NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

MANURE TRANSFER

New York
(number)
code NY634

DEFINITION

A manure conveyance system using structures, conduits or equipment.

PURPOSE

To transfer farm generated agricultural wastes (e.g. manure, soiled bedding material, spilled feed, processing or wash water and other wastes) generated by an agricultural operation. A system includes any combination of hoppers, pumps, tanks, reception pits and pipelines designed to convey waste to one or more of the following:

- a manure storage/treatment facility
- a loading area, and/or
- agricultural land for application and final utilization

CONDITION WHERE PRACTICE APPLIES

This practice applies where:

- the system is part of a planned Waste Management System (NY312)
- the operation is an agricultural operation
- the transfer system can be installed and operated without polluting land or water resources
- the equipment, labor and other resources are available to operate, manage and maintain the system
- components are not covered by other practice standards.

CRITERIA

General

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

Transfer Structures

All structures, including those which provide a work area around pumps, will be designed to withstand the anticipated earth, hydrostatic and dynamic loading in accordance with Practice Standard 313, *Waste Storage Facility*.

The minimum thickness of component elements of concrete structures shall also be in accordance with Practice Standard 313, W*aste Storage Structure.*

When curbs are needed in conjunction with structures, they shall be constructed of concrete or wood. Curbs shall be of sufficient height to insure total manure flow into the structure and be adequately reinforced and anchored.

Collector (Tank, Reception Pit, Hopper)

Openings to structures which receive manure from alley scrapers shall be a minimum of 9 square feet with one dimension no smaller than 4 feet. The opening shall be equipped with a cover or grate and shall be designed to support the anticipated loads.

Collector shall be sized to contain one full days manure production.

Pipelines - Valves - Pumps

General

The minimum pipeline capacity from the collection facilities to the storage/treatment facilities shall be the maximum flow anticipated on a daily basis. The minimum pipeline capacity from the storage/treatment facilities to the

utilization areas shall insure the storage/treatment facilities can be emptied within the time limits stated in the waste management system plan.

Pipelines shall be designed to have a minimum of 2 feet per second and a maximum of 6 feet per second velocity. Ruminant manure transfer in a gravity system can have reduced velocities if a minimum of 5 feet of head is provided on the pipe system with the storage structure full.

Pressure (Liquid) System, Non Gravity

Design of pipelines shall be in accordance with the applicable Practice Standard 430, *Irrigation Water Conveyance*.

Pumps installed for manure transfer shall meet the requirements of Practice Standard 533, *Pumping Plant for Water Control*.

The type of manure pump shall be based on the consistency of manure, (liquid, slurry, or semi-solid) considering distance to be pumped and maximum elevation difference with full storage structure head. Manure pump selection and installation shall be based on pump manufacture's recommendations, discharge capacity, total head, and solids capability. (See Table 1 for guidance)

Gravity Systems

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

Concrete lined ditches shall be designed in accordance with Practice Standard 428A, *Irrigation Water Conveyance-Non-reinforced Concrete Ditch and Canal Lining*. A minimum design velocity of 1.5 feet per second shall be used.

The gravity unloading system shall have a minimum of two (2) independently powered valves. The valves shall be water tight.

Land Application/Utilization

Manure shall be applied to the utilization area in amounts, methods, and at a time consistent with the manure management plan and Practice Standard 633, *Waste Utilization*.

Sprinklers or sprinkler systems shall be designed in accordance with Practice Standard 442, *Irrigation System*, sprinkler. Sprinkler system design capacity shall be adequate to apply the required volume of manure at a rate and uniformity that shall prevent runoff and meet the nutrient needs of the plants. Nozzle size and pressure shall be appropriate for the consistency of the manure applied. Sprinkler applied, manure contaminated water, shall normally contain less than two percent solids unless provisions are made for straining or filtering before application, or additional measures are taken, such as chopping the material.

Manure spreaders and/or tank wagons shall have adequate capacity to transport the manure in it's existing consistency without leakage and insure the emptying of storage/treatment facilities within appropriate time periods as stated in the system operation and maintenance plan.

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

Safety

The manure transfer system design shall include measures to protect the safety of humans and animals during construction and operation.

Open structures shall be provided with covers, grates, or barriers such as gates, fences, etc. designed to support the anticipated loads.

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 properly vented with a water-sealed trap and vent or similar devices to control gas entry into buildings.

Tractors or other vehicles used to transfer, agitate, or pump manure or tow manure spreaders or tank wagons shall be sized 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.

CONSIDERATIONS

Depth of bedrock, water table, environmental hazards, etc. should be considered in the selection of any proposed manure transfer or it's components.

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

Evaluate sanitation needs of all conveyance equipment in order to prevent the spread of disease.

Consider the potential for salt (struvite) deposits in smaller diameter pipe.

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.

Figure 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", "semi-solid", 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

	As Excreted	Liquid	Slurry	Semi-solid	Solid
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%

FIGURE 1

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 tie-stall 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.

Layer poultry manure is generally handled as a semi-solid.

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 tie-stall 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 barnyard 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), sequencing batch reactors and unroofed storage may produce wetter manure than originally placed in them. Solid separation can result in two waste products, one more liquid and one more solid than the original waste. 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.

Determine the appropriate location and need for safety valves, check valves, anti-siphon protection and open air breaks.

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 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 with manure being supplied by a drag hose with a centrifugal chopper irrigation pump.

PLANS AND SPECIFICATIONS

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

OPERATION AND MAINTENANCE

This operation and maintenance plan shall be developed in accordance with the requirements specified in Waste Management System (NY312) or Waste Treatment Lagoon (359), and other component practices used for manure transfer. Operation and maintenance plans will include manufacturer's O&M requirements for any equipment installed for the transfer of manure.

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, NY. 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

Table I - Pump Systems Guidelines

Type of Pump	Manure Consistency	Maximum Total Working Head (feet)	Maximum Distance (feet)	Maximum Pipe Size (inches)
Manure Pumps				
Hydraulic Piston Ram	Semi-Solid	25	250	12-15
	Liquid or slurry	25	400	12-15
Mechanic Hollow Ram	Liquid	25	150	12-15
	Slurry (15% solids)	25	100	12-15
Vertical Centrifugal Pumps (PTO)	Liquids	25	250	6-10
	Slurry (15% solids)	25	150	6-10
Vacuum	Liquids	30 2/	200	4-6
Storage Agitator Pumps	Liquid	16		4-6
	Slurry	16		6
Irrigation (Closed Impeller w/ chopper)	Liquids	100	5,000	6-12
Other Liquid Wastes				
Effluent Pumps 1/	Liquid	50	800	1 1/2 - 4

1. Electric, submersible sump pumps
2. No more than 12 feet can be on the suction side of the pump.

Table 2 - Gravity Systems Guidelines

	Recommended Minimum and Maximum			
Type of Manure	Head2/ (feet)	Slope (%)	Length3/ (feet)	Pipe Diameter (inches)
Dairy1/	5	1-15	200	20-30
Veal	1	0.5-12	200	6-24
Swine	2	0.5-7	200	6-24
Milking Center Waste Water	1	0.5-10	500 4/	4-6

1. Maximum amount of bedding is 2 to 3 pounds per day per head of chopped hay, or straw, or sawdust, or similar material
2. Head equals the elevation difference per 100' horizontal from the hopper inlet to the highest elevation manure is stored.
3. Maximum length for continuous closed conduits.
4. After settling tank for milking parlors. Maximum length from parlor to settling tank is 100 feet, on a continuous grade.