Appendix 5

Groundwater Impact Assessment

prepared by

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(Total No. of pages including blank pages = 233)

COPI MINERAL SANDS PROJECT
GROUNDWATER IMPACT ASSESSMENT

PREPARED FOR:
RZ RESOURCES LIMITED

2324A FEB 2024 GEO-ENG

EXECUTIVE SUMMARY

Project and Site Information

The proposed Copi Mineral Sands Project plans to dredge-mine heavy-mineral (Zircon, Rutile, Ilmenite, etc.) bearing sand deposits (ancient beach strandlines) near to Wentworth, NSW. The site is approximately 40 km north of Lake Victoria and 35 km west of the Great Darling Anabranch. The orebody is in the near-surface sand aquifer to a depth of about 40 m below the groundwater table. The potential mine life is about 26 years, including construction, operations, and rehabilitation. On-going exploration is expected to identify further potential orebodies in the area.

The climate of the area is dry with an average annual rainfall of 256 mm and an average annual evaporation rate of 2066 mm. The land has low agricultural value, being used for sheep grazing when rainfall is sufficient.

The topography is relatively flat and there are no significant water courses or permanent water bodies in the mining area. Several salinas, which collect and evaporate rainfall run-off, are located across or adjacent to the mining area. The lowest points in the salinas are near to the groundwater table level of about RL 24.6 m. The highest elevation across the mine path is about RL 57 m.

The average grade of the heavy-mineral ore is approximately 1% and would be separated from the lighter quartz sand as the sand is washed over gravity spirals. The quartz sand would be placed back into the dredged-out void behind the operation. The dredge pond would generally operate within a few meters below the level of the natural groundwater table and the majority of the clean quartz sand would be returned to below the groundwater table level. Therefore, the mine effect on the groundwater regime would be minimal.

Regional Groundwater

In the Lower Darling region, stretching from Wilcannia to the Murray River, there are three main groundwater aquifers. The mine will interact with the Upper-Aquifer which is hyper-saline. The only other commercial use of the water is another mining operation approximately 75 km to the north-east. Water is also pumped from the upper aquifer near to the Murray River and evaporated in adjacent salinas to reduce the amount of salt entering the river. Beneath the site there is also a thin, low-productivity sand/limestone Middle-Aquifer and a potentially productive coarse-sand Lower-Aquifer, which are both moderately saline. There is an upward gradient between the aquifers, however, the aquifers are separated by thick clay aquitards and have no measurable interaction in the region of the proposed mining.

The groundwater levels have been stable over the last 30+ years of records, with limited response to rainfall recharge. Groundwater flow is from north-east to south-west, with a very flat gradient of about 1V:10,000H. In the Upper-Aquifer the permeability of the beach deposited mineral strands is high, while the surrounding sands have lower permeability. The permeability of the Lower-Aquifer is known to be high in portions of the region, but has not been tested at the Mine Site.

Of the identified Plant Community Types, only one has a potential salinity tolerance to the groundwater found at the Mine Site. (The average groundwater salinity at the mine site is almost twice the salinity of seawater).

Where the groundwater table is near to the surface, salt-pans / salinas have formed where groundwater may evaporate, leaving behind salt deposits. These topographically-low locations also collect rainfall runoff for short periods until the water evaporates.

Mine Groundwater Use

The Project would require on average about 4.5 GL/yr, with a peak requirement of 9.6 GL in Year 1 of the project. Water would be obtained from the dredge pond and bores. Approximately 1 GL/yr of water would be permanently lost to evaporation, with most of the remainder returning to the groundwater table.

There is minimal use of the regional groundwater due to its high salinity, and the average required water supply would be about 5.9% of the 163.3 GL/yr available for allocation from groundwater source.

Mine Impacts on Groundwater

A regional-scale groundwater model of the Lower Darling Basin (from Wilcannia to the Murray River) has been developed using groundwater levels from government and private water bores, site hydrogeological testing, and data from previous hydrogeological studies in the region. A good calibration fit to the available groundwater level data has been achieved by the model. The groundwater model has been used to assess the long-term impact of the planned mining on the regional groundwater levels.

The effect of the mining on the groundwater table in the Upper-Aquifer would have a maximum drawdown of less than 2 m at 2.5 km from the mine path. This drawdown effect would dissipate during the post-mining period. The final dredge pond would be backfilled with stockpiled material to a suitable height above the natural groundwater table, to prevent any on-going water take from the aquifer.

Some minor GDE locations are within the mine path and would be managed in accordance with the vegetation management plan. As there is no permanent surface water at the site there would be no permanent aquatic GDEs.

There are no users of the upper groundwater aquifer within 30 km of the Mine Site, therefore, there would be no effect on any regional water user. The mining would not cause any significant change in the quality of the saline groundwater, which is unsuitable for most uses.

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1.0 PROJECT OVERVIEW

RZ Resources Limited (hereafter referred to as the "Applicant") is proposing to develop the Copi Mineral Sands Project (the "Project"). The Project would be located approximately 75 kilometres (km) northwest of Wentworth in the Far West Region of NSW, within the Wentworth Local Government Area (Figure 1). All areas of mining-related disturbance would be situated within the Mine Site, that would be approximately 35 km east of the Great Darling Anabranch and 40 km north of Lake Victoria.

The Mine Site contains about 2.5 million tonnes of heavy minerals (Zircon, Rutile, Leucoxene, Ilmenite, Monazite and Xenotime) within ancient beach strandline sand deposits. The deposit, with an average orebody thickness of 40 metres, is currently estimated to be about 5 km wide and 23 km long, and is likely to increase based on on-going exploration work. The current estimated mine life is about 26 years including construction, operations, and rehabilitation. On-going exploration has indicated potential additional orebodies in the area.

1.1 Mining Process

The unconsolidated sand orebody (Loxton-Parilla Sands) at the mine site is typically about 45 m thick, with its top being near to the regional groundwater table level. Above the ore are thin clay layers and non-mineralised sand layers and dunes (overburden), with minimal topsoil. At the Mine Site the Loxton-Parilla Sands are underlain by a sequence of clay aquitards. The mining process would comprise 1) separation of topsoil (where present) to stockpiles for use in rehabilitation. 2) the removal of the overburden materials (sand and clay) using excavators and trucks, and 3) dredge mining of the mineral sand orebody (clean sand).

The dredge pond level would be generally a few meters below the natural groundwater table level, with a dredging depth of up to about 40 m. The Applicant would operate three dredges: two removing the low mineral-content upper sand (interburden) and the third following behind dredging the high-grade sand to the full ore-body depth. The dredges combined would pump up to 5,000 tonnes per hour of sand. The interburden would be sent directly to disposal locations,[1] while the mineralised ore would be pumped to a wet (floating) concentrator plant (WCP) where the sand would be passed over a series of spirals, to separate the valuable minerals by gravity from the majority silica sand.[2]

The rejected sand would be pumped as a slurry to disposal locations. The majority of the rejected sand would be placed below natural groundwater table level forming an underwater slope at the back of the pond. Some of the rejected sand would be placed above pond level using land-based stackers.

The produced heavy mineral concentrate would be trucked to Broken Hill and then moved by rail to a mineral separation plant (MSP) near Brisbane or directly to the port.

From about 200 m behind the dredge pond, dry overburden material (sand and clay) would be placed onto the rejected sand to a similar height (where possible) of the pre-mine topography.

Figure 2 shows a long section schematic of the planned mining operation.

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[1] Intial disposal would be to an off-path storage area, with subsequent disposal to the back of the dredge pond. Some zones of the upper sand have recoverable mineral which would be sent to the floating concentrator.

[2] Heavy minerals make up approximately 1% of the ore.

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Base Map: Geoscience Australia 1:5 Million General Reference Map

North

RZ Resources Limited
Copi Mineral Sands Project

Regional Location Plan

Plotted:
Jan 25
2024

Datums: Hor: NA Ver: NA

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Figure 1

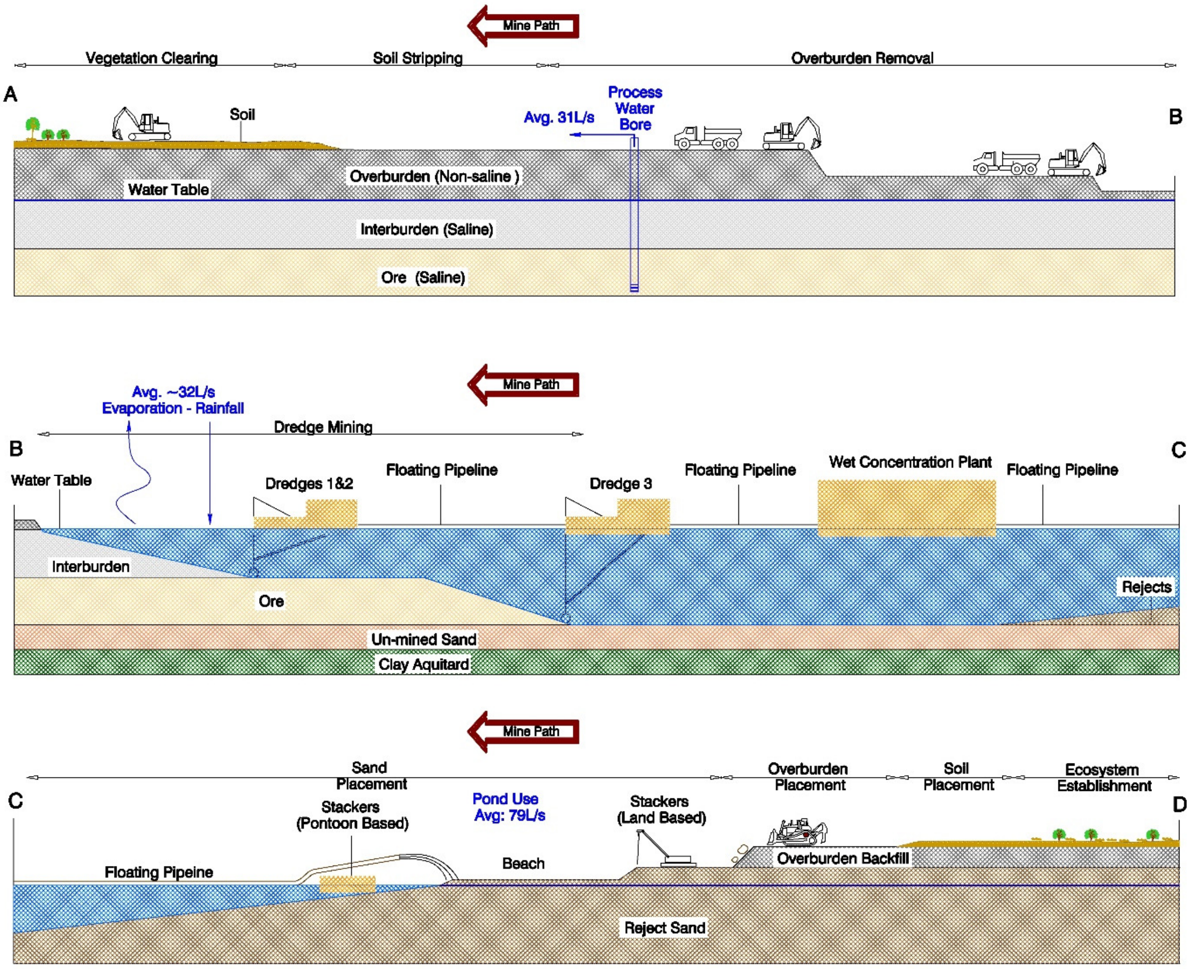

Figure 2 Schematic of Mining Operations—Long Section (Not to Scale)

1.2 Groundwater Effects

The dredge pond would operate within the existing groundwater table, solely in the Loxton-Parilla Sands (Upper-Aquifer). The dredge pond water level will vary by a few meters below natural water table to suit the mine face geology and water balance requirements. There would be minimal change to groundwater levels outside the mining area, and the groundwater level would return to approximately pre-mine conditions behind the dredging operation.

The sand placed back into the dredge pond would have a similar permeability to its pre-mine condition and thus would not significantly alter the local hydrogeology.

The Project would take on average about 4.5 GL/yr (142 L/s) of groundwater, with a peak requirement of 9.6 GL in Year 1 of the project.[3] Water would be obtained from the dredge pond and bores. Approximately 1 GL/yr of water would be permanently lost to evaporation, with most of the remaining water returning to the groundwater table. Yearly water usage estimates are given in Section 12.2.

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[3] Year 1 begins at the start of ore mining.

There is minimal use of the regional groundwater due to its high salinity, and the required peak water supply would be about 5.9% of the 163.3 GL/yr available for allocation from *Western Murray Porous Rock Water Source* in which the mine would operate.

Groundwater impacts are not expected to extend beyond a few kilometres from the mine path as discussed in Section 12.4. Water allocation requirements are detailed in Section 7.1.

2.0 SCOPE OF WORKS

The objective of this groundwater impact assessment is to quantify the effects of the proposed dredge mining operation on the area surrounding the mine site.

2.1 Groundwater Impact Assessment and Model Report

Under NSW legislation and policies, an assessment of the impact of the mining project on the local and regional groundwater aquifers is required to support the development application (SSD 41294067), as part of the environmental assessment of the Project, and is provided in this report.

The DPE Groundwater Assessment Toolbox[4] for Major Projects in NSW and associated technical guidelines[5,6,7] have been considered in the preparation of this assessment (Table 1).

Table 1 Groundwater Assessment Toolbox Reconciliation

Groundwater Assessment Toolbox Item	Section
Overview	See Sections 1.0 and 2.0
Context Setting	See Sections 3.0, 4.0, 8.0, 9.0 and 10.0
Hydrogeological Conceptual Model	See Sections 5.0 and 6.0
Impact Assessment	See Section 12.0
Risk Assessment Peer Review	See Section 15.0 and Appendix P
Mitigation Management and Monitoring	See Section 13.0
Licencing Considerations	See Sections 7.0 and 13.1.1, and Table 13
Groundwater Modelling – Minimum groundwater modelling requirements for major projects in NSW (MGMR MP)	See Sections 11.0, 12.0, 13.0 and 14.0
Water Sharing Plan requirements	See Section 7.1
Aquifer Interference Policy Framework	See Section 12.12

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[4] DPE (2022) *Groundwater assessment toolbox for major projects in NSW – Overview document.*

[5] DPE (2022) *Guidelines for Groundwater Documentation for SSD/SSI Projects. Technical guideline.*

[6] DPE (2022). *Minimum groundwater Modelling Requirements for SSD/SSI Projects. Technical guideline.*

[7] DPE (2022). *Cumulative groundwater impact assessment approaches. Information paper.*

2.2 Planning and Statutory Requirements

2.2.1 DPE's Environmental Assessment Requirements (SEARs)

In accordance with the NSW Department of Planning and Environment Secretary's Environmental Assessment Requirements (SEARs) for the Project, this assessment is required to address the following specific issues (including groundwater components):

Table 2 SEARs Requirements

Secretary's Environmental Assessment Requirements—Water	Section
description of all works/activities that may intercept, extract, use, divert or receive surface water and/or groundwater. This includes the description of any development, activities or structures that would intercept, interfere with or remove groundwater, both temporary and permanent;	**1.2**
details of all water take for the life of the development and the relevant water source where water entitlements are required to account for the water take. If the water is to be taken from an alternative source confirmation should be provided by the supplier that the appropriate volumes can be obtained;	**12.2**
details of Water Access Licences (WALs) held to account for any take of water where required, or demonstration that WALs can be obtained prior to take of water occurring. This should include an assessment of the current market depth where water entitlement is required to be purchased and details of any exemptions or exclusions to requiring approvals or licences under the *Water Management Act 2000*;	**7.1**
an assessment of groundwater conditions that provides an understanding of groundwater level across the site under a range of wet and dry conditions;	**5.0**
an assessment of impacts on surface and groundwater sources (both quality and quantity), related infrastructure, adjacent licensed water users, basic landholder rights, watercourses, riparian land, groundwater dependent ecosystems, and ground water levels; including measures proposed to reduce and mitigate these impacts, having regard to the *Aquifer Interference Policy*;	**12.0**
a detailed and consolidated site water balance, including a description of site water demands, water disposal methods (inclusive of volume and frequency of any water discharges), water supply and transfer infrastructure and water storage structures, and measures to minimise water use;	**12.0, 1.2**
a description of the measures proposed, including monitoring activities and methodologies, to ensure the development can operate in accordance with the requirements of any relevant WSP or water source embargo;	**13.0**
a detailed description of the proposed water management system (including sewage), water monitoring program and other measures to mitigate surface and groundwater impacts;	**13.0, EIS**
a description of construction erosion and sediment controls, how the impacts of the development on areas of erosion, salinity or acid-sulphate risk or erodible soils types would be managed and any contingency requirements to address residual impacts;	**EIS**
identification and impact assessment of all works located on waterfront land including consideration of the Guidelines for *Controlled Activity Approvals*; and	**N/A**
an assessment of any likely flooding impacts of the development including consideration of the hydrology of the site in the site design and the placement of infrastructure to minimise flood risks;	**EIS**

Other Government Agencies—Water		Section
DPE – Crown Lands 09/05/2022	If groundwater is proposed to be used for dust suppression, further consideration is requested as to how this will contribute to dryland salinity in the area and any required mitigation measures.	**EIS**
DPE – Water 21/04/2022	The identification of an adequate and secure water supply for the life of the project. This includes confirmation that water can be sourced from an appropriately authorised and reliable supply. This is also to include an assessment of the current market depth where water entitlement is required to be purchased.	**7.0**
	A detailed and consolidated site water balance.	**12.2**
	Assessment of impacts on surface and ground water sources (both quality and quantity), related infrastructure, adjacent licensed water users, basic landholder rights, watercourses, riparian land, and groundwater dependent ecosystems, and measures proposed to reduce and mitigate these impacts.	**12.0**
	Proposed surface and groundwater monitoring activities and methodologies.	**13.1**
	Consideration of relevant legislation, policies and guidelines, including the NSW Aquifer Interference Policy (2012), the Guidelines for Controlled Activities on Waterfront Land (2018) and the relevant Water Sharing Plans.	**12.12, 7.1**
NSW Environment Protection Authority 04/05/2022	The following potential environmental impacts of the project need to be assessed, quantified and reported on – (c) Water; The Environmental Assessment (EA) should address how the required environmental goals outlined below will be met for each potential impact. The EA should describe mitigation and management options that will be used to prevent, control, abate or mitigate identified potential environmental impacts associated with the project and to reduce risks to human health and prevent the degradation of the environment.	**13.1.6**
	Potential impacts on water quantity and quality.	**12.0**
	A hydrogeological assessment must be undertaken to assess potential groundwater impacts. In particular, the proponent must. a) Identify surrounding groundwater users that may be affected by any adverse impact on groundwater quantity or quality;	**12.5, 12.9**
	c) Quantify the impacts that any proposed water extraction may have on the groundwater resource;	**12.3**
	d) Detail any potential groundwater quality impacts from this proposal and identify appropriate measures that will be undertaken to mitigate any potential adverse impact; and	**12.9**
	e) Describe the proposed re-injection of groundwater and include an assessment of the potential impacts from re-injection and how any adverse impacts will be mitigated.	**N/A**
	Details of the site drainage and any natural or artificial waters within or adjacent to the development must be identified and where applicable measures proposed to mitigate potential impacts of the development on these waters. The EA should provide details of the proposed design and construction of water management systems for the site to ensure surface and ground waters are protected from contaminants.	**EIS**

2.2.2 Water Management Act

The near surface groundwater in the Project area is part of the Western Murray Porous Rock Groundwater Source and is regulated by the *Water Sharing Plan for the NSW Murray Darling Basin Porous Rock Groundwater Sources Order 2020,* under the Water Management Act 2000.

The Porous Rock Groundwater Source (unconsolidated Pliocene and Tertiary sands) overlies low permeability fractured rock at a depth of about 400m (Kanmantoo Fold Belt) which is administered under the *Water Sharing Plan for the NSW Murray Darling Basin Fractured Rock Groundwater Sources Order 2020.* The Project would not have any effect on the fractured rock aquifers.

There would be no impact on other water sources in the region.

The Water Sharing Plan (WSP) contains rules applying to the water source including access licence dealing rules, water supply works approval rules, water allocation account rules etc. Water allocations under the WSP are discussed in Section 7.1.

2.2.3 Aquifer Interference Policy

The *NSW Aquifer Interference Policy*[8] (the AIP) establishes minimal impact considerations for highly productive and less productive groundwater. An assessment of the project with respect to the AIP is summarised in Section 12.12.

2.2.4 Groundwater Dependent Ecosystem Policy

NSW State Groundwater Dependent Ecosystems Policy (DLWC, 2002) recognises the following four Australian groundwater dependent ecosystem types (Hatton and Evans, 1998) that can be found in NSW: 1) terrestrial vegetation; 2) baseflows in streams; 3) aquifer and cave ecosystems; and 4) wetlands.

The potential for Groundwater Dependent Ecosystems (GDEs) is discussed in Section 9.0.

2.3 Modelling Objectives

The broad objective of the groundwater modelling is to provide quantitative input to the Groundwater Impact Assessment. Specific objectives are to:

- predict regional drawdown and/or mounding in the affected aquifers;
- predict drawdown and/or mounding impacts at groundwater dependent ecosystems (GDEs) and third-party wells;
- quantify groundwater usage volumes for water balance and licencing purposes; and
- to provide a platform for future validation and/or modelling of modified activities.

To achieve these aims a 3-D finite element groundwater model has been developed. The model is focused on the Upper-Aquifer in the area which the mine would operate with closer spaced meshing, but also includes information from the wider region for context and future assessments, if there are overlapping effects with other projects. Details of the groundwater model development and methodology to meet these objectives are provided in Section 11.0.

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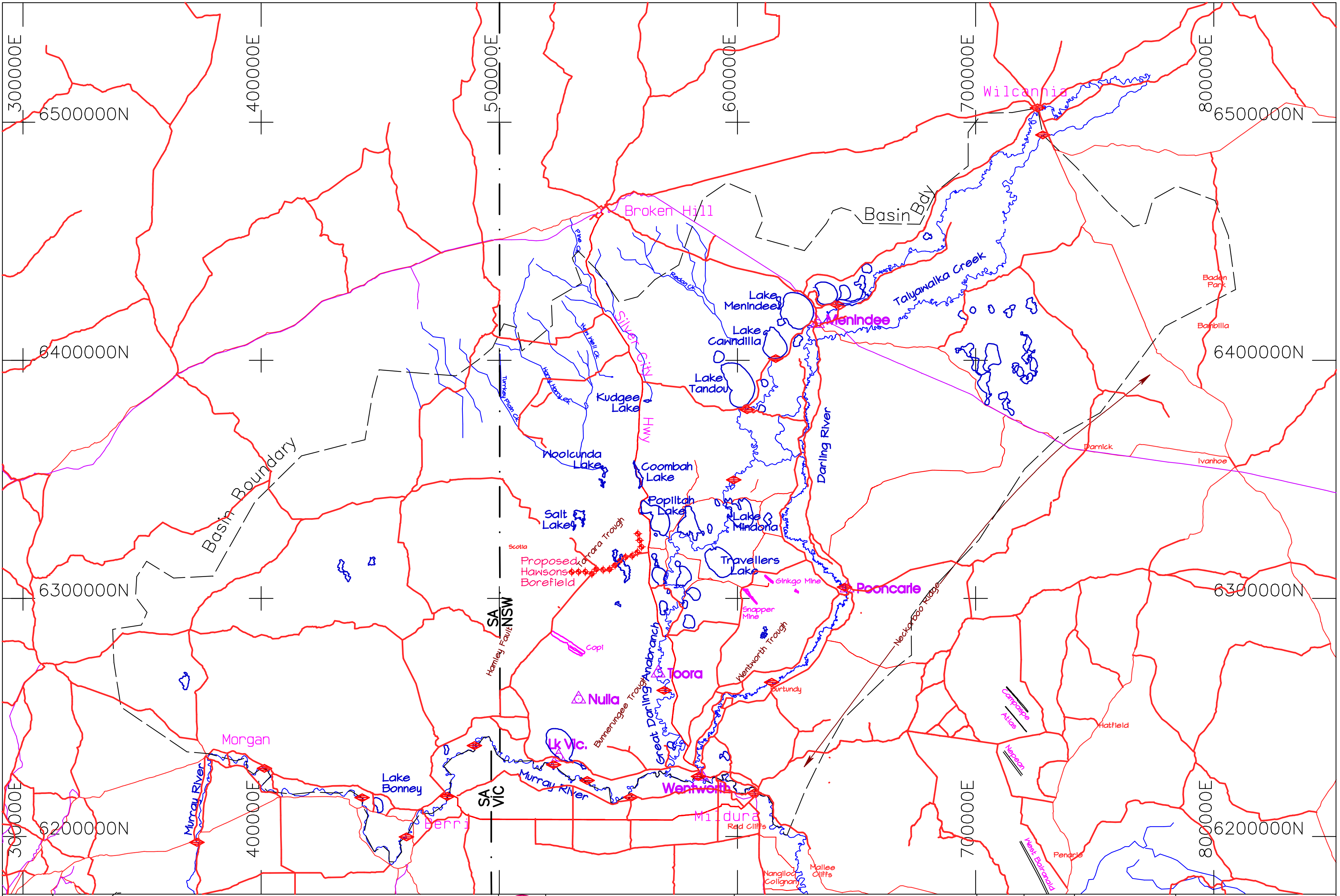
[8] NSW Government, Department of Primary Industries, Office of Water, *NSW Aquifer Interference Policy.* September 2012.



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RZ Resources Limited
Copi Mineral Sands Project

Lower Darling
Groundwater Region

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Figure 3

3.0 ENVIRONMENTAL SETTING

3.1 Drainage and Topography

The lower Darling River Basin (part of the Murray Basin) is located in the south-west corner of NSW and extends into South Australia (Figure 3). The major drainage features are the Murray and Darling Rivers and their associated channels.

The limited rainfall for the Lower Darling region and flat topography has limited the development of any significant local drainage system feeding into the Darling River or Great Darling Anabranch. Rainfall run-off typically collects in local topographic lows before infiltrating to the underlying aquifer or evaporating. Numerous low-lying **salinas** are located in the area of the proposed project, which could hold freshwater over the saline groundwater after major rain events (Figure 4). Localised **freshwater groundwater lenses** may occur below topographic depressions that collect rainfall runoff and concentrate infiltration to the underlying aquifer, however no such lenses have been identified in the Mine Site area.

Regionally the **topography** is relatively flat, with local undulations due to east-west linear sand dune ridges, which have been stabilised by vegetation. Wind transport of material from salinas and intermittent lakes is deposited as lunettes on the eastern side of these depressions. The lowest elevation in the Lower Darling region is about RL 6 mAHD between Lock 1 and Lock 2 on the Murray River at Morgan, South Australia (approximately 150 km to the south-east of the Mine Site). Ground levels rise to above RL 50 mAHD at the northern edges of the basin (approximately 140 km to the north of the Mine Site) above Pre-Tertiary rock.

The proposed Mine Site crosses sand dunes, lunettes and salinas. The topography varies from approximately RL 24.6 mAHD where salinas are close to the groundwater table to sand ridges up to RL 67 mAHD. The highest elevation across the mine path area is about RL 57 m.

Figure 4 Salina at Mine Site, with recent rainfall.

3.2 Surface Water Features

Regional and local hydrological features in the vicinity of the Mine Site are described below:

- The **Darling River** (Figure 1), enters the Lower Darling Basin at Wilcannia and flows south to where it joins the Murray River at Wentworth. Northern sections of the Darling River can vary from a string of stagnant saline pools to a wide flood plain. Significant flooding of the Darling River occurs on average every five years, following prolonged heavy rain in southern Queensland.[9] Flows in the lower part of the river can be regulated by the **Menindee Lakes** water storage system, which was completed in the early 1960s. The Darling River is surrounded by a fresh to brackish groundwater lens (alluvial lens),[10,11] and provides some local fresh water recharge to the regional groundwater aquifers. Interaction to the underlying deeper aquifers is indicated to be localised and episodic.[10,11]
- **Menindee Lakes** – The Menindee Lakes (Figure 1) are natural lakes with man-made weirs to raise their level for water storage. The Menindee Lakes system is used for water storage, irrigation and flow regulation in the Lower Darling and Murray Rivers. Seepage from the lakes provides fresh water recharge to the groundwater table aquifer.[10,11]
- North of Menindee the Darling River forms a wide flood plain with multiple branches and lakes of the **Talyawalka Creek System**. South of Lake Tandou, the **Great Darling Anabranch** is an ancestral, parallel path of the Darling River, which commences to flow naturally when over 9,000 ML/d is flowing in the Darling River downstream of Weir 32.[9] A diversion channel to provide flow from the Darling River to the Great Darling Anabranch was constructed in the late 1800s, but subsequently was replaced by a piped system to reduce evaporation losses from the water supply to downstream landholders. The Anabranch receives discharge flows from **Lake Cawndilla** and flood overflow from the Darling River. Numerous **dry lakes beds** are associated with the Anabranch and Darling River. They occasionally hold water after major flood events, commonly as sets of several continuous wet years, interspersed by periods of 20 to 60 years.[9] Similar to the Darling River, the Great Darling Anabranch is surrounded by a fresh to brackish groundwater lens in the alluvial materials.[10] It is expected that periods of high flow in the Great Darling Anabranch results in some limited contribution to the underlying aquifers. However, due to the intermittent nature of these events and the lack of significant connection between surface and deeper systems, this contribution is likely to be lower than that from the Darling River.[10]
- **Great Darling Anabranch Lakes** – The lakes adjacent to the Great Darling Anabranch (Figure 1) are gentle deflation basins that are normally dry, however some of the lakes do receive water when the Great Darling Anabranch has flow released from the Menindee

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[9] Brodie, R. S. (1998) *The Lower Darling Regional Steady State Groundwater Flow Model*, Australian Geological Survey Organization, Canberra, 1998/19.

[10] CSIRO Land and Water (2004) Salinity Impact Assessment. Appendix K of Darling Anabranch Environmental Impact Assessment for Stock and Domestic Pipeline and Reinstatement of Environmental Flows.

[11] Lawrie, K.C. et. al. (2012) Broken Hill Managed Aquifer Recharge (BHMAR) Project, Geoscience Australia, Report 5, Summary Report, GeoCat #73823, 2012.

Lakes.[12] Occasional wet surface conditions in the lakes would provide small intermittent recharge to the deeper underlying saline groundwater.[1]

- **Salinas** – Water loss from the groundwater table aquifer occurs via evaporation at locations where the surface elevation is near to the groundwater table level. Deposition of salt left behind from the saline water results in "salt pans" or salinas. There are several salinas within and adjacent to the Mine Site.
- **Lake Victoria** – Lake Victoria is a shallow freshwater lake adjacent to the Murray River, approximately 40 km south of the Mine Site (Figure 3). It is managed as an off-river storage by government agencies, with an embankment around its extent to increase storage capacity.[13] Water infiltrates from the base of the lake into the groundwater table aquifer and towards the Murray River.
- **Murray River** – At its closest point, the Murray River is approximately 50 km south of the Mine Site (Figure 3). In this section of the river, the water levels are controlled by a series of locks resulting in a range of effects including groundwater inflow and outflow from the river, depending on the local gradient.[9] Saline groundwater flow from the groundwater table aquifers enters the river along much of its length increasing the salinity load which eventually reaches South Australia.
- **Ephemeral Streams** drain from the bedrock ranges to the north of the basin and flow for 40 km to 60 km into the sand plain. Woolcunda Lake with terminated flow from Turkey Plain Creek (Figure 3) has received filling flows five to six times in about 100 years.[9]

3.3 Rainfall and Evaporation

The climate is semi-arid with low and sporadic rainfall and high evaporation. Average rainfall reduces to the north, ranging from 285 millimetres per year (mm/year) at Wentworth in the south to 244 mm/yr at Menindee in the north. Table 3 summarises rainfall and evapotranspiration data.

Rainfall data from several long-term recording stations (Wentworth, Pooncarie and Menindee) is available from the late 1800s while the nearby Lake Victoria station has data from 1922. Residual rainfall mass curves (monthly rainfall - average monthly rainfall) are shown in Figure 5 for these four long-term rainfall monitoring stations. Recent rainfall years have been near or below the long-term average. Weather Station locations are shown on Figure 3.

Rainfall stations closer to the Mine Site are Toora (#047099, Nov 1972 to July 2016) which is 37 km south-east of the site and Nulla (#047111 Aug 2017 to present) at 24km south of the Mine Site. The average annual rainfall from the Toora record is 269 mm. The record from Nulla is too short to be of use. The long-term climate estimates by SILO[14] (Table 3) indicates an average rainfall of 226 mm/yr.

For this assessment an average rainfall rate of 260 mm/yr has been used, weighted towards the more direct measurements and local data.

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[12] Earthtech (2004) *Darling Anabranch Environmental Impact Statement for Stock and Domestic Pipeline and Reinstatement of Environmental Flows.* Department of Infrastructure, Planning and Natural Resources, NSW.

[13] Murray-Darling Basin Authority. Lake Victoria, https://www.mdba.gov.au/river-information/running-river-murray/lake-victoria.

[14]. <www.longpaddock.qld.gov.au/silo>.

Groundwater level and water quality monitoring in the region indicates that there are locations where rainfall recharge is concentrated, while other areas have negligible infiltration. Infiltration rates to the groundwater table are a small fraction of the rainfall amount as discussed in Section 5.8.

Average annual pan evaporation for the Mine Site is approximately 2066 mm/yr.[15] Evapotranspiration varies as a function of the vegetation cover and surficial geology at the local scale. Average areal actual evapotranspiration has been estimated at 256 mm/year by the Bureau of Meteorology (BOM).[15,16]

The proposed dredge pond area would be on average about 1 km^2. Therefore, the pond evaporation rate would be similar to the average areal potential evapotranspiration rate of about 1086 mm/yr (Table 3).[15] Smaller ponds would have evaporation rates closer to the average point potential evapotranspiration rate of 1869 mm/yr (Table 3).[15]

Table 3 Rainfall and Evapotranspiration Statistics

Month	**Average Monthly Rainfall (mm)[1]**				**Copi Area Rain/Evap (mm)**			
	Menindee 047019	Pooncarie 047029	Wentworth 047053	Lk. Vic. 047016	SILO rain[2]	ETAA[3]	ETAP[4]	ETPP[5]
Jan	23.8	22.8	21.2	19.7	17.4	23.9	167.7	284.5
Feb	20.7	22.6	21.4	18.4	18.1	15.2	132.0	239.6
Mar	18.6	17.9	19.5	14.7	12.9	14.9	106.8	199.6
Apr	17.3	18.2	18.6	18.9	17.0	19.2	65.8	115.8
May	22.5	25.7	27.5	23.0	21.8	24.0	41.0	65.6
Jun	21.4	25.2	26.1	22.3	19.3	19.2	26.8	39.8
Jul	17.8	21.8	23.8	23.6	19.8	24.2	30.8	47.8
Aug	18.1	22.7	25.7	23.5	20.8	22.9	44.8	74.9
Sep	18.9	21.8	26.6	24.3	18.8	24.9	68.0	118.6
Oct	22.5	26.1	27.2	26.4	24.0	27.0	112.8	189.3
Nov	21.2	21.7	24.9	23.6	17.5	20.1	135.8	230.3
Dec	21.7	21.2	22	20.2	18.3	20.9	153.8	263.3
Year	**244**	**268**	**285**	**259**	**226**	**256**	**1086**	**1869**

[1] Bureau of Meteorology Weather Stations (data to July 2022).[17]
[2] SILO interpolated average rainfall data (latitude -33.60°, longitude 141.35°) (1922-2022).
[3] Average areal actual evapotranspiration: BOM 30-year climatology data (1961-1990).[15]
[4] Average areal potential evapotranspiration: BOM 30-year climatology data (1961-1990).[15]
[5] Average point potential evapotranspiration: BOM 30-year climatology data (1961-1990).[15]

3.4 Land Use

The proposed Mine Site area (Figure 3) is primarily used for sheep grazing, with cattle being stocked during better climatic conditions. Feral goat harvesting is an increasing market in the region. Dry-land cropping occurs in some areas. To the north around the Menindee Lakes and in the south along the Murray River there is significant irrigation-based agriculture.

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15. <www.bom.gov.au/jsp/ncc/climate_averages/evapotranspiration/index.jsp>.

16. Morton, F.I. (1983). *Operational estimates of areal evapotranspiration and their significance to the science and practice of hydrology*. Journal of Hydrology, 66: 1-76.

17. <www.bom.gov.au/climate/data/index.shtml>.

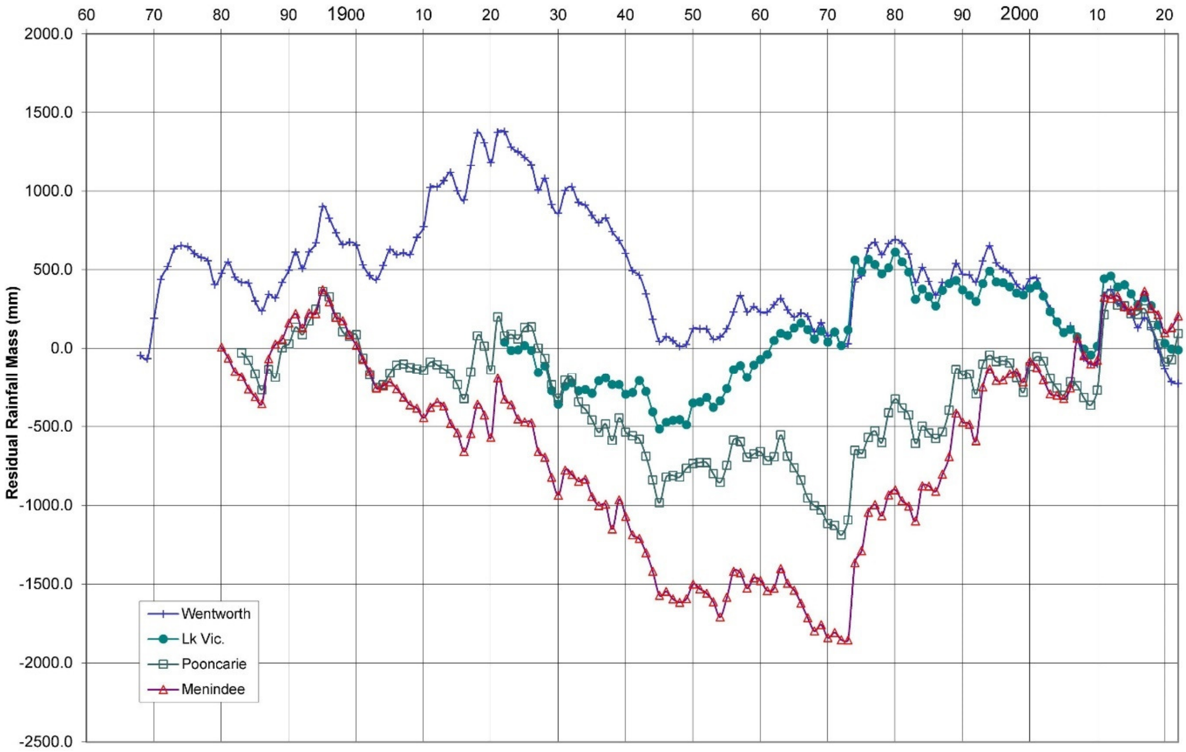

Figure 5 Residual Rainfall Mass Curves

4.0 REGIONAL GEOLOGY

Several large-scale ridges and basins (likely fault bounded blocks) form the pre-Tertiary basement profile, over which the relatively flat lying Tertiary and Quaternary sediments of the Murray Basin have formed.[18]

The stratigraphy of the Lower Darling Basin area, as shown on the hydrogeological cross-sections in Appendix A are summarised in descending order as follows:

Surficial Quaternary sediments range from the sands of the **Coonambidgal Formation** (Qa) found along the river channels, to the silty clays and evaporite deposits of the flood plain lakes (Ql) and includes the **Yamba Formation** (Qly). The **Woorinen Formation** (Qdw) is found as extensive east-west oriented sand dunes, but also includes clayey zones. More recent aeolian sand deposits (Qdx, Qdp) may be found as low dunes and lunettes around the larger dry lakes and salinas (Qdlk). The **Blanchetown Clay** (Qpc) is an extensive lake-bed deposit which can be a significant impediment to rainfall recharge to the underlying aquifers.

The Tertiary-Quaternary **Shepparton Formation** (TQs) is a thin fluvio-lacustrine deposit comprising clay, silty clay and sand with lenses of coarse sand and gravel, and minor aeolian reworked material. The Shepparton Formation is the groundwater table aquifer in portions of the north, east and south-east of the Lower Darling Basin.

The **Loxton-Parilla Sands** (Tps) is primarily a shallow-marine, beach to estuarine deposit, with overlying fluvial and fluvio-lacustrine layers. It grades vertically upwards and laterally landward (east and north) into the fluvio-lacustrine **Calivil Formation** (Tpc). Both of these

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[18] Brown, C.M. and Stephenson, A.E. (1991) *Geology of the Murray Basin, Southeastern Australia*. Bureau of Mineral Resources, Australia. Bulletin 235.

Pliocene aquifers are comprised primarily of fine to medium grained quartz sand, with coarser zones in the beach deposits of the Loxton-Parilla Sands, which also hosts wave concentrated beach strandlines of heavy minerals. Some fine-grained silt, micaceous sand and clay layers are also present. High permeability 'surf-zones' are commonly found in the off-shore direction from the beach deposition of the mineral strandlines, and heavy mineral ore-zone also have a higher permeability than the average for the Loxton-Parilla Sands. The proposed dredge mining would be within the Loxton-Parilla Sands.

The **Tertiary Renmark Group** comprises three geological units: The Upper, Middle and Lower Olney Formations, also described as the Upper, Middle and Lower Renmark Formations.

The **Upper Olney Formation** (Ter3) is a medium to fine grained sand with inter-bedded silt and micaceous sands, and is commonly directly hydraulically connected to the overlying Loxton-Parilla or Calivil Aquifer. To the south, the Upper Olney Formation grades or onlaps with the silty sand and sandy clay of the **Geera Clay Equivalents** (Tmge), and clays of the **Bookpurnong Beds** (Tpb).

The **Middle Olney Formation** (Ter2) is indicated to be fluvio-lacustrine in origin. It is intermittently present and is generally more clay than sand with limited productive aquifer zones. In the central region of the Lower Darling Basin, the Middle Olney Formation grades into the silts and clay of the **Geera Clay** (Tmg) and **Winnambool Formation** (Tmw), which transitions to the **Murray Group Limestone Formation** (Tml) further south.

The **Lower Olney Formation** (Ter1) is primarily sand with some silt and carbonaceous zones. The **Warina Sand** (Tew) is found in the deeper seaward troughs at the base of the Renmark Group composed of coarse-grained sands to gravel. The **Ettrick Formation** (Toe) is a clay aquitard separating the Murray Group Limestone Aquifer from the underlying Lower Renmark Aquifer in the south of the region.

The basement rock includes low-permeability sandstones, claystones, and metasediments.

5.0 HYDROGEOLOGY

5.1 Regional Hydrogeology

The near surface groundwater in the Project area is part of the Western Murray Porous Rock Groundwater Source and is regulated by the *Water Sharing Plan for the NSW Murray Darling Basin Porous Rock Groundwater Sources 2020,* under the Water Management Act 2000.

The Porous Rock Groundwater Source (unconsolidated Pliocene and Tertiary sands) overlies fractured rock at a depth of about 400m (Kanmantoo Fold Belt) which is administered under the *Water Sharing Plan for the NSW Murray Darling Basin Fractured Rock Groundwater Sources 2020.* The Project would not have any effect on the fracture rock aquifers.

Specific hydrogeological information is provided by the Murray Basin Hydrogeological Map Series,[19] which indicates the general geometry of the various aquifers and aquitards, based on

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[19] Australian Geological Survey Organisation (AGSO) and Bureau of Mineral Resources, Geology and Geophysics (BMR) (1991-1994) Murray Basin Hydrogeological Map Series 1:250,000 *Map Sheets, Ana Branch, Menindee, Burra-Chowilla-Olary, Mildura, Pooncarie, Manara, Renmark.*

a sparse distribution of drillholes. Drilling data is also available from various mining exploration projects in the region.

The Mine would operate within the Western Murray Porous Rock Groundwater Source as described in the Water Sharing Plan. At the Mine Site there are three main aquifers (Upper, Middle and Lower) in the Porous Groundwater Source. The Upper-Aquifer may comprise surficial sediments, the Shepparton Formation and Pliocence sands (Loxton-Parilla Sands and Calivil Formation) and the Upper Olney/Renmark Formation (where present), depending on the groundwater table level. The Middle-Aquifer is represented by the Middle Olney/Renmark Formation in the north and the Murray Group Limestone in the south, and is not significant in the central portion of the basin. The Lower-Aquifer comprises the Lower Olney/Renmark Formation and the Warina Sands in deep locations. The Lower-Aquifer is most significant where there are basement troughs and is thin, or not present, over the bedrock highs, and where the profile shallows towards the basin boundaries in the north, west, and east.

The Mine would only interact with the Upper Aquifer (Loxton-Parilla Sands Aquifer), with thick aquitards preventing any interaction with deeper aquifers.

The groundwater flow in all aquifers is generally from recharge areas in the north and east to discharge areas in the south-west towards the Murray River. The groundwater gradient is generally very flat, with an average gradient of about 1V:10,000H.[11]

Direct rainfall recharge is limited over much of the region due to low permeability surface layers and high evaporation rates, with higher rainfall recharge in the south near to the Murray River.[9] In the north, groundwater recharge occurs primarily from ephemeral streams at the basin edges and from flooding of the Darling River.[11] There is groundwater connection to the Lachlan Fan Groundwater region in the north-east, while the Neckarboo Ridge creates a groundwater divide further south along the eastern boundary of the Lower Darling Basin (Figure 3).[20] Groundwater pressures in each aquifer are generally similar, with a small downward gradient in the northern recharge areas and a larger upward gradient from the Lower-Aquifer to the Murray River in the south.

Cross-sections from the Australian Geological Survey Organisation (AGSO) Murray Basin Hydrogeological Map Series,[19] are shown in Appendix A. The section locations are provided on Figure 6. The sections show the geological profile and the influence of basement structure on the overlying basin sediments. Figure 7 shows an additional northeast-southwest section across the proposed groundwater model domain (location indicated in Figure 6).

Aquifer salinity is freshest near to the basin edges in the north, with increasing salinity to the south. Two-digit values (e.g. 6,2) are shown on the AGSO cross-sections (Appendix A) to indicate the salinity and potential groundwater yield of the aquifers as described in the legend in Appendix A.

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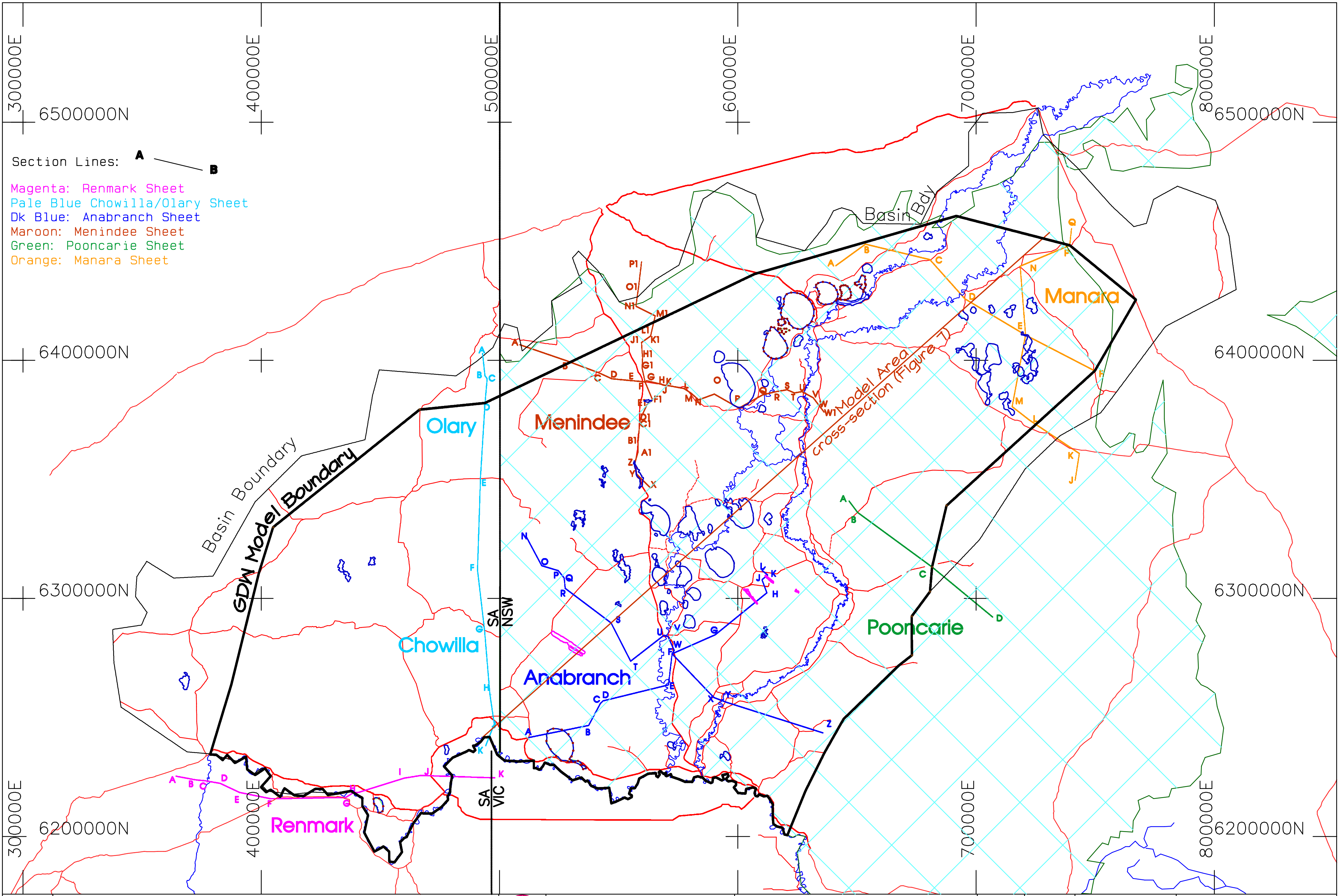
[20] Kellet, J. R. (1997) *Lachlan Fan / Ivanhoe Block Steady State Groundwater Model.* Australian Geological Survey Organization, Canberra.



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28 x 18.72

Legend: Hydrogeological Sections in Appendix A

▨ Western Murray Porous Rock GDW Source WSP Boundary

North

RZ Resources Limited
Copi Mineral Sands Project

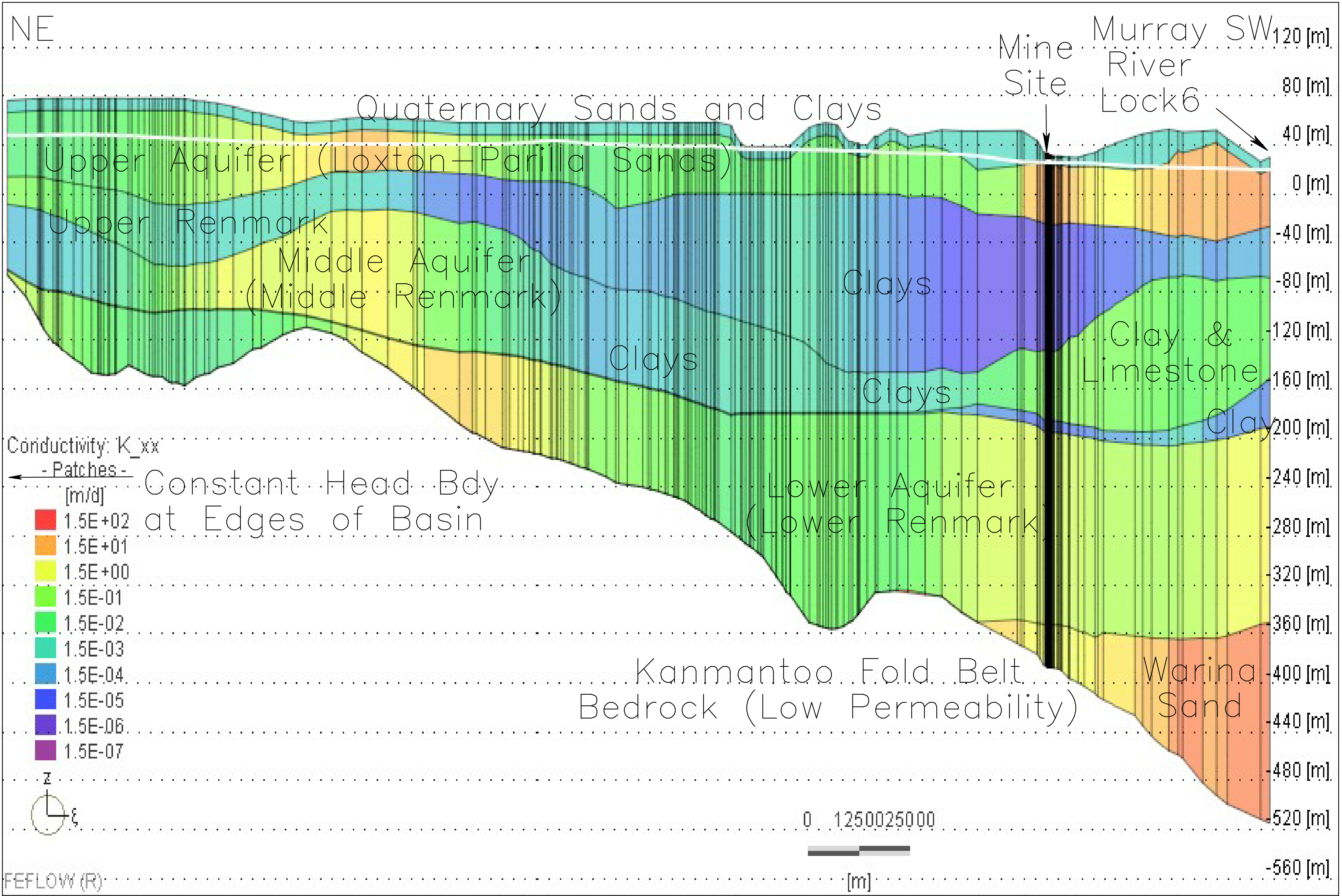
Hydrogeological Sections
Location Plan

Plotted:
Jan 26
2024

Datums: Hor: GDA Ver: AHD

A4 - 1 : 75000

Figure 6



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28 x 18.72	*Legend:* Estimated Horizontal Hydraulic Conductivity (Kxx)	North	RZ Resources Limited Copi Mineral Sands Project	Hydrogeological Section NE - SW	Plotted: Jan 26 2024	Contour int: N/A	Datums: Hor: N/A Ver: AHD Vert. Exag. ~1:250 Figure 7

5.2 Previous Hydrogeological Studies

Regional hydrogeological studies include those by Brodie,[9] Kellet,[20] and Lawrie,[11] which summarise other smaller scale studies. Jacobs has modelled the shallow groundwater around the Menindee Lakes.[21] Many groundwater investigations have been carried out on the alluvial geology of the Murray River and salt-water interception schemes,[22,23,24] but do not extend significantly beyond the river flood plain.

Hydrogeological studies have been carried out for the Ginkgo and Snapper Mines (80 km north-east) by Golder,[25,26,27,28,29,30] Worley Parsons,[31] and GEO-ENG.[32,33,34,35]

GEO-ENG also investigated a potential water supply for the Hawsons Iron Project,[36,37] from the Lower-Aquifer, approximately 35 km north of the Mine Site.

Approximately 200km to the east, Jacobs has reported on the hydrogeology for Iluka's Balranald Mineral Sands Project.[38] The hydrogeology of the Atlas and Campaspe Mineral Sands Mines (which commenced in 2022) was assessed by GEO-ENG.[39]

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21. Jacob (2016) *Menindee Regional Groundwater Modelling*. WaterNSW IH087100.
22. Woods, et. al. (2013) *Woolpunda Numerical Groundwater Model 2013*, Department of Environment, Water and Natural Resources, South Australia.
23. Yan, W. Howles, S.R. and Marsen, Z. (2004) *Chowlilla Floodplain Numerical Groudnwater Model.* Department of Water, Land and Biodiversity Conservation, South Australia, 2004/65.
24. Merrick, N.P., Middlemis, H., and Williams, R.M. (2002) *Buronga Salt Interception Scheme: Groundwater Flow, Solute Transport, and Optimisation Modelling.* Dept. of Land and Water Conservation, Centre for Natural Resouces Report CNR 2002.044.
25. Golder Associates (2001) *Hydrogeological Feasibility Study for the Ginkgo Mineral Sands Project in the Murray Basin*, July 2001, Report # 01612006.
26. Golder Associates (2002) *Hydrogeological Pre-Feasibility Study, joint exploitation of the Snapper and Gingko deposits.* Report # 02611005.
27. Golder Associates (2006) *Hydrogeological study for Snapper deposit.* Report # 06613504.
28. Golder Associates (2007) *Hydrogeological Study for Snapper Deposit Pooncarie, NSW*, Report # 06613504/017.
29. Golder Associates (2007) *Snapper Mineral Sands Project Environmental Assessment Report, Appendix A—Hydrogeological Assessment*, Report # 06613504/016.
30. Golder Associates *(2008) Re-Run of Regional Groundwater Model, Snapper Mineral Sands Project.* Project # 087616009001.
31. Worley Parsons (2005) *Gingko Mineral Sands project water supply wellfield - Drilling, construction and aquifer testing completion report.*
32. GEO-ENG (2010) *BEMAX Resources Limited, Section 75W Modification, Snapper & Ginkgo Mines – Hydrogeological Assessment*, Pooncarie, NSW, 9015C.
33. GEO-ENG (2013) *Cristal Mining Australia, Ginkgo Mine Modification, Crayfish Deposit — Hydrogeological Assessment*, Pooncarie, NSW, 1118G.
34. GEO-ENG (2014) *Cristal Mining Australia, Snapper and Ginkgo Mine Modification, Hydrogeological Review*, Pooncarie, NSW, 1402A.

35 GEO-ENG (2019) *Tronox Mining Australia, Snapper Mine Northern Extension Modification*, Hydrogeological Review. Pooncarie, NSW, 1932A.

36. GEO-ENG (2016) *Hawsons Iron Project, Groundwater Borefield Assessment*, 1516C.
37. HydroSimulations (2016) *Hawsons Iron Project Groundwater Borefield Assessment – Peer Review*, HS2016/04.
38. Jacobs (2015) *Balranald Mineral Sands Project Groundwater Assessment, rev 3.*. Report VE23875.
39. GEO-ENG (2013) *Cristal Mining. Atlas-Campaspe Mineral Sands Project, Appendix F - Hydrogeological and water Supply assessment.*

Previous hydrogeological investigations of the Mine Site have been carried out by Jacobs,[40] and AGE Consultants,[41] which are discussed in Section 5.3.2.

Table 4 provides a summary of hydrogeological parameters from regional assessments in the Lower Darling Basin by Brodie,[9] Lawrie[11] and GEO-ENG.[36] The hydrogeological parameters for individual units in the Brodie report are difficult to determine where multiple lithological layers are combined into single model layers. Data reported by Brodie from previous studies has also been included in the range of data. The data from the studies by Lawrie do not include the deeper layers, and do not specify vertical conductivity.

Table 4 Estimated Hydrogeological Parameter Ranges from Previous Studies

Geology	Brodie [1998]		Lawrie [2012]	GEO-ENG	
	Kh (m/d)	Kv (m/d)	K (m/d)	Kh (m/d)	Kv (m/d)
Quaternary Sediments	1 – 30	1e-8 – 5	6e-4 – 32	1e-5 – 1	1e-8 – 1e-1
Shepparton Formation	0.1 – 0.5	1 – 30	1 – 30	1e-5 – 1	1e-8 – 1e-1
Blanchetown Clay	0.01 – 1	5e-4	2e-5 – 0.018	1e-8 – 0.1	1e-10 – 1e-3
Loxton-Parilla Sands	0.2 – 20		1e-6 – 50	1 – 40	0.001 – 2.5
Upper Renmark (Upper Olney)	0.1 – 5		1e-6 – 17	0.1 – 5	0.01 – 1
Bookpurnong Beds	0.1	1e-7 – 1e-3		1e-8 – 0.1	1e-10 – 1e-3
Middle Renmark (Middle Olney)				0.01 – 10	1e-4 – 0.1
Murray Group Limestone	1 – 3.5	2e-4 – 5e-4		0.01 – 10	1e-4 – 0.1
Geera Clay	0.1	1e-10 – 1e-3		1e-8 – 0.1	1e-10 – 1e-3
Ettrick Clay	0.1	1e-5 – 1e-4		1e-8 – 0.1	1e-10 – 1e-3
Winnambool Formation	0.1			1e-8 – 0.1	1e-10 – 1e-3
Lower Renmark (Lower Olney)	10 – 50			0.01 – 30	1e-4 – 0.3
Warina Sand	10 – 50			1 – 150	0.01 – 1

5.3 Local Hydrogeology

5.3.1 Government Bore Information

A NSW government monitoring site (GW036722) with three standpipes (Upper-, Middle-, and Lower-Aquifers) was constructed in 1987, on the Warwick property, near to the central-south-western side of the orebody. A summary of the drilling log is given in Table 5. The upper sand aquifer is approximately 46 m thick. The Middle-Aquifer was identified as 5 m of sand bands. The bottom aquifer is a 10 m zone of sand and gravel bands. Significant thicknesses of clay aquitards are present between the aquifer zones.

At the Mine Site, the Upper-Aquifer is the Loxton-Parilla Sands which hosts the orebody. The salinity is about 61,000 mg/L. The Middle-Aquifer is indicated to comprise thin sand bands,

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[40] Jacobs (2018) *Copi North Groundwater Input to PFS*, Prepared for TZ Minerals International, WES-WRE-0099.

[41] AGE Consultants (2020) *Groundwater Impact Assessment - Copi Mineral Sands Project*, G1945B.

with a salinity of about 20,000 mg/L. The bottom aquifer is the Lower Olney Formation, with a salinity of about 12,000 mg/L.

The pressure head in the Middle-Aquifer is about 9.5 m greater than the Upper-Aquifer; and there is a further 1.5 m increase in head from the Middle-Aquifer to the Lower-Aquifer. This suggests that there is no significant interconnection between the aquifers in the local area. The Upper-Aquifer is generally unconfined, but may be slightly confined where the groundwater table rises into the overlying Blanchetown clay.

Table 5 Warwick Monitoring Bore (GW036722) Drilling Log

From	To	Description	Material	DTW (m)	TDS (mg/L)
0	1	Topsoil	Topsoil		
1	11	Clay Multicoloured	Clay		
11	19	Sand Grey Water Bearing	Sand		
19	21	Sand Red Water Bearing	Sand		
21	25	Sand Water Bearing	Sand	6.2	~61,000
25	42	Sand Grey Water Bearing	Sand		
42	57	Sand Grey	Sand		
42	57	Clay Grey	Clay		
57	115	Clay Grey Black	Clay		
115	219	Clay Grey Sticky	Clay		
219	226	Clay Black Grey	Clay		
226	231	Clay Black Grey Water Bearing	Clay		
226	231	Sand Bands	Sand	-3.7	~20,000
231	347	Clay Black Grey	Clay		
347	349	Clay Black Grey Some Gravel Bands	Clay		
349	411	Clay Black Grey	Clay		
411	421	Clay Black Grey Water Bearing	Clay		
411	421	Sand Gravel Bands	Sand	-4.9	~12,000
421	464	Clay Grey	Clay		
464	467	Shale Cretaceous Cored	Shale		

DTW—depth to water from collar (m). TDS– Total Dissolved Solids (Salinity) in mg/L.

5.3.2 Site Hydrogeological Investigations

Six groundwater bores were constructed in the Upper-Aquifer and have been monitored since April 2016, as reported by Jacobs (Figure 8).[40,42] AGE Consultants installed a further 45 monitoring bores and four pumping test bores in 2019 (Figure 8).[41] The average bore depth was 31 m. Most of the holes were completed in the Loxton-Parilla Sand with the deepest drilling profile of sand to RL -26 mAHD at B4 (previously labelled INJ01). The base of the Upper-Aquifer was encountered in M14 at RL -17 mAHD, in M3D at RL -2.2 mAHD and in B3 at RL 6 mAHD. Other bores did not indicate the base of the Upper-Aquifer.

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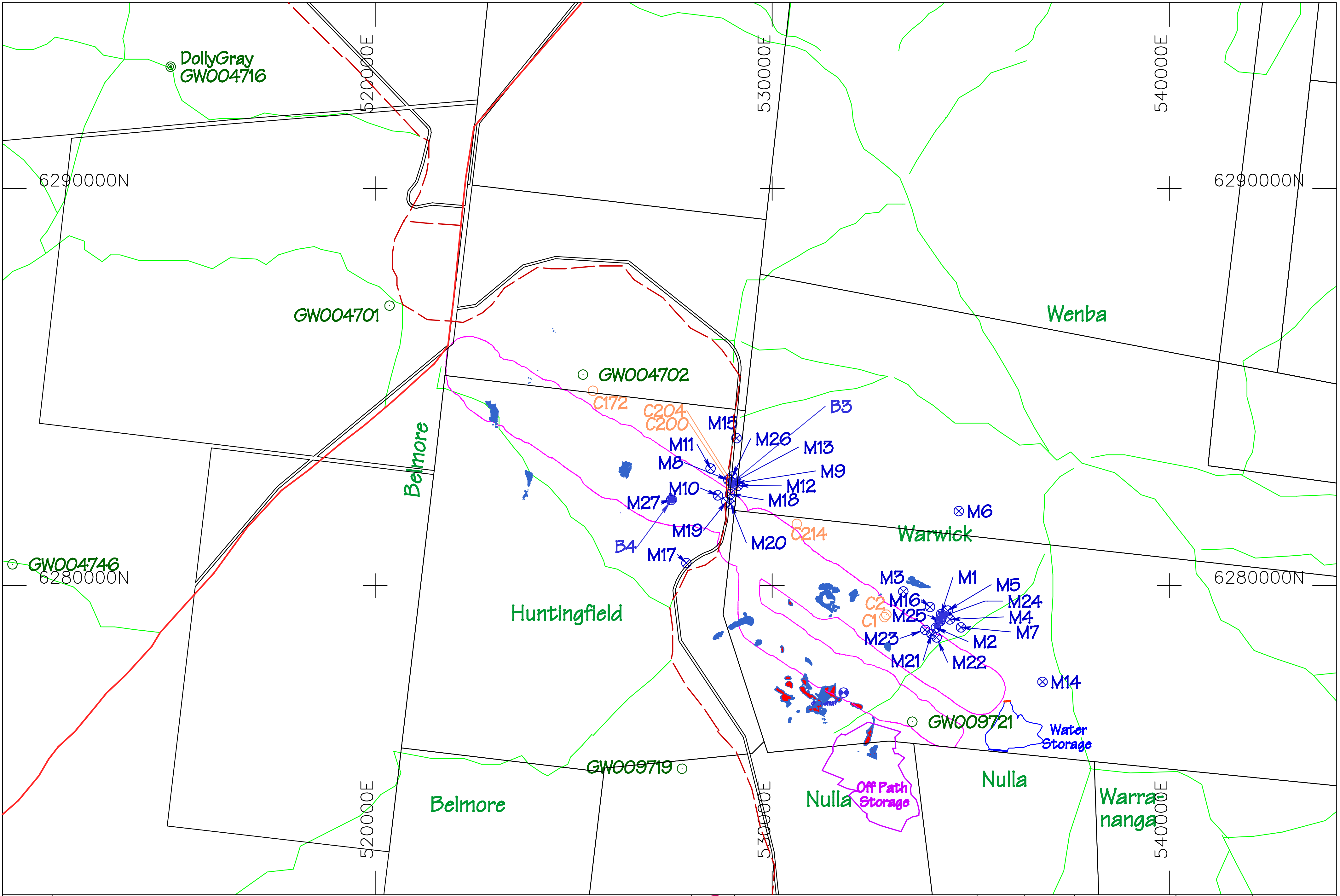
[42] The monitoring bores reported by Jacobs have been relabelled. CNA001 is now C1, etc.



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28 x 18.72	● Gov. Mon. Bore ◎ Farm Bore ● Pumping Test Bore ⊗ 2019 Mon. Bores ○ 2016 Mon. Bore	▬ Salinas	Mine Path	North	RZ Resources Limited Copi Site GDW Monitoring
Plotted: Jan 26 2024	Contour int: NA	Hor: MGA Z54S Ver: AHD	A4 - 1 : 120000 Figure 8		

Drilling logs from the 2019 investigations are included in Appendix B, with approximate elevations. A detailed level survey has not been completed, however, ground elevation, based on LiDAR data has been used to more accurately determine the bore and water levels as summarised in Table 6.[43]

Table 6 Site Investigation Bores

Bore ID	Easting	Northing	Ground	Screen (mBGL)		Base	SWL
			(m) AHD	Top	Bottom	(m) AHD	(m) AHD
C1	532826	6279208	29.96		10.8	19.16	
C002	532873	6279269	29.75		12.2	17.55	
C172	525485	6284905	26.37		9.2	17.17	
C200	529002	6282444	41.48		18.7	22.78	
C204	529033	6282518	39.46		21.2	18.26	
C214	530619	6281554	53.1		30.7	22.4	
B1	534290	6279250	34.3	24	42	-7.7	24.5
B2	534215	6279117	34.55	20	38	-3.5	24.8
B3	528976	6282582	39.28	23.5	41.5	-2.2	24.7
B4	527472	6282166	35.24	42	60	-24.8	
M1S	534253	6279272	34.72	14.5	20.5	14.2	24.8
M1D	534253	6279283	34.7	25	31	3.7	24.8
M2S	534113	6278940	34.59	14.1	20.1	14.5	24.8
M2D	534122	6278940	34.62	27	33	1.6	24.6
M3S	533300	6279852	27.66	13	19	8.7	
M3D	533300	6279852	27.66	24	30	-2.3	
M4S	534466	6279138	33.04	15	21	12.0	24.4
M4D	534475	6279149	33.1	25	31	2.1	24.8
M5S	534430	6279371	33.6	14.3	20.3	13.3	24.6
M5D	534420	6279371	33.7	27	33	0.7	24.6
M6	534698	6281876	39.4	20.3	32.3	7.1	
M7S	534753	6278960	33.0	16	22	11.0	
M7D	534753	6278949	33.1	30	36	-2.9	
M8S	528893	6282660	38.8	18	24	14.8	24.2
M8D	528893	6282660	38.8	26	32	6.8	24.3
M9S	529050	6282582	37.8	17.5	23.5	14.3	24.5
M9D	529050	6282571	38.1	35.5	41.5	-3.4	24.2
M10	528632	6282273	46.3	24	36	10.3	
M11	528448	6282950	37.2	12	24	13.2	
M12S	529143	6282527	37.0	17.5	23.5	13.5	24.5
M12D	529134	6282515	37.4	32	38	-0.6	24.7
M13S	528976	6282594	38.9	18	24	14.9	24.7
M13D	528976	6282582	39.3	29.5	35.5	3.8	24.8

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[43] The AGE drilling locations have been relabelled. PB01 is now B1, MB01S is now M1S, etc. Also the injection test site bore INJ01 is now B4, and the nearby monitoring bore INJMB01 is now M27.

M14	536806	6277577	56.2	70	82	-25.8	
M15	529100	6283713	37.6	17.5	29.5	8.1	
M16S	533975	6279462	35.2	18	24	11.2	
M16D	533975	6279462	35.2	33	39	-3.8	
M17	527838	6280568	41.5	24	30	11.5	
M18S	528938	6282305	44.5	27	33	11.5	24.8
M19S	528845	6282117	41.3	10	26	15.3	
M19D	528845	6282117	41.3	33	39	2.3	
M20	528956	6282050	40.8	12	24	16.8	
M21S	534001	6278796	34.7	19	25	9.7	
M21D	534010	6278785	34.7	25	31	3.7	
M22S	534140	6278696	35.8	14.5	20.5	15.3	
M22D	534140	6278696	35.8	26	32	3.8	24.5
M23S	533862	6278886	35.3	18	24	11.3	
M23D	533853	6278886	35.3	24	30	5.3	
M24S	534290	6279217	34.3	13	19	15.3	24.7
M24D	534281	6279217	34.4	26	32	2.4	24.6
M25S	534234	6279106	34.5	13	19	15.5	24.6
M25D	534234	6279106	34.5	29.6	35.6	-1.1	24.6
M26S	528986	6282738	34.7	18	24	10.7	
M26D	528995	6282749	34.2	30	36	-1.8	
M27	527453	6282155	35.0	47.5	53.5	-18.5	

Coordinates GDA94z54. AHD: Australian Height Datum. mBGL: meters below ground level.

The local groundwater table is at about RL24.6 mAHD in the monitoring bores, and is generally near to the contact between the Blanchetown Clay and the Loxton-Parilla Sands (Upper-Aquifer).

Within the Project area the Loxton-Parilla Sands includes zones of fine and coarse sand and fine gravel, with generally finer sand in the lower ore zone. Fine content (<0.75 mm) is indicated to be approximately 5 to 10%. Some cleaner (less clayey) and more clayey horizons are present, and the top of the Loxton-Parilla Sands beneath the Blanchetown clay typically contains 20-30% clay.

Pumping test data was reported by AGE, at P1, P2 and P3.[41] The tests comprised a step-test at four to five increasing flow rates, with each step being approximately one hour, apart from at PB2 where the steps varied from 10 minutes to 100 minutes. The bores were allowed to recover to 95% of the pre-test levels, before 72-hour constant rate tests were carried out.

Water levels were monitored manually and with logged pressure transducers in the pumping bore and seven to nine observation bores located near to the pumping bore. The observation bores were between 3 m and 360 m from the pumping bore. Drawdown recovery data was recorded until the water levels had restored to at least 80% of the initial water level.

GEO-ENG combined the data from the pumping and monitoring bores for both the step and continuous pumping tests for re-analysis in AQTESOLV software.[44] Table 7 summarises the results of the analyses, which are shown in Appendix C.

Table 7 Pumping Test Results

	Kh (m/d)	Kv/Kh	Sy	Ss (m^{-1})	Sw
Minimum	15	0.1%	0.1037	0.0002	22
Average	29	1.2%	0.1317	0.0033	35
Maximum	42	2.8%	0.2030	0.0138	49

The average horizontal hydraulic conductivity value (Kh) is 29 m/d, while vertical hydraulic conductivity (Kv) is typically about 1.2% of the horizontal value. The average Specific Yield (Sy) (water drained from pore space) is 13%. The Specific Storage (Ss) (water released due to pressure change) is about 0.003. The Wellbore Skin Factor (Sw) has an average value of 35.

The estimated parameters are consistent with the expected range for a fine to coarse sand, and are consistent with results from similar studies in the region. The anisotropy ratio (Kv/Kh) is relatively low, but not unreasonable. The Wellbore Skin Factor is very high indicating significant head loss at the screen zone. It is likely that the thickness of the introduced gravel pack prevented the removal of drilling mud from the sides of the drill hole, resulting in the large well losses. An alternative designs using screens to match the aquifer sand (without introduced a gravel pack) would improve future bore designs.

5.3.3 Groundwater Quality

Away from the rivers and basin edge recharge locations, groundwater salinity/TDS (Total Dissolved Solids) is generally in excess of 5,000 mg/L.[19] Salinity increases to the south-west where values in the Upper-Aquifer exceed 60,000 mg/L. Average salinity for the Lower-Aquifer at the Mine Site area are likely to be about 12,000 mg/L. Table 8 shows typical water quality results from the Upper, Middle and Lower-aquifers.

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44. Duffield, G.M.(2007) *AQTESOLV for Windows Version 4.5 User's Guide*, HydroSOLVE, Inc., Reston, VA.

Table 8 Average Groundwater Quality

		Upper-aquifer[1]	Middle-aquifer[2]	Lower-aquifer[3]
pH	pH Unit	7.10		
Electrical conductivity	µS/cm	93,900		
TDS (Calc)	mg/L	61,000	12,000	10,350
Total Hardness as CaCO3	mg/L	11,167		320
Sulphate as SO4 - Turbidimetric	mg/L	8,053		1,010
Chloride	mg/L	33,433		5,770
Calcium	mg/L	489		180
Magnesium	mg/L	2,420		200
Sodium	mg/L	21,767		3,300
Potassium	mg/L	153		41
Aluminium	mg/L	<0.05		
Arsenic	mg/L	0.01		0.001
Cadmium	mg/L	<0.0005		<0.0001
Chromium	mg/L	<0.005		<0.001
Cobalt	mg/L	<0.005		
Copper	mg/L	0.01		0.0025
Manganese	mg/L	0.41		0.19
Nickel	mg/L	<0.005		<0.001
Zinc	mg/L	<0.025		<0.005
Iron	mg/L	7.84		0.15
Ferrous Iron	mg/L	7.44		
Flouride	mg/L	0.40		
Dissolved organic carbon	mg/L	3.67		

[1] Averaged data from shallow Copi bores in 2020/2021.
[2] Data from sampling of GW036722-2.
[3] Averaged data from multiple samples of the HIP deep bore T9 (44km to north).
Metal results are for dissolved species.

Mapped variations in salinity are shown on the cross-sections in Appendix A. Figure 9 provides a Piper Diagram of the major groundwater cations and anions for several regional bores. The chemistry is dominated by Sodium and Chloride.

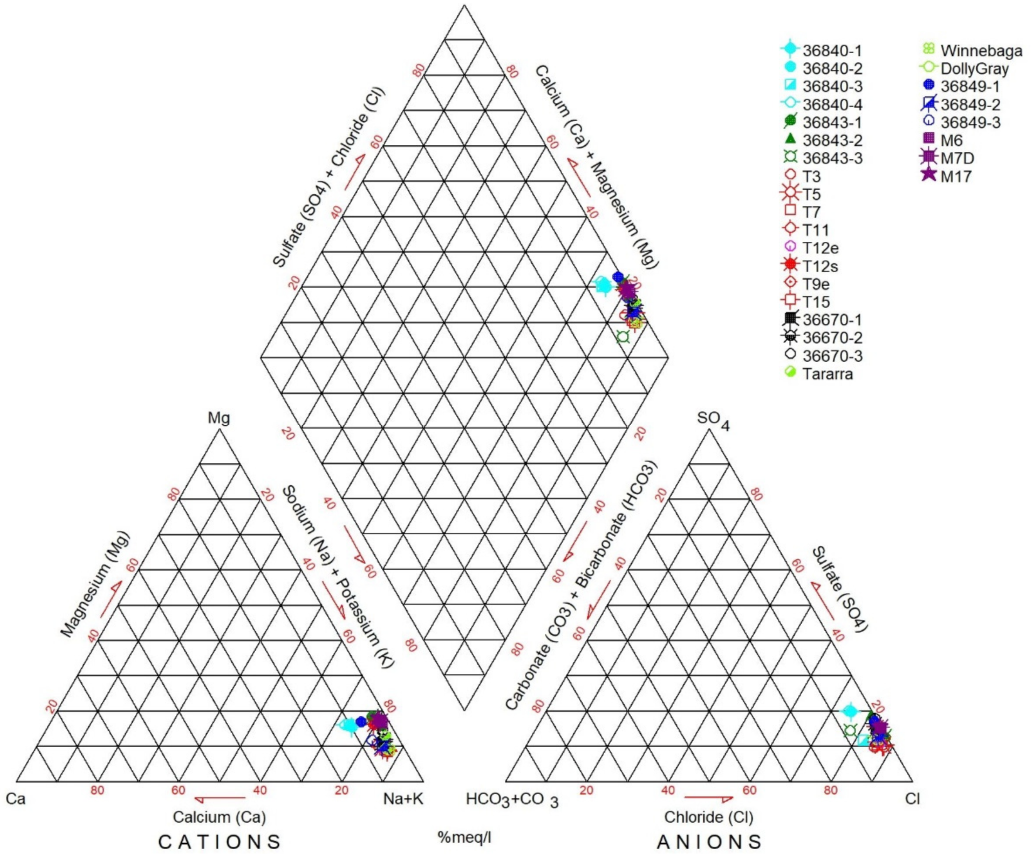

Figure 9 Water Chemistry Piper Diagram

Symbols: Upper-Aquifer—solid; Middle-Aquifer—partially-filled; Upper-Aquifer—unfilled
Order from north to south (see Figure 8 and Figure 10). T3-T15 are from the Hawsons Iron Project at Popiltah and Springwood Stations.

5.4 Regional Water Level Data

5.4.1 Government Monitoring Bores

Groundwater data for NSW government monitoring bores is available from WaterNSW.[45] Monitoring for locations away from the Murray River is generally carried out annually, with more frequent readings near to the irrigation areas. Additional water level and survey data has been collected by mining companies to augment the government records.

Groundwater data for South Australia (SA) is regularly updated on their WaterConnect website, however many of the bore sites away from the Murray River have not been monitored for over 10 years. Some of these more remote locations were visited during a hydro-census in 2015 and are included in Appendix D.

Some water level data from the Victorian groundwater database has also been incorporated to improve the data set for water level contours in Figures 11–13.

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[45] < https://realtimedata.waternsw.com.au/>

5.4.2 Groundwater Bore Census

A census of groundwater bores was managed by GEO-ENG to obtain relevant information (water level, conductivity, infrastructure, usage, etc.) from existing government and private bores in the region. Data was collected from a total of 113 bores. Appendix D provides a summary of measured data of the hydro-census bores from May 2015. Subsequent monitoring indicates stable water quality (GEO-ENG).

5.4.3 Groundwater Level Data Set

A total of 430 bores from the Lower Darling Basin were assessed to have potentially useful data including surveyed elevations. Of these 37 were found to have duplicate data for other sites and 88 had questionable data, or were affected by pumping or irrigation. 53 bores were located outside the proposed groundwater model boundary (primarily in the far south-east near Lambert Island). Of the remaining 252 bores (19 within South Australia), 23 are used for boundary conditions of the model, leaving 229 bores at 184 locations for model calibration

The locations of the calibration and model boundary bores are show in Figure 10. Data for the calibration and boundary bores are summarised in Appendix E.

5.5 Long-Term Groundwater Levels

Hydrographs for 54 government regional monitoring bores with long-term records are shown in Appendix F (Borehole locations are shown on Figure 10). The monitoring bores are grouped by aquifer and general locations.[46]

In the north there has generally been a slight drop in most water levels over the 30 years of data. There appears to be a small delayed response to above average rainfall in 2010-2011 in some of the central/northern monitoring bores (Coombah, Tandou, Yelta Lake and Pooncarie) in all aquifers. Declining water levels at Backwell, Coombah and Tandou may be related to farm bore water use.

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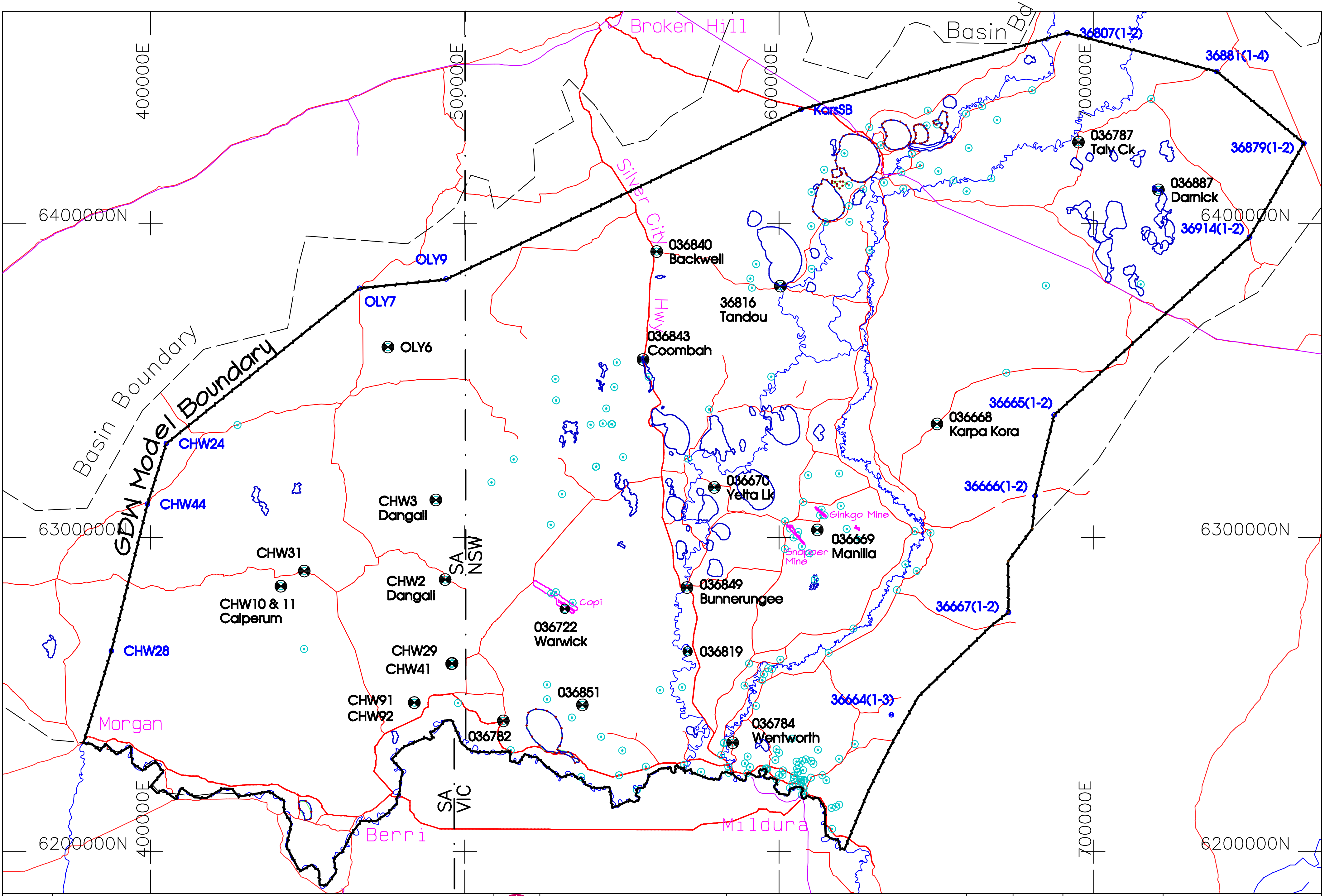
[46] The hydrographs presented are not adjusted for salinity.



Legend: ⊗ Model Bdy Piezometer ⊙ Other WL Data Sites
⊗ Long-Term Monitoring Bore Location

28
x
18.72

North

RZ Resources Limited
Copi Mineral Sands Project

Regional Groundwater Level
Monitoring Bores

Plotted:
Jan 26
2024

Datums: Hor: GDA
Ver: AHD

A4 - 1 : 1500000

Figure 10

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In the southern region there are declines in groundwater levels near Wentworth and Bunnerungee in all aquifers. The Lower-Aquifer bore water levels at Manilla, Bunnerungee, Wentworth and Lake Victoria appear to have dropped and then partially recovered in response to Lower-Aquifer pumping at Snapper Mine between 2010 and 2017. Other monitoring bore water levels, including the shallow bores nearest to the Mine Site (Warwick and Lake Victoria), have remained relatively constant over 30+ years.

5.6 Regional Groundwater Contours

Piezometric groundwater level contour maps based on the most recent data for the Upper-, Middle- (where present) and Lower-Aquifers are shown in Figures 11–13. Contours are truncated where there is limited data in the north and west. The effect of seepage from the Menindee Lakes and irrigation areas along the Murray River is evident in the Upper-Aquifer (Figure 11). Pumping from salt interception schemes results in significant gradients in the Middle-Aquifer near to the Murray River, where it is the groundwater table aquifer (Figure 12).

5.7 Salinity Correction

There are large variations in salinity across the region and between aquifers, and the effect of density differences can be significant in the calculation of hydraulic head gradients. Options for managing salinity effects include: 1) Including the salinity density effect by using a flow and solute–transport model. 2) Correcting each borehole monitoring level to an average or freshwater salinity. 3) Assuming an average salinity for the primary zone of interest.

Table 9 summarises the measured and mapped salinities for the boreholes used in this assessment.

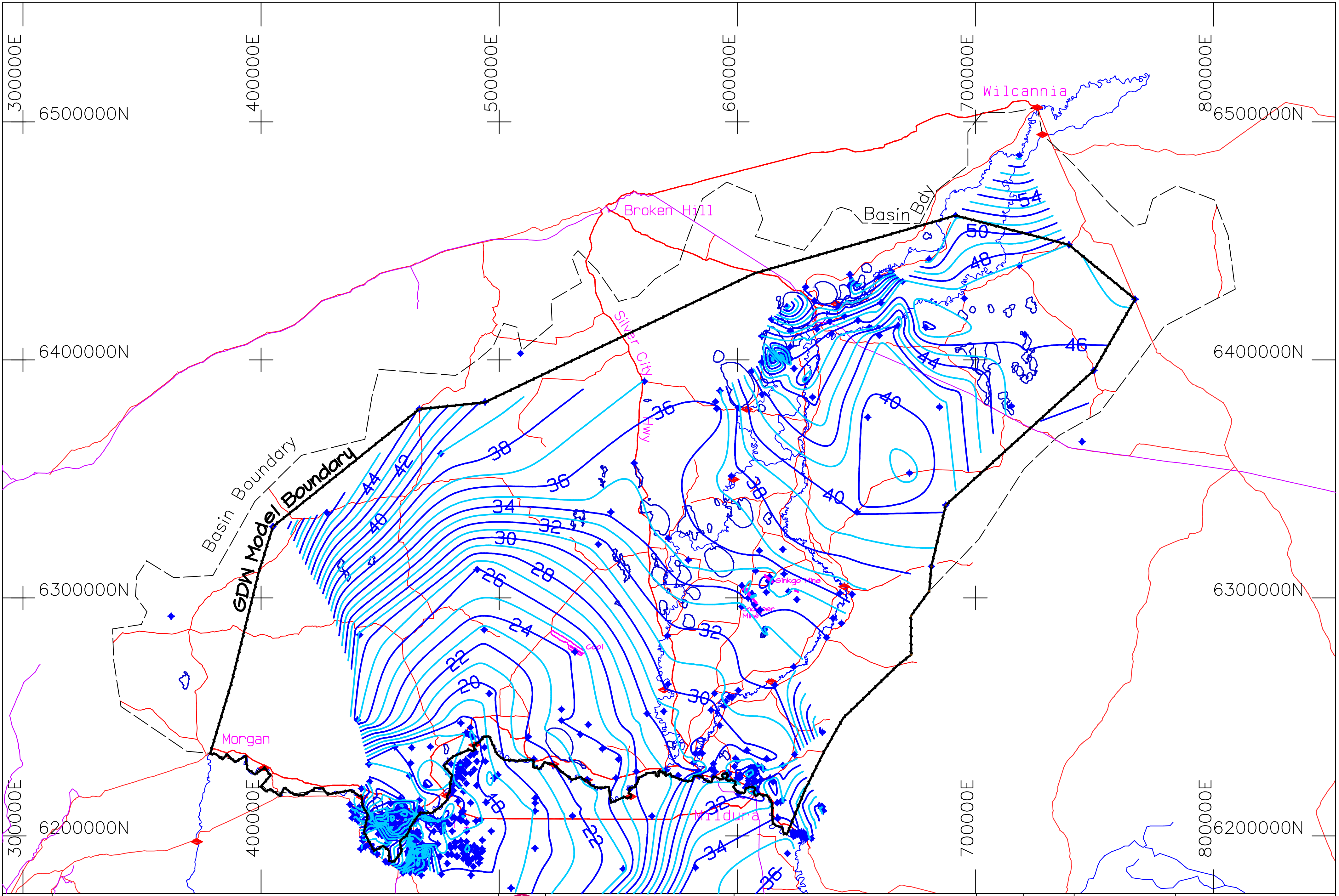
Table 9 Aquifer Groundwater Salinity

Aquifer	Average TDS (mg/L)	Standard Deviation* TDS (mg/L)	Maximum TDS (mg/L)
Upper-Aquifer	24,600	21,400	104,600
Middle-Aquifer	15,700	9,500	36,400
Lower-Aquifer	13,800	6,800	32,500

*The standard deviation assumes a normal distribution, which is not exact, but is useful to give an indication of the range.

A solute-transport solution would add additional complexity of implementing salinity data, for which there is minimal information, and significant variability in quality control.

Direct correction of each borehole to an equivalent freshwater or average salinity head can be used for local calculations, but is strongly dependent on the reference elevation used and is difficult to implement in a groundwater model with multiple aquifers and varying borehole depths. Analysis of using salinity corrections for each monitoring bore in previous work by GEO-ENG, showed that significant errors could develop for the multi-aquifer system. Furthermore, no significant improvement in model calibration was obtained in these previous models using salinity corrected measurement compared to analyses with no salinity correction.



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28 x 18.72

Legend: Upper Aquifer Water Levels
Data Points Indicated

North

RZ Resources Limited
Copi Mineral Sands Project

Upper Aquifer Groundwater Levels
and Monitoring Locations

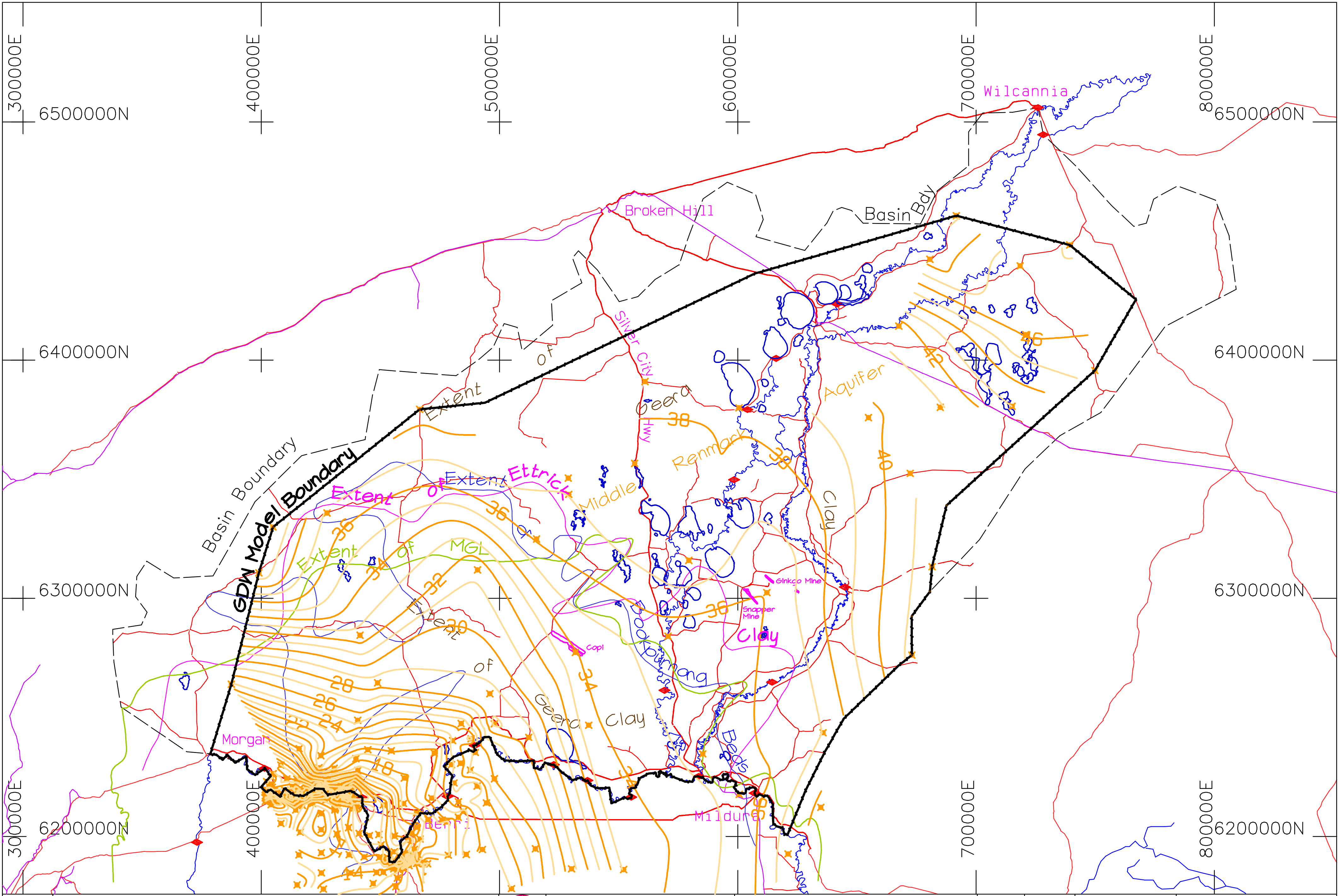
Plotted:
Jan 26
2024

Contour int: as shown

Datums: Hor: GDA Ver: AHD

A4 - 1 : 1500000

Figure 11



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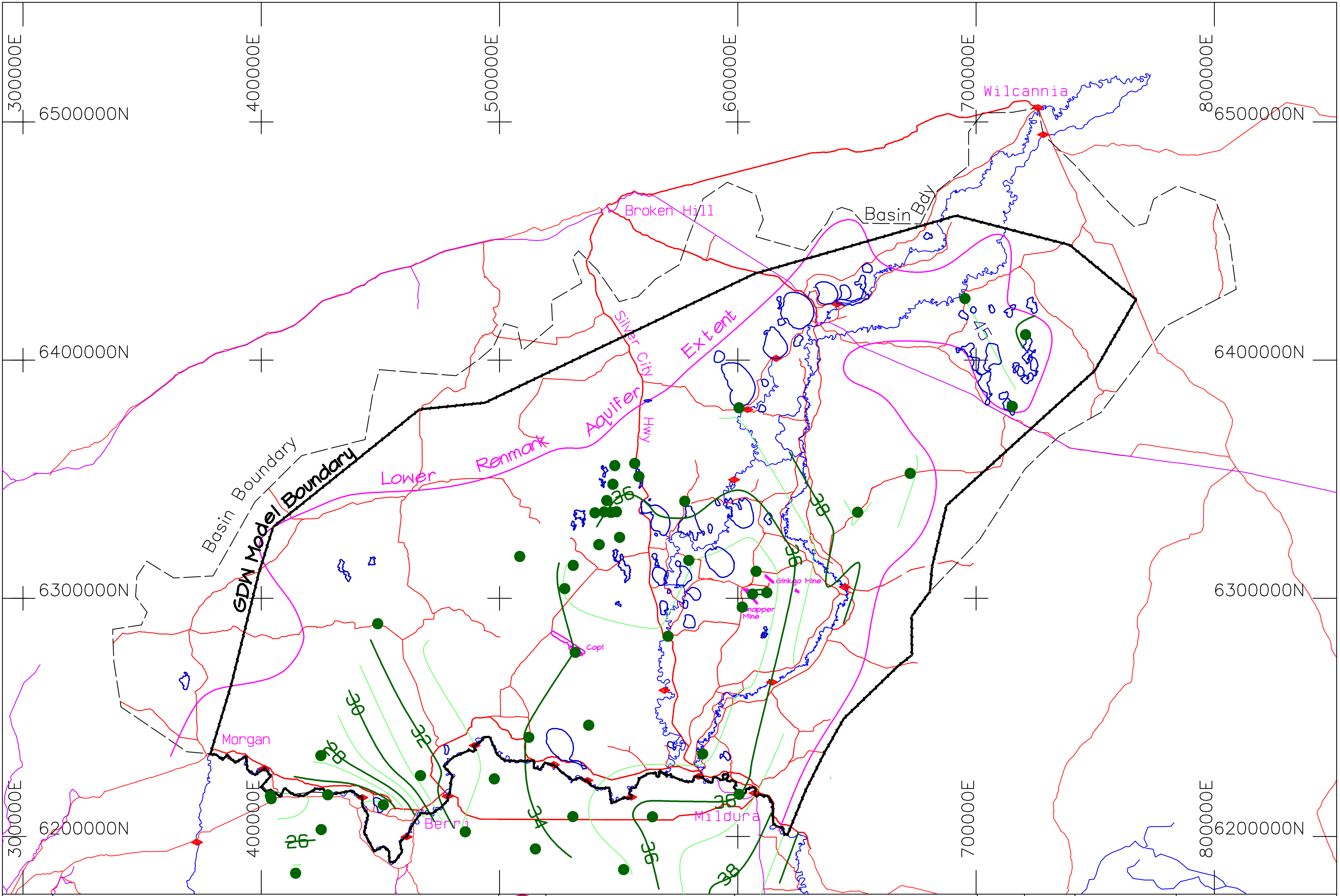
28 x 18.72	*Legend:* Middle Aquifers Pressure Contours Data Points Indicated	North	RZ Resources Limited Copi Mineral Sands Project	Middle Aquifer and Aquitard Extents and Monitoring Locations	Plotted: Jan 26 2024	Contour int: as shown	Datums: Hor: GDA Ver: AHD A4 - 1 : 1500000
							Figure 12



Legend:
Lower Aquifer Pressure Contours
Data Points Indicated

28 x 18.72

RZ Resources Limited
Copi Mineral Sands Project

Lower Aquifer Extent and
Monitoring Locations

Plotted:
Jan 26
2024

Contour int: 1m

Datums: Hor: GDA
Ver: AHD

A4 - 1 : 1500000

Figure 13

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Salinity corrections are also dependent on temperature, which is not usually recorded. Measured water temperatures from pumped bores indicate a significant temperature gradient, with temperatures of about 30°C measured for some deep pumping bores. Measured water levels are typically taken in static monitoring bores, which would have equilibrated in temperature to the surrounding strata and may not fully reflect the higher temperature of the source aquifer.

Based on the issues related to the above options, it has been chosen to not correct the water levels for salinity (effectively assuming an averaged salinity value for the water level data across the region). Resulting errors will be small for the Upper-Aquifer, where salinity corrections would be small, due to the shallow depths. Errors for the Middle-Aquifer will be larger, but are not critical, as this aquifer is not significant in the area of interest. Inaccuracy for the Lower-Aquifer would be the largest given the longer standpipe depths, but would not be critical for the Project.

5.8 Hydrogeological Data Quality Assessment

The consistency of groundwater level measurements and the multi-bore pumping test records are assessed to be of high quality. The effect of salinity on water level measurements reduces the accuracy of the data for assessment work as discussed in Section 5.7. Given that the mining would have a small effect on the groundwater levels (Section 12.4), the data accuracy is assessed to be adequate, and the salinity effects would be immaterial to the assessment of groundwater impacts.

6.0 RECHARGE AND DISCHARGE

The long-term groundwater monitoring sites (Section 5.5 and Appendix F) indicate limited rainfall recharge response, which is consistent with very low rainfall recharge rates. In many locations the shallow unsaturated zone contains clayey materials, which hold up the infiltrating rainfall preventing it from reaching the groundwater table.

Localised rainfall recharge is evident at a few locations as freshwater lenses on top of the saline groundwater.[47] Brodie indicated a typical rate of recharge of 0.1% of rainfall, with a maximum of about 5% in irrigation areas and a low value of 0.05% in areas of undisturbed Mallee.[9]

Lawrie indicated that much of the deep groundwater recharge is likely due to flooding of the Darling River and inflow from ephemeral streams at the northern edges of the basin.[11] This is supported by the results of model calibration, which indicate significant stream loss in the northern part of the groundwater model area (Section 11.7.2).

Lawrie notes that the Darling River and Anabranch and their alluvial zones have limited connectivity to the underlying groundwater regime, with decreasing basal river loss to the south.[11] Brodie indicates that the Darling is a losing stream for most of its length, with 94% of leakage upstream of Menindee.[9]

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[47] A few farm bores near to Ginkgo Mine have drawn small quantities of freshwater from above the saline groundwater aquifer.[35]

Groundwater discharge is primarily to the Murray River in the south. Groundwater is also lost by evaporation at salinas which intersect the groundwater table.[9] Elsewhere the depth to groundwater, and sparse vegetation, limits evapotranspiration from the Upper-Aquifer.

Based on Chlorine and Strontium isotope ratios, Brodie indicated a modern marine source of salt in the Upper-Aquifer, while the deeper aquifer's salt is likely derived from the marine sediments.[9]

Given the distance of the Mine Site area from significant recharge and discharge boundaries, and the minimal response of groundwater levels to rainfall, the groundwater regime is in a relatively steady-state condition, and is relatively insensitive to recharge and discharge effects.

7.0 LICENSING

The proposed Mine Site is located within the Western Murray Porous Rock Water Source as defined in the *Water Sharing Plan for the NSW Murray Darling Basin Porous Rock Groundwater Sources 2020* under the *Water Management Act, 2000*. The Western Murray Porous Rock Water Source includes groundwater contained in all shallow unconsolidated geological layers (Shepparton Formation to Renmark Group Units), but excludes the local alluvial aquifers around the rivers.

There would be no impact on other water sources in the region.

7.1 Murray Darling Basin Porous Rock WSP

The long-term annual extraction limit stipulated in the *Water Sharing Plan for the NSW Murray Darling Basin Porous Rock Groundwater Sources Order 2020* for the *Western Murray Porous Rock Water Source* is 226 GL/yr. The WSP indicates allocation for landowner rights (stock and domestic) is 26.7 GL/yr. As of February 2023, there is 23.6 GL/yr of allocation for aquifer access licences (primarily Tronox Mining Australia Ltd.).[48] Approximately 90% of the water used by Tronox is returned to the aquifer in the mining process. Allocation for salinity and groundwater table management access is 14.0 GL/yr.

Actual usage from recent years has been less than 20% of the allocations for commercial and salinity management.[48]

As detailed in Section 12.2 the Project would require on average about 4.5 GL/yr, with a peak requirement of 9.6 GL in Year 1 of the project. The *Western Murray Porous Rock Water Source* has an indicated available allocation of 163.3 GL/yr.

While specific allocations have been given for salinity and groundwater table management, there is no differentiation within the licensing structure between poor quality saline groundwater which is pumped for salt-interception or can be used for industrial purposes, such as mining, and better-quality water usable for agriculture, environmental or human consumption. Testing of the Upper-Aquifer at the proposed Mine Site indicates a salinity of about 61,000 mg/L, while the Lower-Aquifer, which may be used for water supply indicates a salinity of about 12,000 mg/L, which is at the margin of agricultural usability, only being suitable for sheep for short periods.

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[48] < https://waterregister.waternsw.com.au/water-register-frame>

There is sufficient capacity in the Porous Rock Source that could be allocated for the Project via a commercial or special purpose licences. A peak licence allocation of 9.6 GL/y will be required to be obtained under the WSP. Temporary water allocations could also be obtained by water trade with Tronox for years of high requirements in accordance with Part 10 of the WSP.

Water supply works would be carried out in accordance with Part 9 of the WSP. Mandatory requirements, including metering, record keeping and construction requirements are given in part 11 of the WSP.

7.2 Other Water Sources

There would be no impact on other water sources in the region.

8.0 REGIONAL GROUNDWATER USAGE

There is limited usage of groundwater in the region due to the generally poor quality of the water in the aquifers, particularly the upper aquifer. Table 10 provides information on bore records within 15 km of the Mine Site. The only known active bore is the Lower-Aquifer Dolly Gray Bore (GW004716), which is used for marginal stock water (Figure 8).

Table 10 Local Groundwater Bore Locations

Registered #	East	North	Purpose	Total depth (m)	Notes
GW004701	520362	6287050	Stock & Domestic	Not recorded	Not Found
GW004702	525231	6285314	Stock	196	Not Found
GW004716	515008	6293065	Stock	182.9	Dolly Gray
GW004746	510866	6280536	Stock	199.3	Not Found
GW009719	527729	6275390	Unknown	381.3	Not Found
GW009721	533528	6276573	Unknown	324.3	Not Found
GW036722	531797	6277305	Monitoring	32/231/421	3 standpipes

Source: WaterNSW <https://realtimedata.waternsw.com.au/>

Water supply bores for mineral washing and potable use (via reverse-osmosis treatment) would be installed in the Upper-Aquifer at the Mine Site. The dredge pond for the Project is expected to generally within a few meters below the natural groundwater table in the shallow high-salinity upper aquifer, and thus would have minimal impact outside of the Mine Site area.

8.1 Upper-Aquifer

The primary user of groundwater in the region is Tronox Mining Australia at their Ginkgo Mine, approximately 75 km north-east of the proposed Copi Mineral Sands Project. Most of the saline water used in these dredging operations is recycled back to the upper groundwater aquifer, with a portion lost to evaporation and desalinated water use.

Water quality in the Upper-Aquifer improves to the north, and thus shallow bores are found at some homesteads about 80 km to 100 km to the north of the Mine Site. Shallow perched fresh water lenses are present around the rivers and lakes due to leakage, and at the margins of the basin where there is surface water run-off.

Localised fresh water lenses sitting on top of the saline aquifer have been identified near to the Ginkgo Mine, where rainfall infiltration is concentrated by local topography. Low-yield bores have been installed to capture this water, on an intermittent basis, north of the Ginkgo Mine. These lenses are of limited volume and reduce in quality during periods of low rain, due to mixing with the underlying saline water. There is no evidence of shallow fresh water lenses at the groundwater table in the Project area.

Approximately 50 km to the south along the Murray River, salt-water interception bores pump saline water from the Upper-Aquifer to salinas for evaporation.

8.2 Middle-Aquifer

Several marginal stock bores are located about 60 km to the north of the Mine Site, in what is believed to be sand layers of the Middle Renmark Formation.

It is worth noting that whilst Figure 12 shows a higher piezometric surface for the Middle-Aquifer compared to the Upper-Aquifer, the intervening aquitards are thick and have low permeability thus preventing any significant interaction between the aquifers. There would be negligible effect from the mining on the Middle-Aquifer.

8.3 Lower-Aquifer

There are three artesian bores in the Lower-Aquifer to the north-west (10 km) and north (18 km and 29 km) of the mine site, which produce water with salinities of about 9,000 mg/L to 11,000 mg/L.

75 km to the north-east there are two deep bores (Lake Coombah and Popio Lake), that are also used for stock quality water in a local fresher zone of the Lower-Aquifer.

The Lower-Aquifer is separated from the Upper-Aquifer by thick aquitards and there would be no effect from the mining on the Lower-Aquifer.

9.0 GROUNDWATER DEPENDENT ECOSYSTEMS

No high priority groundwater dependent ecosystems are specifically listed for the Western Murray Porous Rock Water Source defined in the *Water Sharing Plan for the NSW Murray Darling Basin Porous Rock Groundwater Sources 2020, Schedule 2*.

However, the High Priority Groundwater-Dependent Ecosystem Map (GDE023_Version 1) of the *Water Sharing Plan for the NSW Murray Darling Basin Porous Rock Groundwater Sources 2020* (Appendix 2) identifies the presence of groundwater dependent ecosystem vegetation within the Mine Site. This mapped vegetation is situated within the depressions of the Western and Eastern Salt Pans. The mapped high priority GDE vegetation corresponds to the HEVAE Vegetation Groundwater Dependent Ecosystems Value-Western Division spatial dataset (Figure 14).[49]

The DPE Replacement Water Sharing Plan Manual[50] describes the methods by which high priority GDE vegetation are identified for inclusion and consideration in a water sharing plan. These methods include those presented by Dabovic[51] which describes the use of NSW Government mapping to establish the presence of Plant Community Types (PCT) associated with high priority GDE vegetation, as identified in the HEVAE dataset. Table 11 lists relevant PCTs and their tolerance to salt water.

Of the PCTs only Samphire (PCT64) has a potential salinity tolerance to the groundwater found at the Mine Site. Samphire's maximum indicated tolerance of 10,000 mS/m (Table 11),[52] is approximately equivalent to a salinity of about 65,000 mg/L[53] (The average groundwater salinity at the mine site is approximately 61,000 mg/L). The salinity of the water within the Upper Aquifer is at the very upper limit for Samphire, meaning that Samphire is unlikely to be reliant on the Upper Aquifer. Rather, if there is any reliance on groundwater at all, it is likely that that would be limited to near surface, perched, lower salinity groundwater associated with local recharge following rainfall events.

To validate the presence of high priority GDE vegetation within and surrounding the Mine Site, the PCTs of the HEVAE dataset were assessed during detailed field survey for the Project by Envirokey.[54] As shown in Figure 14, Envirokey identified 104.4 ha of PCT64 in the disturbance area of the Mine Site.

With respect to Aquatic Groundwater Dependent Ecosystems any rainwater that collects over the salinas is rare and quickly evaporates. Therefore, the salinas cannot support any permanent aquatic ecosystems.

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[49] High Ecological Values Aquatic Ecosystems datasets <https://datasets.seed.nsw.gov.au/dataset/hevae-vegetation-groundwater-dependent-ecosystems-western-division> 2023

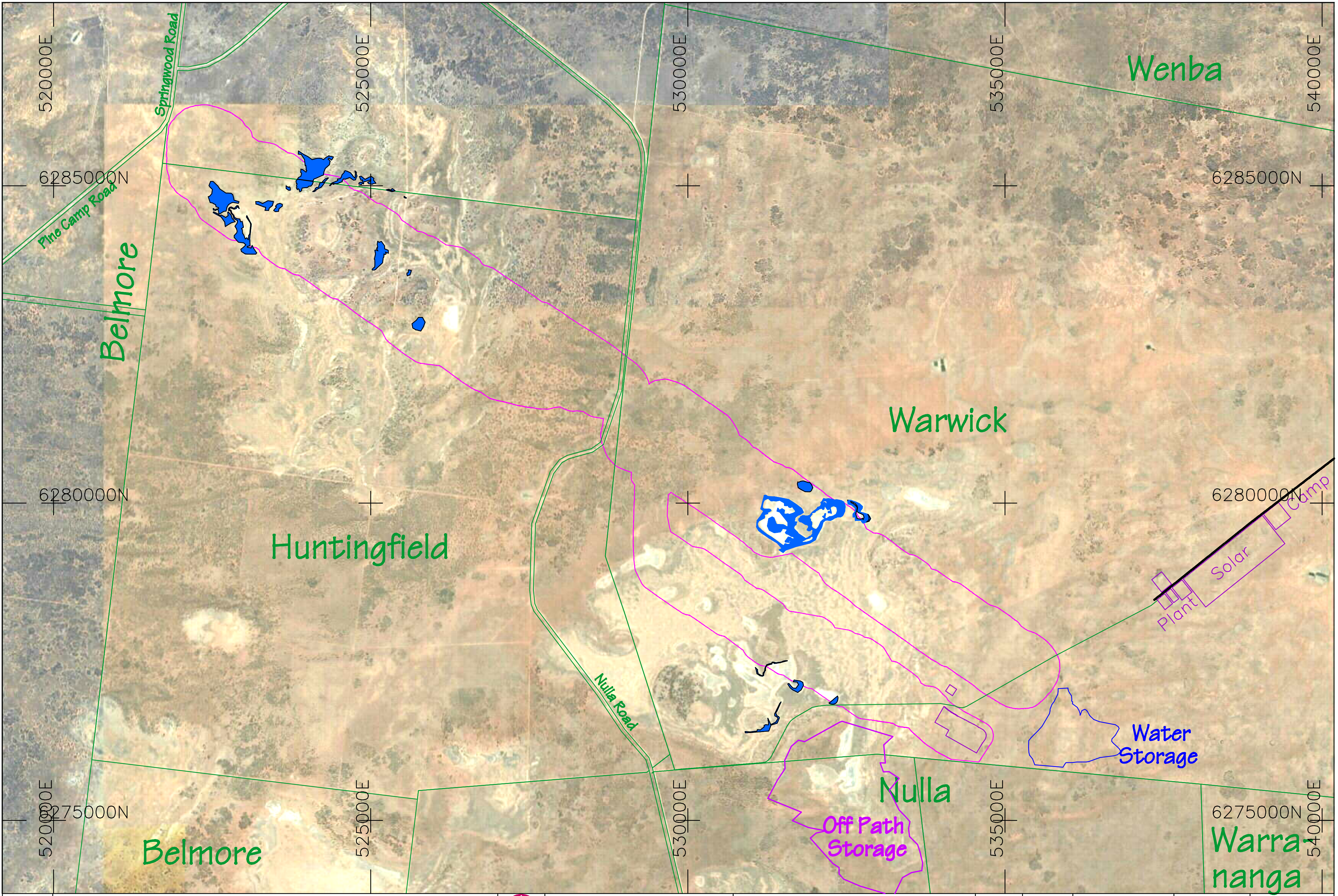
[50] DPE (2022) *Replacement Water Sharing Plan Manual.*

[51] Dabovic, J, Dobbs, L, Byrne, G, Raine, A (2019) *A new approach to prioritising groundwater dependent vegetation communities to inform groundwater management in New South Wales*, Australian Journal of Botany, Issue 67, pp 397–413.

[52] Greenloaning Biostudies (2023) *Preliminary Observations of Groundwater Dependent Ecosystems.*

[53] <https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0006/303666/Measuring-water-salinity.pdf>

[54] EnviroKey (2023) Biodiversity Development Assessment Report for the Copi Mineral Sands Project.



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28 x 18.72

Legend:

●	PCT64 potential disturbance
◯	Mine Path

North

RZ Resources Limited
Copi Mineral Sands Project

Potential GDE Locations

Plotted:
Mar 12
2024

Datums: Hor: GDA94z54 Ver: AHD

Datums: Hor: GDA Ver: AHD

A4 - 1 : 75000

Figure 14

Table 11 Salt Tolerance of Indicative Species for High Probability GDEs at Mine Site

PCT #	PCT Name	Indicative species	Salt Tolerance (mS/m)	Reference
15	Black Box open woodland wetland with chenopod understorey mainly on the outer floodplains in south-western NSW (mainly Riverina Bioregion and Murray Darling Depression Bioregion)	*Eucalyptus largiflorens* (Black Box)	Very tolerant 800-1,600	Agriculture Victoria (2022)
24	Canegrass swamp tall grassland wetland of drainage depressions, lakes and pans of the inland plains	*Eragrostis australasica* (Canegrass)	No information	N/A
64	Samphire - Water Weed - Sea-Heath shrubland saline wetland of depressions	*Halosarcia pergranulata* subsp. *pergranulata*	Extremely tolerant 2,700-6,500 Extremely tolerant 7,000-10,000	Ismail, S, Malcolm, C.V & Ahmad, R (1990) DPI&RD WA (2021)
65	Halosarcia lylei low, open shrubland saline wetland of arid and semi-arid regions	*Halosarcia pergranulata*	Extremely tolerant 2,700-6,500	Ismail, S, Malcolm, C.V & Ahmad, R (1990)
153	Black Bluebush low open shrubland of the alluvial plains and sandplains of the arid and semi-arid zones	*Maireana* spp.	Very Tolerant 600-1,100	Barrett-Lennard, E.G, Bennett, S. J & Altman, M (2013)
157	Bladder Saltbush shrubland on alluvial plains in the semi-arid (warm) zone including Riverina Bioregion	*Atriplex vesicaria* (Bladder Saltbush)	Extremely Tolerant Up to 5,000 Very Tolerant 800-1,600	Mahmood, K. & Malik, K. A (1987) Agriculture Victoria (2022)
191	Snap and Rattle Mallee - Moonah open mallee shrubland in the Murray Darling Depression Bioregion	*Melaleuca lanceolata* subsp. *lanceolata*	Very tolerant 800-1,600	Agriculture Victoria (2022)
221	Black Oak - Pearl Bluebush open woodland of the sandplains	*Casuarina pauper* (Black Oak)	Very tolerant 800-1,600	Agriculture Victoria (2022)
253	Gypseous shrubland on rises in the semi-arid and arid plains	*Maireana* spp.	Very Tolerant 600-1,100	Barrett-Lennard, E.G, Bennett, S. J & Altman, M (2013)

10.0 SURFACE WATER INTERACTIONS

Apart from the temporary water in salinas after heavy rainfall, there are no significant surface water / groundwater interactions near to the Mine Site area. Thus, the project's use of groundwater would not have any influence on surface waters and farm dams.

11.0 GROUNDWATER MODEL DEVELOPMENT

Groundwater modelling has been undertaken in accordance with the NSW Minimum Groundwater Modelling Requirement for SSD/SSI Projects[6] and the Australian Groundwater Modelling Guidelines (AGMG).[55]

11.1 Model Software

Numerical modelling has been undertaken using FEFLOW (Version 8), which is a full 3D Finite Element Groundwater Modelling software package.[56] FEFLOW allows for detailed discretization around the mine area and other locations of significant groundwater gradient change, and allows drying out and rewetting of zones within the model.

The SAMG algebraic multigrid method[57] was used for the numerical equation system solver, with a Symmetric-Matrix System Solver termination criterion of $1x10^{-8}$. The Euclidian L2 integral (RMS) norm error tolerance was set to $1x10^{-3}$. Numerical precision was 64 bit (double-precision floating point format).

11.2 Model Geometry

The extent of the proposed groundwater model is smaller than the full extent of the Lower Darling Basin as shown in Figure 10. The edges of the model have been moved inwards to utilize water levels from existing bores as constant head boundary constraints, rather than the basin edge no-flow boundaries as used by Brodie[9] and previously by GEO-ENG.[34] It is reasonable to use constant head boundaries at these locations as they would not be influenced by the proposed site operations, and long-term monitoring records indicate constant water levels.

Moving the boundaries inwards simplifies the model, removing issues related to highly variable hydrogeological conditions near to the edges of the basin, where layers become thin and pinch out against the bedrock. The eastern boundary of the Lower Darling Basin, was somewhat problematic for Brodie[9] as there is some inflow to the basin in the north-east and possibly further south across the Neckarboo Ridge. Using constant head boundaries removes the uncertainty of determining these boundary inflows.

The groundwater model area averages approximately 180 km across (NW–SE) and about 320 km along the axis of the basin (SW–NE), with a total area of about 57,000 km^2. The maximum depth of the model is about 560 m, for simulating all aquifers. The calibration model has six layers with about 31,000 elements per layer (Figure 15).

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[55] Sinclair Knight Merz and National Centre for Groundwater Research and Training (2012) *Australian Groundwater Modelling Guidelines*. Waterlines Report Series No. 92.

[56] Diersch, H.-J.G. (2005) *FEFLOW: Finite Element Subsurface Flow & Transport Simulation System*. DHI-WASY GmbH, Berlin.

[57] SAMG Version 2019, SCAI Faunhofer.

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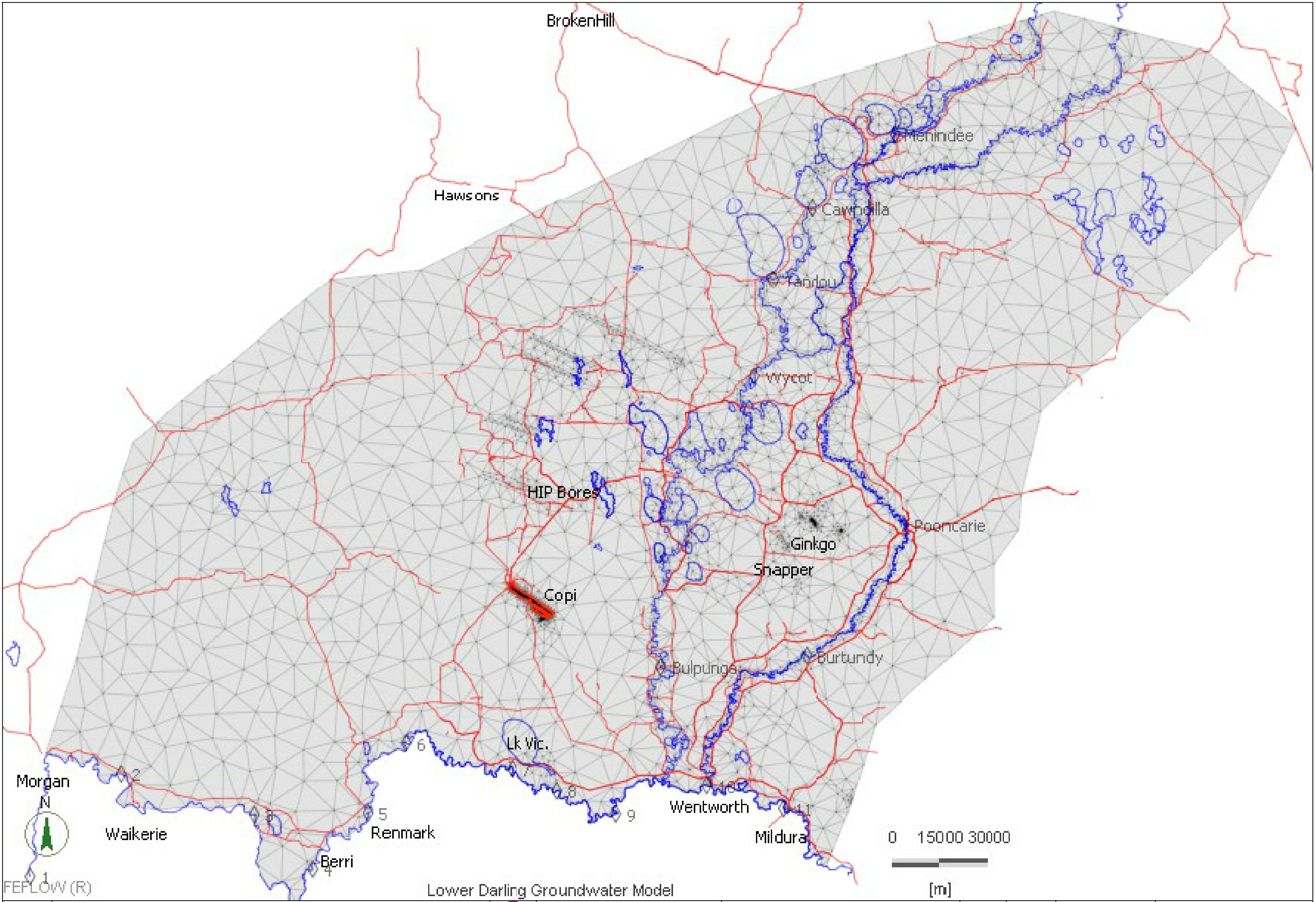

Lower Darling Groundwater Model

28 x 19.2	*Legend:*	North	RZ Resources Limited Copi Mineral Sands Project	Groundwater Model Finite Element Grid	Plotted: Jan 26 2024		Datums: Hor: GDA Ver: AHD A4 - 1 : 75000 Figure 15

Mesh gridding is closer spaced around mine sites, potential recharge and discharge locations (rivers, lakes and salinas) and locations of significant changes in material parameters. The mine path gridding is approximately 50 m across mesh triangles, while the largest mesh is about 9 km across.

11.3 Boundary Conditions

11.3.1 Constant Head Boundaries

As discussed in Section 11.2, the western, northern and eastern model boundaries can be simulated by constant head values, given that long-term groundwater records indicate constant levels and these locations are beyond the influence of the proposed mining. Because the aquifers are thin at these boundaries and there is typically a downward gradient between aquifers, the constant head boundaries are applied to the top slice of the model using water levels measured in the shallowest bore (where there are multiple depths being monitored). Constant head boundary values at nodes between monitoring bores are interpolated.

The southern boundary of the model is the Murray River. Water levels based on interpolated average river levels between locks are applied to the top slice in the model at this boundary.

The southern boundary for the deeper aquifers in the model is effectively a no-flow boundary, with flow from the deeper aquifers exiting upwards towards the river. This is a reasonable design as the indicated horizontal groundwater gradient in the Lower-Aquifer is approximately parallel to the river as indicated in Figure 13, and the influence due to the proposed mining would be insignificant at this distance. The horizontal gradient for the Middle-Aquifer is similar (Figure 12), apart from where the Middle-Aquifer is interacting with the Murray River in South Australia, which is also affected by salt-water interception pumping bores. As this is far from the Mine Site, this is not expected to cause inaccuracy in the model.

11.3.2 Rainfall Recharge and Evaporation

As discussed in Section 6.0, rainfall recharge has limited temporal effect to the regional groundwater levels. There is limited data for calibration of rainfall recharge, and in areas of river/lake recharge it is difficult to differentiate between these effects. Preliminary modelling suggests low rates of recharge consistent with the work by Lawrie.[11]

Evapotranspiration may occur due to the uptake of water by vegetation and could potentially lower the groundwater table where there is better quality water. However, over much of the region the groundwater is too saline and/or too deep to be used by vegetation, and thus plants are primarily dependent on rainfall that does not infiltrate to the groundwater-table.

Direct evaporation occurs where the groundwater table intersects the ground surface and forms salinas. Evaporation is automatically simulated in the model by temporary head boundaries at the ground surface, if the groundwater table intersects the ground level. This effectively removes all water reaching the surface, consistent with the high evaporation rates for the region.

Due to the lack of temporal groundwater monitoring data, the limited rainfall and evapotranspiration, and the potential high correlation between these effects in a groundwater model; a single recharge parameter has been used in the model calibration, which includes both gains and losses due to these processes.

11.3.3 River and Lake Boundaries

Seepage loss from the Darling River, Great Darling Anabranch, Menindee Lakes and Murray River Lakes is simulated in the top layer using a fluid transfer boundary condition with a fixed head level based on the average river or storage level. A transfer function is used to simulate the retardation of seepage due to basal low permeability layers. This transfer function parameter is varied in the calibration to determine the best values.

11.3.4 Dredge Pond and Sand Disposal

Dredging would be carried out at about natural groundwater table, with the majority of the rejected sand returning to below pond level. Pond levels and sand disposal are simulated as Cauchy-type water levels in the model. A modulation function is used to turn on and off based on the planned mine progression. Evaporation from the pond area is estimated based on monthly areal potential average data from the Bureau of Meteorology.[15]

11.3.5 Water Supply Bores

Water supply from groundwater bores have been simulated in the Upper-Aquifer at the location indicated by blue triangles in Appendix M and Appendix N. The initial bore water requirement is about 90 L/s to fill the water dam and to make up for the loss to the off-path storage facility. After the initial years, the average annual pumping rate of about 832 ML/yr (26.4 L/s), is based on plant, dust suppression, and Reverse-Osmosis (RO) requirements.

11.3.6 Other Water Users

Neither irrigation nor shallow bore pumping at the salt interception schemes along the Murray River, (which creates local drawdown in the Upper- and Middle-Aquifers) is simulated in the model as the effect on water levels are very localised and moderated by the proximity to the river. There is not expected to be any measurable interaction of these groundwater effects at the Mine Site.

The effect of pumping, dredge mining and reject sand placement in the Upper-Aquifer at the Tronox Mines, results in recycling of most of the water used. As this effect is localised and a great distance from the Mine Site, there would be no measurable effect at the Mine Site. Mining at Snapper Mine finished in 2022. The Ginkgo Mine is planned to finish in 2024.

Pumping from the proposed Hawsons Iron Project (HIP) Borefield could potentially be used to supply 50 GL/yr, which would cause a large regional depressurisation in the Lower-Aquifer, but would not have any significant effect in the Upper-Aquifer.[36]

The mine groundwater use would have no effect on farm dams.

11.4 Model Layers

The calibrated groundwater model has six layers to represent the important hydrogeological features of the region as shown in Table 12.

The Lower-Aquifer has been split into two, with the majority of the aquifer being the moderate permeability Lower Renmark Formation (Layer 5). Higher permeability zones of the Warina Sand (Layer 6) are found in basement troughs, in the south to central portion of the model area.

The estimated hydraulic parameters presented in Table 12 are based on Brodie,[9] Golder Associates,[25-30] and GEO-ENG,[31-36,39] and analyses carried out for this project.

As layers are required to be continuous across the model, the pinched layers of the Renmark Group at the basement ridges and model boundaries are simulated by a minimal thickness of 0.1 m. The varying thicknesses of the modelled layers are shown in Figure 7, for a cross-section from NE to SW.

Table 12 Model Layers and Estimated Hydrogeological Parameter Ranges

#	Geology	Zone	Kh (m/d)	Kv (m/d)	SY %	Ss (m^{-1})
1	Quaternary Sediments / Shepparton Formation / Loxton-Parilla Sands / Upper Renmark (Upper Olney)	All	0.001 – 30	1e-8 – 3	5–20	1e-5 – 1e-4
2a	Bookpurnong Beds / Geera Clay Winnambool Formation	South & Central	1e-8 – 0.01	1e-10 – 1e-3		1e-5 – 1e-3
2b	Middle Renmark (Middle Olney)	North	1e-6 – 5	1e-8 – 0.05		5e-6 – 1e-4
3a	Murray Group Limestone	South	0.01 – 5	1e-4 – 0.05		1e-6 – 1e-5
3b	Geera Clay	Central	1e-8 – 0.05	1e-10 – 5e-4		1e-5 – 2e-3
3c	Middle Renmark (Middle Olney)	North	1e-6 – 5	1e-4 – 0.05		5e-6 – 1e-4
4a	Ettrick Clay	South	1e-8 – 0.05	1e-10 – 5e-4		1e-5 – 1e-3
4b	Geera Clay / Winnambool Formation	Central	1e-8 – 0.05	1e-10 – 5e-4		1e-5 – 1e-3
4c	Middle Renmark (Middle Olney)	North	0.01 – 5	1e-4 – 0.05		5e-6 – 1e-4
5	Lower Renmark (Lower Olney) /	All	0.01 – 30	1e-4 – 3		5e-6 – 1e-4
6	Warina Sand	All	0.01 – 150	0.01 – 1.0		5e-6 – 1e-4

The ranges for some parameters to be used in the model calibration were set larger than expected values, to potentially offset inaccuracy in layer thicknesses.

11.5 Model Exclusions

The groundwater model does not represent temporal changes at far-field locations due to river or surface water storage changes and their interactions with local shallow/alluvial aquifers. The model assumes approximately fixed water levels in far-field areas and averaged parameters.

The effects of the Tronox Mines, Salt-Water Interception Schemes, Lower-Aquifer pumping at the Hawsons Iron Project and farm bore pumping would not have any significant effect at the Mine Site in the Upper-Aquifer, and thus has not been modelled.

There is limited data regarding aquitards in the region and the model may not accurately simulate water pressures in low permeability layers. Vertical flow components through these layers are expected to be very small.

CLASS		DATA		CALIBRATION		PREDICTION		QUANTITATIVE INDICATORS
1 (simple)		Not much / sparse coverage		Not possible.		Timeframe >> Calibration	√	Timeframe >10x (steady-state)
		No significant metered usage.		Large error in statistic.		Long stress periods.	√	Stresses >5x no historic data
		Low resolution topo DEM.		Inadequate data spread.				Mass balance > 1% (or one-off 5%)
		Poor aquifer geometry.	√	Targets are steady state.	√	Transient predictions are made when calibration is in steady state only.		Properties <> field values.
		Basic / Initial conceptualisation.			√	No data for temporal validation.		No review by Hydro / Modeller.
2 (impact assessment)	√	Some data / OK coverage.		Weak seasonal match.		Timeframe > Calibration		Timeframe = 3-10x
	√	Some usage data/low volumes.		Some long term trends wrong.		Long stress periods.		Stresses = 2-5x
	√	Baseflow estimates. Some K & S measurements.	√	Partial performance (e.g. some stats / part record / model-measure offsets).		OK validation.		Mass balance < 1%
	√	Some high res. topo DEM &/or some aquifer geometry.		Head & Flux targets used to constrain calibration.		Calib. & prediction consistent (transient or steady-state)		Some properties <> field values. Review by Hydrogeologist.
	√	Sound conceptualisation, reviewed & stress-tested.	√	Non-uniqueness and qualitative uncertainty addressed using varying local geological models, which is assessed to be most significant to the groundwater predictions.		Significant new stresses not in calibration		Some coarse discretisation in key areas of grid or at key times
3 (complex simulator)		Plenty of data, good coverage.	√	Good performance stats.		Timeframe ~ Calibration		Timeframe < 3x
		Good metered usage info.		Most long term trends matched.		Similar stress periods.		Stresses < 2x
		Local climate data.		Most seasonal matches OK.		Good validation.	√	Mass balance < 0.5%
		Kh, Kv & Sy measurements from range of tests.		Present day head / flux targets, with good model validation.		Transient calibration and prediction.	√	Properties ~ field measurements.
		High res. topo DEM all areas & good aquifer geometry.		Non-uniqueness minimised, qualitative uncertainty justified.		Similar stresses to those in calibration.	√	No coarse discretisation in key areas (grid or time).
		Mature conceptualisation.						Review by experienced Modeller.

Table 12 Model Class Assessment - based on AGMG (2012) and Middlemis and Peeters (2018)

11.6 Model Confidence Level Classification

Table 2-1 of the AGMG provides guidance on determining model confidence levels based on four categories (Data, Calibration, Prediction and Key Indicators).[55] This classification method has been further developed by Middlemis and Peeters,[58] and is discussed in the following sections and summarised in Table 13.

11.6.1 Data

There is some good long-term water level data from NSW government records for the Lower Darling region, however, the spatial separation between monitoring locations is quite large (typically 50 km). Government groundwater bores in South Australia have limited records and are also widely spaced.

There are only a few private bores in the model region due to the poor quality of the water, and many of the bores cannot be accessed due to pump installations. Accessible private bore sites were monitored in 2014 to 2018 as discussed in Section 5.4.2. Groundwater bores were installed at the Mine Site in 2018 and have been used for monitoring ground-water levels and pumping tests to determine hydrogeological parameters. Water levels and hydrogeological parameters from pumping tests are also available from other resource projects in the region.

The period of records for all monitoring sites is greater than 2 years, with record lengths of up to 37 years. The measurements indicate stable (approximately steady-state) water level over many years.

Topographic data for the region is available, with a grid spacing of 5 m.[59]

The conceptual model for the Lower Darling Basin is based on the work by Brodie[9] and the hydrogeological maps produced by AGSO[19]. The conceptual model is considered to be robust, given the simplicity of the flat layered geology and the extent of government investigations. Locally there is uncertainty with respect to the potential for a large permeability contrast between the strandlines and surrounding sands, which is addressed by considering two local geology models.

Overall, the data would suggest a Class 2 Confidence Level.

11.6.2 Calibration

There is limited data to match to rainfall events, due to the low frequency of monitoring and variable infiltration conditions. There is also uncertainty as to the spatial distribution and significance of rainfall recharge in the catchment, with a major portion of recharge expected to result from rainfall events outside the catchment either from the border ranges and the Menindee portion of the Darling River.[11]

The long-term water level data (Appendix F) suggests near steady-state conditions are prevalent across the Lower-Darling Basin and thus it is assessed that a steady-state calibration would provide the most meaningful assessment of the available data.

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[58] Middlemis H and Peeters LJM (2018) *Uncertainty analysis—Guidance for groundwater modelling within a risk management framework*. A report prepared for the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development through the Department of the Environment and Energy, Commonwealth of Australia 2018

[59] Elvis - Elevation and Depth - Foundation Spatial Data, < https://elevation.fsdf.org.au/>.

Steady-state calibration cannot provide any information on hydrogeological storage parameters. However, there is some long-term pumping and water level data for the Lower-Aquifer from the Tronox Mining operation at Snapper Mine, which has been previously used for a partial transient calibration of the local Lower-Aquifer in the region. Local estimates of storage parameters have also been obtained from the bore pumping tests carried out for the HIP[36] and at the Mine Site as discussed in Section 5.3.1.

A steady-state calibration with limited transient calibration information is considered to give a Class 1 to Class 2 Confidence Level.

11.6.3 Prediction

As the calibration for the Mine Site area will have limited transient calibration information, the confidence level in transient predictions would be Class 1.

11.6.4 Quantitative Indicators

The relevant key indicators for the hydrogeological assessments would default to the prediction confidence level of Class 1 of the AGMG.

11.6.5 Model Accuracy

Based on a Class 1 to Class 2 model, it is expected that water level predictions would be generally +/-30% of the true variation. An accuracy of +/- 30% (in water level or water pressure) is considered appropriate for the assessment given the 'less productive' saline aquifer, the limited potential project impact, and the significant distance to any receiving environment or groundwater use.

11.7 Steady-State Calibration

Automated calibration of hydraulic conductivity and surface inflow rates was carried out using PEST[60]. Pilot points were used to vary the rainfall recharge and the horizontal and vertical hydraulic conductivity in each layer.[61] The areas of surface flux boundary inputs were split into individual zones for each of the lakes and approximately 80 km sections of the river channels.

Regularisation (Tikhonov) and Truncated Single Value Decomposition were implemented to make use of initial estimates of material parameters based on geological knowledge. The distribution of parameters was carried out using radial basis functions from the pilot point locations.

Steady-state calibration was carried out for two potential scenarios: 1) Allowing the hydraulic conductivity to vary smoothly between all pilot points and 2) Using fixed hydraulic conductivities for the strandline areas to better emulate the potentially sharp hydraulic conductivity contrast between the strandlines and the surrounding sand, which has been observed at other nearby mineral sand mine sites. These scenarios are referred to as the 'smooth' and 'sharp' scenarios.

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[60] Watermark Numerical Computing (2010) PEST 5th Edition, and addendum 2012.

[61] The vertical hydraulical conductivity in the bottom layer was not varied.

11.7.1 Hydraulic Conductivity

The best-fit calibrated distributions of Transmissivity (horizontal hydraulic conductivity x layer thickness) for each layer are shown in Appendix G and Appendix H for the two scenarios. To visually highlight the effect of low vertical permeability confinement, leakage coefficients (R= vertical hydraulic conductivity / layer thickness) are shown in Appendix I and Appendix J. Contours of Hydraulic Head and error bars of model fit at each calibration bore are also shown.

11.7.2 Surface Recharge

Surface Water and Rainfall Recharge were discussed in Sections 11.3.2 and 11.3.2. The best-fit calibrated distribution of rainfall and surface water recharge are shown in Appendix **K** and Appendix **L**, for the two scenarios.

Infiltration rates are indicated to be very low at about 0.01% of rainfall. The calibration indicates higher than average recharge zones at irrigation areas along the Murray River and near Menindee; and also, in the far north-east (which may indicate topography and geology that is more conducive to infiltration).

As indicated by Lawrie,[11] the highest river recharge occurs in the northern portion of the basin. Significant river infiltration is also indicated south of Bulpunga at the Darling Ananbranch, which likely reflect local irrigation.

11.7.3 Calibration Performance

The steady-state models have been calibrated based on water levels in 229 (non-boundary) monitoring bores. The distribution of monitoring bores to the slices defining the six layers of the model is shown in Table 14.

Table 14 Slice Distribution of Monitoring Bores

Slice	# of Monitoring Bores
1	42
2	124
3	9
4	22
5	0
6	32
7	0

Slice numbering follows the layer numbers with Slice 1 being at the top of Layer 1, etc. Slice 7 is at the base of Layer 6.

All water level data was equally weighted. Calibration statistics are provided in Table 15.

Table 15 Calibration Performance

Calibration Statistics	Smooth	Sharp
Number of Data (n)	229	229
Root Mean Square (RMS) (m)	0.65	0.58
Scaled Root Mean Square (SRMS) (%)	1.68%	1.5%
Average Residual (m)	-0.06	-0.01
Average Absolute Residual (m)	0.47	0.42
Maximum Residual (m)	1.8	1.9
Minimum Residual (m)	-2.4	-1.8

The SRMS of >1.7% indicates a good fit to the available data. The largest variances between measured and modelled groundwater levels occur in the Upper-Aquifer near to the Menindee Lakes, due to the model not fully simulating small scale layering beneath these recharge locations.

For comparison, the Brodie model for the same region, which was based on a much coarser grid and manual calibration achieved an RMS of 2.25 m, and an Average Absolute Residual of 2.43 m.[9]

Figure 16 is a scattergram plot of modelled versus measured water levels for the Sharp Scenario. The R^2 fit to a 1:1 line is 0.99. The accuracy of the steady-state calibrations is assessed to be very good.

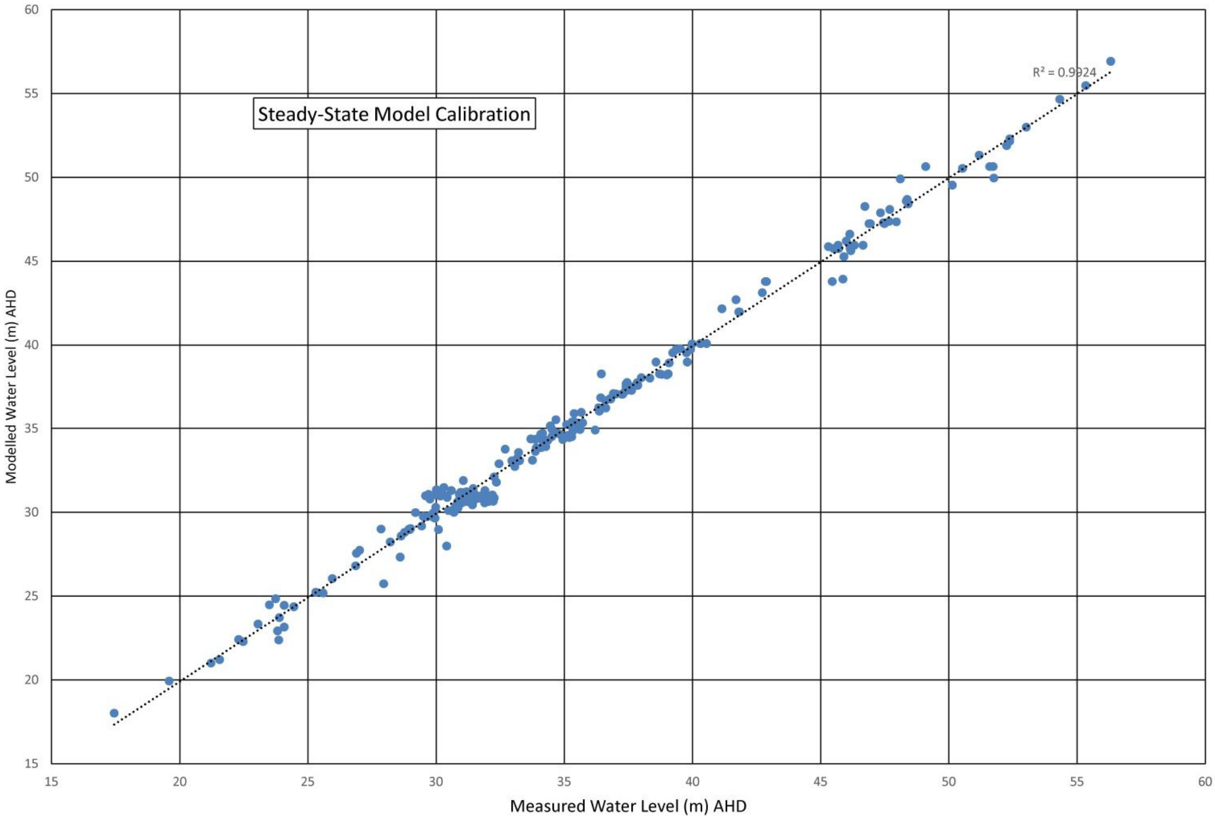

Figure 16 Groundwater Model Calibration Fit to Measured Water Levels

11.7.4 Alternative Calibrations and Sensitivity

Given the large number of potential variables and limited calibration data, other acceptable realisations of the parameter distributions could be obtained with reasonable calibration fit. It was considered that the options of a smooth vs sharp variation in hydraulic conductivity near the strandlines would create the greatest variability in model prediction of the mine effect, as is discussed in Section 12.4.

11.8 Water Balance

For the steady-state calibrations the water balance is restricted to the boundary fluxes, and surface recharge / losses. Several calibrated models were created by varying parameter value ranges, to provide an assessment of potential variability. Table 16 summarises the water balance components for the Sharp Scenario.

Table 16 Steady-State Groundwater Model Water Balance

Location	Outflow (L/s)	Inflow (L/s)	Net (L/s)
Basin Boundary (West, North, East)	-9.0	8.3	-0.7
Surface Water Inflow		15.1	15.1
Rainfall Infiltration		39.9	39.9
Evaporation at Salinas	-5.8		-5.8
Murray River	-150.6	102.1	-48.6
Totals	-165.4	165.4	0.0

Inflow is into the aquifers; outflow is out of the aquifers.

It is not possible to directly compare the water balance to that created by Brodie[9], which covered the same groundwater region, as the total area of the current model is smaller and significant changes were made to boundary conditions. However, in general the flux volumes calculated in this current study are lower than those indicated by Brodie,[9] but are more in-line with the work by Lawrie.[11]

An estimate of the flux from NE to SW can be made based on the average gradient multiplied by an average flow area and average hydraulic conductivity of the aquifers (assuming there is minimal throughflow in the Middle-Aquifer), as shown in Table 17.

Table 17 Manually Estimated Flow Through Aquifers

	Upper-aquifer	Lower-aquifer	Total
gradient 1:	10,000	18,667	
Width (m)	180,000	80,000	
Thick (m)	50	30	
K (m/d)	2	20	
Q (ML/d)	1.8	2.6	4.4
Q (L/s)	21	30	51

This estimate matches reasonably well with the model estimated net outflow to the Murray River of 49 L/s.

12.0 IMPACT ASSESSMENT

12.1 Groundwater Model Modification

Preliminary model assessments indicated no interaction between the planned mining and the deeper aquifers, which are therefore not required to be modelled. As the water table crosses the geological boundary between the surface clays and the Upper Aquifer Sands in the southern portion of the mining area, it would be advantageous to simulate this layering to better represent the effect of mine dewatering. Therefore, for groundwater model predictions, the model was modified by removing Layers 3 to 6 of the calibration model and splitting Layer 1 into a low permeability surface layer and the Loxton-Parilla Sand aquifer. This modification allows for better representation of the mining effect, with no significant variation to the simulation of the regional groundwater system.

12.2 Water Usage

The construction period (Years -2 to -1) would require water for earthworks construction, dust suppression, machine washing and potable water (via a Reverse-Osmosis Plant). During Year-1, approximately 2 GL of water would be pumped to the Water Dam for initial interburden pumping to the off-path storage facility and to float the third dredge and concentrator into the dredge pond.

During mining approximately 26 L/s of water (832 ML/yr) would be required from Bores for mineral separation and, dust suppression and general use. About half of this water would be returned to the water dam or dredge pond.

The mine dredge pond would be kept within a few meters below the natural groundwater table, with the majority of the extracted material being returned to below the groundwater table level. Based on the mining schedule, the dredge pond would average approximately 1.2 km^2 in area (120ha), thus there would be a significant loss of water from the aquifer due to evaporation, which varies with the seasons and size of the pond. A 1.2 km^2 pond would lose about 1 GL/yr (evaporation less rainfall) based on the figures given in Table 3. A significant portion of the bore water is returned to the dredge pond during mining, reducing the total loss from the pond.

Expected yearly groundwater requirements are summarised in Table 18. The average water over the life of the project is about 4.5 GL/yr, with a peak requirement of about 9.6 GL in Year 1. Variability in the dredge pond water take is primarily due to changes in the pond water level to maintain the required mine water balance. The peak water usage includes water pumped for flooding of the Start-Up Pit and water pumped with sand to the Temporary Storage Facility.

Table 18 Predicted Groundwater Take (ML)

Year	Ponds	Bores	Total	Year	Ponds	Bores	Total
- 2	635	1,742	2,376	**9**	3,985	832	4,817
- 1	3,027	2,877	5,904	**10**	4,475	832	5,307
1	7,437	2,165	9,602	**11**	3,949	832	4,781
2	6,766	832	7,598	**12**	2,625	832	3,457
3	4,209	832	5,042	**13**	3,039	832	3,871
4	3,119	832	3,951	**14**	2,819	832	3,651
5	3,970	832	4,803	**15**	2,494	832	3,326
6	3,311	832	4,143	**16**	3,319	832	4,151
7	4,158	832	4,990	**17**	1,505	392	1,898
8	4,635	832	5,467	**18**	212	60	272

It is assumed that mining finishes in Year 17 and the pond is closed, and all mining-related works are completed by the end of Year 18. Rehabilitation works would continue after this date; however, water use would be negligible when compared with water use during mining operations

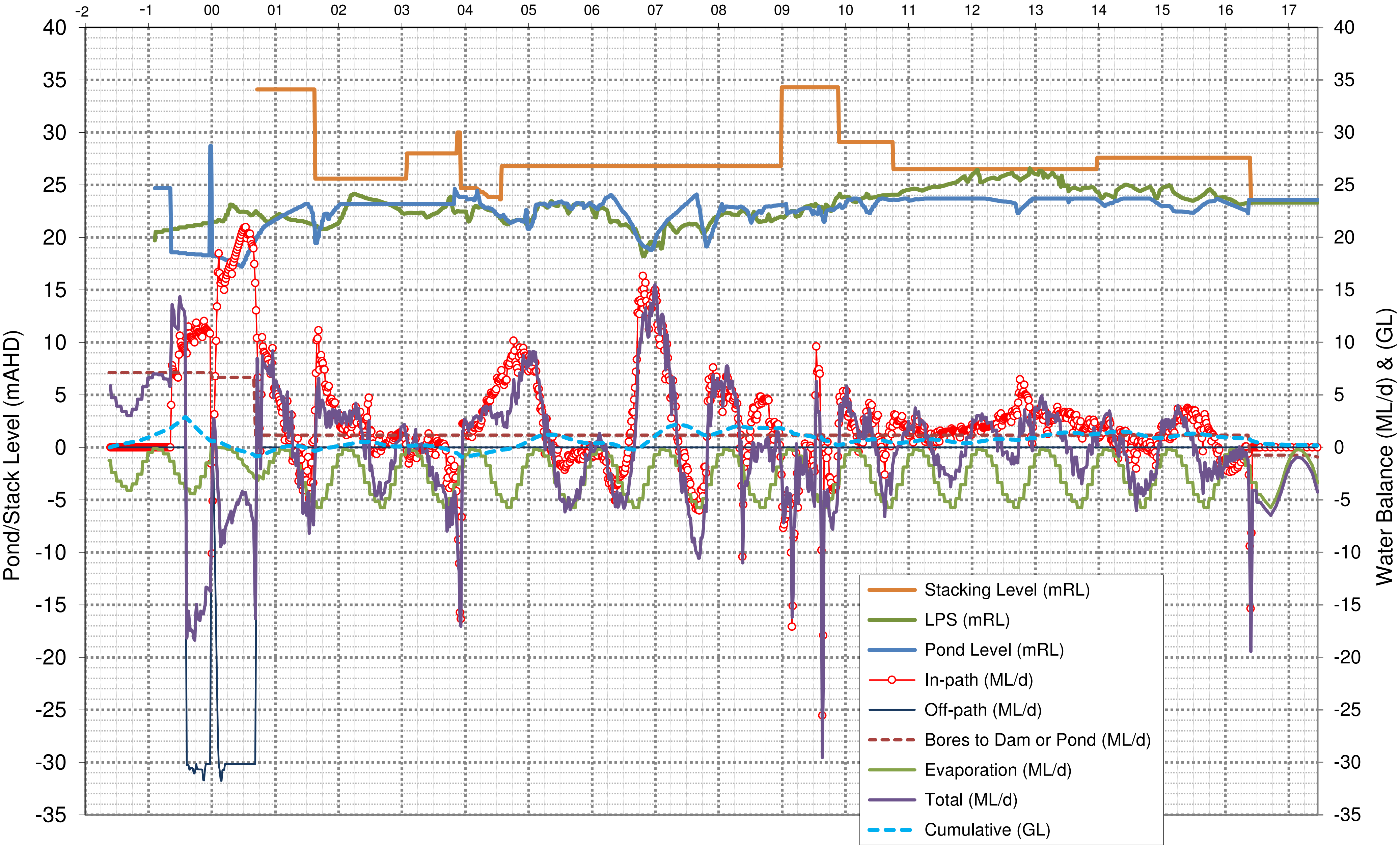

Figure 17 - Mine Groundwater Balance

Figure 17 shows the modelled mine groundwater balance. The water-take data is separated into the in-path and off-path areas, bore pumping and evaporation. Water from the ground (pond and bores) is positive, while inflow to the ground (sand disposal) and evaporation are negative. Bore water used for mineral separation, dust suppression and general use are subtracted from the total bore pumping rate to indicate the "Bore to Dam or Pond" quantity. The pond level was adjusted to achieve a near zero cumulative water balance. The target dredge pond and sand disposal stacking levels are also shown.

12.3 Water Licensing

As detailed in Section 7.1 the *Western Murray Porous Rock Water Source* has an indicated available allocation of 163.3 GL/yr. The Project average requirement of 4.5 GL/yr, and peak requirement of 9.6 GL/yr. A peak licence allocation of 9.6 GL/y will be required to be obtained under the WSP.

12.4 Groundwater Level Effects

The primary uncertainty affecting model water level predictions is the extent of the strandline and the contrast in hydraulic conductivity between the strandline and surrounding sand, as shown in the results for the 'Smooth' and 'Sharp' Scenarios. Both scenarios show minimal impact of the mining operations away from the mine site, with the 2 m drawdown contour remaining within the strandline zone. Figure 18 and Figure 19 show the maximum groundwater drawdown for the Smooth and Sharp Scenarios at the end of mining (Year 17). Bores are indicated as blue triangles. The black contours are groundwater table levels (mAHD) for the upper aquifer. The blue contours and coloured zones (HDiff) indicate the variation in the water table from pre-mine levels in meters.

There would be a temporary groundwater mound beneath the off-path storage facility during Years 1 to 3, which would dissipate over the mining period (Appendices M and N).

Appendix M and Appendix **N** show groundwater drawdown contours for additional time-steps for the 'Smooth' and 'Sharp' Scenarios.
For the **Smooth Scenario** the maximum drawdown is predicted to be less than 2 m (apart from immediately around the water supply bores) for the life of mine. The mine effect would dissipate within about 3 years after mining.
For the **Sharp Scenario**, the drawdown effect is limited to the high permeability strandline zone, which is expected to be within 2.5 km of the mine path. Maximum drawdown is expected to be less than 4 m (apart from immediately around the water supply bores). After mining the drawdown effect would take about 30 years to reduce to below 2 m of drawdown.
Further assessment of the extent of the high permeability strandline area, based on on-going exploration drilling, would be most useful for improving local water level predictions. The prediction of minimal groundwater effects away from the mine site is not expected to change.

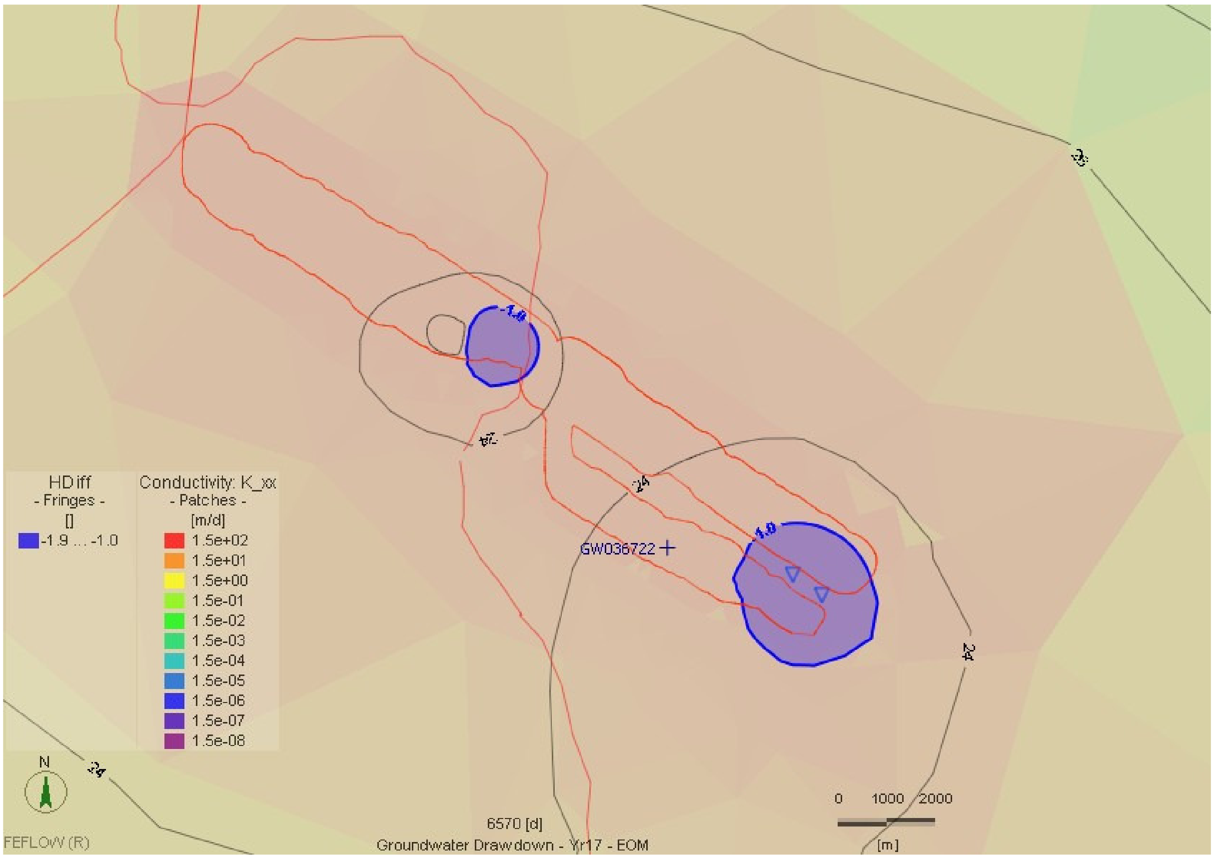

Figure 18 End of Mine Groundwater Drawdown—Smooth Scenario

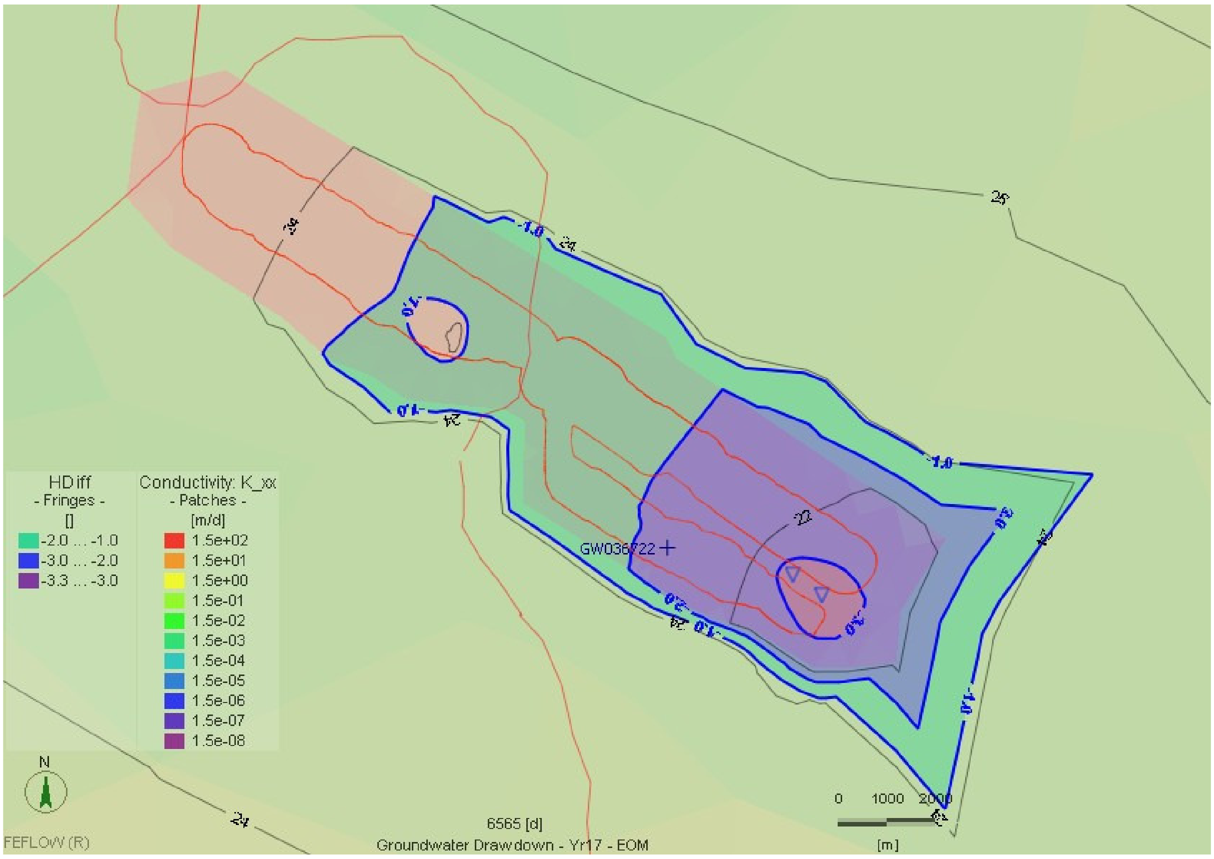

Figure 19 End of Mine Groundwater Drawdown—Sharp Scenario

12.5 Groundwater Users

There are no users of the Upper-Aquifer within 30 km of the Mine Site, and thus there would be no impact to other groundwater users.

The government monitoring bores GW036722–(1,2,3) is located with the proposed dredge pond path and would be removed in Year 3. The Applicant would implement the following measures to ensure that the Department's monitoring capacity is not downgraded by the loss of the bore.

- Grout and seal the bore casings accessing the Middle and Lower Aquifers in accordance with Section 18 of the document Minimum Construction Requirements for Water Bores in Australia[62] or its latest version.
- Reestablish, if required by NSW DCCEEW, a monitoring bore including separate screened intervals within each of the Upper, Middle and Lower Aquifers, in a location to be determined by NSW DCCEEW.

Bore GW009721 is indicated to be a deep bore within the mine path during Year 1. No standpipe has been identified at the surface, at its indicated location, and mining would remove any in-ground casing, if present. The location is on Warwick station which has been purchased by the proponent.

Bores GW004701, GW004702 and GW004719 are indicated to be near the proposed mine path, however, no standpipes have been identified at the surface, at their indicated locations. The groundwater models indicate less than 2 m of drawdown at these locations in the Upper Aquifer. Bores GW004702 and GW004719 are indicated to be screened in the hydraulically disconnected Middle and Lower Aquifers, respectively and thus would not be affected by the mining. The depth of GW004701 is not recorded. The maximum mine effect at this location would be less than 0.5 m in the saline Upper Aquifer.

In summary, there are no identified groundwater supply bores accessing the groundwater resources of the Upper Aquifer within 15 km of the Mine Site. As a result, the Project would not cause any adverse impacts on surrounding groundwater users.

12.6 Groundwater Dependent Ecosystems

As discussed in Section 9.0, the area of mapped vegetation in the disturbance area, that potentially could be dependent on groundwater would be about 104.4 ha of Samphire (PCT64).

Some Samphire locations are within the mine path and would be managed in accordance with the vegetation management plan.

Water table effects are expected to be small, however there is potential for more than 10% cumulative variation (4.5cm)[63] of the water table range at the GDE locations near to the mine path. The water table at these locations would recover after mining and the GDE's would be re-established (where there has been vegetation loss), to match the recorded pre-mine conditions.

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[62] National Uniform Drillers Licensing Committee (2020) *Minimum Construction Requirements for Water Bores in Australia*. ISBN 978-0-646-81881-8

[63] The natural variation in water table is estimated to be about 0.45 m from the record at GW036722_1, (Appendix F).

With respect to Aquatic Groundwater Dependent Ecosystems any rainwater that collects over the salinas is rare and quickly evaporates. Therefore, the salinas cannot support any permanent aquatic ecosystems.

12.7 Aquifer Impact

The mining process as described in Section 1.1 and Figure 2, replaces the material removed in front of the dredging to a similar geological profile behind the mining pond. The reject sand and overburden backfill would have similar hydrogeological properties to the pre-mine conditions. There would be no significant hydrogeological change to any aquifer or aquitard and the hydrogeological regime post-mining would be similar to that prior to mining.

12.8 Cumulative Effects

Given the limited impact of the Project and the substantial distances to other operations, there would be no cumulative effect on the groundwater regime with any other current project interacting with the groundwater regime.

12.9 Groundwater Quality

No reagents would be used during processing operations and processing would largely rely on physical processes to separate the heavy mineral from the gangue. The Applicant anticipates using small quantities of EPA-approved biodegradable flocculant to facilitate settling of finer material within the thickener and for co-disposal of the fines and rejects below the water level.

Hydrocarbons and other chemicals would be managed to capture any spills and prevent contamination entering the groundwater table. Wastewaters would be managed by treatment plants. Treated wastewater would be used to irrigate land in the immediate vicinity of the plant. Brine from the reverse osmosis plants would initially be transferred to purpose-built storage ponds and then to the saline dredge pond.

In summary, the Project is not expected to cause any significant change to groundwater quality.

12.10 Final Void

The final dredge pond would be backfilled with stockpiled material to a suitable height above the natural groundwater table, to limit any on-going water take from the aquifer. The final land form would be arranged so that the total surface area susceptible to evaporative loss from the water table would be consistent with the pre-mine condition.

12.11 Climate Change

The long-term groundwater records indicate low sensitivity to changes in rainfall. Recharge to the aquifer is mainly in the north of the basin, with Mine Site rainfall recharge estimated to be about 0.1 mm/yr. Given this small and/or distant influence of rainfall recharge to the local Mine Site area, any climate change to rainfall would have a limited effect to the period of mining and thus would not significantly affect the model predictions.

12.12 Minimal Impact Consideration—Aquifer Interference Policy

The *NSW Aquifer Interference Policy*[64] (the AIP) establishes minimal impact considerations for highly productive and less productive groundwater. Given the high salinity of the local aquifer there is no highly productive groundwater in the vicinity of the Project.

Table 19 provides an assessment of the Project against the minimal impact considerations in the AIP and include consideration of cumulative impacts where appropriate. The completed form for assessment against the aquifer interference policy is included as Appendix **O**.

Table 19 Less Productive Porous Rock Aquifer–Minimal Impact Considerations

Minimal Impact Consideration	Assessment
Water Table Level 1. Less than or equal to a 10% cumulative variation in the water table, allowing for typical climatic "post-water sharing plan" variations, 40 m from any: (a) High priority GDE; or (b) High priority culturally significant site; listed in the schedule of the relevant water sharing plan. A maximum of a 2 m water table decline, cumulatively at any water supply work. Level 2. If more than 10% cumulative variation in the water table, allowing for typical climatic "post- water sharing plan" variations, 40m from any: (a) high priority groundwater dependent ecosystem; or (b) high priority culturally significant site; listed in the schedule of the relevant water sharing plan if appropriate studies demonstrate to the Minister's satisfaction that the variation will not prevent the long-term viability of the dependent ecosystem or significant site. If more than a 2m decline cumulatively at any water supply work then make good provisions should apply.	Complies with Level 2 minimal impact. Some GDE locations are within the mine path and would be temporarily removed. The ground would be re-established to the pre-mine levels and soil types after mining and the GDE plant species would be restored. Water table effects are expected to be small, however there is potential for more than 10% cumulative variation (5cm) in the water table at the GDE locations near to the mine path. The water table at these locations would recover after mining and the GDE's would be managed in accordance with the vegetation management plan. (Section 12.6). Complies with Level 1 minimal impact. There are no identified high priority culturally significant sites near to the mine site (EIS report). Complies with Level 1 minimal impact. There would be no groundwater table decline at any existing water supply work (Sections 12.4 & 12.5).
Water Pressure Level 1. A cumulative pressure head decline of not more than a 2 m decline, at any water supply work.	Complies with Level 1 minimal impact. The Project would not result in cumulative depressurisation or more than 2 m at any privately owned water supply work (Sections 12.4 & 12.5).
Water Quality Level 1. Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity.	Complies with Level 1 minimal impact. The Project is expected to result in negligible impacts on groundwater quality (Section 12.9). On this basis, the Project would not lower the beneficial use category of the groundwater source.

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[64] NSW Government, Department of Primary Industries, Office of Water, *NSW Aquifer Interference Policy.* September 2012.

13.0 MANAGEMENT AND MITIGATION MEASURES

13.1 Groundwater Monitoring

A Water Management Plan (WMP) would be prepared for the Project prior to the commencement of mining. This plan will describe proposed groundwater monitoring and management measures during mining operations. The plan would also include Trigger Action Response Plans (TARPs) and the site water management system. The following sub sections describe the key monitoring and management aspects of the plan.

13.1.1 Mine Water Use

Monitoring and reporting of groundwater volumes would include the following:

- Bore pumping volumes via accumulating flow meters at all bores;
- Water return volumes from process water returned to the dredge pond;
- Estimated evaporation rates based on recorded pond area and weather station parameters;
- Pond water and reject sand placement levels;
- Regular recording of the dredge and sand pumping flow meters (volume and density).

13.1.2 Groundwater Monitoring Program

A groundwater monitoring network has been installed to assess baseline conditions prior to mining. Selected bores within this network would be manually measured on a monthly basis to provide a record of groundwater levels over time. Monitoring will continue within the existing monitoring network, with additional bores installed as required to:

- replace any bores removed by the advancement of mining operations;
- monitor drawdown created around the mining activities;
- monitor water quality around the mining and off-path sand storage facility;
- monitor bore water supply performance.

13.1.3 Groundwater Quality Monitoring

Groundwater quality monitoring will build upon baseline datasets and include routine analysis of:

- field parameters - pH, EC;
- major cations and ions;
- trace elements;
- hydrocarbons.

13.1.4 Groundwater Model Review

The predictions of the groundwater model will be verified every three years against monitoring data collected from the Mine Site. If the monitoring indicates impacts exceeding those presented in the EIS, then the model will be recalibrated, and updated predictions provided.

13.1.5 Data Management and Reporting

Monitoring data will be managed in a secure database and used to prepare annual reviews and reporting as required by regulatory agencies with the assistance of suitably qualified personnel.

13.1.6 Management and Mitigation Strategies

TARPs will be prepared for groundwater levels and water quality. Groundwater level thresholds would be based on predicted water levels.

Given the high salinity of the water, normal guidelines for water quality are not applicable. Unusual water quality results would be re-tested and assessed with respect to the likely cause and potential impacts.

13.2 Groundwater Users – Management of Impacts

The Project is not expected to have any impact on other water users, as there are no nearby users of the Upper-Aquifer. There would be no effect in the Lower-Aquifer, due to the intervening aquitards.

14.0 GROUNDWATER MODEL LIMITATIONS

The predictive ability of groundwater modelling is generally related to the availability of geological and hydrogeological data of the area. The mining effect is not expected to extend very far from the mining site and thus the most significant uncertainty is the extent of the high-permeability strandline, which is the subject of on-going exploration drilling. However, uncertainty regarding the extent of the strandline is not expected to cause any significant variation to the mining effect beyond a few kilometres outside of the mining lease area.

Given the low value of the groundwater resource and good calibration fit to existing data, the model accuracy is adequate for the required purpose of assessing the range of potential groundwater impacts due to the project. The proposed Groundwater Monitoring Programme (Section 13.1) would provide increasing knowledge of the area to validate the extent of predicted impacts.

15.0 PEER REVIEW CONCLUSIONS

This impact assessment report and groundwater model has been independently reviewed by Hydro Consulting Services (HCS) at several stages during the development.[65] The final review report is attached as Appendix **P**. This version of the Groundwater Impact Assessment includes updates based on the recommendations from the independent peer review.

The Peer Review report indicates that:

- Overall, the groundwater assessment is comprehensive, and generally consistent with the requirements outlined in Table 9 of the Minimum Groundwater Modelling Requirements for SSD / /SSI Projects.

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[65] HSC (2024) *Copi Mineral Sands Project Groundwater Impact Assessment (3D Numerical Groundwater Model 2324A4) – Independent Peer Review*. L270224_RZ.

- The numerical groundwater model for both the smooth and sharp scenarios are well calibrated, with root mean square and scaled root mean square errors indicating an accurate fit to available data.
- The overall confidence level of the numerical groundwater model is Class 1 to Class 2 and the model is "fit for purpose" as:
  - there would be minimal predicted groundwater impacts beyond the Mine Site;
  - groundwater quality of the Upper Aquifer is hypersaline and of low value; and
  - there would be no significant impacts to environmental receptors or beneficial users.

HSC concluded that the numerical groundwater model developed for the Project was consistent with the NSW Aquifer Interference Policy and the Australian Groundwater Modelling Guidelines.

16.0 CONCLUSIONS

The existing groundwater setting is well understood with the assessment of the Project utilising a calibrated numerical groundwater model that has been peer reviewed and deemed "fit for purpose".

The groundwater model developed for the Project indicates that the mining impact on the groundwater table would be limited to a few kilometres from the Mine Site. Groundwater levels beyond the mine site would return to near pre-mine condition within a few years after completion of mining. The final dredge pond would be backfilled with stockpiled material to a suitable height above the natural groundwater table, to prevent any on-going water take from the aquifer.

The groundwater table aquifer is hyper-saline and thus there is minimal pumping from the Upper Aquifer (only distant mining projects and salt water interception schemes). Therefore, there would be no reduced access to groundwater for surrounding groundwater users. The Project would result in the removal of monitoring bore GW036722. The Applicant would replace the bore in consultation with NSW DCCEEW.

Water use during mining would average about 4.5 GL/yr, which is about 5.9% of the allocatable groundwater from the Western Murray Porous Rock Source. The maximum water take would be 9.6 GL/yr in Year 1 of mining. The Applicant would seek allocations to account for the maximum direct groundwater take from production bores, plus the indirect take from evaporation.

There would be some direct impact to small areas of high priority groundwater dependent ecosystem vegetation, however, this would be accounted for and addressed through the biodiversity assessment and offsetting process. Indirect impacts to GDE’s would be unlikely. Ponded water after rainfall in the salinas evaporates relatively quickly, preventing any permanent aquatic ecosystems.

Based on the outcomes of the numerical groundwater modelling, it is considered that potential impacts to the groundwater setting are minimal and the Project is permissible under the Aquifer Interference Policy.

17.0 GLOSSARY AND ACRONYMS

3D	Three–Dimensional
AGE	Australasian Groundwater and Environmental Consultants Pty Ltd
AHD	Australian Height Datum
AIP	NSW Aquifer Interference Policy
BOM	Bureau of Meteorology
DPE	NSW Department of Planning and Environment (replaced by DCCEEW and DPHI)
DCCEEW	NSW Department of Climate Change, Energy, Environment and Water
DPHI	NSW Department of Planning, Housing and Infrastructure
EC	Electrical Conductivity
EIS	Environmental Impact Statement
GDE	Groundwater Dependent Ecosystem
GL/yr	Gigalitres per year
Hydraulic conductivity (K)	Rate at which water moves through an aquifer under a unit hydraulic gradient, expressed as a volume per unit time (e.g. m/day)
Kh	Horizontal hydraulic conductivity
Kv	Vertical hydraulic conductivity
L/S	Litres per second
m/day	metres per day
mAHD	Meters Australian Height Datum
MDBA	Murray Darling Basin Authority
mg/L	milligrams per litre
ML	Megalitres
ML/yr	Megalitres per year
NSW	New South Wales
pH	Measure of acidity or alkalinity of aqueous solution.
SEARs	Secretary’s Environmental Assessment Requirements
SILO	Scientific Information for Landowners is a database of interpolated historical climate records for Australia
Specific storage (Ss)	Volume of water released from a unit volume of an aquifer per the unit decline in head
Specific yield (Sy)	Volumetric ratio of water released from an aquifer via gravity drainage with the volume of the saturated aquifer
TARPs	Trigger Action Response Plans
TDS	Total Dissolved Solids
Transmissivity (T)	Rate at which water is transmitted through a unit width of an aquifer under a unit hydraulic gradient
WMP	Water management plan
WSP	Water Sharing Plan

APPENDIX A

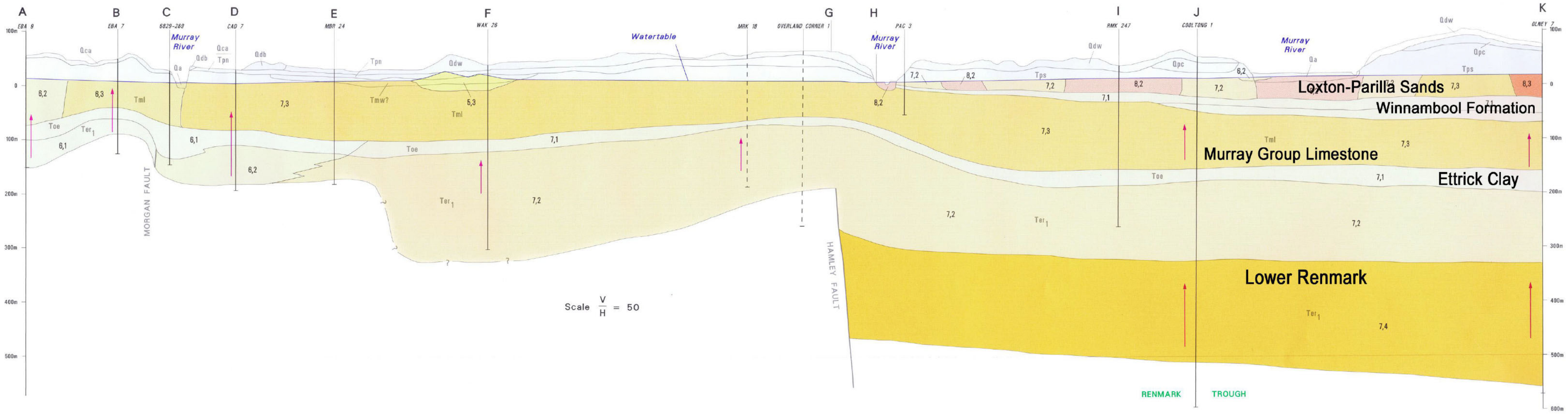
AGSO HYDROGEOLOGICAL CROSS-SECTIONS

MURRAY BASIN HYDROGEOLOGICAL MAP SERIES
1:250:000 AGSO 1993
LOCATIONS SHOWN ON FIGURE 6

Salinity / Yield Matrix Legend

Salinity (mg/L TDS)	Bore Yield (L/s)			
	<0.5	0.5-5	5-50	>50
<500	1,1	1,2	1,3	1,4
500-1,000	2,1	2,2	2,3	2,4
1,000-1,500	3,1	3,2	3,3	3,4
1,500-3,000	4,1	4,2	4,3	4,4
3,000-7,000	5,1	5,2	5,3	5,4
7,000-14,000	6,1	6,2	6,3	6,4
14,000-35,000	7,1	7,2	7,3	7,4
35,000-100,000	8,1	8,2	8,3	8,4
>100,000	9,1	9,2	9,3	9,4

TDS = total dissolved solids, mg/L = milligrams per litre.

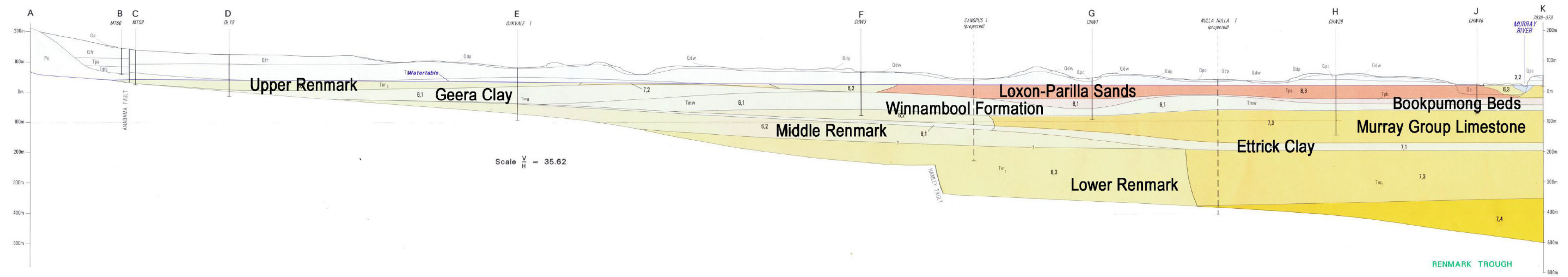


Salinity / Yield Matrix

		Bore Yield (L/s)			
		<0.5	0.5-5	5-50	>50
Salinity (mg/L TDS)	<500	1,1	1,2	1,3	1,4
	500-1,000	2,1	2,2	2,3	2,4
	1,000-1,500	3,1	3,2	3,3	3,4
	1,500-3,000	4,1	4,2	4,3	4,4
	3,000-7,000	5,1	5,2	5,3	5,4
	7,000-14,000	6,1	6,2	6,3	6,4
	14,000-35,000	7,1	7,2	7,3	7,4
	35,000-100,000	8,1	8,2	8,3	8,4
	>100,000	9,1	9,2	9,3	9,4

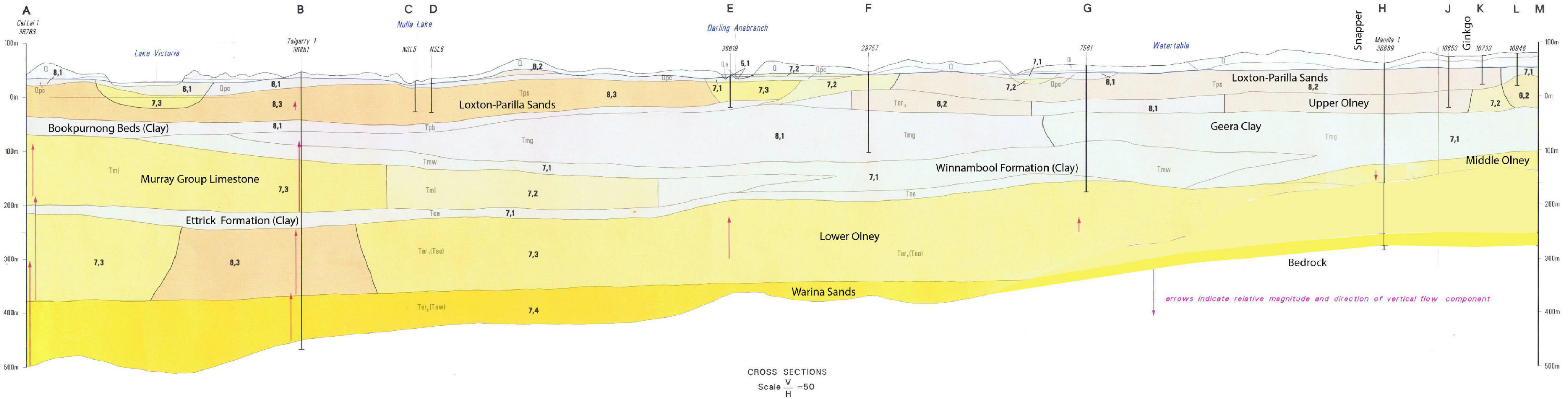
Murray Basin Hydrogeological Map Series 1:250,000 AGSO 1993

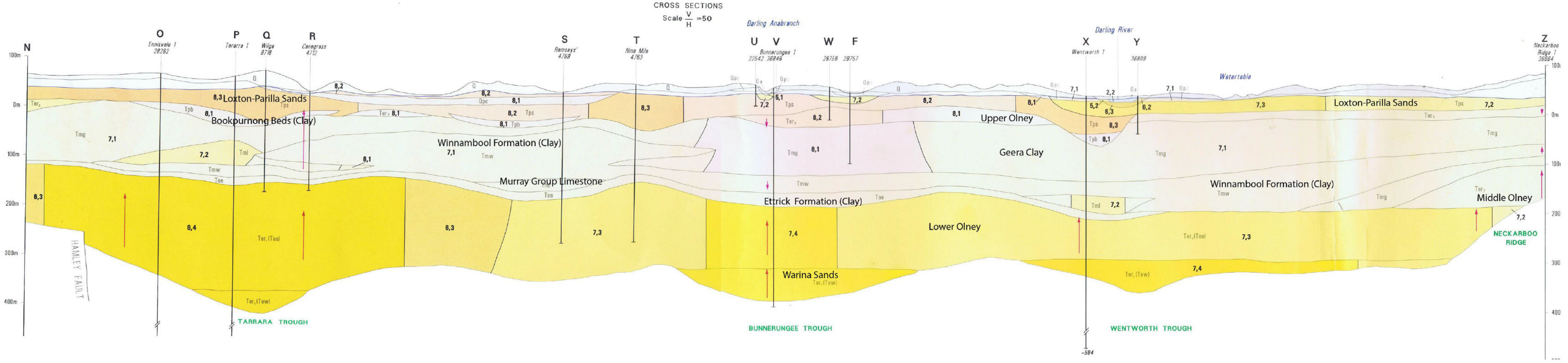
AGSO Sections
Renmark Sheet



AGSO Sections
Chowilla/Olary Sheet

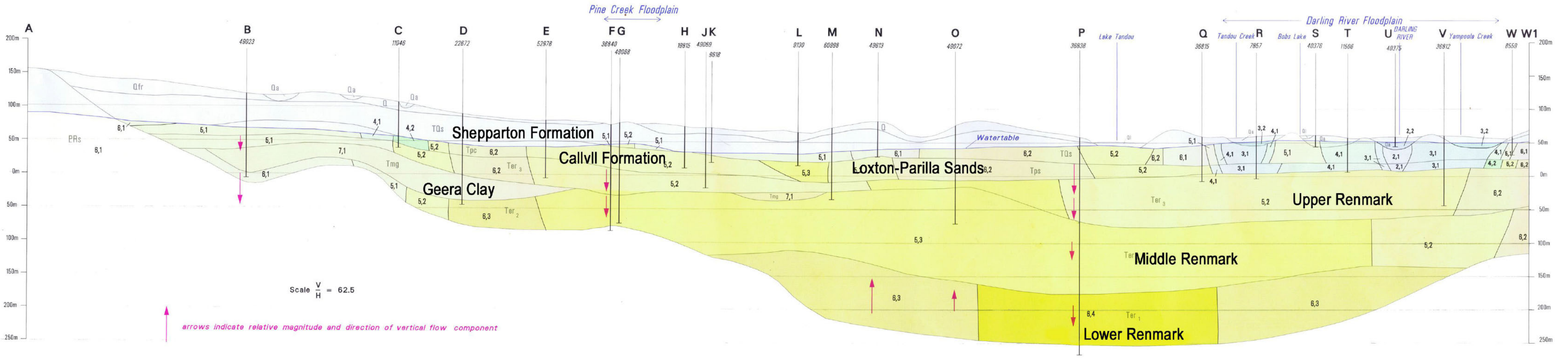
Murray Basin Hydrogeological Map Series 1:250,000 AGSO 1993

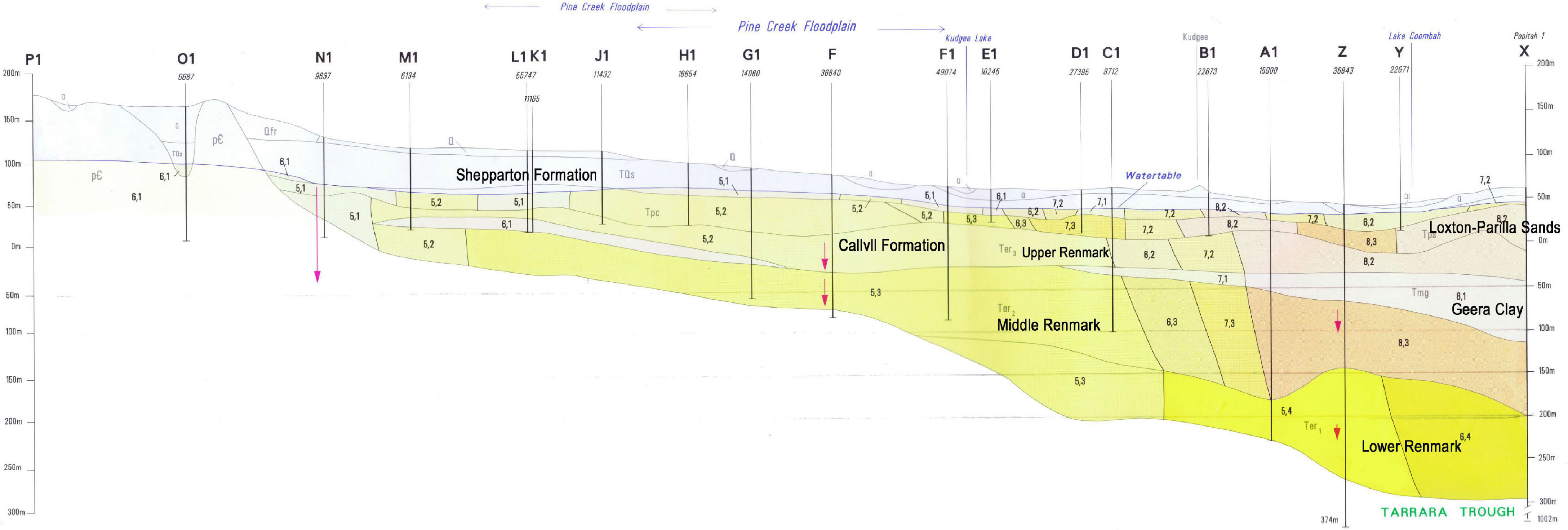




Murray Basin Hydrogeological Map Series 1:250,000 AGSO 1993

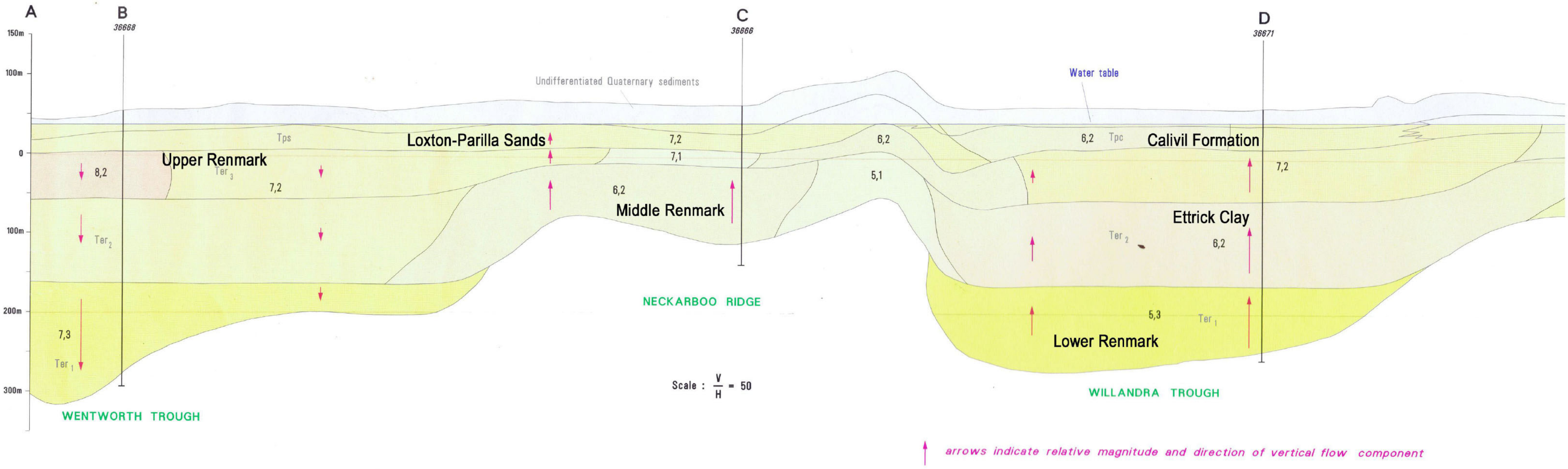
AGSO Sections
Ana Branch Sheet





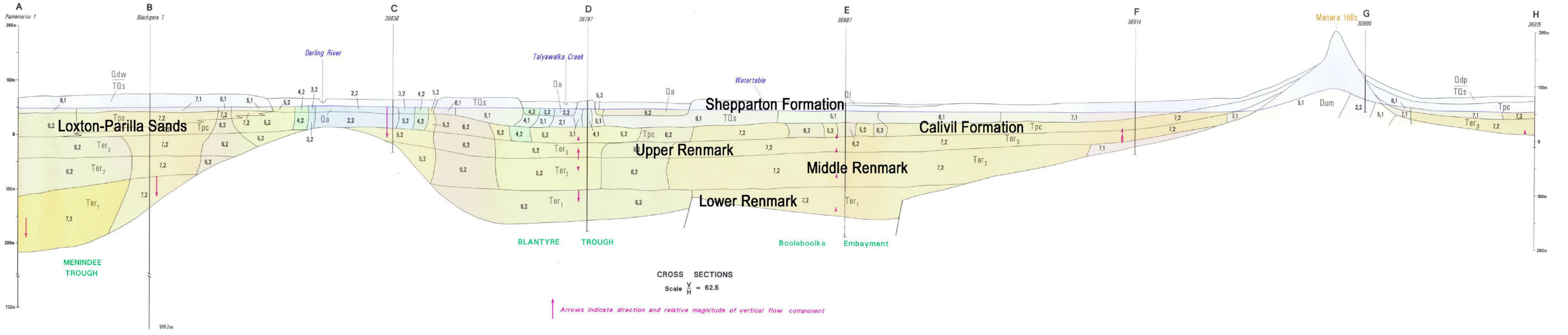
AGSO Sections
Menindee Sheet

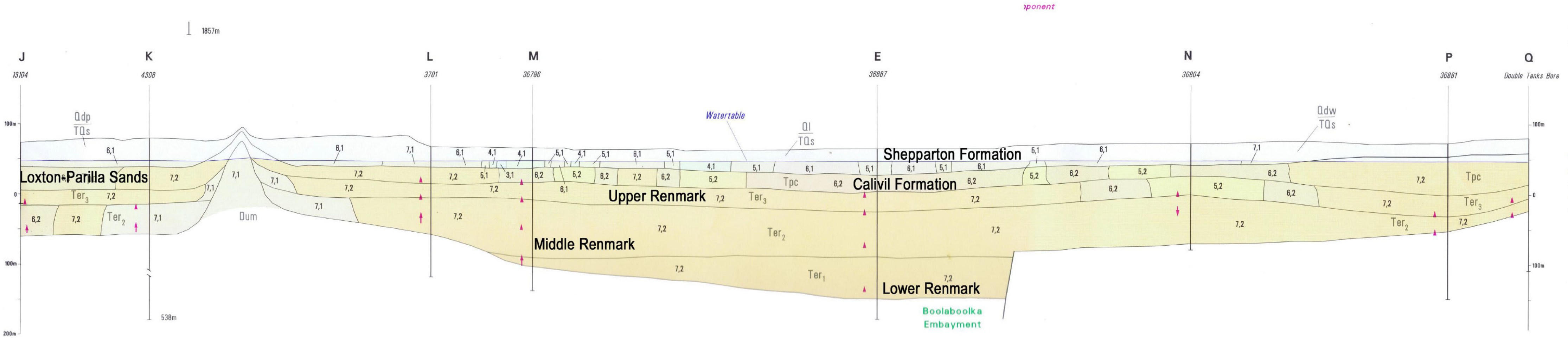
Murray Basin Hydrogeological Map Series 1:250,000 AGSO 1993



Murray Basin Hydrogeological Map Series 1:250,000 AGSO 1993

AGSO Sections
Pooncarie Sheet





AGSO Sections
Manara Sheet

Murray Basin Hydrogeological Map Series 1:250,000 AGSO 1993

APPENDIX B

SITE INVESTIGATION BORES

Coordinates and Elevations are Approximate
See Table 6 for corrected data.

Australasian Groundwater & Environmental Consultants Pty Ltd
Level 2, 15 Mallon Street, Bowen Hills, Queensland 4006

BOREHOLE LOG

page:1 of 2

INJ01

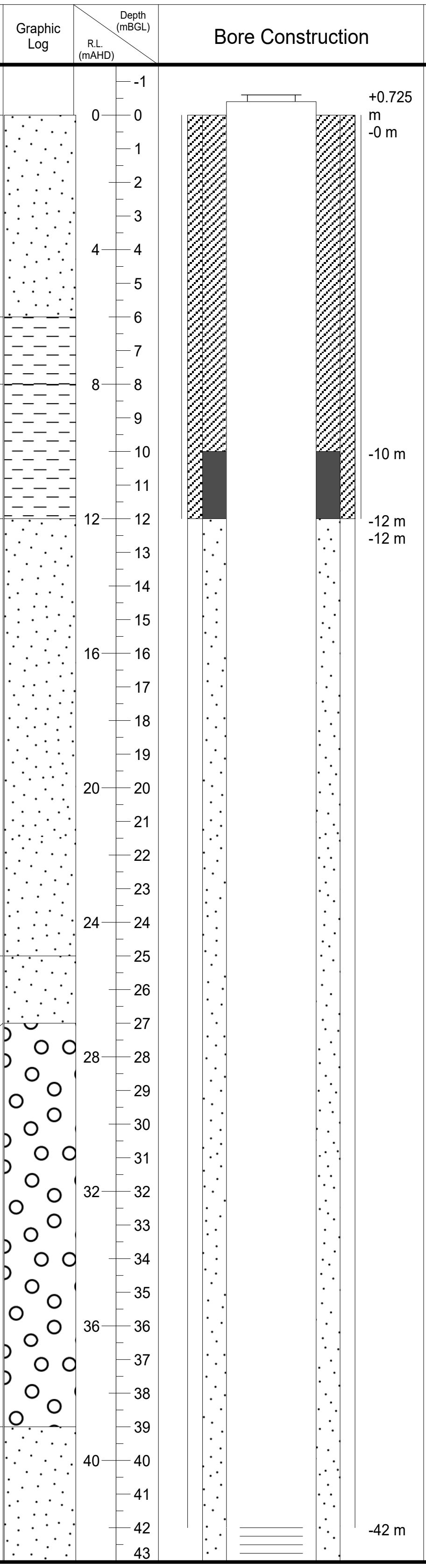
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 10/25/2019
LOGGED BY: K. Düz (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 527469.93 mE
NORTHING: 6282168.4 mN
DATUM: GDA94-Z54
RL: 40.5623 mAHD
TD: 60 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
SAND	SAND: low plasticity, medium sand, sub-angular, well graded, light reddish white / brown, low strength, loose,
CLAY	CLAY: medium plasticity, clay to fine sand, uniform, dark reddish brown / white, medium strength, dense,
CLAY	CLAY: high plasticity, clay, uniform, dark greenish grey / brown, high strength, dense,
SAND	SAND: low plasticity, medium sand to fine sand, sub-rounded, quartzitic, well graded, light yellowish brown / grey, low strength, loose, wet,
SAND	SAND: low plasticity, coarse sand to medium sand, sub-rounded to sub-a, quartzitic, well graded, light yellowish orange / brown, low strength, loose, wet,
GRAVEL	GRAVEL: low plasticity, fine gravel to coarse sand, sub-angular to sub-rounded, quartzitic, well graded, light yellowish grey / orange, low strength, loose, wet,



Bore Description

Stick up: +0.725 m

298.45 mm Blade: 0 m to 60 m (Mud rotary)

280 mm (OD) uPVC conductor casing: 0 m to 42.0 m

Bentonite grout (2.5 %): 0 m to 10 m

150 mm PN18 uPVC blank casing: 0 m to 42 m

Bentonite seal: 10 m to 12 m

2 - 4 mm washed, rounded, quartz gravel pack: 12 m to 60 m

INJ01

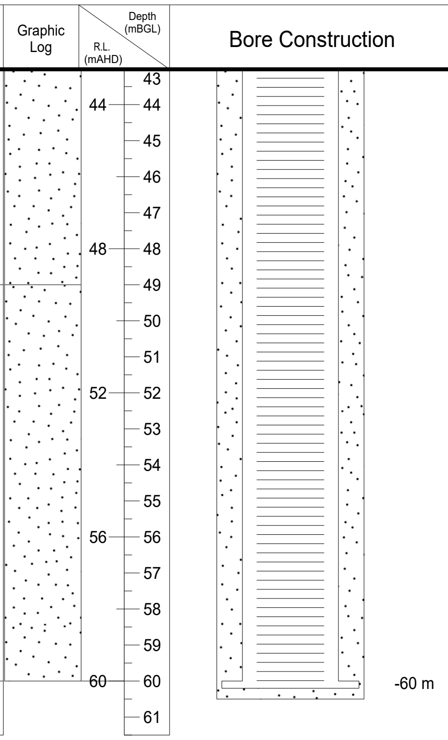
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 10/25/2019
LOGGED BY: K. Düz (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 527469.93 mE
NORTHING: 6282168.4 mN
DATUM: GDA94-Z54
RL: 40.5623 mAHD
TD: 60 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
SAND	SAND: low plasticity, medium sand to coarse sand, sub-angular to sub-rounded, quartzitic, poorly graded, light grey / white / brown, low strength, loose, wet,
SAND	SAND: low plasticity, fine sand to medium sand, sub-rounded, quartzitic, well graded, dark grey / white / brown, low strength, loose, wet,



Bore Description

150 mm steel machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 42 m to 60 m

End cap
End of hole: 60 m BGL

Australasian Groundwater & Environmental Consultants Pty Ltd
Level 2, 15 Mallon Street, Bowen Hills, Queensland 4006

BOREHOLE LOG

page:1 of 2

INJMB01

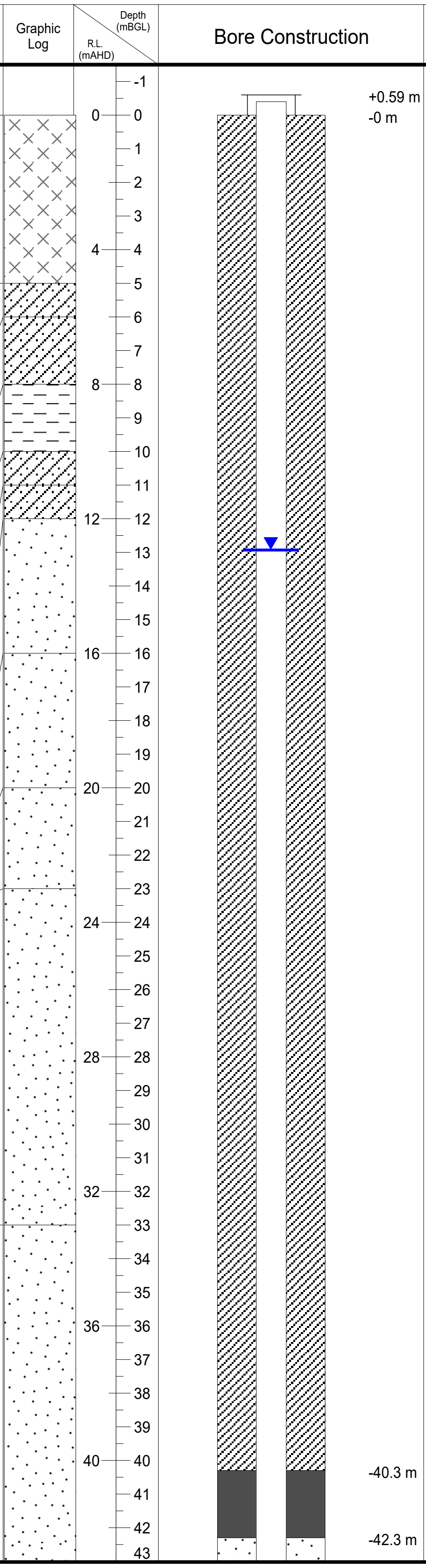
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 10/29/2019
LOGGED BY: P. Ryall (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Augur / Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 527448.6 mE
NORTHING: 6282162.2 mN
DATUM: GDA94-Z54
RL: 39.3717 mAHD
TD: 53 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
SILT	SILT: low plasticity, silt, rounded, well graded, silty matrix, light reddish red / variegated / orange, very low strength, very loose,
SANDY CLAY	SANDY CLAY: low plasticity, medium sand, sub-rounded, quartzitic, poorly graded, clay matrix, light greyish grey / red, low strength, very soft,
SANDY CLAY	SANDY CLAY: medium plasticity, fine sand, sub-rounded, quartzitic, poorly graded, clay matrix, light reddish red / grey / yellow, medium strength, firm,
CLAY	CLAY: medium plasticity, clay, well graded, clay matrix, light reddish red / grey / yellow, high strength, soft,
SANDY CLAY	SANDY CLAY: medium plasticity, fine sand, sub-rounded, quartzitic, poorly graded, clay matrix, light yellowish yellow / orange, medium strength, firm,
SANDY CLAY	SANDY CLAY: medium plasticity, medium sand, sub-rounded, quartzitic, poorly graded, clay matrix, light greyish grey, medium strength, soft,
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, well graded, sand, light orangey orange / grey / yellow, low strength, very loose,
SAND	SAND: low plasticity, medium sand, sub-rounded, quartzitic, well graded, sand, light greyish grey / white, low strength, very loose,
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, well graded, sand, light greyish grey / white, low strength, very loose,
SAND	SAND: low plasticity, coarse sand, sub-angular, quartzitic, well graded, sand, light greyish grey / orange / white, low strength, very loose,
SAND	SAND: low plasticity, medium sand, sub-rounded, quartzitic, well graded, sand, light greyish grey / black / white, low strength, very loose,



Bore Description

Stick up: +0.59 m

95 mm Blade: 0 m to 12 m (Augur)

Bentonite grout (2.5 %): 0 m to 40.3 m

120 mm Blade: 12 m to 53.5 m (Mud rotary)

50 mm PN18 uPVC blank casing: 0 m to 47.5 m

SWL: 12.93 mTOC

Bentonite seal: 40.3 m to 42.3 m

Australasian Groundwater & Environmental Consultants Pty Ltd
Level 2, 15 Mallon Street, Bowen Hills, Queensland 4006

BOREHOLE LOG

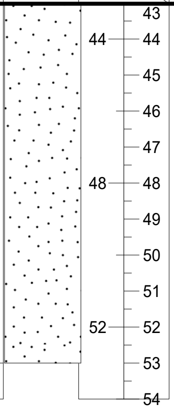
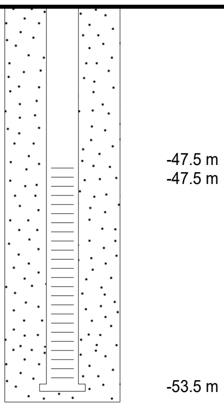
INJMB01

PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 10/29/2019
LOGGED BY: P. Ryall (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Augur / Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 527448.6 mE
NORTHING: 6282162.2 mN
DATUM: GDA94-Z54
RL: 39.3717 mAHD
TD: 53 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description	Graphic Log	R.L. (mAHD) / Depth (mBGL)	Bore Construction	Bore Description
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, well graded, sand, light greyish grey / black / white, low strength, very loose,				2 - 4 mm washed, rounded, quartz gravel pack: 42.3 m to 53.5 m 50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 47.5 m to 53.5 m Bore development: 10 min; EC: 13,960 µS/cm µS/cm; pH: 7.29 Airlift flow rate: 1 L/s End cap End of hole: 53.5 m BGL

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Level 2, 15 Mallon Street, Bowen Hills, Queensland 4006

BOREHOLE LOG

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MB01D

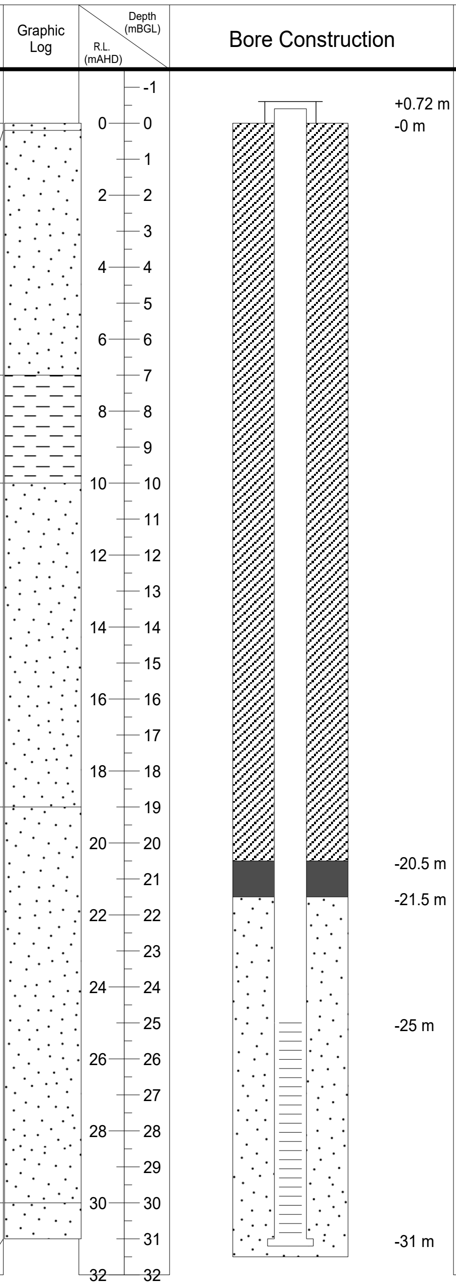
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 9/12/2019
LOGGED BY: K. Düz (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Augur / Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 534257 mE
NORTHING: 6279276 mN
DATUM: GDA94-Z54
RL: 38.2311 mAHD
TD: 31 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
SAND	SAND: low plasticity, fine sand, sub-angular, quartzitic, uniform, light reddish brown / white / orange, Yamba Fm /
SAND	SAND: low plasticity, very fine sand, sub-angular, quartzitic, poorly graded, clay matrix, dark brown / orange, Yamba Fm /
CLAY	CLAY: high plasticity, clay, uniform, light greenish grey / brown, Blanchtown Fm /
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, poorly graded, clay matrix, light yellowish grey / brown / black, Loxton-Parilla Sands Fm: 10-16m - 1-2%; 16-19m - 30% /
SAND	SAND: fine sand, sub-angular, quartzitic, clay matrix, light reddish grey / brown / orange, Loxton-Parilla Sands /
SAND	SAND: coarse sand, sub-angular, quartzitic, clay matrix, dark greyish grey / black, coarse sand /



Bore Description

Stick up: +0.72 m

120 mm Blade: 0 m to 31 m (Mud rotary)

Bentonite grout (2.5 %): 0 m to 20.5 m

50 mm PN18 uPVC blank casing: 0 m to 25 m

Bentonite seal: 20.5 m to 21.5 m

2 - 4 mm washed, rounded, quartz gravel pack: 21.5 m to 31 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 25 m to 31 m
Bore development: 20 min; EC: 80,750 µS/cm µS/cm; pH: 7.41
Airlift flow rate: 0.8 - 1 L/s

End cap
End of hole: 31 m BGL

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BOREHOLE LOG

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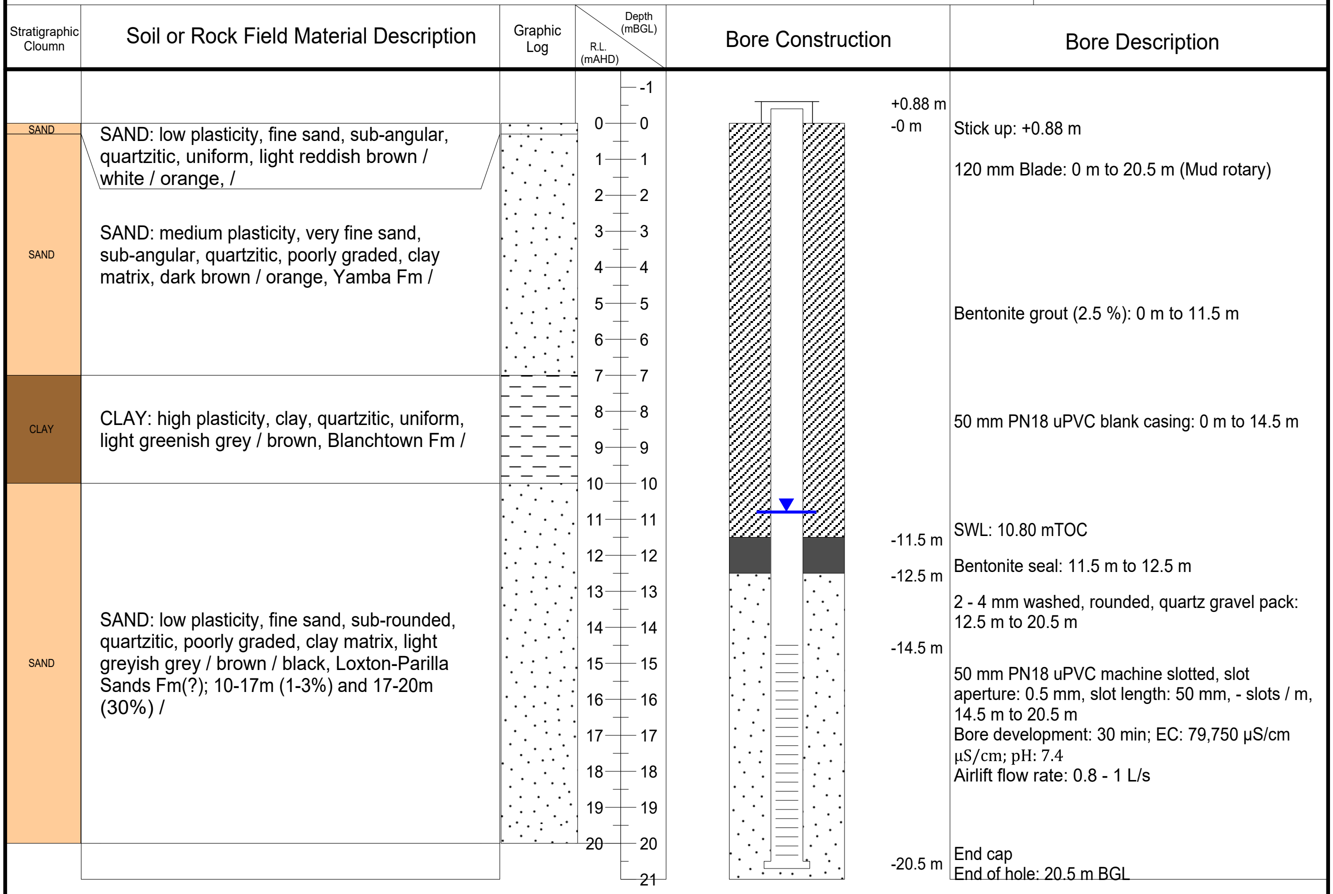
MB01S

PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 9/13/2019
LOGGED BY: K. Düz (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 534252 mE
NORTHING: 6279272 mN
DATUM: GDA94-Z54
RL: 39.4099 mAHD
TD: 20 mBGL

COMMENTS: Survey data not yet available



SAND: low plasticity, fine sand, sub-angular, quartzitic, uniform, light reddish brown / white / orange, /

SAND: medium plasticity, very fine sand, sub-angular, quartzitic, poorly graded, clay matrix, dark brown / orange, Yamba Fm /

CLAY: high plasticity, clay, quartzitic, uniform, light greenish grey / brown, Blanchtown Fm /

SAND: low plasticity, fine sand, sub-rounded, quartzitic, poorly graded, clay matrix, light greyish grey / brown / black, Loxton-Parilla Sands Fm(?); 10-17m (1-3%) and 17-20m (30%) /

Stick up: +0.88 m

120 mm Blade: 0 m to 20.5 m (Mud rotary)

Bentonite grout (2.5 %): 0 m to 11.5 m

50 mm PN18 uPVC blank casing: 0 m to 14.5 m

SWL: 10.80 mTOC

Bentonite seal: 11.5 m to 12.5 m

2 - 4 mm washed, rounded, quartz gravel pack: 12.5 m to 20.5 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 14.5 m to 20.5 m
Bore development: 30 min; EC: 79,750 µS/cm µS/cm; pH: 7.4
Airlift flow rate: 0.8 - 1 L/s

End cap
End of hole: 20.5 m BGL

Australasian Groundwater & Environmental Consultants Pty Ltd
Level 2, 15 Mallon Street, Bowen Hills, Queensland 4006

BOREHOLE LOG

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MB02D

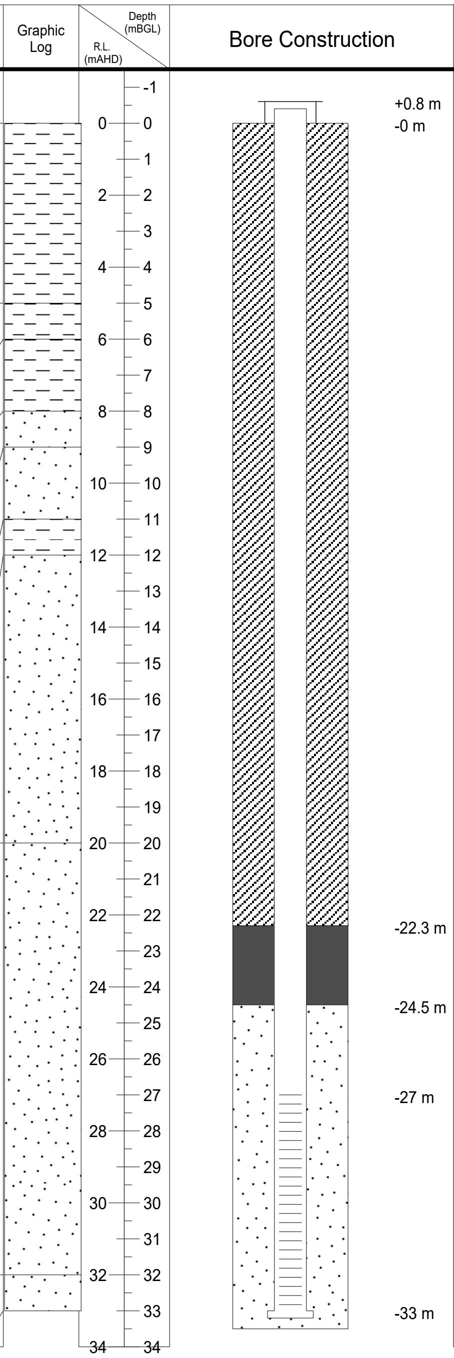
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 9/22/2019
LOGGED BY: P. Ryall (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Augur / Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 534120 mE
NORTHING: 6278929 mN
DATUM: GDA94-Z54
RL: 40.2984 mAHD
TD: 33 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
CLAY	CLAY: medium plasticity, silt, rounded, well graded, silty matrix, light reddish brown / white, low strength, /
CLAY	CLAY: medium plasticity, clay, rounded, well graded, clay matrix, dark reddish brown / orange, medium strength, /
CLAY	CLAY: medium plasticity, silt, rounded, well graded, silty matrix, light reddish brown / white, low strength, /
SAND	SAND: low plasticity, medium sand, sub-rounded, quartzitic, well graded, clay matrix, light orange brown / yellow, very low strength, /
SAND	SAND: low plasticity, medium sand, sub-rounded, quartzitic, well graded, clay matrix, light reddish brown / orange, very low strength, /
CLAY	CLAY: medium plasticity, clay, rounded, well graded, clay matrix, light greyish orange, very low strength, /
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, well graded, silty matrix, light yellowish brown / orange, very low strength, /
SAND	SAND: low plasticity, coarse sand, sub-angular, quartzitic, well graded, silty matrix, light yellowish brown / orange, very low strength, /
SAND	SAND: low plasticity, coarse sand, sub-angular, quartzitic, well graded, silty matrix, dark greyish black, very low strength, /



Bore Description

Stick up: +0.8 m

95 mm Blade: 0 m to 10 m (Augur)

Bentonite grout (2.5 %): 0 m to 22.3 m

120 mm Blade: 10 m to 33 m (Mud rotary)

50 mm PN18 uPVC blank casing: 0 m to 27 m

SWL: 10.85 mTOC

Bentonite seal: 22.3 m to 24.5 m

2 - 4 mm washed, rounded, quartz gravel pack: 24.5 m to 33 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 27 m to 33 m
Bore development: 50 min; EC: 90,100 µS/cm µS/cm; pH: 7.15
Bore developed with potable water

End cap
End of hole: 33 m BGL

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BOREHOLE LOG

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MB02S

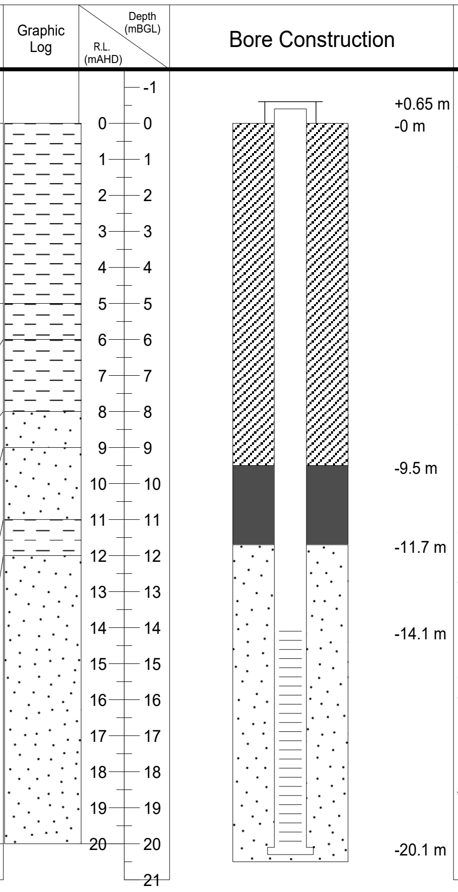
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 9/22/2019
LOGGED BY: P. Ryall (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Augur / Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 534114 mE
NORTHING: 6278933 mN
DATUM: GDA94-Z54
RL: 39.8747 mAHD
TD: 20 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
CLAY	CLAY: medium plasticity, silt, rounded, well graded, silty matrix, light reddish brown / white, low strength, /
CLAY	CLAY: medium plasticity, clay, rounded, well graded, clay matrix, dark reddish brown / orange, medium strength, /
CLAY	CLAY: medium plasticity, silt, rounded, well graded, silty matrix, light reddish brown / white, low strength, /
SAND	SAND: low plasticity, medium sand, sub-rounded, quartzitic, well graded, clay matrix, light orange brown / yellow, very low strength, /
SAND	SAND: low plasticity, medium sand, sub-rounded, quartzitic, well graded, clay matrix, light reddish brown / orange, very low strength, /
CLAY	CLAY: medium plasticity, clay, rounded, well graded, clay matrix, light greyish orange, very low strength, /
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, well graded, silty matrix, light yellowish brown / orange, very low strength, /



Bore Description

Stick up: +0.65 m

95 mm Blade: 0 m to 14 m (Auger)

Bentonite grout (2.5 %): 0 m to 9.5 m

120 mm Blade: 14 m to 20.1 m (Mud rotary)

50 mm PN18 uPVC blank casing: 0 m to 14.1 m

Bentonite seal: 9.5 m to 11.7 m

SWL: 10.48 mTOC

2 - 4 mm washed, rounded, quartz gravel pack: 11.7 m to 20.1 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 14.1 m to 20.1 m

Bore development: 40 min; EC: 77,700 µS/cm µS/cm; pH: 7.39
Airlift flow rate: 0.8 L/s

End cap
End of hole: 20.1 m BGL

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BOREHOLE LOG

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MB03D

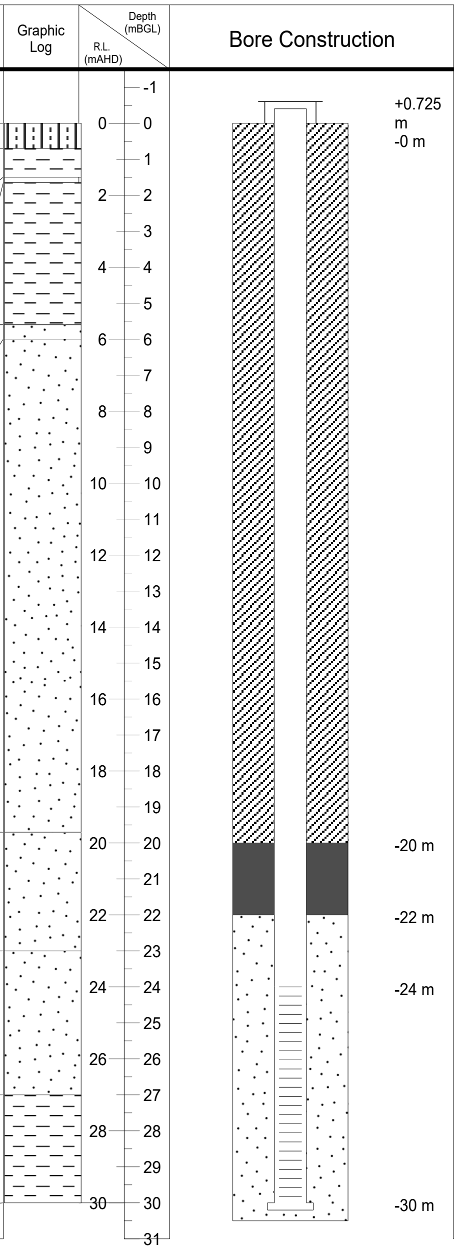
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 9/4/2019
LOGGED BY: K. Düz (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 533300 mE
NORTHING: 6279854 mN
DATUM: GDA94-Z54
RL: 33 mAHD
TD: 30 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
SOIL	SOIL: clay, orange / brown, /
CLAY	CLAY: medium plasticity, clay, uniform, dark bluish brown / orange, /
GYPSUM	GYPSUM: white, crystalline, Well crystalised, creamy white coloured with porous structure, slightly moisturised /
CLAY	CLAY: high plasticity, clay, uniform, light greyish grey, low strength, Water table at 1.65 m /
SAND	SAND: medium sand, angular, quartzitic, poorly graded, light white, wet, /
SAND	SAND: medium sand, angular, quartzitic, poorly graded, dark yellowish yellow, wet, Heavy Mineral Deposit (HMD) /
SAND	SAND: coarse sand, angular, quartzitic, poorly graded, dark bluish brown / orange, /
SAND	SAND: coarse sand, angular, quartzitic, poorly graded, dark bluish brown / black, Dark chocolate coloured fluid return /
CLAY	CLAY: low plasticity, clay, dark bluish brown / black, low strength, Dark brown coloured clay layer, difficult to get samples, fluid colour abruptly changes into dark brown when hitting this lithology /



Bore Description

Stick up: +0.725 m

95 mm Blade: 0 m to 3 m (Auger)

Bentonite grout (2.5 %): 0 m to 20 m

120 mm Cobra: 3 m to 30 m (Mud rotary)

50 mm PN18 uPVC blank casing: 0 m to 24 m

Bentonite seal: 20 m to 22 m

2 - 4 mm washed, rounded, quartz gravel pack: 22 m to 30 m
Dark chocolate fluid 23 - 30 m

55 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 24 m to 30 m

End cap
End of hole: 30 m BGL

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BOREHOLE LOG

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MB03S

PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 9/7/2019
LOGGED BY: K. Düz (AGE)

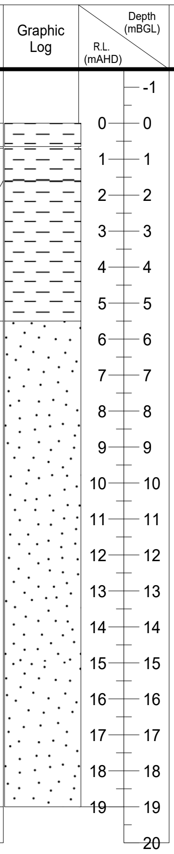
DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 533295 mE
NORTHING: 6279847 mN
DATUM: GDA94-Z54
RL: 31.2 mAHD
TD: 19 mBGL

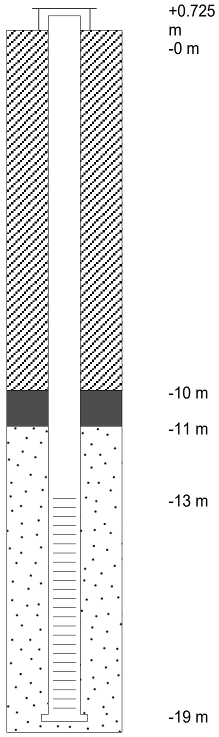
COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
CLAY	CLAY: clay, orange/brown Overburden
CLAY	CLAY: medium plasticity, clay, uniform, dark bluish brown / orange, Yamba Frm; with gypsum fragments /
CLAY	CLAY: high plasticity, clay, uniform, light greyish grey, low strength, Blanchetown Frm /
SAND	SAND: medium sand, angular, quartzitic, poorly graded, dark yellowish yellow / white, Loxton-Parilla Sands (Heavy mineral deposit 1-5%) /

Graphic Log



Bore Construction



Bore Description

Stick up: +0.725 m

95 mm Blade: 0 m to 3 m (Auger)

Bentonite grout (2.5 %): 0 m to 10 m

120 mm Cobra: 3 m to 19 m (Mud rotary)

50 mm PN18 uPVC blank casing: 0 m to 13 m

Bentonite seal: 10 m to 11 m

2 - 4 mm washed, rounded, quartz gravel pack: 11 m to 19 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 13 m to 19 m

End cap
End of hole: 19 m BGL

Australasian Groundwater & Environmental Consultants Pty Ltd

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BOREHOLE LOG

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MB04D

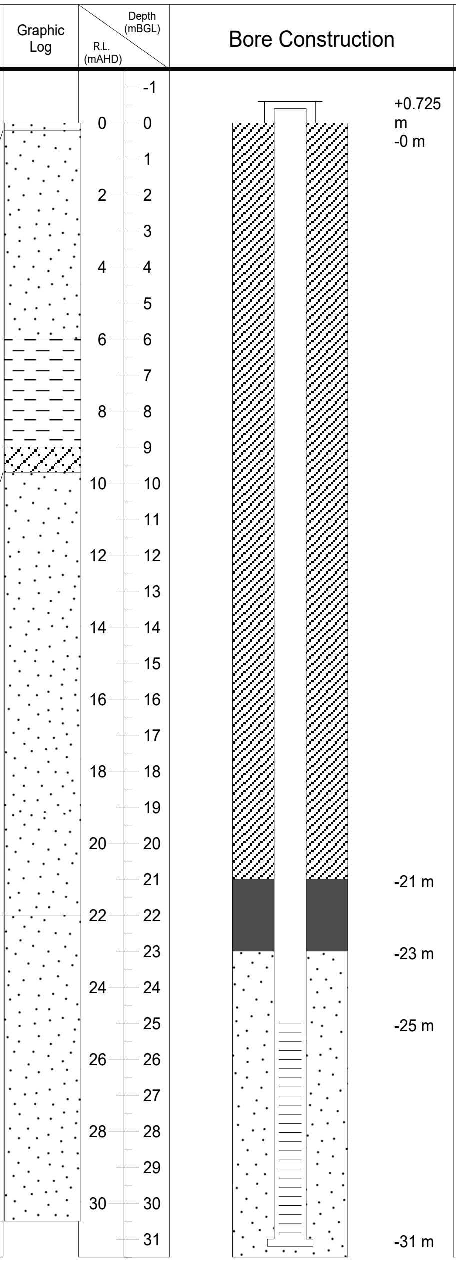
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 9/13/2019
LOGGED BY: K. Düz (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 534475 mE
NORTHING: 6279137 mN
DATUM: GDA94-Z54
RL: 38.3374 mAHD
TD: 30.5 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
SAND	SAND: low plasticity, fine sand, sub-angular, quartzitic, uniform, light reddish brown / white / orange, Yamba Fm /
SAND	SAND: high plasticity, fine sand, sub-rounded, quartzitic, poorly graded, clay matrix, dark brown / orange, Yamba Fm /
CLAY	CLAY: high plasticity, clay, quartzitic, uniform, clay matrix, light greenish grey / brown / yellow, Blanchtown Fm /
SANDY CLAY	SANDY CLAY: low plasticity, clay, rounded, uniform, clay matrix, light greenish white / brown / black, medium strength, Blanchtown Fm /
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, clay matrix, light yellowish grey / brown / white, Loxton-Parilla Sands (HMD: 1-33%) /
SAND	SAND: low plasticity, fine gravel, sub-angular, quartzitic, clay matrix, light reddish grey / brown, coarse sand /



Bore Description

Stick up: +0.725 m

120 mm Blade: 0 m to 31 m (Mud rotary)

Bentonite grout (2.5 %): 0 m to 21 m

50 mm PN18 uPVC blank casing: 0 m to 25 m

Bentonite seal: 21 m to 23 m

2 - 4 mm washed, rounded, quartz gravel pack: 23 m to 31 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 25 m to 31 m

End cap
End of hole: 31 m BGL

Australasian Groundwater & Environmental Consultants Pty Ltd
Level 2, 15 Mallon Street, Bowen Hills, Queensland 4006

BOREHOLE LOG

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MB04S

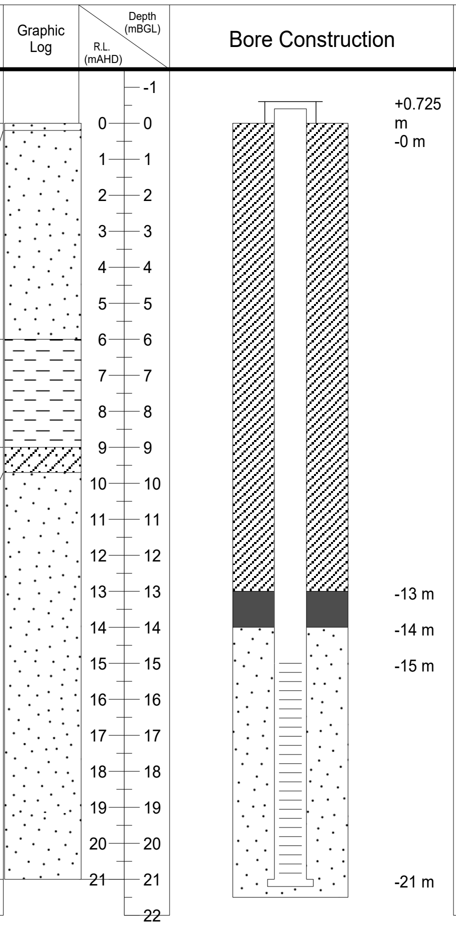
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 9/14/2019
LOGGED BY: K. Düz (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Augur / Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 534469 mE
NORTHING: 6279123 mN
DATUM: GDA94-Z54
RL: mAHD
TD: 21 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
SAND	SAND: low plasticity, fine sand, sub-angular, quartzitic, uniform, light reddish brown / white / orange, /
SAND	SAND: high plasticity, fine sand, sub-rounded, quartzitic, poorly graded, clay matrix, dark brown / orange, /
CLAY	CLAY: high plasticity, clay, quartzitic, uniform, clay matrix, light greenish grey / brown, /
SANDY CLAY	SANDY CLAY: low plasticity, clay, rounded, uniform, clay matrix, light greenish white / brown / yellow, medium strength, /
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, clay matrix, light yellowish grey / brown / black, / HMD % 1-5



Bore Description

Stick up: +0.725 m

120 mm Blade: 0 m to 21 m (Mud rotary)

Bentonite grout (2.5 %): 0 m to 13 m

50 mm PN18 uPVC blank casing: 0 m to 15 m

Bentonite seal: 13 m to 14 m

2 - 4 mm washed, rounded, quartz gravel pack: 14 m to 21 m
50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 15 m to 21 m

End cap
End of hole: 21 m BGL

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BOREHOLE LOG

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MB05D

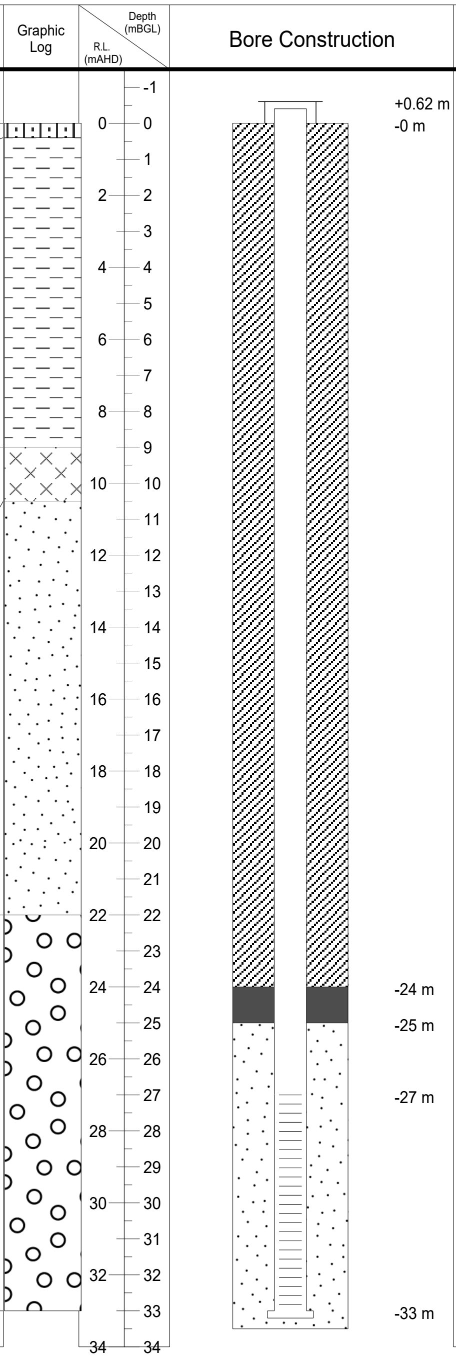
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 9/9/2019
LOGGED BY: K. Düz (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 534428 mE
NORTHING: 6279371 mN
DATUM: GDA94-Z54
RL: 36.8 mAHD
TD: 33 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
SOIL	SOIL: silty matrix, orange / brown, /
CLAY	CLAY: low plasticity, clay, silty matrix, light bluish brown / orange, low strength, /
SILT	SILT: low plasticity, very fine sand to fine sand, sub-rounded, quartzitic, poorly graded, clay matrix, light bluish brown / grey, very low strength, /
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, poorly graded, clay matrix, light greyish grey / brown, low strength, Loxton-Parilla Sands /
GRAVEL	GRAVEL: low plasticity, fine gravel, sub-rounded, quartzitic, poorly graded, silty matrix, light variegated / grey / black, Coarse sand /



Bore Description

Stick up: +0.62 m

95 mm Blade: 0 m to 3 m (Auger)

Bentonite grout (2.5 %): 0 m to 24 m

120 mm Blade: 3 m to 33 m (Mud rotary)

50 mm PN18 uPVC blank casing: 0 m to 27 m

SWL: 9.71 mTOC

SWL: 11.54 mTOC; Myron L conductivity meter not working G31

Bentonite seal: 24 m to 25 m

2 - 4 mm washed, rounded, quartz gravel pack: 25 m to 33 m

50 mm uPVC Class 18 machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 27 m to 33 m
Bore development: 35 min; EC: 88,500 µS/cm µS/cm; pH: 7.24
Airlift flow rate: 1.2 - 1.7 L/s

End cap
End of hole: 33 m BGL

Australasian Groundwater & Environmental Consultants Pty Ltd
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BOREHOLE LOG

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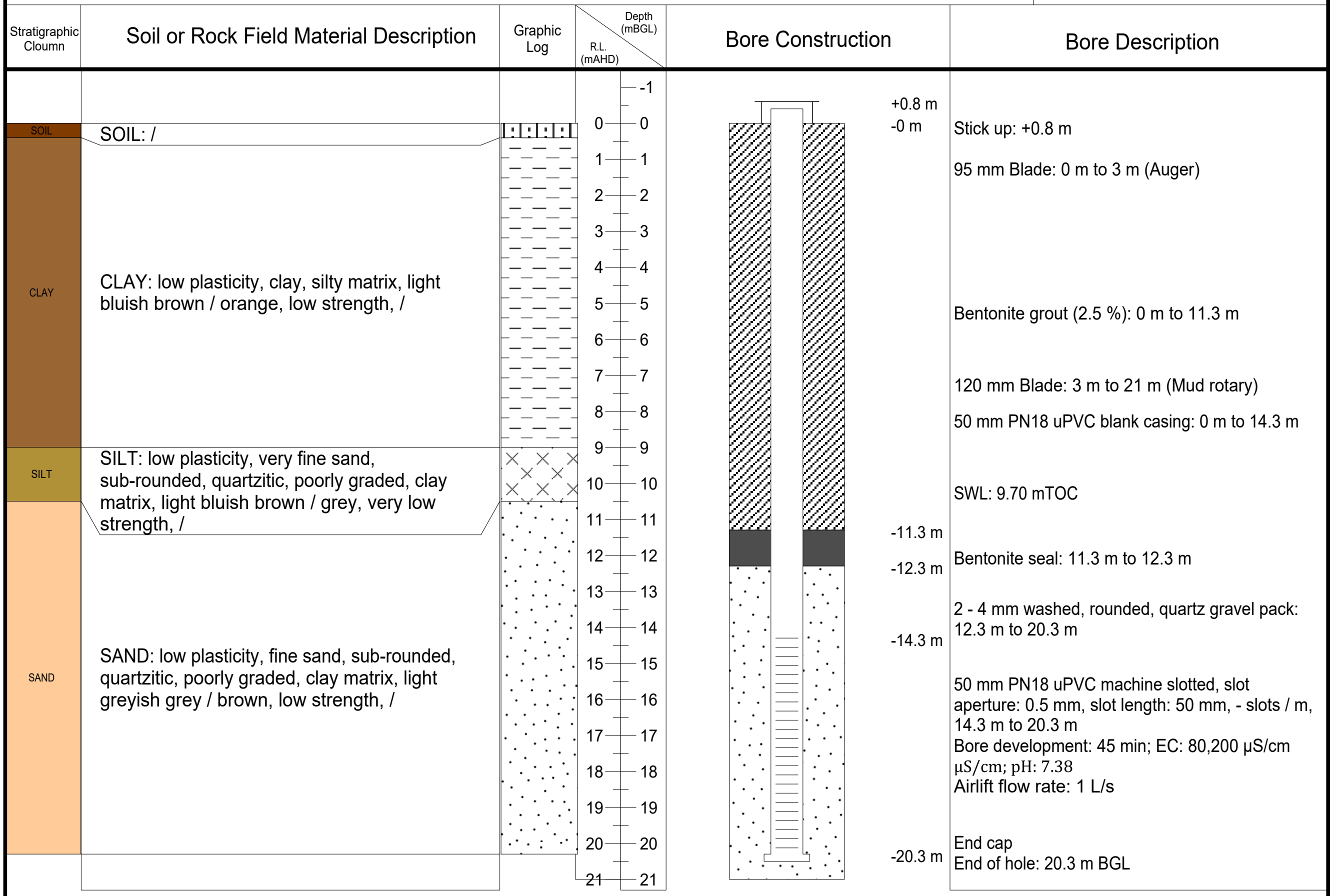
MB05S

PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 9/9/2019
LOGGED BY: K. Düz (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 534417 mE
NORTHING: 6279376 mN
DATUM: GDA94-Z54
RL: 37.2 mAHD
TD: 20.3 mBGL

COMMENTS: Survey data not yet available



Soil or Rock Field Material Description

SOIL: /

CLAY: low plasticity, clay, silty matrix, light bluish brown / orange, low strength, /

SILT: low plasticity, very fine sand, sub-rounded, quartzitic, poorly graded, clay matrix, light bluish brown / grey, very low strength, /

SAND: low plasticity, fine sand, sub-rounded, quartzitic, poorly graded, clay matrix, light greyish grey / brown, low strength, /

Bore Description

Stick up: +0.8 m

95 mm Blade: 0 m to 3 m (Auger)

Bentonite grout (2.5 %): 0 m to 11.3 m

120 mm Blade: 3 m to 21 m (Mud rotary)

50 mm PN18 uPVC blank casing: 0 m to 14.3 m

SWL: 9.70 mTOC

Bentonite seal: 11.3 m to 12.3 m

2 - 4 mm washed, rounded, quartz gravel pack: 12.3 m to 20.3 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 14.3 m to 20.3 m
Bore development: 45 min; EC: 80,200 µS/cm µS/cm; pH: 7.38
Airlift flow rate: 1 L/s

End cap
End of hole: 20.3 m BGL

Australasian Groundwater & Environmental Consultants Pty Ltd
Level 2, 15 Mallon Street, Bowen Hills, Queensland 4006

BOREHOLE LOG

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MB06

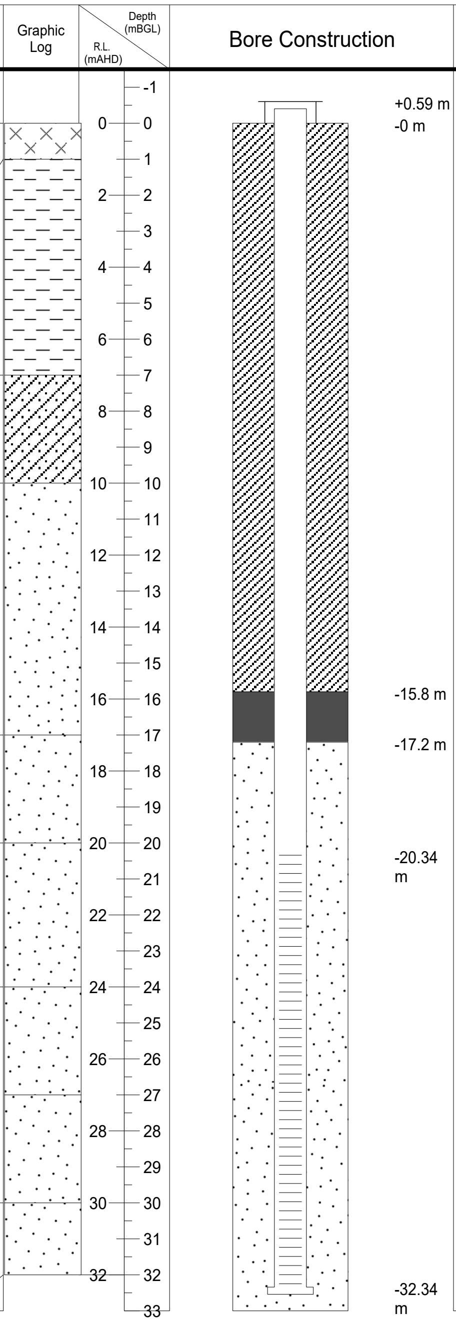
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 10/30/2019
LOGGED BY: P. Ryall (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Augur / Mud rotary
DRILL RIG: Scout MK2

EASTING: 534687.9 mE
NORTHING: 6281868.9 mN
DATUM: GDA94-Z54
RL: 31.1019 mAHD
TD: 32 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
SILT	SILT: low plasticity, silt, rounded, well graded, silty matrix, light reddish red / white / orange, very low strength, very loose, /
CLAY	CLAY: medium plasticity, clay, well graded, clay matrix, light greenish grey / yellow / black, medium strength, soft, /
SANDY CLAY	SANDY CLAY: medium plasticity, fine sand, sub-rounded, poorly graded, clay matrix, light reddish grey / black / yellow, medium strength, firm, /
SAND	SAND: low plasticity, fine sand, sub-rounded, well graded, silty matrix, light greyish grey / white, very low strength, very loose, /
SAND	SAND: low plasticity, fine sand, sub-rounded, well graded, silty matrix, light yellowish yellow / orange / white, very low strength, very loose, /
SAND	SAND: low plasticity, coarse sand, sub-rounded, well graded, silty matrix, light orangey orange / yellow, very low strength, very loose, /
SAND SAND	SAND: low plasticity, medium sand, sub-rounded, well graded, silty matrix, light orangey orange / yellow, very low strength, very loose, /
SAND	SAND: low plasticity, coarse sand, sub-angular, well graded, silty matrix, light orangey orange / yellow / brown, very low strength, very loose, /



Bore Description

Stick up: +0.59 m

95 mm Blade: 0 m to 15 m (Augur)

Bentonite grout (2.5 %): 0 m to 15.8 m

120 mm Blade: 15 m to 32 m (Mud rotary)

50 mm PN18 uPVC blank casing: 0 m to 20.34 m

SWL: 14.35 mTOC

Bentonite seal: 15.8 m to 17.2 m

2 - 4 mm washed, rounded, quartz gravel pack: 17.2 m to 32.34 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 20.34 m to 32.34 m

Bore development: 45 min; EC: 80,710 µS/cm µS/cm; pH: 7.25
Airlift flow rate: 0.13 - 0.17 L/s

End cap
End of hole: 32.34 m BGL

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BOREHOLE LOG

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MB07D

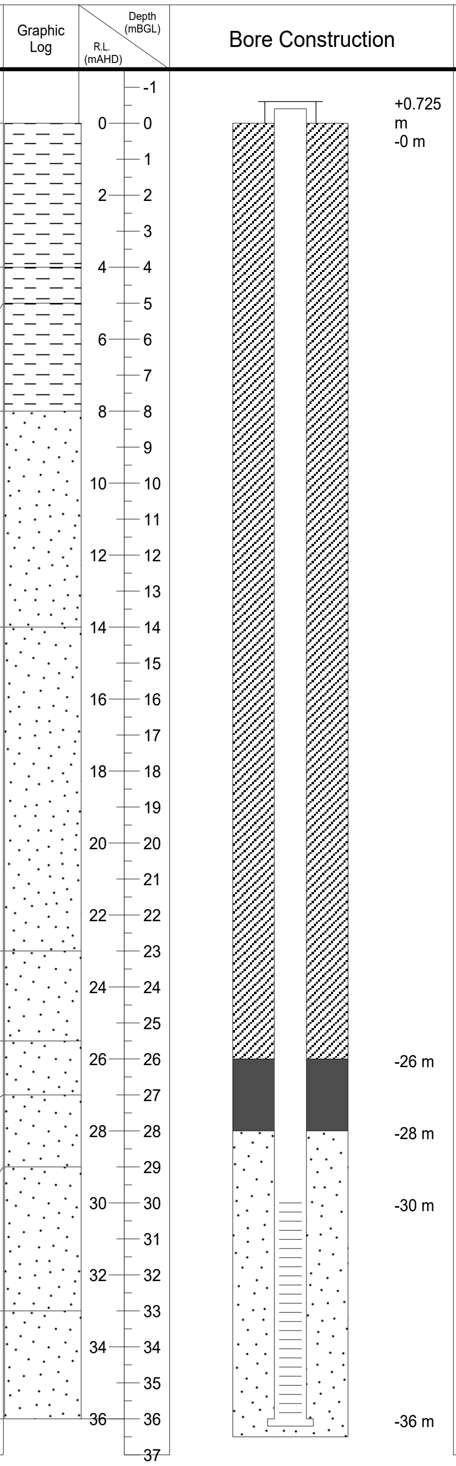
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 9/15/2019
LOGGED BY: K. Düz (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 534748 mE
NORTHING: 6278951 mN
DATUM: GDA94-Z54
RL: 39.6345 mAHD
TD: 36 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
CLAY	CLAY: medium plasticity, silt, rounded, well graded, silty matrix, light reddish brown / white, low strength, /
CLAY	CLAY: medium plasticity, silt, rounded, well graded, silty matrix, dark yellowish brown / orange, medium strength, /
CLAY	CLAY: high plasticity, silt, rounded, poorly graded, silty matrix, light greenish grey / brown, high strength, moist, /
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, well graded, clay matrix, light yellowish brown / orange, very low strength, wet, 0.3-0.5% HMD /
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, well graded, clay matrix, dark yellowish grey / brown / orange, very low strength, wet, 5-10% HMD /
SAND	SAND: low plasticity, coarse sand, sub-angular, quartzitic, poorly graded, silty matrix, light yellowish grey / brown / white, very low strength, wet, /
SAND	SAND: low plasticity, coarse sand, sub-angular, quartzitic, poorly graded, silty matrix, dark reddish brown / white, very low strength, wet,
SAND	SAND: low plasticity, coarse sand, sub-angular, quartzitic, poorly graded, silty matrix, dark yellowish brown / orange / white, very low strength, wet,
SAND	SAND: low plasticity, coarse sand, sub-angular, quartzitic, well graded, silty matrix, dark reddish grey / black, very low strength, wet,
SAND	SAND: low plasticity, fine gravel, sub-angular, quartzitic, poorly graded, silty matrix, dark grey / black / white, very low strength, wet,



Bore Description

Stick up: +0.725 m

120 mm Blade: 0 m to 36 m (Mud rotary)

Bentonite grout (2.5 %): 0 m to 26 m

50 mm PN18 uPVC blank casing: 0 m to 30 m

Bentonite seal: 26 m to 28 m

2 - 4 mm washed, rounded, quartz gravel pack: 28 m to 36 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 30 m to 36 m

End cap
End of hole: 36 m BGL

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BOREHOLE LOG

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MB07S

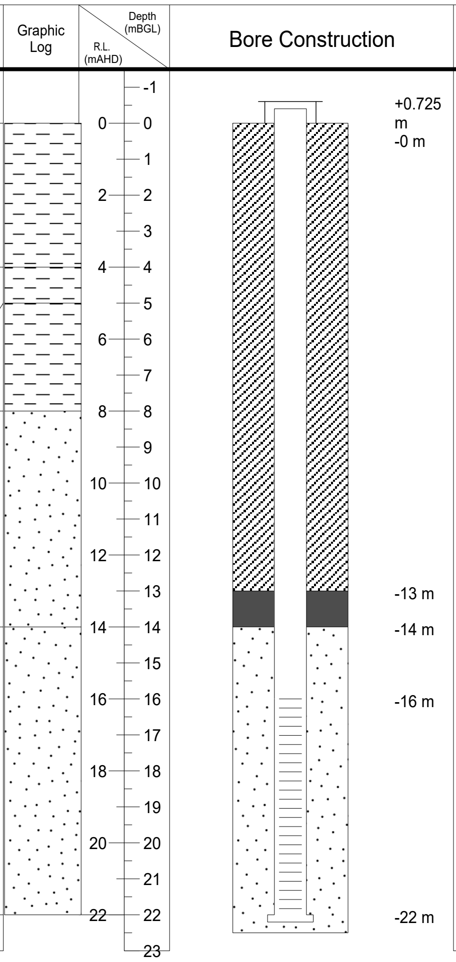
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 9/15/2019
LOGGED BY: K. Düz (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 534755 mE
NORTHING: 6278957 mN
DATUM: GDA94-Z54
RL: 39.917 mAHD
TD: 22 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
CLAY	CLAY: medium plasticity, silt, rounded, well graded, silty matrix, light reddish brown / white, low strength, /
CLAY	CLAY: medium plasticity, silt, rounded, well graded, silty matrix, dark yellowish brown / orange, medium strength, /
CLAY	CLAY: high plasticity, silt, rounded, poorly graded, silty matrix, light greenish grey / brown, high strength, /
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, well graded, clay matrix, light yellowish brown / orange / white, very low strength, / HMD % 1
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, well graded, clay matrix, dark yellowish grey / brown / white, very low strength, / HMD % 20-30



Bore Description
Stick up: +0.725 m
120 mm Blade: 0 m to 22 m (Mud rotary)
Bentonite grout (2.5 %): 0 m to 13 m
50 mm PN18 uPVC blank casing: 0 m to 16 m
Bentonite seal: 13 m to 14 m
2 - 4 mm washed, rounded, quartz gravel pack: 14 m to 22 m
50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 16 m to 22 m
End cap End of hole: 22 m BGL

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BOREHOLE LOG

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MB08D

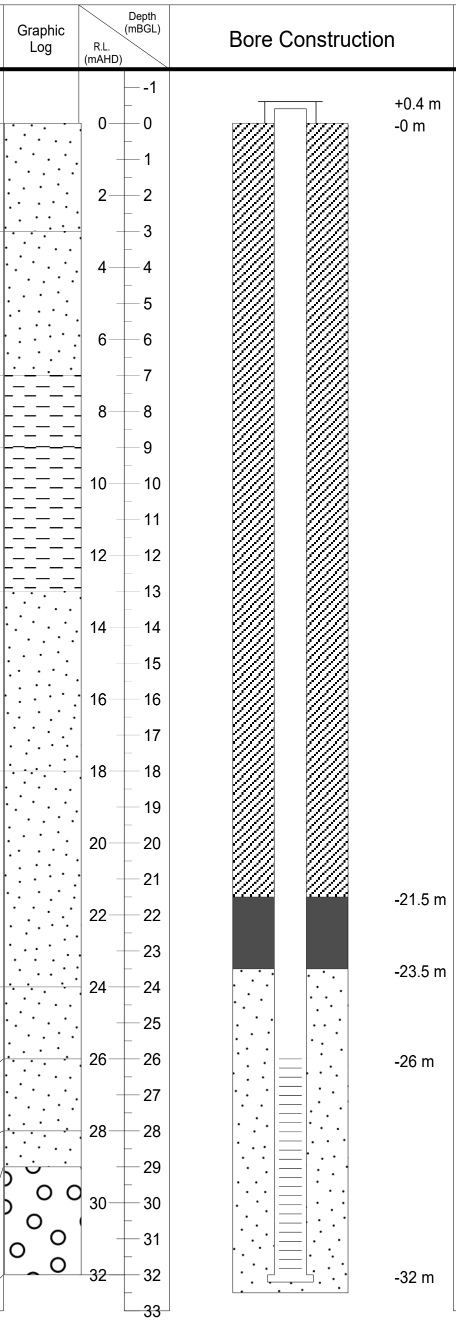
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 10/14/2019
LOGGED BY: K. Düz (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 528889 mE
NORTHING: 6282658 mN
DATUM: GDA94-Z54
RL: 43.0832 mAHD
TD: 32 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
SAND	SAND: low plasticity, fine sand, sub-rounded, well graded, light reddish white / brown, low strength,
SAND	SAND: medium plasticity, clay, poorly graded, dark reddish brown / red, low strength,
CLAY	CLAY: medium plasticity, clay, well graded, light greenish grey / yellow, medium strength,
CLAY	CLAY: high plasticity, clay, dark greenish grey / red, high strength,
SAND	SAND: medium plasticity, fine sand, sub-rounded, quartzitic, poorly graded, clay matrix, light greyish yellow / grey, medium strength, HMD % 0.5-3
SAND	SAND: low plasticity, medium sand, sub-rounded, quartzitic, well graded, silty matrix, light greyish white / grey, low strength, HMD %0.5-3
SAND	SAND: low plasticity, medium sand, sub-angular, quartzitic, poorly graded, silty matrix, light reddish grey / brown / red, low strength,
SAND	SAND: low plasticity, coarse sand, sub-angular, quartzitic, poorly graded, dark reddish white / brown, low strength,
SAND	SAND: medium plasticity, medium sand, sub-angular, quartzitic, poorly graded, silty matrix, light yellowish grey / yellow / brown, low strength,
GRAVEL	GRAVEL: low plasticity, fine gravel, sub-angular, quartzitic, poorly graded, light yellowish white / grey, low strength,



Bore Description

Stick up: +0.4 m

120 mm Blade: 0 m to 32 m (Mud rotary)

Bentonite grout (2.5 %): 0 m to 21.5 m

50 mm PN18 uPVC blank casing: 0 m to 26 m

SWL: 15.67 mTOC

Bentonite seal: 21.5 m to 23.5 m

2 - 4 mm washed, rounded, quartz gravel pack: 23.5 m to 32 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 26 m to 32 m
Bore development: 1 hr; EC: 66,020 µS/cm µS/cm; pH: 7.34
Airlift flow rate: 0.4 L/s

End cap
End of hole: 32 m BGL

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BOREHOLE LOG

MB08S

PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 10/16/2019
LOGGED BY: K. Düz (AGE)

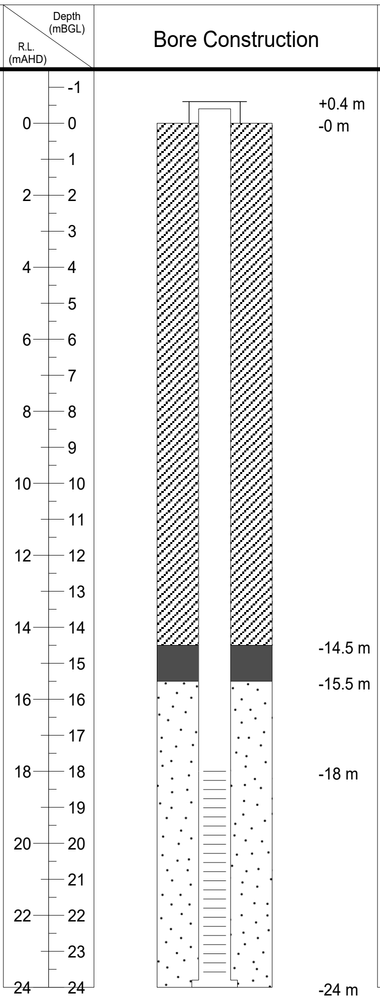
DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: mE
NORTHING: mN
DATUM: GDA94-Z54
RL: mAHD
TD: 24 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
SAND	SAND: low plasticity, fine sand, sub-rounded, well graded, light reddish white / brown, low strength,
SAND	SAND: medium plasticity, clay, poorly graded, dark reddish brown / red, low strength,
CLAY	CLAY: medium plasticity, clay, well graded, light greenish grey / yellow, medium strength,
CLAY	CLAY: high plasticity, clay, dark greenish grey / red, high strength,
SAND	SAND: medium plasticity, fine sand, sub-rounded, quartzitic, poorly graded, clay matrix, light greyish yellow / grey, medium strength,
SAND	SAND: low plasticity, medium sand, sub-rounded, quartzitic, well graded, silty matrix, light greyish white / grey, low strength,

Graphic Log



Bore Description

Stick up: +0.4 m

120 mm Blade: 0 m to 24 m (Mud rotary)

Bentonite grout (2.5 %): 0 m to 14.5 m

50 mm PN18 uPVC blank casing: 0 m to 18 m

Bentonite seal: 14.5 m to 15.5 m

2 - 4 mm washed, rounded, quartz gravel pack: 15.5 m to 24 m
50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 18 m to 24 m

End cap

End of hole: 24 m BGL

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BOREHOLE LOG

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MB09D

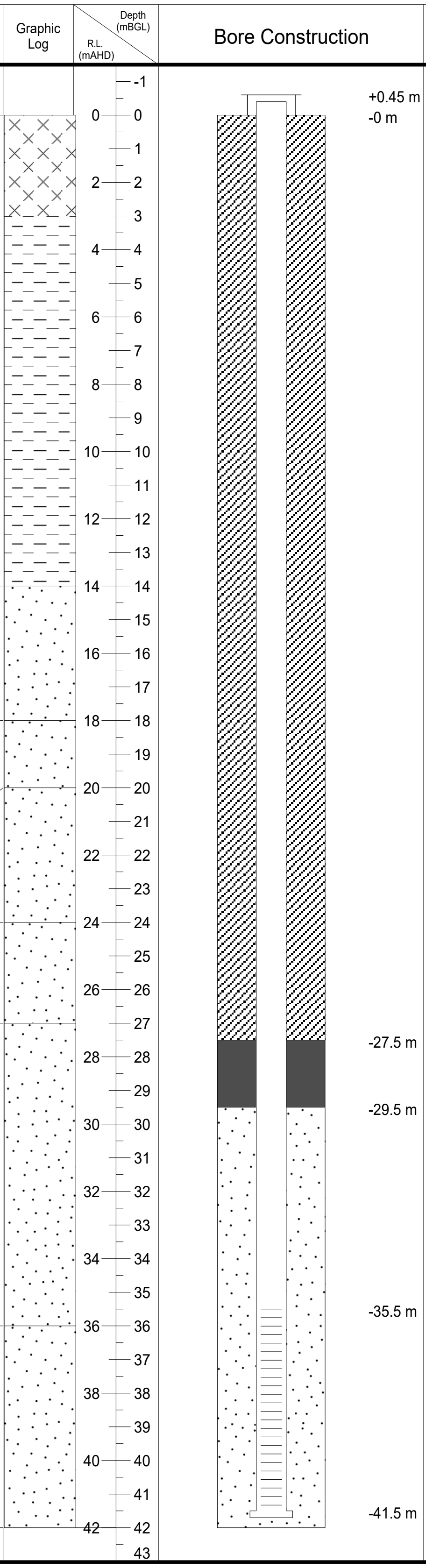
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 11/1/2019
LOGGED BY: P. Ryall (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Augur / Mud rotary
DRILL RIG: Scout MK2

EASTING: 529051 mE
NORTHING: 6282568 mN
DATUM: GDA94-Z54
RL: 48.6431 mAHD
TD: 42 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
SILT	SILT: low plasticity, silt, rounded, well graded, silty matrix, light reddish red / white, very low strength, very loose, /
CLAY	CLAY: high plasticity, clay, well graded, clay matrix, light greyish grey / red / yellow, medium strength, firm, /
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, well graded, silty matrix, light greyish grey / white, very low strength, very loose, 20% HMD /
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, well graded, silty matrix, light greyish grey / white, very low strength, very loose, 10% HMD /
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, well graded, silty matrix, light orangey orange / yellow / green, very low strength, very loose, 5% HMD /
SAND	SAND: low plasticity, medium sand, sub-rounded, quartzitic, well graded, silty matrix, light whitish white / grey, very low strength, very loose, /
SAND	SAND: low plasticity, coarse sand, sub-angular, quartzitic, well graded, silty matrix, light orangey orange / yellow, very low strength, very loose, /
SAND	SAND: low plasticity, medium sand, sub-angular, quartzitic, well graded, silty matrix, light greyish grey / white, very low strength, very loose, /



Bore Description

Stick up: +0.45 m

95 mm Blade: 0 m to 14 m (Augur)

Bentonite grout (2.5 %): 0 m to 27.5 m

120 mm Blade: 14 m to 42 m (Mud rotary)

50 mm PN18 uPVC blank casing: 0 m to 35.5 m

SWL: 14.52 mTOC

Bentonite seal: 27.5 m to 29.5 m

2 - 4 mm washed, rounded, quartz gravel pack: 29.5 m to 41.5 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 35.5 m to 41.5 m

Bore development: 45 min; EC: 11,100 µS/cm µS/cm; pH: 7.24
Airlift flow rate: 0.25 - 0.33 L/s

End cap
End of hole: 41.5 m BGL

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BOREHOLE LOG

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MB09S

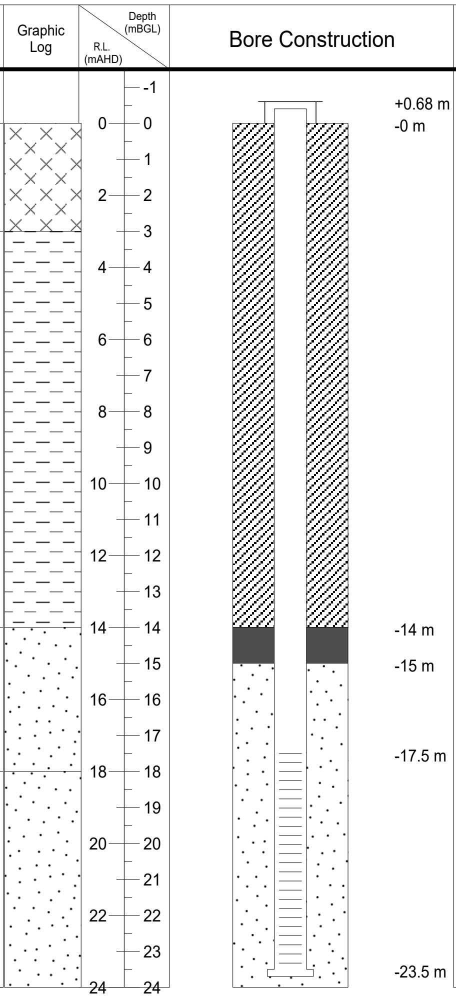
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 11/1/2019
LOGGED BY: P. Ryall (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Augur / Mud rotary
DRILL RIG: Scout MK2

EASTING: 529052 mE
NORTHING: 6282579 mN
DATUM: GDA94-Z54
RL: 48.0742 mAHD
TD: 29 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
SILT	SILT: low plasticity, silt, rounded, well graded, silty matrix, light reddish red / white, very low strength, very loose, /
CLAY	CLAY: high plasticity, clay, well graded, clay matrix, light greyish grey / red / yellow, medium strength, firm, /
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, well graded, silty matrix, light greyish grey / brown, very low strength, very loose, 20% HMD /
SAND	SAND: low plasticity, coarse sand, sub-rounded, quartzitic, well graded, silty matrix, light greyish grey / brown / yellow, very low strength, very loose, 20% HMD /



Bore Description

Stick up: +0.68 m

95 mm Blade: 0 m to 14 m (Augur)

Bentonite grout (2.5 %): 0 m to 14 m

120 mm Blade: 14 m to 24 m (Mud rotary)

50 mm PN18 uPVC blank casing: 0 m to 17.5 m

Bentonite seal: 14 m to 15 m
SWL: 14.83 mTOC
2 - 4 mm washed, rounded, quartz gravel pack: 15 m to 23.5 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 17.5 m to 23.5 m

Bore development: 30 min; EC: 83,770 µS/cm µS/cm; pH: 6.16

End cap
End of hole: 23.5 m BGL

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BOREHOLE LOG

MB10

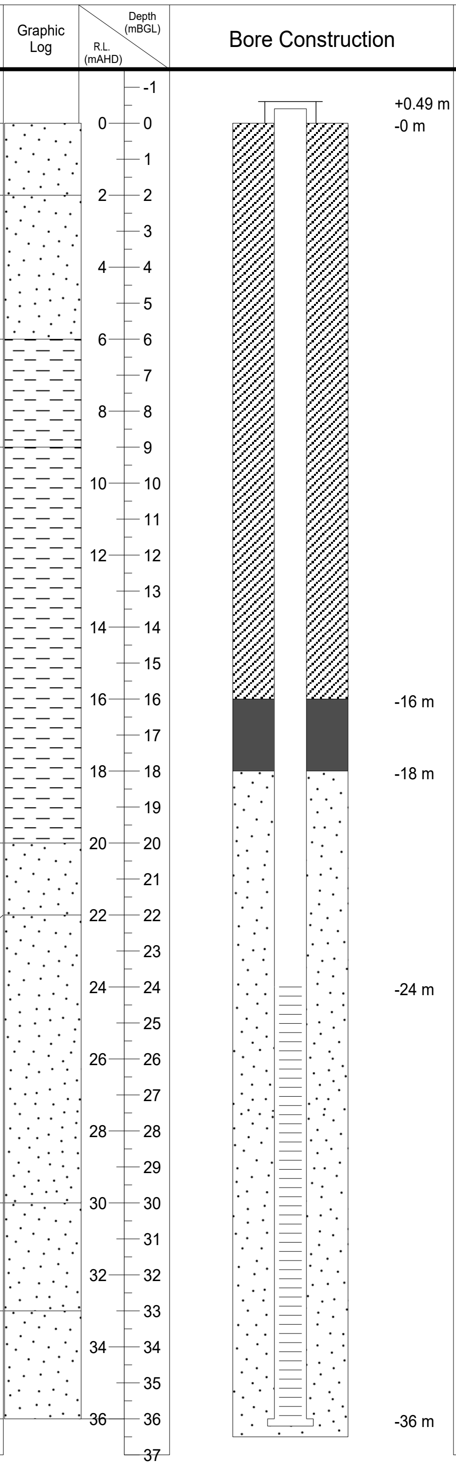
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 10/11/2019
LOGGED BY: K. Düz (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 528634 mE
NORTHING: 6282280 mN
DATUM: GDA94-Z54
RL: 54.725 mAHD
TD: 36 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
SAND	SAND: low plasticity, fine sand, sub-angular, well graded, light reddish white, low strength, loose, Yamba Fm
SAND	SAND: low plasticity, fine sand, sub-angular, well graded, dark reddish brown / red, low strength, loose, Yamba Fm
CLAY	CLAY: medium plasticity, clay, well graded, dark reddish brown / red, low strength, loose, Yamba Fm
CLAY	CLAY: high plasticity, clay, well graded, light greenish grey, low strength, hard, Blanchtown Fm
SAND	SAND: low plasticity, fine sand, sub-angular, quartzitic, well graded, silty matrix, light yellowish grey / yellow, low strength, loose, Blanchtown Fm
SAND	SAND: low plasticity, fine sand, sub-angular, quartzitic, well graded, silty matrix, light greyish grey / white, very high strength, loose, Loxton-Parilla Sands Fm; 0.5% HMD
SAND	SAND: low plasticity, coarse sand, sub-angular, quartzitic, poorly graded, light greyish grey / yellow, low strength, loose, Loxton-Parilla Sands; coarse sand
SAND	SAND: low plasticity, coarse sand, sub-angular, quartzitic, poorly graded, dark reddish grey / red / yellow, low strength, loose, Loxton-Parilla Sands; coarse sand



Bore Description

Stick up: +0.43 m

120 mm Blade: 0 m to 36 m (Mud rotary)

Bentonite grout (2.5 %): 0 m to 16 m

50 mm PN18 uPVC blank casing: 0 m to 24 m

Bentonite seal: 16 m to 18 m

2 - 4 mm washed, rounded, quartz gravel pack: 18 m to 36 m

SWL: 22.21 mTOC

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 24 m to 36 m
Bore development: 2 hrs; EC: 81,740 µS/cm µS/cm; pH: 7.34
Airlift flow rate: 0.01 L/s

End cap
End of hole: 36 m BGL

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BOREHOLE LOG

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MB11

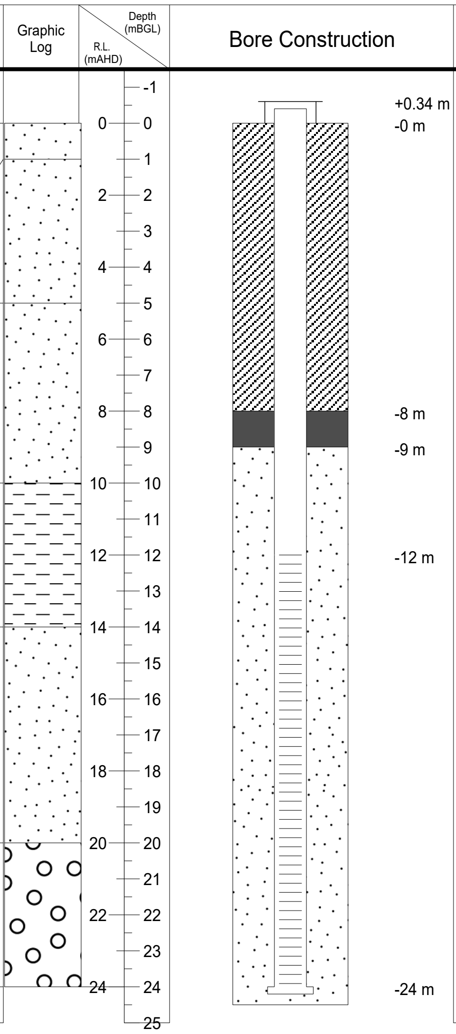
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 10/13/2019
LOGGED BY: K. Düz (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 528451 mE
NORTHING: 6282950 mN
DATUM: GDA94-Z54
RL: 41.2421 mAHD
TD: 24 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
SAND	SAND: low plasticity, fine sand, sub-rounded, well graded, dark reddish brown / red / white, low strength, loose, dry,
SAND	SAND: low plasticity, fine sand, sub-rounded, poorly graded, light reddish white / red / brown, medium strength, firm, dry,
SAND	SAND: low plasticity, medium sand, sub-rounded, poorly graded, dark reddish brown / red / white, low strength, loose, dry,
CLAY	CLAY: high plasticity, clay, dark greenish grey / yellow / brown, high strength, dense, moist,
SAND	SAND: medium plasticity, fine sand, sub-rounded, poorly graded, dark greenish grey / black, low strength, loose, wet,
GRAVEL	GRAVEL: low plasticity, coarse sand, sub-angular, quartzitic, poorly graded, light greyish white / black, low strength, loose, wet,



Bore Description

Stick up: +0.34 m

120 mm Blade: 0 m to 24 m (Mud rotary)

Bentonite grout (2.5 %): 0 m to 9 m

50 mm PN18 uPVC blank casing: 0 m to 12 m
Bentonite seal: 8 m to 9 m

2 - 4 mm washed, rounded, quartz gravel pack: 9 m to 24 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 12 m to 24 m
SWL: 12.85 mTOC
Bore development: 1 hr; EC: 78,820 µS/cm µS/cm; pH: 6.96
Airlift flow rate: 0.3 L/s

End cap
End of hole: 24 m BGL

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BOREHOLE LOG

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MB12D

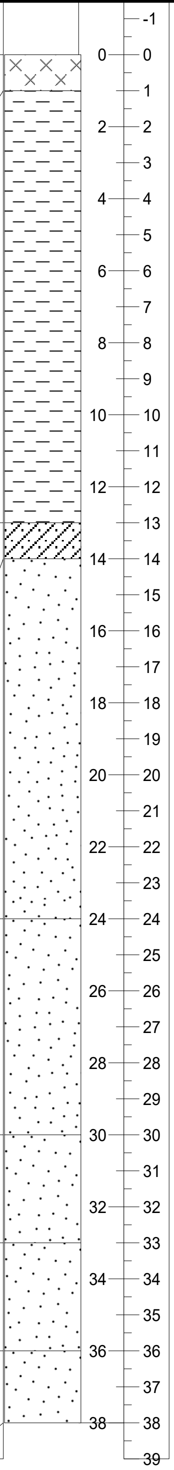
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 11/2/2019
LOGGED BY: P. Ryall (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Augur / Mud rotary
DRILL RIG: Scout MK2

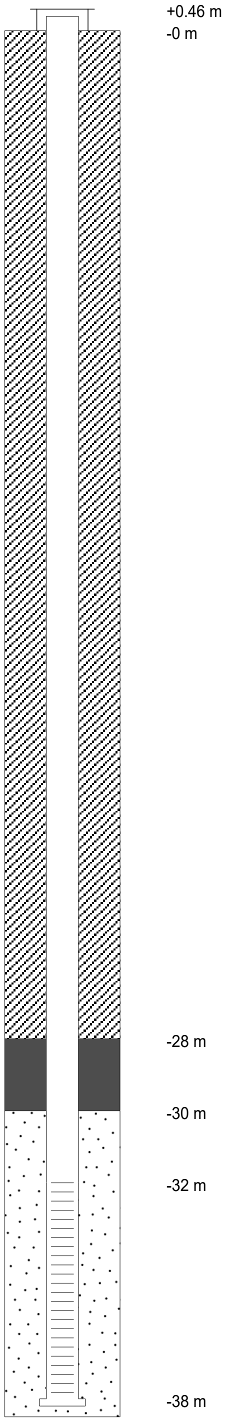
EASTING: 529138.9 mE
NORTHING: 6282516.2 mN
DATUM: GDA94-Z54
RL: 77.0289 mAHD
TD: 38 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
SILT	SILT: low plasticity, silt, rounded, well graded, silty matrix, light reddish red / white, very low strength, very loose,
CLAY	CLAY: high plasticity, clay, well graded, clay matrix, light greyish grey / red / yellow, medium strength, firm,
SANDY CLAY	SANDY CLAY: medium plasticity, clay to medium sand, rounded to sub-rounded, poorly graded, clay matrix, light greyish grey / orange / yellow, medium strength, firm,
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, well graded, silty matrix, light greyish grey / white / brown, very low strength, very loose,
SAND	SAND: low plasticity, coarse sand, sub-angular, quartzitic, well graded, silty matrix, light whitish grey, very low strength, very loose,
SAND	SAND: low plasticity, coarse sand, sub-angular, quartzitic, well graded, silty matrix, light orangey orange / yellow, very low strength, very loose,
SAND	SAND: low plasticity, coarse sand, sub-angular, quartzitic, well graded, silty matrix, light whitish white / orange / green, very low strength, very loose,
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, well graded, silty matrix, light greyish grey / white / brown, very low strength, very loose,



Bore Construction



Bore Description

Stick up: +0.46 m

95 mm Blade: 0 m to 14 m (Augur)

Bentonite grout (2.5 %): 0 m to 28 m

120 mm Blade: 14 m to 38 m (Mud rotary)

50 mm PN18 uPVC blank casing: 0 m to 32 m

SWL: 11.82 mTOC

Bentonite seal: 28 m to 30 m

2 - 4 mm washed, rounded, quartz gravel pack: 30 m to 38 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 32 m to 38 m
Bore development: 50 min; EC: 10,790 µS/cm µS/cm; pH: 7.02
Airlift flow rate: 0.5 - 0.8 L/s

End cap
End of hole: 38 m BGL

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BOREHOLE LOG

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MB12S

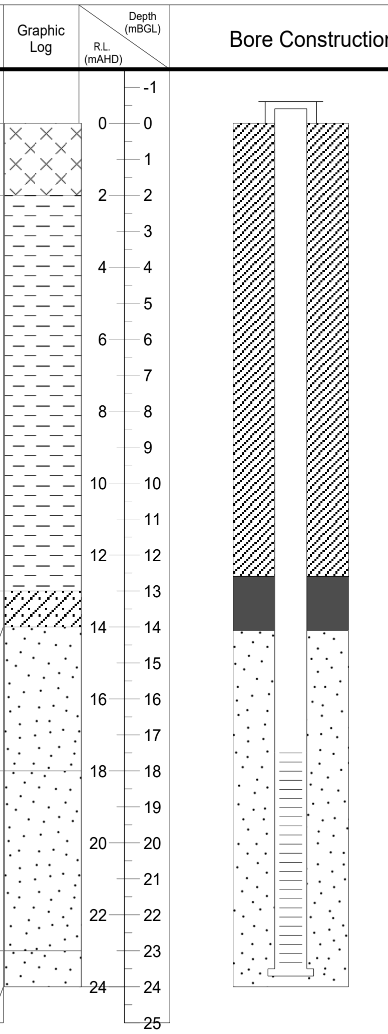
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 11/3/2019
LOGGED BY: P. Ryall (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Augur / Mud rotary
DRILL RIG: Scout MK2

EASTING: 529139 mE
NORTHING: 6282530 mN
DATUM: GDA94-Z54
RL: 58.0706 mAHD
TD: 24 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
SILT	SILT: low plasticity, silt, rounded, well graded, silty matrix, light reddish red / white, very low strength, very loose,
CLAY	CLAY: medium plasticity, clay, well graded, clay matrix, light greyish grey / red / yellow, medium strength, firm,
SANDY CLAY	SANDY CLAY: medium plasticity, clay to medium sand, to sub-rounded, quartzitic, poorly graded, clay matrix, light greyish grey / orange / yellow, medium strength, firm,
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, well graded, silty matrix, light greyish grey / black, very low strength, very loose, 20% HMD
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, well graded, silty matrix, light greyish grey / black / white, very low strength, very loose,
SAND	SAND: low plasticity, coarse sand, sub-angular, quartzitic, well graded, silty matrix, light whitish white / grey, very low strength, very loose,



	Bore Description
+0.34 m	Stick up: +0.34 m
-0 m	95 mm Blade: 0 m to 14 m (Augur)
	Bentonite grout (2.5 %): 0 m to 12.6 m
	120 mm Blade: 14 m to 23.5 m (Mud rotary)
	50 mm PN18 uPVC blank casing: 0 m to 17.5 m
-12.6 m	Bentonite seal: 12.6 m to 14.1 m
-14.1 m	SWL: 13.79 mTOC 2 - 4 mm washed, rounded, quartz gravel pack: 14.1 m to 23.5 m
-17.5 m	50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 17.5 m to 23.5 m
	Bore development: 45 min; EC: 8,050 µS/cm µS/cm; pH: 5.32
-23.5 m	End cap End of hole: 23.5 m BGL

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BOREHOLE LOG

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MB13D

PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 10/20/2019
LOGGED BY: K. Düz (AGE)

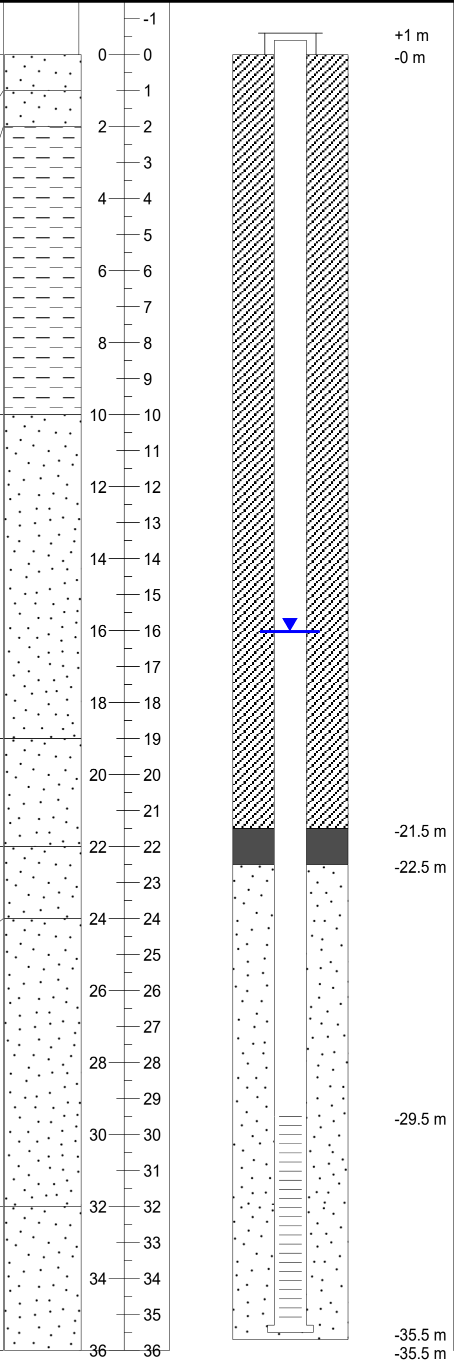
DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: mE
NORTHING: mN
DATUM: GDA94-Z54
RL: mAHD
TD: 36 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
SAND	SAND: low plasticity, fine sand, sub-rounded, poorly graded, dark reddish brown, low strength,
SAND	SAND: low plasticity, medium sand, sub-rounded, poorly graded, dark reddish brown, low strength,
CLAY	CLAY: high plasticity, clay, well graded, dark greenish grey, high strength,
SAND	SAND: low plasticity, medium sand, sub-rounded, quartzitic, well graded, dark dreenish grey, medium strength,
SAND	SAND: low plasticity, fine gravel to coarse sand, sub-angular to sub-rounded, quartzitic, poorly graded, Dark yellowish grey / white, medium strength, loose, wet,
SAND	SAND: low plasticity, fine gravel to coarse sand, sub-angular to sub-rounded, quartzitic, poorly graded, Dark reddish grey / red, low strength, loose, wet,
SAND	SAND: low plasticity, fine gravel to coarse sand, sub-angular to sub-rounded, quartzitic, poorly graded, Dark yellowish grey / yellow, low strength, loose, wet,
SAND	SAND: low plasticity, fine gravel to coarse sand, sub-angular to sub-rounded, quartzitic, poorly graded, Dark grey / white, low strength, loose, wet,

Graphic Log | R.L. (mAHD) | Depth (mBGL) | Bore Construction



Bore Description

Stick up: +1 m

120 mm Blade: 0 m to 35.5 m (Mud rotary)

Bentonite grout (2.5 %): 0 m to 21.5 m

50 mm PN18 uPVC blank casing: 0 m to 29.5 m

SWL: 16.03 mTOC

Bentonite seal: 21.5 m to 22.5 m

2 - 4 mm washed, rounded, quartz gravel pack: 22.5 m to 35.5 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 29.5 m to 35.5 m

Bore development: 30 min; EC: 86,220 µS/cm µS/cm; pH: 7.30
Airlift flow rate: 0.25 - 0.3 L/s

End cap

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BOREHOLE LOG

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MB13S

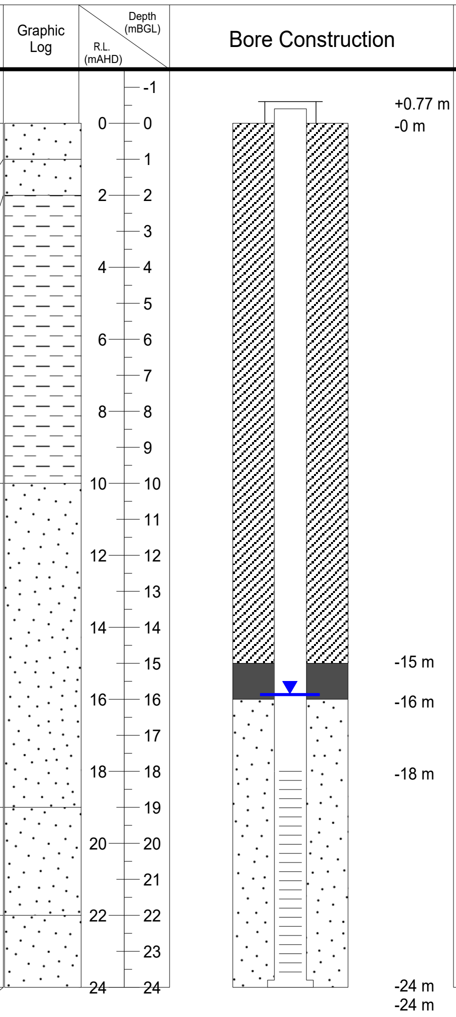
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 10/20/2019
LOGGED BY: K. Düz (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: mE
NORTHING: mN
DATUM: GDA94-Z54
RL: mAHD
TD: 24 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
SAND	SAND: low plasticity, fine sand, sub-rounded, poorly graded, dark reddish brown, low strength,
SAND	SAND: low plasticity, medium sand, sub-rounded, poorly graded, dark reddish brown, low strength,
CLAY	CLAY: high plasticity, clay, well graded, dark greenish grey, high strength,
SAND	SAND: low plasticity, medium sand, sub-rounded, quartzitic, well graded, dark dreenish grey, medium strength,
SAND	SAND: low plasticity, fine gravel to coarse sand, sub-angular to sub-rounded, quartzitic, poorly graded, Dark yellowish grey / white, medium strength, loose, wet,
SAND	SAND: low plasticity, fine gravel to coarse sand, sub-angular to sub-rounded, quartzitic, poorly graded, Dark reddish grey / red, low strength, loose, wet,



Bore Description

Stick up: +0.77 m

120 mm Blade: 0 m to 24 m (Mud rotary)

Bentonite grout (2.5 %): 0 m to 24 m

50 mm PN18 uPVC blank casing: 0 m to 18 m

Bentonite seal: 15 m to 16 m
SWL: 15.87 mTOC

2 - 4 mm washed, rounded, quartz gravel pack: 16 m to 24 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 18 m to 24 m

Bore development: 1 hr 10 min; EC: 79,580 µS/cm µS/cm; pH: 7.04
Airlift flow rate: 0.21 - 0.23 L/s

End cap
End of hole: 24 m BGL

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BOREHOLE LOG

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MB14

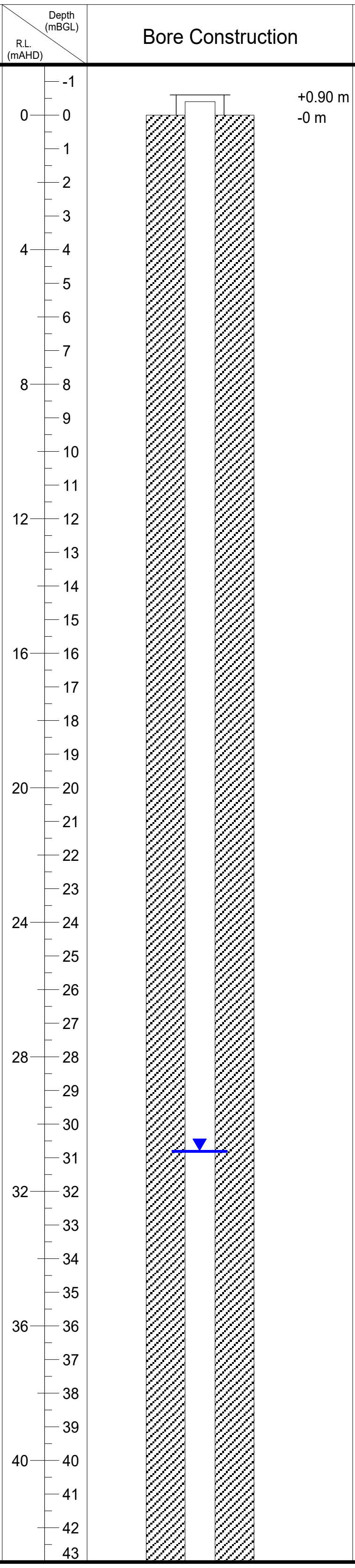
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 10/24/2019
LOGGED BY: K. Düz (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: mE
NORTHING: mN
DATUM: GDA94-Z54
RL: mAHD
TD: 82 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description	Graphic Log
SAND	SAND: low plasticity, wel sorted medium sand, sub-angular uniform, dark reddish brown/white, low strength loose	
CLAY	CLAY: high plasticity, dense clay, light greenish grey/yellow, high strength,	
SAND	SAND: well sorted sand with clay matrix, dark greenish yellow/gray, high strength	
SAND	SAND: low plasticity well sorted sand, light yellowish gray/brown/white, sub-rounded medium sand	
SAND	SAND: low plasticity well sorted sand, dark yellowish gray/yellow, sub-rounded to	



Bore Description

Stick up: +0.90 m

120 mm Blade: 0 m to 82 m (Mud rotary)

Bentonite grout (2.5 %): 0 m to 62 m

50 mm PN18 uPVC blank casing: 0 m to 70 m

SWL: 30.81 mTOC

Bore development: 1hr 5 min; EC: 73,140 µS/cm µS/cm; pH: 7.63
Airlift flow rate: 0.25 - 0.3 L/s

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BOREHOLE LOG

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MB14

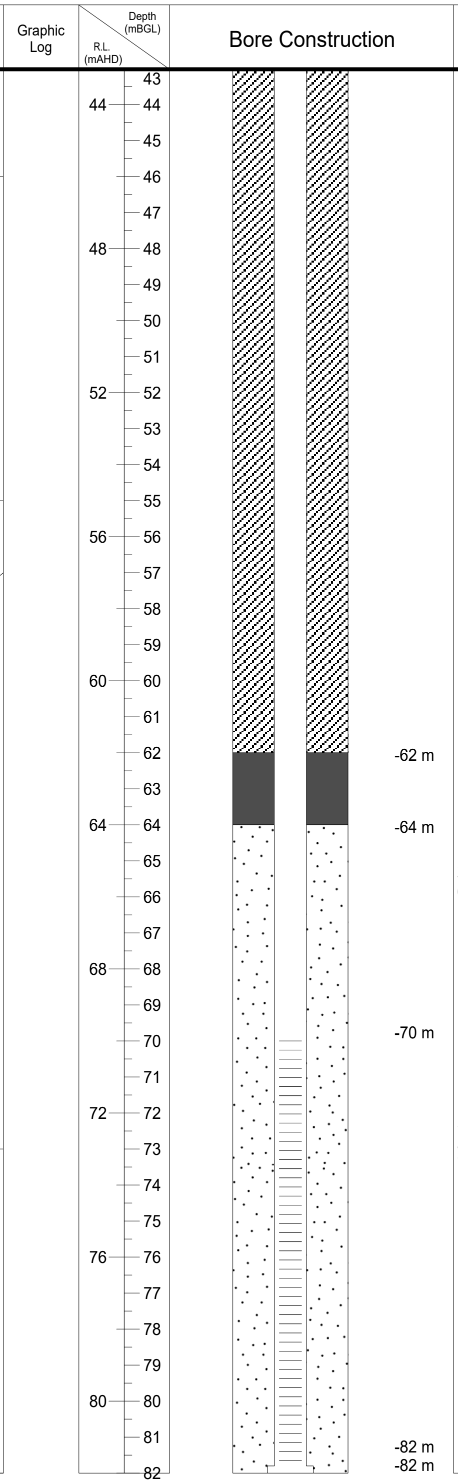
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 10/24/2019
LOGGED BY: K. Düz (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: mE
NORTHING: mN
DATUM: GDA94-Z54
RL: mAHD
TD: 82 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
SAND	sub-angular medium to fine sand, moderate strength, loose
SAND	SAND: low plasticity well sorted sand, light grayish yellow, sub-rounded to sub-angular medium to fine sand,moderate strength, loose
SAND	SAND: low plasticity well sorted sand, light reddish yellow/brown, sub-rounded to sub-angular medium to fine sand, moderate strength, loose
SAND	SAND: low plasticity well sorted sand, dark gray, sub-rounded to sub-angular medium to fine sand, moderate strength, loose
CLAY	CLAY: medium plasticity, dark gray/black moderate strength



Bore Description

Bentonite seal: 62 m to 64 m

2 - 4 mm washed, rounded, quartz gravel pack: 64 m to 82 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 70 m to 82 m

End cap
End of hole: 82 m BGL

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BOREHOLE LOG

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MB15

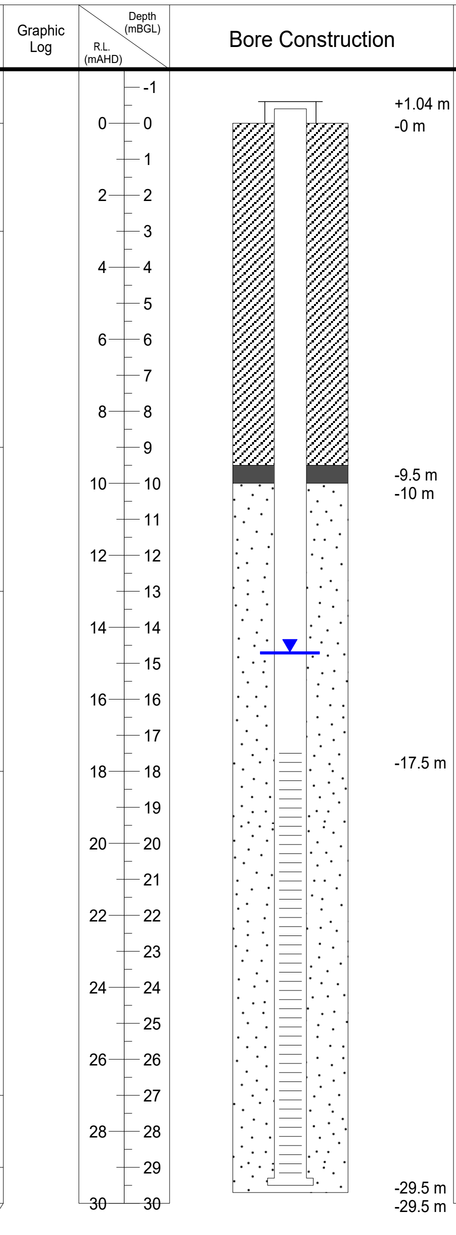
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 10/20/2019
LOGGED BY: K. Düz (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: mE
NORTHING: mN
DATUM: GDA94-Z54
RL: mAHD
TD: 50 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
SAND	SAND: low plasticity, poorlysorted medium sand, sub-angular uniform, dark reddish brown/white, low strength loose
CLAY	CLAY: high plasticity, dense clay, light greenish grey/yellow, high strength,
SAND	SAND: medium plasticity, well sorted fine sand with clay matrix, dark greenish gray/black, moderate strength, medium plasticity
SAND	SAND: medium plasticity, well sorted fine sand with clay matrix, light yellowish black, moderate strength, medium plasticity
SAND	SAND: low plasticity poorly sorted sand, light graayish white/black, sub-angular medium to fine sand, low strength, loose
SAND	SAND: low plasticity poorly sorted sand, dark reddish black/white, sub-angular coarse sand, low strength, loose
SAND	SAND: low plasticity poorly sorted sand, light graayish white/black sub-angular coarse sand, low strength, loose



Bore Description

Stick up: +1.04 m

120 mm Blade: 0 m to 29.5 m (Mud rotary)

Bentonite grout (2.5 %): 0 m to 9.5 m

50 mm PN18 uPVC blank casing: 0 m to 17.5 m

Bentonite seal: 9.5 m to 10 m

2 - 4 mm washed, rounded, quartz gravel pack: 10 m to 29.5 m

SWL: 14.71 mTOC

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 17.5 m to 29.5 m

Bore development: 1hr 5 min; EC: 88,260 µS/cm µS/cm; pH: 7.02
Airlift flow rate: 0.025 - 0.03 L/s

End cap
End of hole: 29.5 m BGL

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BOREHOLE LOG

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MB16D

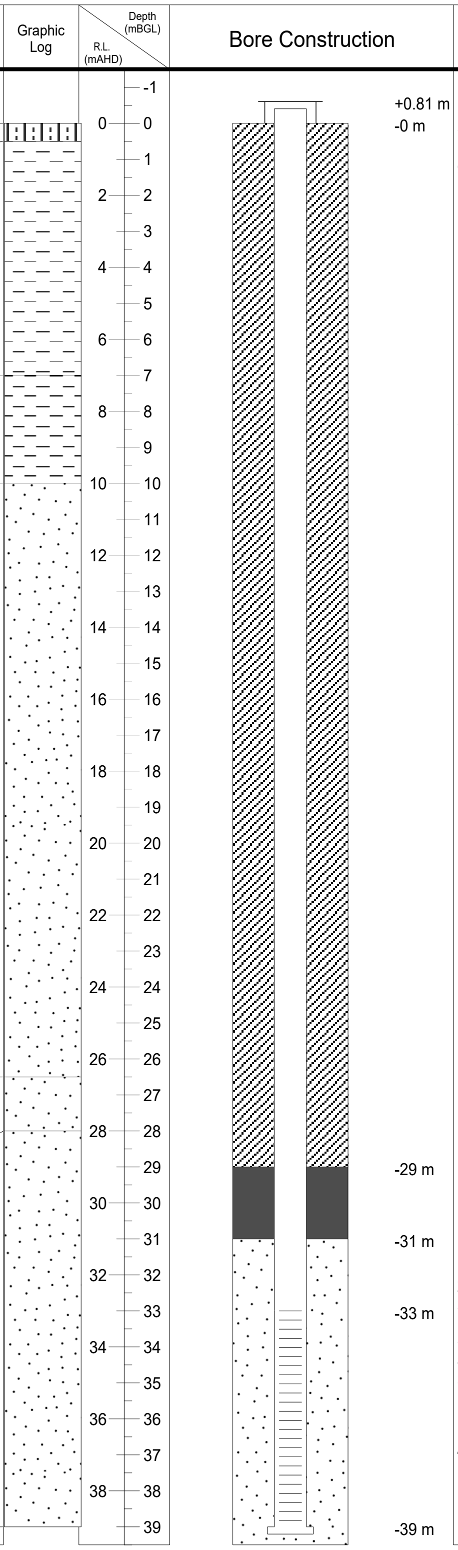
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 9/7/2019
LOGGED BY: K. Düz (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 533981 mE
NORTHING: 6279461 mN
DATUM: GDA94-Z54
RL: 39.9 mAHD
TD: 39 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
SOIL	SOIL: /
CLAY	CLAY: high plasticity, clay, dark bluish brown, low strength, /
CLAY	CLAY: high plasticity, clay, light greyish grey / white, low strength, /
SAND	SAND: low plasticity, fine sand, angular, quartzitic, well graded, clay matrix, dark greyish grey / white, /
SAND	SAND: low plasticity, fine gravel, angular, quartzitic, poorly graded, light greyish grey / white, /
SAND	SAND: low plasticity, poorly graded, dark /



Bore Description

Stick up: +0.81 m

95 mm Blade: 0 m to 3 m (Auger)

Bentonite grout (2.5 %): 0 m to 29 m

120 mm Blade: 3 m to 39 m (-)

50 - mm PN18 uPVC blank casing: 0 m to 33 m

Bentonite seal: 29 m to 31 m

2 - 4 mm washed, rounded, quartz gravel pack: 31 m to 39 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 33 m to 39 m
Bore development: 40 mins; EC: - µS/cm; pH: 7.22

Airlift flow rate: 0.3 - 0.5 L/s

End cap
End of hole: 39 m BGL

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BOREHOLE LOG

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MB16S

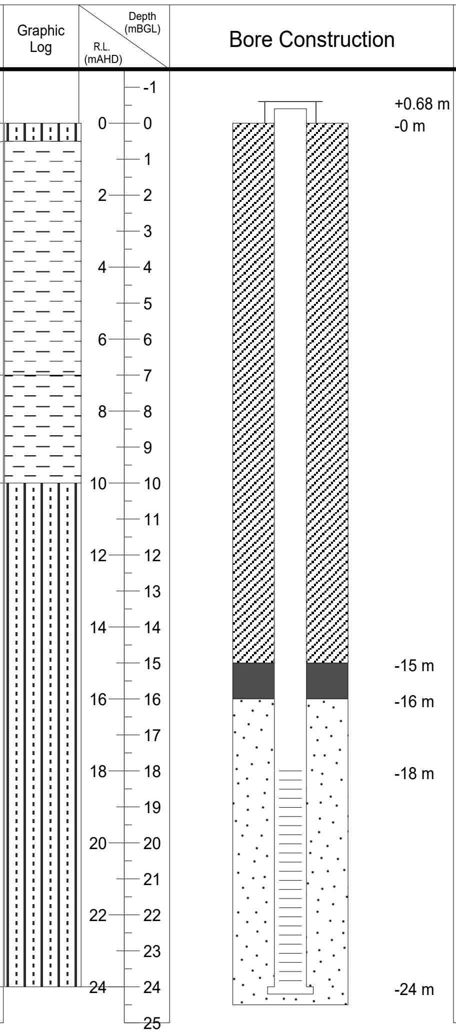
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 9/8/2019
LOGGED BY: K. Düz (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 533971 mE
NORTHING: 6279451 mN
DATUM: GDA94-Z54
RL: 37.7 mAHD
TD: 24 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
SOIL	SOIL: clay, bluish brown, /
CLAY	CLAY: high plasticity, clay, dark bluish brown, low strength, /
CLAY	CLAY: high plasticity, clay, light greyish grey / white, low strength, /
SOIL	SOIL: low plasticity, fine sand, angular, quartzitic, well graded, clay matrix, dark greyish grey / white, /



Bore Description

Stick up: +0.68 m

95 mm Blade: 0 m to 3 m (Auger)

Bentonite grout (2.5 %): 0 m to 15 m

120 mm Blade: 3 m to 24 m (-)

50 mm PN18 uPVC blank casing: 0 m to 18 m

SWL: 11.21 mTOC

Bentonite seal: 15 m to 16 m

2 - 4 mm washed, rounded, quartz gravel pack: 16 m to 24 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 18 m to 24 m

Bore development: 40 min; EC: 77,350 µS/cm µS/cm; pH: 7.22

Airlift flow rate: 0.2 - 0.3 L/s

End cap
End of hole: 24 m BGL

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BOREHOLE LOG

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MB17

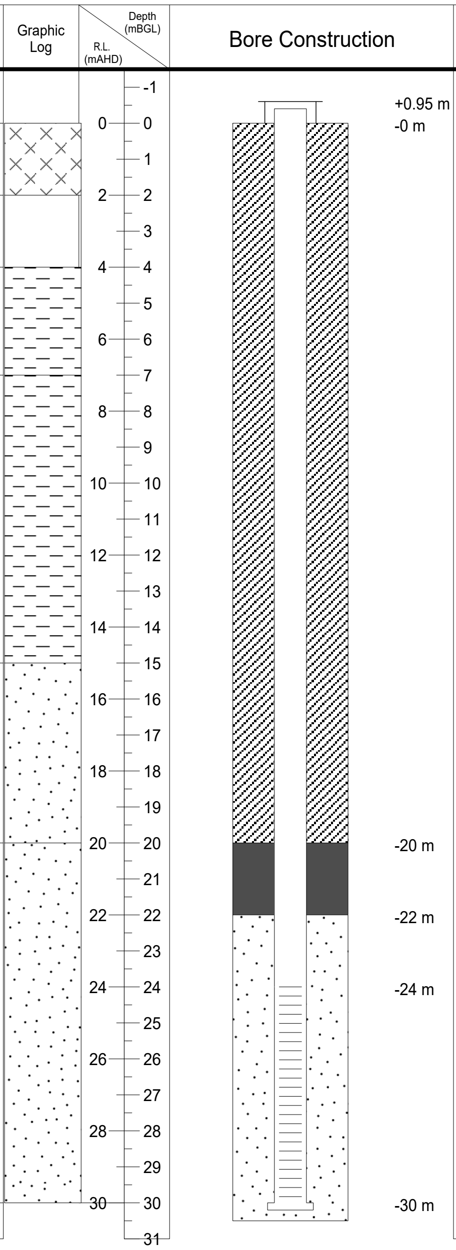
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 10/31/2019
LOGGED BY: P. Ryall (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Augur / Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 527906.99 mE
NORTHING: 6280566 mN
DATUM: GDA94-Z54
RL: 39.281 mAHD
TD: 30 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
SILT	SILT: low plasticity, silt, rounded, well graded, silty matrix, light reddish red / white, very low strength, very loose,
SILTY CLAY	SILTY CLAY: medium plasticity, clay to silt, rounded, well graded, clay matrix, light reddish red / white, medium strength, firm,
CLAY	CLAY: medium plasticity, clay, well graded, clay matrix, light greyish grey / pink / yellow, medium strength, firm,
CLAY	CLAY: medium plasticity, clay, well graded, clay matrix, light greyish grey / yellow / brown, medium strength, firm,
SAND	SAND: low plasticity, fine sand, sub-rounded, well graded, silty matrix, light yellowish yellow / brown, very low strength, very loose,
SAND	SAND: low plasticity, medium sand, sub-rounded, well graded, silty matrix, light yellowish yellow / brown, very low strength, very loose,



Bore Description

Stick up: +0.95 m

95 mm Blade: 0 m to 15 m (Augur)

Bentonite grout (2.5 %): 0 m to 20 m

120 mm Blade: 15 m to 30 m (Mud rotary)

50 mm PN18 uPVC blank casing: 0 m to 24 m

SWL: 18.79 mTOC

Bentonite seal: 20 m to 22 m

2 - 4 mm washed, rounded, quartz gravel pack: 22 m to 30 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 24 m to 30 m
Bore development: 55 min; EC: 71,770 µS/cm µS/cm; pH: 7.98
Airlift flow rate: 0.03 L/s

End cap
End of hole: 30 m BGL

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BOREHOLE LOG

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MB18S

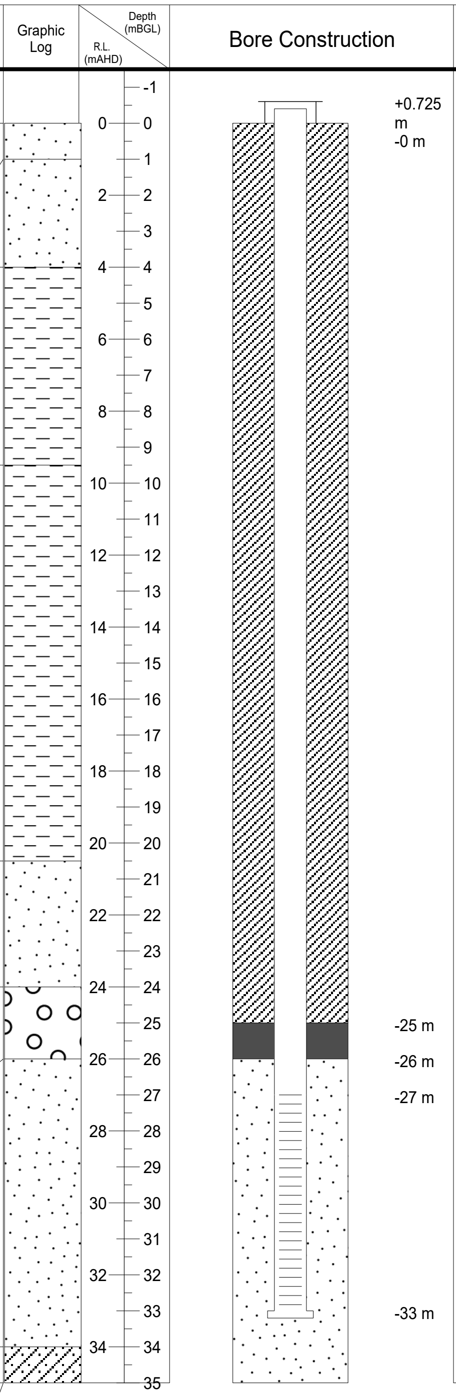
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 10/2/2019
LOGGED BY: K. Düz (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 528939 mE
NORTHING: 6282304 mN
DATUM: GDA94-Z54
RL: 48.4541 mAHD
TD: 35 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
SAND	SAND: low plasticity, fine sand, rounded, quartzitic, well graded, light reddish brown / white, low strength, dry,
SAND	SAND: low plasticity, fine sand, rounded, quartzitic, well graded, light reddish orange / white, low strength, dry,
CLAY	CLAY: low plasticity, fine sand, rounded, poorly graded, silty matrix, dark reddish brown, medium strength, dry,
CLAY	CLAY: high plasticity, clay to silt, rounded, well graded, light greenish grey / brown, high strength, dry,
SAND	SAND: low plasticity, medium sand to fine sand, sub-angular to sub-rounded, quartzitic, poorly graded, silty matrix, light greyish white / brown / red, low strength, wet,
GRAVE L	GRAVEL: low plasticity, fine gravel to coarse sand, sub-angular to sub-rounded, quartzitic, poorly graded, sand, light greyish white / brown / red, low strength,
SAND	SAND: low plasticity, medium sand to fine sand, sub-angular to sub-rounded, quartzitic, poorly graded, silty matrix, light greyish white / brown / red, low strength,
SANDY CLAY	SANDY CLAY: low plasticity, clay to fine sand, rounded, quartzitic, well graded, clay matrix, light reddish brown / mottled / black, high strength,



Bore Description

Stick up: +0.725 m

120 mm Blade: 0 m to 33 m (Mud rotary)

Bentonite grout (2.5 %): 0 m to 25 m

50 mm PN18 uPVC blank casing: 0 m to 27 m

Bentonite seal: 25 m to 26 m

2 - 4 mm washed, rounded, quartz gravel pack: 26 m to 33 m
50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 27 m to 33 m
Bore development: 2 hrs; EC: 70,940 µS/cm
µS/cm; pH: 7.42
Airlift flow rate: 0.05 - 0.07 L/s

End cap
End of hole: 33 m BGL

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BOREHOLE LOG

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MB19D

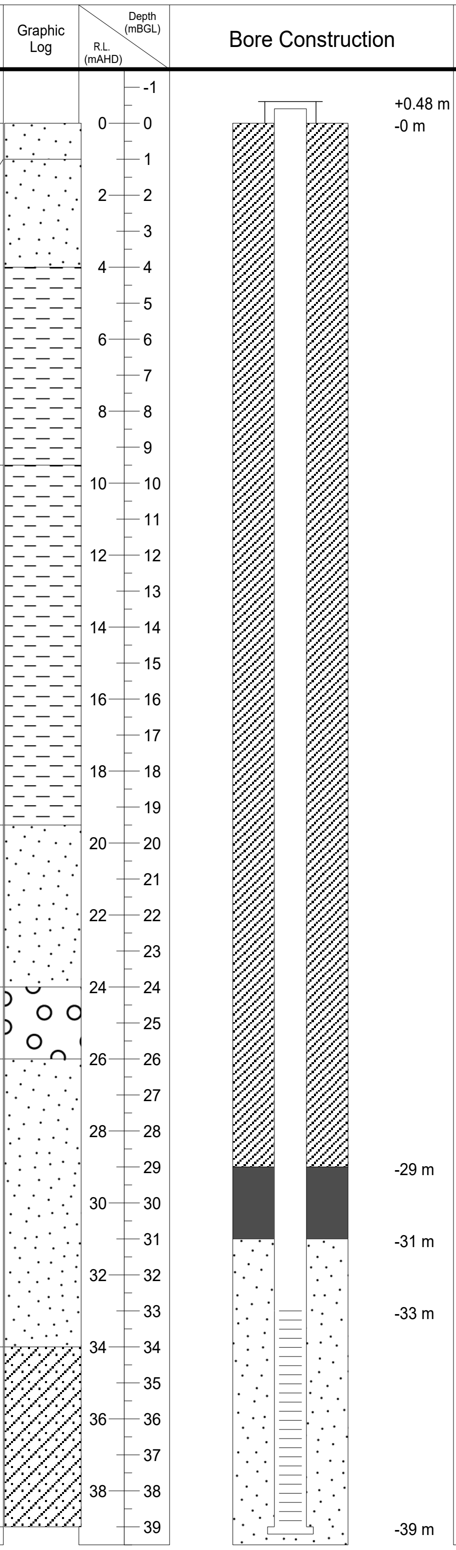
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 10/4/2019
LOGGED BY: K. Düz (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 528846 mE
NORTHING: 6282123 mN
DATUM: GDA94-Z54
RL: 45.9663 mAHD
TD: 39 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
SAND	SAND: low plasticity, fine sand, sub-rounded, well graded, light reddish white / brown, low strength, quartzitic
SAND CLAY	SAND: low plasticity, fine sand, sub-rounded, well graded, light reddish orange / white, low strength
CLAY	CLAY: high plasticity, clay, dark greenish grey, high strength,
SAND	SAND: low plasticity, medium to fine sand, sub-angular to sub-rounded, quartzitic, poorly graded, silty matrix, light reddish grey / brown / red, low strength, HMD %1-2
GRAVEL	SAND: low plasticity, fine gravel to coarsa sand, sub-angular, quartzitic, poorly graded, light yellowish white / grey, low strength,
SAND	SAND: low plasticity, poorly graded, medium to fine silty sand, light grayish white / brown, sub-angular to sub-rounde, quartzitic, loose.
SANDY CLAY	SANDY CLAY: low plasticity, fine sandy clay , rounded, quartzitic, well graded, light reddish brown / black, high strength,



Bore Description

Stick up: +0.48 m

120 mm Blade: 0 m to 39 m (Mud rotary)

Bentonite grout (2.5 %): 0 m to 29 m

50 mm PN18 uPVC blank casing: 0 m to 33 m

SWL: 18.24 mTOC

Bentonite seal: 29 m to 31 m

2 - 4 mm washed, rounded, quartz gravel pack: 31 m to 39 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 33 m to 39 m
Bore development: 1 hr 10 min; EC: 91,770 µS/cm µS/cm; pH: 7.02
Airlift flow rate: 0.21 - 0.23 L/s

End cap
End of hole: 39 m BGL

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Level 2, 15 Mallon Street, Bowen Hills, Queensland 4006

BOREHOLE LOG

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MB19S

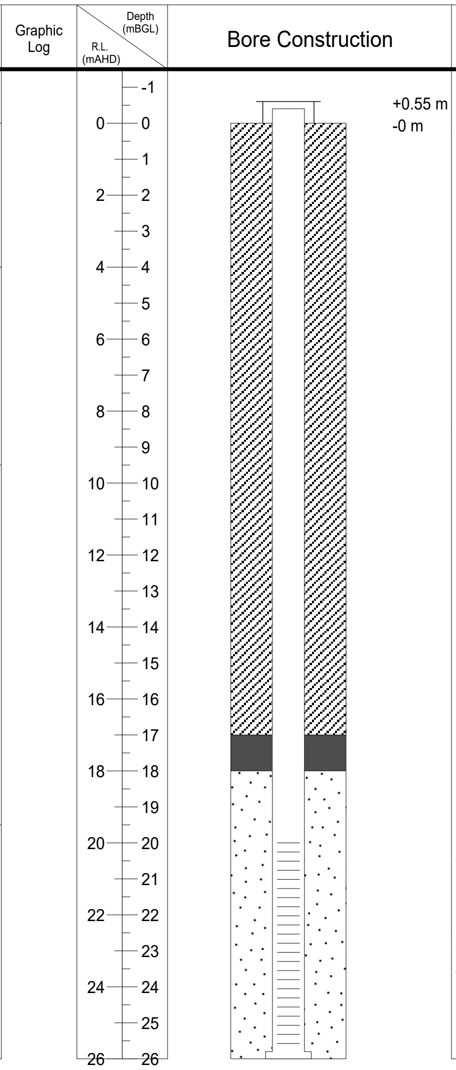
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 10/4/2019
LOGGED BY: K. Düz (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: mE
NORTHING: mN
DATUM: GDA94-Z54
RL: mAHD
TD: 26 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
SAND	SAND: low plasticity, fine sand, sub-rounded, well graded, light reddish orange / white, low strength
SAND	SAND: low plasticity, fine sand, rounded, poorly graded, dark reddish brown, low strength
CLAY	CLAY: high plasticity, clay, dark greenish grey, high strength,
SAND	SAND: low plasticity, medium to fine sand, sub-angular to sub-rounded, quartzitic, poorly graded, silty matrix, light reddish grey / brown / red, low strength, HMD %1-2



Bore Description

Stick up: +0.55 m

120 mm Blade: 0 m to 26 m (Mud rotary)

Bentonite grout (2.5 %): 0 m to 17 m

50 mm PN18 uPVC blank casing: 0 m to 20 m

Bentonite seal: 17 m to 18 m

2 - 4 mm washed, rounded, quartz gravel pack: 18 m to 26 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 20 m to 26 m

End cap
End of hole: 26 m BGL

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BOREHOLE LOG

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MB20

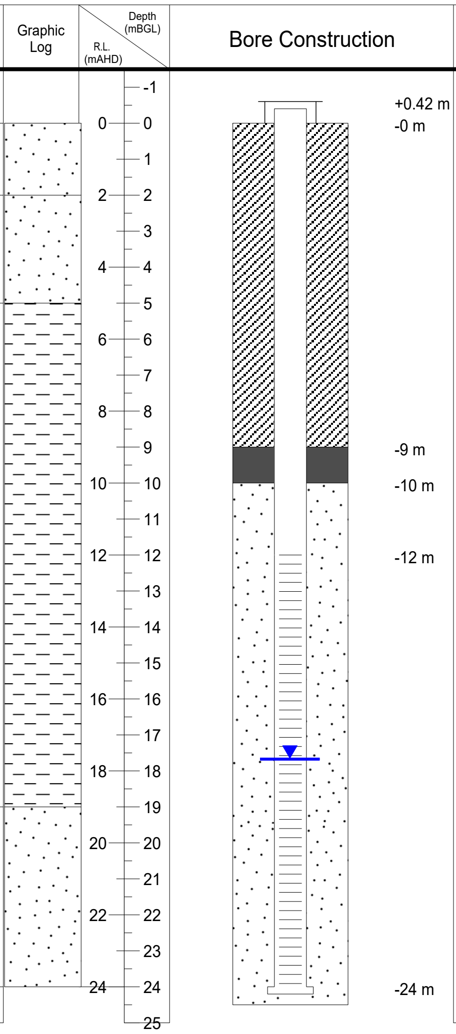
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 10/12/2019
LOGGED BY: K. Düz (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 528955 mE
NORTHING: 6282045 mN
DATUM: GDA94-Z54
RL: 46.3288 mAHD
TD: 24 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
SAND	SAND: low plasticity, fine sand, sub-angular, well graded, light reddish white, low strength, loose, Yamba Fm
SAND	SAND: low plasticity, fine sand, sub-angular, well graded, dark reddish brown / red, low strength, loose, Yamba Fm
CLAY	CLAY: high plasticity, clay, well graded, light greenish grey, high strength, hard, Blanchtown Fm
SAND	SAND: low plasticity, coarse sand, sub-angular, quartzitic, well graded, silty matrix, light greyish grey / white, low strength, loose, Loxton-Parilla Sands: 0.5% HMD



Bore Description

Stick up: +0.42 m

120 mm Blade: 0 m to 24 m (Mud rotary)

Bentonite grout (2.5 %): 0 m to 9 m

50 mm PN18 uPVC blank casing: 0 m to 12 m

Bentonite seal: 9 m to 10 m

2 - 4 mm washed, rounded, quartz gravel pack: 10 m to 24 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 12 m to 24 m
Bore development: 30 min; EC: 45,110 µS/cm µS/cm; pH: 7.46
Airlift flow rate: bailed L/s

SWL: 17.67 mTOC

End cap
End of hole: 24 m BGL

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BOREHOLE LOG

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MB21D

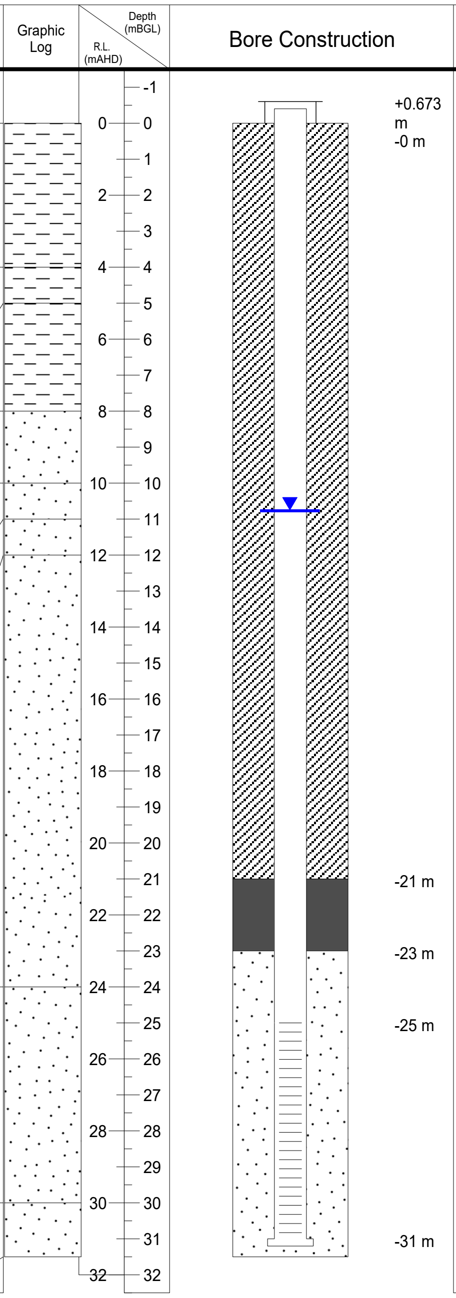
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 9/23/2019
LOGGED BY: P. Ryall (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Augur / Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 534007 mE
NORTHING: 6278787 mN
DATUM: GDA94-Z54
RL: 40.916 mAHD
TD: 31.5 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
CLAY	CLAY: medium plasticity, silt, rounded, well graded, silty matrix, light reddish brown / white, low strength,
CLAY	CLAY: medium plasticity, silt, rounded, well graded, silty matrix, dark reddish brown / orange, medium strength,
CLAY	CLAY: medium plasticity, silt, rounded, well graded, silty matrix, dark reddish brown / orange / grey, medium strength,
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, well graded, clay matrix, light yellowish orange / grey, very low strength,
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, well graded, clay matrix, light greyish grey, very low strength,
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, well graded, silty matrix, light reddish red / brown, very low strength,
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, well graded, silty matrix, light yellowish brown / orange, very low strength,
SAND	SAND: low plasticity, coarse sand, sub-angular, quartzitic, well graded, silty matrix, light yellowish brown / orange, very low strength,
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, well graded, silty matrix, dark brownish very low strength,



Bore Description

Stick up: +0.673 m

95 mm Blade: 0 m to 10 m (Augur)

Bentonite grout (2.5 %): 0 m to 21 m

120 mm Blade: 10 m to 31 m (Mud rotary)

50 mm PN18 uPVC blank casing: 0 m to 25 m

SWL: 10.77 mTOC

Bentonite seal: 21 m to 23 m

2 - 4 mm washed, rounded, quartz gravel pack: 23 m to 31 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 25 m to 31 m
Airlift flow rate: 0.5 - 1.5 L/s
Bore development: 55 min; EC: 84,980 µS/cm µS/cm; pH: 7.16

End cap
End of hole: 31 m BGL

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BOREHOLE LOG

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MB21S

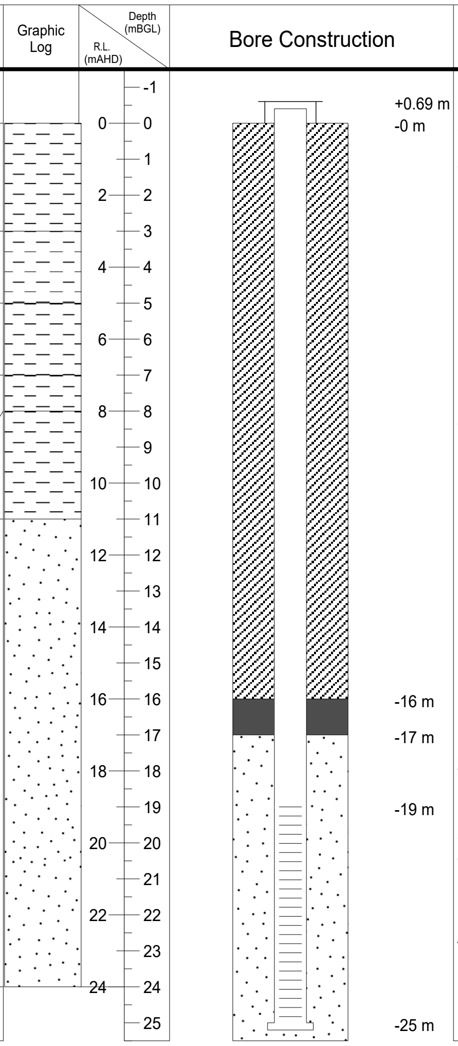
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 9/24/2019
LOGGED BY: P. Ryall (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Augur / Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 534004 mE
NORTHING: 6278792 mN
DATUM: GDA94-Z54
RL: 41.0259 mAHD
TD: 24 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
CLAY	CLAY: medium plasticity, silt, rounded, well graded, clay matrix, light reddish brown / white / r, low strength,
CLAY	CLAY: medium plasticity, clay, rounded, well graded, clay matrix, dark reddish brown / orange, medium strength,
CLAY	CLAY: medium plasticity, silt, rounded, well graded, silty matrix, dark reddish brown / orange / grey, medium strength,
CLAY	CLAY: medium plasticity, clay, rounded, well graded, clay matrix, dark greyish brown / orange, medium strength,
CLAY	CLAY: medium plasticity, silt, rounded, well graded, clay matrix, light yellowish brown / orange, high strength,
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, well graded, clay matrix, light yellowish brown / orange / grey, very low strength,



Bore Description

Stick up: +0.69 m

95 mm Blade: 0 m to 14 m (Augur)

Bentonite grout (2.5 %): 0 m to 16 m

120 mm Blade: 14 m to 25 m (Mud rotary)

50 mm PN18 uPVC blank casing: 0 m to 19 m

Bentonite seal: 16 m to 17 m

2 - 4 mm washed, rounded, quartz gravel pack: 17 m to 25 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 19 m to 25 m
Bore development: 40 min; EC: 77,660 µS/cm µS/cm; pH: 7.37
Airlift flow rate: 1.0 - 1.2 L/s

End cap
End of hole: 25 m BGL

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BOREHOLE LOG

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MB22D

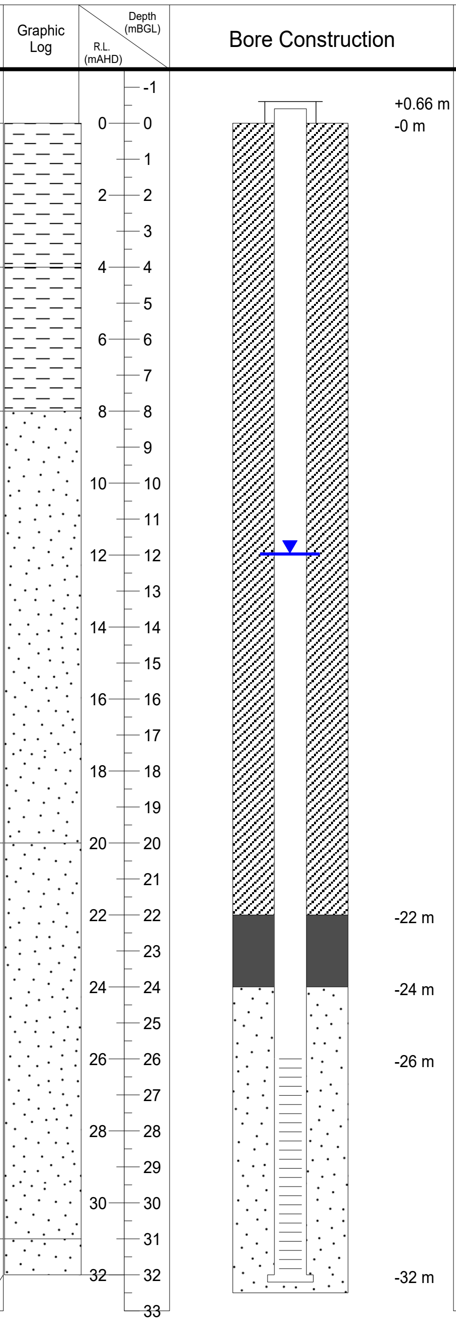
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 9/26/2019
LOGGED BY: P. Ryall (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Augur / Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 534144 mE
NORTHING: 6278693 mN
DATUM: GDA94-Z54
RL: 42.8797 mAHD
TD: 32 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
CLAY	CLAY: medium plasticity, silt, rounded, well graded, silty matrix, light reddish brown / white / red, low strength,
CLAY	CLAY: medium plasticity, silt, rounded, well graded, silty matrix, dark reddish brown / orange, medium strength,
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, well graded, clay matrix, light greyish brown, very low strength,
SAND	SAND: low plasticity, coarse sand, sub-angular, quartzitic, well graded, clay matrix, light greyish brown, very low strength,
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, well graded, clay matrix, dark greyish black, very low strength,



Bore Description

Stick up: +0.66 m

95 mm Blade: 0 m to 14 m (Augur)

Bentonite grout (2.5 %): 0 m to 22 m

120 mm Blade: 14 m to 32 m (Mud rotary)

50 mm PN18 uPVC blank casing: 0 m to 26 m

SWL: 11.97 mTOC

Bentonite seal: 22 m to 24 m

2 - 4 mm washed, rounded, quartz gravel pack: 24 m to 32 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 26 m to 32 m
Bore development: 40 min; EC: 79,670 µS/cm µS/cm; pH: 7.28
Airlift flow rate: 1.2 - 1.5 L/s

End cap
End of hole: 32 m BGL

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BOREHOLE LOG

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MB22S

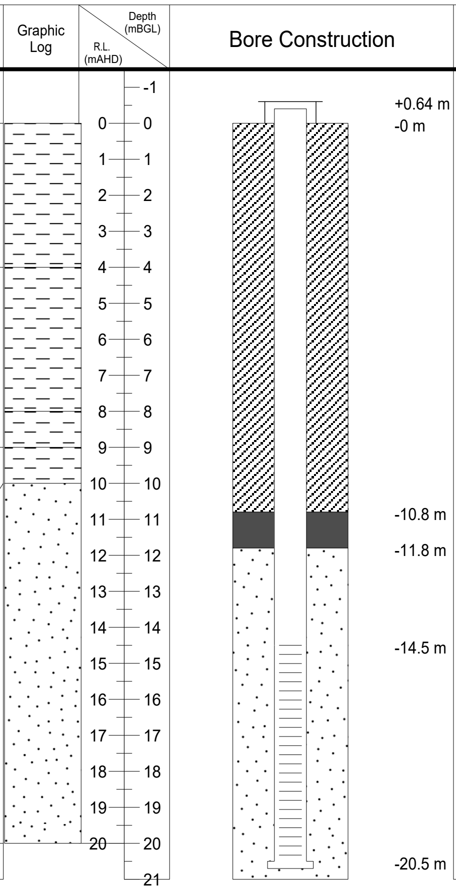
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 9/26/2019
LOGGED BY: P. Ryall (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Augur / Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 534139 mE
NORTHING: 6278694 mN
DATUM: GDA94-Z54
RL: 41.9275 mAHD
TD: 20 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
CLAY	CLAY: medium plasticity, silt, rounded, well graded, silty matrix, light reddish brown / white / red, low strength,
CLAY	CLAY: medium plasticity, silt, rounded, well graded, silty matrix, dark reddish brown / orange, low strength,
CLAY	
CLAY	CLAY: medium plasticity, clay, rounded, well graded, clay matrix, dark reddish brown / orange, medium strength,
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, well graded, clay matrix, light greyish brown, very low strength,



Bore Description

Stick up: +0.64 m

95 mm Blade: 0 m to 14 m (Augur)

Bentonite grout (2.5 %): 0 m to 10.8 m

120 mm Blade: 14 m to 20.5 m (Mud rotary)

50 mm PN18 uPVC blank casing: 0 m to 14.5 m

Bentonite seal: 10.8 m to 11.8 m

2 - 4 mm washed, rounded, quartz gravel pack: 11.8 m to 20.5 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 14.5 m to 20.5 m

Bore development: 1 hr 10 min; EC: 75,300 µS/cm µS/cm; pH: 7.44
Airlift flow rate: 0.2 - 0.8 L/s

End cap
End of hole: 20.5 m BGL

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BOREHOLE LOG

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MB23D

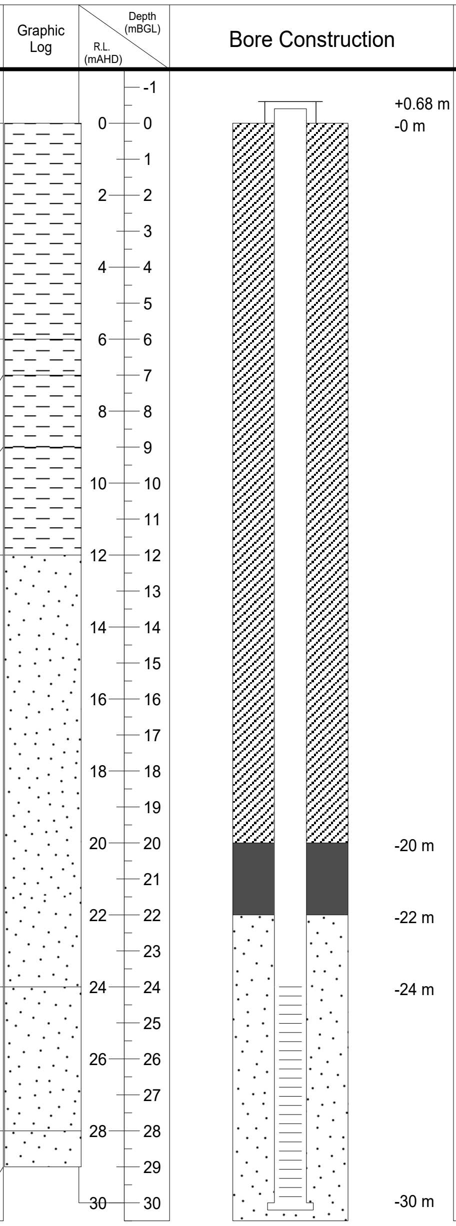
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 9/25/2019
LOGGED BY: P. Ryall (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Augur / Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 533853 mE
NORTHING: 6278890 mN
DATUM: GDA94-Z54
RL: 41.3751 mAHD
TD: 29 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
CLAY	CLAY: medium plasticity, silt, rounded, well graded, silty matrix, light reddish white / brown / orange, low strength,
CLAY	CLAY: medium plasticity, silt, rounded, well graded, silty matrix, dark reddish red / grey, low strength,
CLAY	CLAY: medium plasticity, silt, rounded, well graded, silty matrix, dark greyish red / brown, medium strength,
CLAY	CLAY: medium plasticity, clay, rounded, well graded, clay matrix, dark greyish brown / red, medium strength,
SAND	SAND: low plasticity, fine sand, sub-angular, quartzitic, well graded, silty matrix, light yellowish brown / orange / grey, very low strength,
SAND	SAND: low plasticity, coarse sand, sub-rounded, quartzitic, well graded, silty matrix, light yellowish brown / orange / grey, very low strength,
SAND	SAND: low plasticity, fine sand, sub-angular, quartzitic, well graded, silty matrix, dark greyish brown, very low strength,



Bore Description

Stick up: +0.68 m

95 mm Blade: 0 m to 14 m (Augur)

Bentonite grout (2.5 %): 0 m to 20 m

120 mm Blade: 14 m to 30 m (Mud rotary)

50 mm PN18 uPVC blank casing: 0 m to 24 m

Bentonite seal: 20 m to 22 m

2 - 4 mm washed, rounded, quartz gravel pack: 22 m to 30 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 24 m to 30 m
Bore development: 47 min; EC: 83,600 µS/cm µS/cm; pH: 7.24
Airlift flow rate: 1.0 - 1.4 L/s

End cap
End of hole: 30 m BGL

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BOREHOLE LOG

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MB23S

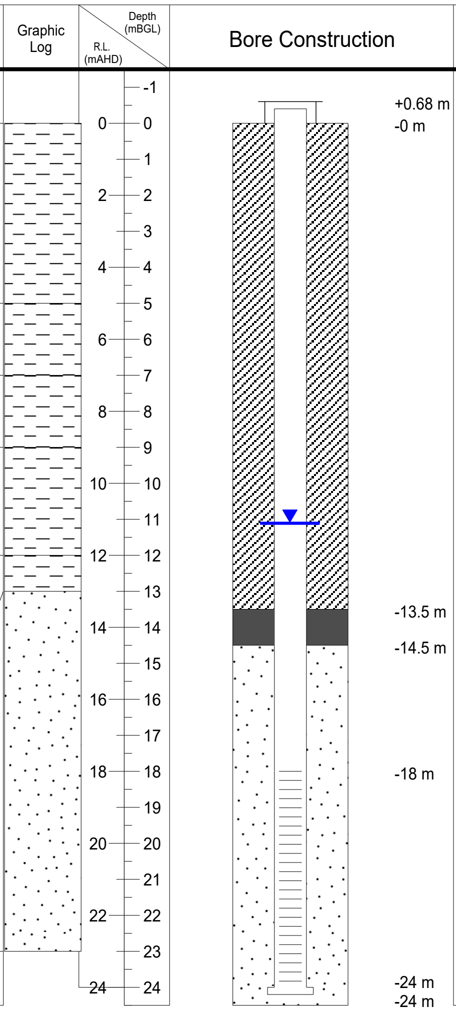
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 9/25/2019
LOGGED BY: P. Ryall (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Augur / Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 533856 mE
NORTHING: 6278886 mN
DATUM: GDA94-Z54
RL: 41.5472 mAHD
TD: 23 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
CLAY	CLAY: medium plasticity, silt, rounded, well graded, silty matrix, light reddish brown / white, low strength,
CLAY	CLAY: medium plasticity, silt, rounded, well graded, silty matrix, light greyish yellow / brown / orange, medium strength,
CLAY	CLAY: medium plasticity, silt, rounded, well graded, silty matrix, dark greyish red / brown, medium strength,
CLAY	CLAY: medium plasticity, clay, rounded, well graded, clay matrix, dark greyish brown / red, medium strength,
CLAY	CLAY: medium plasticity, fine sand, sub-rounded, quartzitic, well graded, clay matrix, light yellowish brown / orange, medium strength,
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, well graded, silty matrix, light yellowish brown / orange / grey, very low strength,



Bore Description

Stick up: +0.68 m

95 mm Blade: 0 m to 14 m (Augur)

Bentonite grout (2.5 %): 0 m to 13.5 m

120 mm Blade: 14 m to 24 m (Mud rotary)

50 mm PN18 uPVC blank casing: 0 m to 18 m

SWL: 11.11 mTOC

Bentonite seal: 13.5 m to 14.5 m

2 - 4 mm washed, rounded, quartz gravel pack: 14.5 m to 24 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 18 m to 24 m
Bore development: 35 min; EC: 79,830 µS/cm µS/cm; pH: 7.35
Airlift flow rate: 0.8 - 1 L/s

End cap
End of hole: 24 m BGL

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BOREHOLE LOG

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MB24D

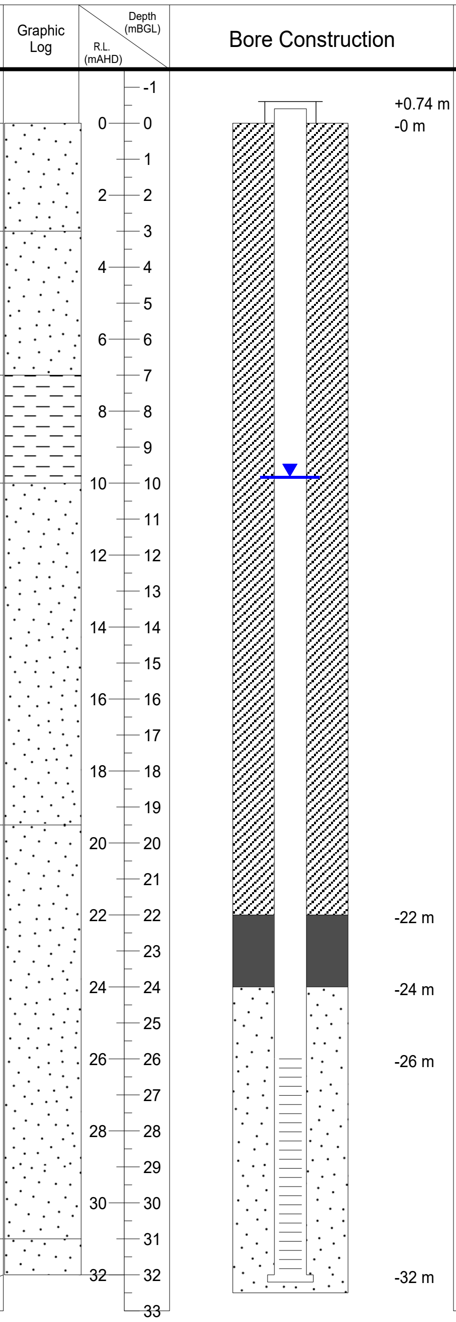
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 9/10/2019
LOGGED BY: K. Düz (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 534287 mE
NORTHING: 6279220 mN
DATUM: GDA94-Z54
RL: 38.6999 mAHD
TD: 32 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
SAND	SAND: low plasticity, fine sand, sub-angular, quartzitic, uniform, light bluish brown / white / orange, Yamba Frm /
SAND	SAND: low plasticity, very fine sand, sub-angular, quartzitic, poorly graded, clay matrix, dark bluish brown / orange, Yamba Frm /
CLAY	CLAY: high plasticity, clay, uniform, light greyish grey, Blanchetown Clay /
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, poorly graded, clay matrix, light greyish grey / brown / black, Loxton-Parilla Sands Frm / HMD % 0.5-3
SAND	SAND: fine gravel, sub-angular, quartzitic, light greyish grey / orange / brown, Coarse sand (target) /
SAND	SAND: coarse sand, sub-angular, quartzitic, clay matrix, dark greyish grey / black, /



Bore Description

Stick up: +0.74 m

95 mm Blade: 0 m to 3 m (Auger)

Bentonite grout (2.5 %): 0 m to 22 m

120 mm Blade: 3 m to 32 m (Mud rotary)

50 mm PN18 uPVC blank casing: 0 m to 26 m

SWL: 9.84 mTOC

Bentonite seal: 22 m to 24 m

2 - 4 mm washed, rounded, quartz gravel pack: 24 m to 32 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 26 m to 32 m

Bore development: 40 min; EC: 81,840 µS/cm µS/cm; pH: 7.27
Airlift flow rate: 0.8 - 1 L/s

End cap
End of hole: 32 m BGL

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BOREHOLE LOG

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MB24S

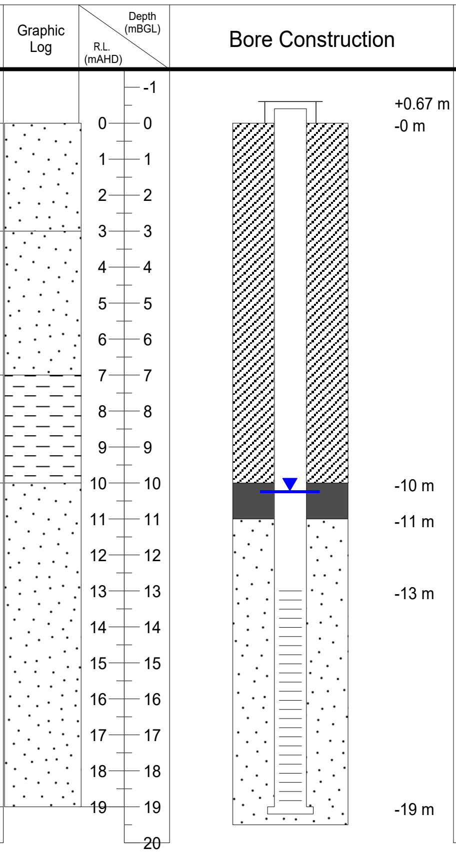
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 9/10/2019
LOGGED BY: K. Düz (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 532297 mE
NORTHING: 6279214 mN
DATUM: GDA94-Z54
RL: 39.1859 mAHD
TD: 19 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
SAND	SAND: low plasticity, fine sand, sub-angular, uniform, light bluish brown / white / orange, /
SAND	SAND: low plasticity, very fine sand, sub-angular, poorly graded, clay matrix, dark bluish brown / orange, /
CLAY	CLAY: high plasticity, clay, uniform, light greyish grey, /
SAND	SAND: low plasticity, fine sand, sub-rounded, poorly graded, clay matrix, light greyish grey, /



Bore Description

Stick up: +0.67 m

95 mm Blade: 0 m to 3 m (Auger)

Bentonite grout (2.5 %): 0 m to 10 m

120 mm Blade: 3 m to 19 m (Mud rotary)

50 mm PN18 uPVC blank casing: 0 m to 13 m

SWL: 10.24 mTOC
Bentonite seal: 10 m to 11 m

2 - 4 mm washed, rounded, quartz gravel pack: 11 m to 19 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 13 m to 19 m
Bore development: 50 min; EC: 78,010 µS/cm µS/cm; pH: 7.29
Airlift flow rate: 1 L/s

End cap
End of hole: 19 m BGL

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BOREHOLE LOG

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MB25D

PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 9/21/2019
LOGGED BY: P. Ryall (AGE)

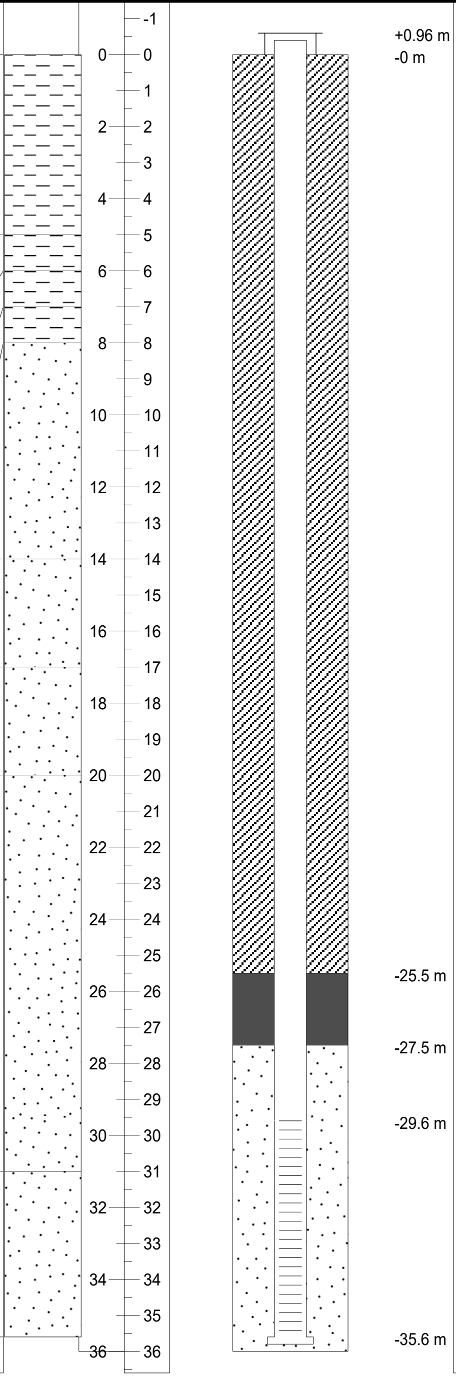
DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Augur / Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 534234 mE
NORTHING: 6279103 mN
DATUM: GDA94-Z54
RL: 40.0987 mAHD
TD: 35.6 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
CLAY	CLAY: medium plasticity, silt, rounded, well graded, silty matrix, light reddish brown / white, low strength,
CLAY	CLAY: medium plasticity, silt, rounded, well graded, silty matrix, dark yellowish brown / orange, low strength,
CLAY	CLAY: medium plasticity, silt, rounded, well graded, silty matrix, light reddish grey / brown / orange, low strength,
CLAY	CLAY: medium plasticity, clay, rounded, well graded, clay matrix, light reddish brown, low strength,
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, well graded, silty matrix, light yellowish grey / orange, very low strength,
SAND	SAND: low plasticity, medium sand, sub-rounded, quartzitic, well graded, silty matrix, dark yellowish grey / brown / orange, very low strength,
SAND	SAND: low plasticity, coarse sand, sub-angular, quartzitic, well graded, silty matrix, dark reddish orange / brown, very low strength,
SAND	SAND: low plasticity, coarse sand, sub-angular, quartzitic, well graded, silty matrix, dark yellowish grey / brown / orange, very low strength,
SAND	SAND: low plasticity, coarse sand, sub-angular, quartzitic, well graded, silty matrix, dark greyish black / orange, very low strength,

Graphic Log | Depth (mBGL) | R.L. (mAHD) | Bore Construction



Bore Description

Stick up: +0.96 m

120 mm Blade: 0 m to 35.6 m (Mud rotary)

Bentonite grout (2.5 %): 0 m to 25.5 m

mm : m to m ()

50 mm PN18 uPVC blank casing: 0 m to 29.6 m

Bentonite seal: 25.5 m to 27.5 m

2 - 4 mm washed, rounded, quartz gravel pack: 27.5 m to 35.6 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 29.6 m to 35.6 m

Bore development: 35 min; EC: 92,180 µS/cm µS/cm; pH: 7.11
Airlift flow rate: 1.3 - 1.5 L/s

End cap
End of hole: 35.6 m BGL

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BOREHOLE LOG

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MB25S

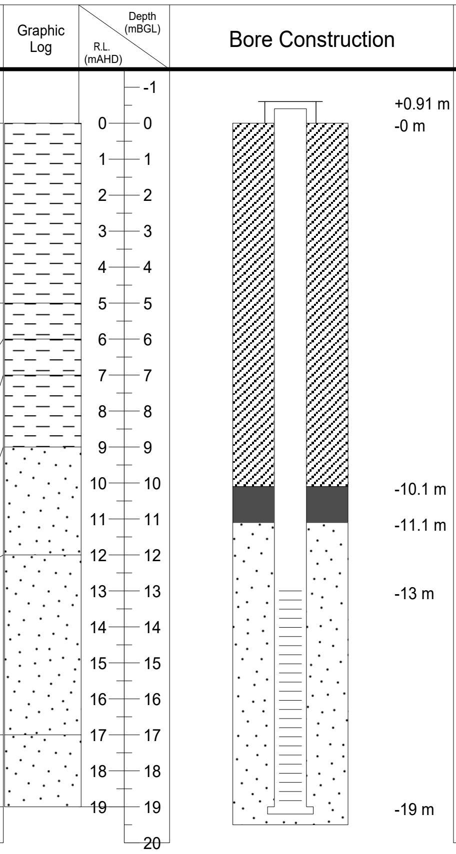
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 9/21/2019
LOGGED BY: P. Ryall (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Augur / Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 534231 mE
NORTHING: 6279104 mN
DATUM: GDA94-Z54
RL: 39.7778 mAHD
TD: 19 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
CLAY	CLAY: medium plasticity, silt, rounded, well graded, silty matrix, light reddish brown / white, low strength,
CLAY	CLAY: medium plasticity, silt, rounded, well graded, silty matrix, dark yellowish brown / orange, low strength,
CLAY	CLAY: medium plasticity, silt, rounded, well graded, silty matrix, light reddish grey / brown / orange, low strength,
CLAY	CLAY: medium plasticity, clay, rounded, well graded, clay matrix, light reddish brown, low strength,
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, well graded, silty matrix, light yellowish grey / orange, very low strength,
SAND	SAND: low plasticity, medium sand, sub-rounded, quartzitic, well graded, silty matrix, dark yellowish grey / brown / orange, very low strength,
SAND	SAND: low plasticity, coarse sand, sub-angular, quartzitic, well graded, silty matrix, dark reddish orange / brown, very low strength,



Bore Description

Stick up: +0.91 m

95 mm Blade: 0 m to 10 m (Augur)

Bentonite grout (2.5 %): 0 m to 10.1 m

120 mm Blade: 10 m to 19 m (Mud rotary)

50 mm PN18 uPVC blank casing: 0 m to 13 m

Bentonite seal: 10.1 m to 11.1 m

2 - 4 mm washed, rounded, quartz gravel pack: 11.1 m to 19 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 13 m to 19 m
Bore development: 40 min; EC: 78,310 µS/cm µS/cm; pH: 7.33
Airlift flow rate: 0.8 L/s

End cap
End of hole: 19 m BGL

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BOREHOLE LOG

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MB26D

PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 10/20/2019
LOGGED BY: K. Düz (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: mE
NORTHING: mN
DATUM: GDA94-Z54
RL: mAHD
TD: 36 mBGL

COMMENTS: Survey data not yet available

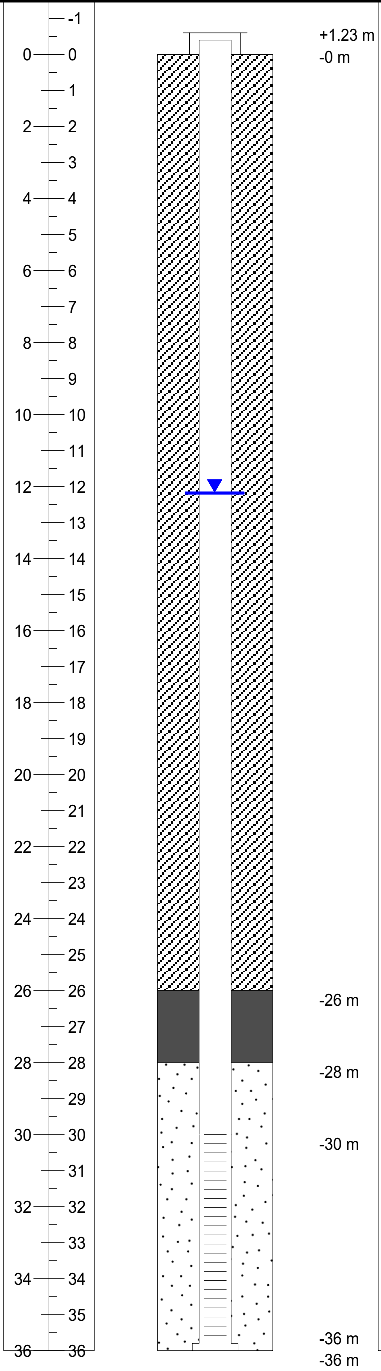
Stratigraphic Cloumn	Soil or Rock Field Material Description
SAND	SAND: low plasticity, fine sand, sub-rounded, uniform, dark reddish brown, low strength,
SAND	SAND: low plasticity, very fine sand, sub-rounded, uniform, dark reddish brown, low strength,
CLAY	CLAY: high plasticity, clay, well graded, dark greenish grey/yellow, high strength,
SAND	SAND: medium plasticity, very fine sand, sub-rounded, quartzitic, well graded, yellowish gray/yellow/black, medium strength,
SAND	SAND: low plasticity, medium sand, sub-angular to sub-rounded, quartzitic, poorly graded, Dark grey / white, low strength, loose, wet,
SAND	SAND: low plasticity, fine gravel to coarse sand, sub-angular , quartzitic, poorly graded, Light yellowish grey / white, low strength, loose, wet,
CLAY	CLAY: moderate plasticity, uniform clay, Light yellowish grey / black / orange, very high strength, dense,wet,
SAND	SAND: low plasticity, fine gravel to coarse sand, sub-angular to sub-rounded, quartzitic, light greenish yellow, very high strength, dense, wet,

Graphic Log

Depth (mBGL)

R.L. (mAHD)

Bore Construction



Bore Description

Stick up: +1.23 m

120 mm Blade: 0 m to 36 m (Mud rotary)

Bentonite grout (2.5 %): 0 m to 26 m

50 mm PN18 uPVC blank casing: 0 m to 30 m

SWL: 12.18 mTOC

Bentonite seal: 26 m to 28 m

2 - 4 mm washed, rounded, quartz gravel pack: 28 m to 36 m

50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 30 m to 36 m

Bore development: 45 min; EC: 101,80 µS/cm µS/cm; pH: 6.74
Airlift flow rate: 0.25 - 0.3 L/s
End cap

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BOREHOLE LOG

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MB26S

PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 10/20/2019
LOGGED BY: K. Düz (AGE)

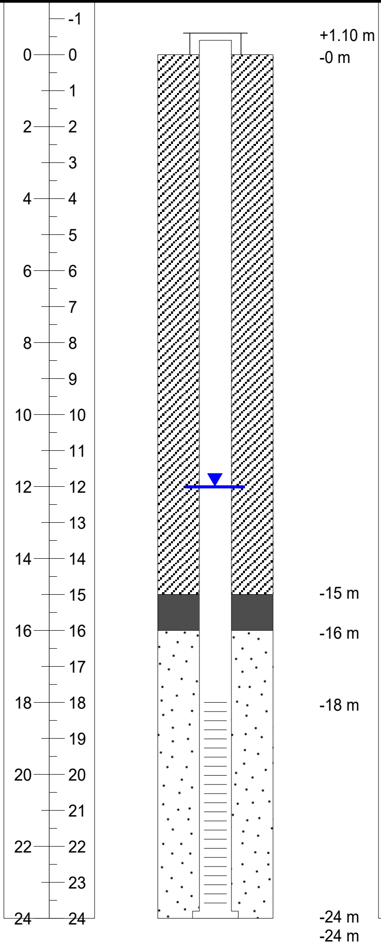
DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: mE
NORTHING: mN
DATUM: GDA94-Z54
RL: mAHD
TD: 24 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
SAND	SAND: low plasticity, fine sand, sub-rounded, uniform, dark reddish brown, low strength,
SAND	SAND: low plasticity, very fine sand, sub-rounded, uniform, dark reddish brown, low strength,
CLAY	CLAY: high plasticity, clay, well graded, dark greenish grey/yellow, high strength,
SAND	SAND: medium plasticity, very fine sand, sub-rounded, quartzitic, well graded, yellowish gray/yellow/black, medium strength,
SAND	SAND: low plasticity, medium sand, sub-angular to sub-rounded, quartzitic, poorly graded, Dark grey / white, low strength, loose, wet,
SAND	SAND: low plasticity, fine gravel to coarse sand, sub-angular , quartzitic, poorly graded, Light yellowish grey / white, low strength, loose, wet,

Graphic Log



Bore Description

Stick up: +1.10 m

120 mm Blade: 0 m to 24 m (Mud rotary)

Bentonite grout (2.5 %): 0 m to 15 m

50 mm PN18 uPVC blank casing: 0 m to 18 m

SWL: 12.01 mTOC

Bentonite seal: 15 m to 16 m

2 - 4 mm washed, rounded, quartz gravel pack: 16 m to 24 m
50 mm PN18 uPVC machine slotted, slot aperture: 0.5 mm, slot length: 50 mm, - slots / m, 18 m to 24 m
Bore development: 40 min; EC: 88,910 µS/cm µS/cm; pH: 7.12
Airlift flow rate: 0.13 - 0.15 L/s

End cap

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BOREHOLE LOG

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PB01

PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 9/11/2019
LOGGED BY: K. Düz (AGE)

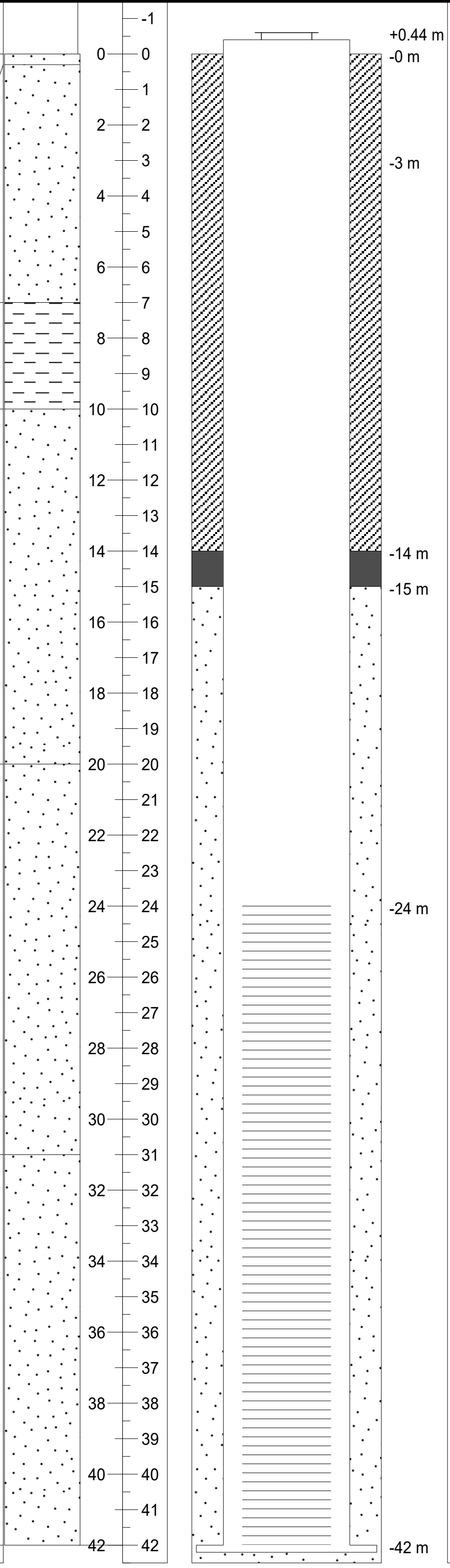
DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 534288 mE
NORTHING: 6279247 mN
DATUM: GDA94-Z54
RL: 37.5863 mAHD
TD: 42 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
SAND	SAND: low plasticity, fine sand, sub-angular, quartzitic, uniform, light reddish brown / white / orange, Yamba Fm
SAND	SAND: low plasticity, very fine sand, sub-angular, quartzitic, poorly graded, clay matrix, dark brown / orange, Yamba Fm
CLAY	CLAY: high plasticity, clay, uniform, light greenish grey / brown, Blanchtown Fm
SAND	SAND: low plasticity, fine sand, sub-angular, quartzitic, poorly graded, clay matrix, light yellowish grey / brown / black, Loxton-Parilla Sands (HMD 10-11 m %0.3, 11-13 m % 5-10, 15-18 m %25-30, 18-19.5 m % 5-6)
SAND	SAND: fine gravel, sub-angular, quartzitic, clay matrix, light reddish grey / brown / orange, Loxton-Parilla Sands
SAND	SAND: coarse sand, sub-angular, quartzitic, clay matrix, dark greyish grey / black, coarse sand

Graphic Log | R.L. (mAHD) | Depth (mBGL) | Bore Construction



Bore Description

Stick up: +0.44 m

298.45 mm Blade: 0 m to 42 m (Mud rotary)

275 mm (OD) uPVC (mm) surface casing: 0 m to 3 m

Bentonite grout (2.5 %): 0 m to 14 m

200 mm PN18 uPVC blank casing: 0 m to 24 m

Bentonite seal: 14 m to 15 m

2 - 4 mm washed, rounded, quartz gravel pack: 15 m to 42 m

200 mm steel machine slotted, slot aperture: 0.5 mm, slot length: - mm, - slots / m, 24 m to 42 m

Bore development: 2 hrs 30 min; EC: 89,560 µS/cm µS/cm; pH: 7.17
Airlift flow rate: 9 - 12 L/s

End cap
End of hole: 42 m BGL

AGE

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BOREHOLE LOG

PB02

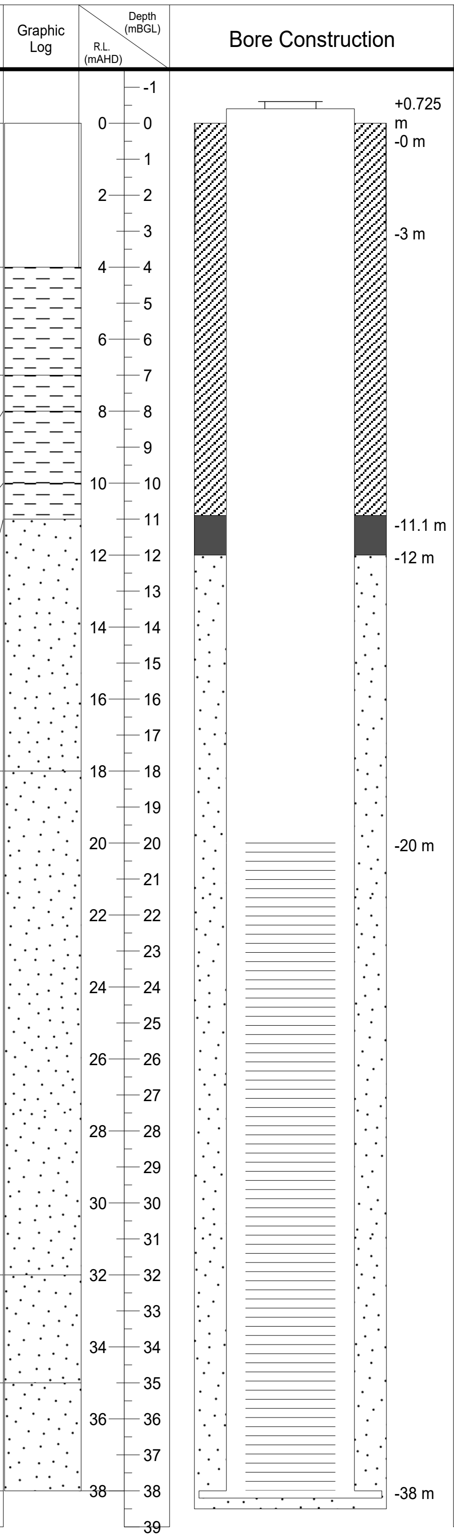
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 9/30/2019
LOGGED BY: P. Ryall (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Augur / Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 534217 mE
NORTHING: 6279117 mN
DATUM: GDA94-Z54
RL: 39.824 mAHD
TD: 40 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
CLAYEY SAND	CLAYEY SAND: medium plasticity, silt, rounded, well graded, silty matrix, light reddish white / brown / orange, low strength, /
CLAY	CLAY: medium plasticity, silt, rounded, well graded, silty matrix, dark reddish brown / orange / yellow, medium strength, /
CLAY	CLAY: medium plasticity, silt, rounded, well graded, clay matrix, dark reddish brown / orange, medium strength, /
CLAY	CLAY: medium plasticity, silt, rounded, well graded, silty matrix, light greyish yellow / brown / orange, medium strength, /
CLAY	CLAY: medium plasticity, fine sand, sub-rounded, quartzitic, well graded, clay matrix, light yellowish brown / orange, medium strength, /
SAND	SAND: low plasticity, coarse sand, sub-rounded, quartzitic, well graded, silty matrix, light yellowish brown / orange / grey, very low strength, /
SAND	SAND: low plasticity, coarse sand, sub-angular, quartzitic, well graded, silty matrix, light yellowish brown / orange / grey, very low strength, /
SAND	SAND: low plasticity, coarse sand, sub-angular, quartzitic, well graded, silty matrix, dark greyish brown / grey, very low strength, /
SAND	SAND: low plasticity, fine sand, sub-rounded, quartzitic, well graded, silty matrix, dark greyish brown / grey, very low strength, /



Bore Description

Stick up: +0.725 m

95 mm Blade: 0 m to 14 m (Augur)

275 mm (OD) uPVC (mm) surface casing: 0 m to 3 m

Bentonite grout (2.5 %): 0 m to 11.1 m

275 mm Blade: 0 m to 41 m (Mud rotary)

200 mm PN18 uPVC blank casing: 0 m to 20 m

Bentonite seal: 11.1 m to 12 m

2 - 4 mm washed, rounded, quartz gravel pack: 12 m to 38.3 m

200 mm steel machine slotted, slot aperture: 0.5 mm, slot length: - mm, - slots / m, 20 m to 38 m

Bore development: 2 hrs 30 min; EC: 92,590 µS/cm µS/cm; pH: 7.13
Airlift flow rate: 20 L/s

End cap
End of hole: 38.3 m BGL

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Consultants Pty Ltd
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BOREHOLE LOG

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PB03

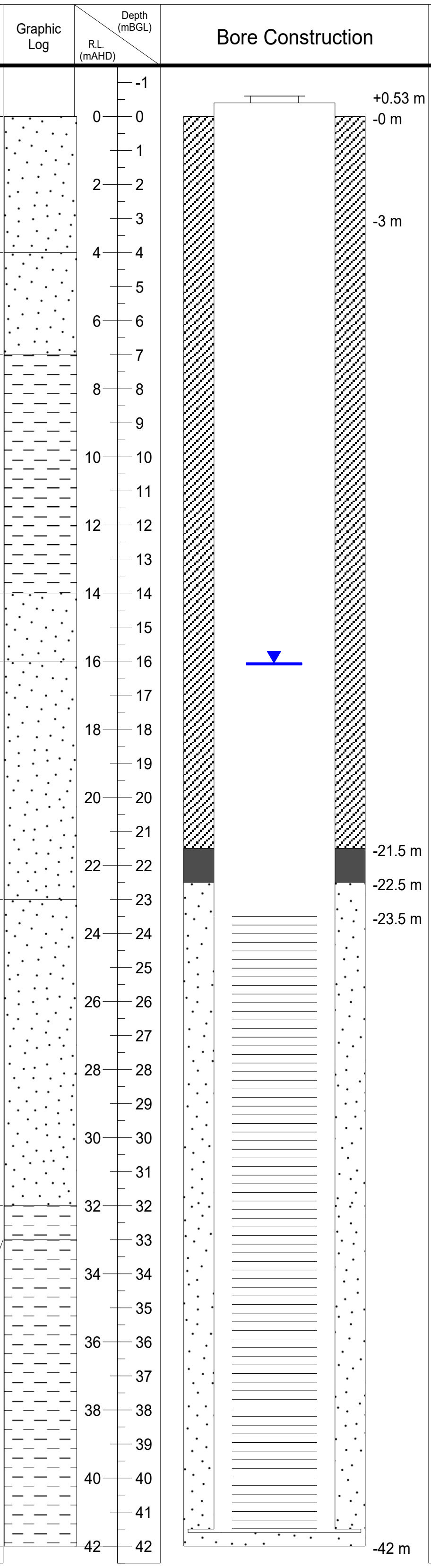
PROJECT No: G1945
PROJECT NAME: Copi Sands
DATE DRILLED: 10/18/2019
LOGGED BY: K. Düz (AGE)

DRILLING COMPANY: BG Drilling
DRILLER: Tim Galvin
DRILLING METHOD: Mud rotary
DRILL RIG: Han-Jin 8D

EASTING: 528978 mE
NORTHING: 6282583 mN
DATUM: GDA94-Z54
RL: 43.163 mAHD
TD: 42 mBGL

COMMENTS: Survey data not yet available

Stratigraphic Cloumn	Soil or Rock Field Material Description
SAND	SAND: low plasticity, fine sand, sub-rounded, uniform, dark reddish brown, very low strength, very loose, dry,
SAND	SAND: low plasticity, very fine sand, sub-angular, uniform, dark reddish brown, very low strength, very loose, dry,
CLAY	CLAY: high plasticity, clay, sub-rounded, uniform, dark greenish grey / yellow / brown, high strength, dense, moist,
SAND	SAND: medium plasticity, very fine sand, sub-rounded, uniform, dark yellowish grey / yellow, medium strength, medium dense, wet,
SAND	SAND: low plasticity, medium sand, sub-angular, poorly graded, dark greyish grey / white, low strength, loose, wet,
SAND	SAND: low plasticity, coarse sand, sub-angular, poorly graded, light yellowish grey / white, low strength, loose, wet,
CLAY	CLAY: medium plasticity, clay, uniform, light yellowish grey / brown / orange, very high strength, dense, alteration of smokey, grey, coarse sand and hard clay layer
CLAY	CLAY: medium plasticity, clay, uniform, light greenish yellow / grey / brown, very high strength, dense, alteration of smokey, grey, coarse sand and hard clay layer



Bore Description

Stick up: +0.53 m

400 mm Blade: 0 m to 42 m (Mud rotary)

298 mm (OD) uPVC (mm) surface casing: 0 m to 3 m

Bentonite grout (2.5 %): 0 m to 21.5 m

280 mm PN18 uPVC blank casing: 0 m to 23.5 m

SWL: 16.08 mTOC

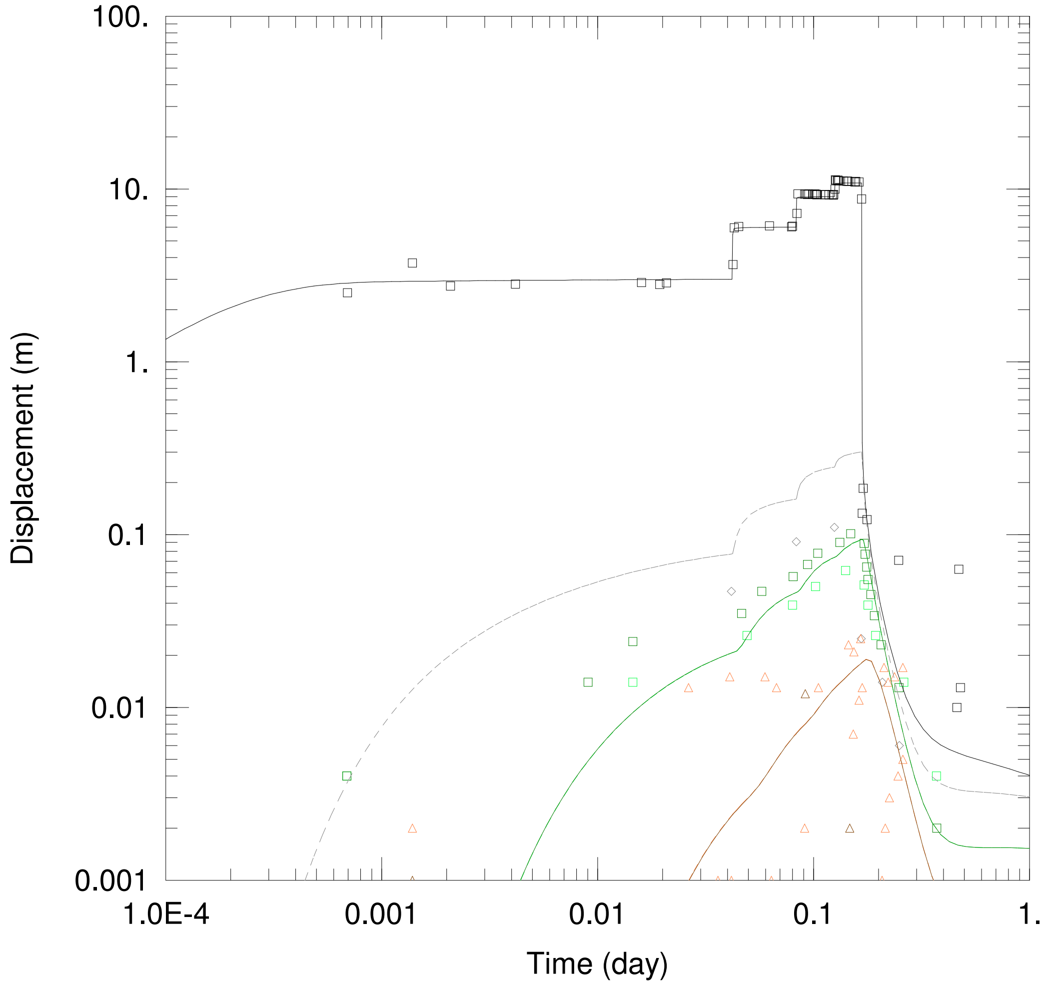
Bentonite seal: 21.5 m to 22.5 m

2 - 4 mm washed, rounded, quartz gravel pack: 22.5 m to 42 m
280 mm steel machine slotted, slot aperture: 0.5 mm, slot length: - mm, - slots / m, 23.5 m to 41.5 m
Bore development: 1 hr 40 min; EC: 95,170 µS/cm µS/cm; pH: 7.25
Airlift flow rate: 15 L/s

End cap
End of hole: 42 m BGL

APPENDIX D

HYDROCENSUS DATA



WELL TEST ANALYSIS

Data Set: H:\GE\Curr\Cont\RZ\Copi\GDW\PumpingTests\AQT\PB1aUMfpS.aqt
Date: 09/06/22 Time: 15:03:42

AQUIFER DATA

Saturated Thickness: 49.05 m Anisotropy Ratio (Kz/Kr): 0.02794

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
PB1	534288	6279247

Observation Wells

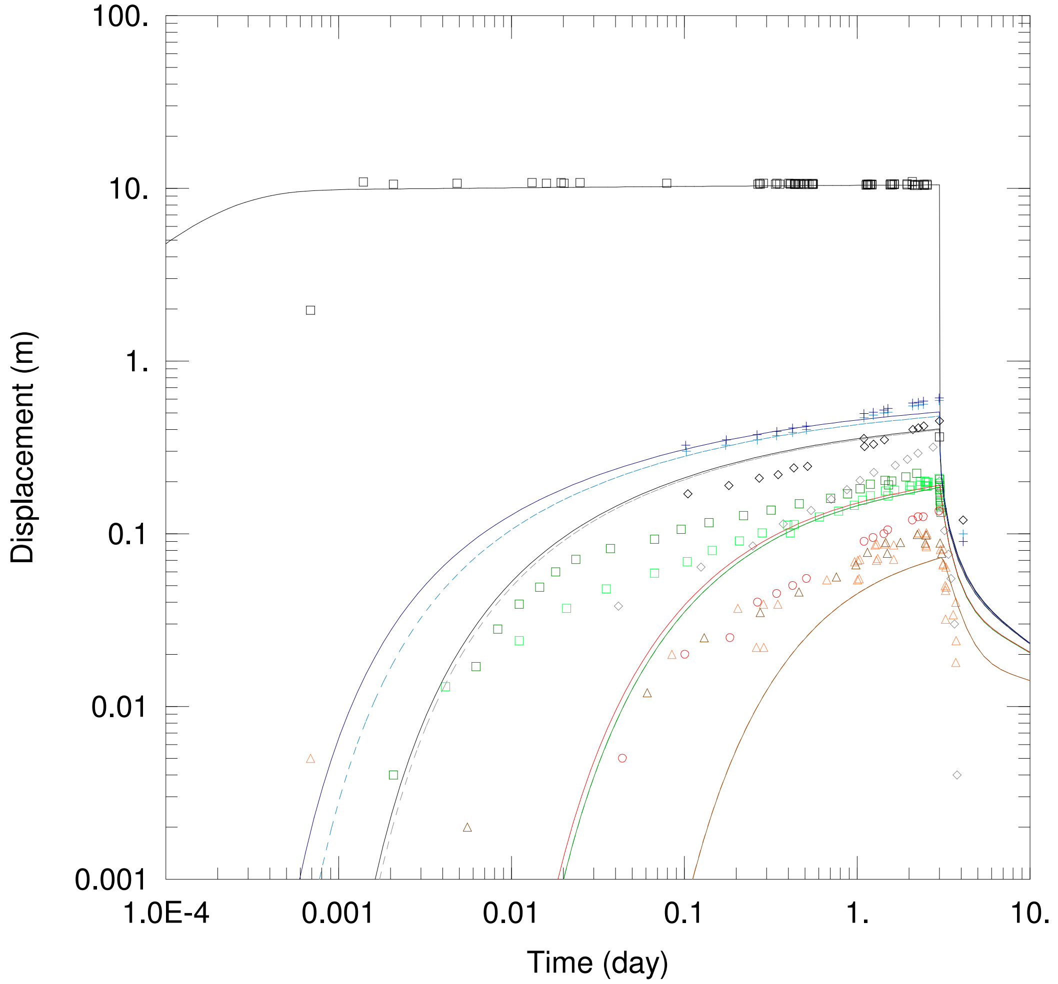
Well Name	X (m)	Y (m)
□ PB1	534288	6279247
◇ MB1S	534252	6279272
△ MB2S	534114	6278933
△ MB2D	534120	6278929
□ MB25S	534231	6279104
□ MB25D	534234	6279103

SOLUTION

Aquifer Model: Unconfined Solution Method: Moench

T = 1108.6 m^2/day
Sy = 0.203
Sw = 41.5
r(c) = 0.1 m

S = 0.001725
Kz/Kr = 0.02794
r(w) = 0.137 m
alpha = 2.8E+9 day^{-1}



WELL TEST ANALYSIS

Data Set: H:\GE\Curr\Cont\RZ\Copi\GDW\PumpingTests\AQT\PB1aUMfp5.aqt
Date: 09/08/22 Time: 08:38:56

AQUIFER DATA

Saturated Thickness: 49.05 m Anisotropy Ratio (Kz/Kr): 0.007217

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
PB1	534288	6279247

Observation Wells

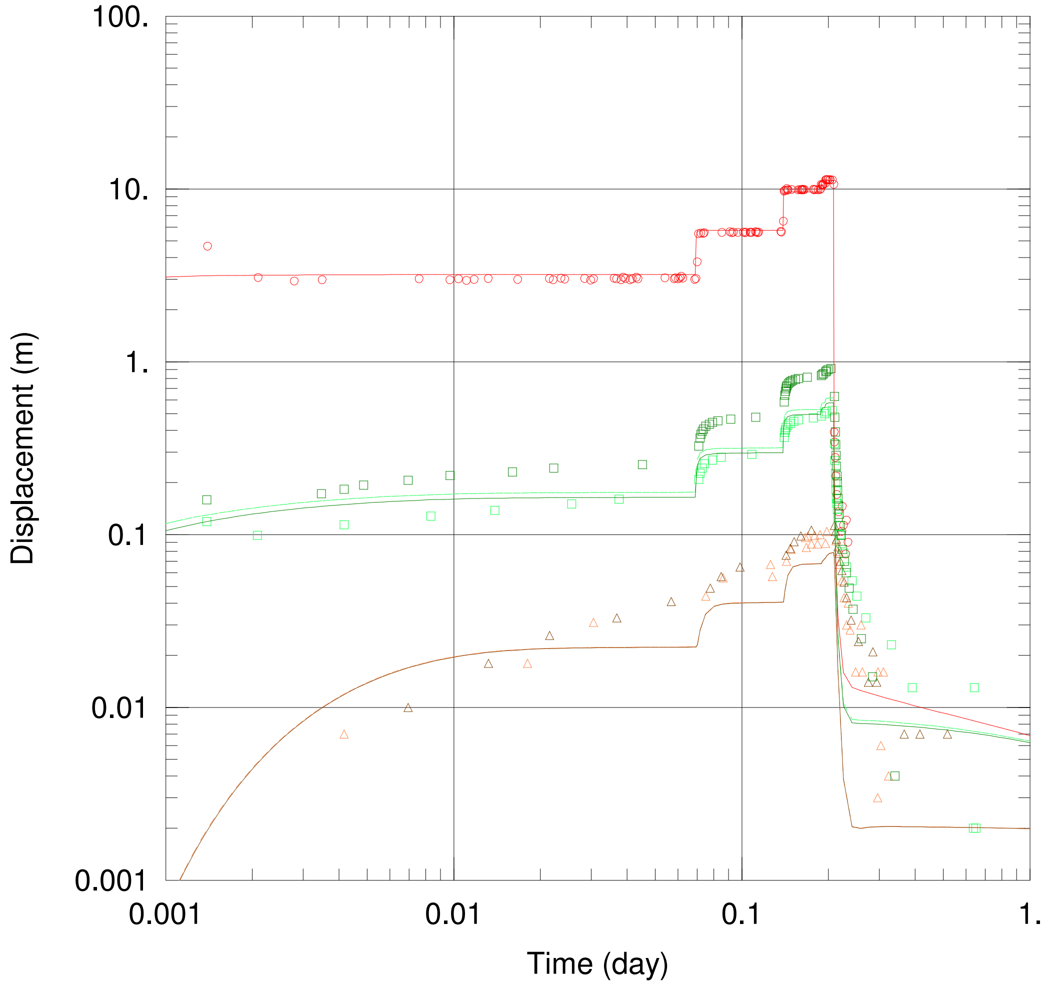
Well Name	X (m)	Y (m)
□ PB1	534288	6279247
◇ MB1S	534252	6279272
◇ MB1D	534257	6279276
△ MB2S	534114	6278933
△ MB2D	534120	6278929
+ MB24S	534291	6279219
+ MB24D	534278	6279225
□ MB25S	534231	6279104
□ MB25D	534234	6279103
○ PB02	534217	6279117

SOLUTION

Aquifer Model: Unconfined Solution Method: Moench

T = 1347.2 m^2/day
Sy = 0.1048
Sw = 48.92
r(c) = 0.1 m

S = 0.01384
Kz/Kr = 0.007217
r(w) = 0.137 m
alpha = 2.8E+9 day^{-1}



Data Set: H:\GE\Curr\Cont\RZ\Copi\GDW\PumpingTests\AQT\PB2UM97fpS7.aqt
Date: 09/06/22 Time: 19:22:40

AQUIFER DATA

Saturated Thickness: 32. m

Anisotropy Ratio (Kz/Kr): 0.01325

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
PB02	534217	6279117

Observation Wells

Well Name	X (m)	Y (m)
○ PB02	534217	6279117
△ MB2S	534114	6278933
△ MB2D	534120	6278929
□ MB25S	534231	6279104
□ MB25D	534234	6279103

SOLUTION

Aquifer Model: Unconfined

Solution Method: Moench

T = 816.9 m^2/day

Sy = 0.1235

Sw = 31.06

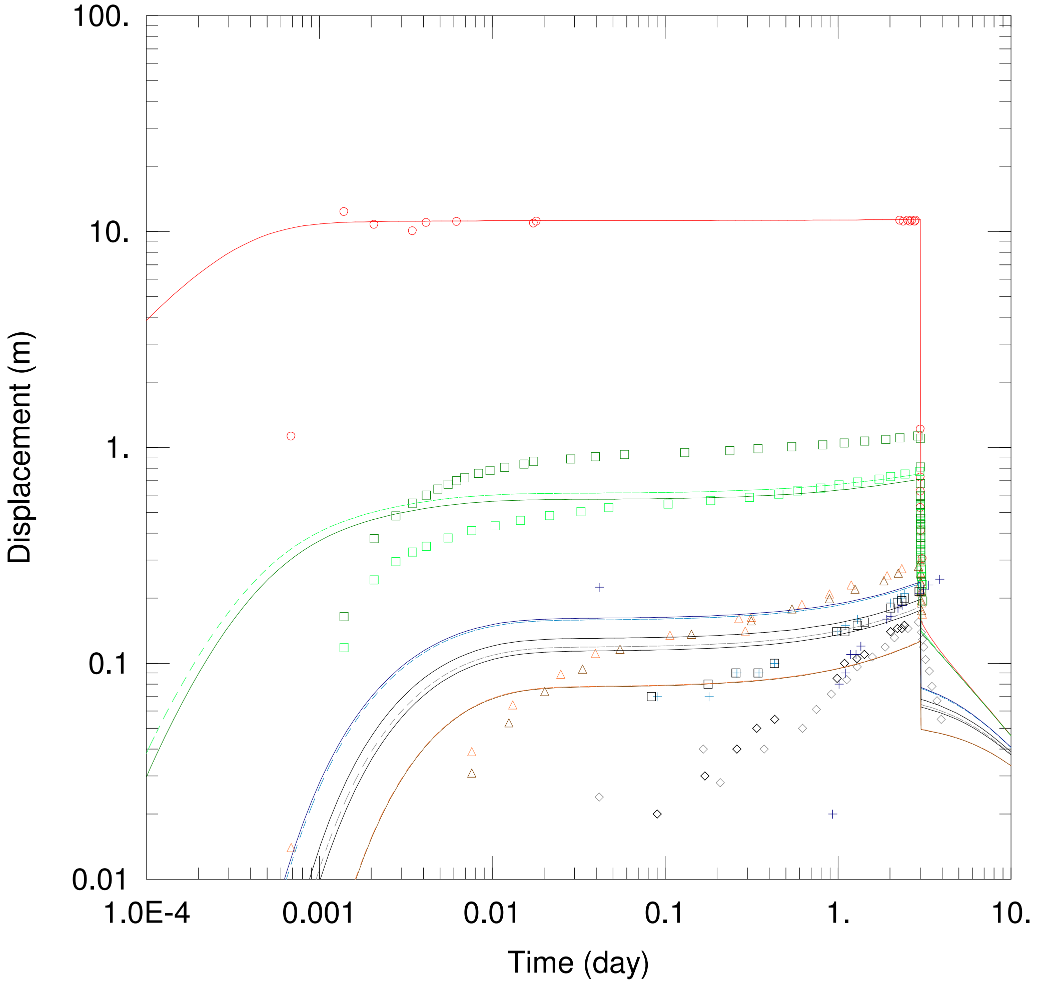
r(c) = 0.1 m

S = 0.0001583

Kz/Kr = 0.01325

r(w) = 0.137 m

alpha = 2.847E+9 day^{-1}



WELL TEST ANALYSIS

Data Set: H:\GE\Curr\Cont\RZ\Copi\GDW\PumpingTests\AQT\PB2UM97fpF.aqt
Date: 09/08/22
Time: 08:40:42

AQUIFER DATA

Saturated Thickness: 32. m
Anisotropy Ratio (Kz/Kr): 0.01325

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
PB02	534217	6279117

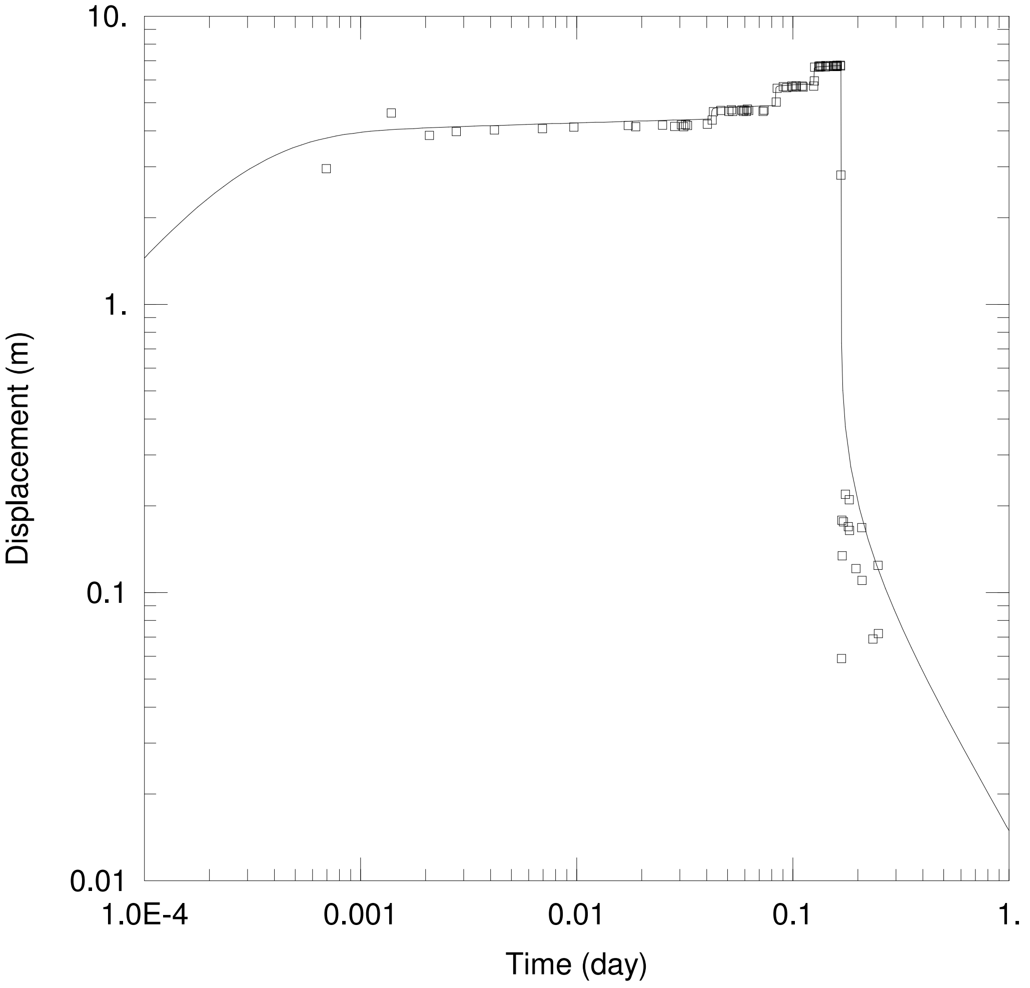
Observation Wells

Well Name	X (m)	Y (m)
○ PB02	534217	6279117
◇ MB1S	534252	6279272
◇ MB1D	534257	6279276
△ MB2S	534114	6278933
△ MB2D	534120	6278929
+ MB24S	534291	6279219
+ MB24D	534278	6279225
□ MB25S	534231	6279104
□ MB25D	534234	6279103
□ PB1	534288	6279247

SOLUTION

Aquifer Model: Unconfined
Solution Method: Moench

T = 816. m^2/day
S = 0.0001583
Sy = 0.1235
Kz/Kr = 0.01325
Sw = 31.06
r(w) = 0.137 m
r(c) = 0.1 m
alpha = 2.8E+9 day^{-1}



WELL TEST ANALYSIS

Data Set: H:\GE\Curr\Cont\RZ\Copi\GDW\PumpingTests\AQT\PB3aUMfpS.aqt
Date: 09/06/22 Time: 19:19:07

AQUIFER DATA

Saturated Thickness: 28. m Anisotropy Ratio (Kz/Kr): 0.0003259

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
PB3	528978	6282583

Observation Wells

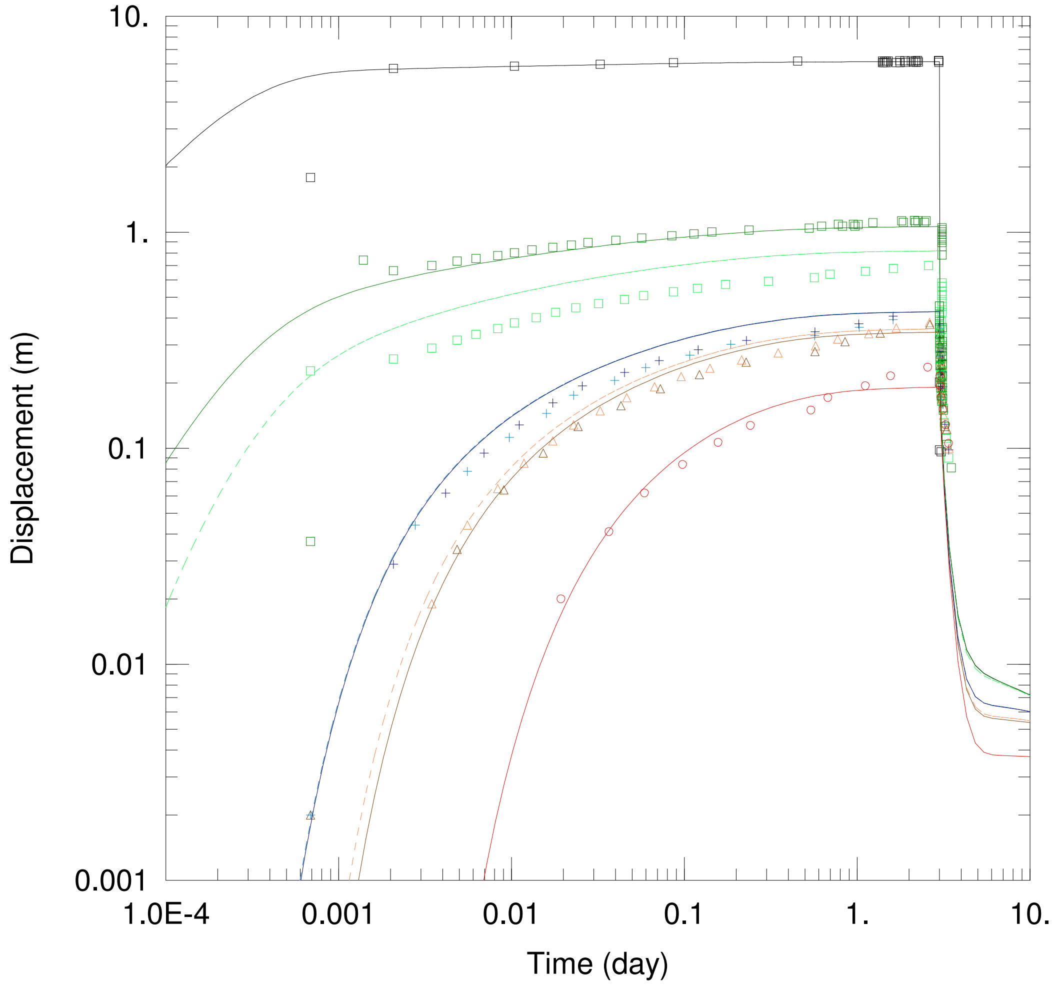
Well Name	X (m)	Y (m)
□ PB3	528978	6282583

SOLUTION

Aquifer Model: Unconfined Solution Method: Moench

T = 359.9 m^2/day
Sy = 0.203
Sw = 16.14
r(c) = 0.1 m

S = 0.001725
ß = 7.802E-9
r(w) = 0.137 m
alpha = 2.8E+9 day^{-1}



WELL TEST ANALYSIS

Data Set: H:\GE\Curr\Cont\RZ\Copi\GDW\PumpingTests\AQT\PB3aUMfpF.aqt
Date: 09/06/22 Time: 20:15:34

AQUIFER DATA

Saturated Thickness: 30. m
Anisotropy Ratio (Kz/Kr): 0.0007517

WELL DATA

Pumping Wells

Well Name	X (m)	Y (m)
PB3	528978	6282583

Observation Wells

Well Name	X (m)	Y (m)
□ PB3	528978	6282583
△ MB8S	528895	6282653
△ MB8D	528889	6282658
+ MB9S	529052	6282579
+ MB9D	529051	6282568
□ MB13S	528975	6282593
□ MB13D	528975	6282584
○ MB18S	528939	6282304

SOLUTION

Aquifer Model: Unconfined
Solution Method: Moench

T = 474.5 m^2/day
Sy = 0.1037
Sw = 21.97
r(c) = 0.1 m

S = 0.0004975
Kz/Kr = 0.0007517
r(w) = 0.137 m
alpha = 2.8E+9 day^{-1}

APPENDIX D

HYDROCENSUS DATA

Property	State	RL	Local Name	Bore ID	GDA_E	GDA_N	DTW	WTRL	Conductivity	Salinity	Total Depth	Notes
		(m)			(m)	(m)	(m)		(mS/cm)	ppK	(m)	
Balah	SA	52.00	CHW28	CHW28	387,478	6,263,954	27.14	24.86	19.0	12160.0	76.4	
Belmore	NSW	38	DollyGray	GW00471	514,850	6,293,067		37.70	11.5	7360.0		Weak flow to surface, no usable collar
Belvedere	NSW	34.04	Winnebaga		530,932	6,313,825	-2.4	36.44	10.8	6912.0	206	
Buckalow	NSW	95.67	Bens Bore A	61512	528,317	6,382,471	60.25	35.42	14.4	9216.0	72.5	
Buckalow	NSW	95.61	Bens Bore B		528389.82	6382462.69	59.98	35.63	7.0	4492.8	75	
Budgeree	NSW	82.0	Budg1		518,133	6,366,981	49	33.00	15.9	10176.0	60.96	cement slab
Budgeree	NSW	80.0	Budg2		521,754	6,368,282	48.75	31.25	41.1	26304.0	68.8	new bore
Burta	NSW	230.0	WestMnt		501,438	6,421,275	21.6	211.3	1.7	1102.1	200	
Burta	NSW	150.8	Gums		508,952	6,402,735	95.93	54.90	6.3	4022.4	107.5	
Burta	NSW		South Yards		508,457	6,398,996	dry			0.0	96	
Calperum	SA	51.80	CHW92	CHW92	483,898	6,247,414	35.27	16.53	17.1	10944.0	52.11	southern most
Calperum	SA	51.67	CHW91	CHW91	483,893	6,247,435	27.38	24.29	14.9	9536.0	160.4	
Calperum	SA	69.91	CHW9	CHW9	448,671	6,264,357	41.01	28.90	11.0	7040.0	99.71	
Calperum	SA	67.34	CHW10	CHW10	441,310	6,284,271	39.12	28.22	21.4	13696.0	51.1	southern most
Calperum	SA	67.75	CHW11	CHW11	441,301	6,284,282	34.37	33.38	10.9	6976.0	130.58	
Calperum	SA	67.61	CHW31	CHW31	448,731	6,289,163	32.9	34.71	12.4	7936.0	234.8	
Calperum	SA	70.99	CHW32	CHW32	459,457	6,275,415	37.42	33.57	0.4	286.1	101.81	middle
Calperum	SA	71.60	CHW43	CHW43	459,467	6,275,416	35.02	36.58	0.2	110.7	53.5	eastern most bore
Chowilla	SA	19.08	CHW93	CHW93	496,243	6,246,744	4.13	14.95	53.9	34496.0	66.7	previously artesian, reading Sept 14
Coombah	NSW	47.19	Coombah	600086	558,459	6,351,127	8.4	38.79	9.1	5806.1	300	
Cuthero	NSW		Cuthero		587,688	6,345,754		0.00		0.0		blocked at 2m
Dangalli	SA	71.41	CHW3	CHW3	490,582	6,311,738	40.5	30.96	8.6	5472.0	151.61	
Dangalli	SA	71.49	CHW4	CHW4	490,581	6,311,730	45.6	25.89	12.7	8128.0	65.76	southern most
Dangalli	SA	44.66	CHW2	CHW2	493,603	6,286,385	22.2	22.46	20.3	12992.0	33.38	
Dangalli	SA	45.69	CHW1	CHW1	493,595	6,286,391	10.6	35.09	0.3	171.5	14.3	under mill
Dangalli	SA	52.96	CHW29	CHW29	495,800	6,259,751	24.02	28.94	13.3	8512.0	134.5	north most hole
Dangalli	SA	51.94	CHW41	CHW41	495,800	6,259,751	32.38	19.56	22.9	14656.0	49.64	
Harriedale	NSW	79.00	Ryans	010248	536,317	6,374,864		79.00	15.5	9920.0	93.1	water below pump 40m tested tank
Harriedale	NSW	84.86	Harriedale		536662.97	6367354.65	46.38	38.48	14.8	9472.0	56.1	under mill
Kars	NSW		KarsH		597,203	6,434,527	53.78	-53.78	2.6	1664.0	70	59m to pump
Kars	NSW	105.4	KarsSB		607,004	6,436,267	61.86	43.58	2.9	1856.0	123	under mill
Kimberley	NSW		Kimberly	600317	509,643	6,368,717		0.00		0.0	91.44	water below pump not tested
Kudgee	NSW		NetleyDam	64522	553,425	6,381,029		0.00		0.0		New bore. Oily film, nr. Netley Dam

Property	State	RL	Local Name	Bore ID	GDA_E	GDA_N	DTW	WTRL	Conductivity	Salinity	Total Depth	Notes
		(m)			(m)	(m)	(m)		(mS/cm)	ppK	(m)	
Kudgee	NSW		Bonds		564,216	6,378,897	20.53	-20.53	10.0	6400.0		under solar pump
Kudgee	NSW		12 Mile		562,118	6,366,542	12.57	-12.57	57.8	36992.0	44.8	cement slab
Kudgee	NSW		KudGov	22673	558,110	6,365,671	8.24	-8.24	7.0	4474.2	9.89	
LochLilly	NSW		LLHouse		501,990	6,348,753		0.00		0.0		No access
LochLilly	NSW		LLSouth	006973	508,768	6,341,795	38.53	-38.53	12.4	7936.0	68.53	under sleeper
Mazar	NSW	98.0	MazarHouse		507,514	6,372,080		98.00		0.0		No access
Mazar	NSW		Maz1		506,985	6,370,989	dry			0.0	41.8	eastern most bore
Mazar	NSW		Maz2		506,985	6,370,989	58.38	-58.38	19.3	12332.8	69	
Mazar	NSW	95.99	Maz3		506982.07	6370992.86	58.45	37.54	19.2	12288.0	69	
Mazar	NSW		Mulga	009708	506,144	6,374,511	62.1	-62.10	18.1	11584.0	69.1	
MiddleCamp	NSW		MChouse		577,493	6,388,130	23.85	-23.85	9.2	5856.6	49	
MiddleCamp	NSW		MC8A		576,163	6,384,104	19.67	-19.67	21.4	13696.0	27.5	
MiddleCamp	NSW		MC8		576,167	6,384,104	22.51	-22.51	9.5	6093.4		under mill with pump
MiddleCamp	NSW		Pioneer		571,412	6,384,532	23.63	-23.63	9.0	5760.0	30	
MiddleCamp	NSW		MC7		578,088	6,393,085	29.15	-29.15	7.5	4769.9	56.6	
MiddleCamp	NSW		2 Mile		580,791	6,388,671	23.88	-23.88	11.3	7232.0	61.92	under mill
MiddleCamp	NSW		Poison		590,481	6,385,374	34	-33.98	15.6	9984.0	54.95	
Mutooroo	SA	124	OLY9	OLY9	493,939	6,382,109	84.03	40.20	19.8	12672.0	121.2	
Mutooroo	SA	124	OLY10	OLY10	493,939	6,382,109		124.23		0.0		dry
Mutooroo	SA	142	OLY7	OLY7	466,346	6,379,139	102.95	38.80		0.0	162	reading Sept 14
Mutooroo	SA	142	OLY8	OLY8	466,347	6,379,145	97.84	43.99	1.2	766.1	104	reading Sept 14
Nagaela	NSW	81.31	NagaelaN	005615	528,817	6,350,460	43.18	38.13	12.6	8064.0	167	
Nagaela	NSW	82.52	NagaelaS	016577	529,025	6,343,640	44.52	38.00	13.7	8768.0	192	
Nanya	NSW		Salt lake1		533,727	6,334,762	0.59	-0.59	39.2	25088.0	29.32	
Nanya	NSW		Sait lake2		533,727	6,334,762	-0.4	0.40	26.1	16704.0	57.53	
Nanya	NSW		Salt lake3		533,727	6,334,762	-0.47	0.47	25.6	16384.0	18.223	
Netley	NSW	100.0	NetHouse	61399	541,940	6,394,637	65.78		1.0	622.1	150?	Elec. Pump in operation, Perched?
Netley	NSW	90.0	Wilkies	65256	541,396	6,389,811				0.0	76	Inaccessible due to pump
Netley	NSW		N9		554,752	6,391,423	36.51		6.7	4277.8	90.61	open disused pipe, new bore
Netley	NSW		N3	40165	572,781	6,391,206			5.3	3417.6		Cup sample only
Oakvale	SA	104	OLY6	OLY6	475,369	6,360,452	65.2	39.14	6.9	4416.0	149.35	under frame
Oakvale	SA		Brooks Bore		492,070	6,350,103		0.00		0.0		under mill water below pump 35.5m
PineCreek	SA	283.77	PineCk		500,067	6,434,159						

Property	State	RL	Local Name	Bore ID	GDA_E	GDA_N	DTW	WTRL	Conductivity	Salinity	Total Depth	Notes
		(m)			(m)	(m)	(m)		(mS/cm)	ppK	(m)	
Popiltah	NSW	73.08	T12s	T12s	546,896	6,336,049	39.38	33.70	57.4	36736.0	69	
Popiltah	NSW	72.80	T12b	T12b	546,904	6,336,062	35.28	37.52	21.4	13696.0	396	
Popiltah	NSW	72.60	T12d	T12d	549,060	6,336,337	35.34	37.26	17.7	11328.0	402	
Popiltah	NSW	71.16	T12e	T12e	546,665	6,336,086	33.84	37.32	16.9	10816.0	383	
Popiltah	NSW	56.01	T3	T3	547,556	6,347,882	18.3	37.71	16.3	10432.0	348	
Popiltah	NSW	43.91	T5	T5	544,999	6,341,053	6.68	37.23	19.9	12736.0	305	
Popiltah	NSW	57.05	T7	T7	543,908	6,336,278	20.75	36.30	19.2	12288.0	360	
Popiltah	NSW	43.49	T11	T11	540,026	6,335,895	7.07	36.42	24.7	15808.0	300	
Popiltah	NSW		Twin wells	10246	559,228	6,337,021	14.17	-14.17	35.2	22528.0	20.17	cement slab
Popiltah	NSW		PopWS		570,786	6,325,948	6.65	-6.65	1.7	1095.7		7.2m top of bore under mill
Popiltah	NSW		36818-1	36818-1	571,015	6,325,092	10.45	-10.45	14.7	9408.0	34	
Popiltah	NSW		38818-2	38818-2	571,015	6,325,092	10.85	-10.85	26.4	16896.0	60	
Coombah	NSW	57.0	Popio	600087	577,731	6,340,761	18	39.10	10.4	6656.0	306	
Quangdong	SA	138.0	CHW22	CHW22	462,661	6,343,261		138.00		0.0	61.6	under water couldn't test, dry Sept 14
Quangdong	SA	198.6	CHW23	CHW23	427,463	6,335,600	dry			0.0	9.85	
Quangdong	SA	198.6	CHW23A	CHW23A	427,458	6,335,585	73.88	124.72	10.1	6464.0	78.32	southern most
Scotia	NSW	53.89	Ennisvale	600002	515,543	6,324,897	17.2	36.69	10.0	6400.0	168	
Scotia	NSW	51.98	Elliots	009725	508,476	6,317,567	22.73	29.25	2.4	1535.4	90.26	under tree
Scotia	NSW	32.96	Tarrara	004704	520,503	6,318,319	0	32.96	20.9	13376.0	189?	water level at collar
Springwood	NSW	46.83	T9s	T9s	541,659	6,322,518	16.18	30.65	59.7	38208.0	48	
Springwood	NSW	47.18	T9b	T9b	541,659	6,322,508	9.86	37.32	17.2	11008.0	381	
Springwood	NSW	44.16	T9e	T9e	541,819	6,322,569	7.23	36.93	16.4	10496.0	353	
Springwood	NSW	35.43	T9d	T9d	542,529	6,323,277	4.85	30.58	16.9	10816.0	384	fault in bore
Springwood	NSW	48.68	T15	T15	550,365	6,325,582	11.12	37.56	16.0	10240.0	408	
Springwood	NSW		Marias		548,572	6,316,536	2.5	-2.50	6.1	3891.2	2.8	Perched Water
SouthIta	NSW	85.0	SthItaN1	034967	544,823	6,375,642	45.98	39.02	13.8	8832.0	87.7	under mill
SouthIta	NSW	85.0	SthItaN2		544,823	6,375,647	47.78	37.22	19.4	12416.0	57.5	5m west of nth bore under tin
SouthIta	NSW		SthItaH	House	547,894	6,370,166		0.00		0.0		No access
SouthIta	NSW		SthItaS	010624	547,823	6,366,224		0.00		0.0		Blocked
SturtVale	SA	129.1	CHW25	CHW25	404,843	6,329,726	74.35	54.78	3.7	2394.9	78.32	
SturtVale	SA	128.3	CHW24	CHW24	404,851	6,329,731	88.27	40.02	11.6	7424.0	134.92	under mill / pick collar attachment
SturtVale	SA	103.2	CHW44	CHW44	399,187	6,310,742	63.75	39.43	6.5	4160.0	74.25	
Tarawi	NSW	33.27	Canegrass	060786	527,334	6,304,061	-3.5	36.77	9.5	6075.5	205	

Property	State	RL	Local Name	Bore ID	GDA_E	GDA_N	DTW	WTRL	Conductivity	Salinity	Total Depth	Notes
		(m)			(m)	(m)	(m)		(mS/cm)	ppK	(m)	
Warwick	NSW	29.2	36722_1	36722_1	531,797	6,277,302	6.16	23.07	50.3	32192.0	40.6	
Warwick	NSW	29.2	36722_2	36722_2	531,797	6,277,305	-3.4	32.63	18.4	11776.0	231	
Warwick	NSW	29.2	36722_3	36722_3	531,797	6,277,308	-4.85	34.08	14.1	9024.0	421	
Wonga	NSW	195.7	W1	W1	514,717	6,412,244	85.55	110.13	20.6	13184.0	100	
Wonga	NSW	187.6	W2	W2	513,856	6,410,267	82.63	104.94	13.1	8384.0	150	
Woodlands	NSW		Woodlands		573,739	6,321,683	8.16	-8.16	0.9	572.2		11m top of pump
Woodlands	NSW		WHouse		585,477	6,320,922	12.7	-12.70	0.8	512.0	21.55	under tin
Woodlands	NSW		Allens		571,795	6,316,340		0.00		0.0		pump installed no access
Woolgangi	SA	131	CHW26	CHW26	362,239	6,292,298	53.2	77.83	8.4	5357.4	78.8	
Woolcunda	NSW		Wwoolshed	011495	548,354	6,355,741	5	-5.00	9.0	5770.2	370?	newly drilled
Woolcunda	NSW		Bennetts		532,411	6,359,327		0.00	12.7	8128.0	160	No access
Woolcunda	NSW		BBoy		538,748	6,359,058		0.00	7.7	4908.2	202	No access
Woolcunda	NSW	47	Wlake	56306	542,924	6,351,588			11.4	7296.0		sample only
Gov Bores Sampled												
Backwell	NSW	76.78	36840_1	36840_1	560,960	6,390,860	39.21	37.57	3.1	1998.7	46	slots 35-40m hs 40m
Backwell	NSW	75.73	36840_2	36840_2	560,960	6,390,866	37.54	38.19	2.9	1875.2	80	slots 74-80m hs 75m
Backwell	NSW	76.78	36840_3	36840_3	560,960	6,390,863	36.97	39.81	2.7	1702.4	107	slots 101-107m hs 103m
Backwell	NSW	76.67	36840_4	36840_4	560,960	6,390,870	36.98	39.69	2.4	1529.6	143	slots 137-143m 144m
Coombah	NSW	44.52	36843_1	36843_1	556,698	6,356,646	10.52	34.00	20.6	13184.0	52	slots 46-52m hs 53m
Coombah	NSW	44.49	36843_2	36843_2	556,698	6,356,643	8.23	36.26	17.8	11392.0	128	slots 116-128m hs 117
Coombah	NSW	44.49	36843_3	36843_3	556,698	6,356,640	5.54	38.95	5.3	3385.0	329	slots 305-328m hs 120m blocked 128m
Tandou	NSW	69.53	87808		590,872	6,382,408	33.54	35.99	13.6	8704.0		
Tandou	NSW	71.68	87809		591,367	6,379,511	35.85	35.83	14.1	9024.0		
Tandou	NSW	55.40	36816_1		600,413	6,380,011	17.08	38.32	11.1	7104.0		
Tandou	NSW	55.40	36816_2		600,413	6,380,011	17.06	38.34	7.7	4915.2		
Tandou	NSW	55.60	36838_1		600,410	6,380,000	16.15	39.45	7.7	4915.2		
Tandou	NSW	55.60	36838_2		600,410	6,380,000	16	39.60	5.4	3449.6		
Tandou	NSW	55.60	36838_3		600,410	6,380,000	16.86	38.74	10.8	6912.0		
Yelta	NSW	59.15	36670_1	36670_1	579,157	6,315,896	24.12	35.03	13.2	8448.0	43	slots ? Hs 35m
Yelta	NSW	58.92	36670_2	36670_2	579,134	6,315,883	24.03	34.89	17.5	11200.0	72	slots 60-70m hs 55m blocked 62m
Yelta	NSW	59.39	36670_3	36670_3	579,155	6,315,881	26.19	33.20	25.7	16448.0	196	slots 184-196m hs 180 blocked 185m
Yelta	NSW	59.14	36670_4	36670_4	579,146	6,315,889	24.25	34.89	24.3	15520.0	147	blocked?
Bun	NSW	56.90	36849_1	36849_1	570,685	6,284,067	25.65	31.25	15.5	9920.0	56	slots 45-51m hs 46m

Property	State	RL	Local Name	Bore ID	GDA_E	GDA_N	DTW	WTRL	Conductivity	Salinity	Total Depth	Notes
		(m)			(m)	(m)	(m)		(mS/cm)	ppK	(m)	
Bun	NSW	56.88	36849_2	36849_2	570,681	6,284,067	21.21	35.67	12.5	8000.0	306	slots 295-301m hs 296m
Bun	NSW	56.77	36849_3	36849_3	570,688	6,284,067	22.48	34.29	12.7	8128.0	446	slots 428-440m hs 277m Blocked 300m

APPENDIX E

CALIBRATION AND BOUNDARY BOREHOLE DATA

ID	GDA_E	GDA_N	SWL	Locality	~Salinity	Screen (mbgl)		Model
	(m)	(m)	(m AHD)		mg/L	from	to	Slice
GW088300_1	589898	6224986	30.48	TandouTps	7566	37	43	1
GW088307_1	583971	6225103	30.69	TandouTps	7729	54	60	1
GW088273_1	575171	6225428	27.01	Tandou	6650	104	113	1
GW088299_1	590732	6226910	29.91	Tandou	4739	195	201	1
GW088058_1	583860	6227004	27.85	Tandou	10615	305	311	1
GW087614_1	569835	6227710	26.89	TandouTps	19370	57.5	58	1
GW600188_1	589147	6228068	29.64	TandouTps	13715	57.5	58	1
GW088480_1	610250	6228919	31.34	TandouTps	14300	57.5	58	1
GW088304_1	607401	6228948	31.74	LkMindona/Wycot	20000	43	49	1
GW600189_1	589982	6230284	29.95	Backwell	4590	74	80	1
GW600192_1	581586	6230709	28.77	Backwell	4050	101	107	1
GW600191_1	582433	6234499	28.97	Backwell	4510	137	143	1
GW600190_1	582493	6234734	30.09	NagaelaN	8645		166.7	1
GW088243_1	592646	6246399	29.19	NagaelaS	9685		192	1
GW088459_1	589017	6252861	29.50	WWoolshed	4284		237.7	1
GW087594_1	594673	6254588	30.84	Coombah	6156		308.4	1
GW036809_1	595193	6256448	31.25	Popio	6760		309	1
GW087612_1	597733	6258128	31.73	Elliots	7345		176.8	1
GW087584_1	596613	6258392	32.02	Ennisvale	11180		160	1
GW040357_1	590451	6259880	29.98	Winnebaga	12800		204.5	1
GW036811_1	637491	6283277	34.09	Canegrass	12415		205	1
GW036820-2	611367	6286600	33.07	Coombah	46400	46	52	1
GW088207_1	643761	6289329	34.12	Coombah	6810	305	323	1
GW088457_1	640207	6291446	34.35	Popiltah	33475	24	32	1
GW500581_1	625022	6299293	34.15	Popiltah	9000	288	294	1
GW040368_1	643160	6302028	36.42	Popiltah	12600	289	295	1
GW036670_1	579157	6315896	35.39	Popiltah	13300	276	282	1
GW036668_1	650285	6336137	39.76	Popiltah	10700	336	342	1
GW036911_1	672339	6352453	38.47	Popiltah	47000	63	66	1
GW036785_1	654819	6375870	39.34	Popiltah	10500	372	387	1
GW036786_1	715116	6380597	45.45	Popiltah	10500	384	390	1
GW036812_1	631608	6384340	44.54	Popiltah	10500	374	380	1
GW036815_1	610367	6385517	41.83	Springwood	10000	372	378	1
GW036840_2	560960	6390866	39.36	Springwood	40625	42	45	1
GW040804_2	628823	6391479	47.66	Springwood	10000	342	360	1
GW087806_1	639562	6411014	45.65	Springwood	10000	343	349	1
GW087787_1	655484	6413675	45.86	Yelta	18200	39	43	1
GW036813_1	638952	6416219	48.33	Yelta	28800	60	72	1
GW087789_1	650710	6416588	46.00	Yelta	15763	259	322	1
GW087786_1	644894	6418444	48.37	Bunn	32300	45	51	1
GW087788_1	642284	6422048	52.25	Bunn	17900	295	301	1
GW087798_1	660349	6423998	47.95	Bunn	18900	428	440	1
GW087791_1	650322	6431444	56.31	Warwick	34320	16	32	1
GW036837_1	659542	6434919	54.32	Warwick	17745	226	231	1
GW087796_1	664679	6437268	55.33	Warwick	13910	411	421	1
GW087127_1	616887	6207232	34.08	LakeVic	59865	42	48	2
GW087123_1	616730	6213917	33.87	LakeVic	20000	160	172	2
GW087124_1	618185	6214315	33.17	LakeVic	20000	264	276	2

ID	GDA_E	GDA_N	SWL	Locality	~Salinity	Screen (mbgl)		Model
	(m)	(m)	(m AHD)		mg/L	from	to	Slice
GW087125_1	619119	6214952	32.95	LakeVic	20000	448	460	2
GW087820_1	607225	6218130	30.83	LakeVic	43550	30	42	2
GW088464_1	607971	6218427	31.44	LakeVic	20000	200	212	2
GW088218_2	554737	6219598	25.59	LakeVic	20000	323	335	2
GW088462_1	607814	6220167	30.01	LakeVic	54600	12	15	2
GW088293_1	603477	6220266	30.95	lake Vic	57655	36	42	2
GW087320_1	607576	6220525	30.59	LakeVic	75205	54	60	2
GW088466_1	606677	6220714	31.03	lake Vic	7326	45	49	2
GW088288_1	604212	6221550	31.08	lake Vic	44748	6.75	7.75	2
GW087573_2	606992	6222182	32.19	lake Vic	39455	27.76	28.76	2
GW088301_1	607742	6222644	31.52	LakeVic	41730	6.98	7.98	2
GW087071_1	615081	6222740	31.90	LakeVic	40560	10.4	11.4	2
GW088473_1	608056	6222764	30.90	LakeVic-Wentworth	28314	25.8	26.8	2
GW088306_1	607165	6222855	31.43	WentworthW	49595	44	50	2
GW088472_1	606796	6222921	30.42	PoonNE	34392	42	49	2
GW088289_1	599177	6223010	31.07	PoonNE	34392	76	82	2
GW087575_1	604696	6223182	31.71	PoonNE	29601	288	300	2
GW088479_1	610156	6223556	30.24	Pooncarie	2550	15.25	16.25	2
GW500586_3	537042	6223767	23.05	Pooncarie	584	25	29	2
GW088298_1	604804	6224237	31.12	Pooncarie	34710	7.05	7.55	2
GW087619_1	549056	6224318	23.74	Poon	540	23.9	24.9	2
GW087519_1	613798	6224321	31.08	Poon	5395	45	57	2
GW088295_1	599976	6224459	31.89	PoonS	2269	19	73	2
GW088296_1	601125	6224484	32.05	PoonS	2249	79	79	2
GW088471_1	605901	6225343	30.93	Manilla	29601	45	51	2
GW088302_1	606035	6225441	31.42	Manilla	29601	184	200	2
GW088297_1	601247	6225854	32.23	Manilla	14000	330	336	2
GW088474_1	607675	6225938	30.16	Ginkgo	23270	68	71	2
GW600024_1	596105	6226156	30.79	Ginkgo	26780	68	71	2
GW036908_2	605739	6226391	31.36	Ginkgo	13000	307.6	310.6	2
GW600023_1	595778	6226459	30.72	Greenvale	255	4.74	7.74	2
GW088482_1	596124	6226512	30.85	ChalkyWell	215	1.77	4.77	2
GW088453_1	557594	6227054	25.30	CNW	33735	34.5	37.5	2
GW088481_1	606284	6227484	30.43	Trelega	23725	74	77	2
GW088477_1	610939	6227974	29.95	Snapper	28925	42	45	2
GW087056_1	605579	6228667	32.26	Snapper	18980	65.5	68.5	2
GW036910_3	598849	6229177	31.41	Snapper	14950	321	324	2
GW088476_1	608536	6229367	29.58	Snapper	20345	55	58	2
GW087606_1	619131	6229578	30.95	Nob Road	24570	53	56	2
GW087060_1	600015	6231495	30.98	Nob Road	13715	312	315	2
GW087622_1	550132	6232194	23.49	Nob Road/South Tank	1261	47	50	2
GW088456_1	514580	6232295	21.22	Snapper North	25870	47	50	2
GW087533_1	612364	6232451	29.70	Snapper Sandy Dam	24050	47	50	2
GW087067_1	599195	6232587	30.80	Salt Lake	33735	15	21	2
GW087607_1	624082	6234228	30.30	Burt	400	22	34	2
GW036784_1	585240	6234678	29.43	SWBurtundy	20000	29	35	2
GW087593_1	604078	6235978	29.76	SWBurtundy	20000	50	56	2
GW500598_3	543346	6236578	23.88	BurtS	715	16.65	17.65	2

ID	GDA_E	GDA_N	SWL	Locality	~Salinity	Screen (mbgl)		Model
	(m)	(m)	(m AHD)		mg/L	from	to	Slice
GW036782_1	512248	6241629	21.55	BurtS	1644	14.77	15.77	2
GW036966_1	534065	6242693	23.81	BurtS	482	21.18	22.18	2
GW036851_1	537403	6246718	24.07	BurtSW	32565	30.7	31.7	2
CHW92	483893	6247418	17.44	Burtundy	36828	27.55	28.55	2
GW088454_1	526171	6248512	23.86	Burtundy	25090	49	55	2
GW088093_1	562103	6251429	27.95	Burtundy	2444	9	14	2
GW088096_1	569135	6252316	28.59	Burtundy	35620	54	60	2
GW088455_1	526149	6253158	22.29	Bulpunga	10199	26	39	2
GW036809_2	595193	6256448	30.84	Bulpunga	26715	0	0	2
CHW41	495802	6259778	19.59	Bulpunga	21125	29.2	30.2	2
GW088460_1	600430	6261100	31.18	WentworthW	26760	11.92	12.92	2
GW036810_1	615786	6263314	32.26	WentworthW	36036	16.85	17.85	2
GW036819_1	570888	6263735	30.41	Wentworth	4693	8.5	9.5	2
GW088458_1	623689	6271032	32.45	Wentworth	374	8.1	9.1	2
GW036722_1	531797	6277305	24.07	Curlwaa	24000	8.08	9.08	2
GW036811_2	637491	6283277	33.91	Curlwaa	23760	10.9	11.9	2
GW036849_1	570685	6284067	31.50	Curlwaa	33072	32.3	36.3	2
CHW11	441436	6284488	28.63	Curlwaa	26700	6.5	9.5	2
CHW2	493718	6286590	22.47	CurlwaaE	27120	31	41	2
GW600107	609652	6294967	34.27	CurlwaaE	26195	38	41	2
SM5-1	601843	6296319	32.69	CurlwaaE	28015	42	45	2
SM4	607267	6297154	34.17	WentworthN	26585	40	58	2
SM3	604593	6299984	33.69	WentworthN	20000	258	276	2
PW2	605795	6300540	35.19	WentworthN	20000	420	432	2
GW036788_1	648193	6301520	37.01	WentworthN	36660	24	28	2
SM2-1	606152	6301769	34.51	WentworthN	37080	24	28	2
GW036669_1	612184	6302401	36.20	WentworthN	28500	30	33	2
GW600105	621529	6302729	35.20	Coomeala	47450	56	62	2
PW1	603487	6302863	35.28	Coomeala	43420	17.51	19.34	2
SM1	601902	6305148	34.82	Coomeala	38675	19.64	21.47	2
GVale	619621	6310073	35.66	Coomeala	46332	21.71	22.71	2
GW600106	607661	6311329	34.67	Coomeala	1938	15.6	16.6	2
CHW4	490756	6311947	25.95	Coomeala	34500	33.77	34.77	2
GW036670_2	579134	6315883	35.30	Coomeala	34260	29.15	30.15	2
GW009725	508477	6317569	29.84	Coomeala	31740	33.95	34.95	2
600071	609271	6319827	36.36	Dareton	24900	23.2	24.2	2
GW016034	619116	6320369	37.86	Dareton	43380	11.74	12.74	2
T9s	541659	6322518	31.06	Dareton	15990	35.4	36.4	2
GW036818_1	571017	6325107	35.33	Dareton	14950	27.5	28.5	2
T12s	546896	6336049	33.75	Dareton	66820	38	44	2
GW036668_2	650285	6336137	39.23	Dareton	30060	23.32	24.32	2
GW036954_1	597525	6351194	37.37	Dareton	37920	21.5	22.5	2
GW036911_2	672339	6352453	38.79	Dareton	67600	38	44	2
GW036843_1	556698	6356646	34.23	Dareton	84435	43	51	2
OLY6	475496	6360609	39.08	DaretonN	17220	30.35	31.35	2
GW036785_2	654819	6375870	39.39	DaretonN	79105	42	48	2
GW087809_1	591365	6379509	35.38	DaretonN	54060	24.5	25.5	2
GW036838_1	600501	6379981	39.52	DaretonN	20000	50	56	2

ID	GDA_E	GDA_N	SWL	Locality	~Salinity	Screen (mbgl)		Model
	(m)	(m)	(m AHD)		mg/L	from	to	Slice
GW036912_1	684936	6380191	40.32	DaretonN	70265	18	24	2
GW087808_1	590869	6382410	36.61	DaretonN	38935	27.02	28.85	2
GW036812_2	631608	6384340	40.26	DaretonN	71100	8.42	9.42	2
GW036815_2	610367	6385517	41.80	DaretonN	87490	48	54	2
GW087807_1	592724	6387036	36.91	DaretonN	72345	38	44	2
GW036840_3	560960	6390863	39.92	DaretonN	44525	22	28	2
GW036967_1	606022	6395269	42.42	DaretonN	62140	43	51	2
GW040802_2	623835	6396366	45.30	DaretonN	53040	24.9	25.9	2
GW036993_1	610242	6399089	45.90	Arumpo	23010	6399083	6399089	2
GW036814_2	614753	6400323	47.44	Arumpo	30940	6400317	6400323	2
GW036992_1	622384	6400498	46.17	Buronga	100044	15	18	2
GW036990_1	622255	6405515	46.13	Buronga	7215	8.98	9.98	2
GW040838_1	610327	6409978	47.33	Buronga	104580	27	31	2
GW087799_1	659687	6410229	41.14	Buronga	4297	28.5	29.5	2
GW036887_1	720752	6410655	46.14	Buronga	91680	10	13	2
GW040837_1	626832	6410839	48.41	BurongaNE	38857	18.13	19.13	2
GW036991_1	622238	6412135	50.13	BurongaNE	17810	17.03	18.86	2
GW087803_1	633411	6412967	47.69	RedCliffs	436	29.96	31.79	2
GW036891_1	667578	6414305	41.69	RedCliffs	5265	24.97	26.8	2
GW040839_1	614366	6417069	50.53	RedCliffs	17095	22.58	23.8	2
GW036982_2	620812	6422299	52.37	RedCliffs	32760	26.96	28.79	2
GW087801_1	632376	6424845	52.37	SA-N	6630		198.6	2
GW036787_1	695310	6425847	46.31	SA-N	9750		90	2
GW087800_1	628719	6430591	51.18	SA-SE	15405		145	2
GW087792_1	646982	6431146	53.01	SA-SE	17095		50	2
GW087797_1	669407	6432901	46.72	SA-SE	11960		130	2
GW087790_1	647330	6435865	48.10	SA-SE	12350		130	2
GW036804_1	718483	6439585	46.88	SA-SE	27365		54	2
GW036836_1	680589	6442339	51.72	SA-SE	10075		415	2
GW036782_2	512248	6241629	28.21	SA-SE	13325		66	3
GW036851_3	537403	6246718	29.90	SA-SE	23985		60	3
CHW23	427611	6335804	37.78	SA-SE	14365		202.2	3
GW036912_2	684936	6380191	40.30	SA-SE	24895		48	3
GW036887_2	720752	6410655	45.70	SA-SE	35035		182	3
GW087801_2	632376	6424845	51.75	DarnickW	34034	28	34	3
GW036787_2	695310	6425847	46.65	DarnickW	34034	64	70	3
GW036804_2	718483	6439585	47.48	DarnickW	22425	103	115	3
GW036836_2	680589	6442339	51.59	DarnickNW	2200	18	30	3
GW036784_2	585240	6234678	36.95	DarnickNW	20000	120	126	4
GW036782_3	512248	6241629	32.35	DarnickNW	32533	177	183	4
CHW93	497789	6247292	26.86	DarnickNW	22750	37	49	4
CHW91	483886	6247437	24.45	DarnickNW	10400	73	79	4
CHW29	495932	6259940	29.00	DarnickNW	24050	107	113	4
CHW9	448815	6264515	28.94	DarnickNW	25350	159	171	4
GW036722_2	531797	6277305	33.90	CawndillaSE	1269	18.68	19.68	4
GW036849_2	570681	6284067	35.61	CawndillaSE	13908	14.43	15.43	4
CHW10	441436	6284488	33.06	Lake Cawndilla	7560	48	60	4
GW036669_2	612184	6302401	35.09	Cawndilla	5402	42	48	4

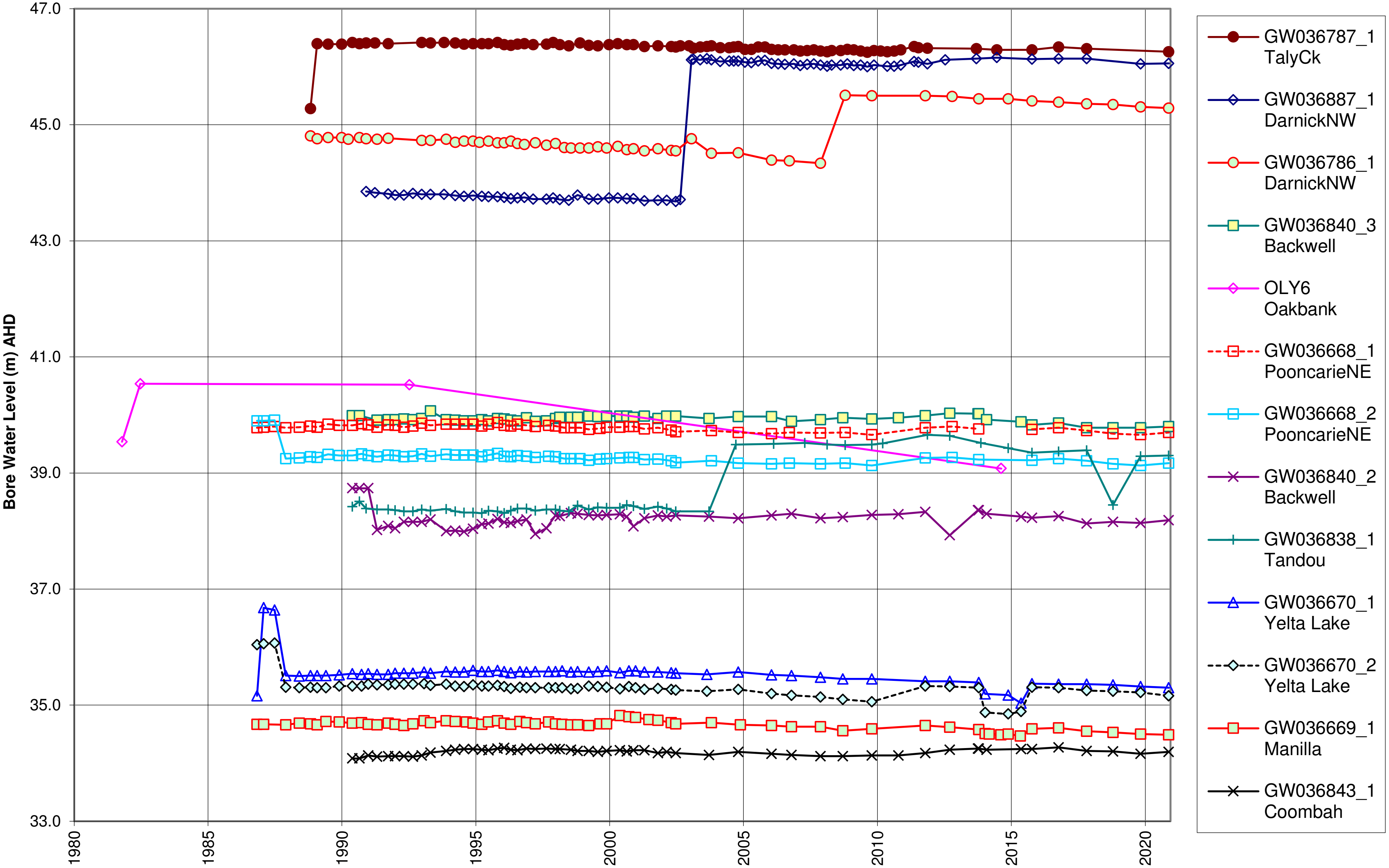
ID	GDA_E	GDA_N	SWL	Locality	~Salinity	Screen (mbgl)		Model
	(m)	(m)	(m AHD)		mg/L	from	to	Slice
GW600002	515543	6324897	36.77	Lake Cawndilla	1645	24	29	4
GW016577	529025	6343640	37.84	Lake Cawndilla	5876	25	29	4
GW005615	528817	6350460	38.00	Lake Cawndilla	6888	70	79	4
GW036911_3	672339	6352453	40.87	Menindee	417	17	17.5	4
GW036785_3	654819	6375870	39.38	LkMenindee	2015	41	53	4
GW036838_2	600501	6379981	39.79	Menindee	871	15.5	16	4
GW036912_3	684936	6380191	40.54	TalyCk	297	28.5	29	4
GW036786_2	715116	6380597	42.84	TalyCk	3372	30	33	4
GW036840_4	560960	6390870	39.98	TalyCk	711	23.6	24.1	4
GW036887_3	720752	6410655	45.65	TalyCk	2334	26	32	4
GW036891_2	667578	6414305	42.72	TalyCk	2334	127	139	4
GW036804_3	718483	6439585	46.93	Menindee	991	23	29	4
GW036836_3	680589	6442339	49.09	TalyCk	15470	24.5	25	4
GW036784_3	585240	6234678	33.86	Lake Menindee	11460	58	67	6
GW036782_4	512248	6241629	33.25	Menindee	18980	23.65	24.14	6
GW036851_4	537403	6246718	33.21	Menindee	2295	16	16.5	6
GW036722_3	531797	6277305	35.13	LkMenindee	448	54	60	6
GW036849_3	570688	6284067	34.52	TalyCk	9315	17	17.5	6
CHW31	448881	6289335	34.74	LkPamamaroo	13780	29	34	6
SM5-2	601843	6296319	35.36	LkPamamaroo	15015	70	77	6
SM2-2	606152	6301769	34.45	TalyCk	10673	48	54	6
GW036669_3	612184	6302401	35.45	TalyCk	5395	94	106	6
GW060786	527334	6304061	36.35	TalyCk	11570	168	174	6
M27-2	607659	6311329	35.71	LkPamamaroo	19500	76.5	77	6
GW009720	530932	6313825	36.60	Tandure	9840	26	31	6
GW036670_4	579146	6315889	35.34	BijijieLk	5616	15	18	6
T9b	541659	6322508	37.27	MundyCk	17940	28.75	29.25	6
T9e	541819	6322569	37.24	MundyCk	759	41	47	6
T15	550365	6325582	37.62	BijijieLk	23400	19.5	20	6
T11	540026	6335895	37.41	MundyCk	274	13	13.5	6
T12b	546904	6336062	37.48	TalyCk	13650	24	30	6
T12e	546665	6336086	37.86	TalyCk	163	50	62	6
GW036668_3	650285	6336137	36.81	TalyCk	6305	127	133	6
T7	543908	6336278	37.49	MundyCk	650	20	26	6
T12d	549060	6336337	37.41	MundyCk	865	52	58	6
GW600087	577731	6340761	38.71	MundyCk	4550	74	83	6
T5	544999	6341053	37.44	Lake Tandou	7716	54	60	6
T3	547556	6347882	38.34	PoonNE	34106	24	30	6
GW600086	558459	6351127	38.79	PoonNE	34106	61	67	6
GW036911_4	672339	6352453	38.72	PoonNE	36400	163	169	6
GW011495	548355	6355717	38.99	PoonNE	22425	201	213	6
GW036843_3	556698	6356640	39.05	PoonN	20000	30	36	6
GW036838_3	600501	6379981	38.57	PoonN	20000	113	119	6
GW036786_3	715116	6380597	42.88	PoonN	20000	200	206	6
GW036887_4	720752	6410655	45.50	CawndillaSE	1108	79	85	6
GW036787_3	695310	6425847	45.67	CawndillaSE	1098	26	32	6

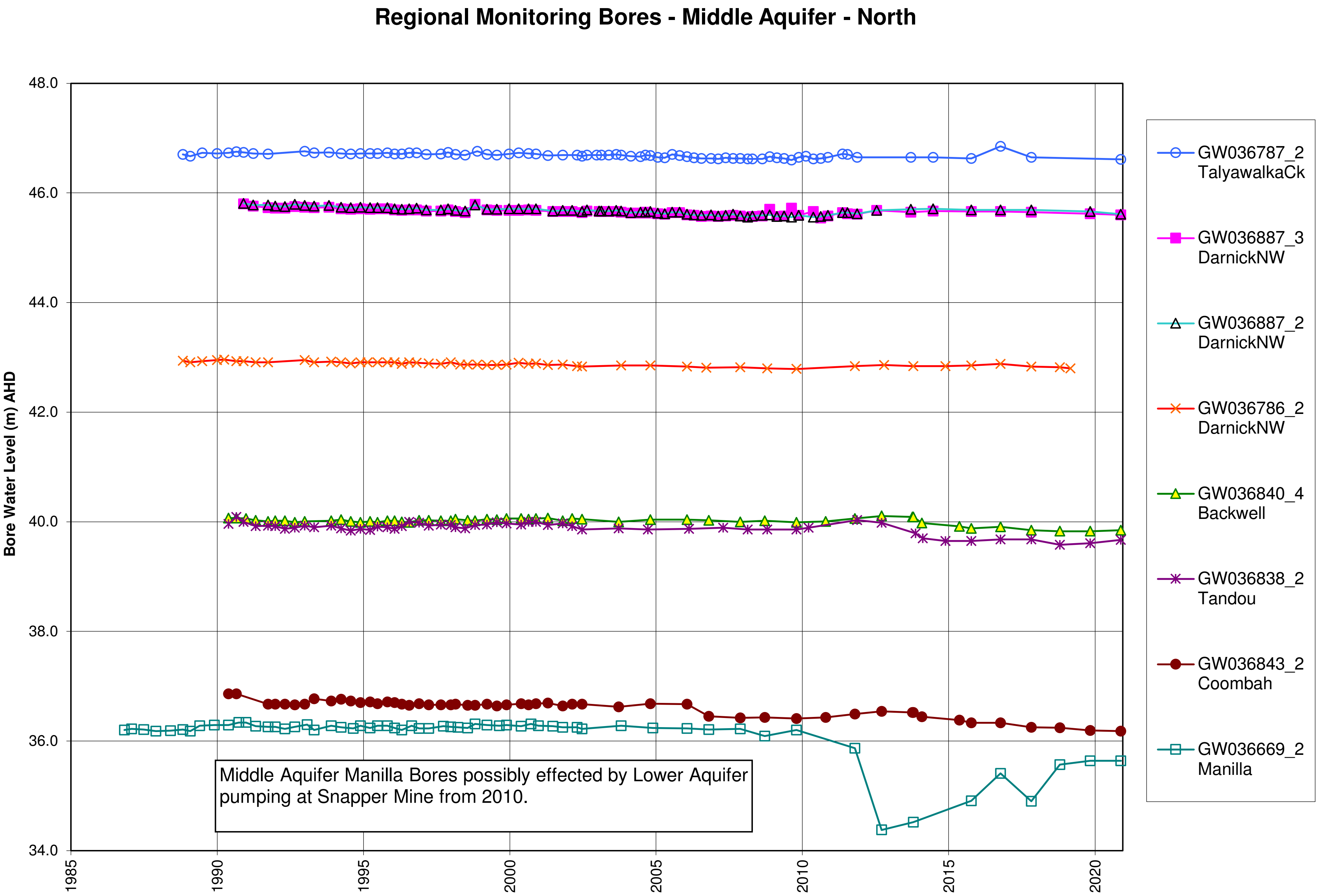
ID	GDA_E	GDA_N	SWL	Locality	~Salinity	Screen (mbgl)		Model
	(m)	(m)	(m AHD)		mg/L	from	to	Slice
Boundary								
GW036664_1	635747	6243570	38.39	BurtundySE	20000	53	65	2
GW036664_2	635747	6243570	33.42	BurtundySE	20000	153	173	4
GW036666_2	681515	6313244	42.41	PoonNE	10000	162	174	4
CHW28	387480	6263949	25.02	SA-N	17160		84	4
CHW44	399002	6310648	39.80	SA-N	11960		78	4
CHW24	404969	6329906	39.99	SA-N	8580		138	4
OLY7	466472	6379319	38.65	SA-N	10000		169	4
OLY9	494032	6382301	39.80	SA-N	10920		138	2
GW036665_2	687572	6338989	40.16	PoonNE	20000	87	89	2
GW036666_1	681515	6313244	38.59	PoonNE	8988	45	51	2
GW036667_2	673030	6276150	41.17	PoonE	20000	138	153	4
GW036664_3	635747	6243570	37.31	BurtundySE	20000	222	234	6
GW036914_1	749806	6395609	45.21	DarnickNW	28529	40	46	2
GW036914_2	749806	6395609	45.38	DarnickNW	28529	60	72	4
GW036879_1	767055	6425465	46.90	Bambilla	20800	35	41	2
GW036879_2	767055	6425465	46.89	Bambilla	33410	61	67	2
GW036881_1	739287	6448321	46.93	TalyCk	23400	28	40	2
GW036881_2	739287	6448321	47.05	TalyCk	23400	75	81	2
GW036881_3	739287	6448321	47.22	TalyCk	24700	109	121	4
GW036881_4	739287	6448321	45.46	TalyCk	325	159	165	7
GW036807_1	691672	6460629	49.31	MundyCk	7748	50	56	4
GW036807_2	691672	6460629	51.40	MundyCk	7748	92	98	2
KarsSB	607004	6436267	43.88	Menindee-Bk Hill Rd			123	2

APPENDIX F

HYDROGRAPHS OF REGIONAL MONITORING BORES

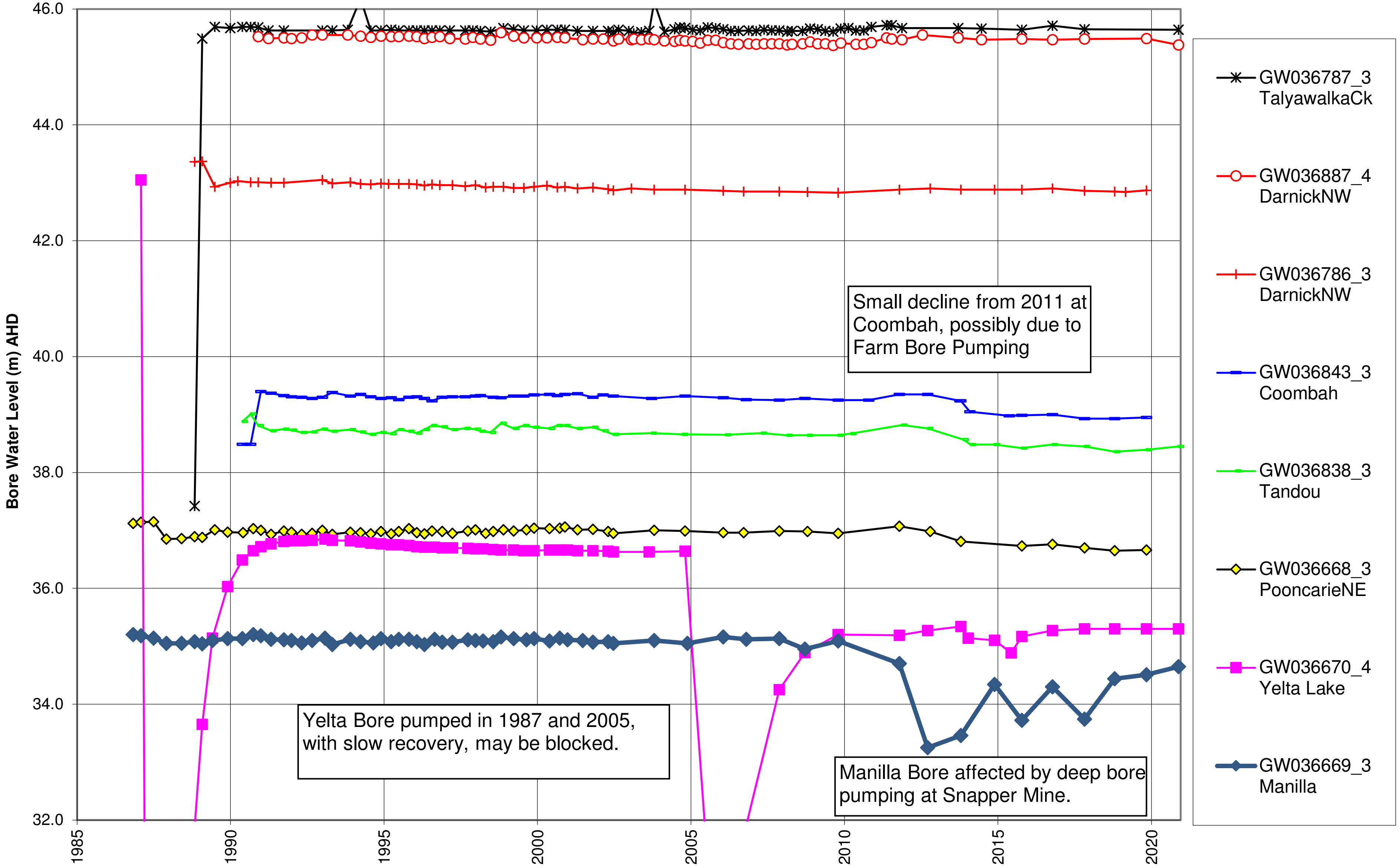
Regional Monitoring Bores - Upper Aquifer - North





Middle Aquifer Manilla Bores possibly effected by Lower Aquifer pumping at Snapper Mine from 2010.

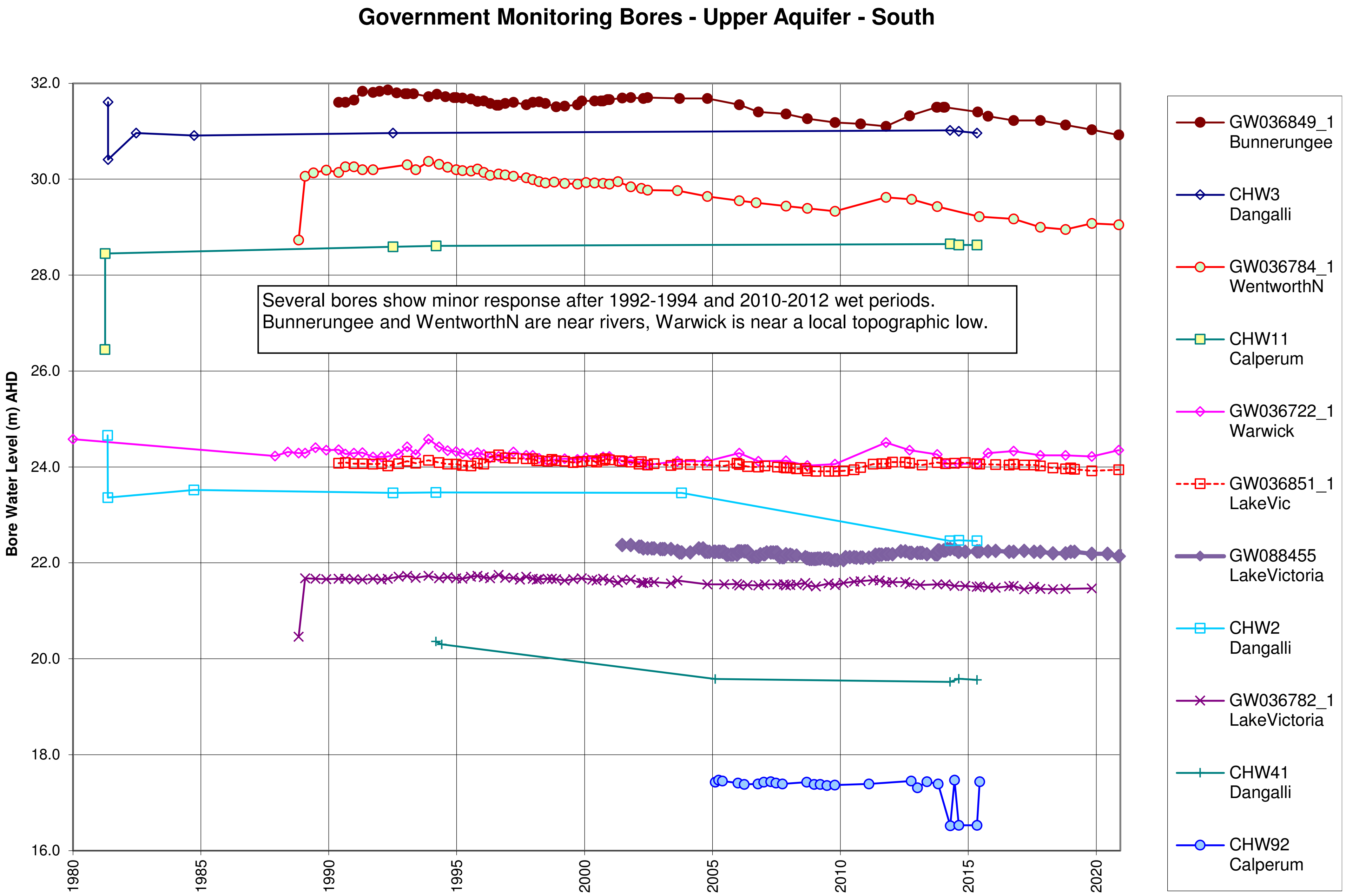
Regional Monitoring Bores - Lower Aquifer - North



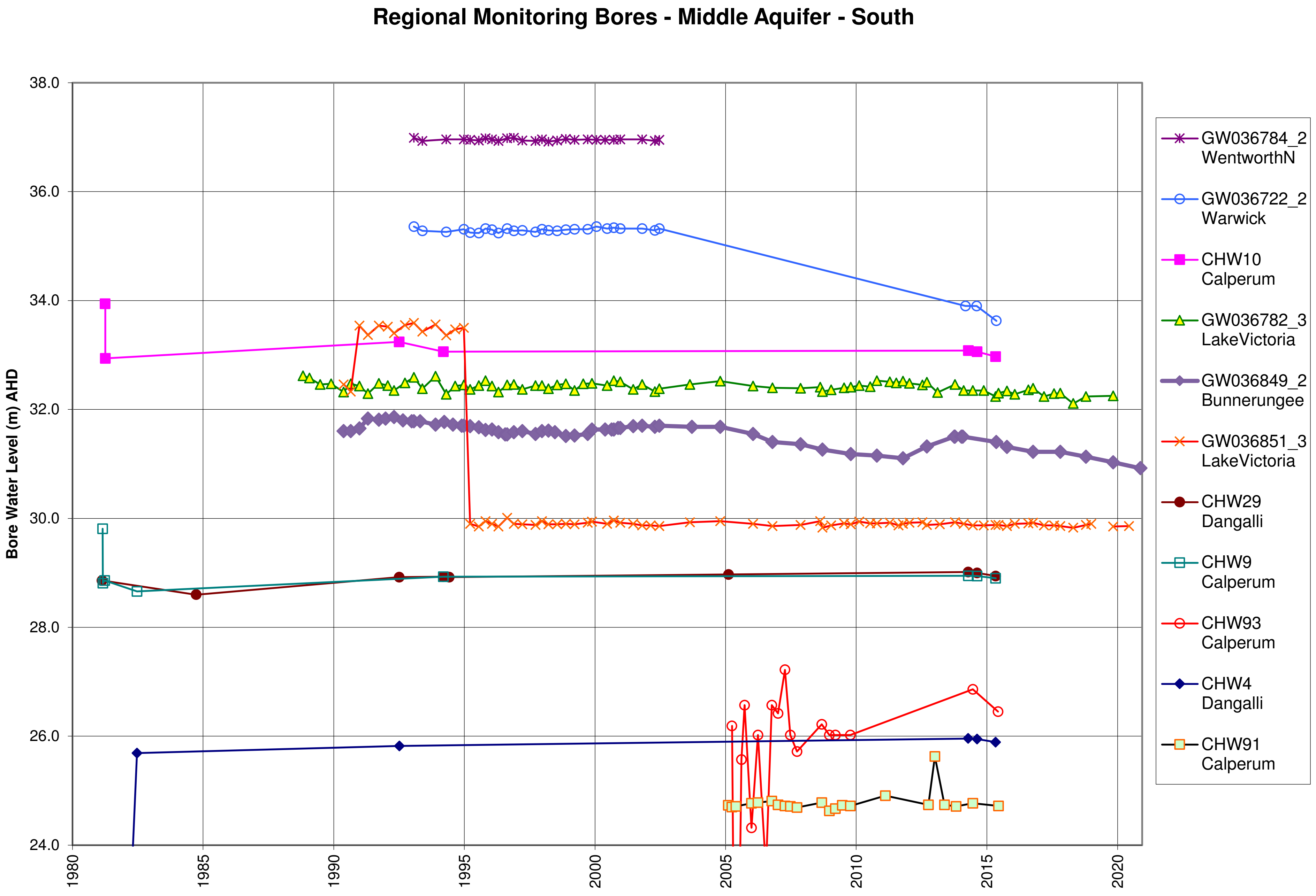
Small decline from 2011 at Coombah, possibly due to Farm Bore Pumping

Yelta Bore pumped in 1987 and 2005, with slow recovery, may be blocked.

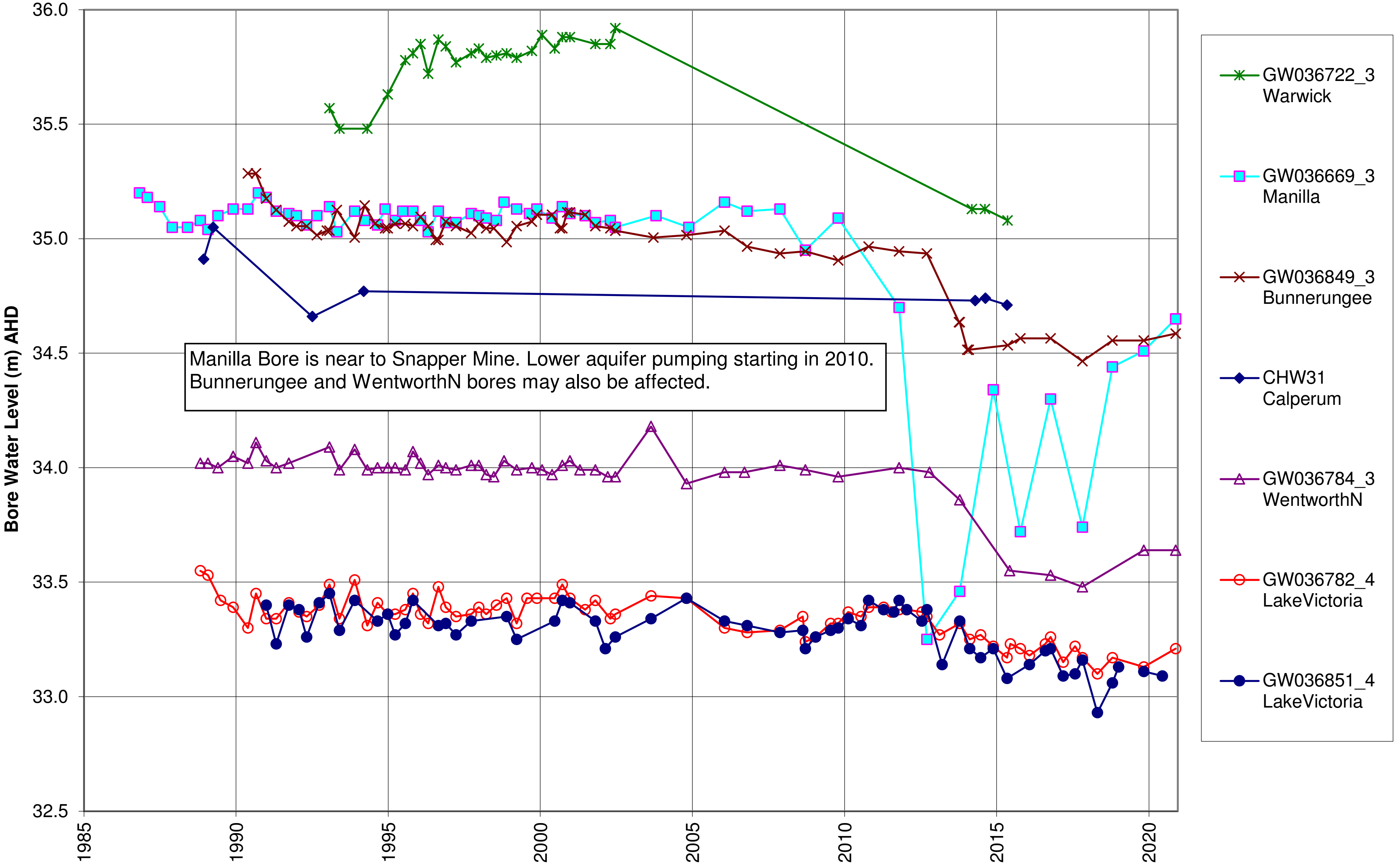
Manilla Bore affected by deep bore pumping at Snapper Mine.



Several bores show minor response after 1992-1994 and 2010-2012 wet periods.
Bunnerungee and WentworthN are near rivers, Warwick is near a local topographic low.


Regional Monitoring Bores - Middle Aquifer - South
Bore Water Level (m) AHD
38.0
36.0
34.0
32.0
30.0
28.0
26.0
24.0
1980
1985
1990
1995
2000
2005
2010
2015
2020
GW036784_2 WentworthN
GW036722_2 Warwick
CHW10 Calperum
GW036782_3 LakeVictoria
GW036849_2 Bunnerungee
GW036851_3 LakeVictoria
CHW29 Dangalli
CHW9 Calperum
CHW93 Calperum
CHW4 Dangalli
CHW91 Calperum

Regional Monitoring Bores - Lower Aquifer - South

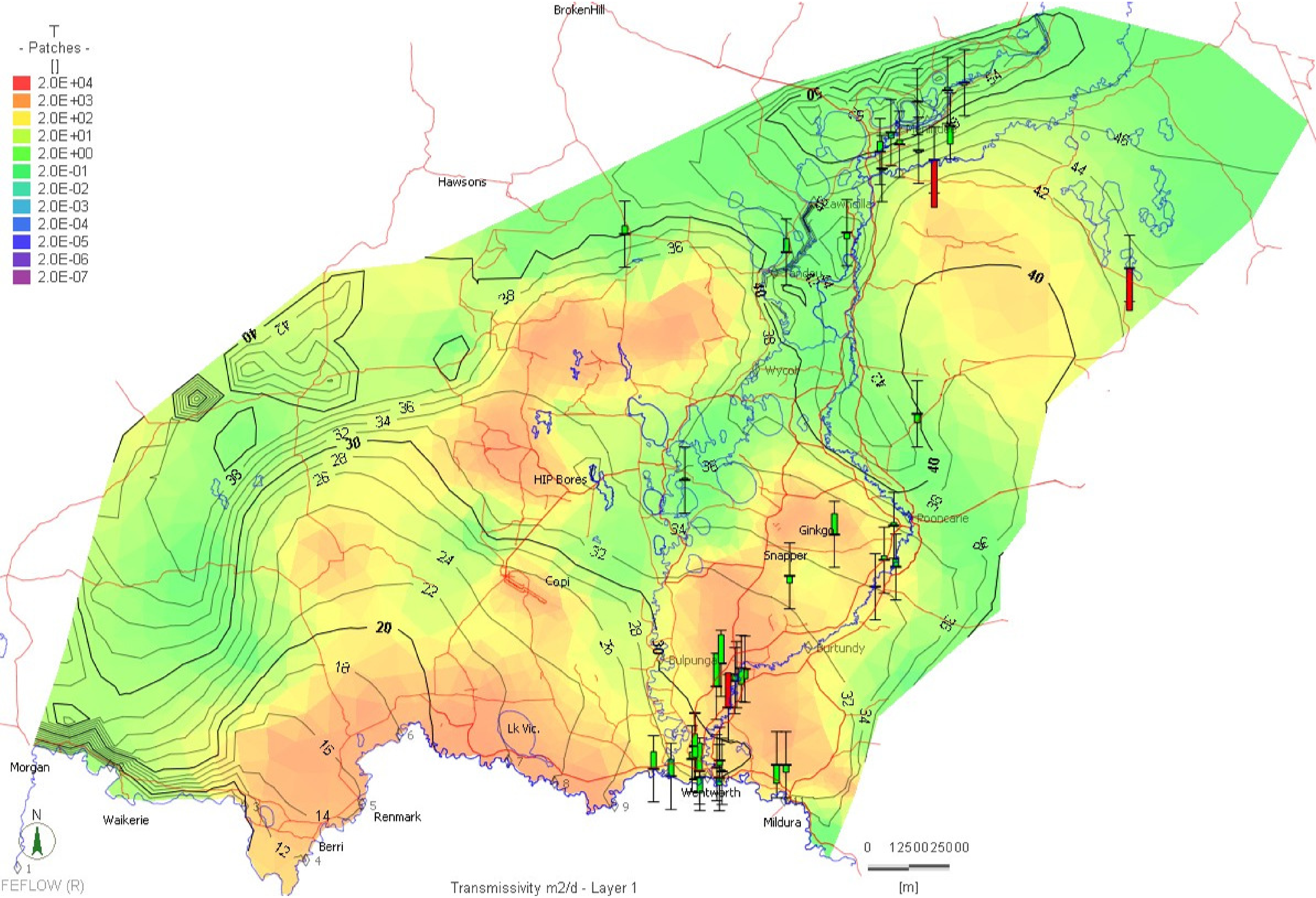


Manilla Bore is near to Snapper Mine. Lower aquifer pumping starting in 2010.
Bunnerungee and WentworthN bores may also be affected.

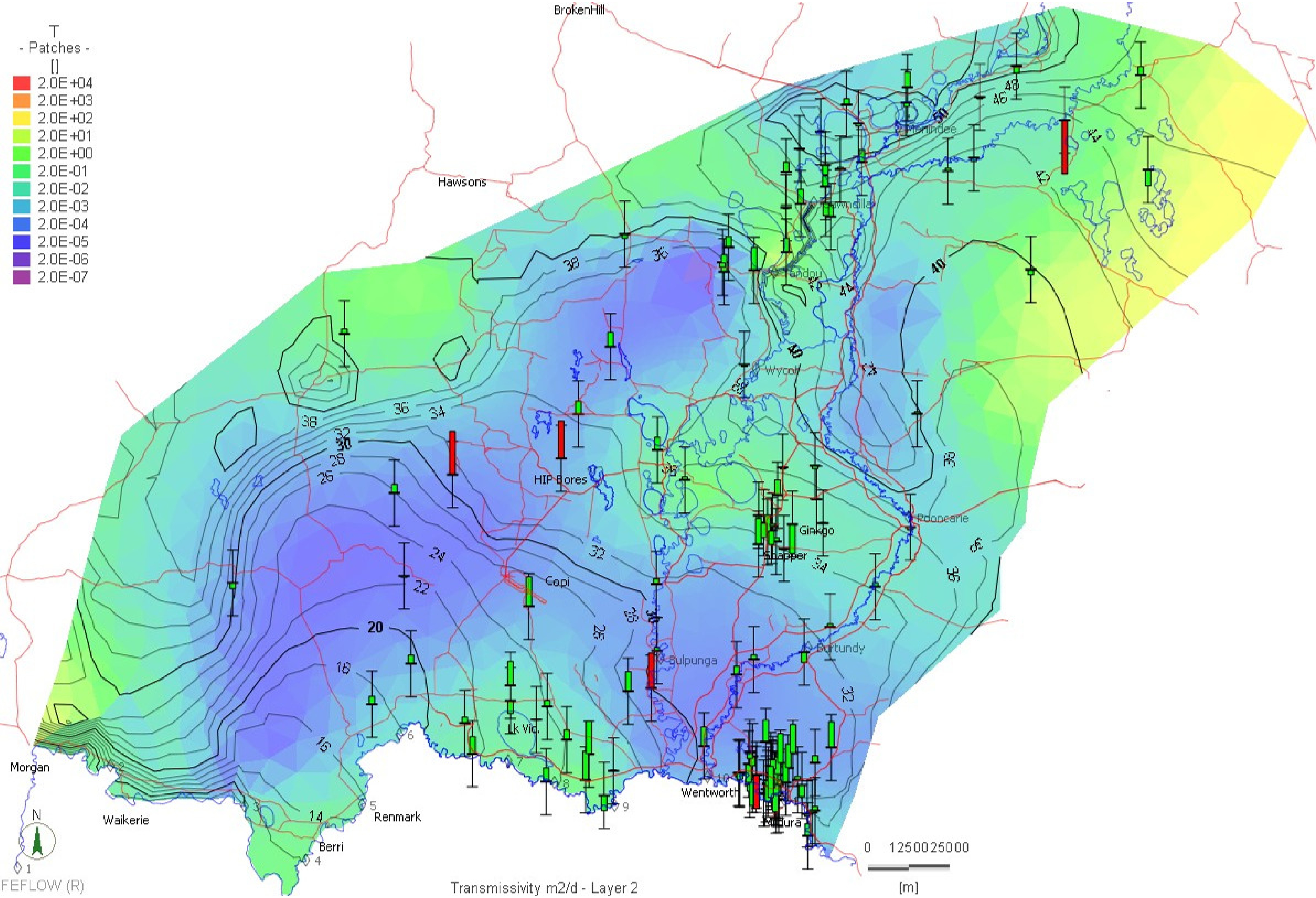
APPENDIX **G**

TRANSMISSIVITY (T) FOR SMOOTH SCENARIO
LAYERS 1–6

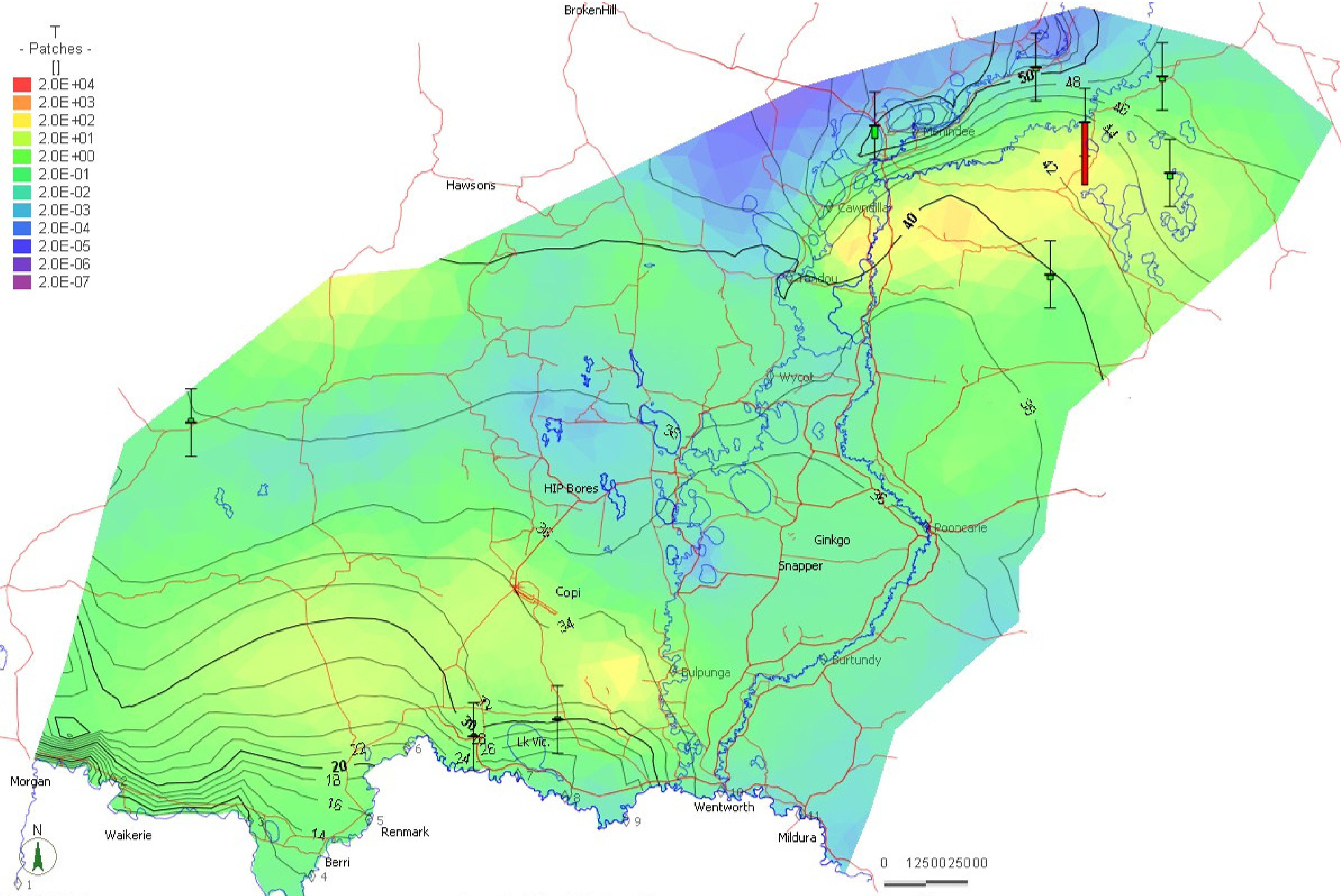
Vertical scale bars indicate model fit to measured monitoring bore levels.
Scale bar is +/-1.5m.



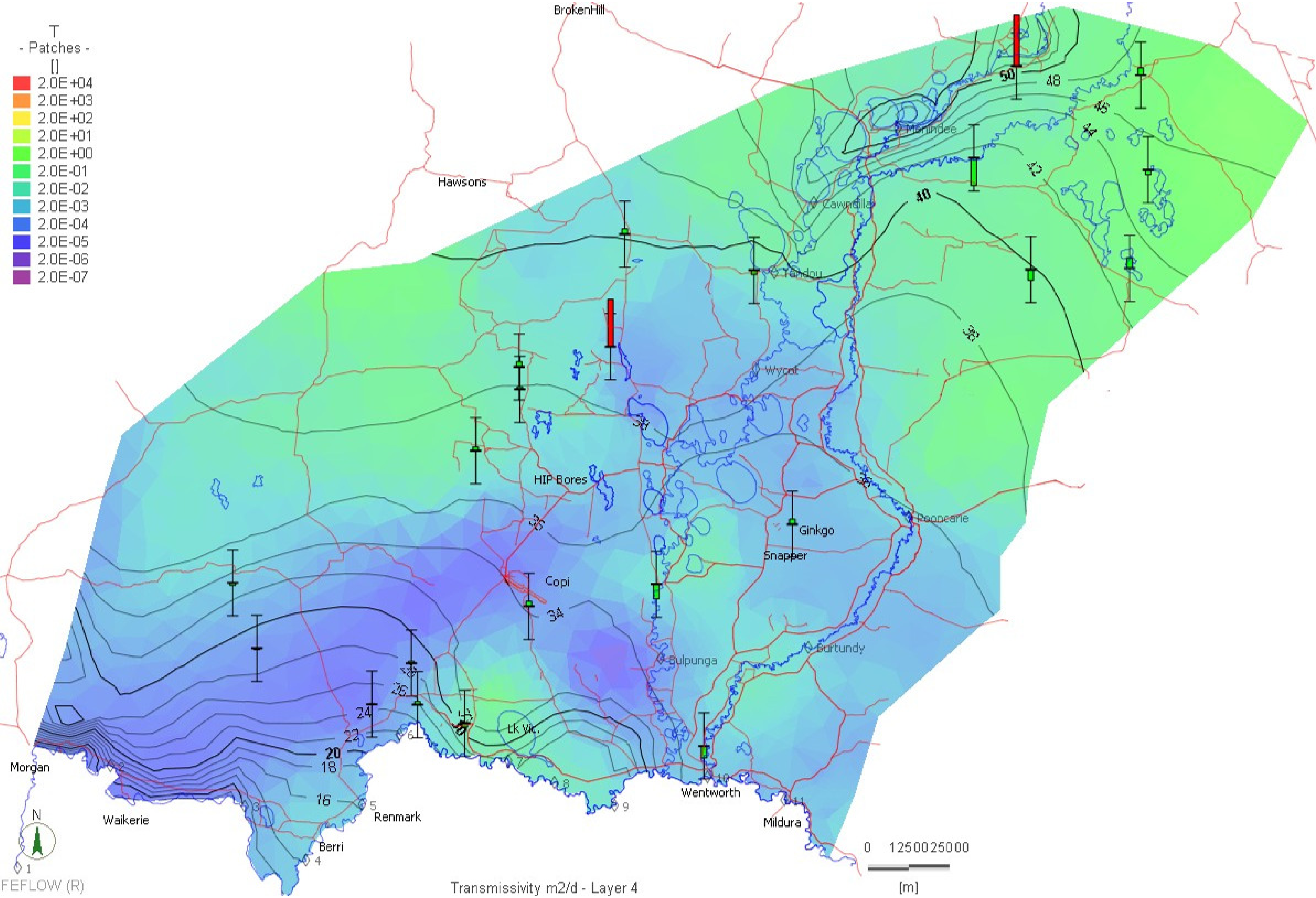
Transmissivity m2/d - Layer 1



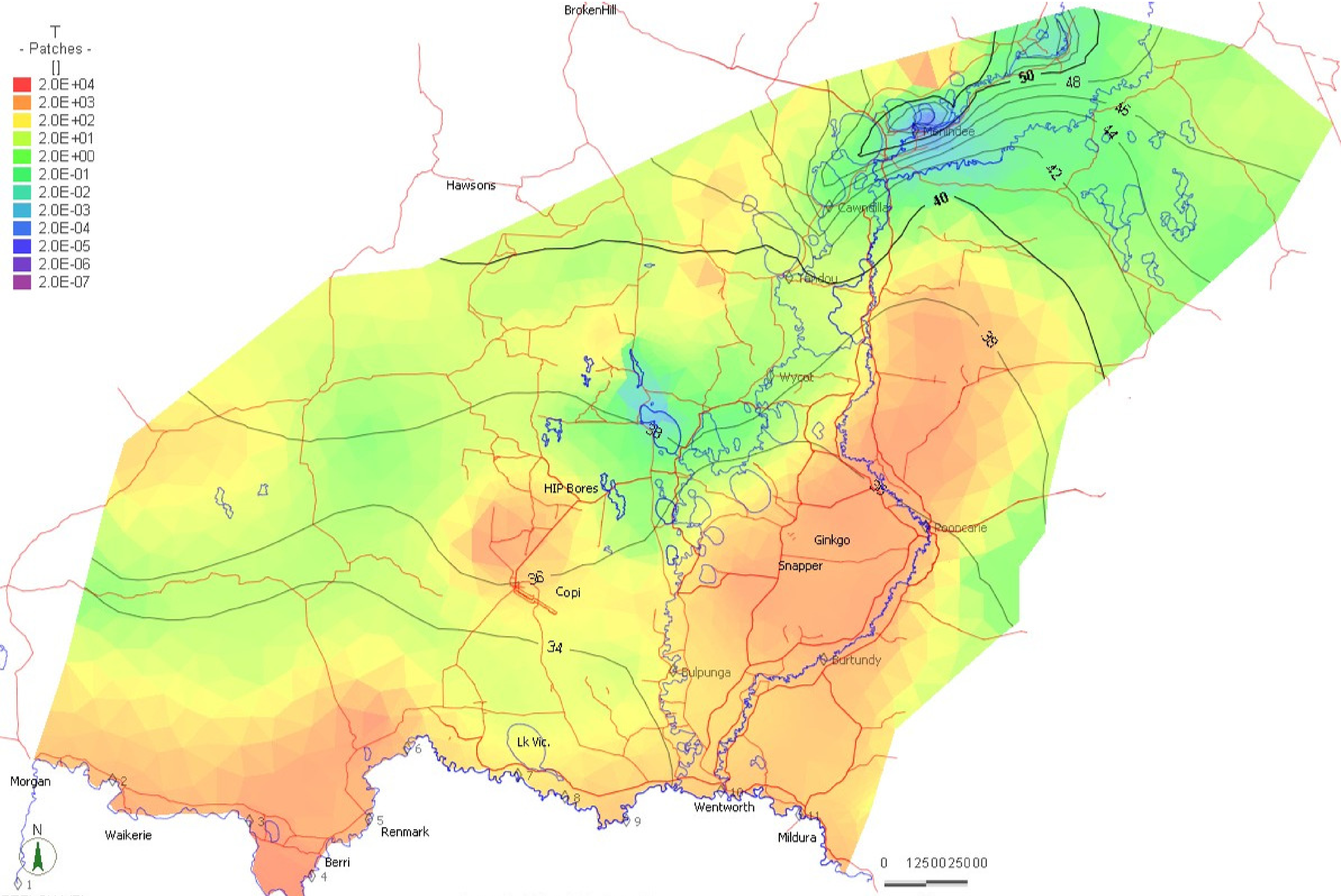
Transmissivity m2/d - Layer 2



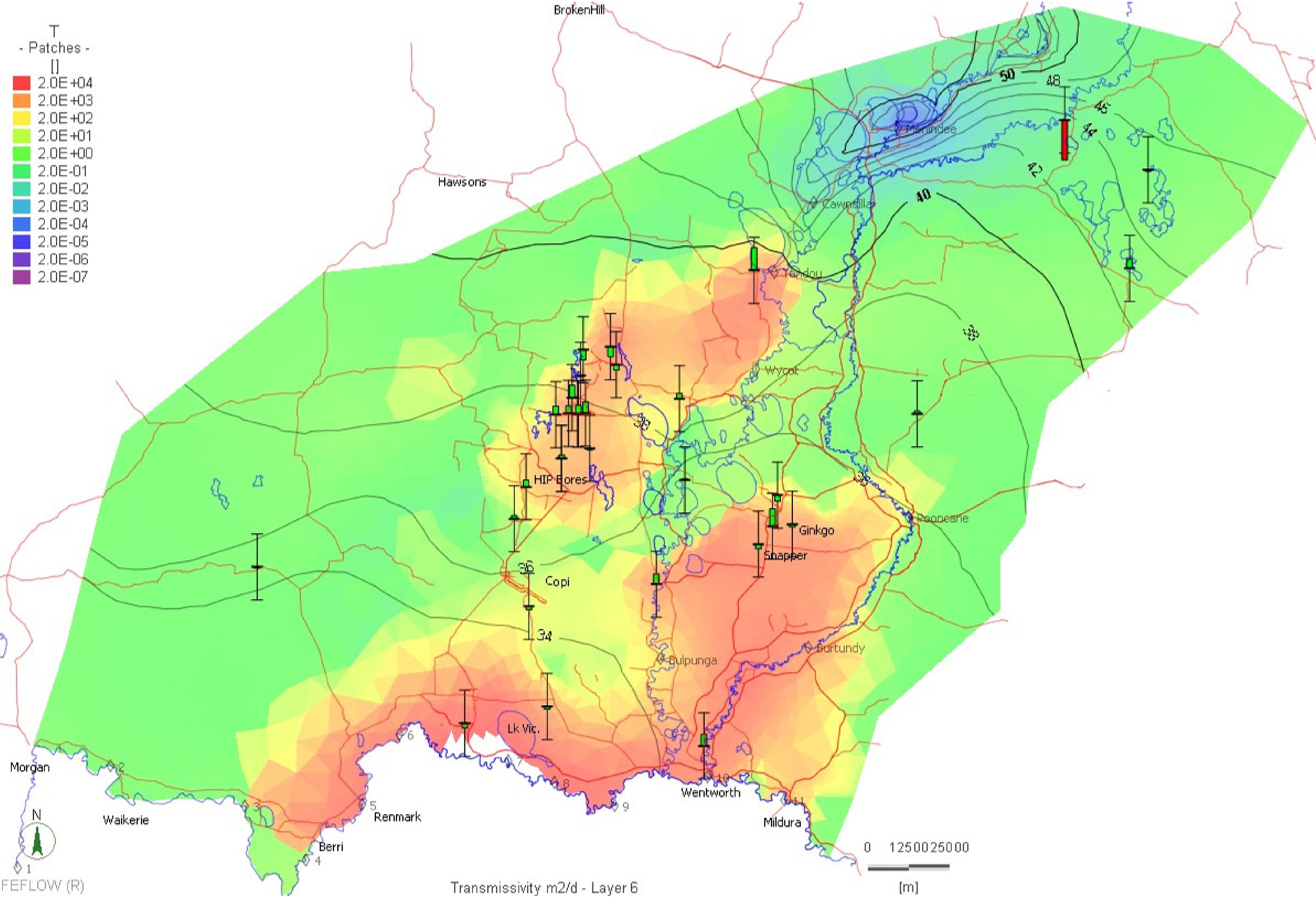
Transmissivity m2/d - Layer 3



Transmissivity m2/d - Layer 4



Transmissivity m2/d - Layer 5

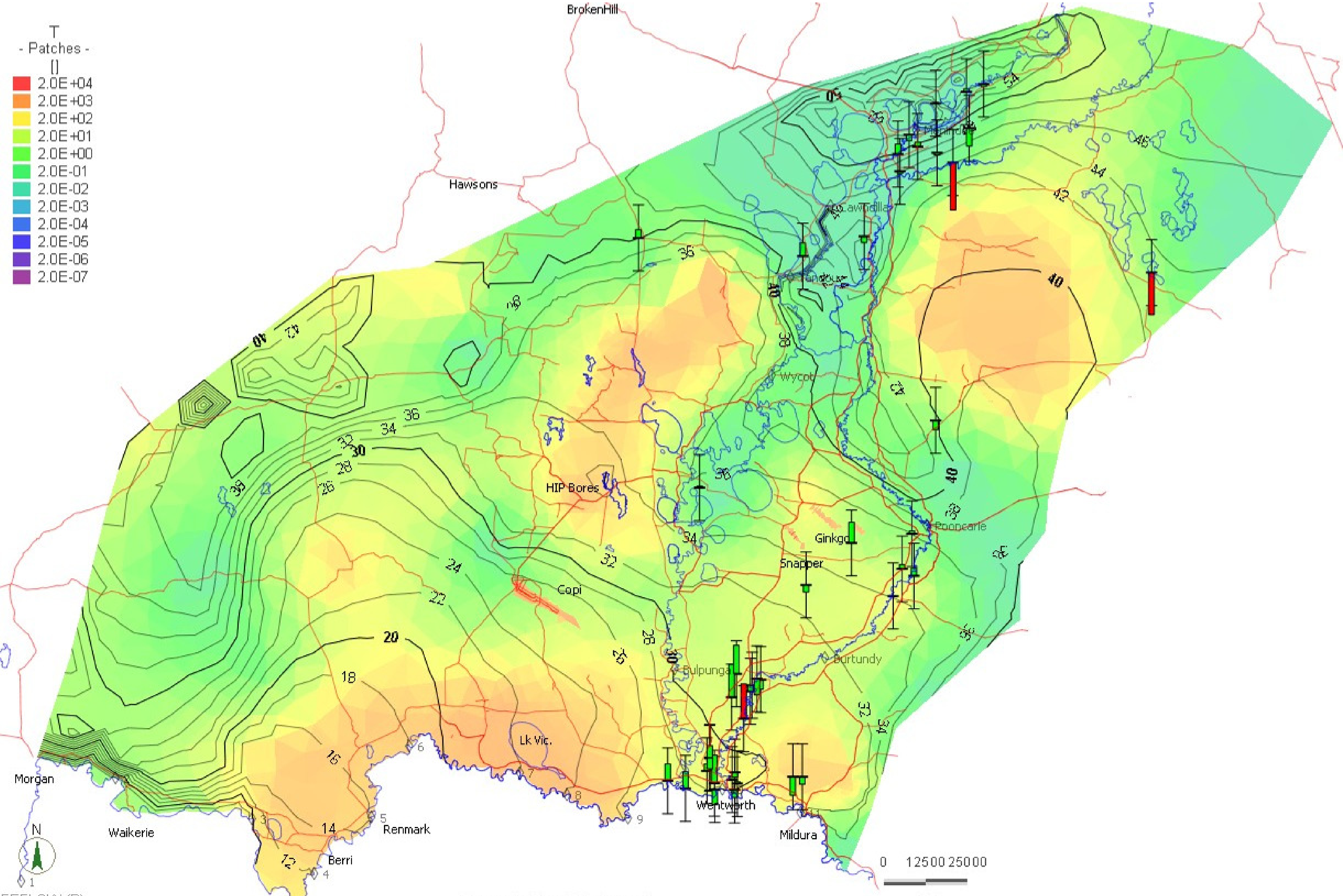


Transmissivity m2/d - Layer 6

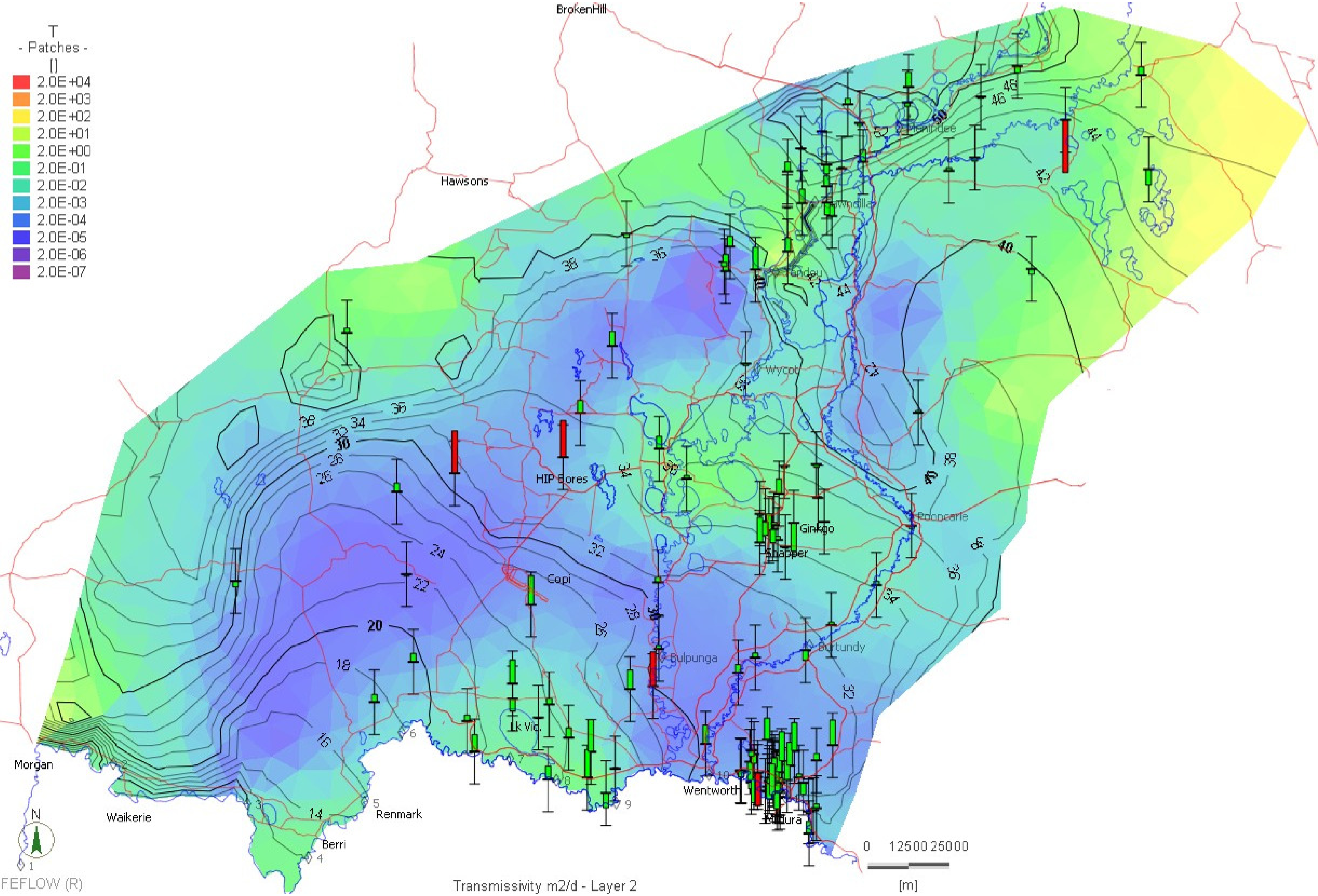
APPENDIX H

TRANSMISSIVITY (T) FOR SHARP SCENARIO
LAYERS 1–6

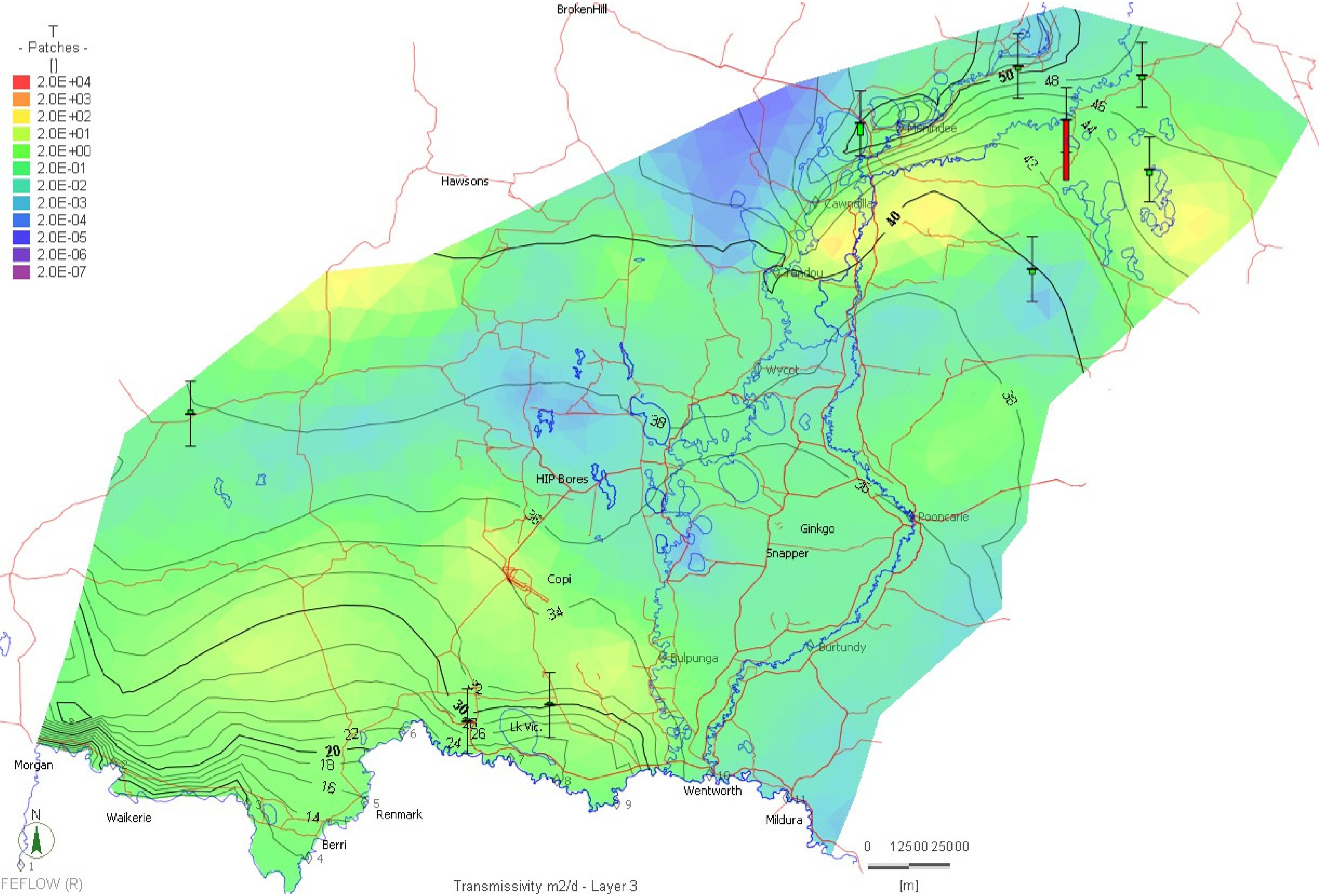
Vertical scale bars indicate model fit to measured monitoring bore levels.
Scale bar is +/-1.5m.



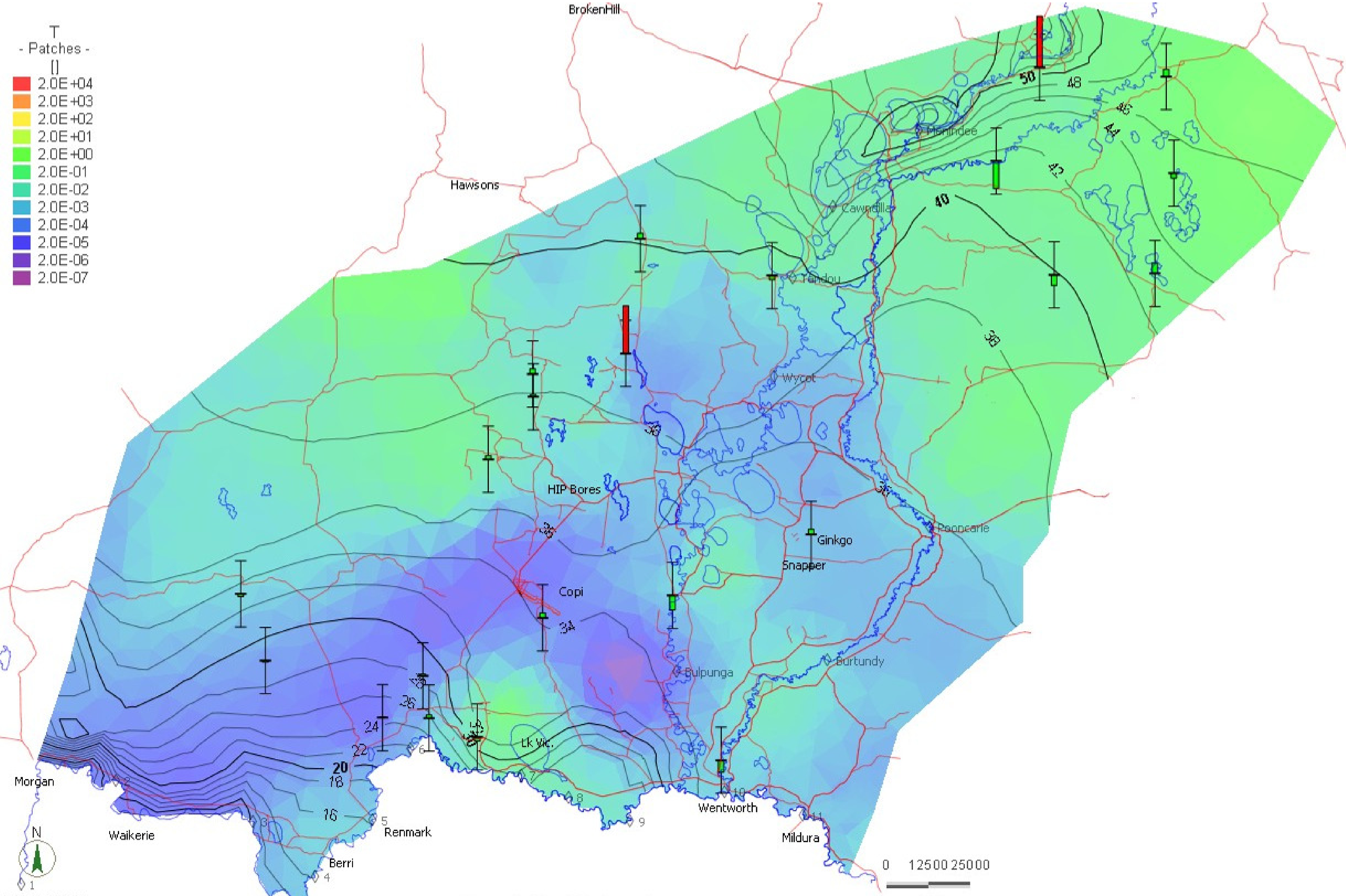
Transmissivity m2/d - Layer 1



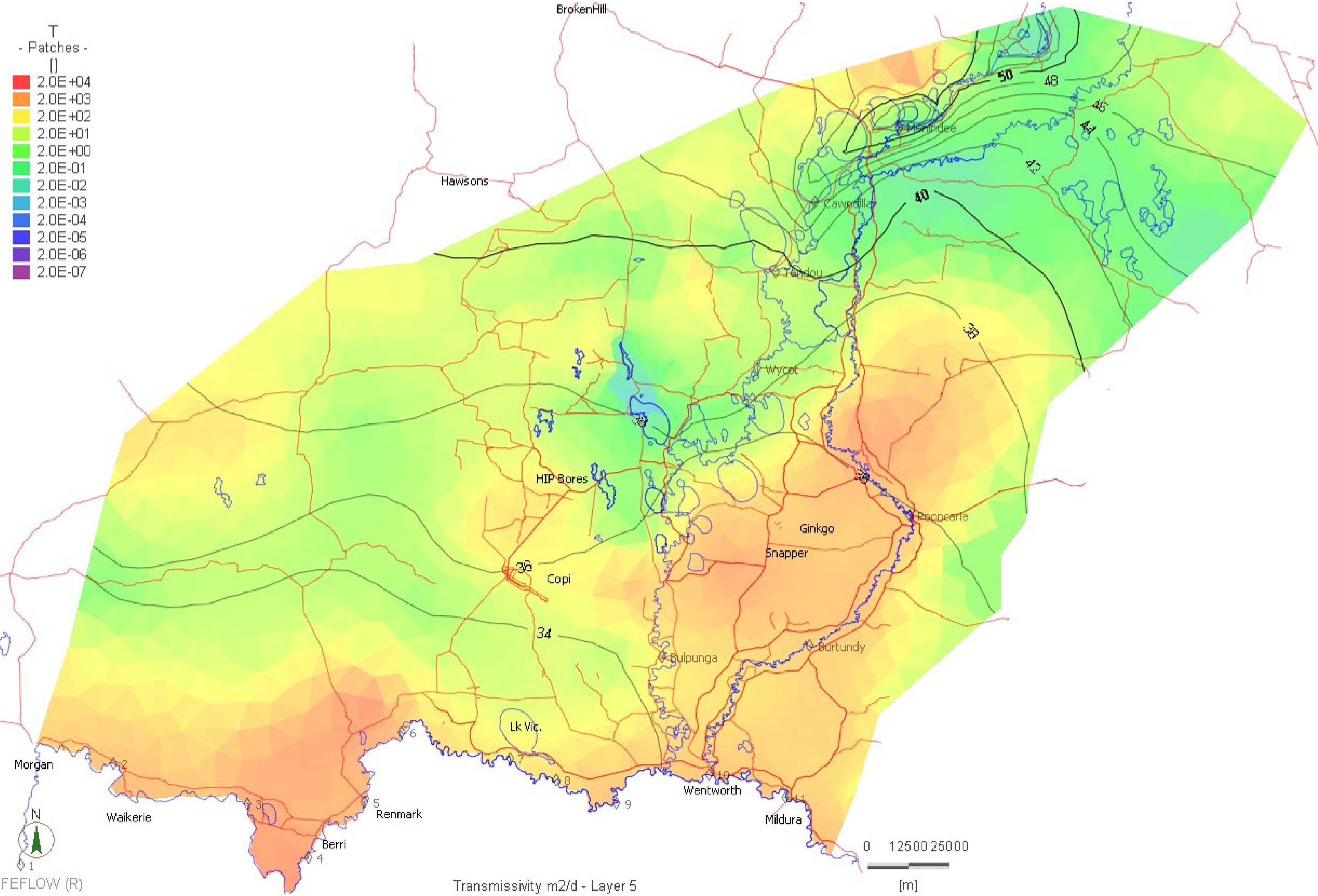
Transmissivity m2/d - Layer 2



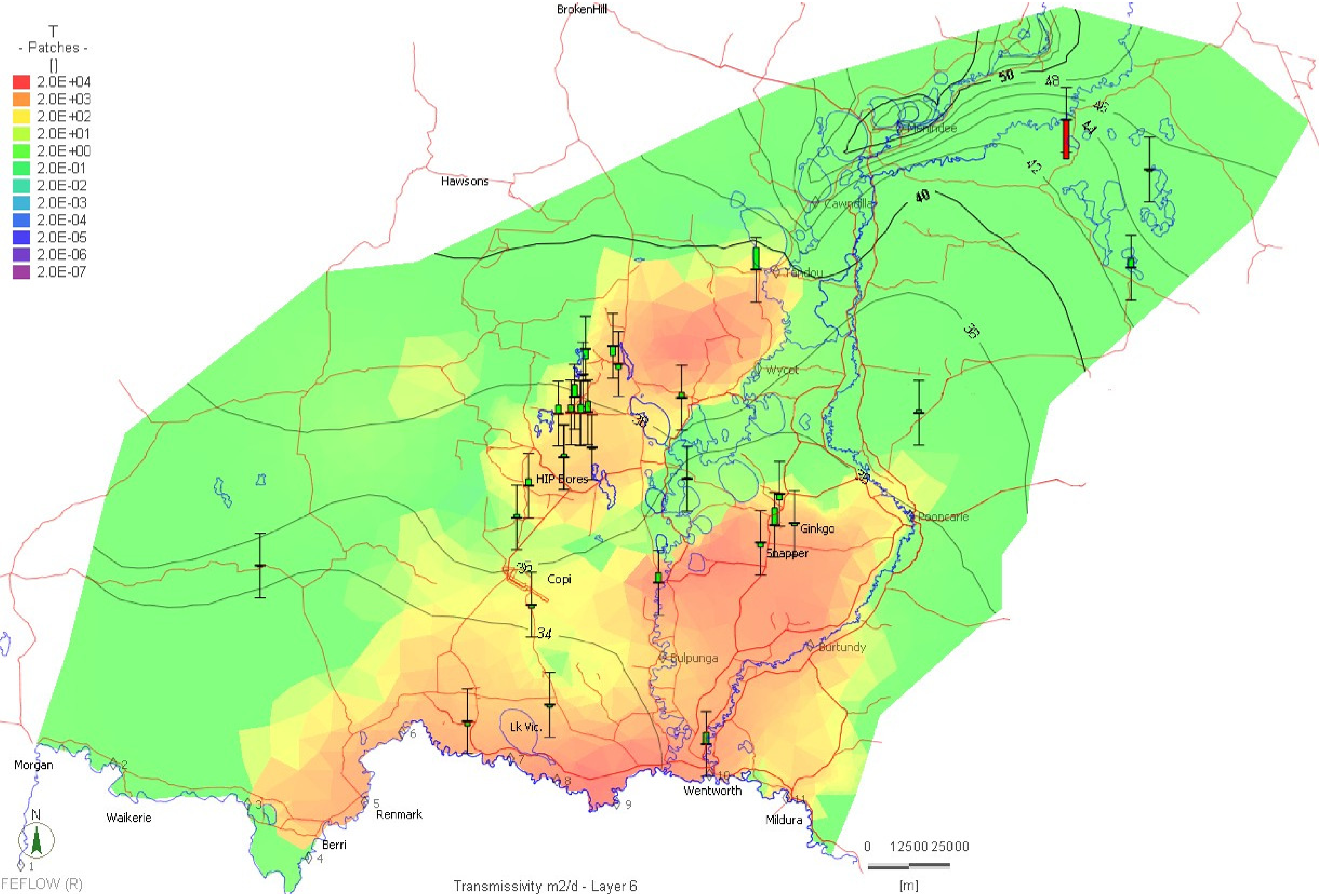
Transmissivity m2/d - Layer 3



Transmissivity m2/d - Layer 4



Transmissivity m2/d - Layer 5

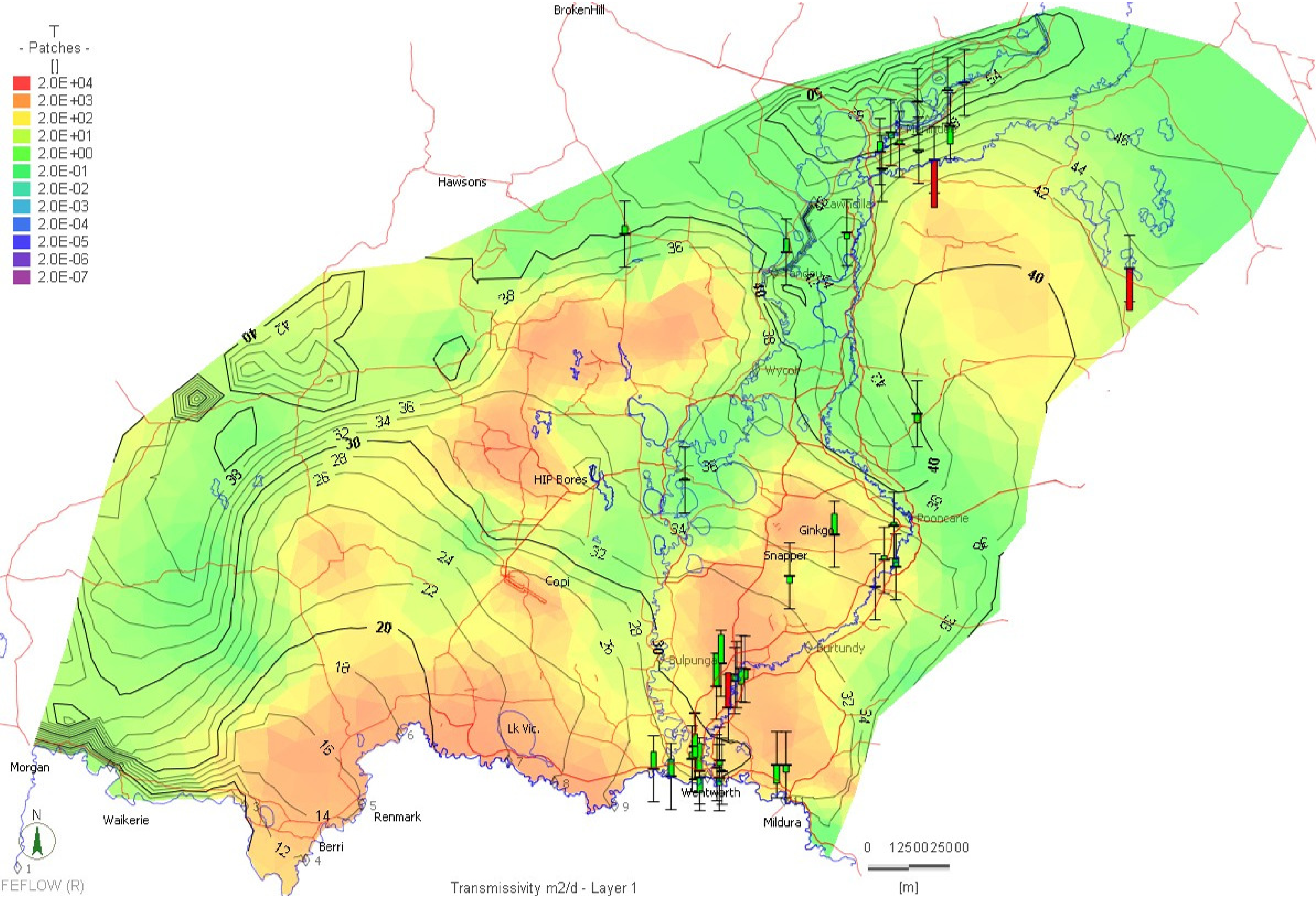


Transmissivity m2/d - Layer 6

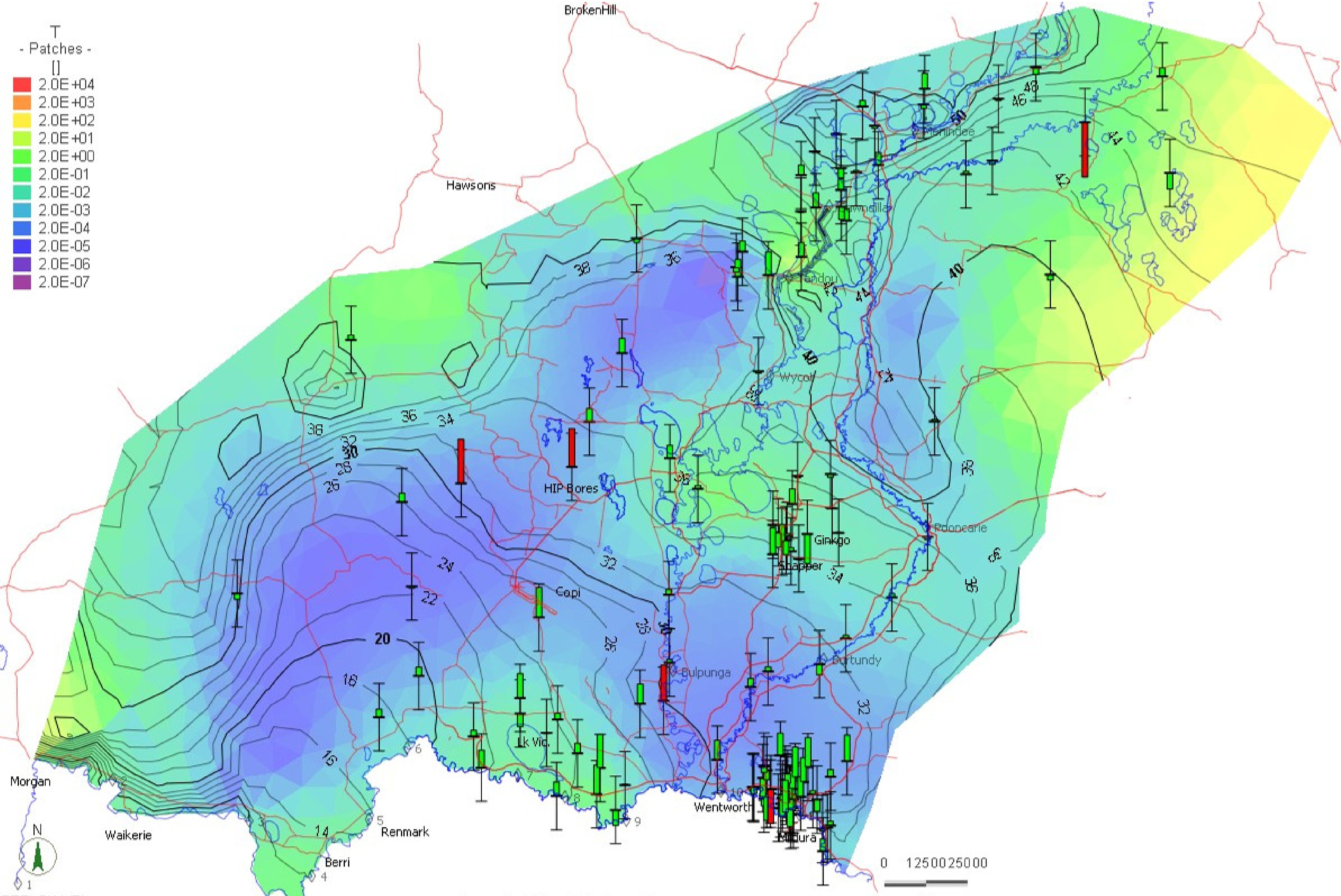
APPENDIX **I**

LEAKAGE COEFFICIENT (R)
LAYERS 1–6

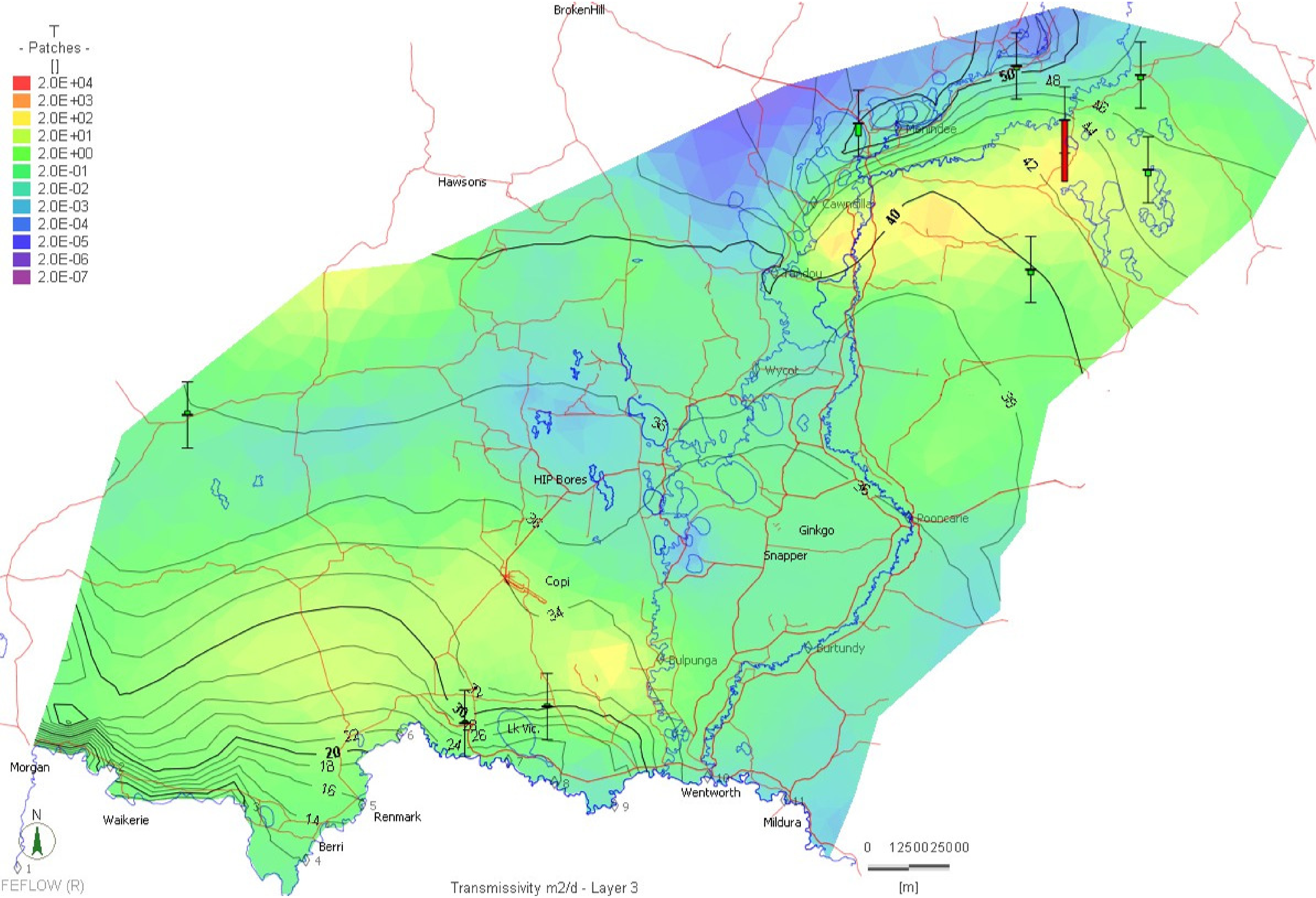
Vertical scale bars indicate model fit to measured monitoring bore levels.
Scale bar is +/-1.5m.



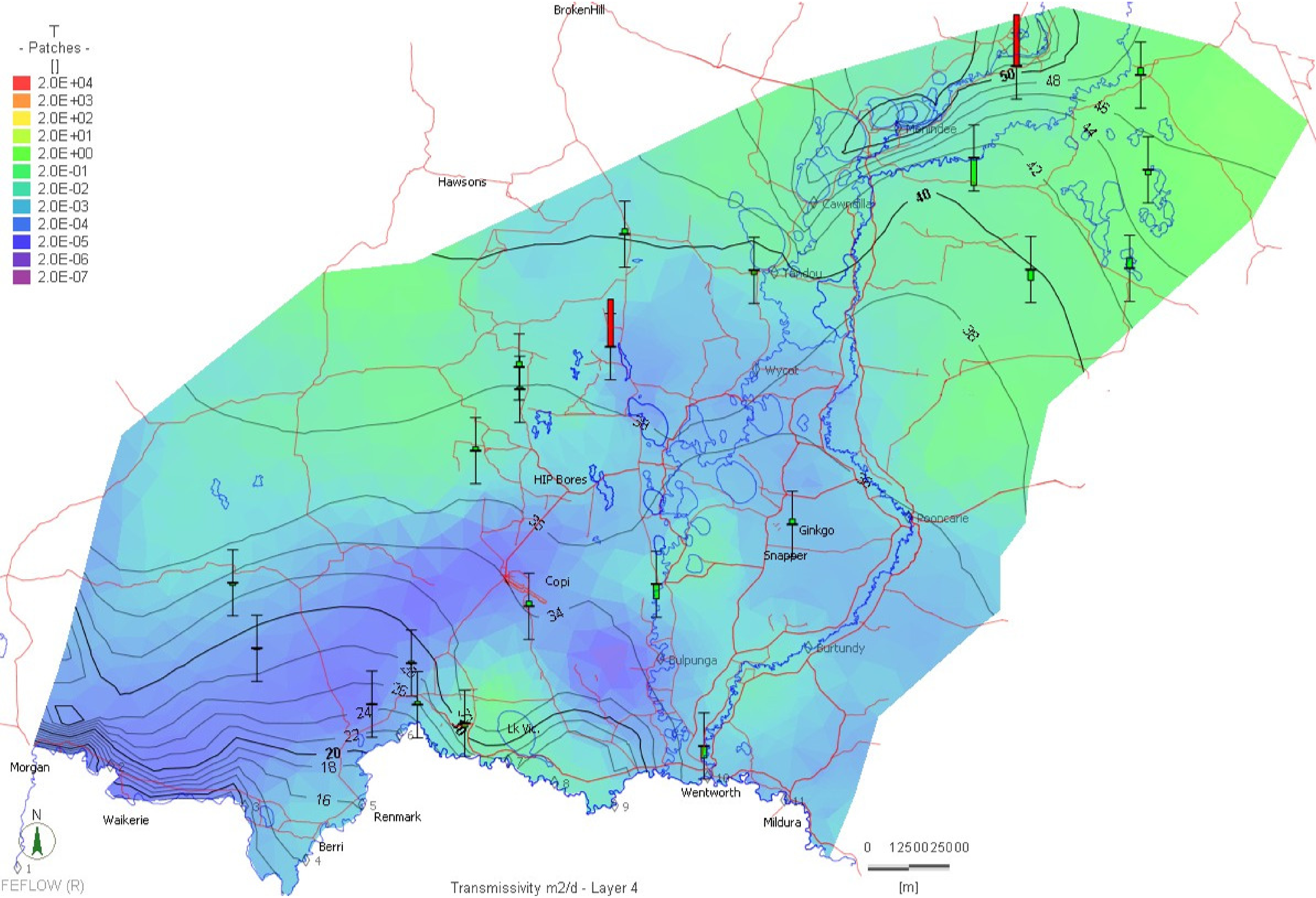
Transmissivity m2/d - Layer 1



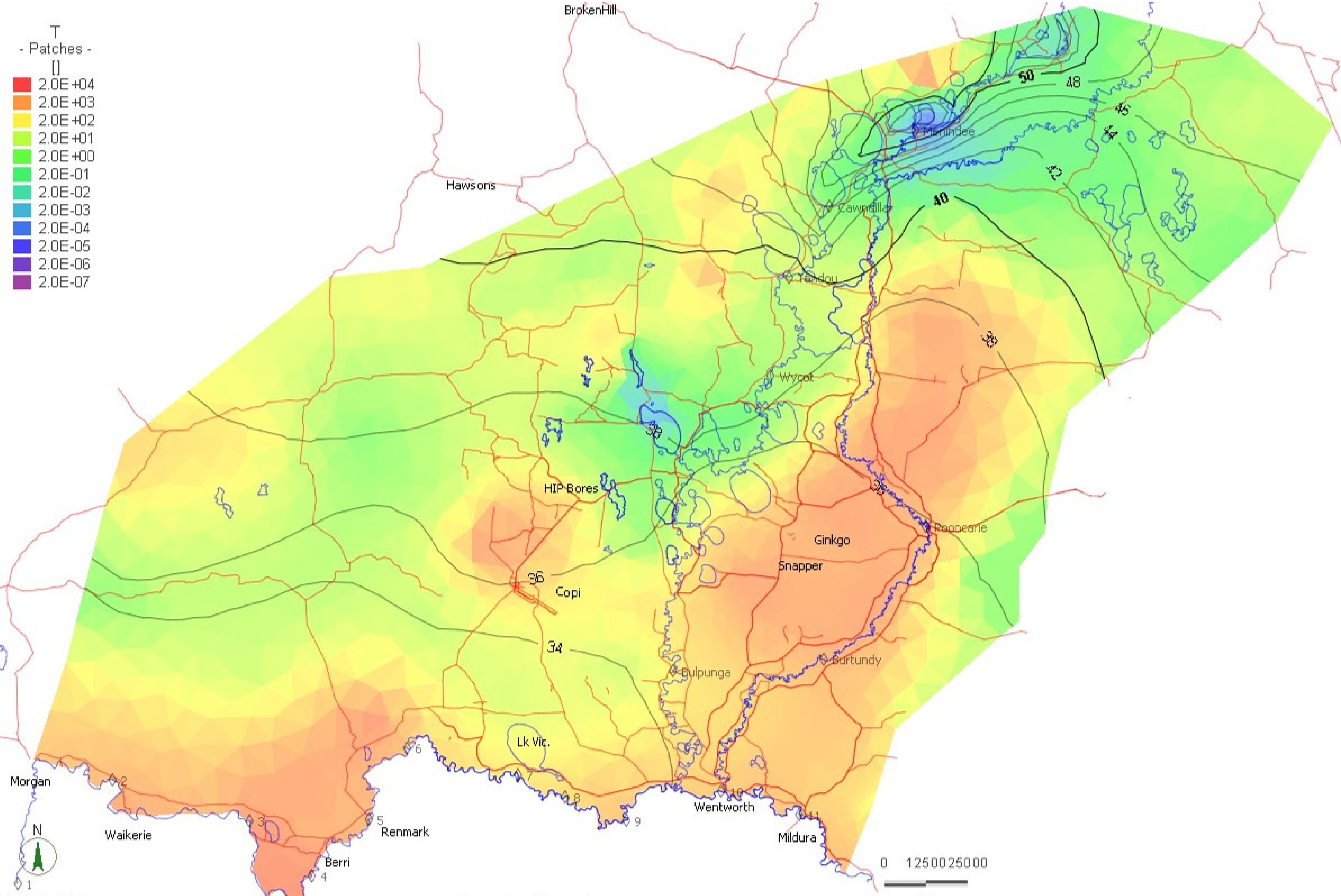
Transmissivity m2/d - Layer 2



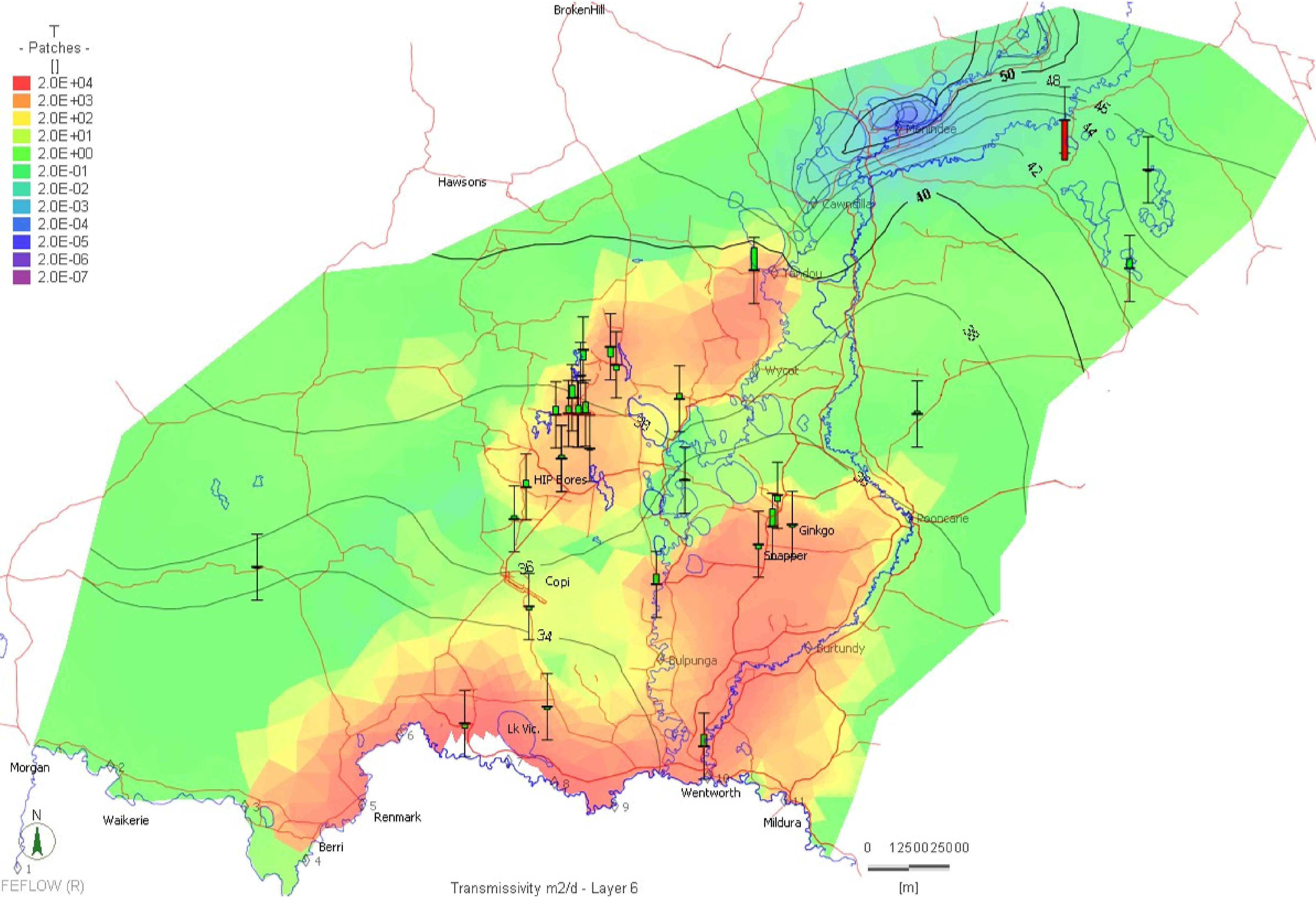
Transmissivity m2/d - Layer 3



Transmissivity m2/d - Layer 4



Transmissivity m2/d - Layer 5

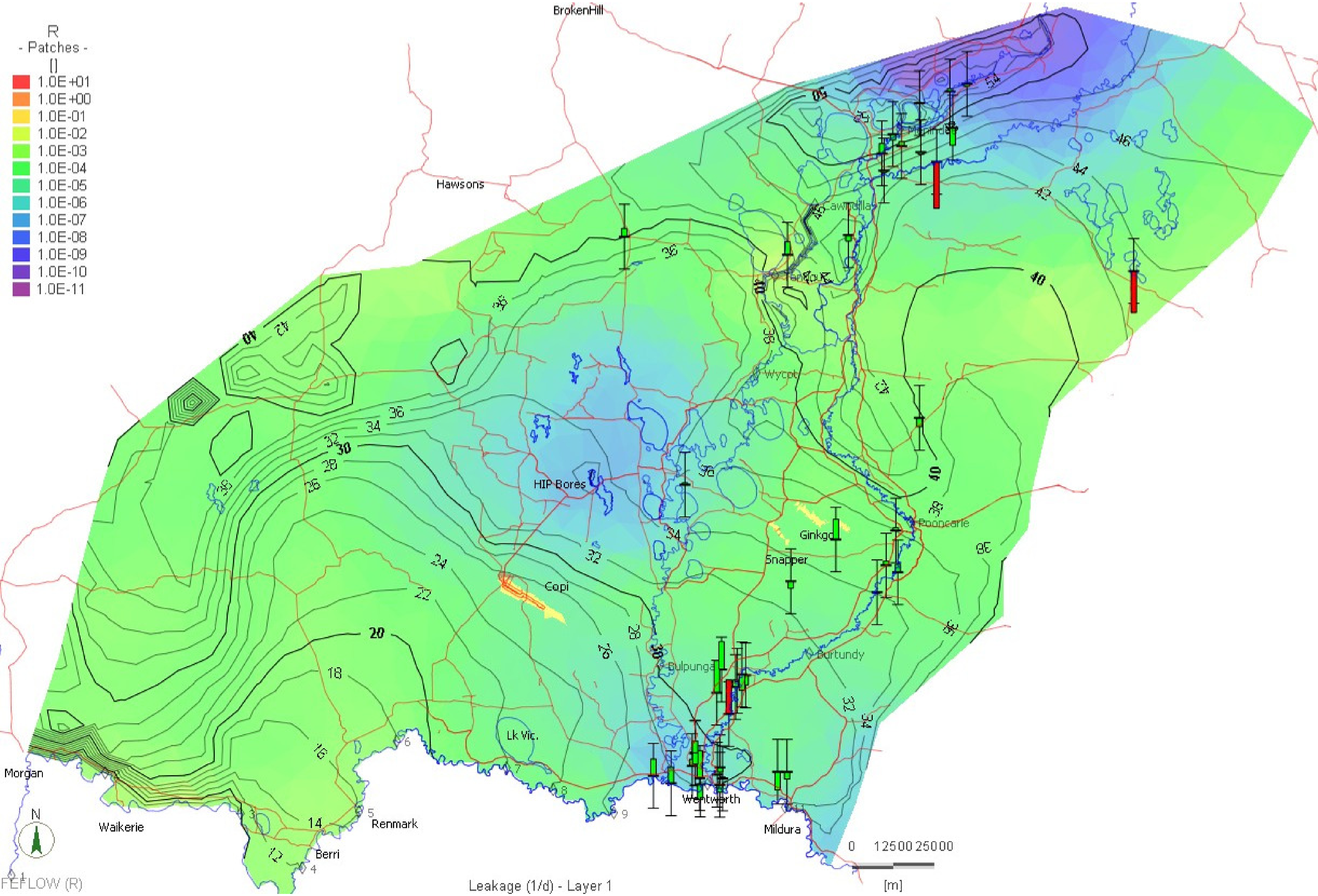


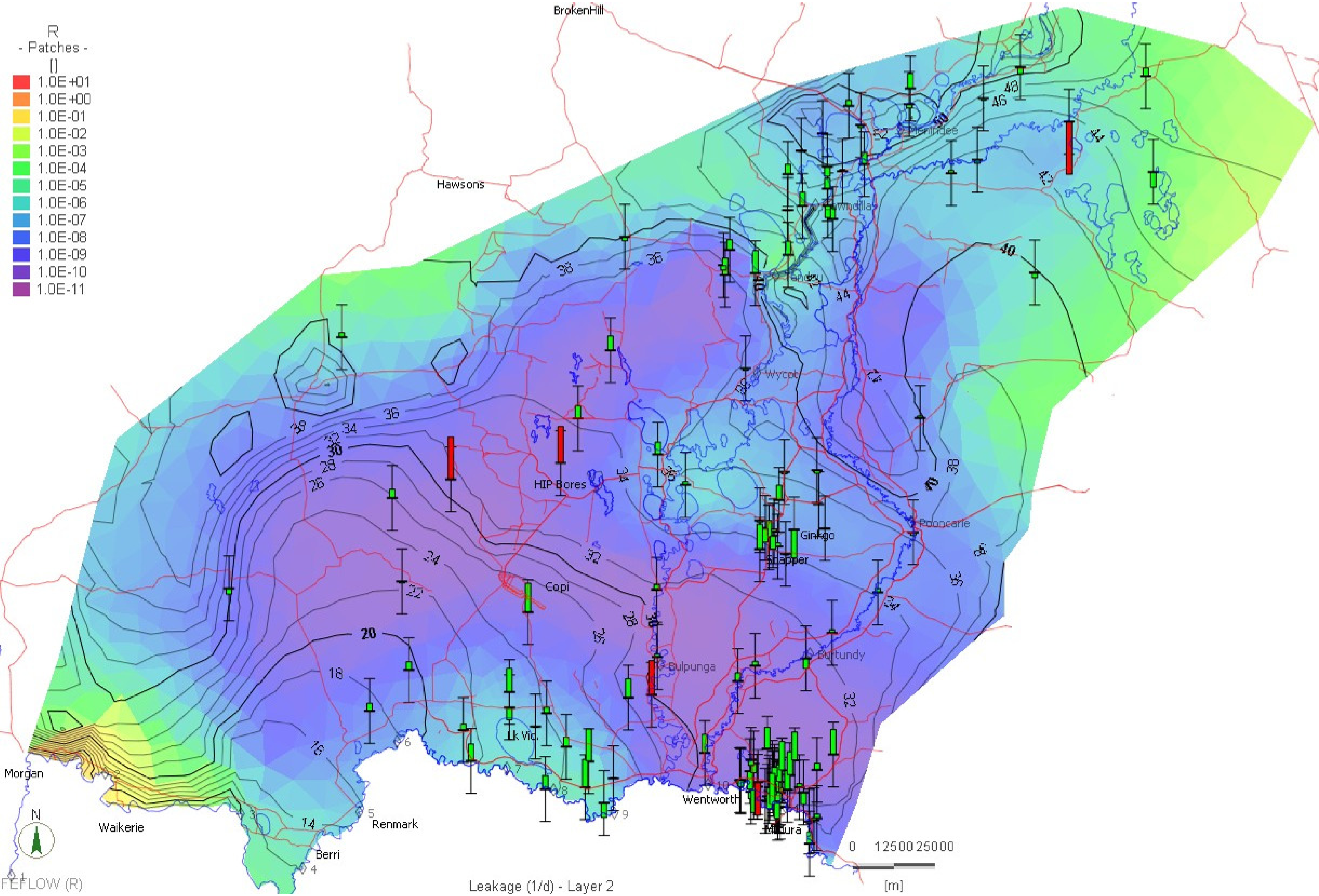
Transmissivity m2/d - Layer 6

APPENDIX J

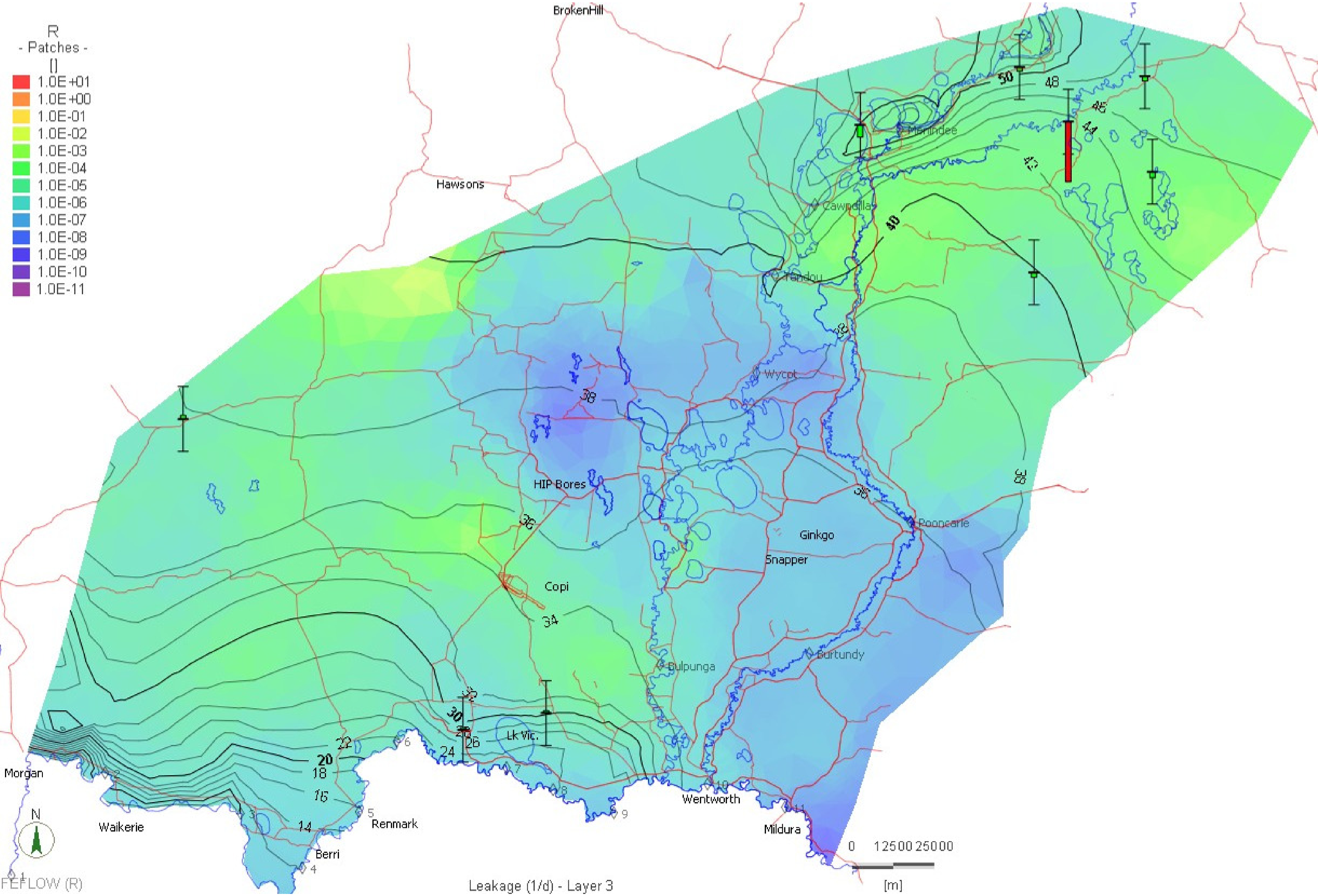
LEAKAGE COEFFICIENT (R) FOR SHARP SCENARIO
LAYERS 1–6

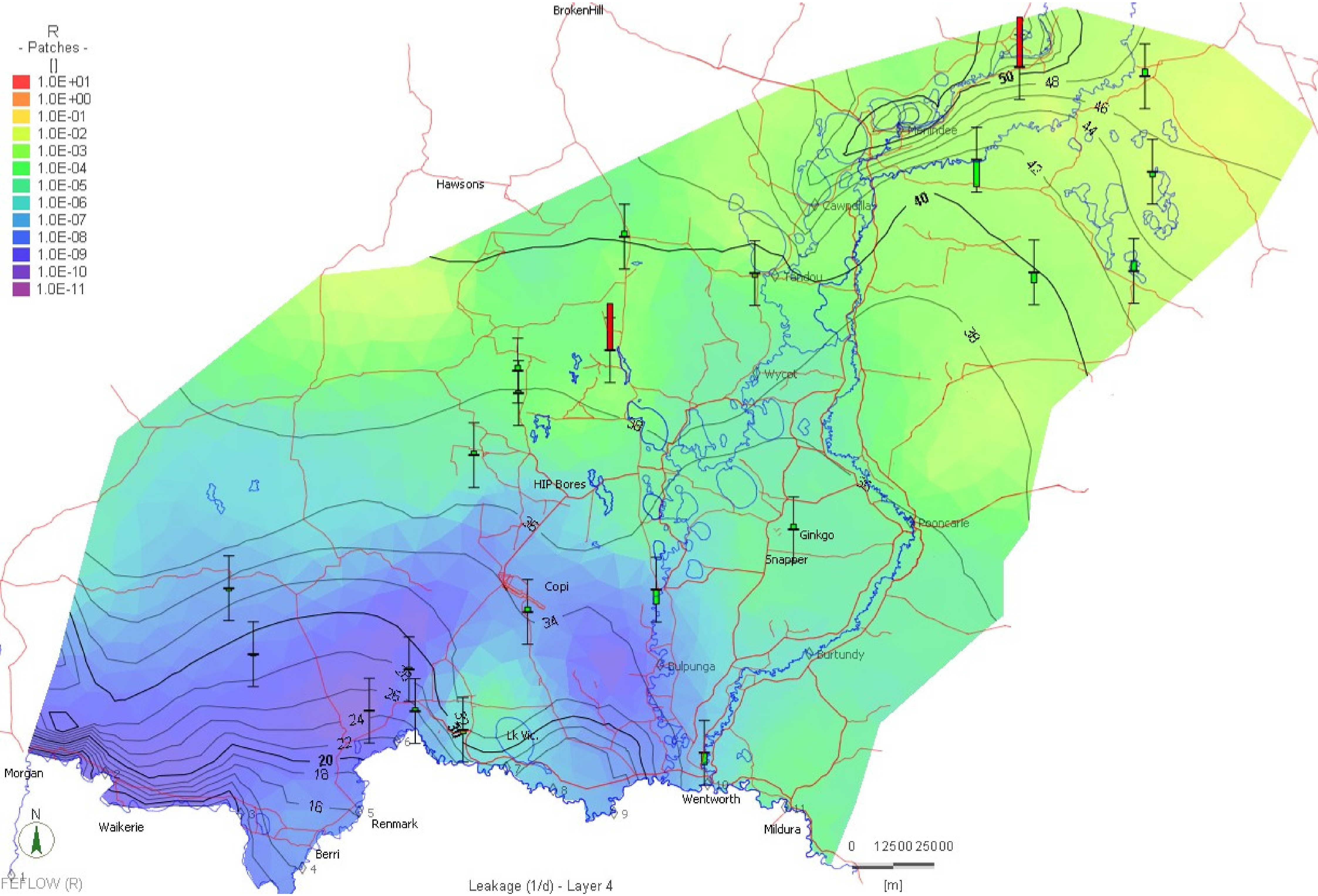
Vertical scale bars indicate model fit to measured monitoring bore levels.
Scale bar is +/-1.5m.

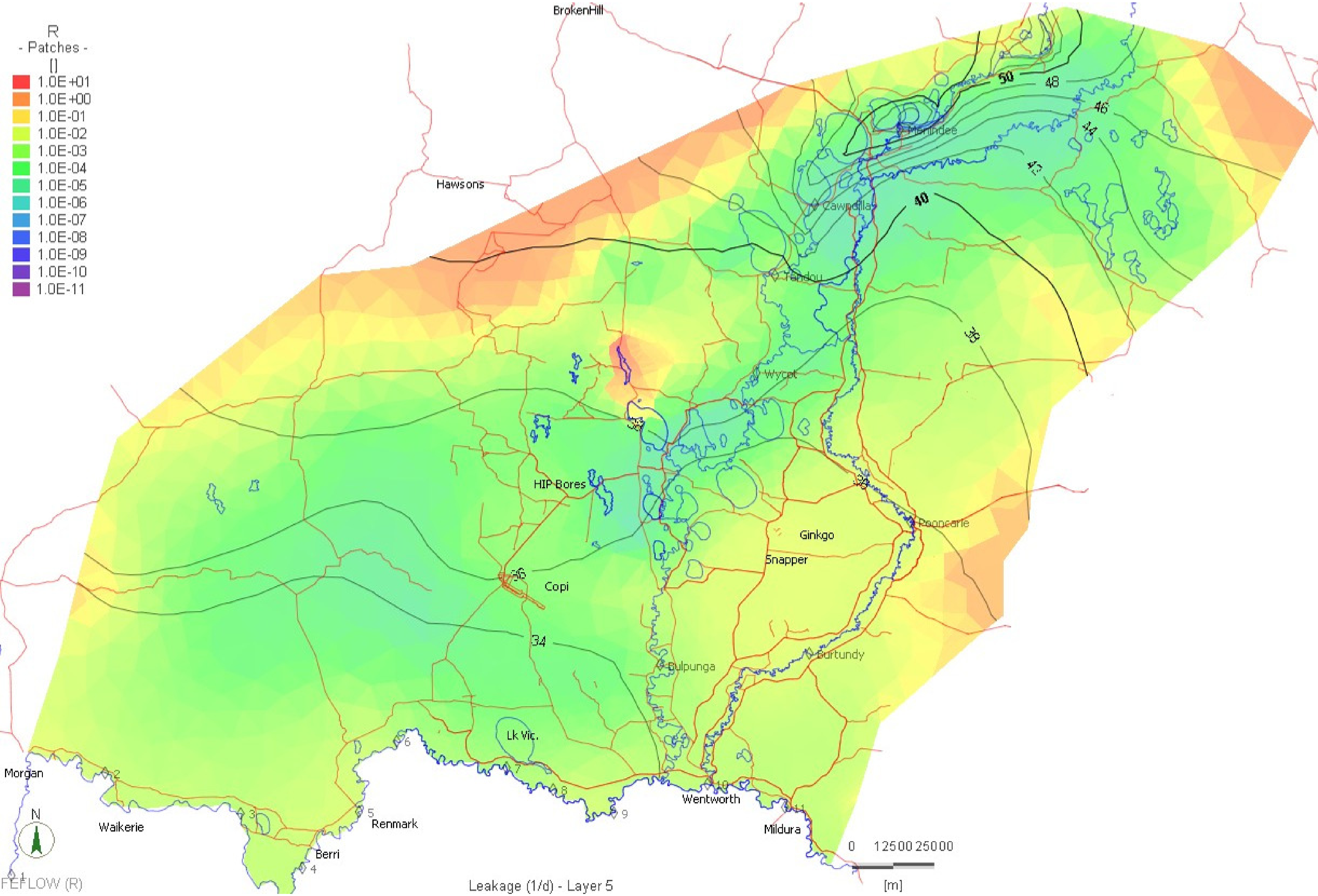

R
- Patches -
[]
1.0E+01
1.0E+00
1.0E-01
1.0E-02
1.0E-03
1.0E-04
1.0E-05
1.0E-06
1.0E-07
1.0E-08
1.0E-09
1.0E-10
1.0E-11
BrokenHill
Hawsons
Menindee
Cawndilla
Tandou
Wycot
HIP Bores
Pooncarie
Ginkgo
Snapper
Copi
Bulpunga
Burtundy
Lk Vic.
Wentworth
Mildura
Morgan
Waikerie
Renmark
Berri
50
54
46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
1
2
3
4
5
6
7
8
9
10
11
N
0
12500
25000
[m]
FEFLOW (R)
Leakage (1/d) - Layer 1

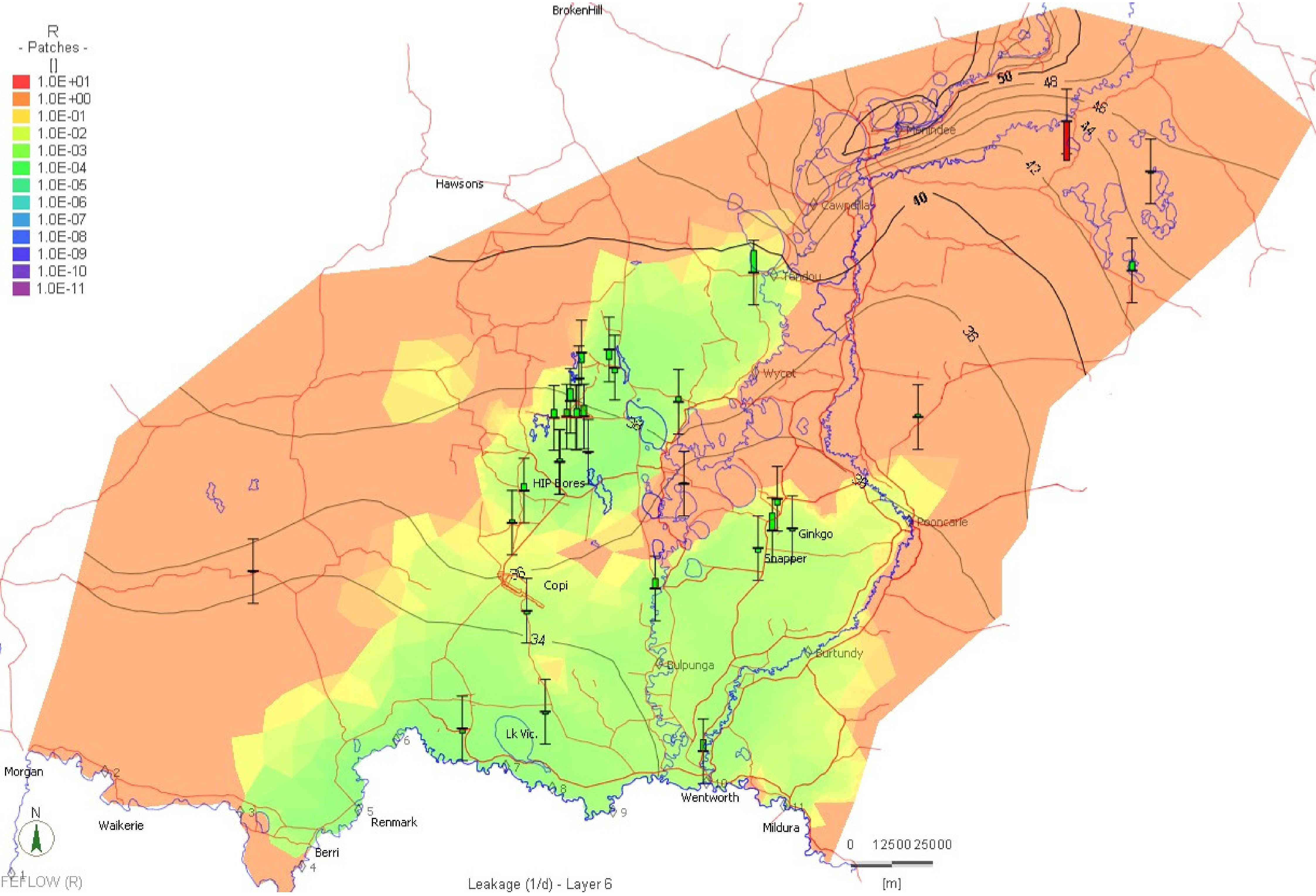


R
- Patches -
[]
🟥 1.0E+01
1.0E+00
1.0E-01
1.0E-02
1.0E-03
1.0E-04
1.0E-05
1.0E-06
1.0E-07
1.0E-08
1.0E-09
1.0E-10
1.0E-11
BrokenHill
Hawsons
Menindee
Pondanoo (?)
Wycot
HIP Bores
Ginkgo
Snapper
Pooncarie
Copi
Bulpunga
Burtundy
Lk Vic.
Wentworth
Mildura
Morgan
Waikerie
Renmark
Berri
N
0 12500 25000
[m]
FEFLOW (R)
Leakage (1/d) - Layer 2


R
- Patches -
[]
1.0E+01
1.0E+00
1.0E-01
1.0E-02
1.0E-03
1.0E-04
1.0E-05
1.0E-06
1.0E-07
1.0E-08
1.0E-09
1.0E-10
1.0E-11
BrokenHill
Hawsons
Menindee
Cawndilla
Tandou
Wycot
HIP Bores
Ginkgo
Snapper
Pooncarie
Copi
Burtundy
Bulpunga
Lk Vic.
Morgan
Waikerie
Renmark
Berri
Wentworth
Mildura
50
48
46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
1
2
3
4
5
6
7
8
9
10
11
N
0
12500
25000
[m]
FEFLOW (R)
Leakage (1/d) - Layer 3


R
- Patches -
[]
🟥 1.0E+01
1.0E+00
1.0E-01
1.0E-02
1.0E-03
1.0E-04
1.0E-05
1.0E-06
1.0E-07
1.0E-08
1.0E-09
1.0E-10
1.0E-11
BrokenHill
Hawsons
Menindee
Cawndilla
Tandou
Wycot
HIP Bores
Ginkgo
Snapper
Pooncarie
Copi
Burtundy
Bulpunga
Lk Vic.
Wentworth
Mildura
Morgan
Waikerie
Renmark
Berri
50
48
46
44
42
40
38
38
36
34
32
30
28
26
24
22
20
18
16
1
2
3
4
5
6
7
8
9
10
11
N
0 12500 25000
[m]
FEFLOW (R)
Leakage (1/d) - Layer 4

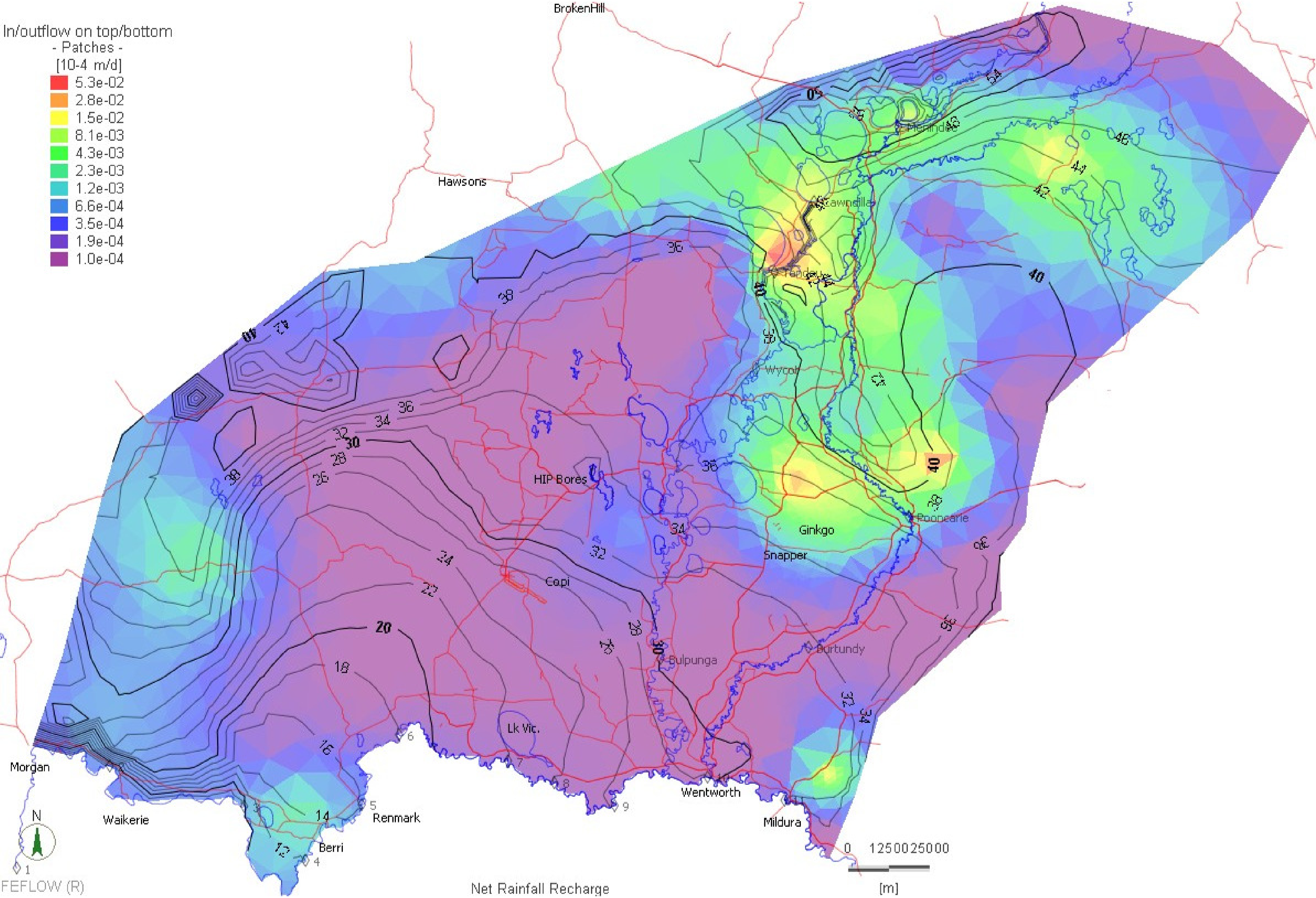

R
- Patches -
[]
1.0E+01
1.0E+00
1.0E-01
1.0E-02
1.0E-03
1.0E-04
1.0E-05
1.0E-06
1.0E-07
1.0E-08
1.0E-09
1.0E-10
1.0E-11
BrokenHill
Hawsons
Menindee
Cawndilla
Tandou
Wycot
HIP Bores
Pooncarie
Ginkgo
Snapper
Copi
Burtundy
Bulpunga
Lk Vic.
Morgan
Waikerie
Renmark
Berri
Wentworth
Mildura
50
48
46
44
42
40
38
36
34
1
2
3
4
5
6
7
8
9
10
11
N
0
12500 25000
[m]
FEFLOW (R)
Leakage (1/d) - Layer 5

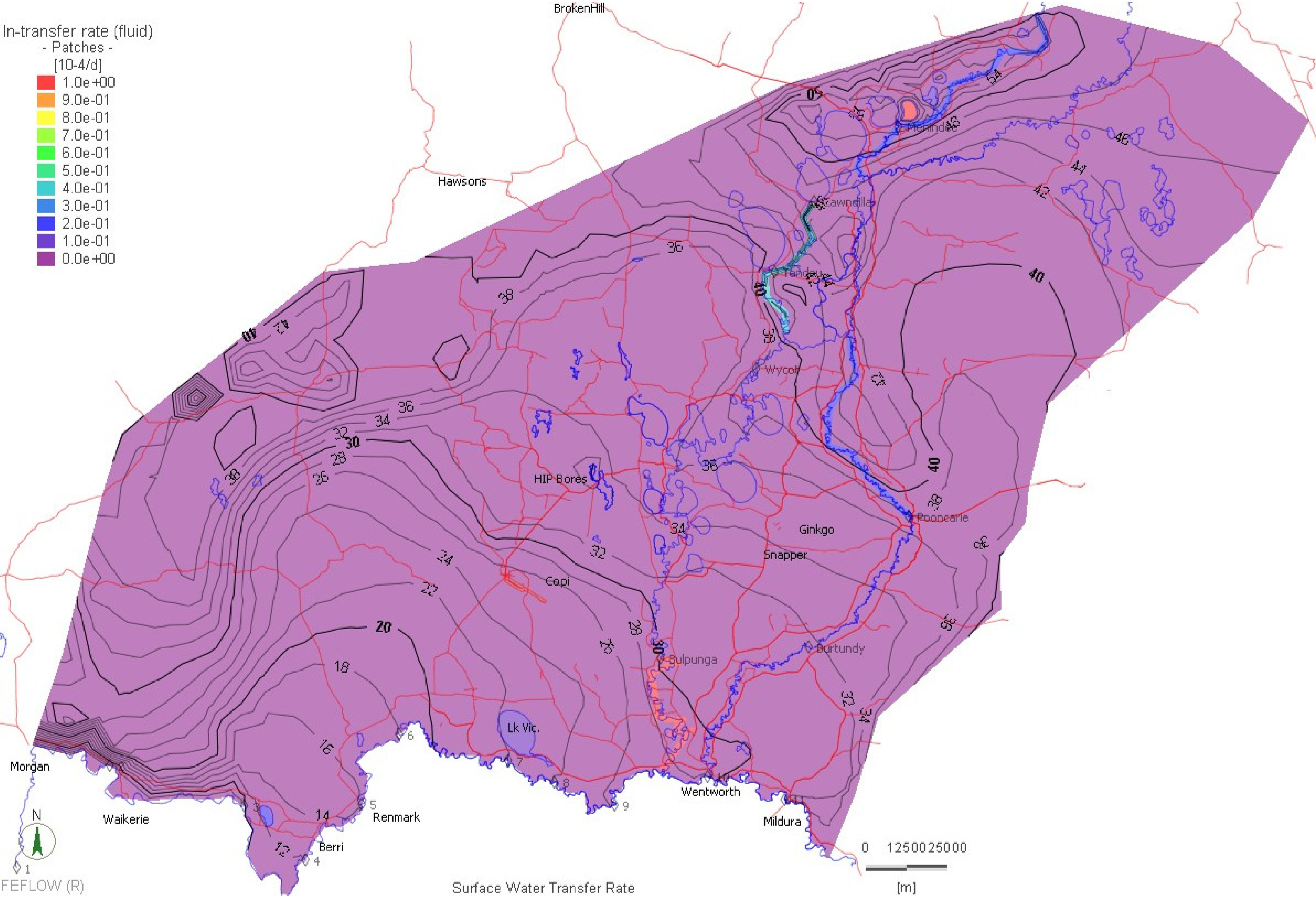


Leakage (1/d) - Layer 6

APPENDIX **K**

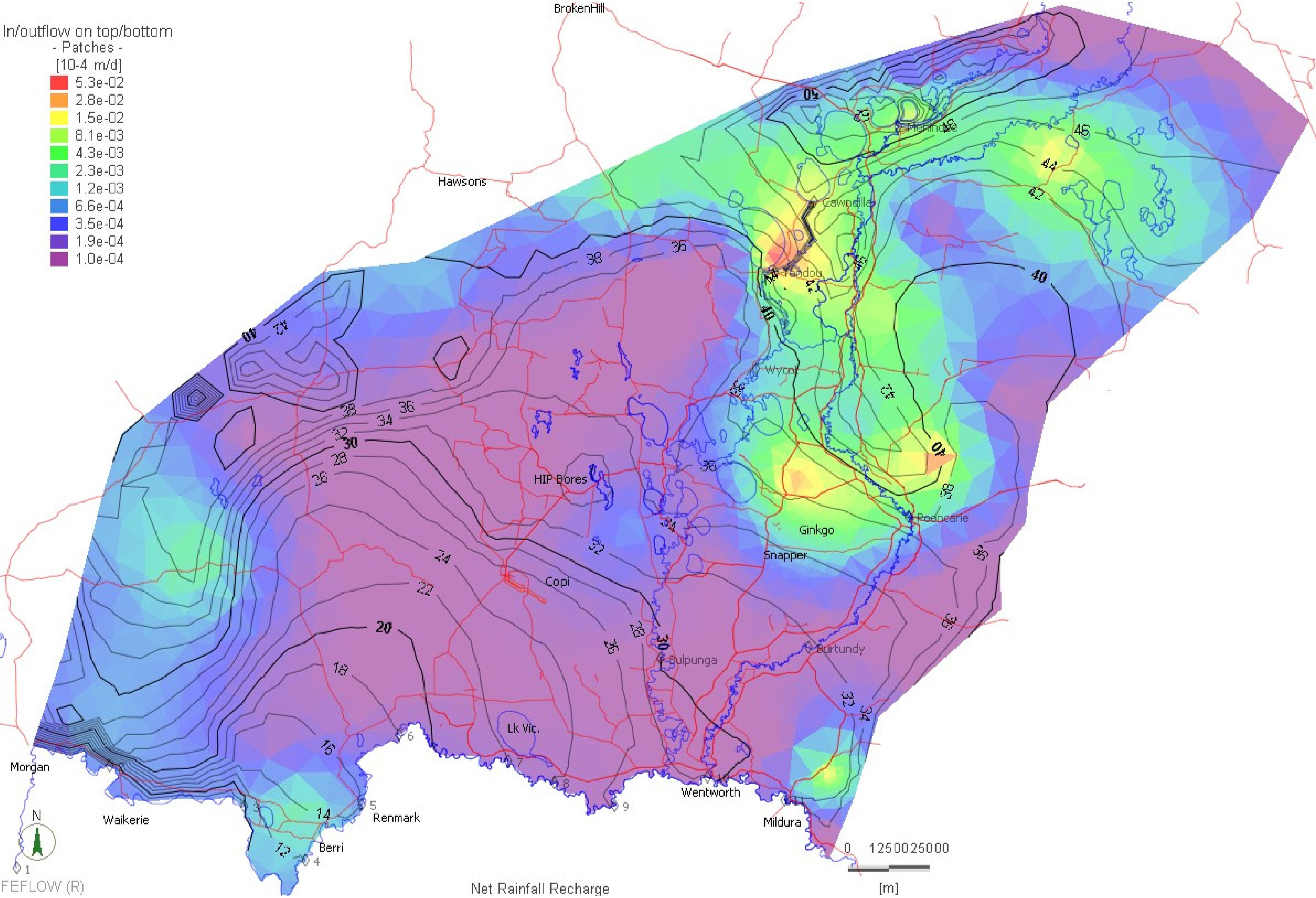
NET RAINFALL AND SURFACE WATER RECHARGE FOR SMOOTH SCENARIO


In/outflow on top/bottom
- Patches -
[10-4 m/d]
🟥 5.3e-02
🟧 2.8e-02
🟨 1.5e-02
🟩 8.1e-03
🟩 4.3e-03
🟩 2.3e-03
🟦 1.2e-03
🟦 6.6e-04
🟦 3.5e-04
🟪 1.9e-04
🟪 1.0e-04
BrokenHill
Hawsons
Menindee
Kawnella
Tandou
Wycot
HIP Bores
Ginkgo
Snapper
Pooncarie
Copi
Bulpunga
Burtundy
Lk Vic.
Wentworth
Mildura
Morgan
Waikerie
Renmark
Berri
N
0 1250025000
[m]
FEFLOW (R)
Net Rainfall Recharge

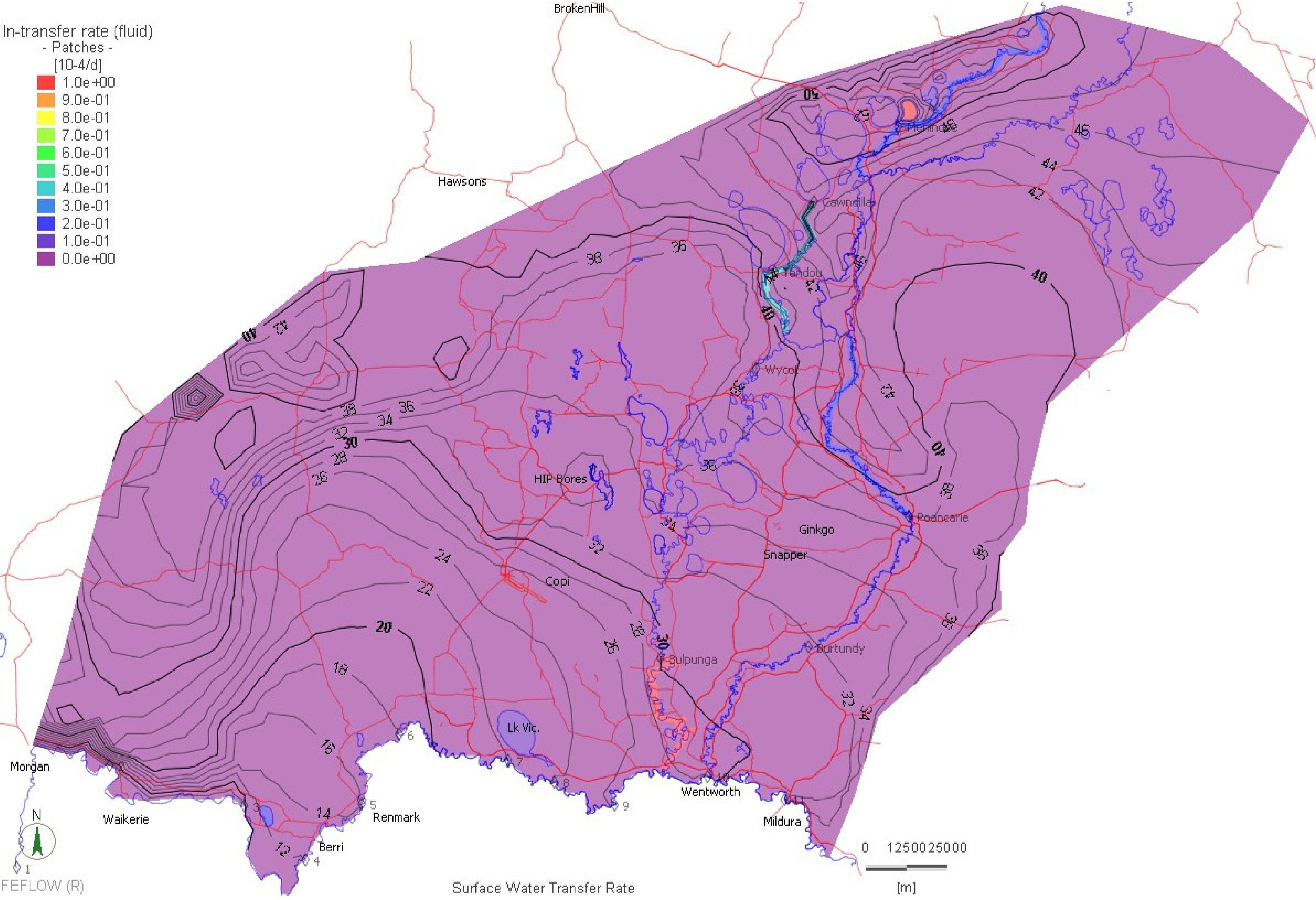

In-transfer rate (fluid)
- Patches -
[10-4/d]
🟥 1.0e+00
9.0e-01
8.0e-01
7.0e-01
6.0e-01
5.0e-01
4.0e-01
3.0e-01
2.0e-01
1.0e-01
0.0e+00
BrokenHill
Hawsons
Menindee
Cawndilla
Tandou
Wycot
HIP Bores
Pooncarie
Ginkgo
Snapper
Copi
Bulpunga
Burtundy
Lk Vic.
Wentworth
Mildura
Renmark
Berri
Waikerie
Morgan
N
0 12500 25000
[m]
FEFLOW (R)
Surface Water Transfer Rate
1
3
4
5
6
7
8
9
10
11
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
50
54

APPENDIX **L**

NET RAINFALL AND SURFACE WATER RECHARGE FOR SHARP SCENARIO



In/outflow on top/bottom
- Patches -
[10-4 m/d]
5.3e-02
2.8e-02
1.5e-02
8.1e-03
4.3e-03
2.3e-03
1.2e-03
6.6e-04
3.5e-04
1.9e-04
1.0e-04
BrokenHill
Hawsons
Menindee
Cawndilla
Tandou
Wycot
HIP Bores
Pooncarie
Ginkgo
Snapper
Copi
Bulpunga
Burtundy
Lk Vic.
Morgan
Waikerie
Renmark
Berri
Wentworth
Mildura
50
46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
1
3
4
5
6
7
8
9
10
11
N
0 12500 25000
[m]
FEFLOW (R)
Net Rainfall Recharge

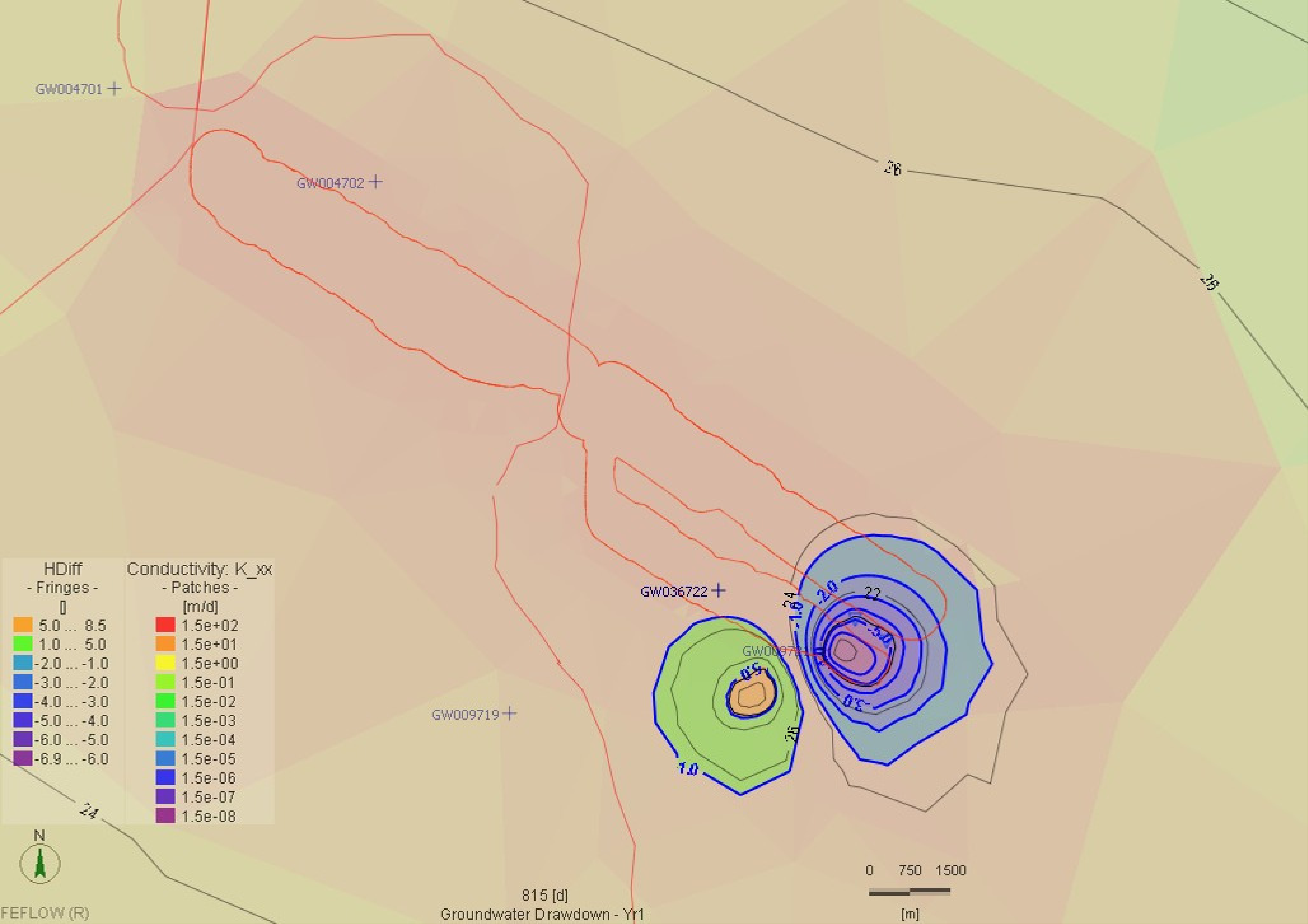


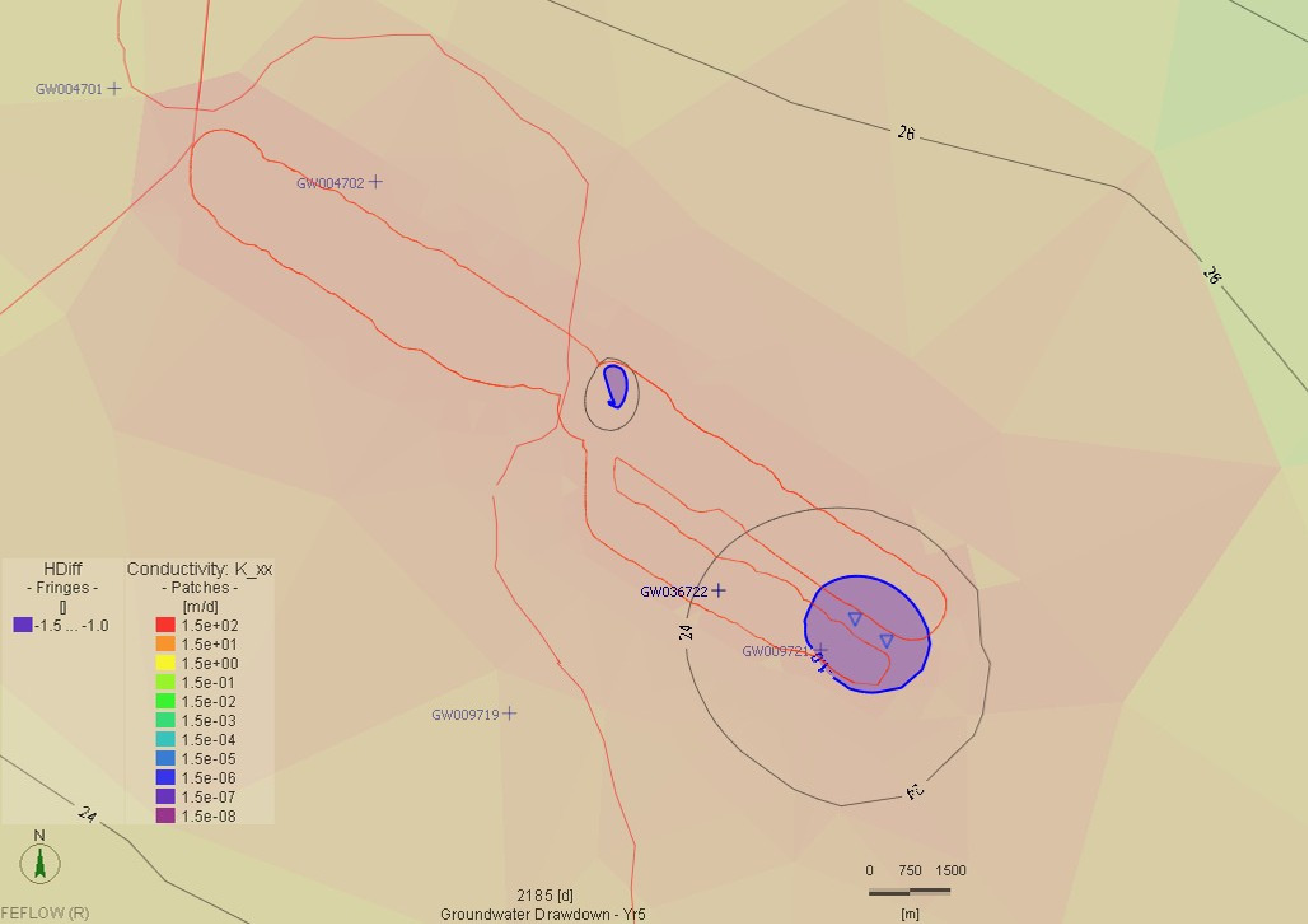
Surface Water Transfer Rate

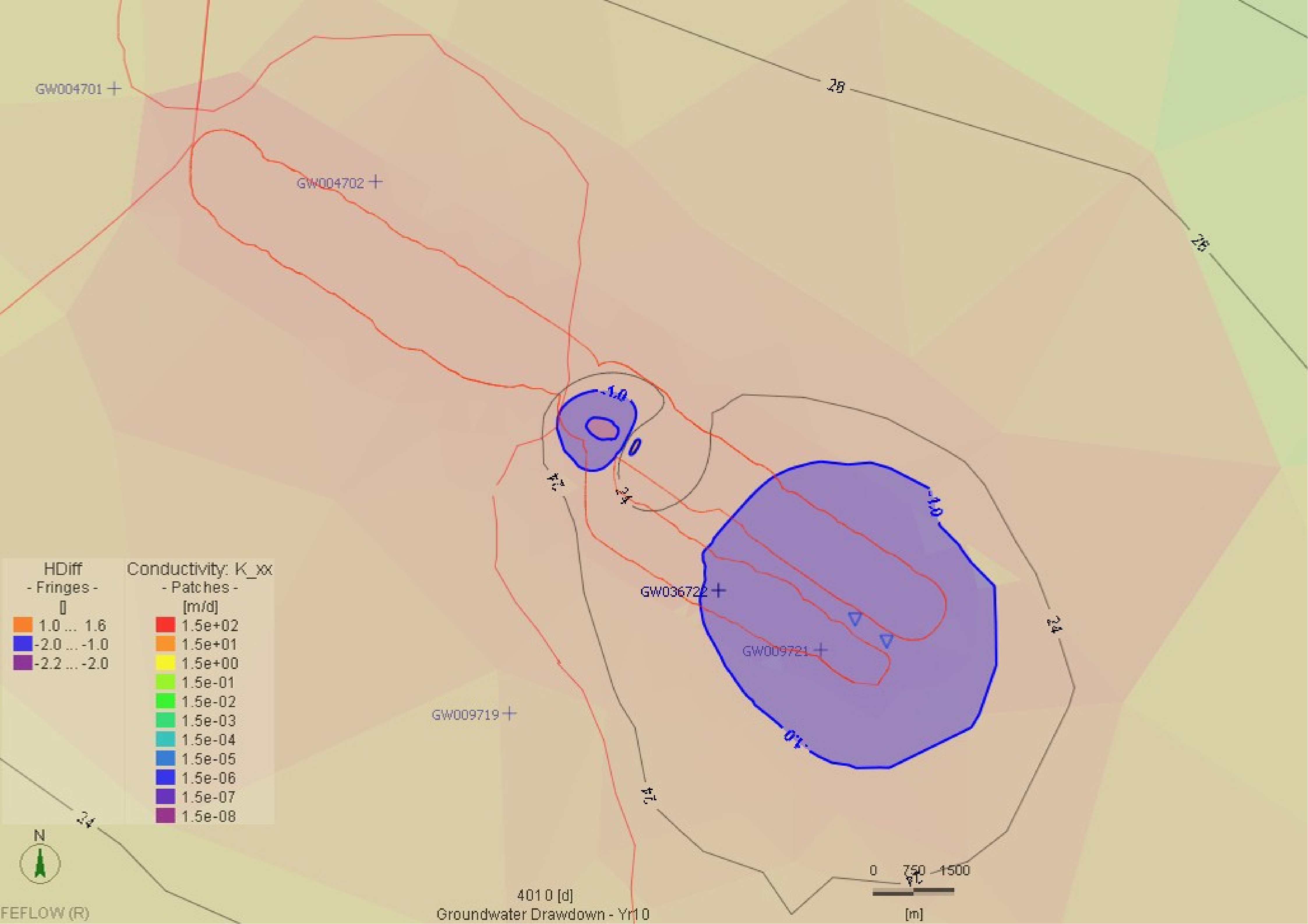
APPENDIX M

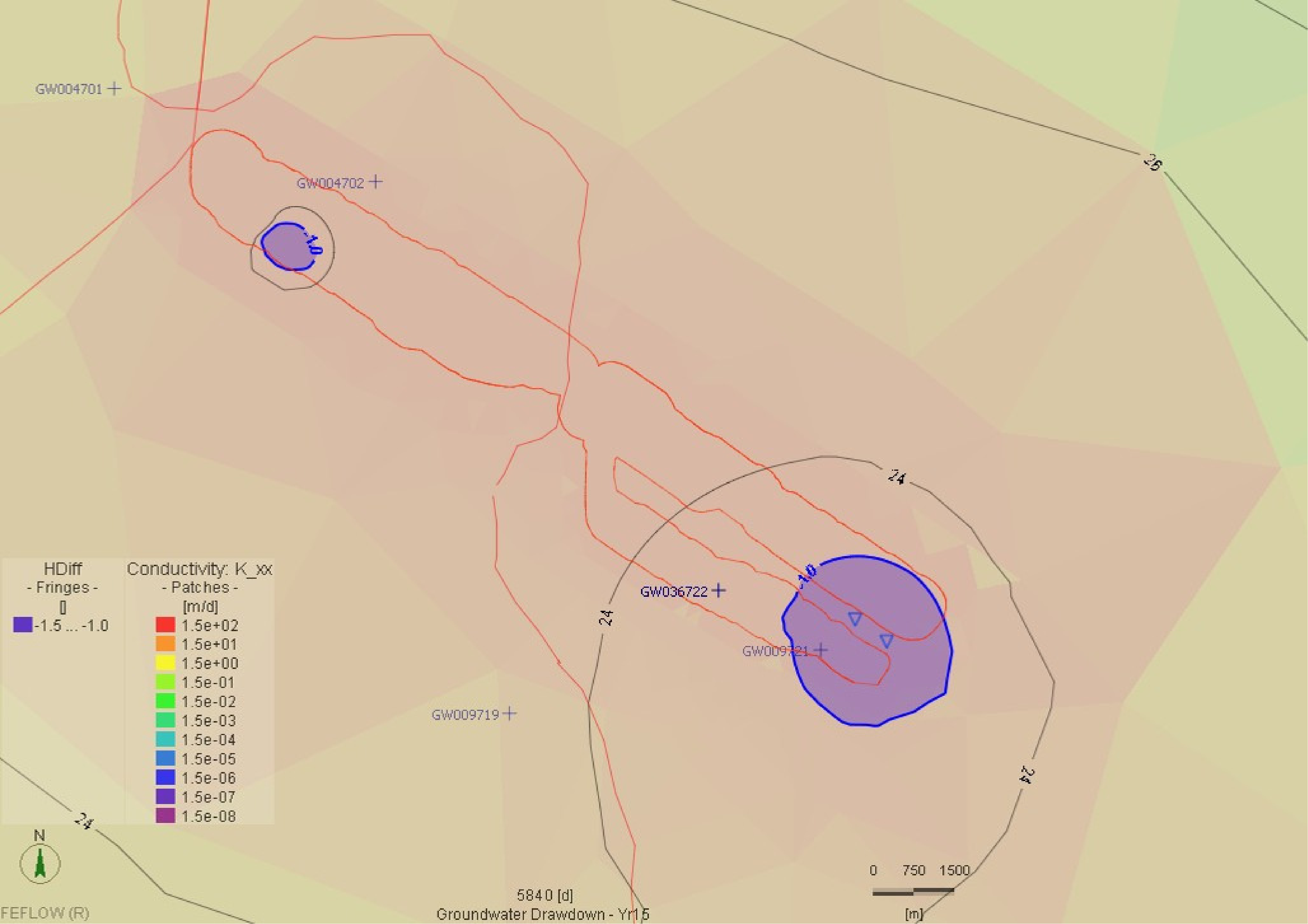
YEARLY GROUNDWATER CONTOURS FOR SMOOTH SCENARIO

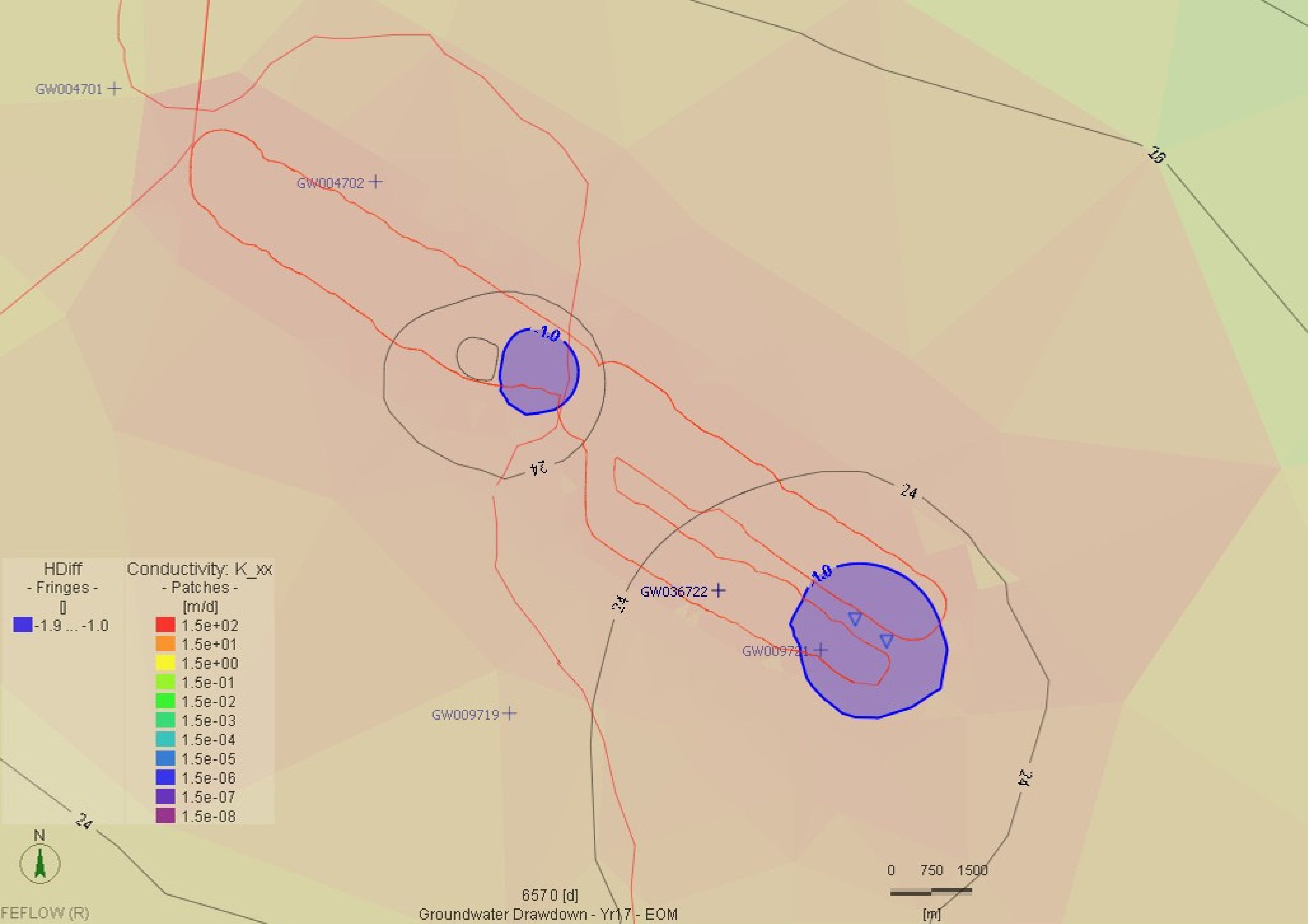
Black Contours = Groundwater Table (AHD).
Blue Contours and coloured zones (HDiff) indicate the variation in the water table from pre-mine levels in meters (m).
Blue Triangles indicate mine bores.


GW004701
GW004702
GW036722
GW009719
GW00978
26
26
24
22
24
26
2.0
1.0
-5.0
-3.0
5.0
1.0
HDiff
- Fringes -
[]
5.0 ... 8.5
1.0 ... 5.0
-2.0 ... -1.0
-3.0 ... -2.0
-4.0 ... -3.0
-5.0 ... -4.0
-6.0 ... -5.0
-6.9 ... -6.0
Conductivity: K_xx
- Patches -
[m/d]
1.5e+02
1.5e+01
1.5e+00
1.5e-01
1.5e-02
1.5e-03
1.5e-04
1.5e-05
1.5e-06
1.5e-07
1.5e-08
N
0 750 1500
[m]
815 [d]
Groundwater Drawdown - Yr1
FEFLOW (R)

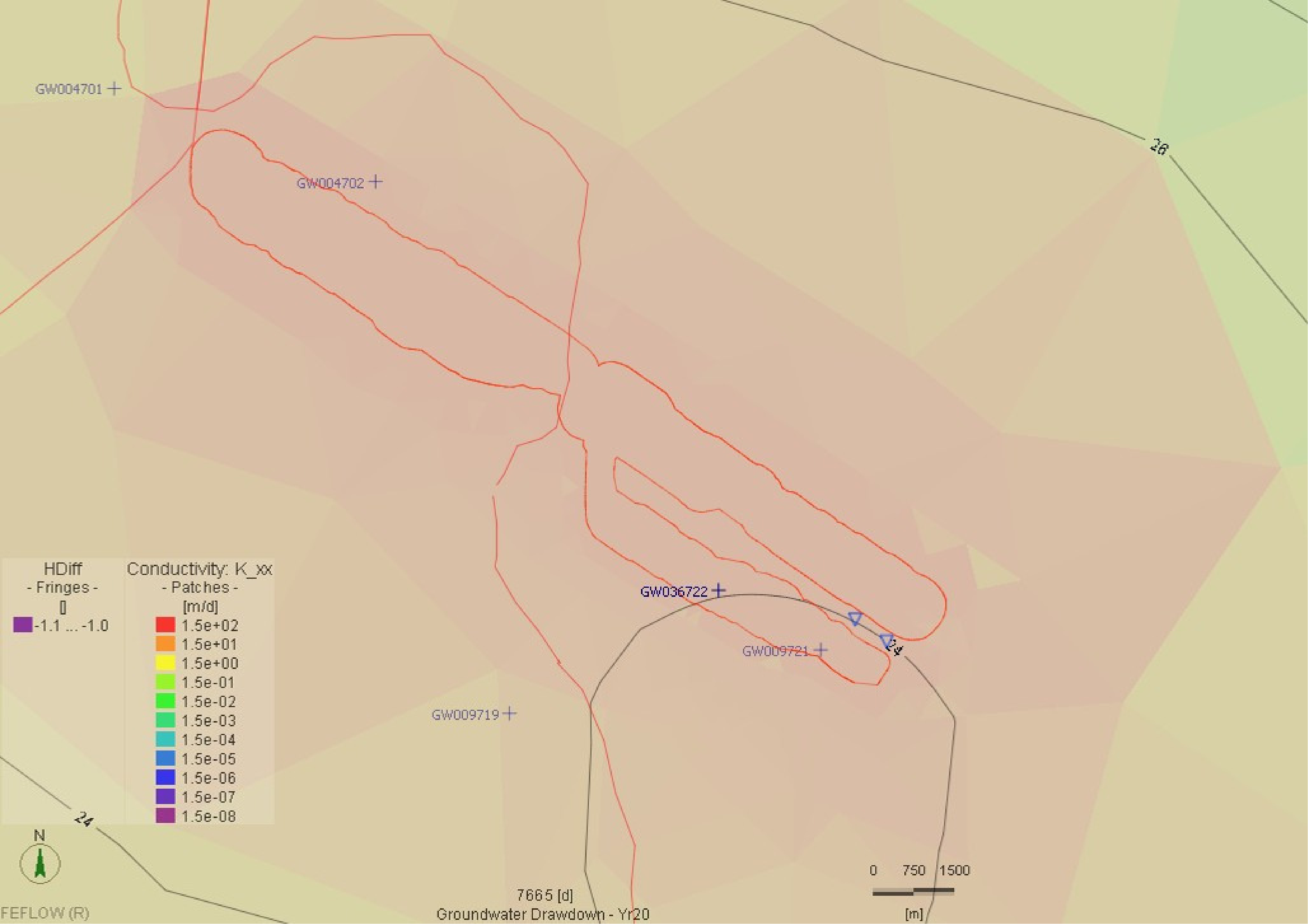

GW004701
GW004702
26
26
GW036722
24
GW009721
-1
GW009719
24
24
HDiff
- Fringes -
[]
-1.5 ... -1.0
Conductivity: K_xx
- Patches -
[m/d]
1.5e+02
1.5e+01
1.5e+00
1.5e-01
1.5e-02
1.5e-03
1.5e-04
1.5e-05
1.5e-06
1.5e-07
1.5e-08
N
0 750 1500
[m]
2185 [d]
Groundwater Drawdown - Yr5
FEFLOW (R)

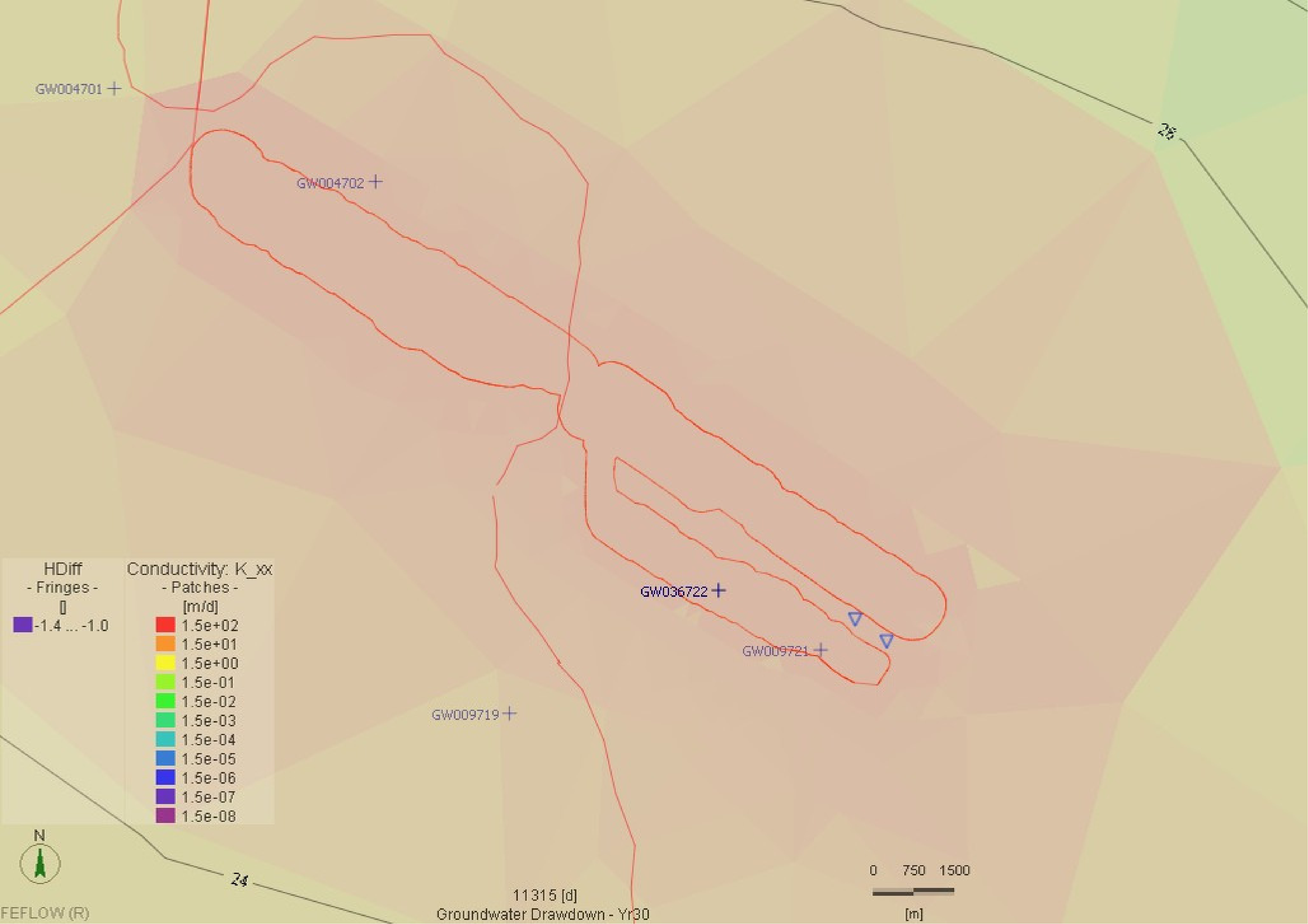

GW004701
GW004702
GW036722
GW009721
GW009719
28
28
24
24
24
24
24
-1.0
0
-1.0
-1.0
HDiff
- Fringes -
[]
1.0 ... 1.6
-2.0 ... -1.0
-2.2 ... -2.0
Conductivity: K_xx
- Patches -
[m/d]
1.5e+02
1.5e+01
1.5e+00
1.5e-01
1.5e-02
1.5e-03
1.5e-04
1.5e-05
1.5e-06
1.5e-07
1.5e-08
N
0
750
1500
[m]
4010 [d]
Groundwater Drawdown - Yr10
FEFLOW (R)


GW004701
GW004702
-1.0
26
24
-1.0
GW036722
GW009721
GW009719
24
24
24
HDiff
- Fringes -
[]
-1.5 ... -1.0
Conductivity: K_xx
- Patches -
[m/d]
1.5e+02
1.5e+01
1.5e+00
1.5e-01
1.5e-02
1.5e-03
1.5e-04
1.5e-05
1.5e-06
1.5e-07
1.5e-08
N
0 750 1500
[m]
5840 [d]
Groundwater Drawdown - Yr15
FEFLOW (R)



6570 [d]
Groundwater Drawdown - Yr17 - EOM


GW004701
GW004702
GW036722
GW009721
GW009719
28
24
24
HDiff
- Fringes -
[]
🟪 -1.1 ... -1.0
Conductivity: K_xx
- Patches -
[m/d]
🟥 1.5e+02
🟧 1.5e+01
🟨 1.5e+00
🟩 1.5e-01
🟩 1.5e-02
🟩 1.5e-03
1.5e-04
🟦 1.5e-05
🟦 1.5e-06
🟪 1.5e-07
🟪 1.5e-08
N
0 750 1500
[m]
7665 [d]
Groundwater Drawdown - Yr20
FEFLOW (R)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25
GW036722
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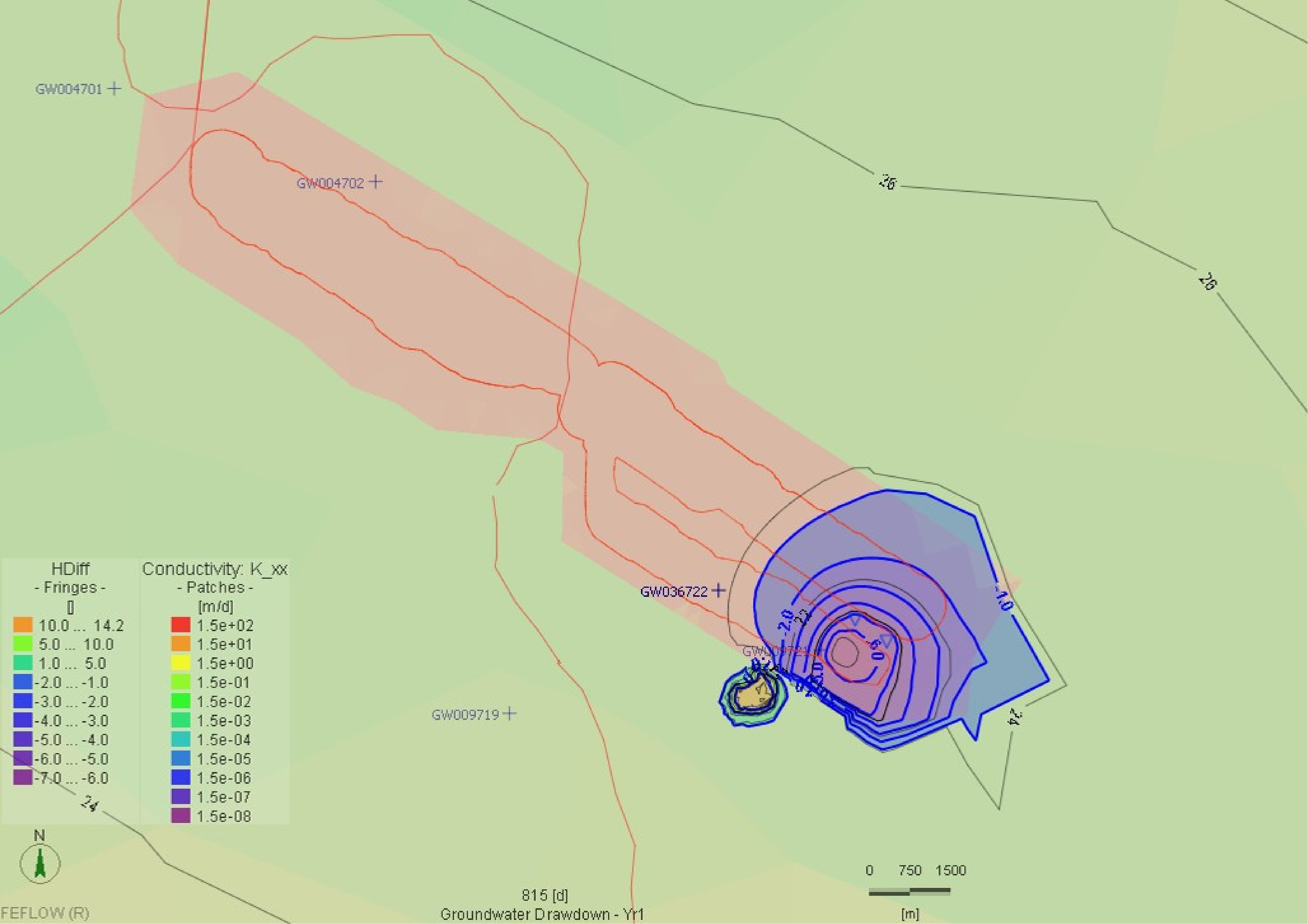
GW009719
24
HDiff
- Fringes -
[]
-1.4 ... -1.0
Conductivity: K_xx
- Patches -
[m/d]
1.5e+02
1.5e+01
1.5e+00
1.5e-01
1.5e-02
1.5e-03
1.5e-04
1.5e-05
1.5e-06
1.5e-07
1.5e-08
N
0 750 1500
[m]
11315 [d]
Groundwater Drawdown - Yr30
FEFLOW (R)

APPENDIX **N**

YEARLY GROUNDWATER CONTOURS FOR SHARP SCENARIO

Black Contours = Groundwater Table (AHD).
Blue Contours and coloured zones (HDiff) indicate the variation in the water table from pre-mine levels in meters (m).
Blue Triangles indicate mine bores.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26
26
24
24
-1.0
-2.0
HDiff
- Fringes -
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5.0 ... 10.0
1.0 ... 5.0
-2.0 ... -1.0
-3.0 ... -2.0
-4.0 ... -3.0
-5.0 ... -4.0
-6.0 ... -5.0
-7.0 ... -6.0
Conductivity: K_xx
- Patches -
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1.5e+01
1.5e+00
1.5e-01
1.5e-02
1.5e-03
1.5e-04
1.5e-05
1.5e-06
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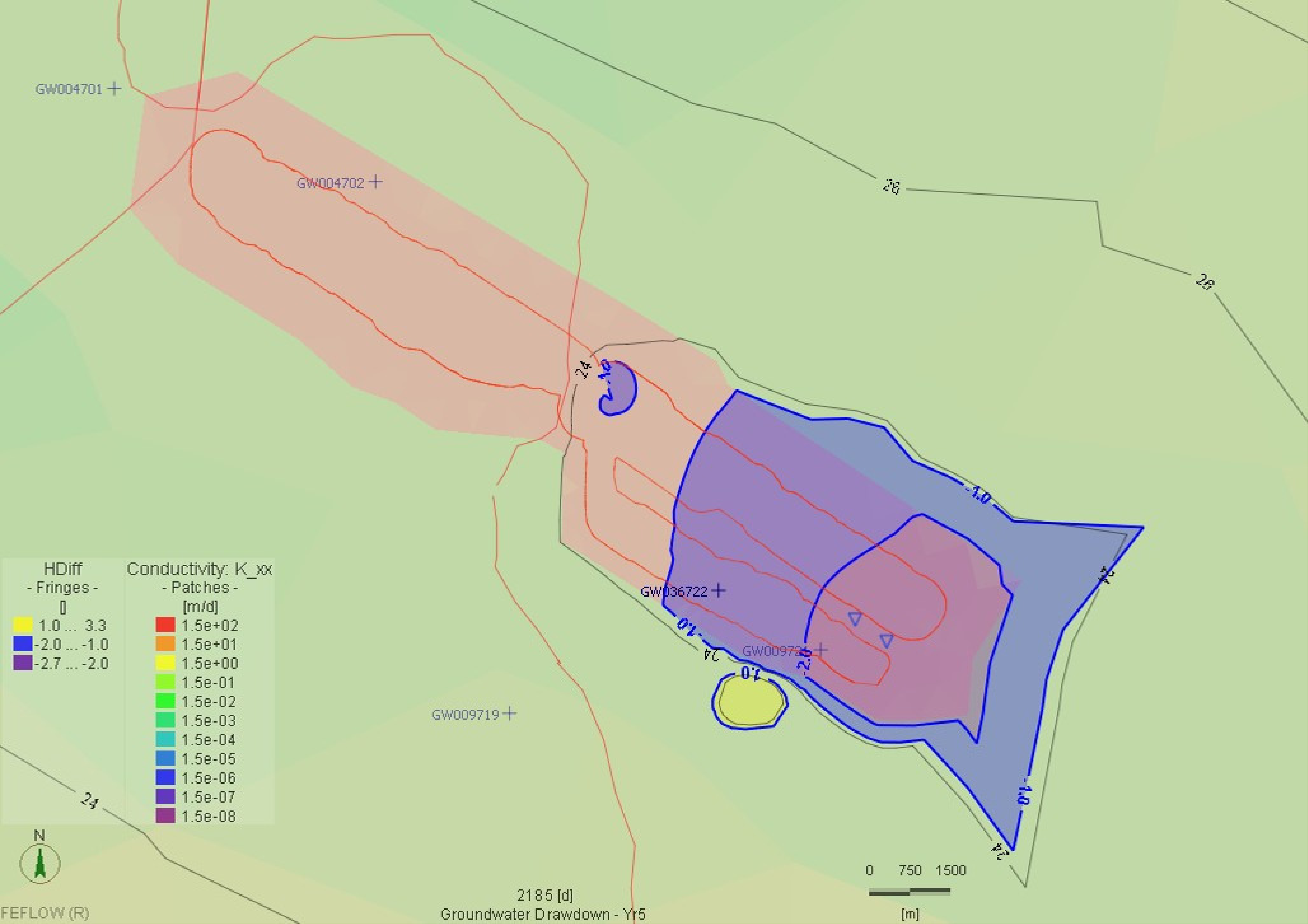
N
0
750
1500
[m]
FEFLOW (R)
815 [d]
Groundwater Drawdown - Yr1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24
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-1.0
-1.0
-1.0
-2.0
1.0
HDiff
- Fringes -
[]
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-2.0 ... -1.0
-2.7 ... -2.0
Conductivity: K_xx
- Patches -
[m/d]
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1.5e+01
1.5e+00
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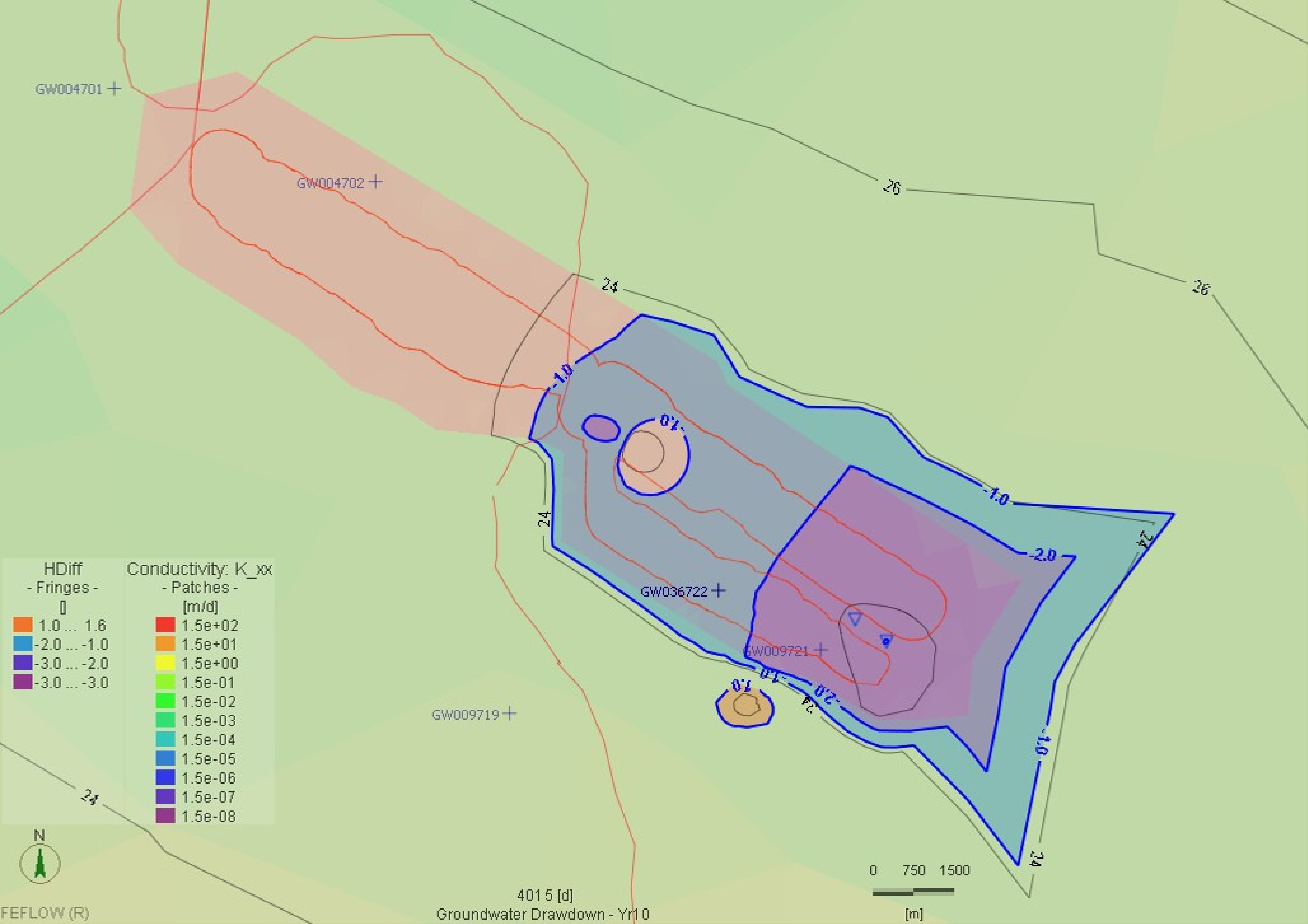
1.5e-02
1.5e-03
1.5e-04
1.5e-05
1.5e-06
1.5e-07
1.5e-08
N
0
750
1500
[m]
2185 [d]
Groundwater Drawdown - Yr5
FEFLOW (R)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24
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-2.0
1.0
GW036722
GW009721
GW009719
HDiff
- Fringes -
[]
1.0 ... 1.6
-2.0 ... -1.0
-3.0 ... -2.0
-3.0 ... -3.0
Conductivity: K_xx
- Patches -
[m/d]
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1.5e+01
1.5e+00
1.5e-01
1.5e-02
1.5e-03
1.5e-04
1.5e-05
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1.5e-08
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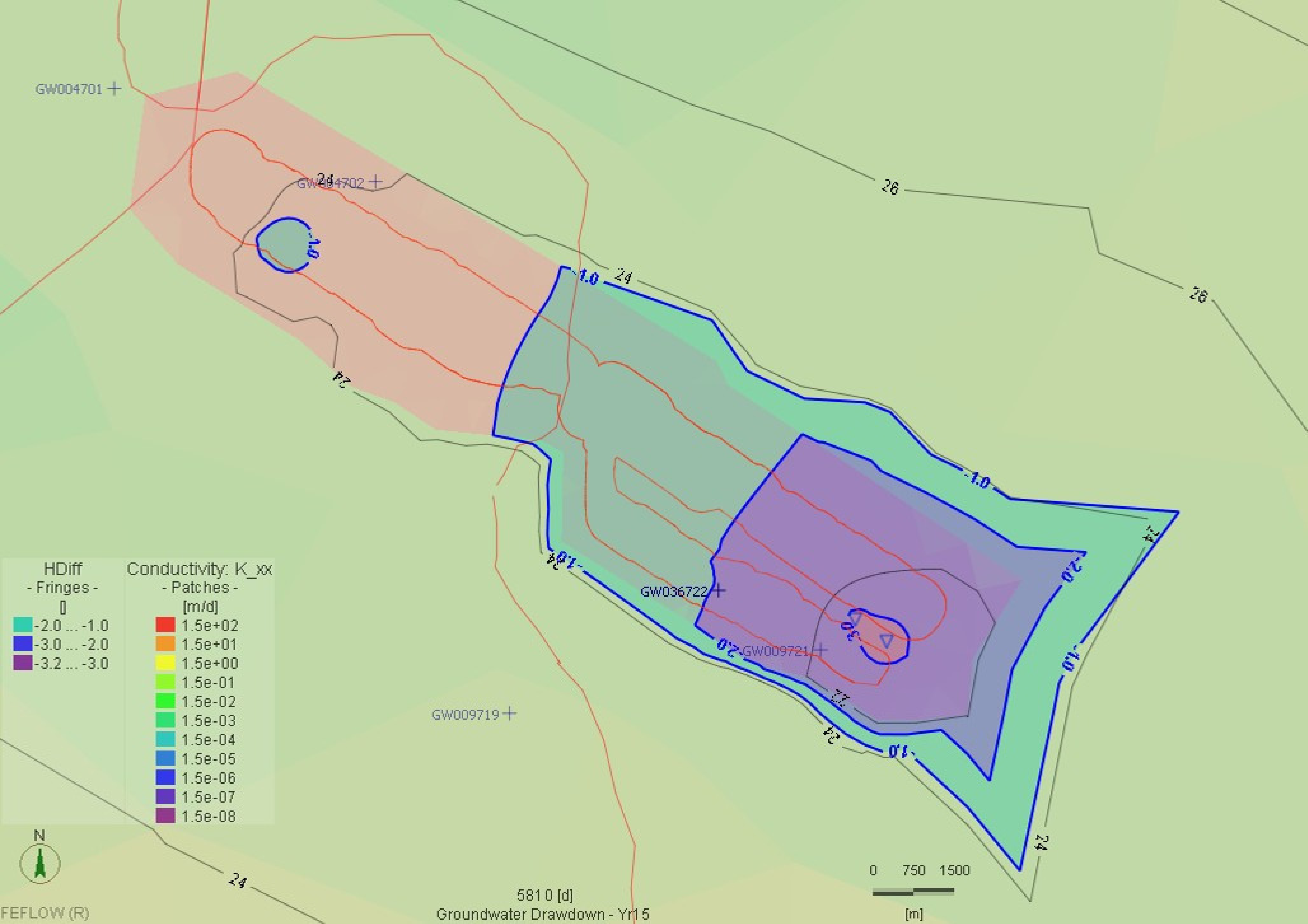
[m]
FEFLOW (R)
4015 [d]
Groundwater Drawdown - Yr10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GW009719
HDiff
- Fringes -
[]
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-3.0 ... -2.0
-3.2 ... -3.0
Conductivity: K_xx
- Patches -
[m/d]
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1.5e-04
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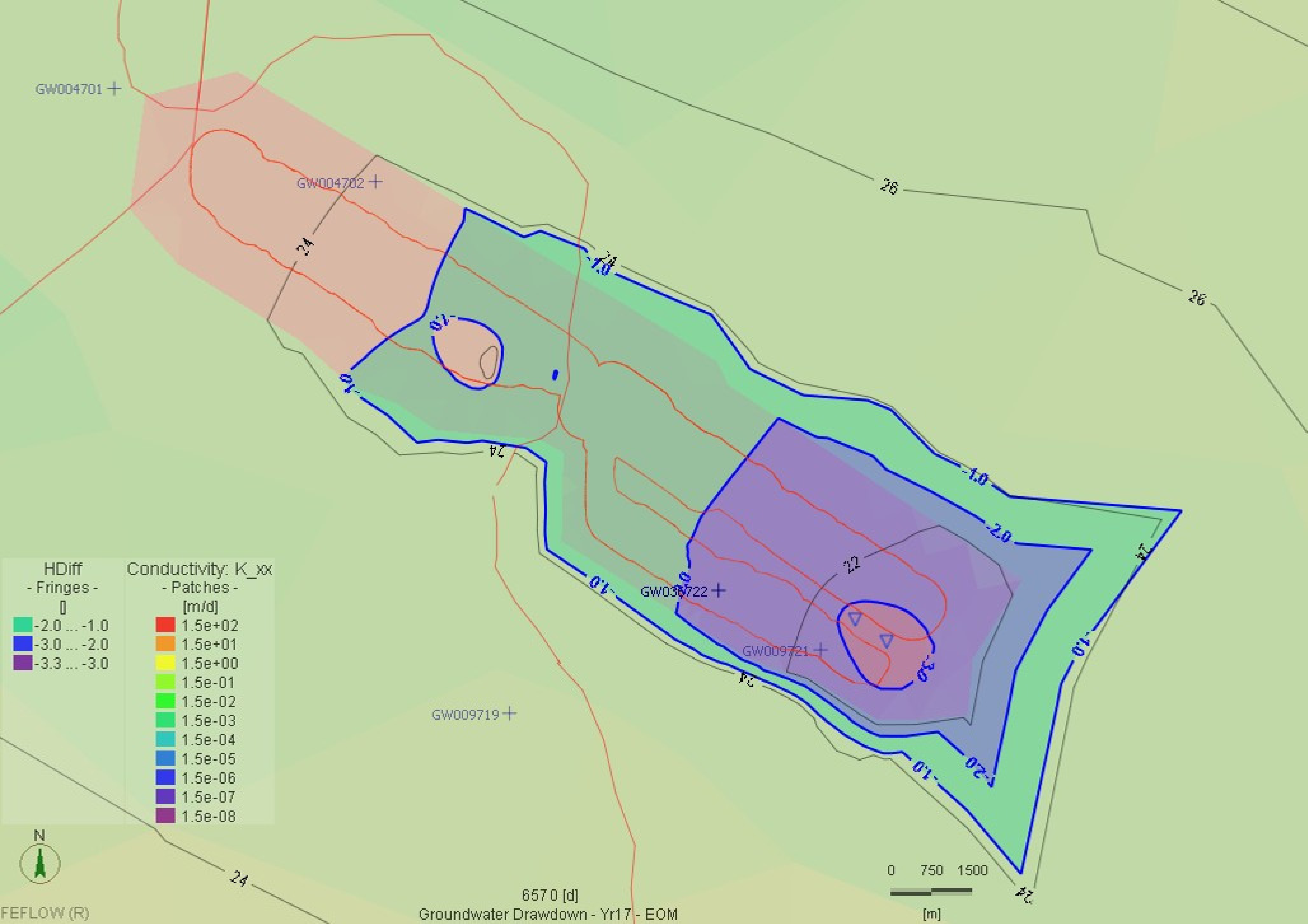
750
1500
[m]
5810 [d]
Groundwater Drawdown - Yr15
FEFLOW (R)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-1.0
-1.0
-1.0
-1.0
-1.0
-2.0
-2.0
-3.0
HDiff
- Fringes -
[]
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-3.0 ... -2.0
-3.3 ... -3.0
Conductivity: K_xx
- Patches -
[m/d]
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1.5e-03
1.5e-04
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1.5e-06
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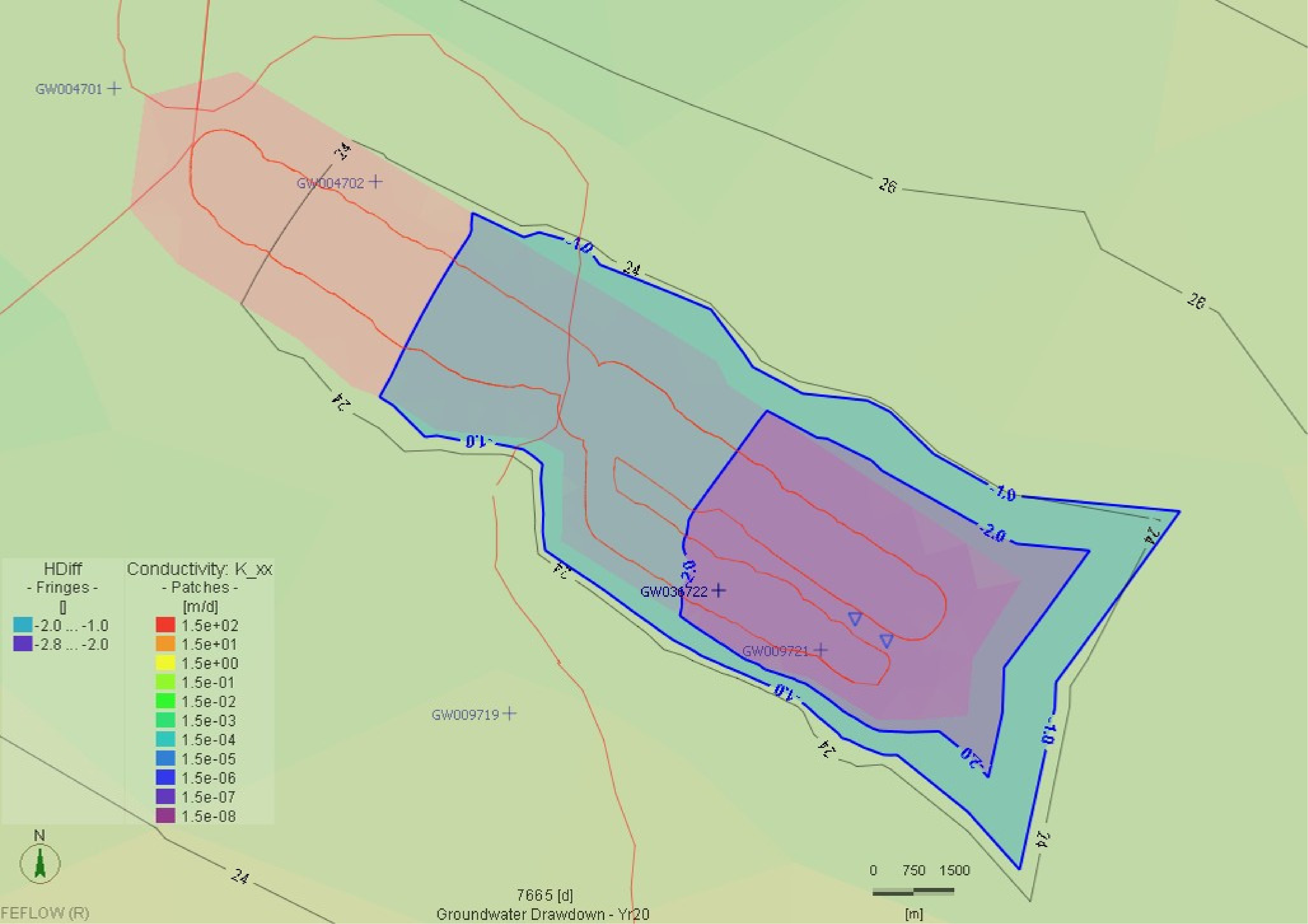
0
750
1500
[m]
FEFLOW (R)
6570 [d]
Groundwater Drawdown - Yr17 - EOM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26
28
-1.0
-2.0
HDiff
- Fringes -
[]
-2.0 ... -1.0
-2.8 ... -2.0
Conductivity: K_xx
- Patches -
[m/d]
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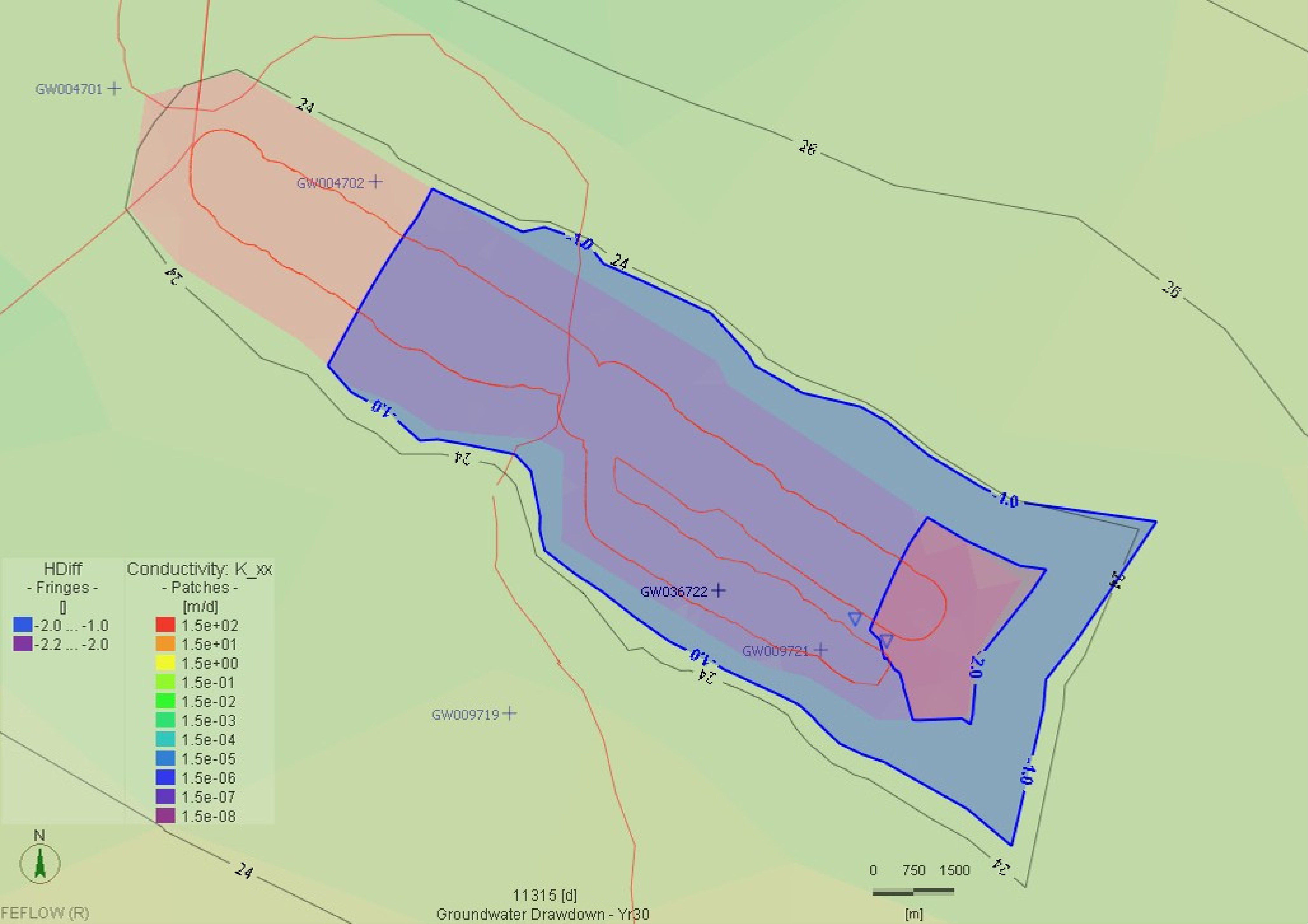
[m]
FEFLOW (R)
7665 [d]
Groundwater Drawdown - Yr20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🟦 -2.0 ... -1.0
🟪 -2.2 ... -2.0
Conductivity: K_xx
- Patches -
[m/d]
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🟦 1.5e-06
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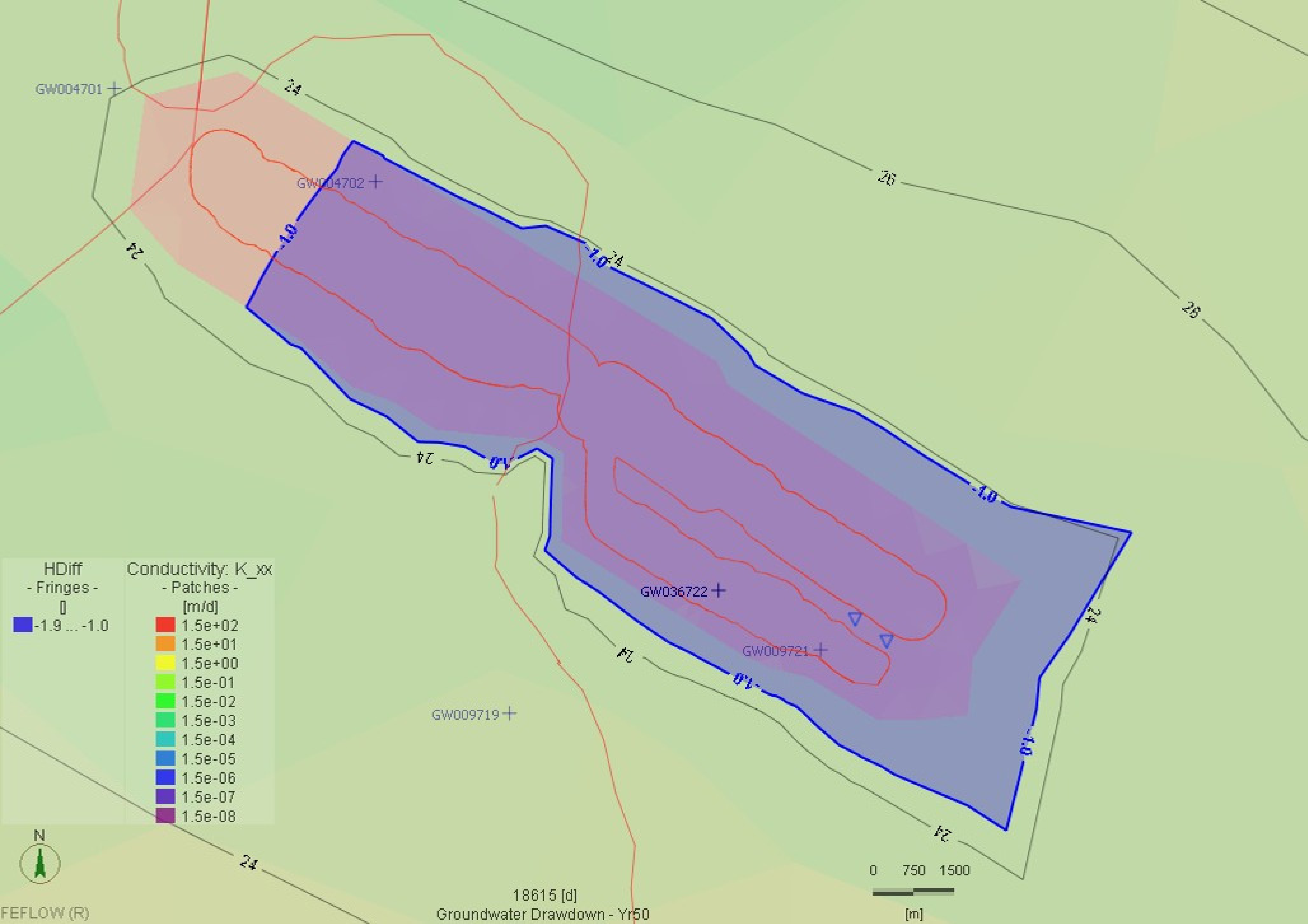
[m]
11315 [d]
Groundwater Drawdown - Yr30
FEFLOW (R)



18615 [d]
Groundwater Drawdown - Yr50

APPENDIX **O**

AQUIFER INTERFERENCE ASSESSMENT FRAMEWORK

Department of Primary Industries
Office of Water

AQUIFER INTERFERENCE ASSESSMENT FRAMEWORK

Assessing a proposal against the NSW Aquifer Interference Policy – step by step guide

Note for proponents

This is the basic framework which the NSW Office of Water uses to assess project proposals against the **NSW Aquifer Interference Policy (AIP).**

The NSW Aquifer Interference Policy can be downloaded from the NSW Office of Water website (www.water.nsw.gov.au under Water management > Law and policy > Key policies > Aquifer interference).

While you are not required to use this framework, you may find it a useful tool to aid the development of a proposal or an **Environmental Impact Statement (EIS)*.***

We suggest that you summarise your response to each AIP requirement in the tables following and provide a reference to the section of your EIS that addresses that particular requirement. Using this tool can help to ensure that all necessary factors are considered, and will help you understand the requirements of the AIP.

Table 1. Does the activity require detailed assessment under the AIP?

Consideration		Response
1	Is the activity defined as an aquifer interference activity?	If **NO,** then no assessment is required under the AIP. If [✓ **YES**], continue to Question 2.
2	Is the activity a defined minimal impact aquifer interference activity according to section 3.3 of the AIP?	If **YES**, then no further assessment against this policy is required. Volumetric licensing still required for any water taken, unless exempt. If [✓ **NO**], then continue on for a full assessment of the activity.

Note for proponents

Section 3.2 of the AIP defines the framework for assessing impacts. These are addressed here under the following headings:

1. Accounting for or preventing the take of water
2. Addressing the minimal impact considerations
3. Proposed remedial actions where impacts are greater than predicted.

1. Accounting for, or preventing the take of water

Where a proposed activity will take water, adequate arrangements must be in place to account for this water. It is the proponent's responsibility to ensure that the necessary licences are held. These requirements are detailed in Section 2 of the AIP, with the specific considerations in Section 2.1 addressed systematically below.

Where a proponent is unable to demonstrate that they will be able to meet the requirements for the licensing of the take of water, consideration should be given to modification of the proposal to prevent the take of water.

Table 2. Has the proponent:

	AIP requirement	Proponent response	NSW Office of Water comment
1	Described the water source(s) the activity will take water from?	Western Murray Porous Rock Water Source (WMPR)	
2	Predicted the total amount of water that will be taken from each connected groundwater or surface water source on an annual basis as a result of the activity?	Average 4.8GL/yr. Maximum 9.5GL/yr (Section 12.2)	
3	Predicted the total amount of water that will be taken from each connected groundwater or surface water source after the closure of the activity?	0 GL/yr	
4	Made these predictions in accordance with Section 3.2.3 of the AIP? (refer to Table 3, below)	Yes	
5	Described how and in what proportions this take will be assigned to the affected aquifers and connected surface water sources?	Pumping from bores and dredge pond. Evaporation from dredge pond. 100% WMPR Source.	
6	Described how any licence exemptions might apply?		
7	Described the characteristics of the water requirements?	Direct take from pumping bores and dredge pond and evaporation.	
8	Determined if there are sufficient water entitlements and water allocations that are able to be obtained for the activity?	The Applicant would seek allocation from the unallocated 163 GL/yr of the WMPR Source.	

AIP requirement		Proponent response	NSW Office of Water comment
9	Considered the rules of the relevant water sharing plan and if it can meet these rules?	The Project is distant from other water users and environmental receivers and would comply with all water sharing plan rules (Section 7.1).	
10	Determined how it will obtain the required water?	Controlled Allocation Order, or Special Purpose Water Licence (Section 7.1).	
11	Considered the effect that activation of existing entitlement may have on future available water determinations?	Negligible effect on future water uses in water source as there would be no long-term effect greater than 2 m drawdown (Section 12). Mine Void to be backfilled to above natural water table level, to prevent on-going effect (Section 12.4).	
12	Considered actions required both during and post-closure to minimize the risk of inflows to a mine void as a result of flooding?	Mine Void to be backfilled to above natural water table level, to prevent on-going effect (Section 12.8).	
13	Developed a strategy to account for any water taken beyond the life of the operation of the project?	No on-going take (Section 12.4).	
Will uncertainty in the predicted inflows have a significant impact on the environment or other authorised water users? No, refer to Section 12 of the assessment report. If **YES,** items 14-16 must be addressed.			
14	Considered any potential for causing or enhancing hydraulic connections, and quantified the risk?	.	
15	Quantified any other uncertainties in the groundwater or surface water impact modelling conducted for the activity?		
16	Considered strategies for monitoring actual and reassessing any predicted take of water throughout the life of the project, and how these requirements will be accounted for?		

Table 3. Determining water predictions in accordance with Section 3.2.3 (complete one row only – consider both during and following completion of activity)

	AIP requirement	Proponent response	NSW Office of Water comment
1	**For the Gateway process**, is the estimate based on a simple modelling platform, using suitable baseline data, that is, fit-for-purpose?		
2	**For State Significant Development or mining or coal seam gas production**, is the estimate based on a complex modelling platform that is: • Calibrated against suitable baseline data, and in the case of a **reliable water source,** over at least two years? • Consistent with the Australian Modelling Guidelines? • Independently reviewed, robust and reliable, and deemed fit-for-purpose?	Groundwater Model calibrated using long-term groundwater data in steady-state (Section 11). Consistent with Australian Modelling Guidelines (Section 11.6). Independent peer review completed (Appendix P).	
3	In all other processes, estimate based on a desk-top analysis that is: • Developed using the available baseline data that has been collected at an appropriate frequency and scale; and • Fit-for-purpose?		

Other requirements to be reported on under Section 3.2.3

Table 4. Has the proponent provided details on:

	AIP requirement	Proponent response	NSW Office of Water comment
1	Establishment of baseline groundwater conditions?	Baseline groundwater condition provided in Section 5.	
2	A strategy for complying with any water access rules?	Licensing discussed in Section 7.	
3	Potential water level, quality or pressure drawdown impacts on nearby basic landholder rights water users?	No potential effect to landholder bores (Section 8).	
4	Potential water level, quality or pressure drawdown impacts on nearby licensed water users in connected groundwater and surface water sources?	No licensed water users in zone of effect (Section 8).	
5	Potential water level, quality or pressure drawdown impacts on groundwater dependent ecosystems?	Effect on groundwater dependent ecosystems to be accounted for by the Project's biodiversity offsetting obligations under the Biodiversity Conservation Act. (Section 12.5).	
6	Potential for increased saline or contaminated water inflows to aquifers and highly connected river systems?	Aquifer is hyper-saline, and the mine will not cause any significant change to the salinity (Section 12.3). There is no connection to surface waters / rivers (Section 10).	
7	Potential to cause or enhance hydraulic connection between aquifers?	N/A	
8	Potential for river bank instability, or high wall instability or failure to occur?	N/A	
9	Details of the method for disposing of extracted activities (for coal seam gas activities)?	N/A	

2. Addressing the minimal impact considerations

Note for proponents

Section 3.2.1 of the AIP describes how aquifer impact assessment should be undertaken.

1. Identify all water sources that will be impacted, referring to the water sources defined in the relevant water sharing plan(s). Assessment against the minimal impact considerations of the AIP should be undertaken for each ground water source.
2. Determine if each water source is defined as ‘highly productive’ or ‘less productive’. If the water source is named in then it is defined as highly productive, all other water sources are defined as less productive.
3. With reference to pages 13-14 of the Aquifer Interference Policy, determine the sub-grouping of each water source (eg alluvial, porous rock, fractured rock, coastal sands).
4. Determine whether the predicted impacts fall within Level 1 or Level 2 of the minimal impact considerations defined in Table 1 of the AIP, for each water source, for each of water table, water pressure, and water quality attributes. The tables below may assist with the assessment. There is a separate table for each sub-grouping of water source – only use the tables that apply to the water source(s) you are assessing, and delete the others.
5. If unable to determine any of these impacts, identify what further information will be required to make this assessment.
6. Where the assessment determines that the impacts fall within the Level 1 impacts, the assessment should be ‘Level 1 – Acceptable’
7. Where the assessment falls outside the Level 1 impacts, the assessment should be ‘Level 2’. The assessment should further note the reasons the assessment is Level 2, and any additional requirements that are triggered by falling into Level 2.
8. If water table or water pressure assessment is not applicable due to the nature of the water source, the assessment should be recorded as ‘N/A – reason for N/A’.

Table 5. Minimal impact considerations – *example tables*

Aquifer	**Porous rock: Western Murray Porous Rock Aquifer**
Category	**Less productive**
Minimal Impact Consideration	**Assessment**
Water table Level 1. Less than or equal to a 10% cumulative variation in the water table, allowing for typical climatic 'post-water sharing plan' variations, 40 metres from any: • high priority groundwater dependent ecosystem or • high priority culturally significant site listed in the schedule of the relevant water sharing plan. A maximum of a 2 metre water table decline cumulatively at any water supply work. Level 2. If more than 10% cumulative variation in the water table, allowing for typical climatic "post- water sharing plan" variations, 40m from any: (a) high priority groundwater dependent ecosystem; or (b) high priority culturally significant site; listed in the schedule of the relevant water sharing plan if appropriate studies demonstrate to the Minister's satisfaction that the variation will not prevent the long-term viability of the dependent ecosystem or significant site. If more than a 2m decline cumulatively at any water supply work then make good provisions should apply.	Complies with Level 2 minimal impact. Some GDE locations are within the mine path and would be temporarily removed. The ground would be re-established to the pre-mine levels and soil types after mining and the GDE plant species would be restored. Water table effects are expected to be small, however there is potential for more than 10% cumulative variation (5cm) in the water table at the GDE locations near to the mine path. The water table at these locations would recover after mining and the GDE's would be re-planted (where there has been vegetation loss) to match the recorded pre-mine conditions. (Section 12.6). Complies with Level 1 minimal impact. There are no identified high priority culturally significant sites near to the mine site (EIS report). Complies with Level 1 minimal impact. There would be no groundwater table decline at any existing water supply work (Section 12.5).
Water pressure Level 1. A cumulative pressure head decline of not more than a 2 metre decline, at any water supply work.	Complies with Level 1 minimal impact. The Project would not result in cumulative depressurisation or more than 2 m at any privately owned water supply work (Sections 12.4 & 12.5).
Water quality Level1. Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 metres from the activity.	Complies with Level 1 minimal impact. The Project is expected to result in negligible impacts on groundwater quality (Section 12.8). On this basis, the Project would not lower the beneficial use category of the groundwater source.

3. Proposed remedial actions where impacts are greater than predicted.

Note for proponents

Point 3 of section 3.2 of the AIP provides a basic framework for considerations to consider when assessing a proponent's proposed remedial actions.

Table 6. Has the proponent:

AIP requirement		Proponent response	NSW Office of Water comment
1	Considered types, scale, and likelihood of unforeseen impacts *during operation*?	Excessive drawdown at landholder bore is extremely unlikely, as only nearby bore is 10km away and in lower-aquifer, isolated from mine effect by thick aquitards (Section 13.2). Volumes used are small and could be made-good by alternative sources.	
2	Considered types, scale, and likelihood of unforeseen impacts *post closure*?	Post-closure the water table will gradually recover. Final pond to be backfilled above natural water table level. No mine pit or other structure to cause long-term water take.	
3	Proposed mitigation, prevention or avoidance strategies for each of these potential impacts?	Make-good water supply from planned pumping system and RO treatment if required.	
4	Proposed remedial actions should the risk minimization strategies fail?	New bores drilled for landholder. Additional make-good water.	
5	Considered what further mitigation, prevention, avoidance or remedial actions might be required?	Turning off bores would stop drawdown and allow recovery of water level/pressure.	
6	Considered what conditions might be appropriate?	Make-good of water to landholders.	

4. Other considerations

Note for proponents

These considerations are not included in the assessment framework outlined within the AIP, however are discussed elsewhere in the document and are useful considerations when assessing a proposal.

Table 7: Has the proponent:

AIP requirement		**Proponent response**	**NSW Office of Water comment**
1	Addressed how it will measure and monitor volumetric take? (page 4 of the AIP)	Bores will be metered. Water levels will be monitored and the groundwater model will be used for assessment.	
2	Outlined a reporting framework for volumetric take? (page 4 of the AIP)	Monthly pumping volumes recorded and reported yearly.	

More information

www.water.nsw.gov.au

Disclaimer:

This is a draft document produced as a guide for discussion, and to aid interpretation and application of the NSW Aquifer Interference Policy (2012). All information in this document is drawn from that policy, and where there is any inconsistency, the policy prevails over anything contained in this document.
Any omissions from this framework do not remove the need to meet any other requirements listed under the Policy.

The information contained in this publication is based on knowledge and understanding at the time of writing (February 2024). However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up to date and to check currency of the information with the appropriate officer of the Department of Primary Industries or the users independent adviser.

Published by the NSW Department of Primary Industries.

Reference 12279.1

APPENDIX **P**

INDEPENDENT PEER REVIEW REPORT

Hydro Consulting Services
ABN 77623222131

Mr Paul Smith
GM Environment Social and Governance
RZ Resources Limited

Our reference: L270224_RZ

27 February 2024

Dear Paul

RE: Copi Mineral Sands Project Groundwater Impact Assessment (3D Numerical Groundwater Model 2324A4) – Independent Peer Review

1 Background and Context

RZ Resources (RZ) is in the approvals phase in the development of the company's Copi Mineral Sands Project (Copi), located 75km northwest of Wentworth, NSW. The Copi mineral sand orebody is located below the water table and contains over 10 million tonnes of heavy minerals (zircon, rutile, leucoxene, ilmenite, monazite and xenotime).

The proposed mining process will involve the removal of overburden using excavators and trucks, and then dredge mining the mineral sand orebody. Three dredges will be involved, two removing low value inter burden and a third following behind to mine the high grade ore body. The dredge pond will be kept near the natural water table level, with a maximum dredging depth of around 40 m below natural ground surface level.

RZ is required to provide a groundwater assessment as part of an Environmental Impact Assessment (EIA), and to assess potential water-related mining impacts and water licensing requirements, to comply with the NSW Aquifer Interference Policy (AIP).

Consulting firm GEO-ENG have previously developed a conceptual hydrogeological model for the Copi project at the request of RZ Resources. The conceptual model incorporates hydrogeological information from site investigations conducted by RZ Resources, as well as groundwater levels and groundwater chemistry from government and private water bores, and previous hydrogeological studies in the region. The conceptual model was independently reviewed by Hydro Consulting Services (HCS) in October 2022 (HCS Report Reference L251022_RZ).

GEO-ENG subsequently completed a detailed 3D numerical groundwater model, and an accompanying report[1], using the earlier conceptual groundwater model as basis. The 3D numerical groundwater model provides a quantitative assessment of the potential groundwater effects resulting from RZ's future dredge mining operations. After HCS review of the initial 3D model (2019B) a revised model was produced by GEO-ENG (2019C) including several changes and additions, including a model run using a sharp hydraulic gradient between strandlines as a sensitivity/uncertainty analysis. Following a change in the planned mine sequencing in late 2023, another model was created and run by GEO-ENG to simulate a change in the dredge path direction (2324A4, this review).

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[1] Copi Mineral Sands Project Groundwater Impact Assessment 2109B (GEO-ENG, November 2022)

The NSW Aquifer Interference Policy 2012 (AIP) requires that groundwater models submitted in support of Major Project developments undergo an independent review, consistent with the Australian Groundwater Modelling Guidelines[2] (AGMG). HCS has assessed the GEO-ENG Model against requirements in the AGMG and the more recent 2022 Minimum Groundwater Modelling Requirements for SSD/SSI Projects[3].

2 Review Scope

This peer review covers the latest model report provided to HCS by GEO-ENG titled 'Copi Mineral Sands Project Groundwater Impact Assessment, 2324A, Feb 2024'.

3 Review Methodology

In January 2022 the NSW Department of Planning and Environment released the Groundwater Assessment Toolbox (GAT) for all major State Significant Developments and State Significant Infrastructure (SSD/SSI) projects in NSW. The GAT is a technical guideline that presents the minimum requirements for groundwater reporting and modelling for major projects in NSW. An overview of the technical guidelines forming the GAT is shown in Figure 1.

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[2] Sinclair Knight Merz and National Centre for Groundwater Research and Training (2012) Australian Groundwater Modelling Guidelines. Waterlines Report Series No. 92.

[3] NSW Department of Planning and Environment (2022) Minimum Groundwater Modelling Requirement for SSD/SSI Projects, PUB22/7

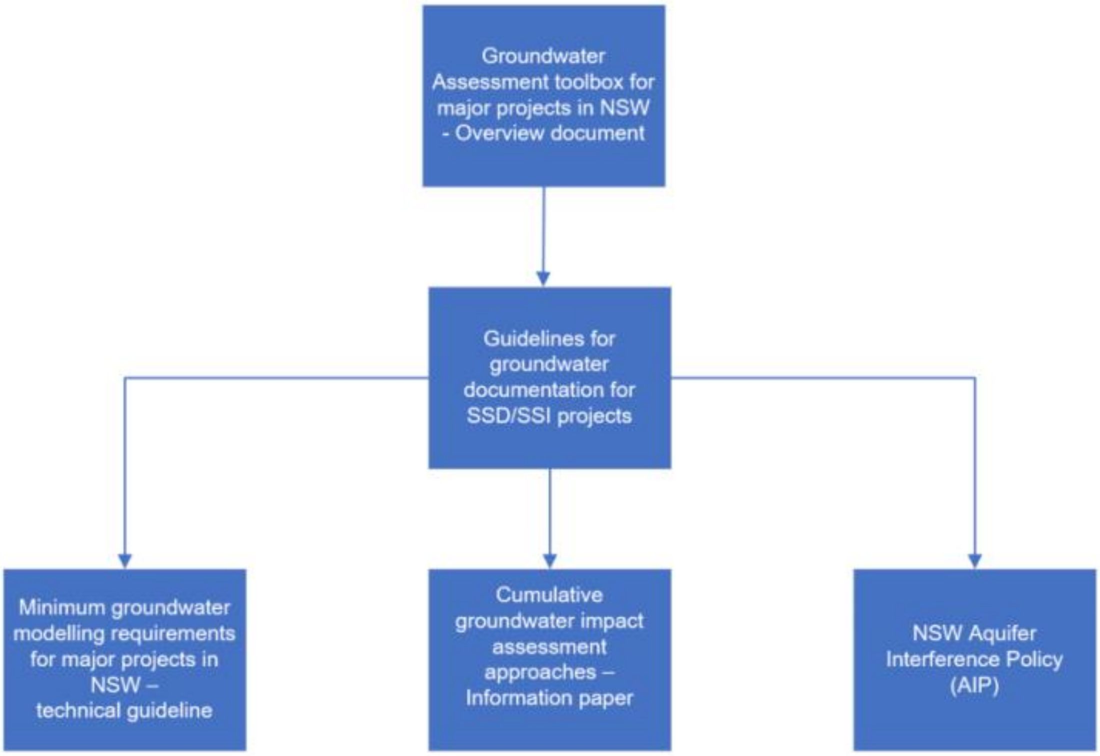

Figure 1. Groundwater Assessment Toolbox (GAT) - framework for assessing SSD/SSI projects in NSW

Following the completion of RZ’s site groundwater investigations GEO-ENG completed and documented a Copi conceptual hydrogeological model, a subsequent numerical 3D groundwater model (2019C), and a most recently a revised 3D groundwater model (2324A) which is the current model and the subject of this review. The 2324A model has been reviewed by HCS against the guideline criteria specified in both the AGMG and AIP.

4 HCS Model Review Commentary

4.1 Previous Studies/Literature Review

Previous hydrogeological studies are adequately summarized in Section 5.2 of the GEO-ENG report, including the appropriate references. Relevant studies include three regional hydrogeological studies and several mining project studies, some of which were conducted by GEO-ENG. Hydrogeological parameters from the previous studies are summarized in Table 3 of the GEO-ENG report by geological unit.

4.2 Hydrogeological Data

RZ commissioned Australian Groundwater Environments (AGE) to install an extensive network of 51 groundwater testing and monitoring bores in the Project Area, centered mainly in and around the planned dredge path. Bore construction logs are included as Appendix B of the GEO-ENG report. Most of the project site investigation bores were completed in the Loxton-Parilla Sand which HCS considers appropriate as the Loxton-Parilla Sand comprises the ‘upper aquifer’ which hosts the Copi orebody.

Pumping tests were conducted on three of these bores by AGE. The pumping test results were analysed by GEO-ENG to establish key hydrogeologic parameters for the Project Area. The aquifer test results from these bores were consistent both with the expected range of parameters for fine to coarse sand, and with previous regional studies, and provided useful data to inform the GEO-ENG model.

Farther from the immediate Project Area, regional groundwater data was obtained from a groundwater bore census, with 23 bores used to establish boundary conditions in the groundwater model and 229 bores at 184 locations used for model calibration. The relatively small number of available bores is due to the high salinity groundwater, which is of no beneficial use to landholders. Given the large area covered by the groundwater model, around 57,000 km^2, the spatial coverage provided by available regional bores is relatively low, which reduces the confidence level class of the groundwater model.

Regional salinity and aquifer yields are adequately presented in Table 2 and in several AGSO cross sections in Appendix A. Average groundwater quality is presented for physical parameters, major ions, dissolved metals and TOC for upper- middle- and lower-aquifers in the Project Area in Table 7. The average salinity of groundwater in the Loxton Parilla Sand (upper aquifer) at Copi is around 61,000 mg/L, nearly twice the salinity of sea water, making it unsuitable for agriculture or other beneficial uses.

HCS believes that the data is sufficient (spatially, temporally and quality) to inform the groundwater model for the assessed confidence level, which is discussed further in Section 5 below.

4.3 Conceptual Groundwater Model

The GEO-ENG conceptual model report was independently reviewed by Hydro Consulting Services (HCS) in October 2022 (HCS Report Reference L251022_RZ). GEO-ENG used the earlier conceptual model as a foundation for the 3D numerical model as per the recommended AGMG approach.

4.4 3D Numerical Groundwater Model

In November 2022 HCS reviewed an initial 3D groundwater model (2019B) produced by GEO-ENG for the Copi Project (HCS Report Reference L271122_RZ). A subsequent GEO-ENG model (2019C) was reviewed by HCS in March 2023 (HCS Report Reference L140323_RZ). Most of the suggestions and recommendations suggested by HCS from the previous reviews have been incorporated by GEO-ENG in the current model report (2324A4).

HCS has systematically reviewed the current GEO-ENG groundwater model (2324A) against 111 individual model component categories in a review checklist, which is included separately to this review as Attachment 1. The model component categories in the checklist were taken directly from Table A2 in the Minimum Groundwater Modelling Requirement for SSD/SSI Projects (which was adopted from the AGMG).

The model report components and sub-components in Attachment 1 were assessed by HCS as either Compliant (Y), Not Compliant (N) or not applicable (NA). The AGMG checklists have been adapted so that a ‘yes’ answer always indicates a pro and a ‘no’ answer always indicates a con.

HCS has been in contact with Mr Mark Robertson from GEO-ENG several times since the development of the initial conceptual groundwater model, to try and ensure each of the main model review components were addressed as the model was being developed. At the time of this review, it is HCS opinion that the GEO-ENG model generally complies with each of the AGMG model component categories (refer Attachment 1) as summarized below:

1. Planning (model is generally compliant in HCS opinion)
2. Conceptualisation (model is generally compliant in HCS opinion)
3. Design and construction (model is generally compliant in HCS opinion) [4]
4. Calibration and sensitivity (model is generally compliant in HCS opinion)
5. Prediction (model is generally compliant in HCS opinion)
6. Uncertainty (model is generally compliant in HCS opinion)
7. Solute transport (Not Applicable)
8. Surface water – groundwater interaction (model is generally compliant in HCS opinion)

The current (2324A4) model has been calibrated for two potential scenarios. In Scenario 1 the hydraulic conductivity is allowed to vary smoothly between the pilot points (GEO-ENG's 'smooth' scenario) while in Scenario 2 the hydraulic conductivity at the Copi Strand Line is fixed, to simulate the expected sharp conductivity contrast between strandlines and the surrounding sands ('sharp' scenario).

This provides the required model sensitivity analysis by comparing statistical parameterisation (PEST) with prior hydrogeological knowledge, based on GEO-ENG's experience in similar hydrogeological environments in mineral sand operations in the Murray Darling Basin.

4.5 Reporting

The current (2324A4) Copi 3D Groundwater Model report was provided to HCS on 22nd February 2024 and is titled 'Copi Mineral Sands Project Groundwater Impact Assessment' and contains the following major sections:

1. Project Overview
2. Scope of Work
3. Environmental Setting
4. Regional Geology
5. Hydrogeology
6. Recharge and Discharge
7. Licensing
8. Regional Groundwater Usage
9. Groundwater Dependent Ecosystems
10. Surface Water Interactions
11. Groundwater Model Development
12. Impact Assessment
13. Management and Mitigation Measures
14. Groundwater Model Limitations and Peer Review

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15. Conclusions
16. Glossary and Acronyms

Appendices include:

A. AGSO Hydrogeological Cross-sections
B. Site Investigation Bores
C. Pumping Test Analysis
D. Hydro-census Data
E. Calibration and Boundary Borehole Data
F. Hydrographs of Regional Monitoring Bores
G. Transmissivity (T) for Smooth Scenario
H. Transmissivity (T) for Sharp Scenario
I. Leakage Coefficient (R) for Smooth Scenario
J. Leakage Coefficient (R) for Sharp Scenario
K. Net Rainfall and Surface Water Recharge for Smooth Scenario
L. Net Rainfall and Surface Water Recharge for Sharp Scenario
M. Yearly Groundwater Contours for Smooth Scenario
N. Yearly Groundwater Contours for Sharp Scenario
O. Aquifer Interference Assessment Framework
P. Independent Peer Review Report

HCS believes the report structure is comprehensive, and generally consistent with the requirements outlined in Table 9 of the Minimum Groundwater Modelling Requirements for SSD/SSI Projects. To fully comply with AGMG and AIP, HCS believes several additions to the model report are required. The recommended report additions are discussed as follows:

1. The report requires a short paragraph in s.2.0 that specifically states the groundwater model objectives, and how they fit the relevant project and regulatory requirements, as required by the AGMG. As the modelling objectives have informed GEO-ENG's selection of model resolution, layering, initial conditions, grid type, boundary conditions, software selection etc this must be clearly stated.

2. More detail is required to address potential risk relating to mining-related groundwater impacts including potential damage to aquifers/aquitards/aquicludes and the typical composition of 'tailings' (eg sand/clay?). In particular, is any permanent aquifer damage resulting from dredging expected to be permanent, or will reinstatement of tailings to the dredge pond likely to return aquifer conditions to near pre-mining conditions?

3. The Figures included in the report are mostly adequate, and clearly illustrate the concepts described in the report text. However, water balance values from the model, or ranges of values, for the pond and tailings including groundwater inflow/outflow, evaporation, rainfall, tailings return, makeup water (if any) and the range of net groundwater abstraction (ML/day for LOM)

could be added to Figure 2 for further clarity. If the modelled water balance values changes significantly during LOM, several figures and a table will be required for representative stages of mine life, including pre-mining and post closure.

HCS notes that its previous recommendations, including an executive summary-style section targeted for non-technical stakeholders including traditional owners and the public, were adopted by GEO-ENG in the current (2324A4) model report. Similarly, a section summarizing RZ's proposed dredge mining methodology with schematic drawings has now been included in the current report. Other items requiring clarification, including simulation of planned water supply bores, have now been adequately addressed. Minor typographical errors have been corrected.

5 Discussion

The GEO-ENG numerical groundwater model is well calibrated to steady state groundwater conditions, with a Root Mean Square of 0.65m and Scaled Root Mean Square of 1.68% for the 'smooth' model and a Root Mean Square of 0.58m and Scaled Root Mean Square of 1.5% for the 'sharp' model, indicating an accurate fit to the available data for both scenarios.

The groundwater model is assessed by GEO-ENG as overall confidence level Class 1 to Class 2 based on AGMG criteria including data quality, calibration, prediction and key indicators. HCS agrees with the assessed confidence class. HCS believes the model's confidence level of Class 1 to Class 2 is acceptable and the model is fit for purpose, given that:

- predicted groundwater impacts resulting from the proposed mining operation will be minimal outside the immediate Project Area,
- groundwater in the upper aquifer (Loxton Parilla Sand) in the Project Area is hypersaline and of low value, and
- there are no potential groundwater environmental receptors or beneficial users that will be significantly affected by the proposed mining operation.

HCS assesses the Copi Mineral Sands Project groundwater model as generally consistent with the requirements set out in the AIP and AGMG and is fit for purpose. However, before submitting the numerical model report to the regulators GEO-ENG should address the remaining reporting gaps identified in this review.

6 Reviewer Qualifications & Experience

This groundwater model review was conducted by Mr James Williams (BSc Hons, MSc). Mr Williams has the required level of professional experience to act as a competent reviewer, including over 20 years Australian and international experience in senior- and principal-level hydrogeology and mine water management positions. Mr Williams has provided groundwater related advice for a wide range of projects, including the development and application of groundwater models for mineral sand mining operations.

7 Limitations

This letter report has been prepared for the sole use of RZ Resources and should be read in full. This report relies entirely on information derived from third parties. The accuracy of assumptions and other party data has not been independently verified by HCS, and no representation or warranty is made as to the accuracy, completeness or reliability of this information.

Yours sincerely

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Attachment 1 – 2324A Groundwater Model Review Checklist (from Table A2 in Minimum Groundwater Modelling Requirements for SSD/SSI Projects, adapted from the AGMG)

Review Question	Y/N	Comment
1. Planning		
1.1 Are the Project objectives stated?	Y	
1.2 Are the model objectives stated?	Y	
1.3 Is it clear how the model will contribute to meeting the Project objectives?	Y	
1.4 Is a groundwater model the best option to address the Project and model objectives?	Y	
1.5 Is the target model confidence level class stated and justified?	Y	Stated target model confidence level is Class 1 to Class 2 (s.11.6) which is in HCS opinion is justified given the limited potential uses of the saline aquifer, limited potential groundwater impacts of dredge mining, and the large distance to potential environmental receptors and/or users
1.6 Are the planned limitations and exclusions of the model stated?	Y	
2. Conceptualisation		
2.1 Has a literature review been completed, including examination of prior investigations?	Y	
2.2 Is the aquifer system adequately described?	Y	
2.2.1 hydrostratigraphy including aquifer type (alluvium, porous rock, fractured rock)	Y	
2.2.2 lateral extent, boundaries, and significant internal features such as faults and regional folds	Y	
2.2.3 aquifer geometry including layer elevations and thicknesses	Y	
2.2.4 confined or unconfined flow and the variation of these conditions in space and time	Y	
2.3 Have data on groundwater stresses been collected and analysed?	Y	pumping test data analysis
2.3.1 recharge from rainfall, irrigation, floods, lakes	Y	The groundwater levels have been stable over the last 30 years of records, with limited response to rainfall recharge
2.3.2 river or lake stage heights	Y	
2.3.3 groundwater usage (pumping, returns, etc.)	Y	mimimal use/effect near project site.
2.3.4 evapotranspiration	Y	
2.3.5 other (specify in comments)	Y	Planned RZ dredge mining project
2.4 Have groundwater level observations been collected and analysed?	Y	extensive hydro-census
2.4.1 selection of representative bore hydrographs	Y	Hydrographs of 54 regional monitoring bores (Apendix F)
2.4.2 comparison of hydrographs	Y	
2.4.3 effect of stresses on hydrographs	Y	Long-term water level data indicates near steady-state conditions across the Lower-Darling Basin

Review Question	**Y/N**	**Comment**
2.4.4 water table maps/piezometric surfaces	Y	
2.4.5 If relevant, are density and barometric effects taken into account in the interpretation of groundwater head and flow data?	Y	There is a large variation in groundwater salinity in the model domain, which is expected to affect hydraulic heads. Despite this, groundwater levels were not corrected for salinity in the Geo-Eng model due to a number of complicating factors, which are described in the model report. Effectively an averaged salinity value was used by Geo-Eng, who acknowledge the resulting reduction in the accuracy of hydraulic data. However, this approach is considered accepetable/fit for purpose by HCS, as density related errors in the upper (shallow) aquifer, which is the main aquifer of interest, are likely to be small.
2.5 Have flow observations been collected and analysed?		
2.5.1 baseflow in rivers	N	Estimated in Model
2.5.2 discharge in springs	N	Estimated in Model
2.5.3 location of diffuse discharge areas	N	Estimated in Model
2.6 Is the measurement error or data uncertainty reported?	Y	Salinity effects discussed
2.6.1 measurement error for directly measured quantities (e.g. piezometric level, concentration, flows)	Y	Stable water table conditions allow for comparison to previous measurements.
2.6.2 spatial variability/heterogeneity of parameters	Y	Pilot Points used to allow for spatial variability in calibration. Section 11.7
2.6.3 interpolation algorithm(s) and uncertainty of gridded data	Y	Radial Basis Functions used for interpolation in automated best fit calibration. Section 11.7
2.7 Have consistent data units and geometric datum been used?	Y	
2.8 Is there a clear description of the conceptual model?	Y	
2.8.1 Is there a graphical representation of the conceptual model?	Y	
2.8.2 Is the conceptual model based on all available, relevant data?	Y	
2.9 Is the conceptual model consistent with the model objectives and target model confidence level class?	Y	
2.9.1 Are the relevant processes identified?	Y	
2.9.2 Is justification provided for omission or simplification of processes?	Y	
2.10 Have alternative conceptual models been investigated?	Y	Regional hydrogelogy of the Murray Darling Basin is already relatively well understood from previous studies. HCS has previously reviewed the Geo-Eng conceptual groundwater model and concluded it is fit for purpose.
3. Design and construction		
3.1 Is the design consistent with the conceptual model?	N	
3.2 Is the choice of numerical method and software appropriate?	Y	
3.2.1 Are the numerical and discretisation methods appropriate?	Y	
3.2.2 Is the software reputable?	Y	FEFLOW (V8) 3D finite element groundwater modelling package - widely used and accepted for modelling projects in NSW

Review Question	Y/N	Comment
3.2.3 Is the software included in the archive or are references to the software provided?	Y	
3.3 Are the spatial domain and discretisation appropriate?	Y	
3.3.1 dimensionality (specify in comments; 1D, 2D, or 3D)	Y	3D
3.3.2 lateral extent	Y	
3.3.3 layer geometry	Y	
3.3.4 Is the horizontal discretisation appropriate for the objectives, problem setting, conceptual model and target confidence level class?	Y	
3.3.5 Is the vertical discretisation appropriate? Are aquitards divided in multiple layers to model time lags of propagation of responses in the vertical direction?	Y	Limited discretisation of aquitards, as not critical
3.4 Are the temporal domain and discretisation appropriate?	Y	
3.4.1 time dependency (specify in comments)	Y	
3.4.2 stress-periods	Y	
3.4.3 time steps	Y	
3.5 Are the boundary conditions plausible and sufficiently unrestrictive?	Y	
3.5.1 Is the implementation of boundary conditions consistent with the conceptual model?	Y	
3.5.2 Are the boundary conditions chosen to have a minimal impact on key model outcomes? How is this ascertained?	Y	Constant head boundary constraints have been used in the model, using 23 pre-existing bores for boundary conditions. This appears reasonable given that long term monitoring indicates stable groundwater levels over 30 years of data.
3.5.3 Is the calculation of diffuse recharge consistent with model objectives and target confidence level class?	Y	There is limited field data available for estimating rainfall recharge, PEST pilot points were used to calibrate varying recharge rates across the region to match the measured groundwater levels.
3.5.4 Are lateral boundaries time-dependency appropriate (constant vs time-invariant)?	Y	
3.6 Are the initial conditions appropriate?	Y	
Supporting charts/figures showing seasonal variation and response to recent and historical climate trends	Y	Minimal variations. Stable water table.
3.6.1 Are the initial heads appropriately based on interpolation or on groundwater modelling? Specify in comments	Y	Groundwater modelled heads, based on measured water levels.
3.6.2 Is the effect of initial conditions on key model outcomes assessed?	Y	Initial conditions are well defined and stable.
3.6.3 If relevant, is the initial concentration of solutes obtained appropriately? Specify how in comments.	NA	
3.7 Is the numerical solution of the model adequately addressed in the following terms?		

Review Question	**Y/N**	**Comment**
3.7.1 solution method/solver	Y	SAMG 2019 - Algebraic multigrid, Fraunhofer SCAI 2x10-8 termination criteria
3.7.2 convergence criteria	Y	Euclidian L2 integral (RMS) norm 1x10-3 error tolerance
3.7.3 numerical precision	Y	64 bit (double-precision floating point format)
4. Calibration and sensitivity		
4.1 Are all available types of observations used for calibration?	Y	No flow rates suitable for steady-state calibration
4.1.1 groundwater head data	Y	
4.1.2 flux observations	Y	No flow rates suitable for steady-state calibration
4.1.3 other: environmental tracers, gradients, age, temperature, concentrations etc.	NA	
4.2 Does the calibration methodology conform to best practice in terms of the following?		
4.2.1 parameterisation	Y	
4.2.2 objective function	Y	
4.2.3 identifiability of parameters	Y	
4.2.4 methodology used for model calibration (manual and/or automatic)	Y	
4.3 Is a sensitivity of history matching outcomes assessed against the following?		
4.3.1 parameters	Y	varying permeability distribution tested in calibration
4.3.2 boundary conditions	Y	Not critical
4.3.3 initial conditions	Y	Well defined initial conditions, Steady-state calibration.
4.3.4 stresses	Y	Steady-state calibration only.
4.4 Have the calibration results been adequately reported as follows?		
4.4.1 Are there graphs showing modelled and observed hydrographs at an appropriate scale?	Y	steady-state stable levels
4.4.2 Is it clear whether observed or assumed vertical head gradients have been replicated by the model?	Y	
4.4.3 Are calibration statistics reported and illustrated in a reasonable manner?	Y	
4.5 Are multiple methods of plotting calibration results used to highlight goodness of fit robustly? Is the model sufficiently calibrated?	Y	
4.5.1 spatially	Y	
4.5.2 temporally	NA	steady-state
4.6 Are the calibrated parameters plausible?	Y	
4.7 Are the water volumes and fluxes in the water balance realistic?	Y	Comparison to analytical estimate.
5. Prediction		

Review Question	**Y/N**	**Comment**
5.1 Are the model predictions designed in a manner that meets the model objectives?	Y	Model objectives given in Section 2.1.
5.2 Is predictive uncertainty acknowledged and addressed?	Y	
5.3 Are the assumed climatic stresses appropriate?	Y	minimal
5.4 Is a null scenario defined?	Y	Null scenario is the steady-state calibrated condition. Differential drawdown contours (relative to stead-state conditions) are shown in the model predictions.
5.5 Are the scenarios defined in accordance with the model objectives and target confidence level class?	Y	2 geological structual variations scenarios, to assess range of variability of effects
5.5.1 Are the pumping stresses similar in magnitude to those of the calibrated model? If not, is there reference to the associated reduction in model confidence?	NA	steady-state calibration
5.5.2 Are well losses accounted for when estimating maximum pumping rates per well?	NA	
5.5.3 Is the temporal scale of the predictions commensurate with the calibrated model? If not, is there reference to the associated reduction in model confidence?	Y	Class 1-2 model due to only steady-state calibration. Adequate for purpose.
5.5.4 Are the assumed stresses and timescale appropriate for the stated objectives?	Y	
5.6 Do the prediction results meet the stated objectives?	Y	
5.7 Are the components of the predicted mass balance realistic?	Y	Comparison to analytical estimate.
5.7.1 Are the pumping rates assigned in the input files equal to the modelled pumping rates?	Y	
5.7.2 Are predicted seepage into or from rivers within measured or expected river flow?	Y	Unable to directly compare to river measurements as local pumping and irrigation near to rivers obscures groundwater baseflow. Flux to Murray River is consistent with overall estimate based on Darcy's equation.
5.7.3 Are there no anomalous boundary fluxes due to superposition of head dependent sinks (e.g. evapotranspiration) on head-dependent boundary cells (Type 1 or Type 3 boundary conditions)?	Y	No anomalous boundary fluxes, apart from effect of locks on Murray River, which have high out flow upstream and high inflows downstream of locks.
5.7.4 Is diffuse recharge from rainfall smaller than rainfall?	Y	Yes ~ 0.01%, Section 11.7.2
5.7.5 Are model storage changes not dominated by anomalous head increases in isolated cells that receive recharge?	Y	No anomalous head increases, result away from mine are consistent with the steady-state model.
6. Uncertainty		
6.1 Is some qualitative or quantitative measure of uncertainty associated with the prediction reported together with the prediction?	Y	

Review Question	**Y/N**	**Comment**
6.2 Is the model with minimum prediction-error variance chosen for each prediction?	Y	
6.3 Are the sources of uncertainty discussed, including		
6.3.1 measurement of uncertainty of observations and parameters	Y	
6.3.2 structural or model uncertainty	Y	
6.4 Is the approach to estimation of uncertainty described and appropriate?	Y	
6.5 Are there useful depictions of uncertainty?	Y	2 geological structual variations, to assess range of variability of effects
7. Solute transport	NA	
8. Surface water - groundwater interaction		
8.1 Is the conceptualisation of surface water – groundwater interaction in accordance with the model objectives?	Y	
8.2 Is the implementation of surface water – groundwater interaction appropriate?	Y	