Brackish and Saline Groundwater Treatment: opportunities in regions with climate variability and freshwater shortages

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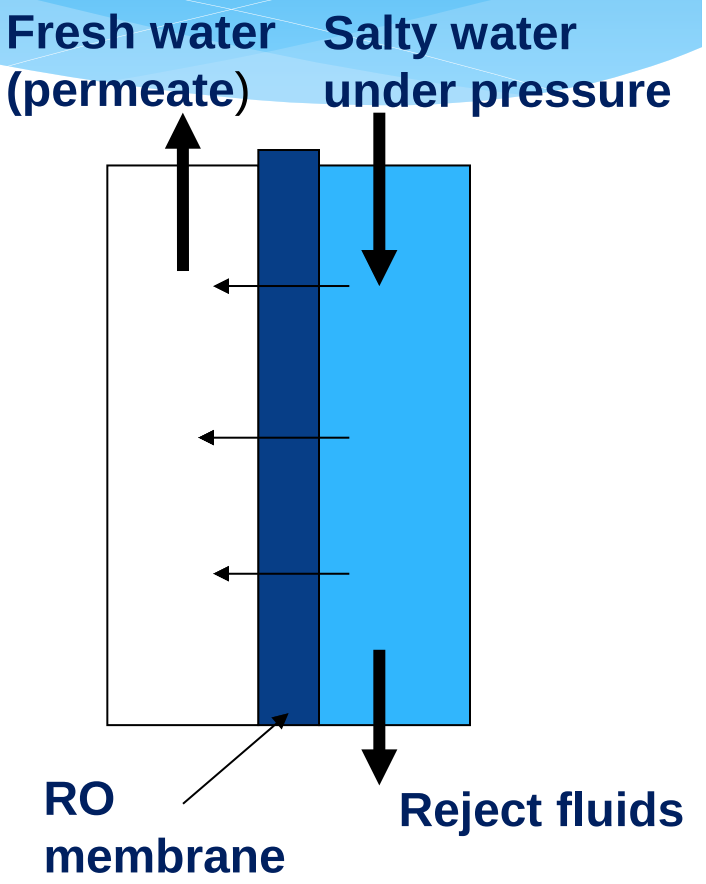
Outline

* Desalination in inland areas
* In-Situ Desalination (ISD)
* Field Trials and results
* Conclusion

Desalination in Inland Areas

- Large centralised plants (rare)
- Often based on small scale Reverse Osmosis (RO) technology near point-of-use, using brackish groundwater feed



Conventional Desalination drawbacks

- Power Costs (seawater quality feed particularly)
- Reject fluids require safe disposal
- Membrane fouling (colloids, biofoulants)
- Scaling
- Licensing

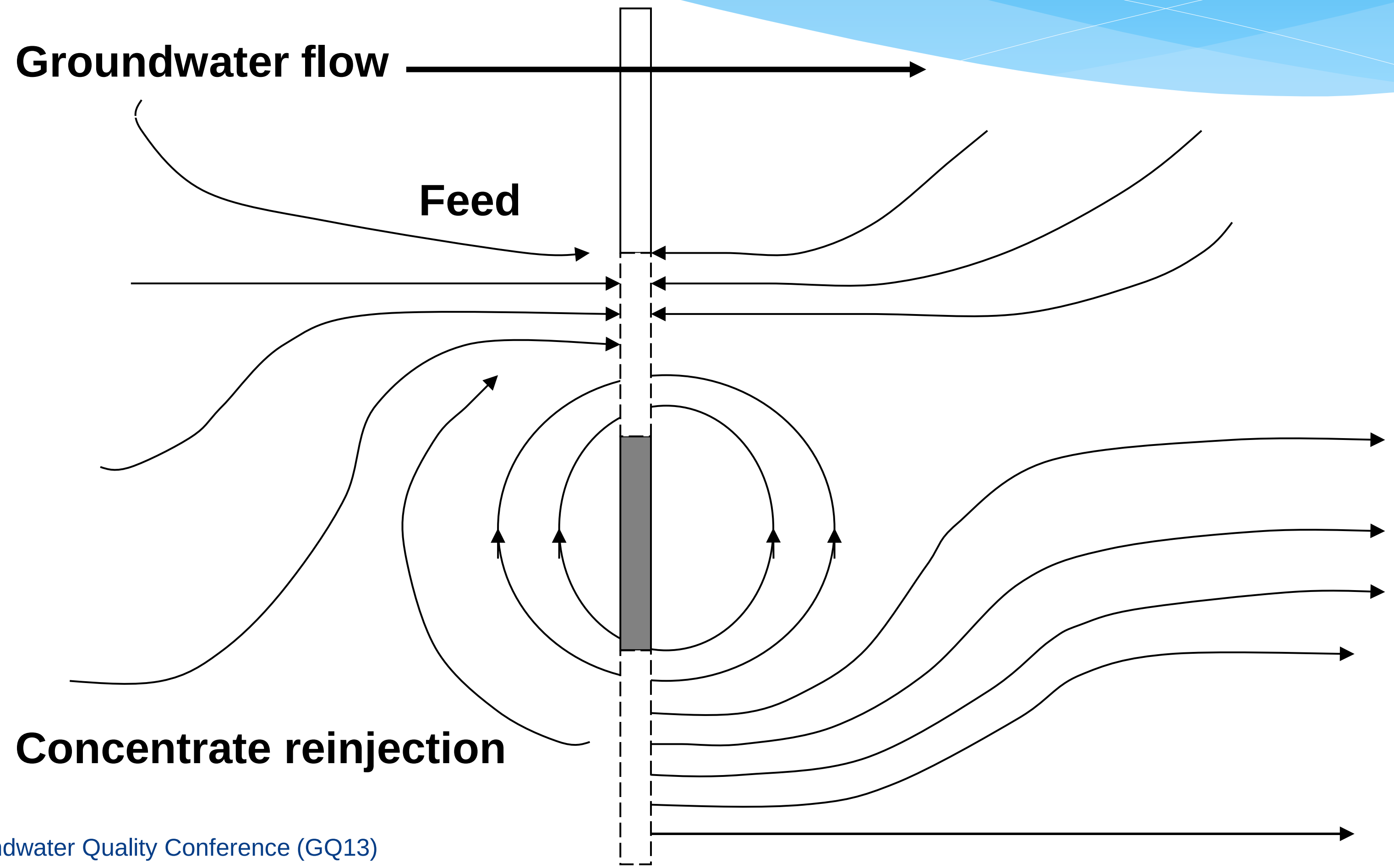
ISD characteristics

- RO-based, distributed system
- Downhole – treatment carried out *in situ* within a brackish aquifer, with dual screens (feed and concentrate reinjection separated by a packer)
- Whole process – groundwater feed, treatment, pumping of permeate to surface and reject reinjection in the lower aquifer powered by a single submersible pump
- International Patents for ISD

Advantages of ISD

- Distributed system - near point of use
- Low energy costs - only permeate is pumped to the surface
- Aquifer provides natural filter
- In situ operation under ambient groundwater conditions (eg anoxia) reduces potential for fouling
- No chemicals added to feed groundwater (antiscalents)
- Rejects contain only groundwater salts and disperse at low elevations in the aquifer (density contrast, natural stratification)
- Low operating recovery gives low salinity of rejects
- Low environmental footprint

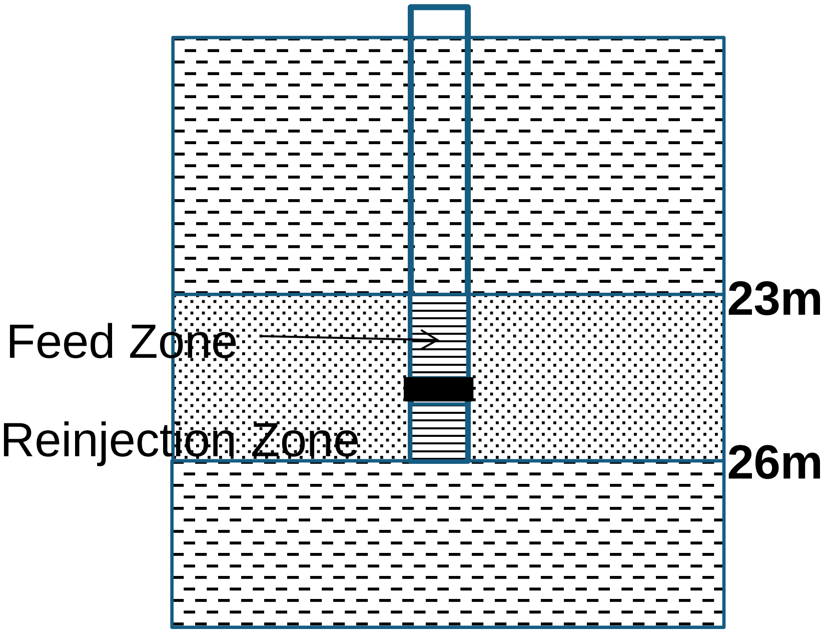
Conceptual model of flowlines during ISD, based on modelling results



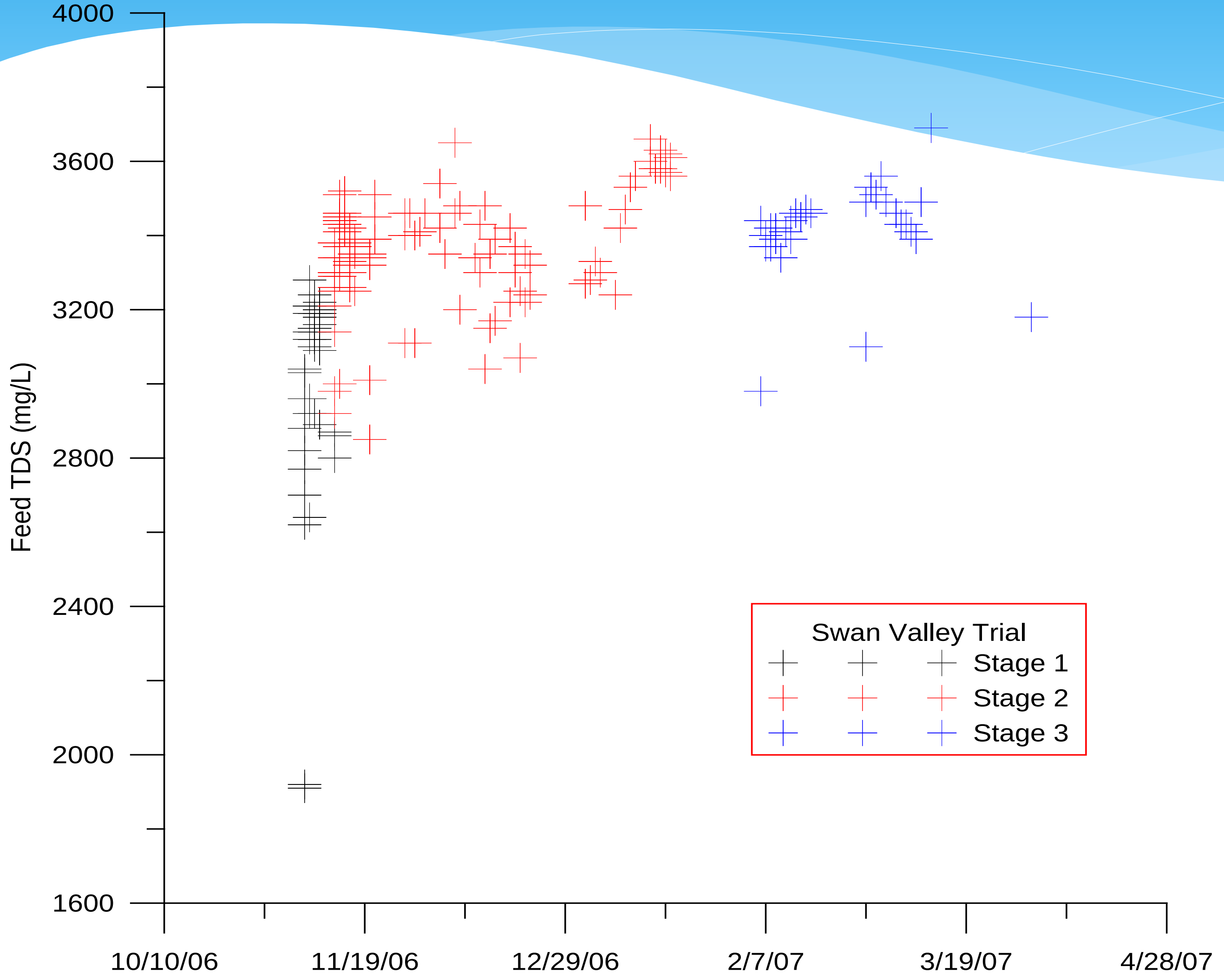
Trial 1 Swan Valley WA

* Background groundwater TDS: 2900mg/L
* Mean Groundwater feed TDS: 3300mg/L
* Groundwater feed flowrate : 1700 L/h

* Permeate TDS : 150mg/L
* Permeate flowrate : 500-600L/h

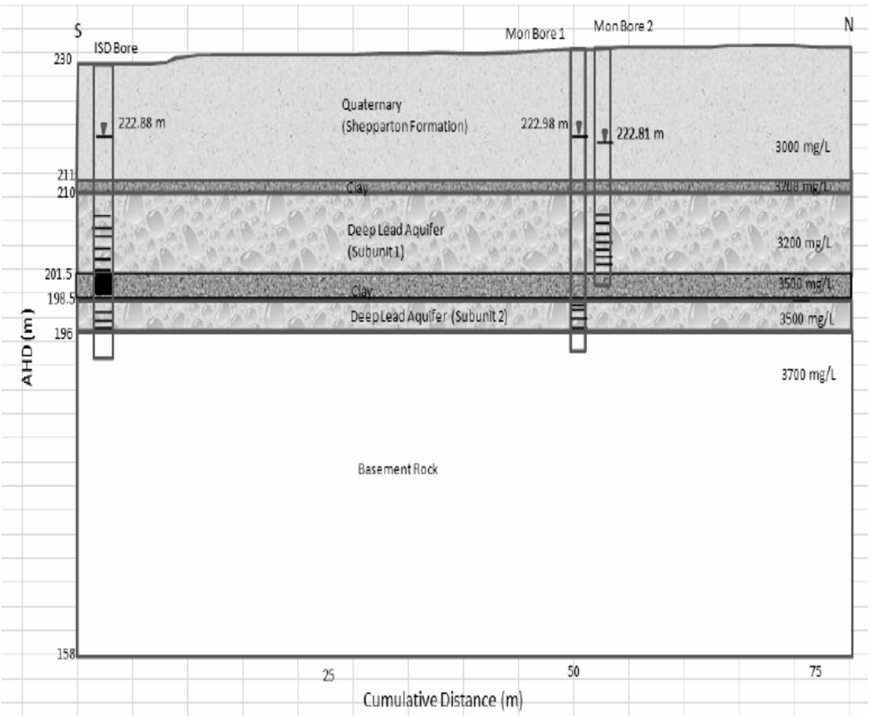


Swan Valley Field Trial: variation in feed TDS



Trial 2 Glenkara Vineyard

- **Tertiary palaeochannel aquifer confined gravel**
- **Groundwater feed TDS: 3200mg/L**
- **Feed flowrate: 10m³/h (3.2L/s)**



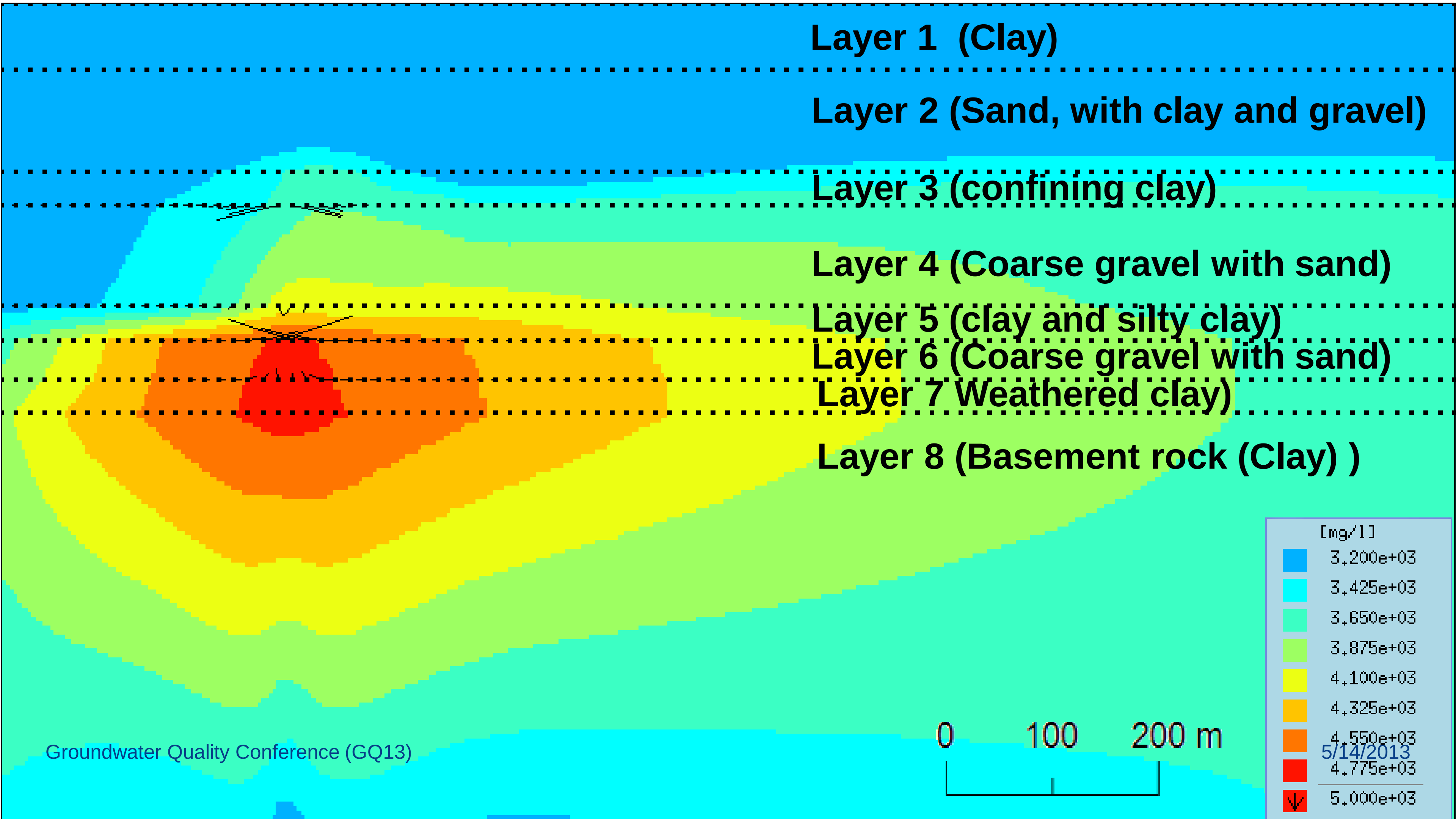
Trial 2 results

* ISD system produced **4 m^3/h (96m^3/d)** per ISD bore at **100mg/L TDS**
* Daily maintenance gave sustainable operation **over 6 months**
* Projected **30ML/y** assuming 10% downtime
* Power costs **1.35KWH/m^3 (A$0.20/$m^3$)**
* Wellfield of 6 units scheduled to produce **150-180ML/y** for vineyard
* Impacts on aquifer minor, minimised by significant vertical movement of reject fluids
* Aquifer beneficial use not considered to be compromised

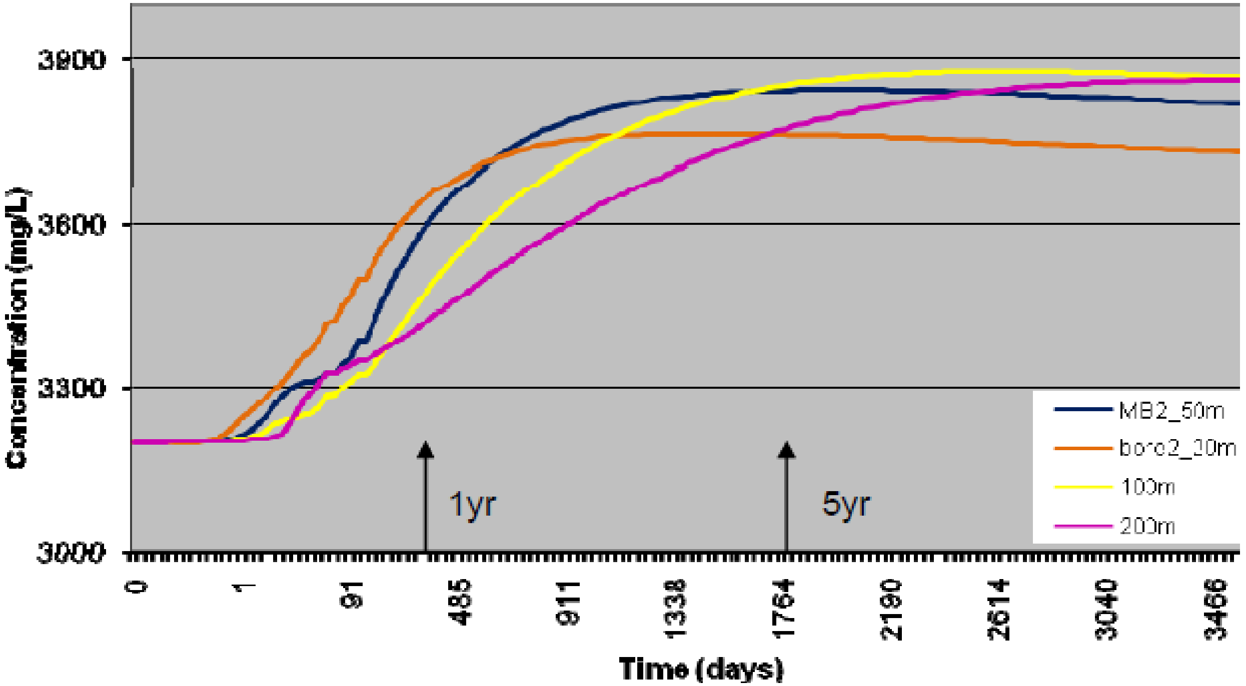
Performance

	Modelled DOW ROSA v6.1 model (DOW Filmtec 2007	After 60 days of operation
Feed groundwater	**3200 mg/L**	**3200 mg/L**
Feed groundwater flow	**9.75KL/h**	**10KL/h**
Permeate TDS	**89 mg/L**	**100 mg/L**
Permeate flow	**3.6KL/h**	**3.8-4.2KL/h**
Concentrate TDS	**5000 mg/L**	**4800-5040mg/L**

Model predictions: Salinity (TDS)
Longitudinal Cross section



Simulated Concentration at Reinjection Zone



Conclusion

* ISD ideally suited to provide a reliable, alternative high quality water needs of communities in regions where low quality groundwater is available.

* New ISD approach provides an alternative, scalable method for brackish and saline water desalination

* Environmental footprint and impacts are low, but impacts need to be quantified

* ISD provides advantages over the more conventional RO system approach, particularly through integrated feed/treatment/ permeate delivery and reject reinjection, giving cost savings

* Sustainable operation of ISD can be achieved, although care required in selection and testing of site hydrogeology and modelling of system behaviour is critical to successful operation.

Thanks

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