Section 3

Grazing **Infrastructure**

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Introduction

The design and layout of grazing infrastructure is crucial to overall herd performance as it can allow more days at grass and hence greater profitability. One extra day at grass is worth €270/day/100 cows in spring. In autumn one extra day is worth €150/day/100 cows.

1. **How do I create an efficient paddock system?**
2. **How can I create a cost-effective road system?**
3. **What drinking water infrastructure do I need?**

chapter 21

Grazing Infrastructure

① How do I create an efficient paddock system?

How to

Set up a paddock system

- Get a map of the farm with areas for each field/paddock.
- Decide on the number of paddocks required; this will depend on whether the paddock will be used for one, two, three or four grazings.
- Determine most suitable road layout to service each paddock.
- Determine most appropriate water trough(s) position in each paddock.
- Allow for multiple entrances into each paddock.
- Ideally keep paddocks square/rectangular, ideally depth: width ratio should be 2:1.

Key risks

Paddock layout

- Long narrow paddocks – too much walking over ground to graze the end of the paddocks can result in excessive risk of poaching.
- Large paddocks – grass regrowths are grazed if over 3-4 grazings per paddock. Using a strip wire to divide the paddock requires extra labour during the main grazing season and it reduces milk solids.
- Small paddocks – insufficient grass for one grazing, extra water troughs are required.
- Farmers expanding should use strip wire until they decide how many cows they will milk.

Alternatives

To a paddock system

Have no set paddock system – use temporary wire for all grazings. The advantage is that the grazing area can be adjusted throughout the year and that surplus grass/silage is more easily harvested.

Other advantages include:

- less expensive to construct
- very flexible
- less under or overgrazing
- interchange of grazing and silage areas
- easier for machinery to work
- no weeds under wire.

A major disadvantage is that it takes time at each grazing change to move the temporary fence. Other disadvantages include:

- higher level of grassland management ability needed
- daily assessment of herd's needs
- daily assessment of grass covers
- difficult to manage calves
- difficult to decide where to site water troughs.

Key facts

- One hectare equals 10,000 square metres (100 metres x 100 metres).
- Rectangular paddocks work best; ideally depth: width ratio should be 2:1, not over 4:1.

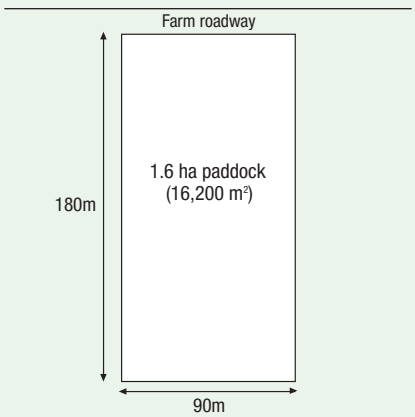


Figure 1: Dimensions of 1.6 ha paddock with depth: width ratio of 2:1. Cows walk less in rectangular paddocks which minimises soil damage in wet weather.

Key target

- Depth of paddock – maximum of 250m from road to end of paddock.
- Wet paddocks – maximum depth of 200m from road to end of paddock.

Number of grazings per paddock

Normally 12 hours (one grazing) is allocated to the herd in spring and autumn. This allows the herd to fully graze out the section during these two critical periods. It is also the period when ground conditions are most challenging and cows should not be allowed to re-walk over ground when conditions are difficult.

For the remainder of the year, allocating grass each day is time-consuming. Therefore paddocks are larger to allow for either two, three or four grazings per paddock, i.e., one to two days. Where cows spend longer than two days in a paddock, re-growth will emerge and will be eaten by cows leading to lower grass growth and production.

How to

Calculate paddock size: (April–June)

Step 1: Establish cow numbers (Plan for long term)

Step 2: Establish daily demand. e.g.100 cows X 18kg DM
= 1,800kg DM for 24 hours

Step 3: Ideal pre-grazing yield is 1,400kg DM/ha in mid season

Step 4: Two grazing 1,800/1,400
= 1.3ha for 100 cows in 24 hours
To calculate paddock size, divide herd demand by ideal pre-grazing yield.

Step 5: Three grazing 1,800 X 1.5 days/1,400
= 1.9ha for 100 cows in 36 hours

Step 6: The remaining area is normally closed for silage during this period. It could also be divided into similar paddocks.

Peak grass growing months April/May/June will normally determine paddock numbers.

Commercial companies: A number of companies specialise in farm mapping. They use GPS to get exact paddock sizes and will lay out paddock, water and road systems to meet individual requirements.

Table 1. Number of grazings per paddock for mid season

Grazing per paddock	Pros	Cons	Recommendation
1 grazing per paddock	Good grass utilisation Regrowths not affected Better in wet weather Easy to identify surplus/ deficit of grass	Cows could be underfed Heifers tend to suffer More water troughs required	Least Recommended
2-3 grazings per paddock	Regrowths protected Cows less restricted Easier for machinery to travel in bigger paddocks	More difficult to manage in first and last rotation	Most Recommended
4+ Grazings per paddock	Fewer water troughs required Fewer paddocks required Allows for future expansion	Regrowths affected More difficult to graze out Harder to get cows out of larger paddocks	

Grazing **Infrastructure**

② How can I create a cost-effective road system?

Cows will make up to 600 return journeys from paddocks to the milking parlour each year. Road layout must allow for good cow flow and have a suitable surface for walking speed and hoof welfare. Road layout must allow access to all paddocks.

Construction of roadway

Table 2. Grazing infrastructure

Roadway type	Options
1. All removed	• Build up with stone • Consider if a lot of heavy machinery is travelling on roadway • Most expensive option
2. No topsoil removed	• Must be prepared during dry weather • Heavy machinery should not travel on this roadway • Geo-textile can be put on top of topsoil followed by stone • More suited for roads far away from farmyard • Less expensive option
3. Invert roadways	• Must be prepared in dry weather • All top soil moved to one side • Sub-soil is brought to top and shaped into road • Top-soil put back where subsoil was • Roll with vibrating roller

Key considerations

Is the road to be used for cows only, light machinery or heavy machinery? Heavy machinery could damage a road that is designed for cows only.

Does top-soil need to be removed? A roadway placed on top of wet soil will sink and may result in water pooling on the road. If heavy machinery will use the road then the top-soil may need to be removed.

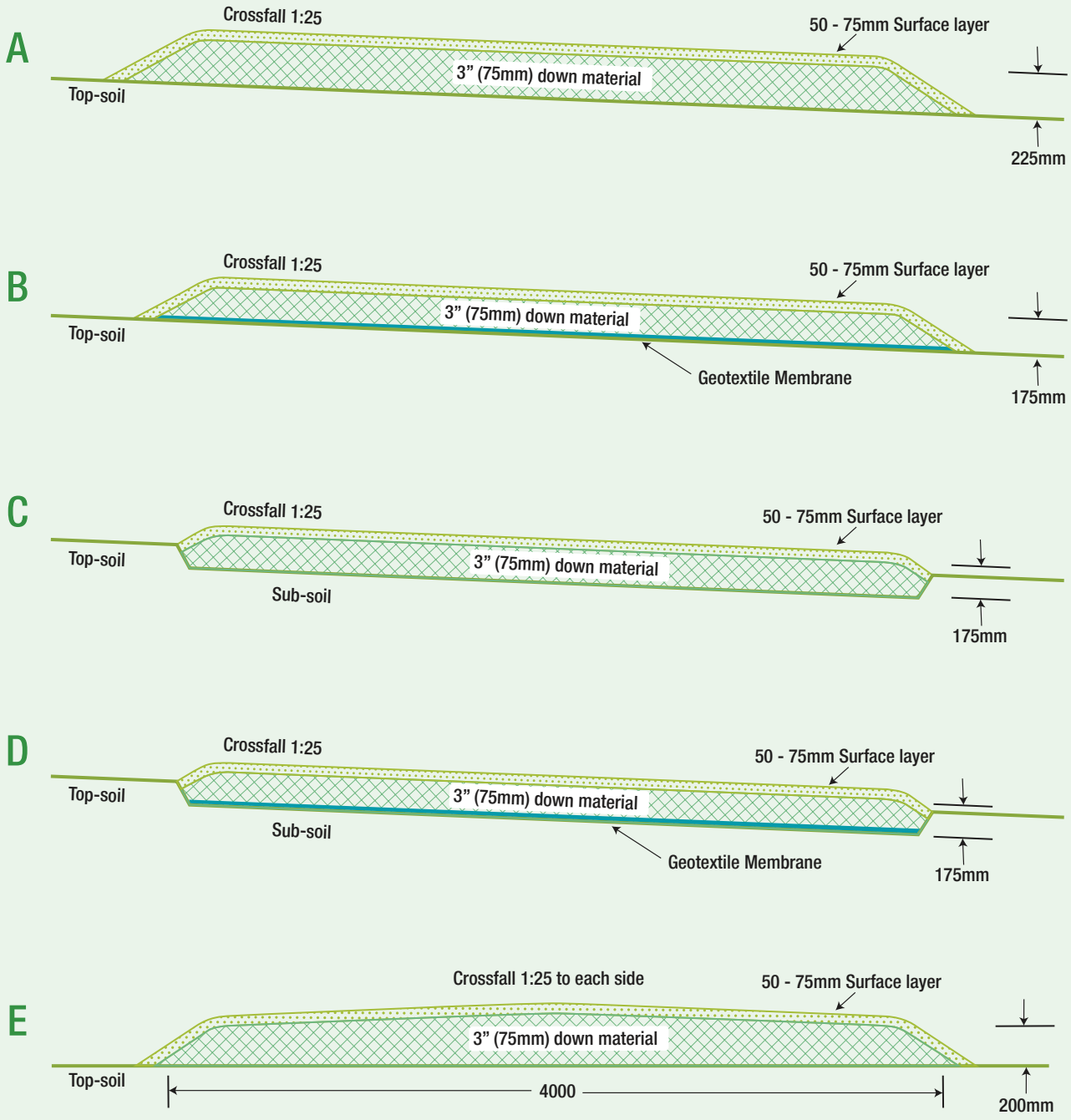
Is there hard-core available on farm? Stone is the major cost of a road system. A 100m road that is 5m wide will require 100m^3 of stone (100 x 5 x 0.2) which is equivalent to 200t of stone (one m^3 weighs about 2t). In addition about 25m^3 (100 x 5 x .05) of binding material would be required which is equivalent to 50t.

1. Remove top-soil.
2. Lay base material and shape to give a curved surface that will shed water onto the grassland.
3. Compact with a large vibrating roller to minimum height above the ground level of 100mm at the outer edge and 150 mm in the centre of the roadway.
4. Allow roadway to settle.
5. Cover with 75-100mm of slig/binding material and compact with a large vibrating roller.

Estimated cost of roadway construction (€/m of road, 2011)

Top-soil removal (10cm) (optional)	**€4**
Hard-core material (20cm)	**€15**
Fine material (5-7cm)	**€5**
Hired roller	**€1**
Total	**€25**

Farm road profile options



Grazing **Infrastructure**

Roadways

Key facts

Road width	50 cows - 3m, 100 cows -4m, 250 cows -5.5m add 1m to the above figures for roadways close to yard
Good camber (slope)	1:25 one-sided slope, 1:15 two-sided slope
Construction	20–25cm hard-core, plus 7–10cm fine material
Cow walking speed	2–3km on good road surface
Road slope	max of 3:1
Fencing	45cm from edge of road
Approx. cost/m	€15 – €25/m

How to

Set up a road system

- Get a map of the farm.
- Mark the location of the dry areas, wet area, obstacles to roadways etc.
- Location of the milking parlour.
- Design a system that allows road to reach every paddock on the farm.
- Establish if the road system is for cows only, or for heavy machinery (silage cutting)as well.
- Minimise bends, angles and corners on road to create good cow flow to and from milking parlour.
- Avoid sharp bends, with no bends less than 90^0.
- Source local hard-core and binding for the roadway.
- Walk proposed roadway for any issues that do not appear on a farm map, e.g., winter ponds, ESB poles, etc. Adjust if necessary.
- Construct roadways on the southern side of hedgerows.

Key risks

Roadways

- Narrow roads: cows can stop walking due to any obstruction e.g. water, branches, other stock etc. Also cows can push in from the electric fence causing increased lameness.
- Uneven surface: this will reduce cow walking speed (<1.5km/hr) and increase lameness.
- Sharp bends: slow walking and increased lameness due to pushing at bends.
- Water troughs on road: slow walking speed.
- Wrong lay-out relative to paddocks:poor grass utilisation due to excessive walking/poaching of paddocks.

Alternatives

There is no alternative to a good road system.
Some farms may use narrow cow tracks rather than completely redesigning the farm roadways. These may be 0.6m to 1.8m wide and usually service long, narrow paddocks. They are not designed for machinery (fertilizer/slurry); these machines enter from the main farm roadway. These tracks must shed water and may need to be raised above ground level, depending on the site.

③ What drinking water infrastructure do I need?

On an average day, a 150 cow herd could drink up to 10,000 litres (65 litres per cow). The water system must be sufficient to deliver this quantity of water to the paddocks. There should also be a reserve in the paddocks, normally nine litres per cow (two gallons) which is equivalent to 1,350 litres for a 150 cow herd.

Water

Key facts

Water intake:	**10 litres on cold wet day, 90 - 140 litres on warm sunny day**
Drinking speed:	**14 litres per minute (3 gallons/min).**
Drinking time:	**30%-50% water intake within one hour of milking**
Trough size:	**Allow nine litres (two gallons) per cow, 1,350 litres (300 gallons) for 150 cows**
Main waterline:	**38-42mm internal diameter for 150 cow herd**
Connecting pipe:	**20-25mm internal diameter**
Ballcock:	**Medium pressure**
Main pipe layout:	**Loop system preferable**

How to

Set up a water system

- Decide on main water line loop. Depending on farm layout, two loops may be required.
- Decide on one or two troughs per paddock and their location.
- Map the farm showing farm roadways and paddock layout.
- Identify location of shut-off valve(s).
- Decide on pipe sizes, main water line and connectors to water troughs.

Key risks

Water pipe too small:	**Reduced water pressure at trough.**
Trough too small:	**Inadequate reserve, bullying at drinking, drop in milk yield**
Ballcock too small:	**Slow filling of water trough**

Inadequate size water tank (no reserve in paddock)

Laying water pipes

- Either by digger or mole plough.
- Lay pipes before roadway construction.
- Mole ploughing (45cm deep) - do a dummy run before inserting the pipes.
- There are a number of companies that can provide this service.

Key performance indicators

- No queuing at water trough.
- Trough always filled after milking.
- No leakage.
- No cow tracks to water trough indicating a long walk to troughs.
- Water system drained over the winter.

Ballcocks

- Size – 12.5mm (half inch) standard, some 20mm available.
- Ballcock pressure: Low – gives flow rate of 42 litres/min.
  - Medium: flow rate of 32 litres/min (preferred option).
  - High – flow rate of 8 litres/min.

High pressure ball cocks usually have small jet sizes (to minimise leaks) and consequently have lower flow rates.

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How to
Calculate water flow rate

Assuming a daily demand of 80 litres per cow, almost 50% of which is consumed in a 3-hour period soon after evening milking, means that an hourly flow rate of 13 litres per cow per hour is required (i.e. 80 x 50%/ 3 = 13 litres/cow/hour.). Therefore, for a herd of 100 cows the flow rate needs to be about: 100 cows x 13 litres/hour = 1,300 litres/hour or 22 litres per minute.

To check the flow rate on your farm:

- Mark the level of water in a trough.
- Tie up the ballcock and empty, say, 25 litres from the trough.
- Release the ballcock, hold it down and measure the time it takes (in minutes) to refill to the original mark.
- Divide the 25 litres by the time taken to refill, e.g. if it takes a minute to refill then the flow rate is 25 litres per minute.

If the flow rate measured is less than that required for your herd, then your water supply system needs to be improved. Check the flow rate of troughs around the farm.

Water costs

Water

- Deep-well, submersible pump €0.14 per 4,500 litres.
- Mains – €2.50–€6 per 4,500 litres.

Well

- Deep-well pump supplied and installed for €1,500 plus VAT.
- Pump house built in a suitable location for €2,500 plus VAT.
- Estimate for drilling and lining a well, e.g. 75m (250ft) deep, at €33 per metre for drilling and €16 per metre for lining is €3,675 plus VAT.

Water pipes

- Approx cost is €1 per metre of 38mm pipe.

Water troughs

- Approx. cost is €1 per 4.5 litre trough capacity (one gallon), equivalent to €300 for 1,350 litre (300 gallon trough).
- Ideally water troughs should be located at the centre of the paddock.
- If there are two troughs per paddock - they should be staggered. One in the first half, the other in the second half (see Fig.3).

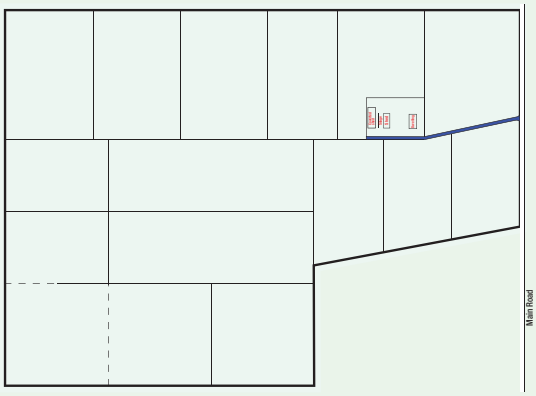

Figure 1. Existing 60ha farm (10 Fields)

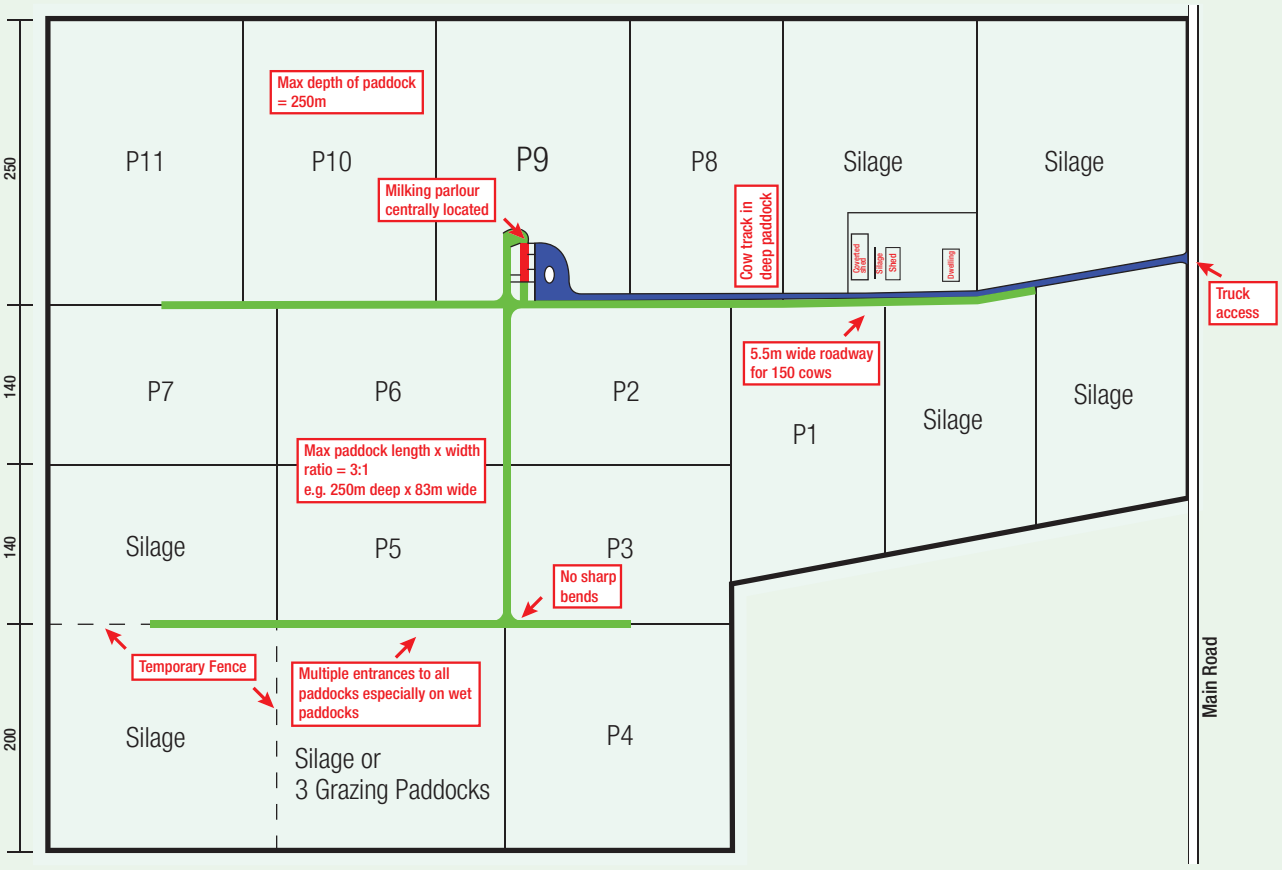

Figure 2. 60ha farm showing farm roadways (green) and grazing paddocks (n=11)

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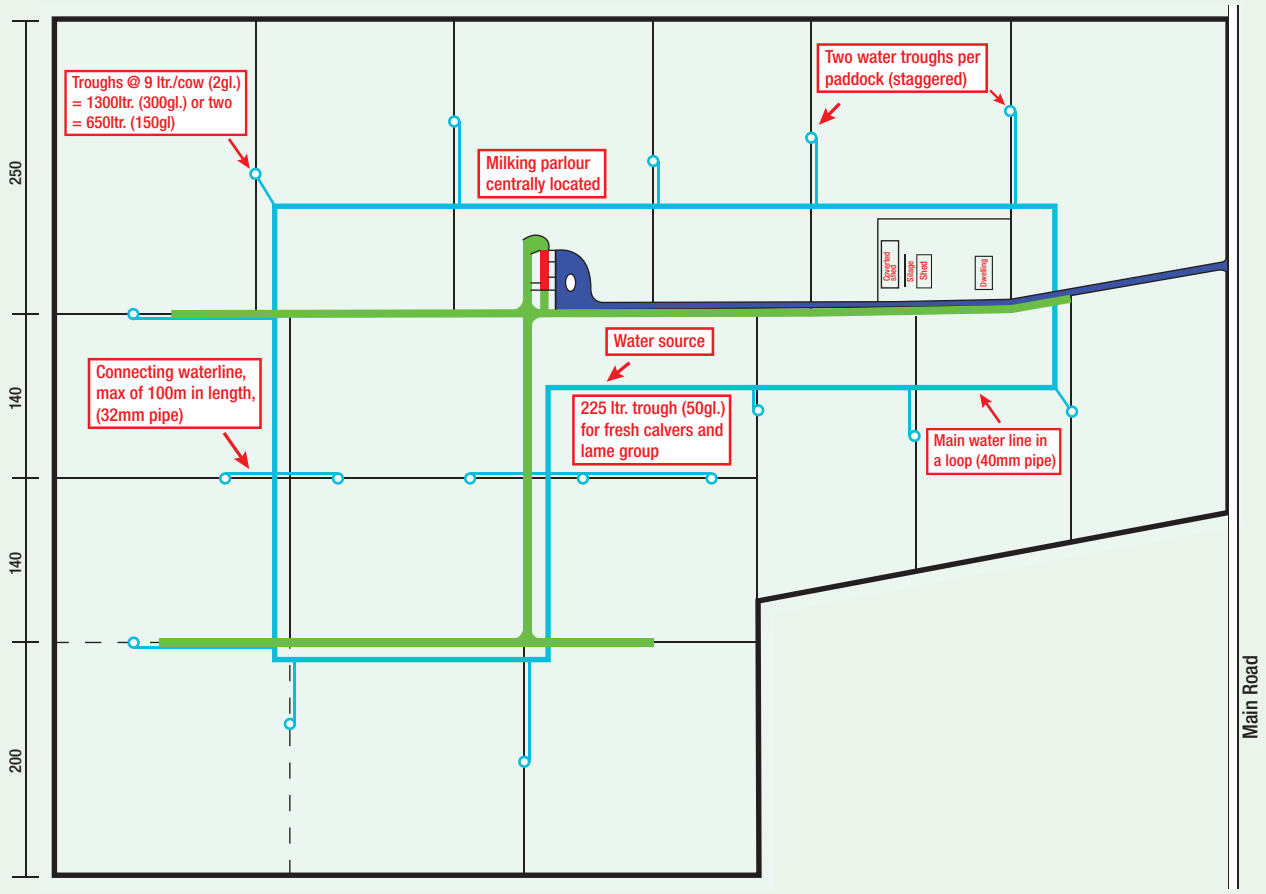

Figure 3. 60ha farm showing farm roadway, paddock design and water system (blue)