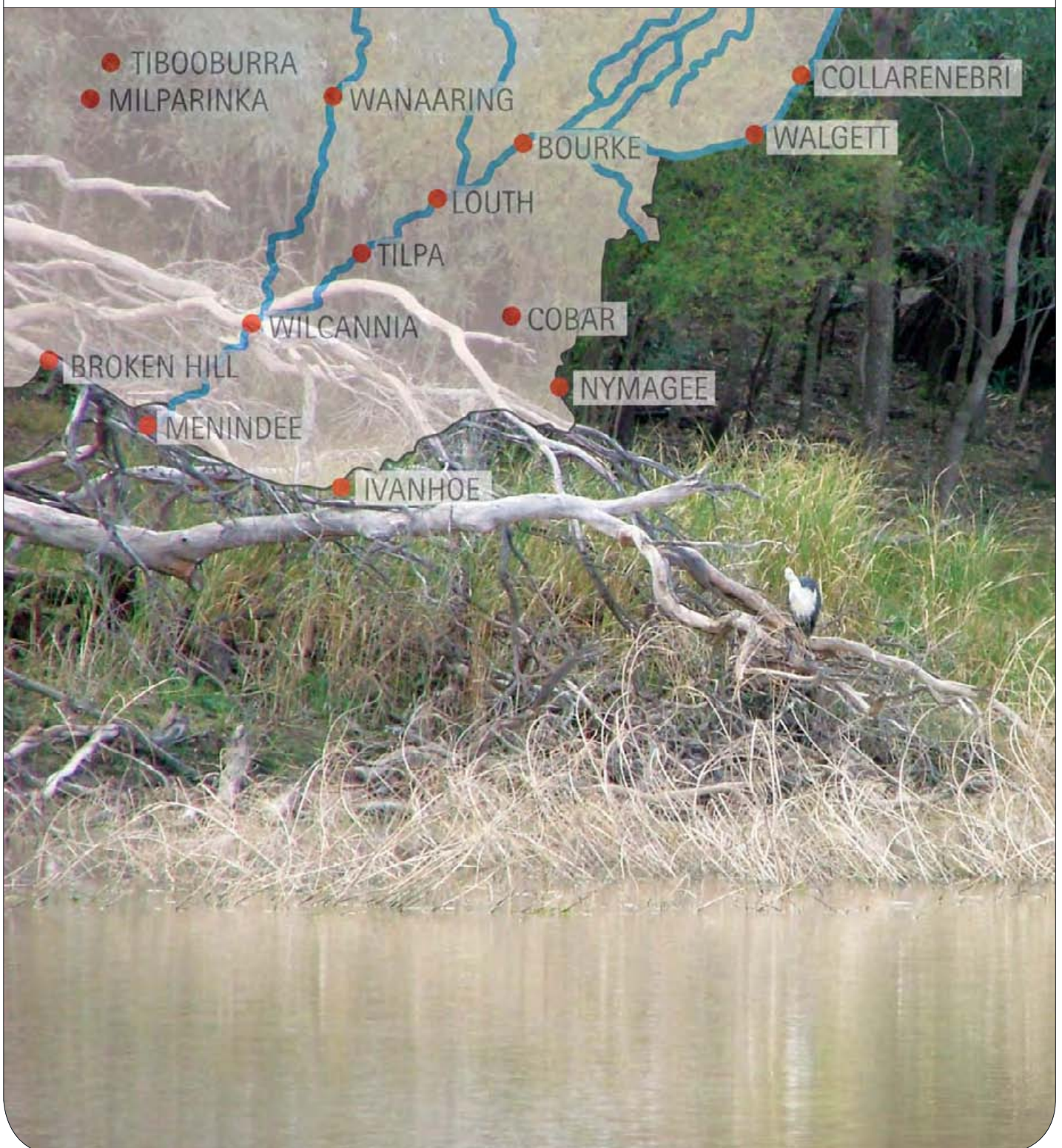


Management of stock and waterways in the Western Catchment



Western Catchment



Project partner:

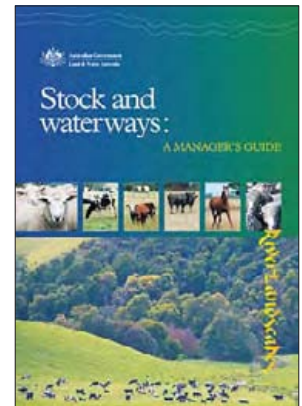


The National Action Plan (NAP) for Salinity and Water Quality Project is committed to spending \$1.4 billion over seven years to apply regional solutions to salinity and water quality problems. The aim is for all levels of government, community groups, individual land managers and local businesses to work together in tackling salinity and improving water quality. Planning and investment at a regional level is the principal delivery mechanism for the NAP. At this level the NAP is jointly delivered with the Natural Heritage Trust.

This NAP project, commenced in October 2003, includes: the development of standard designs for single off-river watering supply systems and coordination of demonstration sites for standard designs; hydrogeological investigation and reporting on alternative water supply; community extension; and project monitoring and evaluation.

Introduction

This booklet has been designed to assist you in the Management of stock and waterways in the Western Catchment. It is recommended it be used with Land & Water Australia's 'Stock and Waterways: A Managers Guide'.



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Disclaimer: The information contained in this publication is intended for general use, to assist public knowledge and discussion and to help improve the sustainable management of land, water and vegetation. It includes general statements based on scientific research. Readers are advised and need to be aware that this information may be incomplete or unsuitable for use in specific situations. Before taking any action or decision based on the information in this publication, readers should seek expert professional, scientific and technical advice.

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Waterways in the Western Catchment

The Western Catchment community expects that their water resources will be managed for the long term to protect river and wetland ecosystems as well as to ensure that they are functional for town and homestead water supplies, stock watering, recreation, industrial use and irrigation. When combined, these objectives represent a clear community desire for healthy surface and groundwater systems.

The Western Catchment is not a discrete catchment on its own. Substantial rivers drain to it from Queensland and other areas of NSW and large areas of the Great Artesian Basin (GAB) occur outside its boundaries. The Western Catchment Management Authority (WCMA) recognises that while much can be achieved by managing the water systems within its region, many of the outcomes for healthy water systems in the Western Catchment are dependent on upstream communities working to achieve similar outcomes in their catchments. The WCMA is committed to influencing these outside management processes to achieve a healthy water system for its community.

The WCMA also recognises its responsibility to deliver similar levels of management to assist catchment communities adjoining the Western Catchment.

The health of water systems can be gauged by measuring a number of different water-related features as defined by the Murray Darling Basin Sustainable Rivers Audit. By using the audit for monitoring sites across the catchment we will know what the overall health of the water resource systems is and how it is changing over time.

The data and modelling capacity exists now to begin to build and use an effective index. The index will be expanded and refined as more data on a wider range of parameters and features becomes available over the time of the Catchment Plan. The WCMA knows that the community is concerned that some water health features are not as good as they should be. It is aware that the water system has been adversely impacted on by many factors in the rivers and their catchments. It also knows that while there are opportunities to make significant improvements, change can sometimes be difficult and can take time.

The water system of the Western Catchment supports significant aquatic native biodiversity values. It is the intent of the WCMA Board that by achieving healthy water ecosystems through the management targets and actions, those aquatic biodiversity values will be protected and enhanced.

These targets are not designed to return the catchment to pre-development conditions as the WCMA Board believes that this is not achievable. However, the WCMA is using the improving knowledge of what healthy ecosystems need, to guide planning and management actions. The extent to which healthy ecosystems are achieved depends on the level of trade off with social/economic health.

Given the WCMA Board's knowledge of what the community expects and what is achievable, the intent over the next ten years is to strive to achieve an improvement in the condition of the Western Catchment surface and groundwater systems by setting catchment targets for water.



"There is a strong correlation between water quality and livestock productivity."

GRAHAM AND KATHY FINLAYSON,
BREWARRINA

What is riparian land?

Riparian land is any land which adjoins, directly influences or is influenced by a body of water.

The main waterways in the Western Catchment are the Barwon-Darling, Culgoa, Paroo, Warrego, Narran, Bokhara and Birrie River catchments.

A Western Catchment Management Authority goal

The Western Catchment Management Authority has a medium term goal of "Habitat improvement actions implemented on 20% of identified priority areas of stream, flood plain, wetland and riparian areas by 2015."

One of the main mechanisms for achieving this goal in the Western Catchment is the management of stock in riparian areas.

What's in it for you?

This booklet will help you manage and maintain your stock water supply to benefit you, the land and the waterways in all conditions including extremes of drought and flood.

Stock need access to good quality water and riparian pastures can produce good quality feed. There are important financial and environmental reasons for you as a grazier to manage riparian land on your property.

This guide provides practical tips to assist graziers in identifying the issues and trade-offs that can occur in managing riparian land. The aim is to increase production and profit while maintaining the land and water's natural resource base and improving its capital value. Some of the information is also useful for managing ground tanks.



How big is the Western Catchment?

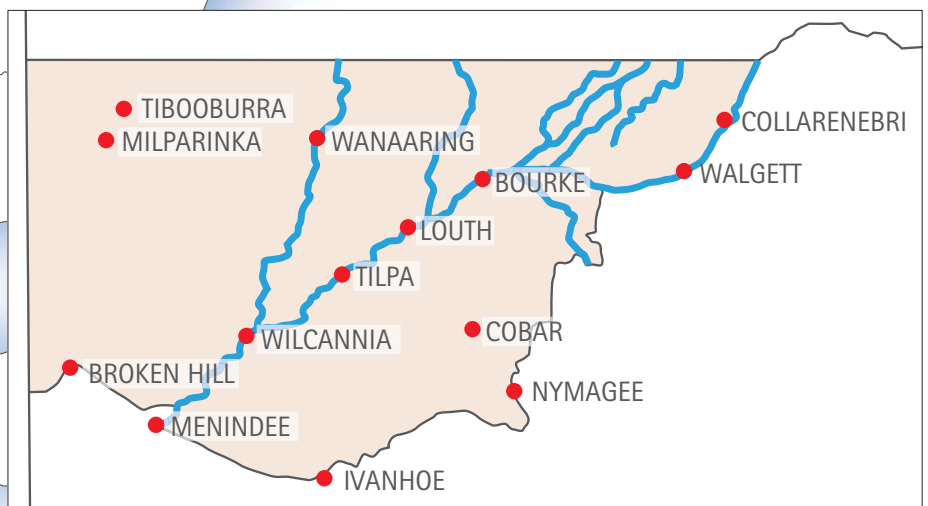
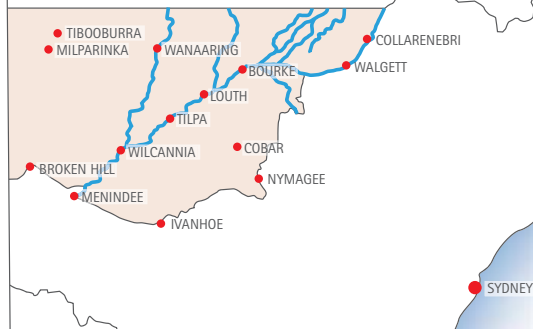
The Western Catchment covers 230,000 square kilometres and is the largest catchment in NSW. It includes the Barwon–Darling, Culgoa, Paroo, Warrego, Narran, Bokhara and Birrie River catchments. It takes in significant portions of the Bourke, Brewarrina, Central Darling, Cobar and Walgett Shires and the Unincorporated Area.

Bourke, Brewarrina, Cobar, Walgett, Lightning Ridge and Broken Hill are the major service centres.

The Western Catchment is mainly leasehold land administered under the Western Lands Act 1901 by the Department of Natural Resources. There are more than 630 pastoral and agricultural holdings. The population of the Western Catchment is approximately 18,000 people not including the City of Broken Hill.

The Western Catchment is different to other catchments. Other catchments are generally associated with a river basin or a river and its tributaries. The Western Catchment is different because it includes the largest and most diverse areas of natural rangelands in NSW as well as a series of river systems.

Rangelands are large areas of arid or semi-arid land which are unsuitable for intensive agriculture because of unreliable rainfall and poor soil, or other constraints, but suitable for open grazing.



Western Catchment

Henry Lawson summed up the 'perception problem' of Australian inland rivers in this verse of his poem 'The Paroo' published in 1900 about the Paroo River:

'But where,' said I,
''s the blooming stream?'
And he replied, 'We're at it!'
I stood awhile, as in a dream,
'Great Scott!' I cried, 'is *that* it?'
'Why, that is some old bridle-track!'
He chuckled, 'Well, I never!
'It's nearly time you came
out-back—
'This is the Paroo River!'

What do we know about inland rivers?

All inland rivers lie at the low end of the river range in terms of flow quantity but they are at the high end of flow variability. This means they are complex and unpredictable. The explorer Charles Sturt saw Cooper Creek as just a creek, yet it forms one of the most magnificent desert river systems in the world.

Inland rivers have long periods of low flow or no flow, followed by periods of extreme flooding. Some floods follow one after the other while decades may separate others. People living on the river tell visitors that no flood is the same, and scientists working in these areas monitoring the changes agree.

Ever changing flood plains impose another level of unpredictability, for example, a fallen log can close off a channel and the river just moves to form a new channel nearby. Complexity in space and time create pathways of connectivity linking different parts of a flood plain to the river. Ever changing patterns of flooding produce wetlands with unique flooding and drying patterns. Whole inland rivers have their own signature of variability, making them ecologically distinctive.

Flood plains

Inland rivers are more than the main river channel commonly defining the river. They also include the flood plain formed when the river breaks its banks. Flood plains form over 90% of the river, and include swamps, channels, lakes, billabongs, wetlands and water holes. These areas are permanently or temporarily flooded and support high biodiversity with an abundance of plants and animals.



Improving the quality of water in the Western Catchment

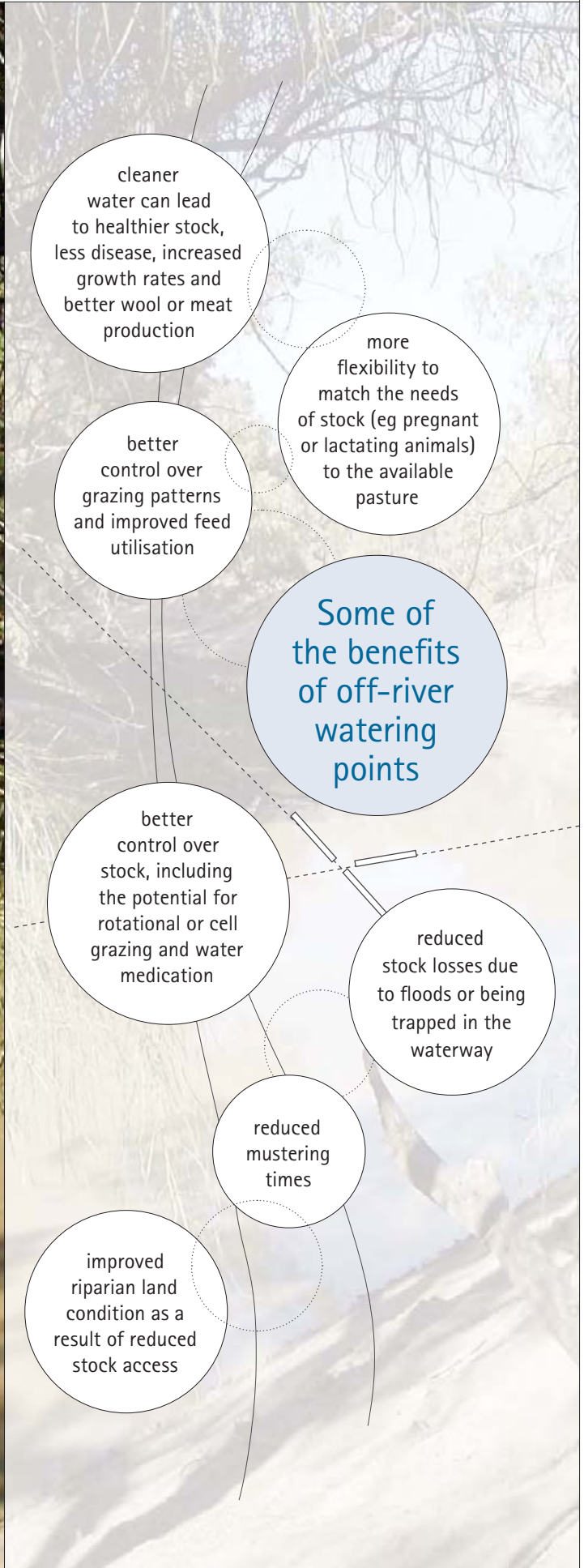
The Western Catchment Management Authority's assessment of streams, creeks, and riparian lands shows that in-stream health has suffered as a result of past land and water management practices. The following management approaches will assist in improving in-stream health and wildlife on individual grazing properties:

- Ensure natural riparian vegetation is retained during property or paddock development.
- Where the natural riparian vegetation has been disturbed and the canopy opened up, replanting can be used to regain natural shade levels, and should include shrubs, grasses and reeds as well as trees.
- When planning the rehabilitation of a stretch of stream, visit undeveloped and natural areas in the local district, and note the mix of riparian vegetation. For smaller streams, up to 10 metres wide and oriented east-west, the northern bank is particularly important for vegetation retention or replanting because it will provide the maximum amount of shade for the stream.
- Landcare or Waterwatch groups can assist with regular water quality and stream health monitoring so that changes over time can be tracked in streams, creeks and wetlands.
- Keep fallen timber in streams so that it can provide habitat for in-stream life.
- In situations where large pieces of wood are present in the channel, these can be dragged back against the banks at an angle of 40° where they have little effect in diverting water flow onto the banks.
- Make sure works on streams, e.g. for diversions or pumping stations, are approved or licensed by the relevant agency.
- The siting and design of these structures must take into account potential consequences on water ways. Protecting, maintaining and restoring riparian land will be of most benefit to wildlife when both the total size and its links with other natural areas are maximised. For example, on stream meander bends it may be cheaper to fence out the whole bend than to attempt to follow the bank curves, this can also provide valuable wildlife habitat.

The pay-back period to recoup the costs and ongoing maintenance of alternative watering systems will vary according to the system used. Grants are available through the Western Catchment Management Authority to help defray some of the capital costs of riparian fencing and associated off stream watering systems.



Western Catchment



Grazing management

Grazing management is the single most important factor influencing the condition and pasture productivity of riparian land. Graziers use a range of grazing management techniques such as set stocking, rotational grazing based on season and feed on offer.

Fencing

The fencing used depends on:

- type of stock
- frequency of grazing on riparian land
- level of exclusion required
- size and shape of riparian channel
- flood frequency
- size of flood peak
- cost
- whether your fenceline will follow the contours of your waterway

Paddock design

Riparian land often features a single stream providing water to several paddocks with fencing separating paddocks and neighbouring properties. When flooding occurs the fencing can be washed away and during dry periods boundaries are lost posing problems such as:

- mobs being boxed
- the spread of disease and parasites

An alternative water supply can significantly reduce these risks.

When altering access to riparian areas it is important to ensure adequate shelter/shade is provided in the newly created grazing area.

Two main options for fencing riparian land

- 1) Fencing which forms an exclusion zone which may entail protection of an area for conservation or minimal grazing for more active total grazing management.
- 2) Alternative stock movement controls such as the use of off stream watering points, mineral or supplement licks or the provision of shade away from the waterway. These methods can change animal behaviour to reduce the amount of time stock spend on riparian land whilst minimising fencing costs.



"Having waterways fenced out saves a considerable amount of time in stock inspection and mustering. It also reduces the risk of sheep becoming bogged and reduces energy expenditure by stock in trying to access water."

TONY AND MICHELLE MCMANUS
"TOORALE STATION", BOURKE

NOTES

Prepare a detailed watering system design

A reticulated watering system can be a valuable management tool for improving the productivity of riparian land. Installing a water system can improve the way you manage riparian land and the way you manage your entire enterprise.

How much water?

Stock often drink in numbers, especially in the mornings and evenings, so the reticulation system has to supply the average daily need in less than a full day. This creates a period of peak demand. Just how quickly water needs to be delivered to a trough depends on how many animals use the trough, and how big the trough is.

The size of the trough indicates how many places are available for stock to drink at one time and how much water the trough holds. As a rule of thumb, the supply to a trough in a paddock should be able to deliver the average daily need of the stock using it in less than four hours.

Table: Water Consumption

User	No.	Daily litres/head	Total litres
SHEEP			
lactating ewes		8	
dry sheep		5.5	
lambs on dry pasture		1.5	
CATTLE			
grazing (up to 550 kg)		35	
over 550 kg		55	
lot feeding		75	
calves		20	
milking		55	
dry cows		35	
HORSES			
working		45	
grazing		30	
DOMESTIC			
per person		275	

REFER TO

For further information refer to the 'Primefacts' fact sheet on how to assess your water resources available from:
<http://www.dpi.nsw.gov.au/aboutus/resources/factsheets/primefacts/stockwater-limited-resource>

Or contact your local DPI Officer for further detail.



Working out peak flow

You can use this formula to work out the peak flow to supply a trough in four hours:

$$(\text{Number of stock} \times \text{daily requirement}) \div 240 = \text{litres per minute}$$

When working out expected peak demand remember:

- Stock are not distributed evenly over a large paddock. Although there might be three troughs in a paddock, it would be unusual for one-third of the stock to drink at each trough. Designing the supply to deliver a peak flow able to deal with half of the stock would give a more reliable supply.
- Different sites have different peak demands. The first factor controlling peak demand is the number of stock using the supply but there are other points to consider. For example, stock using a trough at a holding yard could be stressed after mustering or road travel, and need more water than stock in the paddock.
- Larger troughs can have a lower peak flow demand because they are holding more water to start with.

Where do you need the water?

The location and quantity of your watering points will depend upon the method of grazing management you use, whether is be rotational or conventional. A well developed Property Management Plan will assist in determining the location and quantity of your watering points.

Further assistance in the placement and quantity of watering points is available through the Department of Primary Industries.

Below is an example of a table used to determine maximum water requirements.

Table: An example of how to determine maximum water requirements*

Trough number	Area hectares	DSE number	Litres per DSE	Total litres/day
1	350	900	4.5	4032
2	275	1900	4.5	8512
House	House			10000

* In this example water supply to the house is taken into account.

About 'demand pressure'

While this is normally measured in kPa or psi it can be converted to Metres or Feet of Head. In a pumping system we talk about Total Head in two parts:

$$\text{suction head} - \text{discharge head} = \text{total head}$$

Suction head = static suction head + friction head of the suction piping system

Delivery head = static delivery head + friction head of the delivery piping system + demand pressure

A pump doesn't really pull water up. By pushing water out of the outlet, the pump lowers the pressure at its inlet. When this pressure is low enough, the air pressure on the surface of the water at the source pushes water up the suction pipe.

NOTES



Choosing a pump

The four most common ways of powering a pump are:

1. mains electricity
2. engine (petrol or diesel)
3. solar electricity
4. wind

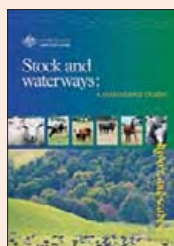
Use the type of pump best suited to the job. No one type of pump is 'better' than all others; they are best in different situations. Before you choose a pump be sure you know:

- the total head
- the suction head
- the peak flow
- the source of power for the pump

Although the basic centrifugal pump is best suited to medium volume and head situations, jet pumps or multi-stage pumps can supply high flows against a large head. Use the pump performance charts provided by pump supply companies to match a pump to your requirements, bearing in mind that you shouldn't choose a pump based on its maximum performance.

REFER TO

For more information about pumps see section 8.



Types of pumps available

Table: Advantages and disadvantages of different pumps

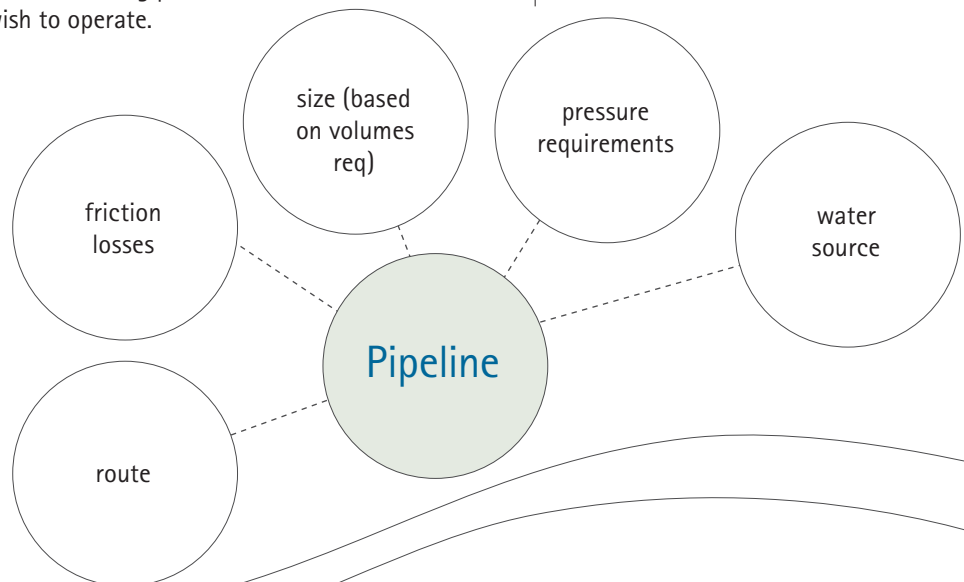
Type of pump	Advantages	Disadvantages
ELECTRIC (mains power)	<ul style="list-style-type: none"> • most suitable for pumping large volumes uphill or long distances • reliable (provided electricity supply is reliable) • can be automated 	<ul style="list-style-type: none"> • need access to mains power • can be expensive to purchase
DIESEL	<ul style="list-style-type: none"> • suitable for pumping large volumes uphill or long distances • portable 	<ul style="list-style-type: none"> • can be expensive to run • needs refuelling • difficult to automate • can be expensive to purchase
PETROL	<ul style="list-style-type: none"> • good back up option for other pumps (e.g. electric) • portable 	<ul style="list-style-type: none"> • can be expensive to run • needs refuelling • difficult to automate • can be expensive to purchase
SOLAR	<ul style="list-style-type: none"> • cheap to operate • ideal for remote areas • reliable • easy to maintain 	<ul style="list-style-type: none"> • not suitable for pumping large volumes or uphill (but becoming more effective as technology improves) • can be expensive to set up (but price is falling as technology improves)
WIND	<ul style="list-style-type: none"> • cheap to operate • used in remote areas 	<ul style="list-style-type: none"> • least reliable • not suitable for pumping large volumes or uphill • needs to be used with large storage tank
WATER (ram pump)	<ul style="list-style-type: none"> • good option for continuous, low volume pumping • no operating costs (provided stream is flowing) 	<ul style="list-style-type: none"> • needs 1 metre fall in waterway • not suitable for pumping large volumes • capacity can decrease in summer months • can be expensive to purchase
AIR	<ul style="list-style-type: none"> • good option where mains power is available, but located too far from pump to use an electric pump • good option where water supply is intermittent (e.g. bore) • suitable for pumping low volumes over long distances 	<ul style="list-style-type: none"> • not suitable for pumping large volumes • air leaks can be difficult to detect • compressor requires second source of power (e.g. mains electricity or solar)
STOCK OPERATED	<ul style="list-style-type: none"> • cheap to buy • stock easily trained to operate • no operating costs • portable • no water wastage 	<ul style="list-style-type: none"> • suitable for low volumes only

Source: Land & Water Australia, Stock and Waterways: A Manager's Guide, page 43.

Watering points – capacity

The capacity of your watering points (i.e the size of your troughs and whether to install tanks) is determined by your peak demand, the recharge capabilities of the watering point and the level of risk at which you wish to operate.

As a guide, healthy cattle will travel 10 kilometres to water and depending on the landscape sheep will travel up to 5 km, but for effective grazing and animal production no more than 3 kilometres is recommended between water points. Refer to your local RLPB or Department of Primary Industries for further information on this topic. As a rule, the more isolated the watering point the lower the level of risk you should operate at.



When looking at an application and selecting a pump you need to know:

- the volume of water that will be required at peak usage. This is expressed in L/Min,
- the margin of safety at which you wish to operate or how reliable you need the supply to be,
- the vertical height through which the water has to be raised. This is referred to as the static head and is usually expressed in metres,
- the friction of the piping system. This depends on the type of pipe being used, its diameter and its length,
- where is the pump going to be? How far is it from the nearest electrical power? Is it in an exposed position suitable for solar or wind?,
- the 'demand pressure' which is the amount of pressure that will be required at the outlet outlets of the system,
- number of pumping hours/day,
- power requirements,
- running costs,
- maintenance requirements and costs,
- any other pump limitations (e.g. yield of bore/well, level and variability of water level if using surface water etc),
- protection requirements (lose of prime, overheating, low/high pressure, engine protection, no. of starts over a period).

Water Source

The two main sources of water are surface and subsurface. To access subsurface water a bore pump is used. A transfer pump is used for dams, creeks, rivers, shallow wells and tank to tank.

A permit or licence may be required to:

- take water from a waterway, surface water or groundwater source
- build a dam or weir
- collect water in a dam
- drill an artesian bore

REFER TO

For further information regarding water requirements for stock:

- refer to the NSW Department of Primary Industries:
www.agric.nsw.gov.au/reader/water-livestock/a054.htm
- Contact your local DNR office for information on licencing.

Fittings

A reticulated water system will include a number of fittings ranging from joiners, elbows and tees, through to valves and tank level indicators.

Fittings come in either poly or steel. Either material is chosen for different applications and for different reasons. Poly is the cheaper of the two materials and is generally the material of choice.

There are a range of fittings required for use around your pump:

- A foot valve (non return valve) stops the pump losing prime when it is not operating. Foot valves are often sold as a combined unit with strainers which filter the large debris prior to its entering the suction line
- A pressure gauge is important to tell if a pump is working properly and should be installed on the pump output line, just past the outlet. Low pressure could mean that the pump is poorly primed, the suction pipe is blocked, or the pump is showing signs of wear. High pressure at the pump when discharge is lower than usual could mean that the discharge line is blocked, or that a valve is partly closed.
- For positive displacement pumps, it is vital to install a pressure relief valve. Mounted on the discharge pipe, these valves open when the pressure in the pipe is over a preset limit.
- If the delivery pipe slopes up from the pump, a check valve stops water from flowing back through the pump and into the water source. The check valve is a one-way valve that keeps the reticulation system full, so that the pump doesn't have to work to refill it. It also stops water being drawn back from the reticulation system, which can contaminate supplies.
- Put a gate valve on the discharge line of any centrifugal pump. When the pump has been primed, start the pump with this valve closed. Open it slowly as discharge pressure rises (another reason to install a pressure gauge). Otherwise the pump tends to throw out the priming water before pressure in the inlet falls enough to allow water to rise from the source. The gate valve lets you close off the reticulation system when the pump or its fittings need to be removed for maintenance. Never leave the gate valve closed for long periods with the pump running. Centrifugal pumps need circulating water to cool the seal at the back of the pump casing. If this overheats, it fails.

Tanks

Water tanks have traditionally been either concrete or galvanised iron, but other materials are appearing on the market.

Lightweight tanks made from materials such as UV stabilised polyethylene (poly tanks) are gaining popularity.

Tanks should have a lid to:

- reduce evaporation
- stop algae growing
- keep birds, animals insects and blown rubbish out.



Western Catchment



Use the table below as a guide to the minimum size for a trough. Because the rate that water flows into the trough affects the amount of water that has to be stored, we have included a suggested inflow rate.

Minimum recommended trough sizes*

Stock type	Inflow (litres /min/head)	Volume (litres/head)
Cattle	2.5	5
Sheep	0.25	1
Horses	1.8	5

*Note: these figures are for herds of animals, not individuals

In average conditions, allow about one metre of trough per 250 sheep or 30 cattle. Stock in dry conditions or travelling stock need more. Avoid using long troughs with the inlet valve at one end. Use two shorter troughs or place the inlet in the middle of the trough.

Troughs

It is important to choose a trough the right size for the number of stock that use it. Although a larger trough holds more water, which helps to meet peak demand, it brings other problems. If the water in the trough isn't changed often enough, algae can grow and the water can become stagnant.

Erosion around a trough can be reduced by laying gravel or some other resistant surface around the trough. The most effective protection is gained from laying a concrete slab around the trough, although this is the more expensive option.

In long troughs, the water furthest away from the inlet tends to become stagnant. This stagnant water is a threat to the health and productivity of the stock using it. Even slightly stagnant water is less palatable, so stock drink less, which reduces their productivity.

In average conditions, allow about one metre of trough for 250 sheep or 30 cattle. Stock in dry conditions or travelling stock need more. Avoid using long troughs with the inlet valve at one end. Use two shorter troughs or place the inlet in the middle of the trough.

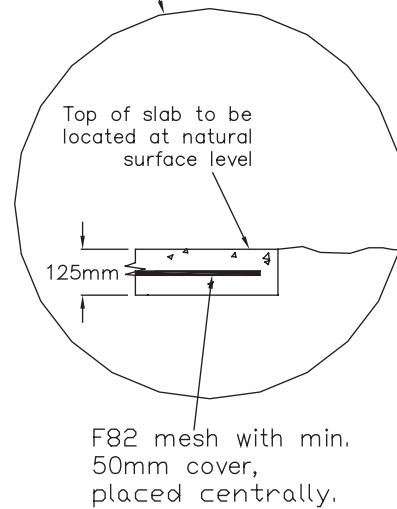
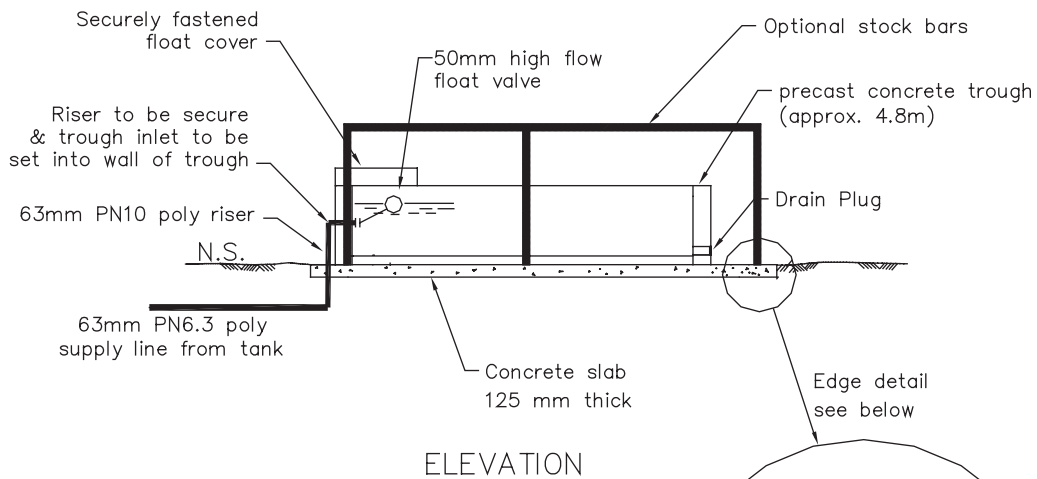
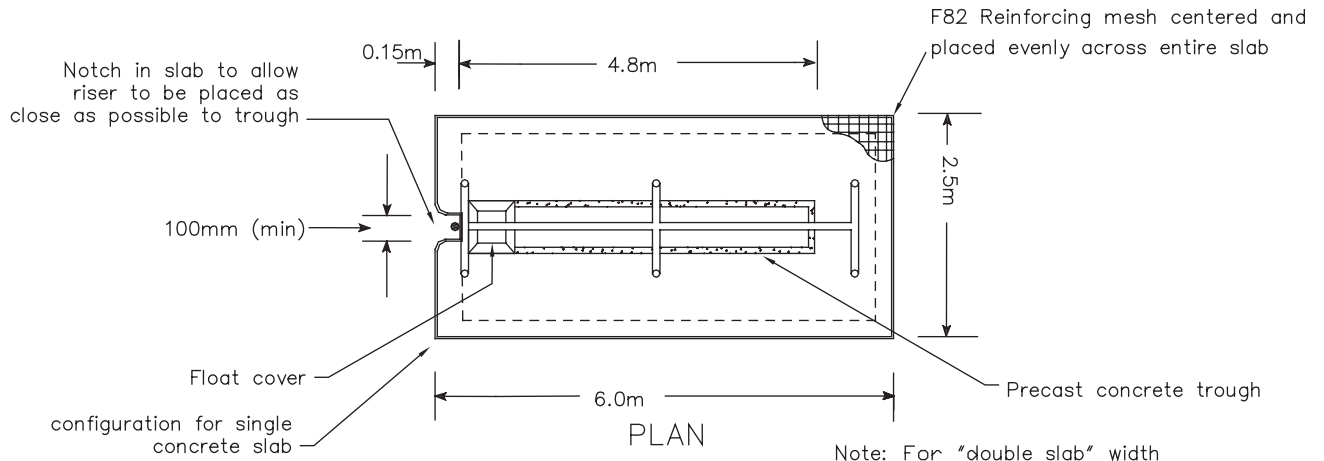
General points to observe when installing troughs:

- always place a trough on firm, well-drained ground. The area around a trough is subject to heavy traffic, and is often wet. To prevent erosion, lay a patch of concrete, compacted road base or gravel under and around the trough
- avoid locating troughs near gateways – they create an obstacle to mustering stock.
- consider using one long trough passing under a fence to provide water in two paddocks. This saves on pipe, installation and maintenance costs. However, this placement can significantly increase animal pressure along the fenceline. This should be taken into account when planning the placement of your troughs.
- Make sure that the float valve has a strong cover. Cattle in particular tend to play with the float which can damage the valve.
- Troughs need a drain plug to allow easier cleaning. They should be flushed out regularly, especially if the water is high in salt.
- Protect the water supply line to the trough. Keep it well buried (at least 300 mm).
- Use galvanised pipe close to the trough and for the above-ground pipe and fittings.
- To avoid stock climbing into troughs and getting stuck, install a barrier over the trough or down the middle. A welded steel frame attached to the trough is a common approach.

Air and scour valves

Any pipe with high and low points accumulates air and sediment that restrict water flow. Air valves and scour valves can control these problems.

Typical trough arrangement



Drawing: Department of Natural Resources

Note: this drawing is not to scale

Priming

Because centrifugal pumps can't pump air to prime themselves, they rely on being correctly set up to make them easy to prime and to stay primed. The main methods are:

- Install the pump so that the inlet is below the surface of the water source. The most common example of this is installing a pressure pump at the base of a water tank. The inlet stays flooded as long as the tank holds water.
- A one way valve (foot valve) at the bottom of the suction pipe usually keeps a pump primed between uses.

Water hammer

Water hammer is a sudden rise in pressure that occurs in pipes when water flow is suddenly stopped or accelerated. It can cause severe damage to pipes and fittings. Water hammer is worse in long runs of pipe.

To have fewer problems:

- choose pipes so that flow velocity is less than 1.5 metres per second
- always open and close valves slowly
- fill long empty pipelines slowly and carefully
- use plastic pipes and fittings
- fit a pressure chamber

Installing poly pipe

Poly comes in rolls, so it doesn't need many joints and can be buried using a special type of ripper. Many rural stores rent out these pipe layers. The tips below will make the job easier:

- Plan the job. Design the whole reticulation system in advance, as part of the whole farm plan.
- Clear along the route of the pipe.
- Prior to ripping check the location of cables etc by contacting 'Dial Before You Dig' – phone 1100
- Rip the line for the pipe to the required depth without any pipe. If the ripper strikes a rock or tree root, you cannot reverse away with pipe behind the ripper.
- Unroll the pipe along the route (to one side). One of the easiest ways to unroll pipe is to: anchor the outside end of the roll; tie the inside end to a vehicle with three to five metres of rope; pull the roll out slowly. You will need someone watching the pipe to make sure that it doesn't kink. The pipe has to be able to untwist itself as it pays out. Anchor the end of the pipe after it is laid out to stop it springing back.
- Position the tractor with the layer at the start of the line. Draw enough pipe through the laying tube to reach the fitting that it will be attached to and anchor the end.
- Move off carefully, using the three point linkage to gradually lower the point of the ripper to the required depth. Keep to the line that you have already ripped.
- If you have a second person available, they can watch the pipe feeding into the layer and make sure that it doesn't kink or get damaged in any other way.
- After you have buried enough pipe to reach the fitting that it will connect to, use a mattock and spade to carefully expose the end of the pipe.



Glossary

Artesian Bore (also flowing bore):

A bore where water rises up the bore column to a point above the land surface.

Cavitation:

The production of voids in a liquid system due to extreme reduction of internal pressure. Collapse of these voids or cavities produces very large impulsive pressure, which can cause considerable damage to nearby surfaces.

Delivery head:

The difference in height from the pump outlet to the delivery point. How far uphill the pump has to push water.

Drawdown:

The lowering of the water table around a well when water is pumped from the well.

Head:

Energy stored in a water mass, produced by elevation, pressure or velocity. One metre of head is equal to 9.8 kPa but many pump distributors use 10 for the sake of convenience.

In-kind contributions:

Non-financial contribution.

Integrated Resource Management:

Management approach considering, in the decision-making process, interdependencies among land, water and vegetation variables.

Pressure:

Measured in kilo Pascals (kPa). Normal air pressure at sea level is 100 kPa. One psi (pounds per square inch) equals 6.8 kPa.

Reticulation system:

A system of bore drains or pipes which may cross one or more properties to distribute water across the landscape.

Everything involved in moving water from the supply to where it is used. This includes pipes, pumps, tanks and valves.

Static head:

The difference in elevation between the surface of the water source and the delivery point. Static head is the sum of delivery head and suction head.

Stock Water Demand:

The volume of water required by stock at a property scale. May be calculated in reference to a specific time period, such as an hour, day or year.

Streamflow:

The discharge that occurs in a natural channel. A more general term than runoff, streamflow may be applied to discharge whether or not it is affected by diversion or regulation.

Suction head:

The vertical distance from the surface of the water at the source to the pump inlet. How far the pump has to 'lift' water.

Total Grazing Pressure:

Net demand grazing animals place on vegetation cover of the land.

Water Hammer:

A sudden rise in pressure that occurs in pipes when water flow is suddenly stopped or accelerated.

Water Infrastructure:

Bores, bore headworks, piping, troughs and tanks related to extraction and distribution of water.

Watering points:

Troughs, tanks or other structures used to provide water.

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Appendix 1: Conversion tables

Surface and Area

Metric		Imperial
6.452 cm ²	1	0.155 sq inches
0.093 m ²	1	10.764 sq feet
0.836 m ²	1	1.196 sq yards
0.405 ha ²	1	2.471 sq acres
259.0 ha	1	0.004 sq mile

Length

Metric		Imperial
25.381 mm	1	0.039 inches
2.538 cm	1	0.394 inches
0.914 m	1	1.0936 yards
1.609 km	1	0.621 mile

Pressure

Metric		Imperial
6.897 kpa	1	0.145 psi

Power

Metric		Imperial
0.75 kW	1	1.34 hp

Capacity

Metric		Imperial
0.0283 m	1	35.34 cu feet
0.765 m	1	1.308 cu yards
4.546 L	1	0.220 gallons

Temperature

Metric		Imperial
5/9 (Fahrenheit-32)	1	[9/5 (Celsius)]+32

Distance

Metric
1000 mm = 100 cm = 1 m = 0.001 km
1000 ml = 1 L = 0.01 hL = 0.000001 ML

Appendix 2: An example of a property costing

Items			Quantity	Unit cost (ex. GST)	Cost (ex. GST)
PUMP STATION AND HEADWORKS					
1. RIVER PUMP				\$-	\$-
1.2	1.2.1	Suction and Discharge Pipework	1	\$2,600.00	\$2,600.00
	1.2.2	valves and Fittings	1	\$3,575.00	\$3,575.00
	1.2.3	shed foundation	0	\$-	\$-
	1.2.4	pump shed	0	\$-	\$-
	1.2.5	pump set (3 ph electric)	1	\$1,690.00	\$1,690.00
	1.2.6	flow metres	0	\$4,550.00	\$-
	1.2.7	installation	1	\$1,300.00	\$1,300.00
	1.2.8	concrete & formwork at pumpsite	1	\$2,600.00	\$2,600.00
2. PIPELINE				\$-	\$-
2..1. PIPES (INCL. JOINERS)					
	2.1.1	S1 63 PN6.3 SDR21 PE80 B	4000	\$2.43	\$9,720.13
	2.1.2	S1 50 PN6.3 SDR21 PE80 B	17000	\$1.56	\$26,480.70
	2.1.3	S1 40 PN6.3 SDR21 PE80 B	0	\$0.99	\$-
2.2. PIPELINE INSTALLATION					
	2.2.1	Pipe route preparation	21000	\$0.18	\$3,780.00
	2.2.2	Trenching and pipeline installation	21000	\$1.31	\$27,468.00
	2.2.3	Pipeline restoration	21000	\$0.06	\$1,260.00
2.3. TEES					
	2.3.1	63 mm	10	\$36.46	\$364.55
	2.3.2	50 mm	10	\$24.33	\$243.26
	2.3.3	40 mm	0	\$16.65	\$-
2.4	Road Crossings (unsealed) incl. Installation		1	\$735.00	\$735.00
2.5	Creek Crossings		0	\$510.00	\$-
3. FITTINGS				\$-	\$-
3.1. IN LINE ISOLATION VALVES					
	3.1.1	63 mm	1	\$184.43	\$184.43
	3.1.2	50 mm nom. (dia.)	1	\$178.64	\$178.64
	3.1.3	40 mm nom. (dia.) glass filled nylon ball valves	0	\$178.64	\$-
3.2	Air Valves (automatic double acting)		5	\$337.26	\$1,686.28

Management of stock and waterways

Items			Quantity	Unit cost (ex. GST)	Cost (ex. GST)
3.3. SCOUR VALVES					
	3.3.1	63 mm	3	\$259.44	\$778.33
	3.3.2	50 mm 40 mm tail	3	\$209.10	\$627.31
	3.3.3	40 mm 40 mm tail	0	\$209.10	\$-
3. FITTINGS				\$-	\$-
3.4	Valve Covers		included	\$-	\$-
3.5	Signs (as per Specs.)		10	\$15.00	\$150.00
3.6		Tank Inlet (incl. strainer, flow control valve, iso. valve, etc.)	9	\$261.45	\$2,353.07
4. INSTALLATION OF FITTINGS				\$-	\$-
4.1		Tank Inlets	9	\$91.00	\$819.00
4.2		Scour Valves	6	\$78.00	\$468.00
4.3		Air Valves	5	\$78.00	\$390.00
4.4		Isolation Valves	2	\$78.00	\$156.00
4.5		Mainline tees etc.	20	\$78.00	\$1,560.00
4.6		Signs	13	\$32.50	\$422.50
6. TANKS				\$-	\$-
6.1		Foundation and site preparation	9	\$52.50	\$472.50
6.2		Water Level Indicator (installed)	9	\$105.00	\$945.00
6.3		Tank outlet fittings (as per specs.)	9	\$205.19	\$1,846.74
6.4		Stock Protection Shield (installed)	9	\$187.50	\$1,687.50
6.5		22,700 L (5,000 Gal) poly tank	9	\$2,185.00	\$19,665.00
6.6		Installation (Tank & fittings)	9	\$198.00	\$1,782.00
7. TROUGHS				\$-	\$-
7.1		Foundation and site preparation	15	\$40.25	\$603.75
7.2		Concrete Slab	15	\$988.00	\$14,820.00
7.3		4.8 m (16') Concrete Squareline Trough	15	\$648.00	\$9,720.00
7.4		Stock Protection Rail	15	\$303.60	\$4,554.00
7.5		Fittings (incl. valves & float valves)	15	\$144.63	\$2,169.40
7.6		Pipeline to troughs- assume 50 m of 63 mm PN6.3 PE80B	15	\$149.50	\$2,242.50
7.7		Installation	15	\$275.00	\$4,125.00
GRAND TOTAL					\$156,223.59
TOTAL EQUIPMENT					\$110,881.84
TOTAL INSTALLATION					\$45,341.75

Appendix 3: Friction Loss (Metric)

Friction Loss – Metres Per 1000 Metres Metric Polyethylene Type 50 – Class 6

Flow rate litres/s	12 mm	16 mm	20 mm	25 mm	32 mm	40 mm	50 mm
0.0	25.1	3.9	1.0				
0.04	90.5	14.2	3.7	1.0			
0.1	191.8	30.1	7.9	2.2	0.6		
0.1	326.8	51.3	13.5	3.7	1.1		
0.1	494.1	77.6	20.3	5.7	1.6	0.5	
0.2		280.1	73.5	20.4	5.7	1.9	0.6
0.3		593.4	155.7	43.3	12.2	4.1	1.4
0.4		1011.0	265.2	73.8	20.7	6.9	2.3
0.5			400.9	111.6	31.3	10.5	3.5
0.6			561.9	156.4	43.9	14.7	4.9
0.7			747.6	208.1	58.4	19.5	6.6
0.8				266.4	74.8	25.0	8.4
0.9				331.4	93.0	31.1	10.5
1.0				402.8	113.1	37.7	12.7
1.2				564.6	158.5	52.9	17.8
1.4				751.1	210.9	70.4	23.7
1.6					270.1	90.1	30.4
1.8					335.9	112.1	37.8
2.0					408.3	136.3	46.0
2.5					617.2	206.0	69.5
3.0					865.1	288.8	97.5
3.5						384.2	129.6
4.0						492.0	165.9
4.5						611.9	206.4
5.0						743.7	250.8
5.5						887.3	299.3
6.0							351.6
7.0							467.7

Appendix 4: Friction Loss (Imperial)

Friction Loss – Metres per 1000 Metres Rural B – Polyethylene – Class 6

Flow rate litres/s	12 mm	20 mm	25 mm	32 mm	40 mm	50 mm
	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"
0.02	5.0					
0.04	16.2	2.6				
0.06	34.0	4.9	1.2			
0.08	58.0	8.4	2.1			
0.1	84.0	12.0	3.2	1.0		
0.2	295.0	43.0	10.5	3.5	1.5	
0.3	590.0	85.0	20.4	7.5	2.9	
0.4		150.0	37.0	12.2	4.8	1.3
0.5		205.0	54.0	18.5	7.1	1.9
0.6		290.0	75.0	20.5	10.0	2.6
0.7		380.0	96.0	32.0	12.8	3.4
0.8		490.0	120.0	42.0	16.5	4.3
0.9		600.0	145.0	51.0	21.0	5.2
1.0		750.0	180.0	62.0	25.0	6.2
1.2			250.0	85.0	34.0	8.5
1.4			340.0	115.0	44.0	11.5
1.6			420.0	140.0	56.0	14.5
2.0			620.0	218.0	85.0	21.0
2.5			900.0	300.0	122.0	32.0
3.5				580.0	230.0	57.0
4.0				750.0	290.0	73.0
4.5				900.0	350.0	90.0
5.0					440.0	105.0
5.5					520.0	131.0
6.0					580.0	143.0
7.0					750.0	200.0
8.0						250.0

About this publication

This booklet will help you manage and maintain your stock water supply to benefit you, the land and the waterways in all conditions including extremes of drought and flood.

Stock need access to good quality water and riparian pastures can produce good quality feed. There are important financial and environmental reasons for you as a grazier to manage riparian land on your property.

This guide provides practical tips to assist graziers in identifying the issues and trade-offs that can occur in managing riparian land. The aim is to increase production and profit while maintaining the land and water's natural resource base and improving its capital value. Some of the information is also useful for managing ground tanks.

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