Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

WASTE TRANSFER

CODE 634

(no)

DEFINITION

A system using structures, pipes, or other conduits installed to convey wastes or waste byproducts from an agricultural source to a storage facility, treatment facility, or land application site.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Prevent nutrient transport to surface or ground water
- Prevent transport of pathogens to surface or ground water

CONDITIONS WHERE PRACTICE APPLIES

The waste transfer system is included as a component of the agricultural production area, storage facility, treatment facility, and land application areas of the agricultural operation.

The practice applies where it is necessary to transfer waste material generated by livestock production or agricultural product processing between the generation site, storage facility, treatment facility, handling area, loading area, or land for agronomic application.

This practice does not apply to hauling waste material with equipment or vehicles.

CRITERIA

General Criteria Applicable to All Purposes

Laws and regulations

Notify landowner and/or contractor of responsibility to locate all buried utilities in the project area, including drainage tile and other structural measures. The landowner is required to obtain all necessary permits for project installation prior to construction. Plan, design, and construct the waste transfer system to meet all Federal, State, Tribal, and local laws and regulations.

Safety

Include appropriate safety features to minimize the hazards of the facility. Provide warning signs, fences, ladders, ropes, bars, rails, and other devices, as appropriate, to ensure the safety of humans and livestock. Ensure that proper ventilation and adequate warning signage is provided for waste transfer structures in an enclosed facility or confined area, as necessary, to prevent explosion, poisoning, or asphyxiation.

Include a water-sealed trap and vent or similar devices where necessary to control gases from a pipeline entering an enclosed building or reception pit.

Prevent tractors and other equipment from slipping into waste collection, storage, or treatment facilities by placing barriers on push-off ramps.

Provide covers or barriers, such as gates, fences, grates, etc., at openings to waste transfer components and manure storage structures. Secure to prevent accidental entry by humans and livestock.

Protect pipes at risk of being damaged by equipment or livestock by placing fences or markers along the pipe.

Provide a secure cover or otherwise restrict access to any manually operated in-line valves of a discharge pipe from a waste storage structure to prevent unauthorized release of effluent.

Electrical Components
Follow the requirements of the National Electrical Code (NEC) based on the location and type of installation for all electrical components, including wiring, boxes, connectors, etc. Local electrical requirements may exceed those set by NEC.

Structural design
Design structures with reinforced concrete, steel, wood, or masonry materials in accordance with NRCS National Engineering Manual (NEM) (Title 210), Part 536, “Structural Engineering.” Account for all items that will influence the performance of the structure, including load assumptions, durability, serviceability, material properties, and construction quality. Ensure that the material used for a fabricated structure is compatible with the waste product being transferred.

Structures
Structures, including concrete reception pits, tanks, hoppers, manholes, and channels used for waste transfer, prefabricated or cast-in-place, must meet the criteria in NRCS Conservation Practice Standard (CPS) Waste Storage Facility (Code 313) for liquid tightness and structural strength, regardless of materials used for construction.

Design all structures, including those that provide a work area around pumps or other equipment to withstand the design static and dynamic loading. Design structures to withstand earth and hydrostatic loading as specified for comparable structural criteria in NRCS CPS Waste Storage Facility (Code 313).

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

Investigate the subsurface conditions (e.g., depth to bedrock, soil classification, water table, etc.) when locating and designing structures.

Use NRCS CPS Roofs and Covers (Code 367) to design roofs or covers where needed for structures.

Reception pits — Specifics
Size reception pits to contain a minimum volume of one full day’s waste production. Provide additional capacity for reception pits receiving stormwater runoff to contain the volume of precipitation and runoff from the 25-year, 24-hour storm plus any required freeboard and emergency capacity. Design the reception pit to be protected from inundation or damage from a 25-year flood event when located in the 100-year floodpain. Reducing a reception pit design volume by flood routing the design storm runoff volume may be used only when there is dependable backup power supply for pumps and where no impact to surface water can occur should the reception pit pump fail.

Design floor openings with structures that receive manure from scrape alley collection to ensure unrestricted access for the material being scraped. In the absence of evidence to support an alternate design, provide the floor opening with a minimum area of 9 square feet, having one dimension of that opening 4 feet or larger. Equip floor grate with openings wide enough to pass the waste and engineered to support the anticipated live loads. Provide safety features to prevent accidental entry to the waste reception pit.

Design curbs, intended to convey waste, to be of sufficient height to ensure all waste flows into the transfer structure. Design curbs to be anchored to withstand working loads.

Pipelines and conduits — General
Design pipes and other conduits considering the waste material properties, management operations, pipe exposure, static and dynamic loads on the pipe, working pressure, transfer system pressure rating, required capacity and all applicable design factors. Pipe pressure rating required may need adjustment based on effluent temperatures and consistency.

Use watertight or sewer grade pipes and connection devices for waste transfer pipes. The type of liquid waste material and the total solids content will determine the pipe designs needed to convey the required flow without plugging.

Provide cleanout access for all pipes transferring waste material to allow for removal of settled solids or obstructions. Space pipe cleanouts at a maximum interval of 150 feet along the pipe length, or a maximum interval of 300 feet along the pipe length if bidirectional cleanouts are used. A pipeline intervention device, such as a foam cleanout ball, is an acceptable method of cleaning out pipes instead of a cleanout access. Incorporate pipe cleanout methods into the design and describe the methods in the operation and maintenance plan.

Design the pipe or conduit from the collection facility to have a minimum flow rate equal to the maximum anticipated design flow. Design flow should be a 25-year, 24-hour event to prevent discharge from the system, otherwise, use a design flow that is required for system operation.

Design the pipe to empty the storage or treatment facility in accordance with the planned application rates outlined in the comprehensive nutrient management plan.

Protect pipes exposed to sunlight from ultraviolet (UV) deterioration by selecting UV-resistant pipe materials or by painting the pipe exterior to withstand UV damage throughout the intended life of the pipe.

Install pipe properly at all locations to accommodate any traffic crossing, farming operations, frost depth, subsurface saturation, or bedrock elevations. Protect pipe from uplift if subjected to hydrostatic forces. Separate pipe installed near bedrock with at least 6 inches of bedding material. Excavation and removal of bedrock is acceptable to provide bedding depth.

Design transfer pipe to be insulated, heated, buried below anticipated frost depth, constructed of freeze-resistant material, or installed such that it can be drained after each use by gravity or compressed air when cold weather operaton is planned.

Taking into account the designed outflow flow rate, size a transfer or lift station to accommodate the peak flow where a station along a pipe is needed for transition of direction or change in elevation and no additional flow will be added to the pipe at that station. Design the station using the reception pit criteria for a station receiving gravity flow and pumping the outflow.

Install pipes with appropriate backflow prevention devices, when applicable.

Install air vents and vacuum relief valves where necessary to eliminate air locks, as well as to protect the pipe against negative pressures.

Pipelines — Pressure
Select pipeline and appurtenance material that meet the design working pressure criteria of the system. Include in the analysis any air and water pressures used to clear the pipeline.

The pipeline working pressure must not exceed 72 percent of the pipe rating.

Provide thrust control designed in accordance with NRCS National Engineering Handbook (NEH) (Title 210), Part 636, Chapter 52, “Structural Design of Flexible Conduits,” for all buried pressure pipelines 4

inches and larger in diameter and for fittings and valves. Mechanical joint restraint may be used and must be certified by the manufacturer as adequate to withstand the unbalanced thrust forces in the system, as computed in 210-NEH-636-52.

Maintain the integrity of a wall or liner at pipe penetrations of waste storage structures, reception tanks, and channels. Protect the pipeline where it penetrates the liner of a waste storage facility by providing a cast-in-place concrete restraint or other support, as necessary. Provide pipe restraint where pipeline movement may damage the integrity of the pipe, wall, or liner system.

For a pumped system, design so that the velocity in the pipeline, when operating at system capacity, will be between 3 and 8 feet per second unless surge protection that is adequate to prevent damage from sudden blockages or water hammer is provided. Limit the velocity in the pipeline to 5 feet per second or less if the transfer pipe is not buried or securely fastened down. Velocity in the pipeline may exceed 5 feet per second without a surge analysis if the pipeline is buried or otherwised secured, installed without gates or valves, and discharges freely to a tank or pond.

The 3 feet per second lower limit for velocity in the pipeline does not apply to a system that is powered by a pump such as a ram plunger or piston type pump that operates by pushing semisolid waste material in a periodic stroke cycle.

Install a check valve near the outlet of each pump except where backflow is incorporated into the design.

Provide a pressure relief valve after the check valve, near the pump(s) to protect the pipeline against any pump shutoff head due to a blockage (unless the pump shutoff head is less than the working pressure of the transfer system).

Provide a pressure relief valve or properly sized water hammer arrestor on the pressure side of shutoff valves to protect against water hammer due to the sudden closing of a valve.

Size pressure relief valves to be no smaller than one-fourth inch for each inch of the pipe diameter. Set pressure relief valves to open at a pressure no greater than 5 pounds per square inch above the transfer system working pressure.

Pipelines — Gravity
In a gravity flow pipe system, a minimum head is required depending upon the consistency of the material. See table 1.

Table 1: Minimum Required Hydraulic Head and Consistency

Minimum Feet of Hydraulic Head	Consistency
4 feet	heavily bedded undiluted manure
2 feet	slurry or semi-liquid manure
<1 foot	liquids and 1:1 dilute liquid manure

For manure gravity pipes over 100 feet in length, increase minimum feet of head by an additional 1 percent of the pipe length exceeding 100 feet. Design for a minimum velocity of 3 feet per second.

Minimum diameter of gravity pipe is 24 inches for heavily bedded manure, including sand-laden manure.

Convey waste into and through the pipe to minimize ponding in the production area. Design the gravity pipe to follow as direct a route as possible. Horizontal curves or bends in the pipe joints of a gravity pipe require special design considerations except for minor deflections of less than 10 degrees.

Account for the process of sand settling out of the waste stream in a gravity flow design that transfers sand-laden manure. The minimum gravity pipe flow velocity for sand-laden manure is 5 feet per second. Design transfer systems to handle potential loss of pipe integrity due to internal erosion by the materials being transported for a flow velocity exceeding 6 feet per second.

For a flume system with slurry manure, limit the design depth of flow in the pipe to 50 percent of the pipe depth to maintain the scouring effect of the flow.

Install a minimum of two manually operated in-line valves, with one located as close to the storage facility as practical, for a pipeline designed to gravity discharge liquid waste from a waste storage or treatment facility. If an automatic valve is used for gravity loading or transfer, the automatic valve will be in addition to the two manually operated in-line valves.

Other conduits
The minimum design velocity for waste transfer in open ditches and channels is 1.5 feet per second.

A minimum concrete thickness of 5 inches is required for a reinforced cast-in-place concrete-lined ditch or channel for waste transfer.

Pumps
Use NRCS CPS Pumping Plant (Code 533) for a waste transfer pump where needed.

Select the pump to transfer the waste material at the system pressure head and rate required. Determine the type of pump by the consistency of the material and the type of solids. Use pump manufacturer's recommendations for the installation requirements.

Correct the total dynamic head for viscosity and specific gravity of the liquid waste used in pump selection. Reference 210-NEH, Part 651, Chapter 11, "Waste Utilization," for increased friction losses caused by higher fluid viscosity, and 210-NEH-651, Chapter 12, "Waste Management Equipment," for pump selection guidance.

Agitators
Include agitators, as needed, to facilitate pumping of liquid or slurry waste for transfer. Size the agitation equipment to provide adequate agitation of the volume of storage. Select equipment compatible with the type and consistency of the waste material. Base requirements for agitator sizing, installation, and operation on manufacturer's recommendations.

Solid/liquid waste separation
Use NRCS CPS Waste Separation Facility (Code 632) to separate a portion of the solids from the manure or liquid waste stream, as needed.

CONSIDERATIONS

General Considerations
Consider economics (including design life), overall nutrient management system plans, and health and safety factors.

Time and locate agitation and transfer activities to minimize odor formation and the breeding of insects within the material.

Cover and/or minimize the disturbance of material to reduce the likelihood of air emissions, hydrogen sulfide formation, and release of particulate matter, volatile organic compounds, methane, and ammonia.

Consider abandonment, relocation, or additional floodproofing for existing reception structures located in flood-prone areas. For additional information on floodproofing structures, see "Floodproofing Non-Residential Buildings" (FEMA P-936, 2013).

Transfer operations
Install permanent aboveground or buried pipes to replace hoses and temporary pipes that are used on a regular basis to transfer waste.

Protect storage structure liners from hydrostatic soil pressures that may be caused by preferential flow paths along the outside of the installed pipe.

Consider a positive displacement pump for liquid waste with total solids exceeding 8 percent.

Increase the total dynamic head up to 30 percent for pumping manure slurries with 3 to 8 percent total solids (wet basis).

Use a wet sump and agitation pump to reduce solids separation within the gravity reception structure.

Select a pump with a low speed for manure slurries which contain abrasives such as sand.

Use a semi-open impeller pump to handle manure slurry with straw, twine, hair, and sludge. Pumps with cutting knives and recirculation agitation capacity also reduce plugging.

Install a cleanout or vent riser within 10 feet of the reception structure and other grade change locations on gravity transfer systems to reduce the risk of an air lock in the pipe.

Use premanufactured manholes as risers at stations to change direction for needed transitions.

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

When applicable and compatible, consider the dual use of waste transfer pipelines for irrigation water delivery.

Install a locator wire in the trench with transfer pipelines.

Consider corrosion resistance and water tightness in the selection of pipe material and joints due to the nature of the waste material.

Consider the potential for struvite phosphate (magnesium ammonium phosphate) mineral deposition in smaller diameter pipes and places where there is high turbulence such as pipe connections and valves. Preventative measures may be needed, such as acid washing the pipe to prevent the buildup of deposits.

Consider the need for additional check valves, cleanouts, vent risers, knife valves, anti-siphon protection, and vacuum relief valves and open-air breaks, as appropriate, on all pipe systems.

Use leak detection methods and equipment for monitoring and periodic pressure testing of waste transfer systems installed in sensitive areas having large daily flow volumes, long flow lengths, or high flow pressures.

Post a warning sign on all risers indicating the pipe pressure rating.

When exporting solid waste material off-farm, consider NRCS CPS Waste Recycling (Code 633).

PLANS AND SPECIFICATIONS

Prepare plans and specifications for constructing a waste transfer system that describe the requirements for applying this practice to achieve its intended use.

- Construction plans and specifications must include a location map, plan view, profiles, cross sections, details and specifications of all structures, etc., to ensure that the project can be properly constructed.
- NRCS acceptance may require pressure testing of a pressure pipe system prior to waste transfer service. If required, include the test protocol and results in the as-built documentation.

OPERATION AND MAINTENANCE

Prepare an operation and maintenance (O&M) plan for review with the landowner or operator responsible for the application of this practice. Provide specific instructions in the O&M plan for proper operation and maintenance of each component of this practice and any detail needed for the level of repairs to maintain the effectiveness over the useful life of the practice. Include—

- Evaluating the overall functionality of the waste transfer system for possible malfunctions that could lead to a spill or release of waste material. Address the identified potential failures in the inspection procedures of the O&M plan. Prepare an emergency response plan to be implemented in the event of such a failure.
- Agitating liquid or slurry waste material adequately prior to transfer.
- Flushing pipes used for transferring waste material with clean water after use and to reduce the risk of gas buildup and pipeline explosion.
- Periodically removing solids from conveyance conduits such as concrete-lined ditches, grates, etc.
- During outbreaks of disease, handling waste products according to the State veterinarian guidance on biosecurity for animal waste material.
- Sanitizing equipment leaving the farm, as appropriate, to prevent the spread of disease during an outbreak.
- Documenting use of confined space entry points and signage requirements and their review prior to entering areas with possible gas buildup or asphyxiation concerns.

REFERENCES

Federal Emergency Management Agency. 2013. FEMA P-936, Floodproofing Non-Residential Buildings. Washington, D.C.

USDA NRCS. 2009. National Engineering Handbook (Title 210), Part 651, Chapter 10, Agricultural Waste Management Systems Component Design. Washington, D.C. https://directives.sc.egov.usda.gov/.

USDA NRCS. 2013. National Engineering Handbook (Title 210), Part 651, Chapter 11, Waste Utilization. Washington, D.C. https://directives.sc.egov.usda.gov/

USDA NRCS. 2011. National Engineering Handbook (Title 210), Part 651, Chapter 12, Waste Management Equipment. Washington, D.C. https://directives.sc.egov.usda.gov/

USDA NRCS. National Engineering Handbook (Title 210), Part 642, Chapter 2, National Construction Specifications. Washington, D.C. https://directives.sc.egov.usda.gov/

USDA NRCS. National Engineering Handbook (Title 210), Part 642, Chapter 3, National Standard Material Specifications. Washington, D.C. https://directives.sc.egov.usda.gov/

USDA NRCS. 2005. National Engineering Handbook (Title 210), Part 636, Chapter 52, Structural Design of Flexible Conduits. Washington, D.C. https://directives.sc.egov.usda.gov/

USDA NRCS. 2017. National Engineering Manual (Title 210), Part 536, Section 536.20, Design Criteria for Reinforced Concrete Structures. Washington, D.C. https://directives.sc.egov.usda.gov/