State of play for the groundwater resources in the McLaren Vale PWA

Steve Barnett
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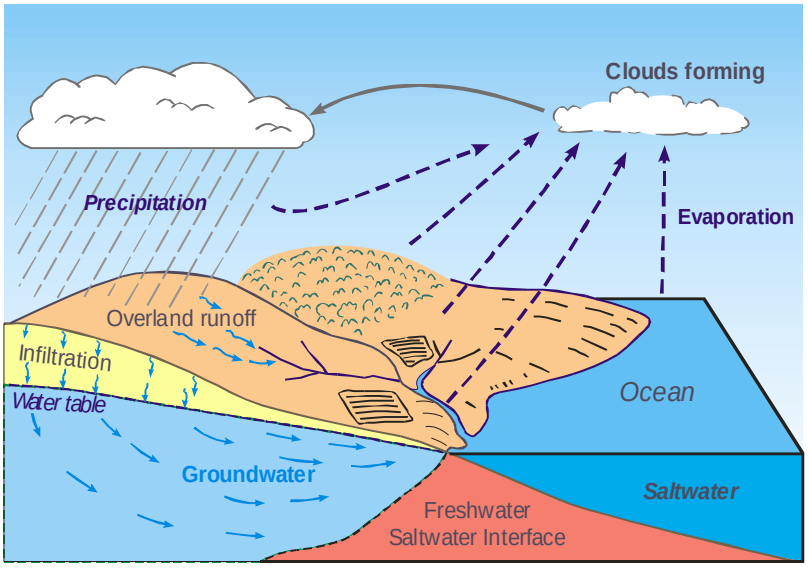
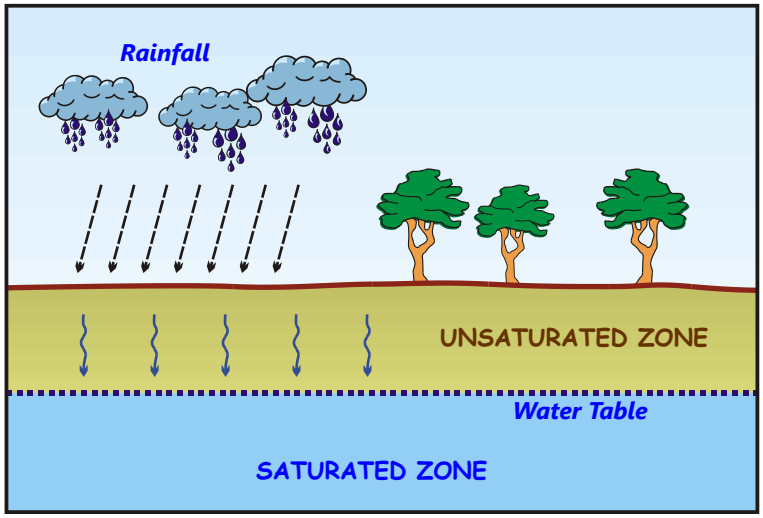
Government of South Australia
Department for Environment and Water

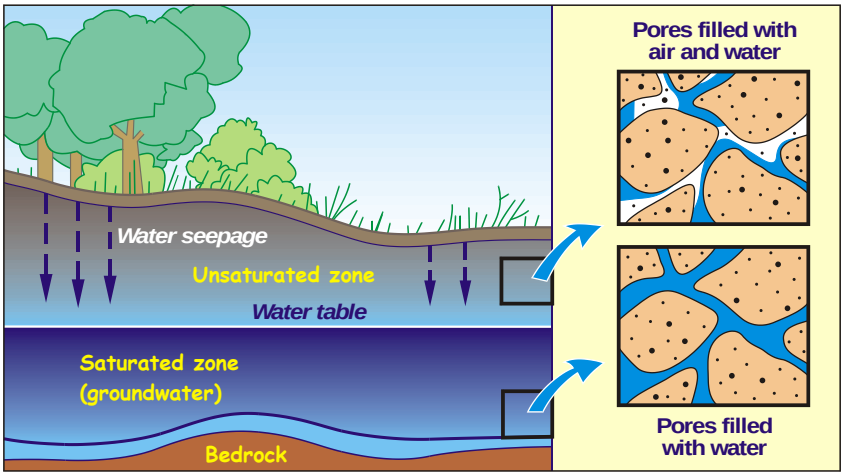
Hydrological Cycle

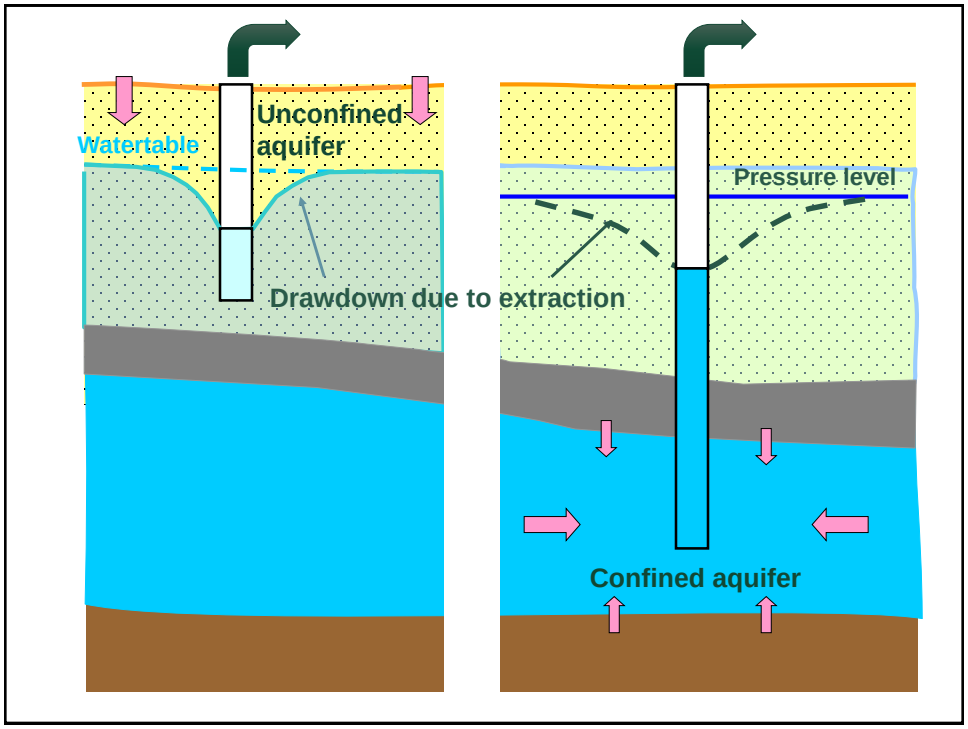


Watertable



The Unsaturated Zone





SURFACE

- Visible, easy to measure
- Moves rapidly (m/sec)
- Reacts quickly to change
- Vulnerable
- Well known

  Straightforward

  Engineers

GROUNDWATER

- Hidden from view
- Moves slowly (m/yr)
- Reacts slowly
- Protected
- Public ignorance

  Complex

  Hydrogeologists

DOCTOR	HYDROGEOLOGIST
• Medical history	• Bore records, geology
• Pulse, blood pressure	• Water level, salinity
• Blood test	• Chemical analysis
• X-Ray	• Geophysics
• ECG stress test	• Pumping test
• Operate	• Drill
Provides relief from pain and suffering	Provides a basic necessity of life

How important is groundwater ?

- Water is our most valuable resource and is fundamental to our health, our way of life, the economy and the environment
- The ONLY source of water for more than 80% of the area of SA is groundwater
- Groundwater provides supplies for towns, irrigated agriculture, the environment, stock, households, mining and energy developments
- Provides a secure water supply at times when surface water is unavailable during drought

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Total groundwater use in SA

~550 GL

~550,000 million

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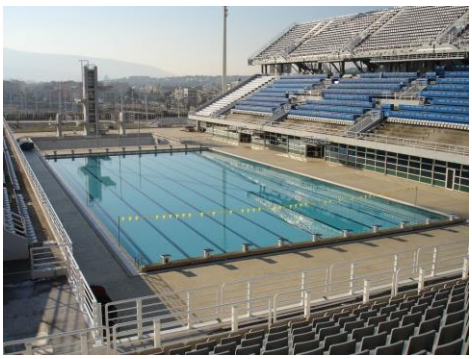
One gigalitre

~ 1,000 X



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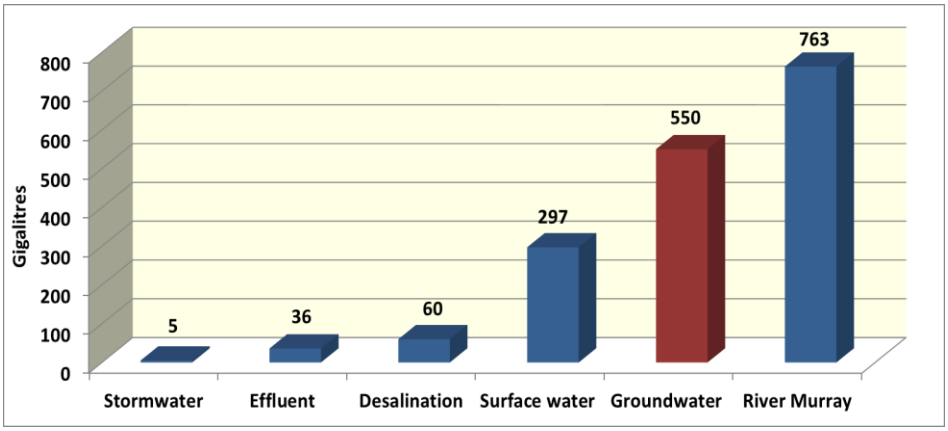
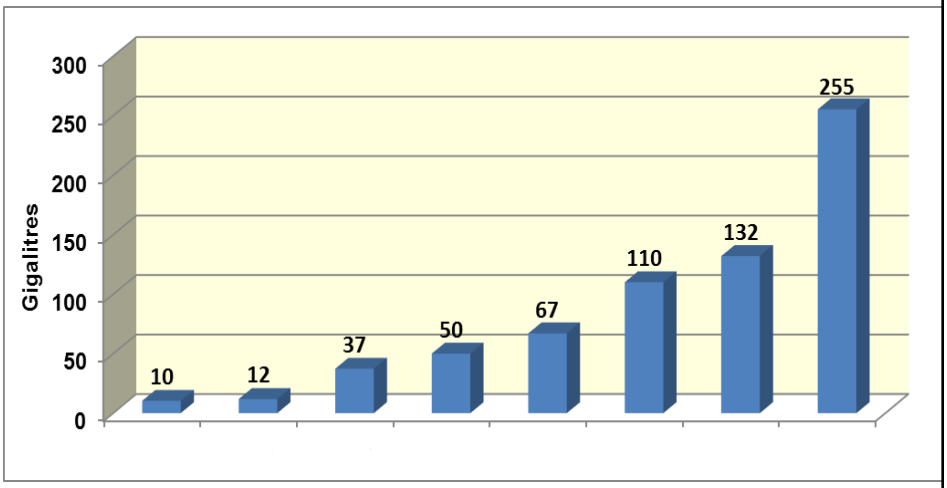
How does this compare to other sources ?



How groundwater is used

Irrigation (fodder, food, wine)
SIS, Mining, TWS, Stock and domestic



Economic significance

AGRICULTURE

Farm gate value of irrigated agriculture

$1.0 billion

MINING

Several very large mining developments in Far North are wholly dependant on groundwater – Roxby Downs, Prominent Hill, Challenger.

Estimated annual value of production

$3.0 billion

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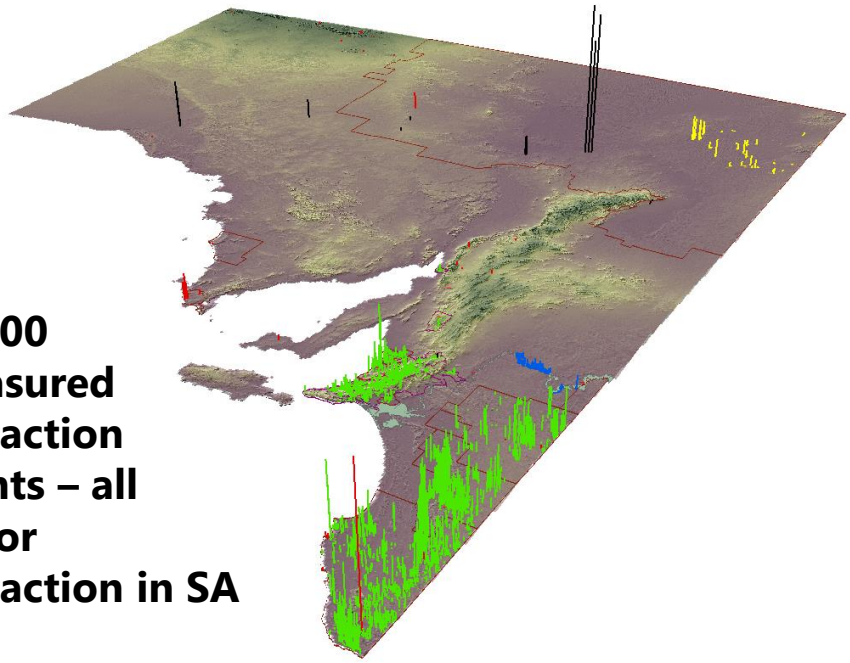

~9000 measured extraction points – all major extraction in SA

Water Allocation Plan

The aim of the WAP is to ;

- control licence holders' use of the groundwater resource, and
- manage the impacts of that use

Water Allocation Plan

To achieve these aims, the WAP manages ;

- Groundwater extraction (allocations)
- Processes that change groundwater quality (not easy)
- Impacts on Groundwater Dependent Ecosystems
- Community expectations

Water Allocation Plan

The WAP usually includes the following tools;

- sustainable yield / allocation limit
- resource condition limits (triggers)
- interference rules
- local trading rules
- monitoring / data collection requirements
- process for allocation reduction if necessary

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Water Allocation Plan

Any changes resulting from this review of the WAP mostly only apply to future drilling/applications/transfers and cannot be made retropesctive and impact existing users

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What does "Sustainability" mean ?

Definition ?

For some, a notion of perpetuity, with no impact

For natural resource development

IN YOUR DREAMS !

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Sustainability considerations

- Time frames
- Future generations
- Trade off between impacts and benefits

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Sustainability definition

"The groundwater extraction regime, measured over a specified planning timeframe, that allows acceptable levels of stress and protects the higher value uses that have a dependency on the groundwater"

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Sustainability definition

- This definition is flexible
- Higher value uses could be irrigation, town water supply, industry or ecosystem support
- Determination and ranking of uses, as well as acceptable impacts, will require both community and expert opinion

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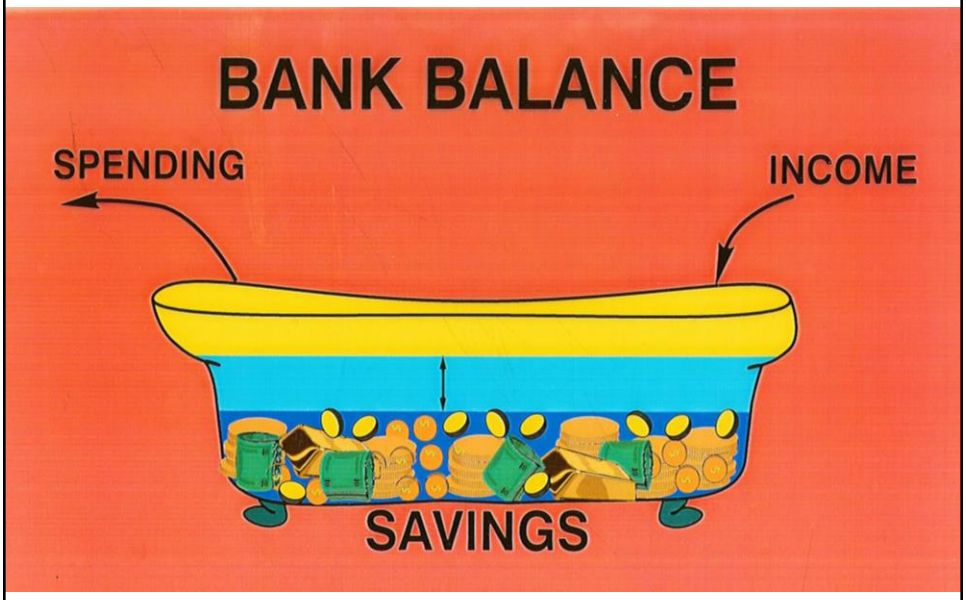
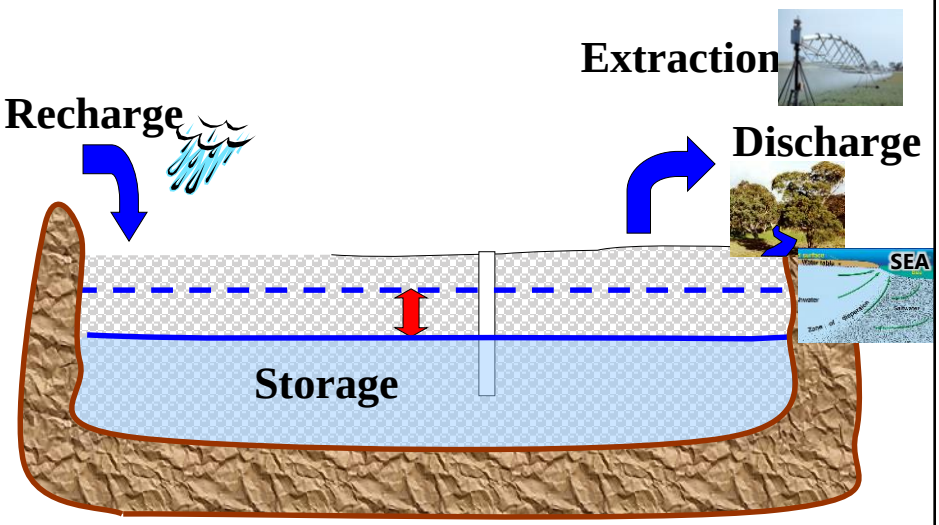
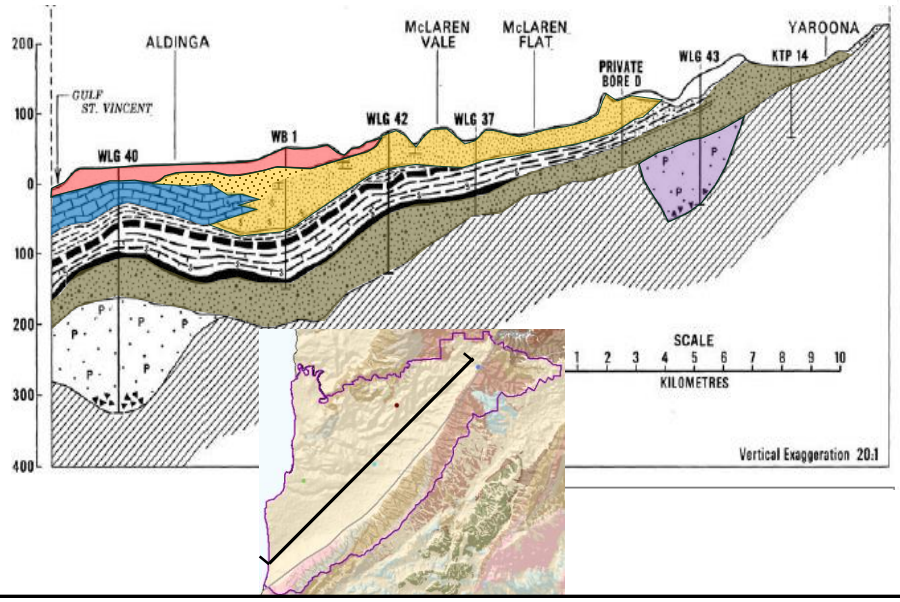


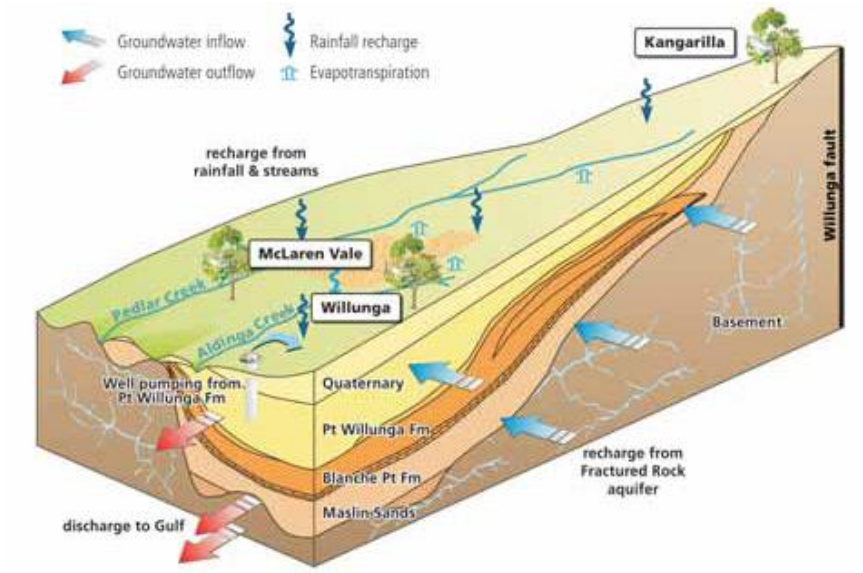
Groundwater balance



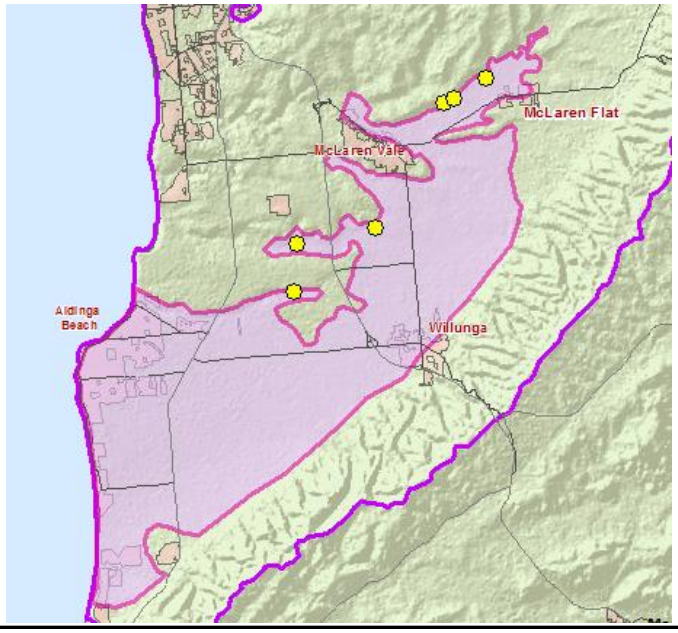
Groundwater System
Cross Section



Groundwater System
3D Cross Section



Quaternary aquifer



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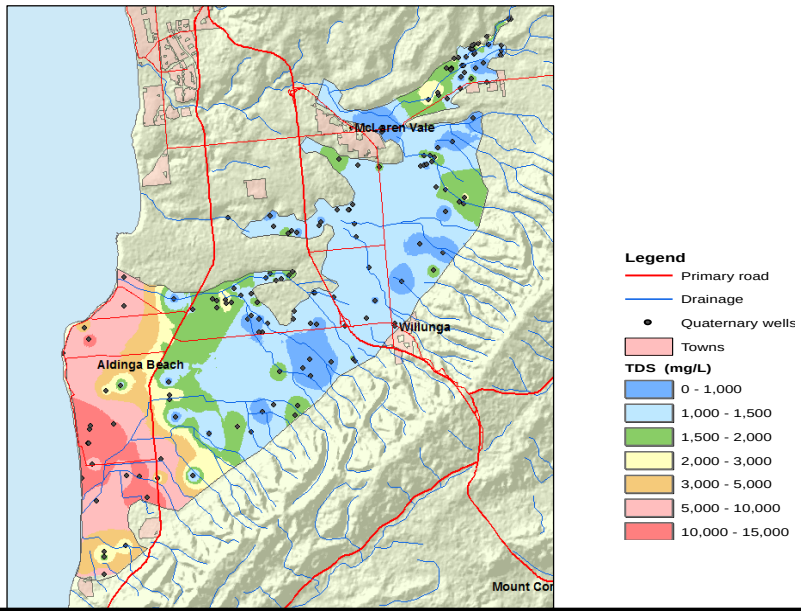
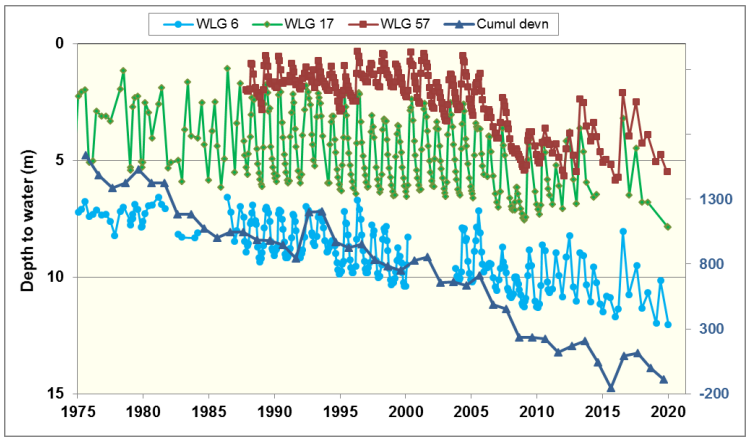


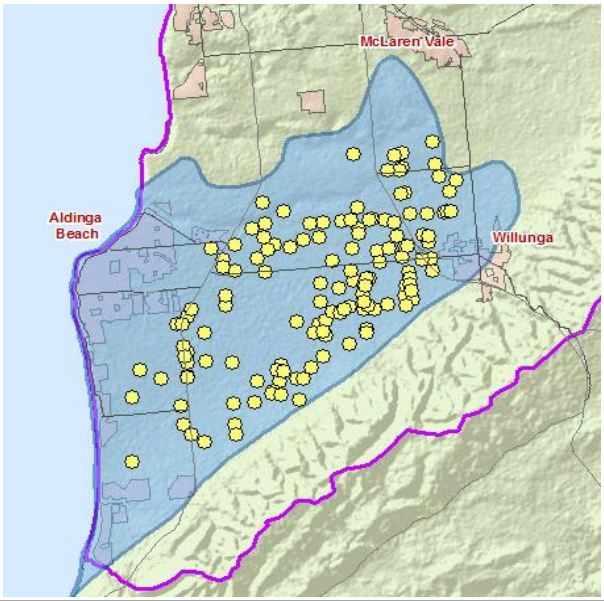
Quaternary aquifer

Water level trends

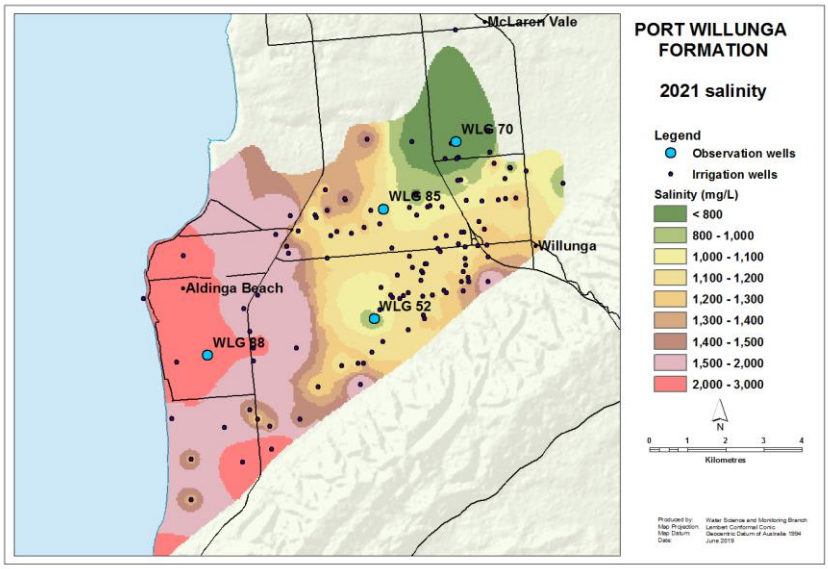
Gradual long term decline related to below average rainfall
May have impacts on GDEs in long term



Port Willunga Formation aquifer



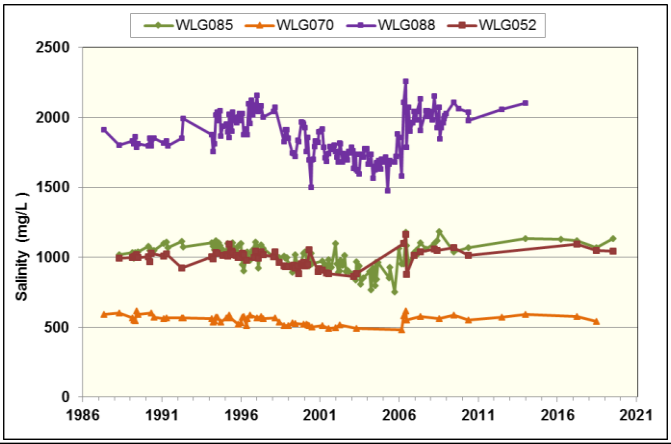
Port Willunga Formation



Port Willunga Formation

Salinity trends

Very gradual long term improvement in main irrigated area

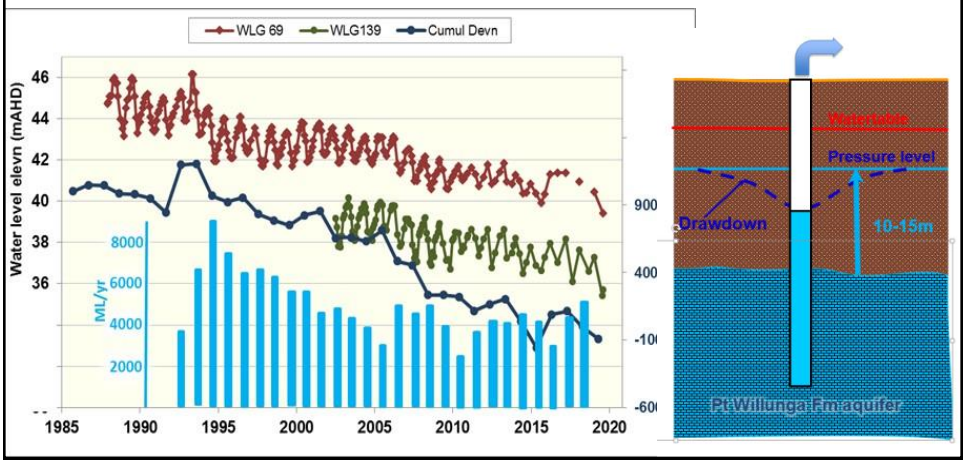


Port Willunga Formation

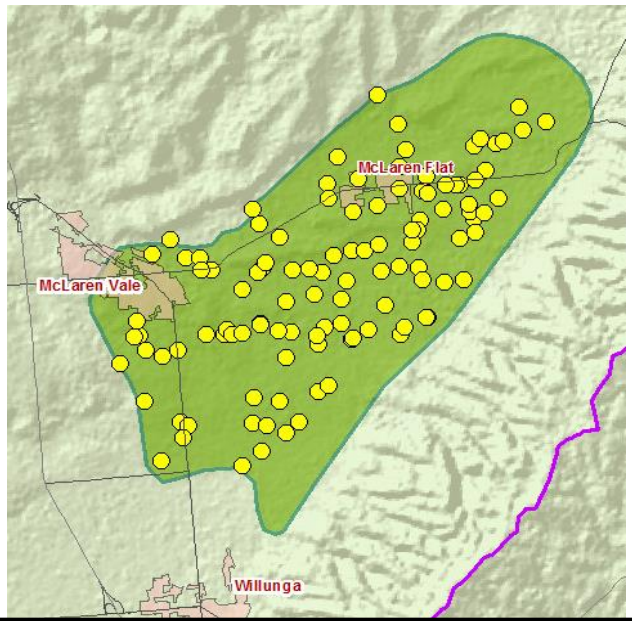
Water level trends

Gradual long term pressure decline in response to rainfall – not of concern at present

~350,000 ML in storage, currently using ~2,800 ML/year



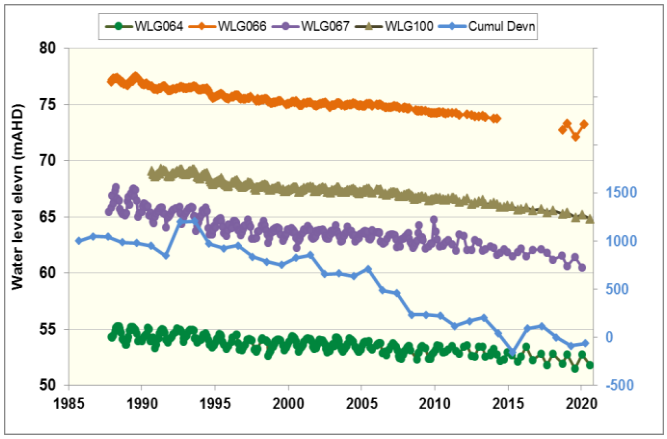
Pirramimma Sand aquifer



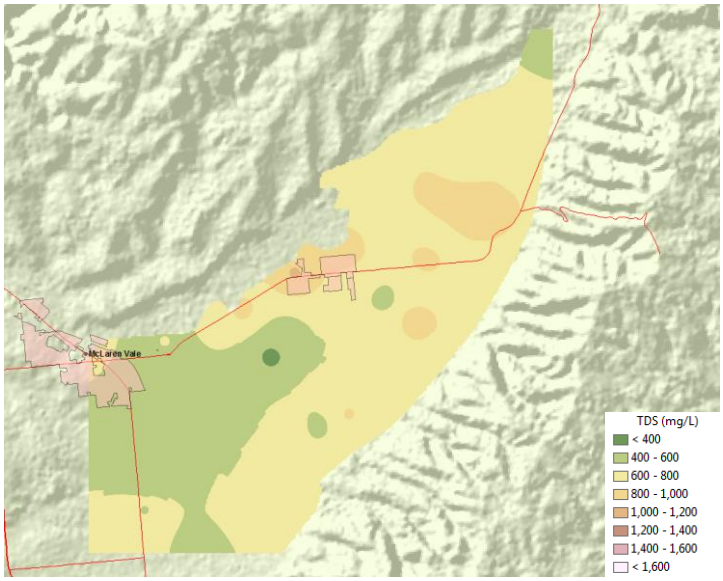
Pirramimma Sands

Water level trends

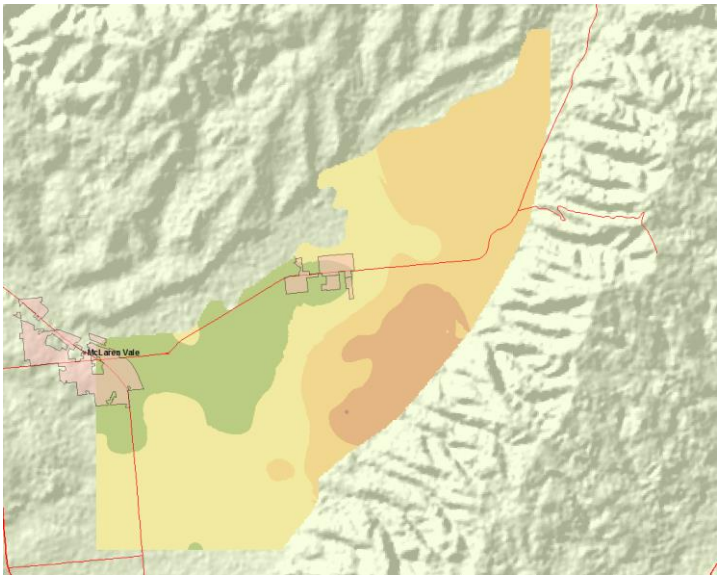
Gradual decline of 0.07 to 0.15 m/year since 1993 in response to below average rainfall – represents a loss of storage of 9%. Aquifer >50m thick



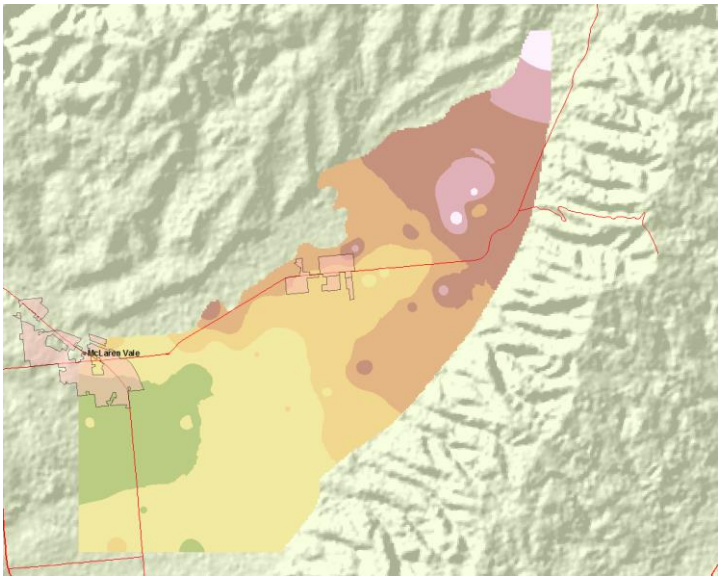
Pirram Sands - **1980**



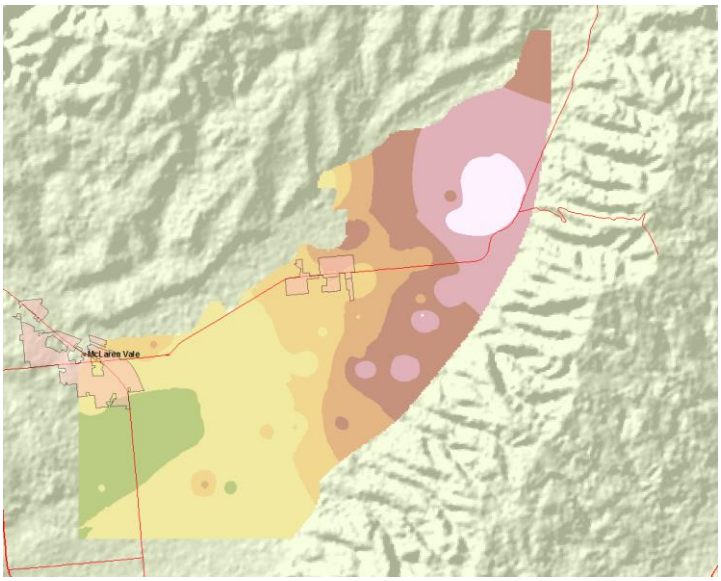
Pirram Sands - **1990**



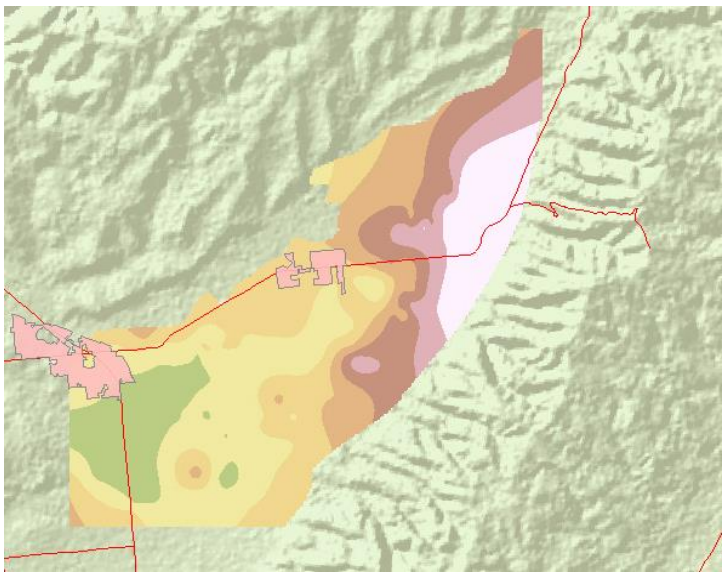
Pirram Sands - **2007**



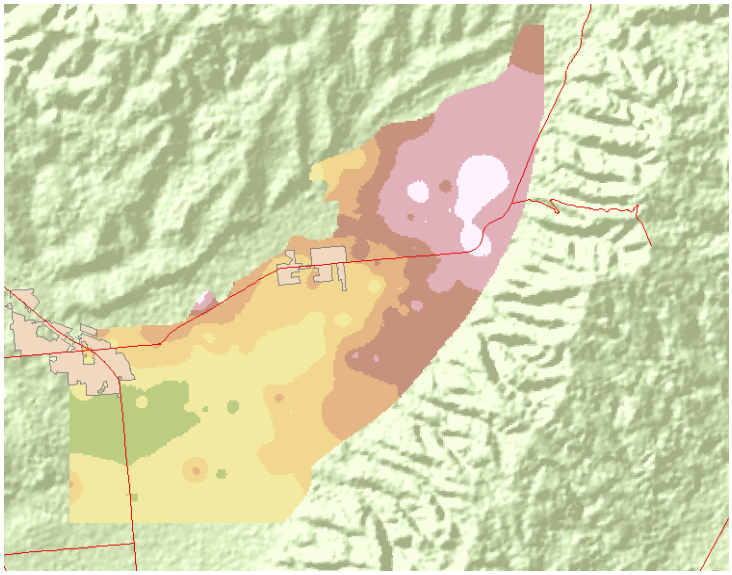
Pirram Sands - **2014**

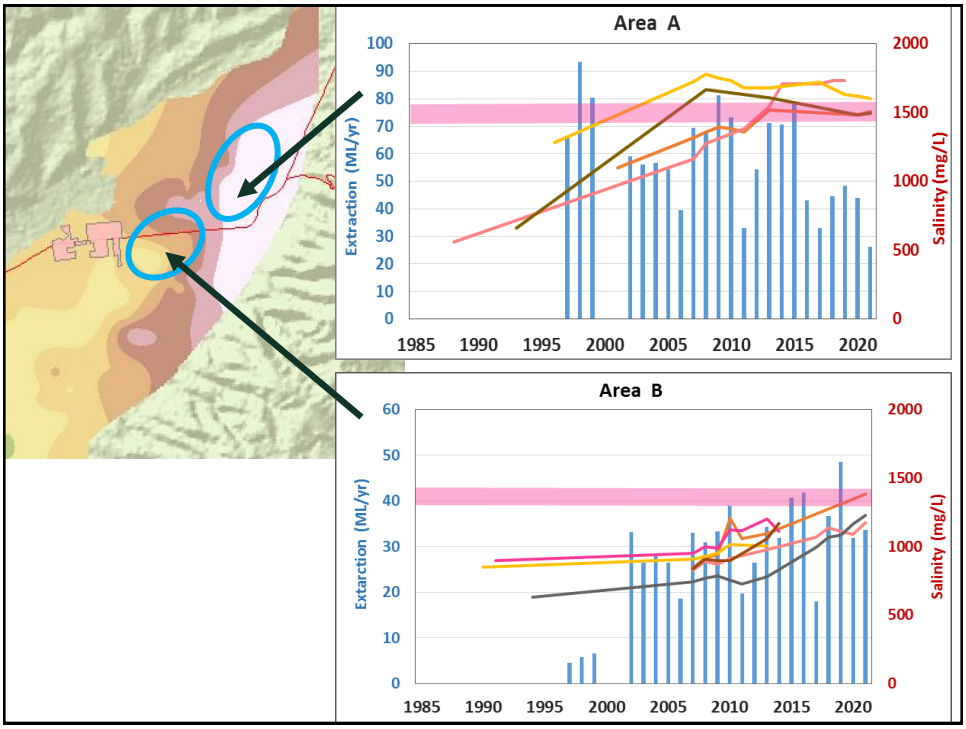


Pirram Sands - **2019**

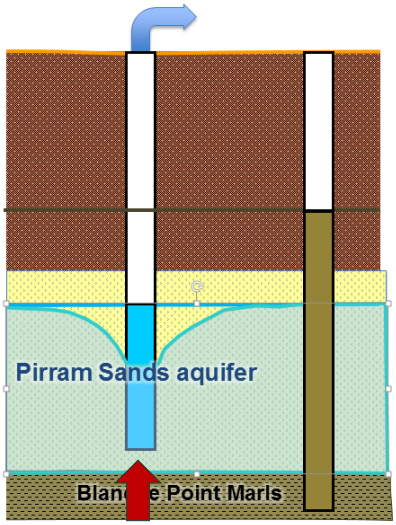


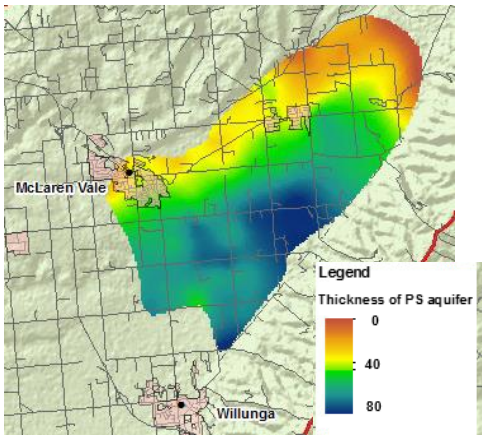
Pirram Sands - **2021**



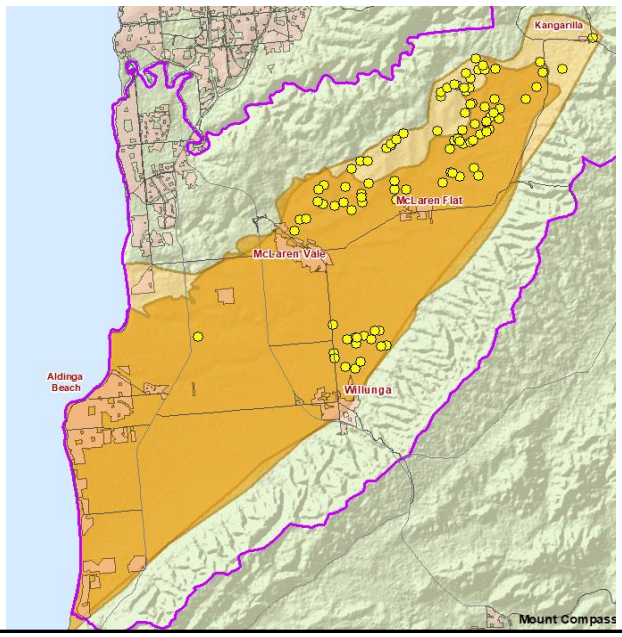


Where is the salt coming from ?
Pirram Sands aquifer





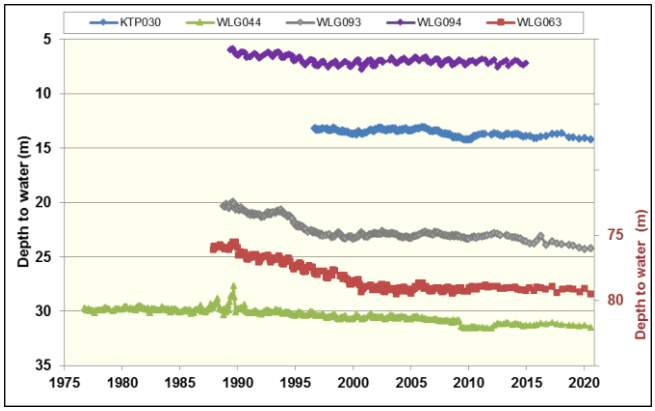
Maslin Sands aquifer



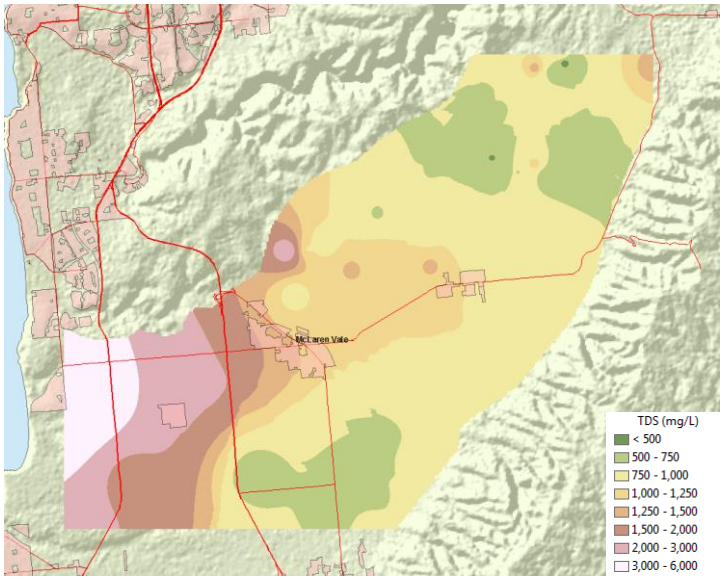
Maslin Sands

Water level trends

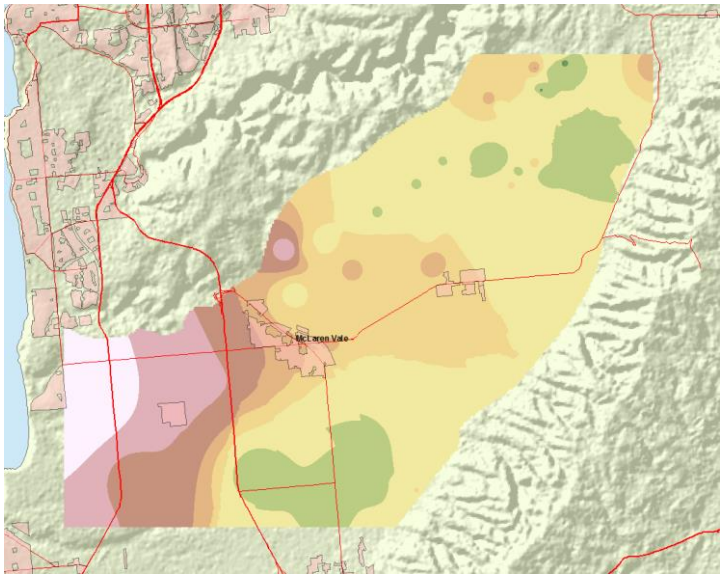
Gradual decline of 0.04 to 0.10 m/year in response to rainfall, but aquifer >50m thick



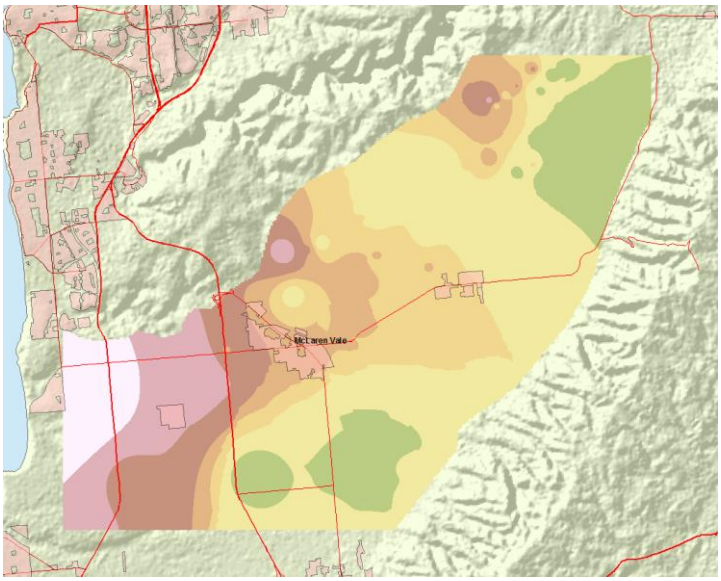
Maslin Sands - **1980**



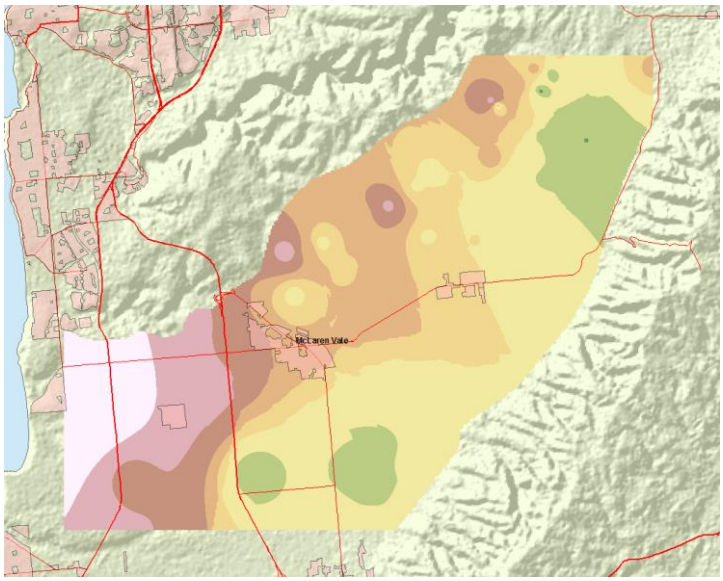
Maslin Sands - **1990**



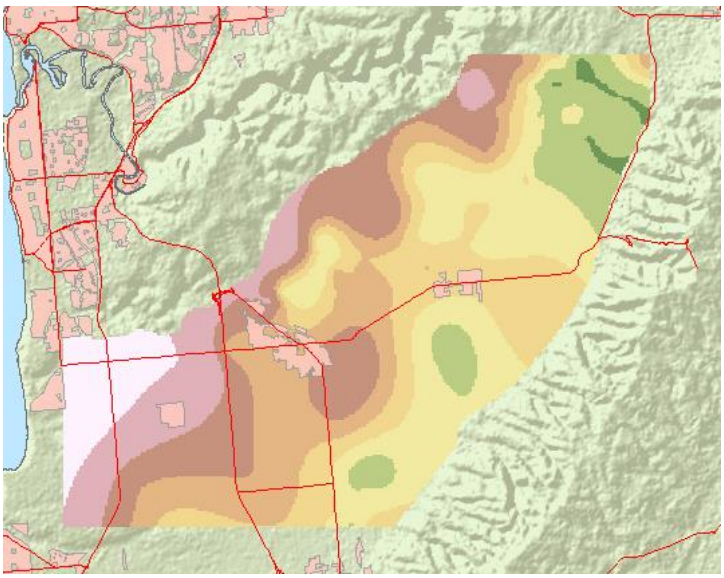
Maslin Sands - **2007**



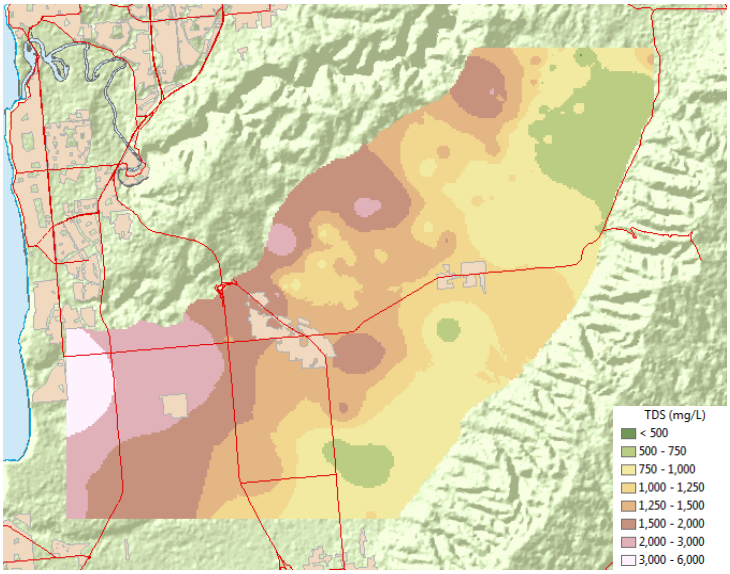
Maslin Sands - **2014**

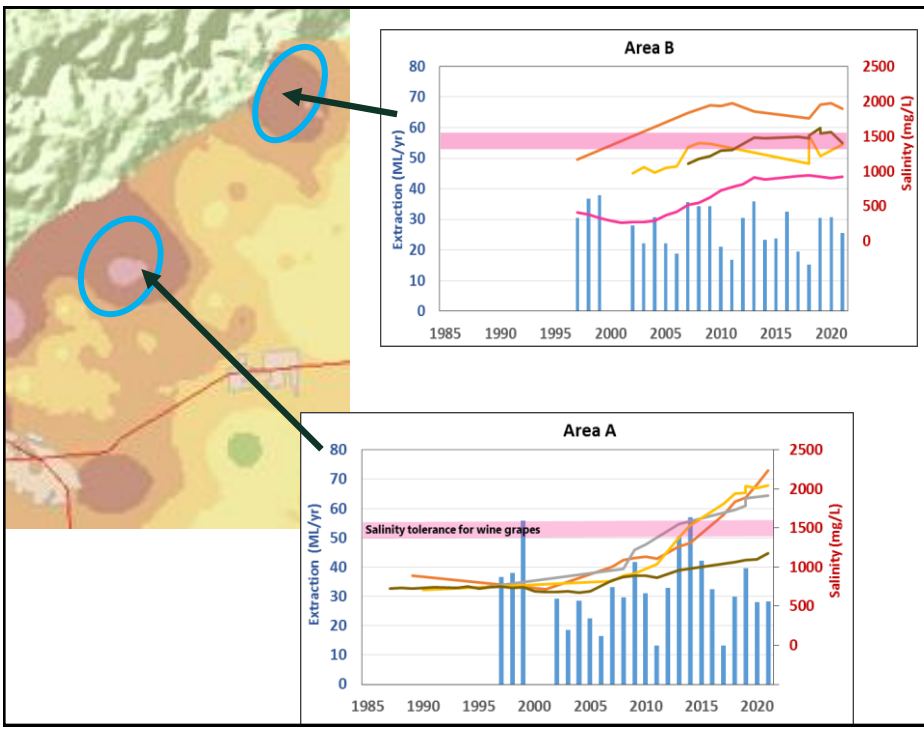


Maslin Sands - **2019**



Maslin Sands - **2021**

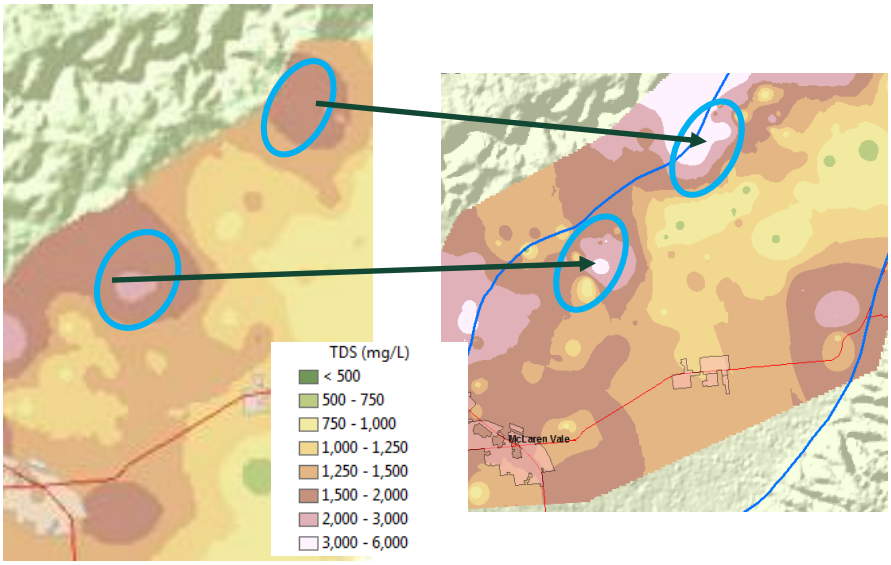


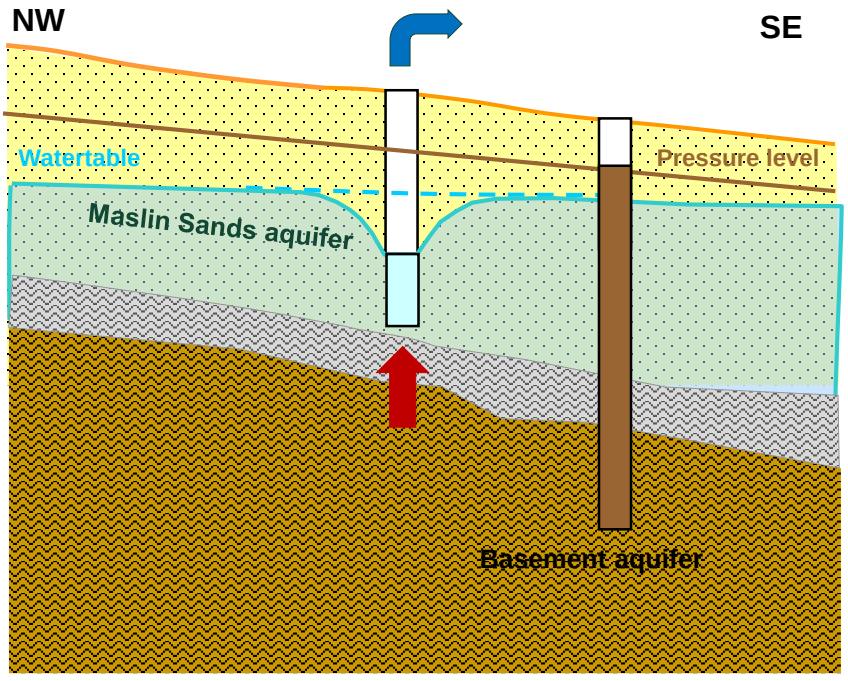


Where is the salt coming from ?
Maslin Sands aquifer

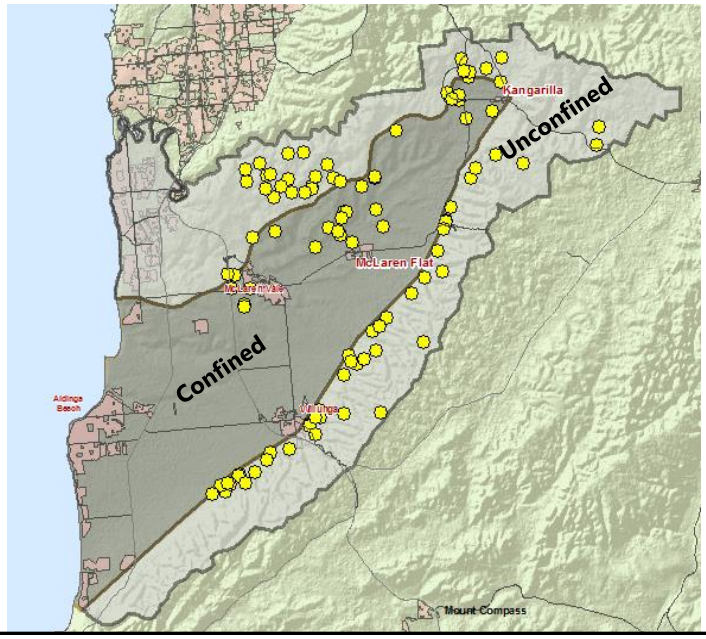
Maslin Sands

Basement





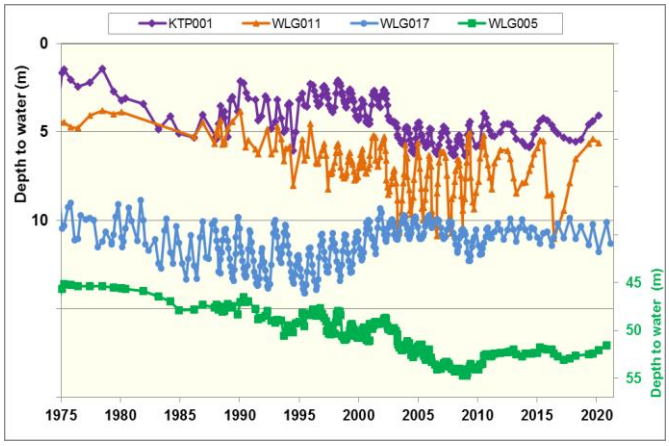
Fractured rock aquifer



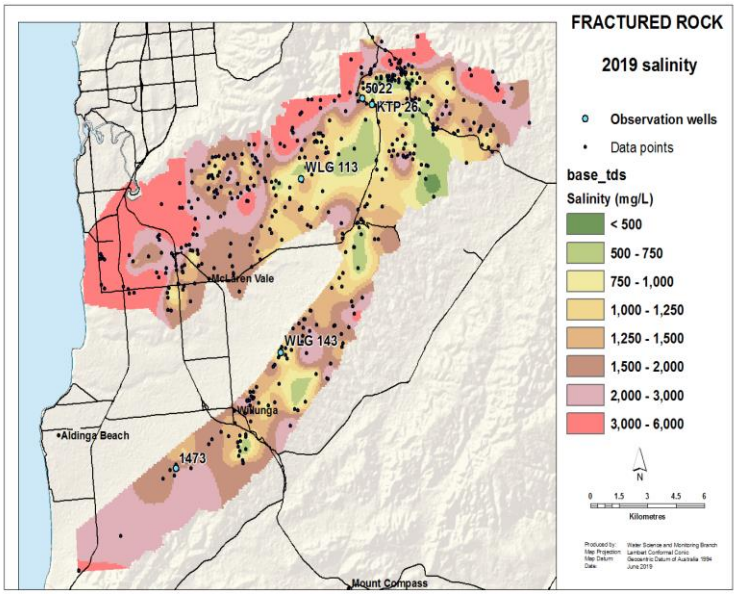
Fractured rock

Water level trends

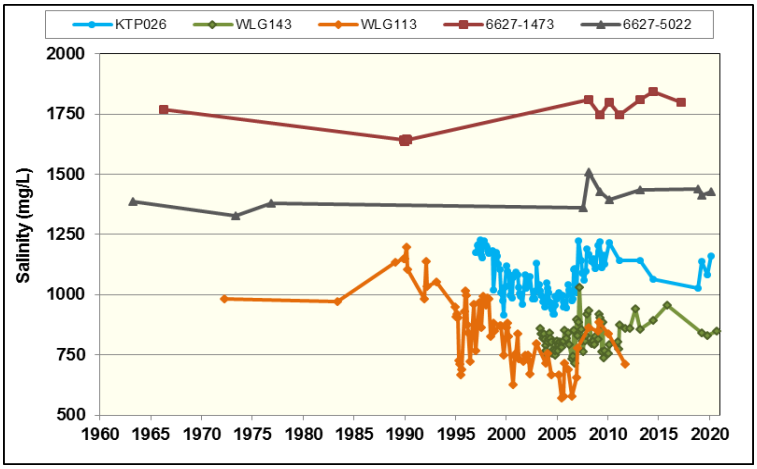
Gradual decline in response to below average rainfall, mostly stable since 2002



Fractured rock



Fractured rock



Summary

- Current extraction regime sustainable for the foreseeable future from a volumetric perspective, despite the gradual long term declining trend (response to rainfall)
- Salinity 'hot spots' need management intervention
- In long term, impacts of climate change likely to place pressure on the capacity of the groundwater resource in some areas

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Existing use and allocations

- In 2019-20, 1,980 ML of unused allocation
- ABS stats on GVIAP for prescribed areas

Horticulture	~$3,000/ML
Pasture (SEast)	~$600–1,000/ML

- Use of full allocation unrealistic because of water supply or quality issues, business decisions

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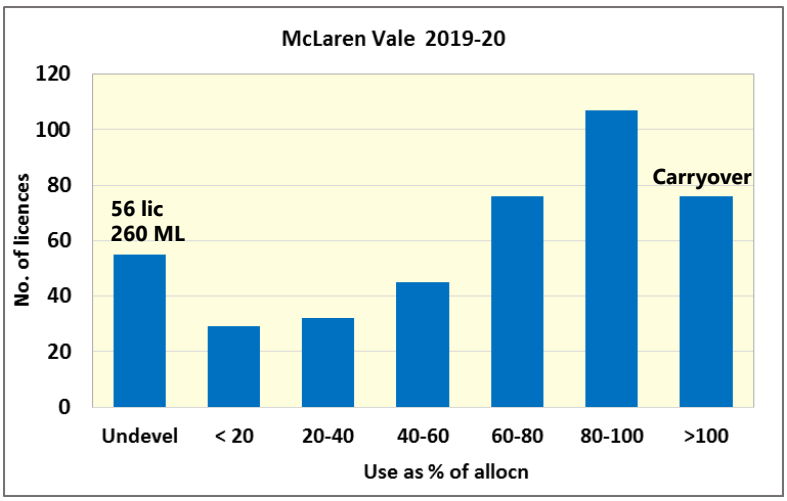
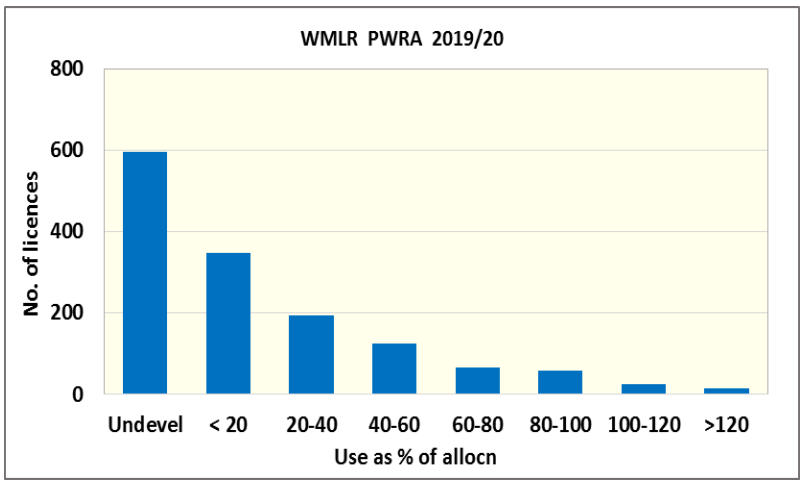

McLaren Vale 2019-20
No. of licences
120
100
80
60
40
20
0
56 lic
260 ML
Carryover
Undevel
< 20
20-40
40-60
60-80
80-100
>100
Use as % of allocn


WMLR PWRA 2019/20
No. of licences
800
600
400
200
0
Undevel
< 20
20-40
40-60
60-80
80-100
100-120
>120
Use as % of allocn

Domestic wells

- In 1975, a seven year water well survey of the Willunga Basin was completed

Irrigation	197
S & D	164
Abandoned	266

- Since 1976, the Water Resources Act requires a well completion report for every well drilled
- We know where they are, but not their current status – disused, abandoned etc

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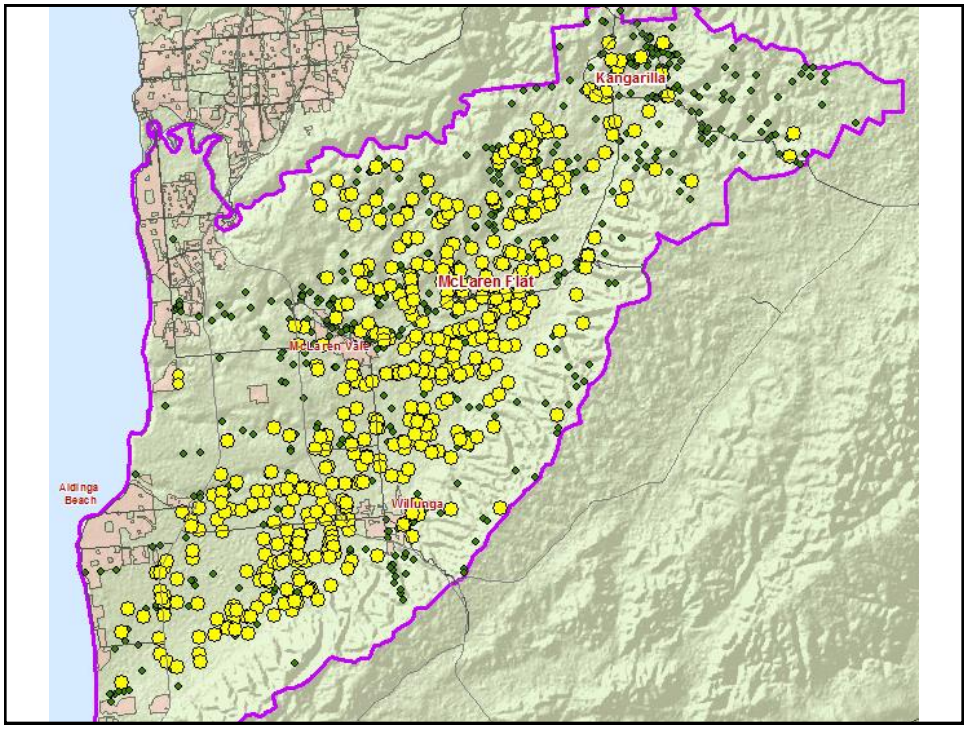
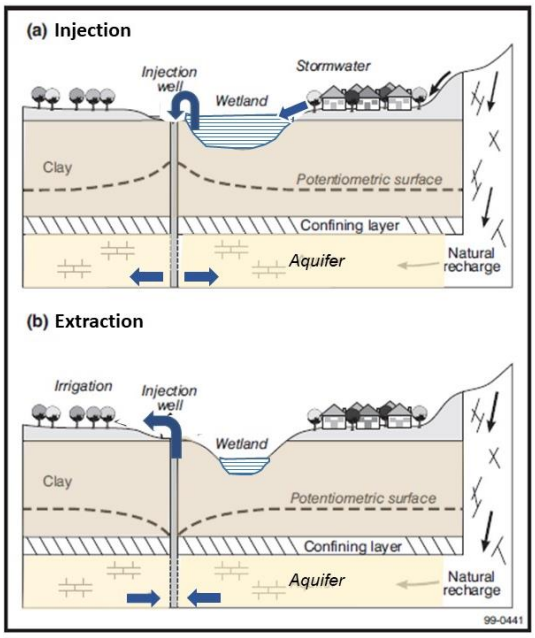


Domestic wells

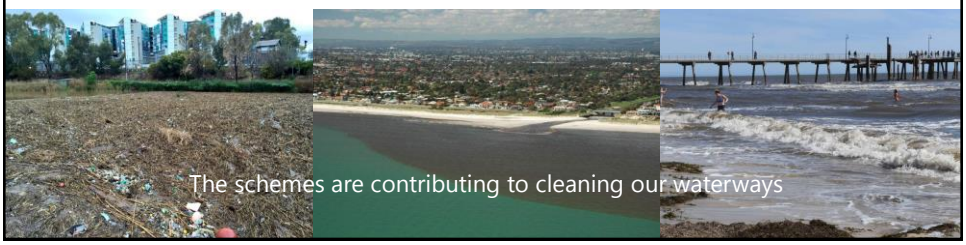
- A domestic well associated with a dwelling can irrigate a garden up to 0.4 ha (1 acre)
- Any water use associated with a winery (or cellar door) is classed as industrial use and must be licenced
- This is a compliance issue, not a resource issue
- Impacts on resource negligible

MAR



Source water types

- Urban stormwater drains
- Creek baseflow
- Creek/drain with detention storage
- Treated wastewater



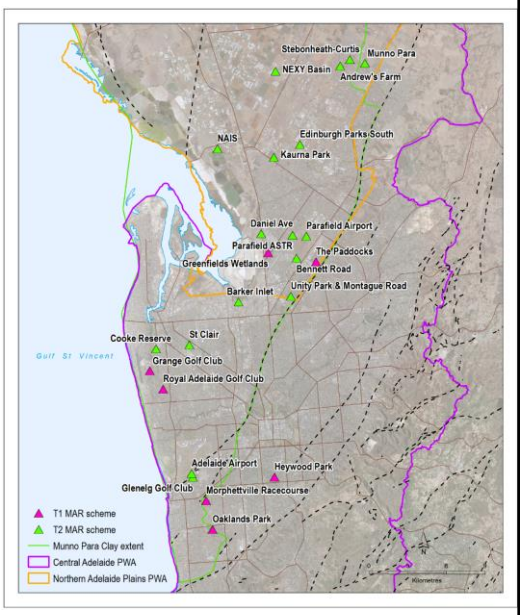
Water treatment (turbidity)

- Wetland
- Biofilters
- Sand filters
- Mechanical filtration

All have stories of success and failure. Low turbidity requirements for UV treatment are a notable hurdle for some.

Tertiary aquifer MAR schemes in metro Adelaide

- 24 operational schemes
- 17 in the T2 aquifer
- 8 in the T1 aquifer
- (Glenelg Golf Club uses both)



Regulation of MAR schemes

EPA

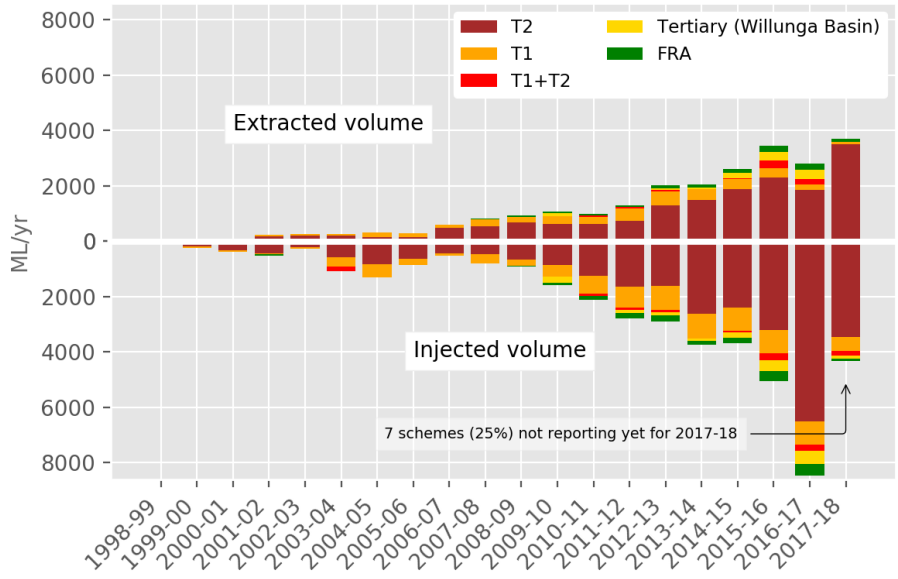
- Licence for injecting stormwater in metropolitan Adelaide or Mt Gambier
- State wide licence for injecting water containing treatment chemicals (i.e. wastewater that is chlorinated)

DEW

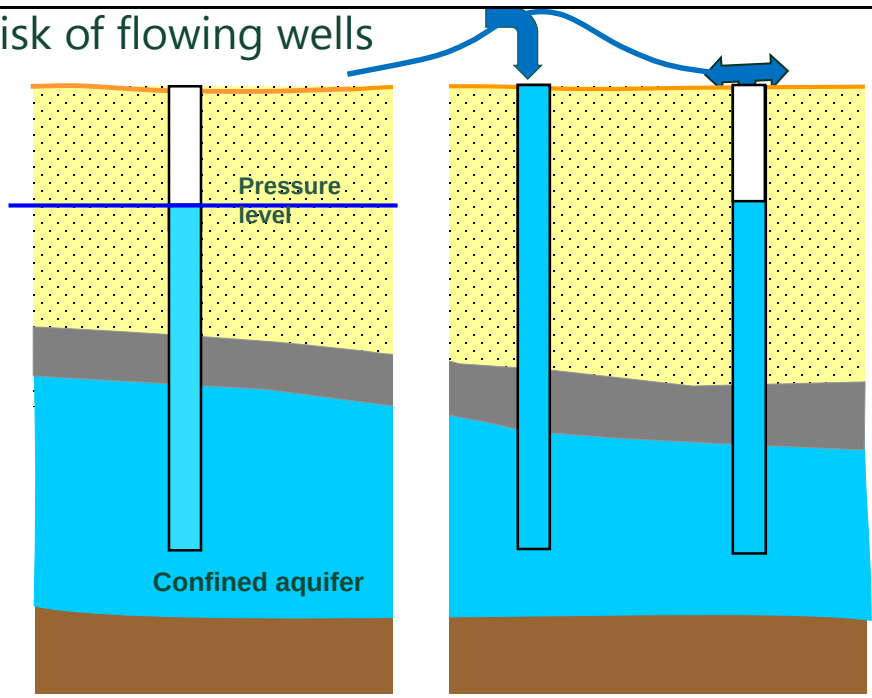
- Permit for injection
- Licence for extraction

MAR schemes required to operate in accordance with an RMMP

MAR volumes



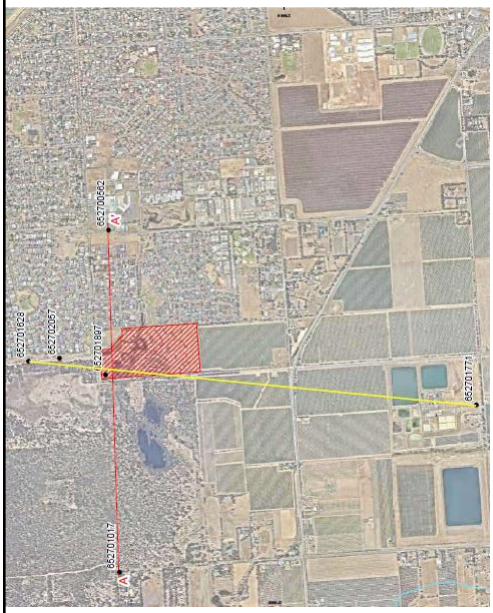
Risk of flowing wells

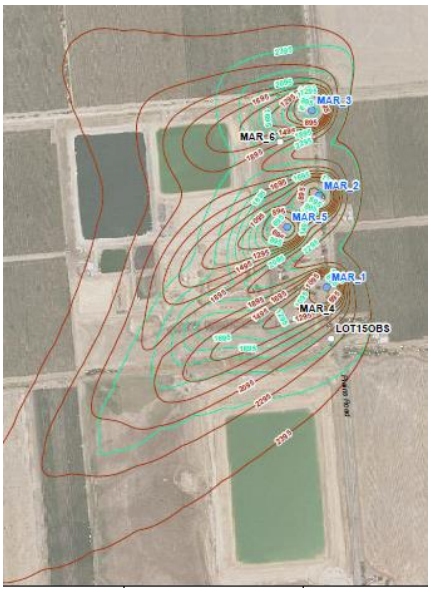


Risk of flowing wells

Operation of MAR schemes

- Because of infrastructure costs, nearly all schemes operated by Councils (stormwater) or SA Water (treated effluent)
- Exceptions include surface water in Angas Bremer PWA (since mid 1970s)
- Only two schemes in McLaten Vale PWA
  - SA Water – effluent at Aldinga WWTP
  - Onka Council – stormwater at proposed site Hart Lane



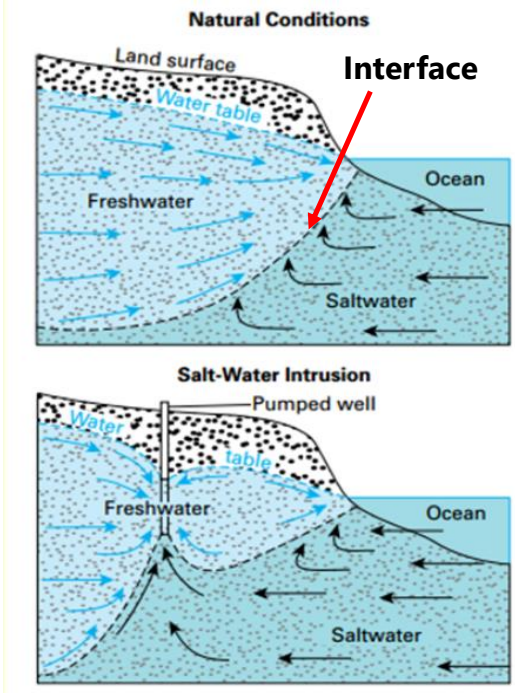


SWI

Salt Water Interface – naturally occurring interface between sea water and groundwater in an aquifer

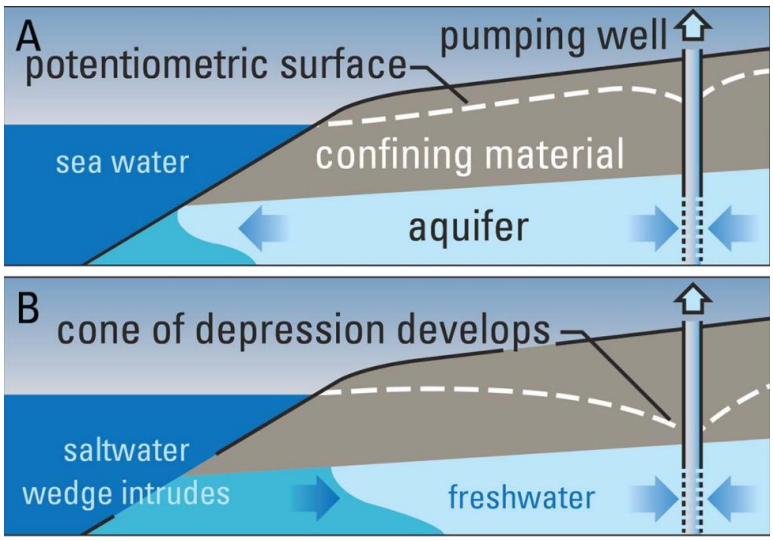
Sea Water Intrusion – occurs when the salt water interface moves inland, usually as a response to groundwater extraction which reverses the seaward gradient driving groundwater flow

Different things !

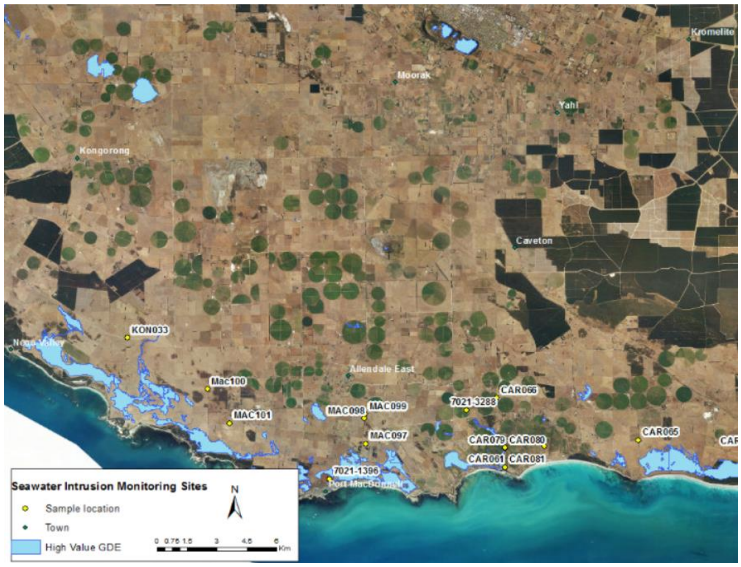


Unconfined aquifer

Confined aquifer

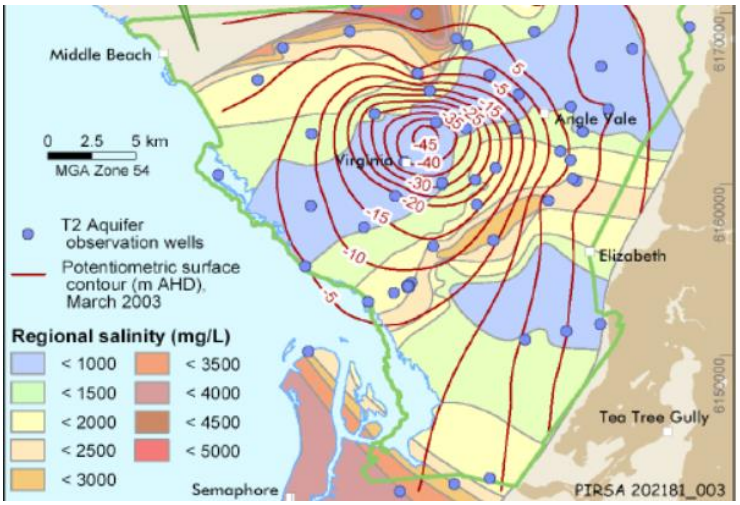


Lower South East



No evidence of SWInstrusion

Northern Adelaide Plains



No evidence of SWInstrusion

NCGRT SWI investigation

- Drilled a number of transects near the coast
- Quantification of groundwater flow at the interface difficult because of variable density effects and tidal effects
- No evidence of active intrusion

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SW Intrusion risk

- Considered low due to distance of most irrigation from the coast and no sign of cones of depression in pressure level contours
- Propose a resource condition limit in WAP that maintains a pressure gradient toward the coast in coastal aquifers

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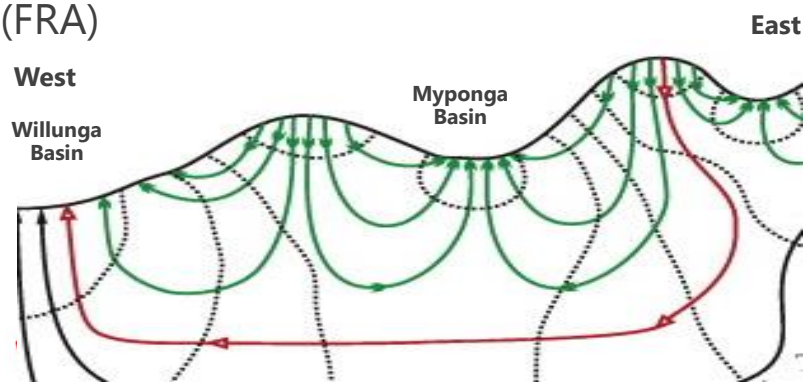
Groundwater flow

- Groundwater generally flows from highest points in the landscape to the lowest
- This movement occurs in local and regional flow systems within the fractured rock aquifers (FRA)



Item 6
McLaren Vale Groundwater Dependent Ecosystems

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Contents

- Priority groundwater dependent ecosystems (GDEs)
- Aquifers supporting GDEs
- Factors affecting risk to GDEs
- Questions to be addressed for WAP review

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Sources of information

- 2007 WAP
- Reports
  - Onkaparinga Catchment Water Management Board (2002)
  - Ecological Associates (2006)
  - Ecological Associates and SKM (2012)
- Dr Doug Green

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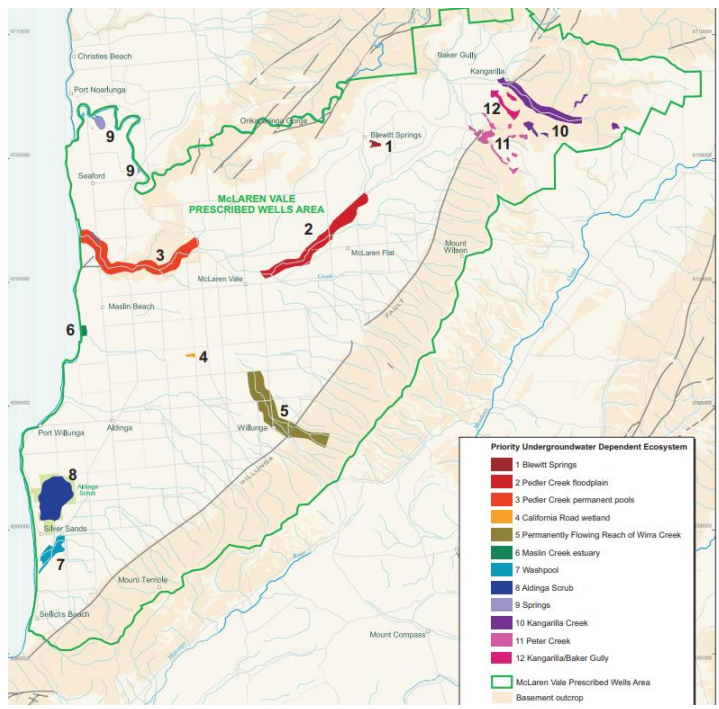

	Name	Type	Aquifer
1	Blewitt Springs	Phreatophytes	Maslin Sands
2	Pedler Creek floodplain	Watercourse	Quaternary
3	Pedler Creek permanent pools	Watercourse	Quaternary
4	California Rd	Wetland	Quaternary
5	Wirra Creek	Watercourse	Fractured rock
6	Maslin Creek estuary	Marine (estuary)	Quaternary
7	Washpool	Wetland	Perched aquifer
8	Aldinga Scrub	Wetland	Perched aquifer
9	Springs	Seeps and springs	Fractured rock
10	Kangarilla Creek	Watercourse	Fractured rock
11	Peter Creek	Watercourse	Fractured rock
12	Kangarilla/Baker Gully	Watercourse	Fractured rock

Types of Groundwater Dependent Ecosystems in McLaren Vale

- Phreatophytic vegetation
- Wetlands
- Watercourses
- Marine environment (incl. estuarine)

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Aquifers supporting ecosystems

- Fractured rock aquifers
- Shallow aquifer in the Blewitt Springs/Kangarilla area (Maslin Sands)
- Shallow Quaternary aquifer on the Willunga Basin plain

- Coastal perched aquifer

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GDEs dependent on Fractured rock

- Springs and soaks in the hills or hills face
- Location dependent on fractures
- Variable flow rates ranging from support of riparian vegetation to producing stream flow
- Level of current development ??
- Typical control for risks include buffer distances for new wells around known GDEs

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Maslin sands outcrop (Blewitt Springs)

- Supports phreatophytic vegetation
- Possibly surface water expression supporting riparian vegetation
- High levels of surface water development in vicinity (dams)
- Less risk of groundwater development pressure in vicinity due to elevated salinity
- Typical control for risk – buffer distance around the GDE for new developments

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Quaternary aquifer (Willunga Basin Plain)

- Supports multiple GDEs including phreatophytic vegetation, watercourses and wetlands
  - River red gums
  - Pedler creek floodplain and permanent pools
  - Wetlands (e.g. California Rd)
- Simple groundwater interaction – watertable close to surface
- Development pressure is low
- Typical controls for risk are buffers around GDEs for new wells

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Coastal perched aquifers

- Supports Aldinga Scrub and Washpool
- Watertable is close to surface
- Development pressure is nil
- Typical controls may be buffer zones for new developments or prohibiting extraction from these perched aquifers.

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Climate change

- Observable long term trend of declining aquifers due to decreased recharge
- Small changes in aquifer level may have significant effects on GDEs.
  - E.g. Dropping water tables may cause permanent pools to dry
  - E.g. Decreased recharge of fractured rock aquifer causing reductions in spring flow
- Graham Green to address at next meeting
- Risk not really controllable through WAP

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Other risks to GDEs

- Impacts of surface water development?
- Context: Aquifers hosting GDEs are partially recharged by streamflow
- Source of risk: Take or impoundment of surface water reduces streamflow, which reduces recharge…
- Existing controls for risk: Western Mt Lofty Ranges WAP
- Level of risk?? Factors include:
  - Potential for surface water development?
  - Effectiveness of WMLR WAP?

Questions for WAP review

- Is the list of priority GDEs from 2007 MV WAP still valid?
- Any other context that affects the risk management task for GDEs (e.g. presence of significant conservation values)
- To what extent are the principles of the existing WAP sufficient to control risk to GDEs at an acceptable level

Assessing risk

- Focus on risks caused by groundwater extraction
- Is the aquifer targeted by development?

Deviation from objective	Description
Very severe	Loss of >1 critical CPS with recovery not feasible over medium to long term (>10 years). Sustained change in ecological character.
Severe	Loss of 1 critical CPS with recovery not feasible over medium term. Change in ecological character
Moderate	Some loss of critical CPS but recovery is feasible over the medium term (10 years) Objectives partially achieved.
Minor	Some change to critical CPS or supporting CPS, but recovery feasible over medium term. Objectives achieved
Insignificant	No loss of critical CPS. Objectives achieved

McLaren Vale Water Allocation Plan Advisory Committee



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Recap of the WAP review process and risk assessment

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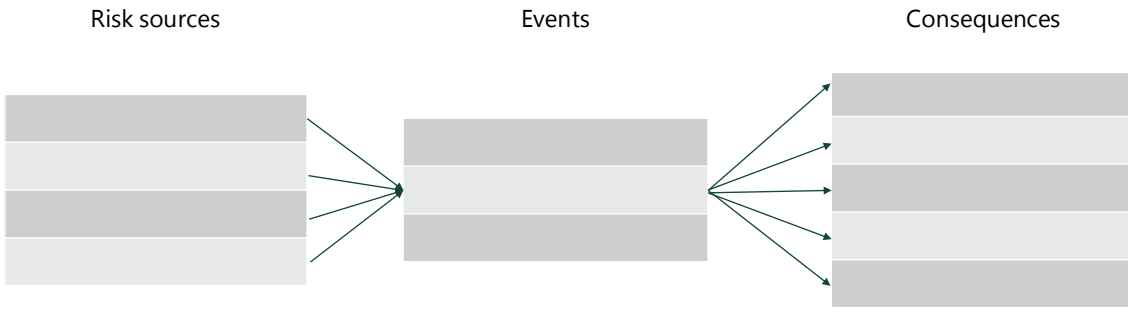
Preview of where we want to get to today



Area:

-Whole McLaren Vale Prescribed Wells Area, OR
-Assess each aquifer

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Kaurna input into the review

- Having an ongoing conversation with Kaurna about how they would prefer to have their views included in the review
- Appropriate for Kaurna to provide the input on cultural values for the review, so that will be developed outside the risk assessment process
- Workshop tentatively scheduled for early Nov.
- Have invited Kaurna to speak at next meeting

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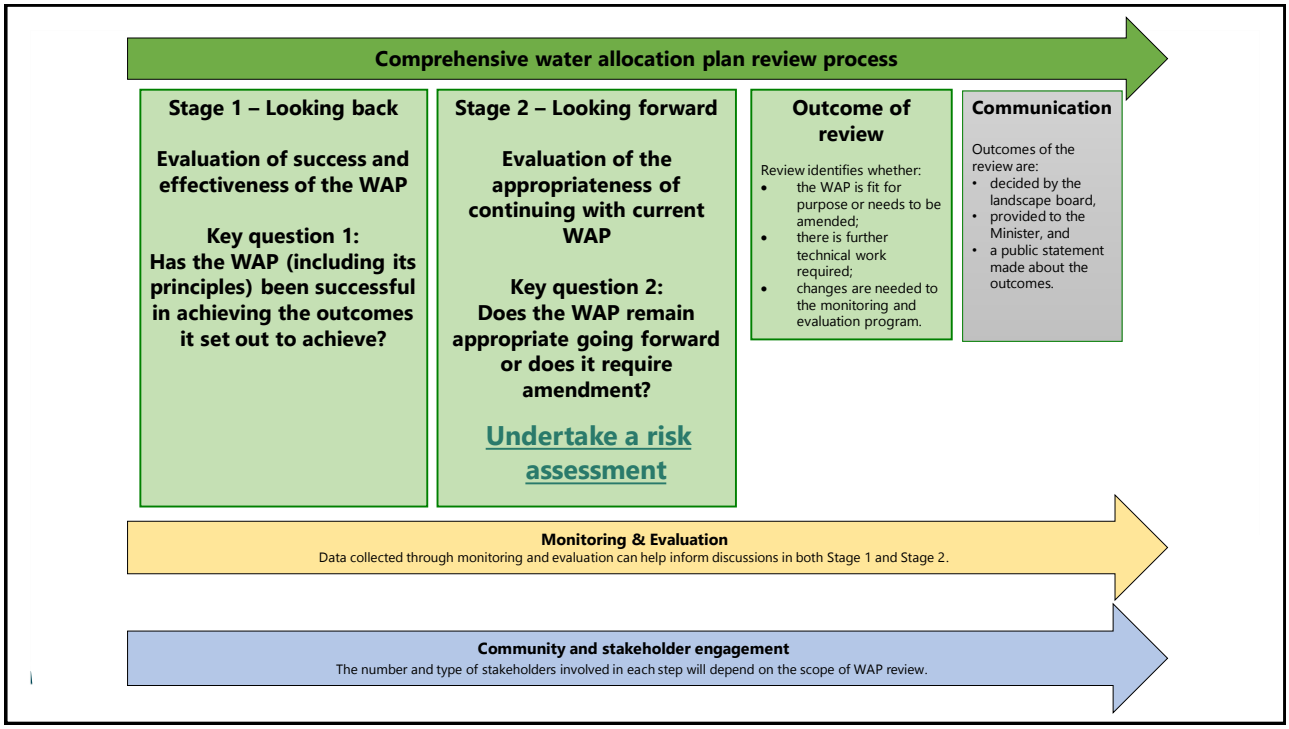

Why risk assessment?

- Is a systematic way of examining risks to economic, environmental and social values of a water resource
- Is widely used in water resource management – was a Basin Plan requirement on the Basin States
- DEW and Landscape Boards have a well established process and is has been found to be effective

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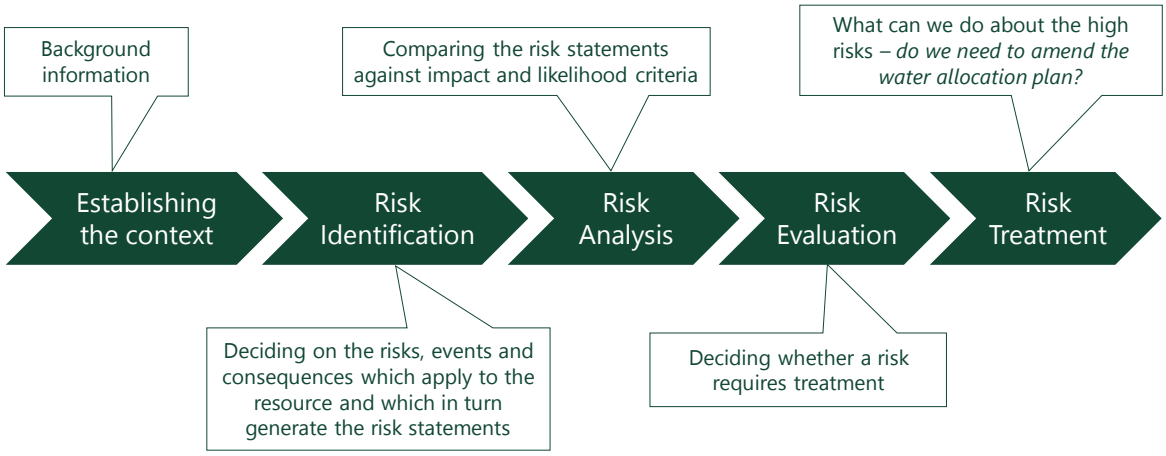
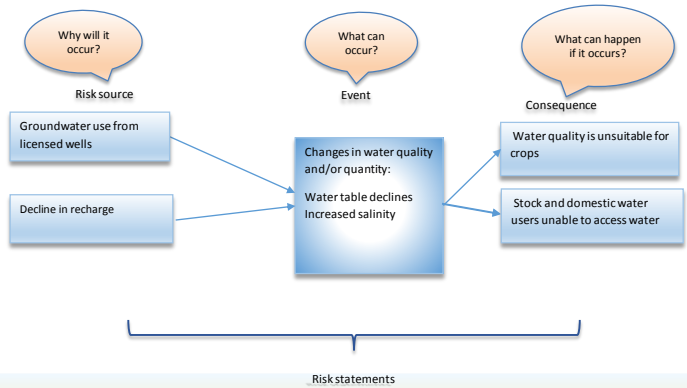
What is risk assessment?



Risk Identification: example of a simple bow tie diagram



- There is the potential that **groundwater use from licensed wells** leads to **changes in water quality and/or quantity** which results in **water quality being unsuitable for crops**
- There is the potential that **groundwater use from licensed wells** leads to **changes in water quality and/or quantity** which results in **stock and domestic water users unable to access water**
- There is the potential that **a decline in recharge** leads to **changes in water quality and/or quantity** which results in **water quality being unsuitable for crops**.
- There is the potential that **a decline in recharge** leads to **changes in water quality and/or quantity** which results in **stock and domestic water users unable to access water**

Risk Analysis:

Comparing the risk statements against impact and likelihood criteria

There is the potential that **groundwater use from licensed wells** leads to **changes in water quality and/or quantity** which results in **impacts on economic use**

Consequence category	Descriptor
Catastrophic	Water not available for economic consumptive use purposes. Water allocation <30% for a single year or <50% for two or more consecutive years, or Economic losses from impacts to ecosystem service provision including reduced productivity of non-consumptive economic use and damage to assets and infrastructure with a total value of >$x
Major	Water not available for economic consumptive use purposes having market value $x. Water allocation <50% for a single year or 50–75% for two or more consecutive years, or Economic losses from impacts to ecosystem service provision including reduced productivity of non-consumptive economic use and damage to assets and infrastructure with a total value of $x
Moderate	Water not available for economic consumptive use purposes having market value $x. Water allocation 75–90%, or Economic losses from impacts to ecosystem service provision including reduced productivity of non-consumptive economic use and damage to assets and infrastructure with a total value of $x
Minor	Water Allocation >90 %, or Losses or damage <$x
Insignificant	No losses or damage

↑ Example, actual descriptors will be decided by WAPAC

Likelihood category	Descriptor	Probability
Almost certain	Expected to occur in all circumstances	91% -100%
Likely	Greater than even chance of occurring	51% - 90%
Possible	Less than even chance of occurring	26 % - 50%
Unlikely	Unusual but not exceptional	11% -25%
Rare	Only occurs in exceptional circumstances	0% -10%

Likelihood	Consequence: Insignificant	Low	Moderate	Major	Catastrophic
Very Likely >90%	Low	Medium	High	High	High
Likely 60% - 90%	Low	Medium	Medium	High	High
Possible 31% - 59%	Low	Low	Medium	Medium	High
Unlikely 10% - 30%	Low	Low	Low	Medium	Medium
Very Unlikely <10%	Low	Low	Low	Low	Low

Risk Evaluation:

Deciding whether a risk requires treatment

- Risk evaluation is where the decision is made whether a risk requires treatment or is acceptable given the current controls in place.

Level of risk	Tolerability	Treatment required?
Low	Tolerated	No. Continue with current WAP policies and level of monitoring/management
Medium	Some tolerability (tolerable if as low as reasonably practical)	Yes. Investigate and where practicable, amend policies to reduce risk, increase monitoring intensity, prioritise further research to reduce knowledge gaps
High	Not tolerated	Yes. Take action, amend the WAP principles if risk level can be reduced by doing so. Could also make changes to monitoring and/or commence further investigations.

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Risk Treatment:

What can we do about the high risks?

Can the level of risk be decreased by amending the WAP?

Which parts of the WAP need to be amended?

Developing specific new policies will be part of the WAP amendment process

High risks that cannot be treated by amending the WAP will be communicated to the landscape board to inform other programs

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Today

- Context – Steve and Hugh's presentations
- Risk Identification – after lunch

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Risk Identification

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Risk Identification

Risk identification is the process of finding, recognising and describing risks including deciding on the important values and risks to those values.

- Risk source
  - e.g. seasonal variability
- Event
  - e.g. water table decline
- Consequence
  - e.g. economic impacts

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Risk Identification cont.

- Relevant to the resource and the water allocation plan
- Meaningful to the WAPAC undertaking the risk assessment
- Collectively cover the issues – but can use broad statements if needed
- Multiplier effect – adding extra sources, events of consequences multiplies the number of risk statements to assess
- One resource or multiple aquifers?

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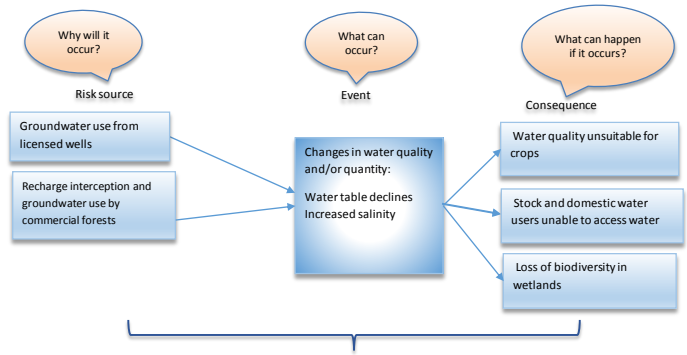
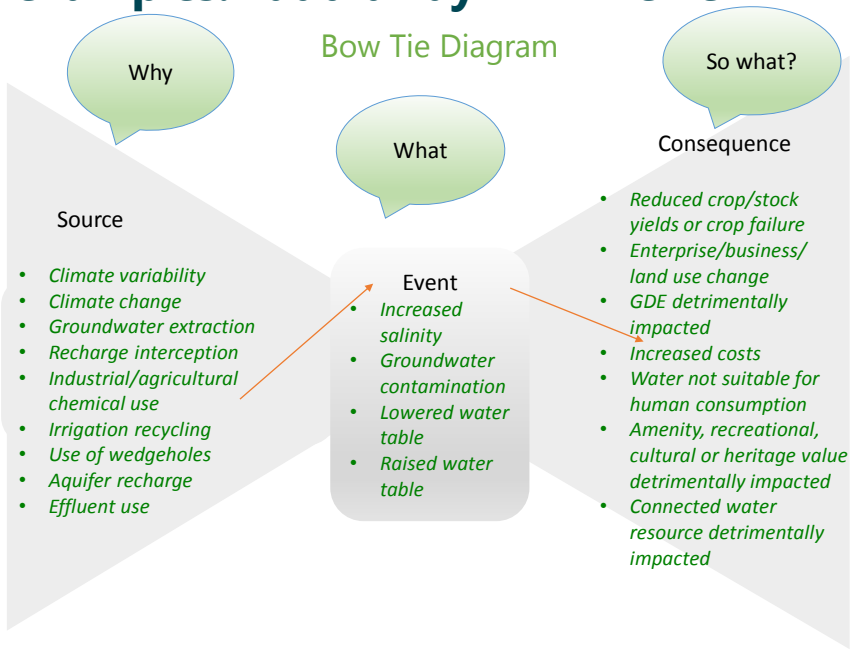
Some examples: DEW draft guidelines



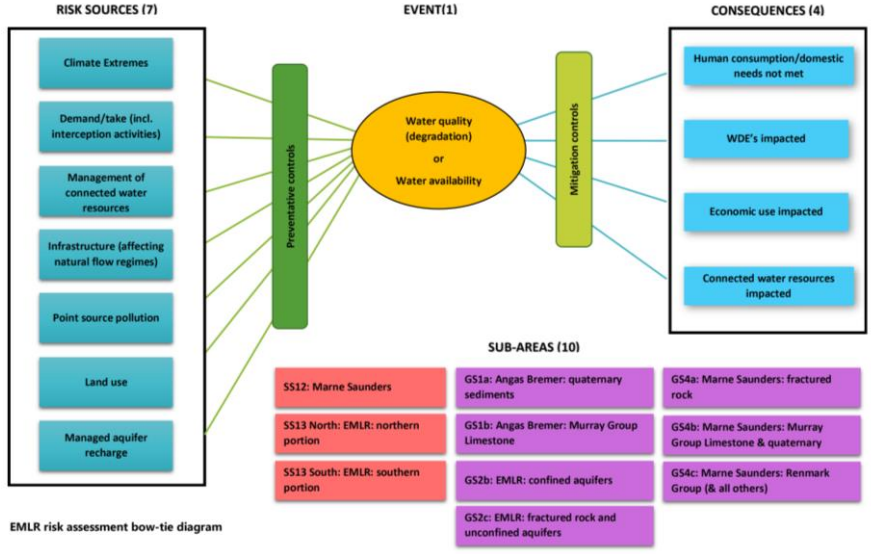
Risk statements

- There is the potential that **groundwater use from licensed wells** leads to **changes in water quality and/or quantity** which results in **water quality unsuitable for crops**
- Etc....

Some examples: Padthaway WAP Review

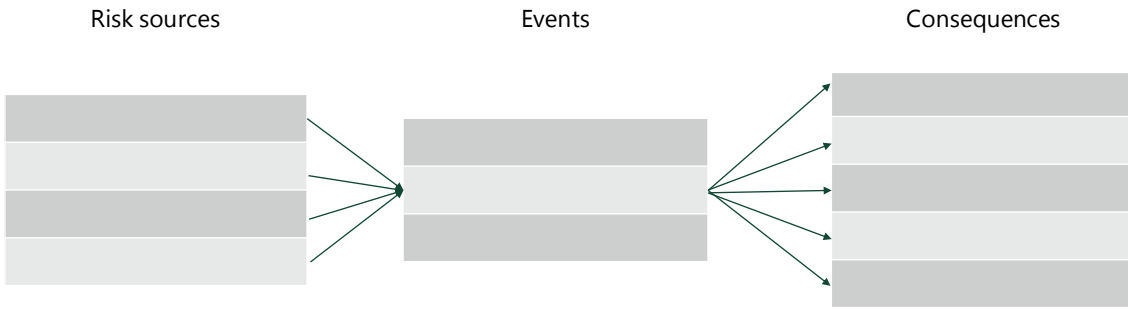


Some examples: Eastern Mount Lofty Ranges



EMLR risk assessment bow-tie diagram

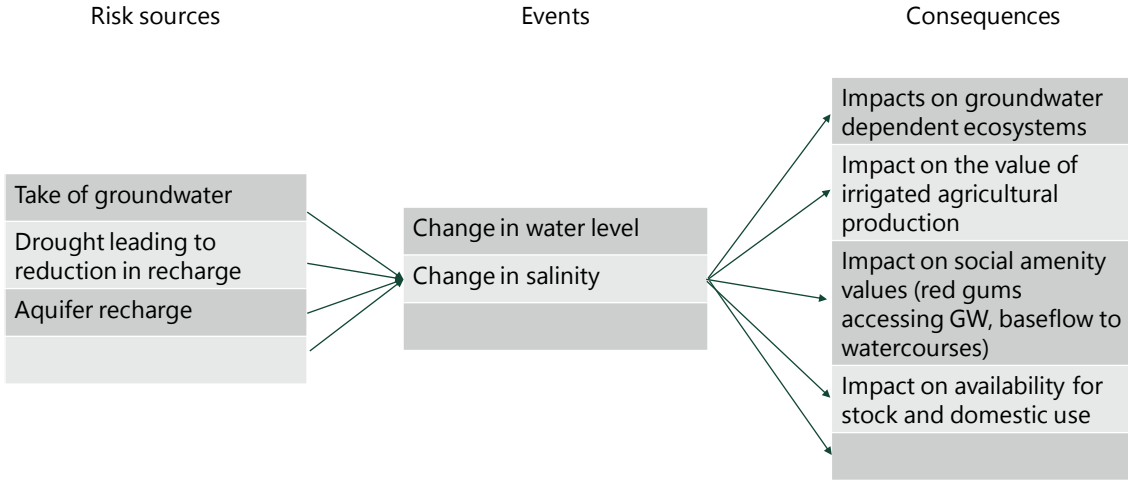
What does a bow tie diagram look like for McLaren Vale?



Area:

-Whole McLaren Vale Prescribed Wells Area, OR
-Assess each aquifer (4)

LANDSCAPE SOUTH AUSTRALIA HILLS AND FLEURIEU



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