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Lucerne is it for me? Participants notes

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INTRODUCTION TO SALINITY

WORKSHOP MANUAL FOR PARTICIPANTS

Introduction to salinity

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ACKNOWLEDGMENTS

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Developed and compiled by Trevor Lacey, Department of Agriculture, Northam WA.

January 2005

Cover Picture
Saltland at Green Hills WA (2003)

These participant notes cover all of the topics discussed and overheads presented within the workshop, with space to add your own comments.

Worksheets provide space for answering questions relating to activities carried out.

These notes are a record of your discussions and any conclusions developed out of this workshop.

Contents

QUIZ

Circle the correct answers for the following questions.

1) What is the major cause of new salinity in the wheatbelt of WA?

a) Flat landscape

b) Surface water run-off

c) Rainfall

d) Clearing

2) How much has leakage changed from pre-clearing native vegetation to post-clearing annual cereal crops in the WA wheatbelt?

a) pre 0 mm post 2 mm

b) pre 0.1–1.0 mm post 6–60 mm

c) pre 10 mm post 100 mm

3) What is the average percentage of cleared land in the wheatbelt of WA affected by salinity?

a) 5%

b) 9%

c) 15%

4) What is the projected growth in total salinity area by 2050+ as a percentage of total cleared land?

a) 7%

b) 20%

c) 30%

5) What is the major origin of the salt causing secondary salinity?

a) Underground aquifers

b) Rainfall

c) Atmosphere

6) In what part of the soil profile is most salt stored?

a) Pallid (clay) zone

b) Aquifers

c) Soil surface

7) What are the respective amounts of salt deposited annually WA?

a) coast 1000 kg/ha/yr inland 40 kg/ha/yr

b) coast 200 kg/ha/yr inland 20 kg/ha/yr

c) coast 30 kg/ha/yr inland 10 kg/ha/yr

8) What percentage of a catchment needs planting to perennials to make a big difference to salinity in the wheatbelt?

a) 25%

b) 40%

c) 60-80%

9) On average, how much salt per hectare is stored in the ground in the wheatbelt?

a) 2-3 t/ha

b) 20-30 t/ha

c) 200–21,000 t/ha

AGENDA

Time	
8:30	Energiser: Aims of workshop
8:45	Quiz: Where salt comes from? What causes secondary salinity? Leakage calculator.
9:30	How hydrology interacts with geomorphology to create salinity?
9:45	Activity - What characterises the local landscapes?
9:45	Salinity risk at a local landscape level (What is happening in my area?).
10:15	Model results from Flowtube and AgET and land monitor predictions.
10:30	Break: morning tea
10:50	What is the risk at the landscape level (land monitor)?
11:15	Soil types and landscapes with the greatest risk of salinisation?
11:25	Identify symptoms of current salinity and signs of potential salinity
11:30	How salinity is expressed in association with soil types and landforms
11:40	Landscape map analogy for PURSL What units are used to measure/describe salinity? Optional
12:00	Pre–field Activity
12:30	Field Trip Including lunch on bus
14:00	The effect of salinity on farm production and profitability
14:05	Waterlogging salinity interactions
14:20	Assess the salinity risk for your farm land – Cost of doing nothing
14:45	Preliminary appraisal of major potential management options for your business Optional workshops - Introduction to the STEP Workshops, Deep drainage – Is it for me? Surface water management – Is it for me?, Lucerne – Is it for me?, Perennial grasses – Are they for me?, Grazing saline land – Is it for me?
14:55	Summary of day
15:00	Evaluation
15:10	Close – Where to from here?

Slide 1.

Introduction to salinity

Slide 2.

Housekeeping

- Emergency exits
- Ground rules for discussion
- Tea, coffee
- Toilets etc.
- Mobile phones turned off

1. Introduction

General

This is the first in a series of workshops looking at dryland salinity and options to manage it. These 'Million hectares' workshops have the common themes of environmental improvement. They provide information to help participants identify the risks within the catchment and at a farm level, assess both the likelihood of the risk occurring and consequences if the risk is not managed and determine the best course of action for individual. Participants will determine their courses of action based on their specific circumstances and goals. There is no one recipe that is suited to all participants.

The Participants Notes when completed should provide a documented record of the risks, their likely impact and planned activities to manage their risk.

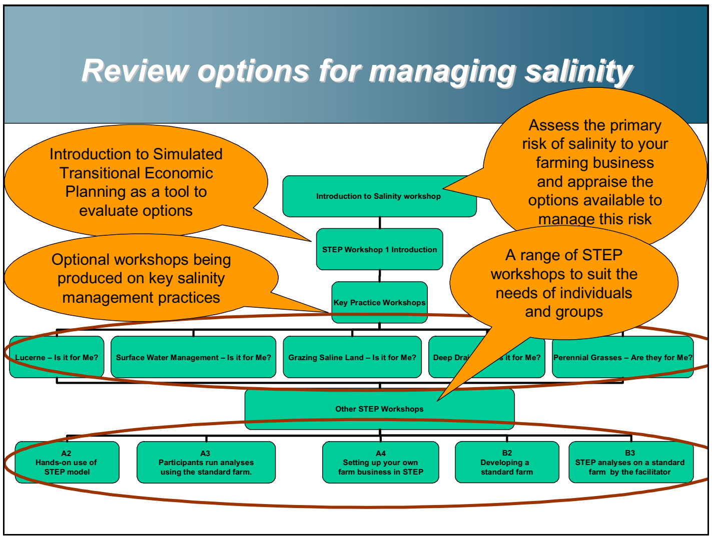
Outcomes for participants

By the end of this workshop, participants will have made an initial assessment of the risk of salinity to their farming business and be aware of some options available to manage that risk.

Participants will be able to:

- Understand of the broad cause and risk of salinity at a landscape level;
- Recognise symptoms of salinity and potential for salinity;
- Calculate of the potential effect of salinity on farm production and profitability;
- Assess the risk of salinity to the farm;
- Identify a number of potential management options.
- Understand the need to develop a transition strategy for adoption of new management options.

Slide 3.



Slide 4.

Outcomes for Participants

Slide produced by: T Lacey

Assessment of risk of salinity to farming business
Awareness of some options to manage risk

- **Understand the cause and risk of salinity**
- **Recognise symptoms and potential for salinity**
- **Calculate implications to production and profitability**
- **Assessment of risk of salinity to your farm business**
- **Identify some potential management options**
- **Understand the need to develop transition strategies**

2. Understanding the cause of salinity

Where does salt come from?

Salt store

Salt store increases as you go east due to the low landscape relief, more sluggish drainage and greater depth of regolith.

- Pre-clearing recharge was in equilibrium with discharge from the system to drainage lines and salt lakes etc. This would have been greater than zero (depending on the season) and generally less than 1 mm. Post-clearing recharge under well-grown cereal crops in the wheatbelt of WA will vary depending on soil types and season but is likely to be in the order of 10-60 mm (equivalent of 10-60 L/m^2 leakage).
- Following clearing and the further expansion of groundwater systems, increasing recharge and rising watertables have dissolved this salt and concentrated it downstream.
- When saline watertables get to within 1–2 metres of the soil surface (depending on soil properties), capillary rise can transport the dissolved salts into the root zone affecting plant growth and leading to the development of salinity.
- A new equilibrium will be reached when the area of discharge from the watertable has expanded to compensate for the increased level of recharge to the system created by the change in vegetative cover etc.

Slide 5.

Where does salt come from?

Slide produced by: T Lacey

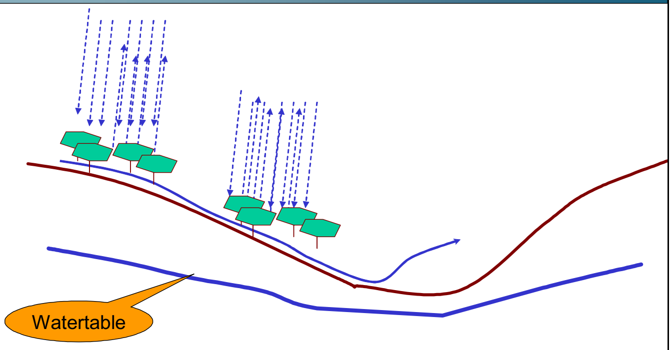
1. Main source - deposited by rainfall over tens of thousands of years
   - 20–200 kg/ha/yr is deposited each year

2. Other sources are:
   - Weathering of minerals in the underlying bedrock
   - Salts in alluvium originating as marine sediments (not in wheatbelt)

Slide 6.

Equilibrium

Slide produced by: T Lacey



What causes secondary salinity?

Comparison of native vegetation to farming systems

Perennials are growing for 12 months of the year over a number of years.

- Summer growth provides the ability to utilise summer rainfall developing a soil moisture buffer prior to winter. The difference between the soil moisture following perennials compared to annual species is the size of the buffer. The soil can hold this additional amount of moisture before leakage to the groundwater system occurs.
- Deep-rooted – Perennials grow for a number of seasons extending their roots down into the soil profile. This enables them to penetrate deeper, using more water from greater depth and creating a greater soil water buffer.
- Diversity – a range of species creating a canopy and understorey, providing greater interception of both light and rainfall.
- High leaf area index (LAI) year-round - this is basically the size of the pump that drives the water extraction from the soil profile by the roots. The greater the leaf area index the greater the pump. Perennials maintain their LAI throughout the year where as annuals' leaf area index drops away to zero when the plants die off. Evaporation will continue to remove moisture from the soil in summer through capillary rise providing there is moisture to the surface. Once the surface layers dry out capillary action will cease.
- High water-using systems aim to mimic features of native vegetation, not to replace it. It is realised that replanting up to 80% of the landscape to trees is not a current option for profitable agriculture.

Mimicking the natural system

This includes being able to use water, preventing recharge and nitrate leaching (reducing development of acidity), preventing wind and water erosion and protecting soil structure.

To help manage watertables, we need management systems that can mimic the function of native vegetation without replanting it. Without high value plantation options available for most of the wheatbelt, planting large proportions (60–80%) of farms back to woody perennial vegetation is unrealistic. Profitable options that mimic some of the functions of the previous remnant vegetation are needed to enable farming to continue on the majority of land.

Slide 7.

What causes secondary salinity?

Slide produced by: T Lacey

- Salt stores in regolith - 200–21,000 t/ha
- Recharge increased dramatically after clearing
- Groundwater risen and saline areas have expanded
- It will take hundreds of years to flush salts from most cleared catchments
- New equilibrium
  - western areas 20-30 years after clearing
  - eastern areas 60-70 years after clearing
- Equilibrium - greater area of discharge compensates for recharge

Western (high rainfall) areas generally receive greater than 450 mm annual rainfall.
Eastern areas generally receive less than 350 mm annual rainfall.
There will be a gradual decline in rainfall from west to east.

Slide 8.

Causes of salinity

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What are the characteristics of native vegetation?

How have they changed with current farming systems?

harge
m/yr
mm/yr

High recharge
23-65 mm/yr
6-65 mm/yr

Currently ared land is saline and could double in next 20 years

What are the characteristics of native vegetation?

How have they changed with current farming systems?

Slide 9.

Slide produced by: T Lacey

Mimic the function of native bush

- **Water-use (prevention of recharge, nitrate leaching)**
- **Wind and water erosion prevention**
- **Soil structure**

Local situation - vegetation remaining

The area of remnant vegetation in the WA wheatbelt is generally low, ranging from 5 to 10%. The vegetation remaining is generally fragmented and lacking genetic diversity. It is often found on hilltops or along drainage lines.

Leakage from crops and pastures compared to perennial vegetation

The Leakage Calculator shows leakage (in mm/yr) for a range of land use options over a number of common soil types for the region. The level of leakage is indicated as being high, medium or low, based on total mm leakage and the permeability of the soil. If the drainage on a soil is low, a small amount of leakage will eventually fill it up whereas the same leakage on a more permeable soil will drain from the system. The total mm of drainage coming from different parts of the farming system are based on soil types and cropping rotations (calculated by AgET).

Note: The figures for leakage as a percentage of annual rainfall are only an indication based on average season's rainfall and standard soil and crop parameters. It is valid to look at the relativities between rotations and soils but the figures should not be treated as actual leakage. In low rainfall years leakage will be reduced and may be low even under annuals; in high rainfall years even the perennials can't use all of the rainfall immediately.

The main difference in leakage is between bare soil, annual crops or pasture, and perennials. The differences in water use between different annual crops and pastures are generally quite small in comparison and will vary from year to year. No one annual crop is likely to be significantly better or worse than another. However, failed crops and bare soil will have significantly higher leakage.

Slide 10.

Causes of salinity - vegetation

Slide produced by: T Lacey

Remnant vegetation remaining:

- **5.1% West Mortlock (Goomalling-Dalwallinu)**
- **4.8% East Mortlock (Meckering-Koorda)**
- **2.7% Green Hills area.**

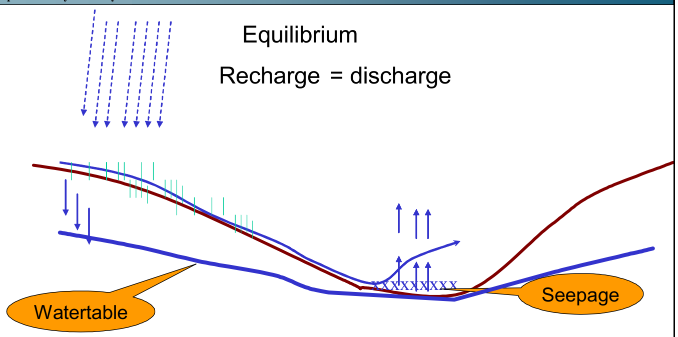
Management options need to

- ***↑ long-term sustainability***
- ***Manage range of resource issues***
- ***Integrated suite of options***

What is the area of remnant vegetation around Green Hills?

Slide 11.

Slide produced by: T Lacey



Slide 12.

Leakage from crops and pastures compared to perennial vegetation

Slide produced by: P Raper

Central Wheatbelt
Soil-Landscape Zone 258
Representative Location Cunderdin
MAR (mm) 370

Rotations
B bare soil
C crop
P annual pasture
Se serradella
G perennial grasses
Lu lucerne
OM oil mallees
S salt bush

Major annual & perennial plant types

Major soil groups in the area

Choose the calculator for your area

Soil Type	Soil Group	LEAKAGE (mm.yr^{-1})							
		B	C	P	Se	G	Lu	OM	S
S1 - Poor sands	446	157	44	51	36	23	7	0	6
S2 - Average sandplain	464	141	37	42	30	14	8	0	5
S3 - Good sandplain	303	109	13	18	13	3	1	0	3
S4 - Shallow duplex soil	502	35	9	13	13	5	0	0	0
S5 - Medium heavy	463	82	7	14	7	5	2	0	1
S6 - Heavy valley floors	542	48	3	5	5	0	0	0	0
S7 - Sandy surfaced valleys	402/404	70	13	18	18	0	0	0	0
S8 - Deep duplex soil	407	76	9	13	13	2	2	0	2

Max. leakage rate: 157 mm

Typical leakage in mm already worked out

Colours indicate high, medium or low leakage rates per unit area

High Leakage - greater than 5% of MAR or greater than 10% of MAR for
Moderate Leakage - 2.5% to 5% of MAR or 5% to 10% of MAR for permeable
Low Leakage - less than 2.5% of MAR or less than 5% of MAR for permeable soils

Buffers created by perennials

When we refer to buffers in soil water created by perennials we are referring to the difference in soil water content under a perennial plant compared to the content under an annual crop or pasture. This buffer is the amount of extra water that can be accommodated before leakage below the plant roots will occur.

The length of time that the buffer lasts is dependent on the soil type and the run of seasons. A buffer of 150 mm in the Northam Shire will last from as little as one year to as long as 18 years (with an average of five years) depending on the run of seasons and soil types.

It is important that the length of the cropping phase following three years of lucerne be modified to accommodate the run of seasons and specific soil types rather than cropping for a set period.

Slide 13.

Leakage from crops and pastures in terms of mean annual rainfall

Slide produced by: P Raper

Central Wheatbelt	
Soil-Landscape Zone	**258**
Representative Location	**Cunderdin**
MAR (mm)	**370**

Rotations

B	bare soil
C	crop
P	annual pasture
Se	serradella
G	perennial grasses
Lu	lucerne
OM	oil mallees
S	salt bush

Typical leakage as a % of mean annual rainfall (MAR) is already worked out

Soil Type	Soil Group	LEAKAGE (% of MAR)							
		B	C	P	Se	G	Lu	OM	S
S1 - Poor sands	446	42	12	14	10	6	2	0	2
S2 - Average sandplain	464	38	10	11	8	4	2	0	1
S3 - Good sandplain	303	29	4	5	4	1	0	0	1
S4 - Shallow duplex soil	502	9	2	4	4	1	0	0	0
S5 - Medium heavy	463	22	2	4	2	1	1	0	0
S6 - Heavy valley floors	542	13	1	1	1	0	0	0	0
S7 - Sandy surfaced valleys	402/404	19	4	5	5	0	0	0	0
S8 - Deep duplex soil	407	21	2	4	4	1	1	0	1

High Leakage - greater than 5% of MAR or greater than 10% of MAR for permeable soils
Moderate Leakage - 2.5% to 5% of MAR or 5% to 10% of MAR for permeable soils
Low Leakage - less than 2.5% of MAR or less than 5% of MAR for permeable soils

Slide 14.

Buffers created by Perennials

Slide produced by: T Lacey

Input data	
Years of perennial (0-5)	3
Max buffer developed by perennial (mm)	150
% of buffer developed in year 1	50
% of buffer developed in year 2	85
% of buffer developed in year 3	100
Years of crop (0-10, v for variable until buffer is filled)	v
Any extra water use by crops (mm)	10

LeBuM

Output Data					
Location	Northam	Northam	Northam	Northam	Northam
Soil Type	Acid loamy sand	Clay	water-logging duplex	Loamy sand	Deep sand
Average Leakage under annuals (mm)	69.1	37.7	37.8	36.7	98.6
Average leakage under new rotation (mm)	25.1	19.9	15.6	13.5	16.3
Average years of crop before buffer is filled	3.3	5.2	5.5	5.2	2.5
Minimum years of crop before buffer is filled	1.0	1.0	3.0	1.0	1.0
Maximum years of crop before buffer is filled	9.0	18.0	11.0	17.0	6.0

Source :Lucerne Buffer Model (LeBuM) developed by Phil Ward CSIRO

Slide 15.

Leakage on Farm

Slide produced by: T Lacey

Prioritise paddocks in relation to leakage "Risk"

Paddock	Area Ha	Land Use C, P, Lu, WP	Main soil type	Rating Soil Type X Rotation	Priority Paddocks
Example Back paddock	40	C	Deep Sand	H (21% leakage)	1
1 ………………..					
2 ………………..					
3 ………………..					
4 ………………..					
5 ………………..					

Farm details
What is your % of annuals?
What are your main rotations?
Would you class your farm in the High, Medium or Low Leakage category?

Rotations: C = crops (annual), P = pasture (annual), Lu = lucerne (perennial pastures), WP = woody perennials

Worksheet - Priority paddocks based on leakage
(Fill in some paddocks on your farm based on the Leakage Calculator output below).

Paddock	Area (ha)	Rotation C, P, Lu, WP	Main soil type	Rating soil type X rotation	Priority paddocks
Example Back paddock	40	CP	Deep sand	H (21% leakage)	1
1 ………………..					
2 ………………..					
3 ………………..					
4 ………………..					

C=crop, P=pasture, Lu=lucerne, WP=woody perennials

Table 1. Leakage Calculator output

Central Wheatbelt	
Soil-Landscape Zone	**258**
Representative Location	**Cunderdin**
MAR (mm)	**370**

Rotations

B	bare soil
C	crop
P	annual pasture
Se	serradella
G	perennial grasses
Lu	lucerne
OM	oil mallees
S	salt bush

Soil Type	Soil Group	LEAKAGE (% of MAR)							
		B	C	P	Se	G	Lu	OM	S
S1 - Poor sands	446	42	12	14	10	6	2	0	2
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S3 - Good sandplain	303	29	4	5	4	1	0	0	1
S4 - Shallow duplex soil	502	9	2	4	4	1	0	0	0
S5 - Medium heavy	463	22	2	4	2	1	1	0	0
S6 - Heavy valley floors	542	13	1	1	1	0	0	0	0
S7 - Sandy surfaced valleys	402/404	19	4	5	5	0	0	0	0
S8 - Deep duplex soil	407	21	2	4	4	1	1	0	1

Red	**High Leakage - greater than 5% of MAR or greater than 10% of MAR for permeable soils**
Yellow	**Moderate Leakage - 2.5% to 5% of MAR or 5% to 10% of MAR for permeable soils**
Green	**Low Leakage - less than 2.5% of MAR or less than 5% of MAR for permeable soils**

Summarise for the whole of farm!

What is your % CROP and PASTURE? Crop %, Pasture %

What are your main rotations?

What main soil types do you have?

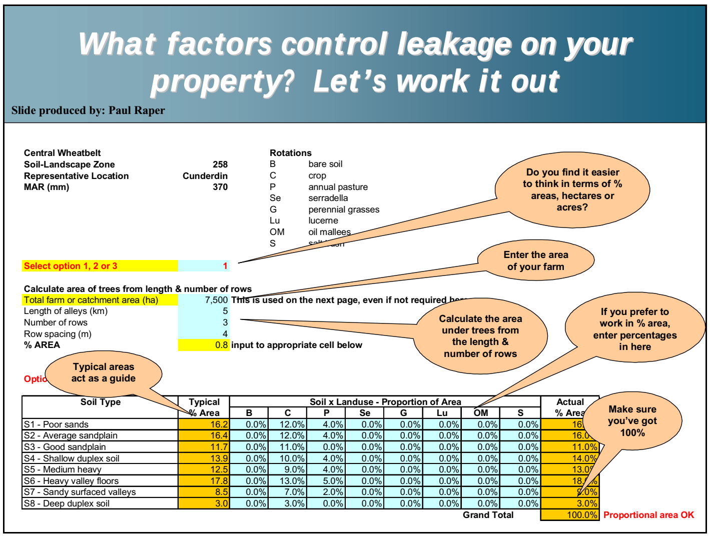
What percentage of your farm would be High, Medium and Low leakage categories?

% High =

% Medium =

% Low =

Slide 16.



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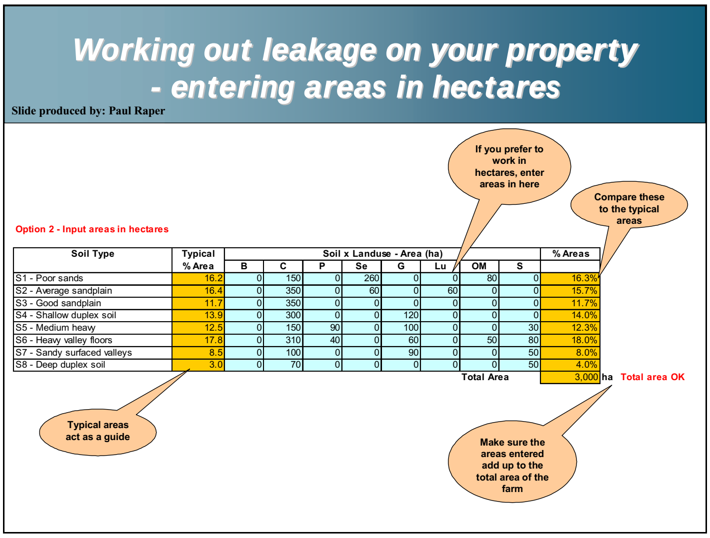

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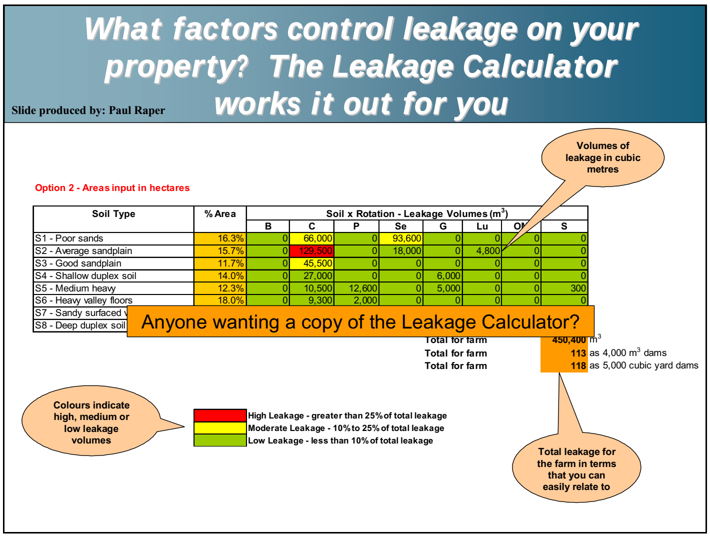


The Leakage Calculator is available from the Department of Agriculture website.

How hydrology interacts with geomorphology to create salinity

Piezometers and aquifers

A perched aquifer/groundwater is an unconfined aquifer (in a saturated condition) near the soil surface and separated from deeper groundwater by unsaturated materials. These are often shallow, thin and ephemeral (temporary) and sit on top of materials with low permeability.

An unconfined aquifer has no aquitard (barrier) above it. The watertable may rise or fall freely as water enters or leaves the aquifer.

A semi-confined aquifer is overlain by a layer that partly restricts the upward movement of water.

Landscape x hydrology - common scenarios

Valley floor - Lateral movement of water may be particularly slow depending on soil types, saprock (mm/yr).

Watertable rise will increase the area of shallow watertables and the potential for salinity. Shape of the valley will impact on the rate of spread of salinity.

Broad flat valley floors may have a mound in the watertable under them. This is thought to result from being cleared for longer (often the better soils that were cleared first) and the additional water received as run-on from other parts of the catchment. These areas also tend to have low hydraulic conductivity with lateral movement of water through them often only being in the order of several millimetres per year. Managing recharge on these at risk-areas (with watertables at depths of 3 to 5 m) is likely to significantly delay the development of salinity on them.

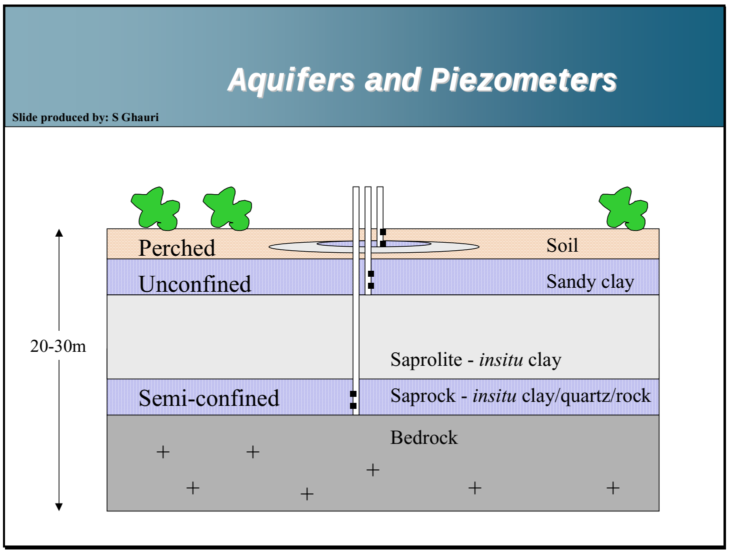
(See Reference: R.J. George *et al.*)

Break of slope - Water is often forced to the surface by a reduction in the slope of the watertable or through a constriction of the watertable (reduced thickness or transmissivity of the aquifer).

This area will often receive run-on from the slopes.

Geological constrictions - Where many structures are present, the catchment may be compartmentalised. The benefit/cost of treating compartments can often be considered separately. Where high value infrastructure is present the value from preventing watertable rise will be greatest. Structures may be seen by rock formations or by change in soil types.

Slide 19.



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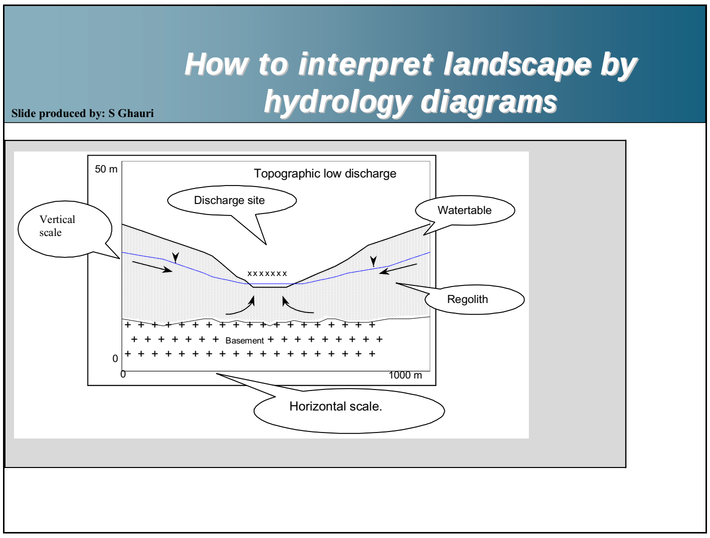

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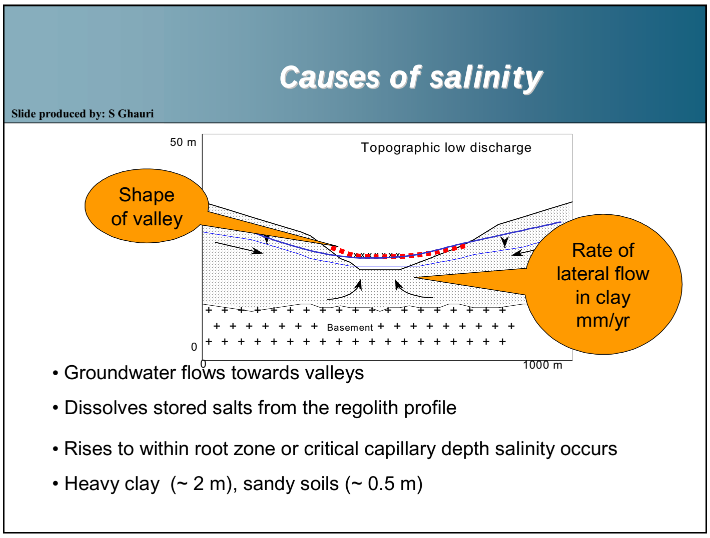


Typical landscape x hydrology common scenarios

Valley floor

What characterises the local landscapes?

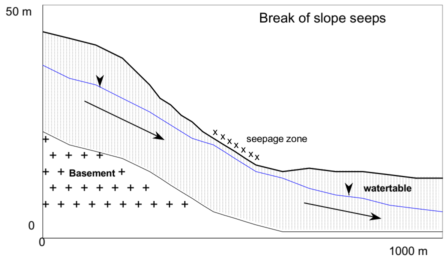
Worksheet 1 - Hydrology, hydrogeology, soils and recharge on them

What is the magnitude of the salinity problem on your farm and in your local area?	
Is it changing and at what rate?	Hill-sides:
	Valleys:
How deep are the watertables?	Hillsides:
	Valleys:
Are they rising and at what rate?	Hillsides:
	Valleys:
How does this relate to the future development of salinity in the area?	
List examples of salinity in the catchment that are associated with the various landscape scenarios?	

Slide 22.

Causes of salinity

Slide produced by: S Ghauri



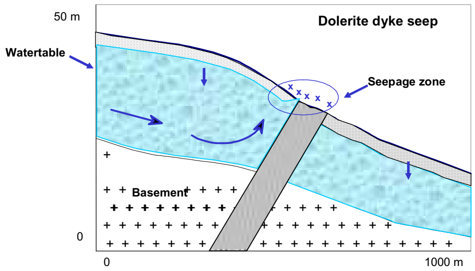
- Groundwater flow is restricted by aquifer transmissivity(deep) or aquifer thinning (perched/sandplain) and expresses itself at the surface
- Many areas of salinity are caused by surface water problems (e.g. roads, small culverts, inundation from slopes without earthworks etc.)

Break of slope - Reduced transmissivity or thinning of the aquifer.

Slide 23.

Causes of salinity

Slide produced by: S Ghauri



Groundwater is unable to flow past geological constriction and builds up until it nears the surface

Geological constrictions.

Man-made structures such as roads may have an impact on hydrology.

Slide 24.

Summary of causes of salinity

Slide produced by: T Lacey

- Recharge levels increase dramatically post-clearing
- Salt stores in regolith around 200–300 t/ha (increasing as you go east)
- Estimated to take hundreds of years to flush salts from most cleared catchments
- Groundwater risen and salinity expanded - recharge
- Equilibrium in western areas - 20-30 years, eastern areas 60-70 years (area of discharge is great enough to compensate for recharge)

3. Recognising salinity

Flow Tree for Evaluating the Risk of Salinity and Determining Management Options Available to Farmers

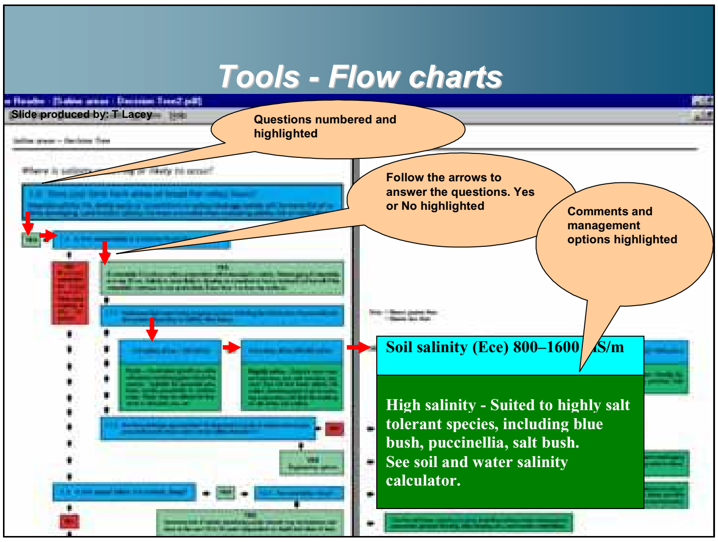
This salinity decision tree has been designed as a tool that can be used to help follow through a logical process when considering the on-farm risk of salinity and subsequent management options available. Before committing to management options it is important to review future objectives and priorities for the farm. **(See Flow Tree handout.)**

- How do you envisage your farm will look in the short (0-5 yr), medium (6–20 yr) and long-term (21+ yr)?
- What are your current objectives for the farm in regard to long-term sustainability (i.e. maintaining status quo, short-term profitability etc.)?
- What are the priority issues with regard to resource management on the farm? (wind erosion , water erosion, soil acidity, soil structure decline, waterlogging or salinity etc)?
- What is your current ability to invest in long-term objectives? (Are there short-term imperatives that need to be adressed as a high priority?)

The options listed are suggestions only and may not be suitable under all situations. More detailed information on all of the options is available through your local Department of Agriculture, private industry or some grower organisations - do your homework.

Not only is it important to look at “what” management option is suitable BUT also “how” it is introduced to the current farming system. How you introduce a new management option can significantly affect the profitability of the farm.

Slide 25.


Tools - Flow charts
Slide produced by: T Lacey
Questions numbered and highlighted
Follow the arrows to answer the questions. Yes or No highlighted
Comments and management options highlighted
Soil salinity (Ece) 800–1600
High salinity - Suited to highly salt tolerant species, including blue bush, puccinellia, salt bush.
See soil and water salinity calculator.

Salinity risk at local landscape level (What is happening in my area?)

All bores shown in Figure 1 have rising trends with greatest rate of rise at the lower and mid-slopes where salinity is yet to develop. Slight reductions in piezometric heads will be measured following dry seasons. MO3D has no statistical correlation with either rainfall or time variables suggesting it is affected by local subsurface variables (e.g. preferred pathways or impermeable barriers).

Based on information from other catchments in the area, salinity in the deeper saprock aquifer is likely to vary from brackish to saline across the catchment, with valley floor salinity being highest. The slightly higher relief areas mainly form local flow systems that may have groundwater of suitable quality for most livestock purposes.

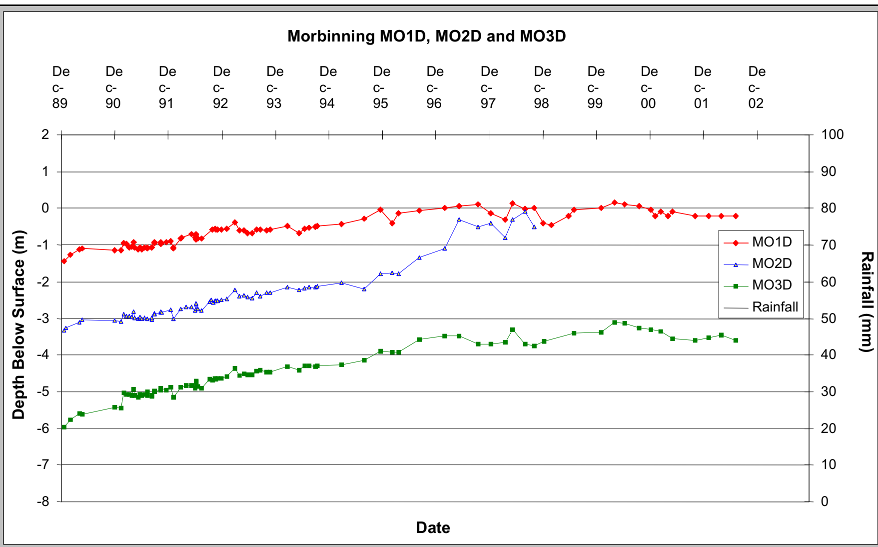
Groundwater systems in the catchment can be categorised into local and intermediate flow systems, depending on their area of influence, recharge/discharge characteristics and the ease with which they can be perturbed by land management practices.

- Local flow systems are typically unconfined (perched) aquifers (principally in deep sands, shallow sands, sandy earths and deep and shallow sandy duplexes) or semi-confined (saprock) aquifers localised by geological structures such as bedrock highs or dolerite dykes. The intermediate flow systems comprise the deeper continuous saprock aquifer that extends over most of the catchment.
- Local flow systems are often linked to intermediate flow systems by both matrix and preferred pathway recharge mechanisms. Local flow systems are more apparent in the higher relief, more compartmentalised western catchment area. They are generally more responsive to strategies that attempt to remediate groundwater rise at a paddock scale than intermediate flow systems.
- Unconfined (perched) aquifers, particularly the shallow and deep sandy duplex soils in lower slope and valley floor landscape positions, contribute significantly to waterlogging. Most unconfined aquifers (except those with a base of competent rock) also contribute to recharge of intermediate semi-confined aquifers (George and Conacher 1993).
- In these local flow systems, rainfall primarily contributes to the unconfined (perched) aquifer of duplex soils and discharges further downslope in ephemeral streams. A portion of this unconfined water will contribute to the deeper semi-confined intermediate flow system via preferred pathway recharge.
- Significant elevation difference along a confined or semi-confined aquifer increases the groundwater pressure head of the lower sections of the aquifer. In artesian systems, the pressure head in the down-gradient section of the aquifer is above the

ground surface, and a free flowing well may establish. Semi-confined aquifers, particularly in zones of groundwater convergence, can yield stock quality water between 50 and 250 m^3 per day (George 1991).

- Continued salinisation in the catchment will occur where:
  1. Groundwater levels become sufficiently shallow enabling evaporation of the capillary fringe and salt concentration at the surface, as is the case in most valleys.. The rate of capillary rise and height of the capillary fringe depend on soil type.. Capillary rise may occur in fine-textured (heavy) soils when the water level is within 2 m of the surface (e.g. clays can have a 2 m capillary fringe). In coarse-textured soils, the capillary fringe is much thinner and so evaporation and salt concentration may only occur when the watertable is much shallower.
  2. An area is seasonally inundated or becomes waterlogged. Over time, the reconcentration of fresh to brackish surface and soil water will lead to the accumulation of moderate to high levels of salt through evaporation.
  3. Coarse-textured unconfined aquifers terminate over an impermeable layer (e.g. duplex subsoil) allowing water to seep to the surface and evaporate, leaving behind salts. Sandplain seeps will be more common in the west of the catchment.
  4. Bedrock and geological structures (such as dykes) act as barriers to groundwater flow, resulting in groundwater accumulation and subsequent rise towards the surface.

General information for the South-West of Western Australia shows that shallow piezometers located near discharge zones typically have little variation in water levels due to evaporation and use by vegetation (equilibrium). Deep piezometers intercepting semi-confined aquifers in similar locations often display rates of rise in the order of 10 cm/year, possibly signifying the presence of an upward vertical hydraulic gradient that may ultimately increase discharge area. Upper and mid-slope catchment areas where recharge dominates usually have groundwater rise in the order of 30 cm/year. With the general exception of shallow piezometers located in discharge areas, seasonal fluctuations of 0.5 to 1 m over an average rainfall season across different landscape positions are common, indicating groundwater response to individual recharge events- (see Mackie River RCA Report).

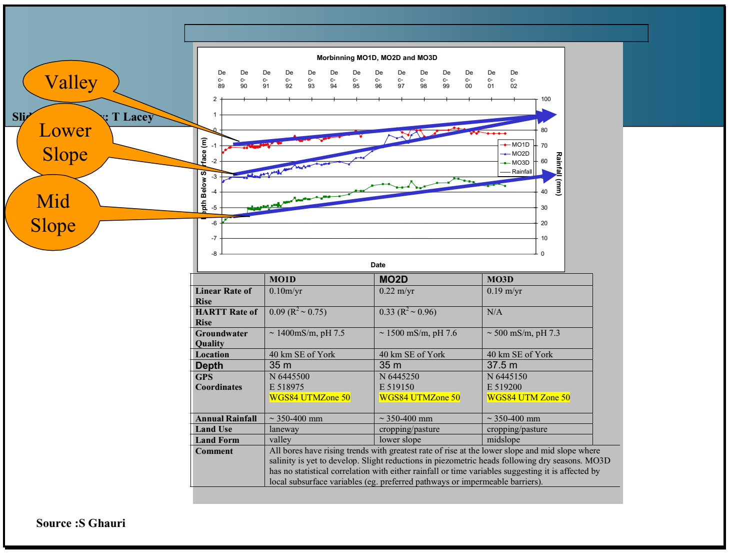


	MO1D	MO2D	MO3D
Linear Rate of Rise	0.10m/yr	0.22 m/yr	0.19 m/yr
HARTT Rate of Rise	0.09 (R^2 ~ 0.75)	0.33 (R^2 ~ 0.96)	N/A
Groundwater Quality	~ 1400mS/m, pH 7.5	~ 1500 mS/m, pH 7.6	~ 500 mS/m, pH 7.3
Location	40 km SE of York	40 km SE of York	40 km SE of York
Depth	35 m	35 m	37.5 m

Source Shahzad Ghauri

Figure 1. Example of local groundwater trends.

Slide 26.



	MO1D	MO2D	MO3D
Linear Rate of Rise	0.10m/yr	0.22 m/yr	0.19 m/yr
HARTT Rate of Rise	0.09 (R^2 ~ 0.75)	0.33 (R^2 ~ 0.96)	N/A
Groundwater Quality	~ 1400mS/m, pH 7.5	~ 1500 mS/m, pH 7.6	~ 500 mS/m, pH 7.3
Location	40 km SE of York	40 km SE of York	40 km SE of York
Depth	35 m	35 m	37.5 m
GPS Coordinates	N 6445500 E 518975 WGS84 UTMZone 50	N 6445250 E 519150 WGS84 UTMZone 50	N 6445150 E 519200 WGS84 UTM Zone 50
Annual Rainfall	~ 350-400 mm	~ 350-400 mm	~ 350-400 mm
Land Use	laneway	cropping/pasture	cropping/pasture
Land Form	valley	lower slope	midslope
Comment	All bores have rising trends with greatest rate of rise at the lower slope and mid slope where salinity is yet to develop. Slight reductions in piezometric heads following dry seasons. MO3D has no statistical correlation with either rainfall or time variables suggesting it is affected by local subsurface variables (eg. preferred pathways or impermeable barriers).		

Slide 27.

What's happening locally?

Slide produced by: T Lacey

- Hydrology - general trends likely to be up based on other catchments, no data
- Recharge - increased since clearing. Highest on sandy, gravelly and shallow duplex soils
- Long period since clearing - 100+ years - new equilibrium may have been reached?

Model results from Flowtube, AgET and Land Monitor predictions

It is important to note that altering farming systems to include some phased crop and perennial pasture rotations can significantly reduce recharge without major changes to the total area of crop and pasture. However, changing from continuous annual pasture to crop-annual pasture rotation or to continuous cropping will only reduce recharge slightly. The use of lucerne and woody perennials in farming systems is considered highly beneficial, as they use almost all of the annual rainfall. Surface water management and engineering options should be part of an integrated system developed for recharge management.

Note: Flowtube modelling cited in this report assumes a constant annual rate of recharge. It does not take into account episodic recharge (high rainfall/flood events which often results in watertables rising and not lowering to their previous, deeper levels). Another major assumption is that all strategies implemented take effect immediately with full potential e.g. lucerne is transpiring water at its full potential from the moment it is included in the program.

Recent modelling is suggesting

Specifically, farmers at most risk should not expect hill-slope recharge management to significantly influence the magnitude of their salinity risk. Valley farmers can provide their own *in situ* risk management, and "buy time" by recharge management. This provides a significant environmental and economic advantage to those at risk who currently have deep (say 3-5 m or more), but rising valley watertables

Slide 28.

Tools available to evaluate problem

Slide produced by: T Lacey

- Land Monitor maps - future and current salinity
- Flowtube modelling, AgET, Leakage Calculator
- Physical markers and local knowledge
- Vegetative indicators
- Soil test 1:5 EC
- Geophysics - EM38, EM31, magnetics, radiometrics
- Drilling/piezometers for groundwater

Slide 29.

Modelling - Flowtube, AgET (East Mortlock)

Slide produced by: T Lacey

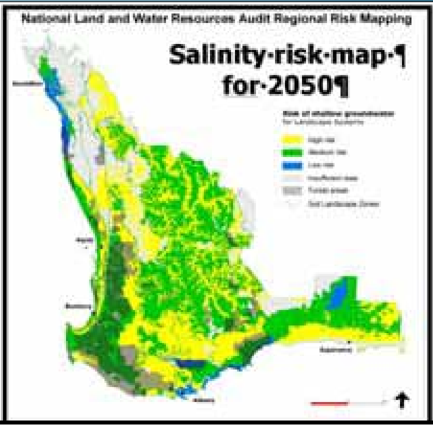
Four options for intervention

- **Do nothing -** Recharge under existing mix of rotations is estimated to be 11% of annual rainfall
- **Low intervention -** Reduce recharge to 9% of annual rainfall (perennials from 5 to 14% of catchment)
- **Moderate intervention -** Increase perennials to 19%, reduce recharge to 8% of annual rainfall
- **High intervention -** Recharge reduction of 50% could be achieved through widespread adoption of perennial pastures, alley farming, tagasaste and oil mallees

Slide 30.

Area of saltland in WA

Slide produced by: T Lacey



Source : Land moni

What is the risk at the landscape level (Land Monitor)?

Introduction to Land Monitor - Salinity maps

These maps show areas where salinity has reduced plant cover in the low-lying areas and valley floors. They indicate a comparison of the extent of salinity in the years 1987-92 and 1995-98. The method involves the processing of historic calibrated Landsat satellite imagery in conjunction with elevation data and ground information to identify areas of land that are salt-affected. They are not 100 per cent accurate, but are better than 90 per cent in the wheatbelt. There are two types of errors: saline areas with unusually dense vegetative cover, as in the higher rainfall areas and mid-slope seeps which are usually too small to be detected by remote sensing (omission errors); and non-saline areas are sometimes mapped as saline when they are located in valley floors and are consistently unproductive – examples are waterlogged, overgrazed, or somehow deficient soils (commission errors). So there are regular mistakes in the maps, but they give a reasonable view of where the main saline areas are. They probably shouldn't be used at paddock/farm scale, but are useful at catchment scale – i.e. 1:50,000.

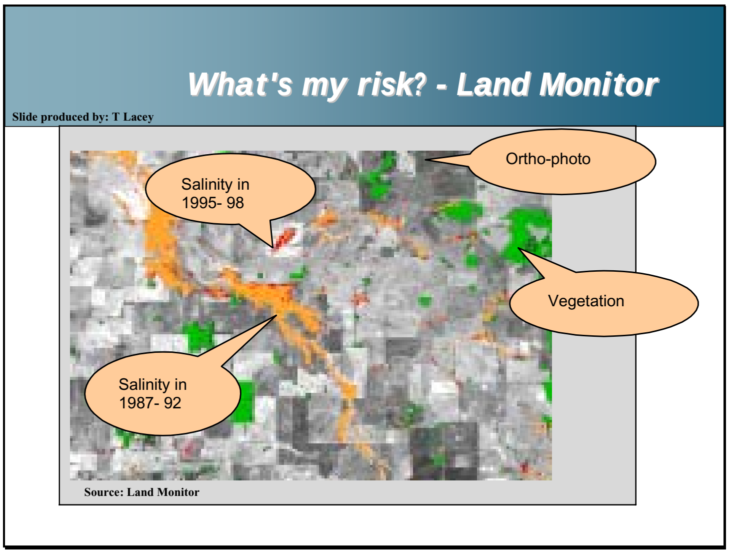
Ortho-photos - Aerial photos are rectified using digital elevation models to produce ortho-photos. Ortho-photos are suitable to produce maps down to 1:10,000 scale and in some cases 1:5,000 scale.

DLI (Department of Land Information) coverage of ortho-photography will be increased with new photography over the agricultural area from Land Monitor.

Land Monitor has identified valley floor areas where the risk from future shallow watertables is likely to be greatest by combining the location of current salinity, digital elevation model data and surface water accumulation models. These maps shouldn't be used at paddock/farm scale, but are useful at catchment scale – i.e. 1:50,000, and indicate areas for further investigation.

Areas mapped as being susceptible to a shallow watertable were done so by height above catchment water flowpaths. These areas accumulate water from the rest of the catchment. The lower sequence (0-0.5 m above flowpath) will be most vulnerable to a shallow watertable, followed in order by the rest of the sequence (Overhead 19). The area of upper catchment affected by shallow watertables caused by seepage, bedrock interaction and/or dykes is not included in the estimation.

Slide 31.



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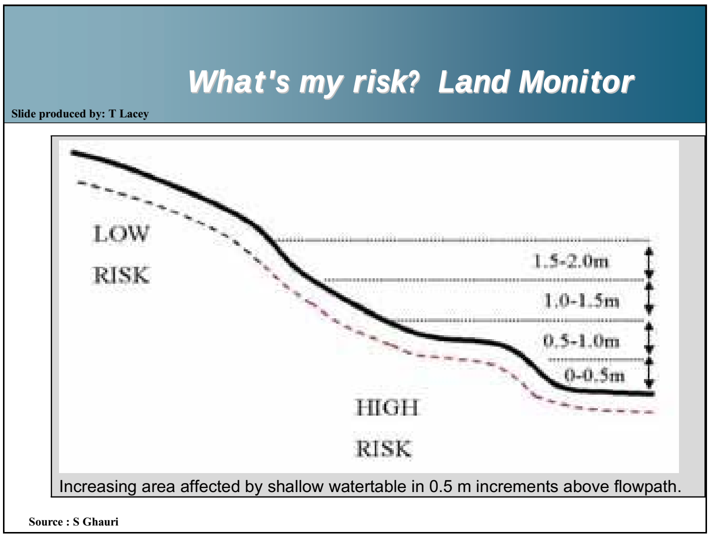

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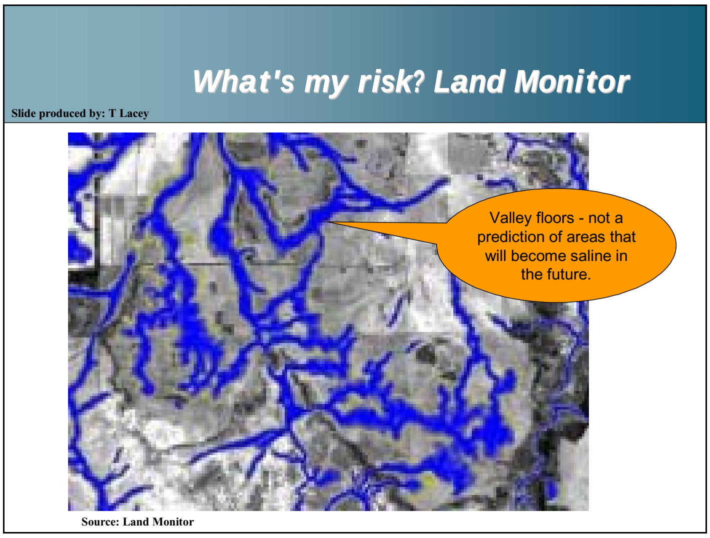


Blue areas on the map indicate valley floors but are not a prediction of areas that will become saline in the future.

Height above valley floor:

It is **important to note** that not all these areas will become saline, as soil variations and groundwater quality beneath these locations are critical factors in determining their susceptibility to salinity. For example, in some areas of the catchment, groundwater may be fresh and therefore pose no major threat. Also, areas mapped as at risk may have a deep sandy soil with minimal capillary fringe, thus preventing capillary rise from causing salinity, even over the longer term.

Valley hazard maps (Valley floor/low-lying area maps):

These are *not* "salinity risk maps"; nor do they identify areas with rising groundwater or watertables. They are topographical maps derived from digital elevation models (DEMs) and simply show low-lying areas. They show 'valley floors' where the country is reasonably dissected (so that surface water flowpaths can be identified), or where the country is so flat that it has basin drainage. Some of these valley floors/low-lying areas may become saline and/or waterlogged in the future, but that will be determined by a range of other hydrological factors. In many of the relatively stable parts of the wheatbelt, the groundwater may never rise close enough to the surface for salinity to express itself. By themselves, these maps are not a useful indicator of areas of hydrological risk, but when other layers of hydrological information are added, they can become a useful indicator. These maps are also useful in defining the general shape of the landscape, and showing where catchment divides occur (particularly in non-rejuvenated landscapes where slope-changes are difficult to determine by eye).

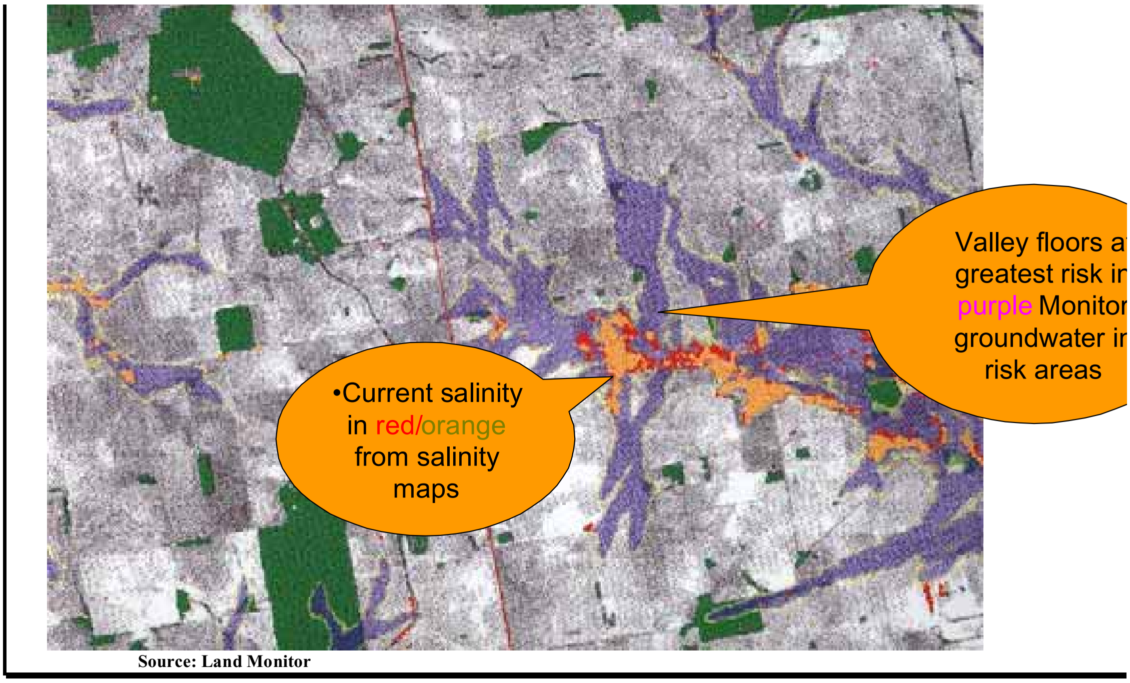
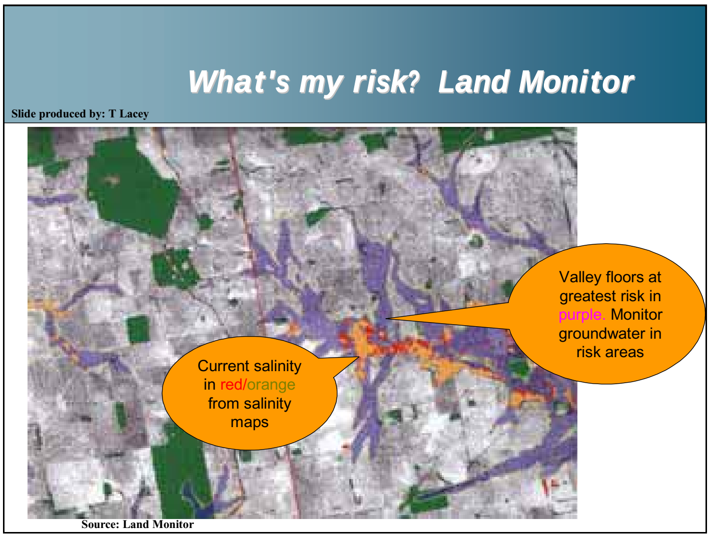


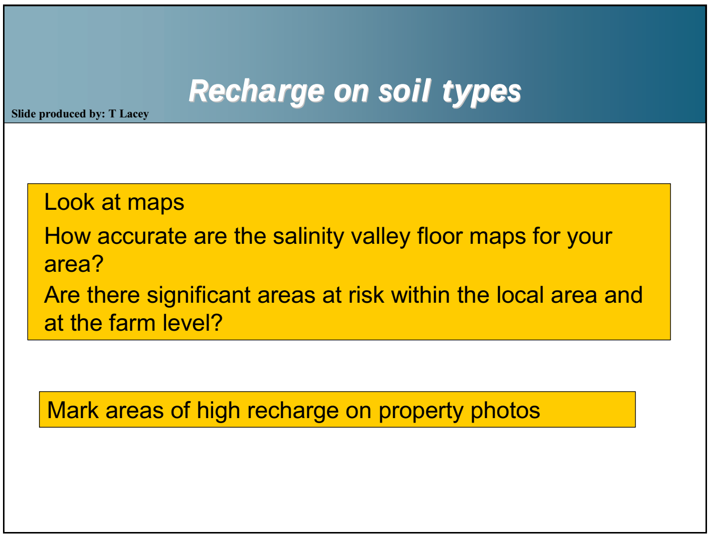
Figure 2. Example of valley hazard map

Slide 34.



Current salinity in red/orange from salinity maps.
Valley floors at greatest risk in purple.
Monitor groundwater levels in risk areas.

Slide 35.



Identify symptoms of current salinity and signs of potential salinity

How salinity is expressed in association with soil types and landforms
Examples:

- creek lines, valley floor pools
- position of the change of slope
- broad soil types and obvious management units.

Geological structures such as fault lines, dykes and bedrock highs have significant impact on the expression of salinity in Western Australia. They can act as either carriers or barriers to water movement through the landscape.
From East Mortlock Catchment Appraisal, the patterns of salinity indicate that geological structures (e.g. faults, quartz veins) control much of the groundwater flow and salinity development. Pre-existing fault lines have, over time, been converted into drainage lines through preferential erosion, and along with their groundwater accumulation qualities, have made them obvious points for salinity development. A significant proportion of catchment salinity has already developed, especially in drainage lines, hence the moderate increase in areas of potentially shallow watertables.

Soil types and landscapes with the greatest risk of salinisation?

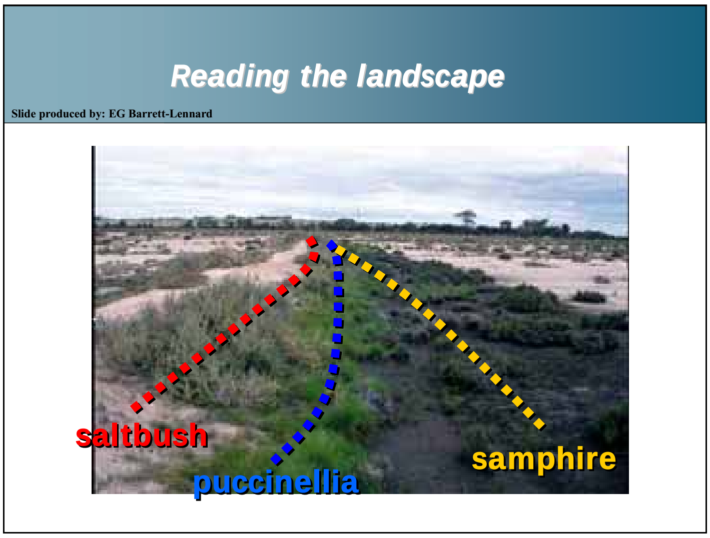
The following is an example of the influence of soils and landscape on salinity.

- Deep sands and ironstone gravels are major soils with high recharge potential. The best way to manage recharge on them is by planting permanent perennials (e.g. revegetation with natives, tagasaste, shelter belts etc.) and phase cropping with perennial pastures, or less effectively, deep-rooted annual pastures (e.g. serradella) or continuous cropping.
- Shallow sandy duplexes are major soils that contribute significantly to recharge via preferred pathways such as large cracks and root channels, particularly when the soil profile is saturated or waterlogged. Recharge will be reduced on this soil by improving surface water management (reducing waterlogging) and altering the farming system to increase perennials and improve crop and pasture water-use.

Slide 36.

Fault traces and associated salinity development evident from aerial photo interpretation. Dashed lines are located just above fault traces (DOLA 1992).

Slide 37.



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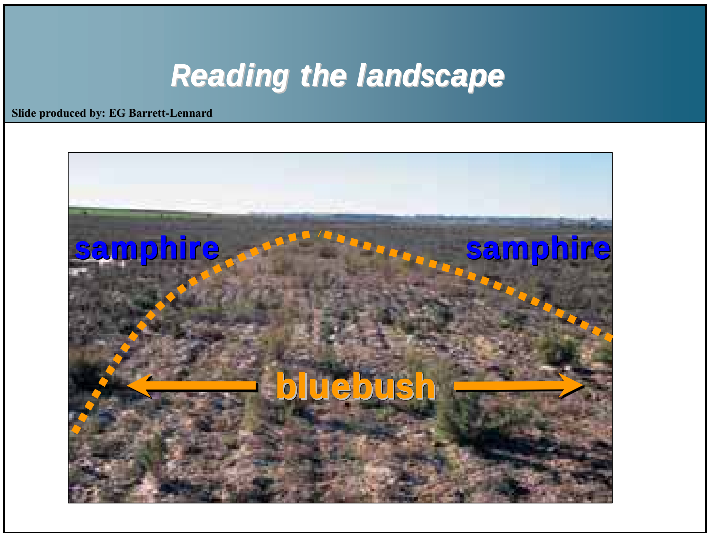

- General results show that middle and lower slopes are at risk of salinisation within 20 years and that the onset of salinity in middle slope areas can be delayed by many years, depending on the level of intervention. However, lower slope and valley areas must not be seen as being completely unproductive in the future, as many areas within salinised paddocks will remain highly productive for salt-tolerant pastures.
- Areas with steeper slopes and shorter distances to discharge points will be less affected by salinisation because of higher groundwater gradients and less constrictive flow, thus reducing groundwater rise. Examples of such areas include stretches of Mortlock River East, particularly on the western flank of the catchment around the Dowerin-Meckering Road and south of Great Eastern Highway between Meckering and Cunderdin.

Landscape map analogy for PURSL

Indicator species and where they grow.
The matrix is used to build a picture of local indicator plants as well as improved species in relation to their salinity/waterlogging tolerance.

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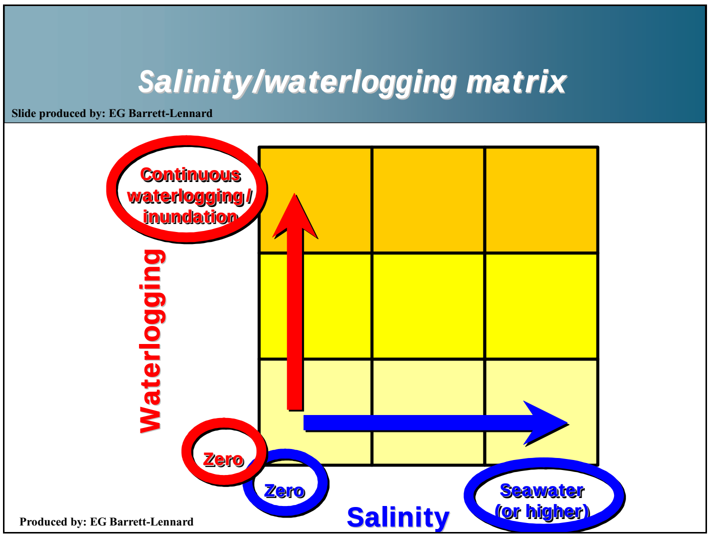

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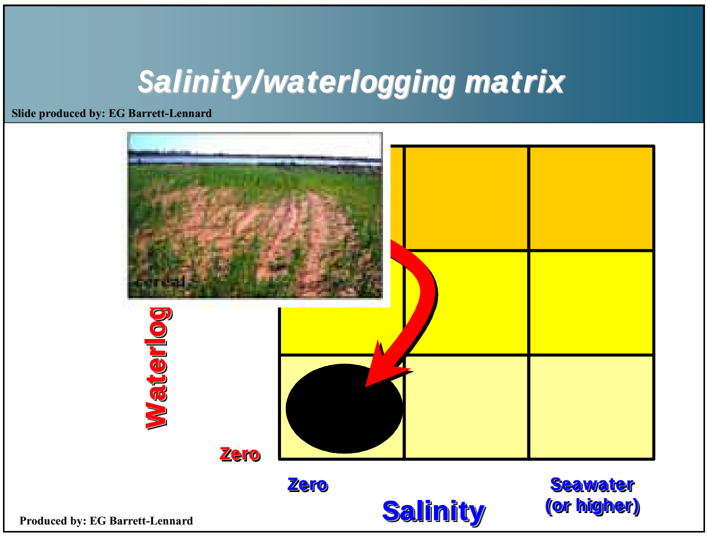

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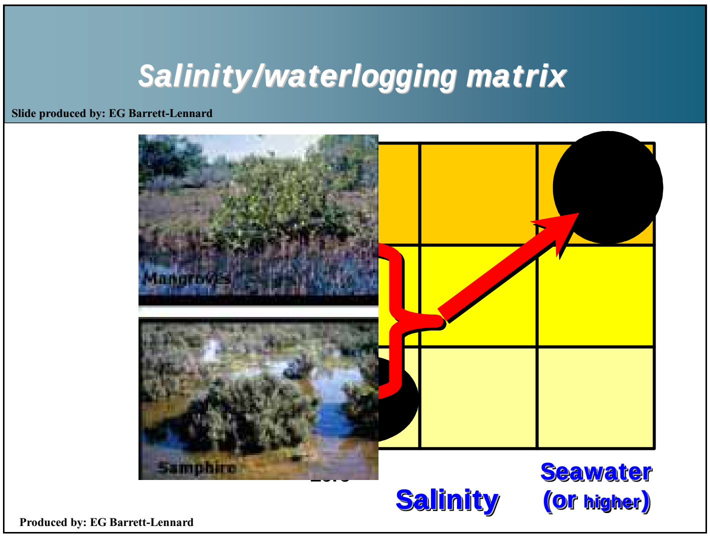

Q. Why does all this matter?
A. $$$.

List indicator species found locally?

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What units are used to measure/describe salinity?

The Department of Agriculture's Salinity Calculator gives approximate conversions between EC_a and EC_e values for three soil textures. (These conversions assume a moist soil in spring.)

Measuring salinity of water or soil

Water: Electrical conductivity in water (EC_w)

Direct measurement with salinity meter. Hand-held salinity meters are available.

Soil: There are two options for measuring salinity of soils:

1. Mix soil with water and measure as a water sample based on how soil sample is prepared:

   A) EC_e **-** Electrical conductivity (extraction)

   Saturation extract method. Soil mixed with distilled water into a paste, then filtered and measured. Most accurate for plant diagnostics but needs to be sent to an accredited laboratory.

   B) $EC_{1:5}$ - Electrical conductivity (1:5 suspension). 1 g soil suspended in 5 mL distilled water and shaken. Less accurate but quicker and can be done on the farm or by local Department of Agriculture office.

2. ECa - Electrical conductivity (apparent). Direct measurement with an electromagnetic induction meter (EM) e.g. EM38 and EM31. Can have full paddock surveys carried out by contractors. Useful to look at relative changes in salinity across a paddock/site. Needs calibration.

Depending on time available and resources such as salinity meters and EM38 you may like to demonstrate and/or have participants measure salinity of samples. Find out who carries out EM surveys.

(Reference: Dept of Agriculture Farmnote 59/2002 'Monitoring groundwater levels'.)

For further information on measuring salinity, refer to Farmnote 105/2001 'Measuring salinity on the farm'. The facilitator *must* have a copy of this Farmnote (or something similarfrom a different State) available for each participant.

To access Farmnotes, go to Dept of Agriculture website on www.agric.wa.gov.au. Look to the right hand side of the home page to a box that says 'Series Publications', and click directly on 'Farmnotes'. Once in the Farmnotes section, enter the Farmnote number (e.g. 59/2002) into the 'Search for' box and enter. A summary of the relevant Farmnote will appear, and you need to click on the title for the full document (best to print the PDF format).

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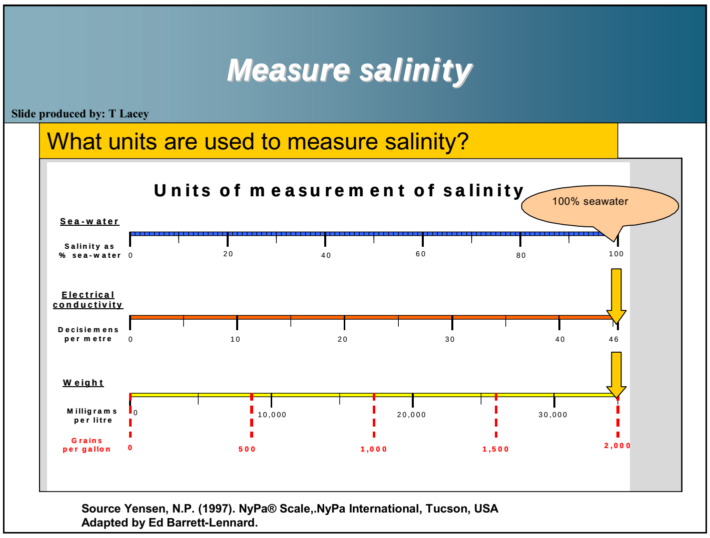

What units are used to measure salinity?

Reference: Yensen, N.P. (1997). NyPa® Scale,.NyPa International, Tucson, USA. Adapted by Ed Barrett-Lennard.

Slide 43.

Measure salinity

Slide produced by: T Lacey

Water: - Electrical conductivity in water **(EC_w)**	Direct measurement with salinity meter.
Soil: - 2 options • Mix soil with water and measure as a water sample	**Based on how soil sample is prepared:** A) EC_e - Electrical conductivity (extraction) Saturation extract method -soil mixed with distilled water into a paste, filtered. Most accurate (accredited laboratory). B) $EC_{1:5}$ - Electrical conductivity (1:5 suspension). 1 g soil suspended in 5 ml distilled water and shaken. Less accurate but quick.
• **ECa** - Electrical conductivity (apparent).	Direct measurement of with an electromagnetic **induction** meter (EM). Eg. EM38 and EM31. Relative changes in salinity across a paddock/site. Needs calibration.

Soil and Water Salinity Calculator

4. Pre-field activity

Work in groups to plan a salinity management strategy based on information relating to the field site.

5. Field trip

Worksheet 2

What broad landscape features are influencing the site (i.e. creek, slope, valley)?
What are the soil types in the catchment?
Are there signs of geological structures such as dykes, bedrock highs?
Some issues to consider in regard to any options that might be adopted include:
• **Farmers' long-term goals etc?**
• **Area of crop and pasture?**
• **Crop yields and areas affected by either salinity or waterlogging?**

• **Stocking enterprise (sheep, cattle, and meat production)?**
• **Area of salinity?**
• **Salinity of the area?**
• **Increases in salinity observed or indicator species (following wet years etc.)?**
• **Where are watertables? Shallow within 3 metres or deeper?**
• **Monitoring of watertables, either on the farm or in similar sites nearby?**

6. The effect of salinity on farm production and profitability

Growth response to salinity

Halophytes grow *better* on mildly saline than non-saline sites. They are therefore key components of saltland pastures.

Non-halophytes *vary* in their tolerance to salt. The more tolerant species may be components of saltland pastures while the less tolerant species will almost certainly not be.

Waterlogging and salinity interactions

Worksheet 3

Write down 2 to 3 effects of waterlogging on plant growth and crop production

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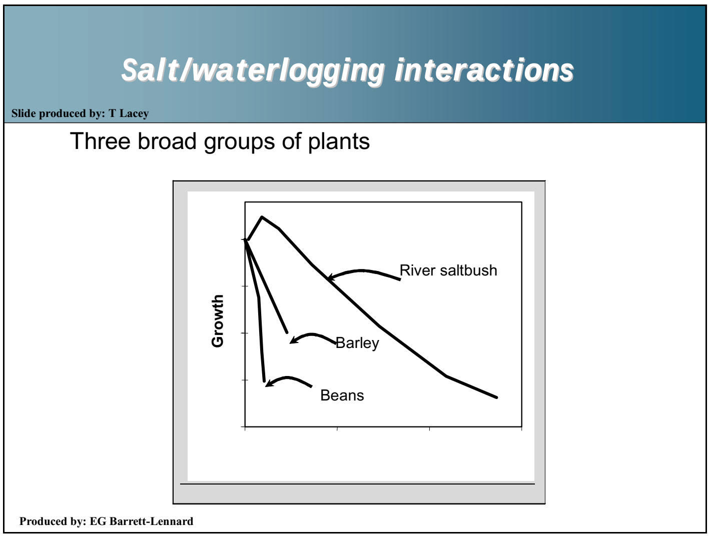

List the effects of waterlogging on crop and pasture production?

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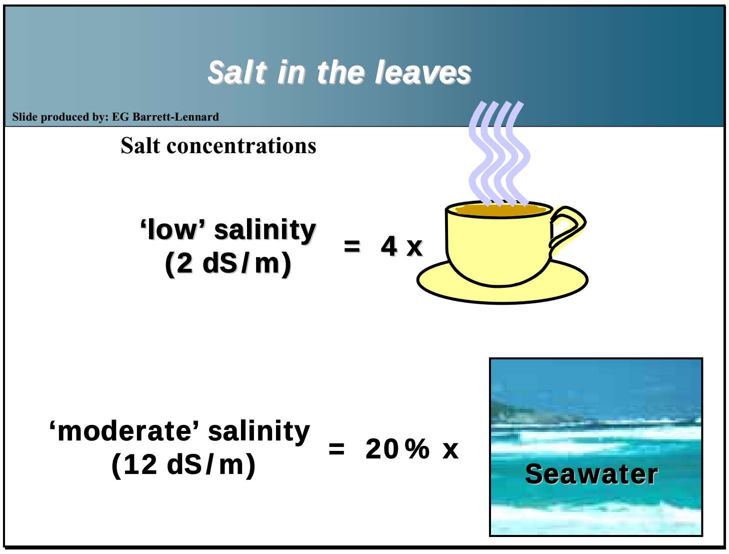
Slide 46.

- Decreases diffusion of oxygen into soil.
- Causes energy deficiency in roots.
- Breaks down salt exclusion.
- Adversely affects growth and survival.

Waterlogging saturates the pores in the soil that are normally filled with gas, making them oxygen deficient. This affects the ability of roots to get energy for their metabolism and makes roots leaky to salt. If salt accumulates to a substantial degree in the shoots, plant growth and survival are affected. The following series of photos shows the effect of salinity and waterlogging on plants.

The four pots pictured in each photo are growing wheat. The two pots on the left are waterlogged while the two pots on the right are freely drained. The photos show the effects of waterlogging on wheat grown with (a) no salt, (b) salt equivalent to 4% sea water and (c) salt equivalent to 20% sea-water. The effect of salinity and waterlogging combined has a much harsher effect on plant growth than salinity on its own. This indicates the potential for removing the waterlogging from the system with surface water drainage. Raised beds are one option that can be used to remove the waterlogging (Barrett-Lennard 2003).

Slide 47.



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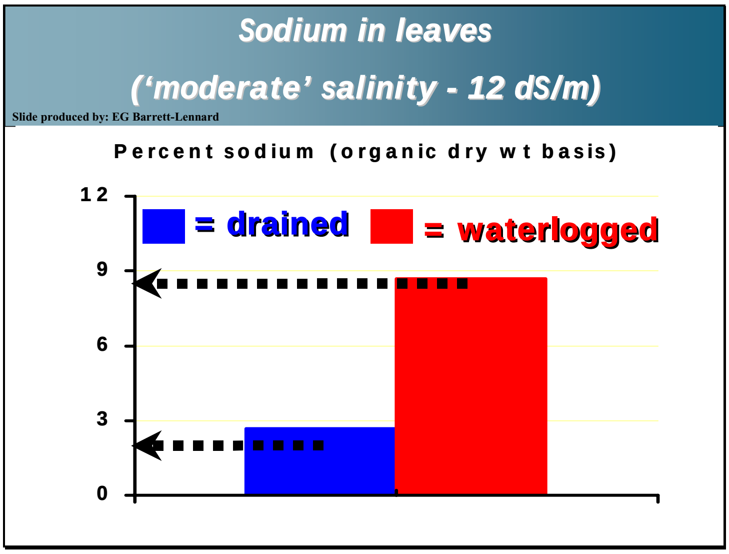

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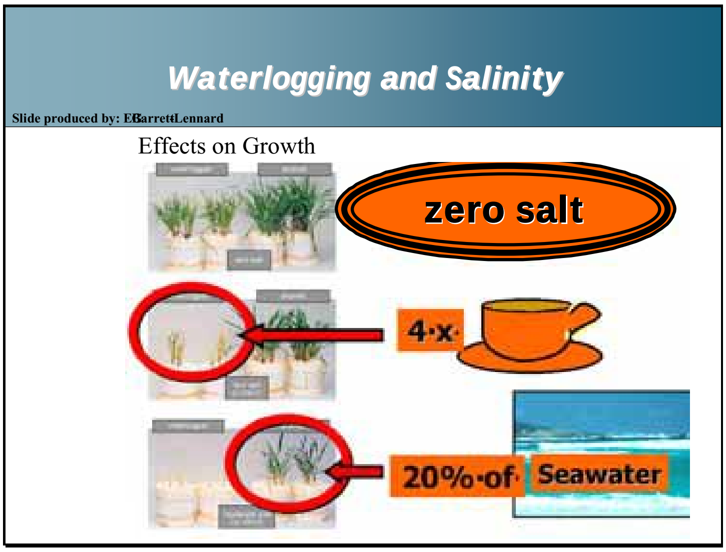


(Photographs: Simon Eyres)

Impact of loss of productivity to profitability of the farm

Options include:

Do nothing (live with salinity) and continue farming with current system and accept that a percentage of land will be lost to salinity in the future. The risk associated with this depends on the area of the farm that is likely to be affected or lost. If you are nearing the new equilibrium where the discharge sites are adequate to deal with the recharge then the best option may be to do nothing, get more land etc. If however you have large areas of valley floors that are likely to go saline before the new equilibrium is reached then the cost to your farm will be greater. The land that goes saline will often be some of the most productive on the farm.

Contain the spread of salt-affected land. This will mean adopting a change in farming systems and mindset. There will be no "Silver Bullet" for managing salinity and a suite of profitable farming practices including perennial pastures, trees, saltland grazing systems and water management practices will need to be adopted. There will be a lag period in seeing results even if moving to 100% perennials, as there is already an excess of water in the groundwater system. Containment may not stop salinisation altogether but it may buy time. Recent modelling work is indicating that areas with broad valley floors (largely in the ancient drainage zones) will get the greatest response (buying time) from managing recharge in the valley floors themselves.

Recovery of salt-affected land. This is the most difficult and costly option to achieve. It will usually involve the continued use of engineering options.

Adaptation to saline areas. This involves the inclusion of alternative productive options on land that has gone saline. Grazing management of saline pastures utilising salt and waterlogging-tolerant species.

There are many ways to move into new farming systems. The transitional period is critical to the profitability of the farm. STEP is one option that allows farmers to examine the implications of a range of transitional strategies.

Slide 50.

Costs and benefits

Slide produced by: T Lacey

Broad options

Do nothing - Cost of lost productive land and land value

Containment - Costs in moving to new profitable system, reduced loss of productive land, land value, feel good etc.

Recovery - Expensive with ongoing cost, disposal of saline water issues

Adaptation - Costs in moving to new profitable system, increased profitability of land

Slide 51.

Decisions on management options

Slide produced by: T Lacey

Need to be kept in context with overall farm objectives and goals

- Reasons for managing salt
- $ spent elsewhere etc.

Slide 52.

Cost of "Do nothing" scenario

Slide produced by: T Lacey

Assumptions: Broad flat valley floor landscapes

- 2000 ha property
- 20% total future salinity (by year 2075)
- Watertables are saline and rising, leading to the areas of salinity indicated in the scenario above

Salinity level		% of potential (Non Saline) profit	2000		2025		2050		2075	
			%	Area Ha	%	Area Ha	%	Area Ha	%	Area Ha
LYSA	Severe (unusable)	0%	2%	32	4%	80	4%	80	5%	100
	Low yield	25%	2%	40	4%	80	6%	120	8%	160
MYSA		40%	2%	40	6%	120	6%	120	6%	120
HYSA (Barley)		85%	2%	32	2%	32	2%	32	1%	20
Total Area			7%	144	16%	312	18%	352	20%	400

Current level of salinity

Cost of “No Change Scenario”

This spreadsheet looks at the cost if no attempts are made to adopt management practices to reduce recharge to the system. The spreadsheet is based upon **“Broad Flat Valley Floors”** where planting 40 to 50% of the area at risk of becoming saline to perennials may increase the time to salinity developing by 40 years (buying 40 years). The spreadsheet allows you to change farm area, future salinity area, current profit from non-saline land and how profitable the new management options are in comparison to current farm management.

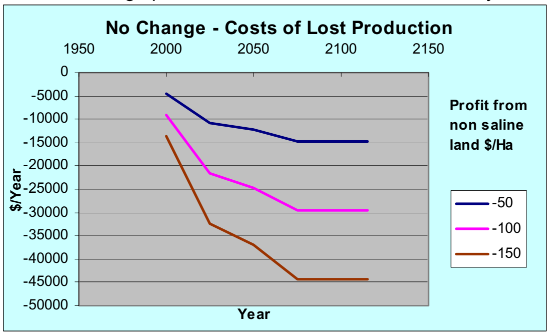
Where management options putting 40% or area at risk into perennials is adopted the same final level of salinity is reached but instead of being reached in the year 2075 it is taking 40 years longer (final salinity levels reached in 2115). The average per year difference can be looked at over the periods of 2000 to 2025, 2000 to 2050, 2000 to 2075 or 2000 to 2115.

Slide 53.

Cost of "Do nothing" scenario

Slide produced by: T Lacey

• Average profit from non-saline areas = $200/ha/yr



Slide 54.

Cost of "40% Management" scenario

Slide produced by: T Lacey

• Recharge management scenario buying 40 years

It has taken 40 years longer to reach the new equilibrium point

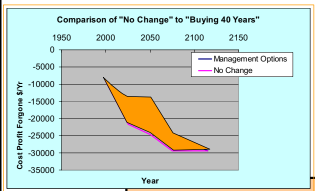
Salinity level		% of potential (Non Saline) profit	2000		2025		2050		2075		2115	
			%	Area Ha	%	Area Ha	%	Area Ha	%	Area Ha	%	Area Ha
LYSA	Severe (unusable)	0%	2%	32	3%	60	3%	60	4%	80	5%	100
	Low yield	25%	2%	40	3%	60	3%	60	6%	120	8%	160
MYSA		40%	2%	40	3%	60	3%	60	6%	120	6%	120
HYSA (Barley)		85%	2%	32	2%	32	2%	32	2%	32	1%	20
Total Area			7%	144	11%	212	11%	212	18%	352	20%	400

Total area, starting and finishing salinity levels haven't changed

Slide 55.

Comparison - Cumulative position

Slide produced by: T Lacey



The value of delaying salinity by 40 years

Cost of loss of productive land to salinity.		
No Change vs delay by 40 years.	**Cumulative $**	**Average $'s Difference/Yr**
Total from **2000** to **2020**	-$88,750	-3550
Total from **2000** to **2050**	-$303,750	-6075
Total from **2000** to **2075**	-$490,250	-6537
Total from **2000** to **2115**	-$586,650	-5101

7. Assess the salinity risk for your farmland

Worksheet 4.

What are your personal goals for the farm?

How do you rate the overall risk to your farm?

What is the value of production on land at risk from salinity?

What are my long-term goals in relation to salinity management?

Monitoring watertables

The depth and salinity of shallow groundwater and its trend is over time is valuable information.

The depth to watertable over summer will determine the level of salinisation through surface evaporation and the risk of waterlogging. The shallower and more saline the watertable the greater the likelihood of topsoil salinisation through evaporation and capillary rise. Waterlogging, salinity and their interactions determine the effect on establishment and growth of plants.

The best way of monitoring depth and salinity of shallow groundwater over time is with shallow (to 2 m depth) bores. How deep is the water level beneath the soil surface? Measure depth to watertable in either an established shallow bore or a hole/soil pit dug to 2 m, using a 'plopper'.

The watertable should be monitored regularly on a monthly or quarterly basis for a number of years if watertable trends are to be identified. If they are not monitored regularly they will only tell the depth of the watertable and the quality of the water but wont tell you what the trend is in regards to groundwater movement.

Department of Agriculture Farmnote 59/2002 'Monitoring groundwater levels' provides good additional information.

8. Preliminary appraisal of major potential management options for your business

Options for managing salinity

Optional workshops - Preferred Pathway

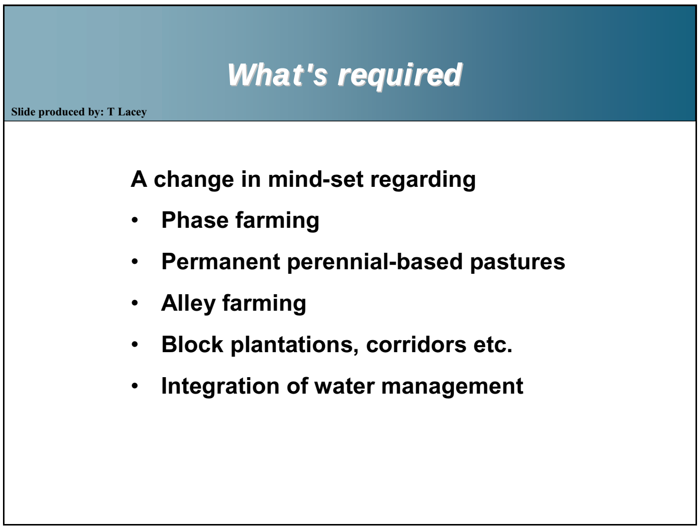
- Recommended sequence of workshops: -
- Introduction to salinity
- STEP introduction half-day
- STEP part 2 or other optional modules.

Introduction to the STEP Workshops

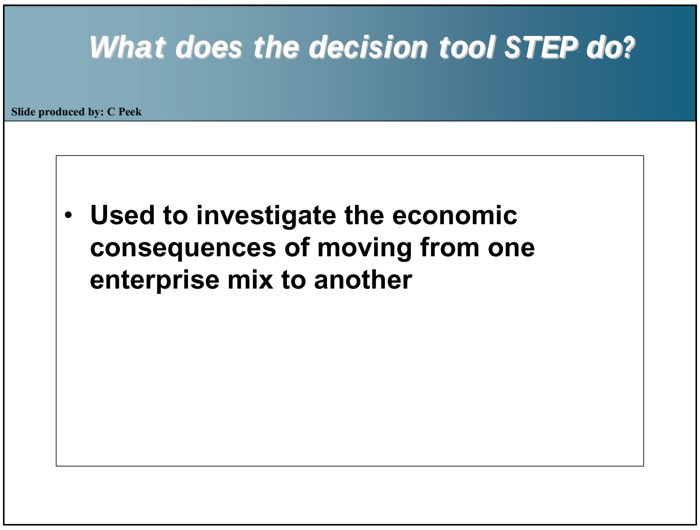
If you would like to know the financial implications of making changes to your farming system, then the STEP workshops may be for you.
STEP (Simulated Transitional Economic Planning) is an economic decision tool which can be used by farm businesses to investigate the economic consequences of making changes to the current farming system.

Example:
A group of 22 farmers in the Gillingarra area of the Northern Agricultural Region were interested in looking at alternative farming systems to reduce the future risk of salinity. A standard farm was designed specifically for the area following consultation with the Gillingarra farmer group. This farm was used to investigate the financial viability of different farming systems for the area and the process of changing from one farming system to another.

Slide 56.



Slide 57.



Details of the rotations and areas of both the current and future farms are shown. The current farm was an annual pasture-based system with Merino sheep. For the future farm, perennials replaced annual pasture on the less productive areas and cattle replaced sheep.

STEP was first used to look at the 10-year cumulative profit of the current farm for different combinations of stocking rate, sheep price and flock structure as shown.

Mixed flock = ewes and wethers

Sheep sale price

Low = $30 lambs, $20 ewes, $25 wethers and rams

High = $65 lambs, $30 ewes, $35 wethers and rams

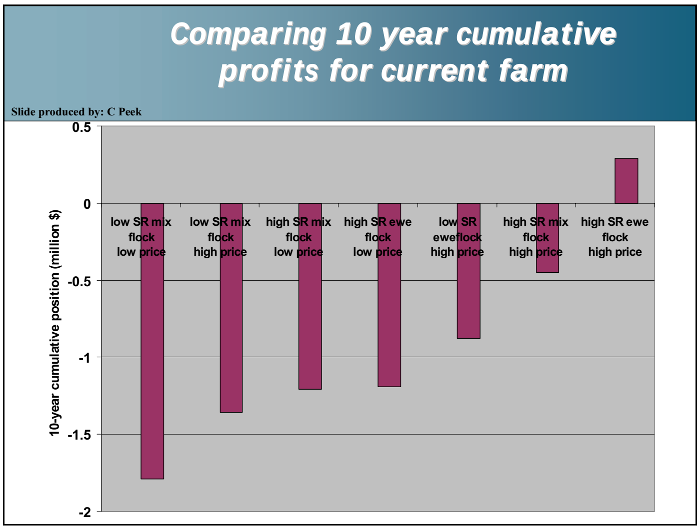
Stocking rate (DSE)

Low = 2.9 winter, 2.1 summer

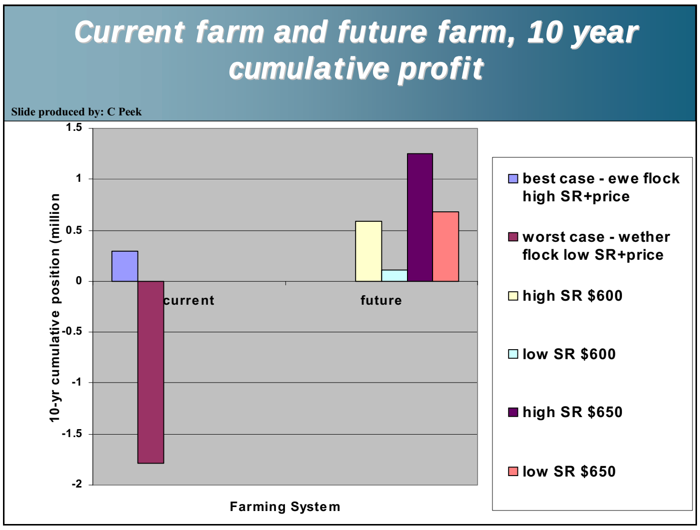
High = 5 winter, 3.8 summer

The only combination showing a positive cumulative profit for the current system is the ewe flock with a high stocking rate and high sheep sale price.

Slide 58.



Slide 59.



Slide 60.

Current and future farm rotations and hectares

Slide produced by: C Peek

Soil types	Area (ha)	Current rotation	Future rotation
weak sand	500	blue lupins	tagasaste
yellow sand	400	Volunteer pasture Improved pasture	Volunteer pasture Improved pasture
sandy gravel	300	Volunteer pasture Improved pasture	Volunteer pasture Improved pasture
sand over gravel	100	Volunteer pasture Improved pasture	Volunteer pasture Improved pasture
waterlogged	100	wet pasture	perennials
Total	1400		

Volunteer pasture = low stocking rate
Improved pasture = high stocking rate

The 10 year cumulative profit of the future farm was analysed for two different stocking rates and two cattle sale prices. The future farm was generally more profitable than the current farm. Only the future scenario with a low stocking rate and low cattle price ($600) was slightly less profitable than the best case scenario for the current farm.

As the financial viability of the future farm looked promising, the next step was to assess the financial viability of transition to the future system. This slide depicts the annual cumulative profit over a 10 year period for different transition strategies. For each transition strategy, lambs were sold each year and cattle gradually introduced into the system. This process occurred more rapidly for the shorter four-year transition than for the longer 10 year transition. The transitions are also compared at a high ($700) and low ($600) cattle sale price.

The graph shows that at a low cattle price of $600 a longer transition period of 10 years appears more financially viable than the shorter transition. However, at a higher cattle price of $700, the shorter transition is the more profitable.

Conclusion

If you are interested in using STEP to assess the economic consequences of changing your farm then the STEP workshops are for you.

The first workshop is an introduction during which you will gain an understanding of how the STEP tool can be used to assess the financial potential of any proposed change to a farming system. If you wish to progress further with STEP there are a number of options available for other workshops:

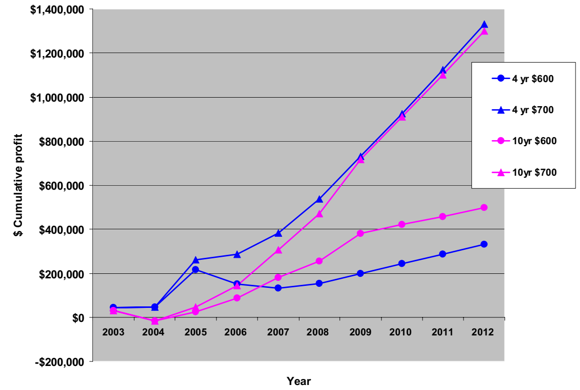
1. You can use STEP to analyse your own farm.
2. Your facilitator can develop a representative farm for your group and either

- you can use STEP to address questions using this farm or
- the facilitator can do some analyses for your group and report the results.

Slide 61.

Cumulative profit for 4 and 10 year transition strategies for a mixed flock

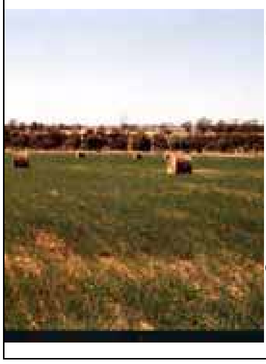
Slide produced by: C Peek



Slide 62.

Lucerne - best perennial option for phase farming currently available

Slide produced by: T Lacey



Benefits from the lucerne phase

- herbicide resistance and weed management
- extended green feed (finishing stock out of season)
- reduced supplementary feeding
- reduced recharge and nitrate leaching

Greatest benefits on high recharge soils

Slide 63.

A solution to the 'problem with saltbush' …

Slide produced by: EG Barrett-Lennard

Lowers watertables