

# Waste Management FACTSHEET



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## DAILY MANURE SCRAPING MANAGEMENT SYSTEMS FOR DAIRY FARMS

**There are many ways to handle manure on a modern dairy farm. The purpose of this note is to assist South Coastal British Columbia dairy producers in the selection of manure handling systems which are compatible with barns designed for daily tractor scraping.**

### DESIGN CONSIDERATIONS

A number of basic design and management considerations apply to daily scraping operations for all dairy barns and are noted below.

1. Manure can be handled as a solid, semisolid or liquid. Dairy manure will vary in consistency and this property will be dependent on the type of management and animal housing in place (see Table 1). It should also be recognized that liquid manure that has frozen during cold winter spells or manure that has dried out considerably during the summer months has the same handling characteristics as solid manure.
2. Tractor scraping operations are considerably easier to carry out if the turning of corners is kept to a minimum. The barn layout should feature straight alleys which allow manure to be deposited directly into manure drops, regardless of whether tractor or automatic scraping systems are employed.
3. All scrape alley surfaces should be roughened to prevent cattle from slipping. The best type of concrete surface is one with a diamond-scored pattern. While roughening can be done by impressing a pattern on the wet concrete surface when the floor slab is being placed, a more expensive higher-quality method is to groove the surface after hardening. Ridging and uneven surfaces adjacent to the grooves are avoided if cutting is done after the concrete has cured.

4. Manure is confined within the scrape alleys by free stall concrete curbs. These should be about 200 millimetres (8 inches) in height. Curbs lower than this will be unable to prevent manure from entering the back of the stalls as it builds up next to the blade while scraping.
5. Modern dairy management practices tend to prefer liquid or semisolid manure management systems. Solid manure management may still be preferred by some operators who do not want to replace existing facilities or who wish to incorporate bedded back group housing.

### TYPES OF MANURE MANAGEMENT SYSTEMS

Depending on individual preferences and existing equipment that may already be in place, every dairy farm has different manure handling needs and challenges. There is no single best manure management system. Table 2 shows a mix of choices and options which are applicable to a daily scraping manure handling operation.

### TRANSFER METHODS

#### Tractor and Automatic Scraping Systems

A tractor equipped with a scraping blade or an automatic system with chain-driven, cable-driven or rope-driven scrapers is used to remove the manure from the free stall alleys. There are many available scraper designs, both commercial and those

**TABLE 1**

**MANAGEMENT PRACTICES AND MANURE CONSISTENCY**

HOUSING AND MANURE MANAGEMENT SYSTEM	EXPECTED MANURE CONSISTENCY
<ul style="list-style-type: none"> <li>▪ Bedded young stock housing and calf pens</li> <li>▪ Tie stall barns with bedding</li> <li>▪ Curbed slab manure storage to divert clean runoff and fitted with a roof to eliminate incident precipitation</li> </ul>	Solid
<ul style="list-style-type: none"> <li>▪ Tie stall barn using limited bedding</li> <li>▪ Deep bedded free stall with concrete traffic alleys</li> <li>▪ Covered storage with no milking centre wastewater added</li> </ul>	Semisolid
<ul style="list-style-type: none"> <li>▪ Tie stall barn using no bedding</li> <li>▪ Free stall barn with minimal bedding and concrete or rubber mats for the free stall base; concrete traffic alleys</li> <li>▪ Free stall barn with slotted floor traffic alleys and minimal bedding for the free stalls</li> <li>▪ Manure storage without roof</li> <li>▪ Covered storage with milking centre wastewater added</li> </ul>	Liquid

fabricated by farmers themselves. For tractor applications, a simple but effective scraper can be constructed out of a large-diameter industrial tire which has been cut to form a semicircular shape and fitted to a three-point-hitch frame. Front wheel diameters on tractors used for scraping should be large enough so as not to create passage problems over drop slots which are incorporated into the manure alleys.

**Gravity Flow Slurry Channels**

Gravity flow slurry channels are popular in new barns as a means by which to transfer liquid manure from the barn to storage. The advantage of gravity flow channels is that they have no moving or mechanical parts. For details on the construction and operation of such structures, refer to BC Ministry of Agriculture Factsheet No. 383.350-1 entitled *Gravity Flow Slurry Channels for Dairy Manure*.

**Gutter Cleaners**

Gutter or barn cleaners work well provided that they operate on level ground. Barn cleaners were the most popular mechanical means of removing primarily solid manure when stanchion and tie stall barns were prevalent in dairy production. Their value as part of free stall layouts with minimal bedding is limited because the manure becomes too

liquid in consistency. The original application for barn cleaner systems was that the solid manure would be transferred to an elevating stacker which would deposit the waste as a solid pile onto an outdoor slab to be regularly moved by tractor to final storage. Elevator stackers are meant for solid manure only and should not be used to lift liquid manure.

Gutter cleaners work well in transferring liquid manure if the receiving structure is either an in-ground reception pit or an in-ground storage facility.

**Reception Tanks**

A reception tank should be incorporated as an intermediary structure between the livestock barn and primary storage in situations where complete gravity flow of manure to final storage is not possible. A reception tank is a manure-receiving vessel constructed below ground level and sized to hold from one to several days of manure production. The reception pit is a convenient location to incorporate pumping and agitation equipment and allows for easy access when the equipment needs servicing or repair. Reception pits are typically constructed of concrete and provide the means by which manure can be pumped to the above-ground storage facility. Agitation is easily accomplished because the pit size is comparatively small.

**TABLE 2**

**MANURE MANAGEMENT SYSTEM OPTIONS**

<b>MANAGEMENT SYSTEM</b>	<b>TRANSFER METHOD</b>	<b>EQUIPMENT TYPE</b>	<b>STORAGE FACILITY</b>
Liquid Manure (Tractor Scraping)	Gravity Flow Channel to Storage	None Required	Below Grade
	Direct Scraping to Storage		
	Direct Scraping to Storage with Ramp	None Required	Above Grade
	Gravity Flow Channel to Reception Pit	Chopper Pump Air Pump Piston Pump	Above Grade
Semisolid Manure (Tractor or Gutter Scraping)	Direct Scraping to Storage	None Required	Below Grade
	Gutter Cleaner to Storage		
	Gravity Flow Channel to Storage		
	Direct Scraping to Storage with Ramp	None Required	Above Grade
	Gutter Cleaner to Reception Pit	Auger Paddle Conveyor Air pump Piston pump	Above Grade
	Gravity Flow Channel to Reception Pit		
Solid Manure (Tractor or Gutter Scraping)	Gutter Cleaner	Manure Stacker to Curbed Slab Storage	Above Grade
	Tractor Scraping	Front-End Loader	

**TRANSFER EQUIPMENT**

**Augers**

Augers or screw conveyors are best suited for semisolid manure handling. Provided that the units are equipped with properly-sized electric motors, augers are mechanically reliable. The primary disadvantage of auger systems is that they have a relatively low delivery rate compared to conventional manure pumps. During winter periods, it is important to reverse auger operation after each use to empty the tube to prevent freezing of the manure contents.

**Paddle Elevators**

Paddle elevators are conveyors capable of moving liquid manure up inclines. The chain-driven paddles drag manure up a rectangular enclosure to deposit manure to storage. The advantages and disadvantages of such systems are similar to those for augers. It is important to clear the manure contents of such units if freezing weather is expected. Front-end loaders may need to be relied upon during cold weather periods as an alternative.

**Air Pumps**

Pressurized air manure transfer systems are suited to both semisolid and liquid manure. A large underground steel tank with an airtight cover is used as a receiving vessel. After the cover is closed, air is

pumped into the tank using a compressor and the resulting compressed air pushes the manure into the main storage structure through an attached underground pipe. The transfer pipe can be constructed of steel or polyvinyl chloride (PVC) and should have a minimum diameter of 300 millimetres (12 inches). This system can transfer manure up to 45 metres (about 150 feet) from the reception tank to storage. These systems are effective but are expensive to purchase and install.

Because the piping is installed underground, air pumps are an excellent option in cold climates. A notable disadvantage is that drier slugs of manure within the pipe can extend transfer times. A further disadvantage is the limited size of the tank. Depending on manure volume, it may require more than one “blow-out” operation during each barn cleaning period.

### **Piston Pumps**

Piston-action pumps are most suitable for liquids but are able to move semisolid manure that is not too dry. The piston itself can be either of solid or hollow construction. Solid piston pumps are more expensive, and are intended for manure with a heavier solids content. Hollow piston pumps are less expensive but are not as effective at moving manure with a high solid matter content. This system will also be able to transfer manure up to 45 metres (about 150 feet) away to storage.

### **Centrifugal Chopper Pumps**

Centrifugal chopper pumps are suited only for liquid manure transfer. A heavy-duty pump is a necessity. Open impeller pumps with chopper blades at the pump inlet are generally the most effective design.

### **STORAGE FACILITY**

The farmstead layout and the choice of an above- or below-grade storage facility will affect the entire manure management system to be chosen.

The manure storage structure should be located at the lowest elevation possible on the farmstead’s

building site to eliminate or reduce the need to lift the manure into storage.

### **RATINGS OF CHOICES**

In an ideal situation where a new farm complex is being planned on a site which allows below grade manure storage, the best daily scraped manure system for South Coastal British Columbia is a liquid manure tank filled by a gravity flow manure channel. The only mechanical equipment required for such a system is an agitator to break up crust and to mix the manure into a uniform slurry and a vacuum tanker to remove manure from the storage for field application.

In all other cases, the best dairy scrape manure management system will depend on the unique needs of a specific farmstead. Table 2 above lists a variety of daily scrape manure handling systems to help a farmer choose an option.

### **SUMMARY**

For more information on manure management and equipment, the following publications are available from the B.C. Ministry of Agriculture.

- 380.700-1 *Management and the Nutrient Value of Manure*
- 381.210-1 *Slotted Floor Free Stall Dairy with Sub-Floor Manure Storage*
- 383.000-1 *Manure Storage Structures*
- 383.100-1 *Earth Bank Storages for Dairy Manure*
- 383.100-2 *Sizing Dairy Manure Storage Facilities*
- 383.350-1 *Gravity Flow Slurry Channels for Dairy Manure*
- 383.510-1 *Circulatory Agitation Systems for Concrete Dairy Manure Storage Tanks*
- 386.100-1 *Environmental Guidelines for Dairy Producers*
- *Environmental Farm Planning Reference Guide*

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