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PASTORAL

STOCK WATER

WORKBOOK

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Sinclair, T. M. (Troy Michael)
Bright, F. A. (Francis Alfred)
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Introduction

In the preparation of this Workbook, a number of pastoralists across the Kimberley were consulted on their use, maintenance and knowledge of different types of stock water. All identified that maintaining and improving water supplies for stock are major considerations in their business operations. Some are investing in new water points to increase their stocking rate, or better manage the station, and others are reworking old water points to improve their operation.

Investment in stock water is often done when the beef industry is buoyant and returns are good. At such times there are cash surpluses that can be turned into income generating assets (such as water points) that produce more beef. When the industry suffers a downturn (such as reduced beef prices) a well designed and constructed water point will tend to continue to generate profits due to better herd productivity and reduced maintenance costs.

In the past, pastoralists have mainly relied on windmill/diesel-powered bores. When labour and fuel were relatively cheap, the cost of supplying water to stock through these types of stock water was low. In today's economic climate, pastoralists face a cost price squeeze as labour and fuel costs rise and income remains the same or worse still decreases. Unless pastoralists closely monitor their costs of production, the profitability of the business will be jeopardised.

Discussions with pastoralists revealed that there is no "magic formula" for developing a perfect system of water points. Each property has a different blend of soil types, topography, pastures, access and existing waters that impact on the location and design of new water points. Station managers are best placed to make the decision of whether or not to invest in a new water point, where it should be located and what type of water point it should be. To make this decision, the manager must have access to a variety of information sources, including the initial set-up cost, the annual running cost and what returns could be expected.

The aim of this Workbook is provide information to assist station managers to make decisions in water point management and investment. Each individual must make their own assessment for what decision is best for their particular circumstance.

Considering its importance to cattle production, it is surprising that little has been written about the economics of stock water management and how to make decisions about investing in new water points. It is hoped that this Workbook will provide a valuable resource for future decision making.

Troy Sinclair and Francis Bright,

Department of Agriculture WA, May 2005

How to use this Workbook

The Pastoral Stock Water Workbook has been developed to assist you to estimate the costs of maintaining stock water and make informed decisions about managing existing and proposed water points.

The first half of the Workbook provides background information on stock water points, their usage, advantages and disadvantages. Whilst the second part contains a series of step-by-step exercises that should be completed as you progress through the Workbook. The latter part of the Workbook aims to:

- Show a worked example of the annual costs of maintaining water;
- Provide tools to calculate water costs for your business;
- Outline how to use this information to plan for future management; and
- Assist you to make water point decisions that increases your business' efficiency.

The economic calculations on stock water are stored as electronic spreadsheet files on the disc included in the Workbook folder. These calculations are easy to complete if you have access to a computer with Microsoft Excel, and some basic experience in its operation. The advantage of using the spreadsheet program is that you can quickly trial different figures to see how they affect the bottom line, without needing to manually calculate the data each time.

Alternately, the Workbook can be read from cover to cover as a source of general information. However, unless the exercises are completed, the Workbook may not achieve its goal of assisting you to make decisions that could increase your profitability.

To get the most value from this Workbook, it is recommended that you also utilise the following resources:

- A current station map, preferably with the land systems shown;
- A compass (or variety of circular objects to trace around) for drawing grazing circles;
- A computer with Microsoft Excel or an equivalent spreadsheet program.

The workbook also contains a variety of information in the Appendices:

- Salinity guide for water use and conversion rates;
- Further reading material on stock water;
- Information on water subsidies, which was correct at the time of printing. Please check with the funding body responsible for managing the subsidy regarding changes to its availability or eligibility criteria over time;
- Friction rates for reticulation pipe;
- Stock water point information sheet. Recording the specifications of a new water point may assist you when talking to commercial suppliers of products. It can also be a record of the details of water points for future reference.

The Workbook contains information that is tailored towards pastoral businesses in the Northern Rangelands of Western Australia. The principles outlined and decision making tools could be applied, with a degree of caution, to other regions with comparable topographic features, climate and production systems.

Section 1: Types of Water Points

Stock water can come from a number of sources, each with their own advantages and disadvantages. Most properties have a mixture of water point types and maintaining these is an important part of, and a substantial cost to, the station.

Natural Surface Water

It is widely believed that the cheapest water point is natural surface water - but even this has its own “costs”, especially if natural waters are relied upon as the primary source of water.

For example, in the late Dry Season and during the Build-up when cattle water needs are highest, most natural waters will have dried up, other than permanent springs, deep waterholes, and large rivers. This increases cattle numbers into small areas and results in overgrazing around the water. In turn the cattle must walk longer distances to feed, and they become weaker as food intake decreases. These problems become worse as the length of the dry period extends and is compounded by increasing stock numbers on a decreasing number of waters.

Some of the “costs” of stock utilizing natural waters are:

- High and continuous cattle numbers at waterholes, fouling the water and silting up waterholes, making them unsuitable as a water source in drier times;
- The presence of natural predators such as saltwater crocodiles in major river systems;
- Dense vegetation adjacent to rivers, creeks and permanent swamps, which can affect the ability to muster cattle;
- Riverbanks may be infested with weeds, which can then be spread by cattle to other areas;
- Cattle bogging around the margins of waterholes;
- Flash flooding, which can result in herd losses if weak cattle are congregated in and around water courses;
- A reduction in the effectiveness of trapping cattle at artificial waters; and
- A reduction in the ability to use water medicators to supplement cattle.

These high costs warrant a reconsideration of the reliance on natural waters. There are also increasing environmental concerns about cattle having direct access to natural waters and the impact on riparian (riverside) vegetation. These areas can have high environmental values, and they may also be important drought reserves if protected during average seasons. Programs are now available (and there may be more in the future) to assist pastoralists with fencing off natural waters.

Artificial Water Points

Many properties have limited surface waters so the only alternative is to develop artificial water points. The pastoralists interviewed made four main points about choosing different types of infrastructure:

- Maintenance issues and backup parts for equipment.
- The more complex the type of infrastructure, the fewer people who can fix it.
- Ensure reliable water points are used in isolated locations, especially if there is no alternative water point as there is high chance of mortality if the water point fails.
- Consideration of the integration of other systems at a water point such as medication and trapping.

Pastoralists identified that there were several types of infrastructure in use in the Northern Rangelands of Western Australia. Below is a summary of some of the more common and developing technologies available today:

Windmills

The basic design and construction of windmills has not changed much since the early 1900s, and today they are still an effective water pumping device. Two advantages of windmills are that they have an extremely long life if serviced regularly and normally most employees know how to fix them. Whilst a disadvantage is that they are classified as an elevated work platform so there are Occupational Safety and Health implications with their maintenance

One of their weaknesses in areas like the far North of Western Australia is wind droughts, which require auxiliary pumping from motorised pumps. This usually occurs late in the year around August to November when cattle are under the most stress and water needs are the highest. The costs involved in running and maintaining these pumps can be very high, even though they are only run for a few months of the year. This is due to the high costs of fuel, refuelling and pump maintenance and replacement.

Hilly areas and tree thickets also reduce the effectiveness of windmills by reducing wind speeds near ground level. These problems can be overcome to a certain extent by increasing fan diameter and tower height, although these in turn cost more to install.

The flatter coastal pastoral areas of the North have the most regular wind supplies making windmills suitable for water pumping. However, these coastal areas are exposed to cyclones that are very destructive to windmills. The loss of windmills to a cyclone is not only expensive, as it could cost $10,000 to replace each unit, but it also creates a water supply crisis for the station. If a significant number of windmills are destroyed then they would need to be repaired or replaced before the ephemeral (short lived) waters dry up. This causes a management crisis as financial and human resources need to be reallocated across re-establishing waters, repairs to fences and buildings and replacing stock.

One way to reduce cyclone damage is to ensure that there is an adequate volume of tank storage at each water point so at a minimum, mills can be feathered off, or preferably towers and fans laid down on the ground. This can easily be done by a boreman, provided that hinges are preinstalled at two of the mounting feet and a pulley/gantry system is available, and that it is done before a cyclone gets too close.

Fuel Powered Pumps

Diesel and petrol powered water pumps are very common in the pastoral areas of the Kimberley. They can either be a direct drive to a pump or an electrical generator that creates power to run a submersible pump.

Situations where fuel driven pumps are used include:

- During wind droughts, which are common during the "Build-up";
- High static head situations eg deep water table;
- High dynamic head situations, such as pumping through long and/or small diameter pipes;
- To supplying large volumes of water, such as next to cattle yards; and
- Close to homesteads.

Fuel powered pump costs include; motor replacement, fuel and fuel cartage to pumps in remote locations. There is a tendency for remote pumps to be fitted with extra capacity fuel tanks to reduce the need for refuelling. This can lead to problems such as motors running over time before servicing or worse still running out of oil and destroying the motor.

Solar Powered Pumps

Solar powered pumps are particularly good for low head situations, and where there are minimal variations in demand. The cost of solar power is often quoted as an inhibitor to development, but the costs of installation are not much more than for installing a complete windmill assembly. Some pastoralists commented that they are waiting for the equipment to become cheaper, however the cost of solar has remained stable. Instead the recent trend has been an improvement in the quality of components and installation of equipment, resulting in increased reliability and better value for money. This reliability has the added bonus of reduced need for visitation, which reduces maintenance costs.

A few points of interest about solar:

- Shading of panels must be avoided as much possible as standard panels lose complete power generation even when partially shaded;
- Panels last for long periods, providing they are not exposed to fire and heavy impact. They are also cyclone resistant if well installed;
- Pumps can be submersible or surface based (eg. draw plunger pumps);
- There have been reported problems with submersible pumps burning out after 2 years, whilst others suggest that they last for at least 10 years;
- Panels must be located where cattle do not have access (such as on top of a tank or inside a robust fence); and
- Panels can lose efficiency due to surface dust accumulation so cleaning should be part of regular maintenance.

Reticulation

Piping water can "move" a water point, which, for whatever reason, may not be in the best location. For example moving a water point away from a fence line will increase the area grazed, stock will utilise pastures more effectively, and fence damage from cattle pressure is reduced. These all contribute to increased productivity and profitability.

Reticulation is often used to move water to good grazing country where no alternative water is available. This is expensive due to the long distances involved, but it may be the only way to utilize good grazing country that is not good water country. An example of this is clay flats with saline groundwater and where the catchments are unsuitable for dam construction, but the grazing can be very productive.

A reticulation system can use an existing bore as a way of reducing the costs. The bore, however, should be checked for its supply capacity and water quality. To check capacity, refer to the original bore drilling notes, check the condition of the casing and do a test pump.

It is advisable to plan for future developments before laying the initial pipe from the bore. A small diameter pipe may be cheaper initially but if there is more than one trough planned in the long term you should look at the relative cost of over-engineering the initial water point by increasing pipe diameter so that in the future, more water points can be added on. If you try and move too much water through too small (or too long) a pipe you can increase pumping costs due to a high resistance to flow. The method for calculating this resistance to flow (or dynamic head as it is also known as) is located in Appendix 6

Another issue that needs to be considered in longer pipelines is how the pipes are joined. Joining lengths of pipe can be imperfect and expensive if using joiners, especially in larger diameter pipes (i.e. greater than 2 inch). If large amounts of big diameter pipe are to be laid then a pipe welder may be a useful investment but they are expensive and training is needed prior to using them (a work safety issue). Employing a contractor to do the pipe welding could be more cost effective than doing the job yourself. A contactor can weld around 3 to 4 welds per hour at a rate of $50-$70 per hour.

Construction costs of reticulation can be high due to distances that need to be covered to get far enough away from the water source. Options to maximize the value of the investment are to:

- Bury pipes at least 20cm deep to reduce damage from stock, fires, and vehicle traffic;
- A GPS record and/or markers of where the pipe is laid
- Shop around for pipe, as prices can vary significantly and it may be cheaper to buy and transport in bulk;
- Use regular pipe breathers to reduce air locks and;
- Install a gas separation tank if the water source has high gas content, e.g. some artesian supplies.

Further reading

- Selecting pipes for the farm, DAWA, Farm note: 65/87 (Agdex 756)
- Stock water reticulation, Factsheet W60, 1999, Dept of Natural Resources, QLD,
- Removing gas from pipelines, Factsheet W29, 1994, Dept of Natural Resources, QLD
- website: www.nrm.qld.gov.au/factsheets

Walk in Dams

Traditional style dams such as gully dams are often quite shallow, resulting in a large water surface area compared with volume. The far north of Western Australia has very high evaporation rates that can reduce the efficiency of year round water storage in a shallow dam. Gully dams also tend to have high maintenance costs due to the need to maintain the walls, repair floodways and undertake de-silting after a few years. Intense monsoonal downpours mean that engineering the spillway is very important otherwise wall failure can occur.

To overcome these problems, small catchment walk-in dams with piped inlets have become popular over the last 10 years. They are a reliable and cheap source of stock water when they are correctly surveyed; constructed and basic maintenance is undertaken. They are carefully surveyed to match the catchment's runoff to the storage volume of the dam, and are sited upstream from creek channels. This ensures there are sufficient catchments to ensure runoff into the dam in low rainfall years, or alternately reduce the chance of flood damage in wet years.

Walk-in dams have steep batter slopes of at least 3:1, which increases the storage depth and decreases the surface area for evaporation. A common misconception of the steep slope is that it causes the bogging and drowning of cattle. Experience has shown that most bogging is due to cattle in declining condition, as they are unable to walk uphill for a short distance.

An added benefit of the steep batters is that cattle do not camp right next to the water due to the uncomfortable slope, thus keeping the water cleaner. The only time bogging is experienced is if the dam goes dry and cattle do not have an alternate supply of water within walking distance. In this case, the paddock should be mustered and the dam isolated with a temporary electric fence and regular checks of the dam site should be performed to locate any stragglers. Temporary electric fencing can also be used to shut off a dam to trap the paddock at an adjacent bore.

The only regular maintenance that is required is to ensure the inlet trash grates are kept clear of debris. After several years some, work may also be required to tidy up the wingbanks with a bulldozer.

Further reading:

- Dam Design for Pastoral Stock Water Supplies, 2003, Bulletin No 4576, Dept of Ag WA.
- Practical Hints for the Layout and Construction of 10,000m^3 Circular Dams, Bulletin No 4352, Dept of Ag WA.
- Farm Dams, Basic Soil Tests, 1994, Factsheet W34, Dept of Natural Resources, QLD,

Tanks: Earthen, Steel and Plastic

The key use of tanks is the provision of storage for a water point. There are three main types of tanks in use in the Kimberley:

1) **Traditional earth tanks,** such as the "turkey nest" style of construction, which can be built with minimal machinery and at a reasonable cost. Earthen tanks can only be built where suitable clay soils are present. Evaporation and seepage losses increase the amount of water that needs to be pumped into the tank. They do have the advantage of a large storage volume and low cost per litre.
2) **Steel tanks**, such as the "settler style" tank, which are constructed on site. Many are fitted with liners to improve water quality, reduce corrosion and extend tank life.
3) **Plastic tanks** are now widely used as they have lower purchase price and location costs. These tanks must be installed correctly to reduce failures. A level compacted sand pad must be constructed prior to installation and outlet pipes supported so as not to stress the walls. Plastic tanks also require a greater level of protection from fire (by keeping grass/weeds down) and from wind damage (by anchoring and/or keeping the tank full). The use of fibreglass tanks is still a good option but they have largely been replaced by plastic.

Many pastoralists can quote bad experiences with a failed tank, and these experiences can influence future decisions. Such failures could be due to:

- Poor pre-installation handling;
- Poor installation;
- Post installation damage (fire, vehicle or animal impact);
- Faulty materials and manufacturing;
- Age of the tank.

Consider the cost of installation, the expected lifespan and the maintenance costs to make sure that a suitable tank is selected for a given situation.

Telemetry

The concept of telemetry (i.e. remote monitoring and control) for stock water is not new, but has only recently been considered as an affordable option for assisting in water point monitoring and management. Commercial technology is now available "off the shelf".

Telemetry uses digital and/or analog sensors to monitor and control water points. Information is transferred to a central monitoring station that can either be a display in a vehicle and/or at the homestead. The link can be via radio, telephone or wire. Sensors can monitor water levels, flow rates and pump running times, as well as visual monitoring using a video camera. Telemetry can also be used to turn pumps on and off, but they will need to be modified so that the telemetry unit can communicate with it.

The initial set-up costs of telemetry must be evaluated against the reduction in the number of bore runs to check and start the bore. Provided the telemetry system is reliable, the costs involved in setting up the system may be recouped in a relatively short period.

Further Reading:

- Remote Stock Water Monitoring, Sep 2002, P. Price, Northern Pastoral Memo, DAWA
- Emerging Metering Technology-Dataloggers & Telemetry, 2004, Factsheet W87, DNR, QLD

Section 2: Exercises

Summary of Exercises

The table below summarises the exercises in this Workbook and the Excel files used. The spreadsheet files are located on a Compact Disc (CD) located in this folder.

Exercise Number	Title	Main Resource
1	Length of a Bore Run	File: Stock water exercise 1 to 4.xls
2	Costs of a Bore Run Vehicle	As above
3	Running Water Costs	As above
4	Total bore Run Costs (based on exercises 1,2,3)	As above
5	Customise the Data to Your Station	File: Stock water exercise 5 to 7.xls
6	Paddock by Paddock Assessment	As above
7	Different Bore Run Cost Scenarios	As above
8	Water Subsidies	Appendix 2
9	Grazing Circles to Assess Water Supply	Station Map
10	Station Access Tracks	Station Map
11	Trap yard Design	Other Publications
12	Identify areas of highly productive land	Station Map
13	Salinity of stock water	Appendix 4
14	Identify Areas for Water Developments	Station Map
15	Business Planning	Station Business Plan
16	Review the Costs of an Example Bore	File: "Stock water exercise 16 to 18.xls".
17	Locating New Waters	Paddock map
18	Calculate the Costs & Benefits of Developing 4 New Water Points	File: "Stock water exercise 16 to 18.xls".
19	Calculate the Costs & Benefits of Developing 2 New Water Points	File: "Stock water exercise 19.xls".
20	Assess Water Point Developments on Your Property	File: "Stock water exercise 20.xls".

Managers who are interested using these files may choose to create a subdirectory named "stock water" so that they can save the above exercises and any of their own customised spreadsheets onto their hard drive.

For assistance with exercises and various spreadsheets please direct your enquires to:

Francis Bright, ph 9166 4016, or email: fbright@agric.wa.gov.au

Costs of a Bore Run

Maintaining adequate quantity and quality of water to cattle is crucial in managing a station, and the bore run is the backbone of this. Most pastoral businesses spend a substantial amount of money on the bore run, but many managers do not know what it costs them, and they may be surprised at the high cost of providing stock water.

It should be noted that the annual running costs of stock water are a maintenance cost and do not actually improve the property capital value. Station managers have a natural tendency to defend their high bore run costs by saying that other jobs are done along the way, but do these jobs need to be done two, three, four or even five times a week?

It is often difficult to calculate bore run costs by looking at station expenditure, as the costs are usually hidden in the overall station budget. An alternative method is to estimate the costs to provide stock water. The workbook will step you through a worked example in the file **"Stock water exercise 1 to 4.xls".** A printed copy of this spreadsheet is located in Appendix 1. The file **"Stock water exercises 5 to 7.xls"** then allows you to modify costs to suit your situation.

The cost of maintaining stock water is made up of the following components:

- Vehicle costs.
- Labour;
- Parts;
- Pump fuel

The cost of running a vehicle is largely defined by the distance travelled each year. So we will look at this first in the following example

EXERCISE 1: Length of a Bore Run
Load the file **"Stock water exercise 1 to 4.xls"**. View the "Length of a Bore Run" spreadsheet, which calculates the annual distance travelled in bore run.

Tip: Three methods of estimating distance are provided. The spreadsheet can use one or an average of all three.

Pastoralists indicated that wear and tear on vehicles is very high. Station tracks can be rough, so parts like wheel bearings, batteries, shock absorbers and tyres are regularly replaced. In addition, heavy loads are carried which substantially increase the running cost. All the spares, fencing wire, highlift jack, drinking water and other gear increases the gross vehicle weight. For example just a full 200-litre fuel drum, increases the net vehicle weight by around 10%.

Many pastoralists stated that the best vehicle in the business was allocated to the bore run due to importance of providing stock water. It is not uncommon for a bore vehicle to last only 2-3 years before being "retired" to another part of the business. This results in substantial vehicle depreciation costs over a short period of time.

EXERCISE 2: Cost of a Bore Run Vehicle
View the "Vehicle costs" spreadsheet, which calculates the cost of a bore run vehicle

☼ **Tip:** Running costs for a vehicle are more then just fuel, tyres and services. Costs for a mechanic to service the vehicle need to be included (or if you do it yourself remember your time should be costed too). Rounding down vehicle costs at this stage may lead to a substantial underestimate of the real costs of maintaining stock water.

☼ **Tip**: Don't forget about other vehicles that may be used in addition to the bore vehicle.

How much did it cost to run the bore vehicle for a kilometre? In this example, running costs are calculated to be 73c per km. When this rate is multiplied by the total distance travelled from Exercise 1, the total bore vehicle works out to be $36,500 per annum.

The next exercise will assess the running costs of different types of waters.

EXERCISE 3: Running Water Costs
View the "Running Water Costs" worksheet.

☼ **Tip:** Careful thought needs to be applied to what it really costs to do the job. For example how often do pump engines need replacing?

To see how the water running costs compare to the vehicle expenses, use the fourth worksheet to compare where the money goes.

EXERCISE 4: Total Bore Run Cost
View the "Total Bore Run Cost" worksheet to assess the various components of a bore run.

☼ **Tip:** Look at the subtotals of each cost area; which one is the most expensive?

In this example the total cost of stock water was $85,386 of which vehicle costs made up 43% of costs. Now that you have a basic understanding of how the spreadsheets operate you can use your own data.

EXERCISE 5: Customise the Data to Your Station
Load the file **"Stock water exercises 5 to 7. xls"**, enter your data into the yellow boxes.

☼ **Tip:** Save the spreadsheet to a new file name using "save as" before making changes. It will help to keep track of computer files if you use a logical file name when saving a new file, use something like the station name and the date e.g. westerndowns dec04.xls.

- Does your bore run cost more than you expected?
- How does your cost per water compare to the example?
- How does your vehicle costs per kilometre compare to the example?
- Can you explain any differences in vehicle costs by the state of your access tracks?

Another way to consider vehicle costs is what it costs to operate a vehicle for a single bore run. The table below shows the range of vehicle costs for one bore run. Note the costs below do not include the costs of maintaining the stock water (starting pumps, refuelling, cleaning troughs) or the labour cost of sitting in the truck whilst travelling.

	Cost of operating bore run vehicle per Km						
Km/trip	$0.50	$0.75	$1.00	$1.25	$1.50	$1.75	$2.00
50	$25.00	$37.50	$50.00	$62.50	$75.00	$87.50	$100.00
100	$50.00	$75.00	$100.00	$125.00	$150.00	$175.00	$200.00
200	$100.00	$150.00	$200.00	$250.00	$300.00	$350.00	$400.00
250	$125.00	$187.50	$250.00	$312.50	$375.00	$437.50	$500.00
300	$150.00	$225.00	$300.00	$375.00	$450.00	$525.00	$600.00
350	$175.00	$262.50	$350.00	$437.50	$525.00	$612.50	$700.00
400	$200.00	$300.00	$400.00	$500.00	$600.00	$700.00	$800.00
450	$225.00	$337.50	$450.00	$562.50	$675.00	$787.50	$900.00
500	$250.00	$375.00	$500.00	$625.00	$750.00	$875.00	$1,000.00

When vehicle and water maintenance costs are combined the average cost is usually $3,000 - $7,000 per water per year. An overall station average is deceptive in that there may be large variations in the water management costs between paddocks. For example, it is cheaper to run a water point next to the homestead than an isolated bore. It is worthwhile breaking down your costs on a paddock by paddock basis to look at which parts of the business are making the most money. For example, does stocking backcountry make, or lose money? Paddock by paddock assessments will also be used later to plan water developments for a station.

EXERCISE 6: Paddock by Paddock Assessment
Use the spreadsheet to compare costs for different paddocks on your property.

Tip: Save each spreadsheet to a new file name using "save as" for each paddock.

The spreadsheets can also be used to see the effect of a change in a cost, for example fuel costs increasing 5 c/L, or the types of water point infrastructure installed.

EXERCISE 7: Different Bore Run Cost Scenarios
Try running different scenarios (eg doing one less bore run per week) and using a range of costs (eg increase vehicle cost/km) to see what their effect are on overall cost.

The results from Exercise 7 demonstrate how the total cost can "blow out" with a slight increase in one cost. For example, an increase in diesel prices increases vehicle costs, fuel bills for pumps and freight for spare parts. Remember what cost increases do to the profitability of your business!

With these increases it is natural to start looking for ways to reduce costs, especially of high cost items. The highest costs item is usually the vehicles, plus the labour sitting in it, due to the long distances of bore runs. However, it is recognised that most stations already have their maintenance program well tuned so there is little scope to save money in this area. It is also difficult to reduce water maintenance costs by simply reducing the number of trips without jeopardising the reliability of stock water. Failed waters may result in the loss of cattle and reduced herd productivity.

The key strategy for decreasing water maintenance without affecting reliability is investing in appropriate infrastructure for each water point. In other words, spending money on upgrading infrastructure to reduce running costs. We will now look at how investment in efficient and reliable water points can affect your business.

Ways to Reduce Watering Costs

Many people say that they cannot afford to redevelop old stock water points, and would rather develop new ones. However as you go through the exercises in this workbook you will be able to calculate the high annual costs of these old and inefficient waters. Such costs can inhibit your financial ability to develop new waters.

Some of the key components to an efficient and a cost effective maintenance program are:
- Well maintained roads to decrease travelling time and vehicle running costs.
- Well laid out ring roads that pass a series of water points to reduce travel distances.
- Reliable water points to reduce the number of special repair trips.
- Use of solar in areas where wind can be unreliable, to reduce fuel bills for pumps.
- Tank volumes that have adequate storage (3 - 5 days) if the pump fails.
- Backup pumps that can be used for an emergency.
- Installation of dams in remote locations to reduce the need to visit.
- Use of telemetry to start pumps and monitor water flow, reducing the need to visit.
- Maintenance of sustainable stocking numbers on a water point to minimise damage.
- Having waters close enough together so that if one does fail then cattle can move to an alternative source.

Whilst the introduction of these components may initially cost more, they can save money in the longer term due to lower operating expenses. To help reduce the extra cost of efficient water points, consider applying for any subsidies that may be available to you. Two examples are the Pastoral Waters Grants Scheme and the Renewable Energy Water Pumping Program.

EXERCISE 8: Water Subsidies
Read the information on water subsidies located in Appendix 2.

Tip: Check records to see if the station has received previous assistance, as this may affect your eligibility for further assistance.

Components of Decision Making

Discussions with pastoralists revealed that there were a number of factors that influenced their decision to invest in a new water point. These factors can be grouped into the three categories of present infrastructure, geography and business issues.

Present Infrastructure

a) Location relative to the main business operation: Pastoralists generally outlined on their station maps where the bulk of the herd was being run. They said that they concentrated their efforts on fully developing that part of the lease first. Investment in water points in remote areas of the lease were considered as a lower priority.

b) Current water distribution: The utilisation of pastures around a water point is highest close to the bore and decreases as you move away from it. There is no specific point at which you can say that there is no grazing, but at a distance of about 5 km from the bore is about the point where the energy expended walking there is often greater than what they would be gained from grazing there. To be productive you therefore want the majority of grazing to be within about 3 km of the water point. You can use your station map to estimate the proportion of your lease that is productively grazed by drawing grazing circles on the map, using the water point as the centre of the circle.

EXERCISE 9: Grazing Circles to Assess Water Supply
Draw grazing circles around the water points on your station map. What proportion of your lease can be grazed with the existing water points? Are there gaps that have high potential productivity but have no water?

☼ **Tip:** Grazing circles of 3 km radius are commonly recommended. Set the compass using the scale bar on your map, then draw the circles on the map using the water point as the centre point. Alternatively your local Department of Agriculture Mapping Officer may be able to arrange these on a map for you.

☼ **Tip:** The area grazed within a 3 km grazing circle is 28 square kilometres. Don't forget to halve areas for water points on boundary fences.

There may be some areas between current waters that are not utilised which could benefit from a "fill-in" water point. If this new water can be maintained as part of the existing bore run, there are no additional vehicle costs to maintaining it. Alternatively if the new water point is in a part of the lease that has no other stock waters there will be substantial costs of track grading and vehicle operating costs. In such areas it needs to be determined if the increase in cattle numbers making use of new areas of pasture will generate sufficient income to outweigh the costs.

c) Public roads. Property frontage to major public roads influences the location of new water points. Some advantages to installing waters close to major roads are improved wet season access and cheaper travel for servicing. These roads also have the disadvantages of cattle mortality from vehicle impacts and the increased exposure to cattle theft.

Reticulation may allow a bore to be located near a public road for easy access, but for the water to be pumped to a trough remote from the road to protect the cattle. It is important to weigh up the costs of stock losses over the years versus the initial cost of the reticulation. For example the income forgone from the loss of two cows and their calves per year may be more than the cost of buying and laying one kilometre of pipe.

d) Access tracks. The state and location of access tracks greatly influences the bore run costs. If access is difficult, such as across country that washes badly, then additional maintenance may be needed to get cost effective access to the water points. Alternately, if a track remains boggy well into the Dry it needs to be assessed if the upfront costs of re-routing or gravelling are less than long term costs of poor access. Such factors could influence where a new water point is located and what kind of water point is used.

EXERCISE 10: Station Access Tracks
What is the state of existing access tracks on your station? How many water points are on a terminating branch road? Is it possible to grade an access track that passes all water points in one paddock?

☼ **Tip**: Use different colour highlighter pens on your station map to identify the quality and seasonality of the roads.

e) Other infrastructure: A new water point is part of a larger network of other infrastructure. For example if the new water point is in an isolated area it may be more economic to muster it by using a trapping facility which may be different to other parts of the lease. Trapped cattle could enable a monetary return from an area that is not economic to muster due to a low density of cattle. The returns from trapped cattle may generate extra income that could be used for further development of the new area, which may then make it economic to aerial muster once fully developed.

EXERCISE 11 (optional): Trap Yard Design
Read up on trap yard design & Total Grazing Management (TGM).

☼ **Tip:** Below are three Department of Agriculture, WA publications
TGM Yards, Farmnote, No 22/03, DAWA,
TGM Results & Observations from the Pimbee Station Trial, Misc Public 14/98, DAWA
TGM Field Guide, Bulletin No 4546, DAWA

Geography

a) Remoteness from homestead: Remote areas may still have production potential but the location affects the type of water point used. Pastoralists preferred low maintenance options such as a walk-in dam or a windmill/turkey nest combination in remote areas. Perhaps another option is to utilise telemetry to save the cost of travelling there each time water needs checking or pumping.

b) Carrying capacity: Some pastoralists stated that they would not invest in a high maintenance water point in low productivity country. The most common choice in these areas was a low maintenance walk in dams, if soil types and topography were suitable.

EXERCISE 12: Identify Areas of High Carrying Capacity
Sketch the areas of highest carrying capacity onto your station map, use a hatching or light shading to highlight these areas or use an overlay of clear plastic. What proportion of these high productivity areas are currently being grazed (i.e. are within a grazing circle)

☼ **Tip:** The landsystems are an indicator of carrying capacity; if you do not have a map with them marked, contact your local Department of Agriculture Mapping Officer.

c) Depth to water: The depth to water influences the type of water pumping system. Deep holes require a diesel or windmill, whereas shallow holes can use any type of pump. Pastoralists stated that the majority of their bores were less than 30 metres deep.

d) Salinity: In some parts of the Kimberley, a saline water table can be a problem. Cattle will consume water sources of marginal salinity, but they will need to drink a greater volume and drink more often. This limits cattle performance by reducing both the time spent grazing and the distance from the bore that they will travel to graze. Salinity can be further increased by evaporation of standing water such as in tank overflow pools, from which cattle may drink.

Pastoralists stated that in some productive areas the water table was unfit for stock consumption, so alternative sources of stock water had to be developed. For example, water could be pumped from good bores to good grazing areas using reticulation.

EXERCISE 13: Salinity of Stock Water
What is the salinity of each of your waters? Consult the salinity chart in Appendix 4 to see how suitable they are for stock

☼**Tip:** Salinity may be recorded in the bore drilling notes or water log book; however it may change over time. It is worth checking salinity by testing it with a salinity meter (also known as a conductivity meter).

☼**Tip**: For more information read,
Water quality for farm, garden and household use, DAWA, Farmnote 41/2004,
Livestock and water salinity, DAWA, Farmnote 59/88.

e) Country type: The country type (land system) influences what type of water point pastoralists put in. For example not all soils are suitable for dams. Whilst steep country may reduce access to some areas making unsuitable for investment in new water points.

EXERCISE 14: Identify Areas for Water Developments
Identify undeveloped areas of suitable topography. Are there areas that have a good topography, that is easily accessible, a high potential carrying capacity, and have good potential sources of water that are not being fully utilised in your business?

☼ **Tip:** Such areas could be the focus of your water infrastructure investment plans.

Business Issues

a) The business plan: Investing in a new water point is not a decision to be taken lightly as it can be expensive initially, but there can be considerable benefits in the future if the right decision is made. Does the investment in new stock water infrastructure fit within the development objectives of the business plan?

EXERCISE 15 (optional): Business Planning
Read your business plan to familiarise yourself with its goals. If you don't have a business plan, consider developing one for your company and/or family.

☼ **Tip:** When developing a business plan consider who may be available to help you such as a Development Officer from the Department of Agriculture, or a consultant. Also consider doing a structured business or grazing management course.

☼ **Tip:** Only progress with water point developments if they are a high priority objective of your business plan.

b) Capital sources and expenditure: A Decision needs to be made about how investing in new water points can be financed by the business. Infrastructure investments can be funded from either operating surpluses or by borrowing capital. Pastoralists' attitudes to debt vary considerably, which will influence how infrastructure investments are financed.

Both the cost of capital and interest repayments needs to be considered if borrowing money for water point infrastructure. Another area that needs to be assessed when borrowing money is the effect of a decrease in beef prices and/or interest rate increases on any borrowings. This is best done in a development budget that also considers the below variables:

- Initial capital required;
- Annual expenditure;
- Fixed costs; and
- Expected returns.

These variables will be assessed in the following exercises.

Benefits and Costs of New Water Points

One of the aims of this workbook is to indicate the likely benefits and costs of investing in water points. The following exercises are tools for managers to use as part of the decision making process.

Some points that need to be considered during these exercises are:

The benefits:
- ✓ The expected income from turning un-utilised grass into kilograms of beef sold
- ✓ Pasture utilisation over a larger area of the lease, or better utilisation of existing areas
- ✓ Better herd productivity or increased herd numbers due to more pasture being accessible
- ✓ Reduced reliance and impact on natural waters.

The capital costs:
- ✓ Capital outlay for the water point
- ✓ Construction of access roads
- ✓ Construction of associated infrastructure such as fencing and trap yards
- ✓ The cost of breeding up additional stock, including buying or breeding bulls

The annual costs:
- ✓ Maintaining access tracks
- ✓ Water maintenance costs
- ✓ Adding distance and time to the bore-run; increasing labour, fuel and vehicle costs
- ✓ Extra variable costs for the additional stock (eg supplements)
- ✓ Non cash costs, including depreciation on fittings and vehicles
- ✓ Increased labour.

Developing Waters in a Paddock

When considering the management and development of water points, pastoralists may like to assess needs on a paddock by paddock basis. The advantage in using this system is that it helps to identify whether it is worthwhile investing in water points in a particular paddock. It may also be used as a guide to determine which paddock has the greatest return for the investment in a new water point.

Many stations in the north of WA have a central area of production that is nearly fully developed and several backcountry paddocks that may have intermittent natural waters and the occasional isolated bore. For a variety of reasons the isolated bores often end up with too many cattle on the one water and this can lead to poor productivity and overgrazing around the bore. This, in turn, can cause increased mortality, lighter sale weights and long term environmental issues. These isolated bores tend to be expensive to run and therefore worthy of investigation

In this exercise we will assess what it currently costs to run an isolated water point and how much return it makes for the business. Then we will look at the cost of installing new water points into the paddocks spreading the cattle more effectively and how the developments affect the cost of the water maintenance program.

EXERCISE 16: Review the Costs of an Example bore
The calculations for this example are located in the Excel file **"Stock water exercise 16 to 18.xls"**. Follow through the spreadsheet **"Existing water"** as you read the below paragraphs.

☼ **Tip**: whilst you may disagree with some of the base numbers used in this example, they are constant throughout, so comparisons can be made across the different development options.

☼ **Tip:** Do not change the spreadsheets at this stage. This can be done in Exercise 20.

Let's look at an example of a make believe station which is located in the middle of the Kimberley region where winds are light and pastures are of a moderate to low value. It has a 200 square kilometre paddock that on average has low carrying capacity (3 head per square km); it has one operational bore and no surface water. The manager would like to know:

1. How much does the paddock produce (gross return)?
2. What it currently costs to run this water point?
3. Is it worthwhile investing in further water points for this paddock?
4. How many water points in the paddock?
5. What type to use? This is decided by what will they cost to build and run, and their returns?

1) What is the current gross return?
The existing windmill driven bore, with diesel backup, is currently in the centre of the paddock. Within the paddock, which is adequately fenced, there are 285 breeders, with 5% bulls and a 65% branding rate. They muster 157* calves per year, that are sold for $272 per head, which works out to be $42,636 worth of cattle sold. The basic costs of production (eg mustering, lick block, drench, transport and fixed costs) are estimated to be $170 per head (or $1.00 per kg).

2) What are current costs to run water?
In this example there is a 14 km return trip undertaken 3 times a week for 9 months of the year at a cost of $1.00/km whilst travelling on average 60km/h. On average half an hour of work is done on the water point per trip, with $1,000 maintenance cost per year and the diesel is run for about 3 months of the year using about 900 litres of fuel at $1.00/litre (includes cost of transport to pump).

The costs are summarised below:

Vehicle costs	$ 1,512
Labour	$ 1,548
Diesel for pump	$ 900
Pump maintenance	$ 1,000
Total cost	**$ 4,796**

3) Is it worthwhile investing in further water points for this paddock?
The cost to maintain the water alone in this paddock is $4,796 which is over 10% of gross income! The combined fixed and variable costs of this water point and the low rate of return from animal sales mean that it would not take a very large increase in costs (eg fuel or labour), or a decrease in income (eg calf mortality or a price decrease) to potentially lose money.

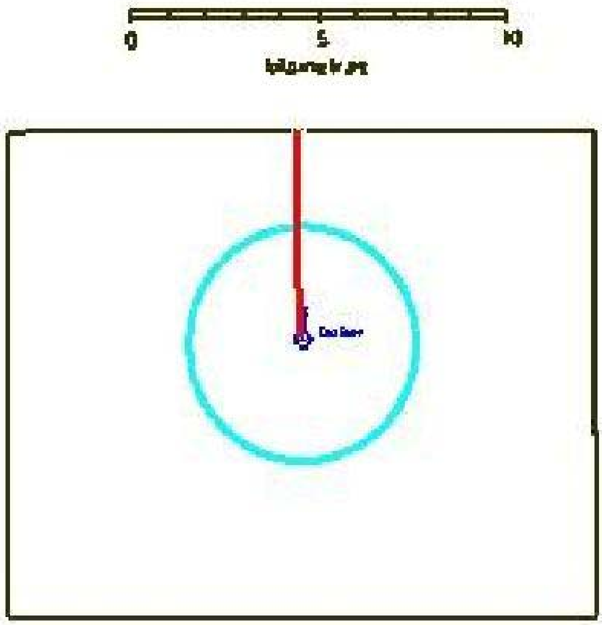
There are two ways to improve the profitability of the paddock; either
1. Minimise the costs, or
2. Install more water points so that more cattle can be run. A grazing circle, centred on the current bore with a radius of 3 km will allow only 14% of the total area of the paddock to be effectively grazed.

The pastoralist has already minimised their costs, and wants to expand production in underutilized paddocks, so therefore decides to invest in new water points.

4) How many waters would be best suited for this paddock?
The paddocks carrying capacity is 3 head per/km^2 over 200 km^2, which works out to be a maximum of 600 head of breeders (assuming continuous stocking, standard management practices and average season). To stock the paddock fully and achieve less than 300 breeders per water at least one new water point would be required. The actual number of water points can only be considered once the shape of the paddock and the landforms are taken into account.

**Footnote: even though only half of these would be saleable steers, we will consider heifers to be sold as they would be moved to a different paddock, and therefore a different part of the business.*

Example Paddock with one bore and a 3 km radius grazing circle



Looking at the map of the paddock, one new and the one existing water would not utilise the pastures in an effective manner. It is a square paddock with the water point in the centre of the paddock; therefore four new water points would make water distribution more even across the whole paddock. The most accurate way to assess this is to draw grazing circles on to the map.

EXERCISE 17: Locating new water points
Draw the location of the 4 new water points and grazing circles on the map.

Tip: Use the scale bar to set your compass to 3 km then draw a grazing circle around the proposed bores. Your four circles should look like the circle for the existing bore, and their edges should just cross over.

From your grazing circles you can see that an even distribution of 5 water points achieves good coverage of the paddock. Your map should look something like the one shown in Appendix 7.

On average only 600* breeders can be supported by the paddock, but if these are spread evenly over the five waters, it is 120 head per water. This lower number of head per water reduces the grazing pressure around the water, which may improve herd productivity. Some might think that this is an excessive number of waters to install into a paddock, but there is a balance between water distribution, pasture production, pasture utilization and improved herd performance. In a later section we will run a second development example with less additional waters.

**Footnote This is a carrying capacity figure, so the actual stocking rate figure could be higher on above average season or lower on below average season, but on average the stocking rate should match carrying capacity.*

5: What type to use, what will they cost to build and run and what are the returns?

The development goal is to have a total of 5 waters (4 new + 1 old). However we must compare the costs of various infrastructure options to determine which to use. In this example we will compare 4 different types of infrastructure options. This will allow comparison of their initial construction costs and maintenance costs over time of the different options. The four options are to invest in:

- Standard bores.
- Monitored bores.
- Reticulated troughs serviced from the existing bore.
- Walk in dams.

EXERCISE 18: Calculating the Costs and Benefits of Four New Water Points
Review the four spreadsheets outlining the four different infrastructure options to see how the construction and running costs compare.

☼ **Tip** The end result of the exercise can be found in the sheet labelled "financial summary". A graphical representation of the breakdown of costs is shown on the worksheet "graph of costs"

The spreadsheets use the existing herd performance and water maintenance costs, and then extends these to the four different infrastructure scenarios. This estimates the costs and incomes for the paddock. A summary of these are included below

Summary of 5 waters in the paddock

	Existing water	Bores	Telem bores	1 Telem bore + Retic troughs	1 Telem Bore + Dams
annual vehicle costs	$1,512.00	$4,320.00	$1,440.00	$1,440.00	$1,440.00
labour cost	$1,584.00	$6,840.00	$2,280.00	$1,380.00	$1,380.00
diesel for pump	$900.00	$4,500.00	$4,500.00	$2,700.00	$900.00
cost of repairs	$800.00	$4,000.00	$4,000.00	$1,600.00	$1,600.00
development cost (over 20y)	$0.00	$10,000.00	$10,500.00	$5,250.00	$8,410.00
Total of Water costs	**$4,796.00**	**$29,660.00**	**$22,720.00**	**$12,370.00**	**$13,730.00**
turnoff (No stock)	157	380	380	380	380
turnoff (kg)	26648	64643	64643	64643	64643
Income	$42,636.00	$103,428.00	$103,428.00	$103,428.00	$103,428.00
Variable costs	$26,647.50	$64,642.50	$64,642.50	$64,642.50	$64,642.50
gross margin	**$15,988.50**	**$38,785.50**	**$38,785.50**	**$38,785.50**	**$38,785.50**
gross margin	$15,989	$38,786	$38,786	$38,786	$38,786
(minus) water costs	$4,796	$29,660	$22,720	$12,370	$13,730
Net Margin of Development	**$11,193**	**$9,126**	**$16,066**	**$26,416**	**$25,056**

The main financial advantage of investing in more water points is the increased returns from running more cattle in the paddock and the improved herd performance of lower numbers of stock per bore. Both of these factors can combine to increase the gross margin, but only if the returns increase more than the costs. It is therefore important to note the relative costs of different types of water points; e.g. four new standard bores are more expensive to install and run than four new walk in dams.

The bottom line of the above table, labelled net margin of development, is the measure of the returns from each option. There are some substantial differences between the different development options. For example 5 bores does not make that much extra money for the paddock compared to the existing bore, whilst the best option more than doubles the profit from that paddock.

The investment in 4 new water points in the hypothetical paddock may be considered too many - what happens if only 2 new water points are installed?

EXERCISE 19: Calculating the Costs and Benefits of Two New Water Points
The calculations for this example are located in the Excel file **"Stock water exercise 19.xls"**. This file uses the same data as for exercises 16 to 18, except less waters are being developed. For example it reduces the number of water points and distances travelled. Compare the table in the "financial summary" to the one above. Which option has made more money?

Summary of 3 waters in the paddock

	Existing water	Bores	Telem bores	1 Telem bore + Retic troughs	1 Telem Bore + Dams
Annual vehicle costs	$1,512.00	$2,160.00	$720.00	$720.00	$720.00
Labour cost	$1,584.00	$3,960.00	$1,320.00	$780.00	$780.00
Diesel for pump	$900.00	$1,800.00	$1,800.00	$2,700.00	$900.00
Cost of repairs	$800.00	$1,600.00	$1,600.00	$1,600.00	$1,200.00
Development cost (over 20y)	$0.00	$6,500.00	$6,800.00	$2,700.00	$5,810.00
Total of Water costs	**$4,796.00**	**$16,020.00**	**$12,240.00**	**$8,500.00**	**$9,410.00**
Turnoff (No of stock)	157	380	380	380	380
turnoff (kg)	26648	64643	64643	64643	64643
Income	$42,636.00	$103,428.00	$103,428.00	$103,428.00	$103,428.00
Variable costs	$26,647.50	$64,642.50	$64,642.50	$64,642.50	$64,642.50
Gross margin	**$15,988.50**	**$38,785.50**	**$38,785.50**	**$38,785.50**	**$38,785.50**
Gross margin	$15,989	$38,786	$38,786	$38,786	$38,786
(minus) water costs	$4,796	$16,020	$12,240	$8,500	$9,410
Net Margin of Development	**$11,193**	**$22,766**	**$26,546**	**$30,286**	**$29,376**

Looking at the bottom line of the two new waters option the competitiveness of the standard bores has improved markedly, whilst the other examples have only improved slightly when compared to the 5 waters option. The reasons for these differences between standard bores and lower maintenance water options relates back to inefficiency of standard bores in today's high fuel and labour cost environment.

It should be noted that just because installing and running two new waters was generally cheaper in these two scenarios, there are also noncash benefits of the 5 waters option that can not been valued in the spreadsheets. Some of these are summarised below:

1 The investment in infrastructure has increased the "capital value" of this paddock and therefore the value of the station as a whole.
2 If there is a major failure of one water point, there are now four fallback water points.

3 Alternative grazing strategies are possible such as rotating stock between water points (by turning off waters or by electric fencing) allowing for pasture spelling.

The above are hypothetical examples designed to demonstrate how to assess the economics of water point developments. Managers can input their own information into the spreadsheets to see how their own development plans stand up to economic assessment.

EXERCISE 20: Assess Water Point Developments on Your Property
Load the file **"stock water exercise 20.xls"** and modify the cost inputs and stock figures to represent a paddock on your property.

🔔 **Tip:** Save the spreadsheet to a new file name each time you trial different scenarios so you can make comparisons between them.

🔔 **Tip:** Remember the cells you can modify are marked in yellow.

Conclusion

In conducting the research for this Workbook, it became clear that each pastoralist has his or her own preferences on the type of water point infrastructure they will use, based on their past experience rather than on economics. This element of human preference is a major factor that cannot be accounted for in any economic modelling. This is one of the reasons why this Workbook uses tools to improve the level of understanding of what water points cost the business. It is hoped that these tools will allow you to consider other infrastructure options for your business even though you may not have had extensive experience with all of them.

The spreadsheets you created in exercises 5, 6, 7 are basic budgeting tools which can help pastoralists understand their current business. The spreadsheet in exercise 20 extends this information to planing for future developments. Theses spreadsheets are a starting point of stock water budgets that people can refine over time as they track true expenditure. It will only be after a few years of data that they will truly represent what you spend on water.

The information the spreadsheets record and calculate can also be used as input into cash flow budgets, development budgets, various investment/project decision support programs, or be provided to an agricultural consultant for their use on your behalf

Whilst some background information on water points has been outlined in this Workbook, there are also other sources of information that pastoralists should seek out. Pastoralists who are considering investment into stock water are urged to source as much information as possible so they are aware of the latest product and pricing information. Information can be sought from the references mentioned in this Workbook, as well as from the internet, suppliers, contractors, various government departments and other pastoralists.

It is hoped that this Workbook has fulfilled the aim of demonstrating that decisions about water point infrastructure require a lot of thought. Each situation should be evaluated on its merits using the best information and advice available. The underlying message from the Workbook is that without reliable and cost effective water supplies for stock, the potential for a viable and sustainable pastoral business can be limited.

Should you have any comments about the information or exercises in the Workbook, you are encouraged to contact the authors so that improvements can be made for future updates. Your feedback will ensure that the Workbook will remain a valuable tool for pastoralists to use for many years to come.

APPENDIX 1 – Examples of Exercises 1-4

Exercise One: Length of a bore run

Exercise 1: Estimating the length of a Bore Run	
yellow boxes are for input data	
Use one or all three of the below methods to estimate the annual distance traveled for maintaining stock water	

Method One	
your estimate (km)	50000

Method Two	
boreman's estimate (km)	50000

Method Three, map method	
part 1: standard run	
length of Bore run (km)	220
number runs per week	5
number of months	9
distance/year (km)	39600
part 2: special trips	
length of special trip (km)	100
number runs per week	2
number of months	10
distance/year (km)	8000
Total (part 1+part 2) =distance per year (km)	**47600**

Average of the three methods (km)	**49200**
The figure you want to use (km)	50000

Exercise Two: Costs of a Bore Run Vehicle

Base Information		annual total	
Number kilometers per year (from exercise 1)		km/y	50000
cost of labour, mechanics($$/h)	20	fuel used (L)	11000
off road fuel economy (L/100km)	22	fuel used $$	**$12,100.00**
Fuel	$1.10	$$ fuel/km	**$0.24**

Vehicle setup costs	unit cost	number units	No hours work	Total
vehicle purchase	$45,000.00	1	6	45120
tray & bar work modifications	$3,000.00	1	10	3200
UHF radio	$500.00	1	2	540
other fit out costs	$500.00	1	1	520
other costs				0
Total setup costs				$49,380

cost of setup funds (7% interest)	**$3,456.60**
$/km	$0.07

Vehicle Salvage		
Vehicle Life	km	200000
salvage value	$$	10000
Vehicle Life	years	4.0
total depreciation		$39,380
Depreciation per year		**$9,845**
$ depreciation/km		$0.20

General running costs	unit cost	number units	Annual hours of work	Total
Tyres (No used per year)	$ 250.00	10	5	2600
tubes	$ 25.00	10	1	270
puncture repairs	$ 5.00	10	10	250
battery	$ 170.00	1	1	190
shock absorbers	$ 80.00	4	1	340
brake liners front	$ 150.00	1	1	170
brake liners rear	$ 150.00	1	1	170
springs	$ 150.00	2	2	340
bushes (complete set of 32)	$ 200.00	1	5	300
wheel bearings (complete set)	$ 200.00	1	5	300
exhaust repairs	$ 150.00	2	2	340
Fan belt replacements	$ 15.00	4	4	140
timing belt replace (100000 km)	$ 200.00	1	3	260
windscreen replacement	$ 300.00	1	2	340
other breakdowns (average cost)	$ 500.00	2	4	1080
licensing	$ 250.00	1	0.5	260
insurance	$ 2,000.00	1	1	2020
other				0
Total general costs				**$9,370**
Total general/km				**$0.19**

Exercise 2: continued

service 5000km	**unit cost**	**number units**	**No hours**	**Total**
grease	$ 10.00	1	0.5	20
oil (10L)	$ 30.00	1	0.5	40
oil filter	$ 30.00	1	0.25	35
air filter	$ 30.00	1	0.25	35
total Labour			1.5	30
cost per service ($)				130
Number of services per year				5
minor service cost per year				$650
service 10000km	**unit cost**	**number units**	**No hours**	**Total**
grease	$ 10.00	1	0.5	20
oil (10L)	$ 30.00	1	0.5	40
oil filter	$ 30.00	1	0.25	35
air filter	$ 30.00	1	0.25	35
transmission oil (7L)	$ 30.00	1	0.25	35
transfer case oil (3L)	$ 20.00	1	0.25	25
diff oil (2 x 4L)	$ 30.00	1	0.25	35
Labour			2.25	45
cost per service ($)				225
Number of services per year				5
major service cost per year				$1,125
Total of services				**$1,775**
cost of service/km				**$0.04**

total annual running cost (add up cost totals in BOLD)	**$36,547**
cost per km ($$/km) = total cost divided by number of annual km	**$0.73**

Exercise Three: Running Waters costs

	Exercise 3: Running Station Waters yellow boxes are for input data Water Point Details	
solar	number solar	5
	cost repairs per solar ($/y)	500
	total	$2,500
diesel	number diesel	6
	cost of repairs per diesel ($/y)	1140
	total cost of diesel for bores($/y)	2500
	total	$9,340
mills	number windmills	4
	cost of repairs per windmill ($/y)	200
	total	$800
dams	number of dams	3
	cost of repairs per dam ($/y)	400
	total	$1,200
troughs	number of retic troughs	0
	cost of repairs per trough ($/y)	100
	total	$0
	total number of waters	18
	total cost of water ($)	$13,840

cost of repairs	
replacement cost ($)	4000
lifespan	10
annualised replacement	400
cost of service ($)	30
No of months operated	9
No of services per month	2
annual service cost ($)	540
overhaul cost ($)	500
No of overhauls/unit	2
annual overhaul cost ($)	100
assorted parts/year ($)	100
total annual cost	**1140**

Labour Cost Details	
No of boremen	1
Boreman wage	30000
Boreman on costs	5000
No of h worked/day	9
No of days worked/year	240
total man hours/ year (h)	2160
total labour cost	$35,000
total labour cost per hour	$16.20

Labour calculator	
No months worked	10
No of days/week	6
total days	240

Exercise Four: total Bore run costs

Exercise 4: Total Costs of Station Bore Run

Vehicle costs	
$$ depreciation/year	$9,845.00
vehicle cost per km	$0.73
total distance/year (km)	50000
total km cost ($)	**$36,546.60**

Water Point Labour costs	
total man hours/ year (h)	2160
total labour cost ($/y)	**$35,000.00**
total labour cost per hour ($/h)	$16.20

Watering costs	
total number of waters	18
cost of waters ($)	**$13,840.00**

Total Costs	
cost of bore run	**$85,386.60**
cost per water	**$4,743.70**

APPENDIX 2 - Water Subsidies

Pastoral Water Grants Scheme

Up to $15,000 dollar for dollar subsidy for developing waters for improved stock management and homestead supplies, where it can be demonstrated the current supply is inadequate. The subsidy works by a 50% reimbursement of costs on projects that are undertaken only after approval for the grant is given. Applications are assessed every four months and are to be submitted to a Department of Agriculture "Technical Support Officer" which are listed in the "Information for Applicants" document that will be provided with the application form

For more information contact:
Waters & Rivers Commission and Department of Environmental Protection
Ph 1800 780 300 (free call)
Fax 9278 0587
PO Box 6740 Hay St
East Perth WA 6892

Renewable Energy Water Pumping Program

Up to $10,000 dollar for dollar subsidy for replacing fossil fuel driven pumps, with renewable energy pumps such as solar or wind. The subsidy works by a 50% reimbursement of costs on projects that are undertaken only after approval for the grant is given. Proposed equipment must meet design and installation requirements that are explained in the program guidelines.

For more information contact:

Sustainable Energy Development Office, WA Office of Energy
Email: sedo@energy.wa.gov.au Web: http://www1.sedo.energy.wa.gov.au/pages/rewp.asp
Ph: 1300 658 158 (cost of a local call)
Fax: 9420 5700
Level 9/197 St Georges Terrace
Perth 6000

Australian Water Fund Communities Programme

http://www.communitywatergrants.gov.au/

APPENDIX 3 - Other Reading

Liquid Assets, Bourchier, J., 1998, Kondinin Group.

Farm Dams, Planning, Construction and Maintenance, Lewis, B. 2002. Landlinks CSIRO Publishing.

Infrastructure Development, Product & Information Kit, 1999, DAWA.

Water Related Pastoral Memo Articles:

REMOTE STOCK WATER MONITORING September 2002 Peter Price, Northern Pastoral Memo (NPM)

GRAZING BEHAVIOUR, September 2002, Peter Smith, NPM

WATER POINT DISTRIBUTION: A Few Thoughts Vol. 18 No. 3 (Aug 1997) Jim Addison, NPM

DAM CATCHMENT CONSIDERATIONS, Vol. 20, No. 1, May 1999, Jim Addison, NPM

KIMBERLEY STOCK - WATER POINTS Vol. 20, No. 1, May 1999, Joanna Embry NPM

SOLAR ELECTRIC PUMPING EQUIVALENTS TO WINDMILLS: Vol. 5 No. 2 June1999 Southern Pastoral Memo,

APPENDIX 4 - Water Salinity Measurement and upper limits

Use	MilliSiemens per metre	Total Soluble Salts (milligrams/litre)*	Total Soluble Salts (grains/gallon)
Hot water systems	180	990	69.3
Human consumption	250	1375	96.3
Poultry	470	2585	181.0
Horses	1000	5500	385.0
Lambs, weaners, breeder ewes	1100	6050	423.5
Septic tanks	1550	8525	596.8
Beef cattle	1550	8525	596.8
Adult sheep	1650-2200	9075-12100	635.3-847.0

Conversion factors

To convert MilliSiemens per metre (mS/m) to Total Soluble Salts (mg/L)*
mS/m multiply by 5.5 = mg/L

To convert Total Soluble Salts (mg/L) to Total Soluble Salts
Mg/L divide by 14.3= grains/gallon

To convert Total Soluble Salts (G/Gal) to MilliSiemens per metre (mS/m)
grains/gallon multiply by 2.6= mS/m

* Total soluble salts may be expressed as mg/L or ppm. They are approximately equal assuming that water density = 1 Kg per L

APPENDIX 5 - Stock Water Point Information Sheet

Copy and use this sheet to record water point information such as bore statistics. This can help keep a record of water point details. It can also be used to send to information to suppliers to assist them in supplying correct equipment

Location of pump (Nearest Town) ? ....

Volume of water required per day ? .... Gallons / Litres (circle one)

When is supply of water most critical ? ☐ Summer ☐ Winter ☐ All year ☐ Other ....

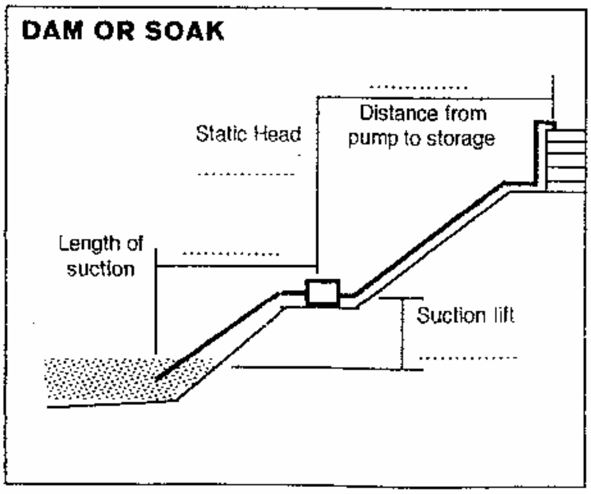
Type of pipe ? ☐ Poly ☐ PVC ☐ Galvanised ☐ None - Please recommend

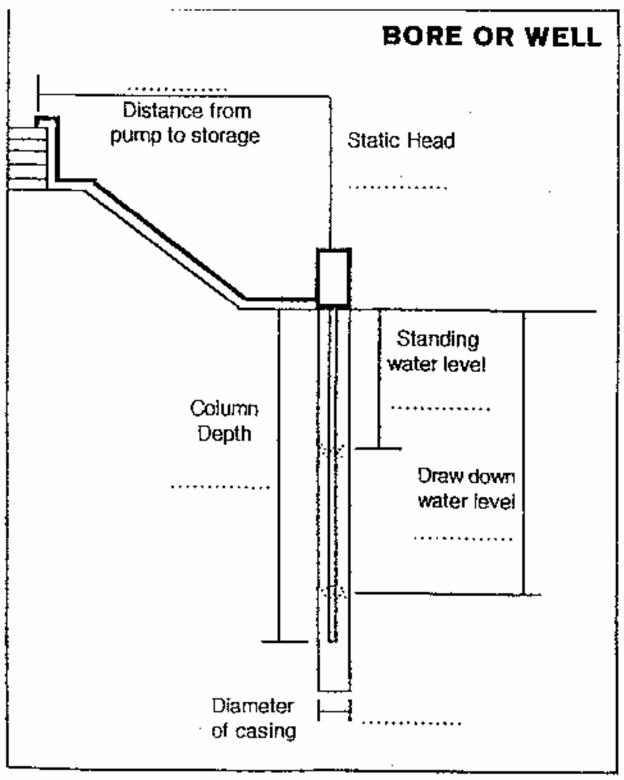
Inside dia. of pipe ? ☐ 1" (25mm) ☐ 1 1/4" (32mm) ☐ 1 1/2" (40mm) ☐ 2" (50mm) ☐ Other ....

What is the condition of the water ? ☐ Clean ☐ Silty ☐ Saline ☐ Hard

Energy source ? ☐ Solar ☐ Wind ☐ Engine ☐ 240vAC ☐ 415vAC

Please complete the blanks below.





OPTIONS

☐ Automatic ☐ Pipe fittings

☐ Float switch ☐ Floating foot valve

☐ Other ....

....

SPECIAL REQUESTS ....

DFF-054 ....

APPENDIX 6 - Reticulation Pipe, resistance to water flow

Pipe diameter and length are important considerations in reticulation systems because they both affect the resistance to water flow (also known as dynamic head). A pipeline that has either a too small an internal diameter or is too long, dramatically increases the resistance to water flow.

Tables are available to calculate the dynamic head for a variety of flow rates through standard pipe diameters. An example of one of these tables is shown in below, or they can be sourced from pipe suppliers. Use these tables to find the resistance per kilometre, and then multiply the resistance by the distance you plan to run the water. This will give you the dynamic head.

To calculate the total head of the system add the dynamic head to the static head (the height you are pumping up hill to the second water point). This gives you the total pump head in metres. Use pumping yield graphs provided by the pump manufacturer to check that the pump is suitable. Doing these calculations allow the most cost effective pump to be selected for the job.

Table for calculating resistance to flow (dynamic head) of reticulation pipe:

Friction Loss of reticulation pipe over 1 km						
Flow Rate (L/Sec)	pipe diameter (imperial rural B class poly)					
	½	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		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
1.8			500.0	170.0	68.0	17.5
2			620.0	218.0	85.0	21.0
2.5			900.0	300.0	122.0	32.0
3				430.0	170.0	44.0

Total Friction Loss = length of the pipeline (km) x friction loss number

APPENDIX 7: Example of Exercises 16 to 19

Exercise 16: costs of a single bore

Water costs: 1 Bore	source data in yellow sections	
Stock Data		
paddock area	200	km2
Number of waters	1	
average carrying capacity	3	hd/km2
weight of sale cattle	170	kg
market value	$1.60	$/kg
cost of production *	$1.00	$/kg
Number of cattle	300	No head
Breeder mortality	10.0%	%
Percentage bulls	5.0%	% bulls
brand rate	65.0%	%
Bore Data		
length of return trip	14	km
No trips per week	3	No
No of months for run	9	months
cost per km	$1.00	$/km
average speed travelled	60	km/h
Water Maintenance		
average labour @ water	0.5	Hours
casual labour rate	20	$/h
diesel backup days run	90	days/y
diesel used per day	10	L/day
cost of diesel	$1.00	$/L
No of diesels	1	No
parts for pump service/repair	400	$/y
cost of a new motorised pump	4000	$$
lifespan of pump	10	y

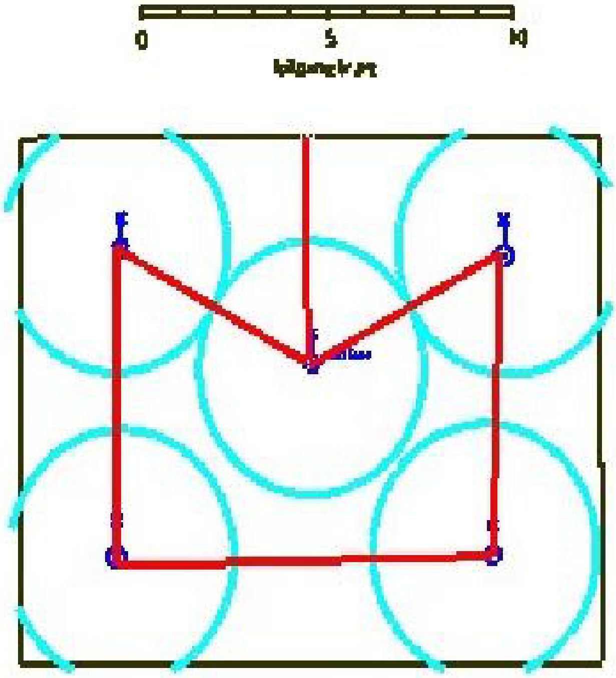
*harvesting cost of production is an estimate of mustering costs, transportation and fixed costs (i.e. overheads)

Calculated data in grey sections					
Area	20000	ha	49420	acres	
max head in paddock	600	head			
value of stock produced	$ 272.00	$$/head			
costs of production	$ 170.00	$$/head			
No per bore	300	head			
No cows	285	head			
herd replacement	29	head			
No calves turned off	157	head			
value of turnoff	$42,636.00	$$ Gross			
Total Variable cost	**$ 26,647.50**	**$$**	No calves x costs of production		
gross margin	**$15,988.50**	**$$**	Gross Turnoff - Total Variable cost		
annual mileage	1512	km/year			
annual vehicle cost	$1,512.00	$$			
labour spent in vehicle	$504.00	$$			
labour spent on repairs	$1,080.00	$$/year			
Total labour cost	$1,584.00	$$/year			
diesel for pump	$900.00	$$/year			
cost of repair to all waters	$400.00	$$/year			
cost of replacing motor pumps	$400.00	$$/year			
total cost of repairs	$800.00	$$/year			
cost of repairs per pump	$800.00	$$/year			

Cost Summary	
annual vehicle costs	$1,512.00
labour cost	$1,584.00
diesel for pump	$900.00
cost of repairs	$800.00
development cost (over 20y)	$0.00
total running cost /year	**$4,796.00**

Exercise 17: Mapping Exercise

Location of four new stock waters with 3 km radius grazing circles and roads



Pastoral Stock Water Workbook

Exercise 18: reviewing the costs of 4 new waters

Development option — **5 waters**

Water costs: Telem Bores	source data in yellow sections		Calculated data in grey sections		

Stock Data		
paddock area	200	km2
average carrying capacity	3	hd/km2
Number of waters	5	
weight of sale cattle	170	kg
market value	$1.60	$/kg
cost of production *	$1.00	$/kg
Number of cattle	600	No head
Breeder mortality	10.0%	%
Percentage bulls	2.5%	% bulls
brand rate	75%	%

area	20000	ha
max head in paddock	600	head
value of stock produced	$ 272.00	$$/head
costs of sale	$ 170.00	$$/head
No per bore	120	head
No cows	585	head
herd replacement	59	head
No calves turned off	380	head
value of turnoff	$103,428.00	$$ Gross
Total Variable cost	**$ 64,642.50**	**$$**
gross margin	**$38,785.50**	**$$**

Vehicle Bore Run Data		
length of return trip	40	km
No trips per week	1	No
No of months for run	9	months
cost per km	$ 1.00	$/km
average speed travelled	60	km/h

annual mileage	1440	km/year
annual vehicle cost	$1,440.00	$$
labour spent in vehicle	$480.00	$$

Water Maintenance		
average labour at each water	0.5	Hours
casual labour rate	20	$/h
diesel backup days run	90	days/y
diesel used per day	10	L/day
cost of diesel	1	$/L
No of diesels	5	No
parts for pump service/repair	400	$/y
cost of a new motorised pump	4000	$$
lifespan of pump	10	y

labour spent on repairs	$1,800.00	$$/year
Total labour cost	$2,280.00	$$/year

diesel for pump	$4,500.00	$$/year
cost of repair to all waters	$2,000.00	$$/year
cost of replacing motor pumps	$2,000.00	$$/year
total cost of repairs	$4,000.00	$$/year
cost of repairs per pump	$800.00	$$/year

Development costs	unit cost	No
bore hole*	20,000	4
Windmill	15,000	4
fence + trap yard	10,000	0
telemetry equipment	2,000	5
breed stock	200	300
road construction	200	31

* assume 25% fail rate

Total Development costs	
bore hole*	$ 80,000.00
windmill	$ 60,000.00
fence + trap yard	$ -
telemetry equipment	$ 10,000.00
breed stock	$ 60,000.00
road construction	$ 6,200.00
total Development costs	**$210,000.00**
cost per year (20 y)	**$ 10,500.00**

Pastoral Stock Water Workbook

Development option — 5 waters

Water costs: 1 Telem bore + retic	source data in yellow sections	
Stock Data		
paddock area	200	km2
average carrying capacity	3	hd/km2
Number of waters	5	
weight of sale cattle	170	kg
market value	$1.60	$/kg
cost of production *	$1.00	$/kg
Number of cattle	600	No head
Breeder mortality	10.0%	%
Percentage bulls	2.5%	% bulls
brand rate	75%	%

Calculated data in grey sections		
area	20000	ha
max head in paddock	600	head
value of stock produced	$ 272.00	$$/head
costs of sale	$ 170.00	$$/head
No per bore	120	head
No cows	585	head
herd replacement	59	head
No calves turned off	380	head
value of turnoff	$103,428.00	$$ Gross
Total Variable cost	**$ 64,642.50**	**$$**
gross margin	**$38,785.50**	**$$**

Vehicle Bore Run Data		
length of return trip	40	km
No trips per week	1	No
No of months for run	9	months
cost per km	$1.00	$/km
average speed travelled	60	km/h

annual mileage	1440	km/year
annual vehicle cost	$1,440.00	$$
labour spent in vehicle	$480.00	$$

Water Maintenance		
average labour at each water	0.25	Hours
casual labour rate	20	$/h
diesel backup days run	90	days/y
diesel used per day	30	L/day
cost of diesel	$1.00	$/L
No of diesels	1	No
parts for pump service/repair	800	$/y
cost of a new motorised pump	8000	$$
lifespan of pump	10	y

labour spent on repairs	$900.00	$$/year
Total labour cost	$1,380.00	$$/year

diesel for pump	$2,700.00	$$/year
cost of repair to all waters	$800.00	$$/year
cost of replacing motor pumps	$800.00	$$/year
total cost of repairs	$1,600.00	$$/year
cost of repairs per pump	$1,600.00	$$/year

Development costs	unit cost	No
retic	2,700	20
trough + tank	10,000	4
fence + trap yard	10,000	
telemetry equipment	2,000	5
bore pump upgrade	1,000	1
breed stock	200	300
road construction	200	31

* assume 25% fail rate

Total Development costs	
retic	54000
trough + tank	40000
fence + trap yard	0
telemetry equipment	10000
bore pump upgrade	1000
breed stock	60000
road construction	6200
total Development costs	**$105,000.00**
cost per year (20 y)	**$ 5,250.00**

Pastoral Stock Water Workbook

Development option — **5 waters**

Water costs: 1 Telem bore+dams	source data in yellow sections		Calculated data in grey sections		
Stock Data					
paddock area	200	km2	area	20000	ha
average carrying capacity	3	hd/km2	max head in paddock	600	head
Number of waters	5				
weight of sale cattle	170	kg	value of stock produced	$ 272.00	$$/head
market value	$1.60	$/kg	costs of sale	$ 170.00	$$/head
cost of production *	$1.00	$/kg	No per bore	120	head
Number of cattle	600	No head	No cows	585	head
Breeder mortality	10.0%	%	herd replacement	59	head
Percentage bulls	2.5%	% bulls	No calves	380	head
brand rate	75%	%	value of turnoff	$103,428.00	$$ Gross
			Total Variable cost	**$ 64,642.50**	**$$**
			gross margin	**$38,785.50**	**$$**

Vehicle Bore Run Data					
length of return trip	40	km			
No trips per week	1	No	annual mileage	1440	km/year
No of months for run	9	months	annual vehicle cost	$1,440.00	$$
cost per km	$1.00	$/km	labour spent in vehicle	$480.00	$$
average speed travelled	60	km/h			

Water Maintenance					
			labour spent on repairs	$900.00	$$/year
average labour at each water	0.25	Hours	Total labour cost	$1,380.00	$$/year
casual labour rate	20	$/h			
diesel backup days run	90	days/y	diesel for pump	$900.00	$$/year
diesel used per day	10	L/day	cost of repair to all waters	$1,200.00	$$/year
cost of diesel	$1.00	$/L	cost of replacing motor pumps	$400.00	$$/year
No of diesels	1	No	total cost of repairs	$1,600.00	$$/year
parts for pump service/repair	400	$/y	cost of repairs per pump	$1,600.00	$$/year
cost of a new motorised pump	4000	$$			
lifespan of pump	10	y			
dam repair	200	$$/dam/y			

Development costs	unit cost	No
10,000 m3 dam	25,000	4
telemetry	2,000	1
fence + trap yard	10,000	0
breed stock	200	300
road construction	200	31

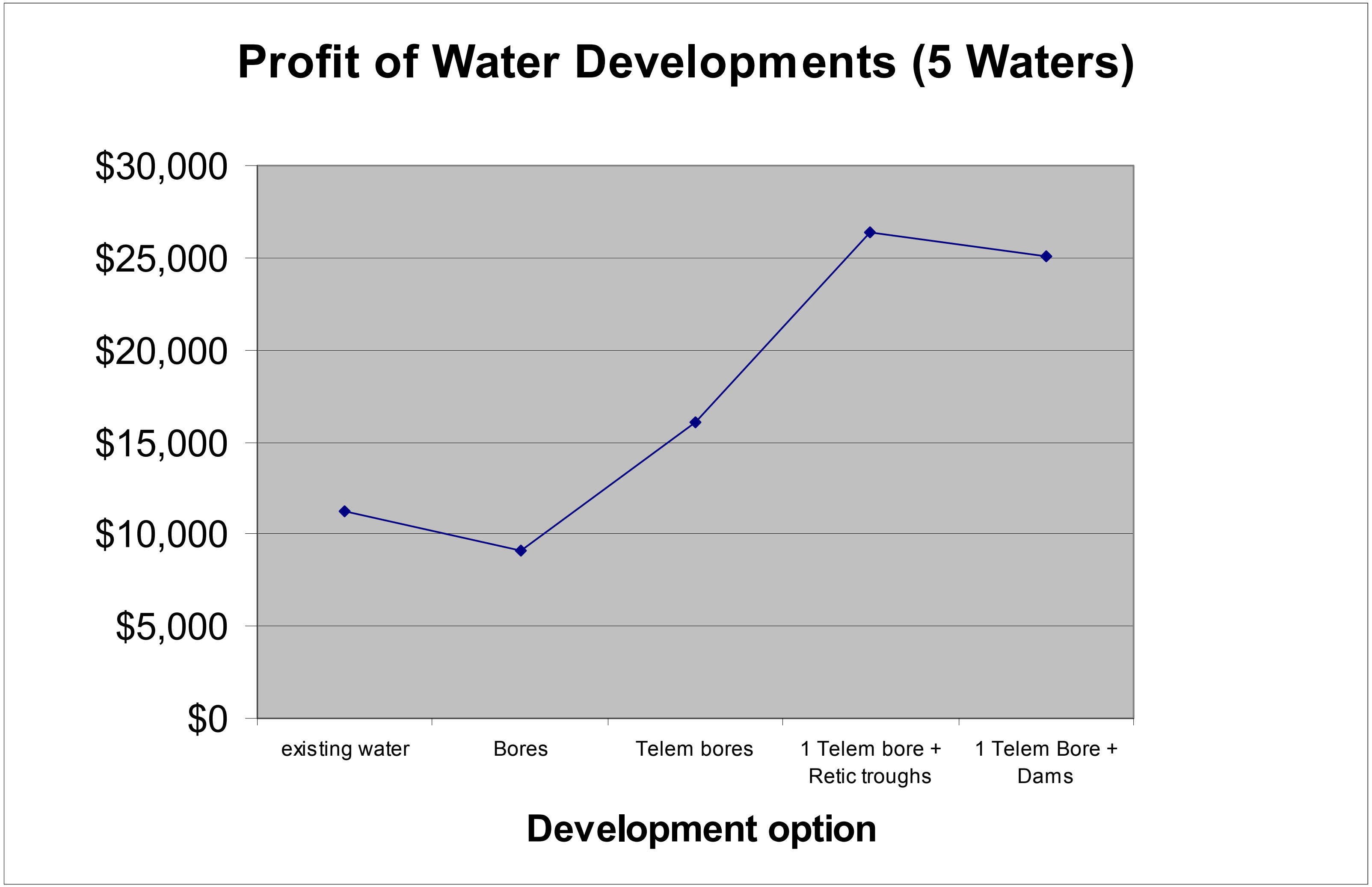
Total Development costs	
10,000 m3 dam	100000
telemetry	2000
fence + trap yard	0
breed stock	60000
road construction	6200
total Development costs	**$168,200.00**
cost per year (20 y)	**$ 8,410.00**

Stock water development summary 5 waters

This sheet is a summary of the production levels, development costs for each option and the profit for the paddock

	existing water	Bores	Telem bores	1 Telem bore + Retic troughs	1 Telem Bore + Dams
annual vehicle costs	$1,512.00	$4,320.00	$1,440.00	$1,440.00	$1,440.00
labour cost	$1,584.00	$6,840.00	$2,280.00	$1,380.00	$1,380.00
diesel for pump	$900.00	$4,500.00	$4,500.00	$2,700.00	$900.00
cost of repairs	$800.00	$4,000.00	$4,000.00	$1,600.00	$1,600.00
development cost (over 20y)	$0.00	$10,000.00	$10,500.00	$5,250.00	$8,410.00
Total of Water costs	**$4,796.00**	**$29,660.00**	**$22,720.00**	**$12,370.00**	**$13,730.00**
turnoff (No stock)	157	380	380	380	380
turnoff (kg)	26648	64643	64643	64643	64643
Income	$42,636.00	$103,428.00	$103,428.00	$103,428.00	$103,428.00
Variable costs	$26,647.50	$64,642.50	$64,642.50	$64,642.50	$64,642.50
gross margin	**$15,988.50**	**$38,785.50**	**$38,785.50**	**$38,785.50**	**$38,785.50**
gross margin	$15,989	$38,786	$38,786	$38,786	$38,786
(minus) water costs	$4,796	$29,660	$22,720	$12,370	$13,730
Net Margin of Development	**$11,193**	**$9,126**	**$16,066**	**$26,416**	**$25,056**

Graph of stock water development 5 waters



Exercises 19 Two New Waters Example.

Development option — **3 waters**

Water costs: Bores	source data in yellow sections		Calculated data in grey sections	
Stock Data				
paddock area	200	km2	area	20000
average carrying capacity	3	hd/km2	max head in paddock	600
Number of waters	3			
weight of sale cattle	170	kg	value of stock produced	$272.00
market value	$1.60	$/kg	costs of sale	$170.00
cost of production *	$1.00	$/kg	No per bore	200
Number of cattle	600	No head	No cows	585
Breeder mortality	10.0%	%	herd replacement	59
Percentage bulls	2.5%	% bulls	No calves turned off	380
brand rate	75.0%	%	value of turnoff	$103,428.00
			Total Variable cost	**$64,642.50**
			gross margin	**$38,785.50**
Vehicle Bore Run Data				
length of return trip	20	km		
No trips per week	3	No	annual mileage	2160
No of months for run	9	months	annual vehicle cost	$2,160.00
cost per km	1	$/km	labour spent in vehicle	$720.00
average speed travelled	60	km/h		
Water Maintenance				
average labour at each water	0.5	Hours	labour spent on repairs	$3,240.00
casual labour rate	20	$/h	Total labour cost	$3,960.00
diesel backup days run	90	days/y		
diesel used per day	10	L/day	diesel for pump	$1,800.00
cost of diesel	$1.00	$/L	cost of repair to all waters	$800.00
No of diesels	2	No	cost of replacing motor pumps	$800.00
parts for pump service/repair	400	$/y	total cost of repairs	$1,600.00
cost of a new motorised pump	4000	$$	cost of repairs per pump	$800.00
lifespan of pump	10	y		

Development costs	unit cost	No	Total Development costs	
bore hole*	20,000	2	bore hole*	$ 40,000.00
Windmill	15,000	2	windmill	$ 30,000.00
fence + trap yard	10,000	0	fence + trap yard	$ -
breed stock	200	300	breed stock	$ 60,000.00
road construction	200	21	road construction	$ 4,200.00
			total Development costs	**$ 130,000.00**
			cost per year (20 y)	**$ 6,500.00**

* assume 25% fail rate

Pastoral Stock Water Workbook

Telemetry Bores

Development option | 3 waters

Water costs: Telem Bores	source data in yellow sections	
Stock Data		
paddock area	200	km2
average carrying capacity	3	hd/km2
Number of waters	3	
weight of sale cattle	170	kg
market value	$1.60	$/kg
cost of production *	$1.00	$/kg
Number of cattle	600	No head
Breeder mortality	10.0%	%
Percentage bulls	2.5%	% bulls
brand rate	75%	%

Calculated data in grey sections		
Area	20000	ha
max head in paddock	600	head
value of stock produced	$ 272.00	
costs of sale	$ 170.00	
No per bore	200	
No cows	585	
herd replacement	59	
No calves turned off	380	
value of turnoff	$103,428.00	
Total Variable cost	**$ 64,642.50**	
gross margin	**$38,785.50**	

Vehicle Bore Run Data		
length of return trip	20	km
No trips per week	1	No
No of months for run	9	months
cost per km	$ 1.00	$/km
average speed travelled	60	km/h

annual mileage	720
annual vehicle cost	$720.00
labour spent in vehicle	$240.00

Water Maintenance		
average labour at each water	0.5	Hours
casual labour rate	20	$/h
diesel backup days run	90	days/y
diesel used per day	10	L/day
cost of diesel	1	$/L
No of diesels	2	No
parts for pump service/repair	400	$/y
cost of a new motorised pump	4000	$$
lifespan of pump	10	y

labour spent on repairs	$1,080.00
Total labour cost	$1,320.00

diesel for pump	$1,800.00
cost of repair to all waters	$800.00
cost of replacing motor pumps	$800.00
total cost of repairs	$1,600.00
cost of repairs per pump	$800.00

Development costs	unit cost	No
bore hole*	20,000	2
Windmill	15,000	2
fence + trap yard	10,000	0
telemetry equipment	2,000	3
breed stock	200	300
road construction	200	21

* assume 25% fail rate

Total Development costs	
bore hole*	$ 40,000.00
Windmill	$ 30,000.00
fence + trap yard	$ -
telemetry equipment	$ 6,000.00
breed stock	$ 60,000.00
road construction	$ 4,200.00
total Development costs	**$136,000.00**
cost per year (20 y)	**$ 6,800.00**

Bore and reticulation

Development option

3 waters

Water costs: 1 Telem bore + retic	source data in yellow sections	Calculated data in grey sections

Stock Data

paddock area	200	km2
average carrying capacity	3	hd/km2
Number of waters	3	
weight of sale cattle	170	kg
market value	$1.60	$/kg
cost of production *	$1.00	$/kg
Number of cattle	600	No head
Breeder mortality	10.0%	%
Percentage bulls	2.5%	% bulls
brand rate	75%	%

Area	20000
max head in paddock	600

value of stock produced	$ 272.00
costs of sale	$ 170.00
No per bore	200
No cows	585
herd replacement	59
No calves turned off	380
value of turnoff	$103,428.00
Total Variable cost	**$ 64,642.50**
gross margin	**$38,785.50**

Vehicle Bore Run Data

length of return trip	20	km
No trips per week	1	No
No of months for run	9	months
cost per km	$1.00	$/km
average speed travelled	60	km/h

annual mileage	720
annual vehicle cost	$720.00
labour spent in vehicle	$240.00

Water Maintenance

average labour at each water	0.25	Hours
casual labour rate	20	$/h
diesel backup days run	90	days/y
diesel used per day	30	L/day
cost of diesel	$1.00	$/L
No of diesels	1	No
parts for pump service/repair	800	$/y
cost of a new motorised pump	8000	$$
lifespan of pump	10	y

labour spent on repairs	$540.00
Total labour cost	$780.00

diesel for pump	$2,700.00
cost of repair to all waters	$800.00
cost of replacing motor pumps	$800.00
total cost of repairs	$1,600.00
cost of repairs per pump	$1,600.00

Development costs	unit cost	No
Retic	2,700	10
trough + tank	10,000	2
fence + trap yard	10,000	
telemetry equipment	2,000	3
bore pump upgrade	1,000	1
breed stock	200	300
road construction	200	21

* assume 25% fail rate

Total Development costs	
Retic	27000
trough + tank	20000
fence + trap yard	0
telemetry equipment	6000
bore pump upgrade	1000
breed stock	60000
road construction	4200
total Development costs	**$ 54,000.00**
cost per year (20 y)	**$ 2,700.00**

Bore and Walk in dams

Development option

3 waters

Water costs: 1 Telem bore+dams	source data in yellow sections	Calculated data in grey sections

Stock Data		
paddock area	200	km2
average carrying capacity	3	hd/km2
Number of waters	3	
weight of sale cattle	170	kg
market value	$1.60	$/kg
cost of production *	$1.00	$/kg
Number of cattle	600	No head
Breeder mortality	10.0%	%
Percentage bulls	2.5%	% bulls
brand rate	75%	%

area	20000
max head in paddock	600
value of stock produced	$ 272.00
costs of sale	$ 170.00
No per bore	200
No cows	585
herd replacement	59
No calves	380
value of turnoff	$103,428.00
Total Variable cost	**$ 64,642.50**
gross margin	**$38,785.50**

Vehicle Bore Run Data		
length of return trip	20	km
No trips per week	1	No
No of months for run	9	months
cost per km	$1.00	$/km
average speed travelled	60	km/h

annual mileage	720
annual vehicle cost	$720.00
labour spent in vehicle	$240.00

Water Maintenance		
average labour at each water	0.25	Hours
casual labour rate	20	$/h
diesel backup days run	90	days/y
diesel used per day	10	L/day
cost of diesel	$1.00	$/L
No of diesels	1	No
parts for pump service/repair	400	$/y
cost of a new motorised pump	4000	$$
lifespan of pump	10	y
dam repair	200	$$/dam/y

labour spent on repairs	$540.00
Total labour cost	$780.00
diesel for pump	$900.00
cost of repair to all waters	$800.00
cost of replacing motor pumps	$400.00
total cost of repairs	$1,200.00
cost of repairs per pump	$1,200.00

Development costs	unit cost	No
10,000 m3 dam	25,000	2
Telemetry	2,000	1
fence + trap yard	10,000	0
breed stock	200	300
road construction	200	21

Total Development costs	
10,000 m3 dam	50000
telemetry	2000
fence + trap yard	0
breed stock	60000
road construction	4200
total Development costs	**$116,200.00**
cost per year (20 y)	**$ 5,810.00**

Summary table

Stock water development summary **3 waters**

This sheet is a summary of the production levels, development costs for each option and the profit for the paddock

	existing water	Bores	Telem bores	1 Telem bore + Retic troughs	1 Telem Bore + Dams
annual vehicle costs	$1,512.00	$2,160.00	$720.00	$720.00	$720.00
labour cost	$1,584.00	$3,960.00	$1,320.00	$780.00	$780.00
diesel for pump	$900.00	$1,800.00	$1,800.00	$2,700.00	$900.00
cost of repairs	$800.00	$1,600.00	$1,600.00	$1,600.00	$1,200.00
development cost (over 20y)	$0.00	$6,500.00	$6,800.00	$2,700.00	$5,810.00
Total of Water costs	**$4,796.00**	**$16,020.00**	**$12,240.00**	**$8,500.00**	**$9,410.00**
turnoff (No stock)	157	380	380	380	380
turnoff (kg)	26648	64643	64643	64643	64643
Income	$42,636.00	$103,428.00	$103,428.00	$103,428.00	$103,428.00
Variable costs	$26,647.50	$64,642.50	$64,642.50	$64,642.50	$64,642.50
gross margin	**$15,988.50**	**$38,785.50**	**$38,785.50**	**$38,785.50**	**$38,785.50**

gross margin	$15,989	$38,786	$38,786	$38,786	$38,786
(minus) water costs	$4,796	$16,020	$12,240	$8,500	$9,410
Net Margin of Development	**$11,193**	**$22,766**	**$26,546**	**$30,286**	**$29,376**

Graph of stock water development 5 waters