



## Key Points:

- Take time to consider how you will manage your herd within the new facility
- Management approaches will determine the need/value of various components of infrastructure
- Well designed treatment facilities will improve the ease of use and ability to draft cows for extended periods of time
- Your feeding management plans will impact on the need for supplementary feeding infrastructure

## Infrastructure for large herd automatic milking systems

By Kendra Kerrisk and Lee-Ann Monks

**The sheer logistics of milking a large herd with robotics requires serious consideration to the supporting infrastructure at the planning stage. The facilities you need will be influenced by your choice of box units or the robotic rotary.**

Some of the equipment and facilities you may consider include:

- Automatic drafting and one-way gates.
- Priority access.
- Treatment facilities.
- Small herringbone facility.
- Backing gate.
- A buffer vat and milk cooling.
- Supplementary feeding.
- Farm layout.
- Gates.

Consider for:

- Robotic rotary
- AMS box units

Automatic drafting and one-way gates are an integral part of the design of an automatic milking system. When designing the yard layout, try to avoid having two drafting gates in succession with a single cow laneway between them. Be mindful of the compromise between minimising the number of drafting gates (and associated costs) and the drafting flexibility you need.

The flexibility needed depends on herd size and planned management strategies such as whether you will have voluntary or batch milking. With large herds additional gates may be needed to give more flexibility in sorting criteria. For example, early lactation cows – which are highly motivated to move around the system – could be offered pre-feeding to avoid very short milking intervals. Sending cows that arrive at the dairy too early back to pasture carries the risk of an undesirably long milking interval by

the time she returns again. Instead, giving her access to feed prior to milking may help extend a very short milking interval by 1-2 hours, thereby increasing milk harvesting efficiency.

Multiple entries from the laneway into the dairy yard may be needed for times of batch milking or when cows are fetched. Consider installing hanging fingers on non-return gates rather than swinging one-way gates. This will allow multiple cows to enter a given area at the same time without creating the engineering issues associated with bracing multiple one-way gates side-by-side.

Ensure that lead-ins to all one-way gates and automatic drafting gates encourage good cow flow. Consider installing manual encourage gates which are useful during training periods.

### Treatment facilities

Consider for:

- Robotic rotary
- AMS box units

With a large herd AMS, it is worth thinking about what facilities you will have for treating cows. Simple facilities that suited a smaller herd could well be inadequate for a large herd. For example, a split calving herd of 800 cows could have up to 50 colostrum cows to handle on any single day, or even more if cows are synchronised at mating.

Most single box AMS are not raised on a platform. It is possible to build a pit alongside double box robots. If they are oriented end to end (for example GEA multibox robots), it is feasible to have the floor lowered on the robot side of the cow.

Although it is possible to access the udder of a cow in a box robot, there are at least three reasons to minimise animal health treatments in the boxes. Firstly, the negative experience may reduce a cow's willingness to milk voluntarily. Secondly, it will

hold up cow flow through the box which will increase the time cows wait in the yard to be milked. Thirdly, it is not effective to treat a large number of cows in an AMS box.

Similarly, it is possible to treat the odd cow on the robotic rotary platform. However, treating large numbers this way is likely to be too disruptive to voluntary milking of the rest of the herd.

Consider having an adjacent herringbone facility which can be used as a treatment facility and to handle milk from colostrum or 'hospital' cows (see next section). If possible design the pit of the herringbone to have a drop-down lid to allow level access for A.I., pregnancy testing and similar practices.



Above: If you install a robotic rotary consider having an adjacent herringbone facility which can be used as a treatment facility and to handle milk from colostrum or 'hospital' cows.

## Small herringbone facility

Consider for:

- Robotic rotary
- AMS box units

Hospital or colostrum cows cannot be milked on the robotic rotary platform at the same time as the milking herd. This is because the robotic rotary cannot automatically divert individual cow's milk to either a separate destination (such as a vat for 'dump' milk or calf milk) or to the drain.

The robotic rotary can accommodate hospital or colostrum cows if they are put through the platform as a separate group. The process requires preventing voluntary cow traffic from the main herd. Cows on the platform need to finish milking and be rotated off. The milking line must be manually diverted to the drain or a separate vat before the hospital and colostrum cows are put on the platform and milked. Then a machine wash must be performed before the main herd can resume milking. However, even a small number of these cows can be disruptive and time consuming if they are handled this way. For example, milking 8-10 hospital cows is likely to take about 40 minutes (excluding wash time). In that time, the robotic rotary could have milked 40-50 cows from the main herd.

Consider having a small herringbone facility for this purpose. Some farmers build a single sided herringbone. It only requires basic equipment, which could be recycled from the decommissioned milk harvesting facility. If suitable, the original milking facility (or just one side of it) may be retained for this purpose. The herringbone facility will probably need 10-20 sets of cups, depending on the calving pattern. Seasonal herds will be used intensively early in the season while year round herds will need fewer sets of cups. However, most herds will use the facility regularly throughout the season for small numbers of hospital cows.

Locate it near the robots for easy access to vacuum and electricity and to provide easy access to feed stations and/or the feed pad. Depending on the location, the milk line from the herringbone could be piped directly to the calf shed, or to a colostrum vat. However, it's worth having sufficient valving to allow milk harvested from the herringbone to be directed to the bulk milk vat. This would allow you want to revert to manually milking (in the herringbone) during downtime for maintenance if ever needed.

Large AMS box installations may also consider having a herringbone facility to allow batch milking of cows that need attention. If you have box units, an alternative is to design the layout with 'priority boxes' (see section on priority access). It is possible to manage either AMS box units or the robotic rotary without a separate milking facility, with a little planning but it will affect throughput capacity. You will still need separate stalling without milking equipment for animal health and husbandry tasks.

If you are batch milking, it is relatively easy to manage either the robotic rotary or AMS boxes without a separate milking facility. The hospital cows are the final batch before the system wash starts. If you operate with voluntary cow movement, recognise that batching the hospital and colostrum cows will disrupt voluntary cow traffic.

## Benefits

A separate herringbone facility will enable the AMS to continue to milk the main herd without disturbing voluntary cow movement. It will allow you to milk, observe and treat colostrum and hospital cows in batches at set times of the day that suit your routine. It is also a much safer place to treat and attend to cows, and has the added bonus of reducing the risk of antibiotic milk ending up in the vat (through user error).

A herringbone facility can be fitted with a drop down platform to cover the pit, providing a convenient facility for administering treatments such as antibiotics or heat mount detectors and for, artificial insemination, pregnancy testing and examining cows. Having a dedicated space can also make completing tasks such as flaming udders and trimming tails easier and safer for staff.

## Re-settling cows onto the robotic rotary

The only downside of milking colostrum and hospital cows through a separate herringbone facility is that there will be a settling period for cows and heifers when they move to the robotic rotary. In particular, pay attention to milking data as the system will not have expected yields for these cows, so it will not be able to accurately identify incomplete milkings.

For mature cows, the robots may need to be re-taught the teat co-ordinates. This will depend on how long she has been out of the main milking herd and how much her udder conformation has changed during that time.

Heifers will have to adjust to two milking systems in their first lactation: the herringbone and then the robotic rotary. Have a staff member present at all of the heifers' first milkings through the robotic rotary to ensure successful cup attachment



[See Info Sheet: Raising Cows for AMS](#)

## Priority access

Consider for:

- Robotic rotary (priority yard and laneway)
- AMS box units (priority boxes)

The idea of priority access is to allow individual cows faster access to the milk harvesting equipment – they get to ‘jump the queue’. Cows which might be given priority access include heifers in training (or those struggling with the system), cows with an incomplete milking and cows whose milking interval is undesirably long.

A relatively new concept, a priority yard and laneway, has been used successfully at the robotic rotary installation at Gala Farm in Tasmania. Although it has not yet been researched, the FutureDairy team expects to have further knowledge available in the near future. With AMS box units, priority access can be achieved by designating one of the boxes as a ‘priority box’. If there are no priority cows in the yard, the ‘priority box’ becomes available to the rest of the herd.

Priority access is most effective when used sparingly. Keep the number of priority cows to a minimum to avoid too much congestion in the priority yard/laneway or at the priority box.



Above: Priority access can be helpful for training heifers (smaller laneway and pen on right hand side of main waiting yard).

## Incomplete cows

With the robotic rotary, cows with incomplete milkings will be sent back to the waiting yard for a second attempt at milking. Experience shows that cows that are sent back to the waiting yard are generally motivated to progress to the milking platform fairly quickly. However cows rapidly lose motivation if they have to wait behind a backing gate, join a large queue or wait in the yard for an extended period. For example, heifers in training are less able to compete with other cows in the yard for access to the milking platform. The priority yard and laneway may alleviate such behaviour. Once they arrive in the priority yard, these cows get access to the next available bail on the platform for a prompt second attempt.

One alternative to a priority laneway and yard is to fit a one-way gate into the backing gate.

## Reasons why a second attempt may be successful after an incomplete milking

- The cause of the problem has been rectified by the farmer/technician (e.g. cleaning a dirty laser).
- The problem was related to a specific bail/box and the cow enters a different bail/box the second attempt.
- The incomplete milking was caused by cow behaviour which was modified at the second attempt.
- Robotic rotary: the incomplete milking was caused by one or two teats not being located by the automatic cup attachment robot (ACA); these teats were more easily detected after the rest of the udder has been milked (i.e. the cow's udder shape changed resulting in a successful second attempt).
- Robotic rotary: the cow eventually moved past the attachment robots; if a milking cup(s) is prematurely removed after this point (e.g. a cow stood on the hose), reattachment cannot occur without returning to the platform for a second attempt.

## Backing gate

Consider for:

- Robotic rotary, especially if batch milking.
- AMS box units.

Backing gates are useful in conventional dairies milking large herds. They are not needed with AMS box units. However, if you intend to milk a large herd through the robotic rotary, a backing gate will be useful in certain situations. If you already have one, it might be worth retaining it in the new installation.

If you plan to batch milk, a backing gate is highly desirable. It will allow the yard to be swept of any cows prior to fetching a new group from the paddock, thereby ensuring cows that have already been waiting are not caught up in another queue of cows.

Although not used as regularly in a voluntary milking system, a backing gate can be very handy at times. Here are some examples of situations where a backing gate may be useful.

They can be used to sweep the yard of cows prior to a scheduled down-time, maintenance or a system wash. This ensures cows are not waiting too long and maintains reasonable milking intervals.

A backing gate can be used in a reverse effect to hold the existing queue toward the end of the yard, so that a small group of priority cows can be milked first. This small group might be cows that are being moved from the colostrum/hospital group to the main milking herd or it might be a small group of cows that need to be milked before a vet visit. In this case you may probably want to observe their first milking to ensure teat cups are successfully attached.

Backing gates may be used when training fresh heifers. Even if the main herd is voluntary milking, some large herd managers elect to milk trainee fresh heifers in batches to minimise disruption to the main herd. In this case, the backing gate can be used to prevent cows from the main herd entering the dairy until after the heifer training session is completed. However, keep in mind the potential impact on the main herd. If they are regularly forced to wait for long periods they may become more reluctant to move to the dairy, since such an action is not associated with a reward. Consider installing a water trough at the back of the yard so that any cows that do have to wait behind the backing gate at least have access to fresh drinking water.



Above: While not essential for a robotic rotary installation, a backing gate can be handy at certain times.

## Buffer vat and milk cooling

Consider for:

- Robotic rotary.
- AMS box units.

All vats need to be washed after milk has been picked up by the tanker. The process of milk collection and automatic at washing can take up to an hour, depending on the robot brand, vat size and set up.

If you intend to operate with voluntary cow movement (rather than batch milking), consider installing a buffer vat. This is a small, additional milk vat that allows the robots to continue milking cows, even when the milk is being collected by the tanker and the main vat is being washed. It avoids having to shut down the whole operation just to get these tasks completed. It gives you time to attend the dairy, clean the bulk milk vat and transfer the milk across from the buffer vat. Once this is done, the milk in the buffer vat can be transferred to the main vat allowing the buffer vat to be cleaned.

An alternative option is to install a second, full sized vat, so that one vat is used each day. This has the added advantage of creating extra storage capacity in case the tanker is delayed. Or you may choose to install two vats instead of one large vat so that milk flow can automatically switch from one vat to the other during pick up and washing.

If you choose not to have a buffer vat (or two bulk milk vats), milking will have to cease during milk collection and while the vat is washed. In this case, it makes sense to conduct a full system wash at the same time. At the very least, a full system rinse should be conducted to ensure bacteria do not multiply in the plan during the vat washing period.

Different robot brands may have different milk storage and cooling solutions. Don't assume that all milk storage options and levels of automation are available for all brands.

Below: A buffer milk vat allows milking to continue during the tanker pick up process.



## Grain-based concentrates

Consider for:

- Robotic rotary
- AMS box units if feeding high levels of supplements

An automatic milking system for a large herd needs to have facilities for feeding supplements. Grain-based concentrates can be fed through AMS box units, up to about 4.5kg concentrates per cow per day. If you want to feed higher levels than this, you'll need to consider additional feeding facilities. The robotic rotary does not have in-bail feeding functions, so you'll need to consider separate feeding facilities. There is some evidence that a stand-alone feed treat can encourage cow movement onto the robotic rotary platform.

You may also consider constructing a feedpad, or allowing room for one in the future.

## AMS box units

Grain-based concentrates can be fed through all AMS box units during milking. They work on a trickle feeding process: feed is supplied at a rate that is similar to the cow's eating rate. The default feeding rate can be adjusted to suit a particular herd. This is usually done in the first few weeks of operation. Make sure you follow the manufacturer's recommendations on calibration of feeding units to ensure they are actually feeding the level that you are intending.

It is quite challenging to encourage pasture-fed cows to consume more than about 4.5kg/concentrate/day through AMS boxes. This depends slightly on the type of feed offered but the key limitation is the amount of time cows spend in the robotic milking units each day. This is influenced by the duration of each visit and the number of visits made to the AMS each day.

If you want to feed more than 4.5kg/cow/day, you will need additional feeding facilities. If you feed a mixed ration for most of the year you have the option of putting a blanket allocation of concentration in the ration. Then you can use the robotic milking units to lift the intakes of individual cows. Another, common option for pasture based systems is to install additional feeding stations in the exit area of the dairy, so that cows can consume any 'left over' allocation before heading to the paddock. The ratio of feed stations to robotic milking units will depend on your needs and should be discussed with the equipment manufacturer.



Above: Cows can be fed up to about 4.5kg concentrate a day through AMS boxes. If you want to feed more than this, consider separate feed stations.

## Incentive at robotic rotary

FutureDairy research has shown that offering a small feed treat to cows in the first bails on the robotic rotary platform dramatically improves cow flow. However the concept is not yet supported by the equipment manufacturer. This is particularly significant if cows are used to receiving feed on the platform. If/when the feed is removed they are much slower at moving onto the platform. The impact may not be as significant if the system is commissioned with cows/heifers that have never experienced in-bail feeding. At this stage we are uncertain about the impact if cows have come from a conventional milking dairy with bail feeding but are never exposed to it on the robotic rotary.

Offering a feed treat can affect cup attachment in the following ways:

- Small cows may be encouraged to stand too far forward in the stall making it difficult for the robotic arm to reach the teats.
- Cows may become competitive for the feed treat, which may discourage them from standing in a favourable and stationary position.

## Position of supplements (before or after milking)

With careful planning and design, a feedpad or feed stations can be used to feed supplements either before or after milking. This gives you the flexibility to feed cows which every way suits you, as your needs change.

Feeding cows before milking means cows move back to the dairy earlier and fewer cows need fetching from the paddock. Cows fed before milking spend longer in the feeding area and waiting yards which means longer average milking intervals. Feeding cows before milking can be a good option for cows that have come back to the dairy and have only just been granted milking permission. You don't want to release these cows back to another paddock but they don't need to be milked urgently.

Feeding cows after milking means cows are likely to move back to the dairy more slowly and there may be more to fetch. But it makes them keen to move through the waiting yards to get to the feed on the other side. Feeding after milking is probably the more common choice by AMS farmers. However some AMS farmers prefer to provide supplementary feed (e.g. hay or silage) in the waiting area to occupy cows waiting for milking.

 **For more information refer to the FutureDairy info sheet: AMS farm layout**

## Out of parlour feed stations

Feed stations allow grain-based concentrates to be allocated to individual cows (or groups of cows), based on production, stage of lactation, body condition or other parameters that you set. They also have the spin off benefits of encouraging cows to exit the milk harvesting equipment and a cleaner environment in the dairy i.e. less dust and a reduced risk of rodents (and the associated damage to wiring etc). The downside is there is no feed incentive to encourage cows to move onto the robotic rotary milking platform. This is not an issue with AMS boxes if feed is offered during milking.

Feed stations are usually installed at the exit area of the dairy. This provides a reward for cows moving through the milking facility. Different feedstuffs can be allocated in different proportions to individuals if the necessary feed storage and delivery systems (silos, augers) are installed. Individual cows can receive a diet customised to different nutritional specifications such as protein or energy levels.

Feed stations located at the exit area of the dairy are also good for udder health: they encourage cows to stand in a clean environment for 10-20 minutes after milking.

At the planning stage, make sure you allow for enough feed stations to prevent competition affecting each cow's ability to eat her allocated portion of concentrates. A large herd is likely to require 10 to 20 feed stations; the exact number will depend on herd size, typical feeding levels and likely milkings per hour. If the area becomes too congested, some cows will completely bypass the feeders and not receive their full day's ration so it pays to err on the side of more rather than less.

There are two placement options for feed stations: back-to-back and parallel. Back-to-back placement takes up slightly less space and also allows you to feed different groups separately. For example you may wish to feed heifers in training separately to prevent bullying or reduce competition. Having the feeders elevated keeps bullying to a minimum (see photo).

*Below: Having the feeders elevated keeps bullying to a minimum.*



## Feedpad

Although not essential for a large herd automatic milking system, a feedpad will minimise wastage of feed and damage to pastures if your system involves large levels of supplementation. If a feedpad has an associated loafing area, it can be used as the third feed allocation in a 3-way feeding system

 **See Management Guidelines for pasture-based AMS farms, p 19-23).**

If you choose to have a feedpad, consider locating it close to the dairy. This has two advantages: the feedpad effluent can be managed with the dairy effluent; and the expectation of feed after milking will encourage cow flow from the milking platform.

A feedpad can also be used to manage the impact of long walking distances on voluntary cow movement around the farm. FutureDairy research has shown that voluntary cow movement starts to become affected if cows have to walk more than 800m to their grazing paddock. This in turn means they are milked less frequently. The larger the herd, the more likely there are to be paddocks further than 800m from the dairy. If you have a feedpad, you could consider using the more distant paddocks for silage or crops which could be cut and carried to the feedpad.



Above: A feedpad can be used to manage the impact of long walking distances on voluntary cow movement around the farm.

## Managing long walking distances

If you don't have a feedpad, an alternative is to have a drafting system that allows only late lactation cows to be sent to the more distant paddocks. The production level of later lactation cows can probably accommodate lower milking frequencies without causing a further drop in production. If you choose this option, you will probably need to fetch these late lactation cows. Late lactation cows are less motivated anyway, and combined with the longer walking distance, their milking frequency is likely to be quite dramatically affected unless they are fetched.

Alternatively you could graze the whole herd on the more distant paddocks during the evenings. Cows will be due to leave these paddocks during the day when you are more likely to be around to observe their traffic and fetch them to the dairy if needed. Avoid grazing distant paddocks during the day as it will be inconvenient to fetch cows from them in batches overnight.

## Design

As a rule of thumb the feedpad should be big enough to accommodate the number of cows that would be milked in a two hour period. FutureDairy research has shown that cows are unlikely to spend more than 2 hours on the feedpad after milking. As cows have already spent time on concrete in the pre-milking holding yard and possibly at feeding stations, they will seek a more comfortable surface to stand on.

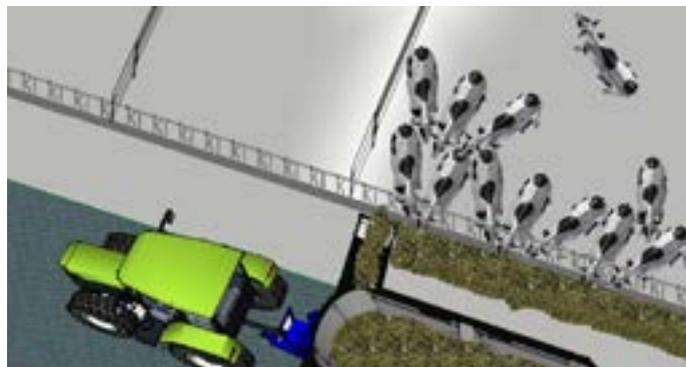
If you plan to have a feedpad, carefully think through the various ways you might use it before you decide on the design. Here are some examples.

If there are times when the feedpad supplement will make up a large proportion of the diet, a nearby loafing area will be needed. Cows that have been standing on concrete for more than 2 hours will move to a more comfortable spot and may prefer to eat, then loaf before eating some more.

A feedpad can be designed to be accessible either before or after milking (see section 'position of supplements').

If you plan to feed only a small volume of feed per cow per day, consider installing a gate part way down the feedpad. This allows you to reduce the size to accommodate only 30-60 minutes of milking. Cows exiting the milking area will continually force other cows off the feed pad as it becomes congested.

A feedpad can be designed to provide two different feeds and draft different cows to each of those feeds. For example, a partial mixed ration (PMR) may be offered to cows in early and mid-lactation, while cows in later lactation are offered hay or silage.



Above: A gate part way down a feedpad reduces the size to accommodate fewer cows and encourages cows to leave the feedpad sooner.

**WWW** [General feedpad design: Links to external website](#)

## Feed volume

With a feedpad you can't strictly control the amount of feed consumed by individual cows. Cows will move to the feedpad in a staggered fashion. Some will consume far more than you intended while others will consume less. It is important to ensure the total daily volume of feed available (through pasture, the dairy, feed stations and the feedpad) is adequate for the herd size and meets cows' daily requirements. It may be preferable to provide any essential elements incorporated into the grain-based supplements at feed stations (or AMS boxes) as you will have more control over individual intake that way.

## Farm layout

Farm layout will have a critical impact on cow flow through the dairy and voluntary cow movement around the farm.

Take advice from your equipment manufacturer regarding the position of various components/infrastructure within the overall farm layout. FutureDairy can review your proposed farm layout/design and provide feedback if requested.

### FOR MORE INFORMATION

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