Mineral Resources Tasmania
Tasmanian Geological Survey
Record 2003/05

A brief investigation of groundwater basins/sub-basins and fractured rock hydrogeological systems on King Island

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Abstract

Regional groundwater resources in bedrock and unconsolidated sedimentary rocks were investigated on King Island. Unconsolidated hydrogeological systems consist of hydraulically-connected coastal basins and internal bedrock-perched sub basins, with groundwater discharging to the coast via surface water drainage systems and natural springs. Tertiary and Quaternary sea level oscillations (and related vegetation changes) have produced a range of regolith soil profiles from the weathering of bedrock, as well as the erosion and remobilisation of overburden. Current hydrological processes, related to drainage density, groundwater gradients, hydraulic heads and sea water intrusions, represent a potential salinity hazard on King Island.

Introduction

Between the 12 and 16 August 2002 Ms Katie Brown (King Island Council) and Andrew Ezzy (Mineral Resources Tasmania) examined aspects of the hydrogeological flow systems on King Island. The objectives of the study were to:

- determine the hydrogeological properties of various materials by slug testing;
- examine water quality by selective sampling of surface and groundwater at key locations within the regional hydrogeological systems; and
- identify potential basins and sub-basins that may represent a salinity risk or hazard for current and future land use.

A summary table of collected field data is presented in Appendix 1.

Geology

The geology of King Island was summarised by Calver (1998*a*, *b*). The distribution of bedrock lithologies and Quaternary sand dune systems is shown in Figure 1.

Hydrology

Surface drainage density

The surface drainage density (D) is excellent in the southwestern area of King Island (D>1.50 km^{-1}). In contrast, the central northern section of the island has a poor drainage density (D<0.60 km^{-1}). The distribution of drainage density appears to be directly related to the location of the Quaternary sand dune systems.

Average precipitation

Australian Bureau of Meteorology rainfall station 098001 at Currie has the longest publicly-accessible rainfall record on King Island. The average annual rainfall for the station is 901.3 mm, with highest rainfall occurring in the winter months (June to August) (fig. 2).

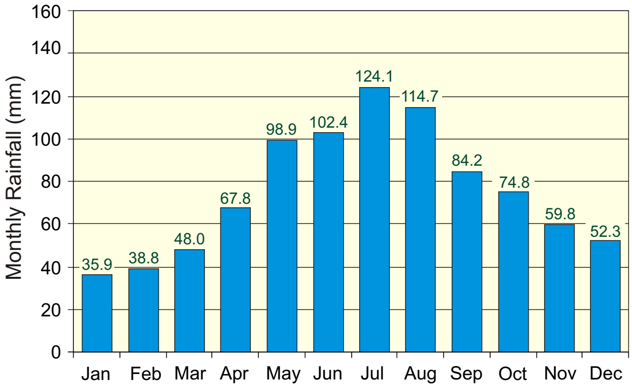

Figure 2

Average monthly rainfall for Australian Bureau of Meteorology rainfall station 098001, Currie Post Office.

Permeability tests

Fifteen slug extraction tests were attempted during the investigations, with one test being abandoned because of poor drawdown (BORIS Site_ID 4928, located on the *Martha Lavinia* property). A summary of the data

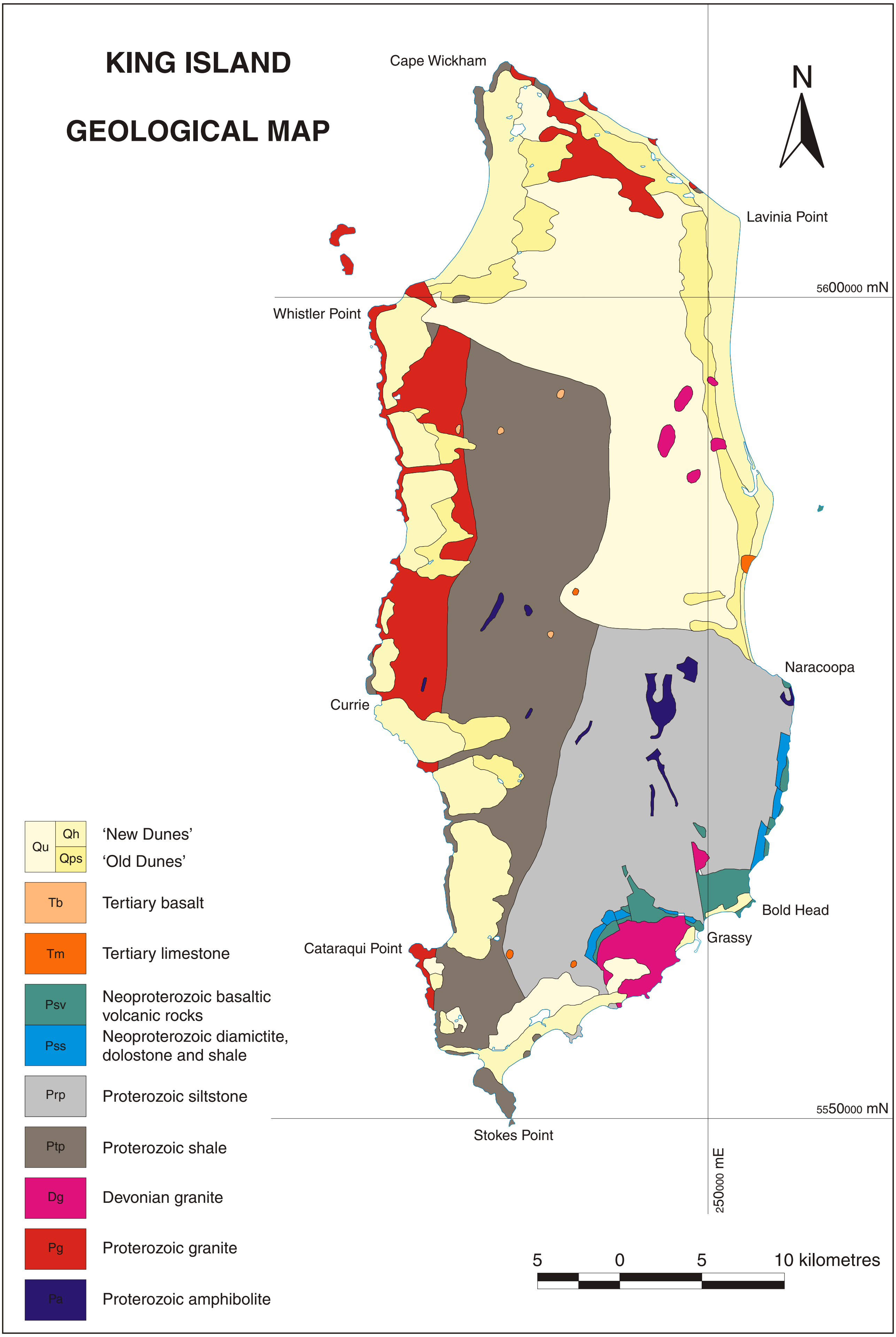
KING ISLAND
GEOLOGICAL MAP
Cape Wickham
N
Lavinia Point
5600000 mN
Whistler Point
Naracoopa
Currie
Bold Head
Grassy
Cataraqui Point
5550000 mN
Stokes Point
250000 mE
5 0 5 10 kilometres
Qu
Qh
'New Dunes'
Qps
'Old Dunes'
Tb
Tertiary basalt
Tm
Tertiary limestone
Psv
Neoproterozoic basaltic volcanic rocks
Pss
Neoproterozoic diamictite, dolostone and shale
Prp
Proterozoic siltstone
Ptp
Proterozoic shale
Dg
Devonian granite
Pg
Proterozoic granite
Pa
Proterozoic amphibolite

Figure 1

collected during the slug extraction tests is presented in Appendix 2.

Test data sets were analysed in the software package *AquiferWin32* (Version 2.17, Environmental Simulations Inc.). The Bouwer and Rice (1976) method was selected as the most appropriate available within the software package. Appendix 2 contains the output graphs of the software package. All calculated hydraulic conductivity values are summarised in Table 1.

Table 1

Summary of calculated hydraulic conductivity values in AquiferWin32 Version 2.17

Pump test number	*Pumping well*	*Hydraulic conductivity (K) (m/d)*	*Property name*
1	Site_ID 4928	Abandoned	Martha Lavinia
2	W1	3.07	Blackwood Flats
3	W2	2.79	Blackwood Flats
4	W3	2.67	Blackwood Flats
5	W4	1.11	Blackwood Flats
6	W5	0.006	Blackwood Flats
7	W6	0.065	Blackwood Flats
8	G1	0.24	Jacksons Bridge/
9	L6	0.037	Livardi Livardi
10	L2A	0.19	Livardi Livardi
11	PR2A	0.83	Paranui
12	PR5	0.19	Paranui
13	SB2	0.53	Surprise Bay
14	SB4	0.63	Surprise Bay
15	SB6	0.34	Surprise Bay

Hydraulic conductivity (K) values for the linear array of bores on the Blackwood Flats property (W1, W2, W3, W4, W5, W6) demonstrate the influence of sand and clay materials on the hydraulic gradient system which recharges the valley floor. Bores located in sand deposits on slopes on the edge of the northern plateau (W1, W2 and W3) have K values 3 to 4 orders of magnitudes higher than those located in the valley floor (W5 and W6).

All other bores screened in the unconsolidated overburden have an average K value of 0.37 metres/day. The value of 3.7×10^{-1} m/d could be used in the future (with respect to local conditions) for hydraulic calculations associated with shallow unconsolidated overburden. The thicker dune systems are more likely to have K values in the order of 10^1 to 10^2 m/d.

Conceptual hydrogeological models

Hard rock fractured aquifers

Bedrock lithology, structural features, related topography and past weathering control deeper groundwater flow directions. Groundwater gradients are very low across the entire island.

Quaternary unconfined unconsolidated aquifers

These aquifers are almost certainly affected by the three-dimensional distribution of the 'old' (Pleistocene) and 'new' (Holocene) dunes. Palaeo-erosion channels within the Pleistocene dunes appear to have been filled by the Holocene dunes (e.g. Phoques Bay). This geomorphological feature, combined with very low hydraulic gradients, probably allows sea water intrusion to extend some distance inland at various localities (e.g. in the estuarine section of Yellow Rock River). The larger unconsolidated basins have the ability to store greater volumes of water and therefore exert a sufficient hydraulic force to limit sea water intrusion (e.g. Tuffa Terraces).

Island scale

Basins and sub-basins have been identified by a combination of information sources including:

- historical groundwater drilling reports;
- topography;
- geology and radiometric geophysical surveying (Calver, 1998*a*);
- geomorphological processes associated with palaeo sea level changes;
- hydrogeological features (e.g. spring locations, drainage patterns);
- vegetation;
- existing surface drainage patterns; and
- observations by local property owners.

It is acknowledged that hydraulic connections will most likely occur between fractured rock aquifers and unconsolidated basins/sub-basins and along basin boundary interfaces (e.g. Greater Currie and Tuffa Terraces basins). Basins and sub-basins are shown on Figure 3 and are summarised, with respect to data collection points for this investigation, in Table 2.

Because of the heterogeneous nature of fractured rock aquifers no attempt has been made to classify these systems. Groundwater quality and quantity in bedrock aquifers is most likely controlled by the host lithology (including facies changes), structural geological implications on the fracture and cleavage orientations (i.e. fracture density of vertical recharge and sub-horizontal storage fractures), and the genetic emplacement processes of the Devonian granite.

Water chemistry

All groundwater samples were collected in accordance with Australian/New Zealand Standard 5667.11:1998. Laboratory testing of the samples was undertaken by the Mineral Resources Tasmania laboratory (Appendix 3). Values for pH ranged from 4.3 to 7.9, with conductivity values ranging between 171 and


MINERAL RESOURCES TASMANIA
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GROUNDWATER BASINS & SUB-BASINS OF KING ISLAND
0 5 10 15 km
230000mE
24
25
26
27
23
5610000mN
60
59
58
57
56
5550000mN
CAPE WICKHAM
Cape Farewell
Disappointment Bay
Flannigan Sub-Basin
Egg Lagoon Sub-Basin
PHOQUES BAY
Phoques Basin
Lavinia Pt
North Nook Basin
Whistler Pt
Vellekoop Basin
Bungaree Sub-Basin
Reekara Sub-Basin
Coopers Basin
RIVER
Cowper Pt
South Nook/Sea Elephant Basin
ELEPHANT
Porky Basin
SEA ELEPHANT BAY
Fraser Basin
Fraser Bluff
Currie
SEA
STRAIT
Greater Currie Basin
Yarra Basin
Tuffa Terraces Basin
Grassy Basin
Bold Head
Fitzmaurice Bay
Grassy
Grassy Bay
Cataraqui Pt
Bowling Basin
Seal Pt
Seal Bay
Surprise Bay
BASS
STOKES POINT

Figure 3

Table 2

Summary of data collection points with respect to identified hydrogeological features.

Aquifer Type	*Hydrogeological feature*	*Data collection points within hydrogeological feature*
Unconfined/unconsolidated basins	Bowling Basin	Bowling spring, salinity bores SB2, SB4 and SB6
	Coopers Basin	Salinity bores PR2A and PR5
	Fraser Basin	BORIS bores Site_ID 16833 and 16816
	Grassy Basin	Nil
	Greater Currie Basin	Nil
	North Nooks Basin	Nil
	Phoques Basin	Wickhams spring
	Porky Basin	Nil
	South Nooks/ Sea Elephant Basin	Nil
	Tuffa Terraces Basin	Tuffa Terraces spring
	Vellekoop Basin	Salinity bores W1–8, G1 and G4B
	Yarra Basin	Nil
Unconfined/unconsolidated sub-basins	Egg Lagoon Sub-basin	BORIS bore SITE_ID 4928, custom bore on *Vivian* property and springs on western end of Egg Lagoon headwaters
	Reekara Sub-basin	Salinity bores L2A and L6
	Bungaree Sub-basin	Nil
	Flannigan Sub-basin	Nil

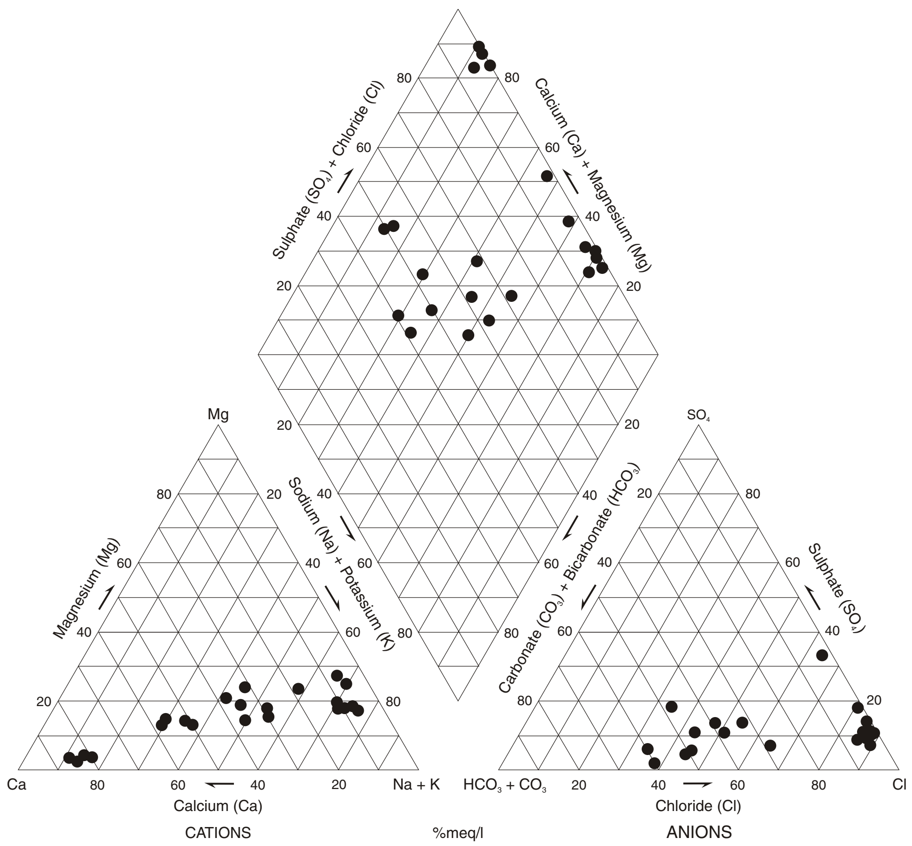


Figure 4

Piper plots for all surface and groundwater sampled during the investigation.

29 000 μS/cm. Figure 4 is a Piper plot of the analysis results of all the surface and groundwater samples.

Water samples from aquifers in unconsolidated sedimentary rocks contained high concentrations of chloride, bicarbonate, calcium, sodium and magnesium. The main ionic complexes in these groundwater systems appear to be sodium chloride and calcium carbonate. Aquifers in fractured rocks have significantly lower concentration of these species and much lower pH values.

Principal conclusions

Surface hydrological features, fractured bedrock aquifers, aquifers in unconsolidated sedimentary rocks and sea water influx are all important components of the hydrogeological systems of King Island. Larger basins have a higher potential to store economic quantities of useable groundwater. Fractured aquifers within Proterozoic siltstone in the southeast of the island, in close proximity to the contact with Neoproterozoic rocks, may also contain high quality groundwater resources. Proterozoic granite and fractured aquifers in shale contain acid water concentrated in various metals.

Pump testing of bores with high salinity on the *Blackwood Flats* property has demonstrated that hydraulic variations occur in host materials within the Vellekoop Basin. Water chemistry data have identified that significant concentrations of sodium chloride and calcium carbonate occur within the King Island hydrogeological flow systems, particularly in the northern half of the island where the drainage density is the lowest.

Future work

Additional bores are required to focus on key hydrological components of areas where salinity has been identified and land use may change, as well as in locations that represent potential high quality water storages on the island. As a potential salinity hazard has been identified by the water chemistry results and by the conceptual hydrogeological modelling, it is strongly recommended that a central data storage location be established for past and future investigations.

Cumulative precipitation data would also be useful to undertake a basin-by-basin precipitation analysis and to identify rainfall gradients across the island.

Additional investigations are also recommended into the recharge mechanisms of the high quality groundwater sampled from the fractured siltstone aquifer beneath the *Karawah* property. Water dating techniques and traces may aid in identifying the source of the recharge water.

References

CALVER, C. R. 1998*a*. Rock and gravel resources of King Island. *Record Tasmanian Geological Survey* 1998/05.

CALVER, C. R. 1998*b*. Rock and gravel resources of King Island — a supplementary report. *Record Tasmanian Geological Survey* 1998/06.

[17 June 2003]

Appendix 1

Key summary table of the data collected during investigations

Date	*Groundwater Basin/Sub-basin*	*Hydrogeological feature*	*Easting (m)*	*Northing (m)*	*TDS (mS/cm)*	*SWL (m)*	*TD (m)*	*SRV (L)*	*MRT lab sample*	*Pump test*	*Water use*	*Environmental issues*	*Comments*	*Local hydrogeological information*
13/08/2002	Egg Lagoon sub-basin	Bore_Card_109	245863	5606217	1.90	4.15	26.4	110	KI_card_109	no	not in use	two hydrocarbon tanks within two metres of bore	100 mm casing	
13/08/2002	Egg Lagoon sub-basin	Bore_custom_design	unknown		0.70	na	na	na	Vivian_bore	no	drinking water	hydrocarbon tank 5 m to east	50 mm casing	
13/08/2002	Egg Lagoon sub-basin	Springs in Egg Lagoon headwaters	238900	5606700	0.60	na	na	na	Egg_lagoon_ boundary_spring	na	stock watering	dewatering drains	New/old dune interface	Groundwater slope/gradient in new dunes controlled by slope of western coastal bedrock
13/08/2002	Vellekoop basin	KB_salinity_bore_W1	236780	5600135	1.80	1.1	2.25	6	W1	yes	none	none	50 mm casing	Bedrock plateau to waterlogged low lying internal plain with man-made drain
13/08/2002	Vellekoop basin	KB_salinity_bore_W2	236775	5600115	1.40	0.45	2.30	12	W2	yes	none	none	50 mm casing	Bedrock plateau to waterlogged low lying internal plain with man-made drain
13/08/2002	Vellekoop basin	KB_salinity_bore_W3	236785	5600165	1.50	1.6	2.95	9	W3	yes	none	none	50 mm casing	Bedrock plateau to waterlogged low lying internal plain with man-made drain
13/08/2002	Vellekoop basin	KB_salinity_bore_W4	236775	5600105	1.40	0.43	3.67	18	W4	yes	none	none	50 mm casing	Bedrock plateau to waterlogged low lying internal plain with man-made drain
13/08/2002	Vellekoop basin	KB_salinity_bore_W5	236790	5600210	2.10	0.2	4.00	24	No MRT sample	yes - ab	none	none	50 mm casing	Bedrock plateau to waterlogged low lying internal plain with man-made drain
13/08/2002	Vellekoop basin	KB_salinity_bore_W6	236795	5600265	1.50	0.26	4.00	24	No MRT sample	yes - ab	none	none	50 mm casing	Bedrock plateau to waterlogged low lying internal plain with man-made drain
13/08/2002	Vellekoop basin	KB_salinity_bore_W7	236805	5600365	1.60	0.34	4.00	24	W7	no	none	none	50 mm casing	Bedrock plateau to waterlogged low lying internal plain with man-made drain
13/08/2002	Vellekoop basin	KB_salinity_bore_W8	236820	5600515	1.30	0.35	3.00	18	W8	no	none	none	50 mm casing	Bedrock plateau to waterlogged low lying internal plain with man-made drain
14/08/2002	Vellekoop basin	KB_salinity_bore_G1	235075	5599300	14.9	0.43	4.77	21	G1	yes	none	none	50 mm casing	Holocene/Pleistocene? sea influx zone in low land Quaternary older dune plains
14/08/2002	Vellekoop basin	KB_salinity_bore_G4B	234925	5599100	15.20	0.86	4.31	21	G4B	no	none	none	50 mm casing	Holocene/Pleistocene? sea influx zone in low land Quaternary older dune plains
14/08/2002	Reekara sub-basin	KB_salinity_bore_L6	240560	5596030	4.10	1.73	6.51	26	L6	yes	none	none	50 mm casing	Island inter sub-basin (structural control?), surface drainage by Yellow Rock River
14/08/2002	Reekara sub-basin	KB_salinity_bore_L2A	240830	5596240	9.50	0.29	3.67	21	L2A	yes	none	none	50 mm casing	Island inter sub-basin (structural control?), surface drainage by Yellow Rock River
14/08/2002	Coopers basin	KB_salinity_bore_PR2A	234720	5593105	8.60	0.86	4.00	24	PR2A	yes	none	none	50 mm casing	Inter Island shallow coastal linked Pleistocene? basin
14/08/2002	Coopers basin	KB_salinity_bore_PR5	234615	5592950	10.30	0.96	4.53	27	PR5	yes	none	none	50 mm casing	Inter Island shallow coastal linked Pleistocene? Basin
14/08/2002	Fraser basin/Karawah fractured aquifer	Bore_Card_150	unknown		0.60	2.13	15.2	85	Bore_Card_150	yes_ab	Fe_build_ abandoned, not in use since Jan 2002	diesel tanks within 2 metres of bore	100 mm casing	Eastern low energy coastal Pliestocene seawater influx? Weathered bedrock/ bedrock bore
15/08/2002	Fraser basin/Karawah fractured aquifer	Bore_Card_136	249760	5574635	0.70	na	21.4	na	Bore_Card_136	no	dairy wash down water	diesel tanks within 10 metres of bore	100 mm casing	Soil over Tertiary weathered bedrock (clay)/bedrock
15/08/2002	Karawah fractured aquifer	Bore_Card_119	244605	5565970	0.10	na	33.5	na	Bore_Card_119	no	house	diesel tanks within 2 metres of bore	100 mm casing	Soil over Tertiary weathered bedrock (clay)/bedrock. Water in siltstone at 25 and 33.5 m
15/08/2002	Bowling basin	Bowling_spring	237300	5553875	0.80	na	na	na	Bowling_spring	na	stock watering	none	na	Discharge of lime sand aquifer from beneath brown clayey sand
15/08/2002	Bowling basin/shale fractured aquifer	KB_salinity_bore_SB2	236375	5555550	0.80	0.49	2.47	12	SB2	yes	none	salinity	50 mm casing	Fractured shale aquifer with weathered bedrock clay overburden
15/08/2002	Bowling basin/shale fractured aquifer	KB_salinity_bore_SB4	236600	5555440	8.40	0.9	3.90	18	SB4	yes	none	salinity	50 mm casing	Fractured shale aquifer with weathered bedrock clay overburden
15/08/2002	Bowling basin/shale fractured aquifer	KB_salinity_bore_SB6	236760	5555305	9.4	0.4	4.00	21	SB6	yes	none	salinity	50 mm casing	Fractured shale aquifer with weathered bedrock clay overburden

Appendix 2

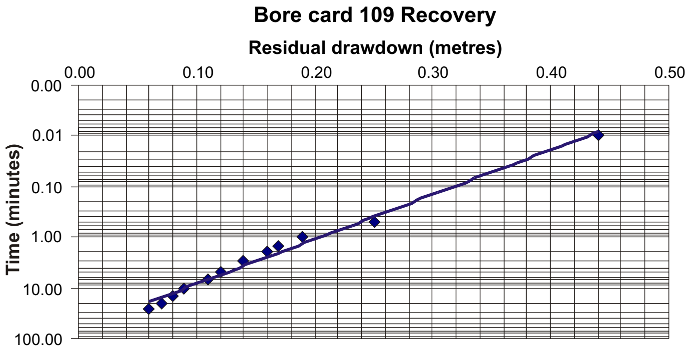
Summary of the data collected during the slug extraction tests

Card 109

Starting standing water level (m):	4.15
Total depth (m):	26.4
Hole diameter (m):	0.1
Screen length (m):	10

Recovery

DTW (m)	*Recovery (m)*	*Time (min)*	*Comments*
4.59	0.44	0.01	Used for 6 months in 1990
4.40	0.25	0.50	Oil film on water in sampling bucket
4.34	0.19	1.00	
4.32	0.17	1.50	
4.31	0.16	2.00	
4.29	0.14	3.00	
4.27	0.12	5.00	
4.26	0.11	7.00	
4.24	0.09	10.00	
4.23	0.08	15.00	
4.22	0.07	20.00	
4.21	0.06	25.00	

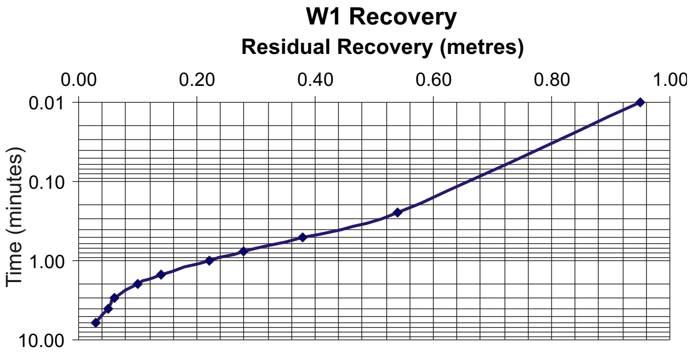


W1

Starting standing water level (m):	1.10
Total depth (m):	2.25
Hole diameter (m):	0.05
Screen interval (m):	2.20–1.95
Screen length (m):	0.30

Recovery

DTW (m)	*Recovery (m)*	*Time (min)*	*Comments*
2.05	0.95	0.01	
1.64	0.54	0.25	
1.48	0.38	0.50	
1.38	0.28	0.75	
1.32	0.22	1.00	
1.24	0.14	1.50	
1.20	0.10	2.00	
1.16	0.06	3.00	
1.15	0.05	4.00	
1.13	0.03	6.00	

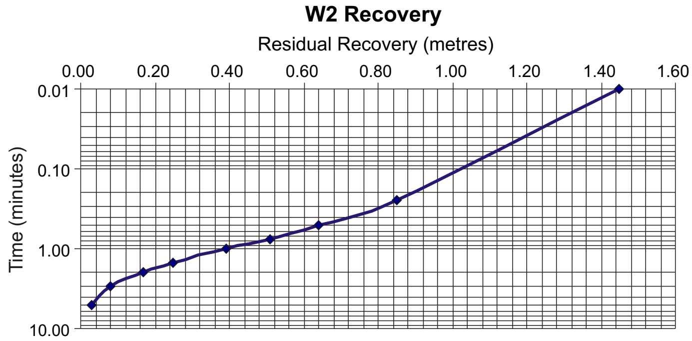


W2

Starting standing water level (m):	0.45
Total depth (m):	2.30
Hole diameter (m):	0.05
Screen interval (m):	2.30–2.00
Screen length (m):	0.30

Recovery

DTW (m)	*Recovery (m)*	*Time (min)*	*Comments*
1.90	1.45	0.01	
1.30	0.85	0.25	
1.09	0.64	0.50	
0.96	0.51	0.75	
0.84	0.39	1.00	
0.70	0.25	1.50	
0.62	0.17	2.00	
0.53	0.08	3.00	
0.48	0.03	5.00	

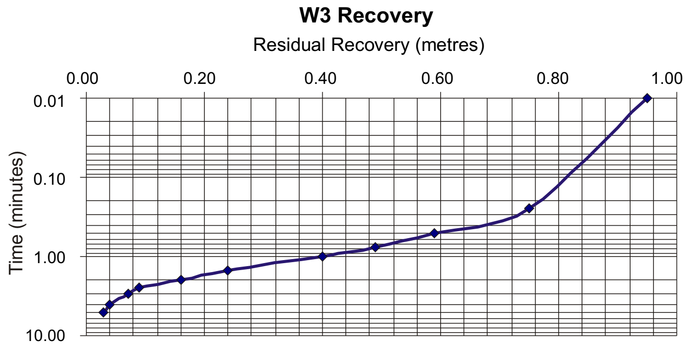


W3

Starting standing water level (m):	1.60
Total depth (m):	2.95
Hole diameter (m):	0.05
Screen interval (m):	2.95–2.65
Screen length (m):	0.30

Recovery

DTW (m)	*Recovery (m)*	*Time (min)*	*Comments*
2.55	0.95	0.01	
2.35	0.75	0.25	
2.19	0.59	0.50	
2.09	0.49	0.75	
2.00	0.40	1.00	
1.84	0.24	1.50	
1.76	0.16	2.00	
1.69	0.09	2.50	
1.67	0.07	3.00	
1.64	0.04	4.00	
1.63	0.03	5.00	

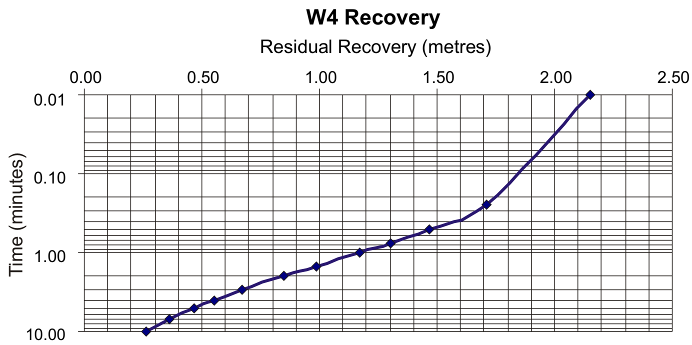


W4

Starting standing water level (m):	0.43
Total depth (m):	3.77
Hole diameter (m):	0.05
Screen interval (m):	3.77–3.47
Screen length (m):	0.30

Recovery

DTW (m)	*Recovery (m)*	*Time (min)*	*Comments*
2.58	2.15	0.01	
2.14	1.71	0.25	
1.90	1.47	0.50	
1.73	1.30	0.75	
1.60	1.17	1.00	
1.42	0.99	1.50	
1.28	0.85	2.00	
1.10	0.67	3.00	
0.98	0.55	4.00	
0.90	0.47	5.00	
0.79	0.36	7.00	
0.69	0.26	10.00	

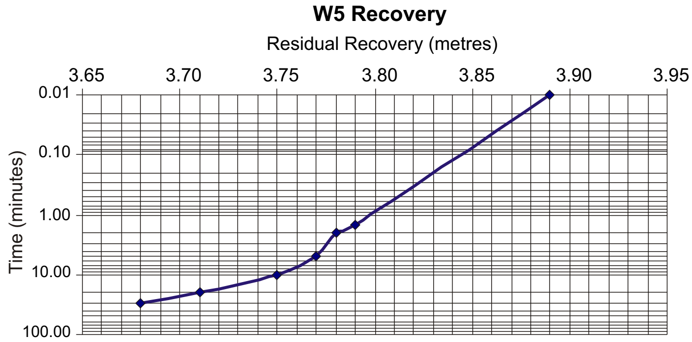


W5

Starting standing water level (m):	0.20
Total depth (m):	4.00
Hole diameter (m):	0.05
Screen interval (m):	4.00–3.70
Screen length (m):	0.30

Recovery

DTW (m)	*Recovery (m)*	*Time (min)*	*Comments*
4.09	3.89	0.01	Blue grey clay clogging bailer sea during plate staging of purging
3.99	3.79	1.50	
3.98	3.78	2.00	
3.97	3.77	5.00	
3.95	3.75	10.00	
3.91	3.71	20.00	
3.88	3.68	30.00	Slug test abandoned due to low recharge

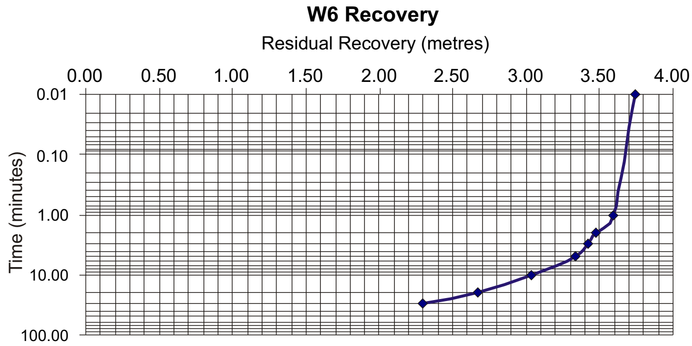


W6

Starting standing water level (m):	0.26
Total depth (m):	4.00
Hole diameter (m):	0.05
Screen interval (m):	4.00–3.70
Screen length (m):	0.30

Recovery

DTW (m)	*Recovery (m)*	*Time (min)*	*Comments*
4.00	3.74	0.01	
3.85	3.59	1.00	
3.73	3.47	2.00	
3.68	3.42	3.00	
3.59	3.33	5.00	
3.30	3.04	10.00	
2.93	2.67	20.00	
2.56	2.30	30.00	Slug test abandoned due to low recharge

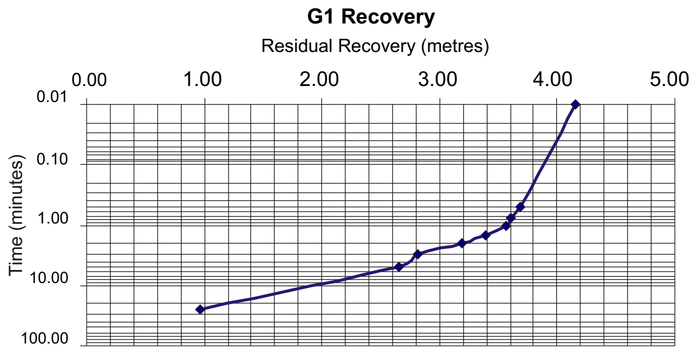


G1

Starting standing water level (m):	
Total depth (m):	
Hole diameter (m):	
Screen interval (m):	
Screen length (m):	0.30

Recovery

DTW (m)	*Recovery (m)*	*Time (min)*	*Comments*
4.58	4.15	0.01	
4.11	3.68	0.50	
4.04	3.61	0.75	
3.99	3.56	1.00	
3.82	3.39	1.50	Grey plug clay in water
3.62	3.19	2.00	
3.24	2.81	3.00	
2.65	2.65	5.00	
0.97	0.97	25.00	

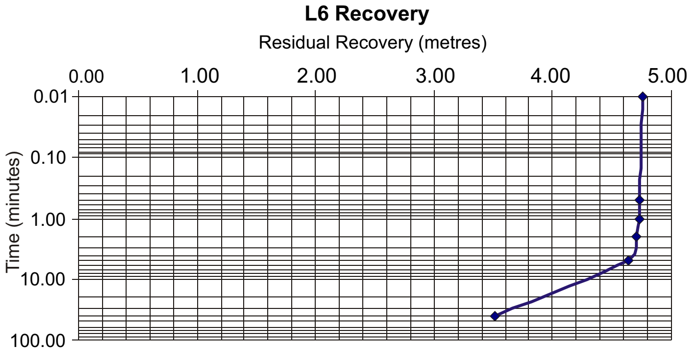


L6

Starting standing water level (m):	1.73
Total depth (m):	6.51
Hole diameter (m):	0.05
Screen interval (m):	6.51–6.21
Screen length (m):	0.30

Recovery

DTW (m)	*Recovery (m)*	*Time (min)*	*Comments*
6.49	4.76	0.01	
6.46	4.73	0.50	
6.46	4.73	1.00	
6.44	4.71	2.00	
6.37	4.64	5.00	Grey plug clay in water
5.24	3.51	40.00	

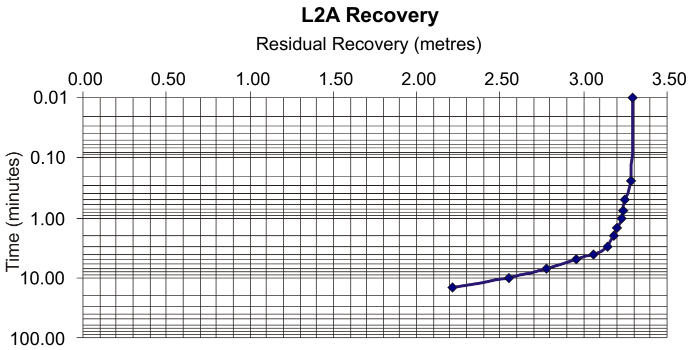


L2A

Starting standing water level (m):	0.29
Total depth (m):	3.67
Hole diameter (m):	0.05
Screen interval (m):	3.67–3.37
Screen length (m):	0.30

Recovery

DTW (m)	*Recovery (m)*	*Time (min)*	*Comments*
3.58	3.29	0.01	
3.57	3.28	0.25	
3.54	3.25	0.50	
3.53	3.24	0.75	
3.52	3.23	1.00	Grey plug clay in water
3.49	3.20	1.50	
3.47	3.18	2.00	
3.43	3.14	3.00	
3.35	3.06	4.00	
3.25	2.96	5.00	
3.07	2.78	7.00	
2.84	2.55	10.00	
2.50	2.21	15.00	

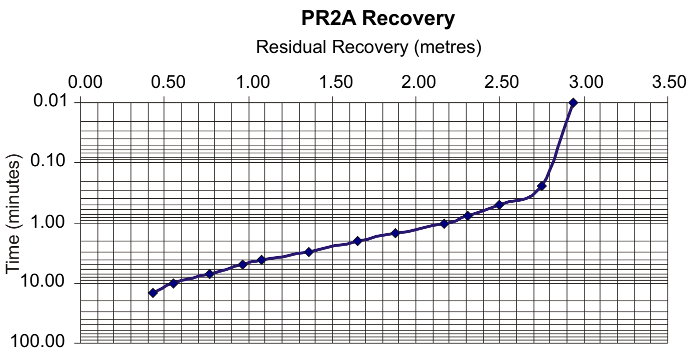


PR2A

Starting standing water level (m):	0.86
Total depth (m):	4.00
Hole diameter (m):	0.05
Screen interval (m):	4.00–3.70
Screen length (m):	0.30

Recovery

DTW (m)	*Recovery (m)*	*Time (min)*	*Comments*
3.80	2.94	0.01	
3.61	2.75	0.25	
3.36	2.50	0.50	
3.17	2.31	0.75	
3.03	2.17	1.00	
2.74	1.88	1.50	
2.51	1.65	2.00	
2.22	1.36	3.00	
1.94	1.08	4.00	
1.83	0.97	5.00	
1.63	0.77	7.00	
1.41	0.55	10.00	
1.29	0.43	15.00	

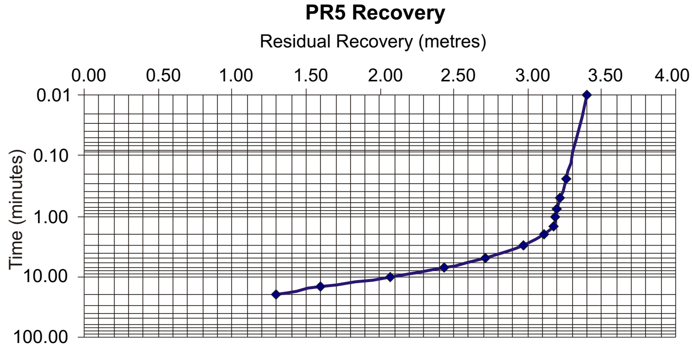


PR5

Starting standing water level (m):	0.96
Total depth (m):	4.53
Hole diameter (m):	0.05
Screen interval (m):	4.53–4.23
Screen length (m):	0.30

Recovery

DTW (m)	*Recovery (m)*	*Time (min)*	*Comments*
4.36	3.40	0.01	
4.22	3.26	0.25	
4.18	3.22	0.50	
4.16	3.20	0.75	
4.15	3.19	1.00	Grey plug clay in water
4.13	3.17	1.50	
4.07	3.11	2.00	
3.93	2.97	3.00	
3.67	2.71	5.00	
3.39	2.43	7.00	
3.03	2.07	10.00	
2.56	1.60	15.00	
2.26	1.30	20.00	

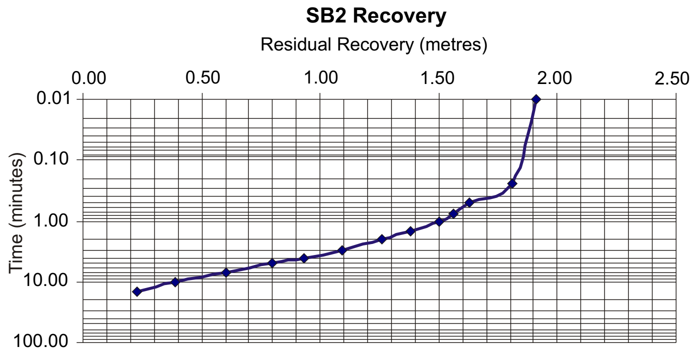


SB2

Starting standing water level (m):	0.49
Total depth (m):	2.47
Hole diameter (m):	0.05
Screen interval (m):	2.47–2.17
Screen length (m):	0.30

Recovery

DTW (m)	*Recovery (m)*	*Time (min)s*	*Comments*
2.40	1.91	0.01	
2.30	1.81	0.25	
2.12	1.63	0.50	
2.05	1.56	0.75	
1.99	1.50	1.00	Grey sandy clay in water
1.87	1.38	1.50	
1.75	1.26	2.00	
1.58	1.09	3.00	
1.42	0.93	4.00	
1.29	0.80	5.00	
1.09	0.60	7.00	
0.88	0.39	10.00	
0.72	0.23	15.00	

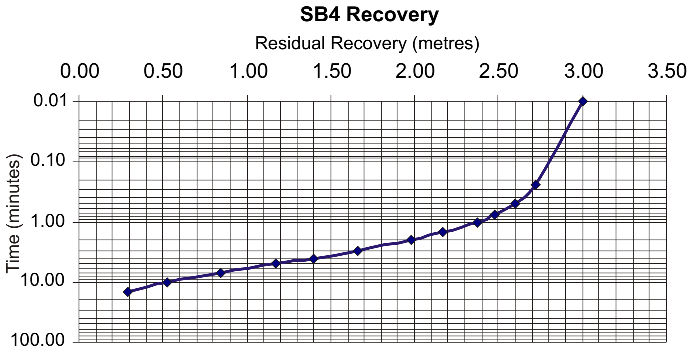


SB4

Starting standing water level (m):	0.90
Total depth (m):	3.90
Hole diameter (m):	0.05
Screen interval (m):	3.90–3.60
Screen length (m):	0.30

Recovery

DTW (m)	*Recovery (m)*	*Time (min)*	*Comments*
3.90	3.00	0.01	
3.62	2.72	0.25	
3.50	2.60	0.50	
3.38	2.48	0.75	
3.27	2.37	1.00	Grey sandy clay in water
3.07	2.17	1.50	
2.88	1.98	2.00	
2.56	1.66	3.00	
2.30	1.40	4.00	
2.07	1.17	5.00	
1.74	0.84	7.00	
1.43	0.53	10.00	
1.19	0.29	15.00	

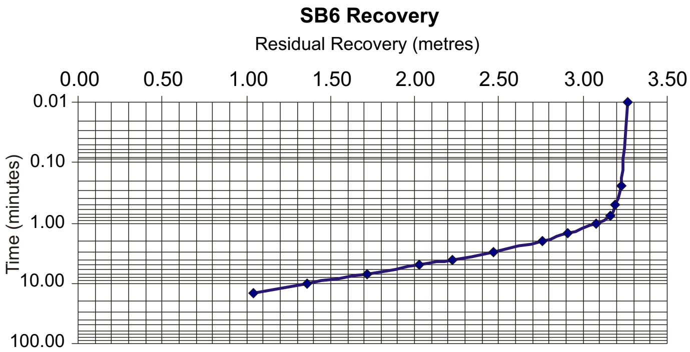


SB6

Starting standing water level (m):	0.40
Total depth (m):	3.98
Hole diameter (m):	0.05
Screen interval (m):	3.98–3.68
Screen length (m):	0.30

Recovery

DTW (m)	*Recovery* (m)	*Time* (min)	*Comments*
3.67	3.27	0.01	
3.63	3.23	0.25	
3.59	3.19	0.50	
3.56	3.16	0.75	
3.48	3.08	1.00	Grey sandy clay in water
3.31	2.91	1.50	
3.16	2.76	2.00	
2.87	2.47	3.00	
2.62	2.22	4.00	
2.43	2.03	5.00	
2.12	1.72	7.00	
1.76	1.36	10.00	
1.44	1.04	15.00	



Appendix 3

Analyses of water samples

Reg #	20020576	20020577	20020578	20020579	20020580	20020581
Site ID	Bowlings Spring	Egg Lagoon dune boundary spring	Bore-card 150	G1	G 4B	Ki-card 109
Date Sampled	15/08/2002	13/08/2002	14/08/2002	14/08/2002	14/08/2002	13/08/2002
Date Analysed	17/09/2002	17/09/2002	17/09/2002	17/09/2002	17/09/2002	17/09/2002
pH	7.7	7.9	4.9	5.9	7.5	6.1
Conductivity (µS/cm)	971	877	574	27800	29000	5420
Item (mg/l)						
Ca^{++}	64	115	39	390	470	130
Mg^{++}	24	18.5	12.5	1050	1200	130
$Fe^{++(+)}$	< 0.1	< 0.1	< 0.1	0.1	0.2	31
Al^{+++}	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	0.2
Na^{+}	130	67	49	5500	5500	940
K^{+}	6.8	5.2	17	81	86	15.5
Cl^{-}	195	125	91	10500	11500	1800
F^{-}	0.4	0.6	< 0.3	0.7	1.8	0.9
SO_4^{--}	52	90	64	2400	1250	240
NO_3^{-}	< 10.0	< 10.0	100	< 10.0	< 10.0	< 10.0
CO_3^{--}	nil	nil	nil	nil	nil	nil
HCO_3^{-}	250	300	5.9	240	710	220
TDS	599	615	448	23900	25800	3950
Permanent Hardness	55	115	145	5000	5500	750
Temporary Hardness	200	240	< 5.0	195	580	180
Alkalinity	200	240	< 5.0	195	580	180

Reg #	20020582	20020583	20020584	20020585	20020586	20020587
Site ID	L 2A	L 6	SB6	PR 2A	PR 5	Vivian Bore
Date Sampled	14/08/2002	14/08/2002	15/08/2002	14/08/2002	14/08/2002	13/08/2002
Date Analysed	17/09/2002	17/09/2002	17/09/2002	17/09/2002	17/09/2002	17/09/2002
pH	6.5	5.7	6.0	6.8	6.3	7.6
Conductivity (µS/cm)	14400	5110	13400	13900	16300	782
Item (mg/l)						
Ca^{++}	330	66	290	610	280	100
Mg^{++}	400	110	320	480	440	13.5
$Fe^{++(+)}$	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Al^{+++}	< 0.2	< 0.2	0.2	0.2	0.2	< 0.2
Na^{+}	2600	920	2400	2200	3200	55
K^{+}	18.5	14.5	39	90	29	5.8
Cl^{-}	5100	1700	4700	5000	5800	100
F^{-}	1.1	< 0.3	0.3	0.5	0.3	0.3
SO_4^{--}	820	280	680	790	1150	23
NO_3^{-}	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	25
CO_3^{--}	nil	nil	nil	nil	nil	nil
HCO_3^{-}	250	66	195	350	240	300
TDS	11100	3500	9620	10500	11800	547
Permanent Hardness	2300	560	1900	3200	2300	68
Temporary Hardness	210	54	160	290	200	240
Alkalinity	210	54	160	290	200	240

Reg #	20020588	20020589	20020590	20020591	20020592	20020593
Site ID	W 1	W 2	W 3	W 4	W 7	W 8
Date Sampled	13/08/2002	13/08/2002	13/08/2002	13/08/2002	13/08/2002	13/08/2002
Date Analysed	17/09/2002	17/09/2002	17/09/2002	17/09/2002	17/09/2002	17/09/2002
pH	7.0	7.3	7.5	6.9	7.7	7.5
Conductivity (µS/cm)	2060	1660	1560	1570	1780	1430
Item (mg/l)						
Ca^{++}	220	135	140	105	27	38
Mg^{++}	36	33	48	48	18	19
$Fe^{++(+)}$	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Al^{+++}	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Na^{+}	130	170	165	160	370	250
K^{+}	68	73	21	17	6	10.5
Cl^{-}	320	290	320	290	320	250
F^{-}	0.4	0.5	< 0.3	0.6	1.1	0.5
SO_4^{--}	26	100	110	110	58	35
NO_3^{-}	10	< 10.0	10	< 10.0	< 10.0	< 10.0
CO_3^{--}	nil	nil	nil	nil	nil	nil
HCO_3^{-}	870	520	330	410	590	490
TDS	1340	1160	1090	1050	1160	926
Permanent Hardness	nil	54	270	125	nil	nil
Temporary Hardness	700	420	270	330	145	175
Alkalinity	720	420	270	330	480	400

Reg #	20020594	20020595	20020596	20020597	20020598	20020599
Site ID	SB 2	SB 4	Bore-card 119	Bore-card 136	Tuffa Terraces	Wickham Springs
Date Sampled	15/08/2002	15/08/2002	15/08/2002	15/08/2002	16/08/2002	16/08/2002
Date Analysed	17/09/2002	17/09/2002	17/09/2002	17/09/2002	17/09/2002	17/09/2002
pH	5.0	5.4	4.9	4.3	7.8	7.5
Conductivity (µS/cm)	832	11200	171	733	892	1730
Item (mg/l)						
Ca^{++}	29	125	2.9	14.5	100	120
Mg^{++}	18.5	260	3.6	18	15.5	39
$Fe^{++(+)}$	0.4	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Al^{+++}	1.6	< 0.2	< 0.2	1	< 0.2	< 0.2
Na^{+}	105	2300	27	82	82	250
K^{+}	55	48	2	46	3.5	11
Cl^{-}	210	3900	48	175	155	430
F^{-}	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	0.5
SO_4^{--}	63	630	6.6	40	20	64
NO_3^{-}	10	< 10.0	< 10.0	50	< 10.0	< 10.0
CO_3^{--}	nil	nil	nil	nil	nil	nil
HCO_3^{-}	< 5.0	23	< 5.0	nil	310	330
TDS	805	7840	104	464	577	1090
Permanent Hardness	160	1350	21	115	64	190
Temporary Hardness	< 5.0	18.5	< 5.0	nil	250	270
Alkalinity	< 5.0	18.5	< 5.0	nil	250	270

Analyses by L. M. Hay, Senior Chemist, Mineral Resources Tasmania