Groundwater Recharge, Flow and Inter-Aquifer Leakage

NAIS Community Committee

Wednesday 10th February 2016

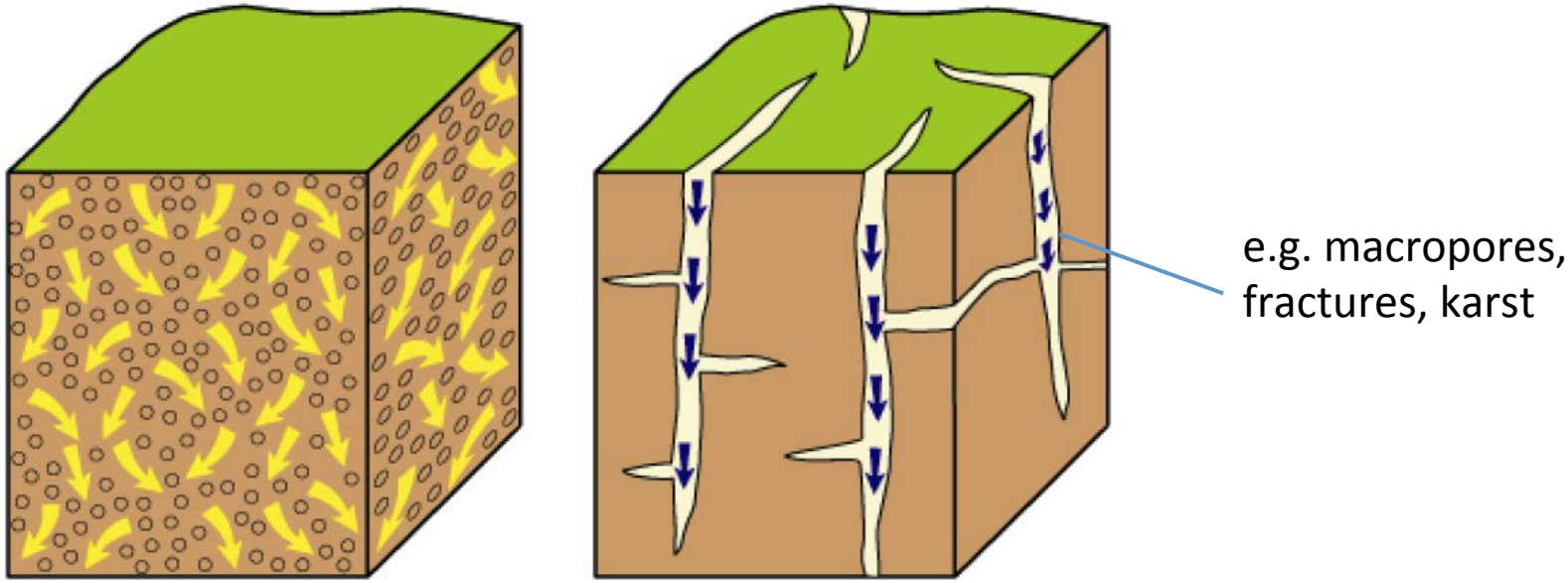
Overview

- aquifer types
- recharge and groundwater flow
- drawdown by pumping bores
- inter-aquifer leakage
- bore construction
- transport of injected recycled water

Two main types of Aquifers

Diffuse flow

Preferential
or bypass flow

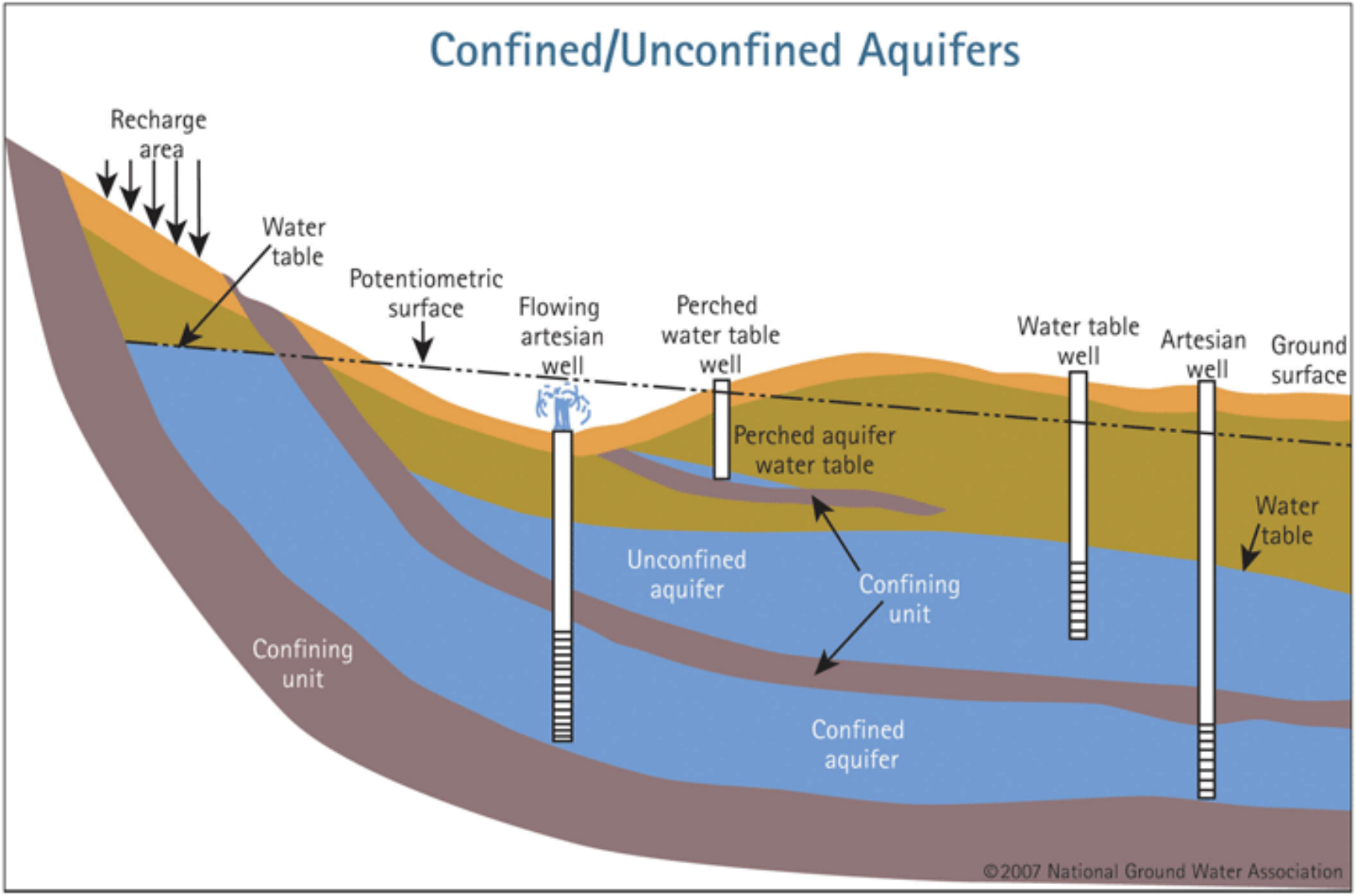


POROUS MEDIA

e.g., sandstone

DUAL-POROSITY MEDIA

e.g., fractured shale or karst limestone


Confined/Unconfined Aquifers
Recharge area
Water table
Potentiometric surface
Flowing artesian well
Perched water table well
Water table well
Artesian well
Ground surface
Perched aquifer water table
Water table
Unconfined aquifer
Confining unit
Confining unit
Confined aquifer
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Groundwater Recharge

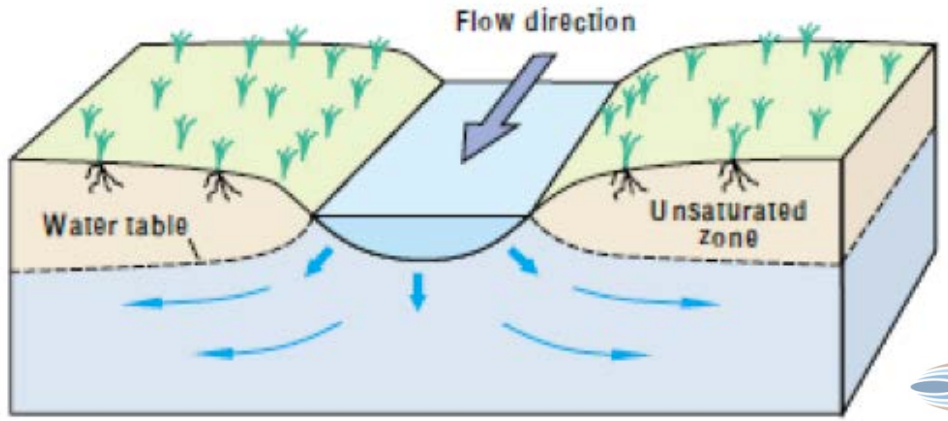
Groundwater Recharge

- Recharge may be defined as [#]

  "*the entry of water into the saturated zone at the water table*"

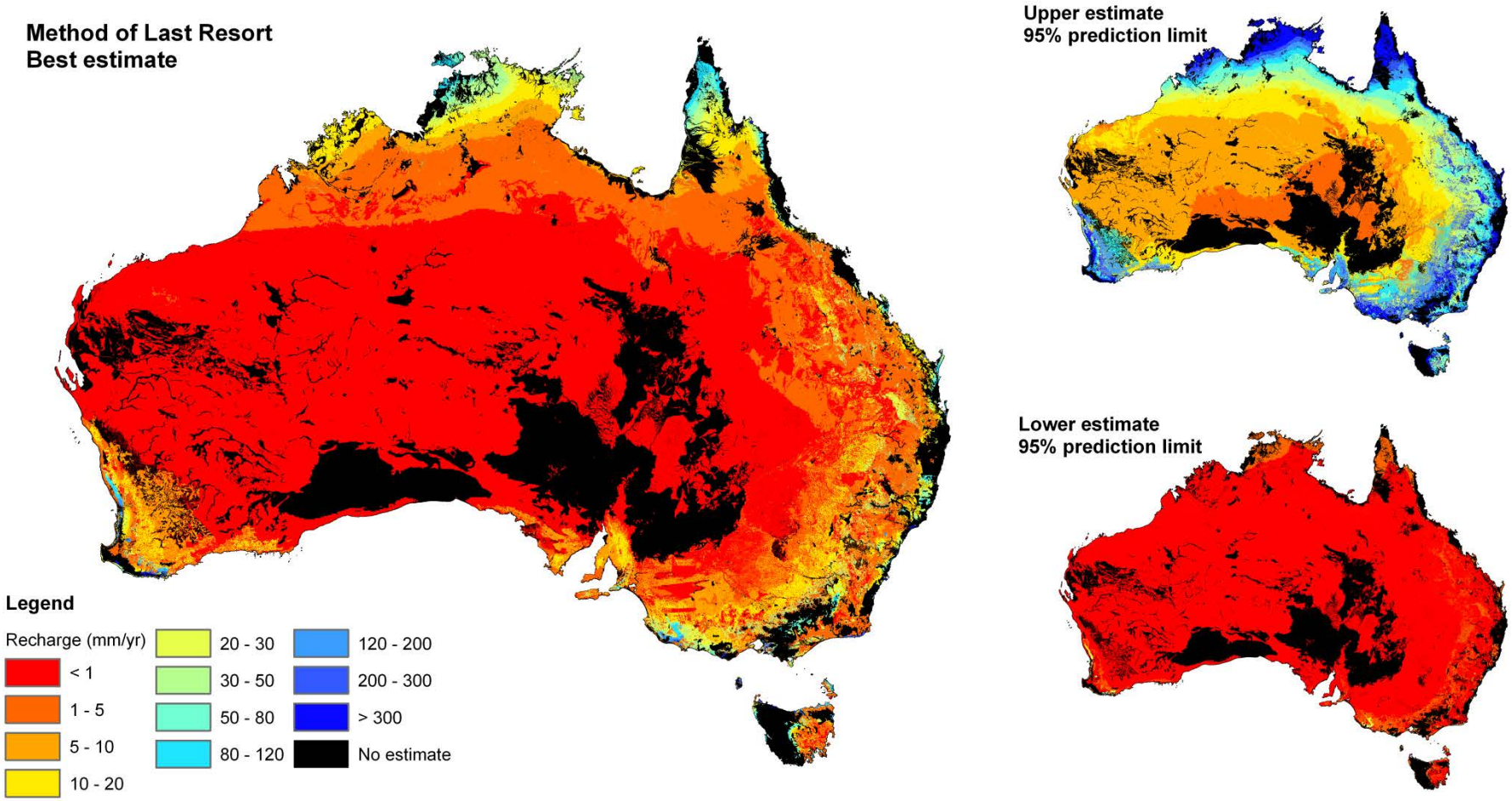
- **Diffuse recharge**:
  - widespread percolation through the soil zone
- **Localised recharge**:
  - focused due to water source or geology
  - streams – within bank and overbank flooding
  - karst features

  (e.g., sink holes etc.)



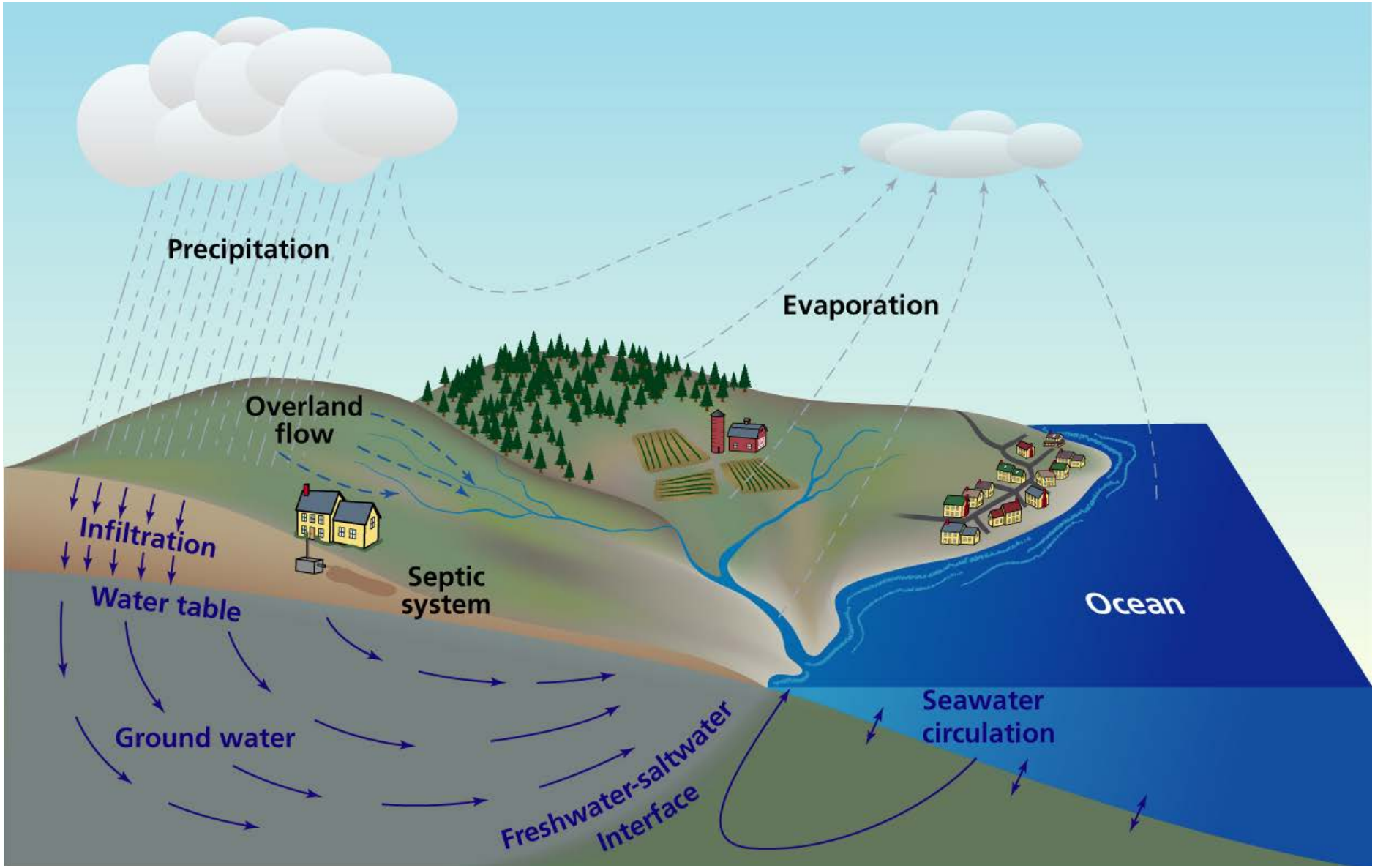
[#] *Freeze and Cherry (1979)*

Recharge is only a small fraction of Rainfall

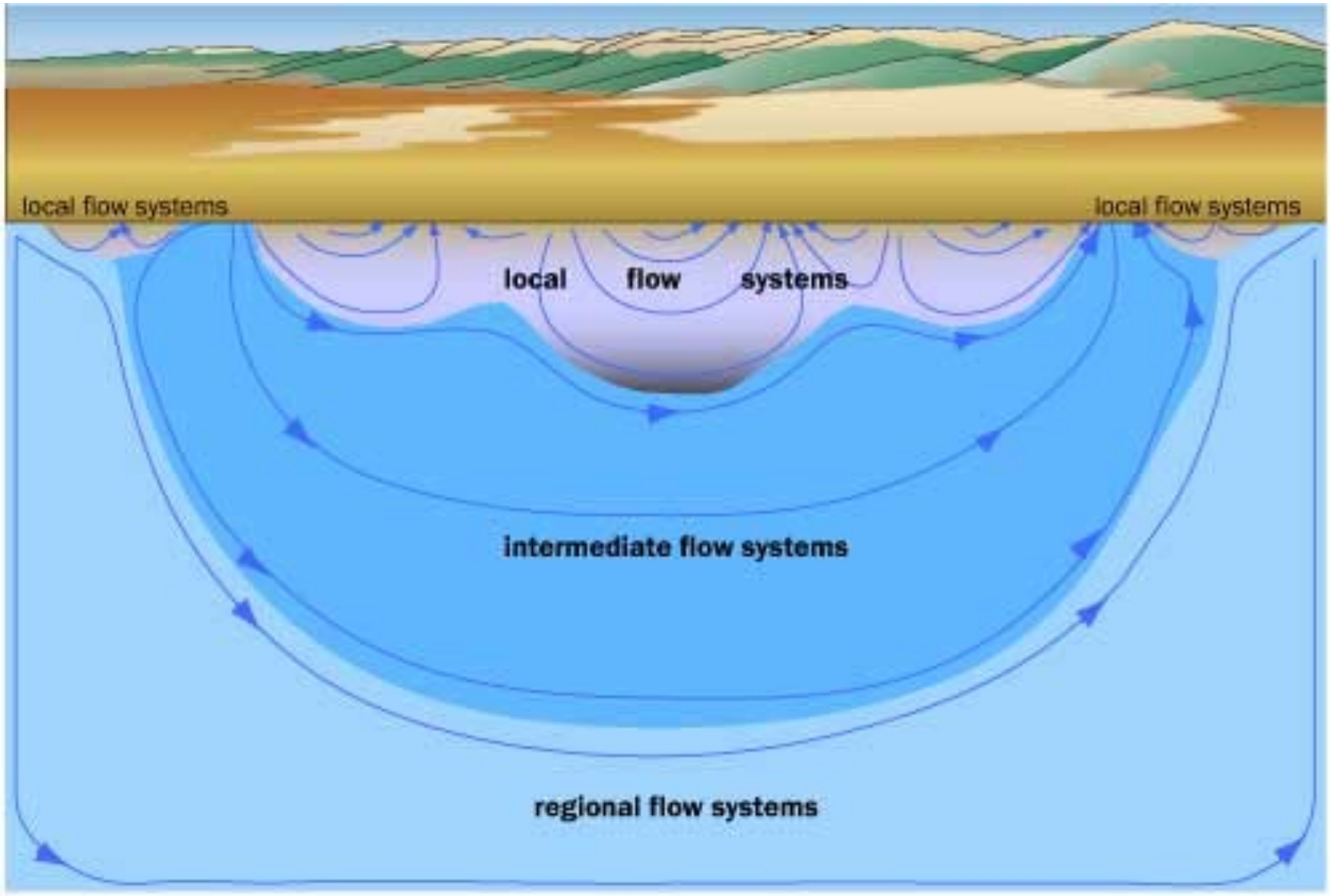


Leaney et al. (2011)

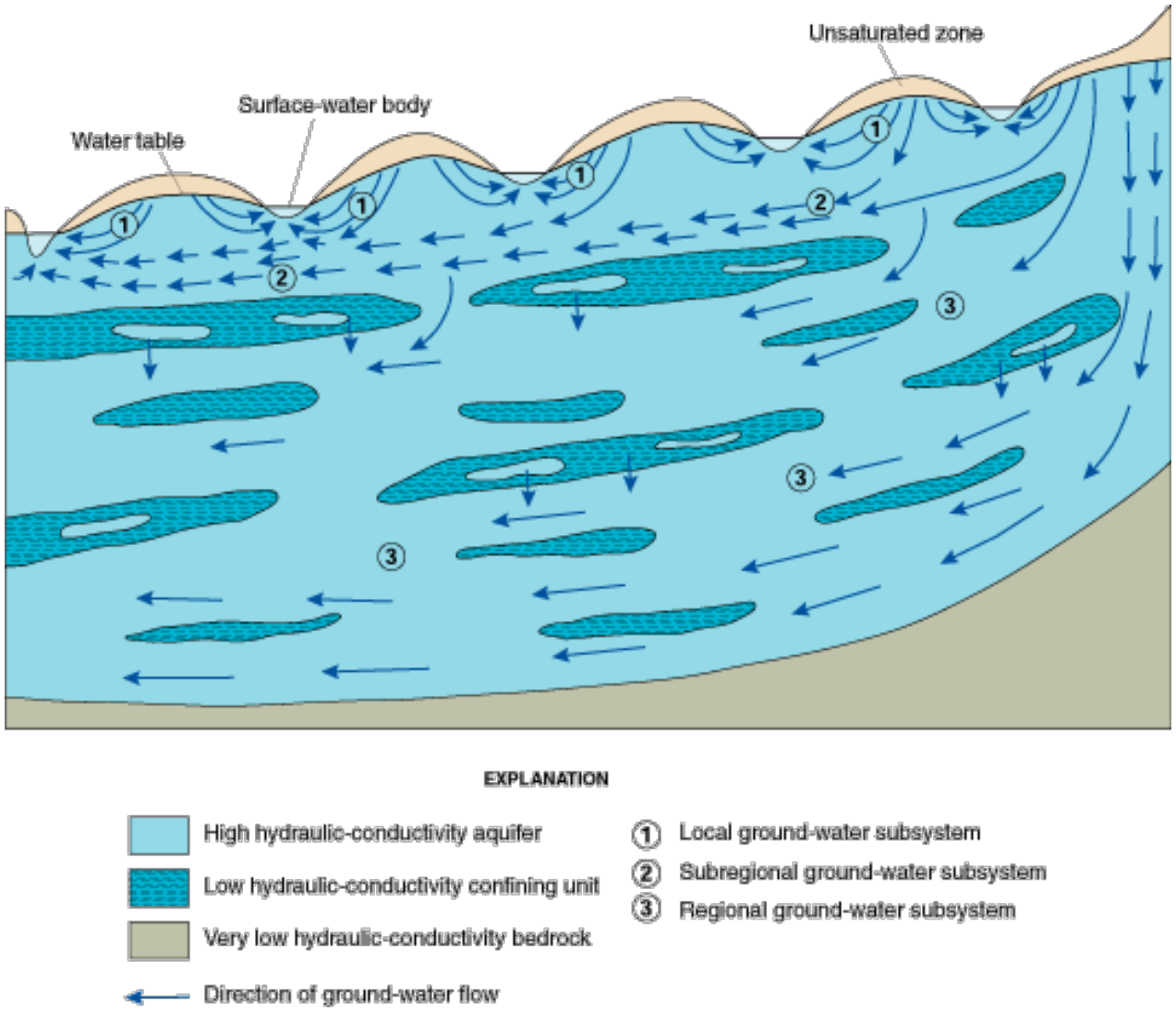
Groundwater in the Hydrologic Cycle

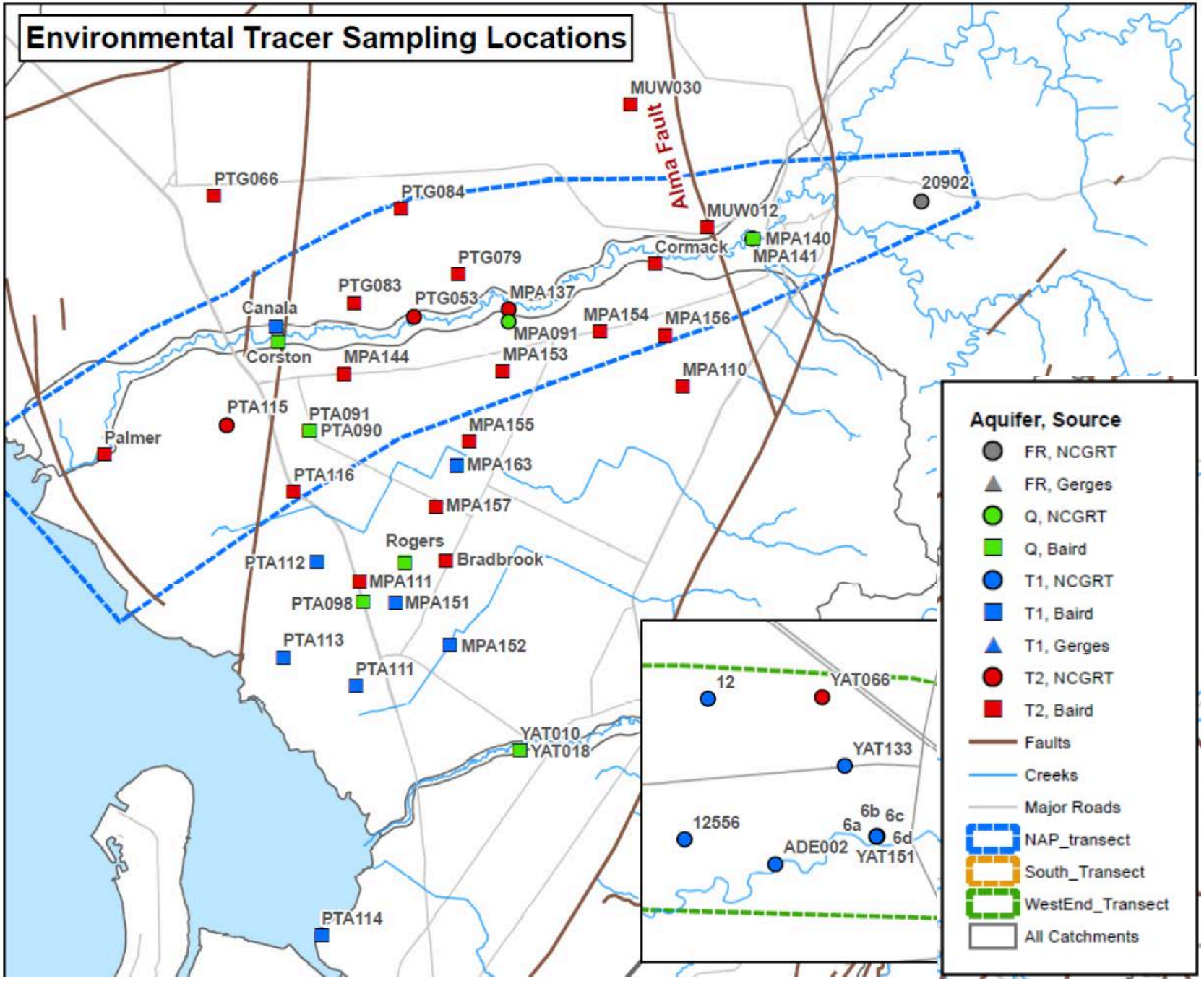


Groundwater Flow Systems



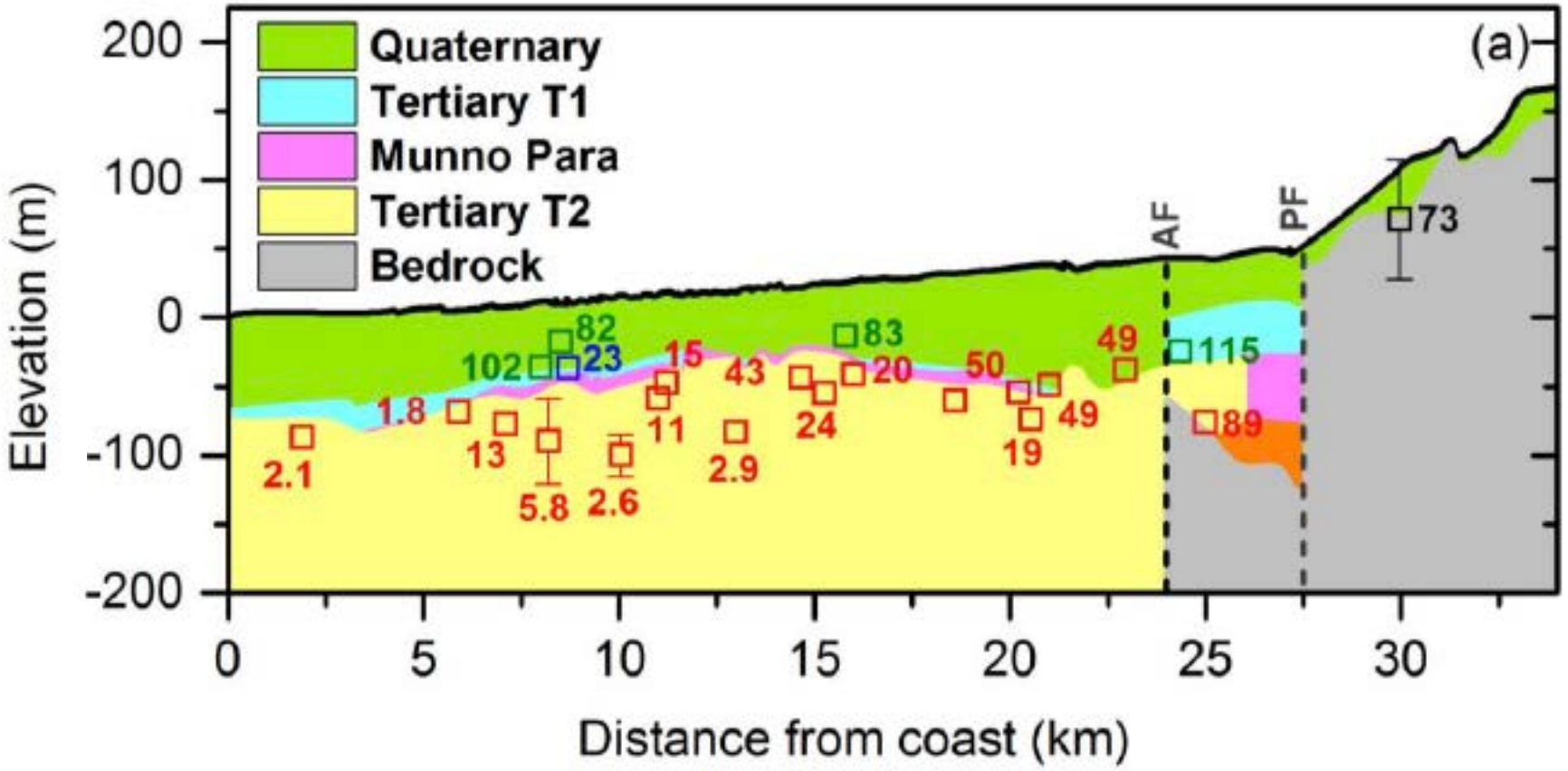
Groundwater Flow Systems





Goyder Institute Project: Assessment of Adelaide Plains Groundwater Resources

Groundwater moves very slowly!



Carbon-14 activity of groundwater samples
(Goyder Institute Project: Assessment of Adelaide Plains Groundwater Resources)

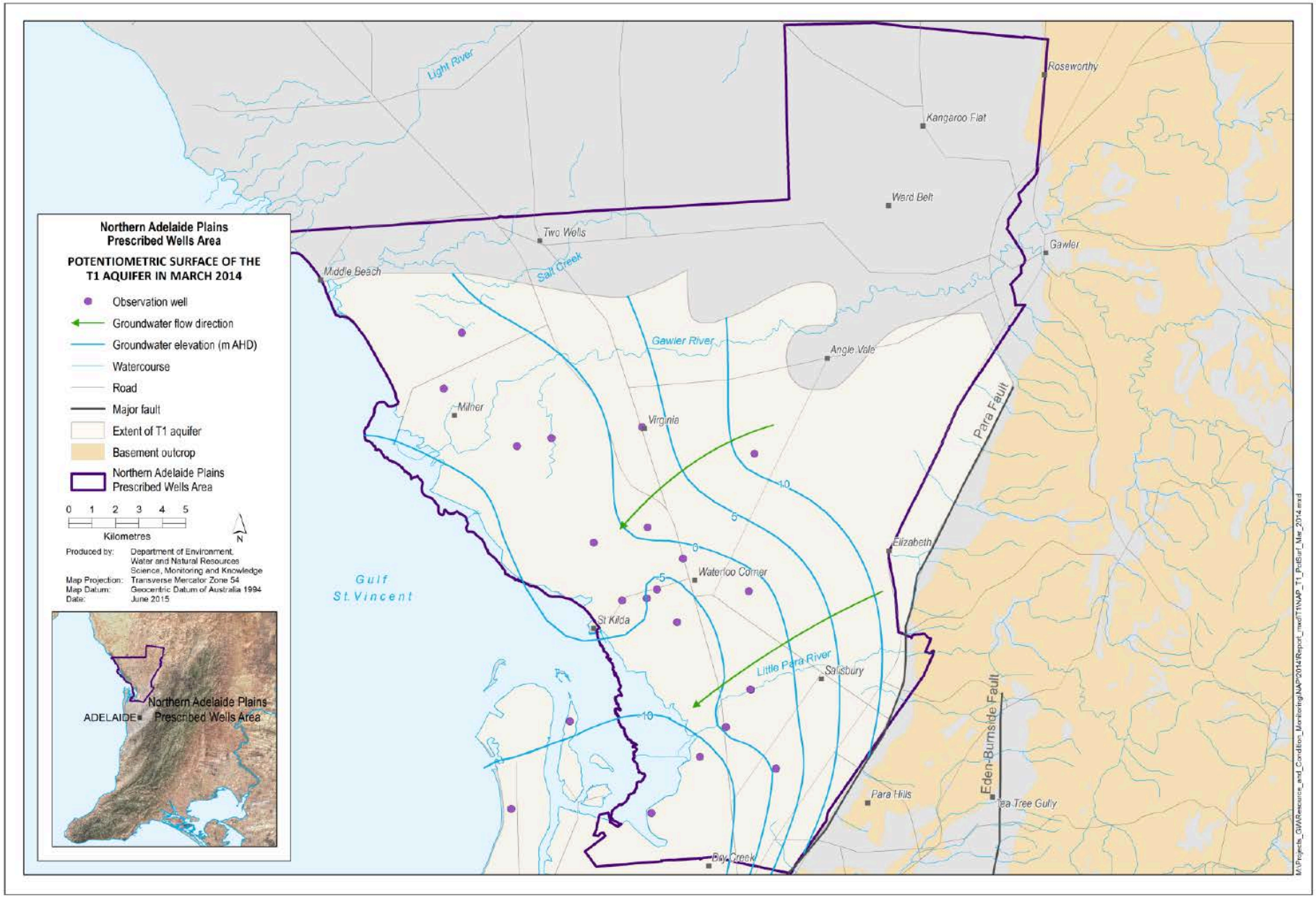


Figure 3. Potentiometric surface and direction of groundwater flow in the T1 aquifer of the Northern Adelaide Plains Prescribed Wells Area in March 2014

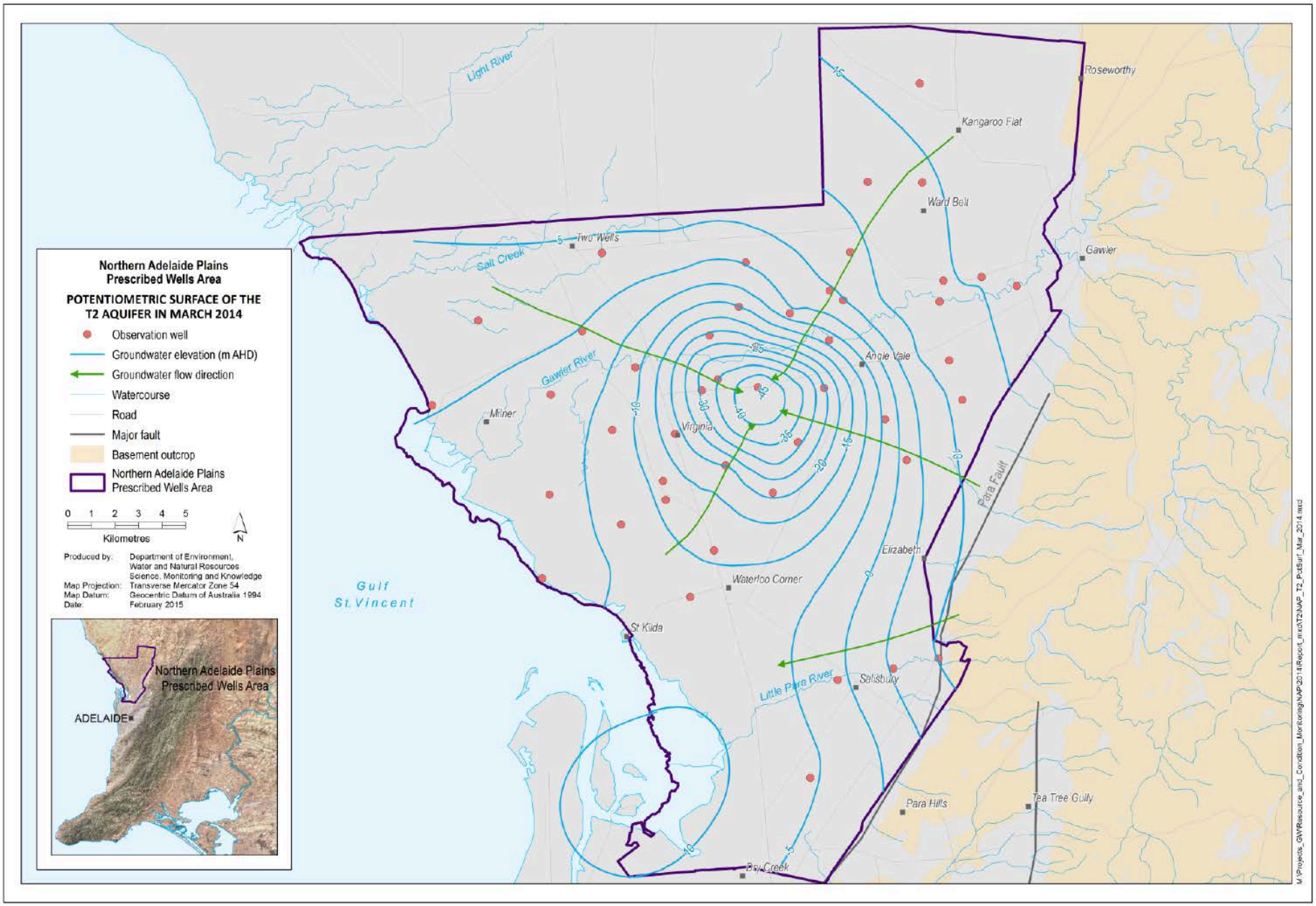
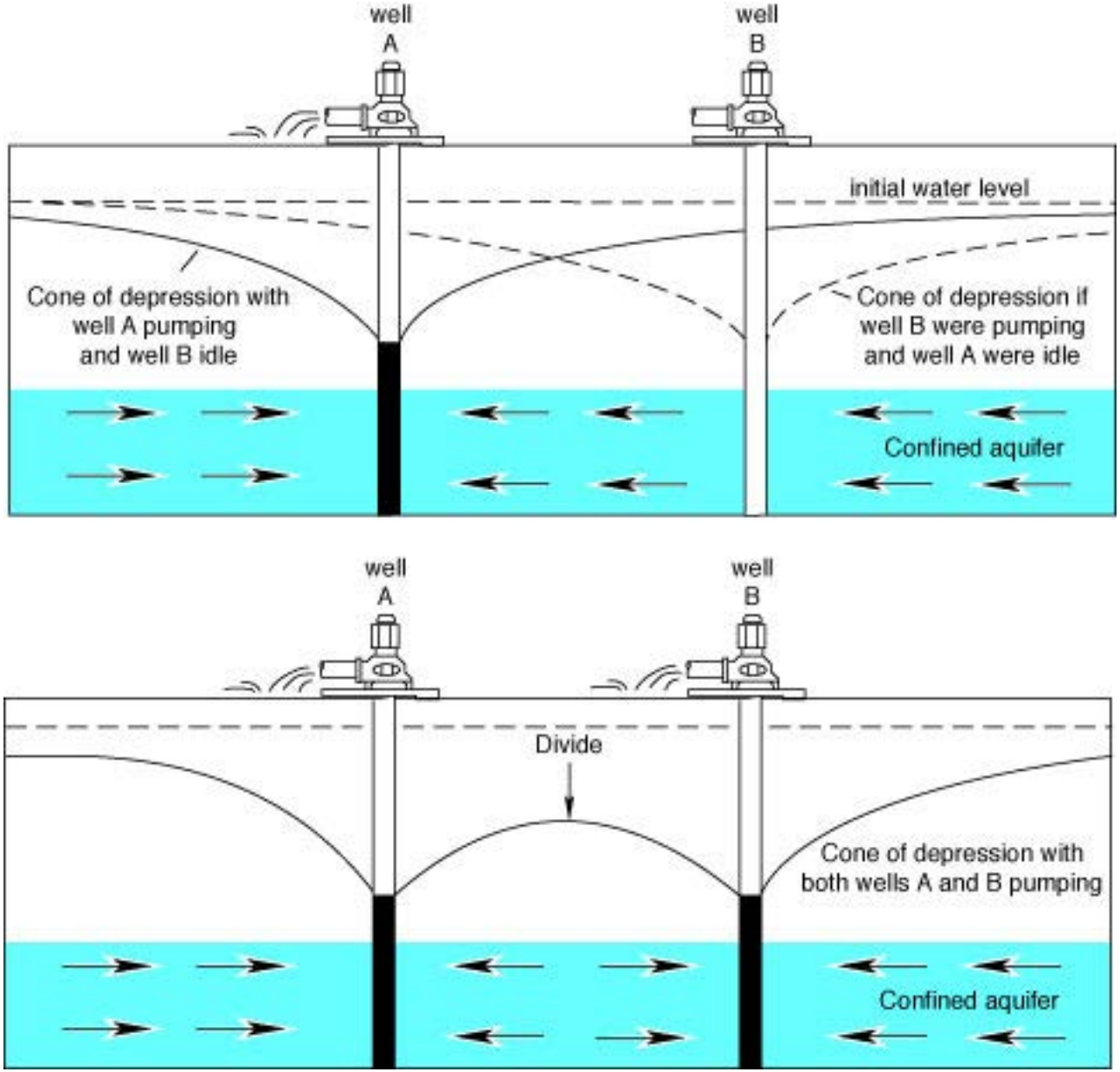
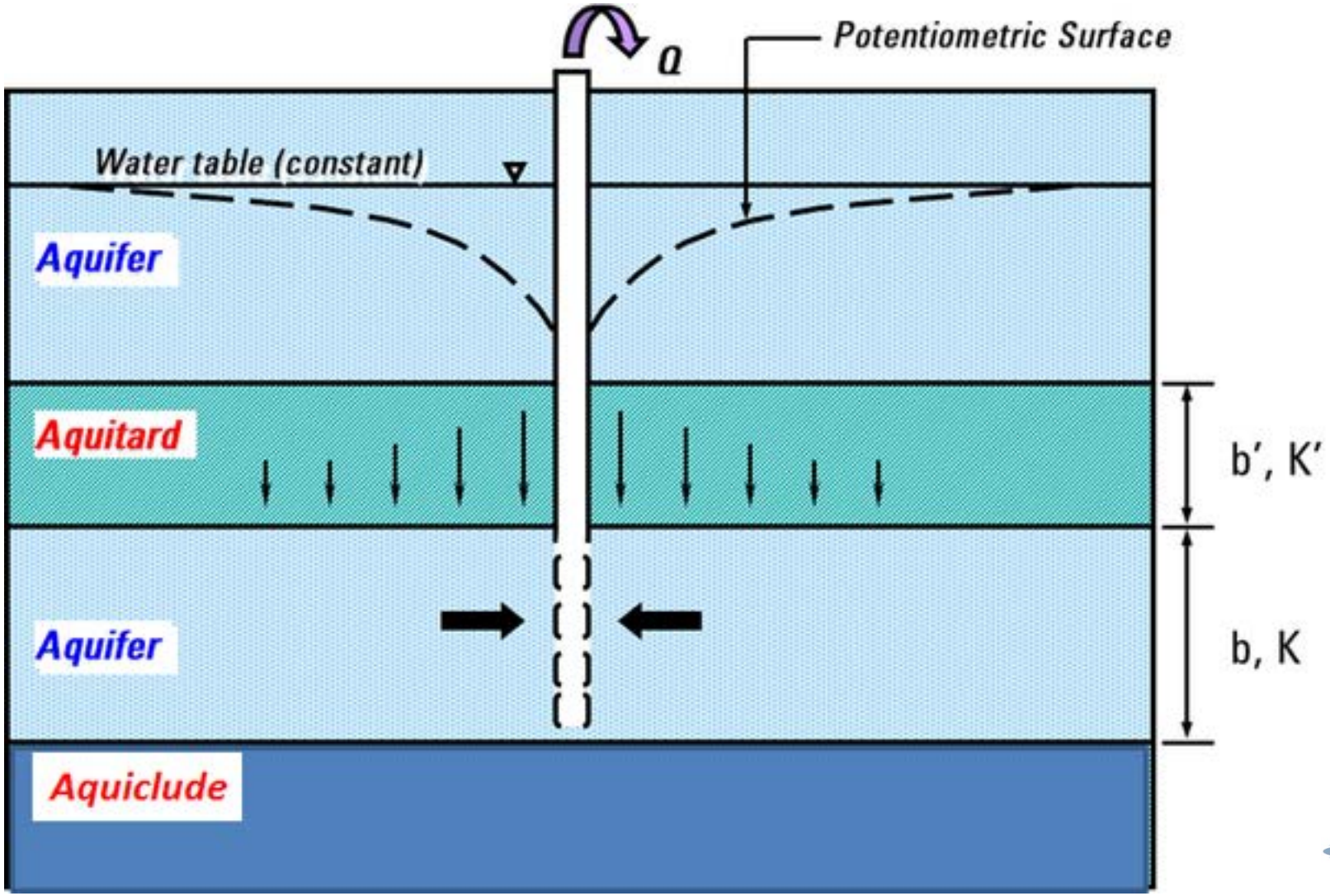


Figure 3. Potentiometric surface and direction of groundwater flow in T2 aquifer of the Northern Adelaide Plains Prescribed Wells Area in March 2014

Drawdown around Pumping Bores



Inter-aquifer Leakage



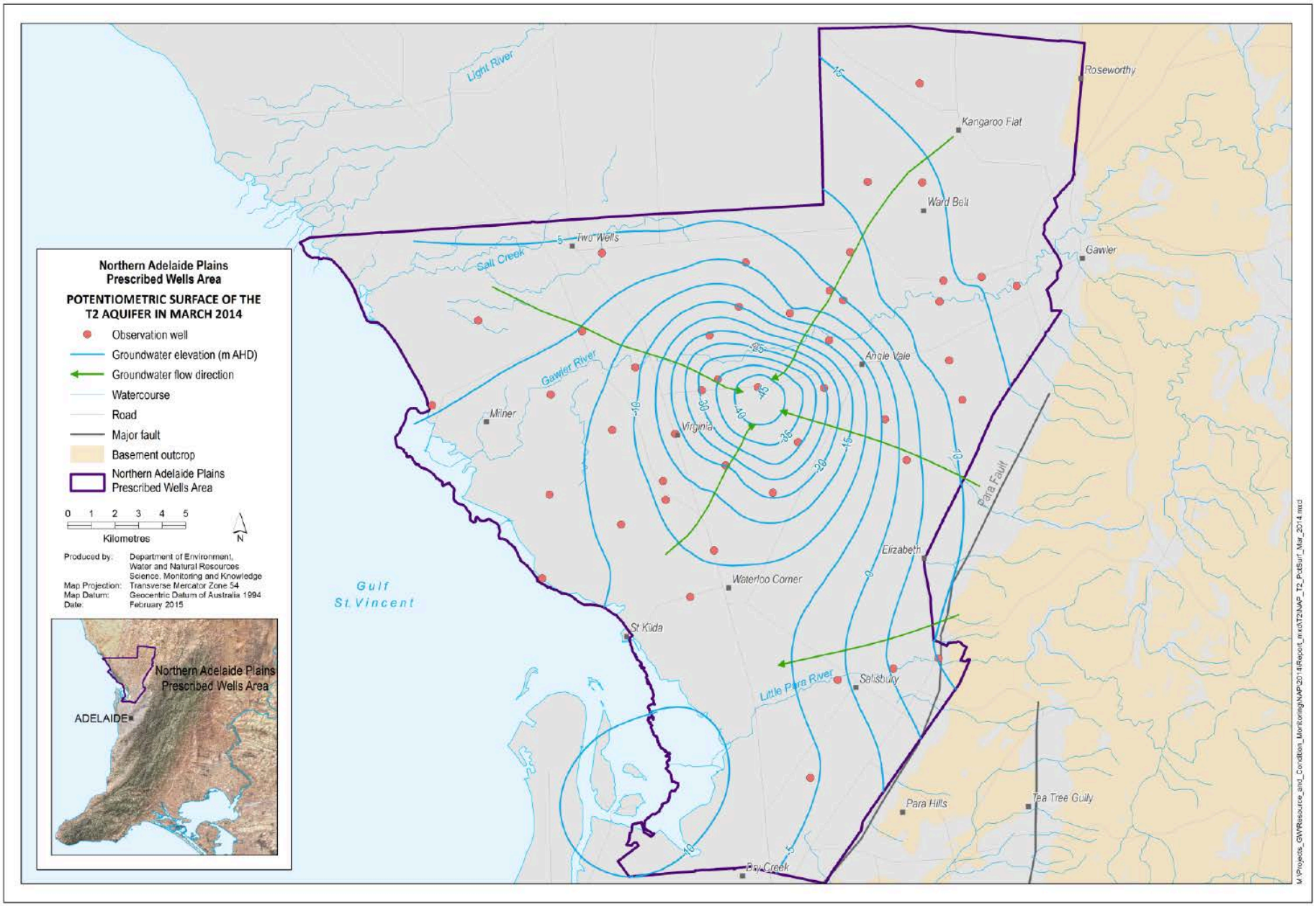


Figure 3. Potentiometric surface and direction of groundwater flow in T2 aquifer of the Northern Adelaide Plains Prescribed Wells Area in March 2014

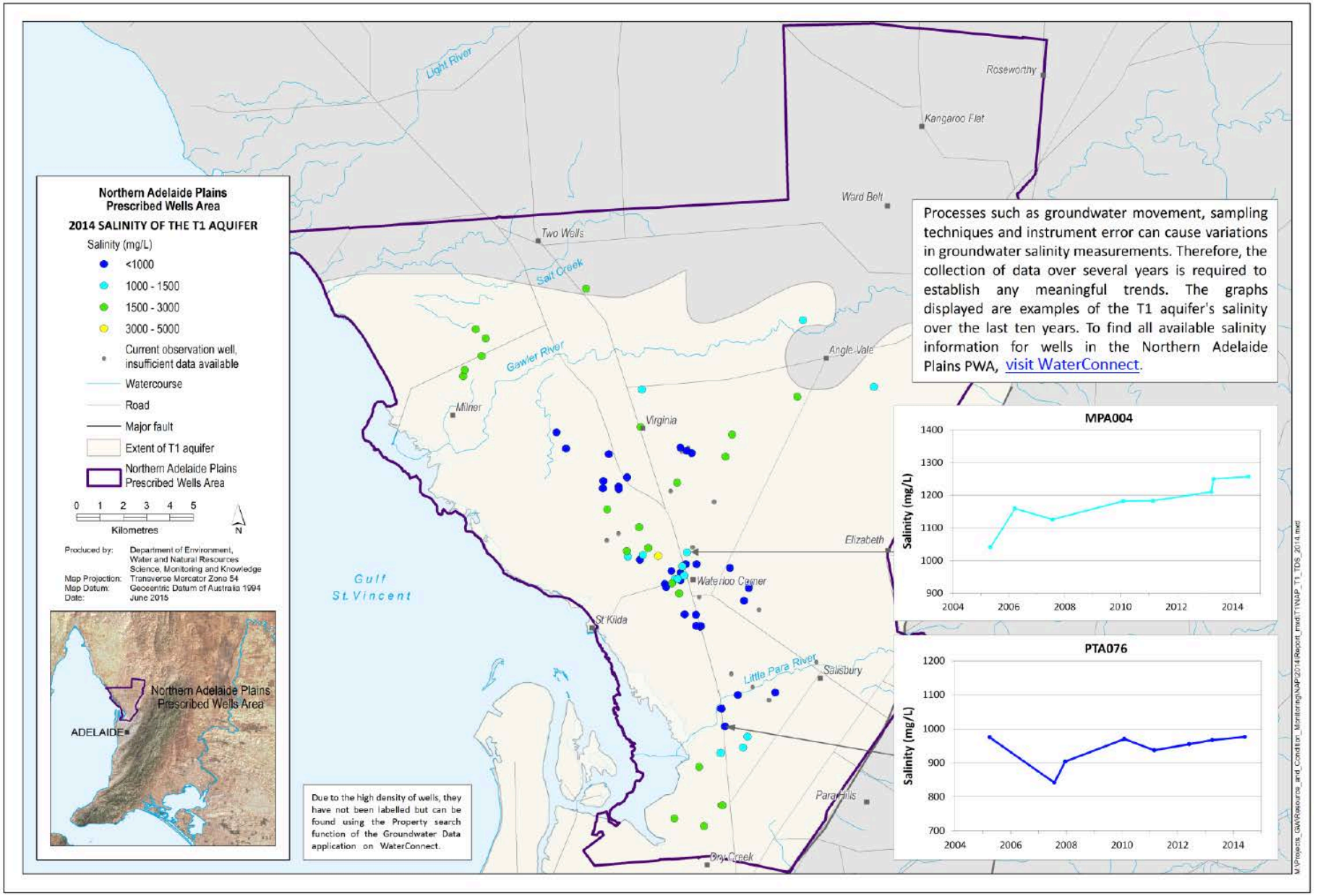


Figure 5. Groundwater salinity of the T1 aquifer of the Northern Adelaide Plains Prescribed Wells Area for 2014

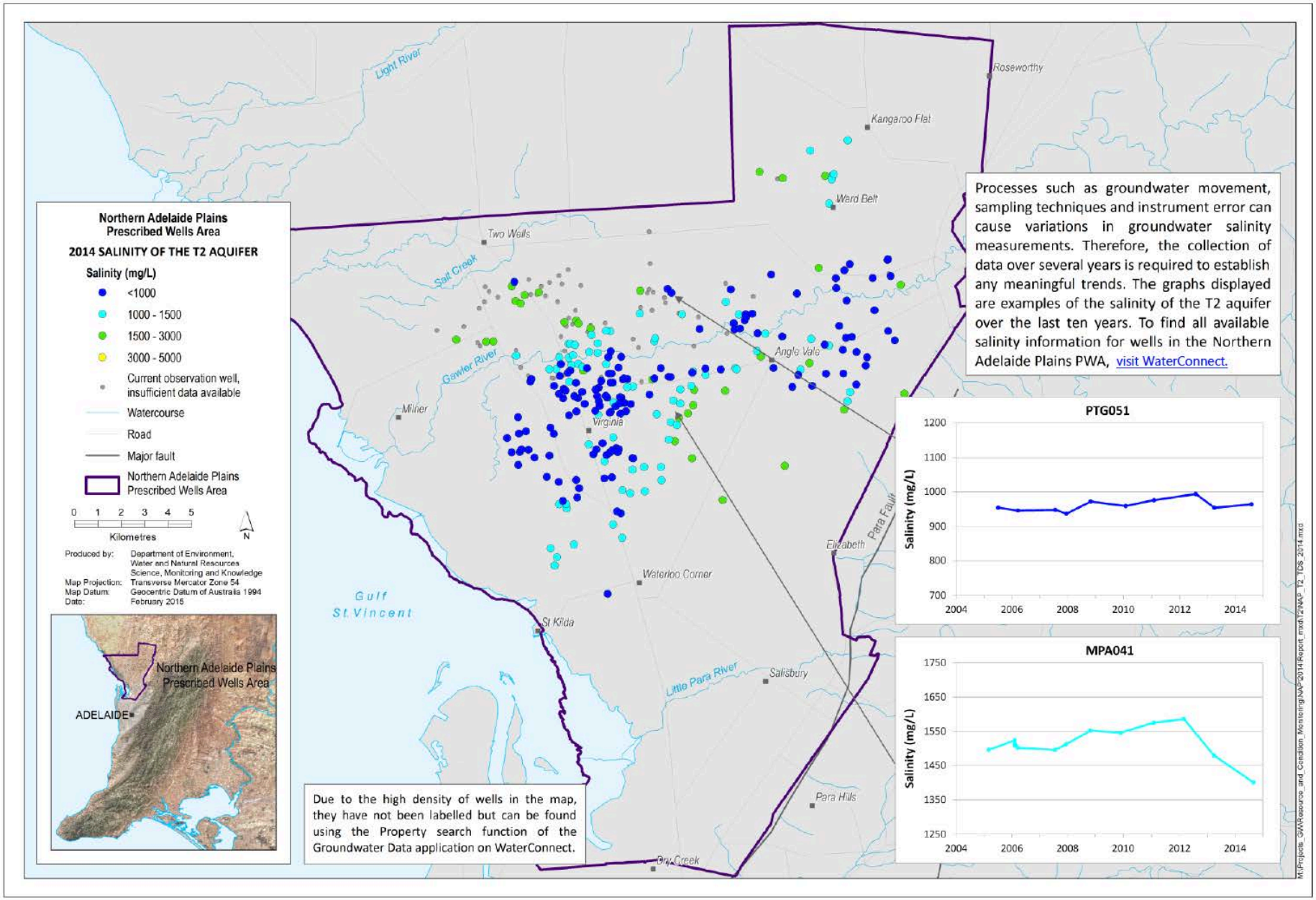


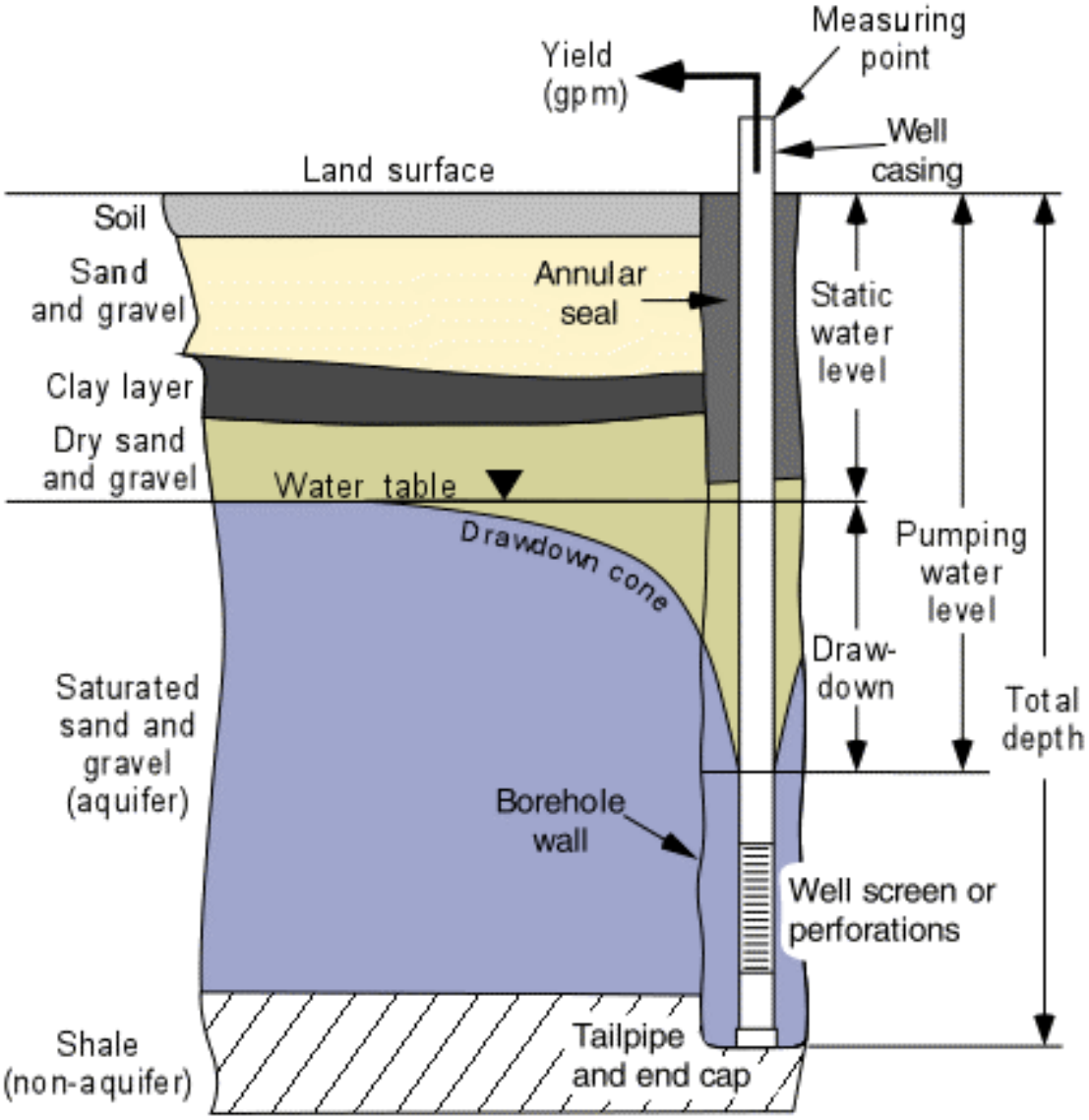
Figure 5. Groundwater salinity of the T2 aquifer of the Northern Adelaide Plains Prescribed Wells Area for 2014

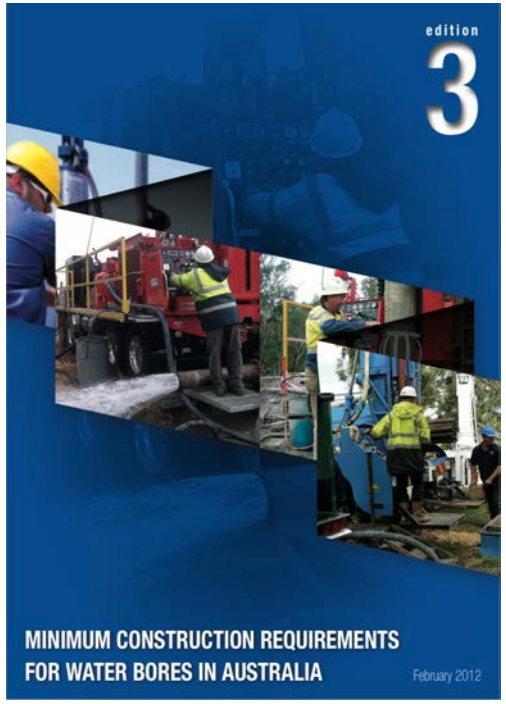
Groundwater Management Objectives

- Long-term resource availability
- Maintaining groundwater throughflow to prevent salinisation “hotspots”
- Maintaining groundwater throughflow to prevent seawater intrusion
- Maintaining aquifer pressure to prevent inter-aquifer leakage of water/salts

- MAR is one option that may help achieve these objectives

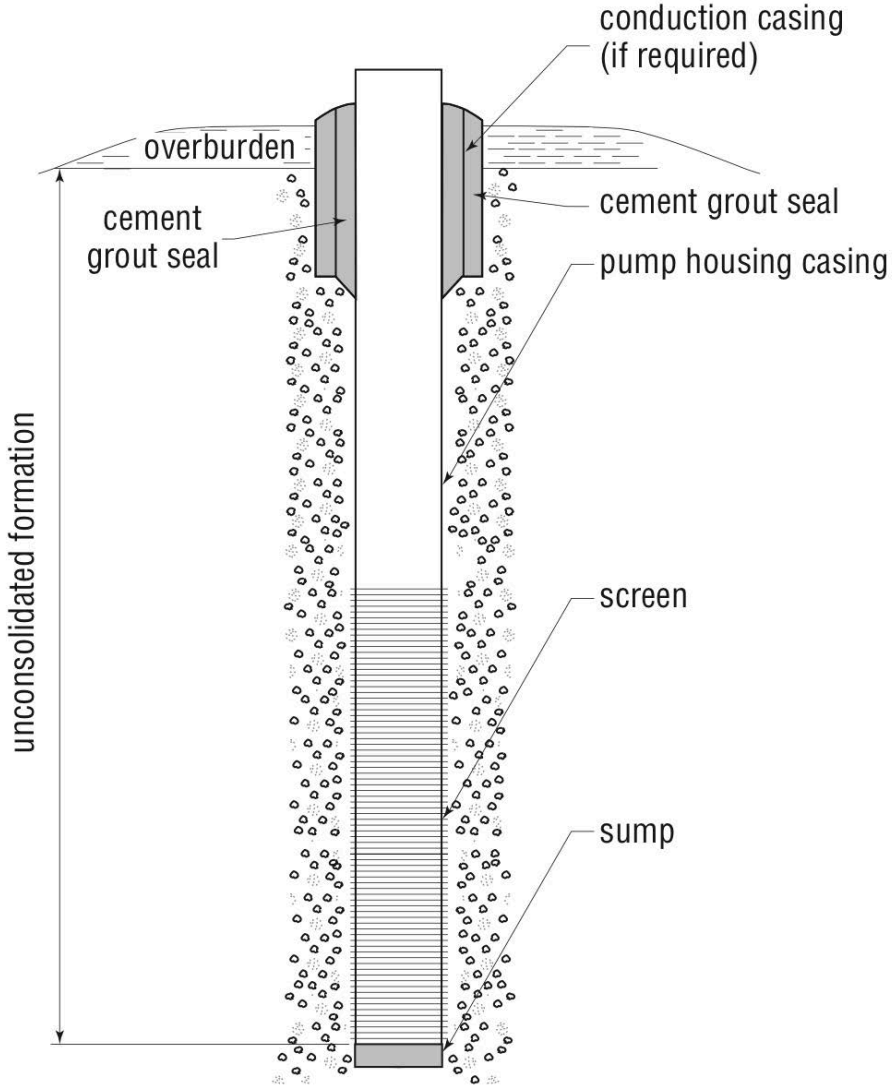
Water Bore Construction



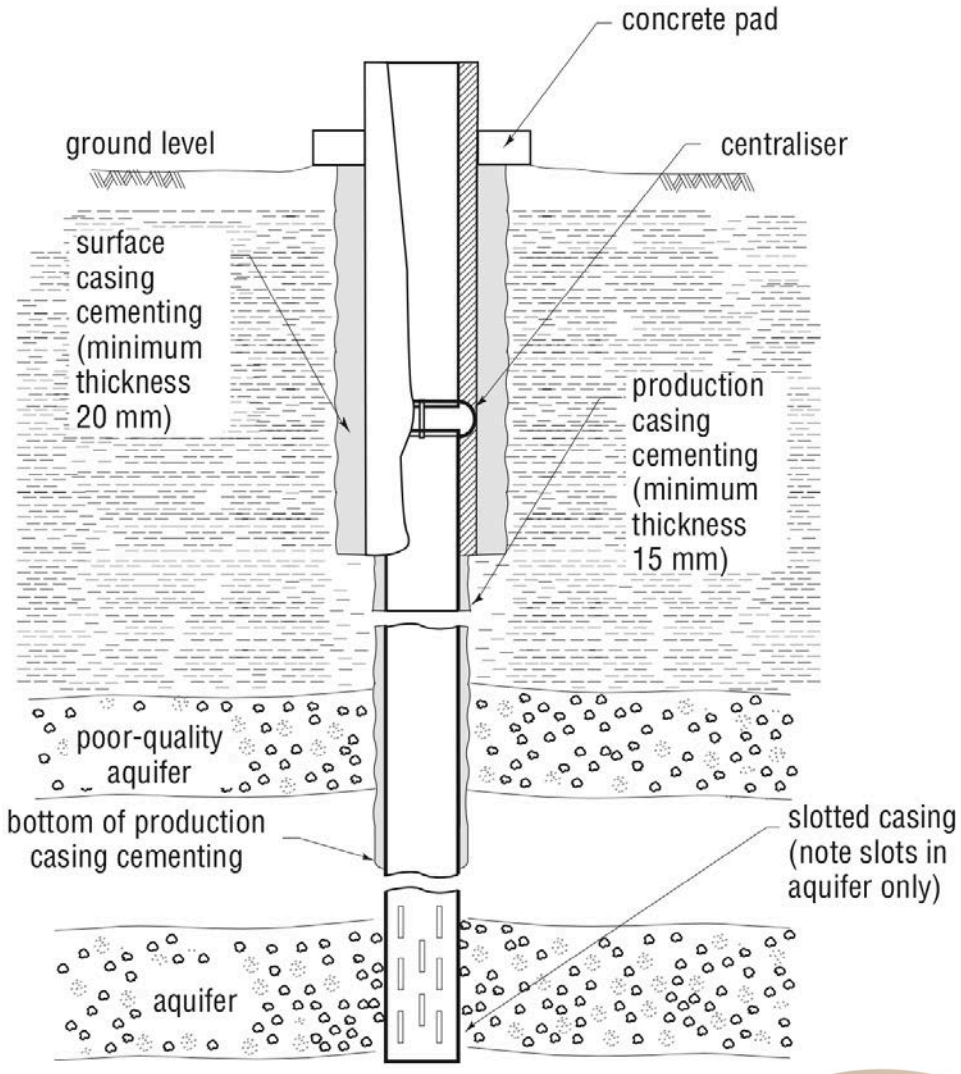


- **Mandatory Requirement**
- **Good Industry Practice**

Minimum Requirements for Water Bores

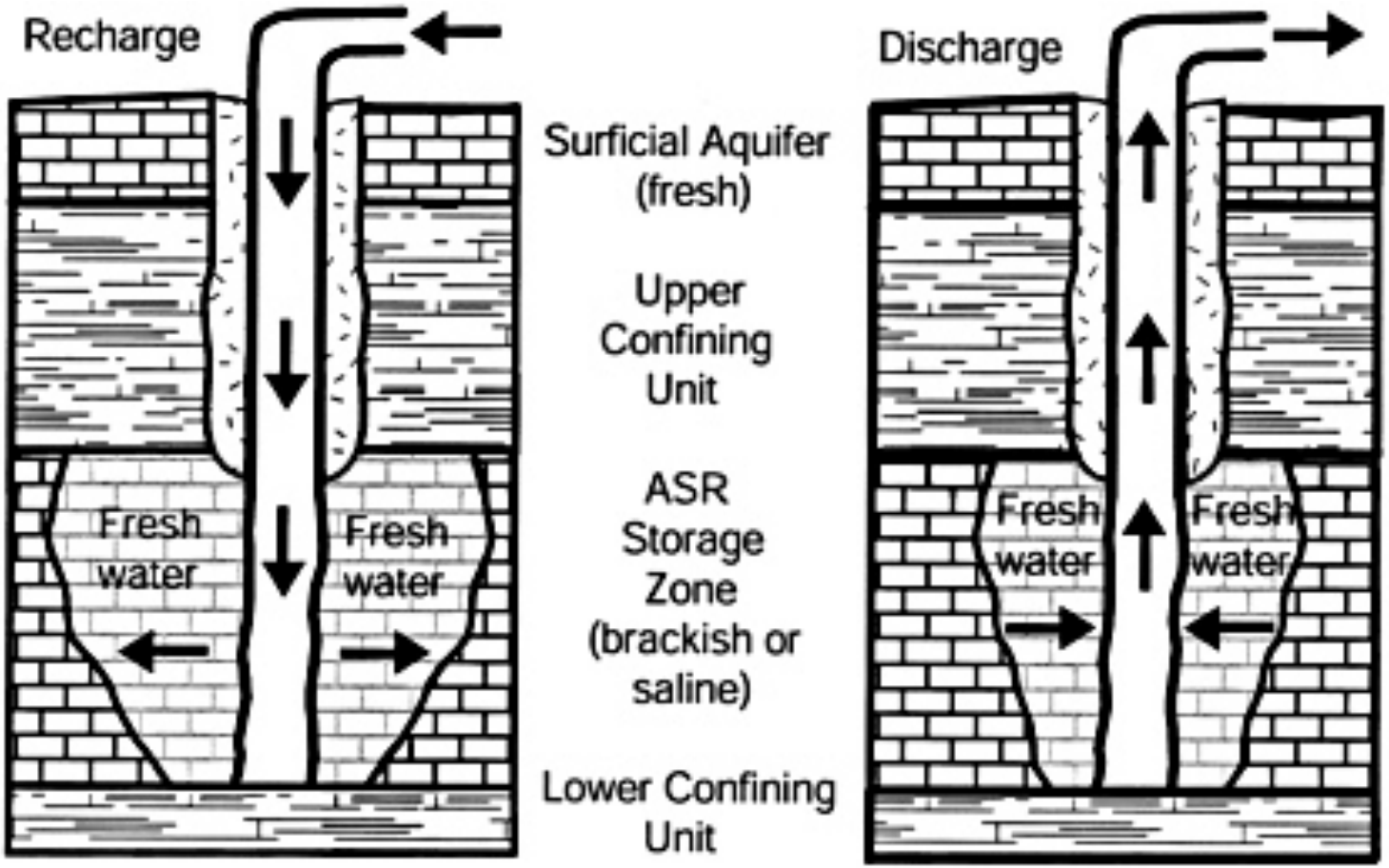


Unconfined aquifer bore

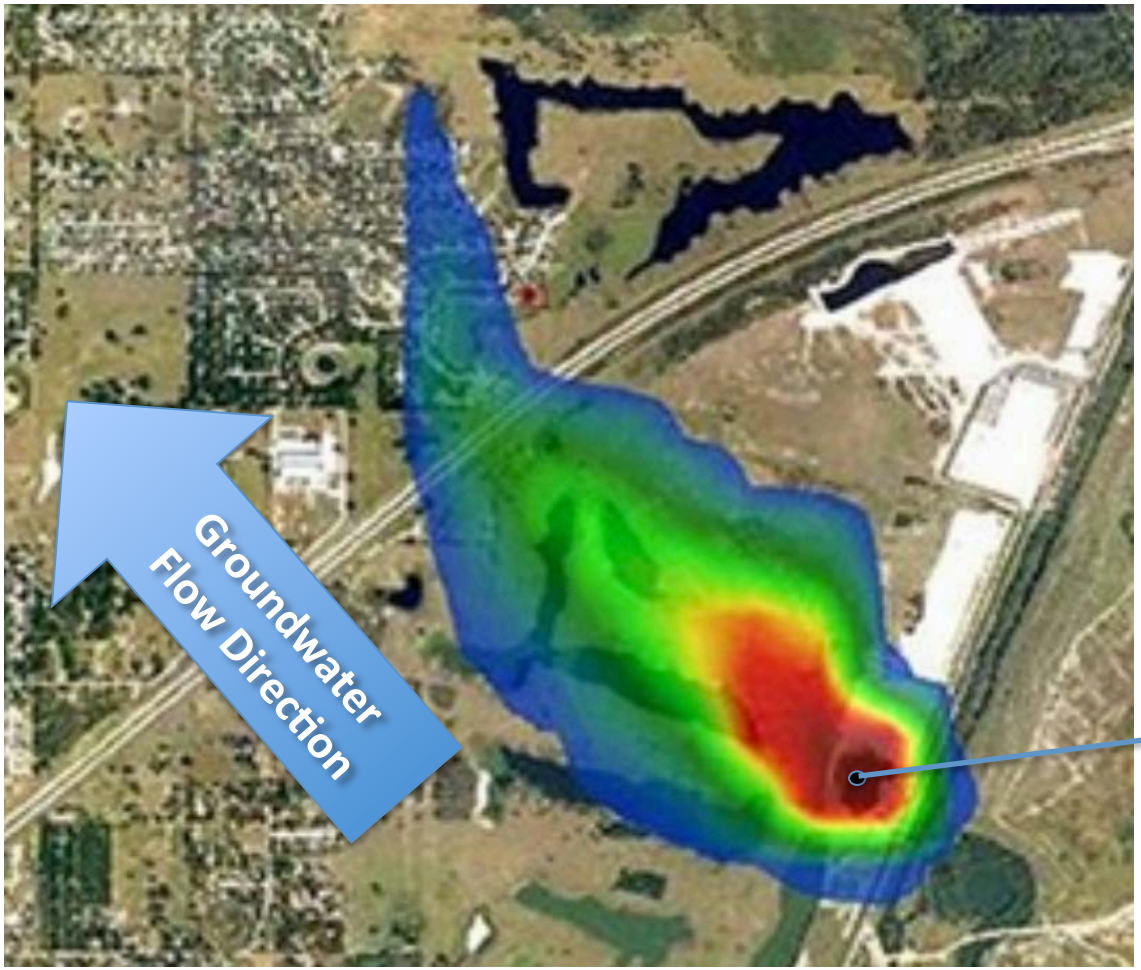


Confined aquifer bore = injection bore

Injecting Recycled Water



Predicting movement of the freshwater “bubble”



- Environmental and/or applied tracers
- Solute transport modelling
- Monitoring

Aquifer characterisation for MAR

- Key knowledge required:
  - Aquifer physical properties (K, T, S)
  - Aquifer salinity characteristics & chemical properties (mineralogy, groundwater chemistry, redox etc.)
- Proven techniques:
  - Aquifer pumping tests
  - Aquifer core analysis
  - Groundwater sampling and analysis
  - Field and laboratory trials
- Critical to establish reliable monitoring systems and manage operations as required

Questions?

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