

Bringing it all together

*Climate and water products for
groundwater specialists*

Brendan Dimech

Hydrogeologist



Australian Government
Bureau of Meteorology



Overview

- Bureau's journey in groundwater
- Groundwater Information Suite overview
- HydroSight



The Millennium Drought

PUBLISHED IN MELBOURNE SINCE 1854

THE BIG DRY

FRIDAY, APRIL 20, 2007

5
Water

DROUGHT Farms to lose vital irrigation supplies unless rain falls within weeks

PM's dire warning on water

By JEWEL TOPSFIELD,
JOSH GORDON
and ORIETTA GUERRERA

LARGE sections of rural Australia are facing economic ruin and consumers have been warned of soaring prices for basic food items unless drought-relieving rain arrives within weeks.

In the most chilling assessment yet of the water crisis, Prime Minister John Howard yesterday said he had received a report warning of an "unprecedentedly dangerous" situation in the Murray-Darling Basin — the national agricultural "food bowl" that spans four states.

Mr Howard said that unless there was "heavy rain" in the next six to eight weeks, there would be no water allocations for irrigation in the basin, which accounts for 71 per cent of Australia's irrigated crops and 41 per cent of the nation's agricultural produce overall.

And economists have warned that continued



FARMING HEARTLAND

The Murray-Darling Basin:

- Contains more than 40 per cent of all Australian farms.
- Value of agricultural production in 2000-01 \$13.6 billion, 40 per cent of the national total.
- Has 75 per cent of nation's irrigated crops and pastures.
- Intakes at lowest in 115 years.
- Population almost 2 million.
- 1.06 million square kilometres: 14 per cent of the continent.
- Uses around 70 per cent of all agricultural water in Australia.

imports made up the shortfall, it could have caused the same effect as cyclone Larry did on

have been doing already, they may have to truck in water," he said. "It is a grim situation and there is no point in pretending to the Australian public otherwise."

Victorian Farmers Federation president Simon Ramsay said Victoria's irrigated agriculture, which was worth \$2.67 billion in 2004-05, would be devastated if there were no water allocations. "Thousands of producers and their families would be suffering and struggling for income. Huge investments in irrigation industry would be ruined and thousands of jobs would be lost," he said.

But he urged farmers not to make hurried decisions based on Mr Howard's announcement, saying the federation had known from February that zero allocations were likely at the beginning of the next season.

The Prime Minister is talking about



GROWERS IN DISTRESS

Dan Silkstone talks to drought-stricken farmers in Northern Victoria. NEWS 8

The Murray-Darling basin



DANNY LEE GRAPE AND CITRUS GROWER

"People in the city don't realise how totally we rely on water. Without water, this is a desert."



DAVID BEARD GRAPE GROWER

"I didn't think morale could go

Murray-Darling Basin

Water capacity: 1.7 million megalitres.
Water lost through evaporation and seepage: 30 per cent.
With 12 billion spent on infrastructure, that could drop to 10 per cent.
This would save at least 200,000 megalitres of water a year.
Melbourne uses about 400,000 megalitres a year.

formal position on the plan but their customers had expressed concerns.

"Our customers are very concerned this takes away the incentive for Melbourne (water authorities) to clean up their own act," Mr Cummins said.

"And once you start water flowing in that manner, jobs and farmers go with it — it is unusual to move water vast distances, so it's never going to come back."

Producers are considering this now because Melbourne is running out of water, and Melbourne takes what Melbourne wants," he said.

Victorian National Party water spokesman, Peter Walsh, also spoke out against the plan, describing it as disturbing.

But in other quarters, support continues to grow. National Water Commission member Pro-

Groundwater worry

Anger at Koroit forum

The Standard THURSDAY, December 28, 2006 - 5

Free water for farms 'ridiculous'

TERRY SIM

HEAP irrigation water in south-west Victoria would promote its veruse in the region, Environment Victoria director Dr Paul nclair has warned. South-west irrigators pay just .65 a megalitre for groundwater while northern Victorian irrigators now pay \$2000 a megalitre. mediate answer. Mr Selway said that on calculations by his committee: "It already appears that about 30,000 megalitres are coming out of that



reassurances appeared to accepted by many at the me Greens parliamentary car Gillian Blair told the meeti her party was the only one g



Water wars at Tarrone

standard.net.au

No more licences — farmers plead



GMA plea heeded

By RAELENE HESTON

SOUTHERN Rural Water will formally apply to the Department of Sustainability and Environment to declare a groundwater management area (GMA) north and west of Warrnambool. SRW's deputy chief

"Our belief is that we need to declare a GMA and assess sustainable yields — what the government now calls permissible consumptive volumes — so we have a formal management regime," he said. SRW can refuse applications for new irrigation licences.

mental agreement (for a GMA) in November 2004," Mr Hawke said. Since then SRW had been talking with DSE officers. "We will now make a formal application for a GMA, setting out the proposed boundary and proposed intention. Then they (DSE) have to formally consider it."

bore were built 30 to 60 years ago of mild steel, which rusts and they are now on the point of collapse. "In one case, we know of a bore which collapsed just a neighbouring dairy was being developed. The bore needs to be reconstructed." And SRW may not know of all

Call for a users group

The Water Act

- Created new water roles for the commonwealth
- The Bureau is required to *"collect, hold, manage, interpret and disseminate Australia's water information"*
 - including groundwater data
- The *Water Regulations (2008)* require organisations to send their data to the Bureau



Water Act 2007

Act No. 137 of 2007 as amended

This compilation was prepared on 9 July 2008
taking into account amendments up to Act No. 73 of 2008

The Water Regulations

- Data in Regulations
 - Bore and borehole data
 - Levels and pressure
 - Salinity and pH
 - Licenced entitlements
 - Groundwater use
- Data outside of Regulations
 - Management areas
 - Aquifer boundaries
 - 3D aquifer models



Water Act 2007

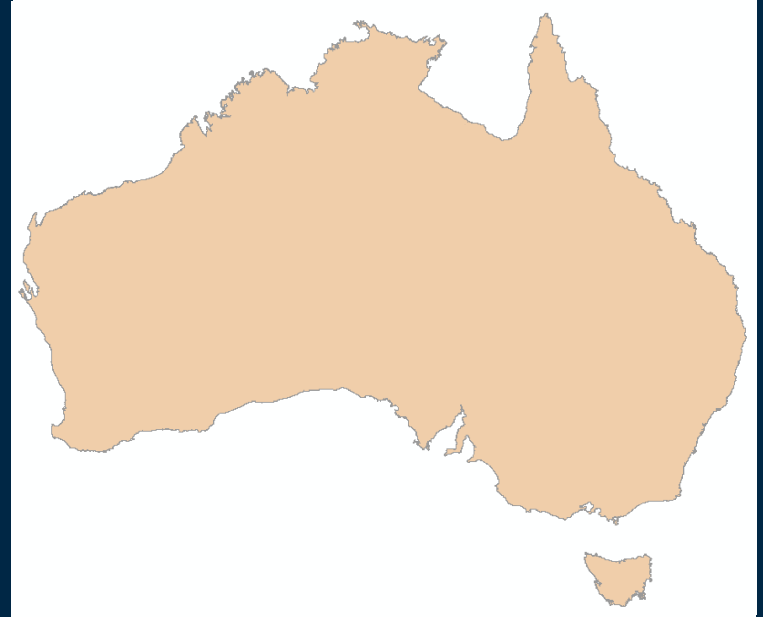
Act No. 137 of 2007 as amended

This compilation was prepared on 9 July 2008
taking into account amendments up to Act No. 73 of 2008

More information: <http://www.bom.gov.au/water/regulations/subCategoriesWaterAuxNav.shtml>

Collaboration

- Agencies provided:
 - Water Regulations data
 - Groundwater datasets
 - Expertise, knowledge...goodwill
- Groundwater Product Reference Group:
 - States and Territories
 - Geoscience Australia
 - Murray–Darling Basin Authority
 - Department of the Environment and Energy



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regional groundwater
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selection and download ...
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groundwater dependent
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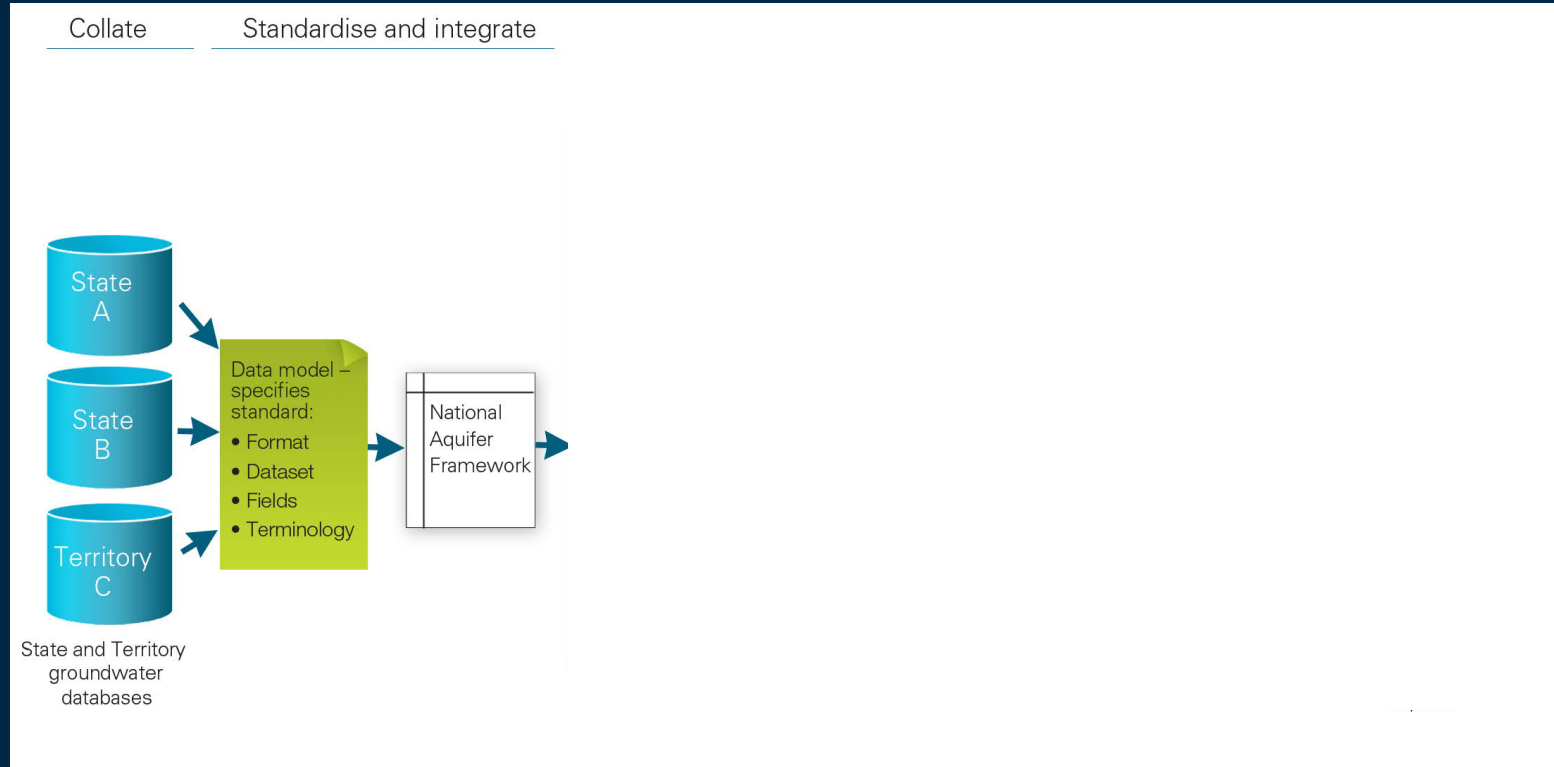


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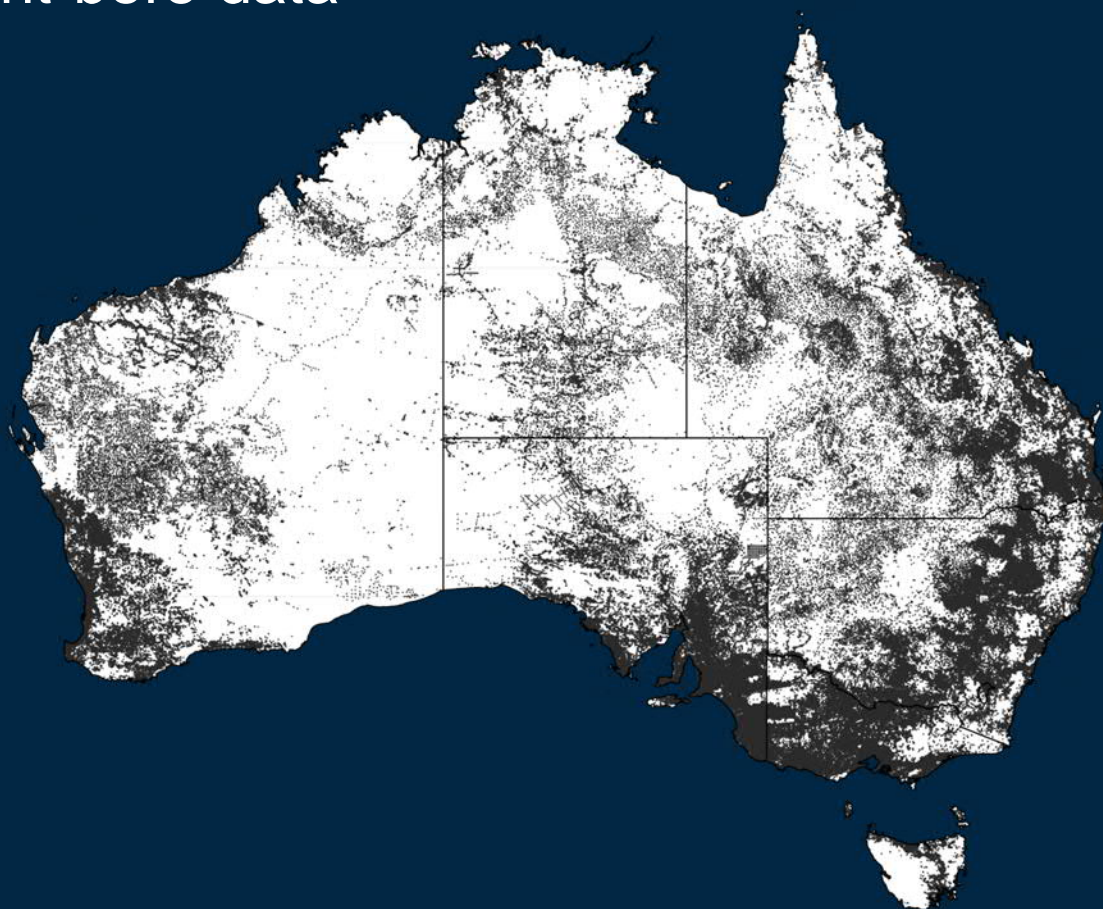
National Groundwater Information System (NGIS)



NGIS - Nationally-consistent bore data

- More than 850 000 bore locations across Australia
- Bore and borehole information
- Construction, lithology and hydrostratigraphy logs

Full national product is publically available as an ArcGIS geodatabase.
To make a request please email:
groundwater@bom.gov.au



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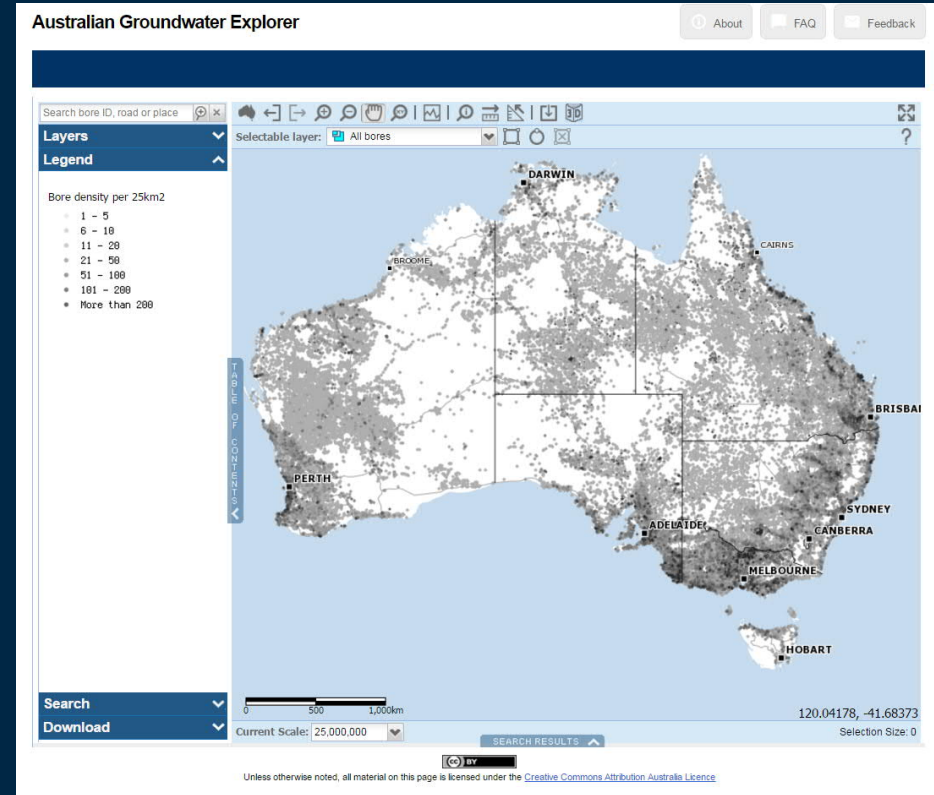
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Australian Groundwater Explorer

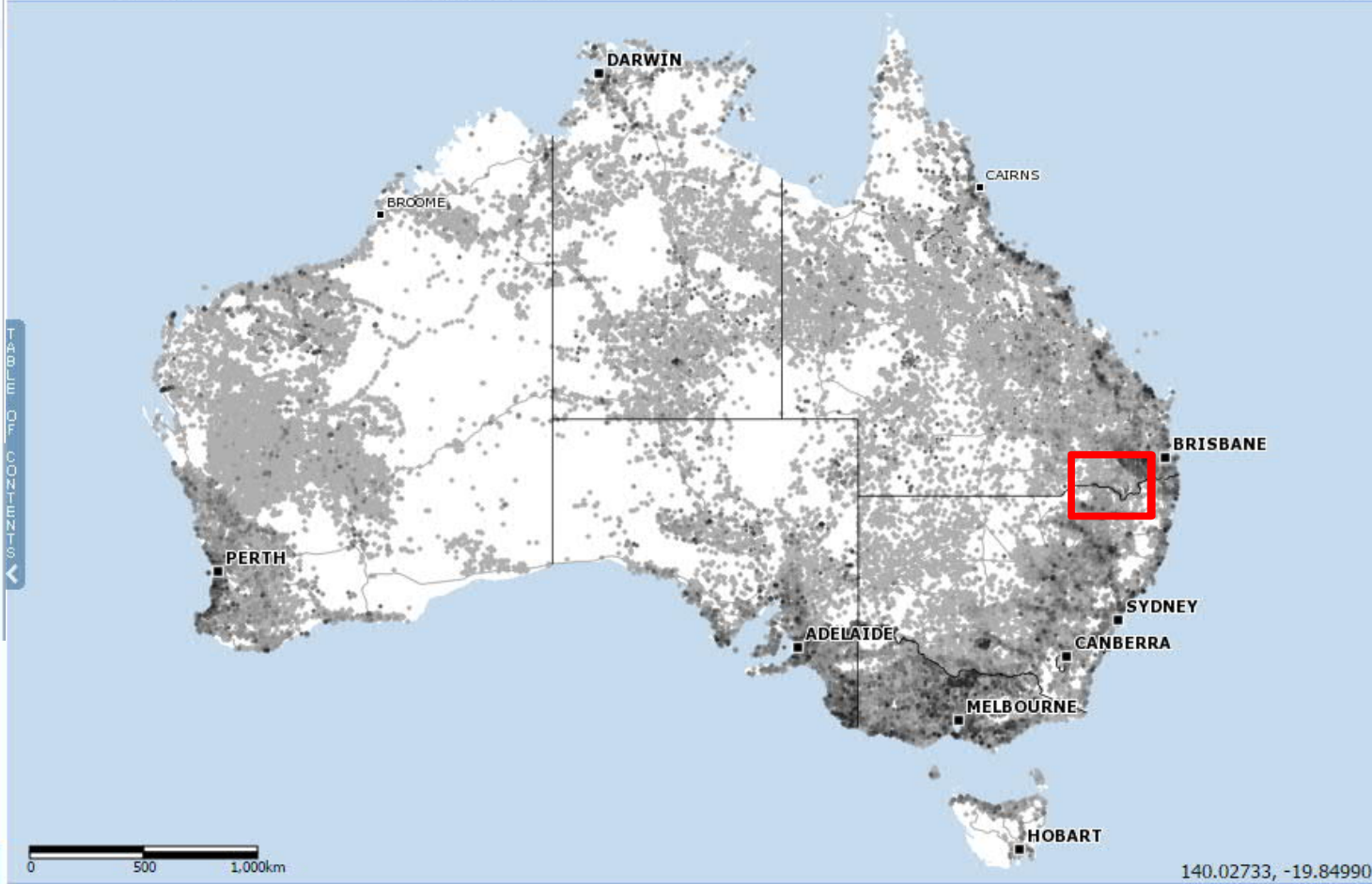
- Online access to groundwater data for technical specialists:
 - Bore data from NGIS
 - Water levels
 - Salinity
 - Rainfall trends
 - Hydrochemistry data
 - Contextual datasets
- View and search data online or download for further analysis



Layers

- ☒ Bores
 - ☒ All bores
 - ☐ Groundwater measurements
 - ☐ Bore purpose
 - ☐ Bore logs
- ☐ 3D aquifer models
- ☐ Water management
- ☐ Hydrology
- ☐ Geology
- ☒ Base maps

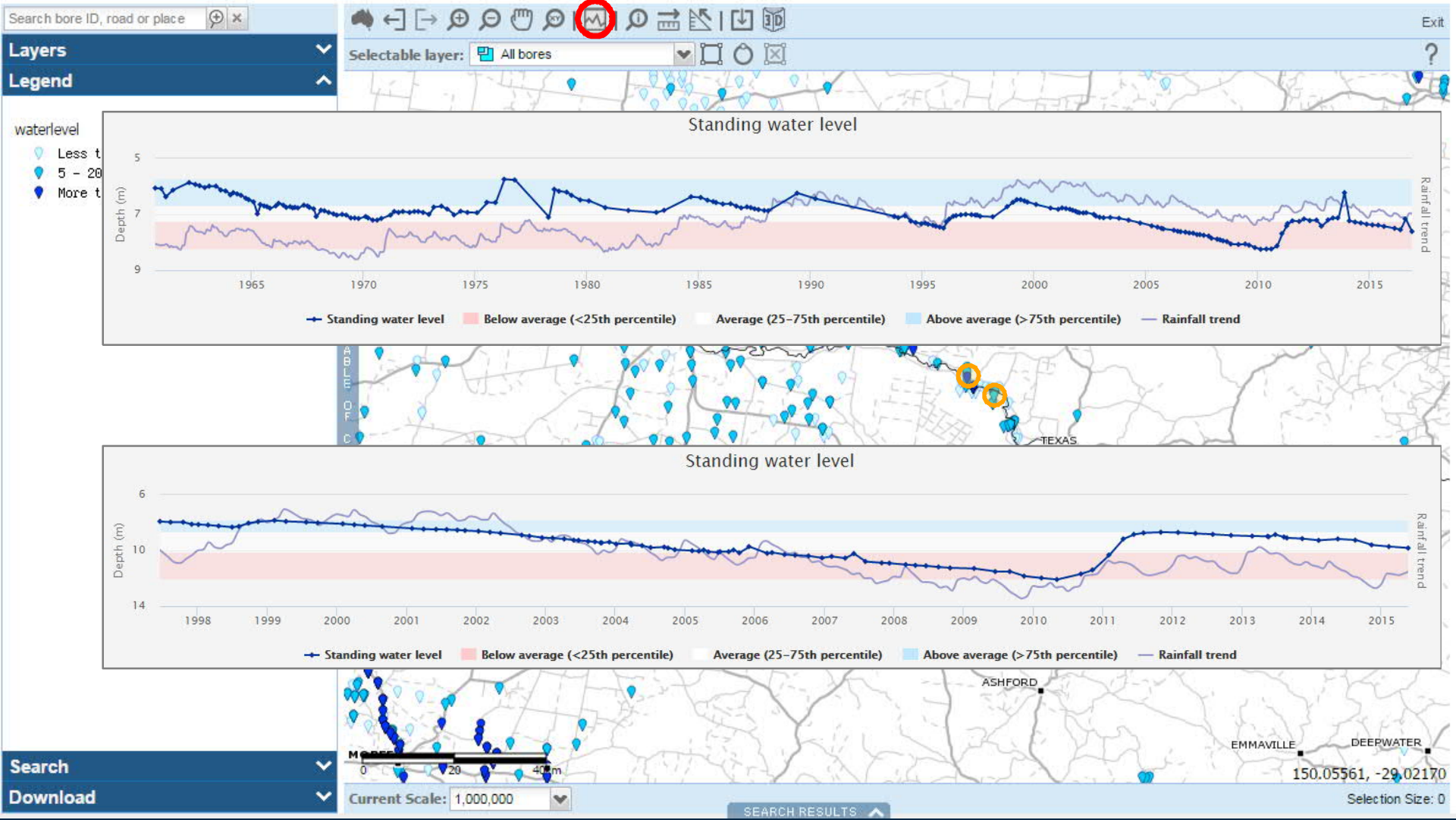
Selectable layer: All bores

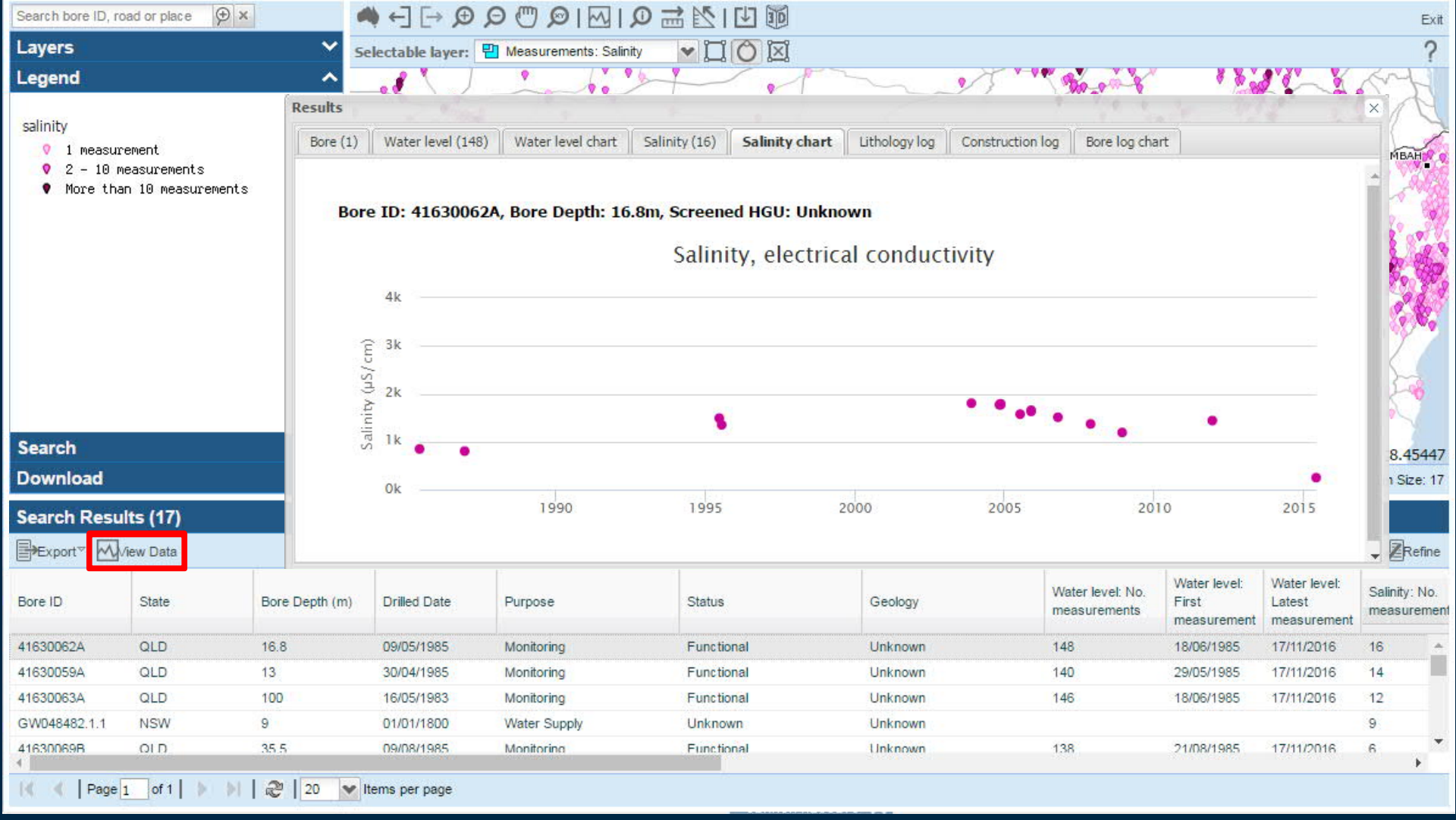


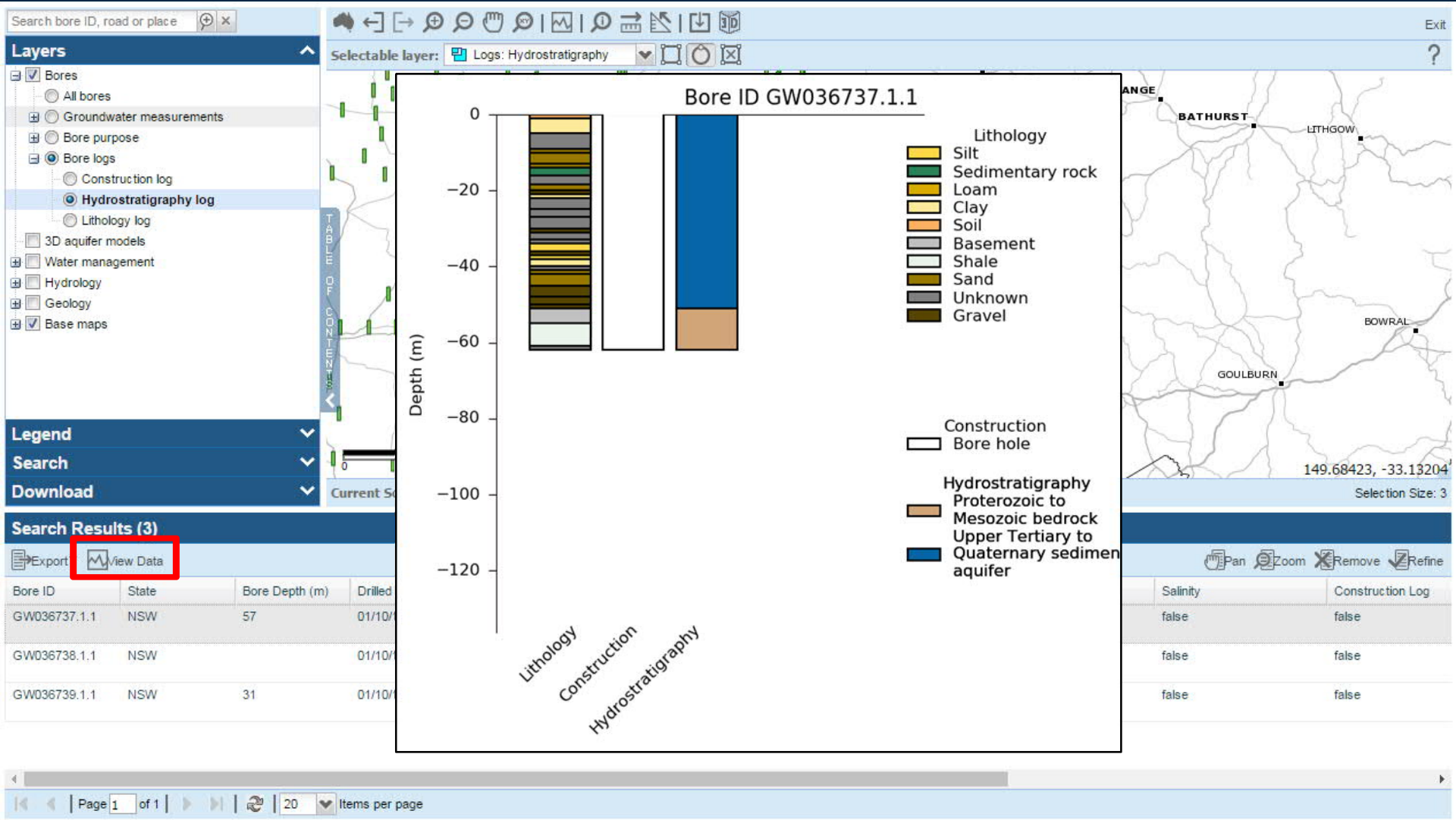
Search

Download

Selection Size: 0







Results

Results

Hydrochemistry (43)

Export

GA Bore ID ▲	GA Name	Sample ID	Date	Variable Grouping	Variable	Result	Unit
600727	Carlyons	2612811		Environmental Tracers	Deuterium (dD)	-36.7	per mille VSMOW
600727	Carlyons	2612811		Environmental Tracers	Hydrogen-3	0.7	TU
600727	Carlyons	2612811		Environmental Tracers	Radon-222	16.0	Bq/L
600727	Carlyons	2612811		Environmental Tracers	36-Cl/Cl uncertainty	9.6	x10E-15
600727	Carlyons	2612811		Environmental Tracers	36-Cl/Cl	149.8	x10E-15
600727	Carlyons	2612811		Environmental Tracers	pMC uncertainty	1.5	% modern carbon
600727	Carlyons	2612811		Environmental Tracers	C 14 Pmc	37.2	% modern carbon
600727	Carlyons	2612811		Environmental Tracers	d13C	-18.9	per mille PDB
600727	Carlyons	2612811		Environmental Tracers	dO18	-6.11	per mille VSMOW
600727	Carlyons	2612811		Nutrients	Phosphate as P	<0.0163	mg/L
600727	Carlyons	2612811		Nutrients	Nitrate as N	<0.0113	mg/L
600727	Carlyons	2612811		Metals	Iodine	<0.05	mg/L
600727	Carlyons	2612811		Inorganic Anions	Fluoride	0.42	mg/L
600727	Carlyons	2612811		Metals	Silica (SiO2)	42.78	mg/L
600727	Carlyons	2612811		Metals	Sulphur	1.82	mg/L
600727	Carlyons	2612811		Metals	Barium	0.056	mg/L
600727	Carlyons	2612811		Metals	Vanadium	<0.01	mg/L
600727	Carlyons	2612811		Metals	Uranium	<0.001	mg/L
600727	Carlyons	2612811		Metals	Lead	0.008	mg/L
600727	Carlyons	2612811		Metals	Lithium	0.018	mg/L
600727	Carlyons	2612811		Metals	Strontium	<0.005	mg/L
600727	Carlyons	2612811		Metals	Zinc	0.377	mg/L
600727	Carlyons	2612811		Metals	Copper	0.018	mg/L

Search bore ID, road or place

Layers

Legend

Search

Download

Download all bore data for an area including bore details, bore logs and water level and salinity measurements.

1. Select Region

State/Territory

Or

River Region

2. Select Format

Shapefile

KML

File Geodatabase



Selectable layer:

Measurements: Hydrochemi



Current Scale: 5,000,000

SEARCH RESULTS

154.36009, -24.16725

Selection Size: 0

Download

Zoom To

Clear

Model Tree

model

- Murray Basin - Hydrogeological Complexes
 - node
 - QA - Quaternary sediments
 - UTQA - Upper Tertiary to Quaternary aquifer
 - UTQD - Upper-Tertiary to Quaternary aquitard
 - UTAM - Upper Tertiary marine aquifer
 - UTAF - Upper Tertiary fluvial aquifer
 - UTD - Upper Tertiary aquitard
 - UMTD - Upper Mid-Tertiary aquitard
 - UMTA - Upper Mid-Tertiary marine aquifer
 - LTA - Lower Tertiary aquifer
 - Product Views

Options

Left

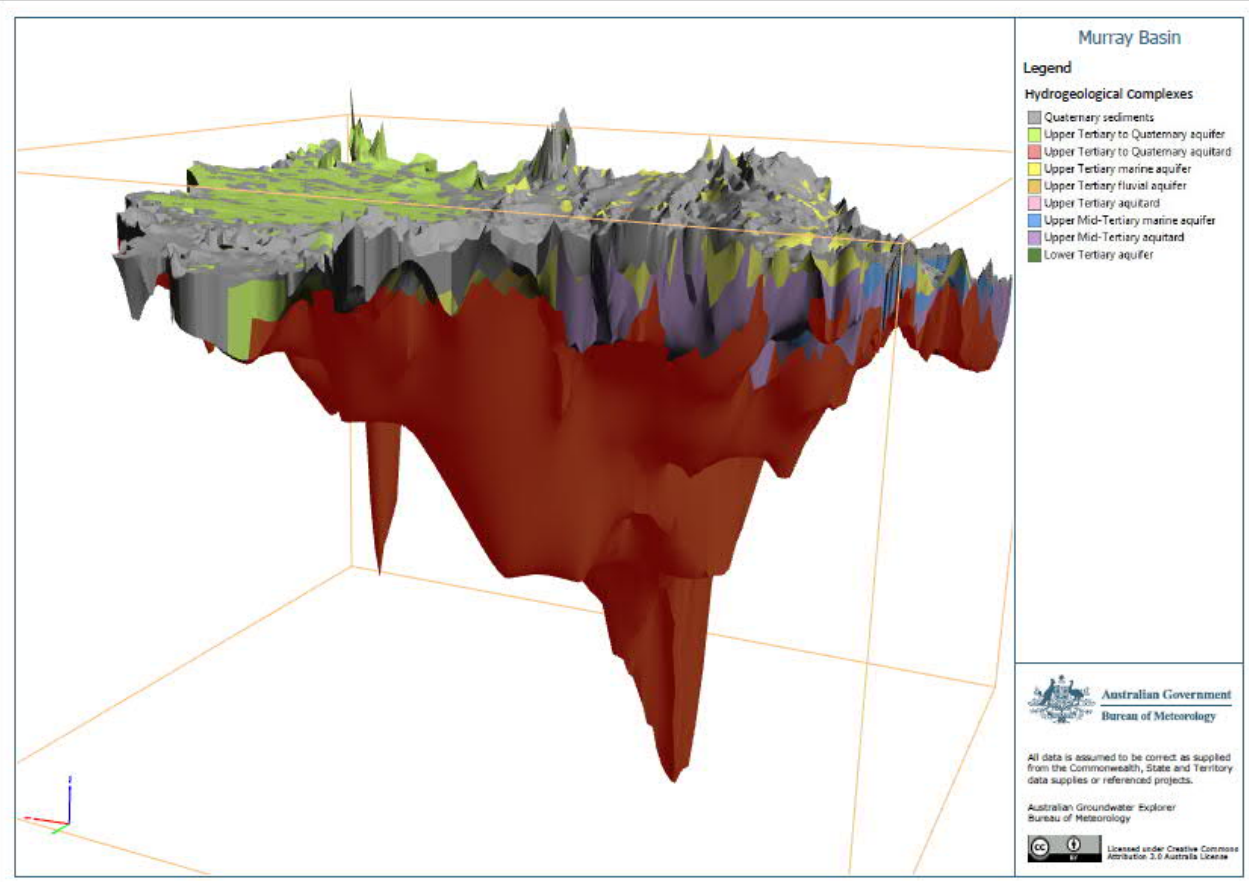
Top

Front

Right

Bottom

Property	Value
----------	-------



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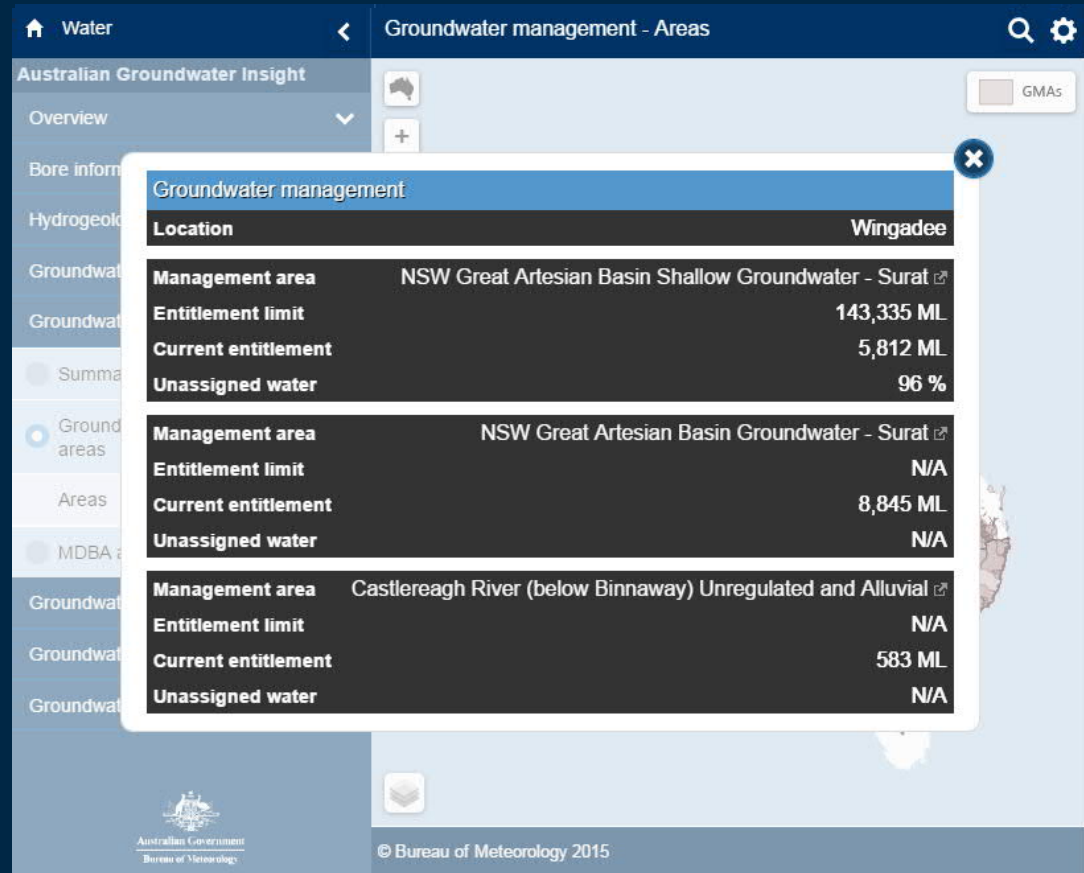


Australian Groundwater Insight

Interpreted groundwater information, particularly for non-groundwater specialists

Answers a range of user questions:

- *What aquifers are in my area?*
- *Where is groundwater licensed for use in Australia?*
- *What management areas cover my property?*



Water < Groundwater management - Areas

Australian Groundwater Insight

Overview

Bore information

Hydrogeology

Groundwater

Groundwater

Summary

Groundwater areas

Areas

MDBA

Groundwater

Groundwater

Groundwater

Groundwater management

Location	Wingadee
Management area	NSW Great Artesian Basin Shallow Groundwater - Surat
Entitlement limit	143,335 ML
Current entitlement	5,812 ML
Unassigned water	96 %

Management area	NSW Great Artesian Basin Groundwater - Surat
Entitlement limit	N/A
Current entitlement	8,845 ML
Unassigned water	N/A

Management area	Castlereagh River (below Binnaway) Unregulated and Alluvial
Entitlement limit	N/A
Current entitlement	583 ML
Unassigned water	N/A

Australian Government
Bureau of Meteorology

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Australian Groundwater Insight

Answers a range of user questions:

- How are groundwater levels changing?
- How saline is groundwater?



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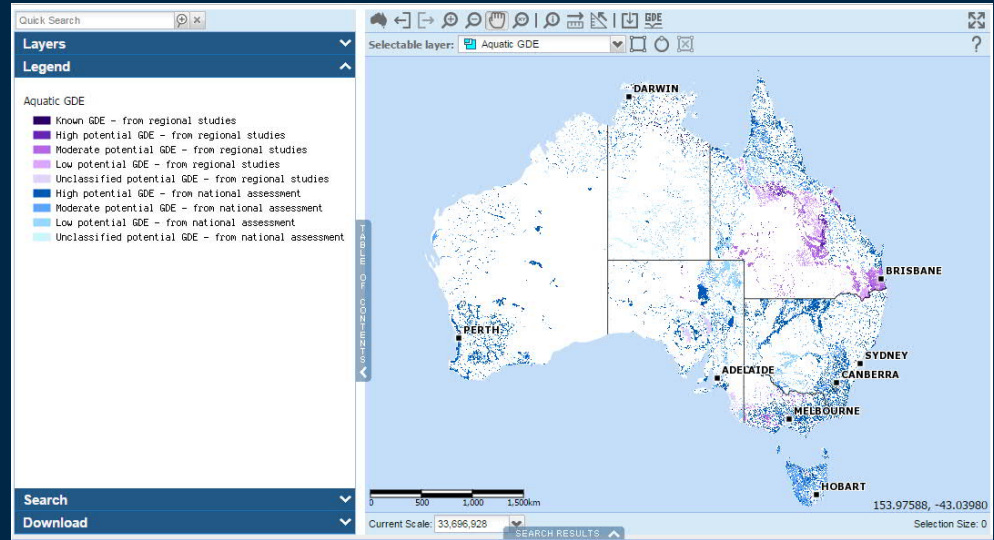


Groundwater Dependent Ecosystems (GDE) Atlas

1. Aquatic - *springs, wetlands, rivers*



Great Artesian Basin Mound Spring, South Australia.
Picture: Luke Doherty

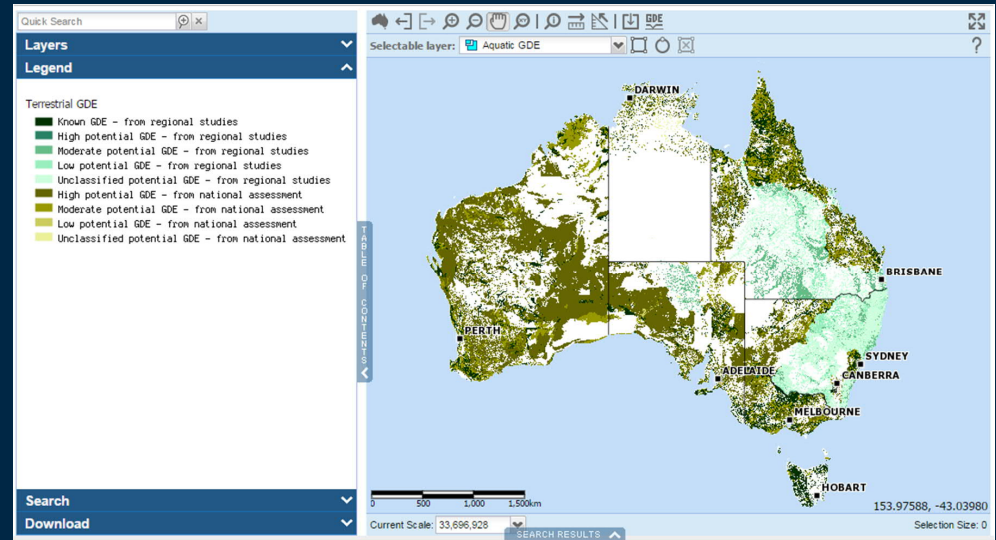


Groundwater Dependent Ecosystems (GDE) Atlas

2. Terrestrial - *vegetation*



Yael Nature Reserve, Western Australia
Picture: Patrick Duane

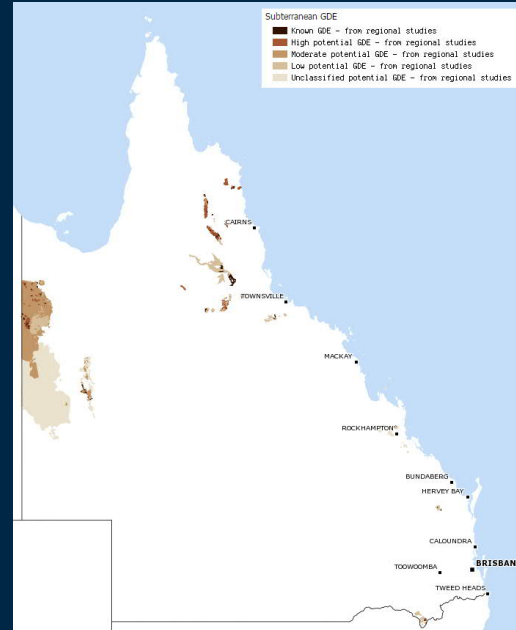


Groundwater Dependent Ecosystems (GDE) Atlas

3. Subterranean - caves, aquifers

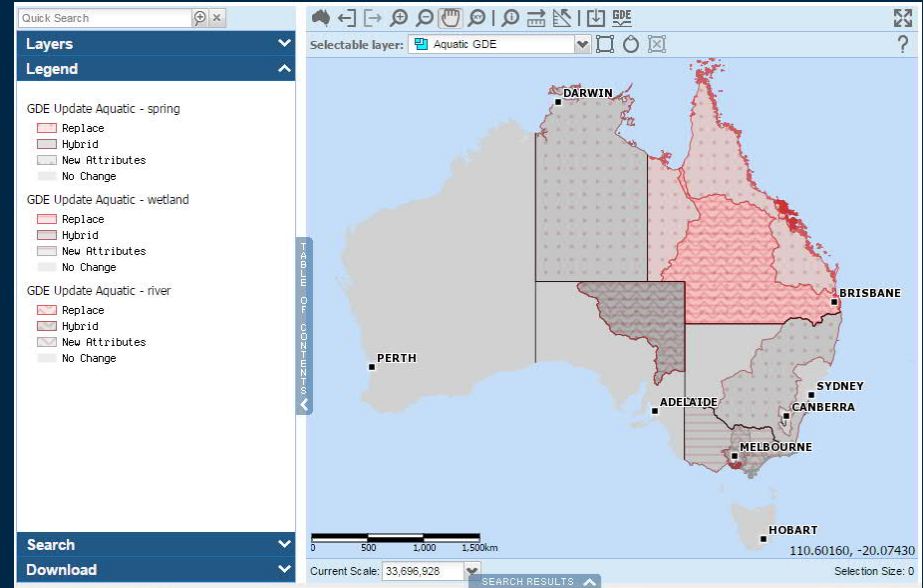


Mole Creek cave system, Tasmania
Picture: Ian Houshold



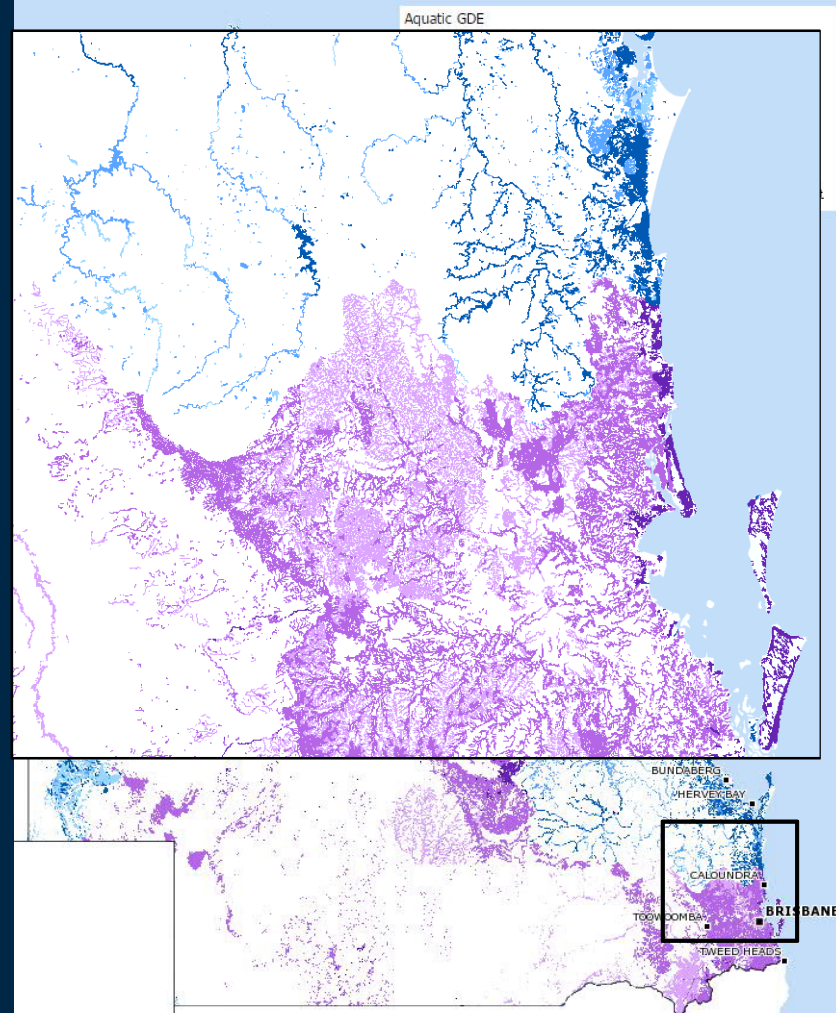
Areas of Updated Data

- A 'GDE Update' coverage layer is being added to the Atlas to show users where updates have occurred
- This layer includes information about the data type and the update method
- The original version of the Atlas datasets will be made available by email request



Updated GDE layers

- Best available, current data
- Greater detail
- New classification/symbology highlights:
 - Areas updated
 - Differences in methodology
- Maintains GDE Atlas as consistent & authoritative dataset for Australian GDEs
 - Latest state & regional data
 - Nationally standardised
 - Available from single location



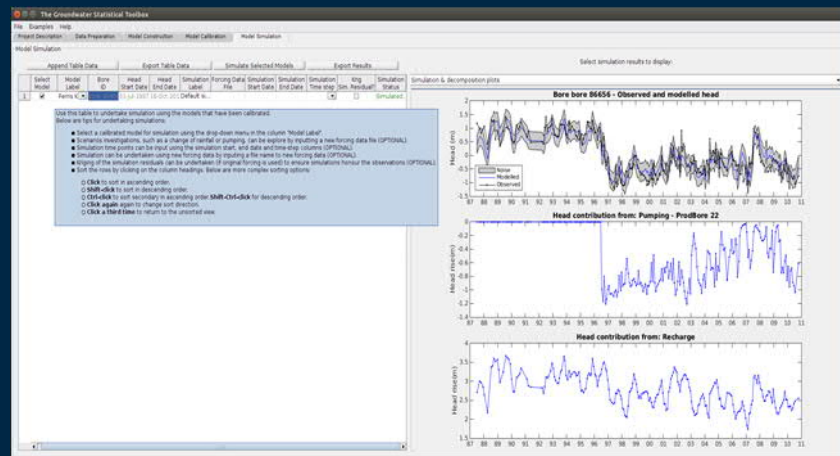
Tools From Research Projects

1. Hydrosight - groundwater time-series modelling program

- Error and outlier detection
- Hydrograph interpolation

2. The water table mapping approach

- R package groundwaterMapper
- To be publically released

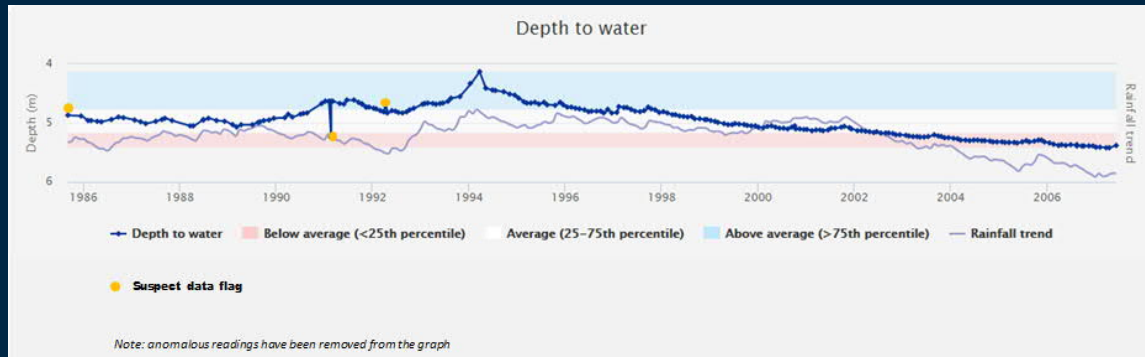
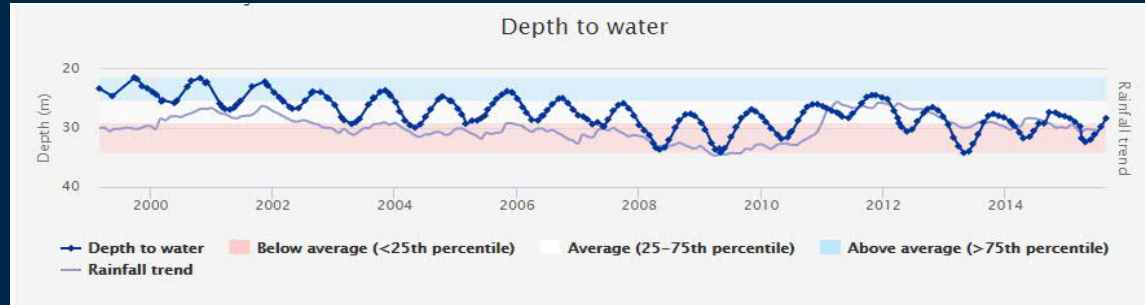


Open source and available at:
<http://peterson-tim-j.github.io/HydroSight/>

Hydrosight - Error and outlier detection

Graphs:

- When there is an error -
Points removed from
graphs
- Data is suspect –
Points highlighted



Hydrosight - Error and outlier detection

New field
Explorer
Quality Code

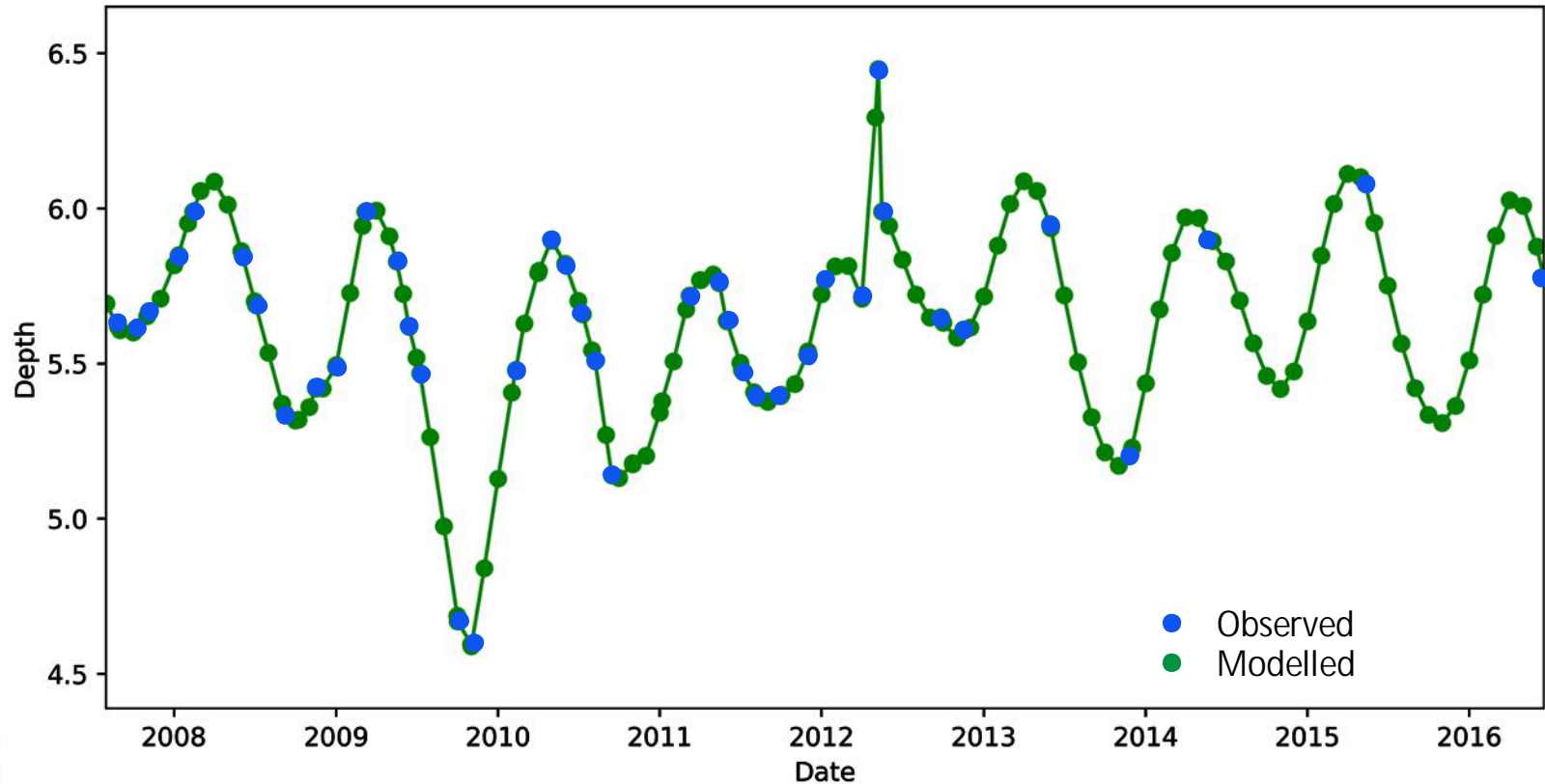
Renamed field
Quality - Agency
Quality Code

All data retained in table + 2 columns:

- Agency Quality Code:
 - Retain Code supplied by state agency, although not standardised, to ensure transparency
- Explorer Quality Code:
 - Add Code from Bureau QC analysis which conveys information about the quality of the data and explains how it is presented on the graph.

Results					
Bore (1) Water level (696) Water level chart Salinity Salinity chart Lithology log Construction log Hydrostratigraphy log Bore log chart					
Export					
Bore ID	Date	Variable	Result (m)	Explorer Quality Code	Agency Quality Code
108158	16/09/1986 00:00:00	DTW	68.5	Reasonable (included)	43
108158	16/09/1986 00:00:00	RSWL (mAHD)	68.13	Reasonable (included)	43
108158	16/09/1986 00:00:00	SWL	68.93	Reasonable (included)	43
108158	11/11/1986 00:00:00	RSWL (mAHD)	67.96	Reasonable (included)	43
108158	11/11/1986 00:00:00	SWL	69.1	Reasonable (included)	43
108158	11/11/1986 00:00:00	DTW	68.67	Reasonable (included)	43
108158	16/12/1986 00:00:00	SWL	69.03	Reasonable (included)	43
108158	16/12/1986 00:00:00	RSWL (mAHD)	68.03	Reasonable (included)	43
108158	16/12/1986 00:00:00	DTW	68.6	Reasonable (included)	43
108158	20/01/1987 00:00:00	SWL	69.12	Reasonable (included)	43
108158	20/01/1987 00:00:00	DTW	68.69	Reasonable (included)	43
108158	20/01/1987 00:00:00	RSWL (mAHD)	67.94	Reasonable (included)	43
108158	12/02/1987 00:00:00	SWL	69.19	Reasonable (included)	43
108158	12/02/1987 00:00:00	RSWL (mAHD)	67.87	Reasonable (included)	43
108158	12/02/1987 00:00:00	DTW	68.76	Reasonable (included)	43
108158	24/03/1987 00:00:00	DTW	68.7	Reasonable (included)	43
108158	24/03/1987 00:00:00	RSWL (mAHD)	67.93	Reasonable (included)	43
108158	24/03/1987 00:00:00	SWL	69.13	Suspect (flagged)	43
108158	14/04/1987 00:00:00	SWL	69.16	Suspect (flagged)	43
108158	14/04/1987 00:00:00	DTW	68.73	Suspect (flagged)	43
108158	14/04/1987 00:00:00	RSWL (mAHD)	67.9	Suspect (flagged)	43
108158	20/05/1987 00:00:00	SWL	69.16	Suspect (flagged)	43
108158	20/05/1987 00:00:00	DTW	68.73	Suspect (flagged)	43
108158	20/05/1987 00:00:00	RSWL (mAHD)	67.9	Suspect (flagged)	43
108158	16/06/1987 00:00:00	SWL	69.19	Suspect (flagged)	43
108158	16/06/1987 00:00:00	DTW	68.76	Suspect (flagged)	43
108158	16/06/1987 00:00:00	RSWL (mAHD)	67.87	Anomalous (removed)	43
108158	01/07/1987 00:00:00	RSWL (mAHD)	67.91	Anomalous (removed)	43
108158	01/07/1987 00:00:00	DTW	68.72	Anomalous (removed)	43
108158	01/07/1987 00:00:00	SWL	69.15	Anomalous (removed)	43
108158	15/07/1987 00:00:00	DTW	68.47	Anomalous (removed)	43
108158	15/07/1987 00:00:00	SWL	68.9	Anomalous (removed)	43
108158	15/07/1987 00:00:00	RSWL (mAHD)	68.16	Anomalous (removed)	43
108158	19/08/1987 00:00:00	DTW	68.69	Anomalous (removed)	43
108158	19/08/1987 00:00:00	SWL	69.12	Anomalous (removed)	43
108158	19/08/1987 00:00:00	RSWL (mAHD)	67.94	Anomalous (removed)	43

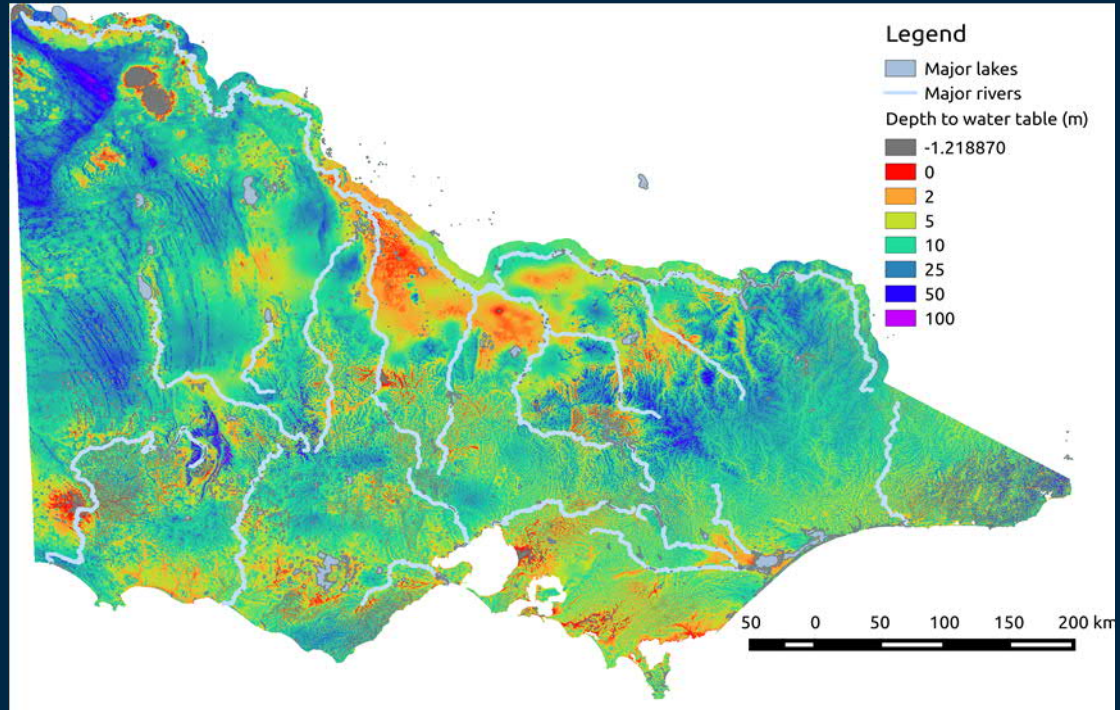
Hydrosight - Hydrograph interpolation



GroundwaterMapper - water table mapping

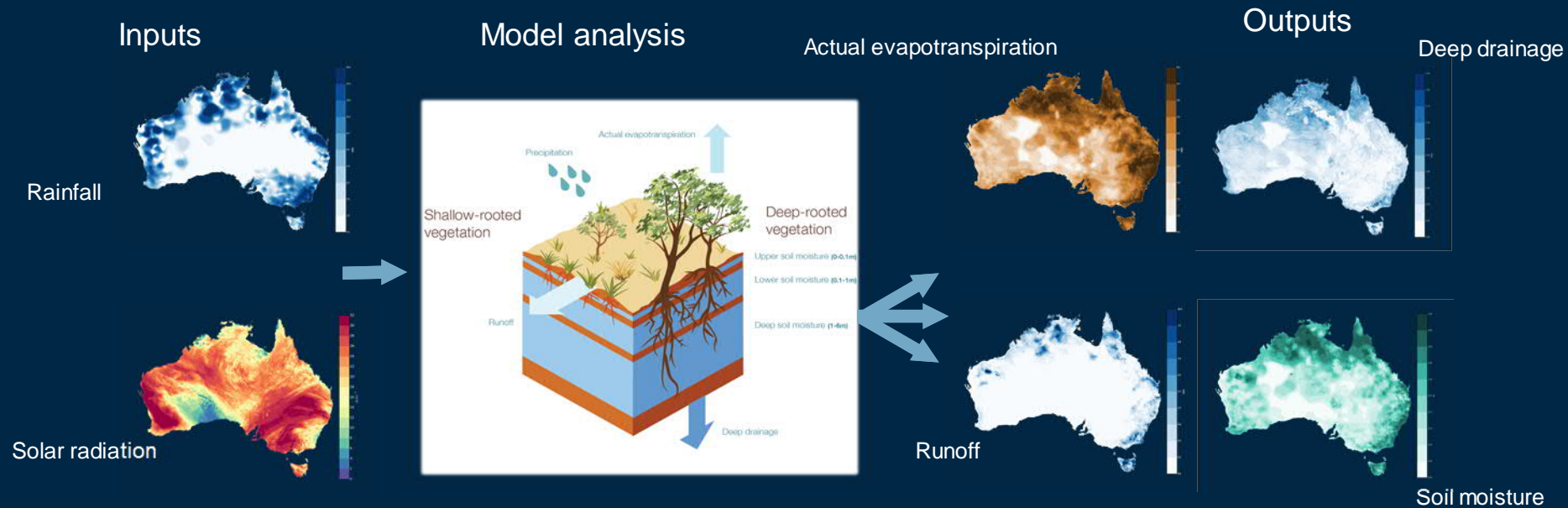
- Use interpolated results from HydroSight
- Run on regional scale.
- Generate large scale water level mapping

Vic depth to water:
Dr. Tim Peterson



Operational continental landscape water balance model

AWRA-L: national, daily time-step, 5 km resolution



Future Groundwater Work

- Release GDE Atlas update – *July 2017*
- Better QC on all data
- Monthly Explorer updates
- Licensed groundwater extraction data
- Improved conceptualisation of aquifer boundaries
- Groundwater time series modelling
- Regional depth to water maps



Thank you

Questions?

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