NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

MANURE TRANSFER

(No.)

CODE 634

DEFINITION

A manure conveyance system using structures, conduits, or equipment.

PURPOSE

To transfer animal manure (bedding material, spilled feed, process and wash water, and other residues associated with animal production may be included) through a hopper or reception pit, a pump (if applicable), a conduit, or hauling equipment to:

- A manure storage/treatment facility,
- A loading area, and
- Agricultural land for final utilization.

CONDITIONS WHERE PRACTICE APPLIES

The manure transfer component is a part of a planned Waste Management System (312) to facilitate manure management or comprehensive nutrient management system.

Where manure is generated by livestock production or processing and a conveyance system is necessary to transfer manure from the source to a storage/treatment facility and/or a loading area, and/or from storage/treatment to an area for utilization. This includes hauling manure from one geographical area with excess manure to a geographical area that can utilize the manure in an acceptable manner.

Apply this practice where it can be installed and operated without contamination of land or water resources. This practice may also require additional equipment, labor and other resources to properly operate, manage, and maintain the system.

This practice does not include components covered under other practice standards. This practice also does not include land application or other use of manure. Criteria for land application of manure are included in NRCS-New York conservation practice standard Nutrient Management (590) or Waste Utilization (633).

CRITERIA

General Criteria Applicable to All Purposes

Manure transfer components shall comply with all federal, state, and local laws, rules and regulations.

Structures. All structures, including those that provide a work area around pumps, shall be designed to withstand the anticipated static and dynamic loading. Structures shall be designed to withstand earth and hydrostatic loading in accordance with practice standard Waste Storage Facility, Code 313. Covers, when needed, shall be designed to support the anticipated dead and live loads.

Reception tanks shall be sized to contain a minimum of one full day's manure production. For reception tanks collecting runoff, the reception pit shall be sized to also contain at least the volume of runoff from the 25-year, 24-hour storm. Additional capacity shall be added as needed for freeboard and emergency storage.

Openings to structures to receive manure from alley scrape collection shall be a minimum of 9 square feet with one dimension no smaller than 4 feet. The opening shall be equipped with a grate to exclude objects larger than 4 inches designed to support the anticipated loads.

Curbs shall be of sufficient height and strength

to ensure total manure flow into the structure and be adequately anchored.

Pipelines. Design of pipelines shall be in accordance with sound engineering principles considering the type of load on the pipe, exposure, etc. The minimum pipeline capacity from collection facilities to storage/treatment facilities shall be the maximum peak flow anticipated on a daily basis.

The minimum pipeline capacity from storage/treatment facilities to utilization areas shall be large enough to meet the peak rates needed to ensure that the storage/treatment facilities can be emptied within the time limits stated in the management plan for manure utilization.

Pipelines used for transferring waste to an irrigation system shall meet the requirements of NRCS conservation practice standard, Irrigation Water Conveyance, Pipeline, Code 430.

All pipes shall be designed based on the type of material and total solids content and shall convey the required flow without plugging. Flow velocities shall be sufficient to minimize settling of solids in the pipeline.

Clean-out access shall be provided for gravity pipelines at a maximum interval of 200 feet for lines carrying non-bedded manure. For gravity pipelines carrying bedded manure the maximum interval shall be 150 feet. Gravity pipelines shall not have horizontal curves or bends except minor deflections (less than 10 degrees) in the pipe joints unless special design considerations are used.

Where slurry manure is transferred in a gravity system, a minimum of 4 feet of head per 100 feet horizontal is required on the pipe system.

Gravity discharge pipes used for emptying a storage/treatment facility shall have a minimum of two gates or valves, one of which shall be manually operated. Valves should be protected against potential vandalism.

Gravity discharge pipes shall have a leakage collection system located down gradient of the outlet.

Joints in pipelines shall be of sufficient quality to prevent contamination of private or public water supply distribution systems and ground water.

Appropriate check valves, anti-siphon protection and open-air breaks shall be required in all pipelines if pumping to a storage facility located at a higher elevation from the inlet of the transfer system.

Other Conduits. Concrete lined ditches shall be designed in accordance with NRCS conservation practice standard Lined Waterway or Outlet, Code 468. A minimum design velocity of 1.5 feet per second shall be used.

Pumps. Pumps installed for manure transfer shall meet the requirements of NRCS conservation practice standard Pumping Plant, Code 533. Pumps shall be sized to transfer manure at the required system head and volume. Type of pump shall be based on the consistency of the manure and the type of bedding used. Requirements for pump installations shall be based on manufacturer's recommendations.

Safety. The system design shall consider the safety of humans and animals during construction and operation.

Open structures shall be provided with covers or barriers such as gates, fences, etc. Ventilation and warning signs shall be provided for manure transfer systems as necessary to warn of the danger of entry and to reduce the risk of explosion, poisoning, or asphyxiation.

Pipelines from enclosed buildings shall be provided with a water-sealed trap and vent or similar devices where necessary to control gas entry into buildings.

Barriers shall be placed on push-off ramps to prevent tractors or other equipment from slipping into waste collection, storage, or treatment facilities.

Tractors or other vehicles used to transfer, agitate, or pump manure or tow manure spreaders or tank wagons shall be sized using manufacturer's recommendations for the equipment it is operating to reduce the danger of unsafe operation or roll-over.

Excavation depths near building foundations should be kept to a minimum and should be shored and/or braced as required to protect the building and workers during construction.

Biosecurity Manure from diseased animals shall be handled in accordance with the recommendations of the state veterinarian.

Equipment leaving the farm shall be sanitized as appropriate to prevent the spread of disease.

Additional Criteria in Support of Agricultural Land for Final Utilization

Waste utilization Manure shall be applied to the utilization area in amounts, uniformity, rates, and at a time consistent with the requirements of the Comprehensive Nutrient Management Plan (CNMP) and/or NRCS- conservation practice standard Nutrient Management (590) or Waste Utilization, (633) as appropriate.

Liquid or slurry manure shall be adequately agitated prior to transfer for the purpose of land application both on and off the farm.

Where manure is to be spread on land not owned or controlled by the producer, the manure management plan, as a minimum, shall document the amount of manure to be transferred, the nutrient content of the manure, the date of transfer, and who is receiving the manure.

Sprinklers or sprinkler systems shall be designed in accordance with the NRCS conservation practice standard Irrigation System – Sprinkler (442). Sprinkler system design capacity shall be adequate to apply the required volume of manure at a rate and uniformity that shall prevent runoff, meet the nutrient needs of the plants, and apply the manure at a flow rate that meets the application window allowed. Nozzle size and pressure shall be appropriate for the consistency of the manure and/or wastewater applied.

Gated pipe and other appurtenances used in conjunction with gravity application shall be designed to insure uniform application amounts.

Hauling equipment Equipment used for hauling manure from one geographical area to another area shall be capable of hauling the manure without spillage, leakage, or wind-blown losses during transport. Equipment used shall ensure that the emptying of storage/treatment facilities is within appropriate time periods as stated in the system operation and maintenance plan. Hauling equipment shall meet all applicable local, state, and federal laws regarding highway transportation. Weight limits of roads used for hauling waste shall be followed.

CONSIDERATIONS

General

Consider economics (including design life), overall manure management system plans, and health and additional safety factors not listed in criteria.

On Farm Transfer

In locating structures, utilize existing topography to the greatest extent possible to generate head on structures and reduce pumping requirements.

Consider the operating space requirements of loading and unloading of equipment in the vicinity of the manure transfer components.

Consider the subsurface conditions, i.e., depth to bedrock, water table, etc., when locating and designing structures.

Pipelines used for transferring manure should be flushed with clean water after use.

When applicable and compatible, consider the joint use of manure transfer pipelines with irrigation system design requirements.

The pipe pressure rating required may need adjustment based on manure temperature. Consider the potential for salt (struvite) deposits in smaller diameter pipes.

Provisions should be made for removing solids from conveyance conduits such as concrete lined ditches, etc

Provisions for cleaning out solids or soil deposition in reception tanks, hoppers, and at outlet of pipelines should be considered.

Off Farm Transfer/Transport

Consider route selection and timing of manure transfer to minimize impact of nuisance odors and traffic on others.

Consider equipment type and covering of manure to minimize particulate matter generation during transport of manure.

Provisions should be made to inform the receiver of the manure of the proper storage and/or utilization requirements. Refer to the New York Agricultural Environmental Management (AEM) Tier II worksheet 'Manure Management: Nutrient Management, Field Application and Storage' for additional guidance.

Consistency and Conveyance

The final consistency of the manure product determines the methodology and equipment needed to move the material. Estimate the consistency of the final combined manure product to be transferred prior to selecting or designing the manure transfer components.

Plan and design the liquid transfer components based on the driest consistency expected. Plan and design the solid transfer components based on the wettest consistency expected.

Manure consistency is affected by the source of the manure, type of manure, amount of bedding, other waste materials, and the amount of water or liquids present or added. The viscosity and flowability of the manure can be affected by the type, size and shape of solid particles in the manure. The sources of manure to be transferred should be determined by locations, types of waste (including animal, milking center, silage leachate, polluted runoff, etc.), and their collection points.

Table 1 provides guidance for determining manure consistency by animal and percent solids. The large overlaps in the percent solids reflect inconsistencies in the use of the descriptive terms "liquid", "slurry", "semisolid", and "solid", as well as the inadequacy of percent solids to fully determine the viscosity of the material.

Relative Handling Characteristics of Different Kinds of Manure and Percent Solids

Table 1

	As Excreted	Liquid	Slurry	Semi-Solid	Soild
Dairy	13%	<8%	3-10%	8-21%	>16%
Swine	10%	<6%	4-15%	13-25%	>23%
Poultry	25%	<5%	4-14%	11-24%	>20%
Beef (feeders)	12%	<6%	3-10%	8-19%	>15%

Manure is classified as one of the following:

Solid Manure is as-produced manure with a large amount of bedding, usually long stalk straw or hay.

Gutter cleaners with conveyance to conventional manure spreaders for land spreading or storage is the typical system for collection of solid manure from stanchion or tiestall barns. Bedded packs are collected manually or with front-end loaders and transferred to conventional manure spreaders or storage.

Solid manure is manure, which is moved by mechanical devices such as front-end loaders and skid-steers. To maintain a solid consistency during storage, it may be appropriate to roof the storage structure.

Solid manure from beef animals is similar to dairy in characteristics and handling.

Broiler poultry manure is typically of solid consistency and handled as such.

Semi-Solid Manure is as-produced manure with less bedding than solid. Bedding is usually long straw or hay, chopped straw or hay, or sawdust. The added solids do not allow the manure to flow naturally.

Semi-solid manure is a consistency that allows the material to be moved by mechanical devices including a hydraulic piston ram.

Conveying semi-solid manure with long stalk bedding from stanchion, tie-stall, or open housing barns is the same as solid manure.

Semi solid manure with chopped straw or hay, or sawdust may be handled as solid manure waste or as slurry manure if liquids such as milkhouse wash water have been added.

Slurry Manure is as produced with limited bedding material, which allows the manure to flow and seek a level plane. This manure could also be semi-solid manure to which a sufficient amount of water or liquid waste has been added. It is handled as a liquid/flowable material, rather than a solid material and can be pumped.

Conveying slurry manure from stanchion or tiestall barns is usually by gutter cleaners or gravity flow gutters to a collection structure, then to a liquid spreader for daily spreading, or treatment (physical or biological), or storage.

Swine manure is generally handled as a slurry of liquid material.

Liquid Manure is as-produced manure with little or no bedding with added water or liquid waste. Flush systems use copious amounts of water to move manure across sloped floors to a collection system.

Some treatment systems such as solid separation and methane digestion, may produce a more liquid effluent. These liquids are collected and transferred to a liquid spreader for daily spreading, or treatment (physical or biological), or storage. Liquid manure is material that has the characteristics of and handles as a liquid.

Other Liquid Waste generated on farm operations may include milking center waste, silage leachate, or barard runoff with minimal solids content. These liquids are generally collected in a tank or sump, and pumped to a liquid spreader, or treatment area, or storage.

Other Influencing Factors

Consider the change in consistency of manure that is treated and/or stored. Anaerobic digestion, wetland treatment (in a humid climate), and unroofed storage may produce wetter manure than originally placed in them. Solid separation can result in two manure products, one more liquid and one more solid than the original manure. Composting, under good management can produce a dryer solid material.

Temperature can influence manure consistency. Frozen and/or dried manure can plug manure transfer components and should be handled separately. Frozen manure should be piled or stacked until thawed.

A water source should be available for liquid slurry systems since manure consistency varies throughout the year. Dried slurry or liquid manure may need water or liquid waste added before loading into a liquid manure transfer component.

Collection

The collection system should be designed to function with the present and future physical layout of the barn and with the management needs of the farm considered.

Existing collection systems should be evaluated to determine if they will function with the planned/designed manure transfer component, the expected manure consistency, and type housing to be used.

Locate collection structures as close to source of manure as possible.

Combine manure at centralized collection points to minimize number of manure transfer components required when manure is being transferred to a common end point. This may require changing existing collection components, changing outlet locations, or the addition of collection structures.

The collector should be located to provide acceptable access for the scraping and cleaning equipment.

Collection tanks/pits, hoppers, sumps, manure pumps, valves, pipelines and gravity drop structures should be liquid tight and sized appropriately.

Collector should be sized considering the planned transfer system to be used and the needs of the producer.

Pipelines, Valves, Pumps

Environmental hazard, corrosion resistance, joint and pipe water tightness, and pipeline operating pressure should be evaluated in selecting the pipe to be used for the manure transfer systems.

The manure transfer should take a direct path from the source of the manure to its final destination. A straight line with as few bends in alignment as possible is the most efficient and best considering operation, maintenance and cost.

Pipelines should be installed more than 25 feet from a well or reservoir. Appropriate bedding and anchorage should be addressed when encountering bedrock or groundwater.

The outlet end of the pipeline should be sufficiently anchored to prevent movement or separation of the last section of pipe.

Design the outlet end of a manure pipeline to enter a storage facility at or near the bottom of the storage.

Pipelines should be installed according to pipe manufacturer's specifications for the grade or quality of pipe.

Pipelines for transfer by pumps should meet the pump manufacturer's pipe requirement and pipe installation specifications including bedding, backflow devices, thrust blocks, anchors, and outlet structures.

Pipelines should be protected from freezing.

Elbows or bends in the pipeline alignment greater than 5 degrees should be made with manufactured fittings.

Manure transfer pipelines, where manure storage is above the pump, should have at least two valves installed in pipelines. One valve should be located immediately after the pump and the second valve should be before entering the storage facility.

Consider the pipeline backflow when sizing the collector when a pump is used.

The manure effluent pump/pump station should be equipped with automatic on/off switches and an emergency alarm wired to a separate power circuit. The electrical wiring should be inspected by a certified electrical inspector.

The recommended gravity pipeline size, transfer distance, and minimum head for various types manure is shown in Table 2.

Milking center wastes gravity piped directly to a waste storage facility should outlet above the maximum full storage volume elevation.

Unless special provisions are made, the use of sand as animal bedding should be avoided with gravity flow transfer.

The minimum depth of the gravity system collector should be (8) eight feet for slurry. If waste is liquid then the minimum depth should be (4) four feet. The inlet structures should have a smooth finish on the inside with a smooth transition into the pipeline. The bottom should be sloped to match the grade of the pipeline.

At least one conveniently located concrete unloading pad should be provided for trailer or tractor mounted power take-off pumps used for agitating and emptying a waste storage facility.

Anti-scour protection to the bottom and sideslopes at agitation points from agitation equipment should be provided for earthen waste storage facility.

Vertical sided waste storage facility side-wall mounted or vertical dock pumps should have a concrete platform for the tractor powering unit and spreader being loaded.

Unloading agitation pumps or agitation equipment are usually tractor PTO operated. Agitating takes more horsepower than unloading of the waste storage facility. Minimum PTO horsepower should be based on the equipment and manure system.

There are potential environmental hazards and management requirements in gravity unload systems for manure storage structures that must be considered when planning. The area below the discharge of the unloading pipeline should be an enclosed impoundment with a minimum volume equal to twice the size of the receiving system or spreader.

Liquid manure with less than 8% solids can be applied by manure injector units. One method of delivery includes manure being supplied by a drag hose with a centrifugal chopper irrigation pump.

PLANS AND SPECIFICATIONS

Plans and specifications for installing manure transfer systems shall be in accordance with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE

An Operation and Maintenance (O&M) Plan must be prepared and reviewed with the landowner or operator responsible for the application of this practice. The O&M Plan shall provide specific instructions for proper operation and maintenance of each component of this practice and shall detail the level of inspections, maintenance, and repairs needed to maintain the effectiveness and useful life of the practice.

The operation and maintenance plan shall describe what actions will be taken to minimize flies, other insects, and odors during the transfer of manure.

For the hauling of manure from one geographical area to another, record keeping by the producer or his/her designated representative will be required and may include such items as:

- the type, nutrient content, and amount of manure transferred,
- the solids percentage of the manure,
- the date of the transfer,
- the name and address of the source and destination of the manure, and
- the condition of the manure as left at the destination (spread, stockpiled and covered, etc.).

REFERENCES

Agricultural Waste Management Field Handbook - Part 651, "National Engineering Handbook", USDA-NRCS, April 1992.

Liquid Manure Application Systems Design Manual, NRAES-89. Northeast Regional Agricultural Engineering Service, 152 Riley-Robb Hall, Ithaca, . February 1998.

Dairy Practice Council, Guidelines for Milking Center Wastewater, June, 1998, DPC 15, Northeast Regional Agricultural Engineering Service. NRAES-115.

Dairy Practice Council, Guidelines for Dairy Manure Management from Barn to Storage, June, 1998, DPC 27, Northeast Regional Agricultural Engineering Service. NRAES-108.