NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

WASTE TREATMENT

(No.)

Code 629

I. DEFINITION

The use of unique or innovative mechanical, chemical or biological technologies that change the characteristics of manure and agricultural waste.

II. PURPOSE

To use manure and waste treatment facilities to improve water quality and air quality by:

- Reducing the nutrient content, organic strength, and/or pathogen levels of manure and agricultural waste.
- Reducing odors and gaseous emissions
- Facilitating desirable waste handling and storage
- Producing value added byproducts that facilitate manure and waste utilization.

III. CONDITIONS WHERE PRACTICE APPLIES

This practice applies where there is a need to implement waste treatment technologies that are not within the scope of other NRCS Conservation Practice Standards and that are sufficiently developed for incorporation into a manure or agricultural waste management system. This includes new or unique components or processes.

This practice applies to:

- **The treatment of milking center wastewater from milking centers producing up to 500 gallons of wastewater per day.**
- **The treatment of leachate and contaminated runoff generated by livestock feed and waste feed storage areas.**

This practice standard criterion does not apply to:

- **treatment of waste milk**
- **treatment of sewage from restrooms or laundry facility waste**
- **industrial inputs or waste stored at an industrial facility (i.e., cannery, distillery, brewery)**
- **feeds considered dry (typically 40% moisture or less) within storage areas protected from precipitation**
- **feed bunk/equipment**
- **self-feeding structures (non-mobile)**

IV. CRITERIA

A. GENERAL CRITERIA APPLICABLE TO ALL PURPOSES

1. **Laws and Regulations.** Ensure that the manure and waste treatment facilities and processes are planned, designed, and constructed to meet all federal, state, and local laws and regulations.

2. **Utilities.** Locate all buried utilities in the project area including drainage tile and other structural measures.

3. **Design.**

   a. The waste treatment technology provider shall complete and supply to the land owner/operator a detailed design of the facility/process clearly

identifying the objectives and anticipated outcomes of implementation.

b. When the planned technology involves a system or process include in the design documentation a process diagram containing, at a minimum, the following information:

   i. Volumetric flow rates including influent, effluent, and recycle streams.

   ii. Waste load projections including volume, mass, and characteristics of the waste important to the waste treatment facility or process.

   iii. Unit process volumes and hydraulic retention times where appropriate.

   iv. Air emissions projections from the system.

   v. Nutrient fate projections within the system.

   vi. Process monitoring and control system requirements as described below in the Monitoring section of the criteria.

c. It is the responsibility of the technology provider to furnish information from a university or other independent research entity to document the effectiveness of the technology to achieve its intended purpose. Provide independent, verifiable data demonstrating results of the use of the facility or process in other similar situations and locations. If available document the effectiveness of the technology under different climatic factors. Documentation from peer reviewed journals is preferable. Where use of a waste treatment facility or process to improve one resource concern negatively impacts another, impacts and mitigation measures, if required by state or local agencies, are to be documented.

d. The 25-year, 24-hour storm design criteria shall be used to exclude clean water runoff from entering the proposed component areas.

e. The treatment system shall be located a minimum of 100 feet from a well (minimum 50 feet from a private well).

f. The treatment system shall be located a minimum of 25 feet from a perforated subsurface clean water drainage tile, unless hydraulically separated to prevent leachate and contaminated runoff from entering drainage tile.

g. Facilities located in flood prone areas shall be protected from inundation, structural damage, and instability. These facilities shall be designed to accommodate any additional loading resulting from static water levels or saturated soil. Facilities shall be protected from inundation or damage from the 25-year flood event.

4. **Components.**

   a. Waste treatment facilities and processes may consist of multiple components. Where criteria for individual components are described in existing NRCS practice standards, use those practice standards and their specific criteria for planning, designing, and installation of that component.

   b. Where components of a facility or process are not described in a current NRCS practice standard, the system provider shall furnish a minimum one

year warranty on all construction, equipment, and applied processes.

c. **The waste treatment facility or process shall have a minimum practice life of ten years. Where components have less than a ten-year service life, their planned replacement during the life of the practice shall be clearly identified in the operation and maintenance plan.**

5. **Expected System Performance.** Clearly document the expected system performance prior to system installation. At a minimum, document all expected system volumetric flow rates, macro-nutrient reductions or changes in form, expected pathogen reductions, gaseous ammonia and hydrogen sulfide emissions reductions (or increases).

6. **Operating Costs.** The system provider shall furnish an annual estimate of operating costs and the time, labor, energy, and equipment requirements for each waste treatment component of the waste management system and on the operation cost or savings the waste treatment component will have on the waste management system as a whole. Identify as estimates the operating costs not based on actual data. Adequately document the anticipated operation cost or savings of the waste treatment component on the entire system.

7. **Monitoring**. Install as a part of the system equipment needed to properly monitor and control the waste treatment facility or process. Identify the process control parameters to be monitored in the design documentation. Identify parameters considered critical to proper system operation in the Operation and Maintenance (O&M) Plan. Monitor critical equipment status and unit processes.

8. **Byproducts.**

   a. Implementation of a waste treatment process or operation of a waste treatment facility shall not result in discharge of byproducts harmful to the environment.

   b. Handle and store all byproducts in such a manner as to prevent nuisances to neighbors or to the public at large.

   c. The land application of byproducts to supply plant nutrients must meet the criteria in NRCS Conservation Practice Standard 590, Nutrient Management.

   d. Handle and dispose of any unmarketable or unused byproducts in accordance with all applicable federal, state, and local laws and regulations. A plan for dealing with such byproducts shall be prepared and approved prior to utilization of the process or installation of the waste treatment facility, and shall include a listing of any permits or permissions required for the execution of the plan.

   e. Recycle the waste treatment byproducts to the extent possible without causing a hazard to the environment.

9. **Safety.**

   a. Include the design of the process or facility safety features to minimize hazards.

   b. Provide guards and shields for moving parts of the equipment used in the treatment process.

   c. Fence waste treatment facilities and post warning signs where needed to prevent children and others from entering a hazardous area.

d. Carry out all treatment processes in accordance with all safety regulations. Wear protective clothing when handling potentially harmful chemicals that may be used in the process. Provide proper ventilation.

e. Minimize the accumulation of gasses; provide ventilation for covered waste-holding structures to reduce the risk of inhalation of poisonous gasses, asphyxiation, or explosion. Note: Adding leachate to manure can produce poisonous gasses.

f. If the facility includes a confined space, the confined space shall be configured in such a way that monitoring for hazardous gases, ventilation, observation of workers in the confined space, and extraction of workers from the confined space are all possible and practicable. Provisions of the American Society of Agricultural and Biological Engineers (ASABE) Standard EP 470, Manure Storage Safety, shall be followed.

B. SPECIFIC CRITERIA – MILKING CENTER WASTEWATER TREATMENT

The milking center wastewater treatment system includes two pretreatment tanks followed by a soil infiltration area using either a soil cover or an organic matter cover. Effluent is distributed to the soil infiltration area via gravity or a pressure distribution system.

1. Milkhouse Plumbing

a. A sanitary trap is required to prevent gasses from flowing into the milking center from the treatment system.

b. Materials must be provided to ensure all riser joints, access openings, and pipe connections are installed watertight.

c. A flow diverter valve shall be installed at the discharge end of the wash water transfer line to divert waste milk from the treatment system.

2. Siting Criteria

a. Soil Evaluation: A soils investigation shall be made at the proposed infiltration area. The USDA Soil Texture designation shall be recorded for all soil horizons to a minimum depth of 5 feet or bedrock, whichever comes first. A suitable number of investigations shall be made to describe the soils at the proposed site, with a minimum of 3 soil investigations.

b. A maximum soil application rate for all soil horizons, from the soil surface to either saturation, bedrock, or to a maximum depth of 5 feet shall be determined from the soil investigation. Soil application rates shall be based on soil texture using Table 1.

Soil Texture	Maximum Application Rate
Course Sand Medium Sand Loamy Sand	0.32 gal/ft^2/day
Find Sand Sandy Loam Loam	0.16 gal/ft^2/day
Silt Loam Silt Clay Loam	0.12 gal/ft^2/day
Sandy Clay Silty Clay Clay	0.06 gal/ft^2/day

Table 1. Maximum Soil Application Rate

c. The subsurface absorption system shall be located a minimum of 50 feet from channelized flow, a surface water feature, or wetland.

d. The subsurface absorption system shall not be located in a sensitive groundwater area or in a delineated wellhead or source water protection area as defined by the North Dakota Department of Health.

3. Design Criteria

a. Design Flow Rate shall be determined by measuring or estimating using the procedures in the American Society of Agricultural and Biological Engineers Paper No: 054103 – "Design Recommendations for Milkhouse Wastewater Treatment Systems" (2005).

b. Pretreatment

1. Wastewater shall be pretreated in two tanks. Each tank shall provide a minimum three-day hydraulic retention (HRT) or the volume of the bulk tank, whichever is greater. HRT is computed based on the gallons per day of wastewater to be treated.

HRT (days) = Tank Volume (gal)/Flow Rate (gpd)

2. Pretreatment can be accomplished using a prefabricated sewage "septic" tank. Septic tanks shall meet the septic tank construction requirements of the North Dakota Uniform Plumbing Code. No structural modifications to prefabricated structures, such as pump attachments, shall be made unless approved in writing by the manufacturer.

3. A commercial size effluent filter shall be installed on the outlet of the pretreatment tank.

c. Infiltrative Surface Design

1. The minimum size of the subsurface absorption system shall be the wastewater production rate, divided by the soil application rate at the infiltrative surface.

2. Exclude surface water runoff from entering the infiltration area.

3. The infiltrative surface shall be located at least 2 feet above the seasonal high water table or bedrock, as determined by the soil investigation.

4. There shall be at least 2 feet of soil beneath the infiltrative surface that has a design soil application rate of greater than zero, as determined by the soil investigation.

5. The bottom of the infiltrative surface shall be level.

6. Scarification of the infiltrative surface of the soil shall be done to reduce smear and shear.

d. Distribution System

1. Pipelines shall be designed to avoid freezing of transferred liquids during operation.

2. Gravity piping upstream of a soil absorption system shall be a minimum 4-inch diameter ASTM D1785 schedule 40 PVC pipe or equal, installed at a minimum grade of 1% or 1/8 inch per foot. Consideration of frost and traffic shall be taken into the design.

3. Pressure piping to a soil absorption system shall be a minimum 2-inch diameter

ASTM D1785 schedule 40 PVC or equal, with a pump sized to produce a velocity in the pipe between two and five feet per second.

4. **Distribution laterals shall be perforated with 1-inch diameter holes, spaced at a maximum of 3 feet, and installed such that the perforations are facing downward at the four and eight o'clock positions.**

5. **Laterals within a soil covered system shall be 4-inch minimum diameter ASTM D1785 schedule 40 PVC; installed level or sloped in the direction of flow at a maximum of 2 inches per 100 feet.**

6. **An air vent shall be connected to the upstream end of the subsurface absorption system piping.**

7. **At least two 4-inch diameter perforated observation pipes shall be installed in each system at the upstream and downstream ends. The observation pipes shall be perforated within the clear washed stone zone and extend from the infiltrative surface to a minimum 1 foot above final grade and shall be capped**

8. **Distribution laterals shall be installed in either level trenches or in level beds.**

   a. **Trenches shall be at least 6 feet wide and the distribution pipe shall be centered within the trench.**

   b. **Beds shall be at least 6 feet wider and longer than the lateral distribution network, and the distribution network shall be centered in the bed. Distribution laterals within a bed shall be spaced a maximum of 6 feet apart.**

e. **Soil Covered Bedding and Cover Criteria**

   1. **Six inches of 1½- to 2½-inch washed stone with less than 5% passing the No. 200 sieve shall be placed beneath the lateral piping for the entire width of the bed or trench. Pipes shall be stabilized by placing stone across the entire width of bed or trench to the top of the pipe.**

   2. **A single layer of non-woven geotextile fabric shall be placed over the soil absorption system stone. Fabric shall meet the requirements of Material Specification 592, Geotextiles, Class II, nonwoven fabric.**

   3. **The infiltration area shall be covered with topsoil to a minimum height of 18 inches, measured from the top of the distribution laterals.**

   4. **The final finished grade of the subsurface absorption system shall be at least 1 foot above surrounding grade.**

   5. **Immediately after completion of final grading, the surface topsoil material shall be stabilized by mulching and seeding.**

i. **Organic Matter Bedding and Cover Criteria**

1. **Six inches of 1½- to 2½-inch clear washed stone with less than 5% passing the No. 200 sieve shall be placed beneath the lateral piping to a width of no less than 24 inches. Pipes shall be stabilized by encasing them in windrows of stone to a height 6 inches above the top of the pipe.**

2. **A single layer of non-woven geotextile fabric shall be placed over the soil absorption system stone. Fabric shall meet the requirements of Material Specification 592, Geotextiles, Class II, nonwoven fabric.**

3. **The infiltration area shall be covered with bark or wood chips to a minimum height of 2 feet above the top of the distribution laterals.**

4. **The final finished grade of the subsurface absorption system shall be at least 1 foot above surrounding grade.**

4. **Specific Operation and Maintenance**

a. **A management plan which specifies information on the pretreatment processes, scheduled maintenance, operational strategies for periods of adverse weather and any other pertinent information.**

b. **Develop provisions to ensure that waste milk is never dumped into the system.**

c. **A contingency plan to address unexpected volumes of waste milk, wastewater, and runoff.**

d. **Develop an emergency response plan to address the containment, clean-up, and reporting of spills.**

e. **Annual pumping and solids removal from pretreatment tanks. Contents of the tank shall be land applied in amounts, uniformity, rates, and at a time consistent with the requirements of NRCS conservation practice standard Nutrient Management Code 590. If necessary, they should be stored in a waste storage facility meeting the criteria of North Dakota NRCS Field Office Technical Guide, Section IV, Conservation Practice Standard 313, Waste Storage Facility.**

f. **Prevent traffic on the system.**

g. **Maintain the thickness of the organic material cover.**

5. **Specific Considerations**

a. **Bark material should have large pore spaces (high porosity) to allow good oxygen transfer to the soil.**

b. **Hardwood bark or chips are preferred over softwood due to expected lifespan.**

C. **SPECIFIC CRITERIA – Feed Storage Leachate**

1. **Leachate is defined as a concentrated liquid which has percolated through or drained from animal feed. All leachate shall be collected and conveyed to a waste transfer and/or waste storage facility.**

2. **Contaminated runoff, defined as runoff that has come through or across a feed storage area, shall be delivered to a vegetated treatment area meeting the criteria contained in North Dakota Field Office Technical Guide Conservation Practice Standard 635, Vegetated Treatment Area, or shall be collected**

and land applied according to a nutrient management plan.

3. **Horizontal feed storage can lose leachate around the perimeter (surface discharge) and through the floor (subsurface discharge).**

   a. **The system shall include a surface collection system which consists of components that intercept and direct leachate to storage.**

   b. **The system shall include a subsurface collection system to direct leachate to storage unless a liquid-tight concrete liner is used. A subsurface collection system shall consist of a suitable subgrade, liner, leachate drainage layer, and surfacing material. The profile and configuration of the collection system must allow gravitational flow to a low point (sump).**

4. **If an existing feed storage area will be expanded as a part of the project, then a soil investigation shall be performed. If leachate is found under the surface of existing feed storage area, a perimeter collection system shall be installed around the existing facility.**

5. **The largest leachate volume is based on the harvest that will produce the largest silage weight. Estimate the leachate volume using ½ cubic foot leachate per ton of stored feed over a 30-day period. Unless determined otherwise, assume 60 pounds per cubic foot of stored feed (33.3 cu. ft./ton).**

6. **Frequent Haul of Leachate– Storage or transfer systems that require manual pump out shall be sized to contain a minimum of 20% of the total leachate volume calculated.**

7. **Transfer components shall meet the criteria contained in North Dakota Field Office Technical Guide Conservation Practice Standard 634, Waste Transfer. Prefabricated tanks shall meet the septic tank construction requirements of the North Dakota Uniform Plumbing Code. No structural modifications to prefabricated structures, such as pump attachments, shall be made unless approved in writing by the manufacturer. Materials shall be corrosion resistant.**

8. **All pumps shall be capable of transferring effluent with fibrous material and be able to withstand acidic corrosive environment. Pumps shall be installed and used in accordance with the manufacturer's recommendations.**

9. **Storage – Facilities for storage of leachate shall be designed in accordance with North Dakota Field Office Technical Guide Conservation Practice Standard 313, Waste Storage Facility. Materials shall be corrosion resistant.**

10. **Soil investigations shall be conducted. The soil investigation shall extend to bedrock or to a minimum depth to ensure the separation distance are achieved. A minimum of one soil investigation per 15,000 square feet of feed storage area footprint with a minimum of two per facility. Soil investigations shall be located in the footprint or no more than 100 feet from the footprint. Soil layers shall be described to thickness, texture using the Unified Soil Classification System (USCS) per ASTM D2488, Munsell color, presence and color of redoximorphic features, gleyed soil, and moisture condition. The elevation of bedrock. The upper elevation of all saturated layers.**

11. **The surface of the feed pad floor shall be a minimum of 2 feet above the seasonal high water table and bedrock, as determined by the soil investigation.**

12. **Specific Criteria for Subsurface Collection System**

    a. **Liner**
       Liner shall consist of an impervious layer of clay, flexible membrane, or concrete.

i. Clay shall have 40% or greater fines passing the #200 sieve and a Plasticity Index equal to or greater than 12. The liner shall be a minimum of 12 inches thick.

ii. Flexible membranes placed under stone surfacing shall be 60 mil High Density Polyethylene (HDPE), 60 mil Very Flexible Polyethylene (VFPE), 60 mil Linear Low Density Polyethylene (LLDPE), or 45 mil Ethylene Propylene Diene Monomer (EPDM)

iii. Flexible membranes placed under concrete or asphalt pavement surfacing shall be 40 mil HDPE, 40 mil VFPE, 40 mil LLDPE, or 45 mil EPDM.

iv. The concrete liner thickness and reinforcement shall be designed for the anticipated equipment loadings and crack control. Slabs on ground subject to equipment loads shall be designed in accordance with American Concrete Institute, ACI 360, "Design of Slabs-on-Ground," and Portland Cement Association Concrete Floors on Ground, Chapter 5. The concrete liner thickness shall be a minimum of 5 inches, contain distributed reinforcing steel and all contraction or expansion joints shall have imbedded non-metallic water stops. Steel shall be continuous through all construction joints.

b. Drainage Layer
Leachate drainage layer is required for clay and flexible membrane liners. When concrete is used as a liner it is also the leachate drainage layer.

i. The drainage layer shall be placed above the liner and below the surfacing material of the feed storage area footprint and apron. The drainage layer shall be a minimum of 6 inches thick after compaction.

ii. Drainage layers for clay liners shall consist of material with less than 5% fines passing the #200 sieve. Sideslopes shall be 3H:1V or flatter.

iii. Drainage layers for flexible membrane liners shall consist of rounded material less than 3/16 inch in size with less than 5% fines passing the #200 sieve.

c. Surfacing Layer
The surfacing layer shall consist of concrete or asphalt. When concrete is used as a liner it is also the surfacing layer.

i. Concrete shall be a minimum of 5 inches thick.

ii. Asphalt shall be a minimum of 4 inches thick in ≥ 2 lifts over 13 inches of crushed stone subbase. Crushed stone shall have 100% passing ¾-inch sieve and 10% maximum passing the #200 sieve.

13. Specific Operation and Maintenance

A management plan which addresses the handling and disposal practices for:

a. Handling and disposal of waste feed

b. Snow storage associated with the feed storage area.

c. Frequency for cleaning the floor for accumulated feed.

d. Interval for removing accumulated solids from the system components.

e. Schedule for inspection of the system to insure proper operation.

f. Develop an emergency response plan to address the containment, clean-up, and reporting of spills.

14. Specific Considerations

a. A collection system for leachate may be installed around the perimeter of the feed storage area.

b. When a manual pump is used, an alarm or indicator to mark the full level is suggested.

c. A sediment basin should be considered to remove solids before entering a transfer system or vegetated treatment area.

d. Mow weeds around the feed storage area to discourage vermin colonization.

V. CONSIDERATIONS

Location. Locate the waste treatment facility as near the source of manure or other waste as practicable and as far from neighboring dwellings or public areas as possible. For proper location also consider slope, distance of manure and other waste transmission, vehicle access, wind direction, proximity of streams and flood plains, and visibility.

In determining the location of the facility, consider elevation and distance from various components to take advantage of gravity flow where possible.

Manure Characteristics. Waste treatment may require specific total solids and nutrient contents of the waste stream. Pretreatment options such as dilution or settling could be used to adjust the solids content before entering the waste treatment facility or process.

Visual Screening. Evaluate the visual impact of the waste treatment facility or process within the overall landscape context. Look at implementing screening with vegetative plantings, landforms, or other measures to alleviate a negative impact or enhance the view.

VI. PLANS AND SPECIFICATIONS

Prepare plans and specifications for waste treatment facilities in accordance with the criteria of this standard and good engineering practice.

As a minimum, provide the following in the plans and specifications:

1. Layout and installation details of livestock facilities, waste collection points, waste transfer components, waste treatment and storage facilities, including supporting documentation.

2. Location of all inflow and discharge pipelines, pipeline materials, diameter and slope.

3. Details of support systems for all components of the treatment facility.

4. Fencing and signage as appropriate for safety purposes.

5. Required tests to determine the effectiveness of the waste treatment as appropriate.

6. Other plans to manage the system including a nutrient management plan for proper land application of byproducts.

VII. OPERATION AND MAINTENANCE

1. Develop and review an O&M plan with the owner/operator prior to construction of an innovative waste treatment facility or implementation of an innovative waste treatment process. Ensure the O&M plan is consistent with the proper operation of all system components and contains requirements including but not limited to:

2. Recommended loading rates of the waste treatment facility or process for hydraulic and critical pollutant parameters.

3. Proper operating procedures for the waste treatment facility or process, including the amount and timing of any chemicals added.

4. Operation and maintenance manuals for pumps, blowers, instrumentation and control devices, and other equipment used as components of the waste treatment facility or process.

5. Description of the planned startup procedures, normal operation, safety issues, and normal maintenance items. This includes procedures for the planned replacement of components with less than a ten year service life.

6. Alternative operation procedures in the event of equipment failure.

7. Troubleshooting guide

8. Monitoring and reporting plan designed to demonstrate system performance on an ongoing basis

9. The service life of each component as identified by the manufacture of service provider. The minimum service life for the waste treatment facility or process is ten years. Where components have less than a ten year service life, clearly identify their planned replacement schedule.

VIII. REFERENCES

American Concrete Institute, ACI 360, Design of Slabs-on-Grade.

American Society of Agricultural and Biological Engineers (ASABE) Standard EP 470, Manure Storage Safety.

ASTM D4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

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USDA, NRCS, National Engineering Handbook, Park 642, National Standard Material Specifications, Chapter 3, Material Specification 592-Geotextile.