Milking Wastewater Infiltration System

GENERAL

The milking center wastewater treatment system is an adaptation of a traditional leach field and an organic matter bed. The traditional leach field and the organic matter bed had problems with excessive sediment and fats getting into the disposal field. The current system increases residence time in the settling tanks to allow more separation before effluent travels to the disposal field.

System components may include a settling trap, a grease trap, a pump station, effluent filter, a stone disposal field with a pipeline distribution system, clean water exclusion devices, and exclusion fencing. Components are customized to fit individual site conditions.

Use the system to treat wastewater generated from the washing of tanks, pipelines, milking machines and associated equipment, animals, and parlor floors. Consider collecting the first rinse from milking machines and associated equipment and feeding it out to reduce the load on the grease trap. Remove excessive solids from parlor floors before washdown to reduce the load on the settling trap. Do not use the system to dispose of “dumped” milk tanks or human sewage.

Settling traps and grease traps provide collection of solids and fats. It is presumed that primary treatment also occurs similar to that of a septic tank. Secondary treatment occurs in the disposal field.

If liquid manure storage is in place on the farm, the milking center wastewater should be incorporated into the storage as the first alternative to the treatment system. The extra liquid may be helpful in moving the manure into the storage and more cost effective than two systems.

SYSTEM COMPONENTS

Air Trap

Use an air trap, also known as a plumber’s P-trap, in the distribution pipeline to prevent odors from entering back into the building. Place before the first settling trap. Most drains have this already in place.

Air Vent

Consider an air vent to maintain atmospheric pressure in gravity systems. This is strongly encouraged on systems that are made up entirely of below ground tank structures.

A pumped system requires an air vent or check valve between the pump and distribution box.

An air vent consists of a vertical plastic pipe open to the atmosphere and connected to the pipeline with a tee. Use (2) 90-degree elbows at the top of a riser pipe to exclude precipitation. Plan the vent locations safe from traffic and work areas. A minor odor may be emitted from the vent.

Pipeline

Gravity systems use 4 inch minimum diameter, ASTM D-1785, SCH 40, PVC pipe, or equivalent, for the pipeline. Minimum slope for gravity pipelines is 1 percent or 1/8 inch per foot. Specify pipe for pump systems according to pump manufacturer’s recommendations for size and pressure rating. Provide access to the pipeline at appropriate intervals for cleanout on remote systems. Minimum soil cover over the pipe is 24 inches. In areas where vehicular traffic crosses over the pipe, a minimum of 36 inches of soil cover is needed. Locate pressure pipe at an adequate depth or otherwise protect it to avoid damage from vehicles and frost.

Solids Traps

A settling trap is needed to capture heavy solids washed into the system. Locate the settling trap first in the system and as close to milking center as possible to prevent settling and plugging of the pipeline.

The settling trap consists of a manufactured tank, such as a precast concrete septic tank. This type of system should not be considered if large amounts of solids build up are expected. Material removed from cleanout can be spread on the land or transferred to a manure storage structure.

The grease trap is needed to allow fats and greases to congeal and coagulate. Install the grease trap(s) after the settling trap. It is imperative that the fats are captured before the effluent continues to the disposal field. A fatcake will develop on the surface of the effluent in the grease trap. Monitor the build-up of the fatcake and remove when it is 12 inches thick or able to flow out the outlet pipe to the disposal field, whichever is first. Remove the fatcake by pumping out with a septic truck or equivalent. The fatcake can be spread on the land or transferred to a manure storage structure.

The volume of the grease traps is dependent on the volume of effluent and the amount of milks and fats going into the system. For example, if the first flush of the milk line is consistently removed from the wastewater produced, the fat in the system is considerably less. If emulsifying soaps are used, they inhibit the congealing of the fats so a larger volume is needed to increase the holding time. It is recommended that the capacity of the grease traps be 6 times the daily production of milkwaste water.

The grease trap commonly consists of a precast concrete grease trap tank, though other structures constructed of durable material such as steel, fiberglass, plastic, and cast-in-place concrete are usable. Ensure that the tank(s) are watertight to prevent leakage. Check lightweight tanks for floatation. The tanks need to have easily accessible ports for year round monitoring and fatcake removal.

Effluent Filter

An effluent filter shall be installed in line between the grease trap and the disposal field. The filter shall be able to handle twice the anticipated flow from the milkhouse. The filter shall have 1/32" openings or smaller. The filter should be readily accessible so it can be removed frequently for cleaning and maintenance.

Pump

If gravity flow is not possible, use a pump to convey wastewater from the traps to the distribution box at the disposal field. Use a standard residential sanitary pump housed in a precast concrete tank or equivalent. The pump house needs be easily accessible for year round monitoring and maintenance. Pump floats should be set to actuate frequently and induce the disposal field with small volumes. Large flow surges can damage the field and lead to system failure.

Distribution Box

Discharge of wastewater into the stone disposal field must be uniform to avoid overloading areas of the field. Use a standard septic system distribution box to feed the disposal field pipes. If a terraced linear system or a proprietary system is used, a distribution box may not be needed, though encouraged to allow access to the pipe.

Disposal Field

The disposal field allows biological tertiary treatment in the organic mat and infiltration into the soil. The disposal field can be a standard septic system stone field or a terraced linear stone trench system. The effluent flows through the crushed stone disposal field through SCH20 PVC perforated distribution pipes. The effluent flows out of the perforations, through the stone, through the organic mat and into the soil.

The disposal field shall be sized and placed according to sections to follow. The field is prepared as specified by location and soils. The surface soil must be scarified and loosened. Clean stone from ¾ inch to 2-½ inch diameter is placed 7 inches thick. The distribution pipes are placed on the clean stone. Perforations shall be no smaller than 3/8 inch and no larger than ¾ inch diameter. Perforations shall be placed so they are on the bottom of the pipe, i.e. 4 o'clock and 8 o'clock positions. Maximum tolerance of slope on pipes shall be no more than 2 inches in 100 feet. The distance between pipes shall be 5 feet. The distance from the pipe to the sidewalls of the field shall be between 1 and 5 feet. Stone (¾ to 2-½ diameter) is placed around the pipes and 1-inch over them. Geotextile filter fabric or 2 inches of compressed hay shall be placed over the stone to keep soil from moving into the stone. Minimum of 8 inches of fill material is placed over the filter and 4 inches of topsoil is placed over the fill. Fill material shall be placed adjacent to the field in a 3 foot wide apron on all sides at finished elevation and then tapered down to natural ground at a slope no steeper than 3:1. Seed and mulch all disturbed areas.

Direct surface runoff from the field with a diversion, if necessary. Use subsurface drainage to lower water table as needed.

Fence

The disposal field shall be fenced to exclude equipment and large animals. The field can be mowed by lightweight equipment that will not damage the pipes.

Table 1 - Minimum Setback Distances from any Edge of the Infiltration Area

Resource Concern	Minimum Downslope Distance	Minimum Upslope Distance
Public Water Supply (b)	1000 feet	1000 feet
Neighboring Dwelling or Water Supply	500 feet	500 feet
Adjoining Property Line	200 feet	100 feet
On-Farm Well or Spring	300 feet	100 feet
Lake/Pond/River/Water Body	300 feet	100 feet
Wetland	300 feet	100 feet
Diversion or Waterway	100 feet	25 feet
Gully/Swale/Ravine	100 feet	25 feet
Slope Greater than 3 to 1	100 feet	25 feet
Culturally Sensitive Areas	50 feet	50 feet

TABLE 2

Parent Material	Soil Profile Number	Textural Classification and Description	Soil Depth to Bedrock (inches)			Soil Depth to Seasonal High Water Table or Hydraulically Restrictive Layer (inches)			Hydraulic Loading Rate (ft^2/gpd)
			0-15	15-24	>24	0-7	7-12	>12	USE TO SIZE BED
			DESIGN CLASS						
Basal Glacial Till	1	Silt loam textured soils throughout entire profile. Lower horizons usually have prismatic or platy structures. The profile tends to become firm, dense, and impervious with depth and, thus, may have a hydraulically restrictive horizon. Angular rock fragments are usually present. Cobbles and stones may be present.	4	2	1	4	2	1	**4.1**
Ablation Till	2	Loam to sandy loam textured soils throughout entire profile. The profile does not have a hydraulically restrictive horizon. Angular rock fragments are present. Cobbles and stones may be present.	4	2	1	4	2	1	**3.3**
Basal Glacial Till	3	Loam to loamy sand textured soils throughout entire profile. Lower horizons usually have well defined prismatic or platy structures that are very compact and are difficult to excavate. These lower horizons are considered to be hydraulically restrictive. Angular rock fragments are present. Cobbles and stones may be present.	4	2	1	4	2	1	**3.3**
Ablation Till	4	Sandy loam to loamy sand textured upper horizons overlying loamy sand textured lower horizon. The profile tends to be loose and easy to excavate. Lower horizons tend not to be firm and are not considered hydraulically restrictive. Angular rock fragments are present along with partially water-worn cobbles and stones.	4	2	1	4	2	1	**2.6**
Stratified Glacial Drift	5	Loam to loamy sand textured upper horizon overlying fine and medium sand parent materials. Stratified horizons of water-sorted materials may be present. Lower horizons tend to be granular or massive. Entire profile tends to be loose except that stratified horizons may be cemented, firm and are, therefore, considered to be hydraulically restrictive. Horizons with rounded rock fragments are common.	4	3	3	4	3	3	**2.6**
Stratified Glacial Drift	6	Loamy sand to sand textured upper horizons overlying stratified coarse sands or gravel parent materials. Stratified horizons of water-sorted materials may be present. Entire profile tends to be loose except that saturated horizons may be cemented, firm and are, therefore, considered to be hydraulically restrictive. Horizons with rounded rock fragments are common.	4	3	3	4	3	3	**2.0**
Mixed Geological Origins	7	Fifteen or more inches of sandy loam to loamy sand glacial till or loamy sand to sand stratified drift parent material overlying marine or lacustrine deposited silt to silty clay or 15 or more inches of loamy sand to sand stratified drift parent material overlying firm basal till. Upper horizons tend to be granular in structure. Lower horizons tend to be firm and massive in structure and are considered to be hydraulically restrictive. Rock fragments may be present in upper horizons but are usually absent in lower horizons, except for basal till	4	2	1	4	2	1	**3.3**
Lacustrine Deposits	8	Loam to fine sandy loam upper horizons overlying firm silt loam to silt textured lower horizons. Upper horizons tend to be granular in structure. Lower horizons tend to be firm and massive in structure and are considered to be hydraulically restrictive. Stratified lenses of fine sand and sandy loam may be present in lower horizons. Coarse rocks are usually absent throughout entire profile.	4	2	1	4	2	1	**4.1**
Marine Deposits	9	Silt loam textured upper horizons overlying firm silt loam to silty clay textured lower horizons. Lower horizons tend to be very firm and are considered to be hydraulically restrictive. Coarse rocks are usually absent throughout entire profile. Thin lenses of very fine sand to silt may be present in the lower horizons.	4	2	1	4	2	1	**5.0**
Organic Deposits	10	Partially decomposed organic material.	4	4	4	4	4	4	
Alluvial Dune Beach Deposits	11	These soils have no typical profile. They are variable in texture and exhibit very little weathering. They are deposited in flood plains, sand dunes or beach environments.	4	4	4	4	4	4	
Filled Sites	12	These soils have no typical profile. They are variable in texture and may contain man-made materials. Use profile that best describes the fill material.							

Table 3

Design Class	Design Requirements
1	System is allowed. These soils have adequate separation distances to bedrock, water table or hydraulically restrictive layer.
2	System is allowed only if the soil is modified. These soils do not have adequate separation distances to bedrock, water table or hydraulically restrictive layer. Modify the soil by: • Raising the disposal field with proper fill material to obtain the minimum separation distance of 24 inches to bedrock and 12 inches to the water table or hydraulically restrictive layer, and/or: • Design a curtain drain above the disposal field to lower the water table under the disposal field in order to obtain the minimum separation distance of 12 inches to the water table.
3	System is allowed only if the soil is modified. These soils (Profiles 5 and 6) have rapid permeability and may overlie aquifers. Proper fill material must be used to maintain a 24-inch separation to bedrock, water table, or hydraulically restrictive layer. If the bottom of the disposal field will be resting on fine and medium sands and/or stratified coarse sands and gravels, a minimum of **6 inches** of proper fill material will be placed at the interface of the natural soil and the bottom of the disposal field. The treatment system will be sized based on the properties of the fill material.
4	System is not allowed on: • Soils with less than 15 inches to bedrock. • Soils with less than 7 inches to water table or hydraulically restrictive layer. • Organic deposits or dune deposits. ***Variances***: In some circumstances, there are no practical alternatives for siting a treatment system in areas other than those with separation distances as indicated above. In these instances specially engineered systems may be designed to treat the wastewater. This will be done in consultation with a team of specialists knowledgeable of subsurface wastewater disposal.

LOCATION

To minimize surface and subsurface water pollution, consider distance to site features when planning the location of the disposal field. Site the disposal field in a down gradient direction where possible. Use **Table 1** as a guideline for minimum setback distances for the disposal field. Place the disposal field as far as is practical from water sources, property lines, and other listed site features. Document the rationale for deviating from the recommended minimum setback distances.

SOILS

Locate disposal fields in soils with moderate permeability and adequate separation distances to bedrock and the water table. Ideally, there should be as much separation distance as possible to avoid groundwater contamination. The minimum design separation distances are 24 inches to bedrock and 12 inches to the water table or hydraulically restrictive layer (24 inches for Profiles 5 and 6). Tables 2 and 3 show minimum design requirements for the disposal field. These tables are based on criteria from

Maine Subsurface Wastewater Disposal Rules. Modify soils that do not meet the minimum design requirements in accordance with Table 3. Avoid areas that flood.

Soils frequently do not fit neatly into the pre-defined classes shown in Table 2. Therefore, a soil scientist should do the site evaluation for the disposal field. Consider a team approach to problem sites.

MODIFYING SOILS

Design Class 2 must be modified to meet the minimum separation distances to bedrock (**24"**) and the water table or hydraulically restrictive layer (**12"**)

Design Class 3 must be modified to reduce permeability and/or meet the minimum separation distances to the water table and/or bedrock (**24"**).

It is recommended that these sites be reviewed by a team of specialists to determine if and how the soils can be modified for safe siting of the disposal field. Ideally, the team would consist of at least a soil scientist and engineer.

MODIFICATION OPTIONS FOR DIFFERENT SOIL LIMITATIONS

- **SOILS WITH WATER TABLES BETWEEN 7 AND 12 INCHES:**
  1. Raise the disposal field to at least **12 inches** above the water table using proper fill material.
  2. Place a curtain drain upslope of the disposal field to lower the water table to at least 12 inches below the disposal field.
- **SOILS WITH A HYDRAULICALLY RESTRICTIVE LAYER BETWEEN 7 AND 12 INCHES:**
  1. Raise the disposal field to at least **12 inches** above the restrictive layer using proper fill material
- **SOIL PROFILES 5 and 6 - WATER DEPOSITED SANDS AND GRAVELS:**
  1. Raise the disposal field to at least **24 inches** above the water table using proper fill material.
  2. If the bottom of the disposal field will be resting on fine and medium sands and/or stratified sands and gravels, a minimum of **6 inches** of proper fill material will be placed at the interface of the natural soil and the bottom of the disposal field.

PROPER FILL MATERIAL

The correct fill material to use in modifying soils consists of coarse sand to gravelly coarse sand with approximately 4 to 8 percent fines passing the No. 200 sieve. The upper limit of clay sized particles in the fine earth fraction is approximately 2 percent. It contains approximately 15 to 30 percent rock fragments (2mm to 3 inches) that are dominantly less than 3 inches in diameter. Soil consistence is loose single grains that can be readily seen and felt, similar to salt and sugar. Select fill material in your local area that most closely meets these characteristics.

Fill material with the above characteristics has been determined to provide the best combination of permeability and treatment. If the fill material contains a greater percentage of fines, it's hydraulic capacity is decreased and if it contains fewer fines, it does not provide adequate treatment of the effluent.

The purpose of the fill material is two fold. First, it spreads the wastewater out over the entire disposal area diminishing the likelihood of groundwater contamination. Second, greater treatment is obtained within the fill material. Wastewater treatment occurs by biological activity and cation exchange. Biological activity occurs in a biological mat, which forms at the interface along the bottom and sides of the bed. A thin biological mat is desirable for treatment. A mat that is too thick will cause hydraulic failure because of its impediment to water movement through it. Once effluent passes through the mat, additional treatment occurs by cation exchange in the very fine silt, clay and organic soil particles. Too many fine soil particles reduce infiltration into the soil. Too few fine particles increase infiltration ant treatment is inadequate.

IMPORTANT: When modifying soils with proper fill material, it should be placed beneath the disposal field, the shoulders, and the fill extensions surrounding the disposal field on all sides. This significantly increases the treatment area in the bed.

SIZING THE DISPOSAL TREATMENT BED

The sizing procedure for the disposal field requires an on-site investigation of the soil profile. Take a minimum of one soil boring or test pit in the area of the treatment bed and describe the soil profile, permeability, and ensure adequate separation distances. Record this information on the Soil Log. The treatment bed size is based upon soil texture, soil permeability, and the rate of wastewater flow. The procedure is described below and an example is given.

The **ACTUAL FLOW** is the rate of flow in gallons per day (gpd) from all sources or wastewater. Generally the discharge from a milkhouse or parlor will range from 2.4 to 8.0 gpd per milking cow. Interview the owner to obtain the actual flow of wastewater, if known, or measure the flow over several days and compute the daily average.

Compute the **DESIGN FLOW** by multiplying the **ACTUAL FLOW** by the **FLOW MULTIPLIER**. The **FLOW MULTIPLIER** is obtained from the following equation:

FLOW MULTIPLIER = [(total suspended solids mg/l + BOD5 mg/l) / 240] 1/3

The **FLOW MULTIPLIER** is an adjustment factor for differing levels of wastewater strength.

For milking center wastewater, a conservative value for the **FLOW MULTIPLIER is 3.0**. This can increase the size of the treatment bed considerably. Management options such as feeding out the first flush of the milk system and design options like sediment traps and multiple grease traps can provide good pre-treatment and result in a lower FLOW MULTIPLIER.

Determine the minimum BED AREA in square feet by multiplying the DESIGN FLOW in gallon per day by the HYDRAULIC LOADING RATE found in Table 2.

The normal shape of the treatment bed on flat slopes is square. As the land slope increases, however, increase the width along the contour and decrease the slope length to balance cuts and fills.

EXAMPLE

The soil on site fits the following:

Soil Profile 3 with bedrock >24 inches and depth to water table > 12 inches.

From site measurements or data from operator:

ACTUAL FLOW = 80 gpd

DESIGN FLOW = ACTUAL FLOW x FLOW MULTIPLIER

= 80 gpd x 3.0

= 240 gpd

From Table 2, for Soil Profile 2:

HYDRAULIC LOADING RATE = 3.3 sf / gpd

Minimum BED AREA = DESIGN FLOW x HYDRAULIC LOADING RATE

= 240 gpd x 3.3 sf / gpd

= 792 sf

Square root of 792 = 28.1 ft.

Selected bed Size = 30 ft. wide (min) x 27 ft long

PERMITS

The facility and all components shall comply with all applicable federal, state, and local laws and codes pertaining to shoreland zoning, Dig-safe, wetlands, floodplains, aquifers, and others. The owner is responsible for obtaining all necessary permits.

INVESTIGATIONS

NRCS may require additional investigations to determine the presence of cultural resources, wetlands, floodplains, and aquifers. A water test of nearby wells is recommended before any construction is started. The water test would give all concerned parties an idea of the existing water quality before construction.

OPERATION AND MAINTENANCE

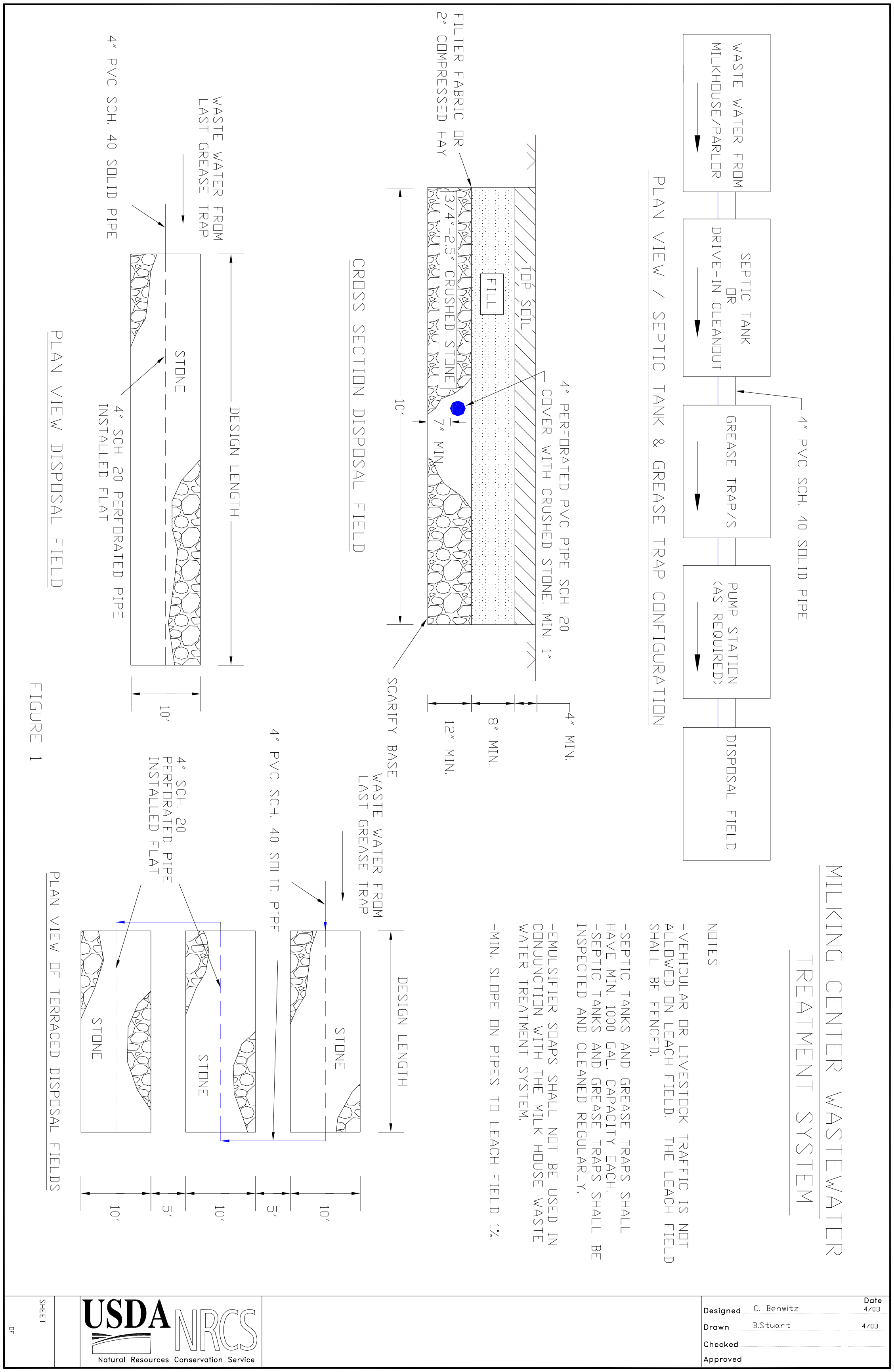
Specify operation and maintenance requirements in the waste management plan. Require removal of solids from the settling trap for those systems where solids are generated in the milking parlor. Frequency of cleaning is dependent upon the degree of management in the parlor.

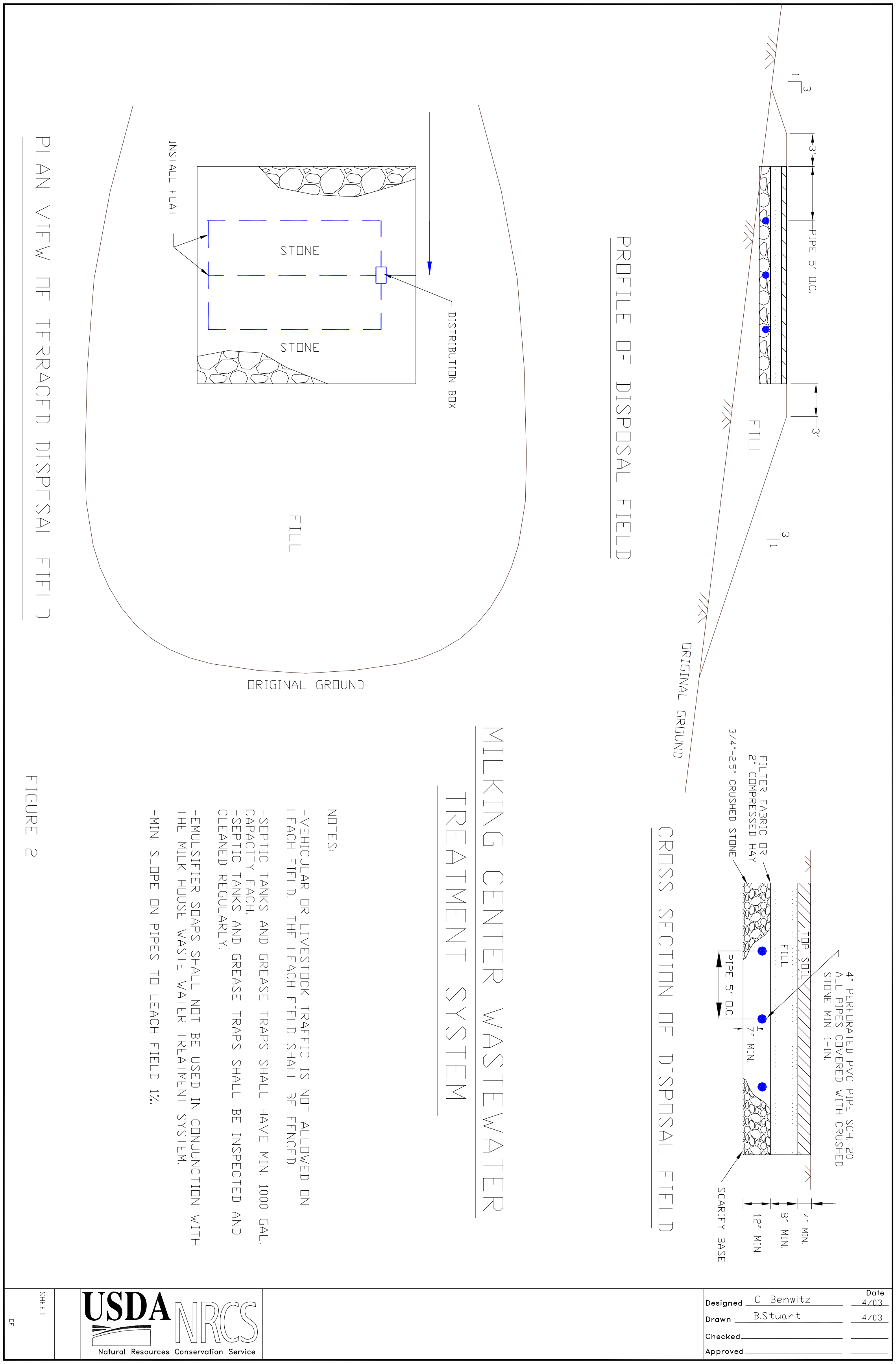
The **most important item for maintenance** is the periodic removal of the “fat cake” from the grease trap/s. Generally, the fat cake accumulates at about 1 inch per month. The fat cake will accumulate more slowly if the first flush of wastewater is diverted, collected, and/or fed to calves, pigs, etc. Managing the system in this way will provide for the long-term sustainability of the treatment system. If the system is not managed in this way, there is a high probability of system failure.

If seepage occurs from the bed, investigate the cause and remedy the problem. The most common causes of seepage are overloading the system and plugging of the infiltration area by milk fat or manure solids.

REFERENCES

- NRCS Agricultural Waste Management Field Handbook
- National Soils Handbook
- Maine Subsurface Waste Water Disposal Rules (June 1, 2000)
- Handbook of Subsurface Waste Water Disposal in Maine (January 1995) (Me. Dept. of Economic and Community Development)


MILKING CENTER WASTEWATER TREATMENT SYSTEM
WASTE WATER FROM MILKHOUSE/PARLOR
SEPTIC TANK OR DRIVE-IN CLEANOUT
GREASE TRAP/S
PUMP STATION (AS REQUIRED)
DISPOSAL FIELD
4" PVC SCH. 40 SOLID PIPE
PLAN VIEW / SEPTIC TANK & GREASE TRAP CONFIGURATION
NOTES:
-VEHICULAR OR LIVESTOCK TRAFFIC IS NOT ALLOWED ON LEACH FIELD. THE LEACH FIELD SHALL BE FENCED.
-SEPTIC TANKS AND GREASE TRAPS SHALL HAVE MIN. 1000 GAL. CAPACITY EACH.
-SEPTIC TANKS AND GREASE TRAPS SHALL BE INSPECTED AND CLEANED REGULARLY.
-EMULSIFIER SOAPS SHALL NOT BE USED IN CONJUNCTION WITH THE MILK HOUSE WASTE WATER TREATMENT SYSTEM.
-MIN. SLOPE ON PIPES TO LEACH FIELD 1%.
FILTER FABRIC OR 2" COMPRESSED HAY
TOP SOIL
FILL
3/4"-2.5" CRUSHED STONE
4" PERFORATED PVC PIPE SCH. 20 COVER WITH CRUSHED STONE. MIN. 1"
7" MIN.
10'
4" MIN.
8" MIN.
12" MIN.
SCARIFY BASE
CROSS SECTION DISPOSAL FIELD
WASTE WATER FROM LAST GREASE TRAP
4" PVC SCH. 40 SOLID PIPE
STONE
DESIGN LENGTH
4" SCH. 20 PERFORATED PIPE INSTALLED FLAT
10'
PLAN VIEW DISPOSAL FIELD
FIGURE 1
WASTE WATER FROM LAST GREASE TRAP
4" PVC SCH. 40 SOLID PIPE
4" SCH. 20 PERFORATED PIPE INSTALLED FLAT
DESIGN LENGTH
STONE
10'
5'
10'
5'
10'
PLAN VIEW OF TERRACED DISPOSAL FIELDS
SHEET
OF
USDA NRCS
Natural Resources Conservation Service
Date
Designed C. Benwitz 4/03
Drawn B.Stuart 4/03
Checked
Approved


PLAN VIEW OF TERRACED DISPOSAL FIELD
INSTALL FLAT
STONE
STONE
DISTRIBUTION BOX
FILL
ORIGINAL GROUND
PROFILE OF DISPOSAL FIELD
PIPE 5' O.C.
3'
3'
FILL
ORIGINAL GROUND
CROSS SECTION OF DISPOSAL FIELD
3/4"-2.5" CRUSHED STONE
FILTER FABRIC OR
2" COMPRESSED HAY
TOP SOIL
FILL
4" PERFORATED PVC PIPE SCH. 20
ALL PIPES COVERED WITH CRUSHED
STONE MIN. 1-IN.
PIPE 5' O.C.
7" MIN.
SCARIFY BASE
4" MIN.
8" MIN.
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MILKING CENTER WASTEWATER
TREATMENT SYSTEM
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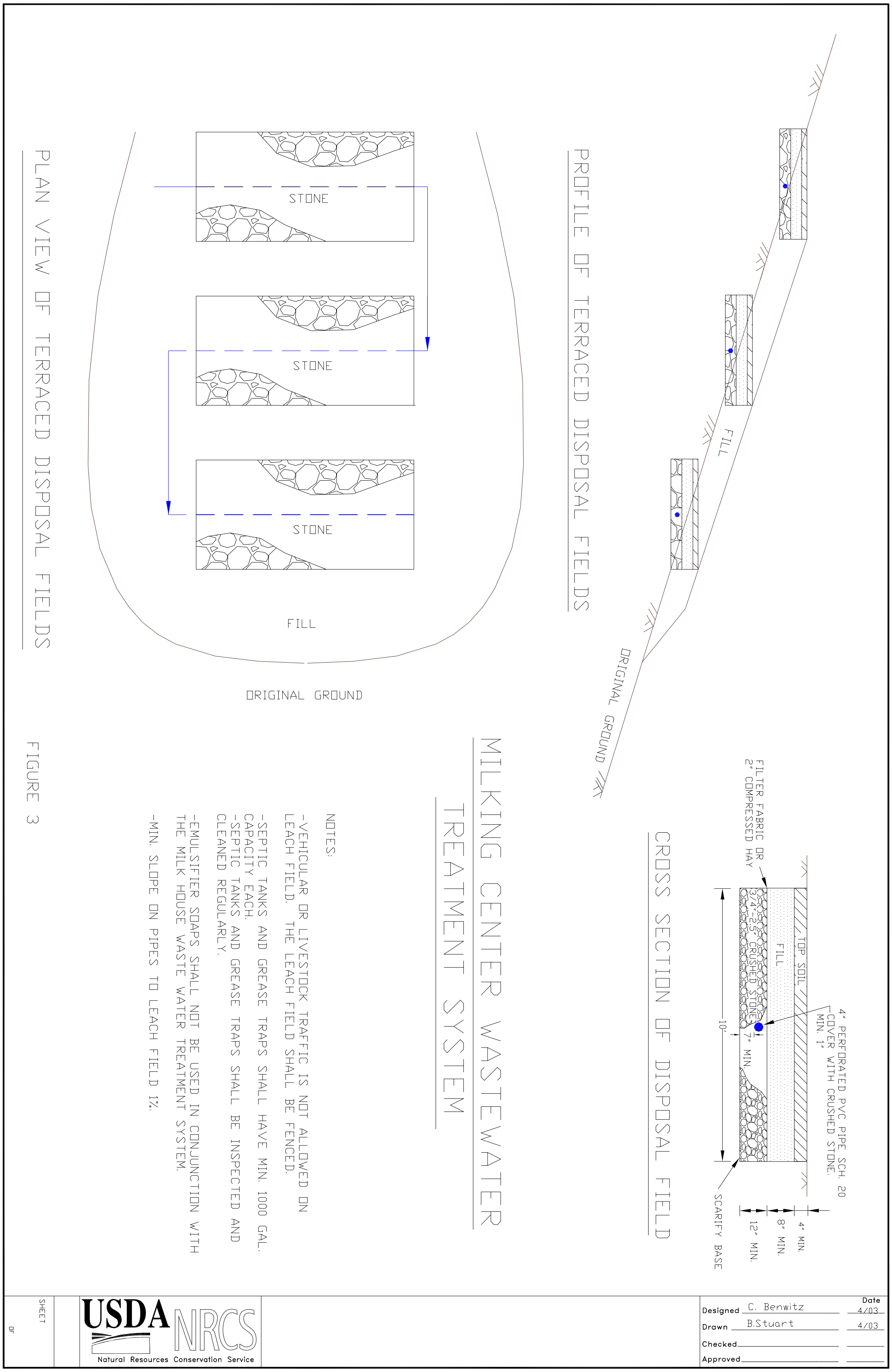
-EMULSIFIER SOAPS SHALL NOT BE USED IN CONJUNCTION WITH
THE MILK HOUSE WASTE WATER TREATMENT SYSTEM.
-MIN. SLOPE ON PIPES TO LEACH FIELD 1%.
FIGURE 2
USDA NRCS
Natural Resources Conservation Service
Designed C. Benwitz
Drawn B.Stuart
Checked
Approved
Date
4/03
4/03
SHEET
OF


PLAN VIEW OF TERRACED DISPOSAL FIELDS
STONE
STONE
STONE
FILL
ORIGINAL GROUND
PROFILE OF TERRACED DISPOSAL FIELDS
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CROSS SECTION OF DISPOSAL FIELD
FILTER FABRIC OR 2" COMPRESSED HAY
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-MIN. SLOPE ON PIPES TO LEACH FIELD 1%.
FIGURE 3
SHEET OF
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Natural Resources Conservation Service
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Drawn B.Stuart 4/03
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Approved
Date