edges of a leveled area (Figure 1). VIBs can be tile drained to avoid vegetation damage from standing water. The drainage commonly contains pollutants, which must be collected and further treated with another system.

### Terrace

Terrace systems use terraced channels to contain and treat runoff on fields with steep slopes. They must be fairly large and well-maintained, and should be planted to grass.

Note berm used to contain runoff in the VIB.

Figure 1. VIB contains runoff with a berm around its edges.

Two types of terrace systems exist: (1) a flow-through terrace system that acts similar to a sloped VTA and (2) a flat channel storage terrace (water storage) similar to a VIB. Terraces used to control erosion in crop fields should not be used as a VTA without modification.

### Constructed Wetlands

Constructed wetlands can be used to manage run-off from feedlots. These shallow impoundments typically have water depths of 6 to 8 inches and contain wetland vegetation such as cattails, bulrush, or reed canary grass. Constructed wetlands typically have the smallest space requirement of any vegetative system but require very tight or low percolation soils.

### Sprinkler VTA

A sprinkler VTA is an area of perennial vegetation with runoff distributed by a sprinkler irrigation system. A solid set sprinkler, tow line, or side roll can be used to distribute the runoff collected in a settling basin. Although more expensive than gravity VTAs, sprinkler VTAs provide uniform application of runoff and nutrients, are applicable to situations where a gravity system is not feasible, and can be used with any soil texture. An all-weather pumping station is required for a sprinkler VTA.

### Tree Treatment Area

Tree filters have been used in some vegetative systems. Fast-growing softwood trees like popular or willow trees are preferred to hardwood trees such as walnut or oak. Selection of the tree is critical since many species do not tolerate saturated soils. If the soils will remain saturated for extended periods, then species such as willows are more adaptable. Softwood trees grow fast and remove more nutrients. However, they may have less economical value than hardwood trees at harvest.

Tree treatment areas may be best suited along the edges and lower end of a VTA. Normally, trees are planted in a grid pattern, and the areas between the tree rows planted to grass and harvested. This enhances the treatment area by functioning as a grass filter with additional nutrients being removed by trees.

## Combined Systems

A combined system can improve VTS performance. One of the advantages of VTSs is that they can be combined in series. For example, a VIB can be placed after a sloped VTA to treat any runoff that leaves the sloped VTA. A combination system provides an added level of assurance as opposed to a single system type. By combining systems, the contaminant reduction is increased (Table 1). The values shown in Table 1 are the authors' best estimates of typical performance for well-designed and managed treatment components. Individual conditions may result in lower performance.

Table 1. Typical contaminant concentration reductions for various treatment components associated with a dairy or beef open lot facility.

| Treatment Component | Contaminant Reduction (CR) | | | |
|---|---|---|---|---|
| | Solids | Total N | Ammonium-N | Total P |
| Settling | 60 | 80 | 80 | 80 |
| VTA | 60 | 70 | 70 | 70 |
| VIB | 80 | 80 | 85 | 80 |
| Wetland | 60 | 50 | 50 | 50 |

To estimate combined system reductions, multiply remaining contaminants (1 -reduction) for each component.

Example: A settling basin and VIB reduces solids concentration by 92%. Estimate as follows:

Reduction = {1 - [(1-CR component 1) x (1-CR component 2) x …]} x 100
= {1 - [(1 - 0.6) x (1- 0.8)]} x 100
= {1 – [0.08]} x 100
= 92%

## Evaluating a Site for a VTS

Use Table 2 to evaluate a potential site for a VTA. Do the features and characteristics of the site make it a good candidate for a VTS? Next, review VTA site characteristics that may guide the appropriate type of vegetative treatment (Figure 2) or the VTA size, shape, and location.

Evaluate each site for its risks to ground and surface water, the ability of a VTS to work with a site's limits, and the type of VTS that might best work within those limits. In many situations, a VTS is not appropriate. A runoff holding pond or abandonment of the barnyard or open lot will be necessary. Consult a design professional, preferably an experienced engineer, to assist with proper siting, design, layout, and construction of a VTS. The design professional should have prior experience with similar systems and treatment components. Individual conditions may result in lower performance.

## Planning a VTS

A VTS is composed of two primary components, a solids removing component, usually a sediment basin, and a liquid and nutrient treatment component, the vegetative area.

### Settling Basin

A settling basin is a shallow basin, usually about 3 to 4 feet deep, that can be accessed for solids cleanout at least yearly. This basin collects and slowly distributes the runoff from the lot to the VTS. Settling basins for VTSs are generally larger than those for holding ponds. Experts recommend that a settling basin for a VTS be able to control the largest expected rainstorm. Rainfall and feedlot runoff entering a VTA at the same time can overwhelm the soil's ability to absorb the water. VTA performance is improved if the outlet between the settling basin and the VTA is (1) controlled by a valve to allow the best time for the release of basin liquids or (2) by an orifice in the pipe that slowly releases the runoff from a large rainstorm over 36 to 72 hours. These options prevent or limit the addition of runoff to the VTS during the rain storm and minimize the chance of a discharge leaving the farm.

Table 2. Will a VTS work for you? Read the site features in the left column and check/circle the description of the actual site condition columns to the right of that feature.

| **Start Here: Review Site Features for Proposed Site** | **Next, circle description that best describes your proposed VTA site:** | | |
|---|---|---|---|
| | **Probably not a good site for a VTS** | **Maybe, condition is marginal for a VTS** | **Good chance the site will be suitable for a VTS** |
| VTA soil depth | Very shallow soils, less than 20 inches | Shallow, 20-48 inches deep | More than 48 inches deep |
| Depth to groundwater | Less than 10 ft | 10-50 ft | More than 50 ft |
| VTA soil type | Sand or gravel | High clay content soils | Silts and low clay content soils |
| Potential for flooding of proposed VTA site | Floods often | Floods rarely | Site never floods |
| Where does runoff leaving the VTA drain? | Stream, natural wetland, or other surface water. | Ditch, waterway, or natural drain. VTA runoff drains to crop or pasture land. | Topography or planned berm does not allow runoff from site. |
| Area for a VTA | < 0.5 acres of VTA to 1 acre of feedlot. Site may still be acceptable for VIB or constructed wetland. | Between 0.5 and 2 acres of VTA per 1 acre of feedlot. Site may still be acceptable for VIB or constructed wetland. | More than 2 acres of VTA to 1 acre of feedlot. |
| Soil phosphorus levels of proposed VTA site? | More than 150 ppm Bray 1, More than 100 ppm Melich or comparable soils analysis | More than 100 ppm Bray 1, more than 70 ppm Melich or comparable soils analysis | Less than 50 ppm Bray 1, less than 35 ppm Melich or comparable soils analysis |

*Are most of your responses in the "Good chance" or "Maybe" columns?* This site has good potential for a VTA application. A second opinion from local Soil and Water Conservation District or USDA Natural Resource Conservation Service staff or local technical expert is encouraged.

*Are there one or more responses in the "Probably not" or "Maybe" column?* This site is most likely not a good candidate for a VTS. Further evaluation is necessary to determine the site's suitability; contact a local Soil and Water Conservation District, USDA NRCS representative, or other technical service provider for a more in-depth assessment.

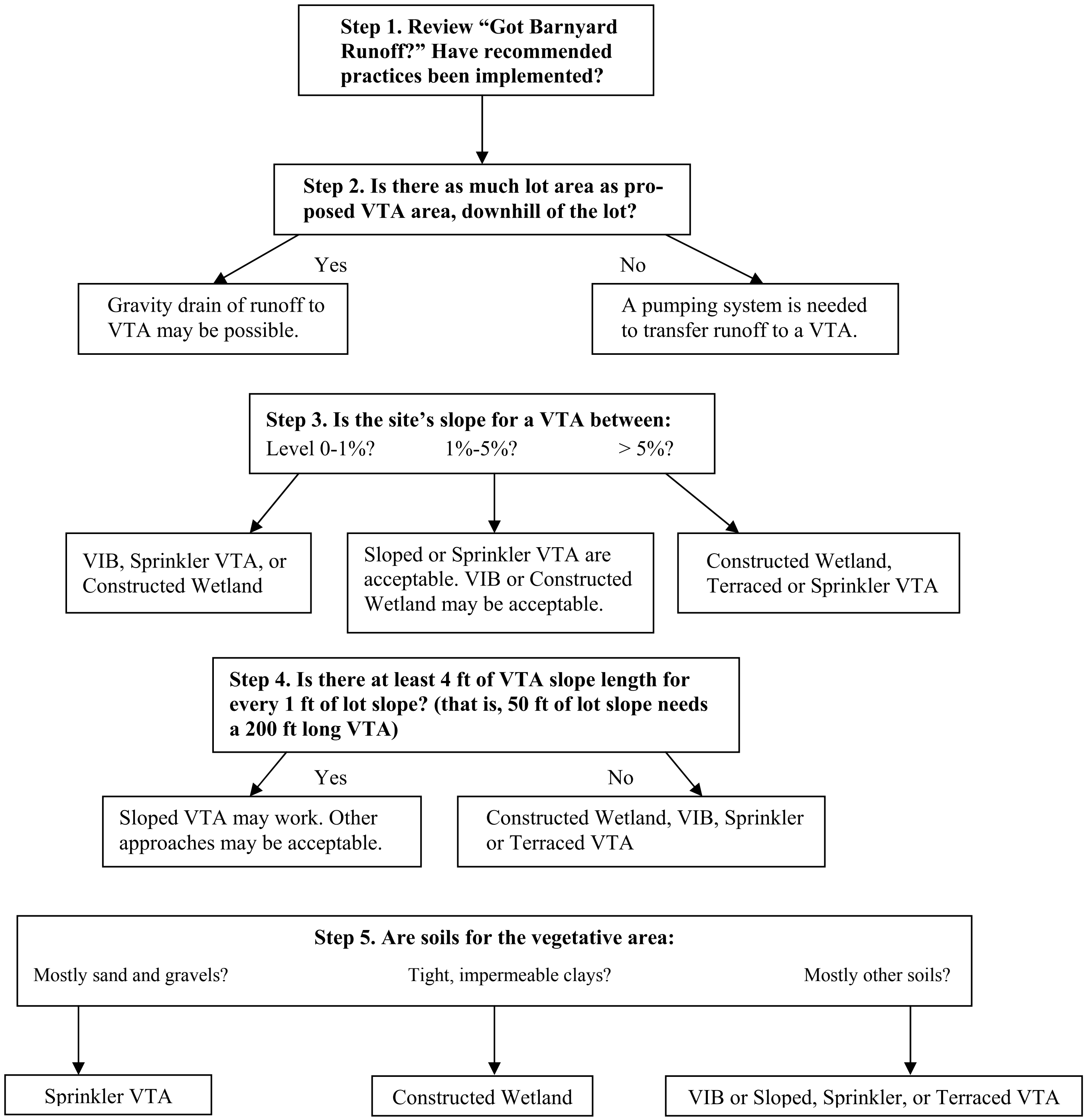


Figure 2. If Table 2 suggests that the proposed site is acceptable, consider the above site characteristics to select the appropriate type of vegetative treatment.

The outlet from a settling basin should be protected from equipment and debris entering the outlet pipe (Figure 3). If a pumping station is used in places that experience cold weather, the pump and the application system must be operational and protected from freezing temperatures. A settling basin is not built for long-term storage. Runoff is applied during or shortly after storms, including those occurring during the winter.

## Sloped and Sprinkler VTAs and VIBs

Two methods are commonly used to size a VTA. Typically, the most conservative method is to size the VTA to use the nutrients in the run-off water. A match of crop nitrogen consumption with runoff nitrogen is common. The second method is a water balance method. The soil's infiltration rate is balanced with the largest expected rainfall.

A good rule is that a VTA needs to be at least as large as the feedlot area. If local sizing procedures are available from your land-grant university or USDA Natural Resource Conservation Service (NRCS), those recommendations should be used. Consult design professionals or technical consultants experienced with VTS design.

Creating uniform or sheet flow across a VTA is important (Figure 4). Pollution risk is low if runoff infiltrates into the soil.

Figure 3. An outlet from a settling basin should screen debris and limit solids' movement into a VTA.

Channel flow or gully formation is a VTA's worst enemy. Liquid must be distributed evenly at the top end of the VTA such as through a gated irrigation pipe. To maintain uniform flow, VTA sites will require land leveling. Additional design measures may need to be considered.

Selecting the plant species for a vegetative system is critical. Grasses should be selected to minimize erosion from a VTA and maximize nutrient uptake. Grasses are more effective than broadleaf species for reducing erosion. Sod-forming grasses are well suited for most VTAs. An initial seeding of oats, wheat, or ryegrass as a cover crop will reduce erosion and hasten the establishment of the VTA. A mixture of warm and cool season grasses are the best vegetation for most VTAs.

The plant species selected should be appropriate for the soil and climate of the area. The grasses selected for a VTA should be able to survive occasional flooding. Plants used in a VIB should be able to survive frequent flooding. Local recommendations for grass or forage species selection should be followed. Plants that provide more than one harvest are best for a VTA and allow for a smaller VTA than single-cutting plants. Also, timing the harvest to avoid field ruts is more critical than high-quality hay. Important design issues for nutrient and water balance methods, outlet and distribution

Figure 4. Uniform or sheet flow is essential to high-performing VTAs.

ideas, solids settling, VTAs, and VIBs are included in a VTS publication described in the "For More Information" section.

## Management

VTAs are sometimes mistakenly promoted as an option requiring low management inputs. For a well-performing VTA, farmers must be willing to:

- Maintain a dense, vigorous stand of vegetation.
- Adjust inlets to evenly spread runoff across the VTA.
- Inspect the VTA after rainstorms.
- Repair areas of erosion or wheel tracks.
- Regularly test the soil. A well-planned fertility program is essential to maintaining vegetation (Figure 5).
- At least yearly, harvest the vegetation to remove accumulated nutrients. More frequent harvesting may promote better weed control and higher quality feed.
- Harvest when soil conditions will not create tire tracks or ruts. If practical, drive the equipment across the slope to prevent downhill ruts and ditches from forming.
- Keep grazing animals off of the VTA. Grazing removes very few nutrients and damages the vegetation.

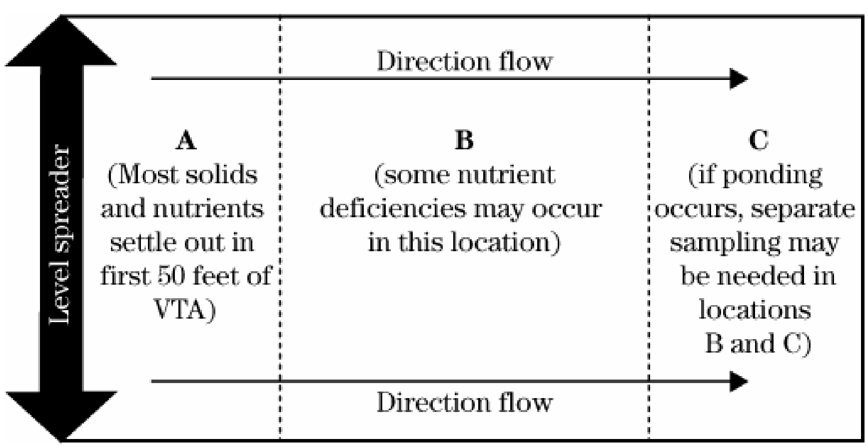


Figure 5. Separate soil-sampling locations within a VTA should account for variation in nutrient distribution. Two or three soil sampling zones may be necessary.

## Summary

A VTS can reduce the environmental concerns associated with runoff from feedlots and barnyards. It offers many advantages over a conventional holding pond, especially when applied to small livestock operations. It also provides livestock producers with an economical solution to an environmental concern. To achieve these economic and environmental advantages, a VTS must be carefully planned, designed, and managed.

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## For More Information

### Technical Resources
In 2004, the USDA NRCS assembled a national team of researchers and practitioners to review the current research and field experience relative to VTSs. This group developed a national publication that summarized VTS siting, design, and management nationwide. These recommendations are currently available at http://www.heartlandwq.iastate.edu/manure. This publication supplements the information presented in this fact sheet.

### Educational Resources
http://www.lpes.org/–To view the Livestock and Poultry Environmental Stewardship (LPES) curriculum resources

http://www.reeusda.gov/1700/statepartners/usa.htm/–To obtain state Cooperative Extension contacts

### Environmental Regulations Resources
http://www.epa.gov/npdes/afo/statecontacts/–To obtain state environmental agency contact

### Small Farm Resources
1-800-583-3071–USDA-CSREES Small Farm hotline

### State-Specific Resources
The local contact for your land-grant university Cooperative Extension program is listed in the phone book under "Cooperative Extension" or "*(county name)* County Cooperative Extension.

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