K

Ground Water Report

Arafura Resources Limited

Nolans Project Environmental Impact Statement

Appendix K: Groundwater

May 2016

Executive summary

A hydrogeological investigation has been undertaken on the Nolans Project using inputs from:

- previous studies on the Ti-Tree Basin
- field studies at the mine site
- field studies of the Southern Basins and Margins Area.

A numerical groundwater flow model has been:

- constructed based on the hydrogeological investigations
- calibrated to steady state observed conditions
- ran as a predictive tool to estimate future conditions
- interrogated to quantify the key impacts (or lack thereof) at key locations across the study area.

This report is subject to, and must be read in conjunction with, the limitations set out in section 1.2 and the assumptions and qualifications contained throughout the Report.

Modelled impacts to groundwater availability are considered from the perspective of groundwater flows (volumes over time), groundwater elevations (heads), groundwater flow direction and groundwater drawdown. In addition, the modelled impacts are considered in terms of impacts to groundwater chemistry and quality.

The groundwater modelling is not considered to be definitive (i.e. absolutely correct), rather it presents our best estimate of the likely conditions based on our existing investigations and uses this to numerically quantify the impacts based on these estimates.

The modelled solution represents a non-unique solution. A different combination of parameters could be applied resulting in an equally valid prediction which could result in impacts with differing magnitudes; however, the modelling does provide a valuable tool capable of quantifying the impacts based on the reasonable documented inputs. The key impacts are summarised below.

Modelled Flows

As basement groundwater is likely to be lost to the system via pit evaporation, there is clearly a net loss to the system in the long term. This water has never been considered a contribution to the Ti-Tree Basin or Southern Basins, however, in reality it is likely to have made some minor contribution. The net loss of water from storage within the Ti-Tree Basin (including its basement rocks) was modelled to be a minor amount (approximately 3 ML/year during mining increasing to 13 ML/year at the end of the 1,000-year closure modelled prediction).

Flowthrough of the Ti-Tree Basin is unlikely to be impacted at a measureable or observable amount. Flowthrough and availability for evapotranspiration within the Southern Basins is likely to be lower but not by an amount that is likely to cause a material impact.

Modelled groundwater elevation and flow directions

The modelled groundwater flow regime displays almost no change (i.e. no impact) at the model (regional) scale when viewed from a flow direction or groundwater head perspective. At this scale, the impacts to flow direction and groundwater head are very localised to the mine area and adjacent to the Southern Basins borefield bores in the Reaphook Palaeochannel area while in operation.

No reversal of groundwater flow direction occurs anywhere within the model area during mining except for immediately adjacent to the pit and immediately adjacent to the bores (but not across the aquifer, i.e. groundwater flow is still generally westwards in the Southern Basins borefield, despite the pumping). The modelled reversal of flow adjacent to the pit at the end of the 1,000-year closure modelled period extends within the basement rocks radially for approximately 4 km towards the Aileron Station Homestead and Aileron Roadhouse area.

The modelled groundwater drawdown is very large in term of magnitude adjacent to the mine but is likely to have very steep gradient due the low permeability of the rock mass. This, combined with the removal of all surface water flow (amongst other things) is likely to have irreversible effects on riparian vegetation for a limited length of the Kerosene Camp Creek estimated to be at least up to the confluence of Nolans Creek which is less than 1 km north of the mine lease. It should be noted that a significant proportion of this section of creek will be adjacent to the waste rock dumps and in the active mining area. The isolated and small aquifer in the orebody at the Nolans pit site will be all but mined out. Beyond this, stock bores on Pine Hill Station and Aileron Station may experience minor drawdowns in the long term but no existing bores are likely to be materially affected by mine drawdown by during their anticipated operational life.

The modelled groundwater drawdown at the borefield is very large in terms of extent and could be referred to as ‘groundwater mining’ as the flow rates should not be considered ‘sustainable’ in the long term (i.e. indefinitely). Despite being unsustainable in the long term, the borefield is considered an appropriate use of the aquifer provided the borefield is ceased at the end of mining and the aquifer allowed to recover. The minor current and potential future uses should not be impacted in a material manner, although it is recognised that minor drawdowns at stock (Napperby Station and Aileron Station south of Yalyirimbi Range within the vicinity of the borefield) and drinking water sources (Aluyen [and Aileron Station Homestead and Aileron Roadhouse] and Laramba [and Napperby Homestead]) are likely to occur.

Groundwater chemistry flowing towards the pit is not likely to be greatly different from the existing groundwater chemistry in the area. Once in the pit, the net evaporation will result in a hypersaline pit lake. Flow will be radially towards the pit lake and thus contribute to the concept of a zero discharge site. The likely chemistry of this pit lake has not been modelled, however, it is highly likely to be of no beneficial use.

The modelled groundwater flow regime displays almost no change (impact) at the model (regional) scale when viewed from a flow direction or groundwater head perspective. As such there is not likely to be any material changes in groundwater chemistry or quality within the aquifer.

Monitoring the impact as well as monitoring to validate the predicted impacts will be required. It is recommended that all mine features (facilities) have a network of groundwater monitoring bores installed and monitored for water levels, water chemistry and water quality as per the Water Management Plan (WMP).

In addition, the borefield itself should be monitored for water levels, water chemistry and water quality. Twelve existing bores as a minimum should be included for monitoring of the aquifer during and after the pumping period and for the monitoring of key specific potential impacts.

Temporal monitoring of water levels (i.e. through the use of automatic loggers) will be essential for validation and the inevitable requirement for re-calibration of the groundwater model. These data are also required for developing the groundwater model to Class 2 or Class 3 according to the Australian Groundwater Modelling Guidelines (Barnett et al, 2012). Temporal groundwater level monitoring should commence significantly (at least one to two years) before the commissioning of pumping to provide a background dataset and should continue through the life of the project and into closure. No pumping should occur without adequate flow monitoring in place.

Table of contents

1. Introduction....1
   - 1.1 Purpose of this report....1
   - 1.2 Scope and limitations....1
   - 1.3 Assumptions....1
   - 1.4 Acknowledgement of input....2
2. Study area....2
   - 2.1 Extent of hydrogeological study area....2
   - 2.1 Topography....4
   - 2.2 Study area climate....4
   - 2.3 Hydrogeological setting....5
3. Conceptual hydrogeological models....16
   - 3.1 Surface water features....16
   - 3.2 Water users....18
   - 3.3 Conceptual water flows....21
4. Groundwater chemistry....24
5. Groundwater modelling....35
   - 5.1 Purpose of the groundwater model....35
   - 5.2 Model platform (and software)....35
   - 5.3 Calibration targets....35
   - 5.4 Target model residuals....35
   - 5.5 Model class....36
   - 5.6 Groundwater model geometry....36
   - 5.7 Model stresses....44
   - 5.8 Steady-state model results....45
6. Physical groundwater impacts....51
   - 6.1 Modelled groundwater elevation....51
   - 6.2 Drawdowns....56
   - 6.3 Mine area....62
   - 6.4 Southern Basins borefield....71
7. Groundwater chemistry impacts....80
   - 7.1 Mine area....80
   - 7.2 Borefield....80
   - 7.3 Processing site, tailings and residue storage facilities....81
8. Conclusions....82
   - 8.1 Overview....82
   - 8.2 Modelled flows....82
   - 8.3 Modelled groundwater elevation and flow directions....83

8.4 Modelled drawdowns 83
8.5 Groundwater chemistry and quality 83
8.6 Monitoring of impacts 84
9. References 86

Table index

Table 1 Mean rainfall (mm) for years 1987 to 2015 at Territory Grape Farm, Site number: 015643 (BOM, 2015) 4
Table 2 Mean maximum temperature (°C) for years 1987 to 2015 at Territory Grape Farm, Site number: 015643 (BOM, 2015) 4
Table 3 Mean minimum temperature (°C) for years 1987 to 2015 at Territory Grape Farm, Site number: 015643 (BOM, 2015) 4
Table 4 Electrical conductivity statistics by aquifer type 27
Table 5 Groundwater current uses and potential beneficial uses 30
Table 6 Existing groundwater extraction assumed rates 44
Table 7 Modelled operating (2018-2060) rates for the Southern Basins borefield 44
Table 8 PEST calibrated horizontal hydraulic conductivity applied in the model 46
Table 9 Recharge across the groundwater model 47
Table 10 Steady state model residuals 49
Table 11 Proposed Southern Basins borefield 84

Figure index

Figure 1 Hydrogeological Study area 3
Figure 2 Daily rainfall records ranked amount at Territory Grape Farm (BOM, 2015) 5
Figure 3 Regional basins and palaeovalleys (after Bell et al., 2012) 6
Figure 4 Simplified geological conceptual model across the Reaphook Palaeochannel, Southern Basins north of the Hann Range and Reaphook Hills (vertically exaggerated), and an idealised orthogonal view of the basin hydrogeological units (Cenozoic Sediments) 9
Figure 5 Geophysics (AEM) displaying point data for top of bedrock, oblique view looking West at 30 degrees with Vert Exaggeration 10 (red displays the deep and blue the shallow – see key in mAHD) 12
Figure 6 Example of the visualisation of the oblique view of mine area looking east at 30 degrees with vertical exaggeration of 10 13
Figure 7 Example of the oblique view of Ti-Tree Basin looking North at 30 degrees with a vertical exaggeration of 10 14

Figure 8 Example of the Southern Basins preliminary visualisation of the oblique view looking east at 15 degree (borehole diameter for visualisation 1000 m) and vertical exaggeration at 10 15
Figure 9 Study area surface water features 17
Figure 10 Study area water users 20
Figure 11 Study area conceptual water flows 23
Figure 12 Groundwater Sample by Aquifer Type 25
Figure 13 Groundwater chemistry by aquifer type 26
Figure 14 Electrical conductivity plotted by aquifer type 27
Figure 15 Electrical Conductivity (min) of Groundwater Samples 28
Figure 16 Electrical Conductivity (Max) of Groundwater Samples 29
Figure 17 Layer 1 hydrogeological model geometry 38
Figure 18 Layer 2 hydrogeological model geometry 39
Figure 19 Layer 3 hydrogeological model geometry 40
Figure 20 Layer 4 hydrogeological model geometry 41
Figure 21 Layer 5 hydrogeological model geometry 42
Figure 22 Layer 6 hydrogeological model geometry 43
Figure 23 Modelled recharge polygons (red and purple - basement and regional - low recharge, blue – creeks, rivers, floodouts and recharge off basement rocks) 48
Figure 24 Steady-state model versus coupled published Ti-Tree Basin contours and observations from bores (RMS = 2.83 m) 49
Figure 25 Steady state model versus observations from bores (RMS = 3.11 m) 50
Figure 26 Modelled groundwater elevation (mAHD) at steady-state (pre-mining) 1/1/2017 52
Figure 27 Modelled groundwater elevation at end of mining 1/1/2060 53
Figure 28 Modelled groundwater elevation 1,000-years after end of mining 1/1/3060 54
Figure 29 Modelled pit inflow cone extent 55
Figure 30 Modelled drawdown at commencement of mining 1/1/2020 57
Figure 31 Modelled drawdown at approximately mid-way through mining 1/1/2040, 20 years after commencement of mining on 1/1/2020 58
Figure 32 Modelled drawdown at end of mining 1/1/2060 59
Figure 33 Modelled drawdown at 100 years of closure 1/1/2160 60
Figure 34 Modelled drawdown at 1,000-years of closure 1/1/3160 61
Figure 35 Modelled drawdown at the pit epicentre 62
Figure 36 Modelled pit inflows 62
Figure 37 Predicted drawdown at Nolans Creek confluence (with Kerosene Camp Creek) 63
Figure 38 Predicted drawdown at the confluence of Kerosene Camp Creek and its larger western branch 64

Figure 39 Predicted drawdown at Woodforde River confluence (with Kerosene Camp Creek) 65

Figure 40 Predicted drawdown at the closest Pine Hill Station bores (RN010759 and RN012624)....67

Figure 41 Loss from storage within the Ti-Tree Basin 68

Figure 42 Loss from storage within the Basement....68

Figure 43 Predicted drawdown at Ti Tree Farms....69

Figure 44 Predicted drawdown at Aileron Station Homestead and Aileron Roadhouse area)....70

Figure 45 Predicted drawdown at Alyuen community....70

Figure 46 Predicted drawdown at Southern Basins borefield epicentre 71

Figure 47 Predicted drawdown at Day Creek 72

Figure 48 Predicted drawdown at Napperby Creek 73

Figure 49 Modelled groundwater availability for evapotranspiration in the Reaphook Palaeochannel area of the Southern Basins 74

Figure 50 Modelled groundwater availability for flowthrough westward in the Reaphook Palaeochannel area of the Southern Basins 75

Figure 51 Modelled groundwater availability for evapotranspiration in the Lake Lewis area of the Southern Basins....76

Figure 52 Predicted drawdown at Old Albs Bore 78

Figure 53 Predicted drawdown at Rabbit Flat....78

Figure 54 Predicted drawdown at Alyuen Community bore (Napperby Road) 79

Figure 55 Predicted drawdown at Laramba/Napperby borefield 79

Appendices

Appendix A - Groundwater level dataset after Ride, 2016

Appendix B - Groundwater chemistry and quality dataset after Ride, 2016

1. Introduction

1.1 Purpose of this report

This report presents the hydrogeological (groundwater) study for the Nolans Project Environmental Impact Statement (EIS). This report covers the Nolans mine site, processing site and borefield with the major emphasis on assessment the impacts of groundwater extraction from the borefield during operation, but also incorporating the cumulative effects of extraction of groundwater from the mine site both during operation and beyond closure. No groundwater extraction will be undertaken at the processing site.

1.2 Scope and limitations

This report: has been prepared by GHD for Arafura Resources Limited (Arafura) and may only be used and relied on by Arafura Resources Limited for the purpose agreed between GHD and the Arafura Resources Limited as set out in section 1.1 of this report.

GHD otherwise disclaims responsibility to any person other than Arafura Resources Limited arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in throughout this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Arafura Resources Limited, Centreprise, Ride Consulting and others (including Government authorities) who provided information to GHD, which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

GHD has not been involved in the preparation of the hydrogeological field program and has had no contribution to, or review of the field program. GHD shall not be liable to any person for any error in, omission from, or false or misleading statement in, any other part of the field program.

1.3 Assumptions

Modelling studies require assumptions based on field data, observations, and estimates. Throughout this report, the presentation of the model (and discussion of the model outputs) documents key assumptions of the modelling process. The modelled solution represents a non-unique solution. A different combination of parameters could be applied resulting in an equally valid prediction which could result in impacts with differing magnitudes; however, the modelling does provide a valuable tool capable of quantifying the impacts based on the reasonable documented inputs.

1.4 Acknowledgement of input

Hydrogeological (or groundwater) studies are normally divided into three areas:

- field-based assessment
- modelling (conceptual and numerical); and the subsequent
- reporting of the hydrogeological assessment.

This report covers the hydrogeological assessment and the background for the modelling (conceptual and numerical) components. This report relies heavily on the field-based assessments undertaken for and by Arafura (including those undertaken by Centreprise, Ride Consulting, and Arafura themselves). The concepts for the modelling approach also draw on these data, as well as conversations with Ride Consulting (Graham Ride), and Arafura (Kelvin Hussey, Rodney Dean and Brian Fowler). Rather than repetitively acknowledging these inputs throughout the report, these inputs are acknowledged here. The field programs are referred to throughout as Centreprise (2013) for the Stage 1 work and Ride (2016) for the Stage 2 and Margins Area studies.

2. Study area

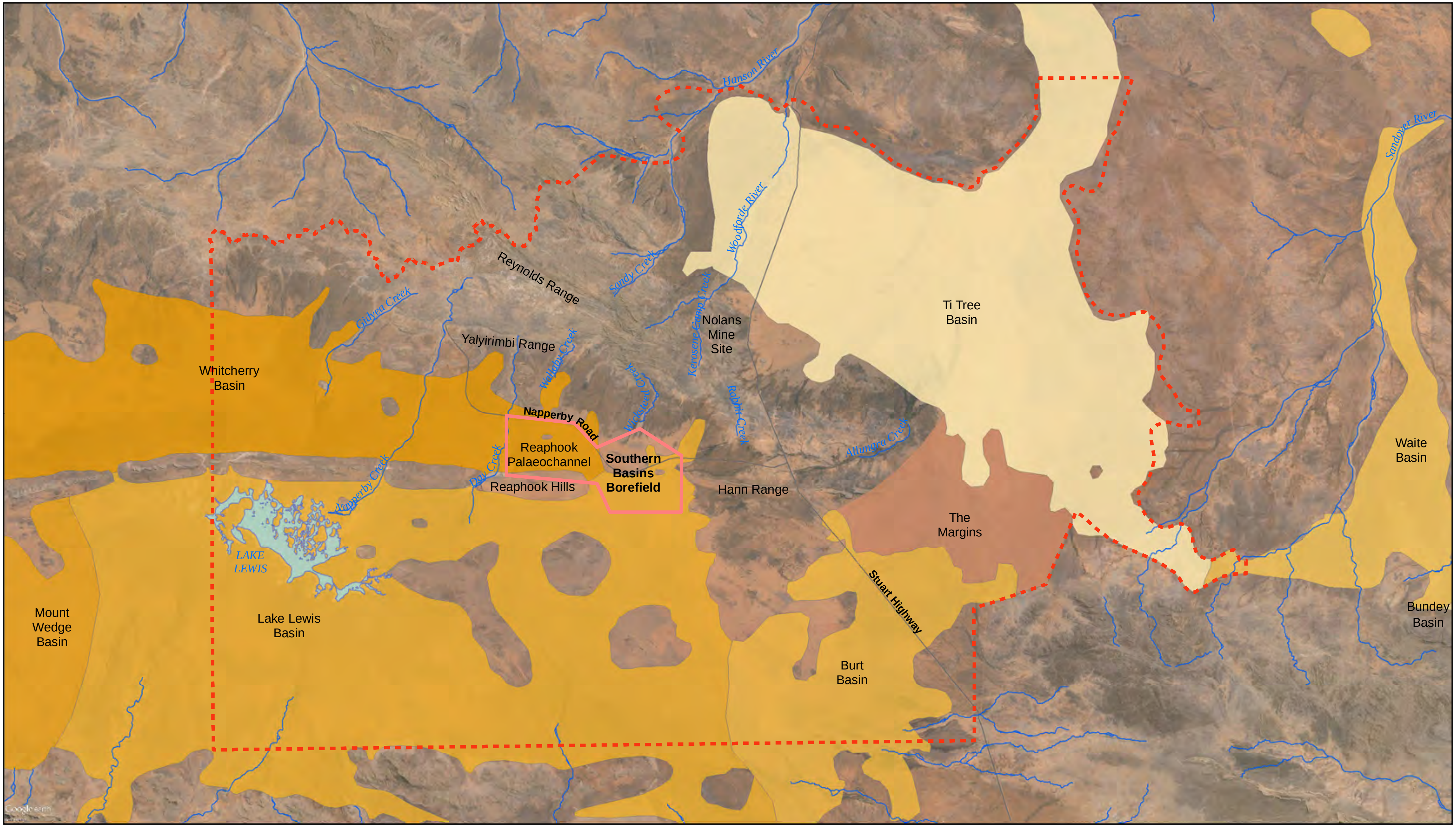
2.1 Extent of hydrogeological study area

The study area (Figure 1) is defined as covering the following 4 key groundwater areas (from north to south):

- The Ti-Tree Basin
- Nolans Mine Site and surrounding fractured rock aquifer/basement
- The area referred to collectively as the Southern Basins (Figure 1)
- The area where the Ti-Tree Basin borders or abuts the Southern Basins which is referred to as The Margins Area (Figure 1).

The study area measures approximately 200 km east to west and 125 km north to south, and occupies a total of 19,000 km^2. In this report, these groundwater areas are collectively referred to as the groundwater system.

The hydrogeology study considers the four areas in a single model, to assess the collective (and individual) impacts of the proposed groundwater extraction. Groundwater extraction is proposed to occur from the Nolans Mine Site for pit dewatering (within the Ti-Tree Water Control District) and within the Southern Basins (borefield) for process and potable water. In addition to active pit dewatering during mining using sump pumping, passive dewatering during groundwater rebound (the period following pumping) and ongoing dewatering via evaporation have been considered.



1:1,000,000 @ A4

0 10 20 30 40

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 53

N

LEGEND

Roads
Waterways
Groundwater Study Area
Southern Basins Borefield

Lake Lewis
Ti Tree Basin
Distant Basins and Palaeovalleys
Bundey Basin

Waite Basin
Southern Basins
Burt Basin
Lake Lewis Basin

Mount Wedge Basin
Whitcherry Basin
The Margins

ARAFURA RESOURCES LIMITED

GHD

Arafura Resources Limited
Nolans Project

Job Number	4322301
Revision	0
Date	22 Mar 2016

Hydrogeological study area

Figure 1

G:\43\22301\GIS\Maps\4322301_604_HydrogeologicalStudyArea.mxd

Level 5 66 Smith Street Darwin NT 0800 Australia **T** 61 8 8982 0100 **F** 61 8 8981 1075 **E** drwmail@ghd.com **W** www.ghd.com

Data source: Google Earth Pro - Imagery (Date extracted: 14/05/2015). GA - Roads, Waterways, Lake Lewis, Placenames (2015). GHD - Groundwater Study Area, Southern Basins Borefield (2015). Created by: CM

2.1 Topography

The topography of the study area is dominated by a flat plain, ranging from approximately 650 mAHD to 570 mAHD (over 120 km heading west) in the Southern Basins and from 650 mAHD to 505 mAHD (over 85 km heading north east in the Ti-Tree Basin. Above this plain, the Hann Range and Reaphook Hills rise up to approximately 150 m above the plain and peaks of the Reynolds Range and Yalyirimbi Range, up to almost 500 m above the plain (Figure 1).

2.2 Study area climate

The study area climate consists of low rainfall (Table 1) and high summer maximum temperatures (average of 37°C, Table 2) and low minimum winter temperatures (average 6°C, Table 3), typical of central Australian arid climates.

Precipitation averages approximately 320 mm/year (Table 1) but importantly for groundwater recharge, precipitation can fall as large rainfall events. Using the Territory Grape Farm weather station data, rainfall events were examined over a 28-year period (Figure 2). Twelve events were recorded for 60 mm or more per day, and 19 events were above 50 mm per day. Considering multiple day events (over five consecutive days), there are 2 occurrences exceeding 250 mm. Considering the low average rainfall, these events are significant as it is likely that most groundwater recharge and stream flow events result from rare, high-rainfall events rather than steady annual recharge. Ride (2014) documents a monthly rainfall of 100 mm or more being required to result in surface water flow in the Ti Tree Basin.

Precipitation is discussed further in terms of recharge in Section 3.3.

Table 1 Mean rainfall (mm) for years 1987 to 2015 at Territory Grape Farm, Site number: 015643 (BOM, 2015)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
62.4	65.8	21.0	18.0	23.3	8.7	4.9	4.7	10.3	15.3	30.9	50.5	317.9

Table 2 Mean maximum temperature (°C) for years 1987 to 2015 at Territory Grape Farm, Site number: 015643 (BOM, 2015)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
37.3	36.2	34.3	30.5	25.5	22.2	22.5	25.3	30.5	33.3	35.6	36.3	30.8

Table 3 Mean minimum temperature (°C) for years 1987 to 2015 at Territory Grape Farm, Site number: 015643 (BOM, 2015)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
21.9	21.7	19.5	14.6	9.5	6.2	5.2	7.1	12.1	15.6	18.8	21.1	14.4

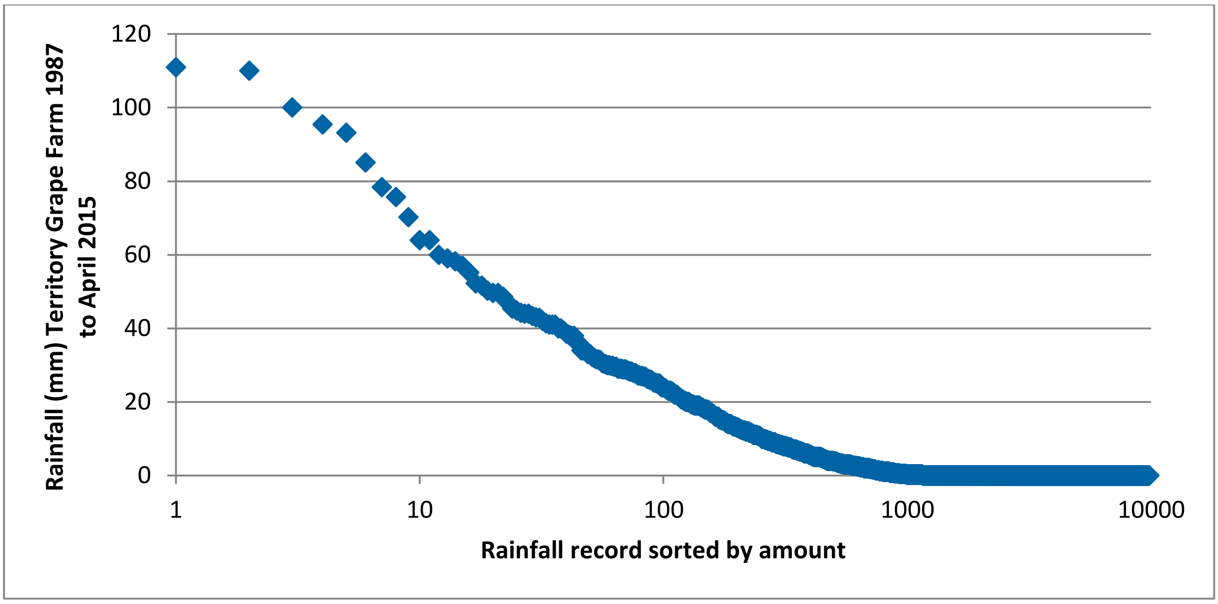


Figure 2 Daily rainfall records ranked amount at Territory Grape Farm (BOM, 2015)

2.3 Hydrogeological setting

2.3.1 Basins

The basins (Southern Basins and Ti-Tree Basin) in the study area are hydrogeologically similar (although not identical) to each other and to adjacent basins across central Australia. Unlike the Ti-Tree Basin, which has been studied in detail and used extensively as a groundwater source, the Southern Basins in the study area have not previously been investigated in detail nor have they been used extensively as a groundwater source.

The Southern Basins encompass Cenozoic sedimentary basins previously referred to as the Whitcherry Basin, the Mount Wedge Basin, the Burt Basin and Lake Lewis Basin. In addition, the Whitcherry Basin overlies the eastern extent of the Palaeozoic Ngalia Basin (Figure 3). The study area encompasses only a small proportion of both the Whitcherry Basin and Mount Wedge Basin. These two basins extend westward beyond the study area boundary for a further 130 km and 220 km respectively. Even beyond this, there is believed to be connection through to the Mackay Basin, and the ultimate discharge point in the endorheic[1] Lake Mackay, approximately 350 km away in the Western Australia border area. All of these basins are considered interconnected in this study and thus the collective term Southern Basins is applied.

Although previously treated as separate systems, the Southern Basins are now considered to be connected to the Ti-Tree Basin in an area referred to as The Margins. Despite the connection, The Margins are primarily a subtle groundwater divide with water flowing north of the divide to the Ti-Tree Basin and south of the divide to the Southern Basins. To the east, the Ti-Tree Basin is connected to the Waite Basin (and then Bundey Basin) and to the north it is believed to be connected to the Hanson Palaeovalley.

[1] A closed drainage basin that retains water and allows no outflow to other external bodies of water, such as rivers or oceans, but converges instead into lakes or swamps (wetlands), permanent or seasonal, that equilibrate through evaporation and sometime only via evapotranspiration (i.e. where no surface water body is present). Such a basin may also be referred to as a closed or terminal basin or as an internal drainage system.

1:3,000,000 @ A4

0 25 50 75 100

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 53

N

LEGEND

- Roads
- Groundwater Study Area
- Southern Basins Borefield
- Lakes
- Ti Tree Basin

Distant Basins & Palaeovalleys

- Bundey Basin
- Hanson Basin
- Mackay (Wilkinkarra)
- Waite Basin

Southern Basins

- Burt Basin
- Lake Lewis Basin
- Mount Wedge Basin
- Whitcherry Basin
- The Margins

Arafura Resources Limited
Nolans Project

Job Number	4322301
Revision	0
Date	22 Mar 2016

Regional Basins and Palaeovalleys

Figure 3

G:\43\22301\GIS\Maps\4322301_605_RegionalBasinsPalaeovalleys.mxd

Level 5 66 Smith Street Darwin NT 0800 Australia **T** 61 8 8982 0100 **F** 61 8 8981 1075 **E** drwmail@ghd.com **W** www.ghd.com

Data source: Google Earth Pro - Imagery (Date extracted: 14/05/2015). GA - Roads, Lakes, Placenames, Palaeovalleys (2015). GHD - Groundwater Study Area, Southern Basins Borefield (2015). Created by: CM

2.3.2 Basement geology and hydrogeology

The basement geology of the study area (Shaw, 1975, D'Addario and Chan, 1982) is complex but for the purposes of this hydrogeological assessment is simplified to the following:

- Proterozoic Arunta Block granites and gneiss outcrop forming the bulk of the hills and ranges adjacent to the mine area (including Reynolds Range and Yalyirimbi Range) and basement rocks beneath the basins
- Proterozoic Vaughan Springs Quartzite and Treuer Member (basal units of the Ngalia Basin), outcropping as the Hann Range and Reaphook Hills as a distinct, almost linear feature across the southern plain, as isolated hills outcropping from the plain at the southern fringe of the Yalyirimbi Range and as basement rocks beneath part of the Southern Basins
- Other Neoproterozoic to Devonian sedimentary units of the Ngalia Basin are present in drill core in the western parts of the study area but they do not outcrop in the study area. These units also form basement to part of the Witcherry Basin.

It is recognised that the Arunta Block also contains multiple units other than granites and gneiss (i.e. schist, quartzite etc.) which may contain higher fracture permeability, but all Arunta Block rocks are collectively grouped as the hydrogeological unit 'basement' for the purpose of this assessment. Only the mineralised areas of the ore deposit that contain primary porosity are considered in isolation as distinct aquifer. The rocks of the Vaughan Springs Quartzite and Treuer Member, as well as the other units of the Ngalia Basin are, like the units of the Arunta Block, collectively included in the hydrogeological unit 'basement'.

2.3.3 Basin geology and hydrogeology

Before the Cenozoic, deformation (folding and faulting) of the basement rocks (Shaw, 1975, D'Addario and Chan, 1982) resulted in significantly deeper basins than can be readily observed today. At present, the basins are almost completely filled with sediment, with only subtle ranges and hills (relative to their former heights) protruding above the plains. During the Cenozoic, these basins filled during periods of erosion from the source rocks above and deposition in these deep palaeovalleys. A simplified conceptual geological model for the filling of these basins is presented in Figure 4.

Hydrogeological units within the basin mimic previously applied geological differentiation and nomenclature. Of the Cenozoic deposits, only minor (usually less than 2-5 m) Quaternary deposits are present. These Quaternary deposits include, but are not limited to, wind blow (aeolian) sand, calcrete, locally derived soils and coarse river bed sands. The major hydrogeological unit differentiation for the basin materials are informally known, as per nomenclature in Higgins and Rafferty (2009) and Hussey (2014), as:

- Napperby Formation to the upper unit
- Waite Formation to the middle unit
- Hale Formation for the lower unit.

Wischusen et al. (2012) apply a different nomenclature and acknowledge the gaps and challenges in inter- or intra-basinal correlation. Whilst the Wischusen et al's. (2012) works provide significant detail, the Higgins and Rafferty (2009) nomenclature and logging provide a more applicable and widespread dataset for this assessment.

Ride's (2016) interpretation of the units within the Southern Basins concluded that despite the similarities between the basins the notable differences included:

- “The main source of the sediments in the NE Southern Basin deep palaeochannel (Reaphook Palaeochannel) appears to be different from the other regional Cainozoic basins though there are similarities with the overlying alluvial, fluvial and lacustrine sediments.”
- “The deep sediments in the Ti Tree Basin, Hale Basin, Burt Basin (NE and south eastern Southern Basins) have paludal sequences which have not been sighted in the NE Southern Basins possibly as we have targeted the deep locations where massive fluvial deposits are present and any pre-existing paludal deposits were likely to be removed by major runoff events”.

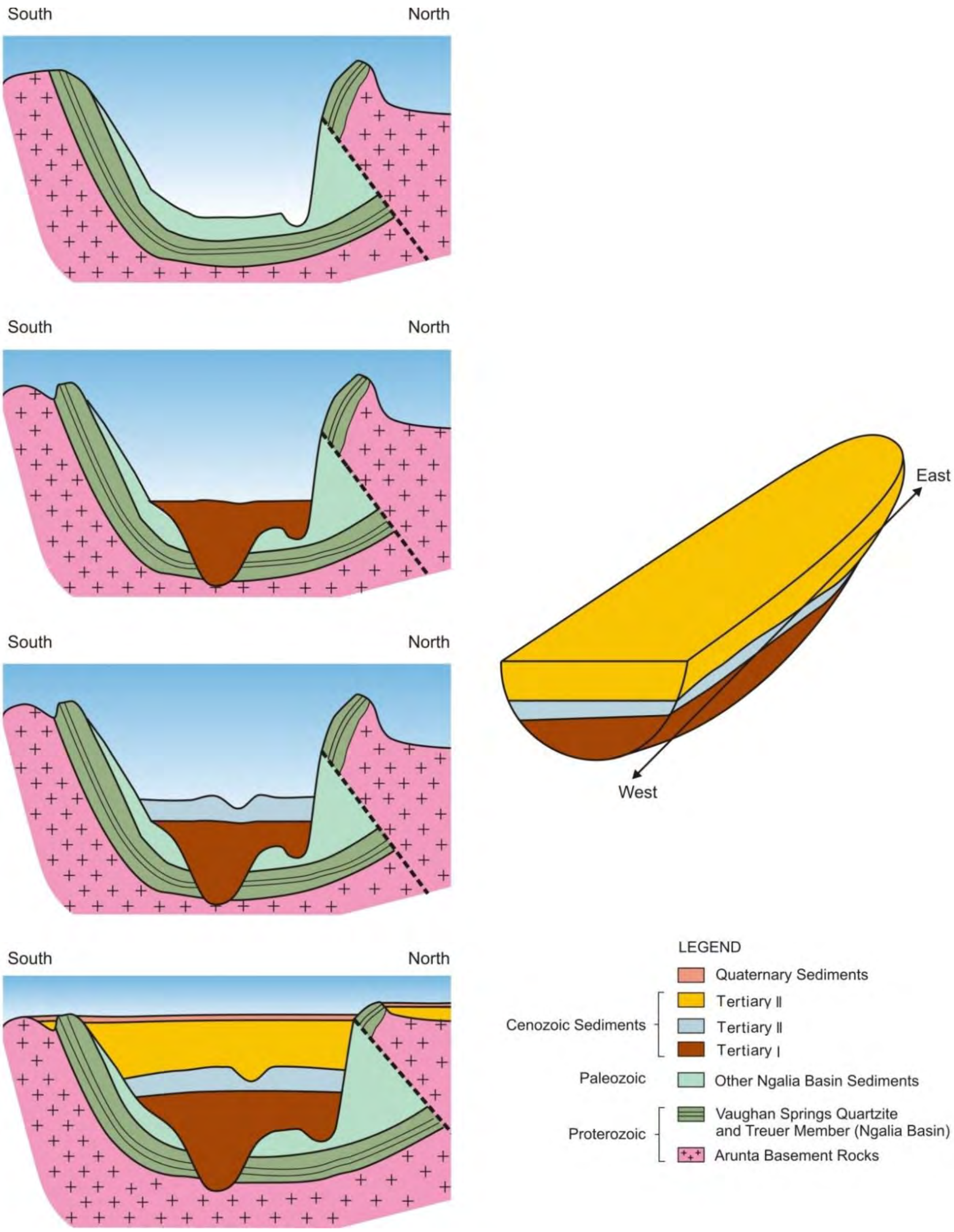


Figure 4 Simplified geological conceptual model across the Reaphook Palaeochannel, Southern Basins north of the Hann Range and Reaphook Hills (vertically exaggerated), and an idealised orthogonal view of the basin hydrogeological units (Cenozoic Sediments)

Napperby Formation

The informal Napperby Formation nomenclature is applied across the Ti-Tree Basin in this study. In the Ti-Tree Basin, the Napperby Formation represents the sequence referred to as the ‘Ti-Tree Aquifer” in Read and Tickell (2007) and Wischusen et al. (2012). Wischusen et al. (2012) describe what we informally refer to as the Napperby Formation as “Ti-Tree Facies 4” and summarises the unit in the Ti-Tree Basin as “an upper aquifer with mottled sandy clays” and refers to this unit as the “Waite Formation” in contrast to our study.

The permeability of the unit is variable on a broad scale and dependent on source rock mineralogy, and therefore weathering and ultimate clay content (and subsequent observed yields from drilling). Using broad areas to define permeability, the Napperby Formation is further divided into the following hydrogeological units:

- Lower permeability Napperby Formation, for areas of the shallow Ti Tree Basin applied in a similar manner to layer 1 in the modelling presented in Knapton (2007) and Water Studies (2001)
- Moderate permeability deeper Napperby Formation for the Ti-Tree Basin applied in a similar manner to layer 2 (Zone 1) in the modelling presented in Knapton (2007) and Water Studies (2001)
- Higher permeability Napperby Formation towards the discharge area (to the North) of the Ti-Tree Basin applied in a similar manner to layer 2 (Zone 2) in the modelling presented in Knapton (2007) and Water Studies (2001).

Waite Formation

The Waite Formation nomenclature is applied in this study across Ti-Tree Basin as a stratigraphic equivalent of the Waite Formation identified in the Hale Basin by Senior et al. (1994).

The Waite Formation is the lowest permeability unit within the basins. This hydrogeological unit in our study encompasses the greenish clays that cover much, but not all, of the Ti Tree Basin extent. This incomplete coverage and variability (including viable sandy lenses) means that although the Waite Formation has significantly lower permeability, it is believed to be leaky, allowing interaction between the Napperby Formation (or upper aquifer) and the Hale Formation (or deep aquifer).

Wischusen et al. (2012) describe this unit in the Ti-Tree Basin as “a confining layer of relatively low hydraulic conductivity dominated by lacustrine clays and fine grained sediments formed in low-energy depositional environments and refer to the unit as “Ti-Tree Facies 3 and 2”. In contrast, Wischusen et al. (2012) describe what our study refers to as the Waite Formation as the Upper and Middle Hale Formations.

Hale Formation

Like the Waite Formation, the Hale Formation nomenclature is applied in this study across the Ti-Tree Basin as a stratigraphic equivalent of the Hale Formation identified in the Hale Basin by Senior et al. (1994).

Wischusen et al. (2012) describe this unit as “at the base of the sequence, a deeper aquifer system consisting of silty sands interspersed with zones of well sorted, clean quartz-bearing sands” and refers to the unit as “Ti-Tree Facies 1” and the “Lower Hale Formation”.

Tertiary 2

The informal Tertiary 2 nomenclature from Ride (2016) is applied across the Southern Basins in this study.

Although analogous to the Ti-Tree Basin Napperby Formation, Tertiary 2 is applied for areas of the Southern Basins due to its differences most likely due to source rocks, but also as a result of potentially differing depositional environments. South of the Hann Range and Reaphook Hills, Tertiary 2 is applied to all layers 2 to 5 based on the lack of the observed presence of other units. This material is relatively low permeability due to inclusion of mafic source rocks (high clay content) from south of the study area. North of Hann Range and Reaphook Hills, Tertiary 2 is applied to the upper Cenozoic unit and incorporates a more permeable lower unit of reworked alluvial sandy clay and gravels. North of the ranges the Tertiary 2 higher permeability is likely due to the source rock being dominantly granite and quartzite. Thus two hydrogeological units are applied for the Tertiary 2 nomenclature.

Tertiary 1

The informal Tertiary 1 nomenclature from Ride (2016) is applied across the Southern Basins in this study. The Tertiary 1 unit is not observed to extend south beyond the basement high at the Hann Range and Reaphook Hills area. The Tertiary 1 consists of fluvial sediments unit represents the highest permeability hydrogeological unit in the Southern Basins.

The Reaphook Palaeochannel aquifer nomenclature adopted by Ride (2016) consists of both Tertiary 2 and Tertiary 1 units.

2.3.4 Basin geometry and visualisation

The basin geometry for the Southern Basins and margins area is defined by a dataset of mineral exploration drill holes and investigation water bores. Of these, 75 water bores were drilled specifically as part of the Arafura Nolans Project and are documented in Environmental Earth Sciences (2011) Centreprise (2013) and Ride (2016). It is believed, that this represents an unprecedented groundwater investigation effort prior to a mining project's operation in the Northern Territory.

In addition to this, mine feature-specific groundwater monitoring bores will also be installed prior to operation.

The basin geometry for the Ti-Tree Basin has been defined by a dataset of mineral exploration drill holes and water bores. In addition, the Napperby Formation geometry has been extensively mapped and modelled. Combined these provides a sound dataset where formation logging is incomplete.

The above datasets are, in part, validated by Arafura's interpretation of the Airborne Electromagnetic (AEM) geophysical datasets (Figure 5). The AEM provides a sound dataset for at least upper aquifers in the area. The AEM data clearly defined the potential for groundwater resources in the Southern basins, and is further supported by an analogous response in the Ti Tree Basin where groundwater resources were already confirmed. Using this dataset, Arafura has successfully identified groundwater resources and basin geometries through basement intersection. This provided the justification for using the geophysics, where appropriate, for basin geometry definition. A simplification of the basin geometry for the Southern Basins north of the Hann Range and Reaphook Hills is presented in Figure 4. This idealised shape represents a sliced cylinder that increases in thickness to the west. In reality the basin depth is highly irregular and appears to include a significantly incised palaeochannel north of the Reaphook Hills. The AEM indicates this palaeochannel could be up to hundreds of metres deep below the plain (current surface level).

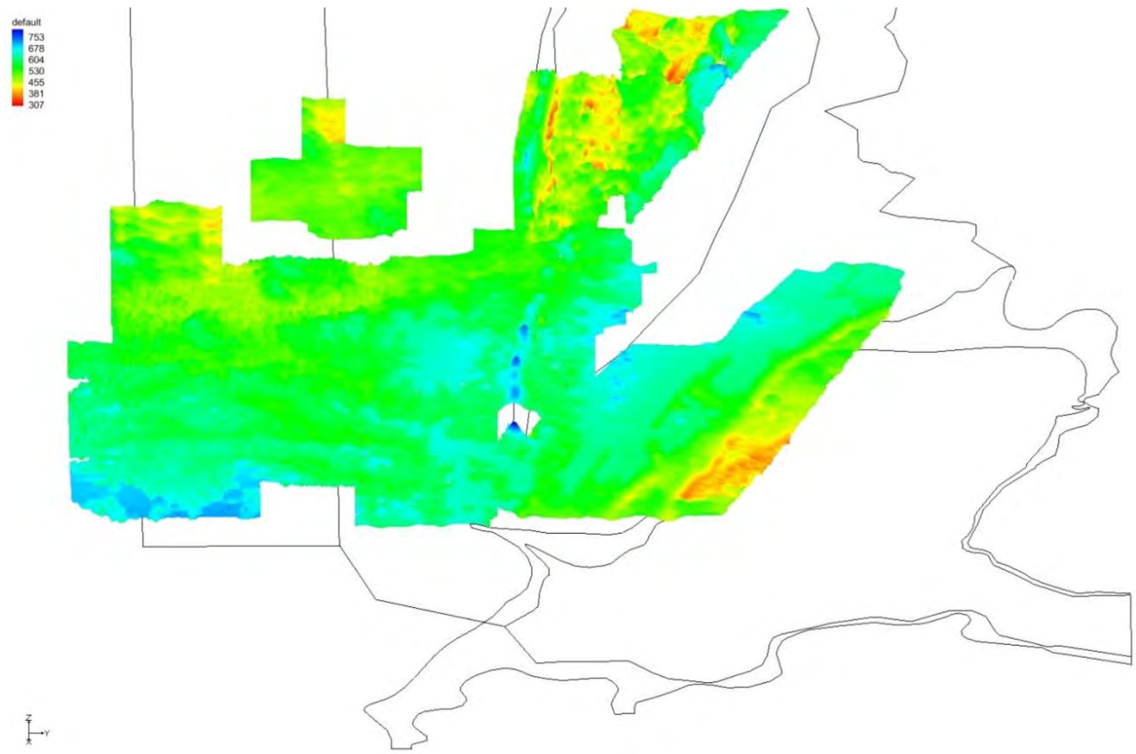


Figure 5 Geophysics (AEM) displaying point data for top of bedrock, oblique view looking West at 30 degrees with Vert Exaggeration 10 (red displays the deep and blue the shallow – see key in mAHD)

Existing borehole logging including those for the mine area (Figure 6 after Environmental Earth Sciences, 2011), the Ti-Tree Basin (Figure 7), and the Southern Basins (Figure 8 after Ride, 2016) were plotted as 3D boreholes and fence diagrams to assist in the production of the conceptual and numerical models. Coupled with the validated AEM, these datasets provided a sound basis for the 3D geometry of the basins and units within them.

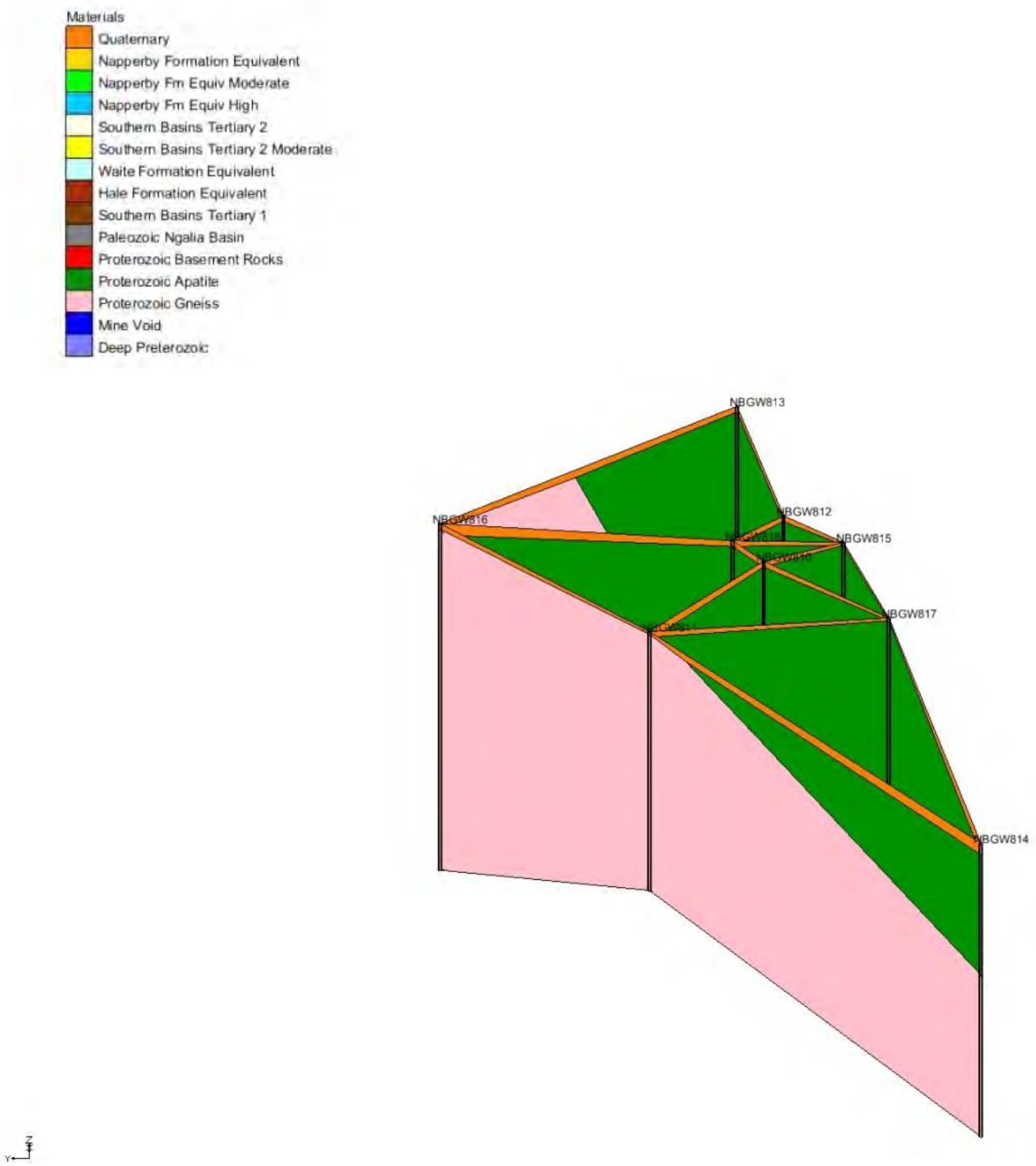


Figure 6 Example of the visualisation of the oblique view of mine area looking east at 30 degrees with vertical exaggeration of 10

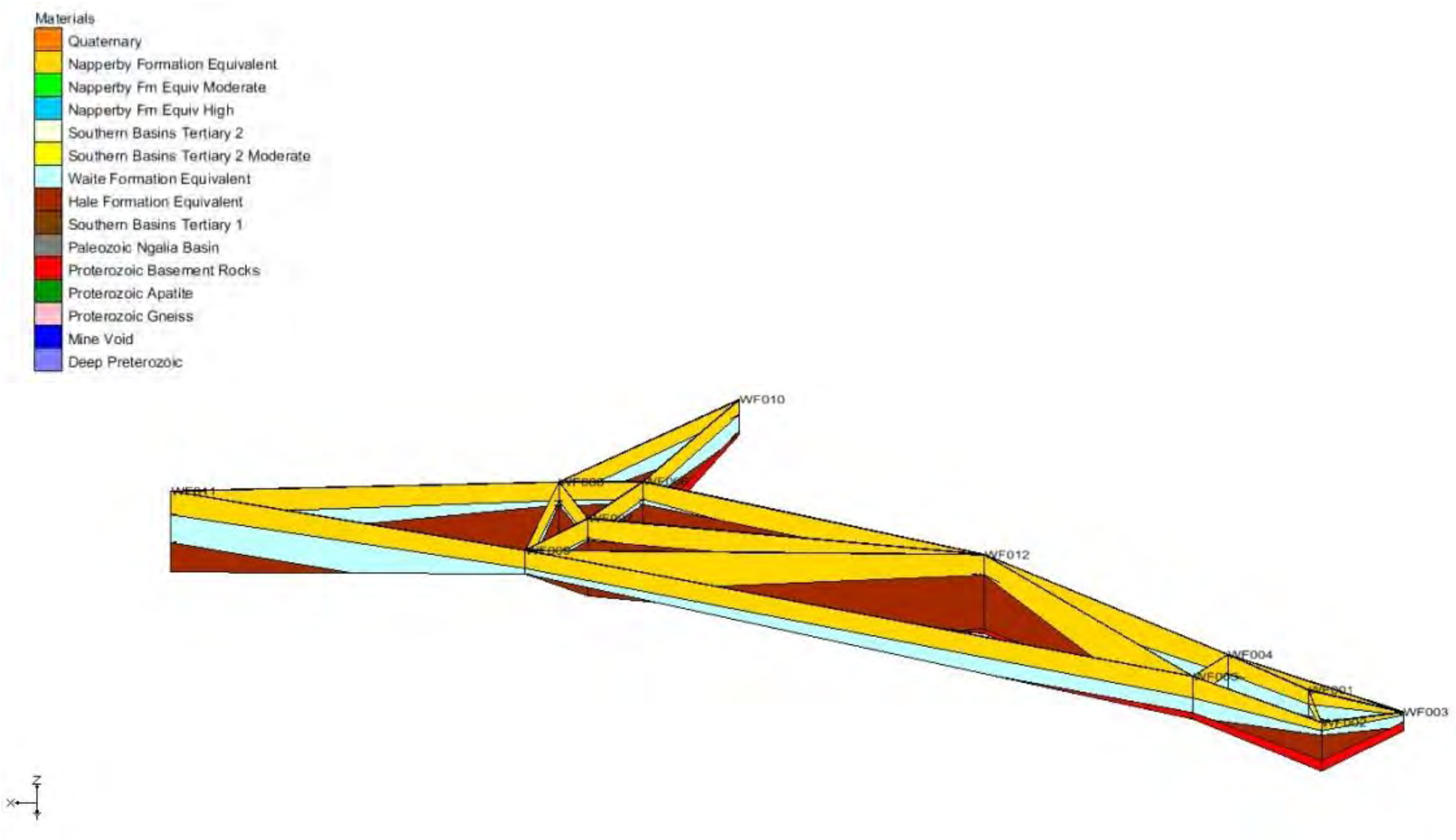


Figure 7 Example of the oblique view of Ti-Tree Basin looking North at 30 degrees with a vertical exaggeration of 10

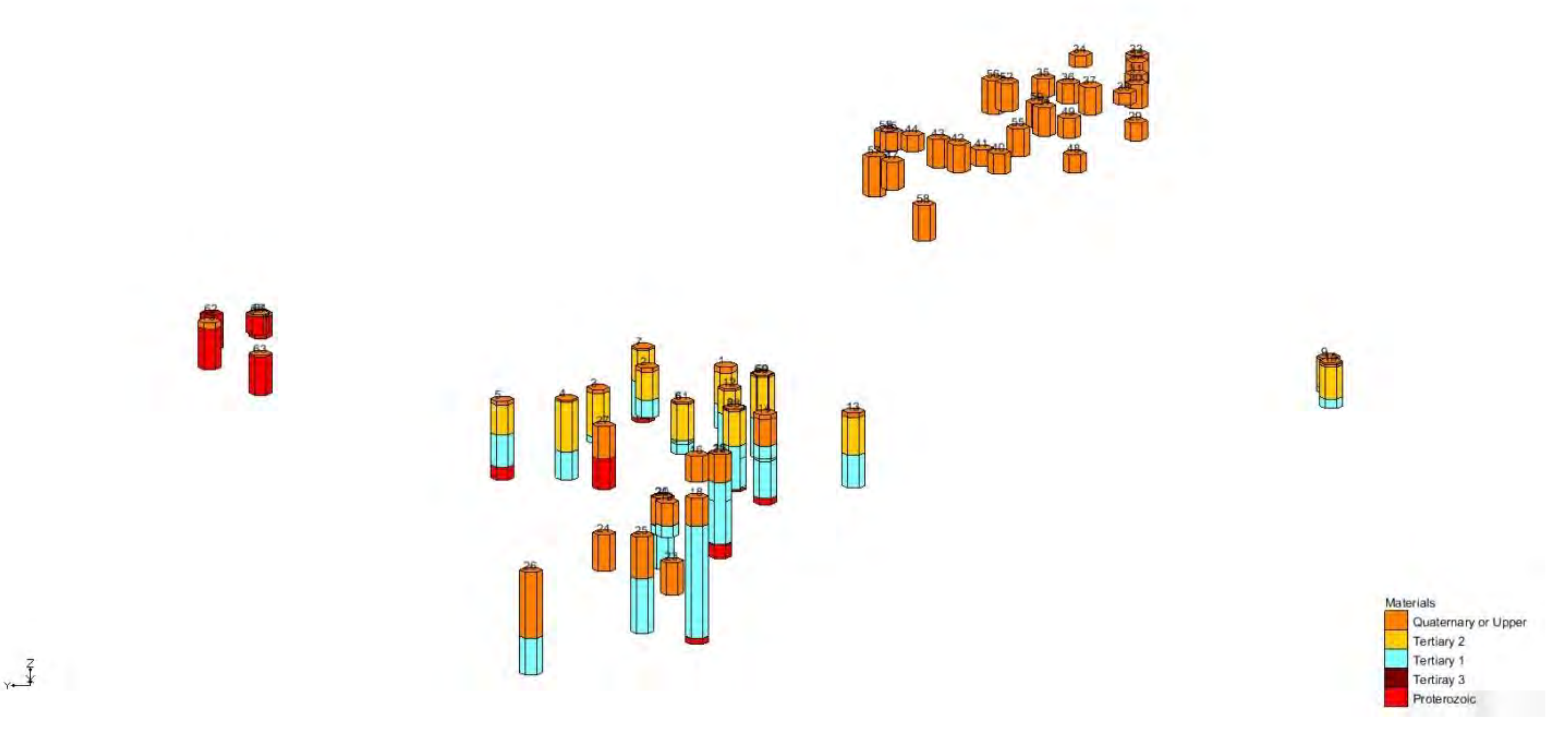


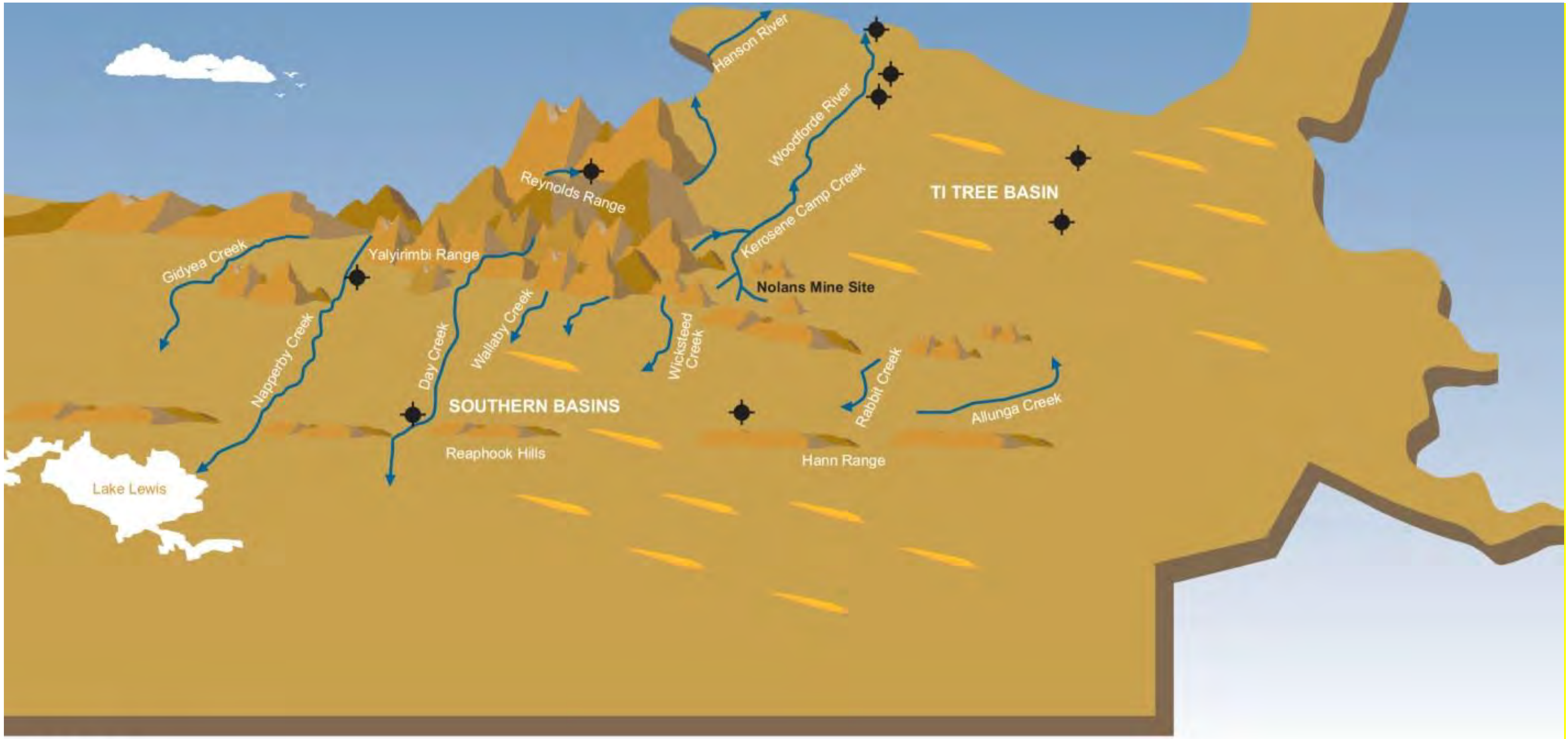
Figure 8 Example of the Southern Basins preliminary visualisation of the oblique view looking east at 15 degree (borehole diameter for visualisation 1000 m) and vertical exaggeration at 10

3. Conceptual hydrogeological models

The conceptual hydrogeological models have been developed for the study and presented as graphics below to build up the hydrogeological picture, by first displaying the surface water features (Figure 9), then the water users (Figure 10) and finally conceptual water flows (Figure 11).

3.1 Surface water features

Surface water features important to the study area are presented in Figure 9. The important surface water drainage features within the study area flow only as a result of precipitation falling within the study area. Surface water flows originate in the catchments of the Reynolds Range and Yalyirimbi Range. These flows typically result in terminal creeks (i.e. their flow does not make it to a secondary water feature for example a lake or river) including the named features Gidyea Creek, Day Creek, Wallaby Creek, Wicksteed Creek, Kerosene Camp Creek, Rabbit Creek and Allungra Creek. Napperby Creek is the exception in that it discharges to the endorheic basin, the ephemeral Lake Lewis, following periodic high rainfall events. Likewise, the Woodforde River also discharges to the Hanson River downstream (north) of the study area. No significant surface water drainage features originate from the Hann Range, Reaphook Hills or in the low lying dune country of the relatively flat plains of the Ti-Tree Basin and Southern Basins.



LEGEND

- Creeks and rivers
- Ephemeral saline lake
- Key groundwater users
- Hills and ranges
- Dunes

Figure 9 Study area surface water features

3.2 Water users

Water users important to the study area are presented in Figure 10 and include:

- Domestic water
- Stock water
- Irrigation for agriculture
- Environmental users including, but potentially not limited to, riparian vegetation.

3.2.1 Domestic water

Groundwater from the basins is the primary source of drinking water in the study area. Power and Water Corporation (PWC) provide groundwater to communities at Ti-Tree, Pmara Jutunta, Laramba (Napperby); and the Central Desert Shire provides water to the Alyuen Community, Aileron Station Homestead and Aileron Roadhouse. Groundwater is also used for domestic purposes at the other stations homesteads in the study area, notably Napperby Station Homestead and Pine Hill Station Homestead. Pine Hill Station Homestead is adjacent to a large permanent/semi-permanent surface water hole visible on aerial imagery and it is understood Napperby Station Homestead sources drinking water from a permanent/semi-permanent surface water source located in the adjacent hills.

1.1.1 Stock water

Stock water, primarily for cattle, is extracted from groundwater within the basins and basement rocks across the study area.

1.1.2 Irrigation for horticulture

Irrigation for agriculture is extracted from the Ti-Tree Basin. Table grapes form the majority of the cropping, in addition to mangoes at Ti-Tree Farms (Figure 10).

1.1.3 Environmental users

Environmental users of water (not necessarily groundwater) in the study area include riparian vegetation, vegetation on the plains and in the hills, as well as fauna. With no permanent surface water across the study area, vegetation and fauna are either capable of surviving in between rainfall events or are able to tap into groundwater. Depths to groundwater levels are known to be shallow in isolated areas across the study area, but over the vast majority of the area are generally well below the reach of most vegetation (i.e. greater than 15 m).

Riparian vegetation

Riparian vegetation (dominated by *Eucalyptus camaldulensis*, colloquially referred to as river red gums, line the larger creeks and rivers in the study area. These larger creeks and rivers with river red gums dominated riparian vegetation include, but may not be limited to, Napperby Creek, Day Creek and Woodforde River (Figure 6). It is conceivable that such riparian vegetation could tap groundwater (potentially even at depths greater than 15 m) and therefore these areas are potential groundwater dependant ecosystems (GDEs), and are considered in this impact assessment.

Floodout vegetation

In addition to riparian vegetation, water appears important for vegetation in floodout areas and at the toe of hills and ranges where runoff is highest. These areas are primarily dominated by *Acacia aneura* (mulga) woodland. These areas are considered in this impact assessment.

Lake Lewis and surrounds

Lake Lewis and surrounds is considered a site of conservation significance at a rating of National Significance. Due to this significance, Lake Lewis is considered in this impact assessment, despite the lake itself being a significant distance (30 km) from the borefield.

Rock-holes

Where water pools in basement rock-holes along drainage lines or in depressions in the outcropping rock mass, these provide a source of water for environmental use until evaporation depletes the water. Such features are present in the hills and ranges across the study area and these features are considered in this impact assessment, despite their distance from extraction points and their low permeability settings.

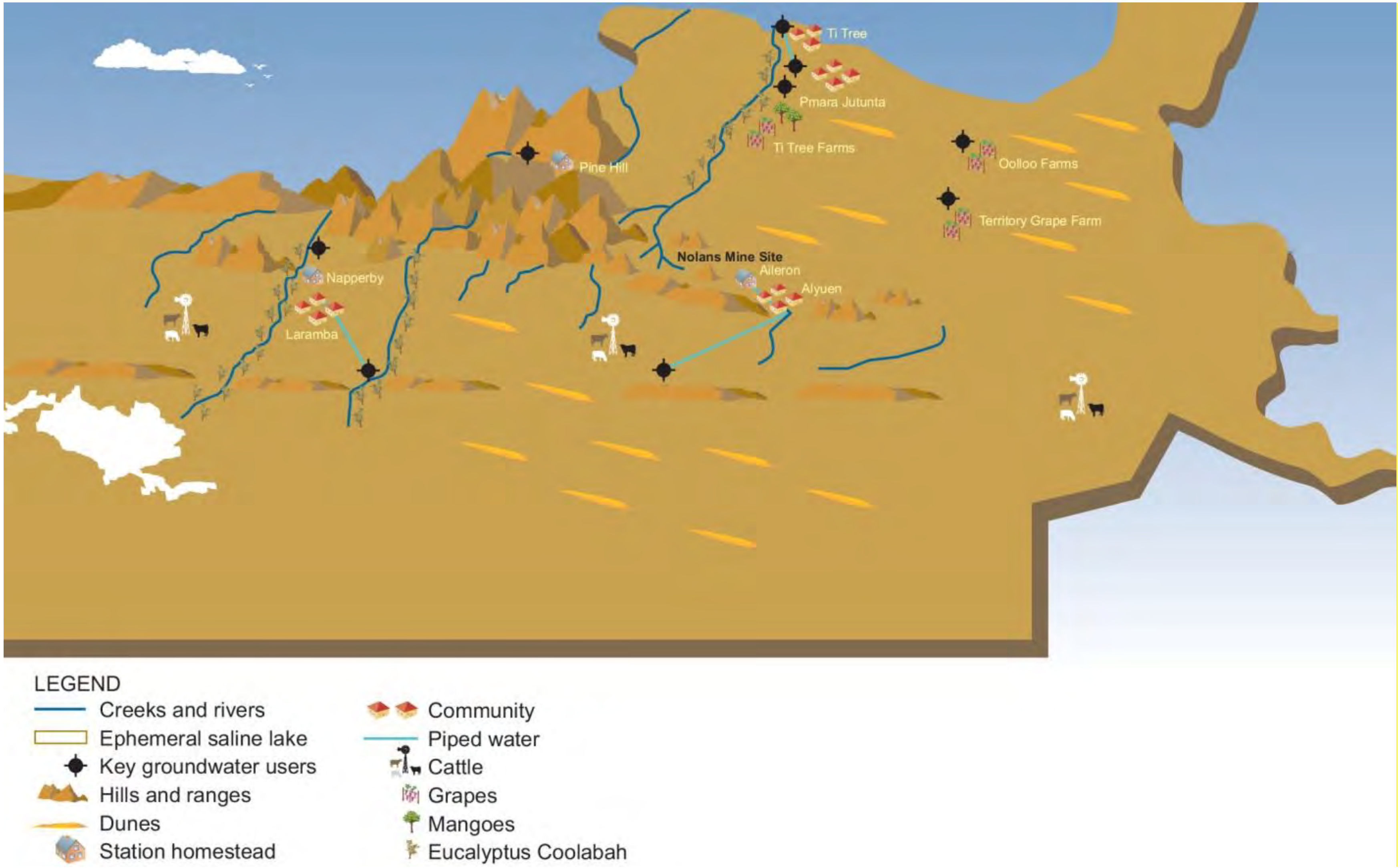


Figure 10 Study area water users

3.3 Conceptual water flows

Conceptual flows are represented in Figure 11 and based on all of the above, are divided into the following groups:

- Boundary conditions
- Recharge
- Evapotranspiration
- Groundwater extraction.

3.3.1 Boundary conditions

Boundary conditions are physical constraints applied at the edge of a model or other internal boundary, to define how the model reacts to external stresses or to provide a hydrogeologically logical limit to the model extent.

Upper no-flow boundaries[2] or external groundwater divides of the models are the topographic high of the ranges and no-flow boundaries of the basin boundaries. Groundwater flows through the subsurface and into the Ti-Tree Basin from the Waite Basin and out to the Hanson Palaeochannel. The divide between the Ti-Tree Basin and the Southern Basins is a connected groundwater high, and thus no boundary condition is applied.

The Southern Basins have three key groundwater flow outputs:

- North of the Reaphook Hills westward through the deep aquifer
- South of the Reaphook Hills westward through the aquifer
- Potentially through discharge at surface into Lake Lewis.

No surface water, significant to the hydrogeological assessment, flows into the study area but surface water leaves the system through the Hanson River and Woodforde River.

3.3.2 Recharge

Recharge throughout the Ti-Tree Basin has been the subject of multiple studies and this assessment makes use of the previous findings and estimates. The key types of recharge applied in the Ti-Tree Basin are:

- Diffuse (uniform infiltration across broad areas of the plains)
- Direct (i.e. through infiltration vertically downwards from surface water flows in drainage lines).

In addition, throughout this broader study area, classification of recharge includes recharge through:

- Fractured rocks of the ranges and hills
- The alluvial fans and plains immediately adjacent to the ranges and hills where runoff infiltrates into the plains at a higher rate than diffuse recharge
- Infiltration from Lake Lewis and the areas locally referred to as ‘swamps’ and ‘clay pans’ following inundation events.

---

[2] Flow cannot cross the boundary, hence there is no lateral flow of water in or out of the model at a no-flow boundary.

This study also differentiates between the smaller and larger creeks or rivers. The larger creeks and rivers maintain flow for longer periods and are of a higher volume. Particularly in these systems, recharge is maintained for longer periods by visible surface water flows (above the bed), but also flows beneath the bed, which persist for well beyond the duration of rainfall. The duration of this recharge can be in the order of weeks for the larger creeks and rivers. Smaller creeks primarily flow during rainfall events only, and only persist beyond the event in the order of days. All of the smaller creeks and some of the larger creeks (for example Day Creek and Gidyea Creek) lose their channel geometry and provide recharge to the plains over vast floodout areas.

3.3.3 Evapotranspiration

The most evident illustration of evapotranspiration is the ephemeral, saline Lake Lewis where water clearly leaves the system as evaporation. Diffuse evapotranspiration occurs across the study area from vegetation, soil (as well as sediments and rock) and water bodies. Additionally, where watertables are shallow, trees (primarily Mulga in the study area), shrubs and even grasses (i.e. spinifex) are likely to tap groundwater and provide areas of higher evapotranspiration. River red gums, for example, tap surface water and either the main water table or elevated and perched groundwater associated with the creek and river channels flowing through the sub-surface, as discussed above.

3.3.4 Groundwater extraction

Groundwater is extracted from the Ti-Tree Basin for irrigation, stock and domestic purposes as discussed above in Section 3.2 and these locations are represented in Figure 11 at the key bores. Elsewhere in the study area, localised small-scale groundwater extraction occurs for stock and domestic purposes as also discussed above in Section 3.2. An additional groundwater extraction of 4.5 GL/year for a 43-year period is proposed for the Nolans Project. The impact of this extraction is the focus of the remainder of this study.

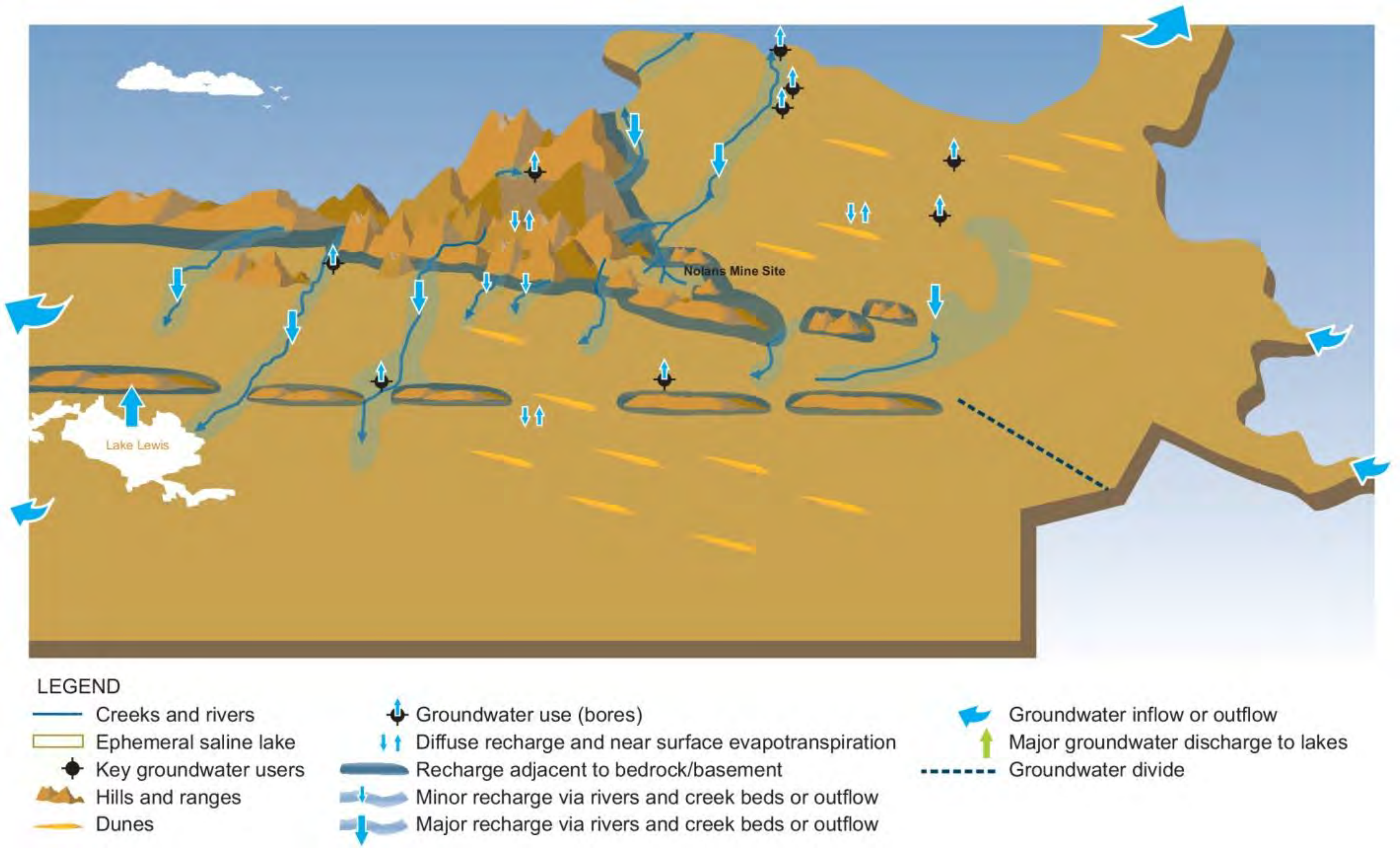


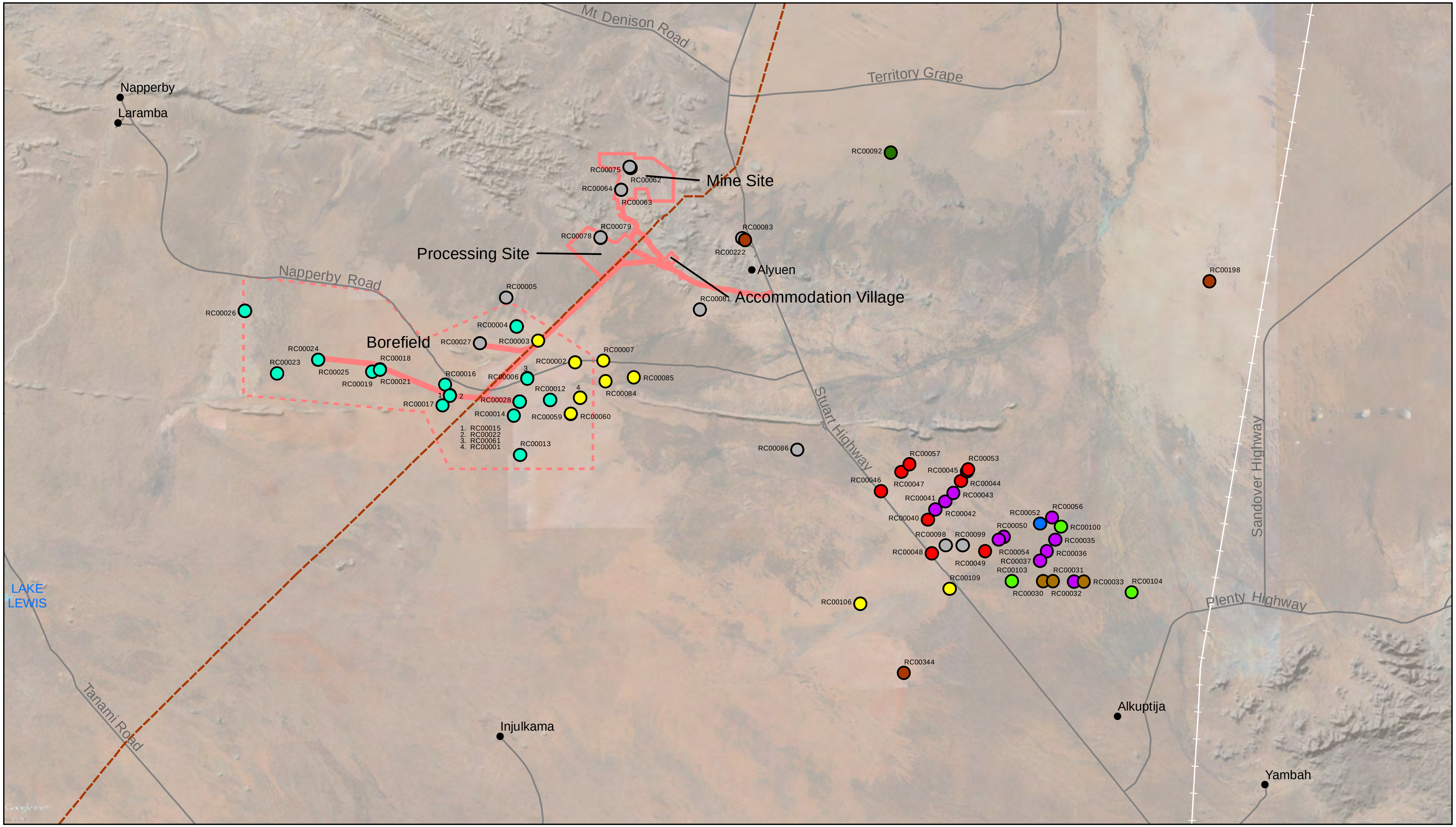
Figure 11 Study area conceptual water flows

4. Groundwater chemistry

A groundwater sampling and analyses dataset has been provided by Ride (2016). The sample set consists of 158 samples from a total of 71 bores. Samples were obtained using numerous opportunistic methods including but not limited to, during airlifts, through the use of existing infrastructure (submersibles, outlets and taps) as well as specific sampling from depth. The dataset is summarised in Appendix B with reference to the following guidelines:

- NHMRC & NRMMC (2011) Australian Drinking Water Guidelines (in this report referred to as ADWG 2011) Aesthetic and Health to assess the risk to human health from potable supplies
- ANZECC & ARMCANZ (2000) Freshwater aquatic ecosystem, protection of 99% of species (FW 99%) to assess the risk to nearby surface water ecosystems (recognising the limited local application for these)
- ANZECC & ARCANZ (2000) Stock Watering guidelines (in this report referred to Stock Watering) to assess the risk to stock water supplies
- ANZECC & ARCANZ (2000) Irrigation - Long-term Trigger Values guidelines (in this report referred to as Irrigation) to assess the risk of use for irrigation in the long term.

These data were characterised by aquifer type by Ride (2016) and this provides the context for the background groundwater quality for the study area and their spatial distribution is presented in Figure 12. The groundwater chemistry plotted by aquifer type display a broad spread of water types (Figure 13) but there is a linear trend likely to be resulting from increases in chloride (Cl) content which may be associated with the evolution of groundwaters, potentially driven by evaporation.



1:500,000 @ A4

0 5 10 15 20

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 53

N

LEGEND

Main Aquifer

- Alluvial
- Alluvial/Fluvial
- Calcrete
- Calcrete/Alluvial
- Calcrete/Alluvial/Fluvial
- Calcrete/Basement
- Reaphook Paleochannel
- Ti Tree Basin Aquifer
- Weathered Basement
- Unknown
- Gas Pipeline
- Major Roads
- Project Areas
- Borefield Area
- Waterbodies

ARAFURA RESOURCES LIMITED

GHD

Arafura Resources Limited
Nolans Project

Groundwater Samples by Aquifer Type

Job Number	4322301
Revision	0
Date	05 May 2016

Figure 12

G:\43\22301\GIS\Maps\4322301_601_GroundSamplesAquiferType.mxd

Level 5 66 Smith Street Darwin NT 0800 Australia T 61 8 8982 0100 F 61 8 8981 1075 E drwmail@ghd.com W www.ghd.com

Data source: Google Earth Pro - Imagery (Date extracted: 04/02/2015). Ride - Groundwater Data (2015). ARL - Project Areas (2015). GA - Placenames, Railways, Gas Pipeline, Major Roads, Waterbodies (2015). Created by: CM

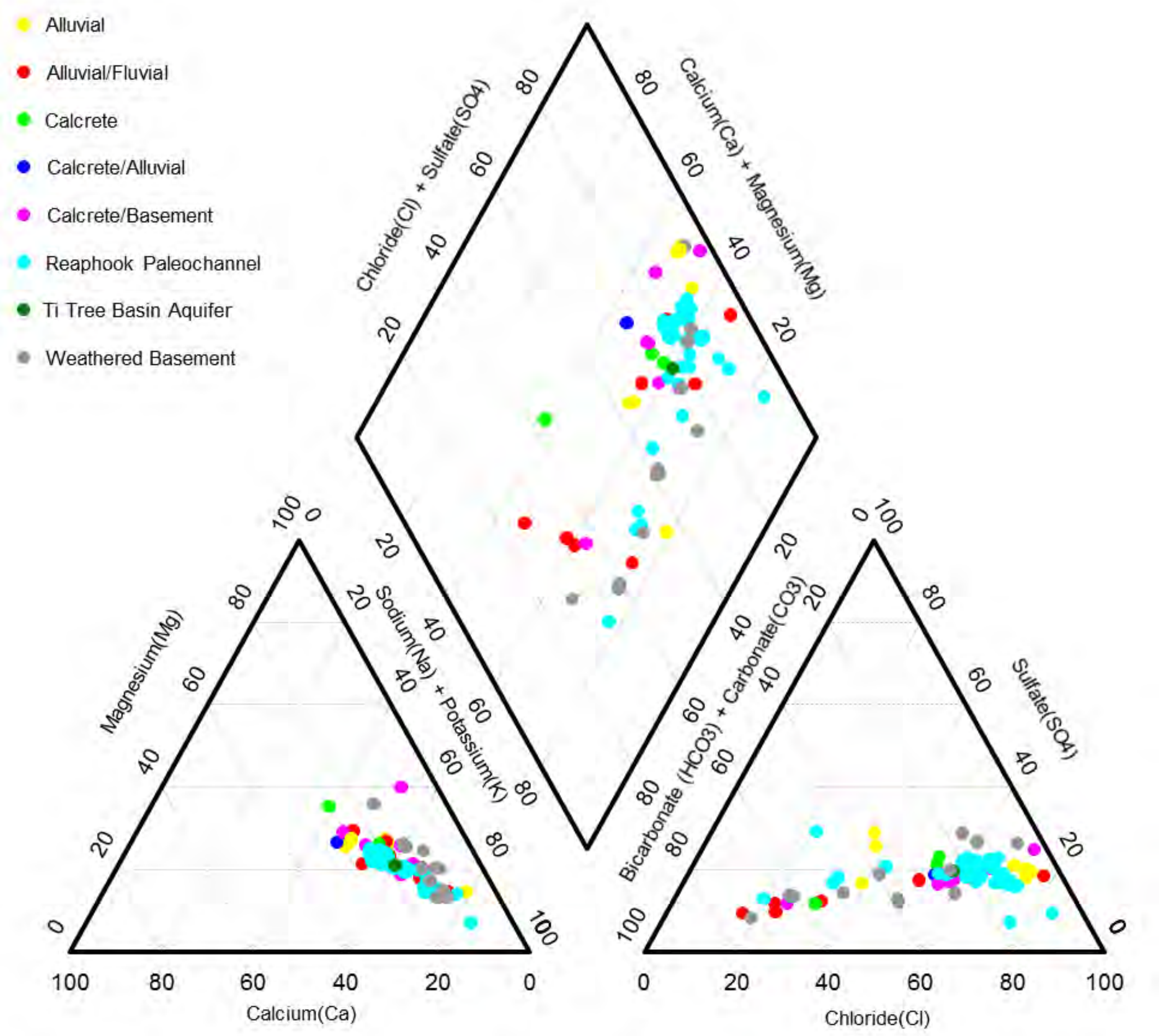


Figure 13 Groundwater chemistry by aquifer type

As a preliminary proxy for water quality, the electrical conductivity of groundwater samples are presented in Figure 14 by aquifer type, in Figure 15 and Figure 16 spatially and summarised in Table 4.

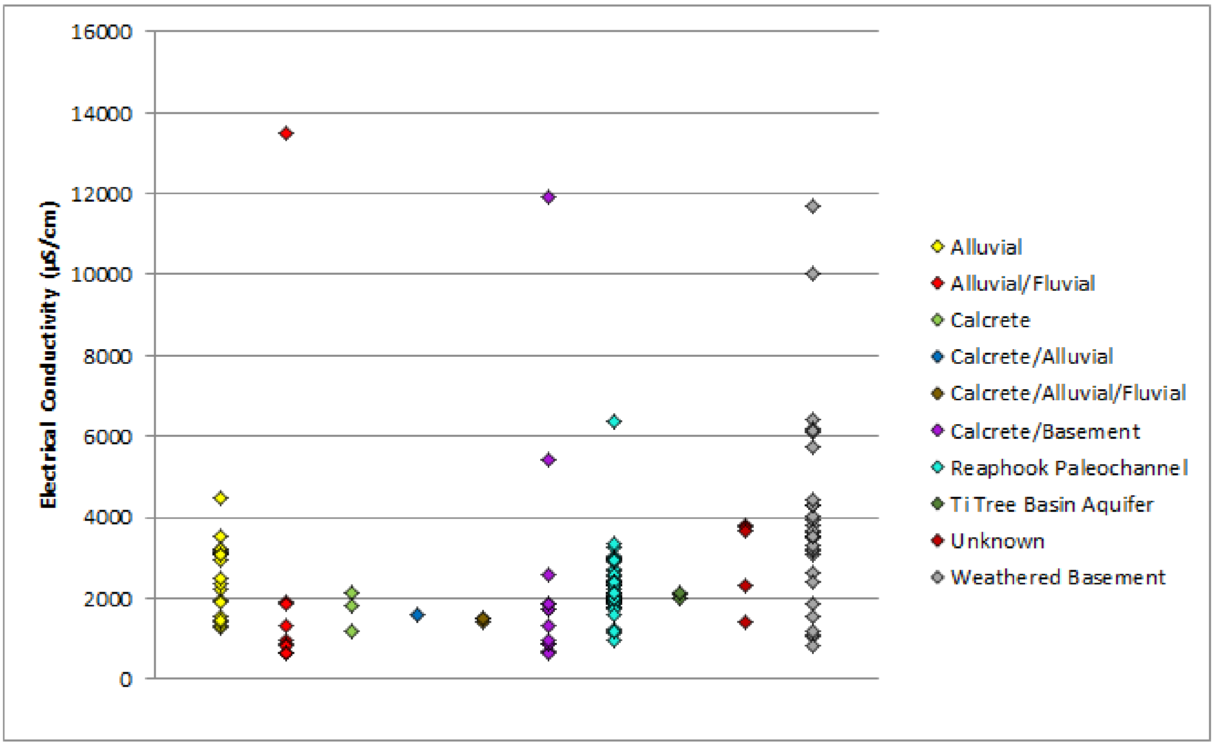
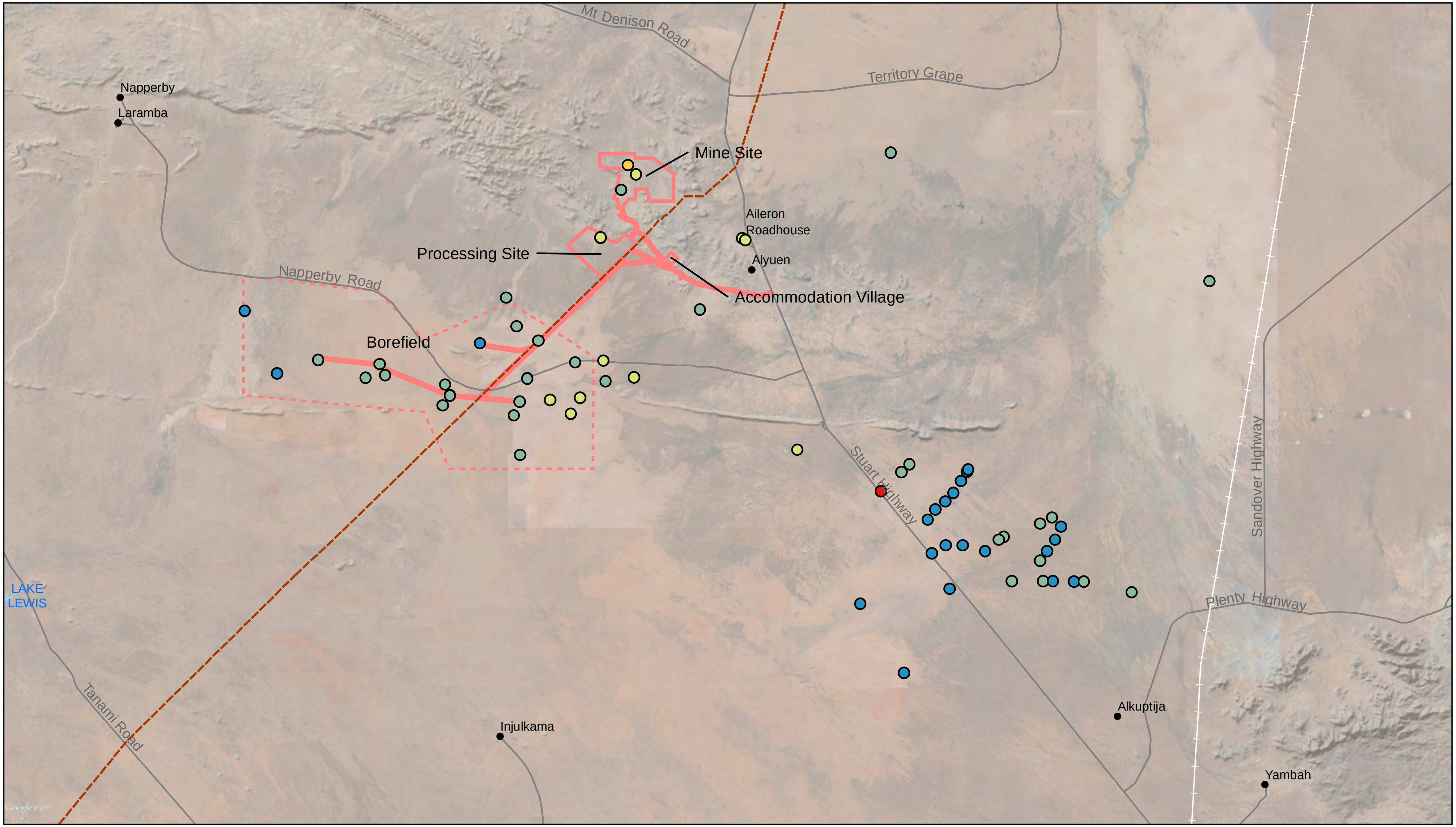


Figure 14 Electrical conductivity plotted by aquifer type

Table 4 Electrical conductivity statistics by aquifer type

Aquifer Type	n	Min EC (µS/cm)	Median EC (µS/cm)	Max EC (µS/cm)
Alluvial	21	1,280	2,950	4,480
Alluvial/Fluvial	10	654	917	13,500
Calcrete	3	1,200	1,820	2,140
Calcrete/Alluvial	1	1,570	1,570	1,570
Calcrete/Alluvial/Fluvial	3	1,430	1,520	1,520
Calcrete/Basement	13	636	1,710	11,900
Reaphook Palaeochannel	59	957	2,130	6,350
Ti Tree Basin Aquifer	3	2,000	2,090	2,120
Unknown	5	1,430	3,585	3,820
Weathered Basement	32	845	3,680	11,700



1:500,000 @ A4

0 5 10 15 20

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 53

N

LEGEND

Electrical Conductivity (uS/cm)

- 0 - 1500
- 1501 - 3000
- 3001 - 4500
- 4501 - 6000
- 6001 - 7500
- 7501 - 13500
- Gas Pipeline
- Major Roads
- Project Areas
- Borefield Area
- Waterbodies

ARAFURA RESOURCES LIMITED

GHD

Arafura Resources Limited
Nolans Project

Job Number 4322301
Revision 0
Date 05 May 2016

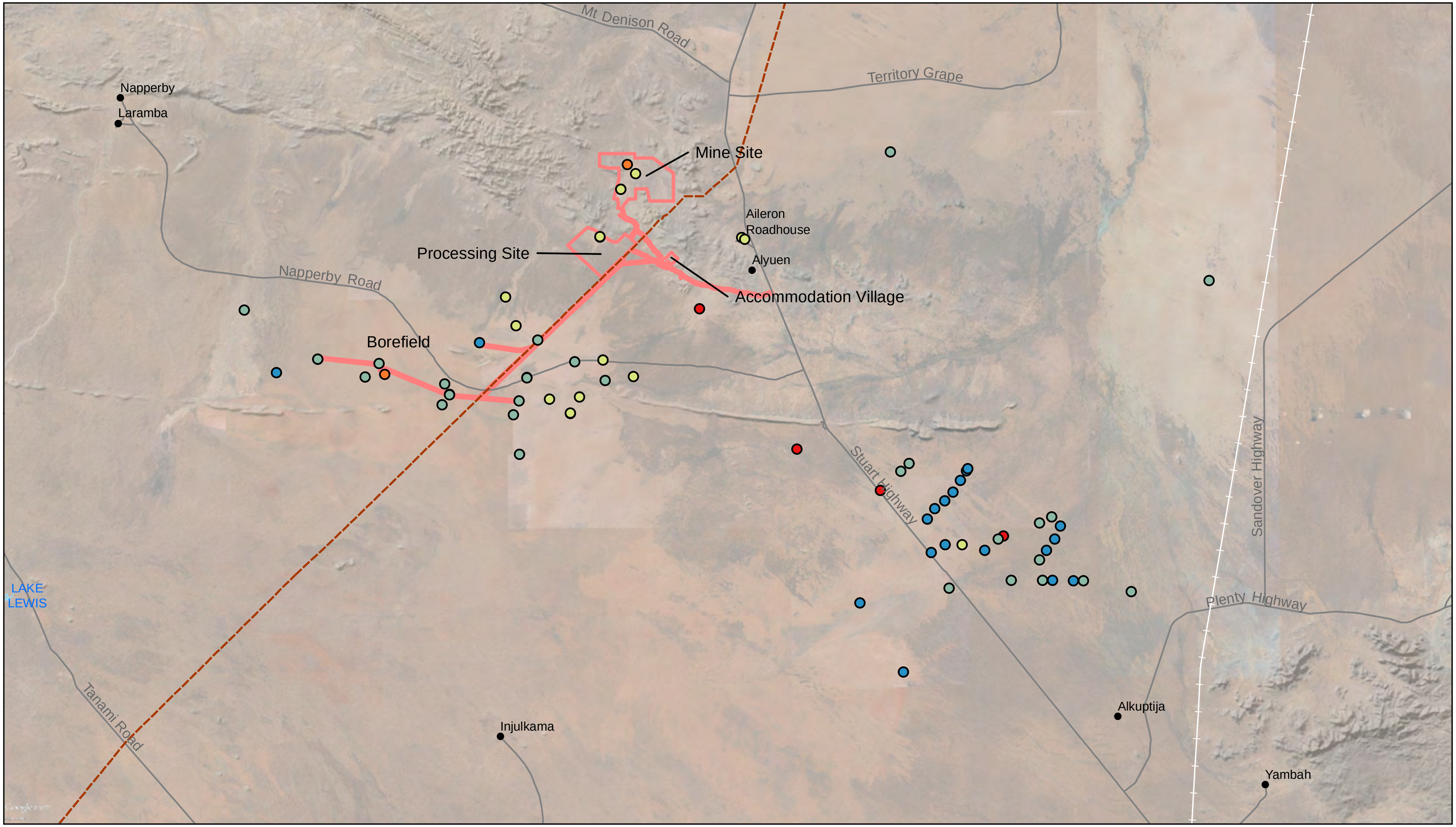
Electrical Conductivity (Min) of Groundwater Samples

Figure 15

G:\43\22301\GIS\Maps\4322301_602_GroundSamplesElectricalConductivity.mxd

Level 5 66 Smith Street Darwin NT 0800 Australia T 61 8 8982 0100 F 61 8 8981 1075 E drwmail@ghd.com W www.ghd.com

Data source: Google Earth Pro - Imagery (Date extracted: 04/02/2015). Ride - Groundwater Data (2015). ARL - Project Areas (2015). GA - Placenames, Railways, Gas Pipeline, Major Roads, Waterbodies (2015). Created by: CM



1:500,000 @ A4

0 5 10 15 20

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 53

N

LEGEND

Electrical Conductivity (uS/cm)

- 0 - 1500
- 1501 - 3000
- 3001 - 4500
- 4501 - 6000
- 6001 - 7500
- 7501 - 13500
- Gas Pipeline
- Major Roads
- Project Areas
- Waterbodies

Arafura Resources Limited
Nolans Project

Job Number	4322301
Revision	0
Date	22 Mar 2016

Electrical Conductivity (Max) of Groundwater Samples

Figure 16

G:\43\22301\GIS\Maps\4322301_603_GroundSamplesElectricalConductivityMax.mxd

Level 5 66 Smith Street Darwin NT 0800 Australia T 61 8 8982 0100 F 61 8 8981 1075 E drwmail@ghd.com W www.ghd.com

Data source: Google Earth Pro - Imagery (Date extracted: 04/02/2015). Ride - Groundwater Data (2015). ARL - Project Areas (2015). GA - Placenames, Railways, Gas Pipeline, Major Roads, Waterbodies (2015). Created by: CM

Table 5 Groundwater current uses and potential beneficial uses

	Current Use Stock water	Stock watering Exceedances	Current Use Drinking water	AWDG 2011 Exceedances	Current Use Irrigation Horticulture and Viticulture	Irrigation Exceedances	Current Use Ecosystems (groundwater dependent ecosystems – GDEs)	Ecosystem comments
Mine Area (Basement) Bores: RC00062 RC00063 RC00064 RC00075	Yes	U, F One bore: Hg	No	N/A (Aesthetic: high pH, TDS, Na, Cl, SO4, Al, Fe Health: SO4, F, Se, U. One bore: NO3, Hg)	No	N/A (F, B, Fe, U. One Bore: Hg)	Potential GDEs down Kerosene Creek and Woodforde River, potential stygofauna	No specific/ appropriate guidelines
Ti Tree Basin Bores: RC00092	Yes	None	Yes	Note: only one bore sampled. Aesthetic: TDS, Cl, Na Health: U, NO3	Yes	Note: only one bore sampled. B, U, F	Potential GDEs down Woodforde River and evapotranspiration locations, potential stygofauna	No specific/ appropriate guidelines
Margins Area Bores: RC00106 RC00109 RC00040 RC00044 RC00045 RC00046 RC00047 RC00048 RC00049 RC00053 RC00057 RC00100 RC00103	Yes	One bore: Se. Two bores: TDS, NO2-, F Three bores: SO4-,U	No	N/A (Aesthetic: High pH, TDS, Na, Cl, SO4, Al, Mn Health: SO4, F, NO3, Fe, Se, U. Three bores: NO2. Two bores: Pb)	No	N/A (F, B, Fe, Mn, U. Three bores: Se)	Potential evapotranspiration locations, potential stygofauna	No specific/ appropriate guidelines

	Current Use Stock water	Stock watering Exceedances	Current Use Drinking water	AWDG 2011 Exceedances	Current Use Irrigation Horticulture and Viticulture	Irrigation Exceedances	Current Use Ecosystems (groundwater dependent ecosystems – GDEs)	Ecosystem comments
RC00104 RC00052 RC00030 RC00031 RC00033 RC00032 RC00035 RC00036 RC00037 RC00041 RC00042 RC00043 RC00050 RC00054 RC00056 RC00344 RC00098 RC00099								
Southern Basins (Basement) Bores: RC00005 RC00078 RC00079 RC00081	Yes	U, F, One bore: TDS, SO4-, Se	No	Aesthetic: High pH, TDS, Na, Cl, SO4, One bore: Al Health: Se, U, F, NO3, SO4	No (considered a potential use with treatment)	B, Fe, Mo, U, F, One bore: Se	Potential evapotranspiration locations, potential stygofauna	No specific/ appropriate guidelines
Southern Basins	No	None, N/A	No (propose	Aesthetic: High pH, Al, Fe, Mn,		N/A	Potential evapotranspiration	No specific/ appropriate

	Current Use Stock water	Stock watering Exceedances	Current Use Drinking water	AWDG 2011 Exceedances	Current Use Irrigation Horticulture and Viticulture	Irrigation Exceedances	Current Use Ecosystems (groundwater dependent ecosystems – GDEs)	Ecosystem comments
(RC00027 Basement) Bore: RC00027			d use as drinking water supply)	TDS, Na Health: U		(F, B, Fe, Mo, U)	locations, potential stygofauna	guidelines
Southern Basins (Alluvials and Calcretes) Bores: RC00001 RC00002 RC00003 RC00007 RC00059 RC00060 RC00084 RC00085	Yes	None	Alyuen, Aileron Station	Aesthetic: TDS, high pH, Na, SO4, Al, Mn, Cl, Na Health: NO3, U. One bore: F, Se	No (considered a potential use with treatment)	B, U, F. One bore: Mo.	Potential GDEs in Day Creek and other creeks and discharge locations in the catchment, potential stygofauna and potential halophiles in Lake Lewis and surrounds	No specific/ appropriate guidelines
Southern Basins (Rheapook Channel) Bores: RC00004 RC00006 RC00012 RC00013 RC00014	Yes	One bore: F, Se	Yes	Aesthetic: High pH, TDS, Na, Cl, Fe, SO4. One bore: Mn Health: F, U, NO3. One bore: NO2, Sb, Pb, Se	No (considered a potential use with treatment)	F, B, Fe, Mo, Se, U. One bore: Al	As above	No specific/ appropriate guidelines

	Current Use Stock water	Stock watering Exceedances	Current Use Drinking water	AWDG 2011 Exceedances	Current Use Irrigation Horticulture and Viticulture	Irrigation Exceedances	Current Use Ecosystems (groundwater dependent ecosystems – GDEs)	Ecosystem comments
RC00015								
RC00016								
RC00017								
RC00018								
RC00019								
RC00021								
RC00022								
RC00023								
RC00024								
RC00025								
RC00026								
RC00028								
RC00061								

The groundwater chemistry dataset (Ride, 2016) forms the start of the background groundwater quality assessment for the Nolans Project but also provides us the context for the development of the conceptual models in the context of potential beneficial use.

The current uses for groundwater are discussed in Section 3.2 and summarised in Table 5 relative to the groundwater analyses provided by Ride (2016) and the guidelines discussed above. Groundwater quality (and chemistry) are variable in all units, however the general trend is that alluvial, shallow fluvial and calcrete aquifers are generally 'fresher' than the Reaphook Palaeochannel aquifer, and the upper Ti-Tree Basin aquifer which in turn are generally 'fresher' than basement aquifers. There are exceptions to this, but the general trend for the conceptual model is hypothesised to be that groundwater quality:

- deteriorates with proximity to basement rocks (due to dissolution associated with weathering) and discharge locations (due to evaporation and subsequent concentration of constituents)
- improves marginally with proximity to preferential recharge locations (i.e. the Day Creek and Reaphook Range intersection) and where diffuse recharge is not associated with runoff from basement rocks (i.e. the centres of basins and The Margins area).

Despite the complexity of the groundwater chemistry and the presence of significant outliers, in this study, potential impacts to groundwater quality are considered using the above conceptual models and in the context of the potential beneficial uses summarised in Table 5.

5. Groundwater modelling

5.1 Purpose of the groundwater model

A numerical groundwater model was built to represent:

- the existing groundwater system (a steady-state numerical groundwater flow model)
- the groundwater system under the influence of the project's operating conditions (a predictive transient numerical groundwater flow model)
- the groundwater system under closure conditions (a long-term [1,000-year] predictive transient numerical groundwater flow model.

The concept of the groundwater modelling exercise was to use all available information to build the Ti-Tree Basin section of the model. This makes use of existing data and reporting of the modelling exercises, and although not intended to be used directly as a Ti-Tree Basin modelling tool for management of groundwater within the Ti-Tree Basin (i.e. not intended to supersede the existing models by Knapton and Water Studies), it allows any potential impacts to be put in the context of the Ti-Tree Basin.

5.2 Model platform (and software)

The graphical user interface (GUI) GMS 10.1 was used with finite-difference MODFLOW version MODFLOW-NWT. The numerical groundwater flow package Upstream Weighting (UPW) and the Newton (NWT) solver were used. The models used the Evaporation package (EVT1), General Head boundary package (GHB1), the Drains (DRN1) package and the Recharge (RCH1) package. The automated parameter estimation package (PEST) was also used extensively to assist in modelling decisions and calibration.

5.3 Calibration targets

The steady-state groundwater model calibration targets were based on a combination of observed groundwater levels from boreholes and in this case the decision was made to calibrate to the very extensively documented groundwater contours of the Ti-Tree Basin. This was chosen over obtaining the bore datasets from the Ti-Tree Basin, to make every effort to best replicate the previous works in representing the Ti-Tree Basin within our broader and deeper model. Due to this non-routine approach, calibration statistics will be reported for the two datasets:

1. The 49 bores with observed groundwater levels measured to Australian Height Datum (AHD) alone (Appendix A)
2. The coupled dataset of these 49 bores with a further 123 spot heights representing the Ti-Tree Basin published groundwater elevations (172 calibration targets).

5.4 Target model residuals

The initial target measure for acceptable calibration for the steady-state modelling was a head or groundwater level scaled root mean squared (SRMS) residual of 5% for heads. Given the range of groundwater heads for calibration is:

- from 500 mAHD to 645 mAHD for the coupled Ti-Tree Basin contour dataset and bores
- from 564 mAHD to 645 mAHD for the bores alone.

The model target root mean squared (RMS) residual for a 5% SRMS is:

- 7.25 m for the coupled Ti-Tree Basin contour dataset and bores
- 4.05 m for the bores alone.

5.5 Model class

The model is calibrated only to groundwater level information and not groundwater flow information. Rather the model relies on boundary conditions and material hydraulic conductivity information based on assumptions and estimations from previous investigations and those made during the field program.

According to the Australian Groundwater Modelling Guidelines (Barnett et al, 2012) this model is in the lowest classification Class 1. The achievement of a higher class model was not possible without monitoring over time due to the following definitions (Barnett et al, 2012):

- "Predictive model time frame far exceeds that of calibration"
- "Transient predictions are made when calibration is in steady state only."

Class 1 models by definition (Barnett et al, 2012) are suitable for the following key specific uses:

- "Predicting long-term impacts of proposed developments in low-value aquifers
- Estimating impacts of low-risk developments
- Understanding groundwater flow processes under various hypothetical conditions
- Provide first-pass estimates of extraction volumes and rates required for mine dewatering
- Developing coarse relationships between groundwater extraction locations and rates and associated impacts."

From a groundwater perspective, the Nolans project is considered low-risk due to the design concept of a zero discharge site. Additionally, the basement aquifer at the mine site and the Southern Basins aquifers at the borefield location are considered low-value due to their current uses, potential beneficial uses (Table 5) and the scale of the aquifer and location. These concepts are discussed further in Section 6.

5.6 Groundwater model geometry

A six-layer model was constructed to represent the groundwater system described in Section 2 and 3. The model consists of layers ranging from a minimum thickness of 2 metres in layer 1 to maximum thicknesses of hundreds of metres in layer 6 to a uniform base of the model at 0 mAHD. The model grid ranges from a minimum grid size of 10 m by 10 m at the centre of the Nolans Mine Site to a maximum of 300 m by 300 m resulting in approximately 266,000 cells per layer.

The model geometry for each layer is presented in Figure 17 to Figure 21 based on the AEM, borehole logs and conceptual model presented in Sections 2.3 and 3.

5.6.1 Layer 1

Layer 1 represents a thin surface skin of the hydrogeological units of surface Proterozoic (i.e. basement), Quaternary (i.e. recent cover material) and an artificial unit Mine Void to define the mining area (Figure 17). Drain cells are applied as seepage faces at the perimeter of Lake Lewis, should groundwater discharge directly to the lake surface. Recharge and evapotranspiration are also applied to layer 1.

5.6.2 Layer 2

Layer 2 (Figure 18) represents the Napperby Formation in the Ti-Tree Basin, Quaternary material in the Margins Area, Tertiary 2 material across the whole of the Southern Basins. The Proterozoic material in the mine area is also further sub-divided into material under cover (referred to as Proterozoic Gneiss although not hydraulically differentiated) and the higher permeability host material (for simplicity referred to as Apatite). The general head boundary at the northern extent of the Ti-Tree Basin lets water out of the model at a head of 500 mAHD in layer 2 (and layers 3, 4, and 5).

5.6.3 Layer 3

Layer 3 (Figure 19) represents the Napperby Formation in the Ti-Tree Basin, Quaternary material in the Margins Area, Tertiary 2 material across the whole of the Southern Basins. The key difference between layer 3 and layer 2 is that the differentiation of the upper aquifer of the Ti-Tree Basin is replicated as close as possible as that described in Water Studies (2001) and Knapton (2007). Layer 3 represents the extent of the Water Studies (2001) and Knapton (2007) models where our model extends deeper both with the Ti-Tree Basin and to within the basement beneath. At the western extent of the Reaphook Palaeochannel, a general head boundary lets water out of the model at 565 mAHD in layer 3 (and layers 4, 5 and 6). Existing groundwater extraction was included using assumed rates at key wells only and was applied to layer 3 of the model as steady-state rates as per Table 6. This approach allows the extraction of impact from the mine and borefield to be isolated from the existing users.

5.6.4 Layer 4

Layer 4 (Figure 20) introduces the materials representing the semi-confining (leaky) Waite Formation equivalent in the Ti-Tree Basin and the material referred to as Tertiary 2 Moderate to the Reaphook Palaeochannel area of the Southern Basins. Mining is replicated in layer 4 through the introduction of a linear interpolation of the progress of the pit through a transient TIN (triangular irregular network) applied to the bottom of elevation of drains covering the pit area. The base of layer 4 is also lowered to a uniform 390 mAHD to aid in this representation.

5.6.5 Layer 5

Layer 5 (Figure 21) introduces the materials representing the Hale Formation equivalent in the Ti-Tree Basin and the material referred to as Tertiary 1 to the Reaphook Palaeochannel area of the Southern Basins. Proposed groundwater extraction from the Reaphook Palaeochannel area of the Southern Basins was applied as transient flow as per Table 7 after Ride (2015). This approach allows the extraction of impact from the mine and borefield to be isolated from the existing users.

5.6.6 Layer 6

Layer 6 (Figure 22) represents the basement rocks across the entire model (i.e. beneath the Southern Basins, the Margins Area, the Ti-Tree Basin as well as the outcropping basement rocks). The only differentiation between basement rocks is the inclusion of a material type Ngalia Basin. To manage potential outflow to the west from the Ngalia Basin, the general head boundary is extended to layer 6.

Figure 17 Layer 1 hydrogeological model geometry

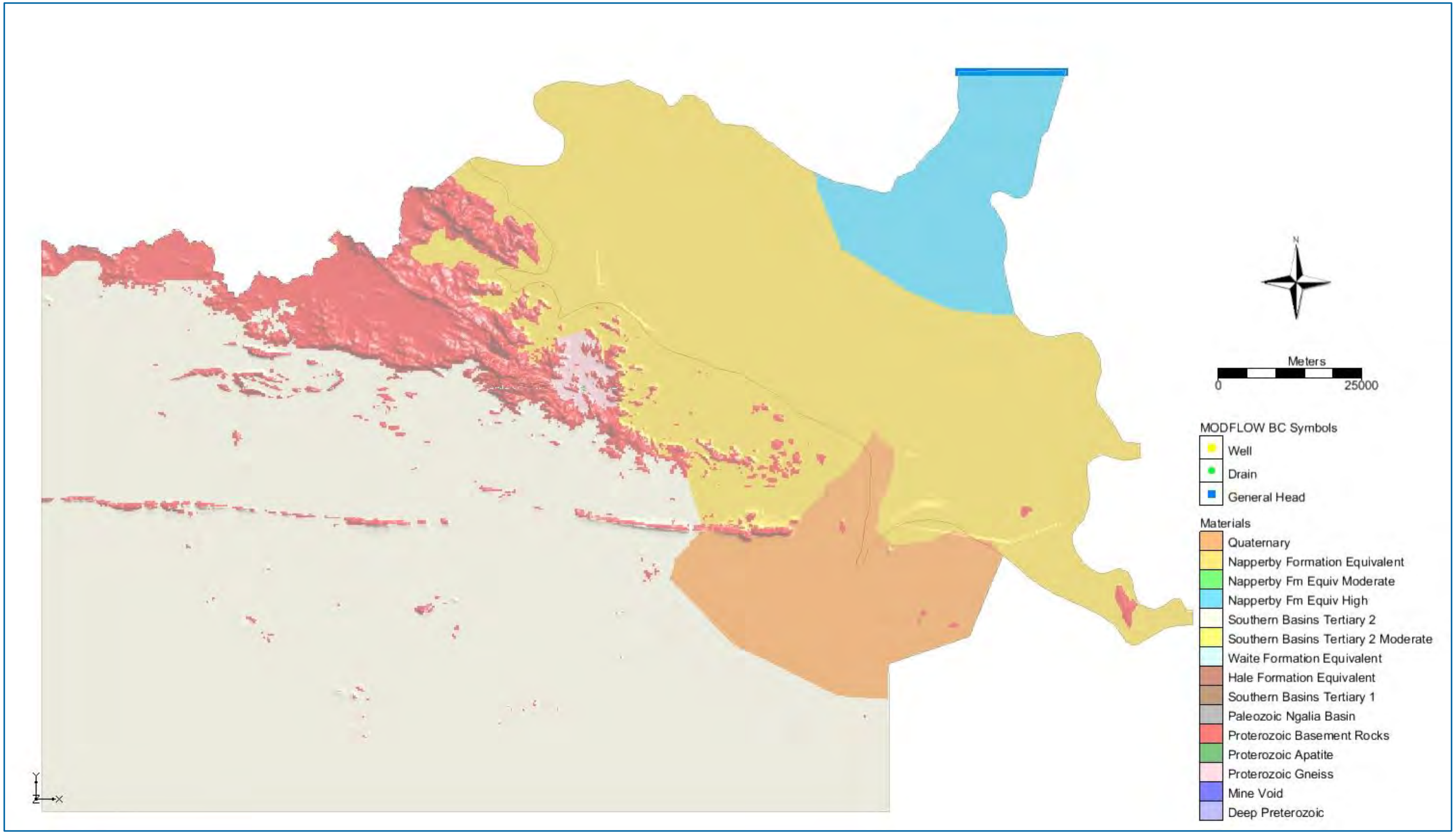


Figure 18 Layer 2 hydrogeological model geometry

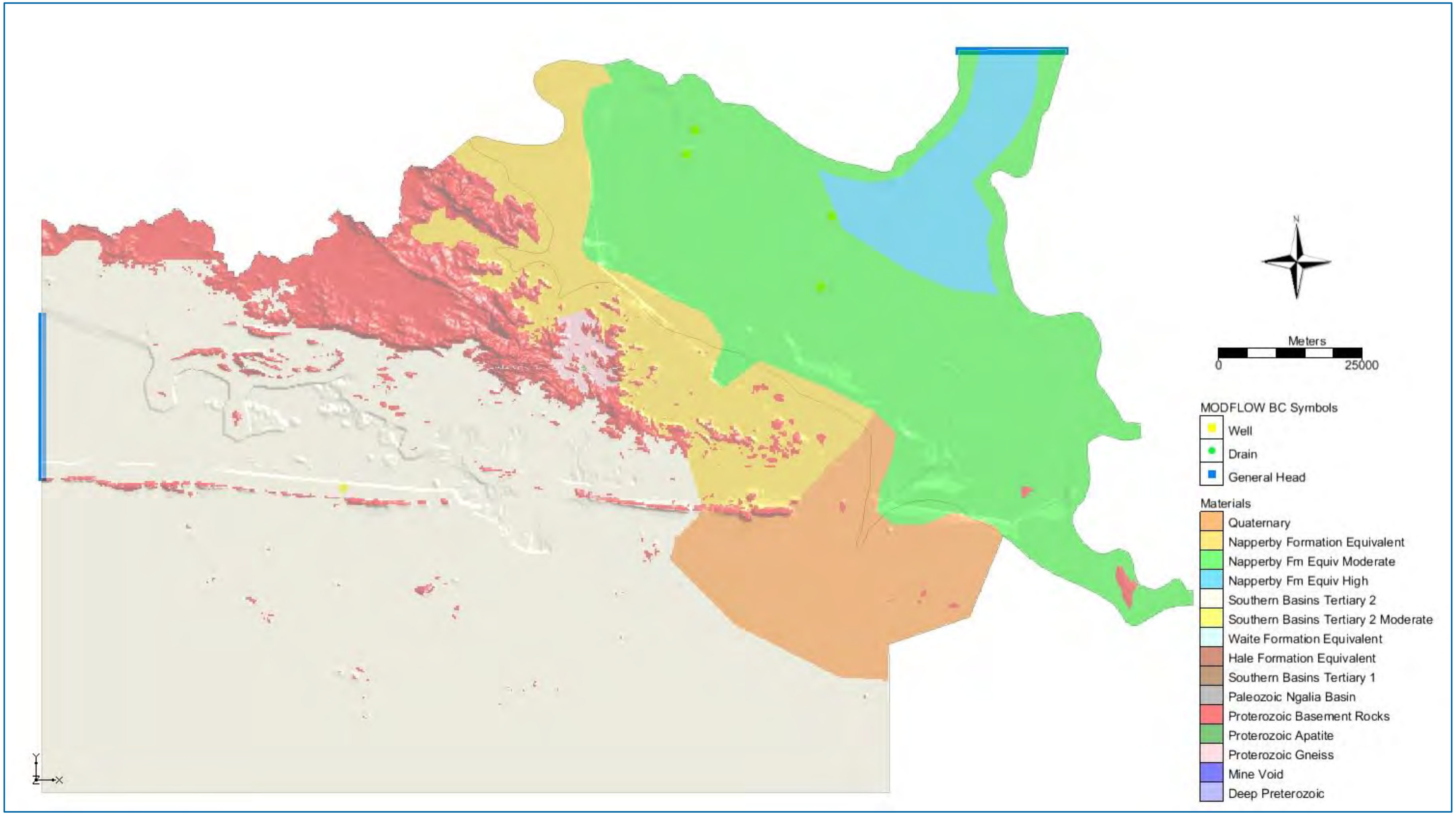


Figure 19 Layer 3 hydrogeological model geometry

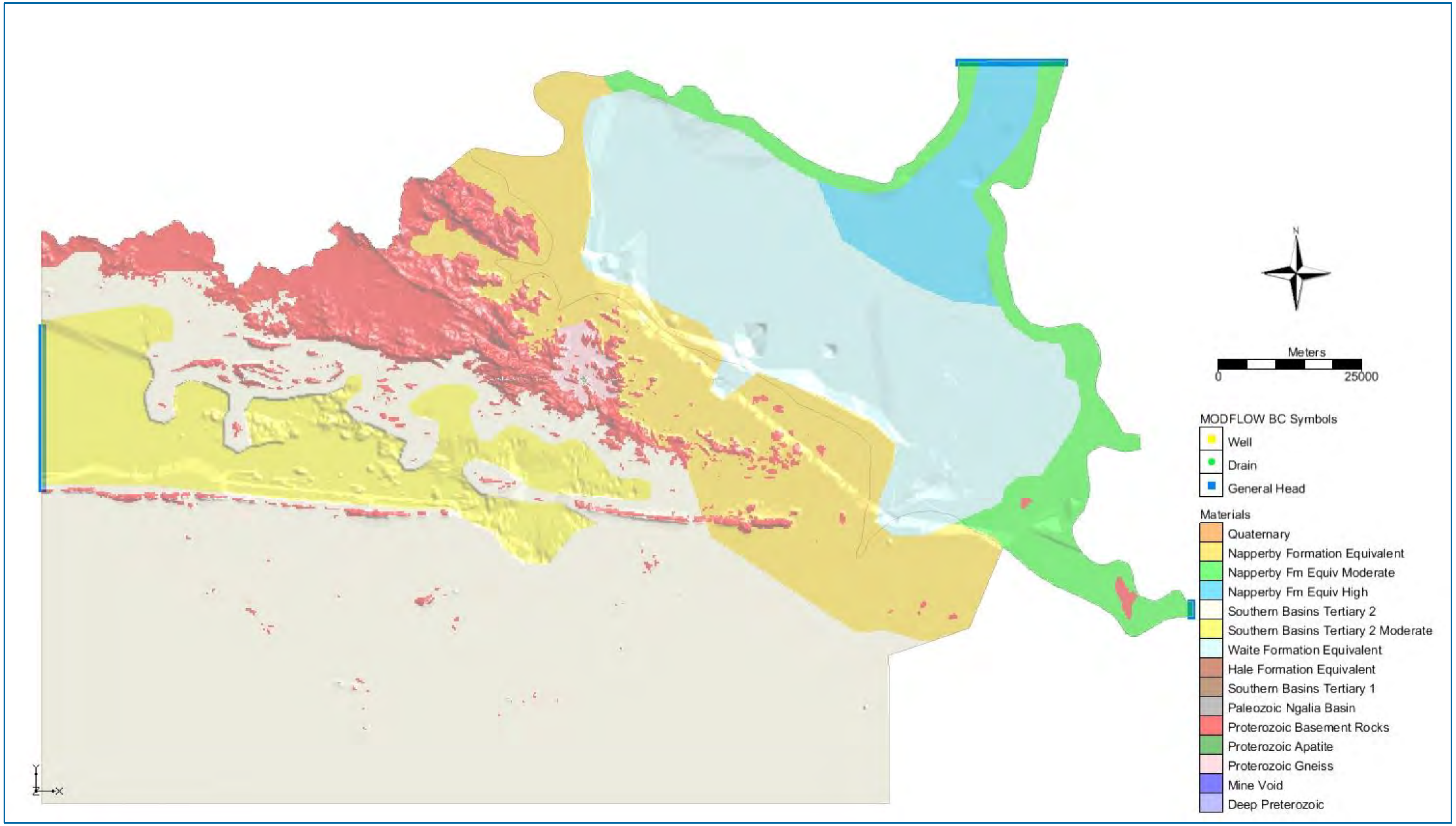


Figure 20 Layer 4 hydrogeological model geometry

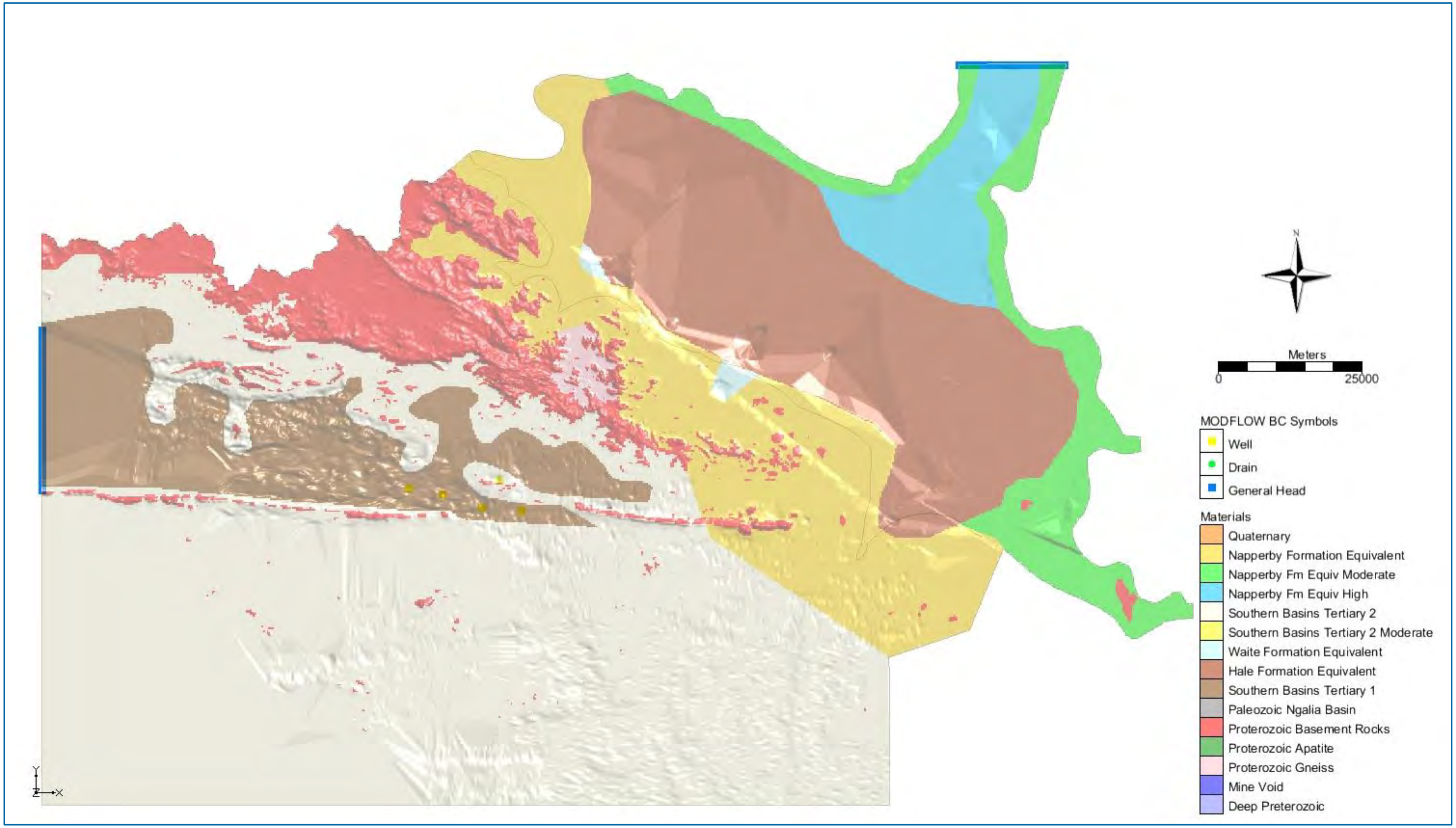


Figure 21 Layer 5 hydrogeological model geometry

Figure 22 Layer 6 hydrogeological model geometry

5.7 Model stresses

The model is designed to test two primary stresses (sources of flow in or out of the model) that will be added to groundwater system as a result of the Nolans Project. These are:

- The mine (modelled as drain cells to represent and quantify sump pumping, i.e. flows are outputs from the model). Drain cells allow water to flow out of the model, controlled by the difference in elevation between the head and the drain and the drain bed conductance.
- The borefield (modelled as well cells to represent bore pumping, i.e. flows are inputs to the model). Well cells extract or inject water from or to the model at the pre-determined rates proposed by Ride (2015).

Secondary stresses include stock bores, Ti-Tree Basin bore pumping for horticultural irrigation and community bores (Pmara Jutunta, Alyuen and Laramba). These bores are included in the transient model as constant-rate stresses using the Well package, such that the impacts of the mine and borefield can be isolated from these pre-existing stresses.

Tertiary stresses include recharge and evapotranspiration. Like the bores, recharge and evapotranspiration are included in the transient model as constant-rate stresses, using the Recharge and Evapotranspiration packages respectively, such that the impacts of the mine and borefield can be isolated.

Table 6 Existing groundwater extraction assumed rates

Name	Easting	Northing	Type	Assumed rates (m3/day)	Assumed rates (L/s)
Table Grapes Growers of Australia	360139	7516188	well	-2738	-32
Australian Territory Farms	362332	7528350	well	-1643	-19
Ti-Tree Farms	336840	7539100	well	-2190	-25
Pmara Jutunta	338250	7543200	well	-329	-4
Laramba	277038	7481156	well	-269	-3

Table 7 Modelled operating (2018-2060) rates for the Southern Basins borefield

Name	Easting	Northing	Type	Modelled operating (2018-2060) rate (m3/day)	Modelled operating (2018-2060) rate (L/s)
SB027	304174.4	7484914.6	well	-274	-3
SB021	294451.4	7482352.0	well	-3559	-41
SB025	288453.9	7483299.9	well	-3833	-44
SB022	301272.4	7479846.3	well	-3285	-38
SB028	308089.1	7479243.2	well	-1917	-22

5.7.1 Mine dewatering and closure

Based on the work undertaken by Environmental Earth Sciences (2011), although the ore body represents a localised aquifer, the pit walls (the majority of which are in gneiss or gneissic rocks) are likely to be of a relatively low permeability. In such settings, the use of dewatering bores as the primary source of pit dewatering is not likely to be feasible or logical. In these settings, pit sumps and surface pumps are more likely to be utilised and in such scenarios the pit void itself is the dewatering mechanism and this can be simulated through the use of the drain package.

Mine dewatering is modelled by applying a linear interpolation to the drain elevation of 1611 cells based on the maximum depth the mine will reach at the location of that particular cell location (i.e. at the centre of the pit mining will reach the 390 mAHD level in 2060 after 41 years of mining). For simplicity, all mine dewatering occurs from layer 4 within the model (which in turn dewaters the overlying layers).

Mine inflow water is not allowed to re-enter the system as no discharge of mine water will occur (i.e. the operation is zero discharge) and it will be managed within the mine ponds. Likewise, these zero discharge features are not explicitly modelled as they are above the water table and designed not to contribute to the groundwater recharge.

After mining ceases, the water level in the pit is allowed to rebound, based on a three-stage linear interpolation which allows the rebound to reach 500 mAHD after 10 years, 550 mAHD after 50 years and finally 575 mAHD after 150 years. This provides a reasonable approximation of the log-linear (typical groundwater rebound) preliminary surface water balance predictions (Appendix I of this EIS) which in turn required input from the preliminary groundwater models. The modelling confirms that evaporation then dominates the flows, even in years containing 1 in 100 year events (Dunn pers. comm., 2015).

5.8 Steady-state model results

5.8.1 Steady state modelling approach

The steady-state modelling approach used existing information, primarily Water Studies (2001), Read and Tickell (2007) and Knapton (2007), as a starting point and built on these datasets to improve model calibration over this deeper and broader groundwater model.

Hydraulic conductivity

Existing values for hydraulic conductivity for basin materials were used as starting values and the groundwater model was manually calibrated. Basement values were not altered; rather best estimates for hydraulic conductivity were applied. It should be noted that there is a high degree of uncertainty around the regional basement hydraulic conductivity and that the values applied reflect not the primary hydraulic conductivity, but the hydraulic conductivity of a representative elementary volume of the rock mass which includes potential fracture and fabric permeability. This provides the most reasonable assessment of potential impact.

Only basin materials were parameterised and PEST was then utilised to lower the residual of the combined observation datasets (Ti-Tree contours, Southern Basins and Margins Area water levels) from at RMS of 5.07 m to 2.83 m.

Horizontal Hydraulic Conductivity “Kh” was applied with a horizontal anisotropy (Kx/Ky) of 1, vertical anisotropy (Kh/Kv) consistent at 3, specific storage “Ss” was consistent at 0.00001 (1/m) and specific yield “Sy” was consistent at 0.1.

Table 8 PEST calibrated horizontal hydraulic conductivity applied in the model

Hydrogeological Unit	PEST Calibrated Horizontal Hydraulic Conductivity "Kh" (m/day)	Calibrated Horizontal Hydraulic Conductivity "Kh" (m/day)
Quaternary	7	1
Napperby Formation Equivalent	0.2	2
Napperby Formation Equivalent Moderate	4	5
Napperby Formation Equivalent High	19	24
Southern Basins Tertiary 2	3	2
Southern Basins Tertiary 2 Moderate	0.8	5
Waite Formation Equivalent	2	1
Hale Formation Equivalent	5	4
Southern Basins Tertiary 1	28	4
Palaeozoic Ngalia Basin	1	0.1
Proterozoic Basement Rocks	0.01	0.01
Proterozoic Apatite	0.1	0.1
Proterozoic Gneiss	0.01	0.01
Mine Void	0.1	0.1
Deep Proterozoic	0.01	0.01

Evapotranspiration

A simplification of the likely evapotranspiration across the model area was simulated by applying evapotranspiration to only to the Quaternary material (i.e. not to basement rock outcrop) at the uniform rate of 3 mm/day with an extinction depth of 1.5 m (i.e. evapotranspiration would not occur unless groundwater was within 1.5 m of the surface. This mirrors the approach and magnitude of evapotranspiration in both Water Studies (2001) and Knapton (2007). Altering (or parameterising) evapotranspiration rates within a realistic range and approaches did not result in significant improvements in calibration (i.e. lower residuals). This may be due to a lack of water level observations in areas where significant evapotranspiration occurs within the model.

Recharge

Recharge was applied in five broad region types across the model but in practice the final calibration approach only utilised two numbers (Table 9 and Figure 23). These are synonymous with the Water Studies (2001) and Knapton (2007) applied values, with one clear difference being the Allungra Creek area. Throughout our calibration it was difficult to justify the very high recharge values applied to this isolated area of the Ti-Tree Basin. One explanation is that these flows are in-part accounted for in our model by areas outside of the previous model area (i.e. the basin areas receiving runoff from the basement outcropping as hilly terrain higher in the catchment, and the smaller terminal creeks and broader flood-out areas). There remains scope for further refinement of these values, particular following the acquisition of a temporal water level dataset.

Table 9 Recharge across the groundwater model

	m/day	mm/day	mm/year
Regional Basin Cover	2.20E-06	2.20E-03	0.8
Regional Basement Outcrop	2.20E-06	2.20E-03	0.8
Basin areas receiving runoff from Basement outcropping as hilly terrain	1.00E-05	1.00E-02	3.7
Large River and Creek Channels	1.00E-05	1.00E-02	3.7
Small Terminal Creeks	1.00E-05	1.00E-02	3.7
Floodout Areas	1.00E-05	1.00E-02	3.7

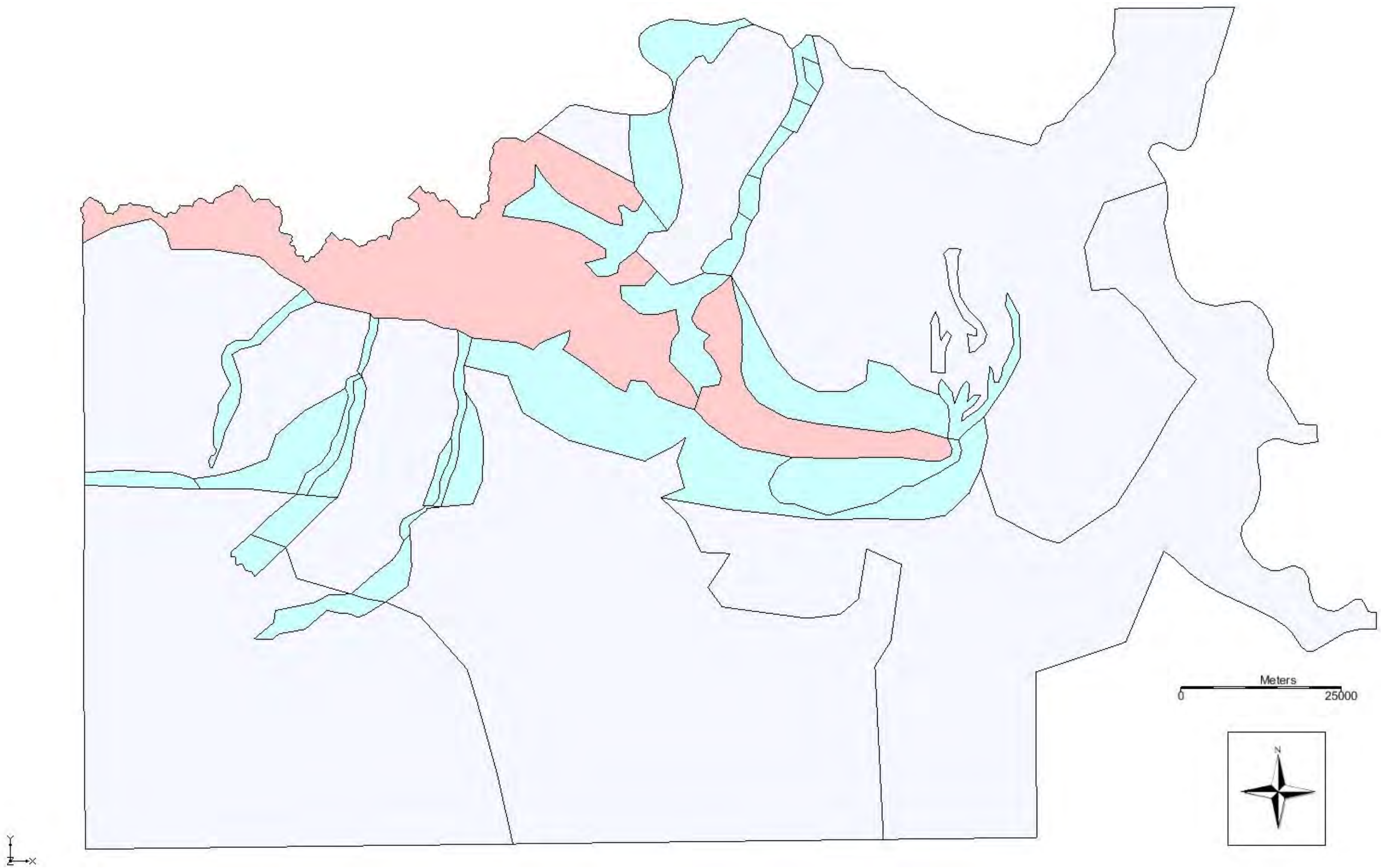


Figure 23 Modelled recharge polygons (red and purple - basement and regional - low recharge, blue – creeks, rivers, floodouts and recharge off basement rocks)

5.8.2 Steady state model residuals

The key measures for the steady state model calibration are the RMS residual and the scale RMS residual. These are presented below in Table 10 which demonstrates the self-imposed targets for calibration were met.

Table 10 Steady state model residuals

Dataset	Calibrated RMS (m)	Target RMS (m)	Calibrated SRMS (%)	Target SRMS (%)
Coupled Ti-Tree Basin contours and bores	2.83	7.25	2	5
Bores	3.11	4.05	4	5

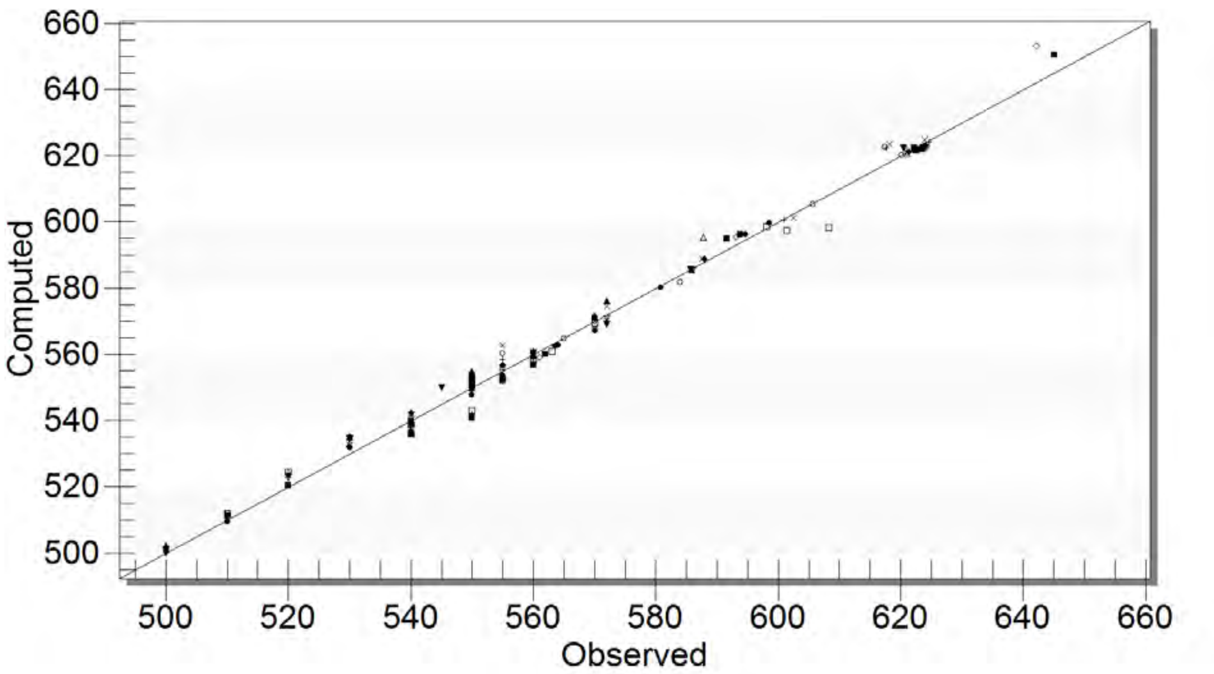


Figure 24 Steady-state model versus coupled published Ti-Tree Basin contours and observations from bores (RMS = 2.83 m)

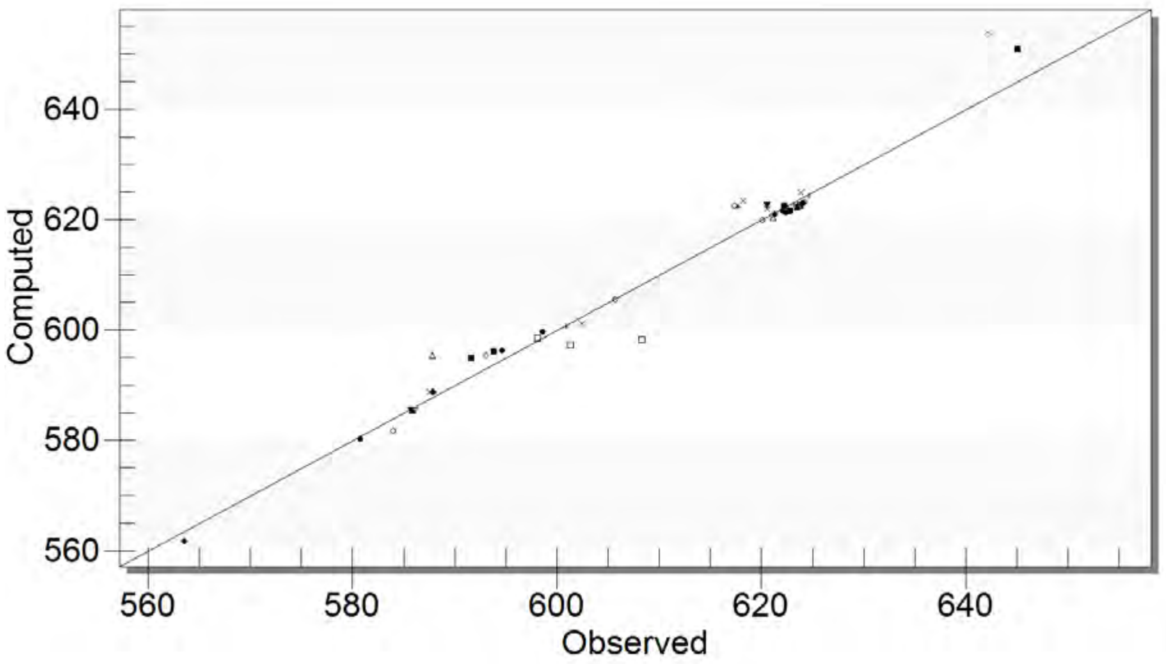


Figure 25 Steady state model versus observations from bores (RMS = 3.11 m)

5.8.3 Steady-state model application

A numerical groundwater flow model has been:

- constructed based on the hydrogeological investigations
- calibrated to steady-state observed conditions
- run as a predictive tool to estimate future conditions
- interrogated to quantify the key impacts (or lack thereof) at key locations across the study area.

The groundwater modelling is not considered to be definitive (i.e. absolutely correct), rather it presents our best estimate of the likely conditions based on our existing investigations, and uses this to numerically quantify the impacts based on these estimates.

No formal sensitivity analysis has been undertaken on the model parameters.

The modelled solution represents a non-unique solution. A different combination of parameters could be applied resulting in an equally valid prediction which could result in impacts with differing magnitudes; however, the modelling does provide a valuable tool capable of quantifying the impacts based on reasonable documented inputs.

The key gap in data that would allow this model to move from a Class 1 model to a Class 2 or 3 model is temporal water level data. Obtaining a temporal dataset (ideally through the deployment of a fleet of water level loggers) and calibrating the transient model to a temporal dataset should be considered the next step in refining the groundwater model.

Capturing both the pre-pumping and the stress of both the pumping and mining periods will be integral to both the validation and ongoing application of the groundwater model.

6. Physical groundwater impacts

6.1 Modelled groundwater elevation

The modelled groundwater elevations, for example in Layer 1, are provided for three key times throughout the model period:

- Steady-state (pre-mining) groundwater elevation 1/1/2017 (Figure 26)
- End of mining groundwater elevation 1/1/2060 (Figure 27)
- 1,000-years of closure 1/1/3160 (Figure 28).

The modelled groundwater flow regime displays almost no change (impact) at the model (regional) scale when viewed from a flow direction or groundwater head perspective. At this scale, the impacts to flow direction and groundwater head are very localised to the mine area and adjacent to the Southern Basins borefield bores in the Reaphook Palaeochannel area while in operation.

No reversal of groundwater flow direction occurs anywhere within the model area during mining, except for immediately adjacent to the pit and immediately adjacent to the bores (but not across aquifer, i.e. groundwater flow is still westwards despite the pumping). The modelled area of reversal at the end of the 1,000-year closure period extends within the basement rocks radially from the mine for approximately 4 km towards the Aileron Station Homestead and Aileron Roadhouse area.

The model area of inflow towards the pit (Figure 29) is limited to an area with the following average radii measured from the centre of the pit (which itself has an average radius of approximately 0.75 km):

- After 10 years of mining, approximately 1 km
- After 20 years of mining, approximately 1.5 km
- After 30 years of mining, approximately 2 km
- At the end of mining, approximately 2.5 km
- After 100 years of closure, approximately 4 km
- After 1,000-years of closure, approximately 5 km and extending northwest along the basement rocks.

This demonstrates that the modelled extent of the inflow cone during mining is limited in extent to almost only the area actually disturbed by mining (i.e. much of this area is beneath the waste rock dumps and tailings storage facility).

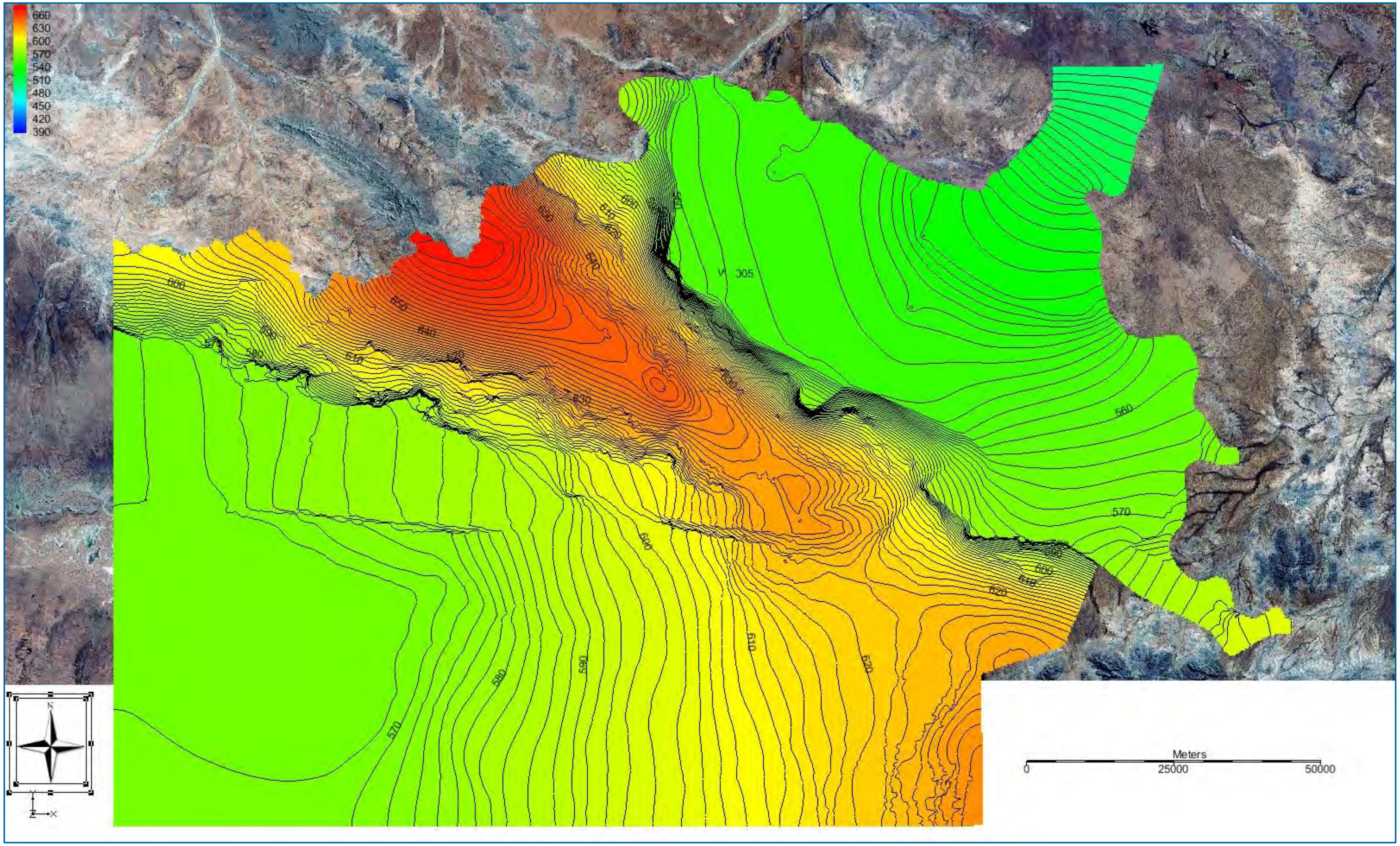


Figure 26 Modelled groundwater elevation (mAHD) at steady-state (pre-mining) 1/1/2017

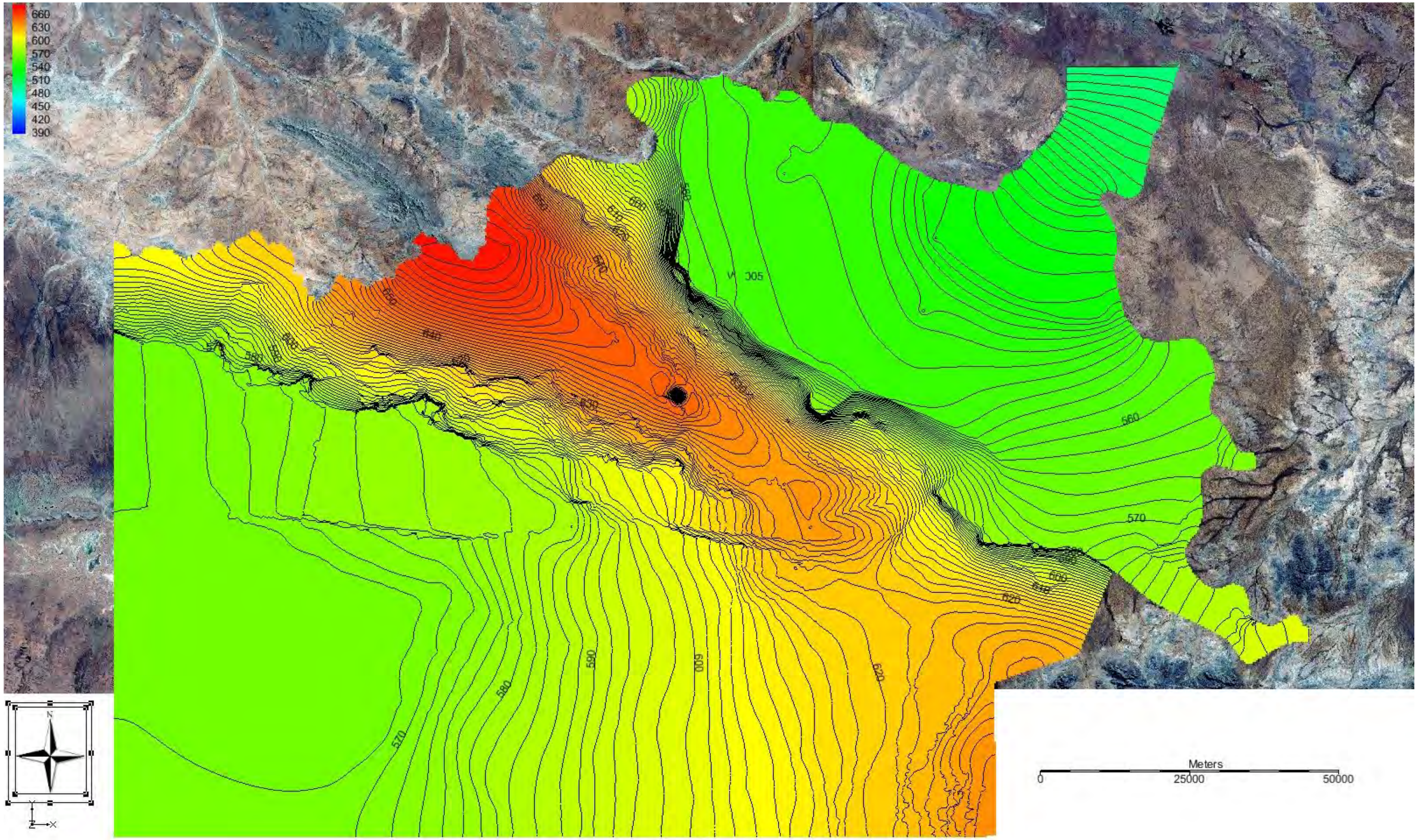


Figure 27 Modelled groundwater elevation at end of mining 1/1/2060

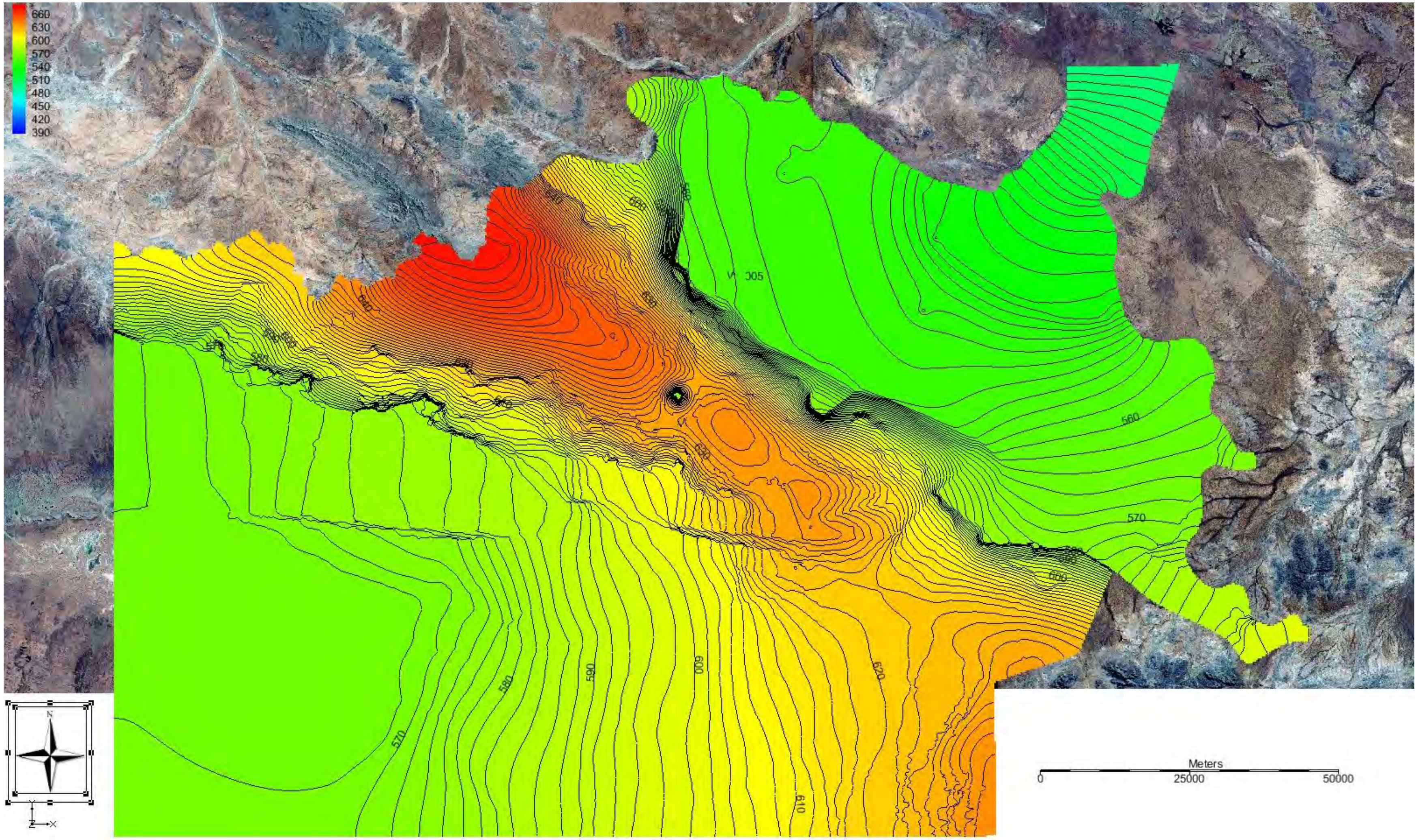
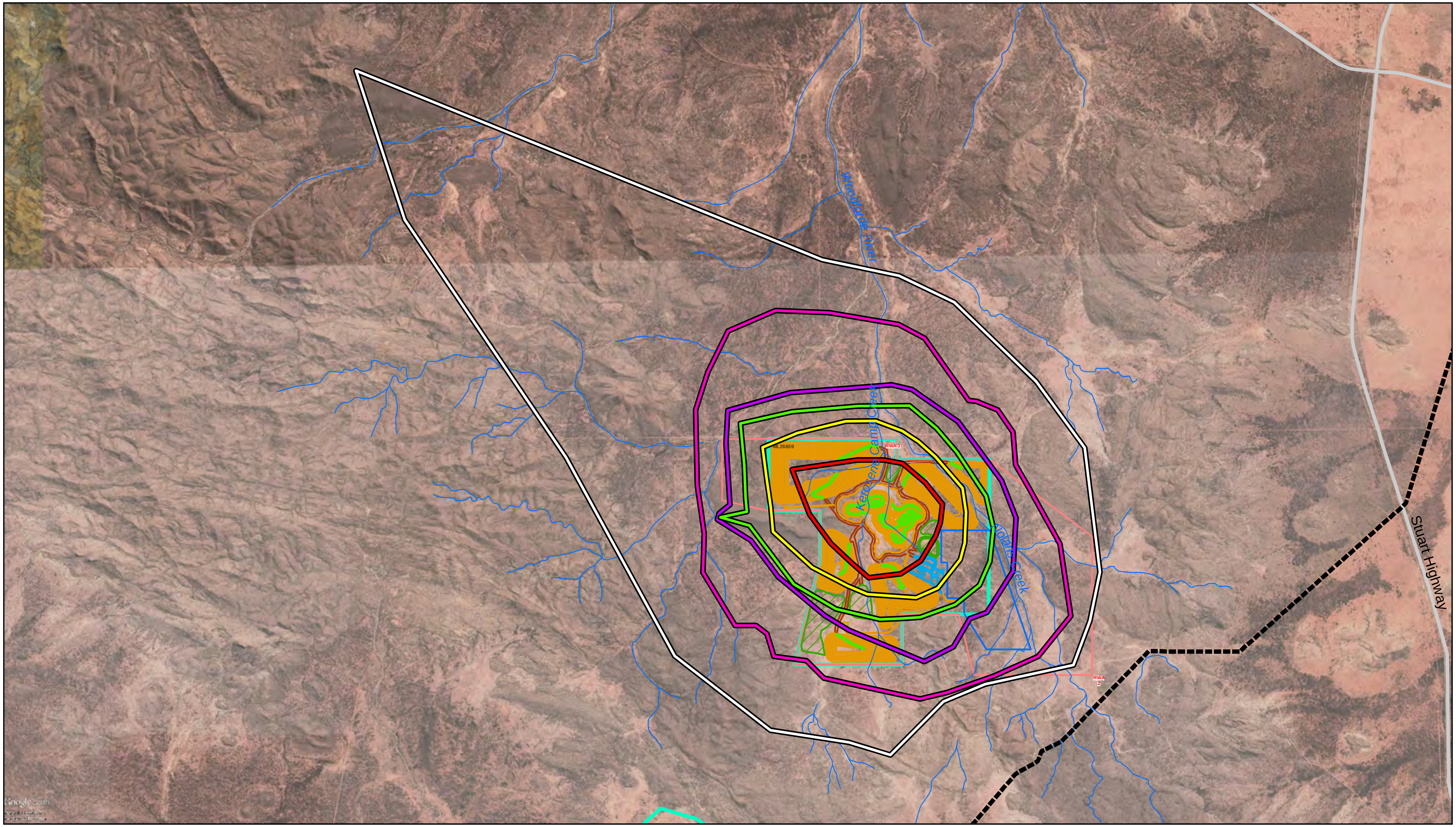


Figure 28 Modelled groundwater elevation 1,000-years after end of mining 1/1/3060



1:100,000 @ A4

0 1 2 3 4

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 53

N

LEGEND

- 2028: 10 years
- 2038: 20 years
- 2048: 30 years
- 2058: life of mine
- 2160: 100 years post closure
- 3060: 1000 years post closure
- Waterways
- Roads
- Proposed Mine Site Boundary
- Mineral Lease

Arafura Resources Limited
Nolans Project

Job Number 4322301
Revision 0
Date 22 Mar 2016

Modelled Pit Inflow Extent

Figure 29

G:\43\22301\GIS\Maps\4322301_606_InflowExtent.mxd

Level 5 66 Smith Street Darwin NT 0800 Australia T 61 8 8982 0100 F 61 8 8981 1075 E drwmail@ghd.com W www.ghd.com

Data source: Google Earth Pro - Imagery (Date extracted: 08/03/2016). ARL - Proposed Pipelines, Proposed Mine Site, Proposed Diversion Channel Options, Tailings Storage Facility (2015). Created by: CM

6.2 Drawdowns

A more detailed demonstration of the impacts at this scale is possible through examination of visualisation of the drawdown associated with mine and borefield groundwater extraction.

The drawdowns, for example in Layer 1, are provided for five key times:

- Commencement of mining 1/1/2020 (Figure 30)
- Approximately mid-way through mining 1/1/2040 (Figure 31)
- End of mining 1/1/2060 (Figure 32)
- 100 years of closure 1/1/2160 (Figure 33)
- 1,000-years of closure 1/1/3060 (Figure 34).

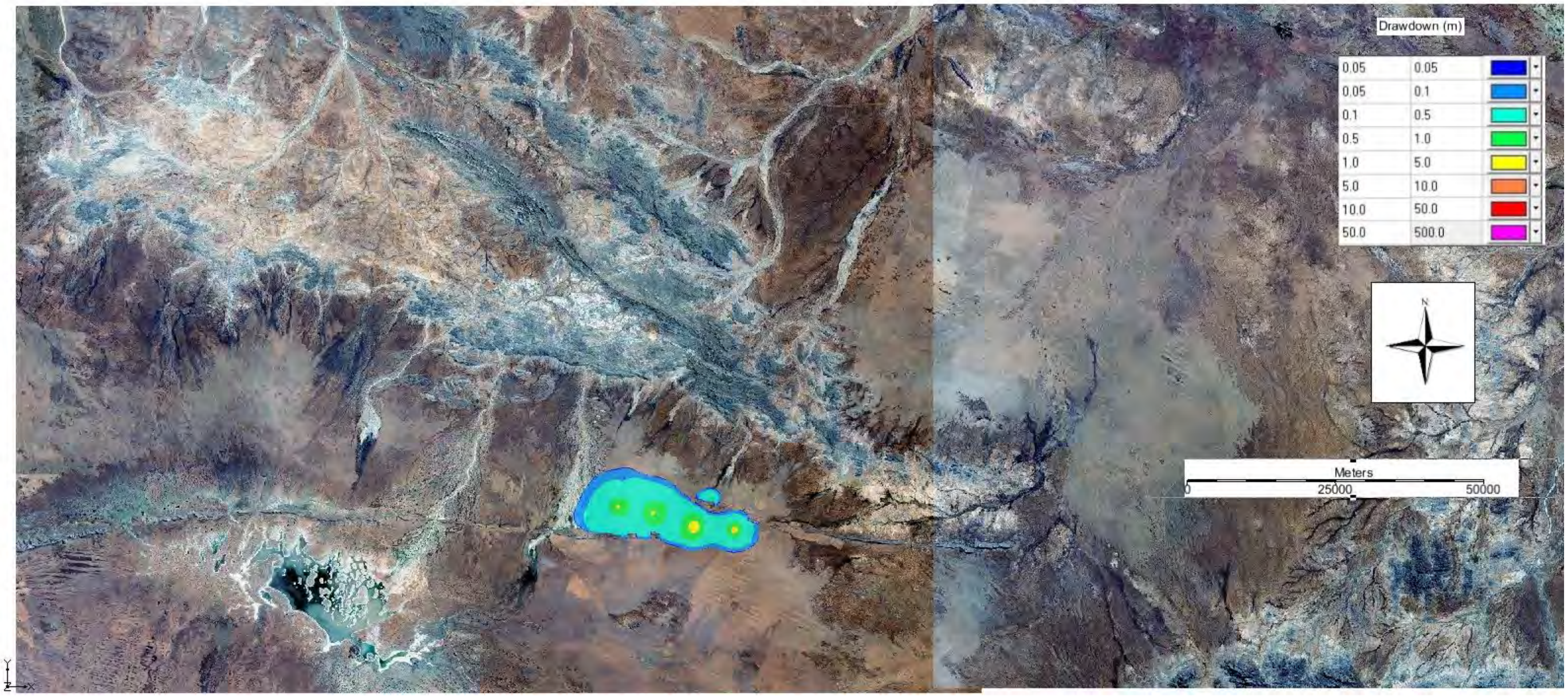


Figure 30 Modelled drawdown at commencement of mining 1/1/2020

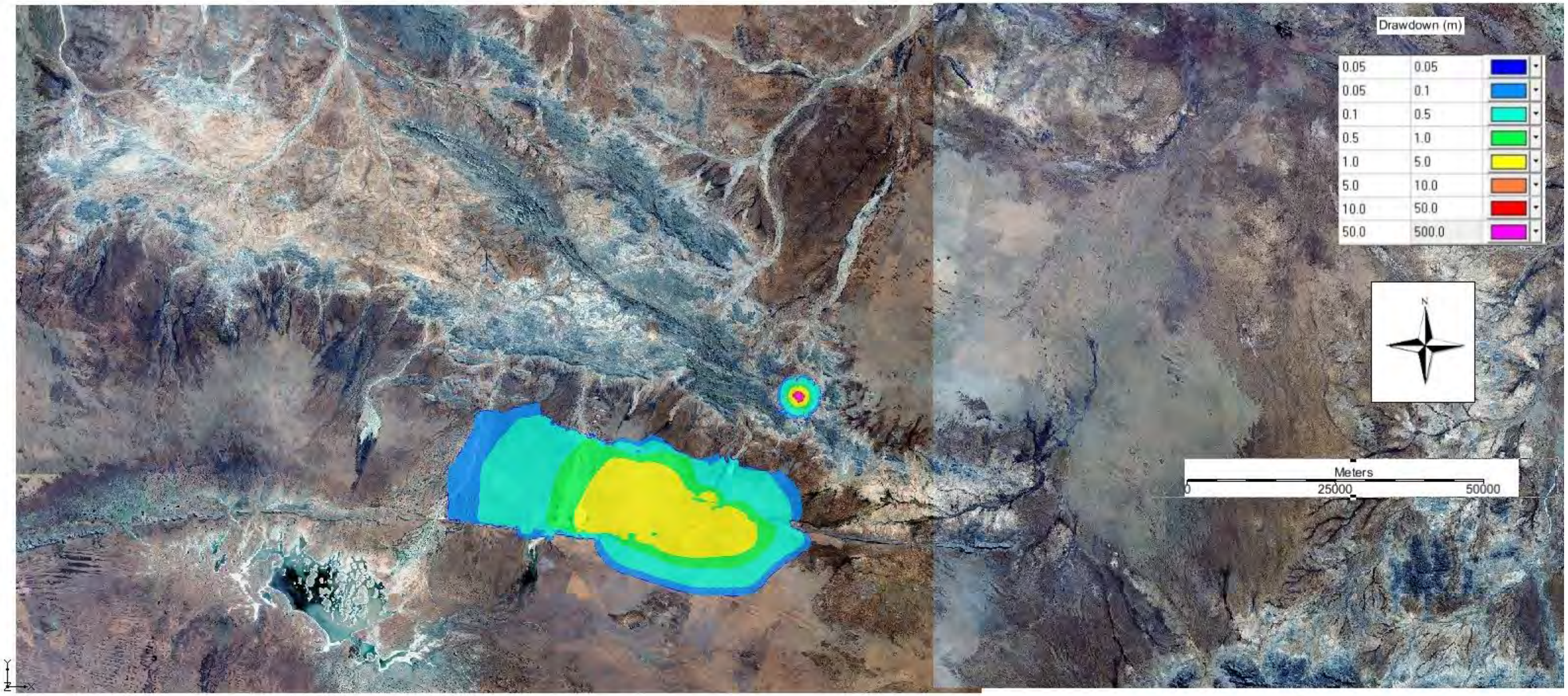


Figure 31 Modelled drawdown at approximately mid-way through mining 1/1/2040, 20 years after commencement of mining on 1/1/2020

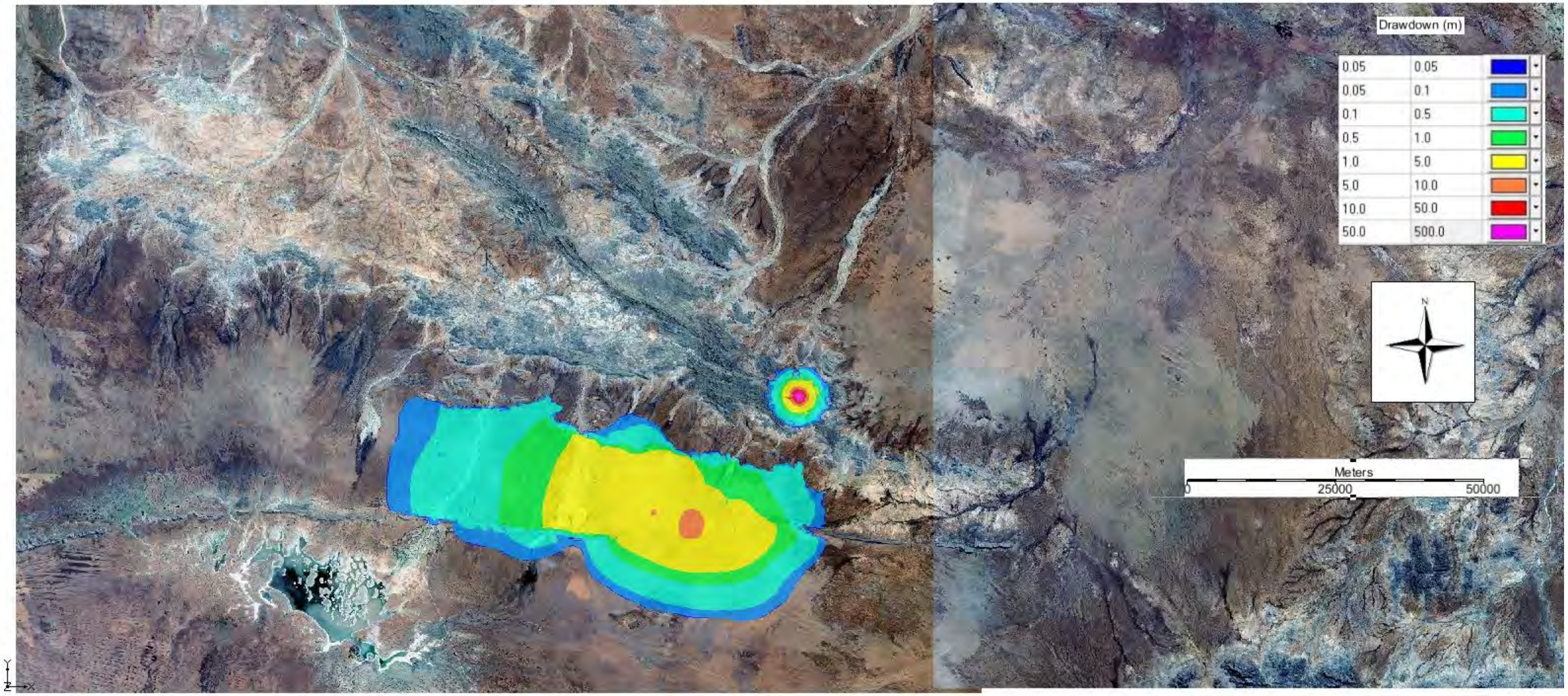


Figure 32 Modelled drawdown at end of mining 1/1/2060

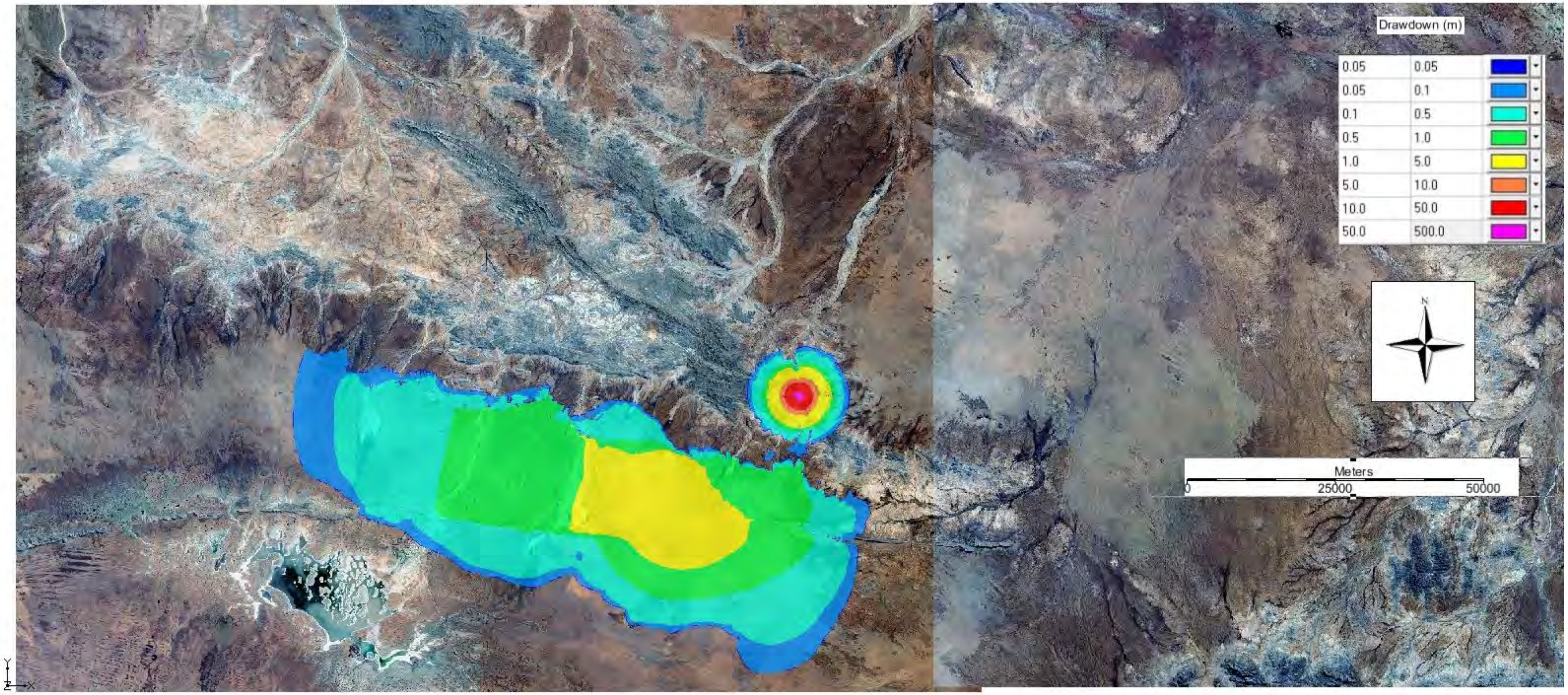


Figure 33 Modelled drawdown at 100 years of closure 1/1/2160

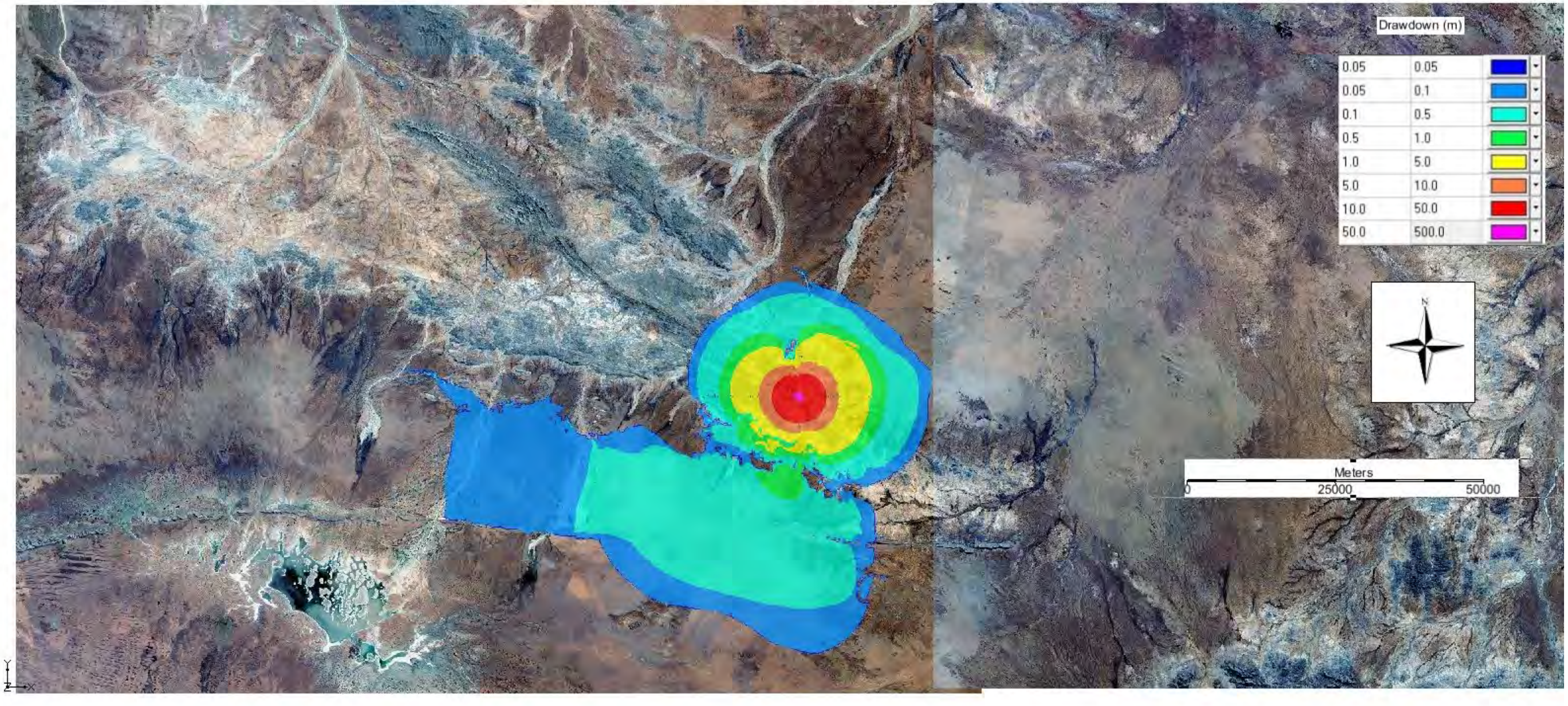


Figure 34 Modelled drawdown at 1,000-years of closure 1/1/3160

6.3 Mine area

The groundwater flow regime is predicted to significantly change in the mine area and result in a permanent sink (i.e. perpetually discharging low point) due to evaporation of pit water. Drawdowns are, as expected, very large at the pit site, reflecting pit levels during operation (i.e. as deep as 390 mAHD which equates to approximately 260 m of drawdown at the completion of mining), and then reflecting the pit lake levels (modelled levels at 575 mAHD which equates to approximately 80 m of drawdown) during closure as the water rebounds to a level where groundwater flow equates to evaporation (Figure 35).

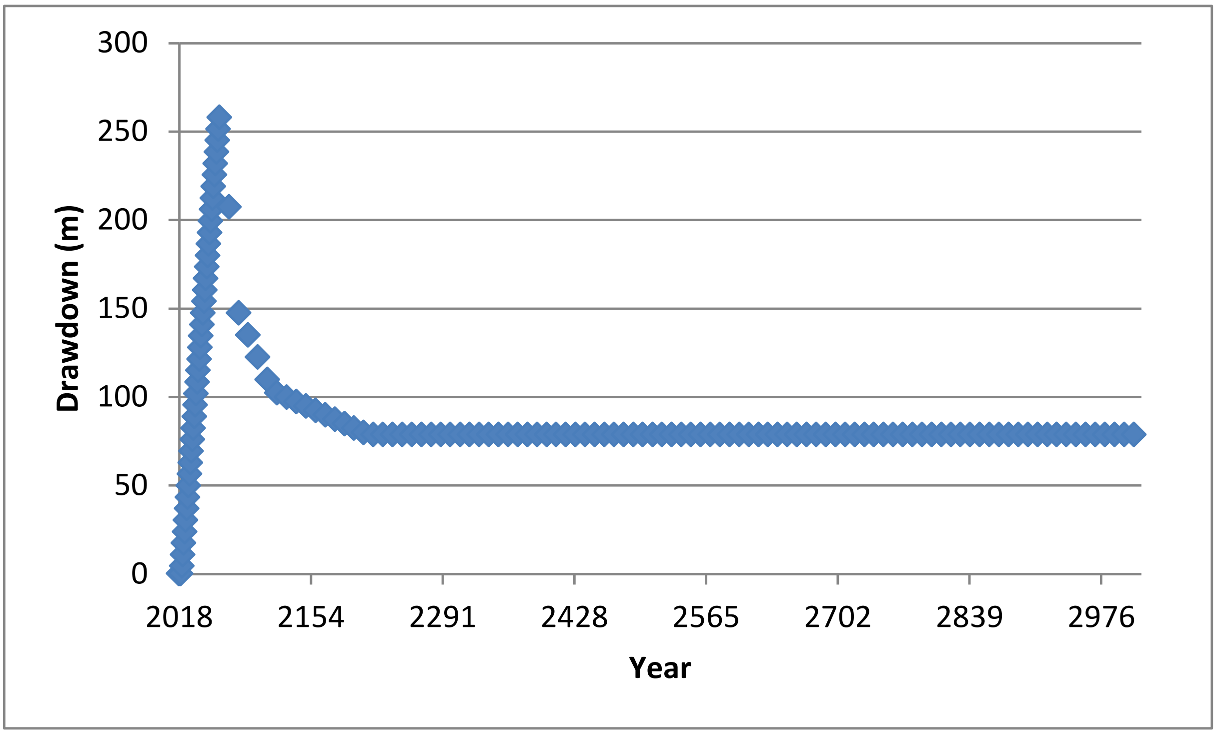


Figure 35 Modelled drawdown at the pit epicentre

Peak pit groundwater inflows (Figure 36) have been predicted at approximately 4000 m^3/day (46 L/s) and steady state post closure inflows at approximately 700 m^3/day (8 L/s).

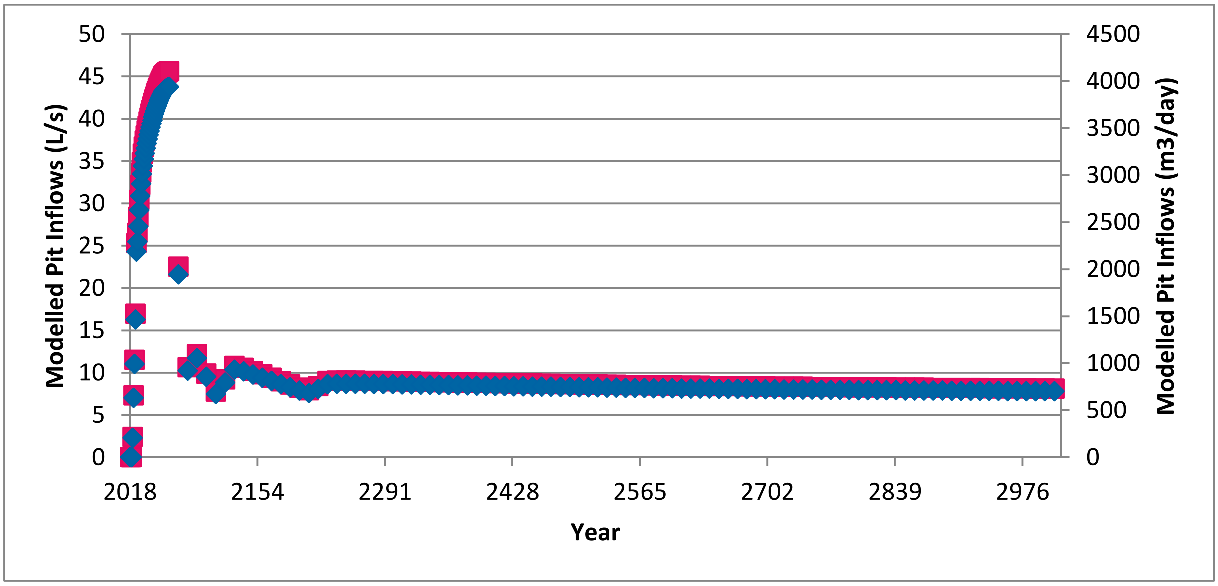


Figure 36 Modelled pit inflows

Although outside of the Ti-Tree Basin (but inside the surface catchments that flow towards the Ti-Tree Basin), technically this is could be considered abstraction from the Ti-Tree Water Control District.

6.3.1 Environment

Riparian vegetation

The riparian vegetation immediately adjacent to the mine area (both upstream to the point of the diversion and downstream in Kerosene Camp Creek to the confluence of Nolans Creek) is highly likely to be irreversibly impacted by the mining operations (i.e. riparian vegetation will die and not recolonise the area), and these conditions will persist beyond mining and into closure. The reason for this includes, but is not limited to:

- the difference in availability of surface water and therefore recharge to groundwater as well as water for direct contact with riparian vegetation (i.e. a section of the creek will longer exist and a section of the creek will be diverted)
- there will be no availability of groundwater within the drawdown cone.

It is reasonable to assert the impact will be greatest immediately adjacent to the pit and decrease radially with distance from the pit. A reasonable estimate for the downgradient extent of this based on the both the modelled drawdown cone and where Kerosene Camp Creek receives additional surface water flow from adjacent catchments (which is likely to in part mask this impact) is the confluence with Nolans Creek. This length of Kerosene Camp Creek beyond the mining area is less than 1 km. At this point (Figure 37) the groundwater model predicts a drawdown of only 2 m during mining but approaches 20 m in the long-term closure model (1,000-years). As discussed above this may be in part masked by recharge from continued surface water inflow beyond the confluence of Nolans Creek but this has not been explicitly incorporated into the modelling.

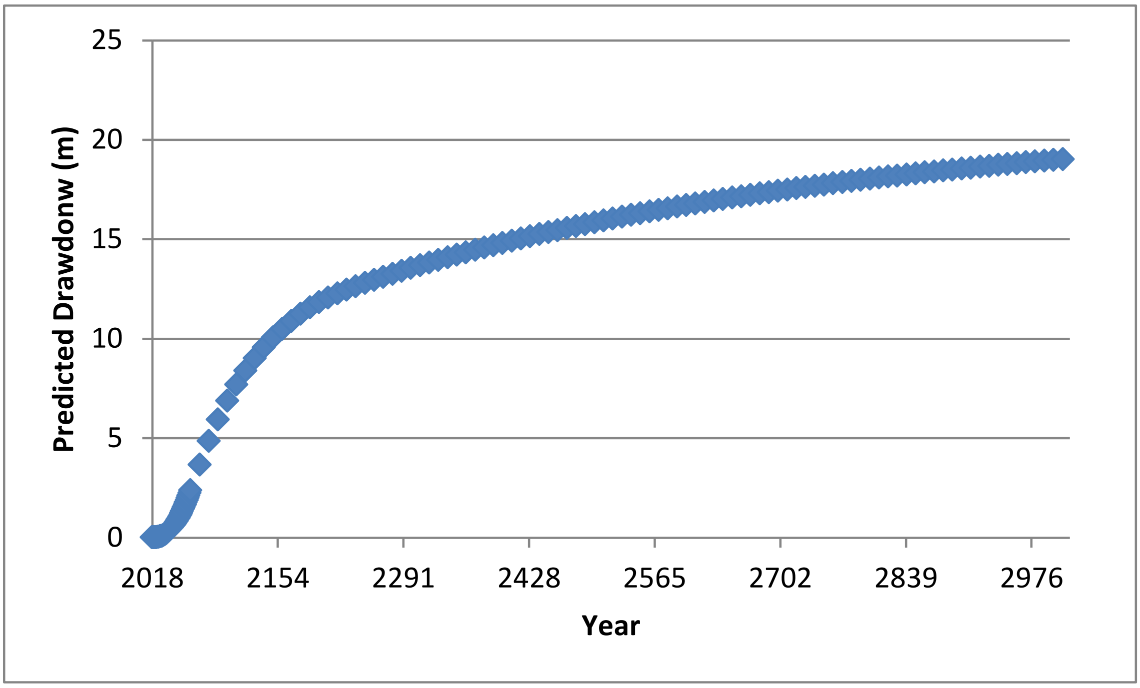


Figure 37 Predicted drawdown at Nolans Creek confluence (with Kerosene Camp Creek)

Due to the mine and diversion, there is one section of Kerosene Camp Creek with less catchment, however, due to the diversion linking back up with Kerosene Camp Creek, only a 6% decrease in the Kerosene Camp Creek catchment is available for surface water flow

(Appendix I in this EIS). Relative to the size of the Woodforde River catchment itself, there is only a minor change to the overall flow in the Woodforde River and highly likely to be no measureable change to surface water available to riparian vegetation along its course nor in subsequent recharge available to the Ti-Tree Basin.

The predicted groundwater drawdown at the confluence of Kerosene Camp Creek and its larger western branch is displayed in Figure 38. As discussed above, it is hypothesised that although this area has modelled drawdown in the long term, that the creeks in this area have continued surface water flow, this drawdown may be masked by this recharge.

Excluding the potential masking effects of continued surface water flow, the predicted groundwater drawdown at the confluence of Kerosene Camp Creek and the Woodforde River (within the Ti-Tree Basin) is displayed in Figure 39.

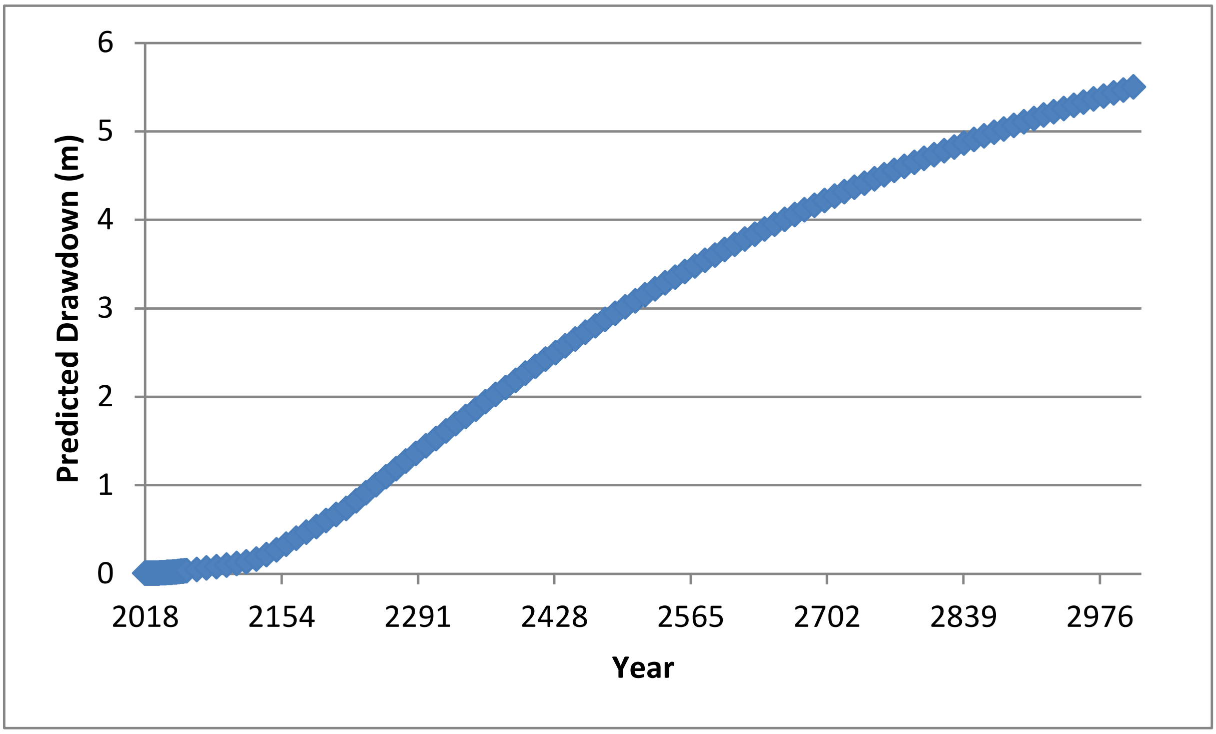


Figure 38 Predicted drawdown at the confluence of Kerosene Camp Creek and its larger western branch

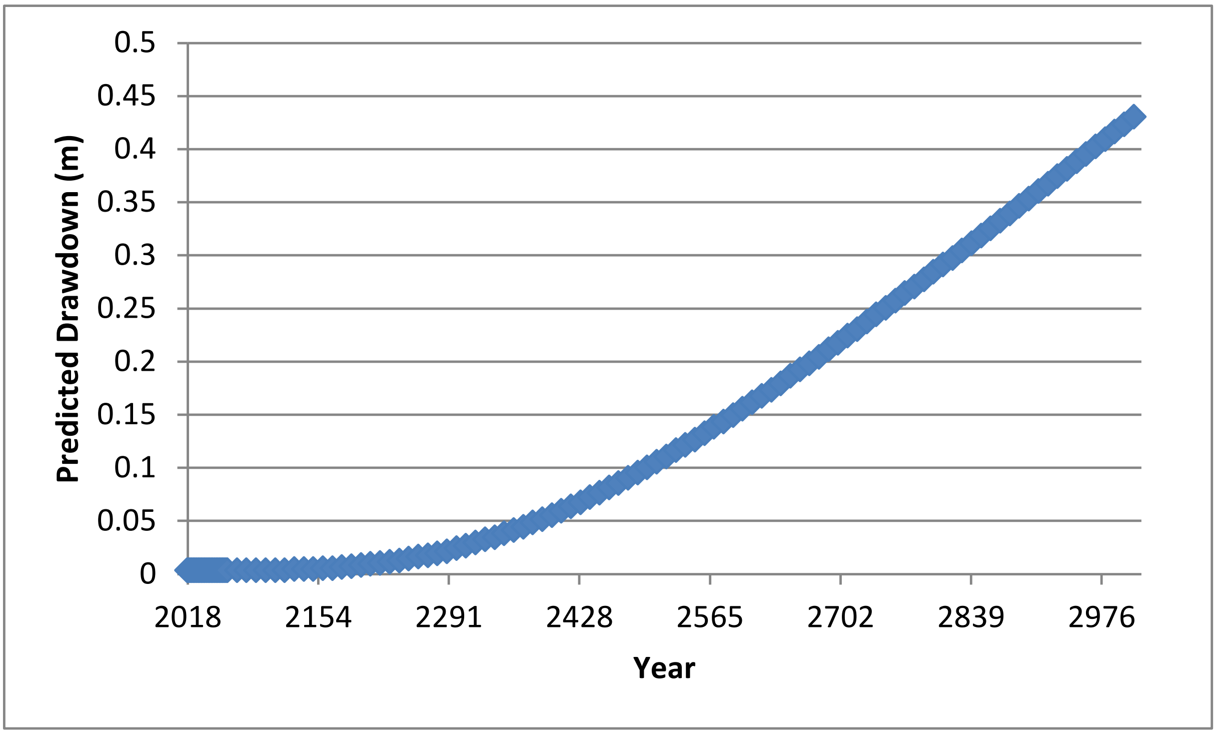


Figure 39 Predicted drawdown at Woodforde River confluence (with Kerosene Camp Creek)

Floodout vegetation

No floodout areas within the Ti-Tree Basin will be impacted by groundwater abstraction in the mine area. The important Allungra Creek floodout is in a different catchment to the mine area and the modelled groundwater drawdown is well away from the area. Any surface features such as roads should be designed in manner that they allow features such as the Allungra Creek to behave in similar manner as they currently do to ensure recharge still occurs as is currently does.

A key measure of availability of groundwater for riparian floodout vegetation areas within Ti-Tree Basin, within the model, is the impact to groundwater available for evapotranspiration. Using this measure, a peak of 5% change in evapotranspiration across the basin was modelled (at the end of the 1,000-year closure period) representing a peak change of 4 m^3/day (0.05 L/s). Of all the model outputs, evapotranspiration is considered to be the least reliable, however this does demonstrate a degree of change to the system dynamics which helps inform this assessment.

Outside of the Ti-Tree Basin in the basement rocks, the modelled groundwater available for evapotranspiration (excluding the pit waters) decreased by a peak of 8% at 119 m^3/day (1.4 L/s). No modelled change was observed in the Margins area, and this is expected as the model indicates no groundwater is available for evapotranspiration (i.e. at depths of 1.5 m or less) under normal conditions.

Stygofauna

No stygofauna were observed during a targeted survey within the footprint of the mine (GHD, 2011). Likewise, the presence of stygofauna outside of the mine footprint but within the modelled drawdown cone has not been confirmed, with reference sites outside the mine footprint examined during GHD (2011) also returning no stygofauna. The most likely potential habitat for stygofauna in this zone are the alluvials and calcretes, which are not believed to be perennially saturated in this area. Considering this, any stygofauna present in this zone would therefore need to be species able to aestivate between rainfall events and groundwater drawdowns are therefore less likely to impact them. Beyond the influence of the cone, there are likely to be no impacts to stygofauna.

6.3.2 Water Users

Stock use

Groundwater at the mine site area is currently used for stock watering (primarily cattle) on Aileron Station from a localised aquifer. Environmental Earth Sciences (2011) and interpretation of the groundwater analyses undertaken by Ride (2016) indicate this water is not suitable for stock watering currently.

This localised aquifer, largely confined to the orebody, will be totally dewatered during mine operations and in its place the pit void will be unsuitable for stock watering. Aileron Station water supplies near the pit location will be impacted by the proposed mine dewatering and remain impacted beyond mine closure. Beyond the pit and mining area it is conceivable that local resources in the basement aquifers and adjacent materials may be impacted due to the pit void limiting flowthrough beyond closure relative to the pre-mining conditions. From a drawdown perspective, the impacts at existing bores are likely to be minor in the long term but no existing bores are likely to be materially affected by mine drawdown during their anticipated operational life.

Pine Hill Station also uses groundwater for stock water from bores as close as the Kerosene Well area, 8 km downstream of the mining lease (bores RN010759 and RN012624). The groundwater modelling indicates that this area is beyond the cone of depression during mining (Figure 40), however, it is conceivable that these local resources may be impacted due to the pit void limiting flowthrough beyond closure relative to the pre-mining conditions. The groundwater modelling predicts no impact at the Pine Hill Station Homestead and nearby outstation.

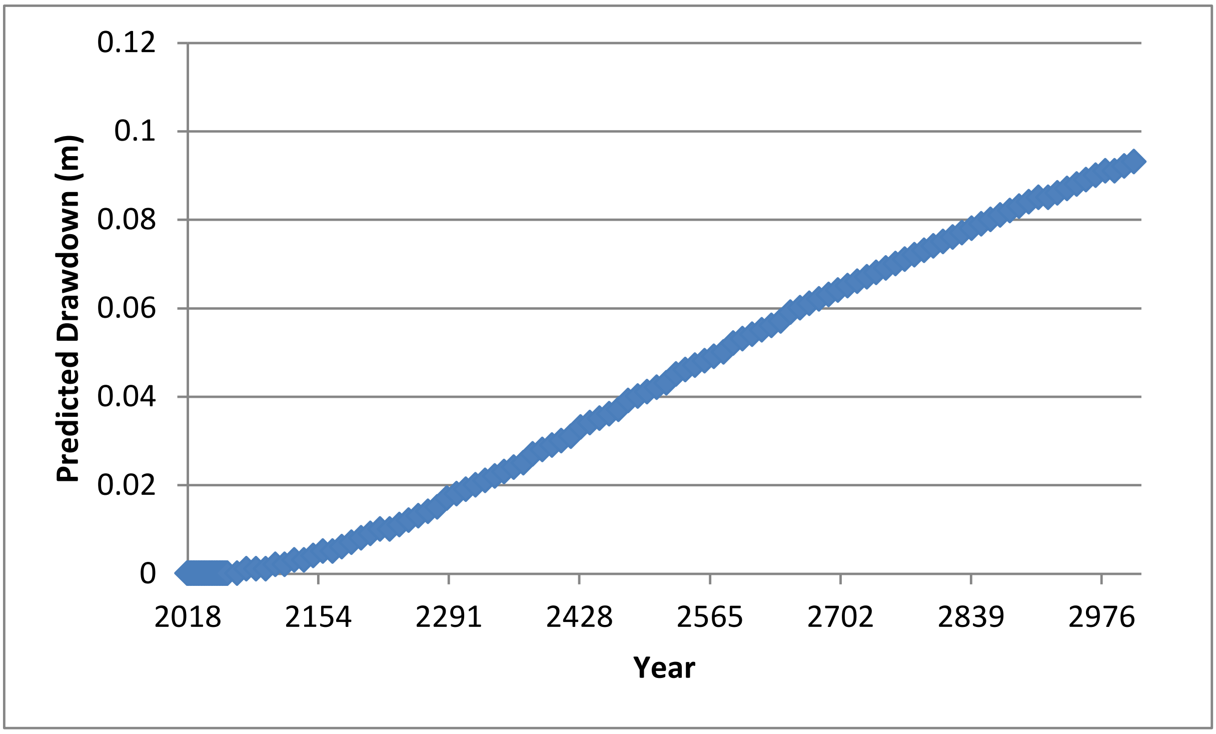


Figure 40 Predicted drawdown at the closest Pine Hill Station bores (RN010759 and RN012624)

Groundwater availability for stock use within the Ti-Tree Basin itself is highly unlikely to be measurably impacted. A key measure of impact or availability within Ti-Tree Basin within the model is the impact to flowthrough (i.e. the outflow to the north at the General Head Boundary). Despite the 8 L/s of long-term modelled pit inflow, there was no significant change in the Ti-Tree outflow (i.e. the modelled outflow only decreased by 0.03% representing a peak change of 4 m^3/day or 0.05 L/s at the end of the 1,000-year closure modelled period). The other important measure is that the remainder of the groundwater comes out of storage within the basement rocks and a minor component from the Ti-Tree Basin itself. The Ti-Tree Basin and basement modelled flows out of storage related to the proposed mine are presented in Figure 41 and Figure 42 respectively. Figure 41 and Figure 42 demonstrate the primary source of the water is from the basement rocks and only a minor proportion is from the Ti-Tree Basin. The net loss of water from storage within the Ti-Tree Basin (including its basement rocks) was modelled at approximately 8 m^3/day (0.1 L/s or 3 ML/year) during mining increasing to 37 m^3/day (0.4 L/s or 13 ML/year) at the end of the 1,000-year closure modelled prediction.

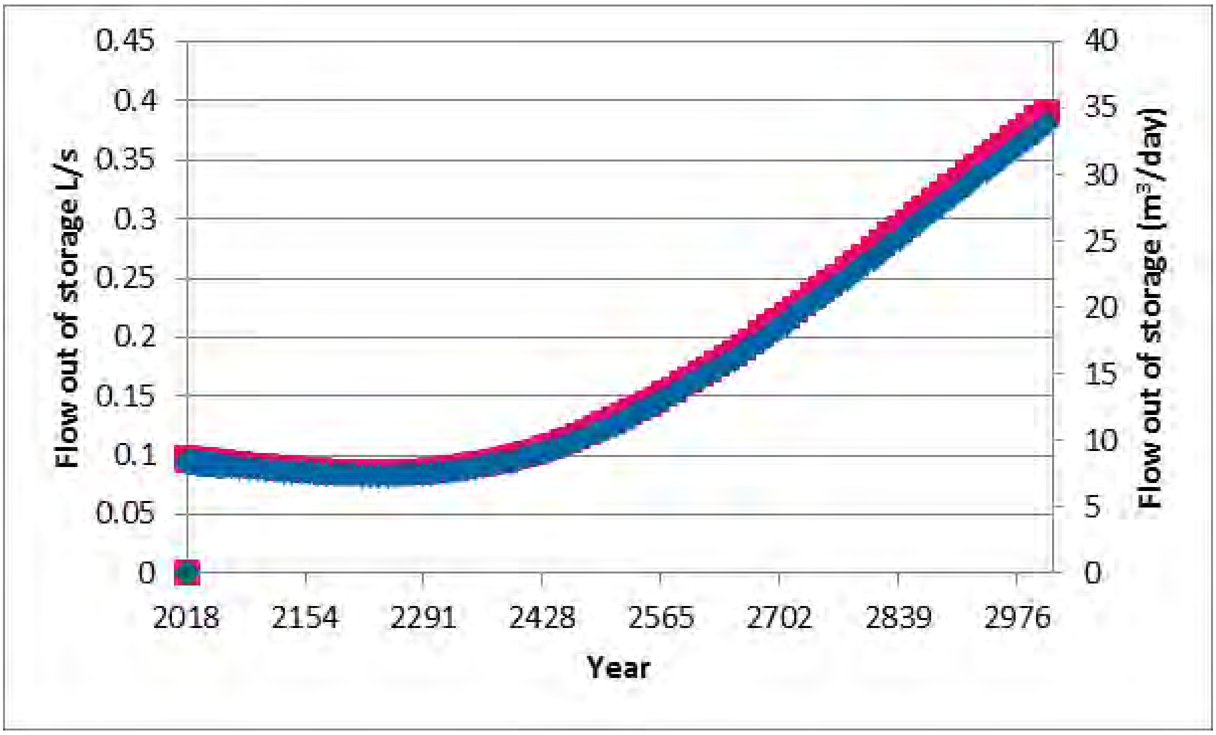


Figure 41 Loss from storage within the Ti-Tree Basin

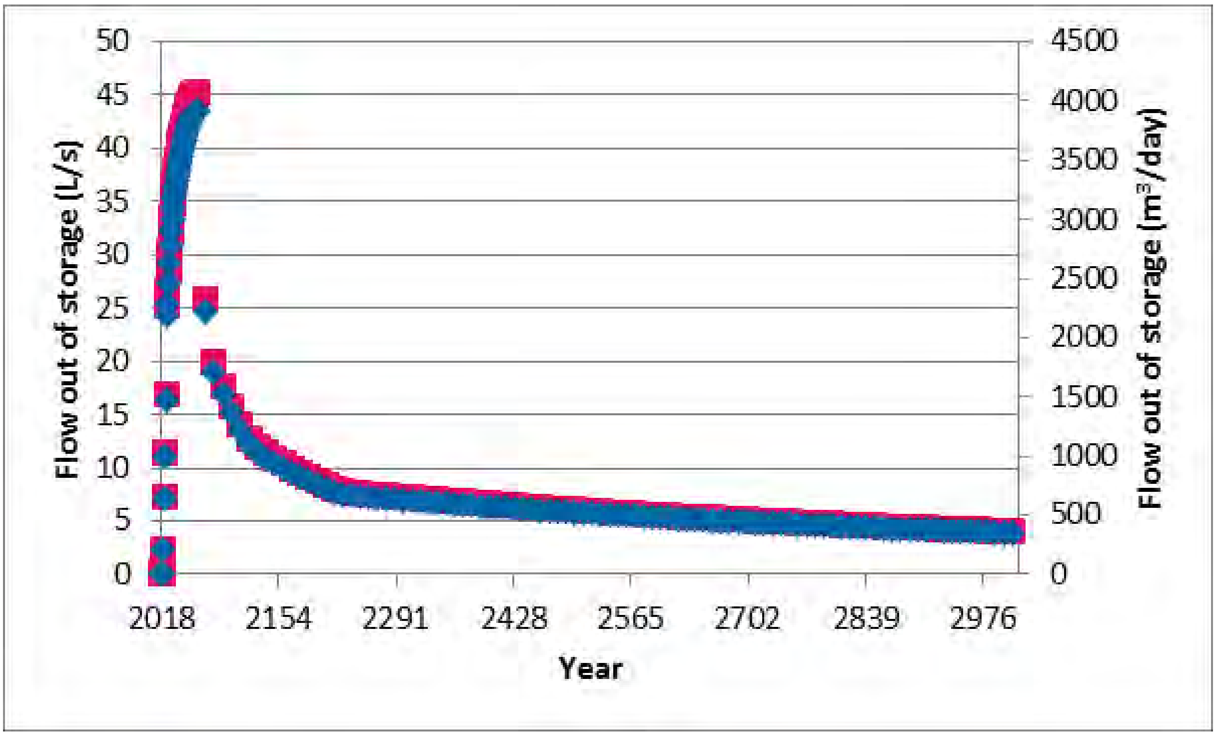


Figure 42 Loss from storage within the Basement

Irrigation for horticulture and viticulture

Groundwater availability for irrigation for horticulture and viticulture within the Ti-Tree Basin is highly unlikely to be measurably impacted. The same measure for water availability for stock water use has been applied to water availability for irrigation for horticulture within the Ti-Tree Basin.

The groundwater modelling indicates that, for example, the Ti-Tree Farms area is beyond the cone of depression during mining (Figure 43), and beyond any measureable drawdown impact during the 1,000-year closure modelled period.

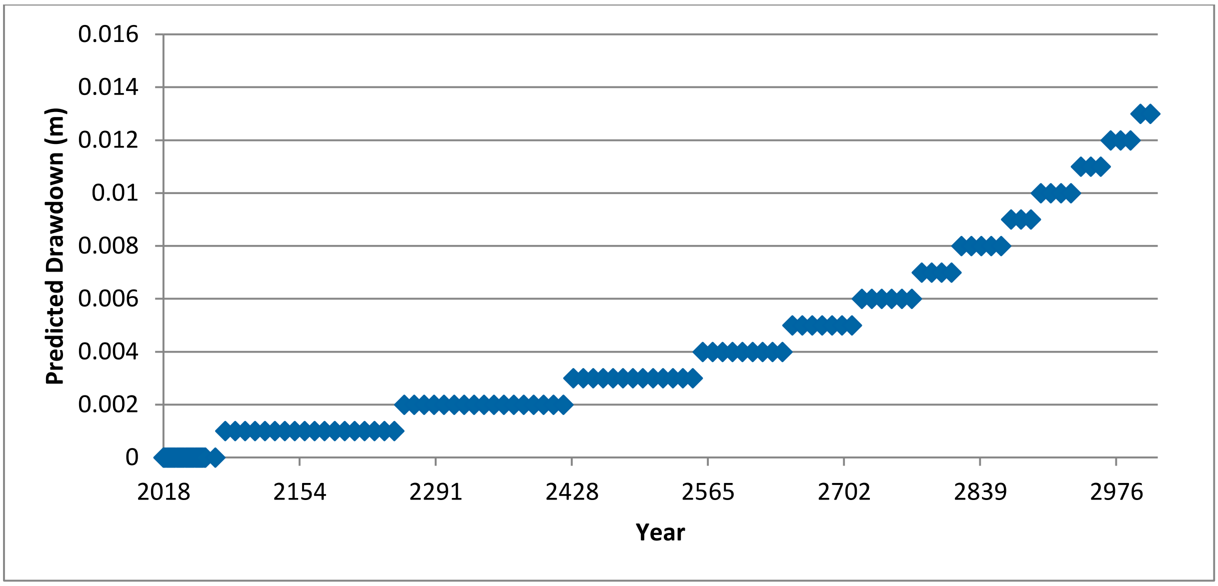


Figure 43 Predicted drawdown at Ti Tree Farms

Other groundwater users are at comparable distances or further from the pit (both geographically and hydrogeologically) so should therefore expect similar or even less impact from the mine.

Drinking and domestic water

Like the above uses, drinking water supplies within the Ti-Tree Basin including those at Pmara Jutunta, private farms and station homesteads are not likely to be impacted by drawdown associated to the proposed mine dewatering.

There are no drinking water users in the mine area and existing groundwater is not of a quality that drinking water could be a future beneficial use.

It is understood that drinking water for Aileron Station Homestead, Aileron Roadhouse and Alyuen Community is currently sourced from the Southern Basins. This source is beyond the reach of the impact of the mine but is discussed later in the borefield assessment (Section 6.4.2).

At the location of existing basement bores in the Alyuen Community and the Aileron Station Homestead and Aileron Roadhouse area, that may have previously been used for drinking water, groundwater levels may be impacted in the long term by mine drawdown (Figure 44 and Figure 45). It should be noted that these waters are not currently considered to be of a quality to have a beneficial use as drinking water.

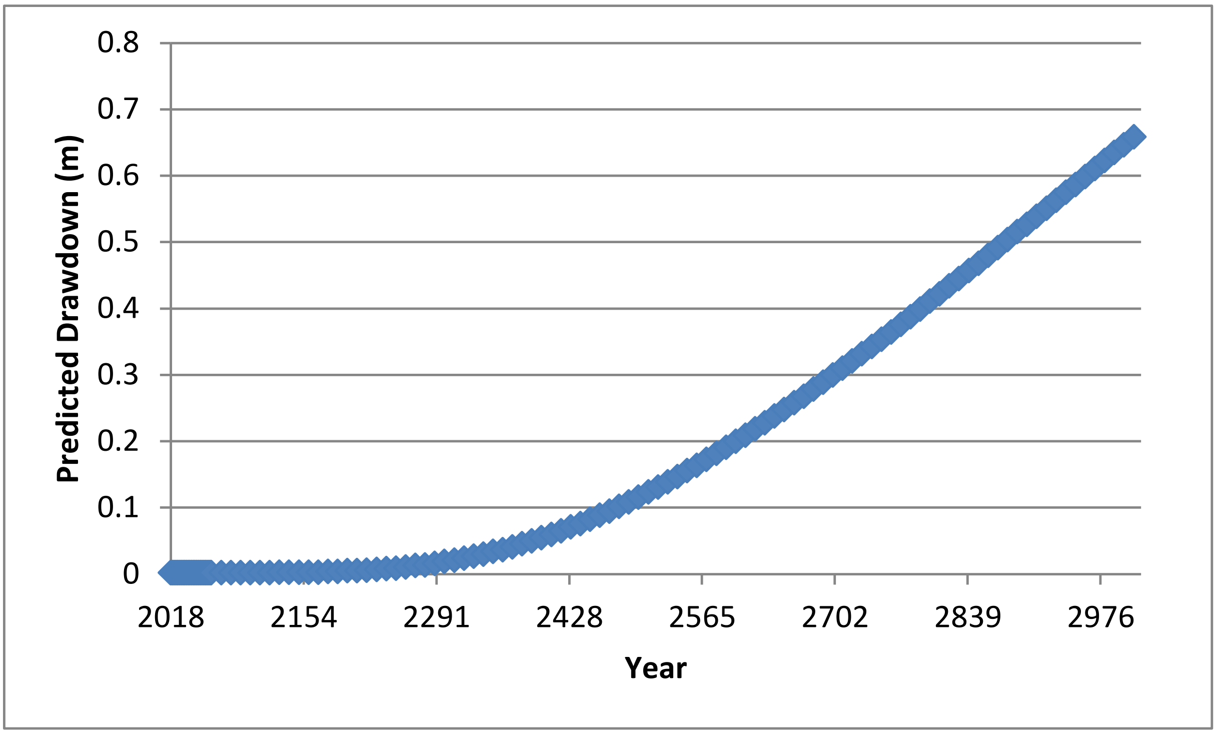


Figure 44 Predicted drawdown at Aileron Station Homestead and Aileron Roadhouse area)

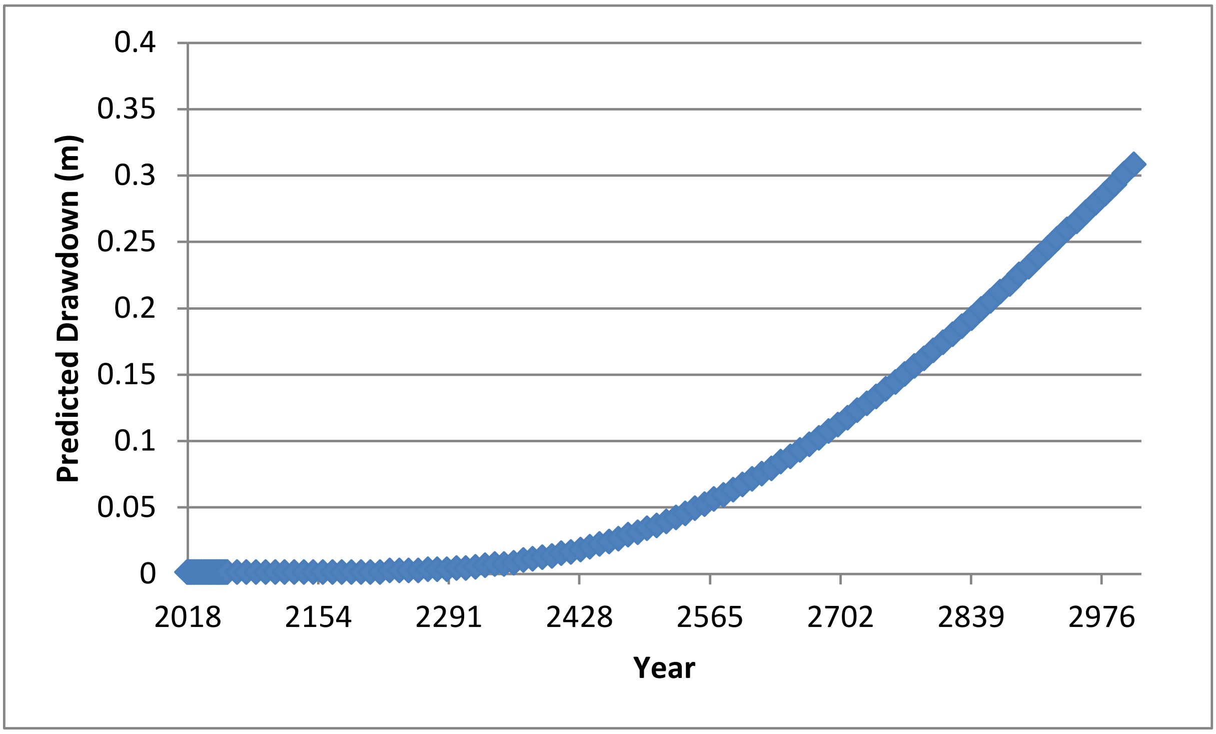


Figure 45 Predicted drawdown at Alyuen community

6.4 Southern Basins borefield

Modelled drawdown in the water table from the operation of the Southern Basins borefield peaks at approximately 6 m (Figure 46) in the centre of the borefield (7 m within the cell containing the modelled well SB022). This excludes actual drawdowns within the operating bores which is more likely to be a coupled function of bore efficiency as well as aquifer drawdown. The drawdown-rebound is a typical log-linear response to aquifer pumping and recovery. Further away the response varies (as expected) and results in a far slower response to recovery (i.e. Figure 47 and Figure 48). This is a function of the aquifer size, material properties and the limited modelled recharge applied.

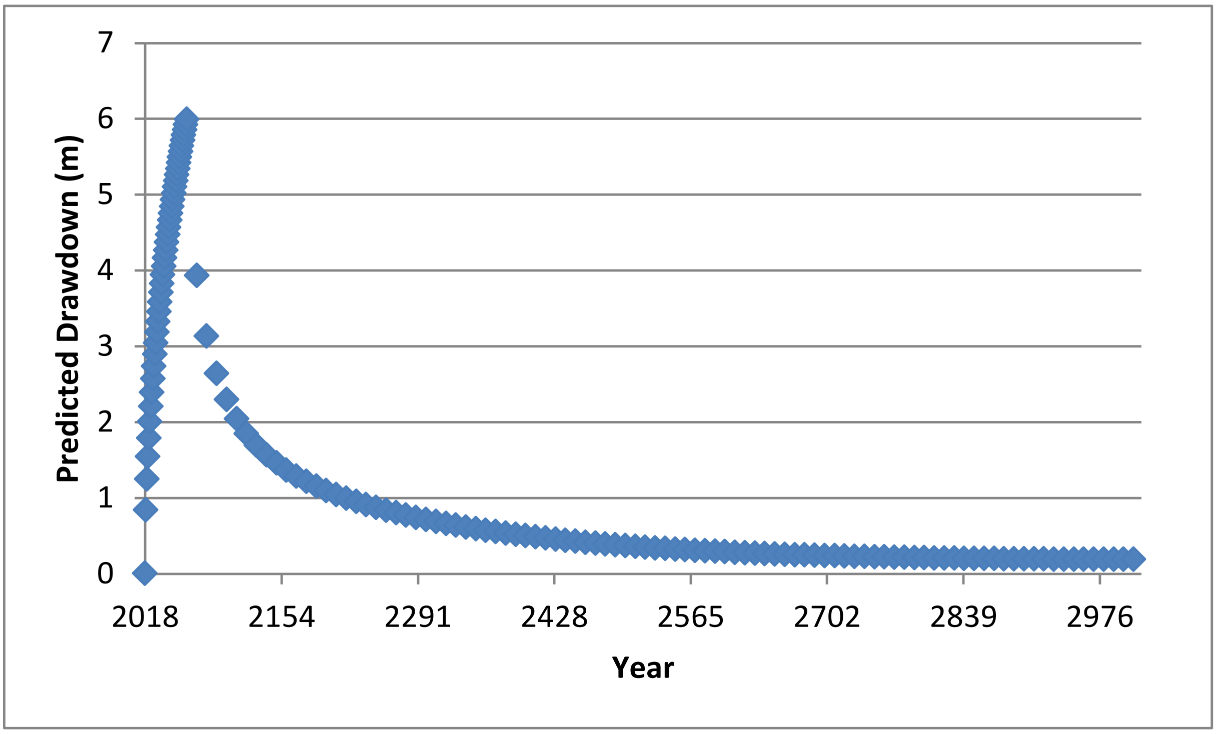


Figure 46 Predicted drawdown at Southern Basins borefield epicentre

6.4.1 Environment

Riparian vegetation

Day Creek

Modelled drawdown from the borefield peaks in the order of 1.5 m in the vicinity of Day Creek (Figure 47) and rebounds rapidly once pumping ceases. If vegetation is currently dependent on the groundwater at these locations, based on watertable level observations (of approximately 28 m below top of collar) in the adjacent SB0026 (RC00026 RN19038), tree roots must be capable of extracting water from greater than 20 m deep, even accounting for the river bank and collar heights. If vegetation is capable of extending its root systems to such depths it is hypothesised that it is reasonable to expect that it could gradually extend its root system a further 1.5 m over the predicted drawdown period during mining.

There are no planned surface works in the Day Creek catchment that are likely to affect the recharge to either the surficial alluvials or the deeper aquifer material. If the vegetation is reliant on shallower or more temporary sources of water, there is no indication that there are any works proposed (including pumping of the borefield) that would alter these conditions.

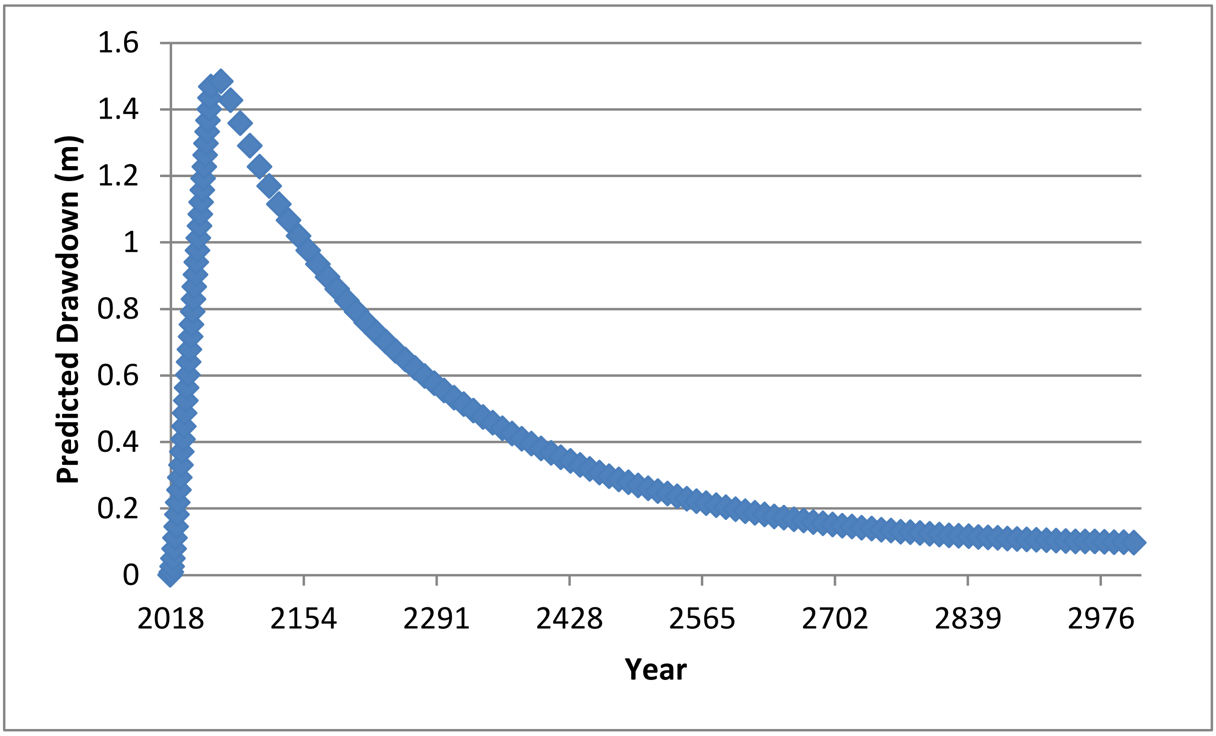


Figure 47 Predicted drawdown at Day Creek

Napperby Creek

Like Day Creek, there are no planned surface works in the Napperby Creek catchment that are likely to affect the recharge to the area. However unlike Day Creek, the modelled drawdown cone does not extend with significant magnitude to the Napperby Creek area during mining operations, but doubles in magnitude in the approximately 50 years following closure (Figure 48) as the aquifer recovers at the centre and extends laterally. The magnitude is half that predicted at Day Creek but the duration to reach it is twice as long, therefore it is reasonable to assert that even less impact (if any) is expected at Napperby Creek.

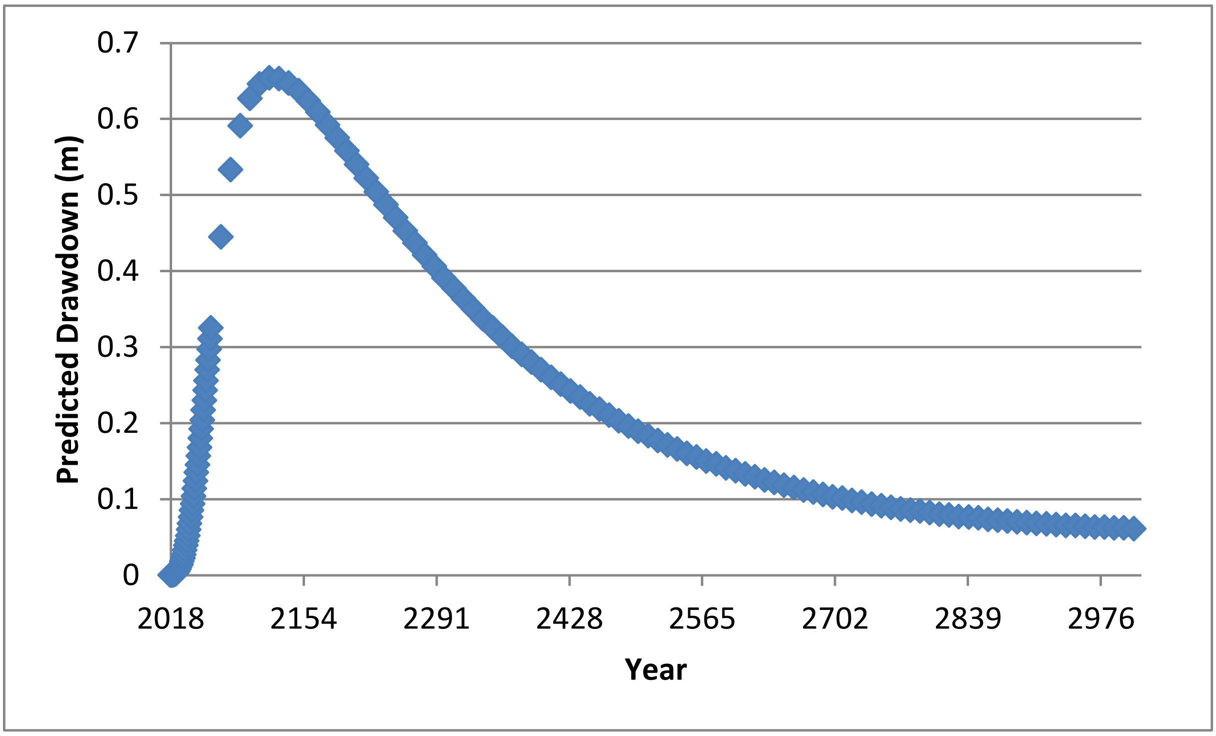


Figure 48 Predicted drawdown at Napperby Creek

Floodout vegetation

In the Southern Basins, there may be minor localised impacts to floodout vegetation and or soaks due to a decrease in groundwater availability for evapotranspiration. The impact will be determined by the current groundwater dependence and how the difference in availability of groundwater affects floodout vegetation and soaks. Given the scale of distance, the minor drawdowns predicted, the percentage differences in groundwater available and the gradual nature of the predicted changes, it is assumed that this impact will be negligible.

In the Reaphook Palaeochannel area of the Southern Basins the modelled difference in groundwater available for evapotranspiration peaks at approximately 100 years after closure. This is well after the pumps in the borefield in the modelled scenario have ceased but corresponds with the period the drawdown cone is still expanding laterally but decreasing in its vertical extent at the epicentre.

The peak decreases in groundwater availability for evapotranspiration in the Reaphook Palaeochannel area is 12% or 306 m^3/day (3.5 L/s) and this rebounds to approach steady state at a decrease of approximately 1% or 31 m^3/day (0.35 L/s).

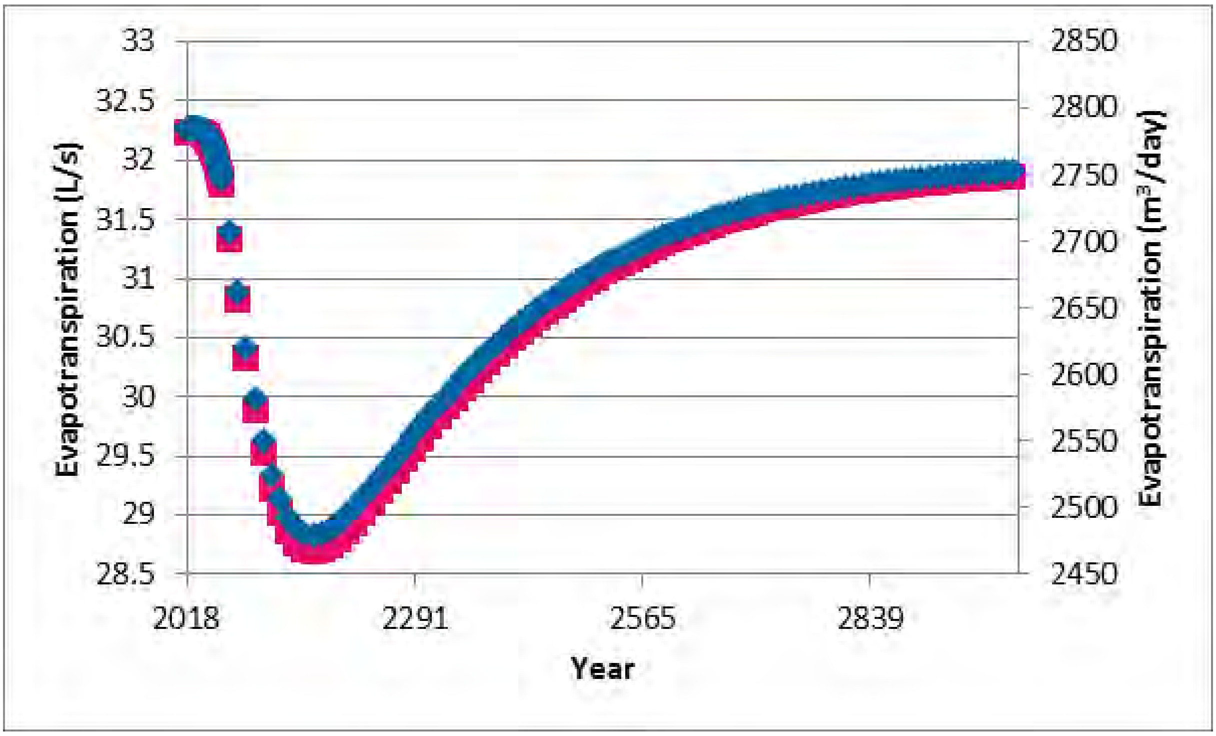


Figure 49 Modelled groundwater availability for evapotranspiration in the Reaphook Palaeochannel area of the Southern Basins

Beyond the model area, the impact to the groundwater resources of the Reaphook Palaeochannel (i.e. volume of groundwater available for flow through) can be further assessed by examining the modelled impact to the general head boundary. The modelled groundwater available for flowthrough decreased by a peak value of 259 m^3/day (3 L/s) or by 2% coinciding with the pumping period (Figure 50) and this rebounds to a decrease of approximately 27 m^3/day (0.3 L/s) or by 0.3%.

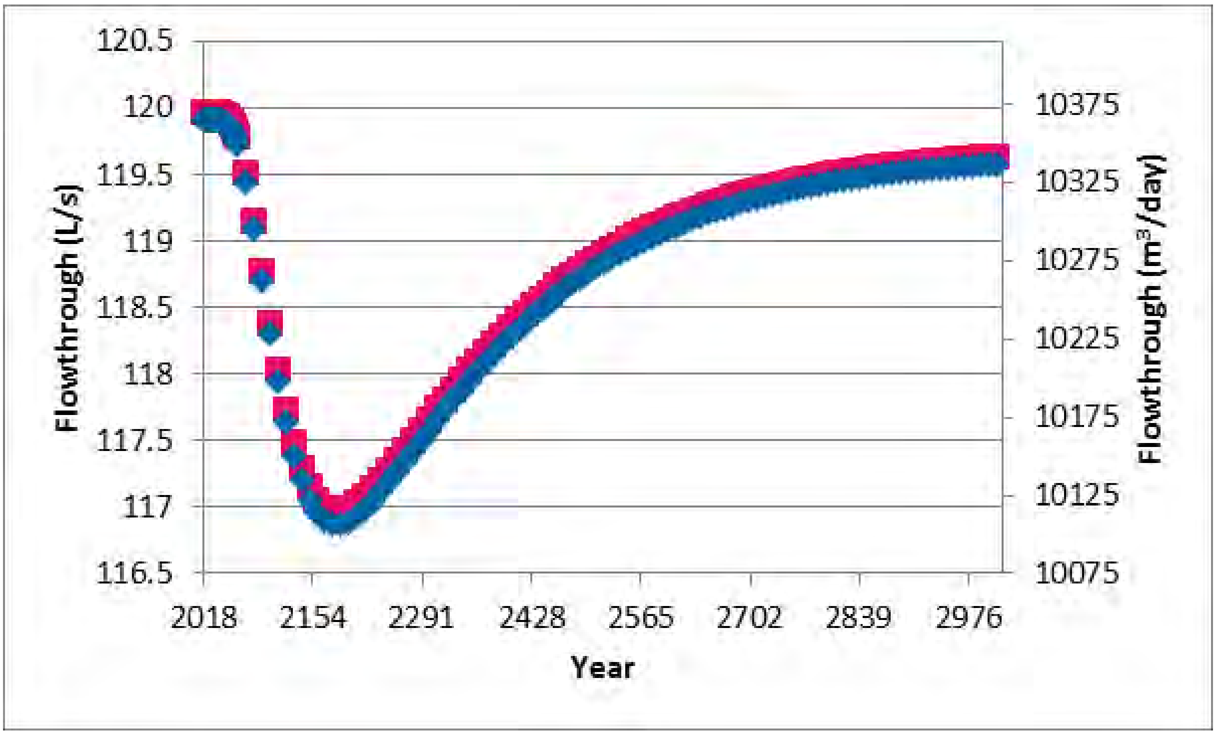


Figure 50 Modelled groundwater availability for flowthrough westward in the Reaphook Palaeochannel area of the Southern Basins

Lake Lewis and surrounds

The key indication for impact to Lake Lewis is whether the area is within the modelled drawdown cone but also if modelled net discharges to the area are affected.

The predicted drawdowns are negligible in the Lake Lewis area and not likely to be measureable. Despite this, the groundwater available for evapotranspiration, like in the Reaphook Palaeochannel area to the north, is likely to be impacted in the Lake Lewis area. The peak decreases in groundwater availability for evapotranspiration in the Lake Lewis area of the Southern Basins is 3% or 712 m^3/day (8 L/s) and this rebounds to approach steady state with a decrease of approximately 0.5 % or 103 m^3/day (1 L/s).

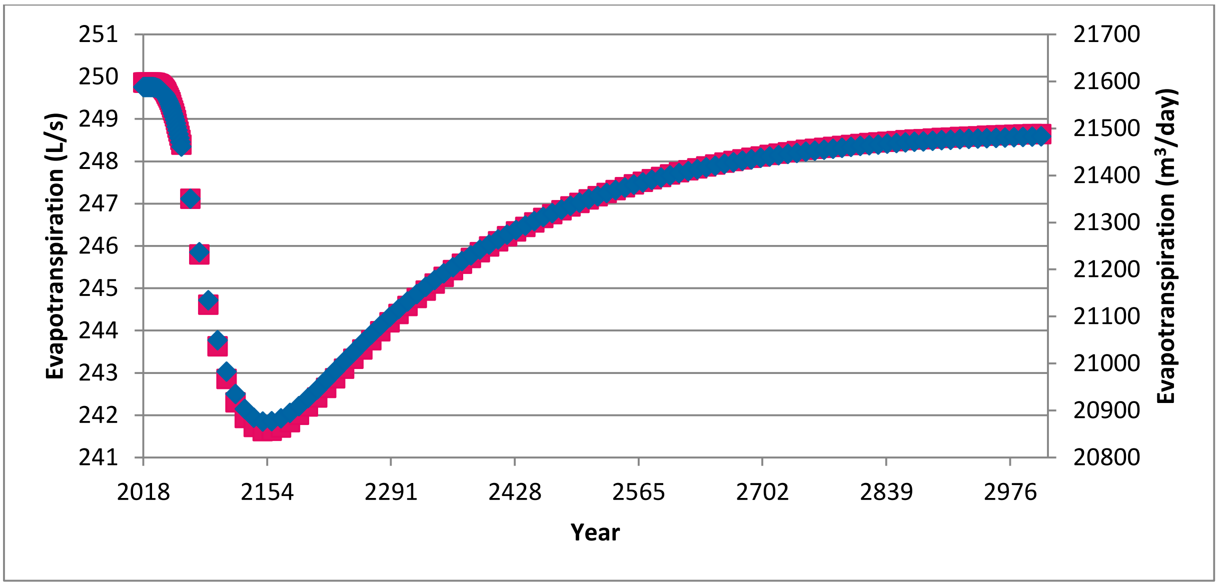


Figure 51 Modelled groundwater availability for evapotranspiration in the Lake Lewis area of the Southern Basins

Rock-holes

There are no conceivable impacts to water bodies in basement rock-holes along drainage lines or in depressions in the outcropping rock mass because they are perched in the bedrock watertable and there is no conceivable change to bedrock permeability associated with the proposed activities.

6.4.2 Water users

Stock use

Groundwater in the Southern Basins and Margins Area is currently used for stock watering (primarily cattle) on Aileron Station, Napperby Station, and to the south Yambah Station and Amburla Station. Drawdowns are likely to have an impact on Napperby Station and Aileron Station groundwater supplies within the Southern Basins as the extraction bores are at these locations and existing stock bores are present within the vicinity of the borefield, particularly towards the eastern end of the Southern Basins on Aileron Station. There may be minor drawdown at these existing extraction points both within the Southern Basins and within the adjacent Basement rocks. As an example two modelled drawdowns (Figure 52 and Figure 53) on Aileron Station are presented for the Old Albs Bore (RN13647) area (noting that this is the site of proposed processing area) and the Rabbit Flat (RN11771) area.

In contrast, the modelling indicates that Yambah Station and Amburla Station will be beyond the measureable impact of the borefield, both during operation and through the 1,000-year closure model period.

Irrigation for horticulture and viticulture

No groundwater is currently extracted for horticulture or viticulture from the Southern Basins with the possible minor exception of the limited use at Napperby Homestead. Although not all groundwater with the Southern Basins is of a quality that long-term irrigation could considered be a beneficial use, it is not unreasonable to assume that there is the potential for future beneficial use of groundwater for irrigation. With this as context, the Southern Borefields could have an impact on this during operation but given the scale of the groundwater resource this is only likely to result in minor interference (i.e. require deeper bores and require greater pumping heads, both only in the order of metres [i.e. less than 10 m] due to minor drawdowns across the aquifer). The use of groundwater from the Southern Basins for the Nolans project does not exclude the use of the aquifer for irrigation on either Napperby Station or Aileron Station.

Drinking and domestic water

Two key groundwater sources currently providing drinking water may be impacted by the Southern Basins borefield extraction. Drinking water is sourced from the Aileron and Alyuen groundwater supply on Napperby Rd and the Laramba and Napperby groundwater supply situated on the western side of Day Creek north of the Reaphook Range. The modelled groundwater drawdowns at the current Aileron and Alyuen groundwater supply and the Laramba and Napperby groundwater supply locations are presented in Figure 54 and Figure 55 respectively. The peak predicted drawdown impacts at the current Aileron and Alyuen supply and the Laramba and Napperby supply locations are approximately 0.6 m and 1.3 m respectively. The material impact of these drawdowns will also depend on the current and future availability for drawdown and contingency (or redundancy) within the existing and future bores at these locations.

Like the assessment for stock water, any drinking water on Yambah Station and Amburla Station, or at Alkupitja (Gillins Bore, RN15638) or at Injulkama will be beyond the measureable impact of the borefield, both during operation and throughout the 1,000-year closure model period.

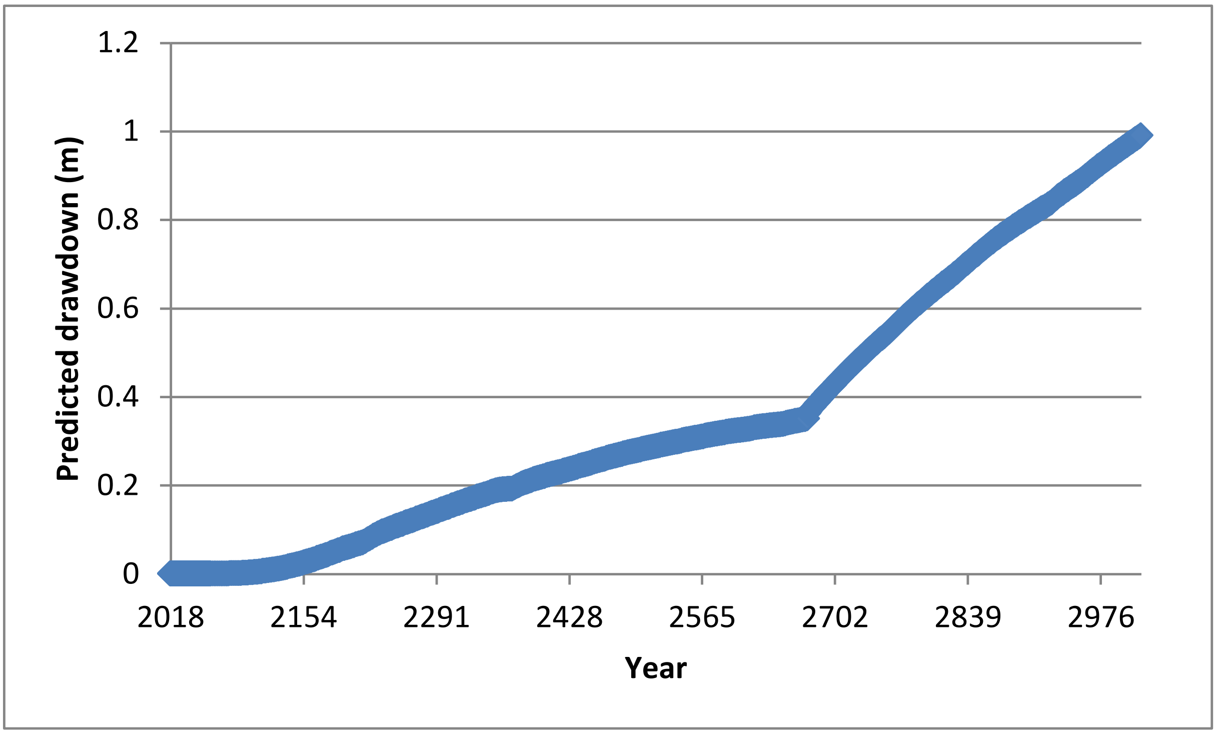


Figure 52 Predicted drawdown at Old Albs Bore

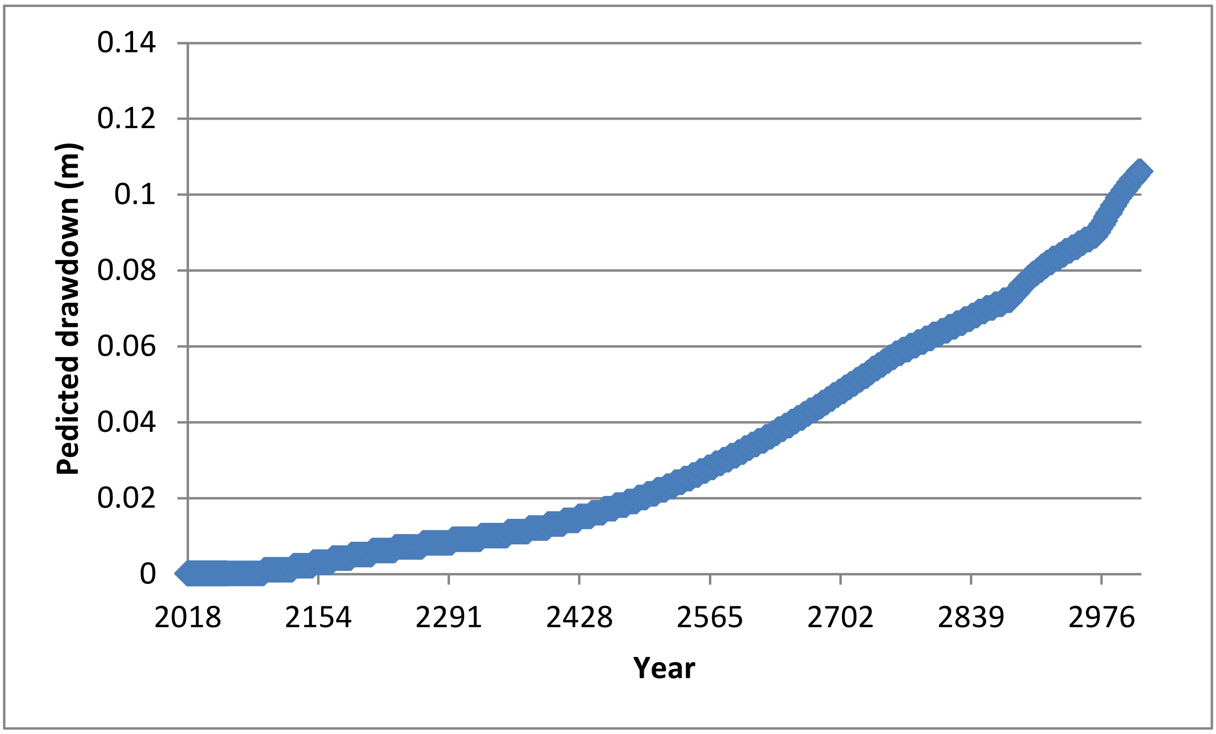


Figure 53 Predicted drawdown at Rabbit Flat

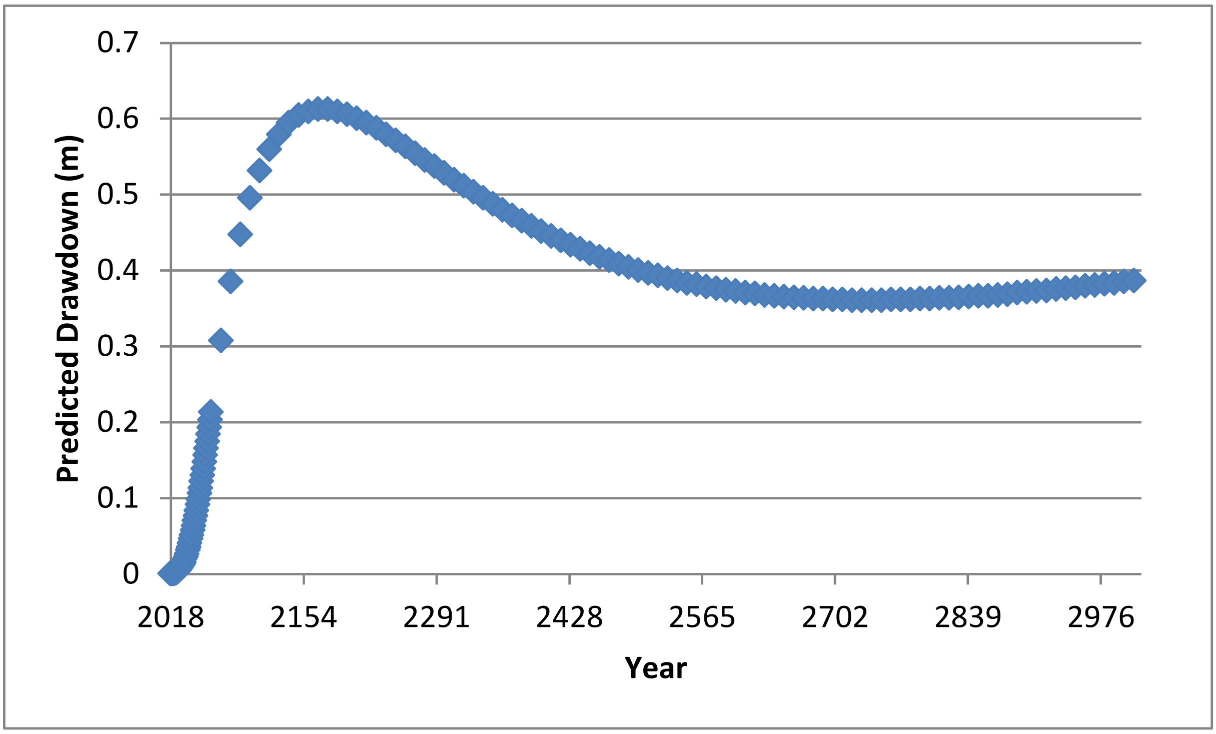


Figure 54 Predicted drawdown at Alyuen Community bore (Napperby Road)

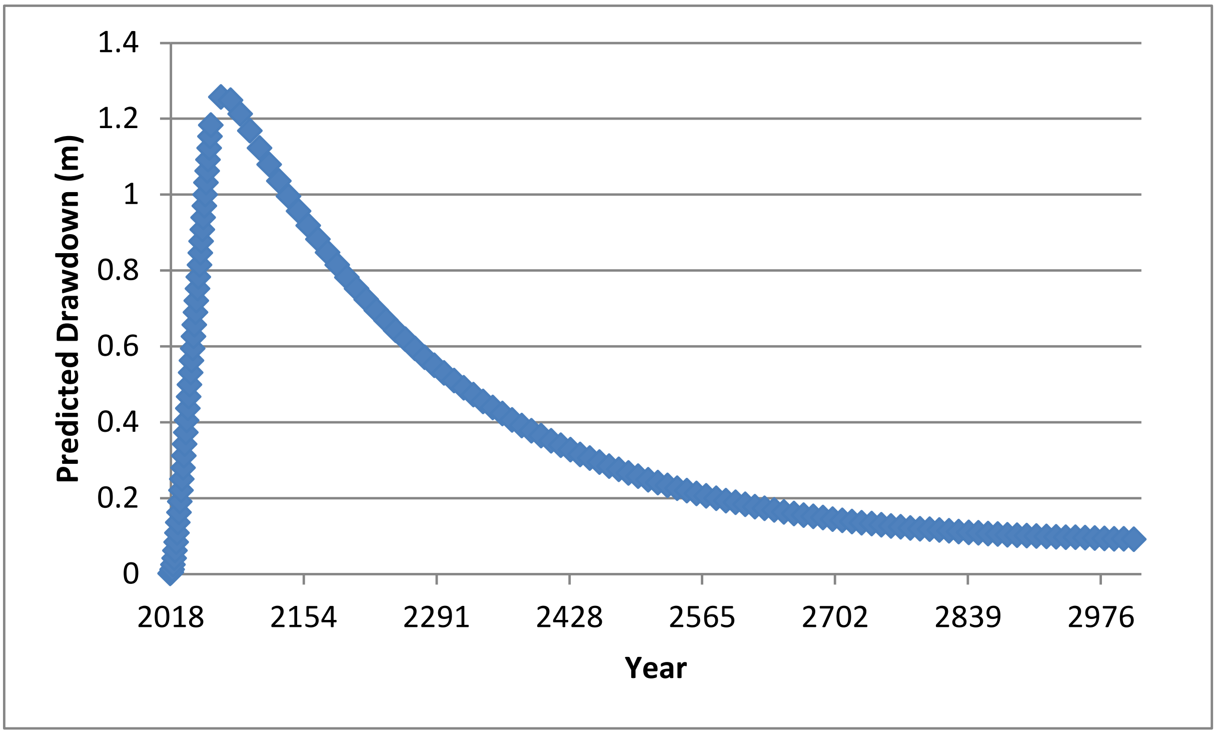


Figure 55 Predicted drawdown at Laramba/Napperby borefield

7. Groundwater chemistry impacts

7.1 Mine area

The chemistry of groundwater flowing towards the mine pit is unlikely to be materially different from the existing groundwater chemistry in the area. There are no predicted mechanisms for change with relatively benign waste rock, pit walls (Appendix L in this EIS) and zero discharge facilities (pers. comm. Fowler, 2015), however, once in the pit, the net evaporation post-closure will result in a hypersaline pit lake. This is anticipated to result in a pit lake with a water level below the current and predicted surrounding groundwater levels. Flow will be radially inwards to the pit lake and thus contribute to the concept of a zero discharge site. The likely chemistry of this pit lake has not been modelled, however, it is highly likely to be of no beneficial use. Given the likely very steep hydraulic gradients adjacent to the pit, it is reasonable to assume that it is unlikely that density driven flow would migrate significantly outward against this inward flow.

In the unlikely event that the pit is filled and decant either to the surface water bodies or groundwater system (i.e. for example in an extreme rain event and the pit lake rapidly rises above adjacent groundwater levels to the point where it is no longer behaving as a sink), this contaminated water could discharge. As such, the catchment design should be such that the water balance can demonstrate that the pit lake will remain a sink in events far greater than any probable maximum flood.

7.2 Borefield

As discussed in the above in Section 6.1 the modelled groundwater flow regime displays almost no change (impact) at the model (regional) scale when viewed from a flow direction or groundwater head perspective. As such, there is no justification for any speculation of material changes in groundwater chemistry or quality within the aquifer.

Despite this, conceptually there still remains the minor potential for hypothesised impacts based on the following:

- extraction of groundwater from the Southern Basins could result in more groundwater with lower quality flowing from storage within the basement rocks
- extraction of groundwater from the Southern Basins could draw fresher water associated with recharge from Day Creek eastwards altering the quality of drinking water available for the extraction.

Likewise, the longevity of the supply of proposed drinking water from the Southern Basins borefield has not been tested. The aquifer under the influence of the Southern Basins borefield proposed pumping regime is likely to be under significantly more dynamic conditions than at present and under such conditions, a more uniform groundwater chemistry is likely to develop.

7.3 Processing site, tailings and residue storage facilities

As all storage facilities are designed as zero discharge facilities (i.e. evaporation controlled), they should be designed or managed such that they do not breach or decant either to the surface water bodies or groundwater system. As such, their design and management should ensure that the water balance can demonstrate that they will remain evaporating controlled events far greater than any probable maximum flood. Likewise, their design and management should ensure zero discharge occurs via leakage.

A breach or decant of contaminated water from the processing site is likely to be in direct contact with the Southern Basins aquifer either via the underlying Quaternary material or along the interface between the Quaternary and Cenozoic material and the underlying basement material. Particle travel distances have been calculated based on assumed effective porosity values and key outputs from the model. Such calculations are considered conservative as they do not consider complicating factors including but not limited to unsaturated flow, dilution, dispersion, diffusion and attenuation. These calculated particle travel distances are in the order of 100 m in a year or 10 to 20 km over the 1,000-year closure period, based on the above scenario but only in the order of hundreds of metres over the 1,000-year closure period if flow was to be through basement material alone.

A breach or decant at the tailings storage would represent a similar outcome, however, depending on the scale, duration and timing, could be self-managed by the down-gradient pit acting as a groundwater sink. Like the processing site, a potential mechanism would be flow in the unsaturated Quaternary material or along the interface of the underlying basement material (i.e. along the Nolans Creek drainage line). These calculated particle travel distances are in the order 50 m in a year based on the above scenario and as such would rapidly (in the order of years) leave site towards the north. In contrast particle travel distances if flow was only within the basement material were calculated at under a hundred metres flow outwards over the entire mining and early closure period before turning inward towards and ultimately being captured by the pit.

The scenarios presented above have not been explicitly modelled; rather based on the model results and calculation results presented above, the facilities should be designed and managed such that if the waters or materials they contain are potentially contaminating, they do not breach or decant and are monitored appropriately throughout the project to ensure this has not occurred.

8. Conclusions

8.1 Overview

A hydrogeological investigation has been undertaken on the Nolans Project using inputs from:

- previous studies on the Ti-Tree Basin
- field studies at the mine site
- field studies of the Southern Basins and Margins Area.

A numerical groundwater flow model has been:

- constructed based on the hydrogeological investigations
- calibrated to steady state observed conditions
- run as a predictive tool to estimate future conditions
- interrogated to quantify the key impacts (or lack thereof) at key locations across the study area.

Modelled impacts to groundwater availability are considered from the perspective of groundwater flows (volumes over time), groundwater elevations (heads), groundwater flow direction and groundwater drawdown. In addition, the modelled impacts are considered in terms of impacts to groundwater chemistry and quality.

The groundwater modelling is not considered to be definitive (i.e. absolutely correct), rather it presents our best estimate of the likely conditions based on our existing investigations and uses this to numerically quantify the impacts based on these estimates.

The modelled solution represents a non-unique solution. A different combination of parameters could be applied resulting in an equally valid prediction which could result in impacts with differing magnitudes; however, the modelling does provide a valuable tool capable of quantifying the impacts based on the reasonable documented inputs. The key impacts are summarised below.

8.2 Modelled flows

The Southern Basins borefield is planned to be operated at approximately 13,000 m^3/day (150 L/s or 4,700 ML/year). The predicted mine dewatering peaks at 4,000 m^3/day (46 L/s or 1,450 ML/year) and steady-state post-closure inflows at approximately 700 m^3/day (8 L/s or 250 ML/year).

As basement groundwater is likely to be lost to the system via pit evaporation, there is clearly a net loss to the system in the long term. This water has never been considered a contribution to the Ti-Tree Basin or Southern Basins in previous studies, however, in reality it is likely to make some minor contribution. The net loss of water from storage within the Ti-Tree Basin (including its basement rocks) was modelled at approximately 8 m^3/day (0.1 L/s or 3 ML/year) during mining increasing to 37 m^3/day (0.4 L/s or 13 ML/year) at the end of the 1,000-year closure modelled prediction.

Flowthrough of the Ti-Tree Basin is unlikely to be impacted at a measureable or observable amount. Flowthrough and availability for evapotranspiration within the Southern Basins is likely to be lower but not by an amount that a material impact is envisaged.

8.3 Modelled groundwater elevation and flow directions

The modelled groundwater flow regime displays almost no change (impact) at the model (regional) scale when viewed from a flow direction or groundwater head perspective. At this scale, the impacts to flow direction and groundwater head are very localised to the mine area and adjacent to the Southern Basins borefield bores in the Reaphook Palaeochannel area while in operation.

No reversal of groundwater flow direction occurs anywhere within the model area during mining except for immediately adjacent to the pit and immediately adjacent to the borefield bores (but not across aquifer, i.e. groundwater flow in the borefield aquifer is still westwards despite the pumping). The modelled reversal of flow direction at the end of the 1000-year closure modelled period extends within the basement rocks radially from the mine for approximately 4 km towards the Aileron Station Homestead and Aileron Roadhouse area.

8.4 Modelled drawdowns

The modelled groundwater drawdown is very large in term of magnitude adjacent to the mine but is likely to have very steep gradient due the low permeability of the rock mass. This, combined with the removal of all surface water flow (amongst other things) is likely to have irreversible effects on riparian vegetation for a limited length (estimated at approximately 1 km) of the Kerosene Camp Creek. The actual isolated and small aquifer in the orebody at the Nolans pit site will be almost completely mined out. Beyond this area, stock bores on Pine Hill Station and Aileron Station may experience minor drawdowns in the long term.

The modelled groundwater drawdown is very large in terms of extent and at the borefield could be referred to as ‘groundwater mining’. As such the flow rates should not be considered ‘sustainable’ in the long term (i.e. indefinitely) as it is not likely replaced by recharge at the same rate as the proposed discharge rate. Despite being unsustainable in the long term, the borefield is considered an appropriate use of the aquifer provided borefield abstraction ceases at the end of mining and the aquifer allowed to recover. The minor current and potential future uses should not be impacted in a material manner, although it is recognised that drawdowns at nearby stock and drinking water sources are likely to occur.

8.5 Groundwater chemistry and quality

The chemistry of groundwater flowing towards the pit is not likely to be greatly different from the existing groundwater chemistry in the area. Once in the pit, the net evaporation will result in a hypersaline pit lake. Flow will be radially towards the pit lake and thus contribute to the concept of a zero discharge site. The likely chemistry of this pit lake has not been modelled, however, it is highly likely to be of no beneficial use.

Should the pit be filled and decant either to the surface water bodies or groundwater system (i.e. the pit lake rises above adjacent groundwater levels to the point where it is no longer behaving as a sink), this contaminated water could discharge.

The modelled groundwater flow regime displays almost no change (impact) at the model (regional) scale when viewed from a flow direction or groundwater head perspective. As such there is no justification for any speculation of material changes in groundwater chemistry or quality within the aquifer.

Despite this, conceptually there still remains the minor potential for hypothesised impacts such as extraction of groundwater from the Southern Basins will result in more groundwater with lower quality flowing from storage within the basement rocks and extraction of groundwater from the Southern Basins will draw fresher water associated with recharge from Day Creek eastwards altering the quality available for the extraction of drinking water.

As all storage facilities are designed as zero discharge facilities (i.e. evaporation controlled), they should be designed or managed such that they do not breach or decant either to the surface water bodies or groundwater system.

8.6 Monitoring of impacts

Monitoring the impact as well as monitoring to validate the predicted impacts will be required. It is recommended that all mine features (facilities) have a network of groundwater monitoring bores installed and monitored for water levels, water chemistry and water quality as per the Water Management Plan (WMP).

In addition, the borefield itself should be monitored for water levels, water chemistry and water quality. The following existing bores as a minimum should be included for monitoring of the aquifer during and after the pumping period and for the monitoring of key specific potential impacts as outlined in Table 11. For borefield monitoring locations, refer to Figure 14.

Table 11 Proposed Southern Basins borefield

RC ID	Location	Aquifer	Monitoring for potential Impact
26	West of Day Creek	Reaphook Palaeochannel	Day Creek
23	East of Day Creek	Reaphook Palaeochannel	Day Creek and Laramba/Napperby drinking water supply
14	Gap between Hann Range and Reaphook Hills	Reaphook Palaeochannel	Drawdown towards the south
13	South of gap between Hann Range and Reaphook Hills	Reaphook Palaeochannel	Southern extent of drawdown
16	Centre of Southern Basins borefield	Reaphook Palaeochannel	Epicentre of borefield drawdown
17	Centre of Southern Basins borefield	Reaphook Palaeochannel	Epicentre of borefield drawdown
6	Immediately north east of Southern Basins borefield	Reaphook Palaeochannel	Drawdown immediately towards the north east
12	Immediately east of Southern Basins borefield	Reaphook Palaeochannel	Drawdown immediately towards the east
7	North eastern extent of Southern Basins	Alluvials	Drawdown towards the east
4	North of Southern Basins borefield	Reaphook Palaeochannel	Drawdown towards the north
5	North of Southern Basins borefield	Basement	Drawdown towards the north
81	North eastern extent of Southern Basins	Basement	North eastern extent of drawn

Temporal monitoring of water levels (i.e. through the use of automatic loggers) will be essential for validation and the inevitable requirement for re-calibration of the groundwater model. These data are also required for developing the groundwater model to Class 2 or Class 3 according to the Australian Groundwater Modelling Guidelines (Barnett et al, 2012). Temporal groundwater level monitoring should commence significantly (at least one to two years) before the commissioning of pumping to provide a background dataset and should continue through the life of the project and into closure. No pumping should occur without adequate flow monitoring place.

9. References

ANZECC & ARMCANZ, 2000, Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Environment and Conservation Council (ANZECC) & Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ).

Barnett et al, 2012, Australian groundwater modelling guidelines, Waterlines report, National Water Commission, Canberra.

Bell, J.G., Kilgour, P.L., English, P.M., Woodgate, M.F., Lewis, S.J. and Wischusen, J.D.H., 2012, WASANT Palaeovalley Map – Distribution of Palaeovalleys in Arid and Semi-arid WA-SA-NT (1st ed.). 1:4,500,000 Geoscience Australia Thematic Map.

BOM, 2015, Bureau of Meteorology, Climate Statistics, http://www.bom.gov.au/climate/averages/tables/.

Cetreprise, 2013, Nolan Project, Northern Burt Basin Stage 1 Groundwater Exploration, Field Reports.

D'Addario G.W, and Chan, R.A., 1982, Napperby 1: :250 000 surface geology mapping Bureau of Mineral Resources Geology and Geophysics, Australia

Environmental Earth Sciences, 2011, Hydrological open pit dewatering investigation, Nolans Bore, Via Aileron, NT, Environmental Earth Sciences Qld, Report to Arafura Resources Limited, July 2011, Version 1.

GHD, 2011. Stygofauna Pilot Survey – Nolans Bore EIS. 13 pp, 1 append.

Higgins, J. and Rafferty, 2009 Aileron Project, EL 24741 Woodforde. Annual Report for period ending 20th April 2009. 174p.

Hussey, K. J., 2014 First and final report for EL 29503 (Black Hole), Aileron-Reynolds Project Area, Northern Territory, Australia.

Knapton A., 2007, Development of a groundwater model for the Ti-Tree Basin. July 07 Using the Finite Element Modelling Package FEFLOW NRETAS Water Resources Branch report. Report 18/2007

NHMRC (2011) Australian Drinking Water Guidelines. National Health and Medical Research Council, Canberra.

Read, R., & Tickell, S., 2007, Groundwater Resources Map of the Ti-Tree Basin. Alice Springs: NRETA.

Ride, G., 2014, Submission to Northern Territory Government Allocation from the Southern Basins Graham Ride, Arafura Resources Limited, Nolans Bore Project, Aileron, Northern Territory.

Ride, G., 2015 Ride Consulting Arafura Resources Limited, Nolan Project, Rare Earth Mine, Proposed Borefields pers. comm.

Ride, G., 2016, Ride Consulting, Stage 2 Water Level and Geochemistry Datasets and Notes.

Senior BR, Truswell EM, Idnurm M, Shaw RD and Warren RG, 1994, Cainozoic sedimentary basins in the Alice Springs region: records of drilling and reconnaissance geology. Australian Geological Survey Organisation Record 1994/66.

Shaw et al., 1975, Alcoota 1:250 000 surface geology mapping, Bureau of Mineral Resources, Geology and Geophysics, Australia.

Water Studies, 2001, Development of a groundwater model for the Ti-Tree Farms Area, Drawn from Water Studies Pty Ltd Technical Report WSDJ00205 of 19 Report 49/2001 A October 2001 (DLPE Report No. 49/2001) Natural Resources Division of DLPE.

Wischusen, J.D.H., E.N. Bastrakov, J.W. Magee, S.J. Lewis, L.J. Gow, P.L. Kilgour, J.G. Bell, and T. Kelly, 2012 Hydrogeological Investigation of Deep Groundwater Resources in the Ti-Tree Basin, Northern Territory Final technical report of the Palaeovalley Groundwater Project for the Ti-Tree demonstration site.

Appendices

Appendix A - Groundwater level dataset after Ride, 2016

RC ID	Easting (MGA Z53)	Northing (MGA Z53)	Date	SWL (mAHD)
1	313937.128	7479631.23	19/12/2015	600.858
4	307763.181	7486548.519	18/12/2015	602.436
7	316193.433	7483227.035	18/12/2015	605.695
8	308126.126	7479251.362	19/12/2015	594.633
12	310991.304	7479445.326	19/12/2015	598.124
13	308091.879	7474063.312	19/12/2015	591.606
14	307457.233	7477916.769	19/12/2015	593.023
15	301281	7479871	19/12/2015	587.884
17	307457.233	7477916.769	19/12/2015	587.806
18	294438	7480880	19/12/2015	585.862
19	293705.95	7482183.292	19/12/2015	586.089
20	294453	7482367	19/12/2015	585.687
21	294442.718	7482392.172	19/12/2015	585.877
22	301305.332	7479870.455	19/12/2015	587.564
23	284426.599	7481960.191	19/12/2015	583.991
26	281259.794	7488103.722	19/12/2015	580.764
27	304170.922	7484940.241	18/12/2015	601.336
28	308061	7479250	19/12/2015	593.818
30	359007.351	7461773.977	10/12/2015	623.65
31	360006.955	7461763.174	10/12/2015	623.92
32	362000.709	7461724.592	10/12/2015	624.608
33	363007.234	7461735.596	10/12/2015	623.873
35	360192.973	7465800.151	10/12/2015	624.259
36	359390.384	7464709.727	10/12/2015	624.046
37	358688.893	7463770.304	10/12/2015	623.82
39	356684.288	7461773.42	10/12/2015	622.824
40	347809.473	7467735.722	31/12/2015	621.054
41	348499.777	7468478.228	31/12/2015	621.304
42	349511.307	7469502.876	31/12/2015	622.601
43	350298.54	7470360.367	31/12/2015	623.496
44	350998.974	7471508.62	31/12/2015	623.773
45	351618.94	7472424.615	31/12/2015	620.542
46	343182.469	7470504.25	17/12/2015	617.704
47	345191.373	7472372.745	31/12/2015	618.205
48	348193.362	7464455.988	31/12/2015	620.134
49	353372.977	7464688.678	10/12/2015	622.386
50	355190.779	7466064.356	10/12/2015	622.28
52	358698.361	7467381.303	10/12/2015	622.207
53	351733.895	7472642.787	31/12/2015	623.576
54	354698.774	7465767.002	10/12/2015	622.017
55	356693.785	7466884.594	10/12/2015	623.195
56	359875.715	7467968.413	10/12/2015	620.582
58	343705.573	7471008.3	31/12/2015	617.392
60	313034	7478052	19/12/2015	598.609
61	308822	7481504	3/01/2016	608.277
64	317941	7499867	18/12/2015	645.065
70	318757.8	7502084	18/12/2015	642.159
92	344181	7503511	17/12/2015	563.542
98	349526	7465263	10/12/2015	621.115

Table 1. Summer 2015-2016 Standing Water Level Dataset (49 bores – calibration dataset)

RC ID	Easting (MGA Z53)	Northing (MGA Z53)	Date	SWL (mAHD)
30	359007.351	7461773.977	5/12/2014	623.701
32	362000.709	7461724.592	5/12/2014	624.708
35	360192.973	7465800.151	5/12/2014	624.297
36	359390.384	7464709.727	5/12/2014	624.112
37	358688.893	7463770.304	5/12/2014	623.865
39	356684.288	7461773.42	5/12/2014	622.994
42	349511.307	7469502.876	14/12/2014	623.361
43	350298.54	7470360.367	5/12/2014	610.289
45	351618.94	7472424.615	5/12/2014	623.776
47	345191.373	7472372.745	14/12/2014	618.675
49	353372.977	7464688.678	14/12/2014	622.456
55	356693.785	7466884.594	14/12/2014	623.198

Table 2. Summer 2014-2015 Standing Water Level Dataset (12 bores)

RC ID	Easting (MGA Z53)	Northing (MGA Z53)	Date	SWL (mAHD)
1	313937.128	7479631.23	25/06/2014	600.731
2	313472.825	7483036.789	25/06/2014	602.065
4	307763.181	7486548.519	25/06/2014	602.448
6	308810.076	7481513.772	25/06/2014	597.831
7	316193.433	7483227.035	25/06/2014	605.46
8	308126.126	7479251.362	25/06/2014	594.513
12	310991.304	7479445.326	25/06/2014	597.998
13	308091.879	7474063.312	25/06/2014	591.537
14	307457.233	7477916.769	25/06/2014	593.443
15	301281	7479871	25/06/2014	587.759
17	307457.233	7477916.769	25/06/2014	587.756
18	294438	7480880	25/06/2014	585.718
19	293705.95	7482183.292	25/06/2014	584.194
20	294453	7482367	25/06/2014	585.844
21	294442.718	7482392.172	25/06/2014	585.926
22	301305.332	7479870.455	25/06/2014	587.569
23	284426.599	7481960.191	25/06/2014	584.166
26	281259.794	7488103.722	25/06/2014	580.794
27	304170.922	7484940.241	25/06/2014	601.416
28	308061	7479250	25/06/2014	593.968
29	358010.979	7461786.285	25/06/2014	Dry
34	363559.755	7464197.014	25/06/2014	Dry
38	357606.376	7462278.612	25/06/2014	Dry
51	357203.032	7466952.443	25/06/2014	Dry

Table 3. Winter 2014 Standing Water Level Dataset (24 bores)

Appendix B - Groundwater chemistry and quality dataset after Ride, 2016

									Major Ions												Nutrients					
					Electrical conductivity (lab)	pH (Lab)	Total Dissolved Solids	Total Suspended Solids	Calcium	Magnesium	Sodium	Potassium	Chloride	Sulphate	Calcium Carbonate	Bicarbonate	Carbonate	Hydroxide	Fluoride	Bromide	Ammonia as N	Nitrate (as N)	Nitrate (as NO3-)	Nitrite (as N)	Nitrite (as NO2-)	Phosphate (as P)
					µS/cm	pH Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
ADWG 2011 Aesthetic						6.5-8.5	600				180		250	250												
ADWG 2011 Health														500					1.5				50		3	
ANZECC 2000 FW 99%																					0.32	0.0038	0.017			
ANZECC 2000 Irrigation - Long-term Trigger Values																			1							
ANZECC 2000 Stock Watering							4000		1000					1000					2			90	400	9.1	30	
Monitoring_Zone	**Location Code**	**Grouping**	**GW Basin**	**Location Type**																						
Alluvial	RC00001	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	3230 - 4480	8.2 - 8.3	2070 - 3580	<10	164 - 281	102 - 139	-	43.4 - 45.4	-	277 - 312	829,000 - 1,280,000	128 - 149	<1	<1	0.8	5.02 - 5.23	0.02 - 0.3	12.4 - 22.5	55.1 - 99.6	<0.005	<0.02	0.01 - 0.015
Alluvial	RC00002	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	2240 - 2480	8.4 - 8.5	1340 - 1510	<10 - 50	90.7 - 98.7	55.4 - 59.6	-	34.9 - 38.8	-	174 - 210	455,000 - 492,000	188 - 201	5 - 7	<1	1.2	3.5 - 3.86	0.005 - 0.495	13.5 - 15.8	60 - 70.1	<0.005 - 0.06	<0.02 - 0.2	0.015
Alluvial	RC00003	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	1920 - 1950	8.7	1170	10 - 20	33.5 - 45.6	43.7 - 46.1	-	35.9 - 36.5	-	185 - 212	263,000 - 303,000	291 - 343	28 - 31	<1	1.2 - 1.7	5.14 - 5.5	0.1 - 0.105	8.79 - 9.19	38.9 - 40.7	0.02	0.06	0.01 - 0.015
Alluvial	RC00007	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	3100 - 3130	8.4 - 8.5	1950 - 2030	<10	127 - 134	109 - 112	-	59.5 - 64.8	-	302 - 312	767,000 - 795,000	190 - 193	7 - 10	<1	1 - 1.2	5.47 - 5.54	0.215 - 1.57	18.8 - 19.3	83.1 - 85.5	0.01 - 0.44	0.02 - 1.44	0.015 - 0.02
Alluvial	RC00059	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	3140 - 3510	7.9 - 8.3	2090 - 2390	<10 - 20	162 - 187	106 - 120	326 - 372	43.2 - 48.8	815 - 928	297 - 333	-	117 - 161	<1	<0.001	0.8 - 1.2	4.56 - 4.89	<0.005 - 0.025	19.6 - 23	86.7 - 102	<0.005 - 0.025	<0.02 - 0.08	0.01 - 0.03
Alluvial	RC00060	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	3060 - 3210	8.2	2090 - 2240	<10 - 10	171 - 177	97.7 - 114	317 - 346	39 - 45.4	806 - 861	265 - 311	-	140 - 149	<1	<0.001	0.9 - 1	4.08 - 4.69	<0.005 - 0.015	15.8 - 21.4	69.8 - 94.7	<0.005	<0.02	0.02
Alluvial	RC00084	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	2950	8.1	1970	40	122	82.4	331	45.5	700	285	-	154	<1	<0.001	0.9	4.3	1.27	16.8	74.4	0.455	1.48	0.025
Alluvial	RC00085	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	3080	8.4	1870	<10	141	98.7	294	48.6	0.015	293	-	174	6	<0.001	0.6	4.36	679	23.3	103	<0.005	<0.02	0.01
Alluvial	RC00106	Margins Area	NE Burt	Aileron Station	1280 - 1430	8.1 - 8.8	770 - 890	<10 - 40	25.8 - 52.6	21.6 - 48.5	158 - 178	25.9 - 28	157	81 - 174	154,000	258 - 283	<1 - 21	<0.001	1.4 - 1.5	1.14 - 1.35	<0.005 - 0.01	10.7 - 25	47.3 - 111	<0.005 - 0.005	<0.02	0.02 - 0.045
Alluvial	RC00109	Margins Area	NE Burt	Aileron Station	1450 - 1530	8.1 - 8.6	890 - 1080	<10 - 20	19.1 - 19.3	26.2 - 26.3	244	39.7 - 40.6	162	93.9 - 94	156,000	294 - 315	<1 - 14	<0.001	1.2 - 1.3	1.3 - 1.41	0.005 - 0.015	23.4 - 25.9	104 - 115	<0.005	<0.02	0.025 - 0.055
Alluvial/Fluvial	RC00040	Margins Area	NE Burt/Arunta	Aileron Station	972	8.4	650	<10	32.1	25	126	29.8	0.01	58.4	-	261	6	<0.001	1.5	0.693	82.2	13.1	58.1	0.03	0.1	<0.005
Alluvial/Fluvial	RC00044	Margins Area	NE Burt	Aileron Station	862	8.5	630	30	17.6	15	131	26	75.2	38.8	-	210	6	<0.001	1.7	0.793	0.01	19.5	86.5	0.13	0.4	<0.005
Alluvial/Fluvial	RC00045	Margins Area	NE Burt	Aileron Station	654	8.5	570	10	30.8	23.3	58	21	26.5	20.1	-	189	6	<0.001	0.9	0.37	0.01	23.9	106	0.02	0.04	<0.005
Alluvial/Fluvial	RC00046	Margins Area	NE Burt	Aileron Station	13,500	8.1	9660	20	406	381	2240	192	4490	1450	-	387	<1	<0.001	1.3	32.2	0.14	1.03	4.56	0.095	0.32	0.01
Alluvial/Fluvial	RC00047	Margins Area	NE Burt	Aileron Station	1900	8	1240	<10	98.8	49.8	213	35.4	413	181	-	211	<1	<0.001	0.8	3	0.135	0.605	2.68	0.13	0.42	0.01
Alluvial/Fluvial	RC00048	Margins Area	NE Burt	Aileron Station	845	8.5	500	10	25.8	22.5	109	26.9	0.005	32.7	-	261	6	<0.001	1.4	0.452	60.1	14.5	64.1	0.19	0.62	<0.005
Alluvial/Fluvial	RC00049	Margins Area	NE Burt	Aileron Station	1340	8.5	880	130	46.1	42.1	139	43.4	191	88.5	-	189	7	<0.001	0.9	2.12	0.025	19.8	87.8	0.01	0.04	<0.005
Alluvial/Fluvial	RC00053	Margins Area	NE Burt	Aileron Station	663	8.3 - 8.6	340 - 630	30 - 190	24 - 24.3	16 - 18.4	73.7 - 77.9	19 - 20.5	34.4 - 36.1	20.3 - 24.4	-	157 - 172	<1 - 9	<0.001	0.9	0.461 - 0.489	0.01 - 0.02	24 - 26	106 - 115	0.01	0.02 - 0.04	<0.005
Alluvial/Fluvial	RC00057	Margins Area	NE Burt	Aileron Station	1860	8.2	1100	20	54.6	40.4	265	32.9	389	154	-	215	<1	<0.001	0.9	2.61	0.15	0.04	0.16	0.025	0.08	0.015
Calcrete	RC00100	Margins Area	Arunta Basement	Aileron Station	1200	8	800	20	65.2	54.2	103	15.9	94.9	48.7	-	297	<1	<0.001	1.1	1.32	0.01	43.3	192	0.02	0.06	0.01
Calcrete	RC00103	Margins Area	NE Burt	Aileron Station	2140	7.8	1230	<10	84.3	68.1	247	32.1	346	187	-	287	<1	<0.001	1.2	3.4	0.01	26.7	118	0.06	0.18	0.01
Calcrete	RC00104	Margins Area	Ti Tree	Aileron Station	1820	7.9	1140	<10	70.7	53.1	238	17	294	176	-	233	<1	<0.001	0.8	2.67	0.01	15.3	67.7	<0.005	<0.02	0.01
Calcrete/Alluvial	RC00052	Margins Area	Ti Tree/Arunta	Aileron Station	1570	8	1060	<10	90.9	51.7	145	32.5	274	130	-	239	<1	<0.001	0.7	2.22	0.045	5	22.1	12	39.5	0.015
Calcrete/Alluvial/Fluvial	RC00030	Margins Area	NE Burt	Aileron Station	1520	8.2	970	<10	53	42	181	33.1	0.045	116	-	210	<1	<0.001	1	2.27	255	11.8	52.3	0.215	0.7	0.005
Calcrete/Alluvial/Fluvial	RC00031	Margins Area	Ti Tree	Aileron Station	1430	7.8	870	40	59.8	52.8	135	32.3	0.02	93.8	-	183	<1	<0.001	0.9	2.64	237	20.8	92	0.01	0.02	<0.005
Calcrete/Alluvial/Fluvial	RC00033	Margins Area	Ti Tree	Aileron Station	1520	8.3	930	20	65.9	48.5	156	29.6	0.005	107	-	163	<1	<0.001	1	2.74	249	30.9	137	0.05	0.18	<0.005
Calcrete/Basement	RC00032	Margins Area	Ti Tree/Arunta	Aileron Station	1340	8	870	200	67.8	47.3	123	25	0.01	84.5	-	205	<1	<0.001	0.9	2.3	192	28.6	127	0.035	0.12	0.005
Calcrete/Basement	RC00035	Margins Area	Ti Tree/Arunta	Aileron Station	680	8.3	450	<10	34.9	37.8	38.7	17.1	0.015	15.5	-	204	1	<0.001	0.8	0.458	26.6	25.3	112	0.015	0.04	<0.005
Calcrete/Basement	RC00036	Margins Area	Ti Tree/Arunta	Aileron Station	636	8.2	470	<10	43.3	30.7	29	16.5	0.01	11.4	-	174	<1	<0.001	1.2	0.459	33.3	27	119	<0.005	<0.02	<0.005
Calcrete/Basement	RC00037	Margins Area	Ti Tree/Arunta	Aileron Station	1710 - 1730	7.9 - 8.2	1110 - 1140	<10 - 60	79.2 - 81.4	54.8 - 56.2	196	25.7 - 26.5	309 - 342	137 - 142	-	243 - 255	<1	<0.001	1.1 - 1.2	2.22 - 2.5	<0.005 - 0.01	23.6 - 24.7	105 - 109	0.01 - 0.03	0.04 - 0.1	<0.005 - 0.02
Calcrete/Basement	RC00041	Margins Area	NE Burt/Arunta	Aileron Station	858	8.4	600	10	26.5	21	113	25.9	0.01	37	-	253	2	<0.001	0.7	0.596	62.9	15	66.4	0.01	0.02	<0.005
Calcrete/Basement	RC00042	Margins Area	NE Burt	Aileron Station	850	8.1	450	140	31.9	19.6	110	23.5	59.3	37.7	-	256	<1	<0.001	0.9	0.615	0.01	17.5	77.7	1.65	5.4	<0.005
Calcrete/Basement	RC00043	Margins Area	NE Burt	Aileron Station	978	8.2	610	50	28.2	28.2	116	31.7	0.015	51.5	-	216	<1	<0.001	1.5	1.03	88	21.8	96.7	0.775	2.54	0.005
Calcrete/Basement	RC00050	Margins Area	NE Burt/Arunta	Aileron Station	1880 - 11,900	7.8 - 8.4	1110 - 8730	<10 - 130	53.3 - 307	47.7 - 659	234 - 1440	59.1 - 302	340 - 3340	139 - 1550	-	220 - 545	<1 - 5	<0.001	0.5 - 0.9	3.46 - 33.1	0.005 - 0.175	3.51 - 17	15.5 - 75.5	0.02 - 0.38	0.04 - 1.24	<0.005 - 0.015
Calcrete/Basement	RC00054	Margins Area	NE Burt/Arunta	Aileron Station	1880	8.4	1110	80	53.3	47.7	234	59.1	340	139	-	231	5	<0.001	0.9	3.46	0.005	9.76	43.2	0.015	0.04	<0.005
Calcrete/Basement	RC00056	Margins Area	Ti Tree/Arunta	Aileron Station	2580	8.3	1590	10	81.1	84.1	334	48.9	479	192	-	410	<1	<0.001	1.2	4.11	0.215	15.5	68.6	18.3	60.2	0.01
Reaphook Paleochannel	RC00004	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	1790 - 3270	8.1 - 8.3	1050 - 2430	<10 - 30	53.9 - 211	45 - 93.2	263 - 280	30.9 - 48.4	0.01 - 263	174 - 238	544,000 - 912,000	159 - 396	<1	<0.001	0.8 - 1.2	1.78 - 2.92	<0.005 - 256	6.97 - 17.2	30.8 - 76	<0.005 - 0.01	<0.02 - 0.02	0.01 - 0.03
Reaphook Paleochannel	RC00006	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	2050	8.5	1210 - 1300	<10 - 20	60.8 - 65.3	48.6 - 49.8	-	34.2 - 34.4	-	173 - 175	357,000 - 363,000	249 - 259	12 - 13	<1	1.3 - 1.4	2.76 - 2.9	<0.005 - 0.04	16.6 - 16.8	73.3 - 74.2	0.01 - 0.065	0.04 - 0.22	0.015 - 0.02
Reaphook Paleochannel	RC00012	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	3010 - 3020	8.3 - 8.4	1530 - 1830	20 - 50	83 - 98.5	97.1 - 112	-	50.8 - 56.7	-	229 - 355	607,000 - 707,000	151 - 256	<1 - 5	<1	2.5 - 2.8	3.43 - 3.55	2.4 - 3.67	2.91 - 6.41	12.9 - 28.4	0.975 - 1.76	3.22 - 5.78	0.01
Reaphook Paleochannel	RC00013	Southern Basins - Reaphook	Eastern Mt Wedge	Aileron Station	2670 - 2710	8 - 8.2	1720 - 1810	20 - 30	128 - 143	83	-	48.3 - 56.1	-	210 - 216	662,000 - 698,000	138 - 144	<1	<1	0.5 - 0.6	3.7 - 3.89	0.04 - 0.36	17.1 - 17.6	75.8 - 78	<0.005 - 0.02	<0.02 - 0.06	0.025
Reaphook Paleochannel	RC00014	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	1940 - 2080	8.5	1230 - 1280	<10	71.1 - 79.9	53.2 - 59.3	225 - 281	35.3 - 47.5	381 - 429	166 - 171	-	157 - 183	9 - 10	<0.001	0.8 - 0.9	2.63 - 3.13	0.01 - 0.035	14.7 - 15.6	64.9 - 68.9	0.005	<0.02 - 0.02	0.02 - 0.025
Reaphook Paleochannel	RC00015	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	1940 - 1950	8.5 - 8.6	1200 - 1230	<10	79.9 - 90.8	54.7 - 59.3	225 - 232	45 - 47.5	365 - 381	171 - 181	-	157 - 188	9 - 14	<0.001	0.7 - 0.8	3.05 - 3.13	0.035 - 0.115	15.6 - 16.5	68.9 - 73.2	0.005 - 0.035	<0.02 - 0.12	0.02 - 0.025
Reaphook Paleochannel	RC00016	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	2240	8.5	1390	<10	92.8	68.4	259	46.2	507	182	-	156	8	<0.001	0.6	3.74	<0.005	13.6	60.2	<0.005	<0.02	0.02
Reaphook Paleochannel	RC00017	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	1780 - 1890	8.6	1110 - 1160	<10 - 20	65.8 - 71	45.6 - 48.3	231 - 246	43.1 - 47.2	309 - 357	140 - 145	-	185 - 202	13 - 17	<0.001	0.7	2.83 - 3.11	<0.005 - 0.04	17.3 - 17.6	76.6 - 77.8	<0.005 - 0.025	<0.02 - 0.08	0.02 - 0.06
Reaphook Paleochannel	RC00018	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	0 - 6350	0 - 8.6	0 - 3710	<10 - 40	0 - 116	0 - 67.7	0 - 1190	0 - 44.3	0 - 1860	0 - 282	-	0 - 229	<1 - 12	<0.001 - 0	0 - 1.2	0 - 3.74	0 - 0.94	0 - 16.1	0 - 71.3	0 - 0.18	0 - 0.58	0 - 0.025
Reaphook Paleochannel	RC00019	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	2580	8.6	1660	<10	101	74.7	305	47.8	552	255	-	180	14	<0.001	0.7	3.22	<0.005	9.62	42.6	<0.005	<0.02	0.03
Reaphook Paleochannel	RC00021	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	0 - 2390	0 - 8.3	0 - 1560	<10 - 420	0 - 88.2	0 - 66.7	0 - 272	0 - 43.4	0 - 601	0 - 226	-	0 - 190	<1 - 0	<0.001 - 0	0 - 0.8	0 - 3.83	0 - 0.085	0 - 6.19	0 - 27.4	<0.005 - 0.135	<0.02 - 0.44	0 - 0.035
Reaphook Paleochannel	RC00022	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	1850 - 1910	7.4 - 7.7	1240 - 1310	<10 - 10	81.7 - 84.3	52 - 56.9	201 - 203	40.8 - 43.6	358 - 397	158 - 162	-	202 - 207	<1	<0.001	0.6 - 0.8	2.78 - 3.05	0.01 - 0.02	14.3 - 14.8	63.3 - 65.4	0.005 - 0.015	<0.02 - 0.06	0.03
Reaphook Paleochannel	RC00023	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	1140	8.5	770	<10	35.4	19.8	168	25.7	79.8	139	-	268	10	<0.001	0.9	0.6300001	0.005	13.5	59.9	<0.005	<0.02	0.045
Reaphook Paleochannel	RC00024	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	1920 - 1960	8.2 - 8.3	1330 - 1350	<10 - 10	78.8 - 79.3	50.3 - 51.1	212 - 219	42.3 - 43.7	369 - 381	189 - 192	-	206 - 210	<1 - 2	<0.001	0.7	2.15 - 2.65	0.01 - 0.015	17.3 - 17.5	76.6 - 77.4	<0.005	<0.02	0.03 - 0.035
Reaphook Paleochannel	RC00025	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	1870 - 2130	8.1 - 8.4	1260 - 1450	<10 - 90	78.5 - 92.7	48.3 - 54.3	207 - 235	37.6 - 42.7	367 - 448	187 - 210	-	195 - 214	<1 - 3	<0.001	0.3 - 0.6	2.18 - 2.44	0.01 - 0.15	10.3 - 17.6	45.6 - 78.1	<0.005 - 0.055	<0.02 - 0.18	0.025 - 0.035
Reaphook Paleochannel	RC00026	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	0 - 2960	0 - 8.7	0 - 1860	<10 - 1590	0 - 98.4	0 - 66.6	0 - 386	0 - 40	0 - 786	0 - 242	-	0 - 323	<1 - 19	<0.001 - 0	0 - 1.9	0 - 3.31	0 - 0.445	0 - 6.76	0 - 29.9	<0.005 - 0.01	<0.02 - 0.02	0 - 0.025
Reaphook Paleochannel	RC00028	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	1590 - 2420	7.4 - 8.4	1020 - 1680	<10 - 60	45 - 106	37.7 - 64.1	246 - 297	30 - 32	283 - 638	134 - 194	-	171 - 232	<1 - 3	<0.001	0.8 - 1.5	1.68 - 3.19	<0.005 - 0.03	12.8 - 18.5	56.6 - 82.1	<0.005 - 0.09	<0.02 - 0.28	<0.005 - 0.015
Reaphook Paleochannel	RC00061	Southern Basins - Reaphook	Eastern Whitcherry	Public Road	2140	8.5	1350	<10	73	54.4	306	34.9	402	185	-	258	14	<0.001	1.1	3.42	<0.005	16.6	73.3	<0.005	<0.02	0.04
Ti Tree Basin Aquifer	RC00092	Ti Tree Basins	Ti Tree	Aileron Station	2000 - 2120	7.5 - 8.2	1230 - 1310	20 - 90	75.8 - 76.5	51.7 - 52.2	259 - 261	37.1 - 41.6	0.01 - 385	177 - 210	405,000	236 - 264	<1	<0.001	0.6 - 1.2	3.38 - 3.6	0.01 - 368	16.1 - 16.5	16.1 - 73.2	<0.005 - 0.02	<0.02 - 0.01	0.01 - 0.04
Unknown	RC00198	N/A	Unknown	Aileron Station	2310	8.1	1270	<10	122	52.6	-	25.7	-	213	521,000	211	<1	<1	0.5	2.64	410	19.7	87.1	<0.005	<0.02	0.05
Unknown	RC00222	N/A	Unknown	Aileron Roadhouse	3680 - 3820	7.7 - 8.6	2110 - 2140	<10 - 10	97.4 - 107	57.9 - 63.2	612	18.7 - 23	<0.005	238 - 264	488,000 - 528,000	492 - 563	<1 - 42	<0.001	3 - 3.5	6.3 - 6.61	<0.005 - 748	2 - 2.39	8.9 - 10.6	<0.005 - 0.005	<0.02	0.005 - 0.025
Unknown	RC00344	Margins Area	Unknown	Yambah Station	1430	8.7	920	<10	49.1	45.6	-	26.8	-	148	311,000	240	17	<1	1.5	1.25	0.01	21.3	94.2	<0.005	<0.02	0.03
Weathered Basement	RC00005	Southen Basins - Basement	Eastern Whitcherry	Aileron Station	2620 - 3060	8.4 - 8.5	1820 - 1860	<10 - 20	154 - 158	107	-	58.3 - 59.3	-	349 - 355	826,000 - 838,000	150 - 237	5 - 13	<1	0.7	4.26 - 4.27	0.22 - 0.28	17.2 - 17.3	76.2 - 76.5	<0.005 - 0.005	<0.02	0.015
Weathered Basement	RC00027	Southern Basins - RC00027 - Basement	Eastern Whitcherry	Aileron Station	0 - 1080	0 - 8.4	0 - 680	<10 - 0	0 - 26.5	0 - 19	0 - 187	0 - 21.1	0 - 87.3	0 - 62.6	-	0 - 347	0 - 4	<0.001 - 0	0 - 1.3	0.5470001 - 0.761	0 - 0.015	0 - 6.26	0 - 27.7	<0.005 - 0	<0.02 - 0	0 - 0.22
Weathered Basement	RC00062	Mine Area - Basement	Arunta Basement	Aileron Station	4280 - 4310	7.5 - 8.5	2530 - 2560	<10	64.3 - 93.2	130 - 138	-	30 - 32.3	-	331 - 347	728,000 - 770,000	818 - 856	<1 - 14	<1	4.2 - 4.5	5.39 - 5.79	<0.005 - 0.065	21.8 - 28.8	96.4 - 128	<0.005 - 0.28	<0.02 - 0.92	0.02 - 0.03
Weathered Basement	RC00063	Mine Area - Basement	Arunta Basement	Aileron Station	3170 - 3800	7.9 - 8.6	1860 - 2300	<10 - 110	62.8 - 74	82.6 - 103	552 - 579	30.3 - 34.3	<0.005 - 614	199 - 245	497,000 - 604,000	676 - 796	<1 - 76	<0.001	0.8 - 6.9	4.74 - 5.39	<0.005 - 615	5.15 - 5.82	22.8 - 25.8	<0.005 - 0.035	<0.02 - 0.12	0.02 - 0.055
Weathered Basement	RC00064	Mine Area - Basement	Arunta Basement	Aileron Station	2410 - 3520	8.1 - 8.2	1430 - 2230	<10 - 390	41.3 - 59.4	57.1 - 97.8	-	26.6 - 34.2	-	136 - 239	338,000 - 551,000	627 - 752	<1	<1	5.5 - 6.7	2.66 - 5.29	<0.005	4.37 - 6.18	19.3 - 27.4	<0.005 - 0.045	<0.02 - 0.14	0.015 - 0.05
Weathered Basement	RC00075	Mine Area - Basement	Arunta Basement	Aileron Station	5730 - 6420	7.8 - 8.5	3760 - 3840	<10 - 30	140 - 155	193 - 203	940 - 970	34.2 - 36.6	<0.005 - 1320	633 - 688	1,180,000 - 1,220,000	731 - 875	<1 - 105	<0.001	2.7 - 3.6	10.2 - 10.9	<0.005 - 1270	7.75 - 9.4	34.3 - 41.6	0.01 - 0.03	0.02 - 0.1	0.02 - 0.045
Weathered Basement	RC00078	Southern Basins - Basement	Arunta Basement	Aileron Station	3930	8.1	2210	20	81.7	102	651	22.2	<0.005	255	-	865	<1	<0.001	3.5	5.95	671	3.29	14.6	<0.005	<0.02	0.03
Weathered Basement	RC00079	Southern Basins - Basement	Arunta Basement	Aileron Station	3650	8.5	2360	30	81.2	101	633	21.4	698	253	-	869	42	<0.001	4.1	6.02	<0.005	3.12	13.8	<0.005	<0.02	0.06
Weathered Basement	RC00081	Southern Basins - Basement	Arunta Basement	Aileron Station	1870 - 10,000	7.8 - 8.6	1140 - 7420	<10 - 70	62.6 - 367	51.8 - 505	1260	27.8 - 29.4	2770	140 - 1450	369,000	267 - 394	<1 - 14	<0.001	0.7 - 2.5	2.3 - 26.5	<0.005 - 0.005	4.51 - 21	20 - 93.1	<0.005	<0.02	0.025 - 0.035
Weathered Basement	RC00083	N/A	Arunta Basement	Aileron Roadhouse	3550	8.4	2210	30	101	59.5	615	19.9	786	252	-	534	15	<0.001	4.3	5.73	0.005	2.07	9.16	0.005	<0.02	0.03
Weathered Basement	RC00086	Margins Area	Arunta Basement	Aileron Station	4010 - 11,700	7.7 - 8.4	2770 - 8180	<10 - 30	121 - 456	134 - 613	539 - 585	32.6 - 64.8	777 - 807	496 - 1690	3,660,000	335 - 399	<1 - 13	<0.001	2.3 - 3	7.32 - 25.3	<0.005 - 0.01	6.49 - 56.8	28.8 - 252	<0.005 - 0.02	<0.02 - 0.04	0.015 - 0.025
Weathered Basement	RC00098	Margins Area	Arunta Basement	Aileron Station	845	7.7	560	<10	24	22.5	121	30.5	54.8	32.3	-	360	<1	<0.001	1.5	0.374	0.17	0.385	1.7	0.03	0.1	0.05
Weathered Basement	RC00099	Margins Area	Arunta Basement	Aileron Station	1170 - 4430	7.9 - 8.5	710 - 2800	<10 - 20	27.2 - 132	21.9 - 143	189 - 234	26.1 - 67.2	136 - 196	73.2 - 554	920,000	319 - 334	<1 - 16	<0.001	1.4 - 3	1.05 - 7.02	<0.005 - 0.01	11 - 55.4	48.8 - 245	<0.005 - 0.005	<0.02 - 0.02	0.02 - 0.05

Statistical Summary - all sample events	EC	pH	TDS	TSS	Calcium	Magnesium	Sodium	Potassium	Chloride	Sulphate	Calcium Carbonate	Bicarbonate	Carbonate	Hydroxide	Fluoride	Bromide	Ammonia as N	Nitrate (as N)	Nitrate (as NO3-)	Nitrite (as N)	Nitrite (as NO2-)	Phosphate (as P)
Number of Results	157	157	157	157	157	157	116	157	116	157	41	157	157	157	157	150	157	157	157	157	157	157
Number of Detects	157	157	157	88	157	157	116	157	112	157	41	157	73	7	157	150	128	157	157	97	88	136
Minimum Concentration	0	0	0	0	0	0	0	0	0	0	154000	0	0	0	0	0	0	0	0	0	0	0
Minimum Detect	636	7.4	340	10	17.3	15	29	15.9	0.005	11.4	154000	117	1	ND	0.3	0.37	0.005	0.04	0.16	0.005	0.01	0.005
Maximum Concentration	13500	8.8	9660	1590	456	659	2240	302	4490	1690	3660000	875	105	<1	6.9	33.1	1270	56.8	252	18.3	60.2	0.22
Maximum Detect	13500	8.8	9660	1590	456	659	2240	302	4490	1690	3660000	875	105	ND	6.9	33.1	1270	56.8	252	18.3	60.2	0.22
Average Concentration	2568	7.9	1653	43	88	77	301	38	442	233	694366	290	5.9	0.13	1.5	4	40	13	58	0.25	0.84	0.023
Median Concentration	2130	8.3	1350	10	81.4	55.4	234.5	35.2	368	191	557000	215	0.5	0.0005	0.9	3.05	0.015	13.5	58.7	0.005	0.02	0.02
Standard Deviation	1971	1.7	1375	142	67	87	298	28	612	250	550293	202	12	0.22	1.4	4.8	156	9.7	43	1.7	5.8	0.027
Number of Guideline Exceedances	0	50	142	0	0	0	87	0	73	35	0	0	0	0	77	0	30	150	150	2	5	0
Number of Guideline Exceedances(Detects Only)	0	50	142	0	0	0	87	0	73	35	0	0	0	0	77	0	30	150	150	2	5	0

					Metals															
					Aluminium	Antimony	Arsenic	Barium	Beryllium	Bismuth	Boron	Cadmium	Cerium	Cesium	Chromium (III+VI)	Cobalt	Copper	Dysprosium	Europium	Gadolinium
					mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
ADWG 2011 Aesthetic					**0.2**												**1**			
ADWG 2011 Health						0.003	0.01	2	0.06		4	0.002					2			
ANZECC 2000 FW 99%					0.027		0.0008				0.09	0.00006			0.00001		0.001			
ANZECC 2000 Irrigation - Long-term Trigger Values					5		0.1		0.1		0.5	0.01			0.1	0.05	0.2			
ANZECC 2000 Stock Watering					*5*		*0.5*				*5*	*0.01*			*1*	*1*	*0.5*			
Monitoring_Zone	**Location Code**	**Grouping**	**GW Basin**	**Location Type**																
Alluvial	RC00001	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	**0.167 - 0.366**	<0.00025	0.00035 - 0.0006	0.0386 - 0.0566	<0.00025	<0.00005	0.588 - 0.595	<0.0001	0.00015 - 0.0054	0.00069 - 0.00101	<0.0005 - 0.0014	0.00013 - 0.00061	0.0004 - 0.0009	<0.00005 - 0.00016	<0.00005 - 0.00006	<0.00005 - 0.0003
Alluvial	RC00002	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	0.043 - 0.17	<0.00025 - 0.0002	0.00035 - 0.001	0.042 - 0.0454	<0.00025	<0.00005	0.603 - 0.611	<0.0001	<0.00005 - 0.00015	0.00023 - 0.00073	<0.0005	0.00014 - 0.00032	0.00014 - 0.00026	<0.00005	<0.00005	<0.00005
Alluvial	RC00003	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	**0.152 - 0.301**	<0.00025	0.0003 - 0.00035	0.035 - 0.0454	<0.00025	<0.00005	0.751 - 0.783	<0.0001	0.00014 - 0.00018	0.00017 - 0.00049	<0.0005	0.00018 - 0.00069	0.0002 - 0.00078	<0.00005	<0.00005	<0.00005
Alluvial	RC00007	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	0.073 - 0.087	<0.00025 - 0.0003	0.00045 - 0.00065	0.0416 - 0.0668	<0.00025	<0.00005	0.718 - 0.782	<0.0001	0.00002 - 0.00021	0.00051 - 0.00082	<0.0005	0.00016 - 0.00119	0.0003 - 0.00357	<0.00005	<0.00005	<0.00005
Alluvial	RC00059	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	-	<0.00025	0.0003 - 0.0005	0.049 - 0.0558	<0.00025	<0.00005	0.416 - 0.515	<0.0001	0.00012 - 0.00188	0.00029 - 0.0004	<0.0005 - 0.0006	0.00009 - 0.00131	0.0003 - 0.00102	<0.00005 - 0.00009	<0.00005	<0.00005 - 0.00008
Alluvial	RC00060	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	-	<0.00025	0.00025 - 0.0004	0.048 - 0.0538	<0.00025	<0.00005	0.487 - 0.494	<0.0001	0.00047 - 0.00143	0.00033 - 0.00036	<0.0005	0.0002 - 0.00301	0.00011 - 0.00013	<0.00005 - 0.00006	<0.00005	<0.00005 - 0.00013
Alluvial	RC00084	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	0	<0.00025	0.00065	0.0332	<0.00025	<0.00005	0.695	<0.0001	<0.00005	0.00152	0.0011	0.00015	0.00098	<0.00005	<0.00005	<0.00005
Alluvial	RC00085	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	0	<0.00025	0.00025	0.0336	<0.00025	<0.00005	0.676	<0.0001	<0.00005	0.00452	0.0021	<0.00005	0.00153	<0.00005	<0.00005	<0.00005
Alluvial	RC00106	Margins Area	NE Burt	Aileron Station	**0 - 0.62**	<0.00005	<0.0005 - 0.0005	0.0392 - 0.1	<0.00005	<0.00001	0.43 - 0.68	<0.00002	<0.00001 - 0.00002	0.00008 - 0.00009	<0.005 - 0.0024	<0.00001 - 0.00002	<0.01 - 0.00039	<0.00001	<0.00001	<0.00001
Alluvial	RC00109	Margins Area	NE Burt	Aileron Station	<0.02 - 0	<0.00005	<0.0005 - 0.0004	0.05 - 0.0628	<0.00005	<0.00001	0.757 - 0.92	<0.00002	<0.00001	0.00004	<0.005 - 0.0035	<0.00001	<0.01 - 0.00009	<0.00001	<0.00001	<0.00001
Alluvial/Fluvial	RC00040	Margins Area	NE Burt/Arunta	Aileron Station	0	0.0003	0.00115	0.0892	<0.00005	0.00003	0.612	<0.00002	0.00104	0.00013	0.0009	0.00038	0.00072	0.00006	0.00002	0.00008
Alluvial/Fluvial	RC00044	Margins Area	NE Burt	Aileron Station	0	0.0001	0.0005	0.122	<0.00005	<0.00001	0.64	0.00002	0.00002	0.00015	0.0001	0.00011	0.00029	<0.00001	<0.00001	<0.00001
Alluvial/Fluvial	RC00045	Margins Area	NE Burt	Aileron Station	0	0.0004	0.0006	0.143	<0.00005	0.00001	0.306	0.00004	0.00072	0.00011	0.0028	0.00023	0.00152	0.00005	0.00002	0.00006
Alluvial/Fluvial	RC00046	Margins Area	NE Burt	Aileron Station	-	<0.001	<0.001	0.231	<0.001	<0.0002	3.13	<0.0004	0.00303	<0.0002	<0.002	0.00675	0.0018	<0.0002	<0.0002	<0.0002
Alluvial/Fluvial	RC00047	Margins Area	NE Burt	Aileron Station	-	0.0001	0.00075	0.107	<0.00005	<0.00001	0.538	0.00002	0.00166	0.00009	0.0011	0.00175	0.0028	0.00003	0.00001	0.00005
Alluvial/Fluvial	RC00048	Margins Area	NE Burt	Aileron Station	0	0.00055	0.00115	0.16	<0.00005	0.00001	0.568	<0.00002	0.00012	0.00008	0.0002	0.00035	0.00022	<0.00001	<0.00001	0.00001
Alluvial/Fluvial	RC00049	Margins Area	NE Burt	Aileron Station	0	<0.00005	0.0003	0.0438	0.00005	0.00005	0.471	0.00004	0.00186	0.00011	0.0005	0.00075	0.00262	0.00013	0.00003	0.00011
Alluvial/Fluvial	RC00053	Margins Area	NE Burt	Aileron Station	0	<0.00005	0.0007	0.108 - 0.166	<0.00005	<0.00001 - 0.00001	0.291 - 0.307	<0.00002	0.00029 - 0.00054	0.00016 - 0.00017	0.0008 - 0.0011	0.00008 - 0.00011	0.00028 - 0.00091	0.00002 - 0.00005	<0.00001 - 0.00002	0.00003 - 0.00007
Alluvial/Fluvial	RC00057	Margins Area	NE Burt	Aileron Station	-	0.0001	0.0004	0.071	<0.00005	<0.00001	0.584	<0.00002	0.00066	0.00017	0.0015	0.00072	0.00075	0.00005	<0.00001	0.00005
Calcrete	RC00100	Margins Area	Arunta Basement	Aileron Station	0	0.0001	0.0003	0.14	<0.00005	<0.00001	0.345	<0.00002	0.00002	0.00004	0.0005	0.00003	0.00012	<0.00001	<0.00001	<0.00001
Calcrete	RC00103	Margins Area	NE Burt	Aileron Station	0	<0.00025	0.0006	0.0464	<0.00025	<0.00005	0.486	<0.0001	<0.00005	0.00011	0.0018	<0.00005	0.0109	<0.00005	<0.00005	<0.00005
Calcrete	RC00104	Margins Area	Ti Tree	Aileron Station	0	<0.00005	0.0003	0.0356	<0.00005	<0.00001	0.354	<0.00002	<0.00001	0.00007	0.0006	0.00002	0.00039	<0.00001	<0.00001	<0.00001
Calcrete/Alluvial	RC00052	Margins Area	Ti Tree/Arunta	Aileron Station	-	0.00005	0.00015	0.104	<0.00005	<0.00001	0.411	<0.00002	0.00066	0.00007	0.0006	0.00092	0.00037	0.00007	0.00002	0.00009
Calcrete/Alluvial/Fluvial	RC00030	Margins Area	NE Burt	Aileron Station	0	0.0001	0.0006	0.0536	<0.00005	<0.00001	0.427	<0.00002	0.00005	0.00012	0.0037	0.00039	0.0006	<0.00001	<0.00001	<0.00001
Calcrete/Alluvial/Fluvial	RC00031	Margins Area	Ti Tree	Aileron Station	**1.32**	0.0002	0.0004	0.0822	0.00005	0.00002	0.428	0.00004	0.00329	0.00018	0.0112	0.00059	0.00204	0.00018	0.00005	0.00023
Calcrete/Alluvial/Fluvial	RC00033	Margins Area	Ti Tree	Aileron Station	0	0.0002	0.00055	0.0976	<0.00005	0.00001	0.364	<0.00002	0.0182	0.00034	0.0008	0.00095	0.0009	0.00074	0.00048	0.00161
Calcrete/Basement	RC00032	Margins Area	Ti Tree/Arunta	Aileron Station	**3.12**	0.0002	0.00255	0.0952	0.0001	0.00003	0.387	0.00004	0.00849	0.00043	0.0095	0.00091	0.00359	0.00041	0.00015	0.00061
Calcrete/Basement	RC00035	Margins Area	Ti Tree/Arunta	Aileron Station	0	<0.00005	0.00055	0.228	<0.00005	<0.00001	0.233	<0.00002	0.00008	0.00004	0.0002	0.00025	0.00017	<0.00001	<0.00001	<0.00001
Calcrete/Basement	RC00036	Margins Area	Ti Tree/Arunta	Aileron Station	0	0.00005	0.0006	0.368	<0.00005	<0.00001	0.171	<0.00002	0.00011	0.00008	0.0012	0.00007	0.00019	<0.00001	<0.00001	0.00002
Calcrete/Basement	RC00037	Margins Area	Ti Tree/Arunta	Aileron Station	**1.4**	<0.00005 - 0.0001	0.0004 - 0.0005	0.157 - 0.16	<0.00005 - 0.00005	<0.00001	0.397 - 0.399	<0.00002	0.00043 - 0.00391	0.00011 - 0.00027	0.0044 - 0.0071	0.00017 - 0.00078	0.00208 - 0.00231	0.00003 - 0.0002	<0.00001 - 0.00007	0.00003 - 0.00028
Calcrete/Basement	RC00041	Margins Area	NE Burt/Arunta	Aileron Station	0	0.0001	0.0009	0.0726	<0.00005	<0.00001	0.602	<0.00002	0.00024	0.00009	0.0037	0.00014	0.00048	0.00002	0.00001	0.00002
Calcrete/Basement	RC00042	Margins Area	NE Burt	Aileron Station	***7***	0.0014	0.0022	0.0838	0.0002	0.0007	0.474	0.00014	0.0127	0.00063	0.016	0.00305	0.017	0.00135	0.00036	0.00152
Calcrete/Basement	RC00043	Margins Area	NE Burt	Aileron Station	0	0.00045	0.00035	0.0912	<0.00005	0.00001	0.545	<0.00002	0.00535	0.00005	0.0015	0.00067	0.0022	0.00024	0.00009	0.00035
Calcrete/Basement	RC00050	Margins Area	NE Burt/Arunta	Aileron Station	**0 - 2.2**	<0.0005 - 0.0003	<0.0005 - 0.0013	0.0804 - 0.214	<0.0005 - 0.00015	<0.0001 - 0.00002	0.558 - 3.17	<0.0002 - 0.00006	0.00518 - 0.0419	<0.0001 - 0.00096	0.0032 - 0.0156	0.00092 - 0.00777	0.00362 - 0.0105	<0.0001 - 0.00172	<0.0001 - 0.00045	0.00015 - 0.00179
Calcrete/Basement	RC00054	Margins Area	NE Burt/Arunta	Aileron Station	**2.24**	0.0003	0.0002	0.0804	0.00015	0.00002	0.558	0.00006	0.0232	0.00025	0.0061	0.00092	0.00362	0.00051	0.0002	0.00066
Calcrete/Basement	RC00056	Margins Area	Ti Tree/Arunta	Aileron Station	-	<0.00025	<0.00025	0.061	<0.00025	<0.00005	0.544	<0.0001	0.00111	0.00007	0.0012	0.00177	0.00007	0.00007	<0.00005	0.00012
Reaphook Paleochannel	RC00004	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	**0 - 0.917**	<0.00005	0.00025 - 0.00035	0.0374 - 0.0548	<0.00005	<0.00001	0.574 - 0.652	<0.00002	<0.00005 - 0.00102	0.0002 - 0.00065	<0.0005 - 0.001	0.00001 - 0.00031	0.00028 - 0.0009	<0.00001 - 0.00006	<0.00001	<0.00001 - 0.00007
Reaphook Paleochannel	RC00006	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	**0.326 - 0.396**	0.0002 - 0.0003	0.00115 - 0.00125	0.0584 - 0.0602	<0.00025	<0.00005	0.668 - 0.68	<0.0001	0.00082 - 0.00116	0.00012 - 0.00016	<0.0005	0.0008 - 0.00088	0.0006 - 0.00107	0.00006 - 0.00007	<0.00005	0.00006 - 0.00011
Reaphook Paleochannel	RC00012	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	**0.764 - 0.868**	<0.00025	0.00055 - 0.00065	0.0486 - 0.0504	<0.00025	<0.00005	0.573 - 0.578	<0.0001	0.00125 - 0.00146	0.00042 - 0.00046	0.0006	0.00089 - 0.00095	0.0124 - 0.0171	0.00008 - 0.00009	<0.00005	0.00009 - 0.00011
Reaphook Paleochannel	RC00013	Southern Basins - Reaphook	Eastern Mt Wedge	Aileron Station	0.081 - 0.175	<0.00025	0.0004	0.0812 - 0.0942	<0.00025	<0.00005	0.507 - 0.532	<0.0001	0.00022 - 0.00024	0.00016 - 0.00021	<0.0005 - 0.0025	0.00027 - 0.00086	0.00081 - 0.00188	<0.00005	<0.00005	<0.00005
Reaphook Paleochannel	RC00014	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	0	<0.00025 - 0.0001	<0.00025 - 0.00055	0.0406 - 0.0484	<0.00005	<0.00001	0.513 - 0.648	<0.00002	0.00037 - 0.00056	0.00024 - 0.00028	<0.0005 - 0.0015	<0.00005 - 0.0001	<0.00005 - 0.00009	<0.00005 - 0.00002	<0.00001	<0.00005 - 0.00003
Reaphook Paleochannel	RC00015	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	**0 - 1.76**	0.0001 - 0.0011	0.00055 - 0.0006	0.0406 - 0.057	<0.00005 - 0.0001	<0.00001 - 0.00002	0.648 - 0.671	<0.00002 - 0.00008	0.00037 - 0.00417	0.00024 - 0.00119	0.0015 - 0.0018	0.0001 - 0.0013	0.00009 - 0.00218	0.00002 - 0.00025	<0.00001 - 0.00007	0.00003 - 0.00035
Reaphook Paleochannel	RC00016	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	0	<0.00025	<0.00025	0.0424	<0.00025	<0.00005	0.618	<0.0001	0.00042	0.00029	<0.0005	0.0004	0.00034	<0.00005	<0.00005	<0.00005
Reaphook Paleochannel	RC00017	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	**0 - 1.78**	<0.00005	0.0002 - 0.0003	0.0418 - 0.0466	<0.00005 - 0.0001	<0.00001 - 0.00002	0.648 - 0.652	<0.00002	0.00039 - 0.00395	0.00007 - 0.00035	0.0001 - 0.0014	0.0006 - 0.0008	0.00019 - 0.00057	0.00002 - 0.00015	<0.00001 - 0.00005	0.00003 - 0.0002
Reaphook Paleochannel	RC00018	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	0	<0.00025 - 0.0034	0 - 0.00585	0 - 0.0626	<0.00005 - 0	<0.00001 - 0.00002	0 - 0.622	<0.00002 - 0.00004	0 - 0.00461	0 - 0.00656	<0.001 - 0.0019	0 - 0.00634	0 - 0.00409	<0.00001 - 0.00018	<0.00001 - 0.00009	<0.0001 - 0.00038
Reaphook Paleochannel	RC00019	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	-	<0.00025	0.00045	0.0374	<0.00025	<0.00005	0.5	<0.0001	0.0007	0.00034	<0.0005	0.0005	0.00035	<0.00005	<0.00005	<0.00005
Reaphook Paleochannel	RC00021	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	-	<0.00025 - 0	0 - 0.00035	0 - 0.0398	<0.00025 - 0	<0.00005 - 0	0 - 0.54	<0.0001 - 0	0 - 0.00051	0 - 0.0005	<0.0005 - 0.0019	0 - 0.0007	0 - 0.00365	<0.00005 - 0	<0.00005 - 0	<0.00005 - 0
Reaphook Paleochannel	RC00022	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	-	<0.00005 - 0.00005	0.0003 - 0.0004	0.0432 - 0.0456	<0.00005	<0.00001	0.589 - 0.615	<0.00002	<0.00001 - 0.00009	0.00042 - 0.00087	0.0006 - 0.0008	0.00012 - 0.00042	0.00225 - 0.107	<0.00001	<0.00001	<0.00001
Reaphook Paleochannel	RC00023	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	0	<0.00025	0.0007	0.0312	<0.00025	<0.00005	0.506	<0.0001	0.00029	0.00014	0.0005	0.00031	0.00019	<0.00005	<0.00005	<0.00005
Reaphook Paleochannel	RC00024	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	0	<0.00025	0.0005 - 0.00065	0.0306 - 0.0376	<0.00025	<0.00005	0.473 - 0.548	<0.0001	0.0003 - 0.00057	0.00018 - 0.00021	<0.0005	0.00048 - 0.00115	0.00023 - 0.00027	<0.00005	<0.00005	<0.00005 - 0.00006
Reaphook Paleochannel	RC00025	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	0	<0.00025	<0.00025 - 0.0006	0.0356 - 0.0654	<0.00025	<0.00005 - 0.00008	0.478 - 0.508	<0.0001	<0.00005 - 0.00971	0.00037 - 0.00181	0.0012 - 0.0023	0.00018 - 0.00073	0.00057 - 0.00393	<0.00005 - 0.00049	<0.00005 - 0.00013	<0.00005 - 0.00056
Reaphook Paleochannel	RC00026	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	***0 - 9.52***	<0.00005 - 0.00005	0 - 0.00195	0 - 0.147	<0.00005 - 0.0012	<0.00005 - 0.00033	0 - 0.599	<0.00002 - 0.00002	<0.00005 - 0.0976	0 - 0.00314	<0.0005 - 0.0173	0 - 0.00867	0 - 0.00908	<0.00005 - 0.00304	<0.00005 - 0.00106	<0.00005 - 0.00554
Reaphook Paleochannel	RC00028	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	-	<0.00025	0.00025 - 0.0008	0.0462 - 0.0604	<0.00025	<0.00005	0.433 - 0.465	<0.0001	<0.00005 - 0.00607	0.00022 - 0.0006	<0.0005 - 0.0019	0.00006 - 0.00091	0.00028 - 0.00582	<0.00005 - 0.0003	<0.00005 - 0.00008	<0.00005 - 0.00035
Reaphook Paleochannel	RC00061	Southern Basins - Reaphook	Eastern Whitcherry	Public Road	0	<0.00025	0.00105	0.0436	<0.00025	<0.00005	0.737	<0.0001	<0.00005	<0.00005	0.0006	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Ti Tree Basin Aquifer	RC00092	Ti Tree Basins	Ti Tree	Aileron Station	0	<0.00005	0.00075	0.0426 - 0.0436	<0.00005	<0.00001	0.589 - 0.636	<0.00002	<0.00005 - 0.00006	0.00517 - 0.0052	0.0019 - 0.002	<0.00005 - 0.00004	0.00042 - 0.00045	<0.00001	<0.00001	<0.00001
Unknown	RC00198	N/A	Unknown	Aileron Station	0.04	<0.0002	<0.0005	<0.05	<0.001	-	0.44	<0.0002	-	-	<0.005	-	<0.01	-	-	-
Unknown	RC00222	N/A	Unknown	Aileron Roadhouse	0 - 0.007	<0.00025	0.00085 - 0.00125	0.0444 - 0.0486	<0.00025	<0.00005	0.808 - 0.841	<0.0001	<0.00005	<0.00005	<0.0005	<0.00005	0.00031 - 0.00055	<0.00005	<0.00005	<0.00005
Unknown	RC00344	Margins Area	Unknown	Yambah Station	<0.02	<0.0002	0.0005	<0.05	<0.001	-	0.5	<0.0002	-	-	<0.005	-	<0.01	-	-	-
Weathered Basement	RC00005	Southen Basins - Basement	Eastern Whitcherry	Aileron Station	**0.194 - 0.344**	0.0018	0.0015 - 0.0017	0.15 - 0.152	<0.00025	<0.00005	0.656 - 0.685	<0.0001	0.00044 - 0.00072	0.00053 - 0.00055	<0.0005	0.00131 - 0.0014	0.00091 - 0.00182	<0.00005	<0.00005	<0.00005 - 0.00007
Weathered Basement	RC00027	Southern Basins - RC00027 - Basement	Eastern Whitcherry	Aileron Station	**1.2**	<0.00005	0.00075 - 0.0008	0.0296 - 0.0404	<0.00005 - 0.00005	<0.00001 - 0.00004	0.534 - 0.574	<0.00002	0.00002 - 0.0121	0.00014 - 0.00032	0.0043 - 0.0053	0.00007 - 0.00272	0.00017 - 0.00383	<0.00001 - 0.00041	<0.00001 - 0.00012	<0.00001 - 0.00049
Weathered Basement	RC00062	Mine Area - Basement	Arunta Basement	Aileron Station	<0.02	<0.0002	<0.0005 - 0.0005	<0.05	<0.001	-	1.48 - 1.58	<0.0002	-	-	<0.005	-	0.02	-	-	-
Weathered Basement	RC00063	Mine Area - Basement	Arunta Basement	Aileron Station	**0 - 2.14**	<0.00025 - 0.0006	0.0015 - 0.0037	0.05 - 0.0914	<0.00025 - 0.00035	<0.00005	0.847 - 0.983	<0.0001	<0.00005 - 0.00019	0.00008 - 0.00019	<0.0005 - 0.01	0.00008 - 0.00018	<0.01 - 0.00173	<0.00005	<0.00005	<0.00005
Weathered Basement	RC00064	Mine Area - Basement	Arunta Basement	Aileron Station	**<0.02 - 1.9**	<0.0005	0.001 - 0.003	<0.05 - 0.1	<0.001	-	0.62 - 0.9	<0.0002	-	-	<0.005	-	<0.01	-	-	-
Weathered Basement	RC00075	Mine Area - Basement	Arunta Basement	Aileron Station	0 - 0.012	<0.00025	0.00125 - 0.00195	0.0274 - 0.033	<0.00025	<0.00005 - 0.00044	1.62 - 1.77	<0.0001 - 0.0005	<0.00005	<0.0001 - 0.00054	<0.0005	0.00022 - 0.00074	0.00038 - 0.00621	<0.00005	<0.00005	<0.00005
Weathered Basement	RC00078	Southern Basins - Basement	Arunta Basement	Aileron Station	0	<0.00025	0.00275	0.0748	0.00055	<0.00005	1.18	<0.0001	<0.00005	0.0002	<0.0005	<0.00005	0.00046	<0.00005	<0.00005	<0.00005
Weathered Basement	RC00079	Southern Basins - Basement	Arunta Basement	Aileron Station	0	<0.00025	0.0032	0.0878	0.00065	<0.00005	1.37	<0.0001	<0.00005	0.00023	<0.0005	<0.00005	0.00013	<0.00005	<0.00005	<0.00005
Weathered Basement	RC00081	Southern Basins - Basement	Arunta Basement	Aileron Station	<0.02 - 0	<0.0002	<0.0005 - 0.00155	<0.05 - 0.0466	<0.001	<0.0002	0.62 - 3.07	<0.0002	<0.0002	0.00051	<0.002	<0.0002	0.00085 - 0.03	<0.0002	<0.0002	<0.0002
Weathered Basement	RC00083	N/A	Arunta Basement	Aileron Roadhouse	0	<0.00025	0.00085	0.047	<0.00025	<0.00005	0.789	<0.0001	0.00212	0.0001	0.0009	<0.00005	0.0137	<0.00005	<0.00005	0.00006
Weathered Basement	RC00086	Margins Area	Arunta Basement	Aileron Station	<0.02 - 0	<0.00025	<0.001 - 0.00045	<0.05 - 0.0552	<0.00025	<0.00005	1.7 - 3.34	<0.0001	<0.00005	<0.00005	<0.0005 - 0.0016	<0.00005	<0.00005 - 0.00082	<0.00005	<0.00005	<0.00005
Weathered Basement	RC00098	Margins Area	Arunta Basement	Aileron Station	-	<0.00005	0.00025	0.134	<0.00005	<0.00001	0.452	<0.00002	0.00064	0.00008	0.0005	0.00033	0.00017	0.00002	0.00001	0.00004
Weathered Basement	RC00099	Margins Area	Arunta Basement	Aileron Station	<0.02 - 0	<0.00005	<0.0005 - 0.0001	<0.05 - 0.0994	<0.00005	<0.00001	0.637 - 1.82	<0.00002	0.00005 - 0.00081	0.00006 - 0.00008	<0.005 - 0.0023	<0.00001 - 0.00002	<0.00001 - 0.00008	<0.00001 - 0.00003	<0.00001 - 0.00002	<0.00001 - 0.00005

Statistical Summary - all sample events	Aluminium	Antimony	Arsenic	Barium	Beryllium	Bismuth	Boron	Cadmium	Cerium	Cesium	Chromium (III+VI)	Cobalt	Copper	Dysprosium	Europium	Gadolinium
Number of Results	107	150	150	150	150	138	150	150	138	138	150	138	150	138	138	135
Number of Detects	99	42	137	142	23	30	150	19	106	129	92	121	137	55	37	62
Minimum Concentration	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Minimum Detect	0.004	0.00005	0.0001	0.0274	0.00005	0.00001	0.171	0.00002	0.00001	0.00004	0.0001	0.00001	0.00007	0.00001	0.00001	0.00001
Maximum Concentration	9.52	0.0034	0.00585	0.368	0.0012	0.0007	3.34	0.0005	0.0976	0.00656	0.0173	0.00867	0.107	0.00304	0.00106	0.00554
Maximum Detect	9.52	0.0034	0.00585	0.368	0.0012	0.0007	3.34	0.0005	0.0976	0.00656	0.0173	0.00867	0.107	0.00304	0.00106	0.00554
Average Concentration	0.52	0.0002	0.00078	0.065	0.00015	0.000035	0.7	0.00005	0.003	0.00059	0.0018	0.00069	0.0031	0.00013	0.000052	0.00018
Median Concentration	0	0.000125	0.0005	0.0481	0.000125	0.000025	0.574	0.00005	0.000215	0.00023	0.0008	0.00027	0.00086	0.000025	0.000025	0.000025
Standard Deviation	1.5	0.00037	0.00083	0.049	0.00017	0.000078	0.53	0.000053	0.011	0.0011	0.003	0.0014	0.0095	0.00039	0.00012	0.0006
Number of Guideline Exceedances	36	1	44	0	0	0	144	97	0	0	144	0	66	0	0	0
Number of Guideline Exceedances(Detects Only)	36	1	42	0	0	0	144	5	0	0	86	0	57	0	0	0

Metals

Monitoring_Zone	Location Code	Grouping	GW Basin	Location Type	Gallium	Gold	Hafnium	Holmium	Indium	Iron	Lanthanum	Lead	Lithium	Manganese	Mercury	Molybdenum	Neodymium	Nickel	Niobium	Osmium	Palladium
					mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	ug/L
ADWG 2011 Aesthetic										0.3				0.1							
ADWG 2011 Health												0.01		0.5	0.001	0.05		0.02			
ANZECC 2000 FW 99%												0.001		1.2	0.00006			0.008			
ANZECC 2000 Irrigation - Long-term Trigger Values										0.2		0.2	2.5	0.2	0.002	0.01		0.2			
ANZECC 2000 Stock Watering												*0.1*			*0.002*	*0.15*		*1*			
Monitoring_Zone	**Location Code**	**Grouping**	**GW Basin**	**Location Type**																	
Alluvial	RC00001	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	<0.00005 - 0.00018	<0.00005	<0.00005	<0.00005	<0.00005	0.06 - 0.1	0.00008 - 0.00216	0.00016 - 0.00036	0.0015 - 0.0105	0.00482 - 0.0137	<0.0001	0.0011 - 0.00175	0.00005 - 0.0021	0.00068 - 0.00138	<0.1	<0.5	<0.25
Alluvial	RC00002	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	<0.00005 - 0.00009	<0.00005	<0.00005	<0.00005	<0.00005	0.02 - 0.058	<0.00005 - 0.00012	0.00006 - 0.00011	0.002 - 0.0065	0.00851 - 0.0156	<0.0001	0.00305 - 0.00415	<0.00005 - 0.0001	0.00043 - 0.00079	<0.1	<0.5	<0.25
Alluvial	RC00003	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	0.00007 - 0.00008	<0.00005	<0.00005	<0.00005	<0.00005	0.074 - 0.194	0.00013 - 0.0002	0.00005 - 0.00018	0.002 - 0.0025	0.0152 - 0.0385	<0.0001	0.00175	0.00015 - 0.00019	0.00073 - 0.00115	<0.1	<0.5	<0.25
Alluvial	RC00007	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.028 - 0.032	<0.00005 - 0.00021	0.00005 - 0.00019	0.001 - 0.0045	0.0138 - 0.0519	<0.0001	0.0024 - 0.00395	<0.00005 - 0.00019	0.00057 - 0.00102	<0.1	<0.5	<0.25
Alluvial	RC00059	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	<0.00005 - 0.00028	0.00009 - 0.00015	<0.00005	<0.00005	<0.00005	-	0.00006 - 0.00118	<0.00005 - 0.00031	0.00065 - 0.0039	0.00979 - 0.103	<0.0001	0.00125 - 0.0105	<0.00005 - 0.00081	0.00079 - 0.00498	<0.1	<0.5	<0.25
Alluvial	RC00060	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	<0.00005	0.00009 - 0.0001	<0.00005	<0.00005	<0.00005	-	0.00017 - 0.00056	0.00006 - 0.0001	0.00045 - 0.0076	0.0298 - 0.0413	<0.0001	0.00175 - 0.0043	0.00016 - 0.00089	0.00091 - 0.00155	<0.1	<0.5	<0.25
Alluvial	RC00084	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	<0.00005	<0.00025	<0.00005	<0.00005	<0.00005	0	<0.00005	<0.00005	0.00075	0.159	<0.0001	0.0012	<0.00005	0.00039	<0.1	<0.5	<0.25
Alluvial	RC00085	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0	<0.00005	0.00014	0.00095	0.00342	<0.0001	0.00095	<0.00005	0.00251	<0.1	<0.5	<0.25
Alluvial	RC00106	Margins Area	NE Burt	Aileron Station	<0.00001	0.00003 - 0.00021	<0.00001	<0.00001	<0.00001 - 0.00001	0 - 0.6	<0.00001 - 0.00001	0.00002 - 0.002	0.0001	<0.005 - 0.00017	<0.00002	0.0016 - 0.005	<0.00001 - 0.00001	<0.002 - 0.00043	<0.02	<0.1	<0.05
Alluvial	RC00109	Margins Area	NE Burt	Aileron Station	<0.00001	0.00002	<0.00001	<0.00001	<0.00001	<0.02 - 0	<0.00001	<0.001 - 0.00001	0.00015	<0.005 - 0.00049	<0.00002	<0.005 - 0.00095	<0.00001	<0.002 - 0.00012	<0.02	<0.1	<0.05
Alluvial/Fluvial	RC00040	Margins Area	NE Burt/Arunta	Aileron Station	0.00015	<0.00001	0.00002	0.00001	<0.00001	0	0.0004	0.00032	0.0026	0.04	<0.00002	0.0105	0.00046	0.00107	<0.02	<0.1	<0.05
Alluvial/Fluvial	RC00044	Margins Area	NE Burt	Aileron Station	0.00003	0.00001	<0.00001	<0.00001	<0.00001	0	<0.00001	0.00002	0.0021	0.00719	<0.00002	0.0145	0.00001	0.00022	<0.02	<0.1	<0.05
Alluvial/Fluvial	RC00045	Margins Area	NE Burt	Aileron Station	0.00011	<0.00001	<0.00001	<0.00001	<0.00001	0	0.00031	0.00988	0.0009	0.0163	<0.00002	0.00095	0.00036	0.00143	0.1	<0.1	<0.05
Alluvial/Fluvial	RC00046	Margins Area	NE Burt	Aileron Station	0.00037	0.00083	<0.0002	<0.0002	<0.0002	680	0.00185	<0.0002	0.0385	0.464	<0.0004	0.0105	0.00203	0.0196	<0.4	<2	<1
Alluvial/Fluvial	RC00047	Margins Area	NE Burt	Aileron Station	0.00015	0.00013	<0.00001	<0.00001	<0.00001	352	0.00043	0.00172	0.0105	0.0977	<0.00002	0.00465	0.00042	0.00554	0.06	<0.1	<0.05
Alluvial/Fluvial	RC00048	Margins Area	NE Burt	Aileron Station	0.00002	<0.00001	0.00001	<0.00001	<0.00001	0	0.00005	0.00005	0.0063	0.0525	<0.00002	0.0071	0.00008	0.00093	<0.02	<0.1	<0.05
Alluvial/Fluvial	RC00049	Margins Area	NE Burt	Aileron Station	0.00014	0.00004	<0.00001	0.00003	0.00005	0	0.00055	0.00029	0.0052	0.0487	<0.00002	0.00325	0.00065	0.00298	0.04	<0.1	<0.05
Alluvial/Fluvial	RC00053	Margins Area	NE Burt	Aileron Station	0.00003 - 0.00013	<0.00001	<0.00001	<0.00001	<0.00001	0	0.00019 - 0.00078	0.00007 - 0.00016	0.002	0.00299 - 0.00357	<0.00002	0.0023 - 0.00375	0.00021 - 0.0007	0.00013 - 0.00018	<0.02	<0.1	<0.05
Alluvial/Fluvial	RC00057	Margins Area	NE Burt	Aileron Station	0.00013	0.00016	<0.00001	<0.00001	<0.00001	288	0.00032	0.00254	0.012	0.0544	<0.00002	0.00485	0.00032	0.00159	0.06	<0.1	<0.05
Calcrete	RC00100	Margins Area	Arunta Basement	Aileron Station	<0.00001	0.00002	<0.00001	<0.00001	<0.00001	0	0.00002	0.00004	0.00175	0.00815	<0.00002	0.00105	0.00001	0.00011	<0.02	<0.1	<0.05
Calcrete	RC00103	Margins Area	NE Burt	Aileron Station	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0	<0.00005	0.0033	<0.00025	0.0204	<0.0001	0.0012	<0.00005	0.00021	<0.1	<0.5	<0.25
Calcrete	RC00104	Margins Area	Ti Tree	Aileron Station	<0.00001	0.00003	<0.00001	<0.00001	<0.00001	0	<0.00001	0.00002	0.0002	0.00816	<0.00002	0.0025	<0.00001	0.00007	<0.02	<0.1	<0.05
Calcrete/Alluvial	RC00052	Margins Area	Ti Tree/Arunta	Aileron Station	0.00008	0.00014	<0.00001	0.00001	<0.00001	186	0.00056	0.00036	0.00195	0.0748	<0.00002	0.00435	0.00058	0.00253	0.04	<0.1	<0.05
Calcrete/Alluvial/Fluvial	RC00030	Margins Area	NE Burt	Aileron Station	0.00001	<0.00001	0.00003	<0.00001	<0.00001	0	0.00002	0.00003	0.0016	0.0207	<0.00002	0.00725	0.00003	0.00119	0.04	<0.1	<0.05
Calcrete/Alluvial/Fluvial	RC00031	Margins Area	Ti Tree	Aileron Station	0.00035	<0.00001	0.00003	0.00003	0.00001	1.1	0.00146	0.00431	0.0007	0.0278	<0.00002	0.00285	0.00182	0.00353	0.1	<0.1	<0.05
Calcrete/Alluvial/Fluvial	RC00033	Margins Area	Ti Tree	Aileron Station	0.00004	<0.00001	0.00002	0.00011	<0.00001	0	0.0127	0.00284	0.00325	0.0383	<0.00002	0.0115	0.0146	0.00067	0.12	<0.1	<0.05
Calcrete/Basement	RC00032	Margins Area	Ti Tree/Arunta	Aileron Station	0.00096	<0.00001	0.00002	0.00007	0.00001	3.35	0.0042	0.0124	0.0015	0.0391	<0.00002	0.00305	0.00439	0.00353	0.12	<0.1	<0.05
Calcrete/Basement	RC00035	Margins Area	Ti Tree/Arunta	Aileron Station	0.00004	<0.00001	<0.00001	<0.00001	<0.00001	0	0.00003	0.00004	0.0006	0.04	<0.00002	0.0024	0.00006	0.00086	<0.02	<0.1	<0.05
Calcrete/Basement	RC00036	Margins Area	Ti Tree/Arunta	Aileron Station	0.00002	<0.00001	0.00001	<0.00001	<0.00001	0	0.00005	0.00003	0.0007	0.00211	<0.00002	0.0023	0.00008	0.00025	<0.02	<0.1	<0.05
Calcrete/Basement	RC00037	Margins Area	Ti Tree/Arunta	Aileron Station	0.00009 - 0.00051	0.00004 - 0.0001	<0.00001	<0.00001 - 0.00004	<0.00001	1.55 - 240	0.00022 - 0.002	0.00062 - 0.00311	0.00045 - 0.0009	0.00771 - 0.0124	<0.00002	0.0019 - 0.002	0.00021 - 0.00193	0.00083 - 0.00222	0.04 - 0.28	<0.1	<0.05
Calcrete/Basement	RC00041	Margins Area	NE Burt/Arunta	Aileron Station	0.00006	<0.00001	<0.00001	<0.00001	<0.00001	0	0.00014	0.00043	0.0006	0.00606	<0.00002	0.00185	0.00017	0.00054	<0.02	<0.1	<0.05
Calcrete/Basement	RC00042	Margins Area	NE Burt	Aileron Station	0.00166	<0.00001	0.00004	0.00027	0.00002	6.55	0.00549	0.0162	0.00495	0.115	<0.00002	0.00375	0.0067	0.00755	0.36	<0.1	<0.05
Calcrete/Basement	RC00043	Margins Area	NE Burt	Aileron Station	0.00005	<0.00001	0.00001	0.00004	<0.00001	0	0.0029	0.00072	0.0165	0.0538	<0.00002	0.02	0.00271	0.0018	0.04	<0.1	<0.05
Calcrete/Basement	RC00050	Margins Area	NE Burt/Arunta	Aileron Station	0.00044 - 0.0043	<0.0002 - 0.00038	<0.00001	<0.0001 - 0.00029	<0.00001	0 - 1220	0.00141 - 0.0129	0.00024 - 0.00802	0.00785 - 0.0505	0.0306 - 0.385	<0.00002	0.0019 - 0.0105	0.00094 - 0.0112	0.00441 - 0.0199	<0.2 - 0.54	<0.1	<0.05
Calcrete/Basement	RC00054	Margins Area	NE Burt/Arunta	Aileron Station	0.00053	0.00005	<0.00001	0.0001	<0.00001	2.05	0.00534	0.00802	0.00785	0.0306	<0.00002	0.0019	0.00535	0.00441	0.38	<0.1	<0.05
Calcrete/Basement	RC00056	Margins Area	Ti Tree/Arunta	Aileron Station	0.0002	0.0002	<0.00005	<0.00005	<0.00005	796	0.00064	0.00048	0.014	0.175	<0.0001	0.00905	0.00076	0.00207	0.12	<0.5	<0.25
Reaphook Paleochannel	RC00004	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	<0.00001 - 0.00032	<0.00005 - 0.00007	<0.00001	<0.00001	<0.00001	0 - 0.392	<0.00001 - 0.00055	<0.00001 - 0.0005	0.00035 - 0.0065	0.00033 - 0.0342	<0.00002	0.0094 - 0.015	<0.00005 - 0.0005	0.00039 - 0.00058	<0.02 - 0.16	<0.1	<0.05
Reaphook Paleochannel	RC00006	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	0.00009	<0.00005	<0.00005	<0.00005	<0.00005	0.264 - 0.322	0.00035 - 0.00091	0.00034 - 0.00059	0.0055 - 0.006	0.0523 - 0.0619	<0.0001	0.0025 - 0.0027	0.00041 - 0.00053	0.00144 - 0.00149	<0.1	<0.5	<0.25
Reaphook Paleochannel	RC00012	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	0.00016 - 0.00023	<0.00005	<0.00005	<0.00005	<0.00005	0.34 - 0.45	0.00068 - 0.00072	0.00037 - 0.00043	0.0015	0.061 - 0.0628	<0.0001	0.00305 - 0.0033	0.00064 - 0.00073	0.00181 - 0.00204	<0.1	<0.5	<0.25
Reaphook Paleochannel	RC00013	Southern Basins - Reaphook	Eastern Mt Wedge	Aileron Station	<0.00005 - 0.00008	<0.00005	<0.00005	<0.00005	<0.00005	0.046 - 0.08	0.00012 - 0.00013	0.00017 - 0.00021	0.0015 - 0.0025	0.00087 - 0.0731	<0.0001	0.00145 - 0.0026	0.00011 - 0.00014	0.00149 - 0.00251	<0.1	<0.5	<0.25
Reaphook Paleochannel	RC00014	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	<0.00005 - 0.00005	<0.00005 - 0.00007	<0.00001	<0.00001	<0.00001	0	0.00018 - 0.0002	<0.00005 - 0.00005	0.0004 - 0.00075	0.00486 - 0.00916	<0.00002	0.0022 - 0.0023	0.00012 - 0.00015	0.0001 - 0.00026	<0.02	<0.1	<0.05
Reaphook Paleochannel	RC00015	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	0.00005 - 0.00047	0.00007	<0.00001 - 0.00005	<0.00001 - 0.00005	<0.00001	0	0.0002 - 0.00196	0.00005 - 0.0018	0.00075 - 0.00735	0.00486 - 0.00917	<0.00002	0.0023 - 0.0025	0.00015 - 0.00308	0.0001 - 0.00182	<0.02 - 0.2	<0.1	<0.05
Reaphook Paleochannel	RC00016	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0	0.00022	<0.00005	0.001	0.0337	<0.0001	0.0022	0.00017	0.00184	<0.1	<0.5	<0.25
Reaphook Paleochannel	RC00017	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	0.00006 - 0.00043	0.00006 - 0.00007	<0.00001 - 0.00002	<0.00001 - 0.00003	<0.00001	0 - 1.4	0.00021 - 0.0015	0.00003 - 0.00041	0.0015 - 0.00185	0.0285 - 0.088	<0.00002	0.00845 - 0.022	0.00022 - 0.00132	0.00163 - 0.00229	<0.02 - 0.18	<0.1	<0.05
Reaphook Paleochannel	RC00018	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	0 - 0.00046	0 - 0.00041	<0.00001 - 0	<0.00001 - 0	<0.00001 - 0	-	0 - 0.00246	0 - 0.00147	0 - 0.0365	0 - 0.0481	<0.00002 - 0	0 - 0.0185	0 - 0.0026	0 - 0.00994	<0.02 - 0	<0.1 - 0	<0.05 - 0
Reaphook Paleochannel	RC00019	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	0.00015	0.00012	<0.00005	<0.00005	<0.00005	-	0.00025	0.00035	0.001	0.0223	<0.0001	0.00355	0.00022	0.00092	<0.1	<0.5	<0.25
Reaphook Paleochannel	RC00021	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	<0.00005 - 0	<0.00005 - 0	<0.00005 - 0	<0.00005 - 0	<0.00005 - 0	-	0 - 0.00031	0 - 0.00027	0 - 0.00045	0 - 0.0646	<0.0001 - 0	0 - 0.00195	0 - 0.00038	0 - 0.00094	<0.1 - 0	<0.5 - 0	<0.25 - 0
Reaphook Paleochannel	RC00022	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	<0.00001 - 0.00001	0.00001 - 0.00002	<0.00001	<0.00001	<0.00001	-	<0.00001 - 0.00004	0.00059 - 0.00235	0.00045 - 0.0015	0.00555 - 0.0316	<0.00002	0.00175 - 0.00215	<0.00001 - 0.00005	0.00149 - 0.00237	<0.02	<0.1	<0.05
Reaphook Paleochannel	RC00023	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	0.00007	0.00006	<0.00005	<0.00005	<0.00005	-	0.00009	0.00007	0.00085	0.0203	<0.0001	0.00295	0.00015	0.00063	<0.1	<0.5	<0.25
Reaphook Paleochannel	RC00024	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	<0.00005 - 0.00014	0.00017 - 0.0002	<0.00005	<0.00005	<0.00005	-	0.00015 - 0.00026	0.00008 - 0.0001	0.00075 - 0.0017	0.0316 - 0.118	<0.0001	0.0017 - 0.0034	0.00015 - 0.00024	0.00088 - 0.00204	<0.1	<0.5	<0.25
Reaphook Paleochannel	RC00025	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	<0.00005 - 0.00093	<0.00005 - 0.00017	<0.00005	<0.00005 - 0.00008	<0.00005	-	<0.00005 - 0.00794	0.00017 - 0.00298	0.0006 - 0.00195	0.00557 - 0.0741	<0.0001	0.00165 - 0.00375	<0.00005 - 0.0037	0.00077 - 0.0017	<0.1 - 0.36	<0.5	<0.25
Reaphook Paleochannel	RC00026	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	<0.00005 - 0.00444	<0.00005 - 0.00035	<0.00005 - 0.00039	<0.00005 - 0.00055	<0.00001 - 0.00003	0 - 8	<0.00005 - 0.0551	0 - 0.034	0 - 0.016	0 - 0.0804	<0.00002 - 0.00026	0 - 0.019	<0.00005 - 0.0469	0 - 0.0161	<0.02 - 0.18	<0.1 - 0	<0.05 - 0
Reaphook Paleochannel	RC00028	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	<0.00005 - 0.00088	<0.00005	<0.00005	<0.00005 - 0.00006	<0.00005	12 - 2710	<0.00005 - 0.00291	<0.00005 - 0.00103	0.0007 - 0.00885	0.00454 - 0.0724	<0.0001	0.00195 - 0.00565	<0.00005 - 0.00249	0.00065 - 0.00204	<0.1 - 0.14	<0.5	<0.25
Reaphook Paleochannel	RC00061	Southern Basins - Reaphook	Eastern Whitcherry	Public Road	<0.00005	0.00007	<0.00005	<0.00005	<0.00005	0	<0.00005	<0.00005	0.0003	0.00275	<0.0001	0.00175	<0.00005	<0.00005	<0.1	<0.5	<0.25
Ti Tree Basin Aquifer	RC00092	Ti Tree Basins	Ti Tree	Aileron Station	<0.00001	<0.00005 - 0.00008	<0.00001	<0.00001	<0.00001	0	<0.00005 - 0.00004	<0.00001	0.0305 - 0.033	0.00013 - 0.00035	<0.00002	0.0015 - 0.0017	<0.00005 - 0.00003	0.00076 - 0.00123	<0.02	<0.1	<0.05
Unknown	RC00198	N/A	Unknown	Aileron Station	-	-	-	-	-	0.3	-	<0.001	-	<0.005	<0.0001	<0.005	-	<0.002	-	-	-
Unknown	RC00222	N/A	Unknown	Aileron Roadhouse	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.01 - 0	<0.00005	<0.0001 - 0.00012	0.0165 - 0.0175	<0.00005	<0.0001	0.014 - 0.0155	<0.00005	0.00015 - 0.00052	<0.1	<0.5	<0.25
Unknown	RC00344	Margins Area	Unknown	Yambah Station	-	-	-	-	-	<0.02	-	<0.001	-	<0.005	<0.0001	<0.005	-	<0.002	-	-	-
Weathered Basement	RC00005	Southen Basins - Basement	Eastern Whitcherry	Aileron Station	<0.00005 - 0.00012	<0.00005	<0.00005	<0.00005	<0.00005	0.122 - 0.226	0.00027 - 0.00034	0.00025 - 0.00046	0.0295 - 0.0305	0.0582 - 0.059	<0.0001	0.017 - 0.0175	0.00028	0.0018 - 0.00229	<0.1	<0.5	<0.25
Weathered Basement	RC00027	Southern Basins - RC00027 - Basement	Eastern Whitcherry	Aileron Station	<0.00001 - 0.0004	0.00001 - 0.00004	<0.00001	<0.00001 - 0.00006	<0.00001	4.2	<0.00001 - 0.00942	0.00007 - 0.00043	0.00325 - 0.00565	0.00479 - 0.109	<0.00002	0.013 - 0.0145	<0.00001 - 0.00374	0.0002 - 0.0046	<0.02 - 0.08	<0.1	<0.05
Weathered Basement	RC00062	Mine Area - Basement	Arunta Basement	Aileron Station	-	-	-	-	-	<0.02 - 0.02	-	<0.001	-	<0.005 - 0.005	<0.0001	<0.005	-	<0.002	-	-	-
Weathered Basement	RC00063	Mine Area - Basement	Arunta Basement	Aileron Station	<0.00005 - 0.00003	<0.00005 - 0.00036	<0.00005	<0.00005	<0.00005 - 0.00008	0 - 5.35	<0.00005 - 0.00009	<0.00005 - 0.0002	0.006 - 0.0074	0.00887 - 0.085	<0.0001	0.0115 - 0.035	<0.00005 - 0.00006	0.00014 - 0.008	<0.1	<0.5	<0.25 - 0.25
Weathered Basement	RC00064	Mine Area - Basement	Arunta Basement	Aileron Station	-	-	-	-	-	0.04 - 0.86	-	<0.001	-	<0.005 - 0.01	<0.0002	0.015	-	<0.002 - 0.004	-	-	-
Weathered Basement	RC00075	Mine Area - Basement	Arunta Basement	Aileron Station	<0.00005 - 0.00043	<0.00005 - 0.00174	<0.00005	<0.00005	<0.00005 - 0.00052	0 - 0.86	<0.00005	<0.00005 - 0.00042	0.0105 - 0.012	0.0141 - 0.0422	<0.0002 - 0.00234	0.00335 - 0.00405	<0.00005	0.00039 - 0.00074	<0.1	<0.5	<0.25 - 0.8
Weathered Basement	RC00078	Southern Basins - Basement	Arunta Basement	Aileron Station	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0	<0.00005	0.00036	0.0053	0.00191	<0.0001	0.0195	<0.00005	0.00014	<0.1	<0.5	<0.25
Weathered Basement	RC00079	Southern Basins - Basement	Arunta Basement	Aileron Station	<0.00005	0.00013	<0.00005	<0.00005	<0.00005	0	<0.00005	0.00041	0.00655	0.008	<0.0001	0.023	<0.00005	0.0002	<0.1	<0.5	<0.25
Weathered Basement	RC00081	Southern Basins - Basement	Arunta Basement	Aileron Station	<0.0002	0.00041	<0.0002	<0.0002	<0.0002	<0.02 - 0	<0.0002	<0.0002	0.0285	<0.00001	<0.0001	<0.005 - 0.0055	<0.0002	<0.002 - 0.00058	<0.4	<2	<1
Weathered Basement	RC00083	N/A	Arunta Basement	Aileron Roadhouse	<0.00005	0.00017	<0.00005	<0.00005	<0.00005	0	0.00106	0.00187	0.0185	0.00092	<0.0001	0.0135	0.00094	0.00118	<0.1	<0.5	<0.25
Weathered Basement	RC00086	Margins Area	Arunta Basement	Aileron Station	<0.00005	<0.00005 - 0.00021	<0.00005	<0.00005	<0.00005	<0.04 - 0	<0.00005	<0.00005 - 0.00016	0.0665 - 0.0875	<0.005 - 0.00523	<0.0001	0.005 - 0.00935	<0.00005	<0.002 - 0.00041	<0.1	<0.5	<0.25
Weathered Basement	RC00098	Margins Area	Arunta Basement	Aileron Station	0.00011	0.00003	<0.00001	<0.00001	<0.00001	300	0.00021	0.00015	0.00025	0.274	<0.00002	0.00255	0.0003	0.00047	0.36	<0.1	<0.05
Weathered Basement	RC00099	Margins Area	Arunta Basement	Aileron Station	<0.00001	0.00003 - 0.00004	<0.00001	<0.00001	<0.00001	0 - 1.32	0.00002 - 0.0003	<0.00001 - 0.00009	0.0023 - 0.0029	0.00015 - 0.015	<0.00002	0.00465 - 0.01	0.00003 - 0.00041	<0.002 - 0.00058	<0.02	<0.1	<0.05
Statistical Summary - all sample events																					
Number of Results					138	138	138	138	138	109	138	150	138	150	150	150	138	150	138	138	138
Number of Detects					78	71	21	28	15	102	99	118	137	138	12	144	102	139	34	6	8
Minimum Concentration					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Minimum Detect					0.00001	0.00001	0.00001	0.00001	0.00001	0.02	0.00001	0.00001	0.0001	0.0001	0.00008	0.00095	0.00001	0.00003	0.04	ND	0.25
Maximum Concentration					0.00444	0.00174	0.00039	0.00055	0.00052	2710	0.0551	0.034	0.0875	0.464	0.00234	0.035	0.0469	0.0199	0.54	<2	<1
Maximum Detect					0.00444	0.00174	0.00039	0.00055	0.00052	2710	0.0551	0.034	0.0875	0.464	0.00234	0.035	0.0469	0.0199	0.54	ND	0.8
Average Concentration					0.00022	0.000083	0.000025	0.000035	0.000024	63	0.0015	0.001	0.0069	0.033	0.00007	0.0057	0.0013	0.0018	0.069	0.19	0.1
Median Concentration					0.00003	0.000025	0.000025	0.000025	0.000025	0.02	0.000125	0.000185	0.002025	0.0133	0.00005	0.00305	0.00013	0.000935	0.05	0.25	0.125
Standard Deviation					0.00061	0.00018	0.000039	0.000063	0.000046	303	0.0059	0.0034	0.012	0.061	0.00021	0.0058	0.0047	0.0032	0.086	0.17	0.11
Number of Guideline Exceedances					0	0	0	0	0	38	0	24	0	10	94	35	0	6	0	0	0
Number of Guideline Exceedances(Detects Only)					0	0	0	0	0	38	0	24	0	10	6	35	0	6	0	0	0

					Metals																			
					Praseodymium	Promethium	Rhenium	Rubidium	Samarium	Scandium	Selenium	Silica (SiO2)	Silver	Strontium	Tantalum	Tellurium	Terbium	Thallium	Thorium	Thulium	Tin	Titanium	Tungsten	Uranium
					ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	mg/L	ug/L	mg/L	mg/L	ug/L	ug/L	ug/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L
ADWG 2011 Aesthetic																								
ADWG 2011 Health											0.01		0.1											0.017
ANZECC 2000 FW 99%											0.005		0.00002											
ANZECC 2000 Irrigation - Long-term Trigger Values											0.02													0.01
ANZECC 2000 Stock Watering											*0.02*													*0.2*
Monitoring_Zone	**Location Code**	**Grouping**	**GW Basin**	**Location Type**																				
Alluvial	RC00001	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	<0.05 - 0.63	<0.05 - 0.63	<0.05	0.0418 - 0.0566	<0.05 - 0.47	<0.25	0.0056	58,400 - 78,600	<0.00025	1.88 - 2.57	<0.25	<0.5	<0.05	<0.00005	<0.00005 - 0.0006	<0.05	<0.0005	<0.01	<0.00025 - 0.00085	0.0171 - 0.0379
Alluvial	RC00002	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	<0.05	<0.05	<0.05	0.0266 - 0.035	<0.05	<0.25	0.0062 - 0.0066	72,400 - 76,600	<0.00025	1.28 - 1.33	<0.25	<0.5	<0.05	<0.00005 - 0.00006	<0.00005	<0.05	<0.0005	<0.01	<0.00025 - 0.0003	0.0595 - 0.0669
Alluvial	RC00003	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	<0.05 - 0.11	<0.05 - 0.11	<0.05	0.0437 - 0.0463	<0.05	<0.25	0.0062 - 0.0076	10,800 - 13,200	<0.00025	1.83 - 2.08	<0.25	<0.5	<0.05	<0.00005	<0.00005 - 0.00008	<0.05	<0.0005	<0.01 - 0.016	<0.00025 - 0.00025	0.0301 - 0.0476
Alluvial	RC00007	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	<0.05	<0.05	<0.05	0.0487 - 0.0521	<0.05	<0.25	0.0108 - 0.013	72,400 - 79,400	<0.00025	1.94 - 1.98	<0.25	<0.5	<0.05	<0.00005 - 0.00011	<0.00005 - 0.00011	<0.05	<0.0005	<0.01	<0.00025 - 0.0011	0.075 - 0.0829
Alluvial	RC00059	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	<0.05 - 0.26	-	<0.05	0.0446 - 0.0509	<0.05 - 0.12	<0.25 - 0.3	0.005 - 0.006	51,000 - 84,600	<0.00025	-	<0.25	<0.5	<0.05	<0.00005	<0.00005 - 0.00047	<0.05	<0.0005	<0.01 - 0.016	<0.00025 - 0.00185	0.0185 - 0.0313
Alluvial	RC00060	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	<0.05 - 0.2	-	<0.05	0.0469 - 0.047	<0.05 - 0.18	<0.25	0.0048 - 0.0066	56,600 - 73,000	<0.00025	-	<0.25	<0.5	<0.05	<0.00005	0.0001 - 0.00011	<0.05	<0.0005	<0.01 - 0.012	<0.00025 - 0.00395	0.0235 - 0.0396
Alluvial	RC00084	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	<0.05	-	<0.05	0.032	<0.05	<0.25	0.0036	60,600	<0.00025	-	<0.25	<0.5	<0.05	<0.00005	<0.00005	<0.05	<0.0005	<0.01	<0.00025	0.00928
Alluvial	RC00085	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	<0.05	-	<0.05	0.0331	<0.05	0.4	0.003	82,000	<0.00025	-	<0.25	<0.5	<0.05	<0.00005	<0.00005	<0.05	<0.0005	<0.01	<0.00025	0.0144
Alluvial	RC00106	Margins Area	NE Burt	Aileron Station	<0.01	-	<0.01	0.018 - 0.0188	<0.01	0.2 - 0.35	0.0026 - 0.003	49,800 - 79,000	<0.00005	-	<0.05	<0.1	<0.01	<0.00001	<0.00001 - 0.00002	<0.01	<0.0001	<0.002	<0.00005 - 0.0002	0.00485 - 0.0075
Alluvial	RC00109	Margins Area	NE Burt	Aileron Station	<0.01	-	<0.01	0.016	<0.01	0.3	0.003	69,400 - 70,000	<0.00005	-	<0.05	<0.1	<0.01	<0.00001	<0.00001	<0.01	<0.0001	<0.002	<0.00005	0.00655 - 0.0067
Alluvial/Fluvial	RC00040	Margins Area	NE Burt/Arunta	Aileron Station	0.12	-	<0.01	0.0263	0.11	0.35	0.0018	70,000	<0.00005	-	<0.05	<0.1	0.01	0.00004	0.00014	<0.01	<0.0001	0.01	0.002	0.0079
Alluvial/Fluvial	RC00044	Margins Area	NE Burt	Aileron Station	<0.01	-	<0.01	0.0229	<0.01	0.4	0.0018	73,800	<0.00005	-	<0.05	<0.1	<0.01	<0.00001	0.00005	<0.01	<0.0001	<0.002	0.00055	0.00044
Alluvial/Fluvial	RC00045	Margins Area	NE Burt	Aileron Station	0.08	-	<0.01	0.0275	0.08	0.4	0.0014	80,000	<0.00005	-	<0.05	<0.1	<0.01	0.00002	0.00007	<0.01	0.0019	0.008	0.00025	0.00486
Alluvial/Fluvial	RC00046	Margins Area	NE Burt	Aileron Station	0.51	-	<0.2	0.0333	0.22	<1	0.014	30,000	<0.001	-	<1	<2	<0.2	<0.0002	<0.0002	<0.2	<0.002	0.056	<0.001	*0.219*
Alluvial/Fluvial	RC00047	Margins Area	NE Burt	Aileron Station	0.12	-	0.02	0.0188	0.07	0.5	0.0032	44,200	<0.00005	-	<0.05	<0.1	<0.01	0.00003	0.00013	<0.01	0.001	0.016	0.0004	0.0118
Alluvial/Fluvial	RC00048	Margins Area	NE Burt	Aileron Station	0.02	-	<0.01	0.0247	0.02	0.35	0.0014	76,200	<0.00005	-	<0.05	<0.1	<0.01	0.00002	0.00002	<0.01	<0.0001	<0.002	0.0026	0.00269
Alluvial/Fluvial	RC00049	Margins Area	NE Burt	Aileron Station	0.16	-	0.05	0.0254	0.15	0.4	0.003	57,400	<0.00005	-	<0.05	<0.1	0.02	0.00007	0.0001	0.01	<0.0001	0.014	0.00115	0.0026
Alluvial/Fluvial	RC00053	Margins Area	NE Burt	Aileron Station	0.05 - 0.2	-	<0.01	0.0274 - 0.028	0.04 - 0.12	0.35 - 0.4	0.0014 - 0.0016	77,200 - 84,800	<0.00005	-	<0.05	<0.1	<0.01	0.00001 - 0.00003	0.00004 - 0.0001	<0.01	<0.0001	0.002 - 0.006	0.00055 - 0.0008	0.00175 - 0.00282
Alluvial/Fluvial	RC00057	Margins Area	NE Burt	Aileron Station	0.1	-	<0.01	0.0233	0.06	0.45	0.0004	49,000	<0.00005	-	<0.05	<0.1	<0.01	<0.00001	0.00009	<0.01	0.0002	0.012	0.0005	0.0103
Calcrete	RC00100	Margins Area	Arunta Basement	Aileron Station	<0.01	-	<0.01	0.00951	<0.01	0.35	0.0044	65,200	<0.00005	-	<0.05	<0.1	<0.01	<0.00001	0.00001	<0.01	<0.0001	<0.002	0.00055	0.00859
Calcrete	RC00103	Margins Area	NE Burt	Aileron Station	<0.05	-	<0.05	0.0243	<0.05	<0.25	0.0064	73,200	<0.00025	-	<0.25	<0.5	<0.05	<0.00005	<0.00005	<0.05	<0.0005	<0.01	<0.00025	0.0083
Calcrete	RC00104	Margins Area	Ti Tree	Aileron Station	<0.01	-	0.01	0.00857	<0.01	0.35	0.0054	75,200	<0.00005	-	<0.05	<0.1	<0.01	<0.00001	<0.00001	<0.01	<0.0001	<0.002	0.00005	0.00777
Calcrete/Alluvial	RC00052	Margins Area	Ti Tree/Arunta	Aileron Station	0.16	-	0.01	0.0249	0.1	0.45	0.0038	48,600	<0.00005	-	<0.05	<0.1	<0.01	0.00003	0.00011	<0.01	0.0002	0.01	0.0002	0.00929
Calcrete/Alluvial/Fluvial	RC00030	Margins Area	NE Burt	Aileron Station	<0.01	-	0.01	0.0215	<0.01	0.35	0.0054	84,000	<0.00005	-	<0.05	<0.1	<0.01	0.00003	<0.00001	<0.01	<0.0001	<0.002	0.00095	0.00408
Calcrete/Alluvial/Fluvial	RC00031	Margins Area	Ti Tree	Aileron Station	0.44	-	0.01	0.0204	0.34	0.35	0.004	45,000	<0.00005	-	<0.05	<0.1	0.03	0.00004	0.00046	0.01	0.0009	0.082	0.00025	0.00398
Calcrete/Alluvial/Fluvial	RC00033	Margins Area	Ti Tree	Aileron Station	3.8	-	<0.01	0.0459	2.52	0.25	0.0038	49,000	<0.00005	-	<0.05	<0.1	0.17	0.0001	0.00247	0.02	0.0002	0.024	0.0155	0.00399
Calcrete/Basement	RC00032	Margins Area	Ti Tree/Arunta	Aileron Station	1.15	-	<0.01	0.0214	0.84	0.55	0.0024	76,800	<0.00005	-	<0.05	<0.1	0.08	0.0001	0.00218	0.02	0.0008	0.046	0.0003	0.00387
Calcrete/Basement	RC00035	Margins Area	Ti Tree/Arunta	Aileron Station	<0.01	-	<0.01	0.0137	<0.01	0.35	0.002	75,400	<0.00005	-	<0.05	<0.1	<0.01	0.00003	0.00006	<0.01	<0.0001	<0.002	0.00155	0.00175
Calcrete/Basement	RC00036	Margins Area	Ti Tree/Arunta	Aileron Station	0.02	-	<0.01	0.0152	0.02	0.3	0.0016	73,800	<0.00005	-	<0.05	<0.1	<0.01	0.00001	0.00003	<0.01	<0.0001	<0.002	0.00055	0.00069
Calcrete/Basement	RC00037	Margins Area	Ti Tree/Arunta	Aileron Station	0.05 - 0.49	-	<0.01	0.0183 - 0.0271	0.04 - 0.35	0.45 - 0.6	0.0052	66,800 - 71,000	<0.00005	-	<0.05	<0.1	<0.01 - 0.04	<0.00001 - 0.00005	0.00005 - 0.00027	<0.01 - 0.01	0.0002 - 0.0006	0.01 - 0.092	0.00005 - 0.0002	0.00672 - 0.00708
Calcrete/Basement	RC00041	Margins Area	NE Burt/Arunta	Aileron Station	0.04	-	<0.01	0.0262	0.03	0.35	0.0018	80,400	<0.00005	-	<0.05	<0.1	<0.01	0.00001	0.00005	<0.01	0.0001	0.004	0.00025	0.0041
Calcrete/Basement	RC00042	Margins Area	NE Burt	Aileron Station	1.63	-	<0.01	0.0333	1.66	1.3	0.0022	56,400	<0.00005	-	<0.05	<0.1	0.23	0.00008	0.00197	0.1	0.001	0.138	0.0001	0.00529
Calcrete/Basement	RC00043	Margins Area	NE Burt	Aileron Station	0.72	-	<0.01	0.0182	0.46	0.25	0.002	40,400	<0.00005	-	<0.05	<0.1	0.05	0.00001	0.00008	0.02	0.0001	0.012	0.00025	0.00831
Calcrete/Basement	RC00050	Margins Area	NE Burt/Arunta	Aileron Station	0.23 - 2.89	-	<0.1 - 0.01	0.0145 - 0.134	0.12 - 2.19	<0.5 - 3.6	*0.0048 - 0.0286*	43,000 - 76,600	<0.00005	-	<0.05	<0.1	<0.1 - 0.27	<0.0001 - 0.00025	0.00018 - 0.00214	<0.1 - 0.03	<0.001 - 0.0015	0.062 - 0.3	<0.0005 - 0.00135	0.00365 - 0.0327
Calcrete/Basement	RC00054	Margins Area	NE Burt/Arunta	Aileron Station	1.42	-	0.01	0.0267	1.05	0.45	0.0048	43,000	<0.00005	-	0.09	0.46	<0.1	0.00003	0.072	3.65	0.0015	0.00005	0.0041	0.0155
Calcrete/Basement	RC00056	Margins Area	Ti Tree/Arunta	Aileron Station	0.16	-	<0.05	0.0146	0.15	0.35	0.0072	41,000	<0.00025	-	<0.25	<0.5	<0.05	<0.00005	0.00019	<0.05	<0.0005	0.03	0.00075	0.013
Reaphook Paleochannel	RC00004	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	<0.01 - 0.12	0.09 - 0.12	<0.01	0.022 - 0.0421	<0.01 - 0.08	<0.25 - 0.26	0.0044 - 0.0052	54,200 - 79,000	<0.00005	0.696 - 0.856	<0.05	<0.1	<0.01	<0.00001	<0.00001 - 0.00023	<0.01	<0.0001	<0.002 - 0.072	<0.00005 - 0.00085	0.0947 - 0.19
Reaphook Paleochannel	RC00006	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	0.09 - 0.14	0.09 - 0.14	<0.05	0.0253 - 0.027	0.07 - 0.15	<0.25	0.0046 - 0.0054	79,000 - 82,200	<0.00025	1.08 - 1.13	<0.25	<0.5	<0.05	<0.00005	0.00012 - 0.00015	<0.05	<0.0005 - 0.0005	<0.01 - 0.01	0.00055	0.0585 - 0.06
Reaphook Paleochannel	RC00012	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	0.15 - 0.2	0.15 - 0.2	<0.05	0.0442 - 0.0459	0.14 - 0.16	0.31 - 0.33	0.0052 - 0.0058	48,800 - 50,400	<0.00025	1.39 - 1.41	<0.25	<0.5	<0.05	<0.00005	0.00032 - 0.00033	<0.05	<0.0005	0.018 - 0.026	0.0007	0.0338 - 0.0345
Reaphook Paleochannel	RC00013	Southern Basins - Reaphook	Eastern Mt Wedge	Aileron Station	<0.05	<0.05	<0.05	0.0485 - 0.0573	<0.05	<0.25 - 0.25	0.0052 - 0.0064	75,000 - 77,800	<0.00025	1.32 - 1.59	<0.25	<0.5	<0.05	<0.00005 - 0.00007	<0.00005 - 0.00005	<0.05	<0.0005	<0.01	<0.00025 - 0.00045	0.018 - 0.0198
Reaphook Paleochannel	RC00014	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	<0.05 - 0.04	-	<0.01	0.0266 - 0.0394	0.04 - 0.05	<0.25 - 0.15	0.0042 - 0.0058	79,400 - 83,200	<0.00005	0	<0.05	<0.1	<0.01	<0.00001	<0.00005 - 0.00004	<0.01	<0.0001	<0.01 - 0.004	<0.00025 - 0.00035	0.0288 - 0.035
Reaphook Paleochannel	RC00015	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	0.04 - 0.5	-	<0.01 - 0.02	0.0394 - 0.0503	0.04 - 0.39	0.15 - 0.35	0.0058 - 0.0066	76,400 - 79,400	<0.00005	1.03 - 1.09	<0.05	<0.1	<0.01 - 0.05	<0.00001 - 0.00077	0.00004 - 0.00094	<0.01 - 0.01	<0.0001 - 0.0002	0.004 - 0.044	0.00015 - 0.00035	0.0288 - 0.0489
Reaphook Paleochannel	RC00016	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	<0.05	-	<0.05	0.0433	<0.05	<0.25	0.006	73,200	<0.00025	0	<0.25	<0.5	<0.05	<0.00005	<0.00005	<0.05	<0.0005	<0.01	<0.00025	0.0185
Reaphook Paleochannel	RC00017	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	0.05 - 0.4	-	<0.01 - 0.01	0.0418 - 0.0449	0.06 - 0.24	0.2 - 0.45	0.0048	78,200 - 86,600	<0.00005	0	<0.05	<0.1	<0.01 - 0.03	0.00002	0.00007 - 0.00069	<0.01	<0.0001 - 0.0002	0.004 - 0.046	0.0004 - 0.00055	0.026 - 0.0354
Reaphook Paleochannel	RC00018	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	<0.01 - 0.59	-	<0.05 - 0.73	0 - 0.105	<0.01 - 0.46	<0.5 - 0.4	*0 - 0.0292*	0 - 79,400	<0.00005 - 0	-	<0.05 - 0	<0.1 - 0	<0.01 - 0.05	0 - 0.00138	0 - 0.00301	<0.01 - 0	<0.0001 - 0	<0.002 - 0.02	0 - 0.0006	0 - 0.0447
Reaphook Paleochannel	RC00019	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	0.07	-	<0.05	0.0499	<0.05	0.35	0.0076	83,400	<0.00025	-	<0.25	<0.5	<0.05	<0.00005	0.00019	<0.05	<0.0005	0.012	0.00015	0.0265
Reaphook Paleochannel	RC00021	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	<0.05 - 0.09	-	<0.05 - 0	0 - 0.0476	<0.05 - 0.06	<0.25 - 0	0 - 0.0076	0 - 79,600	<0.00025 - 0	0	<0.25 - 0	<0.5 - 0	<0.05 - 0	<0.00005 - 0.00009	0 - 0.00018	<0.05 - 0	<0.0005 - 0	<0.01 - 0	<0.00025 - 0	0 - 0.0232
Reaphook Paleochannel	RC00022	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	<0.01 - 0.01	-	<0.01 - 0.01	0.0428 - 0.0466	<0.01 - 0.01	0.15 - 0.2	0.0052 - 0.0058	70,800 - 73,000	<0.00005	1.04 - 1.15	<0.05	<0.1	<0.01	0.00002 - 0.00008	<0.00001 - 0.00007	<0.01	<0.0001 - 0.0004	<0.002 - 0.004	<0.00005 - 0.00005	0.03 - 0.0365
Reaphook Paleochannel	RC00023	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	<0.05	-	<0.05	0.0315	<0.05	0.4	0.0026	88,000	<0.00025	-	<0.25	<0.5	<0.05	<0.00005	0.00012	<0.05	<0.0005	<0.01	<0.00025	0.0274
Reaphook Paleochannel	RC00024	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	<0.05 - 0.06	-	<0.05	0.0458 - 0.0556	0.06	0.35 - 0.4	0.0048 - 0.0062	83,200 - 85,600	<0.00025	-	<0.25	<0.5	<0.05	<0.00005	0.00007 - 0.00011	<0.05	<0.0005	<0.01	<0.00025 - 0.00075	0.0391 - 0.0438
Reaphook Paleochannel	RC00025	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	<0.05 - 1.08	-	<0.05	0.0505 - 0.0717	<0.05 - 0.85	<0.25 - 0.5	0.005 - 0.0068	78,800 - 88,600	<0.00025	-	<0.25	<0.5	<0.05 - 0.08	<0.00005 - 0.00007	<0.00005 - 0.00189	<0.05	<0.0005 - 0.0008	<0.01 - 0.138	<0.00025 - 0.0005	0.0397 - 0.0586
Reaphook Paleochannel	RC00026	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	<0.05 - 13.2	-	<0.01 - 0	0 - 0.0551	<0.05 - 8.94	<0.25 - 2.1	0 - 0.0068	0 - 68,200	<0.00005 - 0	-	<0.05 - 0	<0.1 - 0	<0.05 - 0.68	0 - 0.00022	<0.00005 - 0.0252	<0.05 - 0.2	<0.0005 - 0.0007	<0.01 - 0.078	<0.00025 - 0.00115	0 - 0.0924
Reaphook Paleochannel	RC00028	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	<0.05 - 0.72	-	<0.05	0.0261 - 0.0303	<0.05 - 0.43	<0.25 - 0.55	0.0036 - 0.0054	59,000 - 72,200	<0.00025	-	<0.25	<0.5	<0.05 - 0.05	<0.00005 - 0.00006	<0.00005 - 0.00155	<0.05	<0.0005	<0.01 - 0.072	<0.00025 - 0.0009	0.0417 - 0.0648
Reaphook Paleochannel	RC00061	Southern Basins - Reaphook	Eastern Whitcherry	Public Road	<0.05	-	<0.05	0.0242	<0.05	<0.25	0.0058	87,400	<0.00025	0	<0.25	<0.5	<0.05	<0.00005	<0.00005	<0.05	<0.0005	<0.01	<0.00025	0.0661
Ti Tree Basin Aquifer	RC00092	Ti Tree Basins	Ti Tree	Aileron Station	<0.01	-	<0.01	0.0203 - 0.0207	<0.01	0.2 - 0.4	0.0056 - 0.0064	69,200 - 72,400	<0.00005	-	<0.05	<0.1	<0.01	<0.00005 - 0.00001	<0.00001	<0.01	<0.0001	<0.002	<0.00025 - 0.00015	0.0218 - 0.0222
Unknown	RC00198	N/A	Unknown	Aileron Station	-	-	-	-	-	-	0.006	81,800	<0.01	-	-	-	-	-	-	-	<0.01	-	-	0.0205
Unknown	RC00222	N/A	Unknown	Aileron Roadhouse	<0.05	-	<0.05	0.00322 - 0.00439	<0.05	<2.5 - 0.25	0.0048 - 0.0054	63,600 - 65,200	<0.00025	1.25 - 1.27	<0.25	<0.05	<0.05	<0.00005	<0.00005	<0.05	<0.00005	<0.01	<0.00025	*0.489 - 0.589*
Unknown	RC00344	Margins Area	Unknown	Yambah Station	-	-	-	-	-	-	0.003	78,600	<0.01	-	-	-	-	-	-	-	<0.01	-	-	0.0051
Weathered Basement	RC00005	Southen Basins - Basement	Eastern Whitcherry	Aileron Station	0.06 - 0.11	0.06 - 0.11	<0.05	0.0343 - 0.0353	<0.05 - 0.08	<0.25	0.0062	67,200 - 68,400	<0.00025	1.48 - 1.5	<0.25	<0.5	<0.05	<0.00005	0.00018 - 0.00025	<0.05	<0.0005	<0.01 - 0.034	0.0015 - 0.00155	0.118 - 0.119
Weathered Basement	RC00027	Southern Basins - RC00027 - Basement	Eastern Whitcherry	Aileron Station	<0.01 - 1.2	-	<0.01	0.0191 - 0.0226	<0.01 - 0.69	0.25	0.0014 - 0.0018	0 - 71,600	<0.00005	-	<0.05	<0.1	<0.01 - 0.07	0.00001 - 0.00003	<0.00001 - 0.00143	<0.01 - 0.02	<0.0001 - 0.0001	<0.002 - 0.052	<0.00005 - 0.00005	0.0733 - 0.0826
Weathered Basement	RC00062	Mine Area - Basement	Arunta Basement	Aileron Station	-	-	-	-	-	-	0.006 - 0.008	74,800 - 76,400	<0.01	-	-	-	-	-	-	-	<0.01	-	-	*0.205 - 0.231*
Weathered Basement	RC00063	Mine Area - Basement	Arunta Basement	Aileron Station	<0.05	-	<0.05	0.00986 - 0.0121	<0.05	<0.25 - 0.3	0.009 - 0.011	77,800 - 85,800	<0.00025	1.08 - 1.15	<0.25	<0.05	<0.05	<0.00005	<0.00005	<0.05	<0.00005	<0.01	0.0028 - 0.00315	*0.321 - 0.426*
Weathered Basement	RC00064	Mine Area - Basement	Arunta Basement	Aileron Station	-	-	-	-	-	-	0.005 - 0.011	63,800 - 82,200	<0.01	-	-	-	-	-	-	-	<0.01	-	-	*0.285 - 0.372*
Weathered Basement	RC00075	Mine Area - Basement	Arunta Basement	Aileron Station	<0.05	-	<0.05 - 0.45	0.00912 - 0.0097	<0.05	<0.5 - 0.4	0.0128 - 0.0166	63,800 - 68,400	<0.00025	4.04 - 4.1	<0.25	<0.5	<0.05	<0.0001 - 0.00044	<0.00005	<0.05	<0.0005	<0.01	<0.0005 - 0.0003	*0.338 - 0.365*
Weathered Basement	RC00078	Southern Basins - Basement	Arunta Basement	Aileron Station	<0.05	-	<0.05	0.00842	<0.05	0.3	0.0098	64,200	<0.00025	-	<0.25	<0.5	<0.05	<0.00005	<0.00005	<0.05	<0.0005	<0.01	0.001	*0.748*
Weathered Basement	RC00079	Southern Basins - Basement	Arunta Basement	Aileron Station	<0.05	-	<0.05	0.00998	<0.05	<0.25	0.012	63,200	<0.00025	-	<0.25	<0.5	<0.05	<0.00005	<0.00005	<0.05	<0.0005	<0.01	0.0012	*0.877*
Weathered Basement	RC00081	Southern Basins - Basement	Arunta Basement	Aileron Station	<0.2	-	<0.2	0.0263	<0.2	<1	*0.003 - 0.0268*	67,200 - 76,000	<0.001	-	<1	<2	<0.2	<0.0002	<0.0002	<0.2	<0.002	<0.04	<0.001	0.0076 - 0.173
Weathered Basement	RC00083	N/A	Arunta Basement	Aileron Roadhouse	0.28	-	<0.05	0.00365	<0.05	<0.25	0.0066	63,200	<0.00025	-	<0.25	<0.5	<0.05	<0.00005	<0.00005	<0.05	0.0022	<0.01	<0.00025	*0.531*
Weathered Basement	RC00086	Margins Area	Arunta Basement	Aileron Station	<0.05	-	<0.05	0.0145 - 0.0171	<0.05	<0.25	*0.0142 - 0.036*	25,400 - 77,600	<0.00025	-	<0.25	<0.5	<0.05	<0.00005	<0.00005	<0.05	<0.0005	<0.01	<0.00025	*0.149 - 0.292*
Weathered Basement	RC00098	Margins Area	Arunta Basement	Aileron Station	0.07	-	<0.01	0.013	0.05	0.6	<0.0002	69,400	<0.00005	-	<0.05	<0.1	<0.01	<0.00001	0.00009	<0.01	<0.0001	0.008	0.0005	0.004
Weathered Basement	RC00099	Margins Area	Arunta Basement	Aileron Station	<0.01 - 0.11	-	<0.01	0.0109 - 0.0127	<0.01 - 0.1	0.15 - 0.25	0.0026 - 0.013	25,800 - 51,600	<0.00005	-	<0.05	<0.1	<0.01	<0.00001	0.00001 - 0.00005	<0.01	<0.0001	<0.002	<0.00005	*0.00725 - 0.258*

Statistical Summary - all sample events	Praseodymium	Promethium	Rhenium	Rubidium	Samarium	Scandium	Selenium	Silica (SiO2)	Silver	Strontium	Tantalum	Tellurium	Terbium	Thallium	Thorium	Thulium	Tin	Titanium	Tungsten	Uranium
Number of Results	138	19	138	138	138	138	146	157	150	40	138	138	138	137	138	138	150	138	138	150
Number of Detects	71	10	24	138	66	88	145	157	6	40	7	7	27	60	83	21	32	60	84	150
Minimum Concentration	0	<0.05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Minimum Detect	0.01	0.06	0.01	0.00322	0.01	0.15	0.0004	10800	ND	0.696	0.09	0.46	0.01	0.00001	0.00001	0.01	0.0001	0.00005	0.00005	0.00044
Maximum Concentration	13.2	0.63	0.73	0.134	8.94	<5	0.036	88600	<0.01	4.1	<1	<2	0.68	0.00138	0.072	3.65	<0.01	0.3	0.0155	0.877
Maximum Detect	13.2	0.63	0.73	0.134	8.94	3.6	0.036	88600	ND	4.1	0.09	0.46	0.68	0.00138	0.072	3.65	0.0022	0.3	0.0155	0.877
Average Concentration	0.35	0.1	0.029	0.032	0.25	0.4	0.0062	64815	0.00049	1.3	0.098	0.19	0.037	0.000063	0.001	0.049	0.00067	0.017	0.00064	0.095
Median Concentration	0.025	0.06	0.025	0.02725	0.025	0.25	0.0054	71000	0.000125	1.2	0.125	0.25	0.025	0.000025	0.00005	0.025	0.00025	0.005	0.00025	0.03285
Standard Deviation	1.3	0.14	0.073	0.02	0.9	0.54	0.0053	20608	0.0013	1	0.086	0.18	0.077	0.00015	0.0065	0.31	0.0013	0.035	0.0015	0.15
Number of Guideline Exceedances	0	0	0	0	0	0	90	0	144	0	0	0	0	0	0	0	0	0	0	110
Number of Guideline Exceedances(Detects Only)	0	0	0	0	0	0	90	0	0	0	0	0	0	0	0	0	0	0	0	110

					Metals				
					Vanadium	Ytterbium	Yttrium	Zinc	Zirconium
					mg/L	ug/L	ug/L	mg/L	mg/L
ADWG 2011 Aesthetic								**3**	
ADWG 2011 Health									
ANZECC 2000 FW 99%								0.0024	
ANZECC 2000 Irrigation - Long-term Trigger Values					0.1			2	
ANZECC 2000 Stock Watering								*20*	
Monitoring_Zone	**Location Code**	**Grouping**	**GW Basin**	**Location Type**					
Alluvial	RC00001	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	0.0048 - 0.00825	<0.05	0.05 - 0.42	0.0067 - 0.0143	<0.00025
Alluvial	RC00002	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	0.0079 - 0.022	<0.05	<0.05	0.0026 - 0.005	<0.00025
Alluvial	RC00003	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	0.00465 - 0.0055	<0.05	<0.05 - 0.06	0.0134 - 0.0153	<0.00025
Alluvial	RC00007	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	0.00675 - 0.0115	<0.05	<0.05 - 0.07	0.0039 - 0.0389	<0.00025
Alluvial	RC00059	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	0.00575 - 0.0078	<0.05	0.07 - 0.38	0.0039 - 0.0282	<0.00025
Alluvial	RC00060	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	0.0066 - 0.00715	<0.05	0.1 - 0.24	0.0067 - 0.008	<0.00025
Alluvial	RC00084	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	0.00755	<0.05	<0.05	0.0082	<0.00025
Alluvial	RC00085	Southern Basins - Alluvials and Calcretes	Eastern Whitcherry	Aileron Station	0.0063	<0.05	<0.05	0.0078	<0.00025
Alluvial	RC00106	Margins Area	NE Burt	Aileron Station	0.013 - 0.0175	<0.01	0.02 - 0.03	0.0052 - 0.01	<0.00005
Alluvial	RC00109	Margins Area	NE Burt	Aileron Station	0.015	<0.01	<0.01	<0.01 - 0.0004	<0.00005
Alluvial/Fluvial	RC00040	Margins Area	NE Burt/Arunta	Aileron Station	0.014	0.03	0.33	0.139	0.0001
Alluvial/Fluvial	RC00044	Margins Area	NE Burt	Aileron Station	0.012	<0.01	0.02	0.0123	<0.00005
Alluvial/Fluvial	RC00045	Margins Area	NE Burt	Aileron Station	0.0089	0.02	0.26	0.0168	<0.00005
Alluvial/Fluvial	RC00046	Margins Area	NE Burt	Aileron Station	0.00875	<0.2	0.54	0.218	<0.001
Alluvial/Fluvial	RC00047	Margins Area	NE Burt	Aileron Station	0.00665	0.01	0.19	0.0588	0.0002
Alluvial/Fluvial	RC00048	Margins Area	NE Burt	Aileron Station	0.0165	<0.01	0.04	0.0279	<0.00005
Alluvial/Fluvial	RC00049	Margins Area	NE Burt	Aileron Station	0.00985	0.07	0.84	0.0115	0.00015
Alluvial/Fluvial	RC00053	Margins Area	NE Burt	Aileron Station	0.0135 - 0.014	<0.01 - 0.01	0.1 - 0.23	0.0129 - 0.0155	<0.00005 - 0.00025
Alluvial/Fluvial	RC00057	Margins Area	NE Burt	Aileron Station	0.0034	0.01	0.22	0.0353	0.0002
Calcrete	RC00100	Margins Area	Arunta Basement	Aileron Station	0.0195	<0.01	0.03	0.0058	<0.00005
Calcrete	RC00103	Margins Area	NE Burt	Aileron Station	0.0135	<0.05	<0.05	0.38	<0.00025
Calcrete	RC00104	Margins Area	Ti Tree	Aileron Station	0.0088	<0.01	0.01	0.0028	<0.00005
Calcrete/Alluvial	RC00052	Margins Area	Ti Tree/Arunta	Aileron Station	0.00325	0.03	0.44	0.157	0.00015
Calcrete/Alluvial/Fluvial	RC00030	Margins Area	NE Burt	Aileron Station	0.0083	<0.01	0.03	0.0069	<0.00005
Calcrete/Alluvial/Fluvial	RC00031	Margins Area	Ti Tree	Aileron Station	0.007	0.08	0.91	0.0564	0.00025
Calcrete/Alluvial/Fluvial	RC00033	Margins Area	Ti Tree	Aileron Station	0.013	0.15	2.01	0.0188	0.0002
Calcrete/Basement	RC00032	Margins Area	Ti Tree/Arunta	Aileron Station	0.019	0.16	2.03	0.0473	0.0002
Calcrete/Basement	RC00035	Margins Area	Ti Tree/Arunta	Aileron Station	0.024	<0.01	0.06	0.0036	<0.00005
Calcrete/Basement	RC00036	Margins Area	Ti Tree/Arunta	Aileron Station	0.015	<0.01	0.05	0.0066	<0.00005
Calcrete/Basement	RC00037	Margins Area	Ti Tree/Arunta	Aileron Station	0.011 - 0.0155	0.01 - 0.09	0.24 - 1.02	0.0273 - 0.0571	0.00005 - 0.00015
Calcrete/Basement	RC00041	Margins Area	NE Burt/Arunta	Aileron Station	0.0125	<0.01	0.12	0.0124	0.0001
Calcrete/Basement	RC00042	Margins Area	NE Burt	Aileron Station	0.037	0.56	7.28	0.282	0.0016
Calcrete/Basement	RC00043	Margins Area	NE Burt	Aileron Station	0.019	0.1	1.21	0.0233	0.00005
Calcrete/Basement	RC00050	Margins Area	NE Burt/Arunta	Aileron Station	0.0155 - 0.0535	<0.1 - 0.86	0.77 - 9.15	0.045 - 0.105	<0.0005 - 0.00325
Calcrete/Basement	RC00054	Margins Area	NE Burt/Arunta	Aileron Station	0.00015	105	0.21	0.00025	-
Calcrete/Basement	RC00056	Margins Area	Ti Tree/Arunta	Aileron Station	0.016	<0.05	0.65	0.0821	<0.00025
Reaphook Paleochannel	RC00004	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	0.00445 - 0.027	<0.01	<0.05 - 0.3	<0.0001 - 0.0163	<0.00005
Reaphook Paleochannel	RC00006	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	0.025 - 0.026	<0.05	0.27 - 0.4	0.101 - 0.309	<0.00025
Reaphook Paleochannel	RC00012	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	0.012 - 0.0125	<0.05	0.42 - 0.48	0.0291 - 0.0337	0.0003 - 0.00035
Reaphook Paleochannel	RC00013	Southern Basins - Reaphook	Eastern Mt Wedge	Aileron Station	0.00855 - 0.026	<0.05	0.09 - 0.14	0.0039 - 0.0068	<0.00025
Reaphook Paleochannel	RC00014	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	0.00725 - 0.011	<0.01	<0.05 - 0.07	0.005 - 0.0271	<0.00005
Reaphook Paleochannel	RC00015	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	0.00725 - 0.011	<0.01 - 0.09	0.07 - 1.43	0.0271 - 0.406	<0.00005 - 0.0015
Reaphook Paleochannel	RC00016	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	0.00705	<0.05	0.05	0.01	<0.00025
Reaphook Paleochannel	RC00017	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	0.0049 - 0.0075	<0.01 - 0.06	0.14 - 1.22	0.0022 - 0.0799	0.00005 - 0.0008
Reaphook Paleochannel	RC00018	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	0 - 0.00835	<0.01 - 0	0 - 0.74	0 - 0.0285	<0.0005 - 0.00055
Reaphook Paleochannel	RC00019	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	0.00735	<0.05	0.24	0.0146	<0.00025
Reaphook Paleochannel	RC00021	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	0 - 0.00725	<0.05 - 0	0 - 0.19	0 - 0.0907	<0.00025 - 0
Reaphook Paleochannel	RC00022	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	0.0059 - 0.0069	<0.01	<0.01 - 0.04	0.0969 - 0.233	<0.00005 - 0.0001
Reaphook Paleochannel	RC00023	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	0.0105	<0.05	0.12	0.0027	<0.00025
Reaphook Paleochannel	RC00024	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	0.00755 - 0.0089	<0.05	0.15 - 0.24	0.003 - 0.005	<0.00025
Reaphook Paleochannel	RC00025	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	0.00535 - 0.01	<0.05 - 0.16	<0.05 - 1.89	0.0039 - 0.368	<0.00025 - 0.0015
Reaphook Paleochannel	RC00026	Southern Basins - Reaphook	Eastern Whitcherry	Napperby Station	0 - 0.036	<0.05 - 1.23	<0.05 - 16.2	0 - 0.11	<0.00025 - 0.02
Reaphook Paleochannel	RC00028	Southern Basins - Reaphook	Eastern Whitcherry	Aileron Station	0.0078 - 0.021	<0.05	<0.05 - 1.18	0.0015 - 0.0589	<0.00025 - 0.0016
Reaphook Paleochannel	RC00061	Southern Basins - Reaphook	Eastern Whitcherry	Public Road	0.0275	<0.05	<0.05	0.0065	<0.00025
Ti Tree Basin Aquifer	RC00092	Ti Tree Basins	Ti Tree	Aileron Station	0.0245 - 0.0255	<0.01	<0.05 - 0.01	0.0005 - 0.0017	<0.00005
Unknown	RC00198	N/A	Unknown	Aileron Station	-	-	-	<0.01	-
Unknown	RC00222	N/A	Unknown	Aileron Roadhouse	0.0165 - 0.0205	<0.05	<0.1 - 0.08	0.001 - 0.0021	<0.00025
Unknown	RC00344	Margins Area	Unknown	Yambah Station	-	-	-	<0.01	-
Weathered Basement	RC00005	Southen Basins - Basement	Eastern Whitcherry	Aileron Station	0.015	<0.05	0.17 - 0.21	0.522 - 0.529	<0.00025 - 0.0003
Weathered Basement	RC00027	Southern Basins - RC00027 - Basement	Eastern Whitcherry	Aileron Station	0.018 - 0.0185	<0.01 - 0.1	<0.01 - 1.66	0.0137 - 0.0605	<0.00005
Weathered Basement	RC00062	Mine Area - Basement	Arunta Basement	Aileron Station	-	-	-	0.02 - 0.03	-
Weathered Basement	RC00063	Mine Area - Basement	Arunta Basement	Aileron Station	0.051 - 0.0655	<0.05	<0.05 - 0.14	0.0016 - 0.01	<0.00025
Weathered Basement	RC00064	Mine Area - Basement	Arunta Basement	Aileron Station	-	-	-	<0.01	-
Weathered Basement	RC00075	Mine Area - Basement	Arunta Basement	Aileron Station	0.017 - 0.022	<0.05	<0.05 - 0.45	<0.001 - 0.0037	<0.00025 - 0.0005
Weathered Basement	RC00078	Southern Basins - Basement	Arunta Basement	Aileron Station	0.047	<0.05	<0.05	0.0018	0.00025
Weathered Basement	RC00079	Southern Basins - Basement	Arunta Basement	Aileron Station	0.053	<0.05	<0.05	0.003	<0.00025
Weathered Basement	RC00081	Southern Basins - Basement	Arunta Basement	Aileron Station	0.059	<0.2	<0.2	0.0071 - 0.05	<0.001
Weathered Basement	RC00083	N/A	Arunta Basement	Aileron Roadhouse	0.0165	<0.05	0.18	0.0089	<0.00025
Weathered Basement	RC00086	Margins Area	Arunta Basement	Aileron Station	0.00435 - 0.00485	<0.05	<0.05	<0.01 - 0.0752	<0.00025
Weathered Basement	RC00098	Margins Area	Arunta Basement	Aileron Station	0.0015	0.01	0.18	0.0051	0.00015
Weathered Basement	RC00099	Margins Area	Arunta Basement	Aileron Station	0.0091 - 0.0105	<0.01	<0.01 - 0.12	0.0005 - 0.15	<0.00005

Statistical Summary - all sample events	Vanadium	Ytterbium	Yttrium	Zinc	Zirconium
Number of Results	138	138	138	150	137
Number of Detects	138	34	103	142	44
Minimum Concentration	0	0	0	0	0
Minimum Detect	0.00015	0.01	0.01	0.00025	0.00005
Maximum Concentration	0.0655	105	16.2	0.529	0.02
Maximum Detect	0.0655	105	16.2	0.529	0.02
Average Concentration	0.014	0.81	0.56	0.046	0.0004
Median Concentration	0.01	0.025	0.085	0.01	0.000125
Standard Deviation	0.013	8.9	1.8	0.092	0.0018
Number of Guideline Exceedances	0	0	0	125	0
Number of Guideline Exceedances(Detects Only)	0	0	0	119	0

GHD

Level 5, 66 Smith Street Darwin NT 0800
GPO Box 351 Darwin NT 0801
T: (08) 8982 0100   F: (08) 8981 1075   E: drwmail@ghd.com.au

G:\43\22301\WP\37014.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	Lee Evans	Robert Virtue		Nicole Conroy		29/03/16

www.ghd.com