NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

WASTEWATER TREATMENT STRIP

(Ac.)

CODE 635

DEFINITION

A treatment component of an agricultural waste management system consisting of a strip or area of herbaceous vegetation.

PURPOSE

The purpose of this practice is to improve water quality by reducing loading of nutrients, organics, pathogens, and other contaminants associated with animal manure and other wastes, and wastewater by treating agricultural wastewater and runoff from livestock holding areas with:

- Rapid infiltration
- Overland flow

  or
- The slow rate process

CONDITIONS WHERE PRACTICE APPLIES

This practice applies:

- Where a treatment strip is a component of a planned Agricultural Waste Management System (NY312), in NY, it is anticipated that the slow rate process will be the most common method of treatment.
- Where a treatment strip can be constructed, operated and maintained without polluting air or water resources
- To the treatment of contaminated runoff from such areas as feedlots, barnyards, and other livestock holding areas
- To the treatment of dilute wastewater such as milk house effluent and diluted silage leachate

CRITERIA

General Criteria Applicable To All Purposes

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

Each specific site will need to be evaluated to determine if a Wastewater Treatment Strip (WTS) will meet the objectives in reducing the pollutants that are of concern.

Inflow to wastewater treatment strips shall be pretreated to remove solids as appropriate.

Source control will be used to reduce the total volume, frequency, and concentrations of pollutants, thereby increasing the effectiveness of the WTS.

Discharge to and through treatment, strips shall be as sheet flow. 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 strip. Land grading and structural components necessary to maintain sheet flow throughout the length (dimension parallel to the flow) of the treatment strip shall be provided as necessary.

Permanent grass-based vegetation adapted to the soil and climate shall be established in the treatment strip. Vegetation shall be able to withstand anticipated wetting and/or submerged conditions. Seeding shall be in accordance with conservation practice standard Critical Area Seeding (342).

Clean water shall be diverted from the treatment strip to the fullest extent possible unless needed to promote vegetation growth in the treatment strip.

A WTS design shall:

- exclude clean surface water, up to the peak discharge from a 25 year - 24 hour storm, from the WTS surface
- exclude subsurface seepage.

Contaminated runoff shall be pretreated by solid/liquid separation utilizing a facility such as a settling basin prior to discharge of liquid to the treatment strip.

The treatment strip shall be a uniformly graded strip or wide bottomed trapezoidal channel.

Treatment strips should be located outside of floodplains. However, if site restrictions require location within a floodplain, the WTS shall be protected from inundation or damage from a 25-year flood event, or larger if required by law.

They shall be placed such that the lower edge is a minimum of 25 feet from surface water bodies and the entire filter area is 100 feet or more from a well.

Treatment strips will have at least two feet of soil depth between the bottom of unlined distribution trenches and bedrock and seasonal high groundwater and will have at least two feet of soil depth between the finished surface of the filter area and bedrock and seasonal high groundwater. Distribution trenches shall be lined when soil conditions are such that the potential for groundwater contamination is a risk.

Alternative designs shall be based on the latest edition of the Environmental Protection Agency Technology Transfer Process Design Manual for Land Treatment of Municipal Wastewater or other technically acceptable reference.

Erosion and Sediment Control

An erosion and sediment control plan shall be developed for all disturbed areas. For disturbed areas greater than one acre, the erosion and sediment control plan shall meet the planning, installation, and maintenance requirements of NYS Pollutant Discharge Elimination System General Permit for Storm water Discharges. All Erosion and sediment structures and measures shall be installed prior to earth disturbing activities unless otherwise directed in the construction drawings.

Additional Criteria For Rapid Infiltration Treatment

Rapid infiltration treatment refers to a specific remediation technique that utilizes the filtering capabilities of moderately and highly permeable soils. Treatment for this purpose shall consist of directing wastewater or contaminated runoff from a livestock holding area into a uniformly graded strip or area of grass and allowing it to flow over and infiltrate the treatment strip. This method is not appropriate for treatment of wastewater containing high concentrations of nutrients.

The treatment strip design shall be based on the runoff volume from the 25-year, 24-hour storm event from the livestock holding facility. It may be designed to infiltrate a portion or the entire volume of the design storm. This determination will be based on management objectives. The portion of the design volume not infiltrated shall be transferred to a storage facility unless discharge is permitted by applicable regulations.

The treatment strip's area requirements shall be based on the soil's capacity to infiltrate and retain runoff within the root zone and the vegetation's capability to utilize the nutrient loading. The soil's ability to infiltrate and retain runoff shall be based on its water holding capacity in the root zone, infiltration rate, permeability, and hydraulic conductivity, as obtained from current soil survey data. This determination shall be based on the most restrictive soil layer within the root zone regardless of its thickness. Additionally, the anticipated nutrient loading shall not exceed the vegetation's agronomic nutrient requirement.

The infiltration strip design shall be such that the upper soil profile remains unsaturated except during storm events and returns to an unsaturated condition within two days following storm events. The water table shall be either naturally deep enough or artificially lowered so that the infiltrated runoff does not adversely impact the native ground water. Infiltration strips shall not be planned where soil features such as cracking will result in preferential flow paths that transport untreated runoff from the surface to below the root zone.

Additional Criteria For Overland Flow Treatment

Overland flow treatment refers to a specific microbial remediation technique that has minimal infiltration of wastewater. Treatment by overland flow shall consist of the application of wastewater along the upper portion of a uniformly sloped strip of grass, allowing it to flow over the vegetated surface for aerobic treatment to a collection ditch.

The design hydraulic loading rate and application rate shall be selected based on consideration of the anticipated levels of pretreatment, quality of effluent, temperature, and other climatic conditions. A maximum hydraulic loading rate of 2.0 inches per day and an application rate of eight gallons per hour per foot of slope width shall be used unless higher rates can be justified by on-site studies.

The application period shall not exceed 12 hours per day and the application frequency not exceed 5 days per week unless longer application periods and frequencies can be justified based on local conditions.

The nutrients anticipated to infiltrate the treatment strip shall not exceed the vegetation's agronomic nutrient requirement.

Overland flow treatment shall be constructed on soils with low permeability. The design shall be based on the most restrictive soil layer within the root zone. **The maximum allowable permeability shall be 0.2 inches per hour** unless a natural or constructed barrier within the soil profile mitigates the potential of ground water contamination.

The minimum slope length for the applied wastewater shall be 100 feet.

The sloped areas to receive wastewater shall be uniformly graded to eliminate wastewater ponding and short-circuiting for the length of the flow. Slopes shall be equal to or greater than 2.0% but shall not exceed 8.0%.

Wastewater discharged from the treatment strip shall be transferred to a waste storage facility, a waste treatment lagoon, or other facility for further treatment and/or utilization unless discharge is permitted by regulations.

Additional Criteria for Treating Wastewater with the Slow Rate Process

The slow rate process refers to a specific remediation technique involving the application of wastewater to a vegetated surface for treatment as it flows down through the plant-soil matrix.

The design hydraulic loading shall be based on the more restrictive of two limiting conditions – the capacity of the soil profile to transmit water (soil permeability) or in the nitrogen concentration in the water percolating below the root zone.

The size of the WTS shall be large enough to assure that the total volume of liquid will not exceed 104 inches per year, averaged over the entire WTS area. This is the average annual precipitation plus estimated waste volume.

The percolate nitrate-nitrogen concentration leaving the root zone shall not exceed 10 mg/L. The anticipated nutrient loading shall not exceed the vegetation's agronomic nutrient requirement.

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

Wastewater shall be applied to the treatment strip utilizing a method that will result in an even application of the entire strip and a rate that does not exceed the infiltration rate of the soil.

The WTS shall have:

- a natural permeability of less than 2 inches per hour, or have its site and/or soil modified to achieve acceptable permeability
- at least two feet of soil depth between the bottom of unlined distribution trenches and bedrock and seasonal high groundwater
- at least two feet of soil depth between the finished surface of the filter area and bedrock and seasonal high groundwater
- an establishment Period: Allow at least one full growing season for the vegetation to develop before allowing the area to be used as a filter zone. Inspect and approve vegetation before applying waste. During this period, a temporary conservation practice shall be placed to divert flows from the WTS.

A. For Runoff from Concentrated Livestock Areas

A WTS will be installed only in conjunction with a Agricultural Waste Management System (NY312). Source reduction to remove manure solids from the barnyard is an essential design and maintenance component for the continued functioning of the filter area.

The following are in addition to the general design criteria:

1. Solids Removal

   - Solids will be removed before runoff is discharged to a WTS. Excess solids will smother vegetation and disrupt uniform overland flow interfering with the normal functions of a WTS.
   - A settling basin, low velocity channel, or other suitable device shall be provided between the waste source and filter area.
   - A constructed settling basin shall have sufficient capacity, as a minimum, to store the runoff computed for 15 minutes' duration at the peak inflow rate resulting from 2-year, 24-hour rainfall. Any basin outflow shall be disregarded in computing minimum storage. Additional storage capacity, based on frequency of cleaning, shall be provided for manure and other solids settled within the basin. When the basin is cleaned after every significant runoff event, additional storage equivalent to at least 0.5 inch from the concentrated waste area shall be provided. If only annual cleaning of the basin is planned, additional storage equivalent to at least 6 inches from the concentrated waste area shall be provided.
   - A low velocity channel shall be a minimum of 75 feet long. It shall be designed for a flow depth of 0.5 feet or less to pass the peak flow resulting from a 2-year, 24-hour rainfall at a velocity of 0.5 feet per second or less. Provisions shall be provided for removing settled solids from the channel as necessary to maintain proper functioning.

2. Size of Wastewater Treatment Strip

   - Dimension of a barnyard WTS will be the larger of the hydraulic dimensions or the dimensions needed to meet the N loading criteria.
   - N loading from a barnyard will not exceed 500 lbs. of N per acre of filter area per year. This calculation can be performed by using the filter area spreadsheet contained in the eFOTG, Section IV under Conservation Practices Folder under Wastewater Treatment Strip standard.

- Minimum Hydraulic dimensions shall be based on the routed peak outflow from the concentrated waste area or settling facility, based on a 25 year, 24 hour rainfall when storage is provided, but in no case less than the peak flow from a 2 year, 24 hour rainfall event when storage is not provided.
- Length of Flow - The flow length of a WTS shall be sufficient to provide at least 15 minutes of flow-through time.

Table 1 gives flow lengths for a WTS, for barnyard runoff treatment for various slopes as calculated using Manning's formula with a "n" value of 0.24.

TABLE 1
WTS 15 minute flow length
for barnyards runoff

Average Land Slope (percent)	***Flow length (feet)***
2	***100***
4	***135***
6	***165***
8	***190***

- Width – Wastewater Treatment Strips shall be generally on the contour and sufficiently wide to pass the routed peak or peak flow at a depth of 0.5 inches or less. In all cases, positive control of urine and other liquid sources will be achieved in the barnyard to prevent continual flows into the WTS.

B. For Controlled Overland Treatment of Liquid Wastes (milking parlor, milking center, silage leachate, and compost pad runoff)

The following are in addition to the general design criteria:

I. Milking Center Waste:

1. Size of Treatment Strip area

A WTS shall have a minimum length of flow of:

- on slopes less than 6 percent
  - 100 feet
- on slopes greater than 6 percent
  - Table 1, or
  - 100 feet if using a collection and redistribution system in the middle of the WTS

A WTS shall provide a minimum of 10 square feet of filter area per gallon per day of wash water. When specific data is unavailable, volume can be estimated as 4 gallons per cow per day for milkhouse operations and 8 gallons per cow per day for milking parlor operations.

The effluent flow path shall be a minimum of 300 feet to surface water as measured from the top of the WTS.

2. Solids Removal

- Source control is needed to remove as much milk and manure from the waste stream as possible. Special consideration must be given when high BOD loading and high solid contents are present. These conditions will occur when waste milk is dumped into the waste stream or manure from

milking parlor floors is washed into the waste stream. Additional settling capacity and more frequent clean out will be required with high solid waste.

- Two Wastewater Treatment Strips that allow alternating use and resting are required for high volume waste applications and required for all milking parlor applications.
- A settling tank with PVC pipe tee inlets and outlets will be provided with three day storage capacity. The inlet pipe into the tank should bring the waste in at least 2.5 feet from the bottom of the tank. The outlet shall draw wastewater off the bottom 1 to 1.5 feet of the tank.
- Settling facilities shall be cleaned out at regular intervals where excess manure enters the system. Pumping will not be done from the settling tank - a pump station shall be used.

II. Silage Leachate (tower silo juice and bunk silo runoff):

1. General:
   - The amount of flow will be monitored and adjusted to prevent a large kill zone from developing.
   - Use source control to reduce leachate volume and solids loadings to filter area.
   - Effluent flow path shall be a minimum of 300 feet to surface water as measured from the top of the WTS.
2. Tower silo:
   - Provide settling in accordance with milking center waste.
   - Dilute 1:1 with clean water before applying to WTS and apply at agronomic rates.
3. Bunk silo:
   - Provide 1/3 acre of WTS for each one acre of bunk silo.
   - A WTS will be used only when concentrated low flows have been controlled and eliminated from the filter area.
   - A WTS should flow only when a runoff event is occurring.

III. Compost Pad Runoff

1. General
   - Compost and/or compost ingredients on pad shall be less than 70% moisture or have positive control of any leachate, such as roofs or tarps and/or leachate collection systems to insure that no free water flows from the compost or ingredients.
   - A WTS shall flow only when a runoff event is occurring.
2. Size of Treatment Strip
   - Provide 1/3 acre of WTS for each acre of compost pad.
   - Effluent flow path shall be a minimum of 300 feet to surface water as measured from the top of the WTS.

C. Milkhouse Waste water Infiltration Area

General

The milkhouse wastewater infiltration area and appurtenances shall be planned, designed, and constructed to meet all federal, state, and local laws and regulations, including cultural resources, in compliance with General Manual 420, Part 401.

Components shall be suitable for the site conditions. These conditions include vehicular traffic and soil loads, corrosion of materials, flotation of tanks, and frost action.

Odor Trap

An odor trap, such as a plumber's "P-trap", shall be installed in the distribution pipeline before the air vent, between the milking center and settling trap, to prevent odors from entering buildings. See figure 1.

Air Vent

A combination vent and surge protection outlet shall be located before the distribution box. See figure 1.

Pipeline

For gravity systems, the pipeline shall have a minimum inside diameter of 4 inches and be in accordance with the conservation practice standard Manure Transfer (634). Pipe for pump systems shall meet the pump manufacturer's specifications for size and pressure rating. Provide access to the pipeline at appropriate intervals for cleanout. Pipe shall be located at an adequate depth or otherwise protected to avoid damage from vehicles and frost.

Solids Traps

A grease trap shall be used to remove milk fats and other floatable solids on all systems. Parlor milking systems shall additionally incorporate a solids settling trap.

The capacity of the traps shall be a minimum of three times the actual daily flow. Traps shall be water tight, designed not to float and be accessible year-round for periodic cleanout. Cleanout ports shall have risers and covers for accessibility and safety.

Pump

A pump shall be used if gravity flow is not possible. The pump station shall have a riser and cover for year-round access and safety.

Safety

Ventilation and warning signs must be provided for solids traps and covered storages to warn of potential explosion, poisoning or asphyxiation.

Effluent Distribution

A distribution system shall be used to distribute the effluent through perforated (5/8 inch minimum diameter perforations) header pipes across the uphill side of the infiltration area. Center the header pipe on a 12-inch thick layer of crushed stone at the inlet end of the bed. Extend the stone layer along the entire length of the header pipe. Use a minimum stone layer width of 2 feet, perpendicular to the header pipe.

Infiltration Area

A site investigation is required to locate the organic matter area. Infiltration area shall not be located where it can contaminate water supply aquifers or wells. The area should be located as far as practical from water sources, property lines and other resources of concern. See Table 2 for minimum setback distances for the infiltration area. Exclude all surface and subsurface water from the infiltration area.

Table 2

Minimum Setback Distances (in feet) From Any Edge of the Infiltration Area

Site Features	Setback Distance (ft.) From Infiltration Area
Wells with water usage of 2000 or more GPD	300
Owner's or Neighbor's wells	100
Water supply lines	10
Water course, major (Blue line on topo map)	100
Water course minor	50
Drainage ditches	25
DEC jurisdictional wetland (uphill wetland edge to toe of Organic Matter Bed)	100
Slopes greater than 3:1	10
No basement below grade (slab, frost wall, posts)	15
Full basement below grade	20
Property lines	25
Burial sites or graveyards	25

The infiltration bed area shall be loosened after final grading with a chisel plow or harrow to remove the major compaction of the bed infiltration area caused during construction.

The infiltration area shall be located in soils with moderate to rapidly moderate permeability and adequate depth to bedrock and the water table. A soils investigation, with at least two test pits describing a representative soil profile, and at least one in place permeability test shall be conducted to size and locate the bed. On sites where the soils are modified, documentation shall be provided to verify in place permeability. The infiltration area shall be located in a soil profile that falls within the requirements listed in Table 3.

Table 3

Soil Requirements for Infiltration Area

Property	Requirement	Comments
Permeability of C Horizon (Inches/Hour)	0.2 to 6 inches per hour	-
Depth To Bedrock (Inches)	≥ 40 inches	Soils with <40 inches to bedrock may be used if soil is modified. Modify the soil by raising the area with loam liner material to obtain minimum separation distance of 40 inches to bedrock.
Depth To High Water Table (Feet)	≥ 1.5 feet	Soils with <18 inches to these layers may be used if soil is modified. Modify the soil by raising the area with loam liner material to obtain minimum separation distance of 24 inches to seasonal high water table or hydraulically restrictive layer.
Flooding	≤ once in 25 years	

Sizing of the structure is based upon soil permeability and the rate of wastewater flow. The design flow is the actual flow in gallons per day (gpd) from all sources of wastewater. The required area is obtained by multiplying the gallons/day produced by the factor shown in the 2nd column of table 4 at the appropriate percolation rate.

Table 4

Hydraulic Loading Rates

Percolation Rate inches/hour	Hydraulic Loading Rate (sq. ft. x gal/day)
6.0	7.8
4.0	8.7
3.0	10.0
2.0	11.7
1.5	14.0
1.0	15.5
0.5	23.3
0.2	46.7

Infiltration area shall be constructed with a level bottom and to provide a minimum of 12 inches of containment at the lower edge. See figure 1.

Organic material shall be backfilled over the infiltration area. Organic material for the area shall be any clean carbonaceous material of a somewhat durable nature, such as wood chips, bark, or shavings.

Minimum thickness of organic material over the header pipe is 36 inches. See figure 1.

Fence

Install fence around the infiltration area as necessary to exclude equipment, animals, and people. Fence shall be in accordance with conservation practice standard 382.

CONSIDERATIONS

- More than one overland flow treatment strip should be considered to allow for resting, harvesting vegetation, maintenance, and to minimize the potential for overloading.
- Providing rest periods to maintain an aerobic soil profile. Storage with periodic dosing or alternating Filter Areas may be desirable.
- Pretreating overland flow influent with solid/liquid separation to reduce organic loading, odor generation, and maintenance requirements, using a settling facility before the pump station when waste is pumped to a WTS.
- Using a serpentine or switchback channel to provide a greater length of flow if adequate filter area and length of flow to provide the desired reduction of pollutants is not available.
- Annually checking the rate of nitrogen being applied to grass filter area plant species. For silage leachate, size of the kill zone is an indicator of excess nitrogen loading. If too high, increase the size of the filter area or reduce loading rate.
- Locating the WTS where prevailing winds will minimize odors and other aesthetic problems for neighbors.
- Consider using the NY P Index to assess the viability of an area as a WTS.
- Consider suspension of application to treatment strips when weather conditions are not favorable for aerobic activity or when soil temperatures are lower than 39^0 F. When soil temperatures are between 39^0 F and 50^0 F reduction of application rate and increased application period while maintaining the hydraulic loading rate constant should also be considered.
    - On-farm traffic patterns.
    - Accessibility to the milkhouse wastewater infiltration area components.
    - Adjacent land uses and visibility.
    - Location and height of air vents to avoid the odors that may be prevalent in the pipeline.
    - Visual aesthetics to blend the system into the surrounding landscape.
    - Site, soil, and environmental factors.
    - Availability of organic matter.
    - To eliminate the potential of a leaking dike, obtain the required 12 inch minimum containment by constructing bed area in ground.
    - Install submersible pump in grease trap for agitation and pumping fat cake to manure spreader.
    - Install inline supplemental filter to trap additional fats and solids before reaching filter bed.

- To reduce maintenance and need to clean grease trap as frequently, exclude first rinse of wastewater from the infiltration area by feeding liquid to animals or by handling it with the manure.
- To minimize maintenance, limit this practice to dairies of less than 120 milkers for parlor operations.
- Install an alarm for the pump to alert operator of failure.

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, construction sequence, and vegetation establishment.

Specifications will include:

- length, width, slope of the treatment strips and infiltration areas to accomplish the planned purpose (length refers to flow length down the slope of the treatment strip)
- grass 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 that is consistent with the purposes of the practice, its intended life, safety requirements, and the criteria for its design. The plan shall include the following as appropriate:

- To keep in a growing state or mostly leafy condition, mow when seed heads appear. Cut to a height of 3-6 inches and remove the top growth at least three times each year. Higher cutting heights promote faster regrowth. Avoid driving over the filters if soil moisture conditions will result in vehicle ruts.
- Harvest treatment strip 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.
- Control undesired species.
- Inspect and repair treatment strips 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, according to test results, to maintain the desired species composition and stand density of grass.
- Maintain or restore the treatment strip as necessary by periodically grading when deposition jeopardizes its function, and then reestablishing to grass-based vegetation.
- Routinely de-thatch and/or aerate treatment strips used for treating runoff from livestock holding areas in order to promote infiltration.
- Conduct maintenance activities only when the treatment strip is dry and moisture content in the surface soil layer will not allow compaction or cause rutting.
- Prevent grazing in treatment strips.

Plan for Milkhouse waste water infiltration Area O&M

- Safety procedures required for operation and maintenance of the facility.

- Periodic monitoring and cleanout of the solids traps and any inline supplemental filters. Proper disposal shall be in a manure storage structure, land application, or by other acceptable means.
- Periodic replenishment or replacement of organic matter in the infiltration area. Proper disposal of the used matter shall be in a manure storage structure, land application, composting, or by other acceptable means.
- Maintain adequate vegetative cover on adjacent areas.
- Repair of damage to any earthfills, fences, pipes, and other appurtenances.
- Maintain lids and openings to underground structures to ensure year-round access.
- Maintain grates on drains and subsurface drainage systems to ensure they are functional and that rodent guards are in place.
- Ensure that waste milk is not dumped into the milkhouse wastewater infiltration area.

Erosion and sediment control structures will be maintained periodically and after every major runoff event until the disturbed area is fully protected.

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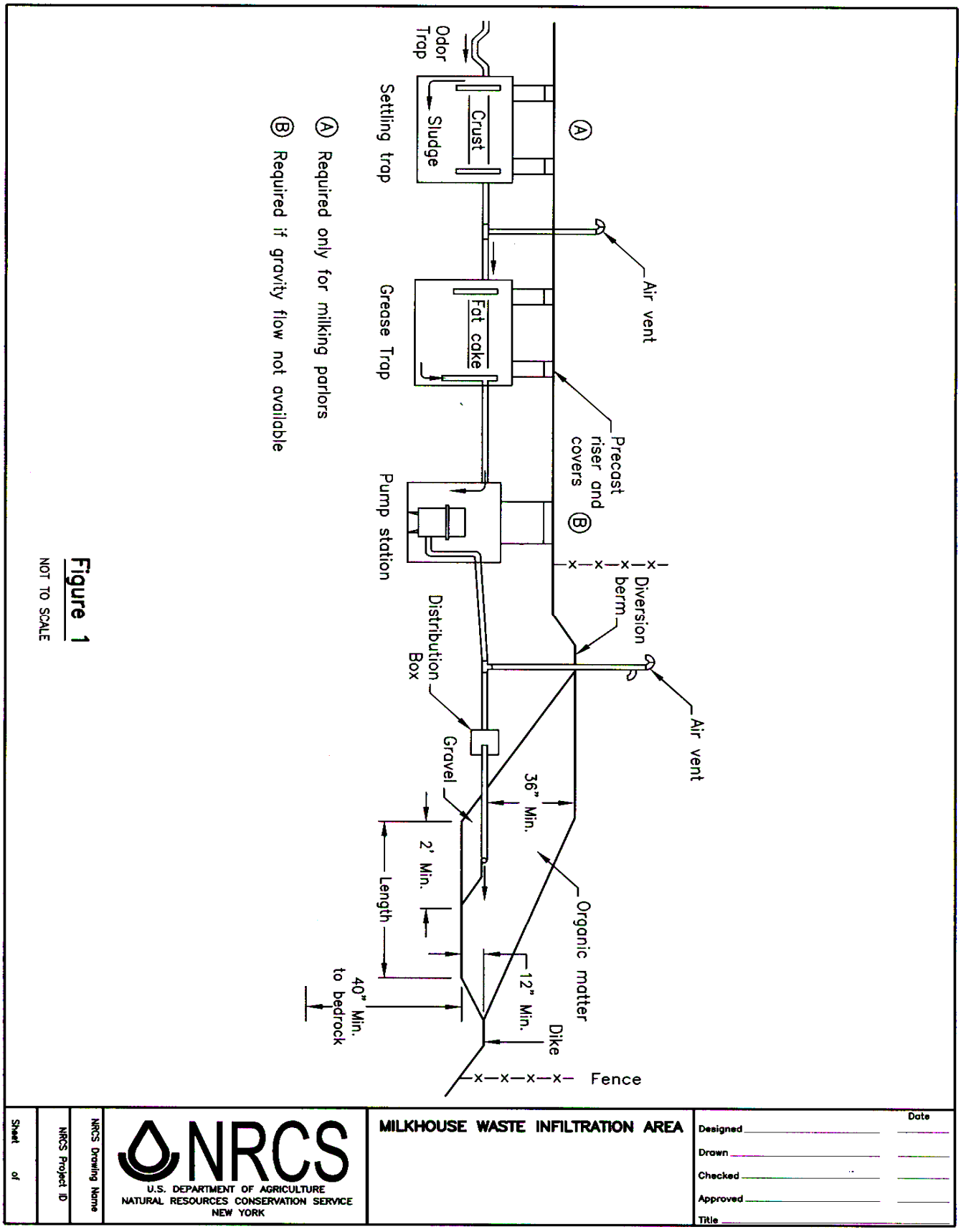
Odor Trap
Settling trap
Crust
Sludge
Grease Trap
Fat cake
Pump station
Distribution Box
Gravel
Length
2' Min.
36" Min.
40" Min. to bedrock
12" Min.
Dike
Organic matter
Fence
Air vent
Air vent
Precast riser and covers
Diversion berm
Ⓐ Required only for milking parlors
Ⓑ Required if gravity flow not available
NOT TO SCALE
Figure 1
NRCS
U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
NEW YORK
MILKHOUSE WASTE INFILTRATION AREA
NRCS Drawing Name
NRCS Project ID
Sheet of
Designed
Drawn
Checked
Approved
Title
Date