A Summary of the Kulin and Dudinin Creek Catchments Water Management Plan

For Community Consultation Meeting

Kulin, 6-7th April 2009

INTRODUCTION

In response to issues associated with the management of surface water quality and the use of deep drainage to control secondary salinisation in the Kulin-Dudinin Creek Catchments the Department of Water (DOW) and Department of Agriculture and Food (DAF) have undertaken development of the Kulin-Dudinin Catchment Water Management Plan. The Plan represents a major commitment to better understand the salinity risks for the catchment and to develop effective, integrated management strategies and actions that will manage the risk. The evaluation and planning process is overseen by a steering committee comprising:

- Land owners from lower, middle and upper catchment areas.
- WA Department of Water (DOW)
- WA Department of Environment and Conservation (DEC)
- WA Department of Agriculture and Food (DAFWA)
- Avon Catchment Council (ACC)

The primary objectives of the management plan are to identify a best practice mix of management strategies to achieve effective and acceptable water and salinity management for the catchment. As components of this the plan seeks to:

- Where feasible preserve low salinity creek flows for stock use.
- Identify a more effective salinity management system for saline land (existing and forecast) and proposed and existing drains.

The development of the Management Plan has progressed so far through the first two of the following three steps:

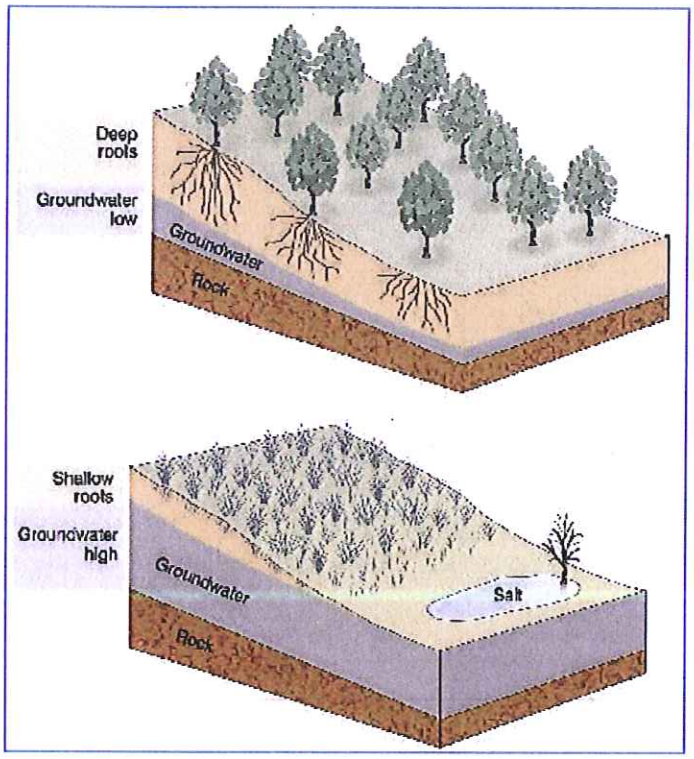
- Landholder Consultation - Consult relevant landholders to determine a range of possible water and salinity management options.
- Evaluation of Management Options – Evaluate selected management options in terms of effectiveness at protecting agricultural production, and the operational requirements (e.g. physical attributes (area and dimensions), governance, maintenance and costs). This evaluation has been undertaken using a computer based model of the catchment that focuses on surface and groundwater interactions.
- Development of a Management Plan – Formulate several possible management options and seek consensus or agreement from effected landholders for progression of a preferred option. This then becomes the basis to the strategy underpinning the Management Plan.

Successful implementation of such a plan requires recognition and adequate management of the technical, social and governance (including legal) components associated with the planning, construction and delivery of drainage and other works. As a result, the development of a Catchment Water Management Plan that addresses the technical and the community issues from a '*whole of catchment*' perspective, is a key outcome. It will also allow individual landholders to confidently move forwards in managing their own holdings.

CATCHMENT SALINITY

Natural, or 'primary salinity' occurs as salt lakes, salt flats, or naturally saline soils towards the bottom of catchments whereas secondary salinity develops as a result of past and present land use practise associated with the development of agriculture. The fundamental cause of secondary salinity is the replacement of long lived, deep-rooted native vegetation with annual shallow-rooted crops and pastures (Figure 1).

Figure 1 A simple illustration of the changes in water table pre and post clearing that leads to an increase in dryland salinity



Agricultural crops and pastures use less water than the native vegetation they replaced and this has resulted in increased run-off and greater percolation of water beyond the root zone - also know as 'groundwater recharge' over the period since clearing. The Kulin-Dudinin catchment has been largely cleared for agriculture (> 90%), with small remnants of native vegetation. Clearing occurred progressively between the 1920s and 1950s, with more recent clearing (1960s - 1970s) taking place in uplands, especially in the south of the catchment.

It is estimated that the groundwater recharge below native vegetation in the Kulin Catchment would have been in the order 0 - 5mm per year. Under agricultural crops and pastures the groundwater recharge is estimated to now be 15 – 40 mm per year. This water accumulates as groundwater and causes the water table to rise.

The original water table in the valley floors was probably in the order of 5 – 15 m below the ground surface. However, when combined with the increased surface flow or ponding, recharge caused water tables to rise and approach the ground surface. Once water levels are within one or two metres of the surface, evaporation of the water occurs and there is an accumulation of salt at the soil surface and in the root zone. This salt may emerge as a 'saline seep' on hillsides but is more often expressed in flat areas as bare patches where evaporation leaves behind concentrated salt deposits known as 'salt scalds'.

It has been estimated that approximately 6% (4100 ha) of the catchment was showing signs of salinity in 2007.

See map as
Figure 2 on next page.

This is expected to increase to approximately 14% (9700 ha) by 2030 if changes are not made in the water is managed in the catchment (estimate from farmer mapping and Dr Richard George, DAFWA).

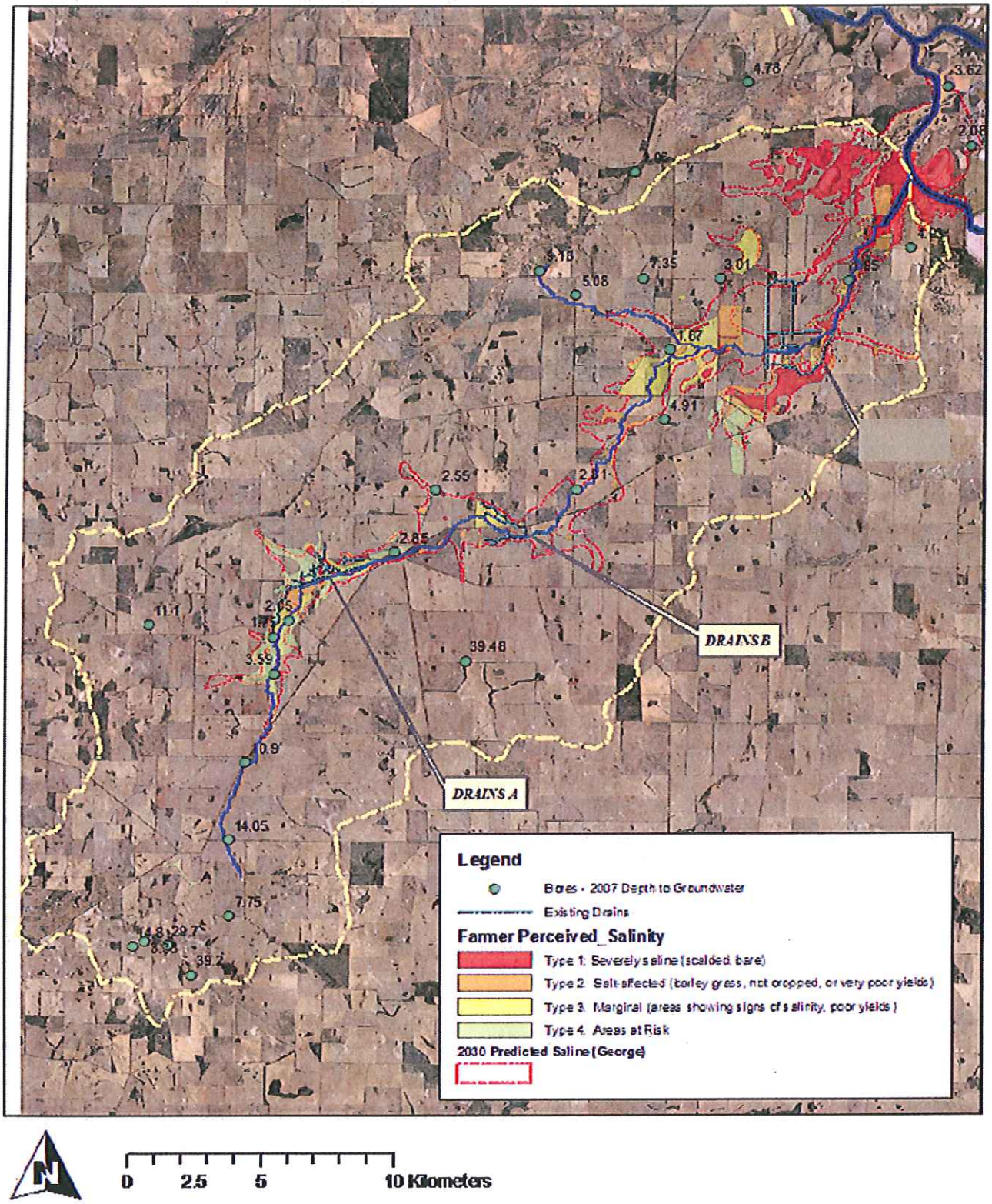


Figure 2. Salinity extent (2007), depths to groundwater in bores and existing drainage systems.

EVALUATION OF MANAGEMENT OPTIONS

The Management Plan seeks to provide a best practice mix of management options, as appropriate, to achieve effective and acceptable water and salinity management for the catchment. This encompasses consideration of the following management possibilities:

- Engineering e.g. banks, diversions, drains, groundwater pumping, pipes, catchment storage;
- Modified farming practice e.g. use of perennials and alternative cropping systems; and
- Revegetation such as Oil Mallees, and protection and enhancement of remnant native vegetation.

Based on these possibilities, a number of initial management options were considered and analysed with a computer model to determine the effectiveness of the proposed options at controlling groundwater levels and the impact on surface water quantity and quality. The most effective and feasible options were then refined and evaluated in terms of effectiveness at protecting agricultural production.

Scenarios Assessed

The computer model was used to assess management options in two sets of scenarios. The first set were done using a coarse grid (200 m grid) across the entire catchment and the second set at a much finer scale (50 m grid) to resolve in more detail drainage effectiveness.

Table 1 Scenarios simulated with the coarse resolution model.

Scenario Number	Scenario Description
0	Base Case (do nothing)
1	Base Case (do nothing) with 20% less rainfall
2	Trees replanted on all upland areas (65% of catchment)
3	Deep rooted farming system (100% of arable) continuous cropping and deeper rooted farming system
4	2m deep drains covering area with groundwater at 1m as of Dec. 2007 (4,100ha)
5	Single deep drain parallel to Dudinin Ck linking existing drains
6	Surface Water Management - No depression storage on valley floor
7	Saltland Perennial System covering area with groundwater at 1m as of Dec. 2007 (4,100ha)

Table 2 Summary of results from the coarse resolution modelling.

Scenario Number	Scenario Short Description	Area with water table less than 1m in 2030	Change in 2030 Area Compared to Base Case		Stream Salinity @ Catchment Outlet #
		(ha)	(ha)	(%)	mg/l (EC: mS/m)
0	Base Case	8,000	0	0	1,800 (320)
1	Base Case with 20% less rainfall	3,800	-3,200	-40	1,200 (215)
2	Trees on all upland areas	7,100	-900	-11	-
3	Deep rooted farming	5,400	-2,600	-32	-
4	2m Deep drains (4100ha)	4,100	-3,900	-49	17,400 (3,100)
5	Single deep drain linking existing drains	7,500	-500	-6	13,800 (2,500)
6	Surface Water Management	7,800	-200	-2	-
7	Saltland Perennial System **	2,100	-5,900	-74	1,700 (300)

Notes: ** The model makes fixed assumptions about the interaction between the groundwater and vegetation uptake such that an over estimation of the effectiveness of this scenario at managing catchment salinity may result.

Time weighted mean based on the mean annual concentration for each of the 5 years summed and then divided by 5.

Finer Scale Modelling

Due to difficulty in modelling the drain flows observed in the existing drains, a finer scale model was developed (50m grid).

Table 3 Scenarios simulated with the finer scale model.

Scenario Number	Scenario Description
8	Base Case (Do Nothing)
9	Engineering Option: Single deep drain parallel to Dudinin Ck linking existing drains and extending down to just upstream of Commonwealth Road where a detention basin will be sited.
10	Vegetation Option: Saltland perennials (e.g. saltbush) on areas identified as showing signs of salinity by farmers in 2007 - 4100ha Areas identified as at risk by 2030 to be treated with a 10% tree (Eg Oil Mallee), 20% perennial plants (E.g. Lucerne), and remainder continuous cropping system. Total 4000ha
11	Combined Engineering and Vegetation Option:

Table 4 Summary of results from the finer resolution modelling.

Scenario Number	Scenario Short Description	Area with water table less than 1m in 2030	Change in 2030 Area Compared to Base Case		Stream Salinity @ Catchment Outlet #
		(ha)	(ha)	(%)	mg/l (EC mS/m)
8	Base Case	12,530	0		2,200 (390)
9	Single deep drain linking existing drains	12,375	-155	-1	2,200 (390)
10	Vegetation	4,155	-8,375	-67	1,200 (215)
11	Combination of treatment options	4,000	-8,530	-67	1,180 (210)

Table Notes: As per Table 2

CONCLUSIONS

Based on the computer modelling results and discussions within the Steering Committee the following Strategies are proposed in the Kulin/Dudinin Catchment Plan.

The most effective option evaluated takes into account a combination of these strategies.

The strategies presented below should allow for a slowing down of the rate of salinisation that is expected to occur within the catchment.

The ongoing impacts of salinisation on surface water quality can be managed such that surface water values may be kept within the range of 1100 to 2000 mg//l in the lower part of the catchment as long as drainage from salinity effected areas is kept and discharged or treated separately.

Table 5

Modelling Observation	Strategy
Deep Drains add a lot of salt to surface waters during periods of low flow . An order of magnitude more salt compared to "do nothing".	Drained water discharge needs to be separated from surface water and disposal options need to be found i.e. evaporation basin/salt lake or diversion.
Deep Drains can have a significant affect on reducing areas with high water tables but effectiveness is dependant on soil type, extent of area to be drained and drainage spacing.	Introduce deep drains where benefit\cost ratios are favourable taking into account arterial drain and disposal options and costs.
Saltland Perennial System have potential to have a significant affect on reducing area with high water tables.	Plant saltland perennial pastures into areas that are showing signs of being salt affected and that are not feasible to drain.
Deeper rooted vegetation (crops and trees) have a moderate affect on reducing area with high water tables.	Promote and implement deeper rooted vegetation into farming systems of the whole catchment.
Future rainfall has a significant affect on the areas with high water table. Both annual amount and temporal pattern of rainfall are significant.	An adaptive management strategy (based on rainfall or groundwater level) would be beneficial in terms of when and where salinity management actions should be triggered/ activated.

Table 5 Continued…

Modelling Observation	Strategy
Surface water management can be useful in reducing future land salinisation however the modelling showed this had a minor impact. This process is not well represented in the model and therefore the importance maybe underestimated.	Promote the use of improved surface drainage to minimise the amount of water laying around after runoff events. This should have benefits for improved water quality and reduced crop water logging, and possibly to a lesser extent reducing the spread of land salinisation.

THE WAY FORWARD

A number of considerations remain to be discussed in taking the Plan forward. These include:

- Consensus as to an agreed strategy from landowners and stakeholders.
- Formulation of a suitable governance model.
- Identification of funding sources for both capital works, governance and maintenance.
- Environmental assessment and approvals associated with a larger drainage scheme discharge.
- Consideration of trials, monitoring and evaluation of options implemented..
- The development of a Salinity Watch style program (ground water level monitoring) for the catchment.

SUMMARY OF 4 OPTIONS UNDER CONSIDERATION

OPTION 8 MAKE NO CHANGES TO CURRENT PRACTISES

What is the option?

This is the "do nothing" option. The existing drains remain blocked and no other management changes are made in the catchment to address the further onset of salinity changes into the future.

Impacts on Salinity

The growth of salinity in the catchment will continue as the water table rises. From 2007 it is predicted that the area of salt effected land could increase from 4,100 ha to approximately 8,000 ha by 2030. Future rainfall will influence the rate of spread.

Impacts on Surface Water Quality

Some increase in stream water salinity is still expected as areas of salinity grow within the valley floor of both creek systems.

OPTION 9 –ENGINEERING OPTION

What is the option?

Deep drains covering an area of 4100 ha linked by transport drains running parallel to Dudinin Ck and extending down to upstream of Commonwealth Road (potential site of a detention basin) or further downstream. To be constructed in stages over a number of years.

Impacts on Salinity

While this scenario has only a minimal impact on slowing salinisation in the catchment overall for the individual land holders there will be a relatively rapid response in land adjacent the deep drains. Deep drains effectiveness is dependant on soil type and drainage density (spacing).

Impacts on Surface Water Quality

Disposal of the drain discharge is an issue. This option addresses this by allowing for several possibilities including; keeping surface and groundwater flows separate, locating a detention basin site near Commonwealth Road, using a shallow transfer drain or carrying the discharge further on into the Lockhart River drainage system.

SUMMARY OF 4 OPTIONS UNDER CONSIDERATION

OPTION 10 – VEGETATION

What is the option?

Areas identified as at risk by 2030 to be treated with a 10% tree (e.g. Oil Mallee), 20% perennial plants (e.g. Lucerne), and remainder continuous cropping system e.g.

Salinity Type 1: Saltbush - block planting

Salinity Type 2 & 3: Saltbush alleys with pasture in between

Salinity Type 4: Reduced Recharge Vegetation System: Oil Malees, Perennial Pasture, Cropping option

Rest of Catchment: Cropping systems that reduced recharge.

Impacts on Salinity

The modelling shows that a vegetation only approach can have a significant impact in reducing the rate of salinisation. Experience elsewhere shows it will take at lest 5 years before this option will deliver significant results.

Impacts on Surface Water Quality

The modelling also indicated that this approach will limit impacts on the salinity of surface and groundwater subject to the natural increases expected as areas of salinity grow within the valley floor.

OPTION 11 - COMBINATION

WHAT IS THE OPTION?

A combination of drains and vegetation.

Impacts on Salinity

The area of predicted salinity will be in the order of 8,530 ha compared to were no management actions is taken of 12,530 ha and 4,100 ha in 2007.

Impacts on Surface Water Quality

The modelling also indicated that this approach will limit impacts on the salinity of surface water subject to the natural increases expected as areas of salinity grow within the valley floor.

The option reflects a "whole of catchment" response and meets the key objectives set for the Management Plan.