TECHNICAL REPORT

FAR NORTH TOWN WATER SUPPLIES—HAWKER AND PARACHILNA, SOUTH AUSTRALIA

2011/25

Government of South Australia
Department for Water

FAR NORTH TOWN WATER SUPPLIES—HAWKER AND PARACHILNA, SOUTH AUSTRALIA

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Technical Report DFW 2011/25

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FOREWORD

South Australia's Department for Water leads the management of our most valuable resource—water.

Water is fundamental to our health, our way of life and our environment. It underpins growth in population and our economy—and these are critical to South Australia's future prosperity.

High quality science and monitoring of our State's natural water resources is central to the work that we do. This will ensure we have a better understanding of our surface and groundwater resources so that there is sustainable allocation of water between communities, industry and the environment.

Department for Water scientific and technical staff continue to expand their knowledge of our water resources through undertaking investigations, technical reviews and resource modelling.

Scott Ashby
CHIEF EXECUTIVE
DEPARTMENT FOR WATER

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1. INTRODUCTION

In late 2010, the Department for Water (DFW) was approached by the South Australian Water Corporation (SA Water) to drill and complete three production wells for the townships of Hawker and Parachilna in the Northern Flinders Ranges region of South Australia (Fig. 1).

These new wells are to be used to supplement the existing town water supplies for both townships. Of the two wells drilled at Hawker, one is required as a replacement of an existing production well while the other will supplement the total Hawker town water supply. The new well at Parachilna is also required for supplementary supply.

Kangarilla Drilling Pty. Ltd., based in McLaren Vale, was contracted to drill and construct the three new wells. Drilling commenced in mid-March 2011 and was completed seven weeks later (May 2011).

DFW Groundwater Technical Services (Walkley Heights) conducted pumping tests in May–June 2011.

1.1. HAWKER TOWN WATER SUPPLY

Hawker is located approximately 370 kilometres north of Adelaide and is reliant on groundwater from fractured rock aquifers for its town water supply. Prior to the commencement of this project, there were two production wells in use: Hawker TWS 1 and Hawker TWS 2.

The groundwater salinity (TDS) in the vicinity of Hawker TWS 1 is approximately 2000–2500 mg/L.

Current pumping rates from Hawker TWS 1 are approximately 8 L/s. While the well is capable of producing larger supplies, the pumping rate is limited by the pipeline infrastructure.

SA Water require two new production wells to be drilled and constructed. Hawker TWS 3 is a replacement well and drilled adjacent to (within 5–10 m) Hawker TWS 1. Hawker TWS 4 is a supplementary supply well drilled in a new location some 170 m east of Hawker TWS 1 and Hawker TWS 3 (Fig. 2).

Details of the Hawker town water supply wells (including new wells) are provided in Table 1.

Table 1. Hawker town water supply well details

Well name	Unit number	Drill date	Depth (m)	Obs date	DTW (m)	Obs date	TDS (mg/L)	Obs date	Yield (L/s)
Hawker TWS 1	6534-141	3 Oct 1963	110.64	30 Mar 2011	23.20	21 Nov 2001	2165	3 Oct 1963	6.31
Hawker TWS 2	6534-146	15 Sep 1972	93.50	17 Mar 2009	24.50	23 Nov 2001	2574	15 Sep 1972	4.55
Hawker TWS 3	6534-340	31 Mar 2011	150.00	28 Mar 2011	24.00	28 May 2011	2347	28 May 2011	15.00
Hawker TWS 4	6534-341	6 May 2011	177.00	6 May 2011	24.00	10 Jun 2011	3552	10 Jun 2011	15.00

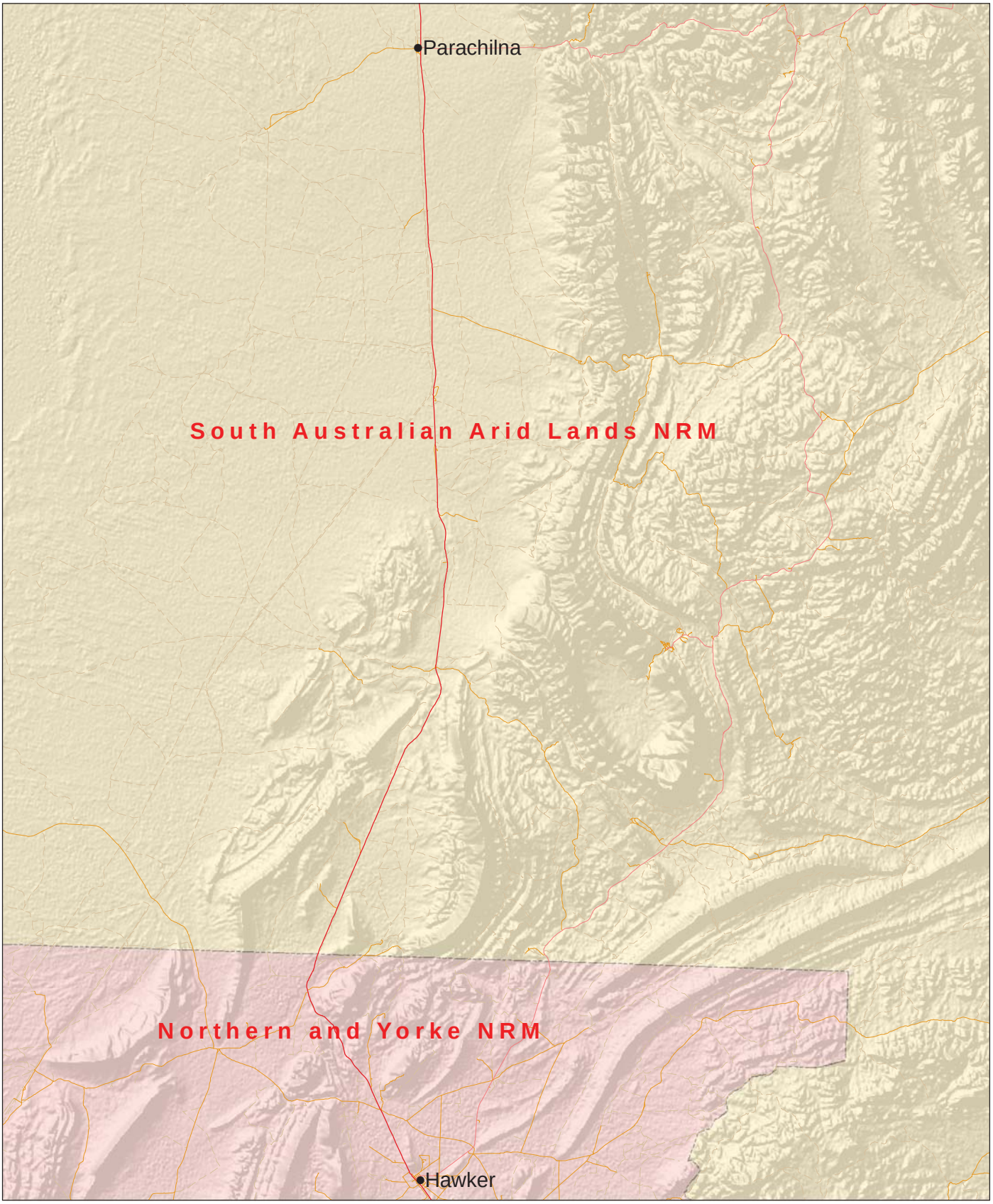


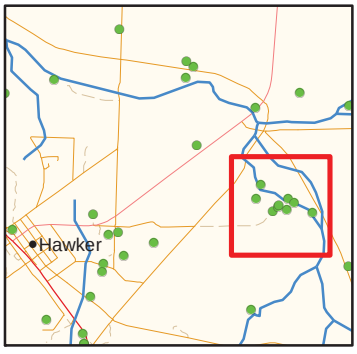
Figure 1. Location of the Hawker and Parachilna townships

Town
New Drillhole
Existing Drillhole
Primary Road
Secondary Road
Minor Road
Track

N

0 100 200

Meters



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Map Projection: Lambert Conformal Conic
Map Datum: Geocentric Datum of Australia 1994
Date: April 2011

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Figure 2. Site location for Hawker TWS 3 and Hawker TWS 4

1.2. PARACHILNA TOWN WATER SUPPLY

Parachilna is located approximately 460 kilometres north of Adelaide and is reliant on groundwater from a confined sedimentary aquifer system for its town water supply. The town primarily relies on water sourced from Parachilna TWS 1 which has provided approximately 100% of the demand since 2005 with salinity (TDS) of approximately 900 mg/L. This supply is used as a potable supply. Prior to 2005 the main source of water was from a natural spring east of the township (Fig. 3).

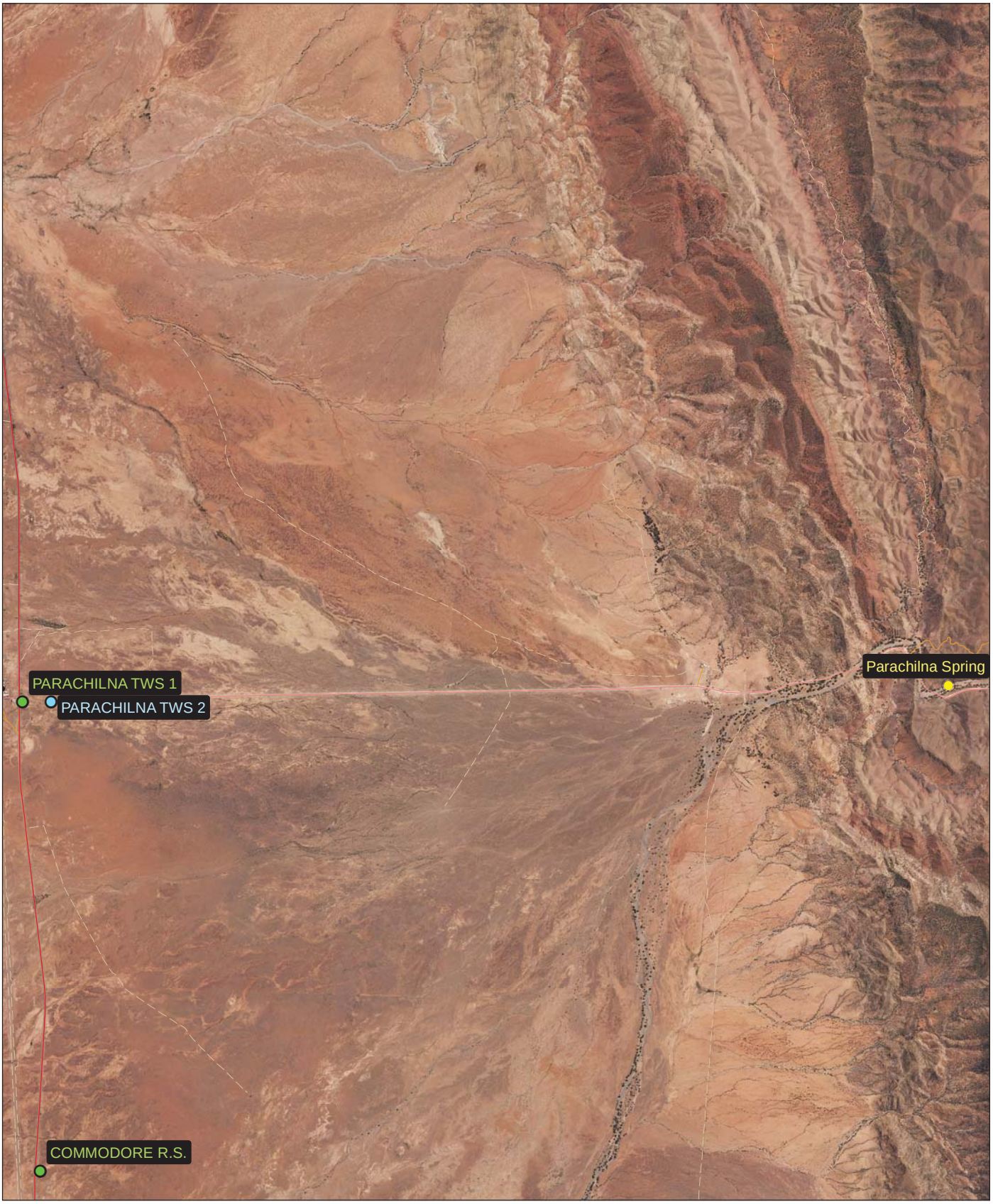
The current pumping rate from Parachilna TWS 1 is low at approximately 1.5 L/s, which is limited by the amount of available drawdown in the well with the pump positioned approximately 1.5 m below the standing water level.

To comply with strategic targets of securing quality drinking water to meet future demand, SA Water resolved to drill a new well (Parachilna TWS 2) 350 m away (Fig. 4) from the existing well (Parachilna TWS 1). This distance was close enough to be confident of obtaining a similar yield, yet far enough away to keep the drawdown experienced by Parachilna TWS 1 to a minimum.

Details of the town water supply wells (including the new well) are given in Table 2.

Table 2. Parachilna town water supply well details

Well name	Unit number	Drill date	Depth (m)	Obs date	DTW (m)	Obs date	TDS (mg/L)	Obs date	Yield (L/s)
Parachilna TWS 1	6535-146	1 Oct 2005	72.50	1 Oct 2005	61.58	1 Oct 2005	882	1 Oct 2005	2.0
Parachilna TWS 2	6535-170	21 Apr 2011	83.00	21 Apr 2011	63.54	15 May 2011	856	15 May 2011	5.0

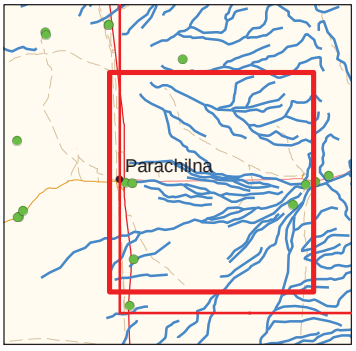


Town
New Drillhole
Existing Drillhole
Parachilna Spring
Primary Road
Secondary Road
Minor Road
Track

N

0 1 2 3 4 5

Kilometres



Produced by: Information Unit - GIS Services
Map Projection: Lambert Conformal Conic
Map Datum: Geocentric Datum of Australia 1994
Date: April 2011

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Figure 3. Site location for Parachilna Spring

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Town
New Drillhole
Existing Drillhole
Primary Road
Secondary Road
Minor Road
Track

N

0 50 100 150

Meters

Produced by: Information Unit - GIS Services
Map Projection: Lambert Conformal Conic
Map Datum: Geocentric Datum of Australia 1994
Date: April 2011

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Figure 4. Site location for Parachilna TWS 2

2. WELL DESIGN AND CONSTRUCTION

Kangarilla Drilling Pty. Ltd. was engaged by DFW to drill and construct the production wells. Two rigs were used for the project (one for Hawker and another for Parachilna) due project timeframes. The drilling rigs employed for the drilling operations were both Ingersoll Rand TH60. These rigs are capable of rotary air and rotary mud methods of drilling.

2.1. HAWKER TWS 3 (UNIT NO. 6534-340)

Hawker TWS 3 was drilled as a production well under permit number 199606 (unit no. 6534-340) and was completed on 31 March 2011. The site location is given in Figure 2, with the well construction details given in Figure 5.

The site of Hawker TWS 3 was chosen by SA Water Hydrogeologists, taking into consideration the following factors:

- A site within 5–10 m of the existing production well (Hawker TWS 1), to intercept the same geological unit and obtain a similar groundwater supply with an acceptable salinity and yield
- Rig access, and proximity to power and the existing pipeline infrastructure.

On instructions from SA Water to reduce construction costs, the well design for Hawker TWS 3 was based on that of Hawker TWS 1, with savings made in areas such as materials, geophysics and standby time. However provision was made for a deeper well design to provide an increased capacity of the well hydraulics.

Hawker TWS 3 was drilled using a combination of drilling techniques. The initial 70 m used mud rotary, at which strata samples indicated competent fractured rock, with the remaining 70–150 m using air.

Final design of Hawker TWS 3 (Fig. 5) was based on information gathered during drilling. The well was drilled and constructed according to the following steps:

- The pilot drillhole was initially drilled to 70 m using a 203 mm (8 in) bit.
- The top 6 m of the drillhole was reamed to 406 mm (16 in) to fit the 355 mm (14 in) surface control casing
- The pilot drillhole was reamed to 70 m using a 343 mm (13.5 in) reamer.
- A Class 12 PVC (253 mm ID) casing string was run into the drillhole.
- The casing was pressure cemented to the surface through the drill string and a shoe was cemented at 70 m.
- Once the cement set (left overnight) the pilot drillhole was drilled on to 150 m (total depth) using a 152 mm (6 in) bit.
- The pilot drillhole was reamed to 150 m using a 251 mm ($9\frac{7}{8}$ in) hammer reamer.
- A second reamed pass using a pick reamer was introduced to smooth the drillhole since clearance between the reamed drillhole and outer diameter (OD) of slotted casing was ~13 mm.
- A Class 12 PVC (203 mm ID) slotted casing string (bells removed and threaded) was run into the drillhole using a J-latch.

Figure 5 indicates the lithological sequence encountered during drilling. Strata samples were taken every 2 m. On-site groundwater salinity and yield were recorded after every rod change where possible (Table 3).

These measurements were important as they would ultimately determine whether the well was fit for purpose, therefore successful, and help determine the final well construction design.

The final depth of the well was measured at 150 m. This resulted in a production zone within a grey limestone unit from 70–150 m.

A number of fractures were intersected during drilling (Table 3). The driller indicated the first water cut was intersected at 75 m. Water cuts were also recorded along with associated groundwater yield and salinity measurements (Table 3). These measurements assisted in the design of the well and location of the production zone.

Table 3. Water cut measured data for Hawker TWS 3

Water cut (m BNS)	Air-lift yield (L/s)	TDS (mg/L)
75	n/a	2194
80	5.5	2199
101	7.5	2256
124	9.0	2262
(?) 150	12.0-15.0	2323

The groundwater salinity (TDS) measured on-site slightly increased to ~2323 mg/L at 150 m.

A final depth to water of 24 m, an airlift yield of ~15 L/s, and salinity of 2323 mg/L were recorded. The depth to water indicates that the fractures intersected during drilling are under pressure, therefore the fractured rock aquifer is essentially a confined aquifer system.

Prior to development, a mixture of chlorine and water was discharged into the production zone and left for 0.5 h to sterilise the well. Development of the well was achieved through airlifting from a depth of 150 m until the groundwater produced from the well was clear. Airlifting was controlled at 15 L/s and full development was achieved after 60 min.

The Well Construction Report (Schedule 8) for Hawker TWS 3 is provided in Appendix A and a complete water well log (including lithological description) is provided in Appendix B.

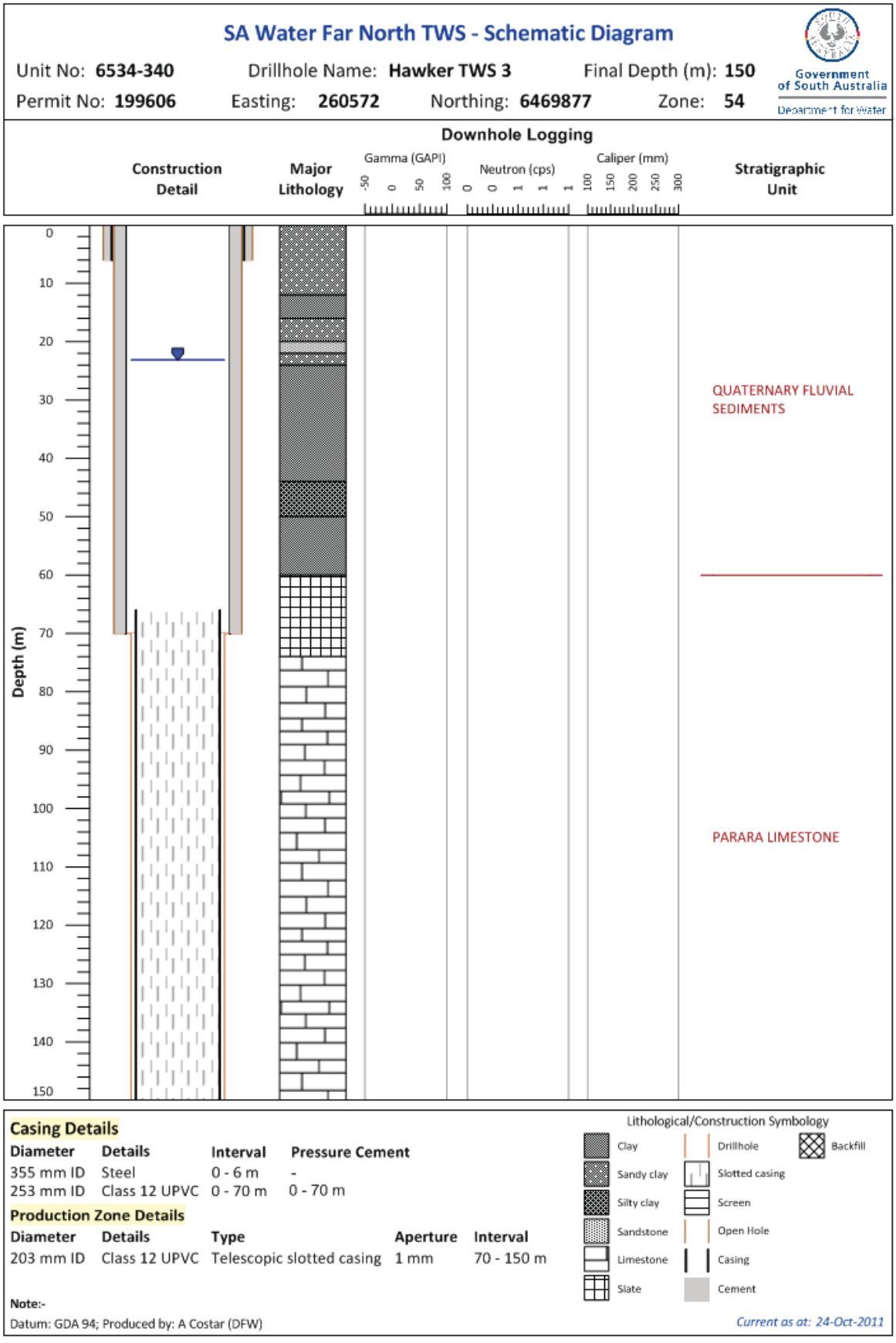


Figure 5. Well construction diagram and lithological sequence for Hawker TWS 3

The wellhead design for Hawker TWS 3 was completed as detailed in Appendix D and cemented in place at the surface.

2.2. HAWKER TWS 4 (UNIT NO. 6534-341)

Hawker TWS 4 was drilled as a production well under permit number 199607 (unit no. 6534-341) and was completed on 6 May 2011. The site location is given in Figure 2, with the well construction details given in Figure 6.

The site of Hawker TWS 4 was chosen by SA Water Hydrogeologists, taking into consideration the following factors:

- A site within the same lithology as the existing Hawker TWS 1 well, to obtain a similar groundwater supply with an acceptable salinity and yield but far enough away to avoid major well interference
- Rig access, and proximity to power and the existing pipeline infrastructure.

On instructions from SA Water to reduce construction costs, the well design for Hawker TWS 4 was based on that of Hawker TWS 1, with savings made in areas such as materials, geophysics and standby time. However provision was made for a deeper well design to provide an increased capacity of the well hydraulics and the relatively unknown nature of the formation depths since the closest well was Hawker TWS 1 and the recently drilled Hawker TWS 3 some 170 m away.

In a similar way to Hawker TWS 3, Hawker TWS 4 was drilled using a combination of drilling techniques. The initial 97.5 m used mud rotary, at which strata samples indicated competent fractured rock, with the remaining 97.5–180 m using air.

Final design of Hawker TWS 4 (Fig. 6) was based on information gathered during drilling. The well was drilled and constructed according to the following steps:

- The pilot drillhole was initially drilled to 97.5 m using a 203 mm (8 in) bit.
- The top 6 m of the drillhole was reamed to 406 mm (16 in) to fit the 355 mm (14 in) surface control casing.
- The pilot drillhole was reamed to 97.5 m using a 343 mm (13.5 in) reamer.
- A Class 12 PVC (253 mm ID) casing string was run into the drillhole.
- The casing was pressure cemented to the surface through the drill string and a shoe was cemented at 97.5 m.
- Once the cement set (left overnight) the pilot drillhole was drilled on to 179 m (total depth) using a 152 mm (6 in) bit.
- The pilot drillhole was reamed to 179 m using a 251 mm ($9\frac{7}{8}$ in) hammer reamer.
- A second reamed pass using a pick reamer was introduced to smooth the drillhole since clearance between the reamed drillhole and OD of slotted casing was ~13 mm.

Figure 6 indicates the lithological sequence encountered during drilling. Strata samples were taken every 2 m. On-site groundwater salinity and yield were recorded after every rod change where possible (Table 4).

These measurements were important as they would ultimately determine whether the well was fit for purpose, therefore successful, and help determine the final well construction design.

There were a number of challenges with drilling this site.

A first attempt at drilling this well was abandoned and backfilled due to a drill bit being lost in the drillhole at 99 m during the reaming process (see Appendix A for the Well Construction Report).

The rig was moved approximately 4 m south and a second attempt was made. During this attempt the pick reamer hit refusal at 179 m during the second reamer pass and upon tripping out of the drillhole it was discovered that the reamer had been lost during the reaming process.

Since it was not clear where the reamer was located and to what depth the reamer managed to smooth the drillhole to facilitate lowering the slotted casing into the drillhole, the following actions where taken for efficiency:

- A bailer was run to depth which was found to be 177.5 m (indicating that the reamer was located at 177.5–179 m).
- To sterilise the well, a mixture of chlorine and water was discharged into the well screen and left for 0.5 h. Development of the well was achieved through airlifting from a depth of 175.5 m until the groundwater produced from the well was clear (2 h).
- A grout plug was set from 177–179 m through the drill string to bury the reamer.
- A tool was developed to the same outer diameter of the slotted casing (OD 225 mm) and run down the drillhole to depth to assess smoothness of drillhole (the tool confirmed cement plug top at 177 m).
- Finally the Class 12 PVC (203 mm ID) slotted casing string (bells removed and threaded) was run into the drillhole using a J-latch.

The final depth of the well was measured at 177 m. This resulted in a production zone within the Parara Limestone from 97.5–177 m.

A number of fractures were intersected during drilling (Table 4). The driller indicated the first water cut was intersected at 126 m. Water cuts were also recorded along with associated groundwater yield and salinity measurements (Table 4). These measurements assisted in the design of the well and location of the production zone.

Table 4. Water cut measured data for Hawker TWS 4

Water cut (m BNS)	Air-lift yield (L/s)	TDS (mg/L)
126	1.5	3361
161	3.0	3379
(?) 176	5.0	3460

The groundwater salinity (TDS) measured on-site slightly increased to ~3460 mg/L at 180 m.

A final depth to water of 24 m, an airlift yield of ~7.5 L/s, and salinity of 3460 mg/L were recorded. The depth to water indicates that the fractures intersected during drilling are under pressure, therefore the fractured rock aquifer is essentially a confined aquifer system.

The Well Construction Report (Schedule 8) for Hawker TWS 4 is provided in Appendix A and a complete water well log (including lithological description) is provided in Appendix B.

The wellhead design for Hawker TWS 4 was completed as detailed in Appendix D and cemented in place at the surface.

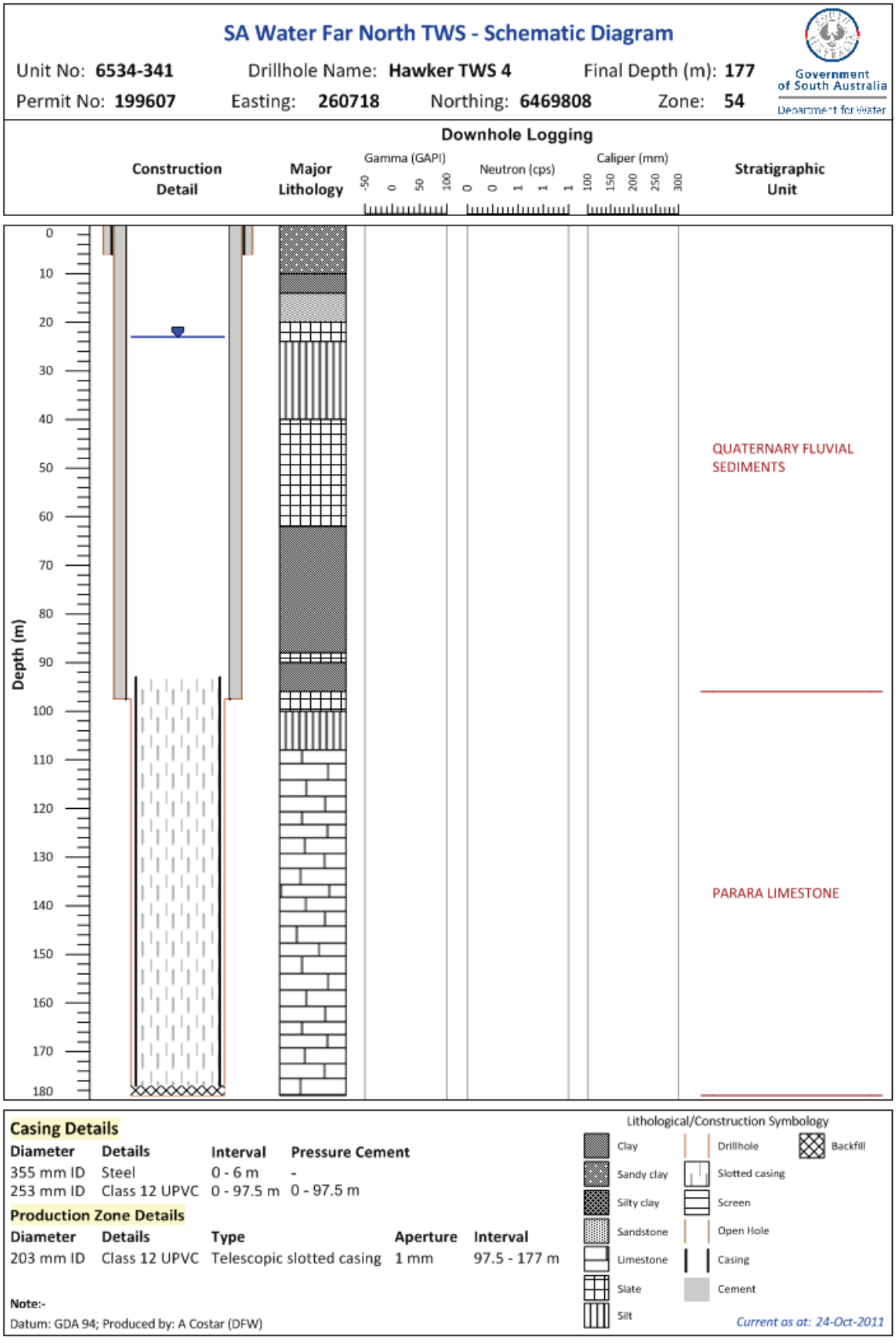


Figure 6. Construction diagram and lithological sequence for Hawker TWS 4

2.3. PARACHILNA TWS 2 (UNIT NO. 6535-170)

Parachilna TWS 2 was drilled as a production well under permit number 200217 (unit no. 6535-170) and was completed on 21 April 2011. The site location is given in Figure 4, with the well construction details given in Figure 7.

The site of Parachilna TWS 2 was chosen by SA Water Hydrogeologists, taking into consideration the following factors:

- A site within the same lithology as the existing Parachilna TWS 1 well, to obtain a similar groundwater supply with an acceptable salinity and yield but far enough away to avoid major well interference
- Rig access, and proximity to power and the existing pipeline infrastructure.

Construction of Parachilna TWS 2 and the nature of the formation in this area was largely based on the existing production well drilled in 2005; Parachilna TWS 1. However as construction details for the existing well were limited and final design not ideal due to limited capacity of the well to supply water, drilling of Parachilna TWS 2 well was considered exploratory.

For this reason, and the uncertainty regarding formation stability, a pilot drillhole was drilled using mud rotary to a total depth of 120 m using a 203 mm (8 in) diameter bit.

Since the drilling method employed was mud rather than air (due to anticipated formation instability), design of the final well was reliant upon strata samples that were taken every 2 m and downhole geophysical logging.

2.3.1. DOWNHOLE LOGGING

DFW Groundwater Technical Services (Glenside) ran a selection of downhole geophysical logging tools on the drillhole. The downhole instrumentation involved:

- gamma probe
- neutron probe
- density probe
- caliper.

A small selection of downhole instrumentation was run to the bottom of the drillhole and back up to surface due to time and budgetary constraints.

The data from each of these tools were able to be viewed in real-time, and post-processing was not necessary (Fig. 7). The neutron log was the most useful tool which indicated locations of the more permeable layers along the drillhole length.

The downhole logging data (as well as the strata samples) assisted in identifying changes in lithology, which was important information for setting the casing depth and assisted in the location of the production zone of the well (Table 5).

Table 5. Permeable zones as delineated by geophysical logging for Parachilna TWS 2

Permeable zones (m BNS)	Air-lift yield (L/s)	TDS (mg/L)
63–68	N/A	N/A
74.5–77	N/A	N/A
81.6–83.6	N/A	N/A
97.6–101.2	N/A	N/A
110.8–114	N/A	N/A

2.3.2. WELL DESIGN AND CONSTRUCTION

Final design of Parachilna TWS 2 (Fig. 7) was based on information gathered during drilling and analysis of the downhole geophysical logging data. The well was drilled and constructed according to the following steps:

- The pilot drillhole was drilled to 120 m using a 203 mm (8 in) bit. It should be noted that gravels and pebbles were encountered to a depth of ~24 m which required driving an 8 in diameter temporary steel casing while drilling.
- Downhole geophysics revealed two gravel zones of interest 63–68 m and 74.5–77 m.
- A grout plug was set from 90–120 m to close off the bottom section of the drillhole.
- The top 24 m of the drillhole was reamed to 343 mm (13.5 in) to fit the 304.8 mm (12 in) surface control casing.
- The pilot drillhole was reamed to 62 m using a 279 mm (11 in) reamer.
- A Class 12 PVC (203 mm ID) casing string was run into the drillhole.
- The casing was pressure cemented to the surface through the drill string and a shoe was cemented at 62 m.
- Once the cement set (left overnight) the drillhole was re-opened to 90 m using a 203 mm (8 in) bit.
- Gravel was set from 83–90 m.
- A 316 stainless steel wire-wound screen (156 mm ID) string with Figure-K Packer. The screen was designed to the following specifications:
    - A 6 m length stainless steel screen with 1 mm aperture set from 62–68 m, screen taped from 62–63 m, producing a production zone 63–68 m
    - A 6 m length stainless steel screen with 0.35 mm aperture set from 68–74 m, screen taped the entire length, producing no production zone
    - A 6 m length stainless steel screen with 0.65 mm aperture set from 74–80 m, screen taped 74–74.5 and 77–80 m, producing a production zone 74.5–77 m
    - A 3 m length stainless steel blank set from 80–83 m.

It should be noted that a basic sieve analysis was conducted on-site since different screen aperture sizes were available for design and configuration of the production zone. Samples of the strata were collected over the two production zones (62–68 m and 74.5–77 m). The samples were dried, weighed and shaken through a nest of sieves so that an analysis of grain size for the formation could be determined. Three brass sieves with aperture sizes 1 mm, 0.6 mm and 0.355 mm with a bottom tray and lid were used. Each sieve filtered out a particular grain size which was then weighed (Appendix C).

The final depth of the well was measured at ~82.3 m (i.e. not 83 m) which may have been due to silting up of the drillhole. This would have resulted in a production zone within the gravel unit from 62.3–67.3 m and 73.8–76.3 m.

The complex well design was implemented due to the variability in sediment particle size. The design incorporates:

- Two production zone sections to maximise available drawdown
- A 6 m sump to catch debris that may fall in from production zone.

Figure 7 indicates the lithological sequence encountered during drilling. Strata samples were taken every 2 m.

These measurements were important as they would ultimately determine whether the well was fit for purpose, therefore successful, and (along with the downhole logging) help determine the final well construction design.

Prior to development, a mixture of chlorine and water was discharged into the well screen and left in the well for 1.5 h. Development of the well was achieved through airlifting from a depth of ~82 m until the groundwater produced from the well was clear. Airlifting was controlled at 1.5 L/s and full development was achieved after 5 hours.

A final depth to water of 63.5 m, an airlift yield of ~1.5 L/s, and salinity of ~1024 mg/L were recorded.

Figure 7 illustrates the final well construction for Parachilna TWS 2 and the stratigraphic sequence encountered during drilling.

The Well Construction Report (Schedule 8) for Parachilna TWS 2 is provided in Appendix A and a complete water well log (including lithological description) is provided in Appendix B.

The wellhead design for Parachilna TWS 2 was completed as detailed in Appendix D and cemented in place at the surface.

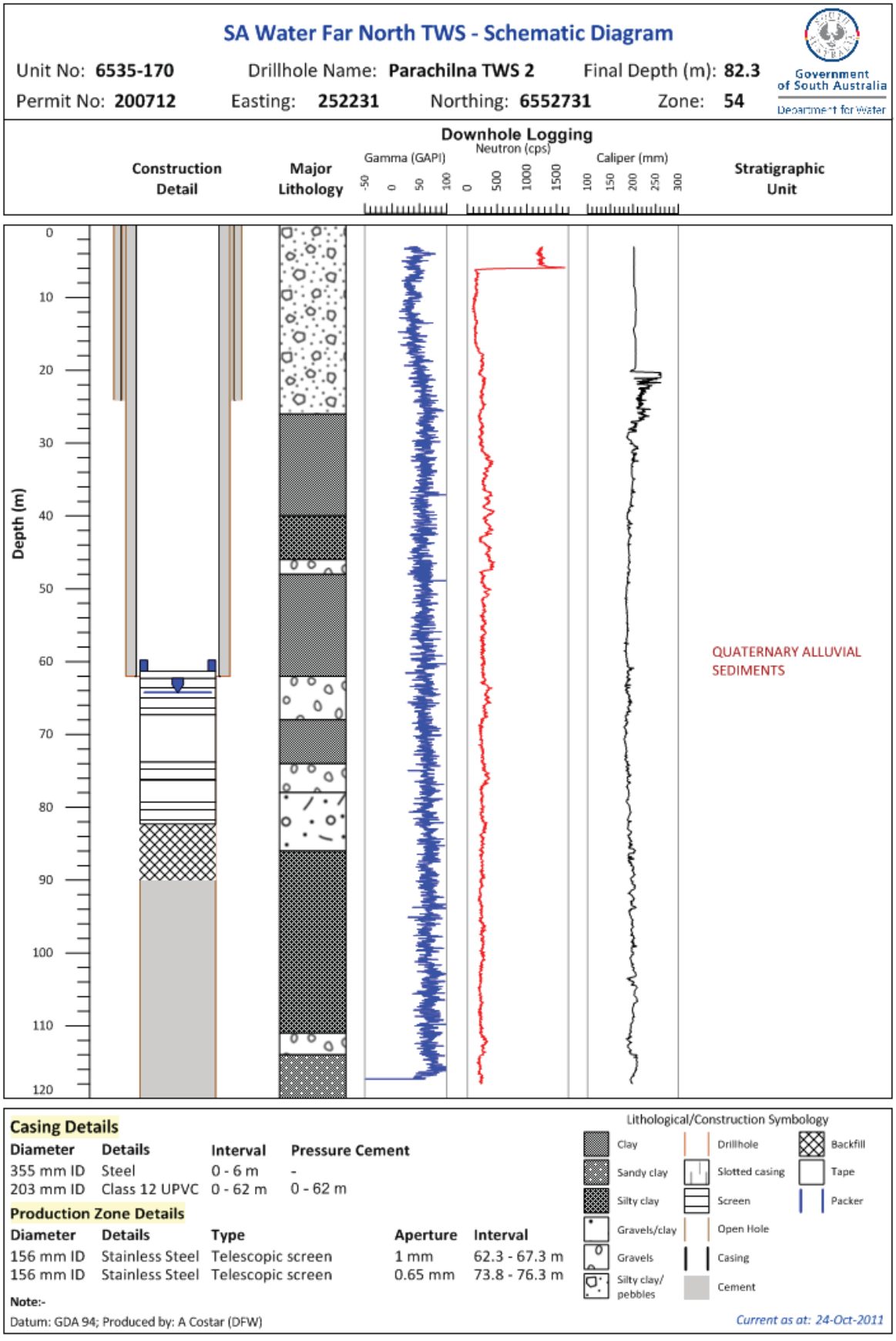


Figure 7. Construction diagram and lithological sequence for Parachilna TWS 2

3. PUMPING TESTS

3.1. PUMPING TEST DESIGN

A pumping test (aquifer test) is conducted by pumping a well and observing the aquifer 'response' (drawdown) in the well and/or neighbouring observation wells. Pumping tests are carried out on wells to determine one or more of the following:

- The aquifer and aquitard hydraulic characteristics used to determine the ability of the aquifer to store and transmit water
- The existence and location of sub-surface hydraulic boundaries which may affect, beneficially or adversely, the long-term pumping performance of the well
- The long-term pumping rate for the well
- The design efficiency of the well
- The performance of the groundwater basin.

In this case, SA Water required a pumping test on the new supply well to determine:

- The maximum sustainable pumping rate
- Suitable depth to position the pump
- Whether dewatering of the aquifer is occurring.

The pumping test conducted on Hawker TWS 3, Hawker TWS 4 and Parachilna TWS 2 consisted of a step drawdown test and a constant rate discharge test.

3.1.1. STEP DRAWDOWN TEST

The step drawdown test usually consists of three or more steps at increasing discharge rates, with the rate kept constant throughout each step.

The objective of step drawdown testing is to determine the well equation *(Equation 1)* which reflects the efficiency of the well design and relates to drawdown, discharge rate and time. This equation (ideally) allows prediction of the hydraulic performance of production wells for a design pumping rate, and generation of yield drawdown curves for any given time (Hazel 1975).

$$s(t) = (a\,Q + c\,Q^2) + b\log(t)\,Q \qquad \textbf{Equation (1)}$$

Where,

s(t)	=	drawdown (m)
Q	=	pumping rate (m^3/min)
t	=	time (mins)
a	=	constant related to well loss for laminar flow
c	=	constant related to well loss for turbulent flow
b	=	constant related to aquifer loss for laminar flow

and,

Well loss (m)	=	$a\,Q + c\,Q^2$
Aquifer loss (m)	=	$b\log(t)\,Q$
Well efficiency	=	(well loss/s(t)) x 100

The well equation allows determination of the maximum sustainable pumping rate of the well and consequently the selection of a suitable pumping rate for the constant rate discharge test.

3.1.2. CONSTANT RATE DISCHARGE TEST

The constant rate discharge test is conducted at a constant pumping rate for a duration commensurate with the intended use of the well. However, this is often compromised by the cost of running long-term tests.

The water level data collected from the constant rate discharge test allows determination of:

- aquifer and aquitard hydraulic characteristics
- presence of hydraulic boundaries which may have an effect on pumping sustainability
- dewatering of the aquifer system, which may have an effect on the sustainability of the well under long-term operational pumping
- neighbouring well interference.

The pumping phase should be followed by monitoring the recovery of the water levels. Ideally, recovery of the groundwater level is monitored until 95% of the drawdown has been recovered. The water level data collected during the recovery period (the residual drawdown) following the constant rate discharge test, allows determination of whether interference effects are present, such as recharge boundaries or alternatively dewatering of the aquifer:

- If no interference effects are present, the extrapolated residual drawdown line should intersect the zero residual drawdown line at $t/t1 = 1$.
- If a recharge boundary has been encountered, the line will intersect the zero residual drawdown line at a value of $t/t1 > 1$.
- If dewatering has occurred or an impermeable boundary has been encountered, the line will intersect the zero residual drawdown line at a value of $t/t1 < 1$.

Monitoring of observation wells during a pumping test provides a useful source of information in terms of understanding wider parameters of the aquifer system itself. Not only do they provide a measure of the well influence caused by the production well, the drawdown data are potentially more reliable than that measured in the pumping well because of the turbulent nature of water around a pump in the production well. Therefore observation well drawdown data can provide a more reliable measure of transmissivity of the aquifer.

In the case of the pumping test conducted at Hawker, observation well data from multiple wells were able to be collected during the test. The pumping test conducted at Parachilna contained one observation well which was monitored.

3.1.3. GROUNDWATER QUALITY TEST

Preliminary groundwater sampling for a town water supply well, in a deep confined aquifer system with a domestic application, should be tested for the following suite of chemical parameters (G Dworak and J West (SA Water) 2011, pers. comm., 5 May):

- basic chemistry: TDS, Na, Ca, Mg, K, CO3, HCO3, Cl, F, SO4, hardness and alkalinity
- pH, colour and turbidity
- nutrients: NH3, NO3, NO2, soluble P and DOC
- metals (total and soluble): Al, Cd, Sb, Ni, Cu, Zn, Pb, Cr, Mn, Fe, As, Ba, Mo, Se, Hg, B, Ag, Be, I, CN, Sn, Zn, Br and U
- radioactivity.

3.1.4. CONDUCT OF TEST

3.1.4.1. Hawker TWS 3 (Unit No. 6534-340)

The pumping tests conducted on Hawker TWS 3 consisted of a step drawdown test, constant rate discharge test and recovery test over the period 23 to 31 May 2011.

DFW Groundwater Technical Services (Walkley Heights) carried out the testing. The pump was placed approximately 100 m below the ground surface. Further development of the well was carried out initially during which pumping rates and groundwater levels were monitored. From this preliminary data, rates were selected for the step drawdown test (Table 6).

The constant rate discharge test commenced on 25 May 2011 at a discharge rate of 10 L/s for the first 48 h (2880 min) then a rate change to 15 L/s for the remaining 24 h (1440 min) of a 72 h (4320 min) pumping duration.

Recovery levels were monitored for 72 h (4320 min) after the pump was switched off.

Groundwater levels and groundwater salinity were monitored throughout the test and groundwater samples were collected for laboratory analysis (Appendix F). The manually recorded hydraulic data for both the step drawdown test and the constant rate discharge test are provided in Appendix E.

Table 6. Pumping test details for Hawker TWS 3

Test type	Test date	Step no.	Duration (min)	Flow rate (L/s)
Step drawdown	24 May 2011	1	100	5
		2	100	10
		3	100	15
		4	60	18
Constant rate discharge	25–28 May 2011	–	2880 1440	10 15
Recovery	28–31 May 2011	–	4320	0

3.1.4.2. Hawker TWS 4 (Unit No. 6534-341)

The pumping test conducted on Hawker TWS 4 consisted of a step drawdown test, constant rate discharge test and recovery test over the period 5 to 13 June 2011.

DFW Groundwater Technical Services (Walkley Heights) carried out the testing. The pump was placed approximately 100 m below the ground surface. Further development of the well was carried out initially during which pumping rates and groundwater levels were monitored. From this data, rates were selected for the step drawdown test (Table 7).

The constant rate discharge test commenced on 7 June 2011 at a discharge rate of 10 L/s for a duration of 72 h (4320 min).

Recovery levels were monitored for 72 h (4320 min) after the pump was switched off.

Groundwater levels and groundwater salinity were monitored throughout the test and groundwater samples were collected for laboratory analysis (Appendix F). The manually recorded hydraulic data for both the step drawdown test and the constant rate discharge test are provided in Appendix E.

Table 7. Pumping test details for Hawker TWS 3

Test type	Test date	Step no.	Duration (min)	Flow rate (L/s)
Step drawdown	6 June 2011	1	100	4
		2	100	8
		3	100	12
		4	100	13.5
Constant rate discharge	7–10 June 2011	–	4320	10
Recovery	10–13 June 2011	–	4320	0

3.1.4.3. Parachilna TWS 2 (Unit No. 6535-170)

The pumping test conducted on Parachilna TWS 2 consisted of a step drawdown test, constant rate discharge test and a recovery test over the period 10 to 15 May 2011.

DFW Groundwater Technical Services (Walkley Heights) carried out the testing. The pump was placed approximately 74 m below the ground surface. Further development of the well was carried out during which pumping rates and groundwater levels were monitored. From this data, rates were selected for the step drawdown test (Table 8).

The constant rate discharge test commenced on 12 May 2011 at a discharge rate of 3 L/s for a duration of 72 h (4320 min).

Full recovery of the well was achieved after only 450 min. Recovery levels were closely monitored for this period.

Groundwater levels and groundwater salinity were monitored throughout the test and groundwater samples were collected for laboratory analysis (Appendix F). The manually recorded hydraulic data for both the step drawdown test and the constant rate discharge test are provided in Appendix E.

Table 8. Pumping test details for Parachilna TWS 2

Test type	Test date	Step no.	Duration (min)	Flow rate (L/s)
Step drawdown	11 May 2011	1	100	2
		2	100	3
		3	100	4
		4	100	5
Constant rate discharge	7–10 June 2011	–	4320	3
Recovery	10–13 June 2011	–	450	0

4. PUMPING TEST RESULTS

4.1. HAWKER TWS 3 (UNIT NO. 6534-340)

4.1.1. STEP DRAWDOWN TEST

The following parameters were measured and recorded prior to the commencement of the step drawdown test conducted on Hawker TWS 3:

- Initial (non-pumping) depth to water (DTW) = ~23.2 m
- Pump depth = ~100 m
- Available drawdown (DD) = ~76.8 m.

Groundwater level measurements were recorded throughout the step drawdown test. The time-series of the drawdown levels (the difference between the initial groundwater level and the groundwater levels during the test) are shown in Figure 8.

The data from the step drawdown test and the parameters specified above were used as input for processing and analysing of the data which determines the hydraulic performance of the well (Fig. 9).

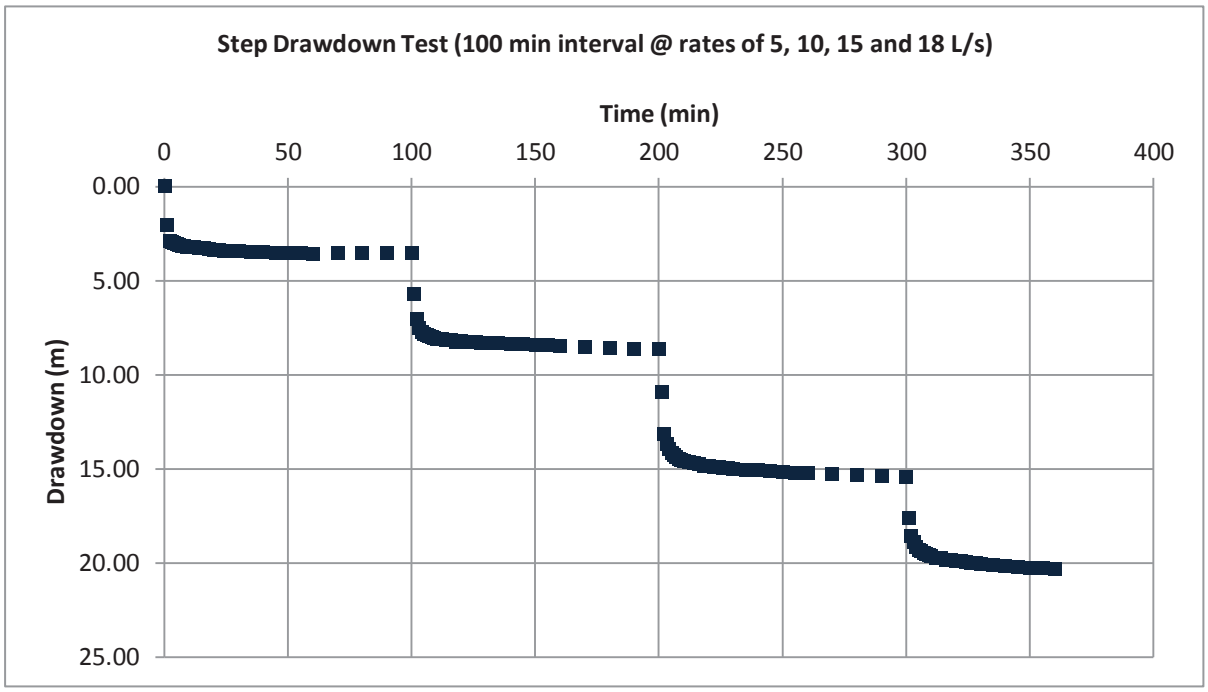
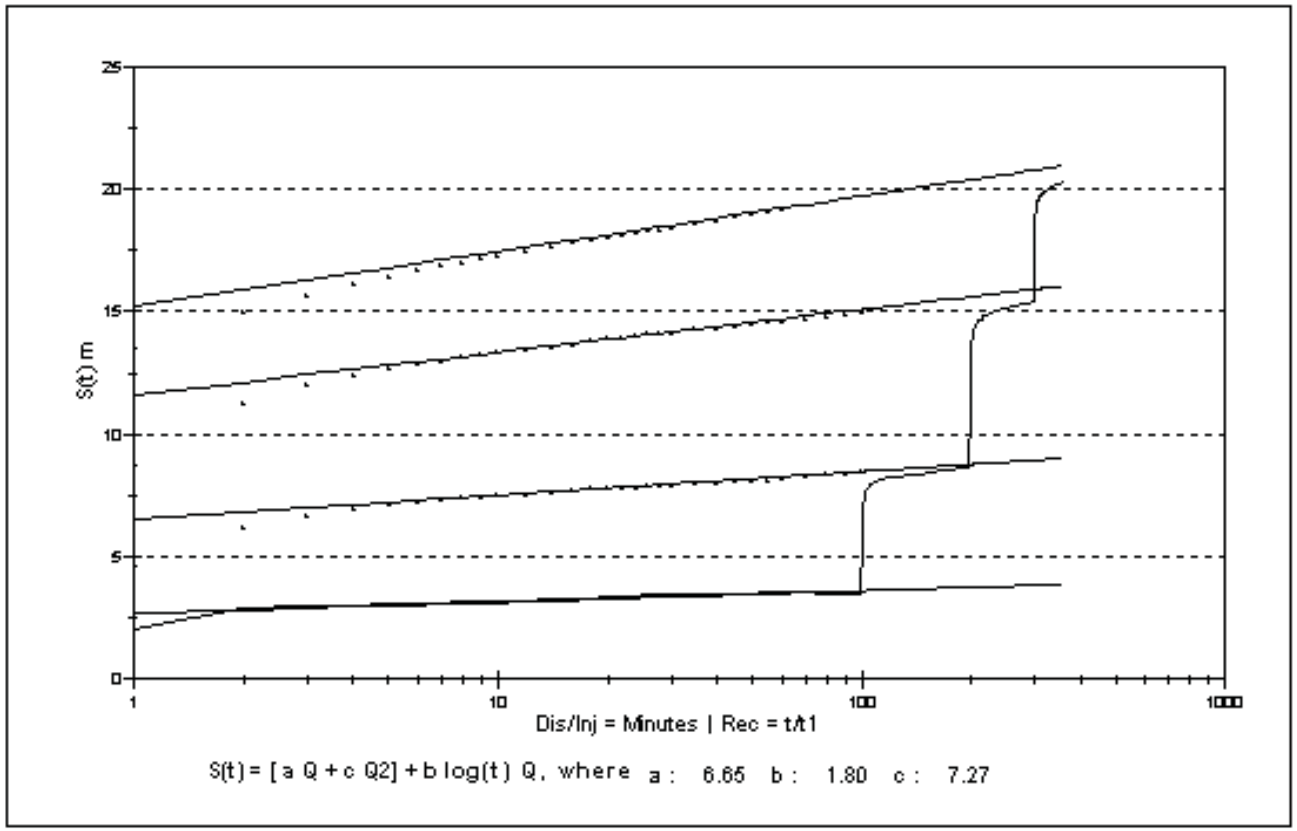
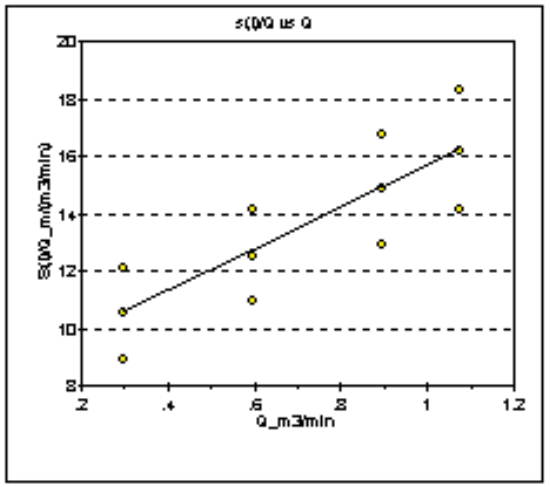
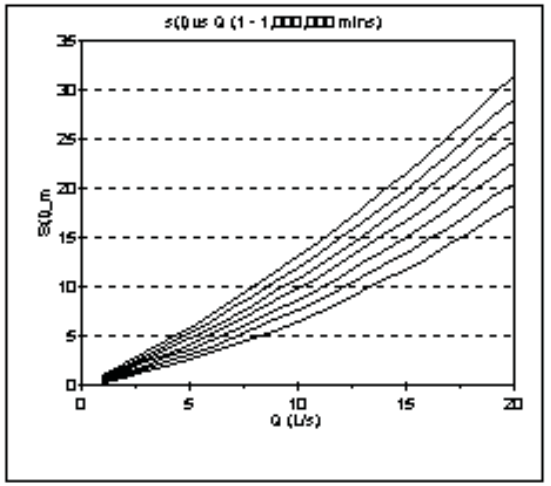


Figure 8. Step drawdown test data for Hawker TWS 3







TheStep	Q_L/s	Q_m3/min	Duration_min	SI1	SI1/Q	SI10	SI10/Q	SI100	SI100/Q	dS	dS/Q	T_m2/day
1	5.00	0.30	100	2.69	8.97	3.16	10.53	3.63	12.10	0.47	1.57	168
2	10.00	0.60	100	6.57	10.96	7.54	12.56	8.51	14.18	0.97	1.62	163
3	15.00	0.90	100	11.62	12.92	13.37	14.86	15.12	16.81	1.75	1.94	136
4	18.00	1.08	60	15.25	14.12	17.50	16.21	19.75	18.29	2.25	2.08	126

Figure 9. Step drawdown test analysis using Hazel method for Hawker TWS 3

Analysis of the step drawdown results leads to the well equation *(Equation 2)*:

$s(t) = 6.65\,Q + 7.27\,Q^2 + 1.80 \log10\,(t)\,Q$ **Equation (2)**

The well equation can also be used as a predictive tool. Table 9 tabulates well equation predictions for the drawdown in Hawker TWS 3 after 1 000 000 min (~2 y) of continuous pumping.

Table 9. Interpolated drawdown data for Hawker TWS 3

Discharge rate (L/s)	Available DD (m)	Duration (min)	Predicted DD (m)
5	76	1 000 000	~5.9
10	76	1 000 000	~13.1
15	76	1 000 000	~21.6
20	76	1 000 000	~31.4

It should be noted that the step drawdown test analysis conducted here may not be fully applicable to a fractured rock aquifer, but provides an indication of the hydraulic behaviour of the well. This is because the hydraulics of fractured rock aquifers are very complex and not well understood.

The numbers provided in Table 9 are an indication of drawdown only. They involve winter pumping conditions and do not account for seasonal groundwater fluctuations, which may result in the available drawdown being significantly reduced during summer, when rainfall (and therefore recharge to the aquifer) is at a minimum and groundwater extractions are at a maximum.

Other useful parameters that relate to well performance can be calculated using the well equation. For a discharge rate of 10 L/s and a time of 2880 min (48 h):

- The specific capacity is ~0.97 L/s/m of drawdown. This implies for every metre of drawdown the well yields 0.97 L/s.
- The well loss (aQ + cQ2) is ~6.61 m.
- The aquifer loss (b log(t) Q) is ~3.74 m. This implies that the well efficiency (well loss as a percentage of total drawdown) is ~64%.

4.1.2. CONSTANT RATE DISCHARGE TEST

Groundwater level measurements were recorded throughout the constant rate discharge test and the recovery period. The time series of drawdown, the difference between the initial groundwater level and the groundwater levels during the test and recovery period are shown in Figure 10.

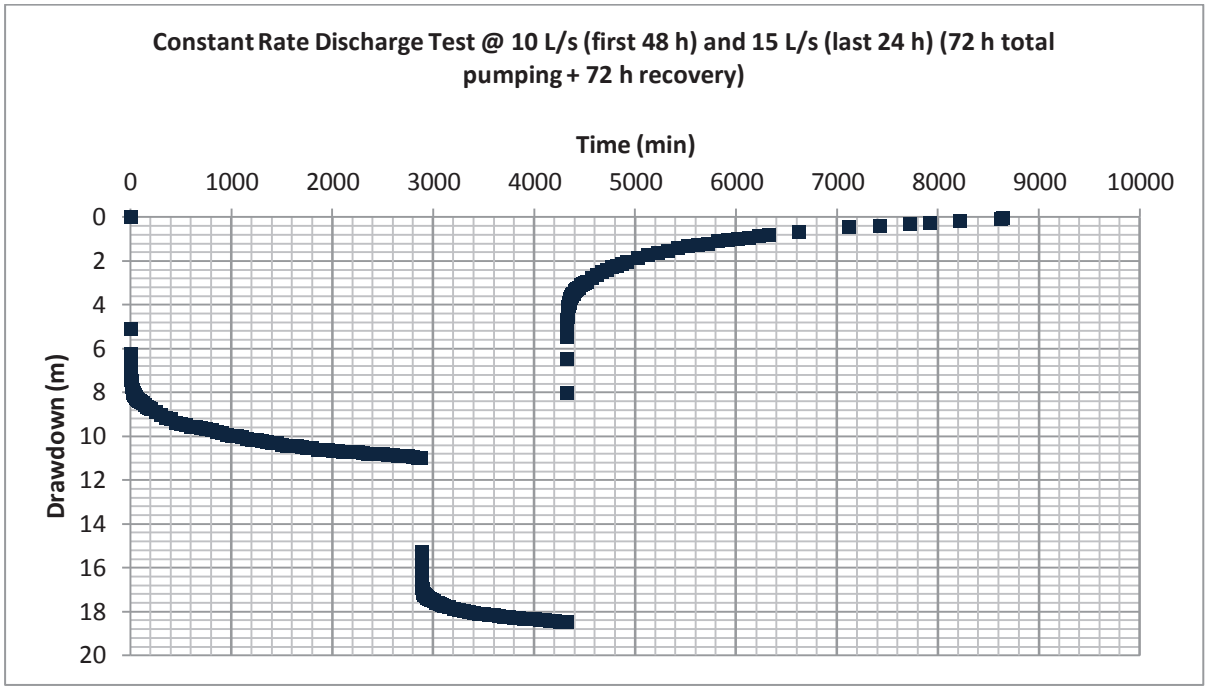


Figure 10. Constant rate discharge test data for Hawker TWS 3

Drawdown versus time and residual drawdown verses t/t_1 (where t is the time since pumping began and t_1 is the time since pumping stopped) are both given in the log-linear plot (Fig. 11).

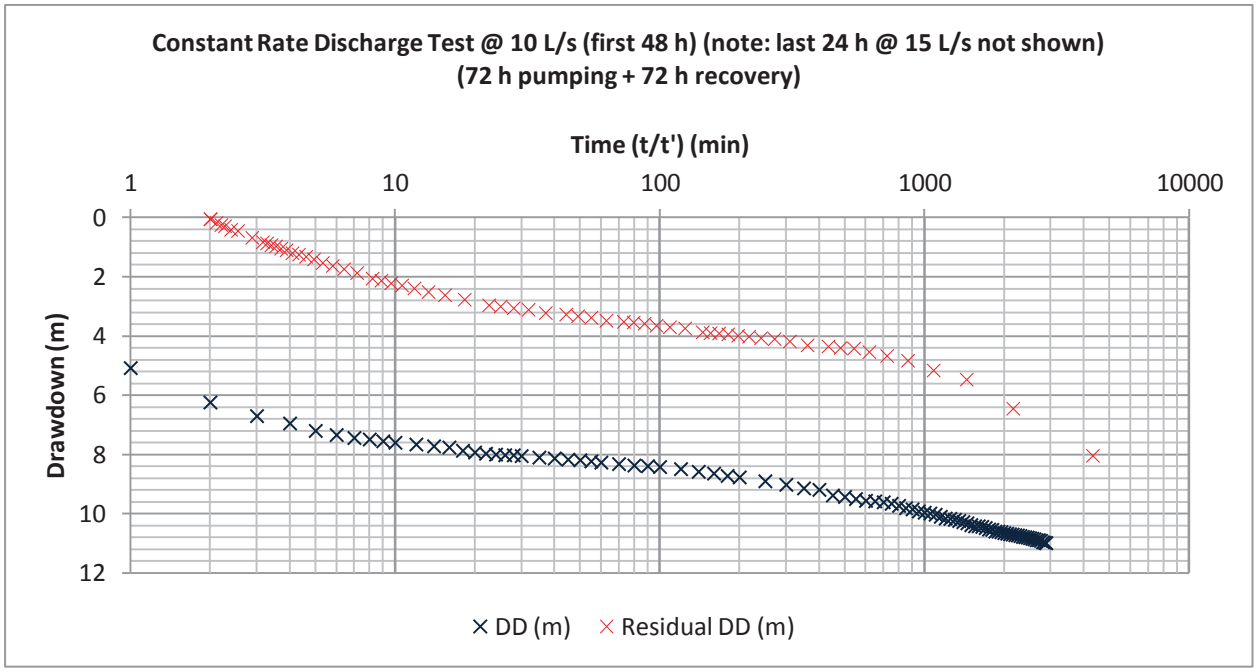


Figure 11. Log-linear plot of constant rate discharge test data and residual drawdown data for Hawker TWS 3

The following general comments can be made in relation to the constant rate discharge test:

- The drawdown data provides evidence of a possible low permeability boundary, which is indicated by the increasing drawdown at 200 min. This may have implications for the actual drawdown when the well is pumped continuously, or intermittently pumped for long periods.

- The extrapolation of the residual drawdown data indicates that intersection with the zero residual drawdown occurs at t/t1 > 1, suggesting the well has encountered a recharge boundary, or at least the aquifer is not undergoing dewatering.
- The well equation (Equation 2), slightly under-predicts the observed drawdown at the test rate of 10 L/s, predicting a value of 10.34 m after 2880 min compared to the actual measurement of 11.00 m.

A summary of aquifer drawdown recorded in the observation wells is reported in Table 10.

Table 10. Drawdown at nearby wells during Hawker TWS 3 constant rate discharge test

Well name	Distance (m) from production well (Hawker TWS 3)	Initial WL (m)	Final WL (m)	DD (m)
Hawker TWS 1	20	66.00**	56.19**	9.82
Hawker TWS 2	140	52.99**	51.64**	1.46
Hawker TWS 4	160	22.74*	25.65*	2.91
EWS 4a (observation well across creek)	210	22.21*	22.22*	0.01
EWS 3 (windmill across creek)	600	18.72*	18.73*	0.01

Note: Initial WL was measured prior to pumping and final WL was measured before pump switched off
*Refers to DTW (depth to water from reference point; usually top of casing)
**Refers to measurements recorded from an SA Water digital logger which measures water level height above the pump (i.e. not DTW)

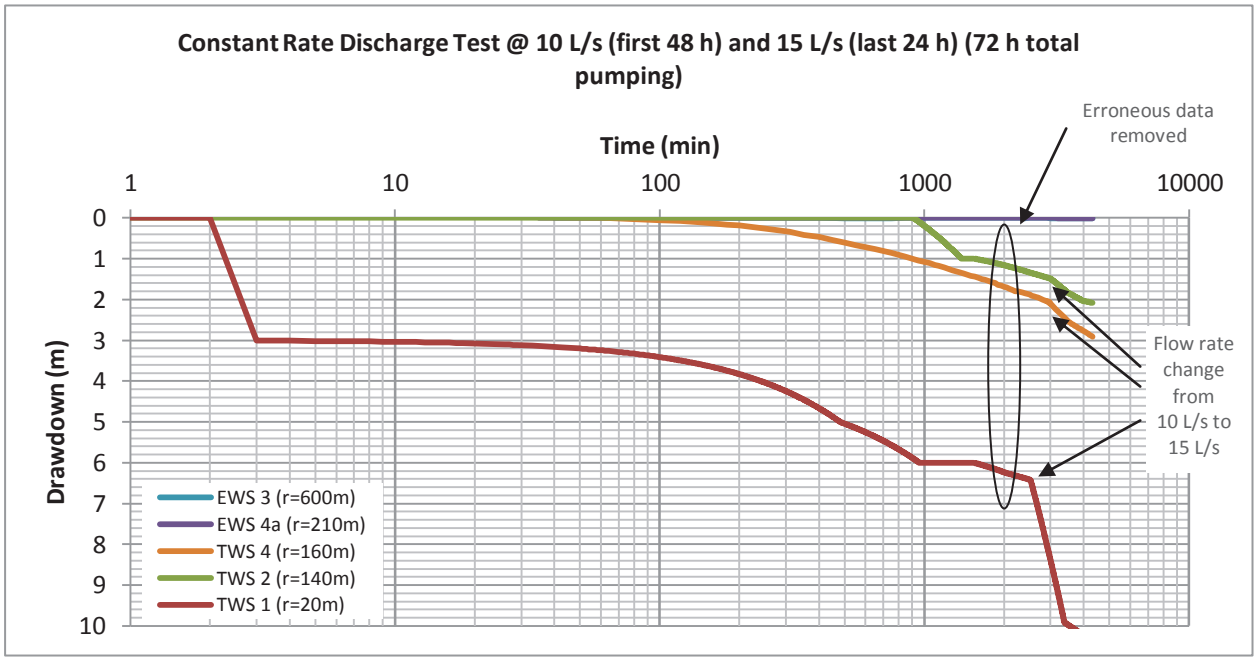


Figure 12. Drawdown experienced in neighbouring observation wells during the constant rate discharge test conducted on Hawker TWS 3

The reason for a lack of drawdown in neighbouring wells EWS 3 and EWS 4a, located on the opposite side of the creek to the production well, could be due to these wells intersecting a different fracture system. It is interesting to note that there was movement, if only minor (0.01 m) after 72 h of pumping, however it is highly likely this is attributed to atmospheric pressure or the accuracy of the measurement.

As expected, observation well Hawker TWS 1 experienced the greatest influence during the pumping test conducted on Hawker TWS 3 since the well is in close proximity (20 m) to the pumping well (Fig. 12). Hawker TWS 2, which is the next closest observation well, experienced less drawdown than Hawker

TWS 4 which is further away. This would imply (to some degree) that Hawker TWS 3 and Hawker TWS 4 are accessing the same fracture zone.

Note the change in flow rate from 10 L/s to 15 L/s at ~3000 min.

The time-drawdown data for observation well Hawker TWS 4 were best fit with the Hantush curve fitting method, which indicates a leaky confined aquifer (Fig. 13).

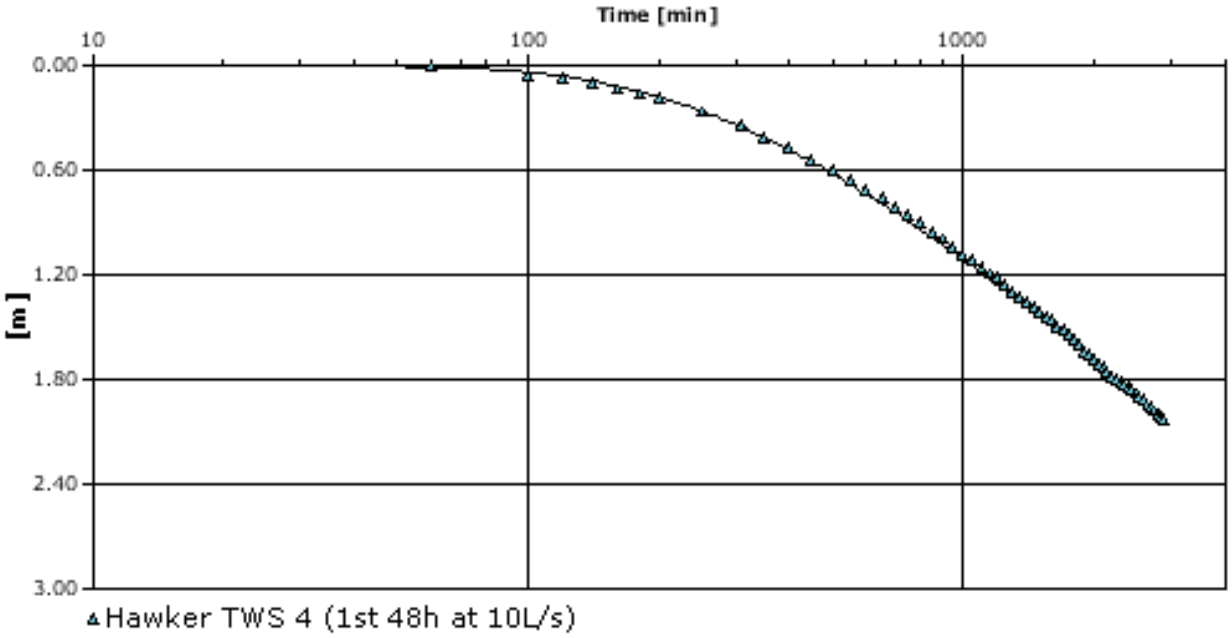


Figure 13. Calculation using Hantush method performed on observation well Hawker TWS 4 (160 m from pumping well Hawker TWS 3)

Analysis of the constant rate discharge drawdown results on observation well Hawker TWS 4 indicate a transmissivity of ~70 m^2/d (Table 11).

Table 11. Pumping tests analysis calculation of hydraulic parameters for Hawker TWS 3

Observation well	Transmissivity (m^2/day)	Storage coefficient	Radial distance to production well (m)	Hydraulic resistance (min)	Method
Hawker TWS 4 (1st 48 h at 10 L/s)	69.5	1.72×10^{-3}	160.0	2.46×10^{8}	Hantush

Data from wells Hawker TWS 1 and Hawker TWS 2 (which were also used as observation wells for this test) should be used only to indicate water level movement during the pumping test (Fig. 12). As these wells normally function as production wells for water supply to Hawker, their casing is sealed off at the surface preventing manual measurements of water level. In situ SA Water digital loggers are on-site and a visual display can be used to inspect water level height above the pump at any time, however the display transmitted measurement values to a small number of significant figures that could not resolve accuracy less than one metre. Data was therefore sort for these two wells for the relevant period from an SA Water facility (Operational Data Store) located at Crystal Brook which records and archives production well data. During processing it was found that data received for Hawker TWS 1 and Hawker TWS 2 contained several periods of erroneous data. Much of this erroneous data at 2000 min was omitted from Figure 12 however due to the quality of the resultant data further analysis was not processed for these wells.

Groundwater salinities were recorded in the field during the constant rate discharge test. Results are given in Figure 14 for total dissolved solids (TDS). The groundwater salinity increased slightly (45 mg/L over 72 h) from the start to the end of the pumping.

Groundwater samples were sent to the Australian Water Quality Centre for analysis (see Appendix F for results).

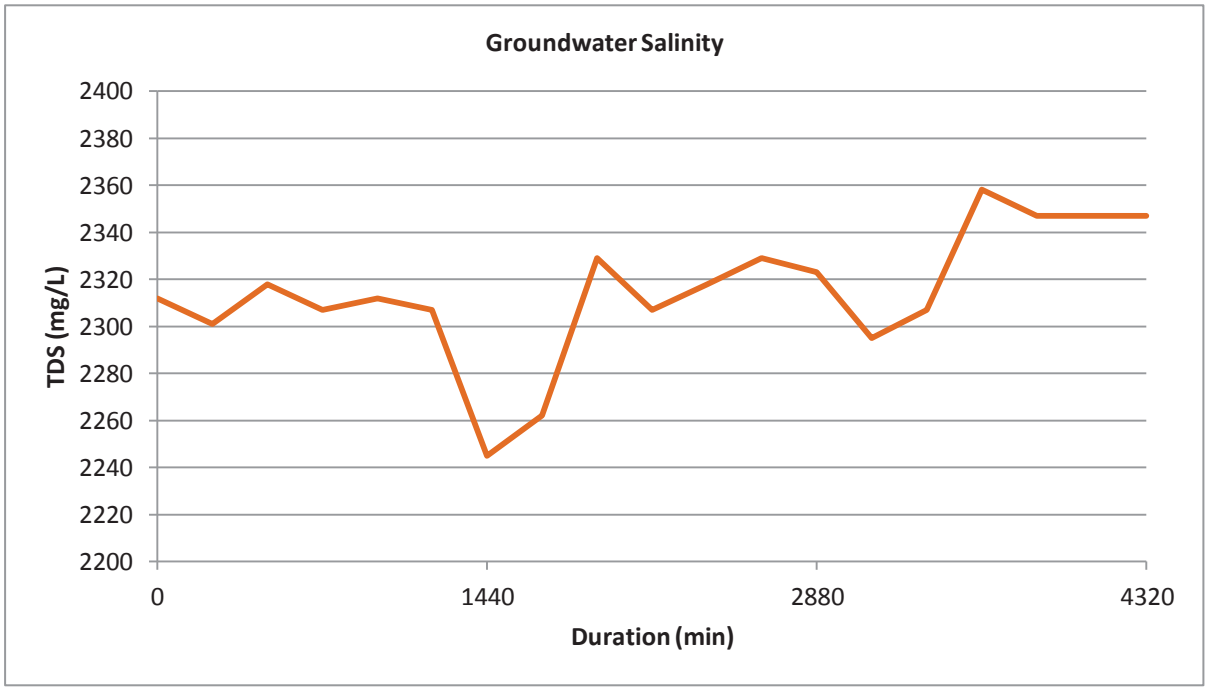


Figure 14. Groundwater salinity during the constant rate discharge test data for Hawker TWS 3

4.2. HAWKER TWS 4 (UNIT NO. 6534-341)

4.2.1. STEP DRAWDOWN TEST

The following parameters were measured and recorded prior to the commencement of the step drawdown test conducted on Hawker TWS 4:

- Initial (non-pumping) depth to water (DTW) = 23.12 m
- Pump setting = 100 m
- Actual available drawdown (DD) = ~76.88 m.

Groundwater level measurements were recorded throughout the step drawdown test. The time-series of the drawdown levels (the difference between the initial groundwater level and the groundwater levels during the test) are shown in Figure 15.

The data from the step drawdown test and the parameters specified above were used as input for processing and analysing of the data which determines the hydraulic performance of the well (Fig. 16).

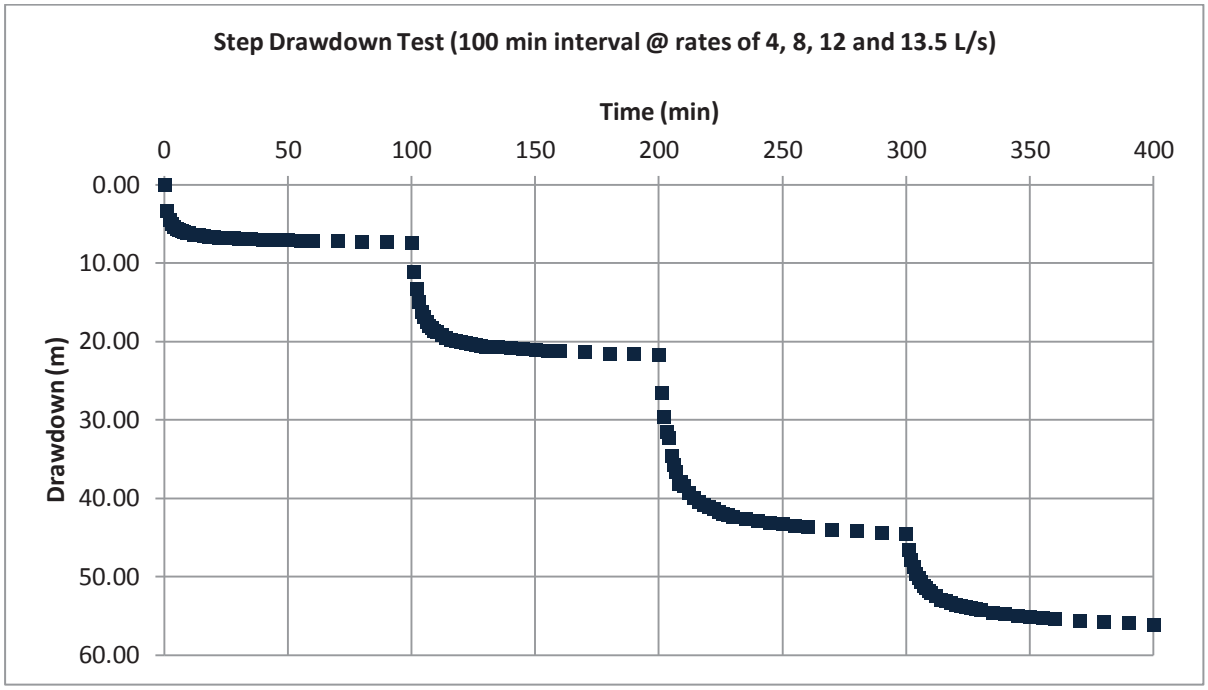


Figure 15. Step drawdown test data for Hawker TWS 4

Analysis of the step drawdown results leads to the well equation *(Equation 3)*:

$$s(t) = 3.9\,Q + 50.36\,Q^2 + 9.41\,\log10\,(t)\,Q \qquad \textbf{Equation (3)}$$

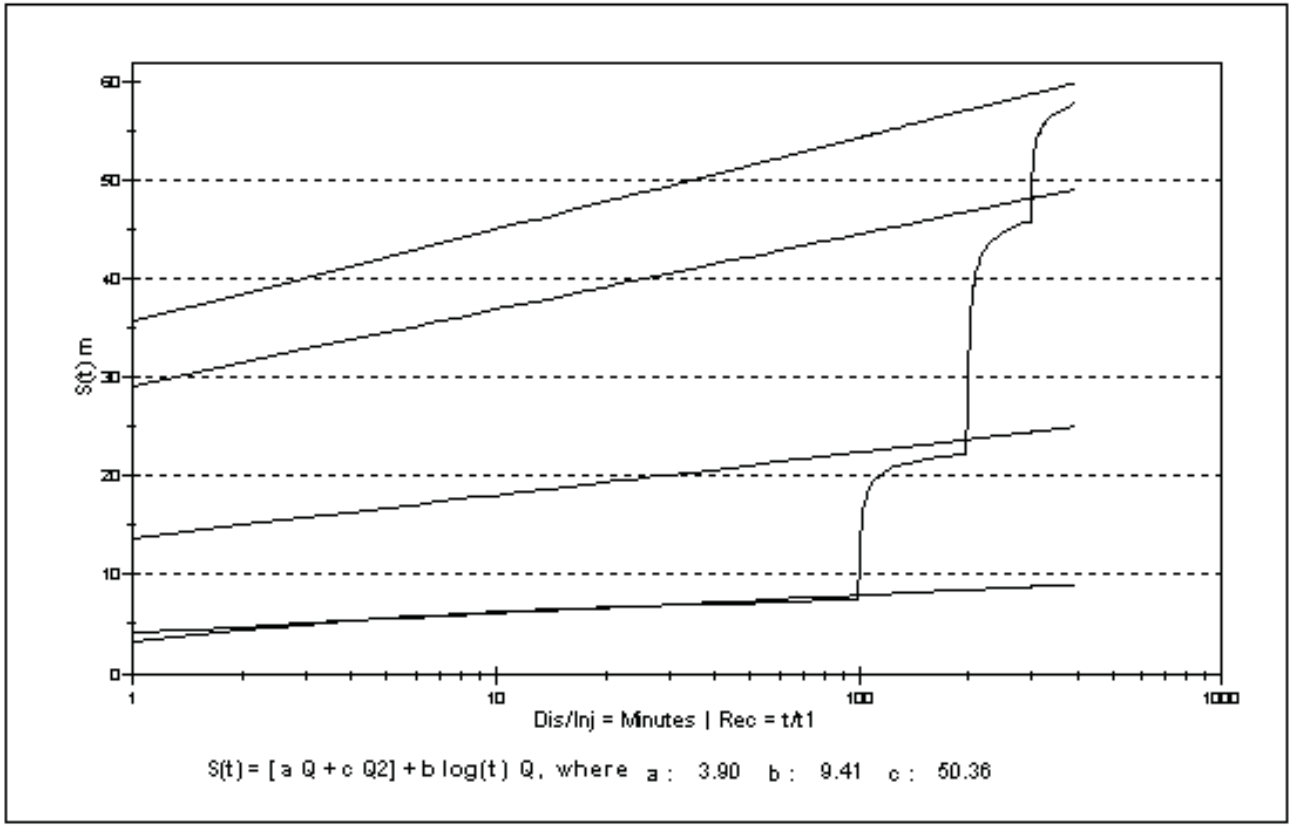
The well equation can also be used as a predictive tool. Table 12 tabulates well equation predictions for the drawdown in Hawker TWS 4 after 1 000 000 min (~2 y) of continuous pumping.

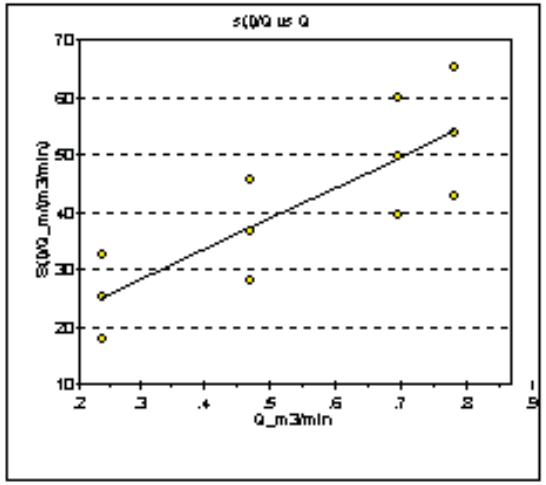
Table 12. Interpolated step drawdown data conducted on Hawker TWS 4

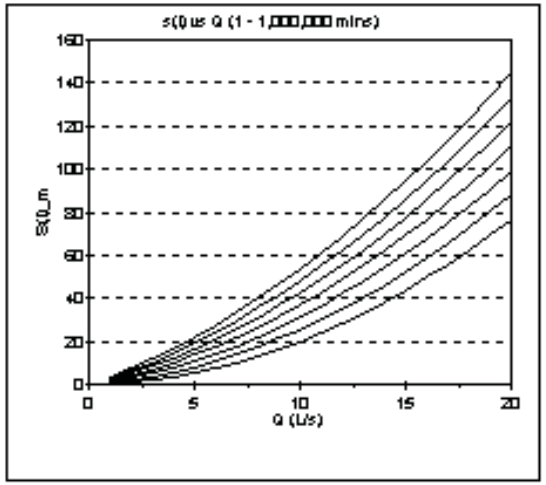
Discharge rate (L/s)	Available DD (m)	Duration (min)	Predicted DD (m)
5	76	1 000 000	~15.5
10	76	1 000 000	~40.0
15	76	1 000 000	~73.6
20	76	1 000 000	~116.3

It should be noted that the step drawdown test analysis conducted here may not be fully applicable to a fractured rock aquifer, but provides an indication of the hydraulic behaviour of the well. This is because the hydraulics of fractured rock aquifers are very complex and not well understood.

The numbers provided in Table 12 are an indication of drawdown only. These are winter pumping conditions and do not account for seasonal groundwater fluctuations, which may result in the available drawdown being significantly reduced during summer, when rainfall (and therefore recharge to the aquifer) is at a minimum and groundwater extractions are at a maximum.







TheStep	Q_L/s	Q_m3/min	Duration_min	St1	St1/Q	St10	St10/Q	St100	St100/Q	dS	dS/Q	T_m2/day
1	4.00	0.24	100	4.27	17.79	6.07	25.29	7.87	32.79	1.80	7.50	35
2	8.00	0.48	100	13.49	28.11	17.69	36.86	21.89	45.61	4.20	8.75	30
3	12.00	0.72	100	28.48	39.56	35.88	49.84	43.28	60.12	7.40	10.28	26
4	13.50	0.81	100	34.74	42.88	43.74	54.00	52.74	65.11	9.00	11.11	24

Figure 16. Step drawdown test analysis using Hazel method for Hawker TWS 4

Other useful parameters that relate to well performance can be calculated using the well equation. For a discharge rate of 10 L/s and a time of 2880 min (48 h):

- The specific capacity is ~0.25 L/s/m of drawdown. This implies for every metre of drawdown the well yields 0.25 L/s.
- The well loss (aQ + cQ2) is ~20.47 m.
- The aquifer loss (b log(t) Q) is ~19.53 m. This implies that the well efficiency (well loss as a percentage of total drawdown) is ~51%.

4.2.2. CONSTANT RATE DISCHARGE TEST

Groundwater level measurements were recorded throughout the constant rate discharge test and the recovery period. The time series of drawdown, the difference between the initial groundwater level and the groundwater levels during the test and recovery period are shown in Figure 17.

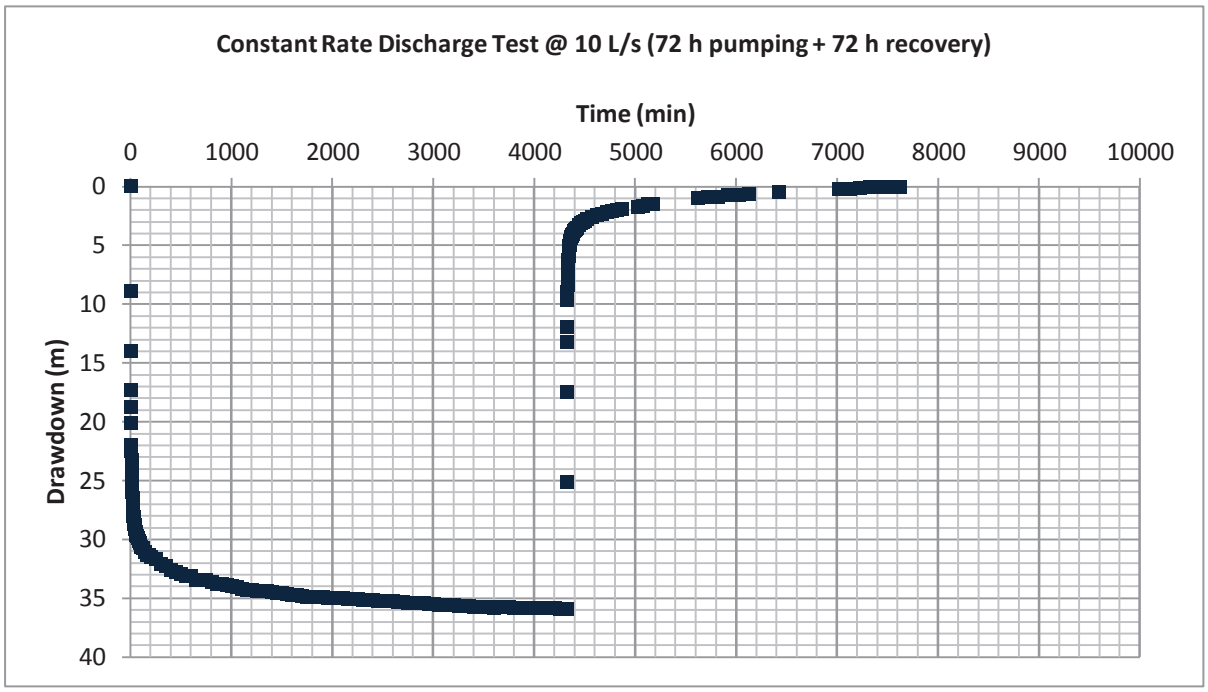


Figure 17. Constant rate discharge test data for Hawker TWS 4

Drawdown versus time and residual drawdown verses t/t_1 (where t is the time since pumping began and t_1 is the time since pumping stopped) are both given in the log-linear plot (Fig. 18).

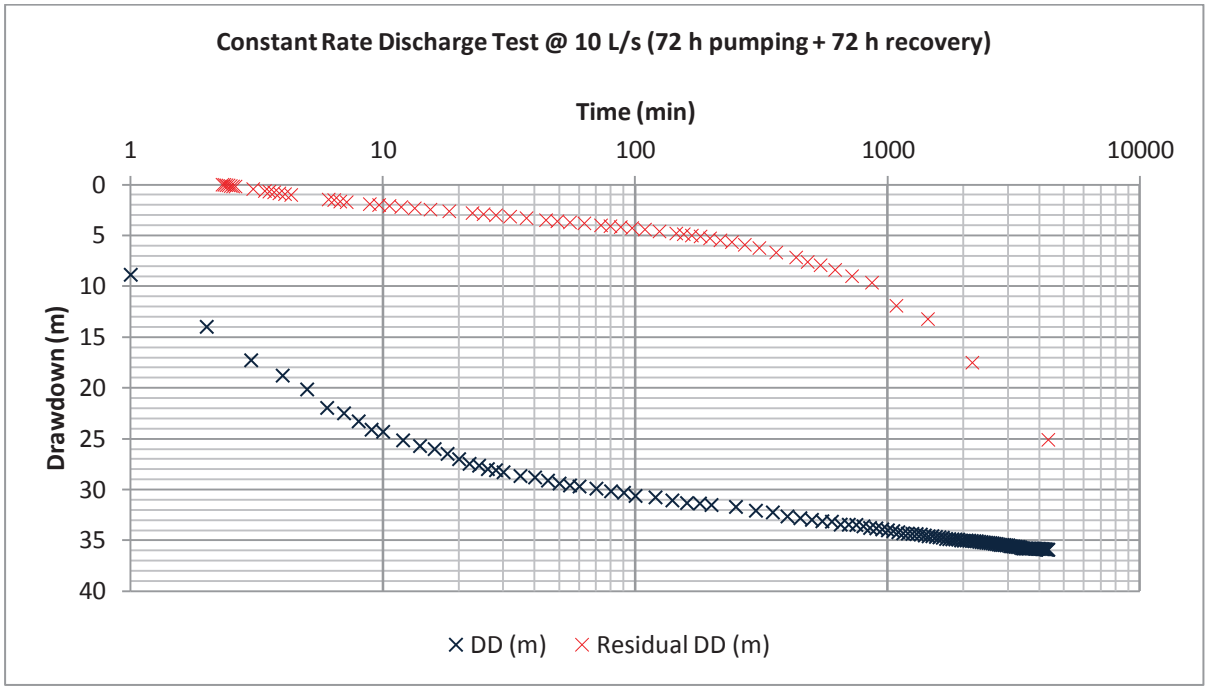


Figure 18. Log-linear plot of constant rate discharge test data and residual drawdown data for Hawker TWS 4

The following general comments can be made in relation to the constant rate discharge test:

- The extrapolation of the residual drawdown data indicates that intersection with the zero residual drawdown occurs at $t/t_1 > 1$, suggesting the well has encountered a recharge boundary, or at least the aquifer is not undergoing dewatering.
- The well equation *(Equation 3)*, slightly over-predicts the observed drawdown at the test rate of 10 L/s, predicting a value of 40.0 m after 2880 min compared to the actual measurement of ~35.47 m.

A summary of aquifer drawdown recorded in the observation wells is reported in Table 13.

Table 13. Drawdown at nearby wells during Hawker TWS 4 constant rate discharge test

Well name	Distance (m) from production well (Hawker TWS 3)	Initial WL (m)	Final WL (m)	DD (m)
Hawker TWS 3	160	22.79*	25.08*	2.29
Hawker TWS 1	160	66.83**	64.61**	2.22
EWS 4a (observation well across creek)	200	22.22*	22.24*	0.02
Hawker TWS 2	240	53.47**	52.67**	0.80
EWS 3 (windmill across creek)	440	18.72*	18.73*	0.01

Note: Initial WL was measured prior to pumping and final WL was measured before pump switched off
*Refers to DTW (depth to water from reference point; usually top of casing)
**Refers to measurements recorded from an SA Water digital logger which measures water level height above the pump (i.e. not DTW)

Similar to the constant rate discharge test results for Hawker TWS 3, the reason for a lack of drawdown in neighbouring wells EWS 3 and EWS 4a located on the opposite side of the creek to the production well could be due to these wells intersecting a different fracture system. It is interesting to note that there was movement, if only minor (0.01-0.02 m) after 72 h of pumping, however it is highly likely this is be attributed to atmospheric pressure or the accuracy of the measurement.

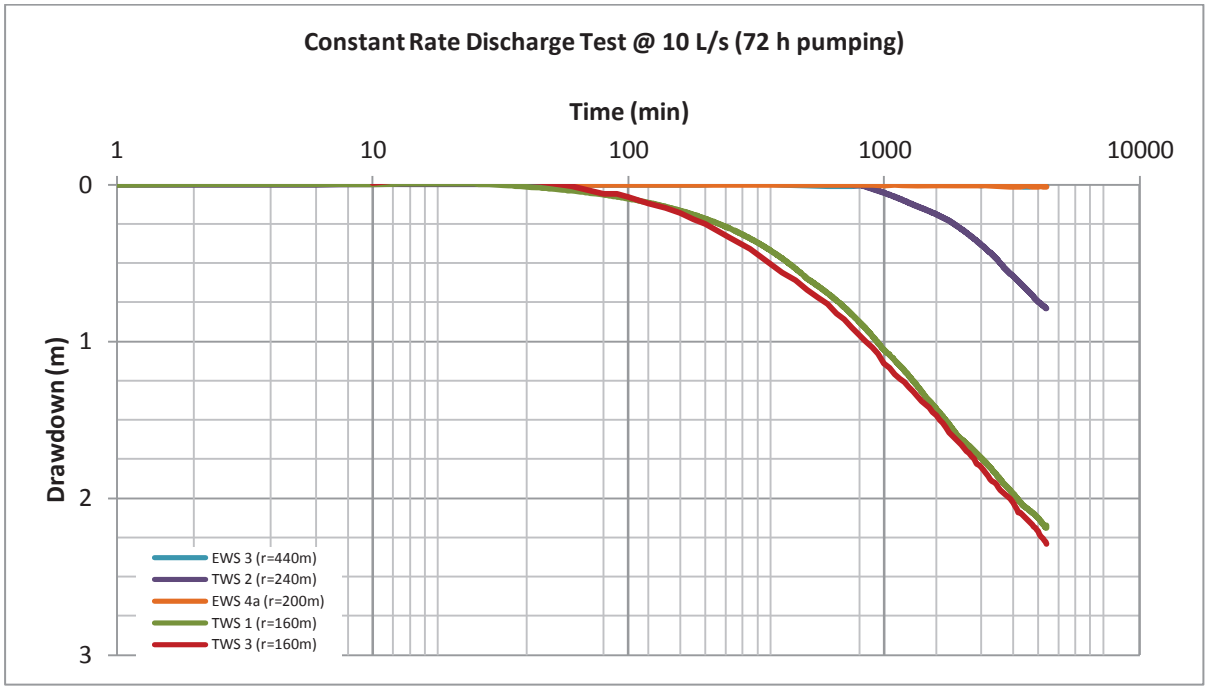


Figure 19. Drawdown experienced in neighbouring observation wells during the constant rate discharge test conducted on Hawker TWS 4

As expected, observation wells Hawker TWS 1 and Hawker TWS 3 experienced the greatest influence from Hawker TWS 4 since they are the closest in proximity (160 m) to the production well (Fig. 19) and as discussed earlier Hawker TWS 4 and Hawker TWS 3 are likely to be located in the same fracture zone.

The time-drawdown data for observation wells Hawker TWS 1 (Fig. 20), Hawker TWS 3 (Fig. 21) and Hawker TWS 2 (Fig. 22) were best fit with the Hantush curve fitting method which indicates a leaky confined aquifer.

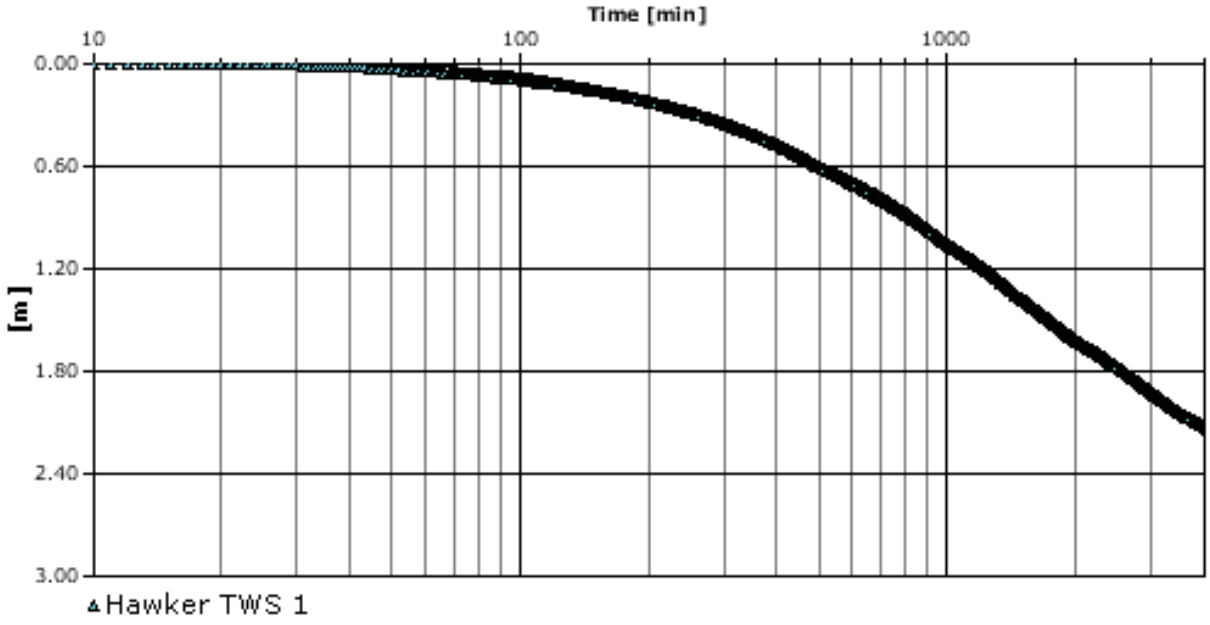


Figure 20. Calculation using Hantush method performed on observation well Hawker TWS 1 (160 m from pumping well Hawker TWS 4)

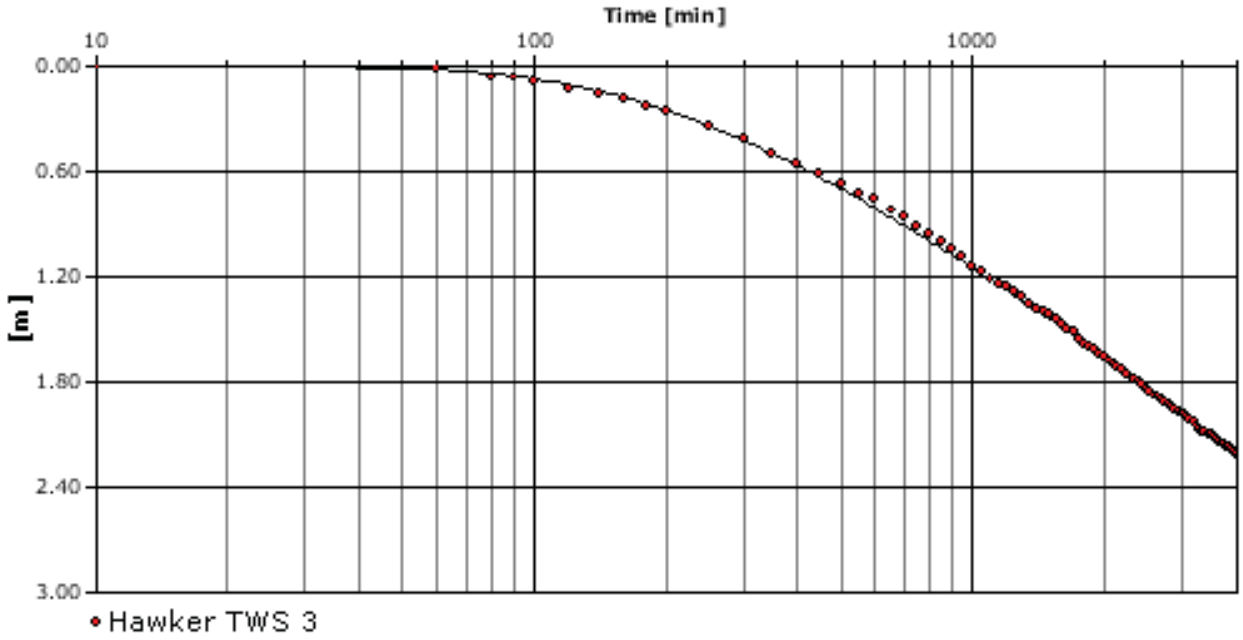


Figure 21. **Calculation using Hantush method performed on observation well Hawker TWS 3 (160 m from pumping well Hawker TWS 4)**

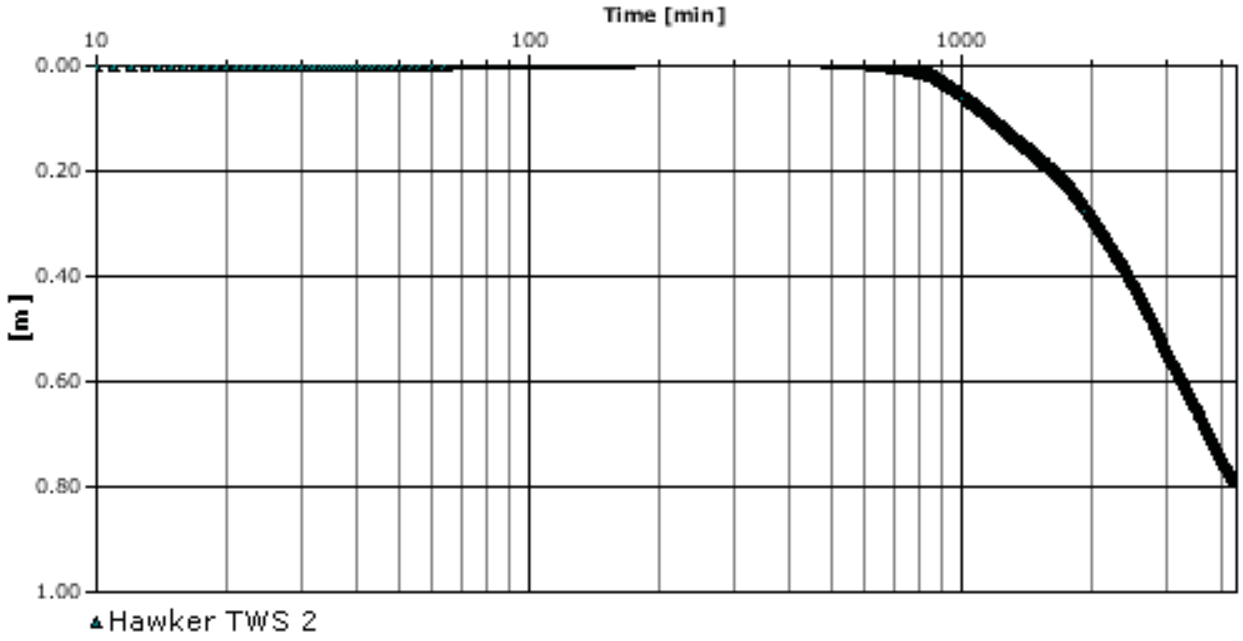


Figure 22. **Calculation using Hantush method performed on observation well Hawker TWS 2 (240 m from pumping well Hawker TWS 4)**

Table 14. Pumping tests analysis calculation of hydraulic parameters for Hawker TWS 4

Observation well	Transmissivity (m^2/d)	Storage coefficient	Radial distance to production well (m)	Hydraulic resistance (min)	Method
Hawker TWS 1	82	1.64×10^{-3}	160.0	5.63×10^{8}	Hantush
Hawker TWS 3	82.5	1.48×10^{-3}	160.0	6.64×10^{8}	Hantush
Hawker TWS 2	24.3	3.05×10^{-3}	240.0	1.73×10^{6}	Hantush

Analyses of the constant rate discharge drawdown results on the observation wells (Table 14) indicate a transmissivity of ~82 m^2/d. The lower transmissivity of ~24 m^2/d attributed to Hawker TWS 2 suggests the well is located in a different aquifer system.

Groundwater salinities were recorded in the field during the constant rate discharge test. Results are given in Figure 23 for total dissolved solids (TDS). The groundwater salinity increased slightly (30 mg/L over 72 h) from the start to the end of the pumping.

Groundwater samples were sent to the Australian Water Quality Centre for analyses (see Appendix F for results).

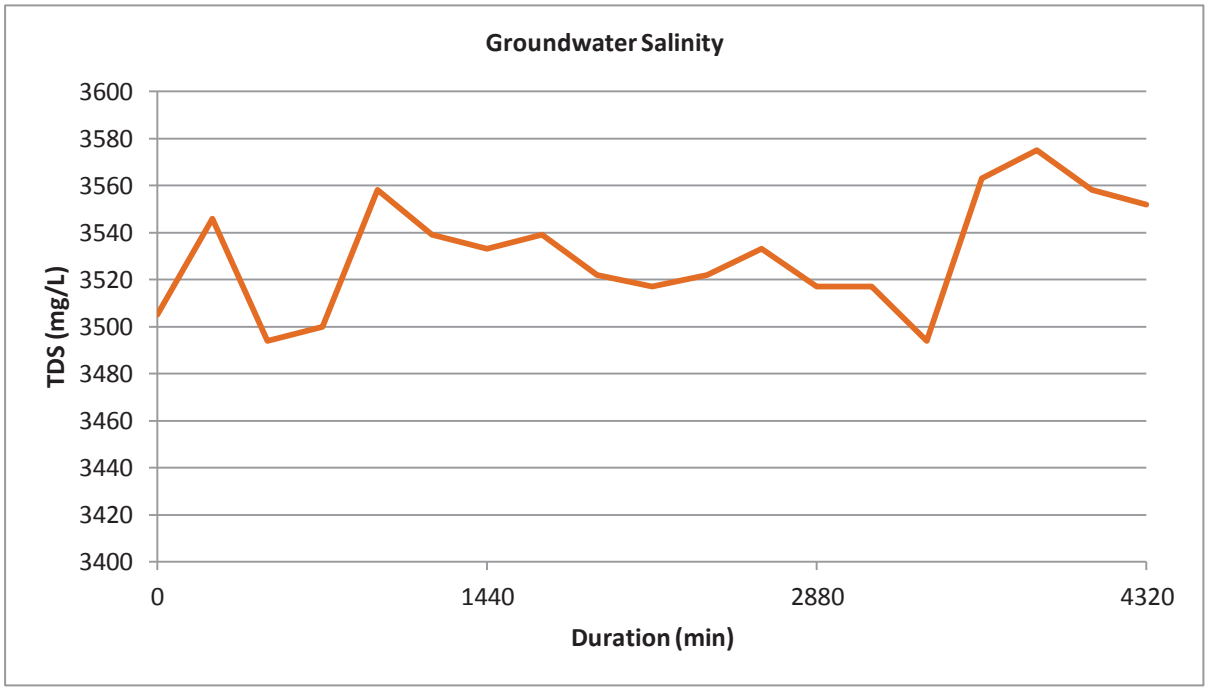


Figure 23. Groundwater salinity during the constant rate discharge test data for Hawker TWS 4

4.3. PARACHILNA TWS 2 (UNIT NO. 6535-170)

4.3.1. STEP DRAWDOWN TEST

The following parameters were measured and recorded prior to the commencement of the step drawdown test conducted on Hawker TWS 3:

- Initial (non-pumping) depth to water (DTW) = 64.29 m
- Pump setting = 74 m
- Actual available drawdown (DD) = ~9.71 m.

Groundwater level measurements were recorded throughout the step drawdown test. The time-series of the drawdown levels (the difference between the initial groundwater level and the groundwater levels during the test) are shown in Figure 24.

The data from the step drawdown test was not able to derive a well equation since the well comfortably handled the maximum pumping capacity of the DFW pump; 5 L/s.

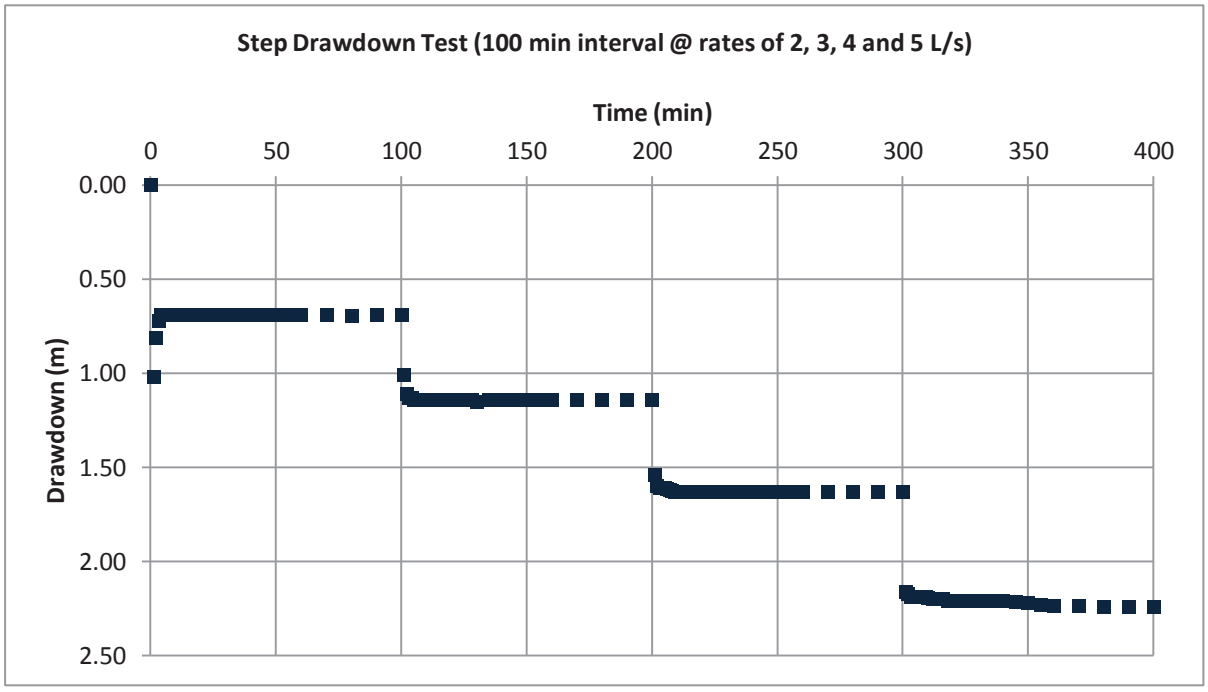


Figure 24. Step drawdown test data for Parachilna TWS 2

In the first minute of the step drawdown test for Parachilna TWS 2 the well experienced an initial drawdown of approximately 1 m. The well then recovered over the next several minutes to approximately 0.7 m where it remained for the duration of the first step at 2 L/s. This initial drawdown followed by recovery may have been due to setting the correct flow rate and adjustment of the gate valve.

4.3.2. CONSTANT RATE DISCHARGE TEST

Groundwater level measurements were recorded throughout the constant rate discharge test and the recovery period. The time series of drawdown, the difference between the initial groundwater level and the groundwater levels during the test and recovery period are shown in Figure 25.

As with the step drawdown test, this initial drawdown followed by recovery in the first few minutes of the constant rate discharge test may have been due to setting the correct flow rate and adjustment of the gate valve.

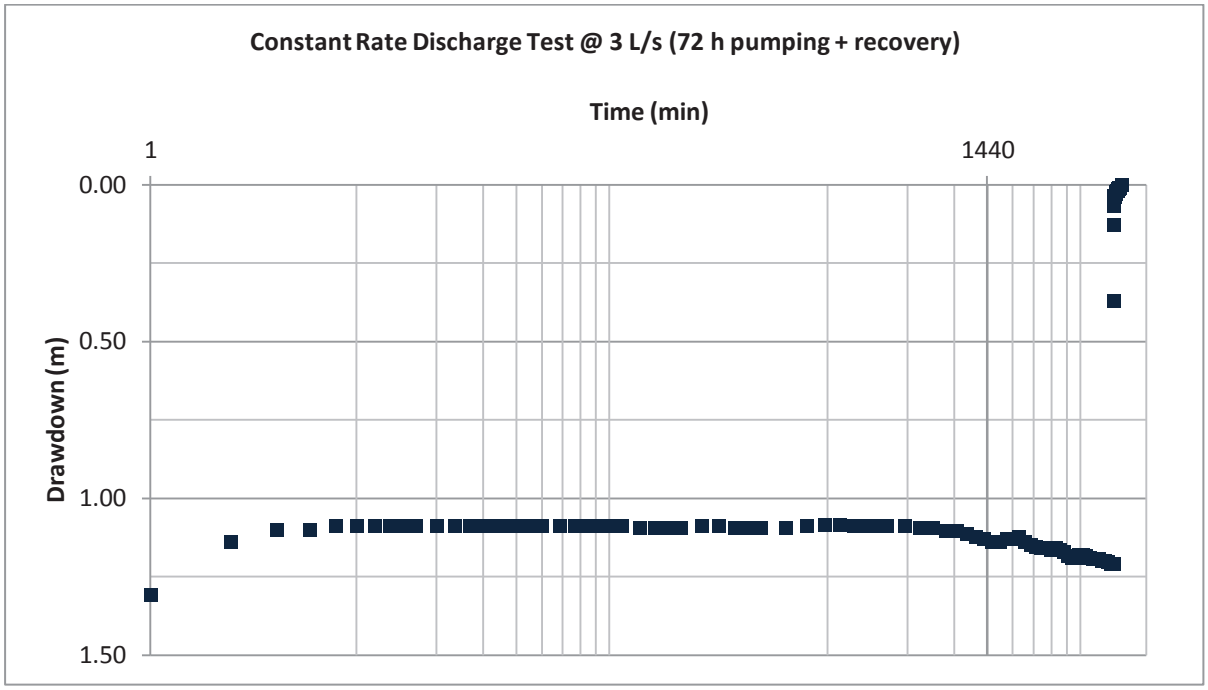


Figure 25. Constant rate discharge test data for Parachilna TWS 2

Drawdown versus time and residual drawdown verses t/t_1 (where t is the time since pumping began and t_1 is the time since pumping stopped) are both given in the log-linear plot (Fig. 26).

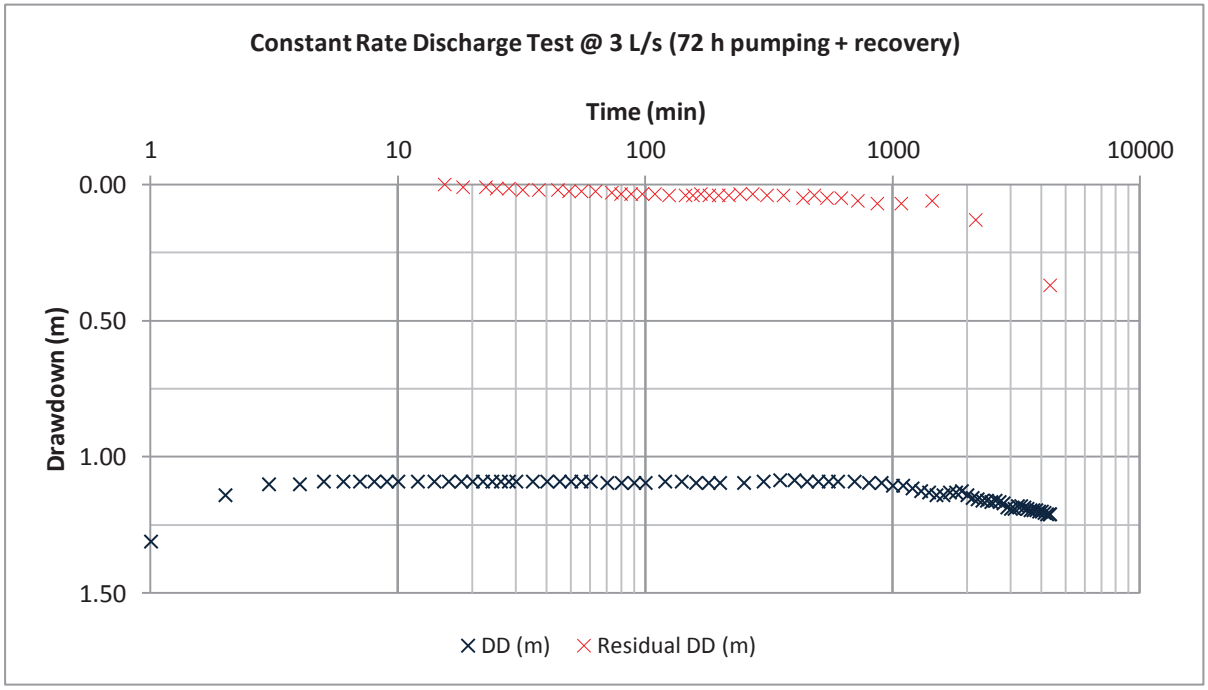


Figure 26. Log-linear plot of constant rate discharge test data and residual drawdown data for Parachilna TWS 2

The following general comments can be made in relation to the constant rate discharge test:

- The drawdown data provides evidence of a possible low permeability boundary, which is indicated by the increasing drawdown at 1000 min. This may have implications for the actual drawdown when the well is pumped continuously, or intermittently pumped for long periods.
- The extrapolation of the residual drawdown data indicates that intersection with the zero residual drawdown occurs at $t/t_1 > 1$, suggesting the well has encountered a recharge boundary, or at least the aquifer is not undergoing dewatering.

One observation well was utilised during this test, the existing town water supply well (Parachilna TWS 1). Data collected during the constant rate discharge test indicates the development of very minor drawdown in the observation well (Table 15).

Table 15. Drawdown at nearby well during Parachilna TWS 2 constant rate discharge test

Well name	Distance (m) from production well (Parachilna TWS 2)	Initial WL (m)	Final WL (m)	DD (m)
Parachilna TWS 1	350	63.504**	63.508**	0.004

Note: Initial WL was measured prior to pumping and final WL was measured before pump switched off
*Refers to DTW (depth to water from reference point; usually top of casing)
**Refers to measurements recorded from an SA Water digital logger which measures water height above the pump (i.e. not DTW)

Groundwater salinities were recorded in the field during the constant rate discharge test. Results are given in Figure 27 for total dissolved solids (TDS). The groundwater salinity remained steady throughout the test at approximately 850 mg/L.

Groundwater samples were sent to the Australian Water Quality Centre for analyses (see Appendix F for results).

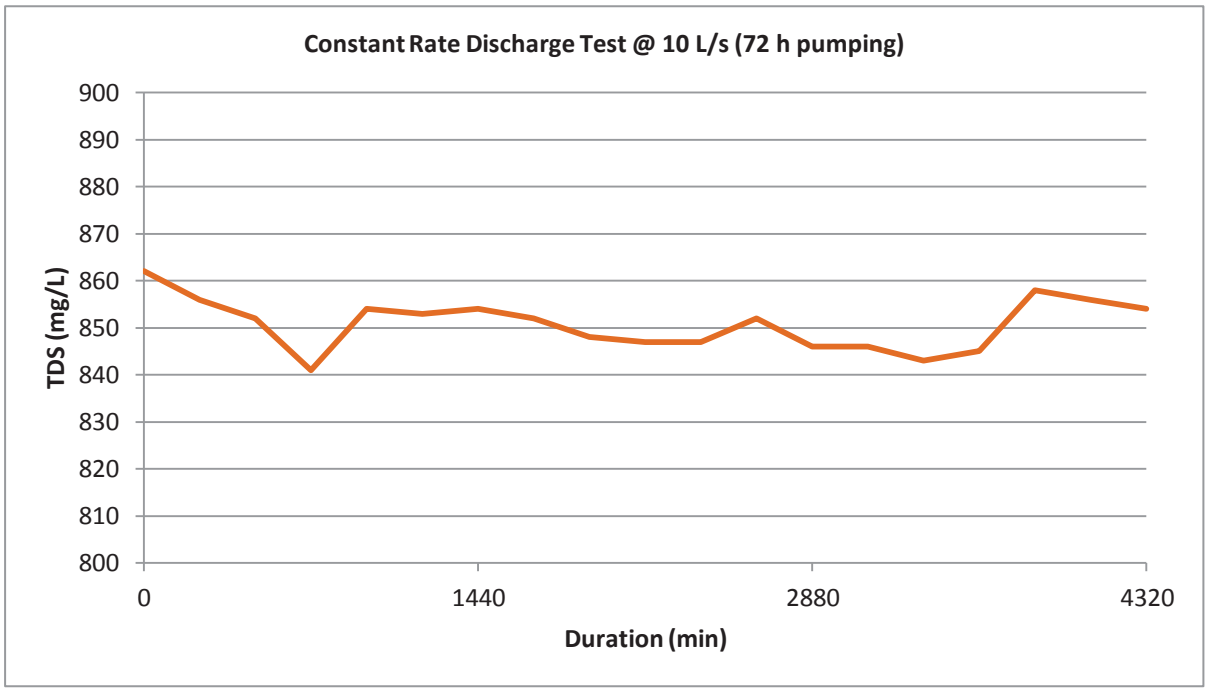


Figure 27. Groundwater salinity during constant rate discharge test data for Parachilna TWS 2

5. RECOMMENDATIONS

For the newly constructed production wells at Hawker (TWS 3 and TWS 4) and Parachilna (TWS 2), it is recommended that the well be pumped operationally and monitored for a full 12 months to accurately determine the long-term hydraulic behaviour of the well.

The current understanding of the hydraulic nature, salinity variability and hence the sustainability of the groundwater resource in the vicinity of the current Hawker town water supply wellfield is limited. It is therefore recommended that regional monitoring of water level (wells within ~5 km of the production wells) be conducted at least every six months. Monitoring of salinity for the current town water supply wellfield (including wells that are not in use) should also be conducted on a six monthly basis.

A well completion and pumping test summary is provided in Table 16.

Table 16. Well completion details and pumping test summary

Specifications	Hawker TWS 3	Hawker TWS 4	Parachilna TWS 2
Unit number	6534-340	6534-341	6535-170
Easting	260572	260720	252231
Northing	6469875	6469806	6552731
GDA 94 Zone	54	54	54
Well completion date	31 Mar 2011	6 May 2011	21 Apr 2011
Well completion depth	150 mBNS	177 mBNS	83 mBNS
Casing length Casing type	70 m Class 12 PVC	97.5 m Class 12 PVC	63 m Class 12 PVC
Casing inner diameter	250 mm	250 mm	203 mm
Production zone	70–150 mBNS (203 mm ID slotted PVC liner)	97.5–177 mBNS (203 mm ID slotted PVC liner)	62.3–67.3 mBNS 73.8–76.3 mBNS (~150 mm ID stainless steel screen)
Depth to water at date of pumping test	23.2 mBNS	23.1 mBNS	64.3 mBNS
CRD test date	25–28 May 2011 (recovery additional 72 h)	7–10 Jun 2011 (recovery additional 72 h)	12–15 May 2011 (recovery additional 450 min)
Discharge rate (CRD test)	10 L/s (first 48 h then rate change to 15 L/s last 24 h)	10 L/s	3 L/s
Pumping duration (CRD test)	72 h	72 h	72 h
Maximum drawdown (CRD test)	11.0 m at 10 L/s after 48 h pumping	35.9 m at 10 L/s after 72 h pumping	1.2 m at 3 L/s after 72 h pumping
Well efficiency	64%	51%	-
Pump depth (CRD and Step test)	100 mBNS	100 mBNS	74 mBNS

Note:

TBA (to be announced)

Recommended pumping rate and pump depth are provided in Table 17.

Table 17. Pump depth recommendation

Recommendations	Hawker TWS 3	Hawker TWS 4	Hawker TWS 4 (Option 2)	Parachilna TWS 2
Pump intake depth	50 m	70 m	92 m	74 m
Assumed depth to water	30 m (safety factor of ~5 m)	30 m (safety factor of ~5 m)	30 m (safety factor of ~5 m)	64 m (no safety factor incorporated since well does not allow a safety factor margin)
Available drawdown	20 m	40 m	62 m	10 m (in theory)
Recommended pumping rate	10* L/s (this well is capable of much greater yields (~18 L/s) depending of pump setting and capacity of SA Water pipe infrastructure)	5* L/s	10* L/s	3* L/s
After 1 000 000 min (2 y) pumping 24/7 the well equation predicts drawdown (at the specified pumping rate above) of	13** m	23** m	55** m	Unknown (no well equation derived) but 2–3 L/s is likely to be sustainable over the pumping schedule required by SA Water
Available drawdown safety factor (after 2 y pumping 24/7)	~7 m	~17 m	~7 m	N/A

Note:

*Rates are conservative allowing for seasonal variation, assuming no influence of low permeable boundaries at longer times and exhaustive pumping schedule of 24/7. Higher rates are achievable by increasing pump depth (i.e. increasing available drawdown) and using a more typical SA Water pumping schedule.

**Numbers are rounded

TBA (to be announced)

APPENDIXES

A. WELL CONSTRUCTION REPORTS

HAWKER TWS 3

GOVERNMENT OF SOUTH AUSTRALIA
DRILLERS WELL CONSTRUCTION REPORT
Natural Resource Management Act 2004
DETAILS OF ALL WORK UNDERTAKEN MUST BE REFLECTED IN THIS REPORT

1. PERMIT NO: 1 9 9 6 0 6 — 08 JUN 2011 — Site:

NAME OF DRILLER Paul Wagenknecht Licence No: 165177
Contact Phone/Mobile No.:
Name of plant operator if under supervision:

PERMIT HOLDER or land occupier DEPARTMENT for WATER
Postal Address LEVEL 11, 25 GREENFELL STREET
ADELAIDE S.A. Post Code 5000

2. LOCATION OF WELL
Date of Survey ..... Surveyed by ..... Method .....
GPS COORDINATES AND DATUM USED
☑ GDA 94/WGS84 ☐ AGD 66/84
545 0260572
UTM 6469877
☐ ZONE 52 ☐ ZONE 53 ☑ ZONE 54

3. WELL NAME
4. LAND IDENTIFICATION
Pastoral Lease or Hundred: CT 5979/490
Title or Plan and Parcel: ARKARA
Name of Property

5. SUMMARY *(Please tick appropriate boxes and complete all relevant details)*
Date work Commenced 16/3/2011 Date work Completed 21/3/2011
Work carried out: New Well ☑ Deepen ☐ Enlarge ☐ Rehabilitate ☐ Backfill ☐
Is this a Replacement well? ~~YES~~/NO if yes please quote replaced well number
Is this an Existing well? ~~YES~~/NO If yes please quote well number or GPS coordinates
Was well Abandoned? ~~YES~~/NO if so please state reason and method of backfill
Maximum Depth Drilled 150 (m) Final Depth 150 (m) Final Standing Water Level 24 (m) Final Yield 12 (L/sec)

6. DRILLING DETAILS If not a drilled well, please complete Sections: 6.2, 9, 10, 11, 12 and 13 as necessary

6.1 Construction Details

From (m)	To (m)	Diam (mm)	Drilling Method Cable Tool, Rotary Auger, Down Hole Hammer, etc.	Fluid Used (Air, Water, Mud Type)
0	5	381	ROTARY	BIO-VIS.
5	70	343	ROTARY	BIO-VIS.
70	150	248	HAMMER	AIR

6.2 Water Cut Details (measurements from natural surface to nearest 0.1 m)

Date	Water Cut From (m)	Water Cut To (m)	Standing Water Level (m)	Estimated Yield (L/sec)	Hole Depth at Test (m)	Casing at Test (m)	Test Method	Salinity (mg/L) or Taste
28/3/11	70	150	24	12	150	70	AIR	2400

7. CASING LEFT IN WELL

7.1 Dimensions / 7.2 Type / 7.3 Casing Cemented

From (m)	To (m)	Internal Diam. (mm)	Swell Joint, Welded Collar, Steel, FRP, PVC, etc.	Yes	No	From (m)	To (m)	Cement (bags)	Water (litres)	Other Additives	Cementing Method Used	Comments
0	5	355	STEEL	☐	☑							
+0.5	70	258	P.V.C CL 12	☑	☐	0	70	60	1620		PRESSURE	

7.4 COLLAR CASING (must be cemented to surface)

				☐	☐				

8. CONSTRUCTION AT PRODUCTION LEVEL

8.1 Method
☐ Open Hole
☑ Slotted Casing
☐ Screen(s)
☐ Other, give details:

8.2 Screen or Casing (*If variable aperture screen used give limits)

Type	From (m)	To (m)	Aperture* (mm)	Inner Diam (mm)	Outer Diam (mm)	Material	Trade Name	Completion of Base
P.V.C CL 12	66	150	1	203	225	P.V.C		BLANK

8.3 Liner Seal (Packer)

Material	Depth (m)	Internal Diam (mm)

8.4 Gravel Packing

Method of Placement	Gravel Passing Mesh Size	From (m)	To (m)

9. IF NOT A DRILLED WELL

Method	Depth (m)	Length (m)	Width (m)	Diam (m)	Lining Material	From (m)	To (m)

10. DEVELOPMENT (State methods and time taken)

Method	Hours	Minutes
AIR WHILE DRILLING +	1	

11. PUMPING TEST (measurements from natural surface to nearest 0.1m)

Interval Tested From (m)	Interval Tested To (m)	Water Level (m)	Test Method	Pump Depth (m)	Discharge Rate (L/sec)	Method of Measuring Discharge	Hours Pumped	Draw Down (m)

12. SAMPLES
The Natural Resources Management Act 2004 and Regulations require that strata and water samples must be obtained. If any samples have not been obtained state reasons:

As the person responsible I advise that the work has been completed as described above.
Signature of Licensed Driller P.T Wagenknecht Date 2.4.11

Driller to deliver this copy together with water samples collected and well location map within 14 days of completion to any of the locations below:
Department of Water, Land and Biodiversity Conservation
Science Monitoring & Information, GPO Box 2834 Adelaide SA 5001 (reports only)
Water Laboratory and Geophysical Services, 23 Conyngham Street GLENSIDE SA 5065 or
Mount Gambier Regional Office, 11 Helen Street MOUNT GAMBIER SA 5290 or
Naracoorte Regional Office, 101 Cedar Avenue, NARACOORTE SA 5271

13. FORMATION LOG

From (m)	To (m)	Description of Material
0	8	RED SANDY CLAY + GRAVEL
8	19	BROWN CLAY WITH GREY CLAY LAYE
19	20	HARD LAYER BROWN CLAY WI
		LARGE GRAVEL
20	23	RED SANDSTONE WITH LIMEST
		LAYERS HARD
23	25	LOST CIRCULATION
25	29	WHITE CLAY + GRAVEL
29	46	BROWN SANDY CLAY + GRAVEL
46	50	YELLOW SILTY CLAY + GRAVEL
50	55	GREY CLAY WITH SLATE LAYER
55	58	GREY CLAY + GRAVEL
58	64	GREY CLAY + SLATE LAYER
64	150	GREY SLATE

6534340
UNIT NUMBER

HAWKER TWS 4

GOVERNMENT OF SOUTH AUSTRALIA
DRILLERS WELL CONSTRUCTION REPORT
Natural Resource Management Act 2004
DETAILS OF ALL WORK UNDERTAKEN MUST BE REFLECTED IN THIS REPORT

1. PERMIT NO: 19607 Site — 08 JUN 2011

NAME OF DRILLER Paul Wagenknecht Licence No: 165177
Contact Phone/Mobile No.:
Name of plant operator if under supervision:

PERMIT HOLDER or land occupier DEPARTMENT for WATER
Postal Address LEVEL 11, 25 GRENFELL STREET
ADELAIDE SA Post Code 5000

2. LOCATION OF WELL
Date of Survey ..... Surveyed by ..... Method .....
GPS COORDINATES AND DATUM USED
☑ GDA 94/WGS84 — 545 02607 18 / 6746 96469 06
☐ AGD 66/84 ☐ ZONE 52 ☐ ZONE 53 ☑ ZONE 54

3. WELL NAME
4. LAND IDENTIFICATION
Pastoral Lease or Hundred: ARKABA
Title or Plan and Parcel: CT 5979/490
Name of Property

5. SUMMARY *(Please tick appropriate boxes and complete all relevant details)*
Date work Commenced 9/4/2011 Date work Completed 6/5/2011
Work carried out: New Well ☑ Deepen ☐ Enlarge ☐ Rehabilitate ☐ Backfill ☐
Is this a Replacement well? YES/NO if yes please quote replaced well number
Is this an Existing well? YES/NO If yes please quote well number or GPS coordinates
Was well Abandoned? YES/NO if so please state reason and method of backfill
Maximum Depth Drilled 180 (m) Final Depth 177 (m) Final Standing Water Level 24 (m) Final Yield 5 (L/sec)

6. DRILLING DETAILS If not a drilled well, please complete Sections: 6.2, 9, 10, 11, 12 and 13 as necessary

6.1 Construction Details

From (m)	To (m)	Diam (mm)	Drilling Method Cable Tool, Rotary Auger, Down Hole Hammer, etc.	Fluid Used (Air, Water, Mud Type)
0	5	381	ROTARY	BIO-VIS
5	97.5	343	ROTARY	BIO-VIS
97.5	177	254	~~DOWN HOLE~~ AIR	AIR

6.2 Water Cut Details (measurements from natural surface to nearest 0.1 m)

Date	Water Cut From (m)	Water Cut To (m)	Standing Water Level (m)	Estimated Yield (L/sec)	Hole Depth at Test (m)	Casing at Test (m)	Test Method	Salinity (mg/L) or Taste
18/11	97.5	177	24	5	177	97.5	AIR	4000

7. CASING LEFT IN WELL

7.1 Dimensions / 7.2 Type / 7.3 Casing Cemented

From (m)	To (m)	Internal Diam. (mm)	7.2 Swell Joint, Welded Collar, Steel, FRP, PVC, etc.	7.3 Yes	7.3 No	From (m)	To (m)	Cement (bags)	Water (litres)	Other Additives	Cementing Method Used	Comments
0	5	355	STEEL.	☐	☑							
+05	97.5	253	P.V.C CL 12	☑	☐	0	97.5	90	2430	—	PRESSURE	

7.4 COLLAR CASING (must be cemented to surface)

				☐	☐							

8. CONSTRUCTION AT PRODUCTION LEVEL
8.1 Method
☐ Open Hole
☑ Slotted Casing
☐ Screen(s)
☐ Other, give details:

8.2 Screen or Casing (*If variable aperture screen used give limits)

Type	From (m)	To (m)	Aperture* (mm)	Inner Diam (mm)	Outer Diam (mm)	Material	Trade Name	Completion of Base
P.V.C 12	93	117	1	203	225	P.V.C		BLANK

8.3 Liner Seal (Packer)

Material	Depth (m)	Internal Diam (mm)

8.4 Gravel Packing

Method of Placement	Gravel Passing Mesh Size	From (m)	To (m)

9. IF NOT A DRILLED WELL

Method	Depth (m)	Length (m)	Width (m)	Diam (m)	Lining Material	From (m)	To (m)

10. DEVELOPMENT (State methods and time taken)

Method	Hours	Minutes
ACQ. WHILE DRILLING +	1	

11. PUMPING TEST (measurements from natural surface to nearest 0.1m)

Interval Tested From (m)	Interval Tested To (m)	Water Level (m)	Test Method	Pump Depth (m)	Discharge Rate (L/sec)	Method of Measuring Discharge	Hours Pumped	Draw Down (m)

12. SAMPLES
The Natural Resource Management Act 2004 and Regulations require that strata and water samples must be obtained. If any samples have not been obtained state reasons:

As the person responsible I advise that the work has been completed as described above.

Signature of Licensed Driller P Wagenknecht Date 9.5.11

Driller to deliver this copy together with water samples collected and well location map within 14 days of completion to any of the locations below:
Department of Water, Land and Biodiversity Conservation
Natural Resources Information, GPO Box 2834 Adelaide SA 5001 (reports only)
Water Laboratory and Geophysical Services, 23 Conyngham Street GLENSIDE SA 5065 or
Mount Gambier Regional Office, 11 Helen Street MOUNT GAMBIER SA 5290 or
Naracoorte Regional Office, 101 Coster Avenue, NARACOORTE SA 5271

13. FORMATION LOG

From (m)	To (m)	Description of Material
0	4	RED SAND & GRAVEL
4	15	BROWN SILTY CLAY WITH GREY CLAY LAYERS
15	21	BROWN SILTY CLAY & GRAVEL
21	29	BROWN CLAY WITH BLACK SLATE LAYERS
29	31	GREY CLAY
31	39	DARK GREY CLAY & SLATE LAYERS
39	50	HARD GREY SLATE
50	60	DARK GREY CLAY & SLATE LAYERS
60	85	WEATHERED MARL
85	95	GREY CLAY & SLATE LAYERS
95	177	HARD GREY SLATE.

UNIT NUMBER 6534341

HAWKER TWS 4 (SITE A – ABANDONED AND BACKFILLED WELL)

GOVERNMENT OF SOUTH AUSTRALIA
DRILLERS WELL CONSTRUCTION REPORT
Natural Resource Management Act 2004
DETAILS OF ALL WORK UNDERTAKEN MUST BE REFLECTED IN THIS REPORT

1. PERMIT NO: 19607 Site A

NAME OF DRILLER PAUL WAGENKNECHT Licence No: 165177
Contact Phone/Mobile No.:
Name of plant operator if under supervision

PERMIT HOLDER or land occupier DEPARTMENT FOR WATER
Postal Address L11, 25 GRENFELL STREET, ADELAIDE, SA Post Code 5000

2. LOCATION OF WELL
Date of Survey ..... Surveyed by ..... Method .....
GPS COORDINATES AND DATUM USED
☐ GDA 94/WGS84
☐ AGD 66/84
☐ ZONE 52 ☐ ZONE 53 ☐ ZONE 54

3. WELL NAME
4. LAND IDENTIFICATION
Pastoral Lease or Hundred: ARKABA
Title or Plan and Parcel: CT 5979/490
Name of Property

5. SUMMARY *(Please tick appropriate boxes and complete all relevant details)*
Date work Commenced 4/4/2011 Date work Completed 15/4/2011
Work carried out: New Well ☑ Deepen ☐ Enlarge ☐ Rehabilitate ☐ Backfill ☐
Is this a Replacement well? ~~YES~~/NO if yes please quote replaced well number
Is this an Existing well? ~~YES~~/NO **If yes please quote well number or GPS coordinates**
Was well Abandoned? YES/~~NO~~ if so please state reason and method of backfill DRILL BIT LOST DOWN HOLE, HOLE BACKFILLED WITH CEMENT
Maximum Depth Drilled 99 (m) Final Depth 0 (m) Final Standing Water Level — (m) Final Yield — (L/sec)

6. DRILLING DETAILS If not a drilled well, please complete Sections: 6.2, 9, 10, 11, 12 and 13 as necessary

6.1 Construction Details

From (m)	To (m)	Diam (mm)	Drilling Method Cable Tool, Rotary Auger, Down Hole Hammer, etc.	Fluid Used (Air, Water, Mud Type)
0	5	381	ROTARY	BIO-VIS
5	99	343	ROTARY	BIO-VIS

6.2 Water Cut Details (measurements from natural surface to nearest 0.1 m)

Date	Water Cut From (m)	Water Cut To (m)	Standing Water Level (m)	Estimated Yield (L/sec)	Hole Depth at Test (m)	Casing at Test (m)	Test Method	Salinity (mg/L) or Taste

7. CASING LEFT IN WELL

7.1 Dimensions / 7.2 Type / 7.3 Casing Cemented

From (m)	To (m)	Internal Diam. (mm)	Swell Joint, Welded Collar, Steel, FRP, PVC, etc.	Yes	No	From (m)	To (m)	Cement (bags)	Water (litres)	Other Additives	Cementing Method Used	Comments
0	5	355	STEEL	☐	☒							
				☐	☐							

7.4 COLLAR CASING (must be cemented to surface)

				☐	☐							

8. CONSTRUCTION AT PRODUCTION LEVEL

8.1 Method
☐ Open Hole
☐ Slotted Casing
☐ Screen(s)
☐ Other, give details:

8.2 Screen or Casing (*If variable aperture screen used give limits)

Type	From (m)	To (m)	Aperture* (mm)	Inner Diam (mm)	Outer Diam (mm)	Material	Trade Name	Completion of Base

8.3 Liner Seal (Packer)

Material	Depth (m)	Internal Diam (mm)

8.4 Gravel Packing

Method of Placement	Gravel Passing Mesh Size	From (m)	To (m)

9. IF NOT A DRILLED WELL

Method	Depth (m)	Length (m)	Width (m)	Diam (m)	Lining Material	From (m)	To (m)

10. DEVELOPMENT (State methods and time taken)

Method	Hours	Minutes

11. PUMPING TEST (measurements from natural surface to nearest 0.1m)

Interval Tested From (m)	Interval Tested To (m)	Water Level (m)	Test Method	Pump Depth (m)	Discharge Rate (L/sec)	Method of Measuring Discharge	Hours Pumped	Draw Down (m)

12. SAMPLES
The Natural Resource Management Act 2004 and Regulations require that strata and water samples must be obtained. If any samples have not been obtained state reasons:

As the person responsible, I advise that the work has been completed as described above.
Signature of Licensed Driller ADRIAN COSTAR (DFW. SENIOR HYDROGEOLOGIST) c/o KINGSDRILL DRILLING Date 11/12/2012

13. FORMATION LOG

From (m)	To (m)	Description of Material
		DRILL HOLE ABANDONED & BACKFILLED
		DRILL HOLE MOVED ~4m SOUTH
		TO E:260718 N:6469808 WITH
		SUCCESSFUL WELL COMPLETION
		FOR FORMATION LOG SEE 6534-341
		(HAWKER TWS4)

Driller to deliver this copy together with water samples collected and well location map within 14 days of completion to any of the locations below:
Department of Water Land and Biodiversity Conservation
Science Monitoring & Information, GPO Box 2834 Adelaide SA 5001 (reports only)
Water Laboratory and Geophysical Services, 23 Conyngham Street GLENSIDE SA 5065 or
Mount Gambier Regional Office, 11 Helen Street MOUNT GAMBIER SA 5290 or
Naracoorte Regional Office, 101 Cedar Avenue, NARACOORTE SA 5271

UNIT NUMBER 6534 342

PARACHILNA TWS 2

GOVERNMENT OF SOUTH AUSTRALIA
DRILLERS WELL CONSTRUCTION REPORT
Natural Resource Management Act 2004

1. PERMIT NO: 20072 Site

NAME OF DRILLER S. Tuckwell Licence No: 33432
Contact Phone/Mobile No.: Kangarilla Drilling
Name of plant operator if under supervision J. Mason

PERMIT HOLDER or land occupier Department For Water
Postal Address Level 11 25 Grenfell Street
Adelaide SA Post Code 5000

2. LOCATION OF WELL
Date of Survey 6/4/11 Surveyed by ..... Method .....
GPS COORDINATES AND DATUM USED
☑ GDA 94/WGS84 ☐ AGD 66/84
54h - 0747939
UTM - 3447291
☐ ZONE 52 ☐ ZONE 53 ☑ ZONE 54

3. WELL NAME
4. LAND IDENTIFICATION
Hundred or Pastoral Lease: Nilpena
Parcel ID or CT number CT 5451/461 Deposited Plan
Name of Property

5. SUMMARY *(Please tick appropriate boxes and complete all relevant details)*
Date work Commenced 6/4/11 Date work Completed 21/4/11
Work carried out: New Well ☑ Deepen ☐ Enlarge ☐ Rehabilitate ☐ Backfill ☐
Is this a Replacement well? YES/(NO) if yes please quote replaced well number
Is this an Existing well? YES/NO **if yes please quote well number or GPS coordinates**
Was well Abandoned? YES/(NO) if so please state reason and method of backfill
Maximum Depth Drilled 120 (m) Final Depth 82.3 (m) Final Standing Water Level (m) Final Yield (L/sec)

6. DRILLING DETAILS If not a drilled well, please complete Sections: 6.2, 9, 10, 11, 12 and 13 as necessary

6.1 Construction Details

From (m)	To (m)	Diam (mm)	Drilling Method Cable Tool, Rotary Auger, Down Hole Hammer, etc.	Fluid Used (Air, Water, Mud Type)
0	23	330	Rotary	Mud (polymer)
23	61.5	305	Rotary	Mud (polymer)
61.5	120	203	Rotary	Mud (polymer)

6.2 Water Cut Details (measurements from natural surface to nearest 0.1 m)

Date	Water Cut From (m)	Water Cut To (m)	Standing Water Level (m)	Estimated Yield (L/sec)	Hole Depth at Test (m)	Casing at Test (m)	Test Method	Salinity (mg/L) or Taste
26/4/11	61.5	82.3	62	1-2	82.3	61.5	Air	

7. CASING LEFT IN WELL

7.1 Dimensions / 7.2 Type / 7.3 Casing Cemented

From (m)	To (m)	Internal Diam. (mm)	Swell Joint, Welded Collar, Steel, FRP, PVC, etc.	Yes	No	From (m)	To (m)	Cement (bags)	Water (litres)	Other Additives	Cementing Method Used	Comments
+0.5	61.5	200	P.V.C C112	☑	☐	61.5	0	35x40kg	1225	50kg bentonite	Pressure	

8. CONSTRUCTION AT PRODUCTION LEVEL

8.1 Method
☐ Open Hole
☐ Slotted Casing
☑ Screen(s)
☐ Other, give details:

8.2 Screen or Casing (*If variable aperture screen used give limits)

Type	From (m)	To (m)	Aperture* (mm)	Inner Diam (mm)	Outer Diam (mm)	Material	Trade Name	Completion of Base
Screen	59.8	82.3	0.1mm	150	168	S.S	Johnsons	End plate

8.3 Liner Seal (Packer)

Material	Depth (m)	Internal Diam (mm)

8.4 Gravel Packing

Method of Placement	Gravel Passing Mesh Size	From (m)	To (m)

9. IF NOT A DRILLED WELL

Method	Depth (m)	Length (m)	Width (m)	Diam (m)	Lining Material	From (m)	To (m)

10. DEVELOPMENT (State methods and time taken)

Method	Hours	Minutes
Air lift	5	30

11. PUMPING TEST (measurements from natural surface to nearest 0.1m)

Interval Tested From (m)	Interval Tested To (m)	Water Level (m)	Test Method	Pump Depth (m)	Discharge Rate (L/sec)	Method of Measuring Discharge	Hours Pumped	Draw Down (m)

12. SAMPLES
The provision of the Natural Resource Management Act 2004 and Regulations require that strata and water samples must be obtained. If any samples have not been obtained state reasons:
Refer to Adrian Costar
As the person responsible I advise that the work has been completed as described above.

Signature of Licensed Driller ..... Date 7/5/11

Driller to deliver this copy together with water samples collected and well location map within 14 days of completion to any of the below locations:
Department of Water Land and Biodiversity Conservation
Water Laboratory and Geophysical Services, 23 Conyngham Street GLENSIDE SA 5065 or
Mount Gambier Regional Office, 11 Helen Street MOUNT GAMBIER SA 5290 or
Naracoorte Regional Office, 101 Cedar Avenue, NARACOORTE SA 5271

13. FORMATION LOG

From (m)	To (m)	Description of Material
0	28	Red silty Clays with gravel/Cobble seams
28	35	Red, Brown Clays + gravels
35	38	gravel seam
38	39	Red, Brown Clay
39	47	Red, brown Clays and Sandy Clays
47	49.5	Hard pand gravels and ore with sandy Clays
49.5	55	Firmer Clays brown and red with gravels
55	60	Brown Clay
60	83	Clays Brown, Red and gravel seams well rounded (tight 20
83	120	Brown Red Clay bands with constant gravel seams
		Bottom of hole backfilled
	with	34x20kg cement + 2% Bentonite

UNIT NUMBER

B. WATER WELL LOGS

Water Well Log

Project: **Far North TWS – Hawker and Parachilna**

Permit Number: **199606**
Date Completed: **31/3/2011**
Unit No: **6534-340**
Drillhole Name: **Hawker TWS 3**
Logged By: **A Costar**

Backfilled (Y/N): **N**
Final Depth (m): **150**
Drill Method: **Rotary Mud/Air**
Drilling Company: **Kangarilla Drilling Pty Ltd**
Driller: **P Wagenknecht**

Coordinates
Easting: **260572**
Northing: **6469877**
Zone: **54**
Datum: **GDA94**

Ground Elevation (mAHD): **TBD**
Reference Elevation (mAHD): **TBD**
Reference Point Type: **TOC**

General Comments: NIL

Lithological Description

Depth (m)		Major Lithological Unit(s)	Lithology	Formation
From	To			
0	2	SANDY CLAY	Browny-red sandy clay with abundant sub-angular limestone gravel and pebbles.	FLUVIAL QUATERNARY SEDIMENTS
2	12	SANDY CLAY	Mottled browny-red sandy clay with sub-angular limestone fragments and some gravel.	
12	16	CLAY	Red-brown clay with some medium grained sand.	
16	20	SANDY CLAY	Mottled browny-red sandy clay with sub-angular limestone fragments and some gravel.	
20	22	SANDSTONE	Sandstone with limestone layers.	
22	24	SANDY CLAY	Brown sandy clay with red sub-angular pebbles.	
24	44	CLAY	White stiff clay with some gravel.	
44	50	SILTY CLAY	Yellow silty clay with minor gravel.	
50	60	CLAY	Grey clay with some slate fragments and gravel.	
60	74	SLATE	Grey dolomitic slate with minor sandy clay.	PARARA LIMESTONE
74	150	LIMESTONE	Grey limestone with slate fragments. END OF LOG	

Water Well Log

Water Cut Information

Depth (m)		Depth to Water (m)	Supply			Water Analysis		
From	To		Yield (L/s)	Test Length	Method	Sample No.	Salinity	Salinity Unit (mg/L or EC)
75	75	N/A	N/A	During drilling	V-notch	-	2194	mg/L
80	80	N/A	5.5	During drilling	V-notch	-	2199	mg/L
101	101	N/A	7.5	During drilling	V-notch	-	2256	mg/L
124	124	N/A	9.0	During drilling	V-notch	-	2262	mg/L
(?) 150	(?) 150	N/A	12.0-15.0	During drilling	V-notch	-	2323	mg/L

Casing and Production Zone Information

Case or Production Zone	Depth (m)		Inner Diam (mm)	Material	Aperture (mm)	Cementing		
	From	To				Y/N	From (m)	To (m)
Surface control casing	0	6	355	Schedule 20 steel	-	Y	0	6
Blank	0	70	253	Class 12 blank PVC	-	Y	0	70
Production zone	70	150	203	Class 12 slotted PVC (bells removed)	1	N	-	-

Water Well Log

Project: **Far North TWS – Hawker and Parachilna**

Permit Number: **199607**
Date Completed: **6/5/2011**
Unit No: **6534-341**
Drillhole Name: **Hawker TWS 4**
Logged By: **A Costar**

Backfilled (Y/N): **N**
Final Depth (m): **177**
Total Depth (m): **179**
Drill Method: **Rotary Mud/Air**
Drilling Company: **Kangarilla Drilling Pty Ltd**
Driller: **P Wagenknecht**

Coordinates
Easting: **260718**
Northing: **6469808**
Zone: **54**
Datum: **GDA94**

Ground Elevation (mAHD): **TBD**
Reference Elevation (mAHD): **TBD**
Reference Point Type: **TOC**

General Comments: NIL
At a first attempt the drillhole was abandoned and backfilled due to a lost drill bit down the hole. Rig was moved approximately 4 m south for drilling of a second (and successful) drillhole.

Lithological Description

Depth (m)		Major Lithological Unit(s)	Lithology	Formation
From	To			
0	2	SANDY CLAY	Red-brown sandy clay with abundant limestone fragments.	FLUVIAL QUATERNARY SEDIMENTS
2	10	SANDY CLAY	Mottled red-brown sandy clay with limestone fragments and some gravel.	
10	14	CLAY	Red-brown clay with some medium grained sand.	
14	20	SANDSTONE	Sandstone with limestone layers.	
20	24	SLATE	Black slate with yellow-brown silt.	UNDIFFERENT-IATED MATERIAL
24	28	SILT	Yellow-brown silt with minor clay and slate.	
28	40	SILT	Grey silt with clay.	
40	62	SLATE	Grey slate fragments (with some minor clay 52-62 m).	
62	82	CLAY	White stiff clay with some gravel.	
82	88	CLAY	Grey clay with some slate fragments and gravel.	
88	90	SLATE	Grey slate fragments with minor clay.	
90	96	CLAY	Grey clay with some slate fragments and gravel.	
96	100	SLATE	Grey slate fragments with minor clay and limestone.	PARARA LIMESTONE
100	108	SILT	Grey slate fragments with minor limestone	
108	179	SLATE/LIMESTONE	Grey slate with minor limestone (bands of dark grey slate fragments (134-154 m and 168-176 m). END OF LOG	

Water Well Log

Water Cut Information

Depth (m)		Depth to Water (m)	Supply			Water Analysis		
From	To		Yield (L/s)	Test Length	Method	Sample No.	Salinity	Salinity Unit (mg/L or EC)
126	126	N/A	1.5	During drilling	V-notch	-	3361	mg/L
161	161	N/A	3.0	During drilling	V-notch	-	3379	mg/L
(?) 176	(?) 176	N/A	5.0	During drilling	V-notch	-	3460	mg/L

Casing and Production Zone Information

Case or Production Zone	Depth (m)		Inner Diam (mm)	Material	Aperture (mm)	Cementing		
	From	To				Y/N	From (m)	To (m)
Surface control casing	0	6	355	Schedule 20 steel	-	Y	0	6
Blank	0	97.5	253	Class 12 blank PVC	-	Y	0	97.5
Production zone	97.5	177	203	Class 12 slotted PVC (bells removed)	1	N	-	-

Water Well Log

Project: **Far North TWS – Hawker and Parachilna**

Permit Number: **200712**
Date Completed: **21/4/2011**
Unit No: **6535-170**
Drillhole Name: **Parachilna TWS 2**
Logged By: **A Costar**

Backfilled (Y/N): **N**
Final Depth (m): **82.3**
Total Depth (m): **120**
Drill Method: **Rotary Mud**
Drilling Company: **Kangarilla Drilling Pty Ltd**
Driller: **S Tuckwell/J Mason**

Coordinates
Easting: **252231**
Northing: **6552731**
Zone: **54**
Datum: **GDA94**

Ground Elevation (mAHD): **TBD**
Reference Elevation (mAHD): **TBD**
Reference Point Type: **TOC**

General Comments: NIL

Lithological Description

Depth (m)		Major Lithological Unit(s)	Lithology	Formation
From	To			
0	2	SANDY CLAY	Red-brown sandy clay with abundant limestone fragments.	ALLUVIAL QUATERNARY SEDIMENTS
2	10	SANDY CLAY	Mottled red-brown sandy clay with limestone fragments and some gravel.	
10	14	CLAY	Red-brown clay with some medium grained sand.	
0	26	SILTY CLAY/PEBBLES	Red-brown silty clay with 50% gravels and well rounded pebbles.	
26	38	CLAY	Red-brown clay with 10% well-rounded gravels and pebbles.	
38	40	CLAY	Red-brown clay.	
40	46	SILTY CLAY	Red-brown silty clay with 30% sub-rounded gravel.	
46	48	GRAVELS	Gravels with minor clay.	
48	56	CLAY	Red-brown clay with 10% well-rounded gravels and pebbles.	
56	62	CLAY	Red-brown clay with <1% gravels.	
62	68	GRAVELS	Gravels with minor brown clay and abundant shale fragments.	
68	74	CLAY	Red-brown clay with 5% well-rounded gravels.	
74	78	GRAVELS	Gravels with minor red-brown clay.	
78	86	GRAVELS/CLAY	Gravels with red-brown clay.	
86	88	SILTY CLAY	Red-brown silty clay with minor gravel.	
88	111	SILTY CLAY	Red-brown silty clay with some fine-medium grained sand.	

Water Well Log

Depth (m)		Major Lithological Unit(s)	Lithology	Formation
From	To			
111	114	GRAVELS	Gravels with clay and the presence of sandstone fragments.	ALLUVIAL QUATERNARY SEDIMENTS
114	120	SANDY CLAY	Red-brown coarse sandy clay with minor silt.	

Permeable Zone Information

Depth (m)		Depth to Water (m)	Supply			Water Analysis		
From	To		Yield (L/s)	Test Length	Method	Sample No.	Salinity	Salinity Unit (mg/L or EC)
74.5	77	N/A	N/A	-	N/A	-	N/A	-
81.6	83.6	N/A	N/A	-	N/A	-	N/A	-
97.6	101.2	N/A	N/A	-	N/A		N/A	-
110.8	114	N/A	N/A	-	N/A	-	N/A	-

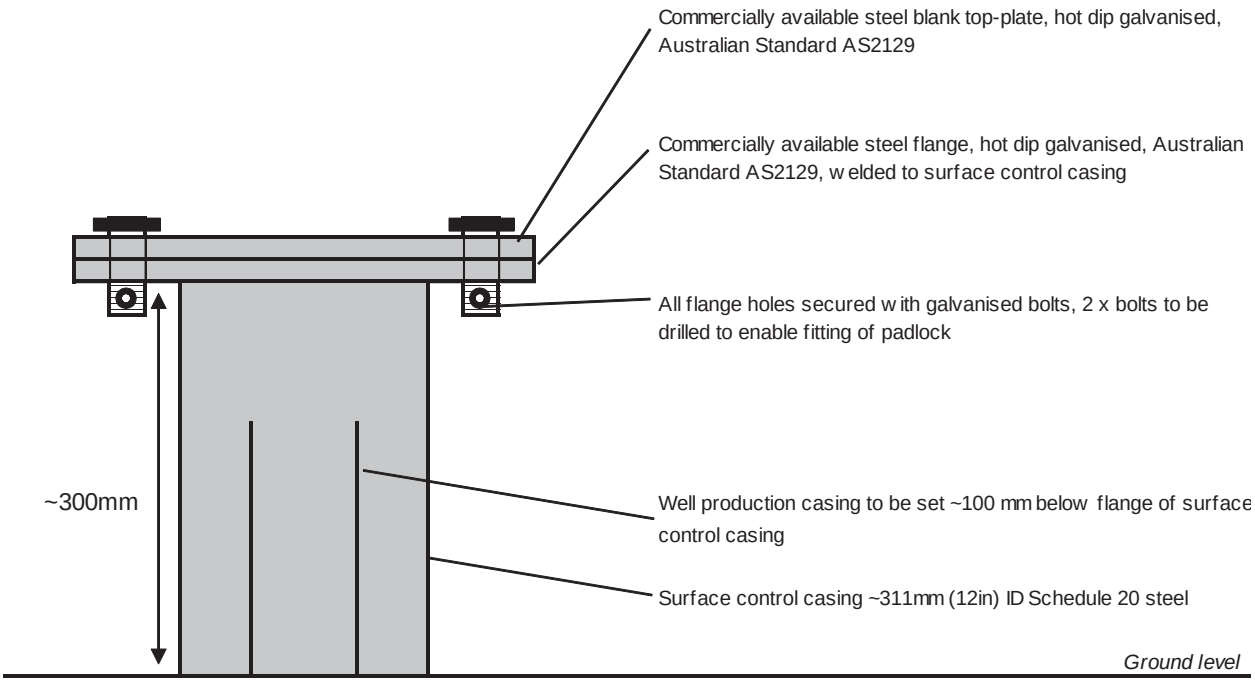
Casing and Production Zone Information

Case or Production Zone	Depth (m)		Inner Diam (mm)	Material	Aperture (mm)	Cementing		
	From	To				Y/N	From (m)	To (m)
Surface control casing	0	24	304.8	Schedule 20 steel	-	Y	0	6
Blank	24	62	253	Class 12 blank PVC	-	Y	0	62
Production zone	62.3	67.3	203	316 stainless wire-wound screen	1	N	-	-
Production zone	73.8	76.3	203	316 stainless wire-wound screen	0.65	N	-	-

C. SIEVE ANALYSIS FOR PARACHILNA TWS 2 PRODUCTION ZONE

Aperture (mm)	Production zone (m)	
	62–68	74.5–77
	% retained	
1	85.4	71.7
0.6	6.5	11.7
0.355	5.0	10.2
Tray	3.1	6.4
Screen aperture size selection (mm)	**0.65**	**1.0**

D. WELLHEAD DESIGN



E. PUMPING TEST DATA

E.1 Production Well Data

Hawker TWS 3—Step drawdown test

Step No.	Rate (L/s)	Duration (min)	DTW (m)	DD (m)
1	5	0	23.23	0.00
1	5	1	25.29	2.06
1	5	2	26.12	2.89
1	5	3	26.20	2.97
1	5	4	26.26	3.03
1	5	5	26.32	3.09
1	5	6	26.36	3.13
1	5	7	26.39	3.16
1	5	8	26.41	3.18
1	5	9	26.43	3.20
1	5	10	26.45	3.22
1	5	12	26.48	3.25
1	5	14	26.50	3.27
1	5	16	26.52	3.29
1	5	18	26.58	3.35
1	5	20	26.61	3.38
1	5	22	26.64	3.41
1	5	24	26.67	3.44
1	5	26	26.68	3.45
1	5	28	26.68	3.45
1	5	30	26.68	3.45
1	5	35	26.71	3.48
1	5	40	26.73	3.50
1	5	45	26.75	3.52
1	5	50	26.76	3.53
1	5	55	26.78	3.55
1	5	60	26.80	3.57
1	5	70	26.78	3.55
1	5	80	26.77	3.54
1	5	90	26.76	3.53
1	5	100	26.76	3.53
2	10	101	28.94	5.71
2	10	102	30.30	7.07
2	10	103	30.74	7.51
2	10	104	30.96	7.73
2	10	105	31.07	7.84

Step No.	Rate (L/s)	Duration (min)	DTW (m)	DD (m)
2	10	106	31.12	7.89
2	10	107	31.20	7.97
2	10	108	31.26	8.03
2	10	109	31.29	8.06
2	10	110	31.32	8.09
2	10	112	31.34	8.11
2	10	114	31.40	8.17
2	10	116	31.42	8.19
2	10	118	31.48	8.25
2	10	120	31.47	8.24
2	10	122	31.49	8.26
2	10	124	31.50	8.27
2	10	126	31.52	8.29
2	10	128	31.53	8.30
2	10	130	31.54	8.31
2	10	135	31.57	8.34
2	10	140	31.60	8.37
2	10	145	31.62	8.39
2	10	150	31.64	8.41
2	10	155	31.66	8.43
2	10	160	31.70	8.47
2	10	170	31.78	8.55
2	10	180	31.84	8.61
2	10	190	31.88	8.65
2	10	200	31.90	8.67
3	15	201	34.15	10.92
3	15	202	36.40	13.17
3	15	203	36.94	13.71
3	15	204	37.21	13.98
3	15	205	37.41	14.18
3	15	206	37.53	14.30
3	15	207	37.62	14.39
3	15	208	37.70	14.47
3	15	209	37.77	14.54
3	15	210	37.81	14.58
3	15	212	37.90	14.67
3	15	214	37.92	14.69
3	15	216	37.97	14.74
3	15	218	38.09	14.86
3	15	220	38.11	14.88
3	15	222	38.14	14.91

Step No.	Rate (L/s)	Duration (min)	DTW (m)	DD (m)
3	15	224	38.15	14.92
3	15	226	38.20	14.97
3	15	228	38.22	14.99
3	15	230	38.23	15.00
3	15	235	38.28	15.05
3	15	240	38.32	15.09
3	15	245	38.37	15.14
3	15	250	38.39	15.16
3	15	255	38.44	15.21
3	15	260	38.46	15.23
3	15	270	38.52	15.29
3	15	280	38.59	15.36
3	15	290	38.63	15.40
3	15	300	38.69	15.46
4	18	301	40.85	17.62
4	18	302	41.79	18.56
4	18	303	42.15	18.92
4	18	304	42.38	19.15
4	18	305	42.54	19.31
4	18	306	42.63	19.40
4	18	307	42.71	19.48
4	18	308	42.79	19.56
4	18	309	42.83	19.60
4	18	310	42.88	19.65
4	18	312	42.97	19.74
4	18	314	43.00	19.77
4	18	316	43.07	19.84
4	18	318	43.10	19.87
4	18	320	43.14	19.91
4	18	322	43.16	19.93
4	18	324	43.19	19.96
4	18	326	43.23	20.00
4	18	328	43.25	20.02
4	18	330	43.29	20.06
4	18	335	43.36	20.13
4	18	340	43.40	20.17
4	18	345	43.45	20.22
4	18	350	43.49	20.26
4	18	355	43.53	20.30
4	18	360	43.59	20.36

Hawker TWS 3—Constant rate discharge test

Rate (L/s)	Duration (min)	DTW (m)	DD (m)
10	0	23.45	0.00
10	1	28.54	5.09
10	2	29.70	6.25
10	3	30.16	6.71
10	4	30.41	6.96
10	5	30.66	7.21
10	6	30.80	7.35
10	7	30.90	7.45
10	8	30.95	7.50
10	9	31.01	7.56
10	10	31.06	7.61
10	12	31.12	7.67
10	14	31.18	7.73
10	16	31.22	7.77
10	18	31.33	7.88
10	20	31.39	7.94
10	22	31.43	7.98
10	24	31.46	8.01
10	26	31.48	8.03
10	28	31.49	8.04
10	30	31.51	8.06
10	35	31.56	8.11
10	40	31.59	8.14
10	45	31.63	8.18
10	50	31.65	8.20
10	55	31.69	8.24
10	60	31.73	8.28
10	70	31.78	8.33
10	80	31.83	8.38
10	90	31.85	8.40
10	100	31.88	8.43
10	120	31.95	8.50
10	140	32.04	8.59
10	160	32.10	8.65
10	180	32.18	8.73
10	200	32.23	8.78
10	250	32.36	8.91
10	300	32.48	9.03
10	350	32.60	9.15

Rate (L/s)	Duration (min)	DTW (m)	DD (m)
10	400	32.65	9.20
10	450	32.84	9.39
10	500	32.89	9.44
10	550	32.96	9.51
10	600	33.02	9.57
10	650	33.04	9.59
10	700	33.07	9.62
10	750	33.12	9.67
10	800	33.19	9.74
10	850	33.27	9.82
10	900	33.31	9.86
10	950	33.38	9.93
10	1000	33.42	9.97
10	1050	33.45	10.00
10	1100	33.49	10.04
10	1150	33.56	10.11
10	1200	33.62	10.17
10	1250	33.63	10.18
10	1300	33.66	10.21
10	1350	33.70	10.25
10	1400	33.74	10.29
10	1450	33.78	10.33
10	1500	33.84	10.39
10	1550	33.88	10.43
10	1600	33.88	10.43
10	1650	33.90	10.45
10	1700	33.94	10.49
10	1750	33.99	10.54
10	1800	34.00	10.55
10	1850	34.06	10.61
10	1900	34.06	10.61
10	1950	34.08	10.63
10	2000	34.11	10.66
10	2050	34.13	10.68
10	2100	34.15	10.70
10	2150	34.16	10.71
10	2200	34.18	10.73
10	2250	34.19	10.74
10	2300	34.21	10.76
10	2350	34.24	10.79
10	2400	34.25	10.80

Rate (L/s)	Duration (min)	DTW (m)	DD (m)
10	2450	34.26	10.81
10	2500	34.28	10.83
10	2550	34.30	10.85
10	2600	34.32	10.87
10	2650	34.35	10.90
10	2700	34.35	10.90
10	2750	34.37	10.92
10	2800	34.42	10.97
10	2850	34.44	10.99
10	2880	34.45	11.00
15	2881	38.75	15.30
15	2882	39.10	15.65
15	2883	39.41	15.96
15	2884	39.76	16.31
15	2885	40.00	16.55
15	2886	40.22	16.77
15	2887	40.28	16.83
15	2888	40.34	16.89
15	2889	40.38	16.93
15	2890	40.44	16.99
15	2892	40.49	17.04
15	2894	40.53	17.08
15	2896	40.56	17.11
15	2898	40.57	17.12
15	2900	40.62	17.17
15	2902	40.64	17.19
15	2904	40.64	17.19
15	2906	40.69	17.24
15	2908	40.69	17.24
15	2910	40.69	17.24
15	2915	40.69	17.24
15	2920	40.72	17.27
15	2925	40.76	17.31
15	2930	40.80	17.35
15	2935	40.82	17.37
15	2940	40.83	17.38
15	2950	40.86	17.41
15	2960	40.88	17.43
15	2970	40.92	17.47
15	2980	40.94	17.49
15	3000	40.95	17.50

Rate (L/s)	Duration (min)	DTW (m)	DD (m)
15	3020	41.05	17.60
15	3040	41.08	17.63
15	3060	41.11	17.66
15	3080	41.14	17.69
15	3100	41.19	17.74
15	3150	41.25	17.80
15	3200	41.33	17.88
15	3250	41.38	17.93
15	3300	41.43	17.98
15	3350	41.48	18.03
15	3400	41.53	18.08
15	3450	41.56	18.11
15	3500	41.58	18.13
15	3550	41.60	18.15
15	3600	41.63	18.18
15	3650	41.67	18.22
15	3700	41.69	18.24
15	3750	41.71	18.26
15	3800	41.73	18.28
15	3850	41.75	18.30
15	3900	41.77	18.32
15	3950	41.79	18.34
15	4000	41.81	18.36
15	4050	41.83	18.38
15	4100	41.86	18.41
15	4150	41.88	18.43
15	4200	41.89	18.44
15	4250	41.91	18.46
15	4300	41.94	18.49
15	4320	41.95	18.50
0	4321	31.50	8.05
0	4322	29.91	6.46
0	4323	28.93	5.48
0	4324	28.62	5.17
0	4325	28.29	4.84
0	4326	28.13	4.68
0	4327	28.00	4.55
0	4328	27.88	4.43
0	4329	27.86	4.41
0	4330	27.81	4.36
0	4332	27.77	4.32

Rate (L/s)	Duration (min)	DTW (m)	DD (m)
0	4334	27.64	4.19
0	4336	27.56	4.11
0	4338	27.53	4.08
0	4340	27.48	4.03
0	4342	27.45	4.00
0	4344	27.40	3.95
0	4346	27.37	3.92
0	4348	27.36	3.91
0	4350	27.33	3.88
0	4355	27.20	3.75
0	4360	27.16	3.71
0	4365	27.11	3.66
0	4370	27.04	3.59
0	4375	27.00	3.55
0	4380	26.98	3.53
0	4390	26.94	3.49
0	4400	26.84	3.39
0	4410	26.79	3.34
0	4420	26.73	3.28
0	4440	26.68	3.23
0	4460	26.57	3.12
0	4480	26.52	3.07
0	4500	26.46	3.01
0	4520	26.42	2.97
0	4570	26.23	2.78
0	4620	26.08	2.63
0	4670	25.97	2.52
0	4720	25.85	2.40
0	4770	25.75	2.30
0	4820	25.68	2.23
0	4870	25.59	2.14
0	4920	25.52	2.07
0	5020	25.33	1.88
0	5120	25.20	1.75
0	5220	25.09	1.64
0	5320	24.99	1.54
0	5420	24.87	1.42
0	5520	24.78	1.33
0	5620	24.71	1.26
0	5720	24.66	1.21
0	5820	24.56	1.11

Rate (L/s)	Duration (min)	DTW (m)	DD (m)
0	5920	24.51	1.06
0	6020	24.43	0.98
0	6120	24.39	0.94
0	6220	24.33	0.88
0	6320	24.29	0.84
0	6620	24.14	0.69
0	7120	23.91	0.46
0	7420	23.87	0.42
0	7720	23.75	0.30
0	7920	23.71	0.26
0	8220	23.64	0.19
0	8620	23.52	0.07
0	8640	23.51	0.06

Hawker TWS 4—Step drawdown test

Step No.	Rate (L/s)	Duration (min)	DTW (m)	DD (m)
1	5	0	23.23	0.00
1	0	0	23.12	0.00
1	4	1	26.49	3.37
1	4	2	27.63	4.51
1	4	3	28.16	5.04
1	4	4	28.51	5.39
1	4	5	28.74	5.62
1	4	6	28.91	5.79
1	4	7	29.04	5.92
1	4	8	29.19	6.07
1	4	9	29.27	6.15
1	4	10	29.35	6.23
1	4	12	29.51	6.39
1	4	14	29.60	6.48
1	4	16	29.68	6.56
1	4	18	29.75	6.63
1	4	20	29.80	6.68
1	4	22	29.88	6.76
1	4	24	29.92	6.80
1	4	26	29.96	6.84
1	4	28	30.00	6.88
1	4	30	30.06	6.94
1	4	35	30.09	6.97

Step No.	Rate (L/s)	Duration (min)	DTW (m)	DD (m)
1	4	40	30.15	7.03
1	4	45	30.20	7.08
1	4	50	30.22	7.10
1	4	55	30.28	7.16
1	4	60	30.31	7.19
1	4	70	30.35	7.23
1	4	80	30.48	7.36
1	4	90	30.51	7.39
1	4	100	30.56	7.44
2	8	101	34.22	11.10
2	8	102	36.48	13.36
2	8	103	38.10	14.98
2	8	104	39.41	16.29
2	8	105	40.05	16.93
2	8	106	40.71	17.59
2	8	107	41.13	18.01
2	8	108	41.42	18.30
2	8	109	41.75	18.63
2	8	110	41.95	18.83
2	8	112	42.36	19.24
2	8	114	42.66	19.54
2	8	116	42.89	19.77
2	8	118	43.06	19.94
2	8	120	43.21	20.09
2	8	122	43.34	20.22
2	8	124	43.44	20.32
2	8	126	43.62	20.50
2	8	128	43.72	20.60
2	8	130	43.78	20.66
2	8	135	43.90	20.78
2	8	140	44.01	20.89
2	8	145	44.13	21.01
2	8	150	44.21	21.09
2	8	155	44.33	21.21
2	8	160	44.40	21.28
2	8	170	44.52	21.40
2	8	180	44.70	21.58
2	8	190	44.77	21.65
2	8	200	44.80	21.68
3	12	201	49.66	26.54
3	12	202	52.78	29.66

Step No.	Rate (L/s)	Duration (min)	DTW (m)	DD (m)
3	12	203	54.72	31.60
3	12	204	55.50	32.38
3	12	205	57.78	34.66
3	12	206	58.87	35.75
3	12	207	59.80	36.68
3	12	208	61.30	38.18
3	12	209	61.00	37.88
3	12	210	61.59	38.47
3	12	212	62.48	39.36
3	12	214	63.15	40.03
3	12	216	63.55	40.43
3	12	218	64.00	40.88
3	12	220	64.29	41.17
3	12	222	64.56	41.44
3	12	224	64.88	41.76
3	12	226	65.09	41.97
3	12	228	65.27	42.15
3	12	230	65.48	42.36
3	12	235	65.80	42.68
3	12	240	66.08	42.96
3	12	245	66.32	43.20
3	12	250	66.46	43.34
3	12	255	66.70	43.58
3	12	260	66.85	43.73
3	12	270	67.19	44.07
3	12	280	67.30	44.18
3	12	290	67.60	44.48
3	12	300	67.71	44.59
4	13.5	301	69.78	46.66
4	13.5	302	71.01	47.89
4	13.5	303	71.94	48.82
4	13.5	304	72.81	49.69
4	13.5	305	73.33	50.21
4	13.5	306	73.83	50.71
4	13.5	307	74.28	51.16
4	13.5	308	74.60	51.48
4	13.5	309	74.95	51.83
4	13.5	310	75.21	52.09
4	13.5	312	75.57	52.45
4	13.5	314	76.05	52.93
4	13.5	316	76.26	53.14

Step No.	Rate (L/s)	Duration (min)	DTW (m)	DD (m)
4	13.5	318	76.45	53.33
4	13.5	320	76.71	53.59
4	13.5	322	76.90	53.78
4	13.5	324	77.00	53.88
4	13.5	326	77.15	54.03
4	13.5	328	77.29	54.17
4	13.5	330	77.38	54.26
4	13.5	335	77.77	54.65
4	13.5	340	77.90	54.78
4	13.5	345	78.12	55.00
4	13.5	350	78.27	55.15
4	13.5	355	78.42	55.30
4	13.5	360	78.51	55.39
4	13.5	370	78.75	55.63
4	13.5	380	78.91	55.79
4	13.5	390	79.00	55.88
4	13.5	400	79.25	56.13

Hawker TWS 4—Constant rate discharge test

Rate (L/s)	Duration (min)	DTW (m)	DD (m)
10	0	23.38	0.00
10	1	32.26	8.88
10	2	37.38	14.00
10	3	40.67	17.29
10	4	42.18	18.80
10	5	43.54	20.16
10	6	45.36	21.98
10	7	45.89	22.51
10	8	46.68	23.30
10	9	47.50	24.12
10	10	47.71	24.33
10	12	48.55	25.17
10	14	49.11	25.73
10	16	49.41	26.03
10	18	49.88	26.50
10	20	50.40	27.02
10	22	50.86	27.48
10	24	51.04	27.66
10	26	51.38	28.00

Rate (L/s)	Duration (min)	DTW (m)	DD (m)
10	28	51.49	28.11
10	30	51.69	28.31
10	35	52.06	28.68
10	40	52.20	28.82
10	45	52.51	29.13
10	50	52.80	29.42
10	55	52.99	29.61
10	60	53.09	29.71
10	70	53.30	29.92
10	80	53.56	30.18
10	90	53.71	30.33
10	100	54.02	30.64
10	120	54.16	30.78
10	140	54.46	31.08
10	160	54.72	31.34
10	180	54.76	31.38
10	200	54.91	31.53
10	250	55.10	31.72
10	300	55.47	32.09
10	350	55.64	32.26
10	400	56.04	32.66
10	450	56.21	32.83
10	500	56.37	32.99
10	550	56.51	33.13
10	600	56.55	33.17
10	650	56.84	33.46
10	700	56.85	33.47
10	750	56.87	33.49
10	800	57.01	33.63
10	850	57.17	33.79
10	900	57.21	33.83
10	950	57.31	33.93
10	1000	57.40	34.02
10	1050	57.48	34.10
10	1100	57.59	34.21
10	1150	57.70	34.32
10	1200	57.72	34.34
10	1250	57.75	34.37
10	1300	57.77	34.39
10	1350	57.82	34.44
10	1400	57.91	34.53

Rate (L/s)	Duration (min)	DTW (m)	DD (m)
10	1450	57.99	34.61
10	1500	57.98	34.60
10	1550	58.05	34.67
10	1600	58.09	34.71
10	1650	58.13	34.75
10	1700	58.25	34.87
10	1750	58.27	34.89
10	1800	58.29	34.91
10	1850	58.30	34.92
10	1900	58.32	34.94
10	1950	58.40	35.02
10	2000	58.42	35.04
10	2050	58.40	35.02
10	2100	58.42	35.04
10	2150	58.45	35.07
10	2200	58.47	35.09
10	2250	58.48	35.10
10	2300	58.53	35.15
10	2350	58.56	35.18
10	2400	58.59	35.21
10	2450	58.62	35.24
10	2500	58.64	35.26
10	2550	58.66	35.28
10	2600	58.68	35.30
10	2650	58.73	35.35
10	2700	58.75	35.37
10	2750	58.80	35.42
10	2800	58.84	35.46
10	2850	58.84	35.46
10	2900	58.85	35.47
10	2950	58.88	35.50
10	3000	58.88	35.50
10	3050	58.96	35.58
10	3100	58.98	35.60
10	3150	58.99	35.61
10	3200	59.02	35.64
10	3250	59.04	35.66
10	3300	59.04	35.66
10	3350	59.09	35.71
10	3400	59.16	35.78
10	3450	59.19	35.81

Rate (L/s)	Duration (min)	DTW (m)	DD (m)
10	3500	59.19	35.81
10	3550	59.19	35.81
10	3600	59.20	35.82
10	3650	59.19	35.81
10	3700	59.19	35.81
10	3750	59.19	35.81
10	3800	59.20	35.82
10	3850	59.21	35.83
10	3900	59.22	35.84
10	3950	59.22	35.84
10	4000	59.23	35.85
10	4050	59.24	35.86
10	4100	59.25	35.87
10	4150	59.26	35.88
10	4200	59.27	35.89
10	4250	59.30	35.92
10	4300	59.31	35.93
10	4320	59.31	35.93
0	4321	48.50	25.12
0	4322	40.91	17.53
0	4323	36.62	13.24
0	4324	35.31	11.93
0	4325	33.04	9.66
0	4326	32.40	9.02
0	4327	31.78	8.40
0	4328	31.32	7.94
0	4329	31.00	7.62
0	4330	30.56	7.18
0	4332	30.08	6.70
0	4334	29.63	6.25
0	4336	29.31	5.93
0	4338	29.05	5.67
0	4340	28.87	5.49
0	4342	28.68	5.30
0	4344	28.49	5.11
0	4346	28.40	5.02
0	4348	28.27	4.89
0	4350	28.20	4.82
0	4355	28.00	4.62
0	4360	27.81	4.43
0	4365	27.67	4.29

Rate (L/s)	Duration (min)	DTW (m)	DD (m)
0	4370	27.57	4.19
0	4375	27.48	4.10
0	4380	27.40	4.02
0	4390	27.20	3.82
0	4400	27.11	3.73
0	4410	27.00	3.62
0	4420	26.89	3.51
0	4440	26.69	3.31
0	4460	26.54	3.16
0	4480	26.41	3.03
0	4500	26.30	2.92
0	4520	26.19	2.81
0	4570	26.02	2.64
0	4620	25.85	2.47
0	4670	25.72	2.34
0	4720	25.60	2.22
0	4770	25.49	2.11
0	4820	25.40	2.02
0	4870	25.31	1.93
0	4920	-	-
0	4970	-	-
0	5020	25.12	1.74
0	5070	25.06	1.68
0	5120	24.91	1.53
0	5170	24.86	1.48
0	5220	-	-
0	5620	24.41	1.03
0	5720	24.33	0.95
0	5820	24.25	0.87
0	5920	24.15	0.77
0	6020	24.08	0.70
0	6120	24.02	0.64
0	6220	-	-
0	6320	-	-
0	6420	23.83	0.45
0	6520	-	-
0	6620	-	-
0	6720	-	-
0	6820	-	-
0	6920	-	-
0	7020	23.58	0.20

Rate (L/s)	Duration (min)	DTW (m)	DD (m)
0	7120	23.57	0.19
0	7220	23.53	0.15
0	7320	23.47	0.09
0	7420	23.45	0.07
0	7520	23.41	0.03
0	7620	23.40	0.02
0	7720	-	-
0	7820	23.37	-0.01
0	7920	-	-
0	8020	-	-
0	8120	-	-
0	8220	-	-
0	8320	-	-
0	8420	-	-
0	8520	23.15	-0.23
0	8620	23.15	-0.23
0	8640	23.15	-0.23

Parachilna TWS 2—Step drawdown test

Step No.	Rate (L/s)	Duration (min)	DTW (m)	DD (m)
1	2	0.0	64.3	0.000
1	2	1.0	65.3	1.020
1	2	2.0	65.1	0.810
1	2	3.0	65.0	0.720
1	2	4.0	65.0	0.690
1	2	5.0	65.0	0.690
1	2	6.0	65.0	0.690
1	2	7.0	65.0	0.690
1	2	8.0	65.0	0.690
1	2	9.0	65.0	0.690
1	2	10.0	65.0	0.690
1	2	12.0	65.0	0.690
1	2	14.0	65.0	0.690
1	2	16.0	65.0	0.690
1	2	18.0	65.0	0.690
1	2	20.0	65.0	0.690
1	2	22.0	65.0	0.690
1	2	24.0	65.0	0.690
1	2	26.0	65.0	0.690

Step No.	Rate (L/s)	Duration (min)	DTW (m)	DD (m)
1	2	28.0	65.0	0.690
1	2	30.0	65.0	0.690
1	2	35.0	65.0	0.690
1	2	40.0	65.0	0.690
1	2	45.0	65.0	0.690
1	2	50.0	65.0	0.690
1	2	55.0	65.0	0.690
1	2	60.0	65.0	0.690
1	2	70.0	65.0	0.690
1	2	80.0	65.0	0.695
1	2	90.0	65.0	0.690
1	2	100.0	65.0	0.690
2	3	101.0	65.3	1.010
2	3	102.0	65.4	1.110
2	3	103.0	65.4	1.130
2	3	104.0	65.4	1.130
2	3	105.0	65.4	1.140
2	3	106.0	65.4	1.140
2	3	107.0	65.4	1.140
2	3	108.0	65.4	1.140
2	3	109.0	65.4	1.140
2	3	110.0	65.4	1.140
2	3	112.0	65.4	1.140
2	3	114.0	65.4	1.140
2	3	116.0	65.4	1.140
2	3	118.0	65.4	1.140
2	3	120.0	65.4	1.140
2	3	122.0	65.4	1.140
2	3	124.0	65.4	1.140
2	3	126.0	65.4	1.140
2	3	128.0	65.4	1.140
2	3	130.0	65.4	1.150
2	3	135.0	65.4	1.140
2	3	140.0	65.4	1.140
2	3	145.0	65.4	1.140
2	3	150.0	65.4	1.140
2	3	155.0	65.4	1.140
2	3	160.0	65.4	1.140
2	3	170.0	65.4	1.140
2	3	180.0	65.4	1.140
2	3	190.0	65.4	1.140

Step No.	Rate (L/s)	Duration (min)	DTW (m)	DD (m)
2	3	200.0	65.4	1.140
3	4	201.0	65.8	1.540
3	4	202.0	65.9	1.600
3	4	203.0	65.9	1.610
3	4	204.0	65.9	1.610
3	4	205.0	65.9	1.610
3	4	206.0	65.9	1.615
3	4	207.0	65.9	1.620
3	4	208.0	65.9	1.625
3	4	209.0	65.9	1.630
3	4	210.0	65.9	1.630
3	4	212.0	65.9	1.630
3	4	214.0	65.9	1.630
3	4	216.0	65.9	1.630
3	4	218.0	65.9	1.630
3	4	220.0	65.9	1.630
3	4	222.0	65.9	1.630
3	4	224.0	65.9	1.630
3	4	226.0	65.9	1.630
3	4	228.0	65.9	1.630
3	4	230.0	65.9	1.630
3	4	235.0	65.9	1.630
3	4	240.0	65.9	1.630
3	4	245.0	65.9	1.630
3	4	250.0	65.9	1.630
3	4	255.0	65.9	1.630
3	4	260.0	65.9	1.630
3	4	270.0	65.9	1.630
3	4	280.0	65.9	1.630
3	4	290.0	65.9	1.630
3	4	300.0	65.9	1.630
4	5	301.0	66.5	2.160
4	5	302.0	66.5	2.170
4	5	303.0	66.5	2.190
4	5	304.0	66.5	2.190
4	5	305.0	66.5	2.190
4	5	306.0	66.5	2.190
4	5	307.0	66.5	2.190
4	5	308.0	66.5	2.190
4	5	309.0	66.5	2.190
4	5	310.0	66.5	2.195

Step No.	Rate (L/s)	Duration (min)	DTW (m)	DD (m)
4	5	312.0	66.5	2.200
4	5	314.0	66.5	2.200
4	5	316.0	66.5	2.200
4	5	318.0	66.5	2.210
4	5	320.0	66.5	2.210
4	5	322.0	66.5	2.210
4	5	324.0	66.5	2.210
4	5	326.0	66.5	2.210
4	5	328.0	66.5	2.210
4	5	330.0	66.5	2.210
4	5	335.0	66.5	2.210
4	5	340.0	66.5	2.210
4	5	345.0	66.5	2.215
4	5	350.0	66.5	2.220
4	5	355.0	66.5	2.230
4	5	360.0	66.5	2.235
4	5	370.0	66.5	2.235
4	5	380.0	66.5	2.240
4	5	390.0	66.5	2.240
4	5	400.0	66.5	2.240

Parachilna TWS 2—Constant rate discharge test

Rate (L/s)	Duration (min)	DTW (m)	DD (m)
3	0	64.310	0.000
3	1	65.620	1.310
3	2	65.450	1.140
3	3	65.410	1.100
3	4	65.410	1.100
3	5	65.400	1.090
3	6	65.400	1.090
3	7	65.400	1.090
3	8	65.400	1.090
3	9	65.400	1.090
3	10	65.400	1.090
3	12	65.400	1.090
3	14	65.400	1.090
3	16	65.400	1.090
3	18	65.400	1.090
3	20	65.400	1.090

Rate (L/s)	Duration (min)	DTW (m)	DD (m)
3	22	65.400	1.090
3	24	65.400	1.090
3	26	65.400	1.090
3	28	65.400	1.090
3	30	65.400	1.090
3	35	65.400	1.090
3	40	65.400	1.090
3	45	65.400	1.090
3	50	65.400	1.090
3	55	65.400	1.090
3	60	65.400	1.090
3	70	65.405	1.095
3	80	65.405	1.095
3	90	65.405	1.095
3	100	65.405	1.095
3	120	65.400	1.090
3	140	65.400	1.090
3	160	65.405	1.095
3	180	65.405	1.095
3	200	65.405	1.095
3	250	65.405	1.095
3	300	65.400	1.090
3	350	65.395	1.085
3	400	65.395	1.085
3	450	65.400	1.090
3	500	65.400	1.090
3	550	65.400	1.090
3	600	65.400	1.090
3	700	65.400	1.090
3	800	65.405	1.095
3	900	65.405	1.095
3	1000	65.415	1.105
3	1100	65.415	1.105
3	1200	65.425	1.115
3	1300	65.435	1.125
3	1400	65.440	1.130
3	1500	65.450	1.140
3	1600	65.450	1.140
3	1700	65.440	1.130
3	1800	65.440	1.130
3	1900	65.435	1.125

Rate (L/s)	Duration (min)	DTW (m)	DD (m)
3	2000	65.450	1.140
3	2100	65.460	1.150
3	2200	65.465	1.155
3	2300	65.470	1.160
3	2400	65.470	1.160
3	2500	65.475	1.165
3	2600	65.470	1.160
3	2700	65.475	1.165
3	2800	65.480	1.170
3	2900	65.495	1.185
3	3000	65.500	1.190
3	3100	65.500	1.190
3	3200	65.490	1.180
3	3300	65.490	1.180
3	3400	65.495	1.185
3	3500	65.500	1.190
3	3600	65.505	1.195
3	3700	65.505	1.195
3	3800	65.505	1.195
3	3900	65.510	1.200
3	4000	65.510	1.200
3	4100	65.515	1.205
3	4200	65.520	1.210
3	4300	65.520	1.210
3	4320	65.520	1.210
0	4321	64.680	0.370
0	4322	64.440	0.130
0	4323	64.370	0.060
0	4324	64.380	0.070
0	4325	64.380	0.070
0	4326	64.370	0.060
0	4327	64.360	0.050
0	4328	64.360	0.050
0	4329	64.350	0.040
0	4330	64.360	0.050
0	4332	64.350	0.040
0	4334	64.350	0.040
0	4336	64.345	0.035
0	4338	64.345	0.035
0	4340	64.350	0.040
0	4342	64.350	0.040

Rate (L/s)	Duration (min)	DTW (m)	DD (m)
0	4344	64.350	0.040
0	4346	64.345	0.035
0	4348	64.350	0.040
0	4350	64.350	0.040
0	4355	64.350	0.040
0	4360	64.345	0.035
0	4365	64.345	0.035
0	4370	64.345	0.035
0	4375	64.345	0.035
0	4380	64.340	0.030
0	4390	64.335	0.025
0	4400	64.335	0.025
0	4410	64.335	0.025
0	4420	64.330	0.020
0	4440	64.330	0.020
0	4460	64.330	0.020
0	4480	64.325	0.015
0	4500	64.325	0.015
0	4520	64.320	0.010
0	4570	64.320	0.010
0	4620	64.310	0.000
0	4670	64.300	-0.010
0	4720	64.300	-0.010
0	4770	64.300	-0.010

E.2 Observation Well Data

Constant rate discharge test production well: Hawker TWS 3

Hawker TWS 1 (acquired from SA Water (Crystal Brook) Operational Data Store)

Date/Time	Duration (min)	Bore Level (mBNS)	Pump Depth (mBNS)	DD* (m)
25/05/2011 9:30	0	66.007	90	0.000
25/05/2011 9:31	1	66.007	90	0.000
25/05/2011 9:32	2	66.007	90	0.000
25/05/2011 9:33	3	63.003	90	3.004
25/05/2011 9:34	4	62.999	90	3.009
25/05/2011 9:35	5	62.995	90	3.013
25/05/2011 9:36	6	62.990	90	3.017
25/05/2011 9:37	7	62.986	90	3.021
25/05/2011 9:38	8	62.982	90	3.025

Date/Time	Duration (min)	Bore Level (mBNS)	Pump Depth (mBNS)	DD* (m)
25/05/2011 9:39	9	62.978	90	3.029
25/05/2011 9:40	10	62.974	90	3.034
25/05/2011 9:41	11	62.970	90	3.038
25/05/2011 9:42	12	62.965	90	3.042
25/05/2011 9:43	13	62.961	90	3.046
25/05/2011 9:44	14	62.957	90	3.050
25/05/2011 9:45	15	62.953	90	3.054
25/05/2011 9:46	16	62.949	90	3.059
25/05/2011 9:47	17	62.945	90	3.063
25/05/2011 9:48	18	62.940	90	3.067
25/05/2011 9:49	19	62.936	90	3.071
25/05/2011 9:50	20	62.932	90	3.075
25/05/2011 9:51	21	62.928	90	3.079
25/05/2011 9:52	22	62.924	90	3.084
25/05/2011 9:53	23	62.920	90	3.088
25/05/2011 9:54	24	62.915	90	3.092
25/05/2011 9:55	25	62.911	90	3.096
25/05/2011 9:56	26	62.907	90	3.100
25/05/2011 9:57	27	62.903	90	3.104
25/05/2011 9:58	28	62.899	90	3.109
25/05/2011 9:59	29	62.894	90	3.113
25/05/2011 10:00	30	62.890	90	3.117
25/05/2011 10:01	31	62.886	90	3.121
25/05/2011 10:02	32	62.882	90	3.125
25/05/2011 10:03	33	62.878	90	3.130
25/05/2011 10:04	34	62.874	90	3.134
25/05/2011 10:05	35	62.869	90	3.138
25/05/2011 10:06	36	62.865	90	3.142
25/05/2011 10:07	37	62.861	90	3.146
25/05/2011 10:08	38	62.857	90	3.150
25/05/2011 10:09	39	62.853	90	3.155
25/05/2011 10:10	40	62.849	90	3.159
25/05/2011 10:11	41	62.844	90	3.163
25/05/2011 10:12	42	62.840	90	3.167
25/05/2011 10:13	43	62.836	90	3.171
25/05/2011 10:14	44	62.832	90	3.175
25/05/2011 10:15	45	62.828	90	3.180
25/05/2011 10:16	46	62.824	90	3.184
25/05/2011 10:17	47	62.819	90	3.188
25/05/2011 10:18	48	62.815	90	3.192

Date/Time	Duration (min)	Bore Level (mBNS)	Pump Depth (mBNS)	DD* (m)
25/05/2011 10:19	49	62.811	90	3.196
25/05/2011 10:20	50	62.807	90	3.200
25/05/2011 10:21	51	62.803	90	3.205
25/05/2011 10:22	52	62.799	90	3.209
25/05/2011 10:23	53	62.794	90	3.213
25/05/2011 10:24	54	62.790	90	3.217
25/05/2011 10:25	55	62.786	90	3.221
25/05/2011 10:26	56	62.782	90	3.225
25/05/2011 10:27	57	62.778	90	3.230
25/05/2011 10:28	58	62.773	90	3.234
25/05/2011 10:29	59	62.769	90	3.238
25/05/2011 10:30	60	62.765	90	3.242
25/05/2011 10:40	70	62.723	90	3.284
25/05/2011 10:50	80	62.682	90	3.326
25/05/2011 11:00	90	62.640	90	3.367
25/05/2011 11:10	100	62.598	90	3.409
25/05/2011 11:20	110	62.557	90	3.451
25/05/2011 11:30	120	62.515	90	3.493
25/05/2011 11:40	130	62.473	90	3.534
25/05/2011 11:50	140	62.431	90	3.576
25/05/2011 12:00	150	62.390	90	3.618
25/05/2011 12:10	160	62.348	90	3.659
25/05/2011 12:20	170	62.306	90	3.701
25/05/2011 12:30	180	62.264	90	3.743
25/05/2011 12:40	190	62.223	90	3.785
25/05/2011 12:50	200	62.181	90	3.826
25/05/2011 13:00	210	62.139	90	3.868
25/05/2011 13:10	220	62.098	90	3.910
25/05/2011 13:20	230	62.056	90	3.952
25/05/2011 13:30	240	62.014	90	3.993
25/05/2011 13:40	250	61.972	90	4.035
25/05/2011 13:50	260	61.931	90	4.077
25/05/2011 14:00	270	61.889	90	4.118
25/05/2011 14:10	280	61.847	90	4.160
25/05/2011 14:20	290	61.805	90	4.202
25/05/2011 14:30	300	61.764	90	4.244
25/05/2011 14:40	310	61.722	90	4.285
25/05/2011 14:50	320	61.680	90	4.327
25/05/2011 15:00	330	61.639	90	4.369
25/05/2011 15:10	340	61.597	90	4.410

Date/Time	Duration (min)	Bore Level (mBNS)	Pump Depth (mBNS)	DD* (m)
25/05/2011 15:20	350	61.555	90	4.452
25/05/2011 15:30	360	61.513	90	4.494
25/05/2011 15:40	370	61.472	90	4.536
25/05/2011 15:50	380	61.430	90	4.577
25/05/2011 16:00	390	61.388	90	4.619
25/05/2011 16:10	400	61.346	90	4.661
25/05/2011 16:20	410	61.305	90	4.703
25/05/2011 16:30	420	61.263	90	4.744
25/05/2011 16:40	430	61.221	90	4.786
25/05/2011 16:50	440	61.180	90	4.828
25/05/2011 17:00	450	61.138	90	4.869
25/05/2011 17:10	460	61.096	90	4.911
25/05/2011 17:20	470	61.054	90	4.953
25/05/2011 17:30	480	61.013	90	4.995
25/05/2011 17:40	490	60.986	90	5.021
25/05/2011 17:50	500	60.965	90	5.042
25/05/2011 18:00	510	60.944	90	5.063
25/05/2011 18:10	520	60.923	90	5.084
25/05/2011 18:20	530	60.902	90	5.105
25/05/2011 18:30	540	60.882	90	5.126
25/05/2011 18:40	550	60.861	90	5.147
25/05/2011 18:50	560	60.840	90	5.168
25/05/2011 19:00	570	60.819	90	5.188
25/05/2011 19:10	580	60.798	90	5.209
25/05/2011 19:20	590	60.777	90	5.230
25/05/2011 19:30	600	60.756	90	5.251
25/05/2011 19:40	610	60.735	90	5.272
25/05/2011 19:50	620	60.714	90	5.293
25/05/2011 20:00	630	60.693	90	5.314
25/05/2011 20:10	640	60.673	90	5.335
25/05/2011 20:20	650	60.652	90	5.356
25/05/2011 20:30	660	60.631	90	5.377
25/05/2011 20:40	670	60.610	90	5.397
25/05/2011 20:50	680	60.589	90	5.418
25/05/2011 21:00	690	60.568	90	5.439
25/05/2011 21:10	700	60.547	90	5.460
25/05/2011 21:20	710	60.526	90	5.481
25/05/2011 21:30	720	60.505	90	5.502
25/05/2011 22:50	800	60.338	90	5.669
26/05/2011 0:30	900	60.129	90	5.878

Date/Time	Duration (min)	Bore Level (mBNS)	Pump Depth (mBNS)	DD* (m)
26/05/2011 2:10	1000	60.000	90	6.007
26/05/2011 3:50	1100	60.000	90	6.007
26/05/2011 5:30	1200	60.000	90	6.007
26/05/2011 7:10	1300	60.000	90	6.007
26/05/2011 8:50	1400	60.000	90	6.007
26/05/2011 10:30	1500	60.000	90	6.007
26/05/2011 12:10	1600	60.469	90	5.538
26/05/2011 13:50	1700	60.418	90	5.589
26/05/2011 15:30	1800	60.367	90	5.640
26/05/2011 17:10	1900	60.316	90	5.691
26/05/2011 18:50	2000	60.265	90	5.742
26/05/2011 20:30	2100	60.223	90	5.784
26/05/2011 22:10	2200	60.188	90	5.819
26/05/2011 23:50	2300	60.152	90	5.855
27/05/2011 1:30	2400	60.117	90	5.891
27/05/2011 3:10	2500	60.081	90	5.926
27/05/2011 4:50	2600	59.748	90	6.259
27/05/2011 6:30	2700	59.332	90	6.675
27/05/2011 8:10	2800	58.917	90	7.091
27/05/2011 9:50	2900	58.501	90	7.506
27/05/2011 11:30	3000	58.104	90	7.904
27/05/2011 13:10	3100	57.707	90	8.300
27/05/2011 14:50	3200	57.310	90	8.697
27/05/2011 16:30	3300	56.913	90	9.094
27/05/2011 18:10	3400	56.573	90	9.435
27/05/2011 19:50	3500	56.521	90	9.487
27/05/2011 21:30	3600	56.469	90	9.538
27/05/2011 23:10	3700	56.417	90	9.590
28/05/2011 0:50	3800	56.365	90	9.642
28/05/2011 2:30	3900	56.323	90	9.685
28/05/2011 4:10	4000	56.291	90	9.716
28/05/2011 5:50	4100	56.260	90	9.748
28/05/2011 7:30	4200	56.228	90	9.779
28/05/2011 9:10	4300	56.197	90	9.810
28/05/2011 10:50	4400	62.880	90	3.127
28/05/2011 12:30	4500	63.298	90	2.710
28/05/2011 14:10	4600	63.715	90	2.293
28/05/2011 15:50	4700	64.132	90	1.875
28/05/2011 17:30	4800	64.549	90	1.458
28/05/2011 19:10	4900	64.739	90	1.268

Date/Time	Duration (min)	Bore Level (mBNS)	Pump Depth (mBNS)	DD* (m)
28/05/2011 20:50	5000	64.867	90	1.141
28/05/2011 22:30	5100	64.994	90	1.014
29/05/2011 0:10	5200	65.121	90	0.886
29/05/2011 1:50	5300	65.248	90	0.759
29/05/2011 3:30	5400	65.330	90	0.677
29/05/2011 5:10	5500	65.412	90	0.596
29/05/2011 6:50	5600	65.493	90	0.514
29/05/2011 8:30	5700	65.574	90	0.433
29/05/2011 10:10	5800	65.652	90	0.355
29/05/2011 11:50	5900	65.713	90	0.294
29/05/2011 13:30	6000	65.774	90	0.233
29/05/2011 15:10	6100	65.835	90	0.172
29/05/2011 16:50	6200	65.896	90	0.111
29/05/2011 18:30	6300	65.952	90	0.056
29/05/2011 20:10	6400	65.997	90	0.010
29/05/2011 21:50	6500	66.043	90	-0.036
29/05/2011 23:30	6600	66.089	90	-0.082
30/05/2011 1:10	6700	66.135	90	-0.127
30/05/2011 2:50	6800	66.185	90	-0.178
30/05/2011 4:30	6900	66.231	90	-0.224
30/05/2011 6:10	7000	66.256	90	-0.249
30/05/2011 7:50	7100	66.282	90	-0.275
30/05/2011 9:30	7200	66.307	90	-0.300
30/05/2011 11:10	7300	66.333	90	-0.325
30/05/2011 12:50	7400	66.360	90	-0.353
30/05/2011 14:30	7500	66.390	90	-0.383
30/05/2011 16:10	7600	66.421	90	-0.414
30/05/2011 17:50	7700	66.452	90	-0.444
30/05/2011 19:30	7800	66.482	90	-0.475
30/05/2011 21:10	7900	66.513	90	-0.505
30/05/2011 22:50	8000	66.543	90	-0.536
31/05/2011 0:30	8100	66.574	90	-0.566
31/05/2011 2:10	8200	66.604	90	-0.597
31/05/2011 3:50	8300	66.635	90	-0.627
31/05/2011 5:30	8400	66.661	90	-0.654
31/05/2011 7:10	8500	66.686	90	-0.679
31/05/2011 8:50	8600	66.711	90	-0.704

Note:
Dataset is a subset of the original dataset from the SA Water Operational Data Store (i.e. original dataset recorded water level measurements every 1 minute therefore a long record)
* Derived

Hawker TWS 2 (acquired from SA Water (Crystal Brook) Operational Data Store)

Date/Time	Duration (min)	Bore Level (mBNS)	Pump Depth (mBNS)	DD* (m)
25/05/2011 9:30	0	52.991	80	0.000
25/05/2011 9:31	1	52.991	80	0.000
25/05/2011 9:32	2	52.991	80	0.000
25/05/2011 9:33	3	52.991	80	0.000
25/05/2011 9:34	4	52.991	80	0.000
25/05/2011 9:35	5	52.991	80	0.000
25/05/2011 9:36	6	52.991	80	0.000
25/05/2011 9:37	7	52.991	80	0.000
25/05/2011 9:38	8	52.991	80	0.000
25/05/2011 9:39	9	52.991	80	0.000
25/05/2011 9:40	10	52.991	80	0.000
25/05/2011 9:41	11	52.991	80	0.000
25/05/2011 9:42	12	52.991	80	0.000
25/05/2011 9:43	13	52.991	80	0.000
25/05/2011 9:44	14	52.991	80	0.000
25/05/2011 9:45	15	52.991	80	0.000
25/05/2011 9:46	16	52.991	80	0.000
25/05/2011 9:47	17	52.991	80	0.000
25/05/2011 9:48	18	52.991	80	0.000
25/05/2011 9:49	19	52.991	80	0.000
25/05/2011 9:50	20	52.991	80	0.000
25/05/2011 9:51	21	52.991	80	0.000
25/05/2011 9:52	22	52.991	80	0.000
25/05/2011 9:53	23	52.991	80	0.000
25/05/2011 9:54	24	52.991	80	0.000
25/05/2011 9:55	25	52.991	80	0.000
25/05/2011 9:56	26	52.991	80	0.000
25/05/2011 9:57	27	52.991	80	0.000
25/05/2011 9:58	28	52.991	80	0.000
25/05/2011 9:59	29	52.991	80	0.000
25/05/2011 10:00	30	52.991	80	0.000
25/05/2011 10:01	31	52.991	80	0.000
25/05/2011 10:02	32	52.991	80	0.000
25/05/2011 10:03	33	52.991	80	0.000
25/05/2011 10:04	34	52.991	80	0.000
25/05/2011 10:05	35	52.991	80	0.000
25/05/2011 10:06	36	52.991	80	0.000
25/05/2011 10:07	37	52.991	80	0.000
25/05/2011 10:08	38	52.991	80	0.000

Date/Time	Duration (min)	Bore Level (mBNS)	Pump Depth (mBNS)	DD* (m)
25/05/2011 10:09	39	52.991	80	0.000
25/05/2011 10:10	40	52.991	80	0.000
25/05/2011 10:11	41	52.991	80	0.000
25/05/2011 10:12	42	52.991	80	0.000
25/05/2011 10:13	43	52.991	80	0.000
25/05/2011 10:14	44	52.991	80	0.000
25/05/2011 10:15	45	52.991	80	0.000
25/05/2011 10:16	46	52.991	80	0.000
25/05/2011 10:17	47	52.991	80	0.000
25/05/2011 10:18	48	52.991	80	0.000
25/05/2011 10:19	49	52.991	80	0.000
25/05/2011 10:20	50	52.991	80	0.000
25/05/2011 10:21	51	52.991	80	0.000
25/05/2011 10:22	52	52.991	80	0.000
25/05/2011 10:23	53	52.991	80	0.000
25/05/2011 10:24	54	52.991	80	0.000
25/05/2011 10:25	55	52.991	80	0.000
25/05/2011 10:26	56	52.991	80	0.000
25/05/2011 10:27	57	52.991	80	0.000
25/05/2011 10:28	58	52.991	80	0.000
25/05/2011 10:29	59	52.991	80	0.000
25/05/2011 10:30	60	52.991	80	0.000
25/05/2011 10:40	70	52.991	80	0.000
25/05/2011 10:50	80	52.991	80	0.000
25/05/2011 11:00	90	52.991	80	0.000
25/05/2011 11:10	100	52.991	80	0.000
25/05/2011 11:20	110	52.991	80	0.000
25/05/2011 11:30	120	52.991	80	0.000
25/05/2011 11:40	130	52.991	80	0.000
25/05/2011 11:50	140	52.991	80	0.000
25/05/2011 12:00	150	52.991	80	0.000
25/05/2011 12:10	160	52.991	80	0.000
25/05/2011 12:20	170	52.991	80	0.000
25/05/2011 12:30	180	52.991	80	0.000
25/05/2011 12:40	190	52.991	80	0.000
25/05/2011 12:50	200	52.991	80	0.000
25/05/2011 13:00	210	52.991	80	0.000
25/05/2011 13:10	220	52.991	80	0.000
25/05/2011 13:20	230	52.991	80	0.000
25/05/2011 13:30	240	52.991	80	0.000

Date/Time	Duration (min)	Bore Level (mBNS)	Pump Depth (mBNS)	DD* (m)
25/05/2011 13:40	250	52.991	80	0.000
25/05/2011 13:50	260	52.991	80	0.000
25/05/2011 14:00	270	52.991	80	0.000
25/05/2011 14:10	280	52.991	80	0.000
25/05/2011 14:20	290	52.991	80	0.000
25/05/2011 14:30	300	52.991	80	0.000
25/05/2011 14:40	310	52.991	80	0.000
25/05/2011 14:50	320	52.991	80	0.000
25/05/2011 15:00	330	52.991	80	0.000
25/05/2011 15:10	340	52.991	80	0.000
25/05/2011 15:20	350	52.991	80	0.000
25/05/2011 15:30	360	52.991	80	0.000
25/05/2011 15:40	370	52.991	80	0.000
25/05/2011 15:50	380	52.991	80	0.000
25/05/2011 16:00	390	52.991	80	0.000
25/05/2011 16:10	400	52.991	80	0.000
25/05/2011 16:20	410	52.991	80	0.000
25/05/2011 16:30	420	52.991	80	0.000
25/05/2011 16:40	430	52.991	80	0.000
25/05/2011 16:50	440	52.991	80	0.000
25/05/2011 17:00	450	52.991	80	0.000
25/05/2011 17:10	460	52.991	80	0.000
25/05/2011 17:20	470	52.991	80	0.000
25/05/2011 17:30	480	52.991	80	0.000
25/05/2011 17:40	490	52.991	80	0.000
25/05/2011 17:50	500	52.991	80	0.000
25/05/2011 18:00	510	52.991	80	0.000
25/05/2011 18:10	520	52.991	80	0.000
25/05/2011 18:20	530	52.991	80	0.000
25/05/2011 18:30	540	52.991	80	0.000
25/05/2011 18:40	550	52.991	80	0.000
25/05/2011 18:50	560	52.991	80	0.000
25/05/2011 19:00	570	52.991	80	0.000
25/05/2011 19:10	580	52.991	80	0.000
25/05/2011 19:20	590	52.991	80	0.000
25/05/2011 19:30	600	52.991	80	0.000
25/05/2011 19:40	610	52.991	80	0.000
25/05/2011 19:50	620	52.991	80	0.000
25/05/2011 20:00	630	52.991	80	0.000
25/05/2011 20:10	640	52.991	80	0.000

Date/Time	Duration (min)	Bore Level (mBNS)	Pump Depth (mBNS)	DD* (m)
25/05/2011 20:20	650	52.991	80	0.000
25/05/2011 20:30	660	52.991	80	0.000
25/05/2011 20:40	670	52.991	80	0.000
25/05/2011 20:50	680	52.991	80	0.000
25/05/2011 21:00	690	52.991	80	0.000
25/05/2011 21:10	700	52.991	80	0.000
25/05/2011 21:20	710	52.991	80	0.000
25/05/2011 21:30	720	52.991	80	0.000
25/05/2011 22:50	800	52.991	80	0.000
26/05/2011 0:30	900	52.991	80	0.000
26/05/2011 2:10	1000	52.800	80	0.191
26/05/2011 3:50	1100	52.589	80	0.403
26/05/2011 5:30	1200	52.377	80	0.614
26/05/2011 7:10	1300	52.166	80	0.826
26/05/2011 8:50	1400	51.990	80	1.001
26/05/2011 10:30	1500	51.990	80	1.001
26/05/2011 12:10	1600	52.709	80	0.282
26/05/2011 13:50	1700	52.674	80	0.318
26/05/2011 15:30	1800	52.638	80	0.353
26/05/2011 17:10	1900	52.602	80	0.389
26/05/2011 18:50	2000	52.567	80	0.425
26/05/2011 20:30	2100	52.531	80	0.460
26/05/2011 22:10	2200	52.496	80	0.496
26/05/2011 23:50	2300	52.460	80	0.532
27/05/2011 1:30	2400	52.424	80	0.567
27/05/2011 3:10	2500	52.389	80	0.603
27/05/2011 4:50	2600	52.357	80	0.634
27/05/2011 6:30	2700	52.327	80	0.665
27/05/2011 8:10	2800	52.296	80	0.695
27/05/2011 9:50	2900	52.265	80	0.726
27/05/2011 11:30	3000	52.235	80	0.756
27/05/2011 13:10	3100	52.164	80	0.827
27/05/2011 14:50	3200	52.093	80	0.898
27/05/2011 16:30	3300	52.022	80	0.969
27/05/2011 18:10	3400	51.951	80	1.041
27/05/2011 19:50	3500	51.885	80	1.106
27/05/2011 21:30	3600	51.844	80	1.147
27/05/2011 23:10	3700	51.804	80	1.188
28/05/2011 0:50	3800	51.763	80	1.228
28/05/2011 2:30	3900	51.722	80	1.269

Date/Time	Duration (min)	Bore Level (mBNS)	Pump Depth (mBNS)	DD* (m)
28/05/2011 4:10	4000	51.691	80	1.300
28/05/2011 5:50	4100	51.676	80	1.315
28/05/2011 7:30	4200	51.661	80	1.331
28/05/2011 9:10	4300	51.646	80	1.346
28/05/2011 10:50	4400	51.630	80	1.361
28/05/2011 12:30	4500	51.677	80	1.314
28/05/2011 14:10	4600	51.769	80	1.223
28/05/2011 15:50	4700	51.860	80	1.131
28/05/2011 17:30	4800	51.952	80	1.039
28/05/2011 19:10	4900	52.044	80	0.948
28/05/2011 20:50	5000	52.107	80	0.884
28/05/2011 22:30	5100	52.163	80	0.828
29/05/2011 0:10	5200	52.219	80	0.772
29/05/2011 1:50	5300	52.275	80	0.716
29/05/2011 3:30	5400	52.331	80	0.660
29/05/2011 5:10	5500	52.367	80	0.624
29/05/2011 6:50	5600	52.403	80	0.589
29/05/2011 8:30	5700	52.438	80	0.553
29/05/2011 10:10	5800	52.474	80	0.518
29/05/2011 11:50	5900	52.510	80	0.482
29/05/2011 13:30	6000	52.545	80	0.446
29/05/2011 15:10	6100	52.581	80	0.411
29/05/2011 16:50	6200	52.616	80	0.375
29/05/2011 18:30	6300	52.652	80	0.339
29/05/2011 20:10	6400	52.688	80	0.304
29/05/2011 21:50	6500	52.723	80	0.268
29/05/2011 23:30	6600	52.759	80	0.233
30/05/2011 1:10	6700	52.794	80	0.197
30/05/2011 2:50	6800	52.830	80	0.161
30/05/2011 4:30	6900	52.849	80	0.143
30/05/2011 6:10	7000	52.874	80	0.117
30/05/2011 7:50	7100	52.900	80	0.092
30/05/2011 9:30	7200	52.925	80	0.066
30/05/2011 11:10	7300	52.951	80	0.041
30/05/2011 12:50	7400	52.976	80	0.015
30/05/2011 14:30	7500	53.001	80	-0.010
30/05/2011 16:10	7600	53.027	80	-0.035
30/05/2011 17:50	7700	53.052	80	-0.061
30/05/2011 19:30	7800	53.078	80	-0.086
30/05/2011 21:10	7900	53.100	80	-0.109

Date/Time	Duration (min)	Bore Level (mBNS)	Pump Depth (mBNS)	DD* (m)
30/05/2011 22:50	8000	53.121	80	-0.129
31/05/2011 0:30	8100	53.141	80	-0.150
31/05/2011 2:10	8200	53.161	80	-0.170
31/05/2011 3:50	8300	53.182	80	-0.190
31/05/2011 5:30	8400	53.198	80	-0.206
31/05/2011 7:10	8500	53.212	80	-0.221
31/05/2011 8:50	8600	53.227	80	-0.235

Note:
Dataset is a subset of the original dataset from the SA Water Operational Data Store (i.e. original dataset recorded water level measurements every 1 minute therefore a long record)
* Derived

Hawker TWS 4

Duration (min)	DTW (m)	DD (m)
0	22.74	0.00
30	22.71	-0.03
60	22.73	-0.01
100	22.79	0.05
120	22.81	0.07
140	22.84	0.10
160	22.87	0.13
180	22.90	0.16
200	22.92	0.18
250	23.00	0.26
310	23.08	0.34
350	23.15	0.41
400	23.21	0.47
450	23.28	0.54
500	23.34	0.60
550	23.40	0.66
600	23.45	0.71
650	23.50	0.76
700	23.55	0.81
750	23.60	0.86
800	23.64	0.90
850	23.69	0.95
900	23.73	0.99
950	23.78	1.04
1000	23.82	1.08
1050	23.85	1.11

Duration (min)	DTW (m)	DD (m)
1100	23.90	1.16
1150	23.93	1.19
1200	23.96	1.22
1250	24.00	1.26
1300	24.04	1.30
1350	24.07	1.33
1400	24.10	1.36
1450	24.13	1.39
1500	24.16	1.42
1550	24.18	1.44
1600	24.20	1.46
1650	24.24	1.50
1700	24.26	1.52
1750	24.28	1.54
1800	24.31	1.57
1850	24.34	1.60
1900	24.38	1.64
1950	24.40	1.66
2000	24.43	1.69
2050	24.45	1.71
2100	24.47	1.73
2150	24.50	1.76
2200	24.53	1.79
2250	24.54	1.80
2300	24.55	1.81
2350	24.57	1.83
2400	24.58	1.84
2450	24.60	1.86
2500	24.62	1.88
2550	24.64	1.90
2600	24.66	1.92
2650	24.68	1.94
2700	24.70	1.96
2750	24.72	1.98
2800	24.74	2.00
2850	24.76	2.02
2880	24.77	2.03
2890	24.77	2.03
2896	24.78	2.04
2906	24.78	2.04
2915	24.78	2.04

Duration (min)	DTW (m)	DD (m)
2925	24.78	2.04
2935	24.79	2.05
2940	24.79	2.05
2950	24.80	2.06
2960	24.81	2.07
2970	24.81	2.07
2980	24.83	2.09
3000	24.84	2.10
3030	24.86	2.12
3040	24.88	2.14
3060	24.90	2.16
3080	24.91	2.17
3100	24.94	2.20
3150	24.99	2.25
3200	25.03	2.29
3250	25.07	2.33
3300	25.11	2.37
3350	25.15	2.41
3400	25.20	2.46
3450	25.24	2.50
3500	25.28	2.54
3550	25.31	2.57
3600	25.34	2.60
3650	25.36	2.62
3700	25.38	2.64
3750	25.40	2.66
3800	25.43	2.69
3850	25.45	2.71
3900	25.47	2.73
3950	25.50	2.76
4000	25.51	2.77
4050	25.53	2.79
4100	25.55	2.81
4150	25.57	2.83
4200	25.60	2.86
4250	25.62	2.88
4300	25.64	2.90
4320	25.65	2.91
4332	25.66	2.92
4336	25.65	2.91
4340	25.66	2.92

Duration (min)	DTW (m)	DD (m)
4346	25.66	2.92
4355	25.66	2.92
4365	25.64	2.90
4375	25.62	2.88
4390	25.60	2.86
4400	25.58	2.84
4410	25.56	2.82
4420	25.54	2.80
4440	25.52	2.78
4460	25.46	2.72
4480	25.42	2.68
4500	25.37	2.63
4520	25.34	2.60
4570	25.23	2.49
4620	25.13	2.39
4670	25.04	2.30
4720	24.95	2.21
4770	24.88	2.14
4820	24.82	2.08
4870	24.75	2.01
4920	24.69	1.95
5020	24.57	1.83
5120	24.44	1.70
5220	24.35	1.61
5320	24.25	1.51
5420	24.15	1.41
5520	24.08	1.34
5620	24.01	1.27
5720	23.95	1.21
5820	23.89	1.15
5920	23.81	1.07
6020	23.75	1.01
6120	23.69	0.95
6220	23.63	0.89
6320	23.62	0.88
6620	23.49	0.75
7120	23.28	0.54
7420	23.21	0.47
7720	23.10	0.36
7920	23.07	0.33
8220	23.00	0.26

Duration (min)	DTW (m)	DD (m)
8620	22.87	0.13
8640	22.86	0.12

EWS 4a

Duration (min)	DTW (m)	DD (m)
0	22.21	0.00
35	22.21	0.00
65	22.21	0.00
110	22.21	0.00
190	22.21	0.00
260	22.21	0.00
320	22.21	0.00
400	22.21	0.00
500	22.21	0.00
600	22.21	0.00
700	22.21	0.00
750	22.21	0.00
850	22.21	0.00
950	22.21	0.00
1050	22.21	0.00
1150	22.21	0.00
1250	22.21	0.00
1400	22.21	0.00
1500	22.21	0.00
1600	22.21	0.00
1700	22.21	0.00
1800	22.21	0.00
1900	22.21	0.00
2000	22.21	0.00
2100	22.21	0.00
2200	22.21	0.00
2300	22.21	0.00
2400	22.21	0.00
2500	22.21	0.00
2600	22.21	0.00
2700	22.21	0.00
2800	22.21	0.00
2900	22.21	0.00
3000	22.21	0.00

Duration (min)	DTW (m)	DD (m)
3100	22.21	0.00
3200	22.215	0.005
3300	22.215	0.005
3400	22.215	0.005
3500	22.215	0.005
3600	22.215	0.005
3700	22.215	0.005
3800	22.215	0.005
3900	22.22	0.01
4000	22.22	0.01
4100	22.22	0.01
4200	22.22	0.01
4300	22.22	0.01
4320	22.22	0.01

EWS 3

Duration (min)	DTW (m)	DD (m)
0	18.72	0.00
40	18.72	0.00
65	18.72	0.00
110	18.72	0.00
190	18.72	0.00
260	18.71	-0.01
320	18.71	-0.01
400	18.72	0.00
500	18.725	0.005
600	18.73	0.01
700	18.73	0.01
750	18.73	0.01
850	18.72	0.00
950	18.71	-0.01
1050	18.71	-0.01
1150	18.71	-0.01
1250	18.71	-0.01
1400	18.72	0.00
1500	18.72	0.00
1600	18.715	-0.005
1700	18.71	-0.01
1800	18.71	-0.01

Duration (min)	DTW (m)	DD (m)
1900	18.72	0.00
2000	18.72	0.00
2100	18.72	0.00
2200	18.72	0.00
2300	18.72	0.00
2400	18.725	0.005
2500	18.72	0.00
2600	18.72	0.00
2700	18.72	0.00
2800	18.72	0.00
2900	18.72	0.00
3000	18.725	0.005
3100	18.73	0.01
3200	18.725	0.005
3300	18.725	0.005
3400	18.73	0.01
3500	18.735	0.015
3600	18.735	0.015
3700	18.735	0.015
3800	18.73	0.01
3900	18.725	0.005
4000	18.725	0.005
4100	18.73	0.01
4200	18.73	0.01
4300	18.73	0.01
4320	18.73	0.01

Constant rate discharge test production well: Hawker TWS 4

Hawker TWS 3

Duration (min)	DTW (m)	DD (m)
0	22.79	0.00
10	22.78	-0.01
15	22.75	-0.04
25	22.75	-0.04
35	22.76	-0.03
45	22.77	-0.02
60	22.80	0.01
80	22.85	0.06

Duration (min)	DTW (m)	DD (m)
90	22.85	0.06
100	22.87	0.08
120	22.91	0.12
140	22.94	0.15
160	22.97	0.18
180	23.01	0.22
200	23.04	0.25
250	23.13	0.34
300	23.20	0.41
350	23.28	0.49
400	23.35	0.56
450	23.40	0.61
500	23.46	0.67
550	23.51	0.72
600	23.55	0.76
650	23.61	0.82
700	23.65	0.86
750	23.70	0.91
800	23.75	0.96
850	23.79	1.00
900	23.83	1.04
950	23.87	1.08
1000	23.93	1.14
1050	23.96	1.17
1100	24.00	1.21
1150	24.03	1.24
1200	24.05	1.26
1250	24.08	1.29
1300	24.11	1.32
1350	24.14	1.35
1400	24.17	1.38
1450	24.19	1.40
1500	24.21	1.42
1550	24.24	1.45
1600	24.26	1.47
1650	24.29	1.50
1700	24.31	1.52
1750	24.34	1.55
1800	24.37	1.58
1850	24.39	1.60
1900	24.41	1.62

Duration (min)	DTW (m)	DD (m)
1950	24.43	1.64
2000	24.45	1.66
2050	24.47	1.68
2100	24.49	1.70
2150	24.50	1.71
2200	24.52	1.73
2250	24.54	1.75
2300	24.57	1.78
2350	24.58	1.79
2400	24.59	1.80
2450	24.61	1.82
2500	24.63	1.84
2550	24.65	1.86
2600	24.67	1.88
2650	24.68	1.89
2700	24.69	1.90
2750	24.70	1.91
2800	24.72	1.93
2850	24.74	1.95
2900	24.75	1.96
2950	24.76	1.97
3000	24.77	1.98
3050	24.78	1.99
3100	24.79	2.00
3150	24.80	2.01
3200	24.82	2.03
3250	24.84	2.05
3300	24.86	2.07
3350	24.88	2.09
3400	24.88	2.09
3450	24.89	2.10
3500	24.90	2.11
3550	24.91	2.12
3600	24.92	2.13
3650	24.93	2.14
3700	24.94	2.15
3750	24.95	2.16
3800	24.96	2.17
3850	24.97	2.18
3900	24.98	2.19
3950	24.99	2.20

Duration (min)	DTW (m)	DD (m)
4000	25.00	2.21
4050	25.02	2.23
4100	25.03	2.24
4150	25.04	2.25
4200	25.05	2.26
4250	25.06	2.27
4300	25.07	2.28
4320	25.08	2.29
4321	-	-
4322	-	-
4323	-	-
4324	25.06	2.27
4325	-	-
4326	-	-
4327	-	-
4328	25.06	2.27
4329	-	-
4330	-	-
4332	-	-
4334	25.07	2.28
4336	-	-
4338	-	-
4340	25.07	2.28
4342	-	-
4344	-	-
4346	25.07	2.28
4348	-	-
4350	25.07	2.28
4355	25.07	2.28
4360	25.07	2.28
4365	25.05	2.26
4370	25.05	2.26
4375	25.04	2.25
4380	25.04	2.25
4390	25.02	2.23
4400	25.01	2.22
4410	24.99	2.20
4420	24.98	2.19
4440	24.95	2.16
4460	24.90	2.11
4480	24.88	2.09

Duration (min)	DTW (m)	DD (m)
4500	24.84	2.05
4520	24.81	2.02
4570	24.72	1.93
4620	24.64	1.85
4670	24.57	1.78
4720	24.50	1.71
4770	24.43	1.64
4820	24.39	1.60
4870	24.34	1.55
4920	-	-
4970	-	-
5020	24.16	1.37
5070	24.12	1.33
5120	24.08	1.29
5170	24.03	1.24
5220	-	-
5620	23.74	0.95
5720	23.67	0.88
5820	23.61	0.82
5920	23.55	0.76
6020	23.51	0.72
6120	23.46	0.67
6220	-	-
6320	-	-
6420	23.36	0.57
6520	-	-
6620	-	-
6720	-	-
6820	-	-
6920	-	-
7020	23.14	0.35
7120	23.13	0.34
7220	23.10	0.31
7320	23.06	0.27
7420	23.03	0.24
7520	23.00	0.21
7620	22.99	0.20
7720	-	-
7820	22.95	0.16
7920	-	-
8020	-	-

Duration (min)	DTW (m)	DD (m)
8120	-	-
8220	-	-
8320	-	-
8420	-	-
8520	22.81	0.02
8620	22.79	0.00
8640	22.79	0.00

Hawker TWS 1 (acquired from SA Water (Crystal Brook) Operational Data Store)

Date/Time	Duration (min)	Bore Level (mBNS)	Pump Depth (mBNS)	DD* (m)
7/06/2011 9:30	0	66.829	90	0.000
7/06/2011 9:31	1	66.830	90	0.000
7/06/2011 9:32	2	66.830	90	-0.001
7/06/2011 9:33	3	66.831	90	-0.001
7/06/2011 9:34	4	66.831	90	-0.001
7/06/2011 9:35	5	66.831	90	-0.002
7/06/2011 9:36	6	66.832	90	-0.002
7/06/2011 9:37	7	66.832	90	-0.002
7/06/2011 9:38	8	66.832	90	-0.003
7/06/2011 9:39	9	66.833	90	-0.003
7/06/2011 9:40	10	66.833	90	-0.004
7/06/2011 9:41	11	66.833	90	-0.004
7/06/2011 9:42	12	66.834	90	-0.004
7/06/2011 9:43	13	66.834	90	-0.005
7/06/2011 9:44	14	66.834	90	-0.005
7/06/2011 9:45	15	66.835	90	-0.005
7/06/2011 9:46	16	66.835	90	-0.006
7/06/2011 9:47	17	66.836	90	-0.006
7/06/2011 9:48	18	66.836	90	-0.006
7/06/2011 9:49	19	66.836	90	-0.007
7/06/2011 9:50	20	66.837	90	-0.007
7/06/2011 9:51	21	66.837	90	-0.007
7/06/2011 9:52	22	66.837	90	-0.008
7/06/2011 9:53	23	66.838	90	-0.008
7/06/2011 9:54	24	66.836	90	-0.007
7/06/2011 9:55	25	66.835	90	-0.006
7/06/2011 9:56	26	66.834	90	-0.004
7/06/2011 9:57	27	66.832	90	-0.003
7/06/2011 9:58	28	66.831	90	-0.002

Date/Time	Duration (min)	Bore Level (mBNS)	Pump Depth (mBNS)	DD* (m)
7/06/2011 9:59	29	66.830	90	0.000
7/06/2011 10:00	30	66.829	90	0.001
7/06/2011 10:01	31	66.827	90	0.002
7/06/2011 10:02	32	66.826	90	0.003
7/06/2011 10:03	33	66.825	90	0.005
7/06/2011 10:04	34	66.824	90	0.006
7/06/2011 10:05	35	66.822	90	0.007
7/06/2011 10:06	36	66.821	90	0.008
7/06/2011 10:07	37	66.820	90	0.010
7/06/2011 10:08	38	66.818	90	0.011
7/06/2011 10:09	39	66.817	90	0.012
7/06/2011 10:10	40	66.816	90	0.014
7/06/2011 10:11	41	66.815	90	0.015
7/06/2011 10:12	42	66.813	90	0.016
7/06/2011 10:13	43	66.812	90	0.017
7/06/2011 10:14	44	66.811	90	0.019
7/06/2011 10:15	45	66.810	90	0.020
7/06/2011 10:16	46	66.808	90	0.021
7/06/2011 10:17	47	66.807	90	0.022
7/06/2011 10:18	48	66.806	90	0.024
7/06/2011 10:19	49	66.804	90	0.025
7/06/2011 10:20	50	66.803	90	0.026
7/06/2011 10:21	51	66.802	90	0.028
7/06/2011 10:22	52	66.801	90	0.029
7/06/2011 10:23	53	66.799	90	0.030
7/06/2011 10:24	54	66.798	90	0.031
7/06/2011 10:25	55	66.797	90	0.033
7/06/2011 10:26	56	66.796	90	0.034
7/06/2011 10:27	57	66.794	90	0.035
7/06/2011 10:28	58	66.793	90	0.036
7/06/2011 10:29	59	66.792	90	0.038
7/06/2011 10:30	60	66.790	90	0.039
7/06/2011 10:40	70	66.778	90	0.052
7/06/2011 10:50	80	66.765	90	0.064
7/06/2011 11:00	90	66.752	90	0.077
7/06/2011 11:10	100	66.740	90	0.090
7/06/2011 11:20	110	66.727	90	0.103
7/06/2011 11:30	120	66.714	90	0.115
7/06/2011 11:40	130	66.701	90	0.128
7/06/2011 11:50	140	66.689	90	0.141
7/06/2011 12:00	150	66.676	90	0.153

Date/Time	Duration (min)	Bore Level (mBNS)	Pump Depth (mBNS)	DD* (m)
7/06/2011 12:10	160	66.663	90	0.166
7/06/2011 12:20	170	66.651	90	0.179
7/06/2011 12:30	180	66.638	90	0.192
7/06/2011 12:40	190	66.625	90	0.204
7/06/2011 12:50	200	66.612	90	0.217
7/06/2011 13:00	210	66.600	90	0.230
7/06/2011 13:10	220	66.587	90	0.243
7/06/2011 13:20	230	66.574	90	0.255
7/06/2011 13:30	240	66.562	90	0.268
7/06/2011 13:40	250	66.549	90	0.281
7/06/2011 13:50	260	66.536	90	0.293
7/06/2011 14:00	270	66.523	90	0.306
7/06/2011 14:10	280	66.511	90	0.319
7/06/2011 14:20	290	66.498	90	0.332
7/06/2011 14:30	300	66.485	90	0.344
7/06/2011 14:40	310	66.472	90	0.357
7/06/2011 14:50	320	66.460	90	0.370
7/06/2011 15:00	330	66.447	90	0.382
7/06/2011 15:10	340	66.434	90	0.395
7/06/2011 15:20	350	66.422	90	0.408
7/06/2011 15:30	360	66.409	90	0.421
7/06/2011 15:40	370	66.396	90	0.433
7/06/2011 15:50	380	66.383	90	0.446
7/06/2011 16:00	390	66.371	90	0.459
7/06/2011 16:10	400	66.358	90	0.471
7/06/2011 16:20	410	66.345	90	0.484
7/06/2011 16:30	420	66.333	90	0.497
7/06/2011 16:40	430	66.320	90	0.510
7/06/2011 16:50	440	66.307	90	0.522
7/06/2011 17:00	450	66.294	90	0.535
7/06/2011 17:10	460	66.282	90	0.548
7/06/2011 17:20	470	66.269	90	0.560
7/06/2011 17:30	480	66.256	90	0.573
7/06/2011 17:40	490	66.244	90	0.586
7/06/2011 17:50	500	66.231	90	0.599
7/06/2011 18:00	510	66.221	90	0.609
7/06/2011 18:10	520	66.211	90	0.618
7/06/2011 18:20	530	66.202	90	0.627
7/06/2011 18:30	540	66.193	90	0.636
7/06/2011 18:40	550	66.184	90	0.645
7/06/2011 18:50	560	66.175	90	0.655

Date/Time	Duration (min)	Bore Level (mBNS)	Pump Depth (mBNS)	DD* (m)
7/06/2011 19:00	570	66.166	90	0.664
7/06/2011 19:10	580	66.157	90	0.673
7/06/2011 19:20	590	66.147	90	0.682
7/06/2011 19:30	600	66.138	90	0.691
7/06/2011 19:40	610	66.129	90	0.700
7/06/2011 19:50	620	66.120	90	0.710
7/06/2011 20:00	630	66.111	90	0.719
7/06/2011 20:10	640	66.102	90	0.728
7/06/2011 20:20	650	66.092	90	0.737
7/06/2011 20:30	660	66.083	90	0.746
7/06/2011 20:40	670	66.074	90	0.755
7/06/2011 20:50	680	66.065	90	0.765
7/06/2011 21:00	690	66.056	90	0.774
7/06/2011 21:10	700	66.047	90	0.783
7/06/2011 21:20	710	66.037	90	0.792
7/06/2011 21:30	720	66.028	90	0.801
7/06/2011 22:50	800	65.955	90	0.874
8/06/2011 0:30	900	65.863	90	0.966
8/06/2011 2:10	1000	65.776	90	1.053
8/06/2011 3:50	1100	65.710	90	1.119
8/06/2011 5:30	1200	65.644	90	1.185
8/06/2011 7:10	1300	65.578	90	1.252
8/06/2011 8:50	1400	65.512	90	1.318
8/06/2011 10:30	1500	65.451	90	1.378
8/06/2011 12:10	1600	65.400	90	1.429
8/06/2011 13:50	1700	65.349	90	1.480
8/06/2011 15:30	1800	65.299	90	1.531
8/06/2011 17:10	1900	65.248	90	1.582
8/06/2011 18:50	2000	65.208	90	1.621
8/06/2011 20:30	2100	65.178	90	1.652
8/06/2011 22:10	2200	65.147	90	1.682
8/06/2011 23:50	2300	65.117	90	1.713
9/06/2011 1:30	2400	65.086	90	1.743
9/06/2011 3:10	2500	65.056	90	1.774
9/06/2011 4:50	2600	65.025	90	1.804
9/06/2011 6:30	2700	64.995	90	1.835
9/06/2011 8:10	2800	64.964	90	1.865
9/06/2011 9:50	2900	64.934	90	1.896
9/06/2011 11:30	3000	-	90	-
9/06/2011 13:10	3100	64.883	90	1.946
9/06/2011 14:50	3200	64.858	90	1.972

Date/Time	Duration (min)	Bore Level (mBNS)	Pump Depth (mBNS)	DD* (m)
9/06/2011 16:30	3300	64.832	90	1.997
9/06/2011 18:10	3400	64.807	90	2.023
9/06/2011 19:50	3500	64.783	90	2.046
9/06/2011 21:30	3600	64.768	90	2.061
9/06/2011 23:10	3700	64.753	90	2.077
10/06/2011 0:50	3800	64.738	90	2.092
10/06/2011 2:30	3900	64.722	90	2.107
10/06/2011 4:10	4000	64.704	90	2.125
10/06/2011 5:50	4100	64.683	90	2.147
10/06/2011 7:30	4200	64.661	90	2.169
10/06/2011 9:10	4300	64.640	90	2.190
10/06/2011 10:50	4400	64.745	90	2.084
10/06/2011 12:30	4500	64.857	90	1.972
10/06/2011 14:10	4600	64.969	90	1.860
10/06/2011 15:50	4700	65.081	90	1.748
10/06/2011 17:30	4800	65.190	90	1.640
10/06/2011 19:10	4900	65.278	90	1.551
10/06/2011 20:50	5000	65.367	90	1.462
10/06/2011 22:30	5100	-	90	-
11/06/2011 0:10	5200	65.564	90	1.265
11/06/2011 1:50	5300	65.636	90	1.194
11/06/2011 3:30	5400	65.707	90	1.123
11/06/2011 5:10	5500	65.778	90	1.051
11/06/2011 6:50	5600	65.847	90	0.983
11/06/2011 8:30	5700	65.902	90	0.927
11/06/2011 10:10	5800	65.958	90	0.871
11/06/2011 11:50	5900	66.014	90	0.815
11/06/2011 13:30	6000	66.070	90	0.759
11/06/2011 15:10	6100	66.121	90	0.709
11/06/2011 16:50	6200	66.161	90	0.668
11/06/2011 18:30	6300	66.202	90	0.628
11/06/2011 20:10	6400	66.243	90	0.587
11/06/2011 21:50	6500	66.283	90	0.546
11/06/2011 23:30	6600	66.318	90	0.511
12/06/2011 1:10	6700	66.349	90	0.481
12/06/2011 2:50	6800	66.379	90	0.450
12/06/2011 4:30	6900	66.410	90	0.420
12/06/2011 6:10	7000	66.440	90	0.389
12/06/2011 7:50	7100	66.471	90	0.359
12/06/2011 9:30	7200	66.501	90	0.328
12/06/2011 11:10	7300	66.532	90	0.298

Date/Time	Duration (min)	Bore Level (mBNS)	Pump Depth (mBNS)	DD* (m)
12/06/2011 12:50	7400	66.562	90	0.267
12/06/2011 14:30	7500	66.593	90	0.237
12/06/2011 16:10	7600	66.608	90	0.221
12/06/2011 17:50	7700	66.624	90	0.206
12/06/2011 19:30	7800	66.639	90	0.191
12/06/2011 21:10	7900	66.654	90	0.175
12/06/2011 22:50	8000	66.671	90	0.158
13/06/2011 0:30	8100	66.697	90	0.133
13/06/2011 2:10	8200	66.722	90	0.107
13/06/2011 3:50	8300	66.748	90	0.082
13/06/2011 5:30	8400	66.773	90	0.056
13/06/2011 7:10	8500	66.792	90	0.037
13/06/2011 8:50	8600	66.802	90	0.027

Note:
Dataset is a subset of the original dataset from the SA Water Operational Data Store (i.e. original dataset recorded water level measurements every 1 minute therefore a long record)
* Derived

EWS 4a

Duration (min)	DTW (m)	DD (m)
0	22.220	0
60	22.220	0
120	22.220	0
180	22.220	0
200	22.220	0
300	22.220	0
400	22.220	0
500	22.220	0
600	22.220	0
700	22.220	0
800	22.220	0
900	22.220	0
1000	22.225	0.005
1100	22.220	0
1200	22.225	0.005
1300	22.225	0.005
1400	22.225	0.005
1500	22.225	0.005
1600	22.225	0.005
1700	22.225	0.005

Duration (min)	DTW (m)	DD (m)
1800	22.225	0.005
1900	22.225	0.005
2000	22.225	0.005
2100	22.225	0.005
2200	22.225	0.005
2300	22.225	0.005
2400	22.225	0.005
2500	22.225	0.005
2600	22.225	0.005
2700	22.230	0.01
2800	22.230	0.01
2900	22.230	0.01
3000	22.235	0.015
3100	22.235	0.015
3200	22.235	0.015
3300	22.235	0.015
3400	22.235	0.015
3500	22.230	0.01
3600	22.225	0.005
3700	22.230	0.01
3800	22.235	0.015
3900	22.235	0.015
4000	22.235	0.015
4100	22.230	0.01
4200	22.235	0.015
4300	22.235	0.015
4320	22.235	0.015

Hawker TWS 2 (acquired from SA Water (Crystal Brook) Operational Data Store)

Date/Time	Duration (min)	Bore Level (mBNS)	Pump Depth (mBNS)	DD* (m)
7/06/2011 9:30	0	53.462	80	0.000
7/06/2011 9:31	1	53.462	80	0.000
7/06/2011 9:32	2	53.463	80	0.000
7/06/2011 9:33	3	53.463	80	0.000
7/06/2011 9:34	4	53.463	80	0.000
7/06/2011 9:35	5	53.463	80	0.000
7/06/2011 9:36	6	53.463	80	0.000
7/06/2011 9:37	7	53.463	80	0.000
7/06/2011 9:38	8	53.463	80	0.000

Date/Time	Duration (min)	Bore Level (mBNS)	Pump Depth (mBNS)	DD* (m)
7/06/2011 9:39	9	53.463	80	0.000
7/06/2011 9:40	10	53.463	80	-0.001
7/06/2011 9:41	11	53.463	80	-0.001
7/06/2011 9:42	12	53.463	80	-0.001
7/06/2011 9:43	13	53.463	80	-0.001
7/06/2011 9:44	14	53.463	80	-0.001
7/06/2011 9:45	15	53.463	80	-0.001
7/06/2011 9:46	16	53.463	80	-0.001
7/06/2011 9:47	17	53.463	80	-0.001
7/06/2011 9:48	18	53.463	80	-0.001
7/06/2011 9:49	19	53.463	80	-0.001
7/06/2011 9:50	20	53.463	80	-0.001
7/06/2011 9:51	21	53.463	80	-0.001
7/06/2011 9:52	22	53.464	80	-0.001
7/06/2011 9:53	23	53.464	80	-0.001
7/06/2011 9:54	24	53.464	80	-0.001
7/06/2011 9:55	25	53.464	80	-0.001
7/06/2011 9:56	26	53.464	80	-0.001
7/06/2011 9:57	27	53.464	80	-0.001
7/06/2011 9:58	28	53.464	80	-0.001
7/06/2011 9:59	29	53.464	80	-0.001
7/06/2011 10:00	30	53.464	80	-0.002
7/06/2011 10:01	31	53.464	80	-0.002
7/06/2011 10:02	32	53.464	80	-0.002
7/06/2011 10:03	33	53.464	80	-0.002
7/06/2011 10:04	34	53.464	80	-0.002
7/06/2011 10:05	35	53.464	80	-0.002
7/06/2011 10:06	36	53.464	80	-0.002
7/06/2011 10:07	37	53.464	80	-0.002
7/06/2011 10:08	38	53.464	80	-0.002
7/06/2011 10:09	39	53.464	80	-0.002
7/06/2011 10:10	40	53.464	80	-0.002
7/06/2011 10:11	41	53.464	80	-0.002
7/06/2011 10:12	42	53.465	80	-0.002
7/06/2011 10:13	43	53.465	80	-0.002
7/06/2011 10:14	44	53.465	80	-0.002
7/06/2011 10:15	45	53.465	80	-0.002
7/06/2011 10:16	46	53.465	80	-0.002
7/06/2011 10:17	47	53.465	80	-0.002
7/06/2011 10:18	48	53.465	80	-0.002
7/06/2011 10:19	49	53.465	80	-0.002

Date/Time	Duration (min)	Bore Level (mBNS)	Pump Depth (mBNS)	DD* (m)
7/06/2011 10:20	50	53.465	80	-0.003
7/06/2011 10:21	51	53.465	80	-0.003
7/06/2011 10:22	52	53.465	80	-0.003
7/06/2011 10:23	53	53.465	80	-0.003
7/06/2011 10:24	54	53.465	80	-0.003
7/06/2011 10:25	55	53.465	80	-0.003
7/06/2011 10:26	56	53.465	80	-0.003
7/06/2011 10:27	57	53.465	80	-0.003
7/06/2011 10:28	58	53.465	80	-0.003
7/06/2011 10:29	59	53.465	80	-0.003
7/06/2011 10:30	60	53.465	80	-0.003
7/06/2011 10:40	70	53.466	80	
7/06/2011 10:50	80	53.466	80	
7/06/2011 11:00	90	53.467	80	
7/06/2011 11:10	100	53.467	80	
7/06/2011 11:20	110	53.468	80	
7/06/2011 11:30	120	53.469	80	
7/06/2011 11:40	130	53.469	80	
7/06/2011 11:50	140	53.470	80	
7/06/2011 12:00	150	53.470	80	
7/06/2011 12:10	160	53.471	80	
7/06/2011 12:20	170	53.471	80	
7/06/2011 12:30	180	53.472	80	
7/06/2011 12:40	190	53.472	80	
7/06/2011 12:50	200	53.473	80	
7/06/2011 13:00	210	53.473	80	
7/06/2011 13:10	220	53.474	80	
7/06/2011 13:20	230	53.474	80	
7/06/2011 13:30	240	53.475	80	
7/06/2011 13:40	250	53.475	80	
7/06/2011 13:50	260	53.476	80	
7/06/2011 14:00	270	53.476	80	
7/06/2011 14:10	280	53.477	80	
7/06/2011 14:20	290	53.477	80	
7/06/2011 14:30	300	53.478	80	
7/06/2011 14:40	310	53.478	80	
7/06/2011 14:50	320	53.479	80	
7/06/2011 15:00	330	53.479	80	
7/06/2011 15:10	340	53.480	80	
7/06/2011 15:20	350	53.479	80	
7/06/2011 15:30	360	53.479	80	

Date/Time	Duration (min)	Bore Level (mBNS)	Pump Depth (mBNS)	DD* (m)
7/06/2011 15:40	370	53.478	80	
7/06/2011 15:50	380	53.478	80	
7/06/2011 16:00	390	53.477	80	
7/06/2011 16:10	400	53.477	80	
7/06/2011 16:20	410	53.476	80	-
7/06/2011 16:30	420	53.476	80	-
7/06/2011 16:40	430	53.475	80	-
7/06/2011 16:50	440	53.475	80	-
7/06/2011 17:00	450	53.474	80	-
7/06/2011 17:10	460	53.474	80	-
7/06/2011 17:20	470	53.473	80	-
7/06/2011 17:30	480	53.473	80	-
7/06/2011 17:40	490	53.472	80	-
7/06/2011 17:50	500	53.472	80	-
7/06/2011 18:00	510	53.471	80	-
7/06/2011 18:10	520	53.471	80	-
7/06/2011 18:20	530	53.470	80	-
7/06/2011 18:30	540	53.470	80	-
7/06/2011 18:40	550	53.469	80	-
7/06/2011 18:50	560	53.469	80	-
7/06/2011 19:00	570	53.468	80	-
7/06/2011 19:10	580	53.468	80	-
7/06/2011 19:20	590	53.467	80	-
7/06/2011 19:30	600	53.467	80	-
7/06/2011 19:40	610	53.466	80	-
7/06/2011 19:50	620	53.466	80	-
7/06/2011 20:00	630	53.465	80	-
7/06/2011 20:10	640	53.465	80	-
7/06/2011 20:20	650	53.464	80	-
7/06/2011 20:30	660	53.464	80	-
7/06/2011 20:40	670	53.463	80	-
7/06/2011 20:50	680	53.463	80	-
7/06/2011 21:00	690	53.462	80	-
7/06/2011 21:10	700	53.462	80	-
7/06/2011 21:20	710	53.461	80	-
7/06/2011 21:30	720	53.461	80	-
7/06/2011 22:50	800	53.457	80	-
8/06/2011 0:30	900	53.436	80	-
8/06/2011 2:10	1000	53.410	80	-
8/06/2011 3:50	1100	53.385	80	-
8/06/2011 5:30	1200	53.360	80	-

Date/Time	Duration (min)	Bore Level (mBNS)	Pump Depth (mBNS)	DD* (m)
8/06/2011 7:10	1300	53.334	80	-
8/06/2011 8:50	1400	53.314	80	-
8/06/2011 10:30	1500	53.293	80	-
8/06/2011 12:10	1600	53.273	80	-
8/06/2011 13:50	1700	53.253	80	-
8/06/2011 15:30	1800	53.231	80	-
8/06/2011 17:10	1900	53.206	80	-
8/06/2011 18:50	2000	53.180	80	-
8/06/2011 20:30	2100	53.155	80	-
8/06/2011 22:10	2200	53.130	80	-
8/06/2011 23:50	2300	53.104	80	-
9/06/2011 1:30	2400	53.079	80	-
9/06/2011 3:10	2500	53.053	80	-
9/06/2011 4:50	2600	53.028	80	-
9/06/2011 6:30	2700	53.002	80	-
9/06/2011 8:10	2800	52.975	80	-
9/06/2011 9:50	2900	52.947	80	-
9/06/2011 11:30	3000	-	80	-
9/06/2011 13:10	3100	52.898	80	0.564
9/06/2011 14:50	3200	52.878	80	0.585
9/06/2011 16:30	3300	52.857	80	0.605
9/06/2011 18:10	3400	52.837	80	0.626
9/06/2011 19:50	3500	52.817	80	0.646
9/06/2011 21:30	3600	52.796	80	0.666
9/06/2011 23:10	3700	52.776	80	0.687
10/06/2011 0:50	3800	52.755	80	0.707
10/06/2011 2:30	3900	52.735	80	0.727
10/06/2011 4:10	4000	52.717	80	0.745
10/06/2011 5:50	4100	52.703	80	0.760
10/06/2011 7:30	4200	52.688	80	0.774
10/06/2011 9:10	4300	52.674	80	0.788
10/06/2011 10:50	4400	52.674	80	0.788
10/06/2011 12:30	4500	52.674	80	0.788
10/06/2011 14:10	4600	52.674	80	0.788
10/06/2011 15:50	4700	52.674	80	0.788
10/06/2011 17:30	4800	52.677	80	0.785
10/06/2011 19:10	4900	52.702	80	0.761
10/06/2011 20:50	5000	52.726	80	0.737
10/06/2011 22:30	5100	-	80	-
11/06/2011 0:10	5200	52.772	80	0.690
11/06/2011 1:50	5300	52.798	80	0.665

Date/Time	Duration (min)	Bore Level (mBNS)	Pump Depth (mBNS)	DD* (m)
11/06/2011 3:30	5400	52.823	80	0.639
11/06/2011 5:10	5500	52.849	80	0.614
11/06/2011 6:50	5600	52.874	80	0.588
11/06/2011 8:30	5700	52.899	80	0.563
11/06/2011 10:10	5800	52.925	80	0.538
11/06/2011 11:50	5900	52.950	80	0.512
11/06/2011 13:30	6000	52.976	80	0.487
11/06/2011 15:10	6100	52.997	80	0.465
11/06/2011 16:50	6200	53.013	80	0.450
11/06/2011 18:30	6300	53.028	80	0.435
11/06/2011 20:10	6400	53.043	80	0.419
11/06/2011 21:50	6500	53.058	80	0.404
11/06/2011 23:30	6600	53.077	80	0.386
12/06/2011 1:10	6700	53.097	80	0.366
12/06/2011 2:50	6800	53.117	80	0.345
12/06/2011 4:30	6900	53.138	80	0.325
12/06/2011 6:10	7000	53.158	80	0.304
12/06/2011 7:50	7100	53.178	80	0.284
12/06/2011 9:30	7200	53.199	80	0.264
12/06/2011 11:10	7300	53.219	80	0.243
12/06/2011 12:50	7400	53.239	80	0.223
12/06/2011 14:30	7500	53.260	80	0.203
12/06/2011 16:10	7600	53.270	80	0.192
12/06/2011 17:50	7700	53.280	80	0.182
12/06/2011 19:30	7800	53.290	80	0.172
12/06/2011 21:10	7900	53.301	80	0.162
12/06/2011 22:50	8000	53.313	80	0.150
13/06/2011 0:30	8100	53.333	80	0.129
13/06/2011 2:10	8200	53.353	80	0.109
13/06/2011 3:50	8300	53.374	80	0.089
13/06/2011 5:30	8400	53.394	80	0.068
13/06/2011 7:10	8500	53.409	80	0.054
13/06/2011 8:50	8600	53.414	80	0.048

Note:
Dataset is a subset of the original dataset from the SA Water Operational Data Store (i.e. original dataset recorded water level measurements every 1 minute therefore a long record)
* Derived

EWS 3

Duration (min)	DTW (m)	DD (m)
0	18.72	0.00
40	18.72	0.00
65	18.72	0.00
110	18.72	0.00
190	18.72	0.00
260	18.71	-0.01
320	18.71	-0.01
400	18.72	0.00
500	18.725	0.005
600	18.73	0.01
700	18.73	0.01
750	18.73	0.01
850	18.72	0.00
950	18.71	-0.01
1050	18.71	-0.01
1150	18.71	-0.01
1250	18.71	-0.01
1400	18.72	0.00
1500	18.72	0.00
1600	18.715	-0.005
1700	18.71	-0.01
1800	18.71	-0.01
1900	18.72	0.00
2000	18.72	0.00
2100	18.72	0.00
2200	18.72	0.00
2300	18.72	0.00
2400	18.725	0.005
2500	18.72	0.00
2600	18.72	0.00
2700	18.72	0.00
2800	18.72	0.00
2900	18.72	0.00
3000	18.725	0.005
3100	18.73	0.01
3200	18.725	0.005
3300	18.725	0.005
3400	18.73	0.01
3500	18.735	0.015

Duration (min)	DTW (m)	DD (m)
3600	18.735	0.015
3700	18.735	0.015
3800	18.73	0.01
3900	18.725	0.005
4000	18.725	0.005
4100	18.73	0.01
4200	18.73	0.01
4300	18.73	0.01

Constant rate discharge test production well: Parachilna TWS 2

Parachilna TWS 1 (acquired from SA Water (Crystal Brook) Operational Data Store)

Date/Time	Duration (min)	Bore Level (mBNS)	Pump Depth (mBNS)	DD* (m)
12/05/2011 8:00	0	1.4957265	65	0
12/05/2011 8:01	1	1.4957265	65	0
12/05/2011 8:02	2	1.4957265	65	0
12/05/2011 8:03	3	1.4957265	65	0
12/05/2011 8:04	4	1.4957265	65	0
12/05/2011 8:05	5	1.4957265	65	0
12/05/2011 8:06	6	1.4957265	65	0
12/05/2011 8:07	7	1.4957265	65	0
12/05/2011 8:08	8	1.4957265	65	0
12/05/2011 8:09	9	1.4957265	65	0
12/05/2011 8:10	10	1.4957265	65	0
12/05/2011 8:11	11	1.4957265	65	0
12/05/2011 8:12	12	1.4957265	65	0
12/05/2011 8:13	13	1.4957265	65	0
12/05/2011 8:14	14	1.4957265	65	0
12/05/2011 8:15	15	1.4957265	65	0
12/05/2011 8:16	16	1.4957265	65	0
12/05/2011 8:17	17	1.4957265	65	0
12/05/2011 8:18	18	1.4957265	65	0
12/05/2011 8:19	19	1.4957265	65	0
12/05/2011 8:20	20	1.4957265	65	0
12/05/2011 8:21	21	1.4957265	65	0
12/05/2011 8:22	22	1.4957265	65	0
12/05/2011 8:23	23	1.4957265	65	0
12/05/2011 8:24	24	1.4957265	65	0
12/05/2011 8:25	25	1.4957265	65	0
12/05/2011 8:26	26	1.4957265	65	0

Date/Time	Duration (min)	Bore Level (mBNS)	Pump Depth (mBNS)	DD* (m)
12/05/2011 8:27	27	1.4957265	65	0
12/05/2011 8:28	28	1.4957265	65	0
12/05/2011 8:29	29	1.4957265	65	0
12/05/2011 8:30	30	1.4957265	65	0
12/05/2011 8:31	31	1.4957265	65	0
12/05/2011 8:32	32	1.4957265	65	0
12/05/2011 8:33	33	1.4957265	65	0
12/05/2011 8:34	34	1.4957265	65	0
12/05/2011 8:35	35	1.4957265	65	0
12/05/2011 8:36	36	1.4957265	65	0
12/05/2011 8:37	37	1.4957265	65	0
12/05/2011 8:38	38	1.4957265	65	0
12/05/2011 8:39	39	1.4957265	65	0
12/05/2011 8:40	40	1.4957265	65	0
12/05/2011 8:41	41	1.4957265	65	0
12/05/2011 8:42	42	1.4957265	65	0
12/05/2011 8:43	43	1.4957265	65	0
12/05/2011 8:44	44	1.4957265	65	0
12/05/2011 8:45	45	1.4957265	65	0
12/05/2011 8:46	46	1.4957265	65	0
12/05/2011 8:47	47	1.4957265	65	0
12/05/2011 8:48	48	1.4957265	65	0
12/05/2011 8:49	49	1.4957265	65	0
12/05/2011 8:50	50	1.4957265	65	0
12/05/2011 8:51	51	1.4957265	65	0
12/05/2011 8:52	52	1.4957265	65	0
12/05/2011 8:53	53	1.4957265	65	0
12/05/2011 8:54	54	1.4957265	65	0
12/05/2011 8:55	55	1.4957265	65	0
12/05/2011 8:56	56	1.4957265	65	0
12/05/2011 8:57	57	1.4957265	65	0
12/05/2011 8:58	58	1.4957265	65	0
12/05/2011 8:59	59	1.4957265	65	0
12/05/2011 9:00	60	1.4957265	65	0
12/05/2011 9:10	70	1.4957265	65	0
12/05/2011 9:20	80	1.4957265	65	0
12/05/2011 9:30	90	1.4957265	65	0
12/05/2011 9:40	100	1.4957265	65	0
12/05/2011 9:50	110	1.4957265	65	0
12/05/2011 10:00	120	1.4957265	65	0
12/05/2011 10:10	130	1.4956938	65	3.266E-05

Date/Time	Duration (min)	Bore Level (mBNS)	Pump Depth (mBNS)	DD* (m)
12/05/2011 10:20	140	1.4956429	65	8.357E-05
12/05/2011 10:30	150	1.4955921	65	0.0001343
12/05/2011 10:40	160	1.4955412	65	0.0001853
12/05/2011 10:50	170	1.4954903	65	0.0002362
12/05/2011 11:00	180	1.4954394	65	0.0002871
12/05/2011 11:10	190	1.4953886	65	0.0003378
12/05/2011 11:20	200	1.4953377	65	0.0003887
12/05/2011 11:30	210	1.4952868	65	0.0004396
12/05/2011 11:40	220	1.4952359	65	0.0004905
12/05/2011 11:50	230	1.495185	65	0.0005414
12/05/2011 12:00	240	1.4951342	65	0.0005922
12/05/2011 12:10	250	1.4950833	65	0.0006431
12/05/2011 12:20	260	1.4950324	65	0.000694
12/05/2011 12:30	270	1.4949815	65	0.0007449
12/05/2011 12:40	280	1.4949307	65	0.0007957
12/05/2011 12:50	290	1.4948798	65	0.0008466
12/05/2011 13:00	300	1.4948289	65	0.0008975
12/05/2011 13:10	310	1.494778	65	0.0009484
12/05/2011 13:20	320	1.4947273	65	0.0009992
12/05/2011 13:30	330	1.4946764	65	0.0010501
12/05/2011 13:40	340	1.4946254	65	0.001101
12/05/2011 13:50	350	1.4945745	65	0.0011519
12/05/2011 14:00	360	1.4945236	65	0.0012028
12/05/2011 14:10	370	1.4944729	65	0.0012536
12/05/2011 14:20	380	1.494422	65	0.0013045
12/05/2011 14:30	390	1.4943711	65	0.0013554
12/05/2011 14:40	400	1.4943202	65	0.0014063
12/05/2011 14:50	410	1.4942694	65	0.0014571
12/05/2011 15:00	420	1.4942185	65	0.001508
12/05/2011 15:10	430	1.4941676	65	0.0015589
12/05/2011 15:20	440	1.4941167	65	0.0016098
12/05/2011 15:30	450	1.4940658	65	0.0016607
12/05/2011 15:40	460	1.494015	65	0.0017115
12/05/2011 15:50	470	1.4939641	65	0.0017624
12/05/2011 16:00	480	1.4939132	65	0.0018133
12/05/2011 16:10	490	1.4938623	65	0.0018642
12/05/2011 16:20	500	1.4938115	65	0.001915
12/05/2011 16:30	510	1.4937606	65	0.0019659
12/05/2011 16:40	520	1.4937097	65	0.0020168
12/05/2011 16:50	530	1.4936588	65	0.0020677
12/05/2011 17:00	540	1.493608	65	0.0021185

Date/Time	Duration (min)	Bore Level (mBNS)	Pump Depth (mBNS)	DD* (m)
12/05/2011 17:10	550	1.4935571	65	0.0021694
12/05/2011 17:20	560	1.4935062	65	0.0022203
12/05/2011 17:30	570	1.4934553	65	0.0022712
12/05/2011 17:40	580	1.4934044	65	0.0023221
12/05/2011 17:50	590	1.4933536	65	0.0023729
12/05/2011 18:00	600	1.4933027	65	0.0024238
12/05/2011 18:10	610	1.4932518	65	0.0024747
12/05/2011 18:20	620	1.4932009	65	0.0025256
12/05/2011 18:30	630	1.4931501	65	0.0025764
12/05/2011 18:40	640	1.4930992	65	0.0026273
12/05/2011 18:50	650	1.4930483	65	0.0026782
12/05/2011 19:00	660	1.4929974	65	0.0027291
12/05/2011 19:10	670	1.4929466	65	0.0027798
12/05/2011 19:20	680	1.4928957	65	0.0028307
12/05/2011 19:30	690	1.4928448	65	0.0028816
12/05/2011 19:40	700	1.4927939	65	0.0029325
12/05/2011 19:50	710	1.492743	65	0.0029835
12/05/2011 20:00	720	1.4926922	65	0.0030342
12/05/2011 21:20	800	1.4922853	65	0.0034412
12/05/2011 23:00	900	1.4917765	65	0.00395
13/05/2011 0:40	1000	1.4912677	65	0.0044588
13/05/2011 2:20	1100	1.4908842	65	0.0048423
13/05/2011 4:00	1200	1.4911386	65	0.0045879
13/05/2011 5:40	1300	1.491393	65	0.0043335
13/05/2011 7:20	1400	1.4916474	65	0.0040791
13/05/2011 9:00	1500	1.4919018	65	0.0038247
13/05/2011 10:40	1600	1.4917856	65	0.0039408
13/05/2011 12:20	1700	1.4910225	65	0.004704
13/05/2011 14:00	1800	1.4902593	65	0.0054672
13/05/2011 15:40	1900	1.4894962	65	0.0062302
13/05/2011 17:20	2000	1.4887331	65	0.0069934
13/05/2011 19:00	2100	1.488544	65	0.0071825
13/05/2011 20:40	2200	1.4887984	65	0.0069281
13/05/2011 22:20	2300	1.4890528	65	0.0066737
14/05/2011 0:00	2400	1.4893072	65	0.0064193
14/05/2011 1:40	2500	1.4895616	65	0.0061649
14/05/2011 3:20	2600	1.4930145	65	0.002712
14/05/2011 5:00	2700	1.4936168	65	0.0021096
14/05/2011 6:40	2800	1.4941256	65	0.0016009
14/05/2011 8:20	2900	1.4946344	65	0.0010921
14/05/2011 10:00	3000	1.4951431	65	0.0005834

Date/Time	Duration (min)	Bore Level (mBNS)	Pump Depth (mBNS)	DD* (m)
14/05/2011 11:40	3100	1.4956518	65	7.463E-05
14/05/2011 13:20	3200	1.4961606	65	-0.0004342
14/05/2011 15:00	3300	1.4966693	65	-0.0009428
14/05/2011 16:40	3400	1.4971781	65	-0.0014516
14/05/2011 18:20	3500	1.4976869	65	-0.0019604
14/05/2011 20:00	3600	1.4981278	65	-0.0024014
14/05/2011 21:40	3700	1.4973646	65	-0.0016382
14/05/2011 23:20	3800	1.4966016	65	-0.0008751
15/05/2011 1:00	3900	1.4958384	65	-0.0001119
15/05/2011 2:40	4000	1.4950753	65	0.0006511
15/05/2011 4:20	4100	1.4942445	65	0.001482
15/05/2011 6:00	4200	1.4932141	65	0.0025123
15/05/2011 7:40	4300	1.4921837	65	0.0035428
15/05/2011 9:20	4400	1.4911534	65	0.0045731
15/05/2011 11:00	4500	1.4901229	65	0.0056036
15/05/2011 12:40	4600	1.4891686	65	0.0065578
15/05/2011 14:20	4700	1.4882866	65	0.0074399

Note:
Dataset is a subset of the original dataset from the SA Water Operational Data Store (i.e. original dataset recorded water level measurements every 1 minute therefore a long record)
* Derived

F. WATER CHEMISTRY

Several water samples were collected and analysed by AWQC from the newly constructed wells particularly Hawker TWS 4. Therefore the follow table provides a guide to the AWQC Final Analytical Report contained within this section.

Unit number (Well name)	Customer sample description	Sample ID	Sample date	Well completion date	Pumping test date (step and CRD test)	Comments
6534-340 (Hawker TWS 3)	Hawker TWS 3	2011-003-6562	31 May 2011	31 Mar 2011	23–31 May 2011	Sample collected at end of pumping test
6534-341 (Hawker TWS 4)	No. 4 Bore Hawker	2011-003-2283	6 May 2011	6 May 2011	5–13 Jun 2011	Partial sample suite collected during drilling phase (once well constructed and during development)
6534-341 (Hawker TWS 4)	Hawker TWS 4	2011-003-6563	7 Jun 2011	6 May 2011	5–13 Jun 2011	Sample collected at start of CRD test
6534-341 (Hawker TWS 4	Hawker TWS 4B	2011-003-9700	10 Jun 2011	6 May 2011	5–13 Jun 2011	Sample collected at end of CRD test
6535-170 (Parachilna TWS 2)	Parachilna TWS 2	2011-003-3153	15 May 2011	21 Apr 2011	10–15 May 2011	Sample collected at end of pumping test

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Australian Water Quality Centre

SAW Infrastructure
ATTN: Franz Lintl
SA Water House
Adelaide
SA 5000 AUSTRALIA

12/07/2011

Dear Franz

Please find attached the Final Analytical Report for

Customer Service Request: 105296-2011-CSR-14
Account: 105296
Project: AWQC-51088 SAW Infrastructure - Hawker Bore Commissioning 10/11

Please note AWQC Sample Receipt hours are Monday to Friday 8.30am - 4.30pm.

Yours sincerely,

Pat Poldervaart
Account Manager
Pat.Poldervaart@sawater.com.au

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Australian Water Quality Centre

FINAL REPORT: 87844

This report supercedes the following issued reports: 85818

Report Information

Project Name	AWQC-51088
Customer	SAW Infrastructure
CSR_ID	105296-2011-CSR-14

Analytical Results

Customer Sample Description	No.4 Bore Hawker
Sampling Point	70013-SAW General Request Northern
Sampled Date	6/05/2011 12:00:00AM
Sample Received Date	6/05/2011 4:14:14PM
Sample ID	2011-003-2283
Status	Endorsed
Collection Type	Customer Collected

Inorganic Chemistry - Metals	LOR	Result
Aluminium - Acid Soluble TIC-003 W09-023		
Aluminium - Acid Soluble	0.001	0.021 mg/L
Aluminium - Soluble TIC-003 W09-023		
Aluminium - Soluble	0.001	<0.001 mg/L
Aluminium - Total TIC-003 W09-023		
Aluminium - Total	0.001	1.459 mg/L
Antimony - Soluble TIC-003 W09-023		
Antimony - Soluble	0.0005	<0.0005 mg/L
Antimony - Total TIC-003 W09-023		
Antimony - Total	0.0005	<0.0005 mg/L
Arsenic - Soluble TIC-003 W09-023		
Arsenic - Soluble	0.0003	0.0011 mg/L
Arsenic - Total TIC-003 W09-023		
Arsenic - Total	0.0003	0.0037 mg/L
Barium - Soluble TIC-003 W09-023		
Barium - Soluble	0.0005	0.0200 mg/L
Barium - Total TIC-003 W09-023		
Barium - Total	0.0005	0.0250 mg/L
Beryllium - Soluble TIC-003 W09-023		
Beryllium - Soluble	0.0003	<0.0003 mg/L
Beryllium - Total TIC-003 W09-023		
Beryllium - Total	0.0003	<0.0003 mg/L
Boron - Soluble TIC-003 W09-023		
Boron - Soluble	0.020	0.741 mg/L
Cadmium - Soluble TIC-003 W09-023		
Cadmium - Soluble	0.0001	<0.0001 mg/L
Cadmium - Total TIC-003 W09-023		
Cadmium - Total	0.0001	<0.0001 mg/L
Calcium TIC-003 W09-023		
Calcium	0.04	262 mg/L
Chromium - Soluble TIC-003 W09-023		

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Customer Sample Description	No.4 Bore Hawker
Sampling Point	70013-SAW General Request Northern
Sampled Date	6/05/2011 12:00:00AM
Sample Received Date	6/05/2011 4:14:14PM
Sample ID	2011-003-2283
Status	Endorsed
Collection Type	Customer Collected

Chromium - Soluble TIC-003 W09-023		
Chromium - Soluble	0.0001	0.0001 mg/L
Chromium - Total TIC-003 W09-023		
Chromium - Total	0.0001	0.0026 mg/L
Copper - Soluble TIC-003 W09-023		
Copper - Soluble	0.0001	0.0004 mg/L
Copper - Total TIC-003 W09-023		
Copper - Total	0.0001	0.0033 mg/L
Iron - Soluble TIC-003 W09-023		
Iron - Soluble	0.0005	<0.0005 mg/L
Iron - Total TIC-003 W09-023		
Iron - Total	0.0005	3.506 mg/L
Langelier Index W09-023		
Langelier Index		1.24
Lead - Soluble TIC-003 W09-023		
Lead - Soluble	0.0001	<0.0001 mg/L
Lead - Total TIC-003 W09-023		
Lead - Total	0.0001	0.0090 mg/L
Magnesium TIC-003 W09-023		
Magnesium	0.04	230 mg/L
Manganese - Soluble TIC-003 W09-023		
Manganese - Soluble	0.0001	0.6272 mg/L
Manganese - Total TIC-003 W09-023		
Manganese - Total	0.0001	0.8371 mg/L
Mercury - Soluble TIC-003 W09-023		
Mercury - Soluble	0.00003	<0.00003 mg/L
Mercury - Total TIC-003 W09-023		
Mercury - Total	0.00003	<0.00003 mg/L
Molybdenum - Soluble TIC-003 W09-023		
Molybdenum - Soluble	0.0001	0.0011 mg/L
Molybdenum - Total TIC-003 W09-023		
Molybdenum - Total	0.0001	0.0011 mg/L
Nickel - Soluble TIC-003 W09-023		
Nickel - Soluble	0.0001	0.0017 mg/L
Nickel - Total TIC-003 W09-023		
Nickel - Total	0.0001	0.0044 mg/L
Potassium TIC-003 W09-023		
Potassium	0.040	10.7 mg/L

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Sampling Point	70013-SAW General Request Northern
Sampled Date	6/05/2011 12:00:00AM
Sample Received Date	6/05/2011 4:14:14PM
Sample ID	2011-003-2283
Status	Endorsed
Collection Type	Customer Collected

Selenium - Soluble TIC-003 W09-023		
Selenium - Soluble	0.0001	<0.0001 mg/L
Selenium - Total TIC-003 W09-023		
Selenium - Total	0.0001	<0.0001 mg/L
Silica - Total TIC-004 W09-023		
Silica - Total	2.0	211 mg/L
Silver - Soluble TIC-003 W09-023		
Silver - Soluble	0.00003	<0.00003 mg/L
Silver - Total TIC-003 W09-023		
Silver - Total	0.00003	<0.00003 mg/L
Sodium TIC-003 W09-023		
Sodium	0.04	780 mg/L
Strontium - Total TIC-003 W09-023		
Strontium - Total	0.0001	5.990 mg/L
Sulphur TIC-004 W09-023		
Sulphate	1.5	1210 mg/L
Tin - Soluble TIC-003 W09-023		
Tin - Soluble	0.0005	<0.0005 mg/L
Tin - Total TIC-003 W09-023		
Tin - Total	0.0005	<0.0005 mg/L
Total Hardness as CaCO3 W09-023		
Total Hardness as CaCO3	2.0	1600 mg/L
Uranium - Soluble TIC-003 W09-023		
Uranium - Soluble	0.0001	0.0023 mg/L
Uranium - Total TIC-003 W09-023		
Uranium - Total	0.0001	0.0028 mg/L
Zinc - soluble TIC-003 W09-023		
Zinc - Soluble	0.0003	0.0015 mg/L
Zinc - Total TIC-003 W09-023		
Zinc - Total	0.0003	0.0102 mg/L

Inorganic Chemistry - Nutrients	**LOR**	**Result**
Ammonia as N T0100-01 W09-023		
Ammonia as N	0.005	0.038 mg/L
Bromide T0114-01 W09-023		
Bromide	0.10	3.38 mg/L
Chloride T0104-02 W09-023		

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Customer Sample Description	No.4 Bore Hawker
Sampling Point	70013-SAW General Request Northern
Sampled Date	6/05/2011 12:00:00AM
Sample Received Date	6/05/2011 4:14:14PM
Sample ID	2011-003-2283
Status	Endorsed
Collection Type	Customer Collected

Chloride T0104-02 W09-023

Chloride	4.0	1230 mg/L

Fluoride W09-023

Fluoride	0.10	1.0 mg/L

Iodide T0117-01 W09-023

Iodide	0.05	<0.05 mg/L

Nitrate + Nitrite as N T0161-01 W09-023

Nitrate + Nitrite as N	0.003	0.008 mg/L

Nitrate + Nitrite as NO3 T0161-01 W09-023

Nitrate + Nitrite as NO3	0.02	0.04 mg/L

Organic Chemistry	LOR	Result

Dissolved Organic Carbon W09-023

Dissolved Organic Carbon	0.3	0.7 mg/L

Inorganic Chemistry - Physical	LOR	Result

Alkalinity Carbonate Bicarbonate and Hydroxide T0101-01 W09-023

Alkalinity as Calcium Carbonate		349 mg/L
Bicarbonate		426 mg/L
Carbonate		0 mg/L
Hydroxide		0 mg/L

Colour - Apparent (456nm) Unfiltered T0029-01 W09-023

Colour - Apparent (456nm)	1	420 HU

Conductivity & Total Dissolved Solids T0016-01 W09-023

Conductivity	1	6000 µScm
Total Dissolved Solids (by EC)	1.0	3400 mg/L

pH T0010-01 W09-023

pH		7.9 pH units

Turbidity T0018-01 W09-023

Turbidity	0.1	64 NTU

Inorganic Chemistry - Waste Water	LOR	Result

Chlorine Demand - 24 hrs T0136-03 W09-023

Chlorine Demand 24hrs		2.57 mg/L

Chlorine Demand - 30 mins T0136-03 W09-023

Chlorine Demand 30 mins		2.36 mg/L

Chlorine Demand - 8 hrs T0136-03 W09-023

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FINAL REPORT: 87844

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Analytical Results

Customer Sample Description	No.4 Bore Hawker
Sampling Point	70013-SAW General Request Northern
Sampled Date	6/05/2011 12:00:00AM
Sample Received Date	6/05/2011 4:14:14PM
Sample ID	2011-003-2283
Status	Endorsed
Collection Type	Customer Collected

Chlorine Demand - 8 hrs T0136-03 W09-023

Chlorine Demand 8 hrs		2.89 mg/L

Cyanide - Total T0167-03 W09-023

Cyanide as CN - Total	0.05	<0.05 mg/L

Western Radiation Services	LOR	Result

Gross Alpha Activity W09-023

Gross Alpha Activity	0.005	0.024 Bq/L

Gross Beta Activity (K-40 corrected) W09-023

Gross Beta Activity (K-40 corrected)	0.010	1.568 Bq/L

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Analytical Results

Customer Sample Description	Parachilna TWS2
Sampling Point	70013-SAW General Request Northern
Sampled Date	15/05/2011 8:30:00AM
Sample Received Date	18/05/2011 10:50:07AM
Sample ID	2011-003-3153
Status	Endorsed
Collection Type	Customer Collected

Inorganic Chemistry - Metals	LOR	Result
Aluminium - Acid Soluble TIC-003 W09-023		
Aluminium - Acid Soluble	0.001	<0.001 mg/L
Aluminium - Soluble TIC-003 W09-023		
Aluminium - Soluble	0.001	<0.001 mg/L
Aluminium - Total TIC-003 W09-023		
Aluminium - Total	0.001	0.001 mg/L
Antimony - Soluble TIC-003 W09-023		
Antimony - Soluble	0.0005	<0.0005 mg/L
Antimony - Total TIC-003 W09-023		
Antimony - Total	0.0005	<0.0005 mg/L
Arsenic - Soluble TIC-003 W09-023		
Arsenic - Soluble	0.0003	0.0003 mg/L
Arsenic - Total TIC-003 W09-023		
Arsenic - Total	0.0003	0.0004 mg/L
Barium - Soluble TIC-003 W09-023		
Barium - Soluble	0.0005	0.0542 mg/L
Barium - Total TIC-003 W09-023		
Barium - Total	0.0005	0.0544 mg/L
Beryllium - Soluble TIC-003 W09-023		
Beryllium - Soluble	0.0003	<0.0003 mg/L
Beryllium - Total TIC-003 W09-023		
Beryllium - Total	0.0003	<0.0003 mg/L
Boron - Soluble TIC-003 W09-023		
Boron - Soluble	0.020	0.293 mg/L
Cadmium - Soluble TIC-003 W09-023		
Cadmium - Soluble	0.0001	<0.0001 mg/L
Cadmium - Total TIC-003 W09-023		
Cadmium - Total	0.0001	<0.0001 mg/L
Calcium TIC-003 W09-023		
Calcium	0.04	61.1 mg/L
Chromium - Soluble TIC-003 W09-023		
Chromium - Soluble	0.0001	0.0010 mg/L
Chromium - Total TIC-003 W09-023		
Chromium - Total	0.0001	0.0015 mg/L
Copper - Soluble TIC-003 W09-023		

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Analytical Results

Customer Sample Description	Parachilna TWS2
Sampling Point	70013-SAW General Request Northern
Sampled Date	15/05/2011 8:30:00AM
Sample Received Date	18/05/2011 10:50:07AM
Sample ID	2011-003-3153
Status	Endorsed
Collection Type	Customer Collected

Copper - Soluble TIC-003 W09-023		
Copper - Soluble	0.0001	<0.0001 mg/L
Copper - Total TIC-003 W09-023		
Copper - Total	0.0001	<0.0001 mg/L
Iron - Soluble TIC-003 W09-023		
Iron - Soluble	0.0005	0.0016 mg/L
Iron - Total TIC-003 W09-023		
Iron - Total	0.0005	0.0285 mg/L
Lead - Soluble TIC-003 W09-023		
Lead - Soluble	0.0001	<0.0001 mg/L
Lead - Total TIC-003 W09-023		
Lead - Total	0.0001	<0.0001 mg/L
Magnesium TIC-003 W09-023		
Magnesium	0.04	42.1 mg/L
Manganese - Soluble TIC-003 W09-023		
Manganese - Soluble	0.0001	0.0209 mg/L
Manganese - Total TIC-003 W09-023		
Manganese - Total	0.0001	0.0211 mg/L
Mercury - Soluble TIC-003 W09-023		
Mercury - Soluble	0.00003	<0.00003 mg/L
Mercury - Total TIC-003 W09-023		
Mercury - Total	0.00003	<0.00003 mg/L
Molybdenum - Soluble TIC-003 W09-023		
Molybdenum - Soluble	0.0001	0.0012 mg/L
Molybdenum - Total TIC-003 W09-023		
Molybdenum - Total	0.0001	0.0012 mg/L
Nickel - Soluble TIC-003 W09-023		
Nickel - Soluble	0.0001	0.0003 mg/L
Nickel - Total TIC-003 W09-023		
Nickel - Total	0.0001	0.0003 mg/L
Potassium TIC-003 W09-023		
Potassium	0.040	3.06 mg/L
Selenium - Soluble TIC-003 W09-023		
Selenium - Soluble	0.0001	0.0008 mg/L
Selenium - Total TIC-003 W09-023		
Selenium - Total	0.0001	0.0008 mg/L
Silver - Soluble TIC-003 W09-023		
Silver - Soluble	0.00003	<0.00003 mg/L

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Sampling Point	70013-SAW General Request Northern
Sampled Date	15/05/2011 8:30:00AM
Sample Received Date	18/05/2011 10:50:07AM
Sample ID	2011-003-3153
Status	Endorsed
Collection Type	Customer Collected

Silver - Total TIC-003 W09-023		
Silver - Total	0.00003	<0.00003 mg/L
Sodium TIC-003 W09-023		
Sodium	0.04	171 mg/L
Sulphur TIC-004 W09-023		
Sulphate	1.5	99.6 mg/L
Tin - Soluble TIC-003 W09-023		
Tin - Soluble	0.0005	<0.0005 mg/L
Tin - Total TIC-003 W09-023		
Tin - Total	0.0005	<0.0005 mg/L
Total Hardness as CaCO3 W09-023		
Total Hardness as CaCO3	2.0	326 mg/L
Uranium - Soluble TIC-003 W09-023		
Uranium - Soluble	0.0001	0.0018 mg/L
Uranium - Total TIC-003 W09-023		
Uranium - Total	0.0001	0.0019 mg/L
Zinc - soluble TIC-003 W09-023		
Zinc - Soluble	0.0003	0.0064 mg/L
Zinc - Total TIC-003 W09-023		
Zinc - Total	0.0003	0.0067 mg/L

Inorganic Chemistry - Nutrients	**LOR**	**Result**
Ammonia as N T0100-01 W09-023		
Ammonia as N	0.005	0.009 mg/L
Bromide T0114-01 W09-023		
Bromide	0.10	0.70 mg/L
Fluoride W09-023		
Fluoride	0.10	0.59 mg/L
Iodide T0117-01 W09-023		
Iodide	0.05	<0.05 mg/L
Nitrate + Nitrite as N T0161-01 W09-023		
Nitrate + Nitrite as N	0.003	1.27 mg/L
Nitrate + Nitrite as NO3 T0161-01 W09-023		
Nitrate + Nitrite as NO3	0.02	5.63 mg/L

Organic Chemistry	**LOR**	**Result**
Acidic Herbicides T0803-03 W09-023		

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FINAL REPORT: 87844

This report supercedes the following issued reports: 85818

Analytical Results

Customer Sample Description	Parachilna TWS2
Sampling Point	70013-SAW General Request Northern
Sampled Date	15/05/2011 8:30:00AM
Sample Received Date	18/05/2011 10:50:07AM
Sample ID	2011-003-3153
Status	Endorsed
Collection Type	Customer Collected

Acidic Herbicides T0803-03 W09-023

# 2 4 5-T	0.05	<0.05 µg/L
# 2 4-D	0.05	<0.05 µg/L
# Chlorsulfuron	0.05	<0.1 µg/L
# Clopyralid	0.5	<0.5 µg/L
# Dicamba	0.2	<0.2 µg/L
# MCPA	0.05	<0.05 µg/L
# Metsulfuron Methyl	0.05	<0.1 µg/L
# Picloram	0.2	<0.2 µg/L
# Silvex	0.05	<0.05 µg/L
# Sulfometuron	0.05	<0.05 µg/L
# Triclopyr	0.1	<0.1 µg/L

Dissolved Organic Carbon W09-023

Dissolved Organic Carbon	0.3	0.4 mg/L

GCMS Scan - Dichloromethane T1072-01 W09-023

# GCMS Scan	The GC scan showed the sample contained one semi-volatile organic compound. Some compounds may not have even been extracted using dichloromethane and/or detected by GC/MS. The peak detected was unable to be identified as NIST Mass Spectral Search Program 2002 showed very poor matches.

OrganoChlorine Pesticides T0700-01 W09-023

Aldrin	0.01	<0.01 µg/L
Chlordane-a	0.01	<0.01 µg/L
Chlordane-g	0.01	<0.01 µg/L
Chlorothalonil	0.05	<0.05 µg/L
Chlorpyrifos	0.05	<0.05 µg/L
Chlorthal-Dimethyl	0.05	<0.05 µg/L
DDD	0.05	<0.05 µg/L
DDE	0.05	<0.05 µg/L
DDT	0.05	<0.05 µg/L
Dieldrin	0.01	<0.01 µg/L
Endosulfan 1	0.05	<0.05 µg/L
Endosulfan 2	0.05	<0.05 µg/L
Endosulfan Sulphate	0.05	<0.05 µg/L
Endrin	0.05	<0.05 µg/L

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Customer Sample Description	Parachilna TWS2
Sampling Point	70013-SAW General Request Northern
Sampled Date	15/05/2011 8:30:00AM
Sample Received Date	18/05/2011 10:50:07AM
Sample ID	2011-003-3153
Status	Endorsed
Collection Type	Customer Collected

OrganoChlorine Pesticides T0700-01 W09-023

Heptachlor	0.05	<0.05 µg/L
Heptachlor Epoxide	0.05	<0.05 µg/L
Hexachlorobenzene	0.05	<0.05 µg/L
Lindane	0.05	<0.05 µg/L
Methoxychlor	0.05	<0.05 µg/L
Trifluralin	0.05	<0.05 µg/L
Vinclozolin	0.05	<0.05 µg/L

Organophosphorous and Triazine Pesticides T0800-01 W09-023

Atrazine	0.5	<0.5 µg/L
Azinphos-methyl	0.5	<0.5 µg/L
Diazinon	0.5	<0.5 µg/L
Fenitrothion	0.5	<0.5 µg/L
Hexazinone	0.5	<0.5 µg/L
Malathion	0.5	<0.5 µg/L
Parathion	0.5	<0.5 µg/L
Parathion methyl	0.3	<0.3 µg/L
Prometryne	0.5	<0.5 µg/L
Simazine	0.5	<0.5 µg/L

Inorganic Chemistry - Physical	LOR	Result

Colour - Apparent (456nm) Unfiltered T0029-01 W09-023

Colour - Apparent (456nm)	1	1 HU

Conductivity & Total Dissolved Solids T0016-01 W09-023

Conductivity	1	1470 µScm
Total Dissolved Solids (by EC)	1.0	810 mg/L

pH T0010-01 W09-023

pH		7.5 pH units

Turbidity T0018-01 W09-023

Turbidity	0.1	0.15 NTU

Inorganic Chemistry - Waste Water	LOR	Result

Chlorine Demand - 24 hrs T0136-03 W09-023

Chlorine Demand 24hrs		0.83 mg/L

Chlorine Demand - 30 mins T0136-03 W09-023

Chlorine Demand 30 mins		1.53 mg/L

Chlorine Demand - 8 hrs T0136-03 W09-023

Chlorine Demand 8 hrs		1.28 mg/L

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Sample Received Date	18/05/2011 10:50:07AM
Sample ID	2011-003-3153
Status	Endorsed
Collection Type	Customer Collected

Cyanide - Total T0167-03 W09-023

Cyanide as CN - Total	0.05	<0.05 mg/L

Sulphide - Soluble T0168-01 W09-023

Sulphide as S - Soluble	0.1	<0.1 mg/L

Sulphide - Total T0168-01 W09-023

Sulphide as S - Total	0.1	<0.1 mg/L

Western Radiation Services	**LOR**	**Result**

Gross Alpha Activity W09-023

Gross Alpha Activity	0.005	<0.005 Bq/L

Gross Beta Activity (K-40 corrected) W09-023

Gross Beta Activity (K-40 corrected)	0.010	0.354 Bq/L

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Customer Sample Description	Hawker TWS 3
Sampling Point	70013-SAW General Request Northern
Sampled Date	31/05/2011 9:30:00AM
Sample Received Date	31/05/2011 8:21:17PM
Sample ID	*2011-003-6562
Status	Endorsed
Collection Type	Customer Collected

Inorganic Chemistry - Metals	LOR	Result
Aluminium - Acid Soluble TIC-003 W09-023		
Aluminium - Acid Soluble	0.001	<0.001 mg/L
Aluminium - Soluble TIC-003 W09-023		
Aluminium - Soluble	0.001	<0.001 mg/L
Aluminium - Total TIC-003 W09-023		
Aluminium - Total	0.001	0.002 mg/L
Antimony - Soluble TIC-003 W09-023		
Antimony - Soluble	0.0005	<0.0005 mg/L
Antimony - Total TIC-003 W09-023		
Antimony - Total	0.0005	<0.0005 mg/L
Arsenic - Soluble TIC-003 W09-023		
Arsenic - Soluble	0.0003	0.0015 mg/L
Arsenic - Total TIC-003 W09-023		
Arsenic - Total	0.0003	0.0022 mg/L
Barium - Soluble TIC-003 W09-023		
Barium - Soluble	0.0005	0.0258 mg/L
Barium - Total TIC-003 W09-023		
Barium - Total	0.0005	0.0264 mg/L
Beryllium - Soluble TIC-003 W09-023		
Beryllium - Soluble	0.0003	<0.0003 mg/L
Beryllium - Total TIC-003 W09-023		
Beryllium - Total	0.0003	<0.0003 mg/L
Boron - Soluble TIC-003 W09-023		
Boron - Soluble	0.020	0.441 mg/L
Cadmium - Soluble TIC-003 W09-023		
Cadmium - Soluble	0.0001	<0.0001 mg/L
Cadmium - Total TIC-003 W09-023		
Cadmium - Total	0.0001	<0.0001 mg/L
Calcium TIC-003 W09-023		
Calcium	0.04	151 mg/L
Chromium - Soluble TIC-003 W09-023		
Chromium - Soluble	0.0001	0.0003 mg/L
Chromium - Total TIC-003 W09-023		
Chromium - Total	0.0001	0.0004 mg/L
Copper - Soluble TIC-003 W09-023		

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Copper - Soluble TIC-003 W09-023		
Copper - Soluble	0.0001	<0.0001 mg/L
Copper - Total TIC-003 W09-023		
Copper - Total	0.0001	0.0007 mg/L
Iron - Soluble TIC-003 W09-023		
Iron - Soluble	0.0005	0.0158 mg/L
Iron - Total TIC-003 W09-023		
Iron - Total	0.0005	0.7142 mg/L
Langelier Index W09-023		
Langelier Index		0.00
Lead - Soluble TIC-003 W09-023		
Lead - Soluble	0.0001	<0.0001 mg/L
Lead - Total TIC-003 W09-023		
Lead - Total	0.0001	0.0005 mg/L
Magnesium TIC-003 W09-023		
Magnesium	0.04	143 mg/L
Manganese - Soluble TIC-003 W09-023		
Manganese - Soluble	0.0001	0.1048 mg/L
Manganese - Total TIC-003 W09-023		
Manganese - Total	0.0001	0.1059 mg/L
Mercury - Soluble TIC-003 W09-023		
Mercury - Soluble	0.00003	<0.00003 mg/L
Mercury - Total TIC-003 W09-023		
Mercury - Total	0.00003	<0.00003 mg/L
Molybdenum - Soluble TIC-003 W09-023		
Molybdenum - Soluble	0.0001	0.0013 mg/L
Molybdenum - Total TIC-003 W09-023		
Molybdenum - Total	0.0001	0.0012 mg/L
Nickel - Soluble TIC-003 W09-023		
Nickel - Soluble	0.0001	0.0007 mg/L
Nickel - Total TIC-003 W09-023		
Nickel - Total	0.0001	0.0009 mg/L
Potassium TIC-003 W09-023		
Potassium	0.040	15.5 mg/L
Selenium - Soluble TIC-003 W09-023		
Selenium - Soluble	0.0001	<0.0001 mg/L
Selenium - Total TIC-003 W09-023		
Selenium - Total	0.0001	<0.0001 mg/L

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Silver - Soluble TIC-003 W09-023		
Silver - Soluble	0.00003	<0.00003 mg/L
Silver - Total TIC-003 W09-023		
Silver - Total	0.00003	<0.00003 mg/L
Sodium TIC-003 W09-023		
Sodium	0.04	490 mg/L
Sulphur TIC-004 W09-023		
Sulphate	1.5	426 mg/L
Tin - Soluble TIC-003 W09-023		
Tin - Soluble	0.0005	<0.0005 mg/L
Tin - Total TIC-003 W09-023		
Tin - Total	0.0005	<0.0005 mg/L
Total Hardness as CaCO3 W09-023		
Total Hardness as CaCO3	2.0	966 mg/L
Uranium - Soluble TIC-003 W09-023		
Uranium - Soluble	0.0001	0.0052 mg/L
Uranium - Total TIC-003 W09-023		
Uranium - Total	0.0001	0.0051 mg/L
Zinc - soluble TIC-003 W09-023		
Zinc - Soluble	0.0003	0.1938 mg/L
Zinc - Total TIC-003 W09-023		
Zinc - Total	0.0003	0.2073 mg/L

Inorganic Chemistry - Nutrients	**LOR**	**Result**
Ammonia as N T0100-01 W09-023		
Ammonia as N	0.005	0.014 mg/L
Bromide T0114-01 W09-023		
Bromide	0.10	2.22 mg/L
Fluoride W09-023		
Fluoride	0.10	0.61 mg/L
Iodide T0117-01 W09-023		
Iodide	0.05	0.12 mg/L
Nitrate + Nitrite as N T0161-01 W09-023		
Nitrate + Nitrite as N	0.003	0.006 mg/L
Nitrate + Nitrite as NO3 T0161-01 W09-023		
Nitrate + Nitrite as NO3	0.02	0.03 mg/L

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Sampled Date	31/05/2011 9:30:00AM
Sample Received Date	31/05/2011 8:21:17PM
Sample ID	*2011-003-6562
Status	Endorsed
Collection Type	Customer Collected

Organic Chemistry	LOR	Result
Acidic Herbicides T0803-03 W09-023		
# 2 4 5-T	0.05	<0.1 µg/L
# 2 4-D	0.05	<0.1 µg/L
# Chlorsulfuron	0.05	<0.15 µg/L
# Clopyralid	0.5	<1 µg/L
# Dicamba	0.2	<0.4 µg/L
# MCPA	0.05	<0.1 µg/L
# Metsulfuron Methyl	0.05	<0.15 µg/L
# Picloram	0.2	<0.4 µg/L
# Silvex	0.05	<0.1 µg/L
# Sulfometuron	0.05	<0.15 µg/L
# Triclopyr	0.1	<0.2 µg/L
Dissolved Organic Carbon W09-023		
Dissolved Organic Carbon	0.3	0.6 mg/L
GCMS Scan - Dichloromethane T1072-01 W09-023		
# GCMS Scan		The GC scan showed the sample contained a number of semi-volatile organic compounds. Some compounds may not have even been extracted using dichloromethane and/or detected by GC/MS. The peaks detected were unable to be identified as NIST Mass Spectral Search Program showed very poor matches.
OrganoChlorine Pesticides T0700-01 W09-023		
Aldrin	0.01	<0.01 µg/L
Chlordane-a	0.01	<0.01 µg/L
Chlordane-g	0.01	<0.01 µg/L
Chlorothalonil	0.05	<0.05 µg/L
Chlorpyrifos	0.05	<0.05 µg/L
Chlorthal-Dimethyl	0.05	<0.05 µg/L
DDD	0.05	<0.05 µg/L
DDE	0.05	<0.05 µg/L
DDT	0.05	<0.05 µg/L
Dieldrin	0.01	<0.01 µg/L
Endosulfan 1	0.05	<0.05 µg/L
Endosulfan 2	0.05	<0.05 µg/L
Endosulfan Sulphate	0.05	<0.05 µg/L

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Sample ID	*2011-003-6562
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Collection Type	Customer Collected

OrganoChlorine Pesticides T0700-01 W09-023

Endrin	0.05	<0.05 µg/L
Heptachlor	0.05	<0.05 µg/L
Heptachlor Epoxide	0.05	<0.05 µg/L
Hexachlorobenzene	0.05	<0.05 µg/L
Lindane	0.05	<0.05 µg/L
Methoxychlor	0.05	<0.05 µg/L
Trifluralin	0.05	<0.05 µg/L
Vinclozolin	0.05	<0.05 µg/L

Organophosphorous and Triazine Pesticides T0800-01 W09-023

Atrazine	0.5	<0.5 µg/L
Azinphos-methyl	0.5	<0.5 µg/L
Diazinon	0.5	<0.5 µg/L
Fenitrothion	0.5	<0.5 µg/L
Hexazinone	0.5	<0.5 µg/L
Malathion	0.5	<0.5 µg/L
Parathion	0.5	<0.5 µg/L
Parathion methyl	0.3	<0.3 µg/L
Prometryne	0.5	<0.5 µg/L
Simazine	0.5	<0.5 µg/L

Inorganic Chemistry - Physical	**LOR**	**Result**

Alkalinity Carbonate Bicarbonate and Hydroxide T0101-01 W09-023

Alkalinity as Calcium Carbonate		344 mg/L
Bicarbonate		419 mg/L
Carbonate		0 mg/L
Hydroxide		0 mg/L

Colour - Apparent (456nm) Unfiltered T0029-01 W09-023

Colour - Apparent (456nm)	1	13 HU

Conductivity & Total Dissolved Solids T0016-01 W09-023

Conductivity	1	4130 µScm
Total Dissolved Solids (by EC)	1.0	2300 mg/L

pH T0010-01 W09-023

pH		6.9 pH units

Turbidity T0018-01 W09-023

Turbidity	0.1	6.6 NTU

Inorganic Chemistry - Waste Water	**LOR**	**Result**

Chlorine Demand - 24 hrs T0136-03 W09-023

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Australian Water Quality Centre

FINAL REPORT: 87844

This report supercedes the following issued reports: 85818

Analytical Results

Customer Sample Description	Hawker TWS 3
Sampling Point	70013-SAW General Request Northern
Sampled Date	31/05/2011 9:30:00AM
Sample Received Date	31/05/2011 8:21:17PM
Sample ID	*2011-003-6562
Status	Endorsed
Collection Type	Customer Collected

Chlorine Demand - 24 hrs T0136-03 W09-023		
Chlorine Demand 24hrs		3.35 mg/L
Chlorine Demand - 30 mins T0136-03 W09-023		
Chlorine Demand 30 mins		2.28 mg/L
Chlorine Demand - 8 hrs T0136-03 W09-023		
Chlorine Demand 8 hrs		2.57 mg/L
Cyanide - Total T0167-03 W09-023		
Cyanide as CN - Total	0.05	<0.05 mg/L
Sulphide - Soluble T0168-01 W09-023		
Sulphide as S - Soluble	0.1	<0.1 mg/L
Sulphide - Total T0168-01 W09-023		
Sulphide as S - Total	0.1	<0.1 mg/L

Western Radiation Services	**LOR**	**Result**
Gross Alpha Activity W09-023		
Gross Alpha Activity	0.005	<0.005 Bq/L
Gross Beta Activity (K-40 corrected) W09-023		
Gross Beta Activity (K-40 corrected)	0.010	<0.010 Bq/L

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Analytical Results

Customer Sample Description	Hawker TWS 4
Sampling Point	70013-SAW General Request Northern
Sampled Date	7/06/2011 12:30:00PM
Sample Received Date	7/06/2011 8:41:07PM
Sample ID	*2011-003-6563
Status	Endorsed
Collection Type	Customer Collected

Inorganic Chemistry - Metals	LOR	Result
Aluminium - Acid Soluble TIC-003 W09-023		
Aluminium - Acid Soluble	0.001	<0.001 mg/L
Aluminium - Soluble TIC-003 W09-023		
Aluminium - Soluble	0.001	<0.001 mg/L
Aluminium - Total TIC-003 W09-023		
Aluminium - Total	0.001	<0.001 mg/L
Antimony - Soluble TIC-003 W09-023		
Antimony - Soluble	0.0005	<0.0005 mg/L
Antimony - Total TIC-003 W09-023		
Antimony - Total	0.0005	<0.0005 mg/L
Arsenic - Soluble TIC-003 W09-023		
Arsenic - Soluble	0.0003	<0.0003 mg/L
Arsenic - Total TIC-003 W09-023		
Arsenic - Total	0.0003	<0.0003 mg/L
Barium - Soluble TIC-003 W09-023		
Barium - Soluble	0.0005	0.0175 mg/L
Barium - Total TIC-003 W09-023		
Barium - Total	0.0005	0.0186 mg/L
Beryllium - Soluble TIC-003 W09-023		
Beryllium - Soluble	0.0003	<0.0003 mg/L
Beryllium - Total TIC-003 W09-023		
Beryllium - Total	0.0003	<0.0003 mg/L
Boron - Soluble TIC-003 W09-023		
Boron - Soluble	0.020	0.762 mg/L
Cadmium - Soluble TIC-003 W09-023		
Cadmium - Soluble	0.0001	<0.0001 mg/L
Cadmium - Total TIC-003 W09-023		
Cadmium - Total	0.0001	<0.0001 mg/L
Calcium TIC-003 W09-023		
Calcium	0.04	283 mg/L
Chromium - Soluble TIC-003 W09-023		
Chromium - Soluble	0.0001	0.0001 mg/L
Chromium - Total TIC-003 W09-023		
Chromium - Total	0.0001	0.0001 mg/L
Copper - Soluble TIC-003 W09-023		

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Customer Sample Description	Hawker TWS 4
Sampling Point	70013-SAW General Request Northern
Sampled Date	7/06/2011 12:30:00PM
Sample Received Date	7/06/2011 8:41:07PM
Sample ID	*2011-003-6563
Status	Endorsed
Collection Type	Customer Collected

Copper - Soluble TIC-003 W09-023		
Copper - Soluble	0.0001	<0.0001 mg/L
Copper - Total TIC-003 W09-023		
Copper - Total	0.0001	0.0021 mg/L
Iron - Soluble TIC-003 W09-023		
Iron - Soluble	0.0005	0.3256 mg/L
Iron - Total TIC-003 W09-023		
Iron - Total	0.0005	0.8338 mg/L
Langelier Index W09-023		
Langelier Index		0.32
Lead - Soluble TIC-003 W09-023		
Lead - Soluble	0.0001	<0.0001 mg/L
Lead - Total TIC-003 W09-023		
Lead - Total	0.0001	<0.0001 mg/L
Magnesium TIC-003 W09-023		
Magnesium	0.04	221 mg/L
Manganese - Soluble TIC-003 W09-023		
Manganese - Soluble	0.0001	0.6343 mg/L
Manganese - Total TIC-003 W09-023		
Manganese - Total	0.0001	0.6583 mg/L
Mercury - Soluble TIC-003 W09-023		
Mercury - Soluble	0.00003	<0.00003 mg/L
Mercury - Total TIC-003 W09-023		
Mercury - Total	0.00003	<0.00003 mg/L
Molybdenum - Soluble TIC-003 W09-023		
Molybdenum - Soluble	0.0001	0.0009 mg/L
Molybdenum - Total TIC-003 W09-023		
Molybdenum - Total	0.0001	0.0008 mg/L
Nickel - Soluble TIC-003 W09-023		
Nickel - Soluble	0.0001	0.0001 mg/L
Nickel - Total TIC-003 W09-023		
Nickel - Total	0.0001	0.0001 mg/L
Potassium TIC-003 W09-023		
Potassium	0.040	9.73 mg/L
Selenium - Soluble TIC-003 W09-023		
Selenium - Soluble	0.0001	<0.0001 mg/L
Selenium - Total TIC-003 W09-023		
Selenium - Total	0.0001	0.0001 mg/L

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Sampling Point	70013-SAW General Request Northern
Sampled Date	7/06/2011 12:30:00PM
Sample Received Date	7/06/2011 8:41:07PM
Sample ID	*2011-003-6563
Status	Endorsed
Collection Type	Customer Collected

Silver - Soluble TIC-003 W09-023		
Silver - Soluble	0.00003	<0.00003 mg/L
Silver - Total TIC-003 W09-023		
Silver - Total	0.00003	<0.00003 mg/L
Sodium TIC-003 W09-023		
Sodium	0.04	879 mg/L
Sulphur TIC-004 W09-023		
Sulphate	1.5	1170 mg/L
Tin - Soluble TIC-003 W09-023		
Tin - Soluble	0.0005	<0.0005 mg/L
Total Hardness as CaCO3 W09-023		
Total Hardness as CaCO3	2.0	1620 mg/L
Uranium - Soluble TIC-003 W09-023		
Uranium - Soluble	0.0001	0.0022 mg/L
Uranium - Total TIC-003 W09-023		
Uranium - Total	0.0001	0.0022 mg/L
Zinc - soluble TIC-003 W09-023		
Zinc - Soluble	0.0003	0.0175 mg/L
Zinc - Total TIC-003 W09-023		
Zinc - Total	0.0003	0.0196 mg/L

Inorganic Chemistry - Nutrients	**LOR**	**Result**
Ammonia as N T0100-01 W09-023		
Ammonia as N	0.005	0.043 mg/L
Bromide T0114-01 W09-023		
Bromide	0.10	3.31 mg/L
Fluoride W09-023		
Fluoride	0.10	1.0 mg/L
Iodide T0117-01 W09-023		
Iodide	0.05	0.24 mg/L
Nitrate + Nitrite as N T0161-01 W09-023		
Nitrate + Nitrite as N	0.003	0.010 mg/L
Nitrate + Nitrite as NO3 T0161-01 W09-023		
Nitrate + Nitrite as NO3	0.02	0.04 mg/L

Organic Chemistry	**LOR**	**Result**
Acidic Herbicides T0803-03 W09-023		

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Sampling Point	70013-SAW General Request Northern
Sampled Date	7/06/2011 12:30:00PM
Sample Received Date	7/06/2011 8:41:07PM
Sample ID	*2011-003-6563
Status	Endorsed
Collection Type	Customer Collected

Acidic Herbicides T0803-03 W09-023

# 2 4 5-T	0.05	<0.1 µg/L
# 2 4-D	0.05	<0.1 µg/L
# Chlorsulfuron	0.05	<0.15 µg/L
# Clopyralid	0.5	<1 µg/L
# Dicamba	0.2	<0.4 µg/L
# MCPA	0.05	<0.1 µg/L
# Metsulfuron Methyl	0.05	<0.15 µg/L
# Picloram	0.2	<0.4 µg/L
# Silvex	0.05	<0.1 µg/L
# Sulfometuron	0.05	<0.15 µg/L
# Triclopyr	0.1	<0.2 µg/L

Dissolved Organic Carbon W09-023

Dissolved Organic Carbon	0.3	0.5 mg/L

GCMS Scan - Dichloromethane T1072-01 W09-023

# GCMS Scan	The GC scan showed the sample contained a number of semi-volatile organic compounds. Some compounds may not have even been extracted using dichloromethane and/or detected by GC/MS. The peaks detected were unable to be identified as NIST Mass Spectral Search Program 2002 showed very poor matches.

OrganoChlorine Pesticides T0700-01 W09-023

Aldrin	0.01	<0.01 µg/L
Chlordane-a	0.01	<0.01 µg/L
Chlordane-g	0.01	<0.01 µg/L
Chlorothalonil	0.05	<0.05 µg/L
Chlorpyrifos	0.05	<0.05 µg/L
Chlorthal-Dimethyl	0.05	<0.05 µg/L
DDD	0.05	<0.05 µg/L
DDE	0.05	<0.05 µg/L
DDT	0.05	<0.05 µg/L
Dieldrin	0.01	<0.01 µg/L
Endosulfan 1	0.05	<0.05 µg/L
Endosulfan 2	0.05	<0.05 µg/L
Endosulfan Sulphate	0.05	<0.05 µg/L
Endrin	0.05	<0.05 µg/L

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Sampled Date	7/06/2011 12:30:00PM
Sample Received Date	7/06/2011 8:41:07PM
Sample ID	*2011-003-6563
Status	Endorsed
Collection Type	Customer Collected

OrganoChlorine Pesticides T0700-01 W09-023

Heptachlor	0.05	<0.05 µg/L
Heptachlor Epoxide	0.05	<0.05 µg/L
Hexachlorobenzene	0.05	<0.05 µg/L
Lindane	0.05	<0.05 µg/L
Methoxychlor	0.05	<0.05 µg/L
Trifluralin	0.05	<0.05 µg/L
Vinclozolin	0.05	<0.05 µg/L

Organophosphorous and Triazine Pesticides T0800-01 W09-023

Atrazine	0.5	<0.5 µg/L
Azinphos-methyl	0.5	<0.5 µg/L
Diazinon	0.5	<0.5 µg/L
Fenitrothion	0.5	<0.5 µg/L
Hexazinone	0.5	<0.5 µg/L
Malathion	0.5	<0.5 µg/L
Parathion	0.5	<0.5 µg/L
Parathion methyl	0.3	<0.3 µg/L
Prometryne	0.5	<0.5 µg/L
Simazine	0.5	<0.5 µg/L

Inorganic Chemistry - Physical	**LOR**	**Result**

Alkalinity Carbonate Bicarbonate and Hydroxide T0101-01 W09-023

Alkalinity as Calcium Carbonate		348 mg/L
Bicarbonate		424 mg/L
Carbonate		0 mg/L
Hydroxide		0 mg/L

Colour - Apparent (456nm) Unfiltered T0029-01 W09-023

Colour - Apparent (456nm)	1	24 HU

Conductivity & Total Dissolved Solids T0016-01 W09-023

Conductivity	1	5900 µScm
Total Dissolved Solids (by EC)	1.0	3300 mg/L

pH T0010-01 W09-023

pH		7.0 pH units

Turbidity T0018-01 W09-023

Turbidity	0.1	12 NTU

Inorganic Chemistry - Waste Water	**LOR**	**Result**

Chlorine Demand - 24 hrs T0136-03 W09-023

Chlorine Demand 24hrs		3.11 mg/L

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Analytical Results

Customer Sample Description	Hawker TWS 4
Sampling Point	70013-SAW General Request Northern
Sampled Date	7/06/2011 12:30:00PM
Sample Received Date	7/06/2011 8:41:07PM
Sample ID	*2011-003-6563
Status	Endorsed
Collection Type	Customer Collected

Chlorine Demand - 30 mins T0136-03 W09-023

Chlorine Demand 30 mins		1.87 mg/L

Chlorine Demand - 8 hrs T0136-03 W09-023

Chlorine Demand 8 hrs		2.2 mg/L

Cyanide - Total T0167-03 W09-023

Cyanide as CN - Total	0.05	<0.05 mg/L

Sulphide - Soluble T0168-01 W09-023

Sulphide as S - Soluble	0.1	<0.1 mg/L

Sulphide - Total T0168-01 W09-023

Sulphide as S - Total	0.1	<0.1 mg/L

Western Radiation Services	LOR	Result

Gross Alpha Activity W09-023

Gross Alpha Activity	0.005	<0.005 Bq/L

Gross Beta Activity (K-40 corrected) W09-023

Gross Beta Activity (K-40 corrected)	0.010	<0.010 Bq/L

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NATA Signatories

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Kerrie Davey - Inorganic Chemistry Technical Officer

Andrew Ford - Inorganic Chemistry Technical Officer

Roger Kennedy - Inorganic Chemistry Process Coordinator

John Martini - Organic Chemistry Scientific Officer

Stephanie Semczuk - Inorganic Chemistry Team Leader

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Incidents

Sample ID	S.Point	Description	Sampled Date	Analysis (where Applicable)	Incident Description
2011-003-6562	70013	Hawker TWS 3	31/05/2011	Molybdenum - Total	Dependent results are within acceptable analytical uncertainty
2011-003-6562	70013	Hawker TWS 3	31/05/2011	Uranium - Total	Dependent results are within acceptable analytical uncertainty
2011-003-6563	70013	Hawker TWS 4	7/06/2011	Manganese - Soluble	
2011-003-6563	70013	Hawker TWS 4	7/06/2011	Manganese - Total	
2011-003-6563	70013	Hawker TWS 4	7/06/2011	Molybdenum - Soluble	Dependent results are within acceptable analytical uncertainty

Bottles Not Collected

Sample ID	S.Point	Description	Sampled Date	Laboratory	Non Collect Reason
2011-003-2283	70013	No.4 Bore Hawker	6/05/2011	Organic Chemistry	Correct bottle not available
2011-003-2283	70013	No.4 Bore Hawker	6/05/2011	Inorganic Chemistry - Waste Water	Correct bottle not available

Analytical Method

Analytical Method Code	Description
T0010-01	Determination of pH
T0016-01	Determination of Conductivity
T0018-01	Turbidity - Nephelometric Measurement
T0029-01	Colour, True - Spectrophotometric Measurement
T0100-01	Ammonia/Ammonium - Automated Flow Colorimetry
T0101-01	Alkalinity - Automated Acidimetric Titration
T0104-02	Chloride - Automated Flow Colorimetry
T0114-01	Bromide
T0117-01	Iodide
T0136-03	Chlorine Demand
T0161-01	Nitrate + Nitrate (NOx) - Automated Flow Colorimetry
T0167-03	Cyanide - Total
T0168-01	Sulfide as S
T0700-01	Chlorinated Pesticides
T0800-01	Nitrogen and Phosphorous Containing Pesticides
T0803-03	Acidic Herbicides by LCMS
T1072-01	Fullscan by GCMS
TIC-003	Elemental Analysis - ICP Mass Spectrometry
TIC-004	Determination of Metals - ICP Spectrometry by ICP2
W-052	Preparation of Samples for Metal Analysis

Sampling Method

Sampling Method Code	Description
W09-023	Sampling Method for Chemical Analyses

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Australian Water Quality Centre

FINAL REPORT: 87844

This report supercedes the following issued reports: 85818

Laboratory Information

Laboratory	NATA accreditation ID
Inorganic Chemistry - Metals	1115
Inorganic Chemistry - Nutrients	1115
Organic Chemistry	1115
Inorganic Chemistry - Physical	1115
Inorganic Chemistry - Waste Water	1115
Western Radiation Services	14174

NATA WORLD RECOGNISED ACCREDITATION

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Chemical and Biological Testing
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Australian Water Quality Centre

SAW Infrastructure
ATTN: Franz Lintl
SA Water House
Adelaide
SA 5000 AUSTRALIA

14/07/2011

Dear Franz

Please find attached the Final Analytical Report for

Customer Service Request: 105296-2011-CSR-14
Account: 105296
Project: AWQC-51906 SAW Infrastructure - Hawker Bore Commissioning 10/11

Please note AWQC Sample Receipt hours are Monday to Friday 8.30am - 4.30pm.

Yours sincerely,

Pat Poldervaart
Account Manager
Pat.Poldervaart@sawater.com.au

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A business unit of the South Australian Water Corporation

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Australian Water Quality Centre

FINAL REPORT: 87999

Report Information

Project Name	AWQC-51906
Customer	SAW Infrastructure
CSR_ID	105296-2011-CSR-14

Analytical Results

Customer Sample Description	Hawker TWS 4B
Sampling Point	70013-SAW General Request Northern
Sampled Date	10/06/2011 12:00:00AM
Sample Received Date	10/06/2011 2:14:28PM
Sample ID	2011-003-9700
Status	Endorsed
Collection Type	Customer Collected

Inorganic Chemistry - Metals	LOR	Result
Aluminium - Acid Soluble TIC-003 W09-023		
Aluminium - Acid Soluble	0.001	<0.001 mg/L
Aluminium - Soluble TIC-003 W09-023		
Aluminium - Soluble	0.001	<0.001 mg/L
Aluminium - Total TIC-003 W09-023		
Aluminium - Total	0.001	<0.001 mg/L
Antimony - Soluble TIC-003 W09-023		
Antimony - Soluble	0.0005	<0.0005 mg/L
Antimony - Total TIC-003 W09-023		
Antimony - Total	0.0005	<0.0005 mg/L
Arsenic - Soluble TIC-003 W09-023		
Arsenic - Soluble	0.0003	<0.0003 mg/L
Arsenic - Total TIC-003 W09-023		
Arsenic - Total	0.0003	<0.0003 mg/L
Barium - Soluble TIC-003 W09-023		
Barium - Soluble	0.0005	0.0179 mg/L
Barium - Total TIC-003 W09-023		
Barium - Total	0.0005	0.0183 mg/L
Beryllium - Soluble TIC-003 W09-023		
Beryllium - Soluble	0.0003	<0.0003 mg/L
Beryllium - Total TIC-003 W09-023		
Beryllium - Total	0.0003	<0.0003 mg/L
Boron - Soluble TIC-003 W09-023		
Boron - Soluble	0.020	0.953 mg/L
Cadmium - Soluble TIC-003 W09-023		
Cadmium - Soluble	0.0001	<0.0001 mg/L
Cadmium - Total TIC-003 W09-023		
Cadmium - Total	0.0001	<0.0001 mg/L
Calcium TIC-003 W09-023		
Calcium	0.04	260 mg/L
Chromium - Soluble TIC-003 W09-023		

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FINAL REPORT: 87999

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Sampled Date	10/06/2011 12:00:00AM
Sample Received Date	10/06/2011 2:14:28PM
Sample ID	2011-003-9700
Status	Endorsed
Collection Type	Customer Collected

Chromium - Soluble TIC-003 W09-023		
Chromium - Soluble	0.0001	0.0002 mg/L
Chromium - Total TIC-003 W09-023		
Chromium - Total	0.0001	0.0002 mg/L
Copper - Soluble TIC-003 W09-023		
Copper - Soluble	0.0001	0.0001 mg/L
Copper - Total TIC-003 W09-023		
Copper - Total	0.0001	0.0007 mg/L
Iron - Soluble TIC-003 W09-023		
Iron - Soluble	0.0005	<0.0005 mg/L
Iron - Total TIC-003 W09-023		
Iron - Total	0.0005	0.3068 mg/L
Langelier Index W09-023		
Langelier Index		0.34
Lead - Soluble TIC-003 W09-023		
Lead - Soluble	0.0001	<0.0001 mg/L
Lead - Total TIC-003 W09-023		
Lead - Total	0.0001	<0.0001 mg/L
Magnesium TIC-003 W09-023		
Magnesium	0.04	228 mg/L
Manganese - Soluble TIC-003 W09-023		
Manganese - Soluble	0.0001	0.6749 mg/L
Manganese - Total TIC-003 W09-023		
Manganese - Total	0.0001	0.7321 mg/L
Mercury - Soluble TIC-003 W09-023		
Mercury - Soluble	0.00003	<0.00003 mg/L
Mercury - Total TIC-003 W09-023		
Mercury - Total	0.00003	<0.00003 mg/L
Molybdenum - Soluble TIC-003 W09-023		
Molybdenum - Soluble	0.0001	0.0009 mg/L
Molybdenum - Total TIC-003 W09-023		
Molybdenum - Total	0.0001	0.0010 mg/L
Nickel - Soluble TIC-003 W09-023		
Nickel - Soluble	0.0001	0.0002 mg/L
Nickel - Total TIC-003 W09-023		
Nickel - Total	0.0001	0.0002 mg/L
Potassium TIC-003 W09-023		
Potassium	0.040	9.10 mg/L

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Sample Received Date	10/06/2011 2:14:28PM
Sample ID	2011-003-9700
Status	Endorsed
Collection Type	Customer Collected

Selenium - Soluble TIC-003 W09-023		
Selenium - Soluble	0.0001	0.0002 mg/L
Selenium - Total TIC-003 W09-023		
Selenium - Total	0.0001	0.0002 mg/L
Silver - Soluble TIC-003 W09-023		
Silver - Soluble	0.00003	<0.00003 mg/L
Silver - Total TIC-003 W09-023		
Silver - Total	0.00003	<0.00003 mg/L
Sodium TIC-003 W09-023		
Sodium	0.04	822 mg/L
Sulphur TIC-004 W09-023		
Sulphate	1.5	1070 mg/L
Tin - Soluble TIC-003 W09-023		
Tin - Soluble	0.0005	<0.0005 mg/L
Tin - Total TIC-003 W09-023		
Tin - Total	0.0005	<0.0005 mg/L
Total Hardness as CaCO3 W09-023		
Total Hardness as CaCO3	2.0	1590 mg/L
Uranium - Soluble TIC-003 W09-023		
Uranium - Soluble	0.0001	0.0019 mg/L
Uranium - Total TIC-003 W09-023		
Uranium - Total	0.0001	0.0023 mg/L
Zinc - soluble TIC-003 W09-023		
Zinc - Soluble	0.0003	0.0085 mg/L
Zinc - Total TIC-003 W09-023		
Zinc - Total	0.0003	0.0091 mg/L

Inorganic Chemistry - Nutrients	**LOR**	**Result**
Ammonia as N T0100-01 W09-023		
Ammonia as N	0.005	0.044 mg/L
Bromide T0114-01 W09-023		
Bromide	0.10	3.49 mg/L
Fluoride W09-023		
Fluoride	0.10	0.93 mg/L
Iodide T0117-01 W09-023		
Iodide	0.05	0.24 mg/L
Nitrate + Nitrite as N T0161-01 W09-023		

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Collection Type	Customer Collected

Nitrate + Nitrite as N T0161-01 W09-023

Nitrate + Nitrite as N	0.003	0.007 mg/L

Nitrate + Nitrite as NO3 T0161-01 W09-023

Nitrate + Nitrite as NO3	0.02	0.03 mg/L

Organic Chemistry	LOR	Result

Acidic Herbicides T0803-03 W09-023

# 2 4 5-T	0.05	<0.05 µg/L
# 2 4-D	0.05	<0.05 µg/L
# Chlorsulfuron	0.05	<0.15 µg/L
# Clopyralid	0.5	<0.5 µg/L
# Dicamba	0.2	<0.2 µg/L
# MCPA	0.05	<0.05 µg/L
# Metsulfuron Methyl	0.05	<0.15 µg/L
# Picloram	0.2	<0.2 µg/L
# Silvex	0.05	<0.05 µg/L
# Sulfometuron	0.05	<0.1 µg/L
# Triclopyr	0.1	<0.1 µg/L

Dissolved Organic Carbon W09-023

Dissolved Organic Carbon	0.3	0.4 mg/L

GCMS Scan - Dichloromethane T1072-01 W09-023

# GCMS Scan		No semi-volatile organic compounds were detected. Some compounds may not have even been extracted using dichloromethane and/or detected by GC/MS.

OrganoChlorine Pesticides T0700-01 W09-023

Aldrin	0.01	<0.01 µg/L
Chlordane-a	0.01	<0.01 µg/L
Chlordane-g	0.01	<0.01 µg/L
Chlorothalonil	0.05	<0.05 µg/L
Chlorpyrifos	0.05	<0.05 µg/L
Chlorthal-Dimethyl	0.05	<0.05 µg/L
DDD	0.05	<0.05 µg/L
DDE	0.05	<0.05 µg/L
DDT	0.05	<0.05 µg/L
Dieldrin	0.01	<0.01 µg/L
Endosulfan 1	0.05	<0.05 µg/L
Endosulfan 2	0.05	<0.05 µg/L
Endosulfan Sulphate	0.05	<0.05 µg/L
Endrin	0.05	<0.05 µg/L

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OrganoChlorine Pesticides T0700-01 W09-023

Heptachlor	0.05	<0.05 µg/L
Heptachlor Epoxide	0.05	<0.05 µg/L
Hexachlorobenzene	0.05	<0.05 µg/L
Lindane	0.05	<0.05 µg/L
Methoxychlor	0.05	<0.05 µg/L
Trifluralin	0.05	<0.05 µg/L
Vinclozolin	0.05	<0.05 µg/L

Organophosphorous and TriaKine Pesticides T0800-01 W09-023

Atrazine	0.5	<0.5 µg/L
Azinphos-methyl	0.5	<0.5 µg/L
Diazinon	0.5	<0.5 µg/L
Fenitrothion	0.5	<0.5 µg/L
Hexazinone	0.5	<0.5 µg/L
Malathion	0.5	<0.5 µg/L
Parathion	0.5	<0.5 µg/L
Parathion methyl	0.3	<0.3 µg/L
Prometryne	0.5	<0.5 µg/L
Simazine	0.5	<0.5 µg/L

Inorganic Chemistry - Physical	**LOR**	**Result**

Alkalinity Carbonate Bicarbonate and Hydroxide T0101-01 W09-023

Alkalinity as Calcium Carbonate		349 mg/L
Bicarbonate		426 mg/L
Carbonate		0 mg/L
Hydroxide		0 mg/L

Colour - Apparent (456nm) Unfiltered T0029-01 W09-023

Colour - Apparent (456nm)	1	42 HU

Conductivity & Total Dissolved Solids T0016-01 W09-023

Conductivity	1	6150 µScm
Total Dissolved Solids (by EC)	1.0	3500 mg/L

pH T0010-01 W09-023

pH		7.0 pH units

Turbidity T0018-01 W09-023

Turbidity	0.1	8.4 NTU

Inorganic Chemistry - Waste Water	**LOR**	**Result**

Chlorine Demand - 24 hrs T0136-03 W09-023

Chlorine Demand 24hrs		2.33 mg/L

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Chlorine Demand - 30 mins T0136-03 W09-023

Chlorine Demand 30 mins		1.15 mg/L

Chlorine Demand - 8 hrs T0136-03 W09-023

Chlorine Demand 8 hrs		1.43 mg/L

Cyanide - Total T0167-03 W09-023

Cyanide as CN - Total	0.05	<0.05 mg/L

Sulphide - Soluble T0168-01 W09-023

Sulphide as S - Soluble	0.1	<0.1 mg/L

Sulphide - Total T0168-01 W09-023

Sulphide as S - Total	0.1	<0.1 mg/L

Western Radiation Services	LOR	Result

Gross Alpha Activity W09-023

Gross Alpha Activity	0.005	0.088 Bq/L

Gross Beta Activity (z -40 corrected) W09-023

Gross Beta Activity (K-40 corrected)	0.010	0.325 Bq/L

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NATA Signatories

Roger Kennedy - Inorganic Chemistry Process Coordinator

John Martini - Organic Chemistry Scientific Officer

Stephanie Semczuk - Inorganic Chemistry Team Leader

David Walker - Inorganic Chemistry Senior Technical Officer

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Analytical Method

Analytical Method Code	Description
T0803-03	Acidic Herbicides by LCMS
T1072-01	Fullscan by GCMS
TIC-003	Elemental Analysis - ICP Mass Spectrometry
TIC-004	Determination of Metals - ICP Spectrometry by ICP2
W-052	Preparation of Samples for Metal Analysis
T0010-01	Determination of pH
T0016-01	Determination of Conductivity
T0018-01	Turbidity - Nephelometric Measurement
T0029-01	Colour, True - Spectrophotometric Measurement
T0100-01	Ammonia/Ammonium - Automated Flow Colorimetry
T0101-01	Alkalinity - Automated Acidimetric Titration
T0114-01	Bromide
T0117-01	Iodide
T0136-03	Chlorine Demand
T0161-01	Nitrate + Nitrate (NOx) - Automated Flow Colorimetry
T0167-03	Cyanide - Total
T0168-01	Sulfide as S
T0700-01	Chlorinated Pesticides
T0800-01	Nitrogen and Phosphorous Containing Pesticides

Sampling Method

Sampling Method Code	Description
W09-023	Sampling Method for Chemical Analyses

Laboratory Information

Laboratory	NATA accreditation ID
Inorganic Chemistry - Metals	1115
Inorganic Chemistry - Nutrients	1115
Organic Chemistry	1115
Inorganic Chemistry - Physical	1115
Inorganic Chemistry - Waste Water	1115
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UNITS OF MEASUREMENT

Units of measurement commonly used (SI and non-SI Australian legal)

Name of unit	Symbol	Definition in terms of other metric units	Quantity
cubic feet per minute	CFM	base unit	volume
day	d	24 h	time interval
gigalitre	GL	10^6 m^3	volume
gram	g	10^{-3} kg	mass
hectare	ha	10^4 m^2	area
hour	h	60 min	time interval
inch	in	imperial unit: 0.0254 m	length
kilogram	kg	base unit	mass
kilolitre	kL	1 m^3	volume
kilometre	km	10^3 m	length
kilo pascal	kPa	10^3 Pa	pressure
litre	L	10^{-3} m^3	volume
megalitre	ML	10^3 m^3	volume
metre	m	base unit	length
microgram	µg	10^{-6} g	mass
microlitre	µL	10^{-9} m^3	volume
milligram	mg	10^{-3} g	mass
millilitre	mL	10^{-6} m^3	volume
millimetre	mm	10^{-3} m	length
minute	min	60 s	time interval
pascal	Pa	base unit	pressure
pounds per square inch	psi	base unit	pressure
second	s	base unit	time interval
tonne	t	1000 kg	mass
year	y	365 or 366 days	time interval

Chemical elements and compounds

Element/compound	Symbol	Element/compound	Symbol
Aluminium	Al	Iron	Fe
Antimony	Sb	Lead	Pb
Arsenic	As	Magnesium	Mg
Ammonium	NH_4	Manganese	Mn
Barium	Ba	Mercury	Hg
Beryllium	Be	Molybdenum	Mo
Bicarbonate	HCO_3	Nickel	Ni
Boron	B	Nitrate	NO_3
Bromide	Br	Nitrite	NO_2
Cadmium	Cd	Phosphorus	P
Calcium	Ca	Potassium	K
Carbonate	CO_3	Selenium	Se
Chloride	Cl	Silver	Ag
Chromium	Cr	Sodium	Na
Copper	Cu	Sulphate	SO_4
Cyanide	CN	Tin	Sn
Dissolved Organic Carbon	DOC	Uranium	U
Fluoride	F	Zinc	Zn
Iodide	I		

Shortened forms

~	approximately equal to
CRD	constant rate discharge
DD	drawdown
DTW	depth to water (measured from a reference point usually top of casing)
EC	electrical conductivity (µS/cm)
ID	inner diameter
K	hydraulic conductivity (m/d)
m BNS	metres below natural surface
NS	natural surface
OD	outer diameter
PVC	polyvinyl chloride
TDS	total dissolved solids (mg/L)

GLOSSARY

Aquifer — An underground layer of rock or sediment that holds water and allows water to percolate through

Aquifer, confined — Aquifer in which the upper surface is impervious (see 'confining layer') and the water is held at greater than atmospheric pressure; water in a penetrating well will rise above the surface of the aquifer

Aquifer test — A hydrological test performed on a well, aimed to increase the understanding of the aquifer properties, including any interference between wells, and to more accurately estimate the sustainable use of the water resources available for development from the well

Aquifer, unconfined — Aquifer in which the upper surface has free connection to the ground surface and the water surface is at atmospheric pressure

Aquitard — A layer in the geological profile that separates two aquifers and restricts the flow between them

Confining layer — A rock unit impervious to water, which forms the upper bound of a confined aquifer; a body of impermeable material adjacent to an aquifer; see also 'aquifer, confined'

DFW — Department for Water (Government of South Australia)

EC — Electrical conductivity; 1 EC unit = 1 micro-Siemen per centimetre (µS/cm) measured at 25°C; commonly used as a measure of water salinity as it is quicker and easier than measurement by TDS

Fracture — General term applied to any break in a material, but commonly applied to more or less clean breaks in rocks or minerals

Groundwater — Water occurring naturally below ground level or water pumped, diverted and released into a well for storage underground; see also 'underground water'

Hydraulic conductivity (K) — A measure of the ease of flow through aquifer material: high K indicates low resistance, or high flow conditions; measured in metres per day

Hydrogeology — The study of groundwater, which includes its occurrence, recharge and discharge processes, and the properties of aquifers; see also 'hydrology'

Infrastructure — Artificial lakes; dams or reservoirs; embankments, walls, channels or other works; buildings or structures; or pipes, machinery or other equipment

Lithology — The description of the microscopic features of a rock

Monitoring — (1) The repeated measurement of parameters to assess the current status and changes over time of the parameters measured (2) Periodic or continuous surveillance or testing to determine the level of compliance with statutory requirements and/or pollutant levels in various media or in humans, animals, and other living things

Observation well — A narrow well or piezometer whose sole function is to permit water level measurements

Owner of land — In relation to land alienated from the Crown by grant in fee simple — the holder of the fee simple; in relation to dedicated land within the meaning of the *Crown Lands Act 1929* that has not been granted in fee simple but which is under the care, control and management of a Minister, body or other person — the Minister, body or other person; in relation to land held under Crown lease or licence — the lessee or licensee; in relation to land held under an agreement to purchase from the Crown — the person entitled to the benefit of the agreement; in relation to any other land — the Minister who is responsible for the care, control and management of the land or, if no Minister is responsible for the land, the Minister for Environment and Heritage.

Permeability — A measure of the ease with which water flows through an aquifer or aquitard, measured in m^2/d

Piezometer — A narrow tube, pipe or well; used for measuring moisture in soil, water levels in an aquifer, or pressure head in a tank, pipeline, etc

Population — (1) For the purposes of natural resources planning, the set of individuals of the same species that occurs within the natural resource of interest. (2) An aggregate of interbreeding individuals of a biological species within a specified location

GLOSSARY

Potable water — Water suitable for human consumption such as drinking or cooking water

Production well — The pumped well in an aquifer test, as opposed to observation wells; a wide-hole well, fully developed and screened for water supply, drilled on the basis of previous exploration wells

SA Water — South Australian Water Corporation (Government of South Australia)

Stratigraphic unit — A body of rock forming a discrete and definable unit which are determined on the basis of their lithology, or their fossil content, or their time span

TDS — Total dissolved solids, measured in milligrams per litre (mg/L); a measure of water salinity

Underground water (groundwater) — Water occurring naturally below ground level or water pumped, diverted or released into a well for storage underground

Unit number — A unique identifier given to all registered wells within South Australia

Well — (1) An opening in the ground excavated for the purpose of obtaining access to underground water. (2) An opening in the ground excavated for some other purpose but that gives access to underground water. (3) A natural opening in the ground that gives access to underground water

REFERENCES

Hazel CP, 1975, 'Groundwater hydraulics', in *Lecture material*, The Irrigation and Water Supply Commission, Queensland