VEGETATED TREATMENT AREA

(Acre)
Code 635

Natural Resources Conservation Service
Conservation Practice Standard

I. Definition

An area of permanent vegetation used for agricultural wastewater treatment.

II. Purpose

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

III. Conditions Where Practice Applies

This practice applies:

- Where a vegetated treatment area can be constructed, operated, and maintained to treat *contaminated runoff*[1] from such areas as *feed storage areas,* feedlots, compost areas, barnyards, and other livestock holding areas; or to treat process wastewater from agricultural operations.
- Where a vegetated treatment area is a component of a planned agricultural waste management system in accordance with Natural Resources Conservation Service (NRCS) Agricultural Waste Management Field Handbook (AWMFH), Chapter 9.
- To the treatment of contaminated runoff from dairy and beef *animal lots* using a *slow rate infiltration process, overland flow process, or buffer process.*
- To not more than 10,000 square feet of animal lot area and to not more than 98 *animal units* per slow rate infiltration process treatment area or overland flow process treatment area.
- To treatment of milking center wastewater by a buffer process, where the wastewater production is up to 500 gallons per day.

This practice does not apply to:

- Treatment of runoff from croplands, which is covered in Wisconsin NRCS Field Office Technical Guide Section IV (FOTG), Conservation Practice Standard 393, Filter Strip.
- Treatment of *leachate* and collected *first flush* volume from silos, feed storage areas, or silage bags.
- Treatment of runoff from manure stacks or storage facilities.
- Animal lots where manure consistency is such that direct discharge of undiluted manure from the animal lot to the vegetated treatment area is possible.
- Swine animal lots.

IV. Federal, Tribal, State, and Local Laws

Vegetated treatment area practices shall comply with all federal, tribal, state, and local laws, rules, or regulations. The operator is responsible for securing required permits. This standard does not contain the text of the federal, tribal, state, or local laws.

V. Criteria

A. General Criteria

1. Management Assessment

   A management assessment shall be performed with the owner/operator to determine planned management and explore design options. The assessment shall be conducted, documented, and incorporated into the design. In addition to the Waste Management System Inventory and Planning Worksheet contained in the Wisconsin supplement to Chapter 9 of the AWMFH, the management assessment for a vegetated treatment area shall address the following:

   a. Waste Characterization

      (1) Animal types and numbers
      (2) Feed type

   b. Animal Lot Management

      (1) Cleaning methods and frequency
      (2) Feeding locations and methods

[1] Words in the standard that are shown in italics are described in Section X. Definitions. The words are italicized the first time they are used in the text.

(3) Animal time on lot

2. Site Assessment

A site assessment shall be conducted, documented, and incorporated into the design. The assessment will determine physical site characteristics that may influence the placement, construction, maintenance, and environmental integrity of the vegetated treatment area. The assessment shall include input from the owner/operators. The site assessment for a vegetated treatment area shall address the following:

a. Identification and characterization of contributing drainage area.

(1) Lot

i. Slope, size, shape, drainage pattern, surfacing
ii. Feeding location
iii. Equipment - access, cleaning, etc.

(2) Non-lot areas

i. Surface types, dimensions
ii. Slopes
iii. Soils

b. Soil boring logs and, if available, a soil survey photo. Soil investigation shall include:

(1) The number and distribution of soil borings sufficient to characterize the soils and to a minimum depth of below the planned vegetated treatment area grade to ensure separation distances are achieved.

(2) The depth to *bedrock* encountered in soil boring(s) and bedrock type, such as sandstone, limestone, dolomite, or granite.

(3) Depth to subsurface saturation encountered in the boring(s). The factors to identify subsurface saturation are contained in WI FOTG Standard 313, Waste Storage Facility.

3. Outside Water Exclusion

All components shall be installed that are needed and practicable to keep uncontaminated runoff from entering the animal lot or vegetated treatment area. A 25-year, 24-hour design storm shall be used. This includes runoff from:

a. Outside land area – Runoff from outside land areas shall be excluded from the animal lot area by use of diversions, dikes, drop inlets with underground outlets, etc., in accordance with the criteria specified in the FOTG standard for the applicable practice.

b. Roof runoff – Runoff from roof areas draining to animal lots shall be excluded in accordance with criteria specified in WI FOTG Standard 558, Roof Runoff Management System.

c. Springs or seepage – Springs or seepage shall be intercepted by a drainage system sized to carry the anticipated volume of seepage water.

d. Other water sources – Measures will be installed to prevent all other water sources such as overflowing waterers or cooling water from draining onto the animal lot.

e. Locate vegetated treatment areas outside of *flood prone areas*. If site restrictions require location within this area, the treatment area shall be protected from inundation or damage from a 25-year, 24-hour flood event, or larger if required by regulation.

4. Uncontrolled Cattle Access

All vegetated treatment areas shall be protected from uncontrolled cattle access.

5. Vegetation in Treatment Areas

a. Treatment area vegetation shall be established and maintained in accordance with criteria specified in WI FOTG Standard 342, Critical Area Planting, or Standard 612, Tree/Shrub Establishment.

b. Vegetation required in the design shall be *well established* in the treatment area prior to introducing wastewater.

c. Constructed treatment areas shall have a 6-inch layer of topsoil placed prior to establishment of vegetation.

d. Vegetation shall be able to withstand anticipated wetting and/or submerged conditions.

e. Harvest vegetated treatment areas as appropriate to encourage dense growth, maintain an upright growth habit, and remove nutrients and other contaminants that are contained in the plant tissue.

B. Specific Criteria for Animal Lot Runoff

1. Animal lot runoff treatment using the slow rate infiltration process.

a. Siting Parameters

The treatment area shall be further than 100 feet from any private water well. The bottom of the planned *root zone* shall be greater than 2 feet above bedrock. The treatment area shall be more than 500 feet from any pond, lake, or sinkhole.

b. Soils

This process shall be limited to well-drained loamy soils listed in Chapter 10 of the AWMFH. No evidence of seasonal subsurface saturation (mottling) can be observed within 2 feet of the bottom of the planned root zone of the soil profile within the proposed treatment area.

c. Pretreatment

Contaminated runoff shall be pretreated by solid/liquid separation using an off-lot sediment basin designed in accordance with WI FOTG Standard 632, Waste Separation Facility, prior to discharge of liquid to the treatment area.

d. Design Criteria

The treatment area shall be sized to infiltrate the 25-year, 24-hour runoff from the animal lot 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 *available soil water capacity* of the soil in the root zone.

e. Treatment Area

The treatment area shall be level, on native undisturbed soils, and with a maximum length to width ratio of 4:1. Soil shall not be excavated to form the level basin. Fill soils 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. Treatment shall be designed in accordance with procedures in Chapter 10 of the AWMFH.

2. Animal lot runoff treatment using the overland flow process.

a. Siting Parameters

The overland flow treatment area shall be situated or constructed in a 2 foot minimum depth of soil with at least 20% passing the No. 200 sieve (P200 ≥ 20%), and a minimum separation to subsurface saturation and bedrock of 2 feet. The treatment area shall be further than 50 feet from any private water well. Runoff from the end of the treatment area shall be:

(1) Routed through a non-channelized flow length of over 200 feet to any c*hannelized flow* or wetland, and have a non-channelized flow length of over 500 feet to any pond, lake, or sinkhole. The soils and slopes would be as required for the treatment area in V.B.2.a. and V.B.2.c. respectively.

or

(2) Routed through another treatment area designed in accordance with section V.B.2.c. There shall be 300 feet of non-channelized flow length between the end of the last

treatment area and a lake, pond, or sinkhole.

or

(3) Collected and transferred to storage meeting the criteria contained in WI FOTG Standard 313, Waste Storage Facility, or to one of the options (1) or (2) above at an off-site location.

See Figure 1 for further illustration.

b. Pretreatment

Contaminated runoff shall be pretreated by solid/liquid separation using a sediment basin designed in accordance with WI FOTG Standard 632, Waste Separation Facility, prior to discharge of liquid to the treatment area. Pretreatment design guidance is included in Chapter 10 of the AWMFH.

c. Treatment Area Design Criteria

The runoff distributed to the treatment area must be spread out across the full width of the treatment area. The treatment area shall be designed to treat runoff from the 25-year, 24-hour storm event. The treatment area shall be a maximum of 30 feet wide, and sized to pass the design flow at a depth of 1 inch or less. The Mannings "n" value shall be 0.3. Flow length shall be adequate to provide a minimum of 755 seconds of contact time for a 1-inch flow depth with a minimum length of 100 feet. Slope of the treatment area shall be between 1% and 4%. Runoff from outside land area shall be excluded from the treatment area.

3. Animal lot runoff treatment using the buffer process.

a. Siting Parameters

The buffer area shall be situated or constructed in a 2 foot minimum depth of soil with at least 20% passing the No. 200 sieve (P200 ≥ 20%), and a minimum separation to subsurface saturation and bedrock of 2 feet The buffer area shall be further than 50 feet from any private water well.

b. Design Criteria

The runoff distributed to the buffer area must be spread out across the full width of the upper end of the buffer area. Solids shall be kept off the buffer area. The buffer area must be graded so that overland flow is maintained.

The annual output of phosphorus from the buffer area shall be 15 lbs. or less as determined based on potentially affected resources documented in the site assessment. If the down-gradient end of the buffer area is within 1,000 feet of a lake or sinkhole, or within 300 feet of a solid or dashed blue line on a 1:24,000 scale USGS map, quarry, or wetland, the annual output of phosphorus shall be less than 5 lbs. Design to lower values of phosphorus output may be specified by local ordinances or requirements.

Only slopes from 1% to 6% may be considered as part of the buffer area. If a row crop is used as part of the buffer area, it must be planted on the contour.

The minimum buffer area shall be 150% of the animal lot size for paved lots and 100% of the animal lot size for earth lots. For combination paved/earth lots, the size of the buffer shall be prorated.

Size the buffer area using the Vegetated Treatment Area spreadsheet available on the Wisconsin NRCS web site. See Chapter 10 of the AWMFH for the specific methodology.

C. Specific Criteria for Milking Center Wastewater Treatment

1. Buffer Process

The buffer process includes a pretreatment tank from which wastewater is delivered to a sod area by an above-ground perforated distribution pipe located on the contour.

a. Siting Parameters

1) Soils – The buffer area shall be situated or constructed in soils having at least 20% passing the No. 200 sieve (P200 ≥ 20%) with a minimum thickness of 2 feet below the buffer surface. The minimum separation to subsurface saturation and bedrock shall be 2 feet.

2) The down gradient end of the buffer area shall be a minimum of 50 feet from any private water well, channelized flow, surface water feature, or karst feature.

3) The slope of the buffer area shall be between 2% and 15%.

b. Design Criteria

1) Pretreatment – Pretreatment tanks shall be provided and shall be sized to provide a minimum three-day hydraulic retention time prior to discharge to the buffer area. The outlet from the pretreatment tank shall be gravity flow to a dosing tank or chamber which shall be separate from the pretreatment tank. A pump or siphon for pressure distribution of wastewater shall be located in the dosing tank or chamber.

2) Minimum filter area shall be based on the greater of either:

- A minimum flow through time of 20 minutes at a maximum flow depth of 0.5 inch using a Manning's n=0.30. The minimum flow depth shall be 0.1 inch.
- A minimum area to accommodate the design loading rate, up to a maximum of 0.9 inch per week.

3) Allowable soil dosing rate

a) The allowable soil dosing rate is shown in Table 1.

Table 1
Allowable Soil Dosing Rates
(gal/sq ft of buffer area)

Soil Drainage Class	Soil >40"	Depth 24"-40"1
Well Drained	0.300	0.250
Moderately Well Drained	0.250	0.200
Somewhat Poorly Drained	0.125	0.075

[1]Not acceptable at soil depth less than 24 inches.

b) Wastewater shall be dosed to the upper end of the buffer at a frequency of no more than once every three days.

c) Wastewater shall be distributed to the buffer through a level perforated plastic pipe suspended between 1.0 feet and 1.5 feet above the ground. Perforations shall be between a ½ inch and 1 inch in diameter, placed in the bottom of the pipe, and spaced at 2-foot to 6-foot intervals.

d) The actual flow depth and *hydraulic loading rate* produced by the selected pump and designed distribution system shall be calculated and shown to be in accordance with criteria in this standard.

c. Buffer Operation and Maintenance

1) Maintain the wastewater spreader to the initial design function.

2) Inspect and repair the buffer area after storm events and fill in gullies, remove flow-disrupting sediment accumulation, re-seed disturbed areas, and take other measures to prevent concentrated flow.

3) Harvest buffer area vegetation as appropriate to encourage dense growth, maintain upright growth, and remove nutrients and other contaminants that are contained in the plant tissue.

Controlled grazing can be an acceptable method of harvest.

4) Conduct controlled grazing, harvesting, and other maintenance activities only when the buffer area is dry and moisture content in the surface soil layer will not allow compaction or rutting.

D. Specific Criteria for Feed Storage Contaminated Runoff

1. Contaminated Runoff

All contaminated runoff shall be delivered (via gravity or pump) to a feed storage runoff treatment area or shall be collected and land applied according to a nutrient management plan. The conveyance system to the vegetated treatment area shall be designed for a minimum flow rate produced by the runoff from 25% of the peak flow of the 25-year, 24-hour storm event. The remaining portion of the 25-year, 24-hour runoff, which is expected to have negligible levels of contaminants, shall be diverted around the VTA in a non-erosive manner so as not to inundate the VTA.

The vegetated treatment area may be reduced if the first flush of contaminated runoff volume is collected and land applied according to a nutrient management plan. See Table 2 for minimum VTA sizing.

If the flow depth over the VTA is maintained at 1 inch or less for 25% of the peak flow for the 25-year, 24-hour storm event, the VTA can be half of the VTA size determined from Table 2.

2. Vegetated Treatment Area Siting Parameters and Operation

a. Siting Parameters

The separation from subsurface saturation and bedrock is the closest distance from any point on the vegetated treatment area soil surface to the feature from which separation is required. Refer to Table 2 for separation distances.

b. Design

The vegetated treatment area shall consist of grassed, wooded, or cropped areas. The treatment area shall meet the criteria as determined by Table 2.

The runoff distributed to the vegetated treatment area must be spread across the full width of the upper end of the treatment area. The minimum length or width of the treatment area shall be 20 feet. The ratio of length:width or width:length shall not be greater than 10:1.

Only slopes from 0.5% to 6% may be considered as part of the treatment area. If a row crop is used as part of the treatment area, it must be planted on the contour. Non-channelized flow shall be maintained.

Solids shall be kept off the treatment area. If a sediment basin is used in conjunction with a vegetated treatment area to remove solids from contaminated runoff, it shall meet the siting parameters specified for the treatment area and surfacing options as specified in WI FOTG Standard 561, Heavy Use Area Protection.

No additional nutrients other than those in the contaminated runoff shall be added to non-cropland vegetated treatment areas.

c. Additional Criteria for Vegetated Treatment Areas at operations regulated under NR 243.

The VTA requires a spreader every 200 feet to ensure sheet flow and prevent rilling. A greater interval may be justified based on uniformity of slope and ability to maintain maximum flow depth.

A minimum vegetated buffer length of 35 feet is required at the end of the discharge point of the VTA if the discharge point is within 100 feet of a surface water feature.

Table 2
Vegetated Treatment Area (VTA) Criteria

1. Feed Storage Area Size				
• Feed Storage Area (FSA)	≤ 1 acre	>1 acre	Any Size[Note 1]	Any Size[Note 1]
2. Soil Requirements				
• Thickness	2.5 ft.			
• % Fines (No. 200 sieve)	≥ 20%			
3. VTA Slope				
• Slope	0.5% - 6%			
4. VTA Size as % of FSA				
1st Flush Collected				
None	100%	100%	N/A	N/A
0.05 inch	50%	85%	100%	N/A
0.10 inch	35%	70%	85%	100%
0.15 inch	15%	55%	70%	85%
0.20 inch	0%	40%	55%	70%
0.25 inch	0%	25%	40%	55%
5. Separation Distances				
• Wells[Note 2]	50 ft.	50 ft.	50 ft.	50 ft.
• Sinkholes	400 ft.	400 ft.	400 ft.	400 ft.
• Subsurface Saturation	2.5 ft.	2.5 ft.	5 ft.	2.5 ft.
• Bedrock	2.5 ft.	2.5 ft.	5 ft.	2.5 ft.

Note[1] Where additional protection to groundwater and surface water is desired or required, such as for permitted facilities regulated under NR 243.

Note[2] NR 243 permitted facilities require 250 feet separation from wells.

VI. Considerations

Additional recommendations relating to design which may enhance the use of, or avoid problems with, this practice, but are not required to ensure its basic conservation function, are as follows:

- Secondary Storage - Consider collecting a portion or all of the discharge from vegetated treatment areas and storing in a waste storage facility.

- Consider storage of lot discharge rather than application to a treatment area when vegetation is dormant or the ground is frozen.

- 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 vegetated treatment area to maintain effectiveness throughout the growing season. Time the harvest of the vegetated treatment area plants so vegetation can regrow to a sufficient height to effectively filter effluent late in the growing season.

VII. Plans and Specifications

Prepare plans and specifications in accordance with the criteria of this standard that describe the requirements for applying the practice to achieve its intended use. Include critical construction perimeters, necessary construction sequence, vegetation establishment requirements, and nutrient removal.

Plans and specifications will include:

- a plan view showing the location of the vegetated treatment area,
- 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, and
- site preparation sufficient to establish and grow selected species.

VIII. 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 may include the following, or other items, as appropriate:

A. Clean the animal lot and/or settling areas as needed to prevent migration of solids to the vegetated treatment area.

B. Maintain the wastewater spreader to the initial design function.

C. Harvest treatment area vegetation as appropriate to encourage dense growth, maintain upright growth, and remove nutrients and other contaminants that are contained in the plant tissue. Controlled grazing can be an acceptable method of harvest.

D. Inspect and repair vegetated 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.

E. Conduct controlled grazing, harvesting, and other maintenance activities only when the vegetated treatment area is dry and moisture content in the surface soil layer will not allow compaction or rutting.

F. Prior to construction, the owner/operator shall sign the operation and maintenance plan to indicate an understanding of the requirements and a commitment to operate and maintain the practice as specified.

IX. References

USDA, NRCS Wisconsin Field Office Technical Guide (FOTG), Section IV, Practice Standards and Specifications.

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

Young, R.A., Otterby M.A., and Roos, A. 1982. An Evaluation System to Rate Feedlot Pollution Potential, Agricultural Research Service, USDA, ARM-NC-17.

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/.

R.A. Larson, and S.I. Safferman. (2012). Field Application of Farmstead Runoff to Vegetated Filter Strips: Surface and Subsurface Water Quality Assessment. Journal of Environmental Quality, 41:1-12.

R.A. Larson, S.I. Safferman. (2012). Land Application of Waste: Soil Column Leachate Water Quality (under review).

Koelsch, R. K., Lorimor, J. C., and Mankin, K. R. (2006). Vegetative Treatment Systems for Management of Open Lot Runoff: Review of Literature. Applied Engineering In Agriculture, 22(1), 141-153.

X. Definitions

Animal lots (*III*) – An animal lot is an area, a building, or combination of contiguous areas and buildings intended for the confined feeding, breeding, raising or holding of beef and/or dairy cattle. An animal lot is specifically designed as a confinement area in which beef/dairy waste may accumulate, or where the concentration of beef or dairy animals is such that a vegetative cover is denuded and cannot be maintained within the enclosure.

Animal Units (III) – A unit of measurement used to determine the total number of single animal types or combination of animal types, as specified in NR 243, which are fed, confined, maintained or stabled in an animal feeding operation. One animal unit is equivalent to one head of beef or slaughter cattle weighing more than 1000 pounds.

Available Soil Water Capacity (V.B.1.d.) – Expressed as inches of water per foot of soil, it is the amount of water held in a soil between field capacity, which is the moisture content of soil after it is wetted and ceases to drain by gravity, and permanent wilting point, which is the moisture content of soil when plants die.

Bedrock (V. A. 2. b. (2)) – The solid or consolidated rock formation typically underlying loose surficial material such as soil, alluvium or glacial drift. Bedrock includes but is not limited to limestone, dolomite, sandstone, shale and igneous and metamorphic rock.

Note: Although solid or consolidated bedrock can sometimes be removed with typical excavation equipment, these materials are included in the above definition

Buffer Process (III) – The application of wastewater at the upper reaches of a vegetated slope, with treatment by physical, chemical, and biological means as it flows in a thin film down the length of the slope.

Channelized flow (V. B. 2. a. (1)) – Water movement in a surface drainage feature including, but not necessarily limited to: swales, draws, grassed waterways, ditches, gullies, creeks, or rivers.

Contaminated Runoff (III) – Runoff that has come through or across a barnyard or animal lot or feed storage area. It generally includes the runoff and any manure, sediment, feed, or other material carried in the runoff. It contains lower concentrations of contaminants than leachate from feed or manure.

Feed Storage Area (III) – An area used to store livestock feed. Livestock feed may include corn silage, haylage, and industrial by-products (i.e., distillers grain, brewers grain, candy, pizza crust, bakery waste, cotton seed, soy bean meal, animal fats, blood meal, fish meal, cannery waste, beet pulp, citrus pulp, soy hulls, corn midlings, whey, potatoes, grocery store vegetables). This is the area defined by the outside edge of the surface of where the feed is stored, including the apron. This area does not include feed stored in bags.

First Flush (III) – The initial contaminated runoff volume, which typically contains higher concentrations of contaminants than runoff produced during the remainder of the storm event.

Flood Prone Areas (V.A.3.e.) – These include areas delineated as floodplains on Federal Emergency Management Agency (FEMA) maps, or local floodplain maps as well as areas along perennial streams (blue lines) shown on the United States Geologic Survey quadrangle sheets that may be subject to out of bank flows.

Hydraulic Loading Rate (V.C.1.b.3)d)) – Considered as the flow rate distributed over the surface area calculated as: HLR = Flow Rate / Surface Area

Leachate (III) – Concentrated liquid which has percolated through or drained from animal feed. It contains much higher concentrations of contaminants than Contaminated Runoff.

Overland Flow Process (III) – The application of wastewater at the upper reaches of a grass covered slope, with treatment by physical, chemical, and biological means as it flows in a thin film down the length of the slope.

Root Zone (V.B.1.a.) – Depth to which the roots of mature crops will extract available soil water.

Slow Rate Infiltration Process (Section III) – The application of wastewater to a vegetated land surface with the applied water being treated as it flows through the plant-soil matrix.

Well Established (V.A.5.b.) – Vegetation is well established when there is 100% ground cover. This can be achieved by adequate existing sod, installed sod that is rooted and growing, or newly established vegetation that has gone through a growing season and provides 100% ground cover.

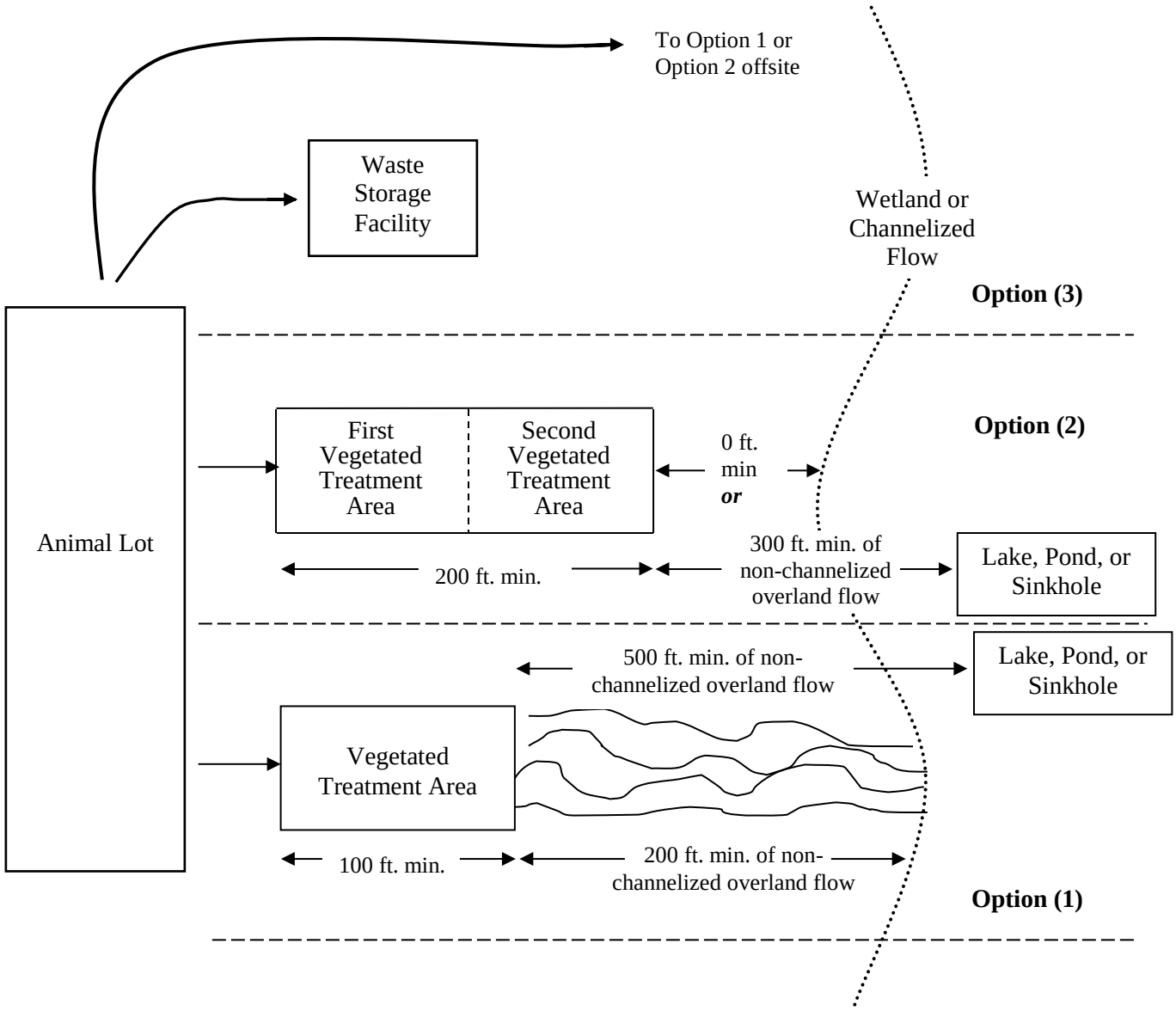

Figure 1. The three options described in section V.B.2. (not to scale)