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Queerfellows Creek Focus Catchment

Benefit:Cost Analysis

Detailed discussion and supporting document to the Benefit:Cost Analysis appearing in the Implementation section of the Queerfellows Creek Catchment Action Plan

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Method and Main Findings - in Brief

(i) Method

The on-farm production costs and benefits of the Queerfellows Creek Focus Catchment action plan have been calculated using a discounted cash flow format over a 20-year period. It assumes the plan is implemented over the first 10 years with the benefits accumulating up to 20 years.

The Benefit:Cost Analysis (BCA) was based on comparing the annual 'production' cash flows from arable land in the catchment under 2 scenarios:

- Crop/pasture production from the catchment if no ameliorative measures were taken (i.e. the "do nothing" approach).
- Crop/pasture production from the catchment if all the proposed strategies were implemented. Plus cash flows from commercial tree options.

The difference in cash flow between these 2 scenarios is a measure of the benefit.

(ii) Farm costs and income

Under the assumptions used, farm income over the 20 years for the catchment if the proposed strategies are adopted will be $123,000 more than a 'do nothing' scenario. But the cost of the strategies is $1.63M. The Benefit:Cost Ratio (BCR) of 0.46 indicates that farmers would only receive 46 cents in return for each $1 invested. From the on-farm financial benefits alone, it is not profitable on a whole of catchment basis for farmers to implement the proposed strategies.

The analysis also separated out the cash flows from individual land management units (LMUs) to see which parts of the proposed strategy might be more profitable:

- The best bet options are not profitable on any of the LMUs but approach brek even on the Broad Valleys and Deep Sands.
- All other LMUs had greater costs than the cash flow benefits and therefore it is difficult to justify farmer investment on these LMUs from the financial effects alone.

However, the strategies should be viewed in the context of an overall integrated plan. Obtaining benefits from one LMU might depend on strategies implemented on other LMUs – and intangible benefits have not been taken into account.

(iii) Capital value

Current value of agricultural land in Queerfellows Creek was assumed to be around $1000/ha. If the strategy 'saves' 245 ha from going salty (i.e. 50% of what it would have been without the strategies), there is an additional benefit (in preservation of capital values) of $245,000. The addition of this benefit to the production benefits means the strategy is still not profitable – with a BCR of 0.61. However, semi saltland is unlikely to attract full land value. The land value would have to be substantially more for break even to be achieved.

If there is also an impact on value of the remaining land (i.e. apart from saving land from going salt), then in order to break even, it would need to be worth $83/ha more than it would without the strategy.

(iv) Subsidisation from wider community

If just the production benefits are considered, non-market factors such as environmental and public good issues are needed to justify the costs of implementation. Preliminary work elsewhere indicates these other values might add up to be about the same as the on-farm financial values – so if total benefits are taken into account, there is a good chance of the strategy being around break-even. Under a 'beneficiary pays' system, external funds would be required to subsidise farmer actions if they are to be encouraged to adopt recommended strategies. Based on the assumptions as listed and excluding capital value considerations, the level of subsidisation would need to be at least 54 cents in the dollar for farmer investment to break even.

About this report – production vs land values

The main text of this document concentrates on the costs of the proposed strategies, and the on-farm financial benefits from forecast production changes – in particular the production differences between the 'do nothing' and 'with strategy' scenarios.

Members of other catchment groups indicated however that their main focus was on preserving their capital base. Hence some discussion of the values of land lost to salt and premiums/discounts for 'landcared' vs 'unlandcared' land appears later in the report. Economics literature suggests that including changes in land values into these analyses is incorrect. It is argued that production differences are actually captured in land sales – people are willing to pay more for land with higher production potential. By adding both production benefits and land value benefits, there is double accounting.

Introduction

The Queerfellows Creek catchment is made up of the following arable land management units:

Poorly drained sandy duplex	950	ha
Moderately drained sandy duplex	4,048	ha
Deep sands	80	ha
Gravelly ridges and slopes	687	ha
Grey clays	145	ha
Red soils	1014	ha
Mallet hills/quartz veins, rock outcrops	426	ha
Broad valleys	281	ha
Salt affected	882	ha
Total arable area	8,513	ha

Estimates of current and future production performance (e.g. rotations, stocking rates, crop yields) under the 'with' action plan and 'without' action plan scenarios were made for each of the above land management units. These estimates are presented in the individual LMU sheets attached, as well as the proposed strategies and their costs.

Benefit:Cost Analysis - Method

Put simply, BCA attaches dollars to the physical plans and outcomes to see whether 'there is a dollar in it' for farmers. There are 4 principles involved in the method:

(a) "With" the plan versus "Without" the plan

Benefit:Cost Analysis is used to assess profitability of a proposed strategy against some other strategy - most often the "do nothing" approach. By comparing the financial outcomes from the 2 scenarios, the difference between them is the benefit (or cost). BCA is used to analyse 2 courses of action - rather than a 'before' and 'after' situation.

(b) Sources of costs

There are 2 types of costs involved in assessing land management strategies:

1. Direct costs - These are the cash costs of implementing any works including purchase costs of trees, fencing, gypsum, improved pasture seed (e.g. lucerne), costs of contractors for construction of earthworks or tree planting. Extra costs of implementation for the farmer that can be calculated such as additional fertiliser, use of machinery, labour should also be accounted for.

2. Indirect costs - These are costs incurred as a consequence of implementing the strategies, mainly loss of productive land. When earthworks are constructed for example, there might be a 5-10 metre width of banks, which can no longer be cropped. When trees are planted, the land is no longer available for crop/pasture enterprises. Productive land has been removed from being able to produce income - even though the new enterprise might produce more income.

(c) Sources of benefits

Benefits to management plans can be obtained in 4 ways:

1. Increased production capacity - Some strategies can result in increased production from the land where the strategy is employed. For example, setting up strategic windbreaks might increase the average yields obtained from the adjoining land. Planting improved pastures (e.g.. balansa, puccinellia, tall wheat grass on saline land) might result in increased grazing capacity.

2. Reducing production decline - Some strategies might not actually increase production capacity but stop it deteriorating, or slow the rate of deterioration down. For example, lime applications will prevent production decline from soil acidity in responsive sites. Drainage earthworks will prevent sustained waterlogging and possible saltland development, which gradually reduces pasture production.

3. Saving land - Higher water use strategies to reduce recharge and keep groundwater levels under control can save land being lost to production from salinity.

4. Changes in enterprise - There could be additional benefits on some LMUs where the strategy allows changes in rotation. For example, sloping duplex land might have very high risk of erosion if cropped so the farmer might restrict land use to low profit sheep grazing. However, the installation of contour bank systems might allow a safe shift to more intensive more profitable cropping. Similarly, flat waterlogged ground might be unsuitable for cropping until surface drainage works are constructed.

(d) Accounting for timing of costs and benefits

With most 'landcare' strategies, some initial investment is made with often long lead times until the benefits start occurring - as per establishing trees which take years of growth until they can be harvested. Or the benefits might be small but they gradually accumulate over time, an example being establishing new pastures, which might slightly increase stocking rates.

Costs and benefits in a BCA are calculated over a longer period - in this case 20 years - so that all the potential benefits can be adequately captured. All future costs and benefits are then discounted back to a "Present Value" so we can assess in today's monetary terms what it all means.

The Queerfellows Creek Catchment Analysis - notes to assist interpretation

- Data is limited to accurately describe the impacts of proposed strategies. When looking out 20 years ahead, we cannot be overconfident about such assumptions. Sensitivity testing of the result to various ranges of assumptions is necessary - refer to 'Sensitivities' towards the end of this report.

- BCA only compares 2 future scenarios to see whether one strategy is more profitable than the other. It can determine whether the proposed strategy is absolutely profitable, but there might be other land uses and treatments that might be more profitable than the strategy under test.

- The analysis is based on a number of assumptions which must be understood to interpret the results. Assumptions can be easily varied as further wisdom is applied, or revised strategies are developed. The BCA format allows ready testing of the profitability of alternative strategies and can be used to specifically target any proposed subsidisation at the non-profitable land management units.

- The proposed strategies are used as the basis for estimating costs. However, it is the level of costs used in the analysis which are important. The costs can be applied to any other appropriate strategy. For example, just because there is an assumption of say $40/ha for the application of lime, this same $40/ha might be used for any other improvement purpose - such as pasture improvement, gypsum/dolomite applications, extra fertiliser, stubble handling, minimum tillage, equivalent investment in windbreaks. All it is saying is that there is a $40/ha investment in 'something' to obtain the benefits as stated.

- This report concentrates mainly on the farm financial effects. That is, only costs and benefits coming from on-farm effects on production and cash flow are incorporated in the calculations. Some assessment of impact on capital values is also attempted as a supporting financial benefit. It is very difficult to quantify the non-financial effects such as appearance of the land, protection of biodiversity, improved stream health, etc. These values can be extremely important, especially when the wider community is considered, but no attempt here is made to value them.

- It is reasonable to assess management plans from a farmer viewpoint <u>in the first place</u> because it is expected that farmers will be the most affected - both from a cost perspective and from the financial impact of any proposed works. The major decision-makers in terms of natural resource management on farms are the landholders themselves. They will have the major say in how their land is treated. A profitable strategy has a greater chance of adoption using the farm resources. If a strategy is not profitable for the landholder, the deficit can be quantified to get an idea of the level of subsidisation needed for the farmer to at least break even on those works.

Results

The following table summarises the outcomes for the arable areas of each of the land management units - based on the assumptions that appear in the attached sheets. Different assumptions will give different results. All future values over the 20-year period were brought back to a present day value (Present Value) by discounting at 7%.

Land Management Unit	Arable area	Present Value "Without" Strategies	Present Value "With" Strategies	Present Value of Benefits	Present Value of Costs	Benefit Cost Ratio*
Poorly drained sandy duplex	950 ha	$798,341	$901,618	$103,278	$180,792	0.57
Moderate drained sandy duplex	4048 ha	$5,138,305	$5,555,849	$417,544	$804,835	0.52
Deep sands	80 ha	$26,629	$37,985	$11,356	$11,951	0.95
Gravelly ridges and slopes	687 ha	$724,150	$799,143	$74,993	$124,125	0.60
Grey clay	145 ha	$128,708	$145,275	$16,567	$26,860	0.62
Red soils	1014 ha	$1,350,104	$1,455,259	$105,155	$188,606	0.56
Mallet hills, rock outcrops, quartz	426 ha	$47,267	$15,943	-$31,324	$158,135	nil
Broad valleys	281 ha	$201,333	$249,996	$48,664	$56,076	0.87
Salt affected	882 ha	$391,450	$386,601	-$4,850	$76,075	nil
Total 1	8,513 ha	**$8,806,286**	**$9,547,669**	**$741,383**	**$1,627,454**	**0.46**
Benefit to saving 245 ha land @ $1000/ha				**$245,000**		
Total 2		**$14,734,007**	**$15,815,322**	**$986,383**	**$1,627,454**	**0.61**

* Benefit:Cost Ratio (BCR) is an indicator of profitability. A BCR greater than 1 means the benefits are greater than the costs - so it is profitable. The BCR of 0.46 for the whole of catchment in effect means that the (farmer) financial benefits are $0.46 for every $1 spent.

Interpretation of the Results

In this outcome (Total 1), *using the assumptions as outlined in the attached LMU sheets*, the overall result for the catchment has a BCR = 0.46. This means the benefits of $741,000 are only 46% of the costs of $1.627M - so it is not profitable from the on-farm cash flow benefits alone.

When an estimate of the capital value lost to saltland is also included (Total 2), the total financial benefits becomes $986,000 – still insufficient to recover all of the costs. There would need to be an additional $83/ha extra value across all LMUs of the remaining land to break even.

The Deep Sands and Broad Valleys are close to profitability. Some minor adjustment to strategy or slightly greater expected returns through some adaption to the farming systems will help this LMU 'into the black'. Then it would be in the farmer's best interests to implement the proposed strategies. No subsidisation of the costs would be warranted

On all other LMUs, the financial benefits from production responses are less than the costs of implementation. From a strictly cash flow perspective, farmers would be loath to embark on the currently proposed strategies on any of these LMUs because it is not profitable to do so. They would need to justify the costs of works from other perspectives such as the benefits they give to adjoining LMUs, differential values for treated vs untreated land, and/or the perceived non-financial benefits. Subsidisation of the cost might be necessary to act as an inducement to adopt the strategies if capital values are not included.

The Moderately drained sandy duplex is having the greatest influence as it is the largest area and carries the biggest cost of implementation. Research and development should be targeted as a priority on this LMU in an endeavour to either prove the proposed strategies are warranted (perhaps reduce the cost if they are not) and/or develop alternative (cheaper) methods of achieving the same ends.

Catchment vs farm scale

This analysis has been done at a catchment scale and hence 'averages' across the area are used. It is intended only to give a broad indication of the situation as a useful starting point for the Queerfellows Creek group to explore options and to assist in sourcing external funds where needed.

Individual farms within the catchment will have varying production and performance levels with a different mix of land management units. Ideally, each farm enterprise should have a BCA done - and results will be very different from the catchment level analysis for different individuals.

Discussion

The analysis needs to be used in an iterative manner. The results of one set of assumptions (nor any set!) should not be taken as 'truth'. Interested people need to ask the "What if?" questions. For example:

- What if expected degradation rates turn out to be lower in the unmanaged scenario?
- What returns from harvested trees are needed to break even?
- What if treated land attracts a 10% premium on sale?
- What if the improvement in stocking rate was greater/lesser than expected?

While this analysis has attempted to incorporate realistic assumptions based on evidence and advice from specialists, different people will have different perspectives. The model is available to help with these questions.

Using this report

Queerfellows Creek catchment group members can use this financial analysis report in 4 main ways:

1. Test the sensitivity of the result to changes in assumptions. The results presented above are one outcome of a single set of assumptions and should not be regarded as the "truth". While the current assumptions have been developed on a 'best bet' basis using as much information as possible (refer LMU sheets), they should be challenged if the group has improved information or want to test alternative enterprises or methods of implementation. Some sensitivity testing appears later in this report to assist this process.

2. Gain confidence in implementing those strategies on the appropriate LMUs where there is a strong chance of profitability. Once some sensitivity testing has been done, it will become obvious that some strategies on some LMUs will be more profitable than others and which should become priorities for action. For example, contour earthworks

on duplex soil might prove to be more profitable than saltland revegetation on a valley floor.

3. Assess the need for initial funding to commence works. The graph and cash flows provided give a picture of the deficits in the first 10 years implementation period relative to the 'do nothing' option. This indicates the amount needed to be 'found' from on-farm sources or from grants or borrowed funds to get started on the program.

4. Seek external funding to subsidise proposed works on the basis that some of the works to be implemented are being done for wider community benefits. It is unreasonable to expect catchment group members to fund the whole plan when they cannot fully recover the costs.

Funding the implementation plan

The total cost (present value) of implementation over a 10 year period will be around $1.627M. From the standard analysis, accumulated benefits to farmers in terms of on-farm production only have a Present Value of $741,000. If possible changes in land asset values are excluded, there needs to be further public benefits of at least around $886,000 to justify the program.

Public benefits are difficult to quantify in $ terms but could be made up by any or all of the following:

- improved aesthetic appearance of the countryside
- preservation of remnant vegetation and biodiversity
- reduced stream siltation and nutrient runoff
- reduced costs to infrastructure such as roads, bridges, culverts, roadside vegetation
- protection of wetlands and reserves
- reduced impact (physical and social) of salinity on towns

It is suggested that NHT be approached to contribute towards the works. NHT is the logical first choice for external funding as those funds are managed by government on behalf of the wider community. However, such an approach would be strengthened if local government was prepared to contribute some funds on behalf of the local community who stand to benefit more directly.

Land Management Unit 1: Poorly drained sandy duplex (950 ha)

Current production value on arable land of this LMU was assumed to be $85/ha.

Base production value assumptions:

- Without treatment: It was assumed that 256 ha would go saline with nil production and that production from the remaining land would deteriorate over 20 years under the effects of 'land degradation' such that only 90% of current production would be obtained. Production value at 20 years in this scenario = $56/ha.
- With treatment: Assuming the strategies listed below were implemented, it was assumed that 50% of the potential saltland would be saved (i.e only 128 ha of salt) and that current production capacity on the non salt affected land would be improved by 10%. Production value with strategy = $80/ha.

Strategies to achieve the assumed benefits

Best bet options as listed in the implementation plan:

- ***Earthworks:*** 2 km interceptor banks ($600/km), 5 km grade banks ($600/km), and 1 km drains ($1000/km) for waterlogging control.
- ***Oil mallees:*** 95 ha (10% of area) of trees planted along grade banks with cost of establishment = $1400/ha. Trees harvested for an average nominal return of $160/ha/year.
- ***Lucerne:*** 50% of the area (non-waterlogged) planted to lucerne @ $125/ha in a phased farming system. Replanted every 8 years in the cycle.
- ***Pastures:*** Waterlogged area (5% of total) planted to balansa clover and tall wheat grass @ $120/ha.

Annual catchment expenditure on 950 ha Poorly drained sandy duplex under the above assumptions is around $20,000 in each of the first 10 years as the above works are installed on the ground. There is an average cost of $5,600 in each of the subsequent years – mainly due to replanting of lucerne. Present Value of Total Costs = $181,000.

Land Management Unit 2: Moderately drained sandy duplex (Area = 4,048 ha)

Current production value on arable land of this LMU was assumed to be $115/ha.

Base production value assumptions:

- Without treatment: It was assumed that 67 ha would go saline with nil production and that production from the remaining land would deteriorate over 20 years under the effects of 'land degradation' such that only 90% of current production would be obtained. Production value at 20 years in this scenario = $102/ha.
- With treatment: Assuming the strategies listed below were implemented, it was assumed that 50% of the potential saltland would be saved (i.e. only 34 ha salt) and that current production capacity on the non salt affected land would be improved by 10%. Production value with strategy = $126/ha.

Strategies to achieve the assumed benefits

Best bet options as listed in the implementation plan:

- *Earthworks:* 30 km grade banks for waterlogging and erosion control @ $600/km together with grassed waterways.
- *Contour alleys:* 400 ha of oil mallees planted along banks and/or in belts. Cost of establishment = $1400/ha. Trees harvested for an average nominal return of $160/ha/year.
- *Lucerne:* 50% of area planted to lucerne in a phase farming system @ $125/ha. Lucerne replanted every 8 years in the cycle.
- *Dams/piezometers:* 16 dams @ $5,000 each. 6 piezometers @ $200.

Catchment expenditure on 4,048 ha Moderately drained sandy duplex under the above assumptions is around $90,000 in each of the first 10 years. Present Value of Total Costs = $805,000.

Land Management Unit 3: Deep sands (Area = 80 ha)

Current production value on arable land of this LMU was assumed to be $30/ha.

Base production value assumptions:

- Without treatment: Production from this LMU would deteriorate over 20 years under the effects of 'land degradation' such that only 90% of current production would be obtained. Production value at 20 years in this scenario = $27/ha.
- With treatment: It was assumed that all of this LMU is planted to maritime pine. Hence existing enterprises disappear to be replaced with a commercial tree option with returns of $200/ha in the first year (either through the incentive scheme or through contract planting), $280/ha in year 13 at the first thinnings harvest, and $480/ha in year 19 at the second thinnings harvest.

Strategies to achieve the assumed benefits

Best bet options as listed in the implementation plan:

- *Maritime pine:* All 80 ha established to pine under a (CALM) sharefarming scheme with a minimal ($5/ha) cost to owner for planting.
- *Fencing:* Assumed deep sand occurs in small patches so requires 12 km fencing @ $1,200/km.

Annual catchment expenditure on 80 ha Deep sands under the above assumptions only averages around $1,500 per year for establishment during the first 10 years then minor costs for plantation maintenance thereafter. Present Value of Total Costs = $12,000.

Land Management Unit 4: *Gravelly ridges and slopes (687 ha)*

Current production value on arable land of this LMU was assumed to be $95/ha.

Base production value assumptions:

- Without treatment: No saltland development on this LMU. It was assumed the production from this land would deteriorate over 20 years under the effects of 'land degradation' such that only 90% of current production would be obtained. Production value at 20 years in this scenario = $86/ha.
- With treatment: Assuming the strategies listed below were implemented, it was assumed that current production capacity would improve by 10%. Production value with strategy = $105/ha.

Strategies to achieve the assumed benefits

Best bet options as listed in the implementation plan:

- ***Contour alleys:*** 68 ha (10% of area) of oil mallees planted with cost of establishment = $1400/ha. Nominal average tree returns of $160/ha/yr.
- ***Lucerne:*** 50% of area planted to lucerne @ $125/ha. Replanted every 8 years in the phase cropping cycle.

Annual catchment expenditure on 687 ha Gravelly ridges and slopes under the above assumptions is around $13,500 in each of the first 10 years and around $4,000 in each of the subsequent years – mainly due to lucerne replanting. Present Value of Total Costs = $124,000.

Land Management Unit 5: Grey clays (Area = 145 ha)

Current production value on this LMU was assumed to be $80/ha.

Base production value assumptions:

- Without treatment: No saltland development on this LMU. It was assumed the production from this land would deteriorate over 20 years under the effects of 'land degradation' such that only 90% of current production would be obtained. Production value at 20 years in this scenario = $72/ha.
- With treatment: Assuming the strategies listed below were implemented, it was assumed that current production capacity would improve by 10%. Production value with strategy = $88/ha.

Strategies to achieve the assumed benefits

Best bet options as listed in the implementation plan:

- *Alleys:* 15 ha (10% of area) planted to oil mallees @ $1400/ha. Nominal average tree returns of $160/ha/yr.
- *Lucerne:* 50% of area planted to lucerne @ $125/ha. Replanted every 8 years in the phase cropping cycle.

Catchment expenditure on 145 ha Grey clays under the above assumptions is around $3,000 in each of the first 10 years then $860 each year thereafter due to lucerne replanting in the phase cropping cycle. Present Value of Total Costs = $27,000.

Land Management Unit 6: Red soils (Area = 1,014 ha)

Current production value on this LMU was assumed to be $120/ha.

Base production value assumptions:

- Without treatment: No saltland development on this LMU. It was assumed the production from this land would deteriorate over 20 years under the effects of 'land degradation' such that only 90% of current production would be obtained. Production value at 20 years in this scenario = $108/ha.
- With treatment: Assuming the strategies listed below were implemented, it was assumed that current production capacity would improve by 10%. Production value with strategy = $132/ha.

Strategies to achieve the assumed benefits

Best bet options as listed in the implementation plan:

- *Earthworks:* 5 km grade banks required to alleviate waterlogging @ $600/km.
- *Contour alleys:* 100 ha planted to oil mallees @ $1400/ha. Can be planted along earthwork lines. Nominal average tree returns of $160/ha/yr.
- *Lucerne:* 50% of the area planted to lucerne @ $125/ha. Replanted every 8 years in the phase cropping cycle.
- *Fencing:* 32 km fencing required @ $1,200/km.

Annual catchment expenditure on 1014 ha Red soils under the above assumptions is around $20,000 in each of the first 10 years and around $6,000 in each of the subsequent years – mainly due to lucerne replanting. Present Value of Total Costs = $189,000.

Land Management Unit 7: *Mallet hills/quartz veins/rock outcrops (Area = 426 ha)*

Current production value on this LMU was assumed to be $10/ha.

Base production value assumptions:

- Without treatment: It was assumed that this land would continue to deteriorate over 20 years under the effects of 'land degradation' such that only 90% of current production would be obtained. Production value at 20 years in this scenario = $9/ha.
- With treatment: This scenario assumes all of this LMU is revegetated with non-commercial native species and fenced off so no land would be available for cropping/grazing after 10 years.

Strategies to achieve the assumed benefits

The base strategy is to revegetate all of this LMU to native species.

- ***Revegetation:*** 426 ha planted/replanted at an average cost of establishment = $300/ha. Non commercial species for biodiversity.
- ***Fencing:*** 61 km fencing required @ $1,200/km.
- ***Absorption banks:*** 2.5 km banks @ $2000/km.

Annual catchment expenditure on 426 ha of this mix of LMUs under the above assumptions is around $21,000 in each of the first 10 years. Present Value of Total Costs = $158,000.

Land Management Unit 8: *Broad valleys (Area = 281 ha)*

Current production value on this LMU was assumed to be $85/ha.

Base production value assumptions:

- Without treatment: It was assumed that 167 ha would go saline with nil production and that production from the remaining land would deteriorate over 20 years under the effects of 'land degradation' such that only 90% of current production would be obtained. Production value at 20 years in this scenario = $31/ha.
- With treatment: Assuming the strategies listed below were implemented, it was assumed that 50% of the potential saltland would be saved (i.e. only 84 ha goes to salt) and that current production capacity on the non salt affected land would be improved by 10%. Production value = $70/ha.

Strategies to achieve the assumed benefits

Best bet options as listed in the implementation plan:

- ***Alleys:*** 25 ha (10% of area) planted to oil mallees @ $1400/ha. Nominal average tree returns of $160/ha/yr.
- ***Lucerne:*** 50% of area planted to lucerne @ $125/ha. Replanted every 8 years in the phase cropping cycle.
- ***Pastures:*** 20% of area planted to improved pastures of balansa clover and tall wheat grass @ $120/ha.
- ***Earthworks:*** 4 km drains @ $1000/km.

Annual catchment expenditure on 281 ha Broad valleys under the above assumptions is around $6,000 in each of the first 10 years and around $1,700 in each of the subsequent years –due to lucerne replanting. Present Value of Total Costs = $56,000.

Land Management Unit 9: *Salt affected (Area = 882 ha)*

Current production value from minor grazing of this LMU was assumed to be $40/ha.

Base production value assumptions:

- Without treatment: It was assumed that production would deteriorate over 20 years as the soil was progressively affected by salt such that only 90% of current production would be obtained. Production value at 20 years in this scenario = $36/ha.
- With treatment: Assuming the strategies listed below were implemented, it was assumed that current production on the non salt affected land would be improved by 10%. Production value with strategy = $44/ha.

Strategies to achieve the assumed benefits

Best bet options as listed in the implementation plan:

- ***Saltland pasture:*** 50% of this LMU rehabilitated with salt tolerant pasture plants (e.g. saltbush, puccinellia) with cost of establishment = $120/ha.
- ***Revegetation:*** 80 ha (10% of area) revegetated in alleys with salt tolerant native plants @ $500/ha.
- ***Drains:*** 10 km drains @ $1,000/km.

Annual catchment expenditure on 882 ha Salt affected land under the above assumptions is around $10,000 in each of the first 10 years. Present Value of Total Costs = $76,000.

Sensitivities

The 'best bet' analysis presented in the results is based on a number of assumptions as listed in the LMU sheets - some or all of which might be wrong! It is important therefore to ask the 'what if?' questions and assess ranges of assumptions to be more confident of what the analysis is saying. By how much do the benefits need to increase (or the costs decrease) in order for break-even to be achieved?

Sensitivities are best done for a purpose – for example when someone notices a best-bet assumption to be different to their own experience, or when there is considerable doubt about the value of an assumption. The following are 2 attempts at varying the assumptions from pessimistic and optimistic perspectives.

Best bet scenario – assumptions

Land lost to salinity in the 'do nothing' scenario – 1372 ha (an additional 490 ha)
Land saved from going salty by the plan – 50% (only 245 ha extra salt)
Deterioration in productivity after 20 years in the 'do nothing' scenario = -10%
Improvement in productivity after 20 years in the 'with strategy' scenario = +10%

Result:	Production benefits only	Land value included ($1000/ha)
Benefit	$741,000	$986,000
Cost	$1,627,000	$1,627,000
Benefit:cost ratio	**0.46** (46 cents benefit per $1 spent)	**0.61** ($0.61 benefit per $1 spent)

Optimistic scenario – assumptions

Land lost to salinity in the 'do nothing' scenario – 1372 ha (an additional 490 ha)
Land saved from going salty by the plan – 75% (only 122 ha extra salt)
Deterioration in productivity after 20 years in the 'do nothing' scenario = -20%
Improvement in productivity after 20 years in the 'with strategy' scenario = +20%

Result:	Production benefits only	Land value included ($1000/ha)
Benefit	$1,270,000	$1,613,000
Cost	$1,627,000	$1,627,000
Benefit:cost ratio	**0.78** ($0.78 benefit per $1 spent)	**0.99** ($0.99 benefit per $1 spent)

Pessimistic scenario – assumptions

Land lost to salinity in the 'do nothing' scenario – 1372 ha (an additional 490 ha)
Land saved from going salty by the plan – 25% (367 ha extra salt)
Deterioration in productivity after 20 years in the 'do nothing' scenario = -5%
Improvement in productivity after 20 years in the 'with strategy' scenario = +5%

Result:	Production benefits only	Land value included ($1000/ha)
Benefit	$460,000	$607,000
Cost	$1,627,000	$1,627,000
Benefit:cost ratio	**0.28** (28 cents benefit per $1 spent)	**0.37** (37 cents benefit per $1 spent)

Break even

From the above scenarios, the optimistic projections on production differentials and saltland saved, as well as including a land asset value on the saltland saved almost makes the strategy profitable – close enough to break-even. What other levels of impact are needed for the strategy to at least break even?

Assuming 50% of the potential saltland is saved, and that there is 10% deterioration in production in the 'do nothing' scenario, then a 41% increase in production in response to the strategy is required for it to break-even with the costs. That is, there needs to be a production increase of 41% on current levels for the on-farm financial benefits to recover the costs of implementation of the strategy. If land value (of $1000/ha) of saltland saved is included, the production increase only needs to be 32%.

These numbers help to understand what levels of response are needed for the strategy to be profitable. Judgement can then be made as to the likelihood of achieving them.

Land Management Units within the Catchment

The Moderately drained sandy duplex LMU occupies 37% of the catchment and has the greatest influence on the whole of catchment outcome through its impact on production and the scale of ameliorative measures. However, it is important to concentrate on the relationship between costs of the strategies and the benefits those strategies might produce. If the benefits are greater than the costs, then it is still profitable to implement those strategies, even though finding the funds to do it still represents a challenge - as in any investment for future returns.

The most difficult thing is to determine the impacts of strategies on that particular LMU versus the wider implications on the rest of the farm, and indeed outside the farm boundary. All the strategies are part of a whole farm integrated system.

There are production benefits on each LMU but it is the cost of the proposed strategies which is affecting profitability. Apart from attempting to lift production responses (through R&D efforts), there are 2 main ways in which profitability can be achieved:

- Reduced cost. Specialists need to revisit the technical recommendations and ascertain whether the same impacts can be obtained with different (cheaper) land treatment options. Do we need absorption banks where grade banks will do? Can we get away with less of them? Can we establish lucerne more cheaply than the estimated $125/ha? Are there farming systems which obviate the need for extensive (and expensive) fencing?

- Subsidise the cost. There are public good issues involved in implementing a whole of catchment management plan and external funds can be sourced to supplement farmer investment. Farmer profitability, and therefore their willingness to adopt ameliorative measures, can be assisted by their not having to fund some of the costs. For the Queerfellows Creek Focus Catchment, on the base case assumptions as listed, a grant to the group of at least part of $886,000 would be needed for the farmer members to consider undertaking the work on a break-even basis.

Integrated vs Individual treatments

This analysis is done on the total treatments proposed for each LMU. But the results disguise the benefits of individual treatments. These need to be assessed on a site-specific basis in each paddock but there are many instances where individual treatments are very profitable. Surface water control earthworks, commercial tree planting, lucerne, improved pastures (e.g. balansa mixtures on wet ground) are examples where profitability has been proved for other farmers around the state.

The problem with including all treatments in a whole of catchment analysis is that the unprofitable treatments (e.g. fencing, revegetation with non-commercial species), where there is major cost but no direct financial return, 'dilutes' the benefits from the profitable treatments. It is logical for farmers embarking on an implementation program to put in place the profitable treatments as a first priority. These can only be assessed at the time for each site-specific situation.

Sourcing and Use of External Funds

Catchment group members (or a subcommittee) need to agree on the BCA assumptions and outcome in order to 'own' the result. This might require a session to adjust the input assumptions and produce a consensus result. Once an acceptable position is finalised, it can be used to support the group's case for external funding – on the basis that the benefits do not adequately compensate for the investment cost.

In this Queerfellows Creek situation, assuming the current best-bet outcome is accepted, an argument can be mounted for a subsidy of 54 cents in the $1 spent – on the basis that higher adoption would result from farmers knowing they would at least break even. Any shortfall would need to be justified by group members from a perspective of it being their contribution to the good of the wider community.

Strategies developed for a farm should be an integrated package such that no LMU is treated in isolation. It is therefore difficult to choose particular LMUs for special funding attention. However, for accountability reasons, a funding body will probably require some control over expenditure. The following is provided for guidance.

- Farmers have least production benefits to gain from treating the discharge sites (e.g. Salt affected land) or revegetation areas with little opportunity for commercial trees (e.g. Mallet hills/Rock outcrops). And successful rehabilitation most often depends on strategies adopted on surrounding land, especially upslope. Perhaps subsidisation of the costs of revegetation on discharge sites could be on the proviso that upslope treatments are implemented.

- Establishment of commercial trees where the income stream is forecast to be better than the current enterprise should not be subsidised. It is in the farmer's best interest to do it anyway. However, there is often a problem in finding the initial investment capital from scarce on-farm sources or by borrowing for very long-term projects. Sharefarming arrangements (if available) are a very appropriate strategy to overcome these problems.

- Surface water control earthworks have generally short pay off times in terms of retrieving waterlogged land and preventing erosion on that paddock. However, some earthworks might need to be overdesigned to satisfy the public good issues - e.g. preventing runoff and siltation/eutrophication of streams. A reasonable subsidisation value might be the difference in cost between a 'normal' structure and the proposed earthworks with higher specifications.

- It may be that, for example, the Mallet hills and Rock outcrops in this Queerfellows Creek catchment requires a lot of 'works', not so much for the sake of on site responses but to afford protection to the rest of the farm. In fact the farmer might be penalised by having to spend money in an area which does not need it and shows little response. He has the costs over a large area but any assumed future benefits might only apply to much smaller adjoining areas – e.g. downslope. External funding assistance would be indicated on this LMU.

Appendix 1: Definition of Production Value

The production values used in this report are provided at the head of each LMU page. They are no more than estimates and derived from farm business performance information collected by Bankwest and Planfarm each year.

For the Queerfellows Creek catchment, the Wagin area of the Bankwest data has been consulted as well as the Planfarm HSRF (High South RainFall) region. The average production value was assumed to be $98/ha – which was then scaled off against each LMU according to the proportional representation of LMUs in the catchment.

Derivation of production value

Production value = Operating surplus minus Capital costs plus Fixed costs
= $85/ha - $17/ha + $30/ha
= $98/ha

* Operating surplus: An 'average' of the last 2 years operating surpluses as provided in the Bankwest and Planfarm data.

* Capital costs: Capital costs are an additional deduction from the operating surplus because the capital costs of new enterprises (e.g. cost of establishment of oil mallees) are included in the analysis – but are not included as a cost in the operating surplus. We need to compare "apples with apples" when we are comparing a 'do nothing' scenario with a 'with strategy' scenario. Capital costs for cropping enterprises are around $35/ha and for livestock enterprises around $10/ha. It was assumed the average enterprise mix in Queerfellows Creek was 30% crop:70% pasture hence an average capital cost of $17/ha.

* Fixed costs: Fixed costs (and variable costs) are deducted from gross receipts to calculate the operating surplus. But in the analysis, no allowance for fixed costs has been made when providing an assumed return for new enterprises. Again, we will not be comparing "apples with apples" unless this adjustment is made.

In the final analysis, it does not matter how the production value is defined. It can be operating surplus, gross margin, net margin, operating profit, whatever – as long as costs/returns for new enterprises are on the same basis as the production value of existing enterprises. This is because the benefit:cost analysis is determined by comparing one scenario with another – it is the differences between them which are the important numbers to look at.