Landcare Notes

How much water do I need?

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This Landcare Note is to assist land managers estimate water use and storage needs for their properties. The figures are provided as guides and need to be adjusted for local conditions.

Further, some circumspection is needed in calculating your requirements, as over-storage could well deprieve down-stream os their entitlements.

This Landcare Note can be used in conjunction with three others in the series:

LC0084: *Finding a dam site*

LC0069: *Soil materials for farm dam construction.*

LC0085 *Construction and maintenance of dams.*

Initial considerations

Few rural properties can be serviced from a public water supply. In most cases, the only option is to use water resources on the farm - and that needs careful planing before costly constructions or other commitments are made.

There are three preliminary planning steps:

1. Determine the use to which the water is to be put, for example, stock, home garden, domestic, crops irrigation etc.
2. Determine how much water is needed for each proposed use, and in which seasons it will be needed most.
3. Determine what options are available to provide the required supplies at the level and timing wanted.

These factors differ between properties and it is important that all estimates be as accurate as possible. It is best to work with average daily or average annual requirements for each proposed use.

When these details are established, they provide the base for the next planning stage, that of harvesting, storing and distributing your water resources.

Any water storage not used for valid stock and domestic use now requires a license from you Rural Water Authority, contact them to find out appropriate guidelines and requirements. It is especially important to get their interpretation of valid stock and domestic allowances for your area.

All tabular figures given in this note are based on general experience in Victoria. In most cases they will benefit from local adjustment to meet specific circumstances.

Annual water requirements can be thought of in terms of domestic, livestock, irrigation and fire fighting.

Domestic needs

Table 1: Typical rates of annual domestic use

Domestic usage	**Litre per year**
House	
with septic system	65,000 per person
without septic system	50,000 per person
Garden	
Native garden (no lawn)	1,000 per sq metre
Lawn with shrubs	3,000 per sq metre
Vegetable garden	5,000 per sq metre

Roof supplies

Roof supply provides high quality water for drinking, hot water services, household cleaning and various veterinary purposes.

The amount of runoff from a roof can be calculated from the following relationship

$$Y_R = R \times A$$

Where Y_R = Annual yield from roof (litre)

R = Annual rainfall (millimetre)

A = Area of roof (square metre)

If the average annual rainfall is 600 millimetres and the roof area is 250 square metres, then

$$Y_R = 600 \times 250$$
$$= 150{,}000 \text{ L}$$

Evaporation directly from the roof surface at the start of rain will reduce the total yield. Perhaps 5% of annual rainfall may be evaporated directly from the roof.

Rainfall replenishments on a regular basis make it possible for more water to be used over the year than actual tank capacity. Therefore, it is advantageous to calculate inputs and outputs on a monthly basis.

On small farms, say up to 8 hectares, where the rainfall is above 700mm per year, large concrete tanks, filled from roof runoff, are often adequate on their own to provide both stock and domestic water. Total storage capacity should be able to cover periods of low rainfall identified from local rainfall records.

Concrete tanks with a minimum capacity of 45 000 litres (10 000 gallons) are considered preferable to galvanised iron tanks. They have advantages of: durability; lower cost; availability; ease of installation; and, insulation.

The adequacy of a particular sized tank for your needs, can be assessed by doing a monthly assessment of the expected monthly use compared to expected monthly inputs. Allow for increased usage over the summer months and also potential changes over the years.

Assume the tank is full at the start of September. Calculate the difference between use and inflow for each month and the amount of water in the tank at the end of the month. Carry this figure over to the start of the next month, but remember that excess water will be lost as overflow. Complete for one whole year and assess whether that sized tank is suitable.

Although monthly average rainfalls are published for Victoria, the actual rainfall for each month can vary widely from year to year. Too much reliance on the published average figures is therefore not advisable when assessing annual inflows. If you have to rely on rainfall, estimate usages generously and inflows at very conservative rates. This will reduce the risk of water storage.

Dam supplies

Where earth dams are used to supply water to a household it is not necessary to work through the monthly use rate relative to monthly rainfall input. Yearly totals are appropriate.

Water quality may be an issue with dam water. Use of a house tank for purposes of settling, clarification, possible disinfection , and provision of a gravity head should be considered.

Livestock needs

Drinking water requirements for stock will vary according to weather, quality and nature of food, water quality, age of animal, condition of animal and even social behaviour. Summer use will usually be about 125% of the average daily requirement. Winter use is usually 75% of average daily requirements.

The following table is given as a starting point for planning stock needs.

Table 2: Typical rates of yearly water use by livestock

Stock	Litres/animal.year
Sheep:	
nursing ewes on dry feed	3,300
fat lambs on dry pasture	800
mature sheep on dry pasture	2,500
fat lambs on irrigated pasture	400
mature sheep on irrigated pasture	1,300
Cattle:	
dairy cows, dry	16,000
dairy cows, milking	25,000
beef cattle	16,000
calves	8,000
Horses:	
working	20,000
grazing	13,000
Pigs:	
brood sows	8,000
mature pigs	4,000
Poultry:	
laying hens	120
pullets	65
turkeys	200

Table 3: Water use for animal enterprises

	litre per yr
Dairies and piggeries	5500 per sq m
Sheep dip	4.5 per sheep
Plunge dip	7 per sheep

Irrigation needs

Irrigation requirements vary according to climate and culture; precise information may be obtained from agricultural consultants with local knowledge.

As a starting point, irrigation requires about:

4,500L per 10 square metres per year

If micro-sprays or drippers are used the requirement will reduce to about:

1,200L per 10 square metres per year

Irrigation is expensive and time consuming and alternative strategies should always be exploited to the fullest before considering irrigation such as runoff collection from “hard surfaces” and disposal of waste water from any specific property activities.

Fire fighting reserve

Table 4: Typical reserve volumes for fire fighting

	litres per sq m
Buildings	1200
Grass areas	750

These figures were nominated by the Water Research Foundation, but some now regard them as somewhat high

Other factors influencing dam size

The additional issues which need to be considered in calculating water storage to meet the above needs include:

- evaporation
- seepage
- dam health reserve
- contingencies

Evaporation

Evaporation is often the biggest consumer of water from a dam. It must be allowed for when choosing dam size. The amount to be allowed for depends on climatic zone, time of the year, dam size, dam shape and specific location of the dam.

A first approximation of annual evaporation loss can calculated from the following relationship:

$$L_E = 0.67\ E \times A_F$$

Where L_E = Evaporative loss (litre)

E = Local annual evaporation (millimetre)

A_F = Surface area of the dam at full supply level (square metre)

The following table lists evaporation losses for Victoria.

Table 5: Annual Evaporation at Victorian Locations

Location	**Evaporation (mm)**
Alexandra	915
Ararat	1059
Bacchus Marsh	1074
Bairnsdale	862
Benalla	1158
Bendigo	1212
Broadford	1053
Charlton	1275
Cobram	1323
Corowa	1218
Echuca	1350
Hamilton	984
Horsham	1173
Kerang	1401
Kooweerup	600
Maryborough	1143
Mildura	1488
Shepparton	1302
Swan Hill	1380
Tallangatta	1068
Wangaratta	1158

Hence, from Table 5, a dam with a surface area of 5000 square metre (0.5 hectare) at Charlton the annual volume of water lost from the storage through evaporation is estimated as:

$$0.67 \times 1275 \times 5000 = 4,270,000 \text{ Litre}$$

Evaporation however varies considerably through the year. During the summer months it is usally about twice that of either spring or autumn months. Hence the 3 summer months account for about one half of the yearly total. This variation will need to be allowed for if estimating evaporations for other than full year periods.

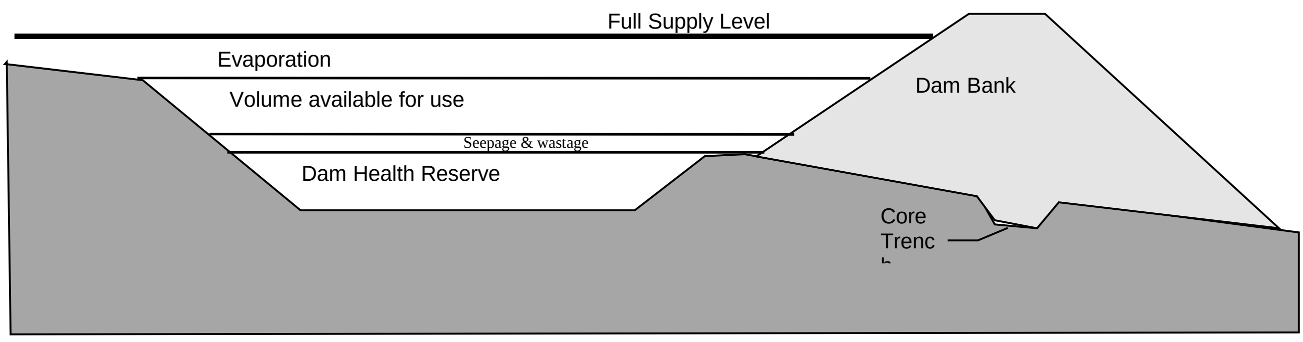

Figure 1 Design categories of water for calculating dam size

Seepage

Seepage loss will depend on the material on which a dam is located and built. It will also depend on the quality of construction. Some dams "hold like a bottle" as is common where soil materials are slightly dispersive. Others can steadily leak into the excavation as is common in 'red mountain soils'.

It may be advisable to use about one tenth of the dam volume as a seepage allowance.

Dam health reserve

When designing a dam it is important to allow some storage to keep as a reserve for the health of the dam itself; both structural health and environmental health. This store is called the minimum drawdown.

In dams with earthen walls this reserve water is important to keep the dam material moist and avoid the problems that arise when dams are allowed to dry out completely.

This residual water also provides an important habitat for fish, plants and other organisms that contribute to good water quality.

There are no absolute values that can be applied to all storage's but if the last 1.5 - 2 metre depth of your storage is kept as a minimum drawdown then most of the issues will have been dealt with.

Contingencies

Farm requirements for water are increasing each year due to changing technology and rising standards of living. For example, milking shed washing and cleaning systems require large amounts of water as do septic tanks, automatic washing machines dishwashers and swimming pools. When calculating water requirements, take into account all possible future consumption needs and calculate your figures generously.

It is important also in the planning stages to consider potential waste and loss of water due to accident or inefficiency associated with water distribution. What is the chance of a broken pipe or a sticking valve? What would be the consequence of this? What allowance should be made for it?

Water quality

Water quality will determine just what the water may be used for. Cool and clean water of low salt content is best for stock health and for household use.

Stock may require more water where salt levels increase.

Further information on water quality is contained in the Landcare Note LC*0089: Water quality needs for farm water supplies.*

Drought proofing and the replenishment period

What length of drought period should be planned for in designing size of water storage?

The term replenishment period is use to define required time that a dam water must last between expected fillings. The length of the period in Australia is related to average annual rainfall. The lower the rainfall, the lower the reliability of potential to refill.

The following chart has been used as a rule of thumb for replenishment periods.

Table 6: Rule of thumb replenishment periods

Annual rainfall (mm)	Replenishment period (months)
Over 800	12
500-800	18
Under 500	24-30

However these may not allow for extended drought periods. Addition reduction to the risk of water storage might require some extension of these replenishment periods. Whether or not this is required will depend on destocking strategies and other drought contingency plans that would be employed.

The preceding information indicates that there are considerable advantages in utilizing large and deep earth storages to meet the intended uses while at the same time minimizing evaporation and seepage. See Landcare Note: *LC0080: Drought Reserves Dams.*

The following table provides rule of thumb guidelines for minimum depths of water for farm dams, assuming normal seepage and evaporation losses.

Table 7: Rule of thumb guide for minimum dam depth

Annual rainfall (mm)	Minimum water depth over 25% of the surface area (meter)
> 1250	2.5
1,000-1,250	3.0
800-1,000	3.5
500-800	4.0
300-500	4.5
< 300	5.0

Summary

Roof tank supplies

Best to look at the maximum amount of water reliably available from the roof area and then relate to the range of domestic requirements to be satisfied.

Earth dam supplies

- Decide on proposed water usages.
- Determine replenishment period for your location and drought strategy.
- Calculate (for the length of the replenishment period) the estimated requirements for:
    - domestic use
    - livestock use

  - other livestock related uses
  - irrigation use
  - fire fighting reserve
- Sum the figures
- Consider possible locations for dam. Seek advice.
- Make first approximation of dam design.
- Calculate volume required to satisfy evaporation.
- Calculate volume required to act as reserve for dam health.
- Consider possible allowance for seepage losses and other contingencies.
- Make grand total
- Adjust required uses if appropriate and recalculate.
- Finalize dam design

Acknowledgements

Compiled from the combined experience of many Victorian Soil Conservation Officers

Further advice

Other related Landcare Notes are available from the Department of Sustainability and Environment.

Local consultants and experienced contractors should be able to provide on-site advice

